

THE RING PROGRAMMING LANGUAGE

```
changeringoperator + plus
changeringkeyword SEE PRINT

Print 5 plus 5

changeringoperator plus +
changeringkeyword PRINT SEE
```

Syntax
Flexibility

```
Load "gameengine.ring"

func main
    oGame = New Game
    {
        title = "My First Game"
        sprite
        {
            type = GE_TYPE_PLAYER
            x=400 y=400 width=100 height=100
            file = "images/player.png"
            transparent = true
            Animate=false
            Move=true
            Scaled=true
        }
    }
```

Declarative
Programming

```
# Natural Code
new program {
    Accept 2 numbers then print the sum
}

# Natural Code Implementation
class program
    # Keywords
    Accept=0 numbers=0 then=0 print=0 the=0 sum=0

    # Execution
    func braceexprval x
        value = x
    func getnumbers
        for x=1 to value
            see "Enter Number (" + x + ") :" give nNumber
            aNumbers + nNumber
        next
    func getsum
        nSum = 0
        for x in aNumbers nSum+= x next
        see "The Sum : " + nSum
    private
        value=0 aNumbers=[]
```

Natural
Language
Programming

The Complete Reference

Ring Documentation

Release 1.22.0

Mahmoud Fayed

Dec 01, 2024

CONTENTS

1 Applications developed in a few hours	2
1.1 Quotes about Ring	2
1.2 FetchStockData Application	10
1.3 Google API Shortener Application	11
1.4 Video-Music-Player Application	12
1.5 Fifteen Puzzle Game	12
1.6 Analog Clock	13
1.7 Squares Puzzle Game	14
1.8 Samples in this book	15
1.9 Innovative	22
1.10 Practical	23
2 Introduction	25
2.1 Motivation (1)	25
2.2 Motivation (2)	26
2.3 Motivation (3)	26
2.4 Motivation (4)	27
2.5 Motivation (5)	27
2.6 Ring and other languages	27
2.7 History	28
2.8 Features	29
2.9 License	32
3 Using Ring Notepad	33
3.1 Ring Notepad - Main Window	33
3.2 Creating and running your first Console Application	34
3.3 Creating and running your first GUI/WebAssembly/Mobile Application	36
3.4 Creating and running your first Web Application	37
3.5 Creating and running your first Desktop/Mobile Game	38
3.6 The Main File in the Project	39
3.7 The File Menu	40
3.8 The Edit Menu	41
3.9 The View Menu	42
3.10 The Program Menu	43
3.11 The Browser Menu	43
3.12 The Tools Menu	44
3.13 The Distribute Menu	44
3.14 The Help Menu	44
4 Getting Started - First Style	46

4.1	Hello World	46
4.2	Run the program	46
4.3	Create Executable File	46
4.4	Not Case-Sensitive	46
4.5	Multi-Line literals	47
4.6	Getting Input	47
4.7	No Explicit End For Statements	47
4.8	Using ? to print expression then new line	47
4.9	Writing Comments	48
5	Getting Started - Second Style	49
5.1	Hello World	49
5.2	Run the program	49
5.3	Create Executable File	49
5.4	Not Case-Sensitive	49
5.5	Multi-Line literals	50
5.6	Getting Input	50
5.7	No Explicit End For Statements	50
5.8	Writing Comments	50
6	Getting Started - Third Style	52
6.1	Hello World	52
6.2	Run the program	52
6.3	Create Executable File	52
6.4	Not Case-Sensitive	52
6.5	Multi-Line literals	53
6.6	Getting Input	53
6.7	No Explicit End For Statements	53
6.8	Writing Comments	53
6.9	Puts() function	54
6.10	Print() function	54
6.11	Print2Str() Function	54
6.12	GetString() function	55
6.13	GetNumber() function	55
7	Variables	56
7.1	Dynamic Typing	56
7.2	Deep Copy	57
7.3	Implicit Conversion	57
8	Operators	58
8.1	Arithmetic Operators	58
8.2	Relational Operators	58
8.3	Logical Operators	59
8.4	Bitwise Operators	59
8.5	Assignment Operators	59
8.6	Misc Operators	60
8.7	Operators Precedence	60
8.8	Mixing Arithmetic Operators and Types	61
8.9	Mixing Relational Operators and Types	63
8.10	Mixing Logical Operators and Types	65
8.11	Mixing Bitwise Operators and Types	66
8.12	Mixing Assignment Operators and Types	66
8.13	Unary Positive and Unary Negative	66

9 Control Structures - First Style	68
9.1 Branching	68
9.2 Looping	69
9.3 Using The Step option with For in	71
9.4 Using For in to modify lists	71
9.5 Do Again Loop	71
9.6 Exit Command	72
9.7 Exit from two loops	72
9.8 Loop Command	72
9.9 Short-circuit evaluation	73
9.10 Comments about evaluation	74
10 Control Structures - Second Style	75
10.1 Branching	75
10.2 Looping	76
10.3 Exceptions	78
11 Control Structures - Third Style	79
11.1 Branching	79
11.2 Looping	80
11.3 Exceptions	83
12 Getting Input	84
12.1 Give Command	84
12.2 GetChar() Function	84
12.3 Input() Function	85
13 Functions - First Style	86
13.1 Define Functions	86
13.2 Call Functions	87
13.3 Declare parameters	87
13.4 Send Parameters	87
13.5 Main Function	88
13.6 Variables Scope	88
13.7 Return Value	89
13.8 Recursion	89
14 Functions - Second Style	90
14.1 Define Functions	90
14.2 Call Functions	91
14.3 Declare parameters	91
14.4 Send Parameters	91
14.5 Main Function	92
14.6 Variables Scope	92
14.7 Return Value	93
14.8 Recursion	93
15 Functions - Third Style	94
15.1 Define Functions	94
15.2 Call Functions	95
15.3 Declare parameters	95
15.4 Send Parameters	95
15.5 Main Function	96
15.6 Variables Scope	96
15.7 Return Value	97

15.8 Recursion	97
16 Program Structure	98
16.1 Source Code File Sections	98
16.2 Using Many Source Code Files	99
16.3 Load Package	99
16.4 Load Again	100
17 Lists	101
17.1 Create Lists	101
17.2 Add Items	102
17.3 Get List Size	103
17.4 Delete Item From List	103
17.5 Get List Item	103
17.6 Set List Item	103
17.7 Search	104
17.8 Sort	105
17.9 Reverse	106
17.10 Insert Items	106
17.11 Nested Lists	106
17.12 Copy Lists	107
17.13 First-class lists	107
17.14 Using Lists during definition	108
17.15 Passing Lists to Functions	108
17.16 Access List Items by String Index	109
17.17 Passing Parameters or Arguments Using List	109
17.18 Passing Parameters or Arguments Using List Array	110
17.19 Return Parameters as List or Hash Table	110
17.20 Creating a Multi-Dimensional Array using List	111
17.21 Swap Lists and Items	113
18 Strings	114
18.1 String Literals	114
18.2 Get String Length	114
18.3 Convert Letters Case	114
18.4 Access String Letters	115
18.5 Left() Function	115
18.6 Right() Function	116
18.7 Trim() Function	116
18.8 Copy() Function	116
18.9 Lines() Function	116
18.10 Substr() Function	117
18.11 Find substring	117
18.12 Get substring from position to end	117
18.13 Get Number of Characters From Position	118
18.14 Transform Substring To Another Substring	118
18.15 strcmp() Function	118
18.16 Reverse() Function	119
18.17 str2list() and list2str() Functions	119
18.18 Merge binary characters	120
19 Date and Time	122
19.1 Clock() Function	122
19.2 ClocksPerSecond() Function	122
19.3 Time() Function	123

19.4	Date() Function	123
19.5	TimeList() Function	123
19.6	AddDays() Function	125
19.7	DiffDays() Function	125
19.8	EpochTime() Function	125
20	Check Data Type and Conversion	127
20.1	Check Data Type	127
20.2	IsString() Function	127
20.3	IsNumber() Function	128
20.4	IsList() Function	128
20.5	Type() Function	128
20.6	IsNULL() Function	128
20.7	Check Character	129
20.8	IsAINum() Function	129
20.9	IsAlpha() Function	130
20.10	IsCntrl() Function	130
20.11	IsDigit() Function	130
20.12	IsGraph() Function	131
20.13	IsLower() Function	131
20.14	IsPrint() Function	131
20.15	IsPunct() Function	131
20.16	IsSpace() Function	132
20.17	IsUpper() Function	132
20.18	IsXdigit() Function	132
20.19	Conversion	133
20.20	Number() Function	133
20.21	String() Function	133
20.22	Ascii() Function	134
20.23	Char() Function	134
20.24	Hex() Function	134
20.25	Dec() Function	134
20.26	Str2hex() Function	135
20.27	Hex2str() Function	135
21	Mathematical Functions	136
21.1	List of functions	136
21.2	Example	137
21.3	Random() Function	138
21.4	SRandom() Function	139
21.5	Unsigned() Function	140
21.6	Decimals() Functions	140
21.7	Using _ in numbers	141
21.8	Using f after numbers	141
21.9	Using Hexadecimal Numbers	141
22	Files	143
22.1	Read() Function	144
22.2	Write() Function	144
22.3	Dir() Function	145
22.4	Rename() Function	145
22.5	Remove() Function	145
22.6	Fopen() Function	146
22.7	Fclose() Function	146

22.8 Fflush() Function	146
22.9 Freopen() Function	146
22.10 Tempfile() Function	147
22.11 Tempname() Function	147
22.12 Fseek() Function	148
22.13 Ftell() Function	148
22.14 Rewind() Function	148
22.15 Fgetpos() Function	148
22.16 Fsetpos() Function	149
22.17 Clearerr() Function	149
22.18 Feof() Function	149
22.19 Ferror() Function	149
22.20 Perror() Function	149
22.21 Fgetc() Function	150
22.22 Fgets() Function	150
22.23 Fputc() Function	150
22.24 Fputs() Function	150
22.25 Ungetc() Function	150
22.26 Fread() Function	151
22.27 Fwrite() Function	151
22.28 Fexists() Function	151
22.29 Direxists() Function	151
22.30 Getpathtype() Function	152
22.31 Getfilesize() Function	152
22.32 Example	153
22.33 Numbers and Bytes	154
23 System Functions	156
23.1 System() Function	157
23.2 SysGet() Function	157
23.3 SysSet() Function	157
23.4 SysUnset() Function	157
23.5 IsMSDOS() Function	157
23.6 IsWindows() Function	158
23.7 IsWindows64() Function	158
23.8 IsUnix() Function	158
23.9 IsMacOSX() Function	158
23.10 IsLinux() Function	158
23.11 IsFreeBSD() Function	159
23.12 IsAndroid() Function	159
23.13 Example	159
23.14 GetArch() Function	159
23.15 Windowsn() Function	160
23.16 Get Command Line Arguments	161
23.17 Get Active Source File Name	161
23.18 PrevFileName() Function	162
23.19 CurrentDir() Function	162
23.20 ExeFileName() Function	163
23.21 ChDir() Function	163
23.22 ExeFolder() Function	163
23.23 Version() Function	163
23.24 Shutdown() Function	164
23.25 NofProcessors() Function	164

24 Eval() and Debugging	165
24.1 Try/Catch/Done	165
24.2 Eval() Function	166
24.3 Raise() Function	166
24.4 Assert() Function	167
25 Demo Programs	169
25.1 Language Shell	169
25.2 Main Menu	170
26 ODBC Functions	173
26.1 odbc_init() Function	173
26.2 odbc_drivers() Function	174
26.3 odbc_datasources() Function	174
26.4 odbc_close() Function	174
26.5 Print List of ODBC Drivers	174
26.6 Print List of ODBC Data Sources	175
26.7 odbc_connect() Function	176
26.8 odbc_disconnect() Function	176
26.9 Open and Close Connection	176
26.10 odbc_execute() Function	177
26.11 odbc_colcount() Function	177
26.12 odbc_fetch() Function	177
26.13 odbc_getdata() Function	177
26.14 Execute Query and Print Result	177
26.15 odbc_tables() Function	178
26.16 odbc_columns() Function	179
26.17 odbc_autocommit() Function	179
26.18 odbc_commit() Function	180
26.19 odbc_rollback() Function	180
26.20 Transactions and Using Commit and Rollback	180
26.21 Save and Restore images	181
27 MySQL Functions	182
27.1 MySQL_Info() Function	182
27.2 MySQL_Init() Function	183
27.3 MySQL_Error() Function	183
27.4 MySQL_Connect() Function	183
27.5 MySQL_Close() Function	183
27.6 MySQL_Query() Function	184
27.7 Create Database	184
27.8 Create Table and Insert Data	184
27.9 MySQL_Insert_ID() Function	185
27.10 MySQL_Result() Function	186
27.11 MySQL_Next_Result() Function	186
27.12 Print Query Result	187
27.13 MySQL_Columns() Function	187
27.14 MySQL_Result2() Function	188
27.15 MySQL_Escape_String() Function	189
27.16 Save Image inside the database	189
27.17 Restore Image From The Database	189
27.18 MySQL_AutoCommit() Function	190
27.19 MySQL_Commit() Function	190
27.20 MySQL_Rollback() Function	190

27.21 Transaction Example	190
28 SQLite Functions	192
28.1 sqlite_init() function	192
28.2 sqlite_open() function	192
28.3 sqlite_execute() function	192
28.4 sqlite_close() function	192
28.5 Example	193
29 PostgreSQL Functions	195
29.1 Loading the library	195
29.2 Examples	195
29.3 RingPostgreSQL Constants	198
29.4 RingPostgreSQL Functions	199
30 Security and Internet Functions	203
30.1 MD5() Function	204
30.2 SHA1() Function	205
30.3 SHA256() Function	205
30.4 SHA512() Function	205
30.5 SHA384() Function	206
30.6 SHA224() Function	206
30.7 SupportedCiphers() Function	207
30.8 Encrypt() Function	207
30.9 Decrypt() Function	207
30.10 Encryption and Decryption Example	207
30.11 File Hash	208
30.12 Randbytes() Function	209
30.13 rsa_generate() Function	209
30.14 rsa_export_params() Function	210
30.15 rsa_import_params() Function	211
30.16 rsa_export_pem() Function	211
30.17 rsa_import_pem() Function	212
30.18 rsa_is_privatekey() Function	212
30.19 rsa_encrypt_pkcs() Function	213
30.20 rsa_decrypt_pkcs() Function	214
30.21 rsa_encrypt_oaep() Function	215
30.22 rsa_decrypt_oaep() Function	216
30.23 rsa_encrypt_raw() Function	217
30.24 rsa_decrypt_raw() Function	218
30.25 rsa_sign_pkcs() Function	220
30.26 rsa_signhash_pkcs() Function	220
30.27 rsa_verify_pkcs() Function	221
30.28 rsa_verifyhash_pkcs() Function	222
30.29 rsa_sign_pss() Function	223
30.30 rsa_signhash_pss() Function	224
30.31 rsa_verify_pss() Function	225
30.32 rsa_verifyhash_pss() Function	226
30.33 openssl_versiontext() Function	227
30.34 openssl_version() Function	227
30.35 Large Files Hash	227
30.36 Download() Function	228
30.37 SendEmail() Function	228
31 Object Oriented Programming (OOP)	230

31.1	Classes and Objects	230
31.2	Access Objects Using Braces	232
31.3	Composition	233
31.4	Setter and Getter	234
31.5	Private Attributes and Methods	235
31.6	Operator Overloading	236
31.7	Inheritance	240
31.8	Dynamic Attributes	241
31.9	Packages	242
31.10	Printing Objects	243
31.11	Find() and List of Objects	243
31.12	Sort() and List of Objects	244
31.13	Using Self.Attribute and Self.Method()	246
31.14	Using This.Attribute and This.Method()	247
31.15	Using This in the class region as Self	247
31.16	Default value for object attributes	248
31.17	Command: New From	249
31.18	Using Objects During Definition	249
32	Functional Programming	251
32.1	Pure Functions	251
32.2	First-class Functions	252
32.3	Higher-order Functions	253
32.4	Anonymous and Nested Functions	253
32.5	Equality of functions	255
33	Reflection and Meta-programming	256
33.1	locals() Function	257
33.2	globals() Function	257
33.3	functions() Function	258
33.4	cfunctions() Function	259
33.5	islocal() Function	259
33.6	isglobal() Function	260
33.7	isFunction() Function	260
33.8	isCfunction() Function	261
33.9	packages() Function	261
33.10	ispackage() Function	262
33.11	classes() Function	263
33.12	isclass() Function	263
33.13	packageclasses() Function	264
33.14	ispackageclass() Function	264
33.15	classname() Function	265
33.16	parentclassname() Function	266
33.17	objectid() Function	266
33.18	isobject() Function	267
33.19	attributes() Function	267
33.20	methods() Function	267
33.21	isattribute() Function	268
33.22	isprivateattribute() Function	268
33.23	ismethod() Function	269
33.24	isprivatemethod() Function	269
33.25	addattribute() Function	270
33.26	addmethod() Function	270
33.27	getattribute() function	272

33.28 setattribute() function	274
33.29 mergemethods() Function	274
33.30 packagename() Function	275
33.31 importpackage() Function	276
33.32 Nothing() function	276
33.33 OptionalFunc() function	276
34 Declarative Programming using Nested Structures	278
34.1 Creating Objects inside Lists	278
34.2 Composition and Returning Objects and Lists by Reference	279
34.3 Executing code after the end of object access	281
34.4 Declarative Programming on the top of Object-Oriented	282
34.5 More Beautiful Code	283
35 Natural Language Programming	284
35.1 History	284
35.2 Example	284
35.3 Change the Ring Keyword ‘And’	285
35.4 Change the Ring Operator ‘+’	287
35.5 Change the ‘=’ operator to ‘is’	287
35.6 Using Eval() with our Natural Code	289
35.7 BraceStart and BraceEnd Methods	290
35.8 BraceExprEval Method	291
35.9 Real Natural Code	291
35.10 BraceError() Method	292
35.11 Clean Natural Code	293
36 Using the Natural Library	295
36.1 Natural Library - Demo Program	295
36.2 Defining Commands	298
36.3 Natural Library - Operators	300
36.4 Defining commands using classes	301
37 Scope Rules for Variables and Attributes	303
37.1 Three Scopes	303
37.2 Defining Variables and Variables Access	303
37.3 How Ring find the variable?	304
37.4 Using Object.Attribute	304
37.5 The Self Object	304
37.6 How Ring Define Variables and Attributes	305
37.7 Conflict between Global Variables and Class Attributes	305
37.8 Conflict between Class Attributes and Local Variables	307
37.9 Using Braces to access objects inside Class Methods	308
37.10 Accessing the class attributes from braces inside class methods	310
37.11 Creating a Class for each Window in GUI applications	312
37.12 Conflict between self inside braces and self in the class region	313
37.13 Using braces to escape from the current object scope	316
37.14 The For Loops uses the local scope	317
37.15 Summary of Scope Rules	318
38 Scope Rules for Functions and Methods	320
38.1 How Ring find the Functions and Methods?	320
38.2 Example about Sharing Names between Functions and Methods	321
38.3 Calling a function sharing the name with a method in the current class	322

39 Syntax Flexibility	324
39.1 Change Language Keywords	324
39.2 Change Language Operators	325
39.3 Load Syntax Files	326
39.4 Using “()” around the function parameters	327
39.5 Using Semi-colon after and between statements	328
39.6 Using \$ and @ in the start of the variable name	328
39.7 Using the ‘elseif’ keyword as ‘but’ in if statement	329
39.8 Using the ‘else’ keyword as ‘other’ in switch statement	329
39.9 Using the ‘end’ keyword in different control structures	330
39.10 Using braces to start and end different control structures	331
39.11 Using ‘put’ and ‘get’ as ‘see’ and ‘give’	332
39.12 Using ‘case’ as ‘on’ in switch statements	332
39.13 Using ‘def’ as ‘func’ in functions/methods definition	333
39.14 Using braces { } in Packages/Classes/Functions	333
39.15 Using ‘break’/‘continue’ keywords	333
39.16 Using ‘end’ keyword after Packages/Classes/Functions	334
39.17 Using ‘function’/‘endfunction’ keywords	334
39.18 Using ‘endif’/‘endfor’/‘endwhile’/‘endswitch’/‘endtry’ keywords	334
39.19 Using ‘endpackage’/‘endclass’/‘endfunc’ keywords after Packages/Classes/Functions	335
39.20 Ignore new lines after keywords	335
39.21 Automatic loading for syntax files	336
39.22 Enable/Disable Hash Comments	337
40 Introduction to the Type Hints Library	338
40.1 Why Type Hints?	338
40.2 Example	338
40.3 User Types	339
40.4 Using Types inside Code	339
40.5 Using Override	340
40.6 Rules	340
41 The Trace Library and the Interactive Debugger	342
41.1 Loading the Trace library	342
41.2 Trace All Events	342
41.3 Trace control flow between functions	343
41.4 Pass Error	343
41.5 Interactive Debugger	343
41.6 Execute Program Line by Line	344
41.7 BreakPoint	344
41.8 Disable BreakPoints	344
41.9 Using the Interactive Debugger	345
42 Embedding Ring in Ring	347
42.1 Embedding Ring in Ring without sharing the State	347
42.2 Serial Execution of Programs	348
42.3 ring_state_setvar()	348
42.4 ring_state_new() and ring_state_mainfile()	349
42.5 Runtime Errors when Embedding Ring in Ring	350
42.6 ring_state_filetokens() function	351
42.7 ring_state_mainfile() and Ring Object File	352
42.8 Pause/Resume the Ring VM	353
42.9 Rules	354
43 Stdlib Functions	356

43.1	IsAppCompiled() Function	356
43.2	AppArguments() Function	357
43.3	AppPath() Function	357
43.4	JustFilePath() Function	357
43.5	JustFileName() Function	358
43.6	Value() Function	358
43.7	Times() Function	358
43.8	Map() Function	359
43.9	Filter() Function	359
43.10	Reduce() Function	359
43.11	Split() Function	360
43.12	SplitMany() Function	360
43.13	Capitalized() Function	360
43.14	IsSpecial() Function	361
43.15	IsVowel() Function	361
43.16	LineCount() Function	361
43.17	Factorial() Function	362
43.18	Fibonacci() Function	362
43.19	IsPrime() Function	362
43.20	Sign() Function	363
43.21	List2File() Function	363
43.22	File2List() Function	363
43.23	StartsWith() Function	364
43.24	EndsWith() Function	364
43.25	GCD() Function	364
43.26	LCM() Function	365
43.27	SumList() Function	365
43.28	ProdList() Function	365
43.29	EvenOrOdd() Function	366
43.30	Factors() Function	366
43.31	IsPalindrome() Function	366
43.32	IsLeapYear() Function	367
43.33	BinaryDigits() Function	367
43.34	MatrixMulti() Function	367
43.35	MatrixTrans() Function	368
43.36	DayOfWeek() Function	368
43.37	Permutation() Function	369
43.38	ReadLine() Function	369
43.39	SubString() Function	369
43.40	ChangeString() Function	370
43.41	Sleep() Function	370
43.42	IsMainSourceFile() Function	371
43.43	MakeDir() Function	371
43.44	Fsize() Function	371
43.45	TrimAll() Function	371
43.46	TrimLeft() Function	372
43.47	TrimRight() Function	372
43.48	EpochTime() Function	372
43.49	SystemCmd() Function	372
43.50	ListAllFiles() Function	373
43.51	SystemSilent() Function	373
43.52	OSCreateOpenFolder() Function	373
43.53	OSCopyFolder() Function	373
43.54	OSDeleteFolder() Function	374

43.55 OSCopyFile() Function	374
43.56 OSDeleteFile() Function	374
43.57 OSRenameFile() Function	374
43.58 List2Code() Function	374
43.59 Str2ASCIIList() Function	375
43.60 ASCIIList2Str() Function	375
43.61 IsListContainsItems() Function	375
43.62 IsBetween() Function	376
43.63 TimeInfo() Function	376
43.64 RandomList() Function	377
43.65 RandomItem() Function	377
43.66 CheckEquality() Function	377
43.67 NumOrZero() Function	378
44 Stdlib Classes	379
44.1 StdBase Class	380
44.2 String Class	380
44.3 List Class	382
44.4 Stack Class	384
44.5 Queue Class	385
44.6 HashTable Class	386
44.7 Tree Class	387
44.8 Math Class	389
44.9 DateTime Class	392
44.10 File Class	394
44.11 System Class	395
44.12 Debug Class	395
44.13 DataType Class	396
44.14 Conversion Class	398
44.15 ODBC Class	399
44.16 MySQL Class	400
44.17 SQLite Class	401
44.18 PostgreSQL Class	402
44.19 Security Class	404
44.20 Internet Class	405
45 Desktop, WebAssembly and Mobile Development using RingQt	406
45.1 The First GUI Application	406
45.2 The Events Loop	408
45.3 Using Layout	409
45.4 Using the QTextEdit Class	410
45.5 Using the QListWidget Class	411
45.6 Using QTreeView and QFileSystemModel	414
45.7 Using QTreeWidget and QTreeWidgetItem	416
45.8 Using QComboBox Class	417
45.9 Creating Menubar	418
45.10 Context Menu	421
45.11 Creating Toolbar	422
45.12 Creating StatusBar	423
45.13 Using QDockWidget	424
45.14 Using QTabWidget	426
45.15 Using QTableWidget	427
45.16 Using QProgressBar	428
45.17 Using QSpinBox	429

45.18 Using QSlider	430
45.19 Using QDateEdit	431
45.20 Using QDial	432
45.21 Using QWebView	435
45.22 Using QCheckBox	436
45.23 Using QRadioButton and QButtonGroup	438
45.24 Adding Hyperlink to QLabel	439
45.25 QVideoWidget and QMediaPlayer	440
45.26 Using QFrame	442
45.27 Display Image using QLabel	443
45.28 Menubar and StyleSheet Example	445
45.29 QLineEdit Events and QMessageBox	446
45.30 Other Widgets Events	449
45.31 Using the QTimer Class	451
45.32 Using QProgressBar and Timer	452
45.33 Display Scaled Image using QLabel	453
45.34 Using the QFileDialog Class	455
45.35 Drawing using QPainter	456
45.36 Printing using QPrinter	457
45.37 Using QPrintPreviewDialog	458
45.38 Creating More than one Window	461
45.39 Playing Sound	462
45.40 Using the QColorDialog Class	462
45.41 Using qLCDNumber Class	464
45.42 Movable Label Example	465
45.43 QMessageBox Example	466
45.44 Using QInputDialog Class	467
45.45 Dialog Functions	468
45.46 KeyPress and Mouse Move Events	469
45.47 Moving Objects using the Mouse	470
45.48 Inheritance from GUI Classes	474
45.49 Using QDesktopWidget Class	475
45.50 Rotate Text	476
45.51 Change Focus	478
45.52 Regular Expressions	479
45.53 Simple Client and Server Example	480
45.54 Dynamic Objects	483
45.55 Weight History Application	484
45.56 Notepad Application	488
45.57 The Cards Game	505
45.58 Classes and their Methods to use the default events	511
45.59 Methods to use Events with Events Filter	514
45.60 The Difference between Qt and RingQt	515
45.61 RingQt Classes and their Qt Documentation	516
45.62 New Classes names - Index Start from 1	516
45.63 TableWidget - AddList() Method	517
45.64 Creating Reports using the WebLib and the GUILib	518
46 Using the Form Designer	522
46.1 The Designer Windows	523
46.2 The Toolbox	523
46.3 The Properties	523
46.4 Running Forms	524
46.5 Events Code	525

46.6	Keyboard Shortcuts	527
46.7	Menubar Designer	527
46.8	Window Flags	528
46.9	Entering Items	529
46.10	Using Layouts	529
46.11	Objects Order and Layouts	529
46.12	More Samples and Tests	532
47	Graphics Programming using RingQt3D	533
47.1	Drawing Cube	533
47.2	Drawing Torus	535
47.3	Drawing Sphere	537
47.4	Drawing Cylinder	539
47.5	Drawing Cone	541
47.6	Drawing Plane	543
47.7	Texture	545
47.8	Key Press	547
47.9	Object Picker	549
47.10	Frame Action	552
47.11	Text 2D	555
47.12	Extruded Text	557
47.13	Model	560
47.14	Model Texture	561
47.15	Draw Office	563
47.16	Many Objects	565
47.17	Camera	568
47.18	Scence	571
48	Objects Library for RingQt Application	576
48.1	Library Usage with GUI Applications	576
48.2	Example	577
48.3	openWindowAndLink() Function	579
48.4	openWindowInPackages() Function	580
48.5	Using ObjectID() and GetWindowByID()	581
48.6	Using ObjectID() and OpenWindowAndLink()	583
48.7	Objects Library Source Code	585
49	Multi-language Applications	586
49.1	Using String2Constant	586
49.2	Form Designer Translation	587
49.3	Forms Translation	588
50	Building RingQt Applications for Mobile	590
50.1	Download Requirements	590
50.2	Install Qt for Android	590
50.3	Using Ring2EXE	591
50.4	The Qt project for your Ring application	592
50.5	Comments about developing for Android using RingQt	595
51	Building RingQt Applications for WebAssembly	598
51.1	Download Requirements	598
51.2	Using Ring2EXE	599
51.3	The Qt project for your Ring application	600
51.4	Comments about developing for WebAssembly using RingQt	603
51.5	Dialogs	605

51.6	Online Applications	605
52	Web Development (CGI Library)	606
52.1	Configure the Apache web server	606
52.2	Setting the shebang line	607
52.3	Grant Ring files execution permission	608
52.4	Ring CGI Hello World Program	608
52.5	Hello World Program using the Web Library	608
52.6	Web Library Features	609
52.7	HTTP Get Example	609
52.8	HTTP POST Example	614
52.9	Upload Files	616
52.10	Cookies	620
52.11	URL Encode	621
52.12	Templates	622
52.13	HTML Special Characters	625
52.14	Hash Functions	625
52.15	Random Image	627
52.16	HTML Lists	628
52.17	HTML Tables	631
52.18	Gradient	632
52.19	Generating Pages using Objects	633
52.20	HtmlPage Class	637
52.21	Using Bootstrap Library using Functions	639
52.22	Using Bootstrap Library using Objects	640
52.23	CRUD Example using MVC	643
52.24	Users registration and Login	646
52.25	Database, ModelBase & ControllerBase classes	652
52.26	WebLib API	658
52.27	Application Class	659
52.28	Page Class	660
52.29	ScriptFunctions Class	662
52.30	StyleFunctions Class	663
52.31	WebPage Class	663
52.32	HtmlPage Class	664
53	Deploying Web Applications in the Cloud	665
53.1	Introduction	665
53.2	Usage	666
53.3	Ring source code files and permissions	666
53.4	Hello World program	667
53.5	Application Database	667
53.6	Deploying after updates	667
53.7	Local Tests	668
54	Graphics and 2D Games programming using RingAllegro	669
54.1	Drawing, Animation and Input	669
54.2	Using TrueType Fonts	676
54.3	Playing Sound Files	677
54.4	Scaling and Rotating Images	678
54.5	Display Transparent Image	679
54.6	Using Threads	680
55	Demo Project - Game Engine for 2D Games	684
55.1	Project Layers	684

55.2	Graphics Library bindings	684
55.3	Interface to graphics library	685
55.4	Game Engine Classes	685
55.5	Games Layer	686
55.6	Game Class	686
55.7	GameObject Class	687
55.8	Sprite Class	687
55.9	Text Class	688
55.10	Animate Class	688
55.11	Sound Class	689
55.12	Map Class	689
55.13	Using the Game Engine - Creating the Game Window	690
55.14	Using the Game Engine - Drawing Text	691
55.15	Using the Game Engine - Moving Text	692
55.16	Using the Game Engine - Playing Sound	693
55.17	Using the Game Engine - Animation	694
55.18	Using the Game Engine - Animation and Functions	695
55.19	Using the Game Engine - Sprite - Automatic Movement using Keyboard	697
55.20	Using the Game Engine - Sprite - Keypress event	698
55.21	Using the Game Engine - Sprite - Mouse event	699
55.22	Using the Game Engine - Sprite - State event	700
55.23	Using the Game Engine - Animate - Events	701
55.24	Using the Game Engine - Map	703
55.25	Using the Game Engine - Map Events	705
55.26	Using the Game Engine - Object and Drawing	706
55.27	Stars Fighter Game	710
55.28	Flappy Bird 3000 Game	719
55.29	Super Man 2016 Game	726
56	Building Games For Android	739
56.1	Download Requirements and Update the Android SDK	739
56.2	Project Folder	740
56.3	Building the project	741
57	Developing Games using RingRayLib	742
57.1	Introduction	742
57.2	Basic Window	742
57.3	Input Keys	743
57.4	Input Mouse	744
57.5	3D Camera	745
57.6	3D Camera Free	747
57.7	Mouse Wheel	749
57.8	Input Multi-touch	750
57.9	Camera First Person	752
57.10	3D Picking	754
57.11	Full Screen	756
57.12	Two Cubes	757
57.13	Basic Shapes	760
57.14	Draw Ring	762
57.15	Bezier Lines	764
57.16	Collision Area	765
57.17	Following Eyes	768
57.18	Colors Palette	770
57.19	Rectangle Scaling	772

57.20 Music Playing	774
57.21 Sound Loading	776
57.22 Image Drawing	778
57.23 Image Generation	779
57.24 Texture Source	782
57.25 Geometric Shapes	784
57.26 Cubic Map	787
57.27 Implementation	788
58 Using RingOpenGL and RingFreeGLUT for 3D Graphics	789
58.1 Samples Source (Authors)	789
58.2 What is RingOpenGL?	789
58.3 What is RingFreeGLUT?	790
58.4 The First Window using RingFreeGLUT	790
58.5 Drawing using RingOpenGL	791
58.6 The First Triangle	793
58.7 Window Resize Event	794
58.8 Triangle Rotation	796
58.9 Keyboard Events and Colors	798
58.10 The Camera	800
58.11 Mouse Events	808
58.12 Menu Events	812
58.13 Using Fonts	820
58.14 Frames Per Second	828
58.15 Make a Cube using RingOpenGL and RingFreeGLUT	839
59 Using RingOpenGL and RingAllegro for 3D Graphics	843
59.1 3D Cube and Texture	843
59.2 Many Cubes	848
59.3 TicTacToe 3D Game	854
59.4 More 3D Samples	865
60 The Gold Magic 800 Game	868
60.1 The Game Story	868
60.2 How to play?	868
60.3 What will you learn?	868
60.4 Screen Shots	869
60.5 Source Code	870
61 RingTilengine Extension	872
61.1 Getting Started	872
61.2 More Samples	873
61.3 Using LibSDL and Tilengine	894
61.4 Reference	899
62 Performance Tips	907
62.1 Introduction	907
62.2 Creating Lists	909
62.3 Arithmetic Operations	910
62.4 Using len() and For Loops	911
62.5 Calling Functions and Methods	911
63 Command Line Options	913
63.1 Printing Tokens	913
63.2 Printing Rules	915

63.3	Printing Intermediate Code	920
63.4	Printing Final Intermediate Code	923
63.5	CGI Support	927
63.6	No Run	927
63.7	Printing Instruction Operation Code	927
63.8	Clock	928
63.9	Generate Object File	928
63.10	Generate Embedded Object File	929
64	Distributing Ring Applications (Manual)	930
64.1	Distributing Applications for Microsoft Windows	930
64.2	Protecting the Source Code	931
64.3	The files ring.ring and ring.ringo	931
64.4	Creating Windows Installer	931
64.5	Using C/C++ Compiler and Linker	931
64.6	Distributing Applications and Games for Mobile	932
65	Distributing Ring Applications using Ring2EXE	933
65.1	Using Ring2EXE	933
65.2	How Ring2EXE works?	933
65.3	Example	934
65.4	Options	934
65.5	Building standalone console application	935
65.6	Distributing RingAllegro Applications	935
65.7	Distributing RingQt Applications	936
65.8	Distributing Applications for Mobile using RingQt	937
65.9	Distributing Applications for WebAssembly using RingQt	937
65.10	Building the Cards Game for Mobile using RingQt	937
65.11	Building the Weight History Application for Mobile using RingQt	938
65.12	Building the Form Designer for Mobile using RingQt	939
65.13	Creating the Qt resource file using Folder2qrc	941
65.14	Important Information about Ring2EXE	941
66	The Ring Package Manager (RingPM)	943
66.1	Features	943
66.2	Discovering Packages	943
66.3	Updating the RingPM Registry	944
66.4	Installing Packages	944
66.5	Printing List of Installed Packages	945
66.6	Run Package	945
66.7	Update Package	946
66.8	Remove Package	946
66.9	Deleting All Packages	946
66.10	Creating New Package	946
66.11	The Package Description File	949
66.12	Create Package in the Current Folder	950
66.13	The RingPM Registry File	952
67	Using ZeroLib	953
67.1	Introduction	953
67.2	Z() function	953
67.3	ZeroBasedList Class	953
67.4	ZeroBasedString Class	954
67.5	Source Code	956

68 FoxRing Functions Reference	957
68.1 FoxRing functions	957
68.2 frAbs() function	958
68.3 frAsc() function	958
68.4 frAddBs() function	959
68.5 frAt() function	959
68.6 frAtC() function	960
68.7 frChr() function	960
68.8 frEmpty() function	961
68.9 frFile() function	961
68.10 frFileToStr() function	961
68.11 frStr() function	962
68.12 frSetIfEmpty() function	963
68.13 frSpace() function	963
68.14 frInList() function	963
68.15 frForcePath() function	964
68.16 frAllTrim() function	964
68.17 frLTrim() function	964
68.18 frJustDrive() function	964
68.19 frJustExt() function	964
68.20 frJustStem() function	965
68.21 frRTrim() function	965
68.22 frJustPath() function	965
68.23 frForceExt() function	965
68.24 frALines() function	965
68.25 frJustFName() function	965
68.26 frPadL() function	966
68.27 frPadR() function	966
68.28 frProper() function	966
68.29 frReplicate() function	966
68.30 frLen() function	966
68.31 frStuff() function	966
68.32 frSubStr() function	967
68.33 frStrTran() function	967
68.34 frListToString() function	967
68.35 frInt() function	967
68.36 frStringToList() function	967
68.37 frIIf() function	968
68.38 frVal() function	968
68.39 frBetween() function	968
68.40 frSetSeparatorTo() function	969
68.41 frTransform() function	969
68.42 frVarType() function	970
68.43 Example	970
69 BigNumber Library	973
69.1 Loading the library	973
69.2 Examples	973
69.3 BigNumber Functions	975
69.4 BigNumber Class	975
69.5 Library Source Code	975
70 Using CSVLib	976
70.1 Introduction	976

70.2 Functions	976
70.3 Examples	976
71 Using JSONLib	979
71.1 Introduction	979
71.2 Functions	979
71.3 Examples	979
72 Using HTTPLib	981
72.1 Introduction	981
72.2 Server Class Methods	981
72.3 Example	981
72.4 Samples	982
72.5 Printing Constants	982
72.6 Using HTTP GET	982
72.7 Using WebLib	984
72.8 Using HTTP Post	985
72.9 More Samples	988
72.10 Using Cookies	991
72.11 Uploading Files	992
72.12 Using Templates	994
72.13 Regular Expressions	995
72.14 Stop the Server	995
73 Using TokensLib	997
73.1 Introduction	997
73.2 RingTokens Class	997
73.3 Example	997
73.4 Constants	998
74 Using RingLibCurl	1001
74.1 Get Request	1001
74.2 Post Request	1001
74.3 Facebook Login	1002
74.4 Save Output to String	1003
74.5 Get Stock Data From Yahoo	1003
75 RingLibCurl Functions Reference	1005
75.1 Introduction	1005
75.2 Reference	1005
76 RingSockets Extension	1014
76.1 TCP Server	1014
76.2 TCP Client	1014
76.3 Functions	1015
76.4 Constants	1015
77 Threads Extension	1016
77.1 Creating Threads	1016
77.2 More Examples	1016
77.3 Reference	1018
78 RingLibUI Extension	1020
78.1 Hello World	1020
78.2 Say Hello	1022

78.3	Control Gallery	1023
78.4	Say Something	1031
78.5	Using the Menubar	1032
78.6	Drawing Sample	1036
78.7	Draw Gradient	1038
78.8	Histogram	1039
78.9	Text Drawing	1045
78.10	More Drawing Samples	1050
79	Using RingZip	1065
79.1	Create Zip File	1065
79.2	Extract Zip File	1065
79.3	Print Files in Zip file	1065
79.4	Using RingZip Classes	1066
79.5	Zip Class Reference	1067
79.6	ZipEntry Class Reference	1067
80	RingLibZip Functions Reference	1068
80.1	Introduction	1068
80.2	Reference	1068
81	RingMurmurHash Functions Reference	1069
81.1	MurmurHash1 functions	1069
81.2	MurmurHash2 functions	1069
81.3	MurmurHash3 functions	1069
81.4	Example	1070
82	RingConsoleColors Functions Reference	1071
82.1	Introduction	1071
82.2	Reference	1071
83	Using RogueUtil	1073
83.1	Change the Console window title	1073
83.2	Using colors	1073
83.3	Change the cursor position	1074
83.4	Print text at specific position	1074
83.5	Respond to keypress events	1075
83.6	Respond to mouse events in Windows command prompt	1077
83.7	Respond to mouse events (Windows Command Prompt or Linux/macOS Terminal)	1079
83.8	Defined Constants	1082
83.9	List of Functions	1083
84	RingAllegro Functions Reference	1084
84.1	Introduction	1084
84.2	Reference	1084
85	Using RingLibSDL	1104
85.1	Create Window	1104
85.2	Display Image	1104
85.3	Switch between two images	1105
85.4	Draw Rectangle	1105
85.5	Display PNG Images	1106
85.6	Use TTF Fonts	1106
85.7	Display Transparent Images	1107
85.8	Close Window Event	1108

85.9 Mouse Events	1109
85.10 Play Sound	1110
86 RingLibSDL Functions Reference	1111
86.1 Introduction	1111
86.2 Reference	1111
87 Using RingLibuv	1136
87.1 First Application using RingLibuv	1136
87.2 The Events Loop	1137
87.3 Server Example	1137
87.4 Client Example	1139
87.5 Server Example Using Classes	1140
87.6 Client Example Using Classes	1142
87.7 Threads Example	1143
87.8 Threads Example - Using Classes	1144
88 RingLibuv Functions Reference	1145
88.1 Introduction	1145
88.2 Reference	1145
89 RingFreeGLUT Functions Reference	1154
89.1 Introduction	1154
89.2 Reference	1154
90 RingStbImage Functions Reference	1165
90.1 Introduction	1165
90.2 Constants	1167
90.3 Functions	1167
91 RingOpenGL (OpenGL 3.2) Functions Reference	1169
91.1 Introduction	1169
91.2 Reference	1169
92 RingQt Classes Reference	1216
92.1 AbstractAxis Class	1216
92.2 AbstractBarSeries Class	1219
92.3 CodeEditor Class	1220
92.4 QAbstractAspect Class	1221
92.5 QAbstractButton Class	1221
92.6 QAbstractCameraController Class	1222
92.7 QAbstractGraphicsShapeItem Class	1222
92.8 QAbstractItemView Class	1222
92.9 QAbstractPrintDialog Class	1224
92.10 QAbstractScrollArea Class	1225
92.11 QAbstractSeries Class	1225
92.12 QAbstractSlider Class	1226
92.13 QAbstractSocket Class	1227
92.14 QAbstractSpinBox Class	1228
92.15 QAction Class	1229
92.16 QAllEvents Class	1231
92.17 QApplication Class	1235
92.18 QAreaLegendMarker Class	1236
92.19 QAreaSeries Class	1236
92.20 QAspectEngine Class	1237

92.21 QAudioOutput Class	1238
92.22 QAxBase Class	1238
92.23 QAxObject Class	1239
92.24 QAxWidget Class	1239
92.25 QAxWidget2 Class	1239
92.26 QBarCategoryAxis Class	1239
92.27 QBarLegendMarker Class	1240
92.28 QBarSeries Class	1240
92.29 QBarSet Class	1241
92.30 QBitmap Class	1242
92.31 QBluetoothAddress Class	1243
92.32 QBluetoothDeviceDiscoveryAgent Class	1243
92.33 QBluetoothDeviceInfo Class	1244
92.34 QBluetoothHostInfo Class	1244
92.35 QBluetoothLocalDevice Class	1244
92.36 QBluetoothServer Class	1245
92.37 QBluetoothServiceDiscoveryAgent Class	1246
92.38 QBluetoothServiceInfo Class	1247
92.39 QBluetoothSocket Class	1248
92.40 QBluetoothTransferManager Class	1249
92.41 QBluetoothTransferReply Class	1249
92.42 QBluetoothTransferRequest Class	1249
92.43 QBluetoothUuid Class	1250
92.44 QBoxLayout Class	1250
92.45 QBoxPlotLegendMarker Class	1251
92.46 QBoxPlotSeries Class	1251
92.47 QBoxSet Class	1252
92.48 QBrush Class	1253
92.49 QBuffer Class	1254
92.50 QButtonGroup Class	1254
92.51 QByteArray Class	1255
92.52 QCalendarWidget Class	1257
92.53 QCamera Class	1258
92.54 QCameraImageCapture Class	1259
92.55 QCameraLens Class	1260
92.56 QCameraSelector Class	1261
92.57 QCameraViewfinder Class	1261
92.58 QCandlestickLegendMarker Class	1261
92.59 QCandlestickModelMapper Class	1261
92.60 QCandlestickSeries Class	1262
92.61 QCandlestickSet Class	1264
92.62 QCategoryAxis Class	1265
92.63 QChar Class	1265
92.64 QChart Class	1268
92.65 QChartView Class	1269
92.66 QCheckBox Class	1270
92.67 QChildEvent Class	1270
92.68 QClipboard Class	1271
92.69 QColor Class	1271
92.70 QColorDialog Class	1274
92.71 QComboBox Class	1274
92.72 QCompleter Class	1276
92.73 QCompleter2 Class	1277
92.74 QCompleter3 Class	1277

92.75 QCompleter4 Class	1277
92.76 QComponent Class	1278
92.77 QConeGeometry Class	1278
92.78 QConeMesh Class	1279
92.79 QCoreApplication Class	1279
92.80 QCuboidMesh Class	1280
92.81 QCullFace Class	1281
92.82 QCursor Class	1281
92.83 QCylinderMesh Class	1282
92.84 QDate Class	1282
92.85 QDateEdit Class	1283
92.86 QDateTime Class	1283
92.87 QDateTimeAxis Class	1284
92.88 QDateTimeEdit Class	1285
92.89 QDepthTest Class	1286
92.90 QDesktopServices Class	1286
92.91 QDial Class	1287
92.92 QDialog Class	1287
92.93 QDiffuseSpecularMaterial Class	1288
92.94 QDir Class	1288
92.95 QDockWidget Class	1290
92.96 QDrag Class	1291
92.97 QDragEnterEvent Class	1292
92.98 QDragLeaveEvent Class	1292
92.99 QDragMoveEvent Class	1292
92.100QDropEvent Class	1292
92.101QEEffect Class	1293
92.102QEntity Class	1293
92.103QEvent Class	1293
92.104QExtrudedTextMesh Class	1294
92.105QFile Class	1294
92.106QFile2 Class	1295
92.107QFileDialog Class	1295
92.108QFileDialog Class	1295
92.109QFileInfo Class	1298
92.110QFileSystemModel Class	1299
92.111QFirstPersonCameraController Class	1300
92.112QFont Class	1301
92.113QFontDialog Class	1302
92.114QFontMetrics Class	1303
92.115QForwardRenderer Class	1304
92.116QFrame Class	1304
92.117QFrame2 Class	1305
92.118QFrame3 Class	1305
92.119QFrameAction Class	1305
92.120QGeoAddress Class	1305
92.121QGeoAreaMonitorInfo Class	1306
92.122QGeoAreaMonitorSource Class	1307
92.123QGeoCircle Class	1307
92.124QGeoCoordinate Class	1307
92.125QGeoPositionInfo Class	1308
92.126QGeoPositionInfoSource Class	1308
92.127QGeoRectangle Class	1309
92.128QGeoSatelliteInfo Class	1309

92.129QGeoSatelliteInfoSource Class	1310
92.130QGeoShape Class	1310
92.131QGoochMaterial Class	1310
92.132QGradient Class	1311
92.133QGraphicsAnchor Class	1311
92.134QGraphicsAnchorLayout Class	1311
92.135QGraphicsEffect Class	1312
92.136QGraphicsEllipseItem Class	1312
92.137QGraphicsGridLayout Class	1313
92.138QGraphicsItem Class	1314
92.139QGraphicsItemGroup Class	1319
92.140QGraphicsLayout Class	1319
92.141QGraphicsLayoutItem Class	1320
92.142QGraphicsLineItem Class	1321
92.143QGraphicsLinearLayout Class	1321
92.144QGraphicsObject Class	1322
92.145QGraphicsPathItem Class	1322
92.146QGraphicsPixmapItem Class	1323
92.147QGraphicsPolygonItem Class	1323
92.148QGraphicsProxyWidget Class	1323
92.149QGraphicsRectItem Class	1324
92.150QGraphicsScene Class	1324
92.151QGraphicsSceneContextMenuEvent Class	1326
92.152QGraphicsSceneDragDropEvent Class	1327
92.153QGraphicsSceneEvent Class	1327
92.154QGraphicsSceneHelpEvent Class	1327
92.155QGraphicsSceneHoverEvent Class	1327
92.156QGraphicsSceneMouseEvent Class	1328
92.157QGraphicsSceneMoveEvent Class	1328
92.158QGraphicsSceneResizeEvent Class	1329
92.159QGraphicsSceneWheelEvent Class	1329
92.160QGraphicsSimpleTextItem Class	1329
92.161QGraphicsSvgItem Class	1329
92.162QGraphicsTextItem Class	1330
92.163QGraphicsVideoItem Class	1331
92.164QGraphicsView Class	1331
92.165QGraphicsWidget Class	1333
92.166QGridLayout Class	1335
92.167QGuiApplication Class	1336
92.168QHBarModelMapper Class	1338
92.169QHBoxLayout Class	1339
92.170QHBoxPlotModelMapper Class	1339
92.171QHCandlestickModelMapper Class	1340
92.172QHPieModelMapper Class	1341
92.173QHXYModelMapper Class	1342
92.174QHeaderView Class	1343
92.175QHorizontalBarSeries Class	1345
92.176QHorizontalPercentBarSeries Class	1345
92.177QHorizontalStackedBarSeries Class	1345
92.178QHostAddress Class	1346
92.179QHostInfo Class	1346
92.180QIODevice Class	1347
92.181QIcon Class	1348
92.182QImage Class	1348

92.183QInputAspect Class	1349
92.184QInputDialog Class	1350
92.185QJsonArray Class	1351
92.186QJsonDocument Class	1352
92.187QJsonObject Class	1352
92.188QJsonParseError Class	1353
92.189QJsonValue Class	1353
92.190QKeySequence Class	1353
92.191QLCDNumber Class	1354
92.192QLabel Class	1354
92.193QLayout Class	1355
92.194QLegend Class	1356
92.195QLegendMarker Class	1357
92.196QLibraryInfo Class	1358
92.197QLineEdit Class	1358
92.198QLineF Class	1360
92.199QLineSeries Class	1361
92.200QLinearGradient Class	1361
92.201QListView Class	1362
92.202QListWidget Class	1363
92.203QListWidgetItem Class	1364
92.204QLocale Class	1365
92.205QLogValueAxis Class	1367
92.206QLogicAspect Class	1368
92.207QMainWindow Class	1368
92.208QMaterial Class	1369
92.209QMatrix4x4 Class	1370
92.210QMdiArea Class	1371
92.211QMdiSubWindow Class	1372
92.212QMediaObject Class	1372
92.213QMediaPlayer Class	1373
92.214QMediaPlaylist Class	1374
92.215QMenu Class	1374
92.216QMenuBar Class	1375
92.217QMesh Class	1376
92.218QMessageBox Class	1376
92.219QMetalRoughMaterial Class	1377
92.220QMimeType Class	1377
92.221QModelIndex Class	1378
92.222QMorphPhongMaterial Class	1379
92.223QMovie Class	1379
92.224QMutex Class	1380
92.225QMutexLocker Class	1381
92.226QNetworkAccessManager Class	1381
92.227QNetworkProxy Class	1382
92.228QNetworkReply Class	1382
92.229QNetworkRequest Class	1383
92.230QNmeaPositionInfoSource Class	1383
92.231QNode Class	1384
92.232QObject Class	1384
92.233QObjectPicker Class	1385
92.234QOpenGLBuffer Class	1386
92.235QOpenGLContext Class	1387
92.236QOpenGLDebugLogger Class	1388

92.237QOpenGLFramebufferObject Class	1388
92.238QOpenGLFunctions Class	1389
92.239QOpenGLFunctions_3_2_Core Class	1393
92.240QOpenGLPaintDevice Class	1401
92.241QOpenGLShader Class	1401
92.242QOpenGLShaderProgram Class	1402
92.243QOpenGLTexture Class	1406
92.244QOpenGLTimerQuery Class	1408
92.245QOpenGLVersionProfile Class	1408
92.246QOpenGLVertexArrayObject Class	1408
92.247QOpenGLWidget Class	1409
92.248QOrbitCameraController Class	1409
92.249QPageSetupDialog Class	1410
92.250QPaintDevice Class	1410
92.251QPainter Class	1410
92.252QPainter2 Class	1413
92.253QPainterPath Class	1413
92.254QPen Class	1414
92.255QPerVertexColorMaterial Class	1415
92.256QPercentBarSeries Class	1415
92.257QPhongMaterial Class	1415
92.258QPicture Class	1416
92.259QPieLegendMarker Class	1416
92.260QPieSeries Class	1416
92.261QPieSlice Class	1418
92.262QPixmap Class	1420
92.263QPixmap2 Class	1421
92.264QPlainTextEdit Class	1421
92.265QPlaneMesh Class	1424
92.266QPoint Class	1424
92.267QPointF Class	1424
92.268QPointLight Class	1425
92.269QPolarChart Class	1425
92.270QPrintDialog Class	1425
92.271QPrintPreviewDialog Class	1426
92.272QPrintPreviewWidget Class	1426
92.273QPrinter Class	1427
92.274QPrinterInfo Class	1428
92.275QProcess Class	1429
92.276QProgressBar Class	1430
92.277QPushButton Class	1431
92.278QQmlEngine Class	1431
92.279QQmlError Class	1432
92.280QQuaternion Class	1432
92.281QQQuickView Class	1433
92.282QQQuickWidget Class	1434
92.283QRadioButton Class	1434
92.284QRect Class	1435
92.285QRectF Class	1436
92.286QRegExp Class	1438
92.287QRegion Class	1439
92.288QRegularExpression Class	1440
92.289QRegularExpressionMatch Class	1440
92.290QRegularExpressionMatchIterator Class	1441

92.291QRenderAspect Class	1441
92.292QRenderPass Class	1441
92.293QScatterSeries Class	1442
92.294QSceneLoader Class	1442
92.295QScreen Class	1443
92.296QScrollArea Class	1444
92.297QScrollBar Class	1444
92.298QSerialPort Class	1444
92.299QSerialPortInfo Class	1446
92.300QSize Class	1446
92.301QSkyboxEntity Class	1446
92.302QSlider Class	1447
92.303QSphereMesh Class	1447
92.304QSpinBox Class	1448
92.305QSplashScreen Class	1448
92.306QSplineSeries Class	1449
92.307QSplitter Class	1449
92.308QSqlDatabase Class	1450
92.309QSqlDriver Class	1451
92.310QSqlDriverCreatorBase Class	1451
92.311QSqlError Class	1451
92.312QSqlField Class	1452
92.313QSqlIndex Class	1452
92.314QSqlQuery Class	1453
92.315QSqlRecord Class	1454
92.316QStackedBarSeries Class	1455
92.317QStackedWidget Class	1455
92.318QStandardPaths Class	1455
92.319QStatusBar Class	1456
92.320QString2 Class	1456
92.321QStringList Class	1458
92.322QStringRef Class	1459
92.323QStyle Class	1460
92.324QStyleOptionGraphicsItem Class	1462
92.325QSurfaceFormat Class	1462
92.326QSystemTrayIcon Class	1463
92.327QTabBar Class	1463
92.328QTabWidget Class	1465
92.329QTableView Class	1466
92.330QTableWidget Class	1468
92.331QTableWidgetItem Class	1470
92.332QTcpServer Class	1471
92.333QTcpSocket Class	1472
92.334QTechnique Class	1473
92.335QTest Class	1473
92.336QText2DEntity Class	1473
92.337QTextBlock Class	1474
92.338QTextBrowser Class	1475
92.339QTextCharFormat Class	1476
92.340QTextCodec Class	1477
92.341QTextCursor Class	1477
92.342QTextDocument Class	1479
92.343QTextEdit Class	1481
92.344QTextOption Class	1484

92.345QTextStream Class	1484
92.346QTextStream2 Class	1486
92.347QTextStream3 Class	1486
92.348QTextStream4 Class	1486
92.349QTextStream5 Class	1486
92.350QTextToSpeech Class	1486
92.351QTextureLoader Class	1487
92.352QTextureMaterial Class	1487
92.353QThread Class	1488
92.354QThreadPool Class	1489
92.355QTime Class	1489
92.356QTimer Class	1490
92.357QToolBar Class	1490
92.358QToolButton Class	1491
92.359QTorusMesh Class	1492
92.360QTransform Class	1492
92.361QTransform2 Class	1493
92.362QTransform3 Class	1494
92.363QTreeView Class	1494
92.364QTreeWidget Class	1496
92.365QTreeWidgetItem Class	1499
92.366QUrl Class	1500
92.367QUuid Class	1501
92.368QVBarModelMapper Class	1501
92.369QVBoxLayout Class	1502
92.370QVBoxLayoutModelMapper Class	1502
92.371QVCandlestickModelMapper Class	1503
92.372QVPieModelMapper Class	1504
92.373QVXYModelMapper Class	1505
92.374QValueAxis Class	1506
92.375QVariant Class	1507
92.376QVariant2 Class	1508
92.377QVariant3 Class	1508
92.378QVariant4 Class	1509
92.379QVariant5 Class	1509
92.380QVariantDouble Class	1509
92.381QVariantFloat Class	1509
92.382QVariantInt Class	1509
92.383QVariantString Class	1509
92.384QVector2D Class	1510
92.385QVector3D Class	1510
92.386QVector4D Class	1511
92.387QVectorQVoice Class	1512
92.388QVersionNumber Class	1512
92.389QVideoWidget Class	1512
92.390QVideoWidgetControl Class	1513
92.391QViewport Class	1513
92.392QVoice Class	1514
92.393QWebEnginePage Class	1514
92.394QWebEngineView Class	1517
92.395QWebView Class	1518
92.396QWidget Class	1519
92.397QWindow Class	1524
92.398QXYLegendMarker Class	1528

92.399QXYSeries Class	1528
92.400QXmlStreamAttribute Class	1530
92.401QXmlStreamAttributes Class	1531
92.402QXmlStreamEntityDeclaration Class	1531
92.403QXmlStreamEntityResolver Class	1531
92.404QXmlStreamNamespaceDeclaration Class	1532
92.405QXmlStreamNotationDeclaration Class	1532
92.406QXmlStreamReader Class	1532
92.407QXmlStreamWriter Class	1534
92.408Qt3DCamera Class	1535
92.409Qt3DWindow Class	1536
92.410RingCodeHighlighter Class	1537
93 Using FastPro	1538
93.1 Bytes2List() function	1538
93.2 List2Bytes() function	1538
93.3 UpdateList() function	1538
93.4 UpdateColumn() function	1543
93.5 Generate Image	1543
93.6 UpdateBytesColumn() function	1545
93.7 AddBytesColumn() function	1546
94 Using RingPDFGen	1548
94.1 Example	1548
94.2 Constants	1549
94.3 Functions	1550
95 Using References	1552
95.1 Introduction	1552
95.2 ref()/reference() function	1553
95.3 refcount() function	1554
95.4 Circular References	1554
95.5 The Tree Class	1555
95.6 Linked list	1556
95.7 Dependency injection	1557
95.8 Passing lists to functions	1558
95.9 Ref() and temp. lists	1559
95.10 Nested Ref()	1560
95.11 Ref() in left side	1560
95.12 Ref() and sub lists	1560
96 Low Level Functions	1562
96.1 callgc() function	1563
96.2 varptr() function	1563
96.3 space() function	1564
96.4 nullpointer() function	1565
96.5 object2pointer() function	1565
96.6 pointer2object() function	1565
96.7 ispointer() function	1567
96.8 ptrcmp() function	1567
96.9 setpointer() function	1568
96.10 getpointer() function	1568
96.11 pointer2string() function	1569
96.12 memcpy() function	1570
96.13 ringvmm_cfunctionslist() function	1570

96.14 ringvm_functionslist() function	1571
96.15 ringvm_classeslist() function	1571
96.16 ringvm_packageslist() function	1572
96.17 ringvm_memorylist() function	1573
96.18 ringvm_calllist() function	1575
96.19 ringvm_fileslist() function	1576
96.20 ringvm_settrace()	1577
96.21 ringvm_tracedata()	1577
96.22 ringvm_traceevent()	1577
96.23 ringvm_tracefunc()	1578
96.24 ringvm_scopescount()	1578
96.25 ringvm_evalinscope()	1578
96.26 ringvm_passerror()	1578
96.27 ringvm_hideerrormsg()	1579
96.28 ringvm_callfunc()	1579
96.29 Example - Using the Trace Functions	1579
96.30 Example - The Trace Library	1583
96.31 ringvm_see() function	1587
96.32 ringvm_give() function	1588
96.33 ringvm_codelist() function	1588
96.34 ringvm_info() function	1588
96.35 ringvm_ismempool() function	1588
96.36 ringvm_runcode() function	1589
97 Tutorial: Ring Extensions in C/C++	1590
97.1 Hello World	1590
97.2 Build the extension on different platforms	1591
97.3 Sum Two Numbers	1592
97.4 Say Hello	1593
97.5 Sum List of Numbers	1594
97.6 Increment List Items	1596
97.7 Filter List Items	1598
97.8 Replicate List Items	1600
97.9 Generate List	1602
97.10 Display List	1604
97.11 Update Table	1608
97.12 Create Table	1611
98 Extension using the C/C++ languages	1616
98.1 ring_ext.h	1616
98.2 ring_ext.c	1616
98.3 Module Organization	1617
98.4 Function Structure	1618
98.5 Check Parameters Count	1619
98.6 Display Error Message	1619
98.7 Check Parameters Type	1620
98.8 Get Parameters Values	1620
98.9 Return Value	1620
98.10 Function Prototype	1621
98.11 Sin() Function Implementation	1621
98.12 Fopen() and Fclose() Functions Implementation	1621
98.13 Ring API - List Functions	1622
98.14 RING_API_STATE	1625
98.15 Ring API - String Functions	1626

98.16 MySQL_Columns() Function Implementation	1627
98.17 Dynamic/Shared Libraries (DLL/So/Dylib) and LoadLib() function	1628
98.18 Using RING_API_RETMANAGEDCPOINTER()	1629
98.19 Memory Functions	1630
99 Embedding Ring Language in C/C++ Programs	1631
99.1 Ring State	1631
99.2 Ring State Functions	1631
99.3 Ring State Variables	1632
100 Code Generator for wrapping C/C++ Libraries	1634
100.1 Using the tool	1634
100.2 Configuration file	1634
100.3 Using the function prototype	1634
100.4 Adding code to the generated code	1636
100.5 Prefix for Functions Names	1636
100.6 Generate function to wrap structures	1637
100.7 Determine Structure Members Types	1637
100.8 Defining Constants	1637
100.9 Register New Functions	1638
100.10 Writing comments in the configuration file	1638
100.11 Executing code during code generation	1638
100.12 Enum and Numbers	1639
100.13 Filtering using Expressions	1639
100.14 Constants Type	1639
100.15 Configuration file for the Allegro Library	1640
100.16 Threads Support	1641
100.17 Code Generator Rules for Wrapping C++ Classes	1643
100.18 Using configuration file that wrap C++ Library	1644
100.19 Configuration file for the Qt Framework	1644
100.20 Static Methods	1655
100.21 Loading Files	1655
100.22 Managed Classes	1656
100.23 Extra names for functions	1656
100.24 Configuration Files Examples	1656
101 Create your first extension	1658
101.1 Location	1658
101.2 Steps to create the extension	1658
101.3 Testing the extension	1659
102 Using Ring for Raspberry Pi Pico Microcontroller	1660
102.1 Install	1660
102.2 Programming	1660
102.3 Building	1661
102.4 Deployment	1661
102.5 Blink sample	1661
102.6 LEDs sample	1661
102.7 LED and Switch sample	1662
102.8 Declarative Programming sample	1663
102.9 Using Wokwi Simulator	1666
103 Language Design	1668
103.1 Why Ring?	1668
103.2 Designed for a Clear Goal	1668

103.3 Simple	1668
103.4 Trying to be natural	1669
103.5 Encourage Organization	1670
103.6 Data Representation	1671
103.7 Compact Syntax	1671
103.8 Define Natural Statements	1672
103.9 Define Declarative Languages	1674
103.10Transparent Implementation	1675
103.11Visual Implementation	1676
103.12Smart Garbage Collector	1678
103.13No Global Interpreter (VM) Lock - No GIL	1678
103.14Fast Enough For Many Applications	1678
104What is new in Ring 1.1?	1679
104.1 List of changes and new features	1679
104.2 Better Natural Language Programming Support	1679
104.3 Generate/Execute Ring Object Files (*.ringo)	1680
104.4 Syntax Flexibility and different styles for I/O and Control Structures	1680
104.5 New Functions and Changes	1683
104.6 StdLib functions and classes written in Ring	1683
104.7 RingLibSDL	1686
104.8 Demo Project - Game Engine for 2D Games	1686
104.9 RingSQLite	1687
104.10Better Code Generator for Extensions	1688
104.11Using Self.Attribute in the Class Region to define new attributes	1688
104.12Using This.Attribute in nested Braces inside the Class Methods	1688
104.13Better Documentation	1689
105What is new in Ring 1.2?	1690
105.1 List of changes and new features	1690
105.2 New Functions	1690
105.3 Better Functions	1691
105.4 Better Ring Notepad	1692
105.5 Better RingQt	1692
105.6 Objects Library for RingQt	1693
105.7 RingLibCurl	1694
105.8 Better Call Command	1694
105.9 Using NULL instead of NULLPointer()	1694
105.10Display Warnings Option	1695
105.11Better Quality	1695
106What is new in Ring 1.3?	1696
106.1 List of changes and new features	1696
106.2 Better RingQt	1696
106.3 Better Ring Notepad	1700
106.4 Ring mode for Emacs Editor	1704
106.5 Better StdLib	1704
106.6 Better Loop Exit Command	1704
106.7 New Functions	1705
106.8 Return Self by Reference	1705
106.9 Using '<' and ':' operators as 'from' keyword	1706
106.10Embedding Ring in Ring without sharing the State	1706
106.11RingZip Library	1707
106.12Form Designer	1708

107What is new in Ring 1.4?	1710
107.1 List of changes and new features	1710
107.2 Change: Basic Extensions are separated from RingVM	1710
107.3 The Natural Library	1711
107.4 New Style is added to Ring Notepad	1713
107.5 RingREPL	1714
107.6 Convert between Numbers and Bytes	1715
107.7 Better StdLib	1716
107.8 Better WebLib	1716
107.9 Better RingQt	1718
107.10Qt Class Converter	1718
107.11What is new in Ring 1.4.1?	1719
108What is new in Ring 1.5?	1723
108.1 List of changes and new features	1723
108.2 Video-Music-Player Application	1724
108.3 Windows StartUp Manager Application	1724
108.4 Calculator Application	1725
108.5 Better Ring Notepad	1726
108.6 Better StdLib	1729
108.7 Better WebLib	1730
108.8 Better RingQt	1733
108.9 Better Objects Library	1736
108.10RingFreeGLUT Extension	1736
108.11RingOpenGL Extension	1747
108.12Better Code Generator for Extensions	1751
108.13Better Documentation Generator for Extensions	1752
108.14Ring VM - Tracing Functions	1752
108.15Trace Library and Interactive Debugger	1757
108.16More Syntax Flexibility	1759
108.17Type Hints Library	1760
108.18Better Quality	1761
108.19What is new in Ring 1.5.1?	1761
108.20What is new in Ring 1.5.2?	1766
108.21What is new in Ring 1.5.3?	1767
108.22What is new in Ring 1.5.4?	1771
109What is new in Ring 1.6?	1772
109.1 List of changes and new features	1772
109.2 Employee Application	1773
109.3 New Tool: Ring2EXE	1773
109.4 Better Ring For Android	1773
109.5 New Tool: Folder2qrc	1775
109.6 Better Scripts for building Ring	1775
109.7 RingConsoleColors Extension	1775
109.8 RingMurmurHash Extension	1776
109.9 Better Ring Notepad	1776
109.10Better RingQt	1778
109.11Better StdLib	1779
109.12Better RingVM	1779
109.13Better RingREPL	1780
109.14Using Tab instead of char(9)	1780
109.15Using CR as Carriage return	1780
109.16Using the ! operator as not	1781

109.17Using && and operators	1781
109.18Using ? to print expression then new line	1782
110What is new in Ring 1.7?	1783
110.1 List of changes and new features	1783
110.2 New Command: Load Package	1783
110.3 ringvm_see() and ringvm_give() functions	1784
110.4 ring_state_new() and ring_state_mainfile() functions	1785
110.5 Better Trace Library	1785
110.6 Better Ring Notepad	1786
110.7 Better RingQt	1786
110.8 Better Ring2EXE	1787
110.9 Better RingZip	1787
110.10Better Documentation	1787
110.11Better Ring VM	1788
110.12RingLibuv Extension	1788
111What is new in Ring 1.8?	1792
111.1 List of changes and new features	1792
111.2 Better Performance	1793
111.3 Find in files Application	1793
111.4 String2Constant Application	1794
111.5 StopWatch Application	1795
111.6 More 3D Samples	1795
111.7 Compiling on Manjaro Linux	1797
111.8 Using This in the class region as Self	1798
111.9 Default value for object attributes is NULL	1799
111.10The For Loops uses the local scope	1800
111.11Merge binary characters	1801
111.12FoxRing Library	1802
111.13Better Form Designer	1802
111.14Better Cards Game	1803
111.15Better RingQt	1803
111.16Better Code Generator For Extensions	1804
111.17Better Ring Compiler and VM	1804
111.18Notes to extensions creators	1805
112What is new in Ring 1.9?	1806
112.1 List of changes and new features	1806
112.2 New Game : Gold Magic 800	1806
112.3 More Games	1808
112.4 Better Ring Notepad	1811
112.5 Better StdLib	1812
112.6 BigNumber Library	1813
112.7 RingPostgreSQL Extension	1815
112.8 Deploying Web applications in the Cloud	1817
112.9 Better RingQt	1817
112.10Better Memory Management	1821
112.11Better Code Generator for Extensions	1821
112.12More Improvements	1822
113What is new in Ring 1.10?	1824
113.1 List of changes and new features	1824
113.2 Chess Game	1824
113.3 Minesweeper Game	1825

113.4 Knight Tour Game	1826
113.5 Game of Life Game	1827
113.6 Pong Game	1828
113.7 Snakes And Ladder Game	1829
113.8 More Games	1830
113.9 Ring Extension for Visual Studio Code	1831
113.10 The Ring Package Manager (RingPM)	1832
113.11 Better Tests	1833
113.12 More Improvements	1833
114 What is new in Ring 1.11?	1835
114.1 List of changes and new features	1835
114.2 More 3D Samples	1835
114.3 Checkers Game	1836
114.4 Sokoban Game	1837
114.5 Maze Game	1838
114.6 Snake Game	1839
114.7 Sudoku Game	1840
114.8 Desktop Screen Shot Application	1842
114.9 Text To Speech Application	1842
114.10 RingRayLib Extension	1843
114.11 ZeroLib Library	1845
114.12 StdLib - More Functions	1846
114.13 Better RingQt	1847
114.14 Better Performance	1849
114.15 Better Documentation	1849
114.16 More Improvements	1849
115 What is new in Ring 1.12?	1851
115.1 List of changes and new features	1851
115.2 Go Game	1851
115.3 ASCII Table application	1852
115.4 BMI Calculator application	1853
115.5 Calendar application	1853
115.6 Julian Day Calendar application	1854
115.7 Tutorial: Number to Words	1855
115.8 Load Again Command	1856
115.9 ring_state_filetokens() function	1857
115.10 Generate Embedded Ring Object File	1858
115.11 Better RingRayLib	1859
115.12 More Improvements	1860
116 What is new in Ring 1.13?	1862
116.1 List of changes and new features	1862
116.2 New Book by Apress	1863
116.3 Ring for WebAssembly	1864
116.4 Better Threads Support	1864
116.5 Laser Game	1865
116.6 Magic Balls Game	1866
116.7 Money Boxes Game	1867
116.8 Matching Game	1867
116.9 Pairs Game	1868
116.10 Word Game	1869
116.11 Tetris Game	1870

116.12	Escape Game	1871
116.13	Hassouna Course Samples	1872
116.14	Ring support in SpaceVim	1873
116.15	Better RingQt	1874
116.16	Better RingRayLib	1876
116.17	RingStbImage Extension	1877
116.18	More Low Level Functions	1878
116.19	Better Organization	1878
116.20	More Improvements	1878
117	What is new in Ring 1.14?	1882
117.1	List of changes and new features	1882
117.2	MyCoffee (Web Application)	1883
117.3	Web Development Samples	1884
117.4	More Samples	1885
117.5	Erlang B Formula	1887
117.6	Customers Form	1888
117.7	RingTilengine Extension	1889
117.8	RingLibui Extension	1892
117.9	RingSockets Extension	1896
117.10	RingThreads Extension	1896
117.11	Better RingOpenSSL	1897
117.12	More Functions	1898
117.13	Better Functions	1899
117.14	Better Performance For Strings	1899
117.15	Better Handling For Numbers	1900
117.16	Using CLOC (Count Lines of Code)	1901
117.17	More Improvements	1902
118	What is new in Ring 1.15?	1904
118.1	List of changes and new features	1904
118.2	New Arabic Book	1904
118.3	Chess Endgame Application	1905
118.4	Chess 3D (Qt3D Sample)	1907
118.5	Better Ring Notepad	1909
118.6	Better StdLib	1910
118.7	Better RingQt	1911
118.8	Better RingLibCurl	1912
118.9	Heroku (Better support)	1912
118.10	Using ‘:’ then Numbers	1913
118.11	More Samples	1913
118.12	More Improvements	1914
119	What is new in Ring 1.16?	1916
119.1	List of changes and new features	1916
119.2	Light GUILib	1916
119.3	UTF-8 File Names in Microsoft Windows	1917
119.4	Nested Methods Call in Separate Lines	1918
119.5	Code Runner Extension support Ring	1919
119.6	Zero and Strings	1920
119.7	Better Installation Scripts	1921
119.8	Better Documentation	1921
119.9	MDI Windows Sample	1921
119.10	More Improvements	1921

120What is new in Ring 1.17	1923
120.1 List of changes and new features	1923
120.2 Merge Two Files	1923
120.3 Poetry Analysis	1924
120.4 Citations Prediction	1925
120.5 TokensLib Library	1926
120.6 CSVLib Library	1927
120.7 JSONLib Library	1929
120.8 HTTPLib Library	1930
120.9 Better GUILib	1931
120.10Better RingOpenSSL	1933
120.11Better RingWinAPI	1933
120.12Better Syntax Flexibility	1934
120.13Better I/O Functions	1934
120.14Better Ring API	1935
120.15Better Code Generator for Extensions	1936
120.16More Improvements	1936
121What is new in Ring 1.18	1939
121.1 List of changes and new features	1939
121.2 Read Files application	1940
121.3 Random User application	1940
121.4 Better CitPre application	1942
121.5 Better Tools	1942
121.6 More Samples	1943
121.7 Syntax Files	1944
121.8 The Power Operator	1945
121.9 Using References	1945
121.10Ring for MS-DOS	1946
121.11Faster (For-In) Loop	1947
121.12Faster BraceError()	1947
121.13Better RingRayLib	1948
121.14Better RingSockets	1950
121.15Heroku (Better support)	1950
121.16Command: New From	1950
121.17ImportPackage() Function	1951
121.18More Low Level Functions	1951
121.19Better WebLib	1951
121.20Better Ring API	1952
121.21Better Documentation	1953
121.22MatrixLib Library	1953
121.23More Improvements	1954
122What is new in Ring 1.19	1957
122.1 List of changes and new features	1957
122.2 Image Pixel application	1958
122.3 Hours Counter application	1958
122.4 Planetary Orbits application	1959
122.5 Listen to Quran application	1959
122.6 More Samples	1960
122.7 Ring for Windows 64bit	1962
122.8 Better batch files for building Ring	1962
122.9 For Loop - Better Performance	1962
122.10Calling Functions - Better Performance	1962

122.11Using Objects During Definition	1963
122.12Nothing() function	1964
122.13OptionalFunc() function	1964
122.14ParentClassName() Function	1965
122.15FastPro Extension	1966
122.16Better TypeHints	1967
122.17Better RingRayLib	1967
122.18Better RingStbImage	1969
122.19Better Extensions Generator	1970
122.20Better Documentation	1971
122.21More Improvements	1971
123What is new in Ring 1.20	1974
123.1 List of changes and new features	1974
123.2 Try Ring Online (WebAssembly)	1974
123.3 Better Samples and Applications	1976
123.4 Better Functions	1977
123.5 Enable/Disable Hash Comments	1978
123.6 Better Files for Loading the StdLib	1979
123.7 Better Performance when using Braces	1980
123.8 Better Support for Threads	1981
123.9 RingRogueUtil Extension	1981
123.10Pause/Resume Embedded Ring VM	1983
123.11Better Tools and Extensions	1983
123.12Better Scripts for Building Ring	1984
123.13Improving Ring Compiler/VM Source Code	1984
123.14Better Documentation	1985
123.15More Improvements	1985
124What is new in Ring 1.21	1986
124.1 List of changes and new features	1986
124.2 Ring for Raspberry Pi Pico	1987
124.3 Lectures Tracker application	1987
124.4 RingPDFGen Extension	1988
124.5 Better MatrixLib	1990
124.6 Better RingQt	1991
124.7 Better RingRayLib	1993
124.8 More Samples	1994
124.9 Faster Function Call	1994
124.10Faster Arithmetic Operations	1996
124.11Faster Compiler	1997
124.12Reducing Memory Usage	1997
124.13ForEach Keyword	1997
124.14NumOrZero() Function	1998
124.15Better Operator Overloading	1998
124.16Syntax Highlighting for Vim/nano	2000
124.17New VM Instructions	2000
124.18More Improvements	2001
124.19What is new in Ring 1.21.1?	2002
124.20What is new in Ring 1.21.2?	2003
125What is new in Ring 1.22	2004
125.1 List of changes and new features	2004
125.2 Research Article	2004

125.3 PWCT 2.0 (Free Software)	2005
125.4 More Projects	2006
125.5 Better Samples	2007
125.6 Better Functions	2009
125.7 Better RingFastPro Extension	2010
125.8 Return Attribute by Reference	2011
125.9 Better Compiler	2012
125.10More Improvements	2013
126Using Other Code Editors	2014
126.1 Using Notepad++	2014
126.2 Using Geany	2015
126.3 Using nano	2016
126.4 Using Atom	2017
126.5 Using Sublime Text 2	2018
126.6 Using Visual Studio IDE	2019
126.7 Using Emacs Editor	2020
126.8 Visual Studio Code	2020
126.9 SpaceVim	2021
126.10Lite XL	2022
127Frequently Asked Questions (FAQ)	2023
127.1 Why do we need Yet Another Programming Language (YAPL)?	2023
127.2 Which of 3 coding styles are commonly used or recommended by the community?	2024
127.3 What is the Ring Architecture?	2025
127.4 What about Memory Management in Ring?	2025
127.5 What about Data Representation in Ring?	2026
127.6 Why is Ring weakly typed?	2028
127.7 What are the advantages to using Ring over Lisp or Smalltalk?	2028
127.8 Why is Ring largely focused on UI creation?	2029
127.9 Is Ring some sort of an improvement of PHP?	2029
127.10What are the advantages of using Ring over native C or C++?	2029
127.11What is the difference between Ring and Python? And is Ring Open Source?	2029
127.12What are the advantages to using Ring over Perl, PHP, Python or Ruby?	2030
127.13What are the advantages to using Ring over Tcl or Lua?	2031
127.14What are the advantages to using Ring over C# or Java?	2031
127.15The documentation says functional programming is supported, but then this happens?	2031
127.16Why the ability to define your own languages Instead of parsing?	2032
127.17Why you can specify the number of loops you want to break out of?	2032
127.18Why Ring uses ‘See’, ‘Give’, ‘But’ and ‘Ok’ Keywords?	2032
127.19What is the philosophy behind data types in Ring?	2033
127.20What about the Boolean values in Ring?	2033
127.21What is the goal of including the “Main” function in Ring?	2034
127.22Why the list index start from 1 in Ring?	2035
127.23Why Ring is not case-sensitive?	2036
127.24Why the Assignment operator uses Deep Copy?	2036
127.25Is there constructor methods in Ring?	2037
127.26What happens when we create a new object?	2038
127.27Can we use the attributes by accessing the Getter and Setter methods?	2039
127.28Why should a search of global names be made while defining the class attributes?	2040
127.29Why Ring doesn’t avoid the conflict between Global Variables and Class Attributes Names?	2041
127.30Where can I write a program and execute it?	2041
127.31How to get the file size using ftell() and fseek() functions?	2042
127.32How to get the current source file path?	2042

127.33	What about predefined parameters or optional parameters in functions?	2043
127.34	How to print keys or values only in List/Dictionary?	2043
127.35	Why I get a strange result when printing nl with lists?	2044
127.36	Could you explain the output of the StrCmp() function?	2044
127.37	How to use many source code files in the project?	2045
127.38	Why this example use the GetChar() twice?	2046
127.39	How to use NULL and ISNULL() function?	2047
127.40	How to print lists that contains objects?	2048
127.41	How to insert an item to the first position in the list?	2048
127.42	How to print new lines and other characters?	2049
127.43	Why I get Calling Function without definition Error?	2049
127.44	Can Ring work on Windows XP?	2050
127.45	Why we don't use () after the QApp class name?	2050
127.46	Why the window title bar is going outside the screen?	2050
127.47	How to create an array of buttons in GUI applications?	2051
127.48	How to Close a window then displaying another one?	2052
127.49	How to create a Modal Window?	2053
127.50	How can I disable maximize button and resize window?	2054
127.51	Why setClickEvent() doesn't see the object methods directly?	2054
127.52	How to extend RingQt and add more classes?	2055
127.53	How to add Combobox and other elements to the cells of a QTableWidgetItem?	2057
127.54	How to perform some manipulations on selected cells in QTableWidgetItem?	2058
127.55	How to use SQLite using ODBC?	2059
127.56	Can I connect to dbase/harbour database?	2060
128	Building From Source Code	2062
128.1	Building using Microsoft Windows	2062
128.2	Complete Build (Compiler/VM, Extensions, Tools, etc.)	2062
128.3	Custom Build for Windows (64bit)	2063
128.4	Custom Build for Windows (32bit)	2063
128.5	Building using Ubuntu Linux	2066
128.6	Complete Build for Ubuntu Linux	2066
128.7	Custom Build for Ubuntu Linux	2066
128.8	Building using MacOS X	2069
128.9	Complete Build for macOS	2069
128.10	Custom Build for macOS	2070
128.11	Building using CMake	2072
129	How to contribute?	2073
129.1	Special thanks to contributors	2073
129.2	Documentation	2073
129.3	Testing	2074
129.4	Samples	2074
129.5	Applications	2074
129.6	Editors Support	2074
129.7	Libraries in Ring	2074
129.8	Extensions in C/C++	2074
129.9	Compiler and Virtual Machine (VM)	2075
130	Language Specification	2076
130.1	Scanner Commands	2076
130.2	Language Keywords	2077
130.3	Language Functions	2078
130.4	Compiler Errors	2084

130.5 Runtime Errors	2085
130.6 Environment Errors	2087
130.7 Language Grammar	2087
130.8 Virtual Machine (VM) Instructions	2089
131Resources	2094
131.1 Ring Language Website	2094
131.2 Source Code	2094
131.3 Ring Group	2094
131.4 Ring Team	2094
Index	2095

**CHAPTER
ONE**

APPLICATIONS DEVELOPED IN A FEW HOURS

Ring is a new programming language that focuses on the Natural Language Programming and Declarative Programming paradigms and will let you think different about programming and how to solve your problems in a better way. In little days after the first release we got thousands of downloads and many developers started learning and using the language. Their feedback are the secret behind the language progress and success. They said that Ring is powerful, beautiful and easy to learn, Some of them provided good examples about what can be done using Ring in a few hours. They are very happy with the language productivity.

1.1 Quotes about Ring

“I like Smalltalk very much but now I like Ring better!”

, Gal Zsolt (Hungary)

“I find the language and its syntax very natural and easy to follow.”

, Bhudda (United States)

“Very nice approach for a new language.”

, Matth Moestl (Austria)

“Very interesting! I will keep an eye on it!”

, Eslipak (Argentina)

“I’d like to see some benchmarks. Otherwise, at first glance, it looks really promising.”

, Alex Deva (Sweden)

“Excellent”

, Liju Sankar (United States)

“I wish you the best with this project.”

, David O’Neil (United States)

“Just fantastic.”

, Jose Antonio (Mexico)

“This looks like it was developed by some very competent people.”

, Jim Clack (United States)

“The Ring programming language seems pretty interesting so far.”

, Eric Johnson (United States)

“Thank you for this awesome language and wonderful ready to use Qt binding.”

, Martial FAESSEL

“I think it’s great what he does for the community of developers and novice programming.”

, Marino Esteban

“Ring is just awesome. The language is so cool and fluent. I am sure it’s going to be BIG.”

, Ahmed Zain

“What a proud, really wish you Eng. Mahmoud Samir and Your Team moving forward ^_^ and from now , considered me a big fan of the Ring programming language.”

, Zainab Mahmoud

“Well guys I love this language and it appears that you have created perfect language.”

, Moemen Ghulmi

“Good work Mahmoud, I’ve installed ring pl, and it’s very perfect language.”

, Ahmed Omar (Egypt)

“Thanks for this great startup programming language. I wish you best of luck.”

, Elkhouaja Khalid

“Congratulations! I am very happy and I wish you Success and good luck.”

, Abobasmla Hassan

“Good Features of multi-use language on the Web, Mobile and Desktop.”

, Abdelrhman Haider

“Very interesting effort.”

, Giannakakis Kostas (Greece)

“I am too lazy to open comment window and write message. But in your case I must say (Perfect) Really, create new remarkable language like your Ring is really perfect job. Even create editor for your language in your language with only few rows... Even noticed in rosettacode.org ! I read your previous articles and I tried these examples a few days ago and I will continue. I love Ring. P.S.: Anders Hejlsberg, Niklaus Wirth, Bjarne Stroustrup, Ada Lovelace Hall of fame is waiting....”

, Martin Nedopil (Czech Republic)

“Ring seems very attractive to me through its very easy design and the Qt bindings. I like its declarative approach and the generous documentation.”

, Shalok Shalom (Austria)

“Ring (and plenty of extension library + Qt) is wonderful.”

, Kovacs Attila (Hungary)

“Since two days I’m trying Ring and I’m really impressed, in add to power commands and easy use, it’s really very efficient and very fast. Each day I hope to find the couple of the year PWCT+RING ... Maybe for my Christmas gift!!!! HO HO HO HO Continue your fantastic job and congratulations.”

, Jose Le Roux (France)

“There are 3 different styles, it looks like Python and C”

, 64remy

“I was taking a tour around Rosettacode and have found Ring. I like the syntax a lot. It’s clean and easy to understand. It looks like a very clean BASIC dialect without sigils. I can say that this is the easiest and the most BASIC-like language I’ve ever tried.”

, Tomaaz

“Thanks for your effort. I took a quick look and found it interesting. You are trying to follow more or less like Clipper with simple command and no rigid declaration rules. Good.”

, Anand Gupta

“Thanks for this wonderful language”

, Vinod kc (India)

“Very enlightening. good job!”

, Southmountain (United States)

“The thing I liked was the loop exiting”

, Leon de boer (Australia)

“An outstanding and easy language to program with.”

, Kenneth Burgo (Philippines)

“I chose your language as I feel I can understand it better than other languages”

, Harry Singh

“I like the totality of the language, far more features than expected and the freedom of expressiveness is unique.”

, Evikone

“Thank you very much Mahmoud! I am using ring for many experiments and so far I love it. I really want to continue using ring and contribute what I can.”

, John (SienSystem)

“Sir, Very Good”

, Kamlesh Patel

“That’s more than a “cool” syntax, the example of writing free-form text between curly-brackets such that each word calls a function. Which could be interesting (A syntax like that would be nice for declaring text styles)”

, LaurieCheers

“If you browse around you see they have listed 160 contributors. This year they have entered Top 100 in the TIOBE index. Lot of effort seem to have been made to make this language pop out and catch the attention of masses.”

, Htuholia

“I like the idea of The Ring being in ANSI C it’s an impressive creation, and a lot of skill went into it”

, Garry Taylor

“Very innovative language! Syntactically clean”

, CodeProject Member

“The author must be commended for the readily-obvious hard work and effort that has gone into creating a rich ecosystem for his language. It seems that the language is quite extensive as well. I would find it useful to see a BNF grammar and concise coverage of its semantics.”

, Xx-Leninist-1917-Xx (Reddit)

“I can see the AI of the future using this technology to solve computational problems for..... the humans.”

, Cryptonite (United States)

“I like your programming language, I like you are going to develop mobile app using RingQt and also I appreciate your web library.”

, Domenico D’Oria (Italy)

“Congratulations for the great work with this new programming language.”

, Kenny Silva (Venezuela)

“Ring is an amazingly full-featured language and so well documented (the bane of most newer languages out there!)”

, Alex McCullie

” I found the language yesterday, and liked the Qt bindings, as they give a declarative way to create a QtWidgets GUI.”

, Cochise Cesar

“Ring does look intriguing, and I’ll be reading more of the documentation soon”

, Jamie Cooper

“I was recently considering designing my own dynamically-typed, prototypical language and then developing a means to compile it into C/C++. However, last night I was surfing the web and noticed a little-known language called “Ring” which you’ve recently created. I began reading the Motivation section in Wikibooks to see why the language was designed and implemented, and I was shocked to see that someone else had created a language with the same intention and need as myself. I mean, it’s mind-blowing that someone would have addressed every issue I have with the currently accepted languages. It’s crazy to think it’s only been around for a year and yet, it’s already, practically a batteries-included language.”

, Gedalya (YouTube)

“Thank you Mr. Mahmoud for all the wonderful work, whenever I dive in the Source code I see the great effort, further development more excellence, God will reward you with what you wish”

, Azzedine Ramal

“What a great joy to find this surprisingly genius language !!!.. It was a total joy to go through the documentation and look at the samples in Rosetta code. Marvelous work. I would even leave my fortune to the development of this language. Keep the good work going and wishing this language will go viral. ps: Thanks for keeping array index to start with 1. It means a lot.”

, Nehemiah Jacob (Sydney, Australia)

“I find it very interesting. Especially the fact that it is cross platform makes it something to keep an eye on.”

, Boudewijn Lutgerink

“The language I like the most. Efficient, simple, easy, flexible and wonderful language.”

, Roshan Ali

“I like variety. The richer the toolbox, the more appropriate the tool.”

, Jonathan Day (Quora)

“I greatly appreciated your work and congratulations on what has been achieved.”

, Umberto Meglio (Italy)

“Thanks a lot I just found Ring two days ago and I decided to learn it, it is amazing, the samples are helping a lot.”

, Zaraki Ken

“Extraordinary. well done sir”

, RugbyLeague (CodeProject Member - United Kingdom)

“The Ring language is pleasant. You get ahead very quickly.”

, Nesuk (CodeProject Member - Switzerland)

“I’m happy to use your language.”

, Akhil Reddy

“I am enjoying using the Ring Programming language.”

, Gabriel Wendt

“I’m loving this language!”

, Pablo Prieto

“Ring Notepad is a an example of the power of Ring. It is like NotePad++ with built in form design capability, drag and drop, object attributes etc. It is a marvelous application”

, Bert Mariani (Italy)

“Ring is the language that offers the greatest potential for converting programmers frustrated with the amount of time it takes to develop apps in C/C++, C# and other OOP-based languages. Considering the extent to which Ring has evolved since the first release in 2016, the Ring team has proven itself worthy of a very high achievement award in the world of programming languages. The extent to which Ring has simplified the development database apps, web apps and GUI apps is a great credit to the Ring team. Ring’s implementation of OOP and GUI based apps is far superior to C++ and C#. Another major achievement of the Ring team is the ease at which programmers can get on-line access to Ring documentation, compared to on-line C++ and C# documentation. The Ring Game Engine is truly elegant and it’s designer (s) deserve lots of credit for such an impressive bit of software.”

, L Godioleskky

“Strongly speaking, it is a strong and new game programming language.”

, isVowel (Japan)

“The language seems to have some interesting features, specially the use of braces to access object fields and methods.”

, Nuaua (Reddit)

“The code that implements the Ring VM actually looks quite nice. There is a bunch of test code – great!”

, Peterfirefly (Reddit)

“Ring seems promising. It first appeared in 2016 although it’s concept is older. It is meant to be portable and can be embedded in C/C++ projects”

, Wim ten Brink (Quora - Top Writer (2018))

“Interesting alternative to Lua.”

, djxtc (Sourceforge)

“Ring is a serious thing in the programming language landscape. One should understand its foundation before she can shape an opinion worth considering. There are several innovations out there with a clear commitment from its designer to simplicity, flexibility and learnability. Natural language as its imagined by Ring opens a window for an unlimited set of applications otherwise impossible to think about. One can build an interactive chatbot based on a rich domain specific language in a matter of hours not months. Combined with a smart yet effective implementation of a declarative programming paradigm, Ring empowers the creation of any kind of programming language on top of it, with any set of syntax. Even the language keywords can be overwritten to serve one’s own keywords in any human language not only english. Ring is a disruption, a big intellectual step forward but also a beautiful reincarnation of several legacy ideas and best practices from other old languages like Basic, Lisp and others. Those ideas are a humanity heritage that new visionaries like Mahmoud S. Fayed, the Ring designer, but also Rick Hickey, the Clojure designer, are trying to callback in today’s world of complex programmability. An other dimension of Ring, which formed one of its basic motivations, relates to visual programming. Software is a fluid and evolutionary creature and textual code is not accessible to the most of common humans. The promise of visual programming is to empower people, enhance understandability and invite business users to the arena of software development more intuitively. Ring was made by design with an objective of having a programming language capable of better supporting the visual paradigm. Gamification is a first-class citizen in the language. This is a tremendous advantage compared to other general-purpose programming languages. Ring supports a large number of gaming libraries and open a large window of capabilities to use, not only in gaming but also in business and education applications. The best way to assessing the power of Ring is to look into it and reflecting about the number of problems it is capable to solve.”

, Mansour Ayouni (Tunisia)

“I have only known ring-lang for few weeks, really love features and visions of ring: bracket access, class region, declarative and natural programming. It’s simple and beautiful the way ring deal with these paradigms. I think it’s really great work what you’re done, and doing. I want to develop ethereum client in ring language, not only but it’s style. It’ll have natural and declarative code on its main part. Furthermore, It will be fantastic if there is “natural language -> evm bytecode” compiler, maybe ring have the solution”

, Asta

“The language looks great!”

, Eric Hawk

“You put a lot of work in the Ring and you’re a great programmer. I saw your examples in 3D I’ve looked at

part of your project, it's really great”

, Rafal Jopek

“Looks like a big project and an impressive piece of work”

, Rochus Keller (PhD From ETH Zurich, Switzerland)

“I see Ring a very useful and easy in PROGRAMMING IN REGIONAL LANGUAGE. I tried to program in my mother language Hindi (India) using UNICODE It is working. No other language give me such an easy platform.”

, Negi Manoj (India)

“I’m glad I could help improve the Ring language. It has good and yet easy to understand design and architecture. I believe it has big potential ahead.”

, Mounir IDRASSI (Creator of VeraCrypt)

“What I like most about Ring Lang is its ease to create complex applications in WebAssembly.”

, Luis Lozad

“I just discovered Ring today and immediately liked it and decided to give it a try. As a senior JAVA / ADA and Python developer I am very curious about the multi-paradigm”

, Bertrand Pivaty

“Wow, that is pretty amazing! It’s not every day to hear about a new programming language that looks actually cool! Oh wow, didn’t even see the VB-like features there. This has some real potential!”

, EternityForest (reddit)

“I am a big fan of your works I look forward to contributing to some of your projects in the future.”

, Adewale Azeez (Nigeria)

“I am a software development manager working in a Canadian Firm. I have been around for 25 years playing with different Programming languages like Python, Perl, VB, C#, Java, REBOL, Euphoria etc. Thanks a lot for the wonderful software and the great documentations”

, Lijo Joseph (Canada)

“I am studying Ring (I am a senior programmer). I certainly never cease to be amazed about this language; it seems to be a wish from a marvellous lamp of computer genius”

, Antonio F.S. (Spain)

“I’m learning the language and so far I’m finding it wonderful. It has great potential.”

, Jose Luis Cuesta (Spain)

“Ring is a breath of fresh air in language designs for application development.”

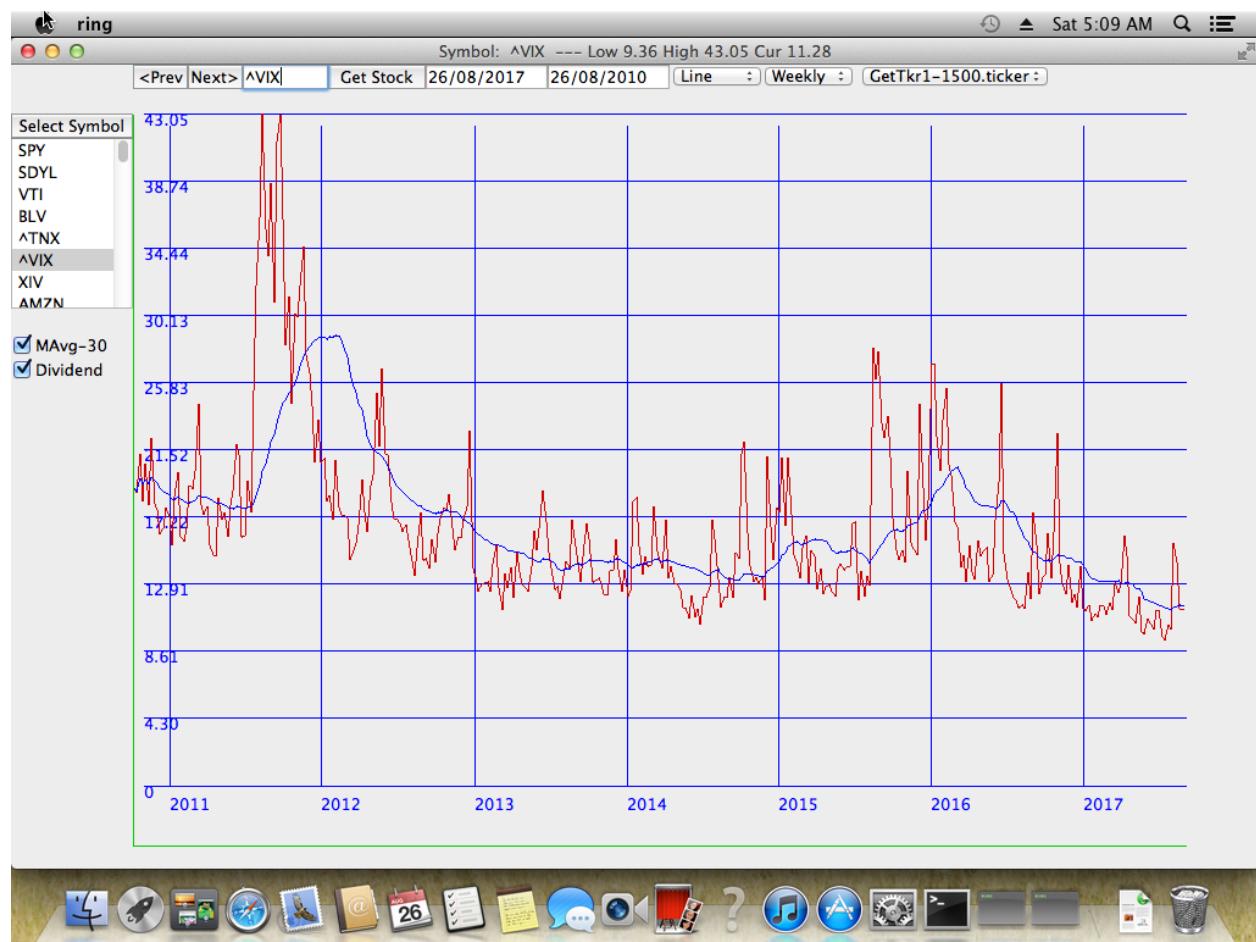
, Gary Chike

“Congratulations to the author and maintainers! If this tool can do even 25% of what is stated, I am going to be amazed. I searched extensively, trying languages like Rust, Elixir, Go, TypeScript, Euphoria, Factor, F#, C, Beef, V, Odin, and OCaml. None of them gave me that thrilling sense of connection to the syntax, which is so important to me. SQL spoiled me; it’s my favorite. then I came across Ring, thanks to a suggestion by Claude AI. I’m incredibly excited to get started and blown away that this project is already stable! I love that there is a dedicated IDE—the installation was EASY, unlike so many languages that get this part wrong”

, Pookiepats

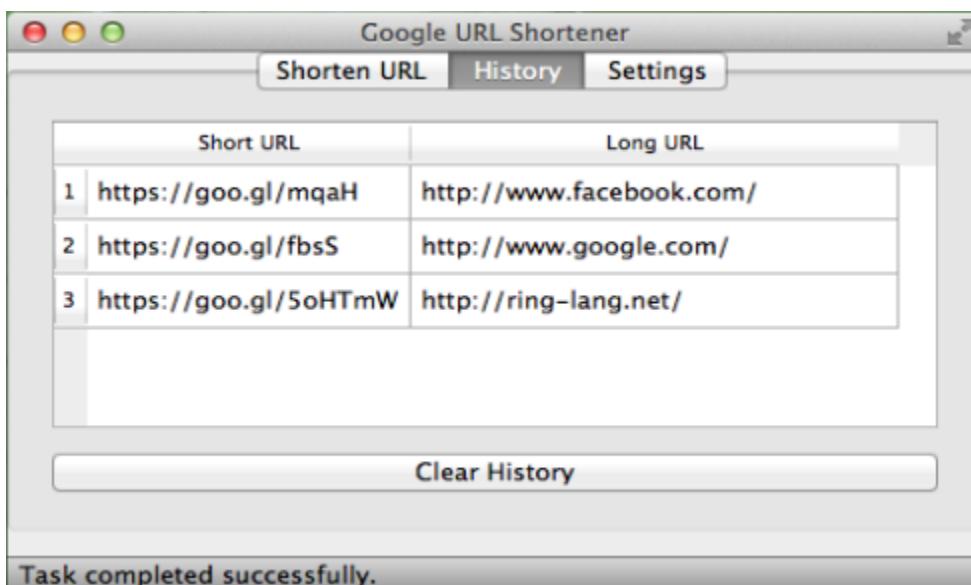
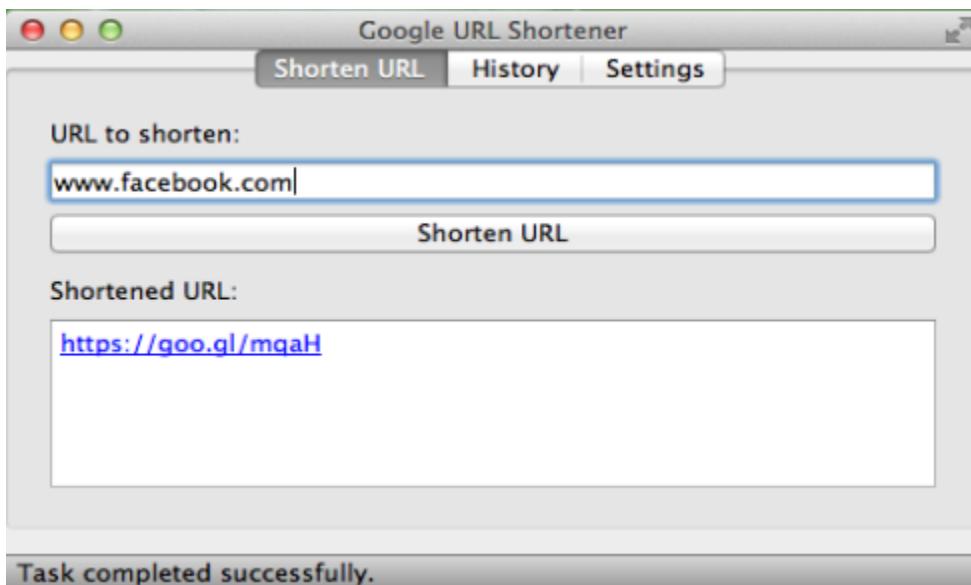
1.2 FetchStockData Application

It will fetch stock data from Yahoo and draw various types of charts.



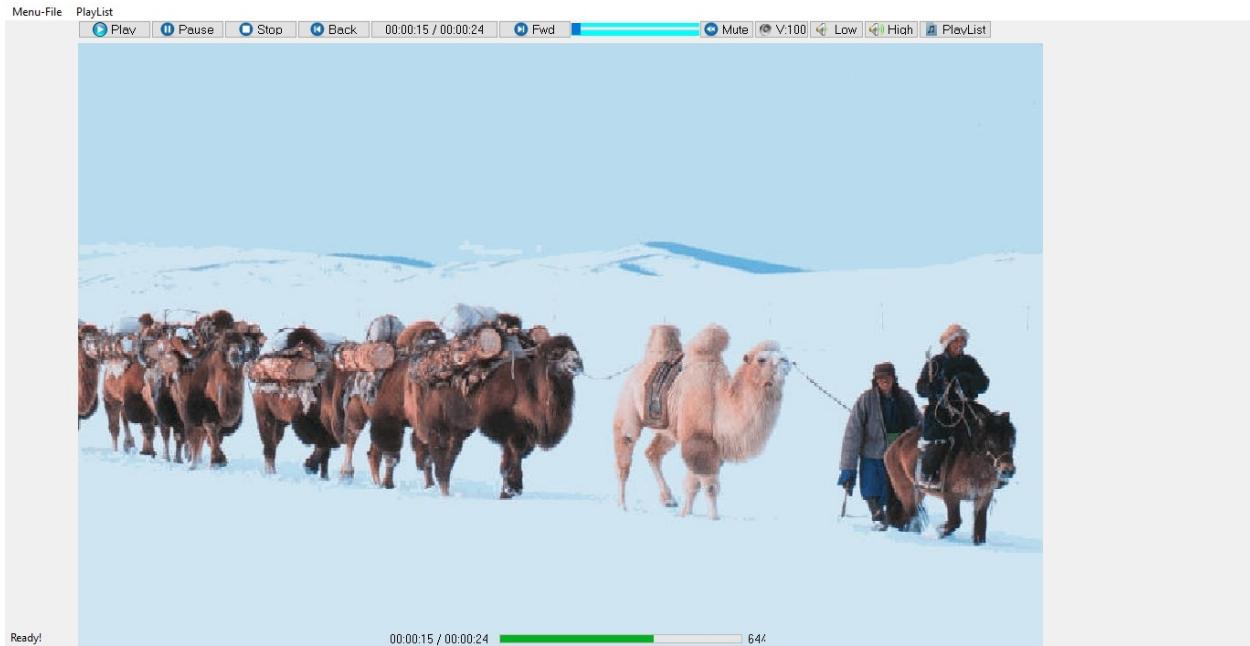
1.3 Google API Shortener Application

A small but very nice tool to shorten urls using the Google shortener API.



1.4 Video-Music-Player Application

An application to play multi-media files.



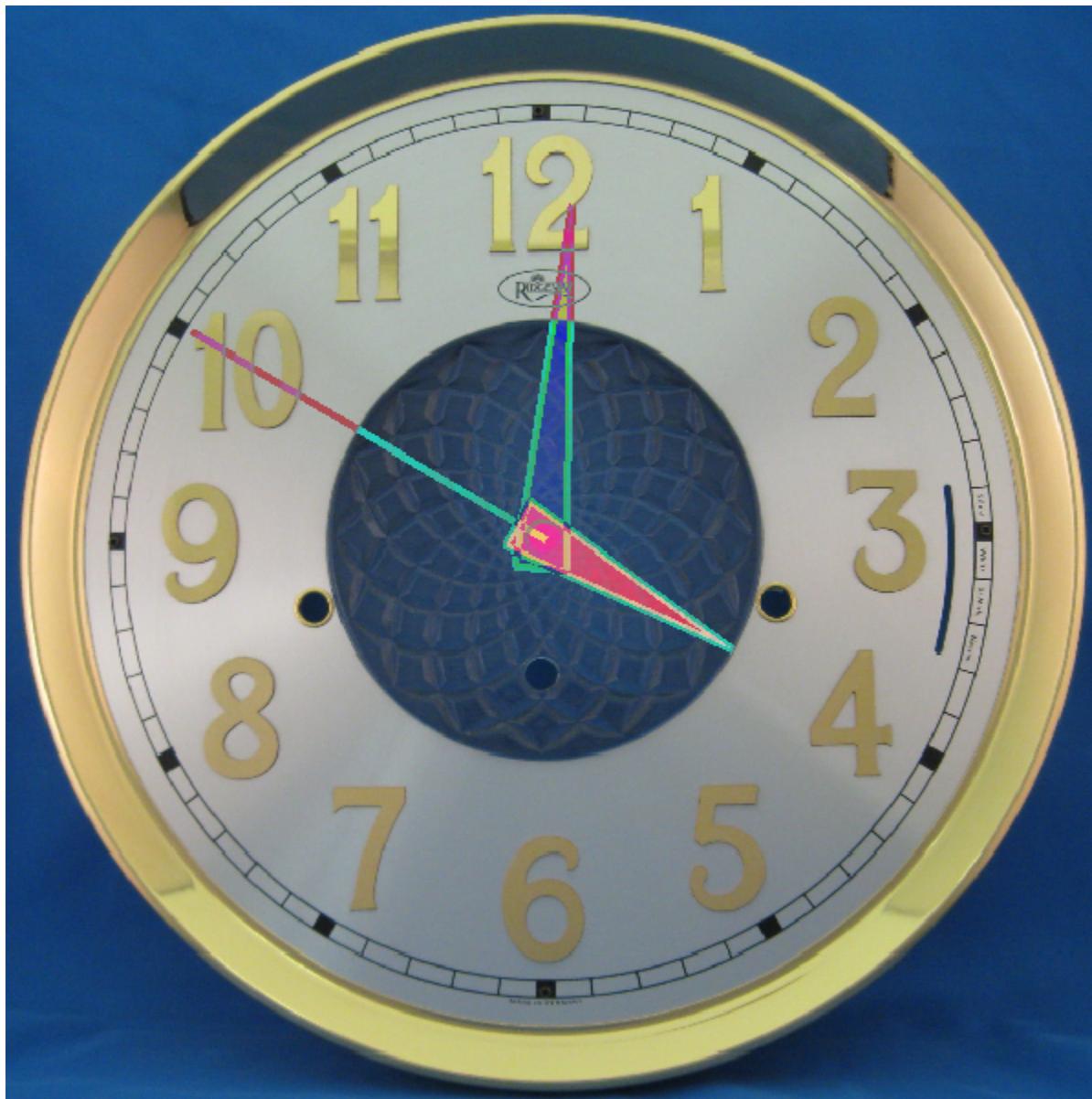
1.5 Fifteen Puzzle Game

An implementation for the Fifteen Puzzle game.



1.6 Analog Clock

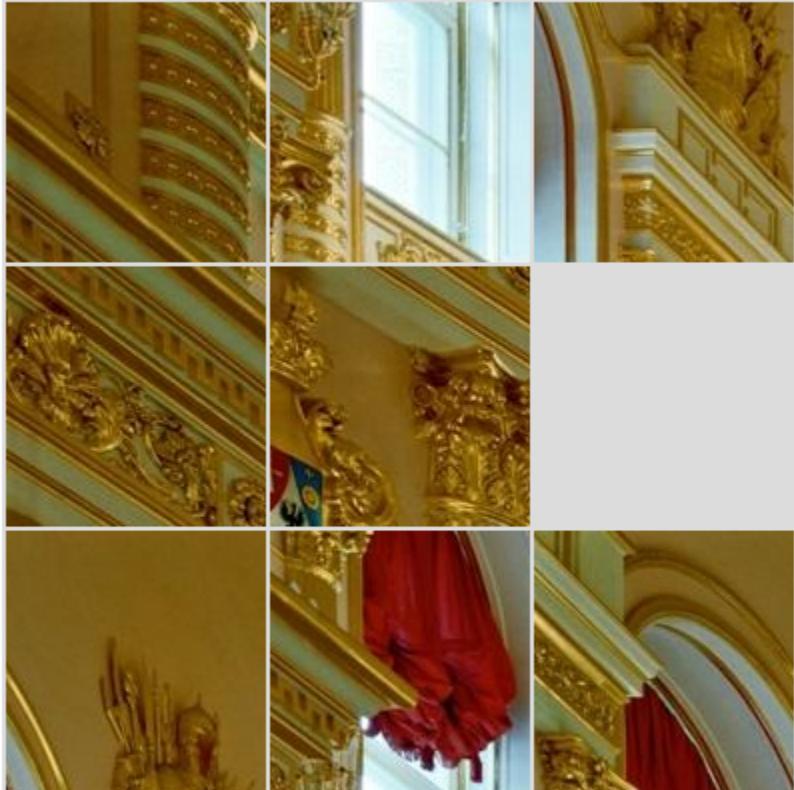
Simple implementation for the Analog Clock.



1.7 Squares Puzzle Game

An implementation for the popular Squares Puzzle game.

SQUARES :)

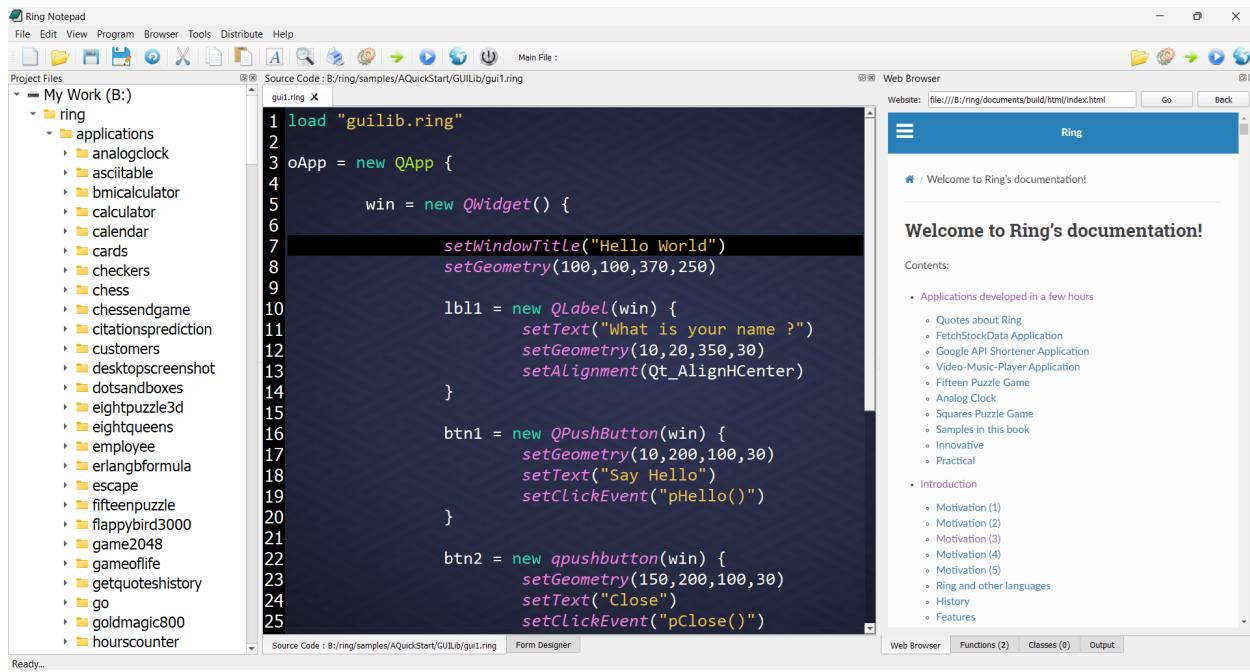


MOVES : 0

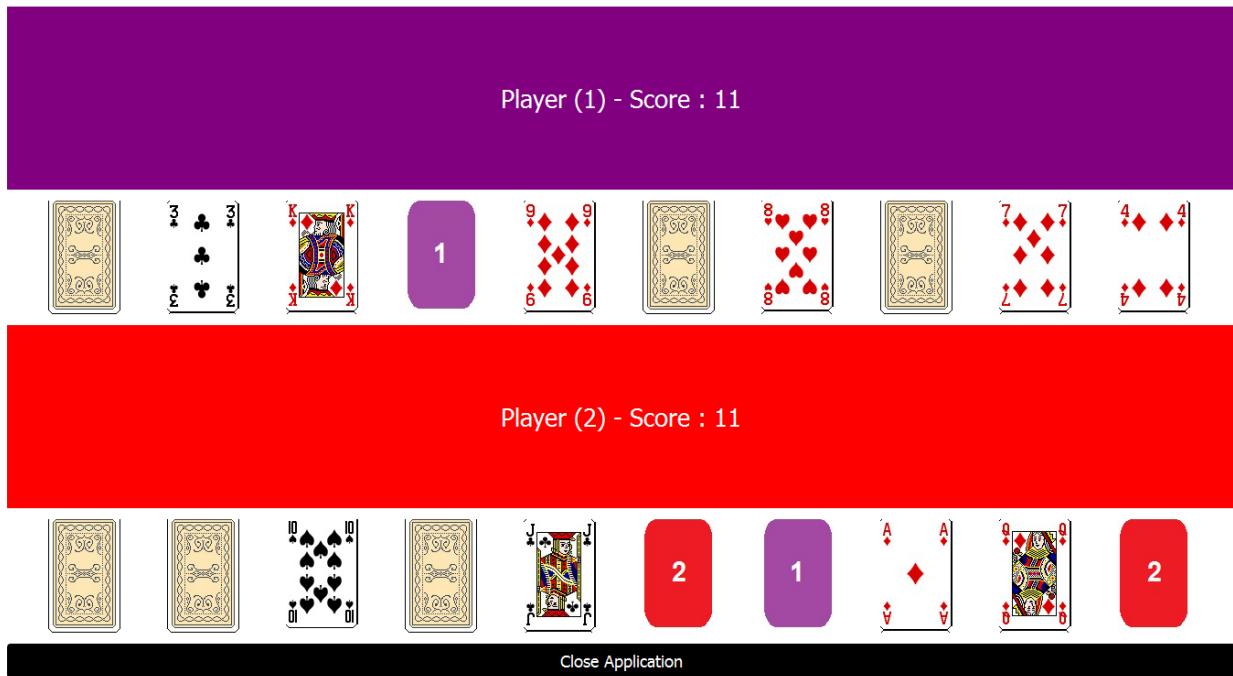
1.8 Samples in this book

The next samples are developed in a few hours and we will introduce them through this book.

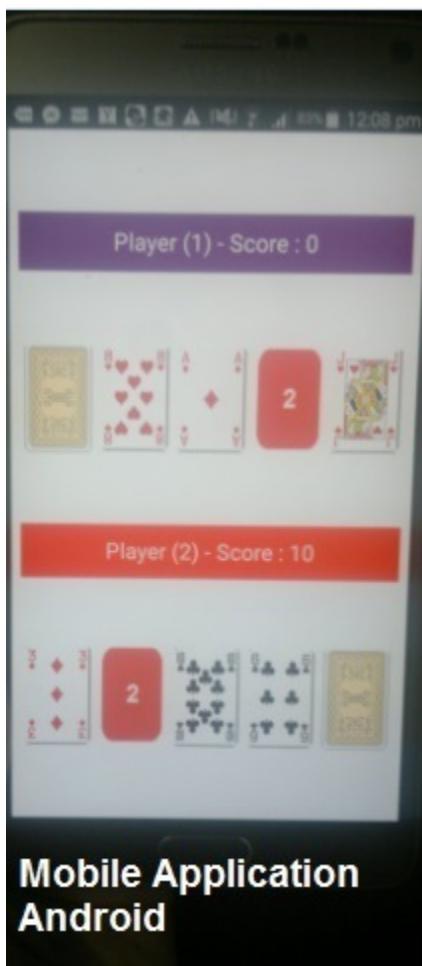
The next screen shot for the Ring Notepad application



The next screen shot for the Cards Game



The next screen shot for the Cards Game (Android)



The next screen shot from the Web Development chapter

The screenshot shows a web-based application titled "Salary Table". The URL in the browser is "localhost/ringapp/ex24.ring?part=1&searchname=m". The page displays a search bar with the text "Name : m" and a "Search" button. Below the search bar is a table with the following data:

ID	Name	Salary	Options
1	Mahmoud	15000	Select Option...
12	Mohammed	56786	Select Option...
131	Mageed	23623	Edit

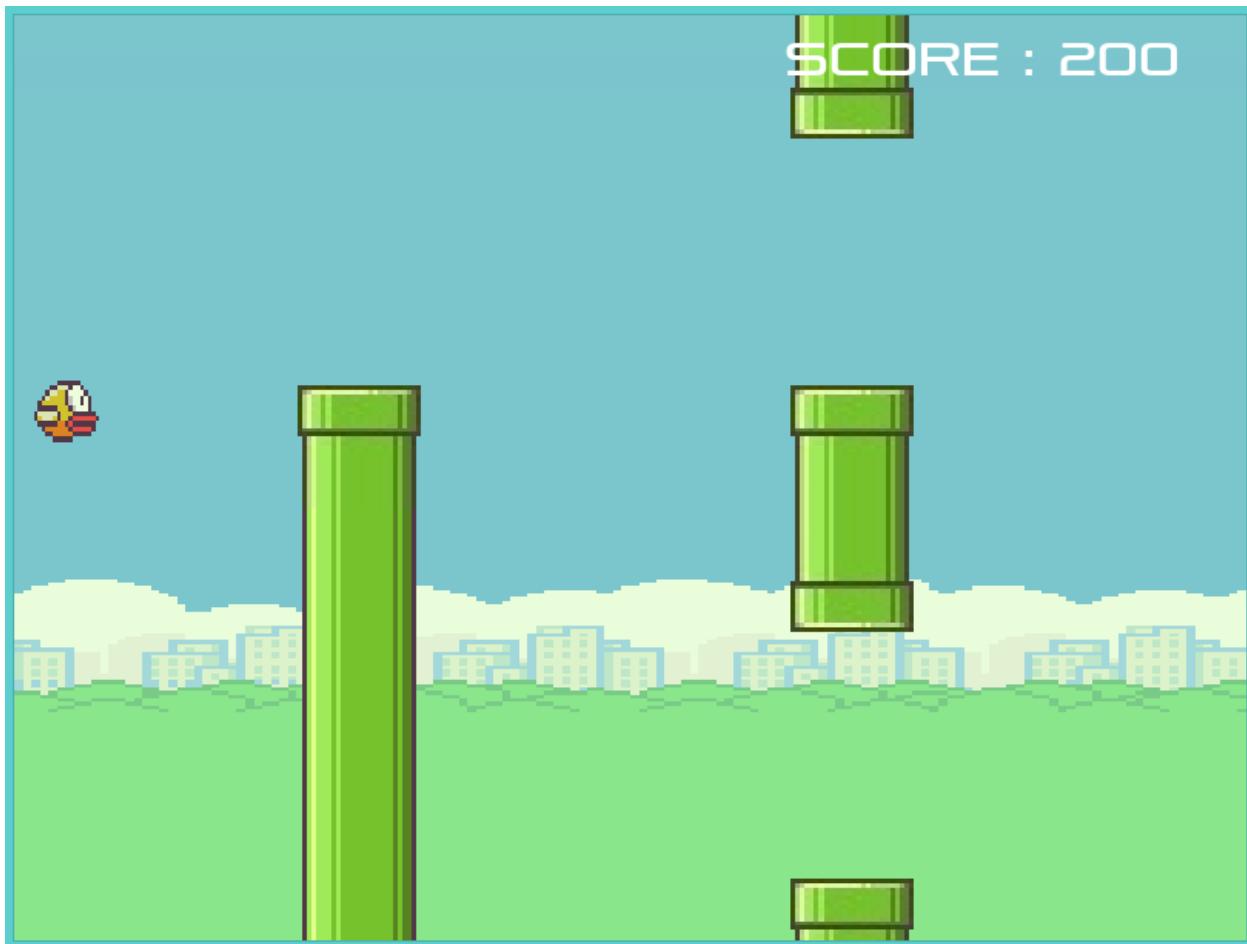
At the bottom of the table, there are navigation links: "First", "Prev", "Next", "Last", and "Records Count (3) : Page 1 of 1". A blue button labeled "Add Record" is located at the bottom left. A modal dialog titled "Salary Table - Edit Record" is open, showing the details for the first record: Name: Mahmoud and Salary: 15000. A "Save" button is at the bottom of the dialog.

The next screen shots for simple 2D Games that we will present in the Game Engine Chapter.

Stars Fighter Game



Flappy Bird 3000 Game



Super Man 2016 Game

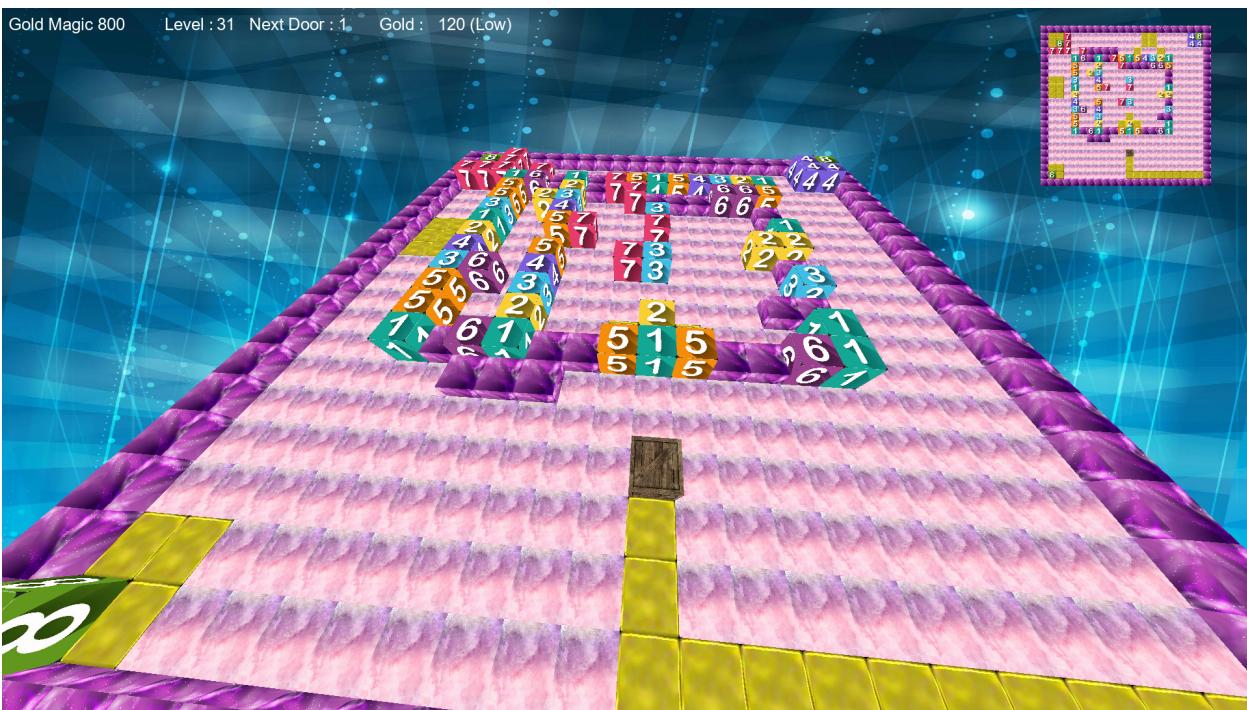


The next screen shot for the TicTacToe 3D Game

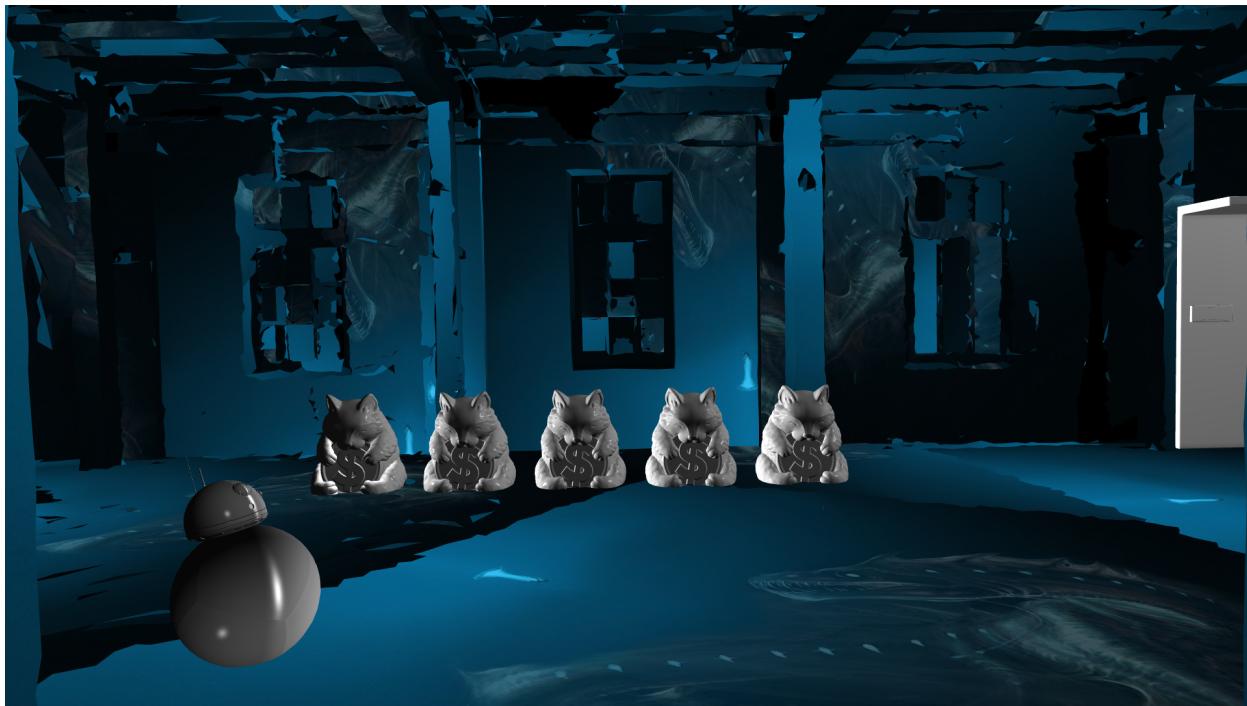
Screen Shot:



The next screen shot for the Gold Magic 800 Game



The next screen shot from the RingQt3D chapter



1.9 Innovative

The language comes with better support for Natural Language Programming and Declarative Programming. The innovation comes in supporting these paradigms with new practical techniques on the top of Object-Oriented Programming and Functional Programming. No need to know anything about (Compilers and Parsing). You get the language constructs ready for use to create domain-specific languages in a fraction of time.

Articles:-

- Natural Language Programming Library :

<https://www.codeproject.com/Articles/1200766/Using-the-Natural-Language-Programming-Library-NLP>

- Natural Language Programming :

<https://www.codeproject.com/Articles/1138605/Natural-Language-Programming-in-the-Ring-Programmi>

- The Declarative Approach :

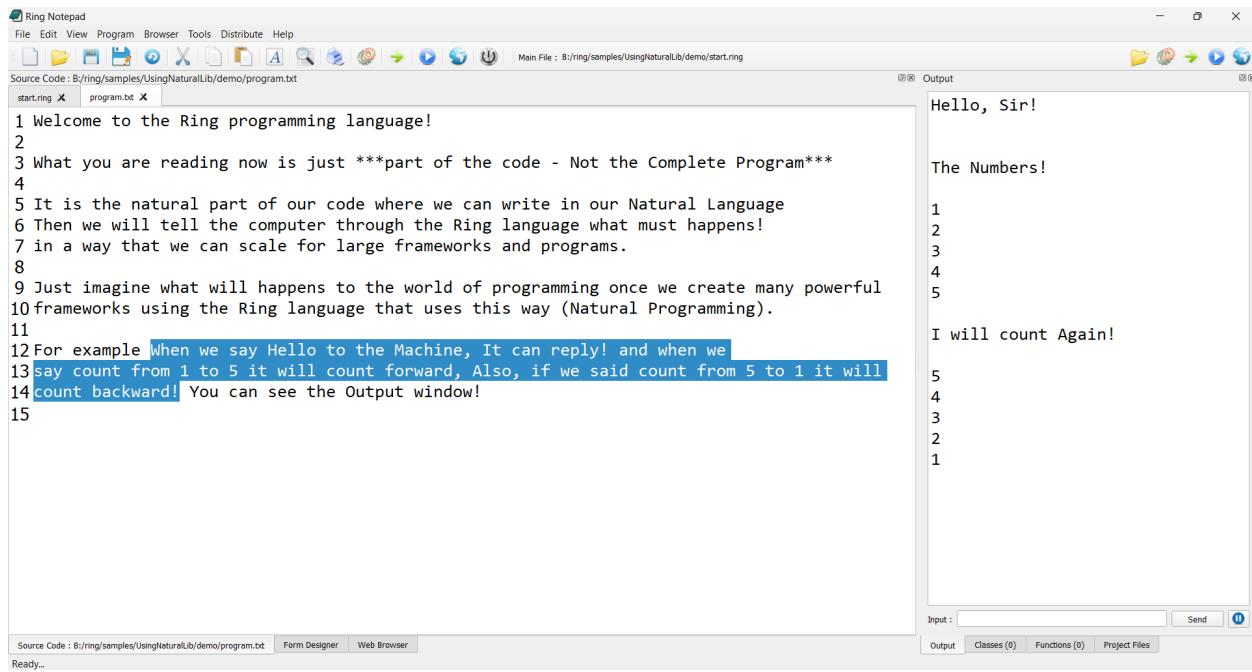
<https://www.codeproject.com/Articles/1222105/The-declarative-approach-of-the-Ring-programming-1>

- Syntax Flexibility :

<https://www.codeproject.com/Articles/1137388/Syntax-Flexibility-in-the-Ring-Programming-Languag>

- The Ring Programming Language :

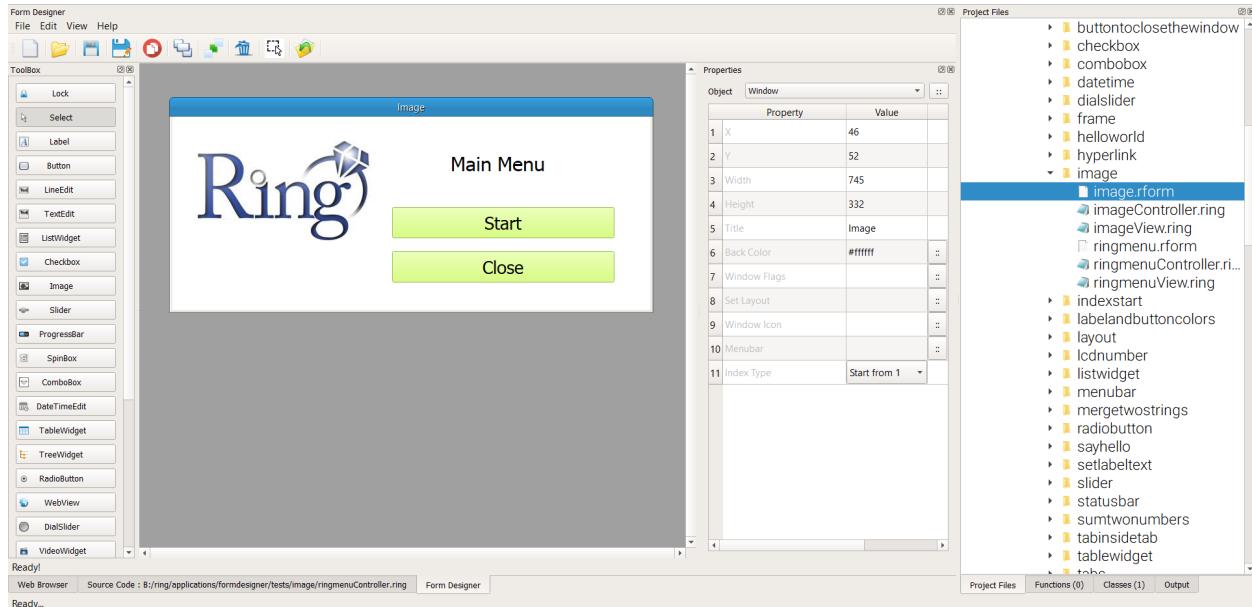
<https://www.codeproject.com/Articles/1089887/The-Ring-Programming-Language>



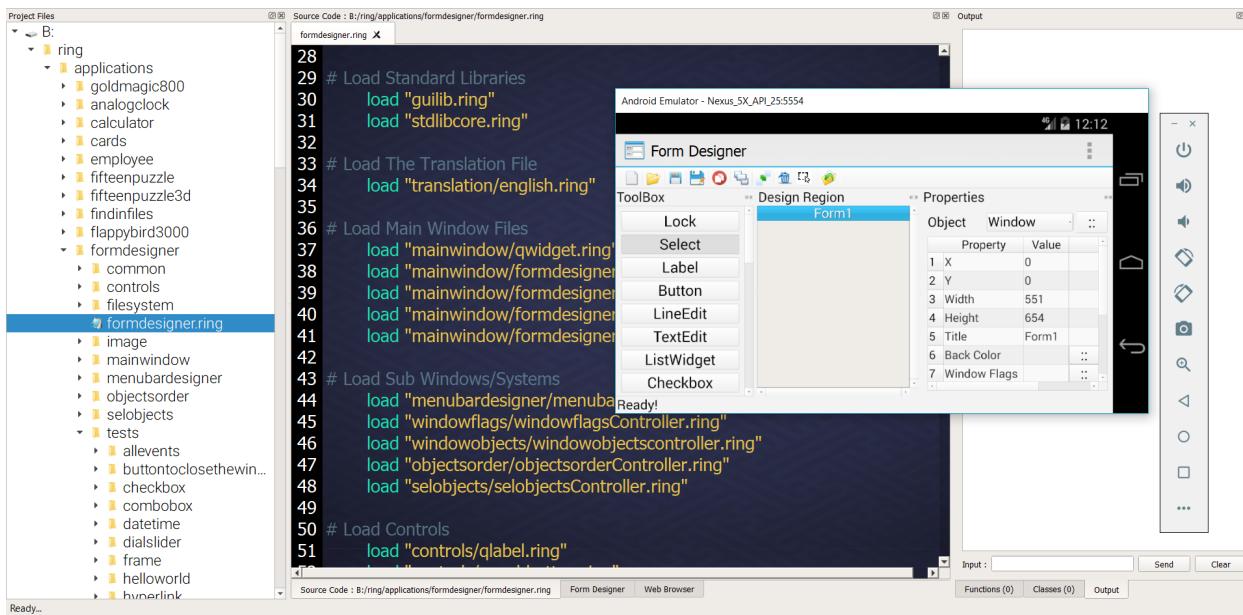
1.10 Practical

Many of the Ring libraries (StdLib, WebLib, Natural Library, Games Engine, etc.) and the Ring IDE (Ring Notepad, Form Designer, etc.) are written in the Ring language itself. Ring is ready for use in production and increase the developers productivity.

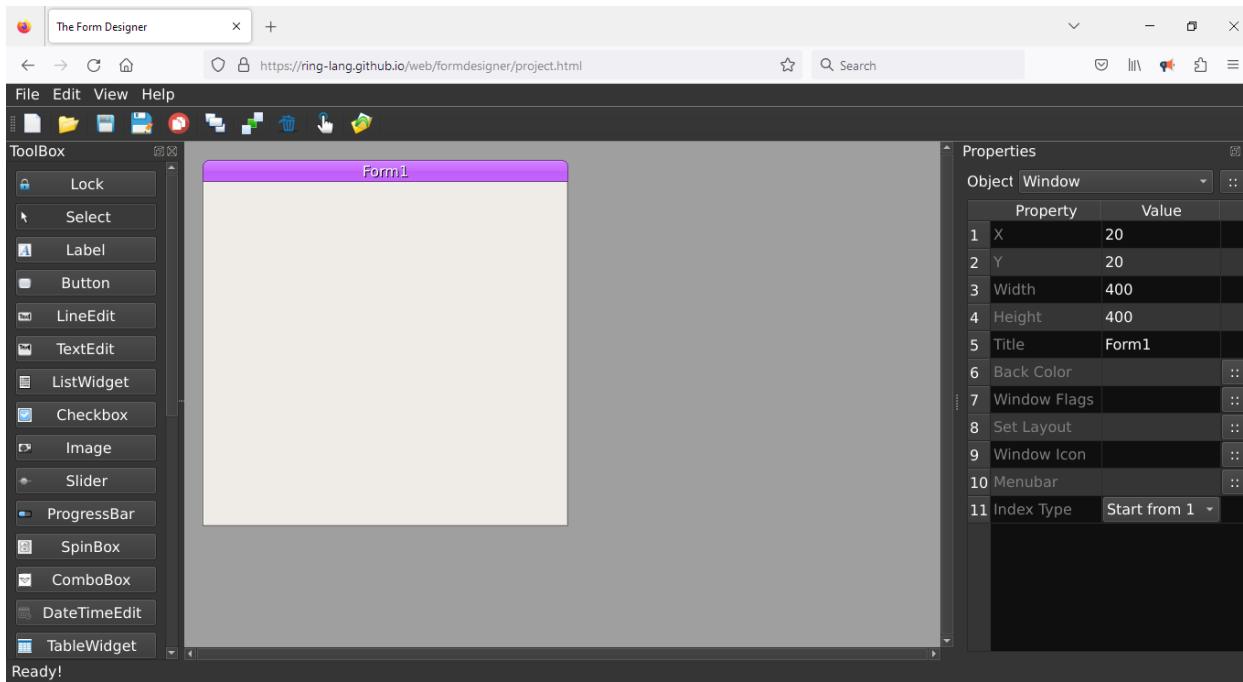
Check the Form Designer source code : <https://github.com/ring-lang/ring/tree/master/tools/formdesigner>



We can run the Form Designer as Android application!



Also we can run it in the Web Browser as a web application using WebAssembly



INTRODUCTION

Welcome to the Ring programming language!

Ring is an Innovative and practical general-purpose multi-paradigm language that can be embedded in C/C++ projects, extended using C/C++ code and/or used as standalone language. The supported programming paradigms are Imperative, Procedural, Object-Oriented, Functional, Meta programming, Declarative programming using nested structures, and Natural programming. The language is portable (MS-DOS, Windows, Linux, macOS, Android, WebAssembly, etc.) and can be used to create Console, GUI, Web, Games and Mobile applications. The language is designed to be Simple, Small and Flexible. Also, It's fast enough for many applications. Its Dynamic Language that compile the source code to byte code then execute it by the Ring Virtual Machine, which is integrated with the Ring Compiler in one program.

In this chapter we are going to discuss the goals behind the language design and implementation.

2.1 Motivation (1)

In Nov. 2011, I started to think about creating a new version of the Programming Without Coding Technology (PWCT) software from scratch.

I was interested in creating multi-platform edition of the software beside adding support for Web & Mobile development.

What I was looking for is a programming language that can be used to build the development environment, provides multi-platform support, more productivity, better performance, can be used for components scripting and developing different kinds of applications.

Instead of using a mix of programming languages, I decided to use one programming language.

I looked at many programming languages, but I discovered that I need a different language that comes with new ideas and intelligent implementation.

Note: The importance of the PWCT2 project to the Ring language design is similar to the importance of the Unix operating system to the C language design. Having a specific project in the mind of a programming language designer help a lot in taking the right decisions towards a clear goal. For example, We know that the PWCT2 visual programming

language will provide readability, this let us focus in Ring design on writability. So, we can get maximum readability and maximum writability at the same time since both languages are designed together. Also, PWCT2 as a visual language requires powerful GUI library and fast graphics. That's why Ring comes with support for the Qt framework as it's primary GUI toolkit.

2.2 Motivation (2)

In 2009-2010, I developed a small domain-specific programming language for GUI development called Supernova. I invested many months of my time to create this language and get something that I can use for small programs. After creating Supernova, I realized that if the programming language have some new features on the top of object-oriented programming, it could help me create a domain-specific language like Supernova in days instead of many months. So Ring as a language provide these features, and using Ring we can create Supernova and enjoy its features in real-world applications development. Ring is designed to be a superset of Supernova and enable us to create many domain-specific languages.

Note: The role that Supernova language played for the Ring language design is similar to the role played by the ABC language for the Python language design. When we create a programming language and try to use it in practical, we will learn a lot of lessons that help us when designing the next language.

2.3 Motivation (3)

We can think of a programming language as a user interface between the user and the machine. The user could be a programmer have deep knowledge about the machine architecture, a developer interested in the application and the requirements of his/her users, or a child wants to discover programming. Also, we have many types of other users like researchers, people with deep knowledge about specific domains and so on.

Providing a programming language that uses just a specific syntax doesn't match what we learned about user interfaces. Ring is a language designed to bring translation, and customization at the level of the language syntax. It's not about providing multiple versions of the software where each version uses a different human language. It's about the ability to change the syntax at the project level, where using one version of Ring, we can switch between different human languages, and different customization of syntax. Instead of developing different programming languages that uses the same VM, Ring uses one compiler that support changing the syntax and this can be done many times in the same project.

Note: Choosing the programming language syntax is a huge power and provide a great joy. Using Ring we transfer this power from the programming language designer to the language users.

2.4 Motivation (4)

Many programming languages for application development come and go. i.e., Becomes no longer under development! I remember having a good time while using Clipper, Classic Visual Basic, Visual FoxPro, etc.

Ring is designed to be a language for application development that can stay for many decades in the future.

To achieve this, Ring is a free and open-source project that works on different platforms and has a small implementation that other programmers could understand and improve. It comes with a visual implementation that could help in this process. Ring is designed and implemented in a way that enables other programmers to easily understand its design and implementation in a short time.

The selection of data types, How the Garbage Collector works, How does the language support threads? All of these decisions are made in a specific way to keep the language very portable and ready for the future (As much as we can, Since we don't know the future, but we can try to invent/predict it!).

Note: We can run Ring on a very old operating system like MS-DOS. Also, we can run it using a modern platform like WebAssembly.

2.5 Motivation (5)

I love programming languages, and I have used a lot of them during my work. When I think about a programming language, I feel something. It's not about the language features; it's about the language spirit and the unique things that can be done using this language. I am not talking about the final result, where we can use many languages in the same group to achieve the same goal. I am talking about the solution itself. the design and the code. How does it look like? Is it beautiful? What about the code size? Is it simple or complex? and things like that, which have a direct effect on source code comprehension and software development productivity.

Ring is designed to include the spirit of many other languages. We don't do this by copying features or mixing things that don't match together! Our technique is different. It's similar to how a child could look like his or her parents. You get the feeling, not a copy!

Note: Ring is designed to be small in size, like Lua, but it comes with standard support for many programming paradigms, like Python and Ruby. This is a challenge when we talk about implementation and development.

2.6 Ring and other languages

Ring is a programming language that comes with better support for Natural Language Programming and Declarative Programming. The innovation comes in supporting these paradigms with new practical techniques on the top of Object-Oriented Programming and Functional Programming.

Also, Ring is influenced by the next programming languages

- Lua
- Python
- Ruby
- C

- C#
- BASIC
- QML
- xBase
- Supernova

2.7 History

In Sept. 2013 I started the design and the implementation of the Ring programming language. After 21 months of development, In May 2015 the language Compiler & Virtual Machine were ready for use!

After that I spent three months testing the language again, trying to discover any bug to fix, writing better tests, by the end of August 2015, all known bugs were fixed, Writing many tests and testing automation helped a lot in getting a stable product.

In September 12, 2015, most of the documentation was written. Before releasing the language I started the marketing by writing a post in Arabic language about it to my facebook profile page asking for contributors interested in the language idea after reading a short description, In the same day I got a lot of emails from developers and friends interested to contribute!

Ring 1.0 is released on January 25, 2016

Ring 1.1 is released on October 6, 2016

Ring 1.2 is released on January 25, 2017

Ring 1.3 is released on May 15, 2017

Ring 1.4 is released on June 29, 2017

Ring 1.5 is released on August 21, 2017

Ring 1.6 is released on November 30, 2017

Ring 1.7 is released on January 25, 2018

Ring 1.8 is released on June 25, 2018

Ring 1.9 is released on October 6, 2018

Ring 1.10 is released on January 25, 2019

Ring 1.11 is released on September 15, 2019

Ring 1.12 is released on January 25, 2020

Ring 1.13 is released on September 15, 2020

Ring 1.14 is released on January 25, 2021

Ring 1.15 is released on September 24, 2021

Ring 1.16 is released on October 23, 2021

Ring 1.17 is released on May 14, 2022

Ring 1.18 is released on July 12, 2023

Ring 1.19 is released on December 31, 2023

Ring 1.20 is released on April 11, 2024

Ring 1.21 is released on September 1, 2024

Ring 1.22 is released on December 1, 2024

2.8 Features

The Ring language comes with the next features

Tip: The language is ready for production!

- Free Open Source (MIT License)
- Hybrid Implementation (Compiler + Virtual Machine)
- Declarative programming on the top of Object-Oriented programming
- Natural Language Programming on the top of Object-Oriented programming
- Natural Language Programming Library
- Three different styles for writing the code and you can create your style
- Syntax Flexibility (You can change the language keywords and operators)
- The language keywords can be translated from English to other languages (Arabic, French, etc)
- Compact Syntax, No explicit end for statements (No ; or ENTER is required)
- Using braces { } we can access objects and use attributes/methods as variables/functions
- Using lists/objects during definition
- Transparent Implementation (See the Tokens, Grammar, and Byte Code for each program)
- Visual Implementation - Developed using Visual Programming (PWCT)
- Written in ANSI C (The code is generated + Looks identical to Handwritten Code)
- **A small language**
 - The Compiler + The Virtual Machine + Standard Functions are less than 25,000 lines of C code
 - The other 500,000 lines of code are related to libraries!
- Portable (MS-DOS, Windows, Linux, macOS, Android, WebAssembly, 32-bit Microcontrollers, etc)
- Comments (One line & Multi-lines)
- Not Case-Sensitive
- Dynamic Typing
- Weakly typed (Automatic conversion between numbers and strings only)
- Lexical Scoping (Global, Local & Object State)
- Default scope for variables inside functions (Local)
- Default scope for variables outside functions (global)
- We can have separate global scope for each library or sub project
- Garbage Collector - Automatic Memory Management (Escape Analysis and Reference Counting)
- In most cases (90%) Ring VM uses Escape Analysis and no need to run the Garbage Collector (Faster)

- Structure Programming
- Rich control structures & Operators
- For in get item by reference not value, you can read/edit the item
- Use exit to go outside from more than one loop (Use it for programming in the small only)
- Procedures/Functions
- Main Function (Optional - To avoid using the Global Scope)
- Call Function before the definition (Top-Down Programming)
- Recursion
- Multi-line literals
- Access (read/write) string letter by index
- The list index start by 1
- No keyword to end Functions/Classes/Packages
- Range operator ex: 1:10 and “a”.”z”
- First Class Variables, Lists, Objects and Functions
- Store/Copy Lists/Objects by value (Deep Copy)
- Pass Lists/Objects by reference
- Create references at any time using Ref() function
- Native Object-Oriented Support
 - Encapsulation
 - Setter/Getter (optional)
 - private state (optional)
 - Instantiation
 - Polymorphism
 - Composition
 - Inheritance (Single Inheritance)
 - Operator Overloading
 - Packages
- Reflection and Meta-programming
- Clear program structure (Statements then functions then packages & classes)
- Exception Handling
- Eval() to execute code during run-time
- 8-bit clean, work on binary data directly
- I/O commands
- Math functions
- String functions
- List functions

- File processing functions
- Database support (ODBC, SQLite, MySQL & PostgreSQL)
- Security Functions (OpenSSL)
- Internet Functions (LibCurl)
- Zip Functions
- CSV Functions
- JSON Functions
- CGI Library (Written in Ring)
 - HTTP Get
 - HTTP Post
 - File upload
 - Cookies
 - URL Encode
 - HTML Templates
 - HTML Special Characters
 - HTML Generation using Functions
 - HTML Generation using Classes
 - CRUD Example (using MVC)
 - Users Example (Register, Login and Check)
- Deploying web applications in the Cloud
- Extension using C/C++ (Simple API)
- Embedding the language in C/C++ programs
- Embedding Ring in Ring (Support Pause/Resume)
- **Comes with code generator (Written in Ring) to quickly wrap C/C++ Libraries**
 - Used to Support Allegro by creating RingAllegro
 - Used to Support LibSDL by creating RingLibSDL
 - Used to Support Qt by creating RingQt
- Create 2D Games for Desktop and Mobile (Using the Allegro Library)
- RingLibSDL Extension
- Comes with simple Game Engine for 2D Games
- RingOpenGL Extension
- RingFreeGLUT Extension
- RingRayLib Extension
- RingTilengine Extension
- Create GUI Applications for Desktop, WebAssembly and Mobile (Using the Qt Framework)
- Comes with IDE contains the Code Editor (Ring Notepad) and the Form Designer

- RingREPL (Read-Eval-Print-Loop)
- Tracing and Debugging
- Type Hints Library
- Comes with Ring2EXE to distribute applications
- RingLibuv Extension
- RingLibui Extension
- RingSockets Extension
- RingThreads Extension
- RingHTTPLib Extension
- RingFastPro Extension
- RingRogueUtil Extension
- RingPDFGen
- RingPico - Support Raspberry Pi Pico Microcontroller
- No Global Interpreter (VM) lock (No GIL) - Better for threads and concurrency (Faster)
- Comes with RingPM (Package Manager)
- Many Samples and Applications
- Complete Documentation.

2.9 License

The Ring Programming Language

Version 1.22.0

The MIT License (MIT)

Copyright (c) Mahmoud Fayed

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the “Software”), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED “AS IS”, WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

USING RING NOTE PAD

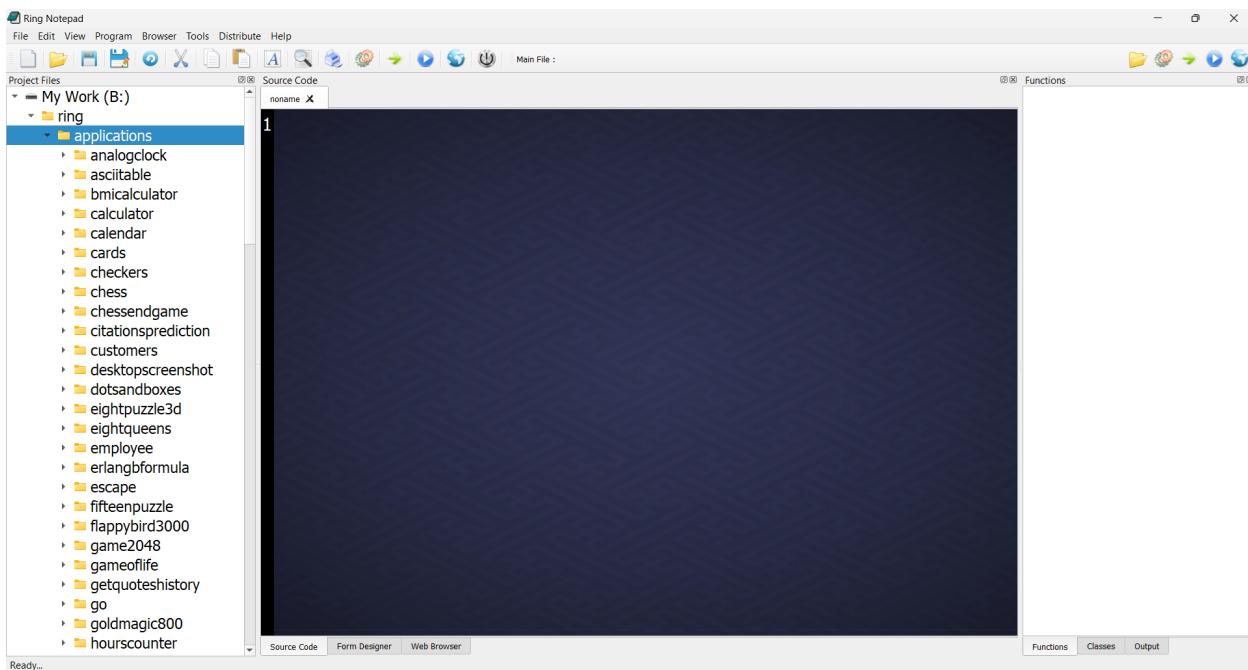
In this chapter we will learn about using Ring Notepad to write and execute Ring programs quickly
Ring Notepad is just an application developed using the Ring programming language.

The source code exist in the ring/tools/ringnotepad folder.

3.1 Ring Notepad - Main Window

When we run the Ring Notepad we get the next dockable windows

- Project Files Window : where we can select and open any ring file (*.ring) quickly.
- Source Code Window : Where we write the source code.
- Form Designer Window : The Form Designer to create GUI application forms.
- Web Browser Window : Where we read the documentation or quickly open any website.
- Output Window : Output when we run programs that print to the standard output
- Function Window : List of functions in the current source file
- Classes Window : List of classes in the current source file

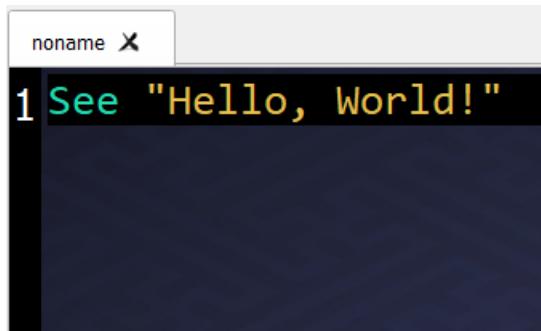


3.2 Creating and running your first Console Application

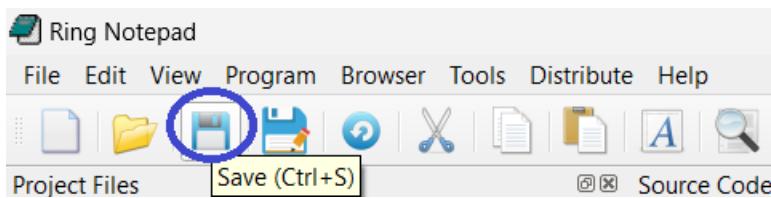
At first we will type the source code

see "Hello, World!"

As in the next image



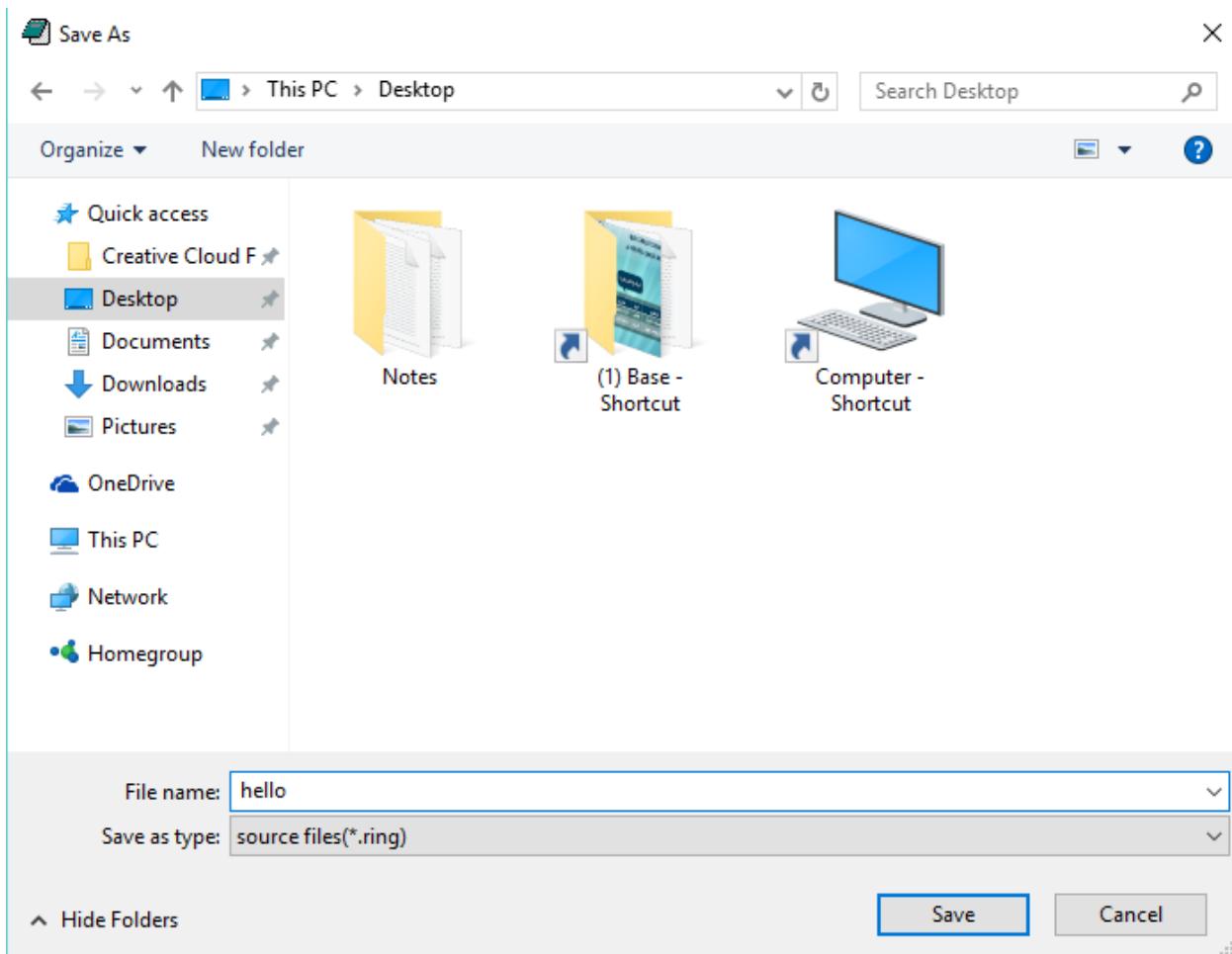
Then we will click on the “Save” button from the toolbar (or press CTRL+S)



Determine the source code file name and location.

For example type : hello

This will create a new source code file called : hello.ring

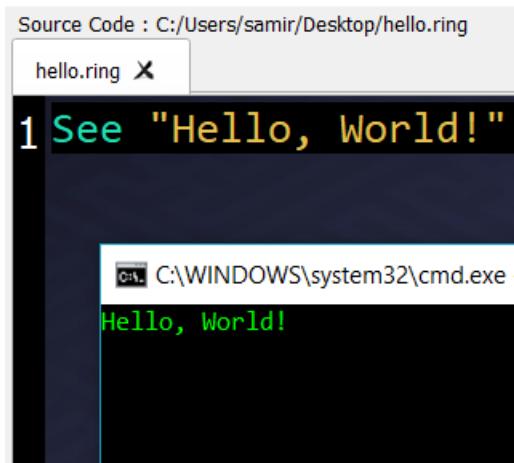


To run the program click on “Debug (Run then wait!)” button from the toolbar



The next screen shot present the application during the runtime

Press Enter to continue and return to the Ring Notepad.



3.3 Creating and running your first GUI/WebAssembly/Mobile Application

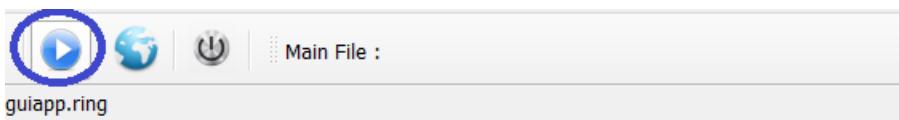
To learn how to create GUI applications using Ring check the “Desktop, WebAssembly and Mobile development using RingQt” chapter.

Source Code:

```
load "guilib.ring"

new qApp {
    new QWidget() {
        resize(400,400)
        setWindowTitle("Hello, World!")
        show()
    }
    exec()
}
```

In Ring notepad we have a special button to run GUI applications without displaying the console window.



The next screen shot present the application during the runtime

Source Code : C:/Users/samir/Desktop/guiapp.ring

The screenshot shows a Ring IDE interface. On the left, a code editor window titled "guiapp.ring" displays the following Ring script:

```

1 load "guilib.ring"
2
3 new qApp {
4     new qWidget() {
5         resize(400,400)
6         setWindowTitle("Hello, World!")
7         show()
8     }
9     exec()
10}

```

On the right, a window titled "Hello, World!" is displayed, showing a blank white screen.

3.4 Creating and running your first Web Application

To learn how to support Ring in your web server and how to create web applications check the “Web Development (CGI Library)” chapter.

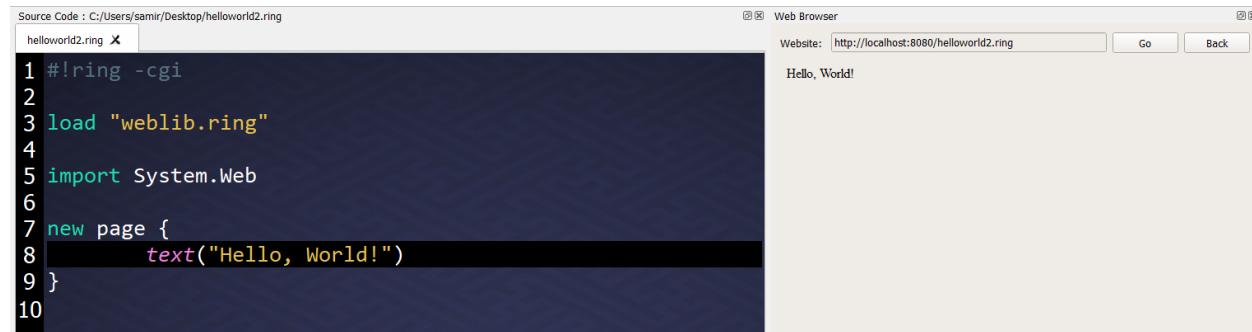
Note: You need to support the Ring language in your web server to be able to run the next example.

Tip: For Windows users, Ring comes with Apache Web server! Using Ring Notepad we can run any web application from any folder directly without doing any configuration.

Source Code:

```
#!ring -cgi
load "weblib.ring"
import System.Web
new Page {
    text("Hello, World!")
}
```

We can run the application in any web browser or in the browser that are embedded in Ring Notepad.



We can run the web application using the Web icon.



3.5 Creating and running your first Desktop/Mobile Game

To learn about creating 2D Games using Ring check the “Demo Project - Game Engine for 2D Games” chapter.

Source Code:

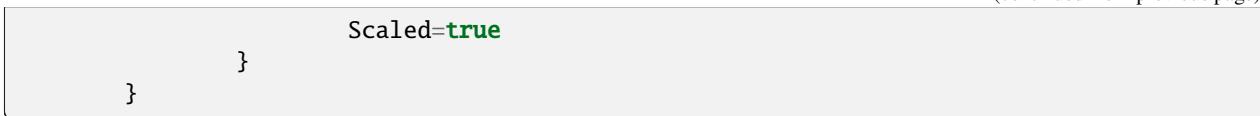
```
load "gameengine.ring"

func main

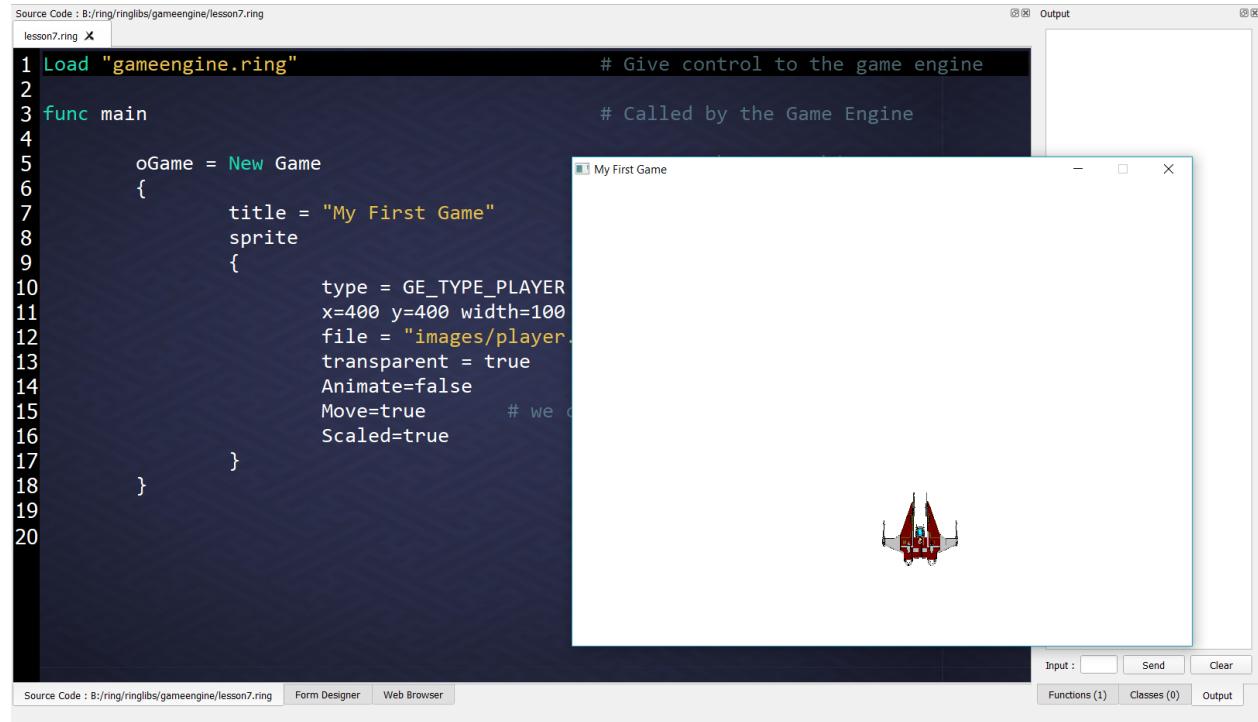
    oGame = New Game
    {
        title = "My First Game"
        sprite
        {
            type = GE_TYPE_PLAYER
            x=400 y=400 width=100 height=100
            file = "images/player.png"
            transparent = true
            Animate=false
            Move=true
        }
    }
```

(continues on next page)

(continued from previous page)



We can run the application as any GUI application.



3.6 The Main File in the Project

The idea of the Main File ToolBar is to determine the main file in the project When the project contains many source code files

Using this feature we can run the project (Main File) at any time while opening other files in the project without the need to switch to the Main File to run the project.

To quickly use this feature

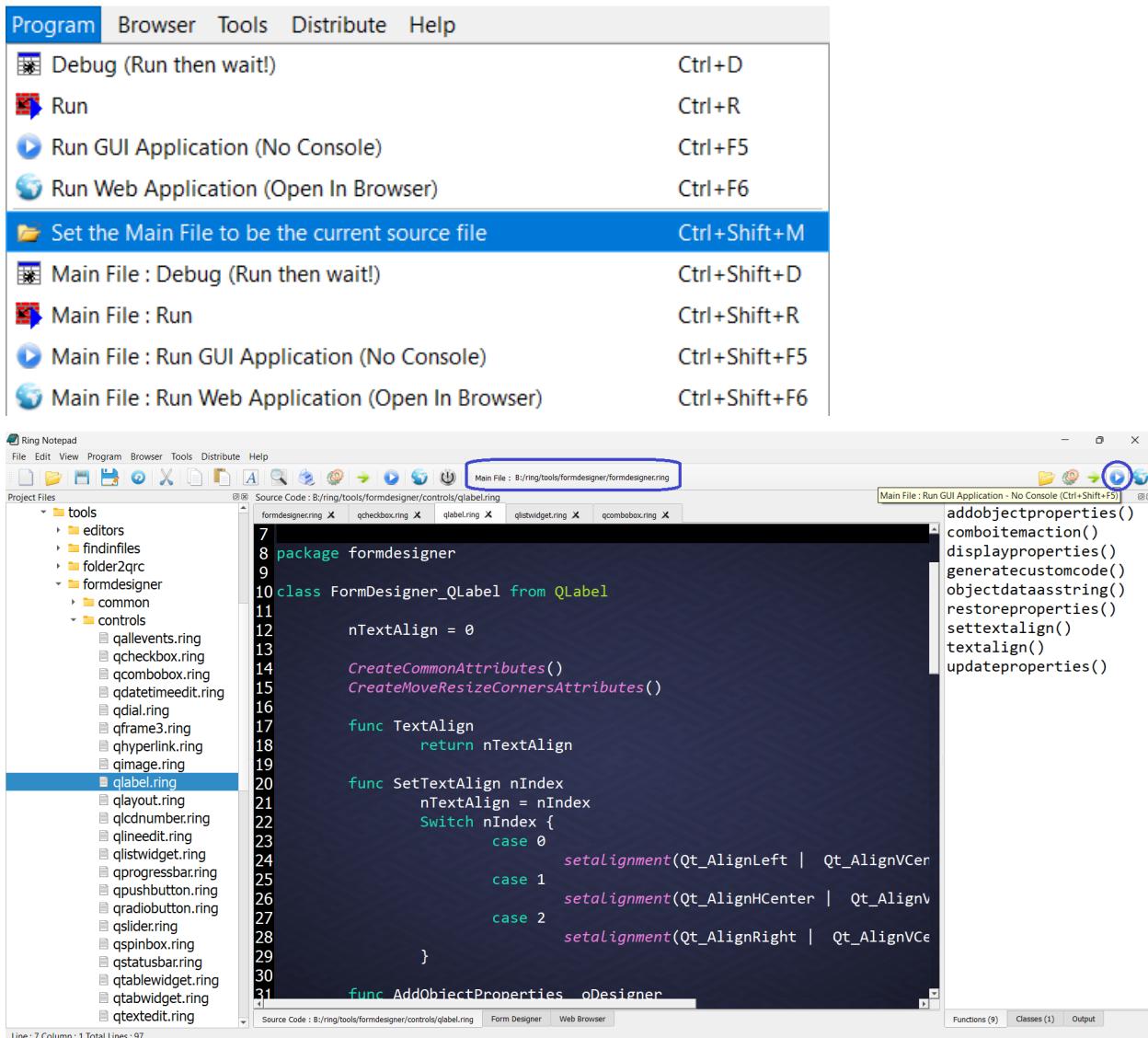
(Open the project main file)

Press Ctrl+Shift+M to set the current source code file as the main file

Open and modify other source code files in the project

To run the project (Main File) at any time press Ctrl+Shift+F5 (GUI) or Ctrl+Shift+D (Console)

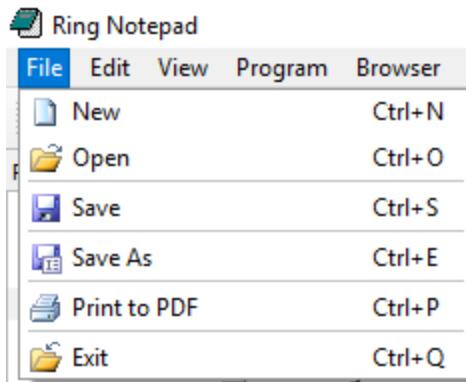
Screen Shots:



3.7 The File Menu

From this menu we can create, open and save the source code files.

Another feature in this menu is “Print to PDF”



3.8 The Edit Menu

From the Edit menu we can Cut, Copy and Paste text.

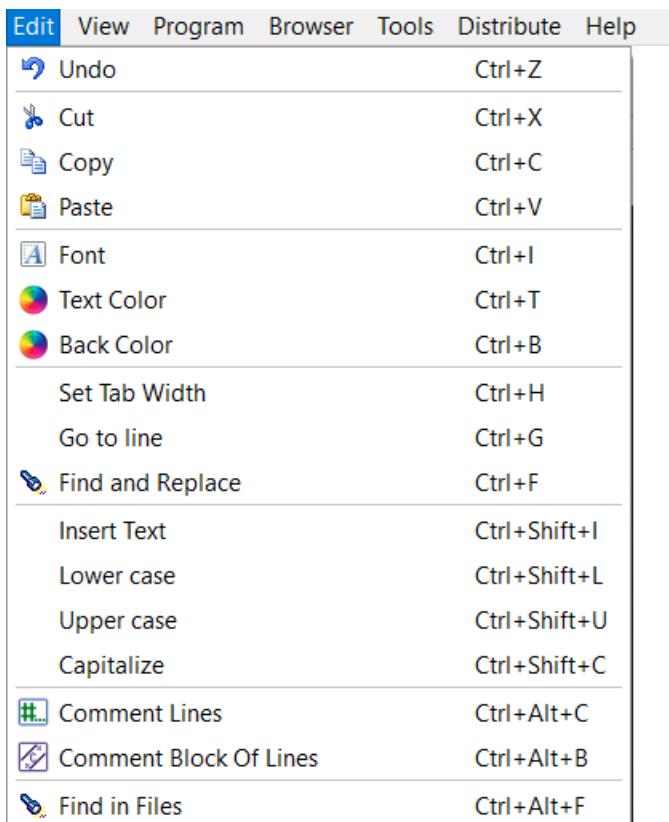
Also we can change the font and the colors.

We can Go to a specific line or use the Find and Replace window to find and replace text.

Also We can set the Tab Width (Number of Spaces)

Starting from Ring 1.8 we have the (Find in Files) option.

Starting from Ring 1.11 we have the (Insert Text, Lower Case, Upper Case & Capitalize) options.

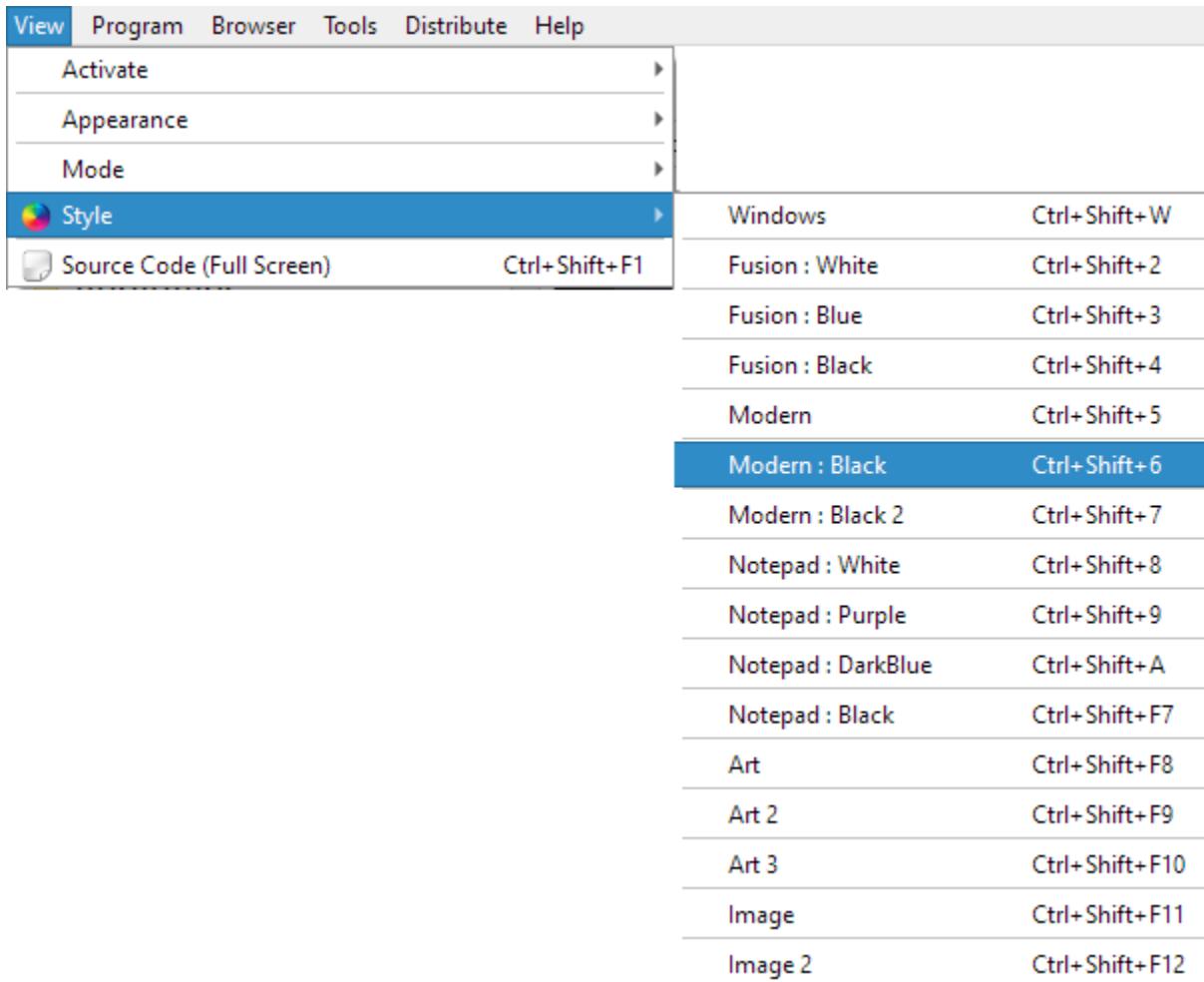


3.9 The View Menu

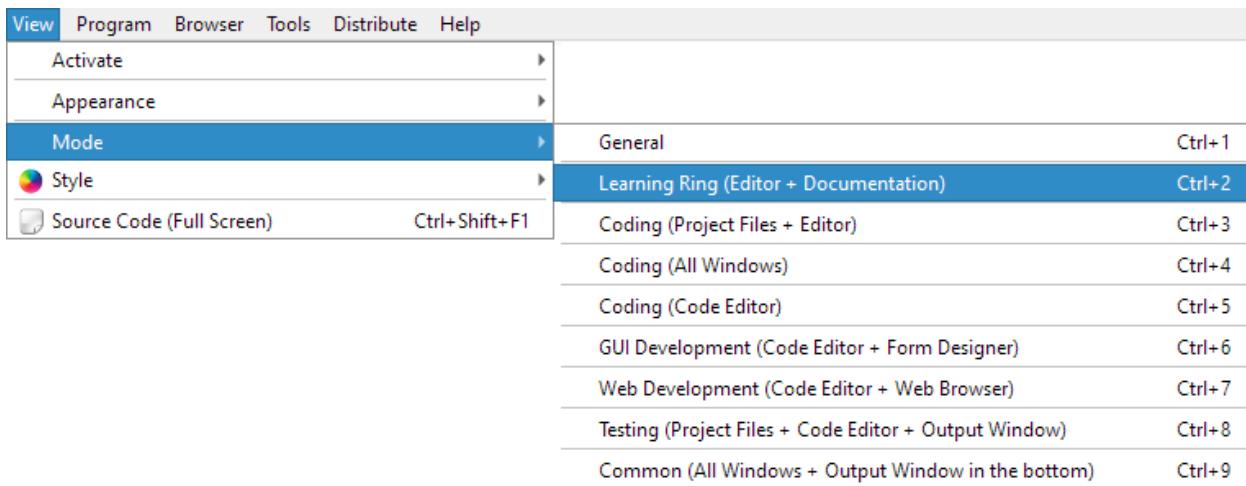
From this menu we can show/hide the dockable windows

Also we can change the Style of the Ring Notepad

Common Styles are (Fusion White and Modern Black)



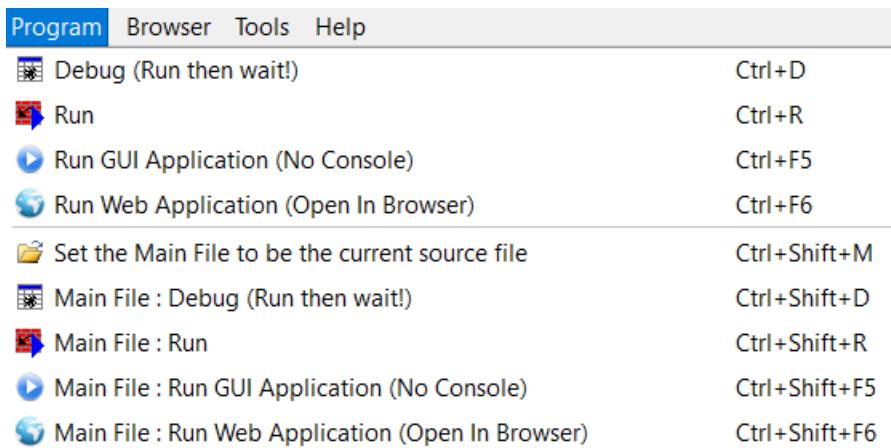
Also we can quickly show/hide group of dockable windows based on the context



3.10 The Program Menu

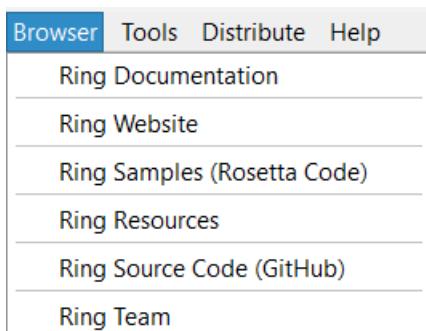
From this menu we can run the programs

Also we can set the Main file in the project



3.11 The Browser Menu

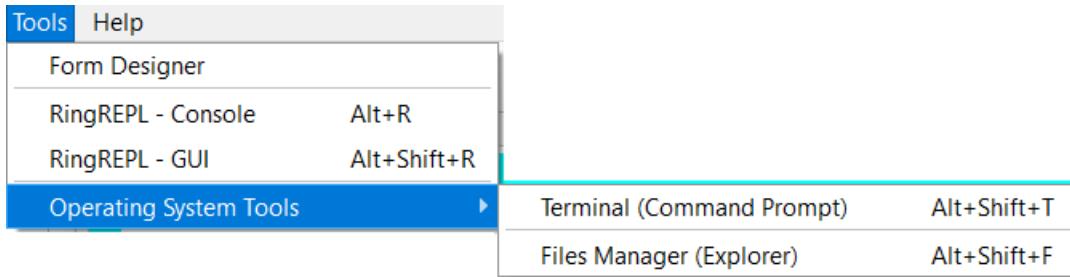
From this menu we can quickly open common links in the browser



3.12 The Tools Menu

From this menu we can run the Form Designer in separate window

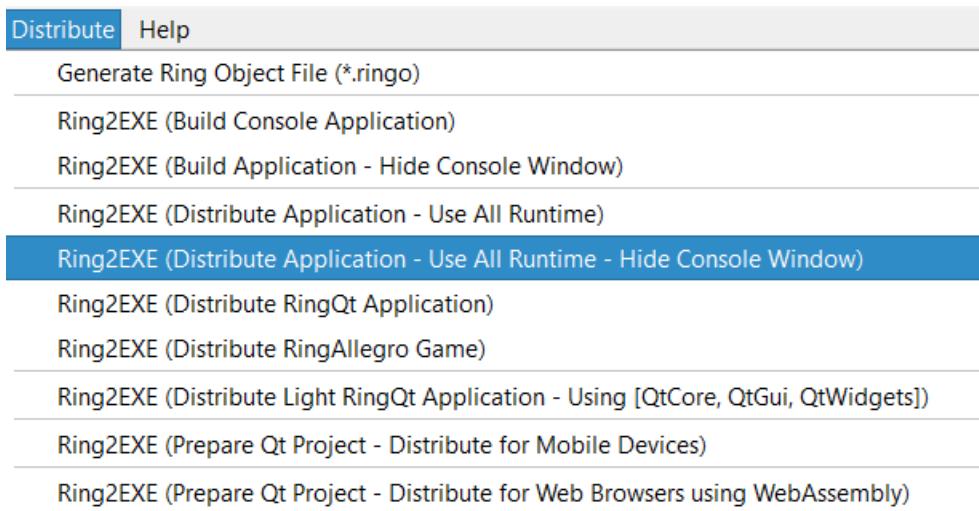
Also we can run the REPL (Read-Eval-Print-Loop) application



3.13 The Distribute Menu

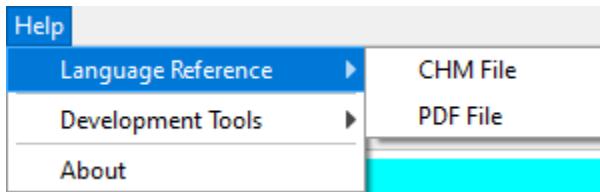
From this menu we can build an executable file for the application

Also we can prepare the application for distribution



3.14 The Help Menu

From this menu we can open the help files (CHM & PDF)



We can download these files from Ring website or using the Ring package manager (ringpm)

```
ringpm install ringhelpchm  
ringpm install ringhelppdf
```

GETTING STARTED - FIRST STYLE

4.1 Hello World

The next program prints the Hello World message on the screen (std-out).

see "Hello World"

4.2 Run the program

to run the program, save the code in a file, for example : hello.ring then from the command line or terminal, run it using Ring

ring hello.ring

4.3 Create Executable File

Using Ring2EXE we can create executable file for our application

ring2exe hello.ring -static

4.4 Not Case-Sensitive

Since the Ring language is not case-sensitive, the same program can be written in different styles

Tip: It's better to select one style and use it in all of the program source code

SEE "Hello World"

See "Hello World"

4.5 Multi-Line literals

Using Ring we can write multi-line literal, see the next example

```
See "
Hello
Welcome to the Ring programming language
How are you?

"
```

Also you can use the nl variable to insert new line and you can use the + operator to concatenate strings

As we have NL for new lines, we have Tab and CR (Carriage return) too!

Note: nl value means a new line and the actual codes that represent a newline is different between operating systems

```
See "Hello" + nl + "Welcome to the Ring programming language" +
nl + "How are you?"
```

4.6 Getting Input

You can get the input from the user using the give command

```
See "What is your name? "
Give cName
See "Hello " + cName
```

4.7 No Explicit End For Statements

You don't need to use ';' or press ENTER to separate statements. The previous program can be written in one line.

```
See "What is your name? " give cName see "Hello " + cName
```

4.8 Using ? to print expression then new line

It's common to print new line after printing an expression, We can use the ? operator to do that!

Example:

```
? "Hello, World!"
for x = 1 to 10
    ? x
next
```

Output:

```
Hello, World!
```

```
1  
2  
3  
4  
5  
6  
7  
8  
9  
10
```

4.9 Writing Comments

We can write one line comments and multi-line comments

The comment starts with # or //

Multi-lines comments are written between /* and */

```
/*  
     Program Name : My first program using Ring  
     Date        : 2016.09.09  
     Author       : Mahmoud Fayed  
*/  
  
See "What is your name? "      # print message on screen  
give cName                    # get input from the user  
see "Hello " + cName          # say hello!  
  
// See "Bye!"
```

Note: Using // to comment a lines of code is just a code style.

GETTING STARTED - SECOND STYLE

5.1 Hello World

The next program prints the Hello World message on the screen (std-out).

```
put "Hello World"
```

5.2 Run the program

to run the program, save the code in a file, for example : hello.ring then from the command line or terminal, run it using Ring

```
ring hello.ring
```

5.3 Create Executable File

Using Ring2EXE we can create executable file for our application

```
ring2exe hello.ring -static
```

5.4 Not Case-Sensitive

Since the Ring language is not case-sensitive, the same program can be written in different styles

Tip: It's better to select one style and use it in all of the program source code

```
PUT "Hello World"
```

```
Put "Hello World"
```

5.5 Multi-Line literals

Using Ring we can write multi-line literal, see the next example

```
Put "
Hello
Welcome to the Ring programming language
How are you?

"
```

Also you can use the nl variable to insert new line and you can use the + operator to concatenate strings

As we have NL for new lines, we have Tab and CR (Carriage return) too!

Note: nl value means a new line and the actual codes that represent a newline is different between operating systems

```
Put "Hello" + nl + "Welcome to the Ring programming language" +
nl + "How are you?"
```

5.6 Getting Input

You can get the input from the user using the get command

```
Put "What is your name? "
Get cName
Put "Hello " + cName
```

5.7 No Explicit End For Statements

You don't need to use ';' or press ENTER to separate statements. The previous program can be written in one line.

```
Put "What is your name? " get cName put "Hello " + cName
```

5.8 Writing Comments

We can write one line comments and multi-line comments

The comment starts with # or //

Multi-lines comments are written between /* and */

```
/*
Program Name : My first program using Ring
Date        : 2016.09.09
Author      : Mahmoud Fayed
*/
```

(continues on next page)

(continued from previous page)

```
Put "What is your name? "      # print message on screen
get cName                      # get input from the user
put "Hello " + cName           # say hello!

// Put "Bye!"
```

Note: Using // to comment a lines of code is just a code style.

GETTING STARTED - THIRD STYLE

6.1 Hello World

The next program prints the Hello World message on the screen (std-out).

```
print("Hello, World!\n")
```

6.2 Run the program

to run the program, save the code in a file, for example : hello.ring then from the command line or terminal, run it using Ring

```
ring hello.ring
```

6.3 Create Executable File

Using Ring2EXE we can create executable file for our application

```
ring2exe hello.ring -static
```

The -static option will avoid the need to ring.dll|ring.so|ring.dylib

```
ring2exe hello.ring -dist -allruntime -noqt -noallegro
```

6.4 Not Case-Sensitive

Since the Ring language is not case-sensitive, the same program can be written in different styles

Tip: It's better to select one style and use it in all of the program source code

```
PRINT("Hello World")
```

```
Print("Hello World")
```

6.5 Multi-Line literals

Using Ring we can write multi-line literal, see the next example

```
Print("Hello
      Welcome to the Ring programming language
      How are you?

")
```

Also you can use the \n to insert new line and you can use #{variable_name} to insert variables values.

```
Print( "Hello\nWelcome to the Ring programming language\nHow are you?")
```

6.6 Getting Input

You can get the input from the user using the getstring() function

```
Print("What is your name? ")
cName = GetString()
Print("Hello #{cName}")
```

6.7 No Explicit End For Statements

You don't need to use ';' or press ENTER to separate statements. The previous program can be written in one line.

```
Print("What is your name? ") cName=getstring() print("Hello #{cName}")
```

6.8 Writing Comments

We can write one line comments and multi-line comments

The comment starts with # or //

Multi-lines comments are written between /* and */

```
/*
Program Name : My first program using Ring
Date        : 2016.09.09
Author       : Mahmoud Fayed
*/
Print("What is your name? ")      # print message on screen
cName=GetString()                # get input from the user
print("Hello #{cName}")          # say hello!

// print("Bye!")
```

Note: Using // to comment a lines of code is just a code style.

6.9 Puts() function

print the value then print new line (nl)

Syntax:

```
puts(expr)
```

Example:

```
Puts("Hello, World!")
```

6.10 Print() function

print string - support \n,\t and \r

Also we can use #{variable_name} to insert variables values.

Syntax:

```
print(string) ---> String
```

Example:

```
print("\nHello, World\n\nHow are you? \t\t I'm fine!\n")
x=10 y=20
print("\nx value = #{x} , y value = #{y} \n")
```

6.11 Print2Str() Function

Syntax:

```
print2Str(string) ---> String
```

Example:

```
world = "World!"
mystring = print2str("Hello, #{world} \nIn Year \n#{2000+17} \n")
see mystring + nl
```

Output:

```
Hello, World!
In Year
2017
```

6.12 GetString() function

Get input from the keyboard - return value as string

```
getstring() ---> string
```

6.13 GetNumber() function

Get input from the keyboard - return value as number

```
getnumber() ---> number
```

CHAPTER SEVEN

VARIABLES

To create a new variable, you just need to determine the variable name & value. The value will determine the variable type and you can change the value to switch between the types using the same variable name.

Syntax:

```
<Variable Name> = <Value>
```

Tip: The operator ‘=’ is used here as an Assignment operator and the same operator can be used in conditions, but for testing equality of expressions.

Note: The Variable will contains the real value (not a reference). This means that once you change the variable value, the old value will be removed from memory (even if the variable contains a list or object).

7.1 Dynamic Typing

Ring is a dynamic programming language that uses Dynamic Typing.

```
x = "Hello"          # x is a string
see x + nl
x = 5                # x is a number (int)
see x + nl
x = 1.2              # x is a number (double)
see x + nl
x = [1,2,3,4]        # x is a list
see x                # print list items
x = date()           # x is a string contains date
see x + nl
x = time()           # x is a string contains time
see x + nl
x = true              # x is a number (logical value = 1)
see x + nl
x = false             # x is a number (logical value = 0)
see x + nl
```

7.2 Deep Copy

We can use the assignment operator ‘=’ to copy variables. We can do that to copy values like strings & numbers. Also, we can copy complete lists & objects. The assignment operator will do a complete duplication for us. This operation called **Deep Copy**

```
list = [1,2,3,"four","five"]
list2 = list
list = []
See list      # print the first list - no items to print
See "*****" + nl
See list2     # print the second list - contains 5 items
```

Note: To copy lists/objects by reference, See the (Using References) chapter about the Ref() function

7.3 Implicit Conversion

Using the plus operator, The language can automatically convert between numbers and strings.

Rules:

```
<NUMBER> + <STRING> --> <NUMBER>
<STRING> + <NUMBER> --> <STRING>
```

Note: The same operator ‘+’ can be used as an arithmetic operator or for string concatenation.

Example:

```
x = 10          # x is a number
y = "20"        # y is a string
sum = x + y    # sum is a number (y will be converted to a number)
Msg = "Sum = " + sum  # Msg is a string (sum will be converted to a string)
? Msg
```

Note: See the Operators chapter to learn more about implicit conversion and mixing operators and types.

**CHAPTER
EIGHT**

OPERATORS

In this chapter we will introduce the operators provided by the Ring programming language.

8.1 Arithmetic Operators

The next table presents all of the arithmetic operators provided by the Ring language. Assume variable X=50 and variable Y=10 then:

Operator	Description	Example	Result
+	Add	x+y	60
-	Subtract	x-y	40
*	Multiplies	x*y	500
/	Divide	x/y	5
%	Modulus	x%y	0
++	Increment	x++	51
--	Decrement	x--	49
** OR ^^	Power	x**3	125000

8.2 Relational Operators

The next table presents all of the relational operators provided by the Ring language. Assume variable X=50 and variable Y=10 then:

Operator	Description	Example	Result
=	Equal	x = y	False
!=	Not Equal	x != y	True
>	Greater than	x > y	True
<	Less than	x < y	False
>=	Greater or Equal	x >= y	True
<=	Less than or Equal	x <= y	False

8.3 Logical Operators

The next table presents all of the logical operators provided by the Ring language. Assume variable X=True and variable Y=False then:

Operator	Description	Example	Result
and	Logical AND	x and y	False
or	Logical OR	x or y	True
not	Logical Not	not x	False

Another style

Operator	Description	Example	Result
&&	Logical AND	x && y	False
	Logical OR	x y	True
!	Logical Not	! x	False

8.4 Bitwise Operators

The next table presents all of the bitwise operators provided by the Ring language. Assume variable X=8 and variable Y=2 then:

Operator	Description	Example	Result
&	Binary AND	x & y	0
	Binary OR	x y	10
^	Binary XOR	x ^ y	10
~	Binary Ones Complement	~x	-9
<<	Binary Left Shift	x << y	32
>>	Binary Right Shift	x >> y	2

8.5 Assignment Operators

The next table presents all of the assignment operators provided by the Ring language.

Assume variable X=8 then:

Operator	Description	Example	Result
=	Assignment	x = 10	x=10
+=	Add AND assignment	x += 5	x=13
-=	Subtract AND assignment	x -= 3	x=5
*=	Multiply AND assignment	x *= 2	x=16
/=	Divide AND assignment	x /= 3	x=2.67
%=	Modulus AND assignment	x %= 2	x=0
<<=	Left shift AND assignment	x <<= 2	x=32
>>=	Right shift AND assignment	x >>= 2	x=2
&=	Bitwise AND assignment	x &= 4	x=0
=	Bitwise OR and assignment	x = 3	x=11
^=	Bitwise XOR and assignment	x ^= 4	x=12

8.6 Misc Operators

Operator	Description
:literal	using : before identifier mean literal
Start:End	create list contains items from start to end
[list items]	define list items
list[index]	access list item
obj.name	using the dot operator to access object members (attributes/methods).
obj {stmts}	execute statements with direct access to object attributes & methods
func(para,...)	call function using parameters separated by comma
? <expr>	Print expression then new line

8.7 Operators Precedence

The next table present operators from higher precedence (Evaluated first) to lower precedence.

Operator
. [] () {}
~ :Literal [list items]
++ --
- (Unary negative) + (Unary positive)
Start:End
* / %
+ -
<< >>
&
^
< > <= >=
= !=
not !
and &&
or
Assignment = += -= *= /= %= >>= <<= &= ^= =
?

Example (1):

? 3+5*4	# prints 23
? True or False and False	# prints 1 (True)

8.8 Mixing Arithmetic Operators and Types

The next table demonstrates what happens when mixing arithmetic operators and different types

First Type	Operator	Second Type	Output Type OR Behavior	Example
Number	“+”	Number	Number	5+5
Number	“+”	String	Number	5+”5”
String	“+”	Number	String	“5”+5
String	“+”	String	String	“5”+”5”
List	“+”	Number	Add number to List	[1,2,3] + 4
List	“+”	String	Add string to List	[1,2,3] + “four”
List	“+”	List	Add list to List	[1,2,3] + [“sub”]
List	“+”	Object	Add object to List	[1,2,3] + new Point
Number	“+”	List	Runtime Error	4 + [1,2,3]
Number	“+”	Object	Check Operator Overloading	4 + new point
String	“+”	List	Runtime Error	“4” + [1,2,3]
String	“+”	Object	Check Operator Overloading	“4” + new point
Object	“+”	Number	Check Operator Overloading	new point + 1
Object	“+”	String	Check Operator Overloading	new point + “test”
Object	“+”	List	Check Operator Overloading	new point + [10,10]
Object	“+”	Object	Check Operator Overloading	new point + new point
Number	“.”	Number	Number	5.5
Number	“_”	String	Number	5-“5”
String	“_”	Number	Number	“5”-5

continues on next page

Table 1 – continued from previous page

First Type	Operator	Second Type	Output Type OR Behavior	Example
String	"_"	String	Number	"5"-“5”
List	"_"	Number	Runtime Error	[1,2,3] - 4
List	"_"	String	Runtime Error	[1,2,3] - “four”
List	"_"	List	Runtime Error	[1,2,3] - [“sub”]
List	"_"	Object	Check Operator Overloading	[1,2,3] - new Point
Number	"_"	List	Runtime Error	4 - [1,2,3]
Number	"_"	Object	Check Operator Overloading	4 - new point
String	"_"	List	Runtime Error	“4” - [1,2,3]
String	"_"	Object	Check Operator Overloading	“4” - new point
Object	"_"	Number	Check Operator Overloading	new point - 1
Object	"_"	String	Check Operator Overloading	new point - “test”
Object	"_"	List	Check Operator Overloading	new point - [10,10]
Object	"_"	Object	Check Operator Overloading	new point - new point
Number	"**"	Number	Number	5*5
Number	"**"	String	Number	5**5”
String	"**"	Number	Number	“5”*5
String	"**"	String	Number	“5”*”5”
List	"**"	Number	Runtime Error	[1,2,3] * 4
List	"**"	String	Runtime Error	[1,2,3] * “four”
List	"**"	List	Runtime Error	[1,2,3] * [“sub”]
List	"**"	Object	Check Operator Overloading	[1,2,3] * new Point
Number	"**"	List	Runtime Error	4 * [1,2,3]
Number	"**"	Object	Check Operator Overloading	4 * new point
String	"**"	List	Runtime Error	“4” * [1,2,3]
String	"**"	Object	Check Operator Overloading	“4” * new point
Object	"**"	Number	Check Operator Overloading	new point * 1
Object	"**"	String	Check Operator Overloading	new point * “test”
Object	"**"	List	Check Operator Overloading	new point * [10,10]
Object	"**"	Object	Check Operator Overloading	new point * new point
Number	"/"	Number	Number	5/5
Number	"/"	String	Number	5/”5”
String	"/"	Number	Number	“5”/5
String	"/"	String	Number	“5”/”5”
List	"/"	Number	Runtime Error	[1,2,3] / 4
List	"/"	String	Runtime Error	[1,2,3] / “four”
List	"/"	List	Runtime Error	[1,2,3] / [“sub”]
List	"/"	Object	Check Operator Overloading	[1,2,3] / new Point
Number	"/"	List	Runtime Error	4 / [1,2,3]
Number	"/"	Object	Check Operator Overloading	4 / new point
String	"/"	List	Runtime Error	“4” / [1,2,3]
String	"/"	Object	Check Operator Overloading	“4” / new point
Object	"/"	Number	Check Operator Overloading	new point / 1
Object	"/"	String	Check Operator Overloading	new point / “test”
Object	"/"	List	Check Operator Overloading	new point / [10,10]
Object	"/"	Object	Check Operator Overloading	new point / new point
Number	"%"	Number	Number	5%5
Number	"%"	String	Number	5%”5”
String	"%"	Number	Number	“5”%5
String	"%"	String	Number	“5”%”5”
List	"%"	Number	Runtime Error	[1,2,3] % 4

continues on next page

Table 1 – continued from previous page

First Type	Operator	Second Type	Output Type OR Behavior	Example
List	"%"	String	Runtime Error	[1,2,3] % "four"
List	"%"	List	Runtime Error	[1,2,3] % ["sub"]
List	"%"	Object	Check Operator Overloading	[1,2,3] % new Point
Number	"%"	List	Runtime Error	4 % [1,2,3]
Number	"%"	Object	Check Operator Overloading	4 % new point
String	"%"	List	Runtime Error	"4" % [1,2,3]
String	"%"	Object	Check Operator Overloading	"4" % new point
Object	"%"	Number	Check Operator Overloading	new point % 1
Object	"%"	String	Check Operator Overloading	new point % "test"
Object	"%"	List	Check Operator Overloading	new point % [10,10]
Object	"%"	Object	Check Operator Overloading	new point % new point
Number	"++"	...	Number	5++
String	"++"	...	Syntax Error/Runtime Error	x="5" x++
List	"++"	...	Syntax Error/Runtime Error	x=[1,2,3] x++
Object	"++"	...	Syntax Error/Runtime Error	x=new point x++
Number	"_"	...	Number	5-
String	"_"	...	Syntax Error/Runtime Error	x="5" x-
List	"_"	...	Syntax Error/Runtime Error	x=[1,2,3] x-
Object	"_"	...	Syntax Error/Runtime Error	x=new point x-

Note: The behavior of the power operator with respect to different types is similar to the -, *, / and % operators.

8.9 Mixing Relational Operators and Types

Using Relational Operators like <, <=, >, >= could produce True, False OR runtime error.

When mixing Strings and Numbers with these operators, The string will be converted to a number.

Example (2):

```
? 5 < 7      # 1 (True)
? "5" < 7    # 1 (True)
? 5 < "7"    # 1 (True)
? "5" < "7"  # 1 (True)
? "test" < 5 # Runtime Error (Invalid numeric string)
```

Note: Using these operators with lists or objects will produce a runtime error. An exception to this rule is having an object the comes first before the operator and this object support operator overloading.

Using relational operators like = or != will only produce True OR False (i.e. no runtime error)

Also, when mixing Strings and Numbers with these operators, The string will be converted to a number.

Example (3):

```
? "5" = 5    # 1 (True)
? 5 = "5"    # 1 (True)
```

(continues on next page)

(continued from previous page)

```
? 5 = 5          # 1 (True)
? "5" = "5"    # 1 (True)
? 5 = 7          # 0 (False)
? "5" = 7      # 0 (False)
? 5 = "7"       # 0 (False)
? "5" = "7"     # 0 (False)
? "test" = 5    # 0 (False)

? "5" != 5      # 0 (False)
? 5 != "5"      # 0 (False)
? 5 != 5        # 0 (False)
? "5" != "5"    # 0 (False)
? 5 != 7        # 1 (True)
? "5" != 7      # 1 (True)
? 5 != "7"      # 1 (True)
? "5" != "7"    # 1 (True)
? "test" != 5   # 1 (True)
```

Example (4):

```
? 12500 = "0012500"          # 1 (True)
? 12500 = "0012500-PRY-09"  # 0 (False)

# When we compare between number and a string
# If we found the number --> Then we ignore Space, Tab, \n, \r after that number
# We consider "" to be like Zero but we don't do that for Space, Tab, \n and \r
# Note: if 0 -> False while if " " -> True

? 1 = "1 x"                # 0 (False)
? 1 = "1"                   # 1 (True)
? 0 = ""                     # 1 (True)
? 0 = "0"                   # 1 (True)
? 1 = "1"                   # 1 (True)
? 0 = "000000"              # 1 (True)
? 0 = "00000"
"                           # 1 (True)
? 1 = "1"
"                           # 1 (True)

? 0 = " "
# 0 (False)

if 0
? :fail
else
? :pass
ok
# pass

if ""
? :fail
else
? :pass
ok
# pass
```

(continues on next page)

(continued from previous page)

```
if " " # True
    ? :pass
else
    ? :fail
ok # pass
```

Note: Using these operators to compare between objects or lists will compare between them at the reference level (not the value)

Example (5):

```
aList = [1,2,3]
aList2 = [1,2,3]
? aList = aList      # 1 (True)
? aList = aList2     # 0 (False)

aList3 = ref(aList)
? aList3 = aList     # 1 (True)
```

8.10 Mixing Logical Operators and Types

We have the next rules:

- Logical operators always produce True/False
- The Zero number is considered False
- The Empty string is considered False
- The Empty list is considered False
- The list that wrap C pointer is considered False if the pointer is NULL
- All other values are True

Example (6):

```
? 1 and 1 # 1 (True)
? "test" and "test" # 1 (True)
? [1,2,3] and "test" # 1 (True)
? 1 and "test" and [1,2,3] # 1 (True)
? 1 and new point # 1 (True)
? 1 and 0 # 0 (False)
? 1 and "" # 0 (False)
? 1 and [] # 0 (False)
? 1 and NULLPointer() # 0 (False)

class point
```

8.11 Mixing Bitwise Operators and Types

These operators support numbers. Also, it will automatically convert strings to numbers if this is possible or produce a runtime error if the string can't be converted.

Using these operators with lists or objects produce a runtime error with an exception to this rule.

The exception is using objects that support operator overloading where the object comes first before the operator.

Example (7):

```
? 1 & 1          # 1
? "1" & 1        # 1
? 1 & "3"        # 1
? "3" & "3"      # 3
? "123" & "123" # 123
```

8.12 Mixing Assignment Operators and Types

Using assignment we can assign any value to any variable.

Using `+=` support Strings & Numbers and will produce a runtime error if used with other types

Using other assignment operators like `-=`, `*=`, `/=`, `%=`, `<<=`, `>>=`, etc. support only numbers and will produce a runtime error if used with other types.

Example (8):

```
cStr = "one"
cStr += " two"
? cStr          # one two
nNum = 100
nNum += 200
? nNum          # 300
```

8.13 Unary Positive and Unary Negative

Rules:

- Using unary positive (+) before any number/variable does nothing.
- Using unary negative (-) before any number will negate the number.
- Using unary negative (-) before a string will convert it to a number then negate the number.
- Using unary negative (-) before a list/object will produce a runtime error.

Example (9):

```
x = +10
? x          # 10
? +x         # 10
y = "10"
? +y         # 10
```

(continues on next page)

(continued from previous page)

```
? type(+y)      # STRING
x = 10
? -x            # -10
y = "10"
? -y            # -10
? type(-y)      # NUMBER

aList = [1,2,3]
? - aList       # RUNTIME ERROR
```

CONTROL STRUCTURES - FIRST STYLE

In this chapter we are going to learn about the control structures provided by the Ring programming language.

9.1 Branching

- If Statement

Syntax:

```
if Expression
    Block of statements
but Expression
    Block of statements
else
    Block of statements
ok
```

Example:

```
see "
    Main Menu
    -----
    (1) Say Hello
    (2) About
    (3) Exit

    " give nOption

if nOption = 1 see "Enter your name : " give name see "Hello " + name + nl
but nOption = 2 see "Sample : using if statement" + nl
but nOption = 3 bye
else see "bad option..." + nl
ok
```

- Switch Statement

Syntax:

```
switch Expression
on Expression
    Block of statements
```

(continues on next page)

(continued from previous page)

other	Block of statements
off	

Example:

```
See "
    Main Menu
    -----
    (1) Say Hello
    (2) About
    (3) Exit

    " Give nOption

Switch nOption
On 1 See "Enter your name : " Give name See "Hello " + name + nl
On 2 See "Sample : using switch statement" + nl
On 3 Bye
Other See "bad option..." + nl
Off
```

9.2 Looping

- While Loop

Syntax:

while Expression	Block of statements
end	

Example:

```
While True

    See "
        Main Menu
        -----
        (1) Say Hello
        (2) About
        (3) Exit

        " Give nOption

    Switch nOption
    On 1
        See "Enter your name : "
        Give name
        See "Hello " + name + nl
    On 2
```

(continues on next page)

(continued from previous page)

```

    See "Sample : using while loop" + nl
On 3
    Bye
Other
    See "bad option..." + nl
Off
End

```

- For Loop

Syntax:

```

for identifier=expression to expression [step expression]
    Block of statements
next

```

Example:

```

# print numbers from 1 to 10
for x = 1 to 10 see x + nl next

```

Example:

```

# Dynamic loop
See "Start : " give nStart nStart = 0+nStart
See "End : " give nEnd nEnd = 0+nEnd
See "Step : " give nStep nStep = 0+nStep
For x = nStart to nEnd Step nStep
    see x + nl
Next

```

Example:

```

# print even numbers from 0 to 10
for x = 0 to 10 step 2
    see x + nl
next

```

Example:

```

# print even numbers from 10 to 0
for x = 10 to 0 step -2
    see x + nl
next

```

- For in Loop

Syntax:

```

for|foreach identifier in List/String [step expression]
    Block of statements
next

```

Example:

```
aList = 1:10    # create list contains numbers from 1 to 10
for x in aList  see x + nl  next # print numbers from 1 to 10
```

Note: We can use the ForEach keyword instead of the For keyword

9.3 Using The Step option with For in

We can use the Step option with For in to skip number of items in each iteration

Example:

```
aList = 1:10    # create list contains numbers from 1 to 10
# print odd items inside the list
for x in aList step 2
    see x + nl
next
```

9.4 Using For in to modify lists

When we use (For in) we get items by reference.

This means that we can read/edit items inside the loop.

Example:

```
aList = 1:5    # create list contains numbers from 1 to 5
# replace list numbers with strings
for x in aList
    switch x
        on 1  x = "one"
        on 2  x = "two"
        on 3  x = "three"
        on 4  x = "four"
        on 5  x = "five"
    off
next
see aList      # print the list items
```

9.5 Do Again Loop

Syntax:

```
do
    Block of statements
again expression
```

Example:

```
x = 1
do
    see x + nl
    x++
again x <= 10
```

9.6 Exit Command

Used to go outside one or more of loops.

Syntax:

```
exit [expression]      # inside loop
```

Example:

```
for x = 1 to 10
    see x + nl
    if x = 5 exit ok
next
```

9.7 Exit from two loops

The next example presents how to use the exit command to exit from two loops in one jump.

Example:

```
for x = 1 to 10
    for y = 1 to 10
        see "x=" + x + " y=" + y + nl
        if x = 3 and y = 5
            exit 2      # exit from 2 loops
        ok
    next
next
```

9.8 Loop Command

Used to jump to the next iteration in the loop.

Syntax:

```
loop [expression]      # inside loop
```

Example:

```
for x = 1 to 10
    if x = 3
        see "Number Three" + nl
```

(continues on next page)

(continued from previous page)

```

loop
ok
see x + nl
next

```

9.9 Short-circuit evaluation

The logical operators and/or follow the short-circuit evaluation.

If the first argument of the AND operator is zero, then there is no need to evaluate the second argument and the result will be zero.

If the first argument of the OR operator is one, then there is no need to evaluate the second argument and the result will be one.

Example:

```

/* output
** nice
** nice
** great
*/
x = 0 y = 10

if (x = 0 and nice()) and (y = 10 and nice())
    see "great" + nl
ok

func nice see "nice" + nl    return 1

```

Example:

```

# No output

x = 0 y = 10

if (x = 1 and nice()) and (y = 10 and nice())
    see "great" + nl
ok

func nice see "nice" + nl    return 1

```

Example:

```

/* output
** nice
** great
*/
x = 0 y = 10

```

(continues on next page)

(continued from previous page)

```
if (x = 0 and nice()) or (y = 10 and nice())
    see "great" + nl
ok

func nice  see "nice" + nl  return 1
```

9.10 Comments about evaluation

- True, False, nl & NULL are variables defined by the language
- True = 1
- False = 0
- nl = new line
- NULL = empty string = “”
- Everything evaluates to True except 0 (False), NULL (Empty String), Empty List and Lists that wrap C pointer where the pointer value is NULL.

Example:

```
# output = message from the if statement

if 5      # 5 evaluates to true because it's not zero (0).
    see "message from the if statement" + nl
ok
```

CONTROL STRUCTURES - SECOND STYLE

In this chapter we are going to learn about the second style of control structures provided by the Ring programming language.

10.1 Branching

- If Statement

Syntax:

```
if Expression
    Block of statements
elseif Expression
    Block of statements
else
    Block of statements
end
```

Example:

```
put "Main Menu
-----
(1) Say Hello
(2) About
(3) Exit

" get nOption

if nOption = 1 put "Enter your name : " get name put "Hello " + name + nl
elseif nOption = 2 put "Sample : using if statement" + nl
elseif nOption = 3 bye
else put "bad option..." + nl
end
```

- Switch Statement

Syntax:

```
switch Expression
case Expression
```

(continues on next page)

(continued from previous page)

```
else           Block of statements
    Block of statements
end
```

Example:

```
Put ""
    Main Menu
    -----
    (1) Say Hello
    (2) About
    (3) Exit

    " Get nOption

Switch nOption
Case 1 Put "Enter your name : "
    Get name Put "Hello " + name + nl
Case 2 Put "Sample : using switch statement" + nl
Case 3 Bye
Else Put "bad option..." + nl
End
```

10.2 Looping

- While Loop

Syntax:

```
while Expression
    Block of statements
end
```

Example:

```
While True

    Put ""
        Main Menu
        -----
        (1) Say Hello
        (2) About
        (3) Exit

        " Get nOption

    Switch nOption
    Case 1
        Put "Enter your name : "
        Get name
        Put "Hello " + name + nl
```

(continues on next page)

(continued from previous page)

```

Case 2
    Put "Sample : using while loop" + nl
Case 3
    Bye
Else
    Put "bad option..." + nl
End
End

```

- For Loop

Syntax:

```

for identifier=expression to expression [step expression]
    Block of statements
end

```

Example:

```

# print numbers from 1 to 10
for x = 1 to 10 put x + nl end

```

Example:

```

# Dynamic loop
Put "Start : " get nStart nStart= 0+nStart
Put "End : " get nEnd nEnd = 0+nEnd
Put "Step : " get nStep nStep = 0+nStep
For x = nStart to nEnd Step nStep
    Put x + nl
End

```

Example:

```

# print even numbers from 0 to 10
for x = 0 to 10 step 2
    Put x + nl
end

```

Example:

```

# print even numbers from 10 to 0
for x = 10 to 0 step -2
    put x + nl
end

```

- For in Loop

Syntax:

```

for identifier in List/String [step expression]
    Block of statements
end

```

Example:

```
aList = 1:10      # create list contains numbers from 1 to 10
for x in aList   put x + nl  end  # print numbers from 1 to 10
```

10.3 Exceptions

```
try
    Block of statements
catch
    Block of statements
end
```

CHAPTER
ELEVEN

CONTROL STRUCTURES - THIRD STYLE

In this chapter we are going to learn about the third style of control structures provided by the Ring programming language.

11.1 Branching

- If Statement

Syntax:

```
if Expression {
    Block of statements
elseif Expression
    Block of statements
else
    Block of statements
}
```

Example:

```
print("Main Menu
-----
(1) Say Hello
(2) About
(3) Exit
")

nOption = getnumber()

if nOption = 1 {
    print("Enter your name : ")
    name = getstring()
    print("Hello #{name}\n")
elseif nOption = 2
    print("Sample : using if statement\n")
elseif nOption = 3
    bye
else
    print("bad option...\n")
}
```

- Switch Statement

Syntax:

```
switch Expression {
    case Expression
        Block of statements
    else
        Block of statements
}
```

Example:

```
print("Main Menu
-----
(1) Say Hello
(2) About
(3) Exit

")

n0ption = GetString()

switch n0ption {
case 1
    print("Enter your name : ")
    name = getstring()
    print("Hello #{name}\n")
case 2
    print("Sample : using switch statement\n")
case 3
    Bye
else
    print("bad option...\n")
}
```

11.2 Looping

- While Loop

Syntax:

```
while Expression {
    Block of statements
}
```

Example:

```
While True {

    print("Main Menu
```

(continues on next page)

(continued from previous page)

```

-----
(1) Say Hello
(2) About
(3) Exit

")

nOption = GetString()

switch nOption {
case 1
    print("Enter your name : ")
    name = getstring()
    print("Hello #{name}\n")
case 2
    print("Sample : using switch statement\n")
case 3
    Bye
else
    print("bad option...\n")
}

}

```

- For Loop

Syntax:

```

for identifier=expression to expression [step expression] {
    Block of statements
}

```

Example:

```

# print numbers from 1 to 10
for x = 1 to 10 {
    print("#{x}\n")
}

```

Example:

```

# Dynamic loop
print("Start : ") nStart = getnumber()
print("End : ") nEnd = getnumber()
print("Step : ") nStep = getnumber()
for x = nStart to nEnd step nStep {
    print("#{x}\n")
}

```

Example:

```

# print even numbers from 0 to 10
for x = 0 to 10 step 2 {

```

(continues on next page)

(continued from previous page)

```
    print("#{x}\n")
}
```

Example:

```
# print even numbers from 10 to 0
for x = 10 to 0 step -2 {
    print("#{x}\n")
}
```

- For in Loop

Syntax:

```
for identifier in List/String [step expression] {
    Block of statements
}
```

Example:

```
aList = 1:10    # create list contains numbers from 1 to 10
for x in aList { print("#{x}\n") }  # print numbers from 1 to 10
```

Example:

```
aList = 1:10    # create list contains numbers from 1 to 10
# print odd items inside the list
for x in aList step 2 {
    print("#{x}\n")
}
```

When we use (For in) we get items by reference.

This means that we can read/edit items inside the loop.

Example:

```
aList = 1:5    # create list contains numbers from 1 to 5
# replace list numbers with strings
for x in aList {
    switch x {
        case 1  x = "one"
        case 2  x = "two"
        case 3  x = "three"
        case 4  x = "four"
        case 5  x = "five"
    }
}
print(aList)    # print the list items
```

11.3 Exceptions

```
try {  
    Block of statements  
catch {  
    Block of statements  
}
```

CHAPTER
TWELVE

GETTING INPUT

We can get input from the keyboard using

- The Give Command
- The GetChar() Function
- The Input() Function

12.1 Give Command

Syntax:

```
Give VariableName
```

Example:

```
See "Enter the first number : " Give nNum1
See "Enter the second number : " Give nNum2
See "Sum : " + ( 0 + nNum1 + nNum2 )
```

Output:

```
Enter the first number : 3
Enter the second number : 4
Sum : 7
```

12.2 GetChar() Function

We can get one character from the standard input using the GetChar() function

Syntax:

```
GetChar() ---> Character
```

Example:

```
While True
    See "
        Main Menu
```

(continues on next page)

(continued from previous page)

```

(1) Say Hello
(2) Exit
"
Option = GetChar()
GetChar() GetChar() # End of line

# the previous two lines can be replaced with the next line
# Give Option

if Option = 1
    see "Enter your name : " give cName
    see "Hello " + cName
else
    bye
ok
End

```

12.3 Input() Function

We can get input from the keyboard using the Input() function

Syntax:

```
Input([nCount]) ----> string
```

The function will wait until nCount characters (at least) are read

Tip: If the nCount is not passed as parameter, the function will read a line.

Example:

```
See "Enter message (30 characters) : " cMsg = input(30)
See "Message : " + cMsg
```

CHAPTER
THIRTEEN

FUNCTIONS - FIRST STYLE

In this chapter we are going to learn about the next topics :-

- Define functions
- Call functions
- Declare parameters
- Send parameters
- Main Function
- Variables Scope
- Return Value
- Recursion

13.1 Define Functions

To define new function

Syntax:

```
func <function_name> [parameters]
    Block of statements
```

Note: No keyword is required to end the function definition.

Example:

```
func hello
    see "Hello from function" + nl
```

13.2 Call Functions

To call function without parameters, we type the function name then ()

Tip: We can call the function before the function definition and the function code.

Example:

```
hello()

func hello
    see "Hello from function" + nl
```

Example:

```
first() second()

func first    see "message from the first function" + nl

func second   see "message from the second function" + nl
```

13.3 Declare parameters

To declare the function parameters, after the function name type the list of parameters as a group of identifiers separated by comma.

Example:

```
func sum x,y
    see x+y+nl
```

13.4 Send Parameters

To send parameters to function, type the parameters inside () after the function name

Syntax:

```
funcname(parameters)
```

Example:

```
/* output
** 8
** 3000
*/
sum(3,5) sum(1000,2000)

func sum x,y see x+y+nl
```

13.5 Main Function

Using the Ring programming language, the Main Function is optional, when it's defined, it will be executed after the end of other statements.

if no other statements comes alone, the main function will be the first entry point

Example:

```
# this program will print the hello world message first then execute the main function

See "Hello World!" + nl

func main
    see "Message from the main function" + nl
```

13.6 Variables Scope

The Ring programming language uses [lexical scoping](#) to determine the scope of a variable.

Variables defined inside functions (including function parameters) are local variables. Variables defined outside functions (before any function) are global variables.

Inside any function we can access the variables defined inside this function beside the global variables.

Example:

```
# the program will print numbers from 10 to 1

x = 10                      # x is a global variable.

func main

    for t = 1 to 10          # t is a local variable
        mycounter()           # call function
    next

func mycounter

    see x + nl              # print the global variable value
    x--                       # decrement
```

Note: Using the main function before the for loop declare the t variable as a local variable, It's recommended to use the main functions instead of typing the instructions directly to set the scope of the new variables to local.

13.7 Return Value

The function can return a value using the Return command.

Syntax:

```
Return [Expression]
```

Tip: the Expression after the return command is optional and we can use the return command to end the function execution without returning any value.

Note: if the function doesn't return explicit value, it will return NULL (empty string = “”).

Example:

```
if novalue() = NULL
    See "the function doesn't return a value" + nl
ok

func novalue
```

13.8 Recursion

The Ring programming language support [Recursion](#) and the function can call itself using different parameters.

Example:

```
see fact(5)      # output = 120

func fact x if x = 0 return 1 else return x * fact(x-1) ok
```

CHAPTER
FOURTEEN

FUNCTIONS - SECOND STYLE

In this chapter we are going to learn about the next topics :-

- Define functions
- Call functions
- Declare parameters
- Send parameters
- Main Function
- Variables Scope
- Return Value
- Recursion

14.1 Define Functions

To define new function

Syntax:

```
def <function_name> [parameters]
    Block of statements
[end]
```

Note: the keyword ‘end’ is optional.

Example:

```
def hello
    put "Hello from function" + nl
end
```

14.2 Call Functions

To call function without parameters, we type the function name then ()

Tip: We can call the function before the function definition and the function code.

Example:

```
hello()

def hello
    put "Hello from function" + nl
end
```

Example:

```
first() second()

def first  put "message from the first function" + nl

def second put "message from the second function" + nl
```

14.3 Declare parameters

To declare the function parameters, after the function name type the list of parameters as a group of identifiers separated by comma.

Example:

```
def sum x,y
    put x+y+nl
end
```

14.4 Send Parameters

To send parameters to function, type the parameters inside () after the function name

Syntax:

```
funcname(parameters)
```

Example:

```
/* output
** 8
** 3000
*/
sum(3,5) sum(1000,2000)
```

(continues on next page)

(continued from previous page)

```
def sum x,y put x+y+nl
```

14.5 Main Function

Using the Ring programming language, the Main Function is optional, when it's defined, it will be executed after the end of other statements.

if no other statements comes alone, the main function will be the first entry point

Example:

```
# this program will print the hello world message first then execute the main function

put "Hello World!" + nl

def main
    put "Message from the main function" + nl
end
```

14.6 Variables Scope

The Ring programming language uses [lexical scoping](#) to determine the scope of a variable.

Variables defined inside functions (including function parameters) are local variables. Variables defined outside functions (before any function) are global variables.

Inside any function we can access the variables defined inside this function beside the global variables.

Example:

```
# the program will print numbers from 10 to 1

x = 10                      # x is a global variable.

def main
    for t = 1 to 10          # t is a local variable
        mycounter()          # call function
    end
end

def mycounter
    put x + nl             # print the global variable value
    x--                     # decrement
end
```

Note: Using the main function before the for loop declare the t variable as a local variable, It's recommended to use the main functions instead of typing the instructions directly to set the scope of the new variables to local.

14.7 Return Value

The function can return a value using the Return command.

Syntax:

```
Return [Expression]
```

Tip: the Expression after the return command is optional and we can use the return command to end the function execution without returning any value.

Note: if the function doesn't return explicit value, it will return NULL (empty string = “”).

Example:

```
if novalue() = NULL
    put "the function doesn't return a value" + nl
end

def novalue
```

14.8 Recursion

The Ring programming language support [Recursion](#) and the function can call itself using different parameters.

Example:

```
put fact(5)      # output = 120

def fact x if x = 0 return 1 else return x * fact(x-1) end
```

CHAPTER
FIFTEEN

FUNCTIONS - THIRD STYLE

In this chapter we are going to learn about the next topics :-

- Define functions
- Call functions
- Declare parameters
- Send parameters
- Main Function
- Variables Scope
- Return Value
- Recursion

15.1 Define Functions

To define new function

Syntax:

```
func <function_name> [parameters] ['{'  
    Block of statements  
[''}']
```

Example:

```
func hello {  
    print("Hello from function \n")  
}
```

15.2 Call Functions

To call function without parameters, we type the function name then ()

Tip: We can call the function before the function definition and the function code.

Example:

```
hello()

func hello {
    print("Hello from function \n")
}
```

Example:

```
first() second()

func first { print("message from the first function \n") }

func second { print("message from the second function \n") }
```

15.3 Declare parameters

To declare the function parameters, after the function name type the list of parameters as a group of identifiers separated by comma.

Example:

```
func sum(x,y) {
    print(x+y)
}
```

15.4 Send Parameters

To send parameters to function, type the parameters inside () after the function name

Syntax:

```
funcname(parameters)
```

Example:

```
/* output
** 8
** 3000
*/
sum(3,5) sum(1000,2000)
```

(continues on next page)

(continued from previous page)

```
func sum(x,y) { print(x+y) }
```

15.5 Main Function

Using the Ring programming language, the Main Function is optional, when it's defined, it will be executed after the end of other statements.

if no other statements comes alone, the main function will be the first entry point

Example:

```
# this program will print the hello world message first then execute the main function

print("Hello, World! \n")

func main {
    print("Message from the main function \n")
}
```

15.6 Variables Scope

The Ring programming language uses [lexical scoping](#) to determine the scope of a variable.

Variables defined inside functions (including function parameters) are local variables. Variables defined outside functions (before any function) are global variables.

Inside any function we can access the variables defined inside this function beside the global variables.

Example:

```
# the program will print numbers from 10 to 1

x = 10                      # x is a global variable.

func main {
    for t = 1 to 10 {        # t is a local variable
        mycounter()          # call function
    }
}

func mycounter {
    print("#[x]\n")          # print the global variable value
    x--                      # decrement
}
```

Note: Using the main function before the for loop declare the t variable as a local variable, It's recommended to use the main functions instead of typing the instructions directly to set the scope of the new variables to local.

15.7 Return Value

The function can return a value using the Return command.

Syntax:

```
Return [Expression]
```

Tip: the Expression after the return command is optional and we can use the return command to end the function execution without returning any value.

Note: if the function doesn't return explicit value, it will return NULL (empty string = “”).

Example:

```
if novalue() = NULL {
    print("the function doesn't return a value\n")
}

func novalue { }
```

15.8 Recursion

The Ring programming language support [Recursion](#) and the function can call itself using different parameters.

Example:

```
print( fact(5) )          # output = 120

func fact(x) { if x = 0 { return 1 else return x * fact(x-1) } }
```

CHAPTER
SIXTEEN

PROGRAM STRUCTURE

In this chapter we will learn about using many source code files in the same project.

16.1 Source Code File Sections

Each source code file may contains the next sections (in the same order).

Source Code File Sections
Load Files
Top-Level Statements and Global Variables
Functions
Packages and Classes

The application maybe one or more of files.

Note: In Ring, using braces during function, package, class, or method definitions doesn't carry any semantic meaning; the Ring Compiler simply ignores them. Similarly, employing special keywords (such as 'END') to conclude function, package, class, or method definitions also lacks semantic significance and is likewise ignored by the Ring Compiler

Tip: In Ring, the language syntax is designed so we don't need keywords like EndFunction, EndPackage, EndClass, etc. (They are optional)

Top-level statements are only supported before functions. In other words, we can't use the 'END' keyword to declare the end of a function and then follow it with top-level statements. The compiler will ignore the 'END' keyword, and any added statements will become part of the function code. If you want to mix functions and top-level statements, consider using anonymous functions.

16.2 Using Many Source Code Files

To include another source file in the project, just use the load command.

Syntax:

```
Load "filename.ring"
```

Note: The Load command is executed directly by the compiler in the parsing stage

Tip: if you don't know the file name until the runtime, or you need to use functions to get the file path, just use eval().

Example:

```
# File : Start.ring
Load "sub.ring"
sayhello("Mahmoud")
```

```
# File : sub.ring
func sayhello cName
    see "Hello " + cName + nl
```

16.3 Load Package

Using the ‘load’ command we can use many ring source files in the same project

But all of these files will share the same global scope

We have also the “Load Package” command

Using “Load Package” we can load a library (*.ring file) in new global scope

This is very useful to create libraries that avoid conflicts in global variables

Example:

File: loadpackage.ring

```
x = 100
? "Hello, World!"
load package "testloadpackage.ring"

? x
test()
```

File: testloadpackage.ring

```
? "Hello from testloadpackage.ring"
x = 1000
test()
func test
? x
```

Output:

```
Hello, World!
Hello from testloadpackage.ring
1000
100
1000
```

16.4 Load Again

Ring 1.12 comes with the Load Again command

Using this command we can load the Ring source file which contains constants more than one time.

This is useful when using Ring source files for translations through global constants.

Example:

The next function is part from a project which support Arabic and English languages

The files english.ring and arabic.ring contains constants for translation

One of these files is loaded in the start of the program

Loading the same file again using the (Load) command is not possible

Because the (Load) command load the same source file only for the first time and ignore next times.

So we have to use the (Load Again) command.

Where we can use these files again during the runtime as in the next code

```
func setLang nLanguage
    if C_ENV_DEFAULT_LANG = nLanguage
        return
    ok
    C_ENV_DEFAULT_LANG = nLanguage
    # Change the language
    switch nLanguage
        on C_TRANSLATION_ENGLISH
            load again "translation/english.ring"
        on C_TRANSLATION_ARABIC
            load again "translation/arabic.ring"
    off
```

CHAPTER
SEVENTEEN

LISTS

In this chapter we are going to learn how to deal with lists.

17.1 Create Lists

We can create new lists by defining the list items inside square brackets.

Example:

```
aList = [1,2,3,4,5]
```

Ring support trailing comma.

Example:

```
aList = ["one",
         "two",
         "three",
         ]
```

```
? aList
```

Also, we can create new lists using the : operator

Example:

```
aList = 1:5
aList2 = "a":"z"
```

Example:

```
aList = 5:1
aList2 = "z":"a"
```

Also we can create lists using the list() function

Syntax:

```
list = list(size)
```

To create 2D list

```
list = list(nRows,nCols)
```

Example (1)

```
aList = list(10)      # aList contains 10 items
```

Example (2)

```
aList = list(5,4)      # Create 2D List contains 5 rows and 4 columns
```

Note: the list index start from 1

17.2 Add Items

To add new items to the list, we can use the Add() function.

When adding a list to another list it will be added as one item.

If you want to change this and add each item in the added list alone pass the third parameter as True

Syntax:

```
Add(List,Item,[lManyItems])
```

Example:

```
aList = ["one","two"]
add(aList,"three")
see aList
```

Also we can do that using the + operator.

Syntax:

```
List + item
```

Example:

```
aList = 1:10      # create list contains numbers from 1 to 10
aList + 11       # add number 11 to the list
see aList        # print the list
```

Example:

```
aList = 1:3
add(aList,4:6)      # Add the list as one item
? len(aList)        # 4

aList = 1:3
add(aList,4:6,True)    # Add each item alone
? len(aList)        # 6
? aList
```

17.3 Get List Size

We can get the list size using the `len()` function

Syntax:

```
Len(List)
```

Example:

```
aList = 1:20 see len(aList) # print 20
```

17.4 Delete Item From List

To delete an item from the list, we can use the `del()` function

Syntax:

```
del(list, index)
```

Example:

```
aList = ["one", "two", "other", "three"]
Del(aList, 3)    # delete item number three
see aList        # print one two three
```

17.5 Get List Item

To get an item from the list, we uses the next syntax

```
List[Index]
```

Example:

```
aList = ["Cairo", "Riyadh"]
see "Egypt : " + aList[1] + nl +
      "KSA : " + aList[2] + nl
```

17.6 Set List Item

To set the value of an item inside the list, we can use the next syntax

```
List[Index] = Expression
```

Example:

```
aList = list(3) # create list contains three items
aList[1] = "one" aList[2] = "two" aList[3] = "three"
see aList
```

17.7 Search

To find an item inside the list we can use the `find()` function

Syntax:

```
Find(List,ItemValue) ---> Item Index
Find(List,ItemValue,nColumn) ---> Search in nColumn, returns the Item Index
Find(List,ItemValue,nColumn,cAttribute) ---> Item Index
```

Example:

```
aList = ["one","two","three","four","five"]
see find(aList,"three")      # print 3
```

Example:

```
mylist = [[{"one":1},
          {"two":2},
          {"three":3}]

see find(mylist,"two",1) + nl      # print 2
see find(mylist,2,2) + nl          # print 2
```

Also we can use the `binarysearch()` function to search in sorted list.

Syntax:

```
BinarySearch(List,ItemValue) ---> Item Index
BinarySearch(List,ItemValue,nColumn) ---> Search in nColumn, returns the Item Index
```

Example:

```
aList = ["one","two","three","four","five"]
aList = sort(aList)
see binarysearch(aList,"three")
```

Output:

```
five
four
one
three
two
4
```

17.8 Sort

We can sort the list using the sort() function.

Syntax:

```
Sort(List) ---> Sorted List
Sort(List,nColumn) ---> Sorted List based on nColumn
Sort(List,nColumn,cAttribute) ---> Sorted List based on Object Attribute
```

Example:

```
aList = [10,12,3,5,31,15]
aList = sort(aList) see aList # print 3 5 10 12 15 31
```

We can sort list of strings

Example:

```
mylist = ["mahmoud", "samir", "ahmed", "ibrahim", "mohammed"]
see mylist          # print list before sorting
mylist = sort(mylist)      # sort list
see "list after sort"+nl
see mylist          # print ahmed ibrahim mahmoud mohammed samir
```

We can sort a list based on a specific column.

Example:

```
aList = [ ["mahmoud",15000] ,
          ["ahmed", 14000] ,
          ["samir", 16000] ,
          ["mohammed", 12000] ,
          ["ibrahim",11000] ] 

aList2 = sort(aList,1)
see aList2
```

Output:

```
ahmed
14000
ibrahim
11000
mahmoud
15000
mohammed
12000
samir
16000
```

17.9 Reverse

We can reverse a list using the reverse() function.

Note: This functions support strings too

Syntax:

```
Reverse(List) ---> Reversed List
```

Example:

```
aList = [10,20,30,40,50]
aList = reverse(aList)
see aList      # print 50 40 30 20 10
```

17.10 Insert Items

To insert an item in the list we can use the insert() function.

Syntax:

```
Insert(List,Index,Item)
```

The inserted item will be AFTER the Index

Example:

```
aList = ["A","B","D","E"]
insert(aList,2,"C")    # Inserts AFTER Index 2, "C" into Position 3
see aList              # print A B C D E
```

17.11 Nested Lists

The list may contain other lists

Example:

```
aList = [ 1 , [10,20,30] , 5 , [100,1000,5000] ]
aList2 = [
"one","two",
[3,4],
[20,30], ["three",
        "four",
        "five",[100,200,300]
    ]
]

see aList[2]          # print 10 20 30
see aList[4][3] + nl  # print 5000
```

(continues on next page)

(continued from previous page)

```
see aList2[5][2] + nl    # print four
see aList2[5][4][3]     # print 300
```

17.12 Copy Lists

We can copy lists (including nested lists) using the Assignment operator.

Example:

```
aList = [
"one", "two",
[3,4],
[20,30], ["three",
            "four",
            "five", [100,200,300]
        ]
]

aList2 = aList      # Copy aList to aList2
aList2[5] = "other" # modify item number five
see aList2[5] + nl # print other
see aList[5]       # print three four five 100 200 300
```

17.13 First-class lists

Lists are [first-class citizens](#) where we can store lists in variables, pass lists to functions, and return lists from functions.

Example:

```
aList = duplicate([1,2,3,4,5])
see aList[10] + nl          # print 5

see mylist()                # print 10 20 30 40 50

func duplicate list
    nMax = len(list)
    for x = 1 to nMax
        list + list[x]
    next
    return list

func mylist return [10,20,30,40,50]
```

17.14 Using Lists during definition

We can use the list and the list items while we are defining the list for the first time.

Example:

```
aList = [ [1,2,3,4,5] , aList[1] , aList[1] ]
see aList      # print 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5
```

Example:

```
x = [ 1, 2, x ]
? x          # print 1 2 1 2
? len(x)     # print 3
? x[1]        # print 1
? x[2]        # print 2
? x[3]        # print 1 2
```

Output:

```
1
2
1
2

3
1
2
1
2
```

17.15 Passing Lists to Functions

Lists are passed to functions by reference, This means that the called function will work on the same list and can modify it.

Example:

```
func main
    aList = [1,2,3,4,5]      # create list, local in function main
    myfunc(aList)           # call function, pass list by reference
    see aList               # print 1 2 3 4 5 6 7 8 9 10

func myfunc list
    list + [6,7,8,9,10]
```

17.16 Access List Items by String Index

Instead of using numbers to determine the item index when we get item value or set item value, We can access items using string index if the item is a list contains two items and the first item is a string.

Example:

```
aList = [ ["one",1] , ["two",2] , ["three",3] ]
see aList["one"] + nl +
      aList["two"] + nl +
      aList["three"]      # print 1 2 3
```

This type of lists can be defined in a better syntax using the : and = operators.

Example:

```
aList = [ :one = 1 , :two = 2 , :three = 3 ]
see aList["one"] + nl +
      aList["two"] + nl +
      aList["three"] + nl # print 1 2 3
see aList[1]           # print one 1
```

Tip: using : before identifier (one word) means literal

Note: using = inside list definition create a list of two items where the first item is the left side and the second item is the right side.

We can add new items to the list using the string index

Example:

```
aList = []
aList["Egypt"] = "Cairo"
aList["KSA"] = "Riyadh"
see aList["Egypt"] + nl +      # print Cairo
      aList["KSA"] + nl       # print Riyadh
```

17.17 Passing Parameters or Arguments Using List

This type of lists is very good for passing parameters to functions Where the order of parameters will not be important (we can change the order).

Also some parameters maybe optional.

Example:

```
myconnect ( [ :server = "myserver.com" , :port = 80 ,
              :username = "mahmoud" , :password = "password" ] )
func myconnect mypara
```

(continues on next page)

(continued from previous page)

```
# print connection details
see "User Name : " + mypara[:username] + nl +
    "Password : " + mypara[:password] + nl +
    "Server   : " + mypara[:server] + nl +
    "Port     : " + mypara[:port]
```

17.18 Passing Parameters or Arguments Using List Array

Passing Arguments or Parameters to a Function in an array format

Example:

```
myList = [5,7,3,9]      ### list with args or parms in an array
result = sum(myList)
See "Sum result: "+ result +n

func sum(aList)
acc = 0
sizeList = len(aList)

for i = 1 to sizeList
    See aList[i] +nl
    acc = acc + aList[i]
next
return acc
```

17.19 Return Parameters as List or Hash Table

Return Parameters from a Function in an Array or Hash Format

Example:

```
sudoku = [  [2,9,0],
            [0,0,1],
            [0,0,0] ]

aOutput = myFunctionArray(sudoku)
        See "Return Array: T/F: "+ aOutput[1] +" Row: "+ aOutput[2] +" Col: "+_
        ↵aOutput[3] +nl

aOutput = myFunctionHash(sudoku)
        See "Return Hash.: T/F: "+ aOutput[:lValue] +" Row: "+ aOutput[:nRow] +" Col: "+_
        ↵aOutput[:nCol] +nl

#####
### isSolvedSoduku - Return ARRAY

Func myFunctionArray(sudoku)
    for Row = 1 to 9
```

(continues on next page)

(continued from previous page)

```

for Col = 1 to 9
    if sudoku[Row][Col] = 0

        //-----
        // Return Array with 3 fields
        return [False, Row, Col]
    ok
next
next
return [True, Row, Col]

###-----
### isSolvedSudoku - Return HASH

Func myFunctionHash(sudoku)
    for Row = 1 to 3
        for Col = 1 to 3
            if sudoku[Row][Col] = 0

                //-----
                // Return Hash Table with 3 fields
                return [ :lValue = False,
                          :nRow   = Row,
                          :nCol   = Col
                ]
            ok
        next
    next

return [ :lValue = False, :nRow = Row, :nCol = Col ]

```

17.20 Creating a Multi-Dimensional Array using List

A Multi-Dimensional Array of any size can be built using recursion in a Function

Example:

```

###-----
### Create Array -- Dimensions Any Size: 3D, 4D, 5D etc

dimList = [4,3,4]
bList   = createDimList(dimList)

###-----
### Populate the arrays using a counter 1 , 4x4x4 = 256 , 2x3x4x5x6 = 720

Counter = 1

for Col=1 to dimList[1]

```

(continues on next page)

(continued from previous page)

```

for Row=1 to dimList[2]
    for Dep=1 to dimList[3]
        blist[Col][Row][Dep] = Counter
        Counter++
    next
next
next

###-----
### Print the array elements in block format

for Col=1 to dimList[1]
    for Row=1 to dimList[2]
        for Dep=1 to dimList[3]
            See bList[Col][Row][Dep] See " "
        next
        See nl
    next
    See nl
next

###-----
### FUNCTIONS

###-----
### Recursive Create a Dimension Array
### Call by passing an array of dimensions: dimList = [2,3,4,5]
### Drop the first entry every iteration call, making newParms
###
### Example:
###     dimList = [4,2,3,2]           <<< Number and size of dimensions in array_
    →format
###     bList   = createDimList(dimList)  <<< Call using the array as input

func createDimList(dimArray)

    sizeList = len(dimArray)

    newParms = []
    for i = 2 to sizeList
        Add(newParms, dimArray[i])
    next

    alist = list(dimArray[1])

    if sizeList = 1
        return alist
    ok

    for t in alist
        t = createDimList(newParms)
    next

```

(continues on next page)

(continued from previous page)

```
return alist
```

17.21 Swap Lists and Items

We can swap lists/items using the Swap() function.

Syntax:

```
swap(aList1,aList2)
swap(aList,nItem1,nItem2)
```

Example:

```
aList = [:one,:two,:four,:three]
see aList
see copy("*,50) + nl
swap(aList,3,4)
see aList
```

Output

```
one
two
four
three
*****
one
two
three
four
```

Example:

```
aList1 = 4:6
aList2 = 1:3
swap(aList1,aList2)
? aList1                      # 1 2 3
? aList2                      # 4 5 6

aList = [ 4:6 , 1:3 ]
? aList                        # 4 5 6 1 2 3
swap(aList[1], aList[2])
? aList                        # 1 2 3 4 5 6

aList = [ 4:6 , 1:3 ]
? aList                        # 4 5 6 1 2 3
swap(aList,1,2)
? aList                        # 1 2 3 4 5 6
```

CHAPTER
EIGHTEEN

STRINGS

In this chapter we are going to learn about strings creation and manipulation.

18.1 String Literals

Syntax:

```
cStr = "This is a string"  
cStr2 = 'Another string'  
cStr3 = :JustAnotherString  
cStr4 = `Yet "another" 'string' !`
```

18.2 Get String Length

We can get the string length (letters count inside a string) using the `len()` function

Syntax:

```
len(string) ---> string length
```

Example:

```
cStr = "How are you?"  
see cStr + nl  
see "String size : " + len(cStr) + nl
```

18.3 Convert Letters Case

Syntax:

```
lower(string) ---> convert string letters to lower case  
upper(string) ---> convert string letters to UPPER case
```

Example:

```
cStr = "Welcome To The Ring Programming Language"  
see cStr + nl + upper(cStr) + nl + lower(cStr)
```

18.4 Access String Letters

We can access a letter inside a string by the letter index

Syntax:

```
string[index] ---> get string letter
string[index] = letter # set string letter
```

Example:

```
# print user name letter by letter (each letter in new line)

See "Hello, Enter your name : " give cName
for x = 1 to len(cName)
    see nl + cName[x]
next
```

We can use for in to get string letters.

Example:

```
# print user name letter by letter (each letter in new line)

See "Hello, Enter your name : " give cName
for x in cName
    see nl + x
next
```

We can modify the string letters

Example:

```
# convert the first letter to UPPER case

See "Enter your name : " give cName
cName[1] = upper(cName[1])
see "Hello " + cName
```

18.5 Left() Function

We can get a specified number of characters from a string using the Left() function.

The starting position is 1.

Syntax:

```
Left(string,count)
```

Example:

```
see left("Hello World!",5) # print Hello
```

18.6 Right() Function

We can get a specified number of characters from a string using the Right() function.

The starting position is the last character on the right.

Syntax:

```
Right(string, count)
```

Example:

```
see Right("Hello World!", 6) # print World!
```

18.7 Trim() Function

We can remove all leading and trailing spaces from a string using the Trim() function.

Syntax:

```
trim(string)
```

Example:

```
cMsg = "      Welcome      "
see trim(cMsg)           # print Welcome
```

18.8 Copy() Function

We can duplicate a string more than one time using the copy() function.

Syntax:

```
copy(string, nCount) ---> string replicated nCount times
```

Example

```
see copy("****hello***", 3) # print ****hello*****hello*****hello***
```

18.9 Lines() Function

We can count the number of lines inside a string using the Lines() function.

Syntax:

```
lines(string) ---> Number of lines inside the string
```

Example:

```
cStr = "Hello
How are you?
are you fine?"
see lines(cStr)      # print 3
```

18.10 Substr() Function

We can work on sub strings inside a string using the substr() function. Using Substr() we can

- Find substring
- Get substring from position to end
- Get Number of characters from position
- Transform Substring To Another Substring

18.11 Find substring

Syntax:

```
substr(string,substring) ---> the starting position of substring in string
```

Example:

```
cStr = "Welcome to the Ring programming language"
see substr(cStr,"Ring")      # print 16
```

18.12 Get substring from position to end

Syntax:

```
substr(string,position) ---> Get substring starting from position to end
```

Example:

```
cStr = "Welcome to the Ring programming language"
nPos = substr(cStr,"Ring")      # nPos = 16
see substr(cStr,nPos)          # print Ring programming language
```

18.13 Get Number of Characters From Position

Syntax:

```
substr(string,position,count) ---> Get characters starting from position
```

Example:

```
cStr = "Welcome to the Ring programming language"
nPos = substr(cStr,"Ring")      # nPos = 16
see substr(cStr,nPos,4)        # print Ring
```

18.14 Transform Substring To Another Substring

Syntax:

```
substr(string,substring,newsubstring) ---> Transformed string (Match case)
substr(string,substring,newsubstring,1) ---> Transformed string (Ignore case)
```

Example:

```
cStr = "Welcome to the New programming language"
see substr(cStr,"New","Ring") + nl # print Welcome to the Ring programming language
see substr(cStr,"new","Ring",1)+ nl # print Welcome to the Ring programming language
```

18.15 strcmp() Function

In Ring we can use the = operator to compare between strings

Also, we can compare between two strings using the strcmp() function.

Syntax:

```
strcmp(cString1,cString2) ---> value = 0 if cString1 = cString2
                                value < 0 if cString1 < cString2
                                value > 0 if cString1 > cString2
```

Example:

```
see strcmp("hello","hello") + nl +
      strcmp("abc","bcd") + nl +
      strcmp("bcd","abc") + nl
```

Output:

```
0
-1
1
```

18.16 Reverse() Function

Using the Reverse() function we can reverse the string characters

Note: This functions support lists too

Syntax:

```
Reverse(cString) ---> cReversedString
```

```
cStr = "Welcome to Ring"
? reverse(cStr)           # gniR ot emocleW
```

18.17 str2list() and list2str() Functions

We can convert string lines to list items using the str2list() function. Also we can convert the list to a string using list2str() function.

Syntax:

<pre>str2list(cString)</pre>	---> list contains the string lines
<pre>list2str(aList)</pre>	---> string contains the list items
<pre>list2str(aList, [nStart], [nEnd])</pre>	---> string contains the list items from nStart to nEnd

Example:

```
/* output:
** Items : 4
** Item : Hello
** Item : How are you ?
** Item : are you fine ?
** Item : ok
** list2Str result = Hello
** How are you ?
** are you fine ?
** ok
** Done
*/
mystr = "Hello
How are you ?
are you fine ?
ok"

mylist = str2list(mystr)
see "Items : " + len(mylist) + nl

for x in mylist
    see "Item : " + x + nl
next
```

(continues on next page)

(continued from previous page)

```

newstr = list2str(mylist)
see "list2Str result = " + newstr

if mystr = newstr
    see nl + "Done"
else
    see nl + "Error!"
ok

```

Example:

```

aList = 1:10
cStr = list2str(aList,6,10)
? cStr                      # 6 7 8 9 10

```

18.18 Merge binary characters

From Ring 1.0 we can create binary strings and do operations on these strings.

Starting from Ring 1.8, we can get individual characters from these strings and merge them together using the '+' operator.

Example:

```

cStr = "Welcome"
? cstr[1] + cstr[2] + cStr[5]
v = cstr[1] + cstr[2] + cStr[5]
? v
? len(v)
c1 = cStr[1]
? c1
aList = [1,2,3]
cStr = ""
for item in aList
    cStr += int2bytes(item)
next
? "All String"
? len(cStr)
? "First Part"
n1 = cStr[1] + cStr[2] + cStr[3] + cStr[4]
? len(n1)
? "Second Part"
n2 = cStr[5] + cStr[6] + cStr[7] + cStr[8]
? len(n2)
? "Third Part"
n3 = cStr[9] + cStr[10] + cStr[11] + cStr[12]
? len(n3)
? "All String"
cString = cStr[1] + cStr[2] + cStr[3] + cStr[4] +
          cStr[5] + cStr[6] + cStr[7] + cStr[8] +

```

(continues on next page)

(continued from previous page)

```
cStr[9] + cStr[10] + cStr[11] + cStr[12]
? len(cString)
? ascii(cStr[1])
? len(cStr[2])
```

Output:

```
Weo
Weo
3
W
All String
12
First Part
4
Second Part
4      }
Third Part
4
All String
12
1
1
```

CHAPTER
NINETEEN

DATE AND TIME

In this chapter we are going to learn about the date and time functions.

19.1 Clock() Function

Syntax:

```
Clock() ---> The number of clock ticks from program start
```

Example:

```
See "Calculate performance" + nl
t1 = clock()
for x = 1 to 1000000 next
see clock() - t1
```

19.2 ClocksPerSecond() Function

Return how many clocks in one second

Syntax:

```
clockspersecond() ---> Number of clocks in one second
```

Example:

```
# Wait 1 second
t = clock()
while clock() - t <= clockspersecond() end
```

19.3 Time() Function

We can get the system time using the Time() function.

Example:

```
See "Time : " + time()
```

19.4 Date() Function

We can get the date using the Date() function.

Syntax:

```
Date() ---> String represent the date "dd/mm/yyyy"
```

Example:

```
See "Date : " + date() # Date : 24/05/2015
```

19.5 TimeList() Function

We can print the date and the time information using the TimeList() function.

Syntax:

```
TimeList() ---> List contains the time and date information.
```

The next table presents the list items

index	value
1	abbreviated weekday name
2	full weekday name
3	abbreviated month name
4	full month name
5	Date & Time
6	Day of the month
7	Hour (24)
8	Hour (12)
9	Day of the year
10	Month of the year
11	Minutes after hour
12	AM or PM
13	Seconds after the hour
14	Week of the year (sun-sat)
15	day of the week
16	date
17	time
18	year of the century
19	year
20	time zone
21	percent sign

Example:

```
/* Output:
** Sun          abbreviated weekday name
** Sunday       full weekday name
** May          abbreviated month name
** May          full month name
** 05/24/15 09:58:38 Date & Time
** 24           Day of the month
** 09           Hour (24)
** 09           Hour (12)
** 144          Day of the year
** 05           Month of the year
** 58           Minutes after hour
** AM           AM or PM
** 38           Seconds after the hour
** 21           Week of the year (sun-sat)
** 0             day of the week
** 05/24/15      date
** 09:58:38      time
** 15           year of the century
** 2015          year
** Arab Standard Time time zone
** %             percent sign
*/
```

See [TimeList\(\)](#)

Example:

```
See "Day Name : " + TimeList() [2]      # Sunday
```

Example:

```
See "Month Name : " + TimeList() [4]      # May
```

19.6 AddDays() Function

Syntax:

```
AddDays(cDate,nDays) ---> Date from cDate and after nDays
```

Example:

```
cDate = date()
see cDate + nl                      # 24/05/2015
cDate = adddays(cDate,10)
see cDate + nl                      # 03/06/2015
```

19.7 DiffDays() Function

Syntax:

```
DiffDays(cDate1,cDate2) ---> number of days (Date1 - Date2)
```

Example:

```
cDate1 = date()
see cDate1 + nl                      # 24/05/2015
cDate2 = adddays(cDate1,10)
see cDate2 + nl                      # 03/06/2015
see "DiffDays = " + diffdays(cDate1,cDate2) + nl    # -10
see "DiffDays = " + diffdays(cDate2,cDate1) + nl    # 10
```

19.8 EpochTime() Function

Syntax:

```
EpochTime( cDate, cTime ) ---> Epoch Seconds
```

Example:

```
#####
# EpochTime()
# Example --- EpochSec = EpochTime( Date(), Time() )
# Call Format: EpochSec = EpochTime( "15/07/2016", "10:15:30" )
#           EpochSec = 1468577730
```

(continues on next page)

(continued from previous page)

```
#-----

Func EpochTime(Date, Time)

arrayDate = split(Date, "/")
arrayTime = split(Time, ":")

Year = arrayDate[3] ; Month = arrayDate[2] ; Day    = arrayDate[1]
Hour = arrayTime[1] ; Minute = arrayTime[2] ; Second = arrayTime[3]

cDate1    = Day +"/"+ Month +"/"+ Year
cDate2    = "01/01/" + Year
DayOfYear = DiffDays( cDate1, cDate2)

### Formula
tm_sec  = Second    * 1
tm_min  = Minute    * 60
tm_hour = Hour      * 3600
tm_yday = DayOfYear * 86400
tm_year = Year      - 1900

tm_year1 = ( tm_year - 70)          * 31536000
tm_year2 = ( floor(( tm_year - 69) / 4) ) * 86400
tm_year3 = ( floor(( tm_year - 1) / 100) ) * 86400
tm_year4 = ( floor(( tm_year + 299) / 400) ) * 86400

### Result
EpochSec = tm_sec + tm_min + tm_hour + tm_yday +
           tm_year1 + tm_year2 - tm_year3 + tm_year4

return EpochSec
```

CHECK DATA TYPE AND CONVERSION

In this chapter we are going to learn about the functions that can be used for

- Checking Data Type
- Checking Character
- Conversion

20.1 Check Data Type

The next functions can be used to check the data type

- isstring()
- isnumber()
- islist()
- type()
- isnull()

20.2 IsString() Function

Using the IsString() function we can know if the value is a string or not

Syntax:

```
IsString(value) ---> 1 if the value is a string or 0 if not
```

Example:

```
see isstring(5) + nl +      # print 0
     isstring("hello") + nl    # print 1
```

20.3 IsNumber() Function

Using the IsNumber() function we can know if the value is a number or not

Syntax:

```
IsNumber(value) ---> 1 if the value is a number or 0 if not
```

Example:

```
see isnumber(5) + nl +      # print 1
    isnumber("hello") + nl + # print 0
```

20.4 IsList() Function

Using the IsList() function we can know if the value is a list or not

Syntax:

```
IsList(value) ---> 1 if the value is a list or 0 if not
```

Example:

```
see islist(5) + nl +      # print 0
    islist("hello") + nl + # print 0
    islist([1,3,5])       # print 1
```

20.5 Type() Function

We can know the type of a value using the Type() Function.

Syntax:

```
Type(value) ---> The Type as String
```

Example:

```
see Type(5) + nl +      # print NUMBER
Type("hello") + nl +    # print STRING
Type([1,3,5])           # print LIST
```

20.6 IsNULL() Function

We can check the value to know if it's null or not using the IsNULL() function

Syntax:

```
IsNULL(value) ---> 1 if the value is NULL or 0 if not
```

Example:

```
see isnull(5) + nl +      # print 0
isnull("hello") + nl +    # print 0
isnull([1,3,5]) + nl +   # print 0
isnull("") + nl +        # print 1
isnull("NULL")           # print 1
```

20.7 Check Character

The next functions can be used to check character

- isalnum()
- isalpha()
- iscntrl()
- isdigit()
- isgraph()
- islower()
- isprint()
- ispunct()
- isspace()
- isupper()
- isxdigit()

20.8 IsAlNum() Function

We can test a character or a string using the IsAlNum() Function

Syntax:

```
IsAlNum(value) ----> 1 if the value is digit/letter or 0 if not
```

Example:

```
see isalnum("Hello") + nl +      # print 1
      isalnum("123456") + nl +    # print 1
      isalnum("ABCabc123") + nl + # print 1
      isalnum("How are you")     # print 0 because of spaces
```

20.9 IsAlpha() Function

We can test a character or a string using the IsAlpha() Function

Syntax:

```
IsAlpha(value) ---> 1 if the value is a letter or 0 if not
```

Example:

```
see isalpha("Hello") + nl +      # print 1
    isalpha("123456") + nl +      # print 0
    isalpha("ABCabc123") + nl +   # print 0
    isalpha("How are you")       # print 0
```

20.10 IsCntrl() Function

We can test a character or a string using the IsCntrl() Function

Syntax:

```
IsCntrl(value) ---> 1 if the value is a control character (no printing position)
                      or 0 if not
```

Example:

```
See iscntrl("hello") + nl +      # print 0
      iscntrl(nl)                 # print 1
```

20.11 IsDigit() Function

We can test a character or a string using the IsDigit() Function

Syntax:

```
IsDigit(value) ---> 1 if the value is a digit or 0 if not
```

Example:

```
see isdigit("0123456789") + nl +      # print 1
      isdigit("0123a")                 # print 0
```

20.12 IsGraph() Function

We can test a character or a string using the IsGraph() Function

Syntax:

```
IsGraph(value) ---> 1 if the value can be printed (Except space) or 0 if not
```

Example:

```
see isgraph("abcdef") + nl +      # print 1
    isgraph("abc def")           # print 0
```

20.13 IsLower() Function

We can test a character or a string using the IsLower() Function

Syntax:

```
IsLower(value) ---> 1 if the value is lowercase letter or 0 if not
```

Example:

```
see islower("abcDEF") + nl +      # print 0
    islower("ghi")               # print 1
```

20.14 IsPrint() Function

We can test a character or a string using the IsPrint() Function

Syntax:

```
IsPrint(value) ---> 1 if the value occupies a printing position or 0 if not
```

Example:

```
see isprint("Hello") + nl +          # print 1
    isprint("Nice to see you") + nl +  # print 1
    isprint(nl)                      # print 0
```

20.15 IsPunct() Function

We can test a character or a string using the IsPunct() Function

Syntax:

```
IsPunct(value) ---> 1 if the value is a punctuation character or 0 if not
```

Example:

```
see ispunct("hello") + nl +      # print 0
      ispunct(",")                # print 1
```

20.16 IsSpace() Function

We can test a character or a string using the IsSpace() Function

Syntax:

```
IsSpace(value) ---> 1 if the value is a white-space or 0 if not
```

Example:

```
see isspace(" ") + nl +      # print 1
      isspace("test")            # print 0
```

20.17 IsUpper() Function

We can test a character or a string using the IsUpper() Function

Syntax:

```
IsUpper(value) ---> 1 if the value is an uppercase alphabetic letter or 0 if not
```

Example:

```
see isupper("welcome") + nl +      # print 0
      isupper("WELCOME")          # print 1
```

20.18 IsXdigit() Function

We can test a character or a string using the IsXdigit() Function

Syntax:

```
IsXdigit(value) ---> 1 if the value is a hexadecimal digit character or 0 if not
```

Example:

```
see isxdigit("0123456789abcdef") + nl +  # print 1
      isxdigit("123z")                  # print 0
```

20.19 Conversion

The next functions can be used for conversion

- number()
- string()
- ascii()
- char()
- hex()
- dec()
- str2hex()
- hex2str()

20.20 Number() Function

We can convert strings to numbers using the Number() function or the + operator.

Syntax:

```
Number(string) ---> Number
0 + string ---> Number
```

Example:

```
see number("5") + 5 + nl      # print 10
see 0 + "10" + 2             # print 12
```

20.21 String() Function

We can convert numbers to strings using the String() function or the + operator.

Syntax:

```
String(number) ---> String
"" + number ---> String
```

Example:

```
see string(5) + 5 + nl      # print 55
see "" + 10 + 2             # print 102
```

20.22 Ascii() Function

We can get the ASCII code for a letter using the Ascii() function

Syntax:

```
Ascii(character) ---> ASCII Code
```

Example:

```
See ascii("m") + nl +      # print 109
      ascii("M")           # print 77
```

20.23 Char() Function

We can convert the ASCII code to character using the Char() function.

Syntax:

```
Char(ASCII Code) ---> character
```

Example:

```
See char(109) + nl +      # print m
      char(77)           # print M
```

20.24 Hex() Function

We can convert decimal to hexadecimal using the Hex() function.

Syntax:

```
Hex(decimal) ---> hexadecimal
```

Example:

```
See hex(10) + nl +      # print a
      hex(200)           # print c8
```

20.25 Dec() Function

We can convert hexadecimal to decimal using the Dec() function

Syntax:

```
Dec(hexadecimal) ---> decimal
```

Example:

```
See dec("a") + n1 +      # print 10
     dec("c8")          # print 200
```

20.26 Str2hex() Function

We can convert string characters to hexadecimal characters using the Str2hex() function.

Syntax:

```
Str2hex(string) ---> hexadecimal string
```

Example:

```
See str2hex("hello")      # print 68656c6c6f
```

20.27 Hex2str() Function

We can convert hexadecimal characters to string using the Hex2str() function

Syntax:

```
Hex2Str(Hexadecimal string) ---> string
```

Example:

```
See hex2str("68656c6c6f")      # print hello
```

CHAPTER
TWENTYONE

MATHEMATICAL FUNCTIONS

In this chapter we are going to learn about the mathematical functions

21.1 List of functions

The Ring programming language comes with the next mathematical functions

Function	Description
sin(x)	Returns the sine of an angle of x radians
cos(x)	Returns the cosine of an angle of x radians
tan(x)	Returns the tangent of an angle of x radians
asin(x)	Returns the principal value of the arc sine of x, expressed in radians
acos(x)	Returns the principal value of the arc cosine of x, expressed in radians
atan(x)	Returns the principal value of the arc tangent of x, expressed in radians
atan2(y,x)	Returns the principal arc tangent of y/x, in the interval [-pi,+pi] radians
sinh(x)	Returns the hyperbolic sine of x radians
cosh(x)	Returns the hyperbolic cosine of x radians
tanh(x)	Returns the hyperbolic tangent of x radians
exp(x)	Returns the value of e raised to the xth power
log(x)	Returns the natural logarithm of x (the base of e)
log(x,b)	Returns the logarithm of x to the base of b
log10(x)	Returns the common logarithm (base-10 logarithm) of x
ceil(x)	Returns the smallest integer value greater than or equal to x
floor(x)	Returns the largest integer value less than or equal to x
fabs(x)	Returns the absolute value of x.
pow(x,y)	Returns x raised to the power of y
sqrt(x)	Returns the square root of x
random(x)	Returns a random number in the range [0,x] or [0,-x]
srandom(x)	Initialize random number generator
unsigned(n,n,c)	Perform operation using unsigned numbers
decimals(n)	Determine the decimals digits after the point in float/double numbers

21.2 Example

```

See "Mathematical Functions" + nl
See "Sin(0) = " + sin(0) + nl
See "Sin(90) radians = " + sin(90) + nl
See "Sin(90) degree = " + sin(90*3.14/180) + nl

See "Cos(0) = " + cos(0) + nl
See "Cos(90) radians = " + cos(90) + nl
See "Cos(90) degree = " + cos(90*3.14/180) + nl

See "Tan(0) = " + tan(0) + nl
See "Tan(90) radians = " + tan(90) + nl
See "Tan(90) degree = " + tan(90*3.14/180) + nl

See "asin(0) = " + asin(0) + nl
See "acos(0) = " + acos(0) + nl
See "atan(0) = " + atan(0) + nl
See "atan2(1,1) = " + atan2(1,1) + nl

See "sinh(0) = " + sinh(0) + nl
See "sinh(1) = " + sinh(1) + nl
See "cosh(0) = " + cosh(0) + nl
See "cosh(1) = " + cosh(1) + nl
See "tanh(0) = " + tanh(0) + nl
See "tanh(1) = " + tanh(1) + nl

See "exp(0) = " + exp(0) + nl
See "exp(1) = " + exp(1) + nl
See "log(1) = " + log(1) + nl
See "log(2) = " + log(2) + nl
See "log10(1) = " + log10(1) + nl
See "log10(2) = " + log10(2) + nl
See "log10(10) = " + log10(10) + nl

See "Ceil(1.12) = " + Ceil(1.12) + nl
See "Ceil(1.72) = " + Ceil(1.72) + nl

See "Floor(1.12) = " + floor(1.12) + nl
See "Floor(1.72) = " + floor(1.72) + nl

See "fabs(1.12) = " + fabs(1.12) + nl
See "fabs(1.72) = " + fabs(1.72) + nl

See "pow(2,3) = " + pow(2,3) + nl

see "sqrt(16) = " + sqrt(16) + nl

```

Program Output:

```

Mathematical Functions
Sin(0) = 0
Sin(90) radians = 0.89

```

(continues on next page)

(continued from previous page)

```

Sin(90) degree = 1.00
Cos(0) = 1
Cos(90) radians = -0.45
Cos(90) degree = 0.00
Tan(0) = 0
Tan(90) radians = -2.00
Tan(90) degree = 1255.77
asin(0) = 0
acos(0) = 1.57
atan(0) = 0
atan2(1,1) = 0.79
sinh(0) = 0
sinh(1) = 1.18
cosh(0) = 1
cosh(1) = 1.54
tanh(0) = 0
tanh(1) = 0.76
exp(0) = 1
exp(1) = 2.72
log(1) = 0
log(2) = 0.69
log10(1) = 0
log10(2) = 0.30
log10(10) = 1
Ceil(1.12) = 2
Ceil(1.72) = 2
Floor(1.12) = 1
Floor(1.72) = 1
fabs(1.12) = 1.12
fabs(1.72) = 1.72
pow(2,3) = 8
sqrt(16) = 4

```

21.3 Random() Function

The Random() function generate a random number and we can set the maximum value (optional).

Syntax:

```
Random(x) ---> Random number in the range [0,x]
```

Example:

```

for x = 1 to 20
    see "Random number : " + random() + nl +
          "Random number Max (100) : " + random(100) + nl
next

```

Program Output:

```

Random number : 31881
Random number Max (100) : 80
Random number : 5573
Random number Max (100) : 63
Random number : 2231
Random number Max (100) : 43
Random number : 12946
Random number Max (100) : 39
Random number : 22934
Random number Max (100) : 48
Random number : 4690
Random number Max (100) : 52
Random number : 13196
Random number Max (100) : 65
Random number : 30390
Random number Max (100) : 87
Random number : 4327
Random number Max (100) : 77
Random number : 12456
Random number Max (100) : 17
Random number : 28438
Random number Max (100) : 13
Random number : 30503
Random number Max (100) : 6
Random number : 31769
Random number Max (100) : 94
Random number : 8274
Random number Max (100) : 65
Random number : 14390
Random number Max (100) : 90
Random number : 28866
Random number Max (100) : 12
Random number : 24558
Random number Max (100) : 70
Random number : 29981
Random number Max (100) : 77
Random number : 12847
Random number Max (100) : 63
Random number : 6632
Random number Max (100) : 60

```

21.4 SRandom() Function

The SRandom() function initialize random number generator.

Syntax:

```
SRandom(x)
```

21.5 Unsigned() Function

We can use unsigned numbers using the Unsigned() function.

Syntax:

```
Unsigned(nNum1, nNum2, cOperator) --> result of cOperator operation on nNum1, nNum2
```

Example:

```
see oat_hash("hello") + nl

# Jenkins hash function - https://en.wikipedia.org/wiki/Jenkins_hash_function
func oat_hash cKey
    h = 0
    for x in cKey
        h = Unsigned(h, ascii(x), "+")
        h = Unsigned(h, Unsigned(h, 10, "<<"), "+")
        r = Unsigned(h, 6, ">>")
        h = Unsigned(h, r, "^")
    next
    h = Unsigned(h, Unsigned(h, 3, "<<"), "+")
    h = Unsigned(h, Unsigned(h, 11, ">>"), "^")
    h = Unsigned(h, Unsigned(h, 15, "<<"), "+")
    return h
```

Output:

```
3372029979.00
```

21.6 Decimals() Functions

We can determine the decimals numbers count after the point in float/double numbers using the decimals() function.

Syntax:

```
Decimals(nDecimalsCount)
```

Example:

```
x = 1.1234567890123
for d = 0 to 14
    decimals(d)
    see x + nl
next
```

Output:

```
1
1.1
1.12
1.123
1.1235
```

(continues on next page)

(continued from previous page)

```
1.12346
1.123457
1.1234568
1.12345679
1.123456789
1.1234567890
1.12345678901
1.123456789012
1.1234567890123
1.12345678901230
```

21.7 Using _ in numbers

We can use `_` between numbers digits.

Example:

```
x = 1_000_000
see type(x)+nl
see x+1+nl
```

Output:

```
NUMBER
100000001
```

21.8 Using f after numbers

We can use the ‘f’ letter after numbers.

Example:

```
x = 19.99f
see type(x) + nl
```

Output:

```
NUMBER
```

21.9 Using Hexadecimal Numbers

We can write Hexadecimal number by preceding with “0x” or “0X”

Example:

```
x = 0x10
? x          # 16
x = 0xff
```

(continues on next page)

(continued from previous page)

```
? x          # 255
x = 0xA
? x          # 10
? 0xFFFF    # 65535
? 0xA + 1   # 10+1 = 11
```

CHAPTER
TWENTYTWO

FILES

In this chapter we are going to learn about files functions.

- Read()
- Write()
- Dir()
- Rename()
- Remove()
- fopen()
- fclose()
- fflush()
- freopen()
- tempfile()
- tempname()
- fseek()
- ftell()
- rewind()
- fgetpos()
- fsetpos()
- clearerr()
- feof()
- perror()
- fgetc()
- fgets()
- fputc()
- fputs()
- ungetc()
- fread()

- fwrite()
- fexists()
- direxists()
- getpathtype()
- getfilesize()
- Numbers and Bytes

22.1 Read() Function

We can read the file content using the Read() function

Syntax:

```
Read(cFileName) ---> String contains the file content
```

Example:

```
see read("myfile.txt")
```

The read function can read binary files too

Example:

```
see read("myapp.exe")
```

22.2 Write() Function

We can write string to file using the Write() function

The write function can write binary data to binary files.

Syntax:

```
Write(cFileName, cString)      # write string cString to file cFileName
```

Example:

```
# copy file
cFile = read("ring.exe")
write("ring2.exe", cFile)
```

22.3 Dir() Function

We can get the folder contents (files & sub folders) using the Dir() function.

Syntax:

```
Dir(cFolderPath) ---> List contains files & sub folders.
```

This function returns a list and each list item is a list of two items

- File/sub folder name
- Type (0 = File , 1 = Folder/Directory)

Example:

```
see "Testing DIR() " + nl
mylist = dir("C:\myfolder")
for x in mylist
    if x[2]
        see "Directory : " + x[1] + nl
    else
        see "File : " + x[1] + nl
    ok
next
see "Files count : " + len(mylist)
```

22.4 Rename() Function

We can rename files using the Rename() function

Syntax:

```
Rename(cOldFileName,cNewFileName) ---> Number ( Status: Success (0) , Error (-1) )
```

Example:

```
rename("file.txt","help.txt")
```

22.5 Remove() Function

We can delete a file using the Remove() function

Syntax:

```
Remove(cFileName)
```

Example:

```
remove("test.txt")
```

22.6 Fopen() Function

We can open a file using the Fopen() function

Syntax:

```
Fopen(cFileName, cMode) ---> File Handle
```

Mode	Description
“r”	Reading (The file must exist)
“w”	Writing (create empty file / overwrite)
“a”	Appends (create file if it doesn’t exist)
“r+”	update (reading/writing)
“w+”	Create empty file (reading/writing)
“a+”	reading & appending

22.7 Fclose() Function

When we open a file using fopen() function, we can close it using the Fclose() function

Syntax:

```
Fclose(file handle)
```

22.8 Fflush() Function

We can flushes the output buffer of a stream using the Fflush() function

Syntax:

```
Fflush(file handle)
```

22.9 Freopen() Function

We can open another file using the same file handle and at the same time close the old file

Syntax:

```
Freopen(cFileName, cMode, file handle) ---> file handle
```

Example:

```
freopen("myprogoutput.txt", "w+", stdout)
see "welcome" + nl
for x = 1 to 10
    see x + nl
next
```

(continues on next page)

(continued from previous page)

```
/*
** Read : https://en.wikipedia.org/wiki/Device_file#Device_files
** The next code is not portable, we can use iswindows() before
** using it and we can write special code for each operating system.
*/
freopen("CON", "w", stdout)      # For Microsoft Windows
see "Done" + nl                 # print to stdout again
```

Output:

```
# Output to stdout
Done

# Output to file : myprogoutput.txt
welcome
1
2
3
4
5
6
7
8
9
10
```

22.10 Tempfile() Function

The function Tempfile() creates a temp. file (binary).

The file will be deleted automatically when the stream is closed

Syntax:

```
TempFile() ---> file handle
```

22.11 Tempname() Function

We can generate temp. file name using the Tempname() function

The generated name will be different from the name of any existing file

Syntax:

```
Tempname() ---> generated file name as string
```

22.12 Fseek() Function

We can set the file position of the stream using the Fseek() function

Syntax:

```
Fseek(file handle, nOffset, nWhence) ---> zero if successful
```

The next table presents the nWhence values

Value	Description
0	Beginning of file
1	Current position
2	End of file

22.13 Ftell() Function

We can know the current file position of a stream using the Ftell() function

Syntax:

```
Ftell(file handle) ---> file position as number
```

22.14 Rewind() Function

We can set the file position to the beginning of the file using the Rewind() function

Syntax:

```
Rewind(file handle)
```

22.15 Fgetpos() Function

We can get handle to the current file position using the Fgetpos() function

Syntax:

```
Fgetpos(file handle) ---> position handle
```

22.16 Fsetpos() Function

We can set the current file position using the Fsetpos() function

Syntax:

```
Fsetpos(file handle,position handle)
```

22.17 Clearerr() Function

We can clear the EOF error and the error indicators of a stream using the clearerr() function

Syntax:

```
Clearerr(file handle)
```

22.18 Feof() Function

We can test the end-of-file indicator using the Feof() function

Syntax:

```
Feof(file handle) ---> returns 1 if EOF and 0 if not
```

22.19 Ferror() Function

We can test the error indicator of a given stream using the Ferror() function

Syntax:

```
Ferror(file handle) ---> returns 1 if error and 0 if not
```

22.20 Perror() Function

We can print error message to the stderr using the Perror() function

Syntax:

```
Perror(cErrorMessage)
```

22.21 Fgetc() Function

We can get the next character from the stream using the Fgetc() function

Syntax:

```
Fgetc(file handle) ---> returns character or EOF
```

22.22 Fgets() Function

We can read new line from the stream using the Fgets() function

Syntax:

```
Fgets(file handle,nSize) ---> string
```

The function stop when nSize characters are read, new line character is read or EOF.

22.23 Fputc() Function

We can write a character to the stream using the Fputc() function

Syntax:

```
Fputc(file handle,cChar)
```

22.24 Fputs() Function

We can write a string to the stream using the Fputs() function

Syntax:

```
Fputs(file handle,cString)
```

22.25 Ungetc() Function

We can push a character to the stream using the Ungetc() function

The character will be available for the next read

Syntax:

```
Ungetc(file handle,character)
```

22.26 Fread() Function

We can read data from a stream using the Fread() function

Syntax:

```
Fread(file handle,nSize)
```

22.27 Fwrite() Function

We can write data to a stream using the Fwrite() function

Syntax:

```
Fwrite(file handle,cString)
```

22.28 Fexists() Function

We can check if a file exists using the Fexists() function

Syntax:

```
Fexists(cFileName) ---> returns 1 if the file exists
```

Example:

```
see fexists(exefolder()+"ring.exe") + nl +
fexists(exefolder()+"nothing.exe") + nl
```

Output:

```
1
0
```

22.29 Direxists() Function

Syntax:

```
Direxists(cDirPath) ---> returns 1 if the directory exists
```

Example:

```
? direxists("b:\ring") + nl +
direxists("b:\ring\bin2")
```

Output:

```
1
0
```

22.30 Getpathtype() Function

We can get the type a given path (file or directory) using the Getpathtype() function

Syntax:

```
Getpathtype(cPath) ---> 0 if the path doesn't exists
                           1 if it corresponds to existing file
                           2 if it corresponds to existing directory
                           -1 if the path exists but has
                               an unknown type (e.g. a pipe)
```

Example:

```
? Getpathtype("b:\ring\bin\ring.exe") + nl +
Getpathtype("b:\ring") + nl +
Getpathtype("b:\ring\bin2")
```

Output:

```
1
2
0
```

22.31 Getfilesize() Function

We can get the size in bytes of a given file using the Getfilesize() function

Syntax:

```
Getfilesize(cFilePath) ---> file size in bytes as a positive Number
                           or -1 in case of failure
                           (e.g. path doesn't exist or not a regular file)
```

Example:

```
? Getfilesize("b:\ring\bin\ring.exe") + nl +
Getfilesize("b:\ring") + nl +
Getfilesize("b:\ring\ring2.exe")
```

Output:

```
80384
-1
-1
```

22.32 Example

The next program test some of the file functions

```

See "testing file functions" + nl

See "open file" + nl
fp = fopen(exefolder() + "../tests/scripts/s65.ring","r")

See "reopen" + nl
fp = freopen(exefolder() + "../tests/scripts/s78.ring","r",fp)
See "close file" + nl
fclose(fp)

see "temp file" + nl
fp = tempfile()
fclose(fp)

see "temp name" + nl
see tempname() + nl

remove(exefolder() + "../tests/scripts/mytest2.txt")
write(exefolder() + "../tests/scripts/tests1.txt","hello")
rename(exefolder() + "../tests/scripts/test1.txt",exefolder() +
                  "../tests/scripts/mytests2.txt")

see "print file" + nl
fp = fopen(exefolder() + "../samples/fromdoc/filefuncs.ring","r")
r = fgetc(fp)
while isstring(r)
      see r
      r = fgetc(fp)
end
fclose(fp)

see nl+"print line from the file" + nl
fp = fopen(exefolder() + "../samples/fromdoc/filefuncs.ring","r")
r = fgets(fp,33)
see r + nl
fclose(fp)
fp = fopen(exefolder() + "../tests/scripts/test78.txt","w+")
fseek(fp,0,2) # goto end of file
fputc(fp,"t")
fputc(fp,"e")
fputc(fp,"s")
fputc(fp,"t")
fputs(fp,"tests2")
fclose(fp)

see "print file" + nl
see read(exefolder() + "../tests/scripts/test78.txt")

fp = fopen(exefolder() + "../tests/scripts/test78.txt","r")

```

(continues on next page)

(continued from previous page)

```

see "testing ungetc() " + nl
for x = 1 to 3
    r = fgetc(fp)
    see r + nl
    ungetc(fp,r)
next
fclose(fp)

see "testing fread() " + nl
fp = fopen(exefilename(),"rb")
r = fread(fp,100)
see r + nl
fclose(fp)

see "testing fwrite() " + nl
fp = fopen(exefolder() + "../tests/scripts/test1.txt","wb")
fwrite(fp,r)
fclose(fp)

```

The next example print part of the content of a binary file

```

see "Testing: fread() " +" FileName: "+ exefilename() +nl +nl
fp = fopen(exefilename(),"rb")
r = fread(fp,800)
for n =1 to len(r)
    if isprint(substr(r, n, 1))
        see substr(r, n, 1)
    else
        see "."
    ok
    ### 80 char per line
    if n % 80 = 0
        see nl
    ok
next
fclose(fp)

```

22.33 Numbers and Bytes

The next functions to convert between Numbers and Bytes.

- Int2Bytes()
- Float2Bytes()
- Double2Bytes()
- Bytes2Int()
- Bytes2Float()
- Bytes2Double()

Example:

```
see "Test Int2Bytes() and Bytes2Int() - Value : 77" + nl
r = Int2Bytes(77)
see "Int Size : " + len(r) + nl
see r + nl
see Bytes2Int(r) + nl
see "Test Float2Bytes() and Bytes2Float() - Value 77.12" + nl
r = Float2Bytes(77.12)
see "Float Size : " + len(r) + nl
see r + nl
see Bytes2Float(r) + nl
see "Test Double2Bytes() and Bytes2Double() - Value 9999977.12345" + nl
r = Double2Bytes(9999977.12345)
see "Double Size : " + len(r) + nl
see r + nl
decimals(5)
see Bytes2Double(r) + nl
```

CHAPTER
TWENTYTHREE

SYSTEM FUNCTIONS

In this chapter we are going to learn about the system functions

- System()
- SysGet()
- SysSet()
- SysUnset()
- IsMSDOS()
- IsWindows()
- IsWindows64()
- IsUnix()
- IsMacOSX()
- IsLinux()
- IsFreeBSD()
- IsAndroid()
- GetArch()
- Windowsnl()
- Get Command Line Arguments
- Get Active Source File Name
- CurrentDir()
- ExeFileName()
- ChDir()
- ExeFolder()
- Version()
- Shutdown()
- NofProcessors()

23.1 System() Function

We can execute system commands using the system() function

Syntax:

```
System(cCommand)
```

Example:

```
System("myapp.exe")      # Run myapp.exe
System("ls")            # print list of files
```

23.2 SysGet() Function

We can get environment variables using the Get() function

Syntax:

```
SysGet(cVariable)
```

Example:

```
see sysget("path")          # print system path information
```

23.3 SysSet() Function

We can set environment variables using the SysSet() function

```
SysSet(cVariable, cValue) ---> Returns 1 for success and return 0 for failure
```

23.4 SysUnset() Function

We can delete an environment variables using the SysUnset() function

```
SysUnset(cVariable) ---> Returns 1 for success and return 0 for failure
```

23.5 IsMSDOS() Function

We can check if the operating system is MSDOS or not using the IsMSDOS() function

Syntax:

```
IsMSDOS() ---> Returns 1 if the operating system is MS-DOS, Returns 0 if it's not
```

23.6 IsWindows() Function

We can check if the operating system is Windows or not using the IsWindows() function

Syntax:

```
IsWindows() ---> Returns 1 if the operating system is Windows, Returns 0 if it's not
```

23.7 IsWindows64() Function

We can check if the operating system is Windows 64bit or not using the IsWindows64() function

Syntax:

```
IsWindows64() ---> Returns 1 if the operating system is Windows64, Returns 0 if it's not
```

23.8 IsUnix() Function

We can check if the operating system is Unix or not using the IsUnix() function

Syntax:

```
IsUnix() ---> Returns 1 if the operating system is Unix, Returns 0 if it's not
```

23.9 IsMacOSX() Function

We can check if the operating system is macOS or not using the IsMacOSX() function

Syntax:

```
IsMacOSX() ---> Returns 1 if the operating system is Mac OS X, Returns 0 if it's not
```

23.10 IsLinux() Function

We can check if the operating system is Linux or not using the IsLinux() function

Syntax:

```
IsLinux() ---> Returns 1 if the operating system is Linux, Returns 0 if it's not
```

23.11 IsFreeBSD() Function

We can check if the operating system is FreeBSD or not using the IsFreeBSD() function

Syntax:

```
IsFreeBSD() ---> Returns 1 if the operating system is FreeBSD, Returns 0 if it's not
```

23.12 IsAndroid() Function

We can check if the operating system is Android or not using the IsAndroid() function

Syntax:

```
IsAndroid() ---> Returns 1 if the operating system is Android, Returns 0 if it's not
```

23.13 Example

```
see "IsMSDOS()    ---> " + ismsdos()      + nl
see "IsWindows()   ---> " + iswindows()     + nl
see "IsWindows64() ---> " + iswindows64()   + nl
see "IsUnix()      ---> " + isunix()        + nl
see "IsMacOSX()    ---> " + ismacosx()      + nl
see "IsLinux()     ---> " + islinux()       + nl
see "IsFreeBSD()   ---> " + isfreebsd()     + nl
see "IsAndroid()   ---> " + isandroid()     + nl
```

Output:

```
IsMSDOS()    ---> 0
IsWindows()   ---> 1
IsWindows64() ---> 0
IsUnix()      ---> 0
IsMacOSX()    ---> 0
IsLinux()     ---> 0
IsFreeBSD()   ---> 0
IsAndroid()   ---> 0
```

23.14 GetArch() Function

We can detect the architecture of the Ring executable using the GetArch() function

Syntax:

```
GetArch() ---> cString (The name of the architecture of the Ring executable)
```

Possible values are:

```
x86
x64
arm64
arm
unknown
```

Example:

```
switch getarch()
on "x86"
    ? "x86 32bit architecture"
on "x64"
    ? "x64 64bit architecture"
on "arm64"
    ? "ARM64 64bit architecture"
on "arm"
    ? "ARM 32bit architecture"
other
    ? "Unknown architecture"
off
```

23.15 Windowsnl() Function

We can get the windows new line string using the Windowsnl() function.

Syntax:

```
WindowsNL() ---> Returns a string contains CR+LF = CHAR(13) + CHAR(10)
```

Example:

```
cStr = read("input.txt")

if iswindows()
    cStr = substr(cStr,windowsnl(),nl)
ok

aList = str2list(cStr)
# to do - list items processing using "for in"
cStr = list2str(aList)

if iswindows()
    cStr = substr(cStr,nl,windowsnl())
ok

write("output.txt",cStr)
```

23.16 Get Command Line Arguments

We can get the command line arguments passed to the ring script using the sysargv variable.

The sysargv variable is a list contains the command line parameters.

Example

```
see copy("=",30) + nl
see "Command Line Parameters" + nl
see "Size : " + len(sysargv) + nl
see sysargv
see copy("=",30) + nl
if len(sysargv) < 4 return ok
nStart = sysargv[3]
nEnd = sysargv[4]
for x = nStart to nEnd
    see x + nl
next
```

Output

```
b:\mahmoud\apps\ring>ring tests\syspara.ring 1 10
=====
Command Line Parameters
Size : 4
ring
tests\syspara.ring
1
10
=====
1
2
3
4
5
6
7
8
9
10
```

23.17 Get Active Source File Name

We can get the active source file name (*.ring) using the filename() function

Syntax:

```
filename() ---> String contains the active source file name.
```

Example:

```
see "Active Source File Name : " + filename() + nl
```

Output:

```
Active Source File Name : tests\filename.ring
```

Example:

```
if sysargv[2] = filename()
    see "I'm the main program file!" + nl
    # we can run tests here!
else
    see "I'm a sub file in a program" + nl
ok
```

23.18 PrevFileName() Function

Using the PrevFileName() function we can get the previous active source file name.

The previous file would be the file of the caller function, Or the file of the function that we called before calling PrevFileName().

Syntax:

```
prevfilename() ---> String contains the previous source file name.
```

Example:

The next function in stdlib.ring uses the PrevFileName() to know if the file of the caller function is the main source file of the program or not.

```
Func IsMainSourceFile
    if PrevFileName() = sysargv[2]
        return true
    ok
    return false
```

23.19 CurrentDir() Function

Return the path of the current directory

Syntax:

```
CurrentDir() ---> String contains the path of the current directory
```

23.20 ExeFileName() Function

Return the Ring executable file name

Syntax:

```
exefilename() ---> String contains the Ring executable file name
```

23.21 ChDir() Function

Change the current directory

Syntax:

```
ChDir(cNewPath)
```

23.22 ExeFolder() Function

Return the Ring executable file path

Syntax:

```
exefolder() ---> String contains the Ring executable path
```

23.23 Version() Function

Return the Ring version

Syntax:

```
version([lPatch]) ---> String contains the Ring version
```

Example:

```
? version()  
? version(True)
```

Output:

```
1.22  
1.22.0
```

23.24 Shutdown() Function

Close the application

Syntax:

```
shutdown(nStatus) ---> Close the application
```

23.25 NofProcessors() Function

We can detect the number of processors using the NofProcessors() Function

Syntax:

```
NofProcessors() ---> nProcessors
```

Example:

```
? NofProcessors()
```

CHAPTER
TWENTYFOUR

EVAL() AND DEBUGGING

In this chapter we are going to learn about

- Error Handling using Try/Catch/Done
- Eval() function
- Raise() function
- Assert() function

24.1 Try/Catch/Done

Syntax:

```
Try
    Statements...
Catch
    Statements...
Done
```

The statements in the Try block will be executed, if any error happens then the statements in the catch block will be executed.

Inside the catch block we can use the variable cCatchError to get the error message

Example:

```
Try
    see 5/0
Catch
    see "Catch!" + nl + cCatchError
Done
```

Output:

```
Catch!
Error (R1) : Can't divide by zero !
```

24.2 Eval() Function

We can execute code during the runtime from string using the Eval() function

Syntax:

```
Eval(cCode)
```

Example:

```
Eval("nOutput = 5+2*5 " )
See "5+2*5 = " + nOutput + nl
Eval("for x = 1 to 10 see x + nl next")
Eval("func test see 'message from test!' ")
test()
```

Output:

```
5+2*5 = 15
1
2
3
4
5
6
7
8
9
10
message from test!
```

We can use the Return command to return a value

Example:

```
see Eval("return 5*5")
```

Output:

```
25
```

24.3 Raise() Function

We can raise an exception using the Raise() function

Syntax:

```
Raise(cErrorMessage)
```

The function will display the error message then end the execution of the program.

We can use Try/Catch/Done to avoid exceptions generated by raise() function.

Example:

```
nMode = 10

if nMode < 0 or nMode > 5
    raise("Error : nMode not in the range 1:4")
ok
```

Output:

```
Line 4 Error : nMode not in the range 1:4
In raise in file tests\raise.ring
```

Example:

```
try
    testmode(6)
catch
    see "avoid raise!"
done

testmode(-1)

func testmode nMode

    if nMode < 0 or nMode > 5
        raise("Error : nMode not in the range 1:4")
    ok
```

Output:

```
avoid raise!
Line 12 Error : nMode not in the range 1:4
In raise In function testmode() in file tests\raise2.ring
called from line 7 in file tests\raise2.ring
```

24.4 Assert() Function

We can use the Assert() function to test conditions before executing the code

If the test fail the program will be terminated with an error message contains the assert condition.

Syntax:

```
Assert( condition )
```

Example:

```
x = 10
assert( x = 10)
assert( x = 100 )
```

Output:

```
Line 3 Assertion Failed!
In assert in file tests\assert.ring
```

CHAPTER
TWENTYFIVE

DEMO PROGRAMS

In this chapter we will see simple demo programs

- Language Shell
- Main Menu

25.1 Language Shell

We can create simple interactive programming environment using the next program

```
while true
    see nl + "code:> "
    give cCode
    try
        eval(cCode)
    catch
        see cCatchError
    done
end
```

Output:

```
code:> see "hello world"
hello world
code:> for x = 1 to 10 see x + nl next
1
2
3
4
5
6
7
8
9
10

code:> func test see "Hello from test" + nl

code:> test()
Hello from test
```

(continues on next page)

(continued from previous page)

```
code:> bye
```

25.2 Main Menu

Example:

```
# Demo Program

while true

    see ""

    Main Menu
    =====
    [1] Say Hello
    [2] Sum two numbers
    [3] Stars
    [4] Fact
    [5] Exit

    " give nMenu see nl

    # we can use Switch-ON-Other-OFF instead of IF-BUT-ELSE-OK

    Switch nMenu
    On 1 sayhello()
    On 2 Sum()
    On 3 Stars()
    On 4
        see "Enter Number : " give x
        see "Output : "

        Try
            see Fact(number(x))
        Catch
            see "Error in parameters!" + nl
        Done

    On "5" return
    Other see "bad option" + nl
    Off

end

func sayhello
    see "Enter your name ? " give fname
    see "Hello " + fname + nl

func sum
```

(continues on next page)

(continued from previous page)

```

see "number 1 : " give num1 see "number 2 : " give num2
see "Sum : " see 0 + num1 + num2

func stars
    for x = 1 to 10
        see space(8)
        for y = 1 to x see "*" next see nl
    next

func fact x if x = 0 return 1 else return x * fact(x-1) ok

func space x y = "" for t=1 to x y += " " next return y

```

Output:

```

Main Menu
=====
[1] Say Hello
[2] Sum two numbers
[3] Stars
[4] Fact
[5] Exit

```

1

Enter your name ? Mahmoud Fayed
Hello Mahmoud Fayed

```

Main Menu
=====
[1] Say Hello
[2] Sum two numbers
[3] Stars
[4] Fact
[5] Exit

```

2

number 1 : 3
number 2 : 4
Sum : 7

```

Main Menu
=====
[1] Say Hello
[2] Sum two numbers
[3] Stars
[4] Fact
[5] Exit

```

3

(continues on next page)

(continued from previous page)

```
*  
**  
***  
****  
*****  
*****  
*****  
*****  
*****  
*****  
*****
```

Main Menu

```
=====
```

- [1] Say Hello
- [2] Sum two numbers
- [3] Stars
- [4] Fact
- [5] **Exit**

4

Enter Number : 5

Output : 120

Main Menu

```
=====
```

- [1] Say Hello
- [2] Sum two numbers
- [3] Stars
- [4] Fact
- [5] **Exit**

5

CHAPTER
TWENTYSIX

ODBC FUNCTIONS

This chapter contains the ODBC functions provided by the Ring programming language.

- odbc_init()
- odbc_drivers()
- odbc_datasources()
- odbc_close()
- odbc_connect()
- odbc_disconnect()
- odbc_execute()
- odbc_colcount()
- odbc_fetch()
- odbc_getdata()
- odbc_tables()
- odbc_columns()
- odbc_autocommit()
- odbc_commit()
- odbc_rollback()

Before using the next function load the `odbclib.ring` library

```
load "odbclib.ring"
# Use ODBC functions
```

26.1 odbc_init() Function

We can create ODBC Handle using the `odbc_init()` function

Syntax:

```
odbc_init() ---> ODBC Handle
```

26.2 odbc_drivers() Function

We can get a list of ODBC drivers using the odbc_drivers() function

Syntax:

```
odbc_drivers(ODBC Handle) ---> List of Drivers
```

26.3 odbc_datasources() Function

We can get a list of ODBC data sources using the odbc_datasources() function

Syntax:

```
odbc_datasources(ODBC Handle) ---> List of Data sources
```

26.4 odbc_close() Function

After the end of using ODBC functions we can free resources using ODBC_Close() function

Syntax:

```
odbc_close(ODBC Handle)
```

26.5 Print List of ODBC Drivers

The next example print a list of ODBC drivers.

```
See "ODBC test 1" + nl
oODBC = odbc_init()
See "Drivers " + nl
see odbc_drivers(oODBC)
odbc_close(oODBC)
```

Output:

```
ODBC test 1
Drivers
Microsoft Access-Treiber (*.mdb) - SQLLevel=0
Driver do Microsoft Paradox (*.db ) - SQLLevel=0
Driver do Microsoft Excel (*.xls) - SQLLevel=0
Microsoft Text Driver (*.txt; *.csv) - SQLLevel=0
Driver da Microsoft para arquivos texto (*.txt; *.csv) - SQLLevel=0
Microsoft dBase-Treiber (*.dbf) - SQLLevel=0
SQL Server - CPTimeout=60
Microsoft Excel Driver (*.xls) - SQLLevel=0
Driver do Microsoft dBase (*.dbf) - SQLLevel=0
Microsoft Paradox-Treiber (*.db ) - SQLLevel=0
```

(continues on next page)

(continued from previous page)

```

Microsoft ODBC for Oracle - CPTimeout=120
Microsoft Text-Treiber (*.txt; *.csv) - SQLLevel=0
Microsoft Excel-Treiber (*.xls) - SQLLevel=0
Microsoft Access Driver (*.mdb) - SQLLevel=0
Driver do Microsoft Access (*.mdb) - SQLLevel=0
Microsoft Paradox Driver (*.db) - SQLLevel=0
Microsoft dBase Driver (*.dbf) - SQLLevel=0
Microsoft Access Driver (*.mdb, *.accdb) - UsageCount=3
Microsoft Excel Driver (*.xls, *.xlsx, *.xlsm, *.xlsb) - UsageCount=3
Microsoft Access Text Driver (*.txt, *.csv) - UsageCount=3
SQL Server Native Client 10.0 - UsageCount=1
SQL Server Native Client 11.0 - UsageCount=1
Microsoft Access dBASE Driver (*.dbf, *.ndx, *.mdx) - UsageCount=3
Microsoft Access Paradox Driver (*.db) - UsageCount=3
MySQL ODBC 5.3 ANSI Driver - UsageCount=1
MySQL ODBC 5.3 Unicode Driver - UsageCount=1
ODBC Driver 11 for SQL Server - UsageCount=1
Lianja ODBC Driver - CPTimeout=60
Microsoft Visual FoxPro Driver - UsageCount=1
Microsoft Visual FoxPro-Treiber - UsageCount=1
Driver para o Microsoft Visual FoxPro - UsageCount=1
Microsoft FoxPro VFP Driver (*.dbf) - UsageCount=1

```

26.6 Print List of ODBC Data Sources

The next example print a list of ODBC data sources.

```

See "ODBC test 2" + nl
pODBC = odbc_init()
See "Data Sources " + nl
see odbc_datasources(pODBC)
odbc_close(pODBC)

```

Output:

```

ODBC test 2
Data Sources
Excel Files - Microsoft Excel Driver (*.xls, *.xlsx, *.xlsm, *.xlsb)
MS Access Database - Microsoft Access Driver (*.mdb, *.accdb)
Customer - Microsoft Access Driver (*.mdb)
IdCardData - Microsoft Access Driver (*.mdb)
MyProjectData2 - Microsoft Access Driver (*.mdb)
MyData - Microsoft Access Driver (*.mdb)
MonprojetcData - Microsoft Access Driver (*.mdb)
dBASE Files - Microsoft Access dBASE Driver (*.dbf, *.ndx, *.mdx)
myvfpdata - Microsoft Visual FoxPro Driver
FACTORYDATA - Microsoft Access Driver (*.mdb)
TRAININGSYSDATA - Microsoft Access Driver (*.mdb)
RVCSYSDATASQLDB - SQL Server Native Client 11.0
PWCTRVCDATA - Microsoft Access Driver (*.mdb)

```

(continues on next page)

(continued from previous page)

```
MyCompany - Microsoft Access Driver (*.mdb)
HCS - Microsoft Access Driver (*.mdb)
HCS2 - Microsoft Access Driver (*.mdb, *.accdb)
MyProjectData - Microsoft Access Driver (*.mdb)
Xtreme Sample Database 2008 - Microsoft Access Driver (*.mdb)
Lianja_Southwind - Lianja ODBC Driver
Visual FoxPro Database - Microsoft Visual FoxPro Driver
Visual FoxPro Tables - Microsoft Visual FoxPro Driver
```

26.7 odbc_connect() Function

We can connect to the database using the odbc_connect() function.

Syntax:

```
odbc_connect(ODBC Handle, cConnectionString)
```

26.8 odbc_disconnect() Function

We can close the connection to the database using the odbc_disconnect() function.

Syntax:

```
odbc_disconnect(ODBC Handle)
```

26.9 Open and Close Connection

The next example connect to the database then close the connection

```
See "ODBC test 3" + nl
pODBC = odbc_init()
See "Connect to database" + nl
see odbc_connect(pODBC, "DBQ=test.mdb;Driver={Microsoft Access Driver (*.mdb)}") + nl
See "disconnect" + nl
odbc_disconnect(pODBC)
See "Close database..." + nl
odbc_close(pODBC)
```

Output:

```
ODBC test 3
Connect to database
1
disconnect
Close database...
```

26.10 odbc_execute() Function

We can execute SQL Statements on the database using the odbc_execute() function.

Syntax:

```
odbc_execute(ODBC Handle, cSQLStatement)
```

26.11 odbc_colcount() Function

We can get columns count in the query result using the odbc_colcount() function.

Syntax:

```
odbc_colcount(ODBC Handle) ---> Columns Count as Number
```

26.12 odbc_fetch() Function

We can fetch a row from the query result using the odbc_fetch() function.

Syntax:

```
odbc_fetch(ODBC Handle)
```

26.13 odbc_getdata() Function

We can get column value from the fetched row using the odbc_getdata() function.

Syntax:

```
odbc_getdata(ODBC Handle, nColumnNumber) ---> Column Value
```

26.14 Execute Query and Print Result

The next example execute query then print the query result.

```
See "ODBC test 4" + nl
pODBC = odbc_init()
See "Connect to database" + nl
see odbc_connect(pODBC, "DBQ=test.mdb;Driver={Microsoft Access Driver (*.mdb)}") + nl
See "Select data" + nl
see odbc_execute(pODBC, "select * from person") + nl
nMax = odbc_colcount(pODBC)
See "Columns Count : " + nMax + nl
while odbc_fetch(pODBC)
    See "Row data:" + nl
    for x = 1 to nMax
```

(continues on next page)

(continued from previous page)

```

        see odbc_getdata(pODBC,x) + " - "
next
end
See "Close database..." + nl
odbc_disconnect(pODBC)
odbc_close(pODBC)

```

26.15 odbc_tables() Function

We can get a list of tables inside the database using the odbc_tables() function.

We can access the result of this function as we get any query result.

Syntax:

```
odbc_tables(ODBC Handle)
```

Example:

```

See "ODBC test - Get Database Tables" + nl
pODBC = odbc_init()
See "Connect to database" + nl
odbc_connect(pODBC,"DBQ=test.mdb;Driver={Microsoft Access Driver (*.mdb)}") + nl
See "Select data" + nl
odbc_tables(pODBC) + nl
nMax = odbc_colcount(pODBC)
See "Columns Count : " + nMax + nl
while odbc_fetch(pODBC)
    for x = 1 to nMax
        see odbc_getdata(pODBC,x)
        if x != nMax see " - " ok
    next
    See nl
end
See "Close database..."
odbc_disconnect(pODBC)
odbc_close(pODBC)

```

Output:

```

ODBC test - Get Database Tables
Connect to database
Select data
Columns Count : 5
.\test - NULL - Customer - TABLE - NULL
.\test - NULL - employee - TABLE - NULL
.\test - NULL - person - TABLE - NULL
.\test - NULL - tel - TABLE - NULL
Close database...

```

26.16 odbc_columns() Function

We can get a list of columns inside the table using the odbc_columns() function.

Syntax:

```
odbc_columns(ODBC Handle, cTableName)
```

Example:

```
See "ODBC test - Get Table Columns" + nl
pODBC = odbc_init()
See "Connect to database" + nl
odbc_connect(pODBC,"DBQ=test.mdb;Driver={Microsoft Access Driver (*.mdb)}") + nl
See "Get Columns inside the Person Table" + nl
odbc_columns(pODBC,"person") + nl
while odbc_fetch(pODBC)
    see odbc_getdata(pODBC,4) + nl
end
See "Close database..." + nl
odbc_disconnect(pODBC)
odbc_close(pODBC)
```

Output:

```
ODBC test - Get Table Columns
Connect to database
Get Columns inside the Person Table
FIRST
LAST
STREET
CITY
STATE
ZIP
HIREDATE
MARRIED
AGE
SALARY
NOTES
Close database...
```

26.17 odbc_autocommit() Function

We can enable or disable the auto commit feature using the odbc_autocommit() function.

Syntax:

```
odbc_autocommit(ODBC Handle, lStatus) # lStatus can be True or False
```

26.18 odbc_commit() Function

We can commit updates to the database using the odbc_commit() function.

Syntax:

```
odbc_commit(ODBC Handle)
```

26.19 odbc_rollback() Function

We can rollback updates to the database using the odbc_rollback() function.

Syntax:

```
odbc_rollback(ODBC Handle)
```

26.20 Transactions and Using Commit and Rollback

Example:

```
See "ODBC Test - Transactions and using Commit and Rollback" + nl
pODBC = odbc_init()
See "Connect to database" + nl
see odbc_connect(pODBC, "DBQ=test.mdb;Driver={Microsoft Access Driver (*.mdb)}") + nl
see "insert data..." + nl
odbc_autocommit(pODBC, 0)
for x = 1 to 10000
    odbc_execute(pODBC, "insert into tel values (" + x + ", 'mahmoud')") 
next
for x = 10001 to 15000
    odbc_execute(pODBC, "insert into tel values (" + x + ", 'samir')") 
next
odbc_commit(pODBC)

for x = 15001 to 20000
    odbc_execute(pODBC, "insert into tel values (" + x + ", 'fayed')") 
next

ODBC_ROLLBACK(pODBC)
odbc_execute(pODBC, "insert into tel values (" + x + ", 'fayed')") 
odbc_commit(pODBC)

See "Close database..." + nl
odbc_disconnect(pODBC)
odbc_close(pODBC)
```

Output:

```
ODBC Test - Transactions and using Commit and Rollback
Connect to database
```

(continues on next page)

(continued from previous page)

```
1
insert data...
Close database...
```

26.21 Save and Restore images

The next example save an image inside the database

```
See "ODBC test - Save image in the database" + nl
pODBC = odbc_init()
See "Connect to database" + nl
see odbc_connect(pODBC, "DBQ=test.mdb;Driver={Microsoft Access Driver (*.mdb)}") + nl
see "Read Image File..." + nl
cFile = str2hex(read("tests\mahmoud.jpg"))
see "size " + len(CFile)+nl
see "Save image in the database..." + nl
stmt = "insert into tel values (20000,'mahmoud','" + cFile + "')"
odbc_execute(pODBC,stmt)
See "Close database..." + nl
odbc_disconnect(pODBC)
odbc_close(pODBC)
```

The next example restore the image from the database

```
See "ODBC Test - Restore image from the database" + nl
pODBC = odbc_init()
See "Connect to database" + nl
see odbc_connect(pODBC, "DBQ=test.mdb;Driver={Microsoft Access Driver (*.mdb)}") + nl
See "Select data" + nl
see odbc_execute(pODBC, "select * from tel where id = 20000") + nl
nMax = odbc_colcount(pODBC)
See "Columns Count : " + nMax + nl
if odbc_fetch(pODBC)
    See "Write image file" + nl
    write("tests\great.jpg",hex2str( odbc_getdata(pODBC,3) ) )
ok
See "Close database..." + nl
odbc_disconnect(pODBC)
odbc_close(pODBC)
```

CHAPTER
TWENTYSEVEN

MYSQL FUNCTIONS

In this chapter we are going to learn about the MySQL functions provided by the Ring programming language.

- MySQL_Info()
- MySQL_Init()
- MySQL_Error()
- MySQL_Connect()
- MySQL_Close()
- MySQL_Query()
- MySQL_Insert_ID()
- MySQL_Result()
- MySQL_Next_Result()
- MySQL_Columns()
- MySQL_Result2()
- MySQL_Escape_String()
- MySQL_AutoCommit()
- MySQL_Commit()
- MySQL_Rollback()

Before using the next function load the mysql.lib.ring library

```
load "mysql.lib.ring"
# Use MySQL functions
```

27.1 MySQL_Info() Function

We can get the MySQL Client version using the MySQL_Info() function.

Syntax:

```
MySQL_Info() ---> string contains the MySQL Client version
```

Example:

```
see "MySQL Client Version : " + mysql_info()
```

Output:

```
MySQL Client Version : 6.1.5
```

27.2 MySQL_Init() Function

We can start using MySQL Client through the MySQL_Init() function.

Syntax:

```
MySQL_Init() ---> MySQL Handle
```

27.3 MySQL_Error() Function

We can get the error message from the MySQL Client using the MySQL_Error() function.

Syntax:

```
MySQL_Error(MySQL Handle) ---> Error message as string
```

27.4 MySQL_Connect() Function

We can connect to the MySQL database server using the MySQL_Connect() function.

Syntax:

```
MySQL_Connect(MySQL Handle, cServer, cUserName, cPassword) ---> lStatus
```

27.5 MySQL_Close() Function

We can close the connection to the MySQL database using the MySQL_Close() function

Syntax:

```
MySQL_Close(MySQL Handle)
```

27.6 MySQL_Query() Function

We can execute SQL queries using the MySQL_Query() function

Syntax:

```
MySQL_Query(MySQL Handle, cSQLQuery)
```

27.7 Create Database

The next example connect to MySQL Server then create new database.

```
See "MySQL Test - Create Database" + nl
con = mysql_init()

See "Connect" + nl
if mysql_connect(con, "localhost", "root", "root") = 0
    see "Can't connect" + nl
    see "Error : " + mysql_error(con) + nl
    mysql_close(con)
    bye
ok

See "Create Database..." + nl
mysql_query(con, "CREATE DATABASE mahdb")

See "Close Connection" + nl
mysql_close(con)
```

Output:

```
MySQL Test - Create Database
Connect
Create Database...
Close Connection
```

27.8 Create Table and Insert Data

The next example create new table and insert records

```
func main
    see "Create Table and Insert Records" + nl
    con = mysql_init()

    see "Connect" + nl
    if mysql_connect(con, "localhost", "root", "root", "mahdb") = 0
        system_error(con)
    ok
```

(continues on next page)

(continued from previous page)

```

see "Drop table" + nl
if mysql_query(con, "DROP TABLE IF EXISTS Employee") system_error(con) ok

see "Create table" + nl
if mysql_query(con, "CREATE TABLE Employee(Id INT, Name TEXT, Salary INT)") system_error(con) ok

see "Insert data" + nl
if mysql_query(con, "INSERT INTO Employee VALUES(1, 'Mahmoud', 15000)") system_error(con) ok

if mysql_query(con, "INSERT INTO Employee VALUES(2, 'Samir', 16000)") system_error(con) ok

if mysql_query(con, "INSERT INTO Employee VALUES(3, 'Fayed', 17000)") system_error(con) ok

see "Close connection" + nl
mysql_close(con)

func system_error con
    see mysql_error(con) mysql_close(con) bye

```

Output:

```

Create Table and Insert Records
Connect
Drop table
Create table
Insert data
Close connection

```

27.9 MySQL_Insert_ID() Function

We can get the inserted row id using the MySQL_Insert_ID() function

Syntax:

```
MySQL_Insert_ID() ---> Inserted row id as number
```

Example:

```

con = mysql_init()
see "connect to database" + nl
mysql_connect(con, "localhost", "root", "root", "mahdb")
see "drop table" + nl
mysql_query(con, "DROP TABLE IF EXISTS Customers")
see "create table" + nl
mysql_query(con, "CREATE TABLE Customers(Id INT PRIMARY KEY AUTO_INCREMENT, Name TEXT)")
see "insert record" + nl
mysql_query(con, "INSERT INTO Customers(Name) VALUES('Mahmoud')")

```

(continues on next page)

(continued from previous page)

```

see "insert record" + nl
mysql_query(con, "INSERT INTO Customers(Name) VALUES('Samir')")
see "insert record" + nl
mysql_query(con, "INSERT INTO Customers(Name) VALUES('Fayed')")
see "insert record" + nl
mysql_query(con, "INSERT INTO Customers(Name) VALUES('Test 2015')")

see "inserted row id : " + mysql_insert_id(con) + nl
see "close database" + nl
mysql_close(con)

```

Output:

```

connect to database
drop table
create table
insert record
insert record
insert record
insert record
insert record
insert record
inserted row id : 4
close database

```

27.10 MySQL_Result() Function

We can get the query result (data without column names) using the MySQL_Result() function.

Syntax:

```
MySQL_Result(MySQL Handle) ---> List contains the query result
```

27.11 MySQL_Next_Result() Function

We can move to the next query result using the MySQL_Next_Result() function. We use this function when we have multiple SQL statements in the same query.

Syntax:

```
MySQL_Next_Result(MySQL Handle)
```

27.12 Print Query Result

The next example execute a query on the database then print the result.

```
con = mysql_init()
see "Connect to database" + nl
mysql_connect(con, "localhost", "root", "root", "mahdb")
see "Execute Query" + nl
mysql_query(con, "SELECT Name FROM Employee WHERE Id=1;" +
            "SELECT Name FROM Employee WHERE Id=3")
see "Print Result" + nl
see mysql_result(con)
mysql_next_result(con)
see mysql_result(con)
see "close database" + nl
mysql_close(con)
```

Output:

```
Connect to database
Execute Query
Print Result
Mahmoud
Fayed
close database
```

27.13 MySQL_Columns() Function

We can get a list of columns names using the MySQL_Columns() function.

Syntax:

```
MySQL_Columns(MySQL Handle) ---> List contains columns information
```

Example:

```
con = mysql_init()
see "Connect to database" + nl
mysql_connect(con, "localhost", "root", "root", "mahdb")
see "Execute Query" + nl
mysql_query(con, "SELECT * FROM Employee")
see "Result" + nl
see mysql_columns(con)
see "Close database" + nl
mysql_close(con)
```

Output:

```
Connect to database
Execute Query
Result
Id
```

(continues on next page)

(continued from previous page)

```

11
3
32768
Name
65535
252
16
16
Salary
11
3
32768
Close database

```

27.14 MySQL_Result2() Function

Instead of using MySQL_Result() to get the result data without columns names, we can use the MySQL_Result2() to get all of the column names then the query result in one list.

Syntax:

```
MySQL_Result2(MySQL Handle) ---> List (query result starts with columns names)
```

Example:

```

con = mysql_init()
see "Connect to database" + nl
mysql_connect(con, "localhost", "root", "root","mahdb")
see "Execute Query" + nl
mysql_query(con, "SELECT * FROM Employee")
see "Print Result" + nl
see mysql_result2(con)
see "Close database" + nl
mysql_close(con)

```

Output:

```

Connect to database
Execute Query
Print Result
Id
Name
Salary
1
Mahmoud
15000
2
Samir
16000
3
Fayed

```

(continues on next page)

(continued from previous page)

```
17000
Close database
```

27.15 MySQL_Escape_String() Function

We can store binary data and special characters in the database after processing using MySQL_Escape_String() function

Syntax:

```
MySQL_Escape_String(MySQL Handle, cString) ---> String after processing
```

27.16 Save Image inside the database

Example:

```
See "Read file" + nl
cFile = read("tests\mahmoud.jpg")
con = mysql_init()
See "Connect to database..." + nl
mysql_connect(con, "localhost", "root", "root","mahdb")
See "Escape string..." + nl
cFile = mysql_escape_string(con,cFile)
stmt = "INSERT INTO photo(id, data) VALUES(1, '" + cFile + "')"
See "Insert data..." + nl
mysql_query(con,stmt)
See "Close database..." + nl
mysql_close(con)
```

Output:

```
Read file
Connect to database...
Escape string...
Insert data...
Close database...
```

27.17 Restore Image From The Database

Example:

```
con = mysql_init()
See "Connect to database..." + nl
mysql_connect(con, "localhost", "root", "root","mahdb")
See "Read data from database..." + nl
mysql_query(con,"SELECT data FROM photo WHERE id=1")
See "Write new file" + nl
result = mysql_result(con)
```

(continues on next page)

(continued from previous page)

```
write("tests\mahmoud2.jpg",result[1][1])
See "Close database..." + nl
mysql_close(con)
```

Output:

```
Connect to database...
Read data from database...
Write new file
Close database...
```

27.18 MySQL_AutoCommit() Function

We can enable or disable the auto commit feature using the MySQL_AutoCommit() function.

Syntax:

```
MySQL_AutoCommit(MySQL Handle, lStatus) # lstatus can be True/False
```

27.19 MySQL_Commit() Function

We can commit updates to the database using the MySQL_Commit() function.

Syntax:

```
MySQL_Commit(MySQL Handle)
```

27.20 MySQL_Rollback() Function

We can rollback updates to the database using the MySQL_Rollback() function.

Syntax:

```
MySQL_Rollback(MySQL Handle)
```

27.21 Transaction Example

The next example presents the usage of MySQL_Autocommit(), MySQL_Commit() & MySQL_RollBack() functions.

Example:

```
func main

    con = mysql_init()

    see "Connect" + nl
```

(continues on next page)

(continued from previous page)

```

if mysql_connect(con, "localhost", "root", "root","mahdb") = 0
    system_error(con) ok

see "Drop table" + nl
if mysql_query(con, "DROP TABLE IF EXISTS Employee2")
    system_error(con) ok

see "Create table" + nl
if mysql_query(con, "CREATE TABLE Employee2(Id INT, Name TEXT, Salary INT)")
    system_error(con) ok

see "Insert data" + nl
if mysql_query(con, "INSERT INTO Employee2 VALUES(1,'Mahmoud',15000)")
    system_error(con) ok

if mysql_query(con, "INSERT INTO Employee2 VALUES(2,'Samir',16000)")
    system_error(con) ok

if mysql_query(con, "INSERT INTO Employee2 VALUES(3,'Fayed',17000)")
    system_error(con) ok

mysql_autocommit(con,False)
mysql_query(con, "INSERT INTO Employee2 VALUES(4,'Ahmed',5000)")
mysql_query(con, "INSERT INTO Employee2 VALUES(5,'Ibrahim',50000)")
mysql_query(con, "INSERT INTO Employee2 VALUES(6,'Mohammed',50000)")
See "Save transaction (y/n) " give nChoice
if upper(nChoice) = "Y"
    mysql_commit(con)
else
    mysql_rollback(con)
ok

see "Close connection" + nl
mysql_close(con)

func system_error con

see mysql_error(con)
mysql_close(con)
bye

```

Output:

```

Connect
Drop table
Create table
Insert data
Save transaction (y/n) y
Close connection

```

CHAPTER
TWENTYEIGHT

SQLITE FUNCTIONS

In this chapter we will learn about using the SQLite database in the Ring programming language.

Before using the next function load the `sqlitelib.ring` library

```
load "sqlitelib.ring"
# Use SQLite functions
```

28.1 `sqlite_init()` function

Syntax:

```
sqlite_init() ---> SQLite Object
```

28.2 `sqlite_open()` function

Syntax:

```
sqlite_open(SQLite Object,cFileName)
```

28.3 `sqlite_execute()` function

Syntax:

```
sqlite_execute(SQLite Object,cSQLStatement)
```

28.4 `sqlite_close()` function

Syntax:

```
sqlite_close(SQLite Object)
```

28.5 Example

The next code create a SQLite database, add new records then display the data.

```
load "sqlitelib.ring"

oSQLite = sqlite_init()

sqlite_open(oSQLite, "mytest.db")

sql = "
    CREATE TABLE COMPANY (
        ID INT PRIMARY KEY      NOT NULL,
        NAME          TEXT      NOT NULL,
        AGE           INT       NOT NULL,
        ADDRESS        CHAR(50),
        SALARY         REAL );
"
sqlite_exec(oSQLite,sql)

sql = "
    INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY)
    VALUES  (1, 'Mahmoud' , 29, 'Jeddah', 20000.00 ),
            (2, 'Ahmed'   , 27, 'Jeddah', 15000.00 ),
            (3, 'Mohammed' , 31, 'Egypt'  , 20000.00 ),
            (4, 'Ibrahim'  , 24, 'Egypt'  , 65000.00 );
"
sqlite_exec(oSQLite,sql)

aResult = sqlite_exec(oSQLite,"select * from COMPANY")
for x in aResult
    for t in x
        ? t[2] + nl
    next
next
? copy("*",50)
for x in aResult
    ? x[:name]
next
sqlite_close(oSQLite)
```

Output:

```
1
Mahmoud
29
Jeddah
20000.0
2
Ahmed
27
Jeddah
```

(continues on next page)

(continued from previous page)

15000.0
3
Mohammed
31
Egypt
20000.0
4
Ibrahim
24
Egypt
65000.0

Mahmoud
Ahmed
Mohammed
Ibrahim

POSTGRESQL FUNCTIONS

In this chapter we will learn about using the PostgreSQL database in the Ring programming language.

29.1 Loading the library

Before using the next function load the postgresql.lib.ring library

```
load "postgresql.lib.ring"
# Use PostgreSQL functions
```

29.2 Examples

Example (1):

```
load "postgresql.lib.ring"

conninfo = "user=postgres password=sa dbname = postgres"

exit_nicely = func conn {
    PQfinish(conn)
    shutdown(1)
}

conn = PQconnectdb(conninfo)

if (PQstatus(conn) != CONNECTION_OK)
    fputs(stderr, "Connection to database failed: "+PQerrorMessage(conn))
    call exit_nicely(conn)
ok

res = PQexec(conn, "select * from pg_database")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Select failed: " + PQerrorMessage(conn))
    PQclear(res)
    exit_nicely(conn)
ok

nFields = PQnfields(res)
```

(continues on next page)

(continued from previous page)

```

for i = 1 to nFields
    ? PQfname(res, i-1)
next

? copy("*,60)

for i = 1 to PQntuples(res)
    for j=1 to nFields
        see PQgetvalue(res, i-1, j-1) + " "
    next
    see nl
next

PQclear(res)

PQfinish(conn)

```

Output:

```

datname
datdba
encoding
datcollate
datctype
datistemplate
datallowconn
datconnlimit
datlastsysoid
datfrozenxid
datminmxid
dattablespace
datacl
*****
postgres 10 6 English_United States.1252
    English_United States.1252 f t -1 12937 549 1 1663
template1 10 6 English_United States.1252 English_United States.1252
    t t -1 12937 549 1 1663 {=c/postgres,postgres=CTc/postgres}
template0 10 6 English_United States.1252 English_United States.1252
    t f -1 12937 549 1 1663 {=c/postgres,postgres=CTc/postgres}
mahdb 10 6 English_United States.1252 English_United States.1252
    f t -1 12937 549 1 1663

```

Example(2):

```

load "postgresqllib.ring"

conninfo = "user=postgres password=sa"

exit_nicely = func conn {
    PQfinish(conn)
    shutdown(1)
}

```

(continues on next page)

(continued from previous page)

```

conn = PQconnectdb(conninfo)

if (PQstatus(conn) != CONNECTION_OK)
    fputs(stderr, "Connection to database failed: " + PQerrorMessage(conn))
    call exit_nicely(conn)
ok

res = PQexec(conn, "DROP DATABASE IF EXISTS mahdb;")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Remove failed: " + PQerrorMessage(conn))
ok
PQclear(res)

res = PQexec(conn, "CREATE DATABASE mahdb;")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Create database failed: " + PQerrorMessage(conn))
ok
PQclear(res)

res = PQexec(conn, "
CREATE TABLE COMPANY (
    ID INT PRIMARY KEY      NOT NULL,
    NAME      TEXT      NOT NULL,
    AGE       INT       NOT NULL,
    ADDRESS   CHAR(50),
    SALARY    REAL );
")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Create Table failed: " + PQerrorMessage(conn))
ok
PQclear(res)

res = PQexec(conn, "
    INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY)
        VALUES  (1, 'Mahmoud' , 31, 'Jeddah', 10.00 ),
                (2, 'Ahmed'   , 27, 'Jeddah', 20.00 ),
                (3, 'Mohammed', 33, 'Egypt'  , 30.00 ),
                (4, 'Ibrahim' , 24, 'Egypt'  , 40.00 );
")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Insert Table failed: " + PQerrorMessage(conn))
ok
PQclear(res)

res = PQexec(conn, "
    select * from COMPANY
")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Select failed: " + PQerrorMessage(conn))

```

(continues on next page)

(continued from previous page)

```

PQclear(res)
call exit_nicely(conn)

ok

nFields = PQnfields(res)
for i = 1 to nFields
    ? PQfname(res, i-1)
next

? copy("*", 60)

for i = 1 to PQntuples(res)
    for j=1 to nFields
        see PQgetvalue(res, i-1, j-1) + " "
    next
    see nl
next

PQclear(res)

PQfinish(conn)

```

Output:

```

id
name
age
address
salary
*****
1 Mahmoud 31 Jeddah 10
2 Ahmed 27 Jeddah 20
3 Mohammed 31 Egypt 30
4 Ibrahim 24 Egypt 40

```

29.3 RingPostgreSQL Constants

The next constants are define by the RingPostgreSQL Library

```

CONNECTION_STARTED
CONNECTION_MADE
CONNECTION_AWAITING_RESPONSE
CONNECTION_AUTH_OK
CONNECTION_SSL_STARTUP
CONNECTION_SETENV
CONNECTION_OK

PQPING_OK
PQPING_REJECT

```

(continues on next page)

(continued from previous page)

```
PQPING_NO_RESPONSE
PQPING_NO_ATTEMPT

PGRES_EMPTY_QUERY
PGRES_COMMAND_OK
PGRES_TUPLES_OK
PGRES_COPY_OUT
PGRES_COPY_IN
PGRES_BAD_RESPONSE
PGRES_NONFATAL_ERROR
PGRES_FATAL_ERROR
PGRES_COPY_BOTH
PGRES_SINGLE_TUPLE

PG_DIAG_SEVERITY
PG_DIAG_SQLSTATE
PG_DIAG_MESSAGE_PRIMARY
PG_DIAG_MESSAGE_DETAIL
PG_DIAG_MESSAGE_HINT
PG_DIAG_STATEMENT_POSITION
PG_DIAG_INTERNAL_POSITION
PG_DIAG_INTERNAL_QUERY
PG_DIAG_CONTEXT
PG_DIAG_SCHEMA_NAME
PG_DIAG_TABLE_NAME
PG_DIAG_COLUMN_NAME
PG_DIAG_DATATYPE_NAME
PG_DIAG_CONSTRAINT_NAME
PG_DIAG_SOURCE_FILE
PG_DIAG_SOURCE_LINE
PG_DIAG_SOURCE_FUNCTION
```

29.4 RingPostgreSQL Functions

The next functions are define by the RingPostgreSQL Library

Reference : <https://www.postgresql.org/docs/9.1/static/libpq.html>

```
PGconn *PQconnectdbParams(const char **keywords,
                           const char **values,int expand_dbname);
PGconn *PQconnectdb(const char *conninfo)
PGconn *PQsetdbLogin(const char *pghost,const char *pgport,
                     const char *pgoptions,const char *pgtty,
                     const char *dbName,const char *login,const char *pwd)
PGconn *PQsetdb(char *pghost,char *pgport,char *pgoptions,
                char *pgtty,char *dbName)
PGconn *PQconnectStartParams(const char **keywords,
                            const char **values,int expand_dbname)
PGconn *PQconnectStart(const char *conninfo)
PostgresPollingStatusType PQconnectPoll(PGconn *conn)
PQconninfoOption *PQconndefaults(void)
```

(continues on next page)

(continued from previous page)

```

PQconninfoOption *PQconninfo(PGconn *conn)
PQconninfoOption *PQconninfoParse(const char *conninfo, char **errmsg)
void PQfinish(PGconn *conn)
void PQreset(PGconn *conn)
int PQresetStart(PGconn *conn)
PostgresPollingStatusType PQresetPoll(PGconn *conn)
PGPing PQpingParams(const char **keywords, const char **values,
                     int expand_dbname)
PGPing PQping(const char *conninfo)
char *PQdb(const PGconn *conn)
char *PQuser(const PGconn *conn)
char *PQpass(const PGconn *conn)
char *PQhost(const PGconn *conn)
char *PQport(const PGconn *conn)
char *PQtty(const PGconn *conn)
char *PQoptions(const PGconn *conn)
ConnStatusType PQstatus(const PGconn *conn)
PGTransactionStatusType PQtransactionStatus(const PGconn *conn)
const char *PQparameterStatus(const PGconn *conn, const char *paramName)
int PQprotocolVersion(const PGconn *conn)
int PQserverVersion(const PGconn *conn)
char *PQerrorMessage(const PGconn *conn)
int PQsocket(const PGconn *conn)
int PQbackendPID(const PGconn *conn)
int PQconnectionNeedsPassword(const PGconn *conn)
int PQconnectionUsedPassword(const PGconn *conn)
int PQsslInUse(const PGconn *conn)
const char *PQsslAttribute(const PGconn *conn, const char *attribute_name)
const char **PQsslAttributeNames(const PGconn *conn)
void *PQsslStruct(const PGconn *conn, const char *struct_name)
void *PQgetssl(const PGconn *conn)
PGresult *PQexec(PGconn *conn, const char *command);
PGresult *PQexecParams(PGconn *conn, const char *command, int nParams,
                      const Oid *paramTypes, const char **paramValues,
                      const int *paramLengths, const int *paramFormats, int resultFormat)
PGresult *PQprepare(PGconn *conn, const char *stmtName,
                    const char *query, int nParams, const Oid *paramTypes)
PGresult *PQexecPrepared(PGconn *conn, const char *stmtName,
                        int nParams, const char **paramValues,
                        const int *paramLengths, const int *paramFormats, int resultFormat)
PGresult *PQdescribePrepared(PGconn *conn, const char *stmtName)
PGresult *PQdescribePortal(PGconn *conn, const char *portalName)
ExecStatusType PQresultStatus(const PGresult *res)
char *PQresStatus(ExecStatusType status)
char *PQresultErrorMessage(const PGresult *res)
char *PQresultErrorField(const PGresult *res, int fieldcode)
void PQclear(PGresult *res)
int PQntuples(const PGresult *res)
int PQnfields(const PGresult *res)
char *PQfname(const PGresult *res, int column_number)
int PQfnumber(const PGresult *res, const char *column_name)
Oid PQftable(const PGresult *res, int column_number)

```

(continues on next page)

(continued from previous page)

```

int PQftablecol(const PGresult *res,int column_number)
int PQfformat(const PGresult *res,int column_number)
Oid PQftype(const PGresult *res,int column_number)
int PQfmod(const PGresult *res,int column_number)
int PQfsize(const PGresult *res,int column_number)
int PQbinaryTuples(const PGresult *res)
char *PQgetvalue(const PGresult *res,int row_number,int column_number)
int PQgetisnull(const PGresult *res,int row_number,int column_number)
int PQgetlength(const PGresult *res,int row_number,int column_number)
int PQnparams(const PGresult *res)
Oid PQparamtype(const PGresult *res, int param_number)
void PQprint(FILE *fout,const PGresult *res,const PQprintOpt *po)
char *PQcmdStatus(PGresult *res)
char *PQcmdTuples(PGresult *res)
Oid PQoidValue(const PGresult *res)
char *PQoidStatus(const PGresult *res)
char *PQescapeLiteral(PGconn *conn, const char *str, size_t length)
char *PQescapeIdentifier(PGconn *conn, const char *str, size_t length)
size_t PQescapeStringConn(PGconn *conn,char *to,
    const char *from, size_t length,int *error)
size_t PQescapeString(char *to, const char *from, size_t length)
unsigned char *PQescapeByteaConn(PGconn *conn,
    const unsigned char *from,size_t from_length,size_t *to_length)
unsigned char *PQescapeBytea(const unsigned char *from,
    size_t from_length,size_t *to_length)
unsigned char *PQunescapeBytea(const unsigned char *from, size_t *to_length)
int PQsendQuery(PGconn *conn, const char *command)
int PQsendQueryParams(PGconn *conn,const char *command,
    int nParams,const Oid *paramTypes,const char **paramValues,
    const int *paramLengths,const int *paramFormats,int resultFormat)
int PQsendPrepare(PGconn *conn,const char *stmtName,
    const char *query,int nParams,const Oid *paramTypes)
int PQsendQueryPrepared(PGconn *conn,const char *stmtName,
    int nParams,const char **paramValues,
    const int *paramLengths,const int *paramFormats,int resultFormat)
int PQsendDescribePrepared(PGconn *conn, const char *stmtName)
int PQsendDescribePortal(PGconn *conn, const char *portalName)
PGresult *PQgetResult(PGconn *conn)
int PQconsumeInput(PGconn *conn)
int PQisBusy(PGconn *conn)
int PQsetnonblocking(PGconn *conn, int arg)
int PQisnonblocking(const PGconn *conn)
int PQflush(PGconn *conn)
int PQsetSingleRowMode(PGconn *conn)
PGcancel *PQgetCancel(PGconn *conn)
void PQfreeCancel(PGcancel *cancel)
int PQcancel(PGcancel *cancel, char *errbuf, int errbufsize)
int PQrequestCancel(PGconn *conn)
PGresult *PQfn(PGconn *conn,int fnid,int *result_buf,
    int *result_len,int result_is_int,const PQArgBlock *args,int nargs)
PGnotify *PQnotifies(PGconn *conn)
int PQputCopyData(PGconn *conn,const char *buffer,int nbytes)

```

(continues on next page)

(continued from previous page)

```

int PQputCopyEnd(PGconn *conn,const char *errmsg)
int PQgetCopyData(PGconn *conn,char **buffer,int async)
int PQgetline(PGconn *conn,char *buffer,int length)
int PQgetlineAsync(PGconn *conn,char *buffer,int bufsize)
int PQputline(PGconn *conn,const char *string)
int PQputnbytes(PGconn *conn,const char *buffer,int nbytes)
int PQendcopy(PGconn *conn)
int PQclientEncoding(const PGconn *conn)
char *pg_encoding_to_char(int encoding_id)
int PQsetClientEncoding(PGconn *conn, const char *encoding)
void PQtrace(PGconn *conn, FILE *stream)
void PQuntrace(PGconn *conn)
void PQfreemem(void *ptr)
void PQconninfoFree(PQconninfoOption *connOptions)
char *PQencryptPasswordConn(PGconn *conn, const char *passwd,
                           const char *user, const char *algorithm)
char *PQencryptPassword(const char *passwd, const char *user)
PGresult *PQmakeEmptyPGresult(PGconn *conn, ExecStatusType status)
int PQfireResultCreateEvents(PGconn *conn, PGresult *res)
PGresult *PQcopyResult(const PGresult *src, int flags)
int PQsetResultAttrs(PGresult *res, int numAttributes, PGresAttDesc *attDescs)
int PQsetvalue(PGresult *res, int tup_num, int field_num,
               char *value, int len)
void *PQresultAlloc(PGresult *res, size_t nBytes)
int PQlibVersion(void)
PQnoticeReceiver PQsetNoticeReceiver(PGconn *conn,
                                     PQnoticeReceiver proc,void *arg)
PQnoticeProcessor PQsetNoticeProcessor(PGconn *conn,
                                       PQnoticeProcessor proc,void *arg)
void PQinitOpenSSL(int do_ssl, int do_crypto)
void PQinitSSL(int do_ssl)
int PQisthreadsafe(void)

```

SECURITY AND INTERNET FUNCTIONS

This chapter contains the security and internet functions provided by the Ring programming language for Hashing, Encryption & Decryption.

Before using the next functions load the openssllib.ring library

```
load "openssllib.ring"
# Use OpenSSL functions
```

- MD5()
- SHA1()
- SHA256()
- SHA512()
- SHA384()
- SHA224()
- SupportedCiphers()
- Encrypt()
- Decrypt()
- Randbytes()
- rsa_generate
- rsa_export_params
- rsa_import_params
- rsa_export_pem
- rsa_import_pem
- rsa_is_privatekey
- rsa_encrypt_pkcs
- rsa_decrypt_pkcs
- rsa_encrypt_oaep
- rsa_decrypt_oaep
- rsa_encrypt_raw
- rsa_decrypt_raw
- rsa_sign_pkcs

- rsa_signhash_pkcs
- rsa_verify_pkcs
- rsa_verifyhash_pkcs
- rsa_sign_pss
- rsa_signhash_pss
- rsa_verify_pss
- rsa_verifyhash_pss
- openssl_versiontext
- openssl_version
- MD5Init(), MD5Update(), MD5Final()
- SHA1Init(), SHA1Update(), SHA1Final()
- SHA256Init(), SHA256Update(), SHA256Final()
- SHA512Init(), SHA512Update(), SHA512Final()
- SHA384Init(), SHA384Update(), SHA384Final()
- SHA224Init(), SHA224Update(), SHA224Final()

Before using the next functions load the internetlib.ring library

```
load "internetlib.ring"
# Use the Internet functions
```

- Download()
- SendEmail()

30.1 MD5() Function

We can calculate the MD5 hash using the MD5() Function

Syntax:

```
MD5(cString) ---> String contains the MD5 hash of the string cString
```

Example:

```
see "md5('happy') = " + md5("happy") + nl +
"md5('Hello') = " + md5("Hello") + nl
```

Output:

```
md5('happy') = 56ab24c15b72a457069c5ea42fcfc640
md5('Hello') = 8b1a9953c4611296a827abf8c47804d7
```

30.2 SHA1() Function

We can calculate the SHA1 hash using the SHA1() Function

Syntax:

```
SHA1(cString) ---> String contains the SHA1 hash of the string cString
```

Example:

```
see "sha1('hello') : " + sha1("hello") + nl +
      "sha1('apple') : " + sha1("apple") + nl
```

Output:

```
sha1('hello') : aaf4c61ddcc5e8a2dabede0f3b482cd9aea9434d
sha1('apple') : d0be2dc421be4fc0172e5afceea3970e2f3d940
```

30.3 SHA256() Function

We can calculate the SHA256 hash using the SHA256() Function

Syntax:

```
SHA256(cString) ---> String contains the SHA256 hash of the string cString
```

Example:

```
see "sha256('hello') : " + sha256("hello") + nl +
      "sha256('apple') : " + sha256("apple") + nl
```

Output:

```
sha256('hello') : 2cf24dba5fb0a30e26e83b2ac5b9e29e1b161e5c1fa7425e73043362938b9824
sha256('apple') : 3a7bd3e2360a3d29eea436fcfb7e44c735d117c42d1c1835420b6b9942dd4f1b
```

30.4 SHA512() Function

We can calculate the SHA512 hash using the SHA512() Function

Syntax:

```
SHA512(cString) ---> String contains the SHA512 hash of the string cString
```

Example:

```
see "sha512('hello') : " + sha512("hello") + nl +
      "sha512('apple') : " + sha512("apple") + nl +
      "sha512('hello world') : " + sha512("hello world") + nl
```

Output:

```
sha512('hello') : 9b71d224bd62f3785d96d46ad3ea3d73319bfbc2890caadae2dff72519673c
a72323c3d99ba5c11d7c7acc6e14b8c5da0c4663475c2e5c3adef46f73bcd043
sha512('apple') : 844d8779103b94c18f4aa4cc0c3b4474058580a991fba85d3ca698a0bc9e52
c5940feb7a65a3a290e17e6b23ee943ecc4f73e7490327245b4fe5d5efb590feb2
sha512('hello world') : 309ecc489c12d6eb4cc40f50c902f2b4d0ed77ee511a7c7a9bcd3ca8
6d4cd86f989dd35bc5ff499670da34255b45b0cf830e81f605dcf7dc5542e93ae9cd76f
```

30.5 SHA384() Function

We can calculate the SHA384 hash using the SHA384() Function

Syntax:

```
SHA384(cString) ----> String contains the SHA384 hash of the string cString
```

Example:

```
see "sha384('hello') : " + sha384("hello") + nl +
"sha384('apple') : " + sha384("apple") + nl +
"sha384('hello world') : " + sha384("hello world") + nl
```

Output:

```
sha384('hello') : 59e1748777448c69de6b800d7a33bbfb9ff1b463e44354c3553bcd9c666fa
90125a3c79f90397bdf5f6a13de828684f
sha384('apple') : 3d8786fc858c93348756c6429717dc6c374a14f7029362281a3b21dc10250
ddf0d0578052749822eb08bc0dc1e68b0f
sha384('hello world') : fdbd8e75a67f29f701a4e040385e2e23986303ea10239211af907fc8
b83578b3e417cb71ce646efd0819dd8c088de1bd
```

30.6 SHA224() Function

We can calculate the SHA224 hash using the SHA224() Function

Syntax:

```
SHA224(cString) ----> String contains the SHA224 hash of the string cString
```

Example:

```
see "sha224('hello') : " + sha224("hello") + nl +
"sha224('apple') : " + sha224("apple") + nl +
"sha224('hello world') : " + sha224("hello world") + nl
```

Output:

```
sha224('hello') : ea09ae9cc6768c50fceee903ed054556e5bfc8347907f12598aa24193
sha224('apple') : b7bbfdf1a1012999b3c466fdeb906a629caa5e3e022428d1eb702281
sha224('hello world') : 2f05477fc24bb4faefd86517156dafdecec45b8ad3cf2522a563582b
```

30.7 SupportedCiphers() Function

The function SupportedCiphers() retrieves the list of all algorithms supported by Encrypt()/Decrypt() functions.

Syntax:

```
SupportedCiphers() ---> List of names of cipher algorithms supported by Encrypt()/
-Decrypt() functions
```

30.8 Encrypt() Function

We can use the Encrypt() function to encrypt the data using the specified algorithm. If no algorithm is specified, Blowfish algorithm is used in CBC mode. Typical algorithm values: “bf”, “des”, “des3”, “aes128”, “aes192”, “aes256” which all use CBC mode. The function CipherAlgorithms() return the list of all supported cipher algorithms.

Syntax:

```
Encrypt(cString, cKey, cIV[, cCipherAlgorithmName]) ---> Encrypted string
```

30.9 Decrypt() Function

We can use the Decrypt() function to decrypt the data encrypted using the Encrypt() function. If no algorithm is specified, Blowfish algorithm is used in CBC mode. Typical algorithm values: “bf”, “des”, “des3”, “aes128”, “aes192”, “aes256” which all use CBC mode. The function CipherAlgorithms() return the list of all supported cipher algorithms.

Syntax:

```
Decrypt(cCipher, cKey, cIV[, cCipherAlgorithm]) ---> Decrypted string
```

30.10 Encryption and Decryption Example

The next example demonstrates how to use the Encrypt() and Decrypt() functions.

These functions use the AES-128 algorithm (AES with 128-bits key)

```
See "Enter a string : " give cStr
list = 0:15  cKey=""    for x in list cKey += char(x) next
list = 1:16  cIV = ""   for x in list cIV += char(x) next
cStr = Encrypt(cStr,cKey,cIV,"aes128")
See "Cipher Text      : " + cStr + nl +
"Plain Text       : " + Decrypt(cStr,cKey,cIV,"aes128") + nl
```

We can write the same example using normal for loop

```
See "Enter a string : " give cStr

cKey=""                      # 16 bytes
for x = 0 to 15
    cKey += char(x)
```

(continues on next page)

(continued from previous page)

```
next

cIV = ""
for x = 1 to 16
    cIV += char(x)
next

cStr = Encrypt(cStr,cKey,cIV,"aes128")
See "Cipher Text      : " + cStr + nl +
    "Plain Text      : " + Decrypt(cStr,cKey,cIV,"aes128") + nl
```

Also we can write the key and the IV directly using strings

```
See "Enter a string : " give cStr

# Note: Don't use simple key in real applications!
cKey = "1234567890@#$%^&@"
cIV  = "FEDCBA0987654321"

cStr = Encrypt(cStr,cKey,cIV,"aes128")
See "Cipher Text      : " + cStr + nl +
    "Plain Text      : " + Decrypt(cStr,cKey,cIV,"aes128") + nl
```

Finally we can specify the key and the IV values using hexadecimal notation

```
See "Enter a string : " give cStr

# Note: Don't use simple key in real applications!
cKey = hex2str("A0A1A2A3A5A6A7A8AAABACADAFB0B1B2")
cIV  = hex2str("00112233445566778899AABBCCDDEEFF")

cStr = Encrypt(cStr,cKey,cIV,"aes128")
See "Cipher Text      : " + cStr + nl +
    "Plain Text      : " + Decrypt(cStr,cKey,cIV,"aes128") + nl
```

30.11 File Hash

The next example demonstrates how to calculate the hash functions for files

```
cStr = read("myapp.exe")
see "Size : " + len(cStr) + nl +
    "md5 : " + md5(cStr) + nl +
    "sha1 : " + sha1(cStr) + nl +
    "sha256 : " + sha256(cStr) + nl +
    "sha224 : " + sha224(cStr) + nl +
    "sha384 : " + sha384(cStr) + nl +
    "sha512 : " + sha512(cStr) + nl
```

Output:

```
Size : 58079876
md5 : 762eee15d8d2fd73b71ea52538b28667
sha1 : 9212c0c7258bad89a62bd239e1358a9276a9d070
sha256 : 7d6724e69b6c553da749ba31b6185dddc965129b64d9e9bf3de88f67df3b1cdc
sha224 : 5a9c8a7d662bce4f880ba94f90a79362b672528b9efd5abc718c7a3d
sha384 : 18e23f973abedbeb3981c423f12aeadecf96f9c6fb28aeabe3be4c484f8540afcc3861b
b370ce2b59cf3c99c130b856b
sha512 : da3d5e997d06f8b2a7a9964b77f7d82eedb76b245c611082c1639f83f51d83880bcd08f
cd53dcab1167bdca0b82fec5071971ac17c76479d76985ced4ab0d18e
```

30.12 Randbytes() Function

We can generate a string of cryptographically secure pseudo-random bytes using the Randbytes() function.

Syntax:

```
Randbytes(nSize) ---> String contains random bytes (bytes count = nSize)
```

Example:

```
salt = randbytes(32)
password = "SecretPassWord@%123"
see salt + nl
see sha256("test" + salt) + nl
```

30.13 rsa_generate() Function

We can generate a random RSA key pair using the rsa_generate() function.

Syntax:

```
rsa_generate(nBits[,nPublicExponent]) ---> a random RSA key pair with nBits as size inbits
If nPublicExponent is omited, then the standard public exponent value 65537 is used.
```

Example:

```
/* generate a new 2048-bit RSA key pair */
try
    rsaKey = rsa_generate(2048)
    rsaKeyParams = rsa_export_params(rsaKey)
    See "Modulus = " + rsaKeyParams[:n] + nl
catch
    See "Failed to generate the RSA key pair: " + cCatchError + nl
done
```

30.14 rsa_export_params() Function

We can export the parameters of an RSA key to a string-indexed list using the `rsa_export_params()` function. The list contains the following string indexes:

- “type” for the key type as a string equal to “RSA” in our case
- “bits” for the bit length of the key as an integer
- “n” for the Modulus as a hexadecimal string
- “e” for the Public Exponent as a hexadecimal string
- “d” for the Private Exponent as a hexadecimal string
- “p” for the first prime as a hexadecimal string
- “q” for the second prime as a hexadecimal string
- “dmp1” for the first CRT exponent as a hexadecimal string
- “dmq1” for the second CRT exponent as a hexadecimal string
- “iqmp” for the CRT coefficient as a hexadecimal string

If the key contains only the public part, then “d”, “p”, “q”, “dmp1”, “dmq1” and “iqmp” will be empty strings.

Syntax:

```
rsa_export_params(pRsaKey) ---> list of the key parameters
```

Example:

```
/* generate a new 2048-bit RSA key pair */
try
    rsaKey = rsa_generate(2048)
    rsaKeyParams = rsa_export_params(rsaKey)
    See "Key Type = " + rsaKeyParams[:type] + nl
    See "Key Size = " + rsaKeyParams[:bits] + " bits" + nl
    See "Modulus = " + rsaKeyParams[:n] + nl
    See "Public Exponent = " + rsaKeyParams[:e] + nl
    See "Private Exponent = " + rsaKeyParams[:d] + nl
    See "Prime 1 = " + rsaKeyParams[:p] + nl
    See "Prime 2 = " + rsaKeyParams[:q] + nl
    See "CRT Exponent 1 = " + rsaKeyParams[:dmp1] + nl
    See "CRT Exponent 2 = " + rsaKeyParams[:dmq1] + nl
    See "CRT Coefficient = " + rsaKeyParams[:iqmp] + nl
catch
    See "Failed to generate the RSA key pair: " + cCatchError + nl
done
```

30.15 rsa_import_params() Function

We can create a new RSA key from parameters stored in a string-indexed list using the rsa_import_params() function. The format of the input list is the one described in the function rsa_export_params

The indexes “n” and “e” must not be empty, otherwise an exception is thrown. If we need to import only an RSA public key, then the indexes “d”, “p”, “q”, “dmp1”, “dmq1” and “iqmp” must be empty.

Syntax:

```
rsa_import_params(pParamsList) ---> a new RSA key
```

Example:

```
/* create an RSA public key from a generated RSA key pair */
try
    rsaKey = rsa_generate(2048)
    rsaKeyParams = rsa_export_params(rsaKey)

    /* create parameters of public key: modulus and public exponent */
    rsaPublicKeyParam = [:n = rsaKeyParams[:n], :e = rsaKeyParams[:e]]
    /* create the public key using rsa_import_params */
    rsaPublicKey = rsa_import_params(rsaPublicKeyParam)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done
```

30.16 rsa_export_pem() Function

We can export an RSA key to a string in PEM format using the rsa_export_pem() function. If the RSA key contains both public and private parts, then returned string will start with “—BEGIN PRIVATE KEY—”. If the RSA key contains only the public part, then returned string will start with “—BEGIN PUBLIC KEY—”

Syntax:

```
rsa_export_pem(pRsaKey) ---> string encoding of the key in PEM format
```

Example:

```
/* generate an RSA key and save it to a file in PEM format */
try
    rsaKey = rsa_generate(2048)
    rsaKeyPEM = rsa_export_pem(rsaKey)
    /* save private key to a file */
    write ("privateKey.pem", rsaKeyPEM)

    /* save public key to a file */
    rsaKeyParams = rsa_export_params(rsaKey)
    rsaPublicKeyParam = [:n = rsaKeyParams[:n], :e = rsaKeyParams[:e]]
    rsaPublicKey = rsa_import_params(rsaPublicKeyParam)
    rsaPublicKeyPEM = rsa_export_pem(rsaPublicKey)
    write ("publicKey.pem", rsaPublicKeyPEM)
```

(continues on next page)

(continued from previous page)

```

catch
    See "Unexpected error occurred: " + cCatchError + nl
done

```

30.17 rsa_import_pem() Function

We can create an RSA key from PEM encoded string using the rsa_import_pem() function. If the PEM string starts with “—BEGIN PRIVATE KEY—”, then a full RSA key pair will be created. if the PEM string starts with “—BEGIN PUBLIC KEY—”, then an RSA public key will be created.

Syntax:

```
rsa_import_pem(cStrPEM) ---> a new RSA key
```

Example:

```

/* create an RSA key from a PEM file */
try
    rsaKeyPEM = Read("privateKey.pem")
    rsaKey = rsa_import_pem(rsaKeyPEM)

    rsaPublicKeyPEM = Read("publicKey.pem")
    rsaPublicKey = rsa_import_pem(rsaPublicKeyPEM)
catch
    See "Unexpected error occurred: " + cCatchError + nl
done

```

30.18 rsa_is_privatekey() Function

We can check whether an RSA key is a private key or public key using the rsa_is_privatekey() function.

Syntax:

```
rsa_is_privatekey(pRsaKey) ---> returns 1 if pRsaKey is an RSA private key and 0 if it is
an RSA public key
```

Example:

```

/* create an RSA key from a PEM file and check if it is a private key */
try
    rsaKeyPEM = Read("key.pem")
    rsaKey = rsa_import_pem(rsaKeyPEM)

    if rsa_is_privatekey(rsaKey)
        See "an RSA private key was loaded" + nl
    else
        See "an RSA public key was loaded" + nl
    ok

```

(continues on next page)

(continued from previous page)

```
catch
  See "Unexpected error occurred: " + cCatchError + nl
done
```

30.19 rsa_encrypt_pkcs() Function

We can encrypt data with an RSA key and PKCS#1 v1.5 padding using the `rsa_encrypt_pkcs()` function. The maximum size of data that can be encrypted by `rsa_encrypt_pkcs` is `(modulusLen - 11)`, with `modulusLen` the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is $2048/8 = 256$ bytes and so the maximum size of data that can be encrypted is $256 - 11 = 245$ bytes. RSA encryption is usually applied to a symmetric key (e.g. AES) which is used to encrypt much larger data. RSA encryption needs only the public part of an RSA key, so `rsa_encrypt_pkcs` can be used with both RSA private key and RSA public key

Syntax:

```
rsa_encrypt_pkcs(pRsaKey, cPlainData) ---> return a string containing the encryption of
  ↵cPlainData
```

Example:

```
/* encrypt a file using AES key and then encrypt the AES key using an RSA public key */
try
  /* read Alice public key */
  rsaPublicKeyPEM = Read("alice_public_key.pem")
  rsaPublicKey = rsa_import_pem(rsaPublicKeyPEM)

  /* encrypt file with random AES-128 key */
  cData = Read ("secret_document.txt")
  cKey = RandBytes(16)
  cIV = RandBytes(16)
  cEncryptedData = Encrypt(cData,cKey,cIV, "aes128")

  /* encrypt the AES-128 key with the RSA public key */
  cEncryptedKey = rsa_encrypt_pkcs(rsaPublicKey, cKey)

  /* store IV, encrypted AES key and encrypted data in a file to be sent to Alice*/
  Write("encrypted_document.enc", cIV + cEncryptedKey + cEncryptedData)

catch
  See "Unexpected error occurred: " + cCatchError + nl
done
```

30.20 rsa_decrypt_pkcs() Function

We can decrypt data encrypted with an RSA key and PKCS#1 v1.5 padding using the rsa_decrypt_pkcs() function. The size of data that can be decrypted by rsa_decrypt_pkcs must be equal to modulusLen which is the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is $2048/8 = 256$ bytes and so the size of encrypted data that can be decrypted must be 256 bytes. For RSA decryption, the RSA key must contain the private key part.

Syntax:

```
rsa_decrypt_pkcs(pRsaKey, cEncryptedData) ---> return a string containing the decryption
→ of cEncryptedData
```

Example:

```
/* decrypt a file by first decrypting AES key that was used to encrypt it
 * and then decrypt the whole content using the AES key
 */
try
    /* read Alice private key */
    rsaKeyPEM = Read("alice_private_key.pem")
    rsaKey = rsa_import_pem(rsaKeyPEM)

    /* calculate the modulus length */
    rsaKeyParams = rsa_export_params(rsaKey)
    modulusLen = rsaKeyParams[:bits]/ 8

    /* read encrypted file */
    cEncryptedContent = Read ("encrypted_document.enc")

    /* IV is the first 16 bytes if the file */
    cIV = substr(cEncryptedContent, 1, 16)

    /* encrypted key follows IV and its length is modulusLen */
    cEncryptedKey = substr(cEncryptedContent, 17, modulusLen)

    /* encrypted data follows the key */
    cEncryptedData = substr(cEncryptedContent, 17 + modulusLen)

    /* decrypt the AES-128 key */
    cKey = rsa_decrypt_pkcs(rsaKey,cEncryptedKey)

    /* decrypt the data using the AES-128 key */

    cPlainData = Decrypt(cEncryptedData,cKey,cIV,"aes128")

    /* store the decrypted data to a file */
    Write("decrypted_document.txt", cPlainData)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done
```

30.21 rsa_encrypt_oaep() Function

We can encrypt data with an RSA key and OAEP padding using the rsa_encrypt_oaep() function. The maximum size of data that can be encrypted by rsa_encrypt_oaep is (modulusLen - 2*hashLen -2), with modulusLen the length of the RSA key modulus in bytes and hashLen and the length of hash algorithm used. For example, for 2048-bit RSA key, the length of modulus is 2048/8 = 256 bytes and so the maximum size of data that can be encrypted using OAEP padding with SHA-1 is 256 - 2*20 - 2 = 214 bytes. RSA encryption is usually applied to a symmetric key (e.g. AES) which is used to encrypt much larger data. RSA encryption needs only the public part of an RSA key, so rsa_encrypt_oaep can be used with both RSA private key and RSA public key.

Syntax:

```
rsa_encrypt_oaep(pRsaKey,cPlainData[,nHashAlgorithm]) ---> return a string containing
→ the OAEP encryption of cPlainData
    nHashAlgorithm indicates the hash algorithm to use for OAEP padding. If omitted,
→ SHA-1 is used by default.
    Possible values for nHashAlgorithm argument are:
        - $OSSL_HASH_MD5 which is equal to 0
        - $OSSL_HASH_SHA1 which is equal to 1
        - $OSSL_HASH_SHA256 which is equal to 2
        - $OSSL_HASH_SHA384 which is equal to 3
        - $OSSL_HASH_SHA512 which is equal to 4
```

Example:

```
/* encrypt a file using AES key and then encrypt the AES key using an RSA public key
→ using OAEP padding */
try
    /* read Alice public key */
    rsaPublicKeyPEM = Read("alice_public_key.pem")
    rsaPublicKey = rsa_import_pem(rsaPublicKeyPEM)

    /* encrypt file with random AES-128 key */
    cData = Read ("secret_document.txt")
    cKey = RandBytes(16)
    cIV = RandBytes(16)
    cEncryptedData = Encrypt(cData,cKey,cIV, "aes128")

    /* encrypt the AES-128 key with the RSA public key */
    cEncryptedKey = rsa_encrypt_oaep(rsaPublicKey,cKey)

    /* store IV, encrypted AES key and encrypted data in a file to be sent to Alice*/
    Write("oaep_encrypted_document.enc", cIV + cEncryptedKey + cEncryptedData)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done
```

30.22 rsa_decrypt_oaep() Function

We can decrypt data encrypted with an RSA key and OAEP padding using the rsa_decrypt_oaep() function. The size of data that can be decrypted by rsa_decrypt_oaep must be equal to modulusLen which is the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is $2048/8 = 256$ bytes and so the size of encrypted data that can be decrypted must be 256 bytes. For RSA decryption, the RSA key must contain the private key part. The hash algorithm specified in rsa_decrypt_oaep() call must be the same as the one used during OAEP encryption.

Syntax:

```
rsa_decrypt_oaep(pRsaKey,cEncryptedData[,nHashAlgorithm]) ---> return a string.  
↳ containing the decryption of cEncryptedData  
    nHashAlgorithm indicates the hash algorithm to use for OAEP padding. If omitted,  
↳ SHA-1 is used by default.  
    Possible values for nHashAlgorithm argument are:  
        - $OSSL_HASH_MD5 which is equal to 0  
        - $OSSL_HASH_SHA1 which is equal to 1  
        - $OSSL_HASH_SHA256 which is equal to 2  
        - $OSSL_HASH_SHA384 which is equal to 3  
        - $OSSL_HASH_SHA512 which is equal to 4
```

Example:

```
/* decrypt a file by first decrypting AES key that was used to encrypt it
 * and then decrypt the whole content using the AES key
 */
try
    /* read Alice private key */
    rsaKeyPEM = Read("alice_private_key.pem")
    rsaKey = rsa_import_pem(rsaKeyPEM)

    /* calculate the modulus length */
    rsaKeyParams = rsa_export_params(rsaKey)
    modulusLen = rsaKeyParams[:bits]/ 8

    /* read encrypted file */
    cEncryptedContent = Read ("oaep_encrypted_document.enc")

    /* IV is the first 16 bytes if the file */
    cIV = substr(cEncryptedContent, 1, 16)

    /* encrypted key follows IV and its length is modulusLen */
    cEncryptedKey = substr(cEncryptedContent, 17, modulusLen)

    /* encrypted data follows the key */
    cEncryptedData = substr(cEncryptedContent, 17 + modulusLen)

    /* decrypt the AES-128 key */
    cKey = rsa_decrypt_oaep(rsaKey,cEncryptedKey)

    /* decrypt the data using the AES-128 key */
```

(continues on next page)

(continued from previous page)

```
cPlainData = Decrypt(cEncryptedData,cKey,cIV,"aes128")

/* store the decrypted data to a file */
Write("oaepe_decrypte_document.txt", cPlainData)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done
```

30.23 rsa_encrypt_raw() Function

We can perform raw RSA encryption on data using the function `rsa_encrypt_raw()`. The size of data must be equal to the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is $2048/8 = 256$ bytes and so the size of input data that can be encrypted using raw RSA is 256 bytes. Raw RSA encryption needs only the public part of an RSA key, so `rsa_encrypt_raw` can be used with both RSA private key and RSA public key. Raw RSA should only be used to implement secure cryptographic protocols. Encrypting user data directly with raw RSA is insecure.

Syntax:

```
rsa_encrypt_raw(pRsaKey,cPlainData) ---> return a string containing the raw RSA
→ encryption of cPlainData
```

Example:

```
/* encrypt a file using AES key and then encrypt the AES key using an RSA public key
→ using PKCS1 padding */
/* we manually add PKCS1 padding and then perform raw RSA encryption */
try
    /* read Alice public key */
    rsaPublicKeyPEM = Read("alice_public_key.pem")
    rsaPublicKey = rsa_import_pem(rsaPublicKeyPEM)

    /* encrypt file with random AES-128 key */
    cData = Read ("secret_document.txt")
    cKey = RandBytes(16)
    cIV = RandBytes(16)
    cEncryptedData = Encrypt(cData,cKey,cIV,"aes128")

    /* encrypt the AES-128 key with the RSA public key */

    /* calculate the modulus length */
    rsaKeyParams = rsa_export_params(rsaPublicKey)
    modulusLen = rsaKeyParams[:bits]/ 8

    /* we manually add PKCS1 padding */
    paddingSize = modulusLen - Len(cKey) - 2 - 1
    paddingStr = space (paddingSize)

    /* encryption case. Add random bytes */
    for i=1 to paddingSize
```

(continues on next page)

(continued from previous page)

```

paddingStr[i] = Char (1 + Random(254))
next

paddedData = Char(0) + Char(2) + paddingStr + Char (0) + cKey

cEncryptedKey = rsa_encrypt_raw(rsaPublicKey, paddedData)

/* store IV, encrypted AES key and encrypted data in a file to be sent to Alice*/
Write("raw_encrypted_document.enc", cIV + cEncryptedKey + cEncryptedData)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done

```

30.24 rsa_decrypt_raw() Function

We can perform raw RSA decryption of data using the rsa_decrypt_pkcs() function. The size of data that can be decrypted by rsa_decrypt_raw must be equal to modulusLen which is the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is 2048/8 = 256 bytes and so the size of encrypted data that can be decrypted must be 256 bytes. For raw RSA decryption, the RSA key must contain the private key part. The size of the result of raw RSA decryption is equal to the length of RSA modulus in bytes.

Syntax:

```
rsa_decrypt_raw(pRsaKey, cEncryptedData) ---> return a string containing the decryption
of cEncryptedData
```

Example:

```

/* decrypt a file by first decrypting AES key that was used to encrypt it
 * and then decrypt the whole content using the AES key
 /* We decrypt AES using rsa_decrypt_raw and then remove padding manually
 */
try
    /* read Alice private key */
    rsaKeyPEM = Read("alice_private_key.pem")
    rsaKey = rsa_import_pem(rsaKeyPEM)

    /* calculate the modulus length */
    rsaKeyParams = rsa_export_params(rsaKey)
    modulusLen = rsaKeyParams[:bits]/ 8

    /* read encrypted file */
    cEncryptedContent = Read ("encrypted_document.enc")

    /* IV is the first 16 bytes if the file */
    cIV = substr(cEncryptedContent, 1, 16)

    /* encrypted key follows IV and its length is modulusLen */
    cEncryptedKey = substr(cEncryptedContent, 17, modulusLen)

```

(continues on next page)

(continued from previous page)

```

/* encrypted data follows the key */
cEncryptedData = substr(cEncryptedContent, 17 + modulusLen)

/* decrypt the AES-128 key */
cPaddedKey = rsa_decrypt_raw(rsaKey, cEncryptedKey)

/* remove PKCS1 padding */
paddedInputLength = len(cPaddedKey)
cKey = ""
if paddedInputLength > 11 AND Ascii(cPaddedKey[1]) = 0 AND Ascii(cPaddedKey[2]) ↵
= 2
    zeroFound = false
    for j = 3 to paddedInputLength
        if Ascii(cPaddedKey[j]) = 0
            i = j
            zeroFound = true
            exit
    ok
next

if zeroFound
    if i = paddedInputLength
        /* unpadded data is empty */
        Raise("Empty data recovered from padding")
    else
        cKey = substr(cPaddedKey, i+1)
    ok
else
    Raise ("Invalid data padding")
ok

/* decrypt the data using the AES-128 key */

cPlainData = Decrypt(cEncryptedData, cKey, cIV, "aes128")

/* store the decrypted data to a file */
Write("decrypted_document.txt", cPlainData)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done

```

30.25 rsa_sign_pkcs() Function

We can sign data with RSA PKCS#1 v1.5 padding using the function `rsa_sign_pkcs()`. The maximum size of data that can be signed by `rsa_sign_pkcs` is `(modulusLen - 11)`, with `modulusLen` the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is $2048/8 = 256$ bytes and so the maximum size of data that can be signed is $256 - 11 = 245$ bytes. For RSA PKCS signature, the RSA key must contain the private key part. The size of the result of RSA PKCS signature is equal to the length of RSA modulus in bytes.

Syntax:

```
rsa_sign_pkcs(pRsaKey, cData) ---> return a string containing RSA PKCS signature
```

Example:

```
/* sign a document using RSA-PKCS with SHA256.
 * digest OID added manually
 */
try
    /* read Alice private key */
    rsaKeyPEM = Read("alice_private_key.pem")
    rsaKey = rsa_import_pem(rsaKeyPEM)

    /* read file content */
    cFileContent = Read ("document.txt")

    /* hash content */
    digest = SHA256(cFileContent)

    /* digest OID of SHA256 */
    digestOID = hex2str("3031300d060960864801650304020105000420")

    /* perform PKCS signing */
    dataToSign = digestOID + digest
    cSignature = rsa_sign_pkcs(rsaKey,dataToSign)

    /* store the signature */
    Write("document.txt.pkcs1.sig", cSignature)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done
```

30.26 rsa_signhash_pkcs() Function

We can sign a hash value with RSA PKCS#1 v1.5 padding using the function `rsa_signhash_pkcs()`. This function infers the hash algorithm from hash value size and it automatically adds OID of hash algorithm before applying the PKCS#1 v1.5 padding. For RSA PKCS signature, the RSA key must contain the private key part. The size of the result of RSA PKCS signature is equal to the length of RSA modulus in bytes.

Syntax:

```
rsa_signhash_pkcs(pRsaKey, cHashValue) ---> return a string containing RSA PKCS signature
```

Example:

```
/* sign a document using RSA-PKCS with SHA256.
*/
try
    /* read Alice private key */
    rsaKeyPEM = Read("alice_private_key.pem")
    rsaKey = rsa_import_pem(rsaKeyPEM)

    /* read file content */
    cFileContent = Read ("document.txt")

    /* hash content */
    digest = SHA256(cFileContent)

    /* perform PKCS signing */
    cSignature = rsa_signhash_pkcs(rsaKey,digest)

    /* store the signature */
    Write("document.txt.pkcs1.sig", cSignature)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done
```

30.27 rsa_verify_pkcs() Function

We can verify an RSA-PKCS signature of data using the function `rsa_verify_pkcs()`. The size of signature must be equal to the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is $2048/8 = 256$ bytes and so the size of input signature that can be verified using RSA-PKCS is 256 bytes. RSA-PKCS verification needs only the public part of an RSA key, so `rsa_verify_pkcs` can be used with both RSA private key and RSA public key.

Syntax:

```
rsa_verify_pkcs(pRsaKey,cData,cSignature) ---> returns 1 if signature is valid and 0 otherwise
```

Example:

```
/* verify a document signature using RSA-PKCS with SHA256
* digest OID is added manually
*/
try
    /* read Alice public key */
    rsaPublicKeyPEM = Read("alice_public_key.pem")
    rsaPublicKey = rsa_import_pem(rsaPublicKeyPEM)

    /* read file content */
    cFileContent = Read ("document.txt")

    /* hash content */
```

(continues on next page)

(continued from previous page)

```

digest = SHA256(cFileContent)

/* digest OID of SHA256 */
digestOID = hex2str("3031300d060960864801650304020105000420")

/* read file signature */
cSignature = Read ("document.txt.pkcs1.sig")

/* perform PKCS verification */
dataToVerify = digestOID + digest
if rsa_verify_pkcs(rsaPublicKey,dataToVerify,cSignature)
    See "file signature is valid" + nl
else
    See "file signature is INVALID" + nl
ok

catch
    See "Unexpected error occurred: " + cCatchError + nl
done

```

30.28 rsa_verifyhash_pkcs() Function

We can verify the RSA-PKCS signature of a hash value using the function `rsa_verifyhash_pkcs()`. This function infers the hash algorithm from hash value size and it automatically uses the OID of hash algorithm during verification. The size of signature must be equal to the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is $2048/8 = 256$ bytes and so the size of input signature that can be verified using RSA-PKCS is 256 bytes. RSA-PKCS verification needs only the public part of an RSA key, so `rsa_verifyhash_pkcs` can be used with both RSA private key and RSA public key.

Syntax:

```
rsa_verifyhash_pkcs(pRsaKey,cHashValue,cSignature) ---> returns 1 if signature is valid
    ↵and 0 otherwise
```

Example:

```

/* verify a document signature using RSA-PKCS with SHA256
*/
try
    /* read Alice public key */
    rsaPublicKeyPEM = Read("alice_public_key.pem")
    rsaPublicKey = rsa_import_pem(rsaPublicKeyPEM)

    /* read file content */
    cFileContent = Read ("document.txt")

    /* hash content */
    digest = SHA256(cFileContent)

    /* read file signature */
    cSignature = Read ("document.txt.pkcs1.sig")

```

(continues on next page)

(continued from previous page)

```

/* perform PKCS verification */
if rsa_verifyhash_pkcs(rsaPublicKey,digest,cSignature)
    See "file signature is valid" + nl
else
    See "file signature is INVALID" + nl
ok

catch
    See "Unexpected error occurred: " + cCatchError + nl
done

```

30.29 rsa_sign_pss() Function

We can sign data with RSA PSS using the function rsa_sign_pss(). The input data will be first hashed using the specified hash algorithm then RSA PSS signing will be applied to the computed hash value. For RSA PSS signature, the RSA key must contain the private key part. The size of the result of RSA PSS signature is equal to the length of RSA modulus in bytes.

Syntax:

```

rsa_sign_pss(pRsaKey,cData,nHashAlgorithm[,nSaltLength]) ---> return a string containing
    ↵RSA PSS signature
        nHashAlgorithm indicates the hash algorithm to use for hashing and PSS padding.
        nSaltLength indicates the length of PSS salt to use. If omitted, then maximum
    ↵salt length is used.
        nSaltLength can have the special values -1 and -2: -1 indicates that salt length
    ↵is equal to hash size
        and -2 indicates that maximum salt length is used.
        Possible values for nHashAlgorithm argument are:
            - $OSSL_HASH_MD5 which is equal to 0
            - $OSSL_HASH_SHA1 which is equal to 1
            - $OSSL_HASH_SHA256 which is equal to 2
            - $OSSL_HASH_SHA384 which is equal to 3
            - $OSSL_HASH_SHA512 which is equal to 4

```

Example:

```

/* sign a document using RSA-PSS with SHA256 and maximal salt length
*/
try
    /* read Alice private key */
    rsaKeyPEM = Read("alice_private_key.pem")
    rsaKey = rsa_import_pem(rsaKeyPEM)

    /* read file content */
    cFileContent = Read ("document.txt")

    /* perform PSS signing */
    cSignature = rsa_sign_pss(rsaKey,cFileContent,$OSSL_HASH_SHA256)

```

(continues on next page)

(continued from previous page)

```

/* store the signature */
Write("document.txt.sig", cSignature)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done

```

30.30 rsa_signhash_pss() Function

We can sign a hash value with RSA PSS using the function `rsa_signhash_pss()`. This function infers the hash algorithm from hash value size. For RSA PSS signature, the RSA key must contain the private key part. The size of the result of RSA PSS signature is equal to the length of RSA modulus in bytes.

Syntax:

```

rsa_signhash_pss(pRsaKey, cHashValue[, nSaltLength]) ---> return a string containing RSA_PSS signature
    nSaltLength indicates the length of PSS salt to use. If omitted, then maximum salt length is used.
        nSaltLength can have the special values -1 and -2: -1 indicates that salt length is equal to hash size
            and -2 indicates that maximum salt length is used.

```

Example:

```

/* sign a document using RSA-PSS with SHA256 and maximal salt length
*/
try
    /* read Alice private key */
    rsaKeyPEM = Read("alice_private_key.pem")
    rsaKey = rsa_import_pem(rsaKeyPEM)

    /* hash file content */
    ctx = SHA256Init()
    cFileContent = Read ("document.txt")
    SHA256Update(ctx, cFileContent)
    digest = SHA256Final(ctx)

    /* perform PSS signing */
    cSignature = rsa_signhash_pss(rsaKey,digest)

    /* store the signature */
    Write("document.txt.sig", cSignature)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done

```

30.31 rsa_verify_pss() Function

We can verify the RSA-PSS signature of data using the function `rsa_verify_pss()`. The input data will be first hashed using the specified hash algorithm then RSA PSS verification will be applied to the computed hash value and the given signature to check if they match or not. The size of signature must be equal to the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is $2048/8 = 256$ bytes and so the size of input signature that can be verified using RSA-PSS is 256 bytes. RSA-PSS verification needs only the public part of an RSA key, so `rsa_verify_pss` can be used with both RSA private key and RSA public key.

Syntax:

```
rsa_verify_pss(pRsaKey,cData,cSignature,nHashAlgorithm[,nSaltLength]) ---> returns 1 if
↳ signature is valid and 0 otherwise
    nHashAlgorithm indicates the hash algorithm to use for hashing and PSS padding.
    nSaltLength indicates the length of PSS salt to use. If omitted, then maximum
↳ salt length is used.
    nSaltLength can have the special values -1 and -2: -1 indicates that salt length
↳ is equal to hash size
    and -2 indicates that maximum salt length is used.
Possible values for nHashAlgorithm argument are:
    - $OSSL_HASH_MD5 which is equal to 0
    - $OSSL_HASH_SHA1 which is equal to 1
    - $OSSL_HASH_SHA256 which is equal to 2
    - $OSSL_HASH_SHA384 which is equal to 3
    - $OSSL_HASH_SHA512 which is equal to 4
```

Example:

```
/* verify a document signature using RSA-PSS with SHA256 and maximal salt length
*/
try
    /* read Alice public key */
    rsaPublicKeyPEM = Read("alice_public_key.pem")
    rsaPublicKey = rsa_import_pem(rsaPublicKeyPEM)

    /* read file content */
    cFileContent = Read ("document.txt")

    /* read file signature */
    cSignature = Read ("document.txt.sig")

    /* perform PSS verification */
    if rsa_verify_pss(rsaPublicKey,cFileContent,cSignature,$OSSL_HASH_SHA256)
        See "file signature is valid" + nl
    else
        See "file signature is INVALID" + nl
    ok

    /* store the signature */
    Write("document.txt.sig", cSignature)

catch
    See "Unexpected error occurred: " + cCatchError + nl
done
```

30.32 rsa_verifyhash_pss() Function

We can verify the RSA-PSS signature of a hash value using the function rsa_verifyhash_pss(). This function infers the hash algorithm from hash value size. The size of signature must be equal to the length of the RSA key modulus in bytes. For example, for 2048-bit RSA key, the length of modulus is $2048/8 = 256$ bytes and so the size of input signature that can be verified using RSA-PSS is 256 bytes. RSA-PSS verification needs only the public part of an RSA key, so rsa_verifyhash_pss can be used with both RSA private key and RSA public key.

Syntax:

```
rsa_verifyhash_pss(pRsaKey, cHashValue, cSignature[, nSaltLength]) ---> returns 1 if
↳ signature is valid and 0 otherwise
    nSaltLength indicates the length of PSS salt to use. If omitted, then maximum
↳ salt length is used.
    nSaltLength can have the special values -1 and -2: -1 indicates that salt length
↳ is equal to hash size
    and -2 indicates that maximum salt length is used.
```

Example:

```
/* verify a document signature using RSA-PSS with SHA256 and maximal salt length
 */
try
    /* read Alice public key */
    rsaPublicKeyPEM = Read("alice_public_key.pem")
    rsaPublicKey = rsa_import_pem(rsaPublicKeyPEM)

    /* hash file content */
    ctx = SHA256Init()
    cFileContent = Read ("document.txt")
    SHA256Update(ctx, cFileContent)
    digest = SHA256Final(ctx)

    /* read file signature */
    cSignature = Read ("document.txt.sig")

    /* perform PSS verification */
    if rsa_verifyhash_pss(rsaPublicKey, digest, cSignature)
        See "file signature is valid" + nl
    else
        See "file signature is INVALID" + nl
    ok

catch
    See "Unexpected error occurred: " + cCatchError + nl
done
```

30.33 openssl_versiontext() Function

We can get the full version text of the OpenSSL library using the function `openssl_versiontext()`. The returned string is equal to the value returned by the command “`openssl.exe version`”

Syntax:

```
openssl_versiontext() ---> return a string containing the full version text of OpenSSL
                                ↵library
```

Example:

```
/* Display the version of OpenSSL library used by Ring
 */
See "Ring is using " + openssl_versionText() + nl
```

30.34 openssl_version() Function

We can get the version numbers (Major,Minor,Fix) of the OpenSSL library using the function `openssl_version()`. The returned list contains three items corresponding to the the three part of the version. For example, for OpenSSL 1.0.2, `openssl_version()` returns the list [1,0,2]

Syntax:

```
openssl_version() ---> return a list containing the version numbers of the OpenSSL
                                ↵library
                                First list item holds the version major number
                                Second list item holds the version minor number
                                Third list item holds the version fix number
```

Example:

```
/* Display the version number of OpenSSL library used by Ring
 */
ver = openssl_version()
OpenSSLVersionMajor = ver[1]
OpenSSLVersionMinor = ver[2]
OpenSSLVersionFix = ver[3]
See "Ring is using OpenSSL version " + OpenSSLVersionMajor + "." + OpenSSLVersionMinor +
                                ↵"." + OpenSSLVersionFix + nl
```

30.35 Large Files Hash

These functions compute the hash of large files/data without the need to load all of the content in a single string.

```
md5init() -> MD5_CTX
md5update (MD5_CTX, string) -> 1 for success or 0 for failure
md5final (MD5_CTX) -> string

shalinit() -> SHA_CTX
```

(continues on next page)

(continued from previous page)

```

sha1update (SHA_CTX, string) -> 1 for success or 0 for failure
sha1final (SHA_CTX) -> string

sha224init() -> SHA224_CTX
sha224update (SHA224_CTX, string) -> 1 for success or 0 for failure
sha224final (SHA224_CTX) -> string

sha256init() -> SHA256_CTX
sha256update (SHA256_CTX, string) -> 1 for success or 0 for failure
sha256final (SHA256_CTX) -> string

sha384init() -> SHA384_CTX
sha384update (SHA384_CTX, string) -> 1 for success or 0 for failure
sha384final (SHA384_CTX) -> string

sha512init() -> SHA512_CTX
sha512update (SHA512_CTX, string) -> 1 for success or 0 for failure
sha512final (SHA512_CTX) -> string

```

30.36 Download() Function

Syntax:

```
Download(cURL) ---> String contains the server response
```

Example:

```
cStr= download("https://ring-lang.github.io/")
see cStr
write("download.txt",cStr)
```

30.37 SendEmail() Function

Syntax:

```
SendEmail(cSMTPServer,cEmail,cPassword,cSender,cReceiver,cCC,cTitle,cContent)
```

Example:

```
See "Send email..." + nl
sendemail("smtp://smtp.gmail.com:587",
          "email@gmail.com",
          "password",
          "email@gmail.com",
          "somebody@yahoo.com",
          "somebodyelse@yahoo.com",
          "Sending email from Ring",
          "Hello")
```

(continues on next page)

(continued from previous page)

```
How are you?  
Are you fine?  
Thank you!  
Greetings,  
Mahmoud")
```

```
see "Done.." + nl
```

OBJECT ORIENTED PROGRAMMING (OOP)

In this chapter we are going to learn how to use the Object-Oriented programming paradigm inside the Ring programming language.

We will learn about

- Classes and Objects
- Access Objects Using Braces
- Composition
- Setter and Getter
- Private Attributes and Methods
- Operator Overloading
- Inheritance
- Dynamic Attributes
- Packages
- Printing Objects
- Find() and List of Objects
- Sort() and List of Objects
- Using Self.Attribute and Self.Method()
- Using This.Attribute and This.Method()
- Command: New From

31.1 Classes and Objects

We can define new classes using the next syntax

Syntax:

```
Class <Class Name> [From|<| : <Parent Class Name>]
    [Attributes]
    [Methods]
    [Private
        [Attributes]
        [Methods]
    ]
```

And we can create objects using the next syntax

Syntax:

```
New <Object Name> [ (init method parameters) ] |  
[ { access object data and methods } ] ---> Object
```

Example:

```
New point { x=10 y=20 z=30 print() }  
Class Point x y z func print see x + nl + y + nl + z + nl
```

Note: We can use { } to access object data and methods.

Tip: we can declare the class attributes directly after the class name.

Output:

```
10  
20  
30
```

We can rewrite the same program in another style

```
New point # create new object using the point class  
{ # access the new object attributes and methods  
    x = 10 # set the x attribute to 10  
    y = 20 # set the y attribute to 20  
    z = 30 # set the z attribute to 30  
    print() # call the print method  
}  
  
Class Point # define the Point class  
    x y z # the class contains three attributes x, y & z  
    func print # define the print method  
        see x + nl + # print the x attribute  
        y + nl + # print the y attribute  
        z + nl # print the z attribute
```

Also we can write the same program in another way

```
P1 = New Point  
P1.x = 10  
P1.y = 20  
P1.z = 30  
P1.Print()  
Class Point x y z func print see x + nl + y + nl + z + nl
```

Note: we can use the dot operator after the object name to access object members.

Also we can write the same program in another way

```
new point { print() }
Class Point
  x = 10  y = 20  z = 30
  func print see x + nl + y + nl + z + nl
```

Note: we can set the default values for the class attributes when we declare them.

Also we can write the same program in another way

```
new point(10,20,30)
Class Point
  x y z
  func init p1,p2,p3 x=p1 y=p2 z=p3 print()
  func print see x + nl + y + nl + z + nl
```

Note: we can call the init method directly using () when we create new objects

Also we can write the same program in another way

```
new point( [ :x = 10 , :y = 20 , :z = 30 ] )
Class Point x y z
  func init aPara x = aPara[:x] y = aPara[:y] z = aPara[:z] print()
  func print see x + nl + y + nl + z + nl
```

Tip: using Hash for passing method parameters enable us to create optional parameters and change the order of parameters when adding them to the Hash.

31.2 Access Objects Using Braces

We can access the object at any time using braces { }

Inside the braces we can use the object attributes and methods directly

This can be done when we create the object using the New keyword or at any time using the next syntax

```
ObjectName { access object data and methods }
```

Example:

```
See "Creating the Object" + nl
o1 = new Point
See "Using the Object" + nl
o1 {
  x=5
  y=15
  z=25
```

(continues on next page)

(continued from previous page)

```

    print()
}
Class Point x y z func print see x + nl + y + nl + z

```

We can use braces to access objects when we call functions or methods

Example:

```

o1 = new Point

print( o1 { x=10 y=20 z=30 } )

func print object
    see object.x + nl +
        object.y + nl +
        object.z

Class Point x y z

```

We can mix between using braces and the dot operator to access the object in the same expression.

Example:

```

o1 = new Point

o1 { x=10 y=20 z=30 }.print()

Class Point x y z
    func print see x + nl + y + nl + z

```

31.3 Composition

The object may contains other objects as attributes.

Using braces to access objects can be nested.

Example:

```

R1 = New Rectangle
{
    Name = "Rectangle 1"

    P1
    {
        X = 10
        Y = 20
    }

    P2
    {
        X = 200
    }
}

```

(continues on next page)

(continued from previous page)

```

        Y = 300
    }

    Color = "Blue"

}

see "Name : " + R1.Name + nl +
"Color: " + R1.Color + nl +
"P1 : (" + R1.P1.X + "," + R1.P1.Y + ")" + nl +
"P2 : (" + R1.P2.X + "," + R1.P2.Y + ")"

Class Rectangle
    name color
    p1 = new Point
    p2 = new Point

Class Point x y

```

Output:

```

Name : Rectangle 1
Color: Blue
P1   : (10,20)
P2   : (200,300)

```

31.4 Setter and Getter

We can define methods to be used when we set and get object attributes.

Syntax:

```

Class ClassName

    AttributeName
    ...

    Func SetAttributeName
    ...

    Func GetAttributeName
    ...

```

Example:

```

o1 = new person

o1.name = "Mahmoud" see o1.name + nl

o1 { name = "Ahmed" see name }

```

(continues on next page)

(continued from previous page)

Class Person

```

name family = "Fayed"

func setname value
    see "Message from SetName() Function!" + nl
    name = value + " " + family

func getname
    see "Message from GetName() Function!" + nl
    return "Mr. " + name

```

Output:

```

Message from SetName() Function!
Message from GetName() Function!
Mr. Mahmoud Fayed
Message from SetName() Function!
Message from GetName() Function!
Mr. Ahmed Fayed

```

31.5 Private Attributes and Methods

We can define private attributes and methods after the keyword `private` inside the class body

Note: A subclass could access private attributes/methods defined in the parent class.

Tip: Once we create an object, no other object (even from the same class) could access it's private attributes/methods directly.

Example:

```

o1 = new person {
    name = "Test"
    age = 20
    print()
    o1.printsalary()
}

try
    see o1.salary
catch
    see cCatchError + nl
done

try
    o1.increasesalary(1000)
catch

```

(continues on next page)

(continued from previous page)

```

see cCatchError + nl
done

Class Person

    name age

    func print
        see "Name : " + name + nl +
        "Age : " + age + nl

    func printsalary
        see "Salary : " + salary + nl

    private

    salary = 15000

    func increasesalary x
        salary += x

```

Output:

```

Name : Test
Age : 20
Salary : 15000
Error (R27) : Using private attribute from outside the class : salary
Error (R26) : Calling private method from outside the class : increasesalary

```

31.6 Operator Overloading

We can add the operator method to our class to enable using operators with the class objects.

Syntax:

```

Class ClassName

    ...

Func operator cOperator ,Para

    ...

```

The function operator takes two parameters, the first represent the operator and the second represent the second parameter after the operator.

Example:

```

o1 = new point { x = 10 y = 10 print("P1 : ") }
o2 = new point { x = 20 y = 40 print("P2 : ") }

```

(continues on next page)

(continued from previous page)

```

o3 = o1 + o2
o3.print("P1+P2 : ")

class point x y

func operator cOperator,Para
    result = new point
    switch cOperator
    on "+"
        result.x = x + Para.x
        result.y = y + Para.y
    on "-"
        result.x = x - Para.x
        result.y = y - Para.y
    off
    return result

func print cPoint
    see cPoint + "X : " + x + " Y : " + y + nl

```

Output:

```

P1      : X : 10 Y : 10
P2      : X : 20 Y : 40
P1+P2 : X : 30 Y : 50

```

The next example from the List class in the stdlib.ring

```

Func operator cOperator,Para
    result = new list
    switch cOperator
    on "+"
        if isobject(para)
            for t in Para.vValue
                vValue + t
            next
        but islist(para)
            for t in Para
                vValue + t
            next
        ok
    on "len"
        return len( vValue )
    on "[ ]"
        return &vValue[para]
    off
    return result

```

The “len” operator is used with (for in) control structure.

The “[]” operator is used when we try to access the list items, In this case we use the & operator to return the item values like strings and numbers by reference, so we can update it when we access the items.

Another Example

```

func main

See "----1"+nl
    a1 = new BigNumber( "123" )
    a2 = new BigNumber( "456" )
    a3 = new BigNumber( "789" )
See nl+"----2"+nl
    a1.print()
    a2.print()
    a3.print()
See nl+"----3"+nl
    a2 = a1 + "45"
See nl+"----4"+nl
    a2.print()
See nl+"----5"+nl
    a3 = a1 + a2
See nl+"----6"+nl
    a3.print()
See nl+"----7"+nl

#####
Func FuncAdd( num1, num2)
    Sum = 0 + num1 + num2      ### Para.aData isNumber
    Sum = "" +Sum              ### Para.adata isString
return Sum                  ### return to Class
#####

class BigNumber

    ### Variables
    aData = "468"

    ### Functions INIT default values
func init aPara
    ? "INIT aPara: " ? aPara
    if isString(aPara)
        aData = aPara
    else
        aData = "" + aPara
    ok

    ### Other Functions
func operator cOperator, Para
    whatType = Type(Para)
    ? nl+"WhatType-PARA: "+ whatType ? Para
    ? nl+"Operator: " ? cOperator ? nl+"PARA: " ? Para ? "      _____" ? nl
        if whatType = "STRING"
            dataInfo = Para
            ? "dataInfo String: " ? dataInfo
        but whatType = "NUMBER"
            datinfo = "" + Para
            ? "dataInfo Number: " ? dataInfo
        else whatType = "OBJECT"

```

(continues on next page)

(continued from previous page)

```

        dataInfo = "" + para.aData
        ? "dataInfo OBJECT: " ? dataInfo
    ok
    ? "dataInfo USING: " ? dataInfo
### Para.aData does NOT exist on first pass ( Object with member)
### Result isObject when assigned "self"
result = self
switch cOperator
on "+"
    answer = FuncAdd( aData, dataInfo )
    ? nl+"AnswerString - FunAdd aData, dataInfo: " ? answer
    ### result = self, is Object, populate Object with aData member
    result.aData = answer
off
### Result = Self is Object
return result

func print
? nl+"ClassPrint aData: " ? aData

```

Starting from Ring 1.21, We support that the value could come first before the object and the operator() method will be called but the letter ‘r’ will comes before the operator (i.e. r+ instead of +)

Example:

```

? f(2)

mylist = new List([1,2,3])

f(mylist).print()

func f x
    return 2+x*x      # Here 2 comes before x and x could be an object

class List

aList = []

func init vValue
    aList = vValue

func operator cOperator,vValue

    if cOperator = "r+"
        cOperator = "+"
    ok

    switch cOperator
    on "+"
        if isNumber(vValue) {
            for t in aList
                t += vValue
            next
        }
    end

```

(continues on next page)

(continued from previous page)

```

        but isObject(vValue)
            for t = 1 to len(aList)
                aList[t] += vValue[t]
            next
        ok
    on "*"
        if isNumber(vValue) {
            for t in aList
                t *= vValue
            next
        but isObject(vValue)
            for t = 1 to len(aList)
                aList[t] *= vValue[t]
            next
        ok
    on "[]"
        return aList[vValue]
    on "len"
        return len(aList)
    off
    return self

func print
    ? aList

```

Output:

```

6
3
6
11

```

Note: the numbers(3,6,11) are the result of applying the function f to the list items [1,2,3]

31.7 Inheritance

We can create class from another class in the class definition using the keyword from.

Syntax:

```
Class <Class Name> [From <Parent Class Name>]
```

We can call a method in the parent class from the child class using Super.

Note: Super provide access to the methods only (No access to the attributes).

Tip: Using ParentClassName(self) we can know the parent class name or get an empty string if no parent class exists.

Syntax:

```
func methodname
    ...
    super.methodname()
    ...
```

Example:

```
Func main
    e1 = new Employee {
        Name = "test"
        age = 20
        job = "programmer"
        salary = 20000000
        print()
    }

Class Human
    Name Age
    func print
        see "Name : " + name + nl + "Age : " + age + nl

Class Employee from Human
    Job Salary
    func print
        super.print()
        see "Job : " + job + nl + "Salary : " + salary + nl
```

Output:

```
Name : test
Age : 20
Job : programmer
Salary : 20000000
```

31.8 Dynamic Attributes

We can write instructions after the class name to be executed when we create new objects

Example:

```
o1 = new dynamicClass
see o1.var5 + nl      # output 5

Class DynamicClass
    for x = 1 to 10
        cStr = "var" + x + " = " + x
        eval(cStr)
    next
```

Tip: in the previous example var1, var2, ..., var10 will be defined as attributes.

Tip: The problem with the previous example is that x and cStr will be defined as attributes too!

Note: we can write class definitions inside a string then using eval() we can execute the string to define the classes

31.9 Packages

We can create a package (a group of classes under a common name) using the next syntax

```
package PackageName
    Class Class1
    ...
    Class Class2
    ...
    Class Class3
    ...
    ...
```

Example

```
o1 = new System.output.console
o1.print("Hello World")

Package System.Output
    Class Console
        Func Print cText
            see cText + nl
```

Note: we can use the dot operator as part of the package name

Instead of typing the long name PackageName.ClassName we can use the import command

When we import a package, we can use any class inside this package directly.

Example

```
import system.output
o1 = new console {
    print("Hello World")
}
Package System.Output
    Class Console
        Func Print cText
            see cText + nl
```

31.10 Printing Objects

We can print the object state (attributes and values) using the see command.

Example:

```
see new point { x=10 y=20 z=30 }
class point x y z
```

Output:

```
x: 10.000000
y: 20.000000
z: 30.000000
```

31.11 Find() and List of Objects

We can use the find() function to search inside a list of objects.

Syntax:

```
Find(List, ItemValue, nColumn, cAttribute) ---> Item Index
```

Example:

```
myList1 = [new Company {position=3 name="Mahmoud" symbol="MHD"},
           new Company {position=2 name="Bert" symbol="BRT"},
           new Company {position=1 name="Ring" symbol="RNG"}]
]

see find(mylist1,"Bert",1,"name") + nl
see find(mylist1,"Ring",1,"name") + nl
see find(mylist1,"Mahmoud",1,"name") + nl
see find(mylist1,"RNG",1,"symbol") + nl
see find(mylist1,"MHD",1,"symbol") + nl
see find(mylist1,"BRT",1,"symbol") + nl
see find(mylist1,3,1,"position") + nl
see find(mylist1,1,1,"position") + nl
see "Other" + nl
see find(mylist1,"test",1,"name") + nl
see find(mylist1,"test",0,"name") + nl
see find(mylist1,"test",5,"name") + nl

class company position name symbol
```

Output:

```
2
3
1
3
1
```

(continues on next page)

(continued from previous page)

```
2
1
3
Other
0
0
0
```

31.12 Sort() and List of Objects

We can sort a list of objects based on an object attribute using the Sort() function.

Syntax:

```
Sort(List,nColumn,cAttribute) ---> Sorted List based on Object Attribute
```

Example:

```
myList1 = [
    new Company {position=3 name="Mahmoud" symbol="MHD"},  

    new Company {position=2 name="Bert" symbol="BRT"},  

    new Company {position=8 name="Charlie" symbol="CHR"},  

    new Company {position=6 name="Easy" symbol="FEAS"},  

    new Company {position=7 name="Fox" symbol="EFOX"},  

    new Company {position=5 name="Dog" symbol="GDOG"},  

    new Company {position=4 name="George" symbol="DGRG"},  

    new Company {position=1 name="Ring" symbol="RNG"}  

]  
  

see sort(mylist1,1,"name")  

see copy("*,70) + nl  

see sort(mylist1,1,"symbol")  

see copy("*,70) + nl  

see sort(mylist1,1,"position")  
  

class company position name symbol
```

Output:

```
position: 2.000000
name: Bert
symbol: BRT
position: 8.000000
name: Charlie
symbol: CHR
position: 5.000000
name: Dog
symbol: GDOG
position: 6.000000
name: Easy
symbol: FEAS
```

(continues on next page)

(continued from previous page)

```
position: 7.000000
name: Fox
symbol: EFOX
position: 4.000000
name: George
symbol: DGRG
position: 3.000000
name: Mahmoud
symbol: MHD
position: 1.000000
name: Ring
symbol: RNG
*****
position: 2.000000
name: Bert
symbol: BRT
position: 8.000000
name: Charlie
symbol: CHR
position: 4.000000
name: George
symbol: DGRG
position: 7.000000
name: Fox
symbol: EFOX
position: 6.000000
name: Easy
symbol: FEAS
position: 5.000000
name: Dog
symbol: GDOG
position: 3.000000
name: Mahmoud
symbol: MHD
position: 1.000000
name: Ring
symbol: RNG
*****
position: 1.000000
name: Ring
symbol: RNG
position: 2.000000
name: Bert
symbol: BRT
position: 3.000000
name: Mahmoud
symbol: MHD
position: 4.000000
name: George
symbol: DGRG
position: 5.000000
name: Dog
```

(continues on next page)

(continued from previous page)

```
symbol: GDOG
position: 6.000000
name: Easy
symbol: FEAS
position: 7.000000
name: Fox
symbol: EFOX
position: 8.000000
name: Charlie
symbol: CHR
```

31.13 Using Self.Attribute and Self.Method()

Inside the class region (After the class name and before any method) and the class methods we can use self.attribute and self.method()

```
Class Point
    self.x = 10
    self.y = 20
    self.z = 30
    func print
        see self.x + nl + self.y + nl + self.z + nl
```

Note: using self.attribute in the class region to define the class attribute protect the class attributes from conflict with global variables.

Tip: if we defined the class attributes without using self or this and there are a global variable with the same name it will be used and the attribute will not be defined.

Check the “Scope Rules” chapter to know about the conflict between the global variable name and the attribute name

What this may happens?

Because

- Because in the class region we can access global variables.
- Before defining any variable, Ring try to find the variable and use it if it's found.

Note: Try to avoid the global variables, use the main function and start their names with \$

Tip: In large programs protect your classes and define their members using self.attribute

Tip: A better solution to avoid using self and this in the class region is to use different global scope and the load package command

31.14 Using This.Attribute and This.Method()

Inside class methods we have access to the object scope directly. we don't need to use Self.attribute or Self.method to read/write attribute and call methods.

But we can use braces {} while we are inside methods to access another object, In this case the current object scope will be changed while we are inside the brace.

How we can get access to our class attributes and methods while we are inside braces?

This can be done using This.Attribute and This.Method()

Example:

```
new point

class point
    x=10 y=20 z=30
    print()
    func print
        new UI {
            display(this.x,this.y,this.z)
        }

Class UI
    func display x,y,z
        see x + nl + y + nl + z + nl
```

31.15 Using This in the class region as Self

The class region is the region that comes after the class name and before any method.

We can use This in the class region as Self.

Example:

```
func main

    o1 = new program {
        test()
    }

    ? o1

class program

    this.name = "My Application"
    this.version = "1.0"
    ? name ? version

    func test
        ? "Name      = " + name
        ? "Version = " + version
```

Output

```
My Application
1.0
Name      = My Application
Version   = 1.0
name: My Application
version: 1.0
```

Note: When we use braces to change the current active object, Using This we can still point to the class.

Tip: The difference between This and Self is that Self point to the current active object that we can change using braces.

Remember that in most cases we don't need to use This or Self in the class region

We can write

```
class program name version
```

Or

```
class program name="My Application" version="1.0"
```

Note: We use This or Self in the class region just to avoid conflict with global variables that are defined with the same name.

31.16 Default value for object attributes

The default value for object attributes is NULL

In Ring, the NULL value is just an empty string or a string that contains “NULL”

We can check for NULL values using the isNULL() function

Example:

```
oProgram = new Program
? oProgram.name
? oProgram.version
? isNULL(oProgram.name)
? isNULL(oProgram.version)
oProgram { name="My Application" version="1.0" }
? isNULL(oProgram.name)
? isNULL(oProgram.version)
? oProgram

class program
    name
    version
```

Output:

```
NULL
NULL
1
1
0
0
name: My Application
version: 1.0
```

31.17 Command: New From

Using (new) we can create a new object from a specific class

Using (new from) we provide a variable which contains the class name

Example:

```
cClassName = "myclass2"
myobj = new from cClassName

cClassName = "myclass"
myobj = new from cClassName

class myclass
    ? :hello

class myclass2
    ? :wow
```

Output:

```
wow
hello
```

31.18 Using Objects During Definition

Starting from Ring 1.19, The language provides better support for using objects during definition where we can mix between this feature and other features like operator overloading without missing the output

Example:

```
OBJECT
x: 10
y: 20
z: 30

NUMBER
11

1
2 myVar = new Point { x=10 y=20 z=30 print(myVar) } + 1
3 ? Type(myVar)
4 ? myVar
5
6 class point x y z func print oObj ? Type(oObj) ? oObj
7     func operator cOp,vValue
8         if cOp = "+" return x + vValue ok
```

- The new point object will be stored directly in myVar during definition
- We can pass myVar as parameter to the print() method
- Using + 1 will call the operator() method
- The operator() method output will be stored in myVar

This means that the Assignment operation is executed TWO TIMES!

The first Assignment is executed to support (Using objects during definition) where myVar is an object contains the new point while in the second time, the Assignment is executed to support storing the Operator Overloading output.

Note: RingQt samples uses this feature to quickly pass the parent window object to the other widgets.

CHAPTER
THIRTYTWO

FUNCTIONAL PROGRAMMING

In previous chapters we learned about Functions and Recursion.

In this chapter we are going to learn about more Functional Programming (FP) concepts like

- Pure Functions
- First-class functions
- Higher-order functions
- Anonymous and nested functions.
- Equality of functions

32.1 Pure Functions

We can create pure functions (functions that doesn't change the state) by the help of the assignment operator to copy variables (Lists & Objects) by value to create new variables instead of working on the original data that are passed to the function by reference.

Example:

```
Func Main
    aList = [1,2,3,4,5]
    aList2 = square(aList)
    see "aList" + nl
    see aList
    see "aList2" + nl
    see aList2

Func Square aPara
    a1 = aPara                # copy the list
    for x in a1
        x *= x
    next
    return a1                  # return new list
```

Output:

```
aList
1
2
```

(continues on next page)

(continued from previous page)

```
3
4
5
aList2
1
4
9
16
25
```

32.2 First-class Functions

Functions inside the Ring programming language are first-class citizens, you can pass functions as parameters, return them as value or store them in variables.

We can pass/return the function by typing the function name as literal like “FunctionName” or :FunctionName for example.

We can pass/return functions using the variable that contains the function name.

We can call function from variables contains the function name using the Call command

Syntax:

```
Call Variable([Parameters])
```

Example:

```
Func Main
    see "before test2()" + nl
    f = Test2(:Test)
    see "after test2()" + nl
    call f()

Func Test
    see "Message from test!" + nl

Func Test2 f1
    call f1()
    See "Message from test2!" + nl
    return f1
```

Output:

```
before test2()
Message from test!
Message from test2!
after test2()
Message from test!
```

32.3 Higher-order Functions

Higher-order functions are the functions that takes other functions as parameters.

Example:

```
Func Main
    times(5,:test)

Func Test
    see "Message from the test function!" + nl

Func Times nCount,F

    for x = 1 to nCount
        Call F()
    next
```

Output:

```
Message from the test function!
```

32.4 Anonymous and Nested Functions

Anonymous Functions are functions without names that can be passed as parameters to other functions or stored in variables.

Syntax:

```
Func [Parameters] { [statements] }
```

Example:

```
test( func x,y {
            see "hello" + nl
            see "Sum : " + (x+y) + nl
        } )

new great { f1() }

times(3, func { see "hello world" + nl } )

func test x
    call x(3,3)
    see "wow!" + nl

func times n,x
    for t=1 to n
```

(continues on next page)

(continued from previous page)

```

call x()
next

Class great
  func f1
    f2( func { see "Message from f1" + nl } )

  func f2 x
    call x()

```

Output:

```

hello
Sum : 6
wow!
Message from f1
hello world
hello world
hello world

```

Example:

```

Func Main
  aList = [1,2,3,4]
  Map (aList , func x {
        return x*x
      } )
  see aList
  aList = [4,9,14,25]
  Map(aList, :myfilter )
  see aList
  aList = [11,12,13,14]
  Map (aList , func x {
    if x%2=0
      return "even"
    else
      return "odd"
    ok
  })
  see aList

Func myfilter x
  if x = 9
    return "True"
  else
    return "False"
  ok

Func Map aList,cFunc
  for x in aList
    x = call cFunc(x)
  next

```

Output:

```
1
4
9
16
False
True
False
False
odd
even
odd
even
```

32.5 Equality of functions

We can test if function = function or not using the '=' or '!=> operators

Example:

```
f1 = func { see "hello" + nl }

f2 = func { see "how are you?" + nl }

f3 = f1

call f1()
call f2()
call f3()

see (f1 = f2) + nl
see (f2 = f3) + nl
see (f1 = f3) + nl
```

Output:

```
hello
how are you?
hello
0
0
1
```

CHAPTER
THIRTYTHREE

REFLECTION AND META-PROGRAMMING

Since the Ring programming language is a dynamic language, we can get answers about the program code and we can modify our code during the runtime.

In this chapter we will learn about this and the available functions to use.

- locals()
- globals()
- functions()
- cfunctions()
- islocal()
- isglobal()
- isfunction()
- iscfunction()
- packages()
- ispackage()
- classes()
- isclass()
- packageclasses()
- ispackageclass()
- classname()
- parentclassname()
- objectid()
- isobject()
- attributes()
- methods()
- isattribute()
- isprivateattribute()
- ismethod()
- isprivatemethod()
- addattribute()

- addmethod()
- getattribute()
- setattribute()
- mergemethods()
- packagename()
- importpackage()
- nothing()
- optionalfunc()

33.1 locals() Function

We can get a list of variables names in the current scope using the locals() function.

Syntax:

```
locals() --> a list contains the variables names in the current scope
```

Example:

```
test("hello")

func test cMsg

    see cMsg + nl

    x = 10
    y = 20
    z = 30

    see locals()
```

Output:

```
hello
cmsg
x
y
z
```

33.2 globals() Function

We can get a list of variables names in the global scope using the globals() function.

Syntax:

```
globals() --> a list contains variables names in the global scope
```

Example:

```
x=10 y=20 z=30
test()

func test
    see "message from test()" + nl +
        "Global Variables:" + nl
    see globals()
```

Output:

```
message from test()
Global Variables:
x
y
z
```

33.3 functions() Function

We can get a list of functions names written in the Ring language using the functions() function.

Syntax:

```
functions() --> a list contains functions names
```

Example:

```
see functions()

func f1
    see "f1" + nl

func f2
    see "f2" + nl

func f3
    see "f3" + nl
```

Output:

```
f1
f2
f3
```

33.4 cfunctions() Function

We can get a list of functions names written in the C language using the cfunctions() function.

Syntax:

```
cfuctions() --> a list contains functions names
```

Example:

```
aList = cfunctions()
See "Count : " + len(aList) + nl
for x in aList
    see x + "()" + nl
next
```

Output:

```
Count : 255
len()
add()
del()
get()
clock()
...
```

Note: The complete list is removed from the previous output.

33.5 islocal() Function

We can check if a variable is defined in the local scope or not using the islocal() function.

Syntax:

```
islocal(cVariableName) --> returns 1 if the variable is defined in the local scope
                                returns 0 if the variable is not defined in the local scope
```

Example:

```
test()

func test
    x=10 y=20
    see islocal("x") + nl +
        islocal("y") + nl +
        islocal("z") + nl
```

Output:

```
1
1
0
```

33.6 isglobal() Function

We can check if a variable is defined in the global scope or not using the isglobal() function.

Syntax:

```
isglobal(cVariableName) --> returns 1 if the variable is defined in the global scope
                                returns 0 if the variable is not defined in the global scope
```

Example:

```
x=10 y=20

test()

func test
    see isglobal("x") + nl +
        isglobal("y") + nl +
        isglobal("z") + nl
```

Output:

```
1
1
0
```

33.7 isfunction() Function

We can check if a Ring function is defined or not using the isfunction() function.

Syntax:

```
isfunction(cFunctionName) --> returns 1 if the Ring function is defined
                                returns 0 if the Ring function is not defined
```

Example:

```
see isfunction("f1") + nl +
    isfunction("f2") + nl +
    isfunction("f3") + nl

func f1
    see "message from f1()" + nl

func f2
    see "message from f2()" + nl
```

Output:

```
1
1
0
```

33.8 iscfunction() Function

We can check if a C function is defined or not using the iscfunction() function.

Syntax:

```
iscfunction(cFunctionName) --> returns 1 if the C function is defined
                                returns 0 if the C function is not defined
```

Example:

```
see iscfunction("len") + nl +
iscfunction("add") + nl +
iscfunction("test") + nl
```

Output:

```
1
1
0
```

33.9 packages() Function

We can get a list of packages names using the packages() function.

Syntax:

```
packages() --> a list contains packages names
```

Example:

```
See packages()

Package Package1
    Class class1
        Func f1

Package Package2
    Class class1
        Func f1

Package Package3
    Class class1
        Func f1

Package Package4
    Class class1
        Func f1
```

Output:

```
package1
package2
package3
package4
```

33.10 ispackage() Function

We can check if a package is defined or not using the ispackage() function.

Syntax:

```
ispackage(cPackageName) --> returns 1 if the Package is defined
                                returns 0 if the Package is not defined
```

Example:

```
See ispackage("package1") + nl +
      ispackage("package4") + nl +
      ispackage("package5") + nl +
      ispackage("package3") + nl
```

```
Package Package1
  Class class1
    Func f1
```

```
Package Package2
  Class class1
    Func f1
```

```
Package Package3
  Class class1
    Func f1
```

```
Package Package4
  Class class1
    Func f1
```

Output:

```
1
1
0
1
```

33.11 classes() Function

We can get a list of classes names using the classes() function.

Syntax:

```
classes() --> a list contains classes names
```

Example:

```
See classes()

Class class1
    Func f1

Class class2
    Func f1

Class class3
    Func f1
```

Output:

```
class1
class2
class3
```

33.12 isclass() Function

We can check if a class is defined or not using the isclass() function.

Syntax:

```
isclass(cClassName) --> returns 1 if the Class is defined
                           returns 0 if the Class is not defined
```

Example:

```
see isclass("class4") + nl +
isclass("class3") + nl +
isclass("class2") + nl

Class class1
    func f1

class class2
    func f1

class class3
    func f1
```

Output:

```
0
1
1
```

33.13 packageclasses() Function

We can get a list of classes names inside a package using the packageclasses() function.

Syntax:

```
packageclasses(cPackageName) --> a list contains classes names inside the package
```

Example:

```
see "classes in Package1" + nl
see packageclasses("Package1")
see "classes in Package2" + nl
see packageclasses("Package2")

Package Package1
    Class class1
        Func f1

Package Package2
    Class class1
        Func f1
    Class class2
        Func f1
    Class class3
        func f1
```

Output:

```
classes in Package1
class1
classes in Package2
class1
class2
class3
```

33.14 ispackageclass() Function

We can check if a class is defined inside package or not using the ispackageclass() function.

Syntax:

```
ispackageclass(cPackageName,cClassName) --> returns 1 if the Class is defined
                                                returns 0 if the Class is not defined
```

Example:

```

see ispackageclass("package1","class1") + nl +
ispackageclass("package1","class2") + nl +
ispackageclass("package2","class1") + nl +
ispackageclass("package2","class2") + nl

Package Package1
  Class class1
    Func f1

Package Package2
  Class class1
    Func f1
  Class class2
    Func f1
  Class class3
    func f1

```

Output:

```

1
0
1
1

```

33.15 classname() Function

We can know the class name of an object using the classname() function

Syntax:

```
classname(object) --> Returns the object class name
```

Example:

```

o1 = new point
o2 = new rect

see classname(o1) + nl      # print point
see classname(o2) + nl      # print rect

class point
class rect

```

33.16 parentclassname() Function

We can know the parent class name of an object using the parentclassname() function

Syntax:

```
parentclassname(object) --> Returns the parent class name of the object class
```

Example:

```
new Child { test() }

class Parent
class Child from Parent
func test
    ? "Parent: " + parentClassName(self)
```

Output:

```
Parent: parent
```

33.17 objectid() Function

We can know the object id using the objectid() function

Syntax:

```
objectid(object) --> Returns the object id
```

Example:

```
o1 = new point
see objectid(o1) + nl
test(o1)

func test v
    see objectid(v) + nl

Class point x y z
```

Output:

```
021B5808
021B5808
```

33.18 isobject() Function

We can check the variable to know if it's an object or not using the isobject() function

Syntax:

```
isobject(variable) --> Returns True if it's an object, False if it's not
```

33.19 attributes() Function

We can get the object attributes using the attributes() function

Syntax:

```
attributes(object) --> Returns a list contains the object attributes
```

Example:

```
o1 = new point
aList = attributes(o1)           # we can use see attributes(o1)
for t in aList see t next       # print xyz
Class Point x y z
```

33.20 methods() Function

We can get the object methods using the methods() function

Syntax:

```
methods(object) --> Returns a list contains the object methods
```

Example:

```
o1 = new test
aList = methods(o1)

for x in aList
    cCode = "o1."+x+"()"
    eval(cCode)
next

Class Test
    func f1
        see "hello from f1" + nl
    func f2
        see "hello from f2" + nl
    func f3
        see "hello from f3" + nl
    func f4
        see "hello from f4" + nl
```

Output:

```
hello from f1
hello from f2
hello from f3
hello from f4
```

33.21 isattribute() Function

We can test if the object contains an attribute or not using the isattribute() function

Syntax:

```
isattribute(object,cAttributeName) --> Returns True if the object contains the attribute
```

Example:

```
o1 = new point

see isattribute(o1,"x") + nl      # print 1
see isattribute(o1,"t") + nl      # print 0
see isattribute(o1,"y") + nl      # print 1
see isattribute(o1,"z") + nl      # print 1

class point x y z
```

33.22 isprivateattribute() Function

We can test if the object contains a private attribute or not using the isprivateattribute() function

Syntax:

```
isprivateattribute(object,cAttributeName) --> Returns True if the object
contains the private attribute
```

Example:

```
o1 = new person

see isprivateattribute(o1,"name") + nl +
isprivateattribute(o1,"address") + nl +
isprivateattribute(o1,"phone") + nl +
isprivateattribute(o1,"job") + nl +
isprivateattribute(o1,"salary")

Class Person
    name address phone
    private
        job salary
```

Output:

```
0
0
0
1
1
```

33.23 ismethod() Function

We can test if the object class contains a method or not using the ismethod() function

Syntax:

```
ismethod(object,cMethodName) --> Returns True if the object class contains the method
```

Example:

```
o1 = new point

see ismethod(o1,"print") + nl          # print 1

mylist = []
mylist + new point

see ismethod(mylist[1],"print") + nl    # print 1

class point x y z
  func print
    see x + nl + y + nl + z + nl
```

33.24 isprivatemethod() Function

We can test if the object class contains a private method or not using the isprivatemethod() function

Syntax:

```
isprivatemethod(object,cMethodName) --> Returns True if the object class contains
                                         the private method
```

Example:

```
o1 = new Test

see isprivatemethod(o1,"f1") + nl +
  isprivatemethod(o1,"f2")

Class Test
  func f1
    see "message from f1()" + nl
  private
    func f2
      see "message from f2()" + nl
```

Output:

```
0
1
```

33.25 addattribute() Function

We can add an attribute (or a group of attributes) to the object state (not the class) using the addattribute() function

Syntax:

```
AddAttribute(object,cAttributeName|aAttributesList)
```

Example(1):

```
see new point {x=10 y=20 z=30}
Class Point
    AddAttribute(self,[ "x", "y", "z" ])
```

Example(2):

```
o1 = new point
addattribute(o1,"x")
addattribute(o1,"y")
addattribute(o1,"z")
see o1 {x=10 y=20 z=30}
class point
```

Output:

```
x: 10.000000
y: 20.000000
z: 30.000000
```

33.26 addmethod() Function

We can add a method to the object class using the addmethod() function This method can be used with any object from the same class.

Syntax:

```
AddMethod(Object,cNewMethodName,cMethodName|AnonymousFunction)
```

Example:

```
o1 = new point { x=10 y=20 z=30 }

addmethod(o1,"print", func { see x + nl + y + nl + z + nl } )

o1.print()
```

(continues on next page)

(continued from previous page)

```
Class point
    x y z
```

Output:

```
10
20
30
```

Instead of using anonymous function to add new method to the class, we can use the function name

Example:

```
o1 = new point { x=10 y=20 z=30 }

myfunc = func { see x + nl + y + nl + z + nl }

addmethod(o1,"print", myfunc )
addmethod(o1,"display", myfunc )
addmethod(o1,"show", myfunc )

o1.print()
o1.display()
o1.show()

Class point
    x y z
```

Output:

```
10
20
30
10
20
30
10
20
30
```

Since we add the method to the class, any object from that class can use this method

Example:

```
o1 = new point { x=10 y=20 z=30 }
o2 = new point { x=100 y=200 z=300 }
o3 = new point { x=50 y=150 z=250 }

addmethod(o1,"print", func { see x + nl + y + nl + z + nl } )

o1.print()
o2.print()
o3.print()
```

(continues on next page)

(continued from previous page)

```
Class point
  x y z
```

Output:

```
10
20
30
100
200
300
50
150
250
```

33.27 getattribute() function

We can get the object attribute value using the getattribute() function

Syntax:

```
GetAttribute(oObject,cAttributeName) ---> Attribute Value
```

Example:

```
o1 = new point

see getattribute(o1,"name") + nl +
      getattribute(o1,"x") + nl +
      getattribute(o1,"y") + nl +
      getattribute(o1,"z") + nl

Class Point
      x=10 y=20 z=30
      name = "3D-Point"
```

Output:

```
3D-Point
10
20
30
```

Example:

We can Find a Class List Member using GetAttribute() using a function findclass() The Find uses the member name, rather than the column number

```
myList =
  [new Company {position=3 name="Mahmoud" symbol="MHD"},  

   new Company {position=2 name="Bert" symbol="BRT"},  

   new Company {position=1 name="Ring" symbol="RNG"}]
```

(continues on next page)

(continued from previous page)

```

]

see myList
see nl + "======" + nl + nl

for i = 1 to len(myList)
    see "Pos: " + i + " | " + myList[i].position + " | " + myList[i].name +
        " | " + myList[i].symbol + " | " + nl
next

See findclass(myList, "MHD", "symbol") +nl    ### Specify Member class name

###-----

func findclass classList, cValue, classMember

    See nl + "FindClass: " + " " + cValue + nl + nl

    for i = 1 to len(classList)
        result = getattribute( classList[i], classMember )

        See "Result-Attr: " + i + " " + result + nl
        if result = cValue
            j = i
            ok
        next
    return j

###-----

class company position name symbol

```

Output:

```

Pos: 1 | 3 | Mahmoud | MHD |
Pos: 2 | 2 | Bert | BRT |
Pos: 3 | 1 | Ring | RNG |

```

```
FindClass: MHD
```

```

Result-Attr: 1 MHD
Result-Attr: 2 BRT
Result-Attr: 3 RNG

```

```
1
```

33.28 setattribute() function

We can set the object attribute value using the setattribute() function

Syntax:

```
SetAttribute(oObject,cAttributeName,Value)
```

Example:

```
o1 = new person
setattribute(o1,"cName","Mahmoud")
setattribute(o1,"nSalary",1000000)
setattribute(o1,"aColors",["white","blue","yellow"])

see o1
see o1.aColors

Class Person
    cName
    nSalary
    aColors
```

Output:

```
cname: Mahmoud
nsalary: 1000000.000000
acolors: List...
white
blue
yellow
```

33.29 mergemethods() Function

We can share methods between classes without inheritance using the MergeMethods() function

This function merge class methods to another class.

Syntax:

```
MergeMethods(cClassNameDestination,cClassNameSource)
```

Example:

```
mergemethods("count","share")
mergemethods("count2","share")

o1 = new count { test() }
o1 = new count2 { test() }

Class Share
    func one
        see "one" + nl
```

(continues on next page)

(continued from previous page)

```

func two
    see "two" + nl
func three
    see "three" + nl

Class Display
    Func printline
        see copy("*",20) + nl

Class Count from Display
    Func test
        printline()
        one()
        two()
        three()
        printline()

Class Count2 from Display
    Func test
        three()
        two()
        one()
        printline()

```

Output:

```

*****
one
two
three
*****
three
two
one
*****

```

33.30 packagename() Function

We can know the package name of the latest successful import command using the packagename() function

Syntax:

```
packagename() --> Returns the package name of the latest successful import
```

Example:

```

load "weplib.ring"
import System.web
see packagename()      # system.web

```

33.31 importpackage() Function

Instead of using the import command we can use the importpackage() function

This function get the package name through a string or variable

This is useful if the package name will be known only during the runtime

Syntax:

```
importpackage(cPackageName)
```

Example:

```
importpackage(:mypackage)
new myclass { myfunction() }

package mypackage
    class myclass
        function myfunction
            ? "Hello, World!"
```

33.32 Nothing() function

This function does nothing and can accept any number/type of parameters. The output will be Zero.

Some of the Use Cases

- (1) Performance measurements, where we can test the performance of calling functions written in C and we can change the number of parameters during tests.
- (2) In places of code that you want to write a function name, and it's not defined yet.
- (3) To disable some feature/code by just changing the function name to nothing without changing the parameters or commenting the code.
- (4) In small programs, where you want to write a function that you can override from a Test program.

33.33 OptionalFunc() function

Using this function we can define functions similar to Nothing() but with a different name.

Syntax:

```
OptionalFunc(cFunctionName)
```

Example:

File: Question.ring

```
optionalFunc(:reply)

? "I love Programming, What about you?"
reply()
? "Ok, Thanks!"
```

Output:

```
I love Programming, What about you?  
Ok, Thanks!
```

File: Answer.ring

```
load "Question.ring"  
  
func reply  
    ? "Me too!"
```

Output:

```
I love Programming, What about you?  
Me too!  
Ok, Thanks!
```

CHAPTER
THIRTYFOUR

DECLARATIVE PROGRAMMING USING NESTED STRUCTURES

In this chapter we are going to learn how to build declarative programming world using nested structures on the top of object oriented.

We will learn about

- Creating Objects inside Lists
- Composition and Returning Objects and Lists by Reference
- Executing code after the end of object access
- Declarative Programming on the top of Object-Oriented

34.1 Creating Objects inside Lists

We can create objects inside lists during list definition. Also we can add objects to the list at any time using the Add() function or the + operator.

Example:

```
alist = [new point, new point, new point]      # create list contains three objects
alist + [1,2,3]                                # add another item to the list

see "Item 4 is a list contains 3 items" + nl
see alist[4]

add(alist , new point)
alist + new point

alist[5] { x = 100 y = 200 z = 300 }
alist[6] { x = 50 y = 150 z = 250 }

see "Object inside item 5" + nl
see alist[5]
see "Object inside item 6" + nl
see alist[6]

class point x y z
```

Output:

```
Item 4 is a list contains 3 items
1
2
3
Object inside item 5
x: 100.000000
y: 200.000000
z: 300.000000
Object inside item 6
x: 50.000000
y: 150.000000
z: 250.000000
```

34.2 Composition and Returning Objects and Lists by Reference

When we use composition and have object as one of the class attributes, when we return that object it will be returned by reference.

if the caller used the assignment operator, another copy of the object will be created.

The caller can avoid using the assignment operator and use the returned reference directly to access the object.

The same is done also if the attribute is a list (not object).

Note: Objects and Lists are treated using the same rules. When you pass them to function they are passed by reference, when you return them from functions they are returned by value except if it's an object attribute where a return by reference will be done.

Example:

```
o1 = new Container
myobj = o1.addobj()      # the assignment will create another copy
myobj.x = 100
myobj.y = 200
myobj.z = 300
see o1.aobjs[1]          # print the object inside the container
see myobj                # print the copy

Class Container
    aobjs = []
    func addobj
        aobjs + new point
        return aobjs[len(aobjs)]      # return object by reference

Class point
    x = 10
    y = 20
    z = 30
```

Output:

```
x: 10.000000
y: 20.000000
z: 30.000000
x: 100.000000
y: 200.000000
z: 300.000000
```

Example(2):

```
func main
    o1 = new screen {
        content[point()] {
            x = 100
            y = 200
            z = 300
        }
        content[point()] {
            x = 50
            y = 150
            z = 250
        }
    }
    see o1.content[1]
    see o1.content[2]

Class Screen
    content = []
    func point
        content + new point
        return len(content)

Class point
    x = 10
    y = 20
    z = 30
```

Output:

```
x: 100.000000
y: 200.000000
z: 300.000000
x: 50.000000
y: 150.000000
z: 250.000000
```

Example(3):

```
func main
    o1 = New Screen {
        point() { # access the object using reference
            x = 100
            y = 200
            z = 300
        }
    }
```

(continues on next page)

(continued from previous page)

```

        }
    point() {                      # access the object using reference
        x = 50
        y = 150
        z = 250
    }
}
see o1.content[1]
see o1.content[2]

Class Screen
    content = []
    func point
        content + new point
        return content[len(content)]      # return the object by reference

Class point x=10 y=20 z=30

```

Output:

```

x: 100.000000
y: 200.000000
z: 300.000000
x: 50.000000
y: 150.000000
z: 250.000000

```

34.3 Executing code after the end of object access

We can access an object using { } to use object attributes and methods.

if the object contains a method called BraceEnd(), it will be executed before the end of the object access.

Example:

```

New Point { See "How are you?" + nl }

Class Point x y z
    func braceend
        see "I'm fine, Thank you!" + nl

```

Output:

```

How are you?
I'm fine, Thank you!

```

34.4 Declarative Programming on the top of Object-Oriented

The next features enable us to build and use declarative programming environment using nested structures on the top of object oriented

- using {} to access the object attributes and methods
- BraceEnd() Method
- returning objects by reference
- Setter/Getter Methods (optional)

Example:

```
# Declarative Programming (Nested Structures)

Screen()
{
    point()
    {
        x = 100
        y = 200
        z = 300
    }

    point()
    {
        x = 50
        y = 150
        z = 250
    }
}

# Functions and Classes

Func screen return new screen

Class Screen

    content = []

    func point
        content + new point
        return content[len(content)]

    func braceend
        see "I have " + len(content) + " points!"

Class point

    x=10 y=20 z=30

    func braceend
```

(continues on next page)

(continued from previous page)

see self

Output:

```
x: 100.000000
y: 200.000000
z: 300.000000
x: 50.000000
y: 150.000000
z: 250.000000
I have 2 points!
```

34.5 More Beautiful Code

We can get better results and a more beautiful code when we can avoid writing () after the method name when the methods doesn't take parameters. This feature is not provided directly by the Ring language because there is a difference between object methods and object attributes. We can get a similar effect on the syntax of the code when we define a getter method for the object attribute. For example instead of defining the point() method. we will define the point attribute then the getpoint() method that will be executed once you try to get the value of the point attribute. since we write the variable name directly without () we can write point instead of point() and the method getpoint() will create the object and return the object reference for us.

Example:

```
new Container
{
    Point
    {
        x=10
        y=20
        z=30
    }
}

Class Container
    aObjs = []
    point
    func getpoint
        aObjs + new Point
        return aObjs[len(aObjs)]

Class Point x y z
    func braceend
        see "3D Point" + nl + x + nl + y + nl + z + nl
```

Output

```
3D Point
10
20
30
```

NATURAL LANGUAGE PROGRAMMING

Using the Ring programming language, we can create Natural programming languages based on classes and objects.

35.1 History

In 2010, I developed a new programming language called Supernova (developed using PWCT). This language uses a code that looks similar to Natural Language statements to create simple GUI applications. Now after five years, In the Ring programming language, we can get similar results, but now we have the ability to create/use code similar to Natural language statements in any domain that we like or need.

The Ring programming language comes with the Supernova spirit, but with more generalization and with mix of other languages spirits.

35.2 Example

The next example presents how to create a class that define two instructions

The first instruction is : I want window

The second instruction is : Window title = <expr>

Also keywords that can be ignored like the ‘the’ keyword

```
New App
{
    I want window
    The window title = "hello world"
}

Class App

    # Attributes for the instruction I want window
    i want window
    nWantwindow = 0
    # Attributes for the instruction Window title
    # Here we don't define the window attribute again
    title
    nWindowTitle = 0
    # Keywords to ignore
    the
```

(continues on next page)

(continued from previous page)

```

func geti
    if nWantwindow = 0
        nWantwindow++
    ok

func getwant
    if nWantwindow = 1
        nWantwindow++
    ok

func getwindow
    if nWantwindow = 2
        nWantwindow= 0
        see "Instruction : I want window" + nl
    ok
    if nWindowTitle = 0
        nWindowTitle++
    ok

func settitle cValue
    if nWindowTitle = 1
        nWindowTitle=0
        see "Instruction : Window Title = " + cValue + nl
    ok

```

Output:

```

Instruction : I want window
Instruction : Window Title = hello world

```

35.3 Change the Ring Keyword ‘And’

What if we want to connect between the two instructions using ‘and’

We have a problem because in Ring ‘and’ is a keyword

We can change that using the ChangeRingKeyword command.

Syntax:

```
ChangeRingKeyword <oldkeyword> <newkeyword>
```

Note: remember to restore the keyword again

Tip: The ChangeRingKeyword command is executed in the scanner stage by the compiler (before parsing).

Example:

```

ChangeRingKeyword      and _and

New App
{
    I want window and the window title = "hello world"
}

Class App

    # Attributes for the instruction I want window
        i want window
        nIwantwindow = 0
    # Attributes for the instruction Window title
    # Here we don't define the window attribute again
        title
        nWindowTitle = 0
    # Keywords to ignore
        the and

ChangeRingKeyword      _and and

    func geti
        if nIwantwindow = 0
            nIwantwindow++
        ok

    func getwant
        if nIwantwindow = 1
            nIwantwindow++
        ok

    func getwindow
        if nIwantwindow = 2
            nIwantwindow= 0
            see "Instruction : I want window" + nl
        ok
        if nWindowTitle = 0
            nWindowTitle++
        ok

    func setttitle cValue
        if nWindowTitle = 1
            nWindowTitle=0
            see "Instruction : Window Title = " + cValue + nl
        ok

    func getand
        see "Using : and" + nl

```

Output:

```

Instruction : I want window
Using : and

```

(continues on next page)

(continued from previous page)

Instruction : Window Title = hello world

35.4 Change the Ring Operator ‘+’

What if we want to define a new behavior for any operator like the “+” operator.

We can do this change using the ChangeRingOperator command to hide operator (change it's name)

Then we can use the operator as identifier that we can handle it's behaviour

Syntax:

ChangeRingOperator <oldoperator> <newoperator>

Note: remember to restore the operator again

Tip: The ChangeRingOperator command is executed in the scanner stage by the compiler (before parsing).

Example:

```
ChangeRingOperator + _+
New App {
    +
}
Class App
    +
    func get+
        see "Plus operator"
ChangeRingOperator _+ +
```

Output:

Plus operator

35.5 Change the ‘=’ operator to ‘is’

Example:

```
ChangeRingKeyword      and _and
ChangeRingOperator     =   is
New App
{
    I want window and the window title is "hello world"
```

(continues on next page)

(continued from previous page)

```

}

ChangeRingOperator      is      =
Class App

    # Attributes for the instruction I want window
        i want window
        nIwantwindow = 0
    # Attributes for the instruction Window title
    # Here we don't define the window attribute again
        title
        nWindowTitle = 0
    # Keywords to ignore
        the and

ChangeRingKeyword      _and   and

    func geti
        if nIwantwindow = 0
            nIwantwindow++
        ok

    func getwant
        if nIwantwindow = 1
            nIwantwindow++
        ok

    func getwindow
        if nIwantwindow = 2
            nIwantwindow= 0
            see "Instruction : I want window" + nl
        ok
        if nWindowTitle = 0
            nWindowTitle++
        ok

    func settitle cValue
        if nWindowTitle = 1
            nWindowTitle=0
            see "Instruction : Window Title = " + cValue + nl
        ok

```

35.6 Using Eval() with our Natural Code

Example:

```
func Main

    cProgram = ' I want window and the window title is "hello world" '

    MyLanguage(cProgram)

Func MyLanguage cCode

    # We add to the code the instructions that change keywords and operators
    # Because Eval() uses a new Compiler Object (the original keywords and operators).

    cCode = '
        ChangeRingKeyword and _and
        ChangeRingOperator = is
    ' + cCode

    New App
    {
        eval(cCode)
    }

Class App

    # Attributes for the instruction I want window
    i want window
    nWantwindow = 0
    # Attributes for the instruction Window title
    # Here we don't define the window attribute again
    title
    nWindowTitle = 0
    # Keywords to ignore
    the

    ChangeRingKeyword and _and
        and=0
    ChangeRingKeyword _and and

    func geti
        if nWantwindow = 0
            nWantwindow++
        ok

    func getwant
        if nWantwindow = 1
            nWantwindow++
        ok

    func getwindow
```

(continues on next page)

(continued from previous page)

```

if nWantwindow = 2
    nWantwindow= 0
    see "Instruction : I want window" + nl
ok
if nWindowTitle = 0
    nWindowTitle++
ok

func settile cValue
    if nWindowTitle = 1
        nWindowTitle=0
        see "Instruction : Window Title = " + cValue + nl
ok

```

35.7 BraceStart and BraceEnd Methods

We can write code that will be executed before/after using { }

Example:

```

o1 = new test {
    see "Hello" + nl
}

o1 {}

class test

    func bracestart
        see "start" + nl

    func braceend
        see "end" + nl

```

Output:

```

start
Hello
end
start
end

```

35.8 BraceExprEval Method

The next example demonstrates how to use the “BraceExprEval” method to get expressions in Natural code.

Example:

```
new natural {
    create 5
}

class natural
    create=0
    lkeyword = false
    func braceexpreval r
        if lkeyword lkeyword=false return ok
        see "expr eval" + nl
        see "type: " + type(r) see nl
        see "value : " see r see nl
    func getcreate
        lkeyword = true
        see "create" + nl
```

Output:

```
create
expr eval
type: NUMBER
value : 5
```

35.9 Real Natural Code

The next example is a more advanced example

```
# Natural Code
new program {
    Accept 2 numbers then print the sum
}

# Natural Code Implementation
class program
    # Keywords
        Accept=0 numbers=0 then=0 print=0 the=0 sum=0

    # Execution
    func braceexpreval x
        value = x
    func getnumbers
        for x=1 to value
            see "Enter Number (" + x + ") :" give nNumber
            aNumbers + nNumber
        next
```

(continues on next page)

(continued from previous page)

```
func getsum
    nSum = 0
    for x in aNumbers nSum+= x next
    see "The Sum : " + nSum
private
    value=0 aNumbers=[]
```

Output:

```
Enter Number (1) :3
Enter Number (2) :4
The Sum : 7
```

35.10 BraceError() Method

The next examples demonstrates how to use the “BraceError” method to handle errors when accessing the object using braces {}.

Example:

```
func main
    o1 = new point {
        x=10 y=20 z=30
        TEST
        SEE test
    }

class point x y z
    func braceerror
        see "Handle Error!" + nl
        SEE "Message :" + cCatchError + nl
        if ( left(cCatchError,11) = "Error (R24)" ) and not isattribute(self,
→"test")
            see "add attribute" + nl
            addattribute(self,"test")
            test = 10
        ok
        see "done" + nl
    return
```

Output:

```
Handle Error!
Message :Error (R24) : Using uninitialized variable : test
add attribute
done
10
```

Example:

```

new point {
    x=10 y=20 z=30
    test()
    see "mmmm..." + NL
}

class point x y z
    func braceerror
        see "Handle Error!" + nl
        see "Message :" + cCatchError + nl
        see self
        see "Done" + NL

```

Output:

```

Handle Error!
Message :Error (R3) : Calling Function without definition !: test
x: 10.000000
y: 20.000000
z: 30.000000
Done
mmmm...

```

35.11 Clean Natural Code

Instead of typing the literal as “literal” we can accept the words directly.

Example:

The next example accept hello world instead of “hello world”

But this example uses braceend() to check the end of the instruction

This means that this class process only one natural statement that end with literal.

```

ChangeRingKeyword      and _and

New App
{
    I want window and the window title is hello world
}

Class App

    # Attributes for the instruction I want window
        i want window
        nIwantwindow = 0
    # Attributes for the instruction Window title
    # Here we don't define the window attribute again
        title is
        nWindowTitle = 0
    # Keywords to ignore
        the and

```

(continues on next page)

(continued from previous page)

```

# Data
        literal = ""

ChangeRingKeyword      _and   and

        func geti
            if nWantwindow = 0
                nWantwindow++
            ok

        func getwant
            if nWantwindow = 1
                nWantwindow++
            ok

        func getwindow
            if nWantwindow = 2
                nWantwindow= 0
                see "Instruction : I want window" + nl
            ok
            if nWindowTitle = 0
                nWindowTitle++
            ok

        func gettitle
            if nWindowTitle = 1
                nWindowTitle=2
            ok

        func getis
            if nWindowTitle = 2
                nWindowTitle=3
            ok

        func braceend
            if nWindowTitle = 3
                see "Instruction : Window Title = " + literal + nl
                nWindowTitle = 0
            ok

        func braceerror
            c= substr(cCatchError,:")
            while c > 0
                c= substr(cCatchError,:")
                cCatchError=substr(cCatchError,c+1)
            end
            literal += substr(cCatchError,1)

```

CHAPTER
THIRTYSIX

USING THE NATURAL LIBRARY

In this chapter we will learn how to use the Natural Library to quickly define a language that contains a group of commands.

To start using the library, We need to call naturallib.ring

```
load "naturallib.ring"
```

After loading the library, We can use the NaturalLanguage class that contains the next methods :-

- SetLanguageName(cLanguageName)
- setCommandsPath(cFolder)
- SetPackageName(cPackageName)
- UseCommand(cCommandName)
- SetOperators(cOperators)
- RunFile(cFileName)
- RunString(cString)

36.1 Natural Library - Demo Program

We will write the natural code in a Text file, for example program.txt

File: program.txt

```
Welcome to the Ring programming language!  
What you are reading now is not comments, I swear!
```

```
After many years of programming I decided to think different about  
programming and solve the problems in a better way.
```

```
We are writing commands or code and the Ring language is reading  
it to understand us! Sure, What you are seeing now is  
just ***part of the code - Not the Complete Program***  
You have to write little things before and after this  
part to be able to run it!
```

```
It is the natural part of our code where we can write in English,  
Arabic or any Natural Language Then we will tell the computer
```

(continues on next page)

(continued from previous page)

through the Ring language what must happens! in a way that we can scale for large frameworks and programs.

Just imagine what will happens to the world of programming once we create many powerful frameworks using the Ring language that uses this way (Natural Programming).

For example When we say Hello to the Machine, It can reply! and when we say count from 1 to 5 it will understand us, Also if we said count from 5 to 1 it will understand us too! You can see the Output window!

This Goal is not new, but the Ring language comes with an innovative solution to this problem.

Output:

Hello, Sir!

The Numbers!

1

2

3

4

5

I will count Again!

5

4

3

2

1

To execute the natural code, We have start.ring

In start.ring we define the language and the commands.

File: start.ring

```
load "stdlib.ring"
load "naturallib.ring"
```

(continues on next page)

(continued from previous page)

```
New NaturalLanguage {
    SetLanguageName(:MyLanguage)
    SetCommandsPath(CurrentDir() + "/../command")
    SetPackageName("MyLanguage.Natural")
    UseCommand(:Hello)
    UseCommand(:Count)
    RunFile("program.txt")
}
```

We defined a language called MyLanguage, We have folder for the language commands.

Each command will define a class that belong to the MyLanguage.Natural package.

We will define two commands, Hello and Count.

So we must have two files for defining the commands in the CurrentDir() + "/..command" folder

File: hello.ring

```
DefineNaturalCommand.SyntaxIsKeyword([
    :Package = "MyLanguage.Natural",
    :Keyword = :hello,
    :Function = func {
        See "Hello, Sir!" + nl + nl
    }
])
```

File: count.ring

```
DefineNaturalCommand.SyntaxIsKeywordNumberNumber([
    :Package = "MyLanguage.Natural",
    :Keyword = :count,
    :Function = func {
        if not isattribute(self, :count_times) {
            AddAttribute(self, :count_times)
            Count_Times = 0
        }
        if Expr(1) > Expr(2) {
            nStep = -1
        }
        else
            nStep = 1
        if Count_Times = 0 {
            see nl + "The Numbers!" + nl
            Count_Times++
        }
        else
            see nl + "I will count Again!" + nl
        for x = Expr(1) to Expr(2) step nStep {
            see nl + x + nl
        }
        CommandReturn(fabs(Expr(1) - Expr(2)) + 1)
    }
])
```

36.2 Defining Commands

To define new command we can use the DefineNaturalCommand object

This object provides the next methods :-

- SyntaxIsKeyword(aPara)
- SyntaxIsKeywordNumber(aPara)
- SyntaxIsKeywordNumberNumber(aPara)
- SyntaxIsKeywordNumbers(aPara,nCount)
- SyntaxIsKeywordString(aPara)
- SyntaxIsKeywordStringString(aPara)
- SyntaxIsKeywordStrings(aPara,nCount)
- SyntaxIsKeywordExpression(aPara)
- SyntaxIsKeywordExpressionExpression(aPara)
- SyntaxIsKeywordExpressions(aPara,nCount)
- SyntaxIsCommand(aPara)
- SyntaxIsCommandNumber(aPara)
- SyntaxIsCommandNumberNumber(aPara)
- SyntaxIsCommandNumbers(aPara,nCount)
- SyntaxIsCommandString(aPara)
- SyntaxIsCommandStringString(aPara)
- SyntaxIsCommandStrings(aPara,nCount)
- SyntaxIsCommandExpression(aPara)
- SyntaxIsCommandExpressionExpression(aPara)
- SyntaxIsCommandExpressions(aPara,nCount)

File: mylanguage.ring

```
load "stdlib.ring"
load "naturallib.ring"

MyLanguage = New NaturalLanguage {
    SetLanguageName(:MyLanguage)
    setCommandsPath(CurrentDir() + "/../command")
    SetPackageName("MyLanguage.Natural")
    UseCommand(:Hello)
    UseCommand(:Count)
    UseCommand(:Print)
    UseCommand(:IWantWindow)
    UseCommand(:WindowTitleIs)
    UseCommand(:IWantButton)
}
```

Example (1)

In the next example we will define the Print command.

We will use the SyntaxIsKeywordExpression() Method.

We pass list (as Hash) to the method. We determine the package name, the keyword and the function that will be executed.

Inside this function we uses the Expr(nExprNumber) function to get the expression value that the user will write after the keyword.

File: print.ring

```
DefineNaturalCommand.SyntaxIsKeywordExpression([
    :Package = "MyLanguage.Natural",
    :Keyword = :print,
    :Function = func {
        See Expr(1)
    }
])
```

Usage:

```
load "mylanguage.ring"

MyLanguage.RunString(
    print "Hello, World!"
')
```

Output:

```
Hello, World!
```

Example (2)

File: iwantwindow.ring

```
DefineNaturalCommand.SyntaxIsCommand([
    :Package = "MyLanguage.Natural",
    :Command = "i want window",
    :Function = func {
        See "Command: I want window" + nl
    }
])
```

Usage:

```
load "mylanguage.ring"

MyLanguage.RunString(
    i want window
')
```

Output:

```
Command: I want window
```

Example (3)

File: windowtitleis.ring

```
DefineNaturalCommand.SyntaxIsCommandString([
    :Package = "MyLanguage.Natural",
    :Command = "window title is",
    :Function = func {
        See "Command: Window title is " + Expr(1) + nl
    }
])
```

Usage:

```
load "mylanguage.ring"

MyLanguage.RunString('
    I want window and the window title is "Hello World"
')
```

Output:

```
Command: I want window
Command: Window title is Hello World
```

36.3 Natural Library - Operators

In the next example we uses the Count command without using operators

```
load "mylanguage.ring"

MyLanguage.RunString("
    Hello
    Count 1 5
    Count 5 1
")
```

We can add more description

```
load "mylanguage.ring"

MyLanguage.RunString("
    Hello, Please    Count from 1 to 5 then count from 5 to 1
")
```

Also we can use operators like “(” and “)” around the instruction

```
load "mylanguage.ring"

MyLanguage {
    SetOperators("()")
    RunString("
        Here we will play and will try something
    ")
}
```

(continues on next page)

(continued from previous page)

```

        that looks like Lisp Syntax
        (count (count 1 5) (count 20 15))
        Just for fun!
    ")
}

```

36.4 Defining commands using classes

This section is related to the implementation details.

When we define new command, Each command is defined by the Natural Library as a class.

We have the choice to define commands using the simple interface provided by the DefineNaturalCommand object or by defining new class as in the next examples.

If we used DefineNaturalCommand (More Simple), The class will be defined during the runtime.

File: hello.ring

```

Package MyLanguage.Natural

class Hello

    func AddAttributes_Hello
        AddAttribute(self, :hello)

    func GetHello
        See "Hello, Sir!" + nl + nl

```

File: count.ring

```

Package MyLanguage.Natural

class Count

    func Getcount
        StartCommand()
        CommandData()[:name] = :Count
        CommandData()[:nExpr] = 0
        CommandData()[:aExpr] = []

    func BraceExprEval_Count nValue
        if isCommand() and CommandData()[:name] = :Count {
            if isNumber(nValue) {
                CommandData()[:nExpr]++
                CommandData()[:aExpr] + nValue
                if CommandData()[:nExpr] = 2 {
                    Count_Execute()
                }
            }
        }

```

(continues on next page)

(continued from previous page)

```
func AddAttributes_Count
    AddAttribute(self,:count)

func Count_Execute
    if not isattribute(self,:count_times) {
        AddAttribute(self,:count_times)
        Count_Times = 0
    }
    if Expr(1) > Expr(2) {
        nStep = -1
    } else
        nStep = 1
    if Count_Times = 0 {
        see nl+"The Numbers!" + nl
        Count_Times++
    } else
        see nl + "I will count Again!" +nl
    for x = Expr(1) to Expr(2) step nStep {
        see nl+x+nl
    }
    CommandReturn(fabs(Expr(1)-Expr(2))+1)
```

SCOPE RULES FOR VARIABLES AND ATTRIBUTES

In this chapter we will learn about scope rules and how Ring find variables.

Also we will learn about conflicts and how to solve/avoid them.

The next information are important once you start developing large applications using Ring

These application may uses

- Global variables (Try to avoid them)
- Classes (Object-Oriented)
- braces { } to access objects
- Declarative Programming
- Natural Programming

Note: In Ring, we can have multiple global scopes using the Load Package command. This feature can help in large programs and avoid conflicts. The solutions in this chapter does not use this feature.

37.1 Three Scopes

In Ring we have three scopes :-

- (1) Public/Global Scope - Each variable you define in the statements part (before functions and classes)
- (2) Object Scope - When you are inside an object (Inside class method or using { } to access the object)
- (3) Local Scope - Related to functions and methods

37.2 Defining Variables and Variables Access

- (1) Ring uses lexical scoping, i.e. the scope of the variable is based on where we defined the variable.
- (2) Inside braces { } when you access an object, You will change the current active object scope to this object scope but you still can access the global scope and the local scope.
- (3) After the 'Class' keyword and the class name, when you write variable names to be defined as attributes, You still can access the global scope.

In this region (class region - after the class name and before methods) we have

- Global Scope —> The Global Scope

- Object Scope —> The Object Scope
- Local Scope —> The Object Scope

Note: Since the local scope in the class region point also to the object scope in this region, we can use nested braces and still have access to the object scope of the class through the local scope.

Tip: You can create windows and controls as attributes by defining them in this region.

Tip: In the class region if you created objects and used braces {} to access them then using self.attribute inside braces will use the class (not the object that you access) because you have access to the class through the local scope.

- (4) Function Parameters are automatically defined in the local scope.

37.3 How Ring find the variable?

1 - Search First in the Local Scope

if not found !

2 - Search in the Object Scope

if not found !

3 - Search in the public scope

if not found —> Runtime Error

if found —> Check if we can do optimization to avoid searching next time (Cache / Pointers for performance).

37.4 Using Object.Attribute

When we use object.attribute the search will be in the object attributes only.

I.e. no search will be done in the local scope or in the global scope for the object attribute.

Note: Using self.attribute will search for the first self before searching for attributes.

37.5 The Self Object

The self object is a reference to the current object that we can use from the class methods.

When we are inside class method and use Self we mean the object that will be created from this class.

Inside the class methods if we used Braces {} this will change the current object scope and self will be changed also inside braces to reference the object that we access using Braces.

Inside the Class Region (after the class name and before any method) we have access to the object through the object scope and the local scope also. In this region using Self will always be a reference to the class object. if we used Braces

to change the object scope then used Self inside Braces, Also self will be a reference to the class object (not the object that we already access using braces) because in the class region we have :-

- Global Scope —> Global Scope
- Object Scope —> Object Scope
- Local Scope —> Object Scope

And using Braces changes the object scope only (not the local scope) and when Ring search for variables it will search in the Local Scope first so it will find self in the class that we are inside.

37.6 How Ring Define Variables and Attributes

Ring will use the variable name in the Assignment operation

- 1 - Search using the variable name
- 2 - If not found —> Avoid the runtime error and define the variable in the current scope

- 3 - If found —> Use the variable and don't define anything in the current scope

- In the global region (before any function or class) the current scope is the global scope.
- In the class region (after the class name and before any method) the current scope is the object attributes.
- In Functions and methods the current scope is the local scope.

37.7 Conflict between Global Variables and Class Attributes

Look at this example:

```
name = "test"
o1 = new person
see o1

class person
    name
    address
    phone
```

In the previous example we have a global variable called ‘name’ inside the class person.

when we use the variable ‘name’, Ring will start the search operation and will try to find it.

if found —> Use it

if not found —> Define new attribute

But the variable name is a global variable, so it will be found and used!

We will not have the attribute name! added to the object.

Solution (1) - Use the Main Function

```
func main
    name = "test"
    o1 = new person
```

(continues on next page)

(continued from previous page)

```
see o1

class person
    name
    address
    phone
```

Solution (2) - Use special mark for global variable names like \$

```
$name = "test"
o1 = new person
see o1

class person
    name
    address
    phone
```

Solution (3) - Use the AddAttribute() Method

```
name = "test"
o1 = new person
see o1

class person
    AddAttribute(self, "name")
    address
    phone
```

Solution (4) - Use self before the attribute name

```
name = "test"
o1 = new person
see o1

class person
    self.name
    address
    phone
```

So what is the best solution to this conflict?

- 1 - Use the \$ Mark for global variables
- 2 - Optional : Try to avoid global variables and use the Main function

In practice i do both of them.

The other solution

- Use self before the attribute name or use AddAttribute()

Note: Ring have a nice feature through the (load package) command which load a Ring source code file in a new global scope different from the current global scope used by the caller.

37.8 Conflict between Class Attributes and Local Variables

This conflict may happen when we access the object using braces

Example:

```
func main
    name = "nice"
    o1 = new person {name="mahmoud" address="Egypt" phone = 000 }
    see o1

class person
    name
    address
    phone
```

In the previous example we have the local variable name.

The value of this variable will be set to “mahmoud” instead of the object attribute.

Solution (1) : Just use Self

```
func main
    name = "nice"
    o1 = new person {self.name="mahmoud" address="Egypt" phone = 000 }
    see o1

class person
    name
    address
    phone
```

Solution (2) : Change the Local variable name

```
func main
    cName = "nice"
    o1 = new person {name="mahmoud" address="Egypt" phone = 000 }
    see o1

class person
    name
    address
    phone
```

Solution (3) : Change Braces and use the Dot operator

```
func main
    name = "nice"
    o1 = new person
    o1.name ="mahmoud"
    o1.address ="Egypt"
    o1.phone = 000
    see o1

class person
```

(continues on next page)

(continued from previous page)

```
name
address
phone
```

37.9 Using Braces to access objects inside Class Methods

Remember that we have Three scopes (Local Scope, Object Scope and Global Scope) and when we are inside a class method, we expect that we have access to the object attributes and methods and this is true until we use braces to access another object attributes and methods because in this case our object scope will be switched to another object.

```
new point { test() }

class point
    x=10 y=20
    func test
        see x + nl + y + nl # works fine
        myobj = new otherclass {
            see name + nl
            see x + nl + y + nl # error !
        }
    class otherclass
        name = "test"
```

Output:

```
10
20
test

Line 8 Error (R24) : Using uninitialized variable : x
In method test() in file methodbraceerror.ring
called from line 5 in file methodbraceerror.ring
```

Now what we will do to solve the previous problem?

Solution (1) : Write the code that access the class attributes outside braces.

```
new point { test() }

class point
    x=10 y=20
    func test
        see x + nl + y + nl # works fine
        myobj = new otherclass {
            see name + nl
        }
        see x + nl + y + nl # Outside braces - works fine
```

(continues on next page)

(continued from previous page)

```
class otherclass
    name = "test"
```

Output:

```
10
20
test
10
20
```

Solution (2) : Don't Use Braces

```
new point { test() }

class point
    x=10 y=20
    func test
        see x + nl + y + nl
        myobj = new otherclass
        see myobj.name
        see x + nl + y + nl

class otherclass
    name = "test"
```

Solution (3) : Copy the self object

We may use this solution if we want to use braces and get access to the class attributes (Just Reading).

```
new point { test() }

class point
    x=10 y=20
    func test
        oSelf = self
        see x + nl + y + nl
        myobj = new otherclass {
            see name + nl
            see oself.x + nl + oself.y + nl
        }

class otherclass
    name = "test"
```

Output:

```
10
20
test
10
20
```

Now look at this line

```
oSelf = self
```

The problem with the previous line is that we will have a new copy from the object. Because in Ring the assignment operator copy lists and objects by value (not by reference).

When we access the new object attributes (reading) we don't have problems

But if we modified the object attributes (Then we will modify the copy!).

Note: We can use braces again with the copy

```
new point { test() }

class point
    x=10 y=20
    func test
        oSelf = self
        see x + nl + y + nl
        myobj = new otherclass {
            see name + nl
            oSelf {
                see x + nl + y + nl
            }
        }
    class otherclass
        name = "test"
```

In a GUI application, we may create a class contains the window objects as attributes to be able to access the controls from different methods. Remember the previous information when you try to access objects using braces inside methods because in this case you can't access the object attributes directly and if you copied the self object you will work on a copy and the new controls that you create will be related to the copy and you can't access them.

37.10 Accessing the class attributes from braces inside class methods

We access the class attributes directly from the class methods, also we have the choice to use the Self reference before the attribute/method name. Using Braces {} inside class method change the active object scope and prevent us from getting direct access to the class attributes. Also using Self will not help because the Self reference will be changed to the object that we access using Braces.

In this case if you want to read an attribute you have to copy the Self object before using Braces and if you want to modify an attribute you have to the copy from local variable to the object attribute after using Braces.

This case happens when you want to read/modify attribute instead braces.

```
Class MyApp

oCon # Attribute

# some code here
```

(continues on next page)

(continued from previous page)

```
Func OpenDatabase
    # some code here
    new QSqlDatabase() {
        oCon = addDatabase("QSQLITE") {
            setDatabaseName("weighthistory.db")
            open()
        }
    }
    self.oCon = oCon
    # some code here
```

In the previous example we want to create the connection object and save it inside the oCon attribute.

The object is an output from the addDatabase() method that we use after accessing the QSqlDatabase() object.

Inside braces we can't use the Self reference to use the object created from the MyApp class. Because the Self reference here will be to the object that we access using Braces.

We solved the problem in the previous example by creating a local variable called oCon then after Braces we copied that variable to the oCon attribute.

The next code is another solution.

```
Class MyApp

    oCon    # Attribute

    # some code here

    Func OpenDatabase
        # some code here
        oCon = new QSqlDatabase()
        oCon = oCon.addDatabase("QSQLITE") {
            setDatabaseName("weighthistory.db")
            open()
        }
        # some code here
```

The next code is a better solution.

```
Class MyApp

    oCon    # Attribute

    # some code here

    Func OpenDatabase
        # some code here
        new QSqlDatabase() {
            this.oCon = addDatabase("QSQLITE") {
                setDatabaseName("weighthistory.db")
                open()
            }
        }
```

(continues on next page)

(continued from previous page)

```

}
# some code here

```

Note: We used this.attribute to access the class attribute (oCon) while we are inside Braces.

37.11 Creating a Class for each Window in GUI applications

A good way for creating classes for windows is to define the window directly after the class name

In this area you can use nested braces without problems to define the window and the controls, and they will be attributes that you can access from methods.

Example:

```

Load "guilib.ring"

new qApp
{
    $ObjectName = "oFirstWindow"
    oFirstWindow = new FirstWindow

    $ObjectName = "oSecondWindow"
    oSecondWindow = new SecondWindow

    exec()
}

Class FirstWindow

    win = new QWidget() {
        setgeometry(0,50,300,200)
        setWindowTitle("First Window")
        label1 = new QLabel(win)
        {
            setgeometry(10,10,300,30)
            setText("0")
        }
        btn1 = new QPushButton(win)
        {
            move(100,100)
            setText("Increment")
            setClickEvent($ObjectName+".increment()")
        }
        show()
    }

    Func Increment
        label1 {
            setText( "" + ( 0 + text() + 1 ) )

```

(continues on next page)

(continued from previous page)

```

}

Class SecondWindow

    win = new QWidget() {
        setGeometry(400,50,300,200)
        setWindowTitle("Second Window")
        label1 = new QLabel(win)
        {
            setGeometry(10,10,300,30)
            setText("0")
        }
        btn1 = new QPushButton(win)
        {
            move(100,100)
            setText("Decrement")
            setClickEvent($ObjectName+.decrement())
        }
        show()
    }

    Func Decrement
    label1 {
        setText(" " + ( 0 + text() - 1 ) )
    }
}

```

37.12 Conflict between self inside braces and self in the class region

In the class region (after the class name and before any methods) we define the attributes.

In this region we have access to the global scope and the local scope will point to the object scope.

Three Scopes

- Global Scope —> Global Scope
- Object Scope —> Object Scope
- Local Scope —> Object Scope

Look at this example

```

New Account {
    see aFriends
}

Class Account
    name = "Mahmoud"
    aFriends = []
    aFriends + new Friend {
        name = "Gal"
    }
}

```

(continues on next page)

(continued from previous page)

```
aFriends + new Friend {
    name = "Bert"
}
```

```
Class Friend
    name
```

Output:

```
name: NULL
name: NULL
```

The problem in the previous example is that the Class account contains an attribute called “name” and the Friend class contains an attribute called “name” also.

If you tried using self.name inside braces you will get the same result!

```
New Account {
    see aFriends
}

Class Account
    name = "Mahmoud"
    aFriends = []
    aFriends + new Friend {
        self.name = "Gal"
    }
    aFriends + new Friend {
        self.name = "Bert"
    }

Class Friend
    name
```

So why using self.name inside braces doesn't solve this conflict?

Because after the class region we have

- global scope —> global scope
- object scope —> object scope (Account Class)
- local scope —> local scope (Account Class)

When we use braces we change the object scope, so we have

- global scope —> global scope
- object scope —> object scope (Friend Class)
- local scope —> local scope (Account Class)

Ring search in the local scope first, so using self.name will use the Account class.

There are many solution

Solution (1) : Access the object through the list

```

New Account {
    see aFriends
}

Class Account
    name = "Mahmoud"
    aFriends = []
    aFriends + new Friend
    aFriends[len(aFriends)] {
        aFriends[len(aFriends)].name = "Gal"
    }
    aFriends + new Friend
    aFriends[len(aFriends)] {
        aFriends[len(aFriends)].name = "Bert"
    }

Class Friend
    name

```

Solution (2) : Create Method in the friend class to set the name attribute.

```

New Account {
    see aFriends
}

Class Account
    name = "Mahmoud"
    aFriends = []
    aFriends + new Friend {
        setname("Gal")
    }
    aFriends + new Friend {
        setname("Bert")
    }

Class Friend
    name
    func setname cName
        name = cName

```

Solution (3) : Create a method in the account class to set the attribute

```

New Account {
    see aFriends
}

Class Account
    name = "Mahmoud"
    aFriends = []
    friend("Gal")
    friend("Bert")

    func friend cName

```

(continues on next page)

(continued from previous page)

```
aFriends + new Friend {
    name = cName
}
```

```
Class Friend
    name
```

Solution (4) : Declarative Programming

```
New Account {
    name = "mahmoud"
    friend {
        name = "Gal"
    }
    friend {
        name = "Bert"
    }
    see aFriends
}

Class Account
    name
    aFriends = []
    friend
    func getfriend
        aFriends + new Friend
        return aFriends[len(aFriends)]
```

```
Class Friend
    name
```

Output:

```
name: Gal
name: Bert
```

37.13 Using braces to escape from the current object scope

Since braces change the current object scope to another object. we can use it to do some work without modifying the class attributes and using the same variable names.

```
new point {x=10 y=20 z=30 start() }
class point x y z
    func start
        see self # print the x y z values (10,20,30)
        new Local {
            x = 100
            y = 200
            z = 300
        }
```

(continues on next page)

(continued from previous page)

```

see self # print the x y z values (10,20,30)
see x + nl # will print 100
see y + nl # will print 200
see z + nl # will print 300
Self { # NO Advantage - Search is done in local scope first
    see x + nl # will print 100
    see y + nl # will print 200
    see z + nl # will print 300
}
see self.x + nl # will print 10
see self.y + nl # will print 20
see self.z + nl # will print 30

class Local

```

Output:

```

x: 10.000000
y: 20.000000
z: 30.000000
x: 10.000000
y: 20.000000
z: 30.000000
100
200
300
100
200
300
10
20
30

```

37.14 The For Loops uses the local scope

Starting from Ring 1.8, when the For Loop defines new identifier (variable) it will define it in the local scope.

Example:

```

x = 10
? x          # Print 10
test1()
? x          # Print 10
test2()
? x          # Print 10

func test1
    for x = 1 to 5
    next
    ? x      # Print 6

```

(continues on next page)

(continued from previous page)

```
func test2
    list = 1:5
    for x in list
    next
? x      # Print NULL (The "For In" loop will kill the reference after the loop)
```

Output:

```
10
6
10
NULL
10
```

37.15 Summary of Scope Rules

At first remember that

- 1 - Each programming language comes with it's scope rules based on the language goals
- 2 - Programming in the small is different than Programming in the Large
- 3 - Some programming language are designed for developing small programs while others are designed for large programs
- 4 - In programming, If we have access to more than one scope - Then problems may come if we don't manage things correctly
- 5 - It's always more secure to reduce the number of visible scopes
- 6 - Some programming languages force you to manage the scope in some way, while others not!

In Ring

- 1 - Special and *very simple* scope rules that are designed for Flexibility first then Security
- 2 - Ring is designed to support programming in the small and programming in the large.
- 3 - The language provide the different programming paradigms that you may select from based on the project size. Errors comes only if you selected a bad paradigm for the target project or you are using the paradigm in a way that is not correct or at least not common.
- 4 - In Ring you have the choice, you can use global variables or avoid them. you can give them a special \$ mark or leave them. you can use object-oriented or stay with procedures. you can use the class region (after the class name and before any method) just for attributes or use it for code too.
- 5 - Just read the next scope rules and think about them then use them in your favorite way.

Scope Rules:

- 1 - At any place in our program code we have only at maximum Three Scopes (Local Scope, Object Scope and Global Scope).
- 2 - When Ring find a variable it will search in the local scope first then in the object scope then in the global scope.
- 3 - At any time inside procedures or methods you can use braces { } to access an object and change the current object scope.

4 - In the class region (After the class name and before any method) this is a special region where both of the object scope and the local scope point to the object scope. I.e. No local variables where each variable you define in this region will become an attribute.

5 - Before defining any variable (in any scope and in the class region too) a search process will be done to use the variable if it's found.

6 - Functions and Methods parameters are defined automatically as local variables to these functions or methods.

7 - Using Object.Attribute will search in the object attributes only.

8 - Using Self.Attribute will lead to a search for Self first then search in Self Attributes.

9 - The Self reference inside class region (after the class name and before any method) always point to the object scope created from the class.

10- The Self reference inside methods will be changed when we uses Braces to be a reference to the object that we access.

11- Writing variable names directly in the class region (after the class name and before any method) means using them or define them (in order).

12- Using self.attribute in the class region reduce search to the object scope (avoid conflict with global scope).

From these rules you can understand all types of conflicts and why you may have them and how to avoid them

Simple advices to avoid any conflict and use the scope rules in a better way

1 - Try to avoid global variables

2 - Use the Main Function - This will help you to avoid global variables

3 - If you are going to use many global variables use the \$ mark before the variable name

4 - In the class region if you don't respect the advice number three (\$) then use self.attribute when you define your attributes

5 - You can use object.attribute and object.method() instead of object { attribute } and object { method() } if you don't like changing the object scope.

6 - If you will use nested braces in a class - think about using the class region if possible because in this region you will have access to the object that you access using { } + access to the class attributes

7 - If you are inside a class method and used nested braces you will change the object scope with each brace and you will loss the access to the class attributes directly but you have access to the local scope before and after using brace { }, if you will read/modify the class attribute from braces then use This.Attribute because using 'This' means (The object created from this class) while using 'Self' means (The object in the current object scope).

After understanding all of the previous points, You will master this topic.

CHAPTER
THIRTYEIGHT

SCOPE RULES FOR FUNCTIONS AND METHODS

In this chapter we will learn about the scope rules for functions and methods.

You need to know the next information once you started using Ring for large applications.

These applications may contains and use

- Many Packages and Classes written in Ring
- Many Functions written in Ring
- Standard Ring Functions (Written in C language)
- Functions and Classes written in C/C++ languages

38.1 How Ring find the Functions and Methods?

When you call a method or function, Ring will start a search process to find this function

If found → Call the function and store the function pointer in the cache so Ring can use it again with doing another search.

If not found → Runtime error message (That you can avoid using Try/Catch)

How the search process is done?

Search for functions/methods follow the next order

- 1 - Search in methods (if we are inside class method or object using braces {})
- 2 - Search in functions written by the programmer using Ring Code
- 3 - Search in functions written in C/C++ like standard Ring functions

This enable us to write clean code inside classes methods and avoid any conflict with functions.

If we want to call a function with the same name as a method in the class we will need a wrapper function or we will access a temp. object using { } then call that function there.

We can replace C/C++ Functions with Ring Functions.

We can replace Ring Functions with Ring Methods.

Note: Using self.method() is not necessary in any use case.

Tip: We can use this.method() to escape from the current active scope that we access using braces {} and call a method in the class that we are inside.

38.2 Example about Sharing Names between Functions and Methods

Look at the next example

```

func main
    o1 = new myclass { test() test2() }
    test2()

func f1
    see "f1 function" + nl

func f2
    see "f2 function" + nl

func f3
    see "f3 function" + nl

func test2
    myline()
    see "test2 function" + nl
    new myclass {
        f1()
        f2()
        f3()
        self.f3()
    }
    myobj = new myclass
    myobj.f3()
    myline()

func myline
    see copy("=",40) + nl

Class myclass

    func test
        myline()
        see "test method" + nl
        f1()
        f2()
        f3()
        myline()

    func f3
        see "f3 method" + nl

    func test2

```

(continues on next page)

(continued from previous page)

```

myline()
"test2 method" + nl
self {
    f1()
    f2()
    f3()
}
myline()

```

Output:

```

=====
test method
f1 function
f2 function
f3 method
=====

=====
test2 method
f1 function
f2 function
f3 method
=====

=====
test2 function
f1 function
f2 function
f3 method
f3 method
f3 method
=====
```

38.3 Calling a function sharing the name with a method in the current class

In the previous example we have a function called f3() and we have a method called f3()

How we can call the f3() function from the test() method ?

Solution (1) : Change the current object scope to another object scope

In this solution we will have an empty class called local that we will use to change the current object scope.

```

func main
    o1 = new myclass { test()}

func f1
    see "f1 function" + nl

func f2
    see "f2 function" + nl

```

(continues on next page)

(continued from previous page)

```
func f3
    see "f3 function" + nl

func myline
    see copy("=",40) + nl

Class myclass

    func test
        myline()
        see "test method" + nl
        f1()
        f2()
        f3()          # call f3() method
        new local { f3() } # call f3() function
        myline()

    func f3
        see "f3 method" + nl

class local
```

Output:

```
=====
test method
f1 function
f2 function
f3 method
f3 function
=====
```

CHAPTER
THIRTYNINE

SYNTAX FLEXIBILITY

In this chapter we will learn about some options that are provided automatically by the Ring compiler for syntax flexibility.

39.1 Change Language Keywords

We can change any keyword using the ChangeRingKeyword command.

Note: Remember to restore the keyword again if the team will mix between styles in the same project.

Tip: The ChangeRingKeyword command is executed in the scanner stage by the compiler (before parsing).

Syntax:

```
ChangeRingKeyword <oldkeyword> <newkeyword>
```

Example:

```
ChangeRingKeyword see print
print "welcome" + nl
ChangeRingKeyword print see
see "Welcome" + nl
```

Example:

```
ChangeRingKeyword func function
ChangeRingKeyword see print
ChangeRingKeyword ok endif
ChangeRingKeyword next endfor
ChangeRingKeyword end endwhile

x = 10
while x > 0
    print "x = " + x + nl
    for t = 1 to 10
```

(continues on next page)

(continued from previous page)

```

        if t = 3
            print "number three" + nl
        endif
    endfor

x--
endwhile

test()

function test
    print "message from test" + nl

ChangeRingKeyword function func
ChangeRingKeyword print see
ChangeRingKeyword endif ok
ChangeRingKeyword endfor next
ChangeRingKeyword endwhile end

```

39.2 Change Language Operators

We can change any operator using the ChangeRingOperator command.

Note: Remember to restore the operator again if the team will mix between styles in the same project.

Tip: The ChangeRingOperartor command is executed in the scanner stage by the compiler (before parsing).

Syntax:

```
ChangeRingOperator <oldkeyword> <newkeyword>
```

Example:

The next program hide the + operator by changing it to _+

```

changeringoperator + _+
changeringkeyword SEE PRINT

try
    print 5 + 10
catch
    print nl print "error" print nl
done

changeringoperator _+ +

```

The next program change the + operator to “plus”.

```
changeringoperator + plus
changeringkeyword SEE PRINT
```

```
Print 5 plus 5
```

```
changeringoperator plus +
changeringkeyword PRINT SEE
```

39.3 Load Syntax Files

You may store a group of ChangeRingKeyword and ChangeRingOperator commands in a file to use later in many source files. You can't use the Load command to call these files because

- ChangeRingKeyword and ChangeRingOperator commands are executed in the scanner phase by the compiler (before parsing).
- The load command is executed in the parsing phase (after the scanner phase).

Solution: Use the LoadSyntax Command which is executed in the scanner phase.

Syntax:

```
LoadSyntax "syntaxfile.ring"
```

Example:

File : StyleBasicOn.ring

```
ChangeRingKeyword see print
ChangeRingKeyword ok endif
ChangeRingKeyword next endfor
ChangeRingKeyword end endwhile
```

File : StyleBasicOff.ring

```
ChangeRingKeyword print see
ChangeRingKeyword endif ok
ChangeRingKeyword endfor next
ChangeRingKeyword endwhile end
```

File : UseStyleBasic.ring

```
LoadSyntax "stylebasicon.ring"

x = 10
while x > 0
    print "x = " + x + nl
    for t = 1 to 10
        if t = 3
            print "number three" + nl
        endif
    endfor
    x--
endwhile
```

(continues on next page)

(continued from previous page)

```
LoadSyntax "stylebasicoff.ring"
see "done" + nl
```

Note: files called by the LoadSyntax command must contains ChangeRingKeyword and ChangeRingOperator commands only.

Tip: files called by the LoadSyntax command doesn't support functions, packages and classes. just imperative commands only.

Note: Using this feature you can create many styles that you can use in the same project and you can support Ring translation to other languages like Arabic, French and so on.

Tip: The effect of LoadSyntax command is related to the current source code file only.

Tip: Using LoadSyntax command is optional, See the (Automatic loading for syntax files) section.

39.4 Using “()” around the function parameters

We can use () around the function parameters (optional).

Example:

```
hello()
sum(3,4)

func hello()
    see "Hello" + nl

func sum(x,y)
    see x+y+nl
```

Output:

```
Hello
7
```

Example:

```
myfunc = func x,y { see x + y + nl }

call myfunc (3,4)
```

(continues on next page)

(continued from previous page)

```
myfunc2 = func (x,y) { see x+y+nl }
call myfunc(3,4)
```

Output:

```
7
7
```

39.5 Using Semi-colon after and between statements

In Ring we can use semi-colon after and between statements (optional).

Example:

```
# Using semi-colon is optional

see "Hello" + nl ; see "How are you?" + nl ; see "Welcome to Ring" + nl ;
one() ; two() ; three() ;
func one ; see "one" + nl ;
func two ; see "two" + nl ;
func three ; see "three" + nl ;
```

Output:

```
Hello
How are you?
Welcome to Ring
one
two
three
```

39.6 Using \$ and @ in the start of the variable name

You can use any unicode character in the variable name also we can use \$ and @ in the name.

This feature may help, for example we can start global variables with \$ and the object attributes with @.

In other languages like Ruby this is the rule, In the Ring language this is just an option without any force from the Compiler.

example:

```
$global_variable = 5

new test { hello() }

class test
```

(continues on next page)

(continued from previous page)

```
@instance_variable = 10

func hello

local_variable = 15

see "Global : " + $global_variable + nl +
"Instance : " + @instance_variable + nl +
"Local : " + local_variable + nl
```

Output:

```
Global : 5
Instance : 10
Local : 15
```

39.7 Using the ‘elseif’ keyword as ‘but’ in if statement

if you don’t like the ‘but’ keyword in if statement Then you can use the ‘elseif’ keyword.

Example:

```
give x
if x = 1 see "one"
elseif x=2 see "two"
elseif x=3 see "three"
elseif x=4 see "four"
else see "other"
ok
see nl
```

39.8 Using the ‘else’ keyword as ‘other’ in switch statement

if you don’t like the ‘other’ keyword in switch statement Then you can use the ‘else’ keyword.

Also you can replace ‘else’ with ‘other’ in if statement.

i.e. ‘other’ keyword is the same as ‘else’ keyword.

Example:

```
x = 1
switch x
    on 10
        see "10" + nl
    else
        see "not 10" + nl
end
```

Output:

not 10

39.9 Using the ‘end’ keyword in different control structures

We can use the ‘end’ keyword to close different control structures

- If statement
- For loop
- Switch
- While
- Try-Catch

Example:

```
see "if statement.." + nl
x = 1
if x = 1
    see "one" + nl
elseif x=2
    see "two" + nl
elseif x=3
    see "three" + nl
end
see "for loop.." + nl
for t = 1 to 10
    see t
end
see nl
see "switch..." + nl
x = 1

switch x
    on 1 see "one" + nl
    on 2 see "two" + nl
end

see "try catch..." + nl
try
    x = 1 / 0
catch
    see "catching error" + nl
end
```

Output:

```
if statement..
one
for loop..
12345678910
switch...
```

(continues on next page)

(continued from previous page)

```
one
try catch...
catching error
```

39.10 Using braces to start and end different control structures

We can use braces { } to start and end different control structures

- If statement
- For loop
- Switch
- While
- Try-Catch

Example:

```
see "if statement.." + nl
x = 1
if x = 1 {
    see "one" + nl
elseif x=2
    see "two" + nl
elseif x=3
    see "three" + nl
}
see "for loop.." + nl
for t = 1 to 10 {
    see t
}
see nl
see "switch..." + nl
x = 1

switch x {
    on 1 see "one" + nl
    on 2 see "two" + nl
}

see "try catch..." + nl
try {
    x = 1 / 0
catch
    see "catching error" + nl
}
```

Output:

```
if statement..
one
```

(continues on next page)

(continued from previous page)

```
for loop..
12345678910
switch...
one
try catch...
catching error
```

39.11 Using ‘put’ and ‘get’ as ‘see’ and ‘give’

We can replace the ‘see’ keyword with the ‘put’ keyword.

Also we can replace the ‘give’ keyword with the ‘get’ keyword.

Example:

```
put "Hello World" + nl
put "Enter Your Name ? " Get Name
Put "Hello " + Name
```

39.12 Using ‘case’ as ‘on’ in switch statements

We can replace the ‘on’ keyword with ‘case’ keyword in the switch statement.

Example (1) :

```
for x=1 to 10
    switch x
        case 1 put "one" + nl
        case 2 put "two" + nl
        case 3 put "three" + nl
        else put "else" + nl
    end
end
```

Example (2) :

```
for x=1 to 10 {
    switch x {
        case 1 put "one" + nl
        case 2 put "two" + nl
        case 3 put "three" + nl
        else put "else" + nl
    }
}
```

39.13 Using ‘def’ as ‘func’ in functions/methods definition

We can use the ‘def’ keyword as the ‘func’ keyword to define functions and methods.

Example:

```
one() two()

def one put "one" + nl
def two put "two" + nl
```

39.14 Using braces { } in Packages/Classes/Functions

Example:

```
load "stdlib.ring"

import mypackage

new myclass {
    myfunc()
}

package mypackage
{
    class myclass
    {
        func myfunc
        {
            print("Hello, World!\n")
        }
    }
}
```

39.15 Using ‘break’/‘continue’ keywords

Instead of using Exit/Loop commands we can use Break/Continue

Example:

```
for t=1 to 10 {
    if t=3 {
        continue
    elseif t=5
        break
    }
    ? t
}
```

Output:

1
2
4

39.16 Using ‘end’ keyword after Packages/Classes/Functions

Example:

```
import mypackage

new myclass {
    myfunc()
}

package mypackage
    class myclass
        def myfunc
            put "Hello, World!"
        end
    end
end
```

39.17 Using ‘function’/‘endfunction’ keywords

Example:

```
one() two() three()
function one
    ? :one
endfunction
function two
    ? :two
endfunction
function three
    ? :three
endfunction
```

39.18 Using ‘endif’/‘endfor’/‘endwhile’/‘endswitch’/‘endtry’ keywords

Example:

```
for t=1 to 10
    if t=3
        ? :three
    endif
endfor
```

39.19 Using 'endpackage'/'endclass'/'endfunc' keywords after Packages/Classes/Functions

Example:

```
import mypackage

new MyClass { myfunc() }

package mypackage
    class MyClass
        func myfunc
            see "welcome" + nl
        endfunc
    endclass
endpackage
```

39.20 Ignore new lines after keywords

Starting from Ring 1.8 the compiler will ignore new lines after keywords that expect tokens after it

Example:

```
see
"
    Hello, World!
"
test()

func
#####
    Test
#####

?
"

Hello from the Test function
```

Output:

```
Hello, World!
```

```
Hello from the Test function
```

39.21 Automatic loading for syntax files

Starting from Ring 1.18 we have better syntax flexibility

- Support running source code files with any extension
- Automatic loading for (ringsyntax.ring) file that exist in the current folder

For example in the the next screen shot

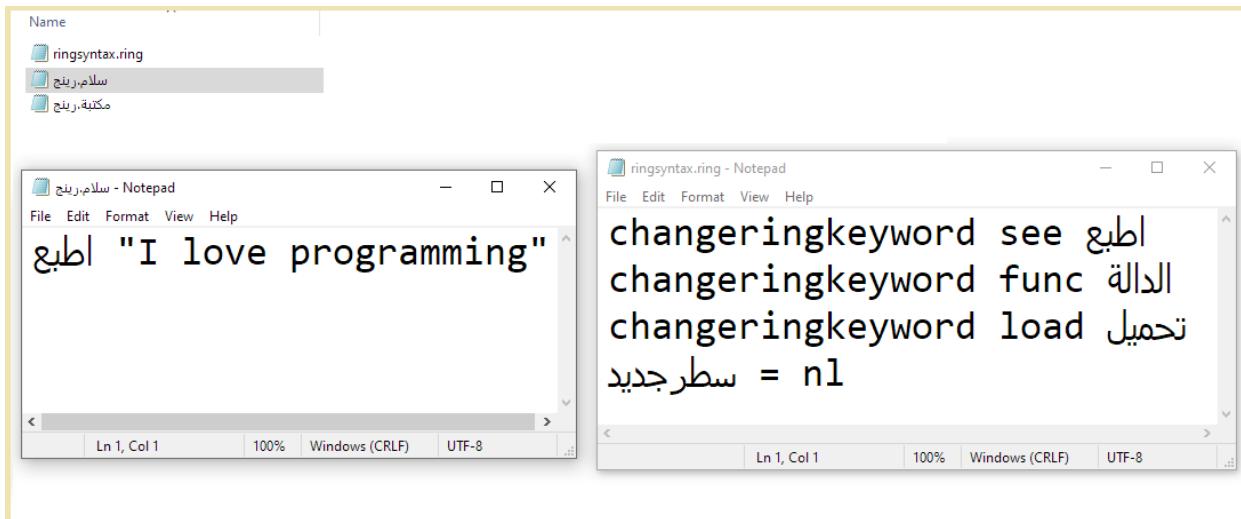
We have (ringsyntax.ring) that translate some of the Ring keywords to Arabic language

When we execute the file with Arabic name which means in English (hello.ring)

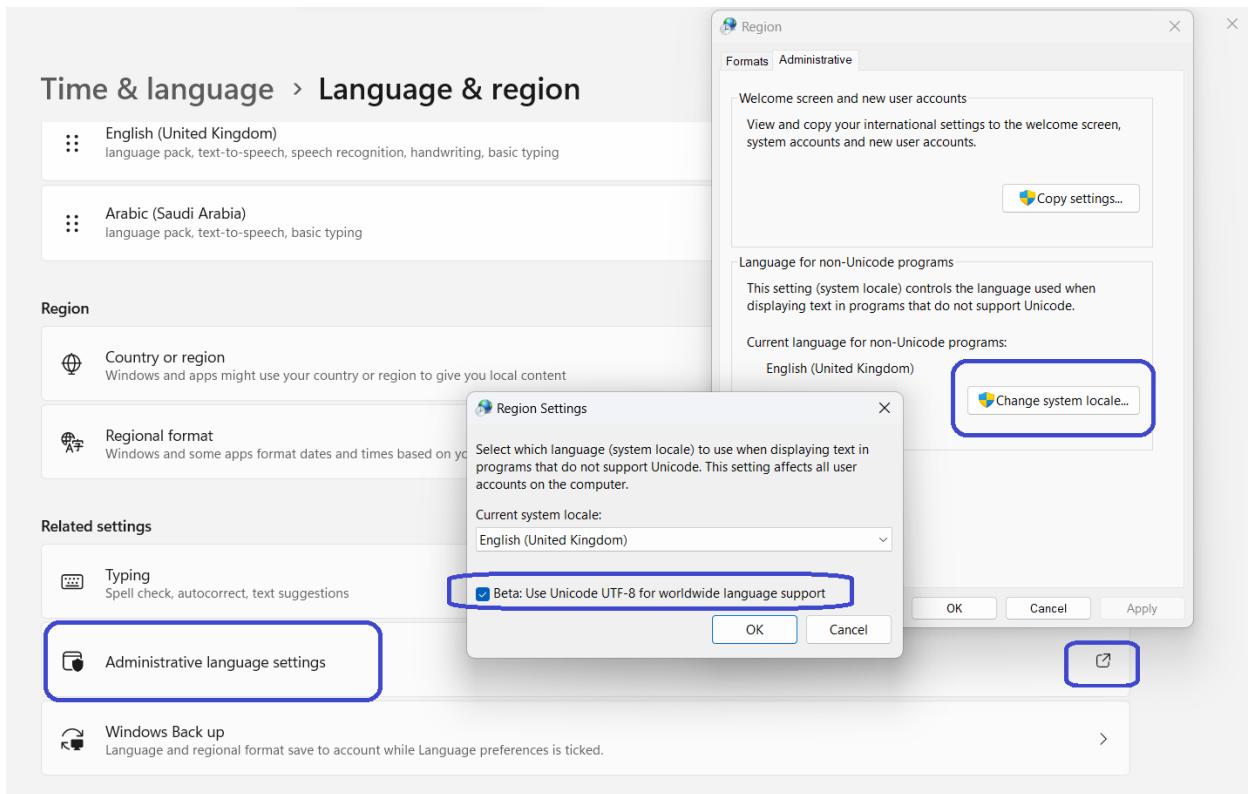
Ring will automatically execute (ringsyntax.ring) using Load Syntax command

Each Folder in the program could have it's optional (ringsyntax.ring) file

We can mix styles in the same project



For Windows users, To use Arabic source code files with Ring, Set the language settings.



39.22 Enable/Disable Hash Comments

Starting from Ring 1.20 we have the next two commands supported by the Ring Scanner

- `EnableHashComments`
- `DisableHashComments`

Example:

```
DisableHashComments
#define = 10
EnableHashComments
# Just a comment
DisableHashComments
? #define
EnableHashComments
# End of program
```

INTRODUCTION TO THE TYPE HINTS LIBRARY

In this chapter we will learn about the Type Hints Library

40.1 Why Type Hints?

Using this library we can add the type information to the source code which will be very useful for tools like

- Code Editors
- Static-Analysis

Note: Ring is a dynamic language, No type checking will be done by the compiler.

40.2 Example

The next example will use the Type Hints library

```
load "typehints.ring"

see sum(3,4) + nl ;
see sayHello("Mahmoud");

int func sum(int x,int y) {
    return x+y ;
}

string func sayHello(string name) {
    return "Hello " + name ;
}
```

40.3 User Types

The Type Hints library is very powerful and will support user types (Classes) automatically

Example:

```
load "typehints.ring"

import mypackage

test() { main(:one,:two,:three) }

myclass func test() {
    see "Testing User Types!" + nl
    return new myclass
}

package mypackage {
    public class myclass {
        public static void func main(list args) {
            see "welcome" + nl
            see args
        }
    }
}
```

40.4 Using Types inside Code

Also you can use the types inside the code (not only the function prototype)

Example:

```
load "typehints.ring"

int      sum = sum(3,4)
string   msg = sayHello("Mahmoud")

see "Sum = " + sum + nl + msg + nl

int func sum(int x,int y) {
    return x+y ;
}

string func sayHello(string name) {
    return "Hello " + name ;
}
```

40.5 Using Override

We can use override or @override

Example:

```
load "typehints.ring"

o = new MyNewLib {
    ? isGreaterThanTwo(10)
    ? isGreaterThanTwo(1)
}

class MyLib {
    boolean func isGreaterThanTwo(int x) {
        if x > 2
            return true
        else
            return false
        ok
    }
}

class MyNewLib < MyLib {
    @override
    boolean func isGreaterThanTwo(int x) {
        ? "Using override"
        return x > 2
    }
}
```

Output:

```
Using override
1
Using override
0
```

40.6 Rules

- To use the types in the function prototype you must use ‘(’ and ‘)’ around parameters
- To use the types in the function code, You must set the variable value (Assignment).

The next types are defined by the library

```
# Low Level Types
char
unsigned
signed
int
short
```

(continues on next page)

(continued from previous page)

```
long
float
double
void
byte
boolean

# High Level Types
string
list
number
object

# Other
public
static
abstract
protected
override
@Override
```

THE TRACE LIBRARY AND THE INTERACTIVE DEBUGGER

In this chapter we will learn about the Trace Library and the Interactive Debugger

41.1 Loading the Trace library

To start using the Trace library, We must load it first!

```
load "tracelib.ring"
```

41.2 Trace All Events

The next example demonstrates the Trace library usage to trace all events.

```
# Trace All Events
trace(:AllEvents)

see "Hello, world!" + nl
see "Welcome" + nl
see "How are you?" +nl

mytest()

new myclass { mymethod() }

func mytest
    see "Message from mytest" + nl

class myclass
    func mymethod
        see "Message from mymethod" + nl
```

41.3 Trace control flow between functions

The next example demonstrates the Trace library usage to trace the control flow between functions.

```
Trace(:Functions)

test1()

func test1
    see :test1 + nl
    test2()

func test2
    see :test2 + nl
    see test3() + nl

func test3
    see :test3 + nl
    return "test 3 output"
```

41.4 Pass Error

The next example demonstrates the Trace library usage to pass an error!

```
Trace(:PassError)

test1()

func test1
    x = 10
    see :test1 + nl
    test2() # Runtime Error!
    see "We can continue!"
```

41.5 Interactive Debugger

The next example demonstrates the Trace library usage to use the Interactive Debugger

```
Trace(:Debugger)

test1()
see "good bye!" + nl

func test1
    x = 10
    see :test1 + nl
    t = 12
    test2() # Runtime Error!
    see "After Error!" +nl
```

(continues on next page)

(continued from previous page)

```
see "t = " see t see nl
see "x = " see x see nl
```

41.6 Execute Program Line by Line

The next example demonstrates the Trace library usage to execute the program line by line!

```
Trace(:LineByLine)

test1()

func test1
    x = 10
    see :test1 + nl
    t = 12
    test2()
    see "After Error!" +nl
    see "t = " + t + nl
```

41.7 BreakPoint

The next example demonstrates the Trace library usage to stop at a breakpoint!

```
test1()

func test1
    x = 10
    see :test1 + nl
    t = 12
    BreakPoint()
    see "After breakpoint!" +nl
    see "t = " + t + nl
    see "End of program!" + nl
```

41.8 Disable BreakPoints

The next example demonstrates the Trace library usage and how to disable the Breakpoints!

```
NoBreakPoints()

test1()

func test1
    x = 10
    see :test1 + nl
    t = 12
```

(continues on next page)

(continued from previous page)

```
BreakPoint()
see "After breakpoint!" +nl
see "t = " + t + nl
see "End of program!" + nl
```

41.9 Using the Interactive Debugger

The next example uses a Breakpoint to open the Interactive Debugger!

```
load "tracelib.ring"

test1()

func test1
    x = 10
    see :test1 + nl
    t = 12
    BreakPoint()
    see "After breakpoint!" +nl
    see "t = " + t + nl
    see "End of program!" + nl
```

Screen Shots:

We have the Interactive Debugger at the Breakpoint!

The screenshot shows a terminal window titled 'C:\WINDOWS\system32\cmd.exe - B:\ring\applications\note\batch\rung "B:/ring/ringlibs/tracelib/samples/sample6.ring"'. The left side of the window displays the Ring source code. The right side shows the interactive debugger interface, which includes a list of commands and their descriptions, such as Command (Exit) for End Program, Command (Cont) for Continue Execution, and Command (Locals) for Print local variables names. A prompt 'code:>' is visible at the bottom of the right pane.

```
5 # BreakPoint
6
7 load "tracelib.ring"
8
9 test1()
10
11 func test1
12     x = 10
13     see :test1 + nl
14     t = 12
15     BreakPoint()
16     see "After breakpoint!" +nl
17     see "t = " + t + nl
18     see "End of program!" + nl
19
20
```

We can print the variables values

The screenshot shows a terminal window with the following content:

```

6 load "tracelib.ring"
7
8
9 test1()
10
11 func test1
12     x = 10
13     see :test1 + nl
14     t = 12
15     BreakPoint()
16     see "After breakpoint!" +nl
17     see "t = " + t + nl
18     see "End of program!" + nl
19
20
=====
Command (Exit)      : End Program
Command (Cont)       : Continue Execution
Command (Locals)    : Print local variables names
Command (LocalsData) : Print local variables data
Command (Globals)   : Print global variables names
Command (CallStack) : Print call stack
We can execute Ring code
=====
code:> localsdata

Variable : x      Type : NUMBER          Value : 10
Variable : t      Type : NUMBER          Value : 12

code:> -

```

We can change the variables values then continue execution

The screenshot shows a terminal window with the following content:

```

5 # BreakPoint
6
7 load "tracelib.ring"
8
9 test1()
10
11 func test1
12     x = 10
13     see :test1 + nl
14     t = 12
15     BreakPoint()
16     see "After breakpoint!" +nl
17     see "t = " + t + nl
18     see "End of program!" + nl
19
20
=====
code:> localsdata

Variable : x      Type : NUMBER          Value : 10
Variable : t      Type : NUMBER          Value : 12

code:> x = 100
code:> t = 200
code:> cont
After breakpoint!
t = 200
End of program!

```

We can run the Interactive Debugger in the Output Window

The screenshot shows the Ring Notepad IDE with the following interface elements:

- Project Files:** Shows a tree view of project files under "My Work (B:)".
- Source Code:** A code editor showing the content of "sample6.ring".
- Output:** An output window titled "Interactive Debugger" showing the same execution history as the previous terminal window.

The "sample6.ring" code is:

```

1 load "tracelib.ring"
2
3 test1()
4
5 func test1
6     x = 10
7     see :test1 + nl
8     t = 12
9     BreakPoint()
10    see "After breakpoint!" +nl
11    see "t = " + t + nl
12    see "End of program!" + nl
13
14
=====
```

EMBEDDING RING IN RING

In this chapter we will learn about embedding Ring in Ring programs and applications.

42.1 Embedding Ring in Ring without sharing the State

From Ring 1.0 we already have functions for embedding Ring in the C language. Also we can execute Ring code inside Ring programs using the eval() function. In this release we provide functions for embedding Ring in Ring programs without sharing the state.

Advantages:

- (1) Quick integration for Ring programs and applications together without conflicts.
- (2) Execute and run Ring code in safe environments that we can trace.

Example:

```
pState = ring_state_init()
ring_state_runcode(pState, "See 'Hello, World!' +nl")
ring_state_runcode(pState, "x = 10")

pState2 = ring_state_init()
ring_state_runcode(pState2, "See 'Hello, World!' +nl")
ring_state_runcode(pState2, "x = 20")

ring_state_runcode(pState, "see x +nl")
ring_state_runcode(pState2, "see x +nl")

v1 = ring_state_findvar(pState, "x")
v2 = ring_state_findvar(pState2, "x")

see v1[3] + nl
see V2[3] + nl

ring_state_delete(pState)
ring_state_delete(pState2)
```

Output:

```
Hello, World!
Hello, World!
10
```

(continues on next page)

(continued from previous page)

```
20
10
20
```

42.2 Serial Execution of Programs

We can execute application after another application using ring_state_main()

Example:

```
chdir(exefolder()+"../applications/formdesigner")
ring_state_main('formdesigner.ring')
chdir(exefolder()+"../applications/cards")
ring_state_main('cards.ring')
```

42.3 ring_state_setvar()

Using ring_state_setvar() we can set variables value

The value could be (String, Number, List or C Pointer)

We need this function to quickly pass lists and C pointers to the Sub Ring Environment

Syntax:

```
ring_state_setvar(oState,cVariableName,Value)
```

Example:

```
load "guilib.ring"

myapp    = null
win      = null

func main
    myapp = new qApp {
        win = new QWidget() {
            setWindowTitle("Advanced Example on using ring_state_setvar()")
            move(100,100)
            resize(600,400)
            new QPushButton(win) {
                setText("Test")
                setClickEvent("Test()")
            }
            # We need this because using load 'guilib.ring' in
            # the sub environment
            # Will create timers by Qt and closing the window
            # will not be enough to close the application
            oFilter = new qAllEvents(win)
            oFilter.setCloseEvent("myapp.quit()")
        }
    }
```

(continues on next page)

(continued from previous page)

```

        win.installeventfilter(oFilter)
        show()
    }
    exec()
}

func test
    pState = ring_state_init()
    ring_state_runcode(pState, "load 'guilib.ring'")
    ring_state_runcode(pState, "x = NULL")
    # Pass String
        ring_state_setvar(pState, "x", "hello")
        ring_state_runcode(pState, "? x")
    # Pass Number
        ring_state_setvar(pState, "x", 100)
        ring_state_runcode(pState, "? x")
    # Pass List
        ring_state_setvar(pState, "x", ["one", "two", "three"])
        ring_state_runcode(pState, "? x")
    # Pass Object
    # We can't pass the Ring Object (win)
    # Because Objects store pointers to the Class Information
    # And the class is related to the Parent Ring Environment
    # And the sub Ring environment can't access it
    # But we can pass C pointers like win.pObject
        ring_state_setvar(pState, "x", win.pObject)
    # Now we create the object again but using the same C pointer
    # So we have access to the Same window in the parent Ring environment
        ring_state_runcode(pState,
            new QWidget {
                pObject = x
                setWindowTitle('Message from the Sub Ring Environment')
            }
        )
    ring_state_delete(pState)
}

```

42.4 ring_state_new() and ring_state_mainfile()

Using ring_state_new() and ring_state_mainfile() we can run Ring programs from Ring programs

But unlike ring_state_main(), Here we can control when to delete the Ring state!

This is important when we run GUI programs from GUI programs

Because they will share the GUI Library (RingQt), And In this case the caller will call

qApp.Exec()

So the sub program, will not stop and will return to the Main program

Here deleting the State of the sub programs will lead to a problem when we run the sub program events

So keeping the state is important for sub GUI programs hosted in GUI programs.

Example:

```

load "guilib.ring"

func main
    new qApp {
        win = new QWidget() {
            setWindowTitle("Test ring_state_mainfile()")
            resize(400,400) move(100,100)
            btn = new QPushButton(win) {
                settext("test")
                setclickevent("mytest()")
            }
            show()
        }
        exec()
    }

func mytest
    pState = ring_state_new()
    ring_state_mainfile(pState, "runprogram.ring")
    # Here we don't delete the state if we will run GUI application
    # So we can run the GUI application events
    // ring_state_delete(pState)

```

If you will use this feature, remember to update the previous example based on your application needs

So you can call `ring_state_delete()` at some point to avoid the memory leak!

42.5 Runtime Errors when Embedding Ring in Ring

Starting from Ring 1.8

When embedding Ring in Ring, the error in the hosted environment will not close the host

Example:

```

? "Start the test!"

pState = ring_state_init()

ring_state_runcode(pState, " ? 'Let us try having an error' ? x")

ring_state_delete(pState)

? ""
? "End of test!"

```

Output:

```

Start the test!
Let us try having an error
Line 1 Error (R24) : Using uninitialized variable : x

```

(continues on next page)

(continued from previous page)

```
in file Ring_EMBEDDED_CODE
End of test!
```

42.6 ring_state_filetokens() function

Starting from Ring 1.12 we have the ring_state_filetokens() function

Using this function we can get all the tokens in the ring source code file.

```
C_FILENAME      = "test_tokens.ring"
C_WIDTH        = 12

# write the file
    write(C_FILENAME,
          see "Hello, World!"
          ? 3*2+3
          Name = "Ring"
          ? Name
    )

# Token Type
C_KEYWORD      = 0
C_OPERATOR     = 1
C_LITERAL      = 2
C_NUMBER       = 3
C_IDENTIFIER   = 4
C_ENDLINE      = 5

# Keywords List
aKEYWORDS = ["IF", "TO", "OR", "AND", "NOT", "FOR", "NEW", "FUNC",
"FROM", "NEXT", "LOAD", "ELSE", "SEE", "WHILE", "OK", "CLASS", "RETURN", "BUT",
"END", "GIVE", "BYE", "EXIT", "TRY", "CATCH", "DONE", "SWITCH", "ON", "OTHER", "OFF",
"IN", "LOOP", "PACKAGE", "IMPORT", "PRIVATE", "STEP", "DO", "AGAIN", "CALL", "ELSEIF",
"PUT", "GET", "CASE", "DEF", "ENDFUNC", "ENDCLASS", "ENDPACKAGE",
"CHANGERINGKEYWORD", "CHANGERINGOPERATOR", "LOADSYNTAX"]

pState = ring_state_new()
aList = ring_state_filetokens(pState, C_FILENAME)
PrintTokens(aList)
ring_state_delete(pState)

func PrintTokens aList
    for aToken in aList
        switch aToken[1]
        on C_KEYWORD
            ? Width("Keyword", C_WIDTH) + ":" + aKeywords[0+aToken[2]]
        on C_OPERATOR
            ? Width("Operator", C_WIDTH) + ":" + aToken[2]
        on C_LITERAL
            ? Width("Literal", C_WIDTH) + ":" + aToken[2]
        on C_NUMBER
            ? Width("Number", C_WIDTH) + ":" + aToken[2]
```

(continues on next page)

(continued from previous page)

```

    ? Width("Number",C_WIDTH) + ":" + aToken[2]
on C_IDENTIFIER
    ? Width("Identifier",C_WIDTH) + ":" + aToken[2]
on C_ENDLINE
    ? "EndLine"
off
next

func Width cText,nWidth
    return cText+copy(" ",nWidth-len(cText))

```

Output:

```

EndLine
Keyword : SEE
Literal : Hello, World!
EndLine
Operator : ?
Number : 3
Operator : *
Number : 2
Operator : +
Number : 3
EndLine
Identifier : name
Operator : =
Literal : Ring
EndLine
Operator : ?
Identifier : name
EndLine

```

42.7 ring_state_mainfile() and Ring Object File

Starting from Ring 1.20 the `ring_state_mainfile()` is updated and support Ring Object Files (*.ringo)

So, we can write a group of functions/classes then compile them to Ring Object File, send this file to another programmer who can use the functions/classes inside his program after loading it in isolated embedded Ring State.

File: mylib.ringo

```

? "Hello from the object file"
func test
    ? "Hello from test() function"

```

Compiling the code to Ring Object File

```
ring mylib.ringo -go
```

This will generate (mylib.ringo)

File: use.ring

```
pState = ring_state_new()
ring_state_mainfile(pstate, "mylib.ringo")
ring_state_runcode(pstate, "? 'We can call functions from Ring Object File!' ")
ring_state_runcode(pstate, "test()")
ring_state_delete(pState)

? :done
```

In practice it's expected that the programmer who will distribute the (*.ringo) file will distribute a simple *.ring file that create the Ring state, load the Ring Object and call functions/methods.

Something like this

File: commercialLib.ring

```
mylib = new mylib

class mylib

    pState = ring_state_new()
    ring_state_mainfile(pstate, "mylib.ringo")

    func test
        ring_state_runcode(pstate, "test()")

    func destroy
        ring_state_delete(pState)
```

Then we can use this library like this

```
load "commercialLib.ring"
mylib.test()
```

42.8 Pause/Resume the Ring VM

Starting from Ring 1.20 we can pause/resume the embedded Ring VM

To pause the VM, just use the (Bye) command which as expected will end the execution but will store the nPC value (Program Counter) so using ring_state_resume() we can continue the execution at any time starting from this nPC value.

Syntax:

```
ring_state_resume(oState, [cPara|nPara], [lUseReturn])
```

The second parameter could be a string or number that we will push to the Stack

The third parameter determine if we would like to execute the Return command before Resume or not.

A common usage for this function exist in the (Try Ring Online) application which uses RingQt for WebAssembly.

You will find the source code in the ring/tools/tryringonline folder.

The usage of Pause/Resume using (Bye/ring_state_resume()) exist in the ring/tools/tryringonline/ringvm.ring file.

This application uses Embedded Ring VM, and replace the Give command with a function like this

```
func ringvm_give
    lActiveGive = True
    bye
```

Once Ring VM find ringvm_give() function is defined, it will call it every time we use the Give command. It's expected from this function to return a string that represent the value entered by the user. What happens here is using the (bye) command to stop the embedded Ring VM execution.

Now, the Ring application that have this embedded Ring VM could provide a UI to get the value from the user and when the user press ENTER or click (Send) the application will resume the execution of the embedded Ring VM

The next send() method is part of the RingVM class in the TryRingOnline application

```
func send cInput

    if ! pState
        return :NoProgramIsRunning
    ok

    vVar = ring_state_findvar(pState,:lActiveGive)
    lActiveGive = vVar[RING_VAR_VALUE]

    if ! lActiveGive
        return :NoInputIsRequired
    ok

    lActiveGive = False
    ring_state_setvar(pState,:lActiveGive, False)

    ring_state_resume(pState,cInput,True)

    return :OutputIsReady
```

42.9 Rules

These functions are considered advanced functions and exist for specific use-cases.

If you are going to use these functions, you need to know the next rules.

- (1) ring_state_runcode() expect that the VM is already created and ready for use. So to be able to use this function you have to create the Ring State and the Ring VM using ring_state_init() function. So, using ring_state_new() alone instead of using ring_state_init() will not be enough because this function (ring_state_new()) doesn't create the Ring VM.
- (2) Using ring_state_new() then using ring_state_mainfile() will create the Ring State and the Ring VM too so we can use ring_state_runcode() after that. But it's not recommended to do that. i.e. It's better to just use ring_state_mainfile() and generate all of the source code before using this function.
- (3) ring_state_runcode() is very similar to the Eval() function. It's designed to delete the code after execution if this code doesn't add new functions/classes. Also, this function uses specific execution loop to execute the generated byte-code. It's similar to what happens when we have a GUI application and a button event. The event will be executed using it's execution loop because the main-loop is already passed the control to the GUI library and can't execute more instructions until the end of the GUI application.

- (4) The `ring_state_resume()` function is considered a low-level function and is designed to be used with `ring_state_mainfile()` function to resume the main-loop. This function is used in the TryRingOnline application. Using this function with the `ring_state_runcode()` which uses specific execution loop is not recommended and not supported at the design/implementation level.

CHAPTER
FORTYTHREE

STDLIB FUNCTIONS

In this chapter we are going to learn about functions in the stdlib.ring

Before using the functions in the library, We must load the library first

```
load "stdlib.ring"
```

Instead of using stdlib.ring we can use stdlibcore.ring

Using stdlibcore.ring we can use the StdLib functions (Without Classes)

```
load "stdlibcore.ring"
```

This is useful when developing standalone console applications

Because using stdlib.ring (functions & classes) will load libraries like RingLibCurl, RingOpenSSL, etc.

Also, Using stdlibclasses.ring we can load stdlib classes without loading functions or extensions like RingLibCurl, RingOpenSSL, etc.

```
load "stdlibclasses.ring"
```

43.1 IsAppCompiled() Function

check whether the application has been compiled using Ring2EXE

Syntax:

```
IsAppCompiled() ---> True/False
```

Example:

```
Load "stdlibcore.ring"

Puts("Test IsAppCompiled()")
if IsAppCompiled() see "Application has been compiled using Ring2EXE"
else see "Application is running under Ring interpreter" ok
```

43.2 AppArguments() Function

Get the effective arguments passed to the Ring script

Syntax:

```
AppArguments() ---> The arguments as a list of strings
```

Example:

```
Load "stdlibcore.ring"

# Application Arguments
Puts("Test AppArguments()")
argsList = AppArguments()
argsCount = Len(argsList)
if argsCount = 0 see "No arguments passed to the Ring script" + nl
else see "Ring script arguments = " + nl + list2str(argsList) + nl ok
```

43.3 AppPath() Function

Get the path of the application folder

Syntax:

```
AppPath() ---> The path as String
```

Example:

```
Load "stdlibcore.ring"

# Application Path
Puts("Test AppPath()")
See AppPath() + nl
```

43.4 JustFilePath() Function

Get the path of the file, remove the file name.

Syntax:

```
JustFilePath(cFile) ---> The path as String
```

Example:

```
load "stdlibcore.ring"

see justfilePath("b:\ring\applications\rnote\rnote.ring")
```

Output:

```
b:\ring\applications\rnote\
```

43.5 JustFileName() Function

Get the file, remove the file path.

Syntax:

```
JustFileName(cFile) ---> The file name as String
```

Example:

```
load "stdlibcore.ring"
see justfileName("b:\ring\applications\rnote\rnote.ring")
```

Output:

```
rnote.ring
```

43.6 Value() Function

create a copy from a list or object

Syntax:

```
value(List) ---> new list
```

Example:

```
Load "stdlibcore.ring"
aList = 1:10
del(value(aList),1) # delete first item
see aList          # print numbers from 1 to 10
```

43.7 Times() Function

Execute a Function nCount times

Syntax:

```
Times(nCount, function)
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Times()")
Times ( 3 , func { see "Hello, World!" + nl } )
```

43.8 Map() Function

Execute a Function on each list item

Syntax:

```
Map(alist,function) ---> List
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Map()")
See Map( 1:10, func x { return x*x } )
```

43.9 Filter() Function

Execute a Function on each list item to filter items

Syntax:

```
Filter(alist,function) ---> List
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Filter()")
See Filter( 1:10 , func x { if x <= 5 return true else return false } )
```

43.10 Reduce() Function

Apply function cFunc to each result xResult from a list aList, return an accumulated value xResult

The input list aList, the optional intial value xInitial and the output xResult, need to be the same Type

Syntax:

```
Reduce(aList,cFunc,xInitial) ---> final value
```

Example:

```
Load "stdlibcore.ring"
? Reduce( 1:3, func x, y { return x + y }, 0 )
? Reduce( ["I","Love","Ring"], func x, y { return x + y }, "" )
```

Output:

```
6
ILoveRing
```

43.11 Split() Function

Convert string words to list items

Note: This function remove all leading and trailing spaces from a string.

Tip: To avoid removing all leading and trailing spaces use the SplitMany() function.

Syntax:

```
Split(cstring,delimiter) ---> List
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Split()")
See Split("one two three four five"," ")
```

43.12 SplitMany() Function

Convert string words to list items. Allow many delimiters.

Syntax:

```
SplitMany(cstring,delimiters as string or list) --> List
```

Example:

```
Load "stdlibcore.ring"

Puts("Test SplitMany()")
See SplitMany("one,two,three,four and five","","")
```

43.13 Capitalized() Function

Return a copy of a string with the first letter capitalized

Syntax:

```
Capitalized(string) ---> string
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Capitalized()")
See capitalized("welcome to the Ring Programming Language")
```

43.14 IsSpecial() Function

Check whether a character is special or not

Syntax:

```
IsSpecial(char) ---> True/False
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Isspecial()")
See "Isspecial = " + isSpecial("%") + nl
```

43.15 IsVowel() Function

Check whether a character is vowel or not

Syntax:

```
IsVowel(char) ---> True/False
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Isvowel()")
See "Isvowel = " + isVowel("c") + nl
```

43.16 LineCount() Function

Return the lines count in a text file.

Syntax:

```
LineCount(cFileName) ---> Lines Count as number
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Linecount()")
See "the number of lines = " + lineCount("test.ring")
```

43.17 Factorial() Function

Return the factorial of a number

Syntax:

```
Factorial(number) ---> number
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Factorial()")
see "6 factorial is : " + Factorial(6)
```

43.18 Fibonacci() Function

Return the fibonacci number

Syntax:

```
Fibonacci(number) ---> number
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Fibonacci()")
see "6 Fibonacci is : " + Fibonacci(6)
```

43.19 IsPrime() Function

Check whether a number is prime or not

Syntax:

```
isprime(number) ---> Number
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Isprime()")
if isPrime(16) see "16 is a prime number"
else see "16 is not a prime number" ok
```

43.20 Sign() Function

Returns an integer value indicating the sign of a number.

Syntax:

```
Sign(number) ---> number ( -1 = negative , 0 , 1 (positive) )
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Sign()")
see "sign of 12 is = " + sign(12) + nl
```

43.21 List2File() Function

Write list items to text file (each item in new line).

Syntax:

```
List2File(aList,cFileName)
```

Example:

```
Load "stdlibcore.ring"
# Test List2File
Puts("Test List2File()")
list2file(1:100,"myfile.txt")
```

43.22 File2List() Function

Read text file and convert lines to list items

Syntax:

```
File2List(cFileName) ---> List
```

Example:

```
Load "stdlibcore.ring"
# Test File2List
Puts("Test File2List()")
see len(file2list("myfile.txt"))
```

43.23 StartsWith() Function

Returns true if the given string starts with the specified substring.

Leading white spaces are ignored.

Syntax:

```
StartsWith(string, substring) ---> True/False
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Startswith()")
see Startswith("CalmoSoft", "Calmo") + nl
```

43.24 EndsWith() Function

Returns true if the given string ends with the specified substring.

Trailing white spaces are ignored.

Syntax:

```
EndsWith(string, substring) ---> True/False
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Endswith()")
see endsWith("CalmoSoft", "Soft") + nl
```

43.25 GCD() Function

Finding of the greatest common divisor of two integers.

Syntax:

```
Gcd(number,number) ---> number
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Gcd()")
see gcd (24, 32) + nl
```

43.26 LCM() Function

Compute the least common multiple of two integers.

Syntax:

```
lcm(number,number) ---> number
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Lcm()")
see Lcm(24,36) + nl
```

43.27 SumList() Function

Compute the sum of a list of integers.

Syntax:

```
sumlist(list) ---> number
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Sumlist()")
aList = [1,2,3,4,5]
see Sumlist(aList) + nl
```

43.28 ProdList() Function

Compute the product of a list of integers.

Syntax:

```
prodlist(list) ---> number
```

Example:

```
Load "stdlibcore.ring"
Puts("Test Prodlist()")
aList = [1,2,3,4,5]
see Prodlist(aList) + nl
```

43.29 EvenOrOdd() Function

Test whether an integer is even or odd.

Result of test (1=odd 2=even).

Syntax:

```
evenorodd(number) ---> 1 (odd) or 2 (even)
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Evenorodd()")
nr = 17
see Evenorodd(nr) + nl
```

43.30 Factors() Function

Compute the factors of a positive integer.

Syntax:

```
factors(number) ---> list
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Factors()")
n = 45
aList = factors(n)
see "Factors of " + n + " = "
for i = 1 to len(aList)
    see "" + aList[i] + " "
next
```

43.31 IsPalindrome() Function

Check if a sequence of characters is a palindrome or not.

Syntax:

```
IsPalindrome(String) ---> True/False
```

Example:

```
Load "stdlibcore.ring"

Puts("Test IsPalindrome()")
```

(continues on next page)

(continued from previous page)

```
cString = "radar"
see IsPalindrome(cString)
```

43.32 IsLeapYear() Function

Check whether a given year is a leap year in the Gregorian calendar.

Syntax:

```
Isleapyear(number) ---> True/False
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Isleapyear()")
year = 2016
if Isleapyear(year) see "" + year + " is a leap year."
else see "" + year + " is not a leap year." ok
```

43.33 BinaryDigits() Function

Compute the sequence of binary digits for a given non-negative integer.

Syntax:

```
binarydigits(number) ---> string
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Binarydigits()")
b = 35
see "Binary digits of " + b + " = " + Binarydigits(b)
```

43.34 MatrixMulti() Function

Multiply two matrices together.

Syntax:

```
Matrixmulti(List,List) ---> List
```

Example:

```
Load "stdlibcore.ring"

# Multiply two matrices together.
Puts("Test Matrixmulti()")
A = [[1,2,3], [4,5,6], [7,8,9]]
B = [[1,0,0], [0,1,0], [0,0,1]]
see Matrixmulti(A, B)
```

43.35 MatrixTrans() Function

Transpose an arbitrarily sized rectangular Matrix.

Syntax:

```
Matrixtrans(List) ---> List
```

Example:

```
Load "stdlibcore.ring"

# Transpose an arbitrarily sized rectangular Matrix.
Puts("Test Matrixtrans()")
matrix = [[78,19,30,12,36], [49,10,65,42,50], [30,93,24,78,10], [39,68,27,64,29]]
see Matrixtrans(matrix)
```

43.36 DayOfWeek() Function

Return the day of the week of given date. (yyyy-mm-dd)

Syntax:

```
dayofweek(string) ---> string
```

Example:

```
Load "stdlibcore.ring"

# Return the day of the week of given date.
Puts("Test Dayofweek()")
date = "2016-04-24"
see "Data : " + date + " - Day : " + Dayofweek(date) + nl
```

43.37 Permutation() Function

Generates all permutations of n different numerals.

Syntax:

```
permutation(list)
```

Example:

```
Load "stdlibcore.ring"

# Generates all permutations of n different numerals
Puts("Test Permutation()")
list = [1, 2, 3, 4]
for perm = 1 to 24
    for i = 1 to len(list)
        see list[i] + " "
    next
    see nl
    Permutation(list)
next
```

43.38 ReadLine() Function

Read line from file

Syntax:

```
readline(fp) ---> string
```

Example:

```
Load "stdlibcore.ring"

# Read a file line by line.
Puts("Test Readline()")
fp = fopen("test.ring", "r")
while not feof(fp)
    See Readline(fp) end
    fclose(fp)
```

43.39 SubString() Function

Return a position of a substring starting from a given position in a string.

Syntax:

```
Substring(str,substr,npos) ---> string
```

Example:

```
Load "stdlibcore.ring"

# Return a position of a substring starting from a given position in a string.
Puts("Test Substring()")
a = "abcxyzqweabc"
b = "abc"
i = 4
see substring(a,b,i)
```

43.40 ChangeString() Function

Change substring from given position to a given position with another substring.

Syntax:

```
Changestring(cString, nPos1, nPos2, cSubstr) ---> cString
```

Example:

```
Load "stdlibcore.ring"

# Change substring from given position for given position with a substring.
Puts("Test Changestring()")
see Changestring("Rmasdg",2,5,"in")      # Ring
```

43.41 Sleep() Function

Sleep for the given amount of time.

Syntax:

```
sleep(nSeconds)
```

Example:

```
Load "stdlibcore.ring"

Puts("Test Sleep()")
see "Wait 3 Seconds!"
Sleep(3)
see nl
```

43.42 IsMainSourceFile() Function

Check if the current file is the main source file

Syntax:

```
IsMainSourceFile() ---> True/False
```

Example:

```
Load "stdlibcore.ring"

if ismainsourcefile()
    # code
ok
```

43.43 MakeDir() Function

Make Directory

Syntax:

```
MakeDir(String)
```

Example:

```
Load "stdlibcore.ring"

# Create Directory
puts("create Directory : myfolder")
makedir("myfolder")
```

43.44 Fsize() Function

The function return the file size in bytes.

Syntax:

```
FSize(File Handle) ---> Number (File Size in Bytes)
```

43.45 TrimAll() Function

Remove all spaces and tabs characters from a string

Syntax:

```
TrimAll(cString) ---> cString # Without Spaces and Tabs
```

43.46 TrimLeft() Function

Remove all spaces and tabs characters from the left side of a string

Syntax:

```
TrimLeft(cString) ---> cString # Without Spaces and Tabs from the left side
```

43.47 TrimRight() Function

Remove all spaces and tabs characters from the right side of a string

Syntax:

```
TrimRight(cString) ---> cString # Without Spaces and Tabs from the right side
```

43.48 EpochTime() Function

Return the Epoch Time

Syntax:

```
EpochTime(cDate, cTime) ---> nEpochTime
```

Example:

```
see EpochTime( Date(), Time() )
```

43.49 SystemCmd() Function

We can execute system commands using the SystemCmd() function that outputs to a variable

Syntax:

```
SystemCmd(cCommand)
```

Example:

```
cYou = SystemCmd("whoami")      # User Name logged in is output to a variable
cThem = SystemCmd("dir c:\Users") # Directory List is output to a variable
```

43.50 ListAllFiles() Function

Using this function we can quickly do a process on a group of files in a folder and it's sub folders.

Syntax:

```
ListAllFiles(cFolder, cExtension) ---> List of Files
```

Example:

```
aList = ListAllFiles("c:/ring/ringlibs","ring") # *.ring only
aList = sort(aList)
see aList
```

Example:

```
see listallfiles("b:/ring/libraries/weplib","","") # All Files
```

43.51 SystemSilent() Function

We can execute system commands using the SystemSilent() function to avoid displaying the output!

Syntax:

```
SystemSilent(cCommand)
```

43.52 OSCreateOpenFolder() Function

Create folder then change the current folder to this new folder

Syntax:

```
OSCreateOpenFolder(cCommand)
```

43.53 OSCopyFolder() Function

Copy folder to the current folder

Parameters : The path to the parent folder and the folder name to copy

Syntax:

```
OSCopyFolder(cParentFolder, cFolderName)
```

Example

To copy the folder b:\ring\ringlibs\stdlib to the current folder

```
OSCopyFolder("b:\ring\ringlibs\","stdlib")
```

43.54 OSDeleteFolder() Function

Delete Folder in the current Directory

Syntax:

```
OSDeleteFolder(cFolderName)
```

43.55 OSCopyFile() Function

Copy File to the current directory

Syntax:

```
OSCopyFile(cFileName)
```

43.56 OSDeleteFile() Function

Delete File

Syntax:

```
OSDeleteFile(cFileName)
```

43.57 OSRenameFile() Function

Rename File

Syntax:

```
OSRenameFile(cOldFileName, cNewFileName)
```

43.58 List2Code() Function

This function convert a Ring list during the runtime to Ring source code that we can save to source files.

The list may contains strings, numbers or sub lists.

Example:

```
load "stdlibcore.ring"
aList = 1:10
? list2Code(aList)
```

Output:

```
[  
    1,2,3,4,5,6,7,8,9,10  
]
```

43.59 Str2ASCIIList() Function

Convert a string of bytes to a list of numbers where each item represent the ASCII code of one byte in the string.

Syntax:

```
Str2ASCIIList(String) ---> List of numbers
```

43.60 ASCIIList2Str() Function

Convert a list of numbers where each item represent the ASCII code of one byte to a string of bytes.

Syntax:

```
ASCIIList2Str(List of numbers) ---> String
```

Example:

```
load "stdlibcore.ring"

cStr = "MmMm"

aList = Str2ASCIIList(cStr)
? aList

cStr2 = ASCIIList2Str(aList)
? cStr2
? len(cStr2)
```

Output:

```
77
109
77
109

MmMm
4
```

43.61 IsListContainsItems() Function

Syntax:

```
IsListContainsItems(aParent,aChild) -----> True/False
```

Example:

```
load "stdlibcore.ring"
aList1 = "a":"z"
aList2 = [:h,:l,:p,:u]
? IsListContainsItems(aList1,aList2)
```

43.62 IsBetween() Function

Syntax:

```
IsBetween(nNumber, nMin, nMax) ----> True/False
```

Example:

```
load "stdlibcore.ring"
? isBetween(1,3,4)
? isBetween(1,-3,4)
? isBetween(4,1,6)
? isBetween(4,3,4)
```

43.63 TimeInfo() Function

Syntax:

```
TimeInfo(cInformation) ----> String
```

The cInformation value could be

```
:hour_24
:hour_12
:minutes
:seconds
:time
:day_short
:day_long
:month_short
:month_long
:date_time
:day
:day_year
:month_year
:am_pm
:week_year
:day_week
:date
:year_century
:year
:time_zone
:percent_sign
```

Example:

```
load "stdlibcore.ring"
? timeInfo(:date)
? timeInfo(:time)
? timeInfo(:hour_12)
```

43.64 RandomList() Function

Syntax:

```
RandomList(aList) --> List contains the same items using Random order
```

Example:

```
load "stdlibcore.ring"
aList = 1:5
? RandomList(aList)
```

43.65 RandomItem() Function

Pick an item from a list (Random Choice)

Syntax:

```
RandomItem(aList) --> Item
```

Example:

```
load "stdlibcore.ring"
aList = 1:5
? RandomItem(aList)
```

43.66 CheckEquality() Function

Check if two items are equal. Deep comparison is performed if the two items are lists. Return 1 if both items are equal and 0 otherwise

Syntax:

```
CheckEquality(aItem1,aItem2) --> value = 1 if aItem1 = aItem2
                                value = 0 if aItem1 != aItem2
```

Example:

```
load "stdlibcore.ring"
aList1 = ["one", 2, [3]]
aList2 = ["one", 2]
aList2 + [3]
? CheckEquality(aList1,aList2)
```

43.67 NumOrZero() Function

This is a new function added to stdlibcore.ring

Using this function we get a number as output (No runtime errors)

Example:

```
load "stdlibcore.ring"

? numorzero(10)
? numorzero("10")
? numorzero("10.2")
? numorzero("10.2 abc")
? numorzero("What")
? numorzero([10])
? numorzero(new point)
```

```
class point
```

Output:

```
10
10
10.20
0
0
0
0
```

CHAPTER
FORTYFOUR

STDLIB CLASSES

In this chapter we are going to learn about the classes in the stdlib.ring

- StdBase Class
- String Class
- List Class
- Stack Class
- Queue Class
- HashTable Class
- Tree Class
- Math Class
- DateTime Class
- File Class
- System Class
- Debug Class
- DataType Class
- Conversion Class
- ODBC Class
- MySQL Class
- SQLite Class
- PostgreSQL Class
- Security Class
- Internet Class

44.1 StdBase Class

Attributes:

- vValue : Object Value

Methods:

Method	Description/Output
Init(x)	Set vValue Attribute to x value
Print()	Print vValue
PrintLn()	Print vValue then New Line
Size()	return number represent the size of vValue
Value()	return vValue
Set(x)	Call Init(x)

44.2 String Class

Parent Class : StdBase Class

Methods:

Method	Description/Output
Init(String Number List)	
Lower()	New String - Lower case characters
Upper()	New String - Upper case characters
Left(x)	New String - contains x characters from the left
Right(x)	New String - contains x characters from the right
Lines()	Number - Lines count
Trim()	New String - Remove Spaces
Copy(x)	New String - repeat string x times
strcmp(cString)	Compare string with cString
tolist()	List (String Lines to String Items)
tofile(cFileName)	Write string to file
mid(nPos1,nPos2)	New String - from nPos1 to nPos2
getfrom(nPos1)	New String - from nPos1 to the end of the string
replace(cStr1,cStr2,lCase)	New String - Replace cStr1 with cStr2 , lCase (True=Match Case)
split()	List - Each Word as list item
startswith(substring)	Return true if the start starts with a substring
endswith(substring)	Return true if the start ends with a substring

Example:

```
Load "stdlib.ring"

See "Testing the String Class" + nl
oString = new string("Hello, World!")
oString.println()
oString.upper().println()
```

(continues on next page)

(continued from previous page)

```

oString.lower().println()
oString.left(5).println()
oString.right(6).println()
oString = new string("Hi" + nl + "Hello" )
See oString.lines() + nl
oString = new string("    Welcome    ")
oString.println()
oString.trim().println()
oString = new string("Hello! ")
oString.copy(3).println()
see oStringstrcmp("Hello! ") + nl
see oStringstrcmp("Hello ") + nl
see oStringstrcmp("Hello!! ") + nl
oString = new string(["one", "two", "three"])
oString.print()
see oString.lines() + nl
oString = new String(1234)
oString.println()
oString = new String("one"+nl+"two"+nl+"three")
aList = oString.tolist()
see "List Items" + nl See aList
oString = new String( "Welcome to the Ring programming language")
See "the - position : " + oString.pos("the") + nl
oString = oString.getfrom(oString.pos("Ring"))
oString.println()
oString.mid(1,4).println()
oString = oString.replace("Ring", "***Ring***", true)
oString.println()
oString = oString.replace("ring", "***Ring***", false)
oString.println()
oString1 = new string("First")
oString2 = new string("Second")
oString = oString1 + oString2
oString.println()
oString = oString1 * 3
oString.println()
for t in ostring see t next
oString.tofile("test.txt")
oString = new string("one two three")
see nl
see ostring.split()
oString {
    set("Hello") println()
    set("How are you?") println()
}

```

Output:

```

Testing the String Class
Hello, World!
HELLO, WORLD!
hello, world!

```

(continues on next page)

(continued from previous page)

```

Hello
World!
2
      Welcome
Welcome
Hello! Hello! Hello!
0
1
-1
one
two
three
4
1234
List Items
one
two
three
the - position : 12
Ring programming language
Ring
***Ring*** programming language
*****Ring***** programming language
FirstSecond
FirstFirstFirst
FirstFirstFirst
one
two
three
Hello
How are you?

```

44.3 List Class

Parent Class : StdBase Class

Methods:

Method	Description/Output
Init(String List)	
Add(Value)	Add item to the list
Delete(nIndex)	Delete item from the list
Item(nIndex)	Get item from the list
First()	Get the first item in the list
Last()	Get the last item in the list
Set(nIndex,Value)	Set item value
FindInColumn(nCol,Value)	Find item in a column
Sort()	Sort items - return new list
Reverse()	Reverse items - return new list
Insert(nIndex,Value)	Inset Item after nIndex

example:

```
Load "stdlib.ring"

oList = new list ( [1,2,3] )
oList.Add(4)
oList.print()
see oList.item(1) + nl
oList.delete(4)
oList.print()
see oList.first() + nl
see oList.last() + nl
oList { set(1,"one") set(2,"two") set(3,"three") print() }
see oList.find("two") + nl
oList.sort().print()
oList.reverse().print()
oList.insert(2,"nice")
oList.print()
oList = new list ( [ [1,"one"],[2,"two"],[3,"three"] ] )
see copy("*",10) + nl
oList.print()
see "Search two : " + oList.findincolumn(2,"two") + nl
see "Search 1 : " + oList.findincolumn(1,1) + nl
oList = new list ( [ "Egypt" , "USA" , "KSA" ] )
for x in oList
    see x + nl
next
oList = new list ( [1,2,3,4] )
oList + [5,6,7]
oList.print()
oList = new list ( ["one","two"] )
oList2 = new list ( ["three","four"] )
oList + oList2
oList.print()
```

output:

```
1
2
3
4
1
1
2
3
1
3
one
two
three
2
one
three
two
```

(continues on next page)

(continued from previous page)

```

three
two
one
one
two
nice
three
*****
1
one
2
two
3
three
Search two : 2
Search 1 : 1
Egypt
USA
KSA
1
2
3
4
5
6
7
one
two
three
four

```

44.4 Stack Class

Parent Class : List Class

Methods:

Method	Description/Output
Init(String Number List)	
Push(Value)	Push item to the stack
Pop()	Pop item from the stack
Print()	Print the stack items

example:

```

Load "stdlib.ring"

oStack = new Stack
oStack.push(1)

```

(continues on next page)

(continued from previous page)

```

oStack.push(2)
oStack.push(3)
see oStack.pop() + nl
see oStack.pop() + nl
see oStack.pop() + nl
oStack.push(4)
see oStack.pop() + nl
oStack { push("one") push("two") push("three") }
oStack.print()

```

output:

```

3
2
1
4
three
two
one

```

44.5 Queue Class

Parent Class : List Class

Methods:

Method	Description/Output
Init(String Number List)	
Remove()	Remove item from the Queue.

example:

```

Load "stdlib.ring"

oQueue = new Queue
oQueue.add(1)
oQueue.add(2)
oQueue.add(3)
see oQueue.remove() + nl
see oQueue.remove() + nl
see oQueue.remove() + nl
oQueue.add(4)
see oQueue.remove() + nl
oQueue { add("one") add("two") add("three") }
oQueue.print()

```

output:

```

1
2

```

(continues on next page)

(continued from previous page)

```
3
4
one
two
three
```

44.6 HashTable Class

Parent Class : List Class

Methods:

Method	Description/Output
Init(List)	
Add(cKey,Value)	Add item to the HashTable
Set(cKey,Value)	Set item value using the Key
GetValue(cKey)	Get item value using the Key
Contains(cKey)	Check if the HashTable contains item using the Key
Index(cKey)	Get the item index using the Key

example:

```
Load "stdlib.ring"

ohashable = new hashtable
See "Test the hashtable Class Methods" + nl
ohashable {
    Add("Egypt","Cairo")
    Add("KSA","Riyadh")
    see self["Egypt"] + nl
    see self["KSA"] + nl
    see contains("Egypt") + nl
    see contains("USA") + nl
    see index("KSA") + NL
    print()
    delete(index("KSA"))
    see copy("*",60) + nl
    print()
}
```

output:

```
Test the hashtable Class Methods
Cairo
Riyadh
1
0
2
Egypt
```

(continues on next page)

(continued from previous page)

Cairo
KSA
Riyadh

Egypt
Cairo

44.7 Tree Class

Data:

Attribute	Description
Data	Node Value
Children	Children List

Methods:

Method	Description/Output
set(value)	Set the node value.
value()	Get the node value.
Add(value)	Add new child.
parent()	Get the parent node.
print()	Print the tree nodes.

example:

```
Load "stdlib.ring"

otree = new tree
See "Test the tree Class Methods" + nl
otree {
    set("The first step")    # set the root node value
    see value() + nl
    Add("one")
    Add("two")
    Add("three") {
        Add("3.1")
        Add("3.2")
        Add("3.3")
        see children
    }
    see children
oTree.children[2] {
    Add("2.1") Add("2.2") Add("2.3") {
        Add("2.3.1") Add("2.3.2") Add("test")
    }
}
```

(continues on next page)

(continued from previous page)

```
    oTree.children[2].children[3].children[3].set("2.3.3")
}
see copy("*.60") + nl
oTree.print()
```

output:

```
Test the tree Class Methods
The first step
data: 3.1
parent: List...
children: List...
data: 3.2
parent: List...
children: List...
data: 3.3
parent: List...
children: List...
data: one
parent: List...
children: List...
data: two
parent: List...
children: List...
data: three
parent: List...
children: List...
*****
one
two
2.1
2.2
2.3
2.3.1
2.3.2
2.3.3
three
3.1
3.2
3.3
```

44.8 Math Class

Methods:

Method	Description
sin(x)	Returns the sine of an angle of x radians
cos(x)	Returns the cosine of an angle of x radians
tan(x)	Returns the tangent of an angle of x radians
asin(x)	Returns the principal value of the arc sine of x, expressed in radians
acos(x)	Returns the principal value of the arc cosine of x, expressed in radians
atan(x)	Returns the principal value of the arc tangent of x, expressed in radians
atan2(y,x)	Returns the principal arc tangent of y/x, in the interval [-pi,+pi] radians
sinh(x)	Returns the hyperbolic sine of x radians
cosh(x)	Returns the hyperbolic cosine of x radians
tanh(x)	Returns the hyperbolic tangent of x radians
exp(x)	Returns the value of e raised to the xth power
log(x)	Returns the natural logarithm of x
log10(x)	Returns the common logarithm (base-10 logarithm) of x
ceil(x)	Returns the smallest integer value greater than or equal to x
floor(x)	Returns the largest integer value less than or equal to x
fabs(x)	Returns the absolute value of x.
pow(x,y)	Returns x raised to the power of y
sqrt(x)	Returns the square root of x
random(x)	Returns a random number in the range [0,x]
unsigned(n,n,c)	Perform operation using unsigned numbers
decimals(n)	Determine the decimals digits after the point in float/double numbers

example:

```
Load "stdlib.ring"

oMath = new Math

See "Test the Math Class Methods" + nl
See "Sin(0) = " + oMath.sin(0) + nl
See "Sin(90) radians = " + oMath.sin(90) + nl
See "Sin(90) degree = " + oMath.sin(90*3.14/180) + nl

See "Cos(0) = " + oMath.cos(0) + nl
See "Cos(90) radians = " + oMath.cos(90) + nl
See "Cos(90) degree = " + oMath.cos(90*3.14/180) + nl

See "Tan(0) = " + oMath.tan(0) + nl
See "Tan(90) radians = " + oMath.tan(90) + nl
See "Tan(90) degree = " + oMath.tan(90*3.14/180) + nl

See "asin(0) = " + oMath.asin(0) + nl
See "acos(0) = " + oMath.acos(0) + nl
See "atan(0) = " + oMath.atan(0) + nl
See "atan2(1,1) = " + oMath.atan2(1,1) + nl
```

(continues on next page)

(continued from previous page)

```

See "sinh(0) = " + oMath.sinh(0) + nl
See "sinh(1) = " + oMath.sinh(1) + nl
See "cosh(0) = " + oMath.cosh(0) + nl
See "cosh(1) = " + oMath.cosh(1) + nl
See "tanh(0) = " + oMath.tanh(0) + nl
See "tanh(1) = " + oMath.tanh(1) + nl

See "exp(0) = " + oMath.exp(0) + nl
See "exp(1) = " + oMath.exp(1) + nl
See "log(1) = " + oMath.log(1) + nl
See "log(2) = " + oMath.log(2) + nl
See "log10(1) = " + oMath.log10(1) + nl
See "log10(2) = " + oMath.log10(2) + nl
See "log10(10) = " + oMath.log10(10) + nl

See "Ceil(1.12) = " + oMath.Ceil(1.12) + nl
See "Ceil(1.72) = " + oMath.Ceil(1.72) + nl

See "Floor(1.12) = " + oMath.floor(1.12) + nl
See "Floor(1.72) = " + oMath.floor(1.72) + nl

See "fabs(1.12) = " + oMath.fabs(1.12) + nl
See "fabs(1.72) = " + oMath.fabs(1.72) + nl

See "pow(2,3) = " + oMath.pow(2,3) + nl

see "sqrt(16) = " + oMath.sqrt(16) + nl

for x = 1 to 20
    see "Random number Max (100) : " + oMath.random(100) + nl
next

x = 1.1234567890123
for d = 0 to 14
    oMath.decimals(d)
    see x + nl
next

cKey = "hello"

h = 0
for x in cKey
    h = oMath.unsigned(h, ascii(x), "+")
    h = oMath.unsigned(h, oMath.unsigned(h, 10, "<<"), "+")
    r = oMath.unsigned(h, 6, ">>")
    h = oMath.unsigned(h, r, "^")
next
h = oMath.unsigned(h, oMath.unsigned(h, 3, "<<"), "+")
h = oMath.unsigned(h, oMath.unsigned(h, 11, ">>"), "^")
h = oMath.unsigned(h, oMath.unsigned(h, 15, "<<"), "+")

see "Hash : " + h

```

output:

```
Test the Math Class Methods
Sin(0) = 0
Sin(90) radians = 0.89
Sin(90) degree = 1.00
Cos(0) = 1
Cos(90) radians = -0.45
Cos(90) degree = 0.00
Tan(0) = 0
Tan(90) radians = -2.00
Tan(90) degree = 1255.77
asin(0) = 0
acos(0) = 1.57
atan(0) = 0
atan2(1,1) = 0.79
sinh(0) = 0
sinh(1) = 1.18
cosh(0) = 1
cosh(1) = 1.54
tanh(0) = 0
tanh(1) = 0.76
exp(0) = 1
exp(1) = 2.72
log(1) = 0
log(2) = 0.69
log10(1) = 0
log10(2) = 0.30
log10(10) = 1
Ceil(1.12) = 2
Ceil(1.72) = 2
Floor(1.12) = 1
Floor(1.72) = 1
fabs(1.12) = 1.12
fabs(1.72) = 1.72
pow(2,3) = 8
sqrt(16) = 4
Random number Max (100) : 87
Random number Max (100) : 49
Random number Max (100) : 99
Random number Max (100) : 58
Random number Max (100) : 15
Random number Max (100) : 46
Random number Max (100) : 37
Random number Max (100) : 64
Random number Max (100) : 73
Random number Max (100) : 35
Random number Max (100) : 89
Random number Max (100) : 80
Random number Max (100) : 20
Random number Max (100) : 33
Random number Max (100) : 44
Random number Max (100) : 89
```

(continues on next page)

(continued from previous page)

```

Random number Max (100) : 82
Random number Max (100) : 94
Random number Max (100) : 83
Random number Max (100) : 68
1
1.1
1.12
1.123
1.1235
1.12346
1.123457
1.1234568
1.12345679
1.123456789
1.1234567890
1.12345678901
1.123456789012
1.1234567890123
1.12345678901230
Hash : 3372029979.0000000000000000

```

44.9 DateTime Class

Methods:

Method	Description/Output
clock()	The number of clock ticks from program start.
time()	Get the system time.
date()	Get the date.
timelist()	List contains the date and the time information.
adddays(cDate,nDays)	Return Date from cDate and after nDays
diffdays(cDate1,cDate2)	Return the Number of days (cDate1 - cDate2)

example:

```

Load "stdlib.ring"

oDateTime = new datetime

See "Test the datetime Class Methods" + nl

See "Calculate performance" + nl
t1 = oDateTime.clock()
for x = 1 to 1000000 next
see oDateTime.clock() - t1 + nl

See "Time : " + oDateTime.time() + nl

See "Date : " + oDateTime.date() + nl

```

(continues on next page)

(continued from previous page)

```

See oDateTime.TimeList()

See "Month Name : " + oDateTime.TimeList()[4]

cDate = oDateTime.date()
see cDate + nl
cDate = oDateTime.adddays(cDate, 10)
see cDate + nl

cDate1 = oDateTime.date()
see cDate1 + nl
cDate2 = oDateTime.adddays(cDate1, 10)
see cDate2 + nl
see "DiffDays = " + oDateTime.diffdays(cDate1, cDate2) + nl
see "DiffDays = " + oDateTime.diffdays(cDate2, cDate1) + nl

```

output:

```

Test the datetime Class Methods
Calculate performance
85
Time : 02:53:35
Date : 31/08/2016
Wed
Wednesday
Aug
August
08/31/16 02:53:35
31
02
02
244
08
53
AM
35
35
3
08/31/16
02:53:35
16
2016
Arab Standard Time
%
Month Name : August31/08/2016
10/09/2016
31/08/2016
10/09/2016
DiffDays = -10
DiffDays = 10

```

44.10 File Class

Methods:

Method	Description/Output
read(cFileName)	Read the file content
write(cFileName,cStr)	Write string to file
dir(cFolderPath)	Get the folder contents (files & sub folders)
rename(cOld,cNew)	Rename files using the Rename() function
remove(cFileName)	Delete a file using the Remove() function
open(cFileName,cMode)	Open a file using the Fopen() function
close()	Close file
flush()	Flushes the output buffer of a stream
reopen(cFileName,cMode)	Open another file using the same file handle
tempfile()	Creates a temp. file (binary).
seek(noffset,n whence)	Set the file position of the stream
tell()	Know the current file position of a stream
rewind()	Set the file position to the beginning of the file
getpos()	Get handle to the current file position
setpos(poshandle)	Set the current file position
clearerr()	Clear the EOF error and the error indicators of a stream
eof()	Test the end-of-file indicator
error()	Test the error indicator
perror(cErrorMessage)	Print error message to the stderr
getc()	Get the next character from the stream
gets(nsize)	Read new line from the stream
putc(cchar)	Write a character to the stream
puts(cStr)	Write a string to the stream
ungetc(cchar)	Push a character to the stream
fread(nsize)	Read data from a stream
fwrite(cString)	Write data to a stream
exists(cFileName)	Check if a file exists

example:

```
Load "stdlib.ring"

ofile = new file

See "Test the file Class Methods" + nl
see ofile.read(filename())

see nl
ofile.open(filename(),"r")
see ofile.gets(100) + nl
ofile.close()
```

44.11 System Class

Methods:

Method	Description/Output
system()	Execute system commands
sysget()	Get environment variables
ismsdos()	Check if the operating system is MSDOS or not
iswindows()	Check if the operating system is Windows or not
iswindows64()	Check if the operating system is Windows 64bit or not
isunix()	Check if the operating system is Unix or not
ismacosx()	Check if the operating system is macOS or not
islinux()	Check if the operating system is Linux or not
isfreebsd()	Check if the operating system is FreeBSD or not
isandroid()	Check if the operating system is Android or not
windowsnl()	Get the windows new line string
sysargv()	Get the command line arguments passed to the ring script
filename()	Get the active source file

example:

```

Load "stdlib.ring"

oSystem = new System

See "Test the System Class Methods" + nl

oSystem.system("dir")
see oSystem.sysget("path") + nl
see oSystem.ismsdos() + nl
see oSystem.iswindows() + nl
see oSystem.iswindows64() + nl
see oSystem.isunix() + nl
see oSystem.ismacosx() + nl
see oSystem.islinux() + nl
see oSystem.isfreebsd() + nl
see oSystem.isandroid() + nl
see oSystem.windowsnl() + nl
see oSystem.sysargv() + nl
see oSystem.filename() + nl

```

44.12 Debug Class

Methods:

Method	Description/Output
eval(cCode)	Execute code during the runtime from string.
raise(cError)	Raise an exception.
assert(cCondition)	Test condition before executing the code.

example:

```
Load "stdlib.ring"

oDebug = new Debug
See "Test the Debug Class Methods" + nl
oDebug.eval("see 'Hello'+nl")
try
    x = 10
    oDebug.assert(x=11)
catch see "assert" + nl done
raise("Error!")
```

44.13 DataType Class

Methods:

Method	Description/Output
isstring(vValue)	We can know if the value is a string or not.
isnumber(vValue)	We can know if the value is a number or not.
islist(vValue)	We can know if the value is a list or not.
type(vValue)	Know the type of a value
isnull(vValue)	Check the value to know if it's null or not.
isalnum(vValue)	1 if the value is digit/letter or 0 if not
isalpha(vValue)	1 if the value is a letter or 0 if not
iscntrl(vValue)	1 if the value is a control character (no printing position)
isdigit(vValue)	1 if the value is a digit or 0 if not
isgraph(vValue)	1 if the value can be printed (Except space) or 0 if not
islower(vValue)	1 if the value is lowercase letter or 0 if not
isprint(vValue)	1 if the value occupies a printing position or 0 if not
ispunct(vValue)	1 if the value is a punctuation character or 0 if not
isspace(vValue)	1 if the value is a white-space or 0 if not
isupper(vValue)	1 if the value is an uppercase alphabetic letter or 0 if not
isxdigit(vValue)	1 if the value is a hexadecimal digit character or 0 if not

example:

```
Load "stdlib.ring"

oDataType = new DataType
See "Test the DataType Class Methods" + nl
see oDataType.isstring("test") + nl
see oDataType.isnumber(1) + nl
see oDataType.islist(1:3) + nl
see oDataType.type("test") + nl
see oDataType.isnull(null) + nl
see oDataType.isalnum("Hello") + nl +      # print 1
oDataType.isalnum("123456") + nl +      # print 1
oDataType.isalnum("ABCabc123") + nl + # print 1
oDataType.isalnum("How are you") + nl      # print 0 because of spaces
```

(continues on next page)

(continued from previous page)

```

see oDataType.isalpha("Hello") + nl +      # print 1
oDataType.isalpha("123456") + nl +      # print 0
oDataType.isalpha("ABCabc123") + nl + # print 0
oDataType.isalpha("How are you") + nl +    # print 0
See oDataType.iscntrl("hello") + nl +      # print 0
oDataType.iscntrl(nl)                  # print 1
see oDataType.isdigit("0123456789") + nl +      # print 1
oDataType.isdigit("0123a") + nl
see oDataType.isgraph("abcdef") + nl +      # print 1
oDataType.isgraph("abc def") + nl          # print 0
see oDataType.islower("abcDEF") + nl +      # print 0
oDataType.islower("ghi") + nl              # print 1
see oDataType.isprint("Hello") + nl +      # print 1
oDataType.isprint("Nice to see you") + nl +  # print 1
oDataType.isprint(nl) + nl                # print 0
see oDataType.isprint("Hello") + nl          # print 1
see oDataType.isupper("welcome") + nl +      # print 0
oDataType.isupper("WELCOME") + nl          # print 1
see oDataType.isxdigit("0123456789abcdef") + nl + # print 1
oDataType.isxdigit("123z")                 # print 0

```

Output:

Test the DataType **Class** Methods

1

1

1

STRING

1

1

1

1

0

1

0

0

0

0

11

0

1

0

0

1

1

1

0

1

0

1

1

0

0

0

0

0

0

44.14 Conversion Class

Methods:

Method	Description/Output
number(vValue)	Convert strings to numbers.
string(vValue)	Convert numbers to strings.
ascii(vValue)	Get the ASCII code for a letter.
char(vValue)	Convert the ASCII code to character.
hex(vValue)	Convert decimal to hexadecimal.
dec(vValue)	Convert hexadecimal to decimal.
str2hex(vValue)	Convert string characters to hexadecimal characters.
hex2str(vValue)	Convert hexadecimal characters to string.

example:

```
Load "stdlib.ring"

oConversion = new conversion
See "Test the conversion Class Methods" + nl
See oConversion.number("3") + 5 + nl
See oConversion.string(3) + "5" + nl
See oConversion.Ascii("m") + nl
See oConversion.char(77) + nl
see oConversion.hex(162) + nl
see oConversion.dec("a2") + nl
cHex = oConversion.str2hex("Hello")
see cHex + nl
see oConversion.hex2str(cHex) + nl
```

Output:

```
Test the conversion Class Methods
8
35
109
M
a2
162
48656c6c6f
Hello
```

44.15 ODBC Class

Methods:

Method	Description/Output
drivers()	Get a list of ODBC drivers.
datasources()	Get a list of ODBC data sources.
close()	Free resources.
connect(cConString)	Connect to the database.
disconnect()	Close the connection.
execute(cSQL)	Execute SQL Statements
colcount()	Get columns count in the query result
fetch()	Fetch a row from the query result
getdata(nCol)	Get column value from the fetched row
tables()	Get a list of tables inside the database
columns(cTableName)	Get a list of columns inside the table
autocommit(lStatus)	Enable or disable the auto commit feature
commit()	Commit updates to the database
rollback()	Rollback updates to the database

example:

```
Load "stdlib.ring"

oodbc = new odbc
See "Test the odbc Class Methods" + nl
oODBC {
    see drivers()
    see datasources()
    See "Connect to database" + nl
    see connect("DBQ=test.mdb;Driver={Microsoft Access Driver (*.mdb)}") + nl
    See "Select data" + nl
    see execute("select * from person") + nl
    nMax = colcount()
    See "Columns Count : " + nMax + nl
    while fetch()
        See "Row data:" + nl
        for x = 1 to nMax
            see getdata(x) + " - "
        next
    end
    See "Close database..." + nl
    disconnect()
    close()
}
```

44.16 MySQL Class

Methods:

Method	Description/Output
info()	Return string contains the MySQL Client version.
error()	Get the error message from the MySQL Client.
connect(cServer,cUser,cPass,cDatabase)	Connect to the MySQL database server.
close()	Close the connection to the MySQL database.
query(cQuery)	Execute SQL queries.
insert_id()	Get the inserted row id.
result()	Get the query result (data without column names).
next_result()	Move to the next query result.
columns()	Get a list of columns names.
result2()	Get all of the column names then the query result in one list.
escape_string(cStr)	Before storing binary data and special characters in the database.
autocommit(lStatus)	Enable or disable the auto commit feature.
commit()	Commit updates to the database.
rollback()	Rollback updates to the database.

example:

```
Load "stdlib.ring"

omysql = new mysql
See "Test the MySQL Class Methods" + nl
omysql {
    see info() + nl
    connect("localhost", "root", "root","mahdb")
    see "Execute Query" + nl
    query("SELECT * FROM Employee")
    see "Print Result" + nl
    see result2()
    see "Close database" + nl
    close()
}
```

Output:

```
Test the MySQL Class Methods
5.5.30
Execute Query
Print Result
Id
Name
Salary
1
Mahmoud
15000
2
Samir
16000
```

(continues on next page)

(continued from previous page)

```
3
Fayed
17000
Close database
```

44.17 SQLite Class

Methods:

Method	Description/Output
open(cDatabase)	Open Database.
close()	Close Database.
errormessage()	Get Error Message.
execute(cSQL)	Execute Query.

example:

```
Load "stdlib.ring"

osqlite = new sqlite
See "Test the sqlite Class Methods" + nl
osqlite {
    open("test.db")
    sql = "CREATE TABLE COMPANY(" + 
        "ID INT PRIMARY KEY      NOT NULL," +
        "NAME      TEXT      NOT NULL," +
        "AGE       INT      NOT NULL," +
        "ADDRESS   CHAR(50)," +
        "SALARY    REAL );"
    execute(sql)

    sql = "INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY) " +
        "VALUES (1, 'Mahmoud', 29, 'Jeddah', 20000.00 ); " +
        "INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY) " +
        "VALUES (2, 'Ahmed', 27, 'Jeddah', 15000.00 ); " +
        "INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY)" +
        "VALUES (3, 'Mohammed', 31, 'Egypt', 20000.00 );" +
        "INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY)" +
        "VALUES (4, 'Ibrahim', 24, 'Egypt ', 65000.00 );"

    execute(sql)

    aResult = execute("select * from COMPANY")
    for x in aResult
        for t in x
            see t[2] + nl
        next
    next
```

(continues on next page)

(continued from previous page)

```

see copy("*",50) + nl
for x in aResult
    see x["name"] + nl
next
close()
}

```

Output:

```

Test the sqlite Class Methods
1
Mahmoud
29
Jeddah
20000.0
2
Ahmed
27
Jeddah
15000.0
3
Mohammed
31
Egypt
20000.0
4
Ibrahim
24
Egypt
65000.0
*****
Mahmoud
Ahmed
Mohammed
Ibrahim

```

44.18 PostgreSQL Class

Methods:

Method	Description/Output
init(cConString)	Open Database.
close()	Close Database.
execute(cSQL)	Execute Query.

example:

```

load "stdlib.ring"

```

(continues on next page)

(continued from previous page)

```

oPostgreSQL = new PostgreSQL("user=postgres password=sa dbname = mahdb")

See "Test the PostgreSQL Class Methods" + nl

oPostgreSQL {

    sql = "CREATE TABLE COMPANY_TEST(" +
        "ID INT PRIMARY KEY      NOT NULL," +
        "NAME          TEXT      NOT NULL," +
        "AGE           INT       NOT NULL," +
        "ADDRESS        CHAR(50)," +
        "SALARY         REAL );"

    execute(sql)

    sql = "INSERT INTO COMPANY_TEST (ID,NAME,AGE,ADDRESS,SALARY) " +
        "VALUES (1, 'Mahmoud', 29, 'Jeddah', 20000.00 ); " +
        "INSERT INTO COMPANY_TEST (ID,NAME,AGE,ADDRESS,SALARY) " +
        "VALUES (2, 'Ahmed', 27, 'Jeddah', 15000.00 ); " +
        "INSERT INTO COMPANY_TEST (ID,NAME,AGE,ADDRESS,SALARY)" +
        "VALUES (3, 'Mohammed', 31, 'Egypt', 20000.00 );" +
        "INSERT INTO COMPANY_TEST (ID,NAME,AGE,ADDRESS,SALARY)" +
        "VALUES (4, 'Ibrahim', 24, 'Egypt ', 65000.00 );"

    execute(sql)

    ? execute("select * from COMPANY_TEST")

    ? copy("/*",50)

    close()
}

```

Output:

```

Test the PostgreSQL Class Methods
id
name
age
address
salary
1
Mahmoud
29
Jeddah
20000
2
Ahmed
27
Jeddah
15000
3

```

(continues on next page)

(continued from previous page)

```
Mohammed
31
Egypt
20000
4
Ibrahim
24
Egypt
65000
```

44.19 Security Class

Methods:

Method	Description/Output
md5(cString)	Calculate the MD5 hash.
sha1(cString)	Calculate the SHA1 hash.
sha256(cString)	Calculate the SHA256 hash.
sha512(cString)	Calculate the SHA512 hash.
sha384(cString)	Calculate the SHA384 hash.
sha224(cString)	Calculate the SHA224 hash.
encrypt(cString,cKey,cIV)	Encrypts the data using the Blowfish algorithm in CBC mode.
decrypt(cString,cKey,cIV)	Decrypt the encrypted data using the Blowfish algorithm in CBC mode.
encrypt_ex(cString,cKey,cIV,cCipher)	Encrypts the data using the given cipher algorithm.
decrypt_ex(cString,cKey,cIV,cCipher)	Decrypt the encrypted data using the given cipher algorithm.
supportedciphers()	List all supported cipher algorithms for encryption/decryption.
randbytes(nSize)	Generate a string of cryptographically secure pseudo-random bytes.

example:

```
Load "stdlib.ring"

oSecurity = new security
See "Test the security Class Methods" + nl
oSecurity {
    see md5("hello") + nl +
    sha1("hello") + nl + sha256("hello") + nl +
    sha512("hello") + nl + sha384("hello") + nl +
    sha224("hello") + nl
    list = 0:15  cKey=""   for x in list cKey += char(x) next
    list = 1:8   cIV = ""   for x in list cIV += char(x) next
    cCipher = encrypt("hello",cKey,cIV)
    see cCipher + nl + decrypt(cCipher,cKey,cIV) + nl
}
```

44.20 Internet Class

Methods:

- download(cURL)
- sendemail(cSMTPServer,cEmail,cPassword,cSender,cReceiver,cCC,cTitle,cContent)

example:

```
Load "stdlib.ring"

ointernet = new internet
See "Test the internet Class Methods" + nl
ointernet {
    see download("www.ring-lang.sf.net")
}
```

DESKTOP, WEBASSEMBLY AND MOBILE DEVELOPMENT USING RINGQT

In this chapter we will learn how to use the Qt framework classes in our Ring applications to create Desktop, WebAssembly and Mobile Applications.

45.1 The First GUI Application

In this example we will create an application to ask the user about his/her name. When the user type the name in the textbox then click on “Say Hello” button, the textbox value will be updated by adding “Hello ” to the name.

```
load "guilib.ring"

oApp = new qApp {

    win1 = new QWidget() {

        setWindowTitle("Hello World")
        setGeometry(100,100,370,250)

        label1 = new QLabel(win1) {
            setText("What is your name ?")
            setGeometry(10,20,350,30)
            setAlignment(Qt.AlignHCenter)
        }

        btn1 = new QPushButton(win1) {
            setGeometry(10,200,100,30)
            setText("Say Hello")
            setclickevent("pHello()")
        }

        btn2 = new QPushButton(win1) {
            setGeometry(150,200,100,30)
            setText("Close")
            setclickevent("pClose()")
        }

        lineedit1 = new QLineEdit(win1) {
            setGeometry(10,100,350,30)
```

(continues on next page)

(continued from previous page)

```
        }

        show()
    }

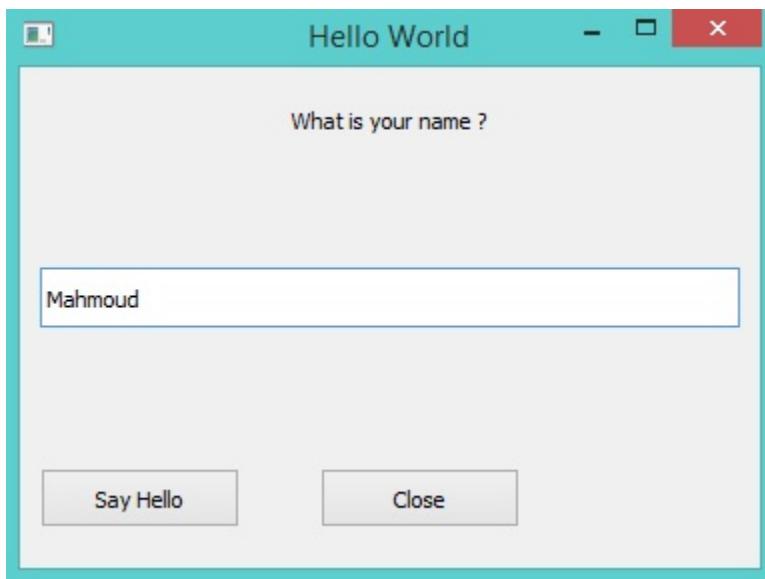
    exec()
}

Func pHHello
    lineedit1.settext( "Hello " + lineedit1.text())

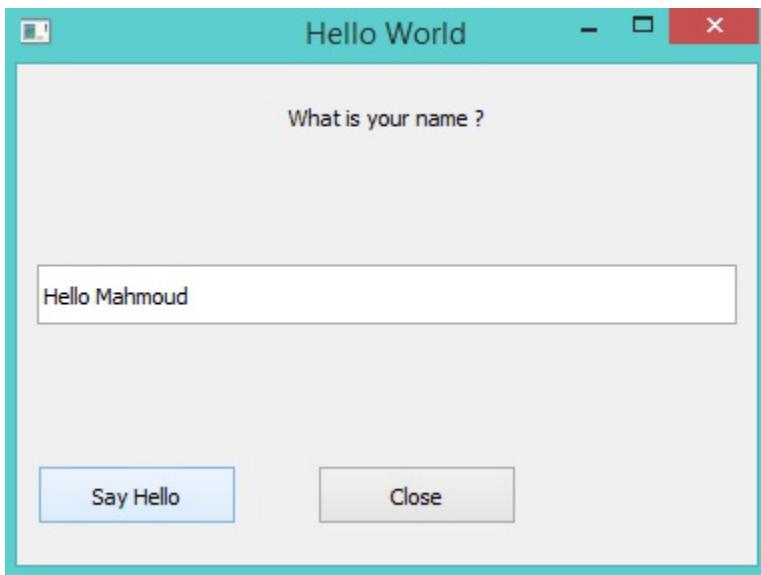
Func pClose
    oApp.quit()
```

Program Output:

At first we type the name in the textbox



Then we click on the say hello button



45.2 The Events Loop

Qt uses Event-Driven and the events loop get the control when we call the exec() method from the qApp class.

Once we call exec(), The events loop starts, and the Widgets starts responding to the different events (Mouse, Keyboard, Timers, etc).

You get the control back again when an event is fired and your callback function is called.

Once the execution of your callback function is done, the control go back again to the events loop.

Useful things to remember

- (1) We can do most of the work using normal events (Events provided directly by each widget).
- (2) We can add more events to any widget using the Events Filter.
- (3) Using Timers we can easily get the control back and check for more things to do.

Also when our callback function is busy with doing time consuming operations, we can call the ProcessEvents() method from the qApp class to avoid stopping the GUI.

`oApp.processevents()`

We can avoid calling the exec() method, and create our main loop

It's not recommended to do that, It's just an option.

```
# Instead of calling the exec() method
while true
    oApp.processevents()      # Respond to GUI Events
    # More Thing to do, We have the control!
    #
end
```

45.3 Using Layout

The next example is just an upgrade to the previous application to use the vertical layout.

```

Load "guilib.ring"

MyApp = New qApp {

    win1 = new QWidget() {

        setWindowTitle("Hello World")
        setGeometry(100,100,400,130)
        label1 = new QLabel(win1) {
            setText("What is your name ?")
            setGeometry(10,20,350,30)
            setAlignment(Qt.AlignHCenter)
        }
        btn1 = new QPushButton(win1) {
            setGeometry(10,200,100,30)
            setText("Say Hello")
            setClickEvent("pHello()")
        }
        btn2 = new QPushButton(win1) {
            setGeometry(150,200,100,30)
            setText("Close")
            setClickEvent("pClose()")
        }
        lineedit1 = new QLineEdit(win1) {
            setGeometry(10,100,350,30)
        }
        layout1 = new QVBoxLayout() {
            addWidget(label1)
            addWidget(lineedit1)
            addWidget(btn1)
            addWidget(btn2)
        }
        win1.setLayout(layout1)
        show()
    }

    exec()
}

Func pHello
    lineedit1.setText( "Hello " + lineedit1.text())

Func pClose
    MyApp.quit()

```

The application during the runtime!



45.4 Using the QTextEdit Class

In this example we will use the QTextEdit Class

```
Load "guilib.ring"

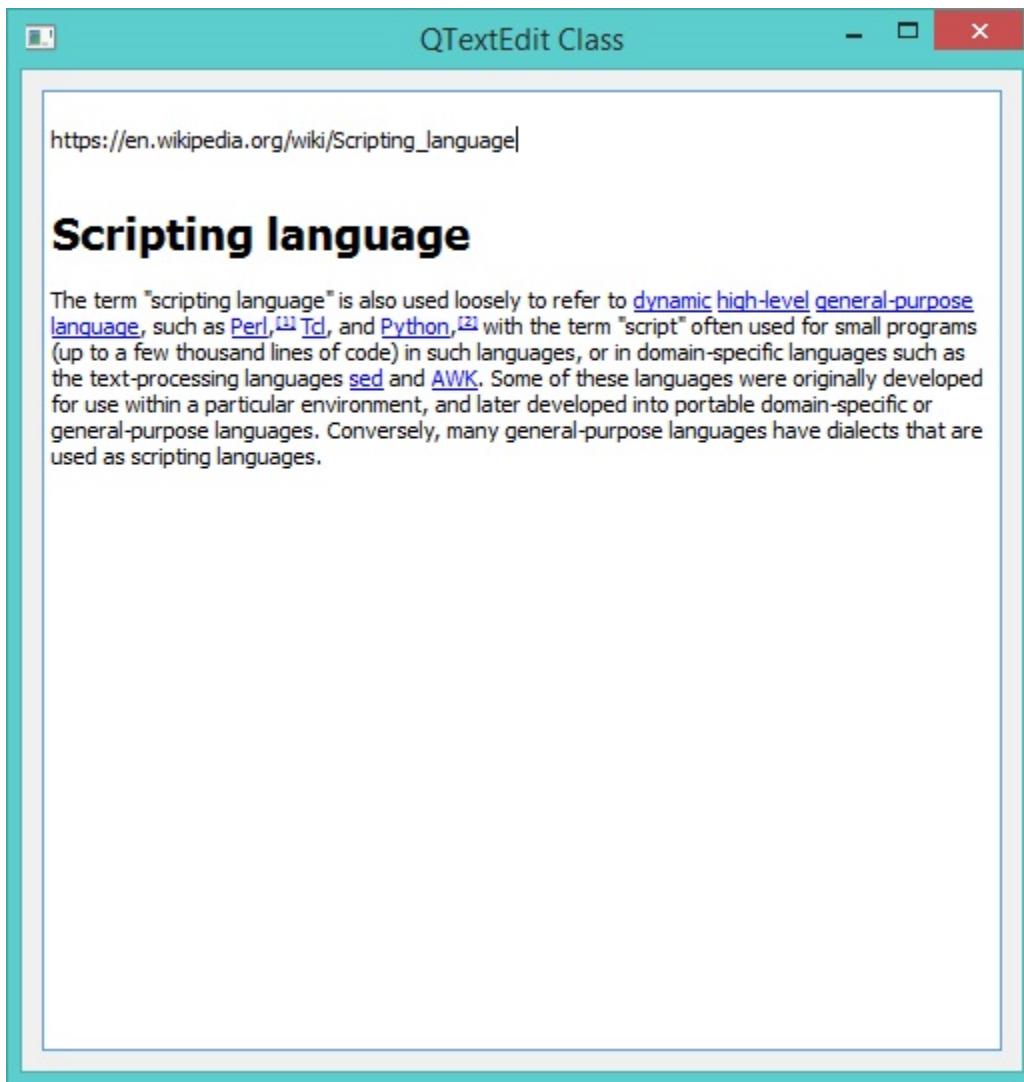
New qApp {

    win1 = new QWidget() {
        setWindowTitle("QTextEdit Class")
        setGeometry(100,100,500,500)

        new QTextEdit(win1) {
            setGeometry(10,10,480,480)
        }
    }
    show()
}

exec()
```

During the runtime we can paste rich text in the qtextedit widget



45.5 Using the QListWidget Class

In this example we will use the QListWidget Class

```
Load "guilib.ring"

New qApp {
    win1 = new QWidget() {
        setGeometry(100,100,400,400)

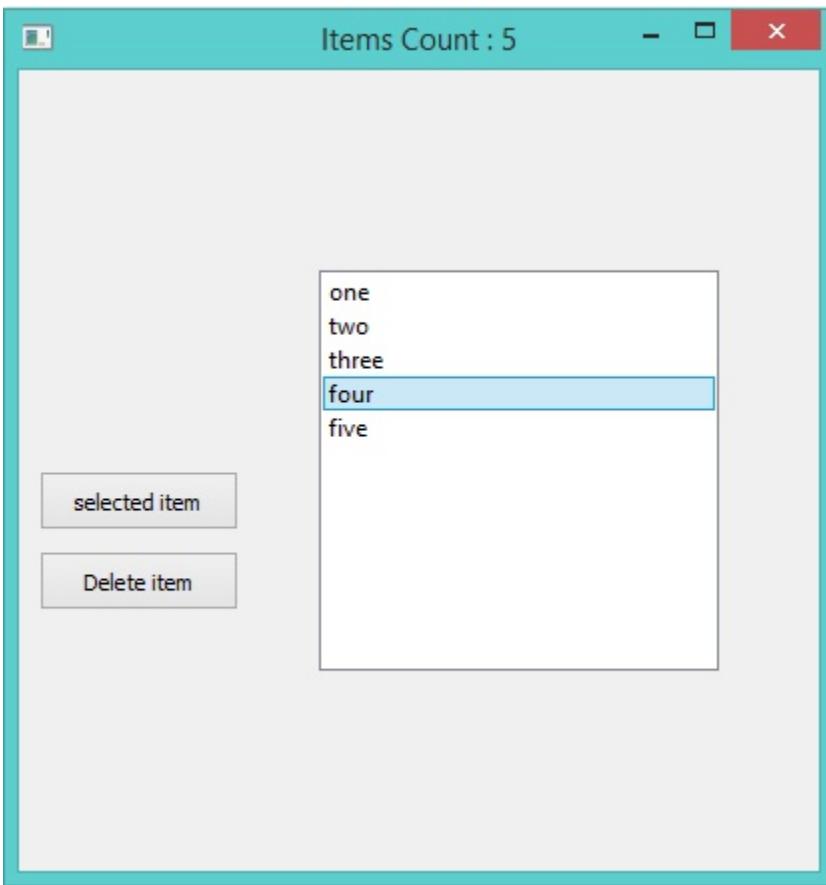
        list1 = new QListWidget(win1) {
            setGeometry(150,100,200,200)
            alist = ["one","two","three","four","five"]
            for x in alist additem(x) next
            setCurrentRow(3,2)
```

(continues on next page)

(continued from previous page)

```
        win1.setWindowTitle("Items Count : " + count() )  
    }  
  
    btn1 = new QPushButton(win1) {  
        setGeometry(10,200,100,30)  
        setText("selected item")  
        setClickEvent("pWork()")  
    }  
  
    btn2 = new QPushButton(win1) {  
        setGeometry(10,240,100,30)  
        setText("Delete item")  
        setClickEvent("pWork2()")  
    }  
  
    show()  
}  
  
exec()  
}  
  
func pWork  
    btn1.setText(string(list1.currentRow()))  
  
func pWork2  
    list1 {  
        takeItem(currentRow())  
    }
```

The application during the runtime



Another Example:

```
Load "guilib.ring"

New qApp {

    win1 = new QWidget() {
        setGeometry(100,100,500,400)

        list1 = new QListWidget(win1) {
            setGeometry(150,100,200,200)
            alist = ["one","two","three","four","five"]
            for x in alist additem(x) next

            setCurrentRow(3,2)
            win1.setWindowTitle("Items Count : " + count())
        }

        btn1 = new QPushButton(win1) {
            setGeometry(10,200,100,30)
            setText("selected item")
            setClickEvent("pWork()")
        }
    }
}
```

(continues on next page)

(continued from previous page)

```

        btn2 = new QPushButton(win1) {
            setGeometry(10, 240, 100, 30)
            setText("Delete item")
            setClickEvent("pWork2()")
        }

        show()
    }

    exec()
}

func pWork

    nbrOfItems = list1.count()
    curItemNbr = list1.currentRow()
    curValue   = list1.item(list1.currentRow()).text()

    win1.setWindowTitle("After Select - NbrOfItems: " + nbrOfItems +
        " CurItemNbr: " + curItemNbr + " CurValue: " + curValue)

    btn1.setText(string(list1.currentRow()) + " --- " +
        list1.item(list1.currentRow()).text())



func pWork2
    list1 {
        takeItem(currentRow())

        nbrOfItems = count()
        curItemNbr = currentRow()
        curValue   = item(currentRow()).text()

        win1.setWindowTitle("After Delete - NbrOfItems: " + nbrOfItems +
            " CurItemNbr: " + curItemNbr + " CurValue: " + curValue)
    }
}

```

45.6 Using QTreeView and QFileSystemModel

In this example we will learn how to use the QTreeView widget to represent the File System

```

Load "guilib.ring"

New qApp {

    win1 = New QWidget() {

        setWindowTitle("Using QTreeView and QFileSystemModel")
        setGeometry(100, 100, 500, 400)
}

```

(continues on next page)

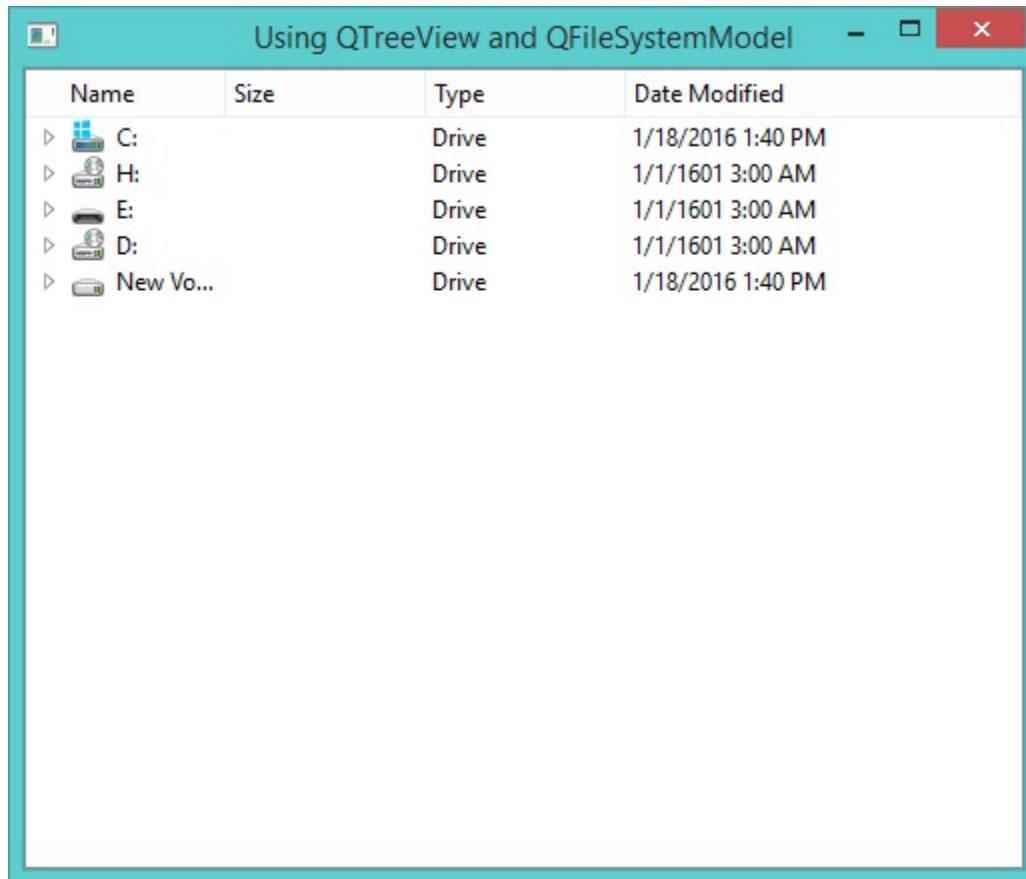
(continued from previous page)

```
New qtreeview(win1) {
    setGeometry(00,00,500,400)
    oDir = new QDir()
    ofile = new QFileSystemModel()
    ofile.setrootpath(oDir.currentpath())
    setmodel(ofile)
}

show()
}

exec()
}
```

The application during the runtime



45.7 Using QTreeWidget and QTreeWidgetItem

In this example we will learn about using the QTreeWidget and QTreeWidgetItem classes

```

Load "guilib.ring"

New qApp {

    win1 = new QWidget() {

        setWindowTitle("TreeWidget")
        setGeometry(100,100,400,400)

        layout1 = new QVBoxLayout()

        tree1 = new QTreeWidget(win1) {
            setGeometry(0,0,400,400)
            setColumnCount(1)
            myitem = new QTreeWidgetItem()
            myitem.setText(0,"The First Step")
            addTopLevelItem(myitem)
            for x = 1 to 10
                myitem2 = new QTreeWidgetItem()
                myitem2.setText(0,"hello"+x)
                myitem.addChild(myitem2)
                for y = 1 to 10
                    myitem3 = new QTreeWidgetItem()
                    myitem3.setText(0,"hello"+x)
                    myitem2.addChild(myitem3)
                next
            next
            setHeaderLabel("Steps Tree")
        }

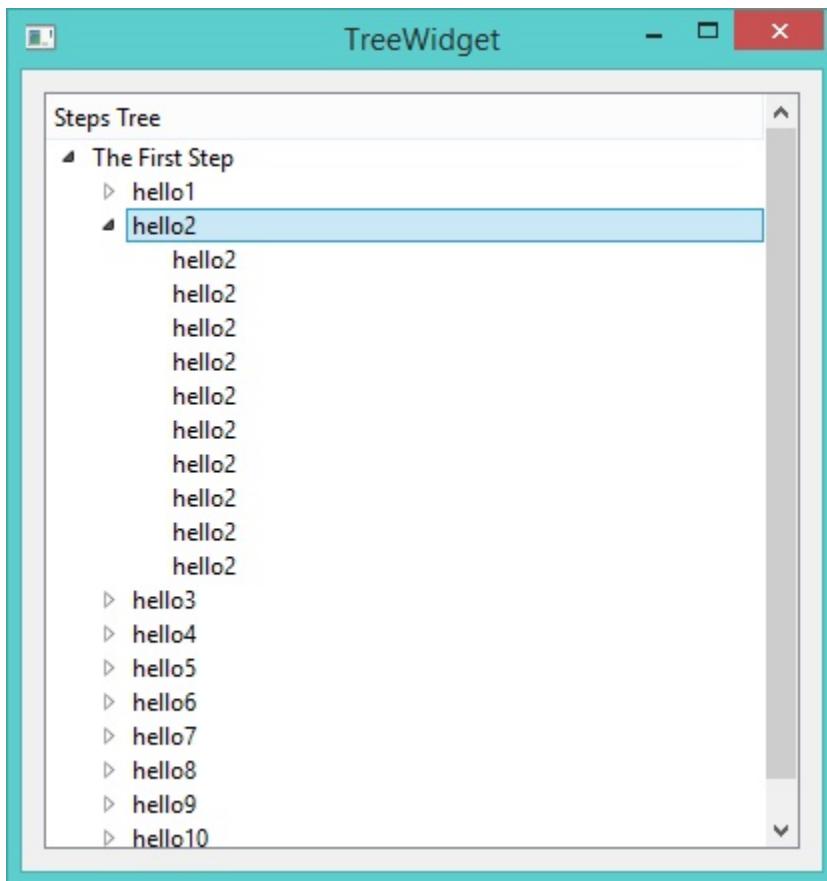
        layout1.addWidget(tree1)
        setLayout(layout1)

        show()
    }

    exec()
}

```

The application during the runtime



45.8 Using QComboBox Class

In this example we will learn about using the QComboBox class

```
Load "guilib.ring"

New qApp {
    win1 = new QWidget() {
        setWindowTitle("Using QComboBox")
        setGeometry(100,100,400,400)

        New QComboBox(win1) {
            setGeometry(150,100,200,30)
            aList = ["one","two","three","four","five"]
            for x in aList additem(x,0) next
        }

        show()
    }

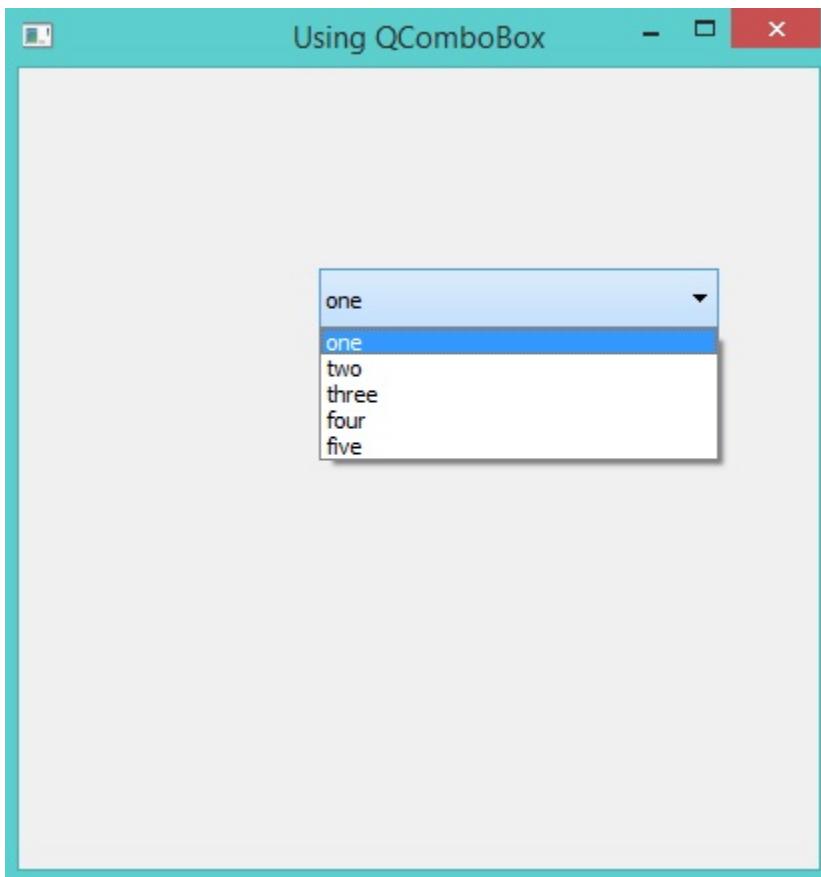
    exec()
}
```

(continues on next page)

(continued from previous page)

}

The application during the runtime



45.9 Creating Menubar

In this example we will learn about using the QMenuBar class

```
Load "guilib.ring"

MyApp = New qApp {

    win1 = new QWidget() {

        setWindowTitle("Using QMenubar")
        setGeometry(100,100,400,400)

        menu1 = new qmenubar(win1) {
            sub1 = addmenu("File")
            sub2 = addmenu("Edit")
            sub3 = addmenu("Help")
            sub1 {

```

(continues on next page)

(continued from previous page)

```

oAction = new QAction(win1) {
    setText("New")
}
addAction(oAction)
oAction = new QAction(win1) {
    setText("Open")
}
addAction(oAction)
oAction = new QAction(win1) {
    setText("Save")
}
addAction(oAction)
oAction = new QAction(win1) {
    setText("Save As")
}
addAction(oAction)
addSeparator()
oAction = new QAction(win1) {
    setText("Exit")
    setClickEvent("myapp.quit()")
}
addAction(oAction)
}
sub2 {
    oAction = new QAction(win1) {
        setText("Cut")
    }
    addAction(oAction)
    oAction = new QAction(win1) {
        setText("Copy")
    }
    addAction(oAction)
    oAction = new QAction(win1) {
        setText("Paste")
    }
    addAction(oAction)
    addSeparator()
    oAction = new QAction(win1) {
        setText("Select All")
    }
    addAction(oAction)
}
sub3 {
    oAction = new QAction(win1) {
        setText("Reference")
    }
    addAction(oAction)
    sub4 = addMenu("Sub Menu")
    sub4 {
        oAction = new QAction(win1) {
            setText("Website")
        }
    }
}

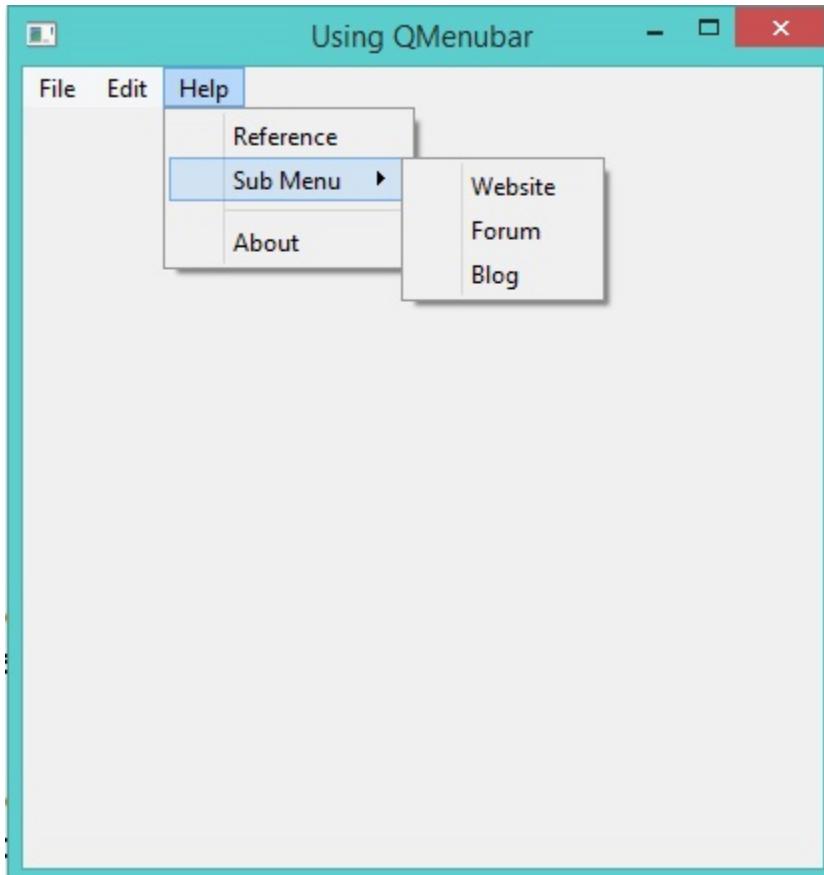
```

(continues on next page)

(continued from previous page)

```
addaction(oAction)
oAction = new QAction(win1) {
    settext("Forum")
}
addaction(oAction)
oAction = new QAction(win1) {
    settext("Blog")
}
addaction(oAction)
}
addseparator()
oAction = new QAction(win1) {
    settext("About")
}
addaction(oAction)
}
show()
}
exec()
}
```

The application during the runtime



45.10 Context Menu

Example:

```

load "guilib.ring"

new qApp {
    win = new QWidget() {
        setWindowTitle("Context Menu")
        resize(400,400)
        myfilter = new QAllEvents(win) {
            setContextMenuEvent("mymenu()")
        }
        installEventFilter(myfilter)
        show()
    }
    exec()
}

func mymenu

    new qMenu(win) {
        oAction = new QAction(win) {
            setText("new")
            setClickEvent("See :New")
        }
        addAction(oAction)
        oAction = new QAction(win) {
            setText("open")
            setClickEvent("See :Open")
        }
        addAction(oAction)
        oAction = new QAction(win) {
            setText("save")
            setClickEvent("See :Save")
        }
        addAction(oAction)
        oAction = new QAction(win) {
            setText("close")
            setClickEvent("See :Close")
        }
        addAction(oAction)
        oCursor = new QCursor()
        exec(oCursor.pos())
    }
}

```

45.11 Creating Toolbar

In this example we will learn about using the QToolBar class

```
Load "guilib.ring"

New qApp {

    win1 = new QMainWindow() {

        setWindowTitle("Using QToolbar")
        setGeometry(100,100,600,400)

        abtns = [
            new QPushButton(win1) { setText("Add") } ,
            new QPushButton(win1) { setText("Edit") } ,
            new QPushButton(win1) { setText("Find") } ,
            new QPushButton(win1) { setText("Delete") } ,
            new QPushButton(win1) { setText("Exit")
                setClickEvent("win1.close()") }
        ]

        tool1 = new QToolBar(win1) {
            for x in abtns addWidget(x) addSeparator() next
            setMovable(true)
            setGeometry(0,0,500,30)
            setFloatable(true)
        }

        show()
    }

    exec()
}
```

The application during the runtime



45.12 Creating StatusBar

In this example we will learn about using the QStatusBar class

```
Load "guilib.ring"

New qApp {

    win1 = new QMainWindow() {

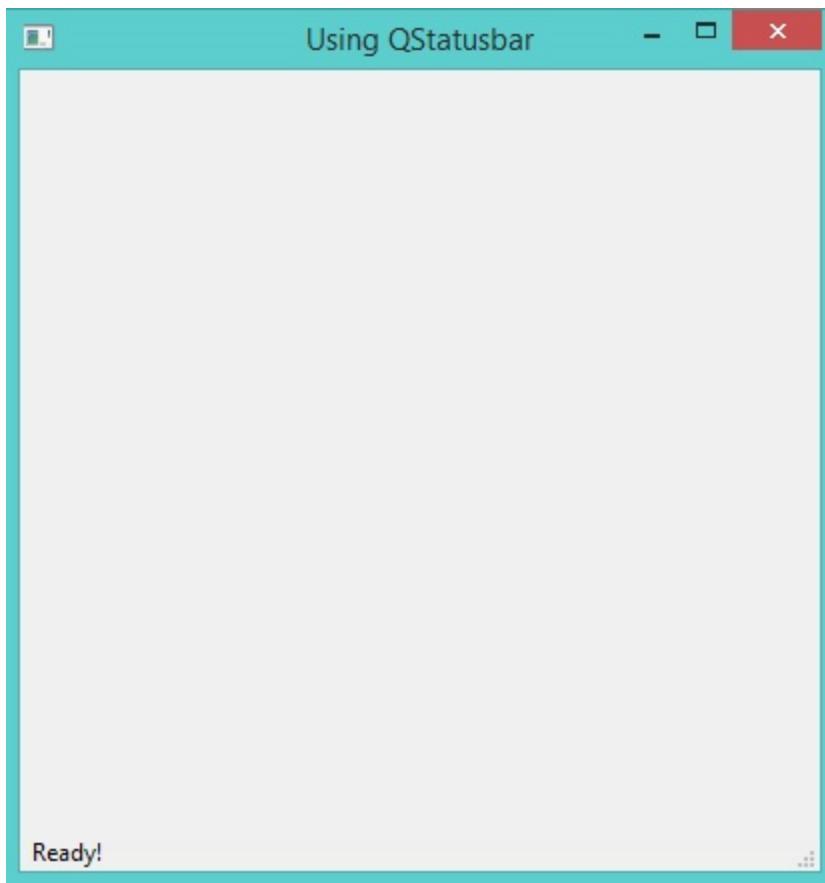
        setWindowTitle("Using QStatusBar")
        setGeometry(100,100,400,400)

        status1 = new qstatusbar(win1) {
            showmessage("Ready!",0)
        }

        setstatusbar(status1)
        show()
    }

    exec()
}
```

The application during the runtime



45.13 Using QDockWidget

In this example we will learn about using the QDockWidget class

```
Load "guilib.ring"

New qApp {

    win1 = new qMainWindow() {

        setWindowTitle("QDockWidget")
        setGeometry(100,100,400,400)

        label1 = new qlabel(win1) {
            setText("Hello")
            setGeometry(300,300,100,100)
        }

        label2 = new qlabel(win1) {
            setText("How are you ?")
            setGeometry(100,100,100,100)
    }
}
```

(continues on next page)

(continued from previous page)

```
        }

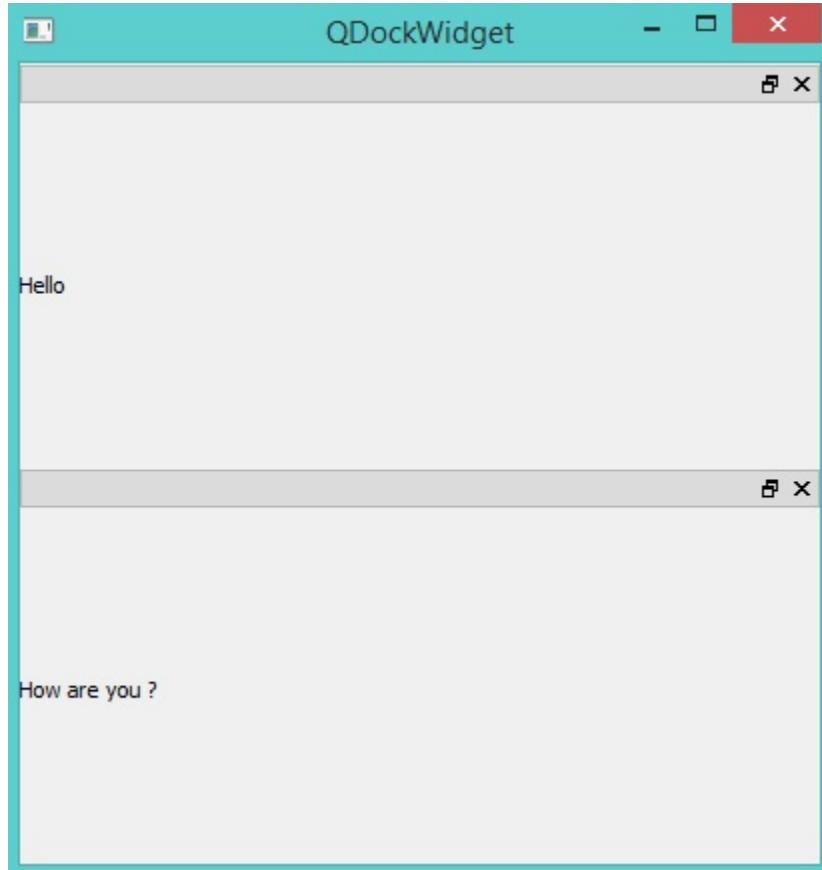
        dock1 = new QDockWidget(win1, 0) {
            setWidget(label1)
            SetAllowedAreas(1)
        }

        dock2 = new QDockWidget(win1, 0) {
            setWidget(label2)
            SetAllowedAreas(2)
        }

        addDockWidget(Qt_LeftDockWidgetArea, dock1, Qt_Horizontal)
        addDockWidget(Qt_LeftDockWidgetArea, dock2, Qt_Vertical)

        show()
    }
    exec()
}
```

The application during the runtime



45.14 Using QTabWidget

In this example we will learn about using the QTabWidget class

```
Load "guilib.ring"

New qApp {

    win1 = new QMainWindow() {

        setWindowTitle("Using QTabWidget")
        setGeometry(100,100,400,400)

        page1 = new QWidget() {
            new QPushButton(page1) {
                setText("The First Page")
            }
        }

        page2 = new QWidget() {
            new QPushButton(page2) {
                setText("The Second Page")
            }
        }

        page3 = new QWidget() {
            new QPushButton(page3) {
                setText("The Third Page")
            }
        }

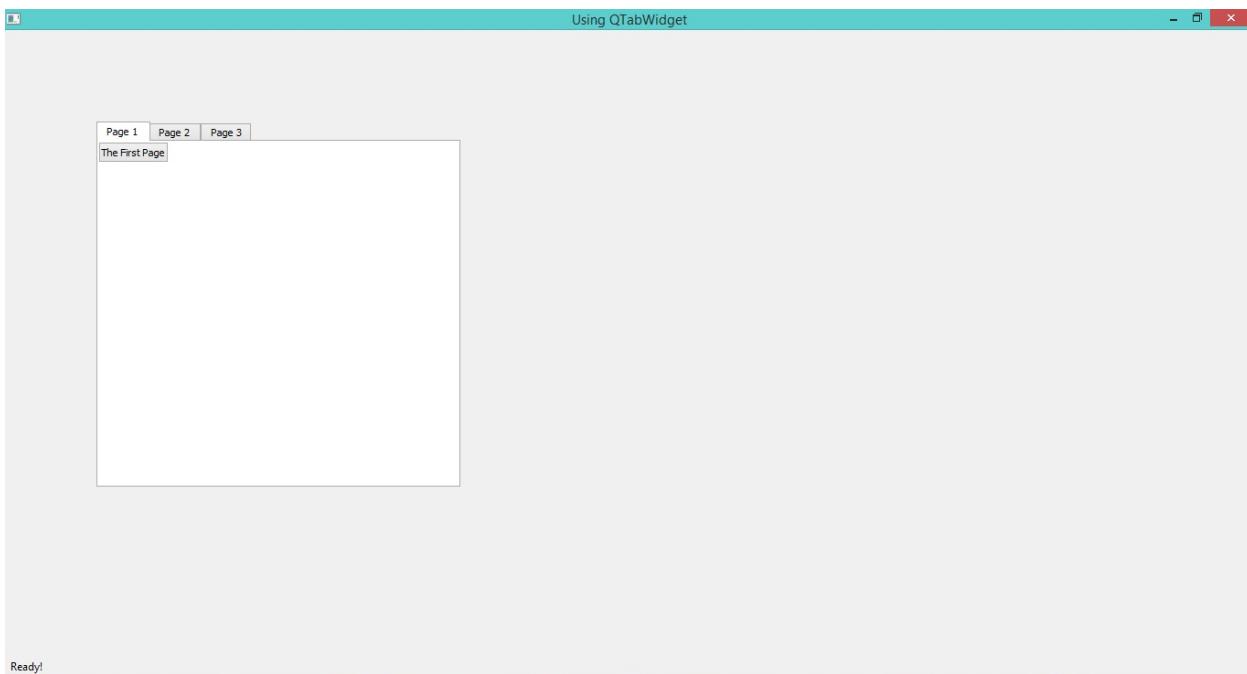
        tab1 = new QTabWidget(win1) {
            insertTab(0,page1,"Page 1")
            insertTab(1,page2,"Page 2")
            insertTab(2,page3,"Page 3")
            setGeometry(100,100,400,400)
        }

        status1 = new QStatusBar(win1) {
            showMessage("Ready!",0)
        }

        setStatusBar(status1)
        showMaximized()
    }

    exec()
}
```

The application during the runtime



45.15 Using QTableWidget

In this example we will learn about using the `QTableWidget` class

```
Load "guilib.ring"

New qApp {

    win1 = new QMainWindow() {

        setGeometry(100,100,1100,370)
        setWindowTitle("Using QTableWidget")

        Table1 = new QTableWidget(win1) {

            setRowCount(10) setColumnCount(10)
            setGeometry(0,0,800,400)
            setSelectionBehavior(QAbstractItemView_SelectRows)

            for x = 1 to 10
                for y = 1 to 10
                    item1 = new QTableWidgetItem("R"+X+"C"+Y)
                    setItem(x-1,y-1,item1)
                next
            next

        }

        setCentralWidget(table1)
        show()
    }
}
```

(continues on next page)

(continued from previous page)

```

    }

    exec()
}

```

The application during the runtime

A screenshot of a Windows application window titled "Using QTableWidget". The window contains a 10x10 grid of cells, each labeled with its row and column index. The columns are labeled 1 through 10 at the top, and the rows are labeled 1 through 10 on the left. The cells are arranged in a grid pattern, with the first cell at the top-left being R1C1 and the last cell at the bottom-right being R10C10. The entire grid is filled with these labels.

	1	2	3	4	5	6	7	8	9	10
1	R1C1	R1C2	R1C3	R1C4	R1C5	R1C6	R1C7	R1C8	R1C9	R1C10
2	R2C1	R2C2	R2C3	R2C4	R2C5	R2C6	R2C7	R2C8	R2C9	R2C10
3	R3C1	R3C2	R3C3	R3C4	R3C5	R3C6	R3C7	R3C8	R3C9	R3C10
4	R4C1	R4C2	R4C3	R4C4	R4C5	R4C6	R4C7	R4C8	R4C9	R4C10
5	R5C1	R5C2	R5C3	R5C4	R5C5	R5C6	R5C7	R5C8	R5C9	R5C10
6	R6C1	R6C2	R6C3	R6C4	R6C5	R6C6	R6C7	R6C8	R6C9	R6C10
7	R7C1	R7C2	R7C3	R7C4	R7C5	R7C6	R7C7	R7C8	R7C9	R7C10
8	R8C1	R8C2	R8C3	R8C4	R8C5	R8C6	R8C7	R8C8	R8C9	R8C10
9	R9C1	R9C2	R9C3	R9C4	R9C5	R9C6	R9C7	R9C8	R9C9	R9C10
10	R10C1	R10C2	R10C3	R10C4	R10C5	R10C6	R10C7	R10C8	R10C9	R10C10

45.16 Using QProgressBar

In this example we will learn about using the QProgressBar class

```

Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {

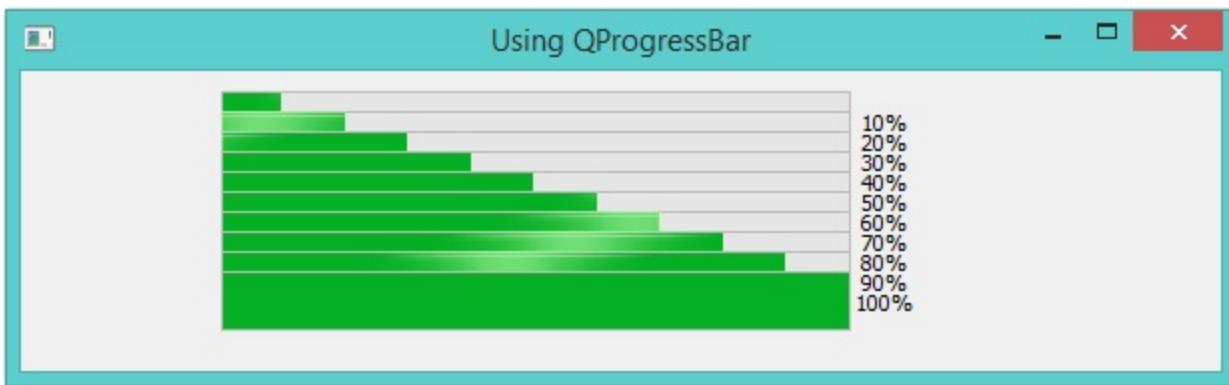
        setGeometry(100,100,600,150)
        setWindowTitle("Using QProgressBar")

        for x = 10 to 100 step 10
            new qprogressbar(win1) {
                setGeometry(100,x,350,30)
                setValue(x)
            }
        next

        show()
    }
    exec()
}

```

The application during the runtime



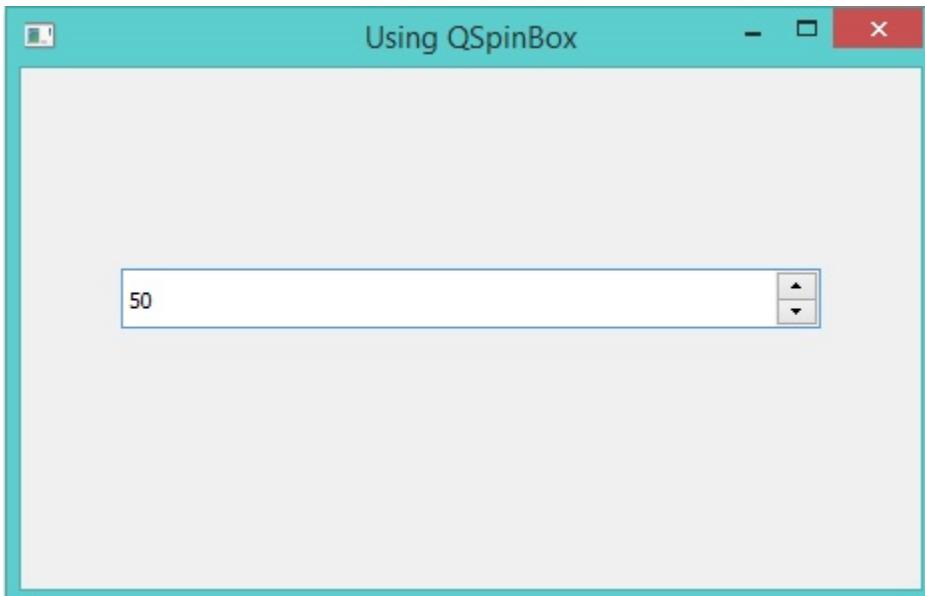
45.17 Using QSpinBox

In this example we will learn about using the QSpinBox class

```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setGeometry(100,100,450,260)
        setWindowTitle("Using QSpinBox")
        new qspinbox(win1) {
            setGeometry(50,100,350,30)
            setValue(50)
        }
        show()
    }
    exec()
}
```

The application during the runtime



45.18 Using QSlider

In this example we will learn about using the QSlider class

```
Load "guilib.ring"

New qApp {

    win1 = new qMainWindow() {

        setGeometry(100,100,500,400)
        setWindowTitle("Using QSlider")

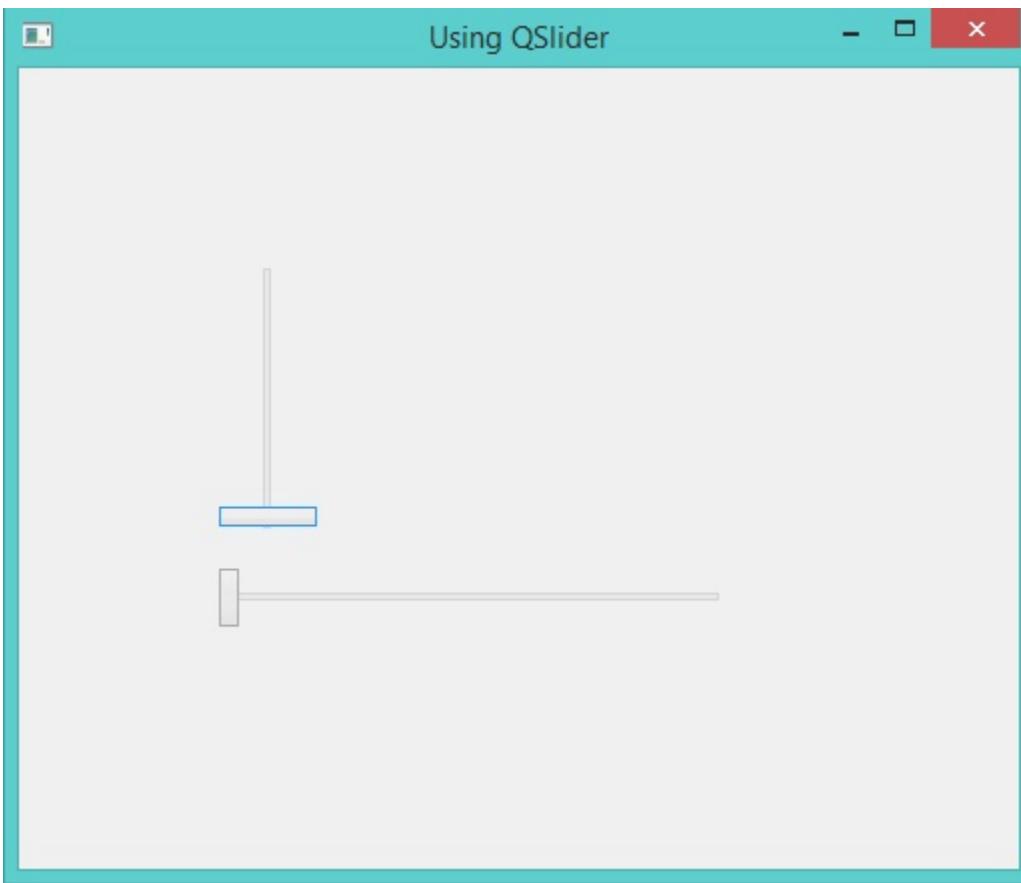
        new qslider(win1) {
            setGeometry(100,100,50,130)
            setTickInterval(50)
        }

        new qslider(win1) {
            setGeometry(100,250,250,30)
            setTickInterval(50)
            setOrientation(Qt_Horizontal)
        }

        show()
    }

    exec()
}
```

The application during the runtime



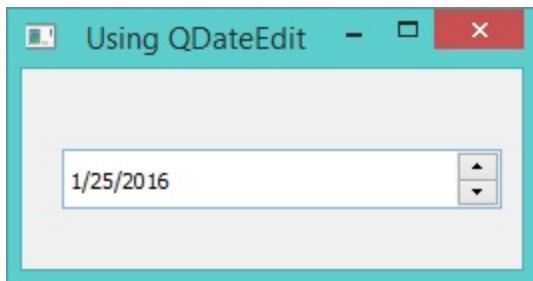
45.19 Using QDateEdit

In this example we will learn about using the QDateEdit class

```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setWindowTitle("Using QDateEdit")
        setGeometry(100,100,250,100)
        new qdateedit(win1) {
            setGeometry(20,40,220,30)
        }
        show()
    }
    exec()
}
```

The application during the runtime



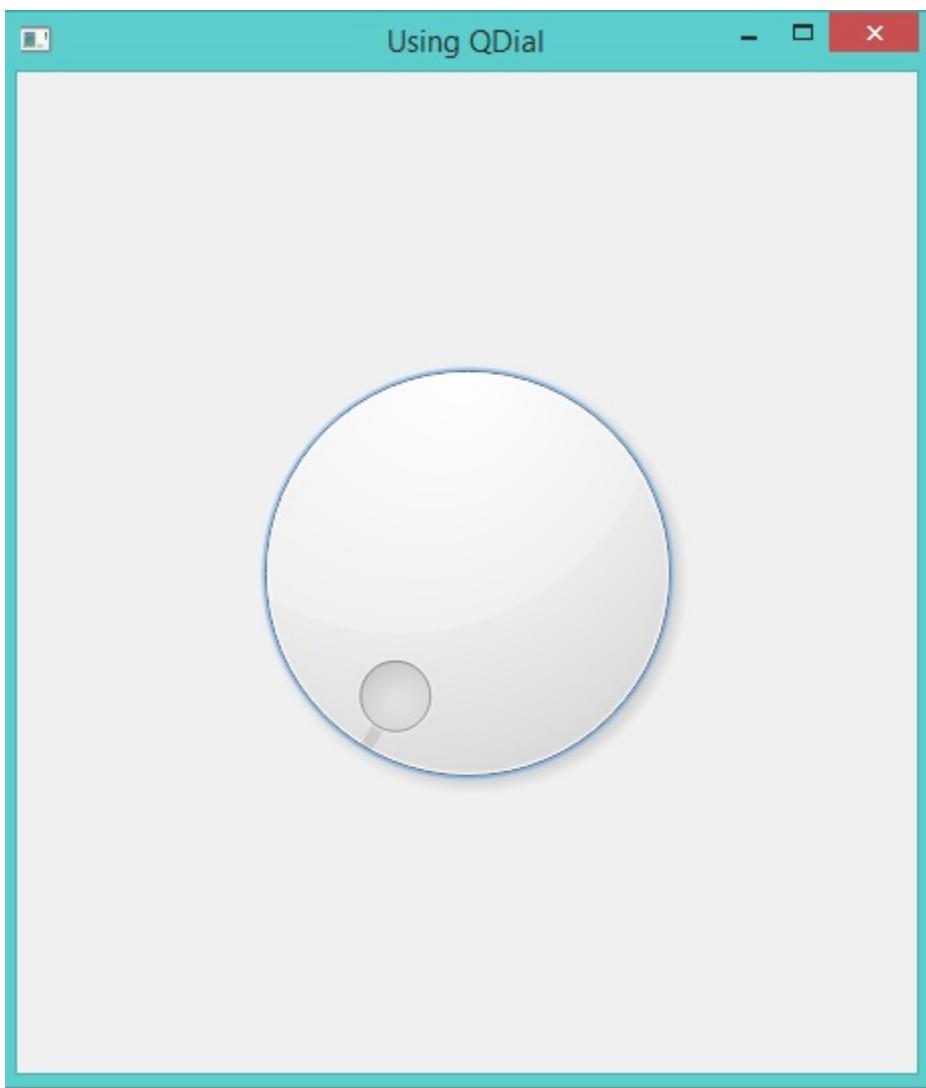
45.20 Using QDial

In this example we will learn about using the QDial class

```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setGeometry(100,100,450,500)
        setWindowTitle("Using QDial")
        new qdial(win1) {
            setGeometry(100,100,250,300)
        }
        show()
    }
    exec()
}
```

The application during the runtime



Another Example

```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow()
    {
        setGeometry(100,100,450,500)
        setWindowTitle("Using QDial")
        button1 = new QPushButton(win1){
            setGeometry(100,350,100,30)
            setText("Increment")
            setClickEvent("pIncrement()")
        }

        button2 = new QPushButton(win1){
            setGeometry(250,350,100,30)
            setText("Decrement")
            setClickEvent("pDecrement()")
        }
    }
}
```

(continues on next page)

(continued from previous page)

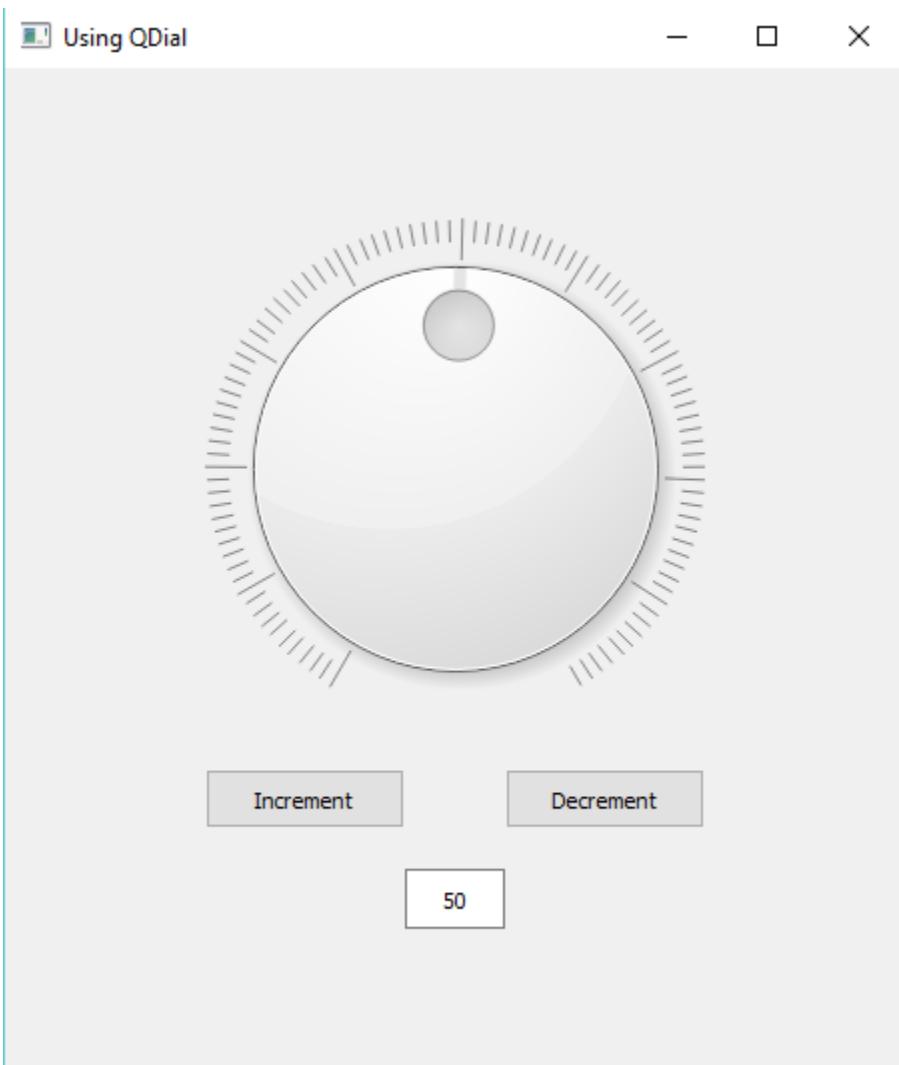
```
        }
        pdial = new QDial(win1) {
            setGeometry(100, 50, 250, 300)
            setNotchesVisible(true)
            setValue(50)
            SetValueChangedEvent("pDialMove()")
        }
        lineedit1 = new QLineEdit(win1) {
            setGeometry(200, 400, 50, 30)
            setAlignment(Qt::AlignHCenter)
            setText(string(pdial.value()))
            setReturnPressedEvent("pPress()")
        }
        show()
    }
    exec()
}

func pIncrement
    pdial{val=value()}
    pdial.setValue(val+1)
    lineedit1.setText(string(val+1))

func pDecrement
    pdial{val=value()}
    pdial.setValue(val-1)
    lineedit1.setText(string(val-1))

func pPress
    lineedit1.setText(text())
    pdial.setValue(number(val))

func pDialMove
    lineedit1.setText(""+pdial.value())
```



45.21 Using QWebView

In this example we will learn about using the QWebView class

```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setWindowTitle("QWebView")
        myweb = new qwebview(win1) {
            setGeometry(10,10,600,600)
            loadpage(new qurl("http://google.com"))
        }
        setcentralwidget(myweb)
        showMaximized()
    }
    exec()
}
```

The application during the runtime



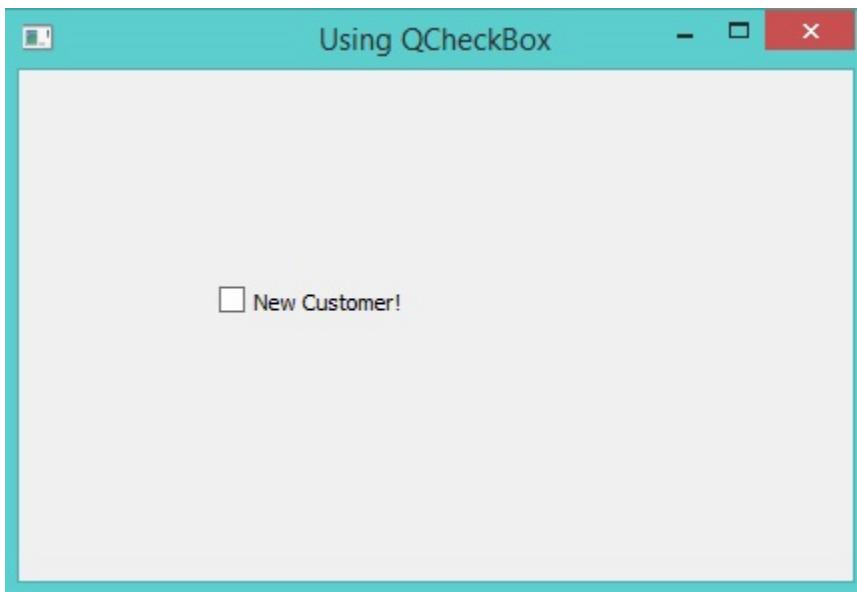
45.22 Using QCheckBox

In this example we will learn about using the QCheckBox class

```
Load "guilib.ring"

New qApp {
    win1 = new QMainWindow() {
        setWindowTitle("Using QCheckBox")
        new qcheckbox(win1) {
            setGeometry(100,100,150,30)
            setText("New Customer!")
        }
        showMaximized()
    }
    exec()
}
```

The application during the runtime



Another Example:

```

Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setGeometry(100,100,400,300)
        setWindowTitle("Using QCheckBox")

        ### 0-Unchecked 1-Checked

        CheckBox = new qcheckbox(win1) {
            setGeometry(100,100,160,30)
            setText("New Customer!")
            setClickedEvent("HandleClickEvent()")
        }

        show()
    }
    exec()
}

Func HandleClickEvent

    if CheckBox.isChecked() = 1
        CheckBox.setText("New Customer. Check 1-ON")
    else
        CheckBox.setText("New Customer. Check 0-OFF")
    ok
  
```

45.23 Using QRadioButton and QButtonGroup

In this example we will learn about using the QRadioButton and QButtonGroup classes

```
Load "guilib.ring"

New qApp {

    win1 = new qMainWindow() {

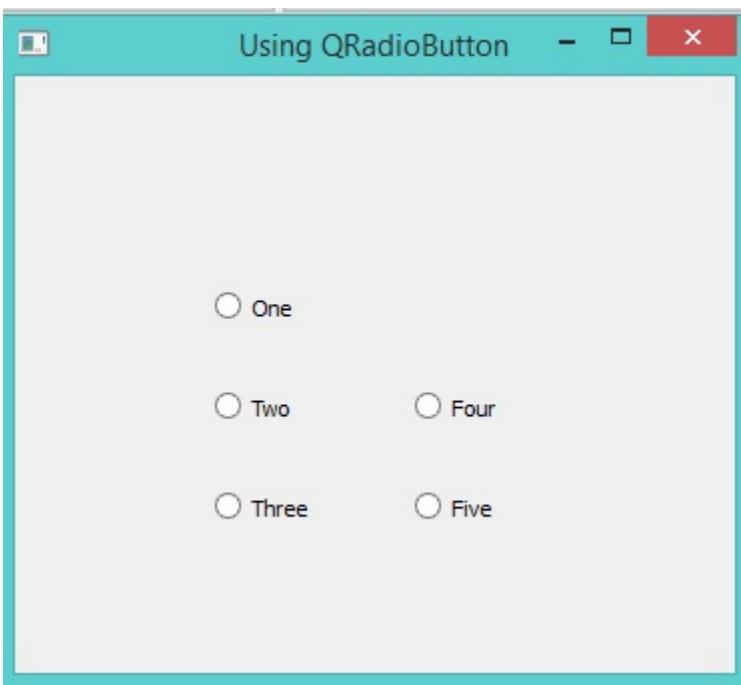
        setWindowTitle("Using QRadioButton")

        new qradiobutton(win1) {
            setGeometry(100,100,100,30)
            setText("One")
        }
        new qradiobutton(win1) {
            setGeometry(100,150,100,30)
            setText("Two")
        }
        new qradiobutton(win1) {
            setGeometry(100,200,100,30)
            setText("Three")
        }

        group2 = new qbuttongroup(win1) {
            btn4 = new qradiobutton(win1) {
                setGeometry(200,150,100,30)
                setText("Four")
            }
            btn5 = new qradiobutton(win1) {
                setGeometry(200,200,100,30)
                setText("Five")
            }
            addbutton(btn4,0)
            addbutton(btn5,0)
        }

        showMaximized()
    }
    exec()
}
```

The application during the runtime



45.24 Adding Hyperlink to QLabel

In this example we will learn about creating Hyperlink using the QLabel class

```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setWindowTitle("QLabel - Hyperlink")
        new qlabel(win1) {
            setGeometry(100,100,100,30)
            setOpenExternalLinks(true)
            setText('<a href="http://google.com">Google</a>')
        }
        showMaximized()
    }
    exec()
}
```

The application during the runtime



45.25 QVideoWidget and QMediaPlayer

In this example we will learn about using the QVideoWidget and QMediaPlayer classes to play a group of movies from different positions at the same time

```
Load "guilib.ring"

New qApp {

    win1 = new QMainWindow() {
        setWindowTitle("QVideoWidget")

        btn1 = new QPushButton(win1) {
            setGeometry(0,0,100,30)
            setText("play")
            setClickEvent("player.play() player2.play()
                           player3.play() player4.play()")
        }

        videowidget = new QVideoWidget(win1) {
            setGeometry(50,50,600,300)
            setStyleSheet("background-color: black")
        }

        videowidget2 = new QVideoWidget(win1) {
            setGeometry(700,50,600,300)
            setStyleSheet("background-color: black")
        }

        videowidget3 = new QVideoWidget(win1) {
            setGeometry(50,370,600,300)
            setStyleSheet("background-color: black")
        }
    }
}
```

(continues on next page)

(continued from previous page)

```
}

videowidget4 = new QVideoWidget(win1) {
    setGeometry(700, 370, 600, 300)
    setStyleSheet("background-color: black")
}

player = new QMediaPlayer() {
    setMedia(new QUrl("1.mp4"))
    setVideoOutput(videowidget)
    setPosition(35*60*1000)

}

player2 = new QMediaPlayer() {
    setMedia(new QUrl("2.mp4"))
    setVideoOutput(videowidget2)
    setPosition(23*60*1000)
}

player3 = new QMediaPlayer() {
    setMedia(new QUrl("3.mp4"))
    setVideoOutput(videowidget3)
    setPosition(14.22*60*1000)
}

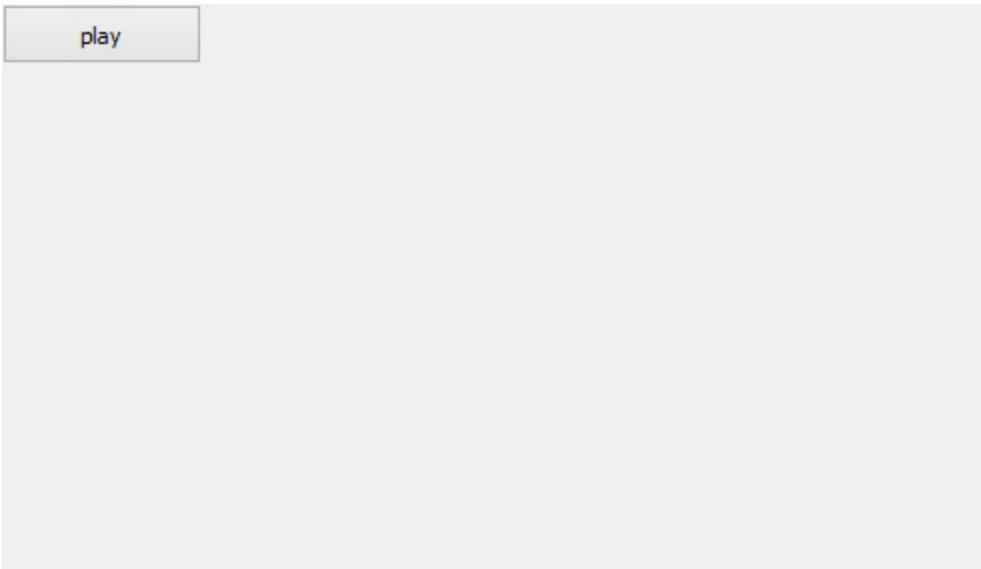
player4 = new QMediaPlayer() {
    setMedia(new QUrl("4.avi"))
    setVideoOutput(videowidget4)
    setPosition(8*60*1000)
}

showFullScreen()

}

exec()
}
```

The application during the runtime



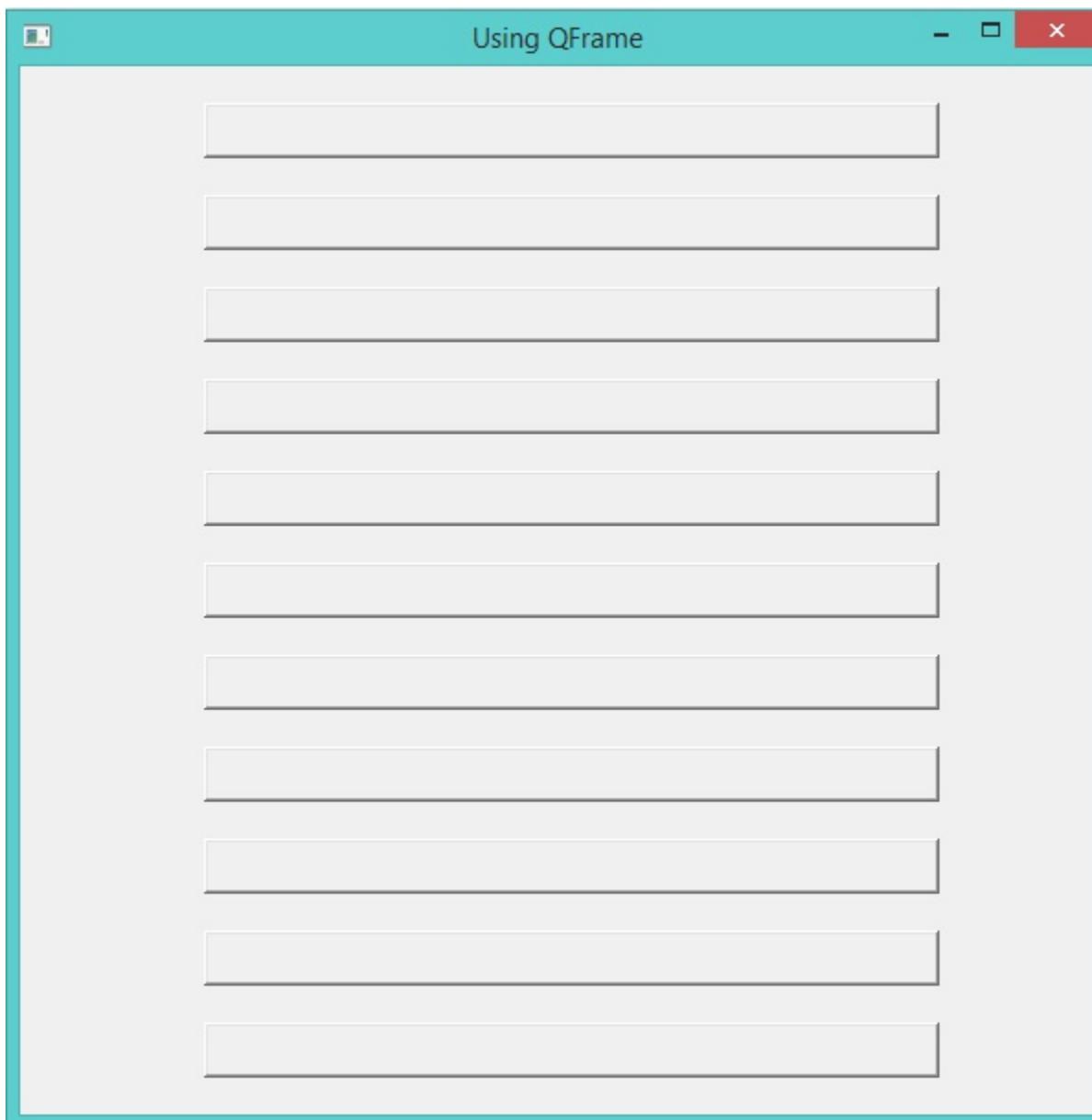
45.26 Using QFrame

In this example we will learn about using the QFrame class

```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setWindowTitle("Using QFrame")
        for x = 0 to 10
            frame1 = new qframe(win1,0) {
                setGeometry(100,20+50*x,400,30)
                setFrameStyle(QFrame_Raised | QFrame_WinPanel)
            }
        next
        showMaximized()
    }
    exec()
}
```

The application during the runtime



45.27 Display Image using QLabel

In this example we will learn about displaying an image using the QLabel widget

```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setWindowTitle("QLabel - Display image")
        new qlabel(win1) {
            image = new qpixmap("images/advice.jpg")
            setpixmap(image)
```

(continues on next page)

(continued from previous page)

```
        setGeometry(0,0,image.width(),image.height())
    }
    showMaximized()
}
exec()
```

The application during the runtime



45.28 Menubar and StyleSheet Example

In this example we will learn about creating menubar and setting the window stylesheet

```
Load "guilib.ring"

New qApp {

    win1 = new QMainWindow() {

        setWindowTitle("Menubar")

        menu1 = new QMenuBar(win1) {
            sub1 = addmenu("File")
            sub1 {
                oAction = new QAction(win1) {
                    setText("New")
                    setEnabled(false)
                }
                addaction(oAction)
                oAction = new QAction(win1) {
                    setText("Open")
                    setCheckable(true)
                    setChecked(true)
                    setStatusTip("open new file")
                }
                addaction(oAction)
                oAction = new QAction(win1) {
                    setText("Save")
                }
                addaction(oAction)
                oAction = new QAction(win1) {
                    setText("Save As")
                }
                addaction(oAction)

                addseparator()
                oAction = new QAction(win1)
                oAction.setText("Exit")
                oAction.setClickEvent("myapp.quit()")
                addaction(oAction)
            }
        }
        status1 = new QStatusBar(win1) {
            showMessage("Ready!", 0)
        }
        setMenuBar(menu1)
        setMouseTracking(true)
        setStatusbar(status1)
        setStyleSheet("color: black; selection-color: black;
selection-background-color:white ;
background: QLinearGradient(x1: 0, y1: 0, x2: 0, y2: 1,
```

(continues on next page)

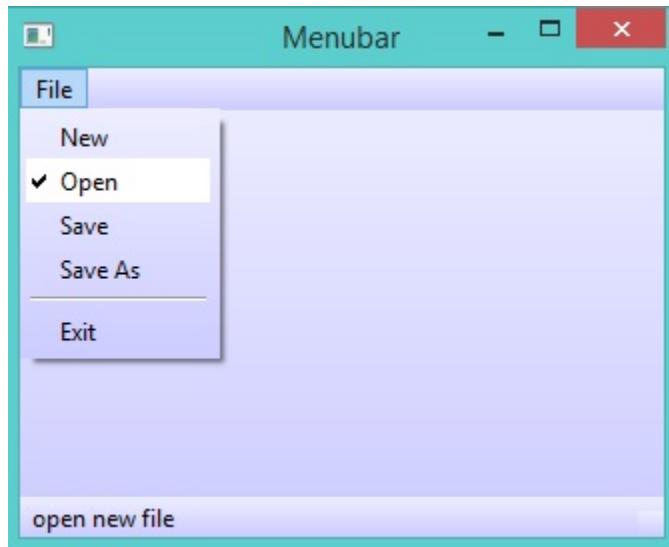
(continued from previous page)

```

        stop: 0 #eef, stop: 1 #ccf;")
showmaximized()
}
exec()
}

```

The application during the runtime



45.29 QLineEdit Events and QMessageBox

In this example we will learn about using QLineEdit Events and displaying a Messagebox

```

Load "guilib.ring"

MyApp = New qApp {
    win1 = new QWidget() {
        setWindowTitle("Welcome")
        setGeometry(100,100,400,300)

        label1 = new QLabel(win1) {
            setText("What is your name ?")
            setGeometry(10,20,350,30)
            setAlignment(Qt.AlignHCenter)
        }

        btn1 = new QPushButton(win1) {
            setGeometry(10,200,100,30)
            setText("Say Hello")
            setClickEvent("pHello()")
        }
    }
}

```

(continues on next page)

(continued from previous page)

```
        btn1 = new QPushButton(win1) {
            setGeometry(150, 200, 100, 30)
            setText("Close")
            setClickEvent("pClose()")
        }

        lineedit1 = new QLineEdit(win1) {
            setGeometry(10, 100, 350, 30)
            setTextChangedEvent("pChange()")
            setReturnPressedEvent("pEnter()")
        }

        show()
    }

    exec()
}

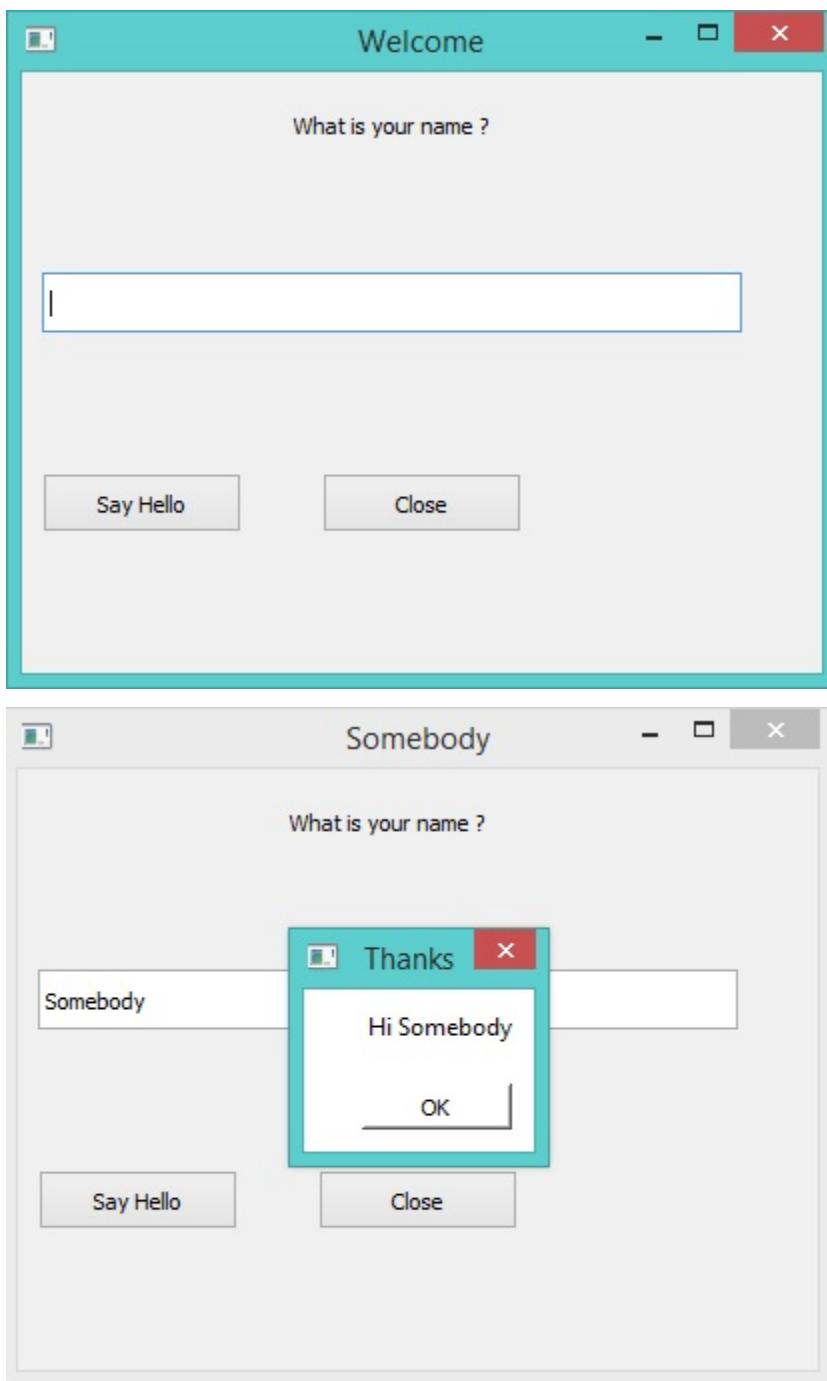
Func pHello
    lineedit1.setText( "Hello " + lineedit1.text())

Func pClose
    MyApp.quit()

Func pChange
    win1 { setWindowTitle( lineedit1.text() ) }

Func pEnter
    new QMessageBox(win1) {
        setWindowTitle("Thanks")
        setText("Hi " + lineedit1.text())
        setStyleSheet("background-color : white")
        show()
    }
```

The application during the runtime



45.30 Other Widgets Events

Each Qt signal can be used in RingQt, just add Set before the signal name and add event after the signal name to get the method that can be used to determine the event code.

For example the QProgressBar class contains a signal named valueChanged() To use it just use the function setValueChangedEvent()

Example:

```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {

        setWindowTitle("QProgressBar valueChanged Event")

        progress1 = new qprogressbar(win1) {
            setGeometry(100,100,350,30)
            setvalue(10)
            setvaluechangedevent("pChange()")
        }

        new QPushButton(win1) {
            setGeometry(10,10,100,30)
            setText("increase")
            setclickevent("pIncrease()")
        }

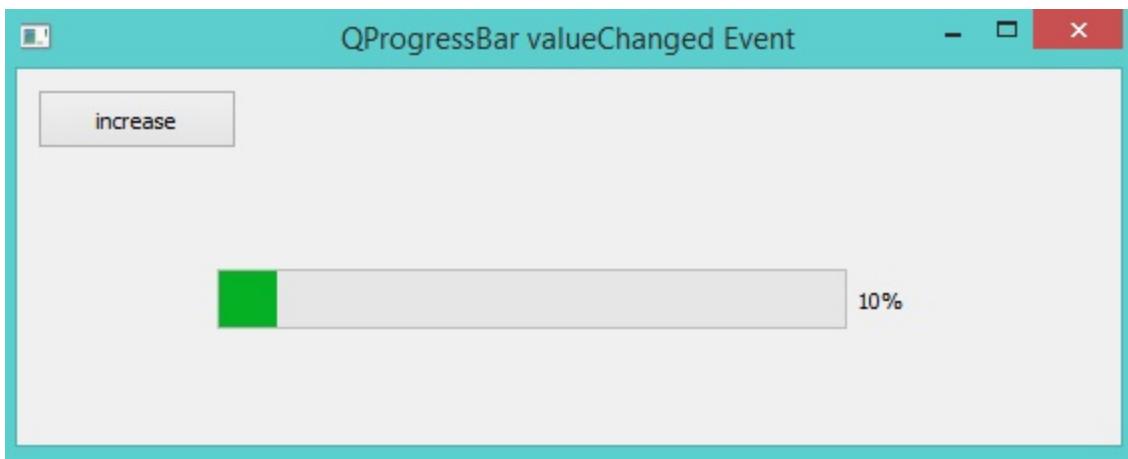
        showMaximized()
    }

    exec()
}

func pIncrease
    progress1 { setvalue(value()+1)  }

func pchange
    win1.setWindowTitle("value : " + progress1.value() )
```

The application during the runtime



Another example for the stateChanged event of the QCheckBox class

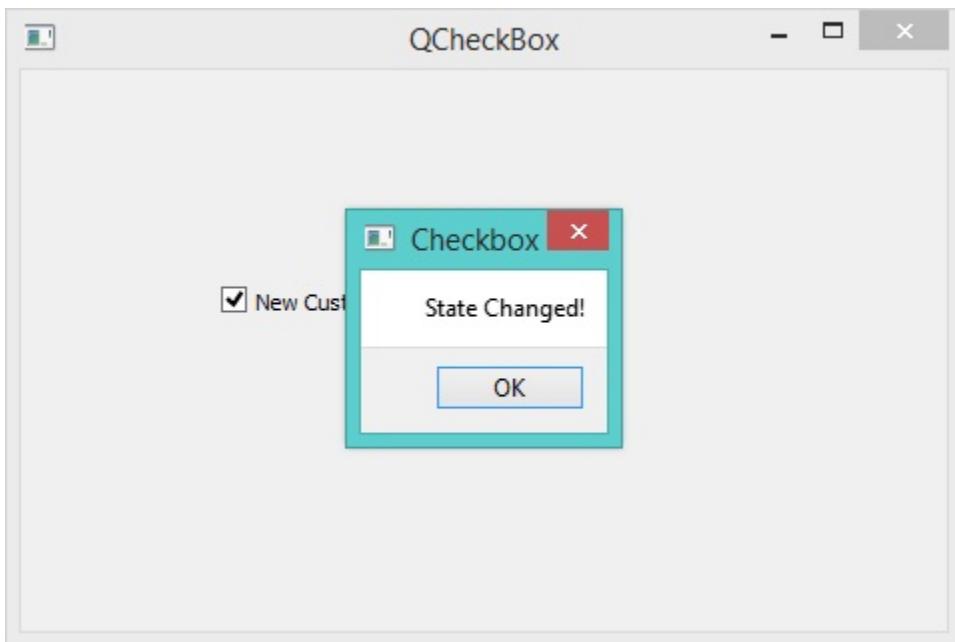
```
Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setWindowTitle("QCheckBox")
        new qcheckbox(win1) {
            setGeometry(100,100,150,30)
            setText("New Customer!")
            setStateChangedEvent("pchange()")
        }
        showMaximized()
    }
    exec()
}

Func pChange

    new qMessageBox(Win1) {
        setWindowTitle("Checkbox")
        setText("State Changed!")
        show()
    }
```

The application during the runtime



45.31 Using the QTimer Class

In this example we will learn about using the QTimer class

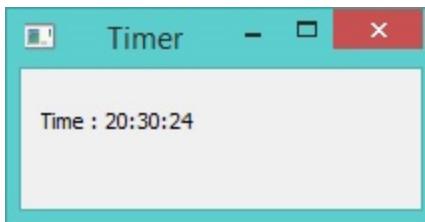
```
Load "guilib.ring"

new qApp {
    win1 = new QWidget() {
        setGeometry(100,100,200,70)
        setWindowTitle("Timer")
        label1 = new QLabel(win1) {
            setGeometry(10,10,200,30)
            setText(theTime())
        }
        new QTimer(win1) {
            setInterval(1000)
            setTimerOutEvent("pTime()")
            start()
        }
        show()
    }
    exec()
}

func pTime
    label1.setText(theTime())

func theTime
    return "Time : " + Time()
```

The application during the runtime



45.32 Using QProgressBar and Timer

In this example we will learn about using the “animated” QProgressBar class and Timer

```
#####
### ProgressBar and Timer Example

Load "guilib.ring"

new qApp
{
    win1 = new QWidget()
    {
        setGeometry(100,100,400,100)
        setWindowTitle("Timer and ProgressBar")

        LabelMan = new QLabel(win1)
        {
            setGeometry(10,10,200,30)
            setText(theTime())           ### ==> func
        }

        TimerMan = new QTimer(win1)
        {
            setInterval(1000)
            setTimeOutEvent("pTime()")  ### ==> func
            start()
        }

        BarMan = new QProgressBar(win1)
        {
            setGeometry(100,50,300,10)   ### Position X y, Length, Thickness
            setValue(0)                 ### Percent filled
        }

        show()
    }
    exec()
}

func pTime
    LabelMan.setText(theTime())      ### ==> func

    Increment = 10

```

(continues on next page)

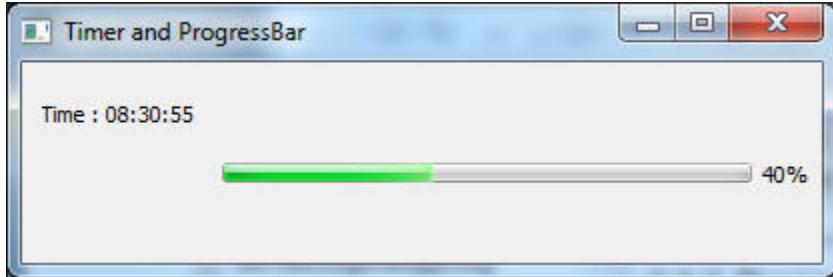
(continued from previous page)

```

if BarMan.value() >= 100      ### ProgressBar start over.
    BarMan.setvalue(0)
ok
BarMan{ setvalue(value() + Increment) }

Func theTime
    return "Time : " + Time()

```



45.33 Display Scaled Image using QLabel

In this example we will learn about displaying and scaling an image so that it looks “animated” using the QLabel widget

```

Load "guilib.ring"

#-----
# REQUIRES: image = "C:\RING\bin\stock.jpg"

# imageStock: start dimensions for growing image

imageW = 200 ; imageH = 200 ; GrowBy = 4

#-----
# Window and Box Size dimensions

WinWidth = 1280 ; WinHeight = 960
BoxWidth = WinWidth -80 ; BoxHeight = WinHeight -80

#-----

New qapp {
    win1 = new QWidget() {

        setGeometry(50,50, WinWidth,WinHeight)
        setWindowTitle("Animated Image - Display Image Scaled and Resized")

        imageStock = new QLabel(win1) {

            image = new QPixmap("C:\RING\bin\stock.jpg")
            AspectRatio = image.width() / image.height()

```

(continues on next page)

(continued from previous page)

```

        imageW = 200
        imageH = imageH / AspectRatio

        ### Size-H, Size-V, Aspect, Transform
        setpixmap(image.scaled(imageW , imageH ,0,0))

        PosLeft = (BoxWidth - imageW ) / 2
        PosTop  = (BoxHeight - imageH ) / 2
        setGeometry(PosLeft,PosTop,imageW,imageH)

    }

    TimerMan = new QTimer(win1) {
        setInterval(100)           ### interval 100 millisecs.
        setTimeOutEvent("pTime()") ### ==> func
        start()
    }

    show()
}
exec()
}

-----
## Function TimerMan: calling interval 100 milliseconds

func pTime

    ## Stop Timer when image is size of Window area
    if imageW > BoxWidth
        TimerMan.stop()
        imageStock.clear()      ## Will clear the image
    ok

    ## Grow image
    imageW += GrowBy
    imageH  = imageW / AspectRatio

    ## Scaled Image: Size-H, Size-V, Aspect, Transform
    imageStock.setpixmap(image.scaled(imageW , imageH ,0,0))

    ## Center the image
    PosLeft = (WinWidth - imageW ) / 2
    PosTop  = (WinHeight - imageH ) / 2
    imageStock.setGeometry(PosLeft,PosTop,imageW,imageH)

```

45.34 Using the QFileDialog Class

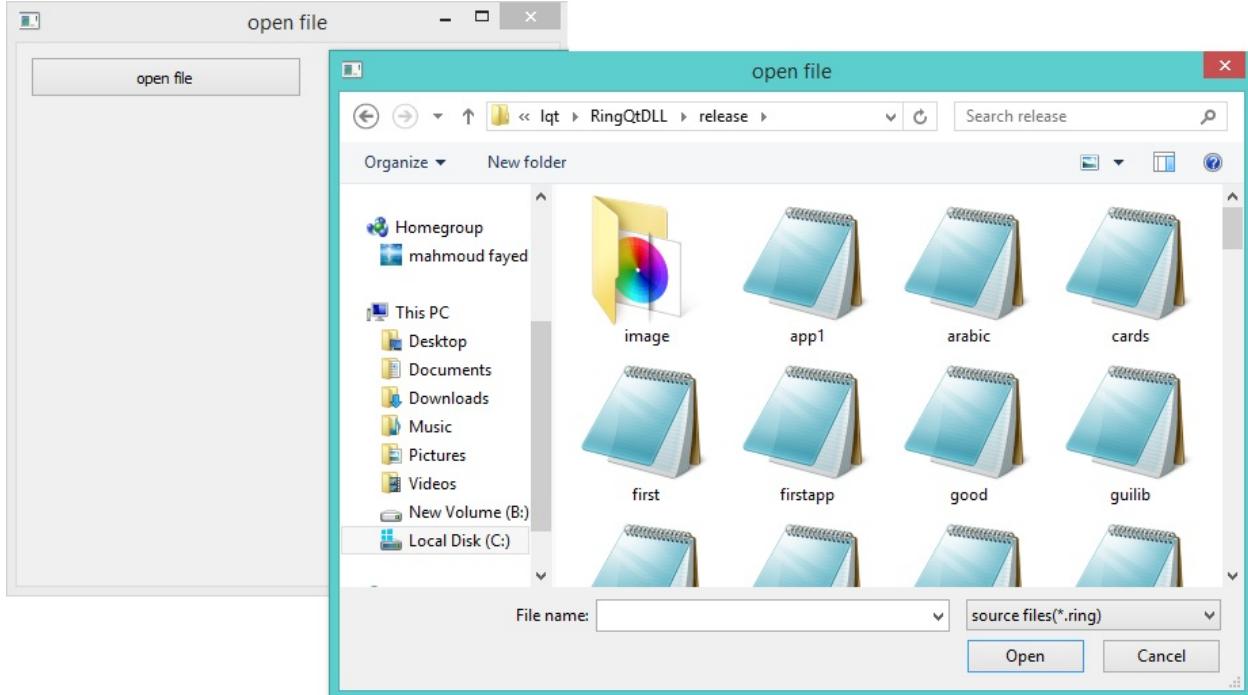
Example

```
Load "guilib.ring"

New qapp {
    win1 = new QWidget() {
        setWindowTitle("open file")
        setGeometry(100,100,400,400)
        new QPushButton(win1) {
            setGeometry(10,10,200,30)
            setText("open file")
            setClickEvent("pOpen()")
        }
        show()
    }
    exec()
}

Func pOpen
    new QFileDialog(win1) {
        cName = getOpenFileName(win1,"open file","c:\\","source files (*.ring)")
        win1.setWindowTitle(cName)
    }
}
```

The application during the runtime



45.35 Drawing using QPainter

In this example we will learn about drawing using the QPainter class

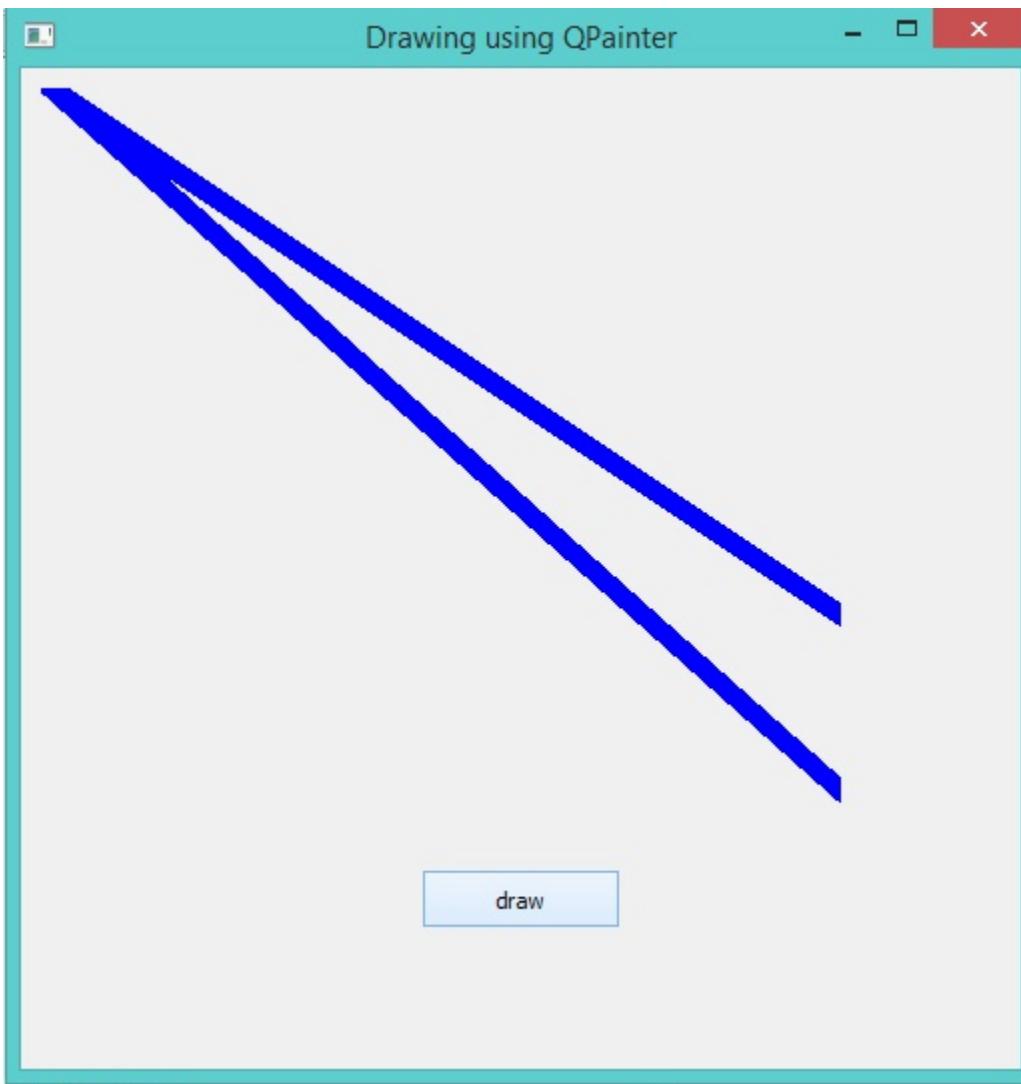
```

Load "guilib.ring"
New qapp {
    win1 = new QWidget() {
        setWindowTitle("Drawing using QPainter")
        setGeometry(100,100,500,500)
        label1 = new QLabel(win1) {
            setGeometry(10,10,400,400)
            setText("")
        }
        new QPushButton(win1) {
            setGeometry(200,400,100,30)
            setText("draw")
            setClickEvent("draw()")
        }
        show()
    }
    exec()
}

Func draw
    p1 = new QPicture()
    color = new QColor() {
        setRGB(0,0,255,255)
    }
    pen = new QPen() {
        setColor(color)
        setWidth(10)
    }
    new QPainter() {
        begin(p1)
        setPen(pen)
        drawLine(500,150,950,450)
        drawLine(950,550,500,150)
        endPaint()
    }
    label1 { setPicture(p1) show() }

```

The application during the runtime



45.36 Printing using QPrinter

In this example we will learn how to print to PDF file using QPrinter

```
Load "guilib.ring"
new qApp {
    win1 = new QWidget() {
        setWindowTitle("Printer")
        setGeometry(100, 100, 500, 500)
        myweb = new QWebView(win1) {
            setGeometry(100, 100, 1000, 500)
            loadPage(new QUrl("http://google.com"))
        }
        new QPushButton(win1) {
            setGeometry(20, 20, 100, 30)
            setText("Print")
            setClickEvent("print()")
        }
    }
}
```

(continues on next page)

(continued from previous page)

```

        }
        showmaximized()
    }
    exec()
}

func print
    printer1 = new qPrinter(0) {
        setoutputformat(1)      # 1 = pdf
        setoutputfilename("test.pdf")
        painter = new qpainter() {
            begin(printer1)
            myfont = new qfont("Times", 50, -1, 0)
            setfont(myfont)
            drawtext(100, 100, "test")
            printer1.newpage()
            drawtext(100, 100, "test2")
            endpaint()
        }
    }

    printer1 = new qPrinter(0) {
        setoutputformat(1)
        setoutputfilename("test2.pdf")
        myweb.print(printer1, ' system("test2.pdf") ')
        myweb.show()
    }

    system ("test.pdf")

```

45.37 Using QPrintPreviewDialog

In this example we will learn how to use the QPrintPreviewDialog class.

Example:

```

load "guilib.ring"

new qApp {
    win1 = new qwidget() {
        setwindowtitle("Printer Preview Dialog")
        setgeometry(100,100,800,880)
        printer1 = new qPrinter(0)
        show()
        oPreview = new qPrintPreviewDialog(printer1) {
            setParent(win1)
            move(10,10)
            setPaintrequestedevent("printPreview()")
            exec()
        }
    }
}

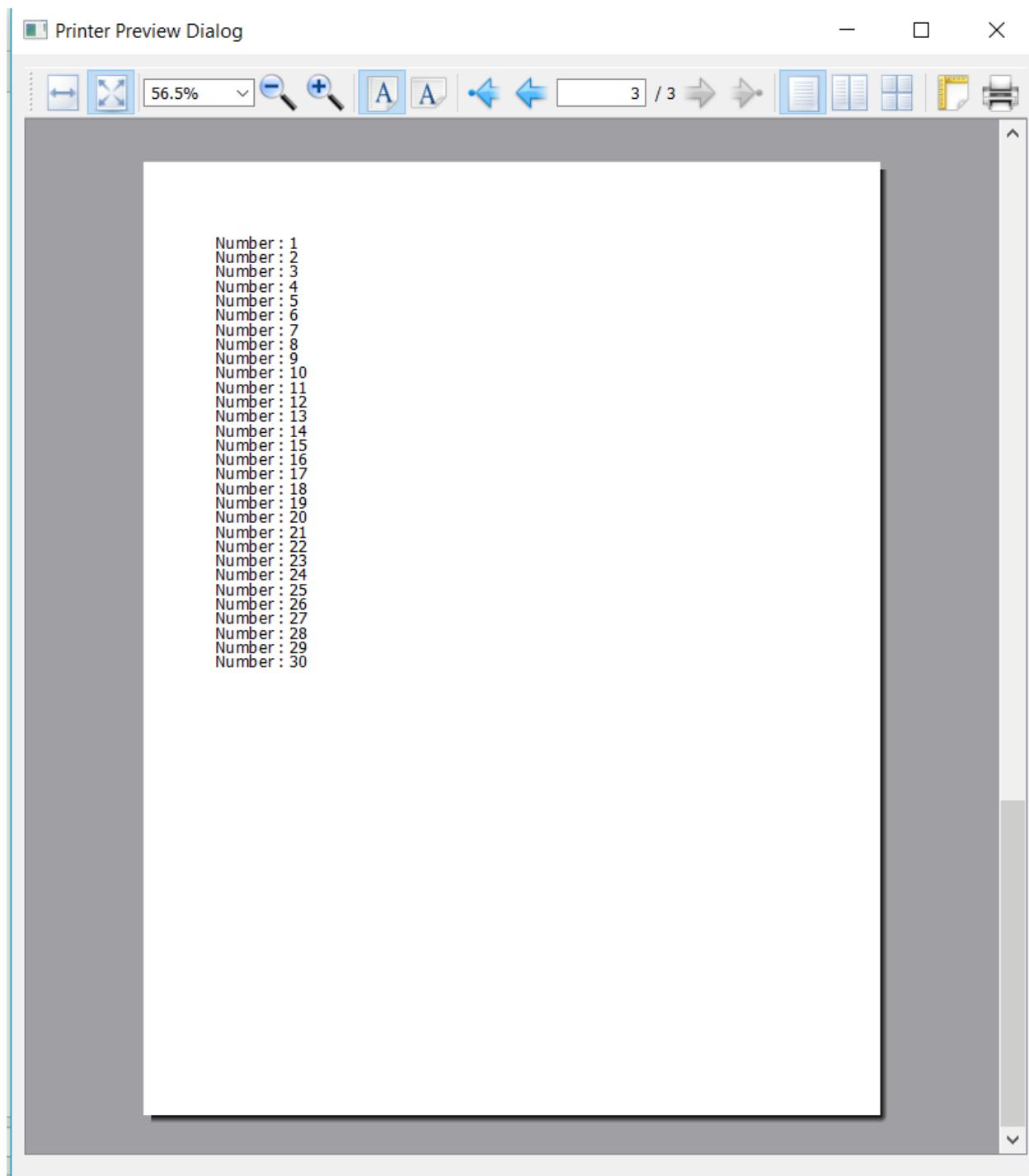
```

(continues on next page)

(continued from previous page)

```
exec()  
}  
  
func printPreview  
    printer1 {  
        painter = new qpainter() {  
            begin(printer1)  
            myfont = new qfont("Times",50,-1,0)  
            setfont(myfont)  
            drawtext(100,100,"Test - Page (1)")  
            printer1.newpage()  
            drawtext(100,100,"Test - Page (2)")  
            printer1.newpage()  
            myfont2 = new qfont("Times",14,-1,0)  
            setfont(myfont2)  
            for x = 1 to 30  
                drawtext(100,100+(20*x),"Number : " + x)  
            next  
            endpaint()  
        }  
    }
```

Screen Shot:



45.38 Creating More than one Window

The next example demonstrates how to create more than one window

```

Load "guilib.ring"
app1 = new qapp {
    win1 = new qwidget() {
        setwindowtitle("First")
        setgeometry(100,100,500,500)

        new qpushbutton(win1) {
            setgeometry(100,100,100,30)
            settext("close")
            setclickevent("app1.quit()")
        }

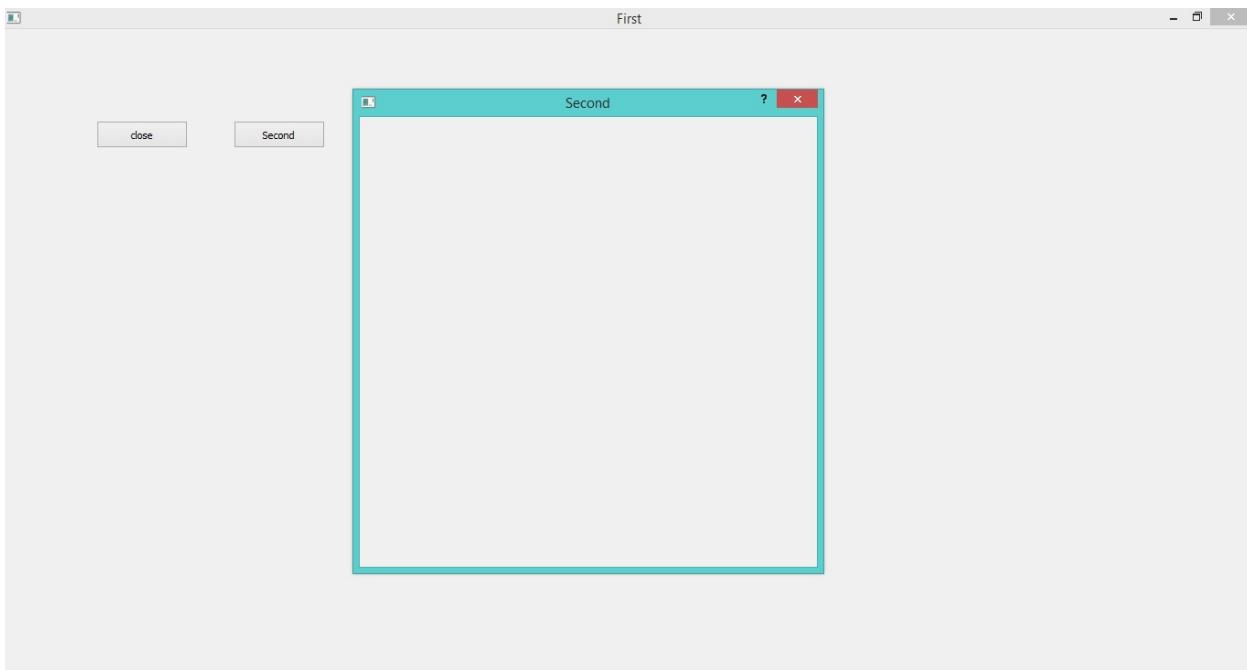
        new qpushbutton(win1) {
            setgeometry(250,100,100,30)
            settext("Second")
            setclickevent("second()")
        }

        showmaximized()
    }
    exec()
}

func second
    win2 = new qwidget() {
        setwindowtitle("Second")
        setgeometry(100,100,500,500)
        setwindowflags(Qt_dialog)
        show()
    }

```

The application during the runtime



45.39 Playing Sound

Example:

```
Load "guilib.ring"
new qapp {
    win1 = new qwidget() {
        setwindowtitle("play sound!") show()
    }
    new qmediaplayer() {
        setmedia(new qurl("footstep.wav"))
        setvolume(50) play()
    }
    exec()
}
```

45.40 Using the QColorDialog Class

Example:

```
Load "guilib.ring"

oApp = new myapp { start() }

Class MyApp

    oColor  win1
```

(continues on next page)

(continued from previous page)

Func start

```

myapp = new qapp

win1 = new qMainWindow() {
    setWindowTitle("Color Dialog")
    setgeometry(100,100,400,400)
}

new QPushButton(win1) {
    setgeometry(10,10,100,30)
    settext("Get Color")
    setclickevent("oApp.pColor()")
}

win1.show()
myapp.exec()

```

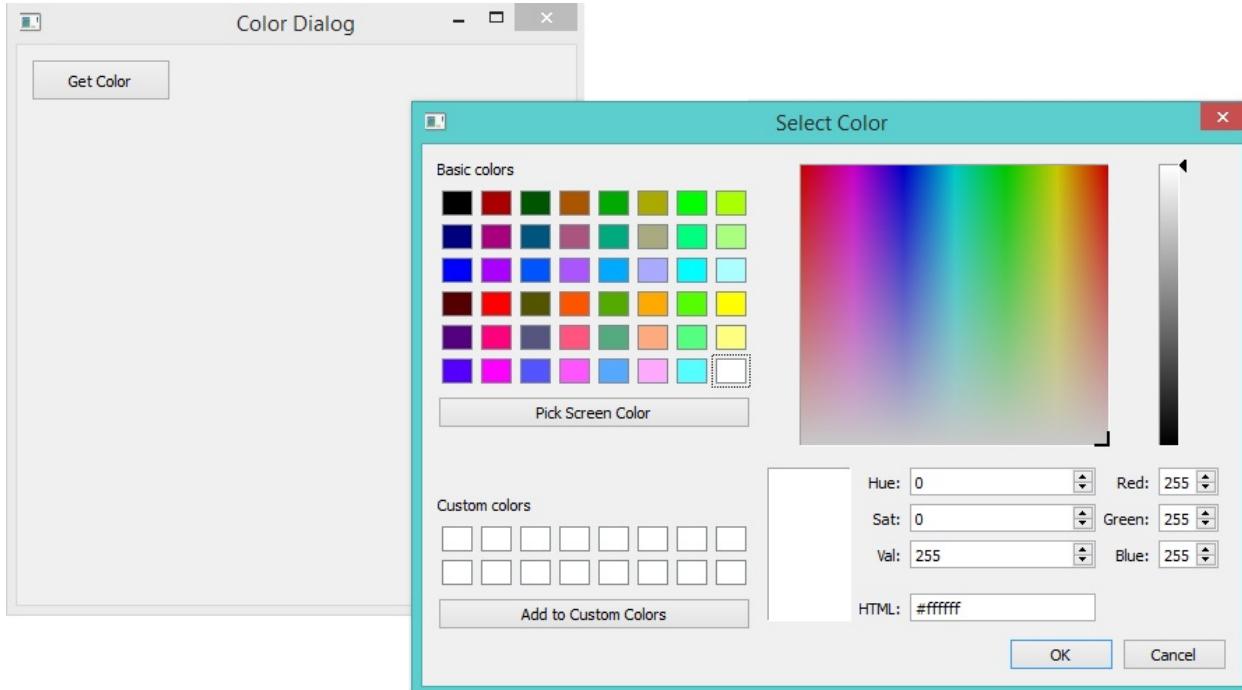
Func pColor

```

myobj = new QColorDialog()
aColor = myobj.GetColor()
r=acolor[1] g=acolor[2] b=acolor[3]
win1.setStyleSheet("background-color: rgb("+r+", " + g+ ", " + b + ")")

```

The application during the runtime



45.41 Using qLCDNumber Class

In this example we will learn about using the qLCDNumber class

```
Load "guilib.ring"

New qApp
{
    win1 = new QWidget()
    {
        setWindowTitle("LCD Number")
        setGeometry(100,100,250,120)

        new qLCDNumber(win1)
        {
            setGeometry(10,10,100,40)
            display(100)

        }

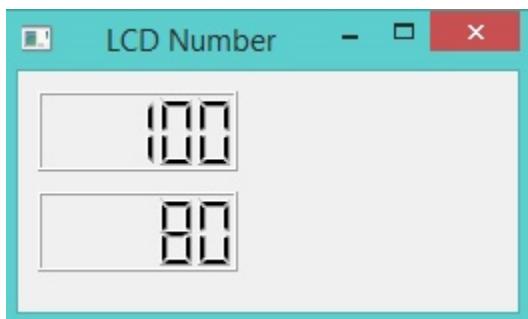
        new qLCDNumber(win1)
        {
            setGeometry(10,60,100,40)
            display(80)

        }

        show()
    }

    exec()
}
```

The application during the runtime



45.42 Movable Label Example

```

Load "guilib.ring"

new qApp {

    win1 = new qWidget()
    {

        label1 = new qLabel(win1)
        {
            setText("Welcome")
            setgeometry(10,10,200,50)
            setstylesheet("color: purple ; font-size: 30pt;")
        }

        new qTimer(win1)
        {
            setInterval(10)
            setTimeOutEvent("pMove()")
            start()
        }

        setWindowTitle("Movable Label")
        setgeometry(100,100,600,80)
        setStyleSheet("background-color: white;")
        show()
    }

    exec()
}

Func pMove
    label1
    {
        move(x()+1,y())
        if x() > 600
            move(10,y())
        ok
    }
}

```

The application during the runtime



45.43 QMessageBox Example

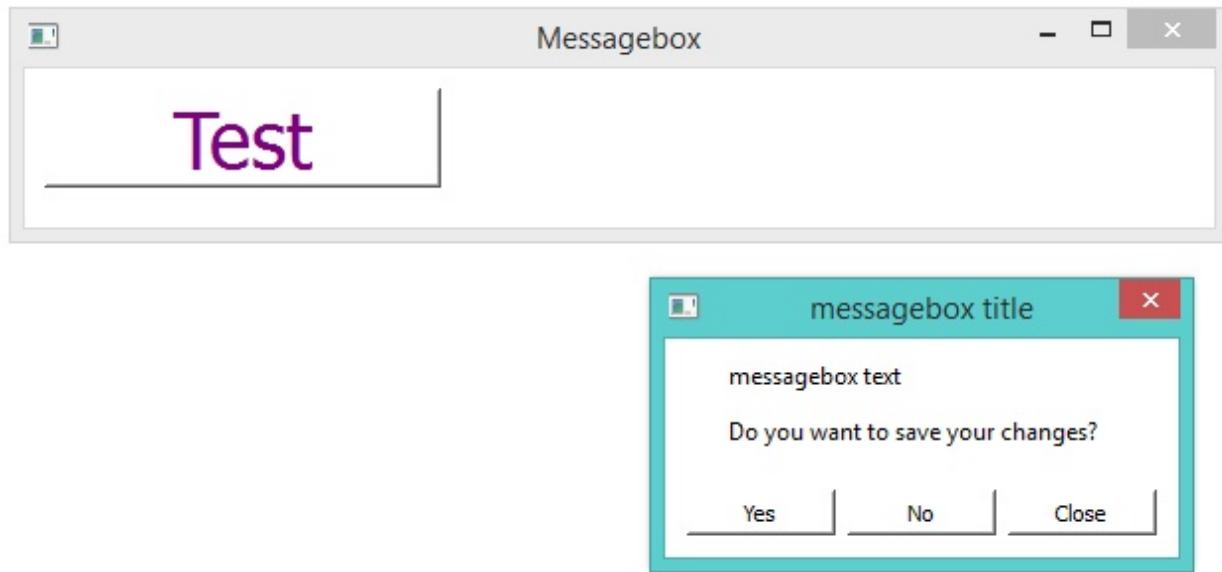
In this section we will learn how to check the output of the Message box

```
Load "guilib.ring"

new qApp {
    win1 = new QWidget()
    {
        label1 = new QPushButton(win1)
        {
            setText("Test")
            setGeometry(10,10,200,50)
            setStyleSheet("color: purple ; font-size: 30pt;")
            setClickEvent("pWork()")
        }
        setWindowTitle("MessageBox")
        setGeometry(100,100,600,80)
        setStyleSheet("background-color: white;")
        show()
    }
    exec()
}

func pWork
{
    new QMessageBox(win1)
    {
        setWindowTitle("messagebox title")
        setText("messagebox text")
        setInformativeText("Do you want to save your changes?")
        setStandardButtons(QMessageBox_Yes | QMessageBox_No | QMessageBox_Close)
        result = exec()
        win1 {
            if result = QMessageBox_Yes
                setWindowTitle("Yes")
            but result = QMessageBox_No
                setWindowTitle("No")
            but result = QMessageBox_Close
                setWindowTitle("Close")
            ok
        }
    }
}
```

The application during the runtime



45.44 Using QInputDialog Class

In the next example we will learn about using the QInputDialog class

```
Load "guilib.ring"

New QApp {
    Win1 = New QWidget () {
        SetGeometry(100,100,400,400)
        SetWindowTitle("Input Dialog")

        New QPushButton(win1)
        {
            SetText ("Input Dialog")
            SetGeometry(100,100,100,30)
            SetClickEvent("pWork()")
        }

        Show()
    }

    exec()
}

Func pWork
    oInput = New QInputDialog(win1)
    {
        setWindowTitle("What is your name?")
        setGeometry(100,100,400,50)
```

(continues on next page)

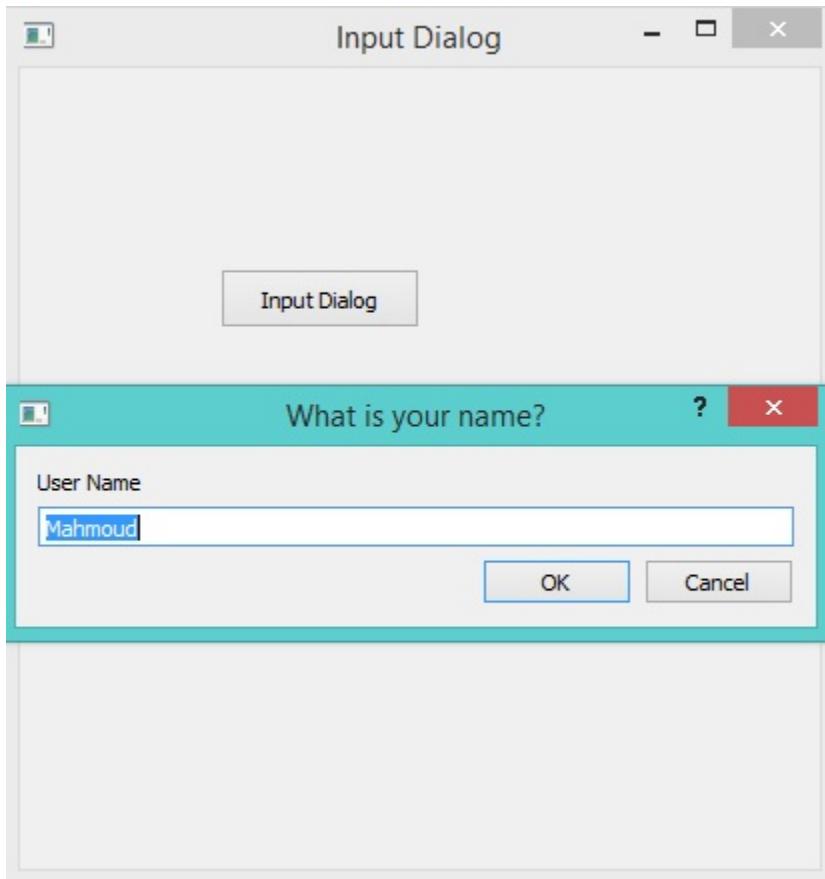
(continued from previous page)

```

setlabeltext("User Name")
settextvalue("Mahmoud")
lcheck = exec()
if lCheck win1.setwindowtitle(oInput.textvalue()) ok
}

```

The application during the runtime



45.45 Dialog Functions

We have the next functions

```

SetDialogIcon(cIconFile)
MsgInfo(cTitle,cMessage)
ConfirmMsg(cTitle,cMessage) --> lResult
InputBox(cTitle,cMessage) --> cValue
InputBoxInt(cTitle,cMessage) --> nValue
InputBoxNum(cTitle,cMessage) --> nValue
InputBoxPass(cTitle,cMessage) --> cValue

```

Example

```

load "guilib.ring"

new qApp {
    SetDialogIcon("notepad.png")
    msginfo(:Ring,:Welcome)
    see confirmMsg(:Ring,"Are you sure?") + nl
    see InputBoxNum(:Ring,"Enter Number(double) :") + nl
    see InputBox(:Ring,"Enter Value :") + nl
    see InputBoxInt(:Ring,"Enter Number(int)") + nl
    see InputBoxPass(:Ring,"Enter Password") +nl
}

```

45.46 KeyPress and Mouse Move Events

In this example we will learn how to use the Events Filter to know about KeyPress and Mouse Move Events

```

Load "guilib.ring"

new qApp {

    win1 = new QWidget()
    {
        setWindowTitle("Test using Event Filter!")
        setGeometry(100,100,400,400)
        setMouseTracking(true)
        myfilter = new qallevents(win1)
        myfilter.setKeyPressEvent("pWork()")
        myfilter.setMouseButtonPressEvent("pClick()")
        myfilter.setMouseMoveEvent("pMove()")

        installEventFilter(myfilter)

        show()
    }

    exec()
}

func pWork
    win1.setWindowTitle('KeyPress! : ' + myfilter.getKeyCode())

func pClick
    new QMessageBox(win1) {
        setGeometry(100,100,400,100)
        setWindowTitle("click event!")
        setText("x : " + myfilter.getx() +
               " y : " + myfilter.gety() + " button : " +
               myfilter.getbutton())
        show()
    }

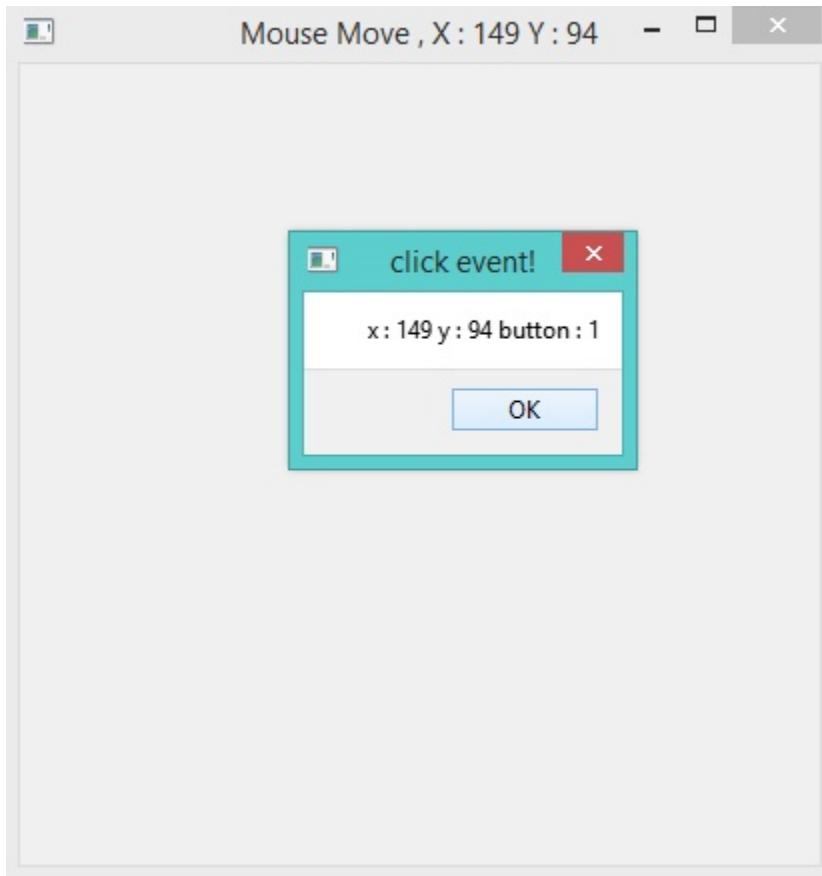
```

(continues on next page)

(continued from previous page)

```
func pMove
    win1.setwindowtitle("Mouse Move , X : " + myfilter.getx() +
                        " Y : " + myfilter.gety() )
```

The application during the runtime



45.47 Moving Objects using the Mouse

In the next example we will learn how to program movable objects where the user can move a label

```
Load "guilib.ring"

lPress = false
nX = 0
nY = 0

new qApp {
    win1 = new QWidget()
{
```

(continues on next page)

(continued from previous page)

```

        setWindowTitle("Move this label!")
        setGeometry(100,100,400,400)
        setstylesheet("background-color:white;")

        Label1 = new QLabel(Win1){
            setGeometry(100,100,200,50)
            setText("Welcome")
            setstylesheet("font-size: 30pt")
            myfilter = new qallevents(label1)
            myfilter.setEnterevent("pEnter()")
            myfilter.setLeaveevent("pLeave()")
            myfilter.setMouseButtonPressEvent("pPress()")
            myfilter.setMouseButtonReleaseEvent("pRelease()")
            myfilter.setMouseMoveEvent("pMove()")
            installearoundeventfilter(myfilter)
        }

        show()
    }

    exec()
}

Func pEnter
    Label1.setStyleSheet("background-color: purple; color:white;font-size: 30pt;")

Func pLeave
    Label1.setStyleSheet("background-color: white; color:black;font-size: 30pt;")

Func pPress
    lPress = True
    nX = myfilter.getglobalx()
    ny = myfilter.getglobaly()

Func pRelease
    lPress = False
    pEnter()

Func pMove
    nX2 = myfilter.getglobalx()
    ny2 = myfilter.getglobaly()
    ndiffx = nX2 - nX
    ndiffy = ny2 - ny
    if lPress
        Label1 {
            move(x()+ndiffx,y()+ndiffy)
            setStyleSheet("background-color: Green;
                          color:white;font-size: 30pt;")
            nX = nX2
            ny = ny2
        }

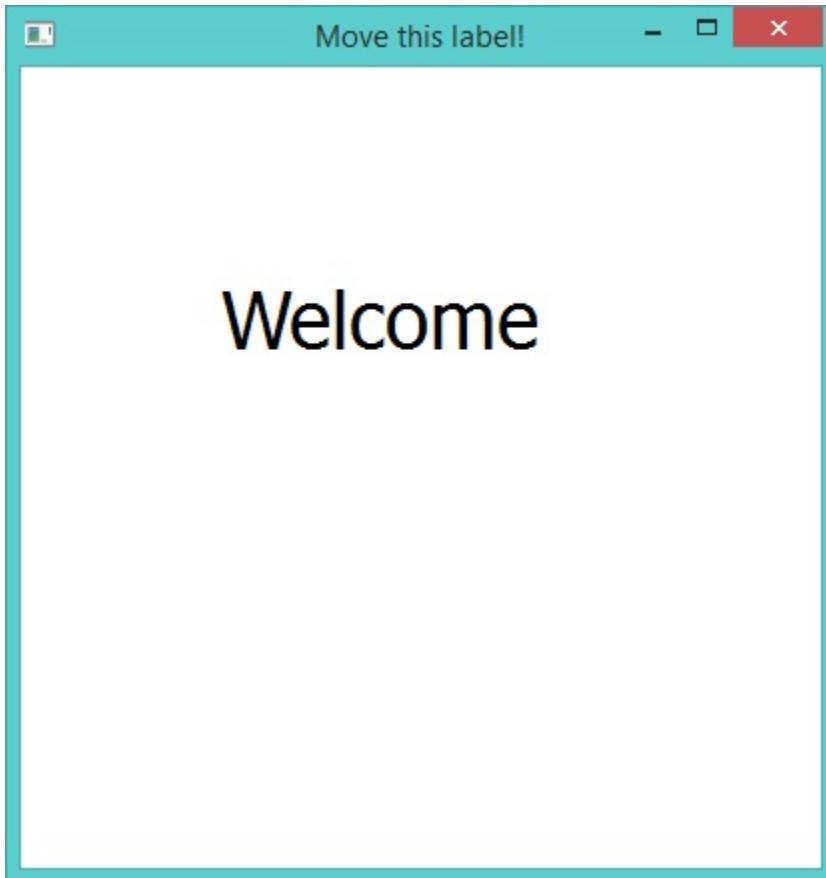
```

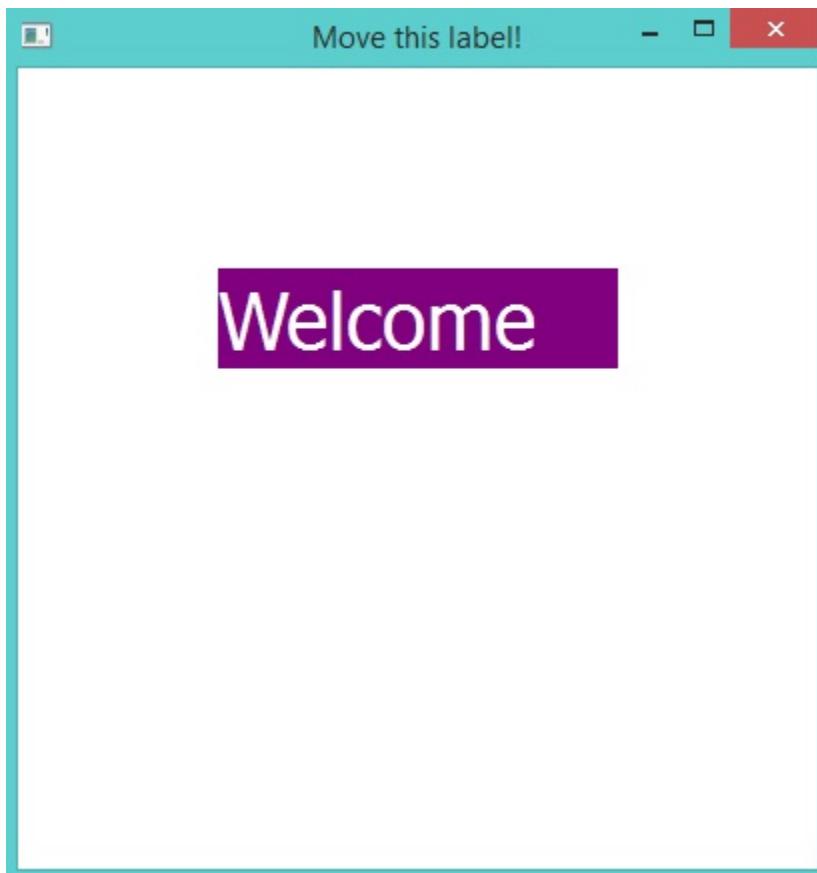
(continues on next page)

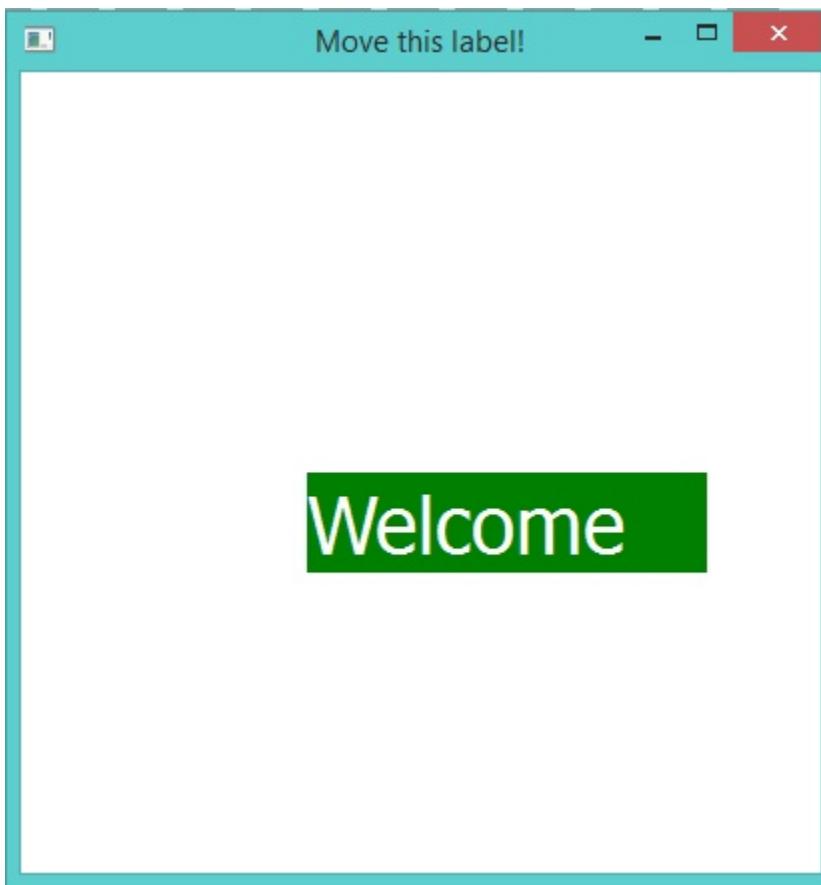
(continued from previous page)

ok

The application during the runtime







45.48 Inheritance from GUI Classes

Example :

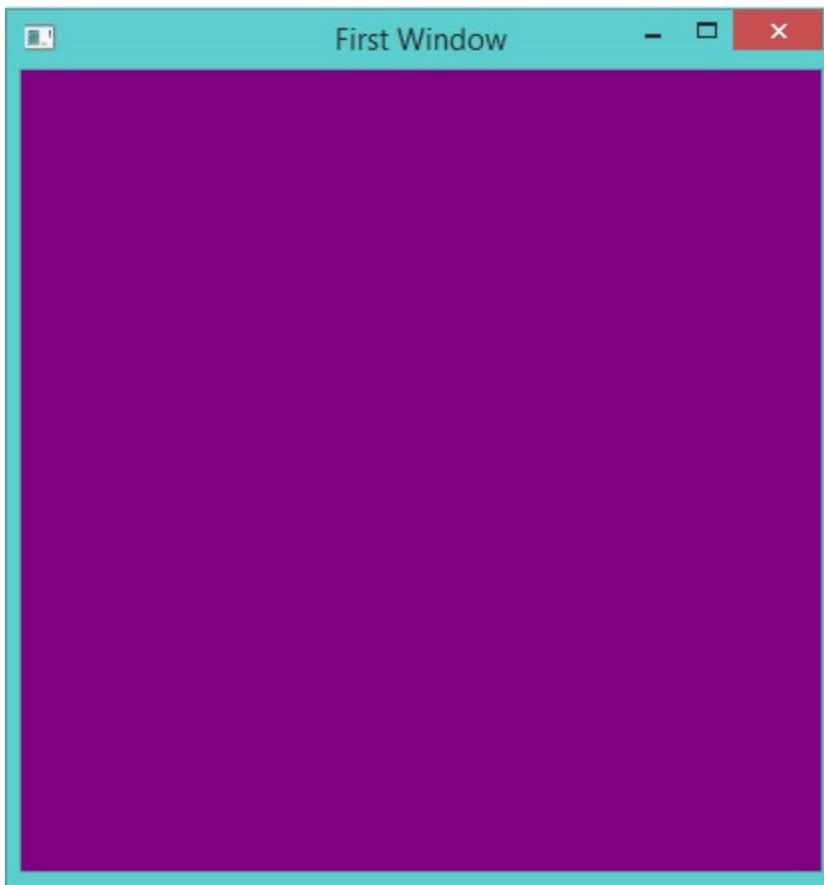
```
Load "guilib.ring"

New MyWindow()

new qApp { exec() }

class mywindow from QWidget
    Func init
        super.init()
        setWindowTitle("First Window")
        setGeometry(100,100,400,400)
        setStyleSheet("background-color: purple;")
        setToolTip("my first window!")
        show()
```

The application during the runtime



45.49 Using QDesktopWidget Class

In the next example we will learn about using the QDesktopWidget class

```
Load "guilib.ring"

New qApp {
    win1 = New qWidget()
    {
        resize(400,400)
        btn1 = new qPushButton(win1)
        {
            setText("Center")
            move(100,100)
            resize(100,30)
            setClickEvent("pCenter()")
        }

        Show()
    }

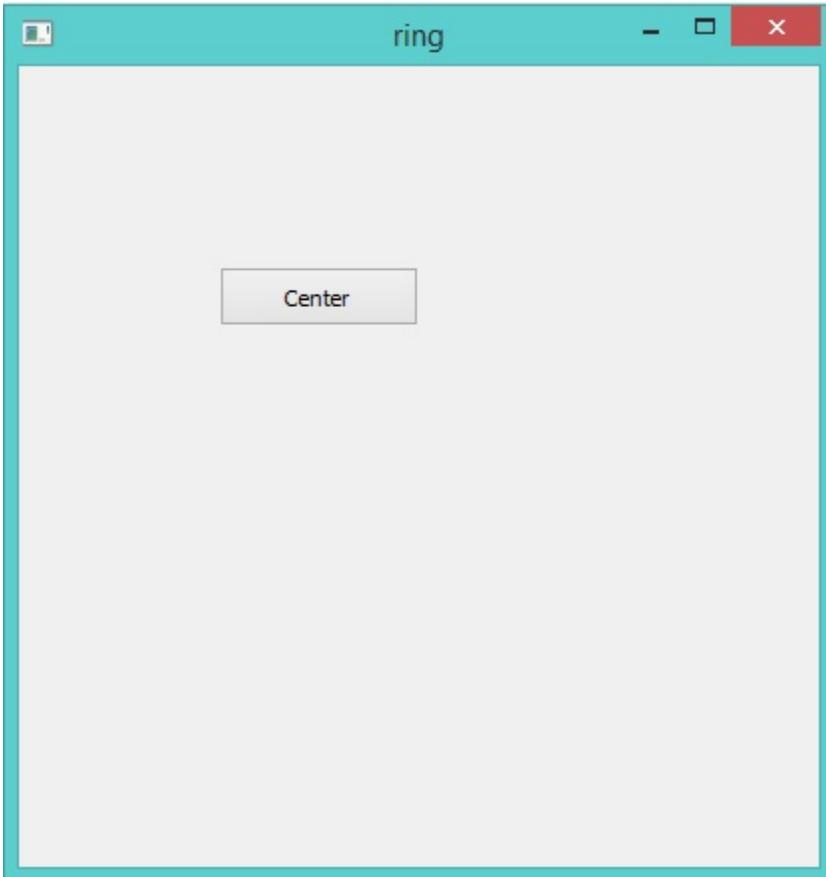
    exec()
}
```

(continues on next page)

(continued from previous page)

```
Func pCenter
    oDesktop = new qDesktopWidget()
    win1.move((oDesktop.width()-win1.width()) /2 , (oDesktop.Height()-win1.Height())/
→2 )
    win1.show()
```

The application during the runtime



45.50 Rotate Text

The next example rotate text using a Timer.

```
Load "guilib.ring"

nAngle = 0

New qapp {
    win1 = new QWidget() {
        setWindowTitle("Rotate Text")
        resize(800,600)
        label1 = new QLabel(win1) {
```

(continues on next page)

(continued from previous page)

```

        settext("")  

        myfilter = new qallevents(win1)  

        myfilter.setMouseButtonPressevent("pClick()")  

        installearEventfilter(myfilter)  

    }  

    new QTimer(win1) {  

        setInterval(50)  

        setTimeOutEvent("pTime()")  

        start()  

    }  

    pDraw()  

    L1 = new QVBoxLayout() { AddWidget(Label1) } SetLayout(L1)  

    showMaximized()  

}  

exec()  

}

Func pDraw  

    p1 = new QPicture()  

    color = new QColor() {  

        setRGB(0, 0, 255, 255)  

    }  

    pen = new QPen() {  

        setColor(color)  

        setWidth(50)  

    }  

    painter = new QPainter() {  

        begin(p1)  

            setPen(pen)  

            myfont = font()  

            myfont.setPointSize(50)  

            setFont(myfont)  

            rotate(nAngle)  

            drawText(350, 0*nAngle, "welcome")  

            drawText(0, 0*nAngle, "welcome")  

        endPaint()  

    }  

    label1 {  

        setPicture(p1)  

        show()  

    }

Func pClick  

    win1 { setWindowTitle("Click Event") }

Func pTime  

    nAngle++  

    if nAngle = 90  

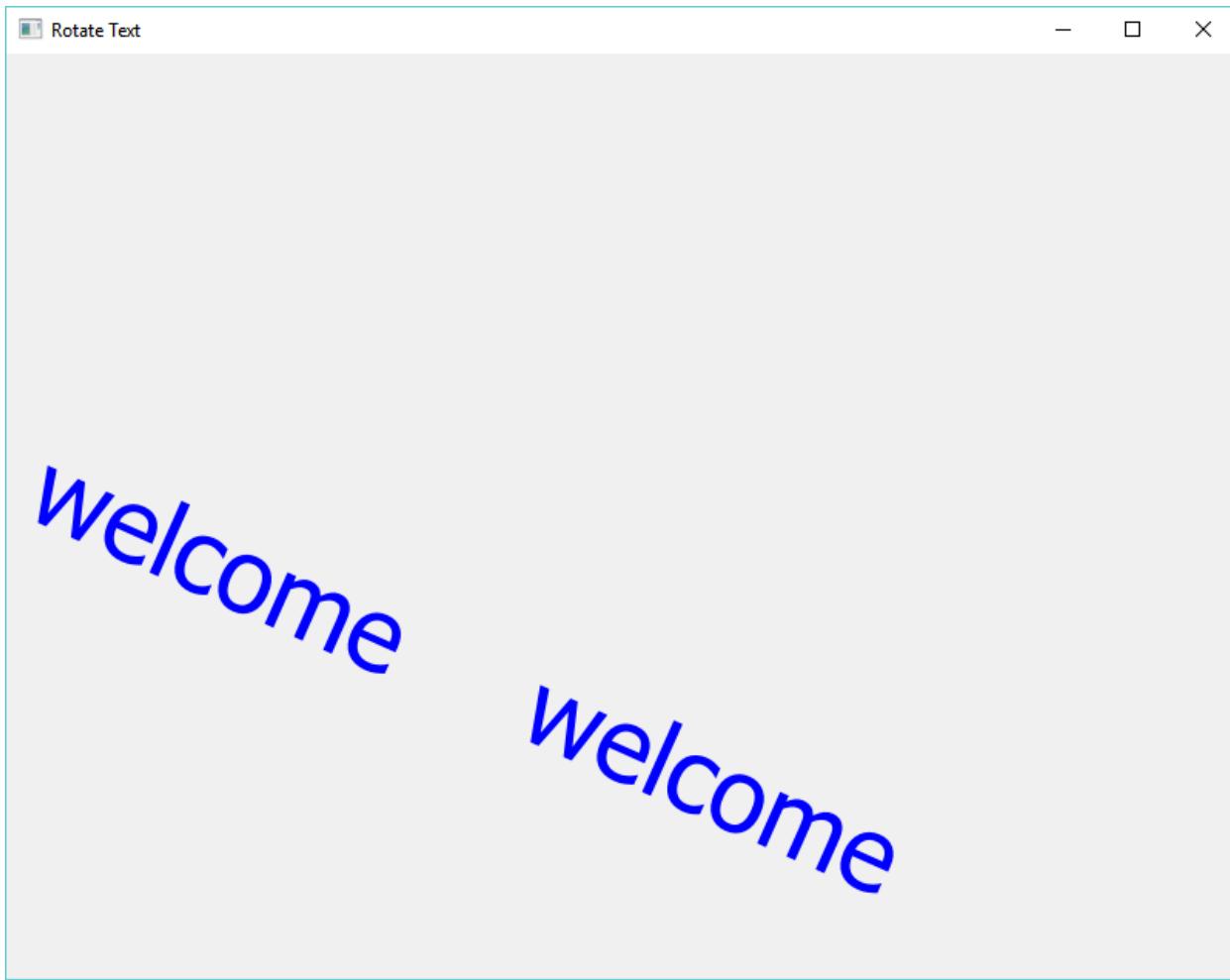
        nAngle = 10  

    ok  

    pDraw()

```

The application during the runtime



45.51 Change Focus

The next example change the focus using the ENTER key.

```
load "guilib.ring"

new qApp {
    win = new QWidget() {
        resize(600,600)
        SetWindowTitle("Change Focus")
        text1 = new QLineEdit(win)
        text2 = new QLineEdit(win)
        text3 = new QLineEdit(win)
        text4 = new QLineEdit(win)
        layout1 = new QVBoxLayout() {
            AddWidget(text1)
            AddWidget(text2)
            AddWidget(text3)
            AddWidget(text4)
    
```

(continues on next page)

(continued from previous page)

```

        }
        setLayout(Layout1)
        aList = [text1,text2,text3,text4]
        oFilter = new qallevents(win)
        oFilter.setKeyPressEvent("pWork()")
        installeventfilter(oFilter)
        show()
    }
    exec()
}

func pWork
    nCode = oFilter.getkeycode()
    if nCode = 16777220      # ENTER Key
        for x=1 to len(aList)
            if aList[x].HasFocus()
                t = x+1
                if t > len(aList) t=1 ok
                aList[t].SetFocus(0)
                exit
            ok
        next
    ok

```

45.52 Regular Expressions

The next example uses the Regular Expressions classes.

```

load "guilib.ring"

new qApp
{
    see "Using Regular Expressions" + nl

    exp = new qregexpattern() {
        setPattern("\d\d \w+")
        see pattern() + nl
        match = match("33 one",0,0,0)
        see match.hasmatch() + nl
        match = match("3 one",0,0,0)
        see match.hasmatch() + nl
        match = match("welcome 11 one",0,0,0)
        see match.hasmatch() + nl
        matched = match.captured(0)
        see matched + nl
    }
    exp = new qregexpattern() {
        setPattern("^(\d\d)/(\d\d)/(\d\d\d\d)$")
        see pattern() + nl
        match = match("08/12/1985",0,0,0)
    }
}

```

(continues on next page)

(continued from previous page)

```

    see match.hasmatch() + nl
    day = match.captured(1)
    month = match.captured(2)
    year = match.captured(3)
    see day + nl + month + nl + year + nl
    see "(" + match.capturedStart(1) + "," + match.capturedEnd(1)+ ")" + nl
    see "(" + match.capturedStart(2) + "," + match.capturedEnd(2)+ ")" + nl
    see "(" + match.capturedStart(3) + "," + match.capturedEnd(3)+ ")" + nl
}
}

```

Output

```

Using Regular Expressions
\d\d \w+
1
0
1
11 one
^(\d\d)/(\d\d)/(\d\d\d\d)$
1
08
12
1985
(0,2)
(3,5)
(6,10)

```

45.53 Simple Client and Server Example

In this section we will learn about creating simple Client and Server Application

```

Load "guilib.ring"

new qApp {
    oClient = new Client { client() }
    oServer = new Server { server() }
    exec()
}

Class Client

    win1 lineedit1 cOutput=""
    oTcpSocket

    func client

        win1 = new QWidget()

```

(continues on next page)

(continued from previous page)

```

new QPushButton(win1) {
    setGeometry(50,50,100,30)
    setText("connect")
    setClickEvent("oClient.Connect()")
}

lineEdit1 = new QTextEdit(win1) {
    setGeometry(150,50,200,300)
}

win1 {
    setWindowTitle("client")
    setGeometry(10,100,400,400)
    show()
}

func connect
    cOutput = "Connect to host 127.0.0.1 port 9999" + nl
    lineEdit1.setText(cOutput)
    oTcpSocket = new QTcpSocket(win1) {
        setConnectedEvent("oClient.pConnected()")
        setReadyReadEvent("oClient.pRead()")
        connectToHost("127.0.0.1", 9999, 3, 0)
        waitForConnected(5000)
    }

func pConnected

    cOutput += "Connected!" + nl
    lineEdit1.setText(cOutput)

func pRead

    cOutput += "Ready Read!" + nl
    lineEdit1.setText(cOutput)
    cOutput += oTcpSocket.readAll().data() + nl
    lineEdit1.setText(cOutput)

```

Class Server

```

win1 lineEdit1
oTcpServer oTcpClient
cOutput = ""

func server

    win1 = new QWidget()

    lineEdit1 = new QTextEdit(win1) {
        setGeometry(150,50,200,300)
    }

```

(continues on next page)

(continued from previous page)

```

win1 {
    setWindowTitle("Server")
    setGeometry(450, 100, 400, 400)
    show()
}

oTcpServer = new QTcpServer(win1) {
    setNewConnectionEvent("oServer.pNewConnection()")
    oHostAddress = new QHostAddress()
    oHostAddress.setAddress("127.0.0.1")
    listen(oHostAddress, 9999)
}
cOutput = "Server Started" + nl +
    "listen to port 9999" + nl

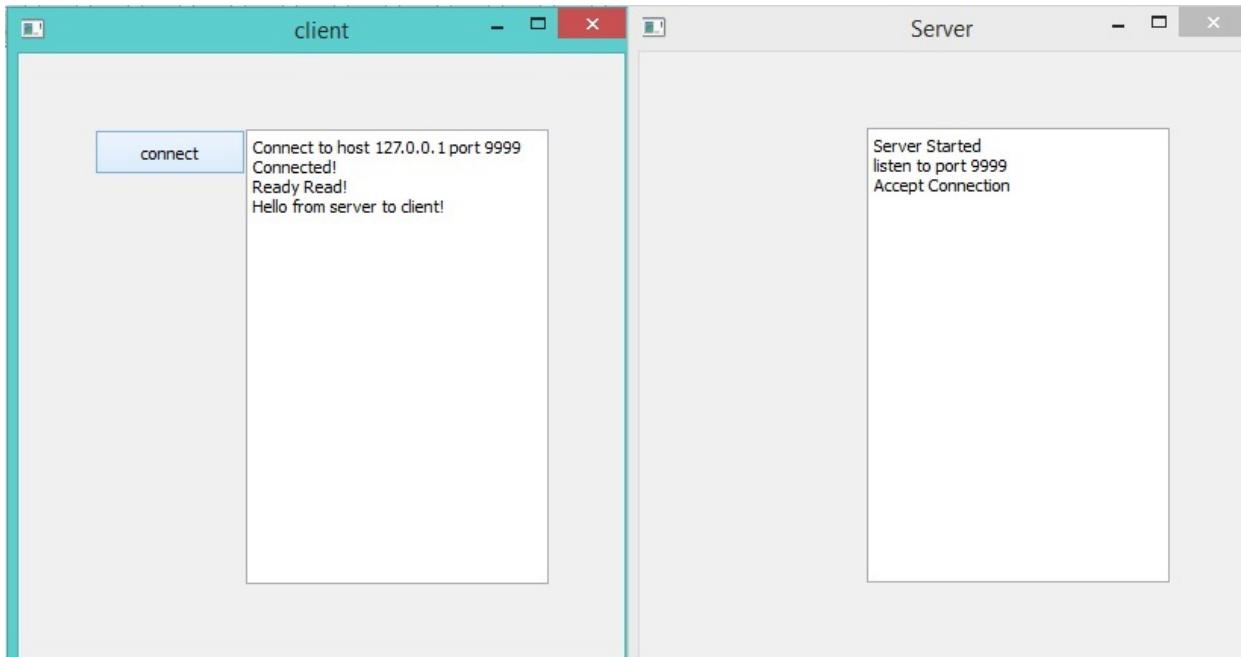
lineedit1.setText(cOutput)

Func pNewConnection

    oTcpClient = oTcpServer.nextPendingConnection()
    cOutput += "Accept Connection" + nl
    lineedit1.setText(cOutput)
    oTcpClient {
        cStr ="Hello from server to client!"+char(13)+char(10)
        write(cStr,len(cStr))
        flush()
        waitForBytesWritten(300000)
        close()
    }
}

```

The application during the runtime



45.54 Dynamic Objects

We may create objects in the runtime and add them to windows.

Example:

```
load "guilib.ring"

oFormDesigner = new FormDesigner { start("oFormDesigner") }

Class FormDesigner

    winToolBox  winForm

    aObjects = []

    func start cObjectName

        oApp = new qApp

        winToolBox = new QWidget()
        winToolBox.setWindowTitle("ToolBox")
        winToolBox.move(10,10)
        winToolBox.resize(300,600)

        btn = new QPushButton(winToolBox)
        btn.resize(300,30)
        btn.setText("Create Button")
        btn.setClickEvent(cObjectName+".pCreateButton()")
        btn.show()

        winToolBox.show()

        winForm = new QWidget() {
            move(400,50)
            setWindowTitle("Form Designer")
            resize(600,600)
            show()
        }

        oApp.exec()

    func pCreateButton

        nCount = len(aObjects)

        aObjects + new MyButton(winForm)
        {
            nIndex = nCount + 1
            setText("Button"+ nIndex)
            Move(30*nIndex,30*nIndex)
            resize(100,30)
```

(continues on next page)

(continued from previous page)

```
        show()
    }
```

```
Class MyButton from qPushButton
nIndex = 0
```

45.55 Weight History Application

The next sample help in recording (Date, Time and Weight).

```
Load "guilib.ring"

MyApp = new qApp
{
    $ApplicationObject = "oApp"      # To be used when calling events
    oApp = new App
    exec()
    oApp.CloseDatabase()
}

class App

cDir = currentdir() + "/"
oCon
aIDs = []

win1 = new QWidget()
{
    setWindowTitle("Weight History")
    resize(600,600)
    layoutButtons = new qhboxlayout()
    {
        label1 = new QLabel(win1) { setText("Weight") }
        text1 = new QLineEdit(win1)
        btnAdd = new QPushButton(win1) {
            setText("Add")
            setClickEvent($ApplicationObject+.AddWeight())
        }
        btnDelete = new QPushButton(win1) {
            setText("Delete")
            setClickEvent($ApplicationObject+.DeleteWeight())
        }
        addWidget(label1)
        addWidget(text1)
        addWidget(btnAdd)
        addWidget(btnDelete)
    }
    layoutData = new qhboxlayout()
    {

```

(continues on next page)

(continued from previous page)

```

Table1 = new qTableWidget(win1) {
    setRowCount(0)
    setColumnCount(3)
    setSelectionBehavior(QAbstractItemView_SelectRows)
    setHorizontalHeaderItem(0, new QTableWidgetItem("Date"))
    setHorizontalHeaderItem(1, new QTableWidgetItem("Time"))
    setHorizontalHeaderItem(2, new QTableWidgetItem("Weight"))
    itemChangedEvent($ApplicationObject+".ItemChanged()")
        setAlternatingRowColors(true)
        horizontalHeader().setStyleSheet("color: blue")
        verticalHeader().setStyleSheet("color: red")
    }
    addWidget(Table1)
}
layoutClose = new QHBoxLayout()
{
    btnClose = new QPushButton(win1) {
        setText("Close")
        clickEvent("MyApp.Quit()")
    }
    addWidget(btnClose)
}
layoutMain = new QVBoxLayout()
{
    addLayout(layoutButtons)
    addLayout(LayoutData)
    addLayout(layoutClose)
}
setLayout(layoutMain)
self.OpenDatabase()
self.ShowRecords()
show()
}

Func OpenDatabase
lCreate = False
if not exists(cDir + "weighthistory.db")
    lCreate = True
ok
new QSqlDatabase() {
    this.oCon = addDatabase("QSQLITE") {
        setDatabaseName("weighthistory.db")
        Open()
    }
}
if lCreate
    new QSqlQuery() {
        exec("create table weighthistory (id integer primary key,"+
            " f_date varchar(10),"+
            " f_time varchar(8), f_weight varchar(8) );")
        delete()
    }
}

```

(continues on next page)

(continued from previous page)

ok

```

Func CloseDatabase
    oCon.Close()

Func AddWeight
    cWeight = text1.text()
    AddRecord(cWeight)

Func DeleteWeight
    Table1 {
        nRow = CurrentRow()
        if nRow >= 0
            nID = this.aIDs[nRow+1]
            new QSqlQuery( ) {
                exec("delete from weighthistory where id = " + nID )
            }
            Del(this.aIDs,nRow+1)
            removerow(nRow)
            selectrow(nRow)
        ok
    }

Func AddRecord cWeight
    new QSqlQuery( ) {
        cStr = "insert into weighthistory (f_date,f_time,f_weight) values"+
        " ('%f1','%f2','%f3')"
        cDate = Date()
        cTime = Time()
        cStr = substr(cStr,"%f1",cDate)
        cStr = substr(cStr,"%f2",cTime)
        cStr = substr(cStr,"%f3",cWeight)
        exec(cStr)
        delete()
    }
    ShowRecords()
    Table1.selectrow(table1.rowcount()-1)

Func ShowRecords
    table1.setItemChangedEvent("")
    aIDs = []
    query = new QSqlQuery() {
        exec("select * from weighthistory")
        nRows = 0
        this.Table1.setRowCount(0)
        while moveNext()
            this.table1 {
                insertRow(nRows)
                this.aIDs + query.value(0).toString()
            }
    }

```

(continues on next page)

(continued from previous page)

```

for x = 1 to 3
    cStr = query.value(x).toString()
    item = new QTableWidgetItem(cStr)
    setItem(nRows,x-1,item)
next
}
nRows++
end
delete()
}
table1.setItemChangedEvent($ApplicationObject+.ItemChanged())

```

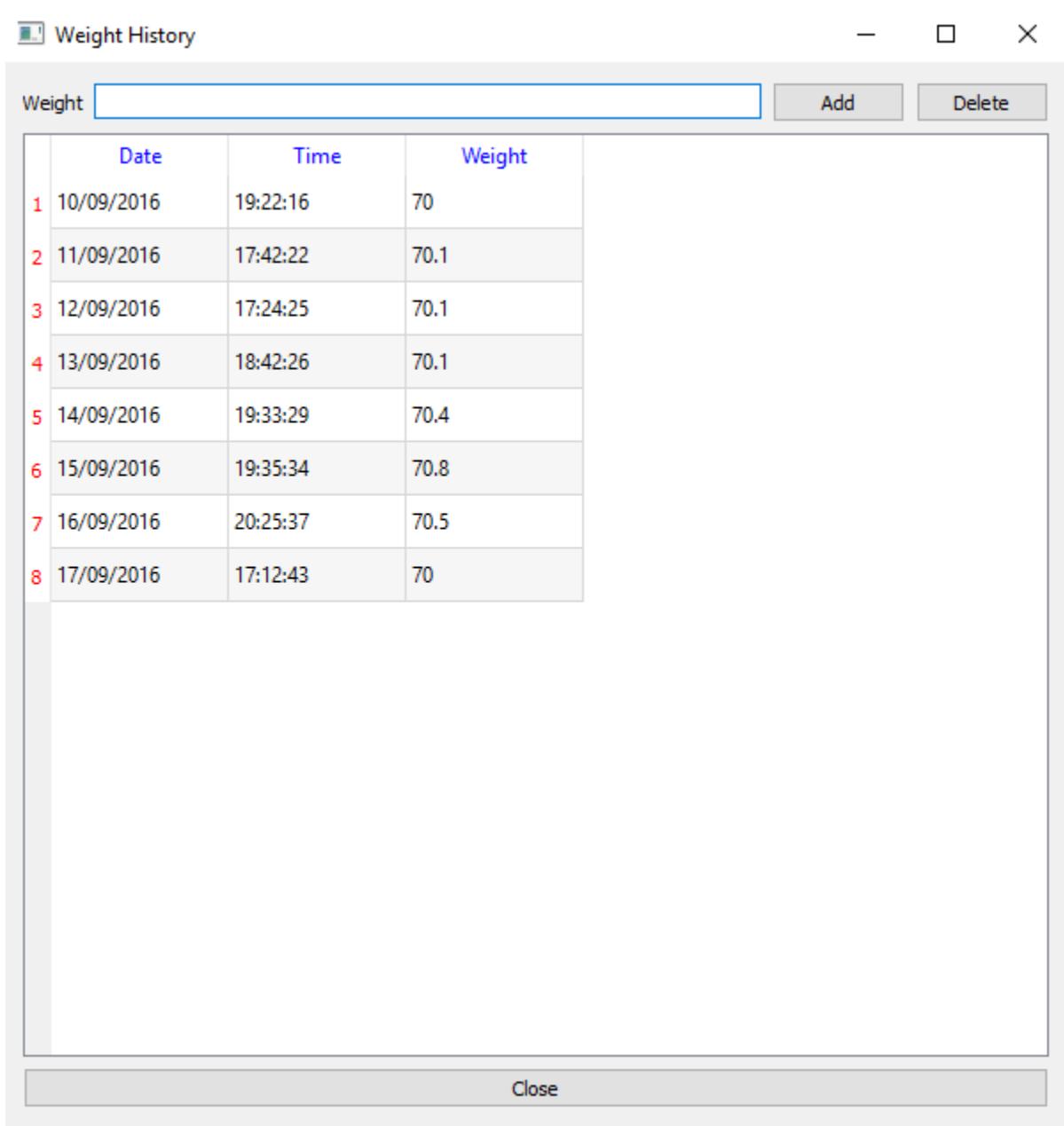
Func ItemChanged

```

nRow = table1.currentRow()
if nRow >= 0
    myitem = Table1.item(table1.currentRow(),0)
    cDate = myitem.text()
    myitem = Table1.item(table1.currentRow(),1)
    cTime = myitem.text()
    myitem = Table1.item(table1.currentRow(),2)
    cWeight = myitem.text()
    new QSqlQuery( ) {
        cStr = "update weighthistory set f_date ='%f1' , f_time = '%f2' , "+
        "f_weight ='%f3' where id = " + this.aIDs[nRow+1]
        cStr = substr(cStr,"%f1",cDate)
        cStr = substr(cStr,"%f2",cTime)
        cStr = substr(cStr,"%f3",cWeight)
        exec(cStr)
        delete()
    }
ok

```

The next screen shot for the application during the runtime



45.56 Notepad Application

In the next example we will see simple Notepad developed using the RingQt

```
Load "guilib.ring"

cActiveFileName = ""
aTextColor = [0,0,0]
aBackColor = [255,255,255]
cFont = "MS Shell Dlg 2,14,-1,5,50,0,0,0,0,0"
cWebsite = "http://www.google.com"
```

(continues on next page)

(continued from previous page)

```

oSearch = NULL
oSearchValue = NULL
oSearchCase = NULL
oSearchFilter = NULL
oReplaceValue = NULL

lAskToSave = false

MyApp = New qApp {
    win1 = new qMainWindow() {

        setWindowTitle("Ring Notepad")
        setGeometry(100,100,400,400)
        aBtns = [
            new QPushButton(win1) {
                setBtnImage(self,"image/new.png")
                setClickEvent("pNew()")
                setToolTip("New File")
            } ,
            new QPushButton(win1) {
                setBtnImage(self,"image/open.png")
                setClickEvent("pOpen()")
                setToolTip("Open File")
            } ,
            new QPushButton(win1) {
                setBtnImage(self,"image/save.png")
                setClickEvent("pSave()")
                setToolTip("Save")
            } ,
            new QPushButton(win1) {
                setBtnImage(self,"image/saveas.png")
                setClickEvent("pSaveAs()")
                setToolTip("Save As")
            } ,
            new QPushButton(win1) {
                setBtnImage(self,"image/cut.png")
                setClickEvent("pCut()")
                setToolTip("Cut")
            } ,
            new QPushButton(win1) {
                setBtnImage(self,"image/copy.png")
                setClickEvent("pCopy()")
                setToolTip("Copy")
            } ,
            new QPushButton(win1) {
                setBtnImage(self,"image/paste.png")
                setClickEvent("pPaste()")
                setToolTip("Paste")
            } ,
            new QPushButton(win1) {
                setBtnImage(self,"image/font.png")

```

(continues on next page)

(continued from previous page)

```

        setclickevent("pFont()")
        settooltip("Font")
    } ,
    new QPushButton(win1) {
        setbtnimage(self,"image/colors.jpg")
        setclickevent("pColor()")
        settooltip("Text Color")
    } ,
    new QPushButton(win1) {
        setbtnimage(self,"image/search.png")
        setclickevent("pFind()")
        settooltip("Find and Replace")
    } ,
    new QPushButton(win1) {
        setbtnimage(self,"image/print.png")
        setclickevent("pPrint()")
        settooltip("Print")
    } ,
    new QPushButton(win1) {
        setbtnimage(self,"image/debug.png")
        setclickevent("pDebug()")
        settooltip("Debug (Run then wait!)")
    } ,
    new QPushButton(win1) {
        setbtnimage(self,"image/run.png")
        setclickevent("pRun()")
        settooltip("Run the program")
    } ,
    new QPushButton(win1) {
        setbtnimage(self,"image/close.png")
        setclickevent("pQuit()")
        settooltip("Quit")
    }
]

tool1 = addtoolbar("files") {
    for x in aBtns addwidget(x) addseparator() next
}

menu1 = new QMenuBar(win1) {
    sub1 = addmenu("File")
    sub2 = addmenu("Edit")
    sub3 = addmenu("View")
    sub4 = addmenu("Help")
    sub1 {
        oAction = new QAction(win1) {
            setShortcut(new QKeySequence("Ctrl+n"))
            setbtnimage(self,"image/new.png")
            settext("New")
            setclickevent("pNew()")
        }
        addaction(oAction)
}

```

(continues on next page)

(continued from previous page)

```

oAction = new QAction(win1) {
    setShortcut(new QKeySequence("Ctrl+o"))
    setbtnimage(self,"image/open.png")
    settext("Open")
    setclickevent("pOpen()")
}
addaction(oAction)
addseparator()
oAction = new QAction(win1) {
    setShortcut(new QKeySequence("Ctrl+s"))
    setbtnimage(self,"image/save.png")
    settext("Save")
    setclickevent("pSave()")
}
addaction(oAction)
addseparator()
oAction = new QAction(win1) {
    setShortcut(new QKeySequence("Ctrl+e"))
    setbtnimage(self,"image/saveas.png")
    settext("Save As")
    setclickevent("pSaveAs()")
}
addaction(oAction)
addseparator()
oAction = new QAction(win1) {
    setShortcut(new QKeySequence("Ctrl+p"))
    setbtnimage(self,"image/print.png")
    settext("Print to PDF")
    setclickevent("pPrint()")
}
addaction(oAction)
addseparator()
oAction = new QAction(win1) {
    setShortcut(new QKeySequence("Ctrl+d"))
    setbtnimage(self,"image/debug.png")
    settext("Debug (Run then wait!)")
    setclickevent("pDebug()")
}
addaction(oAction)
addseparator()
oAction = new QAction(win1) {
    setShortcut(new QKeySequence("Ctrl+r"))
    setbtnimage(self,"image/run.png")
    settext("Run")
    setclickevent("pRun()")
}
addaction(oAction)
addseparator()
oAction = new QAction(win1) {
    setShortcut(new QKeySequence("Ctrl+F5"))
    setbtnimage(self,"image/run.png")
    settext("Run GUI Application (No Console)")
}

```

(continues on next page)

(continued from previous page)

```

        setclickevent("pRunNoConsole()")
    }
    addaction(oAction)
    addseparator()
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+q"))
        setbtnimage(self,"image/close.png")
        settext("Exit")
        setstatusTip("Exit")
        setclickevent("pQuit()")
    }
    addaction(oAction)
}
sub2 {
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+x"))
        setbtnimage(self,"image/cut.png")
        settext("Cut")
        setclickevent("pCut()")
    }
    addaction(oAction)
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+c"))
        setbtnimage(self,"image/copy.png")
        settext("Copy")
        setclickevent("pCopy()")
    }
    addaction(oAction)
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+v"))
        setbtnimage(self,"image/paste.png")
        settext("Paste")
        setclickevent("pPaste()")
    }
    addaction(oAction)
    addseparator()
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+i"))
        setbtnimage(self,"image/font.png")
        settext("Font")
        setclickevent("pFont()")
    }
    addseparator()
    addaction(oAction)
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+t"))
        setbtnimage(self,"image/colors.jpg")
        settext("Text Color")
        setclickevent("pColor()")
    }
    addaction(oAction)
    oAction = new QAction(win1) {

```

(continues on next page)

(continued from previous page)

```

        setShortcut(new QKeySequence("Ctrl+b"))
        setbtnimage(self, "image/colors.jpg")
        settext("Back Color")
        setclickevent("pColor2()")
    }
    addaction(oAction)
    addseparator()
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+g"))
        settext("Go to line")
        setclickevent("pGoto()")
    }
    addaction(oAction)
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+f"))
        setbtnimage(self, "image/search.png")
        settext("Find and Replace")
        setclickevent("pFind()")
    }
    addaction(oAction)
}
sub3 {
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+p"))
        setbtnimage(self, "image/project.png")
        settext("Project Files")
        setclickevent("pProject()")
    }
    addaction(oAction)
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+u"))
        setbtnimage(self, "image/source.png")
        setclickevent("pSourceCode()")
        settext("Source Code")
    }
    addaction(oAction)
    oAction = new QAction(win1) {
        setShortcut(new QKeySequence("Ctrl+w"))
        setbtnimage(self, "image/richtext.png")
        setclickevent("pWebBrowser()")
        settext("Web Browser")
    }
    addaction(oAction)
}
sub4 {
    sub5 = addmenu("Development Tools")
    sub5 {

        oAction = new QAction(win1) {
            settext("Programming Language")
            setclickevent("pLang()")
        }
    }
}

```

(continues on next page)

(continued from previous page)

```

        addaction(oAction)
        oAction = new QAction(win1) {
            settext("GUI Library")
            setclickevent("pGUI()")
        }
        addaction(oAction)
    }
    addseparator()
    oAction = new QAction(win1) {
        settext("About")
        setclickevent("pAbout()")
    }
    addaction(oAction)
}
}

setmenubar(menu1)

status1 = new QStatusBar(win1) {
    showmessage("Ready!", 0)
}

setstatusbar(status1)

tree1 = new QTreeView(win1) {
    setclickedevent("pChangeFile()")
    setGeometry(00, 00, 200, 400)
    oDir = new QDir()
    ofile = new QFileSystemModel() {
        setrootpath(oDir.currentpath())
        myfiles = new QStringList()
        myfiles.append("*.ring")
        myfiles.append("*.rh")
        setnamefilters(myfiles)
        setNameFilterDisables(false)
    }
    setmodel(ofile)
    myindex = ofile.index(oDir.currentpath(), 0)
    for x = 1 to ofile.columncount()
        hidecolumn(x)
    next
    setcurrentindex(myindex)
    setexpanded(myindex, true)
    header().hide()
}

oDock1 = new QDockWidget(win1, 0) {
    setGeometry(00, 00, 200, 200)
    setWindowTitle("Project Files")
    setwidget(tree1)
}

```

(continues on next page)

(continued from previous page)

```

textedit1 = new QTextEdit(win1) {
    setCursorPositionChangedEvent("pCursorPositionChanged()")
    setLineWrapMode(QTextEdit_NoWrap)
    setAcceptRichText(false)
    setTextChangedEvent("lAskToSave = true")
}

oDock2 = new QDockWidget(win1, 0) {
    setWidget(textedit1)
    setWindowTitle("Source Code")
}

oWebBrowser = new QWidget() {
    setWindowFlags(Qt_SubWindow)
    oWBLLabel = new QLabel(win1) {
        setText("Website: ")
    }
    oWBText = new QLineEdit(win1) {
        setText(cWebSite)
        setReturnPressedEvent("pWebGo()")
    }
    oWBGo = new QPushButton(win1) {
        setText("Go")
        setClickEvent("pWebGo()")
    }
    oWBBack = new QPushButton(win1) {
        setText("Back")
        setClickEvent("pWebBack()")
    }
    oWBLLayout1 = new QHBoxLayout() {
        addWidget(oWBLLabel)
        addWidget(oWBText)
        addWidget(oWBGo)
        addWidget(oWBBack)
    }
    oWebView = new QWebView(win1) {
        loadPage(new QUrl(cWebSite))
    }
    oWBLLayout2 = new QVBoxLayout() {
        addLayout(oWBLLayout1)
        addWidget(oWebView)
    }
    setLayout(oWBLLayout2)
}

oDock3 = new QDockWidget(win1, 0) {
    setWidget(oWebBrowser)
    setWindowTitle("Web Browser")
    setFeatures(QDockWidget_DocWidgetClosable)
}

```

(continues on next page)

(continued from previous page)

```

    adddockwidget(1,oDock1,1)
    adddockwidget(2,oDock2,2)
    adddockwidget(2,oDock3,1)

        setwinicon(self,"image/notepad.png")

        showmaximized()
    }
    RestoreSettings()
    exec()
}

func pWebGo
    cWebsite = oWBText.text()
    oWebView.LoadPage( new qurl( cWebsite ) )

func pWebBack
    oWebView.Back()

func pProject
    oDock1.Show()

func pSourceCode
    oDock2.Show()

func pWebBrowser
    oDock3.Show()

func pChangeFile
    myitem = tree1.currentindex()
    if ofile.isdir(myitem)
        return
    ok
    cActiveFileName = ofile.filepath(myitem)
    textedit1.settext(read(cActiveFileName))
    textedit1.setFocus(0)
    pCursorPositionChanged()
    pSetActiveFileName()

func pSetActiveFileName
    oDock2.setWindowTitle("Source Code : " + cActiveFileName)

func pCursorPositionChanged
    status1.showMessage(" Line : "+(textedit1.textcursor().blocknumber()+1)+"
                        " Column : " +(textedit1.textcursor().columnnumber()+1) +
                        " Total Lines : " + textedit1.document().linecount() ,0)

func pGoto
    oInput = New QInputDialog(win1)
    {
        setWindowTitle("Enter the line number?")
        setGeometry(100,100,400,50)

```

(continues on next page)

(continued from previous page)

```

        setlabeltext("Line")
        settextvalue("1")
        exec()
        nLine = 0 + oInput.textvalue()
        oBlock = textedit1.document().findBlockByLineNumber(nLine-1)
        oCursor = textedit1.textcursor()
        oCursor.setposition(oBlock.position(),0)
        textedit1.settextcursor(oCursor)
    }

func pFind
    if isobject(oSearch)
        oSearch.activatewindow()
        return
    ok
    oSearch = new QWidget()
    {
        new QLabel(oSearch)
        {
            setText("Find What : ")
            setgeometry(10,10,50,30)
        }
        oSearchValue = new QLineEdit(oSearch)
        {
            setgeometry(80,10,460,30)
            setReturnPressedEvent("pFindValue()")
        }
        new QLabel(oSearch)
        {
            setText("Replace with ")
            setgeometry(10,45,80,30)
        }
        oReplaceValue = new QLineEdit(oSearch)
        {
            setgeometry(80,45,460,30)
        }
        oSearchCase = new QCheckbox(oSearch)
        {
            setText("Case Sensitive")
            setgeometry(80,85,100,30)
        }
        new QPushButton(oSearch)
        {
            setText("Find/Find Next")
            setgeometry(80,120,100,30)
            setclickevent("pFindValue()")
        }
        new QPushButton(oSearch)
        {
            setText("Replace")
            setgeometry(200,120,100,30)
            setclickevent("pReplace()")
        }
    }
}

```

(continues on next page)

(continued from previous page)

```

        }
    new QPushButton(oSearch)
    {
        setText("Replace All")
        setgeometry(320,120,100,30)
        setclickevent("pReplaceAll()")
    }
    new QPushButton(oSearch)
    {
        setText("Close")
        setgeometry(440,120,100,30)
        setclickevent("pSearchClose()")
    }

    setwinicon(oSearch,"image/notepad.png")
    setWindowTitle("Find/Replace")
    setStyleSheet("background-color:white;")
    setFixedSize(550,160)
    setwindowflags( Qt_CustomizeWindowHint |
                    Qt_WindowTitleHint | Qt_WindowStaysOnTopHint)

    oSearchFilter = new qallevents(oSearch)
    oSearchFilter.setKeyPressEvent("pSearchKeyPress()")
    installearEventfilter(oSearchFilter)

    show()
}

Func pReplace
oCursor = textedit1.textCursor()
if oCursor.HasSelection() = false
    new QMessageBox(oSearch)
    {
        SetWindowTitle("Replace")
        SetText("No Selection")
        show()
    }
    return false
ok
cValue = oSearchValue.text()
cSelected = oCursor.SelectedText()
if oSearchCase.checkState() = Qt_Unchecked
    cValue = lower(cValue)
    cSelected = lower(cSelected)
ok
if cSelected != cValue
    new QMessageBox(oSearch)
    {
        SetWindowTitle("Replace")
        SetText("No Match")
        show()
    }
}

```

(continues on next page)

(continued from previous page)

```

        return false
ok
cValue = oReplaceValue.text()
nStart = oCursor.SelectionStart()
nEnd = oCursor.SelectionEnd()
cStr = textedit1.toPlainText()
cStr = left(cStr,nStart)+cValue+substr(cStr,nEnd+1)
textedit1.setText(cStr)
return pFindValue()

Func pReplaceAll
    cStr = textedit1.toPlainText()
    cOldValue = oSearchValue.text()
    cnewValue = oReplaceValue.text()
    if oSearchCase.checkState() = Qt_Unchecked
        # Not Case Sensitive
        cStr = SubStr(cStr,cOldValue,cnewValue,true)
    else
        # Case Sensitive
        cStr = SubStr(cStr,cOldValue,cnewValue)
    ok
    textedit1.setText(cStr)
    new qMessagebox(oSearch)
{
    SetWindowTitle("Replace All")
    SetText("Operation Done")
    show()
}

Func pSearchClose
    oSearch.close()
    oSearch = NULL

func pSearchKeyPress
    if oSearchFilter.getKeyCode() = Qt_Key_Escape
        pSearchClose()
    ok

func pFindValue
    oCursor = textedit1.textcursor()
    nPosStart = oCursor.Position() + 1
    cValue = oSearchValue.text()
    cStr = textedit1.toPlainText()
    cStr = substr(cStr,nPosStart)
    if oSearchCase.checkState() = Qt_Unchecked
        cStr = lower(cStr)  cValue = lower(cValue)
    ok
    nPos = substr(cStr,cValue)
    if nPos > 0
        nPos += nPosStart - 2
        oCursor = textedit1.textcursor()
        oCursor.setposition(nPos,0)

```

(continues on next page)

(continued from previous page)

```

        textedit1.settextcursor(oCursor)
        oCursor = textedit1.textcursor()
        oCursor.setposition(nPos+len(cValue), 1)
        textedit1.settextcursor(oCursor)
        return true
    else
        new qMessagebox(oSearch)
        {
            SetWindowTitle("Search")
            SetText("Cannot find :" + cValue)
            show()
        }
        return false
    ok

func pNofileopened
    New qMessageBox(win1) {
        setWindowTitle("Sorry")
        setText("Save the file first!")
        show()
    }

func pDebug
    if cActiveFileName = Null return pNofileopened() ok
    cCode = "start run " + cActiveFileName + nl
    system(cCode)

func pRun
    if cActiveFileName = Null return pNofileopened() ok
    cCode = "start ring " + cActiveFileName + nl
    system(cCode)

func pRunNoConsole
    if cActiveFileName = Null return pNofileopened() ok
    cCode = "start /b ring " + cActiveFileName + nl
    system(cCode)

func pSave
    if cActiveFileName = NULL return pSaveAs() ok
    writefile(cActiveFileName, textedit1.toplaintext())
    status1.showmessage("File : " + cActiveFileName + " saved!", 0)
    lAskToSave = false

func pSaveAs
    new qfiledialog(win1) {
        cName = getsavefilename(win1, "Save As", "", "source files(*.ring)")
        if cName != NULL
            cActiveFileName = cName
            writefile(cActiveFileName, textedit1.toplaintext())
            status1.showmessage("File : " + cActiveFileName + " saved!", 0)
            pSetActiveFileName()
            lAskToSave = false
}

```

(continues on next page)

(continued from previous page)

```

        ok
    }

func pPrint
    status1.showmessage("Printing to File : RingDoc.pdf",0)
    printer1 = new qPrinter(0) {
        setoutputformat(1)      # 1 = pdf
        setoutputfilename("RingDoc.pdf")
        textedit1.print(printer1)
    }
    status1.showmessage("Done!",0)
    system("RingDoc.pdf")

func pCut
    textedit1.cut()
    status1.showmessage("Cut!",0)

func pCopy
    textedit1.copy()
    status1.showmessage("Copy!",0)

func pPaste
    textedit1.paste()
    status1.showmessage("Paste!",0)

func pFont
    oFontDialog = new qfontdialog() {
        aFont = getfont()
    }
    textedit1.selectall()
    cFont = aFont[1]
    pSetFont()

Func pSetFont
    myfont = new qfont("",0,0)
    myfont.fromstring(cFont)
    textedit1.setcurrentfont(myfont)

Func pColor
    new qcolordialog() { aTextColor = GetColor() }
    pSetColors()

Func pColor2
    new qcolordialog() { aBackColor = GetColor() }
    pSetColors()

Func pSetColors
    textedit1.setStyleSheet("color: rgb(" + aTextColor[1] + "," + aTextColor[2] +
                           "," + aTextColor[3] + ");" + "background-color: rgb(" +
                           aBackColor[1] + "," + aBackColor[2] + "," +
                           aBackColor[3] + ")")

```

(continues on next page)

(continued from previous page)

```

func pOpen
    new qfiledialog(win1) {
        cName = getopenfilename(win1,"open file","c:\\","source files(*.ring)")
        if cName != NULL
            cActiveFileName = cName
            textedit1.settext(read(cActiveFileName))
        ok
    }

func pNew
    new qfiledialog(win1) {
        cName = getsavefilename(win1,"New file","","source files(*.ring)")
        if cName != NULL
            write(cName,"")
            cActiveFileName = cName
            textedit1.settext(read(cActiveFileName))

        ok
    }

Func WriteFile cFileName,cCode
    aCode = str2list(cCode)
    fp = fopen(cFileName,"wb")
    for cLine in aCode
        fwrite(fp,cLine+char(13)+char(10))
    next
    fclose(fp)

Func MsgBox cTitle,cMessage
    new qmessagebox(win1) {
        setwindowtitle(cTitle)
        setText(cMessage)
        show()
    }

Func pLang
    MsgBox("Programming Language",
           "This application developed using the Ring programming language")

Func pGUI
    MsgBox("GUI Library",
           "This application uses the Qt GUI Library through RingQt")

Func pAbout
    MsgBox("About",
           "2016, Mahmoud Fayed <msfclipper@yahoo.com>")

Func pSaveSettings
    cSettings = "aTextColor = ["+aTextColor[1]+","+aTextColor[2]+
               ","+aTextColor[3]+"]" + nl +
               "aBackColor = ["+aBackColor[1]+","+aBackColor[2]+

```

(continues on next page)

(continued from previous page)

```

        ","+aBackColor[3]+"]" + nl +
        "cFont = '" + cFont + "'"+ nl +
        "cWebSite = '" + cWebsite + "'"+ nl
    cSettings = substr(cSettings,nl,char(13)+char(10))
    write("ringnotepad.ini",cSettings)
    if lAsktoSave
        new qmessagebox(win1)
    {
        setWindowTitle("Save Changes?")
        setText("Some changes are not saved!")
        setInformativeText("Do you want to save your changes?")
        setStandardButtons(QMessageBox_Yes |
                           QMessageBox_No | QMessageBox_Cancel)
        result = exec()
        win1 {
            if result = QMessageBox_Yes
                pSave()
            but result = QMessageBox_Cancel
                return false
            ok
        }
    }
    ok
    return true

Func pSetWebsite
    oWebView { loadpage(new qurl(cWebSite)) }
    oWBText { setText(cWebSite) }

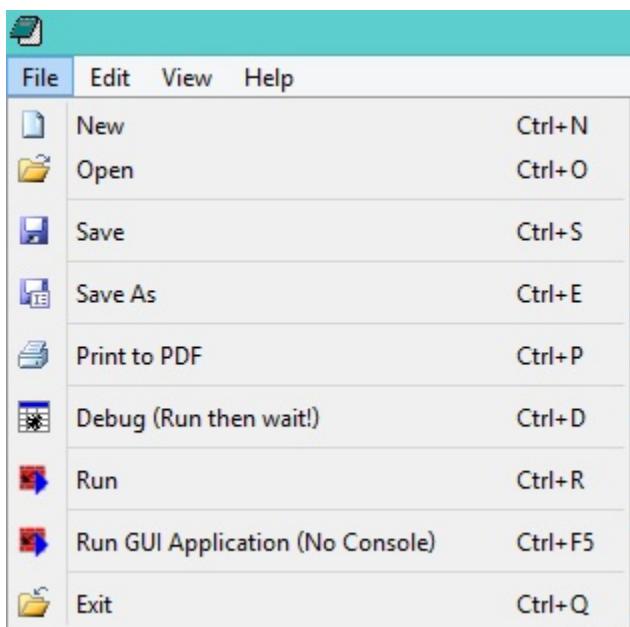
Func RestoreSettings
    eval(read("ringnotepad.ini"))
    pSetColor()
    pSetFont()
    pSetWebsite()

Func pQuit
    if pSaveSettings()
        myapp.quit()
    ok

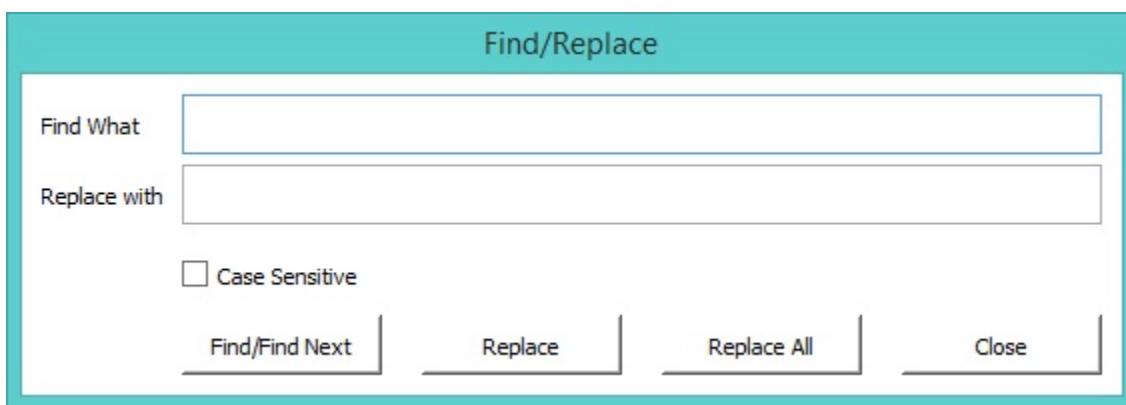
```

The application during the runtime

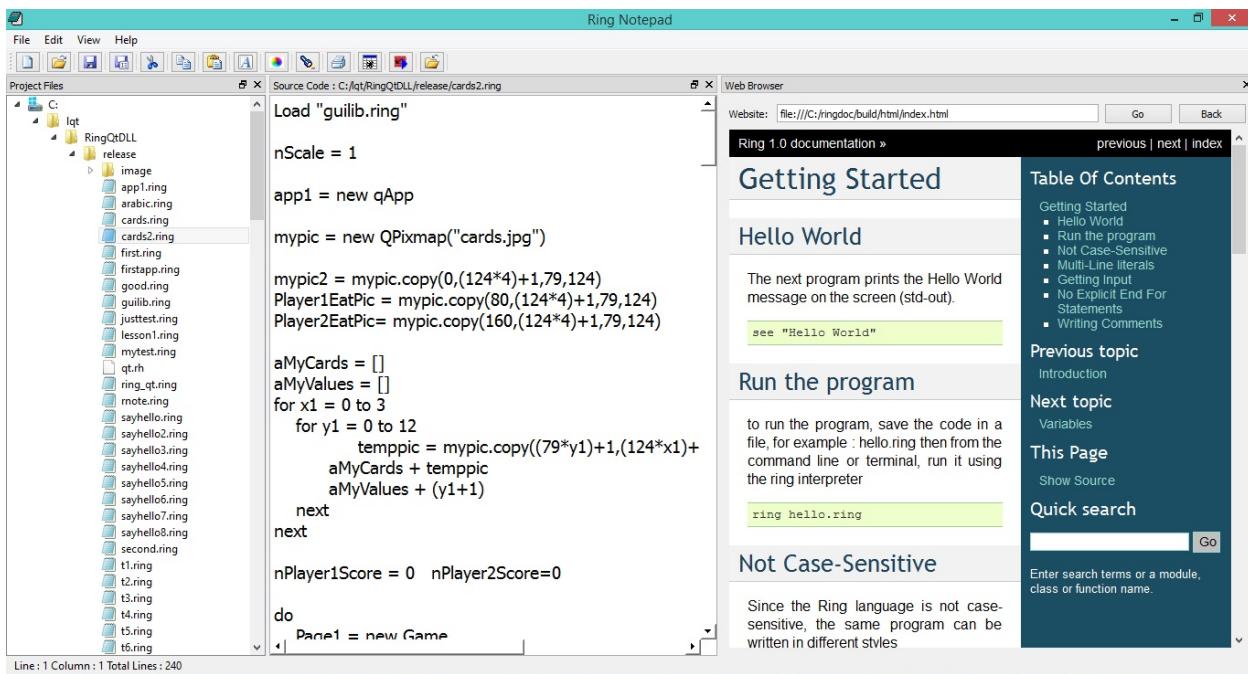
The next screen shot demonstrates the “File” menu



The next window for “search and replace”



The next screen shot demonstrates the application main window



Note: the functions pDebug(), pRun() and pRunNoConsole() in the previous sample are not portable! They are written in this sample for MS-Windows and we can update them for other operating systems.

45.57 The Cards Game

In the next example we will see a simple Cards game developed using RingQt

Each player get 5 cards, the cards are unknown to any one. each time one player click on one card to see it. if the card is identical to another card the play get point for each card. if the card value is “5” the player get points for all visible cards.

```

Load "guilib.ring"

nScale = 1

app1 = new qApp

mypic = new QPixmap("cards.jpg")

mypic2 = mypic.copy(0,(124*4)+1,79,124)
Player1EatPic = mypic.copy(80,(124*4)+1,79,124)
Player2EatPic= mypic.copy(160,(124*4)+1,79,124)

aMyCards = []
aMyValues = []
for x1 = 0 to 3
    for y1 = 0 to 12
        tempPic = mypic.copy((79*y1)+1,(124*x1)+1,79,124)
        aMyCards + tempPic
        aMyValues + (y1+1)
    next
next

nPlayer1Score = 0 nPlayer2Score=0
do
    Page1 = new Game

```

(continues on next page)

(continued from previous page)

```

        aMyValues + (y1+1)
    next
next

nPlayer1Score = 0    nPlayer2Score=0

do
    Page1 = new Game
    Page1.Start()
again Page1.lnewgame

mypic.delete()
mypic2.delete()
Player1EatPic.delete()
Player2EatPic.delete()

for t in aMyCards
    t.delete()
next

func gui_setbttnpixmap pBtn,pPixmap
    pBtn {
        setIcon(new QIcon(pPixmap.scaled(width(),height(),0,0)))
        setIconSize(new QSize(width(),height()))
    }

Class Game

    nCardsCount = 10
    win1 layout1 label1 label2 layout2 layout3 aBtns aBtns2
    aCards nRole=1 aStatus = list(nCardsCount) aStatus2 = aStatus
    aValues      aStatusValues = aStatus  aStatusValues2 = aStatus
    Player1EatPic  Player2EatPic
    lnewgame = false
    nDelayEat = 0.5
    nDelayNewGame = 1

    func start

        win1 = new QWidget() {
            setWindowTitle("Five")
            setStyleSheet("background-color: White")
            showFullScreen()
        }

        layout1 = new QVBoxLayout()

        label1 = new QLabel(win1) {
            setText("Player (1) - Score : " + nPlayer1Score)
            setAlignment(Qt.AlignHCenter | Qt.AlignVCenter)
            setStyleSheet("color: White; background-color: Purple;
                          font-size:20pt")
        }

```

(continues on next page)

(continued from previous page)

```

        setfixedheight(200)
    }

closebtn = new QPushButton(win1) {
    settext("Close Application")
    setstylesheet("font-size: 18px ; color : white ;
                  background-color: black ;")
    setclickevent("Page1.win1.close()")
}

aCards = aMyCards
aValues = aMyValues

layout2 = new QHBoxLayout()

aBtns = []

for x = 1 to nCardsCount
    aBtns + new QPushButton(win1)
    aBtns[x].setfixedwidth(79*nScale)
    aBtns[x].setfixedheight(124*nScale)
    gui_setbtnpixmap(aBtns[x],mypic2)
    layout2.addWidget(aBtns[x])
    aBtns[x].setclickevent("Page1.Player1click("+x+")")
next

layout1.addWidget(label1)
layout1.setLayout(layout2)

label2 = new QLabel(win1) {
    settext("Player (2) - Score : " + nPlayer2Score)
    setalignment(Qt.AlignHCenter | Qt.AlignVCenter)
    setstylesheet("color: white; background-color: red;
                  font-size:20pt")
    setfixedheight(200)
}

layout3 = new QHBoxLayout()

aBtns2 = []
for x = 1 to nCardsCount
    aBtns2 + new QPushButton(win1)
    aBtns2[x].setfixedwidth(79*nScale)
    aBtns2[x].setfixedheight(124*nScale)
    gui_setbtnpixmap(aBtns2[x],mypic2)
    layout3.addWidget(aBtns2[x])
    aBtns2[x].setclickevent("Page1.Player2click("+x+")")
next

layout1.addWidget(label2)
layout1.setLayout(layout3)
layout1.addWidget(closebtn)

```

(continues on next page)

(continued from previous page)

```

        win1.setLayout(layout1)

        app1.exec()

Func Player1Click x
    if nRole = 1 and aStatus[x] = 0
        nPos = ((random(100)+clock())%(len(aCards)-1)) + 1
        gui_setbtnpixmap(aBtns[x],aCards[nPos])
        del(aCards,nPos)
        nRole = 2
        aStatus[x] = 1
        aStatusValues[x] = aValues[nPos]
        del(aValues,nPos)
        Player1Eat(x,aStatusValues[x])
        checknewgame()
    ok

Func Player2Click x
    if nRole = 2 and aStatus2[x] = 0
        nPos = ((random(100)+clock())%(len(aCards)-1)) + 1
        gui_setbtnpixmap(aBtns2[x],aCards[nPos])
        del(aCards,nPos)
        nRole = 1
        aStatus2[x] = 1
        aStatusValues2[x] = aValues[nPos]
        del(aValues,nPos)
        Player2Eat(x,aStatusValues2[x])
        checknewgame()
    ok

Func Player1Eat nPos,nValue

    app1.processEvents()

    delay(nDelayEat)
    lEat = false
    for x = 1 to nCardsCount
        if aStatus2[x] = 1 and (aStatusValues2[x] = nValue or nValue=5)
            aStatus2[x] = 2
            gui_setbtnpixmap(aBtns2[x],Player1EatPic)
            lEat = True
            nPlayer1Score++
        ok
        if (x != nPos) and (aStatus[x] = 1) and
            (aStatusValues[x] = nValue or nValue=5)
            aStatus[x] = 2
            gui_setbtnpixmap(aBtns[x],Player1EatPic)
            lEat = True
            nPlayer1Score++
    ok
    next

```

(continues on next page)

(continued from previous page)

```

if lEat
    nPlayer1Score++
    gui_setbtnpixmap(aBtns[nPos], Player1EatPic)
    aStatus[nPos] = 2
    label1.settext("Player (1) - Score : " + nPlayer1Score)
ok

Func Player2Eat nPos,nValue

    app1.processEvents()

    delay(nDelayEat)
    lEat = false
    for x = 1 to nCardsCount
        if aStatus[x] = 1 and (aStatusValues[x] = nValue or nValue = 5)
            aStatus[x] = 2
            gui_setbtnpixmap(aBtns[x], Player2EatPic)
            lEat = True
            nPlayer2Score++
    ok

        if (x != nPos) and (aStatus2[x] = 1) and
            (aStatusValues2[x] = nValue or nValue=5 )
            aStatus2[x] = 2
            gui_setbtnpixmap(aBtns2[x], Player2EatPic)
            lEat = True
            nPlayer2Score++
    ok
next
if lEat
    nPlayer2Score++
    gui_setbtnpixmap(aBtns2[nPos], Player2EatPic)
    aStatus2[nPos] = 2
    label2.settext("Player (2) - Score : " + nPlayer2Score)
ok

Func checknewgame
    if isnewgame()
        lnewgame = true

        if nPlayer1Score > nPlayer2Score
            label1.settext("Player (1) Wins!!!")
        ok
        if nPlayer2Score > nPlayer1Score
            label2.settext("Player (2) Wins!!!")
        ok

        app1.processEvents()
        delay(nDelayNewGame)

        win1.delete()
        app1.quit()

```

(continues on next page)

(continued from previous page)

```

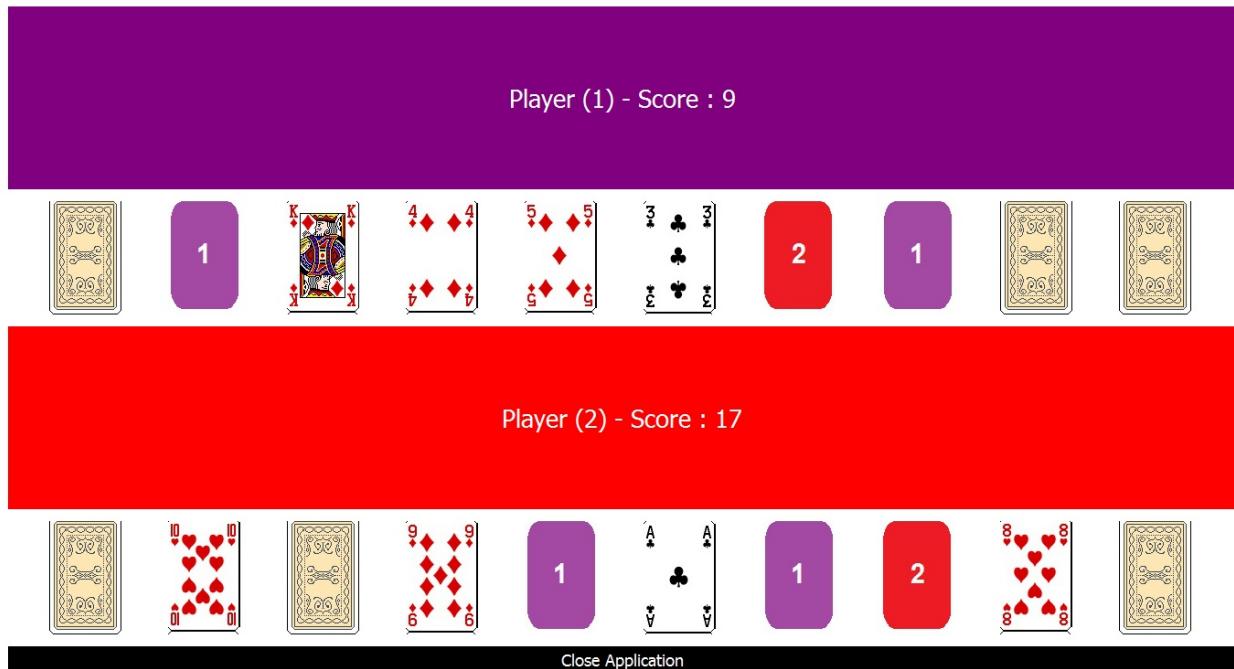
ok

Func isnewgame
    for t in aStatus
        if t = 0
            return false
        ok
    next
    for t in aStatus2
        if t = 0
            return false
        ok
    next
    return true

Func delay x
nTime = x * 1000
oTest = new QTest
oTest.qsleep(nTime)

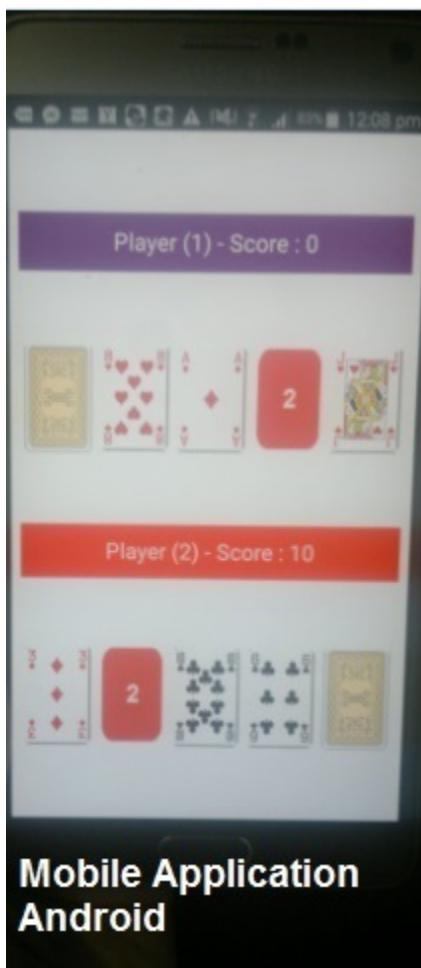
```

The application during the runtime



Note: in the previous screen shot the player get the card number '5' but his score is not increased because he opened this card while no other cards are visible!

The next screen shot while running the game using a Mobile (Android)



Note: using Qt we can run the same application on other Mobile systems

45.58 Classes and their Methods to use the default events

The next table present the class name and the methods that we have to use the default events.

Class Name	Methods to use the default Events
QPushButton	SetClickEvent()
QAction	SetClickEvent()
QLineEdit	SetTextChangeEvent() SetCursorPositionChangedEvent() SetEditingFinishedEvent()
	SetReturnPressedEvent() SetSelectionChangedEvent()
	SetTextEditedEvent()
QTextEdit	SetCopyAvailableEvent() SetCurrentCharFormatChangedEvent()

continues on next page

Table 1 – continued from previous page

Class Name	Methods to use the default Events
	SetCursorPositionChangedEvent()
	SetRedoAvailableEvent()
	SetSelectionChangedEvent()
	SetTextChangedEvent()
	SetUndoAvailableEvent()
QListWidget	SetCurrentItemChangedEvent()
	SetCurrentRowChangedEvent()
	SetCurrentTextChangedEvent()
	SetItemActivatedEvent()
	SetItemChangedEvent()
	SetItemClickedEvent()
	SetItemDoubleClickedEvent()
	SetItemEnteredEvent()
	SetItemPressedEvent()
	SetItemSelectedChangedEvent()
QTreeView	SetCollapseEvent()
	SetExpandedEvent()
	SetActivatedEvent()
	SetClickedEvent()
	SetDoubleClickedEvent()
	SetEnteredEvent()
	SetPressedEvent()
	SetViewportEnteredEvent()
QTreeWidget	SetCollapsedEvent()
	SetExpandedEvent()
	SetActivatedEvent()
	SetClickedEvent()
	SetDoubleClickedEvent()
	SetEnteredEvent()
	SetPressedEvent()
	SetViewportEnteredEvent()
	SetCurrentItemChangedEvent()
	SetItemActivatedEvent()
	SetItemChangedEvent()
	SetItemClickedEvent()
	SetItemCollapsedEvent()
	SetItemDoubleClickedEvent()
	SetItemEnteredEvent()
	SetItemExpandedEvent()
	SetItemPressedEvent()
	SetItemSelectedChangedEvent()
QComboBox	SetActivatedEvent()
	SetCurrentIndexChangedEvent()
	SetEditTextChangedEvent()
	SetHighlightedEvent()
QTabWidget	SetCurrentChangedEvent()
	SetTabCloseRequestedEvent()
QTableWidget	SetCellActivatedEvent()
	SetCellChangedEvent()
	SetCellClickedEvent()

continues on next page

Table 1 – continued from previous page

Class Name	Methods to use the default Events
	SetCellDoubleClickedEvent()
	SetCellEnteredEvent()
	SetCellPressedEvent()
	SetCurrentCellChangedEvent()
	SetCurrentItemChangedEvent()
	SetItemActivatedEvent()
	SetItemChangedEvent()
	SetItemClickedEvent()
	SetItemDoubleClickedEvent()
	SetItemEnteredEvent()
	SetItemPressedEvent()
	SetItemSelectionChangedEvent()
QProgressBar	SetValueChangedEvent()
QSpinBox	SetValueChangedEvent()
QSlider	SetActionTriggeredEvent()
	SetRangeChangedEvent()
	SetSliderMovedEvent()
	SetSliderPressedEvent()
	SetSliderReleasedEvent()
	SetValueChangedEvent()
QDial	SetActionTriggeredEvent()
	SetRangeChangedEvent()
	SetSliderMovedEvent()
	SetSliderPressedEvent()
	SetSliderReleasedEvent()
	SetValueChangedEvent()
QWebView	SetLoadFinishedEvent()
	SetLoadProgressEvent()
	SetLoadStartedEvent()
	SetSelectionChangedEvent()
	SetTitleChangedEvent()
	SetUrlChangedEvent()
QCheckBox	SetStateChangedEvent()
	SetClickedEvent()
	SetPressedEvent()
	SetReleasedEvent()
	SetToggledEvent()
QRadioButton	SetClickedEvent()
	SetPressedEvent()
	SetReleasedEvent()
	SetToggledEvent()
QButtonGroup	SetButtonClickedEvent()
	SetButtonPressedEvent()
	SetButtonReleasedEvent()
QVideoWidget	SetBrightnessChangedEvent()
	SetContrastChangedEvent()
	SetFullScreenChangedEvent()
	SetHueChangedEvent()
	SetSaturationChangedEvent()
QTimer	SetTimeoutEvent()

continues on next page

Table 1 – continued from previous page

Class Name	Methods to use the default Events
QTcpServer	SetAcceptErrorEvent() SetNewConnectionEvent()
QIODevice	SetAboutToCloseEvent() SetBytesWrittenEvent() SetReadChannelFinishedEvent() SetReadyReadEvent()
QAbstractSocket	SetConnectedEvent() SetDisconnectedEvent() SetErrorEvent() SetHostFoundEvent() SetProxyAuthenticationRequiredEvent() SetStateChangedEvent()
QTcpSocket	SetConnectedEvent() SetDisconnectedEvent() SetErrorEvent() SetHostFoundEvent() SetProxyAuthenticationRequiredEvent() SetStateChangedEvent() SetAboutToCloseEvent() SetBytesWrittenEvent() SetReadChannelFinishedEvent() SetReadyReadEvent()
QColorDialog	SetColorSelectedEvent() SetCurrentColorChangedEvent()
QNetworkAccessManager	SetFinishedEvent()
QThread	SetStartedEvent() SetFinishedEvent()

45.59 Methods to use Events with Events Filter

RingQt define a new class called QAllEvents that help you in using Events Filter

The next table presents the methods that we have

Methods to get parameters	Class Name
getKeyCode() -> Number	QAllEvents
getx() -> Number	
gety() -> Number	
getglobalx() -> Number	
getglobaly() -> Number	
getbutton() -> Number	
getbuttons() -> Number	

The next table presents the methods that we have to use events.

Method Name	Class Name
setKeyPressEvent(cEvent)	QAllEvents
setMouseButtonPressEvent(cEvent)	
setMouseButtonReleaseEvent(cEvent)	
setMouseButtonDblClickEvent(cEvent)	
setMouseMoveEvent(cEvent)	
setCloseEvent(cEvent)	
setContextMenuEvent(cEvent)	
setDragEnterEvent(cEvent)	
setDragLeaveEvent(cEvent)	
setDragMoveEvent(cEvent)	
setDropEvent(cEvent)	
setEnterEvent(cEvent)	
setFocusInEvent(cEvent)	
setFocusOutEvent(cEvent)	
setKeyReleaseEvent(cEvent)	
setLeaveEvent(cEvent)	
setNonClientAreaMouseButtonDblClickEvent(cEvent)	
setNonClientAreaMouseButtonPressEvent(cEvent)	
setNonClientAreaMouseButtonReleaseEvent(cEvent)	
setNonClientAreaMouseMoveEvent(cEvent)	
setMoveEvent(cEvent)	
setResizeEvent(cEvent)	
setWindowActivateEvent(cEvent)	
setWindowBlockedEvent(cEvent)	
setWindowDeactivateEvent(cEvent)	
setWindowStateChangeEvent(cEvent)	
setWindowUnblockedEvent(cEvent)	

45.60 The Difference between Qt and RingQt

- (1) RingQt use simple methods to set the code that will be executed for events.

Syntax:

```
Set<Event_Name>Event(cEventCode)
```

- (2) RingQt change the name of some methods to avoid conflict with Ring Keywords.

The next table present these little changes

Class Name	Qt Method Name	RingQt Method Name
QWebView	load	loadpage
QMediaPlaylist	load	loadfile
QMediaPlaylist	next	movenext
QPainter	end	endpaint
QPicture	load	loadfile
QLineEdit	end	endtext
QDialog	done	donedialog
QTextDocument	end	enddoc
QTextBlock	next	nextblock
QSqlQuery	next	movenext
QImage	load	loadimage
QNetworkAccessManager	get	getvalue
QNetworkAccessManager	put	putvalue
QThread	exit	exitfromthread
QRegularExpressionMatchIterator	next	nextitem
QCamera	load	loadcamera

45.61 RingQt Classes and their Qt Documentation

Qt Documentation : <http://doc.qt.io/qt-5/classes.html>

See the “RingQt Classes and Methods Reference” chapter for supported classes and methods.

45.62 New Classes names - Index Start from 1

We added new classes to RingQt - another version of classes where the class names doesn't start with the “q” letter
Also updated methods so the index start from 1 when we deal with the GUI controls like

- ComboBox
- ListView
- TableWidget
- TreeWidget

These classes are inside guilib.ring under the package name : System.GUI

To use it

```
load "guilib.ring"

import System.GUI
```

This doesn't have any effect on our previous code, It's just another choice for better code that is consistent with Ring rules.

Also the form designer is updated to provide us the choice between using classes where (index start from 0) or (index start from 1)

Example (Uses the Form Designer)

- (1) <https://github.com/ring-lang/ring/blob/master/samples/UsingFormDesigner/indexstart/indexstartView.ring>
- (2) <https://github.com/ring-lang/ring/blob/master/samples/UsingFormDesigner/indexstart/indexstartController.ring>

45.63 TableWidget - AddList() Method

Using this method we can add Ring List to the TableWidget

Tip: TableWidget class is a subclass of QTableWidget class

Note: To use TableWidget class, import system.gui after loading guilib.ring or lightguilib.ring

Example:

Source code: <https://github.com/ring-lang/ring/tree/master/samples/UsingQt/TableWidget/AddRingList>

```
class addRingListController from windowsControllerParent

    oView = new addRingListView

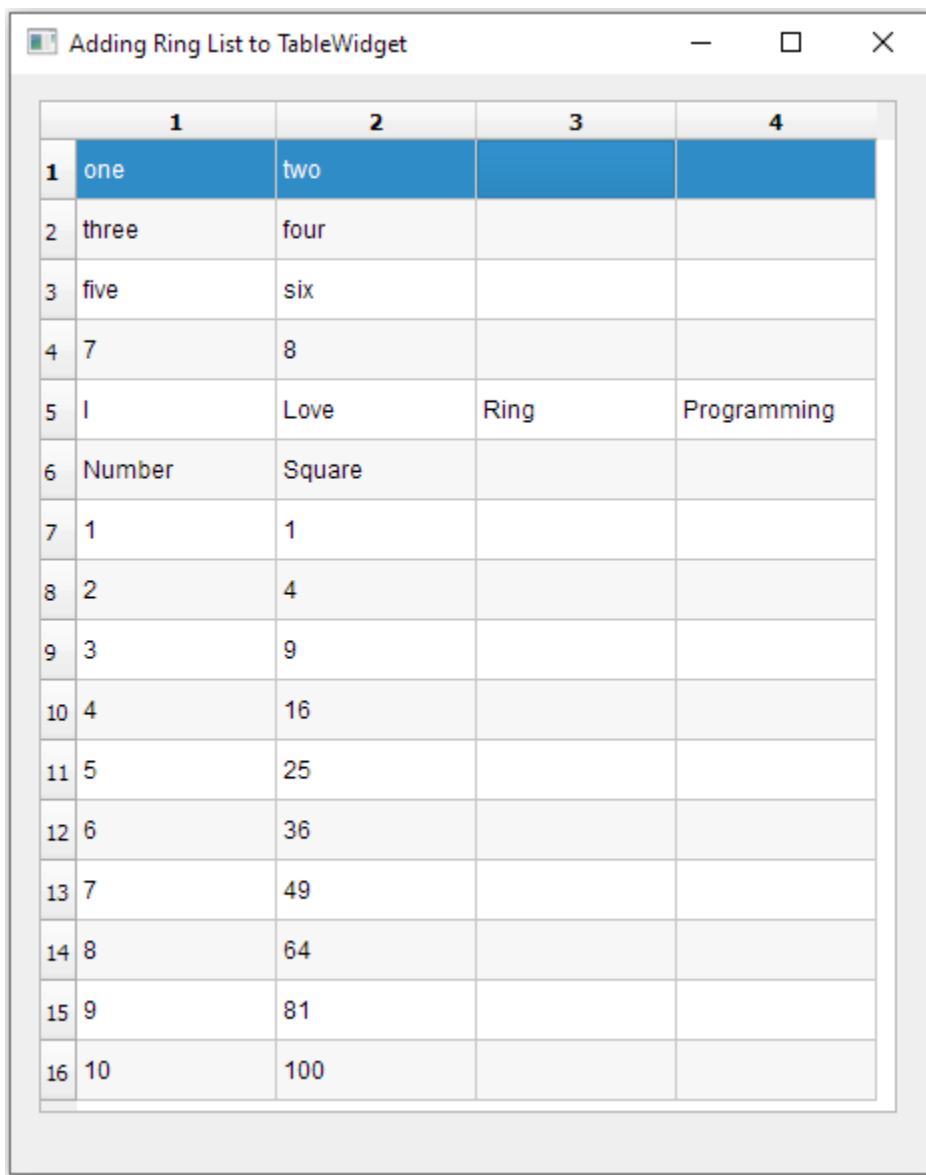
    aList = [[ "one", "two" ],
              [ "three", "four" ],
              [ "five", "six" ],
              [ 7, 8 ],
              [ "I", "Love", "Ring", "Programming" ]]

    oView.tablewidget1.addList(aList)

    aList = [[ "Number", "Square" ]]
    for t = 1 to 10
        aList + [ t, t*t ]
    next

    oView.tablewidget1.addList(aList)
```

Screen Shot:



45.64 Creating Reports using the WebLib and the GUIlib

The WebLib comes with a class called `HtmlPage`

Using this class we can create reports quickly using WebLib & GUILib together

Example:

```
load "stdlib.ring"  
load "weplib.ring"  
load "guilib.ring"  
  
import System.Web  
import System.GUI
```

(continues on next page)

(continued from previous page)

```

new qApp {
    open_window(:CustomersReportController)
    exec()
}

class CustomersReportController from WindowsControllerParent

    oView = new CustomersReportView

    func Start
        CreateReport()

    func CreateReport
        mypage = new HtmlPage {
            h1 { text("Customers Report") }
            Table
            {
                style = stylewidth("100%") + stylegradient(4)
                TR
                {
                    TD { WIDTH="10%" }
                    text("Customers Count : " )
                    TD { text (100) }
                }
            }
            Table
            {
                style = stylewidth("100%") + stylegradient(26)
                TR
                {
                    style = stylewidth("100%") +
                        stylegradient(24)
                    TD { text("Name" ) }
                    TD { text("Age" ) }
                    TD { text("Country" ) }
                    TD { text("Job" ) }
                    TD { text("Company" ) }
                }
                for x = 1 to 100
                    TR
                    {
                        TD { text("Test" ) }
                        TD { text("30" ) }
                        TD { text("Egypt" ) }
                        TD { text("Sales" ) }
                        TD { text("Future" ) }
                    }
                next
            }
        }
        write("report.html",mypage.output())
    }
}

```

(continues on next page)

(continued from previous page)

```

func PrintEvent
    printer1 = new qPrinter(0) {
        setoutputformat(1)
        setoutputfilename("report.pdf")
    }
    oView {
        web.print(printer1, Method( :OpenPDF ) )
        web.show()
    }

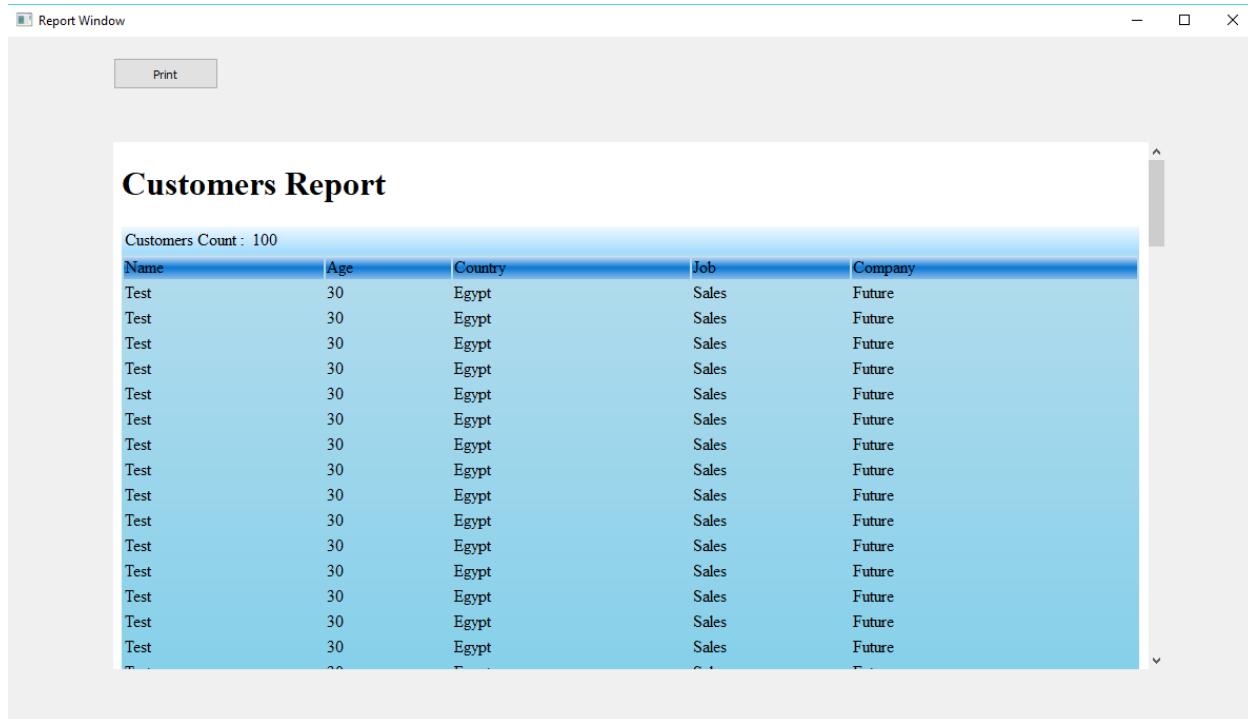
func OpenPDF
    new QDesktopServices {
        OpenURL(new qURL("report.pdf") )
    }

class CustomersReportView

    win = new window() {
        setwindowtitle("Report Window")
        setgeometry(100,100,500,500)
        web = new webview(win) {
            setgeometry(100,100,1000,500)
            loadpage(new qurl("file:///"+
                currentdir() + "/report.html"))
        }
        new pushbutton(win) {
            setGeometry(100,20,100,30)
            setText("Print")
            setclickevent(Method(:PrintEvent))
        }
        showMaximized()
    }
}

```

Screen Shot:



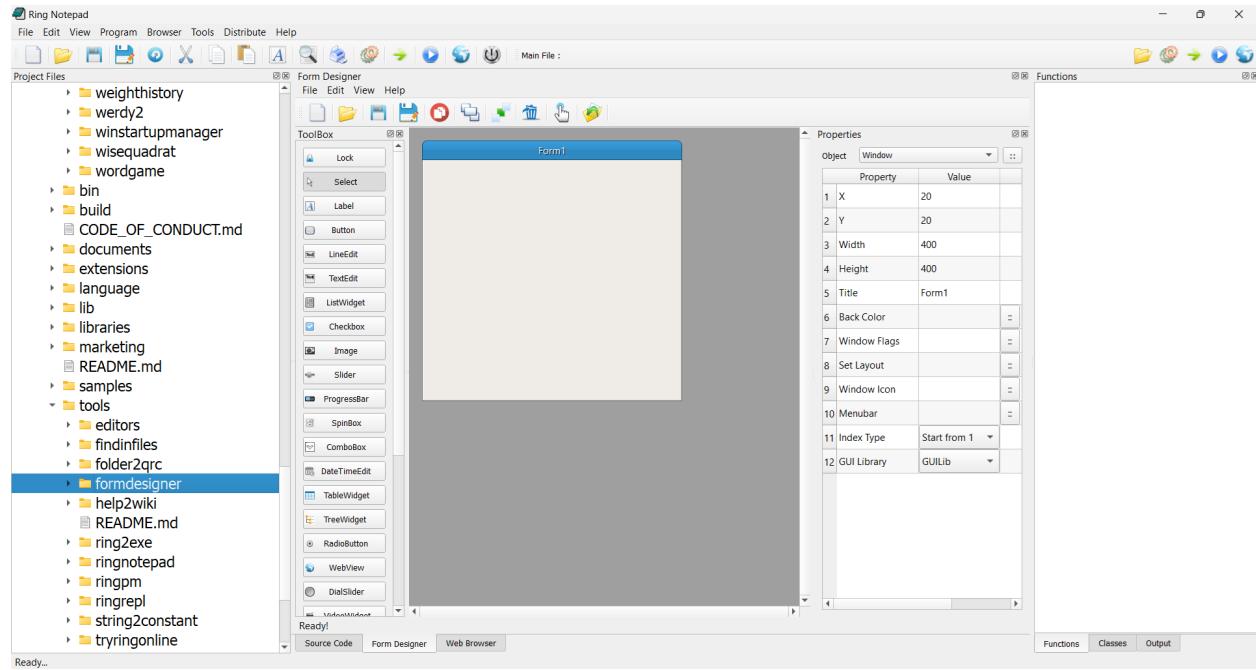
CHAPTER FORTYSIX

USING THE FORM DESIGNER

In this chapter we will learn about using the Form Designer.

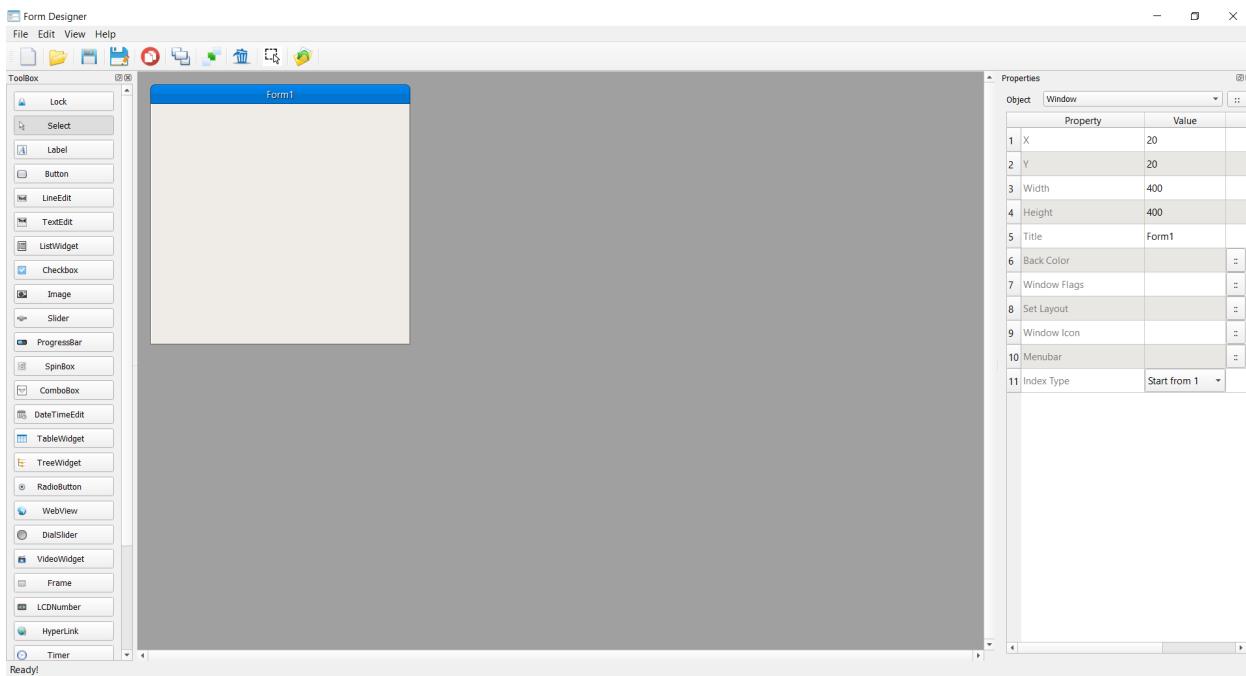
We can run the From Designer from Ring Notepad

From the Menubar in Ring Notepad - View Menu - We can Show/Hide the Form Designer window.



Also we can run the Form Designer in another window.

From the Ring Notepad - Tools Menu - Select the Form Designer.



46.1 The Designer Windows

- **Toolbox** : To select controls to be added to the window.
- **Properties** : To set the properties of the active window or controls.
- **Design Region** : To select, move and resize the window and the controls.

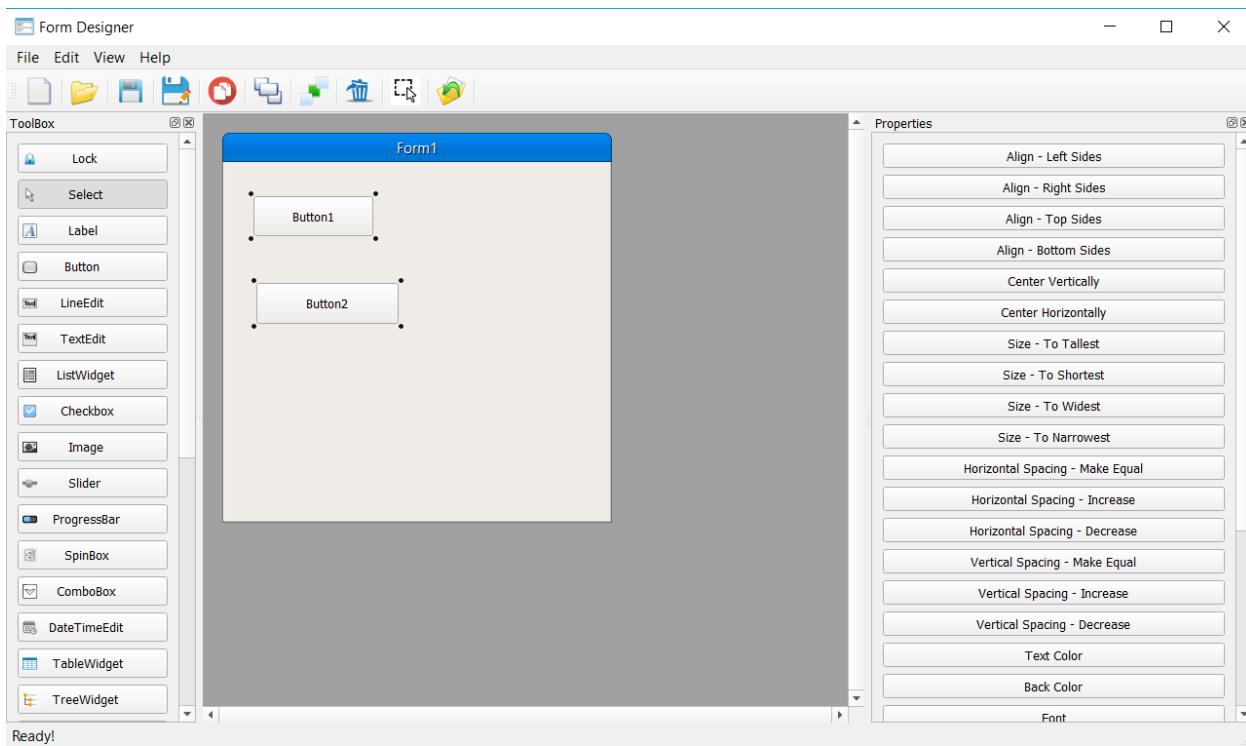
46.2 The Toolbox

We have many buttons.

- **Lock** : We can use it to draw many controls of the same type quickly.
- **Select** : We can use it to select a control in the Design Region
- **Controls Buttons** : Select a control to be added to the window.

46.3 The Properties

- When we select the window or one control, We will have the selected object properties.
- Also In the properties window we have a combobox to select the active control.
- Some properties provide a button next to the property value. We can click on the button to get more options.
- When we select more than one control, We will have options for multi-selection



46.4 Running Forms

When we save the form file (*.rform), The Form Designer will create two Ring files

- The Controller Class
- The View Class

For example, if the form file is helloworld.rform

The form designer will generate two files

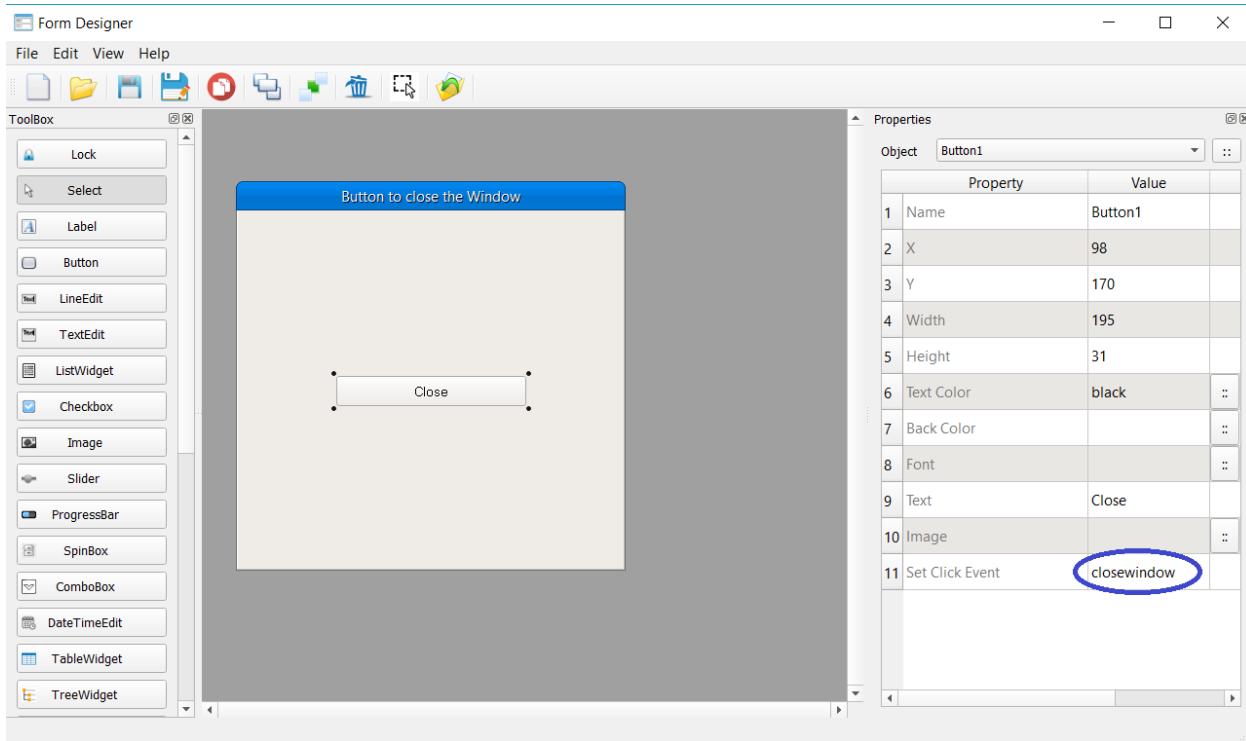
- helloworldcontroller.ring
- helloworldview.ring

To run the program, Open the controller class file then click the Run button (CTRL+F5)

Tip: When you open a form using Ring Notepad, the controller class will be opened automatically, So we can press (CTRL+F5) or click on the Run button while the form designer window is active.

46.5 Events Code

- (1) Just type the method name in the event property.



This will add the next code to the Controller Class

```
func CloseWindow
    oView { }
```

- (2) Then write the method code in the controller class.

Source Code : B:/ring/applications/formdesigner/tests/buttontoclosethewindow/buttontoclosethewindowController.ring

```

buttontoclosethewindowController.ring X
1 # Form/Window Controller - Source Code File
2
3 load "buttontoclosethewindowView.ring"
4
5 if IsMainSourceFile() {
6     new qApp {
7         StyleFusion()
8         open_window(:buttontoclosethewindowController)
9         exec()
10    }
11 }
12
13 class buttontoclosethewindowController from windowsControllerParent
14
15     oView = new buttontoclosethewindowView
16
17 func CloseWindow
18     oView.win.close()
19

```

Source Code : B:/ring/applications/formdesigner/tests/buttontoclosethewindow/buttontoclosethewindowController.ring Form Designer Web Browser

In this example we write

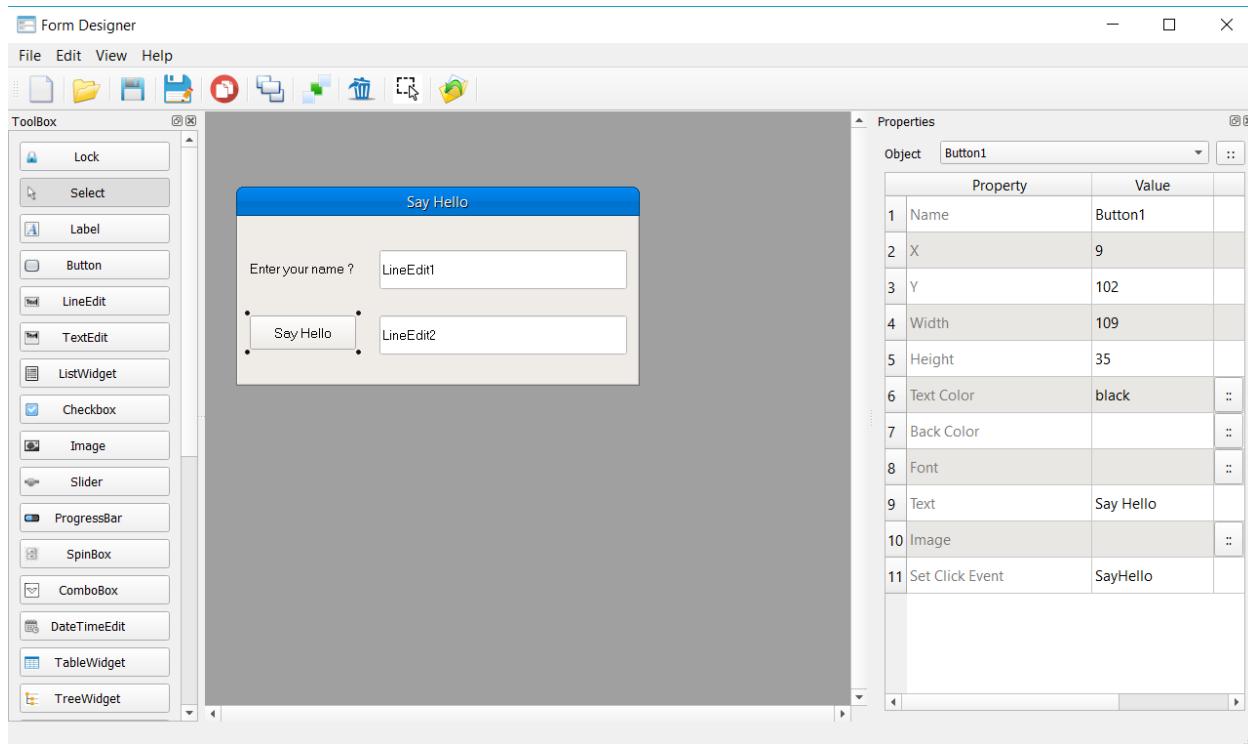
```

func CloseWindow
    oView.win.close()

```

Where inside the controller class, We uses the oView object to access the form.

Another Example :



The Event Code

```
func SayHello
    oView {
        LineEdit2.setText("Hello " + LineEdit1.text() ) }
```

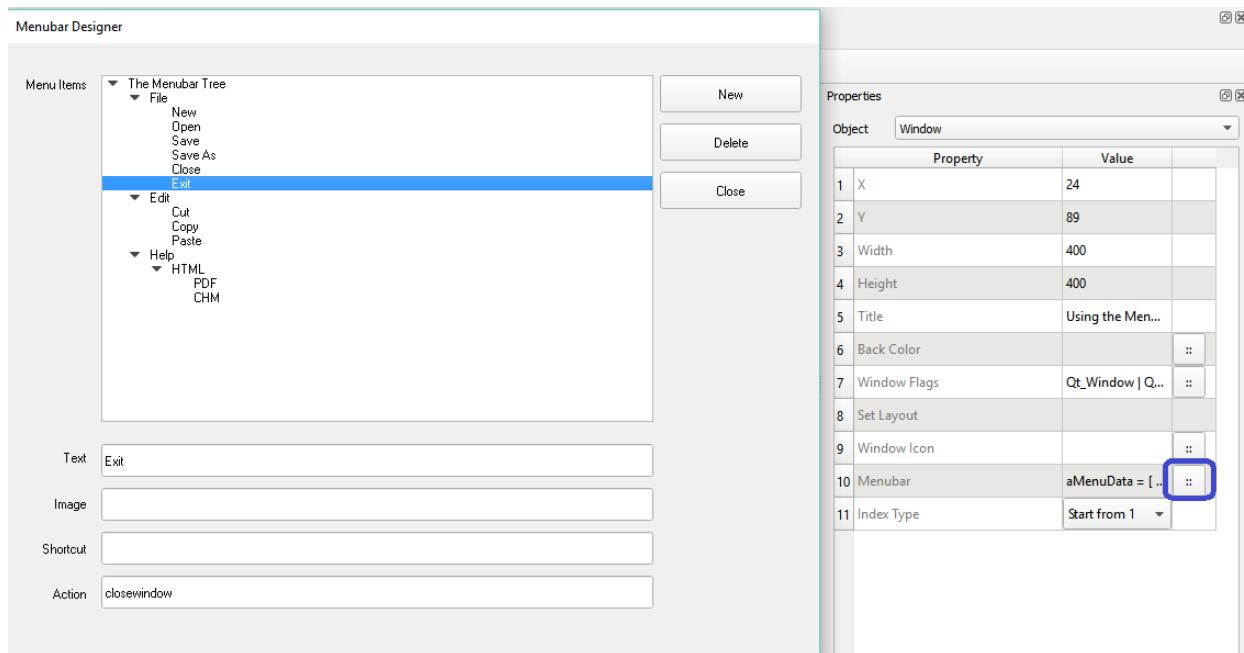
46.6 Keyboard Shortcuts

After selecting one or group of controls

- Use the Arrows (Up, Down, Left and Right) to move them around.
- Shift + the Arrows (Up, Down, Left and Right) to Resize the controls.
- Del button to delete the controls.
- CTRL+SHIFT+V to Duplicate the controls.

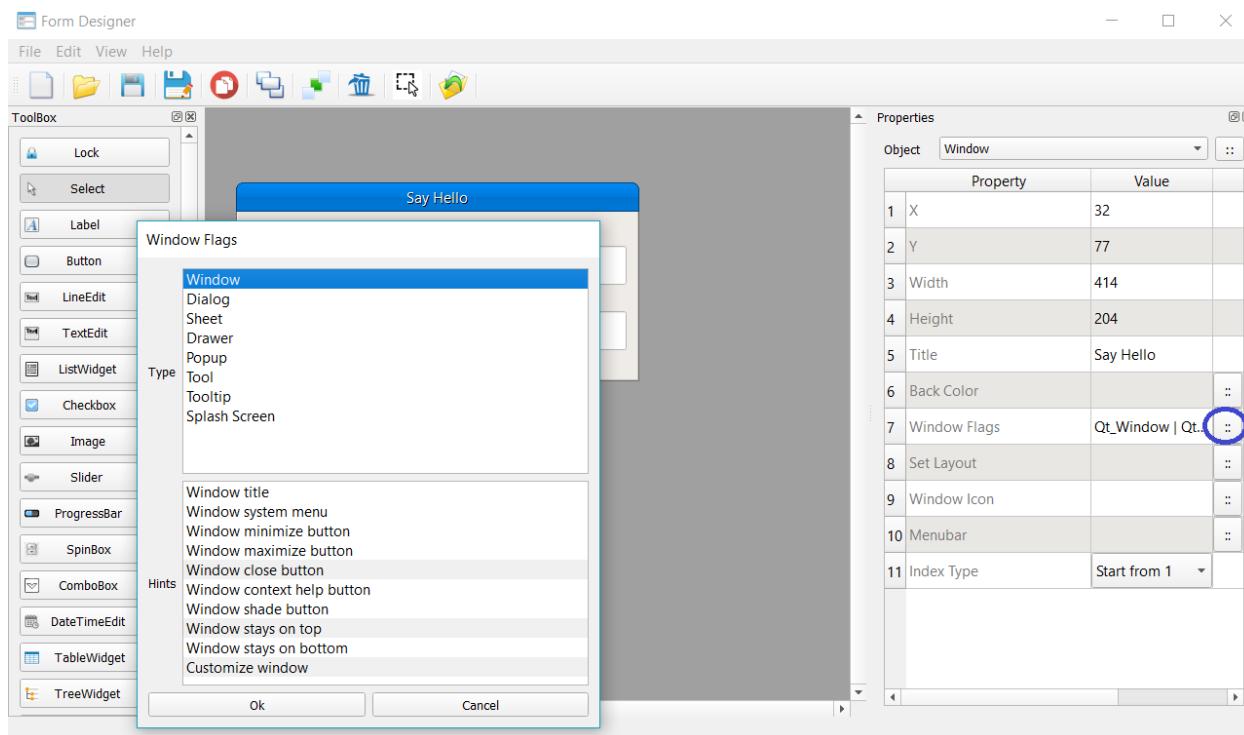
46.7 Menubar Designer

From the Window properties we can open the Menubar Designer



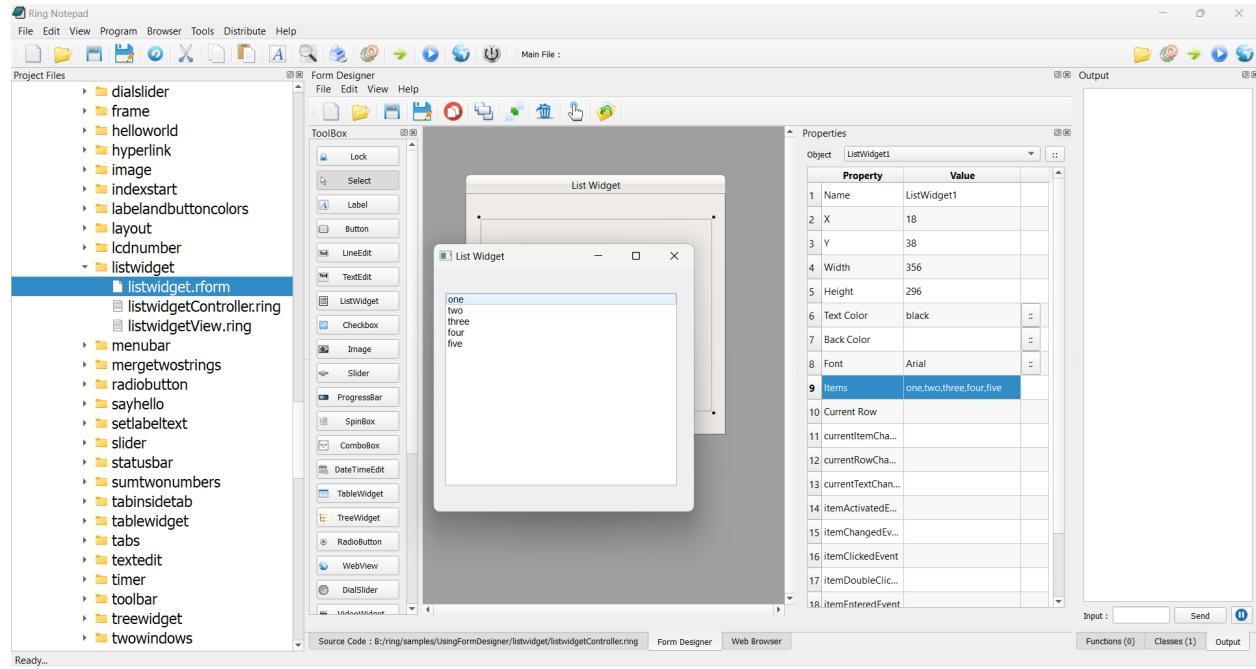
46.8 Window Flags

From the Window properties we can open the Window Flags window.



46.9 Entering Items

For some controls like the List Widget we can enter items separated by comma ‘,’



46.10 Using Layouts

- (1) To use layouts, At first add the layout control to the window.
- (2) Use the window “Set Layout” property to determine the main layout.
- (3) From the layout properties determine the controls and the layout type.

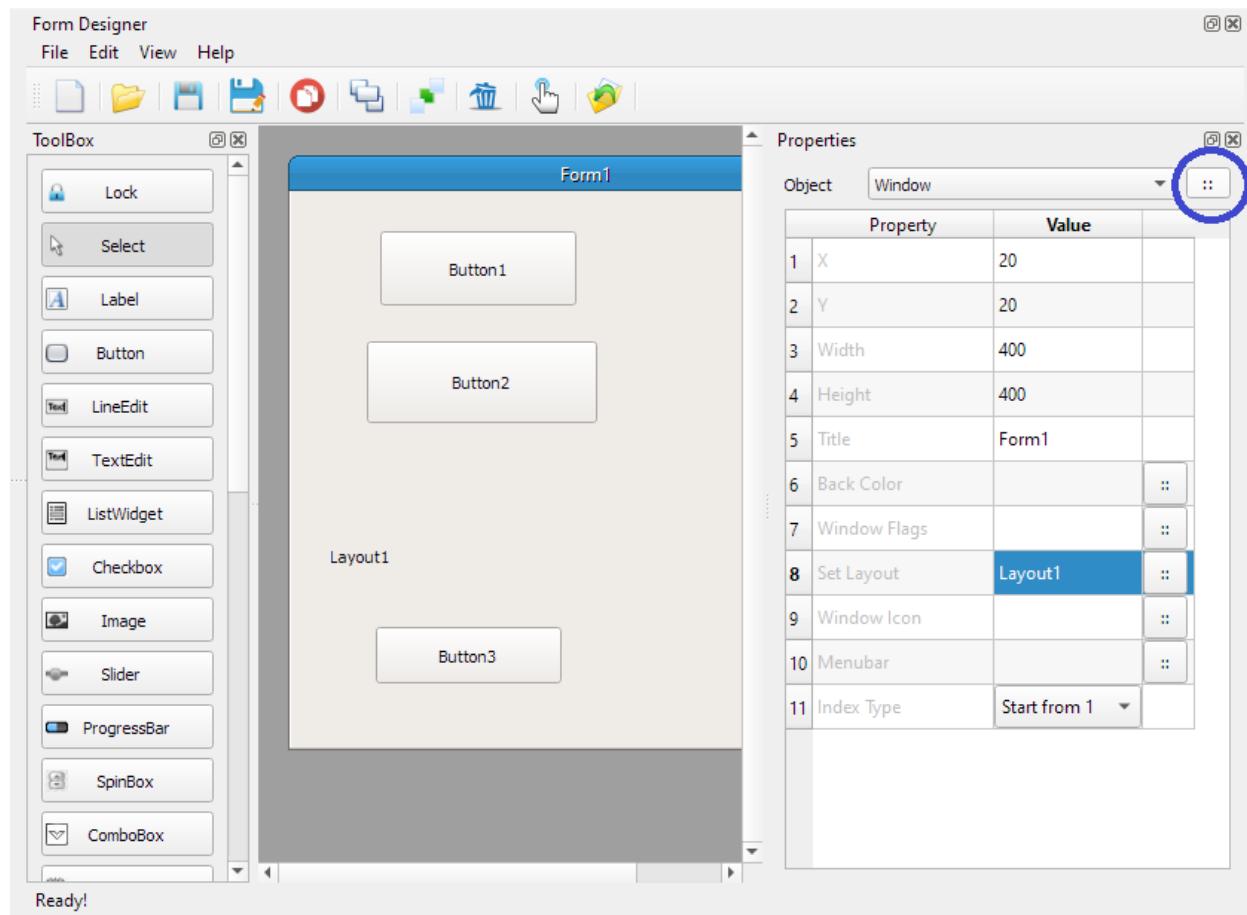
46.11 Objects Order and Layouts

All the objects that are added to a layout must comes first!

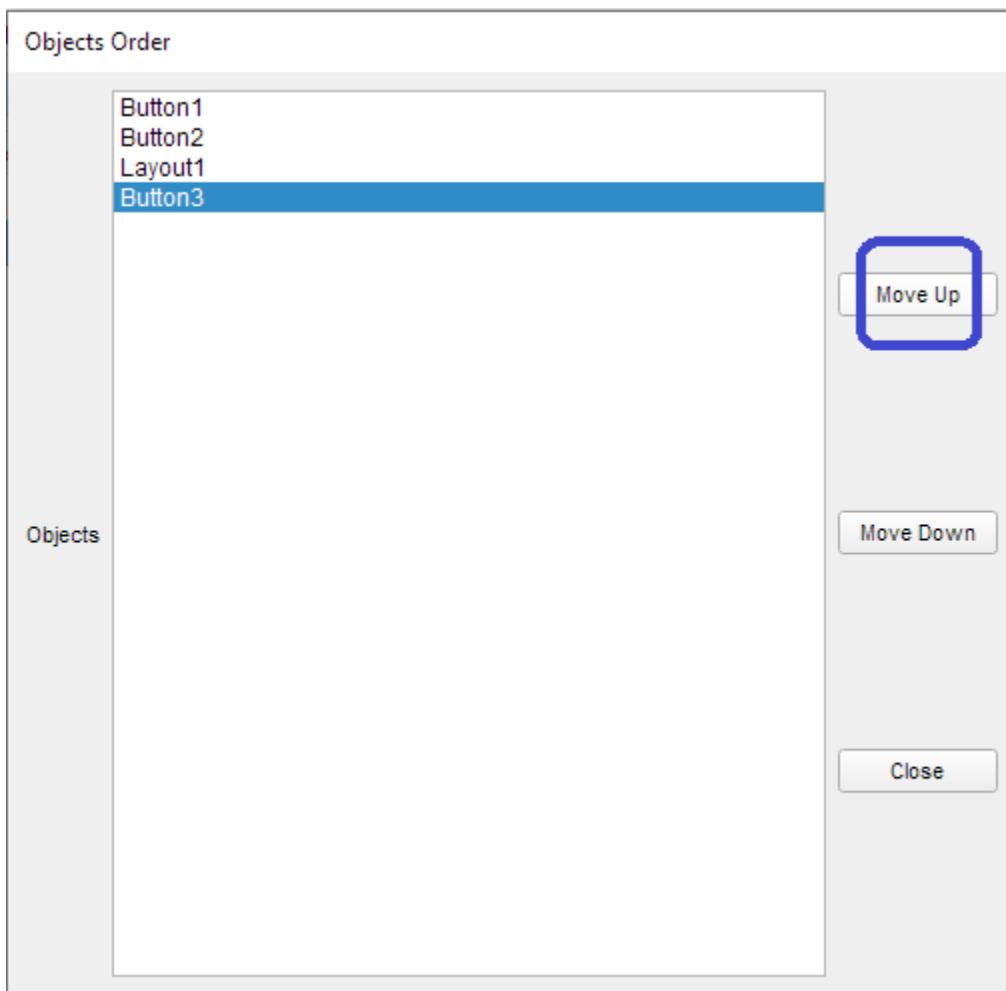
If we have a form that contains two buttons and a Layout

Then adding a third button after creating the layout requires changing the objects order

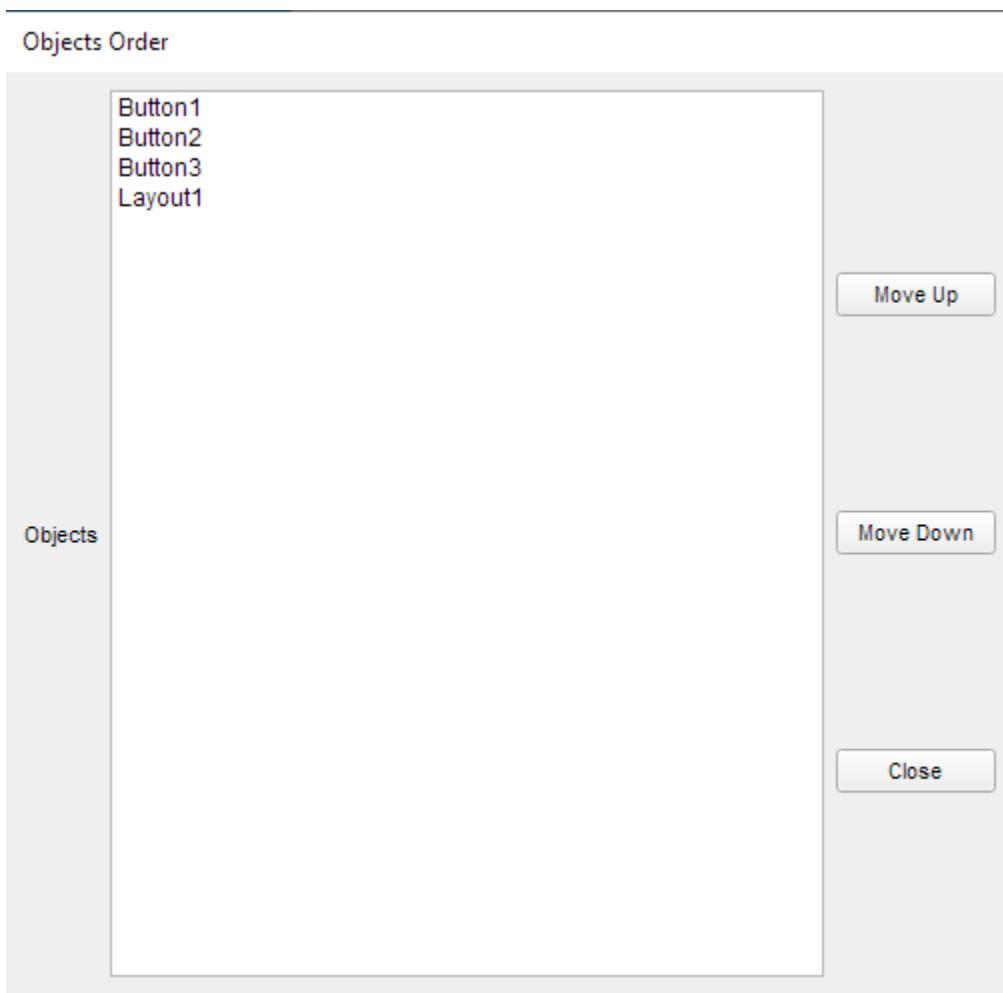
We can open the (Objects Order) window using a button from the (Properties) window



Then we can select the (Button3) and click (Move Up)



Then we close the (Objects Order) window



46.12 More Samples and Tests

Check the folder : ring/samples/UsingFormDesigner

Online : <https://github.com/ring-lang/ring/tree/master/samples/UsingFormDesigner>

GRAPHICS PROGRAMMING USING RINGQT3D

In this chapter we will learn how to use Qt3D through many samples.

47.1 Drawing Cube

```
load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

    oLightEntity = new QEntity(oRootEntity)
        oLight = new QPointLight(oLightEntity)
        oLight.setColor(new QColor() { setRGB(255,255,255,255) })
        oLight.setIntensity(1)
        oLightEntity.addComponent(oLight)

        oLightTransform = new QTransform(oLightEntity)
        oLightTransform.setTranslation(oCameraEntity.position())
        oLightEntity.addComponent(oLightTransform)

    oCamController = new QFirstPersonCameraController(oRootEntity)
        oCamController.setCamera(oCameraEntity)
```

(continues on next page)

(continued from previous page)

```
oCube = new QCuboidMesh(oRootEntity) {
    setXextent(2)
    setYextent(2)
    setZextent(3)
}

oCubeTransform = new QTransform(oCube)
oCubeTransform.setScale(2)
oCubeTransform.setTranslation(new QVector3D(3, 3, 3))

oCubeMaterial = new QPhongMaterial(oCube)
oCubeMaterial.setDiffuse(new QColor() {setRGB(200,100,100,100)})

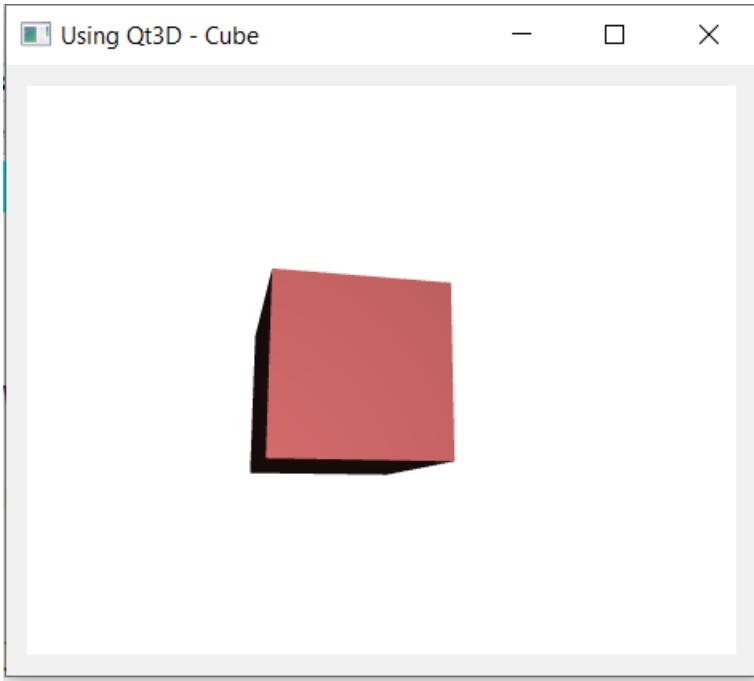
oCubeEntity = new QEntity(oRootEntity)
oCubeEntity.addComponent(oCube)
oCubeEntity.addComponent(oCubeMaterial)
oCubeEntity.addComponent(oCubeTransform)

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Cube")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}
```



47.2 Drawing Torus

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

    oLightEntity = new QEntity(oRootEntity)
        oLight = new QPointLight(oLightEntity)
        oLight.setColor(new QColor() { setRGB(255,255,255,255) })
        oLight.setIntensity(1)
        oLightEntity.addComponent(oLight)
}

```

(continues on next page)

(continued from previous page)

```
oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)

oTorus = new QTorusMesh(oRootEntity)
    oTorus.setRadius(1.0)
    oTorus.setMinorRadius(0.4)
    oTorus.setRings(100)
    oTorus.setSlices(20)

oTorusTransform = new QTransform(oTorus)
oTorusTransform.setScale(2)
oTorusTransform.setTranslation(new QVector3D(3, 3, 3))

oTorusMaterial = new QPhongMaterial(oTorus)
oTorusMaterial.setDiffuse(new QColor() {setRGB(200, 100, 100, 100)})

oTorusEntity = new QEntity(oRootEntity)
oTorusEntity.addComponent(oTorus)
oTorusEntity.addComponent(oTorusMaterial)
oTorusEntity.addComponent(oTorusTransform)

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Torus")
    resize(800, 600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}
```



47.3 Drawing Sphere

```
load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

    oLightEntity = new QEntity(oRootEntity)
```

(continues on next page)

(continued from previous page)

```

        oLight = new QPointLight(oLightEntity)
oLight.setColor(new QColor() { setRGB(255,255,255,255) })
oLight.setIntensity(1)
oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)

oSphere = new QSphereMesh(oRootEntity)
    oSphere.setRadius(1.0)
    oSphere.setRings(100)
    oSphere.setSlices(20)

oSphereTransform = new QTransform(oSphere)
oSphereTransform.setScale(2)
oSphereTransform.setTranslation(new QVector3D(3, 3, 3))

oSphereMaterial = new QPhongMaterial(oSphere)
oSphereMaterial.setDiffuse(new QColor() {setRGB(200,100,100,100)})}

oSphereEntity = new QEntity(oRootEntity)
oSphereEntity.addComponent(oSphere)
oSphereEntity.addComponent(oSphereMaterial)
oSphereEntity.addComponent(oSphereTransform)

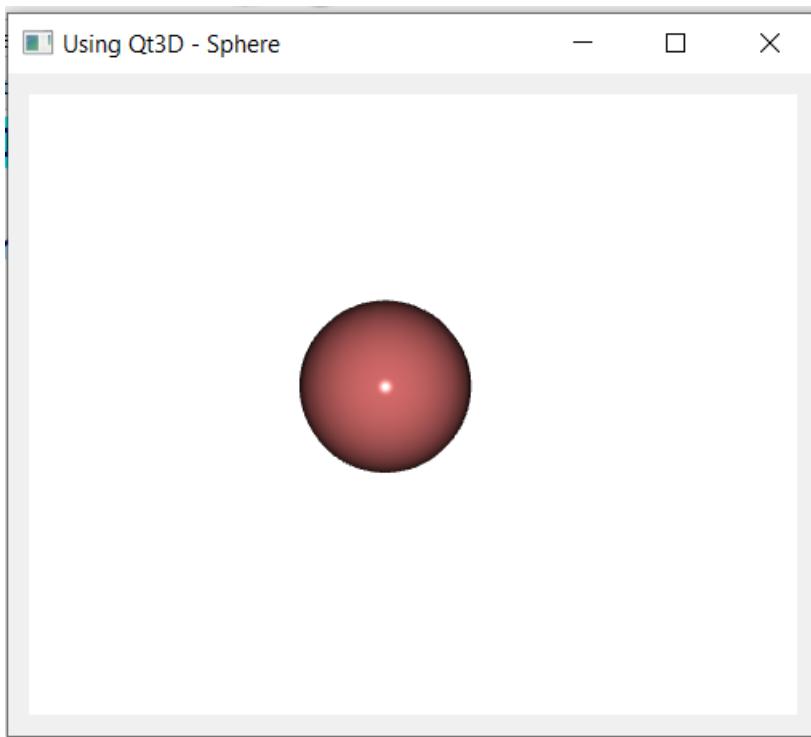
oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Sphere")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}

```



47.4 Drawing Cylinder

```
load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

    oLightEntity = new QEntity(oRootEntity)
        oLight = new QPointLight(oLightEntity)
        oLight.setColor(new QColor() { setRGB(255,255,255,255) })
        oLight.setIntensity(1)
```

(continues on next page)

(continued from previous page)

```
oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
oCamController.setCamera(oCameraEntity)

oCylinder = new QCylinderMesh(oRootEntity)
    oCylinder.setRadius(1)
    oCylinder.setRings(100)
    oCylinder.setSlices(20)
oCylinder.setLength(5)

oCylinderTransform = new QTransform(oCylinder)
oCylinderTransform.setScale(2)
oCylinderTransform.setTranslation(new QVector3D(1, 0, 3))

oCylinderMaterial = new QPhongMaterial(oCylinder)
oCylinderMaterial.setDiffuse(new QColor() {setRGB(200,100,100,100)})

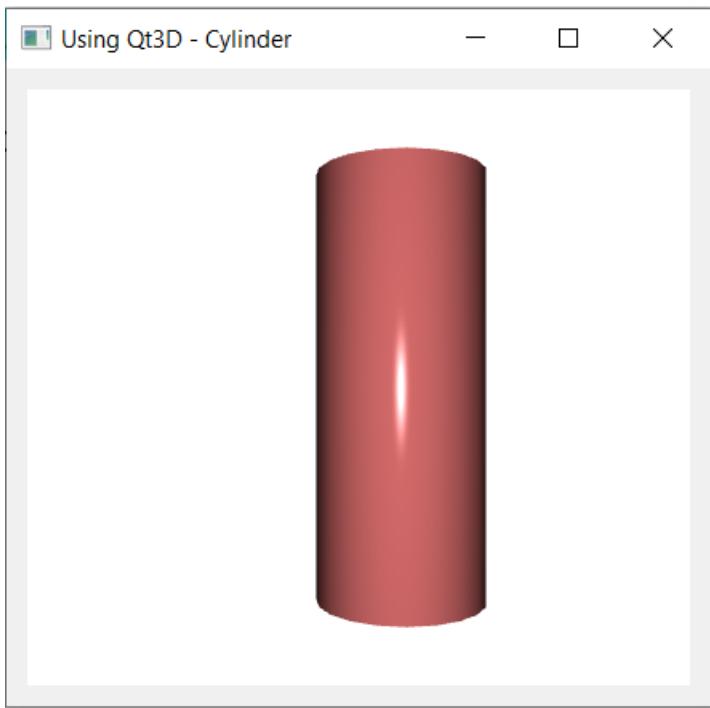
oCylinderEntity = new QEntity(oRootEntity)
oCylinderEntity.addComponent(oCylinder)
oCylinderEntity.addComponent(oCylinderMaterial)
oCylinderEntity.addComponent(oCylinderTransform)

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Cylinder")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}
```



47.5 Drawing Cone

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

    oLightEntity = new QEntity(oRootEntity)
        oLight = new QPointLight(oLightEntity)
        oLight.setColor(new QColor() { setRGB(255,255,255,255) })
        oLight.setIntensity(1)
        oLightEntity.addComponent(oLight)
}

```

(continues on next page)

(continued from previous page)

```
oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
oCamController.setCamera(oCameraEntity)

oCone = new QConeMesh(oRootEntity)
oCone.setRings(100)
oCone.setSlices(20)
oCone.setLength(5)

oConeTransform = new QTransform(oCone)
oConeTransform.setScale(2)
oConeTransform.setTranslation(new QVector3D(1, 0, 3))

oConeMaterial = new QPhongMaterial(oCone)
oConeMaterial.setDiffuse(new QColor() {setRGB(200,100,100,100)})

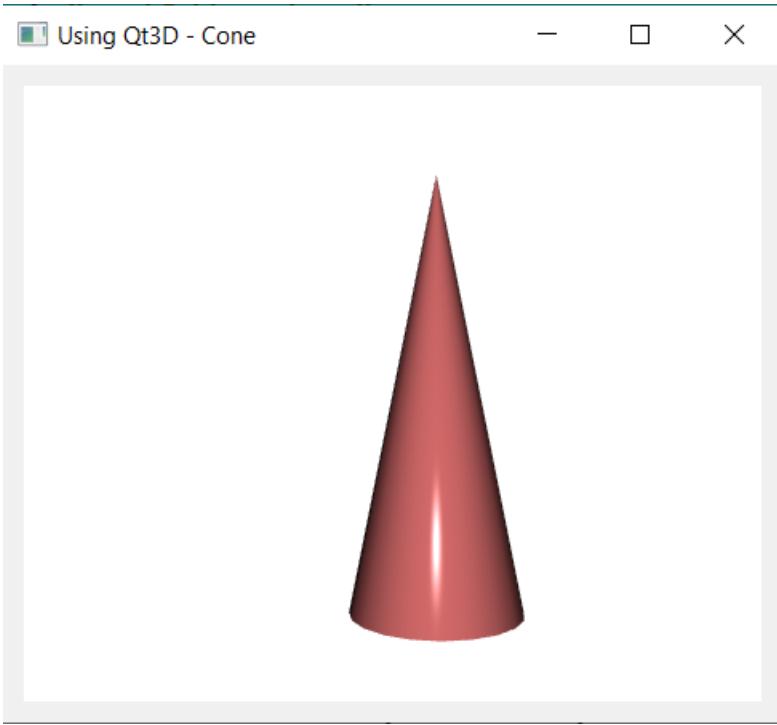
oConeEntity = new QEntity(oRootEntity)
oConeEntity.addComponent(oCone)
oConeEntity.addComponent(oConeMaterial)
oConeEntity.addComponent(oConeTransform)

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Cone")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}
```



47.6 Drawing Plane

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

    oLightEntity = new QEntity(oRootEntity)
        oLight = new QPointLight(oLightEntity)
        oLight.setColor(new QColor() { setRGB(255,255,255,255) })
        oLight.setIntensity(1)
        oLightEntity.addComponent(oLight)
}

```

(continues on next page)

(continued from previous page)

```
oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
oCamController.setCamera(oCameraEntity)

oPlane = new QPlaneMesh(oRootEntity)
oPlane.setHeight(5)
oPlane.setWidth(5)
oPlane.setmeshresolution(new QSize(10,10))

oPlaneTransform = new QTransform(oPlane)
oPlaneTransform.setScale(2)
oPlaneTransform.setTranslation(new QVector3D(0, -4, 4))

oPlaneMaterial = new QPhongMaterial(oPlane)
oPlaneMaterial.setDiffuse(new QColor() {setRGB(200,100,100,100)})

oPlaneEntity = new QEntity(oRootEntity)
oPlaneEntity.addComponent(oPlane)
oPlaneEntity.addComponent(oPlaneMaterial)
oPlaneEntity.addComponent(oPlaneTransform)

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Plane")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}
```



47.7 Texture

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

    oLightEntity = new QEntity(oRootEntity)
        oLight = new QPointLight(oLightEntity)
    oLight.setColor(new QColor() { setRGB(255,255,255,255) })
    oLight.setIntensity(1)
    oLightEntity.addComponent(oLight)

    oLightTransform = new QTransform(oLightEntity)

```

(continues on next page)

(continued from previous page)

```

oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)

oCube = new QCuboidMesh(oRootEntity) {
    setXextent(2)
    setYextent(2)
    setZextent(3)
}

oCubeTransform = new QTransform(oCube)
oCubeTransform.setScale(2)
oCubeTransform.setTranslation(new QVector3D(3, 3, 3))

oTextureLoader = new QTextureLoader(oCube);
oTextureLoader.setSource(
    new QUrl("file:///"+currentdir()+"/assets/texture/gold.jpg") )
oCubeMaterial = new QTextureMaterial(oCube)
oCubeMaterial.setTexture(oTextureLoader)

oCubeEntity = new QEntity(oRootEntity)
oCubeEntity.addComponent(oCube)
oCubeEntity.addComponent(oCubeMaterial)
oCubeEntity.addComponent(oCubeTransform)

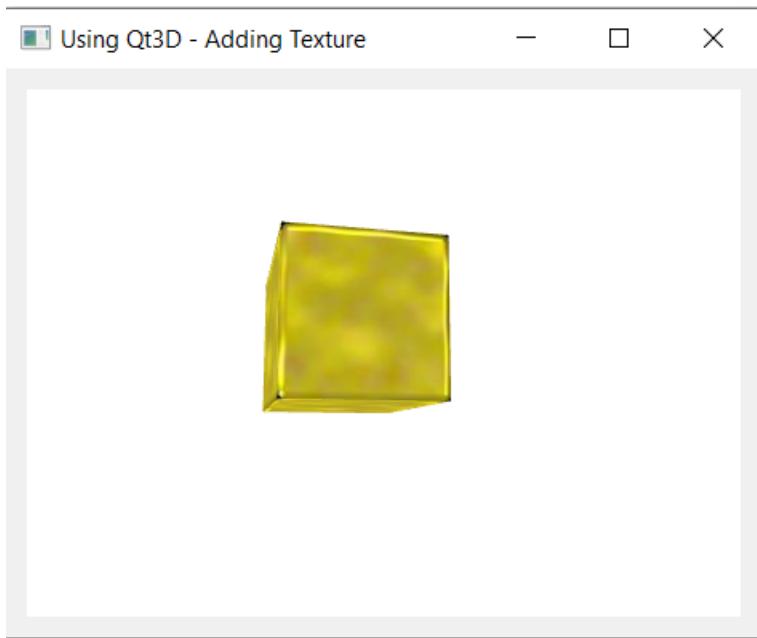
oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Adding Texture")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}

```



47.8 Key Press

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

        oFilter = new qallevents(oView)
        oFilter.setKeyPressEvent("pKeyPress()")
        oView.installEventfilter(oFilter)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

    oLightEntity = new QEntity(oRootEntity)
        oLight = new QPointLight(oLightEntity)
    oLight.setColor(new QColor() { setRGB(255,255,255,255) })

```

(continues on next page)

(continued from previous page)

```

oLight.setIntensity(1)
oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)
oCamController.setEnabled(False)

oCube = new QCuboidMesh(oRootEntity) {
    setXextent(2)
    setYextent(2)
    setZextent(3)
}

oCubeTransform = new QTransform(oCube)
oCubeTransform.setScale(2)
oCubeTransform.setTranslation(new QVector3D(3, 3, 3))

oTextureLoader = new QTextureLoader(oCube);
oTextureLoader.setSource(
    new QUrl("file:///"+currentdir()+"/assets/texture/gold.jpg") )
oCubeMaterial = new QTextureMaterial(oCube)
oCubeMaterial.setTexture(oTextureLoader)

oCubeEntity = new QEntity(oRootEntity)
oCubeEntity.addComponent(oCube)
oCubeEntity.addComponent(oCubeMaterial)
oCubeEntity.addComponent(oCubeTransform)

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Moving Cube using the Keyboard")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

oContainer.setFocus()

exec()
}

func pKeyPress
    nKey = oFilter.getKeyCode()
    oX = oCubeTransform.translation().x()

```

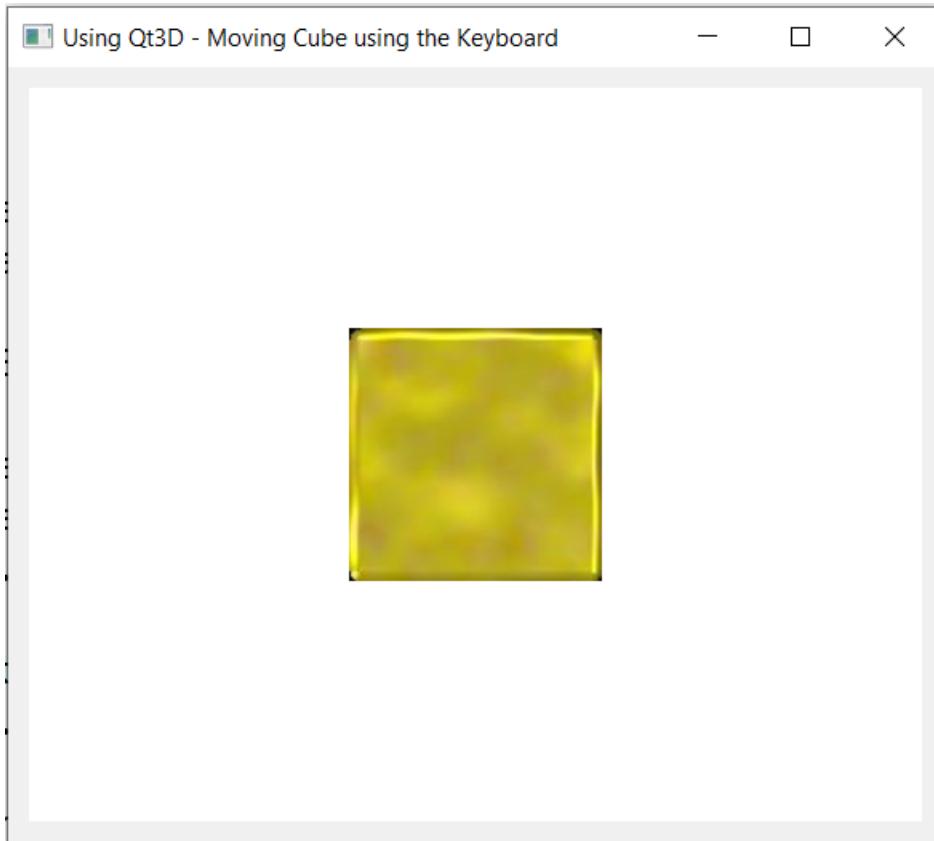
(continues on next page)

(continued from previous page)

```

oY = oCubeTransform.translation().y()
oZ = oCubeTransform.translation().z()
switch nKey
    on Qt_Key_Right
        oX++
    on Qt_Key_Left
        oX--
    on Qt_Key_Up
        oY++
    on Qt_Key_Down
        oY--
off
oCubeTransform.setTranslation(new QVector3D(oX, oY, oZ))

```



47.9 Object Picker

```

load "guilib.ring"

new qApp {
    oView = new Qt3dwindow()
    oWidget = new QWidget()

```

(continues on next page)

(continued from previous page)

```

oContainer = oWidget.createWindowContainer(oView,oWidget,0)

oRootEntity = new QEntity(oContainer)

    oFilter = new qallevents(oView)
    oFilter.setKeyPressEvent("pKeyPress()")
    oView.installEventFilter(oFilter)

oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

oCameraEntity = oView.Camera()

oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
    oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
    oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
    oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

oLightEntity = new QEntity(oRootEntity)
    oLight = new QPointLight(oLightEntity)
    oLight.setColor(new QColor() { setRGB(255,255,255,255) })
    oLight.setIntensity(1)
    oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
    oLightTransform.setTranslation(oCameraEntity.position())
    oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)
    oCamController.setEnabled(False)

oCube = new QCuboidMesh(oRootEntity) {
    setXextent(2)
    setYextent(2)
    setZextent(3)
}

oCubeTransform = new QTransform(oCube)
    oCubeTransform.setScale(2)
    oCubeTransform.setTranslation(new QVector3D(3, 3, 3))

oTextureLoader = new QTextureLoader(oCube);
    oTextureLoader.setSource(
        new QUrl("file:///"+currentdir()+"assets/texture/gold.jpg") )
oCubeMaterial = new QTextureMaterial(oCube)
    oCubeMaterial.setTexture(oTextureLoader)

oCubeEntity = new QEntity(oRootEntity)
    oCubeEntity.addComponent(oCube)
    oCubeEntity.addComponent(oCubeMaterial)
    oCubeEntity.addComponent(oCubeTransform)

```

(continues on next page)

(continued from previous page)

```

oPicker = new qObjectPicker(oCube) {
    setClickedEvent("pClick()")
}
oCubeEntity.addComponent(oPicker)

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Object Picker - Click on the Cube")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

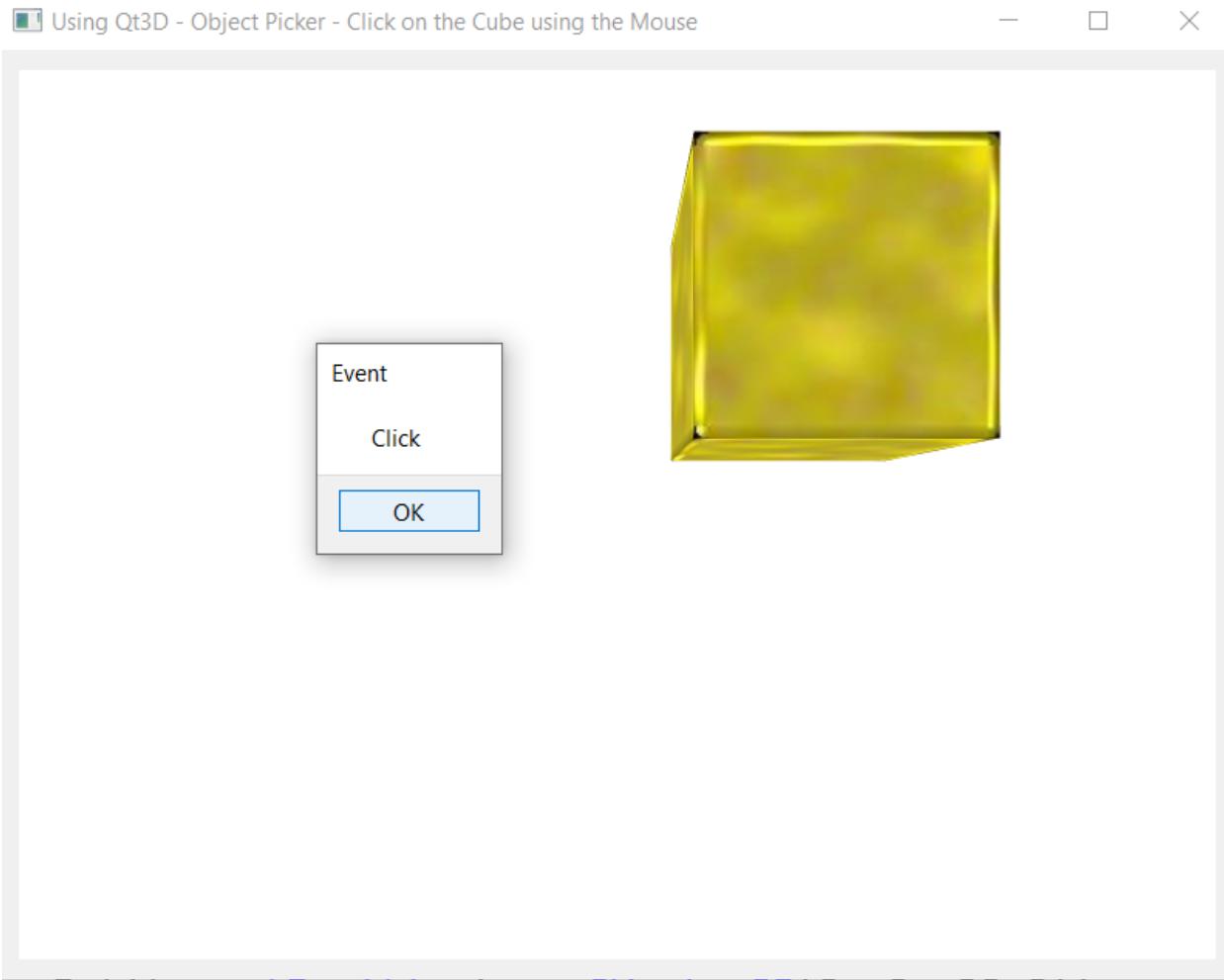
oContainer.setFocus(0)

exec()
}

func pKeyPress
    nKey = oFilter.getKeyCode()
    oX = oCubeTransform.translation().x()
    oY = oCubeTransform.translation().y()
    oZ = oCubeTransform.translation().z()
    switch nKey
        on Qt.Key_Right
            oX++
        on Qt.Key_Left
            oX--
        on Qt.Key_Up
            oY++
        on Qt.Key_Down
            oY--
    off
    oCubeTransform.setTranslation(new QVector3D(oX, oY, oZ))

func pClick
    msgInfo("Event", "Click")
    oContainer.setFocus(0)

```



47.10 Frame Action

```
load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
```

(continues on next page)

(continued from previous page)

```

oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

oLightEntity = new QEntity(oRootEntity)
    oLight = new QPointLight(oLightEntity)
oLight.setColor(new QColor() { setRGB(255,255,255,255) })
oLight.setIntensity(1)
oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)
oCamController.setEnabled(False)

oCube = new QCuboidMesh(oRootEntity) {
    setXextent(1)
    setYextent(1)
    setZextent(1)
}

oCubeTransform = new QTransform(oCube)
oCubeTransform.setScale(2)
oCubeTransform.setTranslation(new QVector3D(-5, -5, -5))

oTextureLoader = new QTextureLoader(oCube);
oTextureLoader.setSource(
    new QUrl("file:///"+currentdir()+"/assets/texture/gold.jpg") )
oCubeMaterial = new QTextureMaterial(oCube)
oCubeMaterial.setTexture(oTextureLoader)

oCubeEntity = new QEntity(oRootEntity)
oCubeEntity.addComponent(oCube)
oCubeEntity.addComponent(oCubeMaterial)
oCubeEntity.addComponent(oCubeTransform)

nAngle=0      nSpeed=0.1
oFrameAction = new qFrameAction(oRootEntity) {
    settriggeredevent("pEvent()")
}

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Frame Action")
    resize(800,600)
}

```

(continues on next page)

(continued from previous page)

```
        setLayout(oLayout)
        showMaximized()
    }

    exec()
}

func pEvent

    # Move the Cube
    oX = oCubeTransform.translation().x()
    oY = oCubeTransform.translation().y()
    oZ = oCubeTransform.translation().z()
    if oX >= 4
        nSpeed=-0.1
    but oX <= -10
        nSpeed=0.1
    ok
    oCubeTransform.setTranslation(
        new QVector3D(oX+nSpeed, oY+nSpeed, oZ+nSpeed))

    # Rotate the Cube
    nAngle+=5 if nAngle=360 nAngle=0 ok
    oQ = new QQuaternion(0,0,0,0)
    oCubeTransform.setRotation(
        oQ.fromAxisAndAngle(new QVector3D(0, 1, 0), nAngle))
```



47.11 Text 2D

```
load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oView.defaultframegraph().setclearcolor(new QColor() {setRGB(100,250,150,255)})

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()
```

(continues on next page)

(continued from previous page)

```

oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
    oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
    oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
    oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

oLightEntity = new QEntity(oRootEntity)
    oLight = new QPointLight(oLightEntity)
    oLight.setColor(new QColor() { setRGB(255,255,255,255) })
    oLight.setIntensity(1)
    oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)

oCube = new QCuboidMesh(oRootEntity) {
    setXextent(2)
    setYextent(2)
    setZextent(3)
}

oCubeTransform = new QTransform(oCube)
oCubeTransform.setScale(2)
oCubeTransform.setTranslation(new QVector3D(0, 3, 4))

oTextureLoader = new QTextureLoader(oCube);
oTextureLoader.setSource(
    new QUrl("file:///"+currentdir()+"/assets/texture/ring.bmp"))
oCubeMaterial = new QTextureMaterial(oCube)
oCubeMaterial.setTexture(oTextureLoader)

oCubeEntity = new QEntity(oRootEntity)
oCubeEntity.addComponent(oCube)
oCubeEntity.addComponent(oCubeMaterial)
oCubeEntity.addComponent(oCubeTransform)

oText2DEntity = new QText2DEntity(oRootEntity) {
    setText("Ring programming language")
    setWidth(400) setHeight(40)
    setColor(new QColor() {setRGB(128,128,128,255)})
}
oText2DTransform = new QTransform(oText2DEntity)
oText2DTransform.setScale(0.1)
oText2DTransform.setTranslation(new QVector3D(-10.5, -5, 0))

oText2DEntity.addComponent(oText2DTransform)

```

(continues on next page)

(continued from previous page)

```

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Text2D")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}

```



47.12 Extruded Text

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oView.defaultframegraph().setclearcolor(new QColor() {setRGB(100,250,150,255)})

    oInput = new QInputAspect(oRootEntity)
}

```

(continues on next page)

(continued from previous page)

```

oView.registerAspect(oInput)

oCameraEntity = oView.Camera()

oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
    oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
    oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
    oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

oLightEntity = new QEntity(oRootEntity)
    oLight = new QPointLight(oLightEntity)
    oLight.setColor(new QColor() { setRGB(255,255,255,255) })
    oLight.setIntensity(1)
    oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)

oCube = new QCuboidMesh(oRootEntity) {
    setXextent(2)
    setYextent(2)
    setZextent(3)
}

oCubeTransform = new QTransform(oCube)
oCubeTransform.setScale(2)
oCubeTransform.setTranslation(new QVector3D(0, 3, 4))

oTextureLoader = new QTextureLoader(oCube);
oTextureLoader.setSource(
    new QUrl("file:///"+currentdir()+"/assets/texture/ring.bmp"))
oCubeMaterial = new QTextureMaterial(oCube)
oCubeMaterial.setTexture(oTextureLoader)

oCubeEntity = new QEntity(oRootEntity)
oCubeEntity.addComponent(oCube)
oCubeEntity.addComponent(oCubeMaterial)
oCubeEntity.addComponent(oCubeTransform)

oTextEntity = new QEntity(oRootEntity)

oTextMesh = new QExtrudedTextMesh(oTextEntity) {
    setText("Ring")
}

oTextTransform = new QTransform(oTextEntity)
oTextTransform.setScale(3)
oTextTransform.setTranslation(new QVector3D(-5.5, -4, 3))

```

(continues on next page)

(continued from previous page)

```
oTextMaterial = new QPhongMaterial(oTextEntity);
oTextMaterial.setDiffuse(new QColor() {setRGB(0,0,255)})

oTextEntity.addComponent(oTextMesh)
oTextEntity.addComponent(oTextTransform)
oTextEntity.addComponent(oTextMaterial)

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Extruded Text")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}
```



47.13 Model

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

    oLightEntity = new QEntity(oRootEntity)
        oLight = new QPointLight(oLightEntity)
    oLight.setColor(new QColor() { setRGB(255,255,255,255) })
    oLight.setIntensity(1)
    oLightEntity.addComponent(oLight)

    oLightTransform = new QTransform(oLightEntity)
    oLightTransform.setTranslation(oCameraEntity.position())
    oLightEntity.addComponent(oLightTransform)

    oCamController = new QFirstPersonCameraController(oRootEntity)
        oCamController.setCamera(oCameraEntity)

    oModel = new qmesh(oRootEntity)

    oModel.setsource(
        new qURL("file:///"+currentdir()+"assets/model/lucky_cat.obj") )

    oModelTransform = new QTransform(oModel)
    oModelTransform.setScale(0.1)
    oModelTransform.setTranslation(new QVector3D(0, 0, 0))
    oQ = new Quaternion(0,0,0,0)
    oModelTransform.setRotation(oQ.fromAxisAndAngle(new QVector3D(0, 1, 0), 180))

    oModelMaterial = new QPhongMaterial(oModel)
    oModelMaterial.setDiffuse(new QColor() {setRGB(0,255,128,255)})

    oModelEntity = new QEntity(oRootEntity)
    oModelEntity.addComponent(oModel)

```

(continues on next page)

(continued from previous page)

```

oModelEntity.addComponent(oModelmaterial)
oModelEntity.addComponent(oModelTransform)

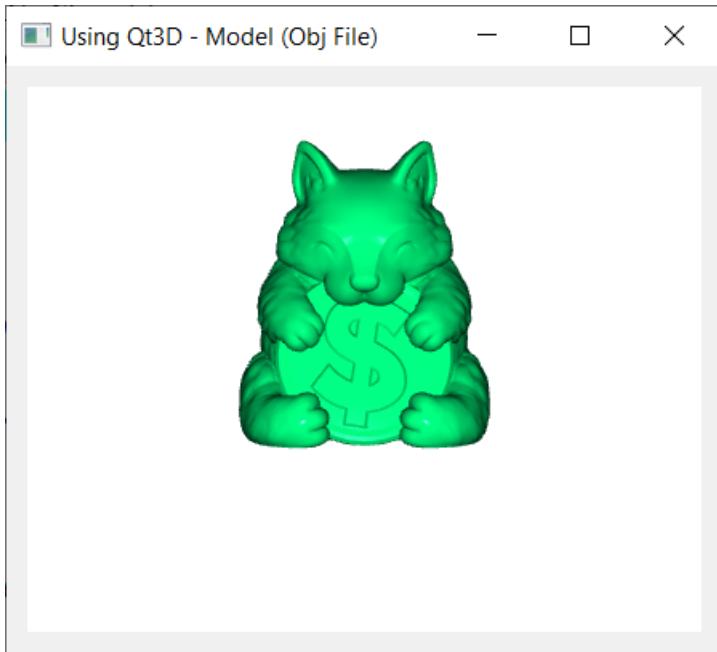
oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Model (Obj File)")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}

```



47.14 Model Texture

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)
}

```

(continues on next page)

(continued from previous page)

```

oRootEntity = new QEntity(oContainer)

oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

oCameraEntity = oView.Camera()

oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
    oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
    oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
    oCameraEntity.setViewCenter(new QVector3D(0, 25, 0))

oLightEntity = new QEntity(oRootEntity)
    oLight = new QPointLight(oLightEntity)
    oLight.setColor(new QColor() { setRGB(255,255,255,255) })
    oLight.setIntensity(1)
    oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
    oLightTransform.setTranslation(oCameraEntity.position())
    oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)

oModel = new qmesh(oRootEntity)

oModel.setsource(
    new qUrl("file:///"+currentdir()+"assets/model/Robot.obj") )

oModelTransform = new QTransform(oModel)
oModelTransform.setScale(0.5)
oModelTransform.setTranslation(new QVector3D(0, 12, 4))

oLoader = new QTextureLoader(oModel)
oModelMaterial = new QTextureMaterial(oModel)
oLoader.setSource(
    new QUrl("file:///"+currentdir()+"assets/texture/Robot.jpg") )
oModelMaterial.setTexture(oLoader)

oModelEntity = new QEntity(oRootEntity)
oModelEntity.addComponent(oModel)
oModelEntity.addComponent(oModelMaterial)
oModelEntity.addComponent(oModelTransform)

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Model Texture")

```

(continues on next page)

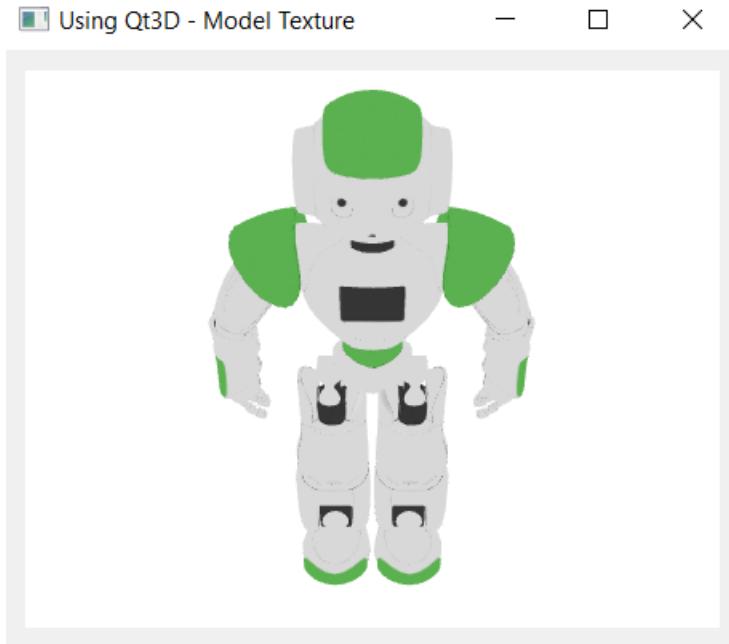
(continued from previous page)

```

        resize(800,600)
        setLayout(oLayout)
        showMaximized()
    }

    exec()
}

```



47.15 Draw Office

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
    oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
}

```

(continues on next page)

(continued from previous page)

```

oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
oCameraEntity.setViewCenter(new QVector3D(0, 0, 0))

oLightEntity = new QEntity(oRootEntity)
    oLight = new QPointLight(oLightEntity)
oLight.setColor(new QColor() { setRGB(255,255,255,255) })
oLight.setIntensity(1)
oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)

oModel = new qmesh(oRootEntity)

oModel.setsource(
    new qURL("file:///"+currentdir()+"assets/model/Reception_Table.obj") )

oModelTransform = new QTransform(oModel)
oModelTransform.setScale(1)
oModelTransform.setTranslation(new QVector3D(0, -2.5, 16))

oModelMaterial = new QPhongMaterial(oModel)
oModelMaterial.setDiffuse(new QColor() {setRGB(0,255,128,255)})

oModelEntity = new QEntity(oRootEntity)
oModelEntity.addComponent(oModel)
oModelEntity.addComponent(oModelmaterial)
oModelEntity.addComponent(oModelTransform)

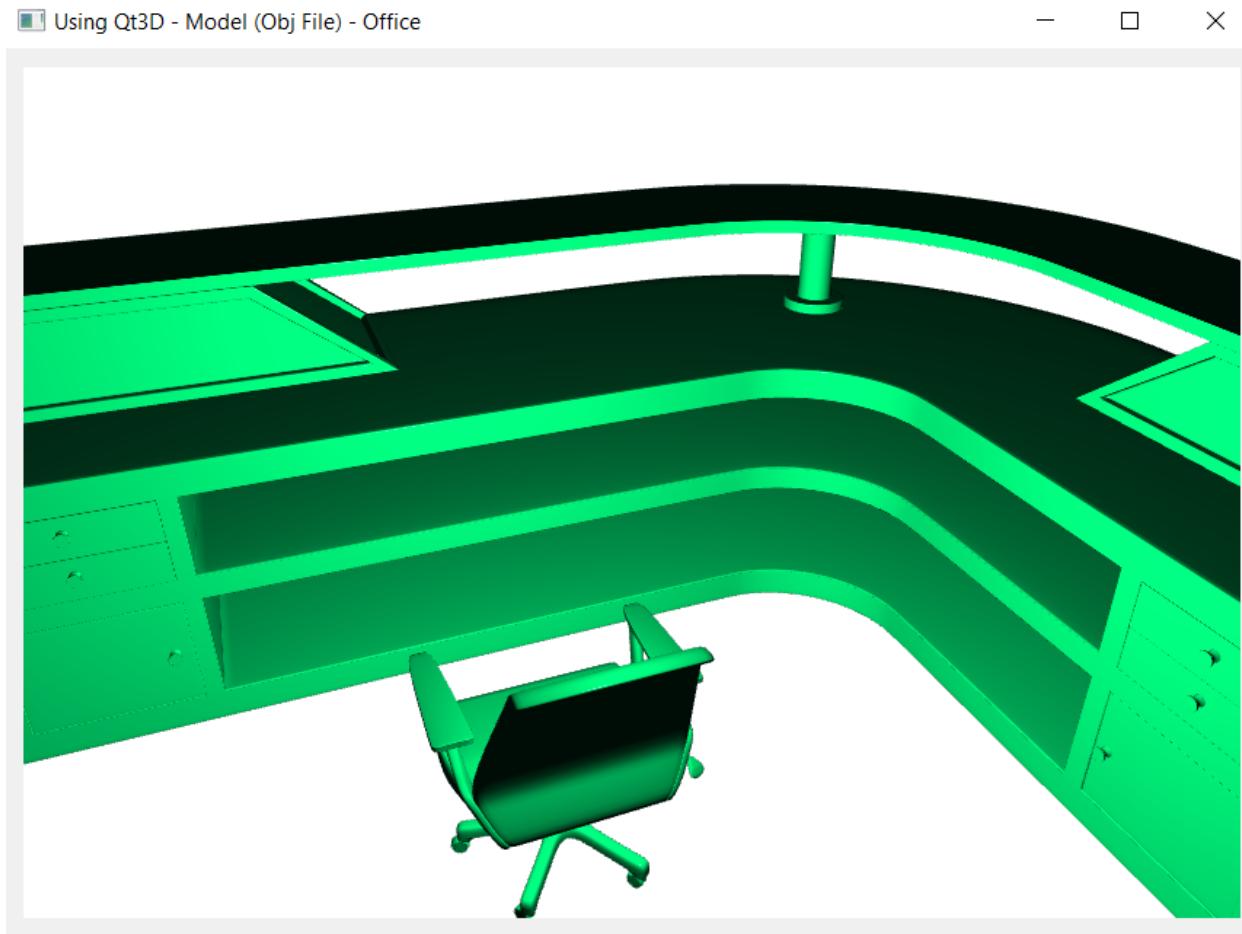
oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Model (Obj File) - Office")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

exec()
}

```



47.16 Many Objects

```
load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
}
```

(continues on next page)

(continued from previous page)

```

oCameraEntity.setViewCenter(new QVector3D(0, 20, 0))

oLightEntity = new QEntity(oRootEntity)
    oLight = new QPointLight(oLightEntity)
oLight.setColor(new QColor() { setRGB(255,255,255,255) })
oLight.setIntensity(1)
oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)

oModel = new qmesh(oRootEntity)
oModel.setsource(
    new qURL("file:///"+currentdir()+"/assets/model/Robot.obj") )

oModelTransform = new QTransform(oModel)
oModelTransform.setScale(0.2)
oModelTransform.setTranslation(new QVector3D(0, 10, 10))

oModelMaterial = new QPhongMaterial(oModel)
oModelMaterial.setDiffuse(new QColor() {setRGB(0,100,0,0)})

oModelEntity = new QEntity(oRootEntity)
oModelEntity.addComponent(oModel)

oLoader = new QTextureLoader(oModel);
oModelMaterial = new QTextureMaterial(oModel)
oLoader.setSource(
    new QUrl("file:///"+currentdir()+"/assets/texture/gold.jpg") )
oModelMaterial.setTexture(oLoader)

oModelEntity.addComponent(oModelMaterial)
oModelEntity.addComponent(oModelTransform)

for n = 1 to 10

    oTorus = new QTorusMesh(oRootEntity)
        oTorus.setRadius(1.0*n)
        oTorus.setMinorRadius(0.4*n)
        oTorus.setRings(100)
        oTorus.setSlices(20)

    oTorusTransform = new QTransform(null)
    oTorusTransform.setScale(2)
    oTorusTransform.setTranslation(new QVector3D(5.0*n, 4.0*n, 0.0))

    oTorusMaterial = new QPhongMaterial(null);
    oTorusMaterial.setDiffuse(new QColor() {setRGB(200,100,100,100)})


```

(continues on next page)

(continued from previous page)

```
oTorusEntity = new QEntity(oRootEntity)
oTorusEntity.addComponent(oTorus)

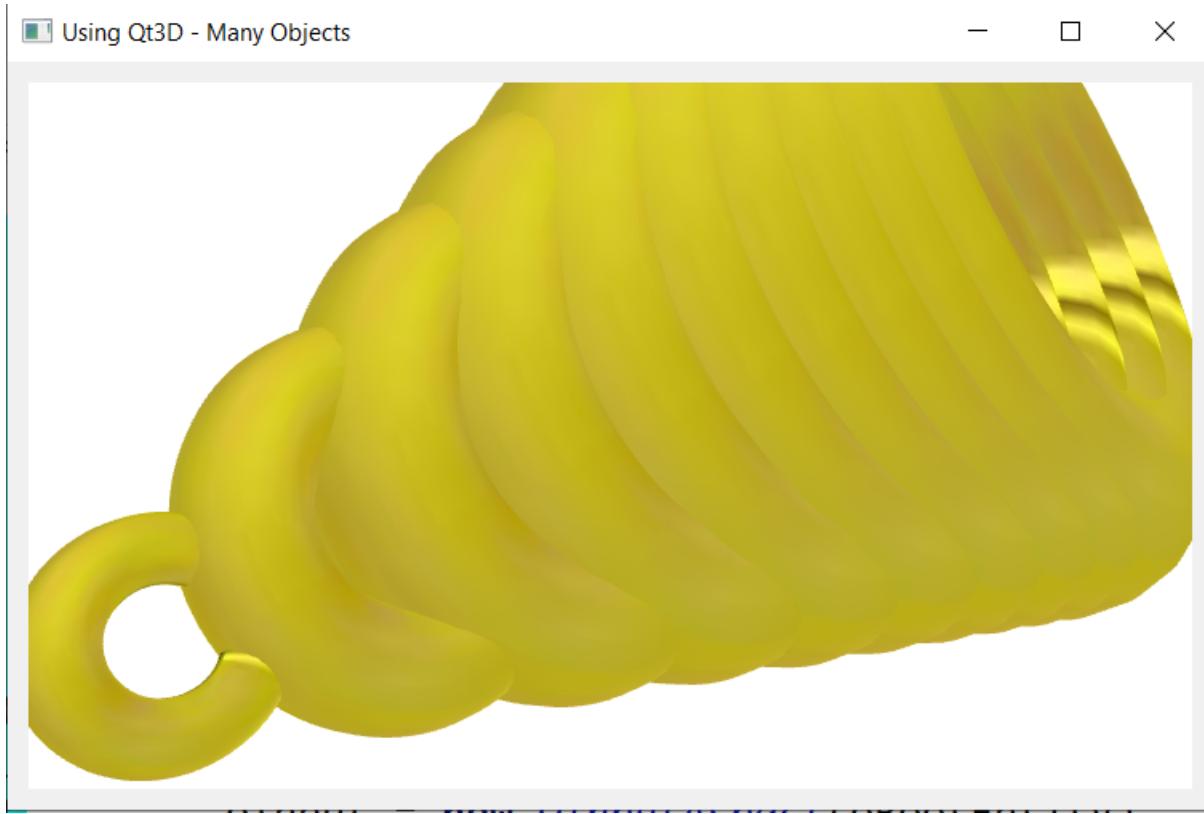
oLoader = new QTextureLoader(oTorus);
oTorusMaterial = new QTextureMaterial(oTorus)
oLoader.setSource(
    new QUrl("file:///"+currentdir()+"/assets/texture/gold.jpg") )
oTorusMaterial.setTexture(oLoader)

oTorusEntity.addComponent(oTorusMaterial)
oTorusEntity.addComponent(oTorusTransform)
next

oView.setRootEntity(oRootEntity)

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)

oWidget {
    setWindowTitle("Using Qt3D - Many Objects")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}
exec()
}
```



47.17 Camera

```

load "guilib.ring"

new qApp {

    oView = new Qt3dwindow()

    oWidget = new QWidget()
    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
        oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000.0)
        oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
        oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
        oCameraEntity.setViewCenter(new QVector3D(0, 20, 0))

    oLightEntity = new QEntity(oRootEntity)
        oLight = new QPointLight(oLightEntity)

```

(continues on next page)

(continued from previous page)

```

oLight.setColor(new QColor() { setRGB(255,255,255,255) })
oLight.setIntensity(1)
oLightEntity.addComponent(oLight)

oLightTransform = new QTransform(oLightEntity)
oLightTransform.setTranslation(oCameraEntity.position())
oLightEntity.addComponent(oLightTransform)

oCamController = new QFirstPersonCameraController(oRootEntity)
    oCamController.setCamera(oCameraEntity)

oModel = new qmesh(oRootEntity)
oModel.setsource(
    new qURL("file:///"+currentdir()+"assets/model/Robot.obj") )

oModelTransform = new QTransform(oModel)
oModelTransform.setScale(.2)
oModelTransform.setTranslation(new QVector3D(0, 10, 10))

oModelMaterial = new QPhongMaterial(oModel)
oModelMaterial.setDiffuse(new QColor() {setRGB(0,100,0,0)})

oModelEntity = new QEntity(oRootEntity)
oModelEntity.addComponent(oModel)

oLoader = new QTextureLoader(oModel);
oModelMaterial = new QTextureMaterial(oModel)
oLoader.setSource(
    new QUrl("file:///"+currentdir()+"assets/texture/gold.jpg") )
oModelMaterial.setTexture(oLoader)

oModelEntity.addComponent(oModelMaterial)
oModelEntity.addComponent(oModelTransform)

for n = 1 to 10

    oTorus = new QTorusMesh(oRootEntity)
        oTorus.setRadius(1.0*n)
        oTorus.setMinorRadius(.4*n)
        oTorus.setRings(100)
        oTorus.setSlices(20)

    oTorusTransform = new QTransform(null)
    oTorusTransform.setScale(2)
    oTorusTransform.setTranslation(new QVector3D(5.0*n, 4.0*n, 0.0))

    oTorusMaterial = new QPhongMaterial(null);
    oTorusMaterial.setDiffuse(new QColor() {setRGB(200,100,100,100)})

    oTorusEntity = new QEntity(oRootEntity)
    oTorusEntity.addComponent(oTorus)

```

(continues on next page)

(continued from previous page)

```

oLoader = new QTextureLoader(oTorus);
oTorusMaterial = new QTextureMaterial(oTorus)
oLoader.setSource(
    new QUrl("file:///"+currentdir()+"/assets/texture/gold.jpg"))
oTorusMaterial.setTexture(oLoader)

oTorusEntity.addComponent(oTorusMaterial)
oTorusEntity.addComponent(oTorusTransform)
next

oView.setRootEntity(oRootEntity)

btn1 = new QPushButton(oWidget) {
    setText("Move the Camera and the Robot") setClickEvent("pMove()")
}

oLayout = new QVBoxLayout()
oLayout.addWidget(oContainer)
oLayout.addWidget(btn1)

oWidget {
    setWindowTitle("Using Qt3D - Camera")
    resize(800,600)
    setLayout(oLayout)
    showMaximized()
}

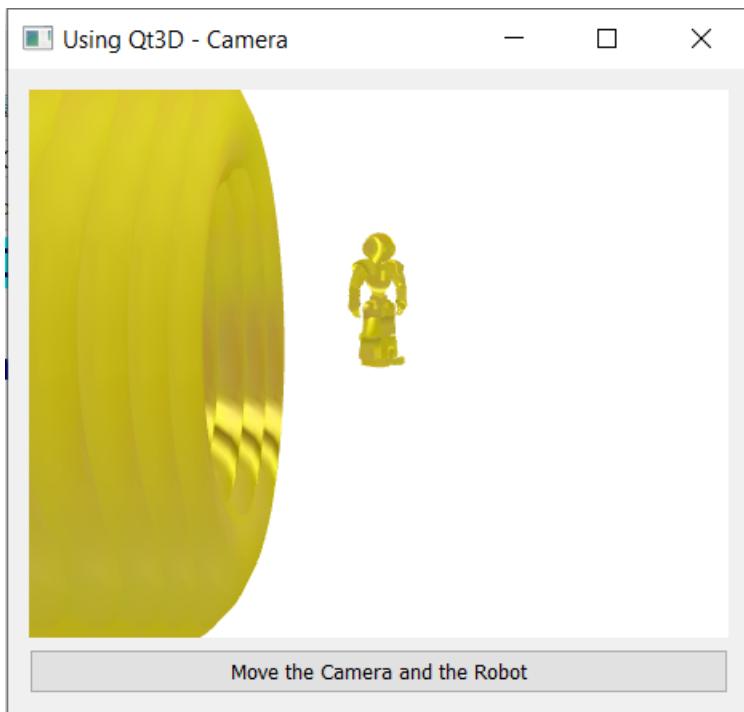
exec()
}

func pMove

    oCameraEntity.setPosition(new QVector3D(0, 0, 20.0))
    oCameraEntity.setUpVector(new QVector3D(0, 1, 0))
    oCameraEntity.setViewCenter(new QVector3D(20, 15, 20))

    oModelTransform.setTranslation(new QVector3D(20, 15, 20))
    oQ = new Quaternion(0,0,0,0)
    oModelTransform.setRotation(oQ.fromAxisAndAngle(new QVector3D(1, 1, 0), 270))

```



47.18 Scence

```

load "guilib.ring"

new qApp {

    oWidget = new QWidget()

    oView = new Qt3DWindow()
    oView.defaultFrameGraph().setClearColor(new QColor() {setRGB(0,0,0,255)})

    oContainer = oWidget.createWindowContainer(oView,oWidget,0)

    oRootEntity = new QEntity(oContainer)

    oInput = new QInputAspect(oRootEntity)
    oView.registerAspect(oInput)

    oCameraEntity = oView.Camera()

    oCameraEntity.lens().setPerspectiveProjection(45.0, 16.0/9.0, 0.1, 1000)
    oCameraEntity.setPosition(new QVector3D(-13.34, -6.43, 16.47))
        oCameraEntity.setUpVector(new QVector3D(0.02, 0, 1))
        oCameraEntity.setViewCenter(new QVector3D(-13.34, 17.05, 15.42))

    oCameraController = new QFirstPersonCameraController(oRootEntity)
    oCameraController.setCamera(oCameraEntity)
    oCameraController.setEnabled(False)

```

(continues on next page)

(continued from previous page)

```

oLongRoomEntity = new QEntity(oRootEntity)

oLongRoomModel = new QMesh(oLongRoomEntity)

oLongRoomModel.setSource(
    new qUrl("file:///"+CurrentDir()+"assets/model/Long_Room.obj") )

oLongRoomTransform = new QTransform(oLongRoomEntity)
oLongRoomTransform.setScale(1)
oLongRoomTransform.setTranslation(new QVector3D(5, 0, 15))

oLongRoomLoader = new QTextureLoader(oLongRoomModel)
oLongRoomMaterial = new QTextureMaterial(oLongRoomModel)
oLongRoomLoader.setSource(
    new QUrl("file:///"+currentdir()+"assets/texture/croc.jpg") )
oLongRoomMaterial.setTexture(oLongRoomLoader)

oLongRoomEntity.addComponent(oLongRoomModel)
oLongRoomEntity.addComponent(oLongRoomMaterial)
oLongRoomEntity.addComponent(oLongRoomTransform)

oTableEntity = new QEntity(oRootEntity)

oTableModel = new QMesh(oTableEntity)
oTableModel.setSource(
    new qUrl("file:///"+CurrentDir()+"assets/model/Reception_Table.obj") )

oTableTransform = new QTransform(oTableEntity)
oTableTransform.setScale(0.3)
oTableTransform.setTranslation(new QVector3D(5, 0, 15))
oQ = new Quaternion(0,0,0,0)
oTableTransform.setRotation(oQ.fromAxisAndAngle(new QVector3D(0, 1, 1), -180))

oTableModelMaterial = new QPhongMaterial(oTableEntity)
oTableModelMaterial.setDiffuse(new QColor() {setRGB(255,255,255,255)})

oTableEntity.addComponent(oTableModel)
oTableEntity.addComponent(oTableModelmaterial)
oTableEntity.addComponent(oTableTransform)

oFirstLightEntity = new QEntity(oRootEntity)

    oFirstLight = new QPointLight(oFirstLightEntity)
oFirstLight.setColor(new QColor() { setRGB(128,128,128,128) })
oFirstLight.setIntensity(1)

oFirstLightTransform = new QTransform(oFirstLightEntity)
oFirstLightTransform.setTranslation(new QVector3D(5, 0, 20))

oFirstLightEntity.addComponent(oFirstLight)
oFirstLightEntity.addComponent(oFirstLightTransform)

```

(continues on next page)

(continued from previous page)

```

aCats = list(5)
for n = 1 to 5
    v = n * 0.1
    aCats[n] = []
    aCats[n][:oCatModelEntity] = new QEntity(oRootEntity)
    aCats[n][:oCatModel] = new QMesh(aCats[n][:oCatModelEntity])
    aCats[n][:oCatModel].setSource(
        new qURL("file:///"+CurrentDir()+"assets/model/Lucky_Cat.obj") )
    aCats[n][:oCatModelMaterial] = new QPhongMaterial(aCats[n][:oCatModel])
    aCats[n][:oCatModelMaterial].setDiffuse(
        new QColor() {setRGB(255,255,255,255)})
    aCats[n][:oCatModelTransform] = new QTransform(aCats[n][:oCatModelEntity])
    aCats[n][:oCatModelTransform].setScale(0.01)
    aCats[n][:oCatModelTransform].setTranslation(
        new QVector3D(-5*(v+v), 1, 15.2))
    oQ = new QQuaternion(0,0,0,0)
    aCats[n][:oCatModelTransform].setRotation(
        oQ.fromAxisAndAngle(
            new QVector3D(0, 1, 1), 180))
    aCats[n][:oCatModelEntity].addComponent(aCats[n][:oCatModel])
    aCats[n][:oCatModelEntity].addComponent(aCats[n][:oCatModelmaterial])
    aCats[n][:oCatModelEntity].addComponent(aCats[n][:oCatModelTransform])
next

oSecondLightEntity = new QEntity(oRootEntity)

oSecondLight = new QPointLight(oSecondLightEntity)
oSecondLight.setColor(new QColor() { setRGB(255,255,255,255) })
oSecondLight.setIntensity(1)

oSecondLightTransform = new QTransform(oSecondLightEntity)
oSecondLightTransform.setTranslation(new QVector3D(-5, 1, 15.5))

oSecondLightEntity.addComponent(oSecondLight)
oSecondLightEntity.addComponent(oSecondLightTransform)

oRobotEntity = new QEntity(oRootEntity)

oRobotModel = new QMesh(oRobotEntity)
oRobotModel.setSource(
    new qURL("file:///"+CurrentDir()+"assets/model/Fat_Robot.obj") )
oRobotTransform = new QTransform(oRobotEntity)
oRobotTransform.setScale(0.006)

robotX = -15
robotY = -2
robotZ = 15

oRobotTransform.setTranslation(new QVector3D(-15, -2, 15))
oQ = new QQuaternion(0,0,0,0)
oRobotTransform.setRotation(

```

(continues on next page)

(continued from previous page)

```

oQ.fromAxisAndAngle(new QVector3D(0, 1, 1), 170))

oRobotMaterial = new QPhongMaterial(oRobotEntity)
oRobotMaterial.setDiffuse(new QColor() {setRGB(128,128,128,255)})

oRobotEntity.addComponent(oRobotModel)
oRobotEntity.addComponent(oRobotTransform)
oRobotEntity.addComponent(oRobotMaterial)

oView.setRootEntity(oRootEntity)

oWidget {
    setWindowTitle("Using Qt3D - Scene")
    showFullScreen()
}

oContainer.resize(oWidget.width(),oWidget.height())

oFilter = new QAllEvents(oView)
oFilter.setKeyPressEvent("pKeyPress()")
oView.installEventFilter(oFilter)
oContainer.setFocus(0)

exec()

}

func pKeyPress

nKey      = oFilter.getKeyCode()
nSpeed   = 0.1
cX       = oCameraEntity.position().x()
cY       = oCameraEntity.position().y()
cZ       = oCameraEntity.position().z()
cVCx     = oCameraEntity.viewCenter().x()
cVCy     = oCameraEntity.viewCenter().y()
cVCz     = oCameraEntity.viewCenter().z()

switch nKey
on Qt_Key_Right
    if cX < 4.8
        robotX+= nSpeed
        oCameraEntity.setPosition(
            new QVector3D(cX+0.1, cY, cZ))
        oCameraEntity.setViewCenter(
            new QVector3D(cVCx+nSpeed, cVCy, cVCz))
        oRobotTransform.setRotation(
            oQ.fromAxisAndAngle(new QVector3D(0, 1, 1), 170))
    ok
on Qt_Key_Left
    if cX > - 13.8
        robotX-= nSpeed

```

(continues on next page)

(continued from previous page)

```

oCameraEntity.setPosition(
    new QVector3D(cX-0.1, cY, cZ))
oCameraEntity.setViewCenter(
    new QVector3D(cVCx-nSpeed, cVCy, cVCz))
oRobotTransform.setRotation(
    oQ.fromAxisAndAngle(new QVector3D(0, 1, 1), 160))

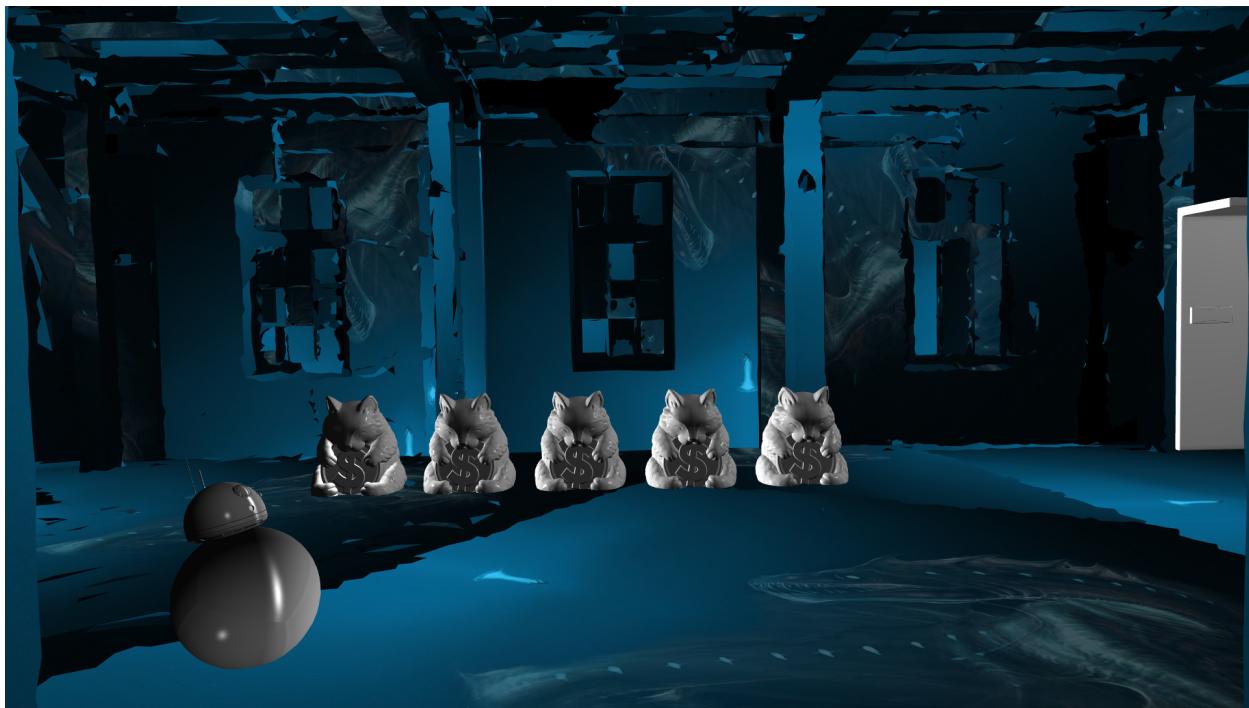
ok
on Qt_Key_Down
    if robotY > -3.5
        robotY-= nSpeed
        oCameraEntity.setPosition(
            new QVector3D(cX, cY, cZ))
        oRobotTransform.setRotation(
            oQ.fromAxisAndAngle(new QVector3D(0, 1, 1), 190))

ok
on Qt_Key_Up
    if robotY < 2
        robotY+= nSpeed
        oCameraEntity.setPosition(
            new QVector3D(cX, cY, cZ))
        oRobotTransform.setRotation(
            oQ.fromAxisAndAngle(new QVector3D(0, 1, 1), 180))

ok
on Qt_Key_Escape
    oWidget.close()
off

oRobotTransform.setTranslation(new QVector3D(robotX, robotY, robotZ))

```



CHAPTER
FORTYEIGHT

OBJECTS LIBRARY FOR RINGQT APPLICATION

In this chapter we will learn about the objects library and using it in GUI applications.

Instead of using global variables for windows objects and connecting events to objects using the object name, the Objects Library will manage a list of the GUI objects and will provide a more natural API to quickly create one or many windows from the same class.

Also the Objects Library provide a way to quickly set methods to be executed when an event is fired. Also the library provide a natural interface to quickly use the parent or the caller windows from the child or sub windows and the other way around.

The Objects Library is designed to be used with the MVC Design Pattern.

The Objects Library uses reflection and meta-programming to add new methods to Controller classes to provide an easy way for communication between these classes.

The Objects Library is called automatically by the GUILib

Also we can call it alone by using the next command

```
load "objectslib.ring"
```

The ObjectsLib provide functions like openObject(), lastObject() and a class called ObjectsParent

The GUILib provide a new specific API for GUI applications like openWindow(), lastWindow(), etc.

48.1 Library Usage with GUI Applications

- Use the openWindow(cWindowControllerClassName) function to open new Windows
- Create at least Two Classes for each window, The Controller Class and the View Class
- Create each controller class from the WindowsControllerParent Class
- Create each view class from the WindowsViewParent Class
- Use the lastWindow() function to get the object of the last window created (The Controller object).
- When you call a sub window, use the SetParentObject() method and pass the self object.
- In the View Class, To determine the event method use the Method(cMethodName) function.
- The Method(cMethodName) function determine the method in the controller class that will be executed.
- Each controller class contains by default the CloseAction() method that you can call to close the window.
- You don't need to call the Show() Method for each window, When you use openWindow() It will be called.
- In the view class, Define the GUI window object as an attribute called win.

- You can use openWindowNoShow() to avoid displaying the window.
- You can use openWindowAndLink() to quickly get methods to access the windows.

48.2 Example

In the next example we will create two types of windows.

- Main Window contains a button. When the user click on the button a sub window will be opened.
- The User Can click on the button many times to open many sub windows.
- Each Sub Window contains Two buttons.
- The first button in the sub window change the Main and the Sub Windows Titles.
- The second button in the sub window close the Sub Window.

```
load "guilib.ring"

new qApp {
    openWindow( :MainWindowController )
    exec()
}

class MainWindowController from WindowsControllerParent
    oView = new MainWindowView
    func SubWindowAction
        openWindow( :SubWindowController )
        lastWindow().SetParentObject(self)

class MainWindowView from WindowsViewParent
    win = new QWidget() {
        SetWindowTitle("Main Window")
        btnSub = new QPushButton(win) {
            setText("Sub Window")
            setClickEvent( Method( :SubWindowAction ) )
        }
        resize(400,400)
    }

class SubWindowController from WindowsControllerParent
    oView = new SubWindowView
    func SetMainWindowTitleAction
        Parent().oView.win.SetWindowTitle("Message from the Sub Window")
        oView.win.SetWindowTitle("Click Event Done!")

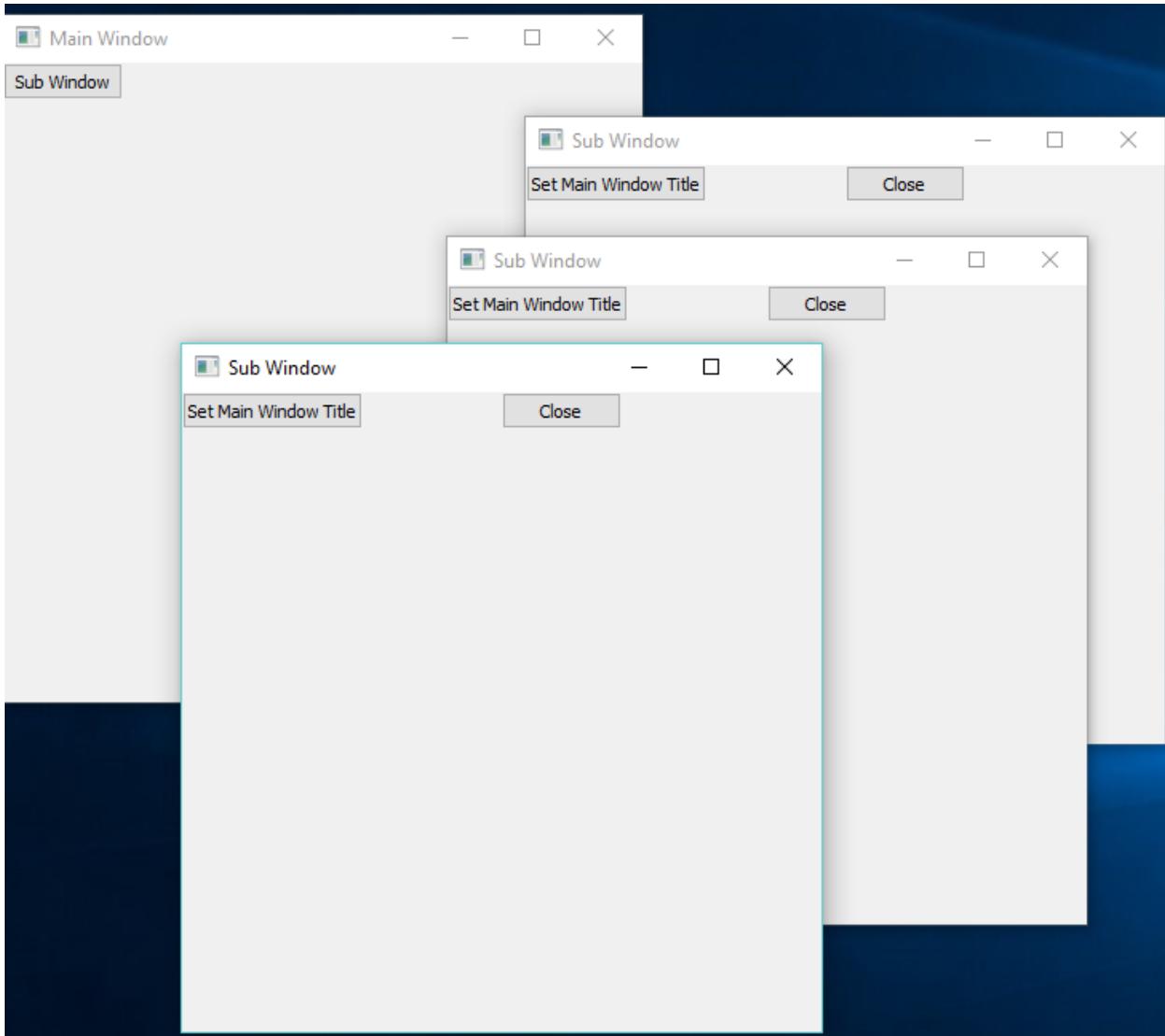
class SubWindowView from WindowsViewParent
    win = new QWidget() {
        SetWindowTitle("Sub Window")
        btnMsg = new QPushButton(win) {
            setText("Set Main Window Title")
            setClickEvent( Method( :SetMainWindowTitleAction ) )
        }
        btnClose = new QPushButton(win) {
```

(continues on next page)

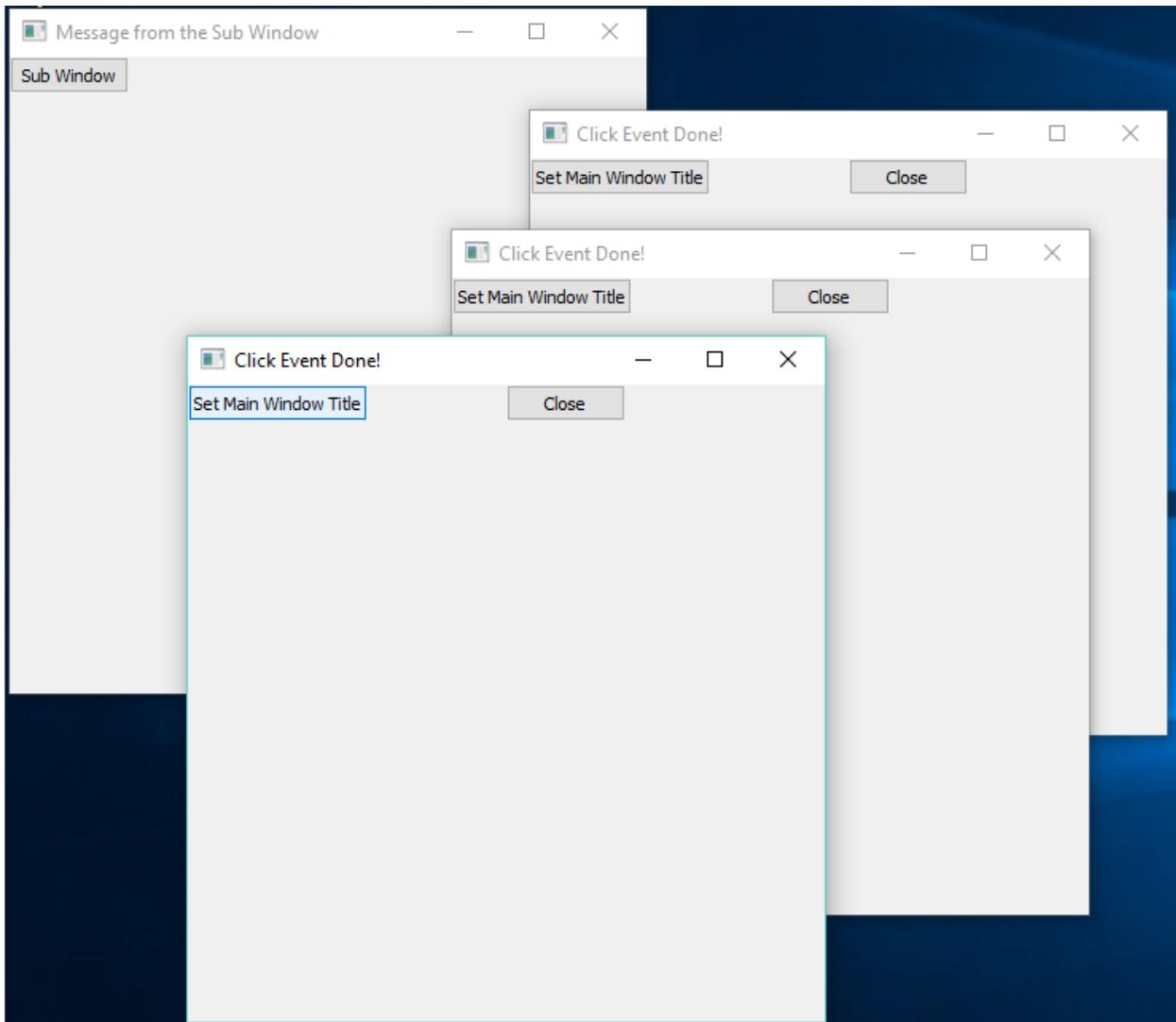
(continued from previous page)

```
        Move(200,0)
        setText("Close")
        setClickEvent( Method( :CloseAction ) )
    }
    resize(400,400)
}
```

The next screen shot after creating three sub windows.



The next screen shot after clicking on the button in each sub window.



48.3 openWindowAndLink() Function

We can use the `openWindowAndLink()` function to connect between the application windows, pass messages (call methods) between the objects.

This function uses Meta-programming to define dynamic methods in the Caller Class to use the dynamic objects of other windows that we create.

Example : (Uses the Form Designer)

First Window

- (1) <https://github.com/ring-lang/ring/blob/master/samples/UsingFormDesigner/twowindowspart5/firstwindowView.ring>
- (2) <https://github.com/ring-lang/ring/blob/master/samples/UsingFormDesigner/twowindowspart5/firstwindowController.ring>

Second Window

- (1) <https://github.com/ring-lang/ring/blob/master/samples/UsingFormDesigner/twowindowspart5/secondwindowView.ring>
- (2) <https://github.com/ring-lang/ring/blob/master/samples/UsingFormDesigner/twowindowspart5/secondwindowController.ring>

In the next code for example (from FirstWindowController.ring)

The openWindowAndLink() will create an object from the SecondWindowController Class

Then will add the SecondWindow() and IsSecondWindow() Methods to the FirstWindowController Class

Also will add the FirstWindow() and IsFirstWindow() Methods to the SecondWindowController Class

So the SendMessage() method in FirstWindowController class can use the SecondWindow() method to access the object.

This is more simple than using lastWindow(), Parent() and SetParentObject() methods.

```
class firstwindowController from windowsControllerParent

    oView = new firstwindowView

    func OpenSecondWindow
        openWindowAndLink(:SecondWindowController, self)

    func SendMessage
        if IsSecondWindow()
            SecondWindow().setMessage("Message from the first window")
        ok

    func setMessage cMessage
        oView.Label1.setText(cMessage)
```

48.4 openWindowInPackages() Function

The openWindowInPackages() function is the same as openWindow() but takes an extra list that determine the packages to import before opening the window.

Syntax:

```
openWindowInPackages(cClassName, aPackagesList)
```

Example:

The next example from the Form Designer source code, Open the Window Flags window using the openWindowInPackages() function.

We determine the class name “WindowFlagsController” and the packages name.

The Window Flags window uses the FormDesigner and System.GUI packages.

```
openWindowInPackages(:WindowFlagsController, [
    "formdesigner",
    "System.GUI"
])
```

48.5 Using ObjectID() and GetWindowByID()

Each window created using the Objects Library have a unique ID

We can get the window ID using the ObjectID() Method in the Controller Class

The Objects Library comes with the GetWindowByID() function

Using this function we can get the controller object of a window using the ID

Example:

```
load "guilib.ring"

new qApp {
    openWindow( :MainWindowController )
    exec()
}

class MainWindowController from WindowsControllerParent

    oView = new MainWindowView

    nFirstWindowID  nSecondWindowID  nThirdWindowID

    func CreateThreeWindowsAction

        openWindow( :SubWindowController )
        nFirstWindowID = lastWindow().objectId()
        openWindow( :SubWindowController )
        nSecondWindowID = lastWindow().objectId()
        openWindow( :SubWindowController )
        nThirdWindowID = lastWindow().objectId()

        FirstWindow().oView.win {
            setWindowTitle("One")
            move(100,100)
        }
        SecondWindow().oView.win {
            setWindowTitle("Two")
            move(200,200)
        }
        ThirdWindow().oView.win {
            setWindowTitle("Three")
            move(300,300)
        }

    func FirstWindow
        return GetWindowByID(nFirstWindowID)

    func SecondWindow
        return GetWindowByID(nSecondWindowID)

    func ThirdWindow
        return GetWindowByID(nThirdWindowID)
```

(continues on next page)

(continued from previous page)

```
class MainWindowView from WindowsViewParent

    win = new QWidget() {
        setWindowTitle("Main Window")
        move(500,100)
        btnSub = new QPushButton(win) {
            setText("Create Three Windows")
            setClickEvent( Method( :CreateThreeWindowsAction ) )
        }
        resize(400,400)
    }

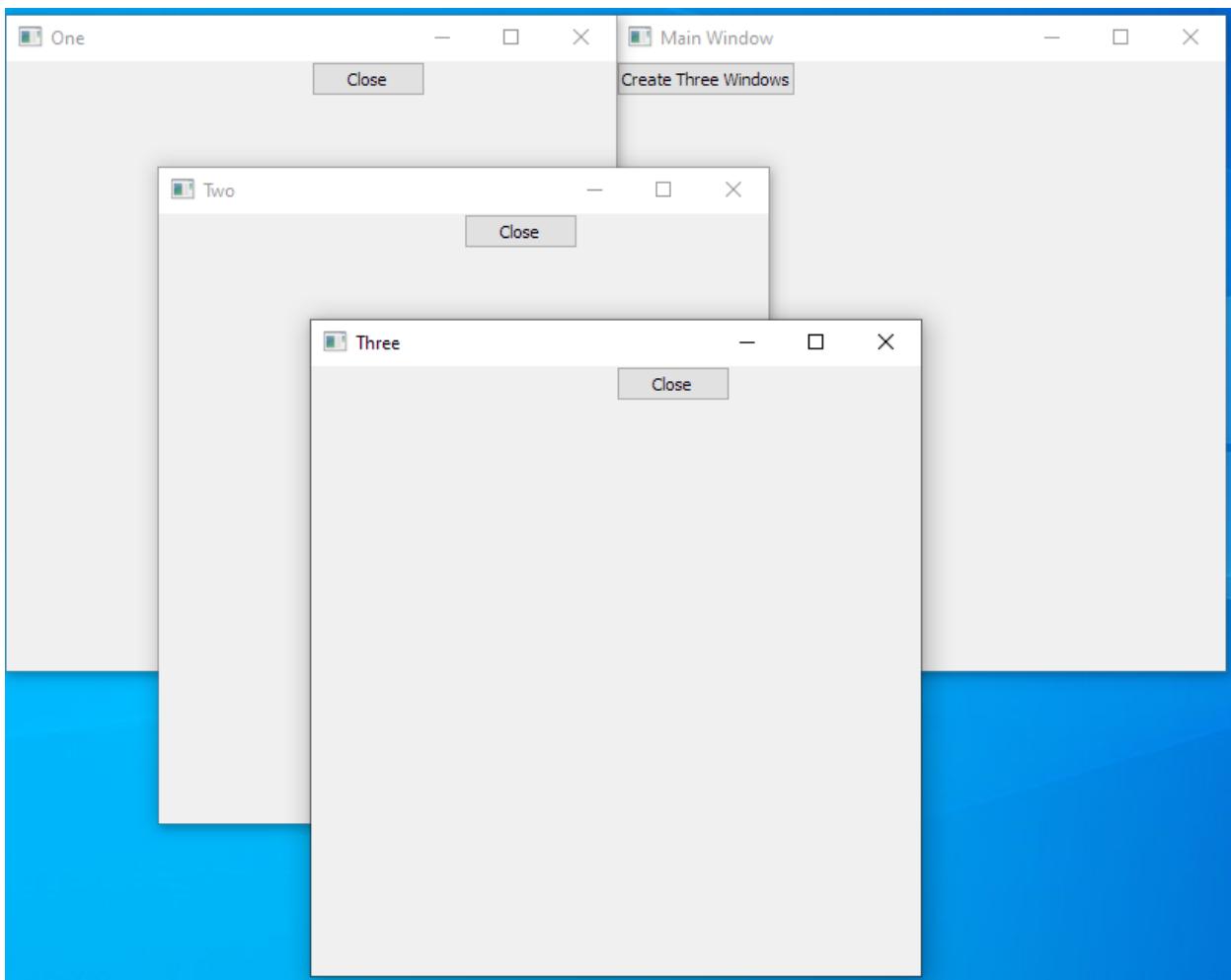
class SubWindowController from WindowsControllerParent

    oView = new SubWindowView

class SubWindowView from WindowsViewParent

    win = new QWidget() {
        setWindowTitle("Sub Window")
        btnClose = new QPushButton(win) {
            move(200,0)
            setText("Close")
            setClickEvent( Method( :CloseAction ) )
        }
        resize(400,400)
    }
```

Screen Shot:



48.6 Using ObjectID() and OpenWindowAndLink()

The next example demonstrates using OpenWindowAndLink() instead of GetWindowByID()

This introduce an interesting question: When to use OpenWindowAndLink()?

If the parent window will call one object of the sub window then use OpenWindowAndLink()

i.e. the relationship between the parent window and the sub window is one-to-one.

If the parent window will call many objects of the sub window at different times

Then use GetWindowByID() to determine which object to use

i.e. the relationship between the parent window and the sub window is one-to-many.

Example:

```
load "guilib.ring"

new qApp {
    openWindow( :MainWindowController )
    exec()
```

(continues on next page)

(continued from previous page)

```

}

class MainWindowController from WindowsControllerParent
    oView = new MainWindowView
    func SubWindowAction
        openWindowAndLink( :SubWindowController, self)
        subWindow().oView.win {
            move(50,100)
            setStyleSheet("background-color:yellow;")
        }

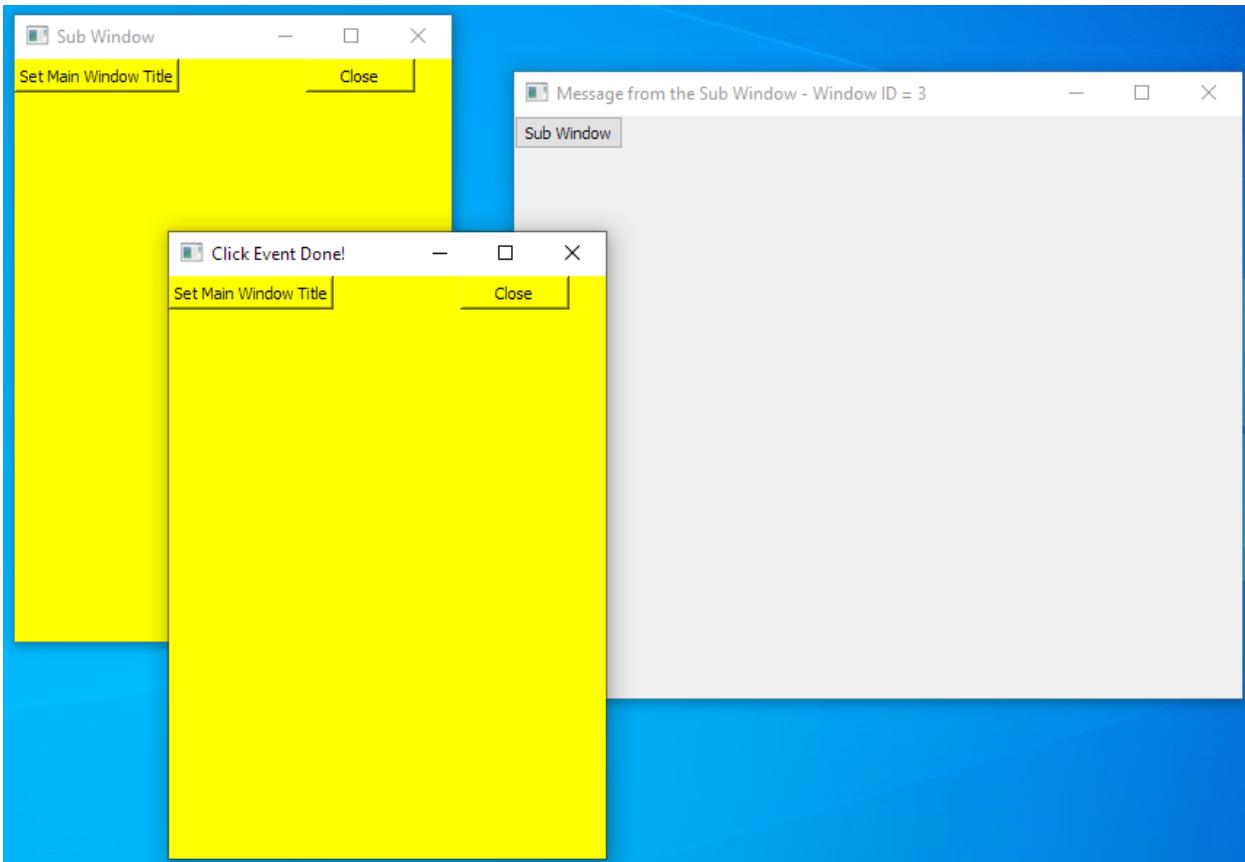
class MainWindowView from WindowsViewParent
    win = new QWidget() {
        setWindowTitle("Main Window")
        resize(500,400)
        btnSub = new QPushButton(win) {
            setText("Sub Window")
            setClickEvent( Method( :SubWindowAction,
→ ) )
        }
    }

class SubWindowController from WindowsControllerParent
    oView = new SubWindowView
    func SetMainWindowTitleAction
        MainWindow().oView.win.setWindowTitle(
            "Message from the Sub Window - Window ID = " + ObjectID()
        )
        oView.win.setWindowTitle("Click Event Done!")

class SubWindowView from WindowsViewParent
    win = new QWidget() {
        setWindowTitle("Sub Window")
        resize(300,400)
        btnMsg = new QPushButton(win) {
            setText("Set Main Window Title")
            setClickEvent( Method(
→ :SetMainWindowTitleAction ) )
        }
        btnClose = new QPushButton(win) {
            Move(200,0)
            setText("Close")
            setClickEvent( Method( :CloseAction ) )
        }
    }
}

```

Screen Shot:



48.7 Objects Library Source Code

The library source code is very simple, You can check the source code files

The source code for the Objects Library (can be used without GUILib)

- <https://github.com/ring-lang/ring/blob/master/libraries/objectslib/objects.ring>
- <https://github.com/ring-lang/ring/blob/master/libraries/objectslib/objectslib.ring>

The source code for the MVC classes in GUILib

- <https://github.com/ring-lang/ring/blob/master/libraries/guilib/mvc/controllerparent.ring>
- <https://github.com/ring-lang/ring/blob/master/libraries/guilib/mvc/viewparent.ring>

MULTI-LANGUAGE APPLICATIONS

There are many ways to create multi-language Ring application!

In this chapter we will learn about using the String2Constant tool

49.1 Using String2Constant

Starting from Ring 1.8 we have the String2Constant application

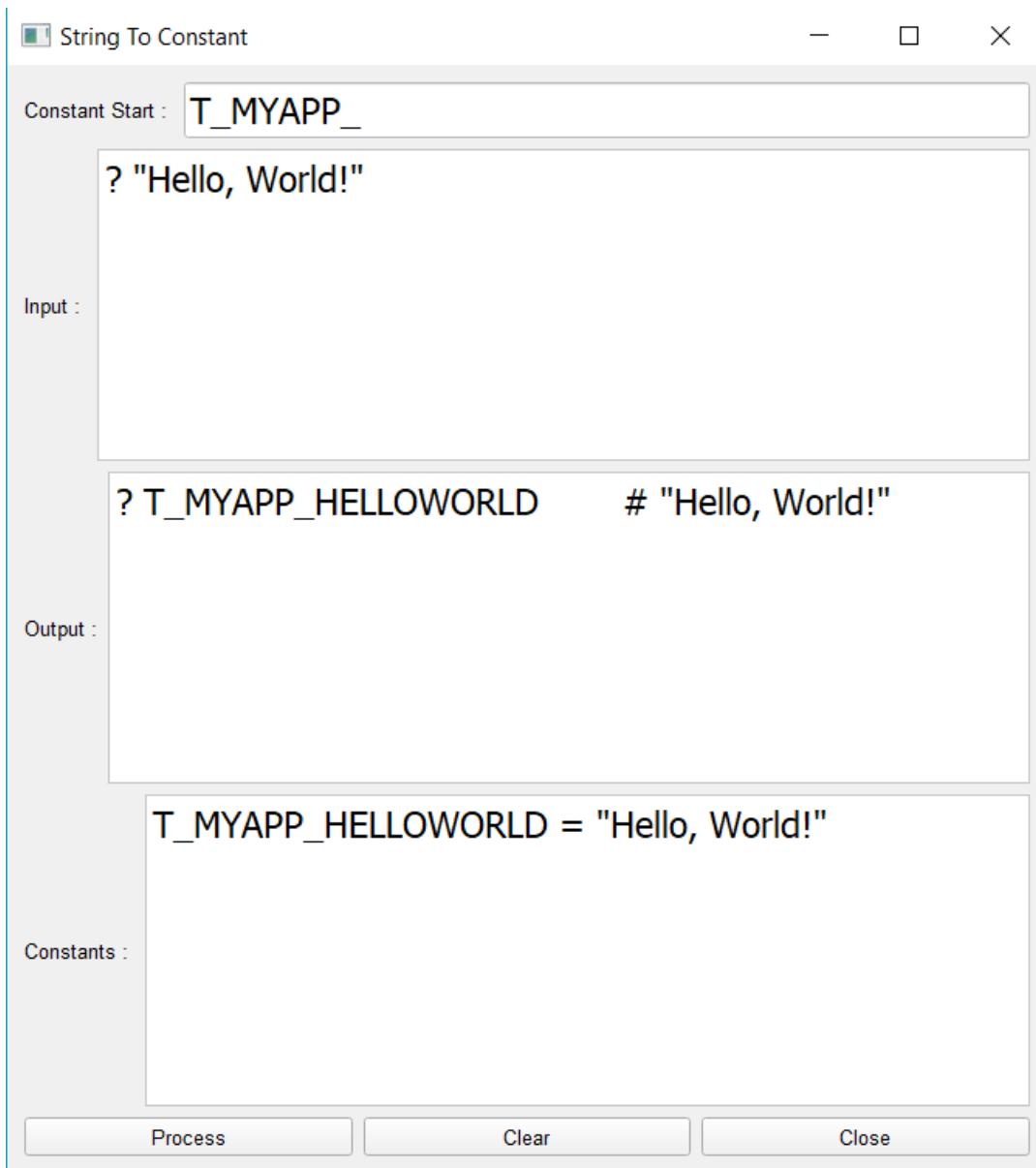
You will find this tool in the ring/tools/string2constant folder

Using this tool we can convert the source code to be based on constants instead of string literals

Then we can store constants in separate source code files that we can translate to different languages

Where we can have special file for each language, like (English.ring, Arabic.ring and so on)

Using this simple tool, the Form Designer is translated to Arabic language too just as an example.



49.2 Form Designer Translation

You will find the form designer application in the ring/applications/formdesigner folder

The files used for translation are stored in the ring/applications/formdesigner/translation folder

You will find two files

- Arabic.ring
- English.ring

You can check these files to get an idea about constants definition.

The next section from the English.ring file

```

T_LANGUAGE = "english"
T_LAYOUTDIRECTION = 0 # Left to Right

T_FORMDESIGNER_FORMDESIGNER = "Form Designer"
T_FORMDESIGNER_FORMTITLE = "Form1"

T_FORMDESIGNER_FILE = "File"
T_FORMDESIGNER_NEW = "New"
T_FORMDESIGNER_OPEN = "Open"
T_FORMDESIGNER_SAVE = "Save"
T_FORMDESIGNER_SAVEAS = "Save As"
T_FORMDESIGNER_CLOSE = "Close"

```

The form designer source code files will use these constants instead of typing the string literals
the next section from the formdesigner/mainwindow/formdesignerview.ring

```

# Create the Main Window and use the Mdi Area
win = new QMainWindow() {
    setWindowTitle(T_FORMDESIGNER_FORMDESIGNER) # "Form Designer"
    setCentralWidget(this.oArea)
    setLayoutDirection(T_LAYOUTDIRECTION)
}

```

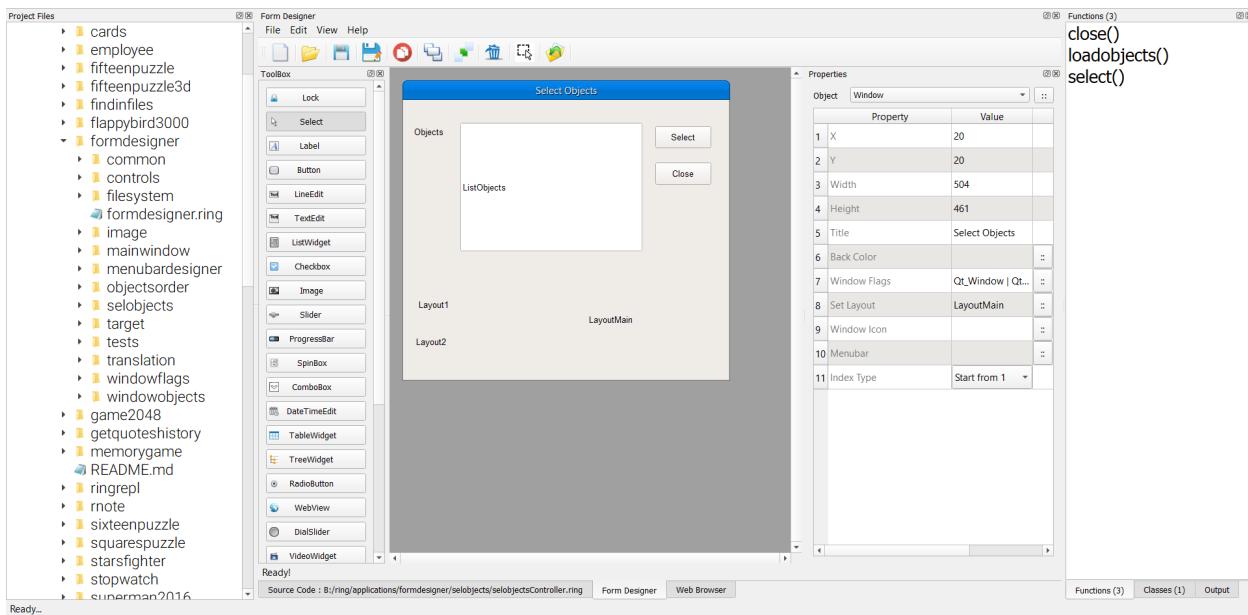
- Using comments we can write the string literal to get more readable code.
- Using setLayoutDirection() method we can set the window direction to be Right To Left.
- Using the Load command, We can determine which translation file to use.

49.3 Forms Translation

After creating the form using the Form Designer, the View class will be generated.

We don't modify the view class, We just add the translation through the Controller class.

For example, we have the form file : ring/formdesigner/selobjects/selobjects.rform



And we add the translation through the Controller class using the next code

And we define the constants in English.ring and Arabic.ring

```
class selobjectsController from windowsControllerParent

    oView = new selobjectsView {
        ListObjects.setSelectionMode(QAbstractItemView_MultiSelection)
        win.setWindowModality(2)
        # Translation
        win.setWindowTitle(T_FORMDESIGNER_SELOBJECTS_TITLE)
        win.setLayoutDirection(T_LAYOUTDIRECTION)
        labelObjects.setText(T_FORMDESIGNER_SELOBJECTS_OBJECTS)
        btnSelect.setText(T_FORMDESIGNER_SELOBJECTS_SELECT)
        btnClose.setText(T_FORMDESIGNER_SELOBJECTS_CLOSE)
    }
```

BUILDING RINGQT APPLICATIONS FOR MOBILE

In this chapter we will learn about Building RingQt Applications for Mobile.

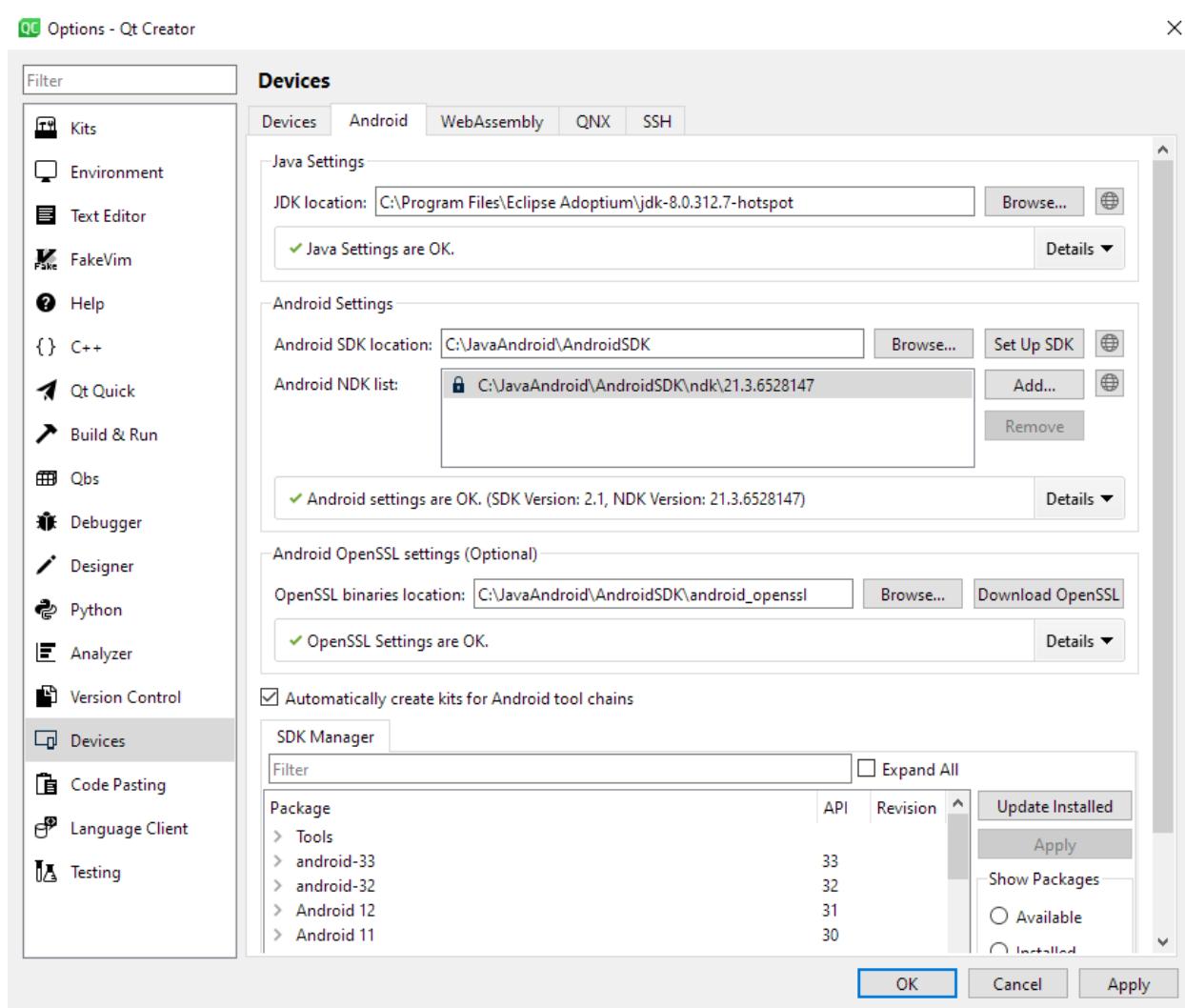
50.1 Download Requirements

- Install Qt 5.15.2
- Install Qt Creator (Tested using Qt Creator 6.0.1)

50.2 Install Qt for Android

- (1) Check the next link : <http://doc.qt.io/qt-5/androidgs.html>
 - Run Qt Creator
 - Select Tools > Options > Devices > Android
 - Set the path for JDK, Android NDK and Android SDK Tools
- (2) Using Qt Creator, We can download these requirements
 - The Android SDK Tools (Tested using version 2.1)
 - The Android NDK (Tested using version 21.3)
 - Java SE Development Kit (JDK) v6 or later
- (3) Update the Android SDK to get the API and tools packages required for development
 - Tested using Android 7.1 (API 25)

Screen Shot:



50.3 Using Ring2EXE

We can use Ring2EXE to quickly prepare Qt project for our application

Example:

```
ring2exe myapp.ring -dist -mobileqt
```

Note: We can use the Distribute Menu in Ring Notepad

Tip: The option (Prepare Qt project for Mobile devices) in the Distribute Menu

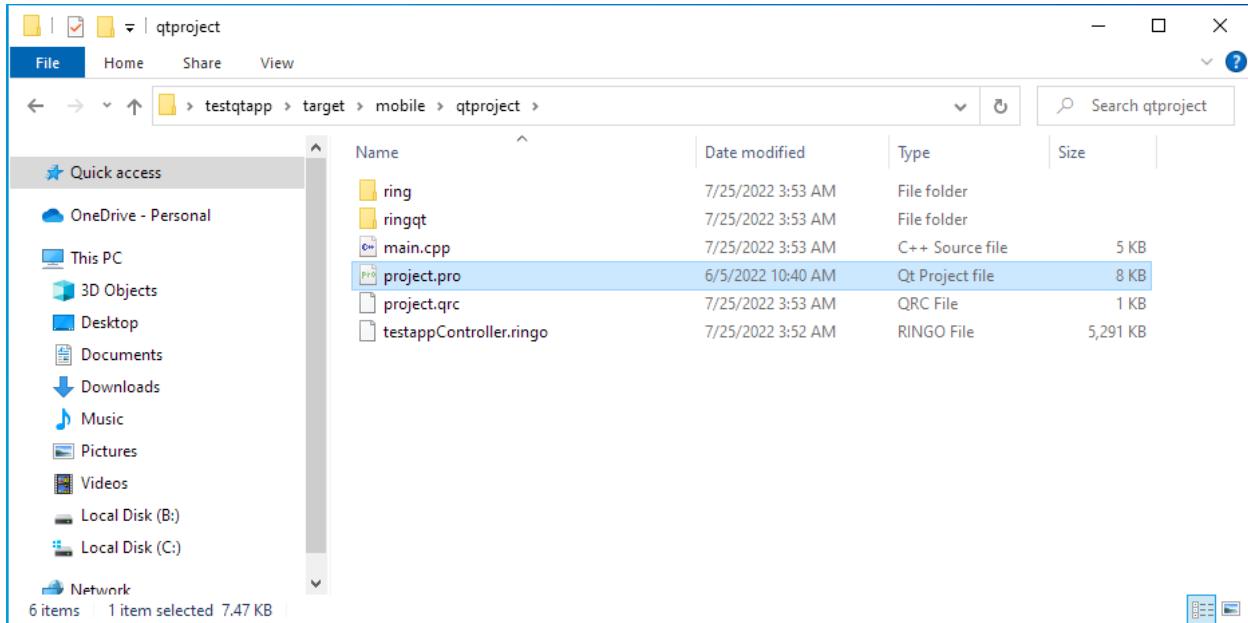
50.4 The Qt project for your Ring application

After using Ring2EXE or the Distribute Menu in Ring Notepad

- Using the Qt Creator Open the generated Qt project

Folder : target/mobile/qtproject

Project file : project.pro



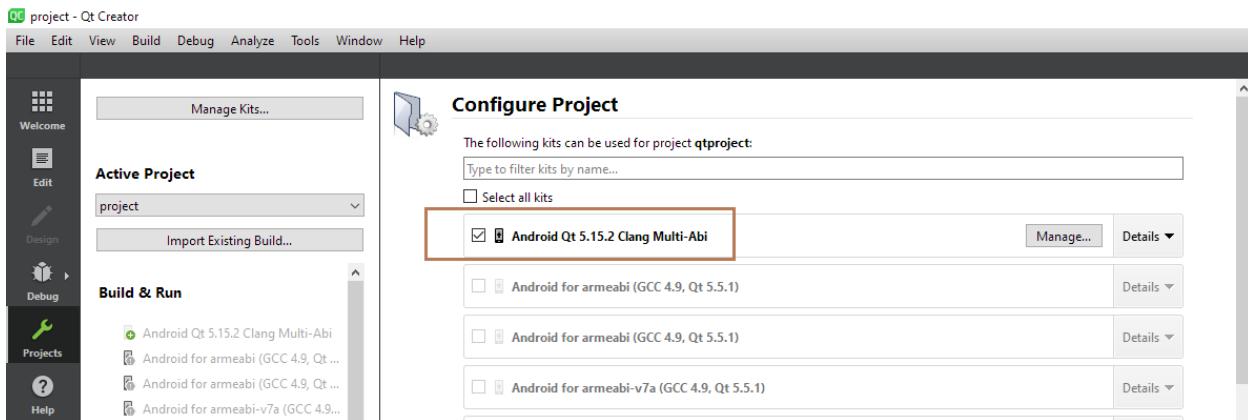
- Using Qt Creator, You will find the compiled Ring application in the resources (YourAppName.ringo)

This file (Ring Object File) is generated by the Ring compiler using

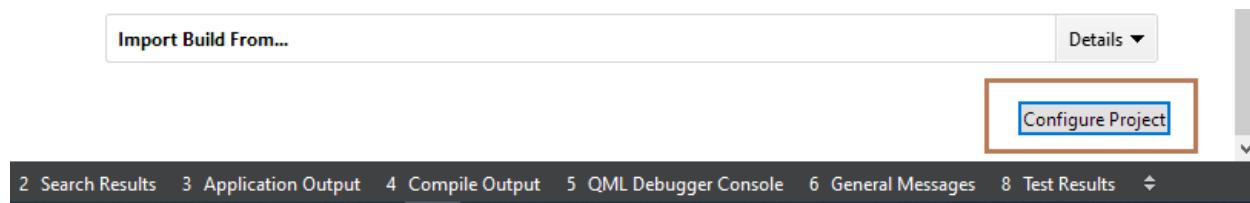
```
ring YourAppName.ring -go -norun
```

- You can build your application using Qt Creator

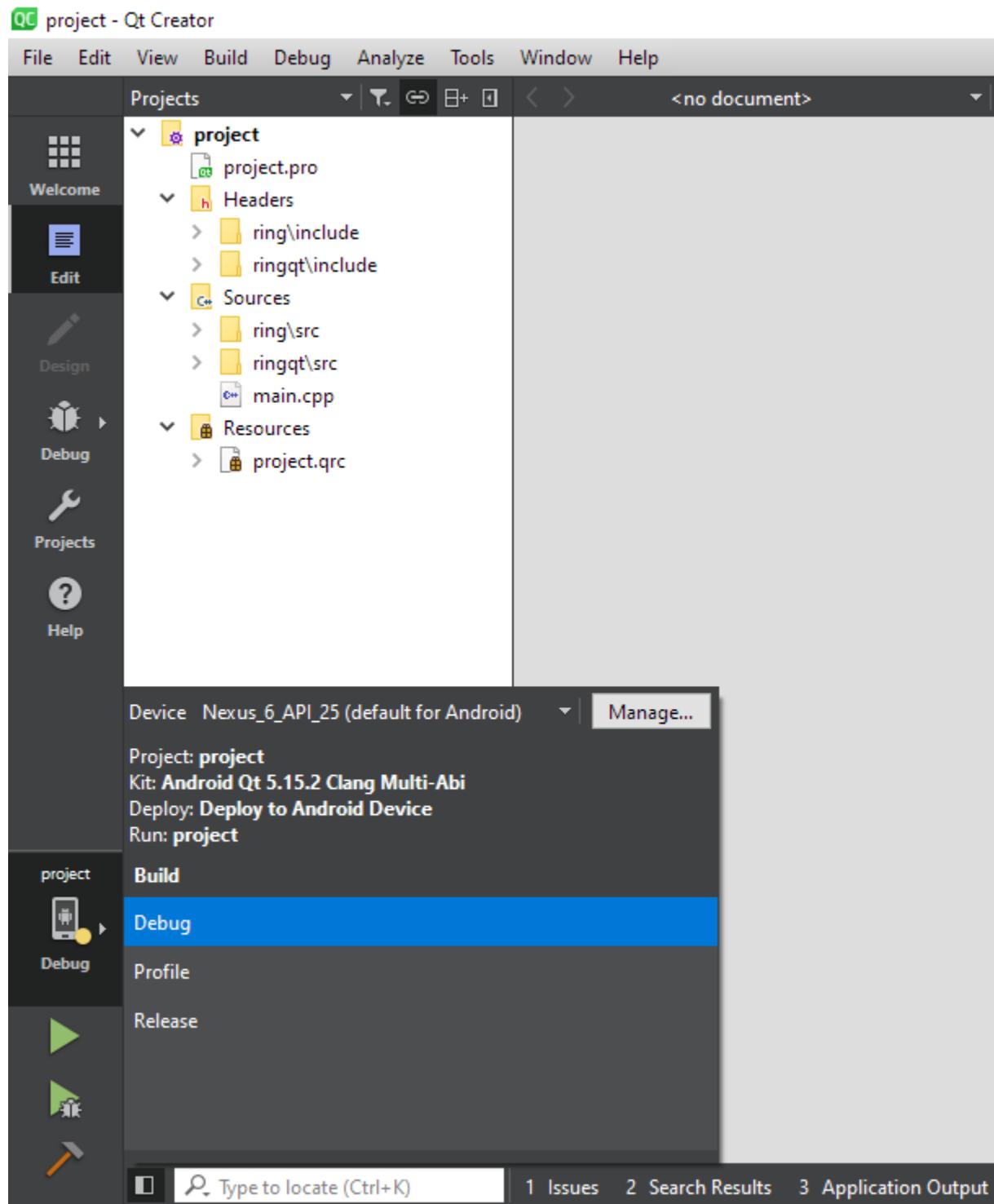
When we open the project file, We can select the Kit



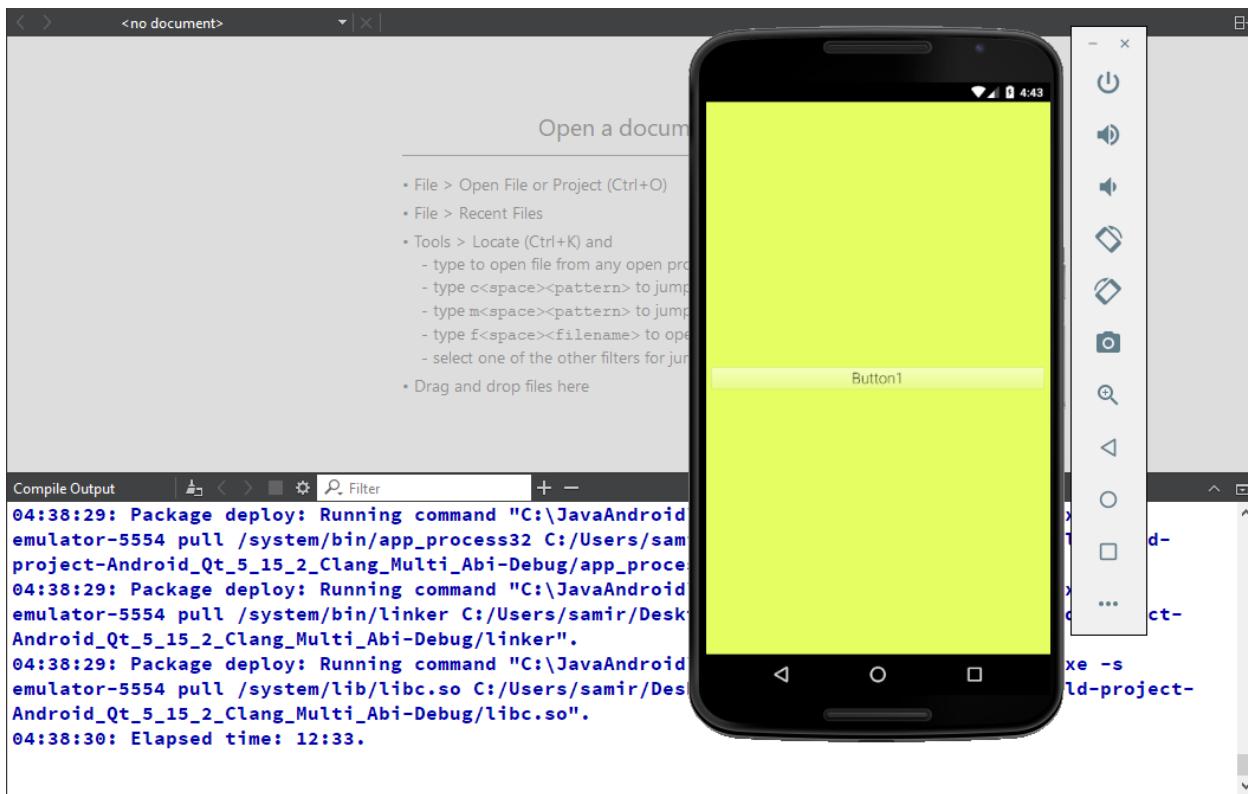
After selecting the Kit, Click Configure Project



Now We can build & Run the application



The next screen shot for the application during the runtime



(1) You can add your application images to the resources

Or You can use any text editor (Notepad) and modify : project.qrc

(2) To find images from your Ring application, You need to use the file name in resources

Example

```
if isandroid()
    mypic = new QPixmap(":/cards.jpg")
else
    mypic = new QPixmap("cards.jpg")
ok
```

50.5 Comments about developing for Android using RingQt

(1) The main project file is main.cpp

This file load Ring Compiler/Virtual Machine and RingQt

Then get the Ring Object File during the runtime from the resources

Then run the Ring Object File (ringapp.ringo) using the Ring VM

Through main.cpp you can extract more files from the resources to temp. folder once you add them (create projects with many files).

(2) The next functions are missing from this Ring edition

- Database (ODBC, SQLite & MySQL)
- Security and Internet functions (LibCurl & OpenSSL)

- RingAllegro (Allegro Library)
- RingLibSDL (LibSDL Library)

Just use Qt Classes through RingQt.

For database access use the QSqlDatabase Class

Note: All of the missing libraries (LibCurl, OpenSSL & Allegro) can be compiled for Android, but they are not included in this Qt project.

(3) use if isandroid() when you want to modify the code just for android

Example:

```
if isandroid()
    // Android code
else
    // other platforms
ok
```

(4) Sometimes you will find that the button text/image is repeated in drawing ! it's Qt problem that you can avoid using the next code.

```
if isandroid()
    setStyleSheet(
        "border-style: outset;
        border-width: 2px;
        border-radius: 4px;
        border-color: black;
        padding: 6px;")
ok
```

(5) Always use Layouts instead of manual setting of controls position and size.

This is the best way to get the expected user interface to avoid problems like (controls with small/extral size)

(6) When you deal with Qt Classes you can determine the images from resources (you don't need to copy them using main.cpp)

Example:

```
if isandroid()
    mypic = new QPixmap(":/cards.jpg")
else
    mypic = new QPixmap("cards.jpg")
ok
```

Now RingQt comes with the AppFile() function to determine the file name

Example:

```
mypic = new QPixmap(AppFile("cards.jpg")) # Desktop or Android
```

(7) When you update your project code, You don't have to use Ring2EXE to generate the Qt project again

Just use the Distribute Menu in Ring Notepad and select (Generate Ring Object File)

Then copy the YourAppName.ringo file to target/mobile/qtproject folder and accept replacing files.

(8) If your application folder contains a Qt resource file (project.qrc)

Then when you use Ring2EXE or Ring Notepad (Distribute - Prepare Qt project for Mobile devices) the resource file will be used

See ring/applications/cards game as an example.

BUILDING RINGQT APPLICATIONS FOR WEBASSEMBLY

In this chapter we will learn about Building RingQt Applications for WebAssembly.

51.1 Download Requirements

Check the next link : <https://doc.qt.io/qt-5/wasm.html>

Tested using

- Qt (5.15.2)
- Qt Creator (11.0.2)
- Emscripten (1.39.8) : https://emscripten.org/docs/getting_started/index.html

Use Git to have emsdk

```
# Get the emsdk repo
git clone https://github.com/emscripten-core/emsdk.git

# Enter that directory
cd emsdk
```

Use emsdk to install and activate the required version for Qt 5.15

```
emsdk install 1.39.8
emsdk activate --embedded 1.39.8
```

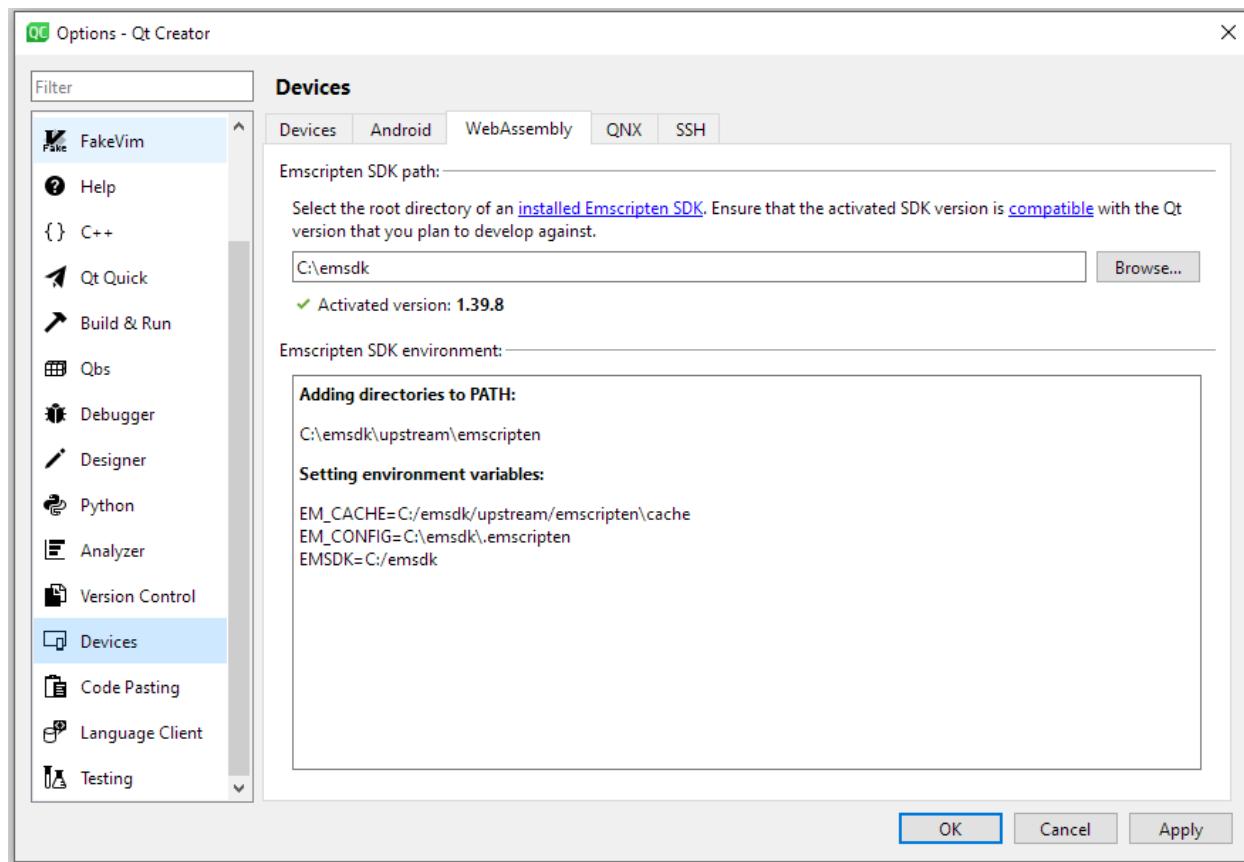
Check Emscripten installation

```
em++ --version
```

Output

```
emcc (Emscripten gcc/clang-like replacement) 1.39.8
(commit 24d88487f47629fac9d4acd231497a3a412bdee8)
Copyright (C) 2014 the Emscripten authors (see AUTHORS.txt)
This is free and open source software under the MIT license.
There is NO warranty; not even for MERCHANTABILITY or FITNESS FOR A
PARTICULAR PURPOSE.
```

- Run Qt Creator
- Select Tools > Options > Devices > WebAssembly



51.2 Using Ring2EXE

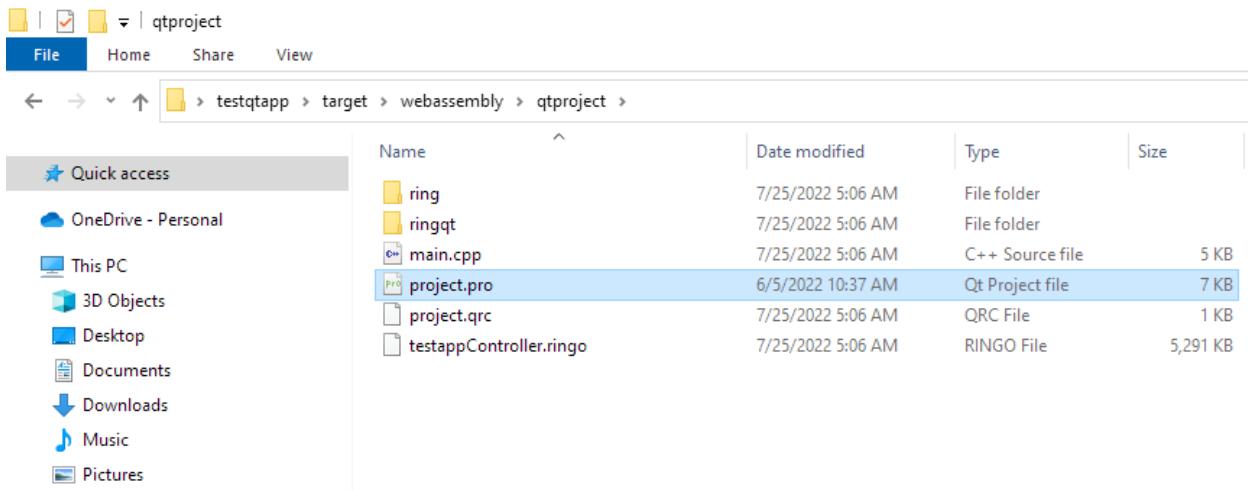
We can use Ring2EXE to quickly prepare Qt project for our application

Example:

```
ring2exe myapp.ring -dist -webassemblyqt
```

Note: We can use the Distribute Menu in Ring Notepad

Tip: The option (Prepare Qt project for WebAssembly) in the Distribute Menu



51.3 The Qt project for your Ring application

After using Ring2EXE or the Distribute Menu in Ring Notepad

- Using the Qt Creator Open the generated Qt project

Folder : target/webassembly/qtproject

Project file : project.pro

The screenshot shows the Qt Project Manager interface with a list of build configurations:

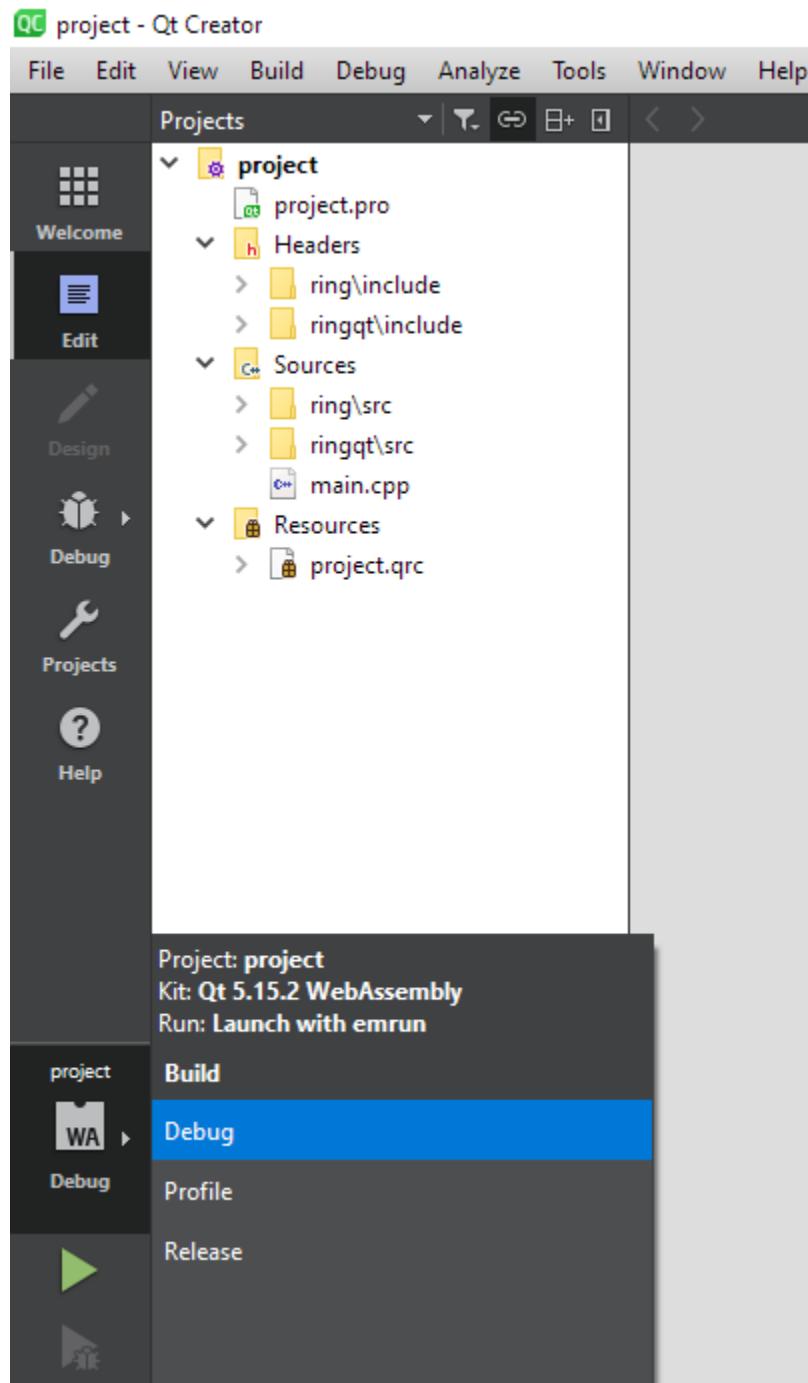
- Qt 5.15.2 WebAssembly** (selected, highlighted with a brown border)
- Qt 5.15.2 for UWP 32bit (MSVC 2019)
- Qt 5.15.2 for UWP 64bit (MSVC 2015)
- Qt 5.15.2 for UWP 64bit (MSVC 2019)
- Qt 5.15.2 for UWP ARMv7 (MSVC 2015)
- Qt 5.15.2 for UWP ARMv7 (MSVC 2019)
- Qt 5.5.1 (mingw492_32) - temporary
- Replacement for "Android for armeabi-v7a (Clang Qt 5.12.6 for Android ARMv7)"
- Replacement for "Android for armeabi-v7a (Clang Qt 5.12.6 for Android ARMv7)"2
- Replacement for "Desktop"
- Import Build From...**

A blue-bordered button labeled **Configure Project** is located at the bottom right of the configuration list.

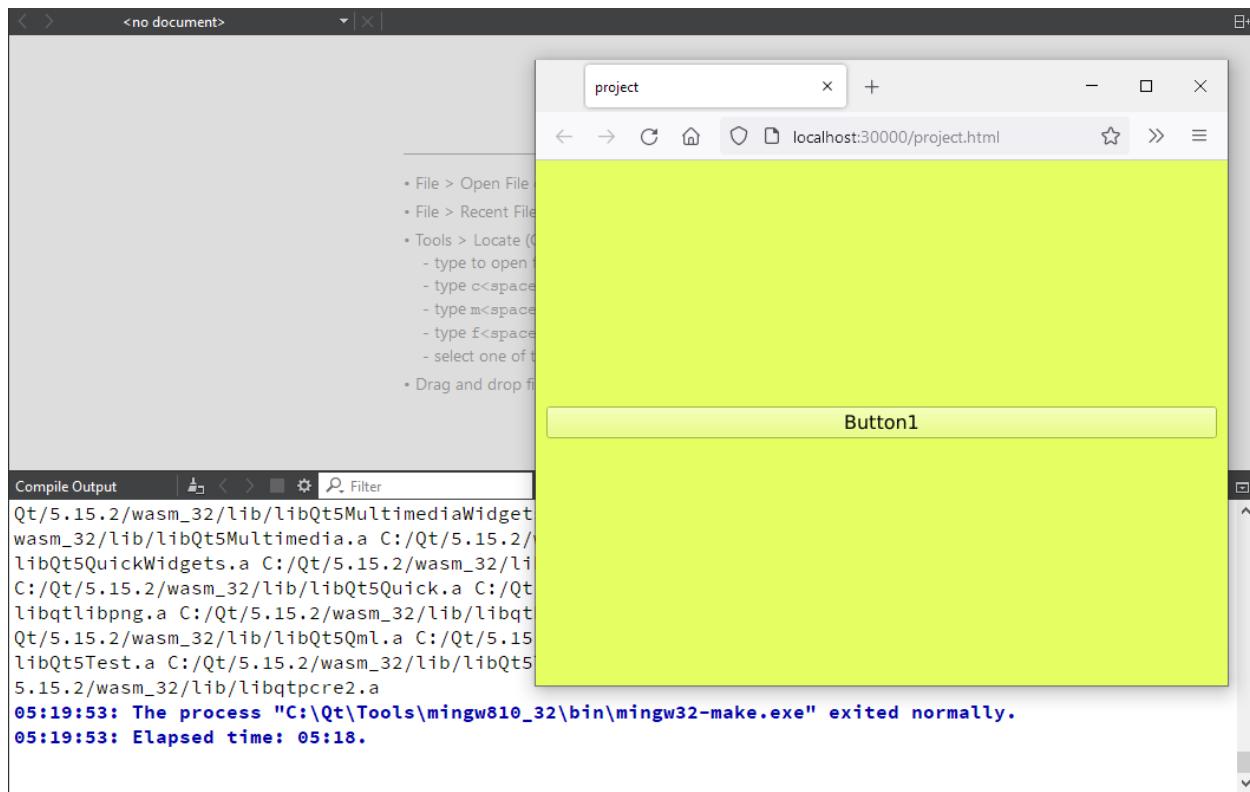
- Using Qt Creator, You will find the compiled Ring application in the resources (YourAppName.ringo)
This file (Ring Object File) is generated by the Ring compiler using

```
ring YourAppName.ringo -go -norun
```

- You can build your application using Qt Creator



The next screen shot for the application during the runtime



- (1) You can add your application images to the resources
 - Or You can use any text editor (Notepad) and modify : project.qrc
 - (2) To find images from your Ring application, You need to use the file name in resources

Example

```
if isWebAssembly()
    mypic = new QPixmap(":/cards.jpg")
else
    mypic = new QPixmap("cards.jpg")
ok
```

51.4 Comments about developing for WebAssembly using RingQt

- (1) The main project file is main.cpp

This file load Ring Compiler/Virtual Machine and RingQt

Then get the Ring Object File during the runtime from the resources

Then run the Ring Object File (ringapp.ringo) using the Ring VM

Through main.cpp you can extract more files from the resources to temp. folder once you add them (create projects with many files).

- (2) use if isWebAssembly() when you want to modify the code just for WebAssembly

Example:

```
if isWebAssembly()
    // WebAssembly code
else
    // other platforms
ok
```

- (3) When you deal with Qt Classes you can determine the images from resources (you don't need to copy them using main.cpp)

Example:

```
if isWebAssembly()
    mypic = new QPixmap(":/cards.jpg")
else
    mypic = new QPixmap("cards.jpg")
ok
```

Now RingQt comes with the AppFile() function to determine the file name

Example:

```
mypic = new QPixmap(AppFile("cards.jpg")) # Desktop, Android or WebAssembly
```

- (4) When you update your project code, You don't have to use Ring2EXE to generate the Qt project again

Just use the Distribute Menu in Ring Notepad and select (Generate Ring Object File)

Then copy the YourAppName.ringo file to target/webassembly/qtproject folder and accept replacing files.

- (5) If your application folder contains a Qt resource file (project.qrc)

Then when you use Ring2EXE or Ring Notepad (Distribute - Prepare Qt project for WebAssembly) the resource file will be used

See ring/applications/cards game as an example.

- (6) Use stdlibcore.ring instead of stdlib.ring when using StdLib functions

- (7) Use ClocksPerSecond() function instead of typing the value (1000)

- (8) Nested events loops are not supported, use events for dialogs instead of calling the exec() method

- (9) Using Sleep() or ProcessEvents() doesn't provide the expected results, use Qt Timers.

- (10) We don't have a direct access to the File System because the applications are executed in a secure environment

Tip: We can use special functions for Uploading/Downloading files (See FileContent sample)

51.5 Dialogs

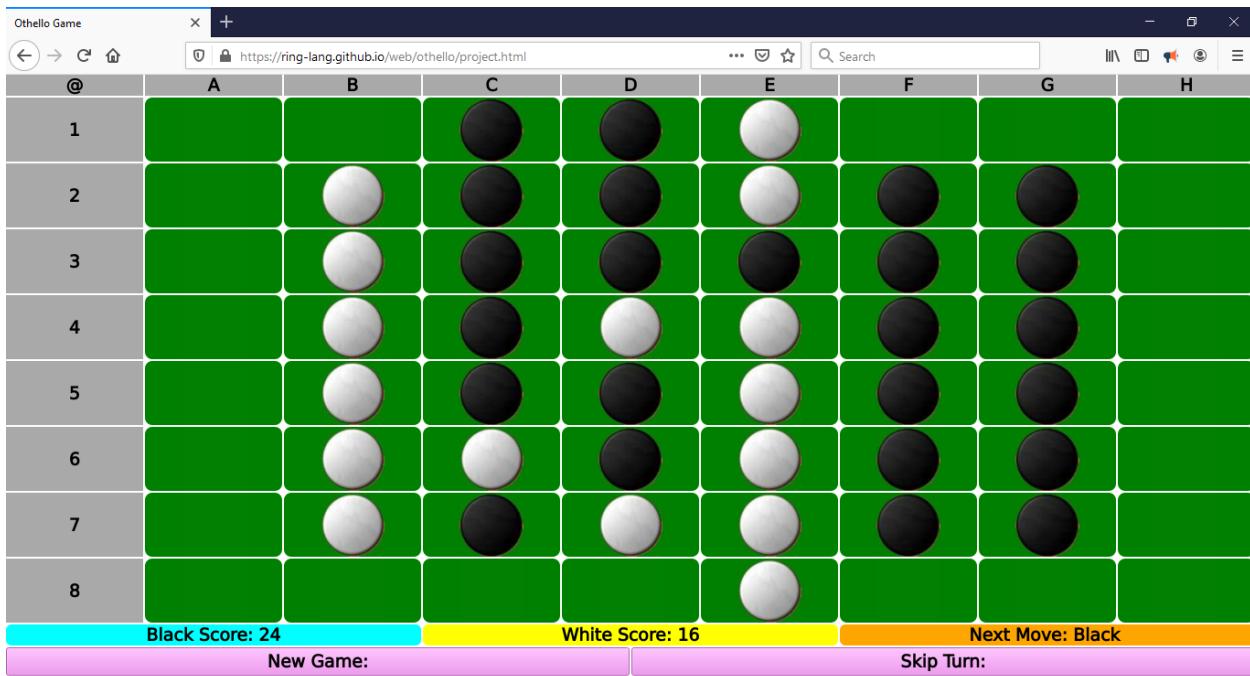
See the folder: ring/samples/UsingQtWASM

Folders:

- ColorDialog
- FontDialog
- FileDialog
- FileContent

51.6 Online Applications

- Hello World : <https://ring-lang.github.io/web/helloworld/project.html>
- Matching Game : <https://ring-lang.github.io/web/matching/project.html>
- Pairs Game : <https://ring-lang.github.io/web/pairs/project.html>
- Othello Game : <https://ring-lang.github.io/web/othello/project.html>
- Game of Life : <https://ring-lang.github.io/web/gameoflife/project.html>
- Form Designer : <https://ring-lang.github.io/web/formdesigner/project.html>



CHAPTER
FIFTYTWO

WEB DEVELOPMENT (CGI LIBRARY)

In this chapter we will learn about developing Web applications using a CGI Library written in the Ring language.

52.1 Configure the Apache web server

In this section we will learn about using Ring with the Apache HTTP Server. We can also use Ring with any web server that supports CGI.

Note: If you are developing your application using Ring Notepad then there's no need to configure Apache manually.

52.1.1 Using XAMPP Apache web server

Here we will use the XAMPP application that has Apache web server already been included. You can download XAMPP package from this link

XAMPP : <https://www.apachefriends.org/download.html>

Install then open the configuration file from the XAMPP application or search for it in the following locations based on your operating system.

For Windows:

```
xampp\apache\conf\httpd.conf
```

For Linux:

```
/opt/lampp/etc/httpd.conf
```

For macOS:

```
/Applications/XAMPP/xamppfiles/etc/httpd.conf
```

Search for the next line and make sure that it's not commented

```
LoadModule cgi_module modules/mod_cgi.so
```

Search for : AddHandler cgi-script

Then add “.ring” to the supported cgi extensions

Example

```
AddHandler cgi-script .cgi .ring
```

Example

```
AddHandler cgi-script .cgi .pl .asp .ring
```

Restart/Start the server using XAMPP “Manage Servers” or “Services” section

Create your web applications in a directory supported by the web server.

For Windows:

```
xampp\htdocs\mywebapplicationfolder
```

For Linux:

```
/opt/lampp/htdocs/mywebapplicationfolder
```

For macOS:

```
Open XAMPP application then go to "Volumes" section
```

```
Mount the "/opt/lampp" volume
```

```
Open Finder then you will find it mounted as an IP address under "Locations" on the left ↴ menu
```

52.2 Setting the shebang line

For Ring files to run properly under CGI we need to set the shebang line to locate the executable file of Ring. So, Inside the source code file (*.ring), Add next line as the very first line in the file:

For Windows:

```
#!ring -cgi
```

For Linux:

```
#!/usr/bin/ring -cgi
```

For macOS:

```
#!/usr/local/bin/ring -cgi
```

Note: Change the previous line based on the path to ring executable in your machine

52.3 Grant Ring files execution permission

In Linux and Mac operating systems ring files cannot be run properly using CGI until we grant them executable permission. You can do that using the properties section of your preferred File manager or you can do it using Terminal as follow:

```
sudo chmod +x ringAppFile.ring
```

Note: If you are developing your application using Ring Notepad then this step will be done automatically.

52.4 Ring CGI Hello World Program

The next program is the Hello World program

For Windows:

```
#!ring -cgi
See "content-type: text/html" +nl+nl+
"Hello World!" + nl
```

For Linux:

```
#!/usr/bin/ring -cgi
See "content-type: text/html" +nl+nl+
"Hello World!" + nl
```

For macOS:

```
#!/usr/local/bin/ring -cgi
See "content-type: text/html" +nl+nl+
"Hello World!" + nl
```

52.5 Hello World Program using the Web Library

We can use the web library to write CGI Web applications quickly

Example (1) :

```
#!ring -cgi
Load "weplib.ring"
Import System.Web
New Page
{
```

(continues on next page)

(continued from previous page)

```
Text("Hello World!")
}
```

Example (2) :

```
#!ring -cgi
Load "weplib.ring"
Import System.Web
WebPage()
{
    Text("Hello World!")
}
```

Tip: the difference between ex. 1 and ex. 2 is using WebPage() function to return the page object instead of creating the object using new statement.

52.6 Web Library Features

The next features are provided by the Web library to quickly create web applications.

- Generate HTML pages using functions
- Generate HTML pages using objects
- HTTP Get
- HTTP Post
- Files Upload
- URL Encode
- Templates
- CRUD MVC Sample
- Users Logic & Registration Sample

52.7 HTTP Get Example

The Page User Interface

```
#!ring -cgi
Load "weplib.ring"
Import System.Web
New Page
{
    Title = "Test HTTP Get"
```

(continues on next page)

(continued from previous page)

```

divstart([ :style = StyleSizeFull() ] )
boxstart()
    text( "Test HTTP GET" )
    newline()
boxend()
divstart([ :style = Styledivcenter("600px","550px") +
           StyleGradient(21) ])
divstart([:style = stylefloatleft() + stylesize("100px","100%") +
           stylecolor("black") + stylegradient(58)])
formstart("ex5.ring")
    tablestart([ :style = stylesize("65%","90%") +
                  stylemarginleft("35%") +
                  stylemargintop("30%") ])
        rowstart([])
            cellstart([])
                text ( "Name : " )
            cellend()
            cellstart([])
                cTextboxStyle = StyleMarginLeft("5%") +
                    StyleWidth("250px") +
                    StyleColor("black") +
                    StyleBackColor("white")
                textbox([ :name = "Name", :style = cTextboxStyle ] )
            cellend()
        rowend()
        rowstart([])
            cellstart([])
                text ( "Address : " )
            cellend()
            cellstart([])
                textbox([ :name = "Address", :style = cTextboxStyle] )
            cellend()
        rowend()
        rowstart([])
            cellstart([])
                text ( "Phone : " )
            cellend()
            cellstart([])
                textbox([ :name = "Phone", :style = cTextboxStyle ] )
            cellend()
        rowend()
        rowstart([])
            cellstart([])
                text ( "Age : " )
            cellend()
            cellstart([])
                textbox([ :name = "Age", :style = cTextboxStyle ] )
            cellend()
        rowend()
        rowstart([])
            cellstart([])
                text ( "City: " )
            cellend()

```

(continues on next page)

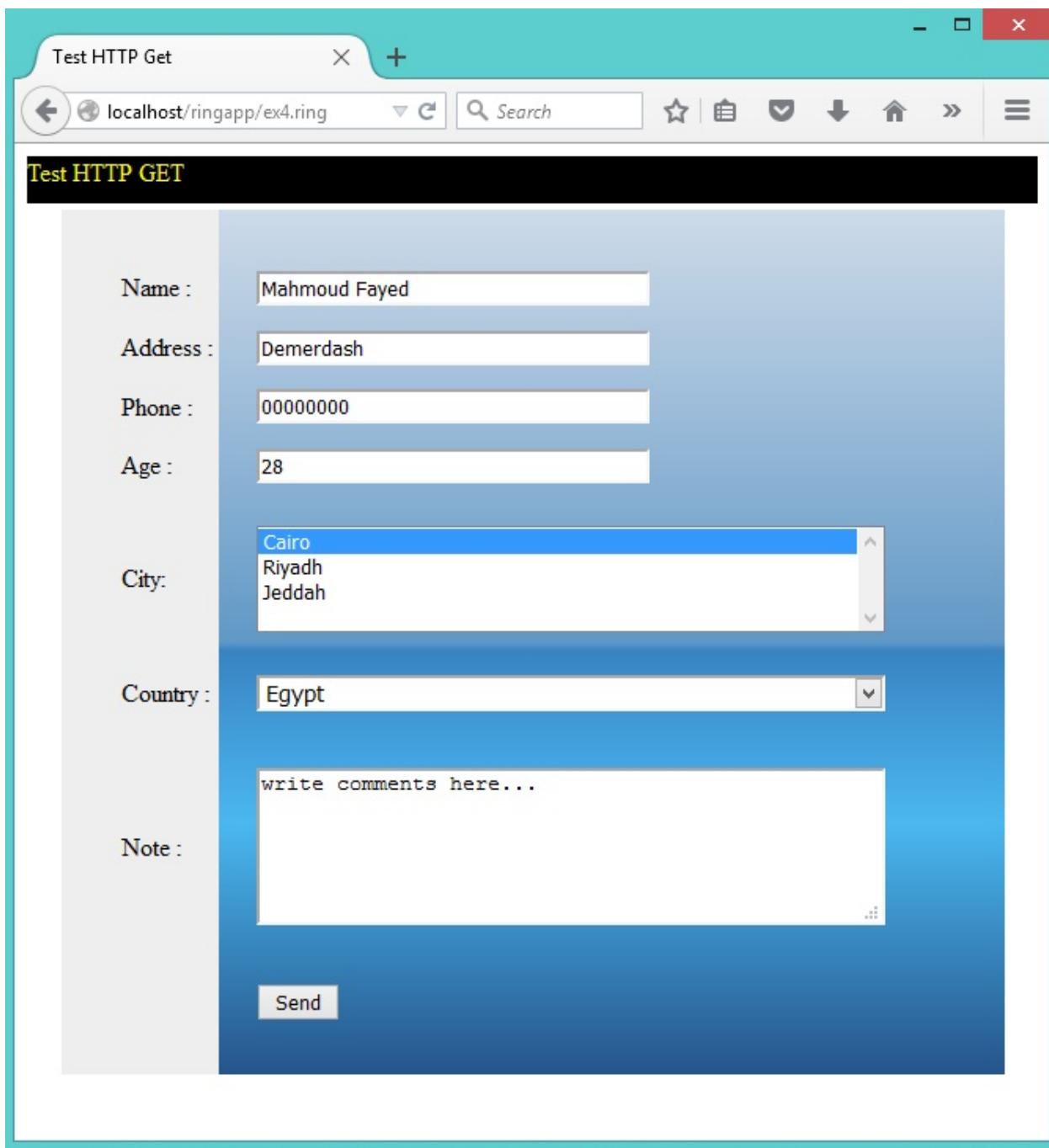
(continued from previous page)

```

cellend()
cellstart([])
    listbox([ :name = "City" , :items = ["Cairo","Riyadh","Jeddah"] ,
             :style = stylemarginleft("5%") + stylewidth("400px") ] )
cellend()
rowend()
rowstart([])
    cellstart([])
        text ( "Country : " )
    cellend()
    cellstart([])
        combobox([ :name = "Country" ,
                   :items = ["Egypt","Saudi Arabia","USA"] ,
                   :style = stylemarginleft("5%") +
                           stylewidth("400px")+
                           stylecolor("black")+
                           stylebackcolor("white")+
                           stylefontsize("14px") ] )
    cellend()
rowend()
rowstart([])
    cellstart([])
        text ( "Note : " )
    cellend()
    cellstart([])
        editbox([ :name = "Notes" ,
                  :style = stylemarginleft("5%") +
                           stylesize("400px","100px")+
                           stylecolor("black")+
                           stylebackcolor("white") ,
                  :value = "write comments here..." ] )
    cellend()
rowend()
rowstart([])
    cellstart([])
    cellend()
    cellstart([])
        submit([ :value = "Send" , :Style = stylemarginleft("5%") ])
    cellend()
rowend()
tableend()
formend()
divend()
divend()
divend()
}

```

Screen Shot:



The Response

```
#!/ring -cgi
Load "weplib.ring"
Import System.Web
New Page
{
    divstart[ :style = styledivcenter("800px", "500px") ]
    boxstart()
        text ( "HTTP GET Response" )  newline()
```

(continues on next page)

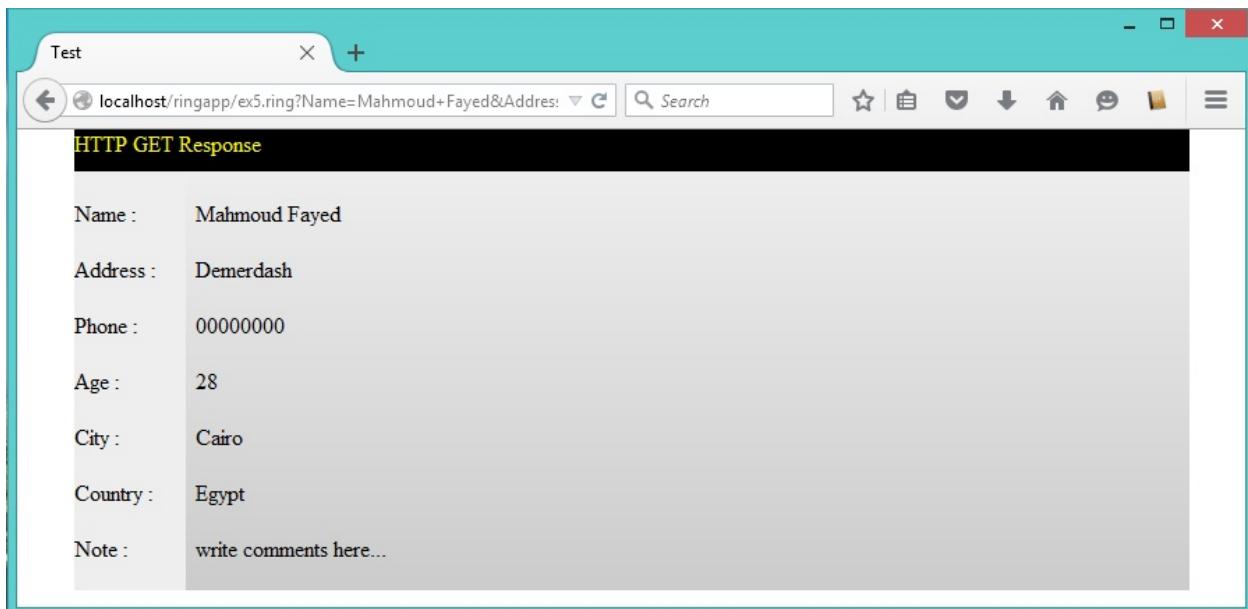
(continued from previous page)

```

boxend()
divstart([ :style = stylefloatleft()+stylewidth("10%")+
           stylecolor("black")+stylegradient(58) ])
    newline()
    text ( "Name : " )
    newline() newline()
    text ( "Address : " )
    newline() newline()
    text ( "Phone : " )
    newline() newline()
    text ( "Age : " )
    newline() newline()
    text ( "City : " )
    newline() newline()
    text ( "Country : " )
    newline() newline()
    text ( "Note : " )
    newline() newline()
divend()
divstart([ :style = stylefloatleft()+stylewidth("90%")+
           stylecolor("black")+stylegradient(47) ])
    divstart([ :style = stylefloatleft() + stylewidth("1%") ])
        newline()
    divend()
    divstart([ :style = stylefloatleft() + stylewidth("95%") ])
        newline()
        text ( aPageVars["Name"] )
        newline() newline()
        text ( aPageVars["Address"] )
        newline() newline()
        text ( aPageVars["Phone"] )
        newline() newline()
        text ( aPageVars["Age"] )
        newline() newline()
        text ( aPageVars["City"] )
        newline() newline()
        text ( aPageVars["Country"] )
        newline() newline()
        text ( aPageVars["Notes"] )
        newline() newline()
    divend()
divend()
divend()
}

```

Screen Shot:

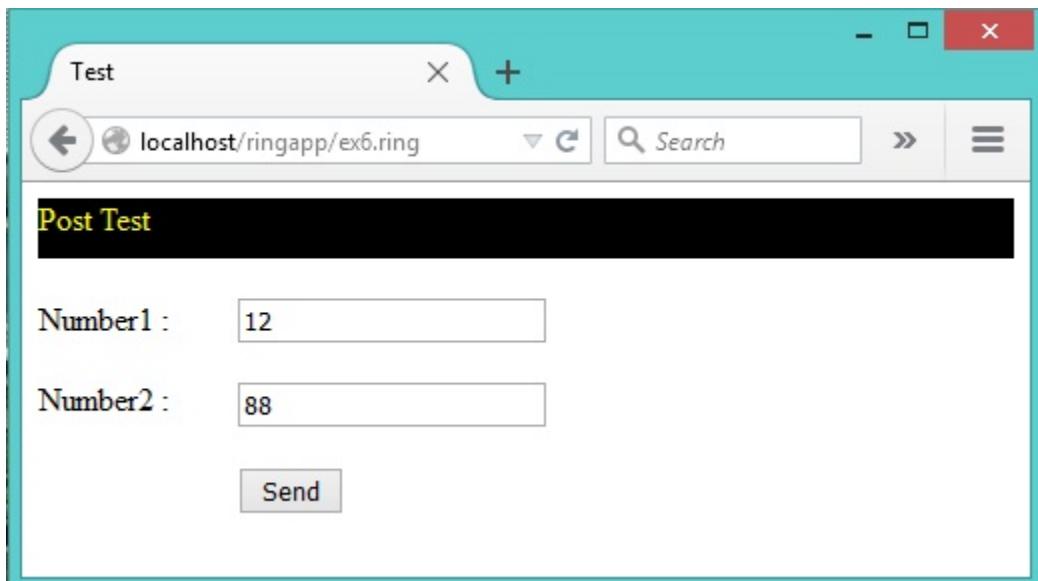


52.8 HTTP POST Example

The Page User Interface

```
#!/ring -cgi
Load "weblib.ring"
Import System.Web
New Page
{
    boxstart()
        text( "Post Test")
        newline()
    boxend()
    divstart([ :style=StyleFloatLeft()+StyleWidth("100px") ])
        newline()
        text( "Number1 : " )    newline() newline()
        text( "Number2 : " )    newline() newline()
    divend()
    formpost("ex7.ring")
        divstart([ :style = styleFloatLeft()+StyleWidth("200px") ])
            newline()
            textbox([ :name = "Number1" ])  newline() newline()
            textbox([ :name = "Number2" ])  newline() newline()
            submit([ :value = "Send" ] )
        divend()
    formend()
}
```

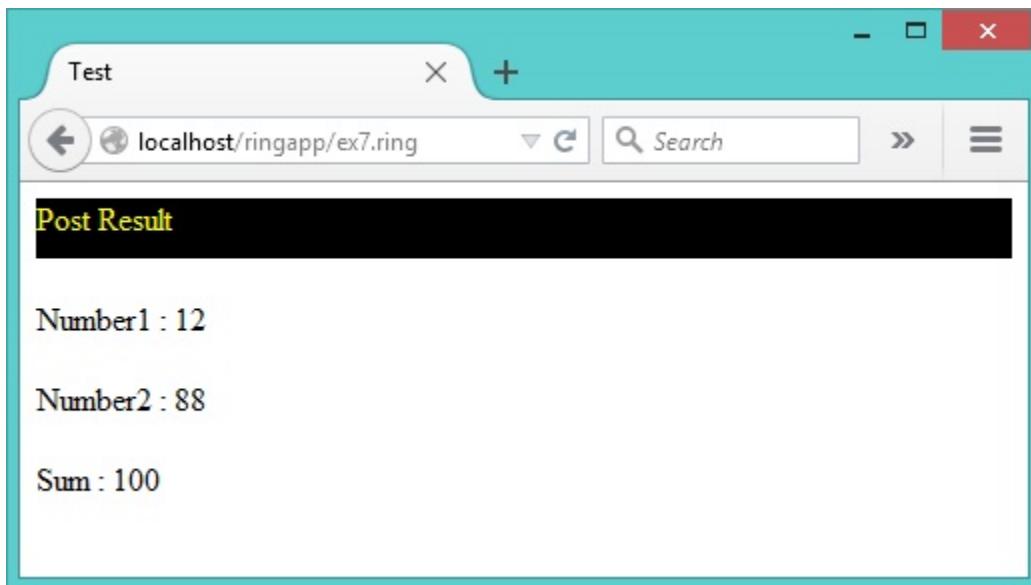
Screen Shot:



The Response

```
#!/ring -cgi
Load "weplib.ring"
Import System.Web
New Page
{
    boxstart()
        text( "Post Result" )
        newline()
    boxend()
    divstart([ :style = styleFloatLeft()+styleWidth("200px") ])
        newline()
        text( "Number1 : " + aPageVars["Number1"] )
        newline() newline()
        text( "Number2 : " + aPageVars["Number2"] )
        newline() newline()
        text( "Sum : " + (@ + aPageVars["Number1"] + aPageVars["Number2"] ) )
        newline()
    divend()
}
```

Screen Shot:

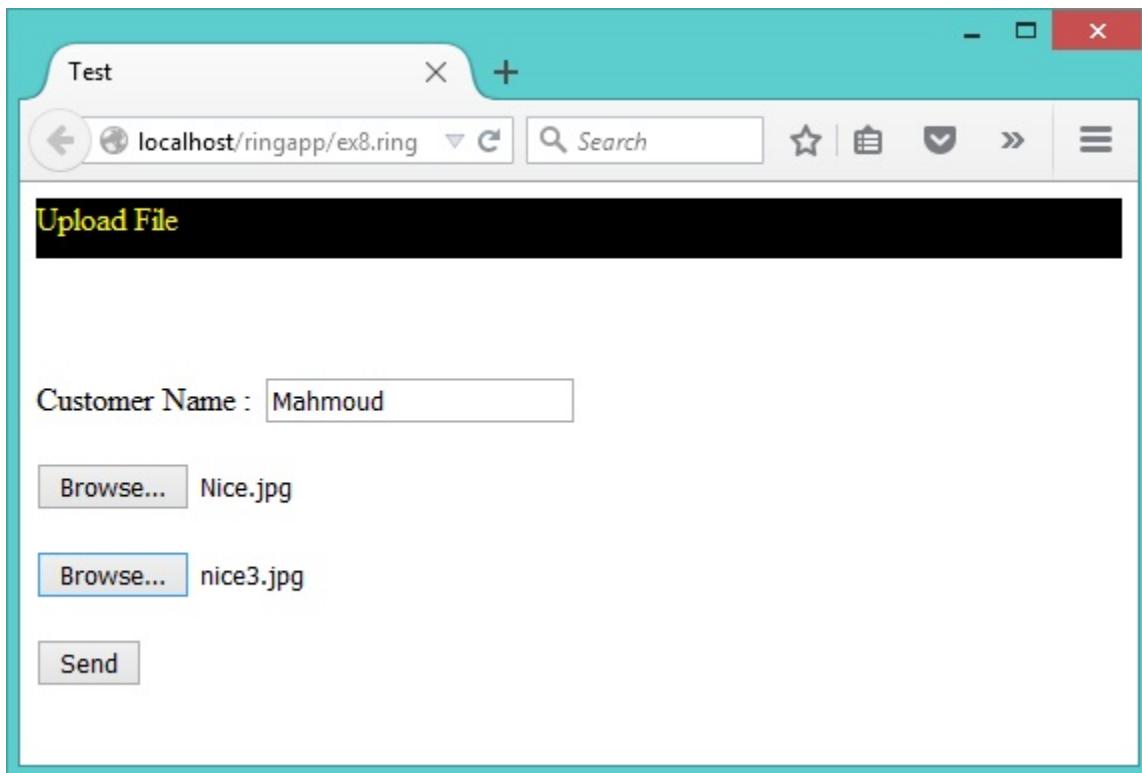


52.9 Upload Files

The Page User Interface

```
#!/ring -cgi
Load "weplib.ring"
Import System.Web
New page
{
    boxstart()
        text( "Upload File" )
        newline()
    boxend()
    for x = 1 to 3 newline() next
    formupload("ex9.ring")
        text( "Customer Name : " )
        textbox([ :name = "custname" ])
        newline() newline()
        divstart([ :style = styleFloatLeft() + styleWidth("90px") ])
            uploadfile("file") newline() newline()
            uploadfile("file2") newline() newline()
            submit([ :value = "Send" ])
        dividend()
    formend()
}
```

Screen Shot:



The Response

```

#!/ring -cgi
Load "weplib.ring"
Import System.Web

cUploadPath = "C:/Apache2.2/htdocs/ringapp/upload/"
cUploadFolder = "/ringapp/upload/"

New page
{
    boxstart()
        text( "Upload Result" )
        newline()
    boxend()
    newline()
    divstart([ :style= styleFloatLeft() + styleWidth("100px") ])
        text( "Name : " + aPageVars["custname"] )
        newline()
    divend()
    if aPageVars["file"] != char(13)
        getuploadedfile(self,"file")
    ok
    if aPageVars["file2"] != char(13)
        getuploadedfile(self,"file2")
    ok
}

Func getuploadedfile oObj,cFile

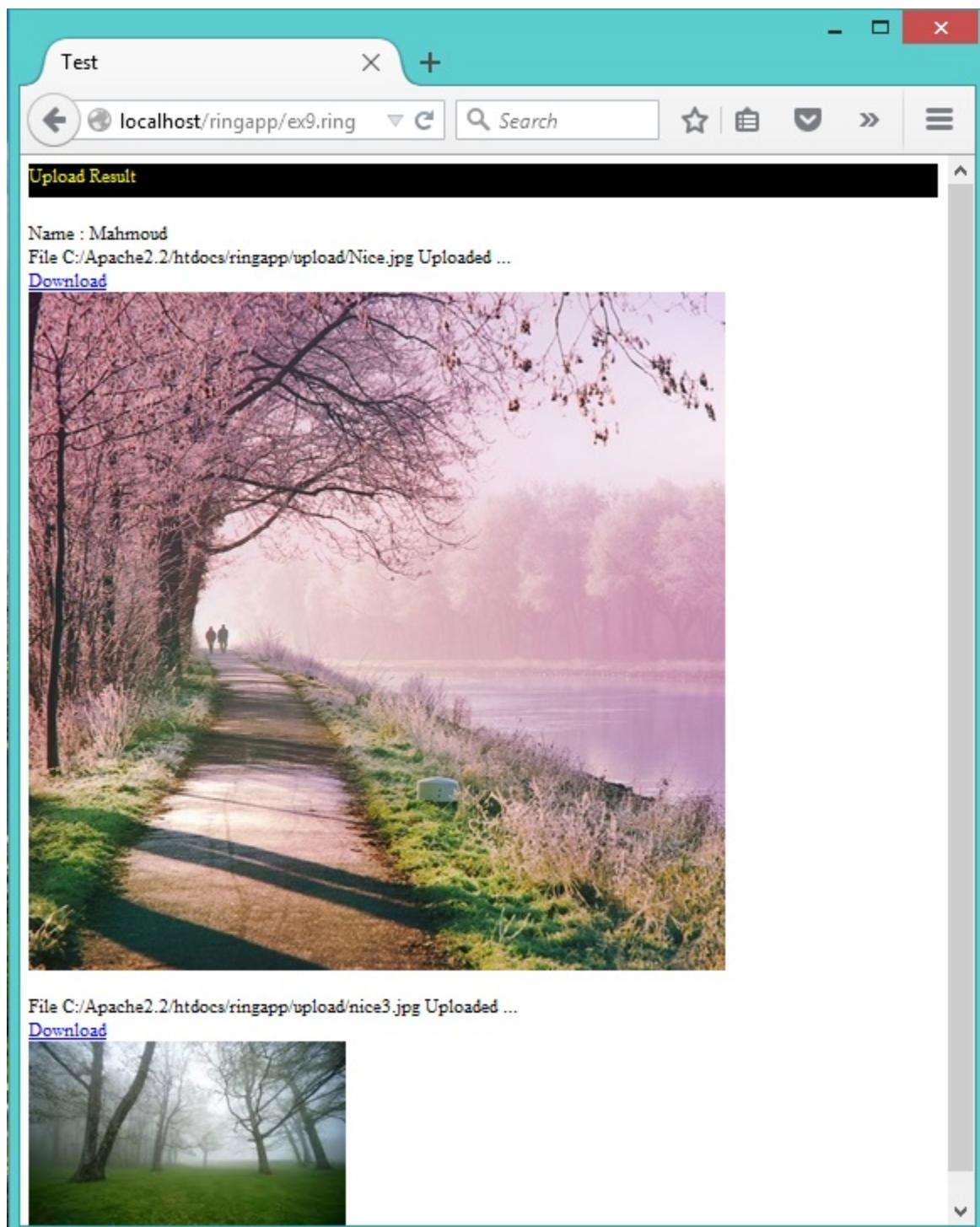
```

(continues on next page)

(continued from previous page)

```
# here we use object.property
# instead of object { } to avoid executing braceend method
cFileName = cUploadPath + oObj.getfilename(aPageVars,cFile)
write(cFileName,aPageVars[cFile])
system("chmod a+x "+cFileName)
oObj.newline()
oObj.text( "File "+cFileName+ " Uploaded . . ." )
oObj.newline()
imageURL = cUploadFolder + oObj.getfilename(aPageVars,cFile)
oObj.link([ :url = imageURL, :title = "Download" ])
oObj.newline()
oObj.image( [ :url = imageURL , :alt = :image ] )
oObj.newline()
```

Screen Shot:



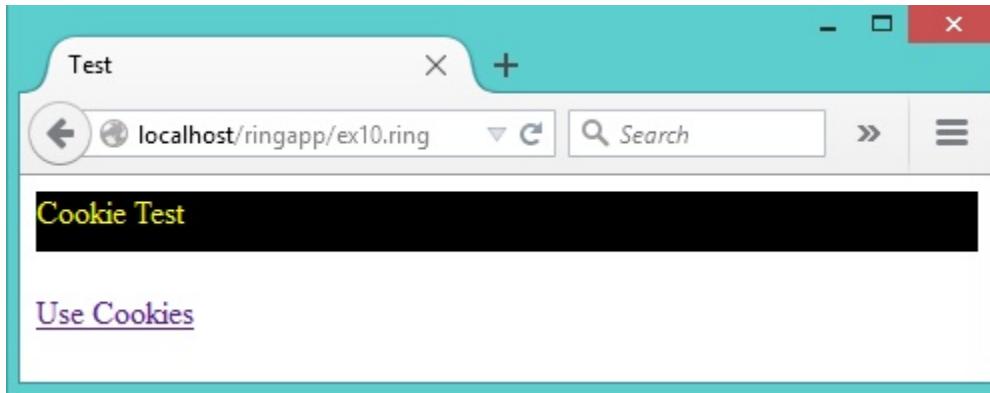
52.10 Cookies

The Page User Interface

```
#!/ring -cgi
Load "weplib.ring"
Import System.Web

New page
{
    boxstart()
        text( "Cookie Test" )
        newline()
    boxend()
    newline()
    link([ :url = "ex11.ring", :title = "Use Cookies" ])
    cookie("custname","Mahmoud Fayed")
    cookie("custage",28)
}
```

Screen Shot:



The Response

```
#!/ring -cgi
Load "weplib.ring"
Import System.Web

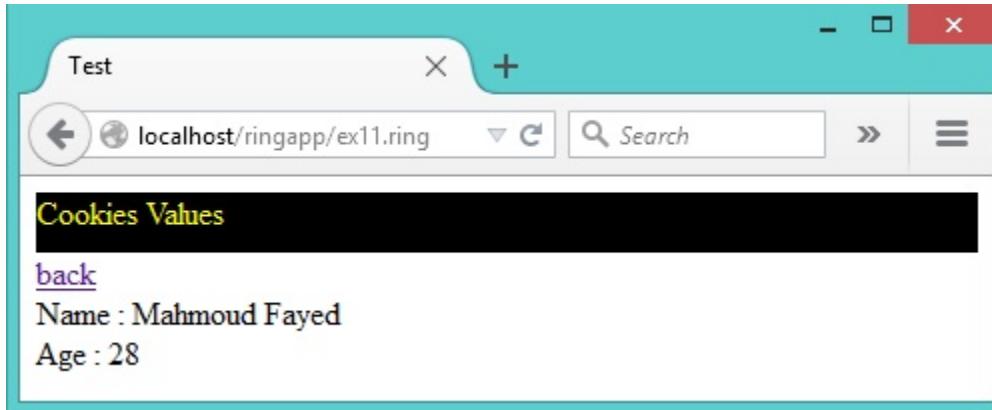
New Page
{
    boxstart()
        text( "Cookies Values" )
        newline()
    boxend()
    link([ :url = "ex10.ring", :title = "back" ])
    newline()
    divstart([:style="float:left;width:200px"])
        text( "Name : " + aPageVars["custname"] )
        newline()
        text( "Age : " + aPageVars["custage"] )
        newline()
}
```

(continues on next page)

(continued from previous page)

```
divend()
}
```

Screen Shot:



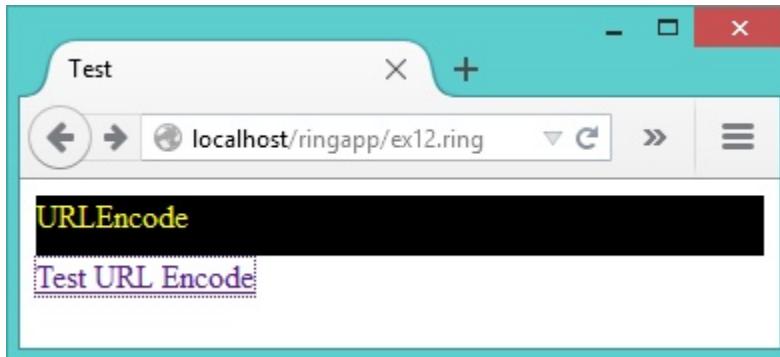
52.11 URL Encode

The Page User Interface

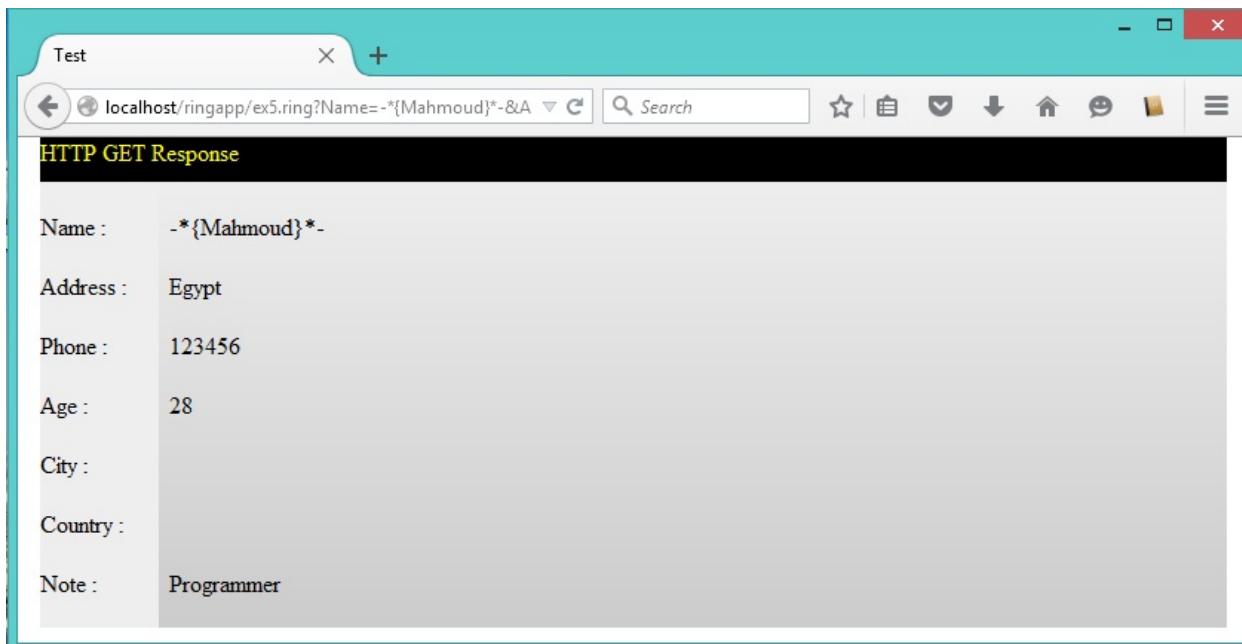
```
#!/ring -cgi
Load "weplib.ring"
Import System.Web

New Page
{
    boxstart()
        text( "URLEncode" )
        newline()
    boxend()
    link([ :url = "ex5.ring?Name="+URLEncode("-*{Mahmoud}*-")+
          "&Address=Egypt&Phone=123456&Age=28&Notes=Programmer",
          :title = "Test URL Encode" ])
}
```

Screen Shot:



Screen Shot:



52.12 Templates

Using Templates we can write Ring code inside HTML files

Syntax:

```
<%= Ring Expression %>
<% Ring Statements %>
```

The HTML Code

```
<h1>Listing Numbers</h1>


```

The Ring Code

```

#!/ring -cgi
Load "weplib.ring"
Import System.Web

New NumbersController { start() }

Class NumbersController

    MyHeader aNumbers

    Func Start

        MyHeader = New Header
        {
            cColumn1 = "Number" cColumn2 = "Square"
        }

        aNumbers = list(20)

        for x = 1 to len(aNumbers)
            aNumbers[x] = new number
            {
                nValue = x    nSquare = x*x
            }
        next

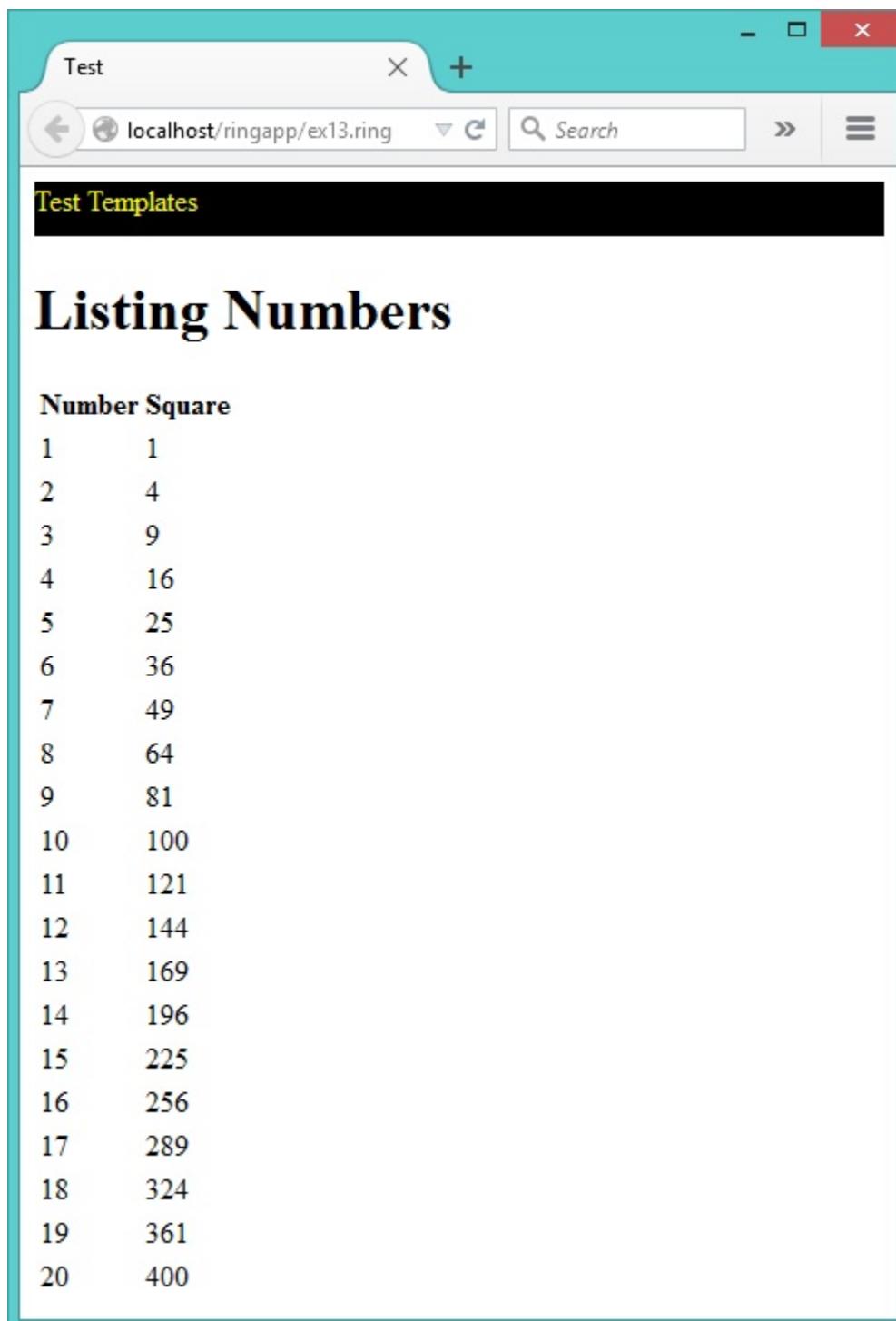
        cTemp = Template("mynumbers.html",self)

        New Page
        {
            boxstart()
                text( "Test Templates" )
                newline()
            boxend()
            html(cTemp)
        }
    }

Class Header cColumn1 cColumn2
Class Number nValue    nSquare

```

Screen Shot:



Listing Numbers

Number Square

1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100
11	121
12	144
13	169
14	196
15	225
16	256
17	289
18	324
19	361
20	400

52.13 HTML Special Characters

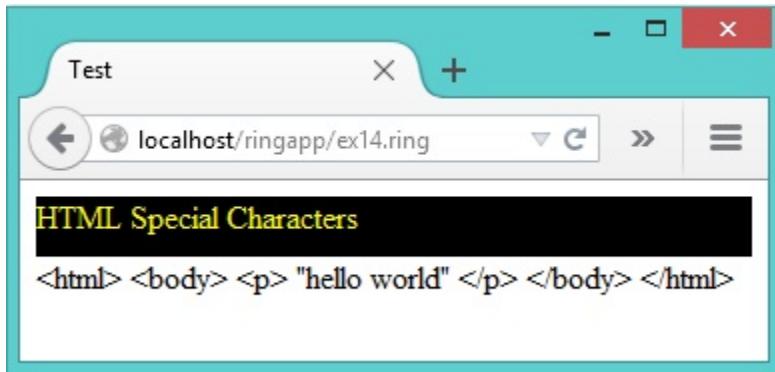
The `text()` function display HTML special characters.

If you want to write html code, use the `html()` function.

```
#!/ring -cgi
Load "weplib.ring"
Import System.Web

New Page
{
    boxstart()
        text("HTML Special Characters")
        newline()
    boxend()
    text('
        <html>
            <body>
                <p> "hello world" </p>
            </body>
        </html>
    ')
}
```

Screen Shot:



52.14 Hash Functions

The Page User Interface

```
#!/ring -cgi
Load "weplib.ring"
Import System.Web

New Page
{
    boxstart()
        text( "Hash Test")
        newline()
}
```

(continues on next page)

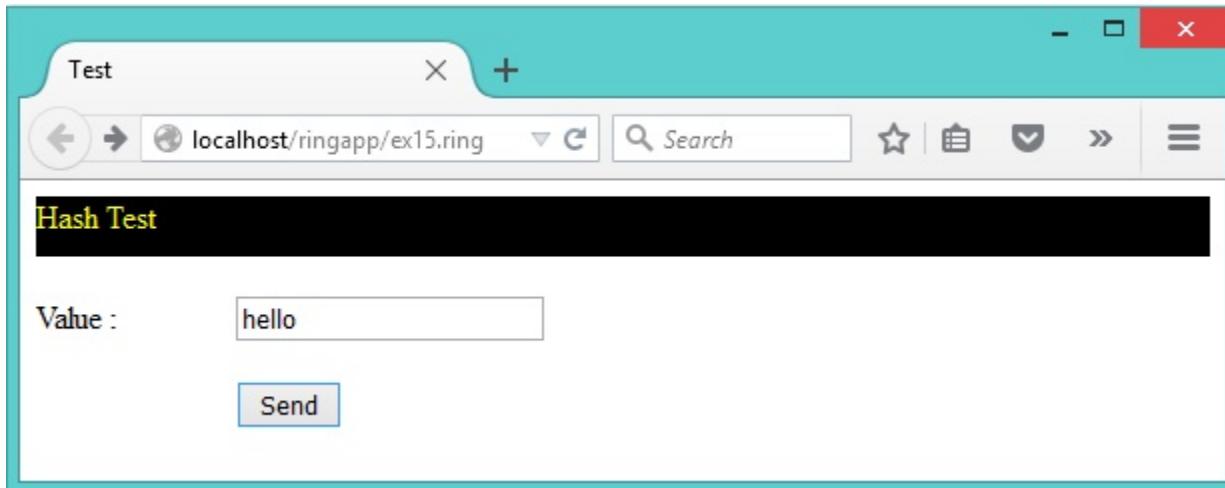
(continued from previous page)

```

boxend()
divstart([ :style = StyleFloatLeft() + StyleWidth("100px") ])
    newline()
    text( "Value : " )
    newline() newline()
divend()
formpost("ex16.ring")
    divstart([ :style = StyleFloatLeft() + StyleWidth("300px") ])
        newline()
        textbox([ :name = "Value" ])
        newline() newline()
        submit([ :value = "Send" ])
    divend()
formend()
}

```

Screen Shot:



The Response

```

#!ring -cgi
Load "weblib.ring"
Import System.Web

New Page
{
    boxstart()
        text( "Hash Result" )
        newline()
    boxend()
    divstart([ :style = styleFloatLeft() + styleWidth("100%") ])
        newline()
        text( "Value : " + aPageVars["Value"] )
        newline()
        text( "MD5 : " + MD5(aPageVars["Value"]) )
        newline()
        text( "SHA1 : " + SHA1(aPageVars["Value"]) )

```

(continues on next page)

(continued from previous page)

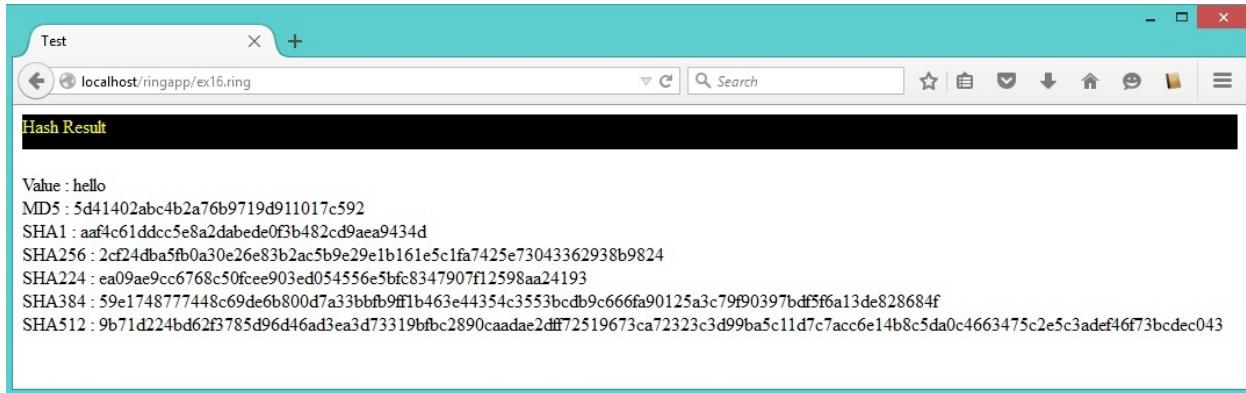
```

newline()
text( "SHA256 : " + SHA256(aPageVars["Value"]) )
newline()
text( "SHA224 : " + SHA224(aPageVars["Value"]) )
newline()
text( "SHA384 : " + SHA384(aPageVars["Value"]) )
newline()
text( "SHA512 : " + SHA512(aPageVars["Value"]) )
newline()

divend()
}

```

Screen Shot:



52.15 Random Image

```

#!/ring -cgi
Load "weplib.ring"
Import System.Web

cUploadPath = "C:/Apache2.2/htdocs/ringapp/upload/"

New Page
{
    boxstart()
        text( "Random Test")
        newline()
    boxend()
    divstart([ :style = styleFloatLeft() + styleWidth("400px") ])
        newline()
        aList = dir(cUploadPath)
        if len(aList) > 0
            nIndex = random(len(aList))
            if nIndex = 0 nIndex = 1 ok
            cItem = "upload/" + aList[nIndex][1]
            newline()
            image( [ :url = cItem , :alt = :image ] )

```

(continues on next page)

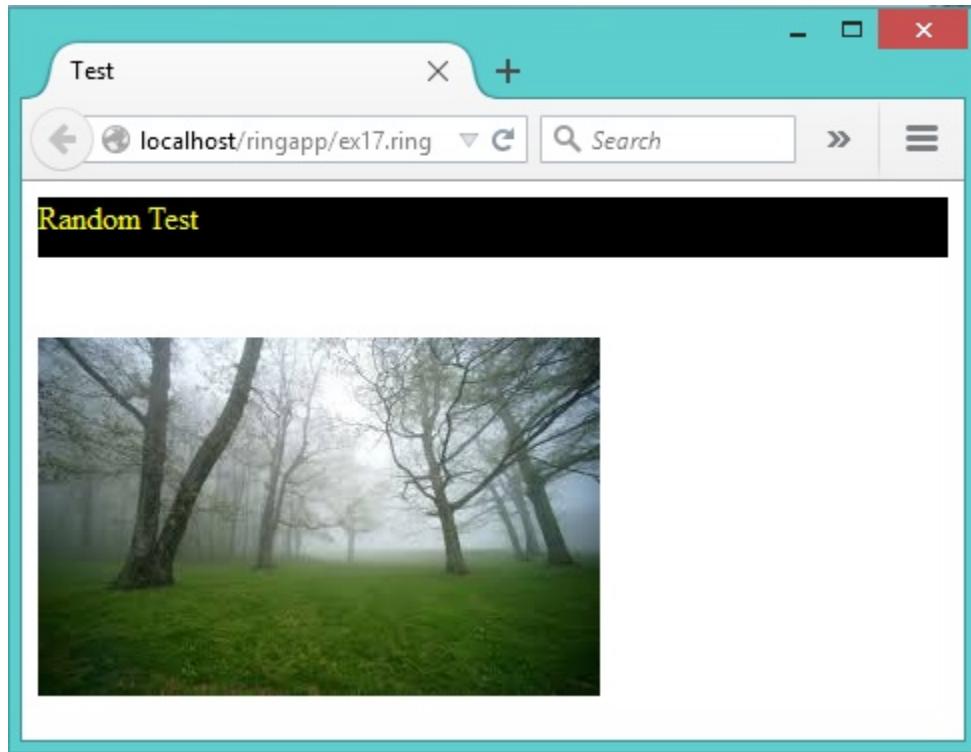
(continued from previous page)

```

    else
        text("No images!") newline()
    ok
divend()
}

```

Screen Shot:



52.16 HTML Lists

The next example print a list contains numbers from 1 to 10

Then print a list from Ring List.

Finally we have a list of buttons and when we press on a button we get a message contains the clicked button number.

To start the list we uses the ulstart() function.

To end the list we uses the ulend() function.

We uses liststart() and liend() to determine the list item.

```

#!ring -cgi
Load "weblib.ring"
Import System.Web

Func Main
    New Page
    {

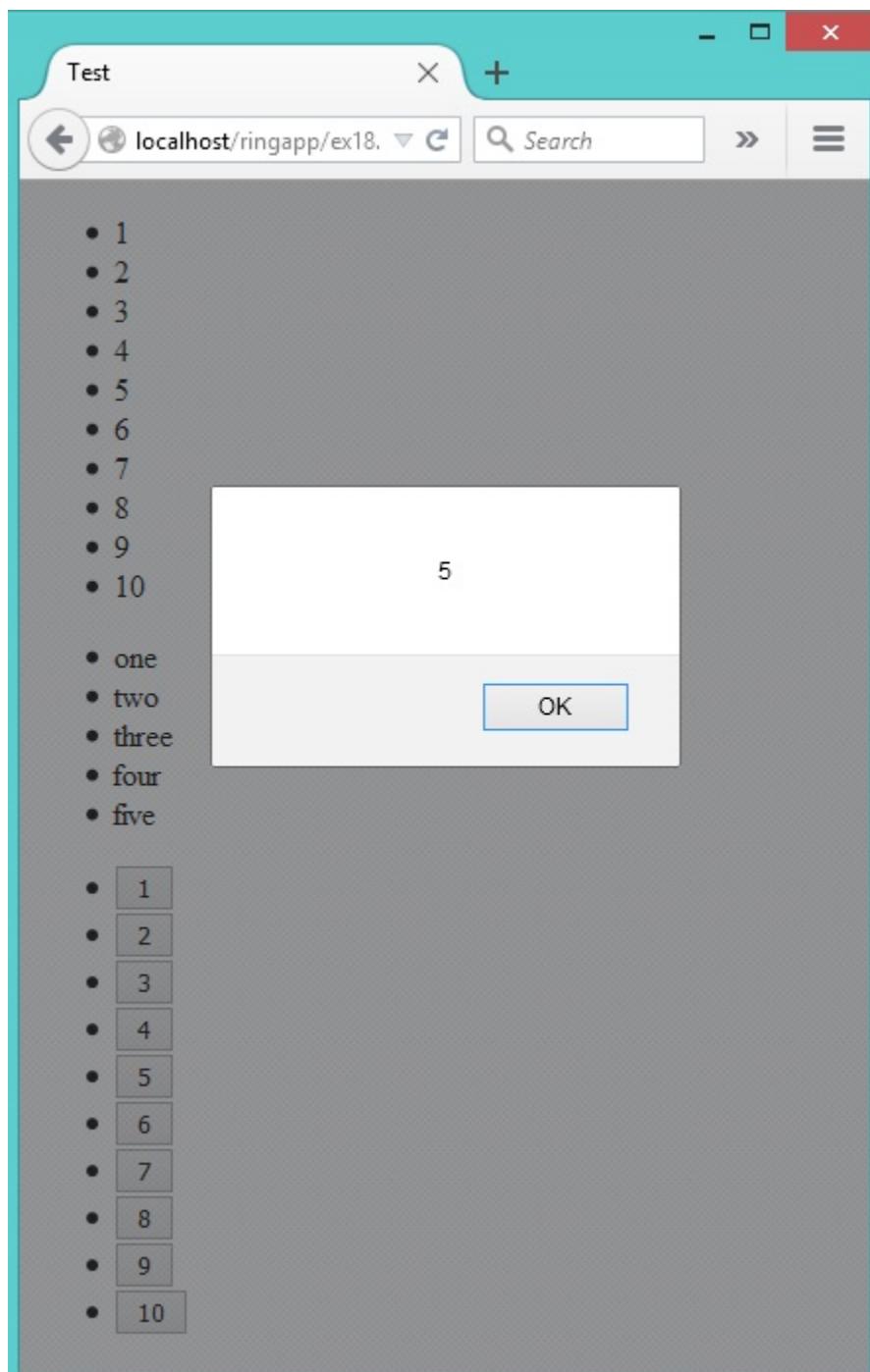
```

(continues on next page)

(continued from previous page)

```
ulstart([])
    for x = 1 to 10
        liststart([])
            text(x)
        liend()
    next
ulend()
list2ul(["one","two","three","four","five"])
ulstart([])
    for x = 1 to 10
        liststart([])
            cFuncName = "btn"+x+"()"
            button([ :onclick = cFuncName , :value = x])
            script(scriptfuncalert(cFuncName,string(x)))
        liend()
    next
ulend()
}
```

Screen Shot:



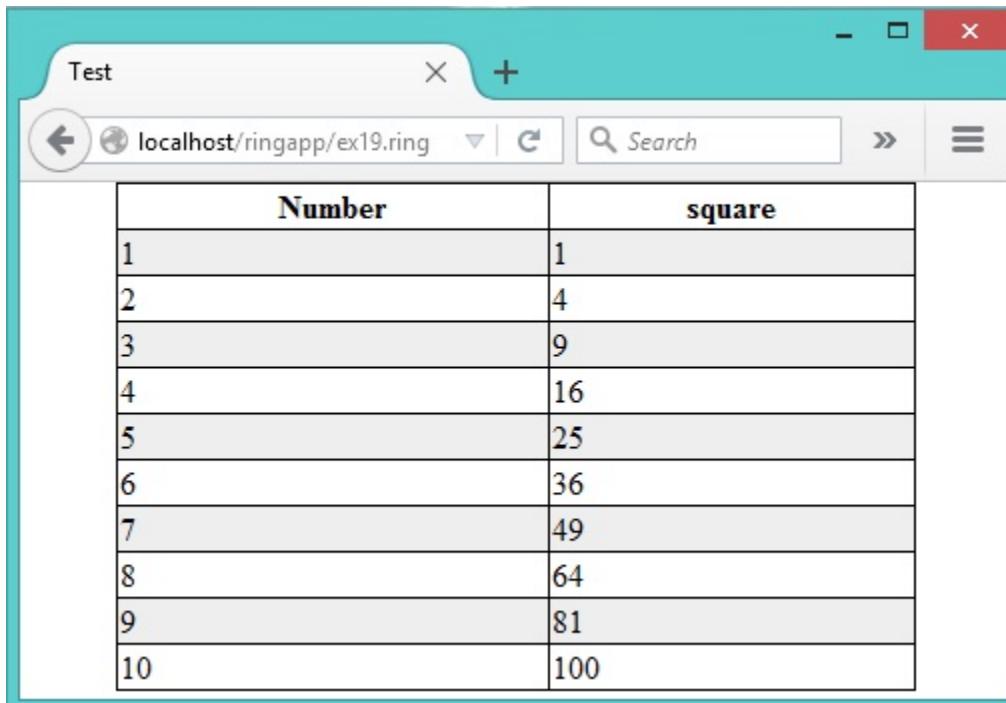
52.17 HTML Tables

In this example we will learn how to generate HTML tables using the tablestart(), tableend(), rowstart(), rowend(), headerstart(), headerend(), cellstart() and cellend() functions.

```
#!ring -cgi
Load "weplib.ring"
Import System.Web

Func Main
    New Page
    {
        divstart([ :style = styledivcenter("400px", "500px") ] )
            style(styletable() + styletablerows("t01"))
            tablestart([ :id = :t01 , :style = stylewidth("100%") ])
                rowstart([])
                    headerstart([]) text("Number") headerend()
                    headerstart([]) text("square") headerend()
                    rowend()
                    for x = 1 to 10
                        rowstart([])
                            cellstart[] text(x) cellend()
                            cellstart[] text(x*x) cellend()
                        rowend()
                    next
                tableend()
            divend()
    }
}
```

Screen Shot:



52.18 Gradient

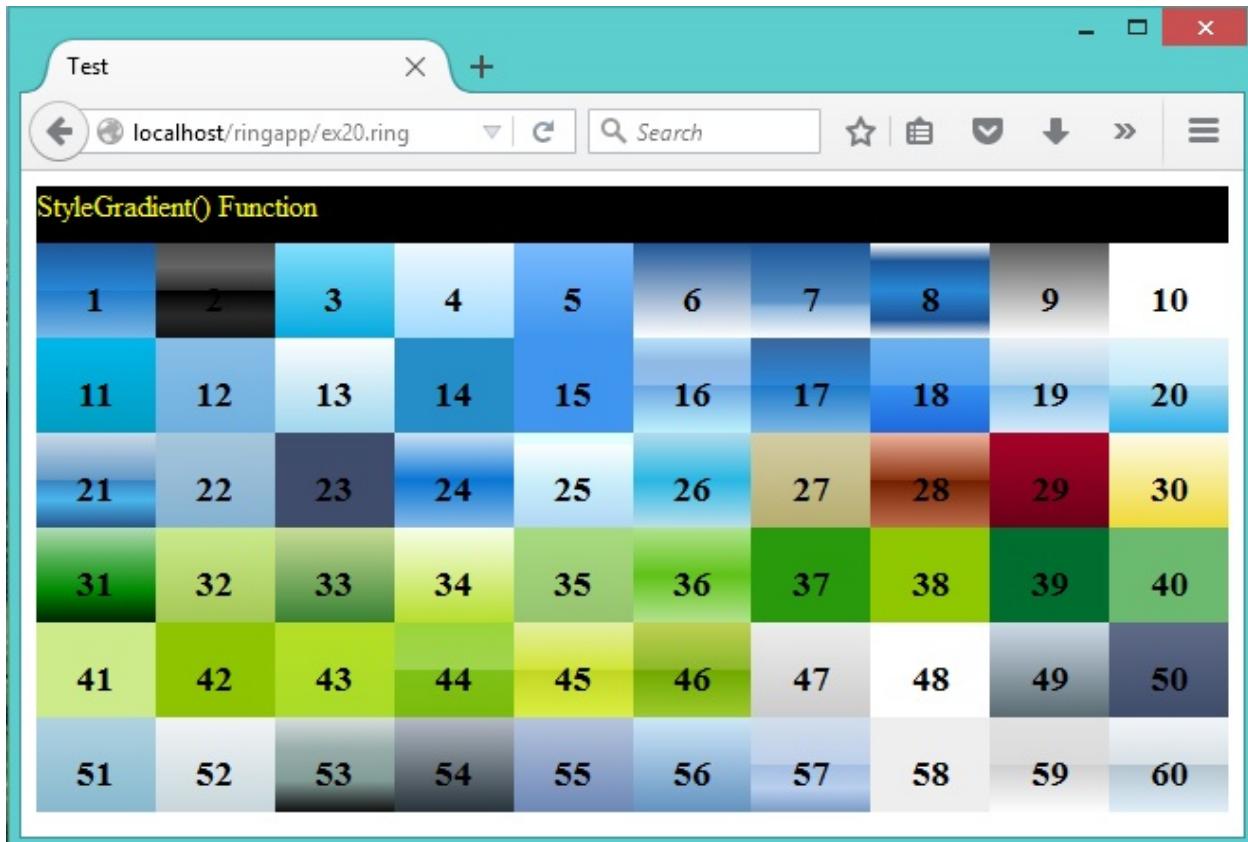
In this example we will learn how to use the StyleGradient() function.

The function takes the style number as input (range from 1 to 60).

```
#!ring -cgi
Load "weplib.ring"
Import System.Web

Func Main
    New Page
    {
        boxstart()
            text("StyleGradient() Function")
        boxend()
        for x = 1 to 60
            divstart([ :id = x , :align = "center" ,
                      :style = stylefloatleft() +
                        stylesize(string(100/60*6)+"%", "50px") +
                        stylegradient(x) ])
                h3(x)
            divend()
        next
    }
}
```

Screen Shot:



52.19 Generating Pages using Objects

Instead of using functions/methods to generate HTML pages, we can use an object for each element in the page.

This choice means more beautiful code but slower.

The fastest method is to print HTML code directly, then using functions then using templates then using objects (slower).

```
#!ring -cgi
Load "weplib.ring"
Import System.Web

Func Main

    WebPage()
    {
        Title = "Using objects to create the Web Page content"
        h1 { text("welcome") }
        link
        {
            Title = "Google"
            Link  = "http://www.google.com"
        }
        div
        {
            id = "div1"
            style = stylegradient(30) + stylesize("50%", "50%")
            text("Outer Div")
            div
            {
                id = "div2"
                color = "white"
                backgroundcolor = "green"
                width = "50%"
                height = "50%"
                marginleft = "5%"
                margintop = "5%"
                text("Inner Div")
            }
        }
        div
        {
            id = "div3"
            color = "black"
            backgroundcolor = "silver"
            width = "100%"
            height = "100%"
            text("Form")
            form
            {
                method = "POST"
                Action = "helloworld.ring"
                Table
            }
        }
    }
}
```

(continues on next page)

(continued from previous page)

```

style = stylewidth("100%") + stylegradient(24)
TR
{
    TD { WIDTH="10%" text("Name : ") }
    TD { Input { type = "text" } }
}
TR
{
    TD { WIDTH="10%" text("Email : ") }
    TD { Input { type = "text" } }
}
TR
{
    TD { WIDTH="10%" text("Password : ") }
    TD { Input { type = "password" } }
}
TR
{
    TD { WIDTH="10%" text("Notes") }
    TD { TextArea { width="100%" rows = 10 cols = 10
                    text("type text here...") } }
}
TR
{
    TD { WIDTH="10%" text("Gender") }
    TD {
        select
        {
            width = "100%"
            option { text("Male") }
            option { text("Female") }
        }
    }
}
TR
{
    TD { WIDTH="10%" text("Role") }
    TD {
        select
        {
            multiple = "multiple"
            width = "100%"
            option { text("student") }
            option { text("admin") }
        }
    }
}
Input { type = "submit" value = "send" }
Image { src="upload/profile1.jpg" alt="profile"}
```

(continues on next page)

(continued from previous page)

```

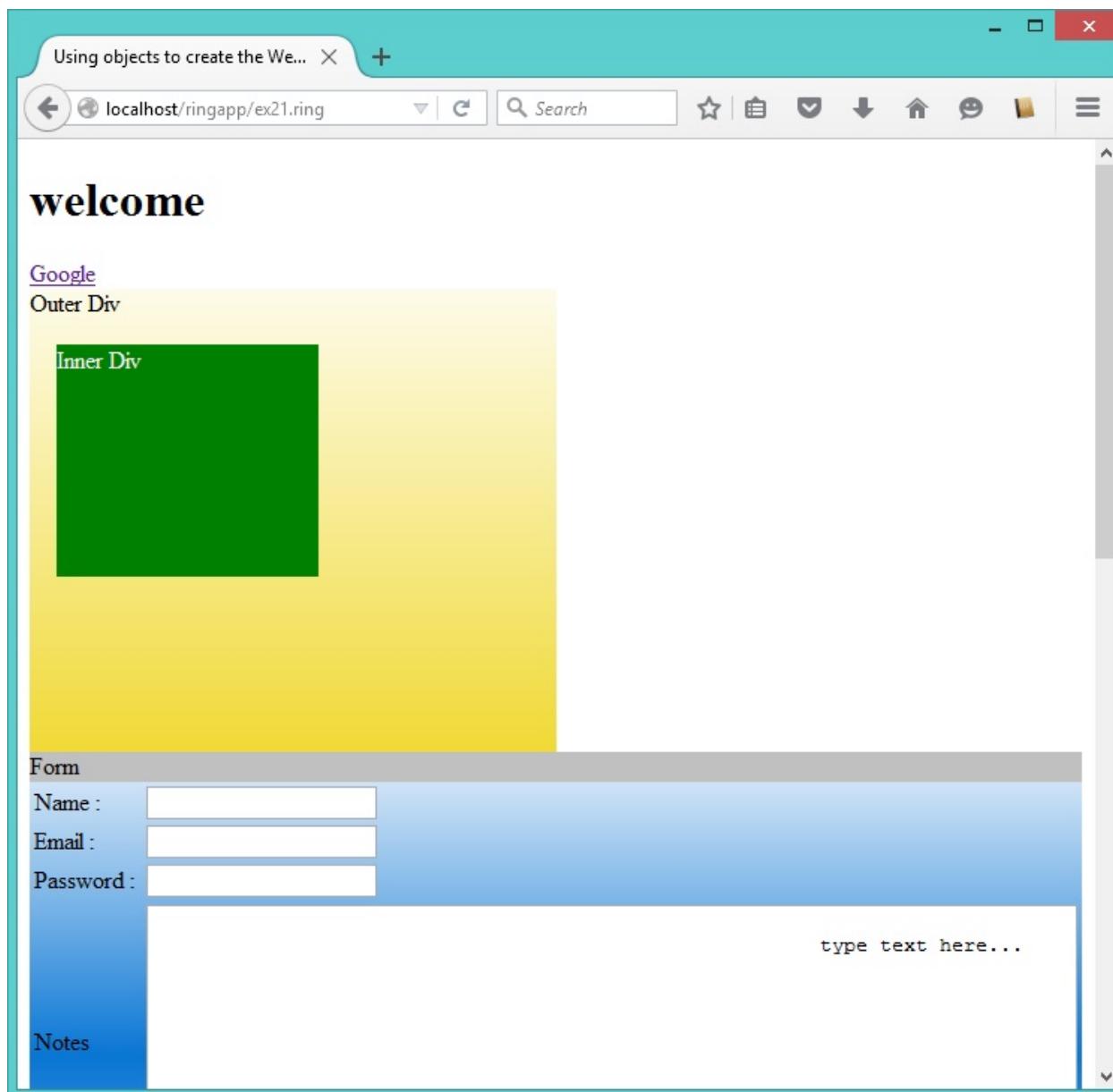
Input { type = "checkbox" value = "Old Member"} text("old member")
Input { type = "range" min=1 max=100}
Input { type = "number" min=1 max=100}
Input { type = "radio" color="black" name="one"
        value = "one"} text("one")
    }
}
div
{
    color = "white"
    backgroundcolor = "blue"
    width = "100%"
    UL
    {
        LI { TEXT("ONE") }
        LI { TEXT("TWO") }
        LI { TEXT("THREE") }
    }
}
div
{
    audio
    {
        src = "horse.ogg"
        type = "audio/ogg"
    }

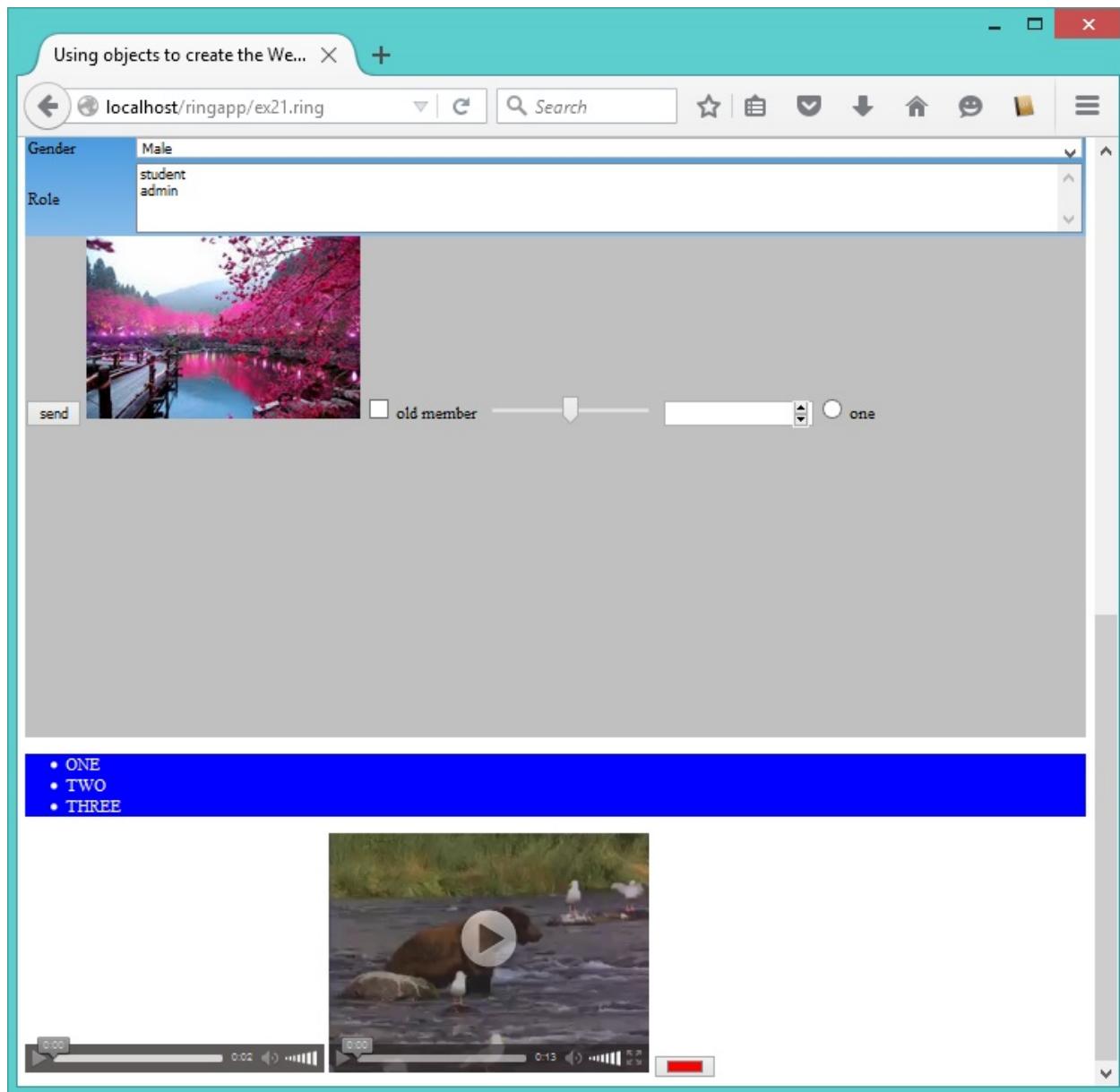
    video
    {
        width = 320
        height = 240
        src = "movie.mp4"
        type = "video/mp4"
    }

    Input
    {
        type = "color"
        value = "#ff0000"
        onchange = "clickColor(0, -1, -1, 5)"
    }
}

```

Screen Shot:





52.20 HtmlPage Class

Using this class we can create HTML documents without printing the output to the standard output

So instead of using the WebLib in Web Applications only

We can use it in Console/GUI/Mobile Applications too

Example:

```
load "stdlib.ring"
load "weplib.ring"

import System.Web
```

(continues on next page)

(continued from previous page)

```

func main

    mypage = new HtmlPage {
        h1 { text("Customers Report") }
        Table
        {
            style = stylewidth("100%") + stylegradient(4)
            TR
            {
                TD { WIDTH="10%" text("Customers Count : ") }
                TD { text(100) }
            }
        }

        Table
        {
            style = stylewidth("100%") + stylegradient(26)
            TR
            {
                style = stylewidth("100%") + stylegradient(24)
                TD { text("Name" ) }
                TD { text("Age" ) }
                TD { text("Country" ) }
                TD { text("Job" ) }
                TD { text("Company" ) }
            }
            for x = 1 to 100
            TR
            {
                TD { text("Test" ) }
                TD { text("30" ) }
                TD { text("Egypt" ) }
                TD { text("Sales" ) }
                TD { text("Future" ) }
            }
            next
        }

    }

    write("report.html",mypage.output())

```

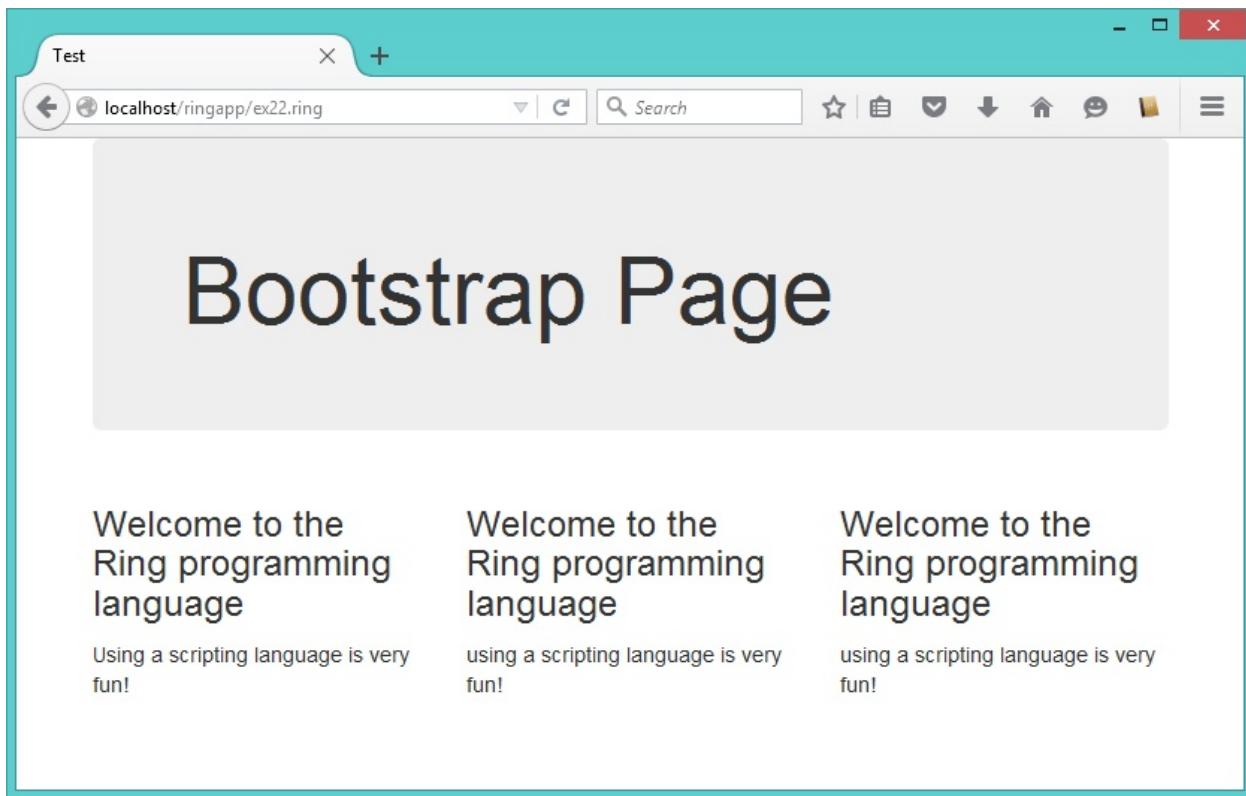
52.21 Using Bootstrap Library using Functions

The next example uses the Bootstrap JavaScript Library when generating the HTML page.

```
#!ring -cgi
Load "weplib.ring"
Import System.Web

Func Main
    new BootstrapPage {
        divstart([ :class = "container" ])
        divstart([ :class = "jumbotron"  ])
            h1("Bootstrap Page")
        divend()
        divstart([ :class = :row ])
            divstart([ :class = "col-sm-4" ])
                h3("Welcome to the Ring programming language")
                p([ :text = "Using a scripting language is very fun!" ])
            divend()
            divstart([ :class = "col-sm-4" ])
                h3("Welcome to the Ring programming language")
                p([ :text = "using a scripting language is very fun!" ])
            divend()
            divstart([ :class = "col-sm-4" ])
                h3("Welcome to the Ring programming language")
                p([ :text = "using a scripting language is very fun!" ])
            divend()
        divend()
        divend()
    }
}
```

Screen Shot:



52.22 Using Bootstrap Library using Objects

The next example uses the Bootstrap JavaScript Library when generating the HTML page.

Instead of using functions to generate the HTML elements, we will use objects.

```
#!/ring -cgi
Load "weplib.ring"
Import System.Web

Func Main
    BootStrapWebPage()
    {
        div
        {
            classname = :container
            div
            {
                classname = :jumbotron
                H1 {   text("Bootstrap Page")   }
            }
            div
            {
                classname = :row
                for x = 1 to 3
                    div
```

(continues on next page)

(continued from previous page)

```

{
    classname = "col-sm-4"
    H3 { html("Welcome to the Ring programming language") }
    P { html("Using a scripting language is very fun!") }
}
next
}
div
{
    classname = :row
div
{
    classname = "col-sm-4"
    Button
    {
        classname = "btn btn-info btn-lg"
        datatoggle= "modal"
        datatarget = "#myModal"
        text("Open Large Modal")
    }
}
div
{
    classname = "col-sm-4"
    Button { classname = "btn btn-default btn-lg" text("default") }
    Button { classname = "btn btn-primary btn-md" text("primary") }
    Button { classname = "btn btn-success btn-sm" text("success") }
    Button { classname = "btn btn-info btn-xs" text("info") }
    Button { classname = "btn btn-warning" text("warning") }
    Button { classname = "btn btn-danger" text("danger") }
    Button { classname = "btn btn-link" text("link") }
}
div
{
    classname = "col-sm-4"
    Button { classname = "btn btn-default btn-block" text("default") }
    Button { classname = "btn btn-primary btn-block" text("primary") }
    Button { classname = "btn btn-success btn-block" text("success") }
    Button { classname = "btn btn-info btn-block" text("info") }
    Button { classname = "btn btn-warning btn-block" text("warning") }
    Button { classname = "btn btn-danger btn-block" text("danger") }
    Button { classname = "btn btn-link btn-block" text("link") }
}
div
{
    classname = "col-sm-4"
    div { classname = "btn-group"
        button { classname="btn btn-primary" text("one") }
        button { classname="btn btn-primary" text("two") }
        button { classname="btn btn-primary" text("three") }
    }
}

```

(continues on next page)

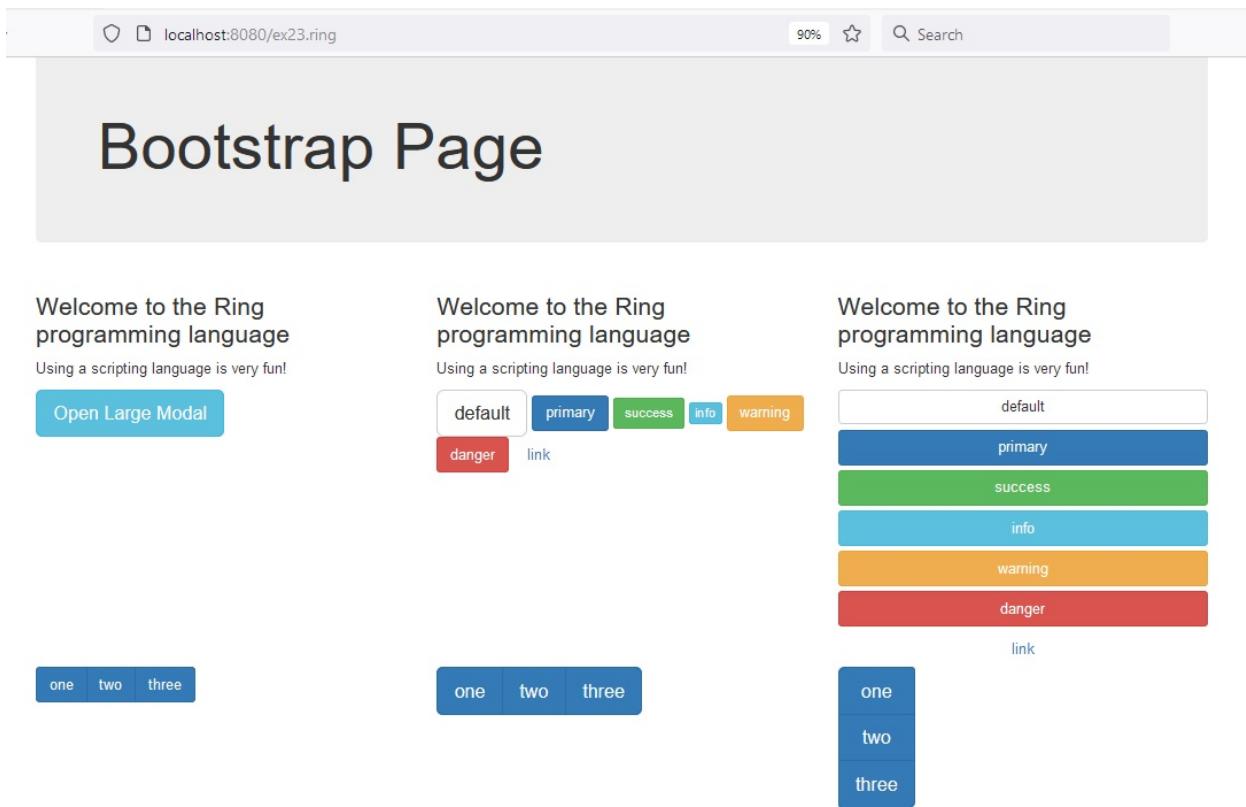
(continued from previous page)

```

div
{
    classname = "col-sm-4"
    div { classname = "btn-group btn-group-lg"
        button { classname="btn btn-primary" text("one") }
        button { classname="btn btn-primary" text("two") }
        button { classname="btn btn-primary" text("three") }
    }
}
div
{
    classname = "col-sm-4"
    div {
        classname = "btn-group-vertical btn-group-lg"
        button { classname="btn btn-primary" text("one") }
        button { classname="btn btn-primary" text("two") }
        button { classname="btn btn-primary" text("three") }
    }
}
div { classname="modal fade" id="myModal" role="dialog"
    div { classname = "modal-dialog modal-lg"
        div { classname="modal-content"
            div { classname="modal-header"
                button { classname="close" datadismiss="modal"
                    html("&times;")
                }
                h4 { classname="modal-title"
                    text("Modal Header")
                }
            }
            div { classname = "modal-body"
                p { text("This is a large modal.") }
            }
            div { classname="modal-footer"
                button { classname = "btn btn-default" datadismiss="modal"
                    text("close")
                }
            }
        }
    }
}

```

Screen Shot:



52.23 CRUD Example using MVC

The next example uses the `weplib.ring` & `datalib.ring`.

The `datalib.ring` contains classes for creating database applications using MVC pattern.

In this example we create an object from the `SalaryController` class then call the `Routing` method.

We define the `website` variable to contains the basic url of the page.

When we create the `SalaryModel` class from the `ModelBase` class, the salary table will be opened and the columns data will be defined as attributes in the model class.

The `SalaryView` class create an object from the `SalaryLanguageEnglish` class to be used for translation.

The method `AddFuncScript` is used to call the form for adding/modifying record data.

The method `FormViewContent` is used to determine the controls in the form when we add or modify a record.

```
#!ring -cgi
Load "weplib.ring"
Load "datalib.ring"
Import System.Web

website = "ex24.ring"

New SalaryController { Routing() }

Class SalaryModel from ModelBase
```

(continues on next page)

(continued from previous page)

```

Class SalaryController From ControllerBase

Class SalaryView From ViewBase

oLanguage = new SalaryLanguageEnglish

Func AddFuncScript oPage,oController
    return oPage.scriptfuncajax("myadd",oController.cMainURL+
        oController.cOperation+"=add","mysubpage")

Func FormViewContent oController,oTranslation,oPage
    return [
        [ oTranslation.aColumnsTitles[2], "textbox", "name",
            oController.oModel.Name, oPage.stylewidth("100%") ],
        [ oTranslation.aColumnsTitles[3], "textbox", "salary",
            oController.oModel.Salary, oPage.stylewidth("50%") ]
    ]

Class SalaryLanguageEnglish
    cTitle = "Salary Table"
    cBack = "back"
    aColumnsTitles = ["ID", "Name", "Salary"]
    cOptions = "Options"
    cSearch = "Search"
    comboitems = ["Select Option...", "Edit", "Delete"]
    cAddRecord = "Add Record"
    cEditRecord = "Edit Record"
    cRecordDeleted = "Record Deleted!"
    aMovePages = ["First", "Prev", "Next", "Last"]
    cPage = "Page"
    cOf = "of"
    cRecordsCount = "Records Count"
    cSave = "Save"
    temp = new page
    c TextAlign = temp.StyleTextRight()
    cNoRecords = "No records!"

```

Screen Shot:

The image consists of two vertically stacked screenshots of a Ring application interface.

Screenshot 1: Salary Table

This screenshot shows a table titled "Salary Table". The table has columns: ID, Name, Salary, and Options. The data is as follows:

ID	Name	Salary	Options
1	Mahmoud	15000	Select Option...
2	Samir	16000	Select Option...
4	Ahmed	50000	Select Option...
5	Ibrahim	50000	Select Option...
12	Mohammed	56786	Select Option...

Below the table are navigation links: First, Prev, Next, Last, and Records Count (15) : Page 1 of 3. There is also an "Add Record" button.

Screenshot 2: Salary Table - Edit Record

This screenshot shows a modal dialog titled "Salary Table - Edit Record". It contains fields for Name (Mahmoud) and Salary (15000). A "Save" button is at the bottom.

52.24 Users registration and Login

We have the users classes (Model, View & Controller) to deal with the users data like username & email.

The next code is stored in ex25_users.ring

```

Class UsersModel from ModelBase
  cSearchColumn = "username"

Class UsersController From ControllerBase
  aColumnsNames = ["id", "username", "email"]

  Func UpdateRecord
    oModel.id = aPageVars[cRecID]
    oModel.updatecolumn("username", aPageVars[:username] )
    oModel.updatecolumn("email", aPageVars[:email] )
    oView.UpdateView(self)

Class UsersView from ViewBase

  oLanguage = new UsersLanguageEnglish

  Func AddFuncScript oPage, oController
    return oPage.scriptfunc("myadd", oPage.scriptredirection("ex26.ring"))

  Func FormViewContent oController, oTranslation, oPage
    return [
      [oTranslation.aColumnsTitles[2], "textbox", "username",
       oController.oModel.UserName, oPage.stylewidth("100%")],
      [oTranslation.aColumnsTitles[3], "textbox", "email",
       oController.oModel.Email, oPage.stylewidth("50%")]
    ]

Class UsersLanguageEnglish
  cTitle = "Users Table"
  cBack = "back"
  aColumnsTitles = ["ID", "User Name", "Email"]
  cOptions = "Options"
  cSearch = "Search"
  comboitems = ["Select Option...", "Edit", "Delete"]
  cAddRecord = "Add Record"
  cEditRecord = "Edit Record"
  cRecordDeleted = "Record Deleted!"
  aMovePages = ["First", "Prev", "Next", "Last"]
  cPage = "Page"
  cOf = "of"
  cRecordsCount = "Records Count"
  cSave = "Save"
  temp = new page
  c TextAlign = temp.StyleTextRight()
  cNoRecords = "No records!"

```

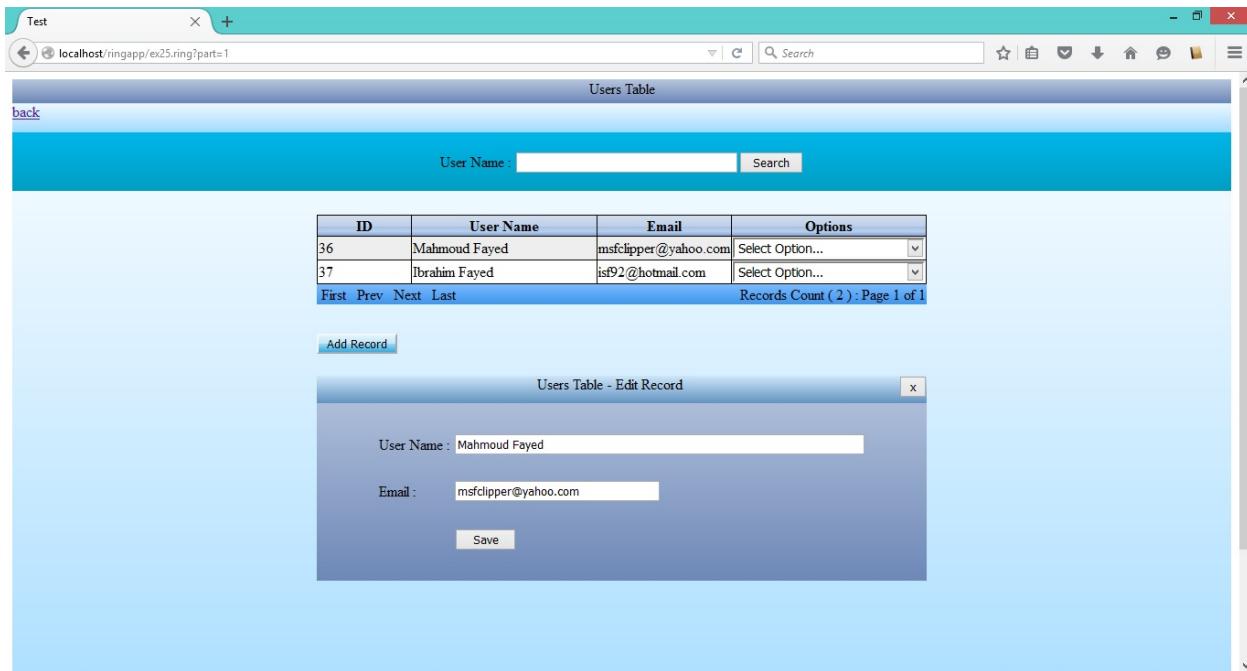
In the file ex25.ring we load ex25_users.ring then create an object from UsersController class.

Using the created object, we call the routing method.

```
#!ring -cgi
Load "weplib.ring"
Load "datalib.ring"
Load "ex25_users.ring"

Import System.Web
website = "ex25.ring"
New UsersController { Routing() }
```

Screen Shot:



See the next code for the registration page

```
#!ring -cgi
Load "weplib.ring"
Load "datalib.ring"
Import System.Web

website = "ex26.ring"

new page {
    boxstart()
        text( "Register")
        newline()
    boxend()
    divstart([:style = stylegradient(6) + stylesize("100%","95%") ])
    link([ :url = website, :title = "back" , :style = stylecolor("white")])
    newline()
    divstart([ :style= styledivcenter("500","160") + stylegradient(52) ])
    formpost("ex27.ring")
        tablestart([ :Style = stylemarginleft("2%") + stylemargintop("2%") +
                    stylemarginright("2%") + stylemarginbottom("2%") ])
            (continues on next page)
```

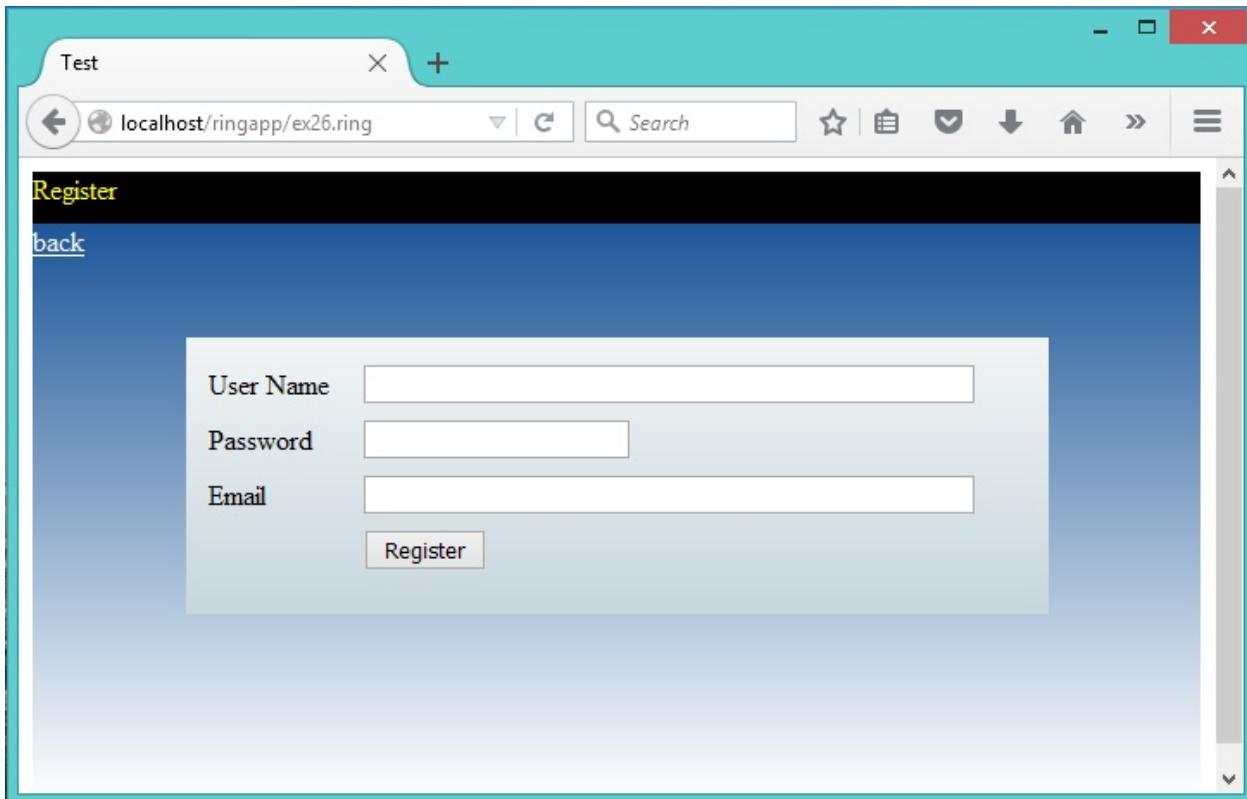
(continued from previous page)

```

        stylewidth("90%") ])
rowstart([])
    cellstart([:style = stylewidth("20%") + styleheight(30)])
        text("User Name")
    cellend()
    cellstart([ :style = stylewidth("80%") ])
        textbox([:name = "username", :style = stylewidth("100%")])
    cellend()
rowend()
rowstart([])
    cellstart([ :Style = styleheight(30)])
        text("Password")
    cellend()
    cellstart([])
        textbox([:name = "password" , :type = "password"])
    cellend()
rowend()
rowstart([])
    cellstart([ :style = styleheight(30)])
        text("Email")
    cellend()
    cellstart([])
        textbox([:name = "email" , :style = stylewidth("100%")])
    cellend()
rowend()
rowstart([])
    cellstart([ :style = styleheight(30)])
    cellend()
    cellstart([ :style = styleheight(30)])
        submit([:value = "Register" ])
    cellend()
rowend()
tableend()
formend()
divend()
divend()
}

```

Screen Shot:



The Registration response

```

#!ring -cgi
Load "weplib.ring"
Load "datalib.ring"
Load "ex25_users.ring"

Import System.Web

oUser = new UsersModel
oUser.Connect()
if oUser.findwith("username",aPageVars["username"])
    new page {
        text("The user name is already registered")
    }
    return
ok
if oUser.findwith("email",aPageVars["email"])
    new page {
        text("This email is already registered")
    }
    return
ok

aPageVars["salt"] = str2hex(RandBytes(32))
aPageVars["pwhash"] = sha256(aPagevars["password"]+aPageVars["salt"])
aPageVars["sessionid"] = str2hex(randbytes(32))
oUser.Insert()

```

(continues on next page)

(continued from previous page)

```
new page {
    cookie("sessionid",aPageVars["sessionid"])
    text("New User Created!")
    newline()
    text("User Name : " + aPageVars["username"])
    newline()
}
oUser.Disconnect()
```

See the next code for the Login page

```
#!/ring -cgi
Load "weblib.ring"
Load "datalib.ring"

Import System.Web

website = "ex28.ring"

new page {
    boxstart()
        text( "Login")
        newline()
    boxend()
    divstart([:style = stylegradient(6) + stylesize("100%","95%") ])
    link([ :url = website, :title = "back" , :style = stylecolor("white")])
    newline()
    divstart([ :style= styledivcenter("500","130") + stylegradient(52) ])
    formpost("ex29.ring")
        tablestart([ :Style = stylemarginleft("2%") + stylemargintop("2%") +
                    stylewidth("90%") ])
            rowstart([])
                cellstart([:style = stylewidth("20%") + styleheight(30)])
                    text("User Name")
                cellend()
                cellstart([ :style = stylewidth("80%") ])
                    textbox([:name = "username" , :style = stylewidth("100%")])
                cellend()
            rowend()
            rowstart([])
                cellstart([ :style = styleheight(30)])
                    text("Password")
                cellend()
                cellstart([])
                    textbox([:name = "password" , :type = "password"])
                cellend()
            rowend()
            rowstart([])
                cellstart([ :style = styleheight(30) ])
                cellend()
                cellstart([])
                    submit([:value = "Login" ])
                cellend()
            rowend()
        tableend()
    divend()
}
```

(continues on next page)

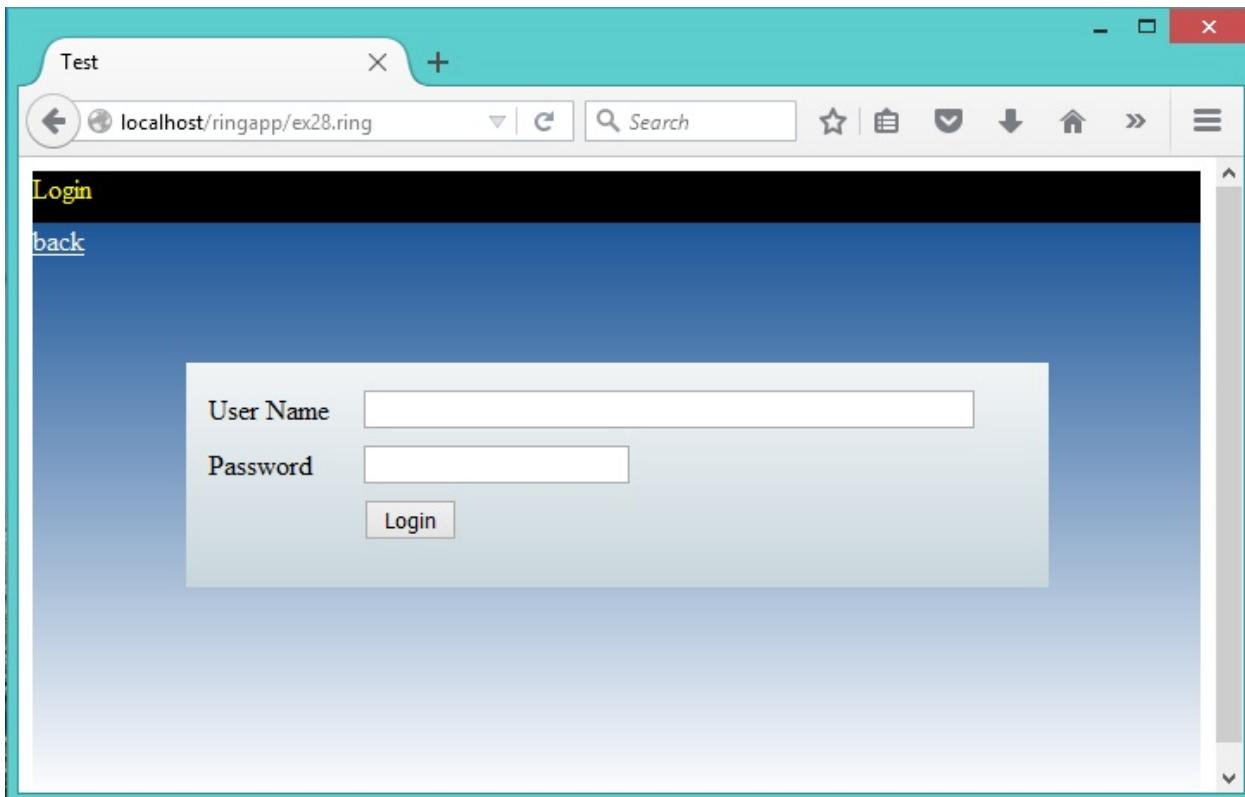
(continued from previous page)

```

    cellend()
    rowend()
    tableend()
formend()
divend()
divend()
}

```

Screen Shot:



The response page

```

#!/ring -cgi
Load "weplib.ring"
Load "datalib.ring"
Load "ex25_users.ring"

Import System.Web

oUser = new UsersModel
oUser.Connect()
lResult = oUser.FindWith("username",aPageVars["username"])
new page {
    if lResult
        if sha256(aPagevars["password"]+oUser.Salt) = oUser.pwhash
            text ("Correct Password!")
            aPageVars["sessionid"] = str2hex(randbytes(32))
}

```

(continues on next page)

(continued from previous page)

```

        oUser.UpdateColumn("sessionid",aPageVars["sessionid"])
        cookie("sessionid",aPageVars["sessionid"])

    else
        text ("Bad password!")
    ok

    else
        text("Bad User Name!")
    ok
}

oUser.Disconnect()

```

The next code for checking if the user needs to login or not

```

#!ring -cgi
Load "weplib.ring"
Load "datalib.ring"
Load "ex25_users.ring"

Import System.Web

oUser = new UsersModel
oUser.Connect()
lResult = oUser.FindWith("sessionid",aPageVars["sessionid"])
new page {
    if lResult
        text("User Name : " + oUser.username )
    else
        text("Please Login First!")
    ok
}
oUser.Disconnect()

```

52.25 Database, ModelBase & ControllerBase classes

In this section we will see some code from datalib.ring

The next code presents the Database, ModelBase & ControllerBase classes

```

Import System.Web

Class Database

cServer = "localhost"
cUserName = "root"
cPassword = "root"
cDatabase = "mahdb"

Func Connect

    con = mysql_init()
    mysql_connect(con, cServer, cUserName, cPassWord,cDatabase)

```

(continues on next page)

(continued from previous page)

```

Func Disconnect
    mysql_close(con)

Func Query cQuery
    mysql_query(con,cQuery)

Func QueryResult
    return mysql_result(con)

Func QueryResultWithColumns
    # return columns names + query result
    return mysql_result2(con)

Func QueryValue
    aResult = mysql_result(con)
    if islist(aResult) and len(aResult) >= 1
        aResult = aResult[1]
        if len(aResult) >= 1
            return aResult[1]
        ok
    ok
    return @

Func EscapeString x
    if isstring(x)
        return MySQL_Escape_String(con,x)
    else
        return MySQL_Escape_String(con,string(x))
    ok

Private
    con = NULL

Class ModelBase from Database

    cTableName = ""
    cSearchColumn = "name"
    aColumns = []
    aQueryResult = []
    ID = @

    # set table name from class name
    classname = lower(classname(self))
    if right(classname,5) = :model
        cTablename = left(classname,len(classname)-5)
    ok

Func Insert

```

(continues on next page)

(continued from previous page)

```
cValues = ""
for x in aColumns
    cValues += "" + EscapeString(aPageVars[x]) + ", "
Next
cValues = left(cValues,len(cValues)-1) # remove last comma
cColumns = ""
for x in aColumns
    cColumns += x + ","
next
cColumns = left(cColumns,len(cColumns)-1)
query("insert into " + cTableName + "("+cColumns+") values (" +
      cValues + ")")
```

Func Update nID

```
cStr = ""
for x in aColumns
    cStr += x + " = '" + EscapeString(aPageVars[x]) + "' , "
# the space after comma is necessary
Next
cStr = left(cStr,len(cStr)-2)
query("update " + cTableName + " set " + cStr + " where id = " + nID )
```

Func UpdateColumn cColumn,cValue

```
query("update " + cTableName + " set " + cColumn + " = '" +
      EscapeString(cValue) + "' where id = " + self.ID )
```

Func Count cValue

```
query("SELECT count(*) FROM " + cTableName +
      " where "+cSearchColumn+" like '" + EscapeString(cValue) + "%' ")
return queryValue()
```

Func Read nStart,nRecordsPerPage

```
query("SELECT * FROM " + cTableName+ " limit " + EscapeString(nStart) + "," +
      EscapeString(nRecordsPerPage) )
aQueryResult = queryResult()
```

Func Search cValue,nStart,nRecordsPerPage

```
query("SELECT * FROM " + cTableName+ " where "+cSearchColumn+" like '" +
      EscapeString(cValue) + "%'" +
      " limit " + EscapeString(nStart) + "," + EscapeString(nRecordsPerPage) )
aQueryResult = queryResult()
```

Func Find nID

```
query("select * from " + cTableName + " where id = " + EscapeString(nID) )
aResult = queryResult()[1]
```

(continues on next page)

(continued from previous page)

```
# move the result from the array to the object attributes
ID = nID
cCode = ""
for x = 2 to len(aResult)
    cCode += aColumns[x-1] + " = hex2str('" + str2hex(aResult[x]) + "')" + nl
next
eval(cCode)
```

Func FindWith cColumn,cValue

```
query("select * from " + cTableName + " where "+cColumn+" = '" +
EscapeString(cValue) + "'")
aResult = queryResult()
if len(aResult) > 0
    aResult = aResult[1]
else
    return 0
ok
# move the result from the array to the object attributes
ID = aResult[1]
cCode = ""
for x = 2 to len(aResult)
    cCode += aColumns[x-1] + " = hex2str('" + str2hex(aResult[x]) + "')" + nl
next
eval(cCode)
return 1
```

Func Delete ID

```
query("delete from " + cTableName + " where id = " + EscapeString(ID) )
```

Func Clear

```
cCode = ""
for x in aColumns
    cCode += x + ' = ""' + nl
next
eval(cCode)
```

Func LoadModel

```
# create the columns array
query("SELECT * FROM "+ cTableName + " limit 0,1")
aQueryResult = QueryResultWithColumns()[1]
for x = 2 to len(aQueryResult)
    aColumns + lower(trim(aQueryResult[x]))
next

# create attribute for each column
for x in aColumns
    addattribute(self,x)
next
```

(continues on next page)

(continued from previous page)

Func Connect

```

Super.Connect()
if nLoadModel = 0
    nLoadModel = 1
    LoadModel()
ok

private

nLoadModel = 0

```

Class ControllerBase

```

nRecordsPerPage = 5
nRecordsCount = 0
nPagesCount = 0
nActivePage = 0

# Dynamic creation of oView = new tablenameView and oModel = new tablename.Model
classname = lower(classname(self))
if right(classname,10) = :controller
    tablename = left(classname,len(classname)-10)
    cCode = "oView = new " + tablename+"View" + nl
    cCode += "oModel = new " + tablename+"Model" + nl
    eval(cCode)
    oModel.connect()
ok

cSearchName = "searchname"
cPart = "part"
cPageError = "The page number is not correct"
cLast = "last"
cOperation = "operation"
cRecID = "recid"

aColumnNames = ["id"]
for t in oModel.aColumns
    aColumnNames + t
next

cMainURL = website + "?"

func Routing

    switch     aPageVars[cOperation]
    on NULL    showtable()
    on :add     addrecord()
    on :save    saverecord()
    on :delete  deleterecord()

```

(continues on next page)

(continued from previous page)

```

on :edit    editrecord()
on :update  updaterecord()
off

func ShowTable

nRecordsCount = oModel.Count( aPageVars[cSearchName] )

nPAGESCOUNT = ceil(nRecordsCount / nRecordsPerPage)

if aPageVars[cPart] = cLast
  aPageVars[cPart] = string(nPagesCount)
ok

nActivePage = number(aPageVars[cPart])
if nActivePage = 0 nActivePage = 1 ok

if ( nActivePage > nPagesCount ) and nRecordsCount > 0
  ErrorMsg(cPageError)
  return
ok

nStart = (nActivePage-1)*nRecordsPerPage

if aPageVars[cSearchName] = NULL
  oModel.Read( nStart,nRecordsPerPage )
else
  oModel.Search( aPageVars[cSearchName],nStart,nRecordsPerPage )
ok

oView.GridView(self)

func AddRecord

oModel.clear()
oView.FormViewAdd(Self,:save,false) # false mean don't include record id

func SaveRecord

oModel.Insert()
oView.SaveView(self)

func EditRecord

oModel.Find( aPageVars[cRecID] )
oView.FormViewEdit(Self,:update,true) # true mean include record id

func UpdateRecord

oModel.update( aPageVars[cRecID] )
oView.UpdateView(self)

```

(continues on next page)

(continued from previous page)

```
func DeleteRecord

    oModel.Delete( aPageVars[cRecID] )
    oView.DeleteView()

func braceend

    oModel.Disconnect()
```

52.26 WebLib API

In this section we will see the web library functions, classes and methods.

Function	Parameters	Description
LoadVars	None	Save the request parameters and cookies to aPageVars List
WebPage	None	Create new object from the WebPage Class
BootStrapWebPage	None	Create new object from the BootStrapWebPage Class
HTMLSpecialChars	cString	Encode Special characters to HTML equivalent
Template	cFile,oObject	Execute Ring Code in cFile after accessing oObject using {}
Alert	cMessage	Generate HTML Web Page that display cMessage using JavaScript Alert()
HTML2PDF	cString	Generate and Display PDF File from HTML String (cString)

The Package System.Web contains the next classes

Class Name	Description
Application	Contains methods for Encoding, Decoding, Cookies & More.
Page	Contains methods to generate HTML pages.
ScriptFunctions	Contains methods to generate some JavaScript Functions.
StyleFunctions	Contains methods to generate CSS.
PageBuffer	Generate HTML Page in memory (don't print the output).
HTML2PDF	Generate PDF File from HTML code.
BootStrapPage	Using BootStrap Library.
WebPage	Generate page using objects for each element.
HtmlPage	Like WebPage but doesn't print the output to stdout.
BootStrapWebPage	Generate page using objects, using BootStrap Library.
ObjsBase	Parent Class for page objects.
NewObjectsFunctions	Methods to create new objects in the page or element.
H1	Wraps HTML H1.
H2	Wraps HTML H2.
H3	Wraps HTML H3.
H4	Wraps HTML H4.
H5	Wraps HTML H5.
H6	Wraps HTML H6.
P	Wraps HTML P.
Link	Wraps HTML link.
NewLine	Wraps HTML NewLine.
Div	Wraps HTML Div.

continues on next page

Table 1 – continued from previous page

Class Name	Description
Form	Wraps HTML Form.
Input	Wraps HTML Input.
TextArea	Wraps HTML TextArea.
Select	Wraps HTML Select.
Option	Wraps HTML Option.
Image	Wraps HTML Image.
UL	Wraps HTML UL.
LI	Wraps HTML LI.
Table	Wraps HTML Table.
TR	Wraps HTML TR.
TD	Wraps HTML TD.
TH	Wraps HTML TH.
Audio	Wraps HTML Audio.
Video	Wraps HTML Video.
Nav	Wraps HTML Nav.
Span	Wraps HTML Span.
Button	Wraps HTML Button.

52.27 Application Class

Method	Parameters	Description
DecodeString	cString	Decode request parameters
Decode	cString	Decode multipart/form-data
GetFileName	aArray,cVar	Get File Name in aArray using cVar
SetCookie	name,value,expires,path,domain,secure	Set Cookie
Cookie	name,value	Set Cookie using name and value only
GetCookies	None	Get Cookies
URLEncode	cString	URL Encode
ScriptLibs	None	Add JavaScript Libraries like BootStrap
Print	None	Print Page Content
Style	cStyle	Add cStyle to page CSS content
StartHTML	None	Add HTTP Header to page content
Redirect	cLocation	Will redirect the webpage
NoJavaScript	None	Avoid JavaScript links

The method DecodeString is used to get HTTP request parameters.

The methods Decode and GetFileName are used for uploading files.

The methods SetCookie, Cookie & GetCookies are used for adding and reading cookies.

The methods StartHTML, ScriptsLibs, Style & Print are used for page structure and JS/CSS support.

The method URLEncode is used to encode a URL to be used in HTML pages.

52.28 Page Class

Method	Parameters	Description
text	x	add HTMLSpecialChars(x) to page content (accept strings and numbers)
html	cString	add html code to page content
h1	x	add x to page content between <h1> and </h1>
h2	x	add x to page content between <h2> and </h2>
h3	x	add x to page content between <h3> and </h3>
h4	x	add x to page content between <h4> and </h4>
h5	x	add x to page content between <h5> and </h5>
h6	x	add x to page content between <h6> and </h6>
p	aPara	HTML <p> </p>, uses aPara List as Hash to get attributes
NewLine	None	add to page content
AddAttributes	aPara	Convert aPara list as hash to HTML element attributes
Link	aPara	HTML <a href> and , uses aPara List as Hash to get attributes
Image	aPara	HTML , uses aPara List as Hash to get attributes
Button	aPara	HTML <input type="button">, uses aPara List as Hash to get attributes
ButtonLink	aPara	HTML <input type="button">, uses link attribute to navigate to link
Textbox	aPara	HTML <input type="text">, uses aPara List as Hash to get attributes
Editbox	aPara	HTML <textarea> and </textarea>, uses aPara to get attributes
Combobox	aPara	HTML <select>, uses items attribute as list for <option>
Listbox	aPara	HTML <select multiple='multiple'>, uses items attribute for <option>
ulstart	aPara	HTML
ulend	aPara	HTML
listart	aPara	HTML
liend	aPara	HTML
List2UL	aList	Generate HTML including items from Ring List items
DivStart	aPara	HTML <div>, uses aPara List as Hash to get attributes
NavStart	aPara	HTML <nav>, uses aPara List as Hash to get attributes
SpanStart	aPara	HTML , uses aPara List as Hash to get attributes
BoxStart	None	Generate Div with black background to be used as page header
DivEnd	None	HTML </div>
NavEnd	None	HTML </nav>
SpanEnd	None	HTML
BoxEnd	None	HTML </div>, the same as divend()
FormStart	cAction	HTML <form>, with cAction as the action attribute or an empty value
FormPost	cAction	HTML <form method="post"> , with cAction as the action attribute
FormEnd	None	HTML </form>
Submit	aPara	HTML <input type="submit">
Hidden	cName,cValue	HTML <input type="hidden">
FormUpload	x	HTML Form, method="post" enctype="multipart/form-data" and x = action
UploadFile	x	HTML <input type="file"> and name = x
Video	aPara	HTML <video>
Audio	aPara	HTML <audio>
GetColor	aPara	Select Color
Radio	aPara	HTML <input type="radio">
Checkbox	aPara	HTML <input type="checkbox">
Spinner	aPara	HTML <input type="number">
Slider	aPara	HTML <input type="range">
TableStart	aPara	HTML <table>
TableEnd	None	HTML </table>

continues on next page

Table 2 – continued from previous page

Method	Parameters	Description
RowStart	aPara	HTML <tr>
RowEnd	None	HTML </tr>
CellStart	aPara	HTML <td>
CellEnd	None	HTML </td>
HeaderStart	aPara	HTML <th>
HeaderEnd	None	HTML </th>
theadStart	aPara	HTML <thead>
theadEnd	None	HTML </thead>
tbodyStart	aPara	HTML <tbody>
tbodyEnd	None	HTML </tbody>
tfootStart	aPara	HTML <tfoot>
tfootEnd	None	HTML </tfoot>

aPara in the page methods is a list contains attributes and values. Using aPara we can set values for the next attributes

```
classname id name align style dir value onclick oncontextmenu ondblclick
onmousedown onmouseenter onmouseleave onmousemove onmouseover onmouseout
onmouseup onkeydown onkeypress onkeyup onabort onbeforeunload onerror
onhashchange onload onpageshow onpagehide onresize onscroll onunload
onblur onchange onfocus onfocusin onfocusout oninput oninvalid onreset
onsearch onselect onsubmit ondrag ondragend ondragenter ondragleave
ondragover ondragstart ondrop oncopy oncut onpaste onafterprint
onbeforeprint oncanplay oncanplaythrough ondurationchange onemptied
onended onloadeddata onloadedmetadata onloadstart onpause onplay
onplaying onprogress onratechange onseeked onseeking onstalled onsuspend
ontimeupdate onvolumechange onwaiting animationend animationiteration
animationstart transitionend onmessage onopen onmousewheel ononline
onoffline onpoststate onshow onstorage ontoggle onwheel ontouchcancel
ontouchend ontouchmove ontouchstart color opacity background backgroundattachment
backgroundcolor backgroundimage backgroundposition backgroundrepeat backgroundclip
backgroundorigin backgroundsize border borderbottom borderbottomcolor
borderbottomleftradius borderbottomrightradius borderbottomstyle borderbottomwidth
bordercolor borderimage borderimageoutset borderimagerepeat borderimageslice
borderimagesource borderimagewidth borderleft borderleftcolor borderleftstyle
borderleftwidth borderradius borderright borderrightcolor borderrightstyle
borderrightwidth borderstyle bordertop bordertopcolor bordertopleftradius
bordertopradius bordertopstyle bordertopwidth borderwidth boxdecorationbreak
boxshadow bottom clear clip display float height left margin marginbottom marginleft
marginright margintop maxheight maxwidth minheight minwidth overflow overflowx
overflowy padding paddingbottom paddingleft paddingright paddingtop position
right top visibility width verticalalign zindex aligncontent alignitems alignself
flex flexbasis flexdirection flexflow flexgrow flexshrink flexwrap justifycontent
order hangingpunctuation hyphens letterspacing linebreak lineheight overflowwrap
tabsize textalign textalignlast textcombineupright textindent textjustify
texttransform whitespace wordbreak wordspacing wordwrap textdecoration
textdecorationcolor textdecorationline textdecorationstyle textshadow
textunderlineposition @fontface @fontfeaturevalues font fontfamily fontfeaturesettings
fontkerning fontlanguageoverride fontsize fontsizeadjust fontstretch fontstyle
fontsynthesis fontvariant fontvariantalternates fontvariantcaps fontvarianteastasian
fontvariantligatures fontvariantnumeric fontvariantposition fontweight direction
```

(continues on next page)

(continued from previous page)

```
textorientation unicodebidi writingmode bordercollapse borderspacing captionside
emptycells tablelayout counterincrement counterreset liststyle liststyleimage
liststyleposition liststyletype @keyframes animation animationdelay animationdirection
animationduration animationfillmode animationiterationcount animationname
animationplaystate animationtimingfunction backfacevisibility perspective
perspectiveorigin transform transformorigin transformstyle transition
transitionproperty transitionduration transitiontimingfunction transitiondelay
boxsizing content cursor imemode navdown navindex navleft navright navup
outline outlinecolor outlineoffset outlinestyle outlinewidth resize textoverflow
breakafter breakbefore breakinside columncount columnfill columngap columnrule
columnrulecolor columnrulestyle columnrulewidth columnspan columnwidth columns
widows orphans pagebreakafter pagebreakbefore pagebreakinside marks quotes
filter imageorientation imagerendering imageresolution objectfit objectposition
mask masktype mark markafter markbefore phonemes rest restafter restbefore
voicebalance voiceduration voicepitch voicepitchrange voicerate voicestress
voicevolume marquedirection marqueeplaycount marqueespeed marqueestyle datatoggle
dataride datatarget dataslideto dataslide datadismiss dataplace datacontent
datatrigger dataspy dataoffset dataoffsettop
```

52.29 ScriptFunctions Class

This class contains methods for adding JavaScript code to the generated web page.

The class methods are merged to the Page class, so we can use the next methods with page objects directly.

Method	Parameters	Description
Script	cCode	Add cCode string between <script> and </script>
ScriptRedirection	cURL	set window.location to cURL
ScriptFunc	cFuncName,cCode	Define function cFuncName that contains cCode
ScriptFuncAlert	cFuncName,cMsg	Define function cFuncName that uses alert() to print cMsg
ScriptFuncAjax	cFuncName,cLink,cDiv	Define function cFuncName that load cLink in cDiv
ScriptFuncClean	cFuncName,cDiv	Define function cFuncName that clear the cDiv
ScriptFuncSelect	cF,aL,cD,cR,cGR,cFC,nTO,cL1,cL2	Used to Edit/Delete Grid Record
ScriptScrollFixed	cDiv,nSize	Set cDiv as Fixed Div with Size = nSize

52.30 StyleFunctions Class

This class contains methods for adding CSS to the generated web page.

Like ScriptFunctions Class, The StyleFunctions class methods are merged to the Page class, so we can use the next methods with page objects directly.

Method	Parameters	Description
StyleFloatLeft	None	Return float: left ;
StyleFloatRight	None	Return float: right ;
StyleSizeFull	None	Return width: 100% ; height: 100% ;
Stylecolor	x	Return " color: " + x + ";"
Stylebackcolor	x	Return " background-color: " + x + ";"
StyleTextCenter	None	Return "text-align: center ;"
StyleTextRight	None	Return "text-align: right ;"
StyleTextLeft	None	Return "text-align: left ;"
StyleSize	x,y	Return " width: " + x + " ; height: " + y + " ;"
StyleWidth	x	Return " width: " + x + " ;"
StyleHeight	x	Return " height: " + x + " ;"
StyleTop	x	Return " top: " + x + " ;"
StyleLeft	x	Return " Left: " + x + " ;"
StylePos	x,y	Return " top: " + x + " ;" + " Left: " + y + " ;"
StyleHorizontalCenter	None	Return " margin-right:auto ; margin-left:auto; "
StyleMarginTop	x	Return " margin-top: " + x + " ;"
StyleMarginRight	x	Return " margin-right: " + x + " ;"
StyleMarginLeft	x	Return " margin-left: " + x + " ;"
StyleDivCenter	nWidth,nHeight	Create Div in the center of the page
StyleAbsolute	None	Return " position:absolute ;"
StyleFixed	None	Return " position:fixed ;"
StyleZIndex	x	Return " z-index: " + x + " ;"
StyleFontSize	x	Return " font-size: " + x + " ;"
StyleGradient	x	Generate Gradient (x values from 1 to 60)
StyleTable	None	Set table properties
StyleTableRows	id	Set different color to even and odd rows in the table
StyleTableNoBorder	None	Return " border-style: none;"

52.31 WebPage Class

We use braces to access the active WebPage object attributes

Each one of these attribute will return a new object to access again using braces.

Attribute	Description
H1	Wraps HTML H1.
H2	Wraps HTML H2.
H3	Wraps HTML H3.
H4	Wraps HTML H4.
H5	Wraps HTML H5.
H6	Wraps HTML H6.

continues on next page

Table 3 – continued from previous page

Attribute	Description
P	Wraps HTML P.
Link	Wraps HTML link.
NewLine	Wraps HTML NewLine.
Div	Wraps HTML Div.
Form	Wraps HTML Form.
Input	Wraps HTML Input.
TextArea	Wraps HTML TextArea.
Select	Wraps HTML Select.
Option	Wraps HTML Option.
Image	Wraps HTML Image.
UL	Wraps HTML UL.
LI	Wraps HTML LI.
Table	Wraps HTML Table.
TR	Wraps HTML TR.
TD	Wraps HTML TD.
TH	Wraps HTML TH.
Audio	Wraps HTML Audio.
Video	Wraps HTML Video.
Nav	Wraps HTML Nav.
Span	Wraps HTML Span.
Button	Wraps HTML Button.
THead	Wraps HTML THEAD.
TBody	Wraps HTML TBODY.
TFoot	Wraps HTML TFOOT.

52.32 HtmlPage Class

The same as the WebPage class with the next changes

- (1) No output to the stdout
- (2) Provide the Output Method to get the output

Syntax:

```
output() ---> The output as string
```

CHAPTER FIFTYTHREE

DEPLOYING WEB APPLICATIONS IN THE CLOUD

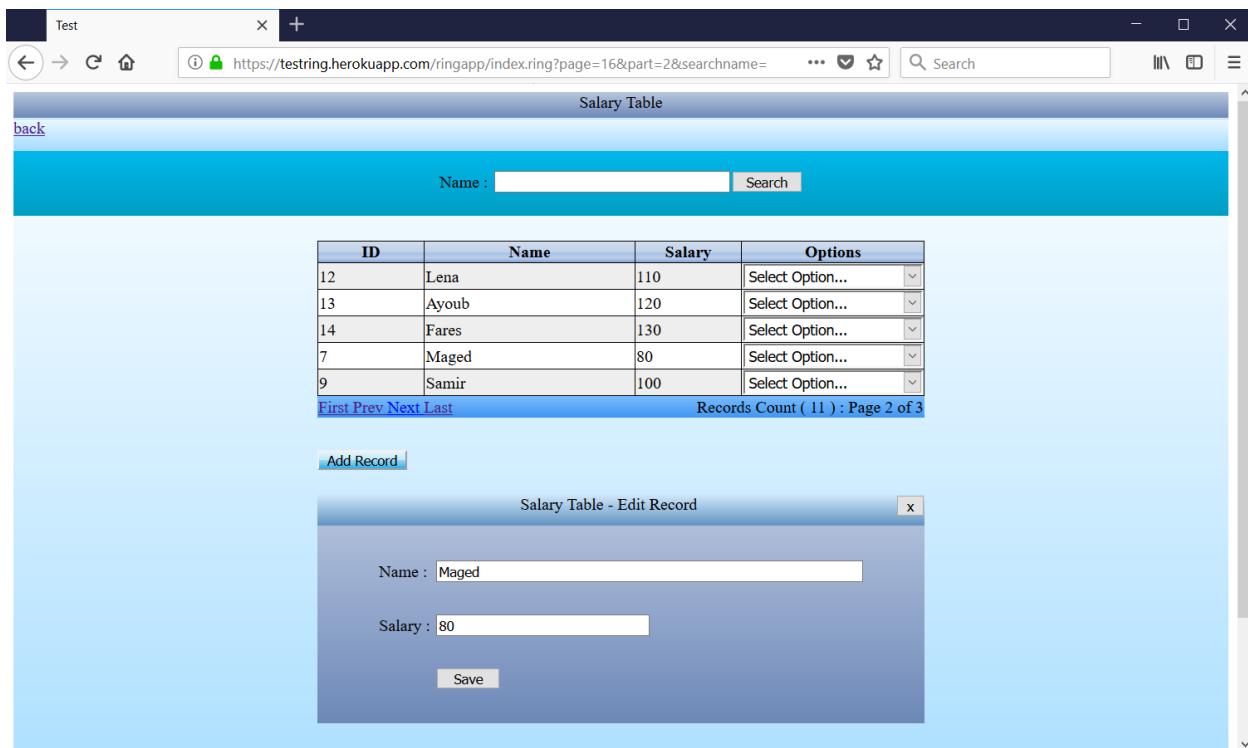
In this chapter we will learn about deploying Ring Web Applications in the Cloud using Heroku

53.1 Introduction

We created a new project and tutorial to explain how to deploy Ring web applications in the Cloud using Heroku

Project : <https://github.com/ring-lang/RingWebAppOnHeroku>

Heroku Website : <https://www.heroku.com/>



53.2 Usage

To use this project and deploy it on Heroku

- (1) Create Heroku account
- (2) Open your Heroku account and create new application

Example : testring

Note (You have to select a unique name for your application)

- (3) Open the command prompt, Create new folder : MyApp

```
md MyApp
```

- (4) Open the application folder

```
cd MyApp
```

- (5) Clone this project using Git (Don't forget the dot in the end to clone in the current directory)

```
git clone https://github.com/ring-lang/RingWebAppOnHeroku .
```

- (6) Login to Heroku (Enter your Email and Password)

```
heroku login
```

- (7) Add heroku (remote) to your Git project

change testring to your application name

```
heroku git:remote -a testring
```

- (8) Set the buildpacks (So Heroku can know how to support your project)

```
heroku buildpacks:add --index 1 https://github.com/ring-lang/heroku-buildpack-apt
heroku buildpacks:add --index 2 https://github.com/ring-lang/heroku-buildpack-ring
```

- (9) Now build your project and deploy it

```
git push heroku master
```

- (10) Test your project (In the browser)

```
heroku open
```

53.3 Ring source code files and permissions

To be able to run your new Ring scripts, Set the permission of the file to be executable using Git

For example, if you created a file : myscript.ring

```
git update-index --chmod=+x myscript.ring
git commit -m "Update file permission"
```

If you are using TortoiseGit, From windows explorer, select the file
 Right click —> Properties —> Git —> Executable (+x)
 Then commit and deploy!

53.4 Hello World program

file : ringapp/helloworld.ring

```
#!/app/runring.sh -cgi

see "content-type: text/html" +nl+nl
see "Hello, World!" + nl
```

file : ringapp/helloworld2.ring

```
#!/app/runring.sh -cgi
load "weblib.ring"
import System.Web
new page {
    text("Hello, World!")
}
```

53.5 Application Database

When you deploy the application, Everything will works directly!

No change is required, but in practice, You will need to update the next files to use your database

There are two scripts to interact with the database (We are using PostgreSQL in the cloud)

You will need to update the connection string in these files if you will use another database

- file: ringapp/database/newdb.ring (We run it using the browser for one time to create the tables)
- file: ringapp/datalib.ring (Class: Database)

In your practical projects, You can write better code (To be able to change the database)

Also you can create configuration file (To write the connection string in one place)

Database service : <https://www.heroku.com/postgres>

53.6 Deploying after updates

Just use Git and commit then push to heroku

file: build.bat contains the next commands for quick tests

```
git add .
git commit -m "Update RingWebAppOnHeroku"
git push heroku master
heroku open
```

53.7 Local Tests

Local tests using Ring Notepad on Windows (Using local Apache Web Server)

Replace the first line in the file : ringapp/index.ring with

```
#!ring -cgi
```

Then run it from Ring Notepad (Ctrl+F6)

CHAPTER
FIFTYFOUR

GRAPHICS AND 2D GAMES PROGRAMMING USING RINGALLEGRO

In this chapter we will learn how to use the allegro game programming library in our Ring applications.

We have the file gamelib.ring that load the DLL library that contains wrappers for the Allegro functions

```
Load "allegro.rh"
if iswindows()
    LoadLib("ring_allegro.dll")
but ismacosx()
    LoadLib("libringallegro.dylib")
else
    LoadLib("libringallegro.so")
ok
```

The file gamelib.ring uses the Load instruction to execute the file allegro.rh which is a ring source code file contains constants to be used in our programs. Then using the function LoadLib() we can load the DLL library “ring_allegro.dll”.

To write portable code we can change the gamelib.ring to check the platform before loading the DLL/So file.

54.1 Drawing, Animation and Input

The next example uses the Allegro library for drawing, moving objects on the screen and getting input from the keyboard and the mouse.

```
Load "gamelib.ring"

al_init()
al_init_image_addon()

display = al_create_display(640,480)

al_show_native_message_box(display, "Hello", "Welcome",
                           "Using Allegro from the Ring programming language",
                           "", 0);

al_clear_to_color(al_map_rgb(0,0,255))

BOUNCER_SIZE = 40
bouncer_x = 10
bouncer_y = 20
bouncer = al_create_bitmap(BOUNCER_SIZE, BOUNCER_SIZE)
```

(continues on next page)

(continued from previous page)

```

al_set_target_bitmap(bouncer)
al_clear_to_color(al_map_rgb(255,0,255))

for x = 1 to 30
    bouncer_x += x
    bouncer_y += x
    al_set_target_bitmap(al_get_backbuffer(display))
    al_clear_to_color(al_map_rgb(0,0,0))
    al_draw_bitmap(bouncer, bouncer_x, bouncer_y, 0)
    al_draw_bitmap(bouncer, 200+bouncer_x,200+ bouncer_y, 0)
    al_flip_display()
    al_rest(0.1)
next

al_clear_to_color(al_map_rgb(255,255,255))
image = al_load_bitmap("man2.jpg")
al_draw_bitmap(image,200,200,0)
al_flip_display()
al_rest(2)

event_queue = al_create_event_queue()
al_register_event_source(event_queue, al_get_display_event_source(display))

ev = al_new_allegro_event()
timeout = al_new_allegro_timeout()
al_init_timeout(timeout, 0.06)

FPS = 60
timer = al_create_timer(1.0 / FPS)
al_register_event_source(event_queue, al_get_timer_event_source(timer))
al_start_timer(timer)
redraw = true

SCREEN_W = 640
SCREEN_H = 480
BOUNCER_SIZE = 32
bouncer_x = SCREEN_W / 2.0 - BOUNCER_SIZE / 2.0
bouncer_y = SCREEN_H / 2.0 - BOUNCER_SIZE / 2.0
bouncer_dx = -4.0
bouncer_dy = 4.0

al_install_mouse()
al_register_event_source(event_queue, al_get_mouse_event_source())

al_install_keyboard()
al_register_event_source(event_queue, al_get_keyboard_event_source())

KEY_UP = 1
KEY_DOWN = 2
KEY_LEFT = 3
KEY_RIGHT = 4
Key = [false,false,false,false]

```

(continues on next page)

(continued from previous page)

```

while true
    al_init_timeout(timeout, 0.06)
    al_wait_for_event_until(event_queue, ev, timeout)
    switch al_get_allegro_event_type(ev)
    on ALLEGRO_EVENT_DISPLAY_CLOSE
        exit
    on ALLEGRO_EVENT_TIMER

        # Animation
        if bouncer_x < 0 or bouncer_x > SCREEN_W - BOUNCER_SIZE
            bouncer_dx = -bouncer_dx
        ok

        if bouncer_y < 0 or bouncer_y > SCREEN_H - BOUNCER_SIZE
            bouncer_dy = -bouncer_dy
        ok

        bouncer_x += bouncer_dx
        bouncer_y += bouncer_dy

        # Keyboard
        if key[KEY_UP] and bouncer_y >= 4.0
            bouncer_y -= 4.0
        ok
        if key[KEY_DOWN] and bouncer_y <= SCREEN_H - BOUNCER_SIZE - 4.0
            bouncer_y += 4.0
        ok
        if key[KEY_LEFT] and bouncer_x >= 4.0
            bouncer_x -= 4.0
        ok
        if key[KEY_RIGHT] and bouncer_x <= SCREEN_W - BOUNCER_SIZE - 4.0
            bouncer_x += 4.0
        ok

        redraw = true

    on ALLEGRO_EVENT_MOUSE_AXES
        bouncer_x = al_get_allegro_event_mouse_x(ev)
        bouncer_y = al_get_allegro_event_mouse_y(ev)
    on ALLEGRO_EVENT_MOUSE_ENTER_DISPLAY
        bouncer_x = al_get_allegro_event_mouse_x(ev)
        bouncer_y = al_get_allegro_event_mouse_y(ev)
    on ALLEGRO_EVENT_MOUSE_BUTTON_UP
        exit
    on ALLEGRO_EVENT_KEY_DOWN
        switch al_get_allegro_event_keyboard_keycode(ev)
            on ALLEGRO_KEY_UP
                key[KEY_UP] = true
            on ALLEGRO_KEY_DOWN
                key[KEY_DOWN] = true
            on ALLEGRO_KEY_LEFT

```

(continues on next page)

(continued from previous page)

```

        key[KEY_LEFT] = true
on ALLEGRO_KEY_RIGHT
        key[KEY_RIGHT] = true
off
on ALLEGRO_EVENT_KEY_UP
    switch al_get_allegro_event_keyboard_keycode(ev)
        on ALLEGRO_KEY_UP
            key[KEY_UP] = false
        on ALLEGRO_KEY_DOWN
            key[KEY_DOWN] = false
        on ALLEGRO_KEY_LEFT
            key[KEY_LEFT] = false
        on ALLEGRO_KEY_RIGHT
            key[KEY_RIGHT] = false
        on ALLEGRO_KEY_ESCAPE
            exit
off
if redraw and al_is_event_queue_empty(event_queue)
    redraw = false
    al_clear_to_color(al_map_rgb(0,0,0))
    al_draw_bitmap(bouncer, bouncer_x, bouncer_y, 0)
    al_flip_display()
ok
callgc()
end

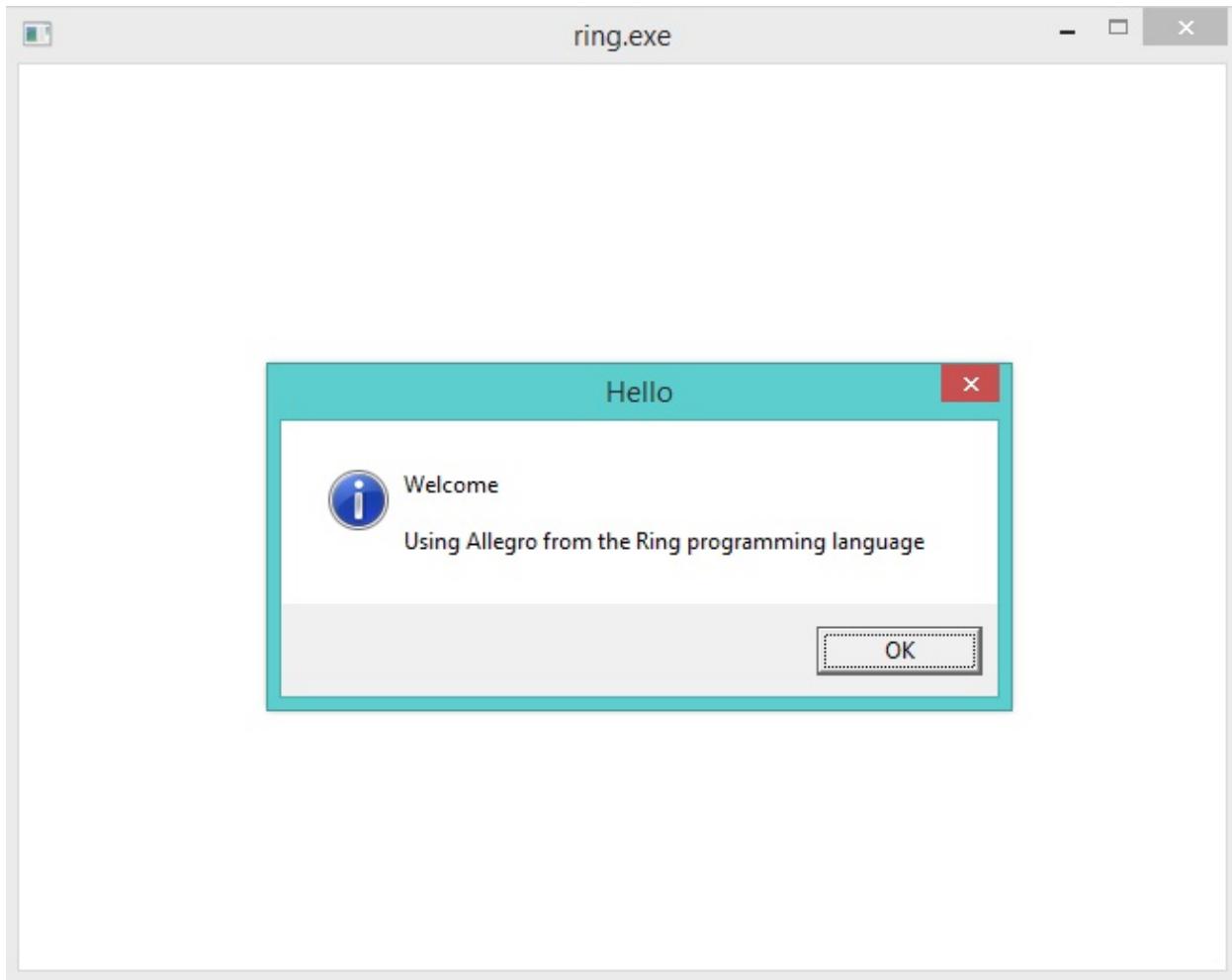
al_destroy_timer(timer)
al_destroy_allegro_event(ev)
al_destroy_allegro_timeout(timeout)
al_destroy_event_queue(event_queue)
al_destroy_bitmap(bouncer)
al_destroy_bitmap(image)
al_destroy_display(display)

```

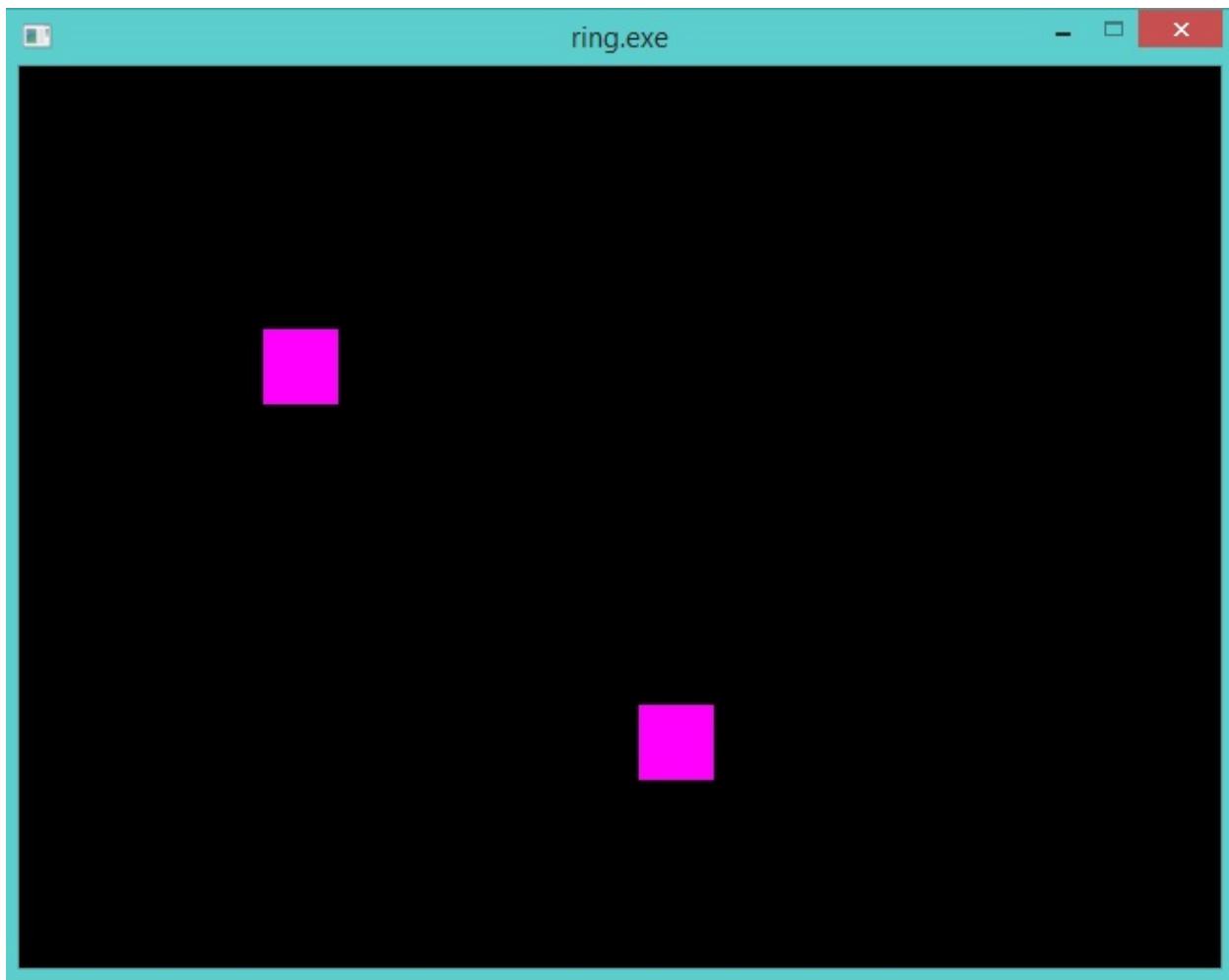
Note: In the previous example we used the function callgc() which is a Ring function to force calling the Garbage collector inside the While/End loop.

Program Output:

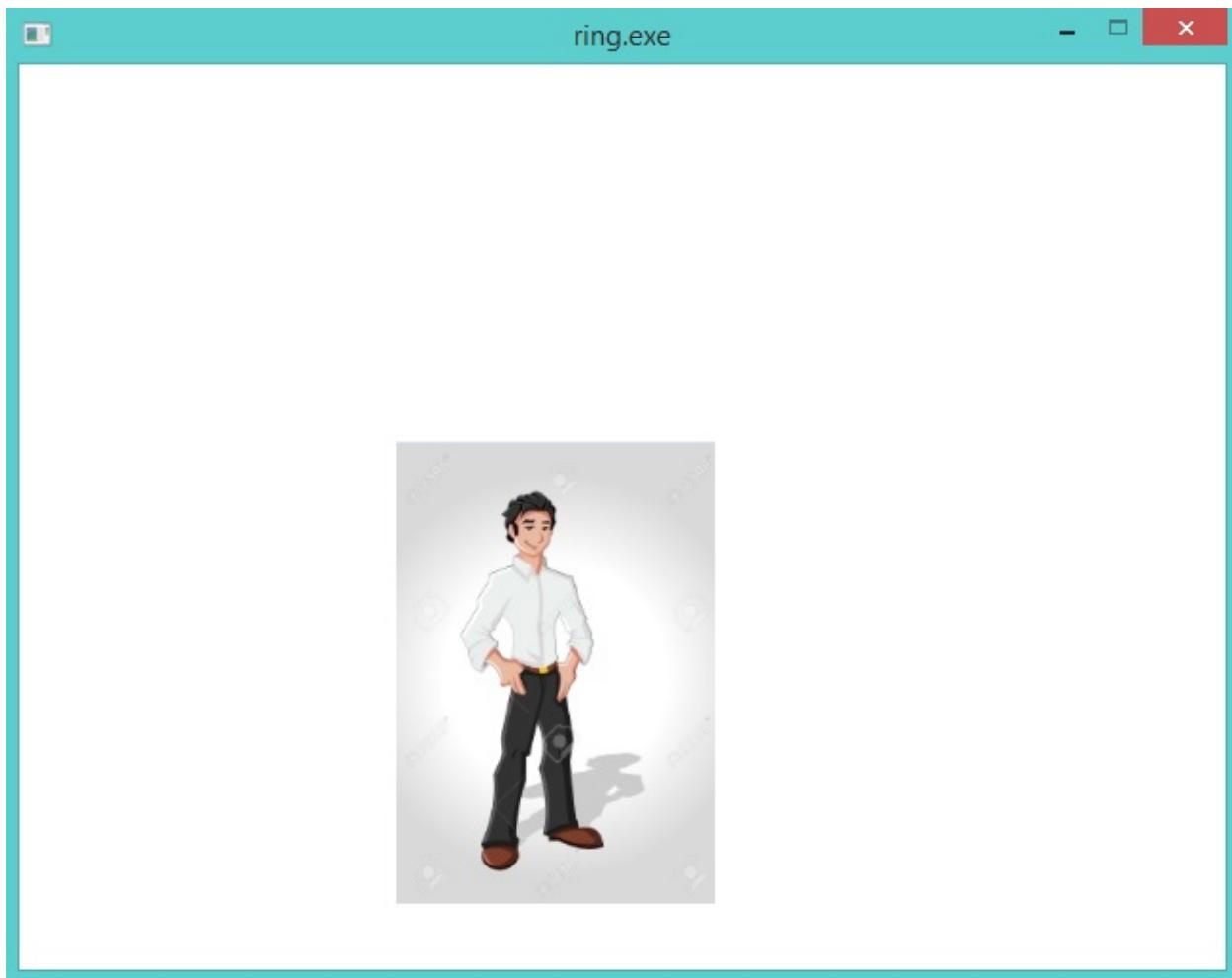
At first the program display a messagebox



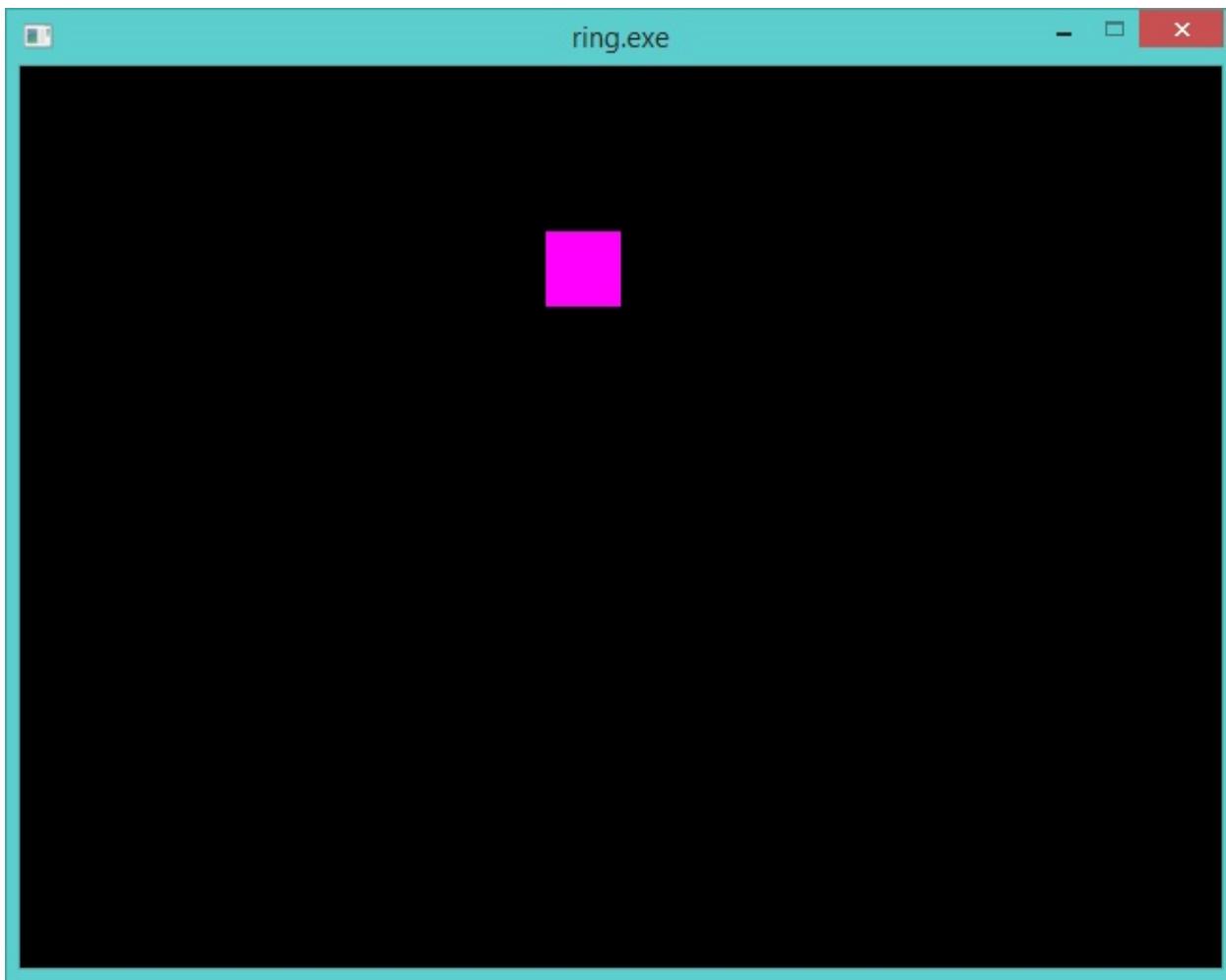
Then we see two rectangles are moving on the screen



Then we see an image displayed on the screen



Finally we have one rectangle, and we see it moving all of the time on the screen but we can control it using the Mouse and/or the Keyboard



54.2 Using TrueType Fonts

In this example we will see how to use TrueType Fonts *.ttf in our Games using Allegro

```
Load "gamelib.ring"

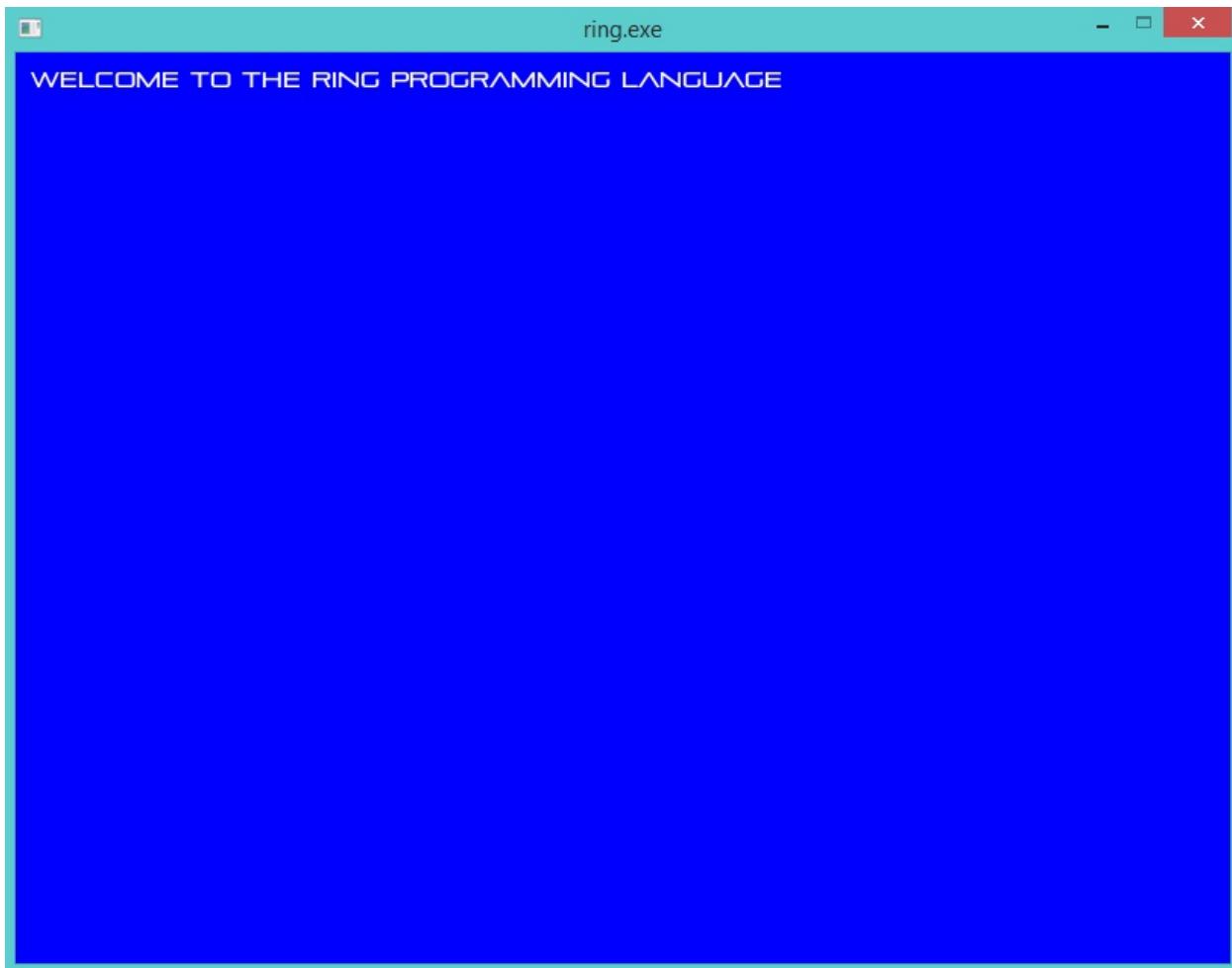
al_init()
al_init_font_addon()
al_init_ttf_addon()

display = al_create_display(800,600)

al_clear_to_color(al_map_rgb(0,0,255))
font = al_load_ttf_font("pirulen.ttf",14,0 )
al_draw_text(font, al_map_rgb(255,255,255), 10, 10,ALLEGRO_ALIGN_LEFT,
            "Welcome to the Ring programming language")
al_flip_display()
al_rest(2)

al_destroy_display(display)
```

Screen Shot:



54.3 Playing Sound Files

The next example play a sound file

```
Load "gamelib.ring"

al_init()
al_install_audio()
al_init_acodec_addon()
al_reserve_samples(1)

sample = al_load_sample( "footstep.wav" )

sampleid = al_new_allegro_sample_id()
al_play_sample(sample, 1.0, 0.0,1.0,ALLEGRO_PLAYMODE_LOOP,sampleid)

display = al_create_display(640,480)
al_clear_to_color(al_map_rgb(0,0,255))
al_flip_display()
```

(continues on next page)

(continued from previous page)

```
al_rest(10)

al_destroy_allegro_sample_id(sampleid)
al_destroy_sample(sample)
al_destroy_display(display)

al_exit()
```

54.4 Scaling and Rotating Images

The next example display and rotate an image

```
Load "gamelib.ring"

al_init()
al_init_image_addon()

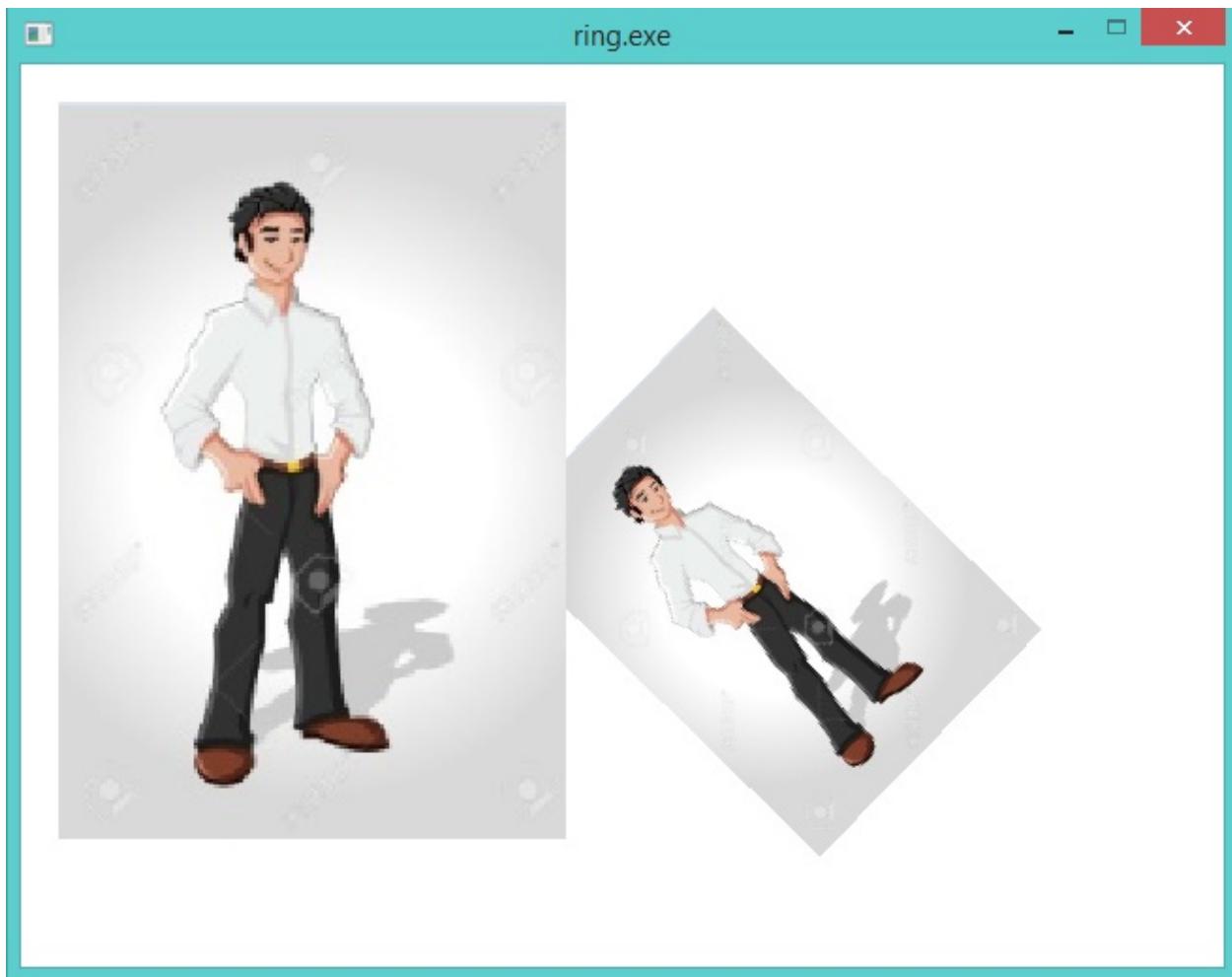
display = al_create_display(640,480)
al_set_target_bitmap(al_get_backbuffer(display))
al_clear_to_color(al_map_rgb(255,255,255))

image = al_load_bitmap("man2.jpg")
al_draw_rotated_bitmap(image,0,0,250,250,150,0)
al_draw_scaled_bitmap(image,0,0,250,250,20,20,400,400,0)

al_flip_display()
al_rest(2)

al_destroy_bitmap(image)
al_destroy_display(display)
```

Screen Shot:



54.5 Display Transparent Image

The next example display image with white background on another image

```
Load "gamelib.ring"

al_init()
al_init_image_addon()

display = al_create_display(640,480)
imageback = al_load_bitmap("palace.jpg")
al_draw_bitmap(imageback,0,0,0)

image = al_load_bitmap("man4.png")
al_convert_mask_to_alpha(image,al_map_rgb(255,255,255))
al_draw_bitmap(image,0,0,0)
al_flip_display()
al_rest(10)

al_destroy_bitmap(image)
```

(continues on next page)

(continued from previous page)

```
al_destroy_display(display)
```

Screen Shot:



54.6 Using Threads

In this example we will learn how to use threads from the Allegro library

```
Load "gamelib.ring"

o1 = new mythreads

Func Main
    al_init()
    for k = 1 to 5
        al_create_thread("o1.thread1()")
        al_create_thread("o1.thread2()")
        al_create_thread("o1.thread3()")
    next
```

(continues on next page)

(continued from previous page)

```

al_rest(2)

Class Mythreads

cAppName = "Threads Application"

Func Thread1
  for x = 1 to 5
    see x + nl
  next
  See 'Thread(1) : Application Name : ' + cAppName + nl

Func Thread2
  for x = 1 to 5
    see '*****' + x + nl
  next
  See 'Thread(2) : Application Name : ' + cAppName + nl

Func Thread3
  for x = 1 to 5
    see '!!!!' + x + nl
  next
  See 'Thread(3) : Application Name : ' + cAppName + nl

```

Output:

```

1
2
3
4
5
Thread(1) : Application Name : Threads Application
*****1
*****2
*****3
*****4
*****5
Thread(2) : Application Name : Threads Application
!!!!1
!!!!2
!!!!3
!!!!4
!!!!5
Thread(3) : Application Name : Threads Application
1
2
3
4
5
Thread(1) : Application Name : Threads Application
!!!!1
!!!!2

```

(continues on next page)

(continued from previous page)

```
!!!!3
!!!!4
!!!!5
Thread(3) : Application Name : Threads Application
*****1
*****2
*****3
*****4
*****5
Thread(2) : Application Name : Threads Application
*****1
*****2
*****3
*****4
*****5
Thread(2) : Application Name : Threads Application
!!!!1
!!!!2
!!!!3
!!!!4
!!!!5
Thread(3) : Application Name : Threads Application
1
2
3
4
5
Thread(1) : Application Name : Threads Application
*****1
*****2
*****3
*****1
*****4
*****2
!!!!1
*****5
*****3
1
!!!!2
Thread(2) : Application Name : Threads Application
1
*****4
!!!!1
2
!!!!3
!!!!4
*****5
!!!!2
3
2
!!!!5
Thread(2) : Application Name : Threads Application
```

(continues on next page)

(continued from previous page)

```
!!!!3
4
3
Thread(3) : Application Name : Threads Application
!!!!4
5
4
!!!!5
Thread(1) : Application Name : Threads Application
5
Thread(3) : Application Name : Threads Application
Thread(1) : Application Name : Threads Application
```

DEMO PROJECT - GAME ENGINE FOR 2D GAMES

In this chapter we will learn about using the different programming paradigms in the same project.

We will create a simple Game Engine for 2D Games.

You can use the Engine directly to create 2D Games for Desktop or Mobile.

55.1 Project Layers

The project contains the next layers

- Games Layer (Here we will use declarative programming)
- Game Engine Classes (Here we will use the Object-Oriented Programming paradigm)
- Interface to graphics library (Here we will use procedural programming)
- Graphics Library bindings (Here we have RingAllegro and RingLibSDL)

55.2 Graphics Library bindings

We already have RingAllegro to use the Allegro game programming library and we have RingLibSDL to use the LibSDL game programming library.

Both of RingAllegro and RingLibSDL are created using the C language with the help of the Ring code generator for extensions.

Each of them is over 10,000 lines of C code which is generated after writing simple configuration files (That are processed by the code generator).

Each configuration file determines the functions names, structures information and constants then the generator process this configuration file to produce the C code and the library that can be loaded from Ring code.

Using RingAllegro and RingLibSDL is very similar to using Allegro and LibSDL from C code where you have the same functions but we can build on that using the Ring language features

- RingAllegro Source Code : <https://github.com/ring-lang/ring/tree/master/extensions/ringallegro>
- RingLibSDL Source Code : <https://github.com/ring-lang/ring/tree/master/extensions/ringsdl>

55.3 Interface to graphics library

In this layer we have `gl_allegro.ring` and `gl_libsdl.ring`

Each library provides the same functions to be used with interacting with the Graphics Library.

This layer hides the details and the difference between RingAllegro and RingLibSDL.

You have the same functions, Just use it and you can switch between Allegro and LibSDL at anytime.

Why ?

Allegro is very simple, we can use it to quickly create 2D games for Windows, Linux and MacOS X.

In Ring 1.0 we started by supporting Allegro.

Also LibSDL is very powerful and popular, very easy to use for Mobile Development.

Ring 1.1 comes with support for LibSDL so we can quickly create games for Mobile.

Note: We can use just one library for Desktop and Mobile development.

- `gl_allegro.ring` source code : https://github.com/ring-lang/ring/blob/master/libraries/gameengine/gl_allegro.ring
- `gl_libsdl.ring` source code : https://github.com/ring-lang/ring/blob/master/libraries/gameengine/gl_libsdl.ring

55.4 Game Engine Classes

The Engine comes with the next classes

- `GameBase` class
- `Resources` class
- `Game` class
- `GameObject` class
- `Sprite` class
- `Text` class
- `Animate` class
- `Sound` class
- `Map` class
- Source Code : <https://github.com/ring-lang/ring/blob/master/libraries/gameengine/gameengine.ring>

55.5 Games Layer

In this layer we create our games using the Game Engine classes

The classes are designed to be used through Declarative Programming.

In our games we will use the next classes

- Game class
- Sprite class
- Text class
- Animate class
- Sound class
- Map class

Note: Other classes in the engine are for internal use by the engine.

We will introduce some examples and three simple games :-

- Stars Fighter Game
- Flappy Bird 3000 Game
- Super Man 2016 Game

55.6 Game Class

The next table present the class attributes.

Attributes	Description
FPS	Number determines how many times the draw() method will be called per second.
FixedFPS	Number determines how many times the animate() method will be called per second.
Title	String determines the window title of the game.
Icon	String determines the window icon (file name)
aObjects	List contains all objects in the game
shutdown	True/False value to end the game loop

The next table present the class methods.

Method	Description
refresh()	Delete objects.
settitle(cTitle)	Set the window title using a string parameter.
shutdown()	Close the application.
find(cName)	Find an object using the object name
remove(nID)	Remove an object using the object ID

The next table present a group of keywords defined by the class.

Keyword	Description
sprite	Create new Sprite object and add it to the game objects.
text	Create new Text object and add it to the game objects.
animate	Create new Animate object and add it to the game objects.
sound	Create new Sound object and add it to the game objects.
map	Create new Map object and add it to the game objects.

55.7 GameObject Class

The next table present the class attributes.

Attributes	Description
enabled	True/False determine the state of the object (Active/Not Active)
x	Number determine the x position of the object.
y	Number determine the y position of the object.
width	Number determine the width of the object.
height	Number determine the height of the object.
nIndex	Number determine the ID of the object.
name	String represent the object name.
animate	True/False to animate the object or not.
move	True/False to move the object using the keyboard or not.
Scaled	True/False to scale the object image or not.
draw	Function to be called when drawing the object.
state	Function to be called for object animation.
keypress	Function to be called when a key is pressed.
mouse	Function to be called when a mouse event happens.

The next table present the class methods.

Method	Description
keyboard(oGame,nkey)	Check Keyboard Events
mouse(oGame,nType,aMouseList)	Check Mouse Events
rgb(r,g,b)	Return new color using the RGB (Red, Green and Blue) Values.

55.8 Sprite Class

Parent Class : GameObject Class

The next table present the class attributes.

Attributes	Description
image	String determine the image file name.
point	Number determine the limit of automatic movement of the object.
direction	Number determine the direction of movement.
nstep	Number determine the increment/decrement during movement.
type	Number determine the object type in the game (Optional).
transparent	True/False value determine if the image is transparent.

The next table present the class methods.

Method	Description
Draw(oGame)	Draw the object

55.9 Text Class

Parent Class : Sprite Class

The next table present the class attributes.

Attributes	Description
size	Number determine the font size
font	String determine the font file name
text	String determine the text to be displayed
color	Number determine the color

The next table present the class methods.

Method	Description
Draw(oGame)	Draw the object

55.10 Animate Class

Parent Class : Sprite Class

The next table present the class attributes.

Attributes	Description
frames	Number determine the number of frames
frame	Number determine the active frame
framewidth	Number determine the frame width.
animate	True/False determine using animate or not.
scaled	True/False determine scaling image or not.

The next table present the class methods.

Method	Description
Draw(oGame)	Draw the object

55.11 Sound Class

Parent Class : GameObject Class

The next table present the class attributes.

Attributes	Description
file	String determine the sound file name.
once	True/False determine to play the file one time or not (loop).

The next table present the class methods.

Method	Description
playsound()	Play the sound file

55.12 Map Class

Parent Class : Sprite Class

The next table present the class attributes.

Attributes	Description
aMap	List determine the map content using numbers.
aImages	List determine the image used for each number in the map.
BlockWidth	Number determine the block width (default = 32).
BlockHeight	Number determine the block height (default = 32).
Animate	True/False determine the animation status.

The next table present the class methods.

Method	Description
getvalue(x,y)	Return the item value in the Map according to the visible part

55.13 Using the Game Engine - Creating the Game Window

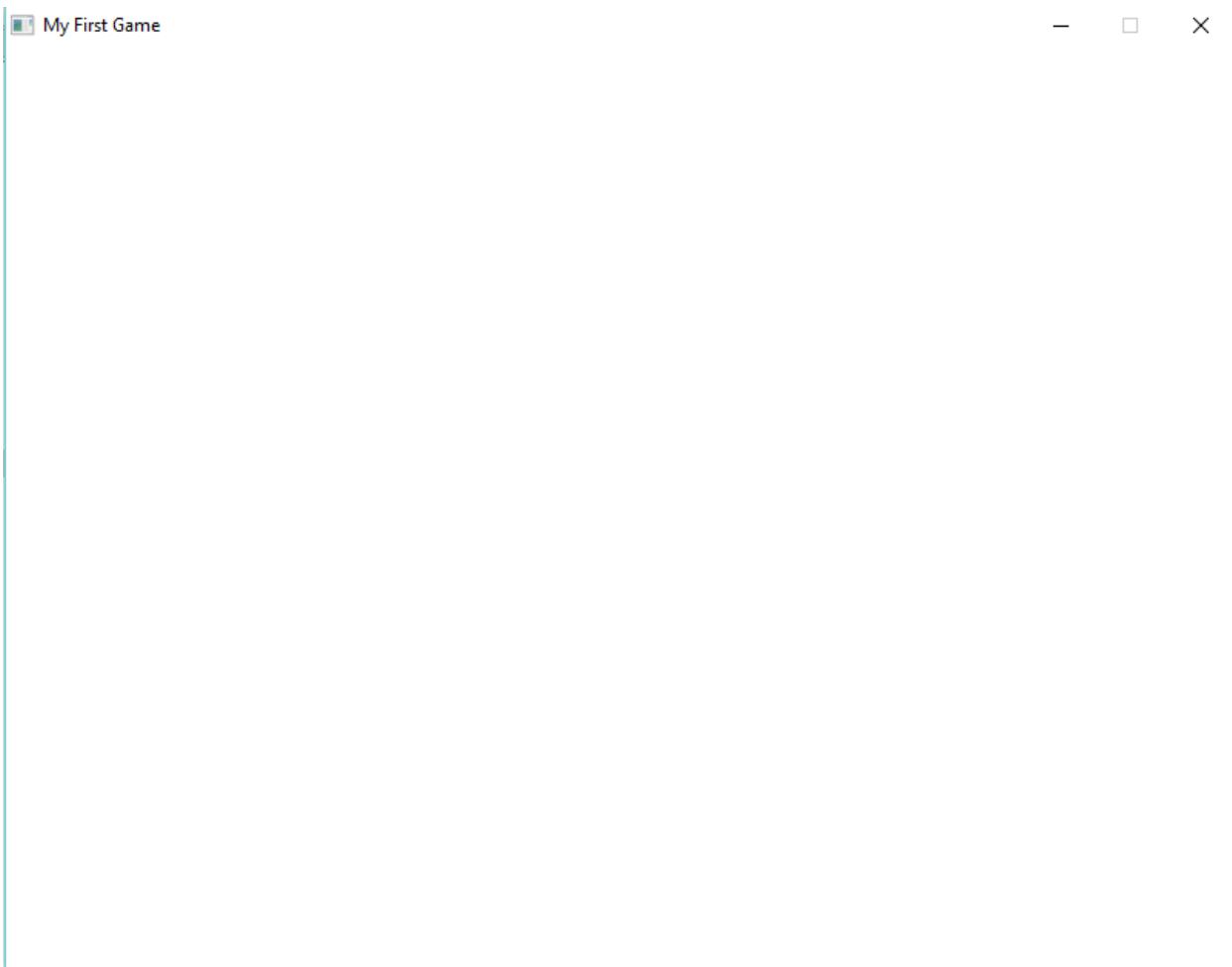
```
Load "gameengine.ring" # Give Control to the Game Engine

func main                # Called by the Game Engine

    oGame = New Game      # Create the Game Object
    {
        title = "My First Game"
    }                      # Start the Events Loop
```

Note: if you want to define global variables, this must be before load “gameengine.ring” because this instruction will give the control to the game engine.

Screen Shot:



55.14 Using the Game Engine - Drawing Text

```
Load "gameengine.ring" # Give Control to the Game Engine

func main # Called by the Game Engine

    oGame = New Game # Create the Game Object
    {
        title = "My First Game"
        text {
            x = 10 y=50
            animate = false
            size = 20
            file = "fonts/pirulen.ttf"
            text = "game development using ring is very fun!"
            color = rgb(0,0,0)
        }
    } # Start the Events Loop
```

Screen Shot:



55.15 Using the Game Engine - Moving Text

```

Load "gameengine.ring" # Give Control to the Game Engine

func main                # Called by the Game Engine

    oGame = New Game      # Create the Game Object
    {
        title = "My First Game"
        text {
            x = 10  y=50
            animate = false
            size = 20
            file = "fonts/pirulen.ttf"
            text = "game development using ring is very fun!"
            color = rgb(0,0,0)      # Color = black
        }
        text {
            x = 10  y=150
            # Animation Part =====
            animate = true          # Use Animation
            direction = GE_DIRECTION_INCVERTICAL   # Increase y
            point = 400              # Continue until y=400
            nStep = 3                # Each time y+= 3
            #=====
            size = 20
            file = "fonts/pirulen.ttf"
            text = "welcome to the real world!"
            color = rgb(0,0,255)     # Color = Blue
        }
    }                      # Start the Events Loop
}

```

Screen Shot:



55.16 Using the Game Engine - Playing Sound

```

Load "gameengine.ring"  # Give Control to the Game Engine

func main                # Called by the Game Engine

    oGame = New Game      # Create the Game Object
    {
        title = "My First Game"
        text {
            x = 10  y=50
            animate = false
            size = 20
            file = "fonts/pirulen.ttf"
            text = "game development using ring is very fun!"
            color = rgb(0,0,0)      # Color = black
        }
        text {
            x = 10  y=150
            # Animation Part =====

```

(continues on next page)

(continued from previous page)

```

animate = true                      # Use Animation
direction = GE_DIRECTION_INCVERTICAL    # Increase y
point = 400                         # Continue until y=400
nStep = 3                           # Each time y+= 3
#=====
size = 20
file = "fonts/pirulen.ttf"
text = "welcome to the real world!"
color = rgb(0,0,255)      # Color = Blue
}
Sound {                                # Play Sound
    file = "sound/music1.wav"        # Sound File Name
}
}                                         # Start the Events Loop

```

55.17 Using the Game Engine - Animation

```

Load "gameengine.ring"  # Give Control to the Game Engine

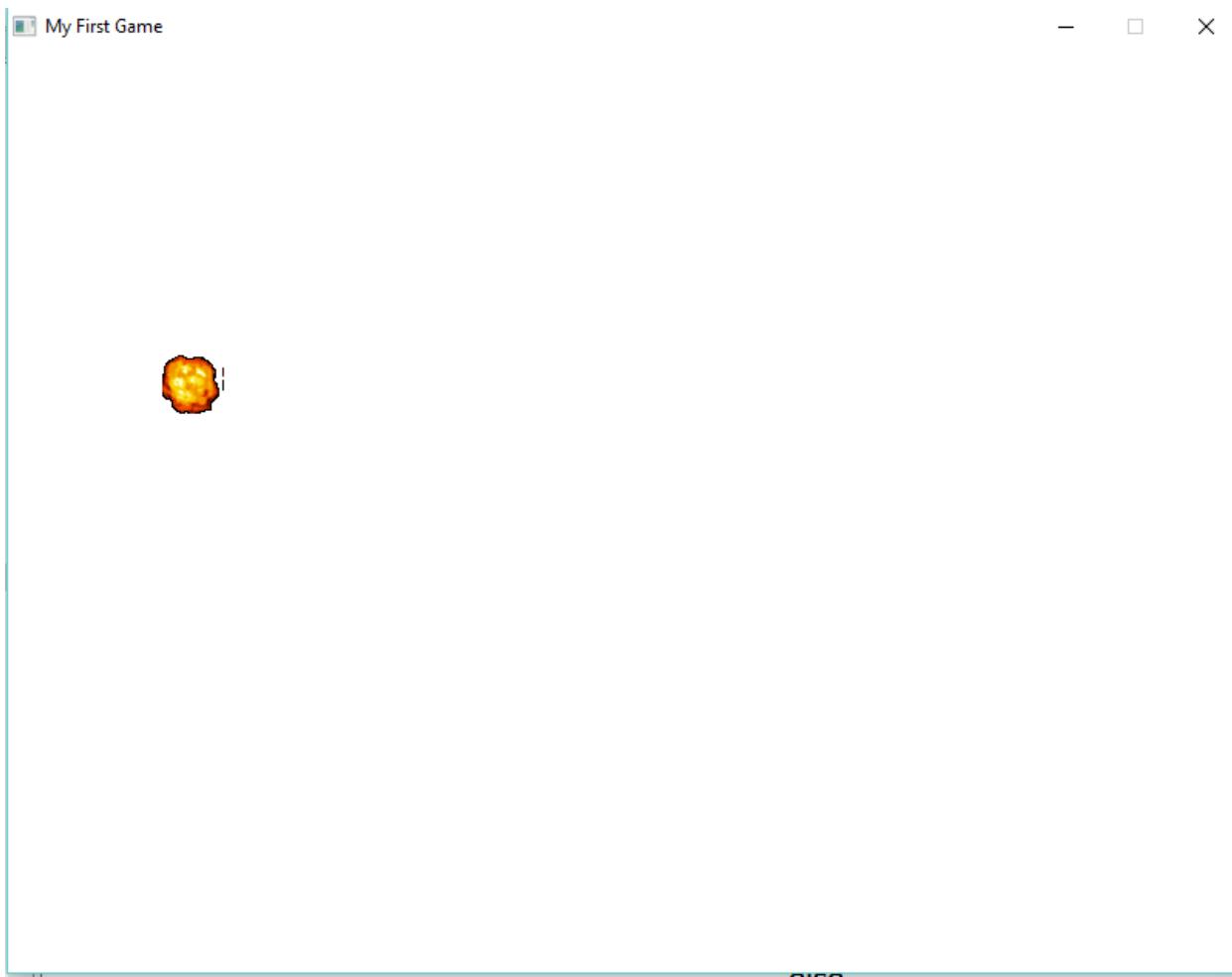
func main                  # Called by the Game Engine

oGame = New Game           # Create the Game Object
{
    title = "My First Game"

    animate {
        file = "images/fire.png"
        x = 100
        y = 200
        framewidth = 40
        height = 42
        nStep = 3      # Used for delay
        transparent = true
        state = func oGame,oSelf { # Called by engine each frame
            oSelf {
                nStep--
                if nStep = 0
                    nStep = 3
                    if frame < 13      # we have 13 frames in animation
                        frame++    # move to next frame
                    else
                        oGame.remove(oself nIndex)    # remove object
                ok
            }
        }
    }
}

# Start the Events Loop

```



55.18 Using the Game Engine - Animation and Functions

```
Load "gameengine.ring" # Give Control to the Game Engine

func main             # Called by the Game Engine

oGame = New Game      # Create the Game Object
{
    title = "My First Game"
    for x = 70 to 700 step 50
        for y = 70 to 500 step 50
            showfire(oGame,x,y)
    next
next

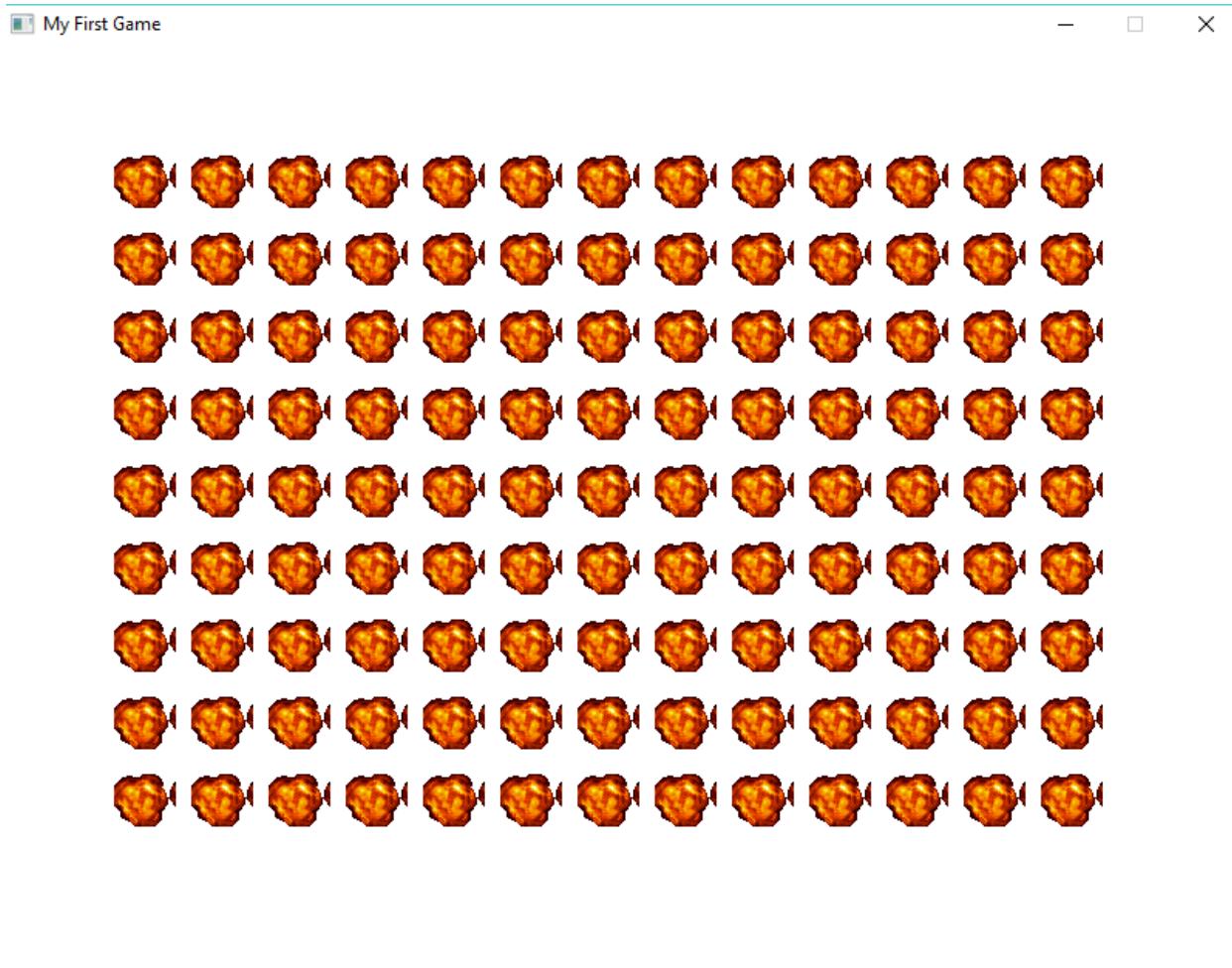
}                   # Start the Events Loop

func showfire oGame,nX,nY
oGame {
    animate {
```

(continues on next page)

(continued from previous page)

```
file = "images/fire.png"
x = nX
y = nY
framewidth = 40
height = 42
nStep = 3      # Used for delay
transparent = true
state = func oGame,oSelf { # Called by engine each frame
    oSelf {
        nStep--
        if nStep = 0
            nStep = 3
            if frame < 13      # we have 13 frames in animation
                frame++   # move to next frame
            else
                frame=1
            ok
        ok
    }
}
}
```



55.19 Using the Game Engine - Sprite - Automatic Movement using Keyboard

```

Load "gameengine.ring"                                # Give control to the game engine

func main                                            # Called by the Game Engine

oGame = New Game                                      # Create the Game Object
{
    title = "My First Game"
    sprite
    {
        type = GE_TYPE_PLAYER                         # Just for our usage
        x=400 y=400 width=100 height=100
        file = "images/player.png"
        transparent = true
        Animate=false
        Move=true           # we can move it using keyboard arrows
        Scaled=true
    }
}

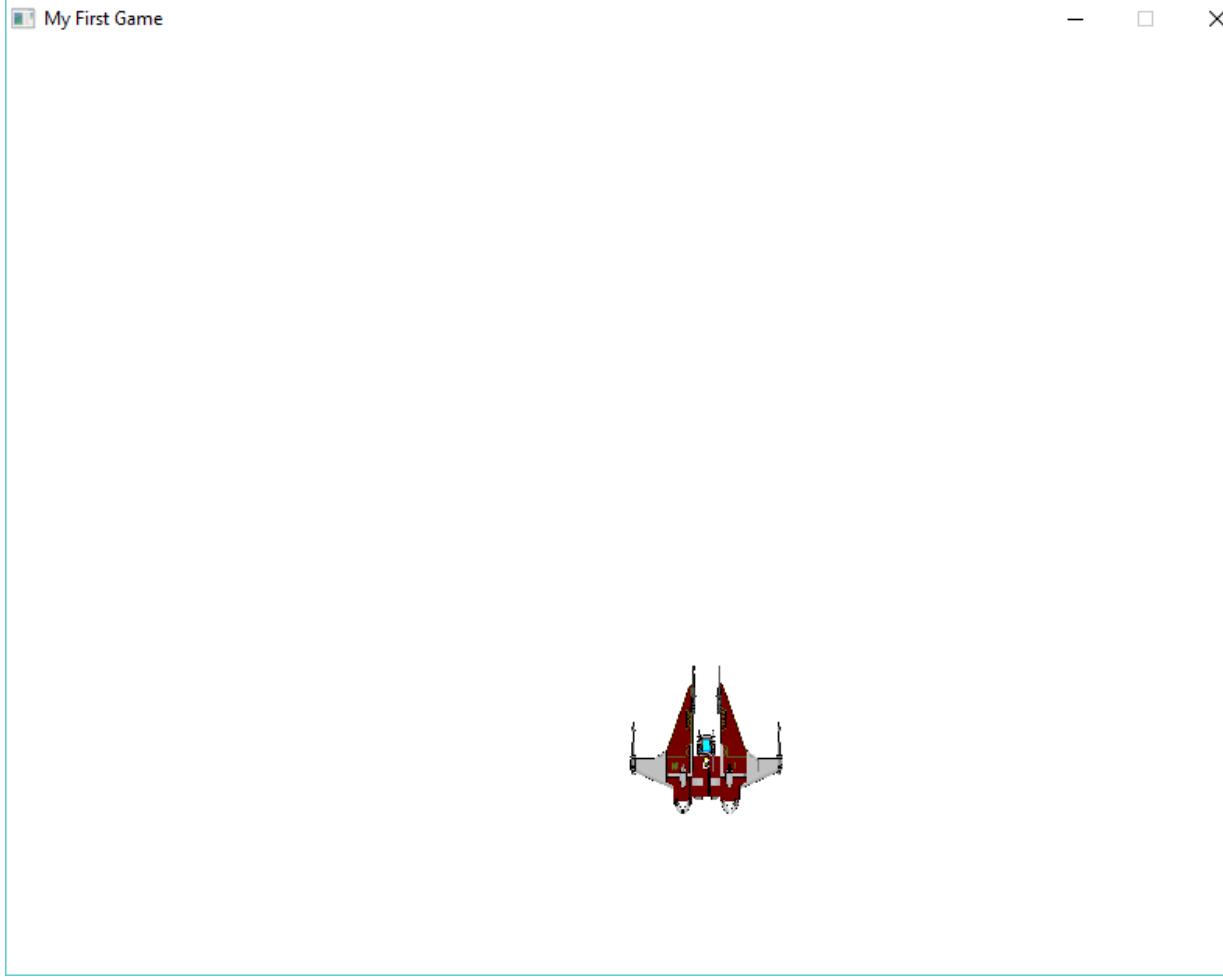
```

(continues on next page)

(continued from previous page)

```
}
```

Start the Events Loop



55.20 Using the Game Engine - Sprite - Keypress event

```
Load "gameengine.ring"                                # Give control to the game engine

func main                                            # Called by the Game Engine

    oGame = New Game                                  # Create the Game Object
    {
        title = "My First Game"
        sprite
        {
            type = GE_TYPE_PLAYER                      # Just for our usage
            x=400 y=400 width=100 height=100
            file = "images/player.png"
            transparent = true
        }
    }
}
```

(continues on next page)

(continued from previous page)

```

Animate=false
Move=false          # Custom Movement
Scaled=true
keypress = func oGame,oSelf,nKey {
    oSelf {
        Switch nKey
        on KEY_LEFT
            x -= 10
        on KEY_RIGHT
            x += 10
        on KEY_UP
            y -= 10
        on KEY_DOWN
            y += 10
        off
    }
}
}                      # Start the Events Loop

```

55.21 Using the Game Engine - Sprite - Mouse event

```

Load "gameengine.ring"                      # Give control to the game engine

func main                                     # Called by the Game Engine

oGame = New Game                                # Create the Game Object
{
    title = "My First Game"
    sprite
    {
        type = GE_TYPE_PLAYER           # Just for our usage
        x=400 y=400 width=100 height=100
        file = "images/player.png"
        transparent = true
        Animate=false
        Move=false          # Custom Movement
        Scaled=true
        keypress = func oGame,oSelf,nKey {
            oSelf {
                Switch nKey
                on KEY_LEFT
                    x -= 10
                on KEY_RIGHT
                    x += 10
                on KEY_UP
                    y -= 10
                on KEY_DOWN
                    y += 10
                off
            }
        }
    }
}

```

(continues on next page)

(continued from previous page)

```

        }
    }
mouse = func oGame,oSelf,nType,aMouseList {
    if nType = GE_MOUSE_UP
        oSelf {
            x = aMouseList[GE_MOUSE_X]
            y = aMouseList[GE_MOUSE_Y]
        }
    ok
}
}
# Start the Events Loop

```

55.22 Using the Game Engine - Sprite - State event

```

Load "gameengine.ring"                                # Give control to the game engine

func main                                         # Called by the Game Engine

oGame = New Game                                     # Create the Game Object
{
    title = "My First Game"
    sprite
    {
        type = GE_TYPE_PLAYER                      # Just for our usage
        x=400 y=400 width=100 height=100
        file = "images/player.png"
        transparent = true
        Animate=false
        Move=false                                     # Custom Movement
        Scaled=true
        keypress = func oGame,oSelf,nKey {
            oSelf {
                Switch nKey
                on KEY_LEFT
                    x -= 10
                on KEY_RIGHT
                    x += 10
                on KEY_UP
                    y -= 10
                on KEY_DOWN
                    y += 10
                off
            }
        }
        mouse = func oGame,oSelf,nType,aMouseList {
            if nType = GE_MOUSE_UP
                oSelf {
                    x = aMouseList[GE_MOUSE_X]
                    y = aMouseList[GE_MOUSE_Y]

```

(continues on next page)

(continued from previous page)

```

        }
    ok
}
state = func oGame,oSelf {
    oSelf {
        if x < 0 x = 0 ok
        if y < 0 y = 0 ok
        if x > ogame.width-width
            x= ogame.width - width ok
        if y > ogame.height-height
            y=ogame.height - height ok
    }
}
# Start the Events Loop

```

55.23 Using the Game Engine - Animate - Events

```

Load "gameengine.ring"                                # Give control to the game engine

func main                                         # Called by the Game Engine

oGame = New Game                                     # Create the Game Object
{
    title = "My First Game"

animate {

    file = "images/fbbird.png"
    x = 10
    y = 10
    framewidth = 20
    scaled = true
    height = 50
    width = 50
    nStep = 3
    transparent = true

state = func oGame,oSelf {
    oSelf {

        # Animation
        nStep--
        if nStep = 0
            nStep = 3
            if frame < 3
                frame++
            else
                frame=1
        ok
    }
}

```

(continues on next page)

(continued from previous page)

```
ok

# Move Down
y += 3
if y > 550 y=550 ok

}

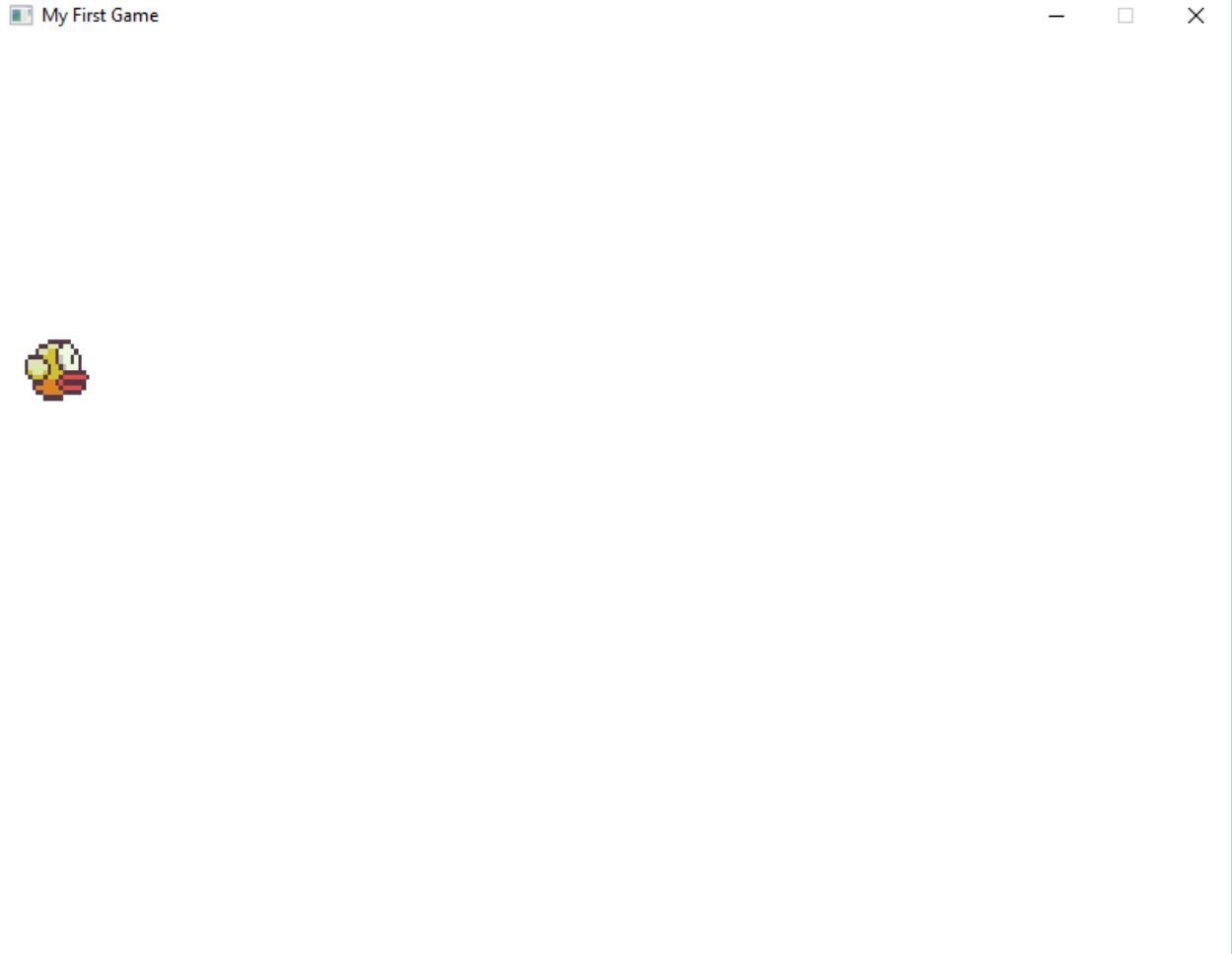
}

keypress = func ogame,oself,nKey {
    oself {
        if nkey = key_space
            y -= 55
            if y<=0 y=0 ok
        ok
    }
}

mouse = func ogame,oself,nType,aMouseList {
    if nType = GE_MOUSE_UP
        cFunc = oself.keypress
        call cFunc(oGame,oSelf,Key_Space)
    ok
}
}

# Start the Events Loop
```

Screen Shot:



My First Game

- □ ×

55.24 Using the Game Engine - Map

```
Load "gameengine.ring"           # Give control to the game engine

func main                      # Called by the Game Engine

oGame = New Game             # Create the Game Object
{
    title = "My First Game"

    Map {

        blockwidth = 80
        blockheight = 80

        aMap = [
            [0,0,0,0,0,0,0,0,0,1,0,0,0,3,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0],
            [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0],
            [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0,0,2,0,0,0,1,0,0,0],
            [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,3,0,0,0,1,0,0,0,1,0,0,0]
        ]
    }
}
```

(continues on next page)

(continued from previous page)

```

[0,0,0,0,0,0,0,0,3,0,0,0,1,0,0,0,0,0,0,1,0,0,0,3,0,0,0],
[0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0],
[0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0],
[0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0]
]

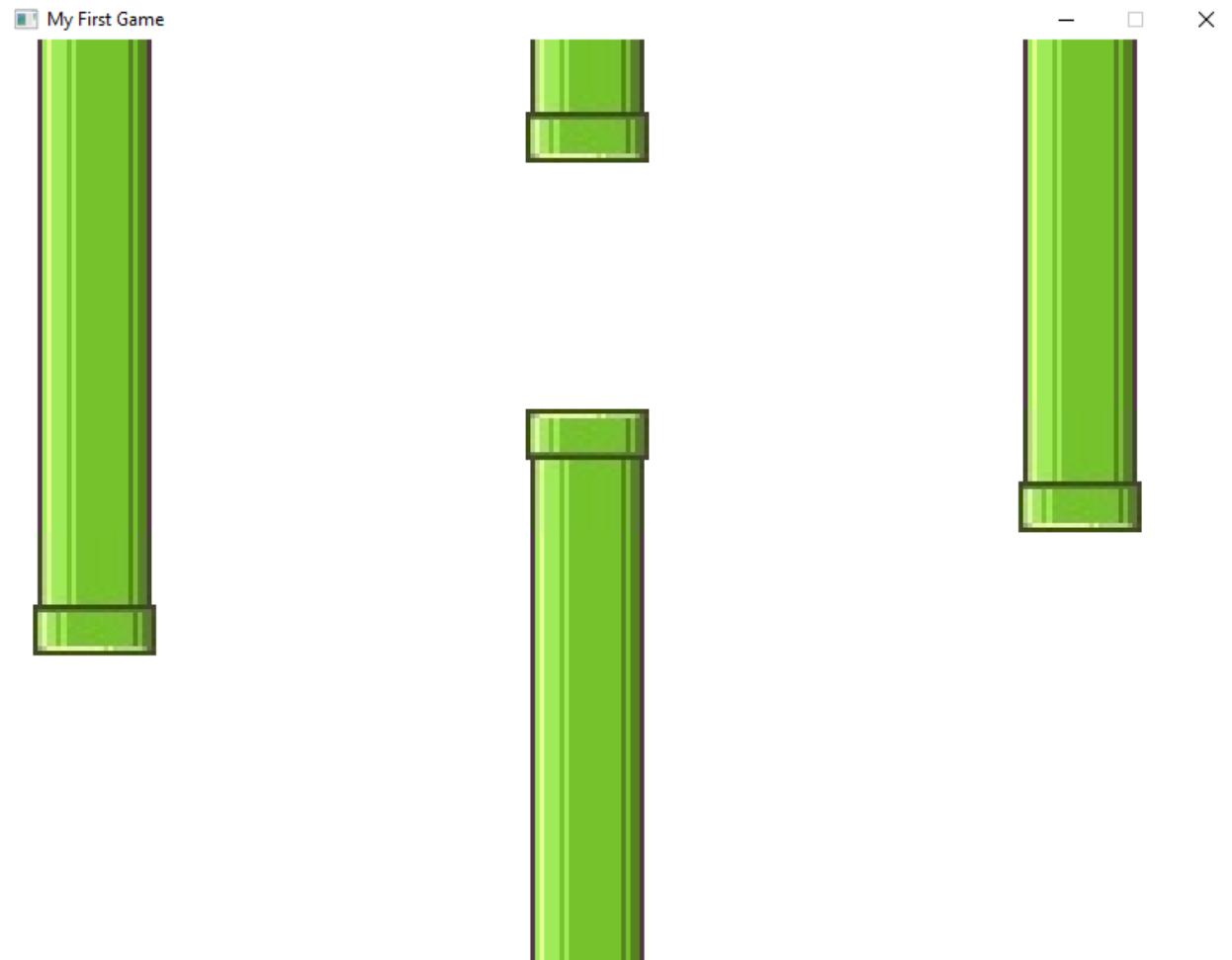
aImages = ["images/fbwall.png",
           "images/fbwallup.png",
           "images/fbwalldown.png"]

state = func oGame,oSelf {
    oSelf {
        x -= 3
        if x < - 2100 x = 0 ok
    }
}

}
# Start the Events Loop

```

Screen Shot:



55.25 Using the Game Engine - Map Events

```

Load "gameengine.ring"          # Give control to the game engine

func main                      # Called by the Game Engine

oGame = New Game                # Create the Game Object
{
    title = "My First Game"

    Map {

        blockwidth = 80
        blockheight = 80

        aMap = [
            [0,0,0,0,0,0,0,0,0,1,0,0,0,3,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0],
            [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0],
            [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,1,0,0,0,2,0,0,0,1,0,0,0],
            [0,0,0,0,0,0,0,0,0,1,0,0,0,2,0,0,0,3,0,0,0,1,0,0,0,1,0,0,0],
            [0,0,0,0,0,0,0,0,0,3,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0,3,0,0,0],
            [0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0],
            [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0,0],
            [0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0,0]
        ]
    }

    aImages = ["images/fbwall.png",
               "images/fbwallup.png",
               "images/fbwalldown.png"]

    state = func oGame,oSelf {
        oSelf {
            x -= 3
            if x < - 2100  x = 0  ok
        }
    }

    mouse = func ogame,oself,nType,aMouseList {
        if nType = GE_MOUSE_UP
            oSelf {
                mX = aMouseList[GE_MOUSE_X]
                mY = aMouseList[GE_MOUSE_Y]
                nValue = GetValue(mX,mY)
                nRow = GetRow(mX,mY)
                nCol = GetCol(mX,mY)
                Switch nValue
                On 1 aMap[nRow][nCol] = 0
                On 2 aMap[nRow][nCol] = 0
                On 3 aMap[nRow][nCol] = 0
                On 0 aMap[nRow][nCol] = 1
                Off
            }
    }
}

```

(continues on next page)

(continued from previous page)

```

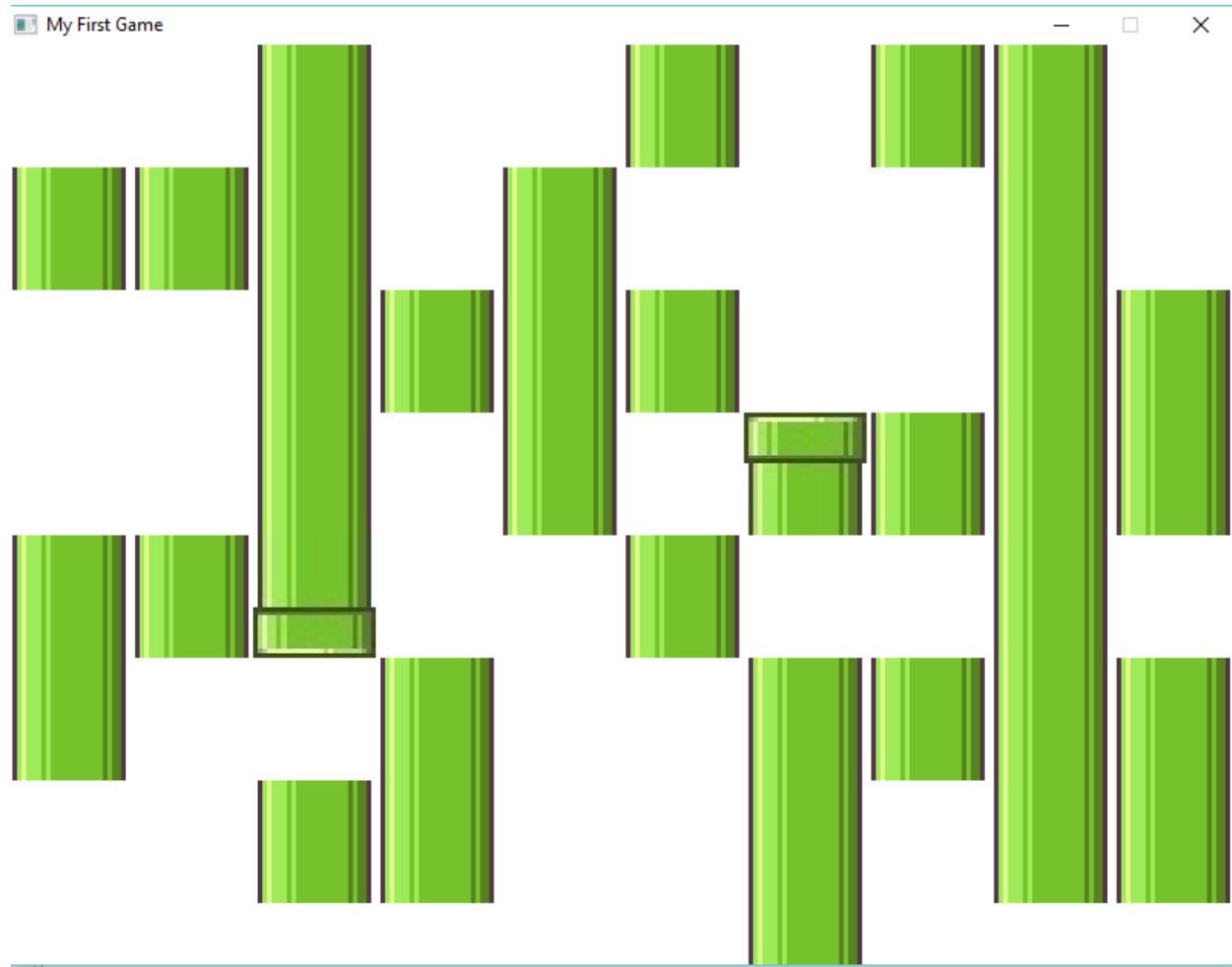
        ok
    }

}

# Start the Events Loop

```

Screen Shot:



55.26 Using the Game Engine - Object and Drawing

We can use the Object keyword (defined by the game engine) to create objects from the GameObject class.

Example:

```

Load "gameengine.ring"                                # Give control to the game engine

func main                                         # Called by the Game Engine

    oGame = New Game                               # Create the Game Object
    {

```

(continues on next page)

(continued from previous page)

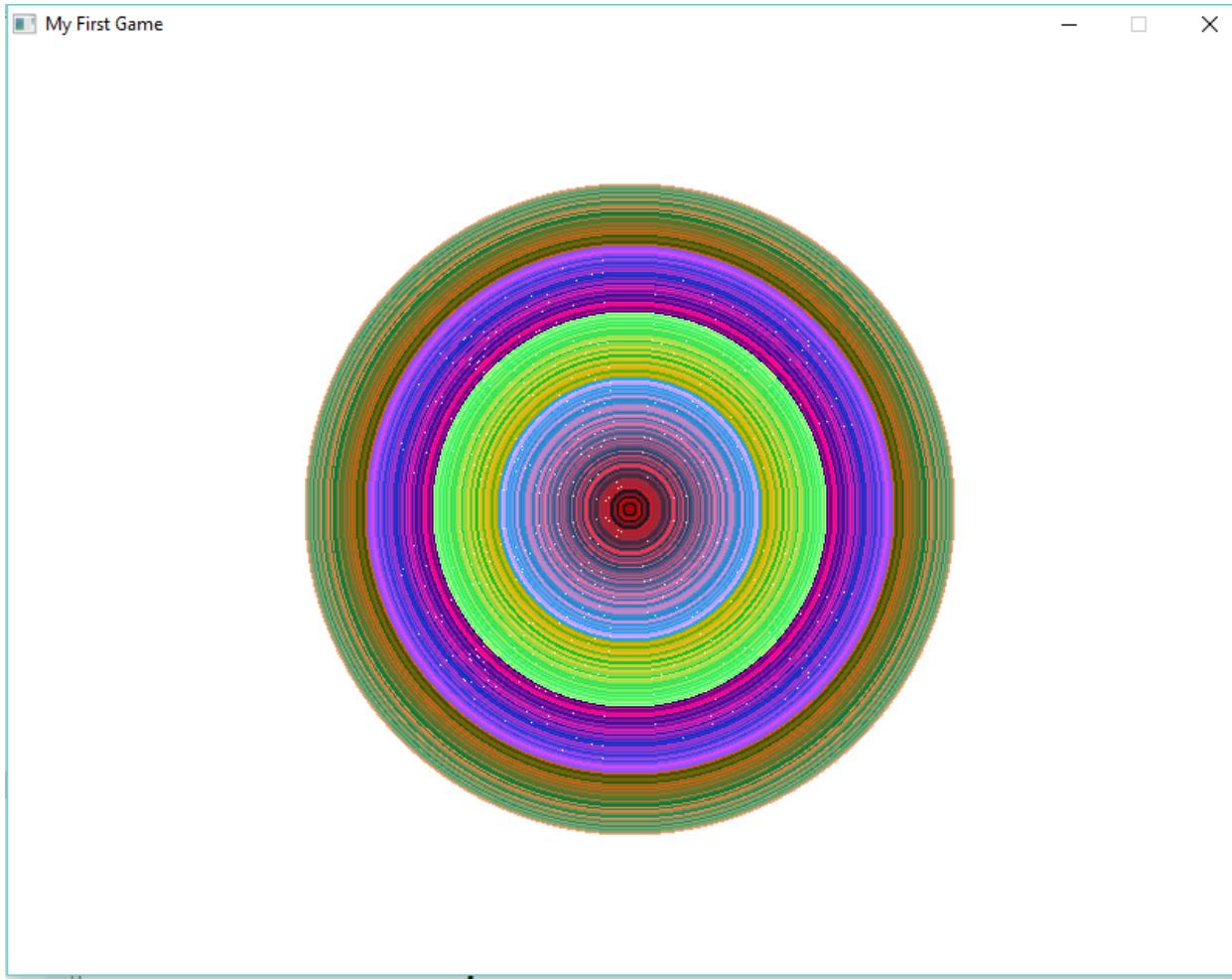
```

title = "My First Game"
Object {
    x = 0 y=300 width = 200 height=200
    draw = func oGame,oSelf {
        oSelf {
            for t = 1 to 210
                gl_draw_circle(x,y,t,
                    gl_map_rgb(t*random(255),
                    t*2,t*3),1)
            next
        }
    }
    state = func oGame,oSelf {
        oSelf {
            if x <= 800
                x+= 3
            else
                x=0
            ok
        }
    }
    keypress = func oGame,oSelf,nKey {
        oSelf {
            Switch nKey
            on KEY_LEFT
                x -= 10
            on KEY_RIGHT
                x += 10
            on KEY_UP
                y -= 10
            on KEY_DOWN
                y += 10
            off
        }
    }
}

# Start the Events Loop

```

Screen Shot:



Example:

```

Load "gameengine.ring"                      # Give control to the game engine

func main                                     # Called by the Game Engine

oGame = New Game                             # Create the Game Object
{
    title = "My First Game"
    Object {
        x = 400 y=300 width = 200 height=200
        draw = func oGame,oSelf {
            oSelf {
                for t = 1 to 210
                    gl_draw_rectangle(x+t,y+t,
                        x+t*2,y+t*2,
                        gl_map_rgb(t*random(255),
                        t*2,t*3),1)
                    gl_draw_rectangle(x+t*2,y+t*2,
                        x-t*2,y-t*2,
                        gl_map_rgb(t*random(255),
                        t*2,t*3),1)
            }
        }
    }
}

```

(continues on next page)

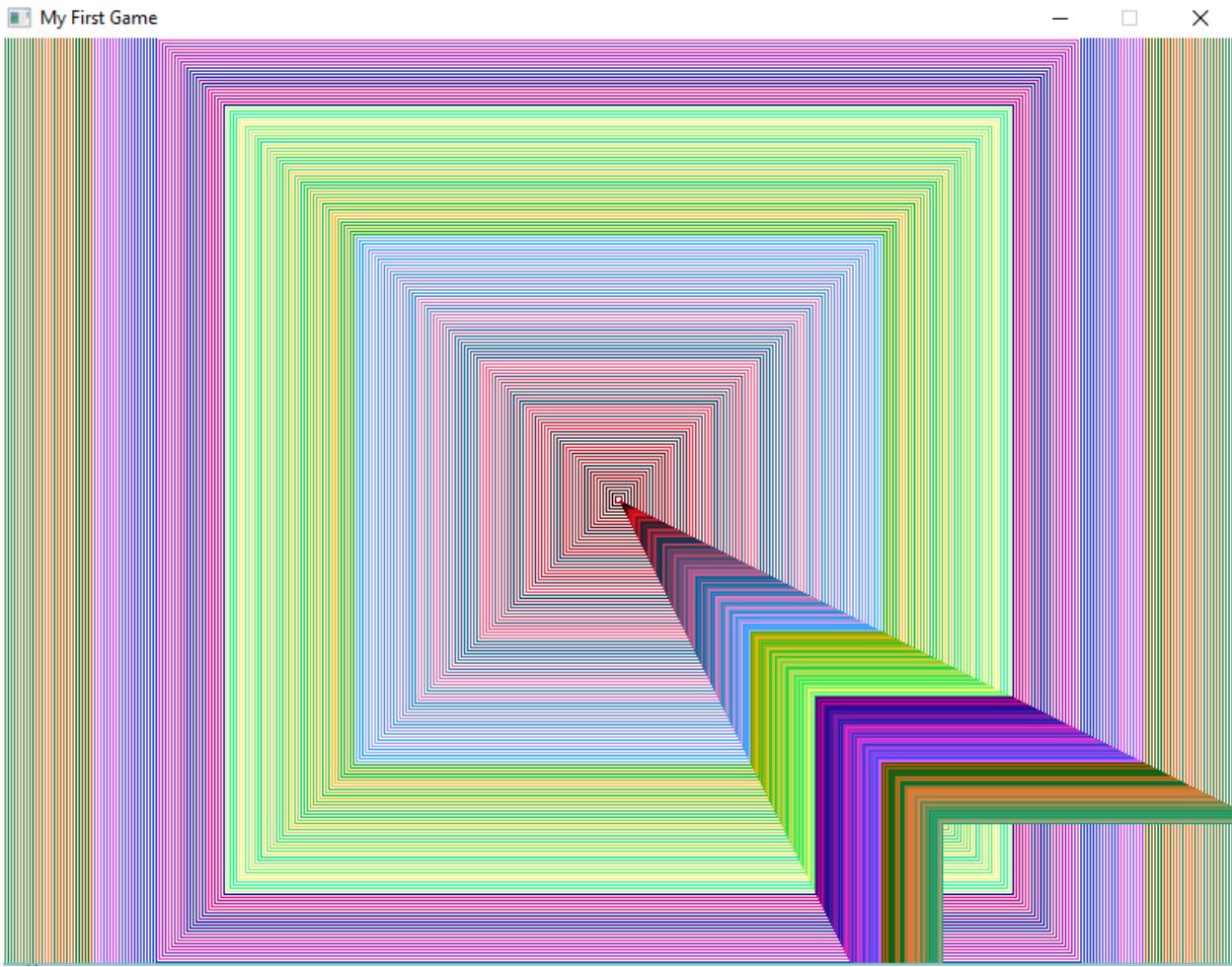
(continued from previous page)

```
        next
    }
}

keypress = func oGame,oSelf,nKey {
    oSelf {
        Switch nKey
        on KEY_LEFT
            x -= 10
        on KEY_RIGHT
            x += 10
        on KEY_UP
            y -= 10
        on KEY_DOWN
            y += 10
        off
    }
}

# Start the Events Loop
```

Screen Shot:



55.27 Stars Fighter Game

The Stars Fighter source code

```
# The Ring Standard Library
# Game Engine for 2D Games
# 2016, Mahmoud Fayed <msfclipper@yahoo.com>

oGameState = NULL

load "gameengine.ring"

func main

oGame = New Game

while true

    oGameState = new GameState
```

(continues on next page)

(continued from previous page)

```

oGame {
    title = "Stars Fighter!"
    sprite
    {
        file = "images/menu1.jpg"
        x = 0 y=0 width=800 height = 600 scaled = true animate = false
        keypress = func ogame,oself,nKey {
            if nkey = key_esc or nKey = GE_AC_BACK
                ogame.shutdown()
            but nKey = key_space
                oGameState.startplay=true
                ogame.shutdown=true
            ok
        }
        mouse = func ogame,oself,nType,aMouseList {
            if nType = GE_MOUSE_UP
                oGameState.startplay=true
                ogame.shutdown=true
            ok
        }
    }
    text {
        animate = false
        size = 35
        file = "fonts/pirulen.ttf"
        text = "Stars Fighter"
        x = 10 y=50
    }
    text {
        animate = false
        size = 25
        file = "fonts/pirulen.ttf"
        text = "Version 1.0"
        x = 80 y=100
    }
    text {
        animate = false
        size = 16
        file = "fonts/pirulen.ttf"
        text = "(C) 2016, Mahmoud Fayed"
        x = 45 y=140
    }

    text {
        animate = false
        size = 25
        file = "fonts/pirulen.ttf"
        text = "Press Space to start"
        x = 190 y=470
    }
    text {
        animate = false
    }
}

```

(continues on next page)

(continued from previous page)

```

        size = 20
        file = "fonts/pirulen.ttf"
        text = "Press Esc to Exit"
        x = 260  y=510
    }
    Sound {
        file = "sound/music1.wav"
    }
}

if oGameState.startplay
    oGame.refresh()
    playstart(oGame)
    oGame.refresh()
ok

end

func playstart oGame

oSound = New Sound {
    file = "sound/music2.wav"
}

while true
    play(oGame)
    if ogame.shutdown = true and oGameState.value = 0
        exit
    ok
    ogame.refresh()
end

oSound.Delete()

func play oGame

oGame
{
    FPS = 60
    FixedFPS = 120
    title = "Stars Fighter!"
    sprite
    {
        file = "images/stars.jpg"
        x = 0
        y = 0
        point = -370
        direction = ge_direction_dec
        type = ge_type_background
        state = func ogame,oself {
            oself {
                if x < -350

```

(continues on next page)

(continued from previous page)

```

        direction = ge_direction_inc
        point = 370
    but x = 0 and direction = ge_direction_inc
        direction = ge_direction_dec
        point = -370
    ok
}
}
}
sprite
{
    file = "images/player.png"
    transparent = true
    type = ge_type_player
    x = 400 y =400 width=100 height=100
    animate=false move=true Scaled=true
    mouse = func ogame,oself,nType,aMouseList {

        if not ( aMouseList[GE_MOUSE_X] >= oSelf.x and
                  aMouseList[GE_MOUSE_X] <= oSelf.x+oSelf.width and
                  aMouseList[GE_MOUSE_Y] >= oself.y and
                  aMouseList[GE_MOUSE_Y] <= oSelf.y+oSelf.height )

        if nType = GE_MOUSE_DOWN
            if aMouseList[1] < oSelf.X # left
                oSelf.X -= 100
            else
                oSelf.X += 100
            ok
            if aMouseList[2] < oSelf.Y # up
                oSelf.Y -= 100
            else
                oSelf.Y += 100
            ok
        ok

        else
            if nType = GE_MOUSE_UP
                cFunc = oself.keypress
                call cFunc(oGame,oSelf,Key_Space)
            ok
        ok
    }
    keypress = func oGame,oself,nkey {
        if nkey = key_space
            ogame {
                sprite {
                    type = ge_type_fire
                    file = "images/rocket.png"
                    transparent = true
                    x = oself.x + 30
                    y = oself.y - 30

```

(continues on next page)

(continued from previous page)

```

width = 30
height = 30
point = -30
nstep = 20
direction = ge_direction_decvertical
state = func oGame,oSelf {
    for x in oGame.aObjects
        if x.type = ge_type_enemy
            if oSelf.x >= x.x and oSelf.y >= x.y and
                oSelf.x <= x.x + x.width and
                oSelf.y <= x.y + x.height
                showfire(oGame,x.x+40,x.y+40)
                ogame.remove(x.nindex)
                oGameState.score+=10
                oGameState.enemies--
                checkwin(oGame)
                exit
            ok
        next
    }
}
but nkey = key_esc or nKey = GE_AC_BACK ogame.shutdown()
ok
}
state = func oGame,oSelf {
    oSelf {
        if x < 0 x = 0 ok
        if y < 0 y = 0 ok
        if x > ogame.screen_w-width x= ogame.screen_w - width ok
        if y > ogame.screen_h-height y=ogame.screen_h-height ok
    }
}
for g = 1 to oGameState.enemies
    sprite
    {
        type = ge_type_enemy
        file = "images/enemy.png"
        transparent = true
        x = g*random(50) y=g width=100 height=100
        animate=true Scaled=true
        direction = ge_direction_random
        state = func oGame,oSelf {
            oSelf {
                if x < 0 x = 0 ok
                if y < 0 y = 0 ok
                if x > ogame.screen_w-width x= ogame.screen_w - width ok
                if y > ogame.screen_h-height y=ogame.screen_h-height ok
            }
            if random(100) = 1
        }
    }
}

```

(continues on next page)

(continued from previous page)

```

oGame {
    sprite {
        type = ge_type_fire
        file = "images/rocket2.png"
        transparent = true
        x = oself.x + 30
        y = oself.y + oself.height+ 30
        width = 30
        height = 30
        point = oGame.screen_h+30
        nstep = 10
        direction = ge_direction_incvertical
        state = func oGame,oSelf {
            x = oGame.aObjects[oGameState.playerindex]
            if oself.x >= x.x and oself.y >= x.y and
                oself.x <= x.x + x.width and
                oself.y <= x.y + x.height
                if oGameState.value > 0
                    oGameState.value-=10
                ok
                oGame.remove(oself.nindex)
                checkgameover(oGame)
            ok
        }
    }
    ok
}
next
text {
    size = 30
    file = "fonts/pirulen.ttf"
    text = "Destroy All Enemies!"
    nstep = 3
    color = GE_COLOR_GREEN
    x = 100 y=50
    direction = ge_direction_incvertical
    point = 500
}
text {
    animate = false
    point = 400
    size = 30
    file = "fonts/pirulen.ttf"
    text = "Score : " + oGameState.score
    x = 500 y=10
    state = func oGame,oSelf { oSelf { text = "Score : " + oGameState.score } }
}
text {
    animate = false
    point = 400
}

```

(continues on next page)

(continued from previous page)

```

size = 30
file = "fonts/pirulen.ttf"
text = "Energy : " + oGameState.value
x = 500 y=50
state = func oGame,oSelf { oSelf { text = "Energy : " + oGameState.value } }
}
text {
    animate = false
    point = 400
    size = 30
    file = "fonts/pirulen.ttf"
    text = "Level : " + oGameState.level
    x = 500 y=90
}
}

func checkwin ogame
if oGameState.gameresult return ok
if oGameState.enemies = 0
    oGameState.gameresult = true
oGame {
    if oGameState.level < 30
    text {
        point = 400
        size = 30
        file = "fonts/pirulen.ttf"
        text = "Level Completed!"
        nStep = 3
        x = 500 y=10
        state = func ogame,oSelf {
            if oSelf.y >= 400
                ogame.shutdown = true
                oGameState.level++
                oGameState.enemies = oGameState.level
                oGameState.gameresult = false
            ok
        }
    }
    else
    text {
        point = 400
        size = 30
        nStep = 3
        file = "fonts/pirulen.ttf"
        text = "You Win !!!"
        x = 500 y=10
        state = func ogame,oSelf {
            if oSelf.y >= 400
                ogame.shutdown = true
                oGameState.value = 0
            ok
        }
    }
}

```

(continues on next page)

(continued from previous page)

```

        }
    }
ok
}

func checkgameover ogame
if oGameState.gameresult  return ok
if oGameState.value <= 0
    oGameState.gameresult = true
oGame {
    text {
        point = 400
        size = 30
        nStep = 3
        file = "fonts/pirulen.ttf"
        text = "Game Over !!!"
        x = 500 y=10
        state = func ogame,oself {
            if oself.y >= 400
                ogame.shutdown = true
            ok
        }
    }
}
showfire(oGame,oGame.aObjects[oGameState.PlayerIndex].x+40,
         oGame.aObjects[oGameState.PlayerIndex].y+40)
oGame.aObjects[oGameState.PlayerIndex].enabled = false
oGame.remove(oGameState.PlayerIndex)
ok

func showfire oGame,nX,nY
oGame {
    animate {
        file = "images/fire.png"
        x = nX
        y = nY
        framewidth = 40
        height = 42
        nStep = 3
        transparent = true
        state = func oGame,oSelf {
            oSelf {
                nStep--
                if nStep = 0
                    nStep = 3
                    if frame < 13
                        frame++
                    else
                        frame=1
                oGame.remove(oself.nIndex)
            }
        }
    }
}

```

(continues on next page)

(continued from previous page)

```
        ok
    ok
}
}
}
}
```

```
class gamestate
score = 0
level = 1
enemies = 1
value = 100
playerindex = 2
gameresult = false
startplay=false
```

Screen Shot:



55.28 Flappy Bird 3000 Game

The Flappy Bird 3000 Game source code

```
# The Ring Standard Library
# Game Engine for 2D Games
# 2016, Mahmoud Fayed <msfclipper@yahoo.com>

oGameState = NULL

Load "gameengine.ring"

func main

    oGame = New Game

    while true

        oGameState = New GameState

        oGame {
            title = "Flappy Bird 3000"
            sprite
            {
                file = "images/fbback.png"
                x = 0 y=0 width=800 height = 600 scaled = true animate = false
                keypress = func ogame,oself,nKey {
                    if nkey = key_esc or nKey = GE_AC_BACK
                        ogame.shutdown()
                    but nKey = key_space
                        oGameState.startplay=true
                        ogame.shutdown=true
                    ok
                }
                mouse = func ogame,oself,nType,aMouseList {
                    if nType = GE_MOUSE_UP
                        cFunc = oself.keypress
                        call cFunc(oGame,oSelf,Key_Space)
                    ok
                }
                text {
                    animate = false
                    size = 35
                    file = "fonts/pirulen.ttf"
                    text = "Flappy Bird 3000"
                    x = 150 y=50
                }
                text {
                    animate = false
                    size = 25
                    file = "fonts/pirulen.ttf"
```

(continues on next page)

(continued from previous page)

```

        text = "Version 1.0"
        x = 280  y=100
    }
    text {
        animate = false
        size = 16
        file = "fonts/pirulen.ttf"
        text = "(C) 2016, Mahmoud Fayed"
        x = 245  y=140
    }

    text {
        animate = false
        size = 25
        file = "fonts/pirulen.ttf"
        text = "To Win Get Score = 3000"
        x = 150  y=270
    }

    text {
        animate = false
        size = 25
        file = "fonts/pirulen.ttf"
        text = "Press Space to start"
        x = 190  y=470
    }
    text {
        animate = false
        size = 20
        file = "fonts/pirulen.ttf"
        text = "Press Esc to Exit"
        x = 260  y=510
    }

animate {
    file = "images/fbbird.png"
    x = 200
    y = 200
    framewidth = 20
    scaled = true
    height = 50
    width = 50
    nStep = 3
    transparent = true
    animate = true
    direction = ge_direction_random
    state = func oGame,oSelf {
        oSelf {
            nStep--
            if nStep = 0
                nStep = 3
                if frame < 3

```

(continues on next page)

(continued from previous page)

```

        frame++
    else
        frame=1
    ok
    ok
    if x <= 0 x=0 ok
    if y <= 0 y=0 ok
    if x >= 750 x= 750 ok
    if y > 550 y=550 ok
}
}

Sound {
    file = "sound/music2.wav"
}
}

if oGameState.startplay
oGame.refresh()
playstart(oGame)
oGame.refresh()
ok

end

func playstart oGame

oGame {
    FPS = 60
    FixedFPS = 120
    Title = "Flappy Bird 3000"
    Sprite {
        file = "images/fbback.png"
        x = 0 y=0 width=800 height = 600 scaled = true animate = false
        keypress = func ogame,oself,nKey {
            if nkey = key_esc or nKey = GE_AC_BACK
                ogame.shutdown()
            ok
        }
    }
}

Map {
    blockwidth = 80
    blockheight = 80
    aMap = [
        [0,0,0,0,0,0,0,0,1,0,0,0,3,0,0,0,1,0,0,0,0,0,0,0,0,1,0,0,0],
        [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0],
        [0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0,2,0,0,0,1,0,0,0],
        [0,0,0,0,0,0,0,0,0,1,0,0,0,2,0,0,0,3,0,0,0,1,0,0,0,1,0,0,0],
        [0,0,0,0,0,0,0,0,0,3,0,0,0,1,0,0,0,0,0,0,0,1,0,0,0,3,0,0,0],
        [0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0]
    ]
}

```

(continues on next page)

(continued from previous page)

(continues on next page)

(continued from previous page)

```

        }
        ok
    }
}

Sound {
    once = true
    file = "sound/sfx_hit.wav"
}
}

ok
ok
}

animate {
    file = "images/fbbird.png"
    x = 10
    y = 10
    framewidth = 20
    scaled = true
    height = 50
    width = 50
    nStep = 3
    transparent = true
    state = func oGame,oSelf {
        oSelf {
            nStep--
            if nStep = 0
                nStep = 3
            if frame < 3
                frame++
            else
                frame=1
            ok
        }
        ok
    }

    if not oGameState.playerwin
        oGameState.down --
    if oGameState.down = 0
        oGameState.down = 3
        osself {
            y += 25
            if y > 550 y=550 ok
        }
    ok
    ok
}

keypress = func ogame,oself,nKey {
    if oGameState.gameresult = false
        osself {

```

(continues on next page)

(continued from previous page)

```

        if nkey = key_space
            y -= 55
            oGameState.down = 60
            if y<=0 y=0 ok
        ok
    }
ok
}
mouse = func ogame,oself,nType,aMouseList {
    if nType = GE_MOUSE_UP
        cFunc = oself.keypress
        call cFunc(ogame,oSelf,Key_Space)
    ok
}
}

text {
    animate = false
    point = 400
    size = 30
    file = "fonts/pirulen.ttf"
    text = "Score : " + oGameState.score
    x = 500 y=10
    state = func oGame,oSelf {
        oSelf { text = "Score : " + oGameState.score }
    }
}
}

func newmap aMap
aV = [
[1,1,3,0,0,2,1,1],
[1,3,0,0,0,2,1,1],
[1,1,1,3,0,2,1,1],
[1,1,1,3,0,0,0,0],
[0,0,0,0,2,1,1,1],
[0,0,2,1,1,1,1,1],
[0,0,0,2,1,1,1,1],
[1,1,1,3,0,2,1,1],
[1,1,1,1,1,3,0,0],
[3,0,0,2,1,1,1,1],
[3,0,0,2,3,0,0,2]
]
for x = 10 to 24 step 4
    aVar = aV[ (random(10)+1) ]
    for y = 1 to 8
        aMap[y][x] = aVar[y]
    next
next

func checkwin ogame

```

(continues on next page)

(continued from previous page)

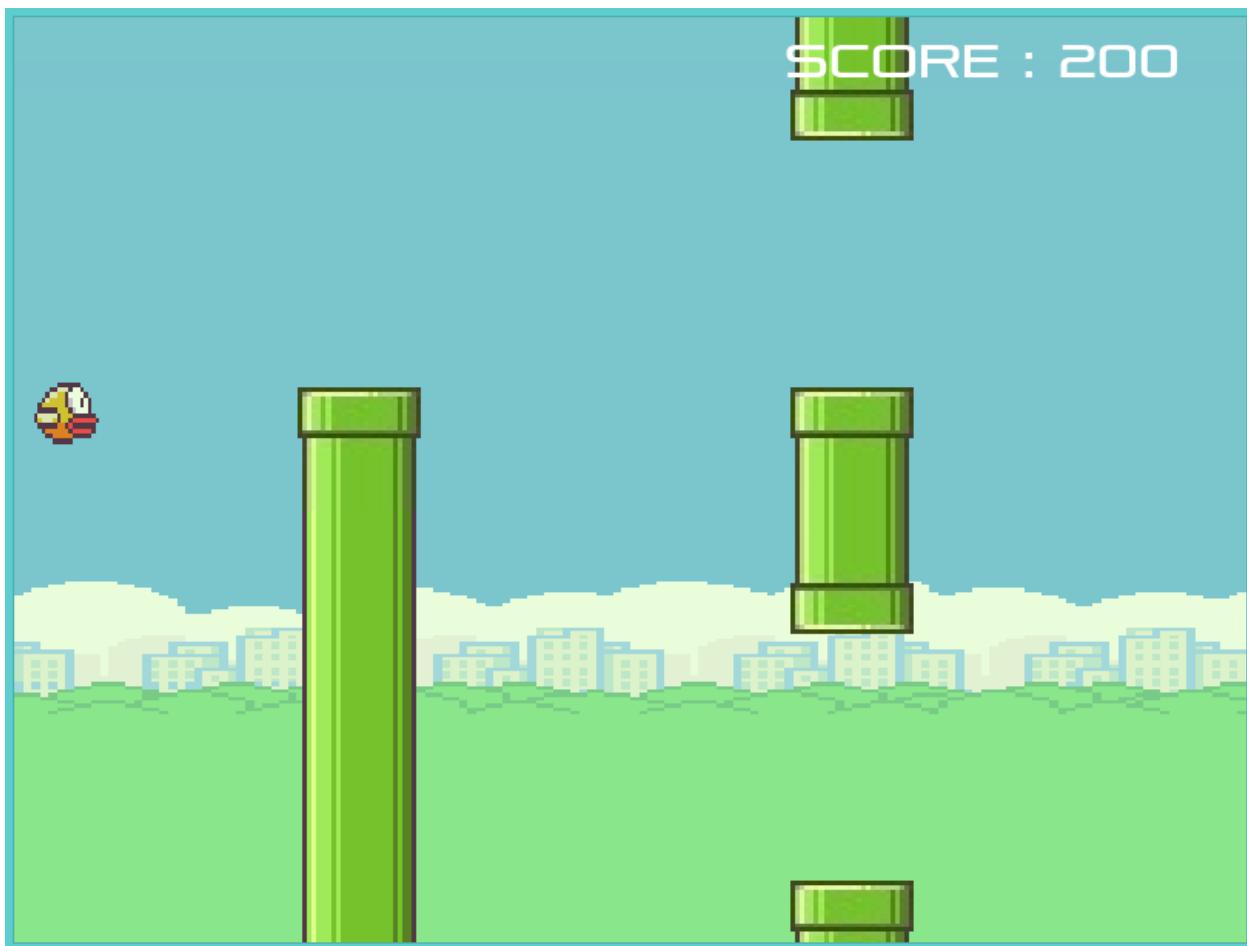
```

if oGameState.score = 3000
    oGameState.gameresult = true
    oGameState.playerwin = true
    oGame {
        text {
            point = 400
            size = 30
            nStep = 3
            file = "fonts/pirulen.ttf"
            text = "You Win !!!"
            x = 500 y=10
            state = func ogame,oself {
                if oself.y >= 400
                    ogame.shutdown = true
                    oGameState.value = 0
                ok
            }
        }
    ok

Class GameState
    down = 3
    gameresult = false
    Score = 0
    startplay=false
    lastcol = 0
    playerwin = false

```

Screen Shot:



55.29 Super Man 2016 Game

The Super Man 2016 Game source code

```
# The Ring Standard Library
# Game Engine for 2D Games
# 2016, Mahmoud Fayed <msfclipper@yahoo.com>

oGameState = NULL

Load "gameengine.ring"

func main

    oGame = New Game

    while true

        oGameState = new GameState

        oGame {
```

(continues on next page)

(continued from previous page)

```

title = "Super Man 2016"
sprite {
    file = "images/superman.jpg"
    x = 0 y=0 width=800 height = 600 scaled = true animate = false
    keypress = func ogame,oself,nKey {
        if nkey = key_esc or nKey = GE_AC_BACK
            ogame.shutdown()
        but nKey = key_space
            oGameState.startplay=true
            ogame.shutdown=true
        ok
    }
    mouse = func ogame,oself,nType,aMouseList {
        if nType = GE_MOUSE_UP
            oGameState.startplay=true
            ogame.shutdown=true
        ok
    }
    state = func ogame,oself {
        oself {
            if x > -500
                x-=1
                y-=1
                width +=1
                height +=4
            ok
        }
    }
}
text {
    animate = false
    size = 35
    file = "fonts/pirulen.ttf"
    text = "Super Man 2016"
    x = 20 y=30
}
text {
    animate = false
    size = 25
    file = "fonts/pirulen.ttf"
    text = "Version 1.0"
    x = 20 y=80
}
text {
    animate = false
    size = 16
    file = "fonts/pirulen.ttf"
    text = "(C) 2016, Mahmoud Fayed"
    x = 20 y=120
}

```

(continues on next page)

(continued from previous page)

```

text {
    animate = false
    size = 25
    file = "fonts/pirulen.ttf"
    text = "Press Space to start"
    x = 190  y=470
}
text {
    animate = false
    size = 20
    file = "fonts/pirulen.ttf"
    text = "Press Esc to Exit"
    x = 260  y=510
}

animate {
    file = "images/superman.png"
    x = 200
    y = 200
    framewidth = 68
    scaled = true
    height = 86
    width = 60
    nStep = 10
    transparent = true
    animate = true
    direction = ge_direction_random
    state = func oGame,oSelf {
        oSelf {
            nStep--
            if nStep = 0
                nStep = 10
                if frame < 1
                    frame++
                else
                    frame=1
                ok
            ok
            if x <= 0 x=0 ok
            if y <= 0 y=0 ok
            if x >= 750 x= 750 ok
            if y > 550 y=550 ok
        }
    }
}

Sound {
    file = "sound/music2.wav"
}
}

if oGameState.startplay
oGame.refresh()

```

(continues on next page)

(continued from previous page)

```

playstart(oGame)
oGame.refresh()
ok

end

func playstart oGame

oGame {
    FPS = 60
    FixedFPS = 15
    Title = "Super Man 2016"
    Sprite {
        file = "images/supermancity.jpg"
        x = 0 y=0 width=800 height = 600 scaled = true animate = false
    }
    Map {
        blockwidth = 80
        blockheight = 80
        aMap = [
            [0,0,0,4,4,4,0,0,0,1,0,0,0,1,4,4,0,1,0,0,0,4,4,0,1,4,
4,4,0,0,0,0,0,0,0,0,0,0,0,0,2,0,1,0,0,0,1,0,0,1,0,3,3,5,3,3,3,3,0],
            [0,0,4,0,4,0,4,0,0,1,0,0,0,3,4,4,4,1,0,0,0,0,4,4,0,1,4,
4,4,0,0,4,4,4,4,4,4,4,4,4,1,4,1,0,0,0,1,0,4,4,4,4,4,4,0],
            [0,0,0,4,4,4,0,0,0,1,0,0,0,4,4,4,4,1,0,0,0,1,0,0,0,0,0,0,3,4,
4,4,0,0,4,0,0,0,0,0,4,2,0,0,4,1,4,1,4,2,4,1,0,2,0,1,0,4,4,4,4,4,4,0],
            [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,4,4,4,4,4,4,4,1,0,0,4,1,4,1,4,1,0,1,0,2,2,2,2,2,2,2,0],
            [0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,2,0,0,0,0,0,2,0,3,0,0,0,1,4,1,4,1,4,1,0,1,0,1,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,0,1,0,0,0,0,2,0,0,0,1,0,0,0,0,2,0,0,0,0,0,0,0,
0,0,0,0,1,0,0,0,0,0,1,0,0,0,0,0,1,4,3,4,1,4,3,0,1,0,3,0,1,0,0,0,0,0,0,0,
0,0,2,0,0,2,0,0,2,1,0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,1,0,0,0,0,0,0,3,0,0,0,0,0,1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,0,0,0,0,0,
0,0,1,0,0,1,0,0,1,3,0,0,0,1,0,0,0,3,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0]
        ]
        aImages = ["images/smwall.png", "images/smwallup.png",
                    "images/smwalldown.png", "images/smstar.png",
                    "images/smkey.png", "images/smstar2.png"]
    }
}

sprite {
    type = ge_type_enemy
    animate = false
    file = "images/smhome.png"
    x = 5000
    y = 400
    width = 290
    height = 200
    transparent = true
}

```

(continues on next page)

(continued from previous page)

```

state = func oGame,oSelf {
    oself {
        x = 5000 + oGame.aObjects[2].x
        if x < 0 or x > SCREEN_W return ok
    }
    if oGameState.gameresult or oGameState.DoorKey = false return ok
    if oGame.aObjects[oGameState.playerindex].x > oself.x + 100 and
        oGame.aObjects[oGameState.playerindex].y > oself.y + 50
        oGameState.gameresult = true
    oGame {
        sprite {
            file = "images/smwin.jpg"
            x=0 y=0 width=800 height=600
            scaled = true animate=false
            state = func ogame,oself {
                oself {
                    x-=5
                    y-=5
                    width +=10
                    height +=10
                    if x = -300
                        ogame.shutdown = true
                ok
            }
        }
    }
    ok
}

animate {
    file = "images/superman.png"
    x = 0
    y = 0
    framewidth = 60
    scaled = true
    height = 86
    width = 60
    nStep = 3
    transparent = true
    state = func oGame,oSelf {

        checkstarskeycol(oGame,oSelf)

        if not oGameState.playerwin
            oself {
                file = "images/superman.png"
                height = 86
                width = 60
    }
}

```

(continues on next page)

(continued from previous page)

```

for t=1 to 8
    if checkwall2(oGame,oSelf,0,5,[2,1])
        y += 5
    else
        exit
    ok
next
if y > 500 y=500 ok
}
ok

}

keypress = func ogame,oself,nKey {
    if oGameState.gameresult = false

        oself {
            if nkey = key_up and checkwall(oGame,oSelf,0,-40)
                oGameState.value -= 1
                checkgameover(ogame)
                file = "images/supermanup.png"
                height = 123
                dotransparent()
                y -= 40
                oGameState.down = 10
                if y<=0 y=0 ok
            but nkey = key_down and checkwall(oGame,oSelf,0,40)
                file = "images/supermandown.png"
                dotransparent()
                y += 40
                if y>=500 y=500 ok
            but nKey = key_right and checkwall(oGame,oSelf,10,0)
                file = "images/supermanright.png"
                dotransparent()
                x += 10
                if x >= 440
                    if oGame.aObjects[2].x > -4500
                        oGame.aObjects[2].x -= 50
                        callenemystate(oGame)
                    else
                        if x <= 750
                            if checkwall(oGame,oSelf,10,0)
                                x += 10
                            ok
                        else
                            if checkwall(oGame,oSelf,-10,0)
                                x -= 10
                            ok
                        ok
                    return
                ok
            x=400
        ok
    ok
}

```

(continues on next page)

(continued from previous page)

```

but nKey = key_left and checkwall(oGame,oSelf,-10,0)
    file = "images/supermanleft.png"
    dotransparent()
    x -= 10
    if x <= 0
        x += 10
        if oGame.aObjects[2].x != 0
            oGame.aObjects[2].x += 50
            callenemystate(oGame)
            x += 50
    ok
    ok
but nkey = key_esc or nKey = GE_AC_BACK
    ogame.shutdown()
ok
}
ok
}
mouse = func ogame,oself,nType,aMouseList {
    if nType = GE_MOUSE_DOWN
        oGameState.moveplayer = TRUE
    But nType = GE_MOUSE_UP
        oGameState.moveplayer = FALSE
    ok
    if oGameState.moveplayer = TRUE
        if aMouseList[GE_MOUSE_X] < oSelf.X # left
            cFunc = oself.keypress
            call cFunc(oGame,oSelf,Key_left)
        else
            cFunc = oself.keypress
            call cFunc(oGame,oSelf,Key_right)
        ok
        if aMouseList[GE_MOUSE_Y] < oSelf.Y # up
            cFunc = oself.keypress
            call cFunc(oGame,oSelf,Key_up)
        else
            cFunc = oself.keypress
            call cFunc(oGame,oSelf,Key_down)
        ok
    ok
}
}

addenemy(oGame,600)
addenemy(oGame,900)
addenemy(oGame,1550)
addenemy(oGame,2350)
addenemy(oGame,3350)
addenemy(oGame,3500)
addenemy(oGame,3670)
addenemy(oGame,3840)

```

(continues on next page)

(continued from previous page)

```

text {
    animate = false
    point = 400
    size = 30
    file = "fonts/pirulen.ttf"
    text = "Score : " + oGameState.score
    x = 500 y=0
    state = func oGame,oSelf {
        oSelf { text = "Score : " + oGameState.score }
    }
}

text {
    animate = false
    point = 400
    size = 30
    file = "fonts/pirulen.ttf"
    text = "Energy : " + oGameState.value
    x = 10 y=0
    state = func oGame,oSelf { oSelf { text = "Energy : " + oGameState.value } }
}
}

func inlist nValue,aList
    for x in aList
        if x = nValue
            return true
        ok
    next
    return false

func checkwall oGame,oSelf,diffx,diffy
    alist = [1,2,3]
    return checkwall2(oGame,oSelf,diffx,diffy,alist)

func checkwall2 oGame,oSelf,diffx,diffy,aList
    xPos = oSelf.x + diffx
    yPos = oSelf.y + diffy
    nValue = oGame.aObjects[2].getvalue(xPos,yPos)
    nValue = inlist(nValue,aList)
    nValue = not nValue
    if nValue = 0 return nValue ok

    xPos = oSelf.x + diffx
    yPos = oSelf.y + diffy + oSelf.height
    nValue = oGame.aObjects[2].getvalue(xPos,yPos)
    nValue = inlist(nValue,aList)
    nValue = not nValue
    if nValue = 0 return nValue ok

    xPos = oSelf.x + diffx + oSelf.width

```

(continues on next page)

(continued from previous page)

```

yPos = oSelf.y + diffy
nValue = oGame.aObjects[2].getvalue(xPos,yPos)
nValue = inlist(nValue,aList)
nValue = not nValue
if nValue = 0 return nValue ok

xPos = oSelf.x + diffx + oSelf.width
yPos = oSelf.y + diffy + oSelf.height
nValue = oGame.aObjects[2].getvalue(xPos,yPos)
nValue = inlist(nValue,aList)
nValue = not nValue
if nValue = 0 return nValue ok

return nValue

func checkopenwall oGame
if oGameState.score = 900
    oGame.aObjects[2].aMap[3][10] = 3
    oGame.aObjects[2].aMap[4][10] = 0
    oGame.aObjects[2].aMap[5][10] = 0
    oGame.aObjects[2].aMap[6][10] = 0
    oGame.aObjects[2].aMap[7][10] = 0
    oGame.aObjects[2].aMap[8][10] = 0
but oGameState.score = 1800
    oGame.aObjects[2].aMap[3][18] = 3
    oGame.aObjects[2].aMap[4][18] = 0
    oGame.aObjects[2].aMap[5][18] = 0
    oGame.aObjects[2].aMap[6][18] = 0
    oGame.aObjects[2].aMap[7][18] = 0
    oGame.aObjects[2].aMap[8][18] = 0
but oGameState.score = 5500
    oGame.aObjects[2].aMap[1][44] = 0
    oGame.aObjects[2].aMap[2][44] = 0
    oGame.aObjects[2].aMap[3][44] = 2
ok

func checkgameover ogame
if oGameState.gameresult return ok
if oGameState.value <= 0
    oGameState.value = 0
    oGameState.gameresult = true
    oGame {
        text {
            point = 400
            size = 30
            nStep = 9
            file = "fonts/pirulen.ttf"
            text = "Game Over !!!"
            x = 500 y=10
            state = func ogame,oself {
                if oself.y >= 400

```

(continues on next page)

(continued from previous page)

```

        ogame.shutdown = true
    ok
}
}
}
showfire(oGame,oGame.aObjects[oGameState.PlayerIndex].x+40,
          oGame.aObjects[oGameState.PlayerIndex].y+40)
oGame.aObjects[oGameState.PlayerIndex].enabled = false
oGame.remove(oGameState.PlayerIndex)
ok

func showfire oGame,nX,nY
oGame {
    animate {
        file = "images/fire.png"
        x = nX
        y = nY
        framewidth = 40
        height = 42
        nStep = 3
        transparent = true
        state = func oGame,oSelf {
            oSelf {
                nStep--
                if nStep = 0
                    nStep = 3
                    if frame < 13
                        frame++
                    else
                        frame=1
                        oGame.remove(oself.nIndex)
                ok
            ok
        }
    }
}

func addenemy oGame,xPos
oGame {
    lbraceend = false
    sprite {
        type = ge_type_enemy
        file = "images/smenemy.png"
        transparent = true
        x = xPos y =10 width=100 height=100
        animate=true Scaled=true
        direction = GE_DIRECTION_NOMOVE
        temp = xPos
        state = func oGame,oSelf {
            oself {

```

(continues on next page)

(continued from previous page)

```

x = oSelf.temp + oGame.aObjects[2].x
if y < 0 y = 0 ok
if y > 100 y=100 ok
if x > SCREEN_W or x < 0 return ok
}

if random(10) = 1
    if oGameState.gameresult return ok
    ogame {
        sprite {
            type = ge_type_fire
            file = "images/smrocket.png"
            scaled = true
            transparent = true
            x = oself.x + 30
            y = oself.y + oself.height+ 30
            width = 30
            height = 30
            point = ogame.screen_h+30
            nstep = 30
            direction = ge_direction_incvertical
            xvalue = oGame.aObjects[2].x
            temp = oself.x + 30 - xvalue
            state = func oGame,oSelf {
                oself { x = oSelf.temp + oGame.aObjects[2].x }
                x = oGame.aObjects[oGameState.playerindex]
                if oself.x >= x.x and oself.y >= x.y and
                    oself.x <= x.x + x.width and
                    oself.y <= x.y + x.height
                if oGameState.value > 0
                    oGameState.value-=1000
                ok
                ogame.remove(oself.nindex)
                checkgameover(oGame)
            ok
        }
    }
}
ok
}
}

ogame.lbraceend = true

```

```
func checkstarskey oGame,oSelf,nValue,nRow,nCol
    switch nValue
        on 4
            oGame.aObjects[2].aMap[nRow][nCol] = 6
            oGameState.Score += 100
            checkopenwall(oGame)
            oGame { Sound {
```

(continues on next page)

(continued from previous page)

```

        once = true
        file = "sound/sfx_point.wav"
    } }
on 5
    oGame.aObjects[2].aMap[nRow][nCol] = 0
    oGameState.DoorKey = true
    oGameState.Score += 500
    checkopenwall(oGame)
    oGame { Sound {
        once = true
        file = "sound/sfx_point.wav"
    } }
off

func checkstarskeycol oGame,oSelf
    nValue = oGame.aObjects[2].getvalue(oSelf.x,oSelf.y)
    nRow = oGame.aObjects[2].getrow(oSelf.x,oSelf.y)
    nCol = oGame.aObjects[2].getcol(oSelf.x,oSelf.y)
    checkstarskey(oGame,oSelf,nValue,nRow,nCol)

    nValue = oGame.aObjects[2].getvalue(oSelf.x+oSelf.width,oSelf.y+oSelf.height)
    nRow = oGame.aObjects[2].getrow(oSelf.x+oSelf.width,oSelf.y+oSelf.height)
    nCol = oGame.aObjects[2].getcol(oSelf.x+oSelf.width,oSelf.y+oSelf.height)
    checkstarskey(oGame,oSelf,nValue,nRow,nCol)

    nValue = oGame.aObjects[2].getvalue(oSelf.x+oSelf.width,oSelf.y)
    nRow = oGame.aObjects[2].getrow(oSelf.x+oSelf.width,oSelf.y)
    nCol = oGame.aObjects[2].getcol(oSelf.x+oSelf.width,oSelf.y)
    checkstarskey(oGame,oSelf,nValue,nRow,nCol)

    nValue = oGame.aObjects[2].getvalue(oSelf.x,oSelf.y+oSelf.height)
    nRow = oGame.aObjects[2].getrow(oSelf.x,oSelf.y+oSelf.height)
    nCol = oGame.aObjects[2].getcol(oSelf.x,oSelf.y+oSelf.height)
    checkstarskey(oGame,oSelf,nValue,nRow,nCol)

func callenemystate oGame
    for t in oGame.aObjects
        t {
            if type = GE_TYPE_ENEMY
                call state(oGame,t)
            ok
        }
    next

Class GameState

    down = 3
    gameresult = false
    Score = 0
    startplay=false
    lastcol = 0
    playerwin = false

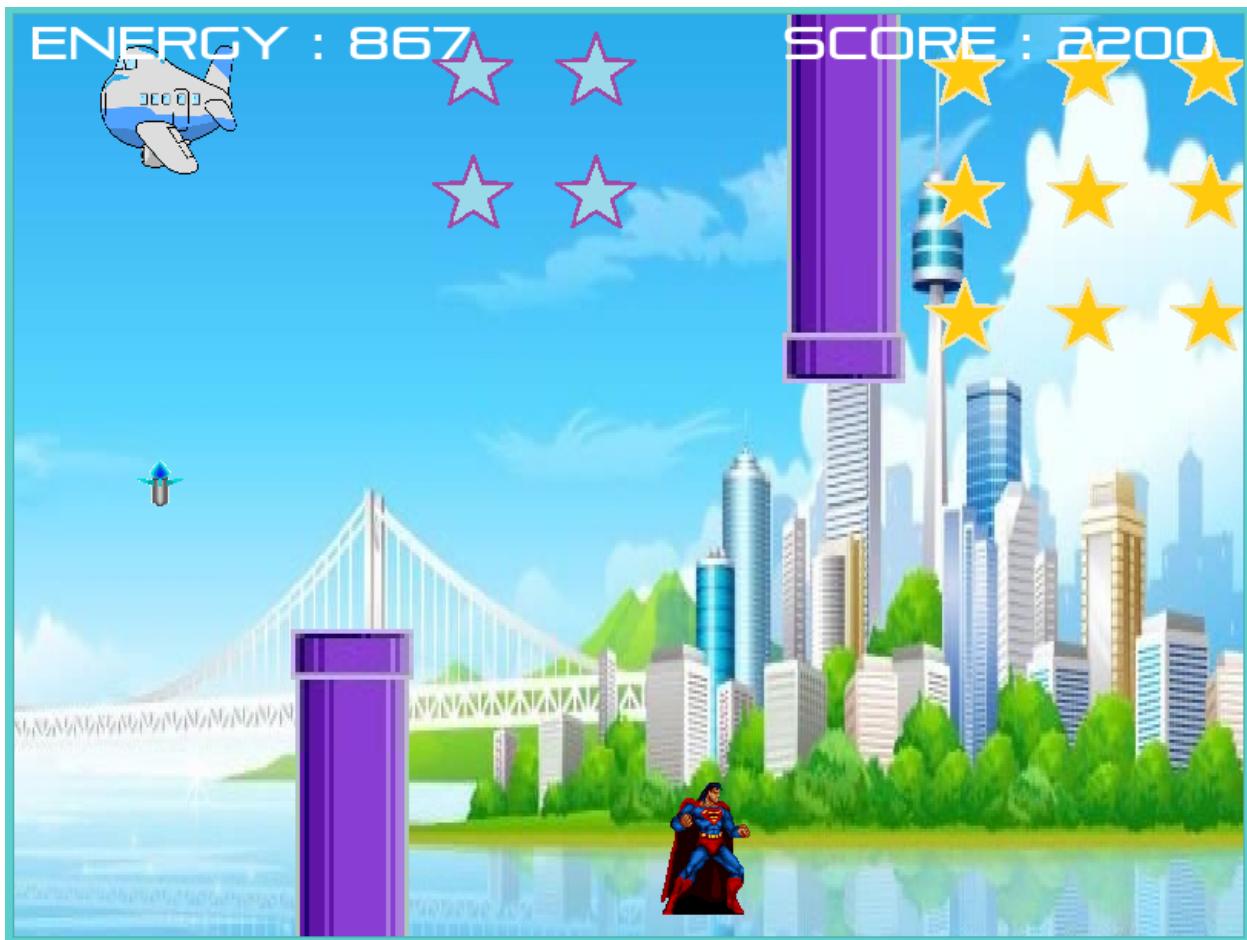
```

(continues on next page)

(continued from previous page)

```
DoorKey = false  
playerindex = 4  
value = 1000  
moveplayer = false
```

Screen Shot:



BUILDING GAMES FOR ANDROID

In this chapter we will learn about Building RingLibSDL Games for Mobile.

So we can create packages (*.apk) for the applications that are developed using Ring Game Engine for 2D Games.

56.1 Download Requirements and Update the Android SDK

- The Android SDK Tools

<https://developer.android.com/studio/index.html>

- The Android NDK (Tested using android-ndk-r10c)

<https://developer.android.com/ndk/index.html>

- Apache Ant v1.8 or later

<http://ant.apache.org/bindownload.cgi>

- Java SE Development Kit (JDK) v6 or later

<http://www.oracle.com/technetwork/java/javase/downloads/jdk7-downloads-1880260.html>

- Update the Android SDK to get the API and tools packages required for development

Tested using Android 4.4.2 (API 19)

- In Windows - Define the next Environment Variables based on your system.

(1) JAVA_HOME

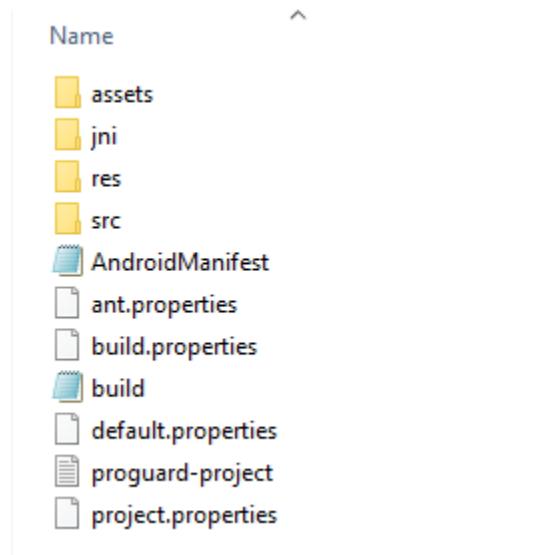
For Example : C:\Program Files (x86)\Java\jdk1.8.0_05

(2) ANDROID_HOME

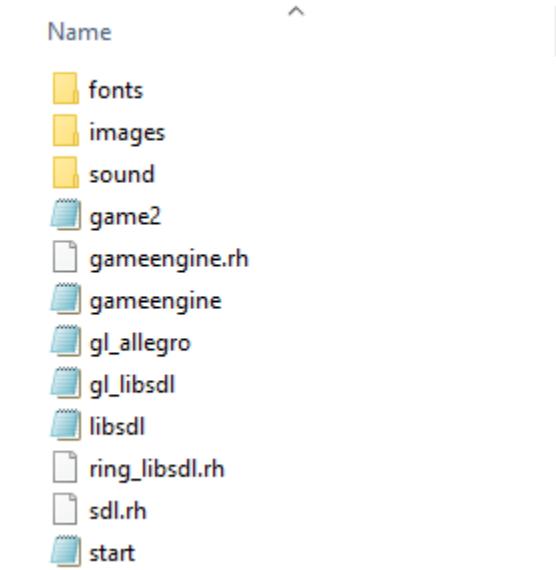
For Example : B:\mahmoud\Tools\Java-Android\adt-bundle-windows-x86-20140702\sdk

56.2 Project Folder

Open the project folder : ring/extensions/android/ringlibsdl/project



You can add the source code (*.ring) and Images/Sound Files to the assets folder.



You will find the Flappy Bird 3000 Game ready for building.

The execution starts from the start.ring file

```
load "game2.ring"
```

56.3 Building the project

Move to the ring/extensions/android/ringlibsdl/project folder

We can build using the next command (We need to do this for one time only).

```
ndk-build
```

Then we can create the package (*.apk) using the next command.

```
ant debug
```

We can write a batch file for building the project (file: build.bat)

```
rem You will need to modify this batch file based on your environment

set JAVA_HOME=C:\Program Files (x86)\Java\jdk1.8.0_05
set ANDROID_HOME=B:\mahmoud\Tools\JavaAndroid\adt-bundle-windows-x86-20140702\sdk
set NDK_ROOT=B:\mahmoud\Tools\JavaAndroid\android-ndk-r10c

set path=%path%;B:\mahmoud\Tools\JavaAndroid\android-ndk-r10c
set path=%path%;B:\mahmoud\Tools\JavaAndroid\apache-ant-1.9.4\bin

ndk-build
```

CHAPTER
FIFTYSEVEN

DEVELOPING GAMES USING RINGRAYLIB

In this chapter we will learn how to use the RingRayLib extension.

57.1 Introduction

RingRayLib is an extension for the RayLib game programming library.

Also RayGUI functions are supported by this extension.

57.2 Basic Window

```
load "raylib.ring"

screenWidth      = 800
screenHeight     = 450

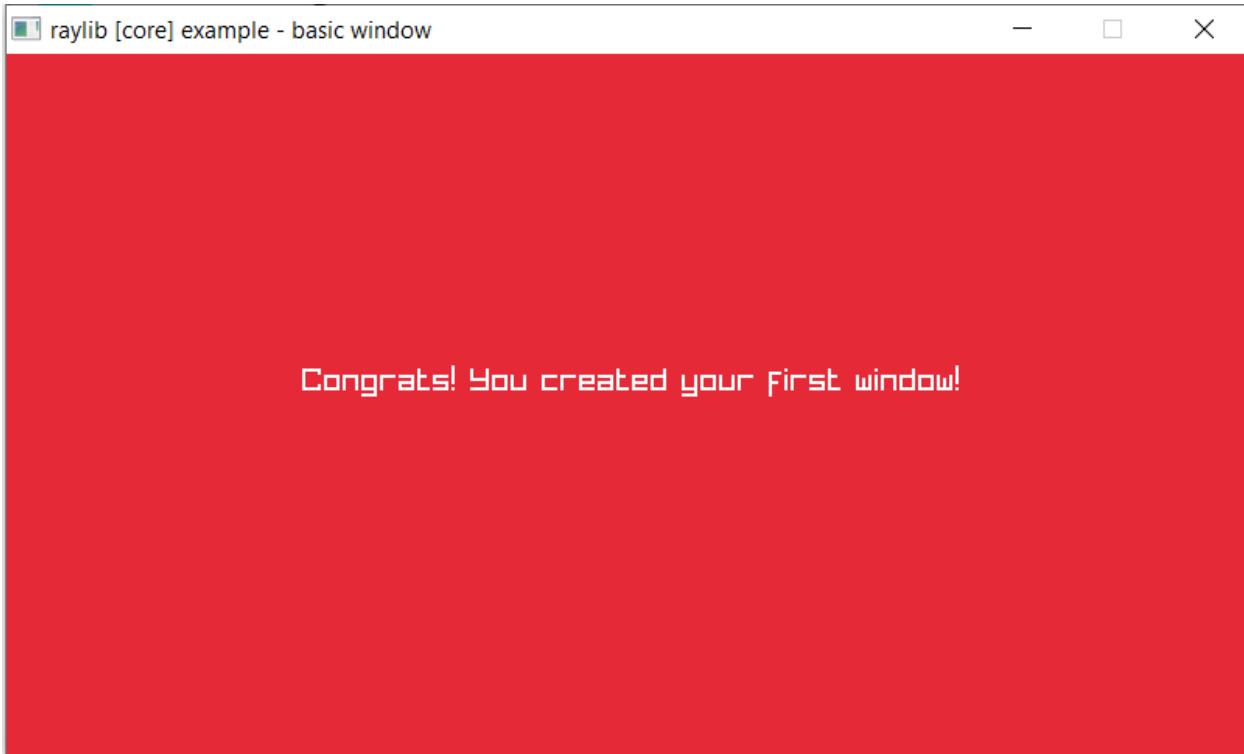
InitWindow(screenWidth, screenHeight, "raylib [core] example - basic window")

SetTargetFPS(60)

while !WindowShouldClose()
    BeginDrawing()
        ClearBackground(RED)
        DrawText("Congrats! You created your first window!", 190, 200, 20, WHITE)
    EndDrawing()
end

CloseWindow()
```

Screen Shot:



57.3 Input Keys

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

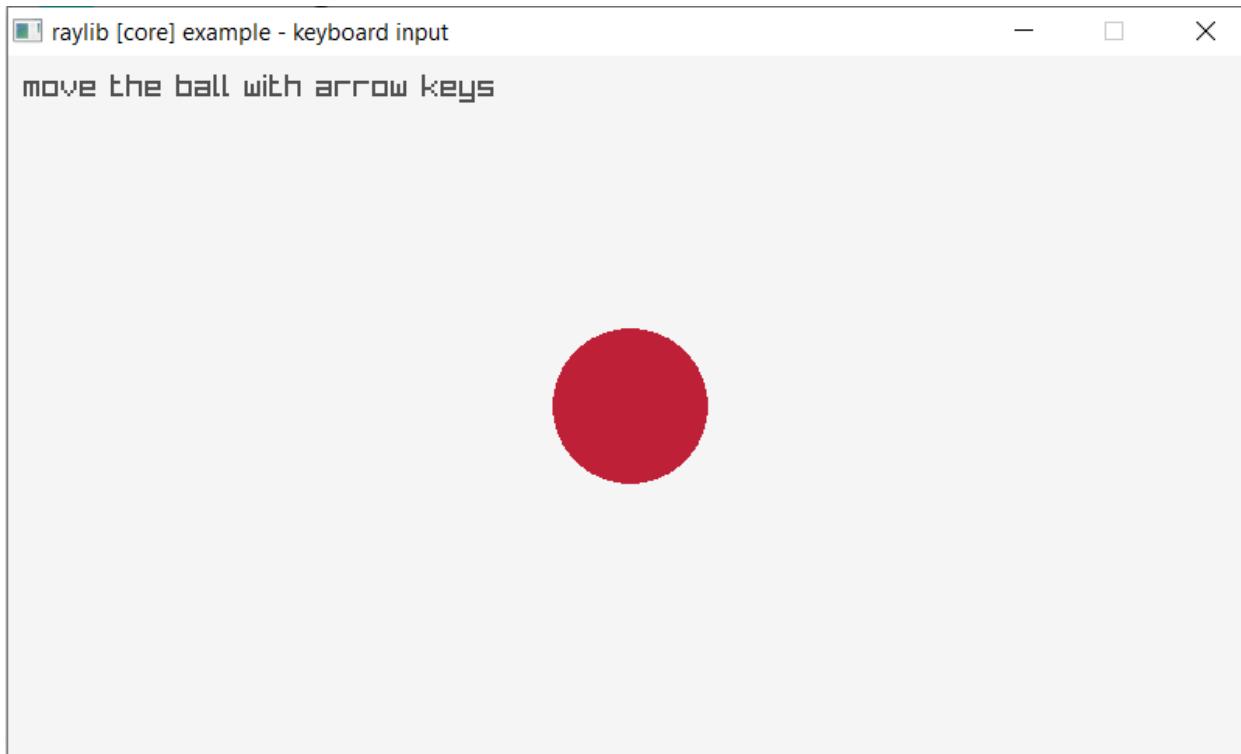
InitWindow(screenWidth, screenHeight, "raylib [core] example - keyboard input")
ballPosition = Vector2(screenWidth/2, screenHeight/2)
SetTargetFPS(60)

while !WindowShouldClose()
    if IsKeyDown(KEY_RIGHT) ballPosition.x += 2 ok
    if IsKeyDown(KEY_LEFT) ballPosition.x -= 2 ok
    if IsKeyDown(KEY_UP) ballPosition.y -= 2 ok
    if IsKeyDown(KEY_DOWN) ballPosition.y += 2 ok
    BeginDrawing()
        ClearBackground(RAYWHITE)
        DrawText("move the ball with arrow keys", 10, 10, 20, DARKGRAY)
        DrawCircleV(ballPosition, 50, MAROON)
    EndDrawing()
end

CloseWindow()

```

Screen Shot:



57.4 Input Mouse

```

load "raylib.ring"

screenWidth  = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [core] example - mouse input")

ballPosition    = Vector2(100, 100)
ballColor       = DARKBLUE

SetTargetFPS(60)

while ! WindowShouldClose()

    ballPosition = GetMousePosition()

    if IsMouseButtonPressed(MOUSE_LEFT_BUTTON)
        ballColor = MAROON
    but IsMouseButtonPressed(MOUSE_MIDDLE_BUTTON)
        ballColor = LIME
    but IsMouseButtonPressed(MOUSE_RIGHT_BUTTON)
        ballColor = DARKBLUE
    ok

    BeginDrawing()

```

(continues on next page)

(continued from previous page)

```

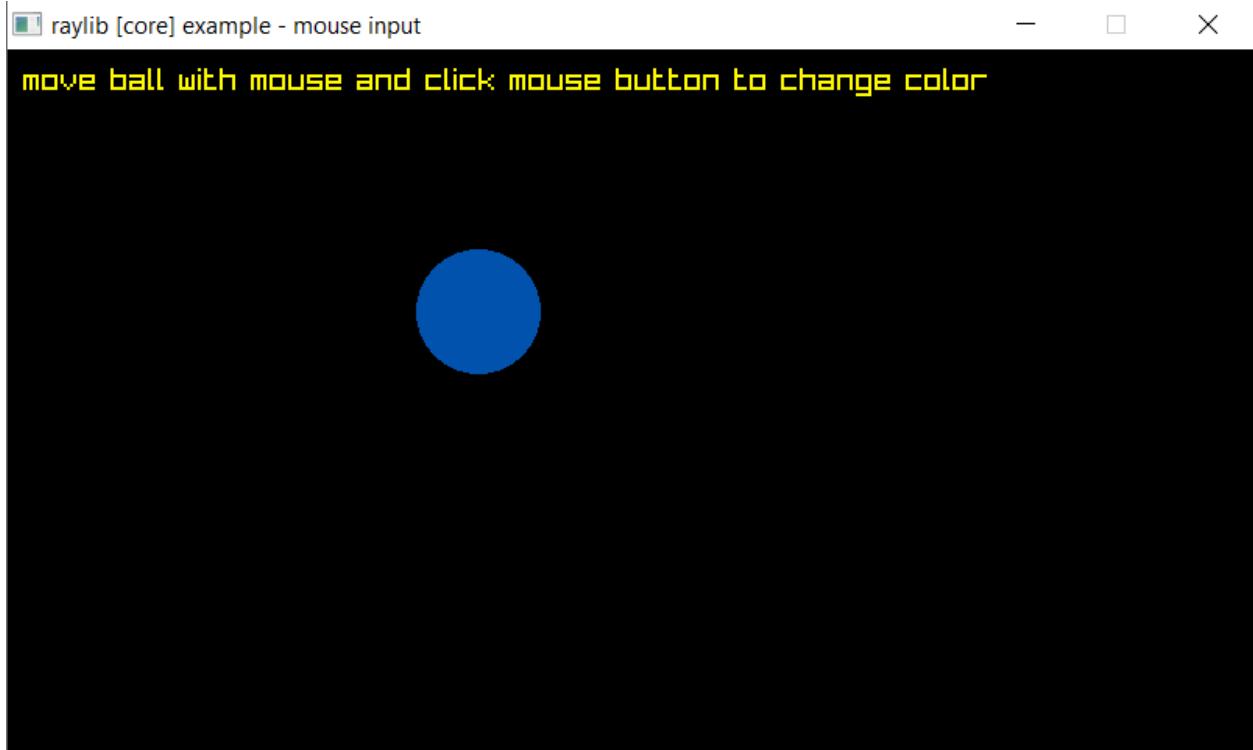
        ClearBackground(BLACK)
        DrawCircleV(ballPosition, 40, ballColor)
        DrawText("move ball with mouse and click mouse button to change color", -10, 10, 20, YELLOW)
    EndDrawing()

end

CloseWindow()

```

Screen Shot:



57.5 3D Camera

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [core] example - 3d camera mode")

camera = Camera3D(
    0, 10, 10,           // Camera position
    0, 0, 0,             // Camera looking at point
    0, 1, 0,             // Camera up vector (rotation towards target)
    45,                  // Camera field-of-view Y

```

(continues on next page)

(continued from previous page)

```
CAMERA_PERSPECTIVE)      // Camera mode type

cubePosition = Vector3(0, 0, 0)

SetTargetFPS(60)

while !WindowShouldClose()

    BeginDrawing()

        ClearBackground(RAYWHITE)

        BeginMode3D(camera)

            DrawCube(cubePosition, 2, 2, 2, RED)
            DrawCubeWires(cubePosition, 2, 2, 2, MAROON)

            DrawGrid(10, 1)

        EndMode3D()

        DrawText("Welcome to the third dimension!", 10, 40, 20, DARKGRAY)

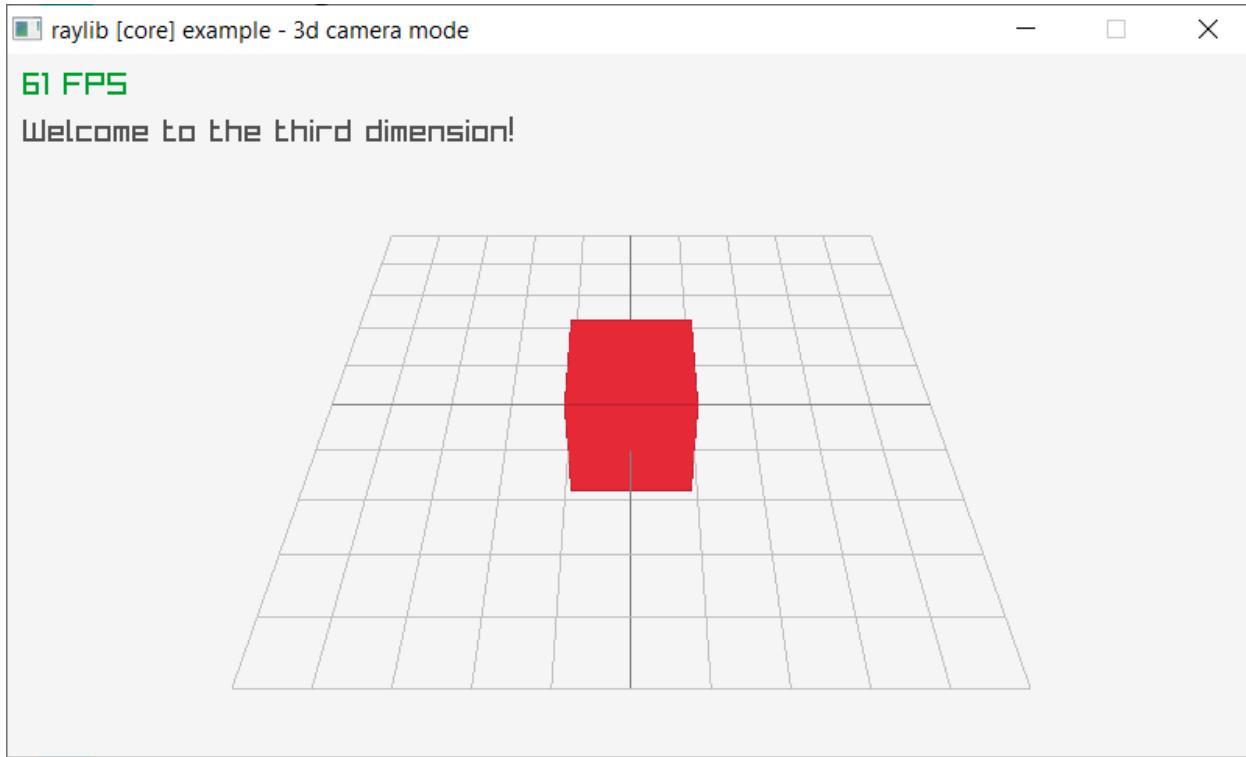
        DrawFPS(10, 10)

    EndDrawing()

end

CloseWindow()
```

Screen Shot:



57.6 3D Camera Free

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [core] example - 3d camera free")

camera = Camera3D(
    10, 10, 10,           // Camera position
    0, 0, 0,               // Camera looking at point
    0, 1, 0,               // Camera up vector (rotation towards target)
    45,                   // Camera field-of-view Y
    CAMERA_PERSPECTIVE)   // Camera mode type

cubePosition = Vector3(0, 0, 0)

SetTargetFPS(60)

while !WindowShouldClose()

    UpdateCamera(camera,CAMERA_FREE)

    if IsKeyDown("Z") camera.target = Vector3( 0, 0, 0) ok

    BeginDrawing()

```

(continues on next page)

(continued from previous page)

```
ClearBackground(RAYWHITE)

BeginMode3D(camera)

    DrawCube(cubePosition, 2, 2, 2, RED)
    DrawCubeWires(cubePosition, 2, 2, 2, MAROON)

    DrawGrid(10, 1)

EndMode3D()

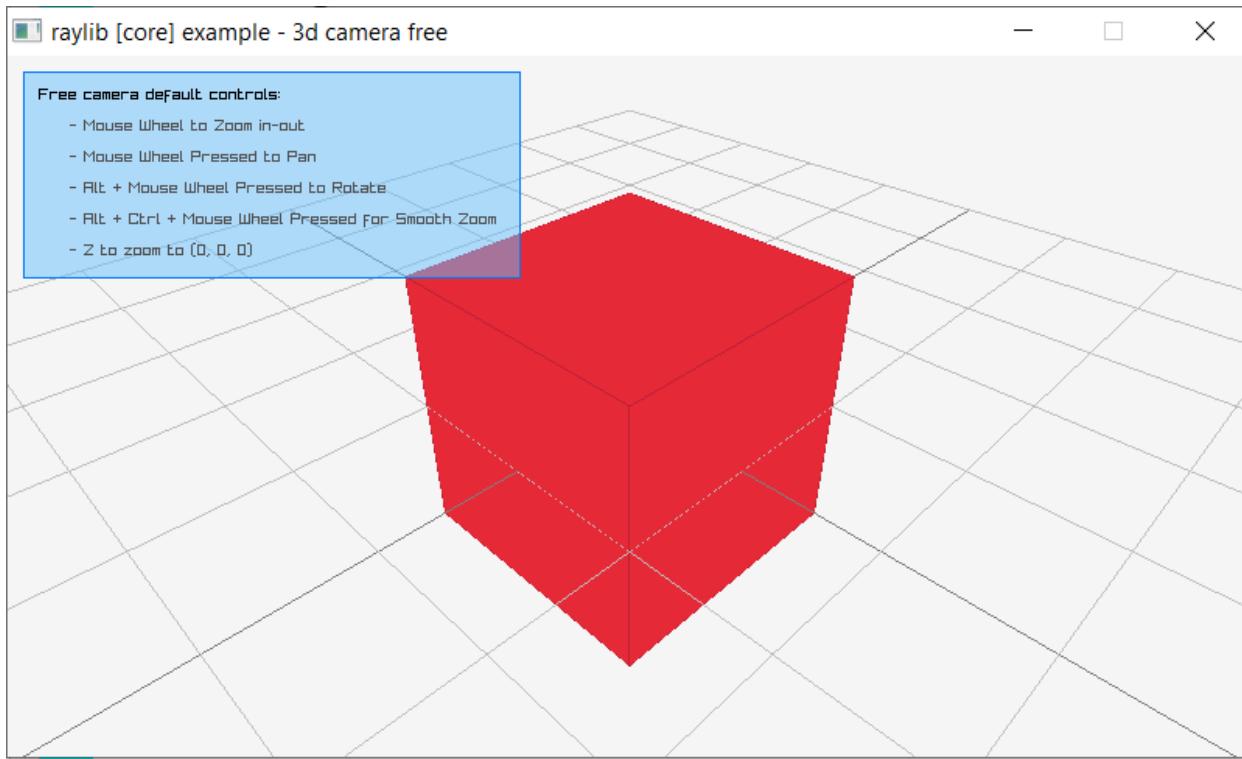
DrawRectangle( 10, 10, 320, 133, Fade(SKYBLUE, 0.5))
DrawRectangleLines( 10, 10, 320, 133, BLUE)

DrawText("Free camera default controls:", 20, 20, 10, BLACK)
DrawText("- Mouse Wheel to Zoom in-out", 40, 40, 10, DARKGRAY)
DrawText("- Mouse Wheel Pressed to Pan", 40, 60, 10, DARKGRAY)
DrawText("- Alt + Mouse Wheel Pressed to Rotate", 40, 80, 10, DARKGRAY)
DrawText("- Alt + Ctrl + Mouse Wheel Pressed for Smooth Zoom", 40, 100, 10, DARKGRAY)
DrawText("- Z to zoom to (0, 0, 0)", 40, 120, 10, DARKGRAY)

EndDrawing()
end

CloseWindow()
```

Screen Shot:



57.7 Mouse Wheel

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [core] example - input mouse wheel")

boxPositionY = screenHeight/2 - 40
scrollSpeed   = 4

SetTargetFPS(60)

while !WindowShouldClose()

    boxPositionY -= (GetMouseWheelMove()*scrollSpeed)

    BeginDrawing()

        ClearBackground(RAYWHITE)

        DrawRectangle(screenWidth/2 - 40, boxPositionY, 80, 80, MAROON)

        DrawText("Use mouse wheel to move the cube up and down!", 10, 10, 20, GRAY)
        DrawText("Box position Y: "+boxPositionY, 10, 40, 20, LIGHTGRAY)
    EndDrawing()
}

```

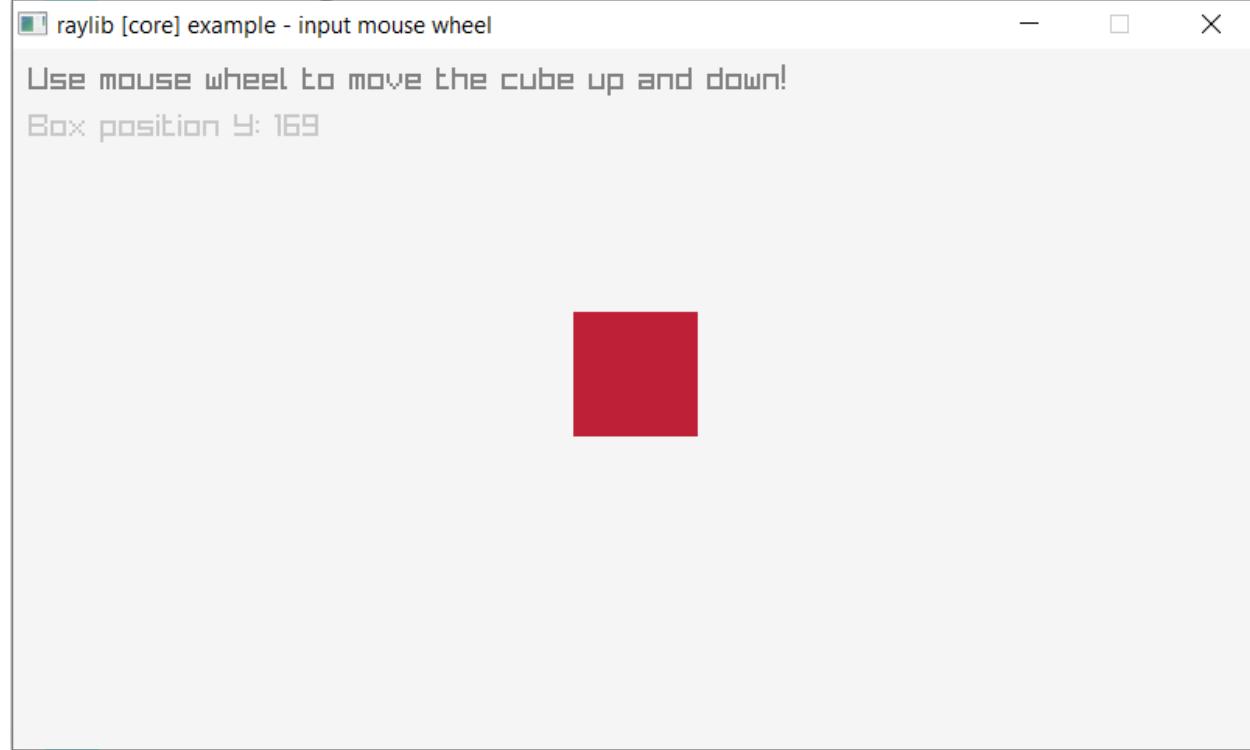
(continues on next page)

(continued from previous page)

```
    EndDrawing()
end

CloseWindow()
```

Screen Shot:



57.8 Input Multi-touch

```
load "raylib.ring"

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [core] example - input multitouch")

ballPosition = Vector2(-100, -100)
ballColor     = BEIGE

touchCounter  = 0
touchPosition = vector2(0,0)

MAX_TOUCH_POINTS = 5

SetTargetFPS(60)
```

(continues on next page)

(continued from previous page)

```

while !WindowShouldClose()

    ballPosition = GetMousePosition()

    ballColor = BEIGE

    if IsMouseButtonDown(MOUSE_LEFT_BUTTON) ballColor = MAROON ok
    if IsMouseButtonDown(MOUSE_MIDDLE_BUTTON) ballColor = LIME ok
    if IsMouseButtonDown(MOUSE_RIGHT_BUTTON) ballColor = DARKBLUE ok

    if IsMouseButtonPressed(MOUSE_LEFT_BUTTON) touchCounter = 10 ok
    if IsMouseButtonPressed(MOUSE_MIDDLE_BUTTON) touchCounter = 10 ok
    if IsMouseButtonPressed(MOUSE_RIGHT_BUTTON) touchCounter = 10 ok

    if touchCounter > 0 touchCounter-- ok

BeginDrawing()

    ClearBackground(RAYWHITE)

    for i = 0 to MAX_TOUCH_POINTS-1
        touchPosition = GetTouchPosition(i)

        if touchPosition.x >= 0 && touchPosition.y >= 0
            DrawCircleV(touchPosition, 34, ORANGE)
            DrawText(""+ i, touchPosition.x - 10, touchPosition.y - 70, 40, BLACK)
        ok
    next

    DrawCircleV(ballPosition, 30 + (touchCounter*3), ballColor)

    DrawText("move ball with mouse and click mouse button to change color", -10, 10, 20, DARKGRAY)
    DrawText("touch the screen at multiple locations to get multiple balls", -10, 30, 20, DARKGRAY)

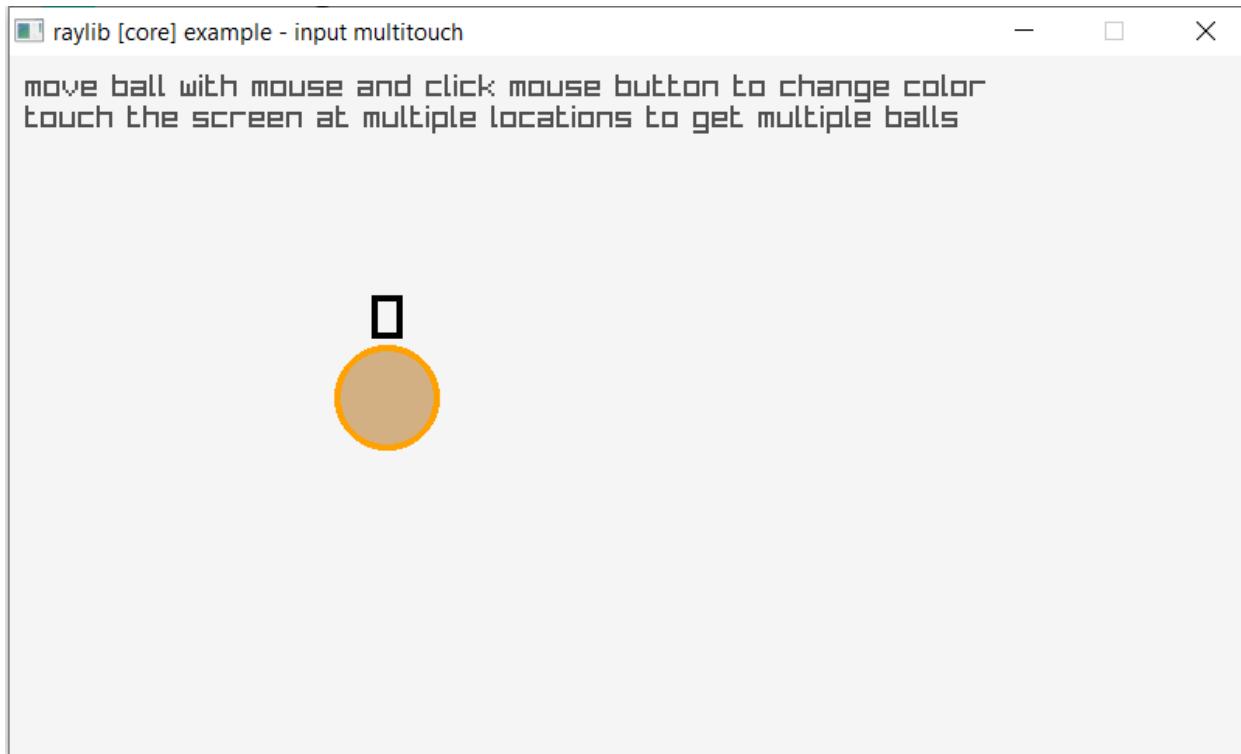
EndDrawing()

end

CloseWindow()

```

Screen Shot:



57.9 Camera First Person

```

load "raylib.ring"

MAX_COLUMNS = 20

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [core] example - 3d camera first person")

camera = Camera3d(
    4, 2, 4,
    0, 1, 0,
    0, 1, 0,
    60,
    CAMERA_PERSPECTIVE
)

heights = list(MAX_COLUMNS)
positions = list(MAX_COLUMNS)
for item in positions item = vector3(0,0,0) next
colors = list(MAX_COLUMNS)
for item in colors item = BLACK next

for i = 1 to MAX_COLUMNS
    heights[i] = GetRandomValue(1, 12)

```

(continues on next page)

(continued from previous page)

```

    positions[i] = Vector3(GetRandomValue(-15, 15), heights[i]/2, GetRandomValue(-15,
← 15) )
    colors[i] = RAYLibColor(GetRandomValue(20, 255), GetRandomValue(10, 55), 30, 255)
←)
next

SetTargetFPS(60)

while !WindowShouldClose()

    UpdateCamera(camera,CAMERA_FIRST_PERSON)

    BeginDrawing()

    ClearBackground(RAYWHITE)

    BeginMode3D(camera)

        DrawPlane(Vector3( 0, 0, 0 ), Vector2(32, 32 ), LIGHTGRAY) // Draw ground
        DrawCube(Vector3( -16, 2.5, 0 ), 1, 5, 32, BLUE)           // Draw a blue wall
        DrawCube(Vector3( 16, 2.5, 0 ), 1, 5, 32, LIME)           // Draw a green wall
        DrawCube(Vector3( 0, 2.5, 16 ), 32, 5, 1, GOLD)          // Draw a yellow
←wall

        for i = 1 to MAX_COLUMNS
            DrawCube(positions[i], 2, heights[i], 2, colors[i])
            DrawCubeWires(positions[i], 2, heights[i], 2, MAROON)
        next

    EndMode3D()

    DrawRectangle( 10, 10, 220, 70, Fade(SKYBLUE, 0.5f))
    DrawRectangleLines( 10, 10, 220, 70, BLUE)

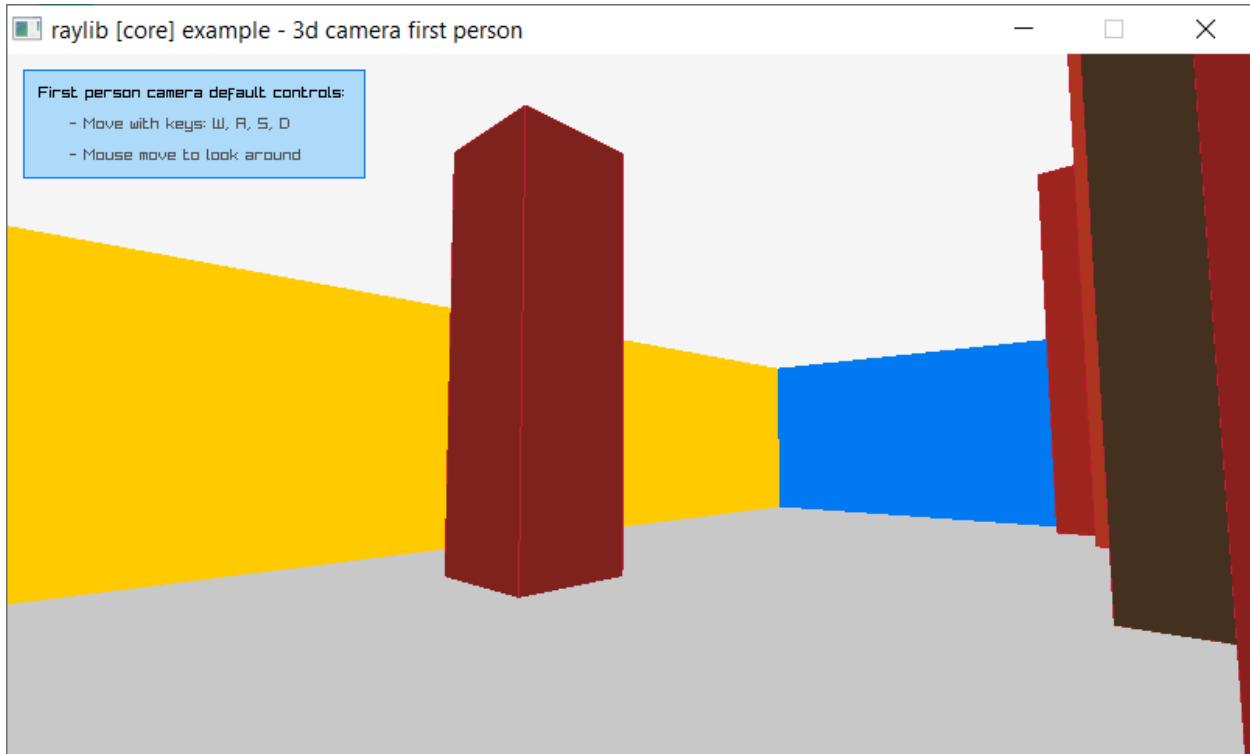
    DrawText("First person camera default controls:", 20, 20, 10, BLACK)
    DrawText("- Move with keys: W, A, S, D", 40, 40, 10, DARKGRAY)
    DrawText("- Mouse move to look around", 40, 60, 10, DARKGRAY)

    EndDrawing()
end

CloseWindow()

```

Screen Shot:



57.10 3D Picking

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [core] example - 3d picking")

camera = Camera3D(
    10, 10, 10,
    0, 0, 0 ,
    0, 1, 0 ,
    45,
    CAMERA_PERSPECTIVE
)

cubePosition = Vector3( 0, 1, 0 )
cubeSize = Vector3( 2, 2, 2 )

ray = Ray(0,0,0,0,0,0)

collision = false

SetTargetFPS(60)

while !WindowShouldClose()

```

(continues on next page)

(continued from previous page)

```

if IsMouseButtonPressed(MOUSE_LEFT_BUTTON)
if !collision
    ray = GetMouseRay(GetMousePosition(), camera)
    collision = GetRayCollisionBox(ray,
        BoundingBox( cubePosition.x - cubeSize.x/2, cubePosition.y - cubeSize.y/
←2, cubePosition.z - cubeSize.z/2,
                cubePosition.x + cubeSize.x/2, cubePosition.y + cubeSize.y/2, ↵
←cubePosition.z + cubeSize.z/2 ) )
    collision = collision.hit
else collision = false
ok
ok

BeginDrawing()

    ClearBackground(RAYWHITE)

    BeginMode3D(camera)

        if collision
            DrawCube(cubePosition, cubeSize.x, cubeSize.y, cubeSize.z, RED)
            DrawCubeWires(cubePosition, cubeSize.x, cubeSize.y, cubeSize.z, ↵
←MAROON)

            DrawCubeWires(cubePosition, cubeSize.x + 0.2f, cubeSize.y + 0.2f, ↵
← cubeSize.z + 0.2f, GREEN)
            else
                DrawCube(cubePosition, cubeSize.x, cubeSize.y, cubeSize.z, GRAY)
                DrawCubeWires(cubePosition, cubeSize.x, cubeSize.y, cubeSize.z, ↵
←DARKGRAY)
            ok

            DrawRay(ray, MAROON)
            DrawGrid(10, 1)

            EndMode3D()

            DrawText("Try selecting the box with mouse!", 240, 10, 20, DARKGRAY)

            if collision DrawText("BOX SELECTED", (screenWidth - MeasureText("BOX_
←SELECTED", 30)) / 2, screenHeight * 0.1f, 30, GREEN) ok

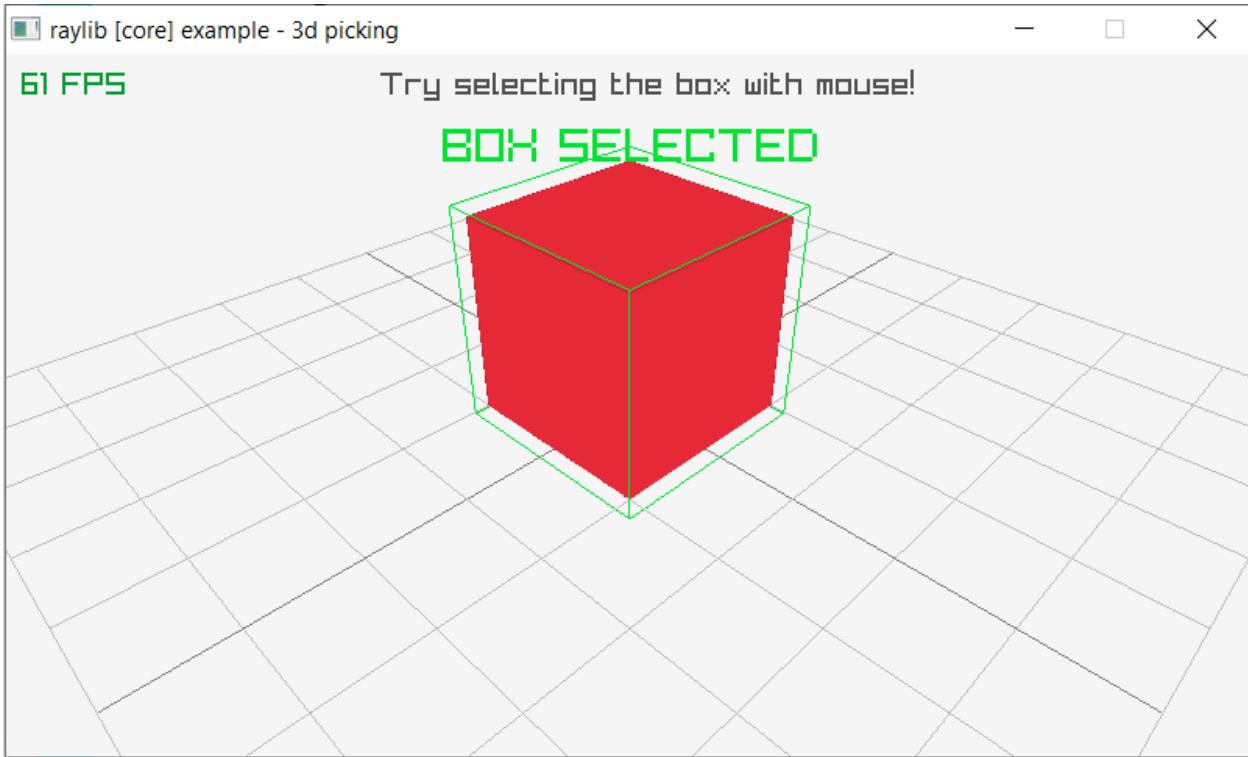
            DrawFPS(10, 10)

        EndDrawing()
end

CloseWindow()

```

Screen Shot:



57.11 Full Screen

```

load "raylib.ring"

screenWidth      = 1024
screenHeight     = 768

InitWindow(screenWidth, screenHeight, "Full Screen")
ToggleFullScreen()

SetTargetFPS(60)

while !WindowShouldClose()
    BeginDrawing()
        ClearBackground(DARKBLUE)
        DrawText("Count from 1 to 10", 190, 200, 20, Yellow)
        for t = 1 to 10
            DrawText("Number: " + t, 190, 200+(30*t), 20, WHITE)
        next
    EndDrawing()
end

CloseWindow()

```

Screen Shot:

```
Count from 1 to 10
Number: 1
Number: 2
Number: 3
Number: 4
Number: 5
Number: 6
Number: 7
Number: 8
Number: 9
Number: 10
```

57.12 Two Cubes

```
load "raylib.ring"

screenWidth  = 800
screenHeight = 450
InitWindow(screenWidth, screenHeight, "raylib [core] example - Two Cubes")

camera = Camera3D(
    10, 10, 10,
    0, 0, 0 ,
    0, 1, 0 ,
    45,
    CAMERA_PERSPECTIVE
)

cubePosition1 = Vector3( 0, 1, 4 )
cubePosition2 = Vector3( 0, 1, -4 )
cubeSize = Vector3( 2, 2, 2 )

ray = Ray(0,0,0,0,0,0)
```

(continues on next page)

(continued from previous page)

```

collision1 = false
collision2 = false

SetTargetFPS(60)

while !WindowShouldClose()

    if IsMouseButtonPressed(MOUSE_LEFT_BUTTON)
        if !collision1
            ray = GetMouseRay(GetMousePosition(), camera)

                collision1 = GetRayCollisionBox(ray,
                    BoundingBox( cubePosition1.x - cubeSize.x/2, cubePosition1.y - cubeSize.
→y/2, cubePosition1.z - cubeSize.z/2,
                    cubePosition1.x + cubeSize.x/2, cubePosition1.y + cubeSize.y/2,_
→cubePosition1.z + cubeSize.z/2 ) )
                collision1 = collision1.hit

        else
            collision1 = false
        ok
        if !collision2
            ray = GetMouseRay(GetMousePosition(), camera)

                collision2 = GetRayCollisionBox(ray,
                    BoundingBox( cubePosition2.x - cubeSize.x/2, cubePosition2.y - cubeSize.
→y/2, cubePosition2.z - cubeSize.z/2,
                    cubePosition2.x + cubeSize.x/2, cubePosition2.y + cubeSize.y/2,_
→cubePosition2.z + cubeSize.z/2 ) )
                collision2 = collision2.hit

        else
            collision2 = false
        ok
        ok

    BeginDrawing()

        ClearBackground(RAYWHITE)

        BeginMode3D(camera)

            if collision1
                DrawCube(cubePosition1, cubeSize.x, cubeSize.y, cubeSize.z, RED)
                DrawCubeWires(cubePosition1, cubeSize.x, cubeSize.y, cubeSize.z,_
→MAROON)

                DrawCubeWires(cubePosition1, cubeSize.x + 0.2f, cubeSize.y + 0.
→2f, cubeSize.z + 0.2f, GREEN)
                collision1 = true
            else
                DrawCube(cubePosition1, cubeSize.x, cubeSize.y, cubeSize.z, GRAY)
                DrawCubeWires(cubePosition1, cubeSize.x, cubeSize.y, cubeSize.z,_
→MAROON)

```

(continues on next page)

(continued from previous page)

```

→DARKGRAY)
    collision1 = false
ok

if collision2
    DrawCube(cubePosition2, cubeSize.x, cubeSize.y, cubeSize.z, RED)
    DrawCubeWires(cubePosition2, cubeSize.x, cubeSize.y, cubeSize.z, →
→MAROON)

    DrawCubeWires(cubePosition2, cubeSize.x + 0.2f, cubeSize.y + 0.
→2f, cubeSize.z + 0.2f, GREEN)
    collision2 = true
else
    DrawCube(cubePosition2, cubeSize.x, cubeSize.y, cubeSize.z, GRAY)
    DrawCubeWires(cubePosition2, cubeSize.x, cubeSize.y, cubeSize.z, →
→DARKGRAY)

    collision2 = false
ok

DrawRay(ray, MAROON)
DrawGrid(10, 1)

EndMode3D()

DrawText("Try selecting the box with mouse!", 240, 10, 20, DARKGRAY)

if collision1 or collision2 DrawText("BOX SELECTED", (screenWidth - →
→MeasureText("BOX SELECTED", 30)) / 2, screenHeight * 0.1f, 30, GREEN) ok

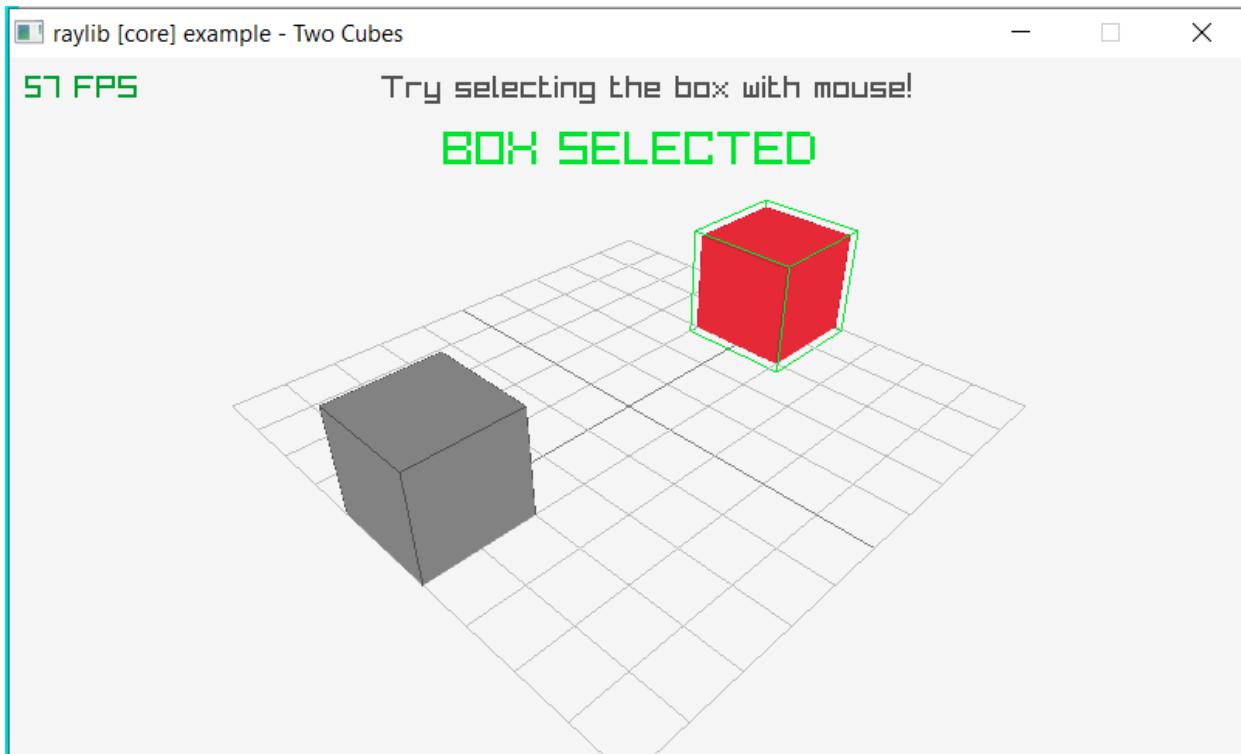
DrawFPS(10, 10)

EndDrawing()
end

CloseWindow()

```

Screen Shot:



57.13 Basic Shapes

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [shapes] example - basic shapes drawing")

SetTargetFPS(60)

while !WindowShouldClose()

    BeginDrawing()

        ClearBackground(RAYWHITE)

        DrawText("some basic shapes available on raylib", 20, 20, 20, DARKGRAY)

        DrawCircle(screenWidth/4, 120, 35, DARKBLUE)

        DrawRectangle(screenWidth/4*2 - 60, 100, 120, 60, RED)
        DrawRectangleLines(screenWidth/4*2 - 40, 320, 80, 60, ORANGE)
        DrawRectangleGradientH(screenWidth/4*2 - 90, 170, 180, 130, MAROON, GOLD)

        DrawTriangle(Vector2(screenWidth/4*3, 80),
                    Vector2(screenWidth/4*3 - 60, 150),

```

(continues on next page)

(continued from previous page)

```
Vector2(screenWidth/4*3 + 60, 150), VIOLET)

DrawPoly(Vector2(screenWidth/4*3, 320), 6, 80, 0, BROWN)

DrawCircleGradient(screenWidth/4, 220, 60, GREEN, SKYBLUE)

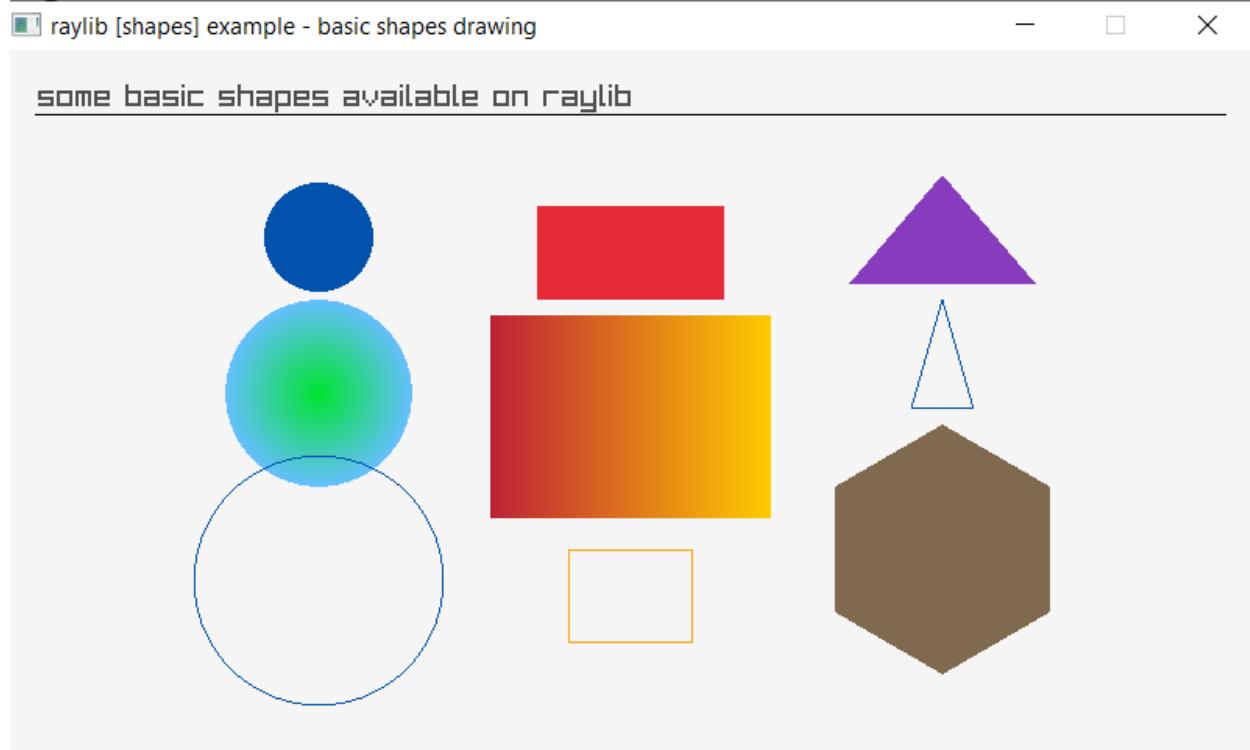
DrawLine(18, 42, screenWidth - 18, 42, BLACK)
DrawCircleLines(screenWidth/4, 340, 80, DARKBLUE)
DrawTriangleLines(Vector2(screenWidth/4*3, 160),
                  Vector2(screenWidth/4*3 - 20, 230),
                  Vector2(screenWidth/4*3 + 20, 230), DARKBLUE)

EndDrawing()

end

CloseWindow()
```

Screen Shot:



57.14 Draw Ring

```

load "raylib.ring"

screenWidth = 800           screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [shapes] example - draw ring")

center = Vector2((GetScreenWidth() - 300)/2, GetScreenHeight()/2)

innerRadius = 80            outerRadius = 190
startAngle = 0              endAngle = 360          segments = 0
drawRing = true             drawRingLines = false   drawCircleLines = false

SetTargetFPS(60)

while !WindowShouldClose()

    BeginDrawing()

        ClearBackground(RAYWHITE)

        DrawLine(500, 0, 500, GetScreenHeight(), Fade(LIGHTGRAY, 0.6))
        DrawRectangle(500, 0, GetScreenWidth() - 500, GetScreenHeight(), Fade(LIGHTGRAY, ↵
        ↵0.3))

        if drawRing DrawRing(center, innerRadius, outerRadius, startAngle, endAngle, ↵
        ↵segments, Fade(MAROON, 0.3)) ok
        if drawRingLines DrawRingLines(center, innerRadius, outerRadius, startAngle, ↵
        ↵endAngle, segments, Fade(BLACK, 0.4)) ok
        if drawCircleLines DrawCircleSectorLines(center, outerRadius, startAngle, ↵
        ↵endAngle, segments, Fade(BLACK, 0.4)) ok

        startAngle = GuiSliderBar(Rectangle( 600, 40, 120, 20 ), "StartAngle", ↵
        ↵startAngle, -450, 450, true)
        endAngle = GuiSliderBar(Rectangle( 600, 70, 120, 20 ), "EndAngle", endAngle, - ↵
        ↵450, 450, true)
        innerRadius = GuiSliderBar(Rectangle( 600, 140, 120, 20 ), "InnerRadius", ↵
        ↵innerRadius, 0, 100, true)
        outerRadius = GuiSliderBar(Rectangle( 600, 170, 120, 20 ), "OuterRadius", ↵
        ↵outerRadius, 0, 200, true)

        segments = GuiSliderBar(Rectangle( 600, 240, 120, 20 ), "Segments", segments, 0, ↵
        ↵100, true)

        drawRing = GuiCheckBox(Rectangle( 600, 320, 20, 20 ), "Draw Ring", drawRing)
        drawRingLines = GuiCheckBox(Rectangle( 600, 350, 20, 20 ), "Draw RingLines", ↵
        ↵drawRingLines)
        drawCircleLines = GuiCheckBox(Rectangle( 600, 380, 20, 20 ), "Draw CircleLines", ↵
        ↵drawCircleLines)

        if segments >= 4           DrawText("MODE: MANUAL", 600, 270, 10, MAROON)

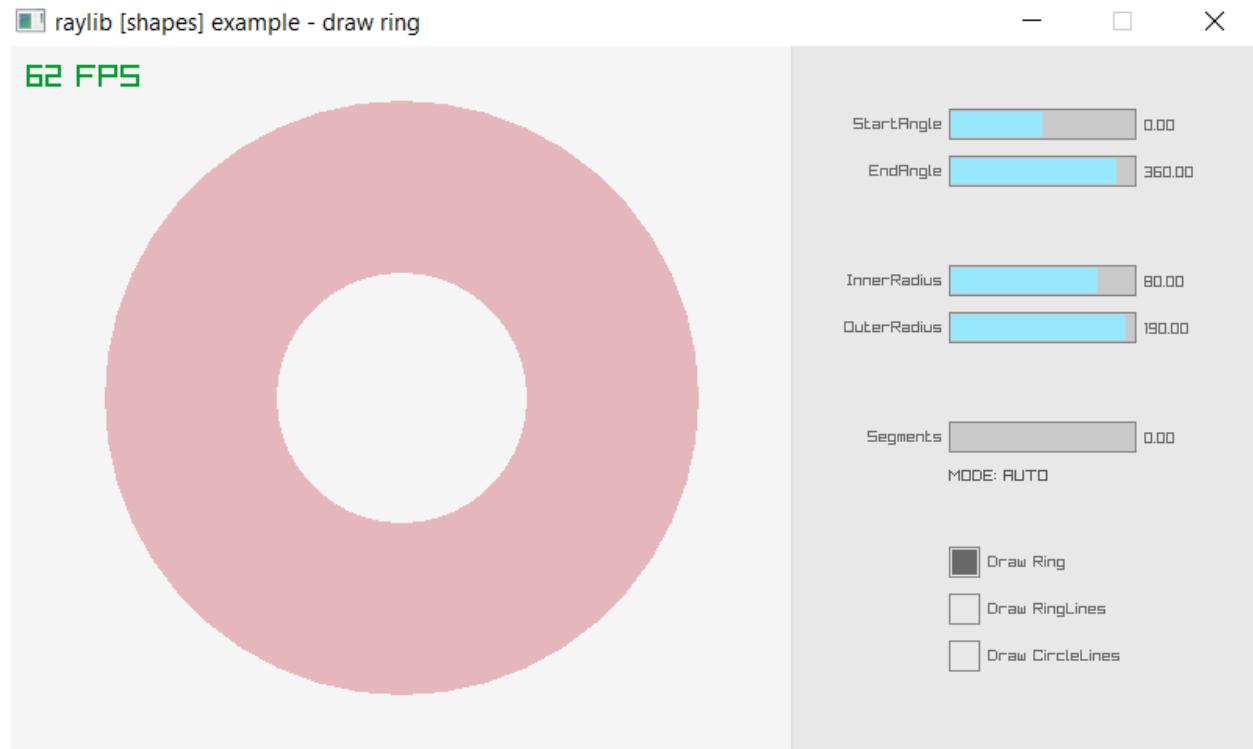
```

(continues on next page)

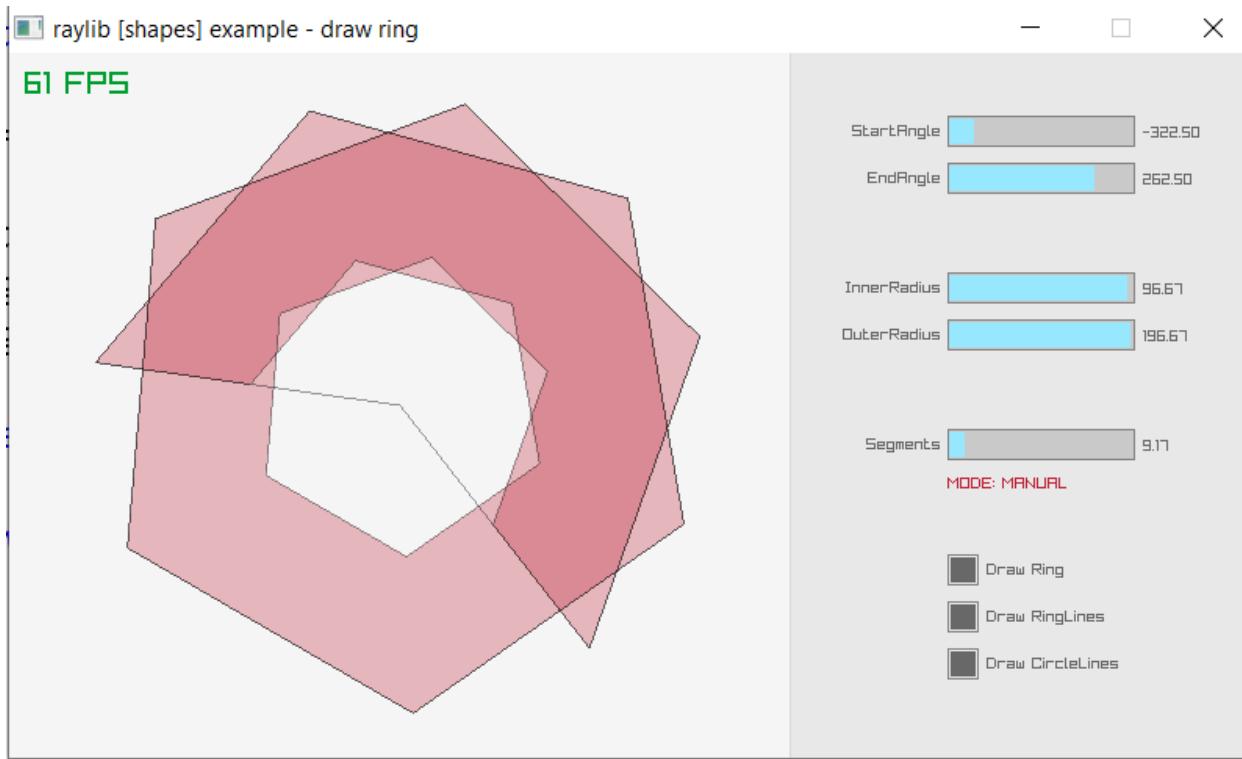
(continued from previous page)

```
else DrawText("MODE: AUTO", 600, 270, 10, DARKGRAY) ok  
DrawFPS(10, 10)  
EndDrawing()  
end  
CloseWindow()
```

Screen Shot:



Screen Shot (2):



57.15 Bezier Lines

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

SetConfigFlags(FLAG_MSAA_4X_HINT)
InitWindow(screenWidth, screenHeight, "raylib [shapes] example - cubic-bezier lines")

start = Vector2(0,0)
endvec = Vector2(screenWidth,screenHeight)

SetTargetFPS(60)

while (!WindowShouldClose())

    if (IsMouseDown(MOUSE_LEFT_BUTTON))
        start = GetMousePosition()
    else (IsMouseDown(MOUSE_RIGHT_BUTTON))
        endvec = GetMousePosition()
    ok

    BeginDrawing()

    ClearBackground(RAYWHITE)

```

(continues on next page)

(continued from previous page)

```

        DrawText("USE MOUSE LEFT-RIGHT CLICK to DEFINE LINE START and END POINTS
→", 15, 20, 20, GRAY)
        DrawLineBezier(start, endvec, 2.0, RED)

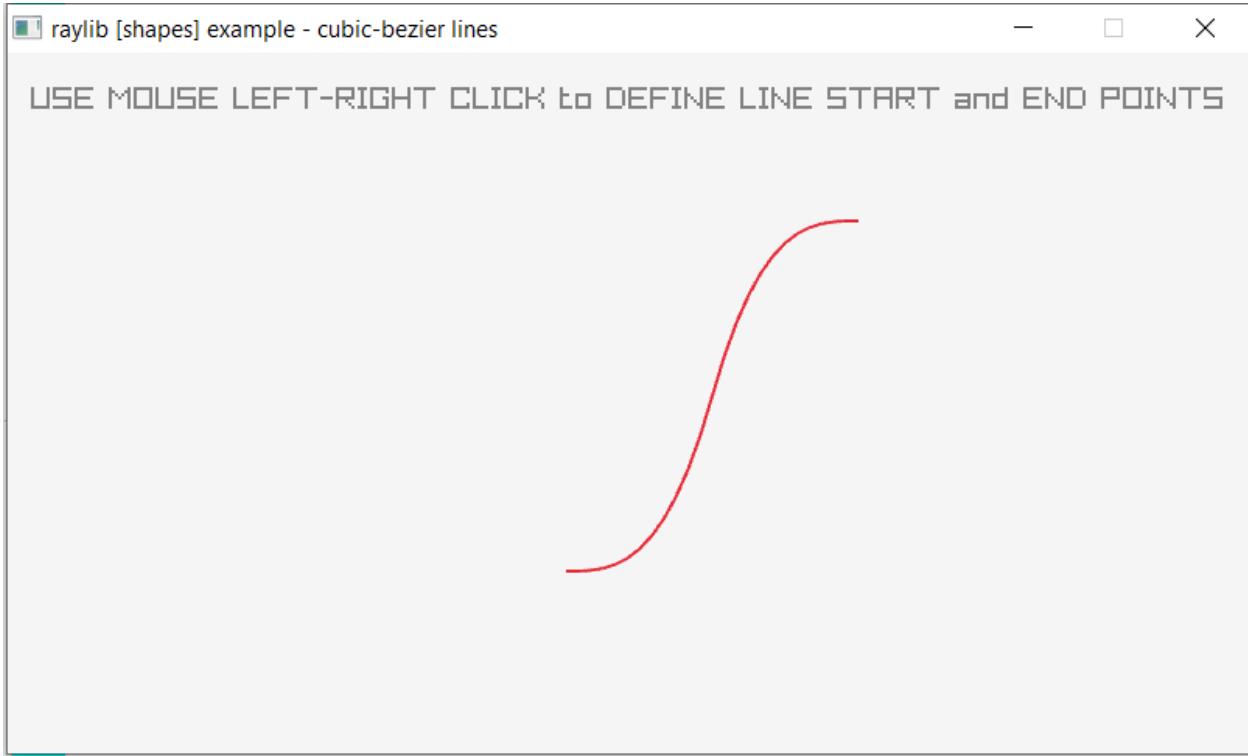
    EndDrawing()

end

CloseWindow()

```

Screen Shot:



57.16 Collision Area

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [shapes] example - collision area")

// Box A: Moving box
boxA = Rectangle(10, GetScreenHeight()/2 - 50, 200, 100)
boxASpeedX = 4

// Box B: Mouse moved box

```

(continues on next page)

(continued from previous page)

```

boxB = Rectangle( GetScreenWidth()/2 - 30, GetScreenHeight()/2 - 30, 60, 60 )

boxCollision = GetCollisionRec(boxA, boxB)

boxCollision = Rectangle( 0,0,0,0 ) // Collision rectangle

screenUpperLimit = 40          // Top menu limits

pause = false                  // Movement pause
collision = false              // Collision detection

SetTargetFPS(60)

while !WindowShouldClose()

    // Move box if not paused
    if (not pause) boxA.x += boxASpeedX ok

    // Bounce box on x screen limits
    if (((boxA.x + boxA.width) >= GetScreenWidth()) or (boxA.x <= 0)) boxASpeedX = ↵
    ↵boxASpeedX*(-1) ok

    // Update player-controlled-box (box02)
    boxB.x = GetMouseX() - boxB.width/2
    boxB.y = GetMouseY() - boxB.height/2

    // Make sure Box B does not go out of move area limits
    if ((boxB.x + boxB.width) >= GetScreenWidth()) boxB.x = GetScreenWidth() - boxB. ↵
    ↵width
    else (boxB.x <= 0) boxB.x = 0 ok

    if ((boxB.y + boxB.height) >= GetScreenHeight()) boxB.y = GetScreenHeight() - ↵
    ↵boxB.height
    else (boxB.y <= screenUpperLimit) boxB.y = screenUpperLimit ok

    // Check boxes collision
    collision = CheckCollisionRecs(boxA, boxB)

    // Get collision rectangle (only on collision)
    if (collision) boxCollision = GetCollisionRec(boxA, boxB) ok

    // Pause Box A movement
    if (IsKeyPressed(KEY_SPACE)) pause = not pause ok

BeginDrawing()

    ClearBackground(RAYWHITE)

    if collision = true
        color = RED
    else
        color = BLACK

```

(continues on next page)

(continued from previous page)

```

ok
DrawRectangle(0, 0, screenWidth, screenUpperLimit, color)
DrawRectangleRec(boxA, GOLD)

boxB.x = GetMouseX() - boxB.width/2
boxB.y = GetMouseY() - boxB.height/2
collision = CheckCollisionRecs(boxA, boxB)
DrawRectangleRec(boxB, BLUE)
boxCollision = GetCollisionRec(boxA, boxB)

if (collision) = true

    // Draw collision area
    DrawRectangleRec(boxCollision, LIME)

    // Draw collision message
    DrawText("COLLISION!", GetScreenWidth()/2 - MeasureText(
        "COLLISION!", 20)/2, screenUpperLimit/2 - 10, 20, BLACK)

    // Draw collision area
    DrawText("Collision Area: " + string(boxCollision.
        width*boxCollision.height), GetScreenWidth()/2 - 100, screenUpperLimit + 10, 20, BLACK)

ok

DrawFPS(10, 10)

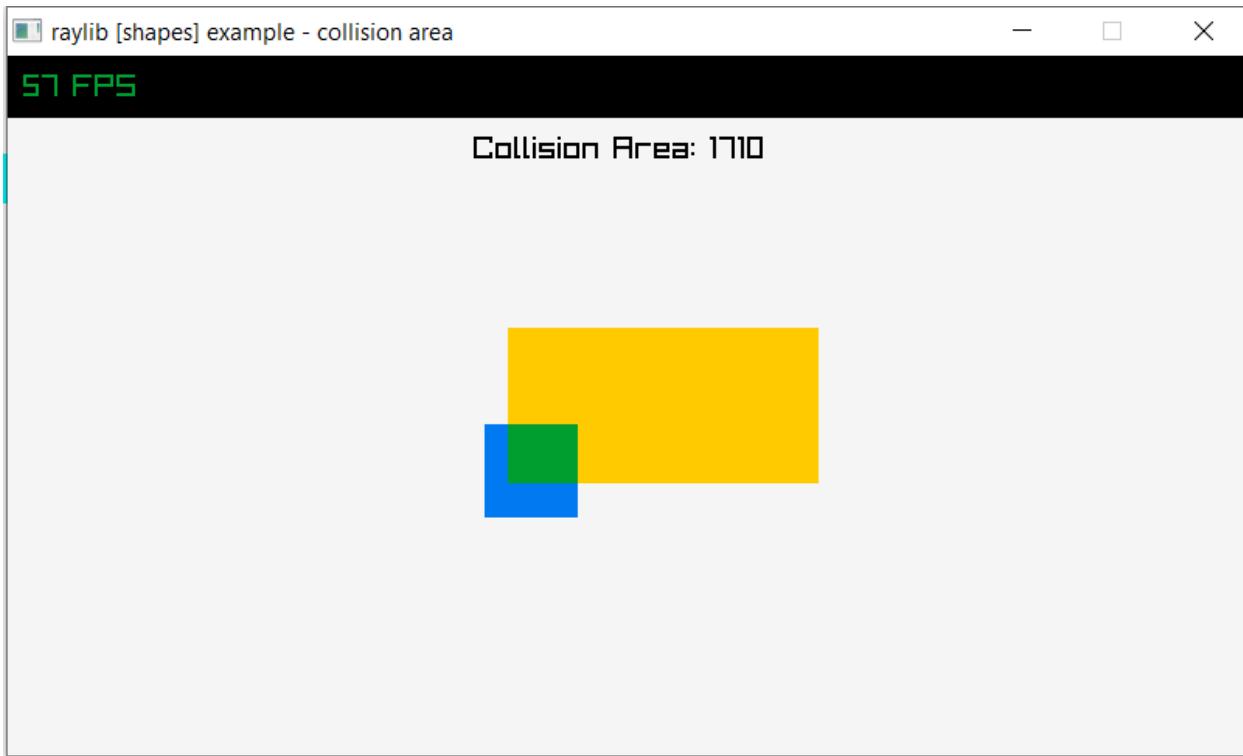
EndDrawing()

end

CloseWindow()

```

Screen Shot:



57.17 Following Eyes

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [shapes] example - following eyes")

scleraLeftPosition = Vector2( GetScreenWidth()/2 - 100, GetScreenHeight()/2 )
scleraRightPosition = Vector2( GetScreenWidth()/2 + 100, GetScreenHeight()/2 )
scleraRadius = 80

irisLeftPosition = Vector2( GetScreenWidth()/2 - 100, GetScreenHeight()/2 )
irisRightPosition = Vector2( GetScreenWidth()/2 + 100, GetScreenHeight()/2 )
irisRadius = 24

angle = 0.0
dx = 0.0 dy = 0.0 dxx = 0.0 dyy = 0.0

SetTargetFPS(60)

while !WindowShouldClose()

    irisLeftPosition = GetMousePosition()
    irisRightPosition = GetMousePosition()

```

(continues on next page)

(continued from previous page)

```

// Check not inside the left eye sclera
if !CheckCollisionPointCircle(irisLeftPosition, scleraLeftPosition, scleraRadius,
→- 20)
    dx = irisLeftPosition.x - scleraLeftPosition.x
    dy = irisLeftPosition.y - scleraLeftPosition.y

    angle = atan2(dy, dx)

    dxx = (scleraRadius - irisRadius)*cos(angle)
    dyy = (scleraRadius - irisRadius)*sin(angle)

    irisLeftPosition.x = scleraLeftPosition.x + dxx
    irisLeftPosition.y = scleraLeftPosition.y + dyy
ok

// Check not inside the right eye sclera
if !CheckCollisionPointCircle(irisRightPosition, scleraRightPosition, scleraRadius -
→- 20)
    dx = irisRightPosition.x - scleraRightPosition.x
    dy = irisRightPosition.y - scleraRightPosition.y

    angle = atan2(dy, dx)

    dxx = (scleraRadius - irisRadius)*cos(angle)
    dyy = (scleraRadius - irisRadius)*sin(angle)

    irisRightPosition.x = scleraRightPosition.x + dxx
    irisRightPosition.y = scleraRightPosition.y + dyy
ok

BeginDrawing()

    ClearBackground(RAYWHITE)

    DrawCircleV(scleraLeftPosition, scleraRadius, LIGHTGRAY)
    DrawCircleV(irisLeftPosition, irisRadius, BROWN)
    DrawCircleV(irisLeftPosition, 10, BLACK)

    DrawCircleV(scleraRightPosition, scleraRadius, LIGHTGRAY)
    DrawCircleV(irisRightPosition, irisRadius, DARKGREEN)
    DrawCircleV(irisRightPosition, 10, BLACK)

    DrawFPS(10, 10)

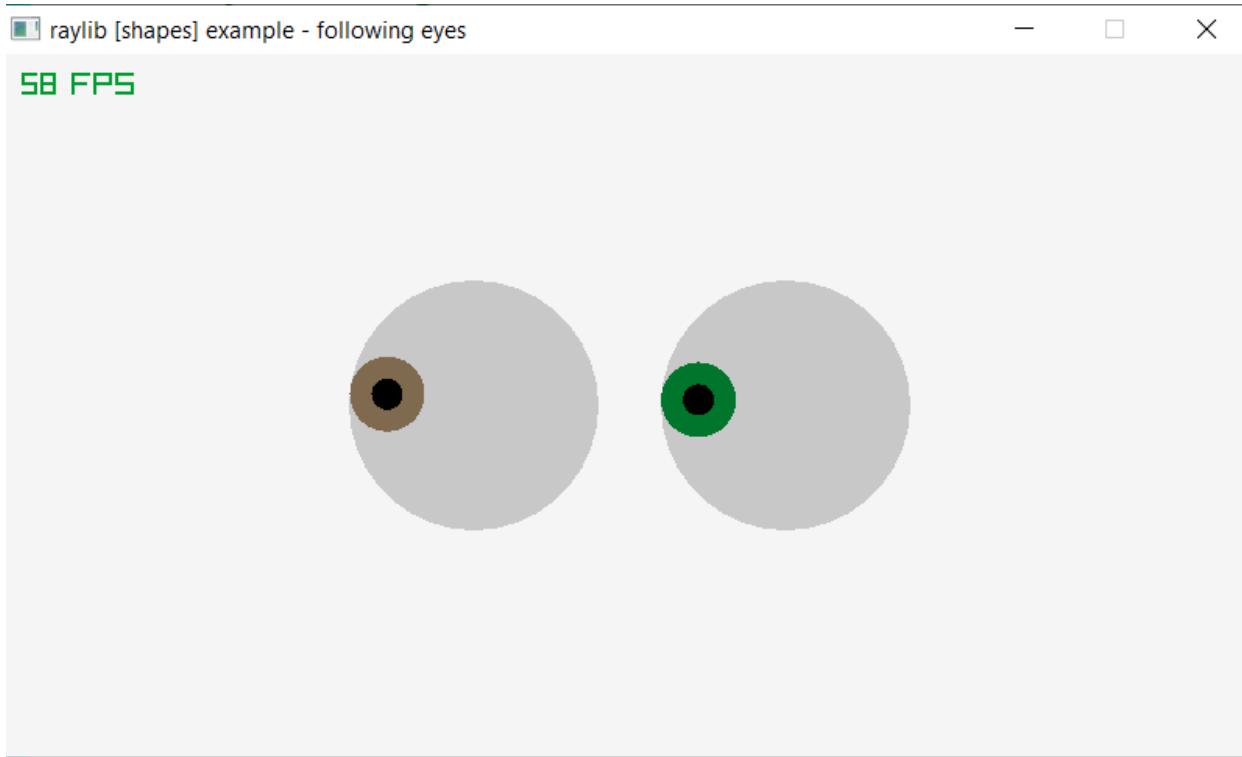
EndDrawing()

end

CloseWindow()

```

Screen Shot:



57.18 Colors Palette

```

load "raylib.ring"

MAX_COLORS_COUNT = 21           // Number of colors available

screenWidth = 800
screenHeight = 450
colors = list(MAX_COLORS_COUNT)
colorNames = list(MAX_COLORS_COUNT)
colorsRecs = list(MAX_COLORS_COUNT)
colorState = list(MAX_COLORS_COUNT)

InitWindow(screenWidth, screenHeight, "raylib [shapes] example - colors palette")

colors = [
    DARKGRAY, MAROON, ORANGE, DARKGREEN, DARKBLUE, DARKPURPLE, DARKBROWN,
    GRAY, RED, GOLD, LIME, BLUE, VIOLET, BROWN, LIGHTGRAY, PINK, YELLOW,
    GREEN, SKYBLUE, PURPLE, BEIGE]

colorNames = [
    "DARKGRAY", "MAROON", "ORANGE", "DARKGREEN", "DARKBLUE", "DARKPURPLE",
    "DARKBROWN", "GRAY", "RED", "GOLD", "LIME", "BLUE", "VIOLET", "BROWN",
    "LIGHTGRAY", "PINK", "YELLOW", "GREEN", "SKYBLUE", "PURPLE", "BEIGE"]

for i = 1 to MAX_COLORS_COUNT
    colorsRecs[i] = new Rectangle(0,0,0,0)

```

(continues on next page)

(continued from previous page)

```

next

for i = 1 to MAX_COLORS_COUNT
    colorState[i] = 0
next

// Fills colorsRecs data (for every rectangle)
for i = 1 to MAX_COLORS_COUNT
    colorsRecs[i].x = 20 + 100*((i-1)%7) + 10*((i-1)%7)
    colorsRecs[i].y = 80 + 100*floor((i-1)/7) + 10*floor((i-1)/7)
    colorsRecs[i].width = 100
    colorsRecs[i].height = 100
next

mousePoint = Vector2( 0.0, 0.0 )

SetTargetFPS(60)

// Main game loop
while !WindowShouldClose()

    mousePoint = GetMousePosition()

    for i = 1 to MAX_COLORS_COUNT
        if (CheckCollisionPointRec(mousePoint, colorsRecs[i])) colorState[i] = 1
        else colorState[i] = 0 ok
    next

    BeginDrawing()

        ClearBackground(RAYWHITE)

        DrawText("raylib colors palette", 28, 42, 20, BLACK)
        DrawText("press SPACE to see all colors", GetScreenWidth() - 180, ↴
        ↴GetScreenHeight() - 40, 10, GRAY)

        for i = 1 to MAX_COLORS_COUNT // Draw all rectangles
            if colorState[i]
                cstate = 0.6
            else
                cstate = 1.0
            ok

            DrawRectangleRec(colorsRecs[i], Fade(colors[i], cstate))

            if (IsKeyDown(KEY_SPACE) || colorState[i])
                DrawRectangle(colorsRecs[i].x, colorsRecs[i].y + ↴
                ↴colorsRecs[i].height - 26, colorsRecs[i].width, 20, BLACK)
                DrawRectangleLinesEx(colorsRecs[i], 6, Fade(BLACK, 0.3f))
                DrawText(colorNames[i], colorsRecs[i].x + colorsRecs[i]. ↴
                ↴width - MeasureText(colorNames[i], 10) - 12,

```

(continues on next page)

(continued from previous page)

```

    ↵colors[i])
        ok
    next

    EndDrawing()

end

CloseWindow()

```

Screen Shot:



57.19 Rectangle Scaling

```

load "raylib.ring"

MOUSE_SCALE_MARK_SIZE = 12

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [shapes] example - rectangle scaling mouse
    ")

rec = Rectangle( 100, 100, 200, 80 )

```

(continues on next page)

(continued from previous page)

```

mousePosition = Vector2( 0,0 )

mouseScaleReady = false
mouseScaleMode = false

SetTargetFPS(60)

while !WindowShouldClose()

    mousePosition = GetMousePosition()

    if (CheckCollisionPointRec(mousePosition, rec) and
        CheckCollisionPointRec(mousePosition, Rectangle(rec.x + rec.width -_
→MOUSE_SCALE_MARK_SIZE, rec.y + rec.height - MOUSE_SCALE_MARK_SIZE, MOUSE_SCALE_MARK_
→SIZE, MOUSE_SCALE_MARK_SIZE)))
        mouseScaleReady = true
        if (IsMouseButtonPressed(MOUSE_LEFT_BUTTON)) mouseScaleMode = true ok
    else mouseScaleReady = false ok

    if (mouseScaleMode)

        mouseScaleReady = true

        rec.width = (mousePosition.x - rec.x)
        rec.height = (mousePosition.y - rec.y)

        if (rec.width < MOUSE_SCALE_MARK_SIZE) rec.width = MOUSE_SCALE_MARK_SIZE_
→ok
        if (rec.height < MOUSE_SCALE_MARK_SIZE) rec.height = MOUSE_SCALE_MARK_
→SIZE ok

        if (IsMouseButtonReleased(MOUSE_LEFT_BUTTON)) mouseScaleMode = false ok
    ok

BeginDrawing()

    ClearBackground(RAYWHITE)

    DrawText("Scale rectangle dragging from bottom-right corner!", 10, 10,_
→20, GRAY)

    DrawRectangleRec(rec, Fade(GREEN, 0.5f))

    if (mouseScaleReady)

        DrawRectangleLinesEx(rec, 1, RED)
        DrawTriangle(Vector2( rec.x + rec.width - MOUSE_SCALE_MARK_SIZE,_
→rec.y + rec.height ), Vector2( rec.x + rec.width, rec.y + rec.height ),
        Vector2( rec.x + rec.width, rec.y + rec.height - MOUSE_SCALE_
→SIZE ), RED)

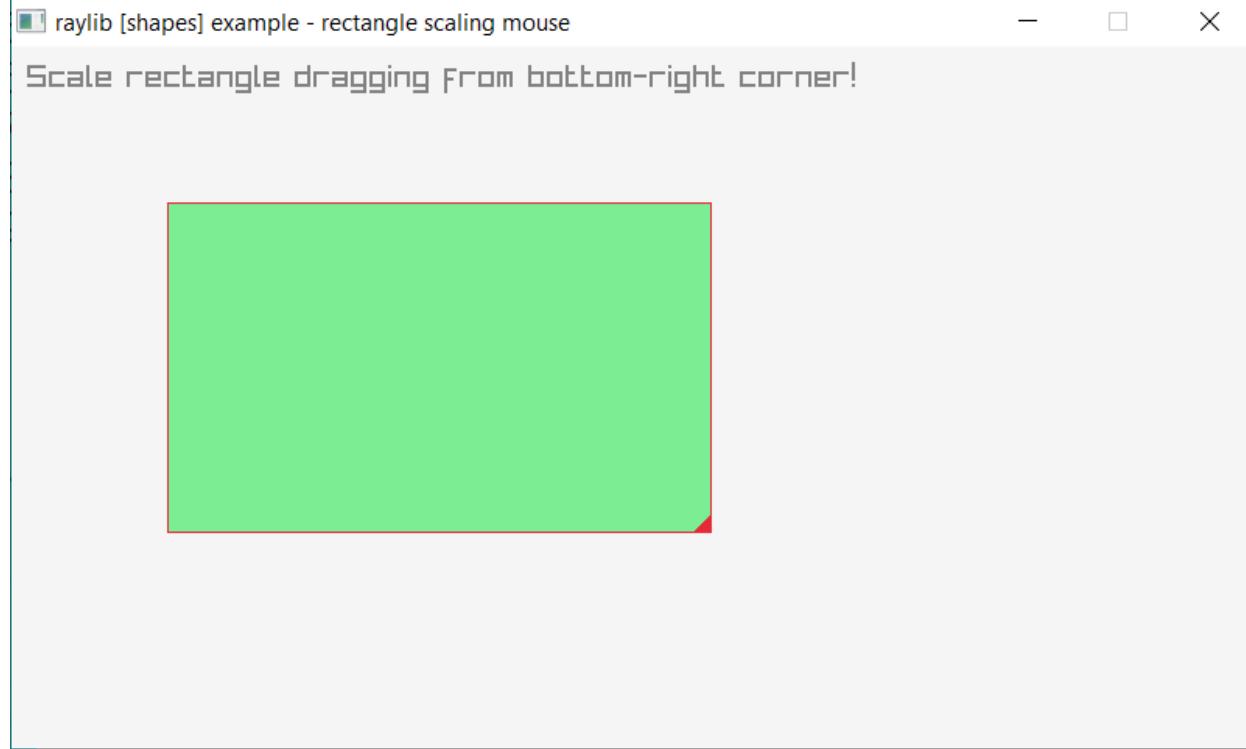
```

(continues on next page)

(continued from previous page)

```
ok  
EndDrawing()  
end  
CloseWindow()
```

Screen Shot:



57.20 Music Playing

```
load "raylib.ring"  
  
screenWidth = 800  
screenHeight = 450  
  
InitWindow(screenWidth, screenHeight, "raylib [audio] example - music playing (streaming)  
→")  
  
InitAudioDevice()  
  
music = LoadMusicStream("guitar_noodling.ogg")  
  
PlayMusicStream(music)
```

(continues on next page)

(continued from previous page)

```

timePlayed = 0.0
pause = false

SetTargetFPS(60)

while !WindowShouldClose()

    UpdateMusicStream(music)

    if IsKeyPressed(KEY_SPACE)
        StopMusicStream(music)
        PlayMusicStream(music)
    ok

    if IsKeyPressed(KEY_P)
        pause = !pause

        if pause
            PauseMusicStream(music)
        else
            ResumeMusicStream(music)
    ok
ok

timePlayed = GetMusicTimePlayed(music) / GetMusicTimeLength(music) *400

if timePlayed > 400
    StopMusicStream(music)
ok

BeginDrawing()

    ClearBackground(RAYWHITE)

    DrawText("MUSIC SHOULD BE PLAYING!", 255, 150, 20, LIGHTGRAY)

    DrawRectangle(200, 200, 400, 12, LIGHTGRAY)
    DrawRectangle(200, 200, timePlayed, 12, MAROON)
    DrawRectangleLines(200, 200, 400, 12, GRAY)

    DrawText("PRESS SPACE TO RESTART MUSIC", 215, 250, 20, LIGHTGRAY)
    DrawText("PRESS P TO PAUSE/RESUME MUSIC", 208, 280, 20, LIGHTGRAY)

EndDrawing()

end

UnloadMusicStream(music)

CloseAudioDevice()

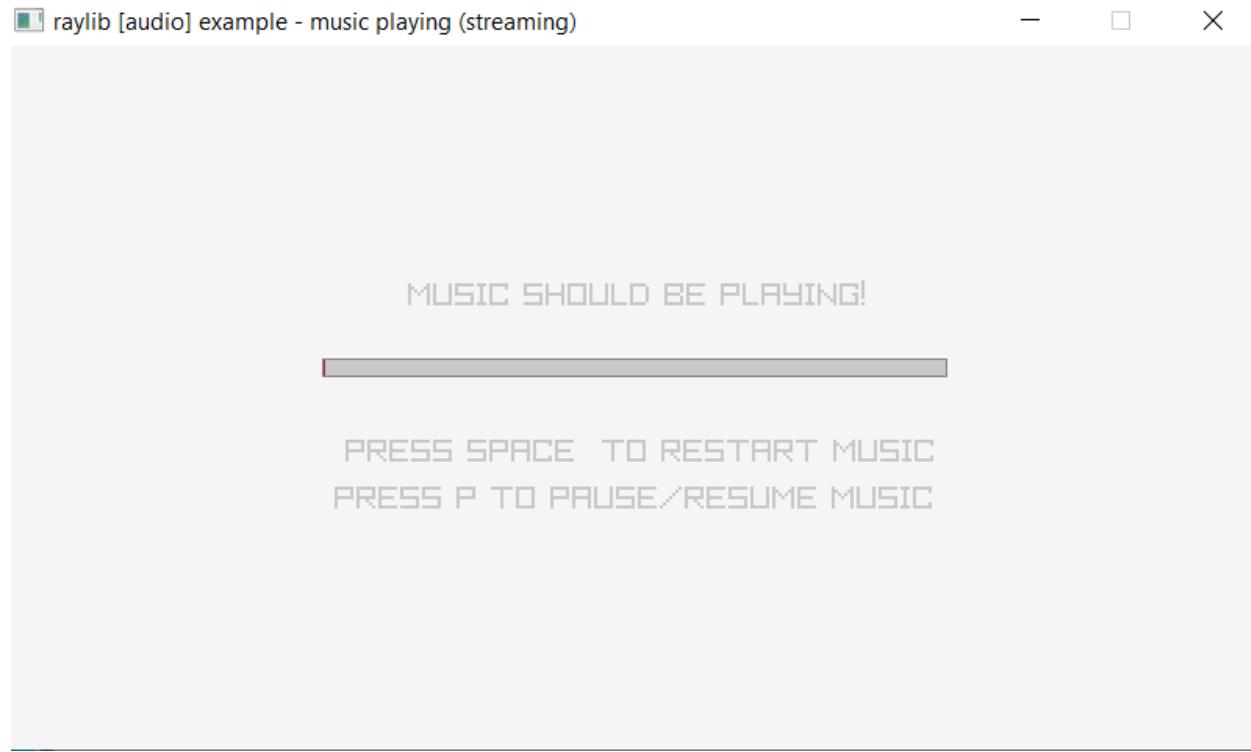
```

(continues on next page)

(continued from previous page)

CloseWindow()

Screen Shot:



57.21 Sound Loading

```

load "raylib.ring"

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [audio] example - sound loading and playing
←")
InitAudioDevice()

fxWav = LoadSound("sound.wav")
fxOgg = LoadSound("tanatana.ogg")

SetTargetFPS(60)

while !WindowShouldClose()

    if IsKeyPressed(KEY_SPACE) PlaySound(fxWav) ok
    if IsKeyPressed(KEY_ENTER) PlaySound(fxOgg) ok

```

(continues on next page)

(continued from previous page)

```
BeginDrawing()

    ClearBackground(RAYWHITE)

    DrawText("Press SPACE to PLAY the WAV sound!", 200, 180, 20, LIGHTGRAY)
    DrawText("Press ENTER to PLAY the OGG sound!", 200, 220, 20, LIGHTGRAY)

EndDrawing()

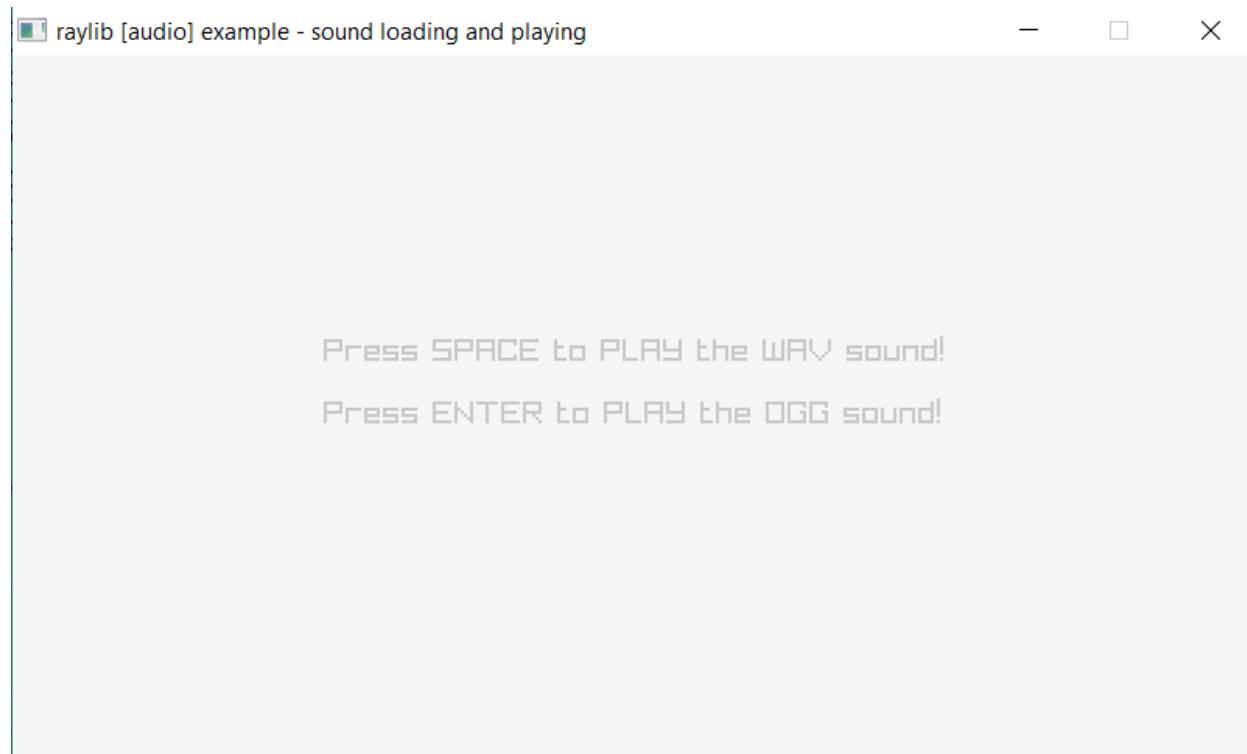
end

UnloadSound(fxWav)
UnloadSound(fxOgg)

CloseAudioDevice()

CloseWindow()
```

Screen Shot:



57.22 Image Drawing

```

load "raylib.ring"

screenWidth  = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [textures] example - image drawing")

cat = LoadImage("cat.png")

ImageCrop( cat, Rectangle( 100, 10, 280, 380 ))
ImageFlipHorizontal( cat)
ImageResize( cat, 150, 200)

parrots = LoadImage("parrots.png")

ImageDraw( parrots, cat, Rectangle( 0, 0, cat.width, cat.height ), Rectangle( 30, 40, ↵
    ↵cat.width*1.5, cat.height*1.5 ))
ImageCrop( parrots, Rectangle( 0, 50, parrots.width, parrots.height - 100 ))

UnloadImage(cat)

font = LoadFont("custom_jupiter_crash.png")

ImageDrawTextEx(parrots, Vector2( 300, 230 ), font, "PARROTS & CAT", font.baseSize, -2, ↵
    ↵WHITE)
UnloadFont(font);

texture = LoadTextureFromImage(parrots)

UnloadImage(parrots)

SetTargetFPS(60)

while !WindowShouldClose()
    BeginDrawing()

        ClearBackground(RAYWHITE)

        DrawTexture(texture, screenWidth/2 - texture.width/2, screenHeight/2 - ↵
            ↵texture.height/2 - 40, WHITE)
        DrawRectangleLines(screenWidth/2 - texture.width/2, screenHeight/2 - ↵
            ↵texture.height/2 - 40, texture.width, texture.height, DARKGRAY)

        DrawText("We are drawing only one texture from various images composed!", ↵
            ↵240, 350, 10, DARKGRAY)
        DrawText("Source images have been cropped, scaled, flipped and copied ↵
            ↵one over the other.", 190, 370, 10, DARKGRAY)

    EndDrawing()
end

```

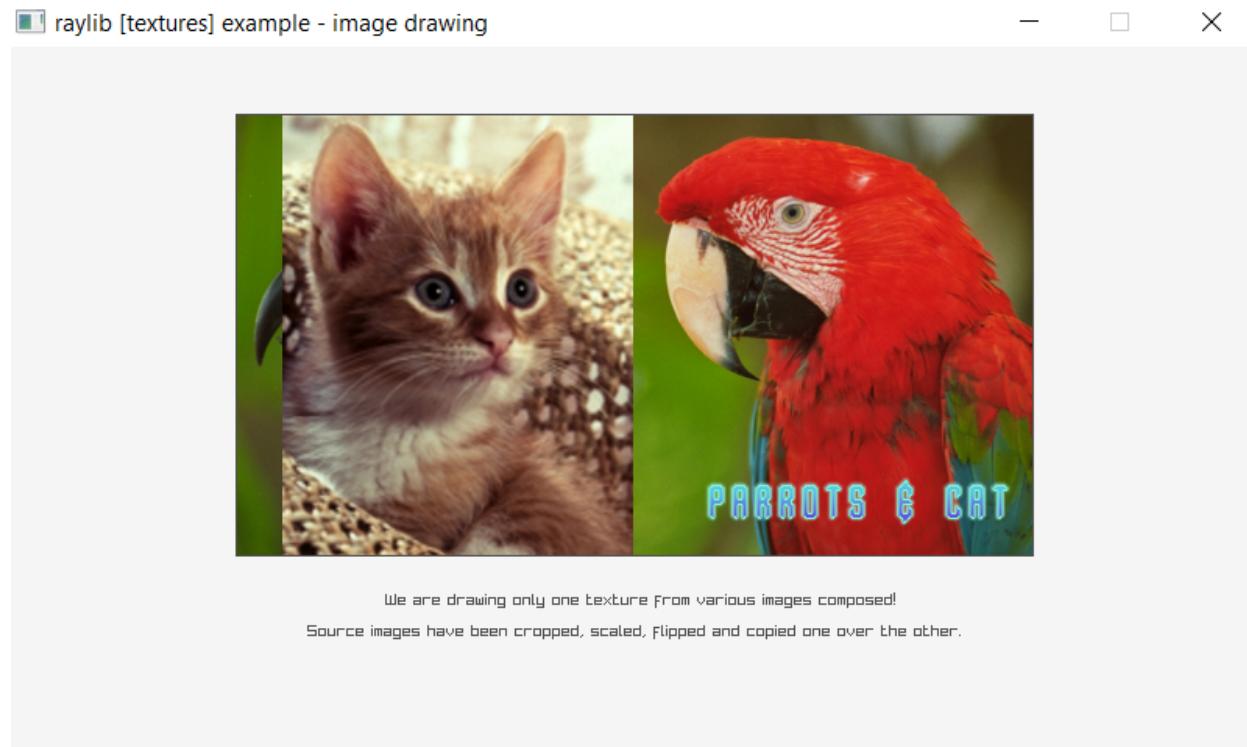
(continues on next page)

(continued from previous page)

```
UnloadTexture(texture)
```

```
CloseWindow()
```

Screen Shot:



57.23 Image Generation

```
load "raylib.ring"

NUM_TEXTURES = 9
textures      = list(NUM_TEXTURES)

screenWidth  = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [textures] example - procedural images"
           ↴generation")

verticalGradient = GenImageGradientLinear(screenWidth, screenHeight, 0, RED, BLUE);
horizontalGradient = GenImageGradientLinear(screenWidth, screenHeight, 90, RED, BLUE);
diagonalGradient = GenImageGradientLinear(screenWidth, screenHeight, 45, RED, BLUE);
radialGradient = GenImageGradientRadial(screenWidth, screenHeight, 0.0f, WHITE, BLACK);
squareGradient = GenImageGradientSquare(screenWidth, screenHeight, 0.0f, WHITE, BLACK);
checked = GenImageChecked(screenWidth, screenHeight, 32, 32, RED, BLUE);
```

(continues on next page)

(continued from previous page)

```

whiteNoise = GenImageWhiteNoise(screenWidth, screenHeight, 0.5f);
perlinNoise = GenImagePerlinNoise(screenWidth, screenHeight, 50, 50, 4.0f);
cellular = GenImageCellular(screenWidth, screenHeight, 32);

textures[NUM_TEXTURES] = 0

textures[1] = LoadTextureFromImage(verticalGradient)
textures[2] = LoadTextureFromImage(horizontalGradient)
textures[3] = LoadTextureFromImage(diagonalGradient)
textures[4] = LoadTextureFromImage(radialGradient)
textures[5] = LoadTextureFromImage(squareGradient)
textures[6] = LoadTextureFromImage(checked)
textures[7] = LoadTextureFromImage(whiteNoise)
textures[8] = LoadTextureFromImage(perlinNoise)
textures[9] = LoadTextureFromImage(cellular)

UnloadImage(verticalGradient)
UnloadImage(horizontalGradient)
UnloadImage(diagonalGradient)
UnloadImage(radialGradient)
UnloadImage(squareGradient)
UnloadImage(checked)
UnloadImage(whiteNoise)
UnloadImage(perlinNoise)
UnloadImage(cellular)

currentTexture = 1

SetTargetFPS(10)

while !WindowShouldClose()

    if IsMouseButtonPressed(MOUSE_LEFT_BUTTON) || IsKeyPressed(KEY_RIGHT)
        currentTexture++
        if currentTexture > NUM_TEXTURES currentTexture = 1 ok
    ok

    BeginDrawing()

        ClearBackground(RAYWHITE)

        DrawTexture(textures[currentTexture], 0, 0, WHITE)

        DrawRectangle(30, 400, 325, 30, Fade(SKYBLUE, 0.5))
        DrawRectangleLines(30, 400, 325, 30, Fade(WHITE, 0.5))
        DrawText("MOUSE LEFT BUTTON to CYCLE PROCEDURAL TEXTURES", 40, 410, 10, WHITE)
        switch(currentTexture)
            on 1 DrawText("VERTICAL GRADIENT", 560, 10, 20, RAYWHITE)
            on 2 DrawText("HORIZONTAL GRADIENT", 540, 10, 20, RAYWHITE)
            on 3 DrawText("DIAGONAL GRADIENT", 540, 10, 20, RAYWHITE)

```

(continues on next page)

(continued from previous page)

```
on 4 DrawText("RADIAL GRADIENT", 580, 10, 20, LIGHTGRAY)
on 5 DrawText("SQUARE GRADIENT", 580, 10, 20, LIGHTGRAY)
on 6 DrawText("CHECKED", 680, 10, 20, RAYWHITE)
on 7 DrawText("WHITE NOISE", 640, 10, 20, RED)
on 8 DrawText("PERLIN NOISE", 630, 10, 20, RAYWHITE)
on 9 DrawText("CELLULAR", 670, 10, 20, RAYWHITE)

off

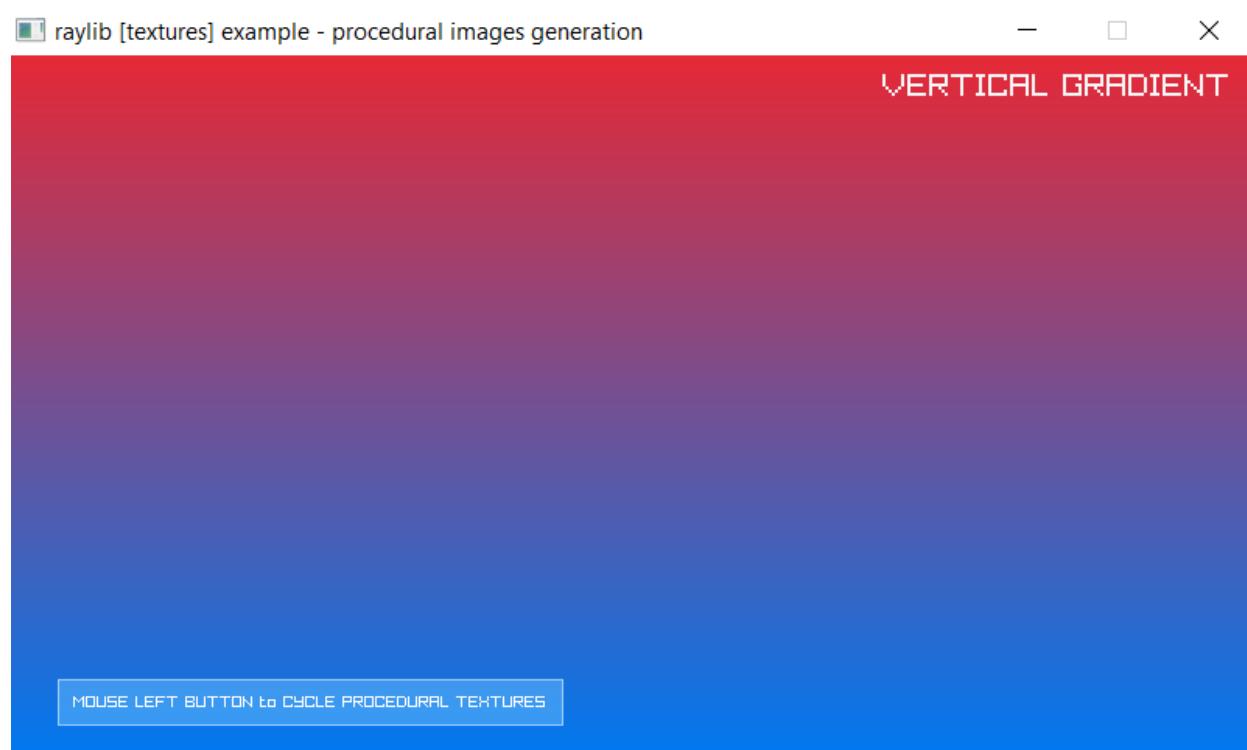
EndDrawing()

end

for i = 1 to NUM_TEXTURES
    UnloadTexture( textures[i] )
next

CloseWindow()
```

Screen Shot:



57.24 Texture Source

```

load "raylib.ring"

screenWidth = 800
screenHeight = 600

InitWindow(screenWidth, screenHeight, "raylib [textures] examples - texture source and
destination rectangles")

// NOTE: Textures MUST be loaded after Window initialization (OpenGL context is required)

scarfy = LoadTexture("RingLogo.png")           // Texture loading

frameWidth = scarfy.width
frameHeight = scarfy.height

// Source rectangle (part of the texture to use for drawing)
sourceRec = Rectangle( 0.0, 0.0, frameWidth, frameHeight )

// Destination rectangle (screen rectangle where drawing part of texture)
destRec = Rectangle( screenWidth/2, screenHeight/2, frameWidth*2, frameHeight*2 )

// Origin of the texture (rotation/scale point), it's relative to destination rectangle
// size
origin = Vector2( frameWidth, frameHeight )

rotation = 0

SetTargetFPS(60)

while !WindowShouldClose()

    rotation = rotation+1

    BeginDrawing()

        ClearBackground(RAYWHITE)

        // NOTE: Using DrawTexturePro() we can easily rotate and scale the part
        // of the texture we draw
        // sourceRec defines the part of the texture we use for drawing
        // destRec defines the rectangle where our texture part will fit
        // (scaling it to fit)
        // origin defines the point of the texture used as reference for
        // rotation and scaling
        // rotation defines the texture rotation (using origin as rotation point)
        DrawTexturePro(scarfy, sourceRec, destRec, origin, rotation, WHITE)

        DrawLine(destRec.x, 0, destRec.x, screenHeight, GRAY)
        DrawLine(0, destRec.y, screenWidth, destRec.y, GRAY)

```

(continues on next page)

(continued from previous page)

```
    DrawText("(c) Scarfy sprite by Eiden Marsal", screenWidth - 200,_
screenHeight - 20, 10, GRAY)

    EndDrawing()

end

UnloadTexture(scarfy)      // Texture unloading

CloseWindow()
```

Screen Shot:



57.25 Geometric Shapes

```
load "raylib.ring"

FOVY_PERSPECTIVE    = 45.0
WIDTH_ORTHOGRAPHIC = 10.0

screenWidth   = 800
screenHeight  = 450
```

(continues on next page)

(continued from previous page)

```

InitWindow(screenWidth, screenHeight, "raylib [models] example - geometric shapes")

camera = Camera3D( 0.0, 10.0, 10.0,
                   0.0, 0.0, 0.0,
                   0.0, 1.0, 0.0,
                   FOVY_PERSPECTIVE, CAMERA_PERSPECTIVE
                 )

SetTargetFPS(60)

while !WindowShouldClose()

  if IsKeyPressed(KEY_SPACE)

    if camera.projection = CAMERA_PERSPECTIVE

      camera.fovy = WIDTH_ORTHOGRAPHIC
      camera.projection = CAMERA_ORTHOGRAPHIC

    else

      camera.fovy = FOVY_PERSPECTIVE
      camera.projection = CAMERA_PERSPECTIVE
    ok
  ok

BeginDrawing()

  ClearBackground(RAYWHITE)

  BeginMode3D(camera)

    DrawCube(Vector3(-4.0, 0.0, 2.0), 2.0, 5.0, 2.0, RED)
    DrawCubeWires(Vector3(-4.0, 0.0, 2.0), 2.0, 5.0, 2.0, GOLD)
    DrawCubeWires(Vector3(-4.0, 0.0, -2.0), 3.0, 6.0, 2.0, MAROON)

    DrawSphere(Vector3(-1.0, 0.0, -2.0), 1.0, GREEN)
    DrawSphereWires(Vector3( 1.0, 0.0, 2.0), 2.0, 16, 16, LIME)

    DrawCylinder(Vector3(4.0, 0.0, -2.0), 1.0, 2.0, 3.0, 4, SKYBLUE)
    DrawCylinderWires(Vector3(4.0, 0.0, -2.0), 1.0, 2.0, 3.0, 4, DARKBLUE)
    DrawCylinderWires(Vector3(4.5, -1.0, 2.0), 1.0, 1.0, 2.0, 6, BROWN)

    DrawCylinder(Vector3(1.0, 0.0, -4.0), 0.0, 1.5, 3.0, 8, GOLD)
    DrawCylinderWires(Vector3(1.0, 0.0, -4.0), 0.0, 1.5, 3.0, 8, PINK)

    DrawGrid(10, 1.0)

```

(continues on next page)

(continued from previous page)

```
EndMode3D()

DrawText("Press Spacebar to switch camera type", 10, GetScreenHeight() - 30, 20, DARKGRAY)

if camera.projection = CAMERA_ORTHOGRAPHIC
    DrawText("ORTHOGRAPHIC", 10, 40, 20, BLACK)
else
    if camera.projection = CAMERA_PERSPECTIVE
        DrawText("PERSPECTIVE", 10, 40, 20, BLACK)
    ok
ok

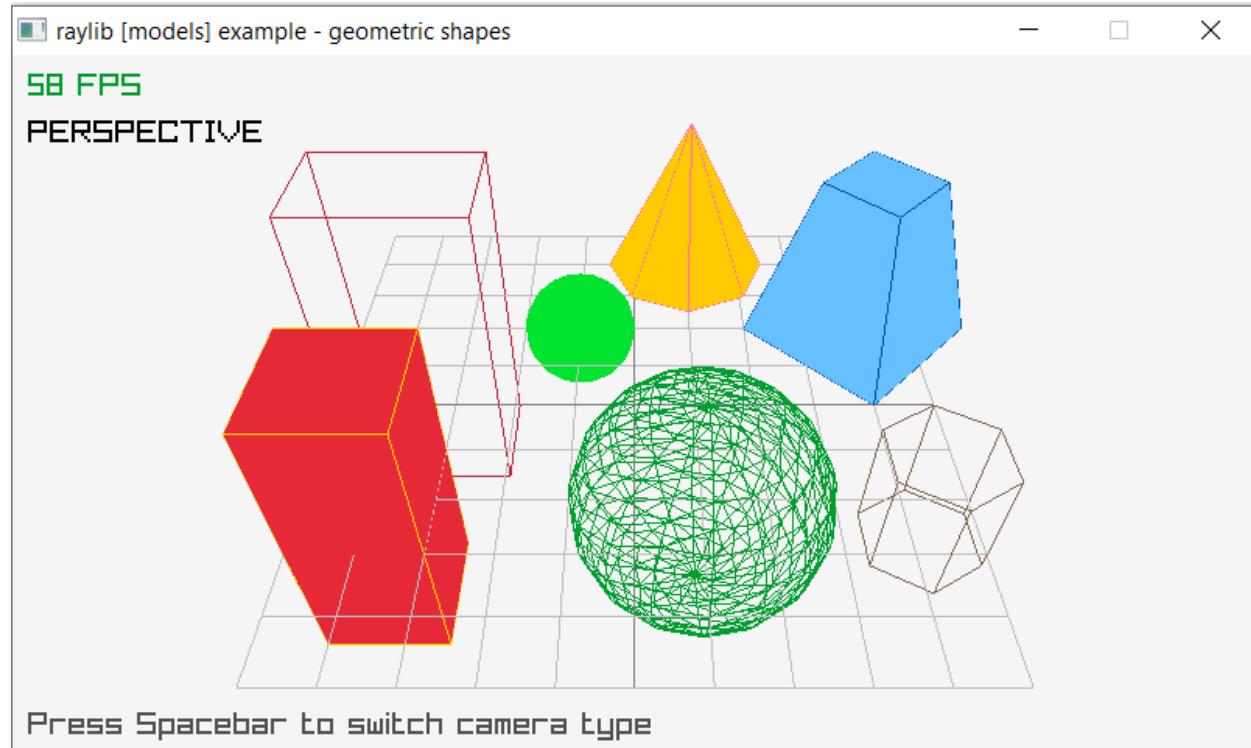
DrawFPS(10, 10)

EndDrawing()

end

CloseWindow()
```

Screen Shot:



57.26 Cubic Map

```

load "raylib.ring"

screenWidth  = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [models] example - cubesmap loading and
←drawing")

camera = Camera3D( 16.0, 14.0, 16.0,
                   0.0, 0.0, 0.0,
                   0.0, 1.0, 0.0,
                   45.0, CAMERA_PERSPECTIVE )

image      = LoadImage("cubicmap.png")
cubicmap = LoadTextureFromImage(image)

mesh       = GenMeshCubicmap(image, Vector3( 1.0, 1.0, 1.0 ))
model     = LoadModelFromMesh(mesh)

texture   = LoadTexture("cubicmap_atlas.png")

setmodelmaterialtexture(model, 0, MAP_DIFFUSE, texture)

mapPosition = Vector3( -16.0, 0.0, -8.0 )

UnloadImage(image)
SetTargetFPS(60)

while !WindowShouldClose()

    UpdateCamera(camera, CAMERA_ORBITAL)

    BeginDrawing()

        ClearBackground(RAYWHITE)
        BeginMode3D(camera)
            DrawModel(model, mapPosition, 1.0, WHITE)
        EndMode3D()

        DrawTextureEx(cubicmap, Vector2( screenWidth - cubicmap.width*4 - 20, 20
        ←),
                      0.0, 4.0, WHITE)
        DrawRectangleLines(screenWidth - cubicmap.width*4 - 20, 20, cubicmap.
        ←width*4,
                           cubicmap.height*4, GREEN)

        DrawText("cubicmap image used to", 658, 90, 10, GRAY)
        DrawText("generate map 3d model", 658, 104, 10, GRAY)
        DrawFPS(10, 10)

```

(continues on next page)

(continued from previous page)

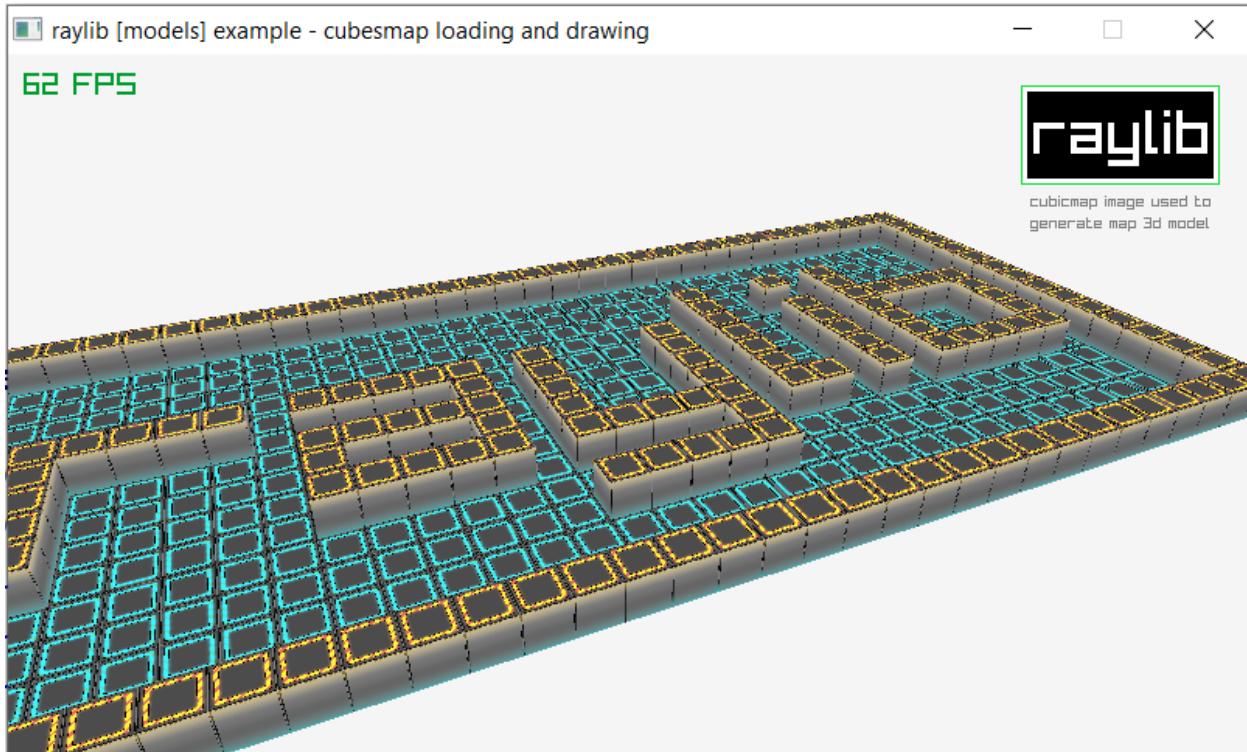
```
    EndDrawing()

end

UnloadTexture(cubemap)
UnloadTexture(texture)
UnloadModel(model)

CloseWindow()
```

Screen Shot:



57.27 Implementation

The extension exist in the ring/extension/ringraylib5 folder

The supported functions are defined in the ring/extensions/ringraylib5/src/raylib.cf file

The samples exist in the ring/samples/UsingRayLib folder

USING RINGOPENGL AND RINGFREEGLUT FOR 3D GRAPHICS

In this chapter we will learn about using RingOpenGL

58.1 Samples Source (Authors)

The samples in this chapter are based on C Tutorials
from

- (1) <http://www.lighthouse3d.com/tutorials/glut-tutorial/>
- (2) <http://www.wikihow.com/Make-a-Cube-in-OpenGL>

58.2 What is RingOpenGL?

RingOpenGL contains the Ring binding to the OpenGL library

You can learn about OpenGL from : <https://www.opengl.org/>

RingOpenGL comes with support for the next versions

- OpenGL 1.1
- OpenGL 1.2
- OpenGL 1.3
- OpenGL 1.4
- OpenGL 1.5
- OpenGL 2.0
- OpenGL 2.1
- OpenGL 3.0
- OpenGL 3.2
- OpenGL 3.3
- OpenGL 4.0
- OpenGL 4.1
- OpenGL 4.2
- OpenGL 4.3

- OpenGL 4.4
- OpenGL 4.5
- OpenGL 4.6

For example, if you want to use OpenGL 2.1 then load RingOpenGL 2.1 library

```
load "opengl21lib.ring"
```

58.3 What is RingFreeGLUT?

RingFreeGLUT contains the Ring binding to the FreeGLUT library

You can learn about FreeGLUT from : <http://freeglut.sourceforge.net/>

To use the RingFreeGLUT library, Just load the library

```
load "freeglut.ring"
```

58.4 The First Window using RingFreeGLUT

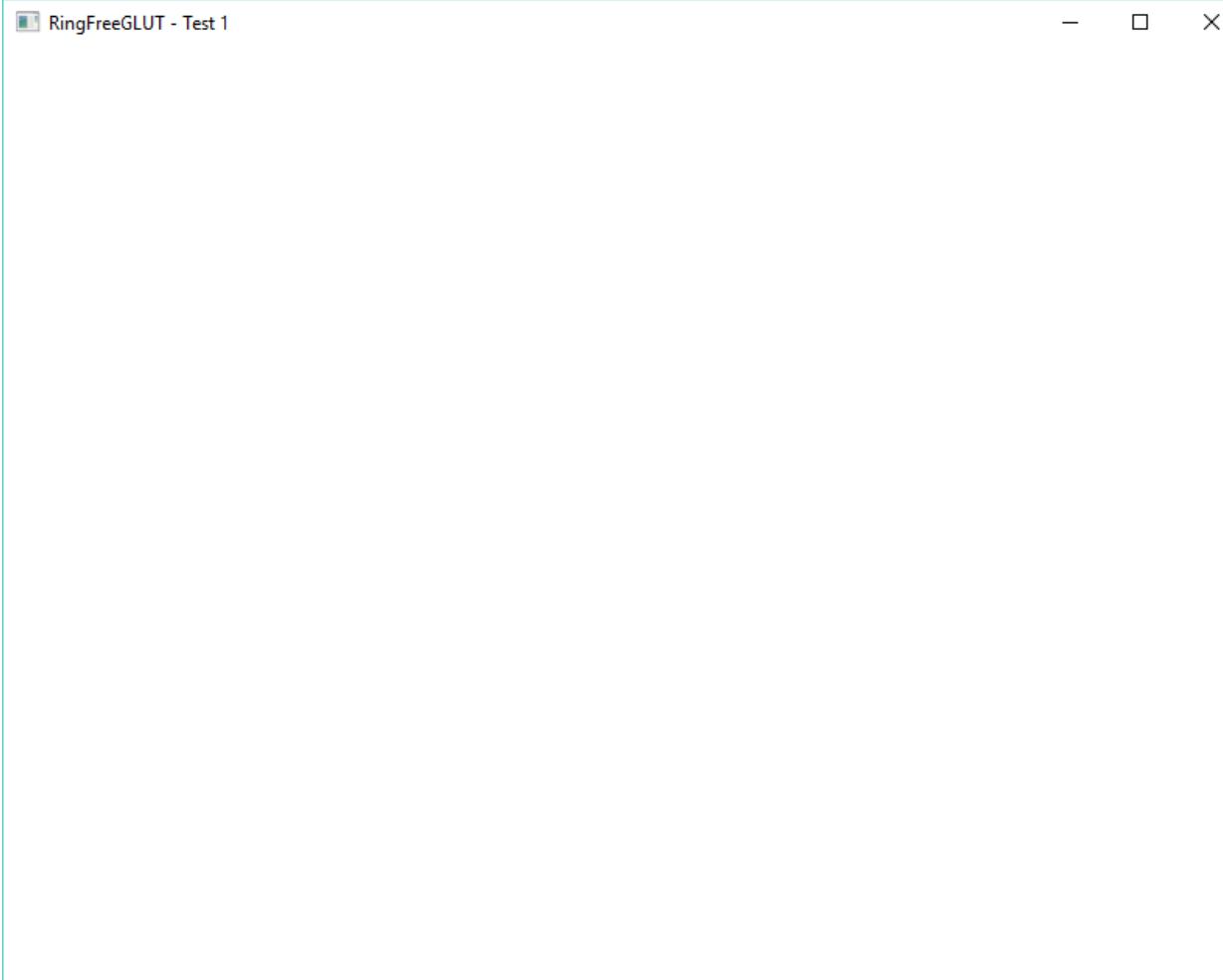
Example:

```
load "freeglut.ring"

func main
    glutInit()
    glutInitDisplayMode(GLUT_SINGLE)
    glutInitWindowSize(800, 600)
    glutInitWindowPosition(100, 10)
    glutCreateWindow("RingFreeGLUT - Test 1")
    glutDisplayFunc(:displayCode)
    glutMainLoop()

func displaycode
```

Screen Shot



58.5 Drawing using RingOpenGL

Example:

```
load "freenglut.ring"
load "opengl21lib.ring"

func main
    glutInit()
    glutInitDisplayMode(GLUT_SINGLE)
    glutInitWindowSize(800, 600)
    glutInitWindowPosition(100, 10)
    glutCreateWindow("RingFreeGLUT - Test 2")
    glutDisplayFunc(:displayCode)
    glutMainLoop()

func displayCode
    glClear(GL_COLOR_BUFFER_BIT)
    glColor3f(0, 255, 0)
```

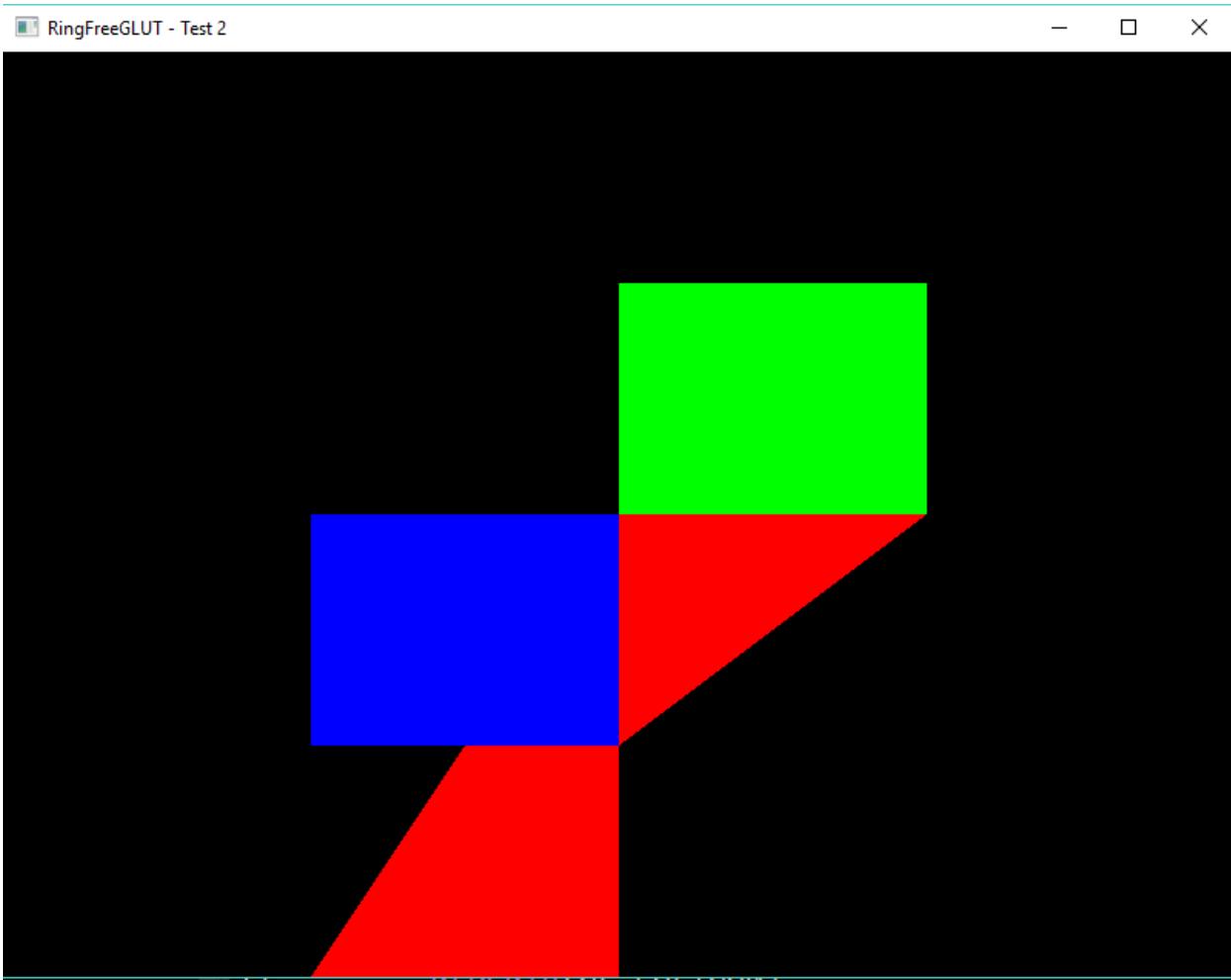
(continues on next page)

(continued from previous page)

```
glBegin(GL_POLYGON)
    glVertex3f(0.0, 0.0, 0.0)
    glVertex3f(0.5, 0.0, 0.0)
    glVertex3f(0.5, 0.5, 0.0)
    glVertex3f(0.0, 0.5, 0.0)
glEnd()
glColor3f(255,0,0)
glBegin(GL_POLYGON)
    glVertex3f(0.0, 0.0, 0.0)
    glVertex3f(0.5, 0.0, 0.0)
    glVertex3f(-0.5,- 1, 0.0)
    glVertex3f(0.0, -1, 0.0)
glEnd()
glColor3f(0,0,255)
glBegin(GL_POLYGON)
    glVertex3f(0.0, 0.0, 0.0)
    glVertex3f(-0.5, 0.0, 0.0)
    glVertex3f(-0.5,- 0.5, 0.0)
    glVertex3f(0.0, -0.5, 0.0)
glEnd()

glFlush()
```

Screen Shot



58.6 The First Triangle

Example:

```
load "freenglut.ring"
load "opengl21lib.ring"

func main
    glutInit()
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)
    glutInitWindowSize(320,320)
    glutInitWindowPosition(100, 10)
    glutCreateWindow("RingFreeGLUT - Test 3")
    glutDisplayFunc(:renderScene)
    glutMainLoop()

func renderScene

    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)
```

(continues on next page)

(continued from previous page)

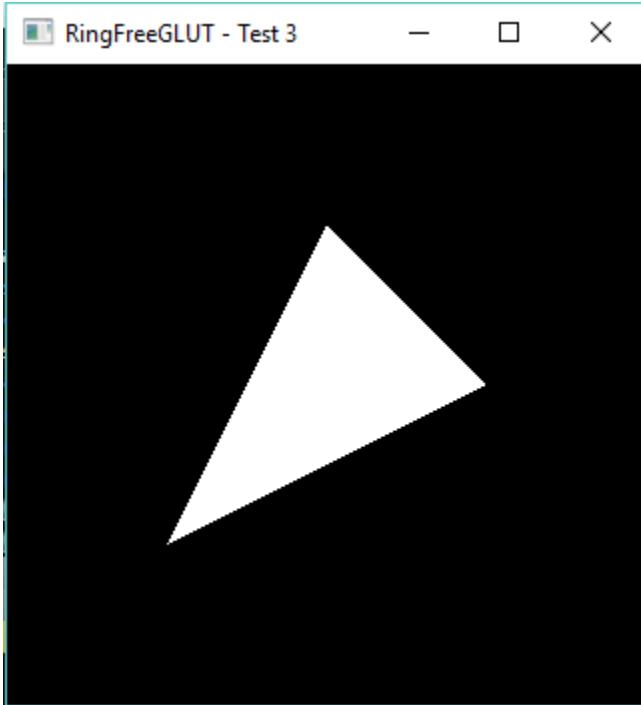
```

glBegin(GL_TRIANGLES)
    glVertex3f(-0.5,-0.5,0.0)
    glVertex3f(0.5,0.0,0.0)
    glVertex3f(0.0,0.5,0.0)
glEnd()

glutSwapBuffers()

```

Screen Shot



58.7 Window Resize Event

Example:

```

load "freenglut.ring"
load "opengl21lib.ring"

func main

    // init GLUT and create window
    glutInit()
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)
    glutInitWindowPosition(100,100)
    glutInitWindowSize(320,320)
    glutCreateWindow("RingFreeGLUT - Test 4")

    glutDisplayFunc(:renderScene)
    glutReshapeFunc(:changeSize)

```

(continues on next page)

(continued from previous page)

```

glutMainLoop()

func renderScene

    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

    glBegin(GL_TRIANGLES)
        glVertex3f(-2,-2,-5.0)
        glVertex3f(2,0.0,-5.0)
        glVertex3f(0.0,2,-5.0)
    glEnd()

    glutSwapBuffers()

func changesize

    h = glutEventHeight()
    w = glutEventWidth()

        // Prevent a divide by zero, when window is too short
        // (you cant make a window of zero width).
    if (h = 0)
        h = 1
    ok

    ratio = w * 1.0 / h

    // Use the Projection Matrix
    glMatrixMode(GL_PROJECTION)

    // Reset Matrix
    glLoadIdentity()

    // Set the viewport to be the entire window
    glViewport(0, 0, w, h)

    // Set the correct perspective.
    gluPerspective(45,ratio,1,100)

    // Get Back to the Modelview
    glMatrixMode(GL_MODELVIEW)

```

58.8 Triangle Rotation

Example:

```

load "freeglut.ring"
load "opengl21lib.ring"

angle = 0

func main

    // init GLUT and create window
    glutInit()
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)
    glutInitWindowPosition(100,100)
    glutInitWindowSize(320,320)
    glutCreateWindow("RingFreeGLUT - Test 5")

    glutDisplayFunc(:renderScene)
    glutReshapeFunc(:changeSize)
    glutIdleFunc(:renderScene)

    glutMainLoop()

func renderScene

    // Clear Color and Depth Buffers
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

    // Reset transformations
    glLoadIdentity()
    // Set the camera
    gluLookAt(      0.0, 0.0, 10.0,
                    0.0, 0.0, 0.0,
                    0.0, 1.0, 0.0)

    glRotatef(angle, 0.0, 1.0, 0.0)

    glBegin(GL_TRIANGLES)
        glVertex3f(-2.0,-2.0, 0.0)
        glVertex3f( 2.0, 0.0, 0.0)
        glVertex3f( 0.0, 2.0, 0.0)
    glEnd()

    angle+=0.1

    glutSwapBuffers();

func changesize

    h = glutEventHeight()
    w = glutEventWidth()

```

(continues on next page)

(continued from previous page)

```
// Prevent a divide by zero, when window is too short
// (you can't make a window of zero width).
if (h == 0)
    h = 1
ok

ratio = w * 1.0 / h

// Use the Projection Matrix
glMatrixMode(GL_PROJECTION)

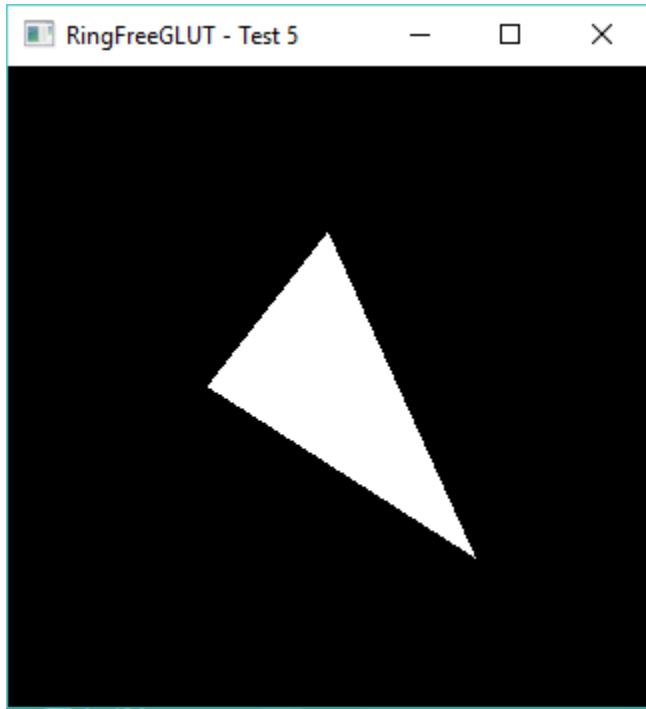
// Reset Matrix
glLoadIdentity()

// Set the viewport to be the entire window
glViewport(0, 0, w, h)

// Set the correct perspective.
gluPerspective(45, ratio, 1, 100)

// Get Back to the Modelview
glMatrixMode(GL_MODELVIEW)
```

Screen Shot



58.9 Keyboard Events and Colors

Example:

```

load "freeglut.ring"
load "opengl21lib.ring"

angle = 0

red=1.0
blue=1.0
green=1.0

func main

    // init GLUT and create window
    glutInit()
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)
    glutInitWindowPosition(100,100)
    glutInitWindowSize(320,320)
    glutCreateWindow("RingFreeGLUT - Test 6")

    glutDisplayFunc(:renderScene)
    glutReshapeFunc(:changeSize)
    glutIdleFunc(:renderScene)

    // here are the new entries
    glutKeyboardFunc(:processNormalKeys)
    glutSpecialFunc(:processSpecialKeys)

    glutMainLoop()

func renderScene

    // Clear Color and Depth Buffers
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

    // Reset transformations
    glLoadIdentity()
    // Set the camera
    gluLookAt(      0.0, 0.0, 10.0,
                  0.0, 0.0,  0.0,
                  0.0, 1.0,  0.0)

    glRotatef(angle, 0.0, 1.0, 0.0)

    glColor3f(red,green,blue);

    glBegin(GL_TRIANGLES)
        glVertex3f(-2.0,-2.0, 0.0)
        glVertex3f( 2.0, 0.0, 0.0)
        glVertex3f( 0.0, 2.0, 0.0)

```

(continues on next page)

(continued from previous page)

```

glEnd()

angle+=0.1

glutSwapBuffers();

func changesize

    h = glutEventHeight()
    w = glutEventWidth()

        // Prevent a divide by zero, when window is too short
        // (you cant make a window of zero width).
    if (h = 0)
        h = 1
    ok

    ratio = w * 1.0 / h

    // Use the Projection Matrix
    glMatrixMode(GL_PROJECTION)

    // Reset Matrix
    glLoadIdentity()

    // Set the viewport to be the entire window
    glViewport(0, 0, w, h)

    // Set the correct perspective.
    gluPerspective(45,ratio,1,100)

    // Get Back to the Modelview
    glMatrixMode(GL_MODELVIEW)

func processNormalKeys
    key = GLUTEventKey()
    if key = 27
        shutdown()
    ok

func processSpecialKeys

    key = GLUTEventKey()

    switch key
        on GLUT_KEY_F1
            red = 1.0
            green = 0.0
            blue = 0.0
        on GLUT_KEY_F2
            red = 0.0
            green = 1.0

```

(continues on next page)

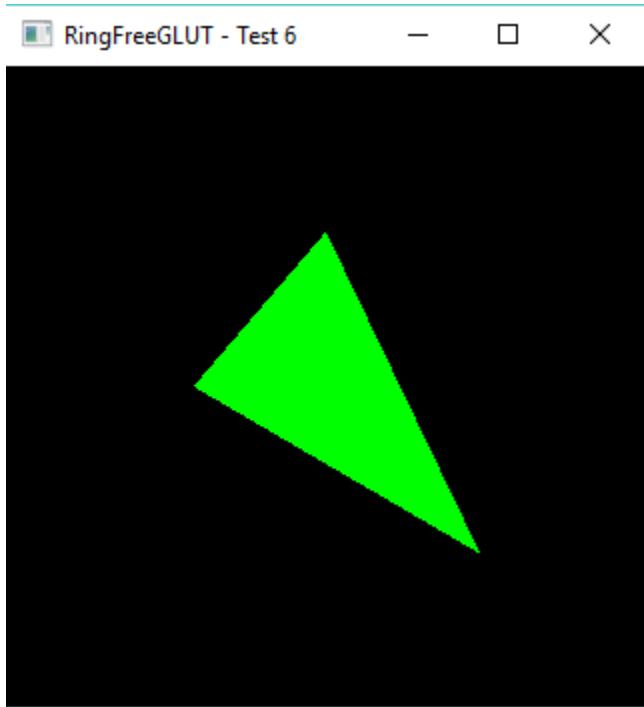
(continued from previous page)

```

        blue = 0.0
on GLUT_KEY_F3
        red = 0.0
        green = 0.0
        blue = 1.0
off

```

Screen Shot



58.10 The Camera

Example:

```

load "freeglut.ring"
load "opengl21lib.ring"

// angle of rotation for the camera direction
angle=0.0
// actual vector representing the camera's direction
lx=0.0
lz=-1.0
// XZ position of the camera
x=0.0
z=5.0

func drawSnowMan

    glColor3f(1.0, 1.0, 1.0)

```

(continues on next page)

(continued from previous page)

```

// Draw Body
    glTranslatef(0.0 ,0.75, 0.0)
    glutSolidSphere(0.75,20,20)

// Draw Head
    glTranslatef(0.0, 1.0, 0.0)
    glutSolidSphere(0.25,20,20)

// Draw Eyes
    glPushMatrix()
    glColor3f(0.0,0.0,0.0)
    glTranslatef(0.05, 0.10, 0.18)
    glutSolidSphere(0.05,10,10)
    glTranslatef(-0.1, 0.0, 0.0)
    glutSolidSphere(0.05,10,10)

    glPopMatrix()

// Draw Nose
    glColor3f(1.0, 0.5 , 0.5)
    glutSolidCone(0.08,0.5,10,2)

func changeSize
    w = glutEventWidth()
    h = glutEventHeight()

    // Prevent a divide by zero, when window is too short
    // (you cant make a window of zero width).
    if h = 0
        h = 1
    ok

    ratio = w * 1.0 / h

        // Use the Projection Matrix
    glMatrixMode(GL_PROJECTION)

        // Reset Matrix
    glLoadIdentity()

    // Set the viewport to be the entire window
    glViewport(0, 0, w, h)

    // Set the correct perspective.
    gluPerspective(45.0, ratio, 0.1, 100.0);

    // Get Back to the Modelview
    glMatrixMode(GL_MODELVIEW)

```

(continues on next page)

(continued from previous page)

```

func processNormalKeys
    key = glutEventKey()

    if key = 27
        shutdown()
    ok

func renderScene

    // Clear Color and Depth Buffers
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

    // Reset transformations
    glLoadIdentity()
    // Set the camera
    gluLookAt(      x, 1.0, z,
                    x+lx, 1.0, z+lz,
                    0.0, 1.0, 0.0)

    // Draw ground
    glColor3f(0.9, 0.9, 0.9)
    glBegin(GL_QUADS)
        glVertex3f(-100.0, 0.0, -100.0)
        glVertex3f(-100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, -100.0)
    glEnd()

    // Draw 36 SnowMen
    for i = -3 to 2
        for j=-3 to 2
            glPushMatrix()
            glTranslatef(i*10.0, 0, j * 10.0)
            drawSnowMan()
            glPopMatrix()
        next
    next
    glutSwapBuffers()
}

func processSpecialKeys

    key = glutEventKey()

    fraction = 0.1

```

(continues on next page)

(continued from previous page)

```

switch key
    on GLUT_KEY_LEFT
        angle -= 0.01
        lx = sin(angle)
        lz = -cos(angle)
    on GLUT_KEY_RIGHT
        angle += 0.01
        lx = sin(angle)
        lz = -cos(angle)
    on GLUT_KEY_UP
        x += lx * fraction
        z += lz * fraction
    on GLUT_KEY_DOWN
        x -= lx * fraction
        z -= lz * fraction
off

func main

    // init GLUT and create window

    glutInit()
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)

    glutInitWindowPosition(100, 100)
    glutInitWindowSize(320, 320)
    glutCreateWindow("RingFreeGLUT - Test 7")

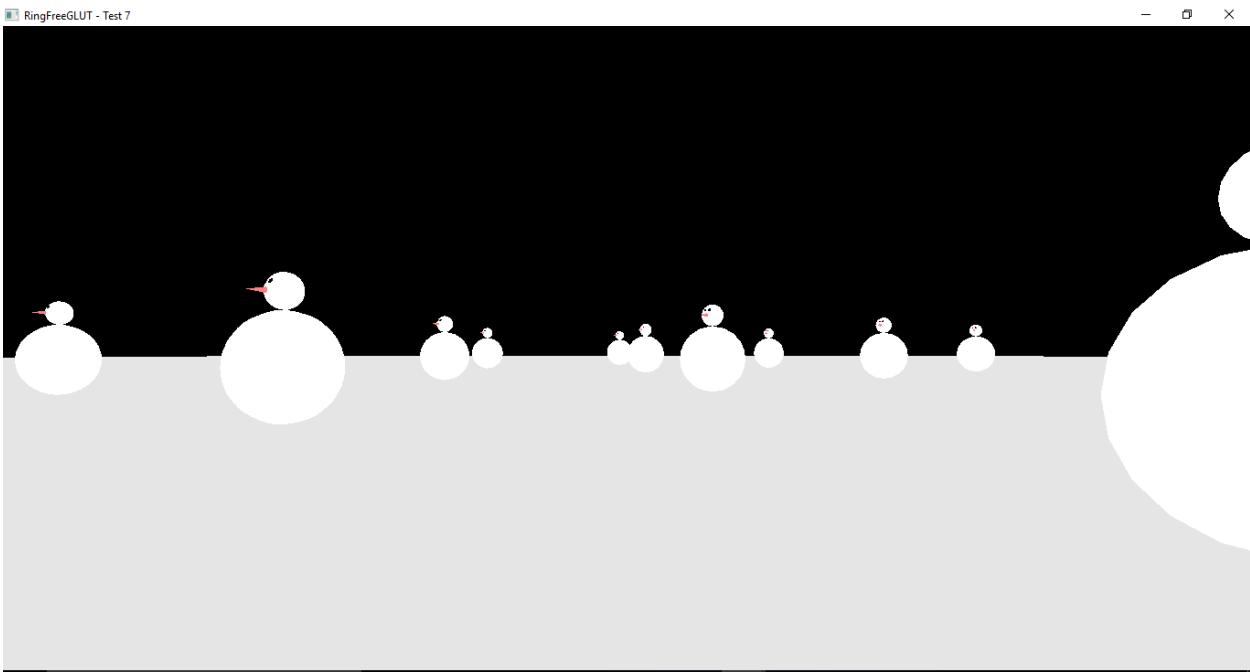
    // register callbacks
    glutDisplayFunc(:renderScene)
    glutReshapeFunc(:changeSize)
    glutIdleFunc(:renderScene)
    glutKeyboardFunc(:processNormalKeys)
    glutSpecialFunc(:processSpecialKeys)

    // OpenGL init
    glEnable(GL_DEPTH_TEST)

    // enter GLUT event processing cycle
    glutMainLoop()

```

Screen Shot



Another Example:

```

load "freeglut.ring"
load "opengl21lib.ring"

// angle of rotation for the camera direction
angle = 0.0

// actual vector representing the camera's direction
lx=0.0 lz=-1.0

// XZ position of the camera
x=0.0 z=5.0
// the key states. These variables will be zero
//when no key is being presses
deltaAngle = 0.0
deltaMove = 0

func changeSize
    w = glutEventWidth()
    h = glutEventHeight()

    // Prevent a divide by zero, when window is too short
    // (you cant make a window of zero width).
    if h = 0
        h = 1
    ok

    ratio = w * 1.0 / h

    // Use the Projection Matrix
    glMatrixMode(GL_PROJECTION)

```

(continues on next page)

(continued from previous page)

```

// Reset Matrix
glLoadIdentity()

// Set the viewport to be the entire window
glViewport(0, 0, w, h)

// Set the correct perspective.
gluPerspective(45.0, ratio, 0.1, 100.0)

// Get Back to the Modelview
glMatrixMode(GL_MODELVIEW)

func drawSnowMan

    glColor3f(1.0, 1.0, 1.0)

    // Draw Body

        glTranslatef(0.0 ,0.75, 0.0)
        glutSolidSphere(0.75,20,20)

    // Draw Head
        glTranslatef(0.0, 1.0, 0.0)
        glutSolidSphere(0.25,20,20)

    // Draw Eyes
        glPushMatrix()
        glColor3f(0.0,0.0,0.0)
        glTranslatef(0.05, 0.10, 0.18)
        glutSolidSphere(0.05,10,10)
        glTranslatef(-0.1, 0.0, 0.0)
        glutSolidSphere(0.05,10,10)
        glPopMatrix()

    // Draw Nose
        glColor3f(1.0, 0.5 , 0.5)
        glRotatef(0.0,1.0, 0.0, 0.0)
        glutSolidCone(0.08,0.5,10,2)

func computePos deltaMove

    x += deltaMove * lx * 0.1
    z += deltaMove * lz * 0.1

func computeDir deltaAngle

    angle += deltaAngle
    lx = sin(angle)

```

(continues on next page)

(continued from previous page)

```

lz = -cos(angle)

func renderScene

    if deltaMove
        computePos(deltaMove)
    ok

    if deltaAngle
        computeDir(deltaAngle)
    ok

    // Clear Color and Depth Buffers
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

    // Reset transformations
    glLoadIdentity()
    // Set the camera
    gluLookAt(      x, 1.0, z,
                    x+lx, 1.0, z+lz,
                    0.0, 1.0, 0.0)

    // Draw ground

    glColor3f(0.9, 0.9, 0.9)
    glBegin(GL_QUADS)
        glVertex3f(-100.0, 0.0, -100.0)
        glVertex3f(-100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, -100.0)
    glEnd()

    // Draw 36 SnowMen

    for i = -3 to 2
        for j=-3 to 2
            glPushMatrix()
            glTranslatef(i*10.0, 0, j * 10.0)
            drawSnowMan()
            glPopMatrix()
        next
    next
    glutSwapBuffers()
}

func pressKey
    key = glutEventKey()
    xx = glutEventX()
    yy = glutEventY()

    switch key
        on GLUT_KEY_LEFT

```

(continues on next page)

(continued from previous page)

```

        deltaAngle = -0.01
on GLUT_KEY_RIGHT
    deltaAngle = 0.01
on GLUT_KEY_UP
    deltaMove = 0.5
on GLUT_KEY_DOWN
    deltaMove = -0.5
off

func releaseKey

key = glutEventKey()

switch key
on GLUT_KEY_LEFT
    deltaAngle = 0.0
on GLUT_KEY_RIGHT
    deltaAngle = 0.0
on GLUT_KEY_UP
    deltaMove = 0
on GLUT_KEY_DOWN
    deltaMove = 0
off

func main

// init GLUT and create window
glutInit()
glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)
glutInitWindowPosition(100, 100)
glutInitWindowSize(320, 320)
glutCreateWindow("RingFreeGLUT - Test 8")

// register callbacks
glutDisplayFunc(:renderScene)
glutReshapeFunc(:changeSize)
glutIdleFunc(:renderScene)

glutSpecialFunc(:pressKey)

// here are the new entries
glutIgnoreKeyRepeat(1)
glutSpecialUpFunc(:releaseKey)

// OpenGL init
 glEnable(GL_DEPTH_TEST)

// enter GLUT event processing cycle
glutMainLoop()

```

58.11 Mouse Events

Example:

```

load "freeglut.ring"
load "opengl21lib.ring"

// angle of rotation for the camera direction
angle = 0.0

// actual vector representing the camera's direction
lx=0.0 lz=-1.0

// XZ position of the camera
x=0.0 z=5.0

// the key states. These variables will be zero
//when no key is being presses
deltaAngle = 0.0
deltaMove = 0.0
xOrigin = -1

func changeSize
    w = glutEventWidth()
    h = glutEventHeight()

    // Prevent a divide by zero, when window is too short
    // (you cant make a window of zero width).
    if h = 0
        h = 1
    ok

    ratio = w * 1.0 / h

    // Use the Projection Matrix
    glMatrixMode(GL_PROJECTION)

    // Reset Matrix
    glLoadIdentity()

    // Set the viewport to be the entire window
    glViewport(0, 0, w, h)

    // Set the correct perspective.
    gluPerspective(45.0, ratio, 0.1, 100.0)

    // Get Back to the Modelview
    glMatrixMode(GL_MODELVIEW)

func drawSnowMan

    glColor3f(1.0, 1.0, 1.0)

```

(continues on next page)

(continued from previous page)

```

// Draw Body
glTranslatef(0.0 ,0.75, 0.0)
glutSolidSphere(0.75,20,20)

// Draw Head
glTranslatef(0.0, 1.0, 0.0)
glutSolidSphere(0.25,20,20)

// Draw Eyes
glPushMatrix()
glColor3f(0.0,0.0,0.0)
glTranslatef(0.05, 0.10, 0.18)
glutSolidSphere(0.05,10,10)
glTranslatef(-0.1, 0.0, 0.0)
glutSolidSphere(0.05,10,10)
glPopMatrix()

// Draw Nose
glColor3f(1.0, 0.5 , 0.5)
glRotatef(0.0,1.0, 0.0, 0.0)
glutSolidCone(0.08,0.5,10,2)

func computePos deltaMove

x += deltaMove * lx * 0.1
z += deltaMove * lz * 0.1

func renderScene

if deltaMove
    computePos(deltaMove)
ok

// Clear Color and Depth Buffers
glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

// Reset transformations
glLoadIdentity()
// Set the camera
gluLookAt(      x, 1.0, z,
               x+lx, 1.0, z+lz,
               0.0, 1.0, 0.0)

// Draw ground

glColor3f(0.9, 0.9, 0.9)
glBegin(GL_QUADS)
    glVertex3f(-100.0, 0.0, -100.0)
    glVertex3f(-100.0, 0.0, 100.0)
    glVertex3f( 100.0, 0.0, 100.0)

```

(continues on next page)

(continued from previous page)

```

        glVertex3f( 100.0, 0.0, -100.0)
glEnd()

// Draw 36 SnowMen

for i = -3 to 2
    for j=-3 to 2
        glPushMatrix()
        glTranslatef(i*10.0,0,j * 10.0)
        drawSnowMan()
        glPopMatrix()
    next
next
glutSwapBuffers()

func processNormalKeys

    key = glutEventKey()

    if key = 27
        shutdown()
    ok

func pressKey
    key = glutEventKey()

    switch key
        on GLUT_KEY_UP
            deltaMove = 0.5
        on GLUT_KEY_DOWN
            deltaMove = -0.5
    off

func releaseKey
    key = glutEventKey()
    switch key
        on GLUT_KEY_UP
            deltaMove = 0
        on GLUT_KEY_DOWN
            deltaMove = 0
    off

func mouseMove
    xx = glutEventX()
    yy = glutEventY()
        // this will only be true when the left button is down
    if xOrigin >= 0

        // update deltaAngle

```

(continues on next page)

(continued from previous page)

```

deltaAngle = (xx - xOrigin) * 0.001

    // update camera's direction
    lx = sin(angle + deltaAngle)
    lz = -cos(angle + deltaAngle)
ok

func mouseButton

    button = glutEventButton()
    state = glutEventState()
    xx = glutEventX()
    yy = glutEventY()

    // only start motion if the left button is pressed
    if button = GLUT_LEFT_BUTTON
        // when the button is released
        if state = GLUT_UP
            angle += deltaAngle
            xOrigin = -1
        else
            // state = GLUT_DOWN
            xOrigin = xx
        ok
        fflush(stdout)
ok

func main

    // init GLUT and create window
    glutInit()
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)
    glutInitWindowPosition(100,100)
    glutInitWindowSize(320,320)
    glutCreateWindow("RingFreeGLUT - Test 9")

    // register callbacks
    glutDisplayFunc(:renderScene)
    glutReshapeFunc(:changeSize)
    glutIdleFunc(:renderScene)

    glutIgnoreKeyRepeat(1)
    glutKeyboardFunc(:processNormalKeys)
    glutSpecialFunc(:pressKey)
    glutSpecialUpFunc(:releaseKey)

    // here are the two new functions
    glutMouseFunc(:mouseButton)
    glutMotionFunc(:mouseMove)

```

(continues on next page)

(continued from previous page)

```
// OpenGL init
glEnable(GL_DEPTH_TEST)

// enter GLUT event processing cycle
	glutMainLoop()
```

58.12 Menu Events

Example:

```
load "freeglut.ring"
load "opengl21lib.ring"

// angle of rotation for the camera direction
angle = 0.0

// actual vector representing the camera's direction
lx=0.0 lz=-1.0

// XZ position of the camera
x=0.0 z=5.0

// the key states. These variables will be zero
//when no key is being presses
deltaAngle = 0.0
deltaMove = 0
xOrigin = -1

// Constant definitions for Menus

// for RingFreeGLUT - We must have different ID for each menu item
C_RED = 1
C_GREEN = 2
C_BLUE = 3
C_ORANGE = 4

C_FILL = 5
C_LINE = 6

C_SHRINK = 7
C_NORMAL = 8

// Pop up menu identifiers
fillMenu= 0
shrinkMenu= 0
mainMenu=0
colorMenu=0
```

(continues on next page)

(continued from previous page)

```

// color for the nose
red = 1.0  blue=0.5  green=0.5

// scale of snowman
scale = 1.0

// menu status
menuFlag = 0

func changeSize
    w = glutEventWidth()
    h = glutEventHeight()

    // Prevent a divide by zero, when window is too short
    // (you cant make a window of zero width).
    if h = 0
        h = 1
    ok

    ratio = w * 1.0 / h

    // Use the Projection Matrix
    glMatrixMode(GL_PROJECTION)

    // Reset Matrix
    glLoadIdentity()

    // Set the viewport to be the entire window
    glViewport(0, 0, w, h)

    // Set the correct perspective.
    gluPerspective(45.0, ratio, 0.1, 100.0)

    // Get Back to the Modelview
    glMatrixMode(GL_MODELVIEW)

func drawSnowMan

    glScalef(scale, scale, scale)
    glColor3f(1.0, 1.0, 1.0)

    // Draw Body
    glTranslatef(0.0 ,0.75, 0.0)
    glutSolidSphere(0.75,20,20)

    // Draw Head
    glTranslatef(0.0, 1.0, 0.0)
    glutSolidSphere(0.25,20,20)

    // Draw Eyes
    glPushMatrix()
    glColor3f(0.0,0.0,0.0)

```

(continues on next page)

(continued from previous page)

```

glTranslatef(0.05, 0.10, 0.18)
glutSolidSphere(0.05,10,10)
glTranslatef(-0.1, 0.0, 0.0)
glutSolidSphere(0.05,10,10)
glPopMatrix()

// Draw Nose
	glColor3f(red, green, blue)
	glRotatef(0.0,1.0, 0.0, 0.0)
	glutSolidCone(0.08,0.5,10,2)

	glColor3f(1.0, 1.0, 1.0)

func computePos deltaMove

    x += deltaMove * lx * 0.1
    z += deltaMove * lz * 0.1

func renderScene

    if deltaMove
        computePos(deltaMove)
    ok

    // Clear Color and Depth Buffers
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

    // Reset transformations
    glLoadIdentity()
    // Set the camera
    gluLookAt(      x, 1.0, z,
                    x+lx, 1.0, z+lz,
                    0.0, 1.0, 0.0)

    // Draw ground

    glColor3f(0.9, 0.9, 0.9)
    glBegin(GL_QUADS)
        glVertex3f(-100.0, 0.0, -100.0)
        glVertex3f(-100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, -100.0)
    glEnd()

    // Draw 36 SnowMen

    for i = -3 to 2
        for j = -3 to 2
            glPushMatrix()
            glTranslatef(i*10.0, 0.0, j * 10.0)

```

(continues on next page)

(continued from previous page)

```

        drawSnowMan()
        glPopMatrix()

    next
next
glutSwapBuffers()

// -----
//           KEYBOARD
// -----


func processNormalKeys
    key = glutEventKey()
    xx = glutEventX()
    yy = glutEventY()

    glutSetMenu(mainMenu)
    switch key
        on 27
            glutDestroyMenu(mainMenu)
            glutDestroyMenu(fillMenu)
            glutDestroyMenu(colorMenu)
            glutDestroyMenu(shrinkMenu)
            shutdown()

        on 's'
            if not menuFlag
                glutChangeToSubMenu(2, "Shrink", shrinkMenu)
            ok
        on 'c'
            if not menuFlag
                glutChangeToSubMenu(2, "Color", colorMenu)
            ok

        off
        if key = 27
            shutdown()
        ok

func pressKey

    key = glutEventKey()
    xx = glutEventX()
    yy = glutEventY()

    switch key
        on GLUT_KEY_UP
            deltaMove = 0.5
        on GLUT_KEY_DOWN
            deltaMove = -0.5
    off

```

(continues on next page)

(continued from previous page)

```

func releaseKey

    key = glutEventKey()

    switch key
        on GLUT_KEY_UP
            deltaMove = 0
        on GLUT_KEY_DOWN
            deltaMove = 0
    off

<-- -----
//           MOUSE
-- -->

func mouseMove
    xx = glutEventX()
    yy = glutEventY()

    // this will only be true when the left button is down
    if xOrigin >= 0

        // update deltaAngle
        deltaAngle = (xx - xOrigin) * 0.001

        // update camera's direction
        lx = sin(angle + deltaAngle)
        lz = -cos(angle + deltaAngle)
    ok

func mouseButton

    button = glutEventButton()
    state = glutEventState()
    xx = glutEventX()
    yy = glutEventY()

    // only start motion if the left button is pressed
    if button = GLUT_LEFT_BUTTON
        // when the button is released
        if state = GLUT_UP
            angle += deltaAngle
            xOrigin = -1
        else
            // state = GLUT_DOWN
            xOrigin = xx
    ok

```

(continues on next page)

(continued from previous page)

```

// -----
//          MENUS
// -----


func processMenuStatus

    status = glutEventStatus()
    xx = glutEventX()
    yy = glutEventY()

    if  status = GLUT_MENU_IN_USE
        menuFlag = 1
    else
        menuFlag = 0
    ok


func processMainMenu

    // nothing to do in here
    // all actions are for submenus


func processFillMenu

    option = glutEventValue()

    switch option

        on C_FILL
            glPolygonMode(GL_FRONT, GL_FILL)
        on C_LINE
            glPolygonMode(GL_FRONT, GL_LINE)
    off


func processShrinkMenu

    option = glutEventValue()

    switch option

        on C_SHRINK
            scale = 0.5
        on C_NORMAL
            scale = 1.0
    off


func processColorMenu

```

(continues on next page)

(continued from previous page)

```

option = glutEventValue()

switch option
    on C_RED
        red = 1.0
        green = 0.0
        blue = 0.0
    on C_GREEN
        red = 0.0
        green = 1.0
        blue = 0.0
    on C_BLUE
        red = 0.0
        green = 0.0
        blue = 1.0
    on C_ORANGE
        red = 1.0
        green = 0.5
        blue = 0.5
off

func createPopupMenu

    shrinkMenu = glutCreateMenu(:processShrinkMenu)

    glutAddMenuEntry("Shrink",C_SHRINK)
    glutAddMenuEntry("NORMAL",C_NORMAL)

    fillMenu = glutCreateMenu(:processFillMenu)

    glutAddMenuEntry("Fill",C_FILL)
    glutAddMenuEntry("Line",C_LINE)

    colorMenu = glutCreateMenu(:processColorMenu)
    glutAddMenuEntry("Red",C_RED)
    glutAddMenuEntry("Blue",C_BLUE)
    glutAddMenuEntry("Green",C_GREEN)
    glutAddMenuEntry("Orange",C_ORANGE)

    mainMenu = glutCreateMenu(:processMainMenu)

    glutAddSubMenu("Polygon Mode", fillMenu)
    glutAddSubMenu("Color", colorMenu)
    // attach the menu to the right button
    glutAttachMenu(GLUT_RIGHT_BUTTON)

    // this will allow us to know if the menu is active
    glutMenuStatusFunc(:processMenuStatus)

// -----

```

(continues on next page)

(continued from previous page)

```
//      MAIN
// -----
func main

    // init GLUT and create window
    glutInit()
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)
    glutInitWindowPosition(100,100)
    glutInitWindowSize(320,320)
    glutCreateWindow("RingFreeGLUT - Test 10")

    // register callbacks
    glutDisplayFunc(:renderScene)
    glutReshapeFunc(:changeSize)
    glutIdleFunc(:renderScene)

    glutIgnoreKeyRepeat(1)
    glutKeyboardFunc(:processNormalKeys)
    glutSpecialFunc(:pressKey)
    glutSpecialUpFunc(:releaseKey)

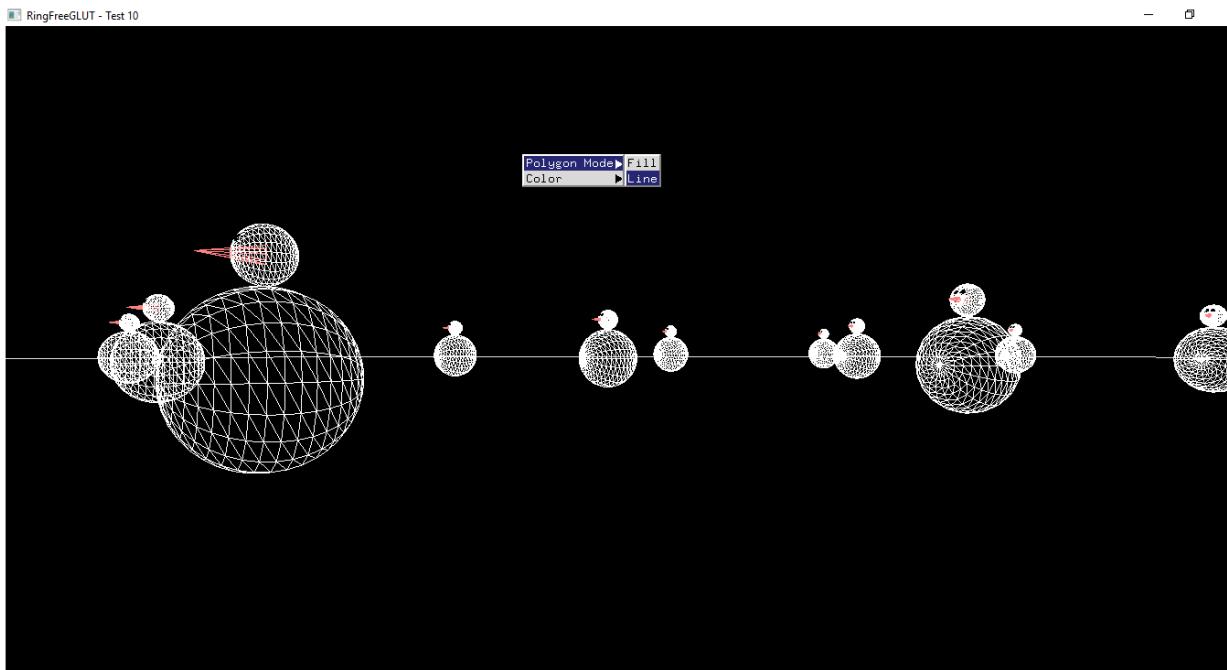
    // here are the two new functions
    glutMouseFunc(:mouseButton)
    glutMotionFunc(:mouseMove)

    // OpenGL init
    glEnable(GL_DEPTH_TEST)
    glEnable(GL_CULL_FACE)

    // init Menus
    createPopupMenus()

    // enter GLUT event processing cycle
    glutMainLoop()
```

Screen Shot



58.13 Using Fonts

Example:

```

load "freetype.ring"
load "opengl21lib.ring"

// angle of rotation for the camera direction
angle = 0.0

// actual vector representing the camera's direction
lx=0.0 lz=-1.0

// XZ position of the camera
x=0.0 z=5.0

// the key states. These variables will be zero
// when no key is being pressed
deltaAngle = 0.0
deltaMove = 0
x0rigin = -1

// Constant definitions for Menus
C_RED = 1
C_GREEN = 2
C_BLUE = 3
C_ORANGE = 4

C_FILL = 5

```

(continues on next page)

(continued from previous page)

```

C_LINE = 6

// Pop up menu identifiers
fillMenu=NULL
fontMenu=NULL
mainMenu=NULL
colorMenu=NULL

// color for the nose
red = 1.0
blue=0.5
green=0.5

// scale of snowman
scale = 1.0

// menu status
menuFlag = 0

// default font
font = GLUT_BITMAP_TIMES_ROMAN_24

C_INT GLUT_BITMAP_8_BY_13 = 7
C_INT GLUT_BITMAP_9_BY_15 = 8
C_INT GLUT_BITMAP_TIMES_ROMAN_10 = 9
C_INT GLUT_BITMAP_TIMES_ROMAN_24 = 10
C_INT GLUT_BITMAP_HELVETICA_10 = 11
C_INT GLUT_BITMAP_HELVETICA_12 = 12
C_INT GLUT_BITMAP_HELVETICA_18 = 13

func changeSize
    w = glutEventWidth()
    h = glutEventHeight()

        // Prevent a divide by zero, when window is too short
        // (you cant make a window of zero width).
        if h = 0
            h = 1
        ok

        ratio = w * 1.0 / h

        // Use the Projection Matrix
        glMatrixMode(GL_PROJECTION)

        // Reset Matrix
        glLoadIdentity()

        // Set the viewport to be the entire window
        glViewport(0, 0, w, h)

        // Set the correct perspective.

```

(continues on next page)

(continued from previous page)

```

gluPerspective(45.0, ratio, 0.1, 100.0)

// Get Back to the Modelview
glMatrixMode(GL_MODELVIEW)

```

```
func drawSnowMan
```

```

glScalef(scale, scale, scale)
glColor3f(1.0, 1.0, 1.0)

// Draw Body
glTranslatef(0.0, 0.75, 0.0)
glutSolidSphere(0.75, 20, 20)

// Draw Head
glTranslatef(0.0, 1.0, 0.0)
glutSolidSphere(0.25, 20, 20)

// Draw Eyes
glPushMatrix()
glColor3f(0.0, 0.0, 0.0)
glTranslatef(0.05, 0.10, 0.18)
glutSolidSphere(0.05, 10, 10)
glTranslatef(-0.1, 0.0, 0.0)
glutSolidSphere(0.05, 10, 10)
glPopMatrix()

```

```

// Draw Nose
glColor3f(red, green, blue)
glRotatef(0.0, 1.0, 0.0, 0.0)
glutSolidCone(0.08, 0.5, 10, 2)

glColor3f(1.0, 1.0, 1.0)

```

```
func renderBitmapString x,y,z,font,string
    glRasterPos3f(x, y, z)
    for c in string
        glutBitmapCharacter(font, ascii(c))
    next
```

```
func computePos deltaMove
```

```

x += deltaMove * lx * 0.1
z += deltaMove * lz * 0.1

```

```
func renderScene
```

```

if deltaMove
    computePos(deltaMove)
ok
```

(continues on next page)

(continued from previous page)

```

// Clear Color and Depth Buffers
glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

// Reset transformations
glLoadIdentity()

// Set the camera
gluLookAt(      x, 1.0, z,
                 x+lx, 1.0, z+lz,
                 0.0, 1.0, 0.0)

// Draw ground

glColor3f(0.9, 0.9, 0.9)
glBegin(GL_QUADS)
    glVertex3f(-100.0, 0.0, -100.0)
    glVertex3f(-100.0, 0.0, 100.0)
    glVertex3f( 100.0, 0.0, 100.0)
    glVertex3f( 100.0, 0.0, -100.0)
glEnd()

// Draw 36 SnowMen
for i = -3 to 2
    for j = -3 to 2
        glPushMatrix()
        glTranslatef(i*10.0, 0.0, j * 10.0)
        drawSnowMan()
        number = (i+3)*6+(j+3)
        renderBitmapString(0.0, 0.5, 0.0, font ,""+number)
        glPopMatrix()
    next
next

glutSwapBuffers()

// -----
//          KEYBOARD
// -----


func processNormalKeys
    key = glutEventKey()
    xx = glutEventX()
    yy = glutEventY()

    switch key
        on 27
            glutDestroyMenu(mainMenu)
            glutDestroyMenu(fillMenu)
            glutDestroyMenu(colorMenu)
            glutDestroyMenu(fontMenu)

```

(continues on next page)

(continued from previous page)

```

        Shutdown()
off

func pressKey

    key = glutEventKey()
    xx = glutEventX()
    yy = glutEventY()

    switch key
        on GLUT_KEY_UP
            deltaMove = 0.5
        on GLUT_KEY_DOWN
            deltaMove = -0.5
    off

func releaseKey

    key = glutEventKey()

    switch key
        on GLUT_KEY_UP
            deltaMove = 0
        on GLUT_KEY_DOWN
            deltaMove = 0
    off

// -----
//          MOUSE
// -----


func mouseMove
    xx = glutEventX()
    yy = glutEventY()

    // this will only be true when the left button is down
    if xOrigin >= 0

        // update deltaAngle
        deltaAngle = (xx - xOrigin) * 0.001

        // update camera's direction
        lx = sin(angle + deltaAngle)
        lz = -cos(angle + deltaAngle)
    ok

func mouseButton

```

(continues on next page)

(continued from previous page)

```

button = glutEventButton()
state = glutEventState()
xx = glutEventX()
yy = glutEventY()

// only start motion if the left button is pressed
if button == GLUT_LEFT_BUTTON
    // when the button is released
    if state == GLUT_UP
        angle += deltaAngle
        xOrigin = -1
    else
        // state == GLUT_DOWN
        xOrigin = xx
    ok
ok

// -----
//      MENUS
// -----


func processMenuStatus

    status = glutEventStatus()

    if status == GLUT_MENU_IN_USE
        menuFlag = 1
    else
        menuFlag = 0
    ok


func processMainMenu

    // nothing to do in here
    // all actions are for submenus


func processFillMenu

    option = glutEventValue()

    switch option

        on C_FILL
            glPolygonMode(GL_FRONT, GL_FILL)
        on C_LINE
            glPolygonMode(GL_FRONT, GL_LINE)
    off

```

(continues on next page)

(continued from previous page)

func processFontMenu

```

        option = glutEventValue()

    switch (option) {
        on C_INT GLUT_BITMAP_8_BY_13
            font = GLUT_BITMAP_8_BY_13
        on C_INT GLUT_BITMAP_9_BY_15
            font = GLUT_BITMAP_9_BY_15
        on C_INT GLUT_BITMAP_TIMES_ROMAN_10
            font = GLUT_BITMAP_TIMES_ROMAN_10
        on C_INT GLUT_BITMAP_TIMES_ROMAN_24
            font = GLUT_BITMAP_TIMES_ROMAN_24
        on C_INT GLUT_BITMAP_HELVETICA_10
            font = GLUT_BITMAP_HELVETICA_10
        on C_INT GLUT_BITMAP_HELVETICA_12
            font = GLUT_BITMAP_HELVETICA_12
        on C_INT GLUT_BITMAP_HELVETICA_18
            font = GLUT_BITMAP_HELVETICA_18
    off

```

func processColorMenu

```

        option = glutEventValue()

    switch option
        on C_RED
            red = 1.0
            green = 0.0
            blue = 0.0
        on C_GREEN
            red = 0.0
            green = 1.0
            blue = 0.0
        on C_BLUE
            red = 0.0
            green = 0.0
            blue = 1.0
        on C_ORANGE
            red = 1.0
            green = 0.5
            blue = 0.5
    off

```

func createPopupMenu

```

        fontMenu = glutCreateMenu(:processFontMenu)

        glutAddMenuEntry("BITMAP_8_BY_13 ",C_INT GLUT_BITMAP_8_BY_13 )
        glutAddMenuEntry("BITMAP_9_BY_15 ",C_INT GLUT_BITMAP_9_BY_15 )
        glutAddMenuEntry("BITMAP_TIMES_ROMAN_10 ",C_INT GLUT_BITMAP_TIMES_ROMAN_10 )

```

(continues on next page)

(continued from previous page)

```

glutAddMenuEntry("BITMAP_TIMES_ROMAN_24",C_INT GLUT_BITMAP_TIMES_ROMAN_24 )
glutAddMenuEntry("BITMAP_HELVETICA_10 ",C_INT GLUT_BITMAP_HELVETICA_10 )
glutAddMenuEntry("BITMAP_HELVETICA_12 ",C_INT GLUT_BITMAP_HELVETICA_12 )
glutAddMenuEntry("BITMAP_HELVETICA_18 ",C_INT GLUT_BITMAP_HELVETICA_18 )

fillMenu = glutCreateMenu(:processFillMenu)

glutAddMenuEntry("Fill",C_FILL)
glutAddMenuEntry("Line",C_LINE)

colorMenu = glutCreateMenu(:processColorMenu)
glutAddMenuEntry("Red",C_RED);
glutAddMenuEntry("Blue",C_BLUE);
glutAddMenuEntry("Green",C_GREEN);
glutAddMenuEntry("Orange",C_ORANGE);

mainMenu = glutCreateMenu(:processMainMenu)

glutAddSubMenu("Polygon Mode", fillMenu)
glutAddSubMenu("Color", colorMenu)
glutAddSubMenu("Font", fontMenu)
// attach the menu to the right button
glutAttachMenu(GLUT_RIGHT_BUTTON)

// this will allow us to know if the menu is active
glutMenuStatusFunc(:processMenuStatus)

// -----
//      MAIN
// -----


func main

    // init GLUT and create window
    glutInit()
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)
    glutInitWindowPosition(100,100)
    glutInitWindowSize(320,320)
    glutCreateWindow("RingFreeGLUT - Test 11")

    // register callbacks
    glutDisplayFunc(:renderScene)
    glutReshapeFunc(:changeSize)
    glutIdleFunc(:renderScene)

    glutIgnoreKeyRepeat(1)
    glutKeyboardFunc(:processNormalKeys)
    glutSpecialFunc(:pressKey)
    glutSpecialUpFunc(:releaseKey)

    // here are the two new functions

```

(continues on next page)

(continued from previous page)

```

glutMouseFunc(:mouseButton)
glutMotionFunc(:mouseMove)

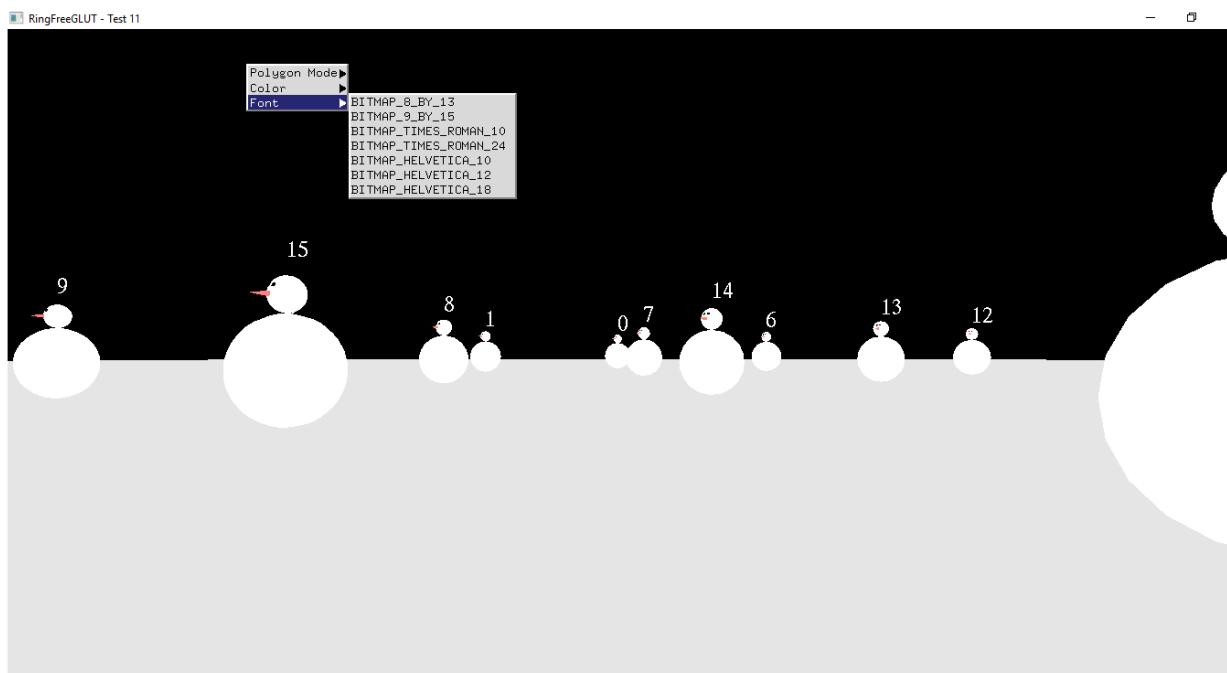
// OpenGL init
glEnable(GL_DEPTH_TEST)
glEnable(GL_CULL_FACE)

// init Menus
createPopupMenus()

// enter GLUT event processing cycle
glutMainLoop()

```

Screen Shot



58.14 Frames Per Second

Example

```

load "freeglut.ring"
load "opengl21lib.ring"

// angle of rotation for the camera direction
angle = 0.0

// actual vector representing the camera's direction
lx=0.0 lz=-1.0

// XZ position of the camera

```

(continues on next page)

(continued from previous page)

```

x=0.0  z=5.0

// the key states. These variables will be zero
//when no key is being presses
deltaAngle = 0.0
deltaMove = 0
xOrigin = -1

// Constant definitions for Menus
C_RED = 1
C_GREEN = 2
C_BLUE = 3
C_ORANGE = 4

C_FILL = 5
C_LINE = 6

// Pop up menu identifiers
fillMenu=NULL
fontMenu=NULL
mainMenu=NULL
colorMenu=NULL

// color for the nose
red = 1.0
blue=0.5
green=0.5

// scale of snowman
scale = 1.0

// menu status
menuFlag = 0

// default font
font = GLUT_BITMAP_TIMES_ROMAN_24

C_INT GLUT_BITMAP_8_BY_13 = 7
C_INT GLUT_BITMAP_9_BY_15 = 8
C_INT GLUT_BITMAP_TIMES_ROMAN_10 = 9
C_INT GLUT_BITMAP_TIMES_ROMAN_24 = 10
C_INT GLUT_BITMAP_HELVETICA_10 = 11
C_INT GLUT_BITMAP_HELVETICA_12 = 12
C_INT GLUT_BITMAP_HELVETICA_18 = 13

// width and height of the window
h = 0
w = 0

// variables to compute frames per second
frame=0
time=0

```

(continues on next page)

(continued from previous page)

```

timebase=0
s = ""

func changeSize
    w = glutEventWidth()
    h = glutEventHeight()

    // Prevent a divide by zero, when window is too short
    // (you cant make a window of zero width).
    if h = 0
        h = 1
    ok

    ratio = w * 1.0 / h

    // Use the Projection Matrix
    glMatrixMode(GL_PROJECTION)

    // Reset Matrix
    glLoadIdentity()

    // Set the viewport to be the entire window
    glViewport(0, 0, w, h)

    // Set the correct perspective.
    gluPerspective(45.0, ratio, 0.1, 100.0)

    // Get Back to the Modelview
    glMatrixMode(GL_MODELVIEW)

func drawSnowMan

    glScalef(scale, scale, scale)
    glColor3f(1.0, 1.0, 1.0)

    // Draw Body
    glTranslatef(0.0, 0.75, 0.0)
    glutSolidSphere(0.75, 20, 20)

    // Draw Head
    glTranslatef(0.0, 1.0, 0.0)
    glutSolidSphere(0.25, 20, 20)

    // Draw Eyes
    glPushMatrix()
    glColor3f(0.0, 0.0, 0.0)
    glTranslatef(0.05, 0.10, 0.18)
    glutSolidSphere(0.05, 10, 10)
    glTranslatef(-0.1, 0.0, 0.0)
    glutSolidSphere(0.05, 10, 10)
    glPopMatrix()

```

(continues on next page)

(continued from previous page)

```

// Draw Nose
    glColor3f(red, green, blue)
    glRotatef(0.0, 1.0, 0.0, 0.0)
    glutSolidCone(0.08, 0.5, 10, 2)

    glColor3f(1.0, 1.0, 1.0)

func renderBitmapString x,y,z,font,string
    glRasterPos3f(x, y, z)
    for c in string
        glutBitmapCharacter(font, ascii(c))
    next

func renderStrokeFontString x,y,z,font,string
    glPushMatrix()
    glTranslatef(x, y, z)
    glScalef(0.002, 0.002, 0.002)
    for c in string
        glutStrokeCharacter(font, Ascii(c));
    next
    glPopMatrix()

func restorePerspectiveProjection

    glMatrixMode(GL_PROJECTION)
    // restore previous projection matrix
    glPopMatrix()

    // get back to modelview mode
    glMatrixMode(GL_MODELVIEW)

func setOrthographicProjection

    // switch to projection mode
    glMatrixMode(GL_PROJECTION)

    // save previous matrix which contains the
    //settings for the perspective projection
    glPushMatrix()

    // reset matrix
    glLoadIdentity()

    // set a 2D orthographic projection
    gluOrtho2D(0, w, h, 0)

    // switch back to modelview mode
    glMatrixMode(GL_MODELVIEW)

```

(continues on next page)

(continued from previous page)

```

func computePos deltaMove

    x += deltaMove * lx * 0.1
    z += deltaMove * lz * 0.1


func renderScene

    if deltaMove
        computePos(deltaMove)
    ok

    // Clear Color and Depth Buffers
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

    // Reset transformations
    glLoadIdentity()

    // Set the camera
    gluLookAt(      x, 1.0, z,
                    x+lx, 1.0, z+lz,
                    0.0, 1.0, 0.0)

    // Draw ground

    glColor3f(0.9, 0.9, 0.9)
    glBegin(GL_QUADS)
        glVertex3f(-100.0, 0.0, -100.0)
        glVertex3f(-100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, -100.0)
    glEnd()

    // Draw 9 SnowMen
    for i = -3 to -1
        for j = -3 to -1
            glPushMatrix()
            glTranslatef(i*10.0, 0.0, j * 10.0)
            drawSnowMan()
            number = (i+3)*3+(j+3)
            renderBitmapString(0.0, 0.5, 0.0, font ,""+number)
            glPopMatrix()
        next
    next

    // Code to compute frames per second
    frame++

    time=glutGet(GLUT_ELAPSED_TIME)
    if time - timebase > 1000
        s = "RingFreeGLUT - FPS: " + (frame*1000.0/(time-timebase))

```

(continues on next page)

(continued from previous page)

```

        timebase = time
        frame = 0
ok

// Code to display a string (fps) with bitmap fonts
setOrthographicProjection()

glPushMatrix()
glLoadIdentity()
renderBitmapString(5,30,0,GLUT_BITMAP_HELVETICA_18,s)
glPopMatrix()

restorePerspectiveProjection()

glutSwapBuffers()

// -----
//          KEYBOARD
// -----


func processNormalKeys
    key = glutEventKey()
    xx = glutEventX()
    yy = glutEventY()

    switch key
        on 27
            glutDestroyMenu(mainMenu)
            glutDestroyMenu(fillMenu)
            glutDestroyMenu(colorMenu)
            glutDestroyMenu(fontMenu)
            Shutdown()
        off

func pressKey

    key = glutEventKey()
    xx = glutEventX()
    yy = glutEventY()

    switch key
        on GLUT_KEY_UP
            deltaMove = 0.5
        on GLUT_KEY_DOWN
            deltaMove = -0.5
    off

func releaseKey

```

(continues on next page)

(continued from previous page)

```

key = glutEventKey()

switch key
    on GLUT_KEY_UP
        deltaMove = 0
    on GLUT_KEY_DOWN
        deltaMove = 0
off

// -----
//          MOUSE
// -----


func mouseMove
    xx = glutEventX()
    yy = glutEventY()

    // this will only be true when the left button is down
    if xOrigin >= 0

        // update deltaAngle
        deltaAngle = (xx - xOrigin) * 0.001

        // update camera's direction
        lx = sin(angle + deltaAngle)
        lz = -cos(angle + deltaAngle)
ok

func mouseButton

    button = glutEventButton()
    state = glutEventState()
    xx = glutEventX()
    yy = glutEventY()

    // only start motion if the left button is pressed
    if button = GLUT_LEFT_BUTTON
        // when the button is released
        if state = GLUT_UP
            angle += deltaAngle
            xOrigin = -1
        else
            // state = GLUT_DOWN
            xOrigin = xx
        ok
    ok

// -----
//          MENUS
// -----
```

(continues on next page)

(continued from previous page)

```

// ----

func processMenuStatus

    status = glutEventStatus()

    if status = GLUT_MENU_IN_USE
        menuFlag = 1
    else
        menuFlag = 0
    ok

func processMainMenu

    // nothing to do in here
    // all actions are for submenus

func processFillMenu

    option = glutEventValue()

    switch option

        on C_FILL
            glPolygonMode(GL_FRONT, GL_FILL)
        on C_LINE
            glPolygonMode(GL_FRONT, GL_LINE)
    off

func processFontMenu

    option = glutEventValue()

    switch (option) {
        on C_INT_GLUT_BITMAP_8_BY_13
            font = GLUT_BITMAP_8_BY_13
        on C_INT_GLUT_BITMAP_9_BY_15
            font = GLUT_BITMAP_9_BY_15
        on C_INT_GLUT_BITMAP_TIMES_ROMAN_10
            font = GLUT_BITMAP_TIMES_ROMAN_10
        on C_INT_GLUT_BITMAP_TIMES_ROMAN_24
            font = GLUT_BITMAP_TIMES_ROMAN_24
        on C_INT_GLUT_BITMAP_HELVETICA_10
            font = GLUT_BITMAP_HELVETICA_10
        on C_INT_GLUT_BITMAP_HELVETICA_12
            font = GLUT_BITMAP_HELVETICA_12
        on C_INT_GLUT_BITMAP_HELVETICA_18
            font = GLUT_BITMAP_HELVETICA_18
    off

```

(continues on next page)

(continued from previous page)

```

func processColorMenu

    option = glutEventValue()

    switch option
        on C_RED
            red = 1.0
            green = 0.0
            blue = 0.0
        on C_GREEN
            red = 0.0
            green = 1.0
            blue = 0.0
        on C_BLUE
            red = 0.0
            green = 0.0
            blue = 1.0
        on C_ORANGE
            red = 1.0
            green = 0.5
            blue = 0.5
    off

func createPopupMenu

    fontMenu = glutCreateMenu(:processFontMenu)

    glutAddMenuEntry("BITMAP_8_BY_13 ",C_INT GLUT_BITMAP_8_BY_13 )
    glutAddMenuEntry("BITMAP_9_BY_15",C_INT GLUT_BITMAP_9_BY_15 )
    glutAddMenuEntry("BITMAP_TIMES_ROMAN_10 ",C_INT GLUT_BITMAP_TIMES_ROMAN_10 )
    glutAddMenuEntry("BITMAP_TIMES_ROMAN_24",C_INT GLUT_BITMAP_TIMES_ROMAN_24 )
    glutAddMenuEntry("BITMAP_HELVETICA_10 ",C_INT GLUT_BITMAP_HELVETICA_10 )
    glutAddMenuEntry("BITMAP_HELVETICA_12",C_INT GLUT_BITMAP_HELVETICA_12 )
    glutAddMenuEntry("BITMAP_HELVETICA_18",C_INT GLUT_BITMAP_HELVETICA_18 )

    fillMenu = glutCreateMenu(:processFillMenu)

    glutAddMenuEntry("Fill",C_FILL)
    glutAddMenuEntry("Line",C_LINE)

    colorMenu = glutCreateMenu(:processColorMenu)
    glutAddMenuEntry("Red",C_RED);
    glutAddMenuEntry("Blue",C_BLUE);
    glutAddMenuEntry("Green",C_GREEN);
    glutAddMenuEntry("Orange",C_ORANGE);

    mainMenu = glutCreateMenu(:processMainMenu)

    glutAddSubMenu("Polygon Mode", fillMenu)
    glutAddSubMenu("Color", colorMenu)

```

(continues on next page)

(continued from previous page)

```

glutAddSubMenu("Font", fontMenu)
// attach the menu to the right button
glutAttachMenu(GLUT_RIGHT_BUTTON)

// this will allow us to know if the menu is active
glutMenuStatusFunc(:processMenuStatus)

// -----
//          MAIN
// -----

func main

    // init GLUT and create window
    glutInit()
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)
    glutInitWindowPosition(100,100)
    glutInitWindowSize(320,320)
    glutCreateWindow("RingFreeGLUT - Test - 9 SnowMan")

    // register callbacks
    glutDisplayFunc(:renderScene)
    glutReshapeFunc(:changeSize)
    glutIdleFunc(:renderScene)

    glutIgnoreKeyRepeat(1)
    glutKeyboardFunc(:processNormalKeys)
    glutSpecialFunc(:pressKey)
    glutSpecialUpFunc(:releaseKey)

    // here are the two new functions
    glutMouseFunc(:mouseButton)
    glutMotionFunc(:mouseMove)

    // OpenGL init
    glEnable(GL_DEPTH_TEST)
    glEnable(GL_CULL_FACE)

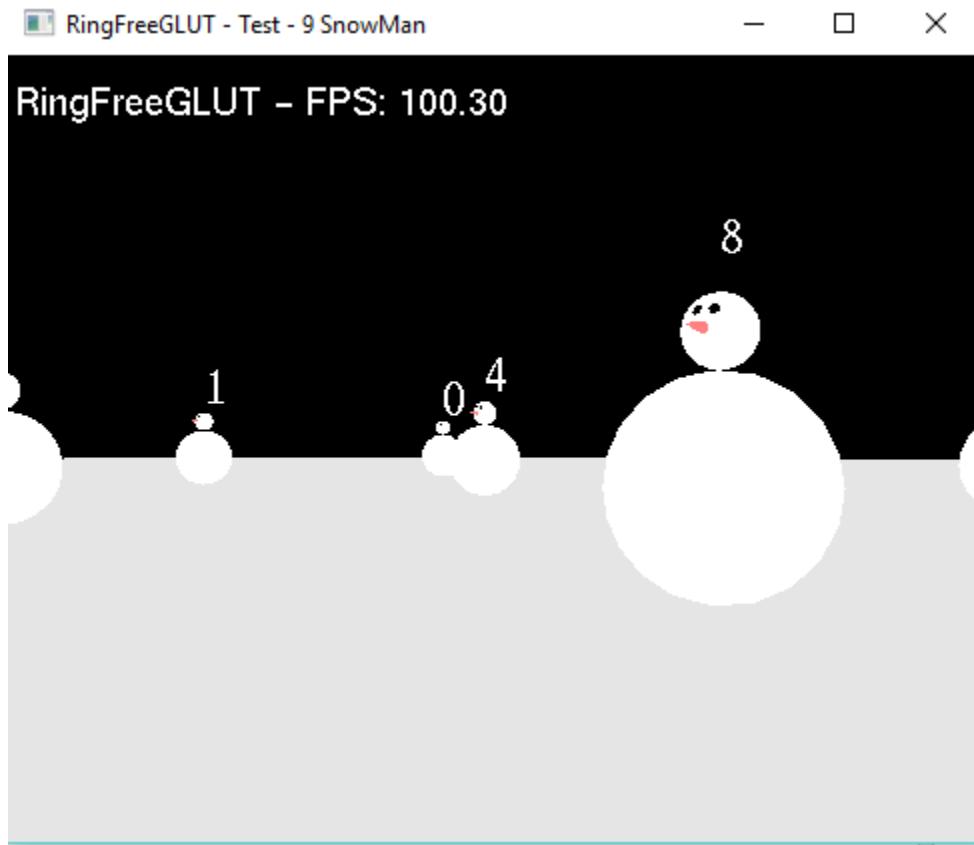
    // init Menus
    createPopupMenus()

    // enter GLUT event processing cycle
    glutMainLoop()

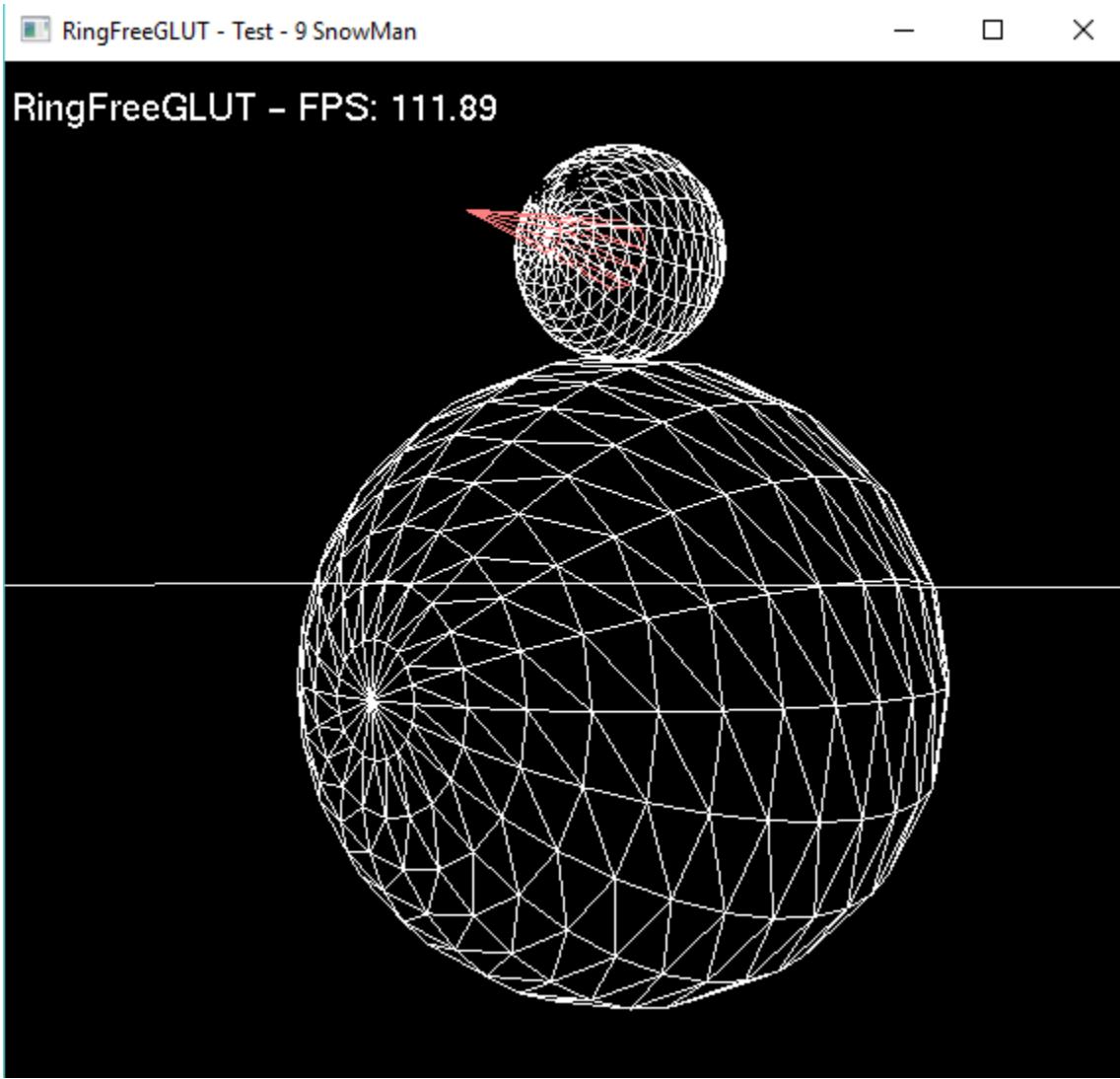
```

Screen Shots:

The First screen shot



The Second screen shot



58.15 Make a Cube using RingOpenGL and RingFreeGLUT

Example:

```
load "freeglut.ring"
load "opengl21lib.ring"

// -----
// Global Variables
// -----
rotate_y=0
rotate_x=0

// -----
// display() Callback function
// -----
```

(continues on next page)

(continued from previous page)

```

func display

    // Clear screen and Z-buffer
    glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)

    // Reset transformations
    glLoadIdentity()

    // Rotate when user changes rotate_x and rotate_y
    glRotatef( rotate_x, 1.0, 0.0, 0.0 )
    glRotatef( rotate_y, 0.0, 1.0, 0.0 )

    //Multi-colored side - FRONT
    glBegin(GL_POLYGON)

    glColor3f( 1.0, 0.0, 0.0 )      glVertex3f( 0.5, -0.5, -0.5 )      # P1 is red
    glColor3f( 0.0, 1.0, 0.0 )      glVertex3f( 0.5, 0.5, -0.5 )      # P2 is green
    glColor3f( 0.0, 0.0, 1.0 )      glVertex3f( -0.5, 0.5, -0.5 )      # P3 is blue
    glColor3f( 1.0, 0.0, 1.0 )      glVertex3f( -0.5, -0.5, -0.5 )     # P4 is purple

    glEnd()

    // White side - BACK
    glBegin(GL_POLYGON)
    glColor3f( 1.0, 1.0, 1.0 )
    glVertex3f( 0.5, -0.5, 0.5 )
    glVertex3f( 0.5, 0.5, 0.5 )
    glVertex3f( -0.5, 0.5, 0.5 )
    glVertex3f( -0.5, -0.5, 0.5 )
    glEnd()

    // Purple side - RIGHT
    glBegin(GL_POLYGON)
    glColor3f( 1.0, 0.0, 1.0 )
    glVertex3f( 0.5, -0.5, -0.5 )
    glVertex3f( 0.5, 0.5, -0.5 )
    glVertex3f( 0.5, 0.5, 0.5 )
    glVertex3f( 0.5, -0.5, 0.5 )
    glEnd()

    // Green side - LEFT
    glBegin(GL_POLYGON)
    glColor3f( 0.0, 1.0, 0.0 )
    glVertex3f( -0.5, -0.5, 0.5 )
    glVertex3f( -0.5, 0.5, 0.5 )
    glVertex3f( -0.5, 0.5, -0.5 )
    glVertex3f( -0.5, -0.5, -0.5 )
    glEnd()

    // Blue side - TOP
    glBegin(GL_POLYGON)
    glColor3f( 0.0, 0.0, 1.0 )

```

(continues on next page)

(continued from previous page)

```

glVertex3f( 0.5, 0.5, 0.5 )
glVertex3f( 0.5, 0.5, -0.5 )
glVertex3f( -0.5, 0.5, -0.5 )
glVertex3f( -0.5, 0.5, 0.5 )
glEnd()

// Red side - BOTTOM
glBegin(GL_POLYGON)
glColor3f( 1.0, 0.0, 0.0 )
glVertex3f( 0.5, -0.5, -0.5 )
glVertex3f( 0.5, -0.5, 0.5 )
glVertex3f( -0.5, -0.5, 0.5 )
glVertex3f( -0.5, -0.5, -0.5 )
glEnd()

glFlush()
glutSwapBuffers()

// -----
// specialKeys() Callback Function
// -----
func specialKeys

    key = glutEventKey()

    // Right arrow - increase rotation by 5 degree
    switch Key

        on GLUT_KEY_RIGHT
            rotate_y += 5

        // Left arrow - decrease rotation by 5 degree
        on GLUT_KEY_LEFT
            rotate_y -= 5

        on GLUT_KEY_UP
            rotate_x += 5

        on GLUT_KEY_DOWN
            rotate_x -= 5

    off

    // Request display update
    glutPostRedisplay()

// -----
// main() function
// -----

```

(continues on next page)

(continued from previous page)

```

func main

    // Initialize GLUT and process user parameters
    glutInit()

    // Request double buffered true color window with Z-buffer
    glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB | GLUT_DEPTH)

    // Create window
    glutCreateWindow("Awesome Cube")

    // Enable Z-buffer depth test
    glEnable(GL_DEPTH_TEST)

    // Callback functions
    glutDisplayFunc(:display)
    glutSpecialFunc(:specialKeys)

    // Pass control to GLUT for events
    glutMainLoop()

    // Return to OS

```

Screen Shot:

22 **glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)**

23

24 // Reset transformations

25 **glLoadIdentity()**

26

27 // Rotate when user changes rotate_x and rotate_y

28 **glRotatef(rotate_x, 1.0, 0.0, 0.0)**

29 **glRotatef(rotate_y, 0.0, 1.0, 0.0)**

30

31 //Multi-colored side - FRONT

32 **glBegin(GL_POLYGON)**

33

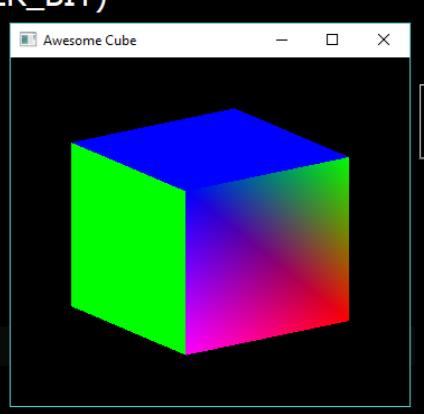
34 **glColor3f(1.0, 0.0, 0.0) glVertex3f(0.5, -0.5, -0.5) # P1 is red**

35 **glColor3f(0.0, 1.0, 0.0) glVertex3f(0.5, 0.5, -0.5) # P2 is green**

36 **glColor3f(0.0, 0.0, 1.0) glVertex3f(-0.5, 0.5, -0.5) # P3 is blue**

37 **glColor3f(1.0, 0.0, 1.0) glVertex3f(-0.5, -0.5, -0.5) # P4 is purple**

38



USING RINGOPENGL AND RINGALLEGRO FOR 3D GRAPHICS

In this chapter we will learn about using RingOpenGL and RingAllegro

59.1 3D Cube and Texture

Source Code:

```
# Load Libraries
load "gamelib.ring"           # RingAllegro Library
load "opengl21lib.ring"        # RingOpenGL Library

#=====
# To Support MacOS X
al_run_main()
func al_game_start            # Called by al_run_main()
    main()                   # Now we call our main function
#=====

func main

    new GraphicsApp {
        start()
    }

class GraphicsApp from GraphicsAppBase

    TITLE = "Ring Cube"

    bitmap texture

    xrot = 0.0
    yrot = 0.0
    zrot = 0.0

    func loadresources

        bitmap = al_load_bitmap("ring.bmp")
        texture = al_get_opengl_texture(bitmap)
```

(continues on next page)

(continued from previous page)

```

func destroyResources

    al_destroy_bitmap(bitmap)

func drawScene

    w = 800 h = 600
    ratio = w / h

    glViewport(0, 0, w, h)
    glMatrixMode(GL_PROJECTION)
    glLoadIdentity()

    gluPerspective(45, ratio, 1, 100)
    glMatrixMode(GL_MODELVIEW)
    glLoadIdentity()

    glEnable(GL_TEXTURE_2D)
    glShadeModel(GL_SMOOTH)
    glClearColor(0.0, 0.0, 0.0, 0.5)
    glClearDepth(1.0)
    glEnable(GL_DEPTH_TEST)
    glEnable(GL_CULL_FACE)
    glDepthFunc(GL_LESS)
    glHint(GL_PERSPECTIVE_CORRECTION_HINT, GL_NICEST)

    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)
    glLoadIdentity()
    glTranslatef(0.0, 0.0, -5.0)

    glRotatef(xrot, 1.0, 0.0, 0.0)
    glRotatef(yrot, 0.0, 1.0, 0.0)
    glRotatef(zrot, 0.0, 0.0, 1.0)

    glBindTexture(GL_TEXTURE_2D, texture)

    glBegin(GL_QUADS)
        // Front Face
        glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, -1.0, 1.0)
        glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, -1.0, 1.0)
        glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, 1.0)
        glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, 1.0)
        // Back Face
        glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0, -1.0)
        glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
        glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)
        glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0, -1.0)
        // Top Face
        glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
        glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, 1.0, 1.0)
        glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, 1.0, 1.0)
        glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)

```

(continues on next page)

(continued from previous page)

```

// Bottom Face
glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, -1.0, -1.0)
glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, -1.0, -1.0)
glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0,  1.0)
glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0,  1.0)
// Right face
glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, -1.0, -1.0)
glTexCoord2f(1.0, 1.0) glVertex3f( 1.0,  1.0, -1.0)
glTexCoord2f(0.0, 1.0) glVertex3f( 1.0,  1.0,  1.0)
glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0,  1.0)
// Left Face
glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, -1.0, -1.0)
glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0,  1.0)
glTexCoord2f(1.0, 1.0) glVertex3f(-1.0,  1.0,  1.0)
glTexCoord2f(0.0, 1.0) glVertex3f(-1.0,  1.0, -1.0)
glEnd()

xrot += 0.3
yrot += 0.2
zrot += 0.4

class GraphicsAppBase

    display event_queue ev timeout
    timer redraw = true

    FPS = 60

    SCREEN_W = 800
    SCREEN_H = 600

    KEY_UP = 1
    KEY_DOWN = 2
    KEY_LEFT = 3
    KEY_RIGHT = 4

    Key = [false, false, false, false]

    TITLE = "Graphics Application"

    func start
        SetUp()
        loadResources()
        eventsLoop()
        destroy()

    func setup
        al_init()
        al_init_image_addon()

```

(continues on next page)

(continued from previous page)

```

al_set_new_display_flags(ALLEGRO_OPENGL)
display = al_create_display(SCREEN_W, SCREEN_H)
al_set_window_title(display, TITLE)
al_clear_to_color(al_map_rgb(0,0,0))
event_queue = al_create_event_queue()
al_register_event_source(event_queue,
    al_get_display_event_source(display))
ev = al_new_allegro_event()
timeout = al_new_allegro_timeout()
al_init_timeout(timeout, 0.06)
timer = al_create_timer(1.0 / FPS)
al_register_event_source(event_queue,
    al_get_timer_event_source(timer))
al_start_timer(timer)
al_install_mouse()
al_register_event_source(event_queue,
    al_get_mouse_event_source())
al_install_keyboard()
al_register_event_source(event_queue,
    al_get_keyboard_event_source())

func eventsLoop

    while true
        al_init_timeout(timeout, 0.06)
        al_wait_for_event_until(event_queue, ev, timeout)
        switch al_get_allegro_event_type(ev)
        on ALLEGRO_EVENT_DISPLAY_CLOSE
            exit
        on ALLEGRO_EVENT_TIMER
            redraw = true
        on ALLEGRO_EVENT_MOUSE_AXES
            mouse_x = al_get_allegro_event_mouse_x(ev)
            mouse_y = al_get_allegro_event_mouse_y(ev)
        on ALLEGRO_EVENT_MOUSE_ENTER_DISPLAY
            mouse_x = al_get_allegro_event_mouse_x(ev)
            mouse_y = al_get_allegro_event_mouse_y(ev)
        on ALLEGRO_EVENT_MOUSE_BUTTON_UP
            exit
        on ALLEGRO_EVENT_KEY_DOWN
            switch al_get_allegro_event_keyboard_keycode(ev)
            on ALLEGRO_KEY_UP
                key[KEY_UP] = true
            on ALLEGRO_KEY_DOWN
                key[KEY_DOWN] = true
            on ALLEGRO_KEY_LEFT
                key[KEY_LEFT] = true
            on ALLEGRO_KEY_RIGHT
                key[KEY_RIGHT] = true
        off
        on ALLEGRO_EVENT_KEY_UP
            switch al_get_allegro_event_keyboard_keycode(ev)

```

(continues on next page)

(continued from previous page)

```

on ALLEGRO_KEY_UP
    key[KEY_UP] = false
on ALLEGRO_KEY_DOWN
    key[KEY_DOWN] = false
on ALLEGRO_KEY_LEFT
    key[KEY_LEFT] = false
on ALLEGRO_KEY_RIGHT
    key[KEY_RIGHT] = false
on ALLEGRO_KEY_ESCAPE
    exit
off
off
if redraw and al_is_event_queue_empty(event_queue)
    redraw = false
    drawScene()
    al_flip_display()
ok
callgc()
end

func destroy

destroyResources()
al_destroy_timer(timer)
al_destroy_allegro_event(ev)
al_destroy_allegro_timeout(timeout)
al_destroy_event_queue(event_queue)
al_destroy_display(display)
al_exit()

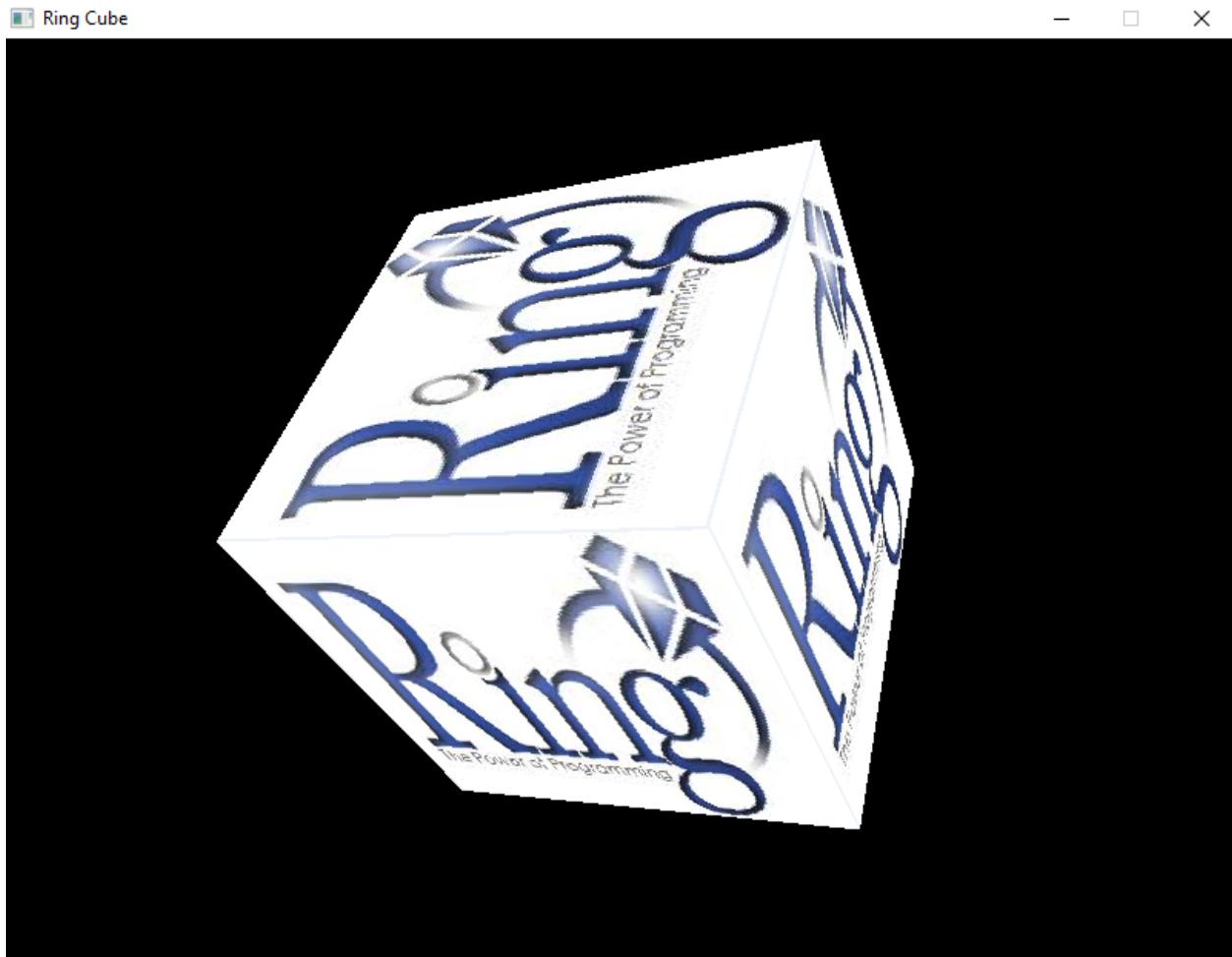
func loadresources

func drawScene

func destroyResources

```

Screen Shot:



59.2 Many Cubes

Source Code:

```
# Load Libraries
load "gamelib.ring"           # RingAllegro Library
load "opengl21lib.ring"        # RingOpenGL Library

#=====
# To Support MacOS X
al_run_main()
func al_game_start            # Called by al_run_main()
    main()                    # Now we call our main function
#=====

func main

    new GraphicsApp {
        start()
```

(continues on next page)

(continued from previous page)

```

}

class GraphicsApp from GraphicsAppBase

    TITLE = "Many Cubes"

    bitmap bitmap2 bitmap3
    texture texture2 texture3

    fps = 120
    xrot = 0.0
    yrot = 0.0
    zrot = 0.0

    nPerspective = 100

    func loadresources

        bitmap = al_load_bitmap("sky1.jpg")
        texture = al_get_opengl_texture(bitmap)

        bitmap2 = al_load_bitmap("sky2.jpg")
        texture2 = al_get_opengl_texture(bitmap2)

        bitmap3 = al_load_bitmap("sky3.jpg")
        texture3 = al_get_opengl_texture(bitmap3)

    func destroyResources

        al_destroy_bitmap(bitmap)
        al_destroy_bitmap(bitmap2)
        al_destroy_bitmap(bitmap3)

    func drawScene

        prepare()
        cubes()
        rotate()

    func Prepare
        w = 800 h = 600
        ratio = w / h
        glViewport(0, 0, w, h)
        glMatrixMode(GL_PROJECTION)
        glLoadIdentity()
        gluPerspective(-nPerspective, ratio, 1, nPerspective)
        glMatrixMode(GL_MODELVIEW)
        glLoadIdentity()
        glEnable(GL_TEXTURE_2D)
        glShadeModel(GL_SMOOTH)
        glClearColor(0.0, 0.0, 0.0, 0.5)

```

(continues on next page)

(continued from previous page)

```

glClearDepth(1.0)
glEnable(GL_DEPTH_TEST)
glEnable(GL_CULL_FACE)
glDepthFunc(GL_LESS)
glHint(GL_PERSPECTIVE_CORRECTION_HINT, GL_NICEST)
glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

func Cubes
    cube(5,-3.4,-5,:sky1)
    cube(0,-3,-5,:sky1)
    cube(-5,-3,-5,:sky1)
    cube(5,0.5,-5,:sky2)
    cube(0,0.5,-5,:sky2)
    cube(-5,0.5,-5,:sky2)
    cube(5,4,-5,:sky3)
    cube(0,4,-5,:sky3)
    cube(-5,4,-5,:sky3)

func Rotate
    xrot += 0.3 * 5
    yrot += 0.2 * 5
    zrot += 0.4 * 5
    nPerspective += 0.5

func cube(x,y,z,nTexture)
    glLoadIdentity()
    glTranslatef(x,y,z)
    glRotatef(xrot,1.0,0.0,0.0)
    glRotatef(yrot,0.0,1.0,0.0)
    glRotatef(zrot,0.0,0.0,1.0)
    drawcube(nTexture)

func drawcube(cTexture)

    switch cTexture
        on :sky1
            glBindTexture(GL_TEXTURE_2D, texture)
        on :sky2
            glBindTexture(GL_TEXTURE_2D, texture2)
        on :sky3
            glBindTexture(GL_TEXTURE_2D, texture3)
    off

    glBegin(GL_QUADS)
        // Front Face
        glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, -1.0, 1.0)
        glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, -1.0, 1.0)
        glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, 1.0)
        glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, 1.0)
        // Back Face

```

(continues on next page)

(continued from previous page)

```

glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0, -1.0)
glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)
glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0, -1.0)
// Top Face
glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, 1.0, 1.0)
glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, 1.0, 1.0)
glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)
// Bottom Face
glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, -1.0, -1.0)
glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, -1.0, -1.0)
glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0, 1.0)
glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0, 1.0)

// Right face
glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, -1.0, -1.0)
glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)
glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, 1.0, 1.0)
glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0, 1.0)

// Left Face
glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, -1.0, -1.0)
glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0, 1.0)
glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, 1.0, 1.0)
glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
glEnd()

```

```

class GraphicsAppBase

    display event_queue ev timeout
    timer   redraw   = true

    FPS      = 60

    SCREEN_W     = 800
    SCREEN_H     = 600

    KEY_UP       = 1
    KEY_DOWN     = 2
    KEY_LEFT     = 3
    KEY_RIGHT    = 4

    Key = [false, false, false, false]

    TITLE = "Graphics Application"

    func start

        SetUp()
        loadResources()

```

(continues on next page)

(continued from previous page)

```

eventsLoop()
destroy()

func setup

    al_init()
    al_init_image_addon()
    al_set_new_display_flags(ALLEGRO_OPENGL)
    display = al_create_display(SCREEN_W, SCREEN_H)
    al_set_window_title(display, TITLE)
    al_clear_to_color(al_map_rgb(0, 0, 0))
    event_queue = al_create_event_queue()
    al_register_event_source(event_queue,
        al_get_display_event_source(display))
    ev = al_new_allegro_event()
    timeout = al_new_allegro_timeout()
    al_init_timeout(timeout, 0.06)
    timer = al_create_timer(1.0 / FPS)
    al_register_event_source(event_queue,
        al_get_timer_event_source(timer))
    al_start_timer(timer)
    al_install_mouse()
    al_register_event_source(event_queue,
        al_get_mouse_event_source())
    al_install_keyboard()
    al_register_event_source(event_queue,
        al_get_keyboard_event_source())

func eventsLoop

    while true
        al_init_timeout(timeout, 0.06)
        al_wait_for_event_until(event_queue, ev, timeout)
        switch al_get_allegro_event_type(ev)
        on ALLEGRO_EVENT_DISPLAY_CLOSE
            exit
        on ALLEGRO_EVENT_TIMER
            redraw = true
        on ALLEGRO_EVENT_MOUSE_AXES
            mouse_x = al_get_allegro_event_mouse_x(ev)
            mouse_y = al_get_allegro_event_mouse_y(ev)
        on ALLEGRO_EVENT_MOUSE_ENTER_DISPLAY
            mouse_x = al_get_allegro_event_mouse_x(ev)
            mouse_y = al_get_allegro_event_mouse_y(ev)
        on ALLEGRO_EVENT_MOUSE_BUTTON_UP
            exit
        on ALLEGRO_EVENT_KEY_DOWN
            switch al_get_allegro_event_keyboard_keycode(ev)
            on ALLEGRO_KEY_UP
                key[KEY_UP] = true
            on ALLEGRO_KEY_DOWN
                key[KEY_DOWN] = true

```

(continues on next page)

(continued from previous page)

```

on ALLEGRO_KEY_LEFT
    key[KEY_LEFT] = true
on ALLEGRO_KEY_RIGHT
    key[KEY_RIGHT] = true
off
on ALLEGRO_EVENT_KEY_UP
    switch al_get_allegro_event_keyboard_keycode(ev)
        on ALLEGRO_KEY_UP
            key[KEY_UP] = false
        on ALLEGRO_KEY_DOWN
            key[KEY_DOWN] = false
        on ALLEGRO_KEY_LEFT
            key[KEY_LEFT] = false
        on ALLEGRO_KEY_RIGHT
            key[KEY_RIGHT] = false
        on ALLEGRO_KEY_ESCAPE
            exit
off
if redraw and al_is_event_queue_empty(event_queue)
    redraw = false
    drawScene()
    al_flip_display()
ok
callgc()
end

func destroy

    destroyResources()
    al_destroy_timer(timer)
    al_destroy_allegro_event(ev)
    al_destroy_allegro_timeout(timeout)
    al_destroy_event_queue(event_queue)
    al_destroy_display(display)
    al_exit()

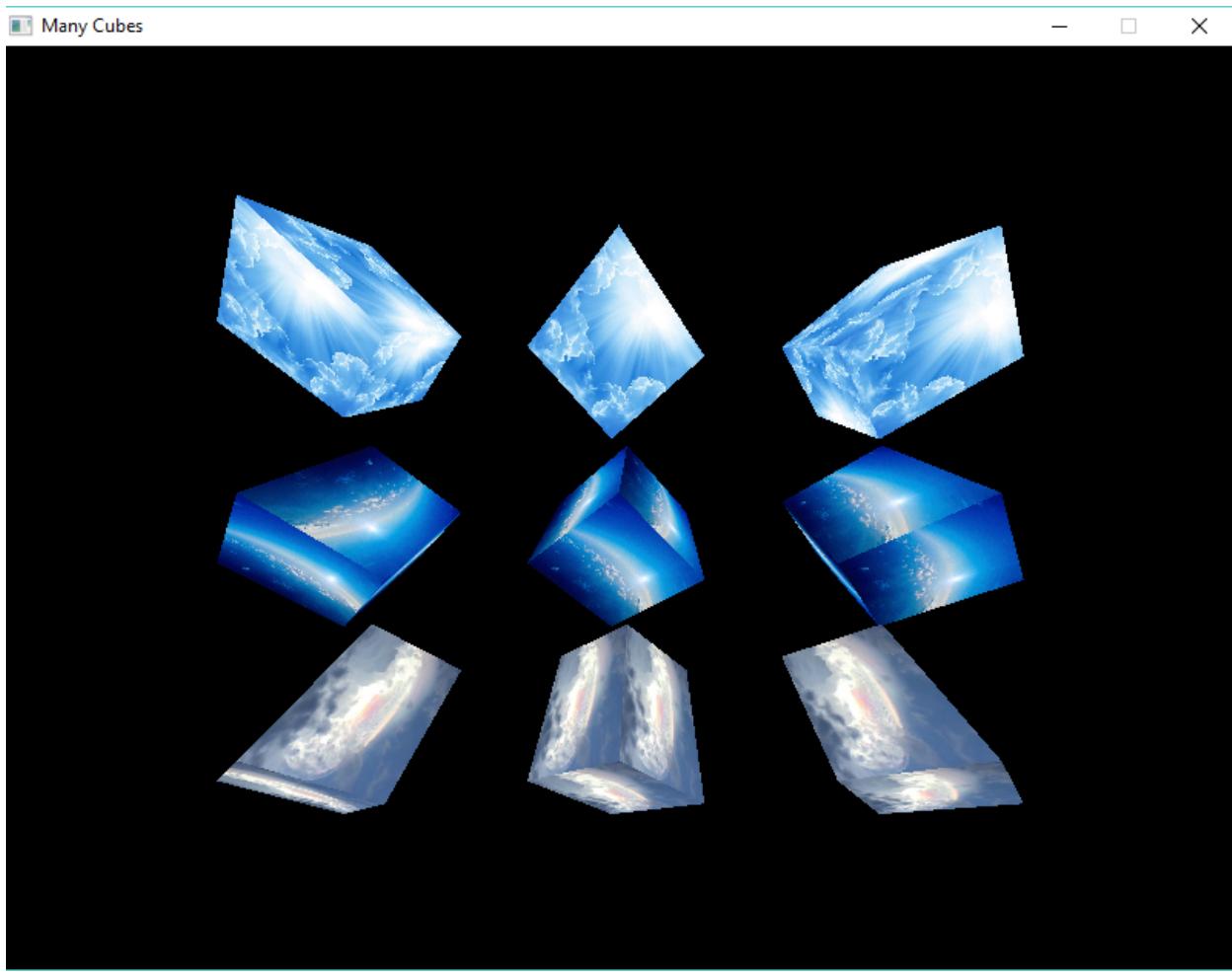
func loadresources

func drawScene

func destroyResources

```

Screen Shot:



59.3 TicTacToe 3D Game

Source Code:

```
# Load Libraries
load "gamelib.ring"           # RingAllegro Library
load "opengl21lib.ring"        # RingOpenGL Library

#=====
# To Support MacOS X
al_run_main()
func al_game_start            # Called by al_run_main()
    main()                    # Now we call our main function
#=====

func main
    new TicTacToe3D {
        start()
    }
```

(continues on next page)

(continued from previous page)

```

class TicTacToe3D from GameLogic

    FPS = 60
    TITLE = "TicTacToe 3D"

    oBackground = new GameBackground
    oGameSound = new GameSound
    oGameCube = new GameCube
    oGameOver = new GameOver
    oGameInterface = new GameInterface

    func loadresources
        oGameOver.loadresources()
        oGameSound.loadresources()
        oBackground.loadresources()
        oGameCube.loadresources()

    func destroyResources
        oGameOver.destroyResources()
        oGameSound.destroyResources()
        oBackground.destroyResources()
        oGameCube.destroyResources()

    func drawScene
        oBackground.update()
        oGameInterface.update(self)

    func MouseClickEvent
        oGameInterface.MouseClickEvent(self)

class GameInterface

    func Update oGame
        prepare()
        cubes(oGame)

    func Prepare
        w = 1024 h = 768
        ratio = w / h
        glViewport(0, 0, w, h)
        glMatrixMode(GL_PROJECTION)
        glLoadIdentity()
        gluPerspective(-120, ratio, 1, 120)
        glMatrixMode(GL_MODELVIEW)
        glLoadIdentity()
        glEnable(GL_TEXTURE_2D)
        glShadeModel(GL_SMOOTH)
        glClearColor(0.0, 0.0, 0.0, 0.5)
        glClearDepth(1.0)
        glEnable(GL_DEPTH_TEST)
        glEnable(GL_CULL_FACE)
        glDepthFunc(GL_LEQUAL)

```

(continues on next page)

(continued from previous page)

```

glHint(GL_PERSPECTIVE_CORRECTION_HINT, GL_NICEST)

func Cubes oGame
    oGame.oGameCube {
        aGameMap = oGame.aGameMap
        cube( 5 , -3 , -5 , aGameMap[1][1] )
        cube( 0 , -3 , -5 , aGameMap[1][2] )
        cube( -5 , -3 , -5 , aGameMap[1][3] )
        cube( 5 , 1 , -5 , aGameMap[2][1] )
        cube( 0 , 1 , -5 , aGameMap[2][2] )
        cube( -5 , 1 , -5 , aGameMap[2][3] )
        cube( 5 , 5 , -5 , aGameMap[3][1] )
        cube( 0 , 5 , -5 , aGameMap[3][2] )
        cube( -5 , 5 , -5 , aGameMap[3][3] )
        rotate()
    }

func MouseEvent oGame
    oGame {
        aBtn = Point2Button(Mouse_X,Mouse_Y)
        nRow = aBtn[1]
        nCol = aBtn[2]
        if nRow != 0 and nCol != 0
            if aGameMap[nRow][nCol] == :n
                aGameMap[nRow][nCol] = cActivePlayer
                ChangeActivePlayer()
                CheckGameOver()
        ok
    }
}

Class GameLogic from GraphicsAppBase

aGameMap = [
    [ :n , :n , :n ] ,
    [ :n , :n , :n ] ,
    [ :n , :n , :n ]
]

aGameButtons = [ # x1,y1,x2,y2
    [176,88,375,261], # [1,1]
    [423,88,591,261], # [1,2]
    [645,88,876,261], # [1,3]
    [176,282,375,428], # [2,1]
    [423,282,591,428], # [2,2]
    [645,282,876,428], # [2,3]
    [176,454,375,678], # [3,1]
    [423,454,591,678], # [3,2]
    [645,454,876,678] # [3,3]
]

cActivePlayer = :x

```

(continues on next page)

(continued from previous page)

```

func point2button x,y
    nRow = 0
    nCol = 0
    for t = 1 to len(aGameButtons)
        rect = aGameButtons[t]
        if x >= rect[1] and x <= rect[3] and
            y >= rect[2] and y <= rect[4]
            switch t
                on 1 nRow = 1 nCol = 1
                on 2 nRow = 1 nCol = 2
                on 3 nRow = 1 nCol = 3
                on 4 nRow = 2 nCol = 1
                on 5 nRow = 2 nCol = 2
                on 6 nRow = 2 nCol = 3
                on 7 nRow = 3 nCol = 1
                on 8 nRow = 3 nCol = 2
                on 9 nRow = 3 nCol = 3
            off
            exit
        ok
    next
    return [nRow,nCol]

func ChangeActivePlayer()
    if cActivePlayer = :x
        cActivePlayer = :o
    else
        cActivePlayer = :x
    ok

func CheckGameOver
    aList = [
        aGameMap[1][1],
        aGameMap[1][2],
        aGameMap[1][3],
        aGameMap[2][1],
        aGameMap[2][2],
        aGameMap[2][3],
        aGameMap[3][1],
        aGameMap[3][2],
        aGameMap[3][3]
    ]
    for item in aList
        switch item
            on :x item = 1
            on :o item = 2
            on :n item = 0
        off
    next
    nStatus = CheckWinner(aList)
    if nStatus

```

(continues on next page)

(continued from previous page)

```

oGameOver {
    Switch nStatus
        on 1 Player1Win(this)
        on 2 Player2Win(this)
        on 3 NoOneWin(this)
    off
}
refreshGame()
ok

func refreshGame
aGameMap = [
    [ :n , :n , :n ] ,
    [ :n , :n , :n ] ,
    [ :n , :n , :n ]
]
cActivePlayer = :x

func CheckWinner lst
    //vertical check
    for v=1 to 9 step 3
        if lst[v]!=0 and lst[v+1]!=0 and lst[v+2]!=0
            if lst[v]=lst[v+1] and lst[v+1]=lst[v+2]
                return lst[v]
            ok
        ok
    next
    //horizontal
    for h=1 to 3
        if lst[h]!=0 and lst[h+3]!=0 and lst[h+6]!=0
            if lst[h]=lst[h+3] and lst[h+3]=lst[h+6]
                return lst[h]
            ok
        ok
    next
    //Cross
    if lst[1]!=0 and lst[5]!=0 and lst[9]!=0
        if lst[1]=lst[5] and lst[5]=lst[9] return lst[1] ok
    ok
    if lst[3]!=0 and lst[5]!=0 and lst[7]!=0
        if lst[3]=lst[5] and lst[5]=lst[7] return lst[3] ok
    ok
    //tie
    tie=true
    for i=1 to 9
        if lst[i]==0 tie=false exit ok
    next
    if tie=true return 3 ok return 0
}

class GameOver

```

(continues on next page)

(continued from previous page)

```

font bitmap

func loadresources
    font = al_load_ttf_font("font/pirulen.ttf", 54, 0 )
    bitmap = al_load_bitmap("image/ballon.png")

func destroyResources
    al_destroy_bitmap(bitmap)
    al_destroy_font(font)

func Player1Win oGame
    showMsg(oGame, 80, 430, "Good job X you won!")

func Player2Win oGame
    showMsg(oGame, 80, 430, "Good job O you won!")

func NoOneWin oGame
    showMsg(oGame, 150, 430, "Oh no it's a tie!")

func ShowMsg oGame, x, y, cMsg
    oGame {
        drawScene()
        al_flip_display()
        al_rest(0.3)
        newdisplay = al_create_display(SCREEN_W, SCREEN_H)
        al_set_window_title(newdisplay, TITLE)
        al_clear_to_color(al_map_rgb(255, 255, 255))
        al_draw_bitmap(this.bitmap, 200, 50, 1)
        al_draw_text(this.font,
                    al_map_rgb(0, 0, 255), x, y,
                    ALLEGRO_ALIGN_LEFT, cMsg)
        al_flip_display()
        al_rest(2)
        al_destroy_display(newdisplay)
        al_set_target_backbuffer(display)
    }

class GameCube

    bitmap bitmap2 bitmap3
    textureX texture0 textureN

    xrot = 0.0
    yrot = 0.0
    zrot = 0.0

    func loadresources
        bitmap = al_load_bitmap("image/o.png")
        texture0 = al_get_opengl_texture(bitmap)
        bitmap2 = al_load_bitmap("image/x.png")
        textureX = al_get_opengl_texture(bitmap2)

```

(continues on next page)

(continued from previous page)

```

bitmap3 = al_load_bitmap("image/empty.png")
textureN = al_get_opengl_texture(bitmap3)

func destroyResources
    al_destroy_bitmap(bitmap)
    al_destroy_bitmap(bitmap2)
    al_destroy_bitmap(bitmap3)

func cube(x,y,z,nTexture)
    glLoadIdentity()
    glTranslatef(x,y,z)
    glRotatef(xrot,1.0,0.0,0.0)
    glRotatef(yrot,0.0,1.0,0.0)
    glRotatef(zrot,0.0,0.0,1.0)
    setCubeTexture(nTexture)
    drawCube()

func setCubeTexture cTexture
    switch cTexture
        on :x
            glBindTexture(GL_TEXTURE_2D, textureX)
        on :o
            glBindTexture(GL_TEXTURE_2D, textureO)
        on :n
            glBindTexture(GL_TEXTURE_2D, textureN)
    off

func Rotate
    xrot += 0.3 * 5
    yrot += 0.2 * 5
    zrot += 0.4 * 5

func drawcube
    glBegin(GL_QUADS)
        // Front Face
        glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, -1.0, 1.0)
        glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, -1.0, 1.0)
        glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, 1.0)
        glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, 1.0)
        // Back Face
        glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0, -1.0)
        glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
        glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)
        glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0, -1.0)
        // Top Face
        glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
        glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, 1.0, 1.0)
        glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, 1.0, 1.0)
        glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)
        // Bottom Face
        glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, -1.0, -1.0)
        glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, -1.0, -1.0)

```

(continues on next page)

(continued from previous page)

```

glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0,  1.0)
glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0,  1.0)

// Right face
glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, -1.0, -1.0)
glTexCoord2f(1.0, 1.0) glVertex3f( 1.0,  1.0, -1.0)
glTexCoord2f(0.0, 1.0) glVertex3f( 1.0,  1.0,  1.0)
glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0,  1.0)

// Left Face
glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, -1.0, -1.0)
glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0,  1.0)
glTexCoord2f(1.0, 1.0) glVertex3f(-1.0,  1.0,  1.0)
glTexCoord2f(0.0, 1.0) glVertex3f(-1.0,  1.0, -1.0)
glEnd()

class GameBackground

nBackX = 0
nBackY = 0
nBackDiffx = -1
nBackDiffy = -1
nBackMotion = 1
aBackMotionList = [
    [ -1, -1 ],           # Down - Right
    [ 0 , 1  ],           # Up
    [ -1, -1 ],           # Down - Right
    [ 0 , 1  ],           # Up
    [ 1 , -1 ],           # Down - Left
    [ 0 , 1  ],           # Up
    [ 1 , -1 ],           # Down - Left
    [ 0 , 1  ]            # Up
]
bitmap

func Update
    draw()
    motion()

func draw
    al_draw_bitmap(bitmap, nBackX, nBackY, 1)

func motion
    nBackX += nBackDiffx
    nBackY += nBackDiffy
    if (nBackY = -350) or (nBackY = 0)
        nBackMotion++
        if nBackMotion > len(aBackMotionList)
            nBackMotion = 1
    ok

```

(continues on next page)

(continued from previous page)

```

        nBackDiffx = aBackMotionList[nBackMotion][1]
        nBackDiffy = aBackMotionList[nBackMotion][2]
    ok

func loadResources
    bitmap = al_load_bitmap("image/back.jpg")

func destroyResources
    al_destroy_bitmap(bitmap)

class GameSound

    sample sampleid

    func loadresources
        sample = al_load_sample( "sound/music1.wav" )
        sampleid = al_new_allegro_sample_id()
        al_play_sample(sample, 1.0, 0.0, 1.0, ALLEGRO_PLAYMODE_LOOP, sampleid)

    func destroyResources
        al_destroy_allegro_sample_id(sampleid)
        al_destroy_sample(sample)

class GraphicsAppBase

    display event_queue ev timeout
    timer
    redraw           = true
    FPS              = 60
    SCREEN_W         = 1024
    SCREEN_H         = 700
    KEY_UP           = 1
    KEY_DOWN         = 2
    KEY_LEFT          = 3
    KEY_RIGHT         = 4
    Key               = [false, false, false, false]
    Mouse_X          = 0
    Mouse_Y          = 0
    TITLE             = "Graphics Application"
    PRINT_MOUSE_XY   = False

    func start
        SetUp()
        loadResources()
        eventsLoop()
        destroy()

    func setup
        al_init()
        al_init_font_addon()

```

(continues on next page)

(continued from previous page)

```

al_init_ttf_addon()
al_init_image_addon()
al_install_audio()
al_init_acodec_addon()
al_reserve_samples(1)
al_set_new_display_flags(ALLEGRO_OPENGL)
display = al_create_display(SCREEN_W, SCREEN_H)
al_set_window_title(display, TITLE)
al_clear_to_color(al_map_rgb(0, 0, 0))
event_queue = al_create_event_queue()
al_register_event_source(event_queue,
    al_get_display_event_source(display))
ev = al_new_allegro_event()
timeout = al_new_allegro_timeout()
al_init_timeout(timeout, 0.06)
timer = al_create_timer(1.0 / FPS)
al_register_event_source(event_queue,
    al_get_timer_event_source(timer))
al_start_timer(timer)
al_install_mouse()
al_register_event_source(event_queue,
    al_get_mouse_event_source())
al_install_keyboard()
al_register_event_source(event_queue,
    al_get_keyboard_event_source())

func eventsLoop
    while true
        al_init_timeout(timeout, 0.06)
        al_wait_for_event_until(event_queue, ev, timeout)
        switch al_get_allegro_event_type(ev)
        on ALLEGRO_EVENT_DISPLAY_CLOSE
            CloseEvent()
        on ALLEGRO_EVENT_TIMER
            redraw = true
        on ALLEGRO_EVENT_MOUSE_AXES
            mouse_x = al_get_allegro_event_mouse_x(ev)
            mouse_y = al_get_allegro_event_mouse_y(ev)
            if PRINT_MOUSE_XY
                see "x = " + mouse_x + nl
                see "y = " + mouse_y + nl
            ok
        on ALLEGRO_EVENT_MOUSE_ENTER_DISPLAY
            mouse_x = al_get_allegro_event_mouse_x(ev)
            mouse_y = al_get_allegro_event_mouse_y(ev)
        on ALLEGRO_EVENT_MOUSE_BUTTON_UP
            MouseClickEvent()
        on ALLEGRO_EVENT_KEY_DOWN
            switch al_get_allegro_event_keyboard_keycode(ev)
            on ALLEGRO_KEY_UP
                key[KEY_UP] = true
            on ALLEGRO_KEY_DOWN

```

(continues on next page)

(continued from previous page)

```

key [KEY_DOWN] = true
on ALLEGRO_KEY_LEFT
    key [KEY_LEFT] = true
on ALLEGRO_KEY_RIGHT
    key [KEY_RIGHT] = true
off
on ALLEGRO_EVENT_KEY_UP
    switch al_get_allegro_event_keyboard_keycode(ev)
        on ALLEGRO_KEY_UP
            key [KEY_UP] = false
        on ALLEGRO_KEY_DOWN
            key [KEY_DOWN] = false
        on ALLEGRO_KEY_LEFT
            key [KEY_LEFT] = false
        on ALLEGRO_KEY_RIGHT
            key [KEY_RIGHT] = false
        on ALLEGRO_KEY_ESCAPE
            exit
off
if redraw and al_is_event_queue_empty(event_queue)
    redraw = false
    drawScene()
    al_flip_display()
ok
callgc()
end

func destroy
    destroyResources()
    al_destroy_timer(timer)
    al_destroy_allegro_event(ev)
    al_destroy_allegro_timeout(timeout)
    al_destroy_event_queue(event_queue)
    al_destroy_display(display)
    al_exit()

func loadresources

func drawScene

func destroyResources

func MouseClickEvent
    exit                                # Exit from the Events Loop

func CloseEvent
    exit                                # Exit from the Events Loop

```

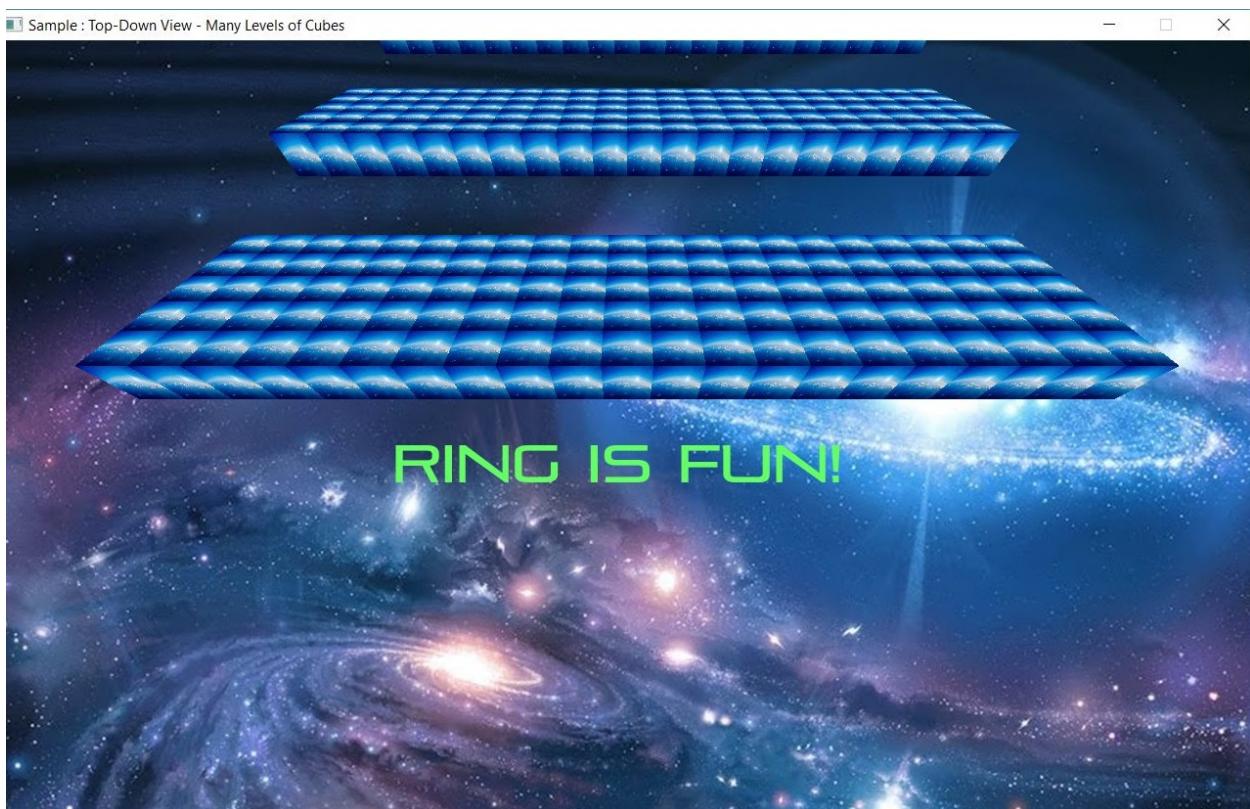
Screen Shot:



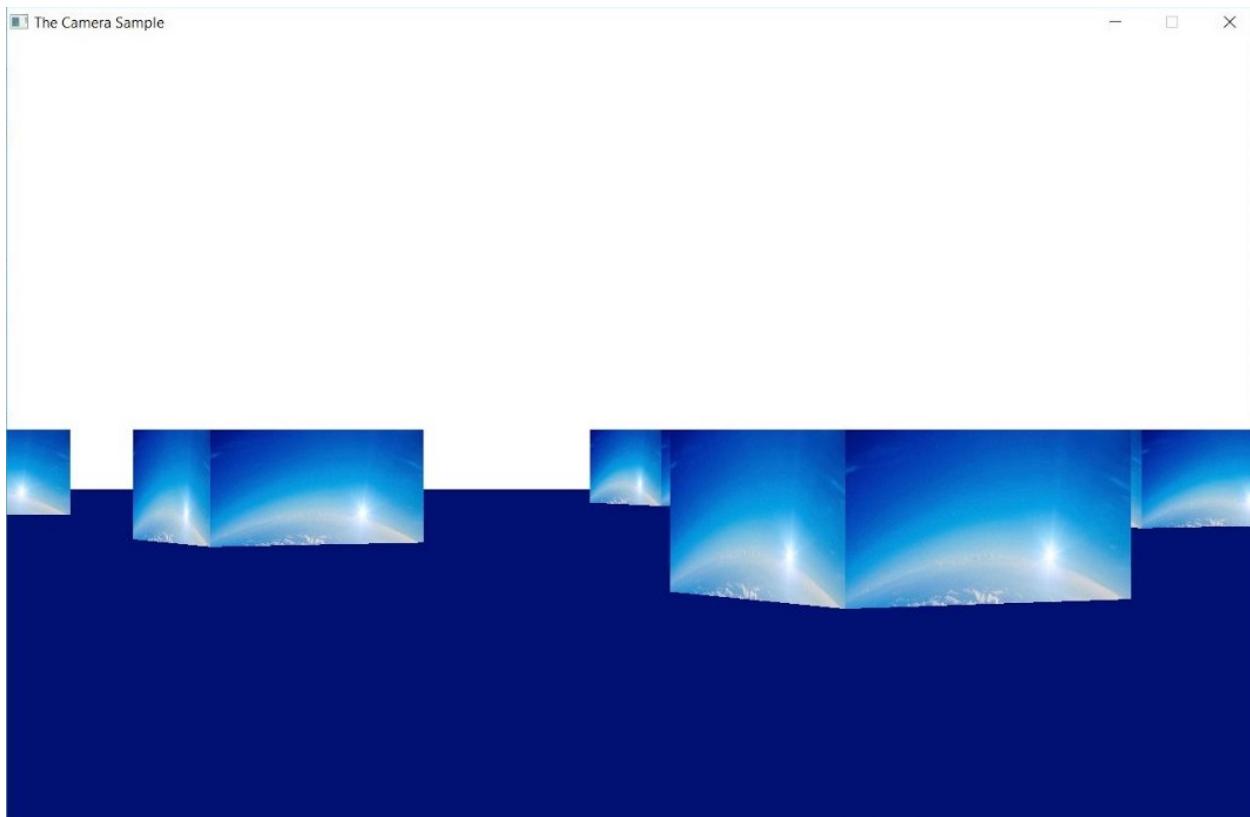
59.4 More 3D Samples

You will find the samples in ring/samples/3D folder

The next screen shot for the Top-Down view - Many levels of cubes sample

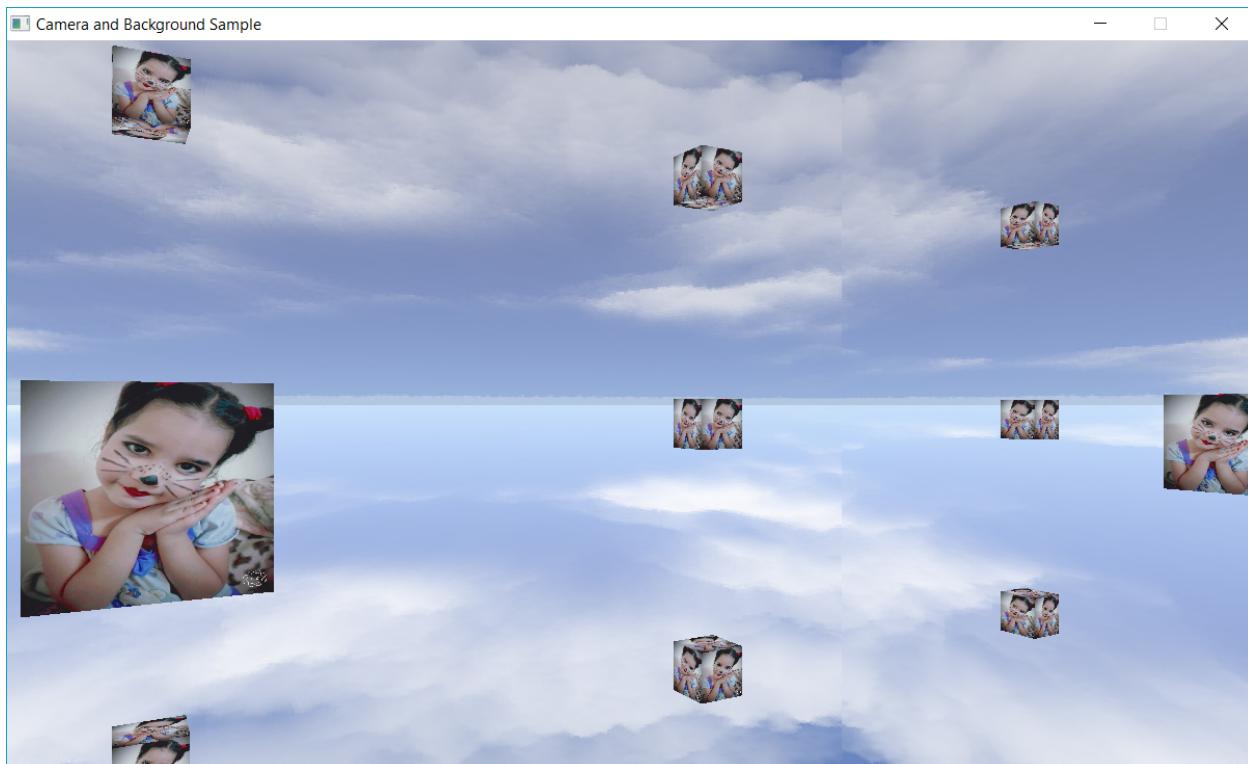


The next screen shot for the Camera Sample



The next screen shot for the Camera and background sample

Developer : Azzeddine Remmal



THE GOLD MAGIC 800 GAME

In this chapter we will learn about the Gold Magic 800 Game

The game is developed using Ring, RingAllegro and RingOpenGL

After installing the package:

```
ringpm install goldmagic800
```

You will find the game in ring/applications/goldmagic800 folder

60.1 The Game Story

Your friend discovered a unique and special box, created by the greatest wizard in the world 7,000 years ago. When you close the box and move it, you will find new gold underneath, making it an infinite source of wealth. The box resides in a special environment full of puzzles, protected by powerful magic that prevents anyone from entering. Your friend has designed a new robot using nanotechnology that can move the box with a remote control device. Your mission is to solve all the puzzles and secure this box forever, making you the richest person in the world.

60.2 How to play?

The Gold Magic 800 is a puzzle game about moving your box through the right way.

The game is based on moving your box around to get gold score (=800) to open the First Door (Box Number 1) Then directly put your box on the Door (this will open the next door), Then continue to put your box on all of the next doors in the level, You need the score (800) only for the first door, The next doors doesn't require this condition, but your way of gold will be converted to a wall once you put the Box on any door, so select your path carefully.

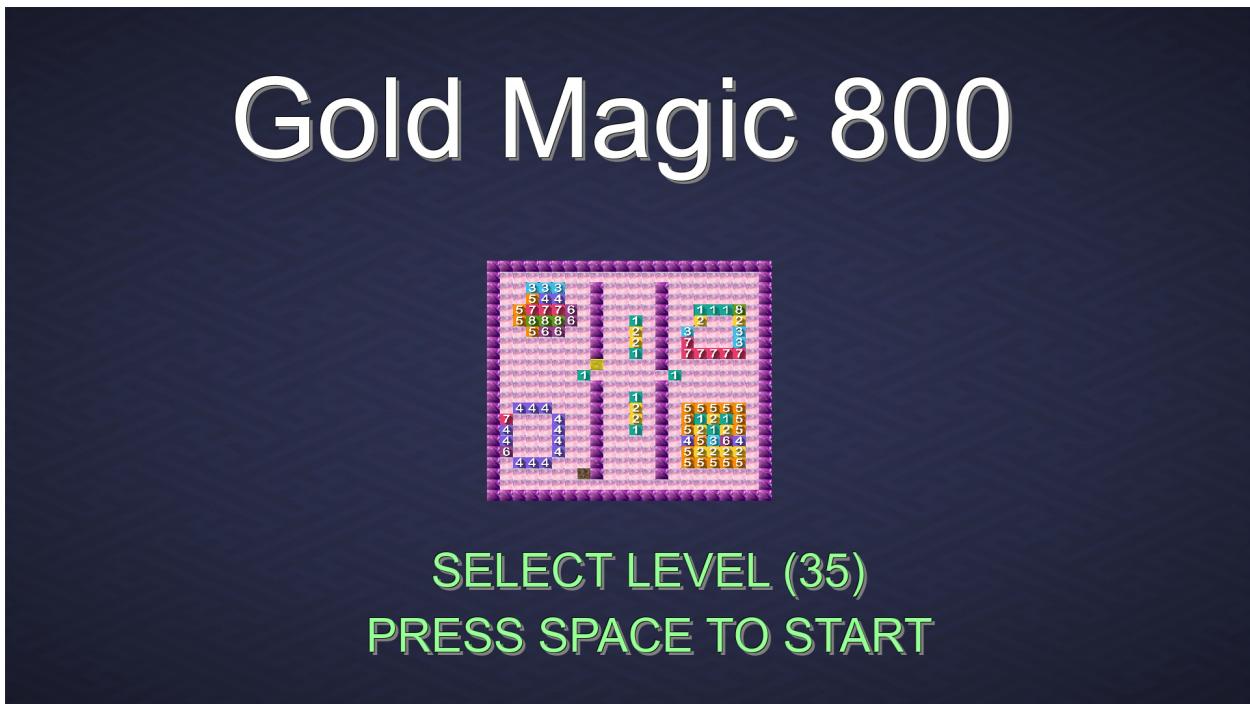
60.3 What will you learn?

- 1- Plan First
- 2- Move to your target directly then go to get the required resources
- 3- Look to the future when you evaluate the different solutions
- 4- Try to avoid mistakes, Also learn from them
- 5- Respect the Cost (800)
- 6- Focus and be careful

7- Be patient and Enjoy!

60.4 Screen Shots

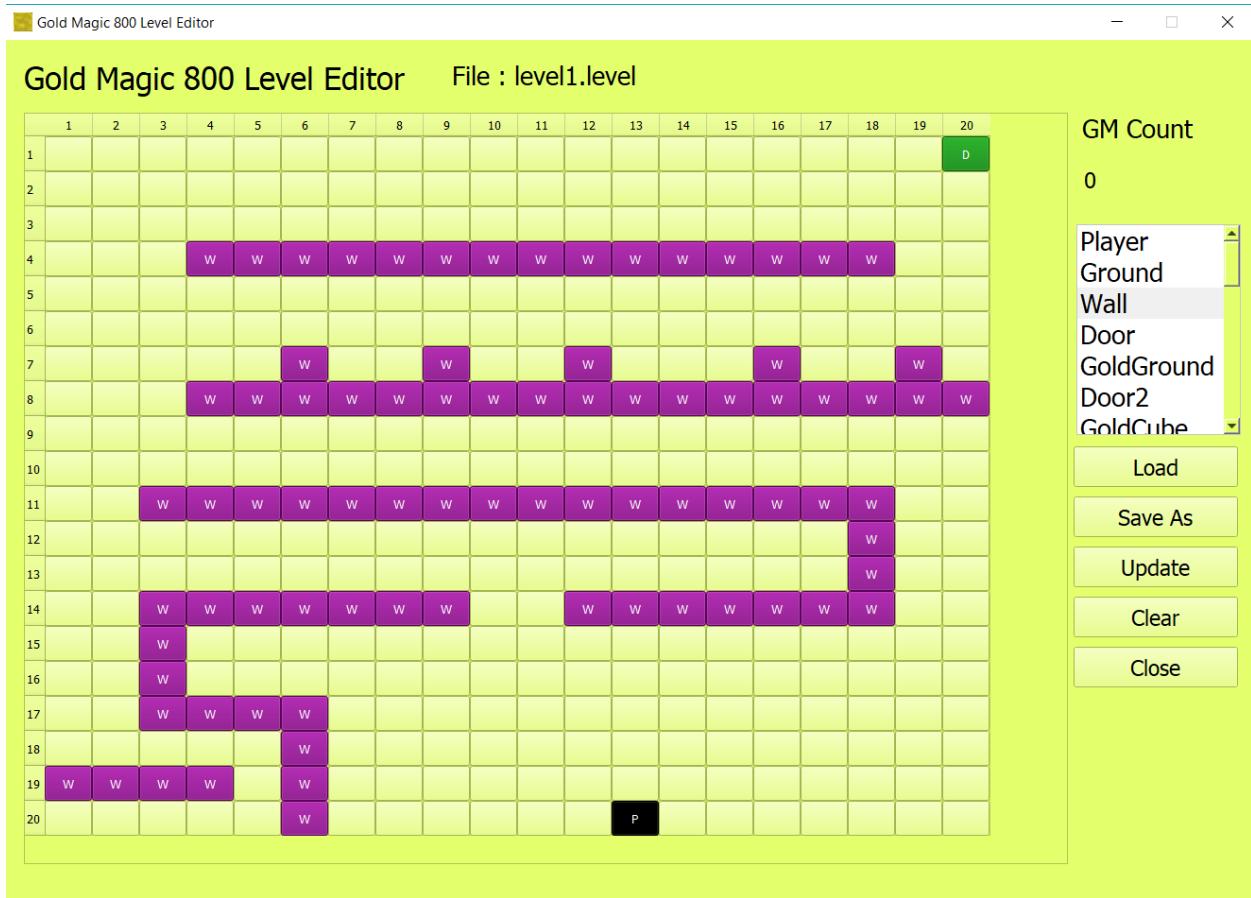
We can select the level



The next screen shot for level (31)



The Gold Magic 800 Level Editor

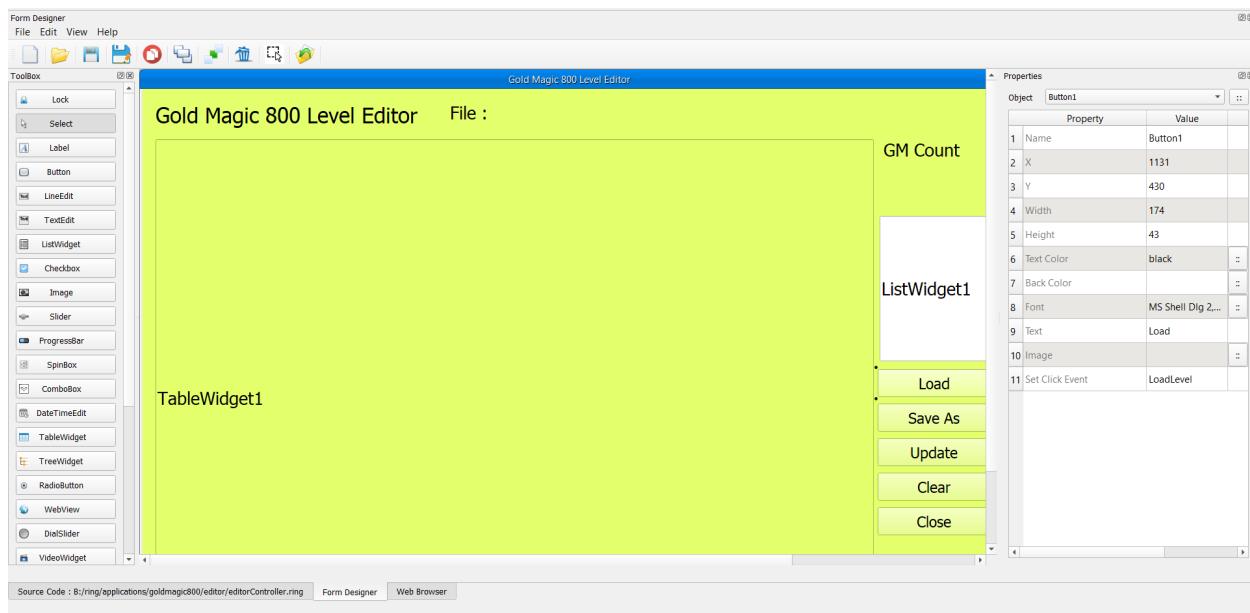


60.5 Source Code

You will find the Level Editor source code in this folder

<https://github.com/ring-lang/ring/tree/master/applications/goldmagic800/editor>

The user interface of the Level Editor is designed using the Ring Form Designer.



The next file contains the Level Editor Controller Class

<https://github.com/ring-lang/ring/blob/master/applications/goldmagic800/editor/editorController.ring>

You will find the Game Engine source code in this folder

<https://github.com/ring-lang/ring/tree/master/applications/goldmagic800>

RINGTILEENGINE EXTENSION

In this chapter we will learn about using the RingTilengine extension.

This extension provides complete support for Tilengine

The 2D retro graphics engine with raster effects

Tilengine URL: <https://github.com/megamarc/Tilengine>

Useful links (Original documentation for C programmers)

- Getting started: https://github.com/ring-lang/Tilengine/blob/master/docs/quick_guide.md
- Initialization: <https://github.com/ring-lang/Tilengine/blob/master/docs/starting.md>
- Using the window: <https://github.com/ring-lang/Tilengine/blob/master/docs/windowing.md>
- External rendering: <https://github.com/ring-lang/Tilengine/blob/master/docs/rendering.md>
- Background layers: <https://github.com/ring-lang/Tilengine/blob/master/docs/layers.md>
- Sprites: <https://github.com/ring-lang/Tilengine/blob/master/docs/sprites.md>

Useful tools

- Tiled Map Editor: <https://www.mapeditor.org/>
- aseprite: <https://www.aseprite.org/>
- Piskel: <https://www.piskelapp.com/>
- GrafX2: <http://grafx2.chez.com/>

Support

- Tilengine Forum: <http://www.tilengine.org/forum/>

61.1 Getting Started

Example (1):

```
load "tilengine.ring"

TLN_Init(400, 240, 1, 0, 0)
TLN_SetLoadPath("assets\sonic")
foreground = TLN_LoadTilemap ("Sonic_md_fg1.tmx", NULL)
TLN_SetLayerTilemap(0, foreground)
```

(continues on next page)

(continued from previous page)

```

TLN_CreateWindow(NULL, 0)
while TLN_ProcessWindow()
    TLN_DrawFrame(0)
end

TLN_DeleteTilemap(foreground)
TLN_Deinit()

```

Screen Shot:



61.2 More Samples

Example (2):

```

load "tilengine.ring"

WIDTH  = 400
HEIGHT = 240

frame = 0

/* setup engine */
TLN_Init(WIDTH, HEIGHT, 1,0,0)

/* load layer */
tilemap = TLN_LoadTilemap("assets/sonic/Sonic_md_fg1.tmx", NULL)

```

(continues on next page)

(continued from previous page)

```

/* setup the layer */
TLN_SetLayer(0, NULL, tilemap)
TLN_SetBGColor(32,32,128)

/* main loop */
TLN_CreateWindow(NULL, 0)
while TLN_ProcessWindow ()

    /* scroll the layer, one pixel per frame */
    TLN_SetLayerPosition (0, frame, 0)

    /* render to the window */
    TLN_DrawFrame (0)

    frame++
end

/* release resources */
TLN_DeleteTilemap(tilemap)
TLN_Deinit()

```

Screen Shot:



Example (3):

```
load "tilengine.ring"
```

(continues on next page)

(continued from previous page)

```

/* engine init */
TLN_Init(640,480,0,0,1)

/* load resources */
TLN_SetLoadPath("assets/color")
background = TLN_LoadBitmap("beach.png")
palette   = TLN_GetBitmapPalette(background)
sp        = TLN_LoadSequencePack("beach.sqx")
sequence  = TLN_FindSequence(sp, "beach")

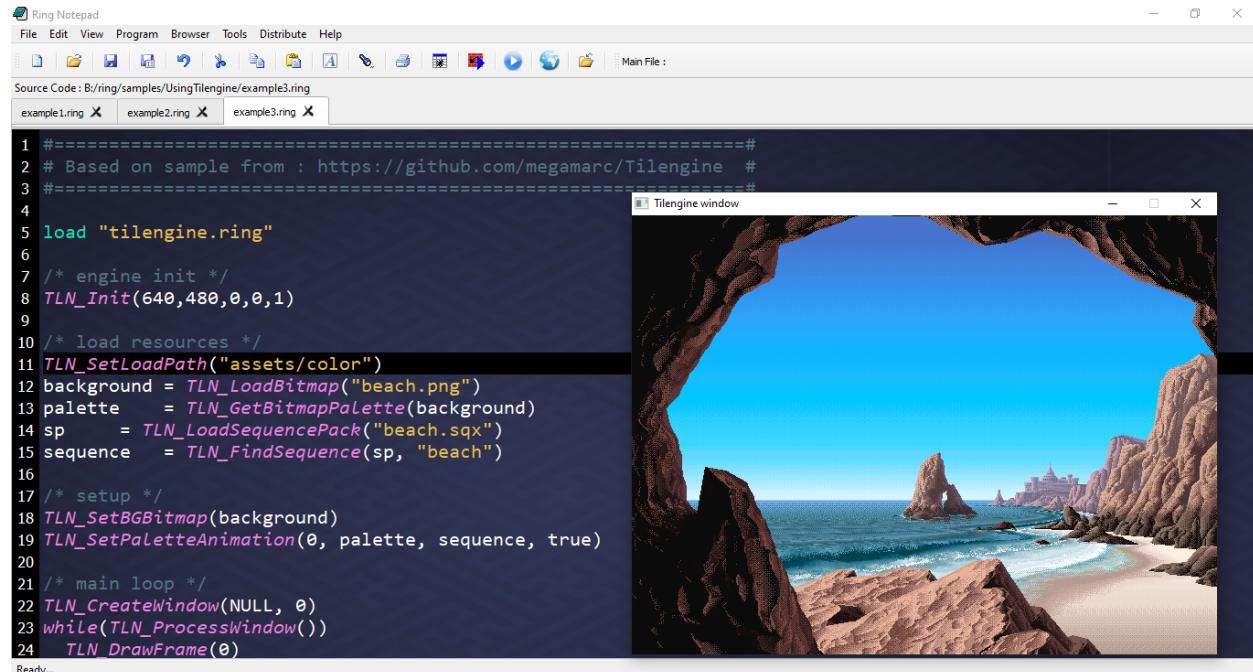
/* setup */
TLN_SetBGBitmap(background)
TLN_SetPaletteAnimation(0, palette, sequence, true)

/* main loop */
TLN_CreateWindow(NULL, 0)
TLN_DisableCRTEffect()
while(TLN_ProcessWindow())
    TLN_DrawFrame(0)
end

TLN_DeleteBitmap(background)
TLN_DeleteSequencePack(sp)
TLN_Deinit()

```

Screen Shot:



Example (4):

```
load "tilengine.ring"
```

(continues on next page)

(continued from previous page)

```

WIDTH = 400
HEIGHT= 240

LAYER_FOREGROUND = 0
LAYER_BACKGROUND = 1
MAX_LAYER = 2

player_x = -16
player_y = 160

/* basic setup */
TLN_Init(WIDTH, HEIGHT, MAX_LAYER, 1, 0)
TLN_SetBGColor(0, 96, 184)

/* load resources */
TLN_SetLoadPath("assets/smw")
foreground = TLN_LoadTilemap("smw_foreground.tmx", NULL)
background = TLN_LoadTilemap("smw_background.tmx", NULL)
TLN_SetLayerTilemap(LAYER_FOREGROUND, foreground)
TLN_SetLayerTilemap(LAYER_BACKGROUND, background)
TLN_SetLayerPosition(LAYER_FOREGROUND, 0, 48)
TLN_SetLayerPosition(LAYER_BACKGROUND, 0, 80)

/* setup sprite */
spriteset = TLN_LoadSpriteset("smw_sprite")
TLN_SetSpriteSet(0, spriteset)
TLN_SetSpritePicture(0, 0)
TLN_SetSpritePosition(0, player_x, player_y)

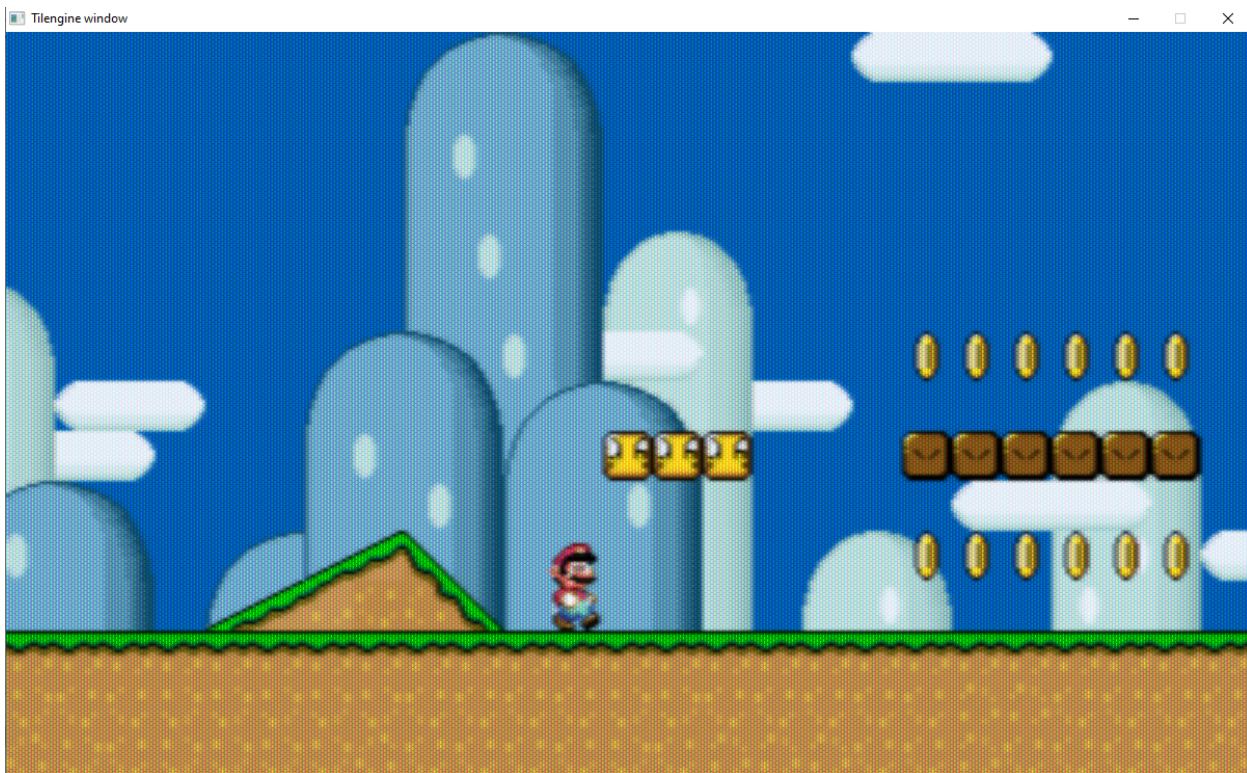
/* setup animations */
seq_walking = TLN_CreateSpriteSequence(NULL, spriteset, "walking", 6)
TLN_SetSpriteAnimation(0, seq_walking, 0)

/* main loop */
TLN_CreateWindow(NULL, 0)
while TLN_ProcessWindow()
    player_x += 1
    if player_x >= WIDTH
        player_x = -16
    ok
    TLN_SetSpritePosition(0, player_x, player_y)
    TLN_DrawFrame(0)
end

/* deinit */
TLN_DeleteTilemap(foreground)
TLN_DeleteTilemap(background)
TLN_Deinit()

```

Screen Shot:



Example (5):

```

load "tilengine.ring"

HRES = 424
VRES = 240

LAYER_PROPS_FRONT      = 0
LAYER_FOREGROUND        = 1
LAYER_PROPS             = 2
LAYER_MIDDLEGROUND       = 3
LAYER_BACKGROUND         = 4
NUM_LAYERS               = 5

xworld = 0
oldx = -1

TLN_Init(HRES, VRES, NUM_LAYERS, 8, 0)

/* load assets */
TLN_SetLogLevel(TLN_LOG_ERRORS)
TLN_SetLoadPath("assets/forest")
foreground = TLN_LoadTilemap("map.tmx", "Main Layer")
middleground = TLN_LoadBitmap("middleground.png")
background = TLN_LoadBitmap("background.png")
atlas = TLN_LoadSpriteset("atlas.png")
props_list = TLN_LoadObjectList("map.tmx", NULL)

/* setup layers */

```

(continues on next page)

(continued from previous page)

```

TLN_SetLayer(LAYER_FOREGROUND, NULL, foreground)
TLN_SetLayerBitmap(LAYER_MIDDLEGROUND, middleground)
TLN_SetLayerBitmap(LAYER_BACKGROUND, background)
width = TLN_GetLayerWidth(LAYER_FOREGROUND)
height = TLN_GetLayerHeight(LAYER_FOREGROUND)

/* objects layer: add back objects (behind sprites) */
TLN_SetLayerObjects(LAYER_PROPS, props_list, NULL)

/* sync props layer positions to main layer */
TLN_SetLayerParent(LAYER_PROPS_FRONT, LAYER_FOREGROUND)
TLN_SetLayerParent(LAYER_PROPS, LAYER_FOREGROUND)

/* create sprite sequences */
idle = TLN_CreateSpriteSequence(NULL, atlas, "player-idle/player-idle-", 6)
skip = TLN_CreateSpriteSequence(NULL, atlas, "player-skip/player-skip-", 6)

/* setup main player sprite */
xplayer = 48
yplayer = 144
TLN_ConfigSprite(0, atlas, 0)
TLN_SetSpriteAnimation(0, idle, 0)

/* create window & main loop */
TLN_CreateWindow(NULL, 0)
TLN_DisableCRTEffect()
while TLN_ProcessWindow()
    TLN_DrawFrame(0)

    /* move 3 pixels right/left main layer */
    if (TLN_GetInput(INPUT_LEFT) && xworld > 0)
        xworld -= 3
    elseif (TLN_GetInput(INPUT_RIGHT) && xworld < width - HRES)
        xworld += 3
    ok

    /* update on change */
    if xworld != oldx
        TLN_SetLayerPosition(LAYER_FOREGROUND, xworld, 32)
        TLN_SetLayerPosition(LAYER_MIDDLEGROUND, xworld / 2, 0)
        TLN_SetLayerPosition(LAYER_BACKGROUND, xworld / 3, 0)
        TLN_SetSpritePosition(0, xplayer - xworld, yplayer)
        oldx = xworld
    ok
end

/* release resources */
TLN_DeleteTilemap(foreground)
TLN_DeleteBitmap(middleground)
TLN_CloseResourcePack()
TLN_DeleteSpriteset(atlas)
TLN_DeleteObjectList(props_list)

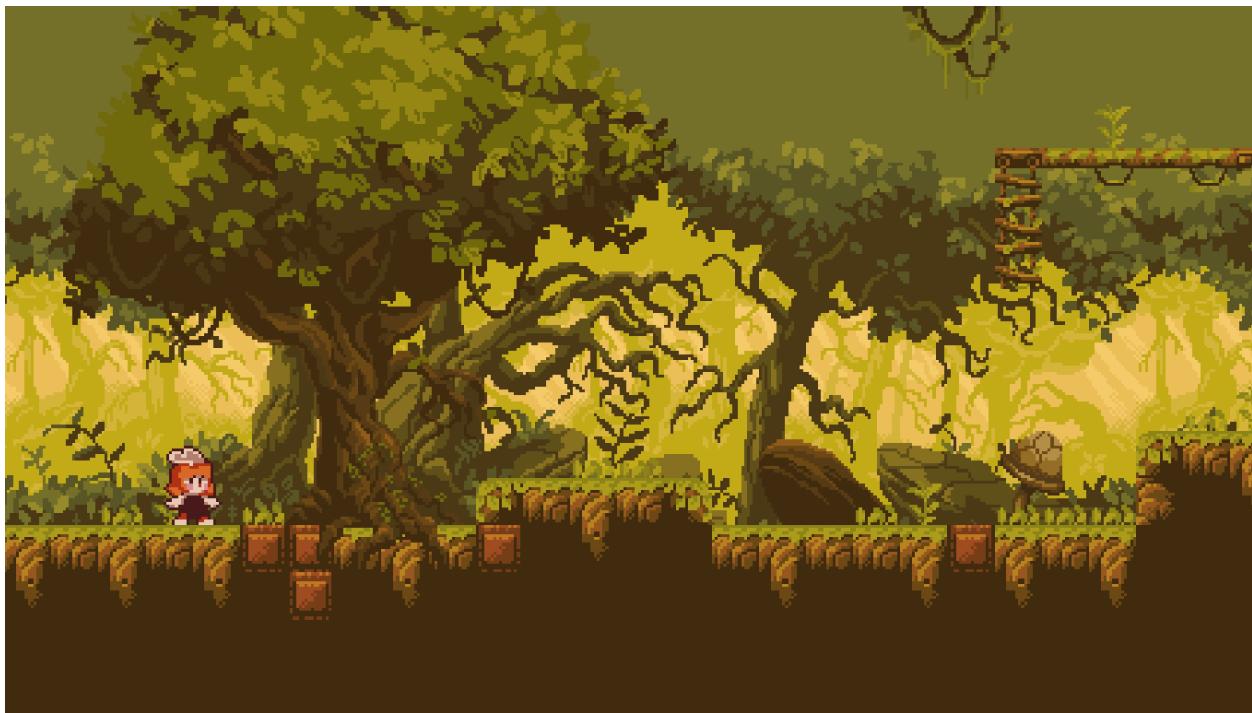
```

(continues on next page)

(continued from previous page)

```
TLN_DeleteWindow()
TLN_Deinit()
```

Screen Shot:



Example (6):

```
load "tilengine.ring"
load "sin.ring"

WIDTH          = 400
HEIGHT         = 240
FIXED_BITS     = 16
LAYER_FOREGROUND = 0
LAYER_BACKGROUND = 1
MAX_LAYER      = 2
MAP_HORIZON    = 0
MAP_TRACK       = 1
MAX_MAP         = 2

road           = NULL
x              = NULL
y              = NULL
angle          = NULL

func main
    /* setup engine */
```

(continues on next page)

(continued from previous page)

```

TLN_Init (WIDTH,HEIGHT, MAX_LAYER, 0, 0)
TLN_SetRasterCallback ("raster_callback()")
TLN_SetBGColor (0,0,0)

/* load resources */

    TLN_SetLoadPath ("assets/smk")
    road = TLN_LoadTilemap ("track1.tmx", NULL)
    horizon = TLN_LoadTilemap ("track1_bg.tmx", NULL)

/* startup display */

    TLN_CreateWindow (NULL, 0)
    x = int2fix(-136)
    y = int2fix(336)
    s = 0
    a = float2fix(0.2)
    angle = 0
    BuildSinTable ()

/* main loop */

    while (TLN_ProcessWindow ())
        TLN_SetLayerTilemap (LAYER_FOREGROUND, horizon)
        TLN_SetLayerTilemap (LAYER_BACKGROUND, horizon)
        TLN_SetLayerPosition (LAYER_FOREGROUND, lerp(angle*2, 0,360, 0,
←256), 24)
        TLN_SetLayerPosition (LAYER_BACKGROUND, lerp(angle, 0,360, 0,
←256), 0)
        TLN_ResetLayerMode (LAYER_BACKGROUND)

        /* input */

            if (TLN_GetInput (INPUT_LEFT))
                angle-=2
            elseif (TLN_GetInput (INPUT_RIGHT))
                angle+=2
            ok

            if (TLN_GetInput (INPUT_UP))
                s += a
                if (s > int2fix(2))
                    s = int2fix(2)
                ok
            elseif (s >= a)
                s -= a
            ok

            if (TLN_GetInput (INPUT_DOWN))
                s -= a
                if (s < -int2fix(2))
                    s = -int2fix(2)

```

(continues on next page)

(continued from previous page)

```

        ok
    elseif (s <= -a)
        s += a
    ok

    if (s != 0)
        angle = angle%360
        if (angle < 0)
            angle += 360
        ok

        x += CalcSin (angle, s)
        y -= CalcCos (angle, s)
    ok

/* render to window */

TLN_DrawFrame (0)
end

/* deinit */

TLN_DeleteTilemap (road)
TLN_DeleteTilemap (horizon)
TLN_DeleteWindow ()
TLN_Deinit ()

/* raster callback (virtual HBLANK) */

func raster_callback

    line = TLN_GETSCANLINE()

    if (line == 24)
        TLN_SetLayerTilemap (LAYER_BACKGROUND, road)
        TLN_SetLayerPosition (LAYER_BACKGROUND, fix2int(x), fix2int(y))
        TLN_DisableLayer (LAYER_FOREGROUND)
    elseif (line >= 24)
        s0 = float2fix (0.2)
        s1 = float2fix (5.0)
        s = lerp (line, 24, HEIGHT, s0, s1)
        scale = fix2float (s)
        TLN_SetLayerTransform (LAYER_BACKGROUND, angle, WIDTH/2, HEIGHT, scale, ↴
←scale)
    ok

func lerp x,x0,x1,fx0,fx1
    return (fx0) + ((fx1) - (fx0)) * ((x) - (x0))/((x1) - (x0))

func float2fix f      return f * (1 << FIXED_BITS)
func int2fix i         return i << FIXED_BITS

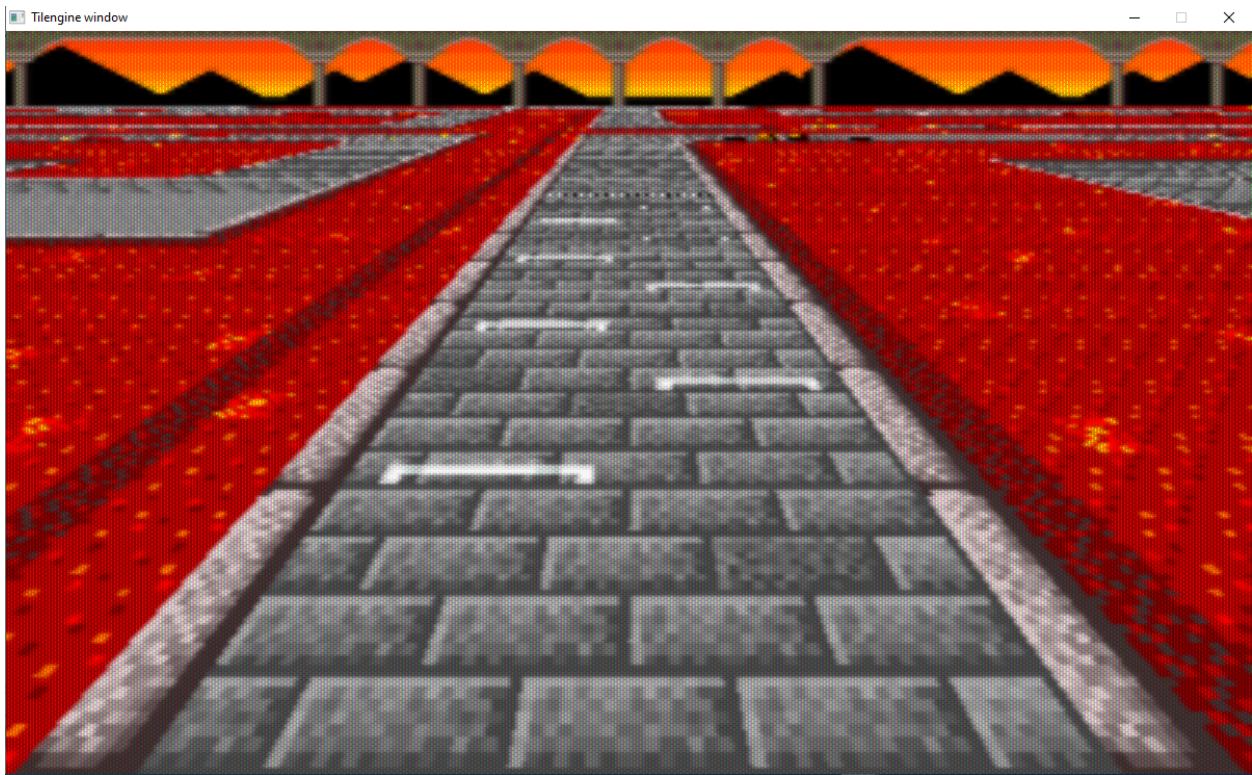
```

(continues on next page)

(continued from previous page)

```
func fix2int f           return f >> FIXED_BITS
func fix2float f        return f/(1 << FIXED_BITS)
```

Screen Shot:



Example (7):

```
load "tilengine.ring"
load "sin.ring"

WIDTH      =      320
HEIGHT     =      192
COLUMNS   = WIDTH/8 + 2

/* layers */
LAYER_FOREGROUND = 0
LAYER_BACKGROUND = 1
MAX_LAYER = 2

frame = 0
column = list(COLUMNS)

/* entry point */
func main

    /* setup engine */

        TLN_Init (WIDTH, HEIGHT, MAX_LAYER, 0, 5)
```

(continues on next page)

(continued from previous page)

```

TLN_SetRasterCallback ("raster_callback()")
TLN_SetBGColor (0,0,0)

/* load resources */

TLN_SetLoadPath ("assets/tf3")
foreground = TLN_LoadTilemap ("tf3_bg2.tmx", NULL)
background = TLN_LoadTilemap ("tf3_bg3.tmx", NULL)
TLN_SetLayerTilemap (LAYER_FOREGROUND, foreground)
TLN_SetLayerTilemap (LAYER_BACKGROUND, background)

BuildSinTable ()

# Convert the Column List to Array of Integers
intArray = "" for item in column intArray += int2Bytes(item) next

TLN_SetLayerColumnOffset (LAYER_BACKGROUND, :intArray)

/* main loop */

TLN_CreateWindow (NULL, 0)
while (TLN_ProcessWindow ())

/* scroll */

TLN_SetLayerPosition (LAYER_FOREGROUND, frame*3, 0)
TLN_SetLayerPosition (LAYER_BACKGROUND, frame, 0)

/* update column offset table */

for c=1 to COLUMNS
    column[c] = CalcSin (frame*5 + c*20, 3)
next

/* render to window */

TLN_DrawFrame (frame)
frame++

end

/* deinit */

TLN_DeleteTilemap (foreground)
TLN_DeleteTilemap (background)
TLN_Deinit ()

func raster_callback

/* raster callback (virtual HBLANK) */

line = TLN_GetScanLine()

```

(continues on next page)

(continued from previous page)

```

    TLN_SetLayerPosition (LAYER_FOREGROUND, frame*2, CalcSin((frame+line)<<1,
← 8) + 8)
    TLN_SetLayerPosition (LAYER_BACKGROUND, frame + CalcSin((frame + line)<
←<1, 10), 0)

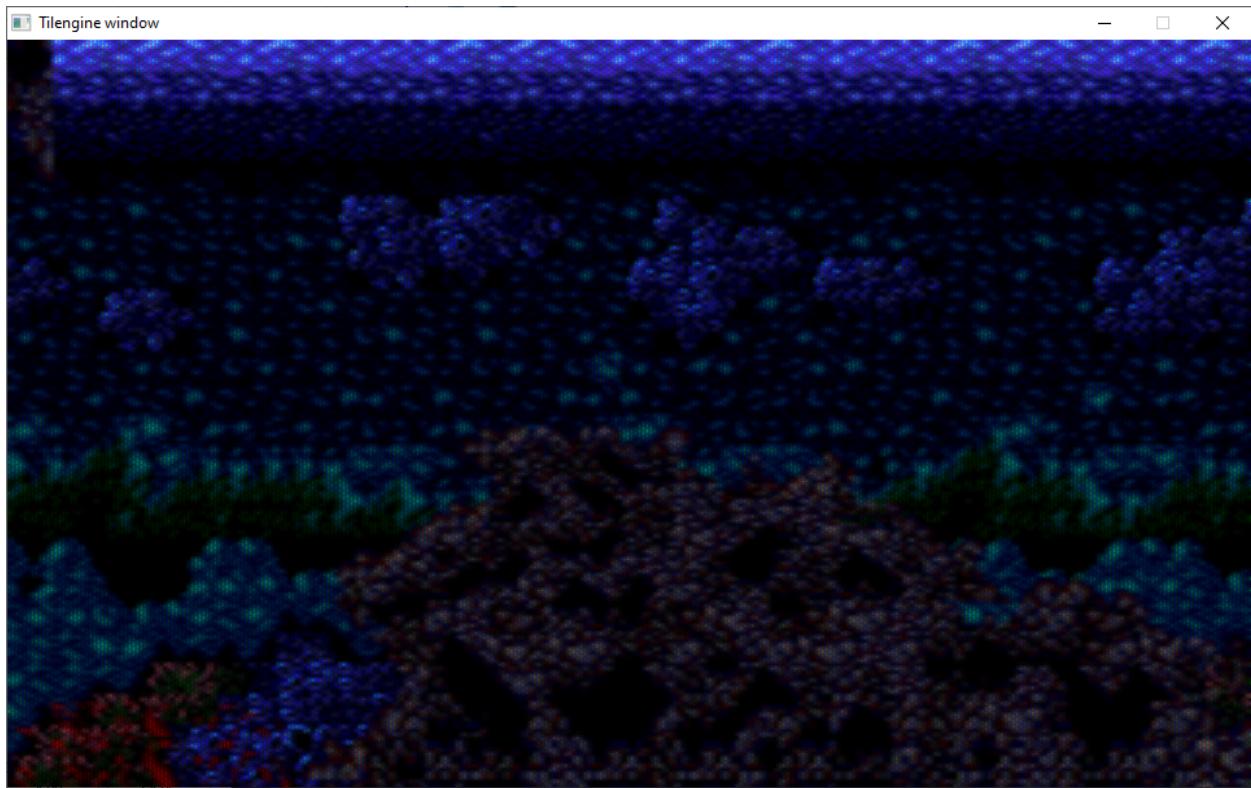
func lerp x,x0,x1,fx0,fx1

/* linear interpolation */

return (fx0) + ((fx1) - (fx0))*((x) - (x0))/((x1) - (x0))

```

Screen Shot:



Example (8):

```

load "tilengine.ring"

WIDTH = 400
HEIGHT = 240

sky = [
    [0x1D, 0x44, 0x7B],
    [0x7F, 0xA4, 0xD9],
    [0x0B, 0x00, 0x4E],
    [0xEB, 0x99, 0x9D]
]

```

(continues on next page)

(continued from previous page)

```

sky_hi_r = 0
sky_hi_g = 0
sky_hi_b = 0
sky_lo_r = 0
sky_lo_g = 0
sky_lo_b = 0

frame = 0
xpos = 0
speed = 2
max_xpos = 4720

/* layers */
    LAYER_FOREGROUND = 0
    LAYER_BACKGROUND = 1
    MAX_LAYER = 2

/* entry point */
func main

    /* setup engine */
        TLN_Init (WIDTH, HEIGHT, 2, 1, 0)
        TLN_SetBGColor (0, 128, 238)
        TLN_SetRasterCallback ("raster_callback()")

    /* load resources */
        TLN_SetLoadPath ("assets/sotb")
        foreground = TLN_LoadTilemap ("SOTB_fg.tmx", NULL)
        background = TLN_LoadTilemap ("SOTB_bg.tmx", NULL)
        TLN_SetLayerTilemap (LAYER_FOREGROUND, foreground)
        TLN_SetLayerTilemap (LAYER_BACKGROUND, background)

        spriteset = TLN_LoadSpriteset ("SOTB")
        walk = TLN_CreateSpriteSequence (NULL, spriteset, "walk", 6)

        TLN_SetSpriteSet (0, spriteset)
        TLN_SetSpritePosition (0, 200, 160)
        TLN_SetSpriteAnimation (0, walk, 0)

        xpos = 2000

        sky_hi_r = sky[1][1]
        sky_hi_g = sky[1][2]
        sky_hi_b = sky[1][3]
        sky_lo_r = sky[2][1]
        sky_lo_g = sky[2][2]
        sky_lo_b = sky[2][3]

    /* main loop */
        TLN_CreateWindow (NULL, 0)
        TLN_DisableCRTEffect()

```

(continues on next page)

(continued from previous page)

```

while (TLN_ProcessWindow ())
{
    if (xpos < max_xpos)
    {
        xpos += speed
        if (xpos >= max_xpos)
        {
            TLN_DisableSpriteAnimation (0)
            TLN_SetSpritePicture (0, 0)
        }
    }

    /* sky gradient */
    if (frame>=300 && frame<=900)
    {
        /* interpolate upper color */
        sky_hi_r = lerp (frame, 300, 900, sky[1][1], sky[3][1])
        sky_hi_g = lerp (frame, 300, 900, sky[1][2], sky[3][2])
        sky_hi_b = lerp (frame, 300, 900, sky[1][3], sky[3][3])

        /* interpolate lower color */
        sky_lo_r = lerp (frame, 300, 900, sky[2][1], sky[4][1])
        sky_lo_g = lerp (frame, 300, 900, sky[2][2], sky[4][2])
        sky_lo_b = lerp (frame, 300, 900, sky[2][3], sky[4][3])
    }

    TLN_SetLayerPosition (LAYER_FOREGROUND, xpos, 0)

    /* render to the window */
    TLN_DrawFrame (frame)
    frame++
}

/* release resources */
TLN_DeleteSequence(walk)
TLN_DeleteTilemap (foreground)
TLN_DeleteTilemap (background)
TLN_Deinit ()

func raster_callback

    line = TLN_GetScanLine()
    pos = 0

    /* sky color */
    if (line < 192)
    {
        //color = new RGB
        /* interpolate between upper and lower color */
        r = lerp (line, 0, 191, sky_hi_r, sky_lo_r)
        g = lerp (line, 0, 191, sky_hi_g, sky_lo_g)
        b = lerp (line, 0, 191, sky_hi_b, sky_lo_b)
    }
}

```

(continues on next page)

(continued from previous page)

```

        TLN_SetBGColor (r, g ,b)
    }

/* background layer */
pos = -1
if (line = 0 || line = 24 || line = 64 || line = 88 || line = 96)
    pos = lerp (line, 0,96, xpos*0.7 , xpos*0.2 )
elseif (line = 120)
    pos = xpos/2
elseif (line = 208 || line = 216 || line = 224 || line = 232)
    pos = lerp (line,208,232,xpos*1,xpos*2)
ok

if (pos != -1)
    TLN_SetLayerPosition (LAYER_BACKGROUND, pos, 0)
ok

/* foreground layer */
pos = -1
if (line = 0)
    pos = xpos
elseif (line = 216)
    pos = xpos*3
ok
if (pos != -1)
    TLN_SetLayerPosition (LAYER_FOREGROUND, pos, 0)
ok

func lerp x,x0,x1,fx0,fx1
/* linear interpolation */
return (fx0 + (fx1-fx0)*(x-x0)/(x1-x0))

```

Screen Shot:



Example (9):

```

load "tilengine.ring"

WIDTH      = 400
HEIGHT     = 240

MIN_SCALE  = 50
MAX_SCALE   = 200

/* RGB sky colors */
sky = [
    [0x19, 0x54, 0x75],
    [0x2C, 0xB0, 0xDC]
]

/* layers */
LAYER_FOREGROUND = 0
LAYER_BACKGROUND = 1
MAX_LAYER = 2

xpos=0 ypos=0 scale=0

/* entry point */
func main

    /* setup engine */
    TLN_Init (WIDTH, HEIGHT, MAX_LAYER, 0, 0)
    TLN_SetBGColor (34,136,170)

```

(continues on next page)

(continued from previous page)

```

TLN_SetRasterCallback ("raster_callback()")

/* load resources */
TLN_SetLoadPath ("assets/fox")
foreground = TLN_LoadTilemap ("psycho.tmx", NULL)
background = TLN_LoadTilemap ("rolo.tmx", NULL)
TLN_SetLayerTilemap (LAYER_FOREGROUND, foreground)
TLN_SetLayerTilemap (LAYER_BACKGROUND, background)

/* initial values */
xpos = 0
ypos = 192
scale = 100

/* main loop */
TLN_CreateWindow (NULL, 0)
TLN_DisableCRTEffect()
while TLN_ProcessWindow ()
    /* user input */
    if TLN_GetInput (INPUT_LEFT)
        xpos-- ok
    if TLN_GetInput (INPUT_RIGHT)
        xpos++ ok
    if TLN_GetInput (INPUT_UP) && ypos > 0
        ypos-- ok
    if TLN_GetInput (INPUT_DOWN)
        ypos++ ok
    if TLN_GetInput (INPUT_A) && scale < MAX_SCALE
        scale += 1 ok
    if TLN_GetInput (INPUT_B) && scale > MIN_SCALE
        scale -= 1 ok

    /* calculate scale factor from fixed point base */
    fgyscale = scale/100.0f
    bgyscale = lerp(scale, MIN_SCALE,MAX_SCALE, 0.75,1.5)

    /* scale dependant lower clipping */
    maxy = 640 - (240*100/scale)
    if ypos > maxy
        ypos = maxy
    ok

    /* update position */
    bgypos = lerp(scale,MIN_SCALE,MAX_SCALE, 0,80)
    TLN_SetLayerPosition (LAYER_FOREGROUND, xpos*2, ypos)
    TLN_SetLayerPosition (LAYER_BACKGROUND, xpos, bgypos)
    TLN_SetLayerScaling (LAYER_FOREGROUND, fgyscale, fgyscale)
    TLN_SetLayerScaling (LAYER_BACKGROUND, bgyscale, bgyscale)

    /* render to the window */
    TLN_DrawFrame (0)
end

```

(continues on next page)

(continued from previous page)

```

/* release resources */
TLN_DeleteTilemap (foreground)
TLN_DeleteTilemap (background)
TLN_Deinit ()

/* sky color gradient with raster effect */
func raster_callback
    line = TLN_GetScanLine()
    if line <= 152
        r = lerp (line, 0,152, sky[1][1], sky[2][1])
        g = lerp (line, 0,152, sky[1][2], sky[2][2])
        b = lerp (line, 0,152, sky[1][3], sky[2][3])
        TLN_SetBGColor (r, g, b)
    ok

/* linear interpolation */
func lerp x,x0,x1,fx0,fx1
    return (fx0) + ((fx1) - (fx0))*((x) - (x0))/((x1) - (x0))

```

Screen Shot:



Example (10):

```

load "tilengine.ring"

WIDTH      = 400
HEIGHT   = 240

```

(continues on next page)

(continued from previous page)

```

sky = [
    [0x1B, 0x00, 0x8B],
    [0x00, 0x74, 0xD7],
    [0x24, 0x92, 0xDB],
    [0x1F, 0x7F, 0xBE]
]

/* layers */
LAYER_FOREGROUND = 0
LAYER_BACKGROUND = 1
MAX_LAYER = 2

pos_foreground = 0
pos_background = list(6)
inc_background = list(6)
speed = 0
ypos = 0

color = list(3)

/* entry point */
func main

    /* setup engine */
    TLN_Init (WIDTH, HEIGHT, MAX_LAYER, 0, 1)
    TLN_SetRasterCallback ("raster_callback()")
    TLN_SetBGColor (0,128,238)

    /* load resources*/
    TLN_SetLoadPath ("assets/sonic")
    foreground = TLN_LoadTilemap ("Sonic_md_fg1.tmx", NULL)
    background = TLN_LoadTilemap ("Sonic_md_bg1.tmx", NULL)
    TLN_SetLayerTilemap (LAYER_FOREGROUND, foreground)
    TLN_SetLayerTilemap (LAYER_BACKGROUND, background)
    sp = TLN_LoadSequencePack ("Sonic_md_seq.sqx")
    sequence = TLN_FindSequence (sp, "seq_water")

    /* assign color sequence to various entries in palette */
    palette = TLN_GetLayerPalette (LAYER_BACKGROUND)
    TLN_SetPaletteAnimation (TLN_GetAvailableAnimation(), palette, sequence, true)

    /* compute increments for variable background scrolling speeds */
    inc_background[1] = 0.562f
    inc_background[2] = 0.437f
    inc_background[3] = 0.375f
    inc_background[4] = 0.625f
    inc_background[5] = 1.0f
    inc_background[6] = 2.0f

    /* startup display */
    TLN_CreateWindow (NULL, 0)

```

(continues on next page)

(continued from previous page)

```

/* main loop */
while TLN_ProcessWindow ()
    if TLN_GetInput (INPUT_RIGHT)
        speed += 0.02
        if speed > 1.0
            speed = 1.0f
        ok
    elseif speed > 0.0
        speed -= 0.02
        if speed < 0.0
            speed = 0.0f
        ok
    ok

    if TLN_GetInput (INPUT_LEFT)
        speed -= 0.02
        if speed < -1
            speed = -1
        ok
    elseif speed < 0
        speed += 0.02
        if speed > 0
            speed = 0
        ok
    ok

    /* scroll */
    pos_foreground += 3*speed
    TLN_SetLayerPosition (LAYER_FOREGROUND, pos_foreground, ypos)
    for c=1 to 6
        pos_background[c] += (inc_background[c] * speed)
    next

    /* render to window */
    TLN_DrawFrame (0)
end

/* deinit */
TLN_DeleteTilemap (foreground)
TLN_DeleteTilemap (background)
TLN_DeleteSequencePack (sp)
TLN_Deinit ()

/* raster callback (virtual HBLANK) */
func raster_callback

    line = TLN_GetScanLine()
    pos -= 1

    if line=0
        pos = pos_background[1]

```

(continues on next page)

(continued from previous page)

```

elseif line=32
    pos = pos_background[2]
elseif line=48
    pos = pos_background[3]
elseif line=64
    pos = pos_background[4]
elseif line=112
    pos = pos_background[5]
elseif line >= 152
    pos = lerp (line, 152,224, pos_background[5], pos_background[6])
ok

if pos != -1
    TLN_SetLayerPosition (LAYER_BACKGROUND, pos, 0)
ok

/* background color gradients */
if line < 112
    InterpolateColor (line, 0,112, sky[1], sky[2], color)
    TLN_SetBGColor (color[1], color[2], color[3])
elseif line >= 144
    InterpolateColor (line, 144,HEIGHT, sky[3], sky[4], color)
    TLN_SetBGColor (color[1], color[2], color[3])
ok

func InterpolateColor v,v1,v2,color1,color2,result
    result[1] = lerp (v, v1,v2, color1[1], color2[1])
    result[2] = lerp (v, v1,v2, color1[2], color2[2])
    result[3] = lerp (v, v1,v2, color1[3], color2[3])

/* linear interpolation */
func lerp x,x0,x1,fx0,fx1
    return (fx0) + ((fx1) - (fx0))*((x) - (x0))/((x1) - (x0))

```

Screen Shot:



61.3 Using LibSDL and Tilengine

Example (11):

```

load "tilengine.ring"
load "libsdl.ring"

width  = 640
height = 480

func main

    # Start Tilengine
    TLM_Init(width, height, 2, 80, 0)

    # Start LibSDL
    SDL_Init(SDL_INIT_EVERYTHING)
    win = SDL_CreateWindow("Using LibSDL and Tilengine", 100, 100, width, ↴
    ↴height, SDL_WINDOW_SHOWN|SDL_WINDOW_OPENGL)
    ren = SDL_CreateRenderer(win, -1, SDL_RENDERER_ACCELERATED | SDL_ ↴
    ↴RENDERER_PRESENTVSYNC )

    # Create the Surface in LibSDL that will be used by Tilengine for Drawing
    surface = SDL_CreateRGBSurface(0, width, height, 32, 0,0,0,0)
    # Get the Surface Pixels pointer from the Surface Structure
    pixels = SDL_Get_SDL_Surface_Pixels(surface)
    # Pass the Pixels pointer to Tilengine

```

(continues on next page)

(continued from previous page)

```

TLN_SetRenderTarget(pixels, width * 4)

# Using Tilengine
TLN_SetLoadPath("assets\sonic")
foreground = TLN_LoadTilemap ("Sonic_md_fg1.tmx", NULL)
TLN_SetLayerTilemap(0, foreground)

# Using LibSDL Events Loop
oEvent = SDL_New	SDL_Event()

while true

    # Using Tilengine to Update the Frame
    TLN_UpdateFrame(0)

    # Draw Tilengine results using LibSDL
    # ( Surface --> Texture --> Render)
    tex = SDL_CreateTextureFromSurface(ren, surface);
    SDL_RenderCopy2(ren,tex)
    SDL_DestroyTexture(tex)

    # Draw Rectangle using LibSDL
    rect = SDL_New	SDL_Rect()
    SDL_Set	SDL_Rect_x(rect,10)
    SDL_Set	SDL_Rect_y(rect,10)
    SDL_Set	SDL_Rect_w(rect,100)
    SDL_Set	SDL_Rect_h(rect,100)
    SDL_SetRenderDrawColor(ren,255,255,255,255)
    SDL_RenderDrawRect(ren,rect)
    SDL_Destroy	SDL_Rect(rect)

    # Display Results using LibSDL
    SDL_RenderPresent(ren)

    # Check Events

    SDL_PollEvent(oEvent)
    switch SDL_Get	SDL_Event_Type(oEvent)
        on SDL_Get	SDL_Quit()
            exit
        on SDL_Get	SDL_KeyDown()
            Key = SDL_Get_
            ↵SDL_Event_key_KeySym(oEvent)
            if key = 27 exit_
        ok
            off
    end

    # End of Tilengine Usage
    TLN_Deinit()

    # End of LibSDL Usage

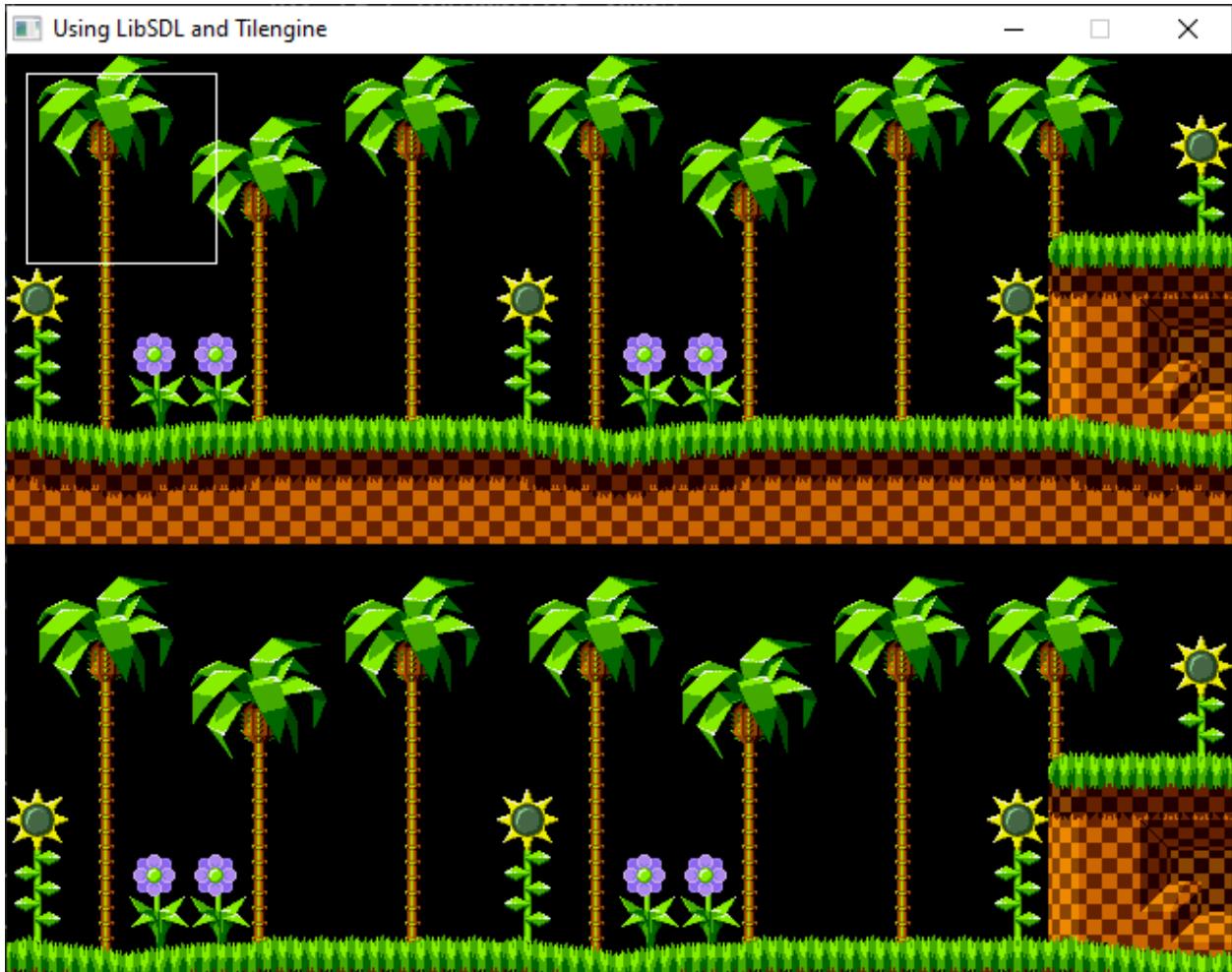
```

(continues on next page)

(continued from previous page)

```
SDL_DestroyWindow(win)
SDL_Quit()
```

Screen Shot:



Example (12):

```
load "tilengine.ring"
load "libsdl.ring"

factor = 3
width  = 400*factor
height = 220*factor

func main

    # Start Tilengine
    TLN_Init(width, height, 2, 80, 0)

    # Start LibSDL
    SDL_Init(SDL_INIT_EVERYTHING)
```

(continues on next page)

(continued from previous page)

```

        win = SDL_CreateWindow("Using LibSDL and Tilengine", 40, 40, width,
    ↳height, SDL_WINDOW_SHOWN|SDL_WINDOW_OPENGL)
        ren = SDL_CreateRenderer(win, -1, SDL_RENDERER_ACCELERATED | SDL_
    ↳RENDERER_PRESENTVSYNC )

        # Create the Surface in LibSDL that will be used by Tilengine for Drawing
        surface = SDL_CreateRGBSurface(0, width, height, 32, 0,0,0,0)
        # Get the Surface Pixels pointer from the Surface Structure
        pixels = SDL_Get_SDL_Surface_Pixels(surface)
        # Pass the Pixels pointer to Tilengine
        TLN_SetRenderTarget(pixels, width * 4)

        # Using Tilengine
        TLN_SetLoadPath("assets\sonic")
        foreground = TLN_LoadTilemap ("Sonic_md_fg1.tmx", NULL)
        TLN_SetLayerTilemap(0, foreground)

        # Using LibSDL Events Loop
        oEvent = SDL_New	SDL_Event()

        while true

            # Using Tilengine to Update the Frame
            TLN_UpdateFrame(0)

            # Draw Tilengine results using LibSDL
            # ( Surface --> Texture --> Render)
            tex = SDL_CreateTextureFromSurface(ren, surface);

            rectSource = SDL_New	SDL_Rect()
            SDL_Set	SDL_Rect_x(rectSource,0)
            SDL_Set	SDL_Rect_y(rectSource,0)
            SDL_Set	SDL_Rect_w(rectSource,400)
            SDL_Set	SDL_Rect_h(rectSource,220)

            rectDest = SDL_New	SDL_Rect()
            SDL_Set	SDL_Rect_x(rectDest,0)
            SDL_Set	SDL_Rect_y(rectDest,0)
            SDL_Set	SDL_Rect_w(rectDest,width)
            SDL_Set	SDL_Rect_h(rectDest,height)

            SDL_RenderCopy(ren,tex,rectSource,rectDest)
            SDL_Destroy	SDL_Rect(rectSource)
            SDL_Destroy	SDL_Rect(rectDest)
            SDL_DestroyTexture(tex)

            # Draw Rectangle using LibSDL
            rect = SDL_New	SDL_Rect()
            SDL_Set	SDL_Rect_x(rect,40)
            SDL_Set	SDL_Rect_y(rect,5)
            SDL_Set	SDL_Rect_w(rect,230)
            SDL_Set	SDL_Rect_h(rect,200)

```

(continues on next page)

(continued from previous page)

```

        SDL_SetRenderDrawColor(ren,255,255,255,255)
        SDL_RenderDrawRect(ren,rect)
        SDL_Destroy	SDL_Rect(rect)

# Display Results using LibSDL
        SDL_RenderPresent(ren)

# Check Events

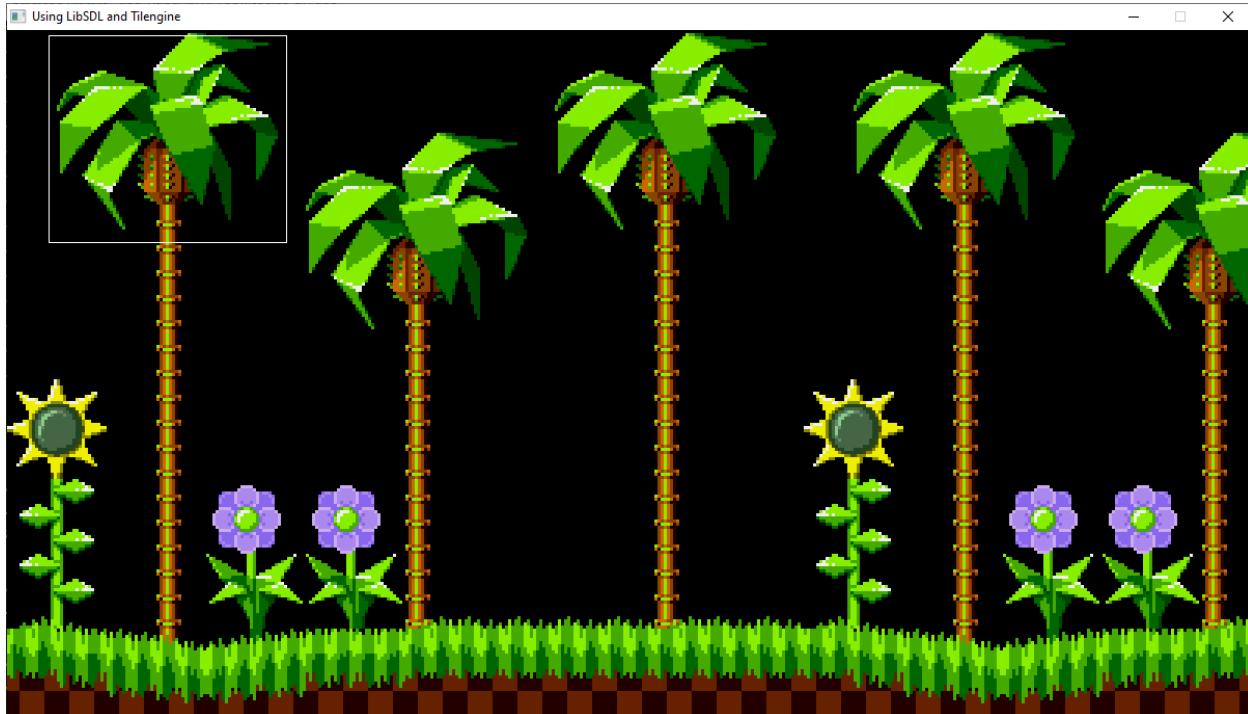
        SDL_PollEvent(oEvent)
        switch SDL_Get_SDL_Event_Type(oEvent)
            on SDL_Get_SDL_Quit()
                exit
            on SDL_Get_SDL_Keydown()
                Key = SDL_Get_
    ↪SDL_Event_key_Keysym_Sym(oEvent)
    ↪ok
                off
        end

# End of Tilengine Usage
        TLN_Deinit()

# End of LibSDL Usage
        SDL_DestroyWindow(win)
        SDL_Quit()

```

Screen Shot:



61.4 Reference

Constants:

- TILEENGINE_VER_MAJ
- TILEENGINE_VER_MIN
- TILEENGINE_VER_REV
- TILEENGINE_HEADER_VERSION
- FLAG_NONE
- FLAG_FLIPX
- FLAG_FLIPY
- FLAG_ROTATE
- FLAG_PRIORITY
- FLAG_MASKED
- BLEND_NONE
- BLEND_MIX25
- BLEND_MIX50
- BLEND_MIX75
- BLEND_ADD
- BLEND_SUB
- BLEND_MOD
- BLEND_CUSTOM
- MAX_BLEND
- BLEND_MIX
- TLN_OVERLAY_NONE
- TLN_OVERLAY_SHADOWMASK
- TLN_OVERLAY_APERTURE
- TLN_OVERLAY_SCANLINES
- TLN_OVERLAY_CUSTOM
- TLN_MAX_OVERLAY
- PLAYER1
- PLAYER2
- PLAYER3
- PLAYER4
- INPUT_NONE
- INPUT_UP
- INPUT_DOWN

- INPUT_LEFT
- INPUT_RIGHT
- INPUT_BUTTON1
- INPUT_BUTTON2
- INPUT_BUTTON3
- INPUT_BUTTON4
- INPUT_BUTTON5
- INPUT_BUTTON6
- INPUT_START
- INPUT_QUIT
- INPUT_CRT
- INPUT_P1
- INPUT_P2
- INPUT_P3
- INPUT_P4
- INPUT_A
- INPUT_B
- INPUT_C
- INPUT_D
- INPUT_E
- INPUT_F
- CWF_FULLSCREEN
- CWF_VSYNC
- CWF_S1
- CWF_S2
- CWF_S3
- CWF_S4
- CWF_S5
- TLN_ERR_OK
- TLN_ERR_OUT_OF_MEMORY
- TLN_ERR_IDX_LAYER
- TLN_ERR_IDX_SPRITE
- TLN_ERR_IDX_ANIMATION
- TLN_ERR_IDX_PICTURE
- TLN_ERR_REF_TILESET
- TLN_ERR_REF_TILEMAP

- TLN_ERR_REF_SPRITESSET
- TLN_ERR_REF_PALETTE
- TLN_ERR_REF_SEQUENCE
- TLN_ERR_REF_SEQPACK
- TLN_ERR_REF_BITMAP
- TLN_ERR_NULL_POINTER
- TLN_ERR_FILE_NOT_FOUND
- TLN_ERR_WRONG_FORMAT
- TLN_ERR_WRONG_SIZE
- TLN_ERR_UNSUPPORTED
- TLN_ERR_REF_LIST
- TLN_MAX_ERR
- TLN_LOG_NONE
- TLN_LOG_ERRORS
- TLN_LOG_VERBOSE

Functions:

- TLN_Engine TLN_Init(int hres, int vres, int numlayers, int numsprites, int numanimations)
- void TLN_Deinit(void)
- bool TLN_DeleteContext(TLN_Engine context)
- bool TLN_SetContext(TLN_Engine context)
- TLN_Engine TLN_GetContext(void)
- int TLN_GetWidth(void)
- int TLN_GetHeight(void)
- uint32_t TLN_GetNumObjects(void)
- uint32_t TLN_GetUsedMemory(void)
- uint32_t TLN_GetVersion(void)
- int TLN_GetNumLayers(void)
- int TLN_GetNumSprites(void)
- void TLN_SetBGColor(uint8_t r, uint8_t g, uint8_t b)
- bool TLN_SetBGColorFromTilemap(TLN_Tilemap tilemap)
- void TLN_DisableBGColor(void)
- bool TLN_SetBGBitmap(TLN_Bitmap bitmap)
- bool TLN_SetBGPalette(TLN_Palette palette)
- void TLN_SetRenderTarget(uint8_t* data, int pitch)
- void TLN_UpdateFrame(int frame)
- void TLN_SetLoadPath(const char * path)

- void TLN_SetCustomBlendFunction(TLN_BlfFunction)
- void TLN_SetLogLevel(TLN_LogLevel log_level)
- bool TLN_OpenResourcePack(const char * filename, const char * key)
- void TLN_CloseResourcePack(void)
- void TLN_SetLastError(TLN_Error error)
- TLN_Error TLN_GetLastError(void)
- const char *TLN_GetErrorString(TLN_Error error)
- bool TLN_CreateWindow(const char * overlay, int flags)
- bool TLN_CreateWindowThread(const char * overlay, int flags)
- void TLN_SetWindowTitle(const char * title)
- bool TLN_ProcessWindow(void)
- bool TLN_IsWindowActive(void)
- bool TLN_GetInput(TLN_Input id)
- void TLN_EnableInput(TLN_Player player, bool enable)
- void TLN_AssignInputJoystick(TLN_Player player, int index)
- void TLN_DefineInputKey(TLN_Player player, TLN_Input input, uint32_t keycode)
- void TLN_DefineInputButton(TLN_Player player, TLN_Input input, uint8_t joybutton)
- void TLN_DrawFrame(int frame)
- void TLN_WaitRedraw(void)
- void TLN_DeleteWindow(void)
- void TLN_EnableBlur(bool mode)
- void TLN_EnableCRTEffect(TLN_Overlay overlay, uint8_t overlay_factor, uint8_t threshold, uint8_t v0, uint8_t v1, uint8_t v2, uint8_t v3, bool blur, uint8_t glow_factor)
- void TLN_DisableCRTEffect(void)
- void TLN_Delay(uint32_t msecs)
- uint32_t TLN_GetTicks(void)
- int TLN_GetWindowWidth(void)
- int TLN_GetWindowHeight(void)
- TLN_Spriteset TLN_CreateSpriteset(TLN_Bitmap bitmap, TLN_SpriteData* data, int num_entries)
- TLN_Spriteset TLN_LoadSpriteset(const char * name)
- TLN_Spriteset TLN_CloneSpriteset(TLN_Spriteset src)
- bool TLN_GetSpriteInfo(TLN_Spriteset spriteset, int entry, TLN_SpriteInfo* info)
- TLN_Palette TLN_GetSpritesetPalette(TLN_Spriteset spriteset)
- int TLN_FindSpritesetSprite(TLN_Spriteset spriteset, const char * name)
- bool TLN_SetSpritesetData(TLN_Spriteset spriteset, int entry, TLN_SpriteData* data, void* pixels, int pitch)
- bool TLN_DeleteSpriteset(TLN_Spriteset Spriteset)

- `TLN_Tileset TLN_CreateTileset(int numtiles, int width, int height, TLN_Palette palette, TLN_SequencePack sp, TLN_TileAttributes* attributes)`
- `TLN_Tileset TLN_CreateImageTileset(int numtiles, TLN_TileImage* images)`
- `TLN_Tileset TLN_LoadTileset(const char * filename)`
- `TLN_Tileset TLN_CloneTileset(TLN_Tileset src)`
- `bool TLN_SetTilesetPixels(TLN_Tileset tileset, int entry, uint8_t* srldata, int srcpitch)`
- `int TLN_GetTileWidth(TLN_Tileset tileset)`
- `int TLN_GetTileHeight(TLN_Tileset tileset)`
- `int TLN_GetTilesetNumTiles(TLN_Tileset tileset)`
- `TLN_Palette TLN_GetTilesetPalette(TLN_Tileset tileset)`
- `TLN_SequencePack TLN_GetTilesetSequencePack(TLN_Tileset tileset)`
- `bool TLN_DeleteTileset(TLN_Tileset tileset)`
- `TLN_Tilemap TLN_CreateTilemap(int rows, int cols, TLN_Tile tiles, uint32_t bgcolor, TLN_Tileset tileset)`
- `TLN_Tilemap TLN_LoadTilemap(const char * filename, const char * layername)`
- `TLN_Tilemap TLN_CloneTilemap(TLN_Tilemap src)`
- `int TLN_GetTilemapRows(TLN_Tilemap tilemap)`
- `int TLN_GetTilemapCols(TLN_Tilemap tilemap)`
- `TLN_Tileset TLN_GetTilemapTileset(TLN_Tilemap tilemap)`
- `bool TLN_GetTilemapTile(TLN_Tilemap tilemap, int row, int col, TLN_Tile tile)`
- `bool TLN_SetTilemapTile(TLN_Tilemap tilemap, int row, int col, TLN_Tile tile)`
- `bool TLN_CopyTiles(TLN_Tilemap src, int srcrow, int srccol, int rows, int cols, TLN_Tilemap dst, int dstrow, int dstcol)`
- `bool TLN_DeleteTilemap(TLN_Tilemap tilemap)`
- `TLN_Palette TLN_CreatePalette(int entries)`
- `TLN_Palette TLN_LoadPalette(const char * filename)`
- `TLN_Palette TLN_ClonePalette(TLN_Palette src)`
- `bool TLN_SetPaletteColor(TLN_Palette palette, int color, uint8_t r, uint8_t g, uint8_t b)`
- `bool TLN_MixPalettes(TLN_Palette src1, TLN_Palette src2, TLN_Palette dst, uint8_t factor)`
- `bool TLN_AddPaletteColor(TLN_Palette palette, uint8_t r, uint8_t g, uint8_t b, uint8_t start, uint8_t num)`
- `bool TLN_SubPaletteColor(TLN_Palette palette, uint8_t r, uint8_t g, uint8_t b, uint8_t start, uint8_t num)`
- `bool TLN_ModPaletteColor(TLN_Palette palette, uint8_t r, uint8_t g, uint8_t b, uint8_t start, uint8_t num)`
- `uint8_t* TLN_GetPaletteData(TLN_Palette palette, int index)`
- `bool TLN_DeletePalette(TLN_Palette palette)`
- `TLN_Bitmap TLN_CreateBitmap(int width, int height, int bpp)`
- `TLN_Bitmap TLN_LoadBitmap(const char * filename)`
- `TLN_Bitmap TLN_CloneBitmap(TLN_Bitmap src)`
- `uint8_t* TLN_GetBitmapPtr(TLN_Bitmap bitmap, int x, int y)`

- int TLN_GetBitmapWidth(TLN_Bitmap bitmap)
- int TLN_GetBitmapHeight(TLN_Bitmap bitmap)
- int TLN_GetBitmapDepth(TLN_Bitmap bitmap)
- int TLN_GetBitmapPitch(TLN_Bitmap bitmap)
- TLN_Palette TLN_GetBitmapPalette(TLN_Bitmap bitmap)
- bool TLN_SetBitmapPalette(TLN_Bitmap bitmap, TLN_Palette palette)
- bool TLN_DeleteBitmap(TLN_Bitmap bitmap)
- TLN_ObjectList TLN_CreateObjectList(void)
- bool TLN_AddTileObjectToList(TLN_ObjectList list, uint16_t id, uint16_t gid, uint16_t flags, int x, int y)
- TLN_ObjectList TLN_LoadObjectList(const char * filename, const char * layername)
- TLN_ObjectList TLN_CloneObjectList(TLN_ObjectList src)
- int TLN_GetListNumObjects(TLN_ObjectList list)
- bool TLN_GetListObject(TLN_ObjectList list, TLN_ObjectInfo* info)
- bool TLN_DeleteObjectList(TLN_ObjectList list)
- bool TLN_SetLayer(int nlayer, TLN_Tileset tileset, TLN_Tilemap tilemap)
- bool TLN_SetLayerTilemap(int nlayer, TLN_Tilemap tilemap)
- bool TLN_SetLayerBitmap(int nlayer, TLN_Bitmap bitmap)
- bool TLN_SetLayerPalette(int nlayer, TLN_Palette palette)
- bool TLN_SetLayerPosition(int nlayer, int hstart, int vstart)
- bool TLN_SetLayerScaling(int nlayer, float xfactor, float yfactor)
- bool TLN_SetLayerAffineTransform(int nlayer, TLN_Affine *affine)
- bool TLN_SetLayerTransform(int layer, float angle, float dx, float dy, float sx, float sy)
- bool TLN_SetLayerPixelMapping(int nlayer, TLN_PixelMap* table)
- bool TLN_SetLayerBlendMode(int nlayer, TLN_Blend mode, uint8_t factor)
- bool TLN_SetLayerColumnOffset(int nlayer, int* offset)
- bool TLN_SetLayerClip(int nlayer, int x1, int y1, int x2, int y2)
- bool TLN_DisableLayerClip(int nlayer)
- bool TLN_SetLayerMosaic(int nlayer, int width, int height)
- bool TLN_DisableLayerMosaic(int nlayer)
- bool TLN_ResetLayerMode(int nlayer)
- bool TLN_SetLayerObjects(int nlayer, TLN_ObjectList objects, TLN_Tileset tileset)
- bool TLN_SetLayerPriority(int nlayer, bool enable)
- bool TLN_SetLayerParent(int nlayer, int parent)
- bool TLN_DisableLayerParent(int nlayer)
- bool TLN_DisableLayer(int nlayer)
- TLN_Palette TLN_GetLayerPalette(int nlayer)

- `bool TLN_GetLayerTile(int nlayer, int x, int y, TLN_TileInfo* info)`
- `int TLN_GetLayerWidth(int nlayer)`
- `int TLN_GetLayerHeight(int nlayer)`
- `bool TLN_ConfigSprite(int nsprite, TLN_Spriteset spriteset, uint32_t flags)`
- `bool TLN_SetSpriteSet(int nsprite, TLN_Spriteset spriteset)`
- `bool TLN_SetSpriteFlags(int nsprite, uint32_t flags)`
- `bool TLN_EnableSpriteFlag(int nsprite, uint32_t flag, bool enable)`
- `bool TLN_SetSpritePosition(int nsprite, int x, int y)`
- `bool TLN_SetSpritePicture(int nsprite, int entry)`
- `bool TLN_SetSpritePalette(int nsprite, TLN_Palette palette)`
- `bool TLN_SetSpriteBlendMode(int nsprite, TLN_Blend mode, uint8_t factor)`
- `bool TLN_SetSpriteScaling(int nsprite, float sx, float sy)`
- `bool TLN_ResetSpriteScaling(int nsprite)`
- `int TLN_GetSpritePicture(int nsprite)`
- `int TLN_GetAvailableSprite(void)`
- `bool TLN_EnableSpriteCollision(int nsprite, bool enable)`
- `bool TLN_GetSpriteCollision(int nsprite)`
- `bool TLN_GetSpriteState(int nsprite, TLN_SpriteState* state)`
- `bool TLN_SetFirstSprite(int nsprite)`
- `bool TLN_SetNextSprite(int nsprite, int next)`
- `bool TLN_EnableSpriteMasking(int nsprite, bool enable)`
- `void TLN_SetSpritesMaskRegion(int top_line, int bottom_line)`
- `bool TLN_SetSpriteAnimation(int nsprite, TLN_Sequence sequence, int loop)`
- `bool TLN_DisableSpriteAnimation(int nsprite)`
- `bool TLN_DisableSprite(int nsprite)`
- `TLN_Palette TLN_GetSpritePalette(int nsprite)`
- `TLN_Sequence TLN_CreateSequence(const char * name, int target, int num_frames, TLN_SequenceFrame* frames)`
- `TLN_Sequence TLN_CreateCycle(const char * name, int num_strips, TLN_ColorStrip* strips)`
- `TLN_Sequence TLN_CreateSpriteSequence(const char * name, TLN_Spriteset spriteset, const char * basename, int delay)`
- `TLN_Sequence TLN_CloneSequence(TLN_Sequence src)`
- `bool TLN_GetSequenceInfo(TLN_Sequence sequence, TLN_SequenceInfo* info)`
- `bool TLN_DeleteSequence(TLN_Sequence sequence)`
- `TLN_SequencePack TLN_CreateSequencePack(void)`
- `TLN_SequencePack TLN_LoadSequencePack(const char * filename)`
- `TLN_Sequence TLN_GetSequence(TLN_SequencePack sp, int index)`

- `TLN_Sequence TLN_FindSequence(TLN_SequencePack sp, const char * name)`
- `int TLN_GetSequencePackCount(TLN_SequencePack sp)`
- `bool TLN_AddSequenceToPack(TLN_SequencePack sp, TLN_Sequence sequence)`
- `bool TLN_DeleteSequencePack(TLN_SequencePack sp)`
- `bool TLN_SetPaletteAnimation(int index, TLN_Palette palette, TLN_Sequence sequence, bool blend)`
- `bool TLN_SetPaletteAnimationSource(int index, TLN_Palette)`
- `bool TLN_GetAnimationState(int index)`
- `bool TLN_SetAnimationDelay(int index, int frame, int delay)`
- `int TLN_GetAvailableAnimation(void)`
- `bool TLN_DisablePaletteAnimation(int index)`
- `void TLN_SetRasterCallback(const char *cCode)`
- `void TLN_SetFrameCallback(const char *cCode)`
- `void TLN_SetSDLCallback(const char *cCode)`
- `int TLN_GetScanLine(void)`
- `SDL_Event *TLN_GetSDLEvent(void)`

CHAPTER
SIXTYTWO

PERFORMANCE TIPS

In this chapter we will learn more about the Ring performance.

Tested using Victus Laptop [13th Gen Intel(R) Core(TM) i7-13700H, Windows 11, Ring 1.21]

62.1 Introduction

Ring is designed to be a simple, small and flexible language in the first place, but also it is fast enough for many applications.

Ring can do each of the following tasks in around one second.

- (1) Compiling 200,000 lines of code
- (2) Executing an empty loop that count from 1 to 100,000,000
- (3) Creating list contains 7,000,000 items then summing all of the list items
- (4) Printing numbers from 1 to 40,000 using command prompt
- (5) Printing numbers from 1 to 500,000 using output redirection and Ring Notepad
- (6) Adding 60,000 nodes to the TreeWidget in GUI applications
- (7) Adding 60,000 items to the ListView in GUI applications
- (8) Executing 3000 search operations using linear search in a list contains 100,000 items, trying to find the last item
(The worst case)

Also when we need more speed we can use C/C++ extensions!

Example:

```
t1=clock()  
for t=1 to 100_000_000 next  
? (clock()-t1)/clocksperssecond()
```

Output:

```
1.06
```

Example:

```
? "Create list contains 100,000 items"  
nMax = 100_000  
aList = list(nMax)
```

(continues on next page)

(continued from previous page)

```

for t=1 to nMax aList[t] = t next

? "Do 3000 search operations - Find the last item (Worst Case!)"
c = clock()

for t=1 to 3000
    find(alist,nMax)
next

? "Time: " + ( clock() - c ) / clockpersecond() + " seconds"

```

Output:

```

Create list contains 100,000 items
Do 3000 search operations - Find the last item (Worst Case!)
Time: 0.81 seconds

```

Example:

```

load "guilib.ring"

C_NODESCOUNT = 60000

func main
new QApp {
    win = new QWidget() {
        move(100,100) resize(500,500)
        setWindowTitle("Many Tree Items - Testing Performance")
        tree = new QTreeWidget(win) {
            blockSignals(True) setUpdatesEnabled(False)
            root = new qTreeWidgetItem()
            root.setText(0,"The Root Node")
            t1 = clock()
            for t = 1 to C_NODESCOUNT
                oItem = new qTreeWidgetItem()
                oItem.setText(0,"Item " + t)
                root.addChild(oItem)
            next
            cTime = (clock()-t1)/clockpersecond()
            setHeaderLabel("Creating "+C_NODESCOUNT+" nodes in " + cTime + " ↵
seconds.")
            addTopLevelItem(root)
            expandItem(root)
            blockSignals(False) setUpdatesEnabled(True)
        }
        oLayout = new QVBoxLayout() {
            addWidget(tree)
        }
        setLayout(oLayout)
        show()
    }
    exec()
}

```

Output:

```
Creating 60000 nodes in 1.00 seconds.
Item 59981
Item 59982
Item 59983
Item 59984
Item 59985
Item 59986
Item 59987
Item 59988
Item 59989
Item 59990
Item 59991
Item 59992
Item 59993
Item 59994
Item 59995
Item 59996
Item 59997
Item 59998
Item 59999
Item 60000
```

62.2 Creating Lists

Example:

```
decimals(3)
C_COUNT = 100_000

? "Create the list using the Range operator"
t1 = clock()
aList = 1:C_COUNT
? "Time : " + ((clock()-t1)/clockspersisecond()) + " seconds"

? "Create the list using the For loop"
t1 = clock()
aList = []
for x = 1 to C_COUNT
    aList + x
next
? "Time : " + ((clock()-t1)/clockspersisecond()) + " seconds"

? "Create the list using the list() function and the For loop"
t1 = clock()
```

(continues on next page)

(continued from previous page)

```
aList = list(C_COUNT)
for x = 1 to C_COUNT
    aList[x] = x
next
? "Time : " + ((clock()-t1)/clocksperssecond()) + " seconds"
```

Output:

```
Create the list using the Range operator
Time : 0.001 seconds
Create the list using the For loop
Time : 0.009 seconds
Create the list using the list() function and the For loop
Time : 0.012 seconds
```

Note: Creating lists using the Range operator is faster than using the For loop or the list() function

Tip: For large lists we always recommend using the List() function

62.3 Arithmetic Operations

Example:

```
C_COUNT = 1_000_000

? "Using * operator"
t1 = clock()
out = 10
for x = 1 to C_COUNT
    out = out * 2
next
? "Time : " + ((clock()-t1)/clocksperssecond()) + " seconds"

? "Using *= operator"
t1 = clock()
for x = 1 to C_COUNT
    out *= 2
next
? "Time : " + ((clock()-t1)/clocksperssecond()) + " seconds"
```

Output:

```
Using * operator
Time : 0.08 seconds
Using *= operator
Time : 0.07 seconds
```

Note: Using the *= operator is faster than using the * operator

62.4 Using len() and For Loops

Example:

```
aList = 1:1000000

? "Using len() in the For loop"
t1 = clock()
for x = 1 to len(aList)
next
? "Time : " + ((clock()-t1)/clocksperssecond()) + " seconds"

? "Using len() before the For loop"
t1 = clock()
nMax = len(aList)
for x = 1 to nMax
next
? "Time : " + ((clock()-t1)/clocksperssecond()) + " seconds"
```

Output:

```
Using len() in the For loop
Time : 0.06 seconds
Using len() before the For loop
Time : 0.03 seconds
```

Note: Using len() before the For loop is faster than using len() in the For loop.

62.5 Calling Functions and Methods

Example:

```
? "calling 100000 functions"
t1 = clock()
for x = 1 to 100000
    test()
next
? "Time : " + ((clock()-t1)/clocksperssecond()) + " seconds"

o1 = new test

? "calling 100000 methods using the dot operator"
t1 = clock()
for x = 1 to 100000
```

(continues on next page)

(continued from previous page)

```

o1.test()
next
? "Time : " + ((clock()-t1)/clocksperssecond()) + " seconds"

? "calling 100000 methods using braces "
t1 = clock()
for x = 1 to 100000
    o1 { test() }
next
? "Time : " + ((clock()-t1)/clocksperssecond()) + " seconds"

? "calling 100000 methods using braces (outside the loop) "
t1 = clock()
o1 {
for x = 1 to 100000
    test()
next
}
? "Time : " + ((clock()-t1)/clocksperssecond()) + " seconds"

func test

class test
    func test

```

Output:

```

calling 100000 functions
Time : 0.01 seconds
calling 100000 methods using the dot operator
Time : 0.04 seconds
calling 100000 methods using braces
Time : 0.09 seconds
calling 100000 methods using braces (outside the loop)
Time : 0.03 seconds

```

Note: Calling functions is faster than calling methods.

Note: Using the dot operator to call a method is faster than using braces.

Tip: Using braces before the for loop will be faster

CHAPTER
SIXTYTHREE

COMMAND LINE OPTIONS

The ring language takes source code file (*.ring*) or the object file (*.ringo*) as input to execute, also the language provide other options like

Option	Description
-tokens	Print a list of tokens in the source code file
-rules	Print grammar rules applied on the tokens
-ic	Print the intermediate byte code (before execution)
-icfinal	Print the final byte code (after execution)
-cgi	Print http response header before error messages
-norun	Don't run the program after compiling
-ins	Print instruction operation code before execution
-clock	Print clock before and after program execution
-go	Generate Object File
-geo	Generate embedded object file (C source code)
-w	Display Warnings

63.1 Printing Tokens

Example:

```
Func Main
    See "Hello World" + nl
    for x = 1 to 10
        see x + nl
    next
    test()

func test
    see "welcome" + nl
    o1 = new point { x=10 y=20 z=30 }
    see o1

class point x y z
```

Command:

```
ring test.ring -tokens -norun
```

Output:

```
=====
Tokens - Generated by the Scanner
=====
```

```

  Keyword : FUNC
Identifier : main
  EndLine
  Keyword : SEE
  Literal : Hello World
  Operator : +
Identifier : nl
  EndLine
  Keyword : FOR
Identifier : x
  Operator : =
    Number : 1
  Keyword : TO
    Number : 10
  EndLine
  Keyword : SEE
Identifier : x
  Operator : +
Identifier : nl
  EndLine
  Keyword : NEXT
  EndLine
Identifier : test
  Operator : (
  Operator : )
  EndLine
  Keyword : FUNC
Identifier : test
  EndLine
  Keyword : SEE
  Literal : welcome
  Operator : +
Identifier : nl
  EndLine
Identifier : o1
  Operator : =
  Keyword : NEW
Identifier : point
  Operator : {
Identifier : x
  Operator : =
    Number : 10
Identifier : y
  Operator : =
    Number : 20
Identifier : z
  Operator : =
```

(continues on next page)

(continued from previous page)

```

Number : 30
Operator : }
EndLine
Keyword : SEE
Identifier : o1
EndLine
Keyword : CLASS
Identifier : point
Identifier : x
Identifier : y
Identifier : z
EndLine
=====
```

63.2 Printing Rules

Command:

```
ring test.ring -rules -norun
```

Output:

```

=====
Grammar Rules Used by The Parser
=====

Rule : Program --> {Statement}

Line 1
Rule : Statement --> 'Func' Identifier [ParaList]

Line 2
Rule : Factor --> Literal
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus ]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : Arithmetic --> Arithmetic + Arithmetic
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot --> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> 'See' Expr
```

(continues on next page)

(continued from previous page)

```

Line 3
Rule : Factor --> Number
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Factor --> Number
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> 'For' Identifier '=' Expr to Expr ['step' Expr]

```

```

Line 4
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : Arithmetic --> Arithmetic + Arithmetic
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> 'See' Expr

```

```

Line 5
Rule : Next --> 'Next'

```

```

Line 6
Rule : Mixer -> '(' [Expr { ',' Expr} ] ')'

```

```

Line 8

```

(continues on next page)

(continued from previous page)

```

Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> Expr
Rule : Statement --> 'Func' Identifier [ParaList]

```

Line 9

```

Rule : Factor --> Literal
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : Arithmetic --> Arithmetic + Arithmetic
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> 'See' Expr

```

Line 10

```

Rule : Factor --> New Identifier {'.' Identifier }
Rule : Mixer --> '{' {Statement} BraceEnd
Rule : Factor --> Number
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Assignment -> '=' Expr
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term

```

(continues on next page)

(continued from previous page)

```

Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> Expr
Rule : Factor --> Number
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Assignment -> '=' Expr
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> Expr
Rule : Factor --> Number
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Assignment -> '=' Expr
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR

```

(continues on next page)

(continued from previous page)

```

Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> Expr
Rule : BraceEnd --> '}'
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Assignment -> '=' Expr
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> Expr

```

Line 11

```

Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> 'See' Expr

```

Line 13

```

Rule : Statement --> 'Class' Identifier
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd

```

(continues on next page)

(continued from previous page)

```

Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> Expr
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> Expr
Rule : Factor --> Identifier [ {Mixer} | Assignment | PlusPlus | MinusMinus]
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> Expr

```

63.3 Printing Intermediate Code

Command:

```
ring test.ring -ic -norun
```

Output:

PC	OPCode	Data
1	ReturnNull	
2	Func	
3	NewLine	2
4	LoadFunc	ringvm_see

(continues on next page)

(continued from previous page)

5	PushC	Hello World	
6	LoadA	nl	
7	PushV		
8	Sum		
9	Call	0	
10	NoOperation		
11	FreeStack		
12	NewLine	3	
13	SetOPCode	72	34
14	NoOperation		
15	LoadAFirst	x	
16	PushN	1.000000	
17	Assignment		
18	NewLine	3	
19	StepFromReg	1.000000	
20	LoadAPushV	x	
21	PushN	10.000000	
22	JumpFor	35	
23	NewLine	4	
24	LoadFunc	ringvm_see	
25	LoadA	x	
26	PushV		
27	LoadA	nl	
28	PushV		
29	Sum		
30	Call	0	
31	NoOperation		
32	FreeStack		
33	NewLine	5	
34	IncJump	x	21
35	NoOperation	3	
36	PopStep		
37	NewLine	6	
38	LoadFunc	test	
39	Call	0	
40	NoOperation		
41	NewLine	8	
42	PushV		
43	FreeStack		
44	ReturnNull		
45	Func		
46	NewLine	9	
47	LoadFunc	ringvm_see	
48	PushC	welcome	
49	LoadA	nl	
50	PushV		
51	Sum		
52	Call	0	
53	NoOperation		
54	FreeStack		
55	NewLine	10	
56	LoadA	o1	

(continues on next page)

(continued from previous page)

57	AssignmentPointer	0	111
58	New	point	0
59	SetScope		
60	PushV		
61	BraceStart		
62	CheckBraceMethod	bracestart	
63	JumpZ	68	
64	LoadFunc	bracestart	
65	Call		
66	NoOperation		
67	PushV		
68	LoadA	x	
69	AssignmentPointer	0	71
70	PushN	10.000000	
71	Assignment		
72	CheckBraceMethod	braceexpreval	
73	JumpZ	79	
74	LoadFunc	braceexpreval	
75	Dup		
76	Call		
77	NoOperation		
78	PushV		
79	FreeStack		
80	LoadA	y	
81	AssignmentPointer	0	83
82	PushN	20.000000	
83	Assignment		
84	CheckBraceMethod	braceexpreval	
85	JumpZ	91	
86	LoadFunc	braceexpreval	
87	Dup		
88	Call		
89	NoOperation		
90	PushV		
91	FreeStack		
92	LoadA	z	
93	AssignmentPointer	0	95
94	PushN	30.000000	
95	Assignment		
96	CheckBraceMethod	braceexpreval	
97	JumpZ	103	
98	LoadFunc	braceexpreval	
99	Dup		
100	Call		
101	NoOperation		
102	PushV		
103	FreeStack		
104	CheckBraceMethod	braceend	
105	JumpZ	110	
106	LoadFunc	braceend	
107	Call		
108	NoOperation		

(continues on next page)

(continued from previous page)

```

109      PushV
110      BraceEnd
111      Assignment
112      FreeStack
113          NewLine           11
114          LoadFunc        ringvm_see
115              LoadA          o1
116          PushV
117          Call             0
118      NoOperation
119          FreeStack
120          NewLine           13
121      ReturnNull
122          Class            point   000001934ECD9560
123      NewLabel
124          FileName         test.ring
125              LoadA          x
126          PushV
127          FreeStack
128              LoadA          y
129          PushV
130          FreeStack
131              LoadA          z
132          PushV
133          FreeStack
134      ReturnNull

```

63.4 Printing Final Intermediate Code

Command:

```
ring test.ring -icfinal
```

Output:

```
Hello World
1
2
3
4
5
6
7
8
9
10
welcome
x: 10
```

(continues on next page)

(continued from previous page)

```
y: 20
z: 30
```

Byte Code - After Execution by the VM

PC	OPCode	Data
1	ReturnNull	0 0
2	Func	0 0
3	NewLine	2 0
4	LoadFuncP	ringvm_see 00007FFB57B8C640
5	PushC	Hello World 0
6	LoadA	nl 0
7	PushV	0 0
8	Sum	0 0
9	Call	0 0
10	NoOperation	0 0
11	FreeStack	0 0
12	NewLine	3 0
13	SetOPCode	72 34
14	NoOperation	0 0
15	LoadAFirst	x 0
16	PushN	1.000000 0
17	Assignment	0 0
18	NewLine	3 0
19	StepFromReg	1.000000 0
20	LoadAPushV	x 0
21	PushN	10.000000 0
22	JumpFor	35 1
23	NewLine	4 0
24	LoadFuncP	ringvm_see 00007FFB57B8C640
25	PushPLocal	x 0000024816180C48
26	PushV	0 0
27	LoadA	nl 0
28	PushV	0 0
29	Sum	0 0
30	Call	0 0
31	NoOperation	0 0
32	FreeStack	0 0
33	NewLine	5 0
34	IncLPJumpStep1	x 21
35	NoOperation	3 0000024816180DA8
36	PopStep	0 0
37	NewLine	6 0
38	LoadFuncP	test 0000000000000000
39	Call	0 0
40	NoOperation	0 0
41	NewLine	8 0
42	PushV	0 0

(continues on next page)

(continued from previous page)

43	FreeStack	0	0
44	ReturnNull	0	0
45	Func	0	0
46	NewLine	9	0
47	LoadFuncP	ringvm_see	00007FFB57B8C640
48	PushC	welcome	0
49	LoadA	nl	0
50	PushV	0	0
51	Sum	0	0
52	Call	0	0
53	NoOperation	0	0
54	FreeStack	0	0
55	NewLine	10	0
56	LoadA	o1	0
57	AssignmentPointer	0	111
58	New	point	0
59	SetScope	0	0
60	PushV	0	0
61	BraceStart	0	0
62	CheckBraceMethod	bracestart	0
63	JumpZ	68	0
64	LoadFunc	bracestart	0
65	Call	0	0
66	NoOperation	0	0
67	PushV	0	0
68	LoadA	x	0
69	AssignmentPointer	0	71
70	PushN	10.000000	0
71	SetProperty	0	0
72	CheckBraceMethod	braceexpreval	0
73	JumpZ	79	0
74	LoadFunc	braceexpreval	0
75	Dup	0	0
76	Call	0	0
77	NoOperation	0	0
78	PushV	0	0
79	FreeStack	0	0
80	LoadA	y	0
81	AssignmentPointer	0	83
82	PushN	20.000000	0
83	SetProperty	0	0
84	CheckBraceMethod	braceexpreval	0
85	JumpZ	91	0
86	LoadFunc	braceexpreval	0
87	Dup	0	0
88	Call	0	0
89	NoOperation	0	0
90	PushV	0	0
91	FreeStack	0	0
92	LoadA	z	0
93	AssignmentPointer	0	95
94	PushN	30.000000	0

(continues on next page)

(continued from previous page)

95	SetProperty	0	0
96	CheckBraceMethod	braceexpreval	0
97	JumpZ	103	0
98	LoadFunc	braceexpreval	0
99	Dup	0	0
100	Call	0	0
101	NoOperation	0	0
102	PushV	0	0
103	FreeStack	0	0
104	CheckBraceMethod	braceend	0
105	JumpZ	110	0
106	LoadFunc	braceend	0
107	Call	0	0
108	NoOperation	0	0
109	PushV	0	0
110	BraceEnd	0	0
111	Assignment	0	0
112	FreeStack	0	0
113	NewLine	11	0
114	LoadFuncP	ringvm_see	00007FFB57B8C640
115	LoadA	o1	0
116	PushV	0	0
117	Call	0	0
118	NoOperation	0	0
119	FreeStack	0	0
120	NewLine	13	0
121	ReturnNull	0	0
122	Class	point	0000024815FA1D50
123	NewLabel	0	0
124	FileName	test.ring	0
125	LoadA	x	0
126	PushV	0	0
127	FreeStack	0	0
128	LoadA	y	0
129	PushV	0	0
130	FreeStack	0	0
131	LoadA	z	0
132	PushV	0	0
133	FreeStack	0	0
134	ReturnNull	0	0

63.5 CGI Support

Command:

```
ring test.ring -cgi
```

63.6 No Run

Command:

```
ring test.ring -norun
```

63.7 Printing Instruction Operation Code

Command:

```
ring test.ring -ins
```

Output:

```
=====
VM Pointer      : 00000273A5CAACE0
VM IR Pointer  : 00000273A5D543C0
Operation       : ReturnNull
PC              : 1
Scopes Count   : 1
Scope Pointer  : 00000273A5CCA4E0
File Name       : test.ring
Line Number     : 1

SP (After)      : 0
FuncSP          : 0
LineNumber     : 1
=====
```

```
....  
....  
....
```

Tip: Output removed from the previous example because it's very large!

63.8 Clock

Command:

```
ring test.ring -clock
```

Output:

```
=====
Date : 2024/08/19 Time : 20:52:39
Clock : 0
=====
```

```
Hello World
```

```
1
2
3
4
5
6
7
8
9
10
welcome
x: 10
y: 20
z: 30
```

```
=====
Date : 2024/08/19 Time : 20:52:39
Clock : 0
=====
```

63.9 Generate Object File

You can generate object file (*.ringo*) from your source code file (*.ring*) using -go option

Tip: You will get one object file to use for distributing/running your application which may contains one or many ring source files that you can keep or distribute based on the application (commercial or open source).

Command:

```
ring test.ring -go
```

To run the compiled object file

```
ring test.ringo
```

63.10 Generate Embedded Object File

You can generate embedded object file (C source code) from your source code file (*.ring) using -geo option

Command:

```
ring test.ring -geo
```

This command will generate at least three files

```
test.c  
ringappcode.c  
ringappcode.h
```

More files could be generated based on the project size

The generated files will pass the byte code to Ring VM to be executed

CHAPTER
SIXTYFOUR

DISTRIBUTING RING APPLICATIONS (MANUAL)

In this chapter we will learn about distributing Ring applications.

The next method is old and was used in Ring 1.5 and previous versions!

Starting from Ring 1.6 we have a nice tool called Ring2EXE

Using Ring2EXE we can distribute applications quickly for Windows, Linux and macOS

Check the Ring2EXE chapter for more information!

64.1 Distributing Applications for Microsoft Windows

Step 1:

```
Copy c:\ring\bin folder to be for example c:\myapp
```

Step 2:

```
Rename c:\myapp\ring.exe to c:\myapp\myapp.exe
```

Step 3:

```
Create a file c:\myapp\ring.ring
```

And write

```
Load "myapp.ring"
```

When you run myapp.exe the file ring.ring will be executed automatically

So your file myapp.ring will be called and executed

Or just rename myapp.ring to ring.ring

It's a fast way to distribute applications.

64.2 Protecting the Source Code

Step 1:

Execute the next command

```
ring myapp.ring -go
```

This will generate one object file (myapp.ringo) from the project files (*.ring)

Step 2:

```
Rename myapp.ringo to ring.ringo
```

When you run the executable file (ring.exe) or (myapp.exe) the file ring.ringo will be executed.

64.3 The files ring.ring and ring.ringo

Ring will run ring.ring or ring.ringo only when

- (1) The file exist in the current directory
- (2) No file is passed to (ring.exe) to execute

We added the support to ring.ring (and ring.ringo) for a way to distribute Ring apps (before Ring2EXE)

64.4 Creating Windows Installer

There are many tools that you can use to distribute your application.

Check : nullsoft scriptable install system

URL : http://nsis.sourceforge.net/Main_Page

64.5 Using C/C++ Compiler and Linker

Another method to distribute applications is to use a C/C++ compiler.

Ring can be embedded in C/C++ projects, We can create executable files using a C/C++ compiler by embedding the Ring language in our project.

Check the “Embedding Ring Language in C/C++ Programs” chapter.

Using this way we will avoid using ring.ring or ring.ringo files.

64.6 Distributing Applications and Games for Mobile

Ring can be embedded in a Qt projects or LibSDL projects to build Mobile applications and Games.

You can build the Qt project or the LibSDL project and get the Android package directly (*.apk)

Check Ring distributions for Mobile development using Qt or LibSDL.

CHAPTER
SIXTYFIVE

DISTRIBUTING RING APPLICATIONS USING RING2EXE

In this chapter we will learn about distributing Ring applications.

Starting from Ring 1.6 we have a nice tool called Ring2EXE (Written in Ring itself)

Using Ring2EXE we can distribute applications quickly for Windows, Linux, macOS, WebAssembly and Mobile devices

Note: We can use the Distribute Menu in the Ring Notepad application (More Easy)

65.1 Using Ring2EXE

```
ring2exe filename.ring [Options]
```

This will set filename.ring as input to the program

The next files will be generated

filename.ringo	(The Ring Object File - by Ring Compiler)
filename.c	(The C Source code file Contains the ringo file content Will be generated by this program)
filename_buildvc.bat	(Will be executed to build filename.c using Visual C/C++)
filename_buildgcc.bat	(Will be executed to build filename.c using GNU C/C++)
filename_buildclang.bat	(Will be executed to build filename.c using CLang C/C++)
filename.obj	(Will be generated by the Visual C/C++ compiler)
filename.exe	(Will be generated by the Visual C/C++ Linker)
filename	(Executable File - On Linux & MacOS X platforms)

65.2 How Ring2EXE works?

At first the Ring compiler will be used to generate the Ring object file (*.ringo)

If we have a C compiler (optional), This object file will be embedded inside a C source code file

Then using the C compiler and the Ring library (Contains the Ring Virtual Machine) the executable file will be generated!

If we don't have a C compiler, the Ring executable will be copied and renamed to your application name

And your Ring object file (*.ringo) will become ring.ringo to be executed at startup of the executable file.
So it's better and easy to have a C compiler on your machine to be used by Ring2EXE.

65.3 Example

We have test.ring contains the next code

```
see "Hello, World!" + nl
```

To build the executable file for Windows, Linux or macOS

```
ring2exe test.ring
```

To run the program (Windows)

```
test
```

To run the program (Linux and macOS)

```
./test
```

65.4 Options

-keep	: Don't delete Temp. Files
-static	: Build Standalone Executable File (Don't use ring.dll/ring.so/ring.dylib)
-gui	: Build GUI Application (Hide the Console Window)
-dist	: Prepare application for distribution
-allruntime	: Include all libraries in distribution
-mobileqt	: Prepare Qt Project to distribute Ring Application for Mobile
-webassemblyqt → (WebAssembly)	: Prepare Qt Project to distribute Ring Application for the web
-noqt	: Remove RingQt from distribution
-noallegro	: Remove RingAllegro from distribution
-noopenssl	: Remove RingOpenSSL from distribution
-nolibcurl	: Remove RingLibCurl from distribution
-nomysql	: Remove RingMySQL from distribution
-noodbc	: Remove RingODBC from distribution
-nosqlite	: Remove RingSQLite from distribution
-noopengl	: Remove RingOpenGL from distribution
-nofreeglut	: Remove RingFreeGLUT from distribution
-nolibzip	: Remove RingLibZip from distribution
-noconsolecolors	: Remove RingConsoleColors from distribution
-nomurmurhash	: Remove RingMurmurHash from distribution
-nocruntime	: Remove C Runtime from distribution
-qt	: Add RingQt to distribution
-allegro	: Add RingAllegro to distribution
-openssl	: Add RingOpenSSL to distribution
-libcurl	: Add RingLibCurl to distribution

(continues on next page)

(continued from previous page)

-mysql	: Add RingMySQL to distribution
-odbc	: Add RingODBC to distribution
-sqlite	: Add RingSQLite to distribution
-postgresql	: Add RingPostgreSQL to distribution
-opengl	: Add RingOpenGL to distribution
-freeglut	: Add RingFreeGLUT to distribution
-libzip	: Add RingLibZip to distribution
-libuv	: Add RingLibuv to distribution
-consolecolors	: Add RingConsoleColors to distribution
-murmurhash	: Add RingMurmurHash to distribution
-cruntime	: Add C Runtime to distribution

65.5 Building standalone console application

Using the “-static” option we can build executable console application

So we don’t have to use ring.dll, ring.so or ring.dylib

This avoid only the need to Ring dynamic link library

If you are using another libraries, You will need to include it with your application.

```
ring2exe test.ring -static
```

65.6 Distributing RingAllegro Applications

We have test2.ring contains the next code

```
# Just a simple program to test Ring2EXE Tool!
# Using RingAllegro

load "gameengine.ring" # Give Control to the Game Engine

func main                # Called by the Game Engine

    oGame = New Game      # Create the Game Object
    {
        title = "My First Game"
    }
```

To build the executable file and prepare for distributing the Game

We use “-dist” option and “-allruntime” to include all libraries

```
ring2exe test2.ring -dist -allruntime
```

After executing the previous command

On Windows we will have : target/windows folder

On Linux we will have : target/linux folder

On macOS we will have : target/macos folder

The previous command will add all of the Ring runtime libraries to our distribution

But we may need only RingAllegro, So it's better to use the next command

```
ring2exe test2.ring -dist -allegro -cruntime
```

This will produce smaller size distribution and will avoid the runtime files that we don't need!

Also we could use the “-gui” option to hide the console window

So it's better to use the next command

```
ring2exe test2.ring -dist -gui -allegro -cruntime
```

65.7 Distributing RingQt Applications

We have test3.ring contains the next code

```
# Just a simple program to test Ring2EXE Tool!
# Using RingQt

load "guilib.ring"

new qApp {
    new QWidget() {
        setWindowTitle("Hello, World!")
        resize(400,400)
        show()
    }
    exec()
}
```

To build the executable file and prepare for distributing the GUI application

We use “-dist” option and “-allruntime” to include all libraries

```
ring2exe test3.ring -dist -allruntime
```

After executing the previous command

On Windows we will have : target/windows folder

On Linux we will have : target/linux folder

On macOS we will have : target/macos folder

The previous command will add all of the Ring runtime libraries to our distribution

But we may need only RingQt, So it's better to use the next command

```
ring2exe test3.ring -dist -qt -cruntime
```

This will produce smaller size distribution and will avoid the runtime files that we don't need!

Also we could use the “-gui” option to hide the console window

So it's better to use the next command

```
ring2exe test3.ring -dist -gui -qt -cruntime
```

65.8 Distributing Applications for Mobile using RingQt

To prepare a Qt project for your RingQt application (test3.ring) use the “-mobileqt” option

Example :

```
ring2exe test3.ring -dist -mobileqt
```

After executing the previous command, We will have the Qt project in target/mobile/qtproject folder

The main project file will be project.pro which we can open using the Qt Creator IDE.

Also we will have the resource file : project.qrc

Another important file is our C++ main file : main.cpp

65.9 Distributing Applications for WebAssembly using RingQt

To prepare a Qt project (WebAssembly) for your RingQt application (myapp.ring) use the “-webassemblyqt” option

Example :

```
ring2exe myapp.ring -dist -webassemblyqt
```

After executing the previous command, We will have the Qt project in target/webassembly/qtproject folder

The main project file will be project.pro which we can open using the Qt Creator IDE.

Also we will have the resource file : project.qrc

Another important file is our C++ main file : main.cpp

65.10 Building the Cards Game for Mobile using RingQt

For a better example, consider building an Android package for the Cards game that comes with the Ring language in this folder : ring/application/cards

The Cards game folder contains three files

cards.ring : The Game source code

cards.jpg : The image file used by the game

project.qrc : Resource file to be used with the Qt project

The resource file contains the next content

```
<RCC>
    <qresource>
        <file>cards.ringo</file>
        <file>cards.jpg</file>
```

(continues on next page)

(continued from previous page)

```
</qresource>
</RCC>
```

We have two files in the resource file

The first file is cards.ringo (The Ring Object File) and the second file is cards.jpg (The image file)

As a start, Ring2EXE will generate this resource file in target/mobile/qtproject/project.qrc

But this file will contains only cards.ringo (That Ring2EXE will generate by calling Ring compiler)

We need to update this resource file to add the image file : cards.jpg

After this update, we copy the resource file to the main application folder

So when we use Ring2EXE again, Our updated resource file will be used!

Now to build the cards game for Mobile

(1) Run the next command

```
ring2exe cards.ringo -dist -mobileqt
```

(2) Open target/mobile/qtproject/project.pro using Qt creator

(3) Build and Run using Qt Creator

How the Cards game will find the image file ?

RingQt comes with a simple function : AppFile() that we can use to determine the files that we may access on Desktop or Mobile platforms

The next code from cards.ring

```
mypic = new QPixmap(AppFile("cards.jpg"))
```

So all what you need is using AppFile() function around your image files!

65.11 Building the Weight History Application for Mobile using RingQt

Another example to distribute your application for Mobile Devices using Ring2EXE and Qt consider building an Android package for the Weight History application that comes with the Ring language in this folder : ring/application/weighthistory

The Weight History application folder contains four files

weighthistory.ring : The application source code

weighthistory.db : The SQLite database

project.qrc : The resource file for the Qt project

main.cpp : The main C++ source file for the Qt project

To build the Weight History application for Mobile

(1) Run the next command

```
ring2exe weighthistory.ring -dist -mobileqt
```

- (2) Open target/mobile/qtproject/project.pro using Qt creator
- (3) Build and Run using Qt Creator

The resource file (project.qrc) contains two files

```
<RCC>
    <qresource>
        <file>weighthistory.ringo</file>
        <file>weighthistory.db</file>
    </qresource>
</RCC>
```

The first file is weighthistory.ringo (Ring Object File - Generated by Ring2EXE by calling Ring compiler)

The database file : weighthistory.db

The main.cpp contains the next little update, To copy the database file from resources to a writable location on the mobile device

```
QString path3 ;
path3 = path+"/weighthistory.db";
QFile::copy(":/weighthistory.db",path3);
```

You will need to do this with database files only!

When we use Ring2EXE, the tool will check for project.qrc and main.cpp, if they exist then your updated files will be used in target/mobile/qtproject instead of the default version generated by Ring2EXE

So Use Ring2EXE to generate these files, Then copy them to your application folder when you update them.

65.12 Building the Form Designer for Mobile using RingQt

To build the Form Designer application (ring/tools/formdesigner) for Mobile

- (1) Run the next command

```
ring2exe formdesigner.ring -dist -mobileqt
```

- (2) Open target/mobile/qtproject/project.pro using Qt creator
- (3) Build and Run using Qt Creator

in the folder ring/application/formdesigner You will find the resource file : project.qrc

It will be used automatically by Ring2EXE

```
<RCC>
    <qresource>
        <file>formdesigner.ringo</file>
        <file>image/allevents.png</file>
        <file>image/checkbox.png</file>
        <file>image/close.png</file>
        <file>image/combobox.bmp</file>
```

(continues on next page)

(continued from previous page)

```

<file>image/datepicker.bmp</file>
<file>image/dial.png</file>
<file>image/formdesigner.png</file>
<file>image/frame.png</file>
<file>image/grid.bmp</file>
<file>image/hyperlink.png</file>
<file>image/image.png</file>
<file>image/label.png</file>
<file>image/layout.png</file>
<file>image/lcdnumber.png</file>
<file>image/listview.png</file>
<file>image/lock.png</file>
<file>image/new.png</file>
<file>image/open.png</file>
<file>image/progressbar.png</file>
<file>image/project.png</file>
<file>image/pushbutton.png</file>
<file>image/radiobutton.png</file>
<file>image/save.png</file>
<file>image/saveas.png</file>
<file>image/select.png</file>
<file>image/slider.png</file>
<file>image/spinner.bmp</file>
<file>image/statusbar.png</file>
<file>image/tab.png</file>
<file>image/textarea.png</file>
<file>image/textfield.png</file>
<file>image/timer.png</file>
<file>image/toolbar.png</file>
<file>image/tree.bmp</file>
<file>image/videowidget.png</file>
<file>image/webview.png</file>
</qresource>
</RCC>

```

As we did in the Cards game, The Form Designer will use the AppFile() function to determine the name of the Image files.

The next code from ring/tools/formdesigner/mainwindow/formdesignerview.ring

```

func CreateToolBar
    aBtns = [
        new qtoolbutton(win) {
            setbtnimage(self,AppFile("image/new.png"))
            setclickevent(Method(:NewAction))
            settooltip("New File")
        },
        new qtoolbutton(win) {
            setbtnimage(self,AppFile("image/open.png"))
            setclickevent(Method(:OpenAction))
            settooltip("Open File")
        },
        new qtoolbutton(win) {

```

(continues on next page)

(continued from previous page)

```

        setbtnimage(self,AppFile("image/save.png"))
        setclickevent(Method(:SaveAction))
        settooltip("Save")
    } ,
    new qtoolbarbutton(win) {
        setbtnimage(self,AppFile("image/saveas.png"))
        setclickevent(Method(:SaveAsAction))
        settooltip("Save As")
    } ,
    new qtoolbarbutton(win) {
        setbtnimage(self,AppFile("image/close.png"))
        setclickevent(Method(:ExitAction))
        settooltip("Exit")
    }
]

tool1 = win.addtoolbar("files") {
    for x in aBtns { addwidget(x) addseparator() }
}

```

From this example, We know that we can use sub folders for images.

65.13 Creating the Qt resource file using Folder2qrc

When we have large RingQt project that contains a lot of images and files, We need to add these files to the resource file (*.qrc) when distributing applications for Mobile devices.

Instead of adding these files one by one, Ring 1.6 comes with a simple tool that save our time, It's called Folder2qrc.

Example:

```
folder2qrc formdesigner.ring
```

We determine the main source file while we are in the application folder, and Folder2qrc will check all of the files in the current folder and sub folders, Then add them to the resource file after the mainfile.ringo (In our example this will be formdesigner.ringo)

The output file will be : project.qrc

You can open it and remove the files that you don't need in the resources!

65.14 Important Information about Ring2EXE

- Using Ring2EXE to prepare distribution will delete all of the files in the old distribution

for example, if you have target/windows folder then used

```
ring2exe test3.ring -dist -allruntime
```

The files in target/windows will be deleted before adding the files again

This is important when you prepare a distribution for Mobile devices

```
ring2exe test3.ring -dist -mobileqt
```

If you modified the resource file : project.qrc or the main file : main.cpp

Don't forget to copy them to the application folder!

So Ring2EXE can use the updated version if you tried the previous command again!

- Ring2EXE is written in Ring, and you can read the source code from

<https://github.com/ring-lang/ring/blob/master/tools/ring2exe/ring2exe.ring>

- The libraries information are stored in a separated files, So these files can be updated in the future

automatically to support new libraries

<https://github.com/ring-lang/ring/blob/master/tools/ring2exe/libs>

THE RING PACKAGE MANAGER (RINGPM)

In this chapter we will learn about using the Ring Package Manager (RingPM)
RingPM is a tool for discovering, installing and updating Ring packages.

66.1 Features

The Package Manager uses Semantic Versioning to check compatibility between packages
The Package Manager comes with the next options

```
Usage   : ringpm [command]
Command : search  [keywords...]
Command : refresh : Update the Registry (Packages List)
Command : install [ <packagename> [from <UserName>] [branch <branchname>] ]
Command : list    [-u : check updates]
Command : run     [packagename]
Command : update  <packagename>
Command : remove  <packagename>
Command : format  : Delete All Packages
Command : new     <packagename>
Command : package : Create package in the current folder
```

66.2 Discovering Packages

We can discover new packages using the Search command

Using this command we can search in the RingPM Registry (Packages Index)

The RingPM Registry is a local copy of all registered packages.

```
ringpm search [keywords...]
```

Example:

```
ringpm search notepad
```

Output:

```
Package : ringnotepad (Ring Notepad)
Package : notepadppeditorextension (Notepad++ Editor Extension package)
```

To print all packages in the RingPM Registry, use the search command without keywords.

Example:

```
ringpm search
```

66.3 Updating the RingPM Registry

The RingPM Registry is a local copy of all registered packages.

We can update the local copy using the Refresh command

Example:

```
ringpm refresh
```

Output:

```
No updates to the Registry, Nothing to do!
```

Or

```
The Registry is updated from revision 110 (2019/01/13) to revision 112 (2019/01/15)
```

66.4 Installing Packages

We can install new packages using the Install command

```
ringpm install [ <packagename> [from <UserName>] [branch <branchname>] ]
```

We can type only the package name to get the package information from the RingPM Registry or we can determine the user name (GitHub) and the branch name of the github project (optional).

If the current folder is a package folder then we don't need to write the package name.

Example (1) :

```
ringpm install ringnotepad
```

Example (2) :

```
ringpm install goldmagic800
```

Example (3) :

```
ringpm install gameoflife
```

If the package is not added to the RingPM Registry, We can install it directly from the GitHub user

Example (4) :

```
ringpm install firstpackage from mahmoudfayed
```

To run the package after installation

```
ringpm run firstpackage
```

To install a package in the current folder

Example (5) :

```
ringpm install
```

66.5 Printing List of Installed Packages

We can know the installed packages using the List command

```
ringpm list [-u : check updates]
```

Example

```
ringpm list
```

Output

(analogclock)	: The AnalogClock Package [master]	-- (1.0.0)
(androidringlibsdl)	: The AndroidRingLibSDL Package [master]	-- (1.0.0)
(androidringqt)	: The AndroidRingQt Package [master]	-- (1.0.0)
(atomeditorextension)	: The AtomEditorExtension Package [master]	-- (1.0.0)
(bignumbers)	: The BigNumber Package [master]	-- (1.0.0)
(calculator)	: The Calculator Package [master]	-- (1.0.0)
(cards)	: The Cards Package [master]	-- (1.0.0)
(checkers)	: The Checkers Package [master]	-- (1.0.0)
(chess)	: The Chess Package [master]	-- (1.0.0)
....		

To check for new updates

```
ringpm list -u
```

66.6 Run Package

After installing a package, we can run it using the Run command.

```
ringpm run [packagename]
```

Example(1):

```
ringpm run ringnotepad
```

Example(2):

```
ringpm run goldmagic800
```

Example(3):

```
ringpm run gameoflife
```

To run a package in the current folder

Example(4):

```
ringpm run
```

66.7 Update Package

We can update a package using the Update command

```
ringpm update <packagename>
```

Example:

```
ringpm update ringnotepad
```

66.8 Remove Package

We can remove a package using the Remove command

```
ringpm remove <packagename>
```

Example:

```
ringpm remove ringnotepad
```

66.9 Deleting All Packages

We can delete all packages using the Format command

Example:

```
ringpm format
```

66.10 Creating New Package

We can create new package using the New command

```
ringpm new <packagename>
```

Example:

```
ringpm new myapp
```

This will create new folder called my myapp

The new folder will contains the next file

- package.ring : The package description and files
- main.ring : main program (used by the Run command)
- lib.ring : library file for the package

File : main.ring

```
# The Main File

load "lib.ring"

func main

? "Hello, World!"
```

File : lib.ring

```
# The Library File
```

File : package.ring

```
aPackageInfo = [
    :name = "The myapp Package",
    :description = "Our myapp package using the Ring programming language",
    :folder = "myapp",
    :developer = "",
    :email = "",
    :license = "MIT License",
    :version = "1.0.0",
    :ringversion = "1.10",
    :versions = [
        [
            :version = "1.0.0",
            :branch = "master"
        ]
    ],
    :libs = [
        [
            :name = "",
            :version = "",
            :providerusername = ""
        ]
    ],
    :files = [
        "lib.ring",
        "main.ring"
    ],
    :ringfolderfiles = [
        [
            ...
        ]
    ],
    :windowsfiles = [
        ...
    ]
]
```

(continues on next page)

(continued from previous page)

```
],
:linuxfiles =  [
],
:ubuntufiles =  [
],
:fedorafiles =  [
],
:macosfiles =  [
],
:windowsringfolderfiles =      [
],
:linuxringfolderfiles =      [
],
:ubunturingfolderfiles =      [
],
:fedoraringfolderfiles =      [
],
:macosringfolderfiles =      [
],
:run = "ring main.ring",
:windowsrun = """",
:linuxrun = """",
:macosrun = """",
:ubunturun = """",
:fedorarun = """",
:setup = """",
:windowssetup = """",
:linuxsetup = """",
:macossetup = """",
:ubuntusetup = """",
:fedorasetup = """",
:remove = """",
:windowsremove = """",
:linuxremove = """",
:macosremove = """",
:ubunturemove = """",
:fedoraremove = """
]
```

]

66.11 The Package Description File

The package description file contains the package information defined in the list aPackageInfo

Attribute	Description
Name	Package Name
Description	Package Description
Folder	The Folder Name (Will be created in ring/ringpm/packages)
Developer	The Package Developer Name
Email	The Package Developer Email
License	The Package License
Version	The Current Version of the Package (Latest Release)
RingVersion	The Required Ring Language Version (Minimum Version)
Versions	List of different versions provided by different branches in the GitHub project
Libs	List of dependencies (Defined by name, version & GitHub user name)
Files	List of files (will be installed in ring/ringpm/packages/[Folder])
RingFolderFiles	List of files (will be installed in ring folder)
WindowsFiles	Like (Files) but for Microsoft Windows Only
LinuxFiles	Like (Files) but for Linux Only
MacOSFiles	Like (Files) but for macOS Only
UbuntuFiles	Like (Files) but for Ubuntu Only
FedoraFiles	Like (Files) but for Fedora Only
WindowsRingFolderFiles	Like (RingFolderFiles) but for Microsoft Windows Only
LinuxRingFolderFiles	Like (RingFolderFiles) but for Linux Only
MacOSRingFolderFiles	Like (RingFolderFiles) but for macOS Only
UbuntuRingFolderFiles	Like (RingFolderFiles) but for Ubuntu Only
FedoraRingFolderFiles	Like (RingFolderFiles) but for Fedora Only
Run	System Command (Command prompt or Terminal) to run the package
WindowsRun	Like (Run) but for Microsoft Windows Only
LinuxRun	Like (Run) but for Linux Only
MacOSRun	Like (Run) but for macOS Only
UbuntuRun	Like (Run) but for Ubuntu Only
FedoraRun	Like (Run) but for Fedora Only
Setup	System Command (Command prompt or Terminal) after downloading the package files
WindowsSetup	Like (Setup) but for Microsoft Windows Only
LinuxSetup	Like (Setup) but for Linux Only
MacOSSetup	Like (Setup) but for macOS Only
UbuntuSetup	Like (Setup) but for Ubuntu Only
FedoraSetup	Like (Setup) but for Fedora Only
Remove	System Command (Command prompt or Terminal) before removing the package files
WindowsRemove	Like (Remove) but for Microsoft Windows Only
LinuxRemove	Like (Remove) but for Linux Only
MacOSRemove	Like (Remove) but for macOS Only
UbuntuRemove	Like (Remove) but for Ubuntu Only
FedoraRemove	Like (Remove) but for Fedora Only

66.12 Create Package in the Current Folder

To create a package for an application that already exists, go to the application folder then type

```
ringpm package
```

This will create the package definition file (package.ring) and will add all of the application files to the package definition.

Each RingPM package contains the package definition file (package.ring)

The package definition file is a list that describe the package information and files.

Example :

The package definition file for the Ring Notepad package

```
aPackageInfo = [
    :name = "The RingNotepad Package",
    :description = "Our RingNotepad package using the Ring programming language",
    :folder = "ringnotepad",
    :developer = "Mahmoud Fayed",
    :email = "msfclipper@yahoo.com",
    :license = "MIT License",
    :version = "1.0.0",
    :ringversion = "1.10",
    :versions = [
        [
            :version = "1.0.0",
            :branch = "master"
        ]
    ],
    :libs = [
        [
            :name = "stdlib",
            :version = "1.0",
            :providerusername = ""
        ],
        [
            :name = "ringqt",
            :version = "1.0",
            :providerusername = ""
        ],
        [
            :name = "findinfiles",
            :version = "1.0",
            :providerusername = ""
        ],
        [
            :name = "formdesigner",
            :version = "1.0",
            :providerusername = ""
        ],
        [
            :name = "libdepwin_apache",
            :version = "1.0",
            :providerusername = ""
        ]
    ]
]
```

(continues on next page)

(continued from previous page)

```

        :version = "1.0",
        :providerusername = ""
    ],
    :files = [
        "main.ring",
        "README.md"
],
:ringfolderfiles = [
    "applications/rnote/batch/killwebserver.bat",
    "applications/rnote/batch/run.bat",
    "applications/rnote/batch/run2.bat",
    "applications/rnote/image/back.jpg",
    "applications/rnote/image/back2.jpg",
    "applications/rnote/image/close.png",
    "applications/rnote/image/colors.png",
    "applications/rnote/image/copy.png",
    "applications/rnote/image/cut.png",
    "applications/rnote/image/debug.png",
    "applications/rnote/image/font.png",
    "applications/rnote/image/formdesigner.png",
    "applications/rnote/image/new.png",
    "applications/rnote/image/notepad.png",
    "applications/rnote/image/open.png",
    "applications/rnote/image/paste.png",
    "applications/rnote/image/print.png",
    "applications/rnote/image/project.png",
    "applications/rnote/image/richtext.png",
    "applications/rnote/image/run.png",
    "applications/rnote/image/rungui.png",
    "applications/rnote/image/save.png",
    "applications/rnote/image/saveas.png",
    "applications/rnote/image/search.png",
    "applications/rnote/image/source.png",
    "applications/rnote/image/undo.png",
    "applications/rnote/image/web.png",
    "applications/rnote/README.md",
    "applications/rnote/rnote.ring",
    "applications/rnote/rnoteactivefile.ring",
    "applications/rnote/rnoteactivefolder.ring",
    "applications/rnote/rnoteautocomplete.ring",
    "applications/rnote/rnotebase.ring",
    "applications/rnote/rnotecontroller.ring",
    "applications/rnote/rnotedistribute.ring",
    "applications/rnote/rnoteeditmenu.ring",
    "applications/rnote/rnoteeditorevents.ring",
    "applications/rnote/rnotefilemenu.ring",
    "applications/rnote/rnotefiles.ring",
    "applications/rnote/rnotefilestabs.ring",
    "applications/rnote/rnotefind.ring",
    "applications/rnote/rnotefindinfiles.ring",
    "applications/rnote/rnoteformdesigner.ring",
]

```

(continues on next page)

(continued from previous page)

```

"applications/rnote/rnotegoto.ring",
"applications/rnote/rnotehelp.ring",
"applications/rnote/rnotelists.ring",
"applications/rnote/rnotemainfiletoolbar.ring",
"applications/rnote/rnotemainwindow.ring",
"applications/rnote/rnotemode.ring",
"applications/rnote/rnoteoutputwindow.ring",
"applications/rnote/rnoteprogrammenu.ring",
"applications/rnote/rnoterun.ring",
"applications/rnote/rnotesettings.ring",
"applications/rnote/rnotestyle.ring",
"applications/rnote/rnotetabwidth.ring",
"applications/rnote/rnotetools.ring",
"applications/rnote/rnotetreeviewevents.ring",
"applications/rnote/rnoteviewmenu.ring",
"applications/rnote/rnotewebbrowser.ring"
],
:run = "ring main.ring"
]

```

66.13 The RingPM Registry File

The RingPM Registry is a local copy of all registered packages.

```

aPackagesRegistry = [
  [ :name = "ringpresentation",
    :description = "Powerpoint presentation for the Ring programming language",
    :ProviderUserName = "ringpackages"
  ]
  #
]

```

Each package is defined using a list that determine

- Package Name
- Package Description
- Provider User Name (GitHub User Name)

We can register new packages by updating the registry file then sending a Pull Request

URL : <https://github.com/ring-lang/ring/blob/master/tools/ringpm/registry/registry.ring>

CHAPTER
SIXTYSEVEN

USING ZEROLIB

In this chapter we will learn how to use the ZeroLib library.

67.1 Introduction

ZeroLib is a simple library written in Ring.

The library provide classes for Lists and String where the index starts from 0.

67.2 Z() function

Syntax:

```
Z(String|List) ---> New Object (ZeroBasedString|ZeroBasedList)
```

67.3 ZeroBasedList Class

Simple class provide a List where the index starts from zero.

Methods:

Method	Description/Output
Init(List)	
Add(Value)	Add item to the list
Insert(nIndex,Value)	Inset Item after nIndex
Find(Value)	Find item
Delete(nIndex)	Delete item from the list
Item(nIndex)	Get item from the list
First()	Get the first item in the list
Last()	Get the last item in the list
Set(nIndex,Value)	Set item value
FindInColumn(nCol,Value)	Find item in a column
Sort()	Sort items - return new list
Reverse()	Reverse items - return new list
Swap(nIndex1,nIndex2)	Swap two items

Example:

```

load "zerolib.ring"

? "Using List - Index start from 0"
List = Z( [1,2,3] )
List.Add(4)
List.Add(5)
? List[0]
? List[1]
? List[2]
? List[3]
? List[4]
nIndex = List.find(2)
? "Find(2) = " + nIndex
List.delete(0)
? "After deleting the first item : List[0]"
? "Now List[0] = " + List[0]

```

Output:

```

Using List - Index start from 0
1
2
3
4
5
Find(2) = 1
After deleting the first item : List[0]
Now List[0] = 2

```

67.4 ZeroBasedString Class

Simple class provide a String where the index starts from zero.

Method	Description/Output
Init(String Number)	
Lower()	New String - Lower case characters
Upper()	New String - Upper case characters
Left(x)	New String - contains x characters from the left
Right(x)	New String - contains x characters from the right
Lines()	Number - Lines count
Trim()	New String - Remove Spaces
Copy(x)	New String - repeat string x times
strcmp(cString)	Compare string with cString
tolist()	List (String Lines to String Items)
tofile(cFileName)	Write string to file
mid(nPos1,nPos2)	New String - from nPos1 to nPos2
getfrom(nPos1)	New String - from nPos1 to the end of the string
replace(cStr1,cStr2,lCase)	New String - Replace cStr1 with cStr2 , lCase (True=Match Case)
split()	List - Each Word as list item
startswith(substring)	Return true if the start starts with a substring
endswith(substring)	Return true if the start ends with a substring

Example:

```
load "zerolib.ring"

? "Using String - Index start from 0"
String = Z( "Welcome" )
? String[0]
? String[1]
? String[2]
? String[3]
? String[4]
? String[5]
? String[6]
```

Output:

```
Using String - Index start from 0
W
e
l
c
o
m
e
```

67.5 Source Code

We can find the library source code in this folder

URL : <https://github.com/ring-lang/ring/tree/master/libraries/zerolib>

FOXRING FUNCTIONS REFERENCE

A class contains functions similar to FoxPro functions.

68.1 FoxRing functions

Function Name	Description
frAbs()	Returns the absolute value of the specified numeric expression.
frAddBs()	Adds a backslash (if needed) to a path expression.
frALines()	Creates an Array with the content of the specified string.
frAllTrim()	Removes all leading and trailing spaces of the specified string.
frAsc()	Returns the ANSI value for the leftmost character in a character expression.
frAt()	Searches a character expression for the occurrence of another character expression.
frAtC()	Searches a character expression for the occurrence of another character expression without regard for the case of these two expressions.
frBetween()	Determines whether the value of an expression is inclusively between the values of two expressions of the same type.
frChr()	Returns the character associated with the specified numeric ANSI code.
frEmpty()	Determines whether an expression evaluates to empty.
frFile()	Checks if a file exists on disk.
frFileToStr()	Returns the contents of a file as a character string.
frForceExt()	Returns a string with the old file name extension replaced by a new extension.
frForcePath()	Returns a file name with a new path name substituted for the old one.
frIf()	Returns one of two values depending on the value of a logical expression.
frInList()	Determines whether an expression matches another expression in a list.
frInt()	Evaluates a numeric expression and returns the integer portion of the expression.
frJustDrive()	Returns the drive letter from a complete path.
frJustExt()	Returns the characters of a file extension from a complete path.
frJustFName()	Returns the file name portion of a complete path and file name.
frJustPath()	Returns the path portion of a complete path and file name.
frJustStem()	Returns the stem name (the file name before the extension) from a complete path and file name.
frLen()	Determines the number of characters in a character expression, indicating the length of the expression.
frListToString()	Creates a string with the string elements of an Array.
frLTrim()	Removes all leading spaces or parsing characters from the specified character expression.
frPadL()	Returns a string from an expression, padded with spaces or characters to a

continues on next page

Table 1 – continued from previous page

Function Name	Description
frPadR()	specified length on the left side.
frProper()	Returns a string from an expression, padded with spaces or characters to a specified length on the right side.
frReplicate()	Returns from a character expression a string capitalized as appropriate for proper names.
frRTrim()	Returns a character string that contains a specified character expression repeated a specified number of times.
frSetIfEmpty()	Removes all trailing spaces or parsing characters from the specified character expression.
frSetSeparatorTo()	Set a Value into a variable if the variable value is empty, null or zero.
frSpace()	Specifies the character for the numeric place separator.
frStr()	Returns a character string composed of a specified number of spaces.
frStringToList()	Returns the character equivalent of a numeric expression.
frStrTran()	Creates a List with the content of the specified string.
frStuff()	Searches a character expression for a second character expression and replaces each occurrence with a third character expression.
frSubStr()	Returns a new character string replaced by a specified number of characters in a character expression with another character expression.
frTransform()	Returns a character string from the given character expression, starting at a specified position in the character expression and continuing for a specified number of characters.
frVal()	Returns a character string from an expression in a format determined by a format code.
frVarType()	Returns a numeric value from a character expression composed of numbers.

68.2 frAbs() function

```

* Syntax      : lnReturnValue = frAbs(tnExpression)
* Description : Returns the absolute value of the specified numeric expression.
*               :
* Arguments   : <tnExpression>
*               : Specifies the numeric expression whose absolute value frAbs()
*               : returns.
* Returns     : <lnReturnValue>
*               : Returns the absolute value of the specified numeric expression.

```

68.3 frAsc() function

```

* Syntax      : lnReturnValue = frAsc(tcExpression)
* Description : Returns the ANSI value for the leftmost character in
*               : a character expression.
* Arguments   : <tcExpression>
*               : Specifies the character expression containing the character
*               : whose ANSI value frAsc()

```

(continues on next page)

(continued from previous page)

```

* : returns. Any characters after the first character in
* : tcExpression are ignored by frAsc().
* Returns : <lnReturnValue>
* : returns the position of the character in the character
* : table of the current code page.
* : Every character has a unique ANSI value in the
* : range from 0 to 255.

```

68.4 frAddBs() function

```

* Syntax      : lcReturnValue = frAddBs(tcPath)
* Description : Adds a backslash (if needed) to a path expression.
* :
* Arguments   : <tcPath>
* : Specifies the path name to which to add the backslash.
* :
* Returns     : <lcReturnValue> The path with the backslash.

```

68.5 frAt() function

```

* Syntax      : lnPos = frAt(tcToSearch, tcString, tnOccurrence)
* Description : Searches a character expression for the occurrence of
* : another character expression.
* : The search performed by frAt() is case-sensitive.
* :
* Arguments   : <tcToSearch>
* : Specifies the character expression to search
* : for in <tcString>.
* : <tcString>
* : Specifies the character expression to search
* : for <tcToSearch>.
* : <tnOccurrence>
* : Specifies which occurrence, first, second, third,
* : and so on, of <tcToSearch> to search for
* : in <tcString>.
* : By default, frAt() searches for the first occurrence
* : of <tcToSearch> (tnOccurrence = 1).
* Returns     : Numeric. frAt() returns an integer indicating the
* : position of the first character for a
* : character expression or memo field within another
* : character expression or memo field,
* : beginning from the leftmost character. If the
* : expression or field is not found, or if
* : <tnOccurrence> is greater than the number of
* : times <tcToSearch> occurs in <tcString>, frAt()
* : returns 0.

```

68.6 frAtC() function

```

* Syntax      : lnPos = frAtC(tcToSearch, tcString, tnOccurrence)
* Description : Searches a character expression for the occurrence
*               : of another character expression
*               : without regard for the case of these two expressions.
*
*               :
* Arguments   : <tcToSearch>
*               : Specifies the character expression to search
*               : for in <tcString>.
*               : <tcString>
*               : Specifies the character expression to search
*               : for <tcToSearch>.
*               : <tnOccurrence>
*               : Specifies which occurrence, first, second, third,
*               : and so on, of <tcToSearch> to search for
*               : in tcString.
*               : By default, frAtC() searches for the first occurrence
*               : of <tcToSearch> (tnOccurrence = 1).
* Returns     : Numeric. frAtC() returns an integer indicating the
*               : position of the first character for a
*               : character expression or memo field within
*               : another character expression or memo field,
*               : beginning from the leftmost character. If the
*               : expression or field is not found, or if
*               : <tnOccurrence> is greater than the number of
*               : times <tcToSearch> occurs in <tcString>, frAtC()
*               : returns 0.

```

68.7 frChr() function

```

* Syntax      : lcReturnValue = frChr(tnExpression)
* Description : Returns the character associated with the specified numeric
*               : ANSI code.
* Arguments   : <tnExpression>
*               : Specifies a number between 0 and 255 whose equivalent ANSI
*               : character frChr() returns.
* Returns     : <lcReturnValue>
*               : Returns a single character corresponding to the numeric
*               : position of the character in the
*               : character table of the current code page.
*               :
* Remarks    : tnExpression must be between 0 and 255

```

68.8 frEmpty() function

```

* Syntax      : llReturnValue = frEmpty(tuExpression)
* Description : Determines whether an expression evaluates to empty.
*
*           :
* Arguments   : <tuExpression>
*           : Specifies the expression that EMPTY() evaluates.
*           : You can specify an expression with Character,
*           : Numeric, or logical type.
*
*           :
* Returns     : <llReturnValue> Logical

```

68.9 frFile() function

```

* Syntax      : llReturnValue = frFile(tcFileName, tnFlag)
* Description : Checks if the specified file exists on disk.
*
*           :
* Arguments   : <tcFileName>
*           : Specifies the name of the file to check.
*           : tcFileName must include
*           : the file extension. You can include a path with
*           : the file name to
*           : search for a file in a directory or on a drive
*           : other than the current directory or drive.
*
*           :
*           : <tnFlag>
*           : tnFlag was included for future compatibility.
*           : In this version, It always returns true whenever
*           : the file exists on disk.
* Returns     : <llReturnValue> Logical
*           : True if file exists on disk.
*           : False if file doesn't exist on disk.

```

68.10 frFileToStr() function

```

* Syntax      : lcReturnValue = frFileToStr(tcFileName)
* Description : Returns the contents of a file as a character string.
*
*           :
* Arguments   : <tcFileName>
*           : Specifies the name of the file whose contents are
*           : returned as a character
*           : string. If the file is in a directory other than
*           : the current default directory,
*           : include a path with the file name.
*
*           :
* Returns     : <lcReturnValue>
*           : A character string with the content of the specified file.
*           :

```

68.11 frStr() function

```

* Syntax      : lcReturnValue = frStr(tnValue, tnLen, tnDec)
* Description : Returns the character equivalent of a numeric expression.
*
*           :
* Arguments   : <tnValue>
*           : Specifies the numeric expression to evaluate.
*
*           :
*           : <tnLen>
*           : Specifies the length of the character string returned.
*           : If tnLen is 0, tnLen defaults to 10 characters.
*           : If tnLen < 0 returns one string with same length as the number.
*
*           : Note
*           : If the expression contains a decimal point,
*           : the length includes one character for
*           : the decimal point and one character
*           : for each digit in the character string.
*
*           :
*           : <tnDec>
*           : Specifies the number of decimal places in the
*           : character string returned.
*           : To specify the number of decimal places using
*           : tnDec, you must include nLength. If nDecimalPlaces is omitted,
*           : the number of decimal places defaults to zero (0).
*
*           :
* Returns     : Character data type. frStr() returns a character string
*           : equivalent to the specified numeric expression.
*           : Depending on certain conditions, frStr() can return the following:
*           : If you specify fewer decimal places than exist in tnValue,
*           : the return value is rounded up. To round results to the nearest
*           : decimal place instead of upward, include the ROUND( ) function.
*           : For more information, see ROUND( ) Function.
*           : If nExpression is an integer, and nLength is less than
*           : the number of digits in nExpression, frStr( ) returns a string of
*           : asterisks, indicating numeric overflow.
*           : If nExpression contains a decimal point, and nLength is equal
*           : to or less than the number of digits to the left of the decimal
*           : point, frStr( ) returns a string of asterisks,
*           : indicating numeric overflow.
*           : If nLength is greater than the length of the value evaluated
*           : by nExpression, frStr( ) returns a character string padded with
*           : leading spaces.
*           : If nExpression has Numeric or Float type, and nLength
*           : is less than the number of digits in nExpression, and , frStr( )
*           : returns a value using scientific notation.

```

68.12 frSetIfEmpty() function

```
* Syntax      : tuReturnValue = frSetIfEmpty(tuValue, tunewValue)
* Description : Set a Value into a variable if the variable
*               : value is empty, null or zero.
* Arguments   : <tuValue>
*               : The value to evaluate.
*               :
*               : <tunewValue>
*               : The value to set if tuValue is empty.
*               :
* Returns     : tunewValue if tuValue is empty, otherwise
*               : returns the original value.
* Remarks    : This function doesn't exist in VFP.
```

68.13 frSpace() function

```
* Syntax      : lcReturnValue = frSpace(tnSpaces)
* Description : Returns a character string composed of a
*               : specified number of spaces.
* Arguments   : <tnSpaces>
*               : Specifies the number of spaces that frSpace() returns.
*               :
* Returns     : <lcReturnValue>
*               : Character
```

68.14 frInList() function

```
* Syntax      : llReturnValue = frInList(tuExpression, taList)
* Description : Determines whether an expression matches another
*               : expression in a set of expressions.
* Arguments   : <tuExpression>
*               : Specifies the expression frInList() searches for in the List.
*               :
*               : <taList>
*               : Specifies the List of expressions to search.
*               : You must include at least one element in the list.
*               : The expressions in the list of expressions needn't to be
*               : of the same data type.
*               :
* Returns     : <luReturnValue> Null or logical value.
```

68.15 frForcePath() function

```

* Syntax      : lcReturnValue = frForcePath(tcFileName, tcPath)
* Description : Returns a file name with a new path name
*              : substituted for the old one.
* Arguments   : <tcFileName>
*              : Specifies the file name (with or without a path or extension),
*              : which will get a new path.
*              : <tcPath>
*              : Specifies the new path for tcFileName.
*              :
* Returns    : <lcReturnValue>
*              : Returns a file name with a new path name
*              : substituted for the old one.

```

68.16 frAllTrim() function

```
Syntax : lcReturnValue = frAllTrim(tcExpression, tcCharacter)
```

68.17 frLTrim() function

```
Syntax : lcRet = frLTrim(tcExpression, tcCharacter)
```

68.18 frJustDrive() function

```

* Syntax      : lcReturnValue = frJustDrive(tcPath)
* Description : Returns the drive letter from a complete path.
*              :
* Arguments   : <tcPath>
*              : Specifies the complete path name for
*              : which you want only the drive.
* Returns    : <lcReturnValue>
*              : Returns the drive letter from a complete path.

```

68.19 frJustExt() function

```

* Syntax      : lcReturnValue = frJustExt(tcPath)
* Description : Returns the characters of a file extension
*              : from a complete path.
* Arguments   : <tcPath>
*              : Specifies the name, which may include the full path,
*              : of the file for which you want only the extension.
* Returns    : <lcReturnValue>

```

(continues on next page)

(continued from previous page)

```

* : Returns the drive characters of a file extension
* : from a complete path.

```

68.20 frJustStem() function

```

* Syntax      : lcReturnValue = frJustStem(tcPath)
* Description : Returns the stem name (the file name before the extension)
*               : from a complete path and file name.
* Arguments   : <tcPath>
*               : Specifies the name (including path) of the file
*               : for which you want only the stem.
* Returns     : <lcReturnValue>
*               : Returns the stem name of a file from a complete path.

```

68.21 frRTrim() function

```
Syntax : lcRet = frRTrim(tcExpression, tcCharacter)
```

68.22 frJustPath() function

```
Syntax : tcReturnValue = frJustPath(tcExpression)
```

68.23 frForceExt() function

```
Syntax : tcReturnValue = frForceExt(tcFileName, tcNewExtension)
```

68.24 frALines() function

```
Syntax : tnReturnValue = frALines(taList, tcExpression, tcSeparator)
```

68.25 frJustFName() function

```
Syntax : tcReturnValue = frJustFName(tcExpression)
```

68.26 frPadL() function

```
Syntax : tcReturnValue = frPadL(tcString, tnLen, tcChar)
```

68.27 frPadR() function

```
Syntax : tcReturnValue = frPadR(tcString, tnLen, tcChar)
```

68.28 frProper() function

```
* Syntax      : tcReturnValue = frProper(tcExpression)
* Description : Returns from a character expression a string
*              : capitalized as appropriate for proper names.
* Arguments   : <tcExpression>
*              : Specifies the character expression from which
*              : frProper() returns a capitalized character string.
* Returns     : <tcReturnValue>
```

68.29 frReplicate() function

```
Syntax : tcReturnValue = frReplicate(tcString, tnTimes)
```

68.30 frLen() function

```
Syntax : tnReturnValue = frLen(tcString)
```

68.31 frStuff() function

```
* Syntax      : tcReturnValue = frStuff(tcExpression, tnStartRep,
                                         tnCharRep, tcToReplace)
* Description : Returns a new character string replaced by a
*              : specified number of characters in a character
*              : expression with another character expression.
*              :
* Arguments   : <tcExpression>
*              : Specify the character expression in which the replacement occurs.
*              :
*              : <tnStartRep>
*              : Specify the position in <tcExpression> where the replacement begins.
*              :
```

(continues on next page)

(continued from previous page)

```

*      : <tnCharRep>
*      : Specifies the number of characters to be replaced.
*      : If <tnCharRep> is 0, the replacement string
*      : <tcToReplace> is inserted into <tcExpression>.
*      :
*      : <tcToReplace>
*      : Specifies the replacement character expression.
*      : If <tcToReplace> is an empty string, the number of
*      : characters specified by <tnCharRep> are removed from <tcExpression>.
*      :
* Returns   : Character

```

68.32 frSubStr() function

```
Syntax : tcReturnValue = frSubStr(tcString, tnInitialPosition, tnNumberBytes)
```

68.33 frStrTran() function

```
Syntax : tcReturnValue = frStrTran(tcString, tcOldString, tcNewString)
```

68.34 frListToString() function

```

* Syntax      : lcRet = frListToString(taList)
* Remarks     : This function doesn't exist in VFP.

```

68.35 frInt() function

```
Syntax      : lnInt = frInt(tnExpression)
```

68.36 frStringToList() function

```

* Syntax      : laList = frStringToList(tcExpression)
* Remarks     : This function doesn't exist in VFP.

```

68.37 frIIf() function

```
* Syntax      : luReturnValue = frIIf(tlExpression, tuReturnIfTrue, tuReturnIfFalse)
* Description : Returns one of two values depending on the
*               : value of a logical expression.
* Arguments   : <tlExpression>
*               : Specifies the logical expression that frIIf() evaluates.
*               :
*               : <tuReturnTrue>, <tuReturnFalse>
*               : If tlExpression evaluates to True, tuReturnIfTrue is
*               : returned and tuReturnIfFalse is not evaluated.
*               : If tlExpression evaluates to False or Null, tuReturnIfFalse is
*               : returned and tuReturnIfTrue is not evaluated.
*               :
* Returns     : <luReturnValue> Defined by <tuReturnIfTrue> or <tuReturnIfFalse>
```

68.38 frVal() function

```
* Syntax      : luReturnValue = frVal(tcExpression)
* Description : Returns a numeric value from a character expression
*               : composed of numbers
* Arguments   : <tcExpression>
*               : Specifies a character expression composed of up to 16 numbers.
*               :
* Returns     : <tnValue>
*               : Return a numeric value.
```

68.39 frBetween() function

```
* Syntax      : luReturnValue = frBetween(tuTestValue, tuLowValue, tuHighValue)
* Description : Determines whether the value of an expression
*               : is inclusively between the
*               : values of two expressions of the same type.
*               :
* Arguments   : <tuTestValue>
*               : Specifies an expression to evaluate.
*               :
*               : <tuLowValue>
*               : Specifies the lower value in the range.
*               :
*               : <tuHighValue>
*               : Specifies the higher value in the range.
*               :
* Returns     : <luReturnValue>
*               : Returns a logical order null value.
```

68.40 frSetSeparatorTo() function

```

* Syntax      : frSetSeparatorTo(tuExpression)
* Description : Specifies the character for the numeric place separator.
*             :
* Arguments   : <tuExpression>
*             : Specifies the character for the numeric place separator.
*             :
*             : Use frSetSeparatorTo() to change the numeric place
*             : separator from default, for example space " " or a comma ",".
*             : Issue frSetSeparatorTo(NULL) to reset the value to its default.
*             :
* Returns     : None

```

68.41 frTransform() function

```

* Syntax      : tcReturnValue = frTransform(tuExpression, tcFormatCodes)
* Description : Returns a character string from an expression in a
*             : format determined by a format code.
* Arguments   : <tuExpression>
*             : Specifies the expression to format.
*             :
*             : <tcFormatCodes>
*             : Specifies one or more format codes that determine how to
*             : format the expression.
*             :
* Returns     : <tcReturnValue>

```

The following table lists the available format codes for tcFormatCodes.

Format Code	Description
@!	Converts an entire character string to uppercase.
@T	Trims leading and trailing spaces from character values.
@B	Left-justifies Numeric data within the display region.
@L	Pads numeric and string data with leading zeros.
@C	Appends CR to positive numeric values to indicate a credit.
@X	Appends DB to negative numeric values to indicate a debit.

68.42 frVarType() function

```

* Syntax      : lcRet = frVarType(tuExpression)
* Description : Returns the data type of an expression.
*
*           :
* Arguments   : <tuExpression>
*           : Specifies the expression for which the data type is returned.
*           : frVartype() returns a
*           : single character indicating the data type of the expression.
*           : The following table lists the characters that frVarType()
*           : returns for each data type.
*
*           :
*           :
*           : -----
*           : Return Value      Data Type
*           : -----
*           : C                Character
*           : N                Numeric
*           : A                List
*           : O                Object
*           : U                Undefined type
*           :
*           :
* Returns     : Character

```

68.43 Example

```

Load "foxring.ring"

mf = new frFunctions

/*-----*/
* frProper() samples
/*-----*/

lcStr1 = "ring is a good language"
?mf.frProper(lcStr1)
?mf.frProper(Upper(lcStr1))

/*-----*/
* frStuff() samples
/*-----*/

lcStr1 = "abcdefghijklm"
lcStr2 = "12345"

// insert
?mf.frStuff(lcStr1, 4, 0, lcStr2)
// replace

```

(continues on next page)

(continued from previous page)

```
?mf.frStuff(lcStr1, 4, 3, lcStr2)
// delete
?mf.frStuff(lcStr1, 4, 6, "")
// replace and insert
?mf.frStuff(lcStr1, 4, 1, lcStr2)
// replace and delete
?mf.frStuff(lcStr1, 4, 4, lcStr2)
// replace, delete rest
?mf.frStuff(lcStr1, 4, Len(lcStr1), lcStr2)

/*-----*/
?mf.frAbs(-45)
?mf.frAbs(10-30)
?mf.frAbs(30-10)

lcNumber1 = 40
lcNumber2 = 2

?mf.frAbs(lcNumber2-lcNumber1)

lcCompletableFuture = "C:\ring\docs\source\contribute.txt"

?mf.frFile(lcCompletableFuture, Null)
if mf.frFile(lcCompletableFuture, Null) {
    ?mf.frFileToStr(lcCompletableFuture)
} else
    ?"File does not exist"
}

lcNewPath = "C:\ring_2\docs\source\
?mf.frJustExt(lcCompletableFuture)
?mf.frJustDrive(lcCompletableFuture)
?mf.frJustStem(lcCompletableFuture)
?mf.frForcePath(lcCompletableFuture, lcNewPath)
?mf.frTransform("    Ring is a good language    ",
               "@! !!!!!!!!!!!!!!!!!!!!!!!")
?mf.frAllTrim("    Ring is a good language    ", Null)
?mf._version
lnValue = 3125.54
?mf.frTransform(lnValue, "@B")+ "Euros"
?mf.frTransform(lnValue, "@C 9999,999,999,999.999")
mf.frSetSeparatorTo(" ")
?mf.frTransform(lnValue, "9999,999,999,999.999")
?mf.frInt(lnValue)
?mf.frForceExt("teste", "dbf")
// Format "@L" Added into frTransform() function
```

(continues on next page)

(continued from previous page)

```
?mf.frTransform("123", "@L 999999")
?mf.frTransform(123, "@L 999999")
```

BIGNUMBER LIBRARY

In this chapter we will learn about using the Big Number library.

69.1 Loading the library

Before using the next function load the bignumber.ring library

```
load "bignumber.ring"
# Use Big Number library functions
```

69.2 Examples

Using the BigNumber library we can do arithmetic operations on huge numbers.

Example:

```
load "bignumber.ring"

num1 = "62345678901234567891678345123456789"      ### Big
num2 = "1237894567890123419871236545"              ### Small
num3 = "64"                                         ### Divide Small
num4 = "765432"                                     ### Power
num5 = "3"                                           ### Power

? "Add big numbers:"
a1 = new BigNumber(num1)           a1.Print()
a2 = new BigNumber(num2)           a2.Print()
a3 = a1 + a2                      a3.Print() ? nl

? "Subtract big numbers:"
a1 = new BigNumber(num1)           a1.Print()
a2 = new BigNumber(num2)           a2.Print()
a3 = a1 - a2                      a3.Print() ? nl

? "Multiply big numbers:"
a1 = new BigNumber(num1)           a1.print()
a2 = new BigNumber(num2)           a2.print()
a3 = a1 * a2                      a3.print() ? nl
```

(continues on next page)

(continued from previous page)

```
? "Divide big numbers:"
a1 = new BigNumber(num1)      a1.print()
a2 = new BigNumber(num2)      a2.print()
a3 = a1 / a2                a3.print() ? nl

? "Divide big numbers: by very small number"
a1 = new BigNumber(num1)      a1.print()
a2 = new BigNumber(num3)      a2.print()
a3 = a1 / a2                a3.print() ? nl

? "Power of big number:"
a1 = new BigNumber(num1)      a1.print()
a2 = new BigNumber(num5)      a2.print()
a3 = a1 ^ a2                a3.print() ? nl
```

Output:

Add big numbers:
62345678901234567891678345123456789
1237894567890123419871236545
62345680139129135781801764994693334

Substract big numbers:
62345678901234567891678345123456789
1237894567890123419871236545
52345687663340000001554925252220244

Multiply big numbers:
62345678901234567891678345123456789
1237894567890123419871236545
77177377243260150103462178714197454736432472780119682305154005

Divide big numbers:
62345678901234567891678345123456789
1237894567890123419871236545
50364288

Divide big numbers: by very small number
62345678901234567891678345123456789
64
974151232831790123307474142554012

Power of big number:
62345678901234567891678345123456789
3
242336636261471172092347146031727004 (Output continue in next line)

(continues on next page)

(continued from previous page)

```
371698195628343934238988256152289508 (Output continue in next line)
493964611043228971692389860897069
```

69.3 BigNumber Functions

The library contains the next functions

```
FuncAdd(num1,num2)
FuncSubtract(num1,num2)
FuncCompare(num1,num2)
FuncDivide(num1,num2)
FuncMultiply(num1,num2)
FuncPower(num1,num2)
FuncBinaryToDecimal(num1)
FuncDecimalToBinary(num1)
printBinaryDigits(binList)
printDecimalDigits(decList)
```

69.4 BigNumber Class

The library contains the next class

```
class BigNumber
    func init aPara
    func operator cOperator, Para
    func print
    func value
```

69.5 Library Source Code

You can see the library source code in : ring/libraries/bignumber folder

Source Code : <https://github.com/ring-lang/ring/blob/master/libraries/bignumber/bignumber.ring>

CHAPTER
SEVENTY

USING CSVLIB

In this chapter we will learn how to use the CSVLib library.

70.1 Introduction

CSVLib is a simple library written in Ring.

The library provide functions to read and write CSV Files.

70.2 Functions

The library comes with the next functions

```
List2CSV(aList) --> cCSVString  
CSV2List(cCSVString) --> aList
```

70.3 Examples

Example(1)

```
load "csvlib.ring"  
  
aList = [ ["number", "square"] ]  
  
for t=1 to 10  
    aList + [ t, t*t ]  
next  
  
write( "squares.csv", list2CSV(aList) )
```

Output:

	A	B	C	D	E	F
1	number	square				
2	1	1				
3	2	4				
4	3	9				
5	4	16				
6	5	25				
7	6	36				
8	7	49				
9	8	64				
10	9	81				
11	10	100				
12						

Example (2)

```
load "csvlib.ring"

if ! fexists("squares.csv")
    ? "The file squares.csv doesn't exist! - Run writeSquaresTable.ring to create it"
    return
ok

aList = CSV2List( read("squares.csv") )

for subList in aList
    ? "" + subList[1] + " - " + subList[2]
next
```

Output:

```
number - square
1 - 1
2 - 4
3 - 9
4 - 16
```

(continues on next page)

(continued from previous page)

5 - 25
6 - 36
7 - 49
8 - 64
9 - 81
10 - 100

CHAPTER
SEVENTYONE

USING JSONLIB

In this chapter we will learn how to use the JSONLib library.

71.1 Introduction

JSONLib is a simple library written in Ring.

The library provide functions to read and write JSON files.

71.2 Functions

The library comes with the next functions

```
List2JSON(aList) --> cJSONObject  
JSONObject2List(cJSONObject) --> aList
```

71.3 Examples

Example (1):

File: sample.json

```
{  
    "firstName": "John",  
    "lastName": "Smith",  
    "age": 20,  
    "address": {  
        "streetAddress": "21 2nd Street",  
        "city": "New York",  
        "state": "NY",  
        "postalCode": "10021"  
    },  
    "phoneNumbers": [  
        { "type": "home", "number": "212 555-1234" },  
        { "type": "fax", "number": "646 555-4567" }  
    ]  
}
```

Ring Code:

```
load "jsonlib.ring"

func main

    aList = JSON2List( read("sample.json") )

    ? aList[:FirstName]
    ? aList[:LastName]
    ? aList[:Age]
    ? aList[:Address][:city]
    ? aList[:phoneNumbers][1][:Type]
    ? aList[:phoneNumbers][1][:Number]
    ? aList[:phoneNumbers][2][:Type]
    ? aList[:phoneNumbers][2][:Number]
```

Output:

```
John
Smith
20
New York
home
212 555-1234
fax
646 555-4567
```

Example (2):

```
load "jsonlib.ring"

func main

    aList = [
        :name = "Ring",
        :year = 2016
    ]

    ? List2JSON(aList)
```

Output:

```
{
    "name": "Ring",
    "year": 2016
}
```

CHAPTER
SEVENTYTWO

USING HTTPLIB

In this chapter we will learn how to use the `HTTPLib` library.

72.1 Introduction

This extension provides support for the `httplib` library

URL: <https://github.com/yhirose/cpp-httplib>

72.2 Server Class Methods

- `route(cType,cURL,cCode)`
- `setContent(cContent,cType)`
- `setHTMLPage(oPage)`
- `shareFolder(cFolder)`
- `setCookie(cStr)`
- `cookies() -> aList`
- `getFileContent(cFile) -> cString`
- `getFileName(cFile) -> cString`

72.3 Example

```
load "httpplib.ring"

oServer = new Server {

    ? "Try localhost:8080/hi"
    route(:Get, "/hi", :mytest)

    ? "Listen to port 8080"
    listen("0.0.0.0", 8080)

}
```

(continues on next page)

(continued from previous page)

```
func mytest
    oServer.setContent("Hello World!", "text/plain")
```

72.4 Samples

The samples exist in ring/samples/UsingHTTPLib folder

72.5 Printing Constants

The next example print the constants defined by the extension

```
load "httpplib.ring"

? "Constants:"

? HTTPLIB_KEEPALIVE_TIMEOUT_SECOND
? HTTPLIB_KEEPALIVE_MAX_COUNT
? HTTPLIB_CONNECTION_TIMEOUT_SECOND
? HTTPLIB_CONNECTION_TIMEOUT_USECOND
? HTTPLIB_READ_TIMEOUT_SECOND
? HTTPLIB_READ_TIMEOUT_USECOND
? HTTPLIB_WRITE_TIMEOUT_SECOND
? HTTPLIB_WRITE_TIMEOUT_USECOND
? HTTPLIB_IDLE_INTERVAL_SECOND
? HTTPLIB_IDLE_INTERVAL_USECOND
? HTTPLIB_REQUEST_URI_MAX_LENGTH
? HTTPLIB_REDIRECT_MAX_COUNT
? HTTPLIB_PAYLOAD_MAX_LENGTH
? HTTPLIB_TCP_NODELAY
? HTTPLIB_COMPRESSION_BUFSIZ
? HTTPLIB_THREAD_POOL_COUNT
? HTTPLIB_RECV_FLAGS
? HTTPLIB_LISTEN_BACKLOG
```

72.6 Using HTTP GET

Example(1):

```
load "httpplib.ring"

? "Start the server..."
oServer = new Server

? "Try localhost:8080/hi"
oServer.route(:Get, "/hi", :mytest)
```

(continues on next page)

(continued from previous page)

```
? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func mytest
    oServer.setContent("Hello World!", "text/plain")
```

Example(2):

```
load "httplib.ring"

? "Start the server..."
oServer = new Server

? "Try localhost:8080/one"
oServer.route(:Get, "/one", :one)
? "Try localhost:8080/two"
oServer.route(:Get, "/two", :two)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func one
    oServer.setContent("one", "text/plain")

func two
    oServer.setContent("two", "text/plain")
```

Example(3):

In this example we will use anonymous function

```
load "httplib.ring"

? "Try localhost:8080/hello"

oServer = new Server {

    route(:Get, "/hello", func {
        oServer.setContent("Hello, World!", "text/plain")
    })

    listen("0.0.0.0", 8080)
}
```

Example(4):

```
load "httplib.ring"

? "Try localhost:8080/hi - See output in console at Server-Side"
? "Try localhost:8080/hello - See output in web browser at Client-Side"
```

(continues on next page)

(continued from previous page)

```

oServer = new Server {

    route(:Get,"/hi",'? "Wow, I love Ring programming!"')
    route(:Get,"/hello",'oServer.setContent("Hello, World!", "text/plain")')

    listen("0.0.0.0", 8080)

}

```

Example(5):

```

load "httpplib.ring"

new Client("localhost:8080") {
    ? download("/one")
    ? download("/two")
}

```

Tip: Using the Download() method in the InternetLib is faster

72.7 Using WebLib

Example(1):

```

load "httpplib.ring"
load "weplib.ring"
import System.Web

? "Start the server..."
oServer = new Server

? "Try localhost:8080/report"
oServer.route(:Get,"/report",:report)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func report
    oPage = New HTMLPage
    {
        nRowCount = 10
        title = "Report"
        h1 { text("Customers Report") }
        Table
        {
            style = stylewidth("100%") + stylegradient(4)
            TR
            {
                TD { WIDTH="10%" text("Customers Count : " ) }

```

(continues on next page)

(continued from previous page)

```

        }
    }
}

Table
{
    style = stylewidth("100%") + stylegradient(26)
    TR
    {
        style = stylewidth("100%") + stylegradient(24)
        TD { text("Name" ) }
        TD { text("Age" ) }
        TD { text("Country" ) }
        TD { text("Job" ) }
        TD { text("Company" ) }
    }
    for x = 1 to nRowCount
        TR
        {
            TD { text("Test" ) }
            TD { text("30" ) }
            TD { text("Egypt" ) }
            TD { text("Sales" ) }
            TD { text("Future" ) }
        }
    next
}
}

oServer.setHTMLPage(oPage)

```

72.8 Using HTTP Post

Example(1):

```

load "httpplib.ring"
load "weplib.ring"
import System.Web

? "Start the server..."
oServer = new Server

? "Try localhost:8080/form"
oServer.route(:Get, "/form", :form)
oServer.route(:Post, "/formresponse", :formresponse)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func form

```

(continues on next page)

(continued from previous page)

```

oPage = New HTMLPageFunctions
{
    boxstart()
        text( "Post Test")
        newline()
    boxend()
    divstart([:style=StyleFloatLeft()+StyleWidth("100px") ])
        newline()
        text( "Number1 : " )    newline() newline()
        text( "Number2 : " )    newline() newline()
    divend()
    formpost("formresponse")
        divstart([ :style = styleFloatLeft()+StyleWidth("200px") ])
            newline()
            textbox([ :name = "Number1" ])  newline() newline()
            textbox([ :name = "Number2" ])  newline() newline()
            submit([ :value = "Send" ] )
        divend()
    formend()
}
oServer.setHTMLPage(oPage)

func formresponse

oPage = New HTMLPageFunctions
{
    boxstart()
        text( "Post Result" )
        newline()
    boxend()
    divstart([ :style = styleFloatLeft()+styleWidth("200px") ])
        newline()
        text( "Number1 : " + oServer["Number1"] )
        newline() newline()
        text( "Number2 : " + oServer["Number2"] )
        newline() newline()
        text( "Sum : " + (0 + oServer["Number1"] +
                           oServer["Number2"] ) )
        newline()
    divend()
}
oServer.setHTMLPage(oPage)

```

Example(2):

```

load "httpplib.ring"
Load "openssllib.ring"
load "weplib.ring"
import System.Web

? "Start the server..."

```

(continues on next page)

(continued from previous page)

```

oServer = new Server

? "Try localhost:8080/hash"
oServer.route(:Get, "/hash", :hash)
oServer.route(:Post, "/hashresponse", :hashresponse)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func hash

    oPage = New HTMLPageFunctions
    {
        boxstart()
            text( "Hash Test")
            newline()
        boxend()
        divstart([:style = StyleFloatLeft() + StyleWidth("100px") ])
            newline()
            text( "Value : ")
            newline() newline()
        divend()
        formpost("/hashresponse")
            divstart([:style = StyleFloatLeft() + StyleWidth("300px") ])
                newline()
                textbox([ :name = "Value" ])
                newline() newline()
                submit([ :value = "Send" ])
            divend()
        formend()
    }
    oServer.setHTMLPage(oPage)

func hashresponse

    oPage = New HTMLPageFunctions
    {
        boxstart()
            text( "Hash Result" )
            newline()
        boxend()
        divstart([:style = styleFloatLeft() + styleWidth("100%") ])
            newline()
            text( "Value : " + oServer["Value"] )
            newline()
            text( "MD5 : " + md5(oServer["Value"]) )
            newline()
            text( "SHA1 : " + SHA1(oServer["Value"]) )
            newline()
            text( "SHA256 : " + SHA256(oServer["Value"]) )
            newline()
            text( "SHA224 : " + SHA224(oServer["Value"]) )
    }

```

(continues on next page)

(continued from previous page)

```

newline()
text( "SHA384 : " + SHA384(oServer["Value"]) )
newline()
text( "SHA512 : " + SHA512(oServer["Value"]) )
newline()
divend()
}

oServer.setHTMLPage(oPage)

```

72.9 More Samples

Using Gradients:

```

load "httplib.ring"
load "weplib.ring"
import System.Web

? "Start the server..."
oServer = new Server

? "Try localhost:8080/gradient"
oServer.route(:Get, "/gradient", :gradient)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func gradient

    oPage = New HTMLPageFunctions
    {
        boxstart()
            text("StyleGradient() Function")
        boxend()
        for x = 1 to 60
            divstart([ :id = x , :align = "center" ,
                      :style = stylefloatleft() +
                                stylesize(string(100/60*6)+"%", 
                                ←"50px") +
                                stylegradient(x) ])
                h3(x)
            divend()
        next
    }
    oServer.setHTMLPage(oPage)

```

Using Lists:

```

load "httplib.ring"
load "weplib.ring"

```

(continues on next page)

(continued from previous page)

```

import System.Web

? "Start the server..."
oServer = new Server

? "Try localhost:8080/lists"
oServer.route(:Get,"/lists",:lists)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func lists

    oPage = New HTMLPageFunctions
    {
        ulstart([])
            for x = 1 to 10
                liststart([])
                    text(x)
                liend()
            next
        ulend()

        list2ul(["one","two","three","four","five"])

        ulstart([])
            for x = 1 to 10
                liststart([])
                    cFuncName = "btn"+x+"()"
                    button([ :onclick = cFuncName , :value = x])
                    script(scriptfuncalert(cFuncName,string(x)))
                liend()
            next
        ulend()
    }
    oServer.setHTMLPage(oPage)

```

Using Tables:

```

load "httplib.ring"
load "weplib.ring"
import System.Web

? "Start the server..."
oServer = new Server

? "Try localhost:8080/table"
oServer.route(:Get,"/table",:table)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

```

(continues on next page)

(continued from previous page)

```
func table

    oPage = New HTMLPageFunctions
    {
        divstart([ :style = styledivcenter("400px", "500px") ] )
            style(styletable() + styletablerows("t01"))
            tablestart([ :id = :t01 , :style = stylewidth("100%") ])
                rowstart([])
                    headerstart([]) text("Number") headerend()
                    headerstart([]) text("square") headerend()
                rowend()
                for x = 1 to 10
                    rowstart([])
                        cellstart([]) text(x) cellend()
                        cellstart([]) text(x*x) cellend()
                    rowend()
                    next
                tableend()
            divend()
    }
    oServer.setHTMLPage(oPage)
```

Play Video:

```
load "httplib.ring"
load "weplib.ring"
import System.Web

? "Start the server..."
oServer = new Server

? "Try localhost:8080/play"
oServer.route(:Get, "/play", :play)

? "We support files in the res folder like res/horse.ogg and res/movie.mp4"
oServer.shareFolder("res")

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func play

    oPage = New HTMLPage
    {
        Title = "Welcome"
        h1 { text("Play sound and video!") }
        div
        {
            audio
            {
                src = "res/horse.ogg"
                type = "audio/ogg"
```

(continues on next page)

(continued from previous page)

```

        }

        video
        {
            width = 320
            height = 240
            src = "res/movie.mp4"
            type = "video/mp4"
        }

    }
oServer.setHTMLPage(oPage)

```

72.10 Using Cookies

Example:

```

load "httpplib.ring"
load "weplib.ring"
import System.Web

? "Start the server..."
oServer = new Server

? "Try localhost:8080/cookie"
oServer.route(:Get,"/cookie",:cookie)
oServer.route(:Get,"/cookieresponse",:cookieresponse)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func cookie

    oPage = New HTMLPageFunctions
    {
        boxstart()
            text( "Cookie Test" )
            newline()
        boxend()
            link([ :url = "/cookieresponse", :title = "Use Cookies" ])
    }

    oServer.setCookie("programminglanguage=Ring")
    oServer.setCookie("library=HTTPLib")

    oServer.setHTMLPage(oPage)

func cookieresponse

```

(continues on next page)

(continued from previous page)

```
aCookies = oServer.Cookies()

oPage = New HTMLPageFunctions
{
    boxstart()
        text( "Cookies Values" )
        newline()
    boxend()
    link([ :url = "cookie", :title = "back" ])
    newline()
    divstart([:style="float:left;width:200px"])
        text( "Programming Language : " + aCookies[:programminglanguage] )
    ↪)
    newline()
    text( "Library : " + aCookies[:library] )
    newline()
    divend()
}
oServer.setHTMLPage(oPage)
```

72.11 Uploading Files

Example:

```
load "httplib.ring"
load "weplib.ring"
import System.Web

? "Start the server..."
oServer = new Server

cUploadFolder = "upload/"
oServer.shareFolder(cUploadFolder)

? "Try localhost:8080/upload"
oServer.route(:Get,"/upload",:upload)
oServer.route(:Post,"/uploadresponse",:uploadresponse)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func upload

    oPage = New HTMLPageFunctions
    {
        boxstart()
            text( "Upload File" )
            newline()
        boxend()
        for x = 1 to 3 newline() next
    }
```

(continues on next page)

(continued from previous page)

```

formupload("/uploadresponse")
    text( "Customer Name : " )
    textbox([ :name = "custname" ])
    newline() newline()
    divstart([ :style = styleFloatLeft() + styleWidth("90px") ])
        uploadfile("file1") newline() newline()
        uploadfile("file2") newline() newline()
        submit([ :value = "Send" ])
    divend()
formend()
}

oServer.setHTMLPage(oPage)

func uploadresponse

oPage = New HTMLPageFunctions
{
    boxstart()
        text( "Upload Result" )
        newline()
    boxend()
    newline()
    divstart([ :style= styleFloatLeft() + styleWidth("100px") ])
        text( "Name : " + oServer["custname"] )
        newline()
    divend()
    getuploadedfile(self,"file1")
    getuploadedfile(self,"file2")
}

oServer.setHTMLPage(oPage)

Func getUploadedFile oObj,cFile
cNewFileName = oServer.getfilename(cFile)
if cNewFileName = NULL return ok
cNewFileContent = oServer.getFileContent(cFile)
/*
    Here we use object.property instead of object { }
    To avoid executing braceend() method
*/
cFileName = cUploadFolder + cNewFileName
write(cFileName,cNewFileContent)
if isLinux()
    system("chmod a+x "+cFileName)
ok
oObj.newline()
oObj.text( "File "+cFileName+ " Uploaded ..." )
oObj.newline()
imageURL = cFileName
oObj.link([ :url = imageURL, :title = "Download" ])

```

(continues on next page)

(continued from previous page)

```

oObj.newLine()
oObj.image( [ :url = imageURL , :alt = :image ] )
oObj.newLine()

```

72.12 Using Templates

Example:

```

load "httpplib.ring"
load "weplib.ring"
import System.Web

? "Start the server..."
oServer = new Server

? "Try localhost:8080/template"
oServer.route(:Get,"/template"," new numbersController { start() } ")

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

class numbersController

    MyHeader aNumbers

    func Start

        MyHeader = New Header
        {
            cColumn1 = "Number" cColumn2 = "Square"
        }

        aNumbers = list(20)

        for x = 1 to len(aNumbers)
            aNumbers[x] = new number
            {
                nValue = x    nSquare = x*x
            }
        next

        cTemp = Template("templates/mynumbers.html",self)

        oPage = new HTMLPageFunctions
        {
            boxstart()
                text( "Test Templates" )
                newline()
            boxend()
            html(cTemp)
        }
    end

```

(continues on next page)

(continued from previous page)

```

    }

    oServer.setHTMLPage(oPage)

Class Header cColumn1 cColumn2

Class Number nValue   nSquare

```

72.13 Regular Expressions

Example:

```

load "httpplib.ring"

? "Start the server..."
oServer = new Server

? "Try localhost:8080/numbers/<number>"
? "Example: localhost:8080/numbers/123"
oServer.route(:Get, "/numbers/(\d+)", :mytest)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func mytest
    cOutput = "Match(1): " + oServer.Match(1) + nl
    cOutput += "Match(2): " + oServer.Match(2) + nl
    oServer.setContent(cOutput, "text/plain")

```

72.14 Stop the Server

Example:

```

load "httpplib.ring"

? "Start the server..."
oServer = new Server

? "Try localhost:8080/time"
? "Try localhost:8080/stop"
oServer.route(:Get, "/time", :gettime)
oServer.route(:Get, "/stop", :stop)

? "Listen to port 8080"
oServer.listen("0.0.0.0", 8080)

func gettime
    oServer.setContent("Time: " + time(), "text/plain")

```

(continues on next page)

(continued from previous page)

```
func stop  
    oServer.stop()
```

CHAPTER
SEVENTYTHREE

USING TOKENSLIB

In this chapter we will learn how to use the TokensLib library.

73.1 Introduction

TokensLib is a simple library written in Ring.

The library provide classes to get Ring tokens from Ring source code.

73.2 RingTokens Class

The class comes with the next methods:

```
fromFile(cFileName)
fromString(cString)
getTokens() --> aTokensList
printTokens()
```

73.3 Example

```
load "tokenslib.ring"

func main
    oTokens = new RingTokens {
        fromFile("hello.ring")
        PrintTokens()
        ? Copy("=", 50)
        fromString("? 1+1")
        PrintTokens()
    }
```

Output:

Keyword	: SEE
Literal	: Hello, World!
EndLine	

(continues on next page)

(continued from previous page)

```
=====
Operator : ? (23)
Number  : 1
Operator : + (1)
Number  : 1
EndLine
```

73.4 Constants

When loading the library, We have access to the next constants

```
# Tokens Table
    C_TOKENTYPE      = 1
    C_TOKENVALUE     = 2
    C_TOKENINDEX     = 3

# Token Type
    C_KEYWORD        = 0
    C_OPERATOR       = 1
    C_LITERAL        = 2
    C_NUMBER         = 3
    C_IDENTIFIER     = 4
    C_ENDLINE        = 5

# Keywords List
    aKEYWORDS = [
        "IF", "TO", "OR", "AND", "NOT", "FOR", "NEW", "FUNC",
        "FROM", "NEXT", "LOAD", "ELSE", "SEE", "WHILE", "OK",
        "CLASS", "RETURN", "BUT",
        "END", "GIVE", "BYE", "EXIT", "TRY", "CATCH", "DONE",
        "SWITCH", "ON", "OTHER", "OFF",
        "IN", "LOOP", "PACKAGE", "IMPORT", "PRIVATE", "STEP", "DO",
        "AGAIN", "CALL", "ELSEIF",
        "PUT", "GET", "CASE", "DEF", "ENDFUNC", "ENDCLASS", "ENDPACKAGE",
        "CHANGERINGKEYWORD", "CHANGERINGOPERATOR", "LOADSYNTAX"
    ]

# Keywords Constants
    K_IF              = 1
    K_TO              = 2
    K_OR              = 3
    K_AND             = 4
    K_NOT             = 5
    K_FOR             = 6
    K_NEW             = 7
    K_FUNC            = 8
    K_FROM            = 9
    K_NEXT            = 10
    K_LOAD            = 11
    K_ELSE            = 12
```

(continues on next page)

(continued from previous page)

K_SEE	= 13
K_WHILE	= 14
K_OK	= 15
K_CLASS	= 16
K_RETURN	= 17
K_BUT	= 18
K_END	= 19
K_GIVE	= 20
K_BYE	= 21
K_EXIT	= 22
K_TRY	= 23
K_CATCH	= 24
K_DONE	= 25
K_SWITCH	= 26
K_ON	= 27
K_OTHER	= 28
K_OFF	= 29
K_IN	= 30
K_LOOP	= 31
K_PACKAGE	= 32
K_IMPORT	= 33
K_PRIVATE	= 34
K_STEP	= 35
K_DO	= 36
K AGAIN	= 37
K_CALL	= 38
K_ELSEIF	= 39
K_PUT	= 40
K_GET	= 41
K_CASE	= 42
K_DEF	= 43
K_ENDFUNC	= 44
K_ENDCLASS	= 45
K_ENDPACKAGE	= 46
K_CHANGERINGKEYWORD	= 47
K_CHANGERINGOPERATOR	= 48
K_LOADSYNTAX	= 49

Operators

OP_PLUS	= 1
OP_MINUS	= 2
OP_MUL	= 3
OP_DIV	= 4
OP_Rem	= 5
OP_DOT	= 6
OP_FOPEN	= 7
OP_FCLOSE	= 8
OP_EQUAL	= 9
OP_COMMA	= 10
OP_NOT	= 11
OP_GREATER	= 12

(continues on next page)

(continued from previous page)

OP_LESS	= 13
OP_LOPEN	= 14
OP_LCLOSE	= 15
OP_RANGE	= 16
OP_BRACEOPEN	= 17
OP_BRACECLOSE	= 18
OP_BITAND	= 19
OP_BITOR	= 20
OP_BITNOT	= 21
OP_XOR	= 22

CHAPTER
SEVENTYFOUR

USING RINGLIBCURL

In this chapter we will learn about using RingLibCurl

74.1 Get Request

Example:

```
load "libcurl.ring"

curl = curl_easy_init()

curl_easy_setopt(curl, CURLOPT_USERAGENT, "curl/7.54.1")
curl_easy_setopt(curl, CURLOPT_FOLLOWLOCATION, 1)
curl_easy_setopt(curl, CURLOPT_URL, "http://ring-lang.sf.net")

curl_easy_perform(curl)

curl_easy_cleanup(curl)
```

74.2 Post Request

Example:

```
load "libcurl.ring"

curl = curl_easy_init()

curl_easy_setopt(curl, CURLOPT_USERAGENT, "curl/7.54.1")

cPostThis = "page=4&Number1=4&Number2=5"
curl_easy_setopt(curl, CURLOPT_URL, "http://localhost/ringapp/index.ring?page=3")
curl_easy_setopt(curl, CURLOPT_POSTFIELDS, cPostThis)

curl_easy_perform(curl)

curl_easy_cleanup(curl)
```

74.3 Facebook Login

Example:

```
load "libcurl.ring"

see "Enter Email : " give $login_email
See "Enter Password : " give $login_pass

curl = curl_easy_init()

curl_easy_setopt(curl, CURLOPT_USERAGENT, "curl/7.54.1")

curl_easy_setopt(curl, CURLOPT_URL, 'https://www.facebook.com/login.php')
curl_easy_setopt(curl, CURLOPT_POSTFIELDS,'charset_test=j u s t a t e s t'+
' &email='+urlencode($login_email)+'&pass='+
urlencode($login_pass)+'&login=Login')
curl_easy_setopt(curl, CURLOPT_POST, 1)
curl_easy_setopt(curl, CURLOPT_HEADER, 0)
curl_easy_setopt(curl, CURLOPT_FOLLOWLOCATION, 1)
curl_easy_setopt(curl, CURLOPT_COOKIEJAR, "cookies.txt")
curl_easy_setopt(curl, CURLOPT_COOKIEFILE, "cookies.txt")
curl_easy_setopt(curl, CURLOPT_USERAGENT, "Mozilla/5.0 (Windows; U;"+
" Windows NT 5.1; en-US; rv:1.8.1.3) Gecko/20070309 Firefox/2.0.0.3")
curl_easy_setopt(curl, CURLOPT_REFERER, "http://www.facebook.com")
curl_easy_setopt(curl, CURLOPT_SSL_VERIFYPEER, FALSE)
curl_easy_setopt(curl, CURLOPT_SSL_VERIFYHOST, 2)

mylist = curl_slist_append(NULL, 'Accept-Charset: utf-8')
curl_slist_append(mylist, 'Accept-Language: en-us,en;q=0.7,bn-bd;q=0.3')
curl_slist_append(mylist, 'Accept: text/xml,application/xml,+'+
'application/xhtml+xml,text/html;q=0.9,text/plain;q=0.8,image/png,*/*;q=0.5')
curl_easy_setopt(curl, CURLOPT_HTTPHEADER, mylist)

curl_easy_setopt(curl, CURLOPT_COOKIESESSION, false)

curl_easy_perform(curl)

curl_easy_cleanup(curl)

Func URLEncode cStr
    cOut = ""
    for x in cStr
        if isalnum(x)
            cOut += x
        but x = " "
            cOut += "+"
        else
            cOut += "%" + str2hex(x)
        ok
    next
    return cOut
```

74.4 Save Output to String

Example:

```
load "libcurl.ring"

curl = curl_easy_init()

curl_easy_setopt(curl, CURLOPT_USERAGENT, "curl/7.54.1")
curl_easy_setopt(curl, CURLOPT_FOLLOWLOCATION, 1)
curl_easy_setopt(curl, CURLOPT_URL, "http://ring-lang.sf.net")

cOutput = curl_easy_perform_silent(curl)

See "Output:" + nl
see cOutput

curl_easy_cleanup(curl)
```

74.5 Get Stock Data From Yahoo

Example:

```
Load "libcurl.ring"

### Part 1 --- Get Crumb and Cookie -----
See "Start curl_easy_init(): "+ nl
curl = curl_easy_init()           ### >>> HANDLE >>> 01006BD0  CURL  0

    curl_easy_setopt(curl, CURLOPT_USERAGENT, "curl/7.54.1")
    curl_easy_setopt(curl, CURLOPT_FOLLOWLOCATION, 1)
    curl_easy_setopt(curl, CURLOPT_COOKIEJAR, "cookies.txt")
    curl_easy_setopt(curl, CURLOPT_COOKIEFILE, "cookies.txt")
    curl_easy_setopt(curl, CURLOPT_URL, "https://finance.yahoo.com/quote/AMZN/history
→")

    ### HTML Data >>> STDOUT Window, Use curl_easy_perform_silent >>> String

cOutput = curl_easy_perform_silent(curl)      ### GO Get Data >>> String

### Extract Crumb from data
### "CrumbStore":{"crumb":"abcdefgijk"},

if cOutput != NULL

    newStr1      = substr(cOutput, substr(cOutput, '"CrumbStore":{"crumb":"' ), 48 )
    nPosS      = substr(newStr1, ':' ) ; ### Start of crumb -2
    nPosE      = substr(newStr1, "}" ) ; ### End of crumb
    nCount     = nPosE - nPosS -2          ### size of crumb
```

(continues on next page)

(continued from previous page)

```

myCrumb      = substr(newStr1, nPosS +2, nCount)

See "myCrumb.: |"+ myCrumb +"| " +nl

### Unicode "\u002F" replace it with "/"
if substr( myCrumb, "\u002F")
    myCrumb = substr( myCrumb, "\u002F", "/")
    See "myCrumb2: |"+ myCrumb +"| "+ nl
ok

else
    See "No Connectivity to Yahoo. Looking for Cookie and Crumb." +nl +nl
ok

### Part 2 --- Send URL with Crumb, and Cookie -----
### Send URL+Crumb to Yahoo to fetch 1st stock history data,
$url = "https://query1.finance.yahoo.com/v7/finance/download/AMZN"+
    "?period1=1277856000&period2=149877545&interval=1wk" +
    "&events=history&crumb=" + myCrumb

curl_easy_setopt(curl, CURLOPT_URL, $url);
cStr = curl_easy_perform_silent(curl)
See cStr

curl_easy_cleanup(curl)  ### REMEMBER to CLOSE CURL

```

Output:

```

myCrumb.: |sEEeW97mxvN|
Date,Open,High,Low,Close,Adj Close,Volume
2010-07-05,110.650002,117.480003,109.000000,117.260002,117.260002,21000400
2010-07-12,117.809998,124.879997,117.320000,118.489998,118.489998,29407300
2010-07-19,118.379997,121.250000,105.800003,118.870003,118.870003,74252100

```

RINGLIBCURL FUNCTIONS REFERENCE

75.1 Introduction

In this chapter we have a list of the supported functions by this extension

75.2 Reference

- CURL_GLOBAL_ALL
- CURL_GLOBAL_SSL
- CURL_GLOBAL_WIN32
- CURL_GLOBAL NOTHING
- CURL_GLOBAL_DEFAULT
- CURL_GLOBAL_ACK_EINTR
- CURLOPT_VERBOSE
- CURLOPT_HEADER
- CURLOPT_NOPROGRESS
- CURLOPT_NOSIGNAL
- CURLOPT_WILDCARDMATCH
- CURLOPT_WRITEFUNCTION
- CURLOPT_WRITEDATA
- CURLOPT_READFUNCTION
- CURLOPT_READDATA
- CURLOPT_IOCTLFUNCTION
- CURLOPT_IOCTLDATA
- CURLOPT_SEEKFUNCTION
- CURLOPT_SEEKDATA
- CURLOPT_SOCKOPTFUNCTION
- CURLOPT_SOCKOPTDATA
- CURLOPT_OPENSOCKETFUNCTION

- CURLOPT_OPENSOCKETDATA
- CURLOPT_CLOSESOCKETFUNCTION
- CURLOPT_CLOSESOCKETDATA
- CURLOPT_PROGRESSFUNCTION
- CURLOPT_PROGRESSDATA
- CURLOPT_HEADERFUNCTION
- CURLOPT_HEADERDATA
- CURLOPT_DEBUGFUNCTION
- CURLOPT_DEBUGDATA
- CURLOPT_SSL_CTX_FUNCTION
- CURLOPT_SSL_CTX_DATA
- CURLOPT_CONV_TO_NETWORK_FUNCTION
- CURLOPT_CONV_FROM_NETWORK_FUNCTION
- CURLOPT_CONV_FROM_UTF8_FUNCTION
- CURLOPT_INTERLEAVEFUNCTION
- CURLOPT_INTERLEAVEDATA
- CURLOPT_CHUNK_BGN_FUNCTION
- CURLOPT_CHUNK_END_FUNCTION
- CURLOPT_CHUNK_DATA
- CURLOPT_FNMATCH_FUNCTION
- CURLOPT_FNMATCH_DATA
- CURLOPT_ERRORBUFFER
- CURLOPT_STDERR
- CURLOPT_FAILONERROR
- CURLOPT_URL
- CURLOPT_PROTOCOLS
- CURLOPT_REDIR_PROTOCOLS
- CURLOPT_PROXY
- CURLOPT_PROXYPORT
- CURLOPT_PROXYTYPE
- CURLOPT_NOPROXY
- CURLOPT_HTTPPROXYTUNNEL
- CURLOPT SOCKS5_GSSAPI_SERVICE
- CURLOPT SOCKS5_GSSAPI_NEC
- CURLOPT_INTERFACE
- CURLOPT_LOCALPORT

- CURLOPT_LOCALPORTRANGE
- CURLOPT_DNS_CACHE_TIMEOUT
- CURLOPT_DNS_USE_GLOBAL_CACHE
- CURLOPT_BUFFERSIZE
- CURLOPT_PORT
- CURLOPT_TCP_NODELAY
- CURLOPT_ADDRESS_SCOPE
- CURLOPT_NETRC
- CURLOPT_NETRC_FILE
- CURLOPT_USERPWD
- CURLOPT_PROXYUSERPWD
- CURLOPT_USERNAME
- CURLOPT_PASSWORD
- CURLOPT_PROXYUSERNAME
- CURLOPT_PROXYPASSWORD
- CURLOPT_HTTPAUTH
- CURLOPT_TLSAUTH_USERNAME
- CURLOPT_TLSAUTH_PASSWORD
- CURLOPT_TLSAUTH_TYPE
- CURLOPT_PROXYAUTH
- CURLOPT_AUTOREFERER
- CURLOPT_ACCEPT_ENCODING
- CURLOPT_TRANSFER_ENCODING
- CURLOPT_FOLLOWLOCATION
- CURLOPT_UNRESTRICTED_AUTH
- CURLOPT_MAXREDIRS
- CURLOPT_POSTREDIR
- CURLOPT_PUT
- CURLOPT_POST
- CURLOPT_POSTFIELDS
- CURLOPT_POSTFIELDSIZE
- CURLOPT_POSTFIELDSIZE_LARGE
- CURLOPT_COPYPOSTFIELDS
- CURLOPT_HTTPPOST
- CURLOPT_REFERER
- CURLOPT_USERAGENT

- CURLOPT_HTTPHEADER
- CURLOPT_HTTP200ALIASES
- CURLOPT_COOKIE
- CURLOPT_COOKIEFILE
- CURLOPT_COOKIEJAR
- CURLOPT_COOKIESSESSION
- CURLOPT_COOKIELIST
- CURLOPT_HTTPGET
- CURLOPT_HTTP_VERSION
- CURLOPT_IGNORE_CONTENT_LENGTH
- CURLOPT_HTTP_CONTENT_DECODING
- CURLOPT_HTTP_TRANSFER_DECODING
- CURLOPT_MAIL_FROM
- CURLOPT_MAIL_RCPT
- CURLOPT_TFTP_BLKSIZE
- CURLOPT_FTPPORT
- CURLOPT_QUOTE
- CURLOPT_POSTQUOTE
- CURLOPT_PREQUOTE
- CURLOPT_APPEND
- CURLOPT_FTP_USE_EPRT
- CURLOPT_FTP_USE_EPSV
- CURLOPT_FTP_USE_PRET
- CURLOPT_FTP_CREATE_MISSING_DIRS
- CURLOPT_FTP_RESPONSE_TIMEOUT
- CURLOPT_FTP_ALTERNATIVE_TO_USER
- CURLOPT_FTP_SKIP_PASV_IP
- CURLOPT_FTPSSLAUTH
- CURLOPT_FTP_SSL_CCC
- CURLOPT_FTP_ACCOUNT
- CURLOPT_FTP_FILEMETHOD
- CURLOPT_RTSP_REQUEST
- CURLOPT_RTSP_SESSION_ID
- CURLOPT_RTSP_STREAM_URI
- CURLOPT_RTSP_TRANSPORT
- CURLOPT_RTSP_CLIENT_CSEQ

- CURLOPT_RTSP_SERVER_CSEQ
- CURLOPT_TRANSFERTEXT
- CURLOPT_PROXY_TRANSFER_MODE
- CURLOPT_CRLF
- CURLOPT_RANGE
- CURLOPT_RESUME_FROM
- CURLOPT_RESUME_FROM_LARGE
- CURLOPT_CUSTOMREQUEST
- CURLOPT_FILETIME
- CURLOPT_DIRLISTONLY
- CURLOPT_NOBODY
- CURLOPT_INFILESIZE
- CURLOPT_INFILESIZE_LARGE
- CURLOPT_UPLOAD
- CURLOPT_MAXFILESIZE
- CURLOPT_MAXFILESIZE_LARGE
- CURLOPT_TIMECONDITION
- CURLOPT_TIMEVALUE
- CURLOPT_TIMEOUT
- CURLOPT_TIMEOUT_MS
- CURLOPT_LOW_SPEED_LIMIT
- CURLOPT_LOW_SPEED_TIME
- CURLOPT_MAX_SEND_SPEED_LARGE
- CURLOPT_MAX_RECV_SPEED_LARGE
- CURLOPT_MAXCONNECTS
- CURLOPT_FRESH_CONNECT
- CURLOPT_FORBID_REUSE
- CURLOPT_CONNECTTIMEOUT
- CURLOPT_CONNECTTIMEOUT_MS
- CURLOPT_IPRESOLVE
- CURLOPT_CONNECT_ONLY
- CURLOPT_USE_SSL
- CURLOPT_RESOLVE
- CURLOPT_SSLCERT
- CURLOPT_SSLCERTTYPE
- CURLOPT_SSLKEY

- CURLOPT_SSLKEYTYPE
- CURLOPT_KEYPASSWD
- CURLOPT_SSLENGINE
- CURLOPT_SSLENGINE_DEFAULT
- CURLOPT_SSLVERSION
- CURLOPT_SSL_VERIFYHOST
- CURLOPT_SSL_VERIFYPEER
- CURLOPT_CAINFO
- CURLOPT_ISSUERCERT
- CURLOPT_CAPATH
- CURLOPT_CRLFILE
- CURLOPT_CERTINFO
- CURLOPT_RANDOM_FILE
- CURLOPT_EGDSOCKET
- CURLOPT_SSL_CIPHER_LIST
- CURLOPT_SSL_SESSIONID_CACHE
- CURLOPT_KRBLEVEL
- CURLOPT_GSSAPI_DELEGATION
- CURLOPT_SSH_AUTH_TYPES
- CURLOPT_SSH_HOST_PUBLIC_KEY_MD5
- CURLOPT_SSH_PUBLIC_KEYFILE
- CURLOPT_SSH_PRIVATE_KEYFILE
- CURLOPT_SSH_KNOWNHOSTS
- CURLOPT_SSH_KEYFUNCTION
- CURLOPT_SSH_KEYDATA
- CURLOPT_PRIVATE
- CURLOPT_SHARE
- CURLOPT_NEW_FILE_PERMS
- CURLOPT_NEW_DIRECTORY_PERMS
- CURLOPT_TELNETOPTIONS
- CURLE_OK
- CURLE_UNKNOWN_OPTION
- CURLE_NOT_BUILT_IN
- CURLINFO_EFFECTIVE_URL
- CURLINFO_RESPONSE_CODE
- CURLINFO_HTTP_CONNECTCODE

- CURLINFO_FILETIME
- CURLINFO_TOTAL_TIME
- CURLINFO_NAMELOOKUP_TIME
- CURLINFO_CONNECT_TIME
- CURLINFO_APPCONNECT_TIME
- CURLINFO_PRETRANSFER_TIME
- CURLINFO_STARTTRANSFER_TIME
- CURLINFO_REDIRECT_TIME
- CURLINFO_REDIRECT_COUNT
- CURLINFO_REDIRECT_URL
- CURLINFO_SIZE_UPLOAD
- CURLINFO_SIZE_DOWNLOAD
- CURLINFO_SPEED_DOWNLOAD
- CURLINFO_SPEED_UPLOAD
- CURLINFO_HEADER_SIZE
- CURLINFO_REQUEST_SIZE
- CURLINFO_SSL_VERIFYRESULT
- CURLINFO_SSL_ENGINES
- CURLINFO_CONTENT_LENGTH_DOWNLOAD
- CURLINFO_CONTENT_LENGTH_UPLOAD
- CURLINFO_CONTENT_TYPE
- CURLINFO_PRIVATE
- CURLINFO_HTTPAUTH_AVAIL
- CURLINFO_PROXYAUTH_AVAIL
- CURLINFO_OS_ERRNO
- CURLINFO_NUM_CONNECTS
- CURLINFO_PRIMARY_IP
- CURLINFO_PRIMARY_PORT
- CURLINFO_LOCAL_IP
- CURLINFO_LOCAL_PORT
- CURLINFO_COOKIELIST
- CURLINFO_LASTSOCKET
- CURLINFO_FTP_ENTRY_PATH
- CURLINFO_CERTINFO
- CURLINFO_CONDITION_UNMET
- CURLINFO_RTSP_SESSION_ID

- CURLINFO_RTSP_CLIENT_CSEQ
- CURLINFO_RTSP_SERVER_CSEQ
- CURLINFO_RTSP_CSEQ_RECV
- CURLFORM_COPYNAME
- CURLFORM_PTRNAME
- CURLFORM_COPYCONTENTS
- CURLFORM_PTRCONTENTS
- CURLFORM_CONTENTSLENGTH
- CURLFORM_FILECONTENT
- CURLFORM_FILE
- CURLFORM_CONTENTTYPE
- CURLFORM_FILENAME
- CURLFORM_BUFFER
- CURLFORM_BUFFERPTR
- CURLFORM_BUFFERLENGTH
- CURLFORM_STREAM
- CURLFORM_ARRAY
- CURLFORM_CONTENTHEADER
- CURLcode curl_global_init(long flags)
- CURL *curl_easy_init(void)
- void curl_easy_cleanup(CURL * handle)
- CURLcode curl_easy_setopt_1(CURL *handle, CURLoption option, int)
- CURLcode curl_easy_setopt_2(CURL *handle, CURLoption option, const char *)
- CURLcode curl_easy_setopt_3(CURL *handle, CURLoption option, void *)
- CURLcode curl_easy_setopt_4(CURL *handle, CURLoption option, CURLLIST *)
- CURLcode curl_easy_perform(CURL * easy_handle)
- String *curl_easy_perform_silent(CURL * easy_handle)
- CURLcode curl_easy_getinfo_1(CURL *handle, CURLINFO info, char **urlp)
- CURLcode curl_easy_getinfo_2(CURL *handle, CURLINFO info, long *codep)
- CURLcode curl_easy_getinfo_3(CURL *handle, CURLINFO info, double *timep)
- CURLcode curl_easy_getinfo_4(CURL *handle, CURLINFO info, CURLLIST **engine_list)
- CURLcode curl_easy_getinfo_5(CURL *handle, CURLINFO info, struct curl_certinfo *chainp)
- CURLcode curl_easy_getinfo_6(CURL *handle, CURLINFO info, struct curl_tlsSessioninfo **session)
- char *curl_version(void)
- time_t curl_getdate(char * datestring , time_t *now)

- CURLFORMcode curl_formadd_1(struct curl_httppost **firstitem, struct curl_httppost **lastitem, CURLformoption, const char *, CURLformoption, const char *, CURLformoption)
- CURLFORMcode curl_formadd_2(struct curl_httppost **firstitem, struct curl_httppost **lastitem, CURLformoption, const char *, CURLformoption, const char *, CURLformoption, const char *, CURLformoption)
- CURLFORMcode curl_formadd_3(struct curl_httppost **firstitem, struct curl_httppost **lastitem, CURLformoption, const char *, CURLformoption, void *, CURLformoption)
- CURLFORMcode curl_formadd_4(struct curl_httppost **firstitem, struct curl_httppost **lastitem, CURLformoption, const char *, CURLformoption, void *, CURLformoption, long , CURLformoption)
- CURLFORMcode curl_formadd_5(struct curl_httppost **firstitem, struct curl_httppost **lastitem, CURLformoption, const char , CURLformoption, void *, CURLformoption, long , CURLformoption, const char , CURLformoption)
- CURLFORMcode curl_formadd_6(struct curl_httppost **firstitem, struct curl_httppost **lastitem, CURLformoption, const char *, CURLformoption, const char *, CURLformoption, void * , CURLformoption, long , CURLformoption)
- CURLFORMcode curl_formadd_7(struct curl_httppost **firstitem, struct curl_httppost **lastitem, CURLformoption, const char *, CURLformoption, struct curl_forms [], CURLformoption)
- void curl_formfree(struct curl_httppost * form)
- CURLLIST *curl_slist_append(CURLLIST * list, const char * string)
- void curl_slist_free_all(CURLLIST * list)
- char *curl_easy_escape(CURL * curl , const char * string , int length)
- char *curl_easy_unescape(CURL * curl , const char * url , int inlength , int * outlength)

CHAPTER
SEVENTYSIX

RINGSOCKETS EXTENSION

In this chapter we will learn about using the RingSockets extension.

76.1 TCP Server

Example (TCP Server Code):

```
load "sockets.ring"

sock = socket(AF_INET, SOCK_STREAM, 0)
bind(sock, "127.0.0.1", 5050)
listen(sock, 5)
ns = accept(sock)

send(ns, "Hello Client")
msg = recv(ns, 1024)
? "Client Say >> " + msg
close(ns)
close(sock)
? "socket connection closed"
```

76.2 TCP Client

Example (TCP Client Code):

```
load "sockets.ring"

sock = socket(AF_INET, SOCK_STREAM)
connect(sock, "127.0.0.1", 5050)

send(sock, "Hello Server")
msg = recv(sock, 1024)
? "Server Say >> " + msg

close(sock)
? "socket connection closed"
```

76.3 Functions

The next functions are provided by this extension

```
socket(nAddressFamily, nConnectionType) -> SocketHandle
bind(pSocketHandle, cHost , nPort)
listen(pSocketHandle, nBacklog)
accept(pSocketHandle) -> pConnectionHandle
send(pConnectionHandle|pSocketHandle,cMessage)
sendto(pSocketHandle,cMessage)
recv(pConnectionHandle|pSocketHandle,nBuffer) -> cData
recvfrom(pSocketHandle, nBuffer) -> cData
connect(pSocketHandle, cHost , nPort) -> return <0> if successful
close(pSocketHandle|pConnectionHandle)
gethostbyname(cHostName) -> cIPAddress
gethostbyaddr(cIPAddress) -> aListOfHostInfo
gethostname() -> cHostName
getservbyname(cName) -> nPort
getservbyport(nPort) -> cName
inet_pton(AdressFamily, IP) -> packed_address
inet_ntop(AdressFamily, packed_address) -> IP
socketsCleanup()
```

Example:

```
load "sockets.ring"

host = gethostbyname("google.com")
? host
line()
? gethostbyaddr(host)
line()
? gethostname()
line()
? getservbyname("ftp")
line()
? getservbyport(21)

func line ? copy("=",30)
```

76.4 Constants

Address Family:

AF_INET	# mean use IPV4
AF_INET6	# IPV6

Connection type:

SOCK_STREAM	# mean use TCP Protocol
SOCK_DGRAM	# UDP

CHAPTER
SEVENTYSEVEN

THREADS EXTENSION

In this chapter we will learn about using the Threads extension.

Supported platforms: Windows (32bit), Linux & macOS

If you are developing for Windows (64bit), Use threads from other extensions like GameLib (RingAllegro) or RingLibuv.

77.1 Creating Threads

Example (1):

```
load "threads.ring"

func main

    t = new_thrd_t()
    thrd_create(t, "Hello()")
    res = 0
    thrd_join(t, :res)

func Hello

    ? "Message from the Hello() function"
```

77.2 More Examples

Example (2):

```
load "threads.ring"

func main

    t = new_thrd_t()
    thrd_create(t, "Hello()")
    res = 0
    thrd_join(t, :res)

    t2 = new_thrd_t()
```

(continues on next page)

(continued from previous page)

```

thrd_create(t2, "Hello2()")
res2 = 0
thrd_join(t2, :res2)

? :done

func Hello

? "Message from the Hello() function"

func Hello2

? "Message from the Hello2() function"

```

Example (3):

```

load "threads.ring"

func main

nThreads = 2
aList = list(nThreads)

for x=1 to nThreads
    aList[x] = new_thrd_t()
    thrd_create(aList[x], "Hello(\"+x+)")
next

for x=1 to nThreads
    res= 0
    thrd_join(aList[x], :res)
next

? :Done

shutdown()

func Hello x

for r=1 to 100
    ? "Message from the Hello(\"+x+)\") function"
next

```

Example (4):

```

load "threads.ring"

func main

nThreads = 10
aList = list(nThreads)

```

(continues on next page)

(continued from previous page)

```

for x=1 to nThreads
    aList[x] = new_thrd_t()
    thrd_create(aList[x], "Hello(\"+x+)\")"
next

for k=1 to nThreads
    ? "*** Before join: " + k + " *** "
    res = 0
    thrd_join(aList[k], :res)
    ? "*** After join: " + k + " *** "
next

? " ===== Done ===== "

```

```

func Hello x

for r=1 to 100
    ? "("+r+") Message from the Hello(\"+x+)\") function"
next

```

77.3 Reference

Constants:

- TIME_UTC
- TINYCTHREAD_VERSION_MAJOR
- TINYCTHREAD_VERSION_MINOR
- TINYCTHREAD_VERSION
- thrd_error
- thrd_success
- thrd_timedout
- thrd_busy
- thrd_nomem
- mtx_plain
- mtx_timed
- mtx_recursive

Functions:

- int mtx_init(mtx_t *mtx, int type)
- void mtx_destroy(mtx_t *mtx)
- int mtx_lock(mtx_t *mtx)
- int mtx_timedlock(mtx_t *mtx, const struct timespec *ts)
- int mtx_trylock(mtx_t *mtx)

- int mtx_unlock(mtx_t *mtx)
- int cnd_init(cnd_t *cond)
- void cnd_destroy(cnd_t *cond)
- int cnd_signal(cnd_t *cond)
- int cnd_broadcast(cnd_t *cond)
- int cnd_wait(cnd_t *cond, mtx_t *mtx)
- int cnd_timedwait(cnd_t *cond, mtx_t *mtx, const struct timespec *ts)
- int thrd_create(thrd_t *thr, const char *cEvent)
- thrd_t thrd_current(void)
- int thrd_detach(thrd_t thr)
- int thrd_equal(thrd_t thr0, thrd_t thr1)
- void thrd_exit(int res)
- int thrd_join(thrd_t thr, int *res)
- int thrd_sleep(const struct timespec *duration, struct timespec *remaining)
- void thrd_yield(void)
- void tss_delete(tss_t key)
- void *tss_get(tss_t key)
- int tss_set(tss_t key, void *val)

CHAPTER
SEVENTYEIGHT

RINGLIBUI EXTENSION

In this chapter we will learn about using the RingLibUI extension.

This extension provides complete support for Libui

Using this extension we can develop and distribute lightweight GUI Applications using Ring (Less than 1 MB)

Runtime files and their size (For Ring 1.14)

- Ring.dll (448 KB)
- Libui.dll (210 KB)
- Ring_Libui.dll (633 KB)
- Total : 1,291 KB without compressing the files
- After compressing the files (To ZIP file) - Total : 504 KB

78.1 Hello World

```
load "libui.ring"

oWindow = uiNewWindow( "Hello, World", 400, 400, True)
uiWindowOnClosing(oWindow,"closeApp()")

btn1 = uiNewButton("SayHello")
uiButtonOnClicked(btn1,"sayHello()")

btn2 = uiNewButton("Close")
uiButtonOnClicked(btn2,"closeApp()")

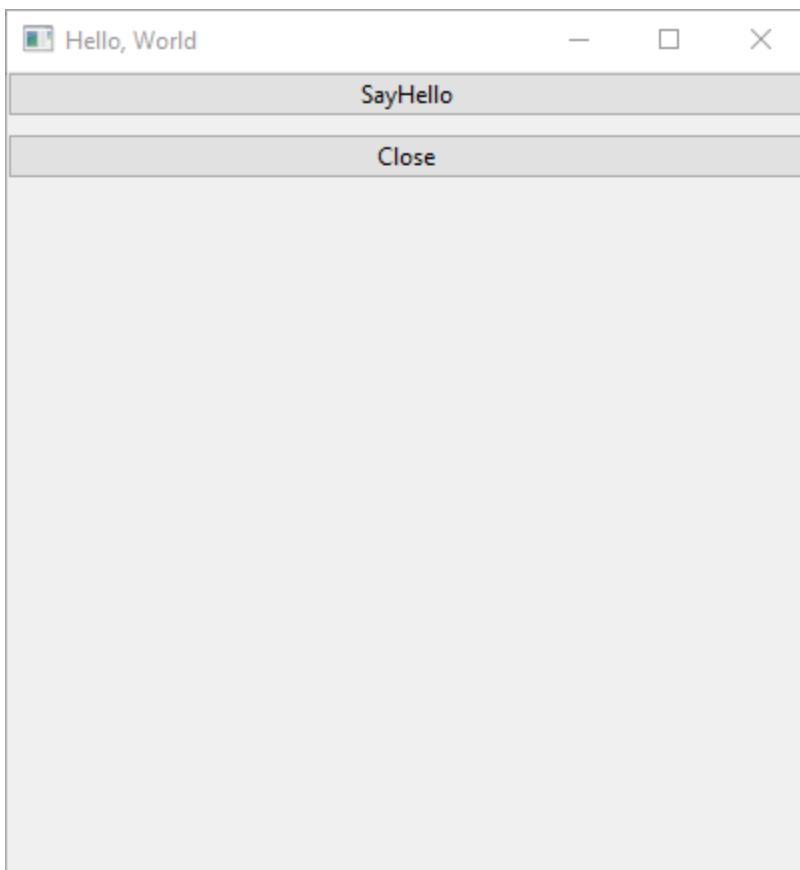
g = uiNewGrid() uiGridSetPadded(g, 1) uiWindowSetChild(oWindow, g)
uiGridAppend(g, btn1, 0, 0, 2, 1, 1, uiAlignFill, 0, uiAlignFill)
uiGridAppend(g, btn2, 0, 1, 1, 1, 1, uiAlignFill, 0, uiAlignFill)

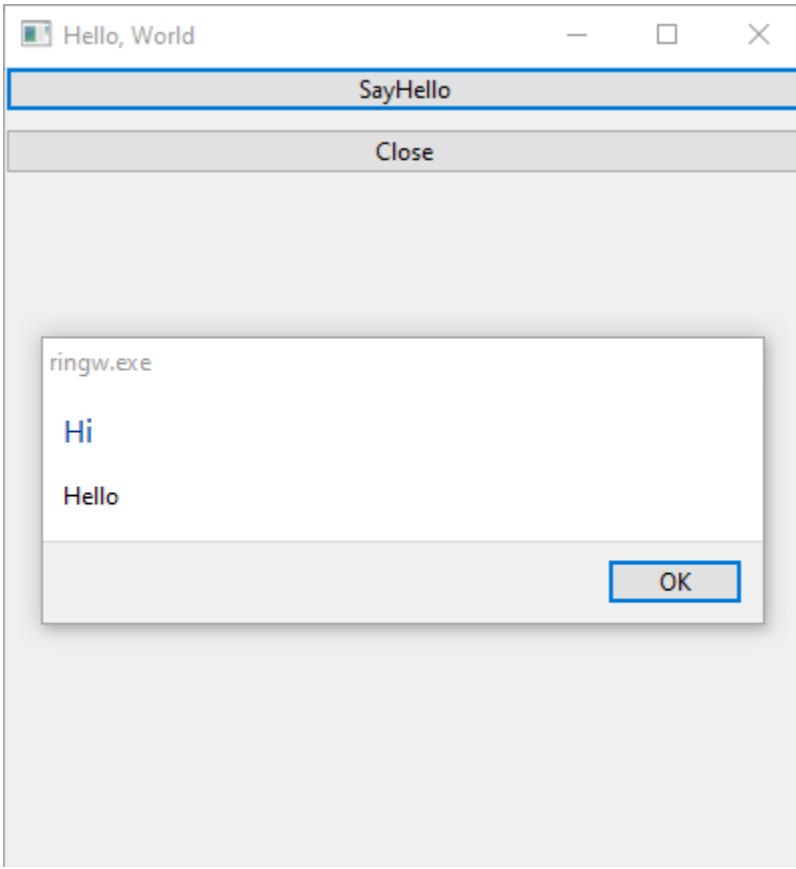
uiControlShow( oWindow )
uiMain()

func sayHello
    uiMsgBox(oWindow,"Hi","Hello")

func closeApp
    uiQuit()
```

Screen Shots:





78.2 Say Hello

```

load "libui.ring"

oWindow = uiNewWindow( "Say Hello", 500, 80, True)
uiWindowOnClosing(oWindow,"closeApp()")

lbl1 = uiNewLabel("Name: ")
text1 = uiNewEntry()

btn1 = uiNewButton("SayHello")
uiButtonOnClicked(btn1,"sayHello()")

btn2 = uiNewButton("Close")
uiButtonOnClicked(btn2,"closeApp()")

lbl2 = uiNewLabel("")

g = uiNewGrid() uiGridSetPadded(g, 1) uiWindowSetChild(oWindow, g)
uiGridAppend(g, lbl1, 0, 0, 2, 1, 1, uiAlignCenter, 0, uiAlignCenter)
uiGridAppend(g, text1, 1, 0, 2, 1, 1, uiAlignFill, 0, uiAlignFill)
uiGridAppend(g, btn1, 0, 1, 1, 2, 1, uiAlignFill, 0, uiAlignFill)
uiGridAppend(g, btn2, 2, 1, 1, 1, 1, uiAlignFill, 0, uiAlignFill)

```

(continues on next page)

(continued from previous page)

```

uiGridAppend(g, lbl2, 0, 3, 2, 1, 1, uiAlignCenter, 0, uiAlignCenter)

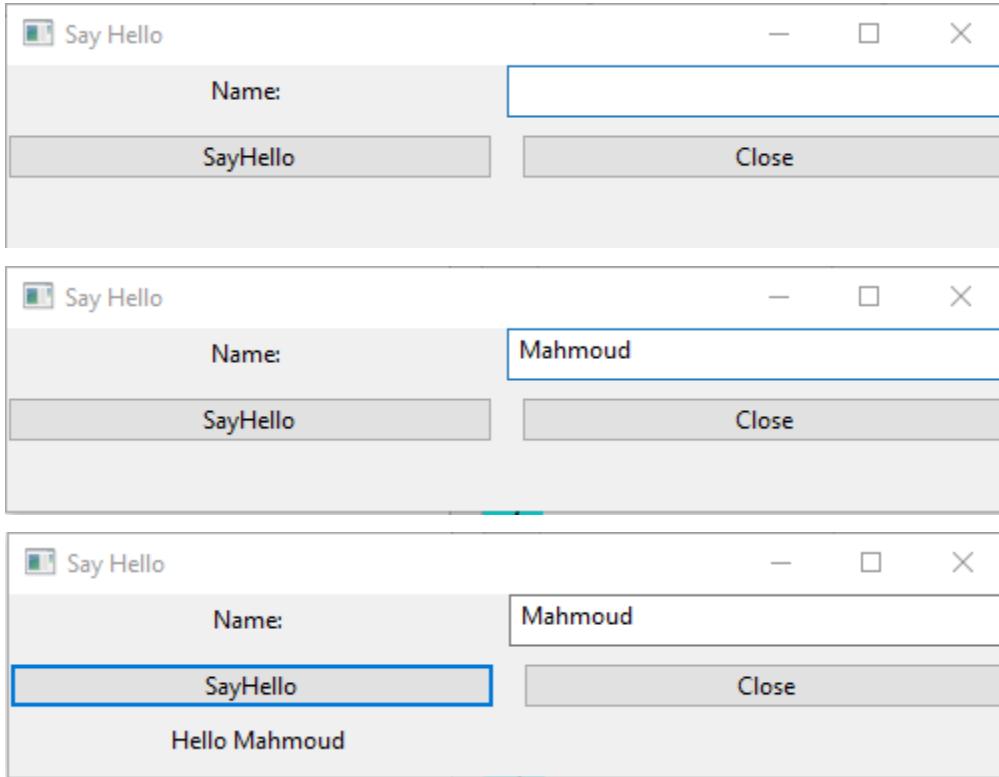
uiControlShow( oWindow )
uiMain()

func sayHello
    uiLabelSetText(lbl2,"Hello " + uiEntryText(text1))

func closeApp
    uiQuit()

```

Screen Shot:



78.3 Control Gallery

```

# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

# Global Variables

    slider = NULL
    spinbox = NULL
    pBar = NULL

```

(continues on next page)

(continued from previous page)

```

entryOpen = NULL
entrySave = NULL

# Main Window

mainwin = uiNewWindow("libui Control Gallery", 640, 480, 1)
uiWindowOnClosing(mainwin, "onClosing()")

tab = uiNewTab()
uiWindowSetChild(mainwin, tab)
uiWindowSetMargined(mainwin, 1)

uiTabAppend(tab, "Basic Controls", makeBasicControlsPage())
uiTabSetMargined(tab, 0, 1)

uiTabAppend(tab, "Numbers and Lists", makeNumbersPage())
uiTabSetMargined(tab, 1, 1)

uiTabAppend(tab, "Data Choosers", makeDataChoosersPage())
uiTabSetMargined(tab, 2, 1)

uiControlShow(mainwin)
uiMain()

func onClosing
    uiQuit()

func makeDataChoosersPage

    hbox = uiNewHorizontalBox()
    uiBoxSetPadded(hbox, 1)

    vbox = uiNewVerticalBox()
    uiBoxSetPadded(vbox, 1)
    uiBoxAppend(hbox, vbox, 0)

    uiBoxAppend(vbox,
        uiNewDatePicker(),
        0)
    uiBoxAppend(vbox,
        uiNewTimePicker(),
        0)
    uiBoxAppend(vbox,
        uiNewDateTimePicker(),
        0)

    uiBoxAppend(vbox,
        uiNewFontButton(),
        0)
    uiBoxAppend(vbox,
        uiNewColorButton(),
        0)

```

(continues on next page)

(continued from previous page)

```

uiBoxAppend(hbox,
    uiNewVerticalSeparator(),
    0)

vbox = uiNewVerticalBox()
uiBoxSetPadded(vbox, 1)
uiBoxAppend(hbox, vbox, 1)

grid = uiNewGrid()
uiGridSetPadded(grid, 1)
uiBoxAppend(vbox, grid, 0)

button = uiNewButton("Open File")
entryOpen = uiNewEntry()
uiEntrySetReadOnly(entryOpen, 1)
uiButtonOnClicked(button, "onOpenFileClicked()")
uiGridAppend(grid, button,
    0, 0, 1, 1,
    0, uiAlignFill, 0, uiAlignFill)
uiGridAppend(grid, entryOpen,
    1, 0, 1, 1,
    1, uiAlignFill, 0, uiAlignFill)

button = uiNewButton("Save File")
entrySave = uiNewEntry()
uiEntrySetReadOnly(entrySave, 1)
uiButtonOnClicked(button, "onSaveFileClicked()")
uiGridAppend(grid, button,
    0, 1, 1, 1,
    0, uiAlignFill, 0, uiAlignFill)
uiGridAppend(grid, entrySave,
    1, 1, 1, 1,
    1, uiAlignFill, 0, uiAlignFill)

msggrid = uiNewGrid()
uiGridSetPadded(msggrid, 1)
uiGridAppend(grid, msggrid,
    0, 2, 2, 1,
    0, uiAlignCenter, 0, uiAlignStart)

button = uiNewButton("Message Box")
uiButtonOnClicked(button, "onMsgBoxClicked()")
uiGridAppend(msggrid, button,
    0, 0, 1, 1,
    0, uiAlignFill, 0, uiAlignFill)
button = uiNewButton("Error Box")
uiButtonOnClicked(button, "onMsgBoxErrorClicked()")
uiGridAppend(msggrid, button,
    1, 0, 1, 1,
    0, uiAlignFill, 0, uiAlignFill)

```

(continues on next page)

(continued from previous page)

```

return hbox

func makeNumbersPage

    hbox = uiNewHorizontalBox()
    uiBoxSetPadded(hbox, 1)

    group = uiNewGroup("Numbers")
    uiGroupSetMargined(group, 1)
    uiBoxAppend(hbox, group, 1)

    vbox = uiNewVerticalBox()
    uiBoxSetPadded(vbox, 1)
    uiGroupSetChild(group, vbox)

    spinbox = uiNewSpinbox(0, 100)
    slider = uiNewSlider(0, 100)
    pbar = uiNewProgressBar()
    uiSpinboxOnChanged(spinbox, "onSpinboxChanged()")
    uiSliderOnChanged(slider, "onSliderChanged()")
    uiBoxAppend(vbox, spinbox, 0)
    uiBoxAppend(vbox, slider, 0)
    uiBoxAppend(vbox, pbar, 0)

    ip = uiNewProgressBar()
    uiProgressBarSetValue(ip, -1)
    uiBoxAppend(vbox, ip, 0)

    group = uiNewGroup("Lists")
    uiGroupSetMargined(group, 1)
    uiBoxAppend(hbox, group, 1)

    vbox = uiNewVerticalBox()
    uiBoxSetPadded(vbox, 1)
    uiGroupSetChild(group, vbox)

    cbox = uiNewCombobox()
    uiComboboxAppend(cbox, "Combobox Item 1")
    uiComboboxAppend(cbox, "Combobox Item 2")
    uiComboboxAppend(cbox, "Combobox Item 3")
    uiBoxAppend(vbox, cbox, 0)

    ecbox = uiNewEditableCombobox()
    uiEditableComboboxAppend(ecbox, "Editable Item 1")
    uiEditableComboboxAppend(ecbox, "Editable Item 2")
    uiEditableComboboxAppend(ecbox, "Editable Item 3")
    uiBoxAppend(vbox, ecbox, 0)

    rb = uiNewRadioButtons()
    uiRadioButtonsAppend(rb, "Radio Button 1")
    uiRadioButtonsAppend(rb, "Radio Button 2")
    uiRadioButtonsAppend(rb, "Radio Button 3")

```

(continues on next page)

(continued from previous page)

```

uiBoxAppend(vbox, rb, 0)

return hbox

func makeBasicControlsPage

    vbox = uiNewVerticalBox()
    uiBoxSetPadded(vbox, 1)

    hbox = uiNewHorizontalBox()
    uiBoxSetPadded(hbox, 1)
    uiBoxAppend(vbox, hbox, 0)

    uiBoxAppend(hbox,
        uiNewButton("Button"),
        0)
    uiBoxAppend(hbox,
        uiNewCheckbox("Checkbox"),
        0)

    uiBoxAppend(vbox,
        uiNewLabel("This is a label. Right now, labels can only span one line."),
        0)

    uiBoxAppend(vbox,
        uiNewHorizontalSeparator(),
        0)

group = uiNewGroup("Entries")
uiGroupSetMargined(group, 1)
uiBoxAppend(vbox, group, 1)

entryForm = uiNewForm()
uiFormSetPadded(entryForm, 1)
uiGroupSetChild(group, entryForm)

uiFormAppend(entryForm,
    "Entry",
    uiNewEntry(),
    0)
uiFormAppend(entryForm,
    "Password Entry",
    uiNewPasswordEntry(),
    0)
uiFormAppend(entryForm,
    "Search Entry",
    uiNewSearchEntry(),
    0)
uiFormAppend(entryForm,
    "Multiline Entry",
    uiNewMultilineEntry(),
    0)

```

(continues on next page)

(continued from previous page)

```

1)
uiFormAppend(entryForm,
    "Multiline Entry No Wrap",
    uiNewNonWrappingMultilineEntry(),
    1)

return vbox

func onSpinboxChanged
    s = uiEventSpinBox()
    uiSliderSetValue(slider, uiSpinboxValue(s));
    uiProgressBarSetValue(pbar, uiSpinboxValue(s));

func onSliderChanged
    s = uiEventSlider()
    uiSpinboxSetValue(spinbox, uiSliderValue(s));
    uiProgressBarSetValue(pbar, uiSliderValue(s));

func onOpenFileClicked
    filename = uiOpenFile(mainwin)
    if ISNULL(filename)
        uiEntrySetText(entryOpen, "(cancelled)")
        return
    ok
    uiEntrySetText(entryOpen, filename)

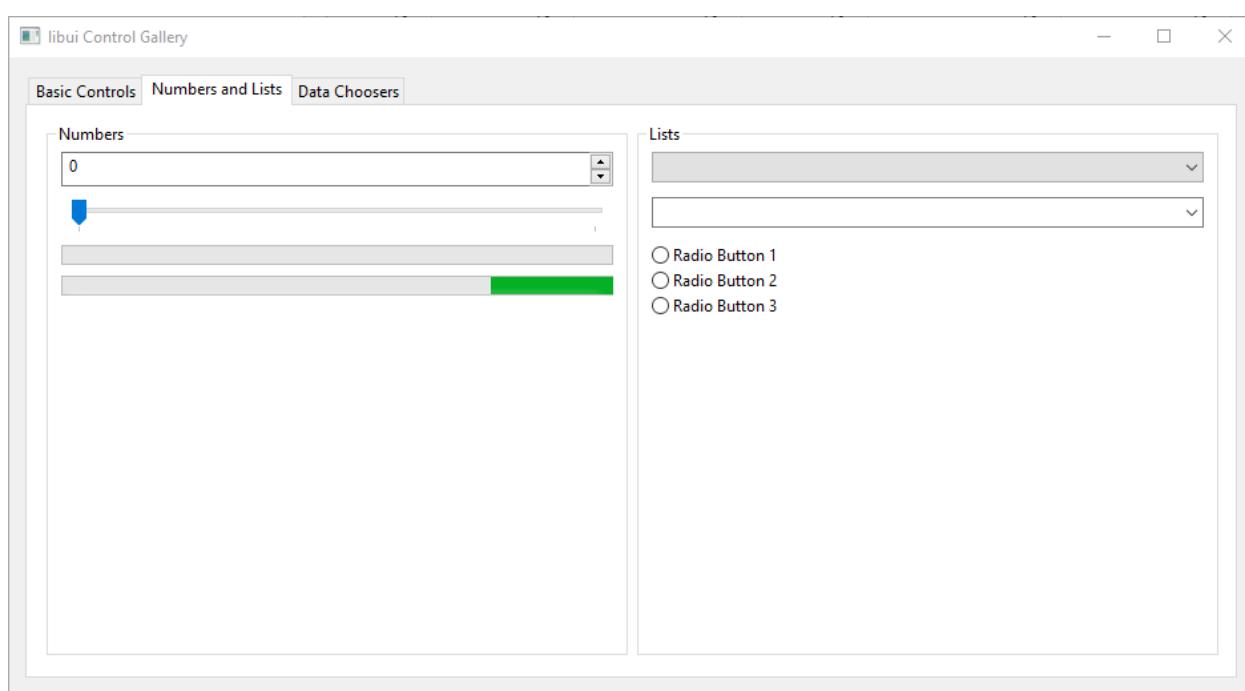
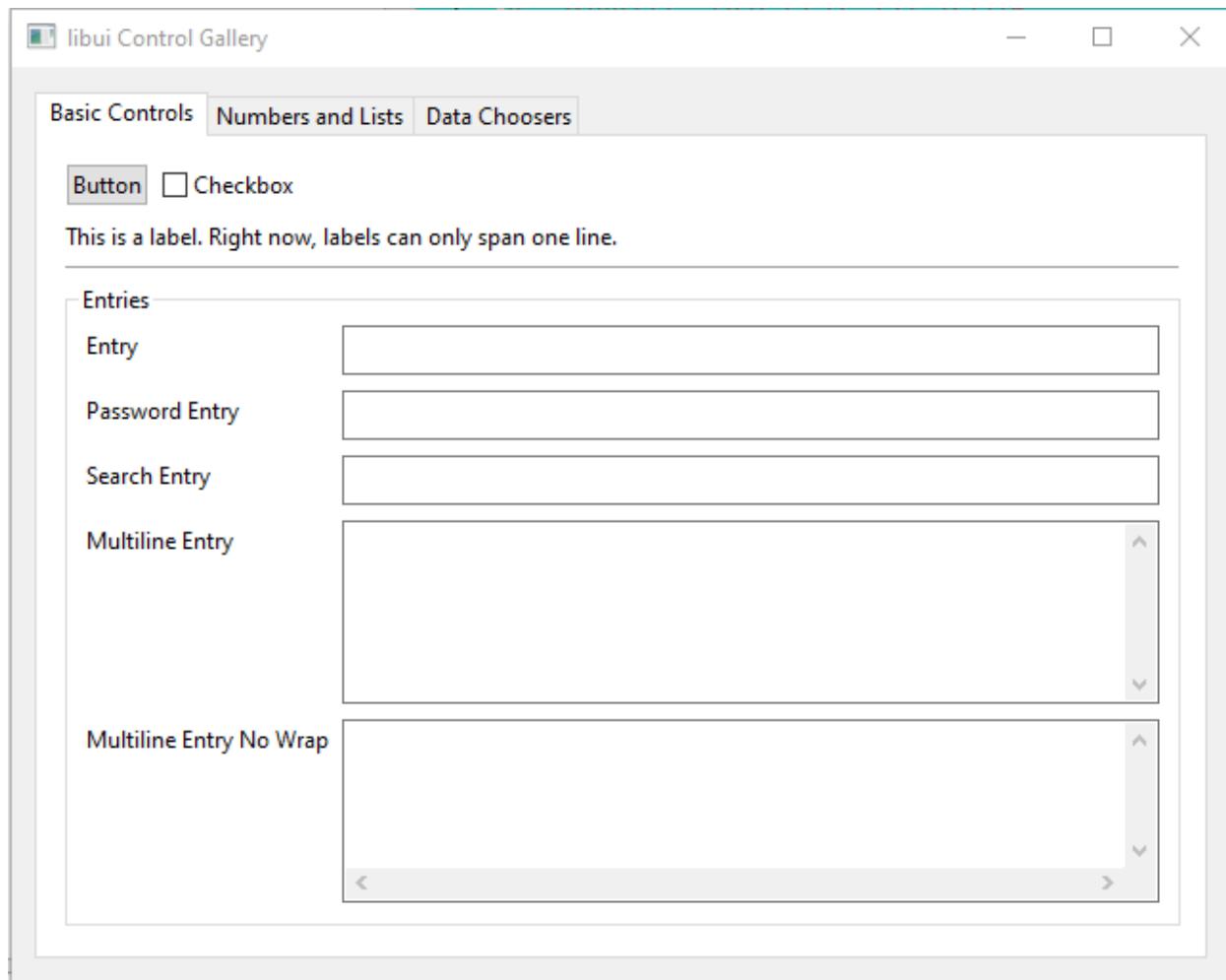
func onSaveFileClicked
    filename = uiSaveFile(mainwin)
    if ISNULL(filename)
        uiEntrySetText(entrySave, "(cancelled)")
        return
    ok
    uiEntrySetText(entrySave, filename)

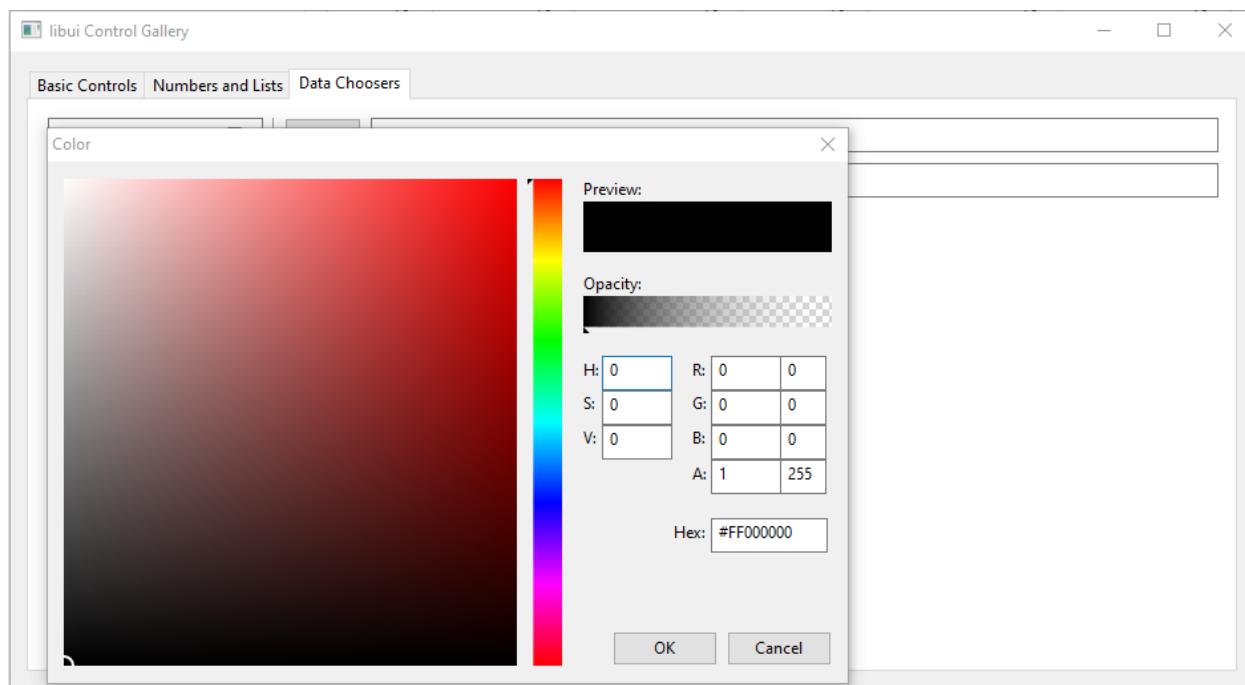
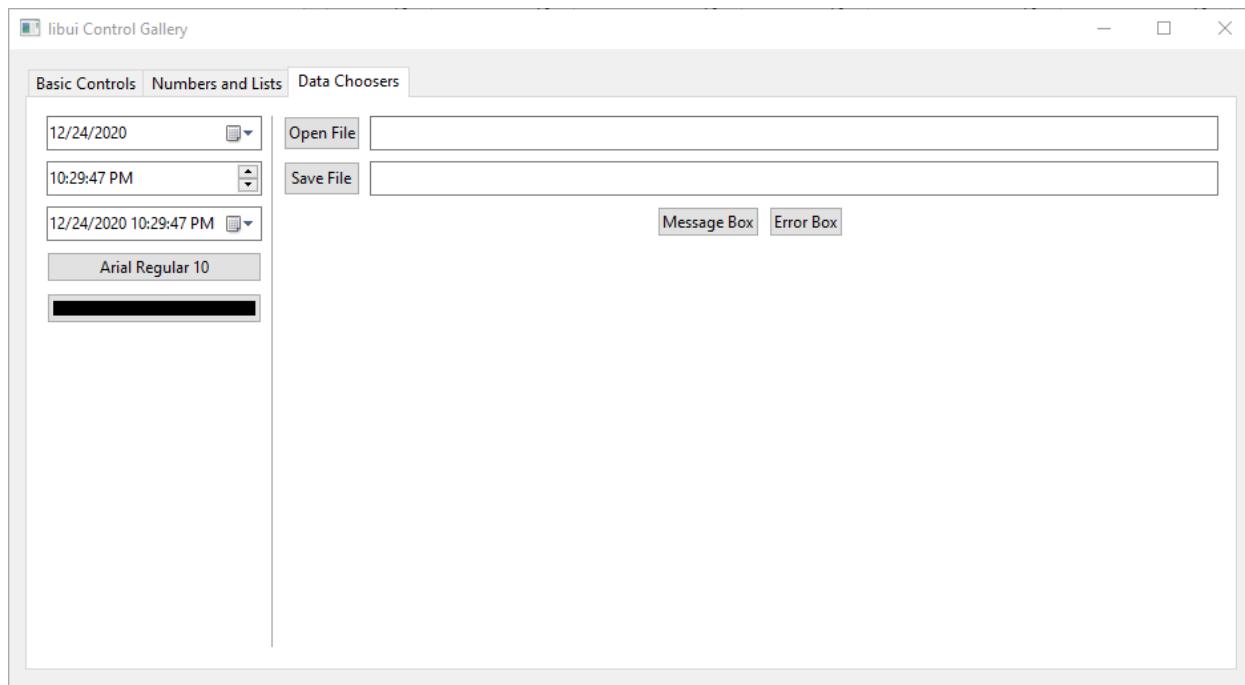
func onMsgBoxClicked
    uiMsgBox(mainwin,
        "This is a normal message box.",
        "More detailed information can be shown here.")

func onMsgBoxErrorClicked
    uiMsgBoxError(mainwin,
        "This message box describes an error.",
        "More detailed information can be shown here.")

```

Screen Shot:





78.4 Say Something

```
# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

w = uiNewWindow("Hello", 320, 240, 0)
uiWindowSetMargined(w, 1)

b = uiNewVerticalBox()
uiBoxSetPadded(b, 1)
uiWindowSetChild(w, b)

e = uiNewMultilineEntry()
uiMultilineEntrySetReadOnly(e, 1)

btn = uiNewButton("Say Something")
uiButtonOnClicked(btn, "saySomething()")
uiBoxAppend(b, btn, 0)

uiBoxAppend(b, e, 1)

uiTimer(1000, "sayTime()")

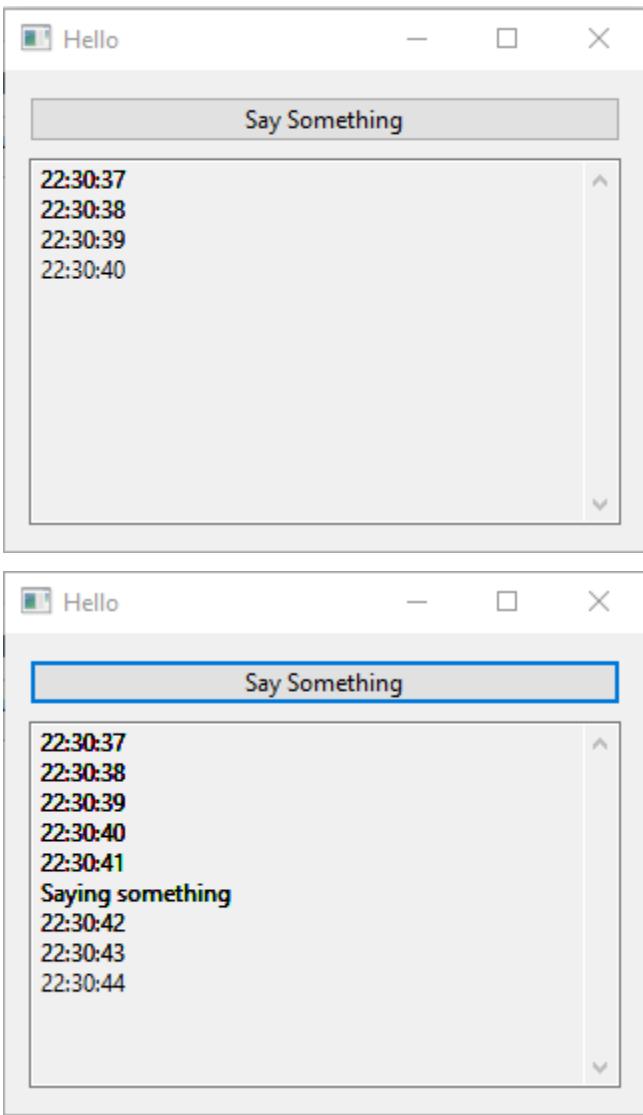
uiWindowOnClosing(w, "onClosing()")
uiControlShow(w)
uiMain()

func saySomething
    uiMultilineEntryAppend(e, "Saying something"+nl)

func sayTime
    uiMultilineEntryAppend(e, Time()+nl)

func onClosing
    uiQuit()
```

Screen Shot:



78.5 Using the Menubar

```
# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

# Create the Menubar

    fileMenu = uiNewMenu("File")
    newItem = uiMenuItemAppend(fileMenu, "New")
    openItem = uiMenuItemAppend(fileMenu, "Open")
    uiMenuAppendSeparator(fileMenu)
    shouldQuitItem = uiMenuItemAppendCheckItem(fileMenu, "Should Quit")
    quitItem = uiMenuItemAppendQuitItem(fileMenu)
```

(continues on next page)

(continued from previous page)

```

editMenu = uiNewMenu("Edit")
undoItem = uiMenuItemAppendItem(editMenu, "Undo")
uiMenuItemDisable(undoItem)
uiMenuItemAppendSeparator(editMenu)
checkItem = uiMenuItemAppendCheckItem(editMenu, "Check Me\tTest")
accelItem = uiMenuItemAppendItem(editMenu, "A&ccelerator T_es__t")
prefsItem = uiMenuItemAppendPreferencesItem(editMenu)

testMenu = uiNewMenu("Test")
enabledItem = uiMenuItemAppendCheckItem(testMenu, "Enable Below Item")
uiMenuItemSetChecked(enabledItem, 1)
enableThisItem = uiMenuItemAppendItem(testMenu, "This Will Be Enabled")
uiMenuItemOnClicked(enabledItem, "enableItemTest(enableThisItem)")
forceCheckedItem = uiMenuItemAppendItem(testMenu, "Force Above Checked")
uiMenuItemOnClicked(forceCheckedItem, "forceOn()")
forceUncheckedItem = uiMenuItemAppendItem(testMenu, "Force Above Unchecked")
uiMenuItemOnClicked(forceUncheckedItem, "forceOff()")
uiMenuItemAppendSeparator(testMenu)
whatWindowItem = uiMenuItemAppendItem(testMenu, "What Window?")
uiMenuItemOnClicked(whatWindowItem, "whatWindow()")

moreTestsMenu = uiNewMenu("More Tests")
quitEnabledItem = uiMenuItemAppendCheckItem(moreTestsMenu, "Quit Item Enabled")
uiMenuItemSetChecked(quitEnabledItem, 1)
prefsEnabledItem = uiMenuItemAppendCheckItem(moreTestsMenu, "Preferences Item Enabled"
    ")
    uiMenuItemSetChecked(prefsEnabledItem, 1)
aboutEnabledItem = uiMenuItemAppendCheckItem(moreTestsMenu, "About Item Enabled")
uiMenuItemSetChecked(aboutEnabledItem, 1)
uiMenuItemAppendSeparator(moreTestsMenu)
checkEnabledItem = uiMenuItemAppendCheckItem(moreTestsMenu, "Check Me Item Enabled")
uiMenuItemSetChecked(checkEnabledItem, 1)

multiMenu = uiNewMenu("Multi")
uiMenuItemAppendSeparator(multiMenu)
uiMenuItemAppendSeparator(multiMenu)
uiMenuItemAppendItem(multiMenu, "Item && Item && Item")
uiMenuItemAppendSeparator(multiMenu)
uiMenuItemAppendSeparator(multiMenu)
uiMenuItemAppendItem(multiMenu, "Item __ Item __ Item")
uiMenuItemAppendSeparator(multiMenu)
uiMenuItemAppendSeparator(multiMenu)

helpMenu = uiNewMenu("Help")
helpItem = uiMenuItemAppendItem(helpMenu, "Help")
aboutItem = uiMenuItemAppendAboutItem(helpMenu)

uiMenuItemOnClicked(quitEnabledItem, "enableItemTest(quitItem)")
uiMenuItemOnClicked(prefsEnabledItem, "enableItemTest(prefsItem)")
uiMenuItemOnClicked(aboutEnabledItem, "enableItemTest(aboutItem)")
uiMenuItemOnClicked(checkEnabledItem, "enableItemTest(checkItem)")

```

(continues on next page)

(continued from previous page)

```
# Create the Window

oWindow = uiNewWindow( "Using the Menubar", 400, 400, True)
uiWindowOnClosing(oWindow,"closeApp()")

uiControlShow( oWindow )
uiMain()

func enableItemTest(data)
    item = uiEventMenuItem()
    if uiMenuItemChecked(item)
        uiMenuItemEnable(data)
    else
        uiMenuItemDisable(data)
    ok

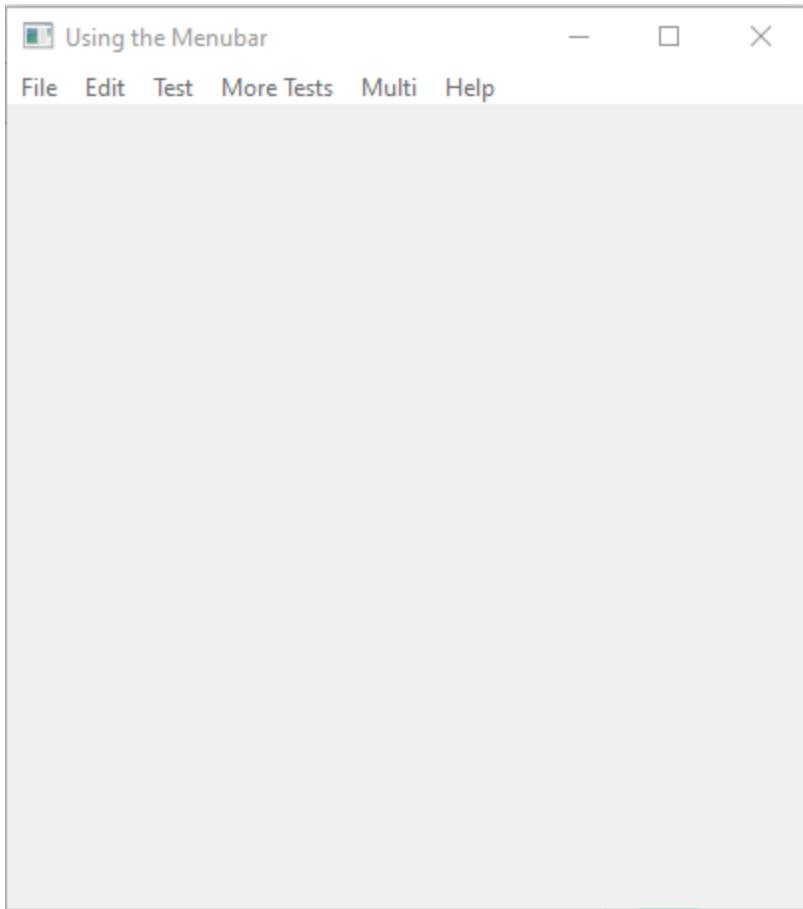
func forceOn
    uiMenuItemSetChecked(enabledItem, 1)

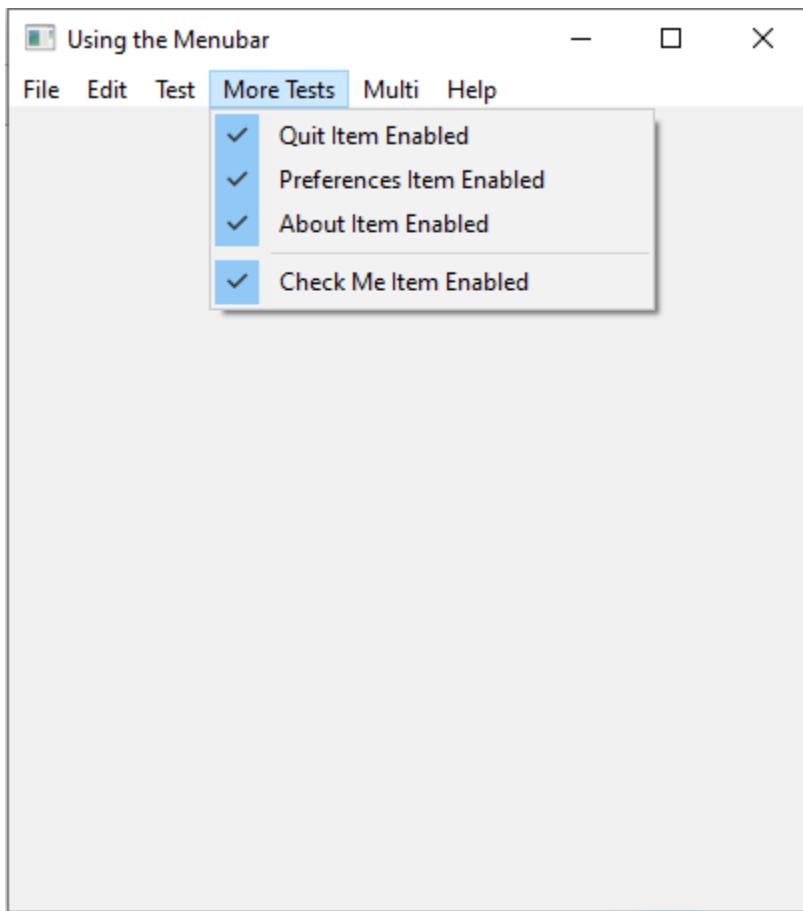
func forceOff
    uiMenuItemSetChecked(enabledItem, 0)

func whatWindow
    ? "menu item clicked on window "
    ? oWindow

func closeApp
    uiQuit()
```

Screen Shot:





78.6 Drawing Sample

```
load "libui.ring"

oWindow = uiNewWindow( "Drawing Sample", 420, 450, True)
uiWindowOnClosing(oWindow,"closeApp()")

oAreaHandler = uiNewAreaHandler("draw()", "", "", "", "")
area = uiNewArea(oAreaHandler)

btnClose = uiNewButton("Close Application")
uiButtonOnClicked(btnClose,"closeApp()")

hbox = uiNewVerticalBox()
uiBoxSetPadded(hbox, 1)
uiBoxAppend(hbox,btnClose,0)
uiBoxAppend(hbox,area,1)
uiWindowSetChild(oWindow, hbox)

uiControlShow( oWindow )
uiMain()
```

(continues on next page)

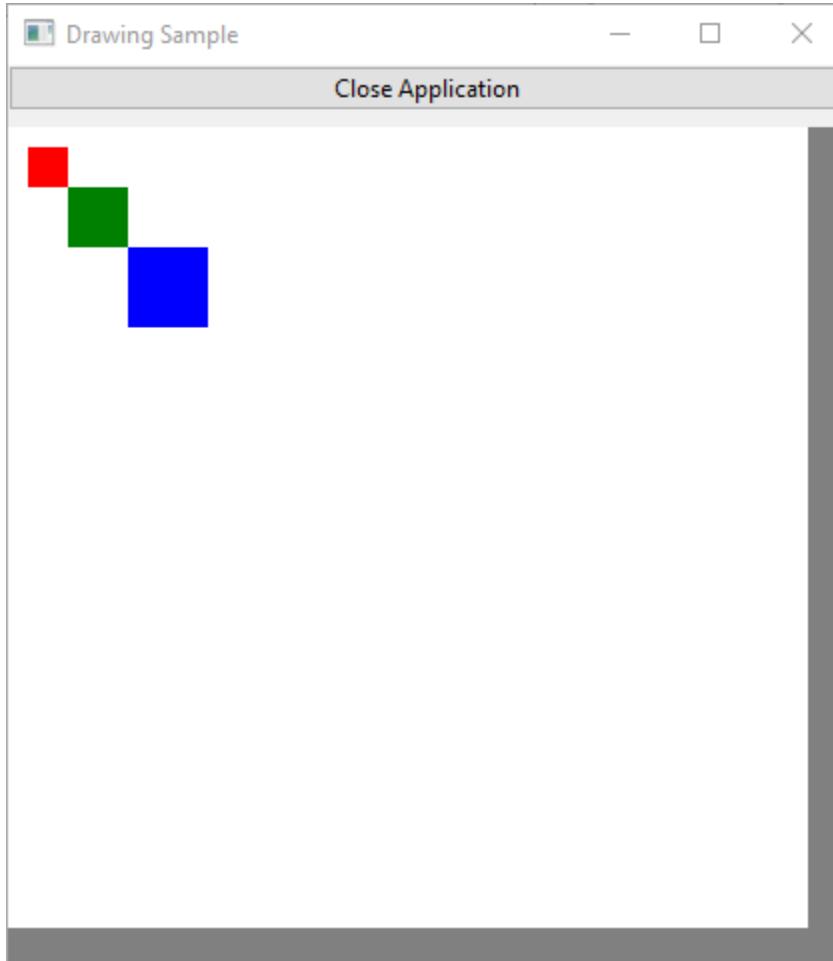
(continued from previous page)

```
func draw
    Rectangle(0, 0, uiEventAreaWidth(), uiEventAreaHeight(), colorGray)
    Rectangle(0, 0, 400, 400, colorWhite)
    Rectangle(10, 10, 20, 20, colorRed)
    Rectangle(30, 30, 30, 30, colorGreen)
    Rectangle(60, 60, 40, 40, colorBlue)

# The Rectangle function is now part of RingLibUI as uiRectangle()
func Rectangle x,y,width,height,color
    oContext = uiEventContext()
    oBrush = uiNewSolidBrush(color)
    oPath = uiDraw newPath(uiDrawFillModeWinding)
    uiDrawPathAddRectangle(oPath, x, y, width, height)
    uiDrawPathEnd(oPath)
    uiDrawFill(oContext, oPath, oBrush)
    uiDrawFreePath(oPath)

func closeApp
    uiQuit()
```

Screen Shot:



78.7 Draw Gradient

```
load "libui.ring"

oWindow = uiNewWindow( "Draw Gradient", 500, 500, True)
uiWindowOnClosing(oWindow,"closeApp()")

oAreaHandler = uiNewAreaHandler("draw()", "", "", "", "")
area = uiNewArea(oAreaHandler)

btnClose = uiNewButton("Close Application")
uiButtonOnClicked(btnClose,"closeApp()")

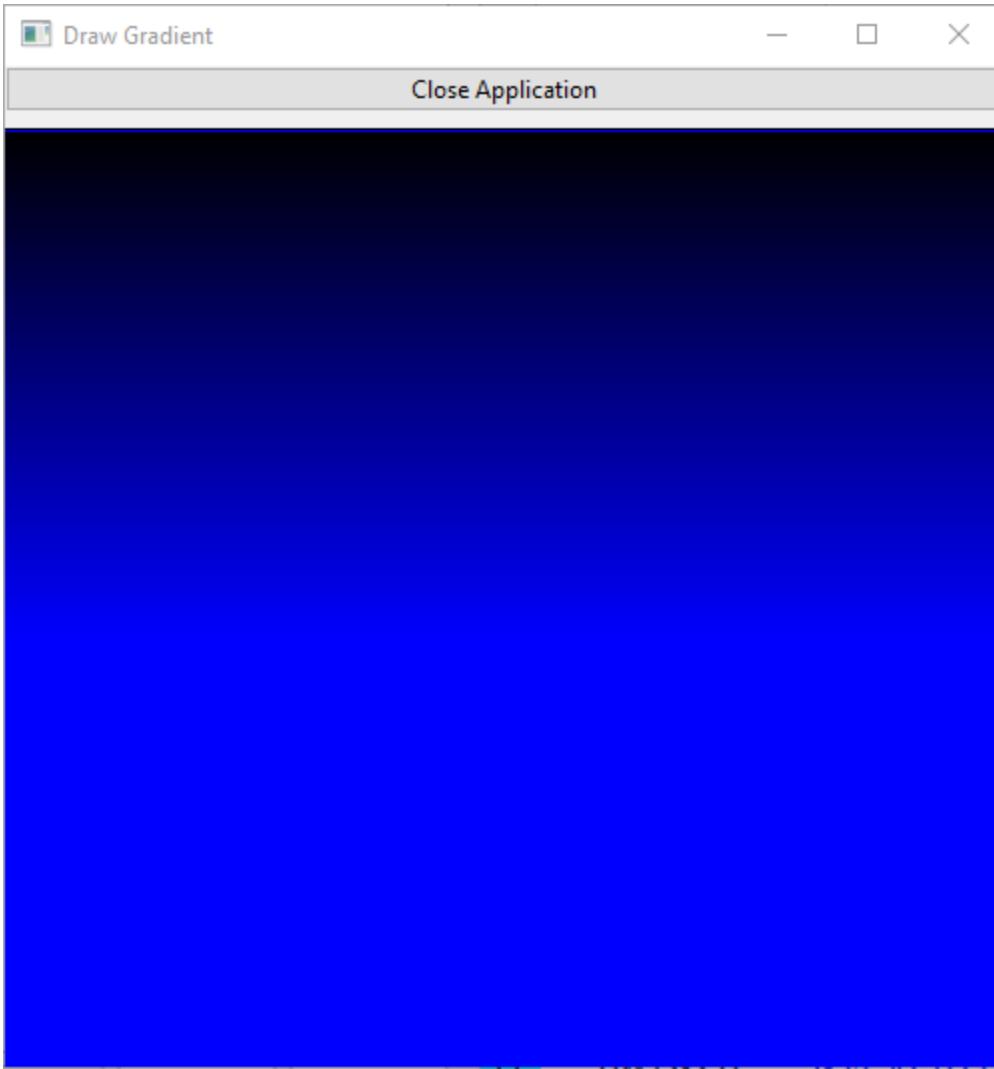
hbox = uiNewVerticalBox()
uiBoxSetPadded(hbox, 1)
uiBoxAppend(hbox,btnClose,0)
uiBoxAppend(hbox,area,1)
uiWindowSetChild(oWindow, hbox)

uiControlShow( oWindow )
uiMain()

func draw
    nWidth = uiEventAreaWidth()           nHeight = uiEventAreaHeight()
    uiRectangle(0, 0, nWidth, nHeight, colorBlue)
    for y=0 to 255 step 2
        customColor = y
        uiRectangle(0, y, nWidth, y+1, customColor)
    next

func closeApp
    uiQuit()
```

Screen Shot:



78.8 Histogram

```
# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

datapoints      = list(10)
currentPoint    = -1

// some metrics
xoffLeft        = 20           /* histogram margins */
yoffTop          = 20
xoffRight       = 20
yoffBottom      = 20
pointRadius     = 5
```

(continues on next page)

(continued from previous page)

```

histogram      = NULL
mainwin       = NULL
colorButton   = NULL

func pointLocations width, height, xs, ys
    xincr = width / 9                      // 10 - 1 to make the last point be at the end
    yincr = height / 100
    for i = 1 to 10
        // get the value of the point
        n = uiSpinboxValue(datapoints[i])
        // because y=0 is the top but n=0 is the bottom, we need to flip
        n = 100 - n;
        xs[i] = xincr * i
        ys[i] = yincr * n
    next

func constructGraph width, height, extend
    xs = list(10)
    ys = list(10)
    pointLocations(width, height, xs, ys)
    path = uiDrawNewPath(uiDrawFillModeWinding)
    uiDrawPathNewFigure(path, xs[1], ys[1])
    for i = 2 to 10
        uiDrawPathLineTo(path, xs[i], ys[i])
    next
    if extend
        uiDrawPathLineTo(path, width, height)
        uiDrawPathLineTo(path, 0, height)
        uiDrawPathCloseFigure(path)
    ok
    uiDrawPathEnd(path)
    return path

func graphSize clientWidth, clientHeight
    graphWidth = clientWidth - xoffLeft - xoffRight
    graphHeight = clientHeight - yoffTop - yoffBottom
    return [graphWidth, graphHeight]

func handlerDraw
    // fill the area with white
    Brush = uiNewSolidBrush(0)
    setSolidBrush(Brush, colorWhite, 1.0)
    path = uiDrawNewPath(uiDrawFillModeWinding)
    uiDrawPathAddRectangle(path, 0, 0, uiEventAreaWidth(), uiEventAreaHeight())
    uiDrawPathEnd(path)
    uiDrawFill(uiEventContext(), path, Brush)
    uiDrawFreePath(path)

    // figure out dimensions
    aOut = graphSize(uiEventAreaWidth(), uiEventAreaHeight())
    graphWidth = aOut[1]

```

(continues on next page)

(continued from previous page)

```

graphHeight = aOut[2]

sp = new_managed_uiDrawStrokeParams()
set_uiDrawStrokeParams_Cap(sp, uiDrawLineCapFlat)
set_uiDrawStrokeParams_Join(sp, uiDrawLineJoinMiter)
set_uiDrawStrokeParams_Thickness(sp, 2)
set_uiDrawStrokeParams_MiterLimit(sp, uiDrawDefaultMiterLimit)
set_uiDrawStrokeParams_NumDashes(sp, 0)

// draw the axes
setSolidBrush(brush, colorBlack, 1.0)
path = uiDrawNewPath(uiDrawFillModeWinding)
uiDrawPathNewFigure(path,
    xoffLeft, yoffTop)
uiDrawPathLineTo(path,
    xoffLeft, yoffTop + graphHeight)
uiDrawPathLineTo(path,
    xoffLeft + graphWidth, yoffTop + graphHeight)
uiDrawPathEnd(path)
uiDrawStroke(uiEventContext(), path, brush, sp)
uiDrawFreePath(path)

// now transform the coordinate space so (0, 0) is the top-left corner of the graph
m = new_managed_uiDrawMatrix()
uiDrawMatrixSetIdentity(m)
uiDrawMatrixTranslate(m, xoffLeft, yoffTop)
uiDrawTransform(uiEventContext(), m)

// now get the color for the graph itself and set up the brush

GraphR=0
GraphG=0
GraphB=0
GraphA=0

uiColorButtonColor(colorButton, :graphR,
    :graphG,
    :graphB,
    :graphA)

uiSetBrushType(brush, uiDrawBrushTypeSolid)
uiSetBrushR(brush, graphR)
uiSetBrushG(brush, graphG)
uiSetBrushB(brush, graphB)

// we set brush->A below to different values for the fill and stroke

// now create the fill for the graph below the graph line
path = constructGraph(graphWidth, graphHeight, 1)

uiSetBrushA(brush, graphA / 2)

```

(continues on next page)

(continued from previous page)

```

uiDrawFill(uiEventContext(), path, brush)
uiDrawFreePath(path)

// now draw the histogram line
path = constructGraph(graphWidth, graphHeight, 0)
uiSetBrushA(brush, graphA)
uiDrawStroke(uiEventContext(), path, brush, sp)
uiDrawFreePath(path)

// now draw the point being hovered over
if currentPoint != -1
    xs = list(10)
    ys = list(10)
    pointLocations(graphWidth, graphHeight, xs, ys)
    path = uiDrawNewPath(uiDrawFillModeWinding)

    uiDrawPathNewFigureWithArc(path,
        xs[currentPoint], ys[currentPoint],
        pointRadius,
        0, 6.23,           // TODO pi
        0)
    uiDrawPathEnd(path)
    // use the same brush as for the histogram lines
    uiDrawFill(uiEventContext(), path, brush)
    uiDrawFreePath(path)
ok

func inPoint x, y, xtest, ytest
    // TODO switch to using a matrix
    x -= xoffLeft
    y -= yoffTop
    return (x >= xtest - pointRadius) &&
        (x <= xtest + pointRadius) &&
        (y >= ytest - pointRadius) &&
        (y <= ytest + pointRadius)

func handlerMouseEvent
    xs = list(10)
    ys = list(10)

    aOut = graphSize(uiEventAreaWidth(), uiEventAreaHeight())
    graphWidth = aOut[1]
    graphHeight = aOut[2]

    pointLocations(graphWidth, graphHeight, xs, ys)

    e = uiEventAreaMouseEvent()
    eX = get_uiAreaMouseEvent_X(e)
    eY = get_uiAreaMouseEvent_Y(e)
    for i=1 to 10
        if inPoint(eX, eY, xs[i], ys[i])
            exit

```

(continues on next page)

(continued from previous page)

```

ok
next
if i = 11           // not in a point
    i = -1
ok

currentPoint = i

uiAreaQueueRedrawAll(histogram)

func onDatapointChanged
    uiAreaQueueRedrawAll(histogram)

func onColorChanged
    uiAreaQueueRedrawAll(histogram);

func onClosing
    uiControlDestroy(uiControl(mainwin))
    uiQuit()
    return 0

func shouldQuit
    uiControlDestroy(uiControl(mainwin))

func main

    uiOnShouldQuit("shouldQuit()")

    mainwin = uiNewWindow("Histogram Sample", 800, 480, 1)
    uiWindowSetMargined(mainwin, 1)
    uiWindowOnClosing(mainwin, "onClosing()")

    Brush = uiNewSolidBrush(0)

    hbox = uiNewHorizontalBox()
    uiBoxSetPadded(hbox, 1)
    uiWindowSetChild(mainwin, uiControl(hbox))

    vbox = uiNewVerticalBox()
    uiBoxSetPadded(vbox, 1)
    uiBoxAppend(hbox, uiControl(vbox), 0)

    srand(random());
    for i=1 to 10
        datapoints[i] = uiNewSpinbox(0, 100)
        uiSpinboxSetValue(datapoints[i], random() % 101)
        uiSpinboxOnChanged(datapoints[i], "onDatapointChanged()")
        uiBoxAppend(vbox, uiControl(datapoints[i]), 0)
    next

    colorButton = uiNewColorButton()

```

(continues on next page)

(continued from previous page)

```
setSolidBrush(brush, colorDodgerBlue, 1.0)

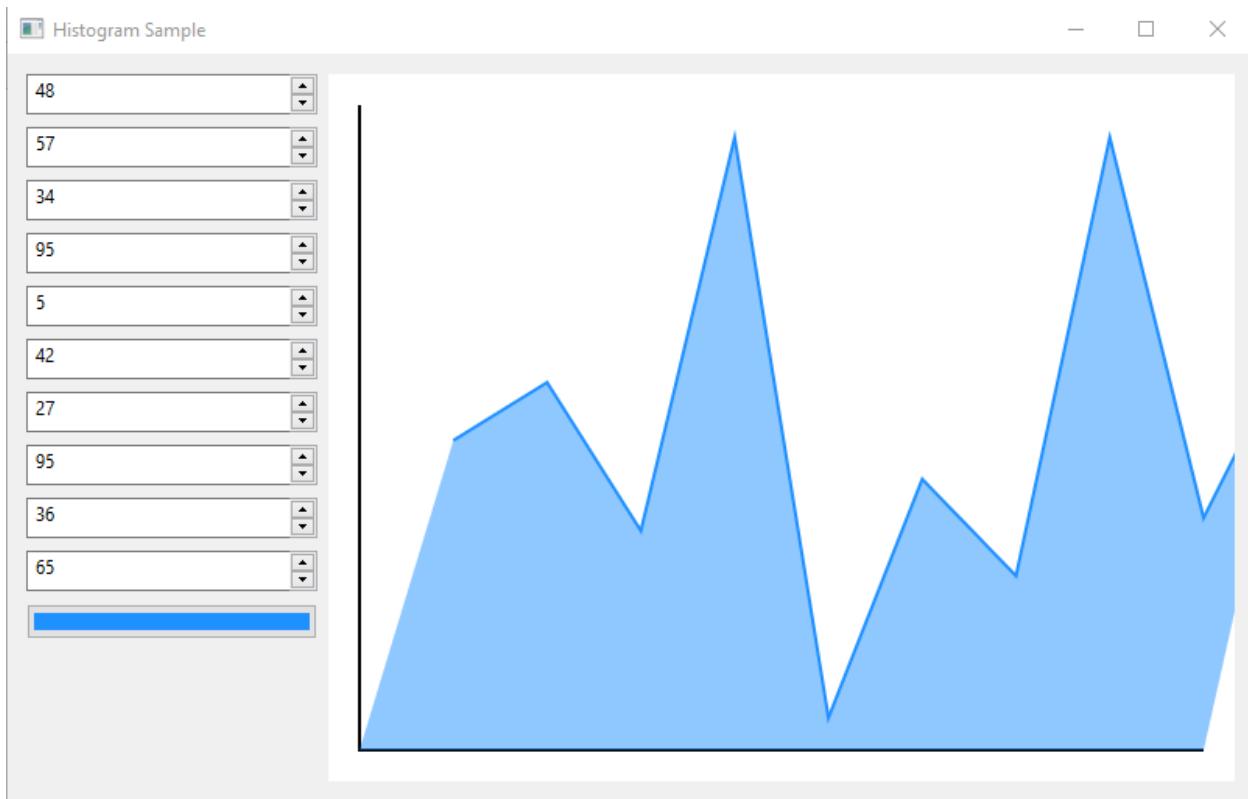
uiColorButtonSetColor(colorButton,
    uiBrushR(brush),
    uiBrushG(brush),
    uiBrushB(brush),
    uiBrushA(brush))

uiColorButtonOnChanged(colorButton, "onColorChanged()")
uiBoxAppend(vbox, uiControl(colorButton), 0)

oAreaHandler = uiNewAreaHandler("handlerDraw()", "handlerMouseEvent()", "", "", "")
histogram = uiNewArea(oAreaHandler)
uiBoxAppend(hbox, uiControl(histogram), 1)

uiControlShow(uiControl(mainwin))
uiMain()
```

Screen Shot:



78.9 Text Drawing

```

# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

# Global Variables
mainwin      = NULL
area         = NULL
handler      = NULL
fontButton   = NULL
alignment    = NULL
attrstr      = NULL

func appendWithAttribute what, attr, attr2
    nStart = uiAttributedStringLen(attrstr)
    nEnd = nStart + len(what)
    uiAttributedStringAppendUnattributed(attrstr, what)
    uiAttributedStringSetAttribute(attrstr, attr, nStart, nEnd)
    if ! ISNULL(attr2)
        uiAttributedStringSetAttribute(attrstr, attr2, nStart, nEnd)
    ok

func makeAttributedString

    attrstr = uiNewAttributedString("Drawing strings with libui is done with the ↵
→uiAttributedString and uiDrawTextLayout objects."+nl+
        "uiAttributedString lets you have a variety of attributes: ")

    attr = uiNewFamilyAttribute("Courier New")
    appendWithAttribute("font family", attr, NULL)
    uiAttributedStringAppendUnattributed(attrstr, ", ")

    attr = uiNewSizeAttribute(18)
    appendWithAttribute("font size", attr, NULL)
    uiAttributedStringAppendUnattributed(attrstr, ", ")

    attr = uiNewWeightAttribute(uiTextWeightBold)
    appendWithAttribute("font weight", attr, NULL)
    uiAttributedStringAppendUnattributed(attrstr, ", ")

    attr = uiNewItalicAttribute(uiTextItalicItalic)
    appendWithAttribute("font italicness", attr, NULL)
    uiAttributedStringAppendUnattributed(attrstr, ", ")

    attr = uiNewStretchAttribute(uiTextStretchCondensed)
    appendWithAttribute("font stretch", attr, NULL)
    uiAttributedStringAppendUnattributed(attrstr, ", ")

    attr = uiNewColorAttribute(0.75, 0.25, 0.5, 0.75)
    appendWithAttribute("text color", attr, NULL)

```

(continues on next page)

(continued from previous page)

```

uiAttributedStringAppendUnattributed(attrstr, " ")

attr = uiNewBackgroundAttribute(0.5, 0.5, 0.25, 0.5)
appendWithAttribute("text background color", attr, NULL)
uiAttributedStringAppendUnattributed(attrstr, " ")

attr = uiNewUnderlineAttribute(uiUnderlineSingle)
appendWithAttribute("underline style", attr, NULL)
uiAttributedStringAppendUnattributed(attrstr, " ")

uiAttributedStringAppendUnattributed(attrstr, "and ")
attr = uiNewUnderlineAttribute(uiUnderlineDouble)
attr2 = uiNewUnderlineColorAttribute(uiUnderlineColorCustom, 1.0, 0.0, 0.5, 1.0)
appendWithAttribute("underline color", attr, attr2)
uiAttributedStringAppendUnattributed(attrstr, ". ")

uiAttributedStringAppendUnattributed(attrstr, "Furthermore, there are attributes")
→allowing for ")
attr = uiNewUnderlineAttribute(uiUnderlineSuggestion)
attr2 = uiNewUnderlineColorAttribute(uiUnderlineColorSpelling, 0, 0, 0, 0)
appendWithAttribute("special underlines for indicating spelling errors", attr, →
attr2)
uiAttributedStringAppendUnattributed(attrstr, " (and other types of errors) ")

uiAttributedStringAppendUnattributed(attrstr, "and control over OpenType")
→features such as ligatures (for instance, ")
otf = uiNewOpenTypeFeatures()
uiOpenTypeFeaturesAdd.otf, ASCII('l'), ASCII('i'), ASCII('g'), ASCII('a'), 0
attr = uiNewFeaturesAttribute(otf)
appendWithAttribute("afford", attr, NULL)
uiAttributedStringAppendUnattributed(attrstr, " vs. ")
uiOpenTypeFeaturesAdd(otf, ASCII('l'), ASCII('i'), ASCII('g'), ASCII('a'), 1)
attr = uiNewFeaturesAttribute(otf)
appendWithAttribute("afford", attr, NULL)
uiFreeOpenTypeFeatures(otf)
uiAttributedStringAppendUnattributed(attrstr, ").\n")

uiAttributedStringAppendUnattributed(attrstr, "Use the controls opposite to the")
→text to control properties of the text.")

func handlerDraw

defaultfont = new_uiFontDescriptor()
params = new_uiDrawTextLayoutParams()

set_uiDrawTextLayoutParams_String(params, attrstr)
uiFontButtonFont(fontButton, defaultFont)
set_uiDrawTextLayoutParams_DefaultFont(params, defaultFont)
set_uiDrawTextLayoutParams_Width(params, uiEventAreaWidth())
set_uiDrawTextLayoutParams_Align(params, uiComboboxSelected(alignment))
textLayout = uiDrawNewTextLayout(params)

```

(continues on next page)

(continued from previous page)

```

uiDrawText(uiEventContext(), textLayout, 0, 0)
uiDrawFreeTextLayout(textLayout)
uiFreeFontButtonFont(defaultFont)

func onFontChanged
    uiAreaQueueRedrawAll(area)

func onComboboxSelected
    uiAreaQueueRedrawAll(area)

func onClosing
    uiControlDestroy(mainwin)
    uiQuit()

func shouldQuit
    uiControlDestroy(mainwin)

func main

    uiOnShouldQuit("shouldQuit()")

    makeAttributedString()

    mainwin = uiNewWindow("libui Text-Drawing Example", 640, 480, 1)
    uiWindowSetMargined(mainwin, 1)
    uiWindowOnClosing(mainwin, "onClosing()")

    hbox = uiNewHorizontalBox()
    uiBoxSetPadded(hbox, 1)
    uiWindowSetChild(mainwin, hbox)

    vbox = uiNewVerticalBox()
    uiBoxSetPadded(vbox, 1)
    uiBoxAppend(hbox, vbox, 0)

    fontButton = uiNewFontButton()
    uiFontButtonOnChanged(fontButton, "onFontChanged()")
    uiBoxAppend(vbox, fontButton, 0)

    form = uiNewForm()
    uiFormSetPadded(form, 1)
    uiBoxAppend(vbox, form, 0)

    alignment = uiNewCombobox()
    uiComboboxAppend(alignment, "Left")
    uiComboboxAppend(alignment, "Center")
    uiComboboxAppend(alignment, "Right")
    uiComboboxSetSelected(alignment, 0)           // start with left alignment
    uiComboboxOnSelected(alignment, "onComboboxSelected()")
    uiFormAppend(form, "Alignment", alignment, 0)

    oAreaHandler = uiNewAreaHandler("handlerDraw()", "", "", "", "")

```

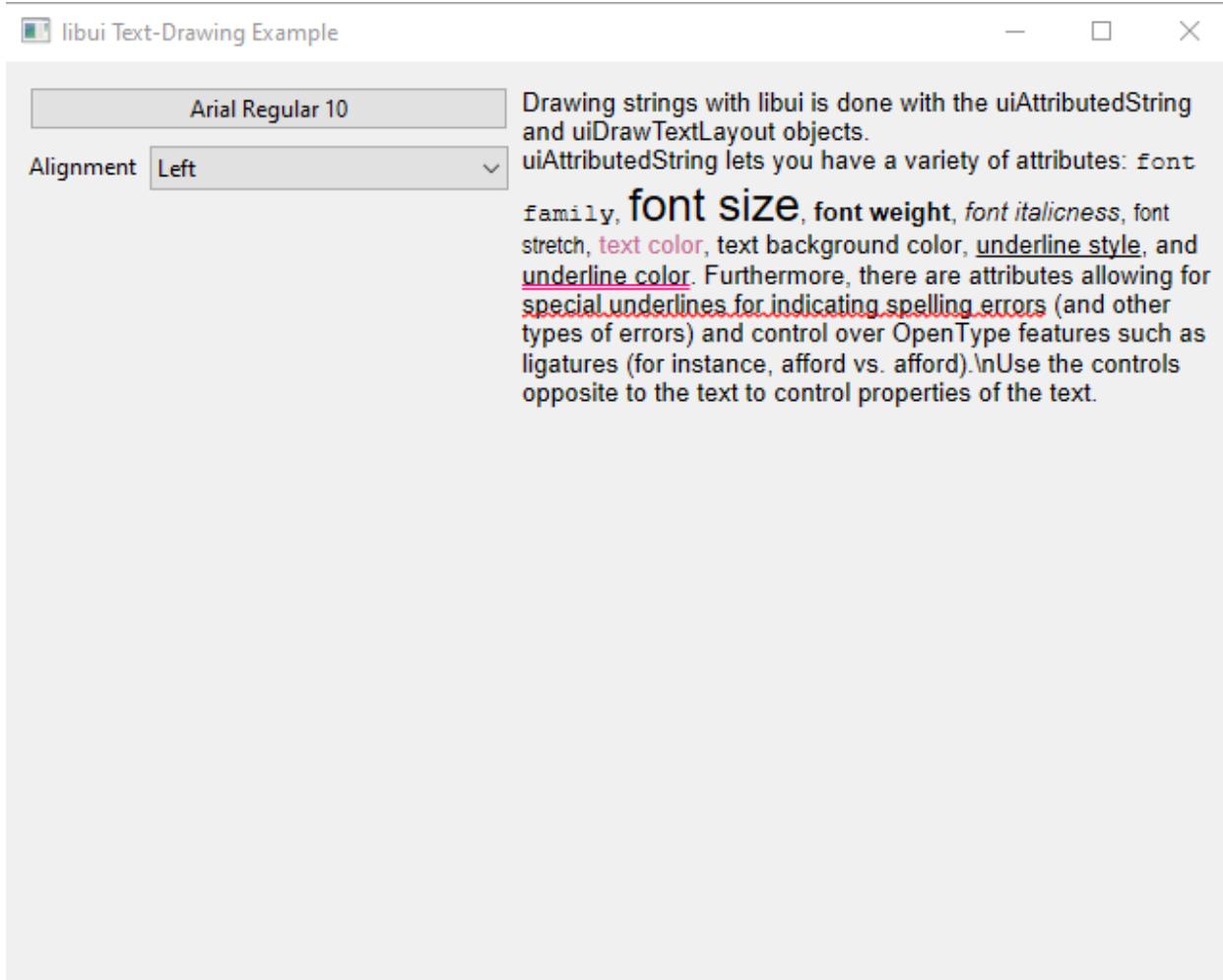
(continues on next page)

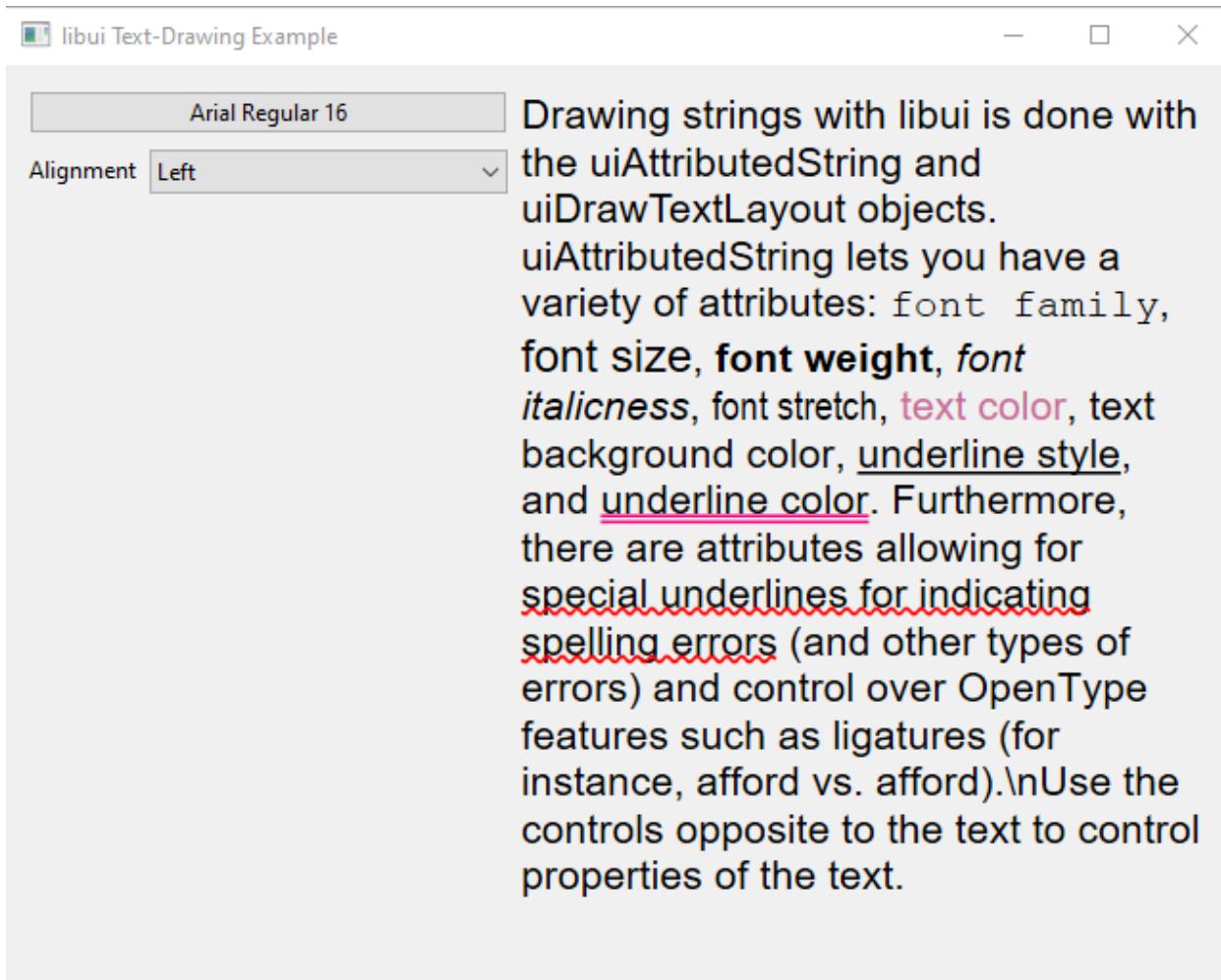
(continued from previous page)

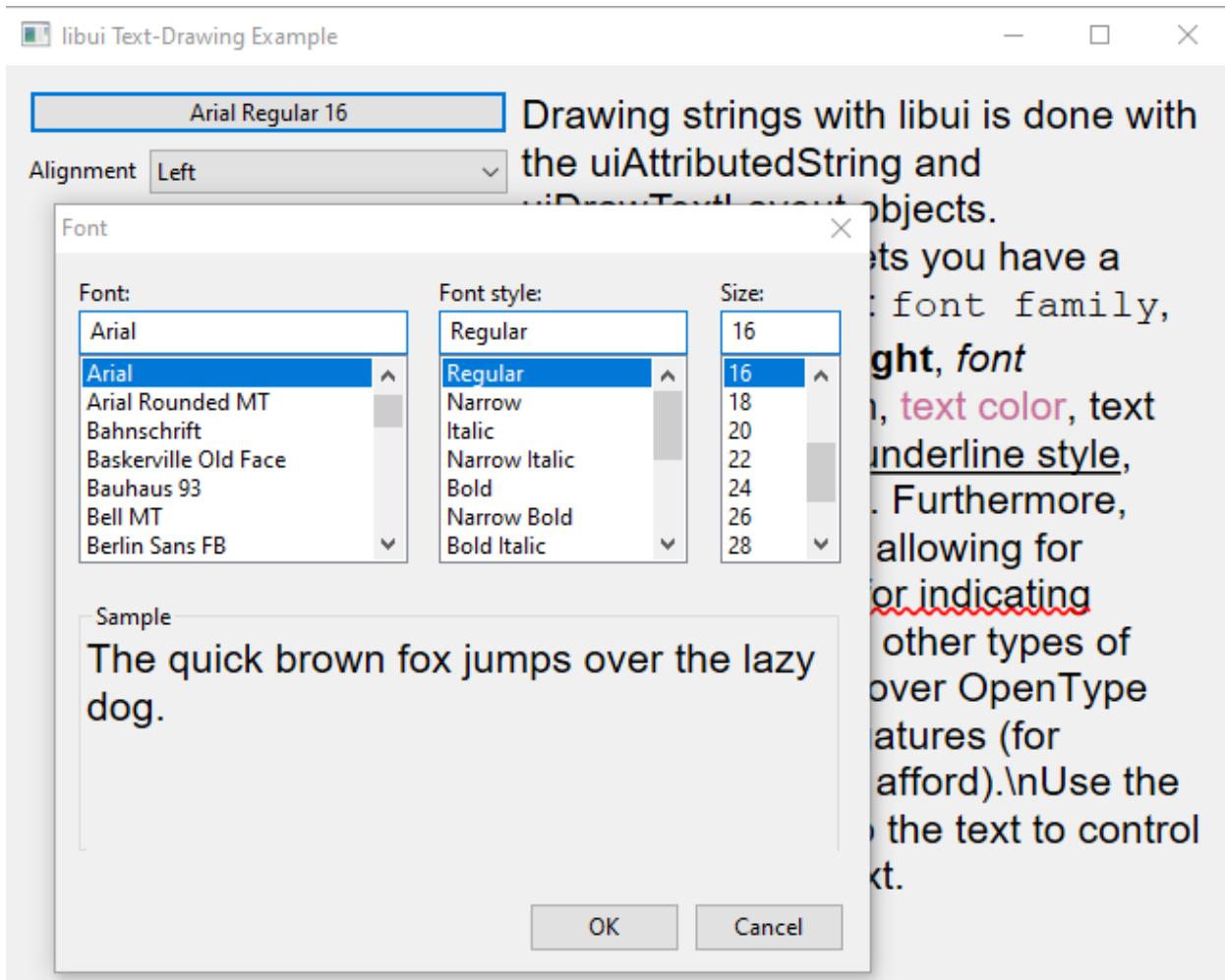
```
area = uiNewArea(oAreaHandler)
uiBoxAppend(hbox, area, 1)

uiControlShow(mainwin)
uiMain()
uiFreeAttributedString(attrstr)
```

Screen Shot:







78.10 More Drawing Samples

Example (1):

```
# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

oWindow = uiNewWindow( "Drawing Sample", 400, 400, True)
uiWindowOnClosing(oWindow,"closeApp()")

oAreaHandler = uiNewAreaHandler("draw()", "", "", "", "")
area = uiNewArea(oAreaHandler)

btnClose = uiNewButton("Close Application")
uiButtonOnClicked(btnClose,"closeApp()")

hbox = uiNewVerticalBox()
```

(continues on next page)

(continued from previous page)

```

uiBoxSetPadded(hbox, 1)
uiBoxAppend(hbox,btnClose,0)
uiBoxAppend(hbox,area,1)
uiWindowSetChild(oWindow, hbox)

uiControlShow( oWindow )
uiMain()

func draw
    nWidth = uiEventAreaWidth()           nHeight = uiEventAreaHeight()
    source = new_uiDrawBrush()
    sp = new_uiDrawStrokeParams()
    source = uiNewSolidBrush(colorBlue)
    set_uiDrawStrokeParams_Cap(sp,uiDrawLineCapFlat)
    set_uiDrawStrokeParams_Join(sp,uiDrawLineJoinMiter)
    set_uiDrawStrokeParams_MiterLimit(sp,uiDrawDefaultMiterLimit)
    set_uiDrawStrokeParams_NumDashes(sp,0)
    set_uiDrawStrokeParams_DashPhase(sp,0)
    set_uiDrawStrokeParams_Thickness(sp,40.96)

    path = uiDraw newPath(uiDrawFillModeWinding)
    uiDrawPathNewFigure(path, 76.8, 84.48)
    uiDrawPathLineTo(path, 76.8 + 51.2, 84.48 -51.2)
    uiDrawPathLineTo(path, 76.8 + 51.2 + 51.2, 84.48 - 51.2 + 51.2)
    uiDrawPathEnd(path)
    set_uiDrawStrokeParams_Join(sp,uiDrawLineJoinMiter)
    uiDrawStroke(uiEventContext(), path, source, sp)
    uiDrawFreePath(path)

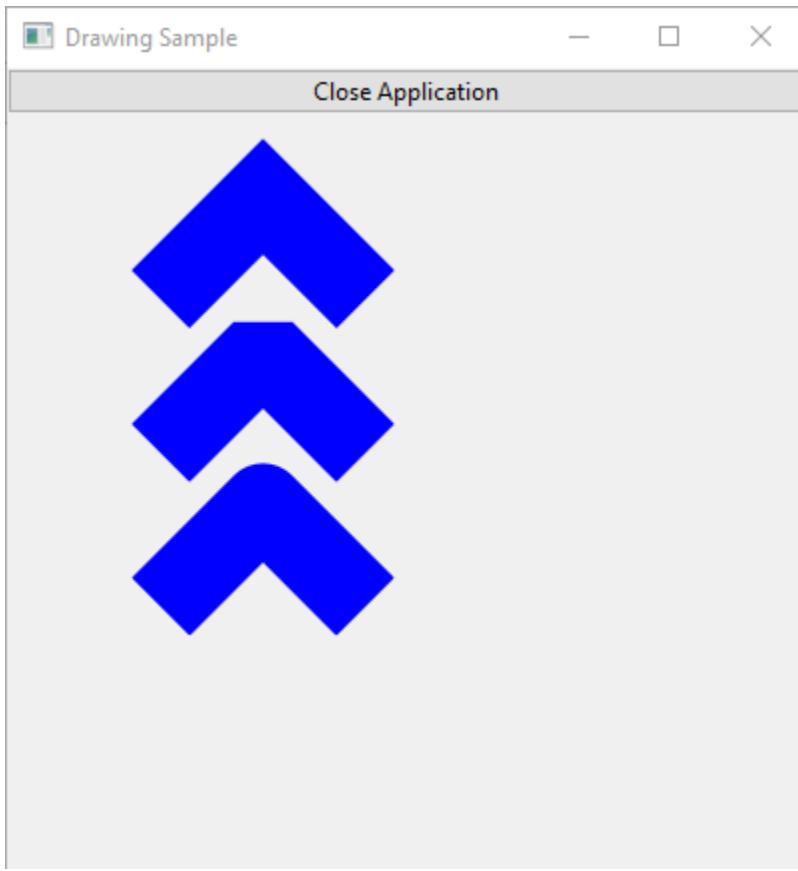
    path = uiDraw newPath(uiDrawFillModeWinding)
    uiDrawPathNewFigure(path, 76.8, 161.28)
    uiDrawPathLineTo(path, 76.8 + 51.2, 161.28 -51.2)
    uiDrawPathLineTo(path, 76.8 + 51.2 + 51.2, 161.28 - 51.2 + 51.2)
    uiDrawPathEnd(path)
    set_uiDrawStrokeParams_Join(sp,uiDrawLineJoinBevel)
    uiDrawStroke(uiEventContext(), path, source, sp)
    uiDrawFreePath(path)

    path = uiDraw newPath(uiDrawFillModeWinding)
    uiDrawPathNewFigure(path, 76.8, 238.08)
    uiDrawPathLineTo(path, 76.8 + 51.2, 238.08 -51.2)
    uiDrawPathLineTo(path, 76.8 + 51.2 + 51.2, 238.08 - 51.2 + 51.2)
    uiDrawPathEnd(path)
    set_uiDrawStrokeParams_Join(sp,uiDrawLineJoinRound)
    uiDrawStroke(uiEventContext(), path, source, sp)
    uiDrawFreePath(path)

func closeApp
    uiQuit()

```

Screen Shot:



Example (2):

```
# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

oWindow = uiNewWindow( "Drawing Sample", 400, 400, True)
uiWindowOnClosing(oWindow,"closeApp()")

oAreaHandler = uiNewAreaHandler("draw()", "", "", "", "")
area = uiNewArea(oAreaHandler)

btnClose = uiNewButton("Close Application")
uiButtonOnClicked(btnClose,"closeApp()")

hbox = uiNewVerticalBox()
uiBoxSetPadded(hbox, 1)
uiBoxAppend(hbox,btnClose,0)
uiBoxAppend(hbox,area,1)
uiWindowSetChild(oWindow, hbox)

uiControlShow( oWindow )
uiMain()

func draw
```

(continues on next page)

(continued from previous page)

```

nWidth = uiEventAreaWidth()           nHeight = uiEventAreaHeight()

source = new_uiDrawBrush()
sp = new_uiDrawStrokeParams()
source = uiNewSolidBrush(colorBlack)
set_uiDrawStrokeParams_Cap(sp,uiDrawLineCapFlat)
set_uiDrawStrokeParams_Join(sp,uiDrawLineJoinMiter)
set_uiDrawStrokeParams_MiterLimit(sp,uiDrawDefaultMiterLimit)
set_uiDrawStrokeParams_NumDashes(sp,0)
set_uiDrawStrokeParams_DashPhase(sp,0)
set_uiDrawStrokeParams_Thickness(sp,30)

set_uiDrawStrokeParams_Cap(sp,uiDrawLineCapFlat)
path = uiDrawNewPath(uiDrawFillModeWinding)
uiDrawPathNewFigure(path, 64.0, 50.0)
uiDrawPathLineTo(path, 64.0, 200.0)
uiDrawPathEnd(path)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

set_uiDrawStrokeParams_Cap(sp,uiDrawLineCapRound)
path = uiDrawNewPath(uiDrawFillModeWinding)
uiDrawPathNewFigure(path, 128.0, 50.0)
uiDrawPathLineTo(path, 128.0, 200.0)
uiDrawPathEnd(path)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

set_uiDrawStrokeParams_Cap(sp,uiDrawLineCapSquare)
path = uiDrawNewPath(uiDrawFillModeWinding)
uiDrawPathNewFigure(path, 192.0, 50.0)
uiDrawPathLineTo(path, 192.0, 200.0)
uiDrawPathEnd(path)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

// draw helping lines
// keep the square cap to match the reference picture on the cairo website
uiCrSourceRGBA(source, 1, 0.2, 0.2, 1)
set_uiDrawStrokeParams_Thickness(sp,2.56)
path = uiDrawNewPath(uiDrawFillModeWinding)
uiDrawPathNewFigure(path, 64.0, 50.0)
uiDrawPathLineTo(path, 64.0, 200.0)
uiDrawPathNewFigure(path, 128.0, 50.0)
uiDrawPathLineTo(path, 128.0, 200.0)
uiDrawPathNewFigure(path, 192.0, 50.0)
uiDrawPathLineTo(path, 192.0, 200.0)
uiDrawPathEnd(path)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

func closeApp

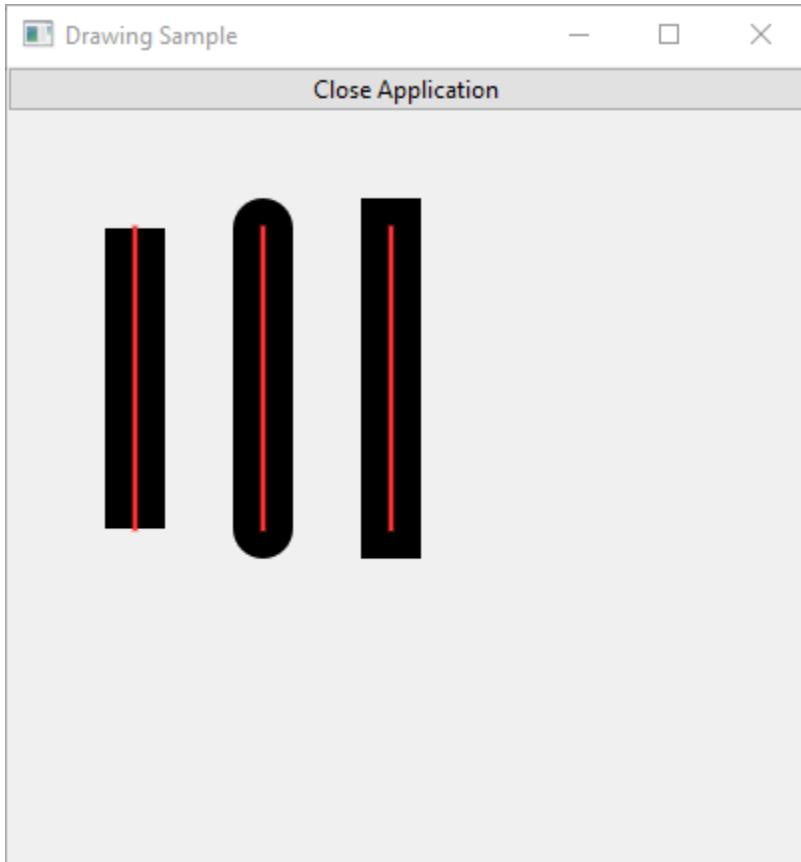
```

(continues on next page)

(continued from previous page)

uiQuit()

Screen Shot:



Example (3):

```
# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

oWindow = uiNewWindow( "Drawing Sample", 260, 300, True)
uiWindowOnClosing(oWindow,"closeApp()")

oAreaHandler = uiNewAreaHandler("draw()", "", "", "", "")
area = uiNewArea(oAreaHandler)

btnClose = uiNewButton("Close Application")
uiButtonOnClicked(btnClose,"closeApp()")

hbox = uiNewVerticalBox()
uiBoxSetPadded(hbox, 1)
uiBoxAppend(hbox, btnClose, 0)
uiBoxAppend(hbox, area, 1)
uiWindowSetChild(oWindow, hbox)
```

(continues on next page)

(continued from previous page)

```

uiControlShow( oWindow )
uiMain()

func draw
    nWidth = uiEventAreaWidth()                      nHeight = uiEventAreaHeight()

    source = new_uiDrawBrush()
    sp = new_uiDrawStrokeParams()

    x          = 25.6
    y          = 25.6
    width      = 204.8
    height     = 204.8
    aspect      = 1.0
    corner_radius = height

    radius = corner_radius / aspect
    degrees = uiPi / 180.0

    source = uiNewSolidBrush(colorBlue)
    set_uiDrawStrokeParams_Cap(sp, uiDrawLineCapFlat)
    set_uiDrawStrokeParams_Join(sp, uiDrawLineJoinMiter)
    set_uiDrawStrokeParams_MiterLimit(sp, uiDrawDefaultMiterLimit)
    set_uiDrawStrokeParams_NumDashes(sp, 0)
    set_uiDrawStrokeParams_DashPhase(sp, 0)
    set_uiDrawStrokeParams_Thickness(sp, 30)

    path = uiDraw newPath(uiDrawFillModeWinding)

    // top right corner
    uiDrawPathNewFigureWithArc(path,
        x + width - radius, y + radius,
        radius,
        -90 * degrees, uiPi / 2,
        0)
    // bottom right corner
    uiDrawPathArcTo(path,
        x + width - radius, y + height - radius,
        radius,
        0 * degrees, uiPi / 2,
        0)
    // bottom left corner
    uiDrawPathArcTo(path,
        x + radius, y + height - radius,
        radius,
        90 * degrees, uiPi / 2,
        0)
    // top left corner
    uiDrawPathArcTo(path,
        x + radius, y + radius,
        radius,
        0 * degrees, uiPi / 2,
        0)

```

(continues on next page)

(continued from previous page)

```

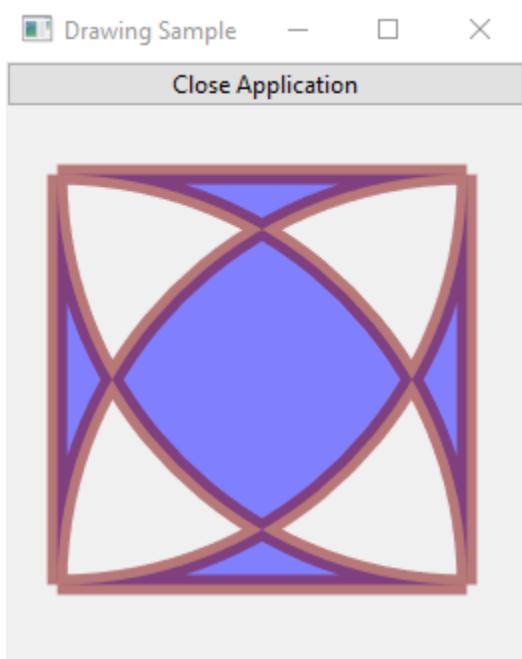
    180 * degrees, uiPi / 2,
    0)
uiDrawPathCloseFigure(path)
uiDrawPathEnd(path)

uiCrSourceRGBA(source, 0.5, 0.5, 1, 1)
uiDrawFill(uiEventContext(), path, source)
uiCrSourceRGBA(source, 0.5, 0, 0, 0.5)
set_uiDrawStrokeParams_Thickness(sp, 10)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

func closeApp
    uiQuit()

```

Screen Shot:



Example (4):

```

# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

oWindow = uiNewWindow( "Drawing Sample", 300, 300, True)
uiWindowOnClosing(oWindow,"closeApp()")

oAreaHandler = uiNewAreaHandler("draw()", "", "", "", "")
area = uiNewArea(oAreaHandler)

btnClose = uiNewButton("Close Application")

```

(continues on next page)

(continued from previous page)

```

uiButtonOnClicked(btnClose, "closeApp()")

hbox = uiNewVerticalBox()
uiBoxSetPadded(hbox, 1)
uiBoxAppend(hbox, btnClose, 0)
uiBoxAppend(hbox, area, 1)
uiWindowSetChild(oWindow, hbox)

uiControlShow( oWindow )
uiMain()

func draw
    nWidth = uiEventAreaWidth()           nHeight = uiEventAreaHeight()

    source = new_uiDrawBrush()
    sp = new_uiDrawStrokeParams()

    source = uiNewSolidBrush(colorBlue)
    set_uiDrawStrokeParams_Cap(sp, uiDrawLineCapFlat)
    set_uiDrawStrokeParams_Join(sp, uiDrawLineJoinMiter)
    set_uiDrawStrokeParams_MiterLimit(sp, uiDrawDefaultMiterLimit)
    set_uiDrawStrokeParams_NumDashes(sp, 0)
    set_uiDrawStrokeParams_DashPhase(sp, 0)

    path = uiDraw newPath(uiDrawFillModeWinding)

    uiDrawPathNewFigure(path, 50.0, 75.0)
    uiDrawPathLineTo(path, 200.0, 75.0)

    uiDrawPathNewFigure(path, 50.0, 125.0)
    uiDrawPathLineTo(path, 200.0, 125.0)

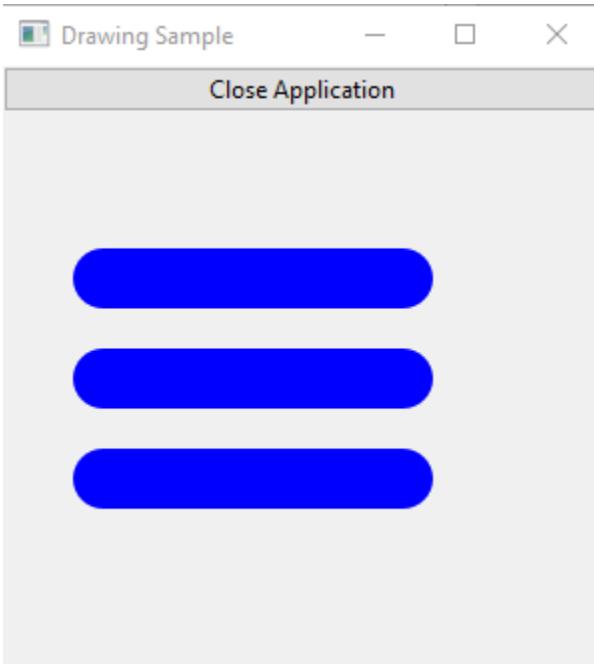
    uiDrawPathNewFigure(path, 50.0, 175.0)
    uiDrawPathLineTo(path, 200.0, 175.0)
    uiDrawPathEnd(path)

    set_uiDrawStrokeParams_Thickness(sp, 30)
    set_uiDrawStrokeParams_Cap(sp, uiDrawLineCapRound)
    uiDrawStroke(uiEventContext(), path, source, sp)
    uiDrawFreePath(path)

func closeApp
    uiQuit()

```

Screen Shot:



Example (5):

```
# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

oWindow = uiNewWindow( "Drawing Sample", 260, 300, True)
uiWindowOnClosing(oWindow,"closeApp()")

oAreaHandler = uiNewAreaHandler("draw()", "", "", "", "")
area = uiNewArea(oAreaHandler)

btnClose = uiNewButton("Close Application")
uiButtonOnClicked(btnClose,"closeApp()")

hbox = uiNewVerticalBox()
uiBoxSetPadded(hbox, 1)
uiBoxAppend(hbox,btnClose,0)
uiBoxAppend(hbox,area,1)
uiWindowSetChild(oWindow, hbox)

uiControlShow( oWindow )
uiMain()

func draw
    nWidth = uiEventAreaWidth()           nHeight = uiEventAreaHeight()

    source = new_uiDrawBrush()
    sp = new_uiDrawStrokeParams()
    m = new_uiDrawMatrix()
    source = uiNewSolidBrush(colorBlue)
```

(continues on next page)

(continued from previous page)

```

set_uiDrawStrokeParams_Cap(sp, uiDrawLineCapFlat)
set_uiDrawStrokeParams_Join(sp, uiDrawLineJoinMiter)
set_uiDrawStrokeParams_MiterLimit(sp, uiDrawDefaultMiterLimit)
set_uiDrawStrokeParams_NumDashes(sp, 0)
set_uiDrawStrokeParams_DashPhase(sp, 0)
set_uiDrawStrokeParams_Thickness(sp, 6)

path = uiDrawNewPath(uiDrawFillModeAlternate)
uiDrawPathAddRectangle(path, 12, 12, 232, 70)
uiDrawPathNewFigureWithArc(path,
    64, 64,
    40,
    0, 2*uiPi,
    0)
uiDrawPathNewFigureWithArc(path,
    192, 64,
    40,
    0, -2*uiPi,
    1)
uiDrawPathEnd(path)

uicrsourcergba(source, 0, 0.7, 0, 1)
uiDrawFill(uiEventContext(), path, source)
uicrsourcergba(source, 0, 0, 0, 1)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

uiDrawMatrixSetIdentity(m)
uiDrawMatrixTranslate(m, 0, 128)
uiDrawTransform(uiEventContext(), m)

path = uiDrawNewPath(uiDrawFillModeWinding)
uiDrawPathAddRectangle(path, 12, 12, 232, 70)
uiDrawPathNewFigureWithArc(path,
    64, 64,
    40,
    0, 2*uiPi,
    0)
uiDrawPathNewFigureWithArc(path,
    192, 64,
    40,
    0, -2*uiPi,
    1)
uiDrawPathEnd(path)

uicrsourcergba(source, 0, 0, 0.9, 1)
uiDrawFill(uiEventContext(), path, source)
uicrsourcergba(source, 0, 0, 0, 1)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

func closeApp

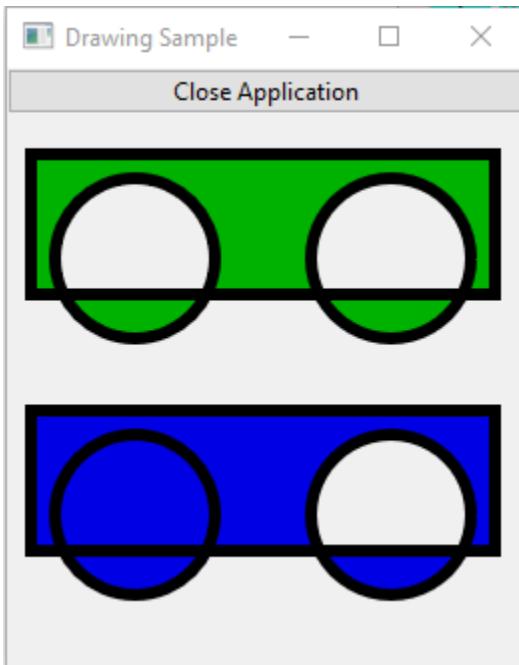
```

(continues on next page)

(continued from previous page)

uiQuit()

Screen Shot:



Example (6):

```
# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

oWindow = uiNewWindow( "Drawing Sample", 260, 300, True)
uiWindowOnClosing(oWindow,"closeApp()")

oAreaHandler = uiNewAreaHandler("draw()", "", "", "", "")
area = uiNewArea(oAreaHandler)

btnClose = uiNewButton("Close Application")
uiButtonOnClicked(btnClose,"closeApp()")

hbox = uiNewVerticalBox()
uiBoxSetPadded(hbox, 1)
uiBoxAppend(hbox,btnClose,0)
uiBoxAppend(hbox,area,1)
uiWindowSetChild(oWindow, hbox)

uiControlShow( oWindow )
uiMain()

func draw
    nWidth = uiEventAreaWidth()           nHeight = uiEventAreaHeight()
```

(continues on next page)

(continued from previous page)

```
source = new_uiDrawBrush()
sp = new_uiDrawStrokeParams()
source = uiNewSolidBrush(colorBlue)
set_uiDrawStrokeParams_Cap(sp,uiDrawLineCapFlat)
set_uiDrawStrokeParams_Join(sp,uiDrawLineJoinMiter)
set_uiDrawStrokeParams_MiterLimit(sp,uiDrawDefaultMiterLimit)
set_uiDrawStrokeParams_NumDashes(sp,0)
set_uiDrawStrokeParams_DashPhase(sp,0)

path = uiDraw newPath(uiDrawFillModeWinding)

uiDrawPathNewFigure(path, 128.0, 25.6)
uiDrawPathLineTo(path, 230.4, 230.4)
uiDrawPathLineTo(path, 230.4 - 102.4, 230.4 + 0.0)
uiDrawPathBezierTo(path, 51.2, 230.4, 51.2, 128.0, 128.0, 128.0)
uiDrawPathCloseFigure(path)

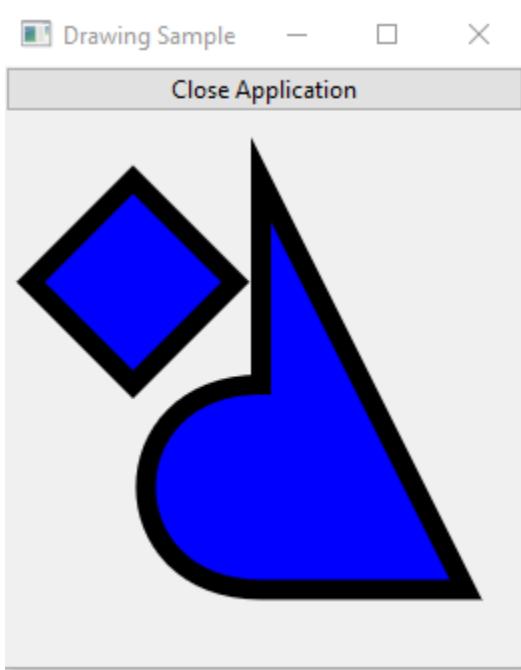
uiDrawPathNewFigure(path, 64.0, 25.6)
uiDrawPathLineTo(path, 64.0 + 51.2, 25.6 + 51.2)
uiDrawPathLineTo(path, 64.0 + 51.2 - 51.2, 25.6 + 51.2 + 51.2)
uiDrawPathLineTo(path, 64.0 + 51.2 - 51.2 - 51.2, 25.6 + 51.2 + 51.2 - 51.2)
uiDrawPathCloseFigure(path)

uiDrawPathEnd(path)

set_uiDrawStrokeParams_Thickness(sp,10)
uicrsourcergba(source, 0, 0, 1, 1)
uiDrawFill(uiEventContext(), path, source)
uicrsourcergba(source, 0, 0, 0, 1)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

func closeApp
    uiQuit()
```

Screen Shot:



Example (7):

```
# Sample ported to Ring
# Based on original sample from : https://github.com/andlabs/libui

load "libui.ring"

oWindow = uiNewWindow( "Drawing Sample", 260, 300, True)
uiWindowOnClosing(oWindow,"closeApp()")

oAreaHandler = uiNewAreaHandler("draw()", "", "", "", "")
area = uiNewArea(oAreaHandler)

btnClose = uiNewButton("Close Application")
uiButtonOnClicked(btnClose,"closeApp()")

hbox = uiNewVerticalBox()
uiBoxSetPadded(hbox, 1)
uiBoxAppend(hbox,btnClose,0)
uiBoxAppend(hbox,area,1)
uiWindowSetChild(oWindow, hbox)

uiControlShow( oWindow )
uiMain()

func draw
    nWidth = uiEventAreaWidth()           nHeight = uiEventAreaHeight()

    source = new_uiDrawBrush()
    sp = new_uiDrawStrokeParams()
    source = uiNewSolidBrush(colorBlue)
```

(continues on next page)

(continued from previous page)

```

x=25.6    y=128.0
x1=102.4  y1=230.4
x2=153.6  y2=25.6
x3=230.4  y3=128.0

uicrsourcergba(source, 0, 0, 0, 1)
set_uiDrawStrokeParams_Cap(sp, uiDrawLineCapFlat)
set_uiDrawStrokeParams_Join(sp, uiDrawLineJoinMiter)
set_uiDrawStrokeParams_MiterLimit(sp, uiDrawDefaultMiterLimit)
set_uiDrawStrokeParams_NumDashes(sp, 0)
set_uiDrawStrokeParams_DashPhase(sp, 0)

path = uiDrawNewPath(uiDrawFillModeWinding)

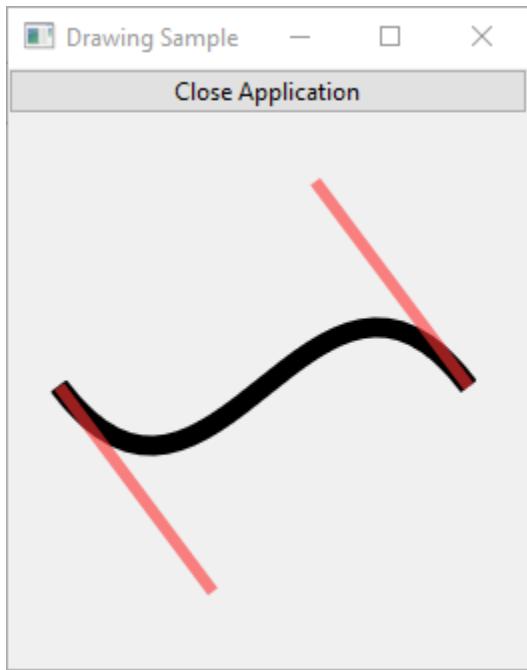
uiDrawPathNewFigure(path, x, y)
uiDrawPathBezierTo(path, x1, y1, x2, y2, x3, y3)
uiDrawPathEnd(path)
set_uiDrawStrokeParams_Thickness(sp, 10)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

uicrsourcergba(source, 1, 0.2, 0.2, 0.6)
set_uiDrawStrokeParams_Thickness(sp, 6)
path = uiDrawNewPath(uiDrawFillModeWinding)
uiDrawPathNewFigure(path, x, y)
uiDrawPathLineTo(path, x1, y1)
uiDrawPathNewFigure(path, x2, y2)
uiDrawPathLineTo(path, x3, y3)
uiDrawPathEnd(path)
uiDrawStroke(uiEventContext(), path, source, sp)
uiDrawFreePath(path)

func closeApp
    uiQuit()

```

Screen Shot:



CHAPTER
SEVENTYNINE

USING RINGZIP

In this chapter we will learn about using RingZip

79.1 Create Zip File

Example : Create myfile.zip contains 4 files

```
load "ziplib.ring"
oZip = zip_openfile("myfile.zip", 'w')
zip_addfile(oZip, "test.c")
zip_addfile(oZip, "zip.c")
zip_addfile(oZip, "zip.h")
zip_addfile(oZip, "miniz.h")
zip_close(oZip)
```

79.2 Extract Zip File

Example : Extract myfile.zip to myfolder folder.

```
load "ziplib.ring"
zip_extract_allfiles("myfile.zip", "myfolder")
```

79.3 Print Files in Zip file

Example : Print file names in the myfile.zip

```
load "ziplib.ring"
oZip = zip_openfile("myfile.zip", 'r')
for x=1 to zip_filescount(oZip)
    see zip_getfilenamebyindex(oZip,x) + nl
next
zip_close(oZip)
```

79.4 Using RingZip Classes

The RingZip library comes with two classes. The Zip class and the ZipEntry class.

Example (1):

```
load "ziplib.ring"

new Zip {
    setFileName("myfile.zip")
    open("w")
    newEntry() {
        open("test.c")
        writefile("test.c")
        close()
    }
    close()
}
```

Example (2):

```
load "ziplib.ring"

new Zip {
    SetFileName("myfile.zip")
    Open("w")
    AddFile("test.c")
    AddFile("zip.c")
    AddFile("zip.h")
    AddFile("miniz.h")
    Close()
}
```

Example (3):

```
load "ziplib.ring"

new zip {
    SetFileName("myfile.zip")
    ExtractAllFiles("myfolder")
}
```

Example (4):

```
load "ziplib.ring"

new Zip {
    SetFileName("myfile.zip")
    Open("r")
    see FilesCount()
    Close()
}
```

Example (5):

```

load "ziplib.ring"

new Zip {
    SetFileName("myfile.zip")
    Open("r")
    for x = 1 to filescount()
        See GetFileNameByIndex(x) + nl
    next
    Close()
}

```

79.5 Zip Class Reference

Methods:

Method	Description/Output
SetFileName(cName)	Set the Zip file name
GetFileName()	Return the Zip file name
Open(cMode)	Open File, cMode = "a", "w" or "r"
Close()	Close the Zip File
AddFile(cFileName)	Add file to the Zip file
ExtractAllFiles(cFolder)	Extract all files from the Zip file
FilesCount()	Return files count in the Zip file
GetFileNameByIndex(nIndex)	Return file name in the Zip file by file index
NewEntry()	Create new ZipEntry object

79.6 ZipEntry Class Reference

Methods:

Method	Description/Output
Open(cFileName)	Open new Entry
WriteFile(cFileName)	Write File to the Entry
WriteString(cString)	Write String to the Entry
Close()	Close the Entry

RINGLIBZIP FUNCTIONS REFERENCE

80.1 Introduction

In this chapter we have a list of the supported functions by this extension

80.2 Reference

- ZIP_T *zip_openfile(const char *, const char *)
- int zip_entry_open(ZIP_T*, const char *)
- int zip_entry_write(ZIP_T*, const char *,int)
- int zip_entry_fwrite(ZIP_T*, const char *)
- int zip_entry_read(ZIP_T*, void *, size_t *)
- int zip_entry_fread(ZIP_T*, const char *cFile)
- int zip_entry_close(ZIP_T*)
- void zip_extract_allfiles(const char *cFile, const char *cFolder)
- void zip_close(ZIP_T*)
- int zip_filescount(ZIP_T *)
- const char *zip_getfilenamebyindex(ZIP_T *pZip,int index)
- void zip_extract_file(const char *cZIPFile,const char *cFile)

RINGMURMURHASH FUNCTIONS REFERENCE

Murmurhash extension is an extension written to implement a full implementation for the MurmurHash library.

81.1 MurmurHash1 functions

```
uint32_t murmurhash1(string key, int seed, [bool return_type]);  
uint32_t murmurhash1_aligned(string key, int seed, [bool return_type]);
```

81.2 MurmurHash2 functions

```
uint32_t murmurhash2(string key, int seed, [bool return_type]);  
uint32_t murmurhash2a(string key, int seed, [bool return_type]);  
uint64_t murmurhash64a(string key, int seed, [bool return_type]);  
uint64_t murmurhash64b(string key, int seed, [bool return_type]);  
uint32_t murmurhash_neutral2(string key, int seed, [bool return_type]);  
uint32_t murmurhash_aligned2(string key, int seed, [bool return_type]);
```

81.3 MurmurHash3 functions

```
uint32_t murmurhash3_x86_32(string key, int seed, [bool return_type]);  
list murmurhash3_x86_128(string key, int seed, [bool return_type]);  
list murmurhash3_x64_128(string key, int seed, [bool return_type]);
```

The third optional parameter is to set the type of the returned value, this parameter accepts a bool value [true, false], true will return a Hex value, while false will return a integer value.

81.4 Example

```
load "murmurhashlib.ring"

key = "Ring Language"

see murmurhash3_x86_32(key, 0, 0) + nl // Output: 1894444853
see murmurhash3_x86_32(key, 0, 1) + nl // Output: 70eaef35
```

RINGCONSOLECOLORS FUNCTIONS REFERENCE

82.1 Introduction

In this chapter we have a list of the supported functions by this extension

82.2 Reference

- CC_FG_NONE
- CC_FG_BLACK
- CC_FG_DARK_RED
- CC_FG_DARK_GREEN
- CC_FG_DARK_YELLOW
- CC_FG_DARK_BLUE
- CC_FG_DARK_MAGENTA
- CC_FG_DARK_CYAN
- CC_FG_GRAY
- CC_FG_DARK_GRAY
- CC_FG_RED
- CC_FG_GREEN
- CC_FG_YELLOW
- CC_FG_BLUE
- CC_FG_MAGENTA
- CC_FG_CYAN
- CC_FG_WHITE
- CC_BG_NONE
- CC_BG_BLACK
- CC_BG_DARK_RED
- CC_BG_DARK_GREEN
- CC_BG_DARK_YELLOW

- CC_BG_DARK_BLUE
- CC_BG_DARK_MAGENTA
- CC_BG_DARK_CYAN
- CC_BG_GRAY
- CC_BG_DARK_GRAY
- CC_BG_RED
- CC_BG_GREEN
- CC_BG_YELLOW
- CC_BG_BLUE
- CC_BG_MAGENTA
- CC_BG_CYAN
- CC_BG_WHITE
- void cc_print(int color,const char *string)

USING ROGUEUTIL

In this chapter we will learn about Using the RogueUtil extension.

This extension is added to the Ring language starting from Ring 1.20.

Contents:

- Change the Console window title
- Using colors
- Change the cursor position
- Print text at specific position
- Respond to keypress events
- Respond to mouse events in Windows command prompt
- Respond to mouse events (Windows Command Prompt or Linux/macOS Terminal)
- Defined Constants
- List of Functions

83.1 Change the Console window title

Example:

```
load "rogueutil.ring"

setConsoleTitle("I Love Programming")

anykey("Press any key to continue!")
```

83.2 Using colors

Example:

```
load "rogueutil.ring"

setConsoleTitle("Using Colors")
```

(continues on next page)

(continued from previous page)

```
setBackgroundColor(Blue)

cls()

anykey("Press any key to continue!")
```

83.3 Change the cursor position

Example:

```
load "rogueutil.ring"

setConsoleTitle("Using GotoXY()")

setColor(White)
setBackgroundColor(Green)

cls()

gotoXY(30,2)
print("I Love Programming!")

for t=1 to 10
    gotoXY(10,10+t)
    print( "Number: " + t)
next

gotoxy(10,22)
anykey("Press any key to continue!")
```

83.4 Print text at specific position

Example:

```
load "rogueutil.ring"

saveDefaultColor()

setConsoleTitle("Using PrintXY()")

setColor(Black)
setBackgroundColor(Cyan)

cls()

printXY(10,2,'In Mathematics, we call multiplying a number by itself "squaring" the
number.')
```

(continues on next page)

(continued from previous page)

```

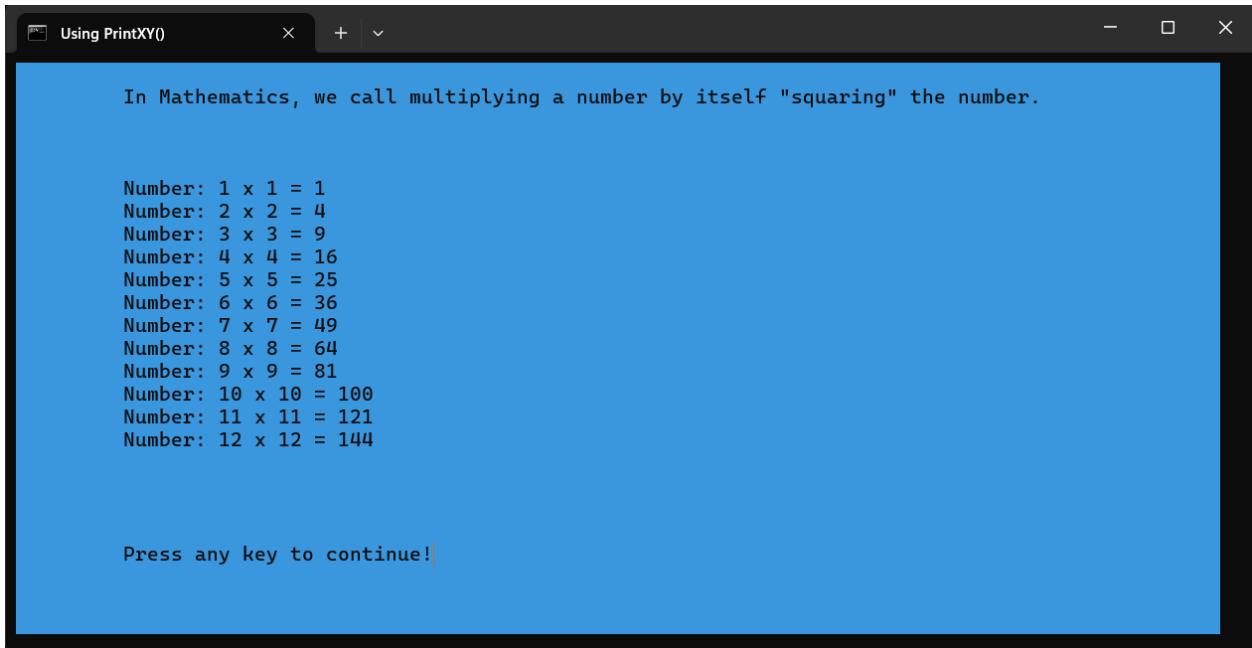
for t=1 to 12
    printXY(10,5+t, "Number: " + t + " x " + t + " = " + (t*t) )
next

printXY(10,22,"Press any key to continue!")
getch()

resetcolor()
showCursor()
cls()

```

Output:



83.5 Respond to keypress events

Example:

```

load "rogueutil.ring"

C_MSG = 'You Can Move Me Using Keyboard Arrows or WSAD'
C_MSGLEN = len(C_MSG)

C_SCREENROWS = tRows()
C_SCREENCOLS = tCols()

C_DEFAULTX = 10
C_DEFAULTY = 10

hideCursor()

```

(continues on next page)

(continued from previous page)

```

setConsoleTitle("Moving Text")

nX = C_DEFAULTX
nY = C_DEFAULTY

prepareScreen()
showMsg()

fflush(stdout)

while True
    if tRows() != C_SCREENROWS or tCols() != C_SCREENCOLS
        prepareScreen()
        nX = C_DEFAULTX
        nY = C_DEFAULTY
        C_SCREENROWS = tRows()
        C_SCREENCOLS = tCols()
        showMsg()

    ok
    if kbhit()
        nKey = getkey()
        if nKey = KEY_ESCAPE exit ok
        clearMsg()
        if nKey = KEY_RIGHT or Upper(Char(nKey)) = "D"
            nX += 1
            if nX > tCols()-C_MSGLEN+1 nX -= 1 ok
        but nKey = KEY_LEFT or Upper(Char(nKey)) = "A"
            nX -= 1
            if nX < 1 nX = 1 ok
        but nKey = KEY_UP or Upper(Char(nKey)) = "W"
            nY -= 1
            if nY < 1 nY = 1 ok
        but nKey = KEY_DOWN or Upper(Char(nKey)) = "S"
            nY += 1
            if nY > tRows() nY -= 1 ok
        ok
        showMsg()

    ok
end

showCursor()
echoON()

func prepareScreen
    setColor(White)
    setBackgroundColor(Red)
    cls()

func showMsg
    printXY(nX,nY,C_MSG)

func clearMsg

```

(continues on next page)

(continued from previous page)

```
printXY(nX,nY,Copy(" ",C_MSGLEN))
```

83.6 Respond to mouse events in Windows command prompt

Example:

```
load "rogueutil.ring"

cls()

C_MSG = 'You Can Move Me Using Arrows/WSAD'

if isWindows()
    C_MSG += ' or Mouse Left Button'
ok

C_MSGLEN = len(C_MSG)

C_SCREENROWS = tRows()
C_SCREENCOLS = tCols()

C_DEFAULTX = 10
C_DEFAULTY = 10

hideCursor()
setConsoleTitle("Using Mouse (For Windows)")

nX = C_DEFAULTX
nY = C_DEFAULTY

prepareScreen()
showMsg()

fflush(stdout)

while True

    # Window resize
    if tRows() != C_SCREENROWS or tCols() != C_SCREENCOLS
        prepareScreen()
        nX = C_DEFAULTX
        nY = C_DEFAULTY
        C_SCREENROWS = tRows()
        C_SCREENCOLS = tCols()
        showMsg()
    ok

    # Using the Keyboard
    if kbhit()
        nKey = getkey()
```

(continues on next page)

(continued from previous page)

```

if nKey = KEY_ESCAPE exit ok
clearMsg()
if nKey = KEY_RIGHT or Upper(Char(nKey)) = "D"
    nX += 1
    if nX > tCols()-C_MSGLEN+1 nX -= 1 ok
but nKey = KEY_LEFT or Upper(Char(nKey)) = "A"
    nX -= 1
    if nX < 1 nX = 1 ok
but nKey = KEY_UP or Upper(Char(nKey)) = "W"
    nY -= 1
    if nY < 1 nY = 1 ok
but nKey = KEY_DOWN or Upper(Char(nKey)) = "S"
    nY += 1
    if nY > tRows() nY -= 1 ok
ok
showMsg()

# Using the Mouse
aMouse = GetMouseInfo()
if aMouse[MOUSEINFO_ACTIVE]

    printxy(1,2,"X: " + aMouse[MOUSEINFO_X] +
           " Y: " + aMouse[MOUSEINFO_Y] +
           " B: " + aMouse[MOUSEINFO_BUTTONS] + "      ")

    if aMouse[MOUSEINFO_EVENTS] = MOUSEINFO_WHEELEVENT
        printxy(1,3,"Scroll Direction : " + aMouse[MOUSEINFO_
SCROLLDIRECTION])
    else
        printxy(1,3,Copy(" ",50))
    ok

    if aMouse[MOUSEINFO_BUTTONS] = MOUSEINFO_LEFTBUTTON
        clearMsg()
        nX = aMouse[MOUSEINFO_X]
        nY = aMouse[MOUSEINFO_Y]
        if nX < 1 nX = 1 ok
        if nY < 1 nY = 1 ok
        if nY > tRows() nY = tRows() ok
        if nX > tCols()-C_MSGLEN+1 nX = tCols()-C_MSGLEN+1 ok
        showMsg()
    ok

ok

end

showCursor()
echoON()

func prepareScreen

```

(continues on next page)

(continued from previous page)

```

setColor(White)
setBackgroundColor(Red)
cls()

func showMsg
    printXY(nX,nY,C_MSG)

func clearMsg
    printXY(nX,nY,COPY(" ",C_MSGLEN))

```

83.7 Respond to mouse events (Windows Command Prompt or Linux/macOS Terminal)

Example:

```

load "rogueutil.ring"

enableMouse()

cls()

C_MSG = 'You Can Move Me Using Arrows/WSAD or Mouse Left Button'

C_MSGLEN = len(C_MSG)

C_SCREENROWS = tRows()
C_SCREENCOLS = tCols()

C_DEFAULTX = 10
C_DEFAULTY = 10

hideCursor()
setConsoleTitle("Using Mouse (Windows/Linux/macOS)")

nX = C_DEFAULTX
nY = C_DEFAULTY

prepareScreen()
showMsg()

fflush(stdout)

while True

    # Window resize
    if tRows() != C_SCREENROWS or tCols() != C_SCREENCOLS
        prepareScreen()
        nX = C_DEFAULTX
        nY = C_DEFAULTY
        C_SCREENROWS = tRows()

```

(continues on next page)

(continued from previous page)

```

C_SCREENCOLS = tCols()
showMsg()

ok

# Using the Keyboard
nBuffer = kbhit()
nKey = 0
if nBuffer
    nKey = getKey()
    if nKey = KEY_ESCAPE exit ok
    clearMsg()
    if nKey = KEY_RIGHT or Upper(Char(nKey)) = "D"
        nX += 1
        if nX > tCols()-C_MSGLEN+1 nX -= 1 ok
    but nKey = KEY_LEFT or Upper(Char(nKey)) = "A"
        nX -= 1
        if nX < 1 nX = 1 ok
    but nKey = KEY_UP or Upper(Char(nKey)) = "W"
        nY -= 1
        if nY < 1 nY = 1 ok
    but nKey = KEY_DOWN or Upper(Char(nKey)) = "S"
        nY += 1
        if nY > tRows() nY -= 1 ok
ok
showMsg()

```

ok

```

# Using the Mouse
aMouse = MouseInfo(nBuffer, nKey)

if aMouse[MOUSEINFO_ACTIVE]

    printxy(1,2,"X: " + aMouse[MOUSEINFO_X] +
            " Y: " + aMouse[MOUSEINFO_Y] +
            " B: " + aMouse[MOUSEINFO_BUTTONS] + "      ")

    if aMouse[MOUSEINFO_EVENTS] = MOUSEINFO_WHEELEVENT
        printxy(1,3,"Scroll Direction : " + aMouse[MOUSEINFO_
SCROLLDIRECTION])
    else
        printxy(1,3,Copy(" ",50))
ok

if aMouse[MOUSEINFO_BUTTONS] = MOUSEINFO_LEFTBUTTON
    clearMsg()
    nX = aMouse[MOUSEINFO_X]
    nY = aMouse[MOUSEINFO_Y]
    if nX < 1 nX = 1 ok
    if nY < 1 nY = 1 ok

```

(continues on next page)

(continued from previous page)

```
if nY > tRows()  nY = tRows() ok
if nX > tCols()-C_MSGLEN+1  nX = tCols()-C_MSGLEN+1 ok
showMsg()
ok

ok

end

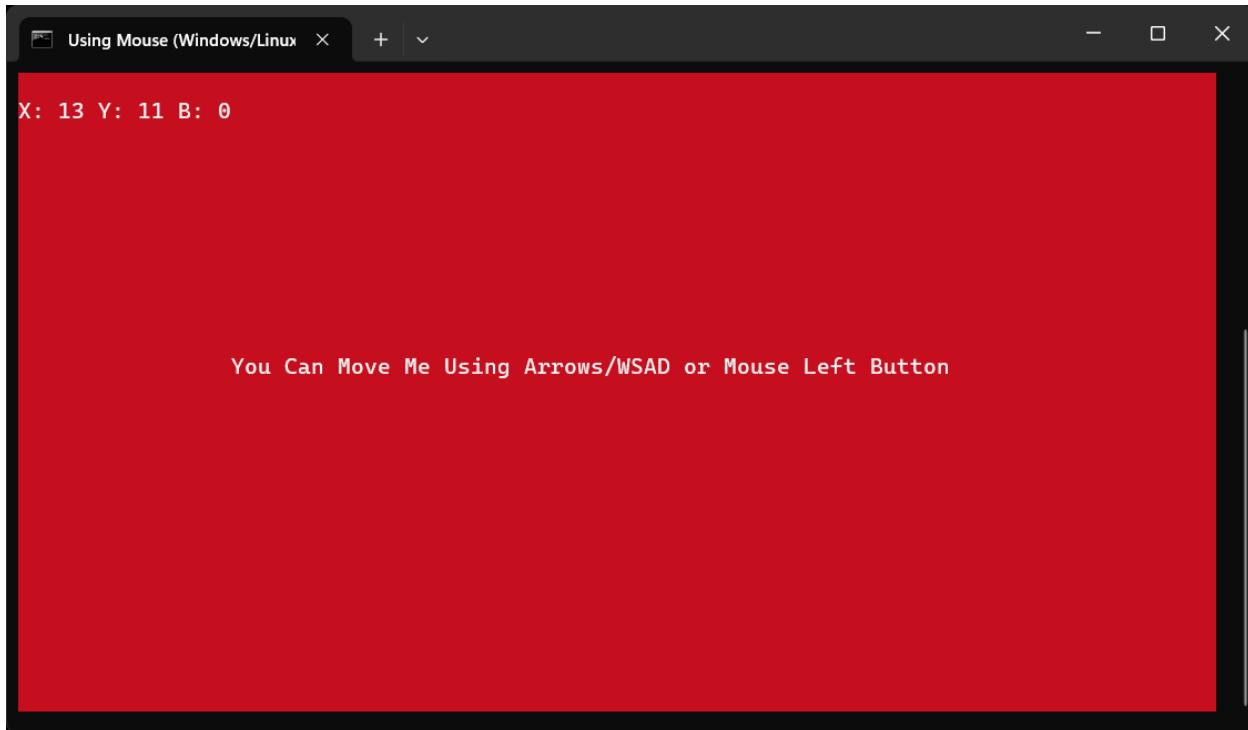
disableMouse()
showCursor()
echoON()

func prepareScreen
    setColor(White)
    setBackgroundColor(Red)
    cls()

func showMsg
    printXY(nX,nY,C_MSG)

func clearMsg
    printXY(nX,nY,Copy(" ",C_MSGLEN))
```

Output:



83.8 Defined Constants

This extension defines the next constants

```
BLACK
BLUE
GREEN
CYAN
RED
MAGENTA
BROWN
GREY
DARKGREY
LIGHTBLUE
LIGHTGREEN
LIGHTCYAN
LIGHTRED
LIGHTMAGENTA
YELLOW
WHITE
KEY_ESCAPE
KEY_ENTER
KEY_SPACE
KEY_INSERT
KEY_HOME
KEY_PGUP
KEY_DELETE
KEY_END
KEY_PGDOWN
KEY_UP
KEY_DOWN
KEY_LEFT
KEY_RIGHT
KEY_F1
KEY_F2
KEY_F3
KEY_F4
KEY_F5
KEY_F6
KEY_F7
KEY_F8
KEY_F9
KEY_F10
KEY_F11
KEY_F12
KEY_NUMDEL
KEY_NUMPAD0
KEY_NUMPAD1
KEY_NUMPAD2
KEY_NUMPAD3
KEY_NUMPAD4
KEY_NUMPAD5
KEY_NUMPAD6
```

(continues on next page)

(continued from previous page)

```
KEY_NUMPAD7
KEY_NUMPAD8
KEY_NUMPAD9
MOUSEEVENT_START
MOUSEEVENT_CLICK
MOUSEMOVE_NOBUTTON
MOUSEMOVE_LEFTBTNDOWN
MOUSEMOVE_RIGHTBTNDOWN
MOUSEEVENT_SCROLL
MOUSEEVENT_SCROLLUP
MOUSEEVENT_SCROLLDOWN
```

83.9 List of Functions

This extension provides the next functions

```
void locate(int x, int y)
int getch(void)
int kbhit(void)
void gotoxy(int x, int y)
int getkey(void)
int nb_getch(void)
char *getANSIColor(const int c)
char *getANSIBgColor(const int c)
void setColor(int c)
void setBackgroundColor(int c)
int saveDefaultColor(void)
void resetColor(void)
void cls(void)
void setString(char *str)
void setChar(char ch)
void setCursorVisibility(char visible)
void hidecursor(void)
void showcursor(void)
void msleep(unsigned int ms)
int trows(void)
int tcols(void)
void anykey(char *msg)
void setConsoleTitle(char *title)
char *getUsername(void)
void printXY(int x, int y, char *msg)
void echoon(void)
void echooff(void)
List *getmouseinfo(void)
void enablemouse(void)
void disablemouse(void)
```

CHAPTER
EIGHTYFOUR

RINGALLEGRO FUNCTIONS REFERENCE

84.1 Introduction

In this chapter we have a list of the supported functions by this extension

84.2 Reference

- void al_exit(void)
- void al_run_main(void)
- int al_init(void)
- ALLEGRO_CONFIG *al_create_config(void)
- void al_destroy_config(ALLEGRO_CONFIG *config)
- ALLEGRO_CONFIG *al_load_config_file(const char *filename)
- ALLEGRO_CONFIG *al_load_config_file_f(ALLEGRO_FILE *file)
- bool al_save_config_file(const char *filename, const ALLEGRO_CONFIG *config)
- bool al_save_config_file_f(ALLEGRO_FILE *file, const ALLEGRO_CONFIG *config)
- void al_add_config_section(ALLEGRO_CONFIG *config, const char *name)
- void al_add_config_comment(ALLEGRO_CONFIG *config, const char *section, const char *comment)
- const char *al_get_config_value(const ALLEGRO_CONFIG *config, const char *section, const char *key)
- void al_set_config_value(ALLEGRO_CONFIG *config, const char *section, const char *key, const char *value)
- char const *al_get_first_config_section(ALLEGRO_CONFIG const *config, ALLEGRO_CONFIG_SECTION **iterator)
- char const *al_get_next_config_section(ALLEGRO_CONFIG SECTION **iterator)
- char const *al_get_first_config_entry(ALLEGRO_CONFIG const *config, char const *section, ALLEGRO_CONFIG_ENTRY **iterator)
- char const *al_get_next_config_entry(ALLEGRO_CONFIG_ENTRY **iterator)
- ALLEGRO_CONFIG *al_merge_config(const ALLEGRO_CONFIG *cfg1, const ALLEGRO_CONFIG *cfg2)
- void al_merge_config_into(ALLEGRO_CONFIG *master, const ALLEGRO_CONFIG *add)
- ALLEGRO_DISPLAY *al_create_display(int w, int h)

- void al_destroy_display(ALLEGRO_DISPLAY *display)
- int al_get_new_display_flags(void)
- void al_set_new_display_flags(int flags)
- int al_get_new_display_option(int option, int *importance)
- void al_set_new_display_option(int option, int value, int importance)
- void al_reset_new_display_options(void)
- void al_get_new_window_position(int *x, int *y)
- void al_set_new_window_position(int x, int y)
- int al_get_new_display_refresh_rate(void)
- void al_set_new_display_refresh_rate(int refresh_rate)
- ALLEGRO_EVENT_SOURCE *al_get_display_event_source(ALLEGRO_DISPLAY *display)
- ALLEGRO_BITMAP *al_get_backbuffer(ALLEGRO_DISPLAY *display)
- void al_flip_display(void)
- void al_update_display_region(int x, int y, int width, int height)
- bool al_wait_for_vsync(void)
- int al_get_display_width(ALLEGRO_DISPLAY *display)
- int al_get_display_height(ALLEGRO_DISPLAY *display)
- bool al_resize_display(ALLEGRO_DISPLAY *display, int width, int height)
- bool al_acknowledge_resize(ALLEGRO_DISPLAY *display)
- void al_get_window_position(ALLEGRO_DISPLAY *display, int *x, int *y)
- void al_set_window_position(ALLEGRO_DISPLAY *display, int x, int y)
- int al_get_display_flags(ALLEGRO_DISPLAY *display)
- bool al_set_display_flag(ALLEGRO_DISPLAY *display, int flag, bool onoff)
- int al_get_display_option(ALLEGRO_DISPLAY *display, int option)
- int al_get_display_format(ALLEGRO_DISPLAY *display)
- int al_get_display_refresh_rate(ALLEGRO_DISPLAY *display)
- void al_set_window_title(ALLEGRO_DISPLAY *display, const char *title)
- void al_set_display_icon(ALLEGRO_DISPLAY *display, ALLEGRO_BITMAP *icon)
- void al_set_display_icons(ALLEGRO_DISPLAY *display, int num_icons, ALLEGRO_BITMAP *icons[])
- bool al_inhibit_screensaver(bool inhibit)
- void al_acknowledge_drawing_halt(ALLEGRO_DISPLAY *display)
- void al_acknowledge_drawing_resume(ALLEGRO_DISPLAY *display)
- int al_get_display_orientation(ALLEGRO_DISPLAY *display)
- void al_set_display_option(ALLEGRO_DISPLAY *display, int option, int value)
- bool al_get_window_constraints(ALLEGRO_DISPLAY *display, int *min_w, int *min_h, int *max_w, int *max_h)

- `bool al_set_window_constraints(ALLEGRO_DISPLAY *display,int min_w, int min_h, int max_w, int max_h)`
- `ALLEGRO_EVENT_QUEUE *al_create_event_queue(void)`
- `void al_destroy_event_queue(ALLEGRO_EVENT_QUEUE *queue)`
- `void al_register_event_source(ALLEGRO_EVENT_QUEUE *queue,ALLEGRO_EVENT_SOURCE *source)`
- `void al_unregister_event_source(ALLEGRO_EVENT_QUEUE *queue,ALLEGRO_EVENT_SOURCE *source)`
- `bool al_is_event_queue_empty(ALLEGRO_EVENT_QUEUE *queue)`
- `bool al_get_next_event(ALLEGRO_EVENT_QUEUE *queue, ALLEGRO_EVENT *ret_event)`
- `bool al_peek_next_event(ALLEGRO_EVENT_QUEUE *queue, ALLEGRO_EVENT *ret_event)`
- `bool al_drop_next_event(ALLEGRO_EVENT_QUEUE *queue)`
- `void al_flush_event_queue(ALLEGRO_EVENT_QUEUE *queue)`
- `void al_wait_for_event(ALLEGRO_EVENT_QUEUE *queue, ALLEGRO_EVENT *ret_event)`
- `bool al_wait_for_event_timed(ALLEGRO_EVENT_QUEUE *queue,ALLEGRO_EVENT *ret_event, float secs)`
- `bool al_wait_for_event_until(ALLEGRO_EVENT_QUEUE *queue,ALLEGRO_EVENT *ret_event, ALLEGRO_TIMEOUT *timeout)`
- `void al_init_user_event_source(ALLEGRO_EVENT_SOURCE *src)`
- `void al_destroy_user_event_source(ALLEGRO_EVENT_SOURCE *src)`
- `intptr_t al_get_event_source_data(const ALLEGRO_EVENT_SOURCE *source)`
- `void al_set_event_source_data(ALLEGRO_EVENT_SOURCE *source, intptr_t data)`
- `ALLEGRO_FILE *al_fopen(const char *path, const char *mode)`
- `ALLEGRO_FILE *al_fopen_interface(const ALLEGRO_FILE_INTERFACE *drv,const char *path, const char *mode)`
- `ALLEGRO_FILE *al_fopen_slice(ALLEGRO_FILE *fp, size_t initial_size, const char *mode)`
- `void al_fclose(ALLEGRO_FILE *f)`
- `size_t al_fread(ALLEGRO_FILE *f, void *ptr, size_t size)`
- `size_t al_fwrite(ALLEGRO_FILE *f, const void *ptr, size_t size)`
- `bool al_fflush(ALLEGRO_FILE *f)`
- `int64_t al_ftell(ALLEGRO_FILE *f)`
- `bool al_fseek(ALLEGRO_FILE *f, int64_t offset, int whence)`
- `bool al_feof(ALLEGRO_FILE *f)`
- `bool al_ferror(ALLEGRO_FILE *f)`
- `void al_fclearerr(ALLEGRO_FILE *f)`
- `int al_fungetc(ALLEGRO_FILE *f, int c)`
- `int64_t al_fsize(ALLEGRO_FILE *f)`
- `int al_fgetc(ALLEGRO_FILE *f)`
- `int al_fputc(ALLEGRO_FILE *f, int c)`

- int16_t al_fread16le(ALLEGRO_FILE *f)
- int16_t al_fread16be(ALLEGRO_FILE *f)
- size_t al_fwrite16le(ALLEGRO_FILE *f, int16_t w)
- size_t al_fwrite16be(ALLEGRO_FILE *f, int16_t w)
- int32_t al_fread32le(ALLEGRO_FILE *f)
- int32_t al_fread32be(ALLEGRO_FILE *f)
- size_t al_fwrite32le(ALLEGRO_FILE *f, int32_t l)
- size_t al_fwrite32be(ALLEGRO_FILE *f, int32_t l)
- char *al_fgets(ALLEGRO_FILE *f, char * const buf, size_t max)
- ALLEGRO_USTR *al_fget_ustr(ALLEGRO_FILE *f)
- int al_fputs(ALLEGRO_FILE *f, char const *p)
- ALLEGRO_FILE *al_fopen_fd(int fd, const char *mode)
- ALLEGRO_FILE *al_make_temp_file(const char *template, ALLEGRO_PATH **ret_path)
- void al_set_new_file_interface(const ALLEGRO_FILE_INTERFACE *file_interface)
- void al_set_standard_file_interface(void)
- const ALLEGRO_FILE_INTERFACE *al_get_new_file_interface(void)
- ALLEGRO_FILE *al_create_file_handle(const ALLEGRO_FILE_INTERFACE *drv, void *userdata)
- void *al_get_file_userdata(ALLEGRO_FILE *f)
- ALLEGRO_FS_ENTRY *al_create_fs_entry(const char *path)
- void al_destroy_fs_entry(ALLEGRO_FS_ENTRY *fh)
- const char *al_get_fs_entry_name(ALLEGRO_FS_ENTRY *e)
- bool al_update_fs_entry(ALLEGRO_FS_ENTRY *e)
- uint32_t al_get_fs_entry_mode(ALLEGRO_FS_ENTRY *e)
- time_t al_get_fs_entry_atime(ALLEGRO_FS_ENTRY *e)
- time_t al_get_fs_entry_ctime(ALLEGRO_FS_ENTRY *e)
- time_t al_get_fs_entry_mtime(ALLEGRO_FS_ENTRY *e)
- off_t al_get_fs_entry_size(ALLEGRO_FS_ENTRY *e)
- bool al_fs_entry_exists(ALLEGRO_FS_ENTRY *e)
- bool al_remove_fs_entry(ALLEGRO_FS_ENTRY *e)
- bool al_filename_exists(const char *path)
- bool al_remove_filename(const char *path)
- bool al_open_directory(ALLEGRO_FS_ENTRY *e)
- ALLEGRO_FS_ENTRY *al_read_directory(ALLEGRO_FS_ENTRY *e)
- bool al_close_directory(ALLEGRO_FS_ENTRY *e)
- char *al_get_current_directory(void)
- bool al_change_directory(const char *path)

- bool al_make_directory(const char *path)
- ALLEGRO_FILE *al_open_fs_entry(ALLEGRO_FS_ENTRY *e, const char *mode)
- void al_set_fs_interface(const ALLEGRO_FS_INTERFACE *fs_interface)
- void al_set_standard_fs_interface(void)
- const ALLEGRO_FS_INTERFACE *al_get_fs_interface(void)
- al_fixed al_itofix(int x);
- int al_fixtoi(al_fixed x);
- int al_fixfloor(al_fixed x);
- int al_fixceil(al_fixed x);
- al_fixed al_ftofix(double x);
- double al_fixtof(al_fixed x);
- al_fixed al_fixmul(al_fixed x, al_fixed y);
- al_fixed al_fixdiv(al_fixed x, al_fixed y);
- al_fixed al_fixadd(al_fixed x, al_fixed y);
- al_fixed al_fixsub(al_fixed x, al_fixed y);
- al_fixed al_fixsin(al_fixed x);
- al_fixed al_fixcos(al_fixed x);
- al_fixed al_fixtan(al_fixed x);
- al_fixed al_fixasin(al_fixed x);
- al_fixed al_fixacos(al_fixed x);
- al_fixed al_fixatan(al_fixed x)
- al_fixed al_fixatan2(al_fixed y, al_fixed x)
- al_fixed al_fixsqrt(al_fixed x)
- al_fixed al_fixhypot(al_fixed x, al_fixed y)
- ALLEGRO_DISPLAY_MODE *al_get_display_mode(int index, ALLEGRO_DISPLAY_MODE *mode)
- int al_get_num_display_modes(void)
- ALLEGRO_COLOR al_map_rgb(unsigned char r, unsigned char g, unsigned char b)
- ALLEGRO_COLOR al_map_rgb_f(float r, float g, float b)
- ALLEGRO_COLOR al_map_rgba(unsigned char r, unsigned char g, unsigned char b, unsigned char a)
- ALLEGRO_COLOR al_map_rgba_f(float r, float g, float b, float a)
- void al_unmap_rgb(ALLEGRO_COLOR color,unsigned char *r, unsigned char *g, unsigned char *b)
- void al_unmap_rgb_f(ALLEGRO_COLOR color, float *r, float *g, float *b)
- void al_unmap_rgba(ALLEGRO_COLOR color,unsigned char *r, unsigned char *g, unsigned char *b, unsigned char *a)
- void al_unmap_rgba_f(ALLEGRO_COLOR color,float *r, float *g, float *b, float *a)
- int al_get_pixel_size(int format)

- int al_get_pixel_format_bits(int format)
- ALLEGRO_LOCKED_REGION *al_lock_bitmap(ALLEGRO_BITMAP *bitmap,int format, int flags)
- ALLEGRO_LOCKED_REGION *al_lock_bitmap_region(ALLEGRO_BITMAP *bitmap,int x, int y, int width, int height, int format, int flags)
- void al_unlock_bitmap(ALLEGRO_BITMAP *bitmap)
- ALLEGRO_BITMAP *al_create_bitmap(int w, int h)
- ALLEGRO_BITMAP *al_create_sub_bitmap(ALLEGRO_BITMAP *parent,int x, int y, int w, int h)
- ALLEGRO_BITMAP *al_clone_bitmap(ALLEGRO_BITMAP *bitmap)
- void al_destroy_bitmap(ALLEGRO_BITMAP *bitmap)
- int al_get_new_bitmap_flags(void)
- int al_get_new_bitmap_format(void)
- void al_set_new_bitmap_flags(int flags)
- void al_add_new_bitmap_flag(int flag)
- void al_set_new_bitmap_format(int format)
- int al_get_bitmap_flags(ALLEGRO_BITMAP *bitmap)
- int al_get_bitmap_format(ALLEGRO_BITMAP *bitmap)
- int al_get_bitmap_height(ALLEGRO_BITMAP *bitmap)
- int al_get_bitmap_width(ALLEGRO_BITMAP *bitmap)
- ALLEGRO_COLOR al_get_pixel(ALLEGRO_BITMAP *bitmap, int x, int y)
- bool al_is_bitmap_locked(ALLEGRO_BITMAP *bitmap)
- bool al_is_compatible_bitmap(ALLEGRO_BITMAP *bitmap)
- bool al_is_sub_bitmap(ALLEGRO_BITMAP *bitmap)
- ALLEGRO_BITMAP *al_get_parent_bitmap(ALLEGRO_BITMAP *bitmap)
- void al_clear_to_color(ALLEGRO_COLOR color)
- void al_draw_bitmap(ALLEGRO_BITMAP *bitmap, float dx, float dy, int flags)
- void al_draw_tinted_bitmap(ALLEGRO_BITMAP *bitmap, ALLEGRO_COLOR tint,float dx, float dy, int flags)
- void al_draw_bitmap_region(ALLEGRO_BITMAP *bitmap,float sx, float sy, float sw, float sh, float dx, float dy, int flags)
- void al_draw_tinted_bitmap_region(ALLEGRO_BITMAP *bitmap,ALLEGRO_COLOR tint,float sx, float sy, float sw, float sh, float dx, float dy,int flags)
- void al_draw_pixel(float x, float y, ALLEGRO_COLOR color)
- void al_draw_rotated_bitmap(ALLEGRO_BITMAP *bitmap,float cx, float cy, float dx, float dy, float angle, int flags)
- void al_draw_tinted_rotated_bitmap(ALLEGRO_BITMAP *bitmap,ALLEGRO_COLOR tint,float cx, float cy, float dx, float dy, float angle, int flags)
- void al_draw_scaled_rotated_bitmap(ALLEGRO_BITMAP *bitmap,float cx, float cy, float dx, float dy, float xscale, float yscale,float angle, int flags)

- void al_draw_tinted_scaled_rotated_bitmap(ALLEGRO_BITMAP *bitmap, ALLEGRO_COLOR tint, float cx, float cy, float dx, float dy, float xscale, float yscale, float angle, int flags)
- void al_draw_tinted_scaled_rotated_bitmap_region(ALLEGRO_BITMAP *bitmap, float sx, float sy, float sw, float sh, ALLEGRO_COLOR tint, float cx, float cy, float dx, float dy, float xscale, float yscale, float angle, int flags)
- void al_draw_scaled_bitmap(ALLEGRO_BITMAP *bitmap, float sx, float sy, float sw, float sh, float dx, float dy, float dw, float dh, int flags)
- void al_draw_tinted_scaled_bitmap(ALLEGRO_BITMAP *bitmap, ALLEGRO_COLOR tint, float sx, float sy, float sw, float sh, float dx, float dy, float dw, float dh, int flags)
- ALLEGRO_BITMAP *al_get_target_bitmap(void)
- void al_put_pixel(int x, int y, ALLEGRO_COLOR color)
- void al_put_blended_pixel(int x, int y, ALLEGRO_COLOR color)
- void al_set_target_bitmap(ALLEGRO_BITMAP *bitmap)
- void al_set_target_backbuffer(ALLEGRO_DISPLAY *display)
- ALLEGRO_DISPLAY *al_get_current_display(void)
- void al_get_blender(int *op, int *src, int *dst)
- void al_get_separate_blender(int *op, int *src, int *dst, int *alpha_op, int *alpha_src, int *alpha_dst)
- void al_set_blender(int op, int src, int dst)
- void al_set_separate_blender(int op, int src, int dst, int alpha_op, int alpha_src, int alpha_dst)
- void al_get_clipping_rectangle(int *x, int *y, int *w, int *h)
- void al_set_clipping_rectangle(int x, int y, int width, int height)
- void al_reset_clipping_rectangle(void)
- void al_convert_mask_to_alpha(ALLEGRO_BITMAP *bitmap, ALLEGRO_COLOR mask_color)
- void al_hold_bitmap_drawing(bool hold)
- bool al_is_bitmap_drawing_held(void)
- ALLEGRO_BITMAP *al_load_bitmap_f(ALLEGRO_FILE *fp, const char *ident)
- bool al_save_bitmap(const char *filename, ALLEGRO_BITMAP *bitmap)
- bool al_save_bitmap_f(ALLEGRO_FILE *fp, const char *ident, ALLEGRO_BITMAP *bitmap)
- bool al_install_joystick(void)
- void al_uninstall_joystick(void)
- bool al_is_joystick_installed(void)
- bool al_reconfigure_joysticks(void)
- int al_get_num_joysticks(void)
- ALLEGRO_JOYSTICK * al_get_joystick(int num)
- void al_release_joystick(ALLEGRO_JOYSTICK *joy)
- bool al_get_joystick_active(ALLEGRO_JOYSTICK *joy)
- const char *al_get_joystick_name(ALLEGRO_JOYSTICK *joy)
- const char *al_get_joystick_stick_name(ALLEGRO_JOYSTICK *joy, int stick)

- `const char *al_get_joystick_axis_name(ALLEGRO_JOYSTICK *joy, int stick, int axis)`
- `const char *al_get_joystick_button_name(ALLEGRO_JOYSTICK *joy, int button)`
- `int al_get_joystick_stick_flags(ALLEGRO_JOYSTICK *joy, int stick)`
- `int al_get_joystick_num_sticks(ALLEGRO_JOYSTICK *joy)`
- `int al_get_joystick_num_axes(ALLEGRO_JOYSTICK *joy, int stick)`
- `int al_get_joystick_num_buttons(ALLEGRO_JOYSTICK *joy)`
- `void al_get_joystick_state(ALLEGRO_JOYSTICK *joy, ALLEGRO_JOYSTICK_STATE *ret_state)`
- `ALLEGRO_EVENT_SOURCE *al_get_joystick_event_source(void)`
- `bool al_install_keyboard(void)`
- `bool al_is_keyboard_installed(void)`
- `void al_uninstall_keyboard(void)`
- `void al_get_keyboard_state(ALLEGRO_KEYBOARD_STATE *ret_state)`
- `bool al_key_down(const ALLEGRO_KEYBOARD_STATE *state, int keycode)`
- `const char *al_keycode_to_name(int keycode)`
- `bool al_set_keyboard_leds(int leds)`
- `ALLEGRO_EVENT_SOURCE *al_get_keyboard_event_source(void)`
- `void *al_malloc_with_context(size_t n,int line, const char *file, const char *func)`
- `void al_free_with_context(void *ptr, int line, const char *file, const char *func)`
- `void *al_realloc_with_context(void *ptr, size_t n,int line, const char *file, const char *func)`
- `void *al_calloc_with_context(size_t count, size_t n,int line, const char *file, const char *func)`
- `void al_set_memory_interface(ALLEGRO_MEMORY_INTERFACE *memory_interface)`
- `int al_get_new_display_adapter(void)`
- `void al_set_new_display_adapter(int adapter)`
- `bool al_get_monitor_info(int adapter, ALLEGRO_MONITOR_INFO *info)`
- `int al_get_num_video_adapters(void)`
- `bool al_install_mouse(void)`
- `bool al_is_mouse_installed(void)`
- `void al_uninstall_mouse(void)`
- `unsigned int al_get_mouse_num_axes(void)`
- `unsigned int al_get_mouse_num_buttons(void)`
- `void al_get_mouse_state(ALLEGRO_MOUSE_STATE *ret_state)`
- `int al_get_mouse_state_axis(const ALLEGRO_MOUSE_STATE *state, int axis)`
- `bool al_mouse_button_down(const ALLEGRO_MOUSE_STATE *state, int button)`
- `bool al_set_mouse_xy(ALLEGRO_DISPLAY *display, int x, int y)`
- `bool al_set_mouse_z(int z)`
- `bool al_set_mouse_w(int w)`

- `bool al_set_mouse_axis(int which, int value)`
- `ALLEGRO_EVENT_SOURCE *al_get_mouse_event_source(void)`
- `ALLEGRO_MOUSE_CURSOR *al_create_mouse_cursor(ALLEGRO_BITMAP *bmp, int x_focus, int y_focus)`
- `void al_destroy_mouse_cursor(ALLEGRO_MOUSE_CURSOR *cursor)`
- `bool al_set_mouse_cursor(ALLEGRO_DISPLAY *display, ALLEGRO_MOUSE_CURSOR *cursor)`
- `bool al_set_system_mouse_cursor(ALLEGRO_DISPLAY *display, ALLEGRO_SYSTEM_MOUSE_CURSOR cursor_id)`
- `bool al_get_mouse_cursor_position(int *ret_x, int *ret_y)`
- `bool al_hide_mouse_cursor(ALLEGRO_DISPLAY *display)`
- `bool al_show_mouse_cursor(ALLEGRO_DISPLAY *display)`
- `bool al_grab_mouse(ALLEGRO_DISPLAY *display)`
- `bool al_ungrab_mouse(void)`
- `ALLEGRO_PATH *al_create_path(const char *str)`
- `ALLEGRO_PATH *al_create_path_for_directory(const char *str)`
- `void al_destroy_path(ALLEGRO_PATH *path)`
- `ALLEGRO_PATH *al_clone_path(const ALLEGRO_PATH *path)`
- `bool al_join_paths(ALLEGRO_PATH *path, const ALLEGRO_PATH *tail)`
- `bool al_rebase_path(const ALLEGRO_PATH *head, ALLEGRO_PATH *tail)`
- `const char *al_get_path_drive(const ALLEGRO_PATH *path)`
- `int al_get_path_num_components(const ALLEGRO_PATH *path)`
- `const char *al_get_path_component(const ALLEGRO_PATH *path, int i)`
- `const char *al_get_path_tail(const ALLEGRO_PATH *path)`
- `const char *al_get_path_filename(const ALLEGRO_PATH *path)`
- `const char *al_get_path_basename(const ALLEGRO_PATH *path)`
- `const char *al_get_path_extension(const ALLEGRO_PATH *path)`
- `void al_set_path_drive(ALLEGRO_PATH *path, const char *drive)`
- `void al_append_path_component(ALLEGRO_PATH *path, const char *s)`
- `void al_insert_path_component(ALLEGRO_PATH *path, int i, const char *s)`
- `void al_replace_path_component(ALLEGRO_PATH *path, int i, const char *s)`
- `void al_remove_path_component(ALLEGRO_PATH *path, int i)`
- `void al_drop_path_tail(ALLEGRO_PATH *path)`
- `void al_set_path_filename(ALLEGRO_PATH *path, const char *filename)`
- `bool al_set_path_extension(ALLEGRO_PATH *path, char const *extension)`
- `const char *al_path_cstr(const ALLEGRO_PATH *path, char delim)`
- `bool al_make_path_canonical(ALLEGRO_PATH *path)`
- `void al_restore_state(ALLEGRO_STATE const *state)`

- void al_store_state(ALLEGRO_STATE *state, int flags)
- int al_get_errno(void)
- void al_set_errno(int errnum)
- void al_uninstall_system(void)
- bool al_is_system_installed(void)
- uint32_t al_get_allegro_version(void)
- ALLEGRO_PATH *al_get_standard_path(int id)
- void al_set_exe_name(char const *path)
- void al_set_app_name(const char *app_name)
- void al_set_org_name(const char *org_name)
- const char *al_get_app_name(void)
- const char *al_get_org_name(void)
- ALLEGRO_CONFIG *al_get_system_config(void)
- ALLEGRO_THREAD *al_create_thread(void)
- void al_run_detached_thread(void)
- void al_start_thread(ALLEGRO_THREAD *thread)
- void al_join_thread(ALLEGRO_THREAD *thread, void **ret_value)
- void al_set_thread_should_stop(ALLEGRO_THREAD *thread)
- bool al_get_thread_should_stop(ALLEGRO_THREAD *thread)
- void al_destroy_thread(ALLEGRO_THREAD *thread)
- ALLEGRO_MUTEX *al_create_mutex(void)
- ALLEGRO_MUTEX *al_create_mutex_recursive(void)
- void al_lock_mutex(ALLEGRO_MUTEX *mutex)
- void al_unlock_mutex(ALLEGRO_MUTEX *mutex)
- void al_destroy_mutex(ALLEGRO_MUTEX *mutex)
- ALLEGRO_COND *al_create_cond(void)
- void al_destroy_cond(ALLEGRO_COND *cond)
- void al_wait_cond(ALLEGRO_COND *cond, ALLEGRO_MUTEX *mutex)
- int al_wait_cond_until(ALLEGRO_COND *cond, ALLEGRO_MUTEX *mutex, const ALLEGRO_TIMEOUT *timeout)
- void al_broadcast_cond(ALLEGRO_COND *cond)
- void al_signal_cond(ALLEGRO_COND *cond)
- double al_get_time(void)
- void al_init_timeout(ALLEGRO_TIMEOUT *timeout, double seconds)
- void al_rest(double seconds)
- ALLEGRO_TIMER *al_create_timer(double speed_secs)

- void al_start_timer(ALLEGRO_TIMER *timer)
- void al_stop_timer(ALLEGRO_TIMER *timer)
- bool al_get_timer_started(const ALLEGRO_TIMER *timer)
- void al_destroy_timer(ALLEGRO_TIMER *timer)
- int64_t al_get_timer_count(const ALLEGRO_TIMER *timer)
- void al_set_timer_count(ALLEGRO_TIMER *timer, int64_t new_count)
- void al_add_timer_count(ALLEGRO_TIMER *timer, int64_t diff)
- double al_get_timer_speed(const ALLEGRO_TIMER *timer)
- void al_set_timer_speed(ALLEGRO_TIMER *timer, double new_speed_secs)
- ALLEGRO_EVENT_SOURCE *al_get_timer_event_source(ALLEGRO_TIMER *timer)
- void al_copy_transform(ALLEGRO_TRANSFORM *dest, const ALLEGRO_TRANSFORM *src)
- void al_use_transform(const ALLEGRO_TRANSFORM *trans)
- const ALLEGRO_TRANSFORM *al_get_current_transform(void)
- void al_invert_transform(ALLEGRO_TRANSFORM *trans)
- int al_check_inverse(const ALLEGRO_TRANSFORM *trans, float tol)
- void al_identity_transform(ALLEGRO_TRANSFORM *trans)
- void al_build_transform(ALLEGRO_TRANSFORM *trans, float x, float y, float sx, float sy, float theta)
- void al_translate_transform(ALLEGRO_TRANSFORM *trans, float x, float y)
- void al_rotate_transform(ALLEGRO_TRANSFORM *trans, float theta)
- void al_scale_transform(ALLEGRO_TRANSFORM *trans, float sx, float sy)
- void al_transform_coordinates(const ALLEGRO_TRANSFORM *trans, float *x, float *y)
- void al_compose_transform(ALLEGRO_TRANSFORM *trans, const ALLEGRO_TRANSFORM *other)
- ALLEGRO_USTR *al_ustr_new(const char *s)
- ALLEGRO_USTR *al_ustr_new_from_buffer(const char *s, size_t size)
- void al_ustr_free(ALLEGRO_USTR *us)
- const char *al_cstr(const ALLEGRO_USTR *us)
- void al_ustr_to_buffer(const ALLEGRO_USTR *us, char *buffer, int size)
- char *al_cstr_dup(const ALLEGRO_USTR *us)
- ALLEGRO_USTR *al_ustr_dup(const ALLEGRO_USTR *us)
- ALLEGRO_USTR *al_ustr_dup_substr(const ALLEGRO_USTR *us, int start_pos, int end_pos)
- const ALLEGRO_USTR *al_ustr_empty_string(void)
- const ALLEGRO_USTR *al_ref_cstr(ALLEGRO_USTR_INFO *info, const char *s)
- const ALLEGRO_USTR *al_ref_buffer(ALLEGRO_USTR_INFO *info, const char *s, size_t size)
- const ALLEGRO_USTR *al_ref_ustr(ALLEGRO_USTR_INFO *info, const ALLEGRO_USTR *us, int start_pos, int end_pos)
- size_t al_ustr_size(const ALLEGRO_USTR *us)

- `size_t al_ustr_length(const ALLEGRO_USTR *us)`
- `int al_ustr_offset(const ALLEGRO_USTR *us, int index)`
- `bool al_ustr_next(const ALLEGRO_USTR *us, int *pos)`
- `bool al_ustr_prev(const ALLEGRO_USTR *us, int *pos)`
- `int32_t al_ustr_get(const ALLEGRO_USTR *ub, int pos)`
- `int32_t al_ustr_get_next(const ALLEGRO_USTR *us, int *pos)`
- `int32_t al_ustr_prev_get(const ALLEGRO_USTR *us, int *pos)`
- `bool al_ustr_insert(ALLEGRO_USTR *us1, int pos, const ALLEGRO_USTR *us2)`
- `bool al_ustr_insert_cstr(ALLEGRO_USTR *us, int pos, const char *s)`
- `size_t al_ustr_insert_chr(ALLEGRO_USTR *us, int pos, int32_t c)`
- `bool al_ustr_append(ALLEGRO_USTR *us1, const ALLEGRO_USTR *us2)`
- `bool al_ustr_append_cstr(ALLEGRO_USTR *us, const char *s)`
- `size_t al_ustr_append_chr(ALLEGRO_USTR *us, int32_t c)`
- `bool al_ustr_remove_chr(ALLEGRO_USTR *us, int pos)`
- `bool al_ustr_remove_range(ALLEGRO_USTR *us, int start_pos, int end_pos)`
- `bool al_ustr_truncate(ALLEGRO_USTR *us, int start_pos)`
- `bool al_ustr_ltrim_ws(ALLEGRO_USTR *us)`
- `bool al_ustr_rtrim_ws(ALLEGRO_USTR *us)`
- `bool al_ustr_trim_ws(ALLEGRO_USTR *us)`
- `bool al_ustr_assign(ALLEGRO_USTR *us1, const ALLEGRO_USTR *us2)`
- `bool al_ustr_assign_substr(ALLEGRO_USTR *us1, const ALLEGRO_USTR *us2,int start_pos, int end_pos)`
- `bool al_ustr_assign_cstr(ALLEGRO_USTR *us1, const char *s)`
- `size_t al_ustr_set_chr(ALLEGRO_USTR *us, int start_pos, int32_t c)`
- `bool al_ustr_replace_range(ALLEGRO_USTR *us1, int start_pos1, int end_pos1,const ALLEGRO_USTR *us2)`
- `int al_ustr_find_chr(const ALLEGRO_USTR *us, int start_pos, int32_t c)`
- `int al_ustr_rfind_chr(const ALLEGRO_USTR *us, int end_pos, int32_t c)`
- `int al_ustr_find_set(const ALLEGRO_USTR *us, int start_pos,const ALLEGRO_USTR *accept)`
- `int al_ustr_find_set_cstr(const ALLEGRO_USTR *us, int start_pos,const char *accept)`
- `int al_ustr_find_cset(const ALLEGRO_USTR *us, int start_pos,const ALLEGRO_USTR *reject)`
- `int al_ustr_find_cset_cstr(const ALLEGRO_USTR *us, int start_pos,const char *reject)`
- `int al_ustr_find_str(const ALLEGRO_USTR *haystack, int start_pos,const ALLEGRO_USTR *needle)`
- `int al_ustr_find_cstr(const ALLEGRO_USTR *haystack, int start_pos,const char *needle)`
- `int al_ustr_rfind_str(const ALLEGRO_USTR *haystack, int end_pos,const ALLEGRO_USTR *needle)`
- `int al_ustr_rfind_cstr(const ALLEGRO_USTR *haystack, int end_pos,const char *needle)`
- `bool al_ustr_find_replace(ALLEGRO_USTR *us, int start_pos,const ALLEGRO_USTR *find, const ALLEGRO_USTR *replace)`

- `bool al_ustr_find_replace_cstr(ALLEGRO_USTR *us, int start_pos,const char *find, const char *replace)`
- `int al_ustr_compare(const ALLEGRO_USTR *us1, const ALLEGRO_USTR *us2)`
- `int al_ustr_ncompare(const ALLEGRO_USTR *us1, const ALLEGRO_USTR *us2, int n)`
- `bool al_ustr_equal(const ALLEGRO_USTR *us1, const ALLEGRO_USTR *us2)`
- `bool al_ustr_has_prefix(const ALLEGRO_USTR *us1, const ALLEGRO_USTR *us2)`
- `bool al_ustr_has_prefix_cstr(const ALLEGRO_USTR *us1, const char *s2)`
- `bool al_ustr_has_suffix(const ALLEGRO_USTR *us1, const ALLEGRO_USTR *us2)`
- `bool al_ustr_has_suffix_cstr(const ALLEGRO_USTR *us1, const char *s2)`
- `ALLEGRO_USTR *al_ustr_new_from_utf16(uint16_t const *s)`
- `size_t al_ustr_size_utf16(const ALLEGRO_USTR *us)`
- `size_t al_ustr_encode_utf16(const ALLEGRO_USTR *us, uint16_t *s,size_t n)`
- `size_t al_utf8_width(int c)`
- `size_t al_utf8_encode(char s[], int32_t c)`
- `size_t al_utf16_width(int c)`
- `LPDIRECT3DDEVICE9 al_get_d3d_device(ALLEGRO_DISPLAY *display)`
- `LPDIRECT3DTEXTURE9 al_get_d3d_system_texture(ALLEGRO_BITMAP *bitmap)`
- `LPDIRECT3DTEXTURE9 al_get_d3d_video_texture(ALLEGRO_BITMAP *bitmap)`
- `bool al_have_d3d_non_pow2_texture_support(void)`
- `bool al_have_d3d_non_square_texture_support(void)`
- `void al_get_d3d_texture_position(ALLEGRO_BITMAP *bitmap, int *u, int *v)`
- `bool al_is_d3d_device_lost(ALLEGRO_DISPLAY *display)`
- `ALLEGRO_OGL_EXT_LIST *al_get_opengl_extension_list(void)`
- `void *al_get_opengl_proc_address(const char *name)`
- `GLuint al_get_opengl_texture(ALLEGRO_BITMAP *bitmap)`
- `void al_get_opengl_texture_size(ALLEGRO_BITMAP *bitmap, int *w, int *h)`
- `void al_get_opengl_texture_position(ALLEGRO_BITMAP *bitmap, int *u, int *v)`
- `GLuint al_get_opengl_fbo(ALLEGRO_BITMAP *bitmap)`
- `void al_remove_opengl_fbo(ALLEGRO_BITMAP *bitmap)`
- `bool al_have_opengl_extension(const char *extension);`
- `uint32_t al_get_opengl_version(void)`
- `int al_get_opengl_variant(void)`
- `void al_set_current_opengl_context(ALLEGRO_DISPLAY *display)`
- `bool al_install_audio(void)`
- `void al_uninstall_audio(void)`
- `bool al_is_audio_installed(void)`
- `bool al_reserve_samples(int reserve_samples)`

- `uint32_t al_get_allegro_audio_version(void)`
- `size_t al_get_audio_depth_size(ALLEGRO_AUDIO_DEPTH depth)`
- `size_t al_get_channel_count(ALLEGRO_CHANNEL_CONF conf)`
- `ALLEGRO_VOICE *al_create_voice(unsigned int freq, ALLEGRO_AUDIO_DEPTH depth, ALLEGRO_CHANNEL_CONF chan_conf)`
- `void al_destroy_voice(ALLEGRO_VOICE *voice)`
- `void al_detach_voice(ALLEGRO_VOICE *voice)`
- `bool al_attach_audio_stream_to_voice(ALLEGRO_AUDIO_STREAM *stream, ALLEGRO_VOICE *voice)`
- `bool al_attach_mixer_to_voice(ALLEGRO_MIXER *mixer, ALLEGRO_VOICE *voice)`
- `bool al_attach_sample_instance_to_voice(ALLEGRO_SAMPLE_INSTANCE *spl, ALLEGRO_VOICE *voice)`
- `unsigned int al_get_voice_frequency(const ALLEGRO_VOICE *voice)`
- `ALLEGRO_CHANNEL_CONF al_get_voice_channels(const ALLEGRO_VOICE *voice)`
- `ALLEGRO_AUDIO_DEPTH al_get_voice_depth(const ALLEGRO_VOICE *voice)`
- `bool al_get_voice_playing(const ALLEGRO_VOICE *voice)`
- `bool al_set_voice_playing(ALLEGRO_VOICE *voice, bool val)`
- `unsigned int al_get_voice_position(const ALLEGRO_VOICE *voice)`
- `bool al_set_voice_position(ALLEGRO_VOICE *voice, unsigned int val)`
- `ALLEGRO_SAMPLE *al_create_sample(void *buf, unsigned int samples, unsigned int freq, ALLEGRO_AUDIO_DEPTH depth, ALLEGRO_CHANNEL_CONF chan_conf, bool free_buf)`
- `void al_destroy_sample(ALLEGRO_SAMPLE *spl)`
- `bool al_play_sample(ALLEGRO_SAMPLE *spl, float gain, float pan, float speed, int loop, ALLEGRO_SAMPLE_ID *ret_id)`
- `void al_stop_sample(ALLEGRO_SAMPLE_ID *spl_id)`
- `void al_stop_samples(void)`
- `ALLEGRO_CHANNEL_CONF al_get_sample_channels(const ALLEGRO_SAMPLE *spl)`
- `ALLEGRO_AUDIO_DEPTH al_get_sample_depth(const ALLEGRO_SAMPLE *spl)`
- `unsigned int al_get_sample_frequency(const ALLEGRO_SAMPLE *spl)`
- `unsigned int al_get_sample_length(const ALLEGRO_SAMPLE *spl)`
- `void *al_get_sample_data(const ALLEGRO_SAMPLE *spl)`
- `ALLEGRO_SAMPLE_INSTANCE *al_create_sample_instance(ALLEGRO_SAMPLE *sample_data)`
- `void al_destroy_sample_instance(ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_play_sample_instance(ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_stop_sample_instance(ALLEGRO_SAMPLE_INSTANCE *spl)`
- `ALLEGRO_CHANNEL_CONF al_get_sample_instance_channels(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `ALLEGRO_AUDIO_DEPTH al_get_sample_instance_depth(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `unsigned int al_get_sample_instance_frequency(const ALLEGRO_SAMPLE_INSTANCE *spl)`

- `unsigned int al_get_sample_instance_length(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_set_sample_instance_length(ALLEGRO_SAMPLE_INSTANCE *spl,unsigned int val)`
- `unsigned int al_get_sample_instance_position(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_set_sample_instance_position(ALLEGRO_SAMPLE_INSTANCE *spl,unsigned int val)`
- `float al_get_sample_instance_speed(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_set_sample_instance_speed(ALLEGRO_SAMPLE_INSTANCE *spl, float val)`
- `float al_get_sample_instance_gain(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_set_sample_instance_gain(ALLEGRO_SAMPLE_INSTANCE *spl, float val)`
- `float al_get_sample_instance_pan(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_set_sample_instance_pan(ALLEGRO_SAMPLE_INSTANCE *spl, float val)`
- `float al_get_sample_instance_time(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `ALLEGRO_PLAYMODE al_get_sample_instance_playmode(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_set_sample_instance_playmode(ALLEGRO_SAMPLE_INSTANCE *spl,ALLEGRO_PLAYMODE val)`
- `bool al_get_sample_instance_playing(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_set_sample_instance_playing(ALLEGRO_SAMPLE_INSTANCE *spl, bool val)`
- `bool al_get_sample_instance_attached(const ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_detach_sample_instance(ALLEGRO_SAMPLE_INSTANCE *spl)`
- `ALLEGRO_SAMPLE *al_get_sample(ALLEGRO_SAMPLE_INSTANCE *spl)`
- `bool al_set_sample(ALLEGRO_SAMPLE_INSTANCE *spl, ALLEGRO_SAMPLE *data)`
- `ALLEGRO_MIXER *al_create_mixer(unsigned int freq,ALLEGRO_AUDIO_DEPTH depth, ALLEGRO_CHANNEL_CONF chan_conf)`
- `void al_destroy_mixer(ALLEGRO_MIXER *mixer)`
- `ALLEGRO_MIXER *al_get_default_mixer(void)`
- `bool al_set_default_mixer(ALLEGRO_MIXER *mixer)`
- `bool al_restore_default_mixer(void)`
- `bool al_attach_mixer_to_mixer(ALLEGRO_MIXER *stream, ALLEGRO_MIXER *mixer)`
- `bool al_attach_sample_instance_to_mixer(ALLEGRO_SAMPLE_INSTANCE *spl,ALLEGRO_MIXER *mixer)`
- `bool al_attach_audio_stream_to_mixer(ALLEGRO_AUDIO_STREAM *stream, ALLEGRO_MIXER *mixer)`
- `unsigned int al_get_mixer_frequency(const ALLEGRO_MIXER *mixer)`
- `bool al_set_mixer_frequency(ALLEGRO_MIXER *mixer, unsigned int val)`
- `ALLEGRO_CHANNEL_CONF al_get_mixer_channels(const ALLEGRO_MIXER *mixer)`
- `ALLEGRO_AUDIO_DEPTH al_get_mixer_depth(const ALLEGRO_MIXER *mixer)`
- `float al_get_mixer_gain(const ALLEGRO_MIXER *mixer)`
- `bool al_set_mixer_gain(ALLEGRO_MIXER *mixer, float new_gain)`
- `ALLEGRO_MIXER_QUALITY al_get_mixer_quality(const ALLEGRO_MIXER *mixer)`

- `bool al_set_mixer_quality(ALLEGRO_MIXER *mixer, ALLEGRO_MIXER_QUALITY new_quality)`
- `bool al_get_mixer_playing(const ALLEGRO_MIXER *mixer)`
- `bool al_set_mixer_playing(ALLEGRO_MIXER *mixer, bool val)`
- `bool al_get_mixer_attached(const ALLEGRO_MIXER *mixer)`
- `bool al_detach_mixer(ALLEGRO_MIXER *mixer)`
- `void al_destroy_audio_stream(ALLEGRO_AUDIO_STREAM *stream)`
- `ALLEGRO_EVENT_SOURCE *al_get_audio_stream_event_source(ALLEGRO_AUDIO_STREAM *stream)`
- `void al_drain_audio_stream(ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_rewind_audio_stream(ALLEGRO_AUDIO_STREAM *stream)`
- `unsigned int al_get_audio_stream_frequency(const ALLEGRO_AUDIO_STREAM *stream)`
- `ALLEGRO_CHANNEL_CONF al_get_audio_stream_channels(const ALLEGRO_AUDIO_STREAM *stream)`
- `ALLEGRO_AUDIO_DEPTH al_get_audio_stream_depth(const ALLEGRO_AUDIO_STREAM *stream)`
- `unsigned int al_get_audio_stream_length(const ALLEGRO_AUDIO_STREAM *stream)`
- `float al_get_audio_stream_speed(const ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_set_audio_stream_speed(ALLEGRO_AUDIO_STREAM *stream, float val)`
- `float al_get_audio_stream_gain(const ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_set_audio_stream_gain(ALLEGRO_AUDIO_STREAM *stream, float val)`
- `float al_get_audio_stream_pan(const ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_set_audio_stream_pan(ALLEGRO_AUDIO_STREAM *stream, float val)`
- `bool al_get_audio_stream_playing(const ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_set_audio_stream_playing(ALLEGRO_AUDIO_STREAM *stream, bool val)`
- `ALLEGRO_PLAYMODE al_get_audio_stream_playmode(const ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_set_audio_stream_playmode(ALLEGRO_AUDIO_STREAM *stream, ALLEGRO_PLAYMODE val)`
- `bool al_get_audio_stream_attached(const ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_detach_audio_stream(ALLEGRO_AUDIO_STREAM *stream)`
- `void *al_get_audio_stream_fragment(const ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_set_audio_stream_fragment(ALLEGRO_AUDIO_STREAM *stream, void *val)`
- `unsigned int al_get_audio_stream_fragments(const ALLEGRO_AUDIO_STREAM *stream)`
- `unsigned int al_get_available_audio_stream_fragments(const ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_seek_audio_stream_secs(ALLEGRO_AUDIO_STREAM *stream, double time)`
- `double al_get_audio_stream_position_secs(ALLEGRO_AUDIO_STREAM *stream)`
- `double al_get_audio_stream_length_secs(ALLEGRO_AUDIO_STREAM *stream)`
- `bool al_set_audio_stream_loop_secs(ALLEGRO_AUDIO_STREAM *stream, double start, double end)`
- `ALLEGRO_SAMPLE *al_load_sample(const char *filename)`
- `ALLEGRO_SAMPLE al_load_sample_f(ALLEGRO_FILE fp, const char *ident)`

- ALLEGRO_AUDIO_STREAM *al_load_audio_stream(const char *filename, size_t buffer_count, unsigned int samples)
- ALLEGRO_AUDIO_STREAM al_load_audio_stream_f(ALLEGRO_FILE fp, const char *ident, size_t buffer_count, unsigned int samples)
- bool al_save_sample(const char *filename, ALLEGRO_SAMPLE *spl)
- bool al_save_sample_f(ALLEGRO_FILE *fp, const char *ident, ALLEGRO_SAMPLE *spl)
- bool al_init_acodec_addon(void)
- uint32_t al_get_allegro_acodec_version(void)
- ALLEGRO_COLOR al_color_cmyk(float c, float m, float y, float k)
- void al_color_cmyk_to_rgb(float cyan, float magenta, float yellow, float key, float *red, float *green, float *blue)
- ALLEGRO_COLOR al_color_hsl(float h, float s, float l)
- void al_color_hsl_to_rgb(float hue, float saturation, float lightness, float *red, float *green, float *blue)
- ALLEGRO_COLOR al_color_hsv(float h, float s, float v)
- void al_color_hsv_to_rgb(float hue, float saturation, float value, float *red, float *green, float *blue)
- ALLEGRO_COLOR al_color_html(char const *string)
- void al_color_html_to_rgb(char const *string, float *red, float *green, float *blue)
- void al_color_rgb_to_html(float red, float green, float blue, char *string)
- ALLEGRO_COLOR al_color_name(char const *name)
- bool al_color_name_to_rgb(char const *name, float *r, float *g, float *b)
- void al_color_rgb_to_cmyk(float red, float green, float blue, float *cyan, float *magenta, float *yellow, float *key)
- void al_color_rgb_to_hsl(float red, float green, float blue, float *hue, float *saturation, float *lightness)
- void al_color_rgb_to_hsv(float red, float green, float blue, float *hue, float *saturation, float *value)
- char const *al_color_rgb_to_name(float r, float g, float b)
- void al_color_rgb_to_yuv(float red, float green, float blue, float *y, float *u, float *v)
- ALLEGRO_COLOR al_color_yuv(float y, float u, float v)
- void al_color_yuv_to_rgb(float y, float u, float v, float *red, float *green, float *blue)
- uint32_t al_get_allegro_color_version(void)
- void al_init_font_addon(void)
- void al_shutdown_font_addon(void)
- ALLEGRO_FONT *al_load_font(char const *filename, int size, int flags)
- void al_destroy_font(ALLEGRO_FONT *f)
- int al_get_font_ascent(const ALLEGRO_FONT *f)
- int al_get_font_descent(const ALLEGRO_FONT *f)
- int al_get_text_width(const ALLEGRO_FONT *f, const char *str)
- int al_get_ustr_width(const ALLEGRO_FONT *f, ALLEGRO_USTR const *ustr)
- void al_draw_text(const ALLEGRO_FONT *font, ALLEGRO_COLOR color, float x, float y, int flags, char const *text)

- void al_draw_ustr(const ALLEGRO_FONT *font,ALLEGRO_COLOR color, float x, float y, int flags,const ALLEGRO_USTR *ustr)
- void al_draw_justified_text(const ALLEGRO_FONT *font,ALLEGRO_COLOR color, float x1, float x2, float y, float diff, int flags, const char *text)
- void al_draw_justified_ustr(const ALLEGRO_FONT *font,ALLEGRO_COLOR color, float x1, float x2, float y, float diff, int flags, const ALLEGRO_USTR *ustr)
- void al_get_text_dimensions(const ALLEGRO_FONT *f,char const *text,int *bbx, int *bby, int *bbw, int *bbh)
- void al_get_ustr_dimensions(const ALLEGRO_FONT *f,ALLEGRO_USTR const *ustr,int *bbx, int *bby, int *bbw, int *bbh)
- uint32_t al_get_allegro_font_version(void)
- ALLEGRO_FONT *al_grab_font_from_bitmap(ALLEGRO_BITMAP *bmp,int ranges_n, const int ranges[])
- ALLEGRO_FONT *al_load_bitmap_font(const char *fname)
- ALLEGRO_FONT *al_create_builtin_font(void)
- bool al_init_ttf_addon(void)
- void al_shutdown_ttf_addon(void)
- ALLEGRO_FONT *al_load_ttf_font(char const *filename, int size, int flags)
- ALLEGRO_FONT *al_load_ttf_font_f(ALLEGRO_FILE *file,char const *filename, int size, int flags)
- ALLEGRO_FONT *al_load_ttf_font_stretch(char const *filename, int w, int h,int flags)
- ALLEGRO_FONT *al_load_ttf_font_stretch_f(ALLEGRO_FILE *file,char const *filename, int w, int h, int flags)
- uint32_t al_get_allegro_ttf_version(void)
- bool al_init_image_addon(void)
- void al_shutdown_image_addon(void)
- uint32_t al_get_allegro_image_version(void)
- ALLEGRO_FILE *al_open_memfile(void *mem, int64_t size, const char *mode)
- uint32_t al_get_allegro_memfile_version(void)
- bool al_init_native_dialog_addon(void)
- void al_shutdown_native_dialog_addon(void)
- ALLEGRO_FILECHOOSEN *al_create_native_file_dialog(char const *initial_path,char const *title,char const *patterns,int mode)
- bool al_show_native_file_dialog(ALLEGRO_DISPLAY *display,ALLEGRO_FILECHOOSEN *dialog)
- int al_get_native_file_dialog_count(const ALLEGRO_FILECHOOSEN *dialog)
- const char *al_get_native_file_dialog_path(const ALLEGRO_FILECHOOSEN *dialog, size_t i)
- void al_destroy_native_file_dialog(ALLEGRO_FILECHOOSEN *dialog)
- int al_show_native_message_box(ALLEGRO_DISPLAY *display,char const *title, char const *heading, char const *text,char const *buttons, int flags)
- ALLEGRO_TEXTLOG *al_open_native_text_log(char const *title, int flags)
- void al_close_native_text_log(ALLEGRO_TEXTLOG *textlog)

- `uint32_t al_get_allegro_native_dialog_version(void)`
- `void al_set_physfs_file_interface(void)`
- `uint32_t al_get_allegro_physfs_version(void)`
- `uint32_t al_get_allegro_primitives_version(void)`
- `bool al_init_primitives_addon(void)`
- `void al_shutdown_primitives_addon(void)`
- `void al_draw_line(float x1, float y1, float x2, float y2, ALLEGRO_COLOR color, float thickness)`
- `void al_draw_triangle(float x1, float y1, float x2, float y2, float x3, float y3, ALLEGRO_COLOR color, float thickness)`
- `void al_draw_filled_triangle(float x1, float y1, float x2, float y2, float x3, float y3, ALLEGRO_COLOR color)`
- `void al_draw_rectangle(float x1, float y1, float x2, float y2, ALLEGRO_COLOR color, float thickness)`
- `void al_draw_filled_rectangle(float x1, float y1, float x2, float y2, ALLEGRO_COLOR color)`
- `void al_draw_rounded_rectangle(float x1, float y1, float x2, float y2, float rx, float ry, ALLEGRO_COLOR color, float thickness)`
- `void al_draw_filled_rounded_rectangle(float x1, float y1, float x2, float y2, float rx, float ry, ALLEGRO_COLOR color)`
- `void al_calculate_arc(float* dest, int stride, float cx, float cy, float rx, float ry, float start_theta, float delta_theta, float thickness, int num_points)`
- `void al_draw_pieslice(float cx, float cy, float r, float start_theta, float delta_theta, ALLEGRO_COLOR color, float thickness)`
- `void al_draw_filled_pieslice(float cx, float cy, float r, float start_theta, float delta_theta, ALLEGRO_COLOR color)`
- `void al_draw_ellipse(float cx, float cy, float rx, float ry, ALLEGRO_COLOR color, float thickness)`
- `void al_draw_filled_ellipse(float cx, float cy, float rx, float ry, ALLEGRO_COLOR color)`
- `void al_draw_circle(float cx, float cy, float r, ALLEGRO_COLOR color, float thickness)`
- `void al_draw_filled_circle(float cx, float cy, float r, ALLEGRO_COLOR color)`
- `void al_draw_arc(float cx, float cy, float r, float start_theta, float delta_theta, ALLEGRO_COLOR color, float thickness)`
- `void al_draw_elliptical_arc(float cx, float cy, float rx, float ry, float start_theta, float delta_theta, ALLEGRO_COLOR color, float thickness)`
- `void al_draw_ribbon(const float *points, int points_stride, ALLEGRO_COLOR color, float thickness, int num_segments)`
- `int al_draw_prim(const void* vtxs, const ALLEGRO_VERTEX_DECL* decl, ALLEGRO_BITMAP* texture, int start, int end, int type)`
- `int al_draw_indexed_prim(const void* vtxs, const ALLEGRO_VERTEX_DECL* decl, ALLEGRO_BITMAP* texture, const int* indices, int num_vtx, int type)`
- `ALLEGRO_VERTEX_DECL* al_create_vertex_decl(const ALLEGRO_VERTEX_ELEMENT* elements, int stride)`
- `void al_destroy_vertex_decl(ALLEGRO_VERTEX_DECL* decl)`
- `ALLEGRO_SHADER *al_create_shader(ALLEGRO_SHADER_PLATFORM platform)`

- `bool al_attach_shader_source(ALLEGRO_SHADER *shader, ALLEGRO_SHADER_TYPE type,const char *source)`
- `bool al_attach_shader_source_file(ALLEGRO_SHADER *shader,ALLEGRO_SHADER_TYPE type, const char *filename)`
- `bool al_build_shader(ALLEGRO_SHADER *shader)`
- `const char *al_get_shader_log(ALLEGRO_SHADER *shader)`
- `ALLEGRO_SHADER_PLATFORM al_get_shader_platform(ALLEGRO_SHADER *shader)`
- `bool al_use_shader(ALLEGRO_SHADER *shader)`
- `void al_destroy_shader(ALLEGRO_SHADER *shader)`
- `bool al_set_shader_sampler(const char *name,ALLEGRO_BITMAP *bitmap, int unit)`
- `bool al_set_shader_matrix(const char *name,const ALLEGRO_TRANSFORM *matrix)`
- `bool al_set_shader_int(const char *name, int i)`
- `bool al_set_shader_float(const char *name, float f)`
- `bool al_set_shader_bool(const char *name, bool b)`
- `bool al_set_shader_int_vector(const char *name,int num_components, const int *i, int num_elems)`
- `bool al_set_shader_float_vector(const char *name,int num_components, const float *f, int num_elems)`
- `char const *al_get_default_shader_source(ALLEGRO_SHADER_PLATFORM platform,ALLEGRO_SHADER_TYPE type)`

CHAPTER
EIGHTYFIVE

USING RINGLIBSDL

In this chapter we will learn about using RingLibSDL to create games based on the LibSDL, SDLImage, SDLTTF and SDLMixer libraries.

Tip: RingLibSDL is not distributed with the binary releases for desktop which uses RingAllegro

Note: To use RingLibSDL, Check ring/android/ringlibsdl folder.

85.1 Create Window

Example:

```
Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)
win = SDL_CreateWindow("Hello World!", 100, 100, 640, 480, SDL_WINDOW_SHOWN)
SDL_Delay(2000)
SDL_DestroyWindow(win)
SDL_Quit()
```

85.2 Display Image

Example:

```
Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)
win = SDL_CreateWindow("Hello World!", 100, 100, 640, 480, SDL_WINDOW_SHOWN)
ren = SDL_CreateRenderer(win, -1, SDL_RENDERER_ACCELERATED | SDL_RENDERER_PRESENTVSYNC )
bmp = SDL_LoadBMP("hello.bmp")
tex = SDL_CreateTextureFromSurface(ren,bmp)
SDL_FreeSurface(bmp)
SDL_RenderClear(ren)
SDL_RenderCopy2(ren,tex)
SDL_RenderPresent(ren)
```

(continues on next page)

(continued from previous page)

```
SDL_Delay(2000)
SDL_DestroyTexture(tex)
SDL_DestroyRenderer(ren)
SDL_DestroyWindow(win)
SDL_Quit()
```

85.3 Switch between two images

Example:

```
Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)
win = SDL_CreateWindow("Hello World!", 100, 100, 640, 480, SDL_WINDOW_SHOWN)
ren = SDL_CreateRenderer(win, -1, SDL_RENDERER_ACCELERATED | SDL_RENDERER_PRESENTVSYNC )
bmp = SDL_LoadBMP("hello.bmp")
tex = SDL_CreateTextureFromSurface(ren,bmp)
SDL_FreeSurface(bmp)
bmp = SDL_LoadBMP("hello2.bmp")
tex2 = SDL_CreateTextureFromSurface(ren,bmp)
SDL_FreeSurface(bmp)

for x = 1 to 10 showtex(tex) showtex(tex2) next

SDL_DestroyTexture(tex)
SDL_DestroyTexture(tex2)
SDL_DestroyRenderer(ren)
SDL_DestroyWindow(win)
SDL_Quit()

func showtex oTex
    SDL_RenderClear(ren)
    SDL_RenderCopy2(ren,oTex)
    SDL_RenderPresent(ren)
    SDL_Delay(200)
```

85.4 Draw Rectangle

Example:

```
Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)
win = SDL_CreateWindow("Hello World!", 100, 100, 640, 480, SDL_WINDOW_SHOWN)
ren = SDL_CreateRenderer(win, -1, SDL_RENDERER_ACCELERATED | SDL_RENDERER_PRESENTVSYNC )
SDL_RenderClear(ren)
rect = sdl_new_sdl_rect()
sdl_set_sdl_rect_x(rect,10)
```

(continues on next page)

(continued from previous page)

```
sdl_set_sdl_rect_y(rect, 10)
sdl_set_sdl_rect_w(rect, 100)
sdl_set_sdl_rect_h(rect, 100)
SDL_SetRenderDrawColor(ren, 255, 255, 255, 255)
SDL_RenderDrawRect(ren, rect)
sdl_destroy_sdl_rect(rect)
SDL_RenderPresent(ren)
SDL_Delay(2000)
SDL_DestroyRenderer(ren)
SDL_DestroyWindow(win)
SDL_Quit()
```

85.5 Display PNG Images

Example:

```
Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)
win = SDL_CreateWindow("Hello World!", 100, 100, 640, 480, SDL_WINDOW_SHOWN)
ren = SDL_CreateRenderer(win, -1, SDL_RENDERER_ACCELERATED | SDL_RENDERER_PRESENTVSYNC )
bmp = IMG_Load("hello3.png")
tex = SDL_CreateTextureFromSurface(ren, bmp)
SDL_FreeSurface(bmp)
SDL_RenderClear(ren)
SDL_RenderCopy2(ren, tex)
SDL_RenderPresent(ren)
SDL_Delay(2000)
SDL_DestroyTexture(tex)
SDL_DestroyRenderer(ren)
SDL_DestroyWindow(win)
SDL_Quit()
```

85.6 Use TTF Fonts

Example:

```
Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)
win = SDL_CreateWindow("Hello World!", 100, 100, 640, 480, SDL_WINDOW_SHOWN)
ren = SDL_CreateRenderer(win, -1, SDL_RENDERER_ACCELERATED | SDL_RENDERER_PRESENTVSYNC )
SDL_RenderClear(ren)

TTF_Init()
font = TTF_OpenFont("pirulen.ttf", 16)
color = sdl_new_sdl_color()
sdl_set_sdl_color_r(color, 0)
```

(continues on next page)

(continued from previous page)

```
sdl_set_sdl_color_g(color, 255)
sdl_set_sdl_color_b(color, 0)
text = TTF_RenderText_Solid(font, "Welcome to the Ring language", color)
surface = SDL_GetWindowSurface(win)
SDL_BlitSurface(text, NULL, surface, NULL)
SDL_UpdateWindowSurface(win)
SDL_Delay(2000)

SDL_Destroy_SDL_Color(color)
SDL_FreeSurface(text)
TTF_CloseFont(font)
SDL_DestroyRenderer(ren)
SDL_DestroyWindow(win)
SDL_Quit()
```

85.7 Display Transparent Images

Example:

```
Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)

flags = IMG_INIT_JPG | IMG_INIT_PNG
IMG_Init(flags)

win = SDL_CreateWindow("Hello World!", 100, 100, 800, 600, SDL_WINDOW_SHOWN)
ren = SDL_CreateRenderer(win, -1, SDL_RENDERER_ACCELERATED | SDL_RENDERER_PRESENTVSYNC )

bmp = IMG_Load("stars.jpg")
tex = SDL_CreateTextureFromSurface(ren, bmp)
SDL_FreeSurface(bmp)
SDL_RenderClear(ren)
SDL_RenderCopy(ren, tex, NULL, NULL)
SDL_DestroyTexture(tex)

bmp = IMG_Load("player.png")
# Image - Set Transparent color (white)
myformat = sdl_get_sdl_surface_format(bmp)
white = SDL_MapRGB(myformat, 255, 255, 255)
SDL_SetColorKey(bmp, SDL_TRUE, white)

tex = SDL_CreateTextureFromSurface(ren, bmp)
SDL_FreeSurface(bmp)
rect = sdl_new_sdl_rect()
sdl_set_sdl_rect_x(rect, 0)
sdl_set_sdl_rect_y(rect, 0)
sdl_set_sdl_rect_w(rect, 100)
sdl_set_sdl_rect_h(rect, 100)
SDL_RenderCopy(ren, tex, NULL, rect)
```

(continues on next page)

(continued from previous page)

```

SDL_SetTextureBlendMode(tex, 2)
SDL_SetTextureAlphaMod(tex, 255)
sdl_set_sdl_rect_x(rect, 200)
sdl_set_sdl_rect_y(rect, 200)
sdl_set_sdl_rect_w(rect, 100)
sdl_set_sdl_rect_h(rect, 100)
SDL_RenderCopy(ren, tex, NULL, rect)

SDL_DestroyTexture(tex)
SDL_Destroy	SDL_Rect(rect)

SDL_RenderPresent(ren)
SDL_Delay(2000)
SDL_DestroyRenderer(ren)
SDL_DestroyWindow(win)
SDL_Quit()

```

85.8 Close Window Event

Example:

```

Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)
win = SDL_CreateWindow("Hello World!", 100, 100, 640, 480, SDL_WINDOW_SHOWN)

myevent = sdl_new_sdl_event()
while true
    thevent = sdl_pollevent(myevent)
    switch sdl_get_sdl_event_type(myevent)
        on sdl_get_sdl_quit()
            exit
        on sdl_get_sdl_keydown()
            Key = SDL_GET_SDL_Event_key_keysym_sym(myevent)
            if key = 27 exit ok

    off
end

SDL_DestroyWindow(win)
SDL_Quit()

```

85.9 Mouse Events

Example:

```

Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)

win = SDL_CreateWindow("Mouse Events ", 100, 100, 640, 480, SDL_WINDOW_SHOWN)

TTF_Init()
font = TTF_OpenFont("pirulen.ttf", 16)
color = sdl_new_sdl_color()
sdl_set_sdl_color_r(color,0)
sdl_set_sdl_color_g(color,255)
sdl_set_sdl_color_b(color,0)

surface = SDL_GetWindowSurface(win)

myevent = sdl_new_sdl_event()
while true
    cMsg = ""
    sdl_pollevent(myevent)
    switch sdl_get_sdl_event_type(myevent)
        on SDL_QUIT
            exit
        on SDL_KEYDOWN
            Key = SDL_GET_SDL_Event_key_keysym_sym(myevent)
            if key = 27 exit ok
        on SDL_MOUSEBUTTONDOWN
            if sdl_get_Sdl_Event_button_button(myevent) = SDL_BUTTON_LEFT
                SDL_SETWINDOWTITLE(win, " Button_Left_Down " )
            but sdl_get_Sdl_Event_button_button(myevent) = SDL_BUTTON_MIDDLE
                SDL_SETWINDOWTITLE(win, " Button_Middle_Down " )
            but sdl_get_Sdl_Event_button_button(myevent) = SDL_BUTTON_RIGHT
                SDL_SETWINDOWTITLE(win, " Button_Right_Down " )
            ok
        on SDL_MOUSEMOTION
            sdl_fillrect(surface,NULL,0)
            if sdl_get_sdl_event_motion_xrel(myevent) < 0
                cMsg += " Left "
            else
                cMsg += " Right "
            ok
            if sdl_get_sdl_event_motion_yrel(myevent) < 0
                cMsg += " Up "
            else
                cMsg += " Down "
            ok
            cMsg += " x = " + sdl_get_sdl_event_motion_x(myevent)
            cMsg += " y = " + sdl_get_sdl_event_motion_y(myevent)
            showmsg(cMsg)
    off

```

(continues on next page)

(continued from previous page)

```

end

SDL_Destroy	SDL_Color(Color)
TTF_CloseFont(font)
SDL_DestroyWindow(win)
SDL_Quit()

func showmsg mymsg
    text = TTF_RenderText_Solid(font,mymsg,color)
    SDL_BlitSurface(text, NULL, surface, NULL)
    SDL_UpdateWindowSurface(win)
    SDL_FreeSurface(text)

```

85.10 Play Sound

Example:

```

Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)
win = SDL_CreateWindow("Hello World!", 100, 100, 640, 480, SDL_WINDOW_SHOWN)
Mix_OpenAudio( 44100, MIX_DEFAULT_FORMAT , 2, 100000)
Mix_AllocateChannels(4)
sound = Mix_LoadWav( "sound.wav" )
Mix_VolumeChunk(sound,1)
Mix_PlayChannel(1,sound,0)

myevent = sdl_new_sdl_event()
while true
    thevent = sdl_pollevent(myevent)
    switch sdl_get_sdl_event_type(myevent)
        on sdl_get_sdl_quit()
            exit
        on sdl_get_sdl_keydown()
            Key = SDL_GET_SDL_Event_key_keysym_sym(myevent)
            if key = 27 exit ok
        off
end

Mix_FreeChunk( sound )
Mix_CloseAudio()
Mix_Quit()
SDL_DestroyWindow(win)
SDL_Quit()

```

RINGLIBSDL FUNCTIONS REFERENCE

86.1 Introduction

In this chapter we have a list of the supported functions by this extension

86.2 Reference

- MIX_DEFAULT_FORMAT
- SDL_QUIT
- SDL_BUTTON_LEFT
- SDL_BUTTON_MIDDLE
- SDL_BUTTON_RIGHT
- SDL_PRESSED
- SDL_RELEASED
- SDL_APP_TERMINATING
- SDL_APP_LOWMEMORY
- SDL_APP_WILLENTERBACKGROUND
- SDL_APP_DIDENTERBACKGROUND
- SDL_APP_WILLENTERFOREGROUND
- SDL_APP_DIDENTERFOREGROUND
- SDL_WINDOWEVENT
- SDL_SYSWMEVENT
- SDL_KEYDOWN
- SDL_KEYUP
- SDL_TEXTEDITING
- SDL_TEXTINPUT
- SDL_MOUSEMOTION
- SDL_MOUSEBUTTONDOWN
- SDL_MOUSEBUTTONUP

- `SDL_MOUSEWHEEL`
- `SDL_JOYAXISMOTION`
- `SDL_JOYBALLMOTION`
- `SDL_JOYHATMOTION`
- `SDL_JOYBUTTONDOWN`
- `SDL_JOYBUTTONUP`
- `SDL_JOYDEVICEADDED`
- `SDL_JOYDEVICEREMOVED`
- `SDL_CONTROLLERAXISMOTION`
- `SDL_CONTROLLERBUTTONDOWN`
- `SDL_CONTROLLERBUTTONUP`
- `SDL_CONTROLLERDEVICEADDED`
- `SDL_CONTROLLERDEVICEREMOVED`
- `SDL_CONTROLLERDEVICEREMAPPED`
- `SDL_FINGERDOWN`
- `SDL_FINGERUP`
- `SDL_FINGERMOTION`
- `SDL_DOLLARGESTURE`
- `SDL_DOLLARRECORD`
- `SDL_MULTIGESTURE`
- `SDL_CLIPBOARDUPDATE`
- `SDL_DROPFILE`
- `SDL_RENDER_TARGETS_RESET`
- `SDL_USEREVENT`
- `SDL_LASTEVENT`
- `SDL_NET_MAJOR_VERSION`
- `SDL_NET_MINOR_VERSION`
- `SDL_NET_PATCHLEVEL`
- `INADDR_ANY`
- `INADDR_NONE`
- `INADDR_BROADCAST`
- `SDLNET_MAX_UDPCHANNELS`
- `SDLNET_MAX_UDPADDRESSES`
- `SDLK_0`
- `SDLK_1`
- `SDLK_2`

- SDLK_3
- SDLK_4
- SDLK_5
- SDLK_6
- SDLK_7
- SDLK_8
- SDLK_9
- SDLK_a
- SDLK_AC_BACK
- SDLK_AC_BOOKMARKS
- SDLK_AC_FORWARD
- SDLK_AC_HOME
- SDLK_AC_REFRESH
- SDLK_AC_SEARCH
- SDLK_AC_STOP
- SDLK AGAIN
- SDLK_ALTERASE
- SDLK_QUOTE
- SDLK_APPLICATION
- SDLK_AUDIOMUTE
- SDLK_AUDIONEXT
- SDLK_AUDIOPLAY
- SDLK_AUDIOPREV
- SDLK_BRIGHTNESSDOWN
- SDLK_BRIGHTNESSUP
- SDLK_c
- SDLK_CALCULATOR
- SDLK_CANCEL
- SDLK_CAPSLOCK
- SDLK_CLEAR
- SDLK_CLEARAGAIN
- SDLK_COMMA
- SDLK COMPUTER
- SDLK_COPY
- SDLK_CRSEL
- SDLK_CURRENCYSUBUNIT

- SDLK_CURRENCYUNIT
- SDLK_CUT
- SDLK_d
- SDLK_DECIMALSEPARATOR
- SDLK_DELETE
- SDLK_DISPLAYSWITCH
- SDLK_DOWN
- SDLK_e
- SDLK_EJECT
- SDLK_END
- SDLK_EQUALS
- SDLK_ESCAPE
- SDLK_EXECUTE
- SDLK_EXSEL
- SDLK_f
- SDLK_F1
- SDLK_F10
- SDLK_F11
- SDLK_F12
- SDLK_F13
- SDLK_F14
- SDLK_F15
- SDLK_F16
- SDLK_F17
- SDLK_F18
- SDLK_F19
- SDLK_F2
- SDLK_F20
- SDLK_F21
- SDLK_F22
- SDLK_F23
- SDLK_F24
- SDLK_F3
- SDLK_F4
- SDLK_F5
- SDLK_F6

- SDLK_F7
- SDLK_F8
- SDLK_F9
- SDLK_FIND
- SDLK_g
- SDLK_BACKQUOTE
- SDLK_h
- SDLK_HELP
- SDLK_HOME
- SDLK_i
- SDLK_INSERT
- SDLK_j
- SDLK_k
- SDLK_KBDILLUMDOWN
- SDLK_KBDILLUMTOGGLE
- SDLK_KBDILLUMUP
- SDLK_KP_0
- SDLK_KP_00
- SDLK_KP_000
- SDLK_KP_1
- SDLK_KP_2
- SDLK_KP_3
- SDLK_KP_4
- SDLK_KP_5
- SDLK_KP_6
- SDLK_KP_7
- SDLK_KP_8
- SDLK_KP_9
- SDLK_KP_A
- SDLK_KP_AMPERSAND
- SDLK_KP_AT
- SDLK_KP_B
- SDLK_KP_BACKSPACE
- SDLK_KP_BINARY
- SDLK_KP_C
- SDLK_KP_CLEAR

- SDLK_KP_CLEARENTRY
- SDLK_KP_COLON
- SDLK_KP_COMMA
- SDLK_KP_D
- SDLK_KP_DBLAMPERSAND
- SDLK_KP_DBLVERTICALBAR
- SDLK_KP_DECIMAL
- SDLK_KP_DIVIDE
- SDLK_KP_E
- SDLK_KP_ENTER
- SDLK_KP_EQUALS
- SDLK_KP_EQUALSAS400
- SDLK_KP_EXCLAM
- SDLK_KP_F
- SDLK_KP_GREATER
- SDLK_KP_HASH
- SDLK_KP_HEXADECIMAL
- SDLK_KP_LEFTBRACE
- SDLK_KP_LEFTPAREN
- SDLK_KP_LESS
- SDLK_KP_MEMADD
- SDLK_KP_MEMCLEAR
- SDLK_KP_MEMDIVIDE
- SDLK_KP_MEMMULTIPLY
- SDLK_KP_MEMRECALL
- SDLK_KP_MEMSTORE
- SDLK_KP_MEMSUBTRACT
- SDLK_KP_MINUS
- SDLK_KP_MULTIPLY
- SDLK_KP_OCTAL
- SDLK_KP_PERCENT
- SDLK_KP_PERIOD
- SDLK_KP_PLUS
- SDLK_KP_PLUSMINUS
- SDLK_KP_POWER
- SDLK_KP_RIGHTBRACE

- SDLK_KP_RIGHTPAREN
- SDLK_KP_SPACE
- SDLK_KP_TAB
- SDLK_KP_VERTICALBAR
- SDLK_KP_XOR
- SDLK_l
- SDLK_LALT
- SDLK_LCTRL
- SDLK_LEFT
- SDLK_LEFTBRACKET
- SDLK_LGUI
- SDLK_LSHIFT
- SDLK_m
- SDLK_MAIL
- SDLK_MEDIASELECT
- SDLK_MENU
- SDLK_MINUS
- SDLK_MODE
- SDLK_MUTE
- SDLK_n
- SDLK_NUMLOCKCLEAR
- SDLK_o
- SDLK_OPER
- SDLK_OUT
- SDLK_p
- SDLK_PAGEDOWN
- SDLK_PAGEUP
- SDLK_PASTE
- SDLK_PAUSE
- SDLK_PERIOD
- SDLK_POWER
- SDLK_PRINTSCREEN
- SDLK_PRIOR
- SDLK_q
- SDLK_r
- SDLK_RALT

- SDLK_RCTRL
- SDLK_RETURN
- SDLK_RETURN2
- SDLK_RGUI
- SDLK_RIGHT
- SDLK_RIGHTBRACKET
- SDLK_RSHIFT
- SDLK_s
- SDLK_SCROLLLOCK
- SDLK_SELECT
- SDLK_SEMICOLON
- SDLK_SEPARATOR
- SDLK_SLASH
- SDLK_SLEEP
- SDLK_SPACE
- SDLK_STOP
- SDLK_SYSREQ
- SDLK_t
- SDLK_TAB
- SDLK_THOUSANDSSEPARATOR
- SDLK_u
- SDLK_UNDO
- SDLK_UNKNOWN
- SDLK_UP
- SDLK_v
- SDLK_VOLUMEDOWN
- SDLK_VOLUMEUP
- SDLK_w
- SDLK_WWW
- SDLK_x
- SDLK_y
- SDLK_z
- SDLK_AMPERSAND
- SDLK_ASTERISK
- SDLK_AT
- SDLK_CARET

- SDLK_COLON
- SDLK_DOLLAR
- SDLK_EXCLAIM
- SDLK_GREATER
- SDLK_HASH
- SDLK_LEFTPAREN
- SDLK_LESS
- SDLK_PERCENT
- SDLK_PLUS
- SDLK_QUESTION
- SDLK_QUOTEDBL
- SDLK_RIGHTPAREN
- SDLK_UNDERSCORE
- SDL_THREAD_PRIORITY_LOW
- SDL_THREAD_PRIORITY_NORMAL
- SDL_THREAD_PRIORITY_HIGH
- void SDL_RenderCopy2(SDL_Renderer *,SDL_Texture *)
- void SDL_Delay(int)
- void SDL_Init(int)
- int SDL_InitSubSystem(Uint32 flags)
- void SDL_Quit(void)
- void SDL_QuitSubSystem(Uint32 flags)
- void SDL_SetMainReady(void)
- Uint32 SDL_WasInit(Uint32 flags)
- SDL_bool SDL_SetHint(const char *name,const char *value)
- SDL_bool SDL_SetHintWithPriority(const char *name,const char *value,SDL_HintPriority priority)
- void SDL_ClearError(void)
- const char *SDL_GetError(void)
- SDL_LogPriority SDL_LogGetPriority(int category)
- void SDL_LogResetPriorities(void)
- void SDL_LogSetAllPriority(SDL_LogPriority priority)
- SDL_ASSERTIONHandler SDL_GetDefaultAssertionHandler(void)
- void SDL_ResetAssertionReport(void)
- void SDL_SetAssertionHandler(SDL_ASSERTIONHandler handler,void *userdata)
- void SDL_TriggerBreakpoint(void)
- void SDL_assert(int)

- void SDL_assert_paranoid(int)
- void SDL_assert_release(int)
- const char * SDL_GetRevision(void)
- int SDL_GetRevisionNumber(void)
- void SDL_GetVersion(SDL_version *ver)
- SDL_Window *SDL_CreateWindow(const char * title,int x, int y,int w,int h,Uint32 flags)
- void SDL_DestroyWindow(SDL_Window *window)
- void SDL_DisableScreenSaver(void)
- void SDL_EnableScreenSaver(void)
- SDL_GLContext SDL_GL_CreateContext(SDL_Window *window)
- void SDL_GL_DeleteContext(SDL_GLContext context)
- SDL_bool SDL_GL_ExtensionSupported(const char *extension)
- int SDL_GL_GetAttribute(SDL_GLattr attr,int *value)
- SDL_GLContext SDL_GL_GetCurrentContext(void)
- SDL_Window *SDL_GL_GetCurrentWindow(void)
- void SDL_GL_GetDrawableSize(SDL_Window *window,int *w,int *h)
- void *SDL_GL_GetProcAddress(const char *proc)
- int SDL_GL_GetSwapInterval(void)
- int SDL_GL_LoadLibrary(const char *path)
- int SDL_GL_MakeCurrent(SDL_Window *window,SDL_GLContext context)
- void SDL_GL_ResetAttributes(void)
- int SDL_GL_SetAttribute(SDL_GLattr attr,int value)
- int SDL_GL_SetSwapInterval(int interval)
- void SDL_GL_SwapWindow(SDL_Window *window)
- void SDL_GL_UnloadLibrary(void)
- **SDL_DisplayMode** *SDL_GetClosestDisplayMode(int mode,SDL_DisplayMode *closest) displayIndex,SDL_DisplayMode
- int SDL_GetCurrentDisplayMode(int displayIndex,SDL_DisplayMode *mode)
- const char *SDL_GetCurrentVideoDriver(void)
- int SDL_GetDesktopDisplayMode(int displayIndex,SDL_DisplayMode *mode)
- int SDL_GetDisplayBounds(int displayIndex,SDL_Rect *rect)
- int SDL_GetNumVideoDisplays(void)
- int SDL_GetNumVideoDrivers(void)
- const char * SDL_GetVideoDriver(int index)
- void *SDL_GetWindowData(SDL_Window *window,const char *name)
- int SDL_GetWindowDisplayIndex(SDL_Window *window)

- int `SDL_GetWindowDisplayMode(SDL_Window *window,SDL_DisplayMode *mode)`
- Uint32 `SDL_GetWindowFlags(SDL_Window *window)`
- `SDL_Window *SDL_GetWindowFromID(Uint32 id)`
- int `SDL_SetWindowGammaRamp(SDL_Window *window,Uint16 *red,Uint16 *green,Uint16 *blue)`
- `SDL_bool SDL_SetWindowGrab(SDL_Window *window)`
- Uint32 `SDL_SetWindowID(SDL_Window* window)`
- void `SDL_SetWindowMaximumSize(SDL_Window *window,int *w,int *h)`
- void `SDL_SetWindowMinimumSize(SDL_Window *window,int *w,int *h)`
- void `SDL_SetWindowPosition(SDL_Window *window,int *x,int *y)`
- void `SDL_SetWindowSize(SDL_Window *window,int *w,int *h)`
- `SDL_Surface *SDL_SetWindowSurface(SDL_Window *window)`
- const char `*SDL_SetWindowTitle(SDL_Window *window)`
- `SDL_bool SDL_IsScreenSaverEnabled(void)`
- void `SDL_MaximizeWindow(SDL_Window *window)`
- void `SDL_MinimizeWindow(SDL_Window *window)`
- void `SDL_RaiseWindow(SDL_Window *window)`
- void `SDL_RestoreWindow(SDL_Window *window)`
- void `SDL_SetWindowBordered(SDL_Window *window,SDL_bool bordered)`
- int `SDL_SetWindowBrightness(SDL_Window *window,float brightness)`
- void `*SDL_SetWindowData(SDL_Window *window,const char *name,void *userdata)`
- int `SDL_SetWindowDisplayMode(SDL_Window *window,const SDL_DisplayMode *mode)`
- int `SDL_SetWindowFullscreen(SDL_Window *window,Uint32 flags)`
- int `SDL_SetWindowGammaRamp(SDL_Window window,const Uint16 *red,const Uint16 *green,const Uint16 blue)`
- void `SDL_SetWindowGrab(SDL_Window *window,SDL_bool grabbed)`
- void `SDL_SetWindowMinimumSize(SDL_Window* window,int min_w,int min_h)`
- void `SDL_SetWindowSize(SDL_Window *window,int w,int h)`
- void `SDL_SetWindowTitle(SDL_Window *window,const char *title)`
- int `SDL_ShowMessageBox(const SDL_MessageBoxData *messageboxdata,int *buttonid)`
- int `SDL_ShowSimpleMessageBox(Uint32 flags,const char *title,const char *message,SDL_Window *window)`
- void `SDL_ShowWindow(SDL_Window *window)`
- int `SDL_UpdateWindowSurface(SDL_Window *window)`
- int `SDL_UpdateWindowSurfaceRects(SDL_Window *window,const SDL_Rect *rects,int numrects)`
- int `SDL_VideoInit(const char *driver_name)`
- void `SDL_VideoQuit(void)`
- `SDL_Renderer *SDL_CreateRenderer(SDL_Window *window,int index,Uint32 flags)`

- `SDL_Renderer *SDL_CreateSoftwareRenderer(SDL_Surface *surface)`
- `SDL_Texture *SDL_CreateTexture(SDL_Renderer *renderer,Uint32 format,int access,int w,int h)`
- `SDL_Texture *SDL_CreateTextureFromSurface(SDL_Renderer *renderer,SDL_Surface *surface)`
- `void SDL_DestroyTexture(SDL_Texture *texture)`
- `int SDL_GL_BindTexture(SDL_Texture *texture,float *texw,float *texh)`
- `int SDL_GL_UnbindTexture(SDL_Texture *texture)`
- `int SDL_GetNumRenderDrivers(void)`
- `int SDL_GetRenderDrawBlendMode(SDL_Renderer *renderer,SDL_BlendMode *blendMode)`
- `int SDL_GetRenderDrawColor(SDL_Renderer *renderer,Uint8 *r,Uint8 *g,Uint8 *b,Uint8 *a)`
- `int SDL_GetRenderDriverInfo(int index,SDL_RendererInfo *info)`
- `SDL_Texture *SDL_GetRenderTarget(SDL_Renderer *renderer)`
- `SDL_Renderer *SDL_GetRenderer(SDL_Window *window)`
- `int SDL_GetRendererInfo(SDL_Renderer *renderer,SDL_RendererInfo *info)`
- `int SDL_GetRendererOutputSize(SDL_Renderer *renderer,int *w,int *h)`
- `int SDL_GetTextureAlphaMod(SDL_Texture *texture,Uint8 *alpha)`
- `int SDL_GetTextureBlendMode(SDL_Texture *texture,SDL_BlendMode *blendMode)`
- `int SDL_GetTextureColorMod(SDL_Texture *texture,Uint8 *r,Uint8 *g,Uint8 *b)`
- `int SDL_LockTexture(SDL_Texture *texture,const SDL_Rect *rect,void **pixels,int *pitch)`
- `int SDL_QueryTexture(SDL_Texture *texture,int *format,int *access,int *w,int *h)`
- `int SDL_RenderClear(SDL_Renderer *renderer)`
- `int SDL_RenderCopy(SDL_Renderer *renderer,SDL_Texture *texture,const SDL_Rect *srcrect,const SDL_Rect *dstrect)`
- `int SDL_RenderCopyEx(SDL_Renderer *renderer,SDL_Texture *texture,const SDL_Rect *srcrect,const SDL_Rect *dstrect,const double angle,const SDL_Point *center,const SDL_RendererFlip flip)`
- `int SDL_RenderDrawLine(SDL_Renderer *renderer,int x1,int y1,int x2,int y2)`
- `int SDL_RenderDrawLines(SDL_Renderer *renderer,const SDL_Point *points,int count)`
- `int SDL_RenderDrawPoint(SDL_Renderer *renderer,int x, int y)`
- `int SDL_RenderDrawPoints(SDL_Renderer *renderer,const SDL_Point *points,int count)`
- `int SDL_RenderDrawRect(SDL_Renderer *renderer,const SDL_Rect *rect)`
- `int SDL_RenderDrawRects(SDL_Renderer *renderer,const SDL_Rect *rects,int count)`
- `int SDL_RenderFillRect(SDL_Renderer *renderer,const SDL_Rect *rect)`
- `int SDL_RenderFillRects(SDL_Renderer renderer,const SDL_Rect rects,int count)`
- `void SDL_RenderGetClipRect(SDL_Renderer *renderer,SDL_Rect *rect)`
- `void SDL_RenderGetScale(SDL_Renderer *renderer,float *scaleX,float *scaleY)`
- `void SDL_RenderGetViewport(SDL_Renderer *renderer,SDL_Rect *rect)`
- `int SDL_RenderReadPixels(SDL_Renderer *renderer,const SDL_Rect *rect,Uint32 format,void *pixels,int pitch)`

- int `SDL_RenderSetClipRect(SDL_Renderer *renderer,const SDL_Rect *rect)`
- int `SDL_RenderSetScale(SDL_Renderer *renderer,float scaleX,float scaleY)`
- int `SDL_RenderSetViewport(SDL_Renderer *renderer,const SDL_Rect *rect)`
- `SDL_bool SDL_RenderTargetSupported(SDL_Renderer *renderer)`
- int `SDL_SetRenderDrawBlendMode(SDL_Renderer *renderer,SDL_BlendMode blendMode)`
- int `SDL_SetRenderDrawColor(SDL_Renderer *renderer,Uint8 r,Uint8 g,Uint8 b,Uint8 a)`
- int `SDL_SetRenderTarget(SDL_Renderer *renderer,SDL_Texture *texture)`
- int `SDL_SetTextureAlphaMod(SDL_Texture *texture,Uint8 alpha)`
- int `SDL_SetTextureBlendMode(SDL_Texture *texture,SDL_BlendMode blendMode)`
- int `SDL_SetTextureColorMod(SDL_Texture *texture,Uint8 r,Uint8 g,Uint8 b)`
- void `SDL_UnlockTexture(SDL_Texture *texture)`
- int `SDL_UpdateTexture(SDL_Texture *texture,const SDL_Rect *rect,const void*pixels,int pitch)`
- int `SDL_UpdateYUVTexture(SDL_Texture *texture,const SDL_Rect *rect,const Uint8 *Yplane,int Ypitch,const Uint8 *Uplane,int Upitch,const Uint8 *Vplane,int Vpitch)`
- `SDL_PixelFormat *SDL_AllocFormat(Uint32 pixel_format)`
- `SDL_Palette *SDL_AllocPalette(int ncolors)`
- void `SDL_CalculateGammaRamp(float gamma,Uint16 *ramp)`
- void `SDL_FreeFormat(SDL_PixelFormat *format)`
- void `SDL_FreePalette(SDL_Palette *palette)`
- const char `*SDL_GetPixelFormatName(Uint32 format)`
- void `SDL_GetRGB(Uint32 pixel,const SDL_PixelFormat* format,Uint8 *r,Uint8 *g,Uint8 *b)`
- void `SDL_GetRGBA(Uint32 pixel,const SDL_PixelFormat* format,Uint8 *r,Uint8 *g,Uint8 *b,Uint8 *a)`
- `Uint32 SDL_MapRGB(const SDL_PixelFormat* format,Uint8 r,Uint8 g, Uint8 b)`
- `Uint32 SDL_MapRGBA(const SDL_PixelFormat* format,Uint8 r,Uint8 g, Uint8 b, Uint8 a)`
- `Uint32 SDL_MasksToPixelFormatEnum(int bpp,Uint32 Rmask,Uint32 Gmask,Uint32 Bmask,Uint32 Amask)`
- `SDL_bool SDL_PixelFormatEnumToMasks(Uint32 format,int *bpp,Uint32 *Rmask,Uint32 *Gmask,Uint32 *Bmask,Uint32 *Amask)`
- int `SDL_SetPaletteColors(SDL_Palette *palette,const SDL_Color *colors,int firstcolor,int ncolors)`
- int `SDL_SetPixelFormatPalette(SDL_PixelFormat *format,SDL_Palette *palette)`
- `SDL_bool SDL_EnclosePoints(const SDL_Point* points,int count,const SDL_Rect *clip,SDL_Rect *result)`
- `SDL_bool SDL_HasIntersection(const SDL_Rect *A,const SDL_Rect *B)`
- `SDL_bool SDL_IntersectRect(const SDL_Rect *A,const SDL_Rect *B,SDL_Rect *result)`
- `SDL_bool SDL_IntersectRectAndLine(const SDL_Rect *rect,int *X1,int *Y1,int *X2,int *Y2)`
- `SDL_bool SDL_RectEquals(const SDL_Rect *a,const SDL_Rect *b)`
- void `SDL_UnionRect(const SDL_Rect *A,const SDL_Rect *B,SDL_Rect *result)`
- int `SDL_BlitScaled(SDL_Surface *src,const SDL_Rect *srcrect,SDL_Surface *dst,SDL_Rect *dstrect)`
- int `SDL_BlitSurface(SDL_Surface src,const SDL_Rect srcrect,SDL_Surface *dst,SDL_Rect *dstrect)`

- int `SDL_ConvertPixels(int width,int height,Uint32 src_format,const void *src,int src_pitch,Uint32 dst_format,void *dst,int dst_pitch)`
- `SDL_Surface *SDL_ConvertSurface(SDL_Surface *src,const SDL_PixelFormat *fmt,Uint32 flags)`
- `SDL_Surface *SDL_ConvertSurfaceFormat(SDL_Surface *src,Uint32 pixel_format,Uint32 flags)`
- `SDL_Surface *SDL_CreateRGBSurface(Uint32 flags,int width,int height,int depth,Uint32 Rmask,Uint32 Gmask,Uint32 Bmask,Uint32 Amask)`
- `SDL_Surface* SDL_CreateRGBSurfaceFrom(void *pixels,int width,int height,int depth,int pitch,Uint32 Rmask,Uint32 Gmask,Uint32 Bmask,Uint32 Amask)`
- int `SDL_FillRect(SDL_Surface *dst,const SDL_Rect *rect,Uint32 color)`
- int `SDL_FillRects(SDL_Surface *dst,const SDL_Rect *rects,int count,Uint32 color)`
- void `SDL_FreeSurface(SDL_Surface *surface)`
- void `SDL_GetClipRect(SDL_Surface *surface,SDL_Rect *rect)`
- int `SDL_GetColorKey(SDL_Surface *surface,Uint32 *key)`
- int `SDL_GetSurfaceAlphaMod(SDL_Surface *surface,Uint8 *alpha)`
- int `SDL_GetSurfaceBlendMode(SDL_Surface *surface,SDL_BlendMode *blendMode)`
- int `SDL_GetSurfaceColorMod(SDL_Surface *surface,Uint8 *r,Uint8 *g,Uint8 *b)`
- `SDL_Surface *SDL_LoadBMP(const char *file)`
- `SDL_Surface *SDL_LoadBMP_RW(SDL_RWops *src,int freesrc)`
- int `SDL_LockSurface(SDL_Surface *surface)`
- int `SDL_LowerBlit(SDL_Surface *src,SDL_Rect *srcrect,SDL_Surface *dst,SDL_Rect *dstrect)`
- int `SDL_LowerBlitScaled(SDL_Surface *src,SDL_Rect *srcrect,SDL_Surface *dst,SDL_Rect *dstrect)`
- `SDL_bool SDL_MUSTLOCK(SDL_Surface *surface)`
- int `SDL_SaveBMP(SDL_Surface *surface,const char *file)`
- int `SDL_SaveBMP_RW(SDL_Surface *surface,SDL_RWops *dst,int freedst)`
- `SDL_bool SDL_SetClipRect(SDL_Surface *surface,const SDL_Rect *rect)`
- int `SDL_SetColorKey(SDL_Surface *surface,int flag,Uint32 key)`
- int `SDL_SetSurfaceAlphaMod(SDL_Surface *surface,Uint8 alpha)`
- int `SDL_SetSurfaceBlendMode(SDL_Surface *surface,SDL_BlendMode blendMode)`
- int `SDL_SetSurfaceColorMod(SDL_Surface *surface,Uint8 r,Uint8 g,Uint8 b)`
- int `SDL_SetSurfacePalette(SDL_Surface *surface,SDL_Palette *palette)`
- int `SDL_SetSurfaceRLE(SDL_Surface *surface,int flag)`
- void `SDL_UnlockSurface(SDL_Surface* surface)`
- `SDL_bool SDL_GetWindowWMInfo(SDL_Window *window,SDL_SysWMinfo *info)`
- `char *SDL_GetClipboardText(void)`
- `SDL_bool SDL_HasClipboardText(void)`
- int `SDL_SetClipboardText(const char *text)`
- void `SDL_AddEventWatch(SDL_EventFilter filter,void *userdata)`

- void SDL_DelEventWatch(SDL_EventFilter filter,void *userdata)
- Uint8 SDL_EventState(Uint32 type,int state)
- void SDL_FilterEvents(SDL_EventFilter filter,void *userdata)
- void SDL_FlushEvent(Uint32 type)
- void SDL_FlushEvents(Uint32 minType,Uint32 maxType)
- SDL_bool SDL_GetEventFilter(SDL_EventFilter *filter,void **userdata)
- Uint8 SDL_GetEventState(Uint32 type)
- int SDL_GetNumTouchDevices(void)
- int SDL_GetNumTouchFingers(SDL_TouchID touchID)
- SDL_TouchID SDL_GetTouchDevice(int index)
- SDL_Finger* SDL_GetTouchFinger(SDL_TouchID touchID,int index)
- SDL_bool SDL_HasEvent(Uint32 type)
- SDL_bool SDL_HasEvents(Uint32 minType,Uint32 maxType)
- int SDL_LoadDollarTemplates(SDL_TouchID touchId,SDL_RWops *src)
- int SDL_PeepEvents(SDL_Event *events,int numevents,SDL_eventaction action,Uint32 minType,Uint32 maxType)
- int SDL_PollEvent(SDL_Event *event)
- void SDL_PumpEvents(void)
- int SDL_PushEvent(SDL_Event *event)
- SDL_bool SDL_QuitRequested(void)
- int SDL_RecordGesture(SDL_TouchID touchId)
- Uint32 SDL_RegisterEvents(int numevents)
- int SDL_SaveAllDollarTemplates(SDL_RWops *dst)
- int SDL_SaveDollarTemplate(SDL_GestureID gestureId,SDL_RWops *dst)
- void SDL_SetEventFilter(SDL_EventFilter filter,void *userdata)
- int SDL_WaitEvent(SDL_Event *event)
- int SDL_WaitEventTimeout(SDL_Event *event,int timeout)
- SDL_Keycode SDL_GetKeyFromName(const char * name)
- SDL_Keycode SDL_GetKeyFromScancode(SDL_Scancode scancode)
- const char * SDL_GetKeyName(SDL_Keycode key)
- SDL_Window* SDL_GetKeyboardFocus(void)
- const Uint8* SDL_GetKeyboardState(int* numkeys)
- SDL_Keymod SDL_GetModState(void)
- SDL_Scancode SDL_GetScancodeFromKey(SDL_Keycode key)
- SDL_Scancode SDL_GetScancodeFromName(const char * name)
- const char * SDL_GetScancodeName(SDL_Scancode scancode)

- `SDL_bool SDL_HasScreenKeyboardSupport(void)`
- `SDL_bool SDL_IsScreenKeyboardShown(SDL_Window* window)`
- `SDL_bool SDL_IsTextInputActive(void)`
- `void SDL_SetModState(SDL_Keymod modstate)`
- `void SDL_SetTextInputRect(SDL_Rect* rect)`
- `void SDL_StartTextInput(void)`
- `void SDL_StopTextInput(void)`
- `SDL_Cursor *SDL_CreateCursor(const Uint8 *data,const Uint8 *mask,int w,int h,int hot_x,int hot_y)`
- `void SDL_FreeCursor(SDL_Cursor *cursor)`
- `SDL_Cursor *SDL_GetCursor(void)`
- `SDL_Cursor *SDL_GetDefaultCursor(void)`
- `Uint32 SDL_GetMouseState(int *x,int *y)`
- `SDL_bool SDL_GetRelativeMouseMode(void)`
- `Uint32 SDL_GetRelativeMouseState(int *x,int *y)`
- `void SDL_SetCursor(SDL_Cursor *cursor)`
- `int SDL_SetRelativeMouseMode(SDL_bool enabled)`
- `int SDL_ShowCursor(int toggle)`
- `void SDL_JoystickClose(SDL_Joystick *joystick)`
- `SDL_bool SDL_JoystickGetAttached(SDL_Joystick *joystick)`
- `Sint16 SDL_JoystickGetAxis(SDL_Joystick *joystick,int axis)`
- `int SDL_JoystickGetBall(SDL_Joystick *joystick,int ball,int *dx,int *dy)`
- `Uint8 SDL_JoystickGetButton(SDL_Joystick *joystick,int button)`
- `SDL_JoystickGUID SDL_JoystickGetDeviceGUID(int device_index)`
- `SDL_JoystickGUID SDL_JoystickGetGUID(SDL_Joystick *joystick)`
- `SDL_JoystickGUID SDL_JoystickGetGUIDFromString(const char *pchGUID)`
- `void SDL_JoystickGetGUIDString(SDL_JoystickGUID guid,char *pszGUID,int cbGUID)`
- `Uint8 SDL_JoystickGetHat(SDL_Joystick *joystick,int hat)`
- `SDL_JoystickID SDL_JoystickInstanceID(SDL_Joystick *joystick)`
- `const char *SDL_JoystickName(SDL_Joystick *joystick)`
- `const char *SDL_JoystickNameForIndex(int device_index)`
- `int SDL_JoystickNumAxes(SDL_Joystick *joystick)`
- `int SDL_JoystickNumBalls(SDL_Joystick *joystick)`
- `int SDL_JoystickNumButtons(SDL_Joystick *joystick)`
- `int SDL_JoystickNumHats(SDL_Joystick *joystick)`
- `SDL_Joystick *SDL_JoystickOpen(int device_index)`
- `void SDL_JoystickUpdate(void)`

- int SDL_NumJoysticks(void)
- int SDL_GameControllerAddMapping(const char *mappingString)
- int SDL_GameControllerAddMappingsFromFile(const char *filename)
- int SDL_GameControllerAddMappingsFromRW(SDL_RWops *rw,int freerw)
- void SDL_GameControllerClose(SDL_GameController *gamecontroller)
- int SDL_GameControllerEventState(int state)
- Sint16 SDL_GameControllerGetAxis(SDL_GameController *gamecontroller,SDL_GameControllerAxis axis)
- SDL_GameControllerAxis SDL_GameControllerGetAxisFromString(const char *pchString)
- SDL_GameControllerButtonBind SDL_GameControllerGetBindForAxis(SDL_GameController *gamecontroller,SDL_GameControllerAxis axis)
- SDL_GameControllerButtonBind SDL_GameControllerGetBindForButton(SDL_GameController *gamecontroller,SDL_GameControllerButton button)
- Uint8 SDL_GameControllerGetButton(SDL_GameController *gamecontroller,SDL_GameControllerButton button)
- SDL_GameControllerButton SDL_GameControllerGetButtonFromString(const char *pchString)
- SDL_Joystick *SDL_GameControllerGetJoystick(SDL_GameController *gamecontroller)
- const char *SDL_GameControllerGetStringForAxis(SDL_GameControllerAxis axis)
- const char *SDL_GameControllerGetStringForButton(SDL_GameControllerButton button)
- char *SDL_GameControllerMapping(SDL_GameController *gamecontroller)
- char *SDL_GameControllerMappingForGUID(SDL_JoystickGUID guid)
- const char *SDL_GameControllerName(SDL_GameController *gamecontroller)
- const char *SDL_GameControllerNameForIndex(int joystick_index)
- SDL_GameController* SDL_GameControllerOpen(int joystick_index)
- void SDL_GameControllerUpdate(void)
- SDL_bool SDL_IsGameController(int joystick_index)
- void SDL_HapticClose(SDL_Haptic* haptic)
- void SDL_HapticDestroyEffect(SDL_Haptic *haptic,int effect)
- int SDL_HapticEffectSupported(SDL_Haptic *haptic,SDL_HapticEffect *effect)
- int SDL_HapticGetEffectStatus(SDL_Haptic *haptic,int effect)
- int SDL_HapticIndex(SDL_Haptic *haptic)
- const char *SDL_HapticName(int device_index)
- int SDL_HapticNewEffect(SDL_Haptic *haptic,SDL_HapticEffect *effect)
- int SDL_HapticNumAxes(SDL_Haptic *haptic)
- int SDL_HapticNumEffects(SDL_Haptic *haptic)
- int SDL_HapticNumEffectsPlaying(SDL_Haptic *haptic)
- SDL_Haptic *SDL_HapticOpen(int device_index)
- SDL_Haptic *SDL_HapticOpenFromJoystick(SDL_Joystick *joystick)

- `SDL_Haptic *SDL_HapticOpenFromMouse(void)`
- `int SDL_HapticOpened(int device_index)`
- `int SDL_HapticPause(SDL_Haptic *haptic)`
- `unsigned int SDL_HapticQuery(SDL_Haptic *haptic)`
- `int SDL_HapticRumbleInit(SDL_Haptic *haptic)`
- `int SDL_HapticRumblePlay(SDL_Haptic *haptic, float strength, Uint32 length)`
- `int SDL_HapticRumbleStop(SDL_Haptic *haptic)`
- `int SDL_HapticRumbleSupported(SDL_Haptic *haptic)`
- `int SDL_HapticRunEffect(SDL_Haptic *haptic, int effect, Uint32 iterations)`
- `int SDL_HapticSetAutocenter(SDL_Haptic *haptic, int autocenter)`
- `int SDL_HapticSetGain(SDL_Haptic *haptic, int gain)`
- `int SDL_HapticStopAll(SDL_Haptic *haptic)`
- `int SDL_HapticStopEffect(SDL_Haptic *haptic, int effect)`
- `int SDL_HapticUnpause(SDL_Haptic *haptic)`
- `int SDL_HapticUpdateEffect(SDL_Haptic *haptic, int effect, SDL_HapticEffect *data)`
- `int SDL_JoystickIsHaptic(SDL_Joystick *joystick)`
- `int SDL_MouseIsHaptic(void)`
- `int SDL_NumHaptics(void)`
- `int SDL_AudioInit(const char * driver_name)`
- `void SDL_AudioQuit(void)`
- `int SDL_BuildAudioCVT(SDL_AudioCVT *cvt, SDL_AudioFormat src_format, Uint8 src_channels, int src_rate, SDL_AudioFormat dst_format, Uint8 dst_channels, int dst_rate)`
- `void SDL_CloseAudioDevice(SDL_AudioDeviceID dev)`
- `int SDL_ConvertAudio(SDL_AudioCVT *cvt)`
- `void SDL_FreeWAV(Uint8 *audio_buf)`
- `const char * SDL_GetAudioDeviceName(int index, int iscapture)`
- `SDL_AudioStatus SDL_GetAudioDeviceStatus(SDL_AudioDeviceID dev)`
- `const char * SDL_GetAudioDriver(int index)`
- `SDL_AudioStatus SDL_GetAudioStatus(void)`
- `const char * SDL_GetCurrentAudioDriver(void)`
- `int SDL_GetNumAudioDevices(int iscapture)`
- `int SDL_GetNumAudioDrivers(void)`
- `SDL_AudioSpec *SDL_LoadWAV_RW(SDL_RWops *src, int freesrc, SDL_AudioSpec *spec, Uint8 **audio_buf, Uint32 *audio_len)`
- `void SDL_LockAudio(void)`
- `void SDL_LockAudioDevice(SDL_AudioDeviceID dev)`
- `void SDL_MixAudio(Uint8 dst, const Uint8 src, Uint32 len, int volume)`

- void SDL_MixAudioFormat(Uint8 *dst,const Uint8 *src,SDL_AudioFormat format,Uint32 len,int volume)
- int SDL_OpenAudio(SDL_AudioSpec *desired,SDL_AudioSpec *obtained)
- SDL_AudioDeviceID SDL_OpenAudioDevice(const char *device,int iscapture,const SDL_AudioSpec *desired,SDL_AudioSpec *obtained,int allowed_changes)
- void SDL_PauseAudio(int pause_on)
- void SDL_PauseAudioDevice(SDL_AudioDeviceID dev,int pause_on)
- void SDL_UnlockAudio(void)
- void SDL_UnlockAudioDevice(SDL_AudioDeviceID dev)
- char *SDL_GetBasePath(void)
- char *SDL_GetPrefPath(const char *org,const char *app)
- SDL_RWops *SDL_AllocRW(void)
- void SDL_FreeRW(SDL_RWops *area)
- *SDL_RWops* *SDL_RWFromConstMem(const void mem,int size)*
- *SDL_RWops* *SDL_RWFromFP(void *fp,SDL_bool autoclose)*
- *SDL_RWops* *SDL_RWFromFile(const char *file,const char *mode)*
- *SDL_RWops* *SDL_RWFromMem(void *mem,int size)*
- int SDL_RWclose(struct SDL_RWops *context)
- size_t *SDL_RWread(struct SDL_RWops *context,void *ptr,size_t size,size_t maxnum)*
- Sint64 *SDL_RWseek(SDL_RWops *context,Sint64 offset,int whence)*
- Sint64 *SDL_RWsize(SDL_RWops *context)*
- Sint64 *SDL_RWtell(struct SDL_RWops *context)*
- size_t *SDL_RWwrite(struct SDL_RWops *context,const void *ptr,size_t size,size_t num)*
- Uint16 *SDL_ReadBE16(SDL_RWops *src)*
- Uint32 *SDL_ReadBE32(SDL_RWops *src)*
- Uint64 *SDL_ReadBE64(SDL_RWops *src)*
- Uint16 *SDL_ReadLE16(SDL_RWops *src)*
- Uint32 *SDL_ReadLE32(SDL_RWops *src)*
- Uint64 *SDL_ReadLE64(SDL_RWops *src)*
- Uint8 *SDL_ReadU8(SDL_RWops *src)*
- size_t *SDL_WriteBE16(SDL_RWops *dst,Uint16 value)*
- size_t *SDL_WriteBE32(SDL_RWops *dst,Uint32 value)*
- size_t *SDL_WriteBE64(SDL_RWops *dst,Uint64 value)*
- size_t *SDL_WriteLE16(SDL_RWops *dst,Uint16 value)*
- size_t *SDL_WriteLE32(SDL_RWops *dst,Uint32 value)*
- size_t *SDL_WriteLE64(SDL_RWops *dst,Uint64 value)*
- size_t *SDL_WriteU8(SDL_RWops *dst,Uint8 value)*

- void *SDL_LoadFunction(void *handle,const char *name)
- void *SDL_LoadObject(const char *sofile)
- void SDL_UnloadObject(void *handle)
- const char *SDL_GetPlatform(void)
- int SDL_GetCPUCacheLineSize(void)
- int SDL_GetCPUCount(void)
- int SDL_GetSystemRAM(void)
- SDL_bool SDL_Has3DNow(void)
- SDL_bool SDL_HasAVX(void)
- SDL_bool SDL_HasMMX(void)
- SDL_bool SDL_HasRDTSC(void)
- SDL_bool SDL_HasSSE(void)
- SDL_bool SDL_HasSSE2(void)
- SDL_bool SDL_HasSSE3(void)
- SDL_bool SDL_HasSSE41(void)
- SDL_bool SDL_HasSSE42(void)
- SDL_PowerState SDL_GetPowerInfo(int *secs,int *pct)
- double SDL_acos(double x)
- int IMG_Init(int flags)
- void IMG_Quit(void)
- SDL_Surface *IMG_Load(const char *file)
- SDL_Surface *IMG_Load_RW(SDL_RWops *src, int freesrc)
- SDL_Surface *IMG_LoadTyped_RW(SDL_RWops *src, int freesrc, char *type)
- SDL_Surface *IMG_LoadCUR_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadBMP_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadPNM_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadXPM_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadXCF_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadPCX_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadGIF_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadJPEG_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadTIF_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadPNG_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadTGA_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadLBM_RW(SDL_RWops *src)
- SDL_Surface *IMG_LoadXV_RW(SDL_RWops *src)

- `SDL_Surface *IMG_ReadXPMFromArray(char **xpm)`
- `int IMG_isCUR(SDL_RWops *src)`
- `int IMG_isICO(SDL_RWops *src)`
- `int IMG_isBMP(SDL_RWops *src)`
- `int IMG_isPNM(SDL_RWops *src)`
- `int IMG_isXPM(SDL_RWops *src)`
- `int IMG_isXCF(SDL_RWops *src)`
- `int IMG_isPCX(SDL_RWops *src)`
- `int IMG_isGIF(SDL_RWops *src)`
- `int IMG_isJPG(SDL_RWops *src)`
- `int IMG_isTIF(SDL_RWops *src)`
- `int IMG_isPNG(SDL_RWops *src)`
- `int IMG_isLBM(SDL_RWops *src)`
- `int IMG_isXV(SDL_RWops *src)`
- `int TTF_Init(void)`
- `int TTF_WasInit(void)`
- `void TTF_Quit(void)`
- `TTF_Font *TTF_OpenFont(const char *file, int ptsize)`
- `TTF_Font *TTF_OpenFontRW(SDL_RWops *src, int freesrc, int ptsize)`
- `TTF_Font *TTF_OpenFontIndex(const char *file, int ptsize, long index)`
- `TTF_Font *TTF_OpenFontIndexRW(SDL_RWops *src, int freesrc, int ptsize, long index)`
- `void TTF_CloseFont(TTF_Font *font)`
- `void TTF_ByteSwappedUNICODE(int swapped)`
- `int TTF_GetFontStyle(TTF_Font *font)`
- `void TTF_SetFontStyle(TTF_Font *font, int style)`
- `int TTF_GetFontOutline(TTF_Font *font)`
- `void TTF_SetFontOutline(TTF_Font *font, int outline)`
- `int TTF_GetFontHinting(TTF_Font *font)`
- `void TTF_SetFontHinting(TTF_Font *font, int hinting)`
- `int TTF_GetFontKerning(TTF_Font *font)`
- `void TTF_SetFontKerning(TTF_Font *font, int allowed)`
- `int TTF_FontHeight(const TTF_Font *font)`
- `int TTF_FontAscent(const TTF_Font *font)`
- `int TTF_FontDescent(const TTF_Font *font)`
- `int TTF_FontLineSkip(const TTF_Font *font)`
- `long TTF_FontFaces(const TTF_Font *font)`

- int TTF_FontFaceIsFixedWidth(const TTF_Font *font)
- char *TTF_FontFaceFamilyName(const TTF_Font *font)
- char *TTF_FontFaceStyleName(const TTF_Font *font)
- int TTF_GlyphIsProvided(const TTF_Font *font, Uint16 ch)
- int TTF_GlyphMetrics(TTF_Font *font, Uint16 ch, int *minx, int *maxx, int *miny, int *maxy, int *advance)
- int TTF_SizeText(TTF_Font *font, const char *text, int *w, int *h)
- int TTF_SizeUTF8(TTF_Font *font, const char *text, int *w, int *h)
- int TTF_SizeUNICODE(TTF_Font *font, const Uint16 *text, int *w, int *h)
- SDL_Surface *TTF_RenderText_Solid(TTF_Font *font, const char *text, SDL_Color fg)
- SDL_Surface *TTF_RenderUTF8_Solid(TTF_Font *font, const char *text,SDL_Color fg)
- SDL_Surface *TTF_RenderUNICODE_Solid(TTF_Font *font, const Uint16 *text,SDL_Color fg)
- SDL_Surface *TTF_RenderGlyph_Solid(TTF_Font *font, Uint16 ch, SDL_Color fg)
- SDL_Surface *TTF_RenderText_Shaded(TTF_Font *font, const char *text,SDL_Color fg, SDL_Color bg)
- SDL_Surface *TTF_RenderUTF8_Shaded(TTF_Font *font, const char *text,SDL_Color fg, SDL_Color bg)
- SDL_Surface *TTF_RenderUNICODE_Shaded(TTF_Font *font, const Uint16 *text,SDL_Color fg, SDL_Color bg)
- SDL_Surface *TTF_RenderGlyph_Shaded(TTF_Font *font, Uint16 ch, SDL_Color fg,SDL_Color bg)
- SDL_Surface *TTF_RenderText_Blended(TTF_Font *font, const char *text,SDL_Color fg)
- SDL_Surface *TTF_RenderUTF8_Blended(TTF_Font *font, const char *text,SDL_Color fg)
- SDL_Surface *TTF_RenderUNICODE_Blended(TTF_Font *font, const Uint16 *text,SDL_Color fg)
- SDL_Surface *TTF_RenderGlyph_Blended(TTF_Font *font, Uint16 ch, SDL_Color fg)
- int Mix_Init(int flags)
- void Mix_Quit(void)
- int Mix_OpenAudio(int frequency, Uint16 format, int channels, int chunksize)
- void Mix_CloseAudio(void)
- int Mix_QuerySpec(int *frequency, Uint16 *format, int *channels)
- int Mix_GetNumChunkDecoders(void)
- const char *Mix_GetChunkDecoder(int index)
- Mix_Chunk *Mix_LoadWAV(char *file)
- Mix_Chunk *Mix_LoadWAV_RW(SDL_RWops *src, int freesrc)
- Mix_Chunk *Mix_QuickLoad_WAV(Uint8 *mem)
- void Mix_FreeChunk(Mix_Chunk *chunk)
- int Mix_AllocateChannels(int numchans)
- int Mix_Volume(int channel, int volume)
- int Mix_PlayChannel(int channel, Mix_Chunk *chunk, int loops)
- int Mix_PlayChannelTimed(int channel, Mix_Chunk *chunk, int loops, int ticks)

- int Mix_FadeInChannel(int channel, Mix_Chunk *chunk, int loops, int ms)
- int Mix_FadeInChannelTimed(int channel, Mix_Chunk *chunk, int loops, int ms, int ticks)
- void Mix_Pause(int channel)
- void Mix_Resume(int channel)
- int Mix_HaltChannel(int channel)
- int Mix_ExpireChannel(int channel, int ticks)
- int Mix_FadeOutChannel(int channel, int ms)
- int Mix_Paused(int channel)
- Mix_Fading Mix_FadingChannel(int which)
- Mix_Chunk *Mix_GetChunk(int channel)
- int Mix_ReserveChannels(int num)
- int Mix_GroupChannel(int which, int tag)
- int Mix_GroupChannels(int from, int to, int tag)
- int Mix_GroupCount(int tag)
- int Mix_GroupAvailable(int tag)
- int Mix_GroupOldest(int tag)
- int Mix_GroupNewer(int tag)
- int Mix_FadeOutGroup(int tag, int ms)
- int Mix_HaltGroup(int tag)
- int Mix_GetNumMusicDecoders(void)
- const char *Mix_GetMusicDecoder(int index)
- Mix_Music *Mix_LoadMUS(const char *file)
- void Mix_FreeMusic(Mix_Music *music)
- int Mix_PlayMusic(Mix_Music *music, int loops)
- int Mix_FadeInMusic(Mix_Music *music, int loops, int ms)
- int Mix_FadeInMusicPos(Mix_Music *music, int loops, int ms, double position)
- int Mix_PlayingMusic(void)
- int Mix_PausedMusic(void)
- Mix_Fading Mix_FadingMusic(void)
- void *Mix_GetMusicHookData(void)
- int Mix_RegisterEffect(int chan, Mix_EffectFunc_t f, Mix_EffectDone_t d, void *arg)
- int Mix_UnregisterEffect(int channel, Mix_EffectFunc_t f)
- int Mix_UnregisterAllEffects(int channel)
- int Mix_SetDistance(int channel, Uint8 distance)
- int Mix_SetPosition(int channel, Sint16 angle, Uint8 distance)
- int Mix_SetReverseStereo(int channel, int flip)

- int SDLNet_Init(void)
- void SDLNet_Quit(void)
- char *SDLNet_GetError(void)
- void SDLNet_Write16(Uint16 value, void *area)
- void SDLNet_Write32(Uint32 value, void *area)
- Uint16 SDLNet_Read16(void *area)
- Uint32 SDLNet_Read32(void *area)
- int SDLNet_ResolveHost(IPAddress *address, const char *host, Uint16 port)
- const char *SDLNet_ResolveIP(IPAddress *address)
- TCPsocket SDLNet_TCP_Open(IPAddress *ip)
- void SDLNet_TCP_Close(TCPsocket sock)
- TCPsocket SDLNet_TCP_Accept(TCPsocket server)
- int SDLNet_TCP_Send(TCPsocket sock, const void *data, int len)
- int SDLNet_TCP_Recv(TCPsocket sock, void *data, int maxlen)
- UDPsocket SDLNet_UDP_Open(Uint16 port)
- void SDLNet_UDP_Close(UDPsocket sock)
- int SDLNet_UDP_Bind(UDPsocket sock, int channel, IPAddress *address)
- void SDLNet_UDP_Unbind(UDPsocket sock, int channel)
- IPAddress *SDLNet_UDP_GetPeerAddress(UDPsocket sock, int channel)
- int SDLNet_UDP_Send(UDPsocket sock, int channel, UDPpacket *packet)
- int SDLNet_UDP_Recv(UDPsocket sock, UDPpacket *packet)
- int SDLNet_UDP_SendV(UDPsocket sock, UDPpacket **packetV, int npackets)
- int SDLNet_UDP_RecvV(UDPsocket sock, UDPpacket **packetV)
- UDPpacket *SDLNet_AllocPacket(int size)
- int SDLNet_ResizePacket(UDPpacket *packet, int size)
- void SDLNet_FreePacket(UDPpacket *packet)
- UDPpacket **SDLNet_AllocPacketV(int howmany, int size)
- void SDLNet_FreePacketV(UDPpacket **packetV)
- SDLNet_SocketSet SDLNet_AllocSocketSet(int maxsockets)
- void SDLNet_FreeSocketSet(SDLNet_SocketSet set)
- int SDLNet_AddSocket(SDLNet_SocketSet set, SDLNet_GenericSocket sock)
- int SDLNet_TCP_AddSocket(SDLNet_SocketSet set, TCPsocket sock)
- int SDLNet_UDP_AddSocket(SDLNet_SocketSet set, UDPsocket sock)
- int SDLNet_DelSocket(SDLNet_SocketSet set, SDLNet_GenericSocket sock)
- int SDLNet_TCP_DelSocket(SDLNet_SocketSet set, TCPsocket sock)
- int SDLNet_UDP_DelSocket(SDLNet_SocketSet set, UDPsocket sock)

- int SDLNet_CheckSockets(SDLNet_SocketSet set, Uint32 timeout)
- int SDLNet_SocketReady(TCPsocket sock)
- int circleRGBA(SDL_Renderer * renderer, Sint16 x, Sint16 y, Sint16 rad, Uint8 r, Uint8 g, Uint8 b, Uint8 a)
- **SDL_Thread ***SDL_CreateThread(SDL_ThreadFunction fn,const char *name,void *data)
- void SDL_DetachThread(SDL_Thread *thread)
- **SDL_threadID** SDL_GetThreadID(SDL_Thread *thread)
- const char *SDL_GetThreadName*(*SDL_Thread* thread)
- int SDL_SetThreadPriority(SDL_ThreadPriority priority)
- **SDL_TLSID** SDL_TLSCreate(void)
- void *SDL_TLSGet(**SDL_TLSID** id)
- int SDL_TLSSet(**SDL_TLSID** id,const void *value,void *)
- **SDL_threadID** SDL_ThreadID(void)
- void SDL_WaitThread(SDL_Thread *thread,int *status)
- int SDL_CondBroadcast(SDL_cond *cond)
- int SDL_CondSignal(SDL_cond *cond)
- int SDL_CondWait(SDL_cond *cond,SDL_mutex *mutex)
- int SDL_CondWaitTimeout(SDL_cond *cond,SDL_mutex *mutex,Uint32 ms)
- **SDL_cond ***SDL_CreateCond(void)
- **SDL_mutex ***SDL_CreateMutex(void)
- **SDL_sem ***SDL_CreateSemaphore(Uint32 initial_value)
- void SDL_DestroyCond(SDL_cond *cond)
- void SDL_DestroyMutex(SDL_mutex *mutex)
- void SDL_DestroySemaphore(SDL_sem *sem)
- int SDL_LockMutex(SDL_mutex *mutex)
- int SDL_SemPost(SDL_sem *sem)
- int SDL_SemTryWait(SDL_sem *sem)
- Uint32 SDL_SemValue(SDL_sem *sem)
- int SDL_SemWait(SDL_sem *sem)
- int SDL_SemWaitTimeout(SDL_sem *sem,Uint32 ms)
- int SDL_TryLockMutex(SDL_mutex *mutex)
- int SDL_UnlockMutex(SDL_mutex *mutex)

CHAPTER
EIGHTYSEVEN

USING RINGLIBUV

In this chapter we will learn about using RingLibuv

Note: To use RingLibuv, Check ring/extensions/ringlibuv folder.

Information from the library website: <http://libuv.org/>

Libuv is a multi-platform support library with a focus on asynchronous I/O.

Feature highlights

- Full-featured event loop backed by epoll, kqueue, IOCP, event ports.
- Asynchronous TCP and UDP sockets
- Asynchronous DNS resolution
- Asynchronous file and file system operations
- File system events
- ANSI escape code controlled TTY
- IPC with socket sharing, using Unix domain sockets or named pipes (Windows)
- Child processes
- Thread pool
- Signal handling
- High resolution clock
- Threading and synchronization primitives

87.1 First Application using RingLibuv

Example:

```
load "libuv.ring"

func main

    myloop = new_uv_loop_t()
    uv_loop_init(myloop)
    ? "Now quitting"
```

(continues on next page)

(continued from previous page)

```
uv_run(myloop, UV_RUN_DEFAULT)
uv_loop_close(myloop)
destroy_uv_loop_t(myloop)
```

Output:

```
Now quitting
```

87.2 The Events Loop

Example:

```
load "libuv.ring"

counter = 0
idler = NULL

func main
    idler = new_uv_idle_t()
    uv_idle_init(uv_default_loop(), idler)
    uv_idle_start(idler, "wait()")
    ? "Idling..."
    uv_run(uv_default_loop(), UV_RUN_DEFAULT);
    uv_loop_close(uv_default_loop());
    destroy_uv_idle_t(idler)

func wait
    counter++
    if counter >= 100000
        uv_idle_stop(idler)
    ok
```

Output:

```
Idling...
```

87.3 Server Example

Example:

```
load "libuv.ring"

? "Testing RingLibuv - Server Side"

DEFAULT_PORT      = 13370
DEFAULT_BACKLOG = 1024

addr      = new_sockaddr_in()
```

(continues on next page)

(continued from previous page)

```

server = NULL
client = NULL
myloop = NULL

func main
    myloop = uv_default_loop()
    server = new_uv_tcp_t()
    uv_tcp_init(myloop, server)
    uv_ip4_addr("127.0.0.1", DEFAULT_PORT, addr)
    uv_tcp_bind(server, addr, 0)
    r = uv_listen(server, DEFAULT_BACKLOG, "newconnection()")
    if r
        ? "Listen error " + uv_strerror(r)
        return 1
    ok
    uv_run(myloop, UV_RUN_DEFAULT)
    destroy_uv_tcp_t(server)
    destroy_uv_sockaddr_in(addr)

func newconnection
    ? "New Connection"
    aPara = uv_Eventpara(server,:connect)
    nStatus = aPara[2]
    if nStatus < 0
        ? "New connection error : " + nStatus
        return
    ok
    client = new_uv_tcp_t()
    uv_tcp_init(myloop, client)
    if uv_accept(server, client) = 0
        uv_read_start(client, uv_myalloccallback(), "echo_read()")
    ok

func echo_read
    aPara = uv_Eventpara(client,:read)
    nRead = aPara[2]
    buf = aPara[3]
    if nRead > 0
        req = new_uv_write_t()
        wrbuf = uv_buf_init(get_uv_buf_t_base(buf), nread)
        uv_write(req, client, wrbuf, 1, "echo_write()")
        ? uv_buf2str(wrbuf)
        message = "message from the server to the client"
        buf = new_uv_buf_t()
        set_uv_buf_t_len(buf,len(message))
        set_uv_buf_t_base(buf,varptr("message",:char))
        uv_write(req, client, buf, 1, "echo_write()")
    ok

func echo_write
    aPara = uv_Eventpara(client,:read)
    req = aPara[1]

```

Output:

When we run the client, We will see the message “New Connection”

Then the message “hello from the client”

```
Testing RingLibuv - Server Side
New Connection
hello from the client
```

87.4 Client Example

Example:

```
load "libuv.ring"

? "Testing RingLibuv - Client Side"

DEFAULT_PORT      = 13370
DEFAULT_BACKLOG = 1024

addr   = new_sockaddr_in()
connect = NULL
buffer = null
socket = null

func main
    myloop  = uv_default_loop()
    Socket  = new_uv_tcp_t()
    connect = new_uv_connect_t()
    uv_tcp_init(myloop, Socket)
    uv_ip4_addr("127.0.0.1", DEFAULT_PORT, addr)
    uv_tcp_connect(connect, Socket, addr, "connect()")
    uv_run(myloop, UV_RUN_DEFAULT)
    destroy_uv_tcp_t(socket)
    destroy_uv_connect_t(connect)

func connect
    ? "Client: Start Connection"
    aPara  = uv_Eventpara(connect,:connect)
    req    = aPara[1]
    nStatus = aPara[2]
    if nStatus = -1
        ? "Error : on_write_end "
        return
    ok
    buf = new_uv_buf_t()
    message = "hello from the client"
    set_uv_buf_t_len(buf,len(message))
    set_uv_buf_t_base(buf,varptr("message",:char))
    tcp      = get_uv_connect_t_handle(req)
    write_req = new_uv_write_t()
```

(continues on next page)

(continued from previous page)

```

buf_count = 1
uv_write(write_req, tcp, buf, buf_count, "on_write_end()")

func on_write_end
    uv_read_start(socket, uv_myalloccallback(), "echo_read()")

func echo_read
    aPara = uv_Eventpara(socket,:read)
    nRead = aPara[2]
    buf   = aPara[3]
    if nRead > 0
        wrbuf = uv_buf_init(get_uv_buf_t_base(buf), nread);
    ? uv_buf2str(wrbuf)
ok

```

Output:

We will run the client after the server

```

Testing RingLibuv - Client Side
Client: Start Connection
hello from the client
message from the server to the client

```

87.5 Server Example Using Classes

Example:

```

load "libuv.ring"
load "objectslib.ring"

? "Testing RingLibuv - Server Side - Using Classes"

open_object(:MyServer)

class MyServer from ObjectControllerParent

    DEFAULT_PORT      = 13370
    DEFAULT_BACKLOG = 1024

    addr      = new_sockaddr_in()
    server   = NULL
    client   = NULL
    myloop   = NULL

    func start
        myloop = uv_default_loop()
        server = new_uv_tcp_t()
        uv_tcp_init(myloop, server)
        uv_ip4_addr("127.0.0.1", DEFAULT_PORT, addr)
        uv_tcp_bind(server, addr, 0)

```

(continues on next page)

(continued from previous page)

```

r = uv_listen(server, DEFAULT_BACKLOG, Method(:newconnection) )
if r
    ? "Listen error " + uv_strerror(r)
    return 1
ok
uv_run(myloop, UV_RUN_DEFAULT)
destroy_uv_tcp_t(server)
destroy_uv_sockaddr_in(addr)

func newconnection
? "New Connection"
aPara = uv_Eventpara(server,:connect)
nStatus = aPara[2]
if nStatus < 0
    ? "New connection error : " + nStatus
    return
ok
client = new_uv_tcp_t()
uv_tcp_init(myloop, client)
if uv_accept(server, client) = 0
    uv_read_start(client, uv_myalloccallback(),
                  Method(:echo_read))
ok

func echo_read
aPara = uv_Eventpara(client,:read)
nRead = aPara[2]
buf = aPara[3]
if nRead > 0
    req = new_uv_write_t()
    wrbuf = uv_buf_init(get_uv_buf_t_base(buf), nread)
    uv_write(req, client, wrbuf, 1, Method(:echo_write))
    ? uv_buf2str(wrbuf)
    message = "message from the server to the client"
    buf = new_uv_buf_t()
    set_uv_buf_t_len(buf,len(message))
    set_uv_buf_t_base(buf,varptr("message",:char))
    uv_write(req, client, buf, 1, Method(:echo_write))
ok

func echo_write
aPara = uv_Eventpara(client,:read)
req = aPara[1]

```

Output:

When we run the client, We will see the message “New Connection”

Then the message “hello from the client”

Testing RingLibuv - Server Side - Using Classes
New Connection
hello from the client

87.6 Client Example Using Classes

Example:

```

load "libuv.ring"
load "objectslib.ring"

? "Testing RingLibuv - Client Side - Using Classes"

open_object(:MyClient)

Class MyClient from ObjectControllerParent

    DEFAULT_PORT      = 13370
    DEFAULT_BACKLOG = 1024

    addr      = new_sockaddr_in()
    connect   = NULL
    buffer    = null
    socket    = null

    func start
        myloop  = uv_default_loop()
        Socket  = new_uv_tcp_t()
        connect  = new_uv_connect_t()
        uv_tcp_init(myloop, Socket)
        uv_ip4_addr("127.0.0.1", DEFAULT_PORT, addr)
        uv_tcp_connect(connect, Socket, addr, Method(:connect))
        uv_run(myloop, UV_RUN_DEFAULT)
        destroy_uv_tcp_t(socket)
        destroy_uv_connect_t(connect)

    func connect
        ? "Client: Start Connection"
        aPara   = uv_Eventpara(connect,:connect)
        req     = aPara[1]
        nStatus = aPara[2]
        if nStatus = -1
            ? "Error : on_write_end"
            return
        ok
        buf = new_uv_buf_t()
        message = "hello from the client"
        set_uv_buf_t_len(buf,len(message))
        set_uv_buf_t_base(buf,varptr("message",:char))
        tcp      = get_uv_connect_t_handle(req)
        write_req = new_uv_write_t()
        buf_count = 1
        uv_write(write_req, tcp, buf, buf_count, Method(:on_write_end))

    func on_write_end
        uv_read_start(socket, uv_myalloccallback(), Method(:echo_read))

```

(continues on next page)

(continued from previous page)

```
func echo_read
    aPara = uv_Eventpara(socket, :read)
    nRead = aPara[2]
    buf   = aPara[3]
    if nRead > 0
        wrbuf = uv_buf_init(get_uv_buf_t_base(buf), nread);
        ? uv_buf2str(wrbuf)
    ok
```

Output:

We will run the client after the server

```
Testing RingLibuv - Client Side - Using Classes
Client: Start Connection
hello from the client
message from the server to the client
```

87.7 Threads Example

Example:

```
load "libuv.ring"

? "Testing RingLibuv - Threads"

func main
    one_id = new_uv_thread_t()
    two_id = new_uv_thread_t()
    uv_thread_create(one_id, "one()")
    uv_thread_create(two_id, "two()")
    uv_thread_join(one_id)
    uv_thread_join(two_id)
    destroy_uv_thread_t(one_id)
    destroy_uv_thread_t(two_id)

func one
    ? "Message from the First Thread!"

func two
    ? "Message from the Second Thread!"
```

Output:

```
Testing RingLibuv - Threads
Message from the First Thread!
Message from the Second Thread!
```

87.8 Threads Example - Using Classes

Example:

```
load "libuv.ring"
load "objectslib.ring"

? "Testing RingLibuv - Threads - Using Classes"

open_object(:MyThreads)

class MyThreads from ObjectControllerParent

    func Start
        one_id = new_uv_thread_t()
        two_id = new_uv_thread_t()
        uv_thread_create(one_id, Method(:One))
        uv_thread_create(two_id, Method(:Two))
        uv_thread_join(one_id)
        uv_thread_join(two_id)
        destroy_uv_thread_t(one_id)
        destroy_uv_thread_t(two_id)

    func one
        ? "Message from the First Thread!"

    func Two
        ? "Message from the Second Thread!"
```

Output:

```
Testing RingLibuv - Threads - Using Classes
Message from the First Thread!
Message from the Second Thread!
```

RINGLIBUV FUNCTIONS REFERENCE

88.1 Introduction

In this chapter we have a list of the supported functions by this extension

88.2 Reference

- int uv_loop_init(uv_loop_t* loop)
- int uv_loop_configure(uv_loop_t* loop, uv_loop_option option, int)
- int uv_loop_close(uv_loop_t* loop)
- uv_loop_t* uv_default_loop(void)
- int uv_run(uv_loop_t* loop, uv_run_mode mode)
- int uv_loop_alive(const uv_loop_t* loop)
- void uv_stop(uv_loop_t* loop)
- size_t uv_loop_size(void)
- int uv_backend_fd(const uv_loop_t* loop)
- int uv_backend_timeout(const uv_loop_t* loop)
- uint64_t uv_now(const uv_loop_t* loop)
- void uv_update_time(uv_loop_t* loop)
- void uv_walk(uv_loop_t* loop, uv_walk_cb walk_cb, void* arg)
- void uv_walk_2(uv_loop_t* loop, uv_walk_cb walk_cb, void* arg)
- int uv_loop_fork(uv_loop_t* loop)
- int uv_is_active(const uv_handle_t* handle)
- int uv_is_closing(const uv_handle_t* handle)
- void uv_close(uv_handle_t* handle, uv_close_cb close_cb)
- void uv_close_2(uv_handle_t* handle, uv_close_cb close_cb)
- void uv_ref(uv_handle_t* handle)
- void uv_unref(uv_handle_t* handle)
- int uv_has_ref(const uv_handle_t* handle)

- `size_t uv_handle_size(uv_handle_type type)`
- `int uv_send_buffer_size(uv_handle_t* handle, int* value)`
- `int uv_recv_buffer_size(uv_handle_t* handle, int* value)`
- `int uv_fileno(const uv_handle_t* handle, uv_os_fd_t* fd)`
- `int uv_cancel(uv_req_t* req)`
- `size_t uv_req_size(uv_req_type type)`
- `int uv_timer_init(uv_loop_t* loop, uv_timer_t* handle)`
- `int uv_timer_start(uv_timer_t* handle, uv_timer_cb cb, uint64_t timeout, uint64_t repeat)`
- `int uv_timer_start_2(uv_timer_t* handle, uv_timer_cb cb, uint64_t timeout, uint64_t repeat)`
- `int uv_timer_stop(uv_timer_t* handle)`
- `int uv_timer_again(uv_timer_t* handle)`
- `void uv_timer_set_repeat(uv_timer_t* handle, uint64_t repeat)`
- `uint64_t uv_timer_get_repeat(const uv_timer_t* handle)`
- `int uv_prepare_init(uv_loop_t* loop, uv_prepare_t* prepare)`
- `int uv_prepare_start(uv_prepare_t* prepare, uv_prepare_cb cb)`
- `int uv_prepare_start_2(uv_prepare_t* prepare, uv_prepare_cb cb)`
- `int uv_prepare_stop(uv_prepare_t* prepare)`
- `int uv_check_init(uv_loop_t* loop, uv_check_t* check)`
- `int uv_check_start(uv_check_t* check, uv_check_cb cb)`
- `int uv_check_start_2(uv_check_t* check, uv_check_cb cb)`
- `int uv_check_stop(uv_check_t* check)`
- `int uv_idle_init(uv_loop_t* loop, uv_idle_t* idle)`
- `int uv_idle_start(uv_idle_t* idle, uv_idle_cb cb)`
- `int uv_idle_start_2(uv_idle_t* idle, uv_idle_cb cb)`
- `int uv_idle_stop(uv_idle_t* idle)`
- `int uv_async_init(uv_loop_t* loop, uv_async_t* async, uv_async_cb async_cb)`
- `int uv_async_init_2(uv_loop_t* loop, uv_async_t* async, uv_async_cb async_cb)`
- `int uv_async_send(uv_async_t* async)`
- `int uv_poll_init(uv_loop_t* loop, uv_poll_t* handle, int fd)`
- `int uv_poll_init_socket(uv_loop_t* loop, uv_poll_t* handle, uv_os_sock_t socket)`
- `int uv_poll_start(uv_poll_t* handle, int events, uv_poll_cb cb)`
- `int uv_poll_start_2(uv_poll_t* handle, int events, uv_poll_cb cb)`
- `int uv_poll_stop(uv_poll_t* poll)`
- `int uv_signal_init(uv_loop_t* loop, uv_signal_t* signal)`
- `int uv_signal_start(uv_signal_t* signal, uv_signal_cb cb, int signum)`
- `int uv_signal_start_2(uv_signal_t* signal, uv_signal_cb cb, int signum)`

- int uv_signal_start_oneshot(uv_signal_t* signal, uv_signal_cb cb, int signum)
- int uv_signal_start_oneshot_2(uv_signal_t* signal, uv_signal_cb cb, int signum)
- int uv_signal_stop(uv_signal_t* signal)
- void uv_disable_stdio_inheritance(void)
- int uv_spawn(uv_loop_t* loop, uv_process_t* handle, const uv_process_options_t* options)
- int uv_process_kill(uv_process_t* handle, int signum)
- int uv_kill(int pid, int signum)
- int uv_shutdown(uv_shutdown_t* req, uv_stream_t* handle, uv_shutdown_cb cb)
- int uv_shutdown_2(uv_shutdown_t* req, uv_stream_t* handle, uv_shutdown_cb cb)
- int uv_listen(uv_stream_t* stream, int backlog, uv_connection_cb cb)
- int uv_listen_2(uv_stream_t* stream, int backlog, uv_connection_cb cb)
- int uv_accept(uv_stream_t* server, uv_stream_t* client)
- int uv_read_start(uv_stream_t* stream, uv_alloc_cb alloc_cb, uv_read_cb read_cb)
- int uv_read_start_2(uv_stream_t* stream, uv_alloc_cb alloc_cb, uv_read_cb read_cb)
- int uv_read_stop(uv_stream_t*)
- int uv_write(uv_write_t* req, uv_stream_t* handle, uv_buf_t *bufs, unsigned int nbufs, uv_write_cb cb)
- int uv_write_2(uv_write_t* req, uv_stream_t* handle, uv_buf_t *bufs, unsigned int nbufs, uv_write_cb cb)
- int uv_write2(uv_write_t* req, uv_stream_t* handle, uv_buf_t bufs, *unsigned int nbufs*, uv_stream_t send_handle, uv_write_cb cb)
- int uv_write2_2(uv_write_t* req, uv_stream_t* handle, uv_buf_t bufs, *unsigned int nbufs*, uv_stream_t send_handle, uv_write_cb cb)
- int uv_try_write(uv_stream_t* handle, uv_buf_t *bufs, unsigned int nbufs)
- int uv_is_readable(const uv_stream_t* handle)
- int uv_is_writable(const uv_stream_t* handle)
- int uv_stream_set_blocking(uv_stream_t* handle, int blocking)
- int uv_tcp_init(uv_loop_t* loop, uv_tcp_t* handle)
- int uv_tcp_init_ex(uv_loop_t* loop, uv_tcp_t* handle, unsigned int flags)
- int uv_tcp_open(uv_tcp_t* handle, uv_os_sock_t sock)
- int uv_tcp_nodelay(uv_tcp_t* handle, int enable)
- int uv_tcp_keepalive(uv_tcp_t* handle, int enable, unsigned int delay)
- int uv_tcp_simultaneous_accepts(uv_tcp_t* handle, int enable)
- int uv_tcp_bind(uv_tcp_t *handle,sockaddr *addr,unsigned int flags)
- int uv_tcp_getsockname(const uv_tcp_t* handle, struct sockaddr* name, int* namelen)
- int uv_tcp_getpeername(const uv_tcp_t* handle, struct sockaddr* name, int* namelen)
- int uv_tcp_connect(uv_connect_t* req, uv_tcp_t* handle, sockaddr * addr, uv_connect_cb cb)
- int uv_tcp_connect_2(uv_connect_t* req, uv_tcp_t* handle, sockaddr * addr, uv_connect_cb cb)
- int uv_pipe_init(uv_loop_t* loop, uv_pipe_t* handle, int ipc)

- int uv_pipe_open(uv_pipe_t* handle, uv_file file)
- int uv_pipe_bind(uv_pipe_t* handle, const char * name)
- void uv_pipe_connect(uv_connect_t* req, uv_pipe_t* handle, const char * name, uv_connect_cb cb)
- void uv_pipe_connect_2(uv_connect_t* req, uv_pipe_t* handle, const char * name, uv_connect_cb cb)
- int uv_pipe_getsockname(const uv_pipe_t* handle, char* buffer, size_t* size)
- int uv_pipe_getpeername(const uv_pipe_t* handle, char* buffer, size_t* size)
- void uv_pipe_pending_instances(uv_pipe_t* handle, int count)
- int uv_pipe_pending_count(uv_pipe_t* handle)
- uv_handle_type uv_pipe_pending_type(uv_pipe_t* handle)
- int uv_pipe_chmod(uv_pipe_t* handle, int flags)
- int uv_tty_init(uv_loop_t* loop, uv_tty_t* handle, uv_file fd, int readable)
- int uv_tty_set_mode(uv_tty_t* handle, uv_tty_mode_t mode)
- int uv_tty_reset_mode(void)
- int uv_tty_get_winsize(uv_tty_t* handle, int* width, int* height)
- int uv_udp_init(uv_loop_t* loop, uv_udp_t* handle)
- int uv_udp_init_ex(uv_loop_t* loop, uv_udp_t* handle, unsigned int flags)
- int uv_udp_open(uv_udp_t* handle, uv_os_sock_t sock)
- int uv_udp_bind(uv_udp_t* handle, sockaddr * addr, unsigned int flags)
- int uv_udp_getsockname(const uv_udp_t* handle, struct sockaddr* name, int* namelen)
- int uv_udp_set_membership(uv_udp_t* handle, const char * multicast_addr, const char * interface_addr, uv_membership membership)
- int uv_udp_set_multicast_loop(uv_udp_t* handle, int on)
- int uv_udp_set_multicast_ttl(uv_udp_t* handle, int ttl)
- int uv_udp_set_multicast_interface(uv_udp_t* handle, const char * interface_addr)
- int uv_udp_set_broadcast(uv_udp_t* handle, int on)
- int uv_udp_set_ttl(uv_udp_t* handle, int ttl)
- int uv_udp_send(uv_udp_send_t* req, uv_udp_t* handle, uv_buf_t *bufs, unsigned int nbufs, sockaddr * addr, uv_udp_send_cb send_cb)
- int uv_udp_send_2(uv_udp_send_t* req, uv_udp_t* handle, uv_buf_t *bufs, unsigned int nbufs, sockaddr * addr, uv_udp_send_cb send_cb)
- int uv_udp_try_send(uv_udp_t* handle, uv_buf_t *bufs, unsigned int nbufs, sockaddr * addr)
- int uv_udp_recv_start(uv_udp_t* handle, uv_alloc_cb alloc_cb, uv_udp_recv_cb recv_cb)
- int uv_udp_recv_start_2(uv_udp_t* handle, uv_alloc_cb alloc_cb, uv_udp_recv_cb recv_cb)
- int uv_udp_recv_stop(uv_udp_t* handle)
- int uv_fs_event_init(uv_loop_t* loop, uv_fs_event_t* handle)
- int uv_fs_event_start(uv_fs_event_t* handle, uv_fs_event_cb cb, const char * path, unsigned int flags)
- int uv_fs_event_start_2(uv_fs_event_t* handle, uv_fs_event_cb cb, const char * path, unsigned int flags)

- int uv_fs_event_stop(uv_fs_event_t* handle)
- int uv_fs_event_getpath(uv_fs_event_t* handle, char* buffer, size_t* size)
- int uv_fs_poll_init(uv_loop_t* loop, uv_fs_poll_t* handle)
- int uv_fs_poll_start(uv_fs_poll_t* handle, uv_fs_poll_cb poll_cb, const char * path, unsigned int interval)
- int uv_fs_poll_start_2(uv_fs_poll_t* handle, uv_fs_poll_cb poll_cb, const char * path, unsigned int interval)
- int uv_fs_poll_stop(uv_fs_poll_t* handle)
- int uv_fs_poll_getpath(uv_fs_poll_t* handle, char* buffer, size_t* size)
- void uv_fs_req_cleanup(uv_fs_t* req)
- int uv_fs_close(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_fs_cb cb)
- int uv_fs_open(uv_loop_t* loop, uv_fs_t* req, const char * path, int flags, int mode, uv_fs_cb cb)
- int uv_fs_read(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_buf_t *bufs, unsigned int nbufs, int64_t offset, uv_fs_cb cb)
- int uv_fs_unlink(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_write(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_buf_t *bufs, unsigned int nbufs, int64_t offset, uv_fs_cb cb)
- int uv_fs_mkdir(uv_loop_t* loop, uv_fs_t* req, const char * path, int mode, uv_fs_cb cb)
- int uv_fs_mkdtemp(uv_loop_t* loop, uv_fs_t* req, const char * tpl, uv_fs_cb cb)
- int uv_fs_rmdir(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_scandir(uv_loop_t* loop, uv_fs_t* req, const char * path, int flags, uv_fs_cb cb)
- int uv_fs_scandir_next(uv_fs_t* req, uv_dirent_t* ent)
- int uv_fs_stat(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_fstat(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_fs_cb cb)
- int uv_fs_lstat(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_rename(uv_loop_t* loop, uv_fs_t* req, const char * path, const char * new_path, uv_fs_cb cb)
- int uv_fs_fsync(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_fs_cb cb)
- int uv_fs_fdatasync(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_fs_cb cb)
- int uv_fs_ftruncate(uv_loop_t* loop, uv_fs_t* req, uv_file file, int64_t offset, uv_fs_cb cb)
- int uv_fs_copyfile(uv_loop_t* loop, uv_fs_t* req, const char * path, const char * new_path, int flags, uv_fs_cb cb)
- int uv_fs_sendfile(uv_loop_t* loop, uv_fs_t* req, uv_file out_fd, uv_file in_fd, int64_t in_offset, size_t length, uv_fs_cb cb)
- int uv_fs_access(uv_loop_t* loop, uv_fs_t* req, const char * path, int mode, uv_fs_cb cb)
- int uv_fs_chmod(uv_loop_t* loop, uv_fs_t* req, const char * path, int mode, uv_fs_cb cb)
- int uv_fs_fchmod(uv_loop_t* loop, uv_fs_t* req, uv_file file, int mode, uv_fs_cb cb)
- int uv_fs_utime(uv_loop_t* loop, uv_fs_t* req, const char * path, double atime, double mtime, uv_fs_cb cb)
- int uv_fs_futime(uv_loop_t* loop, uv_fs_t* req, uv_file file, double atime, double mtime, uv_fs_cb cb)
- int uv_fs_link(uv_loop_t* loop, uv_fs_t* req, const char * path, const char * new_path, uv_fs_cb cb)

- int uv_fs_symlink(uv_loop_t* loop, uv_fs_t* req, const char * path, const char * new_path, int flags, uv_fs_cb cb)
- int uv_fs_readlink(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_realpath(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_chown(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_uid_t uid, uv_gid_t gid, uv_fs_cb cb)
- int uv_fs_fchown(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_uid_t uid, uv_gid_t gid, uv_fs_cb cb)
- int uv_fs_close_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_fs_cb cb)
- int uv_fs_open_2(uv_loop_t* loop, uv_fs_t* req, const char * path, int flags, int mode, uv_fs_cb cb)
- int uv_fs_read_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_buf_t *bufs, unsigned int nbufs, int64_t offset, uv_fs_cb cb)
- int uv_fs_unlink_2(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_write_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_buf_t *bufs, unsigned int nbufs, int64_t offset, uv_fs_cb cb)
- int uv_fs_mkdir_2(uv_loop_t* loop, uv_fs_t* req, const char * path, int mode, uv_fs_cb cb)
- int uv_fs_mkdtemp_2(uv_loop_t* loop, uv_fs_t* req, const char * tpl, uv_fs_cb cb)
- int uv_fs_rmdir_2(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_scandir_2(uv_loop_t* loop, uv_fs_t* req, const char * path, int flags, uv_fs_cb cb)
- int uv_fs_stat_2(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_fstat_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_fs_cb cb)
- int uv_fs_lstat_2(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_rename_2(uv_loop_t* loop, uv_fs_t* req, const char * path, const char * new_path, uv_fs_cb cb)
- int uv_fs_fsync_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_fs_cb cb)
- int uv_fs_fdatasync_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_fs_cb cb)
- int uv_fs_ftruncate_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, int64_t offset, uv_fs_cb cb)
- int uv_fs_copyfile_2(uv_loop_t* loop, uv_fs_t* req, const char * path, const char * new_path, int flags, uv_fs_cb cb)
- int uv_fs_sendfile_2(uv_loop_t* loop, uv_fs_t* req, uv_file out_fd, uv_file in_fd, int64_t in_offset, size_t length, uv_fs_cb cb)
- int uv_fs_access_2(uv_loop_t* loop, uv_fs_t* req, const char * path, int mode, uv_fs_cb cb)
- int uv_fs_chmod_2(uv_loop_t* loop, uv_fs_t* req, const char * path, int mode, uv_fs_cb cb)
- int uv_fs_fchmod_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, int mode, uv_fs_cb cb)
- int uv_fs_utime_2(uv_loop_t* loop, uv_fs_t* req, const char * path, double atime, double mtime, uv_fs_cb cb)
- int uv_fs_futime_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, double atime, double mtime, uv_fs_cb cb)
- int uv_fs_link_2(uv_loop_t* loop, uv_fs_t* req, const char * path, const char * new_path, uv_fs_cb cb)
- int uv_fs_symlink_2(uv_loop_t* loop, uv_fs_t* req, const char * path, const char * new_path, int flags, uv_fs_cb cb)
- int uv_fs_readlink_2(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)
- int uv_fs_realpath_2(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_fs_cb cb)

- int uv_fs_chown_2(uv_loop_t* loop, uv_fs_t* req, const char * path, uv_uid_t uid, uv_gid_t gid, uv_fs_cb cb)
- int uv_fs_fchown_2(uv_loop_t* loop, uv_fs_t* req, uv_file file, uv_uid_t uid, uv_gid_t gid, uv_fs_cb cb)
- int uv_queue_work(uv_loop_t* loop, uv_work_t* req, uv_work_cb work_cb, uv_after_work_cb after_work_cb)
- int uv_queue_work_2(uv_loop_t* loop, uv_work_t* req, uv_work_cb work_cb, uv_after_work_cb after_work_cb)
- int uv_getaddrinfo(uv_loop_t* loop, uv_getaddrinfo_t* req, uv_getaddrinfo_cb getaddrinfo_cb, const char * node, const char * service, const struct addrinfo* hints)
- int uv_getaddrinfo_2(uv_loop_t* loop, uv_getaddrinfo_t* req, uv_getaddrinfo_cb getaddrinfo_cb, const char * node, const char * service, const struct addrinfo* hints)
- void uv_freeaddrinfo(struct addrinfo* ai)
- int uv_getnameinfo(uv_loop_t* loop, uv_getnameinfo_t* req, uv_getnameinfo_cb getnameinfo_cb, sockaddr * addr, int flags)
- int uv_getnameinfo_2(uv_loop_t* loop, uv_getnameinfo_t* req, uv_getnameinfo_cb getnameinfo_cb, sockaddr * addr, int flags)
- int uv_dlopen(const char * filename, uv_lib_t* lib)
- void uv_dlclose(uv_lib_t* lib)
- int uv_dlsym(uv_lib_t* lib, const char * name, void** ptr)
- const char * uv_dlerror(const uv_lib_t* lib)
- int uv_thread_create(uv_thread_t* tid, uv_thread_cb entry, void* arg)
- int uv_thread_create_2(uv_thread_t* tid, uv_thread_cb entry, void* arg)
- uv_thread_t uv_thread_self(void)
- int uv_thread_join(uv_thread_t *tid)
- int uv_thread_equal(const uv_thread_t* t1, const uv_thread_t* t2)
- int uv_key_create(uv_key_t* key)
- void uv_key_delete(uv_key_t* key)
- void* uv_key_get(uv_key_t* key)
- void uv_key_set(uv_key_t* key, void* value)
- int uv_mutex_init(uv_mutex_t* handle)
- int uv_mutex_init_recursive(uv_mutex_t* handle)
- void uv_mutex_destroy(uv_mutex_t* handle)
- void uv_mutex_lock(uv_mutex_t* handle)
- int uv_mutex_trylock(uv_mutex_t* handle)
- void uv_mutex_unlock(uv_mutex_t* handle)
- int uv_rwlock_init(uv_rwlock_t* rwlock)
- void uv_rwlock_destroy(uv_rwlock_t* rwlock)
- void uv_rwlock_rdlock(uv_rwlock_t* rwlock)
- int uv_rwlock_tryrdlock(uv_rwlock_t* rwlock)
- void uv_rwlock_runlock(uv_rwlock_t* rwlock)

- void uv_rwlock_wrlock(uv_rwlock_t* rwlock)
- int uv_rwlock_trywrlock(uv_rwlock_t* rwlock)
- void uv_rwlock_wrunlock(uv_rwlock_t* rwlock)
- int uv_sem_init(uv_sem_t* sem, unsigned int value)
- void uv_sem_destroy(uv_sem_t* sem)
- void uv_sem_post(uv_sem_t* sem)
- void uv_sem_wait(uv_sem_t* sem)
- int uv_sem_trywait(uv_sem_t* sem)
- int uv_cond_init(uv_cond_t* cond)
- void uv_cond_destroy(uv_cond_t* cond)
- void uv_cond_signal(uv_cond_t* cond)
- void uv_cond_broadcast(uv_cond_t* cond)
- void uv_cond_wait(uv_cond_t* cond, uv_mutex_t* mutex)
- int uv_cond_timedwait(uv_cond_t* cond, uv_mutex_t* mutex, uint64_t timeout)
- int uv_barrier_init(uv_barrier_t* barrier, unsigned int count)
- void uv_barrier_destroy(uv_barrier_t* barrier)
- int uv_barrier_wait(uv_barrier_t* barrier)
- uv_handle_type uv_guess_handle(uv_file file)
- int uv_replace_allocator(uv_malloc_func malloc_func, uv_realloc_func realloc_func, uv_calloc_func calloc_func, uv_free_func free_func)
- uv_buf_t uv_buf_init(char* base, unsigned int len)
- char** uv_setup_args(int argc, char** argv)
- int uv_get_process_title(char* buffer, size_t size)
- int uv_set_process_title(const char * title)
- int uv_resident_set_memory(size_t* rss)
- int uv_uptime(double* uptime)
- int uv_getrusage(uv_rusage_t* rusage)
- uv_pid_t uv_os_getpid(void)
- uv_pid_t uv_os_getppid(void)
- int uv_cpu_info(uv_cpu_info_t** cpu_infos, int* count)
- void uv_free_cpu_info(uv_cpu_info_t* cpu_infos, int count)
- int uv_interface_addresses(uv_interface_address_t** addresses, int* count)
- void uv_free_interface_addresses(uv_interface_address_t* addresses, int count)
- int uv_ip6_addr(const char * ip, int port, sockaddr_in6* addr)
- int uv_ip4_name(sockaddr_in* src, char* dst, size_t size)
- int uv_ip6_name(sockaddr_in6* src, char* dst, size_t size)

- int uv_inet_ntop(int af, const void* src, char* dst, size_t size)
- int uv_inet_pton(int af, const char * src, void* dst)
- int uv_if_indextoname(unsigned int ifindex, char* buffer, size_t* size)
- int uv_if_indextooid(unsigned int ifindex, char* buffer, size_t* size)
- int uv_exepath(char* buffer, size_t* size)
- int uv_cwd(char* buffer, size_t* size)
- int uv_chdir(const char * dir)
- int uv_os_homedir(char* buffer, size_t* size)
- int uv_os_tmpdir(char* buffer, size_t* size)
- int uv_os_get_passwd(uv_passwd_t* pwd)
- void uv_os_free_passwd(uv_passwd_t* pwd)
- uint64_t uv_get_total_memory(void)
- uint64_t uv_hrtime(void)
- void uv_print_all_handles(uv_loop_t* loop, FILE* stream)
- void uv_print_active_handles(uv_loop_t* loop, FILE* stream)
- int uv_os_getenv(const char * name, char* buffer, size_t* size)
- int uv_os_setenv(const char * name, const char * value)
- int uv_os_unsetenv(const char * name)
- int uv_os_gethostname(char* buffer, size_t* size)

RINGFREEGLUT FUNCTIONS REFERENCE

89.1 Introduction

In this chapter we have a list of the supported functions by this extension

89.2 Reference

- GLUT_RGB
- GLUT_RGBA
- GLUT_INDEX
- GLUT_SINGLE
- GLUT_DOUBLE
- GLUT_ACCUM
- GLUT_ALPHA
- GLUT_DEPTH
- GLUT_STENCIL
- GLUT_MULTISAMPLE
- GLUT_STEREO
- GLUT_LUMINANCE
- GLUT_KEY_F1
- GLUT_KEY_F2
- GLUT_KEY_F3
- GLUT_KEY_F4
- GLUT_KEY_F5
- GLUT_KEY_F6
- GLUT_KEY_F7
- GLUT_KEY_F8
- GLUT_KEY_F9
- GLUT_KEY_F10

- GLUT_KEY_F11
- GLUT_KEY_F12
- GLUT_KEY_LEFT
- GLUT_KEY_UP
- GLUT_KEY_RIGHT
- GLUT_KEY_DOWN
- GLUT_KEY_PAGE_UP
- GLUT_KEY_PAGE_DOWN
- GLUT_KEY_HOME
- GLUT_KEY_END
- GLUT_KEY_INSERT
- GLUT_LEFT_BUTTON
- GLUT_MIDDLE_BUTTON
- GLUT_RIGHT_BUTTON
- GLUT_DOWN
- GLUT_UP
- GLUT_LEFT
- GLUT_ENTERED
- GLUT_MENU_NOT_IN_USE
- GLUT_MENU_IN_USE
- GLUT_NOT_VISIBLE
- GLUT_VISIBLE
- GLUT_HIDDEN
- GLUT_FULLY_RETAINED
- GLUT_PARTIALLY_RETAINED
- GLUT_FULLY_COVERED
- GLUT_WINDOW_X
- GLUT_WINDOW_Y
- GLUT_WINDOW_WIDTH
- GLUT_WINDOW_HEIGHT
- GLUT_WINDOW_BUFFER_SIZE
- GLUT_WINDOW_STENCIL_SIZE
- GLUT_WINDOW_DEPTH_SIZE
- GLUT_WINDOW_RED_SIZE
- GLUT_WINDOW_GREEN_SIZE
- GLUT_WINDOW_BLUE_SIZE

- GLUT_WINDOW_ALPHA_SIZE
- GLUT_WINDOW_ACCUM_RED_SIZE
- GLUT_WINDOW_ACCUM_GREEN_SIZE
- GLUT_WINDOW_ACCUM_BLUE_SIZE
- GLUT_WINDOW_ACCUM_ALPHA_SIZE
- GLUT_WINDOW_DOUBLEBUFFER
- GLUT_WINDOW_RGBA
- GLUT_WINDOW_PARENT
- GLUT_WINDOW_NUM_CHILDREN
- GLUT_WINDOW_COLORMAP_SIZE
- GLUT_WINDOW_NUM_SAMPLES
- GLUT_WINDOW_STEREO
- GLUT_WINDOW_CURSOR
- GLUT_SCREEN_WIDTH
- GLUT_SCREEN_HEIGHT
- GLUT_SCREEN_WIDTH_MM
- GLUT_SCREEN_HEIGHT_MM
- GLUT_MENU_NUM_ITEMS
- GLUT_DISPLAY_MODE_POSSIBLE
- GLUT_INIT_WINDOW_X
- GLUT_INIT_WINDOW_Y
- GLUT_INIT_WINDOW_WIDTH
- GLUT_INIT_WINDOW_HEIGHT
- GLUT_INIT_DISPLAY_MODE
- GLUT_ELAPSED_TIME
- GLUT_WINDOW_FORMAT_ID
- GLUT_HAS_KEYBOARD
- GLUT_HAS_MOUSE
- GLUT_HAS_SPACEBALL
- GLUT_HAS_DIAL_AND_BUTTON_BOX
- GLUT_HAS_TABLET
- GLUT_NUM_MOUSE_BUTTONS
- GLUT_NUM_SPACEBALL_BUTTONS
- GLUT_NUM_BUTTON_BOX_BUTTONS
- GLUT_NUM_DIALS
- GLUT_NUM_TABLET_BUTTONS

- GLUT_DEVICE_IGNORE_KEY_REPEAT
- GLUT_DEVICE_KEY_REPEAT
- GLUT_HAS_JOYSTICK
- GLUT_OWNS_JOYSTICK
- GLUT_JOYSTICK_BUTTONS
- GLUT_JOYSTICK_AXES
- GLUT_JOYSTICK_POLL_RATE
- GLUT_OVERLAY_POSSIBLE
- GLUT_LAYER_IN_USE
- GLUT_HAS_OVERLAY
- GLUT_TRANSPARENT_INDEX
- GLUT_NORMAL_DAMAGED
- GLUT_OVERLAY_DAMAGED
- GLUT_VIDEO_RESIZE_POSSIBLE
- GLUT_VIDEO_RESIZE_IN_USE
- GLUT_VIDEO_RESIZE_X_DELTA
- GLUT_VIDEO_RESIZE_Y_DELTA
- GLUT_VIDEO_RESIZE_WIDTH_DELTA
- GLUT_VIDEO_RESIZE_HEIGHT_DELTA
- GLUT_VIDEO_RESIZE_X
- GLUT_VIDEO_RESIZE_Y
- GLUT_VIDEO_RESIZE_WIDTH
- GLUT_VIDEO_RESIZE_HEIGHT
- GLUT_NORMAL
- GLUT_OVERLAY
- GLUT_ACTIVE_SHIFT
- GLUT_ACTIVE_CTRL
- GLUT_ACTIVE_ALT
- GLUT_CURSOR_RIGHT_ARROW
- GLUT_CURSOR_LEFT_ARROW
- GLUT_CURSOR_INFO
- GLUT_CURSOR_DESTROY
- GLUT_CURSOR_HELP
- GLUT_CURSOR_CYCLE
- GLUT_CURSOR_SPRAY
- GLUT_CURSOR_WAIT

- GLUT_CURSOR_TEXT
- GLUT_CURSOR_CROSSHAIR
- GLUT_CURSOR_UP_DOWN
- GLUT_CURSOR_LEFT_RIGHT
- GLUT_CURSOR_TOP_SIDE
- GLUT_CURSOR_BOTTOM_SIDE
- GLUT_CURSOR_LEFT_SIDE
- GLUT_CURSOR_RIGHT_SIDE
- GLUT_CURSOR_TOP_LEFT_CORNER
- GLUT_CURSOR_TOP_RIGHT_CORNER
- GLUT_CURSOR_BOTTOM_RIGHT_CORNER
- GLUT_CURSOR_BOTTOM_LEFT_CORNER
- GLUT_CURSOR_INHERIT
- GLUT_CURSOR_NONE
- GLUT_CURSOR_FULL_CROSSHAIR
- GLUT_RED
- GLUT_GREEN
- GLUT_BLUE
- GLUT_KEY_REPEAT_OFF
- GLUT_KEY_REPEAT_ON
- GLUT_KEY_REPEAT_DEFAULT
- GLUT_JOYSTICK_BUTTON_A
- GLUT_JOYSTICK_BUTTON_B
- GLUT_JOYSTICK_BUTTON_C
- GLUT_JOYSTICK_BUTTON_D
- GLUT_GAME_MODE_ACTIVE
- GLUT_GAME_MODE_POSSIBLE
- GLUT_GAME_MODE_WIDTH
- GLUT_GAME_MODE_HEIGHT
- GLUT_GAME_MODE_PIXEL_DEPTH
- GLUT_GAME_MODE_REFRESH_RATE
- GLUT_GAME_MODE_DISPLAY_CHANGED
- GLUT_STROKE_ROMAN
- GLUT_STROKE_MONO_ROMAN
- GLUT_BITMAP_9_BY_15
- GLUT_BITMAP_8_BY_13

- GLUT_BITMAP_TIMES_ROMAN_10
- GLUT_BITMAP_TIMES_ROMAN_24
- GLUT_BITMAP_HELVETICA_10
- GLUT_BITMAP_HELVETICA_12
- GLUT_BITMAP_HELVETICA_18
- void glutInit(void)
- void glutDisplayFunc(const char *)
- void glutReshapeFunc(const char *)
- int glutEventWidth(void)
- int glutEventHeight(void)
- void glutIdleFunc(const char *)
- void glutKeyboardFunc(const char *)
- void glutSpecialFunc(const char *)
- void glutSpecialUpFunc(const char *)
- void glutMouseFunc(const char *)
- void glutMotionFunc(const char *)
- int glutCreateMenu(const char *)
- void glutMenuStatusFunc(const char *)
- int glutEventKey(void)
- int glutEventX(void)
- int glutEventY(void)
- int glutEventButton(void)
- int glutEventState(void)
- int glutEventValue(void)
- int glutEventStatus(void)
- void test_draw(void)
- void glutInitWindowPosition(int x, int y)
- void glutInitWindowSize(int width, int height)
- void glutInitDisplayMode(unsigned displayMode)
- void glutInitDisplayString(const char * displayMode)
- int glutCreateWindow(const char * title)
- int glutCreateSubWindow(int window, int x, int y, int width, int height)
- void glutDestroyWindow(int window)
- void glutSetWindow(int window)
- int glutGetWindow(void)
- void glutSetWindowTitle(const char * title)

- void glutSetIconTitle(const char * title)
- void glutReshapeWindow(int width, int height)
- void glutPositionWindow(int x, int y)
- void glutShowWindow(void)
- void glutHideWindow(void)
- void glutIconifyWindow(void)
- void glutPushWindow(void)
- void glutPopWindow(void)
- void glutFullScreen(void)
- void glutPostWindowRedisplay(int window)
- void glutPostRedisplay(void)
- void glutSwapBuffers(void)
- void glutWarpPointer(int x, int y)
- void glutSetCursor(int cursor)
- void glutEstablishOverlay(void)
- void glutRemoveOverlay(void)
- void glutUseLayer(GLenum layer)
- void glutPostOverlayRedisplay(void)
- void glutPostWindowOverlayRedisplay(int window)
- void glutShowOverlay(void)
- void glutHideOverlay(void)
- void glutDestroyMenu(int menu)
- int glutGetMenu(void)
- void glutSetMenu(int menu)
- void glutAddMenuEntry(const char * label, int value)
- void glutAddSubMenu(const char * label, int subMenu)
- void glutChangeToMenuEntry(int item, const char * label, int value)
- void glutChangeToSubMenu(int item, const char * label, int value)
- void glutRemoveMenuItem(int item)
- void glutAttachMenu(int button)
- void glutDetachMenu(int button)
- int glutGet(GLenum query)
- int glutDeviceGet(GLenum query)
- int glutGetModifiers(void)
- int glutLayerGet(GLenum query)
- void glutBitmapCharacter(void *font, int character)

- int glutBitmapWidth(void *font, int character)
- void glutStrokeCharacter(void *font, int character)
- int glutStrokeWidth(void *font, int character)
- int glutStrokeLength(void *font, char * string)
- GLfloat glutStrokeWidthf(void *font, int character)
- GLfloat glutStrokeLengthf(void *font, char *string)
- int glutBitmapLength(void *font, char * string)
- void glutWireCube(double size)
- void glutSolidCube(double size)
- void glutWireSphere(double radius, GLint slices, GLint stacks)
- void glutSolidSphere(double radius, GLint slices, GLint stacks)
- void glutWireCone(double base, double height, GLint slices, GLint stacks)
- void glutSolidCone(double base, double height, GLint slices, GLint stacks)
- void glutWireTorus(double innerRadius, double outerRadius, GLint sides, GLint rings)
- void glutSolidTorus(double innerRadius, double outerRadius, GLint sides, GLint rings)
- void glutWireDodecahedron(void)
- void glutSolidDodecahedron(void)
- void glutWireOctahedron(void)
- void glutSolidOctahedron(void)
- void glutWireTetrahedron(void)
- void glutSolidTetrahedron(void)
- void glutWireIcosahedron(void)
- void glutSolidIcosahedron(void)
- void glutWireTeapot(double size)
- void glutSolidTeapot(double size)
- void glutGameModeString(const char * string)
- int glutEnterGameMode(void)
- void glutLeaveGameMode(void)
- int glutGameModeGet(GLenum query)
- int glutVideoResizeGet(GLenum query)
- void glutSetupVideoResizing(void)
- void glutStopVideoResizing(void)
- void glutVideoResize(int x, int y, int width, int height)
- void glutVideoPan(int x, int y, int width, int height)
- void glutSetColor(int color, GLfloat red, GLfloat green, GLfloat blue)
- GLfloat glutGetColor(int color, int component)

- void glutCopyColormap(int window)
- void glutIgnoreKeyRepeat(int ignore)
- void glutSetKeyRepeat(int repeatMode)
- void glutForceJoystickFunc(void)
- int glutExtensionSupported(const char * extension)
- void glutReportErrors(void)
- void glutMainLoop(void)
- void glutCloseFunc(const char *)
- GLUT_KEY_NUM_LOCK
- GLUT_KEY_BEGIN
- GLUT_KEY_DELETE
- GLUT_KEY_SHIFT_L
- GLUT_KEY_SHIFT_R
- GLUT_KEY_CTRL_L
- GLUT_KEY_CTRL_R
- GLUT_KEY_ALT_L
- GLUT_KEY_ALT_R
- GLUT_ACTION_EXIT
- GLUT_ACTION_GLUTMAINLOOP_RETURNS
- GLUT_ACTION_CONTINUE_EXECUTION
- GLUT_CREATE_NEW_CONTEXT
- GLUT_USE_CURRENT_CONTEXT
- GLUT_FORCE INDIRECT_CONTEXT
- GLUT_ALLOW_DIRECT_CONTEXT
- GLUT_TRY_DIRECT_CONTEXT
- GLUT_FORCE_DIRECT_CONTEXT
- GLUT_INIT_STATE
- GLUT_ACTION_ON_WINDOW_CLOSE
- GLUT_WINDOW_BORDER_WIDTH
- GLUT_WINDOW_BORDER_HEIGHT
- GLUT_WINDOW_HEADER_HEIGHT
- GLUT_VERSION
- GLUT_RENDERING_CONTEXT
- GLUT_DIRECT_RENDERING
- GLUT_FULL_SCREEN
- GLUT_SKIP_STALE_MOTION_EVENTS

- GLUT_AUX
- GLUT_AUX1
- GLUT_AUX2
- GLUT_AUX3
- GLUT_AUX4
- GLUT_INIT_MAJOR_VERSION
- GLUT_INIT_MINOR_VERSION
- GLUT_INIT_FLAGS
- GLUT_INIT_PROFILE
- GLUT_DEBUG
- GLUT_FORWARD_COMPATIBLE
- GLUT_CORE_PROFILE
- GLUT_COMPATIBILITY_PROFILE
- GLUT_CAPTIONLESS
- GLUT_BORDERLESS
- GLUT_SRGB
- GLUT_HAS_MULTI
- void glutMainLoopEvent(void)
- void glutLeaveMainLoop(void)
- void glutExit(void)
- void glutFullScreenToggle(void)
- void glutLeaveFullScreen(void)
- void glutSetMenuFont(int menuID, void *font)
- void glutSetOption(GLenum option_flag, int value)
- int *glutGetModeValues(GLenum mode, int * size)
- void *glutGetWindowData(void)
- void glutSetWindowData(void *data)
- void *glutGetMenuData(void)
- void glutSetMenuData(void *data)
- int glutBitmapHeight(void* font)
- GLfloat glutStrokeHeight(void* font)
- void glutBitmapString(void* font, char *string)
- void glutStrokeString(void* font, char *string)
- void glutWireRhombicDodecahedron(void)
- void glutSolidRhombicDodecahedron(void)
- void glutWireSierpinskiSponge(int num_levels, double *offset, double scale)

- void glutSolidSierpinskiSponge(int num_levels, double *offset, double scale)
- void glutWireCylinder(double radius, double height, GLint slices, GLint stacks)
- void glutSolidCylinder(double radius, double height, GLint slices, GLint stacks)
- void glutWireTeacup(double size)
- void glutSolidTeacup(double size)
- void glutWireTeaspoon(double size)
- void glutSolidTeaspoon(double size)
- void glutInitContextVersion(int majorVersion, int minorVersion)
- void glutInitContextFlags(int flags)
- void glutInitContextProfile(int profile)
- void glutSetVertexAttribCoord3(GLint attrib)
- void glutSetVertexAttribNormal(GLint attrib)
- void glutSetVertexAttribTexCoord2(GLint attrib)

RINGSTBIMAGE FUNCTIONS REFERENCE

90.1 Introduction

In this chapter we have a list of the supported functions by this extension

Example (1):

```
# Load the library
    load "stbimage.ring"
# Image Information
    width=0 height=0 channels=0
# Ring will Free cData automatically in the end of the program
    cData = stbi_load("ring.jpg",:width,:height,:channels,STBI_rgb)
# Display the output
    ? "Size (bytes): " + len(cData)
    ? "Width : " + width
    ? "Height: " + height
    ? "Channels: " + channels
```

Output:

```
Size (bytes): 557371
Width : 563
Height: 330
Channels: 3
```

Example (2):

```
load "stbimage.ring"

width      = 640
height     = 480
channels   = 3
cData      = space(width*height*channels)

? "Creating the image..."
t1 = clock()
nIndex=0
for x=1 to height
    for y=1 to width
        cData[nIndex++] = x*x
```

(continues on next page)

(continued from previous page)

```
cData[nIndex++] = x*y
cData[nIndex++] = x*2
next
next
t2 = clock()

# Write the image
? "Writing mynewimage.bmp"
stbi_write_bmp("mynewimage.bmp", width, height, channels, cData)
t3 = clock()

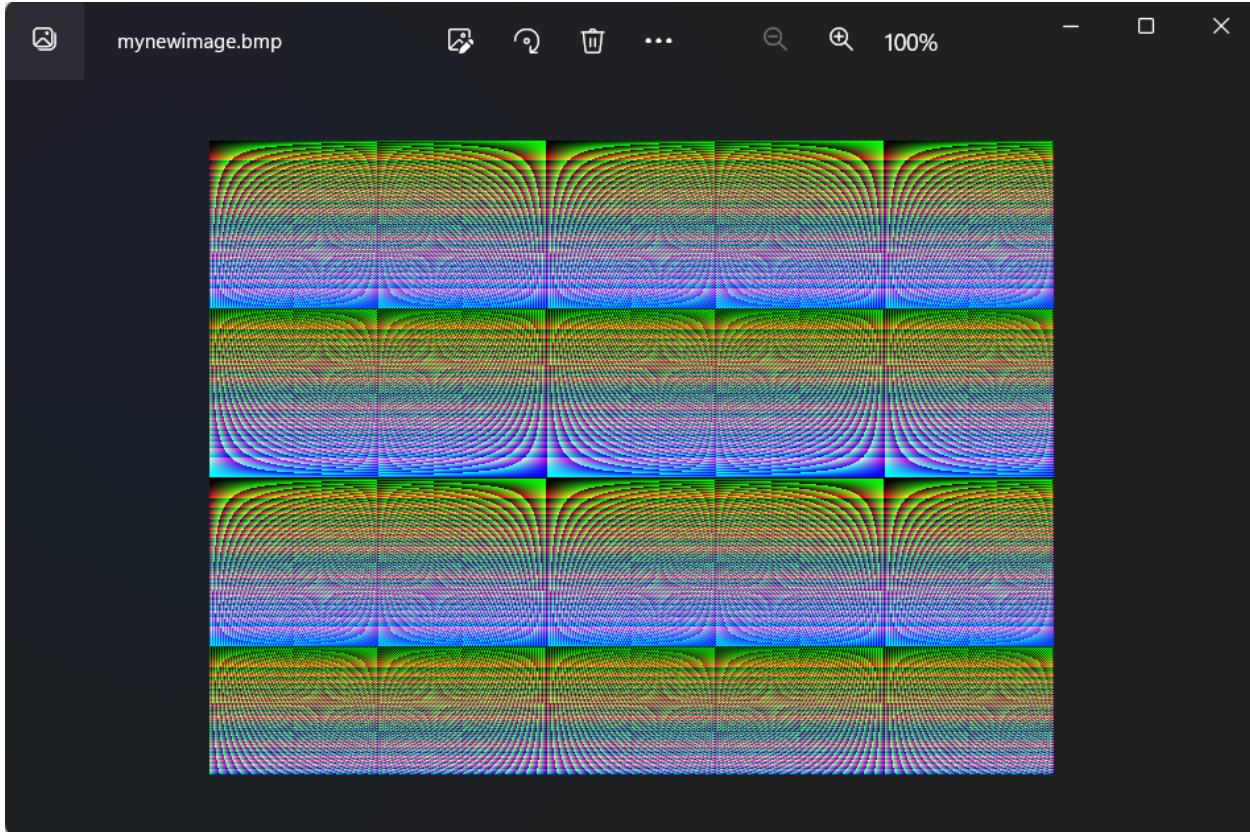
? "Time to create the image : " + ((t2-t1)/clockspersecond()) + " seconds"
? "Time to save the image   : " + ((t3-t2)/clockspersecond()) + " seconds"

system("mynewimage.bmp")
```

Output:

```
Creating the image...
Writing mynewimage.bmp
Time to create the image : 0.12 seconds
Time to save the image   : 0.00 seconds
```

Screen Shot:



90.2 Constants

- STBI_default
- STBI_grey
- STBI_grey_alpha
- STBI_rgb
- STBI_rgb_alpha

90.3 Functions

- `stbi_uc *stbi_load_from_memory(stbi_uc const *buffer, int len,int *x, int *y, int *channels_in_file, int desired_channels)`
- `stbi_uc *stbi_load(char const *filename, int *x, int *y, int *channels_in_file, int desired_channels)`
- `stbi_uc *stbi_load_from_file(FILE *f, int *x, int *y, int *channels_in_file, int desired_channels)`
- `stbi_us *stbi_load_16_from_memory(stbi_uc const *buffer, int len, int *x, int *y, int *channels_in_file, int desired_channels)`
- `stbi_us *stbi_load_16(char const *filename, int *x, int *y, int *channels_in_file, int desired_channels)`
- `stbi_us *stbi_load_from_file_16(FILE *f, int *x, int *y, int *channels_in_file, int desired_channels)`
- `float *stbi_loadf_from_memory(stbi_uc const *buffer, int len, int *x, int *y, int *channels_in_file, int desired_channels)`
- `float *stbi_loadf(char const *filename, int *x, int *y, int *channels_in_file, int desired_channels)`
- `float *stbi_loadf_from_file(FILE *f, int *x, int *y, int *channels_in_file, int desired_channels)`
- `void stbi_hdr_to_ldr_gamma(float gamma)`
- `void stbi_hdr_to_ldr_scale(float scale)`
- `void stbi_ldr_to_hdr_gamma(float gamma)`
- `void stbi_ldr_to_hdr_scale(float scale)`
- `int stbi_is_hdr_from_memory(stbi_uc const *buffer, int len)`
- `int stbi_is_hdr(char const *filename)`
- `int stbi_is_hdr_from_file(FILE *f)`
- `const char *stbi_failure_reason(void)`
- `int stbi_info_from_memory(stbi_uc const *buffer, int len, int *x, int *y, int *comp)`
- `int stbi_is_16_bit_from_memory(stbi_uc const *buffer, int len)`
- `int stbi_info(char const *filename,int *x,int *y,int *comp)`
- `int stbi_info_from_file(FILE *f,int *x,int *y,int *comp)`
- `int stbi_is_16_bit(char const *filename)`
- `int stbi_is_16_bit_from_file(FILE *f)`
- `void stbi_set_unpremultiply_on_load(int flag_true_if_should_unpremultiply)`
- `void stbi_convert_iphone_png_to_rgb(int flag_true_if_should_convert)`

- void stbi_set_flip_vertically_on_load(int flag_true_if_should_flip)
- void stbi_set_flip_vertically_on_load_thread(int flag_true_if_should_flip)
- char *stbi_zlib_decode_malloc_guesssize(const char *buffer, int len, int initial_size, int *outlen)
- char *stbi_zlib_decode_malloc_guesssize_headerflag(const char *buffer, int len, int initial_size, int *outlen, int parse_header)
- char *stbi_zlib_decode_malloc(const char *buffer, int len, int *outlen)
- int stbi_zlib_decode_buffer(char *obuffer, int olen, const char *ibuffer, int ilen)
- char *stbi_zlib_decode_noheader_malloc(const char *buffer, int len, int *outlen)
- int stbi_zlib_decode_noheader_buffer(char *obuffer, int olen, const char *ibuffer, int ilen)
- int stbi_write_png(char const *filename, int w, int h, int comp, const void *data, int stride_in_bytes)
- int stbi_write_bmp(char const *filename, int w, int h, int comp, const void *data)
- int stbi_write_tga(char const *filename, int w, int h, int comp, const void *data)
- int stbi_write_jpg(char const *filename, int w, int h, int comp, const void *data, int quality)
- void stbi_flip_vertically_on_write(int flag)

RINGOPENGL (OPENGL 3.2) FUNCTIONS REFERENCE

91.1 Introduction

In this chapter we have a list of the supported functions by this extension

91.2 Reference

- GL_ZERO
- GL_FALSE
- GL_LOGIC_OP
- GL_NONE
- GL_TEXTURE_COMPONENTS
- GL_NO_ERROR
- GL_POINTS
- GL_CURRENT_BIT
- GL_TRUE
- GL_ONE
- GL_CLIENT_PIXEL_STORE_BIT
- GL_LINES
- GL_LINE_LOOP
- GL_POINT_BIT
- GL_CLIENT_VERTEX_ARRAY_BIT
- GL_LINE_STRIP
- GL_LINE_BIT
- GL_TRIANGLES
- GL_TRIANGLE_STRIP
- GL_TRIANGLE_FAN
- GL_QUADS
- GL_QUAD_STRIP

- GL_POLYGON_BIT
- GL_POLYGON
- GL_POLYGON_STIPPLE_BIT
- GL_PIXEL_MODE_BIT
- GL_LIGHTING_BIT
- GL_FOG_BIT
- GL_DEPTH_BUFFER_BIT
- GL_ACCUM
- GL_LOAD
- GL_RETURN
- GL_MULT
- GL_ADD
- GL_NEVER
- GL_ACCUM_BUFFER_BIT
- GL_LESS
- GL_EQUAL
- GL_NOTEQUAL
- GL_GREATER
- GL_GEQUAL
- GL_ALWAYS
- GL_SRC_COLOR
- GL_ONE_MINUS_SRC_COLOR
- GL_SRC_ALPHA
- GL_ONE_MINUS_SRC_ALPHA
- GL_DST_ALPHA
- GL_ONE_MINUS_DST_ALPHA
- GL_DST_COLOR
- GL_ONE_MINUS_DST_COLOR
- GL_SRC_ALPHA_SATURATE
- GL_STENCIL_BUFFER_BIT
- GL_FRONT_LEFT
- GL_FRONT_RIGHT
- GL_BACK_LEFT
- GL_BACK_RIGHT
- GL_FRONT

- GL_BACK
- GL_LEFT
- GL_RIGHT
- GL_FRONT_AND_BACK
- GL_AUX0
- GL_AUX1
- GL_AUX2
- GL_AUX3
- GL_INVALID_ENUM
- GL_INVALID_VALUE
- GL_INVALID_OPERATION
- GL_STACK_OVERFLOW
- GL_STACK_UNDERFLOW
- GL_OUT_OF_MEMORY
- GL_2D
- GL_3D
- GL_3D_COLOR
- GL_3D_COLOR_TEXTURE
- GL_4D_COLOR_TEXTURE
- GL_PASS_THROUGH_TOKEN
- GL_POINT_TOKEN
- GL_LINE_TOKEN
- GL_POLYGON_TOKEN
- GL_BITMAP_TOKEN
- GL_DRAW_PIXEL_TOKEN
- GL_COPY_PIXEL_TOKEN
- GL_LINE_RESET_TOKEN
- GL_EXP
- GL_VIEWPORT_BIT
- GL_EXP2
- GL_CW
- GL_CCW
- GL_COEFF
- GL_ORDER
- GL_DOMAIN
- GL_CURRENT_COLOR

- GL_CURRENT_INDEX
- GL_CURRENT_NORMAL
- GL_CURRENT_TEXTURE_COORDS
- GL_CURRENT_RASTER_COLOR
- GL_CURRENT_RASTER_INDEX
- GL_CURRENT_RASTER_TEXTURE_COORDS
- GL_CURRENT_RASTER_POSITION
- GL_CURRENT_RASTER_POSITION_VALID
- GL_CURRENT_RASTER_DISTANCE
- GL_POINT_SMOOTH
- GL_POINT_SIZE
- GL_POINT_SIZE_RANGE
- GL_POINT_SIZE_GRANULARITY
- GL_LINE_SMOOTH
- GL_LINE_WIDTH
- GL_LINE_WIDTH_RANGE
- GL_LINE_WIDTH_GRANULARITY
- GL_LINE_STIPPLE
- GL_LINE_STIPPLE_PATTERN
- GL_LINE_STIPPLE_REPEAT
- GL_LIST_MODE
- GL_MAX_LIST_NESTING
- GL_LIST_BASE
- GL_LIST_INDEX
- GL_POLYGON_MODE
- GL_POLYGON_SMOOTH
- GL_POLYGON_STIPPLE
- GL_EDGE_FLAG
- GL_CULL_FACE
- GL_CULL_FACE_MODE
- GL_FRONT_FACE
- GL_LIGHTING
- GL_LIGHT_MODEL_LOCAL_VIEWER
- GL_LIGHT_MODEL_TWO_SIDE
- GL_LIGHT_MODEL_AMBIENT
- GL_SHADE_MODEL

- GL_COLOR_MATERIAL_FACE
- GL_COLOR_MATERIAL_PARAMETER
- GL_COLOR_MATERIAL
- GL_FOG
- GL_FOG_INDEX
- GL_FOG_DENSITY
- GL_FOG_START
- GL_FOG_END
- GL_FOG_MODE
- GL_FOG_COLOR
- GL_DEPTH_RANGE
- GL_DEPTH_TEST
- GL_DEPTH_WRITEMASK
- GL_DEPTH_CLEAR_VALUE
- GL_DEPTH_FUNC
- GL_ACCUM_CLEAR_VALUE
- GL_STENCIL_TEST
- GL_STENCIL_CLEAR_VALUE
- GL_STENCIL_FUNC
- GL_STENCIL_VALUE_MASK
- GL_STENCIL_FAIL
- GL_STENCIL_PASS_DEPTH_FAIL
- GL_STENCIL_PASS_DEPTH_PASS
- GL_STENCIL_REF
- GL_STENCIL_WRITEMASK
- GL_MATRIX_MODE
- GL_NORMALIZE
- GL_VIEWPORT
- GL_MODELVIEW_STACK_DEPTH
- GL_PROJECTION_STACK_DEPTH
- GL_TEXTURE_STACK_DEPTH
- GL_MODELVIEW_MATRIX
- GL_PROJECTION_MATRIX
- GL_TEXTURE_MATRIX
- GL_ATTRIB_STACK_DEPTH
- GL_CLIENT_ATTRIB_STACK_DEPTH

- GL_ALPHA_TEST
- GL_ALPHA_TEST_FUNC
- GL_ALPHA_TEST_REF
- GL_DITHER
- GL_BLEND_DST
- GL_BLEND_SRC
- GL_BLEND
- GL_LOGIC_OP_MODE
- GL_INDEX_LOGIC_OP
- GL_COLOR_LOGIC_OP
- GL_AUX_BUFFERS
- GL_DRAW_BUFFER
- GL_READ_BUFFER
- GL_SCISSOR_BOX
- GL_SCISSOR_TEST
- GL_INDEX_CLEAR_VALUE
- GL_INDEX_WRITEMASK
- GL_COLOR_CLEAR_VALUE
- GL_COLOR_WRITEMASK
- GL_INDEX_MODE
- GL_RGBA_MODE
- GL_DOUBLEBUFFER
- GL_STEREO
- GL_RENDER_MODE
- GL_PERSPECTIVE_CORRECTION_HINT
- GL_POINT_SMOOTH_HINT
- GL_LINE_SMOOTH_HINT
- GL_POLYGON_SMOOTH_HINT
- GL_FOG_HINT
- GL_TEXTURE_GEN_S
- GL_TEXTURE_GEN_T
- GL_TEXTURE_GEN_R
- GL_TEXTURE_GEN_Q
- GL_PIXEL_MAP_I_TO_I
- GL_PIXEL_MAP_S_TO_S
- GL_PIXEL_MAP_I_TO_R

- GL_PIXEL_MAP_I_TO_G
- GL_PIXEL_MAP_I_TO_B
- GL_PIXEL_MAP_I_TO_A
- GL_PIXEL_MAP_R_TO_R
- GL_PIXEL_MAP_G_TO_G
- GL_PIXEL_MAP_B_TO_B
- GL_PIXEL_MAP_A_TO_A
- GL_PIXEL_MAP_I_TO_I_SIZE
- GL_PIXEL_MAP_S_TO_S_SIZE
- GL_PIXEL_MAP_I_TO_R_SIZE
- GL_PIXEL_MAP_I_TO_G_SIZE
- GL_PIXEL_MAP_I_TO_B_SIZE
- GL_PIXEL_MAP_I_TO_A_SIZE
- GL_PIXEL_MAP_R_TO_R_SIZE
- GL_PIXEL_MAP_G_TO_G_SIZE
- GL_PIXEL_MAP_B_TO_B_SIZE
- GL_PIXEL_MAP_A_TO_A_SIZE
- GL_UNPACK_SWAP_BYTES
- GL_UNPACK_LSB_FIRST
- GL_UNPACK_ROW_LENGTH
- GL_UNPACK_SKIP_ROWS
- GL_UNPACK_SKIP_PIXELS
- GL_UNPACK_ALIGNMENT
- GL_PACK_SWAP_BYTES
- GL_PACK_LSB_FIRST
- GL_PACK_ROW_LENGTH
- GL_PACK_SKIP_ROWS
- GL_PACK_SKIP_PIXELS
- GL_PACK_ALIGNMENT
- GL_MAP_COLOR
- GL_MAP_STENCIL
- GL_INDEX_SHIFT
- GL_INDEX_OFFSET
- GL_RED_SCALE
- GL_RED_BIAS
- GL_ZOOM_X

- GL_ZOOM_Y
- GL_GREEN_SCALE
- GL_GREEN_BIAS
- GL_BLUE_SCALE
- GL_BLUE_BIAS
- GL_ALPHA_SCALE
- GL_ALPHA_BIAS
- GL_DEPTH_SCALE
- GL_DEPTH_BIAS
- GL_MAX_EVAL_ORDER
- GL_MAX_LIGHTS
- GL_MAX_CLIP_PLANES
- GL_MAX_TEXTURE_SIZE
- GL_MAX_PIXEL_MAP_TABLE
- GL_MAX_ATTRIB_STACK_DEPTH
- GL_MAX_MODELVIEW_STACK_DEPTH
- GL_MAX_NAME_STACK_DEPTH
- GL_MAX_PROJECTION_STACK_DEPTH
- GL_MAX_TEXTURE_STACK_DEPTH
- GL_MAX_VIEWPORT_DIMS
- GL_MAX_CLIENT_ATTRIB_STACK_DEPTH
- GL_SUBPIXEL_BITS
- GL_INDEX_BITS
- GL_RED_BITS
- GL_GREEN_BITS
- GL_BLUE_BITS
- GL_ALPHA_BITS
- GL_DEPTH_BITS
- GL_STENCIL_BITS
- GL_ACCUM_RED_BITS
- GL_ACCUM_GREEN_BITS
- GL_ACCUM_BLUE_BITS
- GL_ACCUM_ALPHA_BITS
- GL_NAME_STACK_DEPTH
- GL_AUTO_NORMAL
- GL_MAP1_COLOR_4

- GL_MAP1_INDEX
- GL_MAP1_NORMAL
- GL_MAP1_TEXTURE_COORD_1
- GL_MAP1_TEXTURE_COORD_2
- GL_MAP1_TEXTURE_COORD_3
- GL_MAP1_TEXTURE_COORD_4
- GL_MAP1_VERTEX_3
- GL_MAP1_VERTEX_4
- GL_MAP2_COLOR_4
- GL_MAP2_INDEX
- GL_MAP2_NORMAL
- GL_MAP2_TEXTURE_COORD_1
- GL_MAP2_TEXTURE_COORD_2
- GL_MAP2_TEXTURE_COORD_3
- GL_MAP2_TEXTURE_COORD_4
- GL_MAP2_VERTEX_3
- GL_MAP2_VERTEX_4
- GL_MAP1_GRID_DOMAIN
- GL_MAP1_GRID_SEGMENTS
- GL_MAP2_GRID_DOMAIN
- GL_MAP2_GRID_SEGMENTS
- GL_TEXTURE_1D
- GL_TEXTURE_2D
- GL_FEEDBACK_BUFFER_POINTER
- GL_FEEDBACK_BUFFER_SIZE
- GL_FEEDBACK_BUFFER_TYPE
- GL_SELECTION_BUFFER_POINTER
- GL_SELECTION_BUFFER_SIZE
- GL_TEXTURE_WIDTH
- GL_TRANSFORM_BIT
- GL_TEXTURE_HEIGHT
- GL_TEXTURE_INTERNAL_FORMAT
- GL_TEXTURE_BORDER_COLOR
- GL_TEXTURE_BORDER
- GL_DONT_CARE
- GL_FASTEST

- GL_NICEST
- GL_AMBIENT
- GL_DIFFUSE
- GL_SPECULAR
- GL_POSITION
- GL_SPOT_DIRECTION
- GL_SPOT_EXPONENT
- GL_SPOT_CUTOFF
- GL_CONSTANT_ATTENUATION
- GL_LINEAR_ATTENUATION
- GL_QUADRATIC_ATTENUATION
- GL_COMPILE
- GL_COMPILE_AND_EXECUTE
- GL_BYTE
- GL_UNSIGNED_BYTE
- GL_SHORT
- GL_UNSIGNED_SHORT
- GL_INT
- GL_UNSIGNED_INT
- GL_FLOAT
- GL_2_BYTES
- GL_3_BYTES
- GL_4_BYTES
- GL_DOUBLE
- GL_CLEAR
- GL_AND
- GL_AND_REVERSE
- GL_COPY
- GL_AND_INVERTED
- GL_NOOP
- GL_XOR
- GL_OR
- GL_NOR
- GL_EQUIV
- GL_INVERT
- GL_OR_REVERSE

- GL_COPY_INVERTED
- GL_OR_INVERTED
- GL_NAND
- GL_SET
- GL_EMISSION
- GL_SHININESS
- GL_AMBIENT_AND_DIFFUSE
- GL_COLOR_INDEXES
- GL_MODELVIEW
- GL_PROJECTION
- GL_TEXTURE
- GL_COLOR
- GL_DEPTH
- GL_STENCIL
- GL_COLOR_INDEX
- GL_STENCIL_INDEX
- GL_DEPTH_COMPONENT
- GL_RED
- GL_GREEN
- GL_BLUE
- GL_ALPHA
- GL_RGB
- GL_RGBA
- GL_LUMINANCE
- GL_LUMINANCE_ALPHA
- GL_BITMAP
- GL_POINT
- GL_LINE
- GL_FILL
- GL_RENDER
- GL_FEEDBACK
- GL_SELECT
- GL_FLAT
- GL_SMOOTH
- GL_KEEP
- GL_REPLACE

- GL_INCR
- GL_DECR
- GL_VENDOR
- GL_RENDERER
- GL_VERSION
- GL_EXTENSIONS
- GL_S
- GL_ENABLE_BIT
- GL_T
- GL_R
- GL_Q
- GL_MODULATE
- GL_DECAL
- GL_TEXTURE_ENV_MODE
- GL_TEXTURE_ENV_COLOR
- GL_TEXTURE_ENV
- GL_EYE_LINEAR
- GL_OBJECT_LINEAR
- GL_SPHERE_MAP
- GL_TEXTURE_GEN_MODE
- GL_OBJECT_PLANE
- GL_EYE_PLANE
- GL_NEAREST
- GL_LINEAR
- GL_NEAREST_MIPMAP_NEAREST
- GL_LINEAR_MIPMAP_NEAREST
- GL_NEAREST_MIPMAP_LINEAR
- GL_LINEAR_MIPMAP_LINEAR
- GL_TEXTURE_MAG_FILTER
- GL_TEXTURE_MIN_FILTER
- GL_TEXTURE_WRAP_S
- GL_TEXTURE_WRAP_T
- GL_CLAMP
- GL_REPEAT
- GL_POLYGON_OFFSET_UNITS
- GL_POLYGON_OFFSET_POINT

- GL_POLYGON_OFFSET_LINE
- GL_R3_G3_B2
- GL_V2F
- GL_V3F
- GL_C4UB_V2F
- GL_C4UB_V3F
- GL_C3F_V3F
- GL_N3F_V3F
- GL_C4F_N3F_V3F
- GL_T2F_V3F
- GL_T4F_V4F
- GL_T2F_C4UB_V3F
- GL_T2F_C3F_V3F
- GL_T2F_N3F_V3F
- GL_T2F_C4F_N3F_V3F
- GL_T4F_C4F_N3F_V4F
- GL_CLIP_PLANE0
- GL_CLIP_PLANE1
- GL_CLIP_PLANE2
- GL_CLIP_PLANE3
- GL_CLIP_PLANE4
- GL_CLIP_PLANES5
- GL_LIGHT0
- GL_COLOR_BUFFER_BIT
- GL_LIGHT1
- GL_LIGHT2
- GL_LIGHT3
- GL_LIGHT4
- GL_LIGHT5
- GL_LIGHT6
- GL_LIGHT7
- GL_HINT_BIT
- GL_POLYGON_OFFSET_FILL
- GL_POLYGON_OFFSET_FACTOR
- GL_ALPHA4
- GL_ALPHA8

- GL_ALPHA12
- GL_ALPHA16
- GL_LUMINANCE4
- GL_LUMINANCE8
- GL_LUMINANCE12
- GL_LUMINANCE16
- GL_LUMINANCE4_ALPHA4
- GL_LUMINANCE6_ALPHA2
- GL_LUMINANCE8_ALPHA8
- GL_LUMINANCE12_ALPHA4
- GL_LUMINANCE12_ALPHA12
- GL_LUMINANCE16_ALPHA16
- GL_INTENSITY
- GL_INTENSITY4
- GL_INTENSITY8
- GL_INTENSITY12
- GL_INTENSITY16
- GL_RGB4
- GL_RGB5
- GL_RGB8
- GL_RGB10
- GL_RGB12
- GL_RGB16
- GL_RGBA2
- GL_RGBA4
- GL_RGB5_A1
- GL_RGBA8
- GL_RGB10_A2
- GL_RGBA12
- GL_RGBA16
- GL_TEXTURE_RED_SIZE
- GL_TEXTURE_GREEN_SIZE
- GL_TEXTURE_BLUE_SIZE
- GL_TEXTURE_ALPHA_SIZE
- GL_TEXTURE_LUMINANCE_SIZE
- GL_TEXTURE_INTENSITY_SIZE

- GL_PROXY_TEXTURE_1D
- GL_PROXY_TEXTURE_2D
- GL_TEXTURE_PRIORITY
- GL_TEXTURE_RESIDENT
- GL_TEXTURE_BINDING_1D
- GL_TEXTURE_BINDING_2D
- GL_VERTEX_ARRAY
- GL_NORMAL_ARRAY
- GL_COLOR_ARRAY
- GL_INDEX_ARRAY
- GL_TEXTURE_COORD_ARRAY
- GL_EDGE_FLAG_ARRAY
- GL_VERTEX_ARRAY_SIZE
- GL_VERTEX_ARRAY_TYPE
- GL_VERTEX_ARRAY_STRIDE
- GL_NORMAL_ARRAY_TYPE
- GL_NORMAL_ARRAY_STRIDE
- GL_COLOR_ARRAY_SIZE
- GL_COLOR_ARRAY_TYPE
- GL_COLOR_ARRAY_STRIDE
- GL_INDEX_ARRAY_TYPE
- GL_INDEX_ARRAY_STRIDE
- GL_TEXTURE_COORD_ARRAY_SIZE
- GL_TEXTURE_COORD_ARRAY_TYPE
- GL_TEXTURE_COORD_ARRAY_STRIDE
- GL_EDGE_FLAG_ARRAY_STRIDE
- GL_VERTEX_ARRAY_POINTER
- GL_NORMAL_ARRAY_POINTER
- GL_COLOR_ARRAY_POINTER
- GL_INDEX_ARRAY_POINTER
- GL_TEXTURE_COORD_ARRAY_POINTER
- GL_EDGE_FLAG_ARRAY_POINTER
- GL_COLOR_INDEX1_EXT
- GL_COLOR_INDEX2_EXT
- GL_COLOR_INDEX4_EXT
- GL_COLOR_INDEX8_EXT

- GL_COLOR_INDEX12_EXT
- GL_COLOR_INDEX16_EXT
- GL_EVAL_BIT
- GL_LIST_BIT
- GL_TEXTURE_BIT
- GL_SCISSOR_BIT
- GL_ALL_ATTRIB_BITS
- GL_CLIENT_ALL_ATTRIB_BITS
- GL_SMOOTH_POINT_SIZE_RANGE
- GL_SMOOTH_POINT_SIZE_GRANULARITY
- GL_SMOOTH_LINE_WIDTH_RANGE
- GL_SMOOTH_LINE_WIDTH_GRANULARITY
- GL_UNSIGNED_BYTE_3_3_2
- GL_UNSIGNED_SHORT_4_4_4_4
- GL_UNSIGNED_SHORT_5_5_5_1
- GL_UNSIGNED_INT_8_8_8_8
- GL_UNSIGNED_INT_10_10_10_2
- GL_RESCALE_NORMAL
- GL_TEXTURE_BINDING_3D
- GL_PACK_SKIP_IMAGES
- GL_PACK_IMAGE_HEIGHT
- GL_UNPACK_SKIP_IMAGES
- GL_UNPACK_IMAGE_HEIGHT
- GL_TEXTURE_3D
- GL_PROXY_TEXTURE_3D
- GL_TEXTURE_DEPTH
- GL_TEXTURE_WRAP_R
- GL_MAX_3D_TEXTURE_SIZE
- GL_BGR
- GL_BGRA
- GL_MAX_ELEMENTS_VERTICES
- GL_MAX_ELEMENTS_INDICES
- GL_CLAMP_TO_EDGE
- GL_TEXTURE_MIN_LOD
- GL_TEXTURE_MAX_LOD
- GL_TEXTURE_BASE_LEVEL

- GL_TEXTURE_MAX_LEVEL
- GL_LIGHT_MODEL_COLOR_CONTROL
- GL_SINGLE_COLOR
- GL_SEPARATE_SPECULAR_COLOR
- GL_UNSIGNED_BYTE_2_3_3_REV
- GL_UNSIGNED_SHORT_5_6_5
- GL_UNSIGNED_SHORT_5_6_5_REV
- GL_UNSIGNED_SHORT_4_4_4_4_REV
- GL_UNSIGNED_SHORT_1_5_5_5_REV
- GL_UNSIGNED_INT_8_8_8_8_REV
- GL_ALIASED_POINT_SIZE_RANGE
- GL_ALIASED_LINE_WIDTH_RANGE
- GL_MULTISAMPLE
- GL_SAMPLE_ALPHA_TO_COVERAGE
- GL_SAMPLE_ALPHA_TO_ONE
- GL_SAMPLE_COVERAGE
- GL_SAMPLE_BUFFERS
- GL_SAMPLES
- GL_SAMPLE_COVERAGE_VALUE
- GL_SAMPLE_COVERAGE_INVERT
- GL_CLAMP_TO_BORDER
- GL_TEXTURE0
- GL_TEXTURE1
- GL_TEXTURE2
- GL_TEXTURE3
- GL_TEXTURE4
- GL_TEXTURE5
- GL_TEXTURE6
- GL_TEXTURE7
- GL_TEXTURE8
- GL_TEXTURE9
- GL_TEXTURE10
- GL_TEXTURE11
- GL_TEXTURE12
- GL_TEXTURE13
- GL_TEXTURE14

- GL_TEXTURE15
- GL_TEXTURE16
- GL_TEXTURE17
- GL_TEXTURE18
- GL_TEXTURE19
- GL_TEXTURE20
- GL_TEXTURE21
- GL_TEXTURE22
- GL_TEXTURE23
- GL_TEXTURE24
- GL_TEXTURE25
- GL_TEXTURE26
- GL_TEXTURE27
- GL_TEXTURE28
- GL_TEXTURE29
- GL_TEXTURE30
- GL_TEXTURE31
- GL_ACTIVE_TEXTURE
- GL_CLIENT_ACTIVE_TEXTURE
- GL_MAX_TEXTURE_UNITS
- GL_TRANSPOSE_MODELVIEW_MATRIX
- GL_TRANSPOSE_PROJECTION_MATRIX
- GL_TRANSPOSE_TEXTURE_MATRIX
- GL_TRANSPOSE_COLOR_MATRIX
- GL_SUBTRACT
- GL_COMPRESSED_ALPHA
- GL_COMPRESSED_LUMINANCE
- GL_COMPRESSED_LUMINANCE_ALPHA
- GL_COMPRESSED_INTENSITY
- GL_COMPRESSED_RGB
- GL_COMPRESSED_RGBA
- GL_TEXTURE_COMPRESSION_HINT
- GL_NORMAL_MAP
- GL_REFLECTION_MAP
- GL_TEXTURE_CUBE_MAP
- GL_TEXTURE_BINDING_CUBE_MAP

- GL_TEXTURE_CUBE_MAP_POSITIVE_X
- GL_TEXTURE_CUBE_MAP_NEGATIVE_X
- GL_TEXTURE_CUBE_MAP_POSITIVE_Y
- GL_TEXTURE_CUBE_MAP_NEGATIVE_Y
- GL_TEXTURE_CUBE_MAP_POSITIVE_Z
- GL_TEXTURE_CUBE_MAP_NEGATIVE_Z
- GL_PROXY_TEXTURE_CUBE_MAP
- GL_MAX_CUBE_MAP_TEXTURE_SIZE
- GL_COMBINE
- GL_COMBINE_RGB
- GL_COMBINE_ALPHA
- GL_RGB_SCALE
- GL_ADD_SIGNED
- GL_INTERPOLATE
- GL_CONSTANT
- GL_PRIMARY_COLOR
- GL_PREVIOUS
- GL_SOURCE0_RGB
- GL_SOURCE1_RGB
- GL_SOURCE2_RGB
- GL_SOURCE0_ALPHA
- GL_SOURCE1_ALPHA
- GL_SOURCE2_ALPHA
- GL_OPERAND0_RGB
- GL_OPERAND1_RGB
- GL_OPERAND2_RGB
- GL_OPERAND0_ALPHA
- GL_OPERAND1_ALPHA
- GL_OPERAND2_ALPHA
- GL_TEXTURE_COMPRESSED_IMAGE_SIZE
- GL_TEXTURE_COMPRESSED
- GL_NUM_COMPRESSED_TEXTURE_FORMATS
- GL_COMPRESSED_TEXTURE_FORMATS
- GL_DOT3_RGB
- GL_DOT3_RGBA
- GL_MULTISAMPLE_BIT

- GL_BLEND_DST_RGB
- GL_BLEND_SRC_RGB
- GL_BLEND_DST_ALPHA
- GL_BLEND_SRC_ALPHA
- GL_POINT_SIZE_MIN
- GL_POINT_SIZE_MAX
- GL_POINT_FADE_THRESHOLD_SIZE
- GL_POINT_DISTANCE_ATTENUATION
- GL_GENERATE_MIPMAP
- GL_GENERATE_MIPMAP_HINT
- GL_DEPTH_COMPONENT16
- GL_DEPTH_COMPONENT24
- GL_DEPTH_COMPONENT32
- GL_MIRRORED_REPEAT
- GL_FOG_COORDINATE_SOURCE
- GL_FOG_COORDINATE
- GL_FRAGMENT_DEPTH
- GL_CURRENT_FOG_COORDINATE
- GL_FOG_COORDINATE_ARRAY_TYPE
- GL_FOG_COORDINATE_ARRAY_STRIDE
- GL_FOG_COORDINATE_ARRAY_POINTER
- GL_FOG_COORDINATE_ARRAY
- GL_COLOR_SUM
- GL_CURRENT_SECONDARY_COLOR
- GL_SECONDARY_COLOR_ARRAY_SIZE
- GL_SECONDARY_COLOR_ARRAY_TYPE
- GL_SECONDARY_COLOR_ARRAY_STRIDE
- GL_SECONDARY_COLOR_ARRAY_POINTER
- GL_SECONDARY_COLOR_ARRAY
- GL_MAX_TEXTURE_LOD_BIAS
- GL_TEXTURE_FILTER_CONTROL
- GL_TEXTURE_LOD_BIAS
- GL_INCR_WRAP
- GL_DECR_WRAP
- GL_TEXTURE_DEPTH_SIZE
- GL_DEPTH_TEXTURE_MODE

- GL_TEXTURE_COMPARE_MODE
- GL_TEXTURE_COMPARE_FUNC
- GL_COMPARE_R_TO_TEXTURE
- GL_CURRENT_FOG_COORD
- GL_FOG_COORD
- GL_FOG_COORD_ARRAY
- GL_FOG_COORD_ARRAY_BUFFER_BINDING
- GL_FOG_COORD_ARRAY_POINTER
- GL_FOG_COORD_ARRAY_STRIDE
- GL_FOG_COORD_ARRAY_TYPE
- GL_FOG_COORD_SRC
- GL_SRC0_ALPHA
- GL_SRC0_RGB
- GL_SRC1_ALPHA
- GL_SRC1_RGB
- GL_SRC2_ALPHA
- GL_SRC2_RGB
- GL_BUFFER_SIZE
- GL_BUFFER_USAGE
- GL_QUERY_COUNTER_BITS
- GL_CURRENT_QUERY
- GL_QUERY_RESULT
- GL_QUERY_RESULT_AVAILABLE
- GL_ARRAY_BUFFER
- GL_ELEMENT_ARRAY_BUFFER
- GL_ARRAY_BUFFER_BINDING
- GL_ELEMENT_ARRAY_BUFFER_BINDING
- GL_VERTEX_ARRAY_BUFFER_BINDING
- GL_NORMAL_ARRAY_BUFFER_BINDING
- GL_COLOR_ARRAY_BUFFER_BINDING
- GL_INDEX_ARRAY_BUFFER_BINDING
- GL_TEXTURE_COORD_ARRAY_BUFFER_BINDING
- GL_EDGE_FLAG_ARRAY_BUFFER_BINDING
- GL_SECONDARY_COLOR_ARRAY_BUFFER_BINDING
- GL_FOG_COORDINATE_ARRAY_BUFFER_BINDING
- GL_WEIGHT_ARRAY_BUFFER_BINDING

- GL_VERTEX_ATTRIB_ARRAY_BUFFER_BINDING
- GL_READ_ONLY
- GL_WRITE_ONLY
- GL_READ_WRITE
- GL_BUFFER_ACCESS
- GL_BUFFER_MAPPED
- GL_BUFFER_MAP_POINTER
- GL_STREAM_DRAW
- GL_STREAM_READ
- GL_STREAM_COPY
- GL_STATIC_DRAW
- GL_STATIC_READ
- GL_STATIC_COPY
- GL_DYNAMIC_DRAW
- GL_DYNAMIC_READ
- GL_DYNAMIC_COPY
- GL_SAMPLES_PASSED
- GL_BLEND_EQUATION_RGB
- GL_VERTEX_ATTRIB_ARRAY_ENABLED
- GL_VERTEX_ATTRIB_ARRAY_SIZE
- GL_VERTEX_ATTRIB_ARRAY_STRIDE
- GL_VERTEX_ATTRIB_ARRAY_TYPE
- GL_CURRENT_VERTEX_ATTRIB
- GL_VERTEX_PROGRAM_POINT_SIZE
- GL_VERTEX_PROGRAM_TWO_SIDE
- GL_VERTEX_ATTRIB_ARRAY_POINTER
- GL_STENCIL_BACK_FUNC
- GL_STENCIL_BACK_FAIL
- GL_STENCIL_BACK_PASS_DEPTH_FAIL
- GL_STENCIL_BACK_PASS_DEPTH_PASS
- GL_MAX_DRAW_BUFFERS
- GL_DRAW_BUFFER0
- GL_DRAW_BUFFER1
- GL_DRAW_BUFFER2
- GL_DRAW_BUFFER3
- GL_DRAW_BUFFER4

- GL_DRAW_BUFFER5
- GL_DRAW_BUFFER6
- GL_DRAW_BUFFER7
- GL_DRAW_BUFFER8
- GL_DRAW_BUFFER9
- GL_DRAW_BUFFER10
- GL_DRAW_BUFFER11
- GL_DRAW_BUFFER12
- GL_DRAW_BUFFER13
- GL_DRAW_BUFFER14
- GL_DRAW_BUFFER15
- GL_BLEND_EQUATION_ALPHA
- GL_POINT_SPRITE
- GL_COORD_REPLACE
- GL_MAX_VERTEX_ATTRIBS
- GL_VERTEX_ATTRIB_ARRAY_NORMALIZED
- GL_MAX_TEXTURE_COORDS
- GL_MAX_TEXTURE_IMAGE_UNITS
- GL_FRAGMENT_SHADER
- GL_VERTEX_SHADER
- GL_MAX_FRAGMENT_UNIFORM_COMPONENTS
- GL_MAX_VERTEX_UNIFORM_COMPONENTS
- GL_MAX_VARYING_FLOATS
- GL_MAX_VERTEX_TEXTURE_IMAGE_UNITS
- GL_MAX_COMBINED_TEXTURE_IMAGE_UNITS
- GL_SHADER_TYPE
- GL_FLOAT_VEC2
- GL_FLOAT_VEC3
- GL_FLOAT_VEC4
- GL_INT_VEC2
- GL_INT_VEC3
- GL_INT_VEC4
- GL_BOOL
- GL_BOOL_VEC2
- GL_BOOL_VEC3
- GL_BOOL_VEC4

- GL_FLOAT_MAT2
- GL_FLOAT_MAT3
- GL_FLOAT_MAT4
- GL_SAMPLER_1D
- GL_SAMPLER_2D
- GL_SAMPLER_3D
- GL_SAMPLER_CUBE
- GL_SAMPLER_1D_SHADOW
- GL_SAMPLER_2D_SHADOW
- GL_DELETE_STATUS
- GL_COMPILE_STATUS
- GL_LINK_STATUS
- GL_VALIDATE_STATUS
- GL_INFO_LOG_LENGTH
- GL_ATTACHED_SHADERS
- GL_ACTIVE_UNIFORMS
- GL_ACTIVE_UNIFORM_MAX_LENGTH
- GL_SHADER_SOURCE_LENGTH
- GL_ACTIVE_ATTRIBUTES
- GL_ACTIVE_ATTRIBUTE_MAX_LENGTH
- GL_FRAGMENT_SHADER_DERIVATIVE_HINT
- GL_SHADING_LANGUAGE_VERSION
- GL_CURRENT_PROGRAM
- GL_POINT_SPRITE_COORD_ORIGIN
- GL_LOWER_LEFT
- GL_UPPER_LEFT
- GL_STENCIL_BACK_REF
- GL_STENCIL_BACK_VALUE_MASK
- GL_STENCIL_BACK_WRITEMASK
- GL_CURRENT_RASTER_SECONDARY_COLOR
- GL_PIXEL_PACK_BUFFER
- GL_PIXEL_UNPACK_BUFFER
- GL_PIXEL_PACK_BUFFER_BINDING
- GL_PIXEL_UNPACK_BUFFER_BINDING
- GL_FLOAT_MAT2x3
- GL_FLOAT_MAT2x4

- GL_FLOAT_MAT3x2
- GL_FLOAT_MAT3x4
- GL_FLOAT_MAT4x2
- GL_FLOAT_MAT4x3
- GL_SRGB
- GL_SRGB8
- GL_SRGB_ALPHA
- GL_SRGB8_ALPHA8
- GL_SLUMINANCE_ALPHA
- GL_SLUMINANCE8_ALPHA8
- GL_SLUMINANCE
- GL_SLUMINANCE8
- GL_COMPRESSED_SRGB
- GL_COMPRESSED_SRGB_ALPHA
- GL_COMPRESSED_SLUMINANCE
- GL_COMPRESSED_SLUMINANCE_ALPHA
- GL_CLIP_DISTANCE0
- GL_CLIP_DISTANCE1
- GL_CLIP_DISTANCE2
- GL_CLIP_DISTANCE3
- GL_CLIP_DISTANCE4
- GL_CLIP_DISTANCE5
- GL_COMPARE_REF_TO_TEXTURE
- GL_MAX_CLIP_DISTANCES
- GL_MAX_VARYING_COMPONENTS
- GL_CONTEXT_FLAG_FORWARD_COMPATIBLE_BIT
- GL_MAJOR_VERSION
- GL_MINOR_VERSION
- GL_NUM_EXTENSIONS
- GL_CONTEXT_FLAGS
- GL_DEPTH_BUFFER
- GL_STENCIL_BUFFER
- GL_RGBA32F
- GL_RGB32F
- GL_RGBA16F
- GL_RGB16F

- GL_VERTEX_ATTRIB_ARRAY_INTEGER
- GL_MAX_ARRAY_TEXTURE_LAYERS
- GL_MIN_PROGRAM_TEXEL_OFFSET
- GL_MAX_PROGRAM_TEXEL_OFFSET
- GL_CLAMP_VERTEX_COLOR
- GL_CLAMP_FRAGMENT_COLOR
- GL_CLAMP_READ_COLOR
- GL_FIXED_ONLY
- GL_TEXTURE_RED_TYPE
- GL_TEXTURE_GREEN_TYPE
- GL_TEXTURE_BLUE_TYPE
- GL_TEXTURE_ALPHA_TYPE
- GL_TEXTURE_LUMINANCE_TYPE
- GL_TEXTURE_INTENSITY_TYPE
- GL_TEXTURE_DEPTH_TYPE
- GL_TEXTURE_1D_ARRAY
- GL_PROXY_TEXTURE_1D_ARRAY
- GL_TEXTURE_2D_ARRAY
- GL_PROXY_TEXTURE_2D_ARRAY
- GL_TEXTURE_BINDING_1D_ARRAY
- GL_TEXTURE_BINDING_2D_ARRAY
- GL_R11F_G11F_B10F
- GL_UNSIGNED_INT_10F_11F_11F_REV
- GL_RGB9_E5
- GL_UNSIGNED_INT_5_9_9_9_REV
- GL_TEXTURE_SHARED_SIZE
- GL_TRANSFORM_FEEDBACK_VARYING_MAX_LENGTH
- GL_TRANSFORM_FEEDBACK_BUFFER_MODE
- GL_MAX_TRANSFORM_FEEDBACK_SEPARATE_COMPONENTS
- GL_TRANSFORM_FEEDBACK_VARYINGS
- GL_TRANSFORM_FEEDBACK_BUFFER_START
- GL_TRANSFORM_FEEDBACK_BUFFER_SIZE
- GL_PRIMITIVES_GENERATED
- GL_TRANSFORM_FEEDBACK_PRIMITIVES_WRITTEN
- GL_RASTERIZER_DISCARD
- GL_MAX_TRANSFORM_FEEDBACK_INTERLEAVED_COMPONENTS

- GL_MAX_TRANSFORM_FEEDBACK_SEPARATE_ATTRIBS
- GL_INTERLEAVED_ATTRIBS
- GL_SEPARATE_ATTRIBS
- GL_TRANSFORM_FEEDBACK_BUFFER
- GL_TRANSFORM_FEEDBACK_BUFFER_BINDING
- GL_RGBA32UI
- GL_RGB32UI
- GL_RGBA16UI
- GL_RGB16UI
- GL_RGBA8UI
- GL_RGB8UI
- GL_RGBA32I
- GL_RGB32I
- GL_RGBA16I
- GL_RGB16I
- GL_RGBA8I
- GL_RGB8I
- GL_RED_INTEGER
- GL_GREEN_INTEGER
- GL_BLUE_INTEGER
- GL_ALPHA_INTEGER
- GL_RGB_INTEGER
- GL_RGBA_INTEGER
- GL_BGR_INTEGER
- GL_BGRA_INTEGER
- GL_SAMPLER_1D_ARRAY
- GL_SAMPLER_2D_ARRAY
- GL_SAMPLER_1D_ARRAY_SHADOW
- GL_SAMPLER_2D_ARRAY_SHADOW
- GL_SAMPLER_CUBE_SHADOW
- GL_UNSIGNED_INT_VEC2
- GL_UNSIGNED_INT_VEC3
- GL_UNSIGNED_INT_VEC4
- GL_INT_SAMPLER_1D
- GL_INT_SAMPLER_2D
- GL_INT_SAMPLER_3D

- GL_INT_SAMPLER_CUBE
- GL_INT_SAMPLER_1D_ARRAY
- GL_INT_SAMPLER_2D_ARRAY
- GL_UNSIGNED_INT_SAMPLER_1D
- GL_UNSIGNED_INT_SAMPLER_2D
- GL_UNSIGNED_INT_SAMPLER_3D
- GL_UNSIGNED_INT_SAMPLER_CUBE
- GL_UNSIGNED_INT_SAMPLER_1D_ARRAY
- GL_UNSIGNED_INT_SAMPLER_2D_ARRAY
- GL_QUERY_WAIT
- GL_QUERY_NO_WAIT
- GL_QUERY_BY_REGION_WAIT
- GL_QUERY_BY_REGION_NO_WAIT
- GL_TEXTURE_RECTANGLE
- GL_TEXTURE_BINDING_RECTANGLE
- GL_PROXY_TEXTURE_RECTANGLE
- GL_MAX_RECTANGLE_TEXTURE_SIZE
- GL_SAMPLER_2D_RECT
- GL_SAMPLER_2D_RECT_SHADOW
- GL_TEXTURE_BUFFER
- GL_MAX_TEXTURE_BUFFER_SIZE
- GL_TEXTURE_BINDING_BUFFER
- GL_TEXTURE_BUFFER_DATA_STORE_BINDING
- GL_TEXTURE_BUFFER_FORMAT
- GL_SAMPLER_BUFFER
- GL_INT_SAMPLER_2D_RECT
- GL_INT_SAMPLER_BUFFER
- GL_UNSIGNED_INT_SAMPLER_2D_RECT
- GL_UNSIGNED_INT_SAMPLER_BUFFER
- GL_RED_SNORM
- GL_RG_SNORM
- GL_RGB_SNORM
- GL_RGBA_SNORM
- GL_R8_SNORM
- GL_RG8_SNORM
- GL_RGB8_SNORM

- GL_RGBA8_SNORM
- GL_R16_SNORM
- GL_RG16_SNORM
- GL_RGB16_SNORM
- GL_RGBA16_SNORM
- GL_SIGNED_NORMALIZED
- GL_PRIMITIVE_RESTART
- GL_PRIMITIVE_RESTART_INDEX
- GL_BUFFER_ACCESS_FLAGS
- GL_BUFFER_MAP_LENGTH
- GL_BUFFER_MAP_OFFSET
- GL_CONTEXT_CORE_PROFILE_BIT
- GL_CONTEXT_COMPATIBILITY_PROFILE_BIT
- GL_LINES_ADJACENCY
- GL_LINE_STRIP_ADJACENCY
- GL_TRIANGLES_ADJACENCY
- GL_TRIANGLE_STRIP_ADJACENCY
- GL_PROGRAM_POINT_SIZE
- GL_GEOMETRY_VERTICES_OUT
- GL_GEOMETRY_INPUT_TYPE
- GL_GEOMETRY_OUTPUT_TYPE
- GL_MAX_GEOMETRY_TEXTURE_IMAGE_UNITS
- GL_FRAMEBUFFER_ATTACHMENT_LAYERED
- GL_FRAMEBUFFER_INCOMPLETE_LAYER_TARGETS
- GL_GEOMETRY_SHADER
- GL_MAX_GEOMETRY_UNIFORM_COMPONENTS
- GL_MAX_GEOMETRY_OUTPUT_VERTICES
- GL_MAX_GEOMETRY_TOTAL_OUTPUT_COMPONENTS
- GL_MAX_VERTEX_OUTPUT_COMPONENTS
- GL_MAX_GEOMETRY_INPUT_COMPONENTS
- GL_MAX_GEOMETRY_OUTPUT_COMPONENTS
- GL_MAX_FRAGMENT_INPUT_COMPONENTS
- GL_CONTEXT_PROFILE_MASK
- void glAccum(GLenum op,GLfloat value)
- void glActiveTexture(GLenum texture)
- void glAlphaFunc(GLenum func,GLclampf ref)

- `GLboolean glAreTexturesResident(GLsizei n,const GLuint * textures,GLboolean * residences)`
- `void glArrayElement(GLint i)`
- `void glAttachShader(GLuint program,GLuint shader)`
- `void glBegin(GLenum mode)`
- `void glBeginQuery(GLenum target,GLuint id)`
- `void glBindAttribLocation(GLuint program,GLuint index,const GLchar *name)`
- `void glBindBuffer(GLenum target,GLuint buffer)`
- `void glBindTexture(GLenum target,GLuint texture)`
- `void glBitmap(GLsizei width,GLsizei height,GLfloat xorig,GLfloat yorig,GLfloat xmove,GLfloat ymove,const GLubyte * bitmap)`
- `void glBlendColor(GLclampf red,GLclampf green,GLclampf blue,GLclampf alpha)`
- `void glBlendEquation(GLenum mode)`
- `void glBlendEquationSeparate(GLenum modeRGB,GLenum modeAlpha)`
- `void glBlendFunc(GLenum sfactor,GLenum dfactor)`
- `void glBlendFuncSeparate(GLenum srcRGB,GLenum dstRGB,GLenum srcAlpha,GLenum dstAlpha)`
- `void glBufferData(GLenum target,GLsizeiptr size,const GLvoid * data,GLenum usage)`
- `void glBufferSubData(GLenum target,GLintptr offset,GLsizeiptr size,const GLvoid * data)`
- `void glCallList(GLuint list)`
- `void glCallLists(GLsizei n,GLenum type,const GLvoid * lists)`
- `void glClear(GLbitfield mask)`
- `void glClearAccum(GLfloat red,GLfloat green,GLfloat blue,GLfloat alpha)`
- `void glClearColor(GLclampf red,GLclampf green,GLclampf blue,GLclampf alpha)`
- `void glClearDepth(GLclampd depth)`
- `void glClearIndex(GLfloat c)`
- `void glClearStencil(GLint s)`
- `void glClientActiveTexture(GLenum texture)`
- `void glClipPlane(GLenum plane,const GLdouble * equation)`
- `void glColor3b(GLbyte red,GLbyte green,GLbyte blue)`
- `void glColor3s(GLshort red,GLshort green,GLshort blue)`
- `void glColor3i(GLint red,GLint green,GLint blue)`
- `void glColor3f(GLfloat red,GLfloat green,GLfloat blue)`
- `void glColor3d(GLdouble red,GLdouble green,GLdouble blue)`
- `void glColor3ub(GLubyte red,GLubyte green,GLubyte blue)`
- `void glColor3us(GLushort red,GLushort green,GLushort blue)`
- `void glColor3ui(GLuint red,GLuint green,GLuint blue)`
- `void glColor4b(GLbyte red,GLbyte green,GLbyte blue,GLbyte alpha)`

- void glColor4s(GLshort red,GLshort green,GLshort blue,GLshort alpha)
- void glColor4i(GLint red,GLint green,GLint blue,GLint alpha)
- void glColor4f(GLfloat red,GLfloat green,GLfloat blue,GLfloat alpha)
- void glColor4d(GLdouble red,GLdouble green,GLdouble blue,GLdouble alpha)
- void glColor4ub(GLubyte red,GLubyte green,GLubyte blue,GLubyte alpha)
- void glColor4us(GLushort red,GLushort green,GLushort blue,GLushort alpha)
- void glColor4ui(GLuint red,GLuint green,GLuint blue,GLuint alpha)
- void glColor3bv(const GLbyte * v)
- void glColor3sv(const GLshort * v)
- void glColor3iv(const GLint * v)
- void glColor3fv(const GLfloat * v)
- void glColor3dv(const GLdouble * v)
- void glColor3ubv(const GLubyte * v)
- void glColor3usv(const GLushort * v)
- void glColor3uiv(const GLuint * v)
- void glColor4bv(const GLbyte * v)
- void glColor4sv(const GLshort * v)
- void glColor4iv(const GLint * v)
- void glColor4fv(const GLfloat * v)
- void glColor4dv(const GLdouble * v)
- void glColor4ubv(const GLubyte * v)
- void glColor4usv(const GLushort * v)
- void glColor4uiv(const GLuint * v)
- void glColorMask(GLboolean red,GLboolean green,GLboolean blue,GLboolean alpha)
- void glColorMaterial(GLenum face,GLenum mode)
- void glColorPointer(GLint size,GLenum type,GLsizei stride,const GLvoid * pointer)
- void glColorSubTable(GLenum target,GLsizei start,GLsizei count,GLenum format,GLenum type,const GLvoid * data)
- void glColorTable(GLenum target,GLenum internalformat,GLsizei width,GLenum format,GLenum type,const GLvoid * data)
- void glColorTableParameterfv(GLenum target,GLenum pname,const GLfloat * params)
- void glColorTableParameteriv(GLenum target,GLenum pname,const GLint * params)
- void glCompileShader(GLuint shader)
- void glCompressedTexImage1D(GLenum target,GLint level,GLenum internalformat,GLsizei width,GLint border,GLsizei imageSize,const GLvoid * data)
- void glCompressedTexImage2D(GLenum target,GLint level,GLenum internalformat,GLsizei width,GLsizei height,GLint border,GLsizei imageSize,const GLvoid * data)

- void glCompressedTexImage3D(GLenum target,GLint level,GLenum internalformat,GLsizei width,GLsizei height,GLsizei depth,GLint border,GLsizei imageSize,const GLvoid * data)
- void glCompressedTexSubImage1D(GLenum target,GLint level,GLint xoffset,GLsizei width,GLenum format,GLsizei imageSize,const GLvoid * data)
- void glCompressedTexSubImage2D(GLenum target,GLint level,GLint xoffset,GLint yoffset,GLsizei width,GLsizei height,GLenum format,GLsizei imageSize,const GLvoid * data)
- void glCompressedTexSubImage3D(GLenum target,GLint level,GLint xoffset,GLint yoffset,GLint zoffset,GLsizei width,GLsizei height,GLsizei depth,GLenum format,GLsizei imageSize,const GLvoid * data)
- void glConvolutionFilter1D(GLenum target,GLenum internalformat,GLsizei width,GLenum format,GLenum type,const GLvoid * data)
- void glConvolutionFilter2D(GLenum target,GLenum internalformat,GLsizei width,GLsizei height,GLenum format,GLenum type,const GLvoid * data)
- void glConvolutionParameterf(GLenum target,GLenum pname,GLfloat params)
- void glConvolutionParameteri(GLenum target,GLenum pname,GLint params)
- void glConvolutionParameterfv(GLenum target,GLenum pname,const GLfloat * params)
- void glConvolutionParameteriv(GLenum target,GLenum pname,const GLint * params)
- void glCopyColorSubTable(GLenum target,GLsizei start,GLint x,GLint y,GLsizei width)
- void glCopyColorTable(GLenum target,GLenum internalformat,GLint x,GLint y,GLsizei width)
- void glCopyConvolutionFilter1D(GLenum target,GLenum internalformat,GLint x,GLint y,GLsizei width)
- void glCopyConvolutionFilter2D(GLenum target,GLenum internalformat,GLint x,GLint y,GLsizei width,GLsizei height)
- void glCopyPixels(GLint x,GLint y,GLsizei width,GLsizei height,GLenum type)
- void glCopyTexImage1D(GLenum target,GLint level,GLenum internalformat,GLint x,GLint y,GLsizei width,GLint border)
- void glCopyTexImage2D(GLenum target,GLint level,GLenum internalformat,GLint x,GLint y,GLsizei width,GLsizei height,GLint border)
- void glCopyTexSubImage1D(GLenum target,GLint level,GLint xoffset,GLint x,GLint y,GLsizei width)
- void glCopyTexSubImage2D(GLenum target,GLint level,GLint xoffset,GLint yoffset,GLint x,GLint y,GLsizei width,GLsizei height)
- void glCopyTexSubImage3D(GLenum target,GLint level,GLint xoffset,GLint yoffset,GLint zoffset,GLint x,GLint y,GLsizei width,GLsizei height)
- GLuint glCreateProgram(void)
- GLuint glCreateShader(GLenum shaderType)
- void glCullFace(GLenum mode)
- void glDeleteBuffers(GLsizei n,const GLuint * buffers)
- void glDeleteLists(GLuint list,GLsizei range)
- void glDeleteProgram(GLuint program)
- void glDeleteQueries(GLsizei n,const GLuint * ids)
- void glDeleteShader(GLuint shader)
- void glDeleteTextures(GLsizei n,const GLuint * textures)

- void glDepthFunc(GLenum func)
- void glDepthMask(GLboolean flag)
- void glDepthRange(GLclampd nearVal,GLclampd farVal)
- void glDetachShader(GLuint program,GLuint shader)
- void glEnable(GLenum cap)
- void glEnableClientState(GLenum cap)
- void glEnableVertexAttribArray(GLuint index)
- void glDisableVertexAttribArray(GLuint index)
- void glDrawArrays(GLenum mode,GLint first,GLsizei count)
- void glDrawBuffer(GLenum mode)
- void glDrawBuffers(GLsizei n,const GLenum *bufs)
- void glDrawElements(GLenum mode,GLsizei count,GLenum type,const GLvoid * indices)
- void glDrawPixels(GLsizei width,GLsizei height,GLenum format,GLenum type,const GLvoid * data)
- void glDrawRangeElements(GLenum mode,GLuint start,GLuint end,GLsizei count,GLenum type,const GLvoid * indices)
- void glEdgeFlag(GLboolean flag)
- void glEdgeFlagPointer(GLsizei stride,const GLvoid * pointer)
- void glEnd(void)
- void glEndList(void)
- void glEndQuery(GLenum target)
- void glEvalCoord1f(GLfloat u)
- void glEvalCoord1d(GLdouble u)
- void glEvalCoord2f(GLfloat u,GLfloat v)
- void glEvalCoord2d(GLdouble u,GLdouble v)
- void glEvalMesh1(GLenum mode,GLint i1,GLint i2)
- void glEvalPoint1(GLint i)
- void glEvalPoint2(GLint i,GLint j)
- void glFeedbackBuffer(GLsizei size,GLenum type,GLfloat * buffer)
- void glFinish(void)
- void glFlush(void)
- void glFogf(GLenum pname,GLfloat param)
- void glFogi(GLenum pname,GLint param)
- void glFogfv(GLenum pname,const GLfloat * params)
- void glFogiv(GLenum pname,const GLint * params)
- void glFogCoordd(GLdouble coord)
- void glFogCoordf(GLfloat coord)

- void glFogCoorddv(GLdouble * coord)
- void glFogCoordfv(GLfloat * coord)
- void glFogCoordPointer(GLenum type,GLsizei stride,GLvoid * pointer)
- void glFrontFace(GLenum mode)
- void glFrustum(GLdouble left,GLdouble right,GLdouble bottom,GLdouble top,GLdouble nearVal,GLdouble farVal)
- void glGenBuffers(GLsizei n,GLuint * buffers)
- GLuint glGenLists(GLsizei range)
- void glGenQueries(GLsizei n,GLuint * ids)
- void glGenTextures(GLsizei n,GLuint * textures)
- void glGetBooleanv(GLenum pname,GLboolean * params)
- void glGetDoublev(GLenum pname,GLdouble * params)
- void glGetFloatv(GLenum pname,GLfloat * params)
- void glGetIntegerv(GLenum pname,GLint * params)
- void glGetActiveAttrib(GLuint program,GLuint index,GLsizei bufSize,GLsizei *length,GLint *size,GLenum *type,GLchar *name)
- void glGetActiveUniform(GLuint program,GLuint index,GLsizei bufSize,GLsizei *length,GLint *size,GLenum *type,GLchar *name)
- void glGetAttachedShaders(GLuint program,GLsizei maxCount,GLsizei *count,GLuint *shaders)
- GLint glGetUniformLocation(GLuint program,const GLchar *name)
- void glGetBufferParameteriv(GLenum target,GLenum value,GLint * data)
- void glGetBufferPointerv(GLenum target,GLenum pname,GLvoid ** params)
- void glGetBufferSubData(GLenum target,GLintptr offset,GLsizeiptr size,GLvoid * data)
- void glGetClipPlane(GLenum plane,GLdouble * equation)
- void glGetColorTable(GLenum target,GLenum format,GLenum type,GLvoid * table)
- void glGetColorTableParameterfv(GLenum target,GLenum pname,GLfloat * params)
- void glGetColorTableParameteriv(GLenum target,GLenum pname,GLint * params)
- void glGetCompressedTexImage(GLenum target,GLint lod,GLvoid * img)
- void glGetConvolutionFilter(GLenum target,GLenum format,GLenum type,GLvoid * image)
- void glGetConvolutionParameterfv(GLenum target,GLenum pname,GLfloat * params)
- void glGetConvolutionParameteriv(GLenum target,GLenum pname,GLint * params)
- GLenum glGetError(void)
- void glGetHistogram(GLenum target,GLboolean reset,GLenum format,GLenum type,GLvoid * values)
- void glGetHistogramParameterfv(GLenum target,GLenum pname,GLfloat * params)
- void glGetHistogramParameteriv(GLenum target,GLenum pname,GLint * params)
- void glGetLightfv(GLenum light,GLenum pname,GLfloat * params)
- void glGetLightiv(GLenum light,GLenum pname,GLint * params)

- void glGetMapdv(GLenum target,GLenum query,GLdouble * v)
- void glGetMapfv(GLenum target,GLenum query,GLfloat * v)
- void glGetMapiv(GLenum target,GLenum query,GLint * v)
- void glGetMaterialfv(GLenum face,GLenum pname,GLfloat * params)
- void glGetMaterialiv(GLenum face,GLenum pname,GLint * params)
- void glGetMinmax(GLenum target,GLboolean reset,GLenum format,GLenum types,GLvoid * values)
- void glGetMinmaxParameterfv(GLenum target,GLenum pname,GLfloat * params)
- void glGetMinmaxParameteriv(GLenum target,GLenum pname,GLint * params)
- void glGetPixelMapfv(GLenum map,GLfloat * data)
- void glGetPixelMapuiv(GLenum map,GLuint * data)
- void glGetPixelMapusv(GLenum map,GLushort * data)
- void glGetPointerv(GLenum pname,GLvoid ** params)
- void glGetPolygonStipple(GLubyte * pattern)
- void glGetProgramiv(GLuint program,GLenum pname,GLint *params)
- void glGetProgramInfoLog(GLuint program,GLsizei maxLength,GLsizei *length,GLchar *infoLog)
- void glGetQueryObjectiv(GLuint id,GLenum pname,GLint * params)
- void glGetQueryObjectuiv(GLuint id,GLenum pname,GLuint * params)
- void glGetQueryiv(GLenum target,GLenum pname,GLint * params)
- void glGetSeparableFilter(GLenum target,GLenum format,GLenum type,GLvoid * row,GLvoid * column,GLvoid * span)
- void glGetShaderiv(GLuint shader,GLenum pname,GLint *params)
- void glGetShaderInfoLog(GLuint shader,GLsizei maxLength,GLsizei *length,GLchar *infoLog)
- void glGetShaderSource(GLuint shader,GLsizei bufSize,GLsizei *length,GLchar *source)
- const GLubyte *glGetString(GLenum name)
- void glGetTexEnvfv(GLenum target,GLenum pname,GLfloat * params)
- void glGetTexEnviv(GLenum target,GLenum pname,GLint * params)
- void glGetTexGendv(GLenum coord,GLenum pname,GLdouble * params)
- void glGetTexGenfv(GLenum coord,GLenum pname,GLfloat * params)
- void glGetTexGeniv(GLenum coord,GLenum pname,GLint * params)
- void glGetTexImage(GLenum target,GLint level,GLenum format,GLenum type,GLvoid * img)
- void glGetTexLevelParameterfv(GLenum target,GLint level,GLenum pname,GLfloat * params)
- void glGetTexLevelParameteriv(GLenum target,GLint level,GLenum pname,GLint * params)
- void glGetTexParameterfv(GLenum target,GLenum pname,GLfloat * params)
- void glGetTexParameteriv(GLenum target,GLenum pname,GLint * params)
- void glGetUniformLocation(GLuint program,GLint location,GLfloat *params)
- void glGetUniformLocation(GLuint program,GLint location,GLint *params)

- GLint glGetUniformLocation(GLuint program,const GLchar *name)
- void glGetVertexAttribdv(GLuint index,GLenum pname,GLdouble *params)
- void glGetVertexAttribfv(GLuint index,GLenum pname,GLfloat *params)
- void glGetVertexAttribiv(GLuint index,GLenum pname,GLint *params)
- void glGetVertexAttribPointerv(GLuint index,GLenum pname,GLvoid **pointer)
- void glHint(GLenum target,GLenum mode)
- void glHistogram(GLenum target,GLsizei width,GLenum internalformat,GLboolean sink)
- void glIndexs(GLshort c)
- void glIndexi(GLint c)
- void glIndexf(GLfloat c)
- void glIndexd(GLdouble c)
- void glIndexub(GLubyte c)
- void glIndexsv(const GLshort * c)
- void glIndexiv(const GLint * c)
- void glIndexfv(const GLfloat * c)
- void glIndexdv(const GLdouble * c)
- void glIndexubv(const GLubyte * c)
- void glIndexMask(GLuint mask)
- void glIndexPointer(GLenum type,GLsizei stride,const GLvoid * pointer)
- void glInitNames(void)
- void glInterleavedArrays(GLenum format,GLsizei stride,const GLvoid * pointer)
- GLboolean glIsBuffer(GLuint buffer)
- GLboolean glIsEnabled(GLenum cap)
- GLboolean glIsList(GLuint list)
- GLboolean glIsProgram(GLuint program)
- GLboolean glIsQuery(GLuint id)
- GLboolean glIsShader(GLuint shader)
- GLboolean glIsTexture(GLuint texture)
- void glLightf(GLenum light,GLenum pname,GLfloat param)
- void glLighti(GLenum light,GLenum pname,GLint param)
- void glLightfv(GLenum light,GLenum pname,const GLfloat * params)
- void glLightiv(GLenum light,GLenum pname,const GLint * params)
- void glLightModelf(GLenum pname,GLfloat param)
- void glLightModeli(GLenum pname,GLint param)
- void glLightModelfv(GLenum pname,const GLfloat * params)
- void glLightModeliv(GLenum pname,const GLint * params)

- void glLineStipple(GLint factor,GLushort pattern)
- void glLineWidth(GLfloat width)
- void glLinkProgram(GLuint program)
- void glListBase(GLuint base)
- void glLoadIdentity(void)
- void glLoadMatrixd(const GLdouble * m)
- void glLoadMatrixf(const GLfloat * m)
- void glLoadName(GLuint name)
- void glLoadTransposeMatrixd(const GLdouble * m)
- void glLoadTransposeMatrixf(const GLfloat * m)
- void glLogicOp(GLenum opcode)
- void glMap1f(GLenum target,GLfloat u1,GLfloat u2,GLint stride,GLint order,const GLfloat * points)
- void glMap1d(GLenum target,GLdouble u1,GLdouble u2,GLint stride,GLint order,const GLdouble * points)
- void glMap2f(GLenum target,GLfloat u1,GLfloat u2,GLint ustride,GLint uorder,GLfloat v1,GLfloat v2,GLint vstride,GLint vorder,const GLfloat * points)
- void glMap2d(GLenum target,GLdouble u1,GLdouble u2,GLint ustride,GLint uorder,GLdouble v1,GLdouble v2,GLint vstride,GLint vorder,const GLdouble * points)
- void * glMapBuffer(GLenum target,GLenum access)
- void glMapGrid1d(GLint un,GLdouble u1,GLdouble u2)
- void glMapGrid1f(GLint un,GLfloat u1,GLfloat u2)
- void glMapGrid2d(GLint un,GLdouble u1,GLdouble u2,GLint vn,GLdouble v1,GLdouble v2)
- void glMapGrid2f(GLint un,GLfloat u1,GLfloat u2,GLint vn,GLfloat v1,GLfloat v2)
- void glMaterialf(GLenum face,GLenum pname,GLfloat param)
- void glMateriali(GLenum face,GLenum pname,GLint param)
- void glMatrixMode(GLenum mode)
- void glMinmax(GLenum target,GLenum internalformat,GLboolean sink)
- void glMultMatrixd(const GLdouble * m)
- void glMultMatrixf(const GLfloat * m)
- void glMultTransposeMatrixd(const GLdouble * m)
- void glMultTransposeMatrixf(const GLfloat * m)
- void glMultiDrawArrays(GLenum mode,GLint * first,GLsizei * count,GLsizei primcount)
- void glMultiDrawElements(GLenum mode,const GLsizei * count,GLenum type,const GLvoid ** indices,GLsizei primcount)
- void glMultiTexCoord1s(GLenum target,GLshort s)
- void glMultiTexCoord1i(GLenum target,GLint s)
- void glMultiTexCoord1f(GLenum target,GLfloat s)
- void glMultiTexCoord1d(GLenum target,GLdouble s)

- void glMultiTexCoord2s(GLenum target,GLshort s,GLshort t)
- void glMultiTexCoord2i(GLenum target,GLint s,GLint t)
- void glMultiTexCoord2f(GLenum target,GLfloat s,GLfloat t)
- void glMultiTexCoord2d(GLenum target,GLdouble s,GLdouble t)
- void glMultiTexCoord3s(GLenum target,GLshort s,GLshort t,GLshort r)
- void glMultiTexCoord3i(GLenum target,GLint s,GLint t,GLint r)
- void glMultiTexCoord3f(GLenum target,GLfloat s,GLfloat t,GLfloat r)
- void glMultiTexCoord3d(GLenum target,GLdouble s,GLdouble t,GLdouble r)
- void glMultiTexCoord4s(GLenum target,GLshort s,GLshort t,GLshort r,GLshort q)
- void glMultiTexCoord4i(GLenum target,GLint s,GLint t,GLint r,GLint q)
- void glMultiTexCoord4f(GLenum target,GLfloat s,GLfloat t,GLfloat r,GLfloat q)
- void glMultiTexCoord4d(GLenum target,GLdouble s,GLdouble t,GLdouble r,GLdouble q)
- void glMultiTexCoord1sv(GLenum target,const GLshort * v)
- void glMultiTexCoord1iv(GLenum target,const GLint * v)
- void glMultiTexCoord1fv(GLenum target,const GLfloat * v)
- void glMultiTexCoord1dv(GLenum target,const GLdouble * v)
- void glMultiTexCoord2sv(GLenum target,const GLshort * v)
- void glMultiTexCoord2iv(GLenum target,const GLint * v)
- void glMultiTexCoord2fv(GLenum target,const GLfloat * v)
- void glMultiTexCoord2dv(GLenum target,const GLdouble * v)
- void glMultiTexCoord3sv(GLenum target,const GLshort * v)
- void glMultiTexCoord3iv(GLenum target,const GLint * v)
- void glMultiTexCoord3fv(GLenum target,const GLfloat * v)
- void glMultiTexCoord3dv(GLenum target,const GLdouble * v)
- void glMultiTexCoord4sv(GLenum target,const GLshort * v)
- void glMultiTexCoord4iv(GLenum target,const GLint * v)
- void glMultiTexCoord4fv(GLenum target,const GLfloat * v)
- void glMultiTexCoord4dv(GLenum target,const GLdouble * v)
- void glNewList(GLuint list,GLenum mode)
- void glNormal3b(GLbyte nx,GLbyte ny,GLbyte nz)
- void glNormal3d(GLdouble nx,GLdouble ny,GLdouble nz)
- void glNormal3f(GLfloat nx,GLfloat ny,GLfloat nz)
- void glNormal3i(GLint nx,GLint ny,GLint nz)
- void glNormal3s(GLshort nx,GLshort ny,GLshort nz)
- void glNormal3bv(const GLbyte * v)
- void glNormal3dv(const GLdouble * v)

- void glNormal3fv(const GLfloat * v)
- void glNormal3iv(const GLint * v)
- void glNormal3sv(const GLshort * v)
- void glNormalPointer(GLenum type,GLsizei stride,const GLvoid * pointer)
- void glOrtho(GLdouble left,GLdouble right,GLdouble bottom,GLdouble top,GLdouble nearVal,GLdouble farVal)
- void glPassThrough(GLfloat token)
- void glPixelMapfv(GLenum map,GLsizei mapsize,const GLfloat * values)
- void glPixelMapuv(GLenum map,GLsizei mapsize,const GLuint * values)
- void glPixelMapusv(GLenum map,GLsizei mapsize,const GLushort * values)
- void glPixelStoref(GLenum pname,GLfloat param)
- void glPixelStorei(GLenum pname,GLint param)
- void glPixelTransferf(GLenum pname,GLfloat param)
- void glPixelTransferi(GLenum pname,GLint param)
- void glPixelZoom(GLfloat xfactor,GLfloat yfactor)
- void glPointParameterf(GLenum pname,GLfloat param)
- void glPointParameteri(GLenum pname,GLint param)
- void glPointSize(GLfloat size)
- void glPolygonMode(GLenum face,GLenum mode)
- void glPolygonOffset(GLfloat factor,GLfloat units)
- void glPolygonStipple(const GLubyte * pattern)
- void glPushAttrib(GLbitfield mask)
- void glPushClientAttrib(GLbitfield mask)
- void glPushMatrix(void)
- void glPushName(GLuint name)
- void glPrioritizeTextures(GLsizei n,const GLuint * textures,const GLclampf * priorities)
- void glPopMatrix(void)
- void glRasterPos2s(GLshort x,GLshort y)
- void glRasterPos2i(GLint x,GLint y)
- void glRasterPos2f(GLfloat x,GLfloat y)
- void glRasterPos2d(GLdouble x,GLdouble y)
- void glRasterPos3s(GLshort x,GLshort y,GLshort z)
- void glRasterPos3i(GLint x,GLint y,GLint z)
- void glRasterPos3f(GLfloat x,GLfloat y,GLfloat z)
- void glRasterPos3d(GLdouble x,GLdouble y,GLdouble z)
- void glRasterPos4s(GLshort x,GLshort y,GLshort z,GLshort w)

- void glRasterPos4i(GLint x,GLint y,GLint z,GLint w)
- void glRasterPos4f(GLfloat x,GLfloat y,GLfloat z,GLfloat w)
- void glRasterPos4d(GLdouble x,GLdouble y,GLdouble z,GLdouble w)
- void glReadBuffer(GLenum mode)
- void glReadPixels(GLint x,GLint y,GLsizei width,GLsizei height,GLenum format,GLenum type,GLvoid * data)
- void glRectd(GLdouble x1,GLdouble y1,GLdouble x2,GLdouble y2)
- void glRectf(GLfloat x1,GLfloat y1,GLfloat x2,GLfloat y2)
- void glRecti(GLint x1,GLint y1,GLint x2,GLint y2)
- void glRects(GLshort x1,GLshort y1,GLshort x2,GLshort y2)
- void glRectdv(const GLdouble * v1,const GLdouble * v2)
- void glRectfv(const GLfloat * v1,const GLfloat * v2)
- void glRectiv(const GLint * v1,const GLint * v2)
- void glRectsv(const GLshort * v1,const GLshort * v2)
- GLint glRenderMode(GLenum mode)
- void glResetHistogram(GLenum target)
- void glRotated(GLdouble angle,GLdouble x,GLdouble y,GLdouble z)
- void glRotatef(GLfloat angle,GLfloat x,GLfloat y,GLfloat z)
- void glSampleCoverage(GLclampf value,GLboolean invert)
- void glScaled(GLdouble x,GLdouble y,GLdouble z)
- void glScalef(GLfloat x,GLfloat y,GLfloat z)
- void glScissor(GLint x,GLint y,GLsizei width,GLsizei height)
- void glSecondaryColor3b(GLbyte red,GLbyte green,GLbyte blue)
- void glSecondaryColor3s(GLshort red,GLshort green,GLshort blue)
- void glSecondaryColor3i(GLint red,GLint green,GLint blue)
- void glSecondaryColor3f(GLfloat red,GLfloat green,GLfloat blue)
- void glSecondaryColor3d(GLdouble red,GLdouble green,GLdouble blue)
- void glSecondaryColor3ub(GLubyte red,GLubyte green,GLubyte blue)
- void glSecondaryColor3us(GLushort red,GLushort green,GLushort blue)
- void glSecondaryColor3ui(GLuint red,GLuint green,GLuint blue)
- void glSecondaryColor3bv(const GLbyte * v)
- void glSecondaryColor3sv(const GLshort * v)
- void glSecondaryColor3iv(const GLint * v)
- void glSecondaryColor3fv(const GLfloat * v)
- void glSecondaryColor3dv(const GLdouble * v)
- void glSecondaryColor3ubv(const GLubyte * v)
- void glSecondaryColor3usv(const GLushort * v)

- void glSecondaryColor3uiv(const GLuint * v)
- void glSecondaryColorPointer(GLint size,GLenum type,GLsizei stride,const GLvoid * pointer)
- void glSelectBuffer(GLsizei size,GLuint * buffer)
- void glSeparableFilter2D(GLenum target,GLenum internalformat,GLsizei width,GLsizei height,GLenum format,GLenum type,const GLvoid * row,const GLvoid * column)
- void glShadeModel(GLenum mode)
- void glShaderSource(GLuint shader,GLsizei count,const GLchar **string,const GLint *length)
- void glStencilFunc(GLenum func,GLint ref,GLuint mask)
- void glStencilFuncSeparate(GLenum face,GLenum func,GLint ref,GLuint mask)
- void glStencilMask(GLuint mask)
- void glStencilMaskSeparate(GLenum face,GLuint mask)
- void glStencilOp(GLenum sfail,GLenum dpfail,GLenum dppass)
- void glStencilOpSeparate(GLenum face,GLenum sfail,GLenum dpfail,GLenum dppass)
- void glTexCoord1s(GLshort s)
- void glTexCoord1i(GLint s)
- void glTexCoord1f(GLfloat s)
- void glTexCoord1d(GLdouble s)
- void glTexCoord2s(GLshort s,GLshort t)
- void glTexCoord2i(GLint s,GLint t)
- void glTexCoord2f(GLfloat s,GLfloat t)
- void glTexCoord2d(GLdouble s,GLdouble t)
- void glTexCoord3s(GLshort s,GLshort t,GLshort r)
- void glTexCoord3i(GLint s,GLint t,GLint r)
- void glTexCoord3f(GLfloat s,GLfloat t,GLfloat r)
- void glTexCoord3d(GLdouble s,GLdouble t,GLdouble r)
- void glTexCoord4s(GLshort s,GLshort t,GLshort r,GLshort q)
- void glTexCoord4i(GLint s,GLint t,GLint r,GLint q)
- void glTexCoord4f(GLfloat s,GLfloat t,GLfloat r,GLfloat q)
- void glTexCoord4d(GLdouble s,GLdouble t,GLdouble r,GLdouble q)
- void glTexCoord1sv(const GLshort * v)
- void glTexCoord1iv(const GLint * v)
- void glTexCoord1fv(const GLfloat * v)
- void glTexCoord1dv(const GLdouble * v)
- void glTexCoord2sv(const GLshort * v)
- void glTexCoord2iv(const GLint * v)
- void glTexCoord2fv(const GLfloat * v)

- void glTexCoord2dv(const GLdouble * v)
- void glTexCoord3sv(const GLshort * v)
- void glTexCoord3iv(const GLint * v)
- void glTexCoord3fv(const GLfloat * v)
- void glTexCoord3dv(const GLdouble * v)
- void glTexCoord4sv(const GLshort * v)
- void glTexCoord4iv(const GLint * v)
- void glTexCoord4fv(const GLfloat * v)
- void glTexCoord4dv(const GLdouble * v)
- void glTexCoordPointer(GLint size,GLenum type,GLsizei stride,const GLvoid * pointer)
- void glTexEnvf(GLenum target,GLenum pname,GLfloat param)
- void glTexEnvi(GLenum target,GLenum pname,GLint param)
- void glTexGeni(GLenum coord,GLenum pname,GLint param)
- void glTexGenf(GLenum coord,GLenum pname,GLfloat param)
- void glTexGend(GLenum coord,GLenum pname,GLdouble param)
- void glTexGeniv(GLenum coord,GLenum pname,const GLint * params)
- void glTexGenfv(GLenum coord,GLenum pname,const GLfloat * params)
- void glTexGendv(GLenum coord,GLenum pname,const GLdouble * params)
- void glTexImage1D(GLenum target,GLint level,GLint internalFormat,GLsizei width,GLint border,GLenum format,GLenum type,const GLvoid * data)
- void glTexImage2D(GLenum target,GLint level,GLint internalFormat,GLsizei width,GLsizei height,GLint border,GLenum format,GLenum type,const GLvoid * data)
- void glTexImage3D(GLenum target,GLint level,GLint internalFormat,GLsizei width,GLsizei height,GLsizei depth,GLint border,GLenum format,GLenum type,const GLvoid * data)
- void glTexParameterf(GLenum target,GLenum pname,GLfloat param)
- void glTexParameteri(GLenum target,GLenum pname,GLint param)
- void glTexParameterfv(GLenum target,GLenum pname,const GLfloat * params)
- void glTexParameteriv(GLenum target,GLenum pname,const GLint * params)
- void glTexSubImage1D(GLenum target,GLint level,GLsizei xoffset,GLsizei width,GLenum format,GLenum type,const GLvoid * data)
- void glTexSubImage2D(GLenum target,GLint level,GLsizei xoffset,GLsizei yoffset,GLsizei width,GLsizei height,GLenum format,GLenum type,const GLvoid * data)
- void glTexSubImage3D(GLenum target,GLint level,GLsizei xoffset,GLsizei yoffset,GLsizei zoffset,GLsizei width,GLsizei height,GLsizei depth,GLenum format,GLenum type,const GLvoid * data)
- void glTranslated(GLdouble x,GLdouble y,GLdouble z)
- void glTranslatef(GLfloat x,GLfloat y,GLfloat z)
- void glUniform1f(GLint location,GLfloat v0)
- void glUniform2f(GLint location,GLfloat v0,GLfloat v1)

- void glUniform3f(GLint location,GLfloat v0,GLfloat v1,GLfloat v2)
- void glUniform4f(GLint location,GLfloat v0,GLfloat v1,GLfloat v2,GLfloat v3)
- void glUniform1i(GLint location,GLint v0)
- void glUniform2i(GLint location,GLint v0,GLint v1)
- void glUniform3i(GLint location,GLint v0,GLint v1,GLint v2)
- void glUniform4i(GLint location,GLint v0,GLint v1,GLint v2,GLint v3)
- void glUniform1fv(GLint location,GLsizei count,const GLfloat *value)
- void glUniform2fv(GLint location,GLsizei count,const GLfloat *value)
- void glUniform3fv(GLint location,GLsizei count,const GLfloat *value)
- void glUniform4fv(GLint location,GLsizei count,const GLfloat *value)
- void glUniform1iv(GLint location,GLsizei count,const GLint *value)
- void glUniform2iv(GLint location,GLsizei count,const GLint *value)
- void glUniform3iv(GLint location,GLsizei count,const GLint *value)
- void glUniform4iv(GLint location,GLsizei count,const GLint *value)
- void glUniformMatrix2fv(GLint location,GLsizei count,GLboolean transpose,const GLfloat *value)
- void glUniformMatrix3fv(GLint location,GLsizei count,GLboolean transpose,const GLfloat *value)
- void glUniformMatrix4fv(GLint location,GLsizei count,GLboolean transpose,const GLfloat *value)
- void glUniformMatrix2x3fv(GLint location,GLsizei count,GLboolean transpose,const GLfloat *value)
- void glUniformMatrix3x2fv(GLint location,GLsizei count,GLboolean transpose,const GLfloat *value)
- void glUniformMatrix2x4fv(GLint location,GLsizei count,GLboolean transpose,const GLfloat *value)
- void glUniformMatrix4x2fv(GLint location,GLsizei count,GLboolean transpose,const GLfloat *value)
- void glUniformMatrix3x4fv(GLint location,GLsizei count,GLboolean transpose,const GLfloat *value)
- void glUniformMatrix4x3fv(GLint location,GLsizei count,GLboolean transpose,const GLfloat *value)
- void glUseProgram(GLuint program)
- void glValidateProgram(GLuint program)
- void glVertex2s(GLshort x,GLshort y)
- void glVertex2i(GLint x,GLint y)
- void glVertex2f(GLfloat x,GLfloat y)
- void glVertex2d(GLdouble x,GLdouble y)
- void glVertex3s(GLshort x,GLshort y,GLshort z)
- void glVertex3i(GLint x,GLint y,GLint z)
- void glVertex3f(GLfloat x,GLfloat y,GLfloat z)
- void glVertex3d(GLdouble x,GLdouble y,GLdouble z)
- void glVertex4s(GLshort x,GLshort y,GLshort z,GLshort w)
- void glVertex4i(GLint x,GLint y,GLint z,GLint w)
- void glVertex4f(GLfloat x,GLfloat y,GLfloat z,GLfloat w)

- void glVertex4d(GLdouble x,GLdouble y,GLdouble z,GLdouble w)
- void glVertex2sv(const GLshort * v)
- void glVertex2iv(const GLint * v)
- void glVertex2fv(const GLfloat * v)
- void glVertex2dv(const GLdouble * v)
- void glVertex3sv(const GLshort * v)
- void glVertex3iv(const GLint * v)
- void glVertex3fv(const GLfloat * v)
- void glVertex3dv(const GLdouble * v)
- void glVertex4sv(const GLshort * v)
- void glVertex4iv(const GLint * v)
- void glVertex4fv(const GLfloat * v)
- void glVertex4dv(const GLdouble * v)
- void glVertexAttrib1f(GLuint index,GLfloat v0)
- void glVertexAttrib1s(GLuint index,GLshort v0)
- void glVertexAttrib1d(GLuint index,GLdouble v0)
- void glVertexAttrib2f(GLuint index,GLfloat v0,GLfloat v1)
- void glVertexAttrib2s(GLuint index,GLshort v0,GLshort v1)
- void glVertexAttrib2d(GLuint index,GLdouble v0,GLdouble v1)
- void glVertexAttrib3f(GLuint index,GLfloat v0,GLfloat v1,GLfloat v2)
- void glVertexAttrib3s(GLuint index,GLshort v0,GLshort v1,GLshort v2)
- void glVertexAttrib3d(GLuint index,GLdouble v0,GLdouble v1,GLdouble v2)
- void glVertexAttrib4f(GLuint index,GLfloat v0,GLfloat v1,GLfloat v2,GLfloat v3)
- void glVertexAttrib4s(GLuint index,GLshort v0,GLshort v1,GLshort v2,GLshort v3)
- void glVertexAttrib4d(GLuint index,GLdouble v0,GLdouble v1,GLdouble v2,GLdouble v3)
- void glVertexAttrib4Nub(GLuint index,GLubyte v0,GLubyte v1,GLubyte v2,GLubyte v3)
- void glVertexAttrib1fv(GLuint index,const GLfloat *v)
- void glVertexAttrib1sv(GLuint index,const GLshort *v)
- void glVertexAttrib1dv(GLuint index,const GLdouble *v)
- void glVertexAttrib2fv(GLuint index,const GLfloat *v)
- void glVertexAttrib2sv(GLuint index,const GLshort *v)
- void glVertexAttrib2dv(GLuint index,const GLdouble *v)
- void glVertexAttrib3fv(GLuint index,const GLfloat *v)
- void glVertexAttrib3sv(GLuint index,const GLshort *v)
- void glVertexAttrib3dv(GLuint index,const GLdouble *v)
- void glVertexAttrib4fv(GLuint index,const GLfloat *v)

- void glVertexAttrib4sv(GLuint index,const GLshort *v)
- void glVertexAttrib4dv(GLuint index,const GLdouble *v)
- void glVertexAttrib4iv(GLuint index,const GLint *v)
- void glVertexAttrib4bv(GLuint index,const GLbyte *v)
- void glVertexAttrib4ubv(GLuint index,const GLubyte *v)
- void glVertexAttrib4usv(GLuint index,const GLushort *v)
- void glVertexAttrib4uiv(GLuint index,const GLuint *v)
- void glVertexAttribPointer(GLuint index,GLint size,GLenum type,GLboolean normalized,GLsizei stride,const GLvoid * pointer)
- void glVertexPointer(GLint size,GLenum type,GLsizei stride,const GLvoid * pointer)
- void glViewport(GLint x,GLint y,GLsizei width,GLsizei height)
- void glWindowPos2s(GLshort x,GLshort y)
- void glWindowPos2i(GLint x,GLint y)
- void glWindowPos2f(GLfloat x,GLfloat y)
- void glWindowPos2d(GLdouble x,GLdouble y)
- void glWindowPos3s(GLshort x,GLshort y,GLshort z)
- void glWindowPos3i(GLint x,GLint y,GLint z)
- void glWindowPos3f(GLfloat x,GLfloat y,GLfloat z)
- void glWindowPos3d(GLdouble x,GLdouble y,GLdouble z)
- void glWindowPos2sv(const GLshort * v)
- void glWindowPos2iv(const GLint * v)
- void glWindowPos2fv(const GLfloat * v)
- void glWindowPos2dv(const GLdouble * v)
- void glWindowPos3sv(const GLshort * v)
- void glWindowPos3iv(const GLint * v)
- void glWindowPos3fv(const GLfloat * v)
- void glWindowPos3dv(const GLdouble * v)
- void gluBeginCurve(GLUnurbs* nurb)
- void gluBeginPolygon(GLUtesselator* tess)
- void gluBeginSurface(GLUnurbs* nurb)
- void gluBeginTrim(GLUnurbs* nurb)
- void gluCylinder(GLUquadric* quad,GLdouble base,GLdouble top,GLdouble height,GLint slices,GLint stacks)
- void gluDeleteNurbsRenderer(GLUnurbs* nurb)
- void gluDeleteQuadric(GLUquadric* quad)
- void gluDeleteTess(GLUtesselator* tess)
- void gluDisk(GLUquadric* quad,GLdouble inner,GLdouble outer,GLint slices,GLint loops)

- void gluEndCurve(GLUnurbs* nurb)
- void gluEndPolygon(GLUtesselator* tess)
- void gluEndSurface(GLUnurbs* nurb)
- void gluEndTrim(GLUnurbs* nurb)
- const GLubyte * gluErrorString(GLenum error)
- void gluGetNurbsProperty(GLUnurbs* nurb,GLenum property,GLfloat* data)
- const GLubyte * gluGetString(GLenum name)
- void gluGetTessProperty(GLUtesselator* tess,GLenum which,GLdouble* data)
- void gluLoadSamplingMatrices(GLUnurbs* nurb,const GLfloat * model,const GLfloat * perspective,const GLint * view)
- void gluLookAt(GLdouble eyeX,GLdouble eyeY,GLdouble eyeZ,GLdouble centerX,GLdouble centerY,GLdouble centerZ,GLdouble upX,GLdouble upY,GLdouble upZ)
- GLUnurbs *gluNewNurbsRenderer(void)
- GLUquadric *gluNewQuadric(void)
- GLUtesselator* gluNewTess(void)
- void gluNextContour(GLUtesselator* tess,GLenum type)
- void gluNurbsCurve(GLUnurbs* nurb,GLint knotCount,GLfloat * knots,GLint stride,GLfloat * control,GLint order,GLenum type)
- void gluNurbsProperty(GLUnurbs* nurb,GLenum property,GLfloat value)
- void gluNurbsSurface(GLUnurbs* nurb,GLint sKnotCount,GLfloat* sKnots,GLint tKnotCount,GLfloat* tKnots,GLint sStride,GLint tStride,GLfloat* control,GLint sOrder,GLint tOrder,GLenum type)
- void gluOrtho2D(GLdouble left,GLdouble right,GLdouble bottom,GLdouble top)
- void gluPartialDisk(GLUquadric* quad,GLdouble inner,GLdouble outer,GLint slices,GLint loops,GLdouble start,GLdouble sweep)
- void gluPerspective(GLdouble fovy,GLdouble aspect,GLdouble zNear,GLdouble zFar)
- void gluPickMatrix(GLdouble x,GLdouble y,GLdouble delX,GLdouble delY,GLint * viewport)
- GLint gluProject(GLdouble objX,GLdouble objY,GLdouble objZ,const GLfloat * model,const GLfloat * proj,const GLint * view,GLdouble* winX,GLdouble* winY,GLdouble* winZ)
- void gluPwlCurve(GLUnurbs* nurb,GLint count,GLfloat* data,GLint stride,GLenum type)
- void gluQuadricDrawStyle(GLUquadric* quad,GLenum draw)
- void gluQuadricNormals(GLUquadric* quad,GLenum normal)
- void gluQuadricOrientation(GLUquadric* quad,GLenum orientation)
- void gluQuadricTexture(GLUquadric* quad,GLboolean texture)
- GLint gluScaleImage(GLenum format,GLsizei wIn,GLsizei hIn,GLenum typeIn,const void * dataIn,GLsizei wOut,GLsizei hOut,GLenum typeOut,GLvoid* dataOut)
- void gluSphere(GLUquadric* quad,GLdouble radius,GLint slices,GLint stacks)
- void gluTessBeginContour(GLUtesselator* tess)
- void gluTessBeginPolygon(GLUtesselator* tess,GLvoid* data)

- void gluTessEndContour(GLUtesselator* tess)
- void gluTessEndPolygon(GLUtesselator* tess)
- void gluTessNormal(GLUtesselator* tess,GLdouble valueX,GLdouble valueY,GLdouble valueZ)
- void gluTessProperty(GLUtesselator* tess,GLenum which,GLdouble data)
- void gluTessVertex(GLUtesselator* tess,GLdouble * location,GLvoid* data)
- GLint gluUnProject(GLdouble winX,GLdouble winY,GLdouble winZ,const GLdouble * model,const GLdouble * proj,const GLint * view,GLdouble* objX,GLdouble* objY,GLdouble* objZ)
- void glDisable(GLenum cap)
- void glDisableClientState(GLenum array)
- void glBindVertexArray(GLuint array)
- void glGenVertexArrays(GLsizei n,const GLuint * arrays)
- GLenum glewInit(void)
- GLboolean glewIsSupported(const char *name)
- GLboolean glewGetExtension(const char *name)
- const GLubyte *glewGetString(GLenum error)
- const GLubyte *glewGetString(GLenum name)

RINGQT CLASSES REFERENCE

92.1 AbstractAxis Class

Parameters : void

- Qt::Alignment alignment(void)
- QColor gridLineColor(void)
- QPen gridLinePen(void)
- void hide(void)
- bool isGridLineVisible(void)
- bool isLineVisible(void)
- bool isMinorGridLineVisible(void)
- bool isReverse(void)
- bool isTitleVisible(void)
- bool isVisible(void)
- int labelsAngle(void)
- QBrush labelsBrush(void)
- QColor labelsColor(void)
- bool labelsVisible(void)
- QPen linePen(void)
- QColor linePenColor(void)
- QColor minorGridLineColor(void)
- QPen minorGridLinePen(void)
- Qt::Orientation orientation(void)
- void setGridLineColor(QColor color)
- void setGridLinePen(QPen pen)
- void setGridLineVisible(bool visible)
- void setLabelsAngle(int angle)
- void setLabelsBrush(QBrush brush)
- void setLabelsColor(QColor color)

- void setLabelsVisible(bool visible)
- void setLinePen(QPen pen)
- void setLinePenColor(QColor color)
- void setLineVisible(bool visible)
- void setMax(QVariant max)
- void setMin(QVariant min)
- void setMinorGridLineColor(QColor color)
- void setMinorGridLinePen(QPen pen)
- void setMinorGridLineVisible(bool visible)
- void setRange(QVariant min, QVariant max)
- void setReverse(bool reverse)
- void setShadesBorderColor(QColor color)
- void setShadesBrush(QBrush brush)
- void setShadesColor(QColor color)
- void setShadesPen(QPen pen)
- void setShadesVisible(bool visible)
- void setTitleBrush(QBrush brush)
- void setTitleFont(QFont font)
- void setTitleText(QString title)
- void setTitleVisible(bool visible)
- void setVisible(bool visible)
- QColor shadesBorderColor(void)
- QBrush shadesBrush(void)
- QColor shadesColor(void)
- QPen shadesPen(void)
- bool shadesVisible(void)
- void show(void)
- QBrush titleBrush(void)
- QFont titleFont(void)
- QString titleText(void)
- void setcolorChangedEvent(const char *)
- void setgridLineColorChangedEvent(const char *)
- void setgridLinePenChangedEvent(const char *)
- void setgridVisibleChangedEvent(const char *)
- void setlabelsAngleChangedEvent(const char *)
- void setlabelsBrushChangedEvent(const char *)

- void setlabelsColorChangedEvent(const char *)
- void setlabelsEditableChangedEvent(const char *)
- void setlabelsFontChangedEvent(const char *)
- void setlabelsVisibleChangedEvent(const char *)
- void setlinePenChangedEvent(const char *)
- void setlineVisibleChangedEvent(const char *)
- void setminorGridLineColorChangedEvent(const char *)
- void setminorGridLinePenChangedEvent(const char *)
- void setminorGridVisibleChangedEvent(const char *)
- void setreverseChangedEvent(const char *)
- void setshadesBorderColorChangedEvent(const char *)
- void setshadesBrushChangedEvent(const char *)
- void setshadesColorChangedEvent(const char *)
- void setshadesPenChangedEvent(const char *)
- void setshadesVisibleChangedEvent(const char *)
- void settileBrushChangedEvent(const char *)
- void settileFontChangedEvent(const char *)
- void settileTextChangedEvent(const char *)
- void settileVisibleChangedEvent(const char *)
- void setvisibleChangedEvent(const char *)
- const char *getcolorChangedEvent(void)
- const char *getgridLineColorChangedEvent(void)
- const char *getgridLinePenChangedEvent(void)
- const char *getgridVisibleChangedEvent(void)
- const char *getlabelsAngleChangedEvent(void)
- const char *getlabelsBrushChangedEvent(void)
- const char *getlabelsColorChangedEvent(void)
- const char *getlabelsEditableChangedEvent(void)
- const char *getlabelsFontChangedEvent(void)
- const char *getlabelsVisibleChangedEvent(void)
- const char *getlinePenChangedEvent(void)
- const char *getlineVisibleChangedEvent(void)
- const char *getminorGridLineColorChangedEvent(void)
- const char *getminorGridLinePenChangedEvent(void)
- const char *getminorGridVisibleChangedEvent(void)
- const char *getreverseChangedEvent(void)

- const char *getshadesBorderColorChangedEvent(void)
- const char *getshadesBrushChangedEvent(void)
- const char *getshadesColorChangedEvent(void)
- const char *getshadesPenChangedEvent(void)
- const char *getshadesVisibleChangedEvent(void)
- const char *getttitleBrushChangedEvent(void)
- const char *getttitleFontChangedEvent(void)
- const char *getttitleTextChangedEvent(void)
- const char *getttitleVisibleChangedEvent(void)
- const char *getvisibleChangedEvent(void)

92.2 AbstractBarSeries Class

Parameters : void

Parent Class : AbstractSeries

- bool append(QBarSet *set)
- void clear(void)
- int count(void)
- bool insert(int index, QBarSet *set)
- bool isLabelsVisible(void)
- qreal labelsAngle(void)
- QString labelsFormat(void)
- QAbstractBarSeries::LabelsPosition labelsPosition(void)
- int labelsPrecision(void)
- bool remove(QBarSet *set)
- void setBarWidth(qreal width)
- void setLabelsAngle(qreal angle)
- void setLabelsFormat(QString format)
- void setLabelsPosition(QAbstractBarSeries::LabelsPosition position)
- void setLabelsPrecision(int precision)
- void setLabelsVisible(bool visible)
- bool take(QBarSet *set)
- void setbarsetsAddedEvent(const char *)
- void setbarsetsRemovedEvent(const char *)
- void setclickedEvent(const char *)
- void setcountChangedEvent(const char *)

- void setdoubleClickedEvent(const char *)
- void sethoveredEvent(const char *)
- void setlabelsAngleChangedEvent(const char *)
- void setlabelsFormatChangedEvent(const char *)
- void setlabelsPositionChangedEvent(const char *)
- void setlabelsPrecisionChangedEvent(const char *)
- void setlabelsVisibleChangedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- const char *getbarsetsAddedEvent(void)
- const char *getbarsetsRemovedEvent(void)
- const char *getclickedEvent(void)
- const char *getcountChangedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethoveredEvent(void)
- const char *getlabelsAngleChangedEvent(void)
- const char *getlabelsFormatChangedEvent(void)
- const char *getlabelsPositionChangedEvent(void)
- const char *getlabelsPrecisionChangedEvent(void)
- const char *getlabelsVisibleChangedEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)

92.3 CodeEditor Class

Parameters : QWidget *

Parent Class : QPlainTextEdit

- void setCompleter(QCompleter *c)
- QCompleter *completer(void)
- void setLineNumbersAreaColor(QColor oColor)
- void setLineNumbersAreaBackColor(QColor oColor)

92.4 QAbstractAspect Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dcore-qabstractaspect.html>

Parameters : QObject *

Parent Class : QObject

- void scheduleSingleShotJob(Qt3DCore::QAspectJobPtr job)

92.5 QAbstractButton Class

C++ Reference : <http://doc.qt.io/qt-5/qabstractbutton.html>

Parameters : QWidget *parent

Parent Class : QWidget

- bool autoExclusive(void)
- bool autoRepeat(void)
- int autoRepeatDelay(void)
- int autoRepeatInterval(void)
- QButtonGroup *group(void)
- QIcon icon(void)
- QSize iconSize(void)
- bool isCheckable(void)
- bool isChecked(void)
- bool isDown(void)
- void setAutoExclusive(bool)
- void setAutoRepeat(bool)
- void setAutoRepeatDelay(int)
- void setAutoRepeatInterval(int)
- void setCheckable(bool)
- void setDown(bool)
- void setIcon(QIcon)
- void setShortcut(QKeySequence)
- void setText(QString)
- QKeySequence shortcut(void)
- QString text(void)
- void animateClick(int msec)
- void click(void)
- void setChecked(bool)
- void setIconSize(QSize)

- void toggle(void)

92.6 QAbstractCameraController Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qabstractcameracontroller.html>

Parent Class : QEntity

- float acceleration(void)
- Qt3DRender::QCamera * camera(void)
- float deceleration(void)
- float linearSpeed(void)
- float lookSpeed(void)
- void setAcceleration(float acceleration)
- void setCamera(Qt3DRender::QCamera *camera)
- void setDeceleration(float deceleration)
- void setLinearSpeed(float linearSpeed)
- void setLookSpeed(float lookSpeed)

92.7 QAbstractGraphicsShapeItem Class

C++ Reference : <http://doc.qt.io/qt-5/qabstractgraphicsshapeitem.html>

Parameters : QGraphicsItem *

Parent Class : QGraphicsItem

- QBrush brush(void)
- QPen pen(void)
- void setBrush(QBrush brush)
- void setPen(QPen pen)

92.8 QAbstractItemView Class

C++ Reference : <http://doc.qt.io/qt-5/qabstractitemview.html>

Parameters : QWidget *parent

Parent Class : QAbstractScrollArea

- bool alternatingRowColors(void)
- int autoScrollMargin(void)
- void closePersistentEditor(QModelIndex)
- QModelIndex currentIndex(void)
- int defaultDropAction(void)

- int dragDropMode(void)
- bool dragDropOverwriteMode(void)
- bool dragEnabled(void)
- int editTriggers(void)
- bool hasAutoScroll(void)
- int horizontalScrollMode(void)
- QSize iconSize(void)
- QModelIndex indexAt(QPoint)
- QWidget *indexWidget(QModelIndex)
- QAbstractItemDelegate *itemDelegate(QModelIndex)
- QAbstractItemDelegate *itemDelegateForColumn(int column)
- QAbstractItemDelegate *itemDelegateForRow(int row)
- void keyboardSearch(QString)
- QAbstractItemModel *model(void)
- void openPersistentEditor(QModelIndex)
- QModelIndex rootIndex(void)
- void scrollTo(QModelIndex, QAbstractItemView::ScrollHint)
- int selectionBehavior(void)
- int selectionMode(void)
- QItemSelectionModel *selectionModel(void)
- void setAlternatingRowColors(bool enable)
- void setAutoScroll(bool enable)
- void setAutoScrollMargin(int margin)
- void setDefaultDropAction(Qt::DropAction dropAction)
- void setDragDropMode(QAbstractItemView::DragDropMode behavior)
- void setDragDropOverwriteMode(bool overwrite)
- void setDragEnabled(bool enable)
- void setDropIndicatorShown(bool enable)
- void setEditTriggers(QAbstractItemView::EditTrigger triggers)
- void setHorizontalScrollMode(QAbstractItemView::ScrollMode mode)
- void setIconSize(QSize)
- void setIndexWidget(QModelIndex, QWidget *widget)
- void.setItemDelegate(QAbstractItemDelegate *delegate)
- void.setItemDelegateForColumn(int column, QAbstractItemDelegate *delegate)
- void.setItemDelegateForRow(int row, QAbstractItemDelegate *delegate)
- void.setModel(QAbstractItemModel *model)

- void setSelectionBehavior(QAbstractItemView::SelectionBehavior behavior)
- void setSelectionMode(QAbstractItemView::SelectionMode mode)
- void setSelectionModel(QItemSelectionModel *selectionModel)
- void setTabKeyNavigation(bool enable)
- void setTextElideMode(Qt::TextElideMode mode)
- void setVerticalScrollMode(QAbstractItemView::ScrollMode mode)
- bool showDropIndicator(void)
- int sizeHintForColumn(int column)
- QSize sizeHintForIndex(QModelIndex)
- int sizeHintForRow(int row)
- bool tabKeyNavigation(void)
- int textElideMode(void)
- int verticalScrollMode(void)
- QRect visualRect(QModelIndex)
- void clearSelection(void)
- void edit(QModelIndex)
- void scrollToBottom(void)
- void scrollToTop(void)
- void setCurrentIndex(QModelIndex)
- void update(QModelIndex)

92.9 QAbstractPrintDialog Class

C++ Reference : <http://doc.qt.io/qt-5/qabstractprintdialog.html>

Parameters : QPrinter *, QWidget *

Parent Class : QDialog

- int fromPage(void)
- int maxPage(void)
- int minPage(void)
- QAbstractPrintDialog::PrintRange printRange(void)
- QPrinter * printer(void)
- void setFromTo(int from, int to)
- void setMinMax(int min, int max)
- void setOptionTabs(QList<QWidget *> tabs)
- void setPrintRange(QAbstractPrintDialog::PrintRange range)
- int toPage(void)

92.10 QAbstractScrollArea Class

C++ Reference : <http://doc.qt.io/qt-5/qabstractscrollarea.html>

Parameters : QWidget *parent

Parent Class : QFrame

- void addScrollBarWidget(QWidget *widget, Qt::AlignmentFlag alignment)
- QWidget *cornerWidget(void)
- QScrollBar *horizontalScrollBar(void)
- int horizontalScrollBarPolicy(void)
- QSize maximumViewportSize(void)
- QList<QWidget> scrollBarWidgets(Qt::AlignmentFlag)
- void setCornerWidget(QWidget *widget)
- void setHorizontalScrollBar(QScrollBar *scrollBar)
- void setHorizontalScrollBarPolicy(ScrollBarPolicy)
- void setVerticalScrollBar(QScrollBar *scrollBar)
- void setVerticalScrollBarPolicy(ScrollBarPolicy)
- void setViewport(QWidget *widget)
- QScrollBar *verticalScrollBar(void)
- int verticalScrollBarPolicy(void)
- QWidget *viewport(void)

92.11 QAbstractSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qabstractseries.html>

Parameters : void

Parent Class : QObject

- bool attachAxis(QAbstractAxis *axis)
- QList<QAbstractAxis *> attachedAxes(void)
- QChart *chart(void)
- bool detachAxis(QAbstractAxis *axis)
- void hide(void)
- bool isVisible(void)
- QString name(void)
- qreal opacity(void)
- void setName(QString name)
- void setOpacity(qreal opacity)
- void setUseOpenGL(bool enable)

- void setVisible(bool visible)
- void show(void)
- bool useOpenGL(void)
- void setnameChangedEvent(const char *)
- void setopacityChangedEvent(const char *)
- void setuseOpenGLChangedEvent(const char *)
- void setvisibleChangedEvent(const char *)
- const char *getnameChangedEvent(void)
- const char *getopacityChangedEvent(void)
- const char *getuseOpenGLChangedEvent(void)
- const char *getvisibleChangedEvent(void)

92.12 QAbstractSlider Class

C++ Reference : <http://doc.qt.io/qt-5/qabstractslider.html>

Parameters : QWidget *parent

Parent Class : QWidget

- bool hasTracking(void)
- bool invertedAppearance(void)
- bool invertedControls(void)
- bool isSliderDown(void)
- int maximum(void)
- int minimum(void)
- int orientation(void)
- int pageStep(void)
- void setInvertedAppearance(bool)
- void setInvertedControls(bool)
- void setMaximum(int)
- void setMinimum(int)
- void setPageStep(int)
- void setSingleStep(int)
- void setSliderDown(bool)
- void setSliderPosition(int)
- void setTracking(bool enable)
- int singleStep(void)
- int sliderPosition(void)

- void triggerAction(QAbstractSlider::SliderAction action)
- int value(void)
- void setOrientation(Qt::Orientation)
- void setRange(int min, int max)
- void setValue(int)

92.13 QAbstractSocket Class

C++ Reference : <http://doc.qt.io/qt-5/qabstractsocket.html>

Parameters : void

Parent Class : QIODevice

- void abort(void)
- bool bind(QHostAddress address, int port, QAbstractSocket::BindFlag mode)
- void connectToHost(QString hostName, int port, QIODevice::OpenModeFlag openMode, QAbstractSocket::NetworkLayerProtocol protocol)
- void disconnectFromHost(void)
- int error(void)
- bool flush(void)
- bool isValid(void)
- QHostAddress localAddress(void)
- int localPort(void)
- int pauseMode(void)
- QHostAddress peerAddress(void)
- QString peerName(void)
- int peerPort(void)
- QNetworkProxy proxy(void)
- int readBufferSize(void)
- void resume(void)
- void setPauseMode(QAbstractSocket::PauseMode pauseMode)
- void setProxy(QNetworkProxy networkProxy)
- void setReadBufferSize(int size)
- bool setSocketDescriptor(qintptr socketDescriptor, QAbstractSocket::SocketState socketState, QIODevice::OpenModeFlag openMode)
- void setSocketOption(QAbstractSocket::SocketOption option, QVariant value)
- int *socketDescriptor(void)
- QVariant socketOption(QAbstractSocket::SocketOption option)
- int socketType(void)

- int state(void)
- bool waitForConnected(int msecs)
- bool waitForDisconnected(int msecs)
- bool atEnd(void)
- int bytesAvailable(void)
- int bytesToWrite(void)
- bool canReadLine(void)
- void close(void)
- bool isSequential(void)
- bool waitForBytesWritten(int msecs)
- bool waitForReadyRead(int msecs)
- void setconnectedEvent(const char *)
- void setdisconnectedEvent(const char *)
- void seterrorEvent(const char *)
- void sethostFoundEvent(const char *)
- void setproxyAuthenticationRequiredEvent(const char *)
- void setstateChangedEvent(const char *)
- const char *getconnectedEvent(void)
- const char *getdisconnectedEvent(void)
- const char *geterrorEvent(void)
- const char *gethostFoundEvent(void)
- const char *getproxyAuthenticationRequiredEvent(void)
- const char *getstateChangedEvent(void)

92.14 QAbstractSpinBox Class

C++ Reference : <http://doc.qt.io/qt-5/qabstractspinbox.html>

Parameters : QWidget *parent

Parent Class : QWidget

- int alignment(void)
- int buttonSymbols(void)
- int correctionMode(void)
- bool hasAcceptableInput(void)
- bool hasFrame(void)
- void interpretText(void)
- bool isAccelerated(void)

- bool keyboardTracking(void)
- void setAccelerated(bool on)
- void setAlignment(Qt::AlignmentFlag flag)
- void setButtonSymbols(QAbstractSpinBox::ButtonSymbols bs)
- void setCorrectionMode(QAbstractSpinBox::CorrectionMode cm)
- void setFrame(bool)
- void setReadOnly(bool r)
- void setSpecialValueText(QString)
- void setWrapping(bool w)
- QString specialValueText(void)
- void stepBy(int steps)
- QString text(void)
- bool wrapping(void)
- void clear(void)
- void selectAll(void)
- void stepDown(void)
- void stepUp(void)

92.15 QAction Class

C++ Reference : <http://doc.qt.io/qt-5/qaction.html>

Parameters : QWidget *parent

- QActionGroup *actionGroup(void)
- void activate(QAction::ActionEvent event)
- bool autoRepeat(void)
- QVariant data(void)
- QFont font(void)
- QIcon icon(void)
- QString iconText(void)
- bool isChecked(void)
- bool isEnabled(void)
- bool isIconVisibleInMenu(void)
- bool isSeparator(void)
- bool isVisible(void)
- QMenu *menu(void)

- int menuRole(void)
- QWidget *parentWidget(void)
- int priority(void)
- void setActionGroup(QActionGroup *group)
- void setAutoRepeat(bool)
- void setCheckable(bool)
- void setData(QVariant)
- void setFont(QFont)
- void setIcon(QIcon)
- void setIconText(QString)
- void setIconVisibleInMenu(bool visible)
- void setMenu(QMenu *menu)
- void setMenuRole(QAction::MenuRole menuRole)
- void setPriority(QAction::Priority priority)
- void setSeparator(bool b)
- void setShortcut(QKeySequence)
- void setShortcutContext(Qt::ShortcutContext context)
- void setShortcuts(QKeySequence::StandardKey key)
- void setStatusTip(QString)
- void setText(QString)
- void setToolTip(QString)
- void setWhatsThis(QString)
- QKeySequence shortcut(void)
- int shortcutContext(void)
- bool showStatusText(QWidget *widget)
- QString statusTip(void)
- QString text(void)
- QString toolTip(void)
- QString whatsThis(void)
- void hover(void)
- void setChecked(bool)
- void setDisabled(bool)
- void setEnabled(bool)
- void setVisible(bool)
- void toggle(void)
- void trigger(void)

- void setClickEvent(const char *)
- const char *getClickEvent(void)

92.16 QAllEvents Class

Parameters : QWidget *

Parent Class : QWidget

- void accept(void)
- void ignore(void)
- int getKeyCode(void)
- QString getKeyText(void)
- int getModifiers(void)
- int getx(void)
- int gety(void)
- int getglobalx(void)
- int getglobaly(void)
- int getbutton(void)
- int getbuttons(void)
- void setKeyPressEvent(const char *cStr)
- void setMouseButtonPressEvent(const char *cStr)
- void setMouseButtonReleaseEvent(const char *cStr)
- void setMouseButtonDblClickEvent(const char *cStr)
- void setMouseMoveEvent(const char *cStr)
- void setCloseEvent(const char *cStr)
- void setContextMenuEvent(const char *cStr)
- void setDragEnterEvent(const char *cStr)
- void setDragLeaveEvent(const char *cStr)
- void setDragMoveEvent(const char *cStr)
- void setDropEvent(const char *cStr)
- void setEnterEvent(const char *cStr)
- void setFocusInEvent(const char *cStr)
- void setFocusOutEvent(const char *cStr)
- void setKeyReleaseEvent(const char *cStr)
- void setLeaveEvent(const char *cStr)
- void setNonClientAreaMouseButtonDblClickEvent(const char *cStr)
- void setNonClientAreaMousePressEvent(const char *cStr)

- void setNonClientAreaMouseButtonReleaseEvent(const char *cStr)
- void setNonClientAreaMouseMoveEvent(const char *cStr)
- void setMoveEvent(const char *cStr)
- void setResizeEvent(const char *cStr)
- void setWindowActivateEvent(const char *cStr)
- void setWindowBlockedEvent(const char *cStr)
- void setWindowDeactivateEvent(const char *cStr)
- void setWindowStateChangeEvent(const char *cStr)
- void setWindowUnblockedEvent(const char *cStr)
- void setPaintEvent(const char *cStr)
- void setChildAddedEvent(const char *cStr)
- void setChildPolishedEvent(const char *cStr)
- void setChildRemovedEvent(const char *cStr)
- const char *getKeyPressEvent(void)
- const char *getMouseButtonPressEvent(void)
- const char *getMouseButtonReleaseEvent(void)
- const char *getMouseButtonDblClickEvent(void)
- const char *getMouseMoveEvent(void)
- const char *getCloseEvent(void)
- const char *getContextMenuEvent(void)
- const char *getDragEnterEvent(void)
- const char *getDragLeaveEvent(void)
- const char *getDragMoveEvent(void)
- const char *getDropEvent(void)
- const char *getEnterEvent(void)
- const char *getFocusInEvent(void)
- const char *getFocusOutEvent(void)
- const char *getKeyReleaseEvent(void)
- const char *getLeaveEvent(void)
- const char *getNonClientAreaMouseButtonDblClickEvent(void)
- const char *getNonClientAreaMouseButtonPressEvent(void)
- const char *getNonClientAreaMouseButtonReleaseEvent(void)
- const char *getNonClientAreaMouseMoveEvent(void)
- const char *getMoveEvent(void)
- const char *getResizeEvent(void)
- const char *getWindowActivateEvent(void)

- const char *getWindowBlockedEvent(void)
- const char *getWindowDeactivateEvent(void)
- const char *getWindowStateChangeEvent(void)
- const char *getWindowUnblockedEvent(void)
- const char *getPaintEvent(void)
- const char *getChildAddedEvent(void)
- const char *getChildPolishedEvent(void)
- const char *getChildRemovedEvent(void)
- void setEventOutput(bool x)
- QObject *getParentObject(void)
- QWidget *getParentWidget(void)
- void setKeyPressFunc(const char *cStr)
- void setMouseButtonPressFunc(const char *cStr)
- void setMouseButtonReleaseFunc(const char *cStr)
- void setMouseButtonDblClickFunc(const char *cStr)
- void setMouseMoveFunc(const char *cStr)
- void setCloseFunc(const char *cStr)
- void setContextMenuFunc(const char *cStr)
- void setDragEnterFunc(const char *cStr)
- void setDragLeaveFunc(const char *cStr)
- void setDragMoveFunc(const char *cStr)
- void setDropFunc(const char *cStr)
- void setEnterFunc(const char *cStr)
- void setFocusInFunc(const char *cStr)
- void setFocusOutFunc(const char *cStr)
- void setKeyReleaseFunc(const char *cStr)
- void setLeaveFunc(const char *cStr)
- void setNonClientAreaMouseButtonDblClickFunc(const char *cStr)
- void setNonClientAreaMouseButtonPressFunc(const char *cStr)
- void setNonClientAreaMouseButtonReleaseFunc(const char *cStr)
- void setNonClientAreaMouseMoveFunc(const char *cStr)
- void setMoveFunc(const char *cStr)
- void setResizeFunc(const char *cStr)
- void setWindowActivateFunc(const char *cStr)
- void setWindowBlockedFunc(const char *cStr)
- void setWindowDeactivateFunc(const char *cStr)

- void setWindowStateChangeFunc(const char *cStr)
- void setWindowUnblockedFunc(const char *cStr)
- void setPaintFunc(const char *cStr)
- void setChildAddedFunc(const char *cStr)
- void setChildPolishedFunc(const char *cStr)
- void setChildRemovedFunc(const char *cStr)
- const char *getKeyPressFunc(void)
- const char *getMouseButtonPressFunc(void)
- const char *getMouseButtonReleaseFunc(void)
- const char *getMouseButtonDblClickFunc(void)
- const char *getMouseMoveFunc(void)
- const char *getCloseFunc(void)
- const char *getContextMenuFunc(void)
- const char *getDragEnterFunc(void)
- const char *getDragLeaveFunc(void)
- const char *getDragMoveFunc(void)
- const char *getDropFunc(void)
- const char *getEnterFunc(void)
- const char *getFocusInFunc(void)
- const char *getFocusOutFunc(void)
- const char *getKeyReleaseFunc(void)
- const char *getLeaveFunc(void)
- const char *getNonClientAreaMouseButtonDblClickFunc(void)
- const char *getNonClientAreaMouseButtonPressFunc(void)
- const char *getNonClientAreaMouseButtonReleaseFunc(void)
- const char *getNonClientAreaMouseMoveFunc(void)
- const char *getMoveFunc(void)
- const char *getResizeFunc(void)
- const char *getWindowActivateFunc(void)
- const char *getWindowBlockedFunc(void)
- const char *getWindowDeactivateFunc(void)
- const char *getWindowStateChangeFunc(void)
- const char *getWindowUnblockedFunc(void)
- const char *getPaintFunc(void)
- const char *getChildAddedFunc(void)
- const char *getChildPolishedFunc(void)

- const char *getChildRemovedFunc(void)
- QDropEvent *getDropEventObject(void)
- QDragMoveEvent *getDragMoveEventObject(void)
- QDragEnterEvent *getDragEnterEventObject(void)
- QDragLeaveEvent *getDragLeaveEventObject(void)
- QChildEvent *getChildEventObject(void)

92.17 QApp Class

C++ Reference : <http://doc.qt.io/qt-5/qapplication.html>

Parent Class : QGuiApplication

- void exec(void)
- void quit(void)
- void processEvents(void)
- void styleWindows(void)
- void styleWindowsVista(void)
- void styleFusion(void)
- void styleFusionBlack(void)
- void styleFusionCustom(QColor,QColor,QColor,QColor,QColor,QColor,QColor,QColor,QColor,QColor,QColor)
- void closeAllWindows(void)
- Qt::KeyboardModifiers keyboardModifiers(void)
- QClipboard *clipboard(void)
- QStyle *style(void)
- void aboutQt(void)
- QWidget *activeModalWidget(void)
- QWidget *activePopupWidget(void)
- QWidget *activeWindow(void)
- QWidget *focusWidget(void)
- double titlebarHeight(void)

92.18 QAreaLegendMarker Class

C++ Reference : <http://doc.qt.io/qt-5/qarealegendmarker.html>

Parent Class : QLegendMarker

- QAreaSeries * series(void)
- QLegendMarker::LegendMarkerType type(void)

92.19 QAreaSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qareaseries.html>

Parameters : QObject *

Parent Class : QAbstractSeries

- QColor borderColor(void)
- QBrush brush(void)
- QColor color(void)
- QLineSeries * lowerSeries(void)
- QPen pen(void)
- bool pointLabelsClipping(void)
- QColor pointLabelsColor(void)
- QFont pointLabelsFont(void)
- QString pointLabelsFormat(void)
- bool pointLabelsVisible(void)
- bool pointsVisible(void)
- void setBorderColor(QColor color)
- void setBrush(QBrush brush)
- void setColor(QColor color)
- void setLowerSeries(QLineSeries *series)
- void setPen(QPen pen)
- void setPointLabelsClipping(bool enabled)
- void setPointLabelsColor(QColor color)
- void setPointLabelsFont(QFont font)
- void setPointLabelsFormat(QString format)
- void setPointLabelsVisible(bool visible)
- void setPointsVisible(bool visible)
- void setUpperSeries(QLineSeries *series)
- QLineSeries * upperSeries(void)
- void setborderColorChangedEvent(const char *)

- void setclickedEvent(const char *)
- void setcolorChangedEvent(const char *)
- void setdoubleClickedEvent(const char *)
- void sethoveredEvent(const char *)
- void setpointLabelsClippingChangedEvent(const char *)
- void setpointLabelsColorChangedEvent(const char *)
- void setpointLabelsFontChangedEvent(const char *)
- void setpointLabelsFormatChangedEvent(const char *)
- void setpointLabelsVisibilityChangedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- const char *getborderColorChangedEvent(void)
- const char *getclickedEvent(void)
- const char *getcolorChangedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethoveredEvent(void)
- const char *getpointLabelsClippingChangedEvent(void)
- const char *getpointLabelsColorChangedEvent(void)
- const char *getpointLabelsFontChangedEvent(void)
- const char *getpointLabelsFormatChangedEvent(void)
- const char *getpointLabelsVisibilityChangedEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)

92.20 QAspectEngine Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dcore-qaspectengine.html>

Parameters : QObject *

Parent Class : QObject

- QVector<Qt3DCore::QAbstractAspect *> aspects(void)
- QVariant executeCommand(QString command)
- void registerAspect(Qt3DCore::QAbstractAspect *aspect)
- void registerAspect_2(QString name)
- Qt3DCore::QEntityPtr rootEntity(void)
- void setRootEntity(Qt3DCore::QEntityPtr root)
- void unregisterAspect(Qt3DCore::QAbstractAspect *aspect)

- void unregisterAspect_2(QString name)

92.21 QAudioOutput Class

C++ Reference : <http://doc.qt.io/qt-5/qaudiooutput.html>

Parameters : void

- void setVolume(float volume)

92.22 QAxBase Class

C++ Reference : <http://doc.qt.io/qt-5/qaxbase.html>

Parameters : QWidget *

Parent Class : QObject

- QVariant asVariant(void)
- QString control(void)
- void disableClassInfo(void)
- void disableEventSink(void)
- void disableMetaObject(void)
- QVariant dynamicCall(char *function)
- QVariant dynamicCall_2(char *function,QVariant)
- QVariant dynamicCall_3(char *function,QVariant,QVariant)
- QVariant dynamicCall_4(char *function,QVariant,QVariant,QVariant)
- QVariant dynamicCall_5(char *function,QVariant,QVariant,QVariant,QVariant)
- QVariant dynamicCall_6(char *function,QVariant,QVariant,QVariant,QVariant,QVariant)
- QVariant dynamicCall_7(char *function,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant)
- QVariant dynamicCall_8(char *function,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant)
- QVariant dynamicCall_9(char *function,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant)
- QVariant dynamicCall_10(const char *function, QList<QVariant>)
- QString generateDocumentation(void)
- boolisNull(void)
- QAxObject *querySubObject(const char *name)
- QAxObject *querySubObject_2(const char *name,QVariant)
- QAxObject *querySubObject_3(const char *name,QVariant,QVariant)
- QAxObject *querySubObject_4(const char *name,QVariant,QVariant,QVariant)
- QAxObject *querySubObject_5(const char *name,QVariant,QVariant,QVariant,QVariant)
- QAxObject *querySubObject_6(const char *name,QVariant,QVariant,QVariant,QVariant,QVariant)
- QAxObject *querySubObject_7(const char *name,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant)

- QAxObject *querySubObject_8(const char *name,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant)
- QAxObject *querySubObject_9(const char *name,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant,QVariant)
- bool setControl(QString)
- QStringList verbs(void)

92.23 QAxObject Class

C++ Reference : <http://doc.qt.io/qt-5/qaxobject.html>

Parameters : QString

Parent Class : QAxBASE

- bool doVerb(QString)

92.24 QAxWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qaxwidget.html>

Parameters : QWidget *parent, Qt::WindowFlags f

Parent Class : QAxBASE

- bool doVerb(QString)

92.25 QAxWidget2 Class

Parameters : QString c, QWidget *parent, Qt::WindowFlags f

Parent Class : QAxWidget

92.26 QBarCategoryAxis Class

C++ Reference : <http://doc.qt.io/qt-5/qbarcategoryaxis.html>

Parameters : QObject *

Parent Class : QAbstractAxis

- void append(QStringList categories)
- void append_2(QString category)
- QString at(int index)
- QStringList categories(void)
- void clear(void)
- int count(void)
- void insert(int index, QString category)
- QString max(void)

- `QString min(void)`
- `void remove(QString category)`
- `void replace(QString oldCategory, QString newCategory)`
- `void setCategories(QStringList categories)`
- `void setMax(QString max)`
- `void setMin(QString min)`
- `void setRange(QString minCategory, QString maxCategory)`
- `void setcategoriesChangedEvent(const char *)`
- `void setcountChangedEvent(const char *)`
- `void setmaxChangedEvent(const char *)`
- `void setminChangedEvent(const char *)`
- `void setrangeChangedEvent(const char *)`
- `const char *getcategoriesChangedEvent(void)`
- `const char *getcountChangedEvent(void)`
- `const char *getmaxChangedEvent(void)`
- `const char *getminChangedEvent(void)`
- `const char *getrangeChangedEvent(void)`

92.27 QBarLegendMarker Class

C++ Reference : <http://doc.qt.io/qt-5/qbarlegendmarker.html>

Parent Class : QLegendMarker

- `QBarSet * barset(void)`
- `QAbstractBarSeries * series(void)`

92.28 QBarSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qbarseries.html>

Parameters : `QObject *`

Parent Class : QAbstractBarSeries

- `QAbstractSeries::SeriesType type(void)`

92.29 QBarSet Class

C++ Reference : <http://doc.qt.io/qt-5/qbarset.html>

Parameters : QString,QObject *

Parent Class : QObject

- void append(qreal value)
- void append_2(QList<qreal> values)
- qreal at(int index)
- QColor borderColor(void)
- QBrush brush(void)
- QColor color(void)
- int count(void)
- void insert(int index, qreal value)
- QString label(void)
- QBrush labelBrush(void)
- QColor labelColor(void)
- QFont labelFont(void)
- QPen pen(void)
- void remove(int index, int count)
- void replace(int index, qreal value)
- void setBorderColor(QColor color)
- void setBrush(QBrush brush)
- void setColor(QColor color)
- void setLabel(QString label)
- void setLabelBrush(QBrush brush)
- void setLabelColor(QColor color)
- void setLabelFont(QFont font)
- void setPen(QPen pen)
- qreal sum(void)
- void setborderColorChangedEvent(const char *)
- void setbrushChangedEvent(const char *)
- void setclickedEvent(const char *)
- void setcolorChangedEvent(const char *)
- void setdoubleClickedEvent(const char *)
- void sethoveredEvent(const char *)
- void setlabelBrushChangedEvent(const char *)

- void setlabelChangedEvent(const char *)
- void setlabelColorChangedEvent(const char *)
- void setlabelFontChangedEvent(const char *)
- void setpenChangedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- void setvalueChangedEvent(const char *)
- void setvaluesAddedEvent(const char *)
- void setvaluesRemovedEvent(const char *)
- const char *getborderColorChangedEvent(void)
- const char *getbrushChangedEvent(void)
- const char *getclickedEvent(void)
- const char *getcolorChangedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethoveredEvent(void)
- const char *getlabelBrushChangedEvent(void)
- const char *getlabelChangedEvent(void)
- const char *getlabelColorChangedEvent(void)
- const char *getlabelFontChangedEvent(void)
- const char *getpenChangedEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)
- const char *getvalueChangedEvent(void)
- const char *getvaluesAddedEvent(void)
- const char *getvaluesRemovedEvent(void)

92.30 QBitmap Class

C++ Reference : <http://doc.qt.io/qt-5/qbitmap.html>

Parameters : void

Parent Class : QPixmap

- void clear(void)
- void swap(QBitmap)
- QBitmap transformed(QTransform)
- QBitmap fromData(QSize, const uchar * bits, QImage::Format monoFormat)
- QBitmap fromImage(QImage, Qt::ImageConversionFlags flags)

92.31 QBluetoothAddress Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothaddress.html>

Parameters : void

- void clear(void)
- boolisNull(void)
- QString toString(void)
- quint64 toUInt64(void)

92.32 QBluetoothDeviceDiscoveryAgent Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothdevicediscoveryagent.html>

Parameters : QObject *

- QList<QBluetoothDeviceInfo> discoveredDevices(void)
- QBluetoothDeviceDiscoveryAgent::Error error(void)
- QString errorString(void)
- QBluetoothDeviceDiscoveryAgent::InquiryType inquiryType(void)
- bool isActive(void)
- void setInquiryType(QBluetoothDeviceDiscoveryAgent::InquiryType type)
- void start(void)
- void stop(void)
- void setcanceledEvent(const char *)
- void setdeviceDiscoveredEvent(const char *)
- void seterrorEvent(const char *)
- void setfinishedEvent(const char *)
- const char *getcanceledEvent(void)
- const char *getdeviceDiscoveredEvent(void)
- const char *geterrorEvent(void)
- const char *getfinishedEvent(void)

92.33 QBluetoothDeviceInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothdeviceinfo.html>

Parameters : void

- QBluetoothAddress address(void)
- bool isValid(void)
- QBluetoothDeviceInfo::MajorDeviceClass majorDeviceClass(void)
- quint8 minorDeviceClass(void)
- QString name(void)
- qint16 rssi(void)
- QBluetoothDeviceInfo::ServiceClasses serviceClasses(void)
- QList<QBluetoothUuid> serviceUuids(QBluetoothDeviceInfo::DataCompleteness *completeness)
- QBluetoothDeviceInfo::DataCompleteness serviceUuidsCompleteness(void)
- void setCached(bool cached)
- void setServiceUuids(QList<QBluetoothUuid> uuids, QBluetoothDeviceInfo::DataCompleteness completeness)

92.34 QBluetoothHostInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothhostinfo.html>

Parameters : void

- QBluetoothAddress address(void)
- QString name(void)
- void setAddress(QBluetoothAddress address)
- void setName(QString name)

92.35 QBluetoothLocalDevice Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothlocaldevice.html>

Parameters : QObject *

- QBluetoothAddress address(void)
- QBluetoothLocalDevice::HostMode hostMode(void)
- bool isValid(void)
- QString name(void)
- QBluetoothLocalDevice::Pairing pairingStatus(QBluetoothAddress address)
- void powerOn(void)
- void requestPairing(QBluetoothAddress address, QBluetoothLocalDevice::Pairing pairing)

- void setHostMode(QBluetoothLocalDevice::HostMode mode)
- void pairingConfirmation(bool accept)
- QList<QBluetoothHostInfo> allDevices(void)
- void setdeviceConnectedEvent(const char *)
- void setdeviceDisconnectedEvent(const char *)
- void seterrorEvent(const char *)
- void sethostModeStateChangedEvent(const char *)
- void setpairingDisplayConfirmationEvent(const char *)
- void setpairingDisplayPinCodeEvent(const char *)
- void setpairingFinishedEvent(const char *)
- const char *getdeviceConnectedEvent(void)
- const char *getdeviceDisconnectedEvent(void)
- const char *geterrorEvent(void)
- const char *gethostModeStateChangedEvent(void)
- const char *getpairingDisplayConfirmationEvent(void)
- const char *getpairingDisplayPinCodeEvent(void)
- const char *getpairingFinishedEvent(void)

92.36 QBluetoothServer Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothserver.html>

Parameters : QBluetoothServiceInfo::Protocol,QObject *

Parent Class : QObject

- void close(void)
- QBluetoothServer::Error error(void)
- bool hasPendingConnections(void)
- bool isListening(void)
- bool listen(QBluetoothAddress address, quint16 port)
- QBluetoothServiceInfo listen_2(QBluetoothUuid uuid, QString serviceName))
- int maxPendingConnections(void)
- QBluetoothSocket * nextPendingConnection(void)
- QBluetooth::SecurityFlags securityFlags(void)
- QBluetoothAddress serverAddress(void)
- quint16 serverPort(void)
- QBluetoothServiceInfo::Protocol serverType(void)
- void setMaxPendingConnections(int numConnections)

- void setSecurityFlags(QBluetooth::SecurityFlags security)
- void seterrorEvent(const char *)
- void setnewConnectionEvent(const char *)
- const char *geterrorEvent(void)
- const char *getnewConnectionEvent(void)

92.37 QBluetoothServiceDiscoveryAgent Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothservicediscoveryagent.html>

Parameters : QObject *

Parent Class : QObject

- QList<QBluetoothServiceInfo> discoveredServices(void)
- QBluetoothServiceDiscoveryAgent::Error error(void)
- QString errorString(void)
- bool isActive(void)
- QBluetoothAddress remoteAddress(void)
- bool setRemoteAddress(QBluetoothAddress address)
- void setUuidFilter(QList<QBluetoothUuid> uuids)
- void setUuidFilter_2(QBluetoothUuid uuid)
- QList<QBluetoothUuid> uuidFilter(void)
- void clear(void)
- void start(QBluetoothServiceDiscoveryAgent::DiscoveryMode mode)
- void stop(void)
- void setcanceledEvent(const char *)
- void seterrorEvent(const char *)
- void setfinishedEvent(const char *)
- void setserviceDiscoveredEvent(const char *)
- const char *getcanceledEvent(void)
- const char *geterrorEvent(void)
- const char *getfinishedEvent(void)
- const char *getserviceDiscoveredEvent(void)

92.38 QBluetoothServiceInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothserviceinfo.html>

Parameters : void

- QVariant attribute(quint16 attributeId)
- QList<quint16> attributes(void)
- bool contains(quint16 attributeId)
- QBluetoothDeviceInfo device(void)
- bool isComplete(void)
- bool isRegistered(void)
- bool isValid(void)
- QBluetoothServiceInfo::Sequence protocolDescriptor(QBluetoothUuid::ProtocolUuid protocol)
- int protocolServiceMultiplexer(void)
- bool registerService(QBluetoothAddress localAdapter))
- void removeAttribute(quint16 attributeId)
- int serverChannel(void)
- quint8 serviceAvailability(void)
- QList<QBluetoothUuid> serviceClassUuids(void)
- QString serviceDescription(void)
- QString serviceName(void)
- QString serviceProvider(void)
- QBluetoothUuid serviceUuid(void)
- void setAttribute(quint16 attributeId, QVariant value)
- void setAttribute_2(quint16 attributeId, QBluetoothUuid value)
- void setAttribute_3(quint16 attributeId, QBluetoothServiceInfo::Sequence value)
- void setDevice(QBluetoothDeviceInfo device)
- void setServiceAvailability(quint8 availability)
- void setServiceDescription(QString description)
- void setServiceName(QString name)
- void setServiceProvider(QString provider)
- void setServiceUuid(QBluetoothUuid uuid)
- bool unregisterService(void)

92.39 QBluetoothSocket Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothsocket.html>

Parameters : QBluetoothServiceInfo::Protocol,QObject *

Parent Class : QIODevice

- void abort(void)
- void connectToService(QBluetoothServiceInfo service, QIODevice::OpenMode openMode)
- void connectToService_2(QBluetoothAddress address, QBluetoothUuid uuid, QIODevice::OpenMode openMode)
- void connectToService_3(QBluetoothAddress address, quint16 port, QIODevice::OpenMode openMode)
- void disconnectFromService(void)
- QBluetoothSocket::SocketError error(void)
- QString errorString(void)
- QBluetoothAddress localAddress(void)
- QString localName(void)
- quint16 localPort(void)
- QBluetoothAddress peerAddress(void)
- QString peerName(void)
- quint16 peerPort(void)
- bool setSocketDescriptor(int socketDescriptor, QBluetoothServiceInfo::Protocol socketType, QBluetoothSocket::SocketState socketState, QIODevice::OpenMode openMode)
- int socketDescriptor(void)
- QBluetoothServiceInfo::Protocol socketType(void)
- QBluetoothSocket::SocketState state(void)
- void setconnectedEvent(const char *)
- void setdisconnectedEvent(const char *)
- void seterrorEvent(const char *)
- void setstateChangedEvent(const char *)
- const char *getconnectedEvent(void)
- const char *getdisconnectedEvent(void)
- const char *geterrorEvent(void)
- const char *getstateChangedEvent(void)

92.40 QBluetoothTransferManager Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothtransfermanager.html>

Parameters : QObject *

Parent Class : QObject

- QBluetoothTransferReply * put(QBluetoothTransferRequest request, QIODevice *data)
- void setfinishedEvent(const char *)
- const char *getfinishedEvent(void)

92.41 QBluetoothTransferReply Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothtransferreply.html>

Parameters : QObject *

Parent Class : QObject

- QBluetoothTransferManager * manager(void)
- QBluetoothTransferRequest request(void)
- void abort(void)
- void seterrorEvent(const char *)
- void setfinishedEvent(const char *)
- void settransferProgressEvent(const char *)
- const char *geterrorEvent(void)
- const char *getfinishedEvent(void)
- const char *gettransferProgressEvent(void)

92.42 QBluetoothTransferRequest Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothtransferrequest.html>

Parameters : QBluetoothAddress

- QBluetoothAddress address(void)
- QVariant attribute(QBluetoothTransferRequest::Attribute code, QVariant defaultValue))
- void setAttribute(QBluetoothTransferRequest::Attribute code, QVariant value)

92.43 QBluetoothUuid Class

C++ Reference : <http://doc.qt.io/qt-5/qbluetoothuuid.html>

Parameters : void

Parent Class : QUuid

- int minimumSize(void)
- quint16 toUInt16(bool *ok)
- quint32 toUInt32(bool *ok)
- quint128 toUInt128(void)

92.44 QBoxLayout Class

C++ Reference : <http://doc.qt.io/qt-5/qboxlayout.html>

Parameters : QBoxLayout::Direction dir, QWidget *parent

Parent Class : QLayout

- void addLayout(QLayout * layout, int stretch)
- void addSpacerItem(QSpacerItem * spacerItem)
- void addSpacing(int size)
- void addStretch(int stretch)
- void addStrut(int size)
- void addWidget(QWidget * widget, int stretch , Qt::Alignment alignment)
- QBoxLayout::Direction direction(void)
- void insertLayout(int index, QLayout * layout, int stretch)
- void insertSpacerItem(int index, QSpacerItem * spacerItem)
- void insertSpacing(int index, int size)
- void insertStretch(int index, int stretch)
- void insertWidget(int index, QWidget * widget, int stretch , Qt::Alignment alignment)
- void setDirection(QBoxLayout::Direction direction)
- void setSpacing(int spacing)
- void setStretch(int index, int stretch)
- bool setStretchFactor(QWidget * widget, int stretch)
- bool setStretchFactor_2(FlowLayout * layout, int stretch)
- int spacing(void)
- int stretch(int index)

92.45 QBoxPlotLegendMarker Class

C++ Reference : <http://doc.qt.io/qt-5/qboxplotlegendmarker.html>

Parent Class : QLegendMarker

- QBoxPlotSeries * series(void)
- QLegendMarker::LegendMarkerType type(void)

92.46 QBoxPlotSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qboxplotsseries.html>

Parameters : QObject *

Parent Class : QAbstractSeries

- bool append(QBoxSet *set)
- bool append_2(QList<QBoxSet *> sets)
- bool boxOutlineVisible(void)
- QList<QBoxSet *> boxSets(void)
- qreal boxWidth(void)
- QBrush brush(void)
- void clear(void)
- int count(void)
- bool insert(int index, QBoxSet *set)
- QPen pen(void)
- bool remove(QBoxSet *set)
- void setBoxOutlineVisible(bool visible)
- void setBoxWidth(qreal width)
- void setBrush(QBrush brush)
- void setPen(QPen pen)
- bool take(QBoxSet *set)
- QAbstractSeries::SeriesType type(void)
- void setboxOutlineVisibilityChangedEvent(const char *)
- void setboxWidthChangedEvent(const char *)
- void setboxsetsAddedEvent(const char *)
- void setboxsetsRemovedEvent(const char *)
- void setbrushChangedEvent(const char *)
- void setclickedEvent(const char *)
- void setcountChangedEvent(const char *)
- void setdoubleClickedEvent(const char *)

- void sethoveredEvent(const char *)
- void setpenChangedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- const char *getboxOutlineVisibilityChangedEvent(void)
- const char *getboxWidthChangedEvent(void)
- const char *getboxsetsAddedEvent(void)
- const char *getboxsetsRemovedEvent(void)
- const char *getbrushChangedEvent(void)
- const char *getclickedEvent(void)
- const char *getcountChangedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethoveredEvent(void)
- const char *getpenChangedEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)

92.47 QBoxSet Class

C++ Reference : <http://doc.qt.io/qt-5/qboxset.html>

Parameters : QString,QObject *

Parent Class : QObject

- void append(qreal value)
- void append_2(QList<qreal> values)
- qreal at(int index)
- QBrush brush(void)
- void clear(void)
- int count(void)
- QString label(void)
- QPen pen(void)
- void setBrush(QBrush brush)
- void setLabel(QString label)
- void setPen(QPen pen)
- void setValue(int index, qreal value)
- void setbrushChangedEvent(const char *)
- void setclearedEvent(const char *)

- void setclickedEvent(const char *)
- void setdoubleClickedEvent(const char *)
- void sethoveredEvent(const char *)
- void setpenChangedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- void setvalueChangedEvent(const char *)
- void setvaluesChangedEvent(const char *)
- const char *getbrushChangedEvent(void)
- const char *getclearedEvent(void)
- const char *getclickedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethoveredEvent(void)
- const char *getpenChangedEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)
- const char *getvalueChangedEvent(void)
- const char *getvaluesChangedEvent(void)

92.48 QBrush Class

C++ Reference : <http://doc.qt.io/qt-5/qbrush.html>

Parameters : void

- QColor color(void)
- QGradient *gradient(void)
- bool isOpaque(void)
- void setColor(QColor)
- void setStyle(Qt::BrushStyle style)
- void setTexture(QPixmap)
- void setTextureImage(QImage)
- void setTransform(QTransform)
- int style(void)
- void swap(QBrush)
- QPixmap texture(void)
- QImage textureImage(void)
- QTransform transform(void)

92.49 QBuffer Class

C++ Reference : <http://doc.qt.io/qt-5/qbuffer.html>

Parameters : QObject *

Parent Class : QIODevice

- QByteArray buffer(void)
- QByteArray data(void)
- void setBuffer(QByteArray *byteArray)
- void setData(QByteArray data)
- void setData_2(char *data, int size)

92.50 QButtonGroup Class

C++ Reference : <http://doc.qt.io/qt-5/qbuttongroup.html>

Parameters : QObject *parent

- void addButton(QAbstractButton *button, int id)
- QAbstractButton *button(int id)
- QAbstractButton *checkedButton(void)
- int checkedId(void)
- bool exclusive(void)
- int id(QAbstractButton *button)
- void removeButton(QAbstractButton *button)
- void setExclusive(bool)
- void setId(QAbstractButton *button, int id)
- void setbuttonClickedEvent(const char *)
- void setbuttonPressedEvent(const char *)
- void setbuttonReleasedEvent(const char *)
- const char *getbuttonClickedEvent(void)
- const char *getbuttonPressedEvent(void)
- const char *getbuttonReleasedEvent(void)

92.51 QByteArray Class

C++ Reference : <http://doc.qt.io/qt-5/qbytearray.html>

Parameters : void

- QByteArray append(const char *str)
- QByteArray append_2(const char *str,int size)
- char at(int i)
- int capacity(void)
- void chop(int n)
- void clear(void)
- const char *constData(void)
- bool contains(const char *str)
- int count(const char *str)
- const char *data(void)
- bool endsWith(const char *str)
- QByteArray fill(char ch, int size)
- int indexOf(const char *str, int from)
- QByteArray insert(int i, const char *str, int len)
- bool isEmpty(void)
- boolisNull(void)
- int lastIndexOf(const char *str, int from)
- QByteArray left(int len)
- QByteArray leftJustified(int width, char fill, bool truncate)
- int length(void)
- QByteArray mid(int pos, int len)
- QByteArray prepend(const char *str, int len)
- void push_back(const char *str)
- void push_front(const char *str)
- QByteArray remove(int pos, int len)
- QByteArray repeated(int times)
- QByteArray replace(int pos, int len, const char *after, int alen)
- QByteArray replace_2(int pos, int len, QByteArray after)
- QByteArray replace_3(int pos, int len, const char *after)
- QByteArray replace_4(char before, const char *after)
- QByteArray replace_5(char before, QByteArray after)
- QByteArray replace_6(const char *before, const char *after)

- `QByteArray replace_7(const char *before, int bsize, const char *after, int asize)`
- `QByteArray replace_8(const QByteArray before, QByteArray after)`
- `QByteArray replace_9(const QByteArray before, const char *after)`
- `QByteArray replace_10(const char *before, QByteArray after)`
- `QByteArray replace_11(char before, char after)`
- `void reserve(int size)`
- `void resize(int size)`
- `QByteArray right(int len)`
- `QByteArray rightJustified(int width, char fill, bool truncate)`
- `QByteArray setNum(int n, int base)`
- `QByteArray setRawData(const char *data, uint size)`
- `QByteArray simplified(void)`
- `int size(void)`
- `void squeeze(void)`
- `bool startsWith(const char *str)`
- `void swap(QByteArray other)`
- `QByteArray toBase64(void)`
- `doubletoDouble(bool * ok)`
- `float toFloat(bool * ok)`
- `QByteArray toHex(void)`
- `int toInt(bool *ok, int base)`
- `long toLong(bool *ok, int base)`
- `qlonglong toLongLong(bool *ok, int base)`
- `QByteArray toLower(void)`
- `QByteArray toPercentEncoding(QByteArray,QByteArray, char percent)`
- `short toShort(bool *ok, int base)`
- `int toUInt(bool *ok, int base)`
- `int toULong(bool *ok, int base)`
- `int toULongLong(bool * ok, int base)`
- `int toUShort(bool * ok, int base)`
- `QByteArray toUpper(void)`
- `QByteArray trimmed(void)`
- `void truncate(int pos)`
- `QByteArray fromBase64(QByteArray)`
- `QByteArray fromHex(QByteArray)`
- `QByteArray fromPercentEncoding(QByteArray, char percent)`

- QByteArray fromRawData(const char *data, int size)
- QByteArray number(int n, int base)

92.52 QCalendarWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qcalendarwidget.html>

Parameters : QWidget *

Parent Class : QWidget

- int dateEditAcceptDelay(void)
- QMap<QDate, QTextCharFormat> dateTextFormat(void)
- QTextCharFormat dateTextFormat_2(QDate date)
- Qt::DayOfWeek firstDayOfWeek(void)
- QTextCharFormat headerTextFormat(void)
- QCalendarWidget::HorizontalHeaderFormat horizontalHeaderFormat(void)
- bool isDateEditEnabled(void)
- bool isGridVisible(void)
- bool isNavigationBarVisible(void)
- QDate maximumDate(void)
- QDate minimumDate(void)
- int monthShown(void)
- QDate selectedDate(void)
- QCalendarWidget::SelectionMode selectionMode(void)
- void setDateEditAcceptDelay(int delay)
- void setDateEditEnabled(bool enable)
- void setDateTextFormat(QDate date, QTextCharFormat format)
- void setFirstDayOfWeek(Qt::DayOfWeek dayOfWeek)
- void setHeaderTextFormat(QTextCharFormat format)
- void setHorizontalHeaderFormat(QCalendarWidget::HorizontalHeaderFormat format)
- void setMaximumDate(QDate date)
- void setMinimumDate(QDate date)
- void setSelectionMode(QCalendarWidget::SelectionMode mode)
- void setVerticalHeaderFormat(QCalendarWidget::VerticalHeaderFormat format)
- void setWeekdayTextFormat(Qt::DayOfWeek dayOfWeek, QTextCharFormat format)
- QCalendarWidget::VerticalHeaderFormat verticalHeaderFormat(void)
- QTextCharFormat weekdayTextFormat(Qt::DayOfWeek dayOfWeek)
- int yearShown(void)

- void setCurrentPage(int year, int month)
- void setDateRange(QDate min, QDate max)
- void setGridVisible(bool show)
- void setNavigationBarVisible(bool visible)
- void setSelectedDate(QDate date)
- void showNextMonth(void)
- void showNextYear(void)
- void showPreviousMonth(void)
- void showPreviousYear(void)
- void showSelectedDate(void)
- void showToday(void)
- void setactivatedEvent(const char *)
- void setclickedEvent(const char *)
- void setcurrentPageChangedEvent(const char *)
- void setselectionChangedEvent(const char *)
- const char *getactivatedEvent(void)
- const char *getclickedEvent(void)
- const char *getcurrentPageChangedEvent(void)
- const char *getselectionChangedEvent(void)

92.53 QCamera Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qcamera.html>

Parameters : void

Parent Class : QMediaObject

- QCamera::CaptureModes captureMode(void)
- QCamera::Error error(void)
- QString errorString(void)
- QCameraExposure * exposure(void)
- QCameraFocus * focus(void)
- QCameraImageProcessing * imageProcessing(void)
- bool isCaptureModeSupported(QCamera::CaptureModes mode)
- QCamera::LockStatus lockStatus(void)
- QCamera::LockStatus lockStatus_2(QCamera::LockType lockType)
- QCamera::LockTypes requestedLocks(void)
- void setViewfinder(QVideoWidget * viewfinder)

- void setViewfinder_2(QGraphicsVideoItem * viewfinder)
- void setViewfinder_3(QAbstractVideoSurface * surface)
- QCamera::State state(void)
- QCamera::Status status(void)
- QCamera::LockTypes supportedLocks(void)
- void load(void)
- void searchAndLock(void)
- void searchAndLock_2(QCamera::LockTypes locks)
- void setCaptureMode(QCamera::CaptureModes mode)
- void start(void)
- void stop(void)
- void unload(void)
- void unlock(void)
- void unlock_2(QCamera::LockTypes locks)

92.54 QCameralmageCapture Class

C++ Reference : <http://doc.qt.io/qt-5/qcameralmagecapture.html>

Parameters : QMediaObject * mediaObject

- QMultimedia::AvailabilityStatus availability(void)
- QVideoFrame::PixelFormat bufferFormat(void)
- QCameralmageCapture::CaptureDestinations captureDestination(void)
- QImageEncoderSettings encodingSettings(void)
- QCameralmageCapture::Error error(void)
- QString errorString(void)
- QString imageCodecDescription(QString codec)
- bool isAvailable(void)
- bool isCaptureDestinationSupported(QCameralmageCapture::CaptureDestinations destination)
- bool isReadyForCapture(void)
- void setBufferFormat(QVideoFrame::PixelFormat format)
- void setCaptureDestination(QCameralmageCapture::CaptureDestinations destination)
- void setEncodingSettings(QImageEncoderSettings settings)
- QList<QVideoFrame::PixelFormat> supportedBufferFormats(void)
- QStringList supportedImageCodecs(void)
- QList<QSize> supportedResolutions(QImageEncoderSettings settings , bool * continuous)
- void cancelCapture(void)

- int capture(QString file)

92.55 QCameraLens Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qcameralens.html>

Parameters : Qt3DCore::QNode *

- float aspectRatio(void)
- float bottom(void)
- float exposure(void)
- float farPlane(void)
- float fieldOfView(void)
- float left(void)
- float nearPlane(void)
- QMatrix4x4 projectionMatrix(void)
- Qt3DRender::QCameraLens::ProjectionType projectionType(void)
- float right(void)
- void setFrustumProjection(float left, float right, float bottom, float top, float nearPlane, float farPlane)
- void setOrthographicProjection(float left, float right, float bottom, float top, float nearPlane, float farPlane)
- void setPerspectiveProjection(float fieldOfView, float aspectRatio, float nearPlane, float farPlane)
- float top(void)
- void setBottom(float bottom)
- void setExposure(float exposure)
- void setFarPlane(float farPlane)
- void setFieldOfView(float fieldOfView)
- void setLeft(float left)
- void setNearPlane(float nearPlane)
- void setProjectionMatrix(QMatrix4x4 projectionMatrix)
- void setProjectionType(Qt3DRender::QCameraLens::ProjectionType projectionType)
- void setRight(float right)
- void setTop(float top)

92.56 QCameraSelector Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qcameraselector.html>

Parameters : Qt3DCore::QNode *

- Qt3DCore::QEntity * camera(void)
- void setCamera(Qt3DCore::QEntity *camera)

92.57 QCameraViewfinder Class

C++ Reference : <http://doc.qt.io/qt-5/qcameraviewfinder.html>

Parameters : QWidget *

Parent Class : QVideoWidget

92.58 QCandlestickLegendMarker Class

C++ Reference : <http://doc.qt.io/qt-5 qcandlesticklegendmarker.html>

Parent Class : QLegendMarker

- QCandlestickSeries * series(void)
- QLegendMarker::LegendMarkerType type(void)

92.59 QCandlestickModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5 qcandlestickmodelmapper.html>

Parameters : QObject *

Parent Class : QObject

- QAbstractItemModel * model(void)
- Qt::Orientation orientation(void)
- QCandlestickSeries * series(void)
- void setModel(QAbstractItemModel *model)
- void setSeries(QCandlestickSeries *series)
- void setmodelReplacedEvent(const char *)
- void setsseriesReplacedEvent(const char *)
- const char *getmodelReplacedEvent(void)
- const char *getseriesReplacedEvent(void)

92.60 QCandlestickSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qcandlestickseries.html>

Parameters : QObject *

Parent Class : QAbstractSeries

- bool append(QCandlestickSet *set)
- bool append_2(QList<QCandlestickSet *> sets)
- bool bodyOutlineVisible(void)
- qreal bodyWidth(void)
- QBrush brush(void)
- bool capsVisible(void)
- qreal capsWidth(void)
- void clear(void)
- int count(void)
- QColor decreasingColor(void)
- QColor increasingColor(void)
- bool insert(int index, QCandlestickSet *set)
- qreal maximumColumnWidth(void)
- qreal minimumColumnWidth(void)
- QPen pen(void)
- bool remove(QCandlestickSet *set)
- bool remove_2(QList<QCandlestickSet *> sets)
- void setBodyOutlineVisible(bool bodyOutlineVisible)
- void setBodyWidth(qreal bodyWidth)
- void setBrush(QBrush brush)
- void setCapsVisible(bool capsVisible)
- void setCapsWidth(qreal capsWidth)
- void setDecreasingColor(QColor decreasingColor)
- void setIncreasingColor(QColor increasingColor)
- void setMaximumColumnWidth(qreal maximumColumnWidth)
- void setMinimumColumnWidth(qreal minimumColumnWidth)
- void setPen(QPen pen)
- QList<QCandlestickSet *> sets(void)
- bool take(QCandlestickSet *set)
- void setbodyOutlineVisibilityChangedEvent(const char *)
- void setbodyWidthChangedEvent(const char *)

- void setbrushChangedEvent(const char *)
- void setcandlestickSetsAddedEvent(const char *)
- void setcandlestickSetsRemovedEvent(const char *)
- void setcapsVisibilityChangedEvent(const char *)
- void setcapsWidthChangedEvent(const char *)
- void setclickedEvent(const char *)
- void setcountChangedEvent(const char *)
- void setdecreasingColorChangedEvent(const char *)
- void setdoubleClickedEvent(const char *)
- void sethoveredEvent(const char *)
- void setincreasingColorChangedEvent(const char *)
- void setmaximumColumnWidthChangedEvent(const char *)
- void setminimumColumnWidthChangedEvent(const char *)
- void setpenChangedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- const char *getbodyOutlineVisibilityChangedEvent(void)
- const char *getbodyWidthChangedEvent(void)
- const char *getbrushChangedEvent(void)
- const char *getcandlestickSetsAddedEvent(void)
- const char *getcandlestickSetsRemovedEvent(void)
- const char *getcapsVisibilityChangedEvent(void)
- const char *getcapsWidthChangedEvent(void)
- const char *getclickedEvent(void)
- const char *getcountChangedEvent(void)
- const char *getdecreasingColorChangedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethoveredEvent(void)
- const char *getincreasingColorChangedEvent(void)
- const char *getmaximumColumnWidthChangedEvent(void)
- const char *getminimumColumnWidthChangedEvent(void)
- const char *getpenChangedEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)

92.61 QCandlestickSet Class

C++ Reference : <http://doc.qt.io/qt-5/qcandlestickset.html>

Parameters : qreal,QObject *

Parent Class : QObject

- QBrush brush(void)
- qreal close(void)
- qreal high(void)
- qreal low(void)
- qreal open(void)
- QPen pen(void)
- void setBrush(QBrush brush)
- void setClose(qreal close)
- void setHigh(qreal high)
- void setLow(qreal low)
- void setOpen(qreal open)
- void setPen(QPen pen)
- void setTimestamp(qreal timestamp)
- qreal timestamp(void)
- void setbrushChangedEvent(const char *)
- void setclickedEvent(const char *)
- void setcloseChangedEvent(const char *)
- void setdoubleClickedEvent(const char *)
- void sethighChangedEvent(const char *)
- void sethoveredEvent(const char *)
- void setlowChangedEvent(const char *)
- void setopenChangedEvent(const char *)
- void setpenChangedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- void settimestampChangedEvent(const char *)
- const char *getbrushChangedEvent(void)
- const char *getclickedEvent(void)
- const char *getcloseChangedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethighChangedEvent(void)

- const char *gethoveredEvent(void)
- const char *getlowChangedEvent(void)
- const char *getopenChangedEvent(void)
- const char *getpenChangedEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)
- const char *gettimestamppChangedEvent(void)

92.62 QCategoryAxis Class

C++ Reference : <http://doc.qt.io/qt-5/qcategoryaxis.html>

Parameters : QObject *

Parent Class : QValueAxis

- void append(QString categoryLabel, qreal categoryEndValue)
- QStringList categoriesLabels(void)
- int count(void)
- qreal endValue(QString categoryLabel)
- QCATEGORYAxis::AxisLabelsPosition labelsPosition(void)
- void remove(QString categoryLabel)
- void replaceLabel(QString oldLabel, QString newLabel)
- void setLabelsPosition(QCATEGORYAxis::AxisLabelsPosition position)
- void setStartValue(qreal min)
- qreal startValue(QString categoryLabel)
- void setcategoriesChangedEvent(const char *)
- void setlabelsPositionChangedEvent(const char *)
- const char *getcategoriesChangedEvent(void)
- const char *getlabelsPositionChangedEvent(void)

92.63 QChar Class

C++ Reference : <http://doc.qt.io/qt-5/qchar.html>

Parameters : int

- QChar::Category category(void)
- uchar cell(void)
- unsigned char combiningClass(void)
- QString decomposition(void)
- QChar::Decomposition decompositionTag(void)

- int digitValue(void)
- QChar::Direction direction(void)
- bool hasMirrored(void)
- bool isDigit(void)
- bool isHighSurrogate(void)
- bool isLetter(void)
- bool isLetterOrNumber(void)
- bool isLowSurrogate(void)
- bool isLower(void)
- bool isMark(void)
- bool isNonCharacter(void)
- bool isNull(void)
- bool isNumber(void)
- bool isPrint(void)
- bool isPunct(void)
- bool isSpace(void)
- bool isSurrogate(void)
- bool isSymbol(void)
- bool isTitleCase(void)
- bool isUpper(void)
- QChar mirroredChar(void)
- uchar row(void)
- QChar::Script script(void)
- QChar toCaseFolded(void)
- char toLatin1(void)
- QChar toLower(void)
- QChar toTitleCase(void)
- QChar toUpper(void)
- ushort unicode(void)
- ushort unicode_2(void)
- QChar::UnicodeVersion unicodeVersion(void)
- QChar::Category category_2(uint ucs4)
- unsigned char combiningClass_2(uint ucs4)
- QChar::UnicodeVersion currentUnicodeVersion(void)
- QString decomposition_2(uint ucs4)
- QChar::Decomposition decompositionTag_2(uint ucs4)

- int digitValue_2(uint ucs4)
- QChar::Direction direction_2(uint ucs4)
- QChar fromLatin1(char c)
- bool hasMirrored_2(uint ucs4)
- ushort highSurrogate(uint ucs4)
- bool isDigit_2(uint ucs4)
- bool isHighSurrogate_2(uint ucs4)
- bool isLetter_2(uint ucs4)
- bool isLetterOrNumber_2(uint ucs4)
- bool isLowSurrogate_2(uint ucs4)
- bool isLower_2(uint ucs4)
- bool isMark_2(uint ucs4)
- bool isNonCharacter_2(uint ucs4)
- bool isNumber_2(uint ucs4)
- bool isPrint_2(uint ucs4)
- bool isPunct_2(uint ucs4)
- bool isSpace_2(uint ucs4)
- bool isSurrogate_2(uint ucs4)
- bool isSymbol_2(uint ucs4)
- bool isTitleCase_2(uint ucs4)
- bool isUpper_2(uint ucs4)
- ushort lowSurrogate(uint ucs4)
- uint mirroredChar_2(uint ucs4)
- bool requiresSurrogates(uint ucs4)
- QChar::Script script_2(uint ucs4)
- uint surrogateToUcs4(ushort high, ushort low)
- uint surrogateToUcs4_2(QChar high, QChar low)
- uint toCaseFolded_2(uint ucs4)
- uint toLower_2(uint ucs4)
- uint toTitleCase_2(uint ucs4)
- uint toUpper_2(uint ucs4)
- QChar::UnicodeVersion unicodeVersion_2(uint ucs4)

92.64 QChart Class

C++ Reference : <http://doc.qt.io/qt-5/qchart.html>

Parameters : QGraphicsItem *,Qt::WindowFlags

Parent Class : QGraphicsWidget

- void addAxis(QAbstractAxis *axis, Qt::Alignment alignment)
- void addSeries(QAbstractSeries *series)
- int animationDuration(void)
- QEasingCurve animationEasingCurve(void)
- QChart::AnimationOptions animationOptions(void)
- QList<QAbstractAxis *> axes(Qt::Orientations orientation, QAbstractSeries *series)
- QBrush backgroundBrush(void)
- QPen backgroundPen(void)
- qreal backgroundRoundness(void)
- QChart::ChartType chartType(void)
- void createDefaultAxes(void)
- bool isBackgroundVisible(void)
- bool isDropShadowEnabled(void)
- bool isPlotAreaBackgroundVisible(void)
- bool isZoomed(void)
- QLegend *legend(void)
- QLocale locale(void)
- bool localizeNumbers(void)
- QPointF mapToPosition(QPointF value, QAbstractSeries *series)
- QPointF mapToValue(QPointF position, QAbstractSeries *series)
- QMargins margins(void)
- QRectF plotArea(void)
- QBrush plotAreaBackgroundBrush(void)
- QPen plotAreaBackgroundPen(void)
- void removeAllSeries(void)
- void removeAxis(QAbstractAxis *axis)
- void removeSeries(QAbstractSeries *series)
- void scroll(qreal dx, qreal dy)
- QList<QAbstractSeries *> series(void)
- void setAnimationDuration(int msecs)
- void setAnimationEasingCurve(QEasingCurve curve)

- void setAnimationOptions(QChart::AnimationOptions options)
- void setBackgroundBrush(QBrush brush)
- void setBackgroundPen(QPen pen)
- void setBackgroundRoundness(qreal diameter)
- void setBackgroundVisible(bool visible)
- void setDropShadowEnabled(bool enabled)
- void setLocale(QLocale locale)
- void setLocalizeNumbers(bool localize)
- void setMargins(QMargins margins)
- void setPlotArea(QRectF rect)
- void setPlotAreaBackgroundBrush(QBrush brush)
- void setPlotAreaBackgroundPen(QPen pen)
- void setPlotAreaBackgroundVisible(bool visible)
- void setTheme(QChart::ChartTheme theme)
- void setTitle(QString title)
- void setTitleBrush(QBrush brush)
- void setTitleFont(QFont font)
- QChart::ChartTheme theme(void)
- QString title(void)
- QBrush titleBrush(void)
- QFont titleFont(void)
- void zoom(qreal factor)
- void zoomIn(void)
- void zoomIn_2(QRectF rect)
- void zoomOut(void)
- void zoomReset(void)
- void setplotAreaChangedEvent(const char *)
- const char *getplotAreaChangedEvent(void)

92.65 QChartView Class

C++ Reference : <http://doc.qt.io/qt-5/qchartview.html>

Parameters : QWidget *

Parent Class : QGraphicsView

- QChart * chart(void)
- QChartView::RubberBands rubberBand(void)

- void setChart(QChart *chart)
- void setRubberBand(QChartView::RubberBands rubberBand)

92.66 QCheckBox Class

C++ Reference : <http://doc.qt.io/qt-5/qcheckbox.html>

Parameters : QWidget *parent

Parent Class : QAbstractButton

- int checkState(void)
- bool isTristate(void)
- void setCheckState(Qt::CheckState state)
- void setTristate(bool y)
- QSize minimumSizeHint(void)
- QSize sizeHint(void)
- void setstateChangedEvent(const char *)
- void setclickedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- void settoggledEvent(const char *)
- const char *getstateChangedEvent(void)
- const char *getclickedEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)
- const char *gettoggledEvent(void)

92.67 QChildEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qchildevent.html>

Parameters : QEvent::Type,QObject *

Parent Class : QEvent

- bool added(void)
- QObject *child(void)
- bool polished(void)
- bool removed(void)

92.68 QClipboard Class

C++ Reference : <http://doc.qt.io/qt-5/qclipboard.html>

- void clear(QClipboard::Mode mode)
- QImage image(QClipboard::Mode mode)
- QMimeData * mimeData(QClipboard::Mode mode)
- bool ownsClipboard(void)
- bool ownsFindBuffer(void)
- bool ownsSelection(void)
- QPixmap pixmap(QClipboard::Mode mode)
- void setImage(QImage image, QClipboard::Mode mode)
- void setMimeData(QMimeData * src, QClipboard::Mode mode)
- void setPixmap(QPixmap pixmap, QClipboard::Mode mode)
- void setText(QString text, QClipboard::Mode mode)
- bool supportsFindBuffer(void)
- bool supportsSelection(void)
- QString text(QClipboard::Mode mode)

92.69 QColor Class

C++ Reference : <http://doc.qt.io/qt-5/qcolor.html>

Parameters : void

- int alpha(void)
- double alphaF(void)
- int black(void)
- double blackF(void)
- int blue(void)
- double blueF(void)
- QColor convertTo(QColor::Spec colorSpec)
- int cyan(void)
- double cyanF(void)
- QColor darker(int factor)
- void getCMYK(int *c, int *m, int *y, int *k, int *a)
- void getCMYKF(qreal *c, qreal *m, qreal *y, qreal *k, qreal *a)
- void getHSL(int *h, int *s, int *l, int *a)
- void getHSIF(qreal *h, qreal *s, qreal *l, qreal *a)
- void getHSV(int *h, int *s, int *v, int *a)

- void getHsvF(qreal *h, qreal *s, qreal *v, qreal *a)
- void getRgb(int *r, int *g, int *b, int *a)
- void getRgbF(qreal *r, qreal *g, qreal *b, qreal *a)
- int green(void)
- double greenF(void)
- int hslHue(void)
- double hslHueF(void)
- int hslSaturation(void)
- double hslSaturationF(void)
- int hsvHue(void)
- double hsvHueF(void)
- int hsvSaturation(void)
- double hsvSaturationF(void)
- int hue(void)
- double hueF(void)
- bool isValid(void)
- QColor lighter(int factor)
- int lightness(void)
- double lightnessF(void)
- int magenta(void)
- double magentaF(void)
- QString name(void)
- int red(void)
- double redF(void)
- QRgb rgb(void)
- QRgb rgba(void)
- int saturation(void)
- double saturationF(void)
- void setAlpha(int alpha)
- void setAlphaF(double alpha)
- void setBlue(int blue)
- void setBlueF(double blue)
- void setCmyk(int c, int m, int y, int k, int a)
- void setCmykF(double c, double m, double y, double k, double a)
- void setGreen(int green)
- void setGreenF(double green)

- void setHsl(int h, int s, int l, int a)
- void setHslF(double h, double s, double l, double a)
- void setHsv(int h, int s, int v, int a)
- void setHsvF(double h, double s, double v, double a)
- void setNamedColor(QString)
- void setRed(int red)
- void setRedF(double red)
- void setRgb(int r, int g, int b, int a)
- void setRgbF(double r, double g, double b, double a)
- void setRgba(QRgb rgba)
- int spec(void)
- QColor toCmyk(void)
- QColor toHsl(void)
- QColor toHsv(void)
- QColor toRgb(void)
- int value(void)
- double valueF(void)
- int yellow(void)
- double yellowF(void)
- QStringList colorNames(void)
- QColor fromCmyk(int c, int m, int y, int k, int a)
- QColor fromCmykF(double c, double m, double y, double k, double a)
- QColor fromHsl(int h, int s, int l, int a)
- QColor fromHslF(double h, double s, double l, double a)
- QColor fromHsv(int h, int s, int v, int a)
- QColor fromHsvF(double h, double s, double v, double a)
- QColor fromRgb(int r, int g, int b, int a)
- QColor fromRgbF(double r, double g, double b, double a)
- QColor fromRgba(QRgb rgba)
- bool isValidColor(QString)

92.70 QColorDialog Class

C++ Reference : <http://doc.qt.io/qt-5/qcolordialog.html>

Parameters : void

Parent Class : QDialog

- QColor currentColor(void)
- void open(QObject * receiver, char * member)
- QColorDialog::ColorDialogOptions options(void)
- QColor selectedColor(void)
- void setCurrentColor(QColor color)
- void setOption(QColorDialog::ColorDialogOption option, bool on)
- void setOptions(QColorDialog::ColorDialogOptions options)
- bool testOption(QColorDialog::ColorDialogOption option)
- QColor customColor(int index)
- int customCount(void)
- QColor getColor_2(QColor initial, QWidget * parent, QString title, QColorDialog::ColorDialogOptions options)
- void setCustomColor(int index, QColor color)
- void setStandardColor(int index, QColor color)
- QColor standardColor(int index)
- void setcolorSelectedEvent(const char *)
- void setcurrentColorChangedEvent(const char *)
- const char *getcolorSelectedEvent(void)
- const char *getcurrentColorChangedEvent(void)
- int getcolor(void)

92.71 QComboBox Class

C++ Reference : <http://doc.qt.io/qt-5/qcombobox.html>

Parameters : QWidget *

Parent Class : QWidget

- void addItem(QString,int)
- void addItems(QStringList)
- QCompleter *completer(void)
- int count(void)
- int currentIndex(void)
- QString currentText(void)

- bool duplicatesEnabled(void)
- int findData(QVariant, int role, Qt::MatchFlag flags)
- int findText(QString, Qt::MatchFlag flags)
- bool hasFrame(void)
- void hidePopup(void)
- QSize iconSize(void)
- void insertItem(int index, QString, QVariant)
- bool isEditable(void)
- QVariant itemData(int index, int role)
- QAbstractItemDelegate *itemDelegate(void)
- QIcon itemIcon(int index)
- QString itemText(int index)
- QLineEdit *lineEdit(void)
- int maxCount(void)
- int maxVisibleItems(void)
- int minimumContentsLength(void)
- QAbstractItemModel *model(void)
- int modelColumn(void)
- void removeItem(int index)
- QModelIndex rootModelIndex(void)
- void setCompleter(QCompleter *completer)
- void setDuplicatesEnabled(bool enable)
- void setEditable(bool editable)
- void setFrame(bool)
- void setIconSize(QSize)
- void setItemDelegate(QAbstractItemDelegate *delegate)
- void setItemIcon(int index, QIcon)
- void setItemText(int index, QString)
- void setLineEdit(QLineEdit *edit)
- void setMaxCount(int max)
- void setMaxVisibleItems(int maxItems)
- void setMinimumContentsLength(int characters)
- void setModel(QAbstractItemModel *model)
- void setModelColumn(int visibleColumn)
- void setRootModelIndex(QModelIndex)
- void setView(QAbstractItemView *itemView)

- void showPopup(void)
- QAbstractItemView *view(void)
- void clear(void)
- void clearEditText(void)
- void setCurrentIndex(int index)
- void setCurrentText(QString)
- void setEditText(QString)
- void setactivatedEvent(const char *)
- void setcurrentIndexChangedEvent(const char *)
- void seteditTextChangedEvent(const char *)
- void sethighlightedEvent(const char *)
- const char *getactivatedEvent(void)
- const char *getcurrentIndexChangedEvent(void)
- const char *geteditTextChangedEvent(void)
- const char *gethighlightedEvent(void)

92.72 QCompleter Class

C++ Reference : <http://doc.qt.io/qt-5/qcompleter.html>

Parameters : QObject *parent

Parent Class : QObject

- Qt::CaseSensitivity caseSensitivity(void)
- int completionColumn(void)
- int completionCount(void)
- QCompleter::CompletionMode completionMode(void)
- QAbstractItemModel *completionModel(void)
- QString completionPrefix(void)
- int completionRole(void)
- QString currentCompletion(void)
- QModelIndex currentIndex(void)
- int currentRow(void)
- Qt::MatchFlags filterMode(void)
- int maxVisibleItems(void)
- QAbstractItemModel * model(void)
- QCompleter::ModelSorting modelSorting(void)
- QAbstractItemView * popup(void)

- void setCaseSensitivity(Qt::CaseSensitivity caseSensitivity)
- void setCompletionColumn(int column)
- void setCompletionMode(QCompleter::CompletionMode mode)
- void setCompletionRole(int role)
- bool setCurrentRow(int row)
- void setFilterMode(Qt::MatchFlags filterMode)
- void setMaxVisibleItems(int maxItems)
- void setModel(QAbstractItemModel *model)
- void setModelSorting(QCompleter::ModelSorting sorting)
- void setPopup(QAbstractItemView *popup)
- void setWidget(QWidget *widget)
- QWidget * widget(void)
- bool wrapAround(void)
- void complete(QRect rect)
- void setCompletionPrefix(QString prefix)
- void setWrapAround(bool wrap)

92.73 QCompleter2 Class

Parameters : QAbstractItemModel *model, QObject *parent

Parent Class : QCompleter

92.74 QCompleter3 Class

Parameters : QStringList list, QObject *parent

Parent Class : QCompleter

92.75 QCompleter4 Class

Parameters : QStringList list, QObject *parent

Parent Class : QCompleter

92.76 QComponent Class

C++ Reference : <http://doc.qt.io/qt-5/qcomponent.html>

Parameters : Qt3DCore::QNode *

Parent Class : QNode

- bool isShareable(void)
- void setShareable(bool isShareable)

92.77 QConeGeometry Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qconegeometry.html>

Parameters : Qt3DCore::QNode *

- float bottomRadius(void)
- bool hasBottomEndcap(void)
- bool hasTopEndcap(void)
- Qt3DRender::QAttribute * indexAttribute(void)
- float length(void)
- Qt3DRender::QAttribute * normalAttribute(void)
- Qt3DRender::QAttribute * positionAttribute(void)
- int rings(void)
- int slices(void)
- Qt3DRender::QAttribute * texCoordAttribute(void)
- float topRadius(void)
- void updateIndices(void)
- void updateVertices(void)
- void setBottomRadius(float bottomRadius)
- void setHasBottomEndcap(bool hasBottomEndcap)
- void setHasTopEndcap(bool hasTopEndcap)
- void setLength(float length)
- void setRings(int rings)
- void setSlices(int slices)
- void setTopRadius(float topRadius)

92.78 QConeMesh Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qconemesh.html>

Parameters : Qt3DCore::QNode *

- float bottomRadius(void)
- bool hasBottomEndcap(void)
- bool hasTopEndcap(void)
- float length(void)
- int rings(void)
- int slices(void)
- float topRadius(void)
- void setBottomRadius(float bottomRadius)
- void setHasBottomEndcap(bool hasBottomEndcap)
- void setHasTopEndcap(bool hasTopEndcap)
- void setLength(float length)
- void setRings(int rings)
- void setSlices(int slices)
- void setTopRadius(float topRadius)

92.79 QCoreApplication Class

C++ Reference : <http://doc.qt.io/qt-5/qcoreapplication.html>

Parent Class : QObject

- void installNativeEventFilter(QAbstractNativeEventFilter *filterObj)
- void removeNativeEventFilter(QAbstractNativeEventFilter *filterObject)
- void quit(void)
- void addLibraryPath(QString path)
- QString applicationDirPath(void)
- QString applicationFilePath(void)
- QString applicationName(void)
- qint64 applicationPid(void)
- QString applicationVersion(void)
- QStringList arguments(void)
- bool closingDown(void)
- QAbstractEventDispatcher * eventDispatcher(void)
- int exec(void)
- void exit(int returnCode)

- bool installTranslator(QTranslator *translationFile)
- QCoreApplication * instance(void)
- bool isQuitLockEnabled(void)
- QStringList libraryPaths(void)
- QString organizationDomain(void)
- QString organizationName(void)
- void postEvent(QObject *receiver, QEvent *event, int priority)
- void processEvents(QEventLoop::ProcessEventsFlags flags)
- void processEvents_2(QEventLoop::ProcessEventsFlags flags, int maxtime)
- void removeLibraryPath(QString path)
- void removePostedEvents(QObject *receiver, int eventType)
- bool removeTranslator(QTranslator *translationFile)
- bool sendEvent(QObject *receiver, QEvent *event)
- void sendPostedEvents(QObject *receiver, int event_type)
- void setApplicationName(QString application)
- void setApplicationVersion(QString version)
- void setAttribute(Qt::ApplicationAttribute attribute, bool on)
- void setEventDispatcher(QAbstractEventDispatcher *eventDispatcher)
- void setLibraryPaths(QStringList paths)
- void setOrganizationDomain(QString orgDomain)
- void setOrganizationName(QString orgName)
- void setQuitLockEnabled(bool enabled)
- bool startingUp(void)
- bool testAttribute(Qt::ApplicationAttribute attribute)
- QString translate(char *context, char *sourceText, char *disambiguation, int n)

92.80 QCuboidMesh Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qcuboidmesh.html>

Parameters : Qt3DCore::QNode *

- float xExtent(void)
- QSize xyMeshResolution(void)
- QSize xzMeshResolution(void)
- float yExtent(void)
- QSize yzMeshResolution(void)
- float zExtent(void)

- void setXExtent(float xExtent)
- void setXYMeshResolution(QSize resolution)
- void setXZMeshResolution(QSize resolution)
- void setYExtent(float yExtent)
- void setYZMeshResolution(QSize resolution)
- void setZExtent(float zExtent)

92.81 QCullFace Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qcullface.html>

Parameters : Qt3DCore::QNode *

- Qt3DRender::QCullFace::CullingMode mode(void)
- void setMode(Qt3DRender::QCullFace::CullingMode mode)

92.82 QCursor Class

C++ Reference : <http://doc.qt.io/qt-5/qcursor.html>

Parameters : void

- QBitmap *bitmap(void)
- QBitmap *mask(void)
- QPoint hotSpot(void)
- QPixmap pixmap(void)
- void setShape(Qt::CursorShape shape)
- Qt::CursorShape shape(void)
- QPoint pos(void)
- QPoint pos_2(QScreen *)
- void setPos(int x, int y)
- void setPos_2(QScreen *screen, int x, int y)
- void setPos_3(QPoint)
- void setPos_4(QScreen *screen, QPoint)

92.83 QCylinderMesh Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qcylindermesh.html>

Parameters : Qt3DCore::QNode *

- float length(void)
- float radius(void)
- int rings(void)
- int slices(void)
- void setLength(float length)
- void setRadius(float radius)
- void setRings(int rings)
- void setSlices(int slices)

92.84 QDate Class

C++ Reference : <http://doc.qt.io/qt-5/qdate.html>

Parameters : void

- QDate addDays(int ndays)
- QDate addMonths(int nmonths)
- QDate addYears(int nyears)
- int day(void)
- int dayOfWeek(void)
- int dayOfYear(void)
- int daysInMonth(void)
- int daysInYear(void)
- int daysTo(QDate)
- void getDate(int * year, int * month, int * day)
- boolisNull(void)
- boolisValid(void)
- intmonth(void)
- bool setDate(int year, int month, int day)
- int toJulianDay(void)
- QString toString(QString)
- int weekNumber(int * yearNumber)
- int year(void)
- QDate currentDate(void)
- QDate fromJulianDay(int jd)

- QDate fromString(QString, QString)
- bool isLeapYear(int year)

92.85 QDateEdit Class

C++ Reference : <http://doc.qt.io/qt-5/qdateedit.html>

Parameters : QWidget *parent

Parent Class : QDateTimeEdit

92.86 QDateTime Class

C++ Reference : <http://doc.qt.io/qt-5/qdatetime.html>

Parameters : void

- QDateTime addDays(int ndays)
- QDateTime addMsecs(qint64 msecs)
- QDateTime addMonths(int nmonths)
- QDateTime addSecs(int s)
- QDateTime addYears(int nyears)
- QDate date(void)
- int daysTo(QDateTime other)
- boolisNull(void)
- boolisValid(void)
- qint64 msecsTo(QDateTime other)
- int secsTo(QDateTime other)
- void setDate(QDate date)
- void setMsecsSinceEpoch(qint64 msecs)
- void setTime(QTime time)
- void setTimeSpec(Qt::TimeSpec spec)
- QTime time(void)
- Qt::TimeSpec timeSpec(void)
- QDateTime toLocalTime(void)
- qint64 toMsecsSinceEpoch(void)
- QString toString(QString format)
- QString toString_2(Qt::DateFormat format)
- QDateTime toTimeSpec(Qt::TimeSpec specification)
- QDateTime toUTC(void)
- QDateTime currentDate(void)

- QDateTime currentDateTimeUtc(void)
- qint64 currentMSecsSinceEpoch(void)
- QDateTime fromMSecsSinceEpoch(qint64 msecs)
- QDateTime fromString(QString string, Qt::DateFormat format)
- QDateTime fromString_2(QString string, QString format)

92.87 QDateTimeAxis Class

C++ Reference : <http://doc.qt.io/qt-5/qdatetimeaxis.html>

Parameters : QObject *

Parent Class : QAbstractAxis

- QString format(void)
- QDateTime max(void)
- QDateTime min(void)
- void setFormat(QString format)
- void setMax(QDateTime max)
- void setMin(QDateTime min)
- void setRange(QDateTime min, QDateTime max)
- void setTickCount(int count)
- int tickCount(void)
- void setformatChangedEvent(const char *)
- void setmaxChangedEvent(const char *)
- void setminChangedEvent(const char *)
- void setrangeChangedEvent(const char *)
- void settickCountChangedEvent(const char *)
- const char *getformatChangedEvent(void)
- const char *getmaxChangedEvent(void)
- const char *getminChangedEvent(void)
- const char *getrangeChangedEvent(void)
- const char *gettickCountChangedEvent(void)

92.88 QDateEdit Class

C++ Reference : <http://doc.qt.io/qt-5/qdatetimeedit.html>

Parameters : QWidget *parent

Parent Class : QAbstractSpinBox

- bool calendarPopup(void)
- QCalendarWidget *calendarWidget(void)
- void clearMaximumDate(void)
- void clearMaximumDateTime(void)
- void clearMaximumTime(void)
- void clearMinimumDate(void)
- void clearMinimumDateTime(void)
- void clearMinimumTime(void)
- int currentSection(void)
- int currentSectionIndex(void)
- QDate date(void)
- QDateTime dateTime(void)
- QString displayFormat(void)
- int displayedSections(void)
- QDate maximumDate(void)
- QDateTime maximumDateTime(void)
- QTime maximumTime(void)
- QDate minimumDate(void)
- QDateTime minimumDateTime(void)
- QTime minimumTime(void)
- int sectionAt(int index)
- int sectionCount(void)
- QString sectionText(QDateEdit::Section section)
- void setCalendarPopup(bool enable)
- void setCalendarWidget(QCalendarWidget *calendarWidget)
- void setCurrentSection(QDateEdit::Section section)
- void setCurrentSectionIndex(int index)
- void setDateRange(QDate,QDate)
- void setDateRange(QDateTime,QDateTime)
- void setDisplayFormat(QString)
- void setMaximumDate(QDate)

- void setMaximumDate(QDate)
- void setMaximumTime(QTime)
- void setMinimumDate(QDate)
- void setMinimumDate(QDate)
- void setMinimumTime(QTime)
- void setSelectedSection(QDateTimeEdit::Section section)
- void setTimeRange(QTime, QTime)
- void setTimeSpec(Qt::TimeSpec spec)
- QTime time(void)
- Qt::TimeSpec timeSpec(void)
- void setDate(QDate)
- void setDate(QDate)
- void setTime(QTime)
- void setDateChangedEvent(const char *)
- void setDateChangedEvent(const char *)
- void setTimeChangedEvent(const char *)
- const char *getdateChangedEvent(void)
- const char *getdateChangedEvent(void)
- const char *gettimeChangedEvent(void)

92.89 QDepthTest Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qdepthtest.html>

Parameters : Qt3DCore::QNode *

- Qt3DRender::QDepthTest::DepthFunction depthFunction(void)
- void setDepthFunction(Qt3DRender::QDepthTest::DepthFunction depthFunction)

92.90 QDesktopServices Class

C++ Reference : <http://doc.qt.io/qt-5/qdesktopservices.html>

- bool openUrl(QUrl)
- void setUrlHandler(QString, QObject *receiver, const char *method)
- void unsetUrlHandler(QString)

92.91 QDial Class

C++ Reference : <http://doc.qt.io/qt-5/qdial.html>

Parameters : QWidget *parent

Parent Class : QAbstractSlider

- int notchSize(void)
- qreal notchTarget(void)
- bool notchesVisible(void)
- void setNotchTarget(double target)
- bool wrapping(void)
- QSize minimumSizeHint(void)
- QSize sizeHint(void)
- void setNotchesVisible(bool visible)
- void setWrapping(bool on)
- void setactionTriggeredEvent(const char *)
- void setrangeChangedEvent(const char *)
- void setsliderMovedEvent(const char *)
- void setsliderPressedEvent(const char *)
- void setsliderReleasedEvent(const char *)
- void setvalueChangedEvent(const char *)
- const char *getactionTriggeredEvent(void)
- const char *getrangeChangedEvent(void)
- const char *getsliderMovedEvent(void)
- const char *getsliderPressedEvent(void)
- const char *getsliderReleasedEvent(void)
- const char *getvalueChangedEvent(void)

92.92 QDialog Class

C++ Reference : <http://doc.qt.io/qt-5/qdialog.html>

Parameters : QWidget *parent

Parent Class : QWidget

- bool isSizeGripEnabled(void)
- int result(void)
- void setModal(bool modal)
- void setResult(int i)
- void setSizeGripEnabled(bool)

- void accept(void)
- void done(int r) # In RingQt use : void donedialog(int r)
- int exec(void)
- void open(void)
- void reject(void)

92.93 QDiffuseSpecularMaterial Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qdiffusespecularmaterial.html>

Parameters : Qt3DCore::QNode *

- QColor ambient(void)
- QVariant diffuse(void)
- bool isAlphaBlendingEnabled(void)
- QVariant normal(void)
- float shininess(void)
- QVariant specular(void)
- float textureScale(void)
- void setAlphaBlendingEnabled(bool enabled)
- void setAmbient(QColor ambient)
- void setDiffuse(QVariant diffuse)
- void setNormal(QVariant normal)
- void setShininess(float shininess)
- void setSpecular(QVariant specular)
- void setTextureScale(float textureScale)

92.94 QDir Class

C++ Reference : <http://doc.qt.io/qt-5/qdir.html>

Parameters : void

- QString absoluteFilePath(QString fileName)
- QString absolutePath(void)
- QString canonicalPath(void)
- bool cd(QString dirName)
- bool cdUp(void)
- uint count(void)
- QString dirName(void)
- QFileInfoList entryInfoList(QStringList nameFilters, QDir::Filters filters, QDir::SortFlags sort)

- QFileInfoList entryInfoList_2(QDir::Filters filters, QDir::SortFlags sort)
- QStringList entryList(QStringList name QDir::Filters filters, QDir::Filters filters, QDir::SortFlags sort)
- QStringList entryList_2(QDir::Filters filters, QDir::SortFlags sort)
- bool exists(QString name)
- bool exists_2(void)
- QString filePath(QString fileName)
- QDir::Filters filter(void)
- bool isAbsolute(void)
- bool isReadable(void)
- bool isRelative(void)
- bool isRoot(void)
- bool makeAbsolute(void)
- bool mkdir(QString dirName)
- bool mkpath(QString dirPath)
- QStringList nameFilters(void)
- QString path(void)
- void refresh(void)
- QString relativeFilePath(QString fileName)
- bool remove(QString fileName)
- bool removeRecursively(void)
- bool rename(QString oldName, QString newName)
- bool rmdir(QString dirName)
- bool rmpath(QString dirPath)
- void setFilter(QDir::Filters filters)
- void setNameFilters(QStringList name QDir::Filters)
- void setPath(QString path)
- void setSorting(QDir::SortFlags sort)
- QDir::SortFlags sorting(void)
- void swap(QDir other)
- void addSearchPath(QString prefix, QString path)
- QString cleanPath(QString path)
- QDir current(void)
- QString currentPath(void)
- QFileInfoList drives(void)
- QString fromNativeSeparators(QString pathName)
- QDir home(void)

- QString homePath(void)
- bool isAbsolutePath(QString path)
- bool isRelativePath(QString path)
- bool match(QString filter, QString fileName)
- bool match_2(QStringList filters, QString fileName)
- QDir root(void)
- QString rootPath(void)
- QStringList searchPaths(QString prefix)
- QChar separator(void)
- bool setCurrent(QString path)
- void setSearchPaths(QString prefix, QStringList searchPaths)
- QDir temp(void)
- QString tempPath(void)
- QString toNativeSeparators(QString pathName)

92.95 QDockWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qdockwidget.html>

Parameters : QWidget *parent,Qt::WindowType flag

Parent Class : QWidget

- int allowedAreas(void)
- int features(void)
- bool isAreaAllowed(Qt::DockWidgetArea area)
- bool isFloating(void)
- void setAllowedAreas(Qt::DockWidgetArea areas)
- void setFeatures(QDockWidget::DockWidgetFeature features)
- void setFloating(bool floating)
- void setTitleBarWidget(QWidget *widget)
- void setWidget(QWidget *widget)
- QWidget *titleBarWidget(void)
- QAction *toggleViewAction(void)
- QWidget *widget(void)
- void allowedAreasChanged(Qt::DockWidgetArea allowedAreas)
- void dockLocationChanged(Qt::DockWidgetArea area)
- void featuresChanged(QDockWidget::DockWidgetFeature features)
- void topLevelChanged(bool topLevel)

- void visibilityChanged(bool visible)
- void setallowedAreasChangedEvent(const char *)
- void setdockLocationChangedEvent(const char *)
- void setfeaturesChangedEvent(const char *)
- void settopLevelChangedEvent(const char *)
- void setvisibilityChangedEvent(const char *)
- const char *getallowedAreasChangedEvent(void)
- const char *getdockLocationChangedEvent(void)
- const char *getfeaturesChangedEvent(void)
- const char *gettopLevelChangedEvent(void)
- const char *getvisibilityChangedEvent(void)

92.96 QDrag Class

C++ Reference : <http://doc.qt.io/qt-5/qdrag.html>

Parameters : QObject *

Parent Class : QObject

- Qt::DropAction defaultAction(void)
- QPixmap dragCursor(Qt::DropAction action)
- Qt::DropAction exec(Qt::DropActions supportedActions)
- Qt::DropAction exec_2(Qt::DropActions supportedActions, Qt::DropAction defaultDropAction)
- QPoint hotSpot(void)
- QMimeData *mimeData(void)
- QPixmap pixmap(void)
- void setDragCursor(QPixmap cursor, Qt::DropAction action)
- void setHotSpot(QPoint hotspot)
- void setMimeData(QMimeData * data)
- void setPixmap(QPixmap pixmap)
- QObject * source(void)
- Qt::DropActions supportedActions(void)
- QObject * target(void)
- void setactionChangedEvent(const char *)
- void settargetChangedEvent(const char *)
- const char *getactionChangedEvent(void)
- const char *getttargetChangedEvent(void)

92.97 QDragEnterEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qdragenterevent.html>

Parameters : QPoint,Qt::DropActions,const QMimeData *,Qt::MouseButtons,Qt::KeyboardModifiers

Parent Class : QDragMoveEvent

92.98 QDragLeaveEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qdragleaveevent.html>

Parameters : void

Parent Class : QEvent

92.99 QDragMoveEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qdragmoveevent.html>

Parameters : QPoint,Qt::DropActions,const QMimeData *,Qt::MouseButtons,Qt::KeyboardModifiers,QEvent::Type

Parent Class : QDropEvent

- void accept(QRect rectangle)
- void accept_2(void)
- QRect answerRect(void)
- void ignore(QRect rectangle)
- void ignore_2(void)

92.100 QDropEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qdropevent.html>

Parameters : QPointF,Qt::DropActions,const QMimeData *,Qt::MouseButtons,Qt::KeyboardModifiers,QEvent::Type

Parent Class : QEvent

- void acceptProposedAction(void)
- Qt::DropAction dropAction(void)
- Qt::KeyboardModifiers keyboardModifiers(void)
- QMimeData * mimeData(void)
- Qt::MouseButtons mouseButtons(void)
- QPoint pos(void)
- QPointF posF(void)
- Qt::DropActions possibleActions(void)
- Qt::DropAction proposedAction(void)

- void setDropAction(Qt::DropAction action)
- QObject * source(void)

92.101 QEffect Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qeffect.html>

Parameters : Qt3DCore::QNode *

- void addParameter(Qt3DRender::QParameter *parameter)
- void addTechnique(Qt3DRender::QTechnique *t)
- QVector<Qt3DRender::QParameter *> parameters(void)
- void removeParameter(Qt3DRender::QParameter *parameter)
- void removeTechnique(Qt3DRender::QTechnique *t)
- QVector<Qt3DRender::QTechnique *> techniques(void)

92.102 QEntity Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dcore-qentity.html>

Parameters : Qt3DCore::QNode *

Parent Class : QNode

- void addComponent(Qt3DCore::QComponent *comp)
- Qt3DCore::QComponentVector components(void)
- Qt3DCore::QEntity * parentEntity(void)
- void removeComponent(Qt3DCore::QComponent *comp)

92.103 QEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qevent.html>

Parameters : QEvent::Type Type

- void accept(void)
- void ignore(void)
- bool isAccepted(void)
- void setAccepted(bool accepted)
- bool spontaneous(void)
- int type(void)

92.104 QExtrudedTextMesh Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qextrudedtextmesh.html>

Parameters : Qt3DCore::QNode *

- float depth(void)
- QFont font(void)
- QString text(void)
- void setDepth(float depth)
- void setFont(QFont font)
- void setText(QString text)

92.105 QFile Class

C++ Reference : <http://doc.qt.io/qt-5/qfile.html>

Parameters : void

Parent Class : QFileDevice

- bool copy(QString newName)
- bool exists(void)
- bool link(QString linkName)
- bool open(FILE *fh, QIODevice::OpenMode mode, QFile::FileHandleFlags handleFlags)
- bool open_2(int fd, QIODevice::OpenMode mode, QFile::FileHandleFlags handleFlags)
- bool open_3(QIODevice::OpenMode mode)
- bool remove(void)
- bool rename(QString newName)
- void setFileName(QString name)
- QString symLinkTarget(void)
- bool copy_2(QString fileName, QString newName)
- QString decodeName(QByteArray localFileName)
- QString decodeName_2(char *localFileName)
- QByteArray encodeName(QString fileName)
- bool exists_2(QString fileName)
- bool link_2(QString fileName, QString linkName)
- QFile::Permissions permissions(QString fileName)
- bool remove_2(QString fileName)
- bool rename_2(QString oldName, QString newName)
- bool resize(QString fileName, qint64 sz)
- bool setPermissions(QString fileName, QFile::Permissions permissions)

- QString symLinkTarget_2(QString fileName)

92.106 QFile2 Class

Parameters : QString

Parent Class : QFile

92.107 QFileDevice Class

C++ Reference : <http://doc.qt.io/qt-5/qfiledevice.html>

Parent Class : QIODevice

- QFileDevice::FileError error(void)
- bool flush(void)
- int handle(void)
- uchar * map(qint64 offset, qint64 size, QFileDevice::MemoryMapFlags flags)
- QFileDevice::Permissions permissions(void)
- bool resize(qint64 sz)
- QString fileName(void)
- bool unmap(uchar *address)
- void unsetError(void)

92.108 QFileDialog Class

C++ Reference : <http://doc.qt.io/qt-5/qfiledialog.html>

Parameters : QWidget *parent

Parent Class : QDialog

- QFileDialog::AcceptMode acceptMode(void)
- QString defaultSuffix(void)
- QDir directory(void)
- QUrl directoryUrl(void)
- QFileDialog:: FileMode fileMode(void)
- QDir::Filters filter(void)
- QStringList history(void)
- QFileIconProvider * iconProvider(void)
- QAbstractItemDelegate * itemDelegate(void)
- QString labelText(QFileDialog:: DialogLabel label)
- QStringList mimeTypeFilters(void)

- `QStringList nameFilters(void)`
- `void open(QObject * receiver, char * member)`
- `QFileDialog::Options options(void)`
- `QAbstractProxyModel * proxyModel(void)`
- `bool restoreState(QByteArray state)`
- `QByteArray saveState(void)`
- `void selectFile(QString filename)`
- `void selectMimeTypeFilter(QString filter)`
- `void selectNameFilter(QString filter)`
- `void selectUrl(QUrl url)`
- `QStringList selectedFiles(void)`
- `QString selectedNameFilter(void)`
- `QList<QUrl> selectedUrls(void)`
- `void setAcceptMode(QFileDialog::AcceptMode mode)`
- `void setDefaultSuffix(QString suffix)`
- `void setDirectory(QString directory)`
- `void setDirectory_2(QDir directory)`
- `void setDirectoryUrl(QUrl directory)`
- `void set FileMode(QFileDialog:: FileMode mode)`
- `void setFilter(QDir::Filters filters)`
- `void setHistory(QStringList paths)`
- `void setIconProvider(QFileIconProvider * provider)`
- `void setItemDelegate(QAbstractItemDelegate * delegate)`
- `void setLabelText(QFileDialog:: DialogLabel label, QString text)`
- `void setMimeTypeFilters(QStringList filters)`
- `void setNameFilter(QString filter)`
- `void setNameFilters(QStringList filters)`
- `void setOption(QFileDialog:: Option option, bool on)`
- `void setOptions(QFileDialog:: Options options)`
- `void setProxyModel(QAbstractProxyModel * proxyModel)`
- `void setSidebarUrls(QList<QUrl> urls)`
- `void setViewMode(QFileDialog:: ViewMode mode)`
- `QList<QUrl> sidebarUrls(void)`
- `bool testOption(QFileDialog:: Option option)`
- `QFileDialog:: ViewMode viewMode(void)`
- `QString getExistingDirectory(QWidget * parent, QString caption, QString dir, QFileDialog:: Options options)`

- `QUrl getExistingDirectoryUrl(QWidget * parent, QString caption, QUrl dir, QDialog::Options options, QStringList supportedSchemes)`
- `QString getOpenFileName(QWidget * parent, QString caption, QString dir, QString filter)`
- `QString getOpenFileName_2(QWidget * parent, QString caption, QString dir, QString filter, QString * selectedFilter, QDialog::Options options)`
- `QStringList getOpenFileNames(QWidget * parent, QString caption, QString dir, QString filter, QString * selectedFilter, QDialog::Options options)`
- `QUrl getOpenFileUrl(QWidget * parent, QString caption, QUrl dir, QString filter, QString * selectedFilter, QDialog::Options options, QStringList supportedSchemes)`
- `QList<QUrl> getOpenFileUrls(QWidget * parent, QString caption, QUrl dir, QString filter, QString * selectedFilter, QDialog::Options options, QStringList supportedSchemes)`
- `QString getSaveFileName(QWidget * parent, QString caption, QString dir, QString filter)`
- `QString getSaveFileName_2(QWidget * parent, QString caption, QString dir, QString filter, QString * selectedFilter, QDialog::Options options)`
- `QUrl getSaveFileUrl(QWidget * parent, QString caption, QUrl dir, QString filter, QString * selectedFilter, QDialog::Options options, QStringList supportedSchemes)`
- `void setcurrentChangedEvent(const char *)`
- `void setcurrentUrlChangedEvent(const char *)`
- `void setdirectoryEnteredEvent(const char *)`
- `void setdirectoryUrlEnteredEvent(const char *)`
- `void setfileSelectedEvent(const char *)`
- `void setfilesSelectedEvent(const char *)`
- `void setfilterSelectedEvent(const char *)`
- `void seturlSelectedEvent(const char *)`
- `void seturlsSelectedEvent(const char *)`
- `const char *getcurrentChangedEvent(void)`
- `const char *getcurrentUrlChangedEvent(void)`
- `const char *getdirectoryEnteredEvent(void)`
- `const char *getdirectoryUrlEnteredEvent(void)`
- `const char *getFileSelectedEvent(void)`
- `const char *getfilesSelectedEvent(void)`
- `const char *getfilterSelectedEvent(void)`
- `const char *geturlSelectedEvent(void)`
- `const char *geturlsSelectedEvent(void)`
- `void saveFileContent(QByteArray fileContent,QString fileNameHint)`
- `void getOpenFileContent(const char *cFileTypes, const char *cCode)`
- `List *FileContentList(void)`

92.109 QFileInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qfileinfo.html>

Parameters : void

- QDir absoluteDir(void)
- QString absoluteFilePath(void)
- QString absolutePath(void)
- QString baseName(void)
- QString bundleName(void)
- bool caching(void)
- QString canonicalFilePath(void)
- QString canonicalPath(void)
- QString completeBaseName(void)
- QString completeSuffix(void)
- QDir dir(void)
- bool exists(void)
- QString fileName(void)
- QString filePath(void)
- QString group(void)
- int groupId(void)
- bool isAbsolute(void)
- bool isBundle(void)
- bool isDir(void)
- bool isExecutable(void)
- bool isFile(void)
- bool isHidden(void)
- bool isNativePath(void)
- bool isReadable(void)
- bool isRelative(void)
- bool isRoot(void)
- bool isSymLink(void)
- bool isWritable(void)
- QDateTime lastModified(void)
- QDateTime lastRead(void)
- bool makeAbsolute(void)
- QString owner(void)

- uint ownerId(void)
- QString path(void)
- bool permission(QFileDevice::Permission permissions)
- int permissions(void)
- void refresh(void)
- void setCaching(bool enable)
- void setFile(QString)
- int size(void)
- QString suffix(void)
- void swap(QFileInfo)
- QString symLinkTarget(void)

92.110 QFileSystemModel Class

C++ Reference : <http://doc.qt.io/qt-5/qfilesystemmodel.html>

Parameters : void

- QIcon fileIcon(QModelIndex)
- QFileIconProvider *iconProvider(void)
- QModelIndex fileInfo(QModelIndex)
- QString fileName(QModelIndex)
- QString filePath(QModelIndex)
- int filter(void)
- QDateTime lastModified(QModelIndex)
- bool isDir(QModelIndex)
- bool isReadOnly(void)
- QVariant myComputer(int role)
- bool nameFilterDisables(void)
- QStringList nameFilters(void)
- int permissions(QModelIndex)
- bool remove(QModelIndex)
- bool resolveSymlinks(void)
- bool rmdir(QModelIndex)
- QDir rootDirectory(void)
- QString rootPath(void)

- void setFilter(QDir::Filter filters)
- void setIconProvider(QFileIconProvider *provider)
- void setNameFilterDisables(bool enable)
- void setNameFilters(QStringList)
- void setReadOnly(bool enable)
- void setResolveSymlinks(bool enable)
- QModelIndex setRootPath(QString)
- int size(QModelIndex)
- QString type(QModelIndex)
- bool canFetchMore(QModelIndex)
- int columnCount(void)
- QVariant data(QModelIndex index, int role)
- bool dropMimeData(QMimeData *data, Qt::DropAction action, int row, int column, QModelIndex parent)
- void fetchMore(QModelIndex parent)
- int flags(QModelIndex index)
- bool hasChildren(QModelIndex parent)
- QVariant headerData(int section, Qt::Orientation orientation, int role)
- QMimeData * mimeData(QModelIndexList indexes)
- QStringList mimeTypes(void)
- QModelIndex parent(QModelIndex index)
- int rowCount(QModelIndex parent)
- bool setData(QModelIndex idx, QVariant value, int role)
- void sort(int column, Qt::SortOrder order)
- int supportedDropActions(void)

92.111 QFirstPersonCameraController Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qfirstpersoncameracontroller.html>

Parameters : Qt3DCore::QNode *

Parent Class : QAbstractCameraController

92.112 QFont Class

C++ Reference : <http://doc.qt.io/qt-5/qfont.html>

Parameters : QString, int, int, bool

- bool bold(void)
- int capitalization(void)
- QString defaultFamily(void)
- bool exactMatch(void)
- QString family(void)
- bool fixedPitch(void)
- bool fromString(QString)
- int hintingPreference(void)
- bool isCopyOf(QFont)
- bool italic(void)
- bool kerning(void)
- QString key(void)
- double letterSpacing(void)
- int letterSpacingType(void)
- bool overline(void)
- int pixelSize(void)
- int pointSize(void)
- double pointSizeF(void)
- QFont resolve(QFont)
- void setBold(bool enable)
- void setCapitalization(QFont::Capitalization caps)
- void setFamily(QString)
- void setFixedPitch(bool enable)
- void setHintingPreference(QFont::HintingPreference hintingPreference)
- void setItalic(bool enable)
- void setKerning(bool enable)
- void setLetterSpacing(QFont::SpacingType type, double spacing)
- void setOverline(bool enable)
- void setPixelSize(int pixelSize)
- void setPointSize(int pointSize)
- void setPointSizeF(double pointSize)
- void setStretch(int factor)

- void setStrikeOut(bool enable)
- void setStyle(QFont::Style style)
- void setStyleHint(QFont::StyleHint hint, QFont::StyleStrategy strategy)
- void setStyleName(QString)
- void setStyleStrategy(QFont::StyleStrategy s)
- void setUnderline(bool enable)
- void setWeight(int weight)
- void setWordSpacing(double spacing)
- int stretch(void)
- bool strikeOut(void)
- int style(void)
- int styleHint(void)
- QString styleName(void)
- int styleStrategy(void)
- QString toString(void)
- bool underline(void)
- int weight(void)
- double wordSpacing(void)
- void insertSubstitution(QString,QString)
- void insertSubstitutions(QString,QStringList)
- QString substitute(QString)
- QStringList substitutes(QString)
- QStringList substitutions(void)

92.113 QFontDialog Class

C++ Reference : <http://doc.qt.io/qt-5/qfontdialog.html>

Parameters : void

Parent Class : QDialog

- QFont currentFont(void)
- void open(QObject * receiver, char * member)
- QFontDialog::FontDialogOptions options(void)
- QFont selectedFont(void)
- void setCurrentFont(QFont font)
- void setOption(QFontDialog::FontDialogOption option, bool on)
- void setOptions(QFontDialog::FontDialogOptions options)

- bool testOption(QFontDialog::FontDialogOption option)
- QFont getFont_2(bool * ok, QFont initial, QWidget * parent, QString title, QFontDialog::FontDialogOptions options)
- QFont getFont_3(bool * ok, QWidget * parent)
- void setcurrentFontChangedEvent(const char *)
- void setfontSelectedEvent(const char *)
- const char *getcurrentFontChangedEvent(void)
- const char *getfontSelectedEvent(void)
- int getfont(void)

92.114 QFontMetrics Class

C++ Reference : <http://doc.qt.io/qt-5/qfontmetrics.html>

Parameters : QFont

- int ascent(void)
- int averageCharWidth(void)
- QRect boundingRect(QChar ch)
- QRect boundingRect_2(QString text)
- QRect boundingRect_3(int x, int y, int width, int height, int flags, QString text, int tabStops , int * tabArray)
- QRect boundingRect_4(QRect rect, int flags, QString text, int tabStops , int * tabArray)
- int descent(void)
- QString elidedText(QString text, Qt::TextElideMode mode, int width, int flags)
- int height(void)
- bool inFont(QChar ch)
- bool inFontUcs4(uint character)
- int leading(void)
- int leftBearing(QChar ch)
- int lineSpacing(void)
- int lineWidth(void)
- int maxWidth(void)
- int minLeftBearing(void)
- int minRightBearing(void)
- int overlinePos(void)
- int rightBearing(QChar ch)
- QSize size(int flags, QString text, int tabStops , int * tabArray)
- int strikeOutPos(void)
- QRect tightBoundingRect(QString text)

- int underlinePos(void)
- int xHeight(void)
- int horizontalAdvance(QString text, int len)
- int horizontalAdvance_2(QChar ch)

92.115 QForwardRenderer Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qforwardrenderer.html>

Parameters : Qt3DCore::QNode *

- Qt3DCore::QEntity * camera(void)
- QColor clearColor(void)
- QSize externalRenderTargetSize(void)
- float gamma(void)
- bool isFrustumCullingEnabled(void)
- QObject * surface(void)
- QRectF viewportRect(void)
- void setCamera(Qt3DCore::QEntity *camera)
- void setColor(QColor clearColor)
- void setExternalRenderTargetSize(QSize size)
- void setFrustumCullingEnabled(bool enabled)
- void setGamma(float gamma)
- void setSurface(QObject *surface)
- void setViewportRect(QRectF viewportRect)

92.116 QFrame Class

C++ Reference : <http://doc.qt.io/qt-5/qframe.html>

Parameters : QWidget *parent, Qt::WindowType flag

Parent Class : QWidget

- QRect frameRect(void)
- int frameShadow(void)
- int frameShape(void)
- int frameStyle(void)
- int frameWidth(void)
- int lineWidth(void)
- int midLineWidth(void)
- void setFrameRect(QRect)

- void setFrameShadow(QFrame::Shadow)
- void setFrameShape(QFrame::Shape)
- void setFrameStyle(int style)
- void setLineWidth(int)
- void setMidLineWidth(int)
- QSize sizeHint(void)

92.117 QFrame2 Class

Parameters : void

Parent Class : QFrame

92.118 QFrame3 Class

Parameters : QWidget *parent

Parent Class : QFrame

92.119 QFrameAction Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dlogic-qframeaction.html>

Parameters : Qt3DCore::QNode *

- void settriggeredEvent(const char *)
- const char *gettriggeredEvent(void)

92.120 QGeoAddress Class

C++ Reference : <http://doc.qt.io/qt-5/qgeoaddress.html>

Parameters : void

- QString city(void)
- void clear(void)
- QString country(void)
- QString countryCode(void)
- QString county(void)
- QString district(void)
- bool isEmpty(void)
- bool isTextGenerated(void)
- QString postalCode(void)

- void setCity(QString city)
- void setCountry(QString country)
- void setCountryCode(QString countryCode)
- void setCounty(QString county)
- void setDistrict(QString district)
- void setPostalCode(QString postalCode)
- void setState(QString state)
- void setStreet(QString street)
- void setText(QString text)
- QString state(void)
- QString street(void)
- QString text(void)

92.121 QGeoAreaMonitorInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qgeoareamonitorinfo.html>

Parameters : QString

- QGeoShape area(void)
- QDateTime expiration(void)
- QString identifier(void)
- bool isPersistent(void)
- bool isValid(void)
- QString name(void)
- QVariantMap notificationParameters(void)
- void setArea(QGeoShape newShape)
- void setExpiration(QDateTime expiry)
- void setName(QString name)
- void setNotificationParameters(QVariantMap parameters)
- void setPersistent(bool isPersistent)

92.122 QGeoAreaMonitorSource Class

C++ Reference : <http://doc.qt.io/qt-5/qgeoareamonitorsource.html>

Parameters : QObject *

Parent Class : QObject

- QString sourceName(void)
- QStringList availableSources(void)
- QGeoAreaMonitorSource * createDefaultSource(QObject * parent)
- QGeoAreaMonitorSource * createSource(QString sourceName, QObject * parent)

92.123 QGeoCircle Class

C++ Reference : <http://doc.qt.io/qt-5/qgeocircle.html>

Parameters : void

- QGeoCoordinate center(void)
- qreal radius(void)
- void setCenter(QGeoCoordinate center)
- void setRadius(qreal radius)
- void translate(double degreesLatitude, double degreesLongitude)
- QGeoCircle translated(double degreesLatitude, double degreesLongitude)

92.124 QGeoCoordinate Class

C++ Reference : <http://doc.qt.io/qt-5/qgeocoordinate.html>

Parameters : void

- double altitude(void)
- QGeoCoordinate atDistanceAndAzimuth(qreal distance, qreal azimuth, qreal distanceUp)
- qreal azimuthTo(QGeoCoordinate other)
- qreal distanceTo(QGeoCoordinate other)
- bool isValid(void)
- double latitude(void)
- double longitude(void)
- void setAltitude(double altitude)
- void setLatitude(double latitude)
- void setLongitude(double longitude)
- QString toString(QGeoCoordinate::CoordinateFormat format)
- QGeoCoordinate::CoordinateType type(void)

92.125 QGeoPositionInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qgeopositioninfo.html>

Parameters : void

- qreal attribute(QGeoPositionInfo::Attribute attribute)
- QGeoCoordinate coordinate(void)
- bool hasAttribute(QGeoPositionInfo::Attribute attribute)
- bool isValid(void)
- void removeAttribute(QGeoPositionInfo::Attribute attribute)
- void setAttribute(QGeoPositionInfo::Attribute attribute, qreal value)
- void setCoordinate(QGeoCoordinate coordinate)
- void setTimestamp(QDateTime timestamp)
- QDateTime timestamp(void)

92.126 QGeoPositionInfoSource Class

C++ Reference : <http://doc.qt.io/qt-5/qgeopositioninfosource.html>

Parent Class : QObject

- QGeoPositionInfoSource::PositioningMethods preferredPositioningMethods(void)
- QString sourceName(void)
- int updateInterval(void)
- void setErrorEvent(const char *)
- void setPositionUpdatedEvent(const char *)
- void setUpdateTimeoutEvent(const char *)
- const char *getErrorEvent(void)
- const char *GetPositionUpdatedEvent(void)
- const char *GetUpdateTimeoutEvent(void)
- QStringList availableSources(void)
- QGeoPositionInfoSource *createDefaultSource(QObject *parent)
- QGeoPositionInfoSource *createSource(QString sourceName, QObject *parent)

92.127 QGeoRectangle Class

C++ Reference : <http://doc.qt.io/qt-5/qgeorectangle.html>

Parameters : void

Parent Class : QGeoShape

- QGeoCoordinate bottomLeft(void)
- QGeoCoordinate bottomRight(void)
- QGeoCoordinate center(void)
- bool contains(QGeoRectangle rectangle)
- double height(void)
- bool intersects(QGeoRectangle rectangle)
- void setBottomLeft(QGeoCoordinate bottomLeft)
- void setBottomRight(QGeoCoordinate bottomRight)
- void setCenter(QGeoCoordinate center)
- void setHeight(double degreesHeight)
- void setTopLeft(QGeoCoordinate topLeft)
- void setTopRight(QGeoCoordinate topRight)
- void setWidth(double degreesWidth)
- QGeoCoordinate topLeft(void)
- QGeoCoordinate topRight(void)
- void translate(double degreesLatitude, double degreesLongitude)
- QGeoRectangle translated(double degreesLatitude, double degreesLongitude)
- QGeoRectangle united(QGeoRectangle rectangle)
- double width(void)

92.128 QGeoSatelliteInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qgeosatelliteinfo.html>

Parameters : void

- qreal attribute(QGeoSatelliteInfo::Attribute attribute)
- bool hasAttribute(QGeoSatelliteInfo::Attribute attribute)
- void removeAttribute(QGeoSatelliteInfo::Attribute attribute)
- int satelliteIdentifier(void)
- QGeoSatelliteInfo::SatelliteSystem satelliteSystem(void)
- void setAttribute(QGeoSatelliteInfo::Attribute attribute, qreal value)
- void setSatelliteIdentifier(int satId)
- void setSatelliteSystem(QGeoSatelliteInfo::SatelliteSystem system)

- void setSignalStrength(int signalStrength)
- int signalStrength(void)

92.129 QGeoSatelliteInfoSource Class

C++ Reference : <http://doc.qt.io/qt-5/qgeosatelliteinfosource.html>

- QString sourceName(void)
- int updateInterval(void)

92.130 QGeoShape Class

C++ Reference : <http://doc.qt.io/qt-5/qgeoshape.html>

Parameters : void

- bool contains(QGeoCoordinate coordinate)
- bool isEmpty(void)
- bool isValid(void)
- QGeoShape::ShapeType type(void)

92.131 QGoochMaterial Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qgoochmaterial.html>

Parameters : Qt3DCore::QNode *

- float alpha(void)
- float beta(void)
- QColor cool(void)
- QColor diffuse(void)
- float shininess(void)
- QColor specular(void)
- QColor warm(void)
- void setAlpha(float alpha)
- void setBeta(float beta)
- void setCool(QColor cool)
- void setDiffuse(QColor diffuse)
- void setShininess(float shininess)
- void setSpecular(QColor specular)
- void setWarm(QColor warm)

92.132 QGradient Class

C++ Reference : <http://doc.qt.io/qt-5/qgradient.html>

Parameters : void

- QGradient::CoordinateMode coordinateMode(void)
- void setColorAt(qreal position, QColor color)
- void setCoordinateMode(QGradient::CoordinateMode mode)
- void setSpread(QGradient::Spread method)
- void setStops(QGradientStops stopPoints)
- QGradient::Spread spread(void)
- QGradientStops stops(void)
- QGradient::Type type(void)

92.133 QGraphicsAnchor Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsanchor.html>

Parent Class : QObject

- void setSizePolicy(QSizePolicy::Policy policy)
- void setSpacing(qreal spacing)
- QSizePolicy::Policy sizePolicy(void)
- qreal spacing(void)
- void unsetSpacing(void)

92.134 QGraphicsAnchorLayout Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsanchorlayout.html>

Parameters : QGraphicsLayoutItem *

Parent Class : QGraphicsLayout

- QGraphicsAnchor * addAnchor(QGraphicsLayoutItem *firstItem, Qt::AnchorPoint firstEdge, QGraphicsLayoutItem *secondItem, Qt::AnchorPoint secondEdge)
- void addAnchors(QGraphicsLayoutItem *firstItem, QGraphicsLayoutItem *secondItem, Qt::Orientations orientations)
- void addCornerAnchors(QGraphicsLayoutItem *firstItem, Qt::Corner firstCorner, QGraphicsLayoutItem *secondItem, Qt::Corner secondCorner)
- QGraphicsAnchor * anchor(QGraphicsLayoutItem *firstItem, Qt::AnchorPoint firstEdge, QGraphicsLayoutItem *secondItem, Qt::AnchorPoint secondEdge)
- qreal horizontalSpacing(void)
- void setHorizontalSpacing(qreal spacing)

- void setSpacing(qreal spacing)
- void setVerticalSpacing(qreal spacing)
- qreal verticalSpacing(void)

92.135 QGraphicsEffect Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicseffect.html>

Parameters : QObject *

Parent Class : QObject

- QRectF boundingRect(void)
- QRectF boundingRectFor(QRectF rect)
- bool isEnabled(void)
- void setEnabled(bool enable)
- void update(void)
- void setEnabledChangedEvent(const char *)
- const char *getEnabledChangedEvent(void)

92.136 QGraphicsEllipseItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsellipseitem.html>

Parameters : QGraphicsItem *

Parent Class : QAbstractGraphicsShapeItem

- QRectF rect(void)
- void setRect(QRectF rect)
- void setRect_2(qreal x, qreal y, qreal width, qreal height)
- void setSpanAngle(int angle)
- void setStartAngle(int angle)
- int spanAngle(void)
- int startAngle(void)

92.137 QGraphicsGridLayout Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsgridlayout.html>

Parameters : QGraphicsLayoutItem *

Parent Class : QGraphicsLayout

- void addItem(QGraphicsLayoutItem *item, int row, int column, int rowSpan, int columnSpan, Qt::Alignment alignment)
- void addItem_2(QGraphicsLayoutItem *item, int row, int column, Qt::Alignment alignment)
- Qt::Alignment alignment(QGraphicsLayoutItem *item)
- Qt::Alignment columnAlignment(int column)
- int columnCount(void)
- qreal columnMaximumWidth(int column)
- qreal columnMinimumWidth(int column)
- qreal columnPreferredWidth(int column)
- qreal columnSpacing(int column)
- int columnStretchFactor(int column)
- qreal horizontalSpacing(void)
- QGraphicsLayoutItem * itemAt(int row, int column)
- void removeItem(QGraphicsLayoutItem *item)
- Qt::Alignment rowAlignment(int row)
- int rowCount(void)
- qreal rowMaximumHeight(int row)
- qreal rowMinimumHeight(int row)
- qreal rowPreferredHeight(int row)
- qreal rowSpacing(int row)
- int rowStretchFactor(int row)
- void setAlignment(QGraphicsLayoutItem *item, Qt::Alignment alignment)
- void setColumnAlignment(int column, Qt::Alignment alignment)
- void setColumnFixedWidth(int column, qreal width)
- void setColumnMaximumWidth(int column, qreal width)
- void setColumnMinimumWidth(int column, qreal width)
- void setColumnPreferredWidth(int column, qreal width)
- void setColumnSpacing(int column, qreal spacing)
- void setColumnStretchFactor(int column, int stretch)
- void setHorizontalSpacing(qreal spacing)
- void setRowAlignment(int row, Qt::Alignment alignment)
- void setRowFixedHeight(int row, qreal height)

- void setRowMaximumHeight(int row, qreal height)
- void setRowMinimumHeight(int row, qreal height)
- void setRowPreferredHeight(int row, qreal height)
- void setRowSpacing(int row, qreal spacing)
- void setRowStretchFactor(int row, int stretch)
- void setSpacing(qreal spacing)
- void setVerticalSpacing(qreal spacing)
- qreal verticalSpacing(void)

92.138 QGraphicsItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsitem.html>

Parameters : QGraphicsItem *

- bool acceptDrops(void)
- bool acceptHoverEvents(void)
- bool acceptTouchEvents(void)
- Qt::MouseButtons acceptedMouseButtons(void)
- void advance(int phase)
- QRectF boundingRect(void)
- QRegion boundingRegion(QTransform itemToDeviceTransform)
- qreal boundingRegionGranularity(void)
- QGraphicsItem::CacheMode cacheMode(void)
- QList<QGraphicsItem *> childItems(void)
- QRectF childrenBoundingRect(void)
- void clearFocus(void)
- QPainterPath clipPath(void)
- bool collidesWithItem(QGraphicsItem *other, Qt::ItemSelectionMode mode)
- bool collidesWithPath(QPainterPath path, Qt::ItemSelectionMode mode)
- QList<QGraphicsItem *> collidingItems(Qt::ItemSelectionMode mode)
- QGraphicsItem * commonAncestorItem(QGraphicsItem *other)
- bool contains(QPointF point)
- QCursor cursor(void)
- QVariant data(int key)
- QTransform deviceTransform(QTransform viewportTransform)
- qreal effectiveOpacity(void)
- void ensureVisible(QRectF rect, int xmargin, int ymargin)

- void ensureVisible_2(qreal x, qreal y, qreal w, qreal h, int xmargin, int ymargin)
- bool filtersChildEvents(void)
- QGraphicsItem::GraphicsItemFlags flags(void)
- QGraphicsItem * focusItem(void)
- QGraphicsItem * focusProxy(void)
- void grabKeyboard(void)
- void grabMouse(void)
- QGraphicsEffect * graphicsEffect(void)
- QGraphicsItemGroup * group(void)
- bool hasCursor(void)
- bool hasFocus(void)
- void hide(void)
- Qt::InputMethodHints inputMethodHints(void)
- void installSceneEventFilter(QGraphicsItem *filterItem)
- bool isActive(void)
- bool isAncestorOf(QGraphicsItem *child)
- bool isEnabled(void)
- bool isObscured(QRectF rect)
- bool isObscured_2(qreal x, qreal y, qreal w, qreal h)
- bool isObscuredBy(QGraphicsItem *item)
- bool isPanel(void)
- bool isSelected(void)
- bool isUnderMouse(void)
- bool isVisible(void)
- bool isVisibleTo(QGraphicsItem *parent)
- bool isWidget(void)
- bool isWindow(void)
- QTransform itemTransform(QGraphicsItem *other, bool *ok)
- QPointF mapFromItem(QGraphicsItem *item, QPointF point)
- QPolygonF mapFromItem_2(QGraphicsItem *item, QRectF rect)
- QPolygonF mapFromItem_3(QGraphicsItem *item, QPolygonF polygon)
- QPainterPath mapFromItem_4(QGraphicsItem *item, QPainterPath path)
- QPointF mapFromItem_5(QGraphicsItem *item, qreal x, qreal y)
- QPolygonF mapFromItem_6(QGraphicsItem *item, qreal x, qreal y, qreal w, qreal h)
- QPointF mapFromParent(QPointF point)
- QPolygonF mapFromParent_2(QRectF rect)

- `QPolygonF mapFromParent_3(QPolygonF polygon)`
- `QPainterPath mapFromParent_4(QPainterPath path)`
- `QPointF mapFromParent_5(qreal x, qreal y)`
- `QPolygonF mapFromParent_6(qreal x, qreal y, qreal w, qreal h)`
- `QPointF mapFromScene(QPointF point)`
- `QPolygonF mapFromScene_2(QRectF rect)`
- `QPolygonF mapFromScene_3(QPolygonF polygon)`
- `QPainterPath mapFromScene_4(QPainterPath path)`
- `QPointF mapFromScene_5(qreal x, qreal y)`
- `QPolygonF mapFromScene_6(qreal x, qreal y, qreal w, qreal h)`
- `QRectF mapRectFromItem(QGraphicsItem *item, QRectF rect)`
- `QRectF mapRectFromItem_2(QGraphicsItem *item, qreal x, qreal y, qreal w, qreal h)`
- `QRectF mapRectFromParent(QRectF rect)`
- `QRectF mapRectFromParent_2(qreal x, qreal y, qreal w, qreal h)`
- `QRectF mapRectFromScene(QRectF rect)`
- `QRectF mapRectFromScene_2(qreal x, qreal y, qreal w, qreal h)`
- `QRectF mapRectToItem(QGraphicsItem *item, QRectF rect)`
- `QRectF mapRectToItem_2(QGraphicsItem *item, qreal x, qreal y, qreal w, qreal h)`
- `QRectF mapRectToParent(QRectF rect)`
- `QRectF mapRectToParent_2(qreal x, qreal y, qreal w, qreal h)`
- `QRectF mapRectToScene(QRectF rect)`
- `QRectF mapRectToScene_2(qreal x, qreal y, qreal w, qreal h)`
- `QPointF mapToItem(QGraphicsItem *item, QPointF point)`
- `QPolygonF mapToItem_2(QGraphicsItem *item, QRectF rect)`
- `QPolygonF mapToItem_3(QGraphicsItem *item, QPolygonF polygon)`
- `QPainterPath mapToItem_4(QGraphicsItem *item, QPainterPath path)`
- `QPointF mapToItem_5(QGraphicsItem *item, qreal x, qreal y)`
- `QPolygonF mapToItem_6(QGraphicsItem *item, qreal x, qreal y, qreal w, qreal h)`
- `QPointF mapToParent(QPointF point)`
- `QPolygonF mapToParent_2(QRectF rect)`
- `QPolygonF mapToParent_3(QPolygonF polygon)`
- `QPainterPath mapToParent_4(QPainterPath path)`
- `QPointF mapToParent_5(qreal x, qreal y)`
- `QPolygonF mapToParent_6(qreal x, qreal y, qreal w, qreal h)`
- `QPointF mapToScene(QPointF point)`
- `QPolygonF mapToScene_2(QRectF rect)`

- `QPolygonF mapToScene_3(QPolygonF polygon)`
- `QPainterPath mapToScene_4(QPainterPath path)`
- `QPointF mapToScene_5(qreal x, qreal y)`
- `QPolygonF mapToScene_6(qreal x, qreal y, qreal w, qreal h)`
- `void moveBy(qreal dx, qreal dy)`
- `qreal opacity(void)`
- `QPainterPath opaqueArea(void)`
- `void paint(QPainter *painter, QStyleOptionGraphicsItem *option, QWidget *widget)`
- `QGraphicsItem * panel(void)`
- `QGraphicsItem::PanelModality panelModality(void)`
- `QGraphicsItem * parentItem(void)`
- `QGraphicsObject * parentObject(void)`
- `QGraphicsWidget * parentWidget(void)`
- `QPointF pos(void)`
- `void removeSceneEventFilter(QGraphicsItem *filterItem)`
- `void resetTransform(void)`
- `qreal rotation(void)`
- `qreal scale(void)`
- `QGraphicsScene * scene(void)`
- `QRectF sceneBoundingRect(void)`
- `QPointF scenePos(void)`
- `QTransform sceneTransform(void)`
- `void scroll(qreal dx, qreal dy, QRectF rect)`
- `void setAcceptDrops(bool on)`
- `void setAcceptHoverEvents(bool enabled)`
- `void setAcceptTouchEvents(bool enabled)`
- `void setAcceptedMouseButtons(Qt::MouseButtons buttons)`
- `void setActive(bool active)`
- `void setBoundingRegionGranularity(qreal granularity)`
- `void setCacheMode(QGraphicsItem::CacheMode mode, QSize logicalCacheSize)`
- `void setCursor(QCursor cursor)`
- `void setData(int key, QVariant value)`
- `void setEnabled(bool enabled)`
- `void setFiltersChildEvents(bool enabled)`
- `void setFlag(QGraphicsItem::GraphicsItemFlag flag, bool enabled)`
- `void setFlags(QGraphicsItem::GraphicsItemFlags flags)`

- void setFocus(Qt::FocusReason focusReason)
- void setFocusProxy(QGraphicsItem *item)
- void setGraphicsEffect(QGraphicsEffect *effect)
- void setGroup(QGraphicsItemGroup *group)
- void setInputMethodHints(Qt::InputMethodHints hints)
- void setOpacity(qreal opacity)
- void setPanelModality(QGraphicsItem::PanelModality panelModality)
- void setParentItem(QGraphicsItem *newParent)
- void setPos(QPointF pos)
- void setPos_2(qreal x, qreal y)
- void setRotation(qreal angle)
- void setScale(qreal factor)
- void setSelected(bool selected)
- void setToolTip(QString toolTip)
- void setTransform(QTransform matrix, bool combine)
- void setTransformOriginPoint(QPointF origin)
- void setTransformOriginPoint_2(qreal x, qreal y)
- void setTransformations(QList<QGraphicsTransform *> transformations)
- void setVisible(bool visible)
- void setX(qreal x)
- void setY(qreal y)
- void setZValue(qreal z)
- QPainterPath shape(void)
- void show(void)
- void stackBefore(QGraphicsItem *sibling)
- QGraphicsObject * toGraphicsObject(void)
- QGraphicsObject * toGraphicsObject_2(void)
- QString toolTip(void)
- QGraphicsItem * topLevelItem(void)
- QGraphicsWidget * topLevelWidget(void)
- QTransform transform(void)
- QPointF transformOriginPoint(void)
- QList<QGraphicsTransform *> transformations(void)
- int type(void)
- void ungrabKeyboard(void)
- void ungrabMouse(void)

- void unsetCursor(void)
- void update(QRectF rect)
- void update_2(qreal x, qreal y, qreal width, qreal height)
- QGraphicsWidget * window(void)
- qreal x(void)
- qreal y(void)
- qreal zValue(void)

92.139 QGraphicsItemGroup Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsitemgroup.html>

Parameters : QGraphicsItem *

Parent Class : QGraphicsItem

- void addToGroup(QGraphicsItem *item)
- void removeFromGroup(QGraphicsItem *item)

92.140 QGraphicsLayout Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicslayout.html>

Parameters : QGraphicsLayoutItem *

Parent Class : QGraphicsLayoutItem

- void activate(void)
- int count(void)
- void invalidate(void)
- bool isActive(void)
- QGraphicsLayoutItem * itemAt(int i)
- void removeAt(int index)
- void setContentsMargins(qreal left, qreal top, qreal right, qreal bottom)
- void widgetEvent(QEvent *e)

92.141 QGraphicsLayoutItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicslayoutitem.html>

Parameters : QGraphicsLayoutItem *,bool

- QRectF contentsRect(void)
- QSizeF effectiveSizeHint(Qt::SizeHint which, QSizeF constraint)
- QRectF geometry(void)
- void getContentsMargins(qreal *left, qreal *top, qreal *right, qreal *bottom)
- QGraphicsItem * graphicsItem(void)
- bool isLayout(void)
- qreal maximumHeight(void)
- QSizeF maximumSize(void)
- qreal maximumWidth(void)
- qreal minimumHeight(void)
- QSizeF minimumSize(void)
- qreal minimumWidth(void)
- bool ownedByLayout(void)
- QGraphicsLayoutItem * parentLayoutItem(void)
- qreal preferredHeight(void)
- QSizeF preferredSize(void)
- qreal preferredWidth(void)
- void setGeometry(QRectF rect)
- void setMaximumHeight(qreal height)
- void setMaximumSize(QSizeF size)
- void setMaximumSize_2(qreal w, qreal h)
- void setMaximumWidth(qreal width)
- void setMinimumHeight(qreal height)
- void setMinimumSize(QSizeF size)
- void setMinimumSize_2(qreal w, qreal h)
- void setMinimumWidth(qreal width)
- void setParentLayoutItem(QGraphicsLayoutItem *parent)
- void setPreferredHeight(qreal height)
- void setPreferredSize(QSizeF size)
- void setPreferredSize_2(qreal w, qreal h)
- void setPreferredWidth(qreal width)
- void setSizePolicy(QSizePolicy policy)

- void setSizePolicy_2(QSizePolicy::Policy hPolicy, QSizePolicy::Policy vPolicy, QSizePolicy::ControlType controlType)
- QSizePolicy sizePolicy(void)
- void updateGeometry(void)

92.142 QGraphicsLineItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicslineitem.html>

Parameters : QGraphicsItem *

Parent Class : QGraphicsItem

- QLineF line(void)
- QPen pen(void)
- void setLine(QLineF line)
- void setLine_2(qreal x1, qreal y1, qreal x2, qreal y2)
- void setPen(QPen pen)

92.143 QGraphicsLinearLayout Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicslinearlayout.html>

Parameters : QGraphicsLayoutItem *

Parent Class : QGraphicsLayout

- void addItem(QGraphicsLayoutItem *item)
- void addStretch(int stretch)
- Qt::Alignment alignment(QGraphicsLayoutItem *item)
- void insertItem(int index, QGraphicsLayoutItem *item)
- void insertStretch(int index, int stretch)
- qreal itemSpacing(int index)
- Qt::Orientation orientation(void)
- void removeItem(QGraphicsLayoutItem *item)
- void setAlignment(QGraphicsLayoutItem *item, Qt::Alignment alignment)
- void setItemSpacing(int index, qreal spacing)
- void setOrientation(Qt::Orientation orientation)
- void setSpacing(qreal spacing)
- void setStretchFactor(QGraphicsLayoutItem *item, int stretch)
- qreal spacing(void)
- int stretchFactor(QGraphicsLayoutItem *item)

92.144 QGraphicsObject Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsobject.html>

Parameters : QGraphicsItem *

Parent Class : QGraphicsItem

- void grabGesture(Qt::GestureType gesture, Qt::GestureFlags flags)
- void ungrabGesture(Qt::GestureType gesture)
- void setEnabledChangedEvent(const char *)
- void setOpacityChangedEvent(const char *)
- void setParentChangedEvent(const char *)
- void setRotationChangedEvent(const char *)
- void setScaleChangedEvent(const char *)
- void setVisibleChangedEvent(const char *)
- void setXChangedEvent(const char *)
- void setYChangedEvent(const char *)
- void setZChangedEvent(const char *)
- const char *getEnabledChangedEvent(void)
- const char *getOpacityChangedEvent(void)
- const char *getParentChangedEvent(void)
- const char *getRotationChangedEvent(void)
- const char *getScaleChangedEvent(void)
- const char *getVisibleChangedEvent(void)
- const char *getXChangedEvent(void)
- const char *getYChangedEvent(void)
- const char *getZChangedEvent(void)

92.145 QGraphicsPathItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicspathitem.html>

Parameters : QGraphicsItem *

Parent Class : QAbstractGraphicsShapeItem

- QPainterPath path(void)
- void setPath(QPainterPath path)

92.146 QGraphicsPixmapItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicspixmapitem.html>

Parameters : QGraphicsItem *

Parent Class : QGraphicsItem

- QPointF offset(void)
- QPixmap pixmap(void)
- void setOffset(QPointF offset)
- void setOffset_2(qreal x, qreal y)
- void setPixmap(QPixmap pixmap)
- void setShapeMode(QGraphicsPixmapItem::ShapeMode mode)
- void setTransformationMode(Qt::TransformationMode mode)
- QGraphicsPixmapItem::ShapeMode shapeMode(void)
- Qt::TransformationMode transformationMode(void)

92.147 QGraphicsPolygonItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicspolygonitem.html>

Parameters : QGraphicsItem *

Parent Class : QAbstractGraphicsShapeItem

- Qt::FillRule fillRule(void)
- QPolygonF polygon(void)
- void setFillRule(Qt::FillRule rule)
- void setPolygon(QPolygonF polygon)

92.148 QGraphicsProxyWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsproxywidget.html>

Parameters : QGraphicsItem *,Qt::WindowFlags

Parent Class : QGraphicsWidget

- QGraphicsProxyWidget * createProxyForChildWidget(QWidget *child)
- void setWidget(QWidget *widget)
- QRectF subWidgetRect(QWidget *widget)
- QWidget * widget(void)

92.149 QGraphicsRectItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsrectitem.html>

Parameters : QGraphicsItem *

Parent Class : QAbstractGraphicsShapeItem

- QRectF rect(void)
- void setRect(QRectF rectangle)
- void setRect_2(qreal x, qreal y, qreal width, qreal height)

92.150 QGraphicsScene Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsscene.html>

Parameters : QObject *

Parent Class : QObject

- QGraphicsItem * activePanel(void)
- QGraphicsWidget * activeWindow(void)
- QGraphicsEllipseItem * addEllipse(QRectF rect, QPen pen, QBrush brush)
- QGraphicsEllipseItem * addEllipse_2(qreal x, qreal y, qreal w, qreal h, QPen pen, QBrush brush)
- void addItem(QGraphicsItem *item)
- QGraphicsLineItem * addLine(QLineF line, QPen pen)
- QGraphicsLineItem * addLine_2(qreal x1, qreal y1, qreal x2, qreal y2, QPen pen)
- QGraphicsPathItem * addPath(QPainterPath path, QPen pen, QBrush brush)
- QGraphicsPixmapItem * addPixmap(QPixmap pixmap)
- QGraphicsPolygonItem * addPolygon(QPolygonF polygon, QPen pen, QBrush brush)
- QGraphicsRectItem * addRect(QRectF rect, QPen pen, QBrush brush)
- QGraphicsRectItem * addRect_2(qreal x, qreal y, qreal w, qreal h, QPen pen, QBrush brush)
- QGraphicsSimpleTextItem * addSimpleText(QString text, QFont font)
- QGraphicsTextItem * addText(QString text, QFont font)
- QGraphicsProxyWidget * addWidget(QWidget *widget, Qt::WindowFlags wFlags)
- QBrush backgroundBrush(void)
- int bspTreeDepth(void)
- void clearFocus(void)
- QList<QGraphicsItem *> collidingItems(QGraphicsItem *item, Qt::ItemSelectionMode mode)
- QGraphicsItemGroup * createItemGroup(QList<QGraphicsItem *> items)
- void destroyItemGroup(QGraphicsItemGroup *group)
- QGraphicsItem * focusItem(void)
- QBrush foregroundBrush(void)

- bool hasFocus(void)
- qreal height(void)
- QVariant inputMethodQuery(Qt::InputMethodQuery query)
- void invalidate(qreal x, qreal y, qreal w, qreal h, QGraphicsScene::SceneLayers layers)
- bool isActive(void)
- QGraphicsItem * itemAt(QPointF position, QTransform deviceTransform)
- QGraphicsItem * itemAt_2(qreal x, qreal y, QTransform deviceTransform)
- QGraphicsScene::ItemIndexMethod itemIndexMethod(void)
- QList<QGraphicsItem *> items(Qt::SortOrder order)
- QList<QGraphicsItem *> items_2(QPointF pos, Qt::ItemSelectionMode mode, Qt::SortOrder order, QTransform deviceTransform)
- QList<QGraphicsItem *> items_3(QRectF rect, Qt::ItemSelectionMode mode, Qt::SortOrder order, QTransform deviceTransform)
- QList<QGraphicsItem *> items_4(QPolygonF polygon, Qt::ItemSelectionMode mode, Qt::SortOrder order, QTransform deviceTransform)
- QList<QGraphicsItem *> items_5(QPainterPath path, Qt::ItemSelectionMode mode, Qt::SortOrder order, QTransform deviceTransform)
- QList<QGraphicsItem *> items_6(qreal x, qreal y, qreal w, qreal h, Qt::ItemSelectionMode mode, Qt::SortOrder order, QTransform deviceTransform)
- QRectF itemsBoundingRect(void)
- qreal minimumRenderSize(void)
- QGraphicsItem * mouseGrabberItem(void)
- QPalette palette(void)
- void removeItem(QGraphicsItem *item)
- void render(QPainter *painter, QRectF target, QRectF source, Qt::AspectRatioMode aspectRatioMode)
- QRectF sceneRect(void)
- QList<QGraphicsItem *> selectedItems(void)
- QPainterPath selectionArea(void)
- bool sendEvent(QGraphicsItem *item, QEvent *event)
- void setActivePanel(QGraphicsItem *item)
- void setActiveWindow(QGraphicsWidget *widget)
- void setBackgroundBrush(QBrush brush)
- void setBspTreeDepth(int depth)
- void setFocus(Qt::FocusReason focusReason)
- void setFocusItem(QGraphicsItem *item, Qt::FocusReason focusReason)
- void setForegroundBrush(QBrush brush)
- void setItemIndexMethod(QGraphicsScene::ItemIndexMethod method)
- void setMinimumRenderSize(qreal minSize)

- void setPalette(QPalette palette)
- void setSceneRect(QRectF rect)
- void setSceneRect_2(qreal x, qreal y, qreal w, qreal h)
- void setSelectionArea(QPainterPath path, QTransform deviceTransform)
- void setSelectionArea_2(QPainterPath path, Qt::ItemSelectionMode mode, QTransform deviceTransform)
- void setSelectionArea_3(QPainterPath path, Qt::ItemSelectionOperation selectionOperation, Qt::ItemSelectionMode mode, QTransform deviceTransform)
- void setStickyFocus(bool enabled)
- void setStyle(QStyle *style)
- bool stickyFocus(void)
- QStyle * style(void)
- void update(qreal x, qreal y, qreal w, qreal h)
- QList<QGraphicsView *> views(void)
- qreal width(void)
- void advance(void)
- void clear(void)
- void clearSelection(void)
- void invalidate_2(QRectF rect, QGraphicsScene::SceneLayers layers)
- void update_2(QRectF rect)
- void setchangedEvent(const char *)
- void setfocusItemChangedEvent(const char *)
- void setsceneRectChangedEvent(const char *)
- void setselectionChangedEvent(const char *)
- const char *getchangedEvent(void)
- const char *getfocusItemChangedEvent(void)
- const char *getsceneRectChangedEvent(void)
- const char *getselectionChangedEvent(void)

92.151 QGraphicsSceneContextMenuEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsscenecontextmenuevent.html>

Parent Class : QGraphicsSceneEvent

- Qt::KeyboardModifiers modifiers(void)
- QPointF pos(void)
- QGraphicsSceneContextMenuEvent::Reason reason(void)
- QPointF scenePos(void)
- QPoint screenPos(void)

92.152 QGraphicsSceneDragDropEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsscenedragdropevent.html>

Parent Class : QGraphicsSceneEvent

- void acceptProposedAction(void)
- Qt::MouseButtons buttons(void)
- Qt::DropAction dropAction(void)
- QMimeData * mimeData(void)
- Qt::KeyboardModifiers modifiers(void)
- QPointF pos(void)
- Qt::DropActions possibleActions(void)
- Qt::DropAction proposedAction(void)
- QPointF scenePos(void)
- QPoint screenPos(void)
- void setDropAction(Qt::DropAction action)
- QWidget *source(void)

92.153 QGraphicsSceneEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicssceneevent.html>

Parent Class : QEvent

- QWidget * widget(void)

92.154 QGraphicsSceneHelpEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsscenehelpevent.html>

Parent Class : QGraphicsSceneEvent

- QPointF scenePos(void)
- QPoint screenPos(void)

92.155 QGraphicsSceneHoverEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsscenehoverevent.html>

Parent Class : QGraphicsSceneEvent

- QPointF lastPos(void)
- QPointF lastScenePos(void)
- QPoint lastScreenPos(void)

- Qt::KeyboardModifiers modifiers(void)
- QPointF pos(void)
- QPointF scenePos(void)
- QPoint screenPos(void)

92.156 QGraphicsSceneMouseEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsscenemouseevent.html>

Parent Class : QGraphicsSceneEvent

- Qt::MouseButton button(void)
- QPointF buttonDownPos(Qt::MouseButton button)
- QPointF buttonDownScenePos(Qt::MouseButton button)
- QPoint buttonDownScreenPos(Qt::MouseButton button)
- Qt::MouseButtons buttons(void)
- Qt::MouseEventFlags flags(void)
- QPointF lastPos(void)
- QPointF lastScenePos(void)
- QPoint lastScreenPos(void)
- Qt::KeyboardModifiers modifiers(void)
- QPointF pos(void)
- QPointF scenePos(void)
- QPoint screenPos(void)
- Qt::MouseEventSource source(void)

92.157 QGraphicsSceneMoveEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsscenemoveevent.html>

Parent Class : QGraphicsSceneEvent

- QPointF newPos(void)
- QPointF oldPos(void)

92.158 QGraphicsSceneResizeEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicssceneresizeevent.html>

Parent Class : QGraphicsSceneEvent

- QSizeF newSize(void)
- QSizeF oldSize(void)

92.159 QGraphicsSceneWheelEvent Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsscenenewwheelevent.html>

Parent Class : QGraphicsSceneEvent

- Qt::MouseButtons buttons(void)
- int delta(void)
- Qt::KeyboardModifiers modifiers(void)
- Qt::Orientation orientation(void)
- QPointF pos(void)
- QPointF scenePos(void)
- QPoint screenPos(void)

92.160 QGraphicsSimpleTextItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicssimpletextitem.html>

Parameters : QGraphicsItem *

Parent Class : QAbstractGraphicsShapeItem

- QFont font(void)
- void setFont(QFont font)
- void setText(QString text)
- QString text(void)

92.161 QGraphicsSvgItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicssvgitem.html>

Parameters : QGraphicsItem *

Parent Class : QGraphicsObject

- QString elementId(void)
- QSize maximumCacheSize(void)
- QSvgRenderer * renderer(void)

- void setElementId(QString id)
- void setMaximumCacheSize(QSize size)
- void setSharedRenderer(QSvgRenderer *renderer)

92.162 QGraphicsTextItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicstextitem.html>

Parameters : QGraphicsItem *

Parent Class : QGraphicsObject

- void adjustSize(void)
- QColor defaultTextColor(void)
- QTextDocument * document(void)
- QFont font(void)
- bool openExternalLinks(void)
- void setDefaultTextColor(QColor col)
- void setDocument(QTextDocument *document)
- void setFont(QFont font)
- void setHtml(QString text)
- void setOpenExternalLinks(bool open)
- void setPlainText(QString text)
- void setTabChangesFocus(bool b)
- void setTextCursor(QTextCursor cursor)
- void setTextInteractionFlags(Qt::TextInteractionFlags flags)
- void setTextWidth(qreal width)
- bool tabChangesFocus(void)
- QTextCursor textCursor(void)
- Qt::TextInteractionFlags textInteractionFlags(void)
- qreal textWidth(void)
- QString toHtml(void)
- QString toPlainText(void)
- void setlinkActivatedEvent(const char *)
- void setlinkHoveredEvent(const char *)
- const char *getlinkActivatedEvent(void)
- const char *getlinkHoveredEvent(void)

92.163 QGraphicsVideoItem Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsvideoitem.html>

Parameters : void

- Qt::AspectRatioMode aspectRatioMode(void)
- QSizeF nativeSize(void)
- QPointF offset(void)
- void setAspectRatioMode(Qt::AspectRatioMode mode)
- void setOffset(QPointF offset)
- void setSize(QSizeF size)
- QSizeF size(void)

92.164 QGraphicsView Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicsview.html>

Parameters : QWidget *

Parent Class : QAbstractScrollArea

- Qt::Alignment alignment(void)
- QBrush backgroundBrush(void)
- QGraphicsView::CacheMode cacheMode(void)
- void centerOn(QPointF pos)
- void centerOn_2(qreal x, qreal y)
- void centerOn_3(QGraphicsItem *item)
- QGraphicsView::DragMode dragMode(void)
- void ensureVisible(QRectF rect, int xmargin, int ymargin)
- void ensureVisible_2(qreal x, qreal y, qreal w, qreal h, int xmargin, int ymargin)
- void ensureVisible_3(QGraphicsItem *item, int xmargin, int ymargin)
- void fitInView(QRectF rect, Qt::AspectRatioMode aspectRatioMode)
- void fitInView_2(qreal x, qreal y, qreal w, qreal h, Qt::AspectRatioMode aspectRatioMode)
- void fitInView_3(QGraphicsItem *item, Qt::AspectRatioMode aspectRatioMode)
- QBrush foregroundBrush(void)
- bool isInteractive(void)
- bool isTransformed(void)
- QGraphicsItem * itemAt(QPoint pos)
- QGraphicsItem * itemAt_2(int x, int y)
- QList<QGraphicsItem *> items(void)
- QList<QGraphicsItem *> items_2(QPoint pos)

- `QList<QGraphicsItem *> items_3(int x, int y)`
- `QList<QGraphicsItem *> items_4(QRect rect, Qt::ItemSelectionMode mode)`
- `QList<QGraphicsItem *> items_5(int x, int y, int w, int h, Qt::ItemSelectionMode mode)`
- `QList<QGraphicsItem *> items_6(QPolygon polygon, Qt::ItemSelectionMode mode)`
- `QList<QGraphicsItem *> items_7(QPainterPath path, Qt::ItemSelectionMode mode)`
- `QPoint mapFromScene(QPointF point)`
- `QPolygon mapFromScene_2(QRectF rect)`
- `QPolygon mapFromScene_3(QPolygonF polygon)`
- `QPainterPath mapFromScene_4(QPainterPath path)`
- `QPoint mapFromScene_5(qreal x, qreal y)`
- `QPolygon mapFromScene_6(qreal x, qreal y, qreal w, qreal h)`
- `QPointF mapToScene(QPoint point)`
- `QPolygonF mapToScene_2(QRect rect)`
- `QPolygonF mapToScene_3(QPolygon polygon)`
- `QPainterPath mapToScene_4(QPainterPath path)`
- `QPointF mapToScene_5(int x, int y)`
- `QPolygonF mapToScene_6(int x, int y, int w, int h)`
- `QGraphicsView::OptimizationFlags optimizationFlags(void)`
- `void render(QPainter *painter, QRectF target, QRect source, Qt::AspectRatioMode aspectRatioMode)`
- `QPainter::RenderHints renderHints(void)`
- `void resetCachedContent(void)`
- `void resetTransform(void)`
- `QGraphicsView::ViewportAnchor resizeAnchor(void)`
- `void rotate(qreal angle)`
- `QRect rubberBandRect(void)`
- `Qt::ItemSelectionMode rubberBandSelectionMode(void)`
- `void scale(qreal sx, qreal sy)`
- `QGraphicsScene * scene(void)`
- `QRectF sceneRect(void)`
- `void setAlignment(Qt::Alignment alignment)`
- `void setBackgroundBrush(QBrush brush)`
- `void setCacheMode(QGraphicsView::CacheMode mode)`
- `void setDragMode(QGraphicsView::DragMode mode)`
- `void setForegroundBrush(QBrush brush)`
- `void setInteractive(bool allowed)`
- `void setOptimizationFlag(QGraphicsView::OptimizationFlag flag, bool enabled)`

- void setOptimizationFlags(QGraphicsView::OptimizationFlags flags)
- void setRenderHint(QPainter::RenderHint hint, bool enabled)
- void setRenderHints(QPainter::RenderHints hints)
- void setResizeAnchor(QGraphicsView::ViewportAnchor anchor)
- void setRubberBandSelectionMode(Qt::ItemSelectionMode mode)
- void setScene(QGraphicsScene *scene)
- void setSceneRect(QRectF rect)
- void setSceneRect_2(qreal x, qreal y, qreal w, qreal h)
- void setTransform(QTransform matrix, bool combine)
- void setTransformationAnchor(QGraphicsView::ViewportAnchor anchor)
- void setViewportUpdateMode(QGraphicsView::ViewportUpdateMode mode)
- void shear(qreal sh, qreal sv)
- QTransform transform(void)
- QGraphicsView::ViewportAnchor transformationAnchor(void)
- void translate(qreal dx, qreal dy)
- QTransform viewportTransform(void)
- QGraphicsView::ViewportUpdateMode viewportUpdateMode(void)
- void invalidateScene(QRectF rect, QGraphicsScene::SceneLayers layers)
- void updateScene(QList<QRectF> rects)
- void updateSceneRect(QRectF rect)
- void setRubberBandChangedEvent(const char *)
- const char *getRubberBandChangedEvent(void)

92.165 QGraphicsWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qgraphicswidget.html>

Parameters : QGraphicsItem *, Qt::WindowFlags

Parent Class : QGraphicsObject

- QList<QAction *> actions(void)
- void addAction(QAction *action)
- void addActions(QList<QAction *> actions)
- void adjustSize(void)
- bool autoFillBackground(void)
- Qt::FocusPolicy focusPolicy(void)
- QGraphicsWidget * focusWidget(void)
- QFont font(void)

- void getWindowFrameMargins(qreal *left, qreal *top, qreal *right, qreal *bottom)
- int grabShortcut(QKeySequence sequence, Qt::ShortcutContext context)
- void insertAction(QAction *before, QAction *action)
- void insertActions(QAction *before, QList<QAction *> actions)
- bool isActiveWindow(void)
- QGraphicsLayout * layout(void)
- Qt::LayoutDirection layoutDirection(void)
- void paintWindowFrame(QPainter *painter, QStyleOptionGraphicsItem *option, QWidget *widget)
- QPalette palette(void)
- QRectF rect(void)
- void releaseShortcut(int id)
- void removeAction(QAction *action)
- void resize(QSizeF size)
- void resize_2(qreal w, qreal h)
- void setAttribute(Qt::WidgetAttribute attribute, bool on)
- void setAutoFillBackground(bool enabled)
- void setContentsMargins(QMarginsF margins)
- void setContentsMargins_2(qreal left, qreal top, qreal right, qreal bottom)
- void setFocusPolicy(Qt::FocusPolicy policy)
- void setFont(QFont font)
- void setGeometry(qreal x, qreal y, qreal w, qreal h)
- void setLayout(QGraphicsLayout *layout)
- void setLayoutDirection(Qt::LayoutDirection direction)
- void setPalette(QPalette palette)
- void setShortcutAutoRepeat(int id, bool enabled)
- void setShortcutEnabled(int id, bool enabled)
- void setStyle(QStyle *style)
- void setWindowFlags(Qt::WindowFlags wFlags)
- void setWindowFrameMargins(QMarginsF margins)
- void setWindowFrameMargins_2(qreal left, qreal top, qreal right, qreal bottom)
- void setWindowTitle(QString title)
- QSizeF size(void)
- QStyle * style(void)
- bool testAttribute(Qt::WidgetAttribute attribute)
- void unsetLayoutDirection(void)
- void unsetWindowFrameMargins(void)

- Qt::WindowFlags windowFlags(void)
- QRectF windowFrameGeometry(void)
- QRectF windowFrameRect(void)
- QString windowTitle(void)
- Qt::WindowType windowType(void)
- bool close(void)
- void setgeometryChangedEvent(const char *)
- void setlayoutChangedEvent(const char *)
- const char *getgeometryChangedEvent(void)
- const char *getlayoutChangedEvent(void)

92.166 QGridLayout Class

C++ Reference : <http://doc.qt.io/qt-5/qgridlayout.html>

Parameters : void

- void addItem(QLayoutItem * item, int row, int column, int rowSpan , int columnSpan , Qt::Alignment alignment)
- void addLayout(QLayout * layout, int row, int column, Qt::Alignment alignment)
- void addLayout_2(QLayout * layout, int row, int column, int rowSpan, int columnSpan, Qt::Alignment alignment)
- void addWidget(QWidget * widget, int row, int column, Qt::Alignment alignment)
- void addWidget_2(QWidget * widget, int fromRow, int fromColumn, int rowSpan, int columnSpan, Qt::Alignment alignment)
- QRect cellRect(int row, int column)
- int columnCount(void)
- int columnMinimumWidth(int column)
- int columnStretch(int column)
- void getItemPosition(int index, int * row, int * column, int * rowSpan, int * columnSpan)
- int horizontalSpacing(void)
- QLayoutItem * itemAtPosition(int row, int column)
- Qt::Corner originCorner(void)
- int rowCount(void)
- int rowMinimumHeight(int row)
- int rowStretch(int row)
- void setColumnMinimumWidth(int column, int minSize)
- void setColumnStretch(int column, int stretch)
- void setHorizontalSpacing(int spacing)

- void setOriginCorner(Qt::Corner corner)
- void setRowMinimumHeight(int row, int minSize)
- void setRowStretch(int row, int stretch)
- void setSpacing(int spacing)
- void setVerticalSpacing(int spacing)
- int spacing(void)
- int verticalSpacing(void)

92.167 QGuiApplication Class

C++ Reference : <http://doc.qt.io/qt-5/qguiapplication.html>

Parent Class : QCoreApplication

Parameters : int,char **

- qreal devicePixelRatio(void)
- bool isSavingSession(void)
- bool isSessionRestored(void)
- QString sessionId(void)
- QString sessionKey(void)
- QWindowList allWindows(void)
- QString applicationDisplayName(void)
- Qt::ApplicationState applicationState(void)
- void changeOverrideCursor(QCursor cursor)
- QClipboard * clipboard(void)
- bool desktopSettingsAware(void)
- int exec(void)
- QObject * focusObject(void)
- QWindow * focusWindow(void)
- QFont font(void)
- QInputMethod * inputMethod(void)
- bool isLeftToRight(void)
- bool isRightToLeft(void)
- Qt::KeyboardModifiers keyboardModifiers(void)
- Qt::LayoutDirection layoutDirection(void)
- QWindow * modalWindow(void)
- Qt::MouseButtons mouseButtons(void)
- QCursor * overrideCursor(void)

- QPalette palette(void)
- QString platformName(void)
- QPlatformNativeInterface * platformNativeInterface(void)
- QScreen * primaryScreen(void)
- Qt::KeyboardModifiers queryKeyboardModifiers(void)
- bool quitOnLastWindowClosed(void)
- void restoreOverrideCursor(void)
- QList<QScreen *> screens(void)
- void setApplicationDisplayName(QString name)
- void setDesktopSettingsAware(bool on)
- void setFont(QFont font)
- void setLayoutDirection(Qt::LayoutDirection direction)
- void setOverrideCursor(QCursor cursor)
- void setPalette(QPalette pal)
- void setQuitOnLastWindowClosed(bool quit)
- QStyleHints * styleHints(void)
- void sync(void)
- QWindow * topLevelAt(QPoint pos)
- QWindowList topLevelWindows(void)
- void setapplicationDisplaynameChangedEvent(const char *)
- void setapplicationStatechangedEvent(const char *)
- void setcommitDataRequestEvent(const char *)
- void setfocusObjectChangedEvent(const char *)
- void setfocusWindowChangedEvent(const char *)
- void setfontDatabaseChangedEvent(const char *)
- void setlastWindowClosedEvent(const char *)
- void setlayoutDirectionChangedEvent(const char *)
- void setpaletteChangedEvent(const char *)
- void setprimaryScreenChangedEvent(const char *)
- void setsaveStateRequestEvent(const char *)
- void setscreenAddedEvent(const char *)
- void setscreenRemovedEvent(const char *)
- const char *getapplicationDisplaynameChangedEvent(void)
- const char *getapplicationStatechangedEvent(void)
- const char *getcommitDataRequestEvent(void)
- const char *getfocusObjectChangedEvent(void)

- const char *getfocusWindowChangedEvent(void)
- const char *getfontDatabaseChangedEvent(void)
- const char *getLastWindowClosedEvent(void)
- const char *getlayoutDirectionChangedEvent(void)
- const char *getpaletteChangedEvent(void)
- const char *getprimaryScreenChangedEvent(void)
- const char *getsaveStateRequestEvent(void)
- const char *getscreenAddedEvent(void)
- const char *getscreenRemovedEvent(void)

92.168 QHBarModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qhbarmodelmapper.html>

Parameters : QObject *

Parent Class : QObject

- int columnCount(void)
- int firstBarSetRow(void)
- int firstColumn(void)
- int lastBarSetRow(void)
- QAbstractItemModel * model(void)
- QAbstractBarSeries * series(void)
- void setColumnCount(int columnCount)
- void setFirstBarSetRow(int firstBarSetRow)
- void setFirstColumn(int firstColumn)
- void setLastBarSetRow(int lastBarSetRow)
- void setModel(QAbstractItemModel *model)
- void setSeries(QAbstractBarSeries *series)
- void setcolumnCountChangedEvent(const char *)
- void setfirstBarSetRowChangedEvent(const char *)
- void setfirstColumnChangedEvent(const char *)
- void setlastBarSetRowChangedEvent(const char *)
- void setmodelReplacedEvent(const char *)
- void setseriesReplacedEvent(const char *)
- const char *getcolumnCountChangedEvent(void)
- const char *getfirstBarSetRowChangedEvent(void)
- const char *getfirstColumnChangedEvent(void)

- const char *getLastBarSetRowChangedEvent(void)
- const char *getModelReplacedEvent(void)
- const char *GetSeriesReplacedEvent(void)

92.169 QBoxLayout Class

C++ Reference : <http://doc.qt.io/qt-5/qbboxlayout.html>

Parameters : void

Parent Class : QBoxLayout

- void addWidget(QWidget *)
- void addLayout(QLayout *)

92.170 QBoxPlotModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qbboxplotmodelmapper.html>

Parameters : QObject *

Parent Class : QObject

- int columnCount(void)
- int firstBoxSetRow(void)
- int firstColumn(void)
- int lastBoxSetRow(void)
- QAbstractItemModel * model(void)
- QBoxPlotSeries * series(void)
- void setColumnCount(int rowCount)
- void setFirstBoxSetRow(int firstBoxSetRow)
- void setFirstColumn(int firstColumn)
- void setLastBoxSetRow(int lastBoxSetRow)
- void setModel(QAbstractItemModel *model)
- void setSeries(QBoxPlotSeries *series)
- void setColumnCountChangedEvent(const char *)
- void setFirstBoxSetRowChangedEvent(const char *)
- void setFirstColumnChangedEvent(const char *)
- void setLastBoxSetRowChangedEvent(const char *)
- void setModelReplacedEvent(const char *)
- void SetSeriesReplacedEvent(const char *)
- const char *getColumnCountChangedEvent(void)
- const char *getFirstBoxSetRowChangedEvent(void)

- const char *getfirstColumnChangedEvent(void)
- const char *getLastBoxSetRowChangedEvent(void)
- const char *getModelReplacedEvent(void)
- const char *getseriesReplacedEvent(void)

92.171 QCandlestickModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qhcandlestickmodelmapper.html>

Parameters : QObject *

Parent Class : QCandlestickModelMapper

- int closeColumn(void)
- int firstSetRow(void)
- int highColumn(void)
- int lastSetRow(void)
- int lowColumn(void)
- int openColumn(void)
- void setCloseColumn(int closeColumn)
- void setFirstSetRow(int firstSetRow)
- void setHighColumn(int highColumn)
- void setLastSetRow(int lastSetRow)
- void setLowColumn(int lowColumn)
- void setOpenColumn(int openColumn)
- void setTimestampColumn(int timestampColumn)
- int timestampColumn(void)
- void setcloseColumnChangedEvent(const char *)
- void setfirstSetRowChangedEvent(const char *)
- void sethighColumnChangedEvent(const char *)
- void setlastSetRowChangedEvent(const char *)
- void setlowColumnChangedEvent(const char *)
- void setopenColumnChangedEvent(const char *)
- void settimestampColumnChangedEvent(const char *)
- const char *getcloseColumnChangedEvent(void)
- const char *getfirstSetRowChangedEvent(void)
- const char *gethighColumnChangedEvent(void)
- const char *getLastSetRowChangedEvent(void)
- const char *getlowColumnChangedEvent(void)

- const char *getopenColumnChangedEvent(void)
- const char *gettimestampColumnChangedEvent(void)

92.172 QHPieModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qhpiemodelmapper.html>

Parameters : QObject *

Parent Class : QPieModelMapper

- int columnCount(void)
- int firstColumn(void)
- int labelsRow(void)
- QAbstractItemModel * model(void)
- QPieSeries * series(void)
- void setColumnCount(int columnCount)
- void setFirstColumn(int firstColumn)
- void setLabelsRow(int labelsRow)
- void setModel(QAbstractItemModel *model)
- void setSeries(QPieSeries *series)
- void setValuesRow(int valuesRow)
- int valuesRow(void)
- void setcolumnCountChangedEvent(const char *)
- void setfirstColumnChangedEvent(const char *)
- void setlabelsRowChangedEvent(const char *)
- void setmodelReplacedEvent(const char *)
- void setsseriesReplacedEvent(const char *)
- void setvaluesRowChangedEvent(const char *)
- const char *getcolumnCountChangedEvent(void)
- const char *getfirstColumnChangedEvent(void)
- const char *getlabelsRowChangedEvent(void)
- const char *getmodelReplacedEvent(void)
- const char *getseriesReplacedEvent(void)
- const char *getvaluesRowChangedEvent(void)

92.173 QHXYModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qhxymodelmapper.html>

Parameters : QObject *

Parent Class : QXYModelMapper

- int columnCount(void)
- int firstColumn(void)
- QAbstractItemModel * model(void)
- QXYSeries * series(void)
- void setColumnCount(int columnCount)
- void setFirstColumn(int firstColumn)
- void setModel(QAbstractItemModel *model)
- void setSeries(QXYSeries *series)
- void setXRow(int xRow)
- void setYRow(int yRow)
- int xRow(void)
- int yRow(void)
- void setcolumnCountChangedEvent(const char *)
- void setfirstColumnChangedEvent(const char *)
- void setmodelReplacedEvent(const char *)
- void setsseriesReplacedEvent(const char *)
- void setxRowChangedEvent(const char *)
- void setyRowChangedEvent(const char *)
- const char *getcolumnCountChangedEvent(void)
- const char *getfirstColumnChangedEvent(void)
- const char *getmodelReplacedEvent(void)
- const char *getseriesReplacedEvent(void)
- const char *getxRowChangedEvent(void)
- const char *getyRowChangedEvent(void)

92.174 QHeaderView Class

C++ Reference : <http://doc.qt.io/qt-5/qheaderview.html>

Parameters : Qt::Orientation, QWidget *

Parent Class : QAbstractItemView

- bool cascadingSectionResizes(void)
- int count(void)
- Qt::Alignment defaultAlignment(void)
- int defaultSectionSize(void)
- int hiddenSectionCount(void)
- void hideSection(int logicalIndex)
- bool highlightSections(void)
- bool isSectionHidden(int logicalIndex)
- bool isSortIndicatorShown(void)
- int length(void)
- int logicalIndex(int visualIndex)
- int logicalIndexAt(int position)
- int logicalIndexAt_2(int x, int y)
- int logicalIndexAt_3(QPoint pos)
- int maximumSectionSize(void)
- int minimumSectionSize_2(void)
- void moveSection(int from, int to)
- int offset(void)
- Qt::Orientation orientation(void)
- int resizeContentsPrecision(void)
- void resizeSection(int logicalIndex, int size)
- void resizeSections(QHeaderView::ResizeMode mode)
- bool restoreState(QByteArray state)
- QByteArray saveState(void)
- int sectionPosition(int logicalIndex)
- QHeaderView::ResizeMode sectionResizeMode(int logicalIndex)
- int sectionSize(int logicalIndex)
- int sectionSizeHint(int logicalIndex)
- int sectionViewportPosition(int logicalIndex)
- bool sectionsClickable(void)
- bool sectionsHidden(void)

- bool sectionsMovable(void)
- bool sectionsMoved(void)
- void setCascadingSectionResizes(bool enable)
- void setDefaultAlignment(Qt::Alignment alignment)
- void setDefaultSectionSize(int size)
- void setHighlightSections(bool highlight)
- void setMaximumSectionSize(int size)
- void setMinimumSectionSize(int size)
- void setResizeContentsPrecision(int precision)
- void setSectionHidden(int logicalIndex, bool hide)
- void setSectionResizeMode(QHeaderView::ResizeMode mode)
- void setSectionResizeMode_2(int logicalIndex, QHeaderView::ResizeMode mode)
- void setSectionsClickable(bool clickable)
- void setSectionsMovable(bool movable)
- void setSortIndicator(int logicalIndex, Qt::SortOrder order)
- void setSortIndicatorShown(bool show)
- void setStretchLastSection(bool stretch)
- void showSection(int logicalIndex)
- Qt::SortOrder sortIndicatorOrder(void)
- int sortIndicatorSection(void)
- bool stretchLastSection(void)
- int stretchSectionCount(void)
- void swapSections(int first, int second)
- int visualIndex(int logicalIndex)
- int visualIndexAt(int position)
- void headerDataChanged(Qt::Orientation orientation, int logicalFirst, int logicalLast)
- void setOffset(int offset)
- void setOffsetToLastSection(void)
- void setOffsetToSectionPosition(int visualSectionNumber)
- void setgeometriesChangedEvent(const char *)
- void setsectionClickedEvent(const char *)
- void setsectionCountChangedEvent(const char *)
- void setsectionDoubleClickedEvent(const char *)
- void setsectionEnteredEvent(const char *)
- void setsectionHandleDoubleClickedEvent(const char *)
- void setsectionMovedEvent(const char *)

- void setsectionPressedEvent(const char *)
- void setsectionResizedEvent(const char *)
- void setsortIndicatorChangedEvent(const char *)
- const char *getgeometriesChangedEvent(void)
- const char *getsectionClickedEvent(void)
- const char *getsectionCountChangedEvent(void)
- const char *getsectionDoubleClickEvent(void)
- const char *getsectionEnteredEvent(void)
- const char *getsectionHandleDoubleClickEvent(void)
- const char *getsectionMovedEvent(void)
- const char *getsectionPressedEvent(void)
- const char *getsectionResizedEvent(void)
- const char *getsortIndicatorChangedEvent(void)
- void geteventparameters(void)

92.175 QHorizontalBarSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qhorizontalbarseries.html>

Parameters : QObject *

Parent Class : QAbstractBarSeries

- QAbstractSeries::SeriesType type(void)

92.176 QHorizontalPercentBarSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qhorizontalpercentbarseries.html>

Parameters : QObject *

Parent Class : QAbstractBarSeries

- QAbstractSeries::SeriesType type(void)

92.177 QHorizontalStackedBarSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qhorizontalstackedbarseries.html>

Parameters : QObject *

Parent Class : QAbstractBarSeries

- QAbstractSeries::SeriesType type(void)

92.178 QHostAddress Class

C++ Reference : <http://doc.qt.io/qt-5/qhostaddress.html>

Parameters : void

- void clear(void)
- bool isInSubnet(QHostAddress, int netmask)
- boolisNull(void)
- int protocol(void)
- QString scopeId(void)
- bool setAddress(QString)
- int toIPv4Address(void)
- Q_IPV6ADDR toIPv6Address(void)
- QString toString(void)

92.179 QHostInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qhostinfo.html>

Parameters : void

- int error(void)
- QString errorString(void)
- QString hostName(void)
- int lookupId(void)
- void setError(QHostInfo::HostInfoError error)
- void setErrorString(QString)
- void setHostName(QString)
- void setLookupId(int id)
- void abortHostLookup(int id)
- QHostInfo fromName(QString)
- QString localDomainName(void)
- QString localHostName(void)

92.180 QIODevice Class

C++ Reference : <http://doc.qt.io/qt-5/qiodevice.html>

Parameters : void

Parent Class : QObject

- QString errorString(void)
- bool getChar(char *c)
- bool isOpen(void)
- bool isReadable(void)
- bool isTextModeEnabled(void)
- bool isWritable(void)
- int openMode(void)
- int peek(char *data, int maxSize)
- int read(char *data, int maxSize)
- int readLine(char *data, int maxSize)
- void ungetChar(char c)
- int write(const char *data, int maxSize)
- bool atEnd(void)
- bool canReadLine(void)
- void close(void)
- bool open(QIODevice::OpenMode flags)
- qint64 pos(void)
- bool seek(qint64 pos)
- qint64 size(void)
- void setaboutToCloseEvent(const char *)
- void setbytesWrittenEvent(const char *)
- void setreadChannelFinishedEvent(const char *)
- void setreadyReadEvent(const char *)
- const char *getaboutToCloseEvent(void)
- const char *getbytesWrittenEvent(void)
- const char *getreadChannelFinishedEvent(void)
- const char *getreadyReadEvent(void)

92.181 QIcon Class

C++ Reference : <http://doc.qt.io/qt-5/qicon.html>

Parameters : QPixmap

92.182 QImage Class

C++ Reference : <http://doc.qt.io/qt-5/qimage.html>

Parameters : void

- bool allGray(void)
- int bitPlaneCount(void)
- uchar *bits(void)
- int bytesPerLine(void)
- qint64 cacheKey(void)
- QRgb color(int i)
- int colorCount(void)
- const uchar *constBits(void)
- const uchar *constScanLine(int i)
- QImage convertToFormat(QImage::Format format, Qt::ImageConversionFlags flags)
- QImage copy(int x, int y, int width, int height)
- QImage createAlphaMask(Qt::ImageConversionFlags flags)
- QImage createHeuristicMask(bool clipTight)
- QImage createMaskFromColor(QRgb color, Qt::MaskMode mode)
- int depth(void)
- int dotsPerMeterX(void)
- int dotsPerMeterY(void)
- void fill(QColor)
- QImage::Format format(void)
- bool hasAlphaChannel(void)
- int height(void)
- void invertPixels(QImage::InvertMode mode)
- bool isGrayscale(void)
- boolisNull(void)
- bool load(QString, const char *format) # In RingQt use : bool loadimage(QString, const char *format)
- bool loadFromData(QByteArray, const char * format)
- QImage mirrored(bool horizontal, bool vertical)
- QPoint offset(void)

- QRgb pixel(int x, int y)
- int pixelIndex(int x, int y)
- QRect rect(void)
- QImage rgbSwapped(void)
- bool save(QString, const char * format, int quality)
- QImage scaled(int width, int height, Qt::AspectRatioMode aspectRatioMode, Qt::TransformationMode transformMode)
- QImage scaledToHeight(int height, Qt::TransformationMode mode)
- QImage scaledToWidth(int width, Qt::TransformationMode mode)
- uchar *scanLine(int i)
- void setColor(int index, QRgb colorValue)
- void setColorCount(int colorCount)
- void setDotsPerMeterX(int x)
- void setDotsPerMeterY(int y)
- void setOffset(QPoint)
- void setPixel(int x, int y, uint index_or_rgb)
- void setText(QString,QString)
- QSize size(void)
- void swap(QImage)
- QString text(QString)
- QStringList textKeys(void)
- bool valid(int x, int y)
- int width(void)

92.183 QInputAspect Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dinput-qinputaspect.html>

Parameters : QObject *

- QStringList availablePhysicalDevices(void)
- Qt3DInput::QAbstractPhysicalDevice * createPhysicalDevice(QString name)

92.184 QInputDialog Class

C++ Reference : <http://doc.qt.io/qt-5/qinputdialog.html>

Parameters : QWidget *

Parent Class : QDialog

- QString cancelButtonText(void)
- QStringList comboBoxItems(void)
- int doubleDecimals(void)
- double doubleMaximum(void)
- double doubleMinimum(void)
- double doubleValue(void)
- int inputMode(void)
- int intMaximum(void)
- int intMinimum(void)
- int intStep(void)
- int intValue(void)
- bool isComboBoxEditable(void)
- QString labelText(void)
- QString okButtonText(void)
- void open(QObject *receiver, const char *member)
- int options(void)
- void setCancelButtonText(QString)
- void setComboBoxEditable(bool editable)
- void setComboBoxItems(QStringList)
- void setDoubleDecimals(int decimals)
- void setDoubleMaximum(double max)
- void setDoubleMinimum(double min)
- void setDoubleRange(double min, double max)
- void setDoubleValue(double value)
- void setInputMode(QInputDialog::InputMode mode)
- void setIntMaximum(int max)
- void setIntMinimum(int min)
- void setIntRange(int min, int max)
- void setIntStep(int step)
- void setIntValue(int value)
- void setLabelText(QString)

- void setOkButtonText(QString)
- void setOption(QInputDialog::InputDialogOption option, bool on)
- void setOptions(QInputDialog::InputDialogOption options)
- void setTextEchoMode(QLineEdit::EchoMode mode)
- void setTextValue(QString)
- bool testOption(QInputDialog::InputDialogOption option)
- int textEchoMode(void)
- QString textValue(void)
- double getDouble(QWidget *parent,QString,QString, double value, double min, double max , int decimals, bool *ok, Qt::WindowType flags)
- int getInt(QWidget *parent,QString,QString, int value, int min, int max, int step, bool *ok, Qt::WindowType flags)

92.185 QJsonArray Class

C++ Reference : <http://doc.qt.io/qt-5/qjsonarray.html>

Parameters : void

- void append(QJsonValue value)
- QJsonValue at(int i)
- bool contains(QJsonValue value)
- int count(void)
- bool empty(void)
- QJsonValue first(void)
- void insert(int i, QJsonValue value)
- bool isEmpty(void)
- QJsonValue last(void)
- void pop_back(void)
- void pop_front(void)
- void prepend(QJsonValue value)
- void push_back(QJsonValue value)
- void push_front(QJsonValue value)
- void removeAt(int i)
- void removeFirst(void)
- void removeLast(void)
- void replace(int i, QJsonValue value)
- int size(void)
- QJsonValue takeAt(int i)

- QVariantList toVariantList(void)
- QJsonArray fromStringList(QStringList list)
- QJsonArray fromVariantList(QVariantList list)

92.186 QJsonDocument Class

C++ Reference : <http://doc.qt.io/qt-5/qjsondocument.html>

Parameters : void

- QJsonArray array(void)
- bool isArray(void)
- bool isEmpty(void)
- boolisNull(void)
- bool isObject(void)
- QJsonObject object(void)
- void setArray(QJsonArray array)
- void setObject(QJsonObject object)
- QByteArray toJson(QJsonDocument::JsonFormat format)
- QVariant toVariant(void)
- QJsonDocument fromJson(QByteArray json, QJsonParseError * error)
- QJsonDocument fromVariant(QVariant variant)

92.187 QJsonObject Class

C++ Reference : <http://doc.qt.io/qt-5/qjsonobject.html>

Parameters : void

- bool contains(QString key)
- int count(void)
- bool empty(void)
- bool isEmpty(void)
- QStringList keys(void)
- int length(void)
- void remove(QString key)
- int size(void)
- QJsonValue take(QString key)
- QVariantMap toVariantMap(void)
- QJsonValue value(QString key)
- QJsonObject fromVariantMap(QVariantMap map)

92.188 QJsonParseError Class

C++ Reference : <http://doc.qt.io/qt-5/qjsonparseerror.html>

Parameters : void

- QString errorString(void)

92.189 QJsonValue Class

C++ Reference : <http://doc.qt.io/qt-5/qjsonvalue.html>

Parameters : void

- bool isArray(void)
- bool isBool(void)
- bool isDouble(void)
- boolisNull(void)
- bool isObject(void)
- bool isString(void)
- bool isUndefined(void)
- QJsonArray toArray(QJsonArray defaultValue)
- QJsonArray toArray_2(void)
- bool toBool(bool defaultValue)
- double toDouble(double defaultValue)
- int toInt(int defaultValue)
- QJsonObject toObject(QJsonObject defaultValue)
- QJsonObject toObject_2(void)
- QString toString(QString defaultValue)
- QVariant toVariant(void)
- QJsonValue::Type type(void)
- QJsonValue fromVariant(QVariant variant)

92.190 QKeySequence Class

C++ Reference : <http://doc.qt.io/qt-5/qkeysequence.html>

Parameters : QString

92.191 QLCDNumber Class

C++ Reference : <http://doc.qt.io/qt-5/qlcdnumber.html>

Parameters : QWidget *

Parent Class : QFrame

- bool checkOverflow(double num)
- int digitCount(void)
- int intValue(void)
- int mode(void)
- int segmentStyle(void)
- void setDigitCount(int numDigits)
- void setMode(QLCDNumber::Mode)
- void setSegmentStyle(QLCDNumber::SegmentStyle)
- bool smallDecimalPoint(void)
- double value(void)
- void display(double)
- void setBinMode(void)
- void setDecMode(void)
- void setHexMode(void)
- void setOctMode(void)
- void setSmallDecimalPoint(bool)

92.192 QLabel Class

C++ Reference : <http://doc.qt.io/qt-5/qlabel.html>

Parameters : QWidget *

Parent Class : QFrame

- QPicture *picture(void)
- QPixmap *pixmap(void)
- int alignment(void)
- QWidget *buddy(void)
- bool hasScaledContents(void)
- bool hasSelectedText(void)
- int indent(void)
- int margin(void)
- QMovie *movie(void)
- bool openExternalLinks(void)

- `QString selectedText(void)`
- `int selectionStart(void)`
- `void setAlignment(Qt::AlignmentFlag)`
- `void setBuddy(QWidget *buddy)`
- `void setIndent(int)`
- `void setMargin(int)`
- `void setOpenExternalLinks(bool open)`
- `void setScaledContents(bool)`
- `void setSelection(int start, int length)`
- `void setTextFormat(Qt::TextFormat)`
- `void setTextInteractionFlags(Qt::TextInteractionFlag flags)`
- `void setWordWrap(bool on)`
- `QString text(void)`
- `int textFormat(void)`
- `int textInteractionFlags(void)`
- `bool wordWrap(void)`
- `void clear(void)`
- `void setMovie(QMovie *movie)`
- `void setNum(double num)`
- `void setPicture(QPicture)`
- `void setPixmap(QPixmap)`
- `void setText(QString)`

92.193 QLayout Class

C++ Reference : <http://doc.qt.io/qt-5/qlayout.html>

Parameters : `QWidget *`

Parent Class : `QObject`

- `bool activate(void)`
- `void addWidget(QWidget *w)`
- `QMargins contentsMargins(void)`
- `QRect contentsRect(void)`
- `void getContentsMargins(int *left, int *top, int *right, int *bottom)`
- `bool isEnabled(void)`
- `QWidget *menuBar(void)`
- `QWidget *parentWidget(void)`

- void removeItem(QLayoutItem *item)
- void removeWidget(QWidget *widget)
- bool setAlignment(QWidget *w, Qt::Alignment alignment)
- void setAlignment_2(Qt::Alignment alignment)
- bool setAlignment_3(QLayout *l, Qt::Alignment alignment)
- void setContentsMargins(int left, int top, int right, int bottom)
- void setContentsMargins_2(QMargins margins)
- void setEnabled(bool enable)
- void setMenuBar(QWidget *widget)
- void setSizeConstraint(QLayout::SizeConstraint)
- void setSpacing(int)
- QLayout::SizeConstraint sizeConstraint(void)
- int spacing(void)
- void update(void)
- QSize closestAcceptableSize(QWidget * widget, QSize size)

92.194 QLegend Class

C++ Reference : <http://doc.qt.io/qt-5/qlegend.html>

Parent Class : QGraphicsWidget

- Qt::Alignment alignment(void)
- void attachToChart(void)
- QColor borderColor(void)
- QBrush brush(void)
- QColor color(void)
- void detachFromChart(void)
- QFont font(void)
- bool isAttachedToChart(void)
- bool isBackgroundVisible(void)
- QBrush labelBrush(void)
- QColor labelColor(void)
- QLegend::MarkerShape markerShape(void)
- QList<QLegendMarker *> markers(QAbstractSeries *series)
- QPen pen(void)
- bool reverseMarkers(void)
- void setAlignment(Qt::Alignment alignment)

- void setBackgroundVisible(bool visible)
- void setBorderColor(QColor color)
- void setBrush(QBrush brush)
- void setColor(QColor color)
- void setFont(QFont font)
- void setLabelBrush(QBrush brush)
- void setLabelColor(QColor color)
- void setMarkerShape(QLegend::MarkerShape shape)
- void setPen(QPen pen)
- void setReverseMarkers(bool reverseMarkers)
- void setShowToolTips(bool show)
- bool showToolTips(void)

92.195 QLegendMarker Class

C++ Reference : <http://doc.qt.io/qt-5/qlegendmarker.html>

Parameters : void

Parent Class : QObject

- QBrush brush(void)
- QFont font(void)
- bool isVisible(void)
- QString label(void)
- QBrush labelBrush(void)
- QPen pen(void)
- QAbstractSeries * series(void)
- void setBrush(QBrush brush)
- void setFont(QFont font)
- void setLabel(QString label)
- void setLabelBrush(QBrush brush)
- void setPen(QPen pen)
- void setShape(QLegend::MarkerShape shape)
- void setVisible(bool visible)
- QLegend::MarkerShape shape(void)
- void setbrushChangedEvent(const char *)
- void setclickedEvent(const char *)
- void setfontChangedEvent(const char *)

- void sethoveredEvent(const char *)
- void setlabelBrushChangedEvent(const char *)
- void setlabelChangedEvent(const char *)
- void setpenChangedEvent(const char *)
- void setshapeChangedEvent(const char *)
- void setvisibleChangedEvent(const char *)
- const char *getbrushChangedEvent(void)
- const char *getclickedEvent(void)
- const char *getfontChangedEvent(void)
- const char *gethoveredEvent(void)
- const char *getlabelBrushChangedEvent(void)
- const char *getlabelChangedEvent(void)
- const char *getpenChangedEvent(void)
- const char *getshapeChangedEvent(void)
- const char *getvisibleChangedEvent(void)

92.196 QLibraryInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qlibraryinfo.html>

Parameters : void

- bool isDebugBuild(void)
- QVersionNumber version(void)

92.197 QLineEdit Class

C++ Reference : <http://doc.qt.io/qt-5/qlineedit.html>

Parameters : QWidget *

Parent Class : QWidget

- int alignment(void)
- void backspace(void)
- QCompleter *completer(void)
- QMenu *createStandardContextMenu(void)
- void cursorBackward(bool mark, int steps)
- void cursorForward(bool mark, int steps)
- int cursorMoveStyle(void)
- int cursorPosition(void)
- int cursorPositionAt(QPoint)

- void cursorWordBackward(bool mark)
- void cursorWordForward(bool mark)
- void del(void)
- void deselect(void)
- QString displayText(void)
- bool dragEnabled(void)
- int echoMode(void)
- void end(bool mark) # In RingQt use : void endtext(bool mark)
- bool hasAcceptableInput(void)
- bool hasFrame(void)
- bool hasSelectedText(void)
- void home(bool mark)
- QString inputMask(void)
- void insert(QString)
- bool isModified(void)
- bool isReadOnly(void)
- bool isRedoAvailable(void)
- bool isUndoAvailable(void)
- int maxLength(void)
- QString placeholderText(void)
- QString selectedText(void)
- int selectionStart(void)
- void setAlignment(Qt::AlignmentFlag flag)
- void setCompleter(QCompleter *c)
- void setCursorMoveStyle(Qt::CursorMoveStyle style)
- void setCursorPosition(int)
- void setDragEnabled(bool b)
- void setEchoMode(QLLineEdit::EchoMode)
- void setFrame(bool)
- void setInputMask(QString)
- void setMaxLength(int)
- void setModified(bool)
- void setPlaceholderText(QString)
- void setReadOnly(bool)
- void setSelection(int start, int length)
- void setTextMargins(int left, int top, int right, int bottom)

- void setValidator(QValidator *v)
- QString text(void)
- QMargins textMargins(void)
- QValidator *validator(void)
- void clear(void)
- void copy(void)
- void cut(void)
- void paste(void)
- void redo(void)
- void selectAll(void)
- void setText(QString)
- void undo(void)
- void setTextChangedEvent(const char *)
- void setcursorPositionChangedEvent(const char *)
- void seteditingFinishedEvent(const char *)
- void setreturnPressedEvent(const char *)
- void setselectionChangedEvent(const char *)
- void settextEditedEvent(const char *)
- const char *getTextChangedEvent(void)
- const char *getcursorPositionChangedEvent(void)
- const char *geteditingFinishedEvent(void)
- const char *getreturnPressedEvent(void)
- const char *getselectionChangedEvent(void)
- const char *gettextEditedEvent(void)

92.198 QLineF Class

C++ Reference : <http://doc.qt.io/qt-5/qlinef.html>

Parameters : qreal,qreal,qreal,qreal

- QPointF p2(void)
- qreal x1(void)
- qreal x2(void)
- qreal y1(void)
- qreal y2(void)
- qreal angle(void)
- qreal angleTo(QLineF line)

- QPointF center(void)
- qreal dx(void)
- qreal dy(void)
- QLineF::IntersectionType intersects(QLineF line, QPointF *intersectionPoint)
- boolisNull(void)
- qreal length(void)
- QLineF normalVector(void)
- QPointF pointAt(qreal t)
- void setP1(QPointF p1)
- void setP2(QPointF p2)
- void setAngle(qreal angle)
- void setLength(qreal length)
- void setLine(qreal x1, qreal y1, qreal x2, qreal y2)
- void setPoints(QPointF p1, QPointF p2)
- QLine toLine(void)
- void translate(QPointF offset)
- void translate_2(qreal dx, qreal dy)
- QLineF translated(QPointF offset)
- QLineF translated_2(qreal dx, qreal dy)

92.199 QLineSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qlineseries.html>

Parameters : QObject *

Parent Class : QXYSeries

- QAbstractSeries::SeriesType type(void)

92.200 QLinearGradient Class

C++ Reference : <http://doc.qt.io/qt-5/qlineargradient.html>

Parameters : void

Parent Class : QGradient

- QPointF finalStop(void)
- void setFinalStop(QPointF stop)
- void setFinalStop_2(qreal x,qreal y)
- void setStart(QPointF start)
- void setStart_2(qreal x,qreal y)

- QPointF start(void)

92.201 QListview Class

C++ Reference : <http://doc.qt.io/qt-5/qlistview.html>

Parameters : QWidget *

Parent Class : QAbstractItemView

- int batchSize(void)
- void clearPropertyFlags(void)
- QListview::Flow flow(void)
- QSize gridSize(void)
- bool isRowHidden(int row)
- bool isSelectionRectVisible(void)
- bool isWrapping(void)
- QListview::LayoutMode layoutMode(void)
- int modelColumn(void)
- QListview::Movement movement(void)
- QListview::ResizeMode resizeMode(void)
- void setBatchSize(int batchSize)
- void setFlow(QListview::Flow flow)
- void setGridSize(QSize size)
- void setLayoutMode(QListview::LayoutMode mode)
- void setModelColumn(int column)
- void setMovement(QListview::Movement movement)
- void setResizeMode(QListview::ResizeMode mode)
- void setRowHidden(int row, bool hide)
- void setSelectionRectVisible(bool show)
- void setSpacing(int space)
- void setUniformItemSizes(bool enable)
- void setViewMode(QListview::ViewMode mode)
- void setWordWrap(bool on)
- void setWrapping(bool enable)
- int spacing(void)
- bool uniformItemSizes(void)
- QListview::ViewMode viewMode(void)
- bool wordWrap(void)

92.202 QListWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qlistwidget.html>

Parameters : QWidget *

Parent Class : QListView

- void addItem(QString)
- void editItem(QListWidgetItem *item)
- bool isSortingEnabled(void)
- QListWidgetItem *item(int row)
- QListWidgetItem *itemAt(int x, int y)
- QWidget *itemWidget(QListWidgetItem *item)
- void openPersistentEditor(QListWidgetItem *item)
- void removeItemWidget(QListWidgetItem *item)
- int row(QListWidgetItem *item)
- void setCurrentRow(int row, QItemSelectionModel::SelectionFlag command)
- void setItemWidget(QListWidgetItem *item, QWidget *widget)
- void setSortingEnabled(bool enable)
- void sortItems(Qt::SortOrder order)
- QListWidgetItem *takeItem(int row)
- QRect visualItemRect(QListWidgetItem *item)
- void clear(void)
- void scrollToItem(QListWidgetItem *item, QAbstractItemView::ScrollHint hint)
- void setcurrentItemChangedEvent(const char *)
- void setcurrentRowChangedEvent(const char *)
- void setcurrentTextChangedEvent(const char *)
- void setitemActivatedEvent(const char *)
- void setitemChangedEvent(const char *)
- void setitemClickedEvent(const char *)
- void setitemDoubleClickedEvent(const char *)
- void setitemEnteredEvent(const char *)
- void setitemPressedEvent(const char *)
- void setitemSelectionChangedEvent(const char *)
- const char *getcurrentItemChangedEvent(void)
- const char *getcurrentRowChangedEvent(void)
- const char *getcurrentTextChangedEvent(void)
- const char *getitemActivatedEvent(void)

- const char *getitemChangedEvent(void)
- const char *getitemClickedEvent(void)
- const char *getitemDoubleClickedEvent(void)
- const char *getitemEnteredEvent(void)
- const char *getitemPressedEvent(void)
- const char *getitemSelectionChangedEvent(void)

92.203 QListWidgetItem Class

C++ Reference : <http://doc.qt.io/qt-5/qlistwidgetitem.html>

Parameters : void

- QBrush background(void)
- Qt::CheckState checkState(void)
- Qt::ItemFlags flags(void)
- QFont font(void)
- QBrush foreground(void)
- QIcon icon(void)
- bool isHidden(void)
- bool isSelected(void)
- QListWidget *listWidget(void)
- void setBackground(QBrush brush)
- void setCheckState(Qt::CheckState state)
- void setFlags(Qt::ItemFlags flags)
- void setFont(QFont font)
- void setForeground(QBrush brush)
- void setHidden(bool hide)
- void setIcon(QIcon icon)
- void setSelected(bool select)
- void setSizeHint(QSize size)
- void setStatusTip(QString statusTip)
- void setText(QString text)
- void setTextAlignment(int alignment)
- void setToolTip(QString toolTip)
- void setWhatsThis(QString whatsThis)
- QSize sizeHint(void)
- QString statusTip(void)

- `QString text(void)`
- `int textAlignment(void)`
- `QString toolTip(void)`
- `int type(void)`
- `QString whatsThis(void)`

92.204 QLocale Class

C++ Reference : <http://doc.qt.io/qt-5/qlocale.html>

Parameters : `QString`

- `QString amText(void)`
- `QString bcp47Name(void)`
- `QString createSeparatedList(QStringList list)`
- `QString currencySymbol(QLocale::CurrencySymbolFormat format)`
- `QString dateFormat(QLocale::FormatType format)`
- `QString dateTimeFormat(QLocale::FormatType format)`
- `QString dayName(int day, QLocale::FormatType type)`
- `QChar decimalPoint(void)`
- `QChar exponential(void)`
- `Qt::DayOfWeek firstDayOfWeek(void)`
- `QLocale::Language language(void)`
- `QLocale::MeasurementSystem measurementSystem(void)`
- `QString monthName(int month, QLocale::FormatType type)`
- `QString name(void)`
- `QString nativeCountryName(void)`
- `QString nativeLanguageName(void)`
- `QChar negativeSign(void)`
- `QLocale::NumberOptions numberOptions(void)`
- `QChar percent(void)`
- `QString pmText(void)`
- `QChar positiveSign(void)`
- `QString quoteString(QString str, QLocale::QuotationStyle style)`
- `QString quoteString_2(QStringRef str, QLocale::QuotationStyle style)`
- `QLocale::Script script(void)`
- `void setNumberOptions(QLocale::NumberOptions options)`
- `QString standaloneDayName(int day, QLocale::FormatType type)`

- `QString standaloneMonthName(int month, QLocale::FormatType type)`
- `Qt::LayoutDirection textDirection(void)`
- `QString timeFormat(QLocale::FormatType format)`
- `doubletoDouble_2(QStringRef s, bool *ok)`
- `floattoFloat(QString s, bool *ok)`
- `floattoFloat_2(QStringRef s, bool *ok)`
- `inttoInt(QString s, bool *ok)`
- `inttoInt_2(QStringRef s, bool *ok)`
- `qlonglongtoLongLong(QString s, bool *ok)`
- `qlonglongtoLongLong_2(QStringRef s, bool *ok)`
- `QStringtoLowerCase(QString str)`
- `shorttoShort(QString s, bool *ok)`
- `shorttoShort_2(QStringRef s, bool *ok)`
- `QStringtoString(qlonglong i)`
- `QStringtoString_2(qulonglong i)`
- `QStringtoString_4(short i)`
- `QStringtoString_5(ushort i)`
- `QStringtoString_6(int i)`
- `QStringtoString_7(uint i)`
- `QStringtoString_8(double i, char f, int prec)`
- `QStringtoString_9(float i, char f, int prec)`
- `QStringtoString_10(QDate date, QString format)`
- `QStringtoString_11(QTime time, QString format)`
- `QStringtoString_12(QDateTime dateTime, QString format)`
- `QStringtoString_13(QDate date, QLocale::FormatType format)`
- `QStringtoString_14(QTime time, QLocale::FormatType format)`
- `QStringtoString_15(QDateTime dateTime, QLocale::FormatType format)`
- `QTimetotime(QString string, QLocale::FormatType format)`
- `QTimetotime_2(QString string, QString format)`
- `uinttoUInt(QString s, bool *ok)`
- `uinttoUInt_2(QStringRef s, bool *ok)`
- `qulonglongtoULongLong(QString s, bool *ok)`
- `qulonglongtoULongLong_2(QStringRef s, bool *ok)`
- `ushorttoUShort(QString s, bool *ok)`
- `ushorttoUShort_2(QStringRef s, bool *ok)`
- `QStringtoUpperCase(QString str)`

- QStringList uiLanguages(void)
- QList<Qt::DayOfWeek> weekdays(void)
- QChar zeroDigit(void)
- QLocale c(void)
- QString countryToString(QLocale::Country country)
- QString languageToString(QLocale::Language language)
- QList<QLocale> matchingLocales(QLocale::Language language, QLocale::Script script, QLocale::Country country)
- QString scriptToString(QLocale::Script script)
- void setDefault(QLocale locale)
- QLocale system(void)

92.205 QLogValueAxis Class

C++ Reference : <http://doc.qt.io/qt-5/qlogvalueaxis.html>

Parameters : QObject *

Parent Class : QAbstractAxis

- qreal base(void)
- QString labelFormat(void)
- qreal max(void)
- qreal min(void)
- int minorTickCount(void)
- void setBase(qreal base)
- void setLabelFormat(QString format)
- void setMax(qreal max)
- void setMin(qreal min)
- void setMinorTickCount(int minorTickCount)
- void setRange(qreal min, qreal max)
- int tickCount(void)
- void setbaseChangedEvent(const char *)
- void setlabelFormatChangedEvent(const char *)
- void setmaxChangedEvent(const char *)
- void setminChangedEvent(const char *)
- void setminorTickCountChangedEvent(const char *)
- void setrangeChangedEvent(const char *)
- void settickCountChangedEvent(const char *)
- const char *getbaseChangedEvent(void)

- const char *getlabelFormatChangedEvent(void)
- const char *getmaxChangedEvent(void)
- const char *getminChangedEvent(void)
- const char *getminorTickCountChangedEvent(void)
- const char *getrangeChangedEvent(void)
- const char *gettickCountChangedEvent(void)

92.206 QLogicAspect Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dlogic-qlogicaspect.html>

Parameters : QObject *

Parent Class : QAbstractAspect

92.207 QMainWindow Class

C++ Reference : <http://doc.qt.io/qt-5/qmainwindow.html>

Parameters : void

Parent Class : QWidget

- void addDockWidget(Qt::DockWidgetArea area, QDockWidget *dockwidget, Qt::Orientation orientation)
- QToolBar *addToolBar(QString)
- void addToolBar_2(Qt::ToolBarArea area, QToolBar *toolbar)
- void addToolBarBreak(Qt::ToolBarArea)
- QWidget *centralWidget(void)
- int corner(Qt::Corner corner)
- QMenu *createPopupMenu(void)
- int dockOptions(void)
- int dockWidgetArea(QDockWidget *dockwidget)
- bool documentMode(void)
- QSize iconSize(void)
- void insertToolBar(QToolBar *before, QToolBar *toolbar)
- void insertToolBarBreak(QToolBar *before)
- bool isAnimated(void)
- bool isDockNestingEnabled(void)
- QMenuBar *menuBar(void)
- QWidget *menuWidget(void)
- void removeDockWidget(QDockWidget *dockwidget)
- void removeToolBar(QToolBar *toolbar)

- void removeToolBarBreak(QToolBar *before)
- bool restoreDockWidget(QDockWidget *dockwidget)
- bool restoreState(QByteArray state, int version)
- QByteArray saveState(int version)
- void setCentralWidget(QWidget *widget)
- void setCorner(Qt::Corner corner, Qt::DockWidgetArea area)
- void setDockOptions(QMainWindow::DockOption options)
- void setDocumentMode(bool enabled)
- void setIconSize(QSize)
- void setMenuBar(QMenuBar *menuBar)
- void setMenuWidget(QWidget *menuBar)
- void setStatusBar(QStatusBar *statusbar)
- void setTabPosition(Qt::DockWidgetArea areas, QTabWidget::TabPosition tabPosition)
- void setTabShape(QTabWidget::TabShape tabShape)
- void setToolButtonStyle(Qt::ToolButtonStyle toolButtonStyle)
- void setUnifiedTitleAndToolBarOnMac(bool set)
- void splitDockWidget(QDockWidget *first, QDockWidget *second, Qt::Orientation orientation)
- QStatusBar *statusBar(void)
- int tabPosition(Qt::DockWidgetArea area)
- int tabShape(void)
- void tabifyDockWidget(QDockWidget *first, QDockWidget *second)
- int toolBarArea(QToolBar *toolbar)
- bool toolBarBreak(QToolBar *toolbar)
- int toolButtonStyle(void)
- bool unifiedTitleAndToolBarOnMac(void)

92.208 QMaterial Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qmaterial.html>

Parameters : Qt3DCore::QNode *

Parent Class : QComponent

- void addParameter(Qt3DRender::QParameter *parameter)
- Qt3DRender::QEFFECT * effect(void)
- QVector<Qt3DRender::QParameter *> parameters(void)
- void removeParameter(Qt3DRender::QParameter *parameter)
- void setEffect(Qt3DRender::QEFFECT *effect)

92.209 QMatrix4x4 Class

Parameters : qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal,qreal

- QVector4D column(int index)
- qreal * constData(void)
- qreal * data_2(void)
- qreal determinant(void)
- void fill(qreal value)
- void flipCoordinates(void)
- void frustum(qreal left, qreal right, qreal bottom, qreal top, qreal nearPlane, qreal farPlane)
- QMatrix4x4 inverted(bool * invertible)
- bool isIdentity(void)
- void lookAt(QVector3D eye, QVector3D center, QVector3D up)
- QPoint map(QPoint point)
- QPointF map_2(QPointF point)
- QVector3D map_3(QVector3D point)
- QVector4D map_4(QVector4D point)
- QRect mapRect(QRect rect)
- QRectF mapRect_2(QRectF rect)
- QVector3D mapVector(QVector3D vector)
- QMatrix3x3 normalMatrix(void)
- void optimize(void)
- void ortho(qreal left, qreal right, qreal bottom, qreal top, qreal nearPlane, qreal farPlane)
- void ortho_2(QRect rect)
- void ortho_3(QRectF rect)
- void perspective(qreal angle, qreal aspect, qreal nearPlane, qreal farPlane)
- void rotate(qreal angle, QVector3D vector)
- void rotate_2(QQuaternion quaternion)
- void rotate_3(qreal angle, qreal x, qreal y, qreal z)
- QVector4D row(int index)
- void scale(QVector3D vector)
- void scale_2(qreal x, qreal y)
- void scale_3(qreal x, qreal y, qreal z)
- void scale_4(qreal factor)
- void setColumn(int index, QVector4D value)
- void setRow(int index, QVector4D value)

- void setToIdentity(void)
- QTransform toTransform_2(qreal distanceToPlane)
- void translate(QVector3D vector)
- void translate_2(qreal x, qreal y)
- void translate_3(qreal x, qreal y, qreal z)
- QMatrix4x4 transposed(void)

92.210 QMdiArea Class

C++ Reference : <http://doc.qt.io/qt-5/qmdiarea.html>

Parameters : QWidget *

Parent Class : QAbstractScrollArea

- QMdiArea::WindowOrder activationOrder(void)
- QMdiSubWindow * activeSubWindow(void)
- QMdiSubWindow * addSubWindow(QWidget * widget, Qt::WindowFlags windowFlags)
- QBrush background(void)
- QMdiSubWindow * currentSubWindow(void)
- bool documentMode(void)
- void removeSubWindow(QWidget * widget)
- void setActivationOrder(QMdiArea::WindowOrder order)
- void setBackground(QBrush background)
- void setDocumentMode(bool enabled)
- void setOption(QMdiArea::AreaOption option, bool on)
- void setTabPosition(QTabWidget::TabPosition position)
- void setTabShape(QTabWidget::TabShape shape)
- void setTabsClosable(bool closable)
- void setTabsMovable(bool movable)
- void setViewMode(QMdiArea::ViewMode mode)
- QList<QMdiSubWindow *> subWindowList(QMdiArea::WindowOrder order)
- QTabWidget::TabPosition tabPosition(void)
- QTabWidget::TabShape tabShape(void)
- bool tabsClosable(void)
- bool tabsMovable(void)
- bool testOption(QMdiArea::AreaOption option)
- QMdiArea::ViewMode viewMode(void)
- void activateNextSubWindow(void)

- void activatePreviousSubWindow(void)
- void cascadeSubWindows(void)
- void closeActiveSubWindow(void)
- void closeAllSubWindows(void)
- void setActiveSubWindow(QMdiSubWindow * window)
- void tileSubWindows(void)

92.211 QMdiSubWindow Class

C++ Reference : <http://doc.qt.io/qt-5/qmdisubwindow.html>

Parameters : QWidget *

Parent Class : QWidget

- bool isShaded(void)
- int keyboardPageStep(void)
- int keyboardSingleStep(void)
- QMdiArea * mdiArea(void)
- void setKeyboardPageStep(int step)
- void setKeyboardSingleStep(int step)
- void setOption(QMdiSubWindow::SubWindowOption option, bool on)
- void setSystemMenu(QMenu * systemMenu)
- void setWidget(QWidget * widget)
- QMenu * systemMenu(void)
- bool testOption(QMdiSubWindow::SubWindowOption option)
- QWidget * widget(void)
- void showShaded(void)
- void showSystemMenu(void)

92.212 QMediaObject Class

C++ Reference : <http://doc.qt.io/qt-5/qmediaobject.html>

Parameters : void

Parent Class : QWidget

- QStringList availableMetaData(void)
- bool isMetaDataAvailable(void)
- QVariant metaData(QString key)
- int notifyInterval(void)
- void setNotifyInterval(int milliSeconds)

92.213 QMediaPlayer Class

C++ Reference : <http://doc.qt.io/qt-5/qmediaplayer.html>

Parameters : void

- int bufferStatus(void)
- QMediaContent currentMedia(void)
- int duration(void)
- int error(void)
- QString errorString(void)
- bool isAudioAvailable(void)
- bool isMuted(void)
- bool isSeekable(void)
- bool isVideoAvailable(void)
- QMediaContent media(void)
- int mediaStatus(void)
- QIODevice *mediaStream(void)
- qreal playbackRate(void)
- QMediaPlaylist *playlist(void)
- int position(void)
- void setVideoOutput(QVideoWidget *output)
- int state(void)
- int volume(void)
- void pause(void)
- void play(void)
- void setMedia(QUrl)
- void setMuted(bool muted)
- void setPlaybackRate(qreal rate)
- void setPlaylist(QMediaPlaylist *playlist)
- void setPosition(int position)
- void setVolume(int volume)
- void stop(void)

92.214 QMediaPlaylist Class

C++ Reference : <http://doc.qt.io/qt-5/qmediaplaylist.html>

Parameters : void

- int currentIndex(void)
- QMediaContent currentMedia(void)
- int error(void)
- QString errorString(void)
- bool insertMedia(int pos, QMediaContent)
- bool isReadOnly(void)
- QMediaContent media(int index)
- int mediaCount(void)
- int nextIndex(int steps)
- int playbackMode(void)
- int previousIndex(int steps)
- bool save(QUrl, const char * format)
- void next(void) # In RingQt use : void movenext(void)
- void previous(void)
- void setCurrentIndex(int playlistPosition)
- void shuffle(void)

92.215 QMenu Class

C++ Reference : <http://doc.qt.io/qt-5/qmenu.html>

Parameters : QWidget *

Parent Class : QWidget

- QAction *actionAt(QPoint)
- QRect actionGeometry(QAction *act)
- QAction *activeAction(void)
- void addAction(QAction *)
- QMenu *addMenu(QString)
- QAction *addSeparator(void)
- void clear(void)
- QAction *defaultAction(void)
- QAction *exec(const QPoint &)
- QAction *exec_2(void)
- QAction *exec_3(const QPoint &,QAction *)

- void hideTearOffMenu(void)
- QIcon icon(void)
- QAction *insertMenu(QAction *before, QMenu *menu)
- QAction *insertSeparator(QAction *before)
- bool isEmpty(void)
- bool isTearOffEnabled(void)
- bool isTearOffMenuVisible(void)
- QAction *menuAction(void)
- void popup(QPoint, QAction *atAction)
- bool separatorsCollapsible(void)
- void setActiveAction(QAction *act)
- void setDefaultAction(QAction *act)
- void setIcon(QIcon)
- void setSeparatorsCollapsible(bool collapse)
- void setTearOffEnabled(bool)
- void setTitle(QString)
- QString title(void)

92.216 QMenuBar Class

C++ Reference : <http://doc.qt.io/qt-5/qmenubar.html>

Parameters : QWidget *

Parent Class : QWidget

- QAction *actionAt(QPoint)
- QRect actionGeometry(QAction *act)
- QAction *activeAction(void)
- QAction *addAction(QString)
- QAction *addSeparator(void)
- void clear(void)
- QWidget *cornerWidget(Qt::Corner)
- QAction *insertSeparator(QAction *before)
- bool isDefaultUp(void)
- bool isNativeMenuBar(void)
- void setActiveAction(QAction *act)
- void setCornerWidget(QWidget *widget, Qt::Corner)
- void setNativeMenuBar(bool nativeMenuBar)

92.217 QMesh Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qmesh.html>

Parameters : Qt3DCore::QNode *

- QString meshName(void)
- QUrl source(void)
- Qt3DRender::QMesh::Status status(void)
- void setMeshName(QString meshName)
- void setSource(QUrl source)

92.218 QMessageBox Class

C++ Reference : <http://doc.qt.io/qt-5/qmessagebox.html>

Parameters : QWidget *parent

Parent Class : QDialog

- void addButton(QAbstractButton *button, QMessageBox::ButtonRole role)
- QAbstractButton *button(QMessageBox::StandardButton which)
- int buttonRole(QAbstractButton *button)
- QAbstractButton *clickedButton(void)
- QPushbutton *defaultButton(void)
- QString detailedText(void)
- QAbstractButton *escapeButton(void)
- QPixmap iconPixmap(void)
- QString informativeText(void)
- void open(QObject *receiver, const char *member)
- void removeButton(QAbstractButton *button)
- void setDefaultButton(QPushbutton *button)
- void setDetailedText(QString)
- void setEscapeButton(QAbstractButton *button)
- void setIcon(QMessageBox::Icon)
- void setIconPixmap(QPixmap)
- void setInformativeText(QString)
- void setStandardButtons(QMessageBox::StandardButton buttons)
- void setText(QString)
- void setTextFormat(Qt::TextFormat format)
- void setWindowModality(Qt::WindowModality windowModality)
- void setWindowTitle(QString)

- int standardButton(QAbstractButton *button)
- int standardButtons(void)
- QString text(void)
- int textFormat(void)
- int exec(void)
- void about(QWidget *parent, QString,QString)
- void aboutQt(QWidget *parent, QString)
- int critical(QWidget * parent, QString , QString, int buttons, int defaultButton)
- int information(QWidget * parent, QString ,QString, int buttons,int defaultButton)
- int question(QWidget * parent,QString,QString, int buttons ,int defaultButton)
- int warning(QWidget *parent, QString,QString, int buttons,int defaultButton)

92.219 QMetalRoughMaterial Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qmetalroughmaterial.html>

Parameters : Qt3DCore::QNode *

- QVariant ambientOcclusion(void)
- QVariant baseColor(void)
- QVariant metalness(void)
- QVariant normal(void)
- QVariant roughness(void)
- float textureScale(void)
- void setAmbientOcclusion(QVariant ambientOcclusion)
- void setBaseColor(QVariant baseColor)
- void setMetalness(QVariant metalness)
- void setNormal(QVariant normal)
- void setRoughness(QVariant roughness)
- void setTextureScale(float textureScale)

92.220 QMimeData Class

C++ Reference : <http://doc.qt.io/qt-5/qmimedata.html>

Parameters : void

Parent Class : QObject

- void clear(void)
- QVariant colorData(void)
- QByteArray data(QString mimeType)

- QStringList formats(void)
- bool hasColor(void)
- bool hasFormat(QString mimeType)
- bool hasHtml(void)
- bool hasImage(void)
- bool hasText(void)
- bool hasUrls(void)
- QString html(void)
- QVariant imageData(void)
- void removeFormat(QString mimeType)
- void setColorData(QVariant color)
- void setData(QString mimeType, QByteArray data)
- void setHtml(QString html)
- void setImageData(QVariant image)
- void setText(QString text)
- void setUrls(QList<QUrl> urls)
- QString text(void)
- QList<QUrl> urls(void)

92.221 QModelIndex Class

C++ Reference : <http://doc.qt.io/qt-5/qmodelindex.html>

Parameters : void

- int column(void)
- QVariant data(int role)
- Qt::ItemFlags flags(void)
- quintptr internalId(void)
- void * internalPointer(void)
- bool isValid(void)
- QAbstractItemModel * model(void)
- QModelIndex parent(void)
- int row(void)
- QModelIndex sibling(int row, int column)
- QModelIndex siblingAtColumn(int column)
- QModelIndex siblingAtRow(int row)

92.222 QMorphPhongMaterial Class

C++ Reference : <http://doc.qt.io/qt-5/qmorphphongmaterial.html>

Parameters : Qt3DCore::QNode *

- QColor ambient(void)
- QColor diffuse(void)
- float interpolator(void)
- float shininess(void)
- QColor specular(void)
- void setAmbient(QColor ambient)
- void setDiffuse(QColor diffuse)
- void setInterpolator(float interpolator)
- void setShininess(float shininess)
- void setSpecular(QColor specular)

92.223 QMovie Class

C++ Reference : <http://doc.qt.io/qt-5/qmovie.html>

Parameters : QObject *

Parent Class : QObject

- QColor backgroundColor(void)
- QMovie::CacheMode cacheMode(void)
- int currentFrameNumber(void)
- QImage currentImage(void)
- QPixmap currentPixmap(void)
- QIODevice * device(void)
- QString fileName(void)
- QByteArray format(void)
- int frameCount(void)
- QRect frameRect(void)
- bool isValid(void)
- bool jumpToFrame(int frameNumber)
- int nextFrameDelay(void)
- QSize scaledSize(void)
- void setBackgroundColor(QColor color)
- void setCacheMode(QMovie::CacheMode mode)
- void setDevice(QIODevice *device)

- void setFileName(QString fileName)
- void setFormat(QByteArray format)
- void setScaledSize(QSize size)
- int speed(void)
- QMovie::MovieState state(void)
- bool jumpToNextFrame(void)
- void setPaused(bool paused)
- void setSpeed(int percentSpeed)
- void start(void)
- void stop(void)
- void seterrorEvent(const char *)
- void setfinishedEvent(const char *)
- void setframeChangedEvent(const char *)
- void setresizedEvent(const char *)
- void setstartedEvent(const char *)
- void setstateChangedEvent(const char *)
- void setupdatedEvent(const char *)
- const char *geterrorEvent(void)
- const char *getfinishedEvent(void)
- const char *getframeChangedEvent(void)
- const char *getresizedEvent(void)
- const char *getstartedEvent(void)
- const char *getstateChangedEvent(void)
- const char *getupdatedEvent(void)

92.224 QMutex Class

C++ Reference : <http://doc.qt.io/qt-5/qmutex.html>

Parameters : QMutex::RecursionMode

- bool isRecursive(void)
- void lock(void)
- void unlock(void)

92.225 QMutexLocker Class

C++ Reference : <http://doc.qt.io/qt-5/qmutexlocker.html>

Parameters : QMutex *

- QMutex * mutex(void)
- void relock(void)
- void unlock(void)

92.226 QNetworkAccessManager Class

C++ Reference : <http://doc.qt.io/qt-5/qnetworkaccessmanager.html>

Parameters : QObject *

Parent Class : QObject

- void setfinishedEvent(const char *)
- const char *getfinishedEvent(void)
- QNetworkConfiguration activeConfiguration(void)
- QAbstractNetworkCache *cache(void)
- void clearAccessCache(void)
- QNetworkConfiguration configuration(void)
- void connectToHost(QString, quint16)
- QNetworkReply *deleteResource(QNetworkRequest)
- QNetworkReply *get(QNetworkRequest) # In RingQt use : QNetworkReply *getvalue(QNetworkRequest)
- QNetworkReply *head(QNetworkRequest)
- QNetworkAccessManager::NetworkAccessibility networkAccessible(void)
- QNetworkReply *post(QNetworkRequest, QByteArray)
- QNetworkProxy proxy(void)
- QNetworkProxyFactory *proxyFactory(void)
- QNetworkReply *put(QNetworkRequest, QByteArray) # In RingQt use : QNetworkReply *putvalue(QNetworkRequest, QByteArray)
- QNetworkReply *sendCustomRequest(QNetworkRequest, QByteArray, QIODevice *)
- void setCache(QAbstractNetworkCache *cache)
- void setConfiguration(QNetworkConfiguration)
- void setCookieJar(QNetworkCookieJar *cookieJar)
- void setNetworkAccessible(QNetworkAccessManager::NetworkAccessibility accessible)
- void setProxy(QNetworkProxy)
- void setProxyFactory(QNetworkProxyFactory *factory)
- QStringList supportedSchemes(void)

- void geteventparameters(void)

92.227 QNetworkProxy Class

C++ Reference : <http://doc.qt.io/qt-5/qnetworkproxy.html>

Parameters : void

- int capabilities(void)
- bool hasRawHeader(QByteArray headerName)
- QVariant header(QNetworkRequest::KnownHeaders header)
- QString hostName(void)
- bool isCachingProxy(void)
- bool isTransparentProxy(void)
- QString password(void)
- int port(void)
- QByteArray rawHeader(QByteArray headerName)
- void setCapabilities(QNetworkProxy::Capability capabilities)
- void setHeader(QNetworkRequest::KnownHeaders header, QVariant value)
- void setHostName(QString hostName)
- void setPassword(QString password)
- void setPort(int port)
- void setRawHeader(QByteArray headerName, QByteArray headerValue)
- void setType(QNetworkProxy::ProxyType type)
- void setUser(QString user)
- void swap(QNetworkProxy other)
- int type(void)
- QString user(void)
- QNetworkProxy applicationProxy(void)
- void setApplicationProxy(QNetworkProxy networkProxy)

92.228 QNetworkReply Class

C++ Reference : <http://doc.qt.io/qt-5/qnetworkreply.html>

Parameters : void

Parent Class : QIODevice

- QVariant attribute(QNetworkRequest::Attribute code)
- QNetworkReply::NetworkError error(void)
- bool hasRawHeader(QByteArray)

- QVariant header(QNetworkRequest::KnownHeaders header)
- bool isFinished(void)
- bool isRunning(void)
- QNetworkAccessManager *manager(void)
- QNetworkAccessManager::Operation operation(void)
- QByteArray rawHeader(QByteArray)
- qint64 readBufferSize(void)
- QNetworkRequest request(void)

92.229 QNetworkRequest Class

C++ Reference : <http://doc.qt.io/qt-5/qnetworkrequest.html>

Parameters : QUrl

- QVariant attribute(QNetworkRequest::Attribute, QVariant)
- bool hasRawHeader(QByteArray)
- QVariant header(QNetworkRequest::KnownHeaders)
- QObject *originatingObject(void)
- QNetworkRequest::Priority priority(void)
- QByteArray rawHeader(QByteArray)
- void setAttribute(QNetworkRequest::Attribute, QVariant)
- void setHeader(QNetworkRequest::KnownHeaders, QVariant)
- void setOriginatingObject(QObject *object)
- void setPriority(QNetworkRequest::Priority priority)
- void setRawHeader(QByteArray, QByteArray)
- void swap(QNetworkRequest)
- QUrl url(void)

92.230 QNmeaPositionInfoSource Class

C++ Reference : <http://doc.qt.io/qt-5/qnmeapositioninfosource.html>

Parameters : QNmeaPositionInfoSource::UpdateMode,QObject *

Parent Class : QGeoPositionInfoSource

- QIODevice * device(void)
- void setDevice(QIODevice * device)
- QNmeaPositionInfoSource::UpdateMode updateMode(void)

92.231 QNode Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dcore-qnode.html>

Parameters : Qt3DCore::QNode *

Parent Class : QObject

- bool blockNotifications(bool block)
- Qt3DCore::QNodeVector childNodes(void)
- void clearPropertyTracking(QString propertyName)
- void clearPropertyTrackings(void)
- Qt3DCore::QNode::PropertyTrackingMode defaultPropertyTrackingMode(void)
- Qt3DCore::QNodeId id(void)
- bool isEnabled(void)
- bool notificationsBlocked(void)
- Qt3DCore::QNode * parentNode(void)
- Qt3DCore::QNode::PropertyTrackingMode propertyTracking(QString propertyName)
- void setPropertyTracking(QString propertyName, Qt3DCore::QNode::PropertyTrackingMode trackMode)
- void setDefaultPropertyTrackingMode(Qt3DCore::QNode::PropertyTrackingMode mode)
- void setEnabled(bool isEnabled)
- void setParent(Qt3DCore::QNode *parent)

92.232 QObject Class

C++ Reference : <http://doc.qt.io/qt-5/qobject.html>

Parameters : void

- bool blockSignals(bool block)
- QObjectList children(void)
- void dumpObjectInfo(void)
- void dumpObjectTree(void)
- bool inherits(const char *className)
- void installEventFilter(QObject *filterObj)
- bool isWidgetType(void)
- void killTimer(int id)
- void moveToThread(QThread *targetThread)
- QString objectName(void)
- QObject *parent(void)
- QVariant property(const char *name)
- void removeEventFilter(QObject *obj)

- void setObjectName(QString)
- void setParent(QObject *parent)
- bool setProperty(const char *name, QVariant)
- bool setProperty_2(const char *name, int)
- bool setProperty_3(const char *name, float)
- bool setProperty_4(const char *name, double)
- bool setProperty_5(const char *name, QString)
- bool setProperty_int(const char *name, int)
- bool setProperty_float(const char *name, float)
- bool setProperty_double(const char *name, double)
- bool setProperty_string(const char *name, QString)
- bool signalsBlocked(void)
- int startTimer(int interval)
- QThread *thread(void)
- void deleteLater(void)

92.233 QObjectPicker Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qobjectpicker.html>

Parameters : Qt3DCore::QNode *

- bool containsMouse(void)
- bool isDragEnabled(void)
- bool isHoverEnabled(void)
- bool isPressed(void)
- void setDragEnabled(bool dragEnabled)
- void setHoverEnabled(bool hoverEnabled)
- void setclickedEvent(const char *)
- void setcontainsMouseChangedEvent(const char *)
- void setdragEnabledChangedEvent(const char *)
- void setenteredEvent(const char *)
- void setexitedEvent(const char *)
- void sethoverEnabledChangedEvent(const char *)
- void setmovedEvent(const char *)
- void setpressedEvent(const char *)
- void setpressedChangedEvent(const char *)
- void setreleasedEvent(const char *)

- const char *getclickedEvent(void)
- const char *getcontainsMouseEvent(void)
- const char *getdragEnabledChangedEvent(void)
- const char *getenteredEvent(void)
- const char *getexitedEvent(void)
- const char *gethoverEnabledChangedEvent(void)
- const char *getmovedEvent(void)
- const char *getpressedEvent(void)
- const char *getpressedChangedEvent(void)
- const char *getreleasedEvent(void)

92.234 QOpenGLBuffer Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglbuffer.html>

Parameters : void

- void allocate(void *data, int count)
- void allocate_2(int count)
- bool bind(void)
- GLuint bufferId(void)
- bool create(void)
- void destroy(void)
- bool isCreated(void)
- void * map(QOpenGLBuffer::Access access)
- void release(void)
- void setUsagePattern(QOpenGLBuffer::UsagePattern value)
- int size(void)
- QOpenGLBuffer::Type type(void)
- bool unmap(void)
- QOpenGLBuffer::UsagePattern usagePattern(void)
- void write(int offset, void *data, int count)
- void release_2(QOpenGLBuffer::Type type)

92.235 QOpenGLContext Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglcontext.html>

Parameters : QObject *

Parent Class : QObject

- bool create(void)
- GLuint defaultFramebufferObject(void)
- void doneCurrent(void)
- QSet<QByteArray> extensions(void)
- QOpenGLFunctions * functions(void)
- QFunctionPointer getProcAddress(QByteArray procName)
- QFunctionPointer getProcAddress_2(char *procName)
- bool hasExtension(QByteArray extension)
- bool isOpenGLES(void)
- bool isValid(void)
- bool makeCurrent(QSurface *surface)
- QVariant nativeHandle(void)
- QScreen * screen(void)
- void setFormat(QSurfaceFormat format)
- void setNativeHandle(QVariant handle)
- void setScreen(QScreen *screen)
- void setShareContext(QOpenGLContext *shareContext)
- QOpenGLContext * shareContext(void)
- QOpenGLContextGroup * shareGroup(void)
- QSurface * surface(void)
- void swapBuffers(QSurface *surface)
- QAbstractOpenGLFunctions * versionFunctions(QOpenGLVersionProfile versionProfile))
- TYPE * versionFunctions_2(void)
- bool areSharing(QOpenGLContext *first, QOpenGLContext *second)
- QOpenGLContext * currentContext(void)
- QOpenGLContext * globalShareContext(void)
- void * openGLModuleHandle(void)
- QOpenGLContext::OpenGLModuleType openGLModuleType(void)
- bool supportsThreadedOpenGL(void)
- QOpenGLFunctions_3_2_Core *opengl32(void)

92.236 QOpenGLDebugLogger Class

C++ Reference : <http://doc.qt.io/qt-5/qopengldebuglogger.html>

Parameters : QObject *

- void disableMessages(QOpenGLDebugMessage::Sources sources, QOpenGLDebugMessage::Types types, QOpenGLDebugMessage::Severities severities)
- void disableMessages_2(QVector<GLuint> ids, QOpenGLDebugMessage::Sources sources, QOpenGLDebugMessage::Types types)
- void enableMessages(QOpenGLDebugMessage::Sources sources, QOpenGLDebugMessage::Types types, QOpenGLDebugMessage::Severities severities)
- void enableMessages_2(QVector<GLuint> ids, QOpenGLDebugMessage::Sources sources, QOpenGLDebugMessage::Types types)
- bool initialize(void)
- bool isLogging(void)
- QList<QOpenGLDebugMessage> loggedMessages(void)
- QOpenGLDebugLogger::LoggingMode loggingMode(void)
- qint64 maximumMessageLength(void)
- void popGroup(void)
- void pushGroup(QString name, GLuint id, QOpenGLDebugMessage::Source source)
- void logMessage(QOpenGLDebugMessage debugMessage)
- void startLogging(QOpenGLDebugLogger::LoggingMode loggingMode)
- void stopLogging(void)

92.237 QOpenGLFramebufferObject Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglframebufferobject.html>

Parameters : int,int,GLenum

- bool bind(void)
- QOpenGLFramebufferObjectFormat format(void)
- GLuint handle(void)
- int height(void)
- bool isBound(void)
- bool isValid(void)
- bool release(void)
- void setAttachment(QOpenGLFramebufferObject::Attachment attachment)
- QSize size(void)
- QImage toImage(bool flipped)
- QImage toImage_3(bool flipped, int colorQOpenGLFramebufferObject::AttachmentIndex)

- QImage toImage_2(void)
- int width(void)
- bool bindDefault(void)
- bool hasOpenGLFramebufferObjects(void)

92.238 QOpenGLFunctions Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglfunctions.html>

Parameters : void

- void glActiveTexture(GLenum texture)
- void glAttachShader(GLuint program, GLuint shader)
- void glBindAttribLocation(GLuint program, GLuint index, char *name)
- void glBindBuffer(GLenum target, GLuint buffer)
- void glBindFramebuffer(GLenum target, GLuint framebuffer)
- void glBindRenderbuffer(GLenum target, GLuint renderbuffer)
- void glBindTexture(GLenum target, GLuint texture)
- void glBlendColor(GLclampf red, GLclampf green, GLclampf blue, GLclampf alpha)
- void glBlendEquation(GLenum mode)
- void glBlendEquationSeparate(GLenum modeRGB, GLenum modeAlpha)
- void glBlendFunc(GLenum sfactor, GLenum dfactor)
- void glBlendFuncSeparate(GLenum srcRGB, GLenum dstRGB, GLenum srcAlpha, GLenum dstAlpha)
- void glBufferData(GLenum target, qopengl_GLsizeiptr size, void *data, GLenum usage)
- void glBufferSubData(GLenum target, qopengl_GLintptr offset, qopengl_GLsizeiptr size, void *data)
- GLenum glCheckFramebufferStatus(GLenum target)
- void glClear(GLbitfield mask)
- void glClearColor(GLclampf red, GLclampf green, GLclampf blue, GLclampf alpha)
- void glClearDepthf(GLclampf depth)
- void glClearStencil(GLint s)
- void glColorMask(GLboolean red, GLboolean green, GLboolean blue, GLboolean alpha)
- void glCompileShader(GLuint shader)
- void glCompressedTexImage2D(GLenum target, GLint level, GLenum internalformat, GLsizei width, GLsizei height, GLint border, GLsizei imageSize, void *data)
- void glCompressedTexSubImage2D(GLenum target, GLint level, GLint xoffset, GLint yoffset, GLsizei width, GLsizei height, GLenum format, GLsizei imageSize, void *data)
- void glCopyTexImage2D(GLenum target, GLint level, GLenum internalformat, GLint x, GLint y, GLsizei width, GLsizei height, GLint border)
- void glCopyTexSubImage2D(GLenum target, GLint level, GLint xoffset, GLint yoffset, GLint x, GLint y, GLsizei width, GLsizei height)

- GLuint glCreateProgram(void)
- GLuint glCreateShader(GLenum type)
- void glCullFace(GLenum mode)
- void glDeleteBuffers(GLsizei n, GLuint *buffers)
- void glDeleteFramebuffers(GLsizei n, GLuint *framebuffers)
- void glDeleteProgram(GLuint program)
- void glDeleteRenderbuffers(GLsizei n, GLuint *renderbuffers)
- void glDeleteShader(GLuint shader)
- void glDeleteTextures(GLsizei n, GLuint *textures)
- void glDepthFunc(GLenum func)
- void glDepthMask(GLboolean flag)
- void glDepthRangef(GLclampf zNear, GLclampf zFar)
- void glDetachShader(GLuint program, GLuint shader)
- void glDisable(GLenum cap)
- void glDisableVertexAttribArray(GLuint index)
- void glDrawArrays(GLenum mode, GLint first, GLsizei count)
- void glDrawElements(GLenum mode, GLsizei count, GLenum type, GLvoid *indices)
- void glEnable(GLenum cap)
- void glEnableVertexAttribArray(GLuint index)
- void glFinish(void)
- void glFlush(void)
- void glFramebufferRenderbuffer(GLenum target, GLenum attachment, GLenum renderbuffertarget, GLuint renderbuffer)
- void glFramebufferTexture2D(GLenum target, GLenum attachment, GLenum textarget, GLuint texture, GLint level)
- void glFrontFace(GLenum mode)
- void glGenBuffers(GLsizei n, GLuint *buffers)
- void glGenFramebuffers(GLsizei n, GLuint *framebuffers)
- void glGenRenderbuffers(GLsizei n, GLuint *renderbuffers)
- void glGenTextures(GLsizei n, GLuint *textures)
- void glGenerateMipmap(GLenum target)
- void glGetActiveAttrib(GLuint program, GLuint index, GLsizei bufsize, GLsizei *length, GLint *size, GLenum *type, char *name)
- void glGetActiveUniform(GLuint program, GLuint index, GLsizei bufsize, GLsizei *length, GLint *size, GLenum *type, char *name)
- void glGetAttachedShaders(GLuint program, GLsizei maxcount, GLsizei *count, GLuint *shaders)
- GLint glGetUniformLocation(GLuint program, char *name)

- void glGetBooleanv(GLenum pname, GLboolean *params)
- void glGetBufferParameteriv(GLenum target, GLenum pname, GLint *params)
- GLenum glGetError(void)
- void glGetFloatv(GLenum pname, GLfloat *params)
- void glGetFramebufferAttachmentParameteriv(GLenum target, GLenum attachment, GLenum pname, GLint *params)
- void glGetIntegerv(GLenum pname, GLint *params)
- void glGetProgramInfoLog(GLuint program, GLsizei bufsize, GLsizei *length, char *infolog)
- void glGetProgramiv(GLuint program, GLenum pname, GLint *params)
- void glGetRenderbufferParameteriv(GLenum target, GLenum pname, GLint *params)
- void glGetShaderInfoLog(GLuint shader, GLsizei bufsize, GLsizei *length, char *infolog)
- void glGetShaderPrecisionFormat(GLenum shadertype, GLenum precisiontype, GLint *range, GLint *precision)
- void glGetShaderSource(GLuint shader, GLsizei bufsize, GLsizei *length, char *source)
- void glGetShaderiv(GLuint shader, GLenum pname, GLint *params)
- GLubyte * glGetString(GLenum name)
- void glGetTexParameterfv(GLenum target, GLenum pname, GLfloat *params)
- void glGetTexParameteriv(GLenum target, GLenum pname, GLint *params)
- GLint glGetUniformLocation(GLuint program, char *name)
- void glGetUniformLocation(GLuint program, GLint location, GLfloat *params)
- void glGetUniformLocation(GLuint program, GLint location, GLint *params)
- void glGetVertexAttribiv(GLuint index, GLenum pname, GLint *params)
- void glHint(GLenum target, GLenum mode)
- GLboolean glIsBuffer(GLuint buffer)
- GLboolean glIsEnabled(GLenum cap)
- GLboolean glIsFramebuffer(GLuint framebuffer)
- GLboolean glIsProgram(GLuint program)
- GLboolean glIsRenderbuffer(GLuint renderbuffer)
- GLboolean glIsShader(GLuint shader)
- GLboolean glIsTexture(GLuint texture)
- void glLineWidth(GLfloat width)
- void glLinkProgram(GLuint program)
- void glPixelStorei(GLenum pname, GLint param)
- void glPolygonOffset(GLfloat factor, GLfloat units)
- void glReadPixels(GLint x, GLint y, GLsizei width, GLsizei height, GLenum format, GLenum type, GLvoid *pixels)
- void glReleaseShaderCompiler(void)

- void glRenderbufferStorage(GLenum target, GLenum internalformat, GLsizei width, GLsizei height)
- void glSampleCoverage(GLclampf value, GLboolean invert)
- void glScissor(GLint x, GLint y, GLsizei width, GLsizei height)
- void glShaderBinary(GLint n, GLuint *shaders, GLenum binaryformat, void *binary, GLint length)
- void glStencilFuncSeparate(GLenum face, GLenum func, GLint ref, GLuint mask)
- void glStencilMask(GLuint mask)
- void glStencilMaskSeparate(GLenum face, GLuint mask)
- void glStencilOp(GLenum fail, GLenum zfail, GLenum zpass)
- void glStencilOpSeparate(GLenum face, GLenum fail, GLenum zfail, GLenum zpass)
- void glTexImage2D(GLenum target, GLint level, GLint internalformat, GLsizei width, GLsizei height, GLint border, GLenum format, GLenum type, GLvoid *pixels)
- void glTexParameterf(GLenum target, GLenum pname, GLfloat param)
- void glTexParameterfv(GLenum target, GLenum pname, GLfloat *params)
- void glTexParameteri(GLenum target, GLenum pname, GLint param)
- void glTexParameteriv(GLenum target, GLenum pname, GLint *params)
- void glTexSubImage2D(GLenum target, GLint level, GLint xoffset, GLint yoffset, GLsizei width, GLsizei height, GLenum format, GLenum type, GLvoid *pixels)
- void glUniform1f(GLint location, GLfloat x)
- void glUniform1fv(GLint location, GLsizei count, GLfloat *v)
- void glUniform1i(GLint location, GLint x)
- void glUniform1iv(GLint location, GLsizei count, GLint *v)
- void glUniform2f(GLint location, GLfloat x, GLfloat y)
- void glUniform2fv(GLint location, GLsizei count, GLfloat *v)
- void glUniform2i(GLint location, GLint x, GLint y)
- void glUniform2iv(GLint location, GLsizei count, GLint *v)
- void glUniform3f(GLint location, GLfloat x, GLfloat y, GLfloat z)
- void glUniform3fv(GLint location, GLsizei count, GLfloat *v)
- void glUniform3i(GLint location, GLint x, GLint y, GLint z)
- void glUniform3iv(GLint location, GLsizei count, GLint *v)
- void glUniform4f(GLint location, GLfloat x, GLfloat y, GLfloat z, GLfloat w)
- void glUniform4fv(GLint location, GLsizei count, GLfloat *v)
- void glUniform4i(GLint location, GLint x, GLint y, GLint z, GLint w)
- void glUniform4iv(GLint location, GLsizei count, GLint *v)
- void glUniformMatrix2fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix3fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix4fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUseProgram(GLuint program)

- void glValidateProgram(GLuint program)
- void glVertexAttrib1f(GLuint indx, GLfloat x)
- void glVertexAttrib1fv(GLuint indx, GLfloat *values)
- void glVertexAttrib2f(GLuint indx, GLfloat x, GLfloat y)
- void glVertexAttrib2fv(GLuint indx, GLfloat *values)
- void glVertexAttrib3f(GLuint indx, GLfloat x, GLfloat y, GLfloat z)
- void glVertexAttrib3fv(GLuint indx, GLfloat *values)
- void glVertexAttrib4f(GLuint indx, GLfloat x, GLfloat y, GLfloat z, GLfloat w)
- void glVertexAttrib4fv(GLuint indx, GLfloat *values)
- void glVertexAttribPointer(GLuint indx, GLint size, GLenum type, GLboolean normalized, GLsizei stride, void *ptr)
- void glViewport(GLint x, GLint y, GLsizei width, GLsizei height)
- bool hasOpenGLFeature(QOpenGLFunctions::OpenGLFeature feature)
- void initializeOpenGLFunctions(void)
- QOpenGLFunctions::OpenGLFeatures openGLFeatures(void)

92.239 QOpenGLFunctions_3_2_Core Class

C++ Reference : http://doc.qt.io/qt-5/qopenglfunctions_3_2_core.html

Parameters : void

- void glActiveTexture(GLenum texture)
- void glAttachShader(GLuint program, GLuint shader)
- void glBeginConditionalRender(GLuint id, GLenum mode)
- void glBeginQuery(GLenum target, GLuint id)
- void glBeginTransformFeedback(GLenum primitiveMode)
- void glBindAttribLocation(GLuint program, GLuint index, GLchar *name)
- void glBindBuffer(GLenum target, GLuint buffer)
- void glBindBufferBase(GLenum target, GLuint index, GLuint buffer)
- void glBindBufferRange(GLenum target, GLuint index, GLuint buffer, GLintptr offset, GLsizei size)
- void glBindFragDataLocation(GLuint program, GLuint color, GLchar *name)
- void glBindFramebuffer(GLenum target, GLuint framebuffer)
- void glBindRenderbuffer(GLenum target, GLuint renderbuffer)
- void glBindTexture(GLenum target, GLuint texture)
- void glBindVertexArray(GLuint array)
- void glBlendColor(GLfloat red, GLfloat green, GLfloat blue, GLfloat alpha)
- void glBlendEquation(GLenum mode)
- void glBlendEquationSeparate(GLenum modeRGB, GLenum modeAlpha)

- void glBlendFunc(GLenum sfactor, GLenum dfactor)
- void glBlendFuncSeparate(GLenum sfactorRGB, GLenum dfactorRGB, GLenum sfactorAlpha, GLenum dfactorAlpha)
- void glBlitFramebuffer(GLint srcX0, GLint srcY0, GLint srcX1, GLint srcY1, GLint dstX0, GLint dstY0, GLint dstX1, GLint dstY1, GLbitfield mask, GLenum filter)
- void glBufferData(GLenum target, GLsizeiptr size, GLvoid *data, GLenum usage)
- void glBufferSubData(GLenum target, GLintptr offset, GLsizeiptr size, GLvoid *data)
- GLenum glCheckFramebufferStatus(GLenum target)
- void glClampColor(GLenum target, GLenum clamp)
- void glClear(GLbitfield mask)
- void glClearBufferfi(GLenum buffer, GLint drawbuffer, GLfloat depth, GLint stencil)
- void glClearBufferfv(GLenum buffer, GLint drawbuffer, GLfloat *value)
- void glClearBufferiv(GLenum buffer, GLint drawbuffer, GLint *value)
- void glClearBufferuiv(GLenum buffer, GLint drawbuffer, GLuint *value)
- void glClearColor(GLfloat red, GLfloat green, GLfloat blue, GLfloat alpha)
- void glClearDepth(GLdouble depth)
- void glClearStencil(GLint s)
- GLenum glClientWaitSync(GLsync sync, GLbitfield flags, GLuint64 timeout)
- void glColorMask(GLboolean red, GLboolean green, GLboolean blue, GLboolean alpha)
- void glColorMaski(GLuint index, GLboolean r, GLboolean g, GLboolean b, GLboolean a)
- void glCompileShader(GLuint shader)
- void glCompressedTexImage1D(GLenum target, GLint level, GLenum internalformat, GLsizei width, GLsizei border, GLsizei imageSize, GLvoid *data)
- void glCompressedTexImage2D(GLenum target, GLint level, GLenum internalformat, GLsizei width, GLsizei height, GLsizei border, GLsizei imageSize, GLvoid *data)
- void glCompressedTexImage3D(GLenum target, GLint level, GLenum internalformat, GLsizei width, GLsizei height, GLsizei depth, GLsizei border, GLsizei imageSize, GLvoid *data)
- void glCompressedTexSubImage1D(GLenum target, GLint level, GLint xoffset, GLsizei width, GLenum format, GLsizei imageSize, GLvoid *data)
- void glCompressedTexSubImage2D(GLenum target, GLint level, GLint xoffset, GLint yoffset, GLsizei width, GLsizei height, GLenum format, GLsizei imageSize, GLvoid *data)
- void glCompressedTexSubImage3D(GLenum target, GLint level, GLint xoffset, GLint yoffset, GLint zoffset, GLsizei width, GLsizei height, GLsizei depth, GLenum format, GLsizei imageSize, GLvoid *data)
- void glCopyBufferSubData(GLenum readTarget, GLenum writeTarget, GLintptr readOffset, GLintptr writeOffset, GLsizeiptr size)
- void glCopyTexImage1D(GLenum target, GLint level, GLenum internalformat, GLint x, GLint y, GLsizei width, GLsizei border)
- void glCopyTexImage2D(GLenum target, GLint level, GLenum internalformat, GLint x, GLint y, GLsizei width, GLsizei height, GLsizei border)
- void glCopyTexSubImage1D(GLenum target, GLint level, GLint xoffset, GLint x, GLint y, GLsizei width)

- void glCopyTexSubImage2D(GLenum target, GLint level, GLint xoffset, GLint yoffset, GLint x, GLint y, GLsizei width, GLsizei height)
- void glCopyTexSubImage3D(GLenum target, GLint level, GLint xoffset, GLint yoffset, GLint zoffset, GLint x, GLint y, GLsizei width, GLsizei height)
- GLuint glCreateProgram(void)
- GLuint glCreateShader(GLenum type)
- void glCullFace(GLenum mode)
- void glDeleteBuffers(GLsizei n, GLuint *buffers)
- void glDeleteFramebuffers(GLsizei n, GLuint *framebuffers)
- void glDeleteProgram(GLuint program)
- void glDeleteQueries(GLsizei n, GLuint *ids)
- void glDeleteRenderbuffers(GLsizei n, GLuint *renderbuffers)
- void glDeleteShader(GLuint shader)
- void glDeleteSync(GLsync sync)
- void glDeleteTextures(GLsizei n, GLuint *textures)
- void glDeleteVertexArrays(GLsizei n, GLuint *arrays)
- void glDepthFunc(GLenum func)
- void glDepthMask(GLboolean flag)
- void glDepthRange(GLdouble nearVal, GLdouble farVal)
- void glDetachShader(GLuint program, GLuint shader)
- void glDisable(GLenum cap)
- void glDisableVertexAttribArray(GLuint index)
- void glDisablei(GLenum target, GLuint index)
- void glDrawArrays(GLenum mode, GLint first, GLsizei count)
- void glDrawArraysInstanced(GLenum mode, GLint first, GLsizei count, GLsizei instancecount)
- void glDrawBuffer(GLenum mode)
- void glDrawBuffers(GLsizei n, GLenum *bufs)
- void glDrawElements(GLenum mode, GLsizei count, GLenum type, GLvoid *indices)
- void glDrawElementsBaseVertex(GLenum mode, GLsizei count, GLenum type, GLvoid *indices, GLint basevertex)
- void glDrawElementsInstanced(GLenum mode, GLsizei count, GLenum type, GLvoid *indices, GLsizei instancecount)
- void glDrawElementsInstancedBaseVertex(GLenum mode, GLsizei count, GLenum type, GLvoid *indices, GLsizei instancecount, GLint basevertex)
- void glDrawRangeElements(GLenum mode, GLuint start, GLuint end, GLsizei count, GLenum type, GLvoid *indices)
- void glDrawRangeElementsBaseVertex(GLenum mode, GLuint start, GLuint end, GLsizei count, GLenum type, GLvoid *indices, GLint basevertex)

- void glEnable(GLenum cap)
- void glEnableVertexAttribArray(GLuint index)
- void glEnablei(GLenum target, GLuint index)
- void glEndConditionalRender(void)
- void glEndQuery(GLenum target)
- void glEndTransformFeedback(void)
- GLsync glFenceSync(GLenum condition, GLbitfield flags)
- void glFinish(void)
- void glFlush(void)
- void glFlushMappedBufferRange(GLenum target, GLintptr offset, GLsizeiptr length)
- void glFramebufferRenderbuffer(GLenum target, GLenum attachment, GLenum renderbuffertarget, GLuint renderbuffer)
- void glFramebufferTexture(GLenum target, GLenum attachment, GLuint texture, GLint level)
- void glFramebufferTexture1D(GLenum target, GLenum attachment, GLenum textarget, GLuint texture, GLint level)
- void glFramebufferTexture2D(GLenum target, GLenum attachment, GLenum textarget, GLuint texture, GLint level)
- void glFramebufferTexture3D(GLenum target, GLenum attachment, GLenum textarget, GLuint texture, GLint level, GLint zoffset)
- void glFramebufferTextureLayer(GLenum target, GLenum attachment, GLuint texture, GLint level, GLint layer)
- void glFrontFace(GLenum mode)
- void glGenBuffers(GLsizei n, GLuint *buffers)
- void glGenFramebuffers(GLsizei n, GLuint *framebuffers)
- void glGenQueries(GLsizei n, GLuint *ids)
- void glGenRenderbuffers(GLsizei n, GLuint *renderbuffers)
- void glGenTextures(GLsizei n, GLuint *textures)
- void glGenVertexArrays(GLsizei n, GLuint *arrays)
- void glGenerateMipmap(GLenum target)
- void glGetActiveAttrib(GLuint program, GLuint index, GLsizei bufSize, GLsizei *length, GLint *size, GLenum *type, GLchar *name)
- void glGetActiveUniform(GLuint program, GLuint index, GLsizei bufSize, GLsizei *length, GLint *size, GLenum *type, GLchar *name)
- void glGetActiveUniformBlockName(GLuint program, GLuint uniformBlockIndex, GLsizei bufSize, GLsizei *length, GLchar *uniformBlockName)
- void glGetActiveUniformBlockiv(GLuint program, GLuint uniformBlockIndex, GLenum pname, GLint *params)
- void glGetActiveUniformName(GLuint program, GLuint uniformIndex, GLsizei bufSize, GLsizei *length, GLchar *uniformName)

- void glGetActiveUniformsiv(GLuint program, GLsizei uniformCount, GLuint *uniformIndices, GLenum pname, GLint *params)
- void glGetAttachedShaders(GLuint program, GLsizei maxCount, GLsizei *count, GLuint *obj)
- GLint glGetAttribLocation(GLuint program, GLchar *name)
- void glGetBooleani_v(GLenum target, GLuint index, GLboolean *data)
- void glGetBooleanv(GLenum pname, GLboolean *params)
- void glGetBufferParameteri64v(GLenum target, GLenum pname, GLint64 *params)
- void glGetBufferParameteriv(GLenum target, GLenum pname, GLint *params)
- void glGetCompressedTexImage(GLenum target, GLint level, GLvoid *img)
- void glGetDoublev(GLenum pname, GLdouble *params)
- GLenum glGetError(void)
- void glGetFloatv(GLenum pname, GLfloat *params)
- GLint glGetFragDataLocation(GLuint program, GLchar *name)
- void glGetFramebufferAttachmentParameteriv(GLenum target, GLenum attachment, GLenum pname, GLint *params)
- void glGetInteger64i_v(GLenum target, GLuint index, GLint64 *data)
- void glGetInteger64v(GLenum pname, GLint64 *params)
- void glGetIntegeri_v(GLenum target, GLuint index, GLint *data)
- void glGetIntegerv(GLenum pname, GLint *params)
- void glGetMultisamplefv(GLenum pname, GLuint index, GLfloat *val)
- void glGetProgramiv(GLuint program, GLenum pname, GLint *params)
- void glGetQueryObjectiv(GLuint id, GLenum pname, GLint *params)
- void glGetQueryObjectuiv(GLuint id, GLenum pname, GLuint *params)
- void glGetQueryiv(GLenum target, GLenum pname, GLint *params)
- void glGetRenderbufferParameteriv(GLenum target, GLenum pname, GLint *params)
- void glGetShaderInfoLog(GLuint shader, GLsizei bufSize, GLsizei *length, GLchar *infoLog)
- void glGetShaderSource(GLuint shader, GLsizei bufSize, GLsizei *length, GLchar *source)
- void glGetShaderiv(GLuint shader, GLenum pname, GLint *params)
- GLubyte * glGetString(GLenum name)
- GLubyte * glGetStringi(GLenum name, GLuint index)
- void glGetSynciv(GLsync sync, GLenum pname, GLsizei bufSize, GLsizei *length, GLint *values)
- void glGetTexImage(GLenum target, GLint level, GLenum format, GLenum type, GLvoid *pixels)
- void glGetTexLevelParameterfv(GLenum target, GLint level, GLenum pname, GLfloat *params)
- void glGetTexLevelParameteriv(GLenum target, GLint level, GLenum pname, GLint *params)
- void glGetTexParameteriv(GLenum target, GLenum pname, GLint *params)
- void glGetTexParameterIuiv(GLenum target, GLenum pname, GLuint *params)
- void glGetTexParameterfv(GLenum target, GLenum pname, GLfloat *params)

- void glGetTexParameteriv(GLenum target, GLenum pname, GLint *params)
- void glGetTransformFeedbackVarying(GLuint program, GLuint index, GLsizei bufSize, GLsizei *length, GLsizei *size, GLenum *type, GLchar *name)
- GLuint glGetUniformLocation(GLuint program, GLchar *uniformBlockName)
- void glGetUniformfv(GLuint program, GLint location, GLfloat *params)
- void glGetUniformiv(GLuint program, GLint location, GLint *params)
- void glGetUniformuiv(GLuint program, GLint location, GLuint *params)
- void glGetVertexAttribIiv(GLuint index, GLenum pname, GLint *params)
- void glGetVertexAttribIuiv(GLuint index, GLenum pname, GLuint *params)
- void glGetVertexAttribfv(GLuint index, GLenum pname, GLfloat *params)
- void glGetVertexAttribiv(GLuint index, GLenum pname, GLint *params)
- void glHint(GLenum target, GLenum mode)
- void glIndexub(GLubyte c)
- void glIndexubv(GLubyte *c)
- GLboolean glIsBuffer(GLuint buffer)
- GLboolean glIsEnabled(GLenum cap)
- GLboolean glIsEnabledi(GLenum target, GLuint index)
- GLboolean glIsFramebuffer(GLuint framebuffer)
- GLboolean glIsProgram(GLuint program)
- GLboolean glIsQuery(GLuint id)
- GLboolean glIsRenderbuffer(GLuint renderbuffer)
- GLboolean glIsShader(GLuint shader)
- GLboolean glIsSync(GLsync sync)
- GLboolean glIsTexture(GLuint texture)
- GLboolean glIsVertexArray(GLuint array)
- void glLineWidth(GLfloat width)
- void glLinkProgram(GLuint program)
- void glLogicOp(GLenum opcode)
- GLvoid * glMapBuffer(GLenum target, GLenum access)
- GLvoid * glMapBufferRange(GLenum target, GLintptr offset, GLsizeiptr length, GLbitfield access)
- void glMultiDrawArrays(GLenum mode, GLint *first, GLsizei *count, GLsizei drawcount)
- void glPixelStorei(GLenum pname, GLint param)
- void glPointParameterf(GLenum pname, GLfloat param)
- void glPointParameterfv(GLenum pname, GLfloat *params)
- void glPointParameteri(GLenum pname, GLint param)
- void glPointParameteriv(GLenum pname, GLint *params)

- void glPointSize(GLfloat size)
- void glPolygonMode(GLenum face, GLenum mode)
- void glPolygonOffset(GLfloat factor, GLfloat units)
- void glPrimitiveRestartIndex(GLuint index)
- void glProvokingVertex(GLenum mode)
- void glReadBuffer(GLenum mode)
- void glReadPixels(GLint x, GLint y, GLsizei width, GLsizei height, GLenum format, GLenum type, GLvoid *pixels)
- void glRenderbufferStorage(GLenum target, GLenum internalformat, GLsizei width, GLsizei height)
- void glRenderbufferStorageMultisample(GLenum target, GLsizei samples, GLenum internalformat, GLsizei width, GLsizei height)
- void glSampleCoverage(GLfloat value, GLboolean invert)
- void glSampleMaski(GLuint index, GLbitfield mask)
- void glScissor(GLint x, GLint y, GLsizei width, GLsizei height)
- void glStencilFuncSeparate(GLenum face, GLenum func, GLint ref, GLuint mask)
- void glStencilMask(GLuint mask)
- void glStencilMaskSeparate(GLenum face, GLuint mask)
- void glStencilOp(GLenum fail, GLenum zfail, GLenum zpass)
- void glStencilOpSeparate(GLenum face, GLenum sfail, GLenum dpfail, GLenum dpass)
- void glTexBuffer(GLenum target, GLenum internalformat, GLuint buffer)
- void glTexImage1D(GLenum target, GLint level, GLint internalformat, GLsizei width, GLint border, GLenum format, GLenum type, GLvoid *pixels)
- void glTexImage2D(GLenum target, GLint level, GLint internalformat, GLsizei width, GLsizei height, GLint border, GLenum format, GLenum type, GLvoid *pixels)
- void glTexImage2DMultisample(GLenum target, GLsizei samples, GLint internalformat, GLsizei width, GLsizei height, GLboolean fixedsamplelocations)
- void glTexImage3D(GLenum target, GLint level, GLint internalformat, GLsizei width, GLsizei height, GLsizei depth, GLint border, GLenum format, GLenum type, GLvoid *pixels)
- void glTexImage3DMultisample(GLenum target, GLsizei samples, GLint internalformat, GLsizei width, GLsizei height, GLsizei depth, GLboolean fixedsamplelocations)
- void glTexParameterIiv(GLenum target, GLenum pname, GLint *params)
- void glTexParameterIuiv(GLenum target, GLenum pname, GLuint *params)
- void glTexParameterf(GLenum target, GLenum pname, GLfloat param)
- void glTexParameterfv(GLenum target, GLenum pname, GLfloat *params)
- void glTexParameteri(GLenum target, GLenum pname, GLint param)
- void glTexParameteriv(GLenum target, GLenum pname, GLint *params)
- void glTexSubImage1D(GLenum target, GLint level, GLint xoffset, GLsizei width, GLenum format, GLenum type, GLvoid *pixels)

- void glTexSubImage2D(GLenum target, GLint level, GLint xoffset, GLint yoffset, GLsizei width, GLsizei height, GLenum format, GLenum type, GLvoid *pixels)
- void glTexSubImage3D(GLenum target, GLint level, GLint xoffset, GLint yoffset, GLint zoffset, GLsizei width, GLsizei height, GLsizei depth, GLenum format, GLenum type, GLvoid *pixels)
- void glUniform1fv(GLint location, GLsizei count, GLfloat *value)
- void glUniform1i(GLint location, GLint v0)
- void glUniform1iv(GLint location, GLsizei count, GLint *value)
- void glUniform1ui(GLint location, GLuint v0)
- void glUniform1uiv(GLint location, GLsizei count, GLuint *value)
- void glUniform2f(GLint location, GLfloat v0, GLfloat v1)
- void glUniform2fv(GLint location, GLsizei count, GLfloat *value)
- void glUniform2i(GLint location, GLint v0, GLint v1)
- void glUniform2iv(GLint location, GLsizei count, GLint *value)
- void glUniform2ui(GLint location, GLuint v0, GLuint v1)
- void glUniform2uiv(GLint location, GLsizei count, GLuint *value)
- void glUniform3f(GLint location, GLfloat v0, GLfloat v1, GLfloat v2)
- void glUniform3fv(GLint location, GLsizei count, GLfloat *value)
- void glUniform3i(GLint location, GLint v0, GLint v1, GLint v2)
- void glUniform3iv(GLint location, GLsizei count, GLint *value)
- void glUniform3ui(GLint location, GLuint v0, GLuint v1, GLuint v2)
- void glUniform3uiv(GLint location, GLsizei count, GLuint *value)
- void glUniform4f(GLint location, GLfloat v0, GLfloat v1, GLfloat v2, GLfloat v3)
- void glUniform4fv(GLint location, GLsizei count, GLfloat *value)
- void glUniform4i(GLint location, GLint v0, GLint v1, GLint v2, GLint v3)
- void glUniform4iv(GLint location, GLsizei count, GLint *value)
- void glUniform4ui(GLint location, GLuint v0, GLuint v1, GLuint v2, GLuint v3)
- void glUniform4uiv(GLint location, GLsizei count, GLuint *value)
- void glUniformBlockBinding(GLuint program, GLuint uniformBlockIndex, GLuint uniformBlockBinding)
- void glUniformMatrix2fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix2x3fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix2x4fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix3fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix3x2fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix3x4fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix4fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix4x2fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)
- void glUniformMatrix4x3fv(GLint location, GLsizei count, GLboolean transpose, GLfloat *value)

- GLboolean glUnmapBuffer(GLenum target)
- void glUseProgram(GLuint program)
- void glValidateProgram(GLuint program)
- void glViewport(GLint x, GLint y, GLsizei width, GLsizei height)
- void glWaitSync(GLsync sync, GLbitfield flags, GLuint64 timeout)

92.240 QOpenGLPaintDevice Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglpaintdevice.html>

Parameters : void

Parent Class : QPaintDevice

- QOpenGLContext * context(void)
- qreal dotsPerMeterX(void)
- qreal dotsPerMeterY(void)
- void ensureActiveTarget(void)
- bool paintFlipped(void)
- void setDevicePixelRatio(qreal devicePixelRatio)
- void setDotsPerMeterX(qreal dpmx)
- void setDotsPerMeterY(qreal dpmy)
- void setPaintFlipped(bool flipped)
- void setSize(QSize size)
- QSize size(void)

92.241 QOpenGLShader Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglshader.html>

Parameters : QOpenGLShader::ShaderType,QObject *

- bool compileSourceCode(char *source)
- bool compileSourceCode_2(QByteArray source)
- bool compileSourceCode_3(QString source)
- bool compileSourceFile(QString fileName)
- bool isCompiled(void)
- QString log(void)
- GLuint shaderId(void)
- QOpenGLShader::ShaderType shaderType(void)
- QByteArray sourceCode(void)
- bool hasOpenGLShaders(QOpenGLShader::ShaderType type, QOpenGLContext *context)

92.242 QOpenGLShaderProgram Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglshaderprogram.html>

Parameters : QObject *

- bool addShaderFromSourceCode(QOpenGLShader::ShaderType type, char *source)
- bool addShaderFromSourceCode_2(QOpenGLShader::ShaderType type, QByteArray source)
- bool addShaderFromSourceCode_3(QOpenGLShader::ShaderType type, QString source)
- bool addShaderFromSourceFile(QOpenGLShader::ShaderType type, QString fileName)
- int attributeLocation(char *name)
- int attributeLocation_2(QByteArray name)
- int attributeLocation_3(QString name)
- bool bind(void)
- void bindAttributeLocation(char *name, int location)
- void bindAttributeLocation_2(QByteArray name, int location)
- void bindAttributeLocation_3(QString name, int location)
- QVector<float> defaultOuterTessellationLevels(void)
- void disableAttributeArray(int location)
- void disableAttributeArray_2(char *name)
- void enableAttributeArray(int location)
- void enableAttributeArray_2(char *name)
- bool isLinked(void)
- bool link(void)
- QString log(void)
- int maxGeometryOutputVertices(void)
- int patchVertexCount(void)
- GLuint programId(void)
- void release(void)
- void removeAllShaders(void)
- void removeShader(QOpenGLShader *shader)
- void setAttributeArray(int location, GLfloat *values, int tupleSize, int stride)
- void setAttributeArray_2(int location, QVector2D *values, int stride)
- void setAttributeArray_3(int location, QVector3D *values, int stride)
- void setAttributeArray_4(int location, QVector4D *values, int stride)
- void setAttributeArray_5(int location, GLenum type, void *values, int tupleSize, int stride)
- void setAttributeArray_6(char *name, GLfloat *values, int tupleSize, int stride)
- void setAttributeArray_7(char *name, QVector2D *values, int stride)

- void setAttributeArray_8(char *name, QVector3D *values, int stride)
- void setAttributeArray_9(char *name, QVector4D *values, int stride)
- void setAttributeArray_10(char *name, GLenum type, void *values, int tupleSize, int stride)
- void setAttributeBuffer(int location, GLenum type, int offset, int tupleSize, int stride)
- void setAttributeBuffer_2(char *name, GLenum type, int offset, int tupleSize, int stride)
- void setAttributeValue(int location, GLfloat value)
- void setAttributeValue_2(int location, GLfloat x, GLfloat y)
- void setAttributeValue_3(int location, GLfloat x, GLfloat y, GLfloat z)
- void setAttributeValue_4(int location, GLfloat x, GLfloat y, GLfloat z, GLfloat w)
- void setAttributeValue_5(int location, QVector2D value)
- void setAttributeValue_6(int location, QVector3D value)
- void setAttributeValue_7(int location, QVector4D value)
- void setAttributeValue_8(int location, QColor value)
- void setAttributeValue_9(int location, GLfloat *values, int columns, int rows)
- void setAttributeValue_10(char *name, GLfloat value)
- void setAttributeValue_11(char *name, GLfloat x, GLfloat y)
- void setAttributeValue_12(char *name, GLfloat x, GLfloat y, GLfloat z)
- void setAttributeValue_13(char *name, GLfloat x, GLfloat y, GLfloat z, GLfloat w)
- void setAttributeValue_14(char *name, QVector2D value)
- void setAttributeValue_15(char *name, QVector3D value)
- void setAttributeValue_16(char *name, QVector4D value)
- void setDefaultInnerTessellationLevels(QVector<float> levels)
- void setDefaultOuterTessellationLevels(QVector<float> levels)
- void setPatchVertexCount(int count)
- void setUniformValue(int location, GLfloat value)
- void setUniformValue_2(int location, GLint value)
- void setUniformValue_3(char *name, QColor color)
- void setUniformValue_4(char *name, QPoint point)
- void setUniformValue_5(char *name, QPointF point)
- void setUniformValue_6(char *name, QSize size)
- void setUniformValue_7(char *name, QSizeF size)
- void setUniformValue_8(char *name, QMatrix2x2 value)
- void setUniformValue_9(char *name, QMatrix2x3 value)
- void setUniformValue_10(char *name, QMatrix2x4 value)
- void setUniformValue_11(char *name, QMatrix3x2 value)
- void setUniformValue_12(char *name, QMatrix3x3 value)

- void setUniformValue_13(char *name, QMatrix3x4 value)
- void setUniformValue_14(char *name, QMatrix4x2 value)
- void setUniformValue_15(char *name, QMatrix4x3 value)
- void setUniformValue_16(char *name, QMatrix4x4 value)
- void setUniformValue_21(int location, GLuint value)
- void setUniformValue_22(int location, GLfloat x, GLfloat y)
- void setUniformValue_23(int location, GLfloat x, GLfloat y, GLfloat z)
- void setUniformValue_24(int location, GLfloat x, GLfloat y, GLfloat z, GLfloat w)
- void setUniformValue_25(int location, QVector2D value)
- void setUniformValue_26(int location, QVector3D value)
- void setUniformValue_27(int location, QVector4D value)
- void setUniformValue_28(int location, QColor color)
- void setUniformValue_29(int location, QPoint point)
- void setUniformValue_30(int location, QPointF point)
- void setUniformValue_31(int location, QSize size)
- void setUniformValue_32(int location, QSizeF size)
- void setUniformValue_33(int location, QMatrix2x2 value)
- void setUniformValue_34(int location, QMatrix2x3 value)
- void setUniformValue_35(int location, QMatrix2x4 value)
- void setUniformValue_36(int location, QMatrix3x2 value)
- void setUniformValue_37(int location, QMatrix3x3 value)
- void setUniformValue_38(int location, QMatrix3x4 value)
- void setUniformValue_39(int location, QMatrix4x2 value)
- void setUniformValue_40(int location, QMatrix4x3 value)
- void setUniformValue_41(int location, QMatrix4x4 value)
- void setUniformValue_46(char *name, GLfloat value)
- void setUniformValue_47(char *name, GLint value)
- void setUniformValue_48(char *name, GLuint value)
- void setUniformValue_49(char *name, GLfloat x, GLfloat y)
- void setUniformValue_50(char *name, GLfloat x, GLfloat y, GLfloat z)
- void setUniformValue_51(char *name, GLfloat x, GLfloat y, GLfloat z, GLfloat w)
- void setUniformValue_52(char *name, QVector2D value)
- void setUniformValue_53(char *name, QVector3D value)
- void setUniformValue_54(char *name, QVector4D value)
- void setUniformValueArray(int location, GLfloat *values, int count, int tupleSize)
- void setUniformValueArray_2(int location, GLint *values, int count)

- void setUniformValueArray_3(int location, GLuint *values, int count)
- void setUniformValueArray_4(int location, QVector2D *values, int count)
- void setUniformValueArray_5(int location, QVector3D *values, int count)
- void setUniformValueArray_6(int location, QVector4D *values, int count)
- void setUniformValueArray_7(int location, QMatrix2x2 *values, int count)
- void setUniformValueArray_8(int location, QMatrix2x3 *values, int count)
- void setUniformValueArray_9(int location, QMatrix2x4 *values, int count)
- void setUniformValueArray_10(int location, QMatrix3x2 *values, int count)
- void setUniformValueArray_11(int location, QMatrix3x3 *values, int count)
- void setUniformValueArray_12(int location, QMatrix3x4 *values, int count)
- void setUniformValueArray_13(int location, QMatrix4x2 *values, int count)
- void setUniformValueArray_14(int location, QMatrix4x3 *values, int count)
- void setUniformValueArray_15(int location, QMatrix4x4 *values, int count)
- void setUniformValueArray_16(char *name, GLfloat *values, int count, int tupleSize)
- void setUniformValueArray_17(char *name, GLint *values, int count)
- void setUniformValueArray_18(char *name, GLuint *values, int count)
- void setUniformValueArray_19(char *name, QVector2D *values, int count)
- void setUniformValueArray_20(char *name, QVector3D *values, int count)
- void setUniformValueArray_21(char *name, QVector4D *values, int count)
- void setUniformValueArray_22(char *name, QMatrix2x2 *values, int count)
- void setUniformValueArray_23(char *name, QMatrix2x3 *values, int count)
- void setUniformValueArray_24(char *name, QMatrix2x4 *values, int count)
- void setUniformValueArray_25(char *name, QMatrix3x2 *values, int count)
- void setUniformValueArray_26(char *name, QMatrix3x3 *values, int count)
- void setUniformValueArray_27(char *name, QMatrix3x4 *values, int count)
- void setUniformValueArray_28(char *name, QMatrix4x2 *values, int count)
- void setUniformValueArray_29(char *name, QMatrix4x3 *values, int count)
- void setUniformValueArray_30(char *name, QMatrix4x4 *values, int count)
- QList<QOpenGLShader *> shaders(void)
- int uniformLocation(char *name)
- int uniformLocation_2(QByteArray name)
- int uniformLocation_3(QString name)
- bool hasOpenGLShaderPrograms(QOpenGLContext *context)

92.243 QOpenGLTexture Class

C++ Reference : <http://doc.qt.io/qt-5/qopengltexture.html>

Parameters : QOpenGLTexture::Target

- void allocateStorage(void)
- void bind_2(uint unit, QOpenGLTexture::TextureUnitReset reset)
- QColor borderColor(void)
- void borderColor_2(float *border)
- void borderColor_3(int *border)
- void borderColor_4(unsigned int *border)
- QOpenGLTexture * createTextureView(QOpenGLTexture::Target target, QOpenGLTexture::TextureFormat viewFormat, int minimumMipmapLevel, int maximumMipmapLevel, int minimumLayer, int maximumLayer)
- int depth(void)
- QOpenGLTexture::DepthStencilMode depthStencilMode(void)
- void destroy(void)
- int faces(void)
- QOpenGLTexture::TextureFormat format(void)
- void generateMipMaps(void)
- void generateMipMaps_2(int baseLevel, bool resetBaseLevel)
- int height(void)
- bool isAutoMipMapGenerationEnabled(void)
- bool isBound(void)
- bool isBound_2(uint unit)
- bool isCreated(void)
- bool isTextureView(void)
- int layers(void)
- QPair<float, float> levelOfDetailRange(void)
- float levelofDetailBias(void)
- QOpenGLTexture::Filter magnificationFilter(void)
- float maximumAnisotropy(void)
- float maximumLevelOfDetail(void)
- int maximumMipLevels(void)
- float minimumLevelOfDetail(void)
- int mipBaseLevel(void)
- int mipMaxLevel(void)
- void release(void)
- void release_2(uint unit, QOpenGLTexture::TextureUnitReset reset)

- void setBorderColor(QColor color)
- void setBorderColor_4(uint r, uint g, uint b, uint a)
- void setCompressedData_4(int mipLevel, int dataSize, void *data, QOpenGLPixelTransferOptions * options)
- void setCompressedData_5(int dataSize, void *data, QOpenGLPixelTransferOptions * options)
- void setData(int mipLevel, int layer, QOpenGLTexture::CubeMapFace cubeFace, QOpenGLTexture::PixelFormat sourceFormat, QOpenGLTexture::PixelType sourceType, void *data, QOpenGLPixelTransferOptions * options)
- void setData_4(int mipLevel, QOpenGLTexture::PixelFormat sourceFormat, QOpenGLTexture::PixelType sourceType, void *data, QOpenGLPixelTransferOptions * options)
- void setData_5(QOpenGLTexture::PixelFormat sourceFormat, QOpenGLTexture::PixelType sourceType, void *data, QOpenGLPixelTransferOptions * options)
- void setData_6(QImage image, QOpenGLTexture::MipMapGeneration genMipMaps)
- void setDepthStencilMode(QOpenGLTexture::DepthStencilMode mode)
- void setLayers(int layers)
- void setLevelOfDetailRange(float min, float max)
- void setLevelofDetailBias(float bias)
- void setMagnificationFilter(QOpenGLTexture::Filter filter)
- void setMaximumAnisotropy(float anisotropy)
- void setMaximumLevelOfDetail(float value)
- void setMinMagFilters(QOpenGLTexture::Filter minificationQOpenGLTexture::Filter, QOpenGLTexture::Filter magnificationQOpenGLTexture::Filter)
- void setMinificationFilter(QOpenGLTexture::Filter filter)
- void setMinimumLevelOfDetail(float value)
- void setMipBaseLevel(int baseLevel)
- void setMipLevelRange(int baseLevel, int maxLevel)
- void setMipLevels(int levels)
- void setMipMaxLevel(int maxLevel)
- void setSwizzleMask(QOpenGLTexture::SwizzleComponent component, QOpenGLTexture::SwizzleValue value)
- void setSwizzleMask_2(QOpenGLTexture::SwizzleValue r, QOpenGLTexture::SwizzleValue g, QOpenGLTexture::SwizzleValue b, QOpenGLTexture::SwizzleValue a)
- void setWrapMode(QOpenGLTexture::WrapMode mode)
- void setWrapMode_2(QOpenGLTexture::CoordinateDirection direction, QOpenGLTexture::WrapMode mode)
- QOpenGLTexture::SwizzleValue swizzleMask(QOpenGLTexture::SwizzleComponent component)
- int width(void)
- QOpenGLTexture::WrapMode wrapMode(QOpenGLTexture::CoordinateDirection direction)
- GLuint boundTextureId(QOpenGLTexture::BindingTarget target)

92.244 QOpenGLTimerQuery Class

C++ Reference : <http://doc.qt.io/qt-5/qopengltimerquery.html>

Parameters : QObject *

- void begin(void)
- bool create(void)
- void destroy(void)
- void end(void)
- bool isCreated(void)
- bool isResultAvailable(void)
- GLuint objectId(void)
- void recordTimestamp(void)
- GLuint64 waitForResult(void)
- GLuint64 waitForTimestamp(void)

92.245 QOpenGLVersionProfile Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglversionprofile.html>

Parameters : void

- bool hasProfiles(void)
- bool isLegacyVersion(void)
- bool isValid(void)
- QSurfaceFormat::OpenGLContextProfile profile(void)
- void setProfile(QSurfaceFormat::OpenGLContextProfile profile)
- void setVersion(int majorVersion, int minorVersion)
- QPair<int, int> version(void)

92.246 QOpenGLVertexArrayObject Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglvertexarrayobject.html>

Parameters : QObject *

- void bind(void)
- bool create(void)
- void destroy(void)
- bool isCreated(void)
- GLuint objectId(void)
- void release(void)

92.247 QOpenGLWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qopenglwidget.html>

Parameters : QWidget *

Parent Class : QWidget

- void getEventParameters(void)
- void setInitEvent(const char *cStr)
- const char *getInitEvent(void)
- void setPaintEvent(const char *cStr)
- const char *getPaintEvent(void)
- void setResizeEvent(const char *cStr)
- const char *getResizeEvent(void)
- QOpenGLContext * context(void)
- GLuint defaultFramebufferObject(void)
- void doneCurrent(void)
- QSurfaceFormat format(void)
- QImage grabFramebuffer(void)
- bool isValid(void)
- void makeCurrent(void)
- void setFormat(QSurfaceFormat format)
- QOpenGLWidget::UpdateBehavior updateBehavior(void)

92.248 QOrbitCameraController Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qorbitcameracontroller.html>

Parameters : Qt3DCore::QNode *

Parent Class : QAbstractCameraController

- void setZoomInLimit(float zoomInLimit)
- float zoomInLimit(void)

92.249 QPageSetupDialog Class

C++ Reference : <http://doc.qt.io/qt-5/qpagesetupdialog.html>

Parameters : QPrinter *, QWidget *

Parent Class : QDialog

- void open(QObject * receiver, char * member)
- QPrinter * printer(void)

92.250 QPaintDevice Class

C++ Reference : <http://doc.qt.io/qt-5/qpaintdevice.html>

- int colorCount(void)
- int depth(void)
- int devicePixelRatio(void)
- int heightMM(void)
- int logicalDpiX(void)
- int logicalDpiY(void)
- QPaintEngine * paintEngine(void)
- bool paintingActive(void)
- int physicalDpiX(void)
- int physicalDpiY(void)
- int width(void)
- int widthMM(void)

92.251 QPainter Class

C++ Reference : <http://doc.qt.io/qt-5/qpainter.html>

Parameters : void

- QBrush background(void)
- int backgroundMode(void)
- bool begin(QPaintDevice *device)
- void beginNativePainting(void)
- QRect boundingRect(int x, int y, int w, int h, int flags, QString text)
- QBrush brush(void)
- QPoint brushOrigin(void)
- QRectF clipBoundingRect(void)
- QPainterPath clipPath(void)

- `QRegion clipRegion(void)`
- `QTransform combinedTransform(void)`
- `int compositionMode(void)`
- `QPaintDevice *device(void)`
- `QTransform deviceTransform(void)`
- `void drawArc(int x, int y, int width, int height, int startAngle, int spanAngle)`
- `void drawChord(int x, int y, int width, int height, int startAngle, int spanAngle)`
- `void drawEllipse(int x, int y, int width, int height)`
- `void drawGlyphRun(QPointF position, QGlyphRun glyphs)`
- `void drawImage(int x, int y, QImage image)`
- `void drawLine(int x1, int y1, int x2, int y2)`
- `void drawLines(QLine *lines, int lineCount)`
- `void drawPath(QPainterPath path)`
- `void drawPicture(int x, int y, QPicture picture)`
- `void drawPie(int x, int y, int width, int height, int startAngle, int spanAngle)`
- `void drawPixmap(int x, int y, QPixmap)`
- `void drawPoint(int x, int y)`
- `void drawRect(int x, int y, int width, int height)`
- `void drawRects(QRectF *rectangles, int rectCount)`
- `void drawRoundedRect(int x, int y, int w, int h, qreal xRadius, qreal yRadius, Qt::SizeMode mode)`
- `void drawStaticText(int left, int top, QStaticText staticText)`
- `void drawText(int x, int y, QString text)`
- `void drawTiledPixmap(int x, int y, int width, int height, QPixmap pixmap, int sx, int sy)`
- `bool end(void) # In RingQt use : bool endpaint(void)`
- `void endNativePainting(void)`
- `void eraseRect(int x, int y, int width, int height)`
- `void fillPath(QPainterPath path, QBrush brush)`
- `void fillRect(int x, int y, int width, int height, QBrush)`
- `QFont font(void)`
- `QFontInfo fontInfo(void)`
- `bool hasClipping(void)`
- `bool isActive(void)`
- `int layoutDirection(void)`
- `double opacity(void)`
- `QPaintEngine *paintEngine(void)`
- `QPen pen(void)`

- int renderHints(void)
- void resetTransform(void)
- void restore(void)
- void rotate(qreal angle)
- void save(void)
- void scale(double sx, double sy)
- void setBackground(QBrush brush)
- void setBackgroundMode(Qt::BGMode mode)
- void setBrush(QBrush brush)
- void setBrushOrigin(int x, int y)
- void setClipPath(QPainterPath path, Qt::ClipOperation operation)
- void setClipRect(int x, int y, int width, int height, Qt::ClipOperation operation)
- void setClipRegion(QRegion region, Qt::ClipOperation operation)
- void setClipping(bool enable)
- void setCompositionMode(QPainter::CompositionMode mode)
- void setFont(QFont font)
- void setLayoutDirection(Qt::LayoutDirection direction)
- void setOpacity(qreal opacity)
- void setPen(QPen pen)
- void setRenderHint(QPainter::RenderHint hint, bool on)
- void setTransform(QTransform transform, bool combine)
- void setViewTransformEnabled(bool enable)
- void setViewport(int x, int y, int width, int height)
- void setWindow(int x, int y, int width, int height)
- void setWorldMatrixEnabled(bool enable)
- void setWorldTransform(QTransform matrix, bool combine)
- void shear(double sh, double sv)
- void strokePath(QPainterPath path, QPen pen)
- bool testRenderHint(QPainter::RenderHint hint)
- QTransform transform(void)
- void translate(double dx, double dy)
- bool viewTransformEnabled(void)
- QRect viewport(void)
- QRect window(void)
- bool worldMatrixEnabled(void)
- QTransform worldTransform(void)

- void drawPolygon(List *pPoints, Qt::FillRule fillRule)
- void drawConvexPolygon(List *pPoints)
- void drawPoints(List *pPoints)
- void drawPolyline(List *pPoints)
- void drawHSVFLList(List *pPoints)
- void drawRGBFLList(List *pPoints)
- void drawHSVFLListAtXY(List *pPoints,int x,int y)
- void drawRGBFLListAtXY(List *pPoints,int x,int y)
- void drawBytes(int x, int y,const char *cData,int Width,int Height,int channels)

92.252 QPainter2 Class

Parameters : QPaintDevice *

Parent Class : QPainter

92.253 QPainterPath Class

C++ Reference : <http://doc.qt.io/qt-5/qpainterpath.html>

Parameters : void

- void addEllipse(qreal x, qreal y, qreal width, qreal height)
- void addPath(QPainterPath)
- void addPolygon(QPolygonF)
- void addRect(qreal x, qreal y, qreal width, qreal height)
- void addRegion(QRegion)
- void addRoundedRect(qreal x, qreal y, qreal w, qreal h, qreal xRadius, qreal yRadius, Qt::SizeMode mode)
- void addText(qreal x, qreal y, QFont, QString)
- qreal angleAtPercent(qreal t)
- void arcMoveTo(qreal x, qreal y, qreal width, qreal height, qreal angle)
- void arcTo(qreal x, qreal y, qreal width, qreal height, qreal startAngle, qreal sweepLength)
- QRectF boundingRect(void)
- void closeSubpath(void)
- void connectPath(QPainterPath)
- bool contains(QPointF)
- QRectF controlPointRect(void)
- void cubicTo(qreal c1X, qreal c1Y, qreal c2X, qreal c2Y, qreal endPointX, qreal endPointY)
- QPointF currentPosition(void)
- QPainterPath::Element elementAt(int index)

- int elementCount(void)
- Qt::FillRule fillRule(void)
- QPainterPath intersected(QPainterPath)
- bool intersects(QRectF)
- bool isEmpty(void)
- qreal length(void)
- void lineTo(qreal x, qreal y)
- void moveTo(qreal x, qreal y)
- qreal percentAtLength(qreal len)
- QPointF pointAtPercent(qreal t)
- void quadTo(qreal cx, qreal cy, qreal endPointX, qreal endPointY)
- void setElementPositionAt(int index, qreal x, qreal y)
- void setFillRule(Qt::FillRule fillRule)
- QPainterPath simplified(void)
- qreal slopeAtPercent(qreal t)
- QPainterPath subtracted(QPainterPath)
- void swap(QPainterPath)
- QPolygonF toFillPolygon(QTransform)
- QPainterPath toReversed(void)
- void translate(qreal dx, qreal dy)
- QPainterPath translated(qreal dx, qreal dy)
- QPainterPath united(QPainterPath)

92.254 QPen Class

C++ Reference : <http://doc.qt.io/qt-5/qpen.html>

Parameters : void

- QBrush brush(void)
- int capStyle(void)
- QColor color(void)
- double dashOffset(void)
- bool isCosmetic(void)
- bool isSolid(void)
- int joinStyle(void)
- double miterLimit(void)
- void setBrush(QBrush)

- void setCapStyle(Qt::PenCapStyle style)
- void setColor(QColor)
- void setCosmetic(bool cosmetic)
- void setDashOffset(double offset)
- void setJoinStyle(Qt::PenJoinStyle style)
- void setMiterLimit(double limit)
- void setStyle(Qt::PenStyle style)
- void setWidth(int width)
- void setWidthF(double width)
- int style(void)
- void swap(QPen)
- int width(void)
- double widthF(void)

92.255 QPerVertexColorMaterial Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qpervertexcolormaterial.html>

Parameters : Qt3DCore::QNode *

92.256 QPercentBarSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qpercentbarseries.html>

Parameters : QObject *

Parent Class : QAbstractBarSeries

- QAbstractSeries::SeriesType type(void)

92.257 QPhongMaterial Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qphongmaterial.html>

Parameters : Qt3DCore::QNode *

- QColor ambient(void)
- QColor diffuse(void)
- float shininess(void)
- QColor specular(void)
- void setAmbient(QColor ambient)
- void setDiffuse(QColor diffuse)
- void setShininess(float shininess)

- void setSpecular(QColor specular)

92.258 QPicture Class

C++ Reference : <http://doc.qt.io/qt-5/qpicture.html>

Parameters : void

- QRect boundingRect(void)
- const char *data(void)
- boolisNull(void)
- bool load(QString, const char *format) # In RingQt use : bool loadfile(QString, const char *format)
- bool play(QPainter *painter)
- bool save(QString , const char *format)
- void setBoundingRect(QRect)
- int size(void)
- void swap(QPicture)

92.259 QPieLegendMarker Class

C++ Reference : <http://doc.qt.io/qt-5/qpielegendmarker.html>

Parent Class : QLegendMarker

- QPieSlice * slice(void)

92.260 QPieSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qpieseries.html>

Parameters : QObject *

Parent Class : QAbstractSeries

- bool append_2(QList<QPieSlice *> slices)
- QPieSlice * append_3(QString label, qreal value)
- void clear(void)
- int count(void)
- qreal holeSize(void)
- qreal horizontalPosition(void)
- bool insert(int index, QPieSlice *slice)
- bool isEmpty(void)
- qreal pieEndAngle(void)
- qreal pieSize(void)

- qreal pieStartAngle(void)
- bool remove(QPieSlice *slice)
- void setHoleSize(qreal holeSize)
- void setHorizontalPosition(qreal relativePosition)
- void setLabelsPosition(QPieSlice::LabelPosition position)
- void setLabelsVisible(bool visible)
- void setPieEndAngle(qreal angle)
- void setPieSize(qreal relativeSize)
- void setPieStartAngle(qreal startAngle)
- void setVerticalPosition(qreal relativePosition)
- QList<QPieSlice *> slices(void)
- qreal sum(void)
- bool take(QPieSlice *slice)
- qreal verticalPosition(void)
- void setaddedEvent(const char *)
- void setclickedEvent(const char *)
- void setcountChangedEvent(const char *)
- void setdoubleClickedEvent(const char *)
- void sethoveredEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- void setremovedEvent(const char *)
- void setsumChangedEvent(const char *)
- const char *getaddedEvent(void)
- const char *getclickedEvent(void)
- const char *getcountChangedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethoveredEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)
- const char *getremovedEvent(void)
- const char *getsumChangedEvent(void)

92.261 QPieSlice Class

C++ Reference : <http://doc.qt.io/qt-5/qpieslice.html>

Parameters : QObject *

Parent Class : QObject

- QColor borderColor(void)
- int borderWidth(void)
- QBrush brush(void)
- QColor color(void)
- qreal explodeDistanceFactor(void)
- bool isExploded(void)
- bool isLabelVisible(void)
- QString label(void)
- qreal labelArmLengthFactor(void)
- QBrush labelBrush(void)
- QColor labelColor(void)
- QFont labelFont(void)
- QPieSlice::LabelPosition labelPosition(void)
- QPen pen(void)
- qreal percentage(void)
- QPieSeries * series(void)
- void setBorderColor(QColor color)
- void setBorderWidth(int width)
- void setBrush(QBrush brush)
- void setColor(QColor color)
- void setExplodeDistanceFactor(qreal factor)
- void setExploded(bool exploded)
- void setLabel(QString label)
- void setLabelArmLengthFactor(qreal factor)
- void setLabelBrush(QBrush brush)
- void setLabelColor(QColor color)
- void setLabelFont(QFont font)
- void setLabelPosition(QPieSlice::LabelPosition position)
- void setLabelVisible(bool visible)
- void setPen(QPen pen)
- void setValue(qreal value)

- qreal startAngle(void)
- qreal value(void)
- void setangleSpanChangedEvent(const char *)
- void setborderColorChangedEvent(const char *)
- void setborderWidthChangedEvent(const char *)
- void setbrushChangedEvent(const char *)
- void setclickedEvent(const char *)
- void setcolorChangedEvent(const char *)
- void setdoubleClickedEvent(const char *)
- void sethoveredEvent(const char *)
- void setlabelBrushChangedEvent(const char *)
- void setlabelChangedEvent(const char *)
- void setlabelColorChangedEvent(const char *)
- void setlabelFontChangedEvent(const char *)
- void setlabelVisibleChangedEvent(const char *)
- void setpenChangedEvent(const char *)
- void setpercentageChangedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- void setstartAngleChangedEvent(const char *)
- void setvalueChangedEvent(const char *)
- const char *getangleSpanChangedEvent(void)
- const char *getborderColorChangedEvent(void)
- const char *getborderWidthChangedEvent(void)
- const char *getbrushChangedEvent(void)
- const char *getclickedEvent(void)
- const char *getcolorChangedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethoveredEvent(void)
- const char *getlabelBrushChangedEvent(void)
- const char *getlabelChangedEvent(void)
- const char *getlabelColorChangedEvent(void)
- const char *getlabelFontChangedEvent(void)
- const char *getlabelVisibleChangedEvent(void)
- const char *getpenChangedEvent(void)
- const char *getpercentageChangedEvent(void)

- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)
- const char *getstartAngleChangedEvent(void)
- const char *getvalueChangedEvent(void)

92.262 QPixmap Class

C++ Reference : <http://doc.qt.io/qt-5/q pixmap.html>

Parameters : const char *

- QPixmap transformed(QTransform transform, Qt::TransformationMode mode)
- QPixmap copy(int x, int y, int width, int height)
- QPixmap scaled(int width, int height, Qt::AspectRatioMode aspectRatioMode, Qt::TransformationMode transformMode)
- int width(void)
- int height(void)
- QBitmap createMaskFromColor(QColor , Qt::MaskMode)
- QBitmap mask(void)
- void setMask(QBitmap)
- void fill(QColor)
- QPixmap fromImage(QImage,Qt::ImageConversionFlags)
- bool load(QString, const char *, Qt::ImageConversionFlags)
- qint64 cacheKey(void)
- bool convertFromImage(QImage image, Qt::ImageConversionFlags flags)
- QPixmap copy_2(QRect rectangle)
- QBitmap createHeuristicMask(bool clipTight)
- int depth(void)
- void detach(void)
- qreal devicePixelRatio(void)
- bool hasAlpha(void)
- bool hasAlphaChannel(void)
- boolisNull(void)
- bool isQBitmap(void)
- bool loadFromData(uchar *data, uint len, char *format, Qt::ImageConversionFlags flags)
- bool loadFromData_2(QByteArray data, char *format, Qt::ImageConversionFlags flags)
- QRect rect(void)
- bool save(QString fileName, char *format, int quality)
- bool save_2(QIODevice *device, char *format, int quality)

- QPixmap scaled_2(QSize size, Qt::AspectRatioMode aspectRatioMode, Qt::TransformationMode transformMode)
- QPixmap scaledToHeight(int height, Qt::TransformationMode mode)
- QPixmap scaledToWidth(int width, Qt::TransformationMode mode)
- void scroll(int dx, int dy, int x, int y, int width, int height, QRegion *exposed)
- void scroll_2(int dx, int dy, QRect rect, QRegion *exposed)
- void setDevicePixelRatio(qreal scaleFactor)
- QSize size(void)
- void swap(QPixmap other)
- QImage toImage(void)
- QPixmap transformed_2(QTransform matrix, Qt::TransformationMode mode)
- int defaultDepth(void)
- QPixmap fromImage_2(QImage image, Qt::ImageConversionFlags flags)
- QPixmap fromImageReader(QImageReader *imageReader, Qt::ImageConversionFlags flags)
- QTransform trueMatrix(QTransform matrix, int width, int height)

92.263 QPixmap2 Class

Parameters : int width, int height

Parent Class : QPixmap

92.264 QPlainTextEdit Class

C++ Reference : <http://doc.qt.io/qt-5/qplaintextedit.html>

Parameters : QWidget *

Parent Class : QAbstractScrollArea

- void setTabStopDistance(qreal width)
- qreal tabStopDistance(void)
- QString anchorAt(QPoint pos)
- bool backgroundVisible(void)
- int blockCount(void)
- bool canPaste(void)
- bool centerOnScroll(void)
- QMenu * createStandardContextMenu(void)
- QTextCharFormat currentCharFormat(void)
- QTextCursor cursorForPosition(QPoint pos)
- QRect cursorRect(QTextCursor cursor)

- `QRect cursorRect_2(void)`
- `int cursorWidth(void)`
- `QTextDocument * document(void)`
- `QString documentTitle(void)`
- `void ensureCursorVisible(void)`
- `QList<QTextEdit::ExtraSelection> extraSelections(void)`
- `bool find(QString exp, QTextDocument::FindFlags options)`
- `bool isReadOnly(void)`
- `bool isUndoRedoEnabled(void)`
- `QPlainTextEdit::LineWrapMode lineWrapMode(void)`
- `int maximumBlockCount(void)`
- `void mergeCurrentCharFormat(QTextCharFormat modifier)`
- `void moveCursor(QTextCursor::MoveOperation operation, QTextCursor::MoveMode mode)`
- `bool overwriteMode(void)`
- `void print(QPagedPaintDevice *printer)`
- `void setBackgroundVisible(bool visible)`
- `void setCenterOnScroll(bool enabled)`
- `void setCurrentCharFormat(QTextCharFormat format)`
- `void setCursorWidth(int width)`
- `void setDocument(QTextDocument *document)`
- `void setDocumentTitle(QString title)`
- `void setExtraSelections(QList<QTextEdit::ExtraSelection> selections)`
- `void setLineWrapMode(QPlainTextEdit::LineWrapMode mode)`
- `void setMaximumBlockCount(int maximum)`
- `void setOverwriteMode(bool overwrite)`
- `void setReadOnly(bool ro)`
- `void setTabChangesFocus(bool b)`
- `void setTextCursor(QTextCursor cursor)`
- `void setTextInteractionFlags(Qt::TextInteractionFlags flags)`
- `void setUndoRedoEnabled(bool enable)`
- `void setWordWrapMode(QTextOption::WrapMode policy)`
- `bool tabChangesFocus(void)`
- `QTextCursor textCursor(void)`
- `Qt::TextInteractionFlags textInteractionFlags(void)`
- `QString toPlainText(void)`
- `QTextOption::WrapMode wordWrapMode(void)`

- void appendHtml(QString html)
- void appendPlainText(QString text)
- void centerCursor(void)
- void clear(void)
- void copy(void)
- void cut(void)
- void insertPlainText(QString text)
- void paste(void)
- void redo(void)
- void selectAll(void)
- void setPlainText(QString text)
- void undo(void)
- void zoomIn(int range)
- void zoomOut(int range)
- void setblockCountChangedEvent(const char *cStr)
- void setcopyAvailableEvent(const char *cStr)
- void setcursorPositionChangedEvent(const char *cStr)
- void setmodificationChangedEvent(const char *cStr)
- void setredoAvailableEvent(const char *cStr)
- void setselectionChangedEvent(const char *cStr)
- void settextChangedEvent(const char *cStr)
- void setundoAvailableEvent(const char *cStr)
- void setupdateRequestEvent(const char *cStr)
- const char *getblockCountChangedEvent(void)
- const char *getcopyAvailableEvent(void)
- const char *getcursorPositionChangedEvent(void)
- const char *getmodificationChangedEvent(void)
- const char *getredoAvailableEvent(void)
- const char *getselectionChangedEvent(void)
- const char *gettextChangedEvent(void)
- const char *getundoAvailableEvent(void)
- const char *getupdateRequestEvent(void)
- void cyanline(void)
- void setactivelinecolor(QColor)

92.265 QPlaneMesh Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qplanemesh.html>

Parameters : Qt3DCore::QNode *

- float height(void)
- QSize meshResolution(void)
- bool mirrored(void)
- float width(void)
- void setHeight(float height)
- void setMeshResolution(QSize resolution)
- void setMirrored(bool mirrored)
- void setWidth(float width)

92.266 QPoint Class

C++ Reference : <http://doc.qt.io/qt-5/qpoint.html>

Parameters : void

- boolisNull(void)
- int manhattanLength(void)
- int rx(void)
- int ry(void)
- void setX(int x)
- void setY(int y)
- int x(void)
- int y(void)

92.267 QPointF Class

C++ Reference : <http://doc.qt.io/qt-5/qpointf.html>

Parameters : void

- boolisNull(void)
- qreal manhattanLength(void)
- qreal rx(void)
- qreal ry(void)
- void setX(qreal x)
- void setY(qreal y)
- QPoint toPoint(void)

- qreal x(void)
- qreal y(void)

92.268 QPointLight Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qpointlight.html>

Parameters : Qt3DCore::QNode *

- float constantAttenuation(void)
- float linearAttenuation(void)
- float quadraticAttenuation(void)
- void setConstantAttenuation(float value)
- void setLinearAttenuation(float value)
- void setQuadraticAttenuation(float value)
- void setColor(QColor)
- void setIntensity(float intensity)

92.269 QPolarChart Class

C++ Reference : <http://doc.qt.io/qt-5/qpolarchart.html>

Parameters : QGraphicsItem *,Qt::WindowFlags

Parent Class : QChart

- QList<QAbstractAxis *> axes(QPolarChart::PolarOrientations polarOrientation, QAbstractSeries *series)

92.270 QPrintDialog Class

C++ Reference : <http://doc.qt.io/qt-5/qprintdialog.html>

Parameters : QPrinter *,QWidget *

Parent Class : QAbstractPrintDialog

- void open(QObject * receiver, char * member)
- QAbstractPrintDialog::PrintDialogOptions options(void)
- QPrinter * printer(void)
- void setOption(QAbstractPrintDialog::PrintDialogOption option, bool on)
- void setOptions(QAbstractPrintDialog::PrintDialogOptions options)
- bool testOption(QAbstractPrintDialog::PrintDialogOption option)
- void setAcceptedEvent(const char *)
- const char *getAcceptedEvent(void)

92.271 QPrintPreviewDialog Class

C++ Reference : <http://doc.qt.io/qt-5/qprintpreviewdialog.html>

Parameters : QPrinter *

Parent Class : QDialog

- void open(QObject * receiver, char * member)
- QPrinter * printer(void)
- void setpaintRequestedEvent(const char *)
- const char *getpaintRequestedEvent(void)

92.272 QPrintPreviewWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qprintpreviewwidget.html>

Parameters : QPrinter *

Parent Class : QWidget

- int currentPage(void)
- QPrinter::Orientation orientation(void)
- int pageCount(void)
- QPrintPreviewWidget::ViewMode viewMode(void)
- qreal zoomFactor(void)
- QPrintPreviewWidget::ZoomMode zoomMode(void)
- void fitInView(void)
- void fitToWidth(void)
- void print(void)
- void setAllPagesViewMode(void)
- void setCurrentPage(int page)
- void setFacingPagesViewMode(void)
- void setLandscapeOrientation(void)
- void setOrientation(QPrinter::Orientation orientation)
- void setPortraitOrientation(void)
- void setSinglePageViewMode(void)
- void setViewMode(QPrintPreviewWidget::ViewMode mode)
- void setZoomFactor(qreal factor)
- void setZoomMode(QPrintPreviewWidget::ZoomMode zoomMode)
- void updatePreview(void)
- void zoomIn(qreal factor)
- void zoomOut(qreal factor)

- void setpaintRequestedEvent(const char *)
- void setpreviewChangedEvent(const char *)
- const char *getpaintRequestedEvent(void)
- const char *getpreviewChangedEvent(void)

92.273 QPrinter Class

C++ Reference : <http://doc.qt.io/qt-5/qprinter.html>

Parameters : QPrinter::PrinterMode

- bool abort(void)
- bool collateCopies(void)
- int colorMode(void)
- int copyCount(void)
- QString creator(void)
- QString docName(void)
- int duplex(void)
- bool fontEmbeddingEnabled(void)
- int fromPage(void)
- bool fullPage(void)
- bool isValid(void)
- QString outputFileName(void)
- int outputFormat(void)
- QRectF pageRect(QPrinter::Unit unit)
- QRectF paperRect(QPrinter::Unit unit)
- int paperSource(void)
- QPrintEngine *printEngine(void)
- QString printProgram(void)
- int printRange(void)
- QString printerName(void)
- QString printerSelectionOption(void)
- int printerState(void)
- int resolution(void)
- void setCollateCopies(bool collate)
- void setColorMode(QPrinter::ColorMode newColorMode)
- void setCopyCount(int count)
- void setCreator(QString)

- void setDocName(QString)
- void setDuplex(QPrinter::DuplexMode duplex)
- void setFontEmbeddingEnabled(bool enable)
- void setFromTo(int from, int to)
- void setFullPage(bool fp)
- void setOutputFileName(QString)
- void setOutputFormat(QPrinter::OutputFormat format)
- void setPrintProgram(QString)
- void setPrintRange(QPrinter::PrintRange)
- void setPrinterName(QString)
- void setPrinterSelectionOption(QString)
- void setResolution(int dpi)
- bool supportsMultipleCopies(void)
- int toPage(void)
- bool newPage(void)
- QPaintEngine *paintEngine(void)
- void setPageSizeMM(QSizeF)

92.274 QPrinterInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qprinterinfo.html>

Parameters : void

- QString description(void)
- bool isDefault(void)
- boolisNull(void)
- QString location(void)
- QString makeAndModel(void)
- QString printerName(void)
- QPrinterInfo printerInfo(QString printerName)

92.275 QProcess Class

C++ Reference : <http://doc.qt.io/qt-5/qprocess.html>

Parameters : QObject *

Parent Class : QIODevice

- QStringList arguments(void)
- void closeReadChannel(QProcess::ProcessChannel channel)
- void closeWriteChannel(void)
- QProcess::ProcessError error(void)
- int exitCode(void)
- QProcess::ExitStatus exitStatus(void)
- QProcess::InputChannelMode inputChannelMode(void)
- QProcess::ProcessChannelMode processChannelMode(void)
- QProcessEnvironment processEnvironment(void)
- QString program(void)
- QByteArray readAllStandardError(void)
- QByteArray readAllStandardOutput(void)
- QProcess::ProcessChannel readChannel(void)
- void setArguments(QStringList arguments)
- void setInputChannelMode(QProcess::InputChannelMode mode)
- void setProcessChannelMode(QProcess::ProcessChannelMode mode)
- void setProcessEnvironment(QProcessEnvironment environment)
- void setProgram(QString program)
- void setReadChannel(QProcess::ProcessChannel channel)
- void setStandardErrorFile(QString fileName, QIODevice::OpenMode mode)
- void setStandardInputFile(QString fileName)
- void setStandardOutputFile(QString fileName, QIODevice::OpenMode mode)
- void setStandardOutputProcess(QProcess *destination)
- void setWorkingDirectory(QString dir)
- void start(QString program, QStringList arguments, QIODevice::OpenMode mode)
- void start_3(QIODevice::OpenMode mode)
- QProcess::ProcessState state(void)
- bool waitForFinished(int msecs)
- bool waitForStarted(int msecs)
- QString workingDirectory(void)
- void kill(void)

- void terminate(void)
- void setreadyReadStandardErrorEvent(const char *)
- void setreadyReadStandardOutputEvent(const char *)
- const char *getreadyReadStandardErrorEvent(void)
- const char *getreadyReadStandardOutputEvent(void)

92.276 QProgressBar Class

C++ Reference : <http://doc.qt.io/qt-5/qprogressbar.html>

Parameters : QWidget *parent

Parent Class : QWidget

- int alignment(void)
- QString format(void)
- bool invertedAppearance(void)
- bool isTextVisible(void)
- int maximum(void)
- int minimum(void)
- int orientation(void)
- void resetFormat(void)
- void setAlignment(Qt::AlignmentFlag alignment)
- void setFormat(QString)
- void setInvertedAppearance(bool invert)
- void setTextDirection(QProgressBar::Direction textDirection)
- void setTextVisible(bool visible)
- QString text(void)
- int textDirection(void)
- int value(void)
- void reset(void)
- void setMaximum(int maximum)
- void setMinimum(int minimum)
- void setOrientation(Qt::Orientation)
- void setRange(int minimum, int maximum)
- void setValue(int value)
- void setvalueChangedEvent(const char *)
- const char *getvalueChangedEvent(void)

92.277 QPushButton Class

C++ Reference : <http://doc.qt.io/qt-5/qpushbutton.html>

Parameters : QWidget *

Parent Class : QAbstractButton

- void setText(const char *)
- void setClickEvent(const char *)
- void setIcon(QIcon)
- void setIconSize(QSize)
- const char *getClickEvent(void)

92.278 QQmlEngine Class

C++ Reference : <http://doc.qt.io/qt-5/qqmlengine.html>

Parameters : QObject *

- void addImageProvider(QString providerId, QQmlImageProviderBase *provider)
- void addImportPath(QString path)
- void addPluginPath(QString path)
- QUrl baseUrl(void)
- void clearComponentCache(void)
- QQmlImageProviderBase *imageProvider(QString providerId)
- QStringList importPathList(void)
- bool importPlugin(QString filePath, QString uri, QList<QQmlError> *errors)
- QQmlIncubationController *incubationController(void)
- QNetworkAccessManager *networkAccessManager(void)
- QQmlNetworkAccessManagerFactory *networkAccessManagerFactory(void)
- QString offlineStorageDatabaseFilePath(QString databaseName)
- QString offlineStoragePath(void)
- bool outputWarningsToStandardError(void)
- QStringList pluginPathList(void)
- void removeImageProvider(QString providerId)
- QQmlContext *rootContext(void)
- void setBaseUrl(QUrl url)
- void setImportPathList(QStringList paths)
- void setIncubationController(QQmlIncubationController *controller)
- void setNetworkAccessManagerFactory(QQmlNetworkAccessManagerFactory *factory)
- void setOfflineStoragePath(QString dir)

- void setOutputWarningsToStandardError(bool enabled)
- void setPluginPathList(QStringList paths)
- void trimComponentCache(void)
- void retranslate(void)
- QQmlContext * contextForObject(QObject *object)
- QQmlEngine::ObjectOwnership objectOwnership(QObject *object)
- void setContextForObject(QObject *object, QQmlContext *context)
- void setObjectOwnership(QObject *object, QQmlEngine::ObjectOwnership ownership)

92.279 QQmlError Class

C++ Reference : <http://doc.qt.io/qt-5/qqmlerror.html>

Parameters : void

- int column(void)
- QString description(void)
- bool isValid(void)
- int line(void)
- QObject * object(void)
- void setColumn(int column)
- void setDescription(QString description)
- void setLine(int line)
- void setObject(QObject *object)
- void setUrl(QUrl url)
- QString toString(void)
- QUrl url(void)

92.280 QQuaternion Class

C++ Reference : <http://doc.qt.io/qt-5/qquaternion.html>

Parameters : float,float,float,float

- boolisNull(void)
- float length(void)
- float lengthSquared(void)
- void normalize(void)
- QQuaternion normalized(void)
- QVector3D rotatedVector(QVector3D vector)
- float scalar(void)

- void setScalar(float scalar)
- void setVector(QVector3D vector)
- void setVector_2(float x, float y, float z)
- void setX(float x)
- void setY(float y)
- void setZ(float z)
- QVector3D vector(void)
- float x(void)
- float y(void)
- float z(void)
- QQuaternion fromAxisAndAngle_2(float x, float y, float z, float angle)
- QQuaternion nlerp(QQuaternion q1, QQuaternion q2, float t)
- QQuaternion slerp(QQuaternion q1, QQuaternion q2, float t)

92.281 QQuickView Class

C++ Reference : <http://doc.qt.io/qt-5/qquickview.html>

Parameters : void

Parent Class : QWindow

- QQmlEngine *engine(void)
- QList<QQmlError> errors(void)
- QSize initialSize(void)
- QQuickWidget::ResizeMode resizeMode(void)
- QQmlContext *rootContext(void)
- QQuickItem *rootObject(void)
- void setFormat(QSurfaceFormat format)
- void setResizeMode(QQuickView::ResizeMode)
- QUrl source(void)
- QQuickWidget::Status status(void)
- void setSource(QUrl url)

92.282 QQuickWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qquickwidget.html>

Parameters : QWidget *

Parent Class : QWidget

- QQmlEngine *engine(void)
- QList<QQmlError> errors(void)
- QSurfaceFormat format(void)
- QImage grabFramebuffer(void)
- QSize initialSize(void)
- QQuickWindow *quickWindow(void)
- QQuickWidget::ResizeMode resizeMode(void)
- QQmlContext *rootContext(void)
- QQuickItem *rootObject(void)
- void setClearColor(QColor color)
- void setFormat(QSurfaceFormat format)
- void setResizeMode(QQuickWidget::ResizeMode)
- QUrl source(void)
- QQuickWidget::Status status(void)
- void setSource(QUrl url)
- void setSceneGraphErrorEvent(const char *)
- void setStatusChangedEvent(const char *)
- const char *getSceneGraphErrorEvent(void)
- const char *getStatusChangedEvent(void)

92.283 QRadioButton Class

C++ Reference : <http://doc.qt.io/qt-5/qradiobutton.html>

Parameters : QWidget *parent

Parent Class : QAbstractButton

- QSize minimumSizeHint(void)
- QSize sizeHint(void)
- void setClickedEvent(const char *)
- void setPressedEvent(const char *)
- void setReleasedEvent(const char *)
- void setToggledEvent(const char *)
- const char *getClickedEvent(void)

- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)
- const char *gettoggledEvent(void)

92.284 QRect Class

C++ Reference : <http://doc.qt.io/qt-5/qrect.html>

Parameters : void

- void adjust(int dx1, int dy1, int dx2, int dy2)
- QRect adjusted(int dx1, int dy1, int dx2, int dy2)
- int bottom(void)
- QPoint bottomLeft(void)
- QPoint bottomRight(void)
- QPoint center(void)
- bool contains(int x, int y, bool proper)
- void getCoords(int *x1, int *y1, int *x2, int *y2)
- void getRect(int *x, int *y, int *width, int *height)
- int height(void)
- QRect intersected(QRect)
- bool intersects(QRect)
- bool isEmpty(void)
- boolisNull(void)
- bool isValid(void)
- int left(void)
- void moveBottom(int y)
- void moveBottomLeft(QPoint)
- void moveBottomRight(QPoint)
- void moveCenter(QPoint)
- void moveLeft(int x)
- void moveRight(int x)
- void moveTo(int x, int y)
- void moveTop(int y)
- void moveTopLeft(QPoint)
- void moveTopRight(QPoint)
- QRect normalized(void)
- int right(void)

- void setBottom(int y)
- void setBottomLeft(QPoint)
- void setBottomRight(QPoint)
- void setCoords(int x1, int y1, int x2, int y2)
- void setHeight(int height)
- void setLeft(int x)
- void setRect(int x, int y, int width, int height)
- void setRight(int x)
- void setSize(QSize)
- void setTop(int y)
- void setTopLeft(QPoint)
- void setTopRight(QPoint)
- void setWidth(int width)
- void setX(int x)
- void setY(int y)
- QSize size(void)
- int top(void)
- QPoint topLeft(void)
- QPoint topRight(void)
- void translate(int dx, int dy)
- QRect translated(int dx, int dy)
- QRect united(QRect)
- int width(void)
- int x(void)
- int y(void)

92.285 QRectF Class

C++ Reference : <http://doc.qt.io/qt-5/qrectf.html>

Parameters : qreal,qreal,qreal,qreal

- void adjust(qreal dx1, qreal dy1, qreal dx2, qreal dy2)
- QRectF adjusted(qreal dx1, qreal dy1, qreal dx2, qreal dy2)
- qreal bottom(void)
- QPointF bottomLeft(void)
- QPointF bottomRight(void)
- QPointF center(void)

- bool contains(QPointF point)
- bool contains_2(QRectF rectangle)
- bool contains_3(qreal x, qreal y)
- void getCoords(qreal *x1, qreal *y1, qreal *x2, qreal *y2)
- void getRect(qreal *x, qreal *y, qreal *width, qreal *height)
- qreal height(void)
- QRectF intersected(QRectF rectangle)
- bool intersects(QRectF rectangle)
- bool isEmpty(void)
- boolisNull(void)
- bool isValid(void)
- qreal left(void)
- QRectF marginsAdded(QMarginsF margins)
- QRectF marginsRemoved(QMarginsF margins)
- void moveBottom(qreal y)
- void moveBottomLeft(QPointF position)
- void moveBottomRight(QPointF position)
- void moveCenter(QPointF position)
- void moveLeft(qreal x)
- void moveRight(qreal x)
- void moveTo(qreal x, qreal y)
- void moveTo_2(QPointF position)
- void moveTop(qreal y)
- void moveTopLeft(QPointF position)
- void moveTopRight(QPointF position)
- QRectF normalized(void)
- qreal right(void)
- void setBottom(qreal y)
- void setBottomLeft(QPointF position)
- void setBottomRight(QPointF position)
- void setCoords(qreal x1, qreal y1, qreal x2, qreal y2)
- void setHeight(qreal height)
- void setLeft(qreal x)
- void setRect(qreal x, qreal y, qreal width, qreal height)
- void setRight(qreal x)
- void setSize(QSizeF size)

- void setTop(qreal y)
- void setTopLeft(QPointF position)
- void setTopRight(QPointF position)
- void setWidth(qreal width)
- void setX(qreal x)
- void setY(qreal y)
- QSizeF size(void)
- QRect toAlignedRect(void)
- qreal top(void)
- QPointF topLeft(void)
- QPointF topRight(void)
- void translate(qreal dx, qreal dy)
- void translate_2(QPointF offset)
- QRectF translated(qreal dx, qreal dy)
- QRectF translated_2(QPointF offset)
- QRectF transposed(void)
- QRectF united(QRectF rectangle)
- qreal width(void)
- qreal x(void)
- qreal y(void)

92.286 QRegExp Class

C++ Reference : <http://doc.qt.io/qt-5/qregexp.html>

Parameters : void

- QString cap(int nth)
- int captureCount(void)
- QStringList capturedTexts(void)
- Qt::CaseSensitivity caseSensitivity(void)
- QString errorString(void)
- bool exactMatch(QString str)
- int indexIn(QString str, int offset, QRegExp::CaretMode caretMode)
- bool isEmpty(void)
- bool isMinimal(void)
- bool isValid(void)
- int lastIndexIn(QString str, int offset, QRegExp::CaretMode caretMode)

- int matchedLength(void)
- QString pattern(void)
- QRegExp::PatternSyntax patternSyntax(void)
- int pos(int nth)
- void setCaseSensitivity(Qt::CaseSensitivity cs)
- void setMinimal(bool minimal)
- void setPattern(QString pattern)
- void setPatternSyntax(QRegExp::PatternSyntax syntax)
- void swap(QRegExp other)

92.287 QRegion Class

C++ Reference : <http://doc.qt.io/qt-5/qregion.html>

Parameters : void

- QRect boundingRect(void)
- bool contains(QPoint p)
- bool contains_2(QRect r)
- QRegion intersected(QRegion r)
- QRegion intersected_2(QRect rect)
- bool intersects(QRegion region)
- bool intersects_2(QRect rect)
- bool isEmpty(void)
- boolisNull(void)
- int rectCount(void)
- void setRects(QRect *rects, int number)
- QRegion subtracted(QRegion r)
- void swap(QRegion other)
- void translate(int dx, int dy)
- void translate_2(QPoint point)
- QRegion translated(int dx, int dy)
- QRegion translated_2(QPoint p)
- QRegion united(QRegion r)
- QRegion united_2(QRect rect)
- QRegion xored(QRegion r)

92.288 QRegularExpression Class

C++ Reference : <http://doc.qt.io/qt-5/qregularexpression.html>

Parameters : void

- int captureCount(void)
- QString errorString(void)
- QRegularExpressionMatchIterator globalMatch(QString subject, int offset, QRegularExpression::MatchType matchType, QRegularExpression::MatchOptions matchOptions)
- bool isValid(void)
- QRegularExpressionMatch match(QString subject, int offset, QRegularExpression::MatchType matchType, QRegularExpression::MatchOptions matchOptions)
- QStringList namedCaptureGroups(void)
- QString pattern(void)
- int patternErrorOffset(void)
- QRegularExpression::PatternOptions patternOptions(void)
- void setPattern(QString pattern)
- void setPatternOptions(QRegularExpression::PatternOptions options)
- void swap(QRegularExpression other)

92.289 QRegularExpressionMatch Class

C++ Reference : <http://doc.qt.io/qt-5/qregularexpressionmatch.html>

Parameters : void

- QString captured(int nth)
- QString captured_2(const QString name)
- int capturedEnd(int nth)
- int capturedEnd_2(const QString name)
- int capturedLength(int nth)
- int capturedLength_2(const QString name)
- QStringRef capturedRef(int nth)
- QStringRef capturedRef_2(const QString name)
- int capturedStart(int nth)
- int capturedStart_2(const QString name)
- QStringList capturedTexts(void)
- bool hasMatch(void)
- bool hasPartialMatch(void)
- bool isValid(void)

- int lastCapturedIndex(void)
- QRegularExpression::MatchOptions matchOptions(void)
- QRegularExpression::MatchType matchType(void)
- QRegularExpression regularExpression(void)
- void swap(QRegularExpressionMatch other)

92.290 QRegularExpressionMatchIterator Class

C++ Reference : <http://doc.qt.io/qt-5/qregularexpressionmatchiterator.html>

Parameters : void

- bool hasNext(void)
- bool isValid(void)
- QRegularExpression::MatchOptions matchOptions(void)
- QRegularExpression::MatchType matchType(void)
- QRegularExpressionMatch next(void) # In RingQt use : QRegularExpressionMatch nextItem(void)
- QRegularExpressionMatch peekNext(void)
- QRegularExpression regularExpression(void)
- void swap(QRegularExpressionMatchIterator other)

92.291 QRenderAspect Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qrenderspect.html>

Parameters : QObject *

92.292 QRenderPass Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qrenderpass.html>

Parameters : Qt3DCore::QNode *

- void addFilterKey(Qt3DRender::QFilterKey *filterKey)
- void addParameter(Qt3DRender::QParameter *parameter)
- void addRenderState(Qt3DRender::QRenderState *state)
- QVector<Qt3DRender::QFilterKey *> filterKeys(void)
- QVector<Qt3DRender::QParameter *> parameters(void)
- void removeFilterKey(Qt3DRender::QFilterKey *filterKey)
- void removeParameter(Qt3DRender::QParameter *parameter)
- void removeRenderState(Qt3DRender::QRenderState *state)
- QVector<Qt3DRender::QRenderState *> renderStates(void)

- Qt3DRender::QShaderProgram * shaderProgram(void)
- void setShaderProgram(Qt3DRender::QShaderProgram *shaderProgram)

92.293 QScatterSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qscatterseries.html>

Parameters : QObject *

Parent Class : QXYSeries

- QBrush brush(void)
- QScatterSeries::MarkerShape markerShape(void)
- qreal markerSize(void)
- void setBorderColor(QColor color)
- void setMarkerShape(QScatterSeries::MarkerShape shape)
- void setMarkerSize(qreal size)
- void setborderColorChangedEvent(const char *)
- void setcolorChangedEvent(const char *)
- void setmarkerShapeChangedEvent(const char *)
- void setmarkerSizeChangedEvent(const char *)
- const char *getborderColorChangedEvent(void)
- const char *getcolorChangedEvent(void)
- const char *getmarkerShapeChangedEvent(void)
- const char *getmarkerSizeChangedEvent(void)

92.294 QSceneLoader Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qsceneloader.html>

Parameters : Qt3DCore::QNode *

Parent Class : QComponent

- Qt3DCore::QComponent * component(QString entityName, Qt3DRender::QSceneLoader::ComponentType componentType)
- Qt3DCore::QEntity * entity(QString entityName)
- QStringList entityNames(void)
- QUrl source(void)
- Qt3DRender::QSceneLoader::Status status(void)
- void setSource(QUrl arg)

92.295 QScreen Class

C++ Reference : <http://doc.qt.io/qt-5/qscreen.html>

- int angleBetween(Qt::ScreenOrientation a, Qt::ScreenOrientation b)
- QRect availableGeometry(void)
- QSize availableSize(void)
- QRect availableVirtualGeometry(void)
- QSize availableVirtualSize(void)
- int depth(void)
- qreal devicePixelRatio(void)
- QRect geometry(void)
- QPixmap grabWindow(int window, int x, int y, int width, int height)
- QPixmap grabWindow_2(int window)
- QPlatformScreen * handle(void)
- bool isLandscape(Qt::ScreenOrientation o)
- bool isPortrait(Qt::ScreenOrientation o)
- qreal logicalDotsPerInch(void)
- qreal logicalDotsPerInchX(void)
- qreal logicalDotsPerInchY(void)
- QRect mapBetween(Qt::ScreenOrientation a, Qt::ScreenOrientation b, QRect rect)
- QString name(void)
- Qt::ScreenOrientation nativeOrientation(void)
- Qt::ScreenOrientation orientation(void)
- Qt::ScreenOrientations orientationUpdateMask(void)
- qreal physicalDotsPerInch(void)
- qreal physicalDotsPerInchX(void)
- qreal physicalDotsPerInchY(void)
- QSizeF physicalSize(void)
- Qt::ScreenOrientation primaryOrientation(void)
- qreal refreshRate(void)
- void setOrientationUpdateMask(Qt::ScreenOrientations mask)
- QSize size(void)
- QTransform transformBetween(Qt::ScreenOrientation a, Qt::ScreenOrientation b, QRect target)

92.296 QScrollArea Class

C++ Reference : <http://doc.qt.io/qt-5/qscrollarea.html>

Parameters : QWidget *parent

Parent Class : QAbstractScrollArea

- Qt::Alignment alignment(void)
- void ensureVisible(int x, int y, int xmargin , int ymargin)
- void ensureWidgetVisible(QWidget *childWidget, int xmargin , int ymargin)
- void setAlignment(Qt::Alignment)
- void setWidget(QWidget *widget)
- void setWidgetResizable(bool resizable)
- QWidget *takeWidget(void)
- QWidget *widget(void)
- bool widgetResizable(void)

92.297 QScrollBar Class

C++ Reference : <http://doc.qt.io/qt-5/qscrollbar.html>

Parameters : QWidget *parent

Parent Class : QAbstractSlider

92.298 QSerialPort Class

C++ Reference : <http://doc.qt.io/qt-5/qserialport.html>

Parameters : QObject *

Parent Class : QIODevice

- qint32 baudRate(QSerialPort::Directions directions)
- bool clear(QSerialPort::Directions directions)
- void clearError(void)
- QSerialPort::DataBits dataBits(void)
- QSerialPort::SerialPortError error(void)
- QSerialPort::FlowControl flowControl(void)
- bool flush(void)
- void *handle(void)
- bool isDataTerminalReady(void)
- bool isRequestToSend(void)
- QSerialPort::Parity parity(void)

- `QSerialPort::PinoutSignals pinoutSignals(void)`
- `QString portName(void)`
- `qint64 readBufferSize(void)`
- `bool setBaudRate(qint32 baudRate, QSerialPort::Directions directions)`
- `bool setBreakEnabled(bool set)`
- `bool setDataBits(QSerialPort::DataBits dataBits)`
- `bool setDataTerminalReady(bool set)`
- `bool setFlowControl(QSerialPort::FlowControl flowControl)`
- `bool setParity(QSerialPort::Parity parity)`
- `void setPort(QSerialPortInfo serialPortInfo)`
- `void setPortName(QString name)`
- `void setReadBufferSize(qint64 size)`
- `bool setRequestToSend(bool set)`
- `bool setStopBits(QSerialPort::StopBits stopBits)`
- `QSerialPort::StopBits stopBits(void)`
- `void setbaudRateChangedEvent(const char *)`
- `void setbreakEnabledChangedEvent(const char *)`
- `void setdataBitsChangedEvent(const char *)`
- `void setdataTerminalReadyChangedEvent(const char *)`
- `void seterrorEvent(const char *)`
- `void setflowControlChangedEvent(const char *)`
- `void setparityChangedEvent(const char *)`
- `void setrequestToSendChangedEvent(const char *)`
- `void setstopBitsChangedEvent(const char *)`
- `const char *getbaudRateChangedEvent(void)`
- `const char *getbreakEnabledChangedEvent(void)`
- `const char *getdataBitsChangedEvent(void)`
- `const char *getdataTerminalReadyChangedEvent(void)`
- `const char *geterrorEvent(void)`
- `const char *getflowControlChangedEvent(void)`
- `const char *getparityChangedEvent(void)`
- `const char *getrequestToSendChangedEvent(void)`
- `const char *getstopBitsChangedEvent(void)`

92.299 QSerialPortInfo Class

C++ Reference : <http://doc.qt.io/qt-5/qserialportinfo.html>

Parameters : void

- QString description(void)
- bool hasProductIdentifier(void)
- bool hasVendorIdentifier(void)
- boolisNull(void)
- QString manufacturer(void)
- QString portName(void)
- quint16 productIdentifier(void)
- void swap(QSerialPortInfo other)
- QString systemLocation(void)
- quint16 vendorIdentifier(void)

92.300 QSize Class

C++ Reference : <http://doc.qt.io/qt-5/qsize.html>

Parameters : int width, int height

92.301 QSkyboxEntity Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qskyboxentity.html>

Parameters : Qt3DCore::QNode *

Parent Class : QEntity

- QString baseName(void)
- QString extension(void)
- bool isGammaCorrectEnabled(void)
- void setBaseName(QString baseName)
- void setExtension(QString extension)
- void setGammaCorrectEnabled(bool enabled)

92.302 QSlider Class

C++ Reference : <http://doc.qt.io/qt-5/qslider.html>

Parameters : QWidget *parent

Parent Class : QAbstractSlider

- void setTickInterval(int ti)
- void setTickPosition(QSlider::TickPosition position)
- int tickInterval(void)
- int tickPosition(void)
- QSize minimumSizeHint(void)
- QSize sizeHint(void)
- void setactionTriggeredEvent(const char *)
- void setrangeChangedEvent(const char *)
- void setsliderMovedEvent(const char *)
- void setsliderPressedEvent(const char *)
- void setsliderReleasedEvent(const char *)
- void setvalueChangedEvent(const char *)
- const char *getactionTriggeredEvent(void)
- const char *getrangeChangedEvent(void)
- const char *getsliderMovedEvent(void)
- const char *getsliderPressedEvent(void)
- const char *getsliderReleasedEvent(void)
- const char *getvalueChangedEvent(void)

92.303 QSphereMesh Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qspheremesh.html>

Parameters : Qt3DCore::QNode *

- bool generateTangents(void)
- float radius(void)
- int rings(void)
- int slices(void)
- void setGenerateTangents(bool gen)
- void setRadius(float radius)
- void setRings(int rings)
- void setSlices(int slices)

92.304 QSpinBox Class

C++ Reference : <http://doc.qt.io/qt-5/qspinbox.html>

Parameters : QWidget *parent

Parent Class : QWidget

- QString cleanText(void)
- int displayIntegerBase(void)
- int maximum(void)
- int minimum(void)
- QString prefix(void)
- void setDisplayIntegerBase(int base)
- void setMaximum(int max)
- void setMinimum(int min)
- void setPrefix(QString)
- void setRange(int minimum, int maximum)
- void setSingleStep(int val)
- void setSuffix(QString)
- int singleStep(void)
- QString suffix(void)
- int value(void)
- void setValue(int val)
- void setvalueChangedEvent(const char *)
- const char *getvalueChangedEvent(void)

92.305 QSplashScreen Class

C++ Reference : <http://doc.qt.io/qt-5/qsplashscreen.html>

Parameters : QPixmap

Parent Class : QWidget

- void finish(QWidget *mainWin)
- QPixmap pixmap(void)
- void repaint(void)
- void setPixmap(QPixmap pixmap)
- void clearMessage(void)
- void showMessage(QString message, int alignment ,QColor color)

92.306 QSplineSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qsplineseries.html>

Parameters : QObject *

Parent Class : QLineSeries

- QAbstractSeries::SeriesType type(void)

92.307 QSplitter Class

C++ Reference : <http://doc.qt.io/qt-5/qsplitter.html>

Parameters : QWidget *parent

Parent Class : QFrame

- void addWidget(QWidget *widget)
- bool childrenCollapsible(void)
- int count(void)
- void getRange(int index, int *min, int *max)
- QSplitterHandle * handle(int index)
- int handleWidth(void)
- int indexOf(QWidget *widget)
- void insertWidget(int index, QWidget *widget)
- bool isCollapsible(int index)
- bool opaqueResize(void)
- Qt::Orientation orientation(void)
- void refresh(void)
- bool restoreState(QByteArray state)
- QByteArray saveState(void)
- void setChildrenCollapsible(bool)
- void setCollapsible(int index, bool collapse)
- void setHandleWidth(int)
- void setOpaqueResize(bool opaque)
- void setOrientation(Qt::Orientation)
- void setSizes(QList<int> list)
- void setStretchFactor(int index, int stretch)
- QList<int> sizes(void)
- QWidget * widget(int index)

92.308 QSqlDatabase Class

C++ Reference : <http://doc.qt.io/qt-5/qsqldatabase.html>

Parameters : void

- void close(void)
- bool commit(void)
- QString connectOptions(void)
- QString connectionName(void)
- QString databaseName(void)
- QSqlDriver *driver(void)
- QString driverName(void)
- QSqlQuery exec(QString)
- QString hostName(void)
- bool isOpen(void)
- bool isOpenError(void)
- bool isValid(void)
- QSqlError lastError(void)
- QSql::NumericalPrecisionPolicy numericalPrecisionPolicy(void)
- bool open(void)
- QString password(void)
- int port(void)
- QSqlIndex primaryIndex(QString)
- QSqlRecord record(QString)
- bool rollback(void)
- void setConnectOptions(QString)
- void setDatabaseName(QString)
- void setHostName(QString)
- void setNumericalPrecisionPolicy(QSql::NumericalPrecisionPolicy precisionPolicy)
- void setPassword(QString)
- void setPort(int port)
- void setUserName(QString)
- QStringList tables(QSql::TableType type)
- bool transaction(void)
- QString userName(void)
- QSqlDatabase addDatabase(QString)
- QSqlDatabase cloneDatabase(QSqlDatabase, QString)

- QStringList connectionNames(void)
- bool contains(QString)
- QSqlDatabase database(QString , bool)
- QStringList drivers(void)
- bool isDriverAvailable(QString)
- void registerSqlDriver(QString, QSqlDriverCreatorBase *)
- void removeDatabase(QString)

92.309 QSqlDriver Class

C++ Reference : <http://doc.qt.io/qt-5/qsqldriver.html>

Parameters : void

- QSqlError lastError(void)
- QSql::NumericalPrecisionPolicy numericalPrecisionPolicy(void)
- void setNumericalPrecisionPolicy(QSql::NumericalPrecisionPolicy)

92.310 QSqlDriverCreatorBase Class

C++ Reference : <http://doc.qt.io/qt-5/qsqldrivercreatorbase.html>

Parameters : void

92.311 QSqlError Class

C++ Reference : <http://doc.qt.io/qt-5/qsqlerror.html>

Parameters : QString, QString, QSqlError::ErrorType

- QString databaseText(void)
- QString driverText(void)
- bool isValid(void)
- QString text(void)
- QSqlError::ErrorType type(void)

92.312 QSqlField Class

C++ Reference : <http://doc.qt.io/qt-5/qsqlfield.html>

Parameters : QString,QVariant::Type

- void clear(void)
- QVariant defaultValue(void)
- bool isAutoValue(void)
- bool isGenerated(void)
- boolisNull(void)
- bool isReadOnly(void)
- bool isValid(void)
- int length(void)
- QString name(void)
- int precision(void)
- RequiredStatus requiredStatus(void)
- void setAutoValue(bool autoVal)
- void setDefaultValue(QVariant)
- void setGenerated(bool gen)
- void setLength(int fieldLength)
- void setName(QString)
- void setPrecision(int precision)
- void setReadOnly(bool readOnly)
- void setRequired(bool required)
- void setRequiredStatus(QSqlField::RequiredStatus required)
- void setType(QVariant::Type type)
- void setValue(QVariant)
- QVariant::Type type(void)
- QVariant value(void)

92.313 QSqlIndex Class

C++ Reference : <http://doc.qt.io/qt-5/qsqlindex.html>

Parameters : QString, QString

Parent Class : QSqlRecord

- void append(QSqlField, bool)
- QString cursorName(void)
- bool isDescending(int i)

- `QString name(void)`
- `void setCursorName(QString)`
- `void setDescending(int i, bool desc)`
- `void setName(QString)`

92.314 QSqlQuery Class

C++ Reference : <http://doc.qt.io/qt-5/qsqlquery.html>

Parameters : void

- `void addBindValue(QVariant, QSql::ParamType paramType)`
- `int at(void)`
- `void bindValue(QString, QVariant, QSql::ParamType paramType)`
- `QVariant boundValue(QString)`
- `void clear(void)`
- `QSqlDriver * driver(void)`
- `bool exec(QString)`
- `bool exec_2(void)`
- `bool execBatch(QSqlQuery::BatchExecutionMode mode)`
- `QString executedQuery(void)`
- `void finish(void)`
- `bool first(void)`
- `bool isActive(void)`
- `bool isForwardOnly(void)`
- `boolisNull(int field)`
- `bool isSelect(void)`
- `bool isValid(void)`
- `bool last(void)`
- `QSqlError lastError(void)`
- `QVariant lastInsertId(void)`
- `QString lastQuery(void)`
- `bool next(void) # In RingQt use : bool movenext(void)`
- `bool nextResult(void)`
- `int numRowsAffected(void)`
- `QSql::NumericalPrecisionPolicy numericalPrecisionPolicy(void)`
- `bool prepare(QString)`
- `bool previous(void)`

- QSqlRecord record(void)
- QSqlResult *result(void)
- bool seek(int index, bool relative)
- void setForwardOnly(bool forward)
- void setNumericalPrecisionPolicy(QSql::NumericalPrecisionPolicy precisionPolicy)
- int size(void)
- QVariant value(int index)

92.315 QSqlRecord Class

C++ Reference : <http://doc.qt.io/qt-5/qsqlrecord.html>

Parameters : void

- void append(QSqlField)
- void clear(void)
- void clearValues(void)
- bool contains(QString)
- int count(void)
- QSqlField field(int index)
- QString fieldName(int index)
- int indexOf(QString)
- void insert(int pos, QSqlField)
- bool isEmpty(void)
- bool isGenerated(QString)
- boolisNull(QString)
- void remove(int pos)
- void replace(int pos, QSqlField)
- void setGenerated(QString, bool generated)
- void setNull(int index)
- void setValue(int index, QVariant)
- QVariant value(int index)

92.316 QStackedBarSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qstackedbarseries.html>

Parameters : QObject *

Parent Class : QAbstractBarSeries

- QAbstractSeries::SeriesType type(void)

92.317 QStackedWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qstackedwidget.html>

Parameters : QWidget *

Parent Class : QFrame

- int addWidget(QWidget *widget)
- int count(void)
- int currentIndex(void)
- QWidget * currentWidget(void)
- int indexOf(QWidget *widget)
- int insertWidget(int index, QWidget *widget)
- void removeWidget(QWidget *widget)
- QWidget * widget(int index)
- void setCurrentIndex(int index)
- void setCurrentWidget(QWidget *widget)
- void setcurrentChangedEvent(const char *)
- void setwidetRemovedEvent(const char *)
- const char *getcurrentChangedEvent(void)
- const char *getwidetRemovedEvent(void)

92.318 QStandardPaths Class

C++ Reference : <http://doc.qt.io/qt-5/qstandardpaths.html>

Parameters : void

- QString displayName(QStandardPaths::StandardLocation type)
- QString findExecutable(QString executableName, QStringList paths))
- QString locate(QStandardPaths::StandardLocation type, QString fileName, QStandardPaths::LocateOptions options)
- QStringList locateAll(QStandardPaths::StandardLocation type, QString fileName, QStandardPaths::LocateOptions options)

- void setTestModeEnabled(bool testMode)
- QStringList standardLocations(QStandardPaths::StandardLocation type)
- QString writableLocation(QStandardPaths::StandardLocation type)

92.319 QStatusBar Class

C++ Reference : <http://doc.qt.io/qt-5/qstatusbar.html>

Parameters : QWidget *

Parent Class : QWidget

- void addPermanentWidget(QWidget * widget, int stretch)
- void addWidget(QWidget * widget, int stretch)
- QString currentMessage(void)
- int insertPermanentWidget(int index, QWidget * widget, int stretch)
- int insertWidget(int index, QWidget * widget, int stretch)
- bool isSizeGripEnabled(void)
- void removeWidget(QWidget *widget)
- void setSizeGripEnabled(bool)
- void clearMessage(void)
- void showMessage(QString , int timeout)

92.320 QString2 Class

Parameters : void

- QStringList split(QString sep, QString::SplitBehavior behavior , Qt::CaseSensitivity cs)
- QStringList split_2(QChar sep, QString::SplitBehavior behavior , Qt::CaseSensitivity cs)
- QStringList split_3(QRegExp rx, QString::SplitBehavior behavior)
- QStringList split_4(QRegularExpression re, QString::SplitBehavior behavior)
- QString append(QString str)
- QString append_2(QChar ch)
- QByteArray toUtf8(void)
- QByteArray toLatin1(void)
- QByteArray toLocal8Bit(void)
- QChar * unicode(void)
- QString number(ulong n, int base)
- int count(void)
- QString left(int n)
- QString mid(int position, int n)

- `QString right(int n)`
- `int compare(QString other, Qt::CaseSensitivity cs)`
- `bool contains(QString str, Qt::CaseSensitivity cs)`
- `int indexOf(QString str,int from,Qt::CaseSensitivity cs)`
- `int lastIndexOf(QString str,int from,Qt::CaseSensitivity cs)`
- `QString insert(int position, QString str)`
- `bool isRightToLeft(void)`
- `QString repeated(int times)`
- `QString replace(int position, int n, QString after)`
- `QString replace_2(QString before, QString after, Qt::CaseSensitivity)`
- `bool startsWith(QString s, Qt::CaseSensitivity cs)`
- `bool endsWith(QString s, Qt::CaseSensitivity cs)`
- `QString toHtmlEscaped(void)`
- `void clear(void)`
- `boolisNull(void)`
- `void resize(int size)`
- `QString fill(QChar ch, int size)`
- `int localeAwareCompare(QString other)`
- `QString leftJustified(int width, QChar fill, bool truncate)`
- `QString rightJustified(int width, QChar fill, bool truncate)`
- `QString section_1(QChar sep, int start, int end, QString::SectionFlags flags)`
- `QString section_2(QString sep, int start, int end, QString::SectionFlags flags)`
- `QString section_3(QRegExp reg, int start, int end, QString::SectionFlags flags)`
- `QString section_4(QRegularExpression re, int start, int end, QString::SectionFlags flags)`
- `QString simplified(void)`
- `QString toCaseFolded(void)`
- `QString trimmed(void)`
- `void truncate(int position)`
- `qsizetype length(void)`
- `qsizetype size(void)`

92.321 QStringList Class

C++ Reference : <http://doc.qt.io/qt-5/qstringlist.html>

Parameters : void

- QString join(QString)
- void sort(void)
- int removeDuplicates(void)
- QStringList filter(QString, Qt::CaseSensitivity)
- QStringList replaceInStrings(QString,QString, Qt::CaseSensitivity)
- void append(QString)
- QString at(int)
- QString back(void)
- void clear(void)
- bool contains(QString)
- int count(void)
- bool empty(void)
- bool endsWith(QString)
- QString first(void)
- QString front(void)
- int indexOf(QString, int)
- void insert(int, QString)
- bool isEmpty(void)
- QString last(void)
- int lastIndexOf(QString,int)
- int length(void)
- void move(int,int)
- void pop_back(void)
- void pop_front(void)
- void prepend(QString)
- void push_back(QString)
- void push_front(QString)
- int removeAll(QString)
- void removeAt(int)
- void removeFirst(void)
- void removeLast(void)
- bool removeOne(QString)

- void replace(int,QString)
- void reserve(int)
- int size(void)
- bool startsWith(QString)
- QString takeAt(int)
- QString takeFirst(void)
- QString takeLast(void)
- QString value(int)

92.322 QStringRef Class

C++ Reference : <http://doc.qt.io/qt-5/qstringref.html>

Parameters : void

- QStringRef appendTo(QString * string)
- QChar at(int position)
- void clear(void)
- int compare_3(QLatin1String other, Qt::CaseSensitivity cs)
- QChar * constData(void)
- bool contains(QString str, Qt::CaseSensitivity cs)
- bool contains_2(QChar ch, Qt::CaseSensitivity cs)
- bool contains_3(QStringRef str, Qt::CaseSensitivity cs)
- bool contains_4(QLatin1String str, Qt::CaseSensitivity cs)
- int count(void)
- int count_2(QString str, Qt::CaseSensitivity cs)
- int count_3(QChar ch, Qt::CaseSensitivity cs)
- int count_4(QStringRef str, Qt::CaseSensitivity cs)
- QChar * data(void)
- bool endsWith(QString str, Qt::CaseSensitivity cs)
- bool endsWith_2(QChar ch, Qt::CaseSensitivity cs)
- bool endsWith_3(QLatin1String str, Qt::CaseSensitivity cs)
- bool endsWith_4(QStringRef str, Qt::CaseSensitivity cs)
- int indexOf(QString str, int from, Qt::CaseSensitivity cs)
- int indexOf_2(QLatin1String str, int from, Qt::CaseSensitivity cs)
- int indexOf_3(QChar ch, int from, Qt::CaseSensitivity cs)
- int indexOf_4(QStringRef str, int from, Qt::CaseSensitivity cs)
- bool isEmpty(void)

- boolisNull(void)
- intlastIndexOf(QString str, int from, Qt::CaseSensitivity cs)
- intlastIndexOf_2(QChar ch, int from, Qt::CaseSensitivity cs)
- intlastIndexOf_3(QLatin1String str, int from, Qt::CaseSensitivity cs)
- intlastIndexOf_4(QStringRef str, int from, Qt::CaseSensitivity cs)
- intlength(void)
- intlocaleAwareCompare(QString other)
- intlocaleAwareCompare_2(QStringRef other)
- intposition(void)
- intsize(void)
- boolstartsWith(QString str, Qt::CaseSensitivity cs)
- boolstartsWith_2(QLatin1String str, Qt::CaseSensitivity cs)
- boolstartsWith_3(QStringRef str, Qt::CaseSensitivity cs)
- boolstartsWith_4(QChar ch, Qt::CaseSensitivity cs)
- QString *string(void)
- QByteArraytoLatin1(void)
- QByteArraytoLocal8Bit(void)
- QStringtoString(void)
- QVector<uint>toUcs4(void)
- QByteArraytoUtf8(void)
- QChar *unicode(void)
- intcompare_4(QStringRef s1, QString s2, Qt::CaseSensitivity cs)
- intcompare_5(QStringRef s1, QStringRef s2, Qt::CaseSensitivity cs)
- intcompare_6(QStringRef s1, QLatin1String s2, Qt::CaseSensitivity cs)
- intlocaleAwareCompare_3(QStringRef s1, QString s2)
- intlocaleAwareCompare_4(QStringRef s1, QStringRef s2)

92.323 QStyle Class

C++ Reference : <http://doc.qt.io/qt-5/qstyle.html>

Parameters : void

Parent Class : QObject

- intcombinedLayoutSpacing(QSizePolicy::ControlTypes controls1, QSizePolicy::ControlTypes controls2, Qt::Orientation orientation, QStyleOption *option, QWidget *widget)
- voiddrawComplexControl(QStyle::ComplexControl control, QStyleOptionComplex *option, QPainter *painter, QWidget *widget)

- void drawControl(QStyle::ControlElement element, QStyleOption *option, QPainter *painter, QWidget *widget)
- void drawItemPixmap(QPainter *painter, QRect rectangle, int alignment, QPixmap pixmap)
- void drawItemText(QPainter *painter, QRect rectangle, int alignment, QPalette palette, bool enabled, QString text, QPalette::ColorRole textRole)
- void drawPrimitive(QStyle::PrimitiveElement element, QStyleOption *option, QPainter *painter, QWidget *widget)
- QPixmap generatedIconPixmap(QIcon::Mode iconMode, QPixmap pixmap, QStyleOption *option)
- QStyle::SubControl hitTestComplexControl(QStyle::ComplexControl control, QStyleOptionComplex *option, QPoint position, QWidget *widget)
- QRect itemPixmapRect(QRect rectangle, int alignment, QPixmap pixmap)
- QRect itemTextRect(QFontMetrics metrics, QRect rectangle, int alignment, bool enabled, QString text)
- int layoutSpacing(QSizePolicy::ControlType control1, QSizePolicy::ControlType control2, Qt::Orientation orientation, QStyleOption *option, QWidget *widget)
- int pixelMetric(QStyle::PixelMetric metric)
- int pixelMetric_2(QStyle::PixelMetric metric, QStyleOption *option, QWidget *widget)
- void polish(QWidget *widget)
- void polish_2(QApplication *application)
- void polish_3(QPalette palette)
- QStyle * proxy(void)
- QSize sizeFromContents(QStyle::ContentsType type, QStyleOption *option, QSize contentsSize, QWidget *widget)
- QIcon standardIcon(QStyle::StandardPixmap standardIcon, QStyleOption *option, QWidget *widget)
- QPalette standardPalette(void)
- int styleHint(QStyle::StyleHint hint, QStyleOption *option, QWidget *widget, QStyleHintReturn *returnData)
- QRect subControlRect(QStyle::ComplexControl control, QStyleOptionComplex *option, QStyle::SubControl subControl, QWidget *widget)
- QRect subElementRect(QStyle::SubElement element, QStyleOption *option, QWidget *widget)
- void unpolish(QWidget *widget)
- void unpolish_2(QApplication *application)
- QRect alignedRect(Qt::LayoutDirection direction, Qt::Alignment alignment, QSize size, QRect rectangle)
- int sliderPositionFromValue(int min, int max, int logicalValue, int span, bool upsideDown)
- int sliderValueFromPosition(int min, int max, int position, int span, bool upsideDown)
- Qt::Alignment visualAlignment(Qt::LayoutDirection direction, Qt::Alignment alignment)
- QPoint visualPos(Qt::LayoutDirection direction, QRect boundingRectangle, QPoint logicalPosition)
- QRect visualRect(Qt::LayoutDirection direction, QRect boundingRectangle, QRect logicalRectangle)

92.324 QStyleOptionGraphicsItem Class

C++ Reference : <http://doc.qt.io/qt-5/qstyleoptiongraphicsitem.html>

Parent Class : QStyleOption

Parameters : void

- qreal levelOfDetailFromTransform(QTransform worldTransform)

92.325 QSurfaceFormat Class

C++ Reference : <http://doc.qt.io/qt-5/qsurfaceformat.html>

Parameters : void

- int alphaBufferSize(void)
- int blueBufferSize(void)
- int greenBufferSize(void)
- bool hasAlpha(void)
- int majorVersion(void)
- int minorVersion(void)
- QSurfaceFormat::FormatOptions options(void)
- QSurfaceFormat::OpenGLContextProfile profile(void)
- int redBufferSize(void)
- QSurfaceFormat::RenderableType renderableType(void)
- int samples(void)
- void setAlphaBufferSize(int size)
- void setBlueBufferSize(int size)
- void setGreenBufferSize(int size)
- void setMajorVersion(int major)
- void setMinorVersion(int minor)
- void setOption(QSurfaceFormat::FormatOption option, bool on)
- void setOptions(QSurfaceFormat::FormatOptions options)
- void setProfile(QSurfaceFormat::OpenGLContextProfile profile)
- void setRedBufferSize(int size)
- void setRenderableType(QSurfaceFormat::RenderableType type)
- void setSamples(int numSamples)
- void setStencilBufferSize(int size)
- void setStereo(bool enable)
- void setSwapBehavior(QSurfaceFormat::SwapBehavior behavior)
- void setSwapInterval(int interval)

- void setVersion(int major, int minor)
- int stencilBufferSize(void)
- bool stereo(void)
- QSurfaceFormat::SwapBehavior swapBehavior(void)
- int swapInterval(void)
- bool testOption(QSurfaceFormat::FormatOption option)
- QSurfaceFormat defaultFormat(void)
- void setDefaultFormat(QSurfaceFormat format)

92.326 QSystemTrayIcon Class

C++ Reference : <http://doc.qt.io/qt-5/qsystemtrayicon.html>

Parameters : void

- QMenu *contextMenu(void)
- QRect geometry(void)
- QIcon icon(void)
- bool isVisible(void)
- void setContextMenu(QMenu *menu)
- void setIcon(QIcon)
- void setToolTip(QString)
- QString toolTip(void)
- void hide(void)
- void setVisible(bool visible)
- void show(void)
- void showMessage(QString, QString, QSystemTrayIcon::MessageIcon, int millisecondsTimeoutHint)
- bool isSystemTrayAvailable(void)
- bool supportsMessages(void)

92.327 QTabBar Class

C++ Reference : <http://doc.qt.io/qt-5/qtabbar.html>

Parameters : QWidget *

Parent Class : QWidget

- int addTab(QString text)
- int addTab_2(QIcon icon, QString text)
- int count(void)
- int currentIndex(void)

- bool documentMode(void)
- bool drawBase(void)
- Qt::TextElideMode elideMode(void)
- bool expanding(void)
- QSize iconSize(void)
- int insertTab(int index, QString text)
- int insertTab_2(int index, QIcon icon, QString text)
- bool isMovable(void)
- bool isTabEnabled(int index)
- void moveTab(int from, int to)
- void removeTab(int index)
- QTabBar::SelectionBehavior selectionBehaviorOnRemove(void)
- void setDocumentMode(bool set)
- void setDrawBase(bool drawTheBase)
- void setElideMode(Qt::TextElideMode)
- void setExpanding(bool enabled)
- void setIconSize(QSize size)
- void setMovable(bool movable)
- void setSelectionBehaviorOnRemove(QTabBar::SelectionBehavior behavior)
- void setShape(QTabBar::Shape shape)
- void setTabButton(int index, QTabBar::ButtonPosition position, QWidget * widget)
- void setTabData(int index, QVariant data)
- void setTabEnabled(int index, bool enabled)
- void setTabIcon(int index, QIcon icon)
- void setTabText(int index, QString text)
- void setTabTextColor(int index, QColor color)
- void setTabToolTip(int index, QString tip)
- void setTabWhatsThis(int index, QString text)
- void setTabsClosable(bool closable)
- void setUsesScrollButtons(bool useButtons)
- QTabBar::Shape shape(void)
- int tabAt(QPoint position)
- QWidget * tabButton(int index, QTabBar::ButtonPosition position)
- QVariant tabData(int index)
- QIcon tabIcon(int index)
- QRect tabRect(int index)

- `QString tabText(int index)`
- `QColor tabTextColor(int index)`
- `QString tabToolTip(int index)`
- `QString tabWhatsThis(int index)`
- `bool tabsClosable(void)`
- `bool usesScrollButtons(void)`
- `void setCurrentIndex(int index)`
- `void setcurrentChangedEvent(const char *)`
- `void settabCloseRequestedEvent(const char *)`
- `void settabMovedEvent(const char *)`
- `const char *getcurrentChangedEvent(void)`
- `const char *gettabCloseRequestedEvent(void)`
- `const char *gettabMovedEvent(void)`

92.328 QTabWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qtabwidget.html>

Parameters : `QWidget *parent`

Parent Class : `QWidget`

- `QTabBar *tabBar(void)`
- `int addTab(QWidget *page, QString)`
- `void clear(void)`
- `QWidget *cornerWidget(Qt::Corner corner)`
- `int count(void)`
- `int currentIndex(void)`
- `QWidget *currentWidget(void)`
- `bool documentMode(void)`
- `int elideMode(void)`
- `QSize iconSize(void)`
- `int indexOf(QWidget *w)`
- `int insertTab(int index, QWidget *page,QString)`
- `bool isMovable(void)`
- `bool isTabEnabled(int index)`
- `void removeTab(int index)`
- `void setCornerWidget(QWidget *widget, Qt::Corner corner)`
- `void setDocumentMode(bool set)`

- void setElideMode(Qt::TextElideMode)
- void setIconSize(QSize)
- void setMovable(bool movable)
- void setTabEnabled(int index, bool enable)
- void setTabIcon(int index, QIcon)
- void setTabText(int index, QString)
- void setTabToolTip(int index, QString)
- void setTabWhatsThis(int index, QString)
- void setTabsClosable(bool closeable)
- void setUsesScrollButtons(bool useButtons)
- QIcon tabIcon(int index)
- QString tabText(int index)
- QString tabToolTip(int index)
- QString tabWhatsThis(int index)
- bool tabsClosable(void)
- bool usesScrollButtons(void)
- QWidget *widget(int index)
- int heightForWidth(int width)
- QSize minimumSizeHint(void)
- QSize sizeHint(void)
- void setCurrentIndex(int index)
- void setCurrentWidget(QWidget *widget)
- void setcurrentChangedEvent(const char *)
- void settabCloseRequestedEvent(const char *)
- const char *getcurrentChangedEvent(void)
- const char *gettabCloseRequestedEvent(void)
- void geteventparameters(void)

92.329 QTableView Class

C++ Reference : <http://doc.qt.io/qt-5/qtableview.html>

Parameters : QWidget *parent

Parent Class : QAbstractItemView

- void clearSpans(void)
- int columnAt(int x)
- int columnSpan(int row, int column)

- int columnViewportPosition(int column)
- int columnWidth(int column)
- Qt::PenStyle gridStyle(void)
- QHeaderView *horizontalHeader(void)
- bool isColumnHidden(int column)
- bool isCornerButtonEnabled(void)
- bool isRowHidden(int row)
- bool isSortingEnabled(void)
- int rowAt(int y)
- int rowHeight(int row)
- int rowSpan(int row, int column)
- int rowViewportPosition(int row)
- void setColumnHidden(int column, bool hide)
- void setColumnWidth(int column, int width)
- void setCornerButtonEnabled(bool enable)
- void setGridStyle(Qt::PenStyle style)
- void setHorizontalHeader(QHeaderView *header)
- void setRowHeight(int row, int height)
- void setRowHidden(int row, bool hide)
- void setSortingEnabled(bool enable)
- void setSpan(int row, int column, int rowSpanCount, int columnSpanCount)
- void setVerticalHeader(QHeaderView *header)
- void setWordWrap(bool on)
- bool showGrid(void)
- void sortByColumn(int column, Qt::SortOrder order)
- QHeaderView *verticalHeader(void)
- bool wordWrap(void)
- void hideColumn(int column)
- void hideRow(int row)
- void resizeColumnToContents(int column)
- void resizeColumnsToContents(void)
- void resizeRowToContents(int row)
- void resizeRowsToContents(void)
- void selectColumn(int column)
- void selectRow(int row)
- void setShowGrid(bool show)

- void showColumn(int column)
- void showRow(int row)

92.330 QTableWidgetItem Class

C++ Reference : <http://doc.qt.io/qt-5/qtablewidget.html>

Parameters : QWidget *parent

Parent Class : QTableView

- QWidget *cellWidget(int row, int column)
- void closePersistentEditor(QTableWidgetItem *item)
- int column(QTableWidgetItem *item)
- int columnCount(void)
- int currentColumn(void)
- QTableWidgetItem *currentItem(void)
- int currentRow(void)
- void editItem(QTableWidgetItem *item)
- QTableWidgetItem *horizontalHeaderItem(int column)
- QTableWidgetItem *item(int row, int column)
- QTableWidgetItem *itemAt(int ax, int ay)
- QTableWidgetItem *itemPrototype(void)
- void openPersistentEditor(QTableWidgetItem *item)
- void removeCellWidget(int row, int column)
- int row(const QTableWidgetItem *item)
- int rowCount(void)
- QList<QTableWidgetItem *> selectedItems(void)
- QList<QTableWidgetItemSelectionRange> selectedRanges(void)
- void setCellWidget(int row, int column, QWidget *widget)
- void setColumnCount(int columns)
- void setCurrentCell(int row, int column)
- void setCurrentItem(QTableWidgetItem * item)
- void setHorizontalHeaderItem(int column, QTableWidgetItem *item)
- void setHorizontalHeaderLabels(QStringList)
- void setItem(int row, int column, QTableWidgetItem *item)
- void setItemPrototype(QTableWidgetItem *item)
- void setRowCount(int rows)
- void setVerticalHeaderItem(int row, QTableWidgetItem *item)

- void sortItems(int column, Qt::SortOrder order)
- QTableWidgetItem *takeHorizontalHeaderItem(int column)
- QTableWidgetItem *takeItem(int row, int column)
- QTableWidgetItem *takeVerticalHeaderItem(int row)
- QTableWidgetItem *verticalHeaderItem(int row)
- int visualColumn(int logicalColumn)
- QRect visualItemRect(QTableWidgetItem *)
- int visualRow(int logicalRow)
- void clear(void)
- void clearContents(void)
- void insertColumn(int column)
- void insertRow(int row)
- void removeColumn(int column)
- void removeRow(int row)
- void scrollToItem(QTableWidgetItem *item, QAbstractItemView::ScrollHint hint)
- void setcellActivatedEvent(const char *)
- void setcellChangedEvent(const char *)
- void setcellClickedEvent(const char *)
- void setcellDoubleClickedEvent(const char *)
- void setcellEnteredEvent(const char *)
- void setcellPressedEvent(const char *)
- void setcurrentCellChangedEvent(const char *)
- void setcurrentItemChangedEvent(const char *)
- void setitemActivatedEvent(const char *)
- void setitemChangedEvent(const char *)
- void setitemClickedEvent(const char *)
- void setitemDoubleClickedEvent(const char *)
- void setitemEnteredEvent(const char *)
- void setitemPressedEvent(const char *)
- void setitemSelectionChangedEvent(const char *)
- const char *getcellActivatedEvent(void)
- const char *getcellChangedEvent(void)
- const char *getcellClickedEvent(void)
- const char *getcellDoubleClickedEvent(void)
- const char *getcellEnteredEvent(void)
- const char *getcellPressedEvent(void)

- const char *getcurrentCellChangedEvent(void)
- const char *getcurrentItemChangedEvent(void)
- const char *getitemActivatedEvent(void)
- const char *getitemChangedEvent(void)
- const char *getitemClickedEvent(void)
- const char *getitemDoubleClickedEvent(void)
- const char *getitemEnteredEvent(void)
- const char *getitemPressedEvent(void)
- const char *getitemSelectionChangedEvent(void)

92.331 QTableWidgetItem Class

C++ Reference : <http://doc.qt.io/qt-5/qtablewidgetitem.html>

Parameters : QString

- QBrush background(void)
- int checkState(void)
- QTableWidgetItem *clone(void)
- int column(void)
- QVariant data(int role)
- int flags(void)
- QFont font(void)
- QBrush foreground(void)
- QIcon icon(void)
- bool isSelected(void)
- void read(QDataStream)
- int row(void)
- void setBackground(QBrush)
- void setCheckState(Qt::CheckState state)
- void setData(int role, QVariant)
- void setFlags(Qt::ItemFlag flags)
- void setFont(QFont)
- void setForeground(QBrush)
- void setIcon(QIcon)
- void setSelected(bool select)
- void setSizeHint(QSize)
- void setStatusTip(QString)

- void setText(QString)
- void setTextAlignment(int alignment)
- void setToolTip(QString)
- void setWhatsThis(QString)
- QSize sizeHint(void)
- QString statusTip(void)
- QTableWidget *tableWidget(void)
- QString text(void)
- int textAlignment(void)
- QString toolTip(void)
- int type(void)
- QString whatsThis(void)
- void write(QDataStream)

92.332 QTcpServer Class

C++ Reference : <http://doc.qt.io/qt-5/qtcpserver.html>

Parameters : QWidget *

- void close(void)
- QString errorString(void)
- bool hasPendingConnections(void)
- bool isListening(void)
- bool listen(QHostAddress, int port)
- int maxPendingConnections(void)
- QTcpSocket *nextPendingConnection(void)
- void pauseAccepting(void)
- QNetworkProxy proxy(void)
- void resumeAccepting(void)
- QHostAddress serverAddress(void)
- int serverError(void)
- int serverPort(void)
- void setMaxPendingConnections(int numConnections)
- void setProxy(QNetworkProxy)
- bool setSocketDescriptor(qintptr socketDescriptor)
- int *socketDescriptor(void)
- bool waitForNewConnection(int msec, bool *timedOut)

- void setacceptErrorEvent(const char *)
- void setnewConnectionEvent(const char *)
- const char *getacceptErrorEvent(void)
- const char *getnewConnectionEvent(void)

92.333 QTcpSocket Class

C++ Reference : <http://doc.qt.io/qt-5/qtcpsocket.html>

Parameters : QObject *

Parent Class : QAbstractSocket

- void setconnectedEvent(const char *)
- void setdisconnectedEvent(const char *)
- void seterrorEvent(const char *)
- void sethostFoundEvent(const char *)
- void setproxyAuthenticationRequiredEvent(const char *)
- void setstateChangedEvent(const char *)
- void setaboutToCloseEvent(const char *)
- void setbytesWrittenEvent(const char *)
- void setreadChannelFinishedEvent(const char *)
- void setreadyReadEvent(const char *)
- const char *getconnectedEvent(void)
- const char *getdisconnectedEvent(void)
- const char *geterrorEvent(void)
- const char *gethostFoundEvent(void)
- const char *getproxyAuthenticationRequiredEvent(void)
- const char *getstateChangedEvent(void)
- const char *getaboutToCloseEvent(void)
- const char *getbytesWrittenEvent(void)
- const char *getreadChannelFinishedEvent(void)
- const char *getreadyReadEvent(void)

92.334 QTechnique Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qtechnique.html>

Parameters : Qt3DCore::QNode *

- void addFilterKey(Qt3DRender::QFilterKey *filterKey)
- void addParameter(Qt3DRender::QParameter *parameter)
- void addRenderPass(Qt3DRender::QRenderPass *pass)
- QVector<Qt3DRender::QFilterKey *> filterKeys(void)
- Qt3DRender::QGraphicsApiFilter * graphicsApiFilter(void)
- QVector<Qt3DRender::QParameter *> parameters(void)
- void removeFilterKey(Qt3DRender::QFilterKey *filterKey)
- void removeParameter(Qt3DRender::QParameter *parameter)
- void removeRenderPass(Qt3DRender::QRenderPass *pass)
- QVector<Qt3DRender::QRenderPass *> renderPasses(void)

92.335 QTest Class

C++ Reference : <http://doc.qt.io/qt-5/qtest.html>

- void qsleep(int)

92.336 QText2DEntity Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qtext2dentity.html>

Parameters : Qt3DCore::QNode *

Parent Class : QEntity

- QColor color(void)
- QFont font(void)
- float height(void)
- void setColor(QColor color)
- void setFont(QFont font)
- void setHeight(float height)
- void setText(QString text)
- void setWidth(float width)
- QString text(void)
- float width(void)

92.337 QTextBlock Class

C++ Reference : <http://doc.qt.io/qt-5/qtextblock.html>

Parameters : void

- int blockFormatIndex(void)
- int blockNumber(void)
- QTextCharFormat charFormat(void)
- int charFormatIndex(void)
- void clearLayout(void)
- bool contains(int position)
- QTextDocument *document(void)
- bool isValid(void)
- bool isVisible(void)
- QTextLayout * layout(void)
- int length(void)
- int lineCount(void)
- QTextBlock next(void) # In RingQt use : QTextBlock nextblock(void)
- int position(void)
- QTextBlock previous(void)
- int revision(void)
- void setLineCount(int count)
- void setRevision(int rev)
- void setUserData(QTextBlockUserData * data)
- void setUserState(int state)
- void setVisible(bool visible)
- QString text(void)
- int textDirection(void)
- QTextList * textList(void)
- QTextBlockUserData * userData(void)
- int userState(void)

92.338 QTextBrowser Class

C++ Reference : <http://doc.qt.io/qt-5/qtextbrowser.html>

Parameters : QWidget *

Parent Class : QTextEdit

- int backwardHistoryCount(void)
- void clearHistory(void)
- int forwardHistoryCount(void)
- QString historyTitle(int i)
- QUrl historyUrl(int i)
- bool isBackwardAvailable(void)
- bool isForwardAvailable(void)
- bool openExternalLinks(void)
- bool openLinks(void)
- QStringList searchPaths(void)
- void setOpenExternalLinks(bool open)
- void setOpenLinks(bool open)
- void setSearchPaths(QStringList paths)
- QUrl source(void)
- void setanchorClickedEvent(const char *)
- void setbackwardAvailableEvent(const char *)
- void setforwardAvailableEvent(const char *)
- void sethighlightedEvent(const char *)
- void sethistoryChangedEvent(const char *)
- void setsourceChangedEvent(const char *)
- const char *getanchorClickedEvent(void)
- const char *getbackwardAvailableEvent(void)
- const char *getforwardAvailableEvent(void)
- const char *gethighlightedEvent(void)
- const char *gethistoryChangedEvent(void)
- const char *getsouceChangedEvent(void)

92.339 QTextCharFormat Class

C++ Reference : <http://doc.qt.io/qt-5/qtextcharformat.html>

Parameters : void

- QString anchorHref(void)
- QStringList anchorNames(void)
- QFont font(void)
- QFont::Capitalization fontCapitalization(void)
- QString fontFamily(void)
- bool fontFixedPitch(void)
- QFont::HintingPreference fontHintingPreference(void)
- bool fontItalic(void)
- bool fontKerning(void)
- qreal fontLetterSpacing(void)
- QFont::SpacingType fontLetterSpacingType(void)
- bool fontOverline(void)
- qreal fontPointSize(void)
- int fontStretch(void)
- bool fontStrikeOut(void)
- QFont::StyleHint fontStyleHint(void)
- QFont::StyleStrategy fontStyleStrategy(void)
- bool fontUnderline(void)
- int fontWeight(void)
- qreal fontWordSpacing(void)
- bool isAnchor(void)
- bool isValid(void)
- void setAnchor(bool anchor)
- void setAnchorHref(QString value)
- void setAnchorNames(QStringList names)
- void setFontCapitalization(QFont::Capitalization capitalization)
- void setFontFamily(QString family)
- void setFontFixedPitch(bool fixedPitch)
- void setFontHintingPreference(QFont::HintingPreference hintingPreference)
- void setFontItalic(bool italic)
- void setFontKerning(bool enable)
- void setFontLetterSpacing(qreal spacing)

- void setFontLetterSpacingType(QFont::SpacingType letterSpacingType)
- void setFontOverline(bool overline)
- void setFontPointSize(qreal size)
- void setFontStretch(int factor)
- void setFontStrikeOut(bool strikeOut)
- void setFontStyleHint(QFont::StyleHint hint, QFont::StyleStrategy strategy)
- void setFontStyleStrategy(QFont::StyleStrategy strategy)
- void setFontUnderline(bool underline)
- void setFontWeight(int weight)
- void setFontWordSpacing(qreal spacing)
- void setTextOutline(QPen pen)
- void setToolTip(QString text)
- void setUnderlineColor(QColor color)
- void setUnderlineStyle(QTextCharFormat::UnderlineStyle style)
- void setVerticalAlignment(QTextCharFormat::VerticalAlignment alignment)
- QPen textOutline(void)
- QString toolTip(void)
- QColor underlineColor(void)
- QTextCharFormat::UnderlineStyle underlineStyle(void)
- QTextCharFormat::VerticalAlignment verticalAlignment(void)

92.340 QTextCodec Class

C++ Reference : <http://doc.qt.io/qt-5/qtextcodec.html>

- QTextCodec *codecForName(const char *name)
- void setCodecForLocale(QTextCodec *c)

92.341 QTextCursor Class

C++ Reference : <http://doc.qt.io/qt-5/qtextcursor.html>

Parameters : void

- int anchor(void)
- bool atBlockEnd(void)
- bool atBlockStart(void)
- bool atEnd(void)
- bool atStart(void)
- void beginEditBlock(void)

- QTextBlock block(void)
- QTextCharFormat blockCharFormat(void)
- QTextBlockFormat blockFormat(void)
- int blockNumber(void)
- QTextCharFormat charFormat(void)
- void clearSelection(void)
- int columnNumber(void)
- QTextList *createList(QTextListFormat)
- QTextFrame *currentFrame(void)
- QTextList *currentList(void)
- QTextTable *currentTable(void)
- void deleteChar(void)
- void deletePreviousChar(void)
- QTextDocument *document(void)
- void endEditBlock(void)
- bool hasComplexSelection(void)
- bool hasSelection(void)
- void insertBlock(void)
- void insertFragment(QTextDocumentFragment)
- QTextFrame *insertFrame(QTextFrameFormat)
- void insertHtml(QString)
- void insertImage(QTextImageFormat)
- QTextList *insertList(QTextListFormat)
- QTextTable * insertTable(int rows, int columns, QTextTableFormat)
- void insertText(QString)
- void insertText_2(QString, QTextCharFormat)
- bool isCopyOf(QTextCursor)
- boolisNull(void)
- void joinPreviousEditBlock(void)
- bool keepPositionOnInsert(void)
- void mergeBlockCharFormat(QTextCharFormat)
- void mergeBlockFormat(QTextBlockFormat)
- void mergeCharFormat(QTextCharFormat)
- bool movePosition(QTextCursor::MoveOperation operation, QTextCursor::MoveMode mode, int n)
- int position(void)
- int positionInBlock(void)

- void removeSelectedText(void)
- void select(QTextCursor::SelectionType selection)
- void selectedTableCells(int *firstRow, int *numRows, int *firstColumn, int *numColumns)
- QString selectedText(void)
- QTextDocumentFragment selection(void)
- int selectionEnd(void)
- int selectionStart(void)
- void setBlockCharFormat(QTextCharFormat)
- void setBlockFormat(QTextBlockFormat)
- void setCharFormat(QTextCharFormat)
- void setKeepPositionOnInsert(bool b)
- void setPosition(int pos, QTextCursor::MoveMode m)
- void setVerticalMovementX(int x)
- void setVisualNavigation(bool b)
- int verticalMovementX(void)
- bool visualNavigation(void)

92.342 QTextDocument Class

C++ Reference : <http://doc.qt.io/qt-5/qtextdocument.html>

Parameters : void

Parent Class : QObject

- void addResource(int type,QUrl name, QVariant resource)
- void adjustSize(void)
- QVector<QTextFormat> allFormats(void)
- int availableRedoSteps(void)
- int availableUndoSteps(void)
- QTextBlock begin(void)
- int blockCount(void)
- QChar characterAt(int pos)
- int characterCount(void)
- void clearUndoRedoStacks(QTextDocument::Stacks stacksToClear)
- QTextDocument *clone(QObject *parent)
- int defaultCursorMoveStyle(void)
- QFont defaultFont(void)
- QString defaultStyleSheet(void)

- QTextOption defaultTextOption(void)
- QAbstractTextDocumentLayout *documentLayout(void)
- double documentMargin(void)
- void drawContents(QPainter *p, QRectF rect)
- QTextBlock end(void) # In RingQt use : QTextBlock enddoc(void)
- QTextCursor find(QString subString, QTextCursor cursor, QTextDocument::FindFlag options)
- QTextBlock findBlock(int pos)
- QTextBlock findBlockByLineNumber(int lineNumber)
- QTextBlock findBlockByNumber(int blockNumber)
- QTextBlock firstBlock(void)
- double idealWidth(void)
- double indentWidth(void)
- bool isEmpty(void)
- bool isModified(void)
- bool isRedoAvailable(void)
- bool isUndoAvailable(void)
- bool isUndoRedoEnabled(void)
- QTextBlock lastBlock(void)
- int lineCount(void)
- void markContentsDirty(int position, int length)
- int maximumBlockCount(void)
- QString metaInformation(QTextDocument::MetaInformation info)
- QTextObject *object(int objectIndex)
- QTextObject *objectForFormat(QTextFormat f)
- int pageCount(void)
- QSizeF pageSize(void)
- void print(QPrinter *printer)
- void redo(QTextCursor *cursor)
- QVariant resource(int type, QUrl name)
- int revision(void)
- QTextFrame *rootFrame(void)
- void setDefaultCursorMoveStyle(Qt::CursorMoveStyle style)
- void setDefaultFont(QFont font)
- void setDefaultStyleSheet(QString sheet)
- void setDefaultTextOption(QTextOption option)
- void setDocumentLayout(QAbstractTextDocumentLayout * layout)

- void setDocumentMargin(double margin)
- void setHtml(QString html)
- void setIndentWidth(double width)
- void setMaximumBlockCount(int maximum)
- void setMetaInformation(QTextDocument::MetaInformation info, QString string)
- void setPageSize(QSizeF size)
- void setPlainText(QString text)
- void setTextWidth(double width)
- void setUndoRedoEnabled(bool enable)
- void setUseDesignMetrics(bool b)
- QSizeF size(void)
- qreal textWidth(void)
- QString toHtml(QByteArray encoding)
- QString toPlainText(void)
- void undo(QTextCursor *cursor)
- bool useDesignMetrics(void)
- void setModified(bool m)

92.343 QTextEdit Class

C++ Reference : <http://doc.qt.io/qt-5/qtextedit.html>

Parameters : QWidget *

Parent Class : QAbstractScrollArea

- void setTabStopDistance(qreal width)
- qreal tabStopDistance(void)
- bool acceptRichText(void)
- int alignment(void)
- QString anchorAt(QPoint)
- bool canPaste(void)
- QTextCharFormat currentCharFormat(void)
- QFont currentFont(void)
- QTextCursor cursorForPosition(QPoint)
- QRect cursorRect(void)
- int cursorWidth(void)
- QTextDocument *document(void)
- QString documentTitle(void)

- void ensureCursorVisible(void)
- bool find(QString, QTextDocument::FindFlag)
- QString fontFamily(void)
- bool fontItalic(void)
- double fontPointSize(void)
- bool fontUnderline(void)
- int fontWeight(void)
- bool isReadOnly(void)
- bool isUndoRedoEnabled(void)
- int lineWrapColumnOrWidth(void)
- QVariant loadResource(int, QUrl)
- void mergeCurrentCharFormat(QTextCharFormat)
- void moveCursor(QTextCursor::MoveOperation operation, QTextCursor::MoveMode mode)
- bool overwriteMode(void)
- void print(QPrinter * printer)
- void setAcceptRichText(bool accept)
- void setCurrentCharFormat(QTextCharFormat)
- void setCursorPosition(int width)
- void setDocument(QTextDocument *document)
- void setDocumentTitle(QString)
- void setLineWrapColumnOrWidth(int w)
- void setLineWrapMode(QTextEdit::LineWrapMode)
- void setOverwriteMode(bool overwrite)
- void setReadOnly(bool)
- void setTabChangesFocus(bool)
- void setTextCursor(QTextCursor)
- void setTextInteractionFlags(Qt::TextInteractionFlag flags)
- void setUndoRedoEnabled(bool enable)
- void setWordWrapMode(QTextOption::WrapMode policy)
- bool tabChangesFocus(void)
- QColor textBackgroundColor(void)
- QColor textColor(void)
- QTextCursor textCursor(void)
- int textInteractionFlags(void)
- QString toHtml(void)
- QString toPlainText(void)

- int wordWrapMode(void)
- void append(QString)
- void clear(void)
- void copy(void)
- void cut(void)
- void insertHtml(QString)
- void insertPlainText(QString)
- void paste(void)
- void redo(void)
- void scrollToAnchor(QString)
- void selectAll(void)
- void setAlignment(Qt::AlignmentFlag a)
- void setCurrentFont(QFont)
- void setFontFamily(QString)
- void setFontItalic(bool italic)
- void setFontPointSize(double s)
- void setFontUnderline(bool underline)
- void setFontWeight(int weight)
- void setHtml(QString)
- void setPlainText(QString)
- void setText(QString)
- void setTextBackgroundColor(QColor)
- void setTextColor(QColor)
- void undo(void)
- void zoomIn(int range)
- void zoomOut(int range)
- void setcopyAvailableEvent(const char *)
- void setcurrentCharFormatChangedEvent(const char *)
- void setcursorPositionChangedEvent(const char *)
- void setredoAvailableEvent(const char *)
- void setselectionChangedEvent(const char *)
- void settextChangedEvent(const char *)
- void setundoAvailableEvent(const char *)
- const char *getcopyAvailableEvent(void)
- const char *getcurrentCharFormatChangedEvent(void)
- const char *getcursorPositionChangedEvent(void)

- const char *getredoAvailableEvent(void)
- const char *getselectionChangedEvent(void)
- const char *gettextChangedEvent(void)
- const char *getundoAvailableEvent(void)
- void cyanline(void)
- void setactivelinecolor(QColor)

92.344 QTextOption Class

C++ Reference : <http://doc.qt.io/qt-5/qtextoption.html>

Parameters : Qt::Alignment

- Qt::Alignment alignment(void)
- QTextOption::Flags flags(void)
- void setAlignment(Qt::Alignment alignment)
- void setFlags(QTextOption::Flags flags)
- void setTextDirection(Qt::LayoutDirection direction)
- void setUseDesignMetrics(bool enable)
- void setWrapMode(QTextOption::WrapMode mode)
- qreal tabStopDistance(void)
- Qt::LayoutDirection textDirection(void)
- bool useDesignMetrics(void)
- QTextOption::WrapMode wrapMode(void)

92.345 QTextStream Class

C++ Reference : <http://doc.qt.io/qt-5/qtextstream.html>

Parameters : void

- bool atEnd(void)
- bool autoDetectUnicode(void)
- QTextCodec * codec(void)
- QIODevice * device(void)
- QTextStream::FieldAlignment fieldAlignment(void)
- int fieldWidth(void)
- void flush(void)
- bool generateByteOrderMark(void)
- int integerBase(void)
- QLocale locale(void)

- QTextStream::NumberFlags numberFlags(void)
- QChar padChar(void)
- qint64 pos(void)
- QString read(qint64 maxlen)
- QString readAll(void)
- QString readLine(qint64 maxlen)
- QTextStream::RealNumberNotation realNumberNotation(void)
- int realNumberPrecision(void)
- void reset(void)
- void resetStatus(void)
- bool seek(qint64 pos)
- void setAutoDetectUnicode(bool enabled)
- void setCodec(QTextCodec * codec)
- void setCodec_2(char * codecName)
- void setDevice(QIODevice * device)
- void setFieldAlignment(QTextStream::FieldAlignment mode)
- void setFieldWidth(int width)
- void setGenerateByteOrderMark(bool generate)
- void setIntegerBase(int base)
- void setLocale(QLocale locale)
- void setNumberFlags(QTextStream::NumberFlags flags)
- void setPadChar(QChar ch)
- void setRealNumberNotation(QTextStream::RealNumberNotation notation)
- void setRealNumberPrecision(int precision)
- void setStatus(QTextStream::Status status)
- void setString(QString * string, QIODevice::OpenMode openMode)
- void skipWhiteSpace(void)
- QTextStream::Status status(void)
- QString * string(void)

92.346 QTextStream2 Class

Parameters : QIODevice * device

Parent Class : QTextStream

92.347 QTextStream3 Class

Parameters : FILE * fileHandle, QIODevice::OpenMode

Parent Class : QTextStream

92.348 QTextStream4 Class

Parameters : QString *, QIODevice::OpenMode

Parent Class : QTextStream

92.349 QTextStream5 Class

Parameters : QByteArray *, QIODevice::OpenMode

Parent Class : QTextStream

92.350 QTextToSpeech Class

C++ Reference : <http://doc.qt.io/qt-5/qtexttospeech.html>

Parameters : QObject *

Parent Class : QObject

- QVector<QLocale> availableLocales(void)
- QVector<QVoice> availableVoices(void)
- QLocale locale(void)
- double pitch(void)
- double rate(void)
- QTextToSpeech::State state(void)
- QVoice voice(void)
- double volume(void)
- void pause(void)
- void resume(void)
- void say(QString text)
- void setLocale(QLocale locale)

- void setPitch(double pitch)
- void setRate(double rate)
- void setVoice(QVoice voice)
- void setVolume(double volume)
- void stop(void)
- QStringList availableEngines(void)
- void setlocaleChangedEvent(const char *)
- void setpitchChangedEvent(const char *)
- void setrateChangedEvent(const char *)
- void setstateChangedEvent(const char *)
- void setvoiceChangedEvent(const char *)
- void setvolumeChangedEvent(const char *)
- const char *getlocaleChangedEvent(void)
- const char *getpitchChangedEvent(void)
- const char *getrateChangedEvent(void)
- const char *getstateChangedEvent(void)
- const char *getvoiceChangedEvent(void)
- const char *getvolumeChangedEvent(void)

92.351 QTextureLoader Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qtextureloader.html>

Parameters : Qt3DCore::QNode *

- bool isMirrored(void)
- QUrl source(void)
- void setMirrored(bool mirrored)
- void setSource(QUrl source)

92.352 QTextureMaterial Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qtexturematerial.html>

Parameters : Qt3DCore::QNode *

- bool isAlphaBlendingEnabled(void)
- Qt3DRender::QAbstractTexture *texture(void)
- QVector2D textureOffset(void)
- QMatrix3x3 textureTransform(void)
- void setAlphaBlendingEnabled(bool enabled)

- void setTexture(Qt3DRender::QAbstractTexture *texture)
- void setTextureOffset(QVector2D textureOffset)
- void setTextureTransform(QMatrix3x3 matrix)

92.353 QThread Class

C++ Reference : <http://doc.qt.io/qt-5/qthread.html>

Parameters : QObject *

Parent Class : QObject

- QAbstractEventDispatcher *eventDispatcher(void)
- void exit(int returnCode) # In RingQt use : void exitfromthread(int returnCode)
- bool isFinished(void)
- bool isInterruptionRequested(void)
- bool isRunning(void)
- QThread::Priority priority(void)
- void requestInterruption(void)
- void setEventDispatcher(QAbstractEventDispatcher *eventDispatcher)
- void setPriority(QThread::Priority priority)
- void setStackSize(uint stackSize)
- uint stackSize(void)
- bool wait(unsigned long time)
- void quit(void)
- void start(QThread::Priority priority)
- void terminate(void)
- QThread *currentThread(void)
- Qt::HANDLE currentThreadId(void)
- int idealThreadCount(void)
- void msleep(unsigned long msecs)
- void sleep(unsigned long secs)
- void usleep(unsigned long usecs)
- void yieldCurrentThread(void)
- void setStartedEvent(const char *)
- void setFinishedEvent(const char *)
- const char *getStartedEvent(void)
- const char *getFinishedEvent(void)

92.354 QThreadPool Class

C++ Reference : <http://doc.qt.io/qt-5/qthreadpool.html>

Parameters : void

Parent Class : QObject

- int activeThreadCount(void)
- void clear(void)
- int expiryTimeout(void)
- int maxThreadCount(void)
- void releaseThread(void)
- void reserveThread(void)
- void setExpiryTimeout(int expiryTimeout)
- void setMaxThreadCount(int maxThreadCount)
- void start(QRunnable * runnable, int priority)
- bool tryStart(QRunnable * runnable)
- bool waitForDone(int msecs)
- QThreadPool *globalInstance(void)

92.355 QTime Class

C++ Reference : <http://doc.qt.io/qt-5/qtime.html>

Parameters : void

- QTime addMSecs(int ms)
- QTime addSecs(int s)
- int hour(void)
- boolisNull(void)
- boolisValid(void)
- int minute(void)
- int msec(void)
- int msecsSinceStartOfDay(void)
- int msecsTo(QTime)
- int second(void)
- int secsTo(QTime)
- bool setHMS(int h, int m, int s, int ms)
- QString toString(QString)
- QTime currentTime(void)
- QTime fromMSecsSinceStartOfDay(int msecs)

- QTime fromString(QString,QString)

92.356 QTimer Class

C++ Reference : <http://doc.qt.io/qt-5/qtimer.html>

Parameters : QObject *parent

- int interval(void)
- bool isActive(void)
- bool isSingleShot(void)
- void setInterval(int msec)
- void setSingleShot(bool singleShot)
- int timerId(void)
- void start(void)
- void stop(void)
- void setTimeoutEvent(const char *)
- const char *getTimeoutEvent(void)

92.357 QToolBar Class

C++ Reference : <http://doc.qt.io/qt-5/qtoolbar.html>

Parameters : QWidget *

Parent Class : QWidget

- QAction *actionAt(int x, int y)
- QAction *addAction(QString)
- QAction *addSeparator(void)
- QAction *addWidget(QWidget *widget)
- int allowedAreas(void)
- void clear(void)
- QSize iconSize(void)
- QAction *insertSeparator(QAction *before)
- QAction *insertWidget(QAction *before, QWidget *widget)
- bool isAreaAllowed(Qt::ToolBarArea area)
- bool isFloatable(void)
- bool isFloating(void)
- bool isMovable(void)
- int orientation(void)
- void setAllowedAreas(Qt::ToolBarArea areas)

- void setFloatable(bool floatable)
- void setMovable(bool movable)
- void setOrientation(Qt::Orientation orientation)
- QAction *toggleViewAction(void)
- int toolButtonStyle(void)
- QWidget *widgetForAction(QAction *action)
- void setIconSize(QSize)
- void setToolButtonStyle(Qt::ToolButtonStyle toolButtonStyle)

92.358 QToolButton Class

C++ Reference : <http://doc.qt.io/qt-5/qtoolbutton.html>

Parameters : QWidget *

Parent Class : QAbstractButton

- Qt::ArrowType arrowType(void)
- bool autoRaise(void)
- QAction * defaultAction(void)
- QMenu * menu(void)
- QToolButton::ToolButtonPopupMode popupMode(void)
- void setArrowType(Qt::ArrowType type)
- void setAutoRaise(bool enable)
- void setMenu(QMenu * menu)
- void setPopupMode(QToolButton::ToolButtonPopupMode mode)
- Qt::ToolButtonStyle toolButtonStyle(void)
- void setDefaultAction(QAction * action)
- void setToolButtonStyle(Qt::ToolButtonStyle style)
- void showMenu(void)
- void settriggeredEvent(const char *)
- const char *gettriggeredEvent(void)
- void setClickEvent(const char *)
- const char *getClickEvent(void)

92.359 QTorusMesh Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qtorusmesh.html>

Parameters : Qt3DCore::QNode *

- float minorRadius(void)
- float radius(void)
- int rings(void)
- int slices(void)
- void setMinorRadius(float minorRadius)
- void setRadius(float radius)
- void setRings(int rings)
- void setSlices(int slices)

92.360 QTransform Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dcore-qtransform.html>

Parameters : Qt3DCore::QNode *

- QMatrix4x4 matrix(void)
- QQuaternion rotation(void)
- float rotationX(void)
- float rotationY(void)
- float rotationZ(void)
- float scale(void)
- QVector3D scale3D(void)
- QVector3D translation(void)
- void setMatrix(QMatrix4x4 matrix)
- void setRotation(QQuaternion rotation)
- void setRotationX(float rotationX)
- void setRotationY(float rotationY)
- void setRotationZ(float rotationZ)
- void setScale(float scale)
- void setScale3D(QVector3D scale)
- void setTranslation(QVector3D translation)
- QQuaternion fromAxes(QVector3D xAxis, QVector3D yAxis, QVector3D zAxis)
- QQuaternion fromAxesAndAngles(QVector3D axis1, float angle1, QVector3D axis2, float angle2)
- QQuaternion fromAxesAndAngles_2(QVector3D axis1, float angle1, QVector3D axis2, float angle2, QVector3D axis3, float angle3)

- QQuaternion fromAxisAndAngle(QVector3D axis, float angle)
- QQuaternion fromAxisAndAngle_2(float x, float y, float z, float angle)
- QQuaternion fromEulerAngles(QVector3D eulerAngles)
- QQuaternion fromEulerAngles_2(float pitch, float yaw, float roll)
- QMatrix4x4 rotateAround(QVector3D point, float angle, QVector3D axis)
- QMatrix4x4 rotateFromAxes(QVector3D xAxis, QVector3D yAxis, QVector3D zAxis)

92.361 QTransform2 Class

Parameters : qreal,qreal,qreal,qreal,qreal,qreal

- qreal m11(void)
- qreal m12(void)
- qreal m13(void)
- qreal m21(void)
- qreal m22(void)
- qreal m23(void)
- qreal m31(void)
- qreal m32(void)
- qreal m33(void)
- QTransform adjoint(void)
- qreal determinant(void)
- qreal dx(void)
- qreal dy(void)
- QTransform inverted(bool *invertible)
- bool isAffine(void)
- bool isIdentity(void)
- bool isInvertible(void)
- bool isRotating(void)
- bool isScaling(void)
- bool isTranslating(void)
- void map(qreal x, qreal y, qreal *tx, qreal *ty)
- QPoint map_2(QPoint point)
- QPointF map_3(QPointF p)
- QLine map_4(QLine l)
- QLineF map_5(QLineF line)
- QPolygonF map_6(QPolygonF polygon)

- QPolygon map_7(QPolygon polygon)
- QRegion map_8(QRegion region)
- QPainterPath map_9(QPainterPath path)
- void map_10(int x, int y, int *tx, int *ty)
- QRectF mapRect(QRectF rectangle)
- QRect mapRect_2(QRect rectangle)
- QPolygon mapToPolygon(QRect rectangle)
- void reset(void)
- QTransform rotate(qreal angle, Qt::Axis axis)
- QTransform rotateRadians(qreal angle, Qt::Axis axis)
- QTransform scale(qreal sx, qreal sy)
- void setMatrix(qreal m11, qreal m12, qreal m13, qreal m21, qreal m22, qreal m23, qreal m31, qreal m32, qreal m33)
- QTransform shear(qreal sh, qreal sv)
- QTransform translate(qreal dx, qreal dy)
- QTransform transposed(void)
- QTransform::TransformationType type(void)

92.362 QTransform3 Class

Parameters : void

Parent Class : QTransform2

92.363 QTreeView Class

C++ Reference : <http://doc.qt.io/qt-5/qtreeview.html>

Parameters : QWidget *

Parent Class : QAbstractItemView

- bool allColumnsShowFocus(void)
- int autoExpandDelay(void)
- int columnAt(int x)
- int columnViewportPosition(int column)
- int columnWidth(int column)
- bool expandsOnDoubleClick(void)
- QHeaderView *header(void)
- int indentation(void)
- QModelIndex indexAbove(QModelIndex)

- `QModelIndex indexBelow(QModelIndex)`
- `bool isAnimated(void)`
- `bool isColumnHidden(int column)`
- `bool isExpanded(QModelIndex)`
- `bool isFirstColumnSpanned(int row, QModelIndex)`
- `bool isHeaderHidden(void)`
- `bool isRowHidden(int row,QModelIndex)`
- `bool isSortingEnabled(void)`
- `bool itemsExpandable(void)`
- `bool rootIsDecorated(void)`
- `void setAllColumnsShowFocus(bool enable)`
- `void setAnimated(bool enable)`
- `void setAutoExpandDelay(int delay)`
- `void setColumnHidden(int column, bool hide)`
- `void setColumnWidth(int column, int width)`
- `void setExpanded(QModelIndex, bool expanded)`
- `void setExpandsOnDoubleClick(bool enable)`
- `void setFirstColumnSpanned(int row, QModelIndex, bool span)`
- `void setHeader(QHeaderView * header)`
- `void setHeaderHidden(bool hide)`
- `void setIndentation(int i)`
- `void setItemsExpandable(bool enable)`
- `void setRootIsDecorated(bool show)`
- `void setRowHidden(int row,QModelIndex, bool hide)`
- `void setSortingEnabled(bool enable)`
- `void setUniformRowHeights(bool uniform)`
- `void setWordWrap(bool on)`
- `void sortByColumn(int column,Qt::SortOrder order)`
- `bool uniformRowHeights(void)`
- `bool wordWrap(void)`
- `void dataChanged(QModelIndex,QModelIndex)`
- `QModelIndex indexAt(QPoint)`
- `void keyboardSearch(QString)`
- `void reset(void)`
- `void scrollTo(QModelIndex, QAbstractItemView::ScrollHint)`
- `void selectAll(void)`

- void setModel(QAbstractItemModel *model)
- void setRootIndex(QModelIndex)
- void setSelectionModel(QItemSelectionModel *selectionModel)
- QRect visualRect(QModelIndex)
- void collapse(QModelIndex)
- void collapseAll(void)
- void expand(QModelIndex)
- void expandAll(void)
- void expandToDepth(int depth)
- void hideColumn(int column)
- void resizeColumnToContents(int column)
- void showColumn(int column)
- void setcollapsedEvent(const char *)
- void setexpandedEvent(const char *)
- void setactivatedEvent(const char *)
- void setclickedEvent(const char *)
- void setdoubleClickedEvent(const char *)
- void setenteredEvent(const char *)
- void setpressedEvent(const char *)
- void setviewportEnteredEvent(const char *)
- const char *getcollapsedEvent(void)
- const char *getexpandedEvent(void)
- const char *getactivatedEvent(void)
- const char *getclickedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *getenteredEvent(void)
- const char *getpressedEvent(void)
- const char *getviewportEnteredEvent(void)

92.364 QTreeWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qtreewidget.html>

Parameters : QWidget *

Parent Class : QTreeView

- void addTopLevelItem(QTreeWidgetItem *item)
- void closePersistentEditor(QTreeWidgetItem *item, int column)

- int columnCount(void)
- int currentColumn(void)
- QTreeWidgetItem * currentItem(void)
- void editItem(QTreeWidgetItem * item, int column)
- QTreeWidgetItem * headerItem(void)
- int indexOfTopLevelItem(QTreeWidgetItem * item)
- void insertTopLevelItem(int index, QTreeWidgetItem * item)
- QTreeWidgetItem * invisibleRootItem(void)
- QTreeWidgetItem * itemAbove(QTreeWidgetItem * item)
- QTreeWidgetItem * itemAt(int x, int y)
- QTreeWidgetItem * itemBelow(QTreeWidgetItem * item)
- QWidget * itemWidget(QTreeWidgetItem * item, int column)
- void openPersistentEditor(QTreeWidgetItem * item, int column)
- void removeItemWidget(QTreeWidgetItem * item, int column)
- void setColumnCount(int columns)
- void setCurrentItem(QTreeWidgetItem * item, QItemSelectionModel::SelectionFlag column)
- void setHeaderItem(QTreeWidgetItem * item)
- void setHeaderLabel(QString)
- void setHeaderLabels(QStringList)
- void setItemWidget(QTreeWidgetItem * item, int column, QWidget * widget)
- int sortColumn(void)
- void sortItems(int column, Qt::SortOrder order)
- QTreeWidgetItem * takeTopLevelItem(int index)
- QTreeWidgetItem * topLevelItem(int index)
- int topLevelItemCount(void)
- QRect visualItemRect(QTreeWidgetItem * item)
- void setSelectionModel(QItemSelectionModel * selectionModel)
- void clear(void)
- void collapseItem(QTreeWidgetItem * item)
- void expandItem(QTreeWidgetItem * item)
- void scrollToItem(QTreeWidgetItem * item, QAbstractItemView::ScrollHint hint)
- void setcollapsedEvent(const char *)
- void setexpandedEvent(const char *)
- void setactivatedEvent(const char *)
- void setclickedEvent(const char *)
- void setdoubleClickedEvent(const char *)

- void setenteredEvent(const char *)
- void setpressedEvent(const char *)
- void setviewportEnteredEvent(const char *)
- void setcurrentItemChangedEvent(const char *)
- void setitemActivatedEvent(const char *)
- void setitemChangedEvent(const char *)
- void setitemClickedEvent(const char *)
- void setitemCollapsedEvent(const char *)
- void setitemDoubleClickedEvent(const char *)
- void setitemEnteredEvent(const char *)
- void setitemExpandedEvent(const char *)
- void setitemPressedEvent(const char *)
- void setitemSelectionChangedEvent(const char *)
- const char *getcollapsedEvent(void)
- const char *getexpandedEvent(void)
- const char *getactivatedEvent(void)
- const char *getclickedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *getenteredEvent(void)
- const char *getpressedEvent(void)
- const char *getviewportEnteredEvent(void)
- const char *getcurrentItemChangedEvent(void)
- const char *getitemActivatedEvent(void)
- const char *getitemChangedEvent(void)
- const char *getitemClickedEvent(void)
- const char *getitemCollapsedEvent(void)
- const char *getitemDoubleClickedEvent(void)
- const char *getitemEnteredEvent(void)
- const char *getitemExpandedEvent(void)
- const char *getitemPressedEvent(void)
- const char *getitemSelectionChangedEvent(void)

92.365 QTreeWidgetItem Class

C++ Reference : <http://doc.qt.io/qt-5/qtreewidgetitem.html>

Parameters : void

- void addChild(QTreeWidgetItem *child)
- QBrush background(int column)
- int checkState(int column)
- QTreeWidgetItem *child(int index)
- int childCount(void)
- int childIndicatorPolicy(void)
- QTreeWidgetItem *clone(void)
- int columnCount(void)
- QVariant data(int column, int role)
- int flags(void)
- QFont font(int column)
- QBrush foreground(int column)
- QIcon icon(int column)
- int indexOfChild(QTreeWidgetItem *child)
- void insertChild(int index, QTreeWidgetItem *child)
- bool isEnabled(void)
- bool isExpanded(void)
- bool isFirstColumnSpanned(void)
- bool isHidden(void)
- bool isSelected(void)
- QTreeWidgetItem *parent(void)
- void read(QDataStream)
- void removeChild(QTreeWidgetItem *child)
- void setBackground(int column,QBrush)
- void setCheckState(int column, Qt::CheckState state)
- void setChildIndicatorPolicy(QTreeWidgetItem::ChildIndicatorPolicy policy)
- void setData(int column, int role,QVariant)
- void setDisabled(bool disabled)
- void setExpanded(bool expand)
- void setFirstColumnSpanned(bool span)
- void setFlags(Qt::ItemFlag flags)
- void setFont(int column, QFont)

- void setForeground(int column, QBrush)
- void setHidden(bool hide)
- void setIcon(int column, QIcon)
- void setSelected(bool select)
- void setSizeHint(int column, QSize)
- void setStatusTip(int column, QString)
- void setText(int column, QString)
- void setTextAlignment(int column, int alignment)
- void setToolTip(int column, QString)
- void setWhatsThis(int column, QString)
- QSize sizeHint(int column)
- void sortChildren(int column, Qt::SortOrder order)
- QString statusTip(int column)
- QTreeWidgetItem *takeChild(int index)
- QString text(int column)
- int textAlign(int column)
- QString toolTip(int column)
- QTreeWidget *treeWidget(void)
- int type(void)
- QString whatsThis(int column)
- void write(QDataStream)

92.366 QUrl Class

C++ Reference : <http://doc.qt.io/qt-5/qurl.html>

Parameters : QString

- void clear(void)
- QString errorString(void)
- QString fileName(QUrl::ComponentFormattingOption options)
- QString fragment(QUrl::ComponentFormattingOption options)
- bool hasFragment(void)
- bool hasQuery(void)
- QString host(QUrl::ComponentFormattingOption options)
- bool isEmpty(void)
- bool isLocalFile(void)
- bool isParentOf(QUrl)

- bool isRelative(void)
- bool isValid(void)
- QString path(QUrl::ComponentFormattingOption options)
- int port(int defaultPort)
- QString query(QUrl::ComponentFormattingOption options)
- QUrl resolved(QUrl)
- QString scheme(void)
- void setAuthority(QString, QUrl::ParsingMode mode)
- void setFragment(QString, QUrl::ParsingMode mode)
- void setHost(QString, QUrl::ParsingMode mode)
- void setPassword(QString, QUrl::ParsingMode mode)
- void setPath(QString, QUrl::ParsingMode mode)
- void setPort(int port)
- void setQuery(QString, QUrl::ParsingMode mode)
- void setScheme(QString)
- void setUrl(QString, QUrl::ParsingMode parsingMode)
- void setUserInfo(QString, QUrl::ParsingMode mode)
- void setUserName(QString, QUrl::ParsingMode mode)
- void swap(QUrl)
- QString userInfo(QUrl::ComponentFormattingOption options)
- QString userName(QUrl::ComponentFormattingOption options)
- QUrl fromLocalFile(QString)

92.367 QUuid Class

C++ Reference : <http://doc.qt.io/qt-5/quuid.html>

Parameters : void

- QString toString(void)

92.368 QVBarModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qvbarmodelmapper.html>

Parameters : QObject *

Parent Class : QObject

- int firstRow(void)
- int lastBarSetColumn(void)
- QAbstractItemModel * model(void)

- int rowCount(void)
- QAbstractBarSeries * series(void)
- void setFirstBarSetColumn(int firstBarSetColumn)
- void setFirstRow(int firstRow)
- void setLastBarSetColumn(int lastBarSetColumn)
- void setModel(QAbstractItemModel *model)
- void setRowCount(int rowCount)
- void setSeries(QAbstractBarSeries *series)
- void setfirstBarSetColumnChangedEvent(const char *)
- void setfirstRowChangedEvent(const char *)
- void setlastBarSetColumnChangedEvent(const char *)
- void setmodelReplacedEvent(const char *)
- void setrowCountChangedEvent(const char *)
- void setsseriesReplacedEvent(const char *)
- const char *getfirstBarSetColumnChangedEvent(void)
- const char *getfirstRowChangedEvent(void)
- const char *getLastBarSetColumnChangedEvent(void)
- const char *getmodelReplacedEvent(void)
- const char *getrowCountChangedEvent(void)
- const char *getseriesReplacedEvent(void)

92.369 QVBoxLayout Class

C++ Reference : <http://doc.qt.io/qt-5/qvboxlayout.html>

Parameters : void

Parent Class : QBoxLayout

- void addWidget(QWidget *)
- void addLayout(FlowLayout *)

92.370 QVBoxPlotModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qvboxplotmodelmapper.html>

Parameters : QObject *

Parent Class : QObject

- int firstRow(void)
- int lastBoxSetColumn(void)
- QAbstractItemModel * model(void)

- int rowCount(void)
- QBoxPlotSeries * series(void)
- void setFirstBoxSetColumn(int firstBoxSetColumn)
- void setFirstRow(int firstRow)
- void setLastBoxSetColumn(int lastBoxSetColumn)
- void setModel(QAbstractItemModel *model)
- void setRowCount(int rowCount)
- void setSeries(QBoxPlotSeries *series)
- void setfirstBoxSetColumnChangedEvent(const char *)
- void setfirstRowChangedEvent(const char *)
- void setlastBoxSetColumnChangedEvent(const char *)
- void setmodelReplacedEvent(const char *)
- void setrowCountChangedEvent(const char *)
- void setsseriesReplacedEvent(const char *)
- const char *getfirstBoxSetColumnChangedEvent(void)
- const char *getfirstRowChangedEvent(void)
- const char *getLastBoxSetColumnChangedEvent(void)
- const char *getmodelReplacedEvent(void)
- const char *getrowCountChangedEvent(void)
- const char *getseriesReplacedEvent(void)

92.371 QVCandlestickModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qvcandlestickmodelmapper.html>

Parameters : QObject *

Parent Class : QCandlestickModelMapper

- int closeRow(void)
- int firstSetColumn(void)
- int highRow(void)
- int lastSetColumn(void)
- int lowRow(void)
- int openRow(void)
- void setCloseRow(int closeRow)
- void setFirstSetColumn(int firstSetColumn)
- void setHighRow(int highRow)
- void setLastSetColumn(int lastSetColumn)

- void setLowRow(int lowRow)
- void setOpenRow(int openRow)
- void setTimestampRow(int timestampRow)
- int timestampRow(void)
- void setcloseRowChangedEvent(const char *)
- void setfirstSetColumnChangedEvent(const char *)
- void sethighRowChangedEvent(const char *)
- void setlastSetColumnChangedEvent(const char *)
- void setlowRowChangedEvent(const char *)
- void setopenRowChangedEvent(const char *)
- void settimestampRowChangedEvent(const char *)
- const char *getcloseRowChangedEvent(void)
- const char *getfirstSetColumnChangedEvent(void)
- const char *gethighRowChangedEvent(void)
- const char *getlastSetColumnChangedEvent(void)
- const char *getlowRowChangedEvent(void)
- const char *getopenRowChangedEvent(void)
- const char *gettimestepRowChangedEvent(void)

92.372 QVPieModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qvpiemodelmapper.html>

Parameters : QObject *

Parent Class : QPieModelMapper

- int firstRow(void)
- int labelsColumn(void)
- QAbstractItemModel * model(void)
- int rowCount(void)
- QPieSeries * series(void)
- void setFirstRow(int firstRow)
- void setLabelsColumn(int labelsColumn)
- void setModel(QAbstractItemModel *model)
- void setRowCount(int rowCount)
- void setSeries(QPieSeries *series)
- void setValuesColumn(int valuesColumn)
- int valuesColumn(void)

- void setfirstRowChangedEvent(const char *)
- void setlabelsColumnChangedEvent(const char *)
- void setmodelReplacedEvent(const char *)
- void setrowCountChangedEvent(const char *)
- void setsseriesReplacedEvent(const char *)
- void setvaluesColumnChangedEvent(const char *)
- const char *getfirstRowChangedEvent(void)
- const char *getlabelsColumnChangedEvent(void)
- const char *getmodelReplacedEvent(void)
- const char *getrowCountChangedEvent(void)
- const char *setsseriesReplacedEvent(void)
- const char *setvaluesColumnChangedEvent(void)

92.373 QVXYModelMapper Class

C++ Reference : <http://doc.qt.io/qt-5/qvxymodelmapper.html>

Parameters : QObject *

Parent Class : QXYModelMapper

- int firstRow(void)
- QAbstractItemModel * model(void)
- int rowCount(void)
- QXYSeries * series(void)
- void setFirstRow(int firstRow)
- void setModel(QAbstractItemModel *model)
- void setRowCount(int rowCount)
- void setSeries(QXYSeries *series)
- void setXColumn(int xColumn)
- void setYColumn(int yColumn)
- int xColumn(void)
- int yColumn(void)
- void setfirstRowChangedEvent(const char *)
- void setmodelReplacedEvent(const char *)
- void setrowCountChangedEvent(const char *)
- void setsseriesReplacedEvent(const char *)
- void setxColumnChangedEvent(const char *)
- void setyColumnChangedEvent(const char *)

- const char *getfirstRowChangedEvent(void)
- const char *getmodelReplacedEvent(void)
- const char *getrowCountChangedEvent(void)
- const char *getseriesReplacedEvent(void)
- const char *getxColumnChangedEvent(void)
- const char *getyColumnChangedEvent(void)

92.374 QValueAxis Class

C++ Reference : <http://doc.qt.io/qt-5/qvalueaxis.html>

Parameters : QObject *

Parent Class : QAbstractAxis

- QString labelFormat(void)
- qreal max(void)
- qreal min(void)
- int minorTickCount(void)
- void setLabelFormat(QString format)
- void setMax(qreal max)
- void setMin(qreal min)
- void setMinorTickCount(int count)
- void setRange(qreal min, qreal max)
- void setTickCount(int count)
- void setTickAnchor(qreal anchor)
- void setTickInterval(qreal interval)
- void setTickType(QValueAxis::TickType type)
- qreal tickAnchor(void)
- qreal tickInterval(void)
- QValueAxis::TickType tickType(void)
- int tickCount(void)
- void setlabelFormatEvent(const char *)
- void setmaxChangedEvent(const char *)
- void setminChangedEvent(const char *)
- void setminorTickCountChangedEvent(const char *)
- void setrangeChangedEvent(const char *)
- void settickAnchorChangedEvent(const char *)
- void settickCountChangedEvent(const char *)

- void settickIntervalChangedEvent(const char *)
- void settickTypeChangedEvent(const char *)
- const char *getlabelFormatChangedEvent(void)
- const char *getmaxChangedEvent(void)
- const char *getminChangedEvent(void)
- const char *getminorTickCountChangedEvent(void)
- const char *getrangeChangedEvent(void)
- const char *gettickAnchorChangedEvent(void)
- const char *gettickCountChangedEvent(void)
- const char *gettickIntervalChangedEvent(void)
- const char *gettickTypeChangedEvent(void)

92.375 QVariant Class

C++ Reference : <http://doc.qt.io/qt-5/qvariant.html>

Parameters : void

- bool canConvert(int targetTypeId)
- void clear(void)
- bool convert(int targetTypeId)
- boolisNull(void)
- bool isValid(void)
- void swap(QVariant)
- QBitArray toBitArray(void)
- bool toBool(void)
- QByteArray toByteArray(void)
- QChar toChar(void)
- QDate toDate(void)
- QDateTime toDateTime(void)
- double toDouble(bool *ok)
- QEasingCurve toEasingCurve(void)
- float toFloat(bool *ok)
- int toInt(bool *ok)
- QJsonArray toJsonArray(void)
- QJsonDocument toJsonDocument(void)
- QJsonObject toJsonObject(void)
- QJsonValue toJsonValue(void)

- QLine toLine(void)
- QLineF toLineF(void)
- QLocale toLocale(void)
- qlonglong toLongLong(bool *ok)
- QModelIndex toModelIndex(void)
- QPointF toPointF(void)
- qreal toReal(bool *ok)
- QRect toRect(void)
- QRectF toRectF(void)
- QRegExp toRegExp(void)
- QRegularExpression toRegularExpression(void)
- QSize toSize(void)
- QSizeF toSizeF(void)
- QStringList toStringList(void)
- QTime toTime(void)
- uint toUInt(bool *ok)
- qulonglong toULongLong(bool *ok)
- QUrl toUrl(void)
- QUuid toUuid(void)
- QVariant::Type type(void)
- const char *typeName(void)
- int userType(void)
- QString toString(void)

92.376 QVariant2 Class

Parent Class : QVariant

Parameters : int

92.377 QVariant3 Class

Parent Class : QVariant

Parameters : float

92.378 QVariant4 Class

Parent Class : QVariant

Parameters : double

92.379 QVariant5 Class

Parent Class : QVariant

Parameters : QString

92.380 QVariantDouble Class

C++ Reference : <http://doc.qt.io/qt-5/qvariantdouble.html>

Parent Class : QVariant

Parameters : double

92.381 QVariantFloat Class

C++ Reference : <http://doc.qt.io/qt-5/qvariantfloat.html>

Parent Class : QVariant

Parameters : float

92.382 QVariantInt Class

C++ Reference : <http://doc.qt.io/qt-5/qvariantint.html>

Parent Class : QVariant

Parameters : int

92.383 QVariantString Class

C++ Reference : <http://doc.qt.io/qt-5/qvariantstring.html>

Parent Class : QVariant

Parameters : QString

92.384 QVector2D Class

C++ Reference : <http://doc.qt.io/qt-5/qvector2d.html>

Parameters : float,float

- float distanceToLine(QVector2D point, QVector2D direction)
- float distanceToPoint(QVector2D point)
- boolisNull(void)
- float length(void)
- float lengthSquared(void)
- void normalize(void)
- QVector2D normalized(void)
- void setX(float x)
- void setY(float y)
- QPoint toPoint(void)
- QPointF toPointF(void)
- QVector3D toVector3D(void)
- QVector4D toVector4D(void)
- float x(void)
- float y(void)
- float dotProduct(QVector2D v1, QVector2D v2)

92.385 QVector3D Class

C++ Reference : <http://doc.qt.io/qt-5/qvector3d.html>

Parameters : float,float,float

- float distanceToLine(QVector3D point, QVector3D direction)
- float distanceToPlane(QVector3D plane, QVector3D normal)
- float distanceToPlane_2(QVector3D plane1, QVector3D plane2, QVector3D plane3)
- float distanceToPoint(QVector3D point)
- boolisNull(void)
- float length(void)
- float lengthSquared(void)
- void normalize(void)
- QVector3D normalized(void)
- QVector3D project(QMatrix4x4 modelView, QMatrix4x4 projection, QRect viewport)
- void setX(float x)
- void setY(float y)

- void setZ(float z)
- QPoint toPoint(void)
- QPointF toPointF(void)
- QVector2D toVector2D(void)
- QVector4D toVector4D(void)
- QVector3D unproject(QMatrix4x4 modelView, QMatrix4x4 projection, QRect viewport)
- float x(void)
- float y(void)
- float z(void)
- QVector3D crossProduct(QVector3D v1, QVector3D v2)
- float dotProduct(QVector3D v1, QVector3D v2)
- QVector3D normal(QVector3D v1, QVector3D v2)
- QVector3D normal_2(QVector3D v1, QVector3D v2, QVector3D v3)

92.386 QVector4D Class

C++ Reference : <http://doc.qt.io/qt-5/qvector4d.html>

Parameters : float,float,float,float

- boolisNull(void)
- float length(void)
- float lengthSquared(void)
- void normalize(void)
- QVector4D normalized(void)
- void setW(float w)
- void setX(float x)
- void setY(float y)
- void setZ(float z)
- QPoint toPoint(void)
- QPointF toPointF(void)
- QVector2D toVector2D(void)
- QVector2D toVector2DAffine(void)
- QVector3D toVector3D(void)
- QVector3D toVector3DAffine(void)
- float w(void)
- float x(void)
- float y(void)

- float z(void)
- float dotProduct(QVector4D v1, QVector4D v2)

92.387 QVectorQVoice Class

C++ Reference : <http://doc.qt.io/qt-5/qvectorqvoice.html>

Parameters : void

- int count(void)
- QVoice value(int i)

92.388 QVersionNumber Class

C++ Reference : <http://doc.qt.io/qt-5/qversionnumber.html>

Parameters : void

- bool isNormalized(void)
- bool isNull(void)
- bool isPrefixOf(QVersionNumber other)
- int majorVersion(void)
- int microVersion(void)
- int minorVersion(void)
- QVersionNumber normalized(void)
- int segmentAt(int index)
- int segmentCount(void)
- QVector<int> segments(void)
- QString toString(void)

92.389 QVideoWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qvideowidget.html>

Parameters : QWidget *parent

Parent Class : QWidget

- int aspectRatioMode(void)
- int brightness(void)
- int contrast(void)
- int hue(void)
- bool isFullScreen(void)
- int saturation(void)

- void setAspectRatioMode(Qt::AspectRatioMode mode)
- void setBrightness(int brightness)
- void setContrast(int contrast)
- void setFullScreen(bool fullScreen)
- void setHue(int hue)
- void setSaturation(int saturation)
- void setbrightnessChangedEvent(const char *)
- void setcontrastChangedEvent(const char *)
- void setfullScreenChangedEvent(const char *)
- void sethueChangedEvent(const char *)
- void setsaturationChangedEvent(const char *)
- const char *getbrightnessChangedEvent(void)
- const char *getcontrastChangedEvent(void)
- const char *getfullScreenChangedEvent(void)
- const char *gethueChangedEvent(void)
- const char *getsaturationChangedEvent(void)

92.390 QVideoWidgetControl Class

C++ Reference : <http://doc.qt.io/qt-5/qvideowidgetcontrol.html>

Parent Class : QMediaControl

92.391 QViewport Class

C++ Reference : <http://doc.qt.io/qt-5/qt3drender-qviewport.html>

Parameters : Qt3DCore::QNode *

- float gamma(void)
- QRectF normalizedRect(void)
- void setGamma(float gamma)
- void setNormalizedRect(QRectF normalizedRect)

92.392 QVoice Class

C++ Reference : <http://doc.qt.io/qt-5/qvoice.html>

Parameters : void

- QVoice::Age age(void)
- QVoice::Gender gender(void)
- QString name(void)
- QString ageName(QVoice::Age age)
- QString genderName(QVoice::Gender gender)

92.393 QWebEnginePage Class

C++ Reference : <http://doc.qt.io/qt-5/qwebenginepage.html>

Parameters : QObject *

Parent Class : QObject

- QAction * action(QWebEnginePage::WebAction action)
- QColor backgroundColor(void)
- QSizeF contentsSize(void)
- QWebEnginePage * devToolsPage(void)
- void download(QUrl url, QString filename)
- void findText(QString subString, QWebEnginePage::FindFlags options, QWebEngineCallback<bool> resultCallback)
- bool hasSelection(void)
- QWebEngineHistory * history(void)
- QIcon icon(void)
- QUrl iconUrl(void)
- QWebEnginePage * inspectedPage(void)
- bool isAudioMuted(void)
- void load_3(QWebEngineHttpRequest request)
- void print(QPrinter *printer, QWebEngineCallback<bool>)
- bool recentlyAudible(void)
- QUrl requestedUrl(void)
- void runJavaScript(QString scriptSource)
- void runJavaScript_2(QString scriptSource, quint32 worldId)
- QPointF scrollPosition(void)
- QString selectedText(void)
- void setAudioMuted(bool muted)

- void setBackgroundColor(QColor color)
- void setContent(QByteArray data, QString mimeType, QUrl baseUrl)
- void setDevToolsPage(QWebEnginePage *devToolsPage)
- void setFeaturePermission(QUrl securityOrigin, QWebEnginePage::Feature feature, QWebEnginePage::PermissionPolicy policy)
- void setHtml(QString html, QUrl baseUrl)
- void setInspectedPage(QWebEnginePage *page)
- void setWebChannel_2(QWebChannel *channel)
- void setZoomFactor(qreal factor)
- QWebEngineSettings * settings(void)
- QString title(void)
- QUrl url(void)
- QWidget * view(void)
- QWebChannel * webChannel(void)
- qreal zoomFactor(void)
- void setaudioMutedChangedEvent(const char *)
- void setauthenticationRequiredEvent(const char *)
- void setcontentsSizeChangedEvent(const char *)
- void setfeaturePermissionRequestCanceledEvent(const char *)
- void setfeaturePermissionRequestedEvent(const char *)
- void setfindTextFinishedEvent(const char *)
- void setfullScreenRequestedEvent(const char *)
- void setgeometryChangeRequestedEvent(const char *)
- void seticonChangedEvent(const char *)
- void seticonUrlChangedEvent(const char *)
- void setloadFinishedEvent(const char *)
- void setloadProgressEvent(const char *)
- void setloadStartedEvent(const char *)
- void setpdfPrintingFinishedEvent(const char *)
- void setprintRequestedEvent(const char *)
- void setproxyAuthenticationRequiredEvent(const char *)
- void setquotaRequestedEvent(const char *)
- void setrecentlyAudibleChangedEvent(const char *)
- void setrecommendedStateChangedEvent(const char *)
- void setregisterProtocolHandlerRequestedEvent(const char *)
- void setselectClientCertificateEvent(const char *)

- void setselectionChangedEvent(const char *)
- void settitleChangedEvent(const char *)
- void seturlChangedEvent(const char *)
- void setvisibleChangedEvent(const char *)
- void setwindowCloseRequestedEvent(const char *)
- const char *getaudioMutedChangedEvent(void)
- const char *getauthenticationRequiredEvent(void)
- const char *getcontentsSizeChangedEvent(void)
- const char *getfeaturePermissionRequestCanceledEvent(void)
- const char *getfeaturePermissionRequestedEvent(void)
- const char *getfindTextFinishedEvent(void)
- const char *getfullScreenRequestedEvent(void)
- const char *getgeometryChangeRequestedEvent(void)
- const char *geticonChangedEvent(void)
- const char *geticonUrlChangedEvent(void)
- const char *getloadFinishedEvent(void)
- const char *getloadProgressEvent(void)
- const char *getloadStartedEvent(void)
- const char *getpdfPrintingFinishedEvent(void)
- const char *getprintRequestedEvent(void)
- const char *getproxyAuthenticationRequiredEvent(void)
- const char *getquotaRequestedEvent(void)
- const char *getrecentlyAudibleChangedEvent(void)
- const char *getrecommendedStateChangedEvent(void)
- const char *getregisterProtocolHandlerRequestedEvent(void)
- const char *getselectClientCertificateEvent(void)
- const char *getselectionChangedEvent(void)
- const char *getttitleChangedEvent(void)
- const char *geturlChangedEvent(void)
- const char *getvisibleChangedEvent(void)
- const char *getwindowCloseRequestedEvent(void)

92.394 QWebEngineView Class

C++ Reference : <http://doc.qt.io/qt-5/qwebengineview.html>

Parameters : QWidget *parent

Parent Class : QWidget

- bool hasSelection(void)
- QWebEngineHistory *history(void)
- void load(QUrl) # In RingQt use : void loadpage(QUrl)
- QWebEnginePage *page(void)
- QAction *pageAction(QWebEnginePage::WebAction action)
- QString selectedText(void)
- void setContent(QByteArray,QString,QUrl)
- void setHtml(QString,QUrl)
- void setPage(QWebEnginePage *page)
- void setUrl(QUrl)
- void setZoomFactor(qreal factor)
- QWebSettings *settings(void)
- QString title(void)
- void triggerPageAction(QWebEnginePage::WebAction action, bool checked)
- QUrl url(void)
- qreal zoomFactor(void)
- void back(void)
- void forward(void)
- void reload(void)
- void stop(void)
- void setloadFinishedEvent(const char *)
- void setloadProgressEvent(const char *)
- void setloadStartedEvent(const char *)
- void setselectionChangedEvent(const char *)
- void settitleChangedEvent(const char *)
- void seturlChangedEvent(const char *)
- const char *getloadFinishedEvent(void)
- const char *getloadProgressEvent(void)
- const char *getloadStartedEvent(void)
- const char *getselectionChangedEvent(void)
- const char *getttitleChangedEvent(void)

- const char *geturlChangedEvent(void)
- void print(QPrinter *printer,const char *cCode)

92.395 QWebView Class

C++ Reference : <http://doc.qt.io/qt-5/qwebview.html>

Parameters : QWidget *parent

Parent Class : QWebEngineView

- QWebHistory *history(void)
- QAction *pageAction(QWebPage::WebAction action)
- void setContent(QByteArray,QString,QString)
- void setHtml(QString,QString)
- void setPage(QWebPage *page)
- void setZoomFactor(qreal factor)
- QWebSettings *settings(void)
- void triggerPageAction(QWebPage::WebAction action, bool checked)
- QString url(void)
- qreal zoomFactor(void)
- void back(void)
- void forward(void)
- void print(QPrinter *printer)
- void reload(void)
- void stop(void)
- void setloadProgressEvent(const char *)
- void setloadStartedEvent(const char *)
- void setselectionChangedEvent(const char *)
- void seturlChangedEvent(const char *)
- const char *getloadFinishedEvent(void)
- const char *getloadProgressEvent(void)
- const char *getloadStartedEvent(void)
- const char *getselectionChangedEvent(void)
- const char *getttitleChangedEvent(void)
- const char *geturlChangedEvent(void)

92.396 QWidget Class

C++ Reference : <http://doc.qt.io/qt-5/qwidget.html>

Parameters : void

Parent Class : QObject

- bool acceptDrops(void)
- QString accessibleDescription(void)
- QString accessibleName(void)
- void activateWindow(void)
- void addAction(QAction *action)
- void adjustSize(void)
- bool autoFillBackground(void)
- int backgroundRole(void)
- QSize baseSize(void)
- QWidget *childAt(int x, int y)
- QRect childrenRect(void)
- QRegion childrenRegion(void)
- void clearFocus(void)
- void clearMask(void)
- QMargins contentsMargins(void)
- QRect contentsRect(void)
- int contextMenuPolicy(void)
- QCursor cursor(void)
- int effectiveWinId(void)
- void ensurePolished(void)
- int focusPolicy(void)
- QWidget *focusProxy(void)
- QWidget *focusWidget(void)
- QFont font(void)
- QFontInfo fontInfo(void)
- int foregroundRole(void)
- QRect frameGeometry(void)
- QSize frameSize(void)
- QRect geometry(void)
- QPixmap grab(QRect)
- void grabGesture(Qt::GestureType gesture, Qt::GestureFlag flags)

- void grabKeyboard(void)
- void grabMouse(void)
- int grabShortcut(QKeySequence , Qt::ShortcutContext context)
- QGraphicsEffect *graphicsEffect(void)
- QGraphicsProxyWidget *graphicsProxyWidget(void)
- bool hasFocus(void)
- bool hasMouseTracking(void)
- int height(void)
- int heightForWidth(int w)
- int inputMethodHints(void)
- QVariant inputMethodQuery(Qt::InputMethodQuery query)
- void insertAction(QAction *before, QAction *action)
- bool isActiveWindow(void)
- bool isAncestorOf(QWidget *child)
- bool isEnabled(void)
- bool isEnabledTo(QWidget *ancestor)
- bool isFullScreen(void)
- bool isHidden(void)
- bool isMaximized(void)
- bool isMinimized(void)
- bool isModal(void)
- bool isVisible(void)
- bool isVisibleTo(QWidget *ancestor)
- bool isWindow(void)
- bool isWindowModified(void)
- QLayout *layout(void)
- int layoutDirection(void)
- QLocale locale(void)
- QPoint mapFrom(QWidget *parent, QPoint)
- QPoint mapFromGlobal(QPoint)
- QPoint mapFromParent(QPoint)
- QPoint mapTo(QWidget *parent, QPoint)
- QPoint mapToGlobal(QPoint pos)
- QPoint mapToParent(QPoint pos)
- QRegion mask(void)
- int maximumHeight(void)

- QSize maximumSize(void)
- int maximumWidth(void)
- int minimumHeight(void)
- QSize minimumSize(void)
- int minimumWidth(void)
- void move(int x, int y)
- QWidget *nativeParentWidget(void)
- QWidget *nextInFocusChain(void)
- QRect normalGeometry(void)
- void overrideWindowFlags(Qt::WindowType flags)
- QPalette palette(void)
- QWidget *parentWidget(void)
- QPoint pos(void)
- QWidget *previousInFocusChain(void)
- QRect rect(void)
- void releaseKeyboard(void)
- void releaseMouse(void)
- void releaseShortcut(int id)
- void removeAction(QAction *action)
- void render(QPaintDevice *target, QPoint, QRegion, QWidget::RenderFlag)
- void repaint(void)
- void resize(int w, int h)
- bool restoreGeometry(QByteArray)
- QByteArray saveGeometry(void)
- void scroll(int dx, int dy)
- void setAcceptDrops(bool on)
- void setAccessibleDescription(QString)
- void setAccessibleName(QString)
- void setAttribute(Qt::WidgetAttribute attribute, bool on)
- void setAutoFillBackground(bool enabled)
- void setBackgroundRole(QPalette::ColorRole role)
- void setBaseSize(int basew, int baseh)
- void setContentsMargins(int left, int top, int right, int bottom)
- void setContextMenuPolicy(Qt::ContextMenuPolicy policy)
- void setCursor(QCursor)
- void setFixedHeight(int h)

- void setFixedSize(int w, int h)
- void setFixedWidth(int w)
- void setFocus(Qt::FocusReason reason)
- void setFocusPolicy(Qt::FocusPolicy policy)
- void setFocusProxy(QWidget *w)
- void setFont(QFont)
- void setForegroundRole(QPalette::ColorRole role)
- void setGeometry(int x, int y, int w, int h)
- void setGraphicsEffect(QGraphicsEffect *effect)
- void setInputMethodHints(Qt::InputMethodHint hints)
- void setLayout(QLayout *layout)
- void setLayoutDirection(Qt::LayoutDirection direction)
- void setLocale(QLocale)
- void setMask(QBitmap)
- void setMaximumHeight(int maxh)
- void setMaximumSize(int maxw, int maxh)
- void setMaximumWidth(int maxw)
- void setMinimumHeight(int minh)
- void setMinimumSize(int minw, int minh)
- void setMinimumWidth(int minw)
- void setMouseTracking(bool enable)
- void setPalette(QPalette)
- void setParent(QWidget *parent)
- void setShortcutAutoRepeat(int id, bool enable)
- void setShortcutEnabled(int id, bool enable)
- void setSizeIncrement(int w, int h)
- void setSizePolicy(QSizePolicy::Policy horizontal, QSizePolicy::Policy vertical)
- void setStatusTip(QString)
- void setStyle(QStyle *style)
- void setToolTip(QString)
- void setUpdatesEnabled(bool enable)
- void setWhatsThis(QString)
- void setWindowFilePath(QString)
- void setWindowFlags(Qt::WindowType type)
- void setWindowIcon(QIcon)
- void setWindowIconText(QString)

- void setWindowModality(Qt::WindowModality windowModality)
- void setWindowOpacity(double level)
- void setWindowRole(QString)
- void setWindowState(Qt::WindowState windowState)
- QSize size(void)
- QSize sizeIncrement(void)
- QSizePolicy sizePolicy(void)
- void stackUnder(QWidget *w)
- QString statusTip(void)
- QStyle *style(void)
- QString styleSheet(void)
- bool testAttribute(Qt::WidgetAttribute attribute)
- QString toolTip(void)
- bool underMouse(void)
- void ungrabGesture(Qt::GestureType gesture)
- void unsetCursor(void)
- void unsetLayoutDirection(void)
- void unsetLocale(void)
- void update(int x, int y, int w, int h)
- void updateGeometry(void)
- bool updatesEnabled(void)
- QRegion visibleRegion(void)
- QString whatsThis(void)
- int width(void)
- int winId(void)
- QWidget *window(void)
- QString windowFilePath(void)
- int windowFlags(void)
- QWindow *windowHandle(void)
- QIcon windowIcon(void)
- QString windowIconText(void)
- int windowModality(void)
- double windowOpacity(void)
- QString windowRole(void)
- int windowState(void)
- QString windowTitle(void)

- int windowType(void)
- int x(void)
- int y(void)
- bool close(void)
- void hide(void)
- void lower(void)
- void raise(void)
- void setDisabled(bool disable)
- void setEnabled(bool)
- void setHidden(bool hidden)
- void setStyleSheet(QString)
- void setWindowModified(bool)
- void setWindowTitle(QString)
- void show(void)
- void showFullScreen(void)
- void showMaximized(void)
- void showMinimized(void)
- void showNormal(void)
- QWidget *find(int id)
- QWidget *keyboardGrabber(void)
- QWidget *mouseGrabber(void)
- void setTabOrder(QWidget *first, QWidget *second)
- QWidget *createWindowContainer(QWindow *window, QWidget *parent, Qt::WindowFlags flags)

92.397 QWindow Class

C++ Reference : <http://doc.qt.io/qt-5/qwindow.html>

Parameters : QScreen *

Parent Class : QObject

- QSize baseSize(void)
- Qt::ScreenOrientation contentOrientation(void)
- void create(void)
- QCursor cursor(void)
- void destroy(void)
- qreal devicePixelRatio(void)
- QString filePath(void)

- Qt::WindowFlags flags(void)
- QObject * focusObject(void)
- QRect frameGeometry(void)
- QMargins frameMargins(void)
- QPoint framePosition(void)
- QRect geometry(void)
- int height(void)
- QIcon icon(void)
- bool isActive(void)
- bool isAncestorOf(QWindow *child, QWindow::AncestorMode mode)
- bool isExposed(void)
- bool isModal(void)
- bool isTopLevel(void)
- bool isVisible(void)
- QPoint mapFromGlobal(QPoint pos)
- QPoint mapToGlobal(QPoint pos)
- QRegion mask(void)
- int maximumHeight(void)
- QSize maximumSize(void)
- int maximumWidth(void)
- int minimumHeight(void)
- QSize minimumSize(void)
- int minimumWidth(void)
- Qt::WindowModality modality(void)
- qreal opacity(void)
- QPoint position(void)
- void reportContentOrientationChange(Qt::ScreenOrientation orientation)
- QSurfaceFormat requestedFormat(void)
- void resize(QSize newSize)
- void resize_2(int w, int h)
- QScreen * screen(void)
- void setBaseSize(QSize size)
- void setCursor(QCursor cursor)
- void setFilePath(QString filePath)
- void setFlags(Qt::WindowFlags flags)
- void setFormat(QSurfaceFormat format)

- void setFramePosition(QPoint point)
- void setGeometry(int posx, int posy, int w, int h)
- void setGeometry_2(QRect rect)
- void setIcon(QIcon icon)
- bool setKeyboardGrabEnabled(bool grab)
- void setMask(QRegion region)
- void setMaximumSize(QSize size)
- void setMinimumSize(QSize size)
- void setModality(Qt::WindowModality modality)
- bool setMouseGrabEnabled(bool grab)
- void setOpacity(qreal level)
- void setParent(QWindow *parent)
- void setPosition(QPoint pt)
- void setPosition_2(int posx, int posy)
- void setScreen(QScreen *newScreen)
- void setSizeIncrement(QSize size)
- void setTransientParent(QWindow *parent)
- void setVisibility(QWindow::Visibility v)
- void setWindowState(Qt::WindowState state)
- QSize sizeIncrement(void)
- QString title(void)
- QWindow * transientParent(void)
- Qt::WindowType type(void)
- void unsetCursor(void)
- QWindow::Visibility visibility(void)
- int width(void)
- WId winId(void)
- Qt::WindowState windowState(void)
- int x(void)
- int y(void)
- void alert(int msec)
- bool close(void)
- void hide(void)
- void lower(void)
- void raise(void)
- void requestActivate(void)

- void setHeight(int arg)
- void setMaximumHeight(int h)
- void setMaximumWidth(int w)
- void setMinimumHeight(int h)
- void setMinimumWidth(int w)
- void setTitle(QString)
- void setVisible(bool visible)
- void setWidth(int arg)
- void setX(int arg)
- void setY(int arg)
- void show(void)
- void showFullScreen(void)
- void showMaximized(void)
- void showMinimized(void)
- void showNormal(void)
- QWindow * fromWinId(WId id)
- void setactiveChangedEvent(const char *)
- void setcontentOrientationChangedEvent(const char *)
- void setfocusObjectChangedEvent(const char *)
- void setheightChangedEvent(const char *)
- void setmaximumHeightChangedEvent(const char *)
- void setmaximumWidthChangedEvent(const char *)
- void setminimumHeightChangedEvent(const char *)
- void setminimumWidthChangedEvent(const char *)
- void setmodalityChangedEvent(const char *)
- void setopacityChangedEvent(const char *)
- void setscreenChangedEvent(const char *)
- void setvisibilityChangedEvent(const char *)
- void setvisibleChangedEvent(const char *)
- void setwidthChangedEvent(const char *)
- void setWindowStateChangedEvent(const char *)
- void setWindowTitleChangedEvent(const char *)
- void setxChangedEvent(const char *)
- void setyChangedEvent(const char *)
- const char *getactiveChangedEvent(void)
- const char *getcontentOrientationChangedEvent(void)

- const char *getfocusObjectChangedEvent(void)
- const char *getheightChangedEvent(void)
- const char *getmaximumHeightChangedEvent(void)
- const char *getmaximumWidthChangedEvent(void)
- const char *getminimumHeightChangedEvent(void)
- const char *getminimumWidthChangedEvent(void)
- const char *getmodalityChangedEvent(void)
- const char *getopacityChangedEvent(void)
- const char *getscreenChangedEvent(void)
- const char *getvisibilityChangedEvent(void)
- const char *getvisibleChangedEvent(void)
- const char *getwidthChangedEvent(void)
- const char *getwindowStateChangedEvent(void)
- const char *getwindowTitleChangedEvent(void)
- const char *getxChangedEvent(void)
- const char *getyChangedEvent(void)

92.398 QXYLegendMarker Class

C++ Reference : <http://doc.qt.io/qt-5/qxylegendmarker.html>

Parent Class : QLegendMarker

- QXYSeries * series(void)
- QLegendMarker::LegendMarkerType type(void)

92.399 QXYSeries Class

C++ Reference : <http://doc.qt.io/qt-5/qxyseries.html>

Parent Class : QAbstractSeries

- void append(qreal x, qreal y)
- void append_2(QPointF point)
- void append_3(QList<QPointF> points)
- QPointF at(int index)
- QBrush brush(void)
- void clear(void)
- QColor color(void)
- int count(void)
- void insert(int index, QPointF point)

- QPen pen(void)
- bool pointLabelsClipping(void)
- QColor pointLabelsColor(void)
- QFont pointLabelsFont(void)
- QString pointLabelsFormat(void)
- bool pointLabelsVisible(void)
- QList<QPointF> points(void)
- QVector<QPointF> pointsVector(void)
- bool pointsVisible(void)
- void remove(qreal x, qreal y)
- void remove_2(QPointF point)
- void remove_3(int index)
- void removePoints(int index, int count)
- void replace(qreal oldX, qreal oldY, qreal newX, qreal newY)
- void replace_2(QPointF oldPoint, QPointF newPoint)
- void replace_3(int index, qreal newX, qreal newY)
- void replace_4(int index, QPointF newPoint)
- void replace_5(QList<QPointF> points)
- void replace_6(QVector<QPointF> points)
- void setBrush(QBrush brush)
- void setColor(QColor color)
- void setPen(QPen pen)
- void setPointLabelsClipping(bool enabled)
- void setPointLabelsColor(QColor color)
- void setPointLabelsFont(QFont font)
- void setPointLabelsFormat(QString format)
- void setPointLabelsVisible(bool visible)
- void setPointsVisible(bool visible)
- void setclickedEvent(const char *)
- void setcolorChangedEvent(const char *)
- void setdoubleClickedEvent(const char *)
- void sethoveredEvent(const char *)
- void setpenChangedEvent(const char *)
- void setpointAddedEvent(const char *)
- void setpointLabelsClippingChangedEvent(const char *)
- void setpointLabelsColorChangedEvent(const char *)

- void setpointLabelsFontChangedEvent(const char *)
- void setpointLabelsFormatChangedEvent(const char *)
- void setpointLabelsVisibilityChangedEvent(const char *)
- void setpointRemovedEvent(const char *)
- void setpointReplacedEvent(const char *)
- void setpointsRemovedEvent(const char *)
- void setpointsReplacedEvent(const char *)
- void setpressedEvent(const char *)
- void setreleasedEvent(const char *)
- const char *getclickedEvent(void)
- const char *getcolorChangedEvent(void)
- const char *getdoubleClickedEvent(void)
- const char *gethoveredEvent(void)
- const char *getpenChangedEvent(void)
- const char *getpointAddedEvent(void)
- const char *getpointLabelsClippingChangedEvent(void)
- const char *getpointLabelsColorChangedEvent(void)
- const char *getpointLabelsFontChangedEvent(void)
- const char *getpointLabelsFormatChangedEvent(void)
- const char *getpointLabelsVisibilityChangedEvent(void)
- const char *getpointRemovedEvent(void)
- const char *getpointReplacedEvent(void)
- const char *getpointsRemovedEvent(void)
- const char *getpointsReplacedEvent(void)
- const char *getpressedEvent(void)
- const char *getreleasedEvent(void)

92.400 QXmlStreamAttribute Class

C++ Reference : <http://doc.qt.io/qt-5/qxmlstreamattribute.html>

Parameters : void

- bool isDefault(void)
- QStringRef name(void)
- QStringRef namespaceUri(void)
- QStringRef prefix(void)
- QStringRef qualifiedName(void)

- QStringRef value(void)

92.401 QXmlStreamAttributes Class

C++ Reference : <http://doc.qt.io/qt-5/qxmlstreamattributes.html>

Parameters : void

- void append(QString namespaceUri, QString name, QString value)
- void append_2(QString qualifiedName, QString value)
- bool hasAttribute(QString qualifiedName)
- bool hasAttribute_2(QLatin1String qualifiedName)
- bool hasAttribute_3(QString namespaceUri, QString name)
- QStringRef value(QString namespaceUri, QString name)
- QStringRef value_2(QString namespaceUri, QLatin1String name)
- QStringRef value_3(QLatin1String namespaceUri, QLatin1String name)
- QStringRef value_4(QString qualifiedName)
- QStringRef value_5(QLatin1String qualifiedName)

92.402 QXmlStreamEntityDeclaration Class

C++ Reference : <http://doc.qt.io/qt-5/qxmlstreamentitydeclaration.html>

Parameters : void

- QStringRef name(void)
- QStringRef notationName(void)
- QStringRef publicId(void)
- QStringRef systemId(void)
- QStringRef value(void)

92.403 QXmlStreamEntityResolver Class

C++ Reference : <http://doc.qt.io/qt-5/qxmlstreamentityresolver.html>

Parameters : void

92.404 QXmlStreamNamespaceDeclaration Class

C++ Reference : <http://doc.qt.io/qt-5/qxmlstreamnamespacedeclaration.html>

Parameters : void

- QStringRef namespaceUri(void)
- QStringRef prefix(void)

92.405 QXmlStreamNotationDeclaration Class

C++ Reference : <http://doc.qt.io/qt-5/qxmlstreamnotationdeclaration.html>

Parameters : void

- QStringRef name(void)
- QStringRef publicId(void)
- QStringRef systemId(void)

92.406 QXmlStreamReader Class

C++ Reference : <http://doc.qt.io/qt-5/qxmlstreamreader.html>

Parameters : void

- void addData(QByteArray)
- void addData_2(QString)
- void addData_3(const char * data)
- void addExtraNamespaceDeclaration(QXmlStreamNamespaceDeclaration)
- void addExtraNamespaceDeclarations(QXmlStreamNamespaceDeclarations)
- bool atEnd(void)
- QXmlStreamAttributes attributes(void)
- qint64 characterOffset(void)
- void clear(void)
- qint64 columnNumber(void)
- QIODevice *device(void)
- QStringRef documentEncoding(void)
- QStringRef documentVersion(void)
- QStringRef dtdName(void)
- QStringRef dtdPublicId(void)
- QStringRef dtdSystemId(void)
- QXmlStreamEntityDeclarations entityDeclarations(void)
- QXmlStreamEntityResolver *entityResolver(void)

- Error error(void)
- QString errorString(void)
- bool hasError(void)
- bool isCDATA(void)
- bool isCharacters(void)
- bool isComment(void)
- bool isDTD(void)
- bool isEndDocument(void)
- bool isEndElement(void)
- bool isEntityReference(void)
- bool isProcessingInstruction(void)
- bool isStandaloneDocument(void)
- bool isStartDocument(void)
- bool isStartElement(void)
- bool isWhitespace(void)
- qint64 lineNumber(void)
- QStringRef name(void)
- QXmlStreamNamespaceDeclarations namespaceDeclarations(void)
- bool namespaceProcessing(void)
- QStringRef namespaceUri(void)
- QXmlStreamNotationDeclarations notationDeclarations(void)
- QStringRef prefix(void)
- QStringRef processingInstructionData(void)
- QStringRef processingInstructionTarget(void)
- QStringRef qualifiedName(void)
- void raiseError(QString)
- QString readElementText(QXmlStreamReader::ReadElementTextBehaviour)
- TokenType readNext(void)
- bool readNextStartElement(void)
- void setDevice(QIODevice *device)
- void setEntityResolver(QXmlStreamEntityResolver *resolver)
- void setNamespaceProcessing(bool)
- void skipCurrentElement(void)
- QStringRef text(void)
- QString tokenString(void)
- TokenType tokenType(void)

92.407 QXmlStreamWriter Class

C++ Reference : <http://doc.qt.io/qt-5/qxmlstreamwriter.html>

Parameters : void

- bool autoFormatting(void)
- int autoFormattingIndent(void)
- QTextCodec *codec(void)
- QIODevice *device(void)
- bool hasError(void)
- void setAutoFormatting(bool enable)
- void setAutoFormattingIndent(int spacesOrTabs)
- void setCodec(QTextCodec *codec)
- void setCodec_2(const char *codecName)
- void setDevice(QIODevice *device)
- void writeAttribute(QString, QString, QString)
- void writeAttribute_2(QString, QString)
- void writeAttribute_3(QXmlStreamAttribute)
- void writeAttributes(QXmlStreamAttributes)
- void writeCDATA(QString text)
- void writeCharacters(QString text)
- void writeComment(QString text)
- void writeCurrentToken(QXmlStreamReader reader)
- void writeDTD(QString dtd)
- void writeDefaultNamespace(QString namespaceUri)
- void writeEmptyElement(QString namespaceUri, QString name)
- void writeEmptyElement_2(QString qualifiedName)
- void writeEndDocument(void)
- void writeEndElement(void)
- void writeEntityReference(QString name)
- void writeNamespace(QString namespaceUri, QString prefix)
- void writeProcessingInstruction(QString target, QString data)
- void writeStartDocument(QString version)
- void writeStartDocument_2(QString version, bool standalone)
- void writeStartDocument_3(void)
- void writeStartElement(QString namespaceUri, QString name)
- void writeStartElement_2(QString qualifiedName)

- void writeTextElement(QString namespaceUri, QString name, QString text)
- void writeTextElement_2(QString qualifiedName, QString text)

92.408 Qt3DCamera Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dcamera.html>

Parameters : Qt3DCore::QNode *

Parent Class : QEntity

- float aspectRatio(void)
- float bottom(void)
- float exposure(void)
- float farPlane(void)
- float fieldOfView(void)
- float left(void)
- QCameraLens *lens(void)
- float nearPlane(void)
- void pan(float angle)
- void pan_2(float angle, QVector3D axis)
- void panAboutViewCenter(float angle)
- void panAboutViewCenter_2(float angle, QVector3D axis)
- QQuaternion panRotation(float angle)
- QVector3D position(void)
- QMatrix4x4 projectionMatrix(void)
- Qt3DRender::QCameraLens::ProjectionType projectionType(void)
- float right(void)
- void roll(float angle)
- void rollAboutViewCenter(float angle)
- QQuaternion rollRotation(float angle)
- void rotate(QQuaternion q)
- void rotateAboutViewCenter(QQuaternion q)
- QQuaternion rotation(float angle, QVector3D axis)
- void tilt(float angle)
- void tiltAboutViewCenter(float angle)
- QQuaternion tiltRotation(float angle)
- float top(void)
- Qt3DCore::QTransform * transform(void)

- void translate(QVector3D vLocal, Qt3DRRender::QCamera::CameraTranslationOption option)
- void translateWorld(QVector3D vWorld, Qt3DRRender::QCamera::CameraTranslationOption option)
- QVector3D upVector(void)
- QVector3D viewCenter(void)
- QVector3D viewVector(void)
- void setAspectRatio(float aspectRatio)
- void setBottom(float bottom)
- void setExposure(float exposure)
- void setFarPlane(float farPlane)
- void setFieldOfView(float fieldOfView)
- void setLeft(float left)
- void setNearPlane(float nearPlane)
- void setPosition(QVector3D position)
- void setProjectionMatrix(QMatrix4x4 projectionMatrix)
- void setProjectionType(Qt3DRRender::QCameraLens::ProjectionType type)
- void setRight(float right)
- void setTop(float top)
- void setUpVector(QVector3D upVector)
- void setViewCenter(QVector3D viewCenter)
- void viewAll(void)
- void viewEntity(Qt3DCore::QEntity *entity)
- void viewSphere(QVector3D center, float radius)

92.409 Qt3DWindow Class

C++ Reference : <http://doc.qt.io/qt-5/qt3dextras-qt3dwindow.html>

Parameters : void

Parent Class : QWindow

- Qt3DRRender::QFrameGraphNode * activeFrameGraph(void)
- QForwardRenderer * defaultFrameGraph(void)
- void registerAspect(Qt3DCore::QAbstractAspect *aspect)
- void registerAspect_2(QString name)
- Qt3DRRender::QRenderSettings * renderSettings(void)
- void setActiveFrameGraph(Qt3DRRender::QFrameGraphNode *activeFrameGraph)
- void setRootEntity(Qt3DCore::QEntity *root)
- Qt3DCamera *camera(void)

92.410 RingCodeHighlighter Class

Parameters : QTextDocument *parent

- void setColors(QColor c1,QColor c2,QColor c3,QColor c4,QColor c5)
- void setKeywordsBold(int nStatus)
- void setUseDefaultKeywords(int nStatus)
- void setCustomKeywords(QStringList aKeywords)

CHAPTER
NINETYTHREE

USING FASTPRO

In this chapter we will learn about Using the FastPro extension.

This extension is added to the Ring language starting from Ring 1.19.

Contents:

- Bytes2List() function
- List2Bytes() function
- UpdateList() function
- UpdateColumn() function
- UpdateBytesColumn() function
- AddBytesColumn() function

93.1 Bytes2List() function

Syntax:

```
Bytes2List(cBytes,nWidth,nHeight,nChannels) -> aList // [[R,G,B],...]
```

93.2 List2Bytes() function

Syntax:

```
List2Bytes(aList,nChannels) -> cBytes // "RGBA...."
```

93.3 UpdateList() function

A function that could update 1D and 2D lists and provide very high performance.

This function support using numbers only.

Syntax:

```
updateList(<aList>,<cCommand>,<cSelection>,<nPara1>,[<nPara2>],[nPara3])
```

cCommand could be :set, :add, :sub, :mul, :div, :rem, :pow, :serial, :merge and :copy

cSelection could be :col, :row, :manycols, :manyrows and :items

Example:

```
updateList(<aList>,:set,:row,<nRow>,<nValue>)
updateList(<aList>,:set,:col,<nCol>,<nValue>)
updateList(<aList>,:set,:manyrows,<nRowStart>,<nRowEnd>,<nValue>)
updateList(<aList>,:set,:manycols,<nColStart>,<nColEnd>,<nValue>)
updateList(<aList>,:set,:items,<nValue>)
updateList(<aList>,:copy,:row,<nRowSrc>,<nRowDest>)
updateList(<aList>,:copy,:col,<nColSrc>,<nColDest>)
updateList(<aList>,:merge,:row,<nRowDest>,<nRow>)
updateList(<aList>,:merge,:col,<nColDest>,<nCol>)
updateList(<aList>,:mul,:col,<nCol>,<nValue>,<nColDest>)
```

The required parameters depend on the cCommand/cSelection.

The parameters could be columns/rows numbers.

Also, some commands requires a value like the set command.

Example:

```
load "fastpro.ring"

aList = [ [1,2,3],
          [4,5,6],
          7:9 ]

# Set the values of the first row to 10
    updateList(aList,:set,:row,1,10)
# Add 10 to each value in the first row
    updateList(aList,:add,:row,1,10)
# Sub 5 from each value in the first row
    updateList(aList,:sub,:row,1,5)
# Multiply each value in the first row by 10
    updateList(aList,:mul,:row,1,10)
# Divide each value in the first row by 2
    updateList(aList,:div,:row,1,2)
# Copy the first row values to the second row
    updateList(aList,:copy,:row,1,2)
# Sum the third row and the second row
# And the result will be in the third row
    updateList(aList,:merge,:row,3,2)

? aList
```

Output:

The list will be [[75,75,75], [75,75,75], [82,83,84]]

```
75
75
75
75
```

(continues on next page)

(continued from previous page)

```
75
75
82
83
84
```

Using :col as the third parameter we can do operations on the list columns.

Example:

```
load "fastpro.ring"

# Store [ [1,2,3], [4,5,6], [7,8,9] ] in aList
aList = [ 1:3,
          4:6,
          7:9 ]

updateList(aList,:set,:col,1,100)
updateList(aList,:mul,:col,2,10)
updateList(aList,:div,:col,3,3)

? aList
```

Output:

The list will be [[100,20,1], [100,50,2], [100,80,3]]

```
100
20
1
100
50
2
100
80
3
```

We can determine a destination column through the six parameter.

Example:

```
load "fastpro.ring"

aList = [
          [10,20,0],
          [30,40,0],
          [50,60,0]
        ]

updateList(aList,:mul,:col,1,10,3)

? aList
```

Output:

The list will be [[10,20,100], [30,40,300], [50,60,500]]

```
10
20
100
30
40
300
50
60
500
```

Using :manyrows or :manycols we can do operations on many rows/columns

Example:

```
load "fastpro.ring"

aList = [
    1:3,
    4:6,
    7:9
]

# Starting from row 1 to row 2, set each value to 100
updateList(aList,:set,:manyrows,1,2,100)
# Starting from row 2 to row 3, multiply each value by 10
updateList(aList,:mul,:manyrows,2,3,10)

? aList
```

Output:

```
100
100
100
1000
1000
1000
70
80
90
```

Using :items as the third parameter we can do operations on 1D lists.

Example:

```
load "fastpro.ring"

aList = 1:5

updateList(aList,:set,:items,1000)
updateList(aList,:mul,:items,2)
? aList
```

Output:

The list will be [2000,2000,2000,2000,2000]

```
2000
2000
2000
2000
2000
```

Using :serial, we can set default values for multiple items based on their positions.

Example:

The next code updates the list with values incremented by 5 in each column.

```
load "fastpro.ring"

aList = [
    list(5),
    list(5),
    list(5),
    list(5),
    list(5)
]

updateList(aList,:serial,:col,1,0)
updateList(aList,:serial,:col,2,5)
updateList(aList,:serial,:col,3,10)
updateList(aList,:serial,:col,4,15)
updateList(aList,:serial,:col,5,20)

? copy("*,20)

for x=1 to 5
    for y=1 to 5
        print(aList[x][y])
        if y != 5 print (" ") ok
    next
? ""
next
```

Output:

The output displays a row of asterisks followed by the elements of the list arranged in a structured format.

```
*****
1-6-11-16-21
2-7-12-17-22
3-8-13-18-23
4-9-14-19-24
5-10-15-20-25
```

93.4 UpdateColumn() function

Syntax:

```
updateColumn(<aList>, [<cCommand>, <nPara1>, [<nPara2>], [nPara3]], ...)
```

Using this function we can execute many commands on the list columns.

Instead of using updateList() many times and each time we pass :col as the third parameter, we can use updateColumn(). This function support using numbers only.

Note: The ImagePixel application uses a similar function called updateBytesColumn() to process bytes directly.

93.5 Generate Image

The next example generate an image using a string that contain bytes

Then uses Bytes2List() to convert the generated image to Ring List

Using updateColumn() the list is updated and the colors are converted to Gray

Then using List2Bytes() we get another string contains bytes that represent the Gray Image

Then using the drawBytes() method in RingQt - QPainter class we draw the generated images

Note: We can update the string bytes directly without conversion to a Ring list

Tip: It's better to use the updateBytesColumn() function to reduce memory usage and have better performance

```
load "stbimage.ring"
load "fastpro.ring"
load "lightguilib.ring"

width    = 640
height   = 480
channels = 3
cImage   = space(width*height*channels)

RVALUE   = 1
GVALUE   = 2
BVALUE   = 3

WindowWidth = Width*2 + 100

nIndex=0
for x=1 to height
    for y=1 to width
        cImage[nIndex++] = x*x
        cImage[nIndex++] = x*y
```

(continues on next page)

(continued from previous page)

```

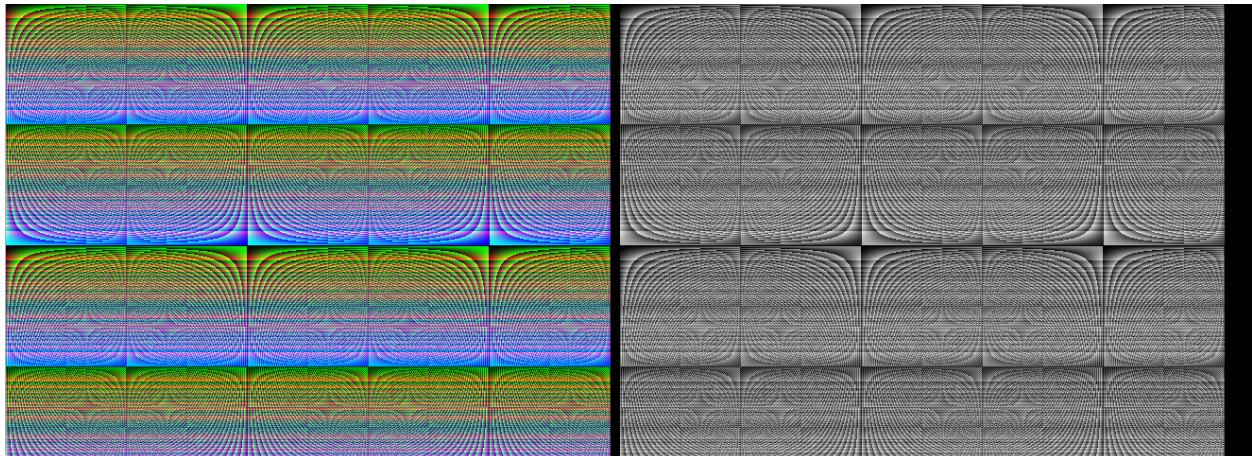
cImage[nIndex++] = x*x
next
next

aList = Bytes2List(cImage,Width,Height,Channels,255)
updateColumn(aList,:mul,RVALUE,0.3,           # R *= 0.3
             :mul,GVALUE,0.59,           # G *= 0.59
             :mul,BVALUE,0.11,           # B *= 0.11
             :merge,RVALUE,GVALUE,      # R += G
             :merge,RVALUE,BVALUE,      # R += B
             :copy,RVALUE,GVALUE,       # G = R
             :copy,RVALUE,BVALUE)       # B = R
cGrayImage = list2Bytes(aList,Channels,255)

MyApp = new QApplication()
{
    win1 = new QWidget()
    {
        setWindowTitle("Generate Image & Convert it to Gray")
        setGeometry(0,0,WindowWidth,Height)
        Canvas = new QLabel(win1)
        {
            MonaLisa = new QPixmap( WindowWidth, Height)
            daVinci = new QPainter()
            {
                begin(MonaLisa)
                drawbytes(0,0,cImage, width, Height, channels)
                drawbytes(width+10,0,cGrayImage, width, Height, channels)
                endPaint()
            }
            setPixmap(MonaLisa)
        }
        show()
    }
    exec()
}

```

Output:



A faster version of the previous sample could be written by replacing the next code

```
aList = Bytes2List(cImage,Width,Height,Channels,255)
updateColumn(aList,:mul,RVALUE,0.3,           # R *= 0.3
             :mul,GVALUE,0.59,          # G *= 0.59
             :mul,BVALUE,0.11,          # B *= 0.11
             :merge,RVALUE,GVALUE,      # R += G
             :merge,RVALUE,BVALUE,      # R += B
             :copy,RVALUE,GVALUE,       # G = R
             :copy,RVALUE,BVALUE)       # B = R
cGrayImage = list2Bytes(aList,Channels,255)
```

With this code

```
cGrayImage = updateBytesColumn(cImage,Channels,Width*Height,255,
                               :mul,RVALUE,0.3,           # R *= 0.3
                               :mul,GVALUE,0.59,          # G *= 0.59
                               :mul,BVALUE,0.11,          # B *= 0.11
                               :merge,RVALUE,GVALUE,      # R += G
                               :merge,RVALUE,BVALUE,      # R += B
                               :copy,RVALUE,GVALUE,       # G = R
                               :copy,RVALUE,BVALUE)       # B = R
```

93.6 UpdateBytesColumn() function

Using this function we can process the Bytes directly instead of using Bytes2List() & List2Bytes()

Syntax:

```
updateBytesColumn(cBytes, nColumns, nCount, nDiv, [cCommand,nPara1,nPara2,[nPara3]],...) ↵
    ↵-> cNewBytes
```

Example:

```
load "stbimage.ring"
load "fastpro.ring"

RVALUE = 1
GVALUE = 2
BVALUE = 3

CIMAGE = "ring.jpg"

# Image Information
width=0 height=0 channels=0
# Ring will Free cData automatically in the end of the program
? "Load image: " + CIMAGE
cData = stbi_load(CIMAGE,:width,:height,:channels,STBI_rgb)

# Convert to Gray
cNewData = updateBytesColumn(cData,channels,width*height,255,
                             :mul,RVALUE,0.3,           # R *= 0.3
```

(continues on next page)

(continued from previous page)

```

:mul,GVALUE,0.59,          # G *= 0.59
:mul,BVALUE,0.11,          # B *= 0.11
:merge,RVALUE,GVALUE,      # R += G
:merge,RVALUE,BVALUE,      # R += B
:copy,RVALUE,GVALUE,       # G = R
:copy,RVALUE,BVALUE)       # B = R

# Write the image
? "Writing mynewimage.bmp"
stbi_write_bmp("mynewimage.bmp", width, height, channels, cNewData)
system("mynewimage.bmp")

```

This function is used in the ImagePixel application to convert the image to Gray.

```

384 //=====
385 // GRAY SCALE -- Display Color RGB in GRAY Scale
386 // Average looks better brighter than Gamma Corrected
387 // Color corrected is for eye sensitivity Red 30%, Green 59% Blue 11%.
388
389 elseif lGray
390
391     MCOrig = updateBytesColumn(MCOrig,nImageChannels,nImageWidth*nImageHeight,255,
392                                 :mul,RVALUE,0.3,           # R *= 0.3
393                                 :mul,GVALUE,0.59,          # G *= 0.59
394                                 :mul,BVALUE,0.11,          # B *= 0.11
395                                 :merge,RVALUE,GVALUE,      # R += G
396                                 :merge,RVALUE,BVALUE,      # R += B
397                                 :copy,RVALUE,GVALUE,       # G = R
398                                 :copy,RVALUE,BVALUE)       # B = R
399
400 ok
401

```

93.7 AddBytesColumn() function

If we have an image that uses three channels (R,G,B) and is represented through a string of bytes

We can use AddBytesColumn() function to add an extra channel like the Alpha channel.

Syntax:

```
addBytesColumn(cBytes, nColumns, nCount) -> cNewBytes
```

Example:

```

cImageFile      = "ring.jpg"
nImageWidth     = 0
nImageHeight    = 0
nImageChannels   = 0

stbi_info(cImageFile,:nImageWidth,:nImageHeight,:nImageChannels)

if nImageChannels = 3
    cImageData   = stbi_load(cImageFile,:nImageWidth,:nImageHeight,:nImageChannels,

```

(continues on next page)

(continued from previous page)

```
→STBI_rgb)
    cImageData      = addBytesColumn(cImageData,nImageChannels,
→nImageWidth*nImageHeight)
    nImageChannels = 4
else
    cImageData = stbi_load(cImageFile,:nImageWidth,:nImageHeight,:nImageChannels,
→STBI_rgb_alpha)
ok
```

CHAPTER
NINETYFOUR

USING RINGPDFGEN

In this chapter we will learn about Using the RingPDFGen extension.

This extension is added to the Ring language starting from Ring 1.21.

Contents:

- Example
- Constants
- Functions

94.1 Example

The next source code generate a PDF file using RingPDFGen extension

```
load "pdffgen.ring"

cPDFFFileName = "output.pdf"

pdf = pdf_create(PDF_A4_WIDTH, PDF_A4_HEIGHT, [
    :creator  = "My software",
    :producer = "My software",
    :title    = "My document",
    :author   = "My name",
    :subject  = "My subject",
    :date     = "Today"
] )

pdf_set_font(pdf, "Times-Roman")
pdf_append_page(pdf)

pdf_add_text(pdf, NULL, "This is text", 12, 50, 20, PDF_BLACK)
pdf_add_line(pdf, NULL, 50, 24, 150, 24, 0, 0)
pdf_add_text(pdf, NULL, "This is text", 24, 250, 20, PDF_BLUE)

for t=1 to 30
    pdf_add_text(pdf, NULL, "Number: " + t, 14, 250, 50+(20*t), PDF_RED)
next

pdf_add_text(pdf, NULL, "I LOVE PROGRAMMING!", 48, 30, 700,PDF_BLUE)
```

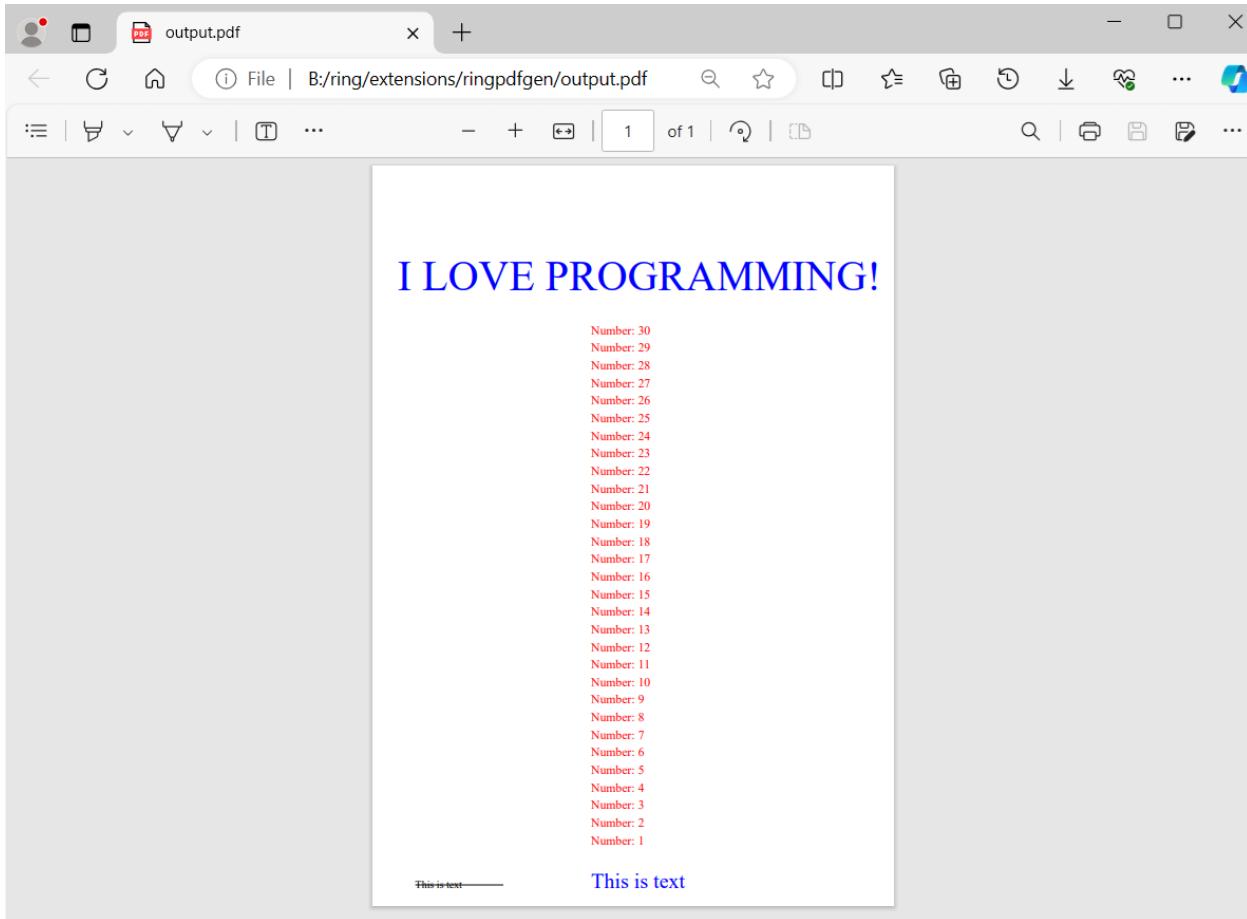
(continues on next page)

(continued from previous page)

```
pdf_save(pdf, cPDFFFileName)
pdf_destroy(pdf)

system(cPDFFFileName)
```

Output:



94.2 Constants

```
IMAGE_PNG
IMAGE_JPG
IMAGE_PPM
IMAGE_BMP
IMAGE_UNKNOWN

PNG_COLOR_GREYSCALE
PNG_COLOR_RGB
PNG_COLOR_INDEXED
PNG_COLOR_GREYSCALE_A
PNG_COLOR_RGBA
```

(continues on next page)

(continued from previous page)

```
PNG_COLOR_INVALID
PPM_BINARY_COLOR_RGB
PPM_BINARY_COLOR_GRAY

PDF_LETTER_WIDTH
PDF_LETTER_HEIGHT
PDF_A4_WIDTH
PDF_A4_HEIGHT
PDF_A3_WIDTH
PDF_A3_HEIGHT
PDF_RED
PDF_GREEN
PDF_BLUE
PDF_BLACK
PDF_WHITE
PDF_TRANSPARENT
PDF_ALIGN_LEFT
PDF_ALIGN_RIGHT
PDF_ALIGN_CENTER
PDF_ALIGN_JUSTIFY
PDF_ALIGN_JUSTIFY_ALL
PDF_ALIGN_NO_WRITE
```

94.3 Functions

```
struct pdf_doc *pdf_create@2(float width, float height,const struct pdf_info *info)
void pdf_destroy(struct pdf_doc *pdf)

const char *pdf_get_err(const struct pdf_doc *pdf, int *errval)
void pdf_clear_err(struct pdf_doc *pdf)

int pdf_set_font(struct pdf_doc *pdf, const char *font)
int pdf_get_font_text_width(struct pdf_doc *pdf, const char *font_name,const char *text,_
→float size, float *text_width);

float pdf_height(const struct pdf_doc *pdf)
float pdf_width(const struct pdf_doc *pdf)
float pdf_page_height(const struct pdf_object *page)
float pdf_page_width(const struct pdf_object *page)
struct pdf_object *pdf_append_page(struct pdf_doc *pdf)
struct pdf_object *pdf_get_page(struct pdf_doc *pdf, int page_number)
int pdf_page_set_size(struct pdf_doc *pdf, struct pdf_object *page,float width, float_
→height)

int pdf_save(struct pdf_doc *pdf, const char *filename)
int pdf_save_file(struct pdf_doc *pdf, FILE *fp)

int pdf_add_text(struct pdf_doc *pdf, struct pdf_object *page,const char *text, float_
→size, float xoff, float yoff,uint32_t colour)
```

(continues on next page)

(continued from previous page)

```

int pdf_add_text_rotate(struct pdf_doc *pdf, struct pdf_object *page,const char *text,_
→float size, float xoff, float yoff,float angle, uint32_t colour)
int pdf_add_text_wrap(struct pdf_doc *pdf, struct pdf_object *page,const char *text,_
→float size, float xoff, float yoff,float angle, uint32_t colour, float wrap_width,int_
→align, float *height)

int pdf_add_line(struct pdf_doc *pdf, struct pdf_object *page, float x1,float y1, float_
→x2, float y2, float width, uint32_t colour)
int pdf_add_cubic_bezier(struct pdf_doc *pdf, struct pdf_object *page,float x1, float y1,
→ float x2, float y2, float xq1,float yq1, float xq2, float yq2, float width,uint32_t_
→colour)
int pdf_add_quadratic_bezier(struct pdf_doc *pdf, struct pdf_object *page,float x1,_
→float y1, float x2, float y2,float xq1, float yq1, float width,uint32_t colour)
int pdf_add_custom_path(struct pdf_doc *pdf, struct pdf_object *page,const struct pdf_
→path_operation *operations,int operation_count, float stroke_width,uint32_t stroke_
→colour, uint32_t fill_colour)
int pdf_add_ellipse(struct pdf_doc *pdf, struct pdf_object *page, float x,float y, float_
→xradius, float yradius, float width,uint32_t colour, uint32_t fill_colour)
int pdf_add_circle(struct pdf_doc *pdf, struct pdf_object *page, float x,float y, float_
→radius, float width, uint32_t colour,uint32_t fill_colour)
int pdf_add_rectangle(struct pdf_doc *pdf, struct pdf_object *page, float x,float y,_
→float width, float height, float border_width,uint32_t colour)
int pdf_add_filled_rectangle(struct pdf_doc *pdf, struct pdf_object *page,float x, float_
→y, float width, float height,float border_width, uint32_t colour_fill,uint32_t colour_
→border)

int pdf_add_bookmark(struct pdf_doc *pdf, struct pdf_object *page, int parent,const char_
→*name)
int pdf_add_link(struct pdf_doc *pdf, struct pdf_object *page, float x,float y, float_
→width, float height,struct pdf_object *target_page, float target_x,float target_y)
int pdf_add_barcode(struct pdf_doc *pdf, struct pdf_object *page, int code,float x,_
→float y, float width, float height,const char *string, uint32_t colour)
int pdf_add_image_data(struct pdf_doc *pdf, struct pdf_object *page, float x,float y,_
→float display_width, float display_height,const uint8_t *data, size_t len)
int pdf_add_rgb24(struct pdf_doc *pdf, struct pdf_object *page, float x,float y, float_
→display_width, float display_height,const uint8_t *data, uint32_t width, uint32_t_
→height)
int pdf_add_grayscale8(struct pdf_doc *pdf, struct pdf_object *page, float x,float y,_
→float display_width, float display_height,const uint8_t *data, uint32_t width, uint32_
→t height)
int pdf_add_image_file(struct pdf_doc *pdf, struct pdf_object *page, float x,float y,_
→float display_width, float display_height,const char *image_filename)
int pdf_parse_image_header(struct pdf_img_info *info, const uint8_t *data,size_t length,_
→char *err_msg,size_t err_msg_length)
uint32_t PDF_RGB(int r, int g, int b)
uint32_t PDF_ARGB(int r, int g, int b, int a)

```

USING REFERENCES

In this chapter we will learn about using references.

This feature is added to the Ring language starting from Ring 1.18.

Contents:

- Introduction
- Ref()/Reference() function
- Refcount() function
- Circular references
- The Tree class
- Linked list
- Dependency injection
- Passing lists to functions
- Ref() and temp. lists
- Nested Ref()
- Ref() in left side
- Ref() and sub lists

95.1 Introduction

In Ring, Using the Assignment (=) operator copy variables by value. Also, Adding a List/Object to another List create a new copy. To change this behavior, We can use the Ref()/Reference() function. This function doesn't create the reference directly. It's a flag setter, And Ring VM will decide when to create the reference.

Once we have more than one reference, No need to use the Ref() again with the same list/object Because Ring will use Copy by Reference with this list/object. If the reference count drop to one again then Ring will change the behavior and will use the default rule (copy lists/objects by value).

In general Ring as a language is designed to reduce references usage. This feature is added to be used in special cases like teaching data structures and implementing specific design patterns.

95.2 ref()/reference() function

Syntax:

```
ref(aList|oObject)      ---> aList|oObject (Enable Reference Flag) # Short name
reference(aList|oObject) ---> aList|oObject (Enable Reference Flag) # Long name
```

Example:

```
aList      = [1,2,3]
aListCopy = aList      # Copy by Value
aList2    = ref(aList) # Copy by Reference (RC: 2)
aList3    = aList      # Copy by Reference (RC: 3)
for item in aList
    item *= 10
next
? aList3           # 10 20 30
? aListCopy        # 1 2 3
aList2    = NULL
aList3    = NULL
aList2    = aList      # Copy by Value
for item in aList2
    item /= 10
next
? aList           # 10 20 30
? aList2          # 1 2 3
```

Output:

```
10
20
30

1
2
3

10
20
30

1
2
3
```

95.3 `refcount()` function

Using the `refcount()` function we can know how many references exist.

Syntax:

```
refcount(variable) ---> Number (References Count)
```

Example:

```
aList = 1:10
aList2 = ref(aList)
? refcount(aList)      # 2
? refcount(aList2)    # 2
aList3 = aList2
aList4 = aList
aList5 = aList4
? refcount(aList)      # 5
? refcount(aList2)    # 5
? refcount(aList3)    # 5
? refcount(aList4)    # 5
? refcount(aList5)    # 5
aList5 = NULL
aList4 = []
aList3 = [10]
? refcount(aList)      # 2
? refcount(aList2)    # 2
```

Output:

```
2
2
5
5
5
5
5
5
2
2
```

95.4 Circular References

Using `Ref()` we can create circular references

Ring VM can detect them and free memory when the variable is deleted.

Example:

```
aList = [ 10,20,30, ref(aList) ]
? aList[4][1]
? aList[4][4][4][4][4][2]
? refcount(aList)
```

Output:

10
20
2

95.5 The Tree Class

The Tree class is a good example about using the Ref() function.

In this class each object contains a group of objects and these objects have a reference to the parent object.

Example:

```
Class tree

    data parent
    children = []

    func set x
        data = x

    func value
        return data

    func add x
        children + new tree
        nMax = len(children)
        children[nMax].parent = ref(self)
        children[nMax].data = x
        return children[nMax]

    func parent
        if ! isObject(parent)
            raise("This node is the root!")
            return
        ok
        return parent

    func print
        for x in children
            ? x.data
            x.print()
        next
```

Tip: The Tree class already exist in the StdLib

95.6 Linked list

The next example demonstrates how to create a linked list using the Ref() function.

Tip: In practice we don't need to do this since Ring comes with lists

Example:

```
func main

    n1 = new node(:one)
    n2 = new node(:two)
    n3 = new node(:three)
    n4 = new node(:four)
    n5 = new node(:five)

    n1 { pNext = ref(n2) "No Previous Node" }
    n2 { pNext = ref(n3) pPrev = ref(n1) }
    n3 { pNext = ref(n4) pPrev = ref(n2) }
    n4 { pNext = ref(n5) pPrev = ref(n3) }
    n5 { "No Next Node" pPrev = ref(n4) }

    n3 {
        toTheEnd()
        ? Copy("=",20)
        toTheStart()
    }

class node

    pPrev pNext

    func init value
        data = value

    func toTheEnd

        print()
        pCurrent = pNext
        while isObject(pCurrent)
            pCurrent.print()
            pCurrent = pCurrent.pNext
        end

    func toTheStart

        print()
        pCurrent = pPrev
        while isObject(pCurrent)
            pCurrent.print()
            pCurrent = pCurrent.pPrev
        end
    
```

(continues on next page)

(continued from previous page)

```
func print
    ? data
private
    data pCurrent
```

Output:

```
three
four
five
=====
three
two
one
```

95.7 Dependency injection

The next example demonstrates how to apply dependency injection using the Ref() function

Example:

```
func main
    v1 = new MyClass1  v2 = new MyClass2
    oCont = new Controller(v1,v2)
    v1.value = "one"  v2.value = "two"
    oCont.test()
    v1 = 10  v2 = 20  ? v1 ? v2
    oCont.test()

class MyClass1 value func test ? :myclass1
class MyClass2 value func test ? :myclass2
class Controller o1 o2
    func init myo1,myo2
        o1=ref(myo1) o2=ref(myo2)
    func test
```

(continues on next page)

(continued from previous page)

```
o1.test()  o2.test()
? o1.value ? o2.value
```

Output:

```
myclass1
myclass2
one
two
10
20
myclass1
myclass2
one
two
```

95.8 Passing lists to functions

In Ring, when we pass a list/object to a function, This function will have full ownership on the list/object variable.

This means it can delete it and change the variable type.

Example:

```
func main
    ? "Hello from Main() function"
    aList = [1,2,3]
    ? aList
    sub(aList)
    ? "Hello from Main() function (Again)"
    if ! isList(aList)
        ? "We don't have a list!"
    ok

func sub aList
    ? "Hello from Sub() function"
    aList = NULL
```

Output:

```
Hello from Main() function
1
2
3

Hello from Sub() function
Hello from Main() function (Again)
We don't have a list!
```

Using Ref() function we can change this behavior and pass a reference to the list/object instead of sharing it.

Example:

```

func main
    ? "Hello from Main() function"
    aList = [1,2,3]
    ? aList
    sub(Ref(aList))
    ? "Hello from Main() function (Again)"
    if ! isList(aList)
        ? "We don't have a list!"
    else
        ? "We still have our list!"
        ? aList
    ok

func sub aList
    ? "Hello from Sub() function"
    aList = NULL

```

Output:

```

Hello from Main() function
1
2
3

Hello from Sub() function
Hello from Main() function (Again)
We still have our list!
1
2
3

```

95.9 Ref() and temp. lists

Using Ref() and temp. lists/objects does nothing.

Example:

```

aList = ref([1,2,3])      # The same as aList = [1,2,3]
? refcount(aList)          # 1
aList = ref(1:10)          # The same as aList = 1:10
? refcount(aList)          # 1
aList = ref(list(10))      # The same as aList = list(10)
? refcount(aList)          # 1
myobj = ref(new point)     # The same as myobj = new point
? refcount(myobj)          # 1
class point x y z

```

95.10 Nested Ref()

Since Ref() function is a flag setter, nested Ref() usage is not useful.

Example:

```
aList = [1,2,3]
aList2 = ref(ref(ref(ref(aList)))) # The same as aList2 = ref(aList)
? refcount(aList)               # 2
```

95.11 Ref() in left side

Using Ref() in left side of an assignment is not useful and will disable the assignment i.e. will not change the value.

Example:

```
aList = [1,2,3]
ref(aList) = [4,5]
? aList
```

Output:

```
1
2
3
```

95.12 Ref() and sub lists

Using Ref() with a sub list will create a strong reference to this sub list

Tip: if the sub list contains other references, we will get weak references to them.

Example:

```
a = [[ref(a),ref(a),3],[4,5,6]]
? a
b = ref(a[1])    # Get Weak references to References inside a[1]
? b
b = NULL
? a
c = a[1]          # Get Strong references to References inside a[1]
? c
c = NULL
? a
? :done
```

Output:

[...] (RC:3)

[...] (RC:3)

3

4

5

6

[...] (RC:3)

[...] (RC:3)

3

[...] (RC:3)

[...] (RC:3)

3

4

5

6

[...] (RC:5)

[...] (RC:5)

3

[...] (RC:3)

[...] (RC:3)

3

4

5

6

done

CHAPTER
NINETYSIX

LOW LEVEL FUNCTIONS

In this chapter we will learn about the low level functions provided by Ring

It's not recommended to use these functions in your application code

These functions exist for C/C++ developers who are developing Ring libraries/tools

We expect from those developers to know about pointers and dynamic memory management

```
* callgarbagecollector() | callgc()
* variablepointer()      | varptr()
* space()
* nullpointer()          | nullptr()
* object2pointer()       | obj2ptr()
* pointer2object()       | ptr2obj()
* ispointer()
* pointercompare()       | ptrcmp()
* setpointer()           | setptr()
* getpointer()           | getptr()
* pointer2string()       | ptr2str()
* memorycopy()           | memcpy()
* ringvm_cfunctionslist()
* ringvm_functionslist()
* ringvm_classeslist()
* ringvm_packageslist()
* ringvm_memorylist()
* ringvm_calllist()
* ringvm_fileslist()
* ringvm_settrace()
* ringvm_tracedata()
* ringvm_traceevent()
* ringvm_tracefunc()
* ringvm_scopescount()
* ringvm_evalinscope()
* ringvm_passerror()
* ringvm_hideerrorMsg()
* ringvm_callfunc()
* ringvm_see()
* ringvm_give()
* ringvm_info()
* ringvm_ismempool()
* ringvm_codelist()
```

96.1 callgc() function

Syntax:

```
callgc()                      # Short name
callgarbagecollector()        # Long name
```

Use this function to force calling the garbage collector during function execution when you use a loop that create temp. variables that you don't free using the assignment operation.

It's very rare to need this function but it's useful when you create something like event-loop for your game engine and start creating lists on the fly when you call functions.

Example

```
While True

    # process events
    # call functions using temp. lists like myfunc(["temp list"])

    # call the garbage collector
    callgc()

End
```

Tip: In Ring the garbage collector works automatically in the end of function execution or when you use the assignment statement.

96.2 varptr() function

Use the varptr() function when you need to pass a pointer to a C/C++ function.

Syntax:

```
varptr(cVariableName,cPointerType) ---> Low Level Object (C Pointer)
variablepointer(cVariableName,cPointerType) ---> Low Level Object (C Pointer)
```

example:

```
r = 10
z = 20
see r + nl
see varptr("r","int")
see varptr("z","int")
```

Output:

```
10
00E3C740
int
2
00E3BEC0
```

(continues on next page)

(continued from previous page)

```
int
2
```

Note: the low level object is a list contains three items (The Pointer, The Type, The Status)

96.3 space() function

Use the space function to allocate a specific number of bytes in Memory.

Syntax:

```
Space(nBytesCount) ---> String
```

Example:

```
mystring = space(200)
See "String Size : " + len(mystring) + nl
See "String : " + mystring + nl
See "String Pointer : "
See varptr("mystring",:char)
```

Output:

```
String Size : 200
String :
String Pointer : 00FF8FE8
char
2
```

Note: You may need the space() and VarPtr() functions to pass buffers to C functions.

Tip: To free the memory allocated using the space() function, use the Assignment operator

```
mystring = space(1000) # Allocate memory (1000 bytes)
mystring = NULL         # Free memory stored in mystring
```

Note: We don't need to free the memory if it's a local variable that will be deleted after the function execution.

96.4 nullpointer() function

Syntax:

<code>nullptr()</code>	<i># Short name</i>
<code>nullpointer()</code>	<i># Long name</i>

You may need to pass the NULL pointer to a C function that may expect a pointer as parameter and accept NULL pointers for optional parameters.

Example:

The next example uses the `SDL_BlitSurface()` function from the LibSDL Library through RingSDL. The function accept `SDL_Rect` pointers in the second and the last parameter. Also the function accept NULL pointers, so we can pass them using the `NULLPointer()` Function.

<code>SDL_BlitSurface(text, nullpointer(), surface, nullpointer())</code>

Note: The previous code doesn't work alone, you need to learn how to use RingSDL first.

Tip: We can pass NULL as parameter instead of using the `NULLPointer()` function

<code>SDL_BlitSurface(text, NULL, surface, NULL)</code>

96.5 object2pointer() function

Use this function to get a C pointer for Ring lists and objects

Syntax:

<code>obj2ptr(List Object) --> Low Level Object (C Pointer)</code>	<i># Short name</i>
<code>object2pointer(List Object) --> Low Level Object (C Pointer)</code>	<i># Long name</i>

Note: You have to be sure that the Pointer still valid (Doesn't point to deallocated memory)

96.6 pointer2object() function

Use this function to get the Ring list and/or object from the low level object (C Pointer)

Syntax:

<code>ptr2obj(Low Level Object) ---> ListReference ObjectReference</code>	<i># Short name</i>
<code>pointer2object(Low Level Object) ---> ListReference ObjectReference</code>	<i># Long name</i>

Note: Before using Pointer2Object() to create a reference, Be sure that the Pointer is valid (Doesn't point to deallocated memory, i.e. deleted list/object)

Tip: After using Pointer2Object() to create a reference, and if the original List/Object is deleted, Ring will uses reference counting and will keep the List/Object until the latest reference is removed

Example:

```
# Create the list
mylist = 1:5

# Create pointer to the list
x = object2pointer(mylist)
see x

see nl

# Add items to the list
mylist + "welcome"

# Get a copy from the list
y = pointer2object(x)
# print the new list items
see y
```

Output:

```
0069A5D8
OBJECTPOINTER
0

1
2
3
4
5
welcome
```

Note: In Ring the assignment operator copy lists and objects by value, to copy lists and objects by reference Just use the object2pointer() and pointer2object() functions.

The functions Object2Pointer() and Pointer2Object() are low level functions

We have to be careful when using them to avoid memory problems

If we created a Pointer to a (Local Variable)

This local variable will be deleted from the memory after the end of the function/method execution

This means that the pointer created with Object2Pointer() will becomes a dangling pointer

i.e. A pointer that points to the memory location of the deallocated memory

Using this invalid pointer could lead to (CRASH or Memory Corruption).

If you will use pointers (Using Object2Pointer() or Pointer2Object()) then never use pointers that point to the memory that are deallocated.

In simple words, Keep the memory (Don't delete it if you still need it)

i.e. instead of using (Local Variables) that will be deleted, You can use Class Attributes or Global Variables.

96.7 ispointer() function

Check if the parameter is a pointer (C Object) or not.

Syntax:

```
IsPointer(vPara) ---> True|False # Long name
```

Example :

```
fp = fopen(filename(), "r")
? type(fp)
? ispointer(fp)
```

Output :

```
file
1
```

96.8 ptrcmp() function

We can compare between two pointers (C Objects) using the ptrcmp() function.

Syntax:

```
ptrcmp(oObject1,oObject2) ---> value = 1 if oObject1 = oObject2
                                value = 0 if oObject1 != oObject2
pointercompare(oObject1,oObject2) ---> value = 1 if oObject1 = oObject2
                                         value = 0 if oObject1 != oObject2
```

Example:

```
fp = fopen("ptrcmp.ring", "r")
fp2 = fp
fp3 = fopen("ptrcmp.ring", "r")

see ptrcmp(fp,fp2) + nl
see ptrcmp(fp,fp3) + nl

fclose(fp)
fclose(fp3)
```

Output:

1
0

96.9 setpointer() function

Set the pointer address to another address

Syntax:

<code>setptr(pointer,nNewAddress)</code>	<i># Short name</i>
<code>setpointer(pointer,nNewAddress)</code>	<i># Long name</i>

Note: Using setPointer() and getPointer() functions we can change the Memory Address

96.10 getpointer() function

Get the pointer address

Syntax:

<code>getptr(pointer) ---> nAddress</code>	<i># Short name</i>
<code>getpointer(pointer) ---> nAddress</code>	<i># Long name</i>

Example:

```
? "Sample about using setPointer() and getPointer() functions"
? copy("=",50)
pointer = NULLPOINTER()
? pointer
? "Type: " + type(pointer)
? "Address: " + Upper(hex(getpointer(pointer)))
? copy("=",50)
name = "ring"
pointer = varptr(:name,:char)
? pointer
? "Type: " + type(pointer)
? "Address: " + Upper(hex(getpointer(pointer)))
? copy("=",50)
setpointer(pointer, getpointer(pointer) + 1 )
? "After Update"
? "Address: " + Upper(hex(getpointer(pointer)))
? copy("=",50)
```

Output:

```
=====
00000000
NULLPOINTER
0
```

(continues on next page)

(continued from previous page)

```
Type: NULLPOINTER
Address: 0
=====
026E2BA8
char
0

Type: char
Address: 26E2BA8
=====
After Update
Address: 26E2BA9
=====
```

96.11 pointer2string() function

Convert a pointer to a string of binary data

If you want to convert the string to a pointer again use VarPtr() function

Syntax:

<code>ptr2str(pointer,nStart,nCount) ---> cString</code>	<i># Short name</i>
<code>pointer2string(pointer,nStart,nCount) ---> cString</code>	<i># Long name</i>

Note: pointer2String() return another copy of the data

Note: if nStart is Zero, this means starting from the first character

Example:

```
name = "ring"
pointer = varptr(:name,:char)
? pointer
? "Type: " + type(pointer)
? "Address: " + Upper(hex(getpointer(pointer)))

? "Get 4 bytes starting from the pointer address"
mystring = Pointer2String(pointer,0,4)
? mystring

? "Get 2 bytes starting from the pointer address + 1"
mystring2 = Pointer2String(pointer,1,2)
? mystring2
```

Output:

```
01E03380
char
@

Type: char
Address: 1E03380
Get 4 bytes starting from the pointer address
ring
Get 2 bytes starting from the pointer address + 1
in
```

96.12 memcpy() function

Syntax:

<code>memcpy(pDestinationPointer,cSourceString,nSize)</code>	<i># Short name</i>
<code>memorycopy(pDestinationPointer,cSourceString,nSize)</code>	<i># Long name</i>

Example:

```
str = space(9)
pointer = varptr(:str,"char")
memcpy(pointer,"one",3)
? str
setPointer(pointer,getPointer(pointer)+3)
memcpy(pointer,"one",3)
? str
setPointer(pointer,getPointer(pointer)+3)
memcpy(pointer,"one",3)
? str
```

Output:

one
oneone
oneoneone

96.13 ringvm_cfunctionslist() function

The Function return a list of functions written in C.

Syntax:

<code>RingVM_CFunctionsList()</code>	---> List
--------------------------------------	------------------

Example:

See	<code>RingVM_CFunctionsList()</code>
------------	--------------------------------------

96.14 ringvm_functionslist() function

The Function return a list of functions written in Ring.

Each List Member is a list contains the next items

- Function Name
- Program Counter (PC) - Function Position in Byte Code.
- Source Code File Name
- Private Flag (For Private Methods in Classes)

Syntax:

```
RingVM_FunctionsList() ---> List
```

Example:

```
test()

func test
    see ringvm_functionslist()
```

Output:

```
test
8
B:/ring/tests/scripts/functionslist.ring
0
```

96.15 ringvm_classeslist() function

The Function return a list of Classes.

Each List Member is a list contains the next items

- Class Name
- Program Counter (PC) - Class Position in Byte Code.
- Parent Class Name
- Methods List
- Flag (Is parent class information collected)
- Pointer to the package (or NULL if no package is used)

Syntax:

```
RingVM_ClassesList() ---> List
```

Example:

```
see ringvm_classeslist()

class class1
    func f1
class class2 from class1
class class3 from class1
```

Output:

```
class1
9

f1
13
B:/ring/tests/scripts/classeslist.ring
0
0
00000000
class2
16
class1
0
00000000
class3
20
class1
0
00000000
```

96.16 ringvm_packageslist() function

The Function return a list of Packages.

Each List Member is a list contains the next items

- Package Name
- Classes List

Syntax:

```
RingVM_PackagesList() ---> List
```

Example:

```
see ringvm_packageslist()

package package1
    class class1

package package2
    class class1
```

(continues on next page)

(continued from previous page)

```
package package3
    class class1
```

Output:

```
package1
class1
11

0
00FEF838
package2
class1
17

0
00FEF978
package3
class1
23

0
00FEFF68
```

96.17 ringvm_memorylist() function

The Function return a list of Memory Scopes and Variables.

Each List Member is a list contains variables in a different scope.

Each Item in the scope list is a list contains the next items

- Variable Name
- Variable Type
- Variable Value
- Pointer Type (List/Item) if the value is a list
- Private Flag (if the variable is an attribute in a Class)

Syntax:

```
RingVM_MemoryList() ---> List
```

Example:

```
x = 10
test()
func test
    y = 20
    see ringvm_memorylist()
```

Output:

```
true
2
1
0
0
false
2
0
0
0
0
nl
1

0
0
null
1

0
0
ring_gettemp_var
4
00000000
0
0
ccatcherror
1
NULL
0
0
ring_settemp_var
4
00000000
0
0
ring_tempflag_var
2
0
0
0
0
stdin
3
50512DB8
file
0
0
0
stdout
3
50512DD8
file
0
```

(continues on next page)

(continued from previous page)

```
0
0
stderr
3
50512DF8
file
0
0
0
this
4
00000000
0
0
sysargv
3
B:\ring\bin\ring
B:/ring/tests/scripts/memorylist.ring
0
0
x
2
10
0
0
y
2
20
0
0
```

96.18 ringvm_calllist() function

The Function return a list of the functions call list.

Each List Member is a list contains the next items

- Function Type
- Function Name
- Program Counter (PC)
- Stack Pointer (SP)
- Method or Function Flag
- Caller PC
- Caller Line Number
- Parameters Count

Syntax:

RingVM_CallList() ---> **List**

Example:

```
hello()
func hello
    test()

func test
    mylist = ringvm_calllist()
    for t in mylist see t[2] + nl next
```

Output:

```
hello
test
ringvm_calllist
```

96.19 ringvm_fileslist() function

Function return a list of the Ring Files.

Syntax:

RingVM_FilesList() ---> **List**

Example:

```
load "stdlib.ring"
see ringvm_fileslist()
```

Output:

```
B:/ring/tests/scripts/fileslist.ring
B:\ring\bin\stdlib.ring
eval
stdlib.ring
stdlib.rh
stdclasses.ring
stdfunctions.ring
stdbase.ring
stdstring.ring
stdlist.ring
stdstack.ring
stdqueue.ring
stdmath.ring
stddatetime.ring
stdfile.ring
stdsystem.ring
stddebug.ring
stddatatype.ring
stdconversion.ring
```

(continues on next page)

(continued from previous page)

```
stdodbc.ring
stdmysql.ring
stdsecurity.ring
stdinternet.ring
stdhashtable.ring
stdtree.ring
```

96.20 ringvm_settrace()

The function ringvm_settrace() determine the Trace function name

The trace function is a Ring function that will be called for each event

Syntax:

```
RingVM_SetTrace(cCode)
```

96.21 ringvm_tracedata()

Inside the function that we will use for tracing events

We can use the ringvm_tracedata() function to get the event data.

The event data is a list contains the next items

- The Source Code Line Number
- The Source File Name
- The Function/Method Name
- Method or Function (Bool : True=Method, False=Function/File)

Syntax:

```
RingVM_TraceData() ---> aDataList
```

96.22 ringvm_traceevent()

Inside the function that we will use for tracing events

We can use ringvm_traceevent() to know the event type

- New Line
- Before Function
- After Function
- Runtime Error
- Before C Function
- After C Function

Syntax:

```
RingVM_TraceEvent() ---> nTraceEvent
```

96.23 ringvm_tracefunc()

The function return the name of the function that we are using for tracing events.

Syntax:

```
RingVM_TraceEvent() ---> cCode
```

96.24 ringvm_scopescount()

We can use the RingVM_ScopesCount() function to know the number of scopes used in the application.

In the start of the program, We have the (global scope only)

When we call a function, A new scope is created.

When the function execution is done, the function scope is deleted.

Syntax:

```
RingVM_ScopesCount() ---> nScopes
```

96.25 ringvm_evalinscope()

The function ringvm_evalinscope() is similar to the eval() function

Unlike eval() which execute the code in the current scope

Using RingVM_EvalInScope() we can execute the code in a specific scope.

Syntax:

```
RingVM_EvalInScope(nScope, cCode)
```

96.26 ringvm_passerror()

When we have runtime error, After printing the Error message, Ring will end the execution of the program.

Using ringvm_passerror() we can avoid that, and continue the execution of our program.

Syntax:

```
RingVM_PassError()
```

96.27 ringvm_hideerrmsg()

We can disable/enable displaying the runtime error messages using the RingVM_HideErrorMsg() function.

Syntax:

```
RingVM_HideErrorMsg(lStatus)
```

96.28 ringvm_callfunc()

We can call a function from a string without using eval() using the ringvm_callfunc()

Syntax:

```
RingVM_CallFunc(cFuncName)
```

96.29 Example - Using the Trace Functions

The next example use the Trace Functions to trace the program Events!

In practical, We will use the Trace Library instead of these low level functions!

```
load "tracelib.ring"

ringvm_settrace("mytrace()")

see "Hello, world!" + nl
see "Welcome" + nl
see "How are you?" +nl
mytest()
new myclass { mymethod() }

func mytest
    see "Message from mytest" + nl

func mytrace
    see "===== The Trace function is Active =====" + nl +
        "Trace Function Name : " + ringvm_TraceFunc() + nl +
        "Trace Event : "
    switch ringvm_TraceEvent()
        on TRACEEVENT_NEWLINE          see "New Line"
        on TRACEEVENT_NEWFUNC          see "New Function"
        on TRACEEVENT_RETURN           see "Return"
        on TRACEEVENT_ERROR            see "Error"
        on TRACEEVENT_BEFOREFUNC      see "Before C Function"
        on TRACEEVENT_AFTERFUNC       see "After C Function"
    off
    see nl +
        "Line Number : " + ringvm_tracedata()[TRACEDATA_LINENUMBER] + nl +
        "File Name   : " + ringvm_tracedata()[TRACEDATA_FILENAME] + nl +
```

(continues on next page)

(continued from previous page)

```

"Function Name : " + ringvm_tracedata() [TRACEDATA_FUNCNAME] + nl +
"Method or Function : "
if ringvm_tracedata() [TRACEDATA_METHODORFUNC] =
    TRACEDATA_METHODORFUNC_METHOD
    see "Method"
else
    if ringvm_tracedata() [TRACEDATA_FUNCNAME] = NULL
        see "Command"
    else
        see "Function"
ok
see nl + Copy("=", 42) + nl

class myclass
func mymethod
    see "Message from mymethod" + nl

```

Output:

```

===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : After C Function
Line Number : 3
File Name   : test1.ring
Function Name : ringvm_settrace
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 5
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
Hello, world!
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 6
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
Welcome
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 7
File Name   : test1.ring
Function Name :

```

(continues on next page)

(continued from previous page)

```
Method or Function : Command
=====
How are you?
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 8
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Function
Line Number : 8
File Name   : test1.ring
Function Name : mytest
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 12
File Name   : test1.ring
Function Name : mytest
Method or Function : Function
=====
Message from mytest
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 14
File Name   : test1.ring
Function Name : mytest
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Return
Line Number : 8
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 9
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
```

(continues on next page)

(continued from previous page)

```
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 43
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Before C Function
Line Number : 9
File Name   : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : After C Function
Line Number : 9
File Name   : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Function
Line Number : 9
File Name   : test1.ring
Function Name : mymethod
Method or Function : Method
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 44
File Name   : test1.ring
Function Name : mymethod
Method or Function : Method
=====
Message from mymethod
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Return
Line Number : 9
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Before C Function
```

(continues on next page)

(continued from previous page)

```

Line Number : 9
File Name   : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : After C Function
Line Number : 9
File Name   : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Before C Function
Line Number : 9
File Name   : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : After C Function
Line Number : 9
File Name   : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 11
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
```

96.30 Example - The Trace Library

The next example uses the Trace functions provided by the Ring language to create the Trace library.

Using the Trace library we have nice Tracing tools and Interaction debugger too.

```
# Trace Events
TRACEEVENT_NEWLINE      = 1
TRACEEVENT_NEWFUNC       = 2
TRACEEVENT_RETURN        = 3
TRACEEVENT_ERROR         = 4
TRACEEVENT_BEFORECFUNC   = 5
TRACEEVENT_AFTERCFUNC    = 6
```

(continues on next page)

(continued from previous page)

```

# Trace Data
TRACEDATA_LINENUMBER      = 1
TRACEDATA_FILENAME         = 2
TRACEDATA_FUNCNAME         = 3
TRACEDATA_METHODORFUNC     = 4

# Method of Function
TRACEDATA_METHODORFUNC_METHOD      = TRUE
TRACEDATA_METHODORFUNC_NOTMETHOD   = FALSE

TRACE_BREAKPOINTS = TRUE

TRACE_TEMPLIST = []

func Trace cType
    switch trim(lower(cType))
    on :AllEvents
        ringvm_settrace("TraceLib_AllEvents()")
    on :Functions
        ringvm_settrace("TraceLib_Functions()")
    on :PassError
        ringvm_settrace("TraceLib_PassError()")
    on :Debugger
        ringvm_settrace("TraceLib_Debugger()")
    on :LineByLine
        ringvm_settrace("TraceLib_LineByLine()")
    off

func TraceLib_AllEvents
    if right(ringvm_tracedata() [TRACEDATA_FILENAME],13) = "tracelib.ring"
        return
    ok
    see "===== The Trace function is Active =====" + nl +
        "Trace Function Name : " + ringvm_TraceFunc() + nl +
        "Trace Event : "
    switch ringvm_TraceEvent()
        on TRACEEVENT_NEWLINE           see "New Line"
        on TRACEEVENT_NEWFUNC          see "New Function"
        on TRACEEVENT_RETURN            see "Return"
        on TRACEEVENT_ERROR             see "Error"
        on TRACEEVENT_BEFOREFUNC       see "Before C Function"
        on TRACEEVENT_AFTERFUNC         see "After C Function"
    off
    see nl +
        "Line Number : " + ringvm_tracedata() [TRACEDATA_LINENUMBER] + nl +
        "File Name : " + ringvm_tracedata() [TRACEDATA_FILENAME] + nl +
        "Function Name : " + ringvm_tracedata() [TRACEDATA_FUNCNAME] + nl +
        "Method or Function : "
        if ringvm_tracedata() [TRACEDATA_METHODORFUNC] =
            TRACEDATA_METHODORFUNC_METHOD
            see "Method"

```

(continues on next page)

(continued from previous page)

```

else
    if ringvm_tracedata()[TRACEDATA_FUNCNAME] = NULL
        see "Command"
    else
        see "Function"
ok
see nl + Copy("=",42) + nl

func TraceLib_Functions
    if right(ringvm_tracedata()[TRACEDATA_FILENAME],13) = "tracelib.ring"
        return
ok
switch ringvm_TraceEvent()
    on TRACEEVENT_NEWFUNC
        see "Open Func : " +
            ringvm_TraceData()[TRACEDATA_FUNCNAME] + nl
    on TRACEEVENT_RETURN
        see "Return to Func : " +
            ringvm_TraceData()[TRACEDATA_FUNCNAME] + nl
off

func TraceLib_PassError
    if right(ringvm_tracedata()[TRACEDATA_FILENAME],13) = "tracelib.ring"
        return
ok
switch ringvm_TraceEvent()
    on TRACEEVENT_ERROR
        see nl
        see "TraceLib : After Error !" + nl
        ringvm_passerror()
off

func TraceLib_Debugger
    if right(ringvm_tracedata()[TRACEDATA_FILENAME],13) = "tracelib.ring"
        return
ok
switch ringvm_TraceEvent()
    on TRACEEVENT_ERROR
        _BreakPoint()
off

func TraceLib_LineByLine
    if right(ringvm_tracedata()[TRACEDATA_FILENAME],13) = "tracelib.ring" or
        ringvm_TraceEvent() != TRACEVENT_NEWLINE
        return
ok
aList = ringvm_tracedata()
see "Before Line : " + aList[TRACEDATA_LINENUMBER] + nl
_BreakPoint()

func BreakPoint

```

(continues on next page)

(continued from previous page)

```

if not TRACE_BREAKPOINTS
    return
ok
_BreakPoint()

func _BreakPoint
    see nl+nl+Copy("=",60) + nl +
    Copy(" ",20)+"Interactive Debugger" + nl +
    Copy("=",60) + nl +
    "Command (Exit)      : End Program" + nl +
    "Command (Cont)     : Continue Execution" + nl +
    "Command (Locals)   : Print local variables names" + nl +
    "Command (LocalsData) : Print local variables data" + nl +
    "Command (Globals)  : Print global variables names" + nl +
    "We can execute Ring code" + nl +
    Copy("=",60) + nl
while true
    see nl + "code:> "
    give cCode
    cmd = trim(lower(cCode))
    if cmd = "exit" or cmd = "bye"
        shutdown()
    ok
    nScope = ringvm_scopescount()-2
    switch cmd
        on "locals"
            ringvm_EvalInScope(nScope,"see locals() callgc()")
            loop
        on "localsdata"
            PrintLocalsData(nScope)
            loop
        on "globals"
            ringvm_EvalInScope(nScope,"see globals() callgc()")
            loop
        on "cont"
            ringvm_passerror()
            exit
    off
    Try
        ringvm_EvalInScope(nScope,cCode)
        catch
            see cCatchError
        done
    end

func NoBreakPoints
    TRACE_BREAKPOINTS = FALSE

func PrintLocalsData nScope
    if nScope = 1    # Global
        ringvm_Evalinscope(nScope,'TRACE_TEMPLIST = globals() ')

```

(continues on next page)

(continued from previous page)

```

else
    ringvm_Evalinscope(nScope, 'TRACE_TEMPLIST = locals() callgc()')
ok
see nl
aTempList = TRACE_TEMPLIST
TRACE_TEMPLIST = []
nSpaces = 5
for TRACE_ITEM in aTempList
    if len(TRACE_ITEM) + 5 > nSpaces
        nSpaces = len(TRACE_ITEM) + 5
    ok
next
for TRACE_ITEM in aTempList
    see "Variable : " + TRACE_ITEM
    cVarName = TRACE_ITEM
    see copy(" ",nSpaces-len(cVarName)) + " Type : "
    ringvm_Evalinscope(nScope,"see type(" + TRACE_ITEM +")")
    ringvm_Evalinscope(nScope,"see Copy(' ',fabs(15-len(type(" +
        TRACE_ITEM +")))))")
    see " Value : "
    ringvm_Evalinscope(nScope,"see " + TRACE_ITEM)
    see nl
next

```

96.31 ringvm_see() function

Using the ringvm_see() function we can redefine the behavior of the See command

Also we can use ring_see() to have the original behavior

Example:

```

see "Hello world" + nl
see 123 + nl
see ["one", "two", "three"]
see new point {x=10 y=20 z=30}

func ringvm_see t
    ring_see("We want to print: ")
    ring_See(t)

class point x y z

```

Output:

```

We want to print: Hello world
We want to print: 123
We want to print: one
two
three
We want to print: x: 10.000000

```

(continues on next page)

(continued from previous page)

```
y: 20.000000
z: 30.000000
```

96.32 ringvm_give() function

Using the ringvm_give() function we can redefine the behavior of the Give command

Example:

```
see "Name: " give name
see "Hello " + name

func ringvm_give
    see "Mahmoud" + nl
    return "Mahmoud"
```

Output:

```
Name: Mahmoud
Hello Mahmoud
```

96.33 ringvm_codelist() function

The Function return a list contains the Byte Code of the current program.

Each item is a sub list that represent an instruction

This sub list starts with the operation code (A Number) then the parameters

96.34 ringvm_info() function

The ringvm_info() is an internal function that return a list of information about the Ring VM structure.

It's used only by the Ring Team in advanced tests to check the VM status.

Syntax:

```
ringvm_info() ---> List of information about the VM structure
```

96.35 ringvm_ismempool() function

Check if we still have items in the memory pool or not

This function is used to write tests that could detect a memory leak

Syntax:

```
ringvm_ismempool() ---> lStatus
```

96.36 ringvm_runcode() function

Similar to the Eval() function

- 1 - Used for GUI events like RingQt applications
- 2 - Execute the Main Loop (i.e. Eval + MainLoop in one function)
- 3 - Maximum nested events is 255 events

This function is used to write tests that contains events

Syntax:

```
ringvm_runcode(cCode)
```

CHAPTER
NINETYSEVEN

TUTORIAL: RING EXTENSIONS IN C/C++

In this chapter we will see simple examples about using C code in Ring programs

97.1 Hello World

Sample : ring/extensions/tutorial/helloworld

The file mylib.c contains

```
#include "ring.h"

#include "stdlib.h"

RING_FUNC(ring_myfunction)
{
    printf("Hello, World!");
}

RING_LIBINIT
{
    RING_API_REGISTER("myfunction",ring_myfunction);
}
```

As we see in the source code, we start with including the ring.h file which contains the definitions for Ring API

Then we use the RING_FUNC macro to define new functions, it's a good idea to start the function definition with **ring_** to make these definitions unique and different than normal C functions

Then we have the function RING_LIBINIT that will be called when the extension is loaded by the Ring VM

In this function we use the RING_API_REGISTER() function to register the new functions in Ring VM

Then we build the extension using :

```
buildvc.bat // Ring for Windows 32-bit
buildvc_x64.bat // Ring for windows 64-bit
```

The file buildvc_x64.bat contains the next commands to build the extension using Visual C/C++ (64bit)

```
cls
call ../../src/locatevc.bat x64
cl /c /DEBUG mylib.c -I"..\..\..\include"
```

(continues on next page)

(continued from previous page)

```
link /DEBUG mylib.obj ..\..\..\lib\ring.lib /DLL /OUT:mylib.dll
del mylib.obj
```

Then we test the function using

```
ring test.ring
```

The file test.ring contains

```
? "Loading Library"
loadlib("mylib.dll")

? "Calling a C Function"
myfunction()
```

Output

```
Loading Library
Calling a C Function
Hello, World!
```

97.2 Build the extension on different platforms

Sample : ring/extensions/tutorial/helloworld2

This extension is the same as the first one but in this time, we support Windows, Linux and macOS.

We will use the next files

```
buildvc.bat
buildvc_x64.bat
buildgcc.sh
buildclang.sh
```

Where we use buildvc.bat/buildvc_x64.bat in Windows, buildgcc.sh in Linux and buildclang.sh in macOS

The file buildgcc.sh contains the next commands

```
gcc -c -fpic mylib.c -I $PWD/../../include
gcc -shared -o libmylib.so mylib.o -L $PWD/../../lib -lring
sudo cp libmylib.so /usr/lib
sudo cp libmylib.so /usr/lib64
```

The file buildclang.sh contains

```
clang -c -fpic mylib.c -I $PWD/../../include
clang -dynamiclib -o libmylib.dylib mylib.o -L $PWD/../../lib -lring
cp libmylib.dylib /usr/local/lib
```

This time we use mylib.ring instead of using LoadLib() function directly

In mylib.ring we have the next code

```

if iswindows()
    LoadLib("mylib.dll")
but ismacosx()
    LoadLib("libmylib.dylib")
else
    LoadLib("libmylib.so")
ok

```

The file test.ring contains

```

? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

```

Then we test the function using

```
ring test.ring
```

Output

```

Loading Library
Calling a C Function
Hello, World!

```

97.3 Sum Two Numbers

Sample : ring/extensions/tutorial/sumtwonumbers

In this extension we learn how to create a C function to sum two numbers

This extension is an update to the (Hello World 2) extension in : ring/extensions/tutorial/helloworld2 folder

In mylib.c we update the file to add

```

RING_FUNC(ring_sumtwonumbers)
{
    double nNum1,nNum2,nSum;
    // Check Parameters Count
    if (RING_API_PARACOUNT != 2) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return;
    }
    // Check Parameters Type
    if ( ! (RING_API_ISNUMBER(1) && RING_API_ISNUMBER(2)) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    // Sum Numbers
    nNum1 = RING_API_GETNUMBER(1);
    nNum2 = RING_API_GETNUMBER(2);
    nSum = nNum1 + nNum2 ;
}

```

(continues on next page)

(continued from previous page)

```
// Return Output
    RING_API_RETNUMBER(nSum);
}
```

Then we register the new function

```
RING_API_REGISTER("sumtwonumbers", ring_sumtwonumbers);
```

The previous code is written to check errors, and to be easy to understand

We can write short code like

```
RING_API_RETNUMBER(RING_API_GETNUMBER(1) + RING_API_GETNUMBER(2));
```

The file test.ring contains

```
? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)
```

Then we test the function using

```
ring test.ring
```

Output

```
Loading Library
Calling a C Function
Hello, World!
Sum Two Numbers (3,5)
8
```

97.4 Say Hello

Sample : ring/extensions/tutorial/sayhello

In this extension we learn how to create a C function that get a name as string then say hello.

This extension is an update to the (sumtwonumbers) extension in : ring/extensions/tutorial/sumtwonumbers folder

In mylib.c we update the file to add

```
RING_FUNC(ring_sayhello)
{
    // Check Parameters Count
    if (RING_API_PARACOUNT != 1) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return;
```

(continues on next page)

(continued from previous page)

```

    }
    // Check Parameters Type
    if ( ! RING_API_ISSTRING(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    printf("Hello %s\n",RING_API_GETSTRING(1));
}

```

Then we register the new function

```
RING_API_REGISTER("sayhello",ring_sayhello);
```

The file test.ring contains

```

? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)

? "Say Hello"
SayHello("Mahmoud")

```

Then we test the function using

```
ring test.ring
```

Output

```

Loading Library
Calling a C Function
Hello, World!
Sum Two Numbers (3,5)
8
Say Hello
Hello Mahmoud

```

97.5 Sum List of Numbers

Sample : ring/extensions/tutorial/sumlist

In this extension we learn how to create a C function that sum list of numbers.

This extension is an update to the (sayhello) extension in : ring/extensions/tutorial/sayhello folder

In mylib.c we update the file to add

```
RING_FUNC(ring_sumlist)
{
    List *pList;
    int x,nSum;
    // Check Parameters Count
    if (RING_API_PARACOUNT != 1) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return;
    }
    // Check Parameters Type
    if ( ! RING_API_ISLIST(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    // Sum List Numbers
    nSum = 0;
    pList = RING_API_GETLIST(1);
    for(x=1 ; x <= ring_list_getsize(pList) ; x++) {
        if (ring_list_isdouble(pList,x) ) {
            nSum += (int) ring_list_getdouble(pList,x) ;
        }
    }
    // Return Output
    RING_API_RETNUMBER(nSum);
}
```

Then we register the new function

```
RING_API_REGISTER("sumlist",ring_sumlist);
```

The file test.ring contains

```
? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)

? "Say Hello"
SayHello("Mahmoud")

? "Sum List contains numbers from 1 to 10"
aList = 1:10
? SumList(aList)
```

Then we test the function using

```
ring test.ring
```

Output

```

Loading Library
Calling a C Function
Hello, World!
Sum Two Numbers (3,5)
8
Say Hello
Hello Mahmoud
Sum List contains numbers from 1 to 10
55

```

97.6 Increment List Items

Sample : ring/extensions/tutorial/incrementlist

In this extension we learn how to create a C function that increment the list items.

This extension is an update to the (sumlist) extension in : ring/extensions/tutorial/sumlist folder

In mylib.c we update the file to add

```

RING_FUNC(ring_inclist)
{
    List *pList;
    int x,nSum;
    // Check Parameters Count
    if (RING_API_PARACOUNT != 2) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return;
    }
    // Check Parameters Type
    if ( ! ( RING_API_ISLIST(1) && RING_API_ISNUMBER(2) ) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    // Increment List Items
    nSum = 0;
    pList = RING_API_GETLIST(1);
    for(x=1 ; x <= ring_list_getsize(pList) ; x++) {
        if ( ring_list_isdouble(pList,x) ) {
            ring_list_setdouble_gc(RING_API_STATE,pList,x,
                ring_list_getdouble(pList,x) +
                RING_API_GETNUMBER(2));
        }
    }
    // Return Output
    RING_API RETLIST(pList);
}

```

Then we register the new function

```
RING_API_REGISTER("inclist",ring_inclist);
```

The file test.ring contains

```
? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)

? "Say Hello"
SayHello("Mahmoud")

? "Sum List contains numbers from 1 to 10"
aList = 1:10
? SumList(aList)

? "Increment List Items"
? inclist(aList,10)
```

Then we test the function using

```
ring test.ring
```

Output

```
Loading Library
Calling a C Function
Hello, World!
Sum Two Numbers (3,5)
8
Say Hello
Hello Mahmoud
Sum List contains numbers from 1 to 10
55
Increment List Items
11
12
13
14
15
16
17
18
19
20
```

97.7 Filter List Items

Sample : ring/extensions/tutorial/filterlist

In this extension we learn how to create a C function that filter the list items.

This extension is an update to the (incrementlist) extension in : ring/extensions/tutorial/incrementlist folder

In mylib.c we update the file to add

```
RING_FUNC(ring_filterlist)
{
    List *pList;
    int x;
    // Check Parameters Count
    if (RING_API_PARACOUNT != 2) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return;
    }
    // Check Parameters Type
    if ( ! ( RING_API_ISLIST(1) && RING_API_ISNUMBER(2) ) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    // Filter List Items
    pList = RING_API_GETLIST(1);
    for(x = ring_list_getsize(pList) ; x >= 1 ; x--)
        if (ring_list_isdouble(pList,x))
            if ( ! (ring_list_getdouble(pList,x) >
                    RING_API_GETNUMBER(2)) )
                ring_list_deleteitem_gc(RING_API_STATE,pList,x) ;
    // Return Output
    RING_API RETLIST(pList);
}
```

Then we register the new function

```
RING_API_REGISTER("filterlist",ring_filterlist);
```

The file test.ring contains

```
? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)

? "Say Hello"
SayHello("Mahmoud")

? "Sum List contains numbers from 1 to 10"
aList = 1:10
```

(continues on next page)

(continued from previous page)

```
? SumList(aList)  
?  
? "Increment List Items"  
? inclist(aList,10)  
  
? "Filter List Items (Items > 15)"  
? filterlist(aList,15)
```

Then we test the function using

```
ring test.ring
```

Output

```
Loading Library  
Calling a C Function  
Hello, World!  
Sum Two Numbers (3,5)  
8  
Say Hello  
Hello Mahmoud  
Sum List contains numbers from 1 to 10  
55  
Increment List Items  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
  
Filter List Items (Items > 15)  
16  
17  
18  
19  
20
```

97.8 Replicate List Items

Sample : ring/extensions/tutorial/replicatelist

In this extension we learn how to create a C function that add more items to the list.

This extension is an update to the (filterlist) extension in : ring/extensions/tutorial/filterlist folder

In mylib.c we update the file to add

```
RING_FUNC(ring_replicatelist)
{
    List *pList;
    int x,y,nTimes,nSize;
    // Check Parameters Count
    if (RING_API_PARACOUNT != 2) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return;
    }
    // Check Parameters Type
    if ( ! ( RING_API_ISLIST(1) && RING_API_ISNUMBER(2) ) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    // Replicate List Items
    pList = RING_API_GETLIST(1);
    nSize = ring_list_getsize(pList);
    nTimes = (int) RING_API_GETNUMBER(2);
    if (nTimes < 1) {
        RING_API_ERROR("Error: The second parameter must be >= 1 \n");
        return;
    }
    for(x = 1 ; x <= nTimes ; x++)
        for(y = 1 ; y <= nSize ; y++)
            if (ring_list_isdouble(pList,y) )
                ring_list_adddouble_gc(RING_API_STATE,pList,
                                       ring_list_getdouble(pList,y));
    // Return Output
    RING_API RETLIST(pList);
}
```

Then we register the new function

```
RING_API_REGISTER("replicatelist",ring_replicatelist);
```

The file test.ring contains

```
? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)
```

(continues on next page)

(continued from previous page)

```
? "Say Hello"
SayHello("Mahmoud")

? "Sum List contains numbers from 1 to 10"
aList = 1:10
? SumList(aList)

? "Increment List Items"
? inclist(aList,10)

? "Filter List Items (Items > 15)"
? filterlist(aList,15)

aList = 1:3
? "Replicate list (1:3) three times then print the items (We expect 12 items)"
? replicatelist(aList,3)
```

Then we test the function using

```
ring test.ring
```

Output

```
Loading Library
Calling a C Function
Hello, World!
Sum Two Numbers (3,5)
8
Say Hello
Hello Mahmoud
Sum List contains numbers from 1 to 10
55
Increment List Items
11
12
13
14
15
16
17
18
19
20

Filter List Items (Items > 15)
16
17
18
19
20
```

(continues on next page)

(continued from previous page)

```
Replicate list (1:3) three times then print the items (We expect 12 items)
```

```
1
2
3
1
2
3
1
2
3
1
2
3
```

97.9 Generate List

Sample : ring/extensions/tutorial/generatelist

In this extension we learn how to create a C function that create new list and add items to the list.

This extension is an update to the (replicatelist) extension in : ring/extensions/tutorial/replicatelist folder

In mylib.c we update the file to add

```
RING_FUNC(ring_generatelist)
{
    List *pList;
    int x,nSize;
    // Check Parameters Count
    if (RING_API_PARACOUNT != 1) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return;
    }
    // Check Parameters Type
    if ( ! RING_API_ISNUMBER(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    // Create the List
    pList = RING_API_NEWMEM();
    // Generate List Items
    nSize = (int) RING_API_GETNUMBER(1);
    if (nSize < 1) {
        RING_API_ERROR("Error: The list size must be >= 1 \n");
        return;
    }
    for(x = 1 ; x <= nSize ; x++)
        ring_list_adddouble_gc(RING_API_STATE,pList,(double) x);
    // Return Output
    RING_API.RET(pList);
}
```

Then we register the new function

```
RING_API_REGISTER("generatelist",ring_generatelist);
```

The file test.ring contains

```
? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)

? "Say Hello"
SayHello("Mahmoud")

? "Sum List contains numbers from 1 to 10"
aList = 1:10
? SumList(aList)

? "Increment List Items"
? inclist(aList,10)

? "Filter List Items (Items > 15)"
? filterlist(aList,15)

aList = 1:3
? "Replicate list (1:3) three times then print the items (We expect 12 items)"
? replicatelist(aList,3)

? "Create list contains 5 items using C code"
aList = GenerateList(5)
? aList
```

Then we test the function using

```
ring test.ring
```

Output

```
Loading Library
Calling a C Function
Hello, World!
Sum Two Numbers (3,5)
8
Say Hello
Hello Mahmoud
Sum List contains numbers from 1 to 10
55
Increment List Items
11
12
```

(continues on next page)

(continued from previous page)

```
13
14
15
16
17
18
19
20
```

Filter List Items (Items > 15)

```
16
17
18
19
20
```

Replicate list (1:3) three times then print the items (We expect 12 items)

```
1
2
3
1
2
3
1
2
3
1
2
3
```

Create list contains 5 items using C code

```
1
2
3
4
5
```

97.10 Display List

Sample : ring/extensions/tutorial/displaylist

In this extension we learn how to create a C function that display all of the list items including nested lists

In mylib.c we update the file to add

```
void mylib_displaylist(List *pList);

RING_FUNC(ring_displaylist)
{
    List *pList;
```

(continues on next page)

(continued from previous page)

```

// Check Parameters Count
    if (RING_API_PARACOUNT != 1) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return;
    }
// Check Parameters Type
    if ( ! RING_API_ISLIST(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
// Get the List
    pList = RING_API_GETLIST(1);
// Display the List Items including Nested Lists
    mylib_displaylist(pList);
}

void mylib_displaylist(List *pList) {
    int x;
    for (x=1; x <= ring_list_getsize(pList); x++) {
        if ( ring_list_isdouble(pList,x) ) {
            printf("Number : %f \n", ring_list_getdouble(pList,x) );
        } else if ( ring_list_isstring(pList,x) ) {
            printf("String : %s \n", ring_list_getstring(pList,x) );
        } else if ( ring_list_islist(pList,x) ) {
            printf("Sub List..\n");
            mylib_displaylist(ring_list_getlist(pList,x));
        }
    }
}

```

Then we register the new function

```
RING_API_REGISTER("displaylist",ring_displaylist);
```

The file test.ring contains

```

load "stdlib.ring"

? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)

? "Say Hello"
SayHello("Mahmoud")

? "Sum List contains numbers from 1 to 10"
aList = 1:10

```

(continues on next page)

(continued from previous page)

```
? SumList(aList)

? "Increment List Items"
? inclist(aList,10)

? "Filter List Items (Items > 15)"
? filterlist(aList,15)

aList = 1:3
? "Replicate list (1:3) three times then print the items (We expect 12 items)"
? replicatelist(aList,3)

? "Create list contains 5 items using C code"
aList = GenerateList(5)
? aList

? "Create List (3,2)"
aList = newList(3,2)
aList[1][1] = "R 1 C 1"
aList[1][2] = "R 1 C 2"
aList[2][1] = "R 2 C 1"
aList[2][2] = "R 2 C 2"
aList[3][1] = "R 3 C 1"
aList[3][2] = "R 3 C 2"
? "Print the List using Ring"
? aList
? "Print the List by calling C Code"
displayList(aList)
```

Then we test the function using

```
ring test.ring
```

Output

```
Loading Library
Calling a C Function
Hello, World!
Sum Two Numbers (3,5)
8
Say Hello
Hello Mahmoud
Sum List contains numbers from 1 to 10
55
Increment List Items
11
12
13
14
15
16
17
```

(continues on next page)

(continued from previous page)

```
18  
19  
20
```

```
Filter List Items (Items > 15)
```

```
16  
17  
18  
19  
20
```

```
Replicate list (1:3) three times then print the items (We expect 12 items)
```

```
1  
2  
3  
1  
2  
3  
1  
2  
3  
1  
2  
3
```

```
Create list contains 5 items using C code
```

```
1  
2  
3  
4  
5
```

```
Create List (3,2)
```

```
Print the List using Ring
```

```
R 1 C 1  
R 1 C 2  
R 2 C 1  
R 2 C 2  
R 3 C 1  
R 3 C 2
```

```
Print the List by calling C Code
```

```
Sub List..  
String : R 1 C 1  
String : R 1 C 2  
Sub List..  
String : R 2 C 1  
String : R 2 C 2  
Sub List..  
String : R 3 C 1  
String : R 3 C 2
```

97.11 Update Table

Sample : ring/extensions/tutorial/updatetable

In this extension we learn how to create a C function that update a table contains rows and columns

In mylib.c we update the file to add

```
RING_FUNC(ring_updatetable)
{
    List *pList, *pRow;
    int nRow,nCol;
    // Check Parameters Count
    if (RING_API_PARACOUNT != 2) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return;
    }
    // Check Parameters Type
    if ( ! ( RING_API_ISLIST(1) && RING_API_ISNUMBER(2) ) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    // Get the List (Represent a Table)
    pList = RING_API_GETLIST(1);
    // Update the Table Rows and Columns
    for (nRow = 1 ; nRow <= ring_list_getsize(pList) ; nRow++ ) {
        if ( ring_list_islist(pList,nRow) ) {
            pRow = ring_list_getlist(pList,nRow);
            for (nCol = 1 ; nCol <= ring_list_getsize(pRow) ; nCol++ ) {
                if ( ring_list_isdouble(pRow,nCol) ) {
                    ring_list_setdouble_gc(RING_API_STATE,pRow,nCol,RING_API_
GETNUMBER(2));
                } else {
                    RING_API_ERROR("Error : We expect numbers!\n");
                    return ;
                }
            }
        } else {
            RING_API_ERROR("Error : The parameter is not a table! \n");
            return ;
        }
    }
}
```

Then we register the new function

```
RING_API_REGISTER("updatetable",ring_updatetable);
```

The file test.ring contains

```
load "stdlib.ring"
?
? "Loading Library"
load "mylib.ring"
```

(continues on next page)

(continued from previous page)

```

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)

? "Say Hello"
SayHello("Mahmoud")

? "Sum List contains numbers from 1 to 10"
aList = 1:10
? SumList(aList)

? "Increment List Items"
? inclist(aList,10)

? "Filter List Items (Items > 15)"
? filterlist(aList,15)

aList = 1:3
? "Replicate list (1:3) three times then print the items (We expect 12 items)"
? replicatelist(aList,3)

? "Create list contains 5 items using C code"
aList = GenerateList(5)
? aList

? "Create List (3,2)"
aList = newList(3,2)
aList[1][1] = "R 1 C 1"
aList[1][2] = "R 1 C 2"
aList[2][1] = "R 2 C 1"
aList[2][2] = "R 2 C 2"
aList[3][1] = "R 3 C 1"
aList[3][2] = "R 3 C 2"
? "Print the List using Ring"
? aList
? "Print the List by calling C Code"
displayList(aList)
? ""

? "Create List (2,2)"
aList = newList(2,2)
? "Update the list using C code - set all cells to 10"
UpdateTable(aList,10)
? "aList[1][1] : " + aList[1][1]
? "aList[1][2] : " + aList[1][2]
? "aList[2][1] : " + aList[2][1]
? "aList[2][2] : " + aList[2][2]

```

Then we test the function using

```
ring test.ring
```

Output

```
Loading Library
Calling a C Function
Hello, World!
Sum Two Numbers (3,5)
8
Say Hello
Hello Mahmoud
Sum List contains numbers from 1 to 10
55
Increment List Items
11
12
13
14
15
16
17
18
19
20
```

```
Filter List Items (Items > 15)
16
17
18
19
20
```

```
Replicate list (1:3) three times then print the items (We expect 12 items)
1
2
3
1
2
3
1
2
3
1
2
3
```

```
Create list contains 5 items using C code
1
2
3
4
5
```

(continues on next page)

(continued from previous page)

```

Create List (3,2)
Print the List using Ring
R 1 C 1
R 1 C 2
R 2 C 1
R 2 C 2
R 3 C 1
R 3 C 2

Print the List by calling C Code
Sub List..
String : R 1 C 1
String : R 1 C 2
Sub List..
String : R 2 C 1
String : R 2 C 2
Sub List..
String : R 3 C 1
String : R 3 C 2

Create List (2,2)
Update the list using C code - set all cells to 10
aList[1][1] : 10
aList[1][2] : 10
aList[2][1] : 10
aList[2][2] : 10

```

97.12 Create Table

Sample : ring/extensions/tutorial/createtable

In this extension we learn how to create a C function that create a table contains rows and columns

In mylib.c we update the file to add

```

RING_FUNC(ring_createtable)
{
    List *pList, *pRow;
    int x,y,nRows,nCols;
    // Check Parameters Count
    if (RING_API_PARACOUNT != 2) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return;
    }
    // Check Parameters Type
    if ( ! ( RING_API_ISNUMBER(1) && RING_API_ISNUMBER(2) ) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    // Create the List

```

(continues on next page)

(continued from previous page)

```

    pList = RING_API_NEWTLIST;
    // Create the table items
    nRows = (int) RING_API_GETNUMBER(1);
    nCols = (int) RING_API_GETNUMBER(2);
    if ( (nRows < 1) || (nCols < 1) ) {
        RING_API_ERROR("Error: The table rows and columns must be >= 1 \n");
        return;
    }
    for(x = 1 ; x <= nRows ; x++) {
        pRow = ring_list_newlist(pList);
        for(y = 1 ; y <= nCols ; y++)
            ring_list_adddouble_gc(RING_API_STATE,pRow,0.0);
    }
    // Return Output
    RING_API RETLIST(pList);
}

```

Then we register the new function

```
RING_API_REGISTER("createtable",ring_createtable);
```

The file test.ring contains

```

load "stdlib.ring"

? "Loading Library"
load "mylib.ring"

? "Calling a C Function"
myfunction()

? "Sum Two Numbers (3,5)"
? SumTwoNumbers(3,5)

? "Say Hello"
SayHello("Mahmoud")

? "Sum List contains numbers from 1 to 10"
aList = 1:10
? SumList(aList)

? "Increment List Items"
? inclist(aList,10)

? "Filter List Items (Items > 15)"
? filterlist(aList,15)

aList = 1:3
? "Replicate list (1:3) three times then print the items (We expect 12 items)"
? replicatelist(aList,3)

? "Create list contains 5 items using C code"

```

(continues on next page)

(continued from previous page)

```
aList = GenerateList(5)
? aList

? "Create List (3,2)"
aList = newList(3,2)
aList[1][1] = "R 1 C 1"
aList[1][2] = "R 1 C 2"
aList[2][1] = "R 2 C 1"
aList[2][2] = "R 2 C 2"
aList[3][1] = "R 3 C 1"
aList[3][2] = "R 3 C 2"
? "Print the List using Ring"
? aList
? "Print the List by calling C Code"
displayList(aList)
? ""

? "Create List (2,2)"
aList = newList(2,2)
? "Update the list using C code - set all cells to 10"
UpdateTable(aList,10)
? "aList[1][1] : " + aList[1][1]
? "aList[1][2] : " + aList[1][2]
? "aList[2][1] : " + aList[2][1]
? "aList[2][2] : " + aList[2][2]
? ""

? "Create List (3,3) using C code"
aList = CreateTable(3,3)
? "aList[1][1] : " + aList[1][1]
? "aList[1][2] : " + aList[1][2]
? "aList[1][3] : " + aList[1][3]
? "aList[2][1] : " + aList[2][1]
? "aList[2][2] : " + aList[2][2]
? "aList[2][3] : " + aList[2][3]
? "aList[3][1] : " + aList[3][1]
? "aList[3][2] : " + aList[3][2]
? "aList[3][3] : " + aList[3][3]
```

Then we test the function using

```
ring test.ring
```

Output

```
Loading Library
Calling a C Function
Hello, World!
Sum Two Numbers (3,5)
8
Say Hello
Hello Mahmoud
```

(continues on next page)

(continued from previous page)

```
Sum List contains numbers from 1 to 10
```

```
55
```

```
Increment List Items
```

```
11
```

```
12
```

```
13
```

```
14
```

```
15
```

```
16
```

```
17
```

```
18
```

```
19
```

```
20
```

```
Filter List Items (Items > 15)
```

```
16
```

```
17
```

```
18
```

```
19
```

```
20
```

```
Replicate list (1:3) three times then print the items (We expect 12 items)
```

```
1
```

```
2
```

```
3
```

```
1
```

```
2
```

```
3
```

```
1
```

```
2
```

```
3
```

```
1
```

```
2
```

```
3
```

```
Create list contains 5 items using C code
```

```
1
```

```
2
```

```
3
```

```
4
```

```
5
```

```
Create List (3,2)
```

```
Print the List using Ring
```

```
R 1 C 1
```

```
R 1 C 2
```

```
R 2 C 1
```

```
R 2 C 2
```

```
R 3 C 1
```

```
R 3 C 2
```

(continues on next page)

(continued from previous page)

```
Print the List by calling C Code
Sub List..
String : R 1 C 1
String : R 1 C 2
Sub List..
String : R 2 C 1
String : R 2 C 2
Sub List..
String : R 3 C 1
String : R 3 C 2

Create List (2,2)
Update the list using C code - set all cells to 10
aList[1][1] : 10
aList[1][2] : 10
aList[2][1] : 10
aList[2][2] : 10

Create List (3,3) using C code
aList[1][1] : 0
aList[1][2] : 0
aList[1][3] : 0
aList[2][1] : 0
aList[2][2] : 0
aList[2][3] : 0
aList[3][1] : 0
aList[3][2] : 0
aList[3][3] : 0
```

CHAPTER
NINETYEIGHT

EXTENSION USING THE C/C++ LANGUAGES

We can extend the Ring Virtual Machine (RingVM) by adding new functions written in the C programming language or C++. The RingVM comes with many functions written in C that we can call like any Ring function.

We can extend the language by writing new functions then rebuilding the RingVM again, or we can create shared library (DLL/So/Dylib) file to extend the RingVM without the need to rebuild it.

The Ring language source code comes with two files to add new modules to the RingVM, ring_ext.h and ring_ext.c

98.1 ring_ext.h

The file ring_ext.h contains constants that we can change to include/exclude modules during the build process.

```
#ifndef ringext_h
#define ringext_h
/* Constants */
#define RING_VM_LISTFUNCS      1
#define RING_VM_REFMETA        1
#define RING_VM_MATH           1
#define RING_VM_FILE           1
#define RING_VM_OS             1
#define RING_VM_MYSQL          1
#define RING_VM_ODBC           1
#define RING_VM_OPENSSL         1
#define RING_VM_CURL           1
#define RING_VM_DLL            1
#endif
```

98.2 ring_ext.c

The file ring_ext.c check constants defined in ring_ext.h before calling the start-up function in each module.

Each module contains a function that register the module functions in the RingVM.

```
#include "ring.h"

void ring_vm_extension ( RingState *pRingState )
{
    /* Reflection and Meta-programming */
```

(continues on next page)

(continued from previous page)

```

#if RING_VM_REFMETA
    ring_vm_refmeta_loadfunctions(pRingState);
#endif
/* List Functions */
#if RING_VM_LISTFUNCS
    ring_vm_listfuncs_loadfunctions(pRingState);
#endif
/* Math */
#if RING_VM_MATH
    ring_vm_math_loadfunctions(pRingState);
#endif
/* File */
#if RING_VM_FILE
    ring_vm_file_loadfunctions(pRingState);
#endif
/* OS */
#if RING_VM_OS
    ring_vm_os_loadfunctions(pRingState);
#endif
/* MySQL */
#if RING_VM_MYSQL
    ring_vm_mysql_loadfunctions(pRingState);
#endif
/* ODBC */
#if RING_VM_ODBC
    ring_vm_odbc_loadfunctions(pRingState);
#endif
/* OPENSSL */
#if RING_VM_OPENSSL
    ring_vm_openssl_loadfunctions(pRingState);
#endif
/* CURL */
#if RING_VM_CURL
    ring_vm_curl_loadfunctions(pRingState);
#endif
/* DLL */
#if RING_VM_DLL
    ring_vm_dll_loadfunctions(pRingState);
#endif
}

```

98.3 Module Organization

Each module starts by include the ring header file (ring.h). This files contains the Ring API that we can use to extend the RingVM.

Each module comes with a function to register the module functions in the RingVM. The registration is done by using RING_API_REGISTER() function.

The RING_API_REGISTER() function takes two parameters, the first is the function name that will be used by Ring programs to call the function. The second parameter is the function pointer in the C program.

for example, the ring_vmmath.c module contains the next code to register the module functions

```
#include "ring.h"

void ring_vm_math_loadfunctions ( RingState *pRingState )
{
    RING_API_REGISTER("sin",ring_vm_math_sin);
    RING_API_REGISTER("cos",ring_vm_math_cos);
    RING_API_REGISTER("tan",ring_vm_math_tan);
    RING_API_REGISTER("asin",ring_vm_math_asin);
    RING_API_REGISTER("acos",ring_vm_math_acos);
    RING_API_REGISTER("atan",ring_vm_math_atan);
    RING_API_REGISTER("atan2",ring_vm_math_atan2);
    RING_API_REGISTER("sinh",ring_vm_math_sinh);
    RING_API_REGISTER("cosh",ring_vm_math_cosh);
    RING_API_REGISTER("tanh",ring_vm_math_tanh);
    RING_API_REGISTER("exp",ring_vm_math_exp);
    RING_API_REGISTER("log",ring_vm_math_log);
    RING_API_REGISTER("log10",ring_vm_math_log10);
    RING_API_REGISTER("ceil",ring_vm_math_ceil);
    RING_API_REGISTER("floor",ring_vm_math_floor);
    RING_API_REGISTER("fabs",ring_vm_math fabs);
    RING_API_REGISTER("pow",ring_vm_math_pow);
    RING_API_REGISTER("sqrt",ring_vm_math_sqrt);
    RING_API_REGISTER("unsigned",ring_vm_math_unsigned);
    RING_API_REGISTER("decimals",ring_vm_math_decimals);
    RING_API_REGISTER("murmur3hash",ring_vm_math_murmur3hash);
}
```

Tip: Remember that the function ring_vm_math_loadfunctions() will be called by the ring_vm_extension() function (in the ring_ext.c file).

98.4 Function Structure

Each module function may contains the next steps

- 1 - Check Parameters Count
- 2 - Check Parameters Type
- 3 - Get Parameters Values
- 4 - Execute Code/Call Functions
- 5 - Return Value

The structure is very similar to any function (Input - Process - Output) But here we will use the Ring API for the steps 1,2,3 and 5.

98.5 Check Parameters Count

We can check the parameters count using the RING_API_PARACOUNT macro.

We can compare RING_API_PARACOUNT with any numeric value using == or != operators.

Example:

```
if ( RING_API_PARACOUNT != 1 ) {
    /* code */
}
```

Example:

```
if ( RING_API_PARACOUNT == 1 ) {
    /* code */
}
```

98.6 Display Error Message

We can display error messages using the RING_API_ERROR() function.

The function will display the error and end the execution of the program.

Note: the behaviour of this function can be changed by the Ring code using Try/Catch/Done statements, so in your C code, use Return after this function.

Syntax:

```
RING_API_ERROR(const char *cErrorMsg);
```

The Ring API comes with some of predefined error messages that we can use

```
#define RING_API_MISS1PARA "Bad parameters count, the function expect one parameter"
#define RING_API_MISS2PARA "Bad parameters count, the function expect two parameters"
#define RING_API_MISS3PARA "Bad parameters count, the function expect three parameters"
#define RING_API_MISS4PARA "Bad parameters count, the function expect four parameters"
#define RING_API_BADPARATYPE "Bad parameter type!"
#define RING_API_BADPARACOUNT "Bad parameters count!"
#define RING_API_BADPARARANGE "Bad parameters value, error in range!"
#define RING_API_NOTPOINTER "Error in parameter, not pointer!"
#define RING_API_NULLPOINTER "Error in parameter, NULL pointer!"
#define RING_API_EMPTYLIST "Bad parameter, empty list!"
```

98.7 Check Parameters Type

We can check the parameter type using the next functions

```
int RING_API_ISNUMBER(int nParameterNumber);
int RING_API_ISSTRING(int nParameterNumber);
int RING_API_ISLIST(int nParameterNumber);
int RING_API_ISCPOINTER(int nParameterNumber);
int RING_API_ISPOINTER(int nParameterNumber); // List or C Pointer
```

The output of these functions will be 1 (True) or 0 (False).

98.8 Get Parameters Values

We can get parameters values using the next functions

```
double RING_API_GETNUMBER(int nParameterNumber);
const char *RING_API_GETSTRING(int nParameterNumber);
int RING_API_GETSTRINGSIZE(int nParameterNumber);
List *RING_API_GETLIST(int nParameterNumber);
void *RING_API_GETCPOINTER(int nParameterNumber, const char *cPoinerType);
int RING_API_GETPOINTERTYPE(int nParameterNumber);
```

If we would like to get pointers to char, int, float & double

We can use the next functions

```
char *RING_API_GETCHARPOINTER(int nParameterNumber);
int *RING_API_GETINTPOINTER(int nParameterNumber);
void RING_API_ACCEPTINTVALUE(int nParameterNumber);
float *RING_API_GETFLOATPOINTER(int nParameterNumber);
void RING_API_ACCEPTFLOATVALUE(int nParameterNumber);
double *RING_API_GETDOUBLEPOINTER(int nParameterNumber);
```

98.9 Return Value

We can return values from our function using the next functions.

```
RING_API_RETNUMBER(double nValue);
RING_API_RETSTRING(const char *cString);
RING_API_RETSTRING2(const char *cString, int nStringSize);
RING_API_RETLIST(List *pList);
RING_API_RETCPOINTER(void *pValue, const char *cPointerType);
RING_API_RETMANAGEDCPOINTER(void *pValue, const char *cPointerType,
                           void (* pFreeFunc)(void *, void *))
```

98.10 Function Prototype

When we define new function to be used for RingVM extension, we use the next prototype

```
void my_function_name( void *pPointer );
```

or we can use the RING_FUNC() Macro

```
RING_FUNC(my_function_name);
```

98.11 Sin() Function Implementation

The next code represents the sin() function implementation using the Ring API and the sin() C function.

```
void ring_vm_math_sin ( void *pPointer )
{
    if ( RING_API_PARACOUNT != 1 ) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return ;
    }
    if ( RING_API_ISNUMBER(1) ) {
        RING_API_RETNUMBER(sin(RING_API_GETNUMBER(1)));
    } else {
        RING_API_ERROR(RING_API_BADPARATYPE);
    }
}
```

98.12 Fopen() and Fclose() Functions Implementation

The next code represents the fopen() function implementation using the Ring API and the fopen() C Function.

The function takes two parameters, the first parameter is the file name as string. The second parameter is the mode as string.

In the file ring_vmfile.h we have some constants to use as the pointer type like

```
#define RING_VM_POINTER_FILE      "file"
#define RING_VM_POINTER_FILEPOS   "filepos"
```

The function implementation in ring_vmfile.c

```
void ring_vm_file_fopen ( void *pPointer )
{
    FILE *fp ;
    if ( RING_API_PARACOUNT != 2 ) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return ;
    }
    if ( RING_API_ISSTRING(1) && RING_API_ISSTRING(2) ) {
        fp = fopen(RING_API_GETSTRING(1),RING_API_GETSTRING(2));
    }
}
```

(continues on next page)

(continued from previous page)

```

        RING_API RETCPOINTER(fp,RING_VM_POINTER_FILE);
    } else {
        RING_API_ERROR(RING_API_BADPARATYPE);
    }
}

```

The next code represents the fclose() function implementation

```

void ring_vm_file_fclose ( void *pPointer )
{
    FILE *fp ;
    if ( RING_API_PARACOUNT != 1 ) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return ;
    }
    if ( RING_API_ISCPOINTER(1) ) {
        fp = (FILE *) RING_API_GETCPOINTER(1,RING_VM_POINTER_FILE) ;
        if ( fp != NULL ) {
            RING_API_RETNUMBER(fclose(fp));
            RING_API_SETNULLPOINTER(1);
        }
    } else {
        RING_API_ERROR(RING_API_BADPARATYPE);
    }
}

```

From fopen() and fclose() implementation we learned

- 1 - how to return C pointer using RING_API RETCPOINTER() function
- 2 - how to check if the parameter is a pointer using the RING_API_ISCPOINTER() function
- 3 - how to get C pointer value using the RING_API GETCPOINTER() function
- 4 - how to set the C pointer variable (in RingVM) to NULL using the RING_API SETNULLPOINTER() function

98.13 Ring API - List Functions

In this section we will learn about the list functions provided by the Ring API to create new lists and manipulate the list items.

This section contains the most important functions required for common use-cases

For a complete list of function, including functions that store and process integers, pointers & objects, see this file: ring/language/include/rlist.h

If your list will be modified by Ring code then it's required to use the _gc version of the functions

Lists created using ring_list_new()/ring_list_new_gc() must be deleted using ring_list_delete()/ring_list_delete_gc().

If we created a list using RING_API_NEWTLIST then deleting the list is not required and may cause problems, because Ring VM will delete it automatically after the end of the caller scope.

Using RING_API_NEWTLISTUSINGBLOCKS1D and RING_API_NEWTLISTUSINGBLOCKS2D is similar to RING_API_NEWTLIST but we have better performance when we create large lists.

```

// Create and delete lists

List * RING_API_NEWTABLE
List * RING_API_NEWTABLEUSINGBLOCKS1D(int nItems)
List * RING_API_NEWTABLEUSINGBLOCKS2D(int nRows,int nColumns)
List * ring_list_new_gc ( void *pState,unsigned int nSize ) ;
List * ring_list_delete_gc ( void *pState,List *pList ) ;

List * ring_list_new ( unsigned int nSize ) ;
List * ring_list_delete ( List *pList ) ;

// Add Items

void ring_list_adddouble_gc ( void *pState,List *pList,double x ) ;
void ring_list_addstring_gc ( void *pState,List *pList,const char *str ) ;
void ring_list_addstring2_gc ( void *pState,List *pList,const char *str,int nStrSize ) ;
List * ring_list_newlist_gc ( void *pState,List *pList ) ;

void ring_list_adddouble ( List *pList,double x ) ;
void ring_list_addstring ( List *pList,const char *str ) ;
void ring_list_addstring2 ( List *pList,const char *str,int nStrSize ) ;
List * ring_list_newlist ( List *pList ) ;

// Get List Size

int ring_list_getsize( List *pList ) ;

// Check Item Type

int ring_list_isdouble ( List *pList, unsigned int index ) ;
int ring_list_isstring ( List *pList, unsigned int index ) ;
int ring_list_islist ( List *pList, unsigned int index ) ;
int ring_list_isobject ( List *pList ) ;

// Get Items

double ring_list_getdouble ( List *pList, unsigned int index ) ;
char * ring_list_getstring ( List *pList, unsigned int index ) ;
int ring_list_getstringsize ( List *pList, unsigned int index ) ;
String * ring_list_getstringobject ( List *pList, unsigned int index ) ;
List * ring_list_getlist ( List *pList, unsigned int index ) ;

// Insert Items

void ring_list_insertdouble_gc ( void *pState,List *pList,unsigned int nPos,double x ) ;
void ring_list_insertstring_gc ( void *pState,List *pList,unsigned int nPos,const char *str ) ;
void ring_list_insertstring2_gc ( void *pState,List *pList,unsigned int nPos,const char *str,int nStrSize ) ;
List * ring_list_insertlist_gc ( void *pState,List *pList,unsigned int nPos ) ;

void ring_list_insertdouble ( List *pList,unsigned int nPos,double x ) ;
void ring_list_insertstring ( List *pList,unsigned int nPos,const char *str ) ;

```

(continues on next page)

(continued from previous page)

```

void ring_list_insertstring2 ( List *pList,unsigned int nPos,const char *str,int
~nStrSize ) ;
List * ring_list_insertlist ( List *pList,unsigned int nPos ) ;

// Set Items

void ring_list_setdouble_gc ( void *pState,List *pList, unsigned int index ,double
~number ) ;
void ring_list_setstring_gc ( void *pState,List *pList, unsigned int index ,const char*
~*str ) ;
void ring_list_setstring2_gc ( void *pState,List *pList, unsigned int index ,const char*
~*str,int nStrSize ) ;
void ring_list_setlist_gc ( void *pState,List *pList, unsigned int index ) ;

void ring_list_setdouble ( List *pList, unsigned int index ,double number ) ;
void ring_list_setstring ( List *pList, unsigned int index ,const char *str ) ;
void ring_list_setstring2 ( List *pList, unsigned int index ,const char *str,int
~nStrSize ) ;
void ring_list_setlist ( List *pList, unsigned int index ) ;

// Delete Items

void ring_list_deleteitem_gc ( void *pState,List *pList, unsigned int index ) ;
void ring_list_deleteallitems_gc ( void *pState,List *pList ) ;

void ring_list_deleteitem ( List *pList, unsigned int index ) ;
void ring_list_deleteallitems ( List *pList ) ;

// Copy Lists

void ring_list_copy_gc ( void *pState,List *pNewList, List *pList ) ;
void ring_list_copy ( List *pNewList, List *pList ) ;

// Find Items

int ring_list_findstring ( List *pList,const char *str, unsigned int nColumn ) ;
int ring_list_finddouble ( List *pList,double nNum1, unsigned int nColumn ) ;

// Swap

void ring_list_swap ( List *pList, unsigned int x, unsigned int y ) ;
void ring_list_swaptwolists ( List *pList1, List *pList2 ) ;

// Print

void ring_list_print ( List *pList ) ;
void ring_list_print2 ( List *pList, unsigned int nDecimals ) ;
void ring_list_printobj ( List *pList, unsigned int nDecimals ) ;

```

98.14 RING_API_STATE

To modify or delete the Lists and Strings created using Ring code, We have to use specific Lists/Strings functions. These functions requires that the Ring State to be passed as the first parameter.

Also, these functions add _gc to the function name which means that it uses the Ring Garbage Collector.

Some of these functions are

```
void ring_list_setdouble_gc ( void *pState, List *pList, int index , double number ) ;
void ring_list_adddouble_gc ( void *pState, List *pList, double x ) ;
void ring_list_deleteitem_gc ( void *pState, List *pList, int index ) ;
```

Example:

The next C code implement the filterList() function

We pass a list and a number to this function and it will check each item in the list.

If the item value is not greater than the passed number, then the item will be deleted.

In the implementation we uses ring_list_deleteitem_gc() function to delete the item and we pass Ring state as the first parameter using RING_API_STATE.

```
RING_FUNC(ring_filterlist)
{
    List *pList;
    int x;
    // Check Parameters Count
    if (RING_API_PARACOUNT != 2) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return;
    }
    // Check Parameters Type
    if ( ! ( RING_API_ISLIST(1) && RING_API_ISNUMBER(2) ) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }
    // Filter List Items
    pList = RING_API_GETLIST(1);
    for(x = ring_list_getsize(pList) ; x >= 1 ; x--)
        if ( ring_list_isdouble(pList,x) )
            if ( ! (ring_list_getdouble(pList,x) >
                     RING_API_GETNUMBER(2)) )
                ring_list_deleteitem_gc(RING_API_STATE,pList,x) ;
    // Return Output
    RING_API_RETLIST(pList);
}
```

98.15 Ring API - String Functions

In this section we will learn about the string functions provided by the Ring API to create new string and manipulate the string content.

As in List functions, the GC version of these functions (which add _gc to the name) exist.

Here, Using the GC version of the functions is not necessary for stability but it could be helpful for performance.

Why it's not necessary for stability as we have in the List functions?

Because Ring API uses List * to pass lists from Ring VM to C code and also uses List * to return lists from C code to Ring. These lists are passed by pointers, They are the same lists, and we need the same memory functions to process the list items.

While when using Strings, Ring API create new strings when using RING_API_GETSTRING() or RING_API_RETSTRING()

For a complete list of function, including functions that uses the GC, see this file: ring/language/include/rstring.h

```
// Create and delete strings

String * ring_string_new ( const char *str ) ;
String * ring_string_new2 ( const char *str,int nStrSize ) ;
String * ring_string_delete ( String *pString ) ;

// Get string

char * ring_string_get ( String *pString ) ;
int ring_string_size ( String *pString ) ;

// Add text to the string

void ring_string_add ( String *pString,const char *str ) ;
void ring_string_add2 ( String *pString,const char *str,int nStrSize ) ;

// Change the string

void ring_string_set ( String *pString,const char *str ) ;
void ring_string_set2 ( String *pString,const char *str,int nStrSize ) ;
void ring_string_setfromint ( String *pString,int x ) ;

// Print the string

void ring_string_print ( String *pString ) ;

// Convert to lower/UPPER case

void ring_string_tolower(String *pString)
void ring_string_toupper(String *pString)
char * ring_string_lower ( char *cStr ) ;
char * ring_string_upper ( char *cStr ) ;
char * ring_string_lower2 ( char *cStr,int nStrSize ) ;
char * ring_string_upper2 ( char *cStr,int nStrSize ) ;

// Find
```

(continues on next page)

(continued from previous page)

```
char * ring_string_find ( char *cStr1,char *cStr2 ) ;
char * ring_string_find2 ( char *cStr1,int nStrSize1,char *cStr2,int nStrSize2 ) ;
```

98.16 MySQL_Columns() Function Implementation

The next code presents the MySQL_Columns() function implementation.

This function returns table columns information.

```
void ring_vm_mysql_columns ( void *pPointer )
{
    MYSQL *con ;
    MYSQL_RES *result ;
    int nColumns,x ;
    MYSQL_ROW row ;
    MYSQL_FIELD *field ;
    List *pList, *pList2 ;
    if ( RING_API_PARACOUNT != 1 ) {
        RING_API_ERROR(RING_API_MISS1PARA) ;
        return ;
    }
    if ( RING_API_ISCPOINTER(1) ) {
        con = (MYSQL *) RING_API_GETCPOINTER(1,RING_VM_POINTER_MYSQL) ;
        if ( con == NULL ) {
            return ;
        }
        result = mysql_store_result(con) ;
        if ( result == NULL ) {
            RING_API_RETNUMBER(0) ;
            return ;
        }
        pList = RING_API_NEWTLIST ;
        nColumns = mysql_num_fields(result) ;
        if ( row = mysql_fetch_row(result) ) {
            while ( field = mysql_fetch_field(result) ) {
                pList2 = ring_list_newlist_gc(RING_API_STATE,pList) ;
                ring_list_addstring(pList2,field->name) ;
                ring_list_adddouble(pList2,field->length) ;
                ring_list_adddouble(pList2,field->type) ;
                ring_list_adddouble(pList2,field->flags) ;
            }
        }
        mysql_free_result(result) ;
        RING_API_RELIST(pList) ;
    } else {
        RING_API_ERROR(RING_API_BADPARATYPE) ;
    }
}
```

Lists are of type List, in the previous function we declared two pointers of type List using List *pList, *pList2;

Note: The function uses RING_API_NEWTLIST to create new list instead of ring_list_new() to create the list in Temp. Memory related to the function scope. This way we can return the list from the function. Also we don't delete the list, if it's stored in a variable by Ring Code it will be saved, if not it will be automatically deleted by RingVM.

The list can contains sub lists, we used the function ring_list_newlist_gc() to create a sublist.

The function ring_list_addstring() is used to add string items to the list/sublist.

The function ring_list_adddouble() is used to add numeric items to the list/sublist.

Note: All numeric items in lists returned from RingVM extension functions must be of type double and added to the list using ring_list_adddouble() function.

We return the list from the extension function using the RING_API RETLIST() function.

98.17 Dynamic/Shared Libraries (DLL/So/Dylib) and LoadLib() function

Instead of rebuilding the RingVM after writing new functions using C/C++ and the Ring API, we can create a DLL/So/Dylib file and dynamically use the functions provided by this file in the runtime using the LoadLib() function.

Dynamic library example in C

```
#include "ring.h"

RING_DLL __declspec(dllexport)

RING_FUNC(ring_ringlib_dlfnc)
{
    printf("Message from dlfnc");
}

RING_LIBINIT
{
    RING_API_REGISTER("dlfunc", ring_ringlib_dlfnc);
}
```

the idea is to create the RING_LIBINIT function, this function will be called by the RingVM when we use the generated DLL file through the LoadLib() function.

Inside the RING_LIBINIT function we can register the module function or call a function that do the registration process for all of the module functions.

The next Ring code demonstrates how to use the DLL library during the runtime.

```
See "Dynamic DLL" + NL
LoadLib("ringlib.dll")
dlfunc()
```

Output:

Dynamic DLL
Message **from** dfunc

98.18 Using RING_API_RETMANAGEDCPOINTER()

Using RING_API_RETMANAGEDCPOINTER() the Ring extensions written in C/C++ languages can return a managed pointer to Ring. This pointer can be controlled by the Ring VM using reference counting.

This is important to avoid the need to write code that free the unmanaged resources like QPixMap objects in RingQt.

Also the Code Generator for extensions is updated to automatically use RING_API_RETMANAGEDCPOINTER() based on need.

Syntax:

```
RING_API_RETMANAGEDCPOINTER(void *pValue, const char *cPointerType,
                           void (* pFreeFunc)(void *,void *))
```

Example:

The next example from ring_qt.cpp - QPixMap Class - Scaled() Method.

```
RING_FUNC(ring_QPixmap_scaled)
{
    QPixmap *pObject ;
    if ( RING_API_PARACOUNT != 5 ) {
        RING_API_ERROR(RING_API_BADPARACOUNT) ;
        return ;
    }
    RING_API_IGNORECPOINTERTYPE ;
    if ( ! RING_API_ISCPOINTER(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE) ;
        return ;
    }
    pObject = (QPixmap *) RING_API_GETCPOINTER(1,"QPixmap") ;
    if ( ! RING_API_ISNUMBER(2) ) {
        RING_API_ERROR(RING_API_BADPARATYPE) ;
        return ;
    }
    if ( ! RING_API_ISNUMBER(3) ) {
        RING_API_ERROR(RING_API_BADPARATYPE) ;
        return ;
    }
    if ( ! RING_API_ISNUMBER(4) ) {
        RING_API_ERROR(RING_API_BADPARATYPE) ;
        return ;
    }
    if ( ! RING_API_ISNUMBER(5) ) {
        RING_API_ERROR(RING_API_BADPARATYPE) ;
        return ;
    }
    {
        QPixmap *pValue ;
```

(continues on next page)

(continued from previous page)

```

    pValue = new QPixmap() ;
    *pValue = pObject->scaled( (int ) RING_API_GETNUMBER(2),
                               (int ) RING_API_GETNUMBER(3),
                               (Qt::AspectRatioMode ) (int) RING_API_GETNUMBER(4),
                               (Qt::TransformationMode ) (int) RING_API_GETNUMBER(5));
    RING_API_RETMANAGEDCPOINTER(pValue,"QPixmap",ring_QPixmap_freefunc);
}
}

```

The function that will free the memory takes two parameters (Ring State and the allocated Memory Pointer)

Example:

```

void ring_QPixmap_freefunc(void *pState,void *pPointer)
{
    QPixmap *pObject ;
    pObject = (QPixmap *) pPointer;
    delete pObject ;
}

```

98.19 Memory Functions

Ring API provides the next functions for Memory Management

These functions uses the Memory pool provided by Ring VM

```

RING_API_MALLOC(nSize)
RING_API_CALLOC(nItems,nItemSize)
RING_API_REALLOC(pPointer,nSize)
RING_API_FREE(pPointer)
RING_API_FREEFUNC

```

- Use RING_API_MALLOC() instead of the malloc() function.
- Use RING_API_CALLOC() instead of the calloc() function.
- Use RING_API_REALLOC() instead of the realloc() function.
- Use RING_API_FREE() instead of the free() function.
- RING_API_FREEFUNC provides a function pointer to the ring_state_free() function

EMBEDDING RING LANGUAGE IN C/C++ PROGRAMS

We can use the Ring language from C/C++ programs using the next functions

```
RingState *ring_state_init();
ring_state_runcode(RingState *pState,const char *cCode);
ring_state_delete(RingState *pState);
```

99.1 Ring State

The idea is to use the ring_state_init() to create new state for the Ring Language then call the ring_state_runcode() function to execute Ring code using the same state. When we are done, we call the ring_state_delete() to free the memory.

Example:

```
#include "ring.h"
#include "stdlib.h"
int main(int argc, char *argv[])
{
    RingState *pState = ring_state_init();
    printf("welcome\n");
    ring_state_runcode(pState,"see 'hello world from the ring programming language'+nl");
    ring_state_delete(pState);
}
```

Output:

```
welcome
hello world from the ring programming language
```

99.2 Ring State Functions

The Ring API comes with the next functions to create and delete the state. Also we have functions to create new variables and get variables values.

```
RingState * ring_state_init ( void ) ;
RingState * ring_state_delete ( RingState *pRingState ) ;
void ring_state_runcode ( RingState *pRingState,const char *cStr ) ;
```

(continues on next page)

(continued from previous page)

```
List * ring_state_findvar ( RingState *pRingState, const char *cStr ) ;
List * ring_state_newvar ( RingState *pRingState, const char *cStr ) ;
void ring_state_main ( int argc, char *argv[] ) ;
int ring_state_runfile ( RingState *pRingState, const char *cFileName ) ;
void ring_state_runobjectfile ( RingState *pRingState, const char *cFileName ) ;
void ring_state_runobjectstring ( RingState *pRingState, char *cString, const char *
→*cFileName ) ;
```

99.3 Ring State Variables

We can create more than one ring state in the same program and we can create and modify variable values.

To get the variable list we can use the `ring_state_findvar()` function.

To create new variable we can use the `ring_state_newvar()` function.

Example:

```
#include "ring.h"
#include "stdlib.h"

int main(int argc, char *argv[])
{
    List *pList;

    RingState *pState = ring_state_init();
    RingState *pState2 = ring_state_init();

    printf("welcome\n");
    ring_state_runcode(pState,"see 'hello world from the ring programming language'+nl");

    printf("Again from C we will call ring code\n");
    ring_state_runcode(pState,"for x = 1 to 10 see x + nl next");

    ring_state_runcode(pState2,"for x = 1 to 5 see x + nl next");

    printf("Now we will display the x variable value from ring code\n");
    ring_state_runcode(pState,"see 'x value : ' + x + nl ");
    ring_state_runcode(pState2,"see 'x value : ' + x + nl ");

    pList = ring_state_findvar(pState,"x");

    printf("Printing Ring variable value from C , %.0f\n",
           ring_list_getdouble(pList,RING_VAR_VALUE));

    printf("now we will set the ring variable value from C\n");
    ring_list_setdouble(pList,RING_VAR_VALUE,20);

    ring_state_runcode(pState,"see 'x value after update : ' + x + nl ");

    pList = ring_state_newvar(pState,"v1");
```

(continues on next page)

(continued from previous page)

```

ring_list_setdouble(pList,RING_VAR_VALUE,10);

pList = ring_state_newvar(pState, "v2");
ring_list_setdouble(pList,RING_VAR_VALUE,20);

ring_state_runcode(pState,"see 'v1 + v2 = ' see v1+v2 see nl");

ring_state_runcode(pState,"see 'end of test' + nl");

ring_state_delete(pState);
ring_state_delete(pState2);
}

```

Output:

```

welcome
hello world from the ring programming language
Again from C we will call ring code
1
2
3
4
5
6
7
8
9
10
1
2
3
4
5
Now we will display the x variable value from ring code
x value : 11
x value : 6
Printing Ring variable value from C , 11
now we will set the ring variable value from C
x value after update : 20
v1 + v2 = 30
end of test

```

CODE GENERATOR FOR WRAPPING C/C++ LIBRARIES

In this chapter we will learn how to use the code generator to wrap C/C++ Libraries to use it in our Ring applications.

100.1 Using the tool

The code generator program is `parsec.ring` that can be executed as any ring code using the ring language.

URL : <https://github.com/ring-lang/ring/tree/master/extensions/codegen>

for example to read a configuration file called `test.cf` to generate the source code file `test.c` run `parsec.ring` as in the next command

```
ring parsec.ring test.cf test.c
```

100.2 Configuration file

The configuration file (`*.cf`) is the input file that we pass to the code generator. This file determine the functions prototypes that we need to use from a C/C++ library.

Writing configuration files is simple according to the next rules

100.3 Using the function prototype

- To generate code that wraps a C function, we just write the C function prototype

Example:

```
ALLEGRO_DISPLAY *al_create_display(int w, int h)
void al_destroy_display(ALLEGRO_DISPLAY *display)
int al_get_new_display_flags(void)
void al_set_new_display_flags(int flags)
int al_get_new_display_option(int option, int *importance)
```

The previous example will guide the code generator to generate 5 functions that wraps the `al_create_display()`, `al_destroy_display()`, `al_get_new_display_flags()`, `al_set_new_diply_flas()` and `al_get_new_display_option()` functions.

The generated code will be as in the next example

```

RING_FUNC(ring_al_create_display)
{
    if ( RING_API_PARACOUNT != 2 ) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return ;
    }
    if ( ! RING_API_ISNUMBER(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return ;
    }
    if ( ! RING_API_ISNUMBER(2) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return ;
    }
    RING_API RETCPOINTER(al_create_display( (int ) RING_API_GETNUMBER(1),
                                            (int ) RING_API_GETNUMBER(2)), "ALLEGRO_DISPLAY");
}

RING_FUNC(ring_al_destroy_display)
{
    if ( RING_API_PARACOUNT != 1 ) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return ;
    }
    if ( ! RING_API_ISPOINTER(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return ;
    }
    al_destroy_display((ALLEGRO_DISPLAY *) RING_API_GETCPOINTER(1, "ALLEGRO_DISPLAY"));
}

RING_FUNC(ring_al_get_new_display_flags)
{
    if ( RING_API_PARACOUNT != 0 ) {
        RING_API_ERROR(RING_API_BADPARACOUNT);
        return ;
    }
    RING_API RETNUMBER(al_get_new_display_flags());
}

RING_FUNC(ring_al_set_new_display_flags)
{
    if ( RING_API_PARACOUNT != 1 ) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return ;
    }
    if ( ! RING_API_ISNUMBER(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return ;
    }
}

```

(continues on next page)

(continued from previous page)

```

    al_set_new_display_flags( (int ) RING_API_GETNUMBER(1));
}

RING_FUNC(ring_al_get_new_display_option)
{
    if ( RING_API_PARACOUNT != 2 ) {
        RING_API_ERROR(RING_API_MISS2PARA);
        return ;
    }
    if ( ! RING_API_ISNUMBER(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return ;
    }
    if ( ! RING_API_ISSTRING(2) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return ;
    }
    RING_API_RETNUMBER(al_get_new_display_option( (int ) RING_API_GETNUMBER(1),
                                                RING_API_GETINTPOINTER(2)));
    RING_API_ACCEPTINTVALUE(2) ;
}

```

from the previous example we can see how much of time and effort is saved using the Code Generator.

100.4 Adding code to the generated code

- To generate code directly type it between <code> and </code>

Example :

```
<code>
    /* some C code will be written here */
</code>
```

We use this feature when we need to do something without the help of the code generator. for example including header files and defining constants using Macro.

100.5 Prefix for Functions Names

- **To determine a prefix in all of the functions names type it between <funcstart> and </funcstart>**
for example when we wrap the Allegro game programming library and we need all of the library functions to start with “al” we type the next code in the configuration file

```
<funcstart>
al
</funcstart>
```

100.6 Generate function to wrap structures

- To generate functions that wrap structures (create/delete/get structure members)

just type the structures names between <struct> and </struct> also after the structure name you can type the structure members between { } separated by comma.

Example

```
<struct>
ALLEGRO_COLOR
ALLEGRO_EVENT { type , keyboard.keycode , mouse.x , mouse.y }
</struct>
```

from the previous example we will generate two function to create/delete the structure ALLEGRO_COLOR Also we will generate two functions to create/delete the structure ALLEGRO_EVENT and four functions to get the structure ALLEGRO_EVENT members (type, keyboard.keycode, mouse.x, mouse.y).

100.7 Determine Structure Members Types

You can determine the pointer name before the structure member name.

Example:

```
SDL_Surface {flags,SDL_PixelFormat *format,w,h,pitch,void *pixels}
```

100.8 Defining Constants

You can define constants using <constant> and </constant>

The generator will generate the required functions to get the constant values

And will define the constants to be used with the same name in Ring code using *.rh file that will be generated too.

rh = Ring Header

Example:

```
<constant>
MIX_DEFAULT_FORMAT
SDL_QUIT
SDL_BUTTON_LEFT
SDL_BUTTON_MIDDLE
SDL_BUTTON_RIGHT
</constant>
```

Note: You will need to pass the *.rh file name to parsec.ring after the generated source file name.

Example:

```
ring ..\codegen\parsec.ring libsdl.cf ring_libsdl.c ring_libsdl.rh
```

100.9 Register New Functions

We can register functions by typing the function prototype between <register> and </register>. We need this feature only when we don't provide the function prototype as input directly where we need to write the code of this function.

Example:

```
<register>
void al_exit(void)
</register>

<code>
RING_FUNC(ring_al_exit)
{
    if ( RING_API_PARACOUNT != 0 ) {
        RING_API_ERROR(RING_API_BADPARACOUNT);
        return ;
    }
    exit(0);
}
</code>
```

In the previous example we register the al_exit() function. This function is not part of the Allegro Library, it's just an extra function that we need to add. Then the code if this function is written inside <code> and </code>. This function call the exit() function from the C language library.

100.10 Writing comments in the configuration file

- To type comments just type it between <comment> and </comment>

Example:

```
<comment>
configuration files
</comment>
```

100.11 Executing code during code generation

- To ask from the code generator to execute Ring code during reading the configuration file, just write the code between <runcode> and </runcode>

Example:

```
<runcode>
aNumberTypes + "al_fixed"
</runcode>
```

The previous line of code add the string "al_fixed" to the list aNumberTypes. This list contains types that can be considered as numbers when the code generator find it in the function prototype.

100.12 Enum and Numbers

We have the list aEnumTypes to use for adding each Enumeration we uses in the functions prototype.

Example:

```
<runcode>
aNumberTypes + "qreal"
aNumberTypes + " qint64"
aEnumTypes + "Qt::GestureType"
aEnumTypes + "Qt::GestureFlag"
</runcode>
```

100.13 Filtering using Expressions

using <filter> and </filter> we can include/exclude parts of the configuration file based on a condition, for example

```
<filter> iswindows()
    ... functions related to windows
</filter>
```

100.14 Constants Type

The default type for constant is Number But Some constants may be another type, for example (pointer : void *)

before using <constant> and </constant> we can use <runcode> and </runcode> to determine the constant type using two global variables used by the code generator.

The first variable is \$nDefaultConstantType which can be * C_CONSTANT_TYPE_NUMBER * C_CONSTANT_TYPE_STRING * C_CONSTANT_TYPE_POINTER

if we are using C_CONSTANT_TYPE_POINTER then we will need the second global variable which is \$cDefaultConstantPointerType to determine the pointer type.

Example :

The next example uses this feature to define constants in the FreeGLUT library

```
<runcode>
$nDefaultConstantType = C_CONSTANT_TYPE_POINTER
$cDefaultConstantPointerType = "void"
</runcode>
<constant>
    GLUT_STROKE_ROMAN
    GLUT_STROKE_MONO_ROMAN
    GLUT_BITMAP_9_BY_15
    GLUT_BITMAP_8_BY_13
    GLUT_BITMAP_TIMES_ROMAN_10
    GLUT_BITMAP_TIMES_ROMAN_24
    GLUT_BITMAP_HELVETICA_10
    GLUT_BITMAP_HELVETICA_12
```

(continues on next page)

(continued from previous page)

```
GLUT_BITMAP_HELVETICA_18
</constant>
```

100.15 Configuration file for the Allegro Library

The next configuration file enable us to use the Allegro library functions. The configuration file size is less than 1000 lines. when the code generator take this file as input the generated source code file in the C language will be 12000 lines of code!

We can see this configuration file as a complete example about using the code generator Also we can use it to know the functions that can be used from RingAllegro when you use it to create 2D games!

```
<code>
#define ALLEGRO_NO_MAGIC_MAIN

#include <allegro5/allegro.h>
#include "allegro5/allegro_image.h"
#include <allegro5/allegro_font.h>
#include <allegro5/allegro_ttf.h>
#include <allegro5/allegro_audio.h>
#include <allegro5/allegro_acodec.h>
#include <allegro5/allegro_opengl.h>
#include <allegro5/allegro_direct3d.h>
#include <allegro5/allegro_color.h>
#include <allegro5/allegro_memfile.h>
#include "allegro5/allegro_native_dialog.h"
#include <allegro5/allegro_physfs.h>
#include <allegro5/allegro_primitives.h>
</code>

<funcstart>
al
</funcstart>

<struct>
ALLEGRO_EVENT { type , keyboard.keycode , mouse.x , mouse.y }
ALLEGRO_TIMEOUT
ALLEGRO_SAMPLE_ID
ALLEGRO_COLOR
</struct>

<register>
void al_exit(void)
</register>

<code>
RING_FUNC(ring_al_exit)
{
    if ( RING_API_PARACOUNT != 0 ) {
        RING_API_ERROR(RING_API_BADPARACOUNT);
        return ;
    }
}
```

(continues on next page)

(continued from previous page)

```

    }
    exit(0);
}
</code>

int al_init(void)

<comment>
configuration files
</comment>

<runcode>
aNumberTypes + "al_fixed"
</runcode>

ALLEGRO_CONFIG *al_create_config(void)
void al_destroy_config(ALLEGRO_CONFIG *config)
ALLEGRO_CONFIG *al_load_config_file(const char *filename)
ALLEGRO_CONFIG *al_load_config_file_f(ALLEGRO_FILE *file)
bool al_save_config_file(const char *filename, const ALLEGRO_CONFIG *config)
bool al_save_config_file_f(ALLEGRO_FILE *file, const ALLEGRO_CONFIG *config)
void al_add_config_section(ALLEGRO_CONFIG *config, const char *name)

```

Note: we just provided part of the configuration file, for complete copy check the Ring source code distribution.

100.16 Threads Support

Next, another part of the configuration file, it's important because we can learn from it how to add threads to our Ring applications by using a threads library.

The idea is using ring_vm_mutexfunctions() and ring_vm_runcodefromthread() to execute Ring code.

```

<comment>
Threads
</comment>

<code>
void *al_func_thread(ALLEGRO_THREAD *thread, void *pPointer)
{
    List *pList;
    VM *pVM;
    const char *cStr;
    pList = (List *) pPointer ;
    pVM = (VM *) ring_list_getpointer(pList, 2);
    cStr = ring_list_getstring(pList, 1);
    ring_vm_runcodefromthread(pVM, cStr);
    ring_list_delete(pList);
    return NULL;
}

```

(continues on next page)

(continued from previous page)

```

RING_FUNC(ring_al_create_thread)
{
    ALLEGRO_THREAD *pThread;
    List *pList;
    if ( RING_API_PARACOUNT != 1 ) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return ;
    }
    if ( ! RING_API_ISSTRING(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return ;
    }
    pList = ring_list_new(0);
    ring_list_addstring(pList,RING_API_GETSTRING(1));
    ring_list_addpointer(pList,pPointer);
    ring_vm_mutexfunctions((VM *) pPointer,al_create_mutex,
                           al_lock_mutex,al_unlock_mutex,al_destroy_mutex);
    pThread = al_create_thread(al_func_thread, pList);
    al_start_thread(pThread);
    RING_API RETCPOINTER(pThread, "ALLEGRO_THREAD");
}

RING_FUNC(ring_al_run_detached_thread)
{
    List *pList;
    if ( RING_API_PARACOUNT != 1 ) {
        RING_API_ERROR(RING_API_MISS1PARA);
        return ;
    }
    if ( ! RING_API_ISSTRING(1) ) {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return ;
    }
    pList = ring_list_new(0);
    ring_list_addstring(pList,RING_API_GETSTRING(1));
    ring_list_addpointer(pList,pPointer);
    ring_vm_mutexfunctions((VM *) pPointer,al_create_mutex,
                           al_lock_mutex,al_unlock_mutex,al_destroy_mutex);
    al_run_detached_thread(al_func_thread, pList);
}
</code>

<register>
ALLEGRO_THREAD *al_create_thread(void)
void al_run_detached_thread(void)
</register>

void al_start_thread(ALLEGRO_THREAD *thread)
void al_join_thread(ALLEGRO_THREAD *thread, void **ret_value)
void al_set_thread_should_stop(ALLEGRO_THREAD *thread)
bool al_get_thread_should_stop(ALLEGRO_THREAD *thread)

```

(continues on next page)

(continued from previous page)

```

void al_destroy_thread(ALLEGRO_THREAD *thread)
ALLEGRO_MUTEX *al_create_mutex(void)
ALLEGRO_MUTEX *al_create_mutex_recursive(void)
void al_lock_mutex(ALLEGRO_MUTEX *mutex)
void al_unlock_mutex(ALLEGRO_MUTEX *mutex)
void al_destroy_mutex(ALLEGRO_MUTEX *mutex)
ALLEGRO_COND *al_create_cond(void)
void al_destroy_cond(ALLEGRO_COND *cond)
void al_wait_cond(ALLEGRO_COND *cond, ALLEGRO_MUTEX *mutex)

```

100.17 Code Generator Rules for Wrapping C++ Classes

- We can define classes between <class> and </class>
- Between <class> and <class> we set attributes like “name, nonew, para, parent, codename, passvmpointer, abstract and staticmethods”
- we set the attributes using the style attributename:value or attributename only if no values are required
- The “name” attribute determine the class name in C++ code and this name will be the default name in the Ring code
- The nonew instruction means that we don’t need new/delete methods
- The parent attribute determine the parent class name
- The codename attribute determine another class name in C++ code
- The passvmpoint instruction means passing the Ring VM pointer to the class constructor when we create new objects, this happens when we set the codename attribute to a class that we will define and this class need the Virtual Machine pointer (for example to use it to execute Ring code from C++ code).
- The abstract instruction means that no new method is required for this class “no objects will be created”.
- The staticmethods instruction means that method doesn’t need an object to be called.
- Using <nodllstartup> we can avoid #include “ring.h”, We need this to write our startup code.
- Using <libinitfunc> we can change the function name that register the library functions
- Using <ignorecpointerype> we can ignore pointer type check
- Using the aStringTypes list when can defined new types that treated like const char *
- Using the aBeforeReturn list when can define code that is inserted after the variable name when we return that variable from a function
- Using the aNewMethodName list we can define another method name to be used in Ring code when we call the C++ method. this feature is required because some C++ method may be identical to Ring Keywords like “load”, “next”, “end” and “done”.
- in method prototype - when we use @ in the method name, we mean that we have the same method with different parameters (As in C++)

100.18 Using configuration file that wrap C++ Library

To run the code generator to generate code for using C++ library in the Ring application, we can do that as we did with using C libraries but here we will generate *.cpp file instead of *.c file*. *Also we will determine another file to be generated (.ring)*. This file will contains classes in Ring code that wraps C++ functions for using C++ classes and objects.

```
ring parsec.ring generator\qt.cf ring_qt.cpp ring_qt.ring
```

100.19 Configuration file for the Qt Framework

The next configuration file is used to wrap many Qt classes. The configuration file is around 3500 lines and generate C++ code around 56000 lines and generate also Ring code around 9000 lines.

```
<nodllstartup>

<libinitfunc> ring_qt_start

<ignorecpointertype>

<code>

extern "C" {
    #include "ring.h"
}

#include "ring_qt.h"
#include "gpushbutton.h"
#include "gaction.h"
#include "glineedit.h"
#include "gtextedit.h"
#include "glistwidget.h"
#include "gtreeview.h"
#include "gtreewidget.h"
#include "gcombobox.h"
#include "gtabwidget.h"
#include "gtablewidget.h"
#include "gprogressbar.h"
#include "gspinbox.h"
#include "gslider.h"
#include "gdial.h"
#include "gwebview.h"
#include "gcheckbox.h"
#include "gradiobutton.h"
#include "gbuttongroup.h"
#include "gvideowidget.h"
#include "gtimer.h"
#include "gtcpserver.h"
#include "giodevice.h"
#include "gabstractsocket.h"
#include "gtcpsocket.h"
```

(continues on next page)

(continued from previous page)

```
#include "gcolordialog.h"
#include "gallevents.h"
#include <QApplication>
#include <QObject>
#include <QWidget>
#include <QLabel>
#include <QPixmap>
#include <QIcon>
#include <QSize>
#include <QPushButton>
#include <QMainWindow>
#include <QVBoxLayout>
#include <QHBoxLayout>
#include <QLineEdit>
#include <QTextEdit>
#include <QListWidget>
#include <QTreeView>
#include <QDir>
#include <QFileSystemModel>
#include <QTreeWidget>
#include <QTreeWidgetItem>
#include <QComboBox>
#include <QVariant>
#include <QMenuBar>
#include <QMenu>
#include <QToolBar>
#include <QMainWindow>
#include <QStatusBar>
#include <QDockWidget>
#include <QTabWidget>
#include <QTableWidget>
#include <QTableWidgetItem>
#include <QSizePolicy>
#include <QFrame>
#include <QAbstractScrollArea>
#include <QAbstractItemView>
#include <QProgressBar>
#include <QSpinBox>
#include <QSlider>
#include <QAbstractSlider>
#include <QDateEdit>
#include <QDateTimeEdit>
#include <QAbstractSpinBox>
#include <QDial>
#include <QWebView>
#include <QUrl>
#include <QCheckBox>
#include <QRadioButton>
#include <QButtonGroup>
#include <QMediaPlayer>
#include <QMediaPlaylist>
#include <QVideoWidget>
```

(continues on next page)

(continued from previous page)

```

#include <QPrinter>
#include <QAction>
#include <QEvent>
#include <QMessageBox>
#include <QTimer>
#include <QFileDialog>
#include <QPainter>
#include <QPicture>
#include <QPen>
#include <QColor>
#include <QPrinter>
#include <QFont>
#include <QWebSettings>
#include <QBrush>
#include <QByteArray>
#include <QIODevice>
#include <QAbstractSocket>
#include <QTcpSocket>
#include <QTcpServer>
#include <QNetworkProxy>
#include <QHostAddress>
#include <QHostInfo>
#include <QList>
#include <QFileInfo>
#include <QDirModel>
#include <QModelIndex>
#include <QFileDialog>
#include <QDialog>
#include <QTextCursor>
#include <QTextBlock>
#include <QTextDocumentFragment>
#include <QColorDialog>
#include <QHeaderView>
#include <QStringList>
#include <QKeySequence>
#include <QLCDNumber>
#include <QInputDialog>
#include <QDesktopWidget>
#include <QRect>
#include <QTextDocument>

extern "C" {

    #define RING_DLL __declspec(dllexport)

    RING_DLL void ringlib_init(RingState *pRingState)
    {
        new QApplication(pRingState->nArgc,pRingState->pArgv);
        ring_qt_start(pRingState) ;
    }
}

```

(continues on next page)

(continued from previous page)

```

}

</code>

<runcode>
aStringTypes + "QString"
aBeforeReturn + ["QString", ".toStdString().c_str()"]
aNewMethodName + ["QWebView", "load", "loadpage"]
aNewMethodName + ["QMediaPlaylist", "load", "loadfile"]
aNewMethodName + ["QMediaPlaylist", "next", "movenext"]
aNewMethodName + ["QPainter", "end", "endpaint"]
aNewMethodName + ["QPicture", "load", "loadfile"]
aNewMethodName + ["QLineEdit", "end", "endtext"]
aNewMethodName + ["QDialog", "done", "donedialog"]
aNewMethodName + ["QTextDocument", "end", "enddoc"]
aNewMethodName + ["QTextBlock", "next", "nextblock"]
</runcode>

<class>
name: qApp
nonew
</class>

<register>
void exec(void)
void quit(void)
void processEvents(void)
</register>

<code>

RING_FUNC(ring_qApp_quit)
{
    qApp->quit();
}

RING_FUNC(ring_qApp_exec)
{
    qApp->exec();
}

RING_FUNC(ring_qApp_processEvents)
{
    qApp->processEvents();
}

</code>

<class>
name: QObject
para: void
</class>

```

(continues on next page)

(continued from previous page)

```
bool blockSignals(bool block)
QObjectList children(void)
void dumpObjectInfo(void)
void dumpObjectTree(void)
bool inherits(const char *className)
void installEventFilter(QObject *filterObj)
bool isWidgetType(void)
void killTimer(int id)
void moveToThread(QThread *targetThread)
QString objectName(void)
QObject *parent(void)
QVariant property(const char *name)
void removeEventFilter(QObject *obj)
void setObjectName(QString)
void setParent(QObject *parent)
boolsetProperty(const char *name, QVariant)
bool signalsBlocked(void)
int startTimer(int interval)
QThread *thread(void)
void deleteLater(void)

<class>
name: QWidget
para: void
parent: QObject
</class>

bool acceptDrops(void)
QString accessibleDescription(void)
QString accessibleName(void)
void activateWindow(void)
void addAction(QAction *action)
void adjustSize(void)
bool autoFillBackground(void)
int backgroundRole(void)
QSize baseSize(void)
QWidget *childAt(int x, int y)
QRect childrenRect(void)
QRegion childrenRegion(void)
void clearFocus(void)
void clearMask(void)
QMargins contentsMargins(void)
QRect contentsRect(void)
int contextMenuPolicy(void)
QCursor cursor(void)
int effectiveWinId(void)
void ensurePolished(void)
int focusPolicy(void)
QWidget *focusProxy(void)
QWidget *focusWidget(void)
QFont font(void)
```

(continues on next page)

(continued from previous page)

```

QFontInfo fontInfo(void)
QFontMetrics fontMetrics(void)
int foregroundRole(void)
 QRect frameGeometry(void)
 QSize frameSize(void)
 QRect geometry(void)
 void getContentsMargins(int *left, int *top, int *right, int *bottom)
 void grabGesture(int gesture, int flags)
 void grabKeyboard(void)
 void grabMouse(void)
 int grabShortcut(QKeySequence , int context)
 QGraphicsEffect *graphicsEffect(void)
 QGraphicsProxyWidget *graphicsProxyWidget(void)
 bool hasFocus(void)
 bool hasMouseTracking(void)
 int height(void)
 int heightForWidth(int w)
 int inputMethodHints(void)
 QVariant inputMethodQuery(int query)
 void insertAction(QAction *before, QAction *action)
 bool isActiveWindow(void)
 bool isAncestorOf(QWidget *child)
 bool isEnabled(void)
 bool isEnabledTo(QWidget *ancestor)
 bool isFullScreen(void)
 bool isHidden(void)
 bool isMaximized(void)
 bool isMinimized(void)
 bool isModal(void)
 bool isVisible(void)
 bool isVisibleTo(QWidget *ancestor)
 bool isWindow(void)
 bool isWindowModified(void)
 QLayout *layout(void)
 int layoutDirection(void)
 QLocale locale(void)
 QPoint mapFrom(QWidget *parent, QPoint)
 QPoint mapFromGlobal(QPoint)
 QPoint mapFromParent(QPoint)
 QPoint mapTo(QWidget *parent, QPoint)
 QPoint mapToGlobal(QPoint pos)
 QPoint mapToParent(QPoint pos)
 QRegion mask(void)
 int maximumHeight(void)
 QSize maximumSize(void)
 int maximumWidth(void)
 int minimumHeight(void)
 QSize minimumSize(void)
 int minimumWidth(void)
 void move(int x, int y)
 QWidget *nativeParentWidget(void)
 QWidget *nextInFocusChain(void)

```

(continues on next page)

(continued from previous page)

```
QRect normalGeometry(void)
void overrideWindowFlags(int flags)
QPalette palette(void)
QWidget *parentWidget(void)
QPoint pos(void)
QWidget *previousInFocusChain(void)
QRect rect(void)
void releaseKeyboard(void)
void releaseMouse(void)
void releaseShortcut(int id)
void removeAction(QAction *action)
void render(QPaintDevice *target, QPoint, QRegion, int)
void repaint(int x, int y, int w, int h)
void resize(int w, int h)
bool restoreGeometry(QByteArray)
QByteArray saveGeometry(void)
void scroll(int dx, int dy)
void setAcceptDrops(bool on)
void setAccessibleDescription(QString)
void setAccessibleName(QString)
void setAttribute(int attribute, bool on)
void setAutoFillBackground(bool enabled)
void setBackgroundRole(int role)
void setBaseSize(int basew, int baseh)
void setContentsMargins(int left, int top, int right, int bottom)
void setContextMenuPolicy(int policy)
void setCursor(QCursor)
void setFixedHeight(int h)
void setFixedSize(int w, int h)
void setFixedWidth(int w)
void setFocus(int reason)
void setFocusPolicy(int policy)
void setFocusProxy(QWidget *w)
void setFont(QFont)
void setForegroundRole(int role)
void setGeometry(int x, int y, int w, int h)
void setGraphicsEffect(QGraphicsEffect *effect)
void setInputMethodHints(int hints)
void setLayout(QLayout *layout)
void setLayoutDirection(int direction)
void setLocale(QLocale)
void setMask(QBitmap)
void setMaximumHeight(int maxh)
void setMaximumSize(int maxw, int maxh)
void setMaximumWidth(int maxw)
void setMinimumHeight(int minh)
void setMinimumSize(int minw, int minh)
void setMinimumWidth(int minw)
void setMouseTracking(bool enable)
void setPalette(QPalette)
void setParent(QWidget *parent)
void setShortcutAutoRepeat(int id, bool enable)
```

(continues on next page)

(continued from previous page)

```
void setShortcutEnabled(int id, bool enable)
void setSizeIncrement(int w, int h)
void setSizePolicy(int horizontal, int vertical)
void setStatusTip(QString)
void setStyle(QStyle *style)
void setToolTip(QString)
void setUpdatesEnabled(bool enable)
void setWhatsThis(QString)
void setWindowFilePath(QString)
void setWindowFlags(int type)
void setWindowIcon(QIcon)
void setWindowIconText(QString)
void setWindowModality(int windowModality)
void setWindowOpacity(double level)
void setWindowRole(QString)
void setWindowState(int windowState)
QSize size(void)
QSize sizeIncrement(void)
QSizePolicy sizePolicy(void)
void stackUnder(QWidget *w)
QString statusTip(void)
QStyle *style(void)
QString styleSheet(void)
bool testAttribute(int attribute)
QString toolTip(void)
bool underMouse(void)
void ungrabGesture(int gesture)
void unsetCursor(void)
void unsetLayoutDirection(void)
void unsetLocale(void)
void update(int x, int y, int w, int h)
void updateGeometry(void)
bool updatesEnabled(void)
QRegion visibleRegion(void)
QString whatsThis(void)
int width(void)
int winId(void)
QWidget *window(void)
QString windowFilePath(void)
int windowFlags(void)
QIcon windowIcon(void)
QString windowIconText(void)
int windowModality(void)
double windowOpacity(void)
QString windowRole(void)
int windowState(void)
QString windowTitle(void)
int windowType(void)
int x(void)
int y(void)
bool close(void)
void hide(void)
```

(continues on next page)

(continued from previous page)

```

void lower(void)
void raise(void)
void setDisabled(bool disable)
void setEnabled(bool)
void setHidden(bool hidden)
void setStyleSheet(QString)
void setWindowModified(bool)
void setWindowTitle(QString)
void show(void)
void showFullScreen(void)
void showMaximized(void)
void showMinimized(void)
void showNormal(void)
QWidget *find(int id)
QWidget *keyboardGrabber(void)
QWidget *mouseGrabber(void)
void setTabOrder(QWidget *first, QWidget *second)

<class>
name: QLabel
para: QWidget *
parent: QWidget
</class>

int alignment(void)
QWidget *buddy(void)
bool hasScaledContents(void)
bool hasSelectedText(void)
int indent(void)
int margin(void)
QMovie *movie(void)
bool openExternalLinks(void)
QPicture *picture(void)
QPixmap * pixmap(void)
QString selectedText(void)
int selectionStart(void)
void setAlignment(int)
void setBuddy(QWidget *buddy)
void setIndent(int)
void setMargin(int)
void setOpenExternalLinks(bool open)
void setScaledContents(bool)
void setSelection(int start, int length)
void setTextFormat(int)
void setTextInteractionFlags(int flags)
void setWordWrap(bool on)
QString text(void)
int textFormat(void)
int textInteractionFlags(void)
bool wordWrap(void)
void clear(void)
void setMovie(QMovie *movie)

```

(continues on next page)

(continued from previous page)

```

void setNum(double num)
void setPicture(QPicture)
void setPixmap(QPixmap)
void setText(QString)

<class>
name: QPushButton
para: QWidget *
parent: QWidget
codename: GPushButton
passvmpointer
</class>

void setText(const char *)
void setClickEvent(const char *)
void setIcon(QIcon)
void setIconSize(QSize)

<class>
name: QLineEdit
para: QWidget *
parent: QWidget
codename: GLineEdit
passvmpointer
</class>

int alignment(void)
void backspace(void)
QCompleter *completer(void)
QMenu *createStandardContextMenu(void)
void cursorBackward(bool mark, int steps)
void cursorForward(bool mark, int steps)
int cursorMoveStyle(void)
int cursorPosition(void)
int cursorPositionAt(QPoint)
void cursorWordBackward(bool mark)
void cursorWordForward(bool mark)
void del(void)
void deselect(void)
QString displayText(void)
bool dragEnabled(void)
int echoMode(void)
void end(bool mark)
void getTextMargins(int *left, int *top, int *right, int *bottom)
bool hasAcceptableInput(void)
bool hasFrame(void)
bool hasSelectedText(void)
void home(bool mark)
QString inputMask(void)
void insert(QString)
bool isModified(void)
bool isReadOnly(void)

```

(continues on next page)

(continued from previous page)

```
bool isRedoAvailable(void)
bool isUndoAvailable(void)
int maxLength(void)
QString placeholderText(void)
QString selectedText(void)
int selectionStart(void)
void setAlignment(int flag)
void setCompleter(QCompleter *c)
void setCursorMoveStyle(int style)
void setCursorPosition(int)
void setDragEnabled(bool b)
void setEchoMode(int)
void setFrame(bool)
void setInputMask(QString)
void setMaxLength(int)
void setModified(bool)
void setPlaceholderText(QString)
void setReadOnly(bool)
void setSelection(int start, int length)
void setTextMargins(int left, int top, int right, int bottom)
void setValidator(QValidator *v)
QString text(void)
QMargins textMargins(void)
QValidator *validator(void)

void clear(void)
void copy(void)
void cut(void)
void paste(void)
void redo(void)
void selectAll(void)
void setText(QString)
void undo(void)

void setTextChangedEvent(const char *)
void setcursorPositionChangedEvent(const char *)
void seteditingFinishedEvent(const char *)
void setreturnPressedEvent(const char *)
void setselectionChangedEvent(const char *)
void settextEditedEvent(const char *)
```

Note: Most of the content of the previous configuration file is removed from this documentation, for a complete version see the Ring source code distribution.

100.20 Static Methods

Starting from Ring 1.8 the code generator support the staticmethods option.

So the code generator can know that the class doesn't need an object to call the methods.

Example:

```
<class>
name: QStandardPaths
para: void
nonew
staticmethods
</class>

QString displayName(QStandardPaths::StandardLocation type)
QString findExecutable(QString executableName, QStringList paths))
```

100.21 Loading Files

Starting from Ring 1.9 the code generator support the <loadfile> command.

```
<loadfile> filename.cf
```

This is useful to separate the extension configuration file to many files

Example:

The file : qt_module_network.cf in the RingQt Extension

```
<comment>
                                Module (network)
</comment>

<loadfile> qabstractsocket.cf
<loadfile> qnetworkproxy.cf
<loadfile> qtcpsocket.cf
<loadfile> qtcpserver.cf
<loadfile> qhostaddress.cf
<loadfile> qhostinfo.cf
<loadfile> qnetworkrequest.cf
<loadfile> qnetworkaccessmanager.cf
<loadfile> qnetworkreply.cf
```

100.22 Managed Classes

Starting from Ring 1.9 the code generator support the <managed> option when defining classes.

Using this option, the generator will use RING_API_RETMANAGEDCPOINTER() to return the C pointer.

So the Garbage Collector will manage these C pointers.

Example

```
<class>
name: QFont
para: QString, int, int, bool
managed
</class>
```

100.23 Extra names for functions

Starting from Ring 1.19

The code generator is updated and support defining extra names for functions

Using the predefined list (aExtraFunctionName) we can define the extra names

Example:

To define vec2() as another name for raylib_new_managed_vector2()

```
<runcode>
aExtraFunctionName + ["vec2","raylib_new_managed_vector2"]
aExtraFunctionName + ["vec2setx","raylib_set_vector2_x"]
aExtraFunctionName + ["vec2sety","raylib_set_vector2_y"]
</runcode>
```

100.24 Configuration Files Examples

You can learn from the next examples

- RingAllegro : <https://github.com/ring-lang/ring/blob/master/extensions/ringallegro/allegro.cf>
- RingQt : <https://github.com/ring-lang/ring/blob/master/extensions/ringqt/classes/qt.cf>
- RingLibSDL : <https://github.com/ring-lang/ring/blob/master/extensions/ringsdl/libsdl.cf>

After modifying the configuration file, You will need to generate the code, You can learn from the next examples

- RingAllegro : <https://github.com/ring-lang/ring/blob/master/extensions/ringallegro/gencode.bat>
- RingQt : <https://github.com/ring-lang/ring/blob/master/extensions/ringqt/gencode.bat>
- RingLibSDL : <https://github.com/ring-lang/ring/blob/master/extensions/ringsdl/gencode.bat>

After generating the code, You will need to build the library, You can learn from the next examples

- RingAllegro : <https://github.com/ring-lang/ring/blob/master/extensions/ringallegro/buildvc.bat>
- RingQt : <https://github.com/ring-lang/ring/blob/master/extensions/ringqt/buildmingw32.bat>

- RingLibSDL : <https://github.com/ring-lang/ring/blob/master/extensions/ringsdl/buildvc.bat>

**CHAPTER
ONE**

CREATE YOUR FIRST EXTENSION

In this chapter we will create RingBeep

RingBeep is a simple extension for the beep() function in Windows API

Just a simple example about creating extensions

101.1 Location

You will find this extension in the ring/extensions/ringbeep folder

101.2 Steps to create the extension

At first we write the configuration file in : ringbeep.cf

```
notepad ringbeep.cf
```

The file ringbeep.cf contains

```
<code>
#include "windows.h"
</code>

int Beep(int dwFreq,int dwDuration)
```

Then we run : gencode.bat to generate ringbeep.c

```
gencode.bat
```

The gencode.bat contains the next command to call Ring Extensions Generator

```
ring ..\codegen\parsec.ring ringbeep.cf ringbeep.c
```

Then we build the extension using :

```
buildvc.bat
```

The file buildvc.bat contains the next commands to build the extension using Visual C/C++

```
cls
call ../../src/locatevc.bat
cl /c /DEBUG ringbeep.c -I"..\..\include"
link /DEBUG ringbeep.obj  ..\..\lib\ring.lib kernel32.lib /DLL /OUT:ringbeep.dll ^
/SUBSYSTEM:CONSOLE,"5.01"
del ringbeep.obj
```

101.3 Testing the extension

Then we test the function using

```
ring test.ring
```

The file test.ring contains

```
loadlib("ringbeep.dll")

for f = 750 to 1000 step 50
    beep(f,300)
next
```

USING RING FOR RASPBERRY PI PICO MICROCONTROLLER

In this chapter we will learn about Using Ring for Raspberry Pi Pico Microcontroller.

This extension is added to the Ring language starting from Ring 1.21.

Using this extension We can write Ring programs that runs on the RP2040 Microcontroller

Extension folder: ring/extensions/microcontroller/ringpico

Contents:

- Install
- Programming
- Building
- Deployment
- Blink sample
- LEDs sample
- LED and Switch sample
- Declarative Programming sample
- Using Wokwi Simulator

102.1 Install

- Install Ring 1.21 (Required to compile the Ring program in the Building step)
- Install Pico-SDK from: <https://github.com/raspberrypi/pico-setup-windows>
- Update config.bat to point to the Pico-SDK folder on your computer

102.2 Programming

- Samples exist in the (ring/extensions/microcontroller/ringpico/projects) folder
- You can create a sub folder for your project in the (projects) folder
- You can update the (ring/extensions/microcontroller/ringpico/main.ring) file to load your project

102.3 Building

To build your project, just run the build.bat file

102.4 Deployment

- Connect Raspberry Pi Pico to your computer while pressing on the BOOTSEL button.
- Keep pressing the BOOTSEL button until you see the File Explorer window.
- Run the deploy.bat file which will copy the ringpico.uf2 file to the device

102.5 Blink sample

```
DELAY    = 100
LED_PIN = PICO_DEFAULT_LED_PIN

gpio_init(LED_PIN)
gpio_set_dir(LED_PIN, GPIO_OUT)

while True
    gpio_put(LED_PIN, True)
    sleep_ms(DELAY)
    gpio_put(LED_PIN, False)
    sleep_ms(DELAY)
end
```

102.6 LEDs sample

```
DELAY    = 100
LED_PIN = PICO_DEFAULT_LED_PIN
LED1    = 14
LED2    = 15

aPins = [LED_PIN, LED1, LED2]

for nPin in aPins
    gpio_init(nPin)
    gpio_set_dir(nPin, GPIO_OUT)
next

while True
    gpio_put(LED_PIN, True)           sleep_ms(DELAY)
    gpio_put(LED1, True)             gpio_put(LED2, False) sleep_ms(DELAY)
    gpio_put(LED1, False)            gpio_put(LED2, True)  sleep_ms(DELAY)
    gpio_put(LED_PIN, False)         sleep_ms(DELAY)
end
```

102.7 LED and Switch sample

File: main.ring

```
load "mylib.ring"

SWITCH_PIN = 14
LED_PIN    = 15

func main

    oSwitch = new LEDSwitch {
        setPin(SWITCH_PIN)
        LED { setPin(LED_PIN) }
    }

    while True
        oSwitch.process()
    end
```

File: mylib.ring

```
class LED

    Pin

    func setPin nPin
        Pin = nPin
        gpio_init(Pin)
        gpio_set_dir(Pin,GPIO_OUT)

    func Enable
        gpio_put(Pin,True)

    func Disable
        gpio_put(Pin,False)

class LEDSwitch

    Pin
    Status = False
    LED = new LED

    func setPin nPin
        Pin = nPin
        gpio_init(Pin)
        gpio_pull_up(Pin)

    func getStatus
        return gpio_get(Pin)

    func Process
        if ! getStatus()
```

(continues on next page)

(continued from previous page)

```

Status = ! Status
if Status
    LED.enable()
else
    LED.disable()
ok
sleep_ms(30)
while ! getStatus() end
sleep_ms(30)
ok

```

102.8 Declarative Programming sample

File: main.ring

```

load "circuit.ring"

SWITCH_PIN = 14
LED_PIN     = 15

func main

    Circuit {
        LED {
            Pin      = PICO_DEFAULT_LED_PIN
            Blink   = True
            Delay   = 0.1
        }
        LEDSwitch {
            Pin = SWITCH_PIN
            LED {
                Pin      = LED_PIN
                Blink   = True
                Delay   = 3
            }
        }
    }
}

```

File: Circuit.ring

```

circuit = new Circuit

class Circuit

    LED
    LEDSwitch

    aObjects = []

    lCallBraceEnd = True

```

(continues on next page)

(continued from previous page)

```

func getLED
    aObjects + new LED
    return aObjects[len(aObjects)]


func getLEDSwitch
    aObjects + new LEDSwitch
    return aObjects[len(aObjects)]


func braceEnd
    if ! lCallBraceEnd return ok
    lCallBraceEnd = False
    while True
        for oObj in aObjects
            oObj.process()
        next
    end

class CircuitComponent

    func process


class LED from CircuitComponent

    Pin

    Delay = 1
    Blink = False
    t1 = clock()

    lStatus = False
    lCallBraceEnd = True
    lEnableProcess = True

    func setPin nPin
        Pin = nPin
        gpio_init(Pin)
        gpio_set_dir(Pin,GPIO_OUT)

    func Enable
        lStatus = True
        gpio_put(Pin,True)

    func Disable
        lStatus = False
        gpio_put(Pin,False)

    func braceEnd
        if ! lCallBraceEnd return ok
        enable()

    func process

```

(continues on next page)

(continued from previous page)

```

if ! lEnableProcess return ok
if Blink and ( ((clock()-t1)/clocksperssecond()) > Delay )
    lStatus = ! lStatus
    gpio_put(Pin,lStatus)
    t1 = clock()
ok

class LEDSwitch from CircuitComponent

Pin
Status = False

LED = new LED { lCallBraceEnd = False lEnableProcess = False }

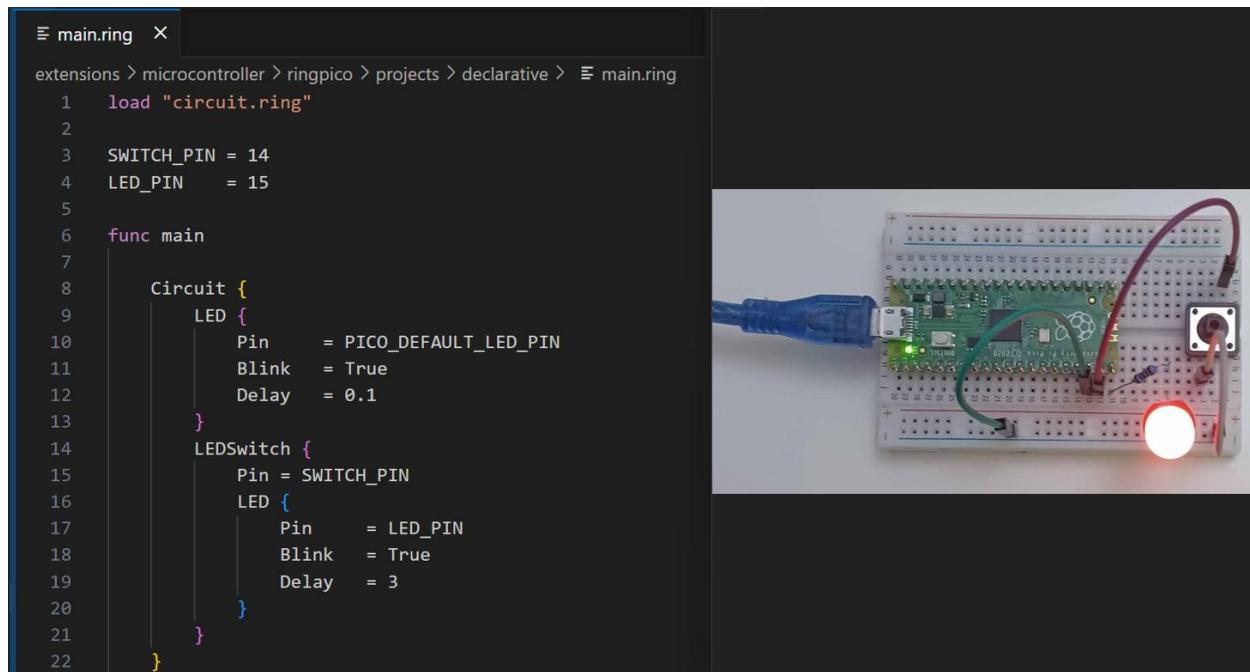
func setPin nPin
    Pin = nPin
    gpio_init(Pin)
    gpio_pull_up(Pin)

func getStatus
    return gpio_get(Pin)

func Process
    LED.process()
    if ! getStatus()
        Status = ! Status
        if Status
            LED.enable()
        else
            LED.disable()
    ok
    LED.t1 = clock()
    LED.lEnableProcess = Status
    sleep_ms(30)
    while ! getStatus() end
    sleep_ms(30)
ok

```

Screen Shot:



102.9 Using Wokwi Simulator

Using this simulator, We can test RingPico programs without the need to use real hardware.

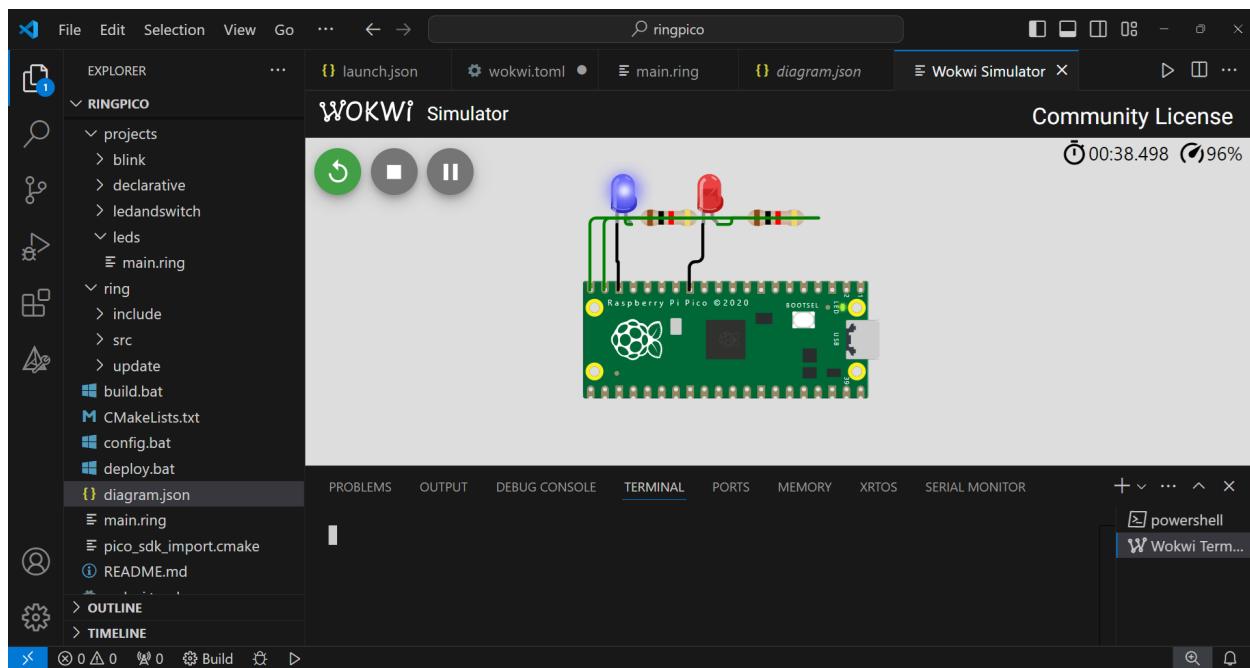
Steps:

- Update `main.ring` to use the LEDs project

```
load "projects/leds/main.ring"
```

- Build the project using `build.bat`
- Install Visual Studio Code
- Install Wokwi Simulator extension
- Open the folder `ring/extensions/microcontroller/ringpico` using VS Code
- Run the project using the Simulator (Press F1 then select Wokwi: Start Simulator)

Screen Shot:



LANGUAGE DESIGN

In this chapter we will learn about the basic concepts behind the language design.

103.1 Why Ring?

The language is simple, trying to be natural, encourage organization and comes with transparent and visual implementation. It comes with compact syntax and a group of features that enable the programmer to create natural interfaces and declarative domain-specific languages in a fraction of time. It is very small, fast and comes with smart garbage collector that puts the memory under the programmer control. It supports many programming paradigms, comes with useful and practical libraries. The language is designed for productivity and developing high quality solutions that can scale.

103.2 Designed for a Clear Goal

- Applications programming language.
- Productivity and developing high quality solutions that can scale.
- Small and fast language that can be embedded in C/C++ projects.
- Simple language that can be used in education and introducing Compiler/VM concepts.
- General-Purpose language that can be used for creating domain-specific libraries, frameworks and tools.
- Practical language designed for creating the next version of the Programming Without Coding Technology software.

103.3 Simple

Ring is a very simple language, and has a very straightforward syntax. It encourages programmers to program without boilerplate code

See "Hello, World!"

The Main function is optional and will be executed after the statements, and is useful for using the local scope.

Func Main
See "Hello, World!"

Uses Dynamic Typing and Lexical scoping. No \$ is required before the variable name! You can use the ‘+’ operator for string concatenation and the language is weakly typed and will convert automatically between numbers and strings based on the context.

```
nCount = 10      # Global variable
Func Main
    nID = 1 # Local variable
    See "Count = " + nCount + nl + " ID = " + nID
```

103.4 Trying to be natural

Ring is not case-sensitive

```
See "Enter your name ? "
Give name
See "Hello " + Name      # Name is the same as name
```

The list index starts from 1

```
aList = ["one", "two", "three"]
See aList[1]      # print one
```

Call functions before definition

```
one()
two()
three()
Func one
    See "One" + nl
Func two
    See "two" + nl
Func three
    See "three" + nl
```

The assignment operator uses Deep copy (no references in this operation)

```
aList = ["one", "two", "three"]
aList2 = aList
aList[1] = 1
see alist[1]      # print 1
see aList2[1]      # print one
```

Pass numbers and strings by value, but pass lists and objects by reference. The for in loop can update the list items.

```
Func Main
    aList = [1,2,3]
    update(aList)
    see aList      # print one two three

Func update aList
    for x in aList
        switch x
```

(continues on next page)

(continued from previous page)

```

on 1 x = "one"
on 2 x = "two"
on 3 x = "three"
off
next

```

Using Lists during definition

```

aList = [ [1,2,3,4,5] , aList[1] , aList[1] ]
see aList      # print 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5

```

Exit from more than one loop

```

for x = 1 to 10
    for y = 1 to 10
        see "x=" + x + " y=" + y + nl
        if x = 3 and y = 5
            exit 2      # exit from 2 loops
        ok
    next
next

```

103.5 Encourage Organization

The language encourage organization, Forget bad days using languages where the programmer start with function then class then function and a strange mix between things!

Each source file follow the next structure

- Load Files
- Statements and Global Variables
- Functions
- Packages and Classes

This enable us to use Packages, Classes and Functions without the need to use a keyword to end these components.

We can write one line comments and multi-line comments The comment starts with # or // Multi-line comments are written between /* and */

```

/*
    Program Name : My first program using Ring
    Date        : 2015.05.08
*/

See "What is your name? "          # print message on screen
give cName                         # get input from the user
see "Hello " + cName               # say hello!

// See "Bye!"

```

103.6 Data Representation

Ring contains only 4 types that represent the program data

These types are (String, Number, List & Object)

The idea is to have many use cases for each type which increase the flexibility and the ability to write functions that are more usable in different situations.

The String type is used to represent:

- * One character
- * A string of many characters
- * Multi-line string
- * Binary Data

```
cStr1 = "a"                                # One character
cStr2 = "Hello, World!"                      # A string of many characters
cStr3 = "Hello
Welcome to the Ring language!
"                                         # Multi-line string
cStr4 = read(EXEFileName())                  # Read executable file (Binary Data)
```

The Number type is used to represent

- * Boolean Values
- * Signed/Unsigned Integers
- * Float/Double

```
nNum1 = True                                # Boolean Value (1)
nNum2 = False                               # Boolean Value (0)
nNum3 = 10                                   # Integer
nNum4 = -10                                  # Signed Integer
nNum5 = 1250.11                             # Float/Double
```

The List type is used instead of

- * One Dimension Arrays
- * Multi-Dimension Arrays
- * Lists of multiple types
- * Nested Lists
- * Hash Tables (Key & Value)
- * Tree
- * Wrapper around a C Pointer

```
aList1 = ["one", "two", "three"]                # Strings
aList2 = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]       # Numbers
aList3 = ["Ring", 1234]                         # Multiple types
aList4 = [["Fayed", "Egypt"], ["Mansour", "Tunisia"]] # Nested Lists
aList5 = [ :name = "Fayed", :country = "Egypt"]   # Hash Tables
```

The Object type is used to represent objects created from classes

Using classes and operator overloading we can create custom types

103.7 Compact Syntax

The language is not line sensitive, you don't need to write ; after statements, also you don't need to press ENTER or TAB, so we can write the next code

```
See "The First Message" See " Another message in the same line! " + nl
See "Enter your name?" Give Name See "Hello " + Name
```

The next code create a class called Point contains three attributes X,Y and Z. No keywords is used to end the package/class/function definition. Also, we can write the attributes names directly below the class name.

```
Class Point X Y Z
```

We can use classes and functions before their definition, In this example we will create new object, set the object attributes then print the object values.

```
o1 = New point o1.x=10 o1.y=20 o1.z=30 See 01 Class Point X Y Z
```

Instead of using the dot `.` operator to access the object attributes and methods we can use braces `{ }` to access the object, then we can use the object attributes and methods.

```
o1 = New point { x=10 y=20 z=30 } See 01 Class Point X Y Z
```

Now we will call a method after accessing the object using ` { }`

```
oPerson = new Person
{
    Name = "Somebody"
    Address = "Somewhere"
    Phone = "0000000"
    Print() # here we call the Print() method
}
Class Person Name Address Phone
Func Print
    See "Name :" + name + nl +
        "Address :" + Address + nl +
        "Phone : " + phone + nl
```

When we use ` { }` to access the object then write any attribute name, the language will check the class for any setter/getter methods that will be called automatically.

```
New Number {
    See one      # Execute GetOne()
    See two      # Execute GetTwo()
    See three    # Execute GetThree()
}
Class Number one two three
Func GetOne
    See "Number : One" + nl
    return 1
Func GetTwo
    See "Number : Two" + nl
    return 2
Func GetThree
    See "Number : Three" + nl
    return 3
```

103.8 Define Natural Statements

After the object access using ` { }` if the class contains a method called BraceEnd() it will be executed!

```
TimeForFun = new journey
# The first surprise!
TimeForFun {
    Hello it is me      # What a beautiful programming world!
}
# Our Class
```

(continues on next page)

(continued from previous page)

```
Class journey
    hello=0 it=0 is=0 me=0
    func GetHello
        See "Hello" + nl
    func braceEnd
        See "Goodbye!" + nl
```

We can execute code written in strings using the Eval() function

```
cCode = "See 'Code that will be executed later!' "
Eval(cCode)      # execute the code to print the message
```

We can create a list then execute code generated from that list

```
aWords = ["hello", "it", "is", "me"]
for word in aWords cCode=word+"=0" eval(cCode) next
```

We can read text files using the Read(cFileName) function and we can write files using the Write(cFileName,cString) function.

```
See "Enter File Name:" Give cFileName See Read(cFileName) # Print the file content
```

The next example presents how to create a class that defines two instructions The first instruction is : I want window The second instruction is : Window title = Expression Also keywords that can be ignored like the 'the' keyword

```
New App
{
    I want window
    The window title = "hello world"
}

Class App

    # Attributes for the instruction I want window
    i want window
    nWantwindow = 0
    # Attributes for the instruction Window title
    # Here we don't define the window attribute again
    title
    nWindowTitle = 0
    # Keywords to ignore, just give them any value
    the=0

    func geti
        if nWantwindow = 0
            nWantwindow++
        ok

    func getwant
        if nWantwindow = 1
            nWantwindow++
        ok
```

(continues on next page)

(continued from previous page)

```

func getwindow
    if nWantwindow = 2
        nWantwindow= 0
        see "Instruction : I want window" + nl
    ok
    if nWindowTitle = 0
        nWindowTitle++
    ok

func setttitle cValue
    if nWindowTitle = 1
        nWindowTitle=0
        see "Instruction : Window Title = " + cValue + nl
    ok

```

To complete the previous example, use read() to get the content of a file that contains

```
I want window
The window title = "hello world"
```

Then use eval() to execute the content of that file!. Also, you can update the methods GetWindow() and SetTitle() to create Real windows using the GUI Library

103.9 Define Declarative Languages

We learned how to use Natural statements to execute our code and using the same features we can use nested structures to execute our code.

The next example from the Web library, generate HTML document using the Bootstrap library. No HTML code is written directly in this example, we created a similar language (just as example) Then using this declarative language that uses nested structures, we generated the HTML Document.. The idea in this example is that the GetDiv() and GetH1() methods return an object that we can access using {} and after each object access the method BraceEnd() will be executed to send the generated HTML to the parent object until we reach to the root where BraceEnd() will print the output.

```

Load "weplib.ring"
Import System.Web

Func Main

BootStrapWebPage()
{
    div
    {
        classname = :container
        div
        {
            classname = :jumbotron
            H1 {   text("Bootstrap Page")   }
        }
        div
    }
}

```

(continues on next page)

(continued from previous page)

```

{
    classname = :row
    for x = 1 to 3
        div
    {
        classname = "col-sm-4"
        H3 { html("Welcome to the Ring programming language") }
        P { html("Using a scripting language is very fun!") }
    }
    next
}
}
}

```

The classes that power the declarative interface looks like this

```

Class Link from ObjsBase
    title link
    Func braceend
        c0output = nl+GetTabs() + "<a href=''" +
                    Link + "'> "+ Title + " </a> " + nl

Class Div from ObjsBase
    Func braceend
        c0output += nl+'<div'
        addattributes()
        AddStyle()
        getobjsdata()
        c0output += nl+"</div>" + nl
        c0output = TabMLString(c0output)

```

103.10 Transparent Implementation

Ring comes with transparent implementation. We can know what is happening in each compiler stage and what is going on during the run-time by the Virtual Machine Example : ring helloworld.ring -tokens -rules -ic

See "Hello, World!"

Output

```
=====
Tokens - Generated by the Scanner
=====
```

```

Keyword : SEE
Literal : Hello, World!
EndLine
=====
```

(continues on next page)

(continued from previous page)

Grammar Rules Used by The Parser

Rule : Program --> {Statement}

Line 1

```
Rule : Factor --> Literal
Rule : Range --> Factor
Rule : Term --> Range
Rule : Arithmetic --> Term
Rule : BitShift --> Arithmetic
Rule : BitAnd --> BitShift
Rule : BitOrXOR --> BitAnd
Rule : Compare --> BitOrXOR
Rule : EqualOrNot --> Compare
Rule : LogicNot -> EqualOrNot
Rule : Expr --> LogicNot
Rule : Statement --> 'See' Expr
```

Byte Code - Before Execution by the VM

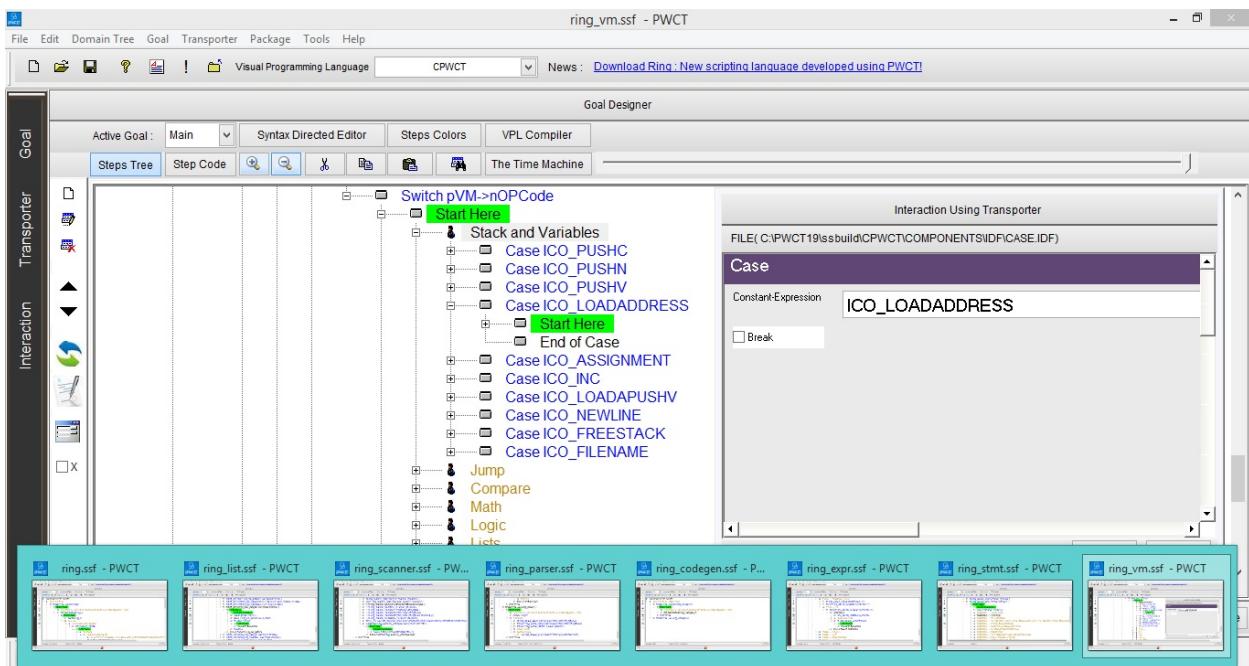
PC	OPCode	Data
1	FuncExE	
2	PushC	Hello, World!
3	Print	
4	ReturnNull	

Hello, World!

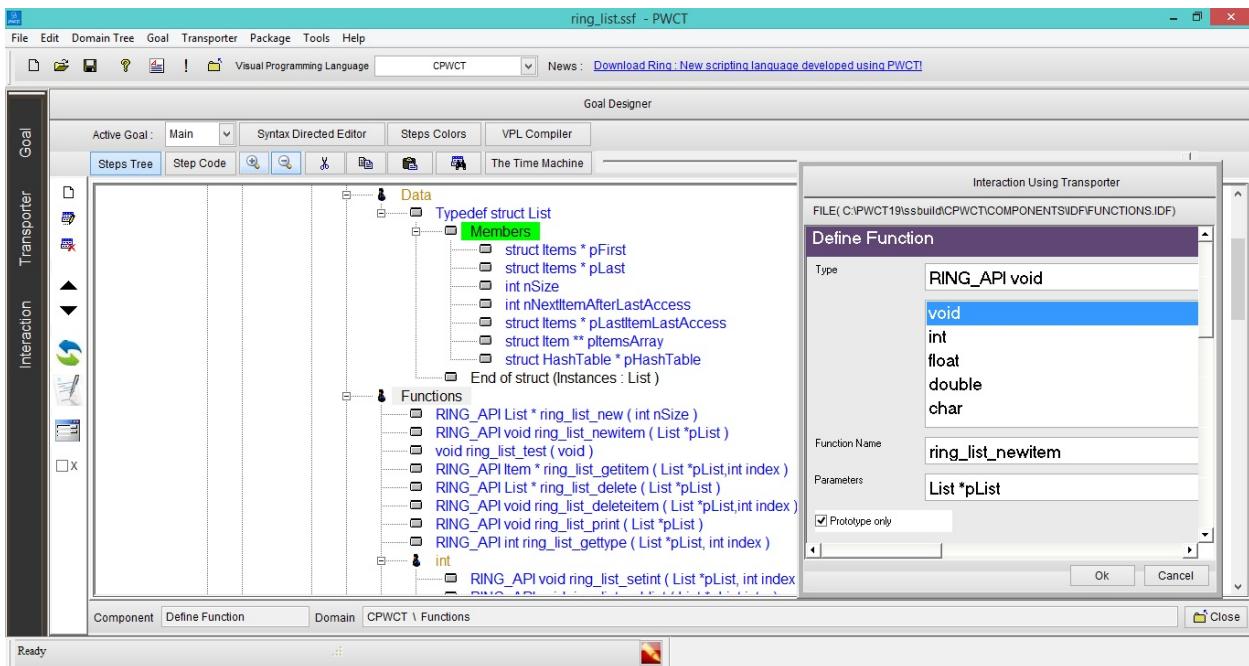
103.11 Visual Implementation

The Ring programming language is designed using the PWCT visual programming tool and you will find the visual source of the language in the folder “language/visualsrc” - *.ssf files and the generated source code (In the C Language) in the language/src folder and the language/include folder.

The next screen shot from the ring_vm.ssf file (Generate ring_vm.c and ring_vm.h)



The next screen shot from the ring_list.ssf file (Generate ring_list.c and ring_list.h)



103.12 Smart Garbage Collector

Avoid memory problems :-

- Invalid Memory Access
- Memory leaks
- Uninitialized Memory Access
- Dangling pointer

Rules :-

- Global variables always stay in the memory, until you delete these variables using the assignment statement.
- Local variables always deleted after the end of the function.
- The programmer have full control on when to delete the variable from the memory using the Assignment statement.

Example:

```
aList = [1,2,3,4,5]
aList = "nice"
```

After the second line directly, The list [1,2,3,4,5] will be deleted from the memory and we will have a string “nice”

- The programmer can call the function callgc() to force running the garbage collector.
- If we have a reference to a variable (when we pass objects and lists to functions), then deleting variables will be based on reference counting, if no references everything will be deleted, but if we have a reference, the data will stay in memory.

103.13 No Global Interpreter (VM) Lock - No GIL

When we use threads in Ring applications, We don't have global interpreter (VM) lock (No GIL)

So threads can work in parallel and execute Ring instructions at the same time

This is better for threads and concurrency (More Faster!)

103.14 Fast Enough For Many Applications

Ring is designed to be a simple, small and flexible language in the first place, but also it is fast enough for many applications.

Also when we need more speed we can use C/C++ extensions!

WHAT IS NEW IN RING 1.1?

In this chapter we will learn about the changes and new features in Ring 1.1 release.

104.1 List of changes and new features

Ring 1.1 comes with many new features

- Better Natural Language Programming Support
- Generate/Execute Ring Object Files (*.ringo)
- Syntax Flexibility and different styles for I/O and Control Structures
- New Functions and Changes
- StdLib functions and classes written in Ring
- RingLibSDL
- Demo Project - Game Engine for 2D Games
- RingSQLite
- Better Code Generator for Extensions
- Using Self.Attribute in the Class Region to define new attributes
- Using This.Attribute in nested Braces inside the Class Methods
- Better Documentation

104.2 Better Natural Language Programming Support

Ring is an innovative language because of it's compact syntax, smart implementation (small, transparent & visual) and it's ability to create declarative and natural domain specific languages in a fraction of time.

This release add support for calling methods when an expression is evaluated

check this example:

```
# Natural Code
new program {
    Accept 2 numbers then print the sum
}
```

(continues on next page)

(continued from previous page)

```
# Natural Code Implementation
class program
    # Keywords
        Accept=0 numbers=0 then=0 print=0 the=0 sum=0

    # Execution
    func braceexpval x
        value = x
    func getnumbers
        for x=1 to value
            see "Enter Number (" +x+ ") :" give nNumber
            aNumbers + nNumber
        next
    func getsum
        nSum = 0
        for x in aNumbers nSum+= x next
        see "The Sum : " + nSum
    private
        value=0 aNumbers=[]
```

Output:

```
Enter Number (1) :3
Enter Number (2) :4
The Sum : 7
```

for more information see the “Natural Language Programming” chapter.

104.3 Generate/Execute Ring Object Files (*.ringo)

This feature enable you to distribute your applications without distributing the source code. Also it makes application distribution a simple process where you get one Ring object file for the complete project (many source code files). Also using Ring object file remove the loading time required for compiling the application.

Check the “command line options” chapter to know more about this feature.

104.4 Syntax Flexibility and different styles for I/O and Control Structures

Programmers are sensitive to the programming language syntax. Great programmers know how to work using many different styles but each programmer may have his/her favorite style.

Each programming language comes with a style that you may like or not. Ring is just one of these languages, but as a response to many programmers asking for a better syntax we decided to provide more options.

Also some of these features are very necessary for Natural Language Programming.

Example :

We have two commands to change language keywords and operators.

```
ChangeRingOperator + plus
ChangeRingKeyword see print
```

Print 5 plus 5

```
ChangeRingOperator plus +
ChangeRingKeyword print see
```

We have new styles (Optional) for Input/Output.

Example :

```
Put "What is your name? "
Get cName
Put "Hello " + cName
```

Example :

```
Load "stdlib.ring"

Print("What is your name? ")      # print message on screen
cName=GetString()                # get input from the user
print("Hello #{cName}")          # say hello!
```

We have new styles (optional) for control structures.

Example :

While True

```
Put "
    Main Menu
-----
    (1) Say Hello
    (2) About
    (3) Exit

" Get nOption

Switch nOption
Case 1
    Put "Enter your name : "
    Get name
    Put "Hello " + name + nl
Case 2
    Put "Sample : using while loop" + nl
Case 3
    Bye
Else
    Put "bad option..." + nl
End
End
```

Example :

```

Load "stdlib.ring"

While True {

    print("
        Main Menu
        -----
        (1) Say Hello
        (2) About
        (3) Exit

    ")

    n0ption = GetString()

    switch n0ption {
    case 1
        print("Enter your name : ")
        name = getstring()
        print("Hello #{name}\n")
    case 2
        print("Sample : using switch statement\n")
    case 3
        Bye
    else
        print("bad option...\n")
    }

}

```

Check the next chapters:-

- Getting Started - Second Style
- Getting Started - Third Style
- Control Structures - Second Style - May looks like Lua and Ruby
- Control Structures - Third Style - May looks like C (uses braces)
- Syntax Flexibility

Note: All of these styles are provided automatically by the compiler at the same time, It's better to select one style for the same project (you can create your style as a mix from these styles) for example you can use Put/Get and Braces.

104.5 New Functions and Changes

Changed:

- get() function : changed to sysget()
- sort() function : can now work on list of objects
- find() function : can now work on list of objects

Added:

- clockspersisecond()
- CurrentDir()
- ExeFileName()
- ChDir()
- ExeFolder()
- varptr()
- space()
- nullpointer()
- object2pointer()
- pointer2object()

Check the next chapters

- System Functions
- Object Oriented Programming (OOP)
- Low Level Functions

104.6 StdLib functions and classes written in Ring

Ring 1.1 comes with a library called StdLib, it's written in Ring by the help of Ring Team

The library provide a useful group of new functions and classes

Example:

```
Load "stdlib.ring"

Puts("Test Times()")
Times ( 3 , func { see "Hello, World!" + nl } )
```

Example:

```
Load "stdlib.ring"

Puts("Test Map()")
See Map( 1:10 , func x { return x*x } )
```

Example:

```
Load "stdlib.ring"

Puts("Test Filter()")
See Filter( 1:10 , func x { if x <= 5 return true else return false ok } )
```

Example:

```
Load "stdlib.ring"

See "Testing the String Class" + nl
oString = new string("Hello, World!")
oString.println()
oString.upper().println()
oString.lower().println()
oString.left(5).println()
oString.right(6).println()
```

Example:

```
Load "stdlib.ring"

oList = new list ( [1,2,3] )
oList.Add(4)
oList.print()
```

Example:

```
Load "stdlib.ring"

oStack = new Stack
oStack.push(1)
oStack.push(2)
oStack.push(3)
see oStack.pop() + nl
```

Example:

```
Load "stdlib.ring"

oQueue = new Queue
oQueue.add(1)
oQueue.add(2)
oQueue.add(3)
see oQueue.remove() + nl
```

Example:

```
Load "stdlib.ring"

ohashtable = new hashtable
See "Test the hashtable Class Methods" + nl
ohashtable {
    Add("Egypt","Cairo")
    Add("KSA","Riyadh")
```

(continues on next page)

(continued from previous page)

```

see self["Egypt"] + nl
see self["KSA"] + nl
see contains("Egypt") + nl
see contains("USA") + nl
see index("KSA") + NL
print()
delete(index("KSA"))
see copy("*",60) + nl
print()
}

```

Example:

```

Load "stdlib.ring"

otree = new tree
See "Test the tree Class Methods" + nl
otree {
    set("The first step") # set the root node value
    see value() + nl
    Add("one")
    Add("two")
    Add("three") {
        Add("3.1")
        Add("3.2")
        Add("3.3")
        see children
    }
    see children
    oTree.children[2] {
        Add("2.1") Add("2.2") Add("2.3") {
            Add("2.3.1") Add("2.3.2") Add("test")
        }
    }
    oTree.children[2].children[3].children[3].set("2.3.3")
}
see copy("*",60) + nl
oTree.print()

```

Check the next chapters:

- StdLib Functions
- StdLib Classes

104.7 RingLibSDL

Ring 1.0 provided RingAllegro to be able to create games using the Allegro game programming library

Now Ring 1.1 provide RingLibSDL also so we can have the choice between Allegro or LibSDL

Example:

```
Load "libsdl.ring"

SDL_Init(SDL_INIT_EVERYTHING)
win = SDL_CreateWindow("Hello World!", 100, 100, 640, 480, SDL_WINDOW_SHOWN)
SDL_Delay(2000)
SDL_DestroyWindow(win)
SDL_Quit()
```

See the RingLibSDL Chapter.

104.8 Demo Project - Game Engine for 2D Games

In practice we would create a game engine in a language like C/C++ to get the best performance then provide Ring classes to use the engine.

But many 2D Games are simple and creating a game engine in Ring will be fast enough in many cases

Also this would be a good demo project to learn about the language concepts where we build things using Object Oriented Programming (OOP) then access the power that we have using declarative programming using nested structures or using natural programming.

In this project we selected the first way (declarative programming using nested structures)

Example:

```
Load "gameengine.ring" # Give Control to the Game Engine

func main # Called by the Game Engine

    oGame = New Game # Create the Game Object
    {
        title = "My First Game"
        text {
            x = 10 y=50
            animate = false
            size = 20
            file = "fonts/pirulen.ttf"
            text = "game development using ring is very fun!"
            color = rgb(0,0,0) # Color = black
        }
        text {
            x = 10 y=150
            # Animation Part =====
            animate = true # Use Animation
            direction = GE_DIRECTION_INCVERTICAL # Increase y
            point = 400 # Continue until y=400
        }
    }
```

(continues on next page)

(continued from previous page)

```

nStep = 3           # Each time y+= 3
#=====
size = 20
file = "fonts/pirulen.ttf"
text = "welcome to the real world!"
color = rgb(0,0,255)    # Color = Blue
}
Sound {           # Play Sound
    file = "sound/music1.wav"   # Sound File Name
}
}                   # Start the Events Loop

```

See the “Demo Project - Game Engine for 2D Games” chapter.

104.9 RingSQLite

Ring 1.0 provided support for ODBC to use any database and provided native support for MySQL.

Now Ring 1.1 provide native support for SQLite database too.

Example:

```

oSQLite = sqlite_init()

sqlite_open(oSQLite,"mytest.db")

sql = "CREATE TABLE COMPANY(  +
        "ID INT PRIMARY KEY      NOT NULL , " +
        "NAME          TEXT      NOT NULL , " +
        "AGE           INT       NOT NULL , " +
        "ADDRESS        CHAR(50), " +
        "SALARY         REAL ) ;"

sqlite_execute(oSQLite,sql)

sql = "INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY) " +
      "VALUES (1, 'Mahmoud', 29, 'Jeddah', 20000.00 ); " +
      "INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY) " +
      "VALUES (2, 'Ahmed', 27, 'Jeddah', 15000.00 ); " +
      "INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY)" +
      "VALUES (3, 'Mohammed', 31, 'Egypt', 20000.00 );" +
      "INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY)" +
      "VALUES (4, 'Ibrahim', 24, 'Egypt ', 65000.00 );"

sqlite_execute(oSQLite,sql)

aResult = sqlite_execute(oSQLite,"select * from COMPANY")
for x in aResult
    for t in x
        see t[2] + nl
    next

```

(continues on next page)

(continued from previous page)

```
next
see copy("*",50) + nl
for x in aResult
    see x["name"] + nl
next
sqlite_close(oSQLite)
```

104.10 Better Code Generator for Extensions

We are using the code generator (written in Ring) every day to add new libraries to Ring.

The generator is used to create RingQt and RingAllegro

Also in Ring 1.1 it's used to create RingLibSDL.

more features are added like

- Set/Get structure members (numbers & pointers)
- Using constants
- Better Generated Code

See the Code Generator chapter.

104.11 Using Self.Attribute in the Class Region to define new attributes

We can use Self.Attribute in the Class Region (after the class name and before any methods) to define new attributes.

```
class Person
    name          # Define name as attribute if it's not a global variable
    address
    phone

class person2
    self.name      # Must Define the attribute
    self.address
    self.phone
```

104.12 Using This.Attribute in nested Braces inside the Class Methods

We can use nested braces {} while we are inside methods to access another objects, In this case the current object scope will be changed while we are inside the brace and Self will point to the object that we access using braces {}. In this case we can use This.Attribute and This.Method() to access the object that will be created from the current class.

Check the Object Oriented Programming chapter for more information.

Also Check the Weight History Application in GUI Development using RingQt chapter.

104.13 Better Documentation

Ring 1.1 documentation (800 pages) is better than Ring 1.0 documentation (340 pages)

Many chapters are added for providing better information about the language like:

- Language Reference
- Scope Rules
- FAQ

And more!

WHAT IS NEW IN RING 1.2?

In this chapter we will learn about the changes and new features in Ring 1.2 release.

105.1 List of changes and new features

Ring 1.2 comes with many new features

- New Functions
- Better Functions
- Better Ring Notepad
- Better RingQt
- Objects Library for RingQt
- RingLibCurl
- Better Call Command
- Using NULL instead of NULLPointer()
- Display Warnings Option
- Better Quality

105.2 New Functions

- PtrCmp() Function is a new function that compare between C pointers like the GUI objects.
- PrevFileName() Function is added to return the previous active source file name.
- RingVM_CFunctionsList() Function is added to return a list of functions written in C.
- RingVM_FunctionsList() Function is added to return a list of functions written in Ring.
- RingVM_ClassesList() Function is added to return a list of Classes.
- RingVM_PackagesList() Function is added to return a list of Packages.
- RingVM_MemoryList() Function is added to return a list of Memory Scopes and Variables.
- RingVM_CallList() Function is added to return a list of the functions call list.
- RingVM_FilesList() Function is added to return a list of the Ring Files.

Example:

```

fp = fopen("ptrcmp.ring", "r")
fp2 = fp
fp3 = fopen("ptrcmp.ring", "r")

see ptrcmp(fp,fp2) + nl
see ptrcmp(fp,fp3) + nl

fclose(fp)
fclose(fp3)

```

Output:

```

1
0

```

Also we can compare between them using the '=' operator

Example:

```

fp = fopen("ptrcmp2.ring", "r")
fp2 = fopen("ptrcmp2.ring", "r")
fp3 = fp
see fp = fp2
see nl
see fp = fp3
fclose(fp)
fclose(fp2)

```

Output:

```

0
1

```

Example:

The next function in stdlib.ring uses the PrevFileName() to know if the file of the caller function is the main source file of the program or not.

```

Func IsMainSourceFile
    if PrevFileName() = sysargv[2]
        return true
    ok
    return false

```

105.3 Better Functions

The find() function is updated to support searching in lists using C pointers like GUI Objects.

The type() function is updated to display the C pointers types (like the GUI Object Class Name).

105.4 Better Ring Notepad

The Ring Notepad will save the current line number of opened files to be restored when we switch between files.

Also Ring Notepad will ask the user to save the file if the file content is changed when the user switch between files.

105.5 Better RingQt

RingQt classes are updated to include methods to get events (The code that will be executed when an event is fired). This is necessary to enable/disable events for some time or to get the events information.

For example the next code disable an event then call a method then enable the event again.

```
cEvent = oView.oListResult.getCurrentItemChangedEvent()
oView.oListResult.setCurrentItemChangedEvent("")
FindValueAction()      # Call Method while an event is disabled
oView.oListResult.setCurrentItemChangedEvent(cEvent)
```

Also the QAllEvents class is updated where we can set the output from the event function to be true or false using a new method added to the class called setEventOutput.

```
Load "guilib.ring"

MyApp = New qApp {
    win = new QWidget() {
        setWindowTitle("Hello World")
        setGeometry(100,100,370,250)
        lineedit1 = new QLineEdit(win) {
            setGeometry(10,100,350,30)
            setInputMask("9999;_")
            oFilter = new QAllEvents(lineedit1)
            oFilter.setFocusOutEvent("pMove()")
            installEventFilter(oFilter)
        }
        lineedit2 = new QLineEdit(win) {
            setGeometry(10,150,350,30)
        }
        show()
    }
    exec()
}

func pMove
    win.setWindowTitle("xxxx")
    oFilter.setEventOutput(False)
```

105.6 Objects Library for RingQt

Ring 1.2 comes with the Objects library for RingQt applications. Instead of using global variables for windows objects and connecting events to objects using the object name, the Objects Library will manage the GUI objects and will provide a more natural API to quickly create one or many windows from the same class and the library provide a way to quickly set methods to be executed when an event is fired. Also the library provide a natural interface to quickly use the parent or the caller windows from the child or sub windows.

The Objects Library is designed to be used with the MVC Design Pattern.

The Objects Library is merged in RingQt so you can use it directly when you use RingQt

Example :

```
load "guilib.ring"

new qApp {
    open_window( :MainWindowController )
    exec()
}

class MainWindowController from WindowsControllerParent
    oView = new MainWindowView
    func SubWindowAction
        Open_window( :SubWindowController )
        Last_Window().SetParentObject(self)

class MainWindowView from WindowsViewParent
    win = new QWidget() {
        SetWindowTitle("Main Window")
        btnSub = new QPushButton(win) {
            setText("Sub Window")
            setClickEvent( Method( :SubWindowAction ) )
        }
        resize(400,400)
    }

class SubWindowController from WindowsControllerParent
    oView = new SubWindowView
    func SetMainWindowTitleAction
        Parent().oView.win.SetWindowTitle("Message from the Sub Window")
        oView.win.SetWindowTitle("Click Event Done!")

class SubWindowView from WindowsViewParent
    win = new QWidget() {
        SetWindowTitle("Sub Window")
        btnMsg = new QPushButton(win) {
            setText("Set Main Window Title")
            setClickEvent( Method( :SetMainWindowTitleAction ) )
        }
        btnClose = new QPushButton(win) {
            Move(200,0)
            setText("Close")
            setClickEvent( Method( :CloseAction ) )
        }
    }
```

(continues on next page)

(continued from previous page)

```

    }
    resize(400,400)
}

```

105.7 RingLibCurl

The LibCurl library is used starting from Ring 1.0 for the Download() and SendEmail() functions implementation. In Ring 1.2 more functions are added to provide a powerful library (RingLibCurl) around LibCurl.

Example:

```

load "libcurl.ring"

curl = curl_easy_init()

cPostThis = "page=4&Number1=4&Number2=5"
curl_easy_setopt(curl, CURLOPT_URL, "http://localhost/ringapp/index.ring?page=3")
curl_easy_setopt(curl, CURLOPT_POSTFIELDS, cPostThis)

curl_easy_perform(curl)

curl_easy_cleanup(curl)

```

105.8 Better Call Command

The Call command is updated to support calling functions from object attributes also (not only variables).

For example the next code from the Stars Fighter Game

```

cFunc = oself.keypress
call cFunc(oGame,oSelf,Key_Space)

```

Can be written in one line

```
call oself.keypress(oGame,oSelf,Key_Space)
```

105.9 Using NULL instead of NULLPointer()

We can pass NULL to functions instead of using NULLPointer()

For example the next code from RingLibSDL

```
SDL_RenderCopy(SDL_ren,tex,NULLPointer(),rect)
```

Can be written as in the next line

```
SDL_RenderCopy(SDL_ren,tex,NULL,rect)
```

105.10 Display Warnings Option

In Ring 1.2 the Ring compiler is updated to include the Display Warnings option (-w)

Example:

```
load "stdlib.ring"
load "stdlib.ring"
```

compiling the program using the Display Warnings option will display the file duplication warning, While without that option the error will pass silent.

This is a warning (not an error) because in large projects you may use the same file more than one time. For example it's common to start each file with the next code. where the function IsMainSourceFile() is part from the stdlib.ring

```
load "stdlib.ring"
if IsMainSourceFile()
    // Testing
ok
```

105.11 Better Quality

Ring 1.2 is more stable, We discovered and fixed more bugs during Ring usage everyday in practical projects. Some functions are optimized to be faster like the SubStr() function. Also the documentation is more better.

WHAT IS NEW IN RING 1.3?

In this chapter we will learn about the changes and new features in Ring 1.3 release.

106.1 List of changes and new features

Ring 1.3 comes with many new features

- Better RingQt
- Better Ring Notepad
- Ring mode for Emacs Editor
- Better StdLib
- Better Loop/Exit Command
- New Functions
- Return Self by Reference
- Using ‘<’ and ‘:’ operators as ‘from’ keyword
- Embedding Ring in Ring without sharing the State
- RingZip Library
- Form Designer

106.2 Better RingQt

(1) Another version of QPixMap class is added (QPixMap2) which takes (int width,int height) during object init.

Example:

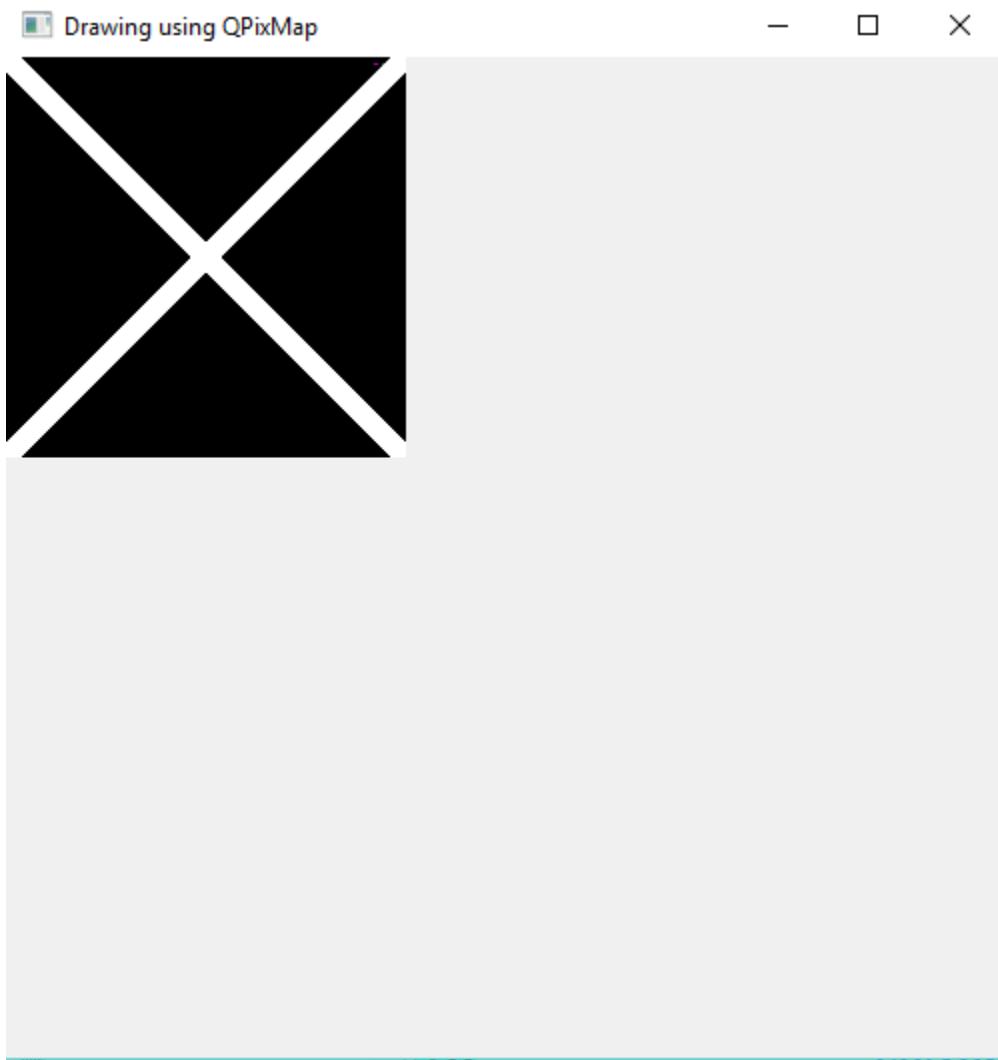
```
Load "guilib.ring"
New qapp
{
    win1 = new QWidget()
    {
        setWindowTitle("Drawing using QPixMap")
        setGeometry(100,100,500,500)
        label1 = new QLabel(win1)
    }
```

(continues on next page)

(continued from previous page)

```
        setgeometry(10,10,400,400)
        settext(""))
    }
imageStock = new qlabel(win1)
{
    image = new qPixmap(200,200)
    color = new QColor() {
        setrgb(255,255,255,255)
    }
    pen = new QPen() {
        setColor(color)
        setWidth(10)
    }
    QPainter() {
        begin(image)
            setPen(pen)
            drawLine(0,0,200,200)
            drawLine(200,0,0,200)
        endPaint()
    }
    setPixmap(image)
}
show()
}
exec()
}
```

Screen Shot:



(2) The Objects Library is updated to include the next functions

- Last_WindowID()
- Open_WindowNoShow()
- Open_WindowAndLink()

Also the class name (WindowViewBase) is changed to (WindowsViewParent).

In The next code for example the Open_WindowAndLink() will create an object from the SecondWindowController Class Then will add the Method SecondWindow() to the FirstWindowController Class Also will add the Method FirstWindow() to the SecondWindowController Class

So the SendMessage() method in FirstWindowController class can use the SecondWindow() method to access the object.

```
class firstwindowController from windowsControllerParent

    oView = new firstwindowView

    func OpenSecondWindow
```

(continues on next page)

(continued from previous page)

```

Open_WindowAndLink(:SecondWindowController,self)

func SendMessage
  if IsSecondWindow()
    SecondWindow().setMessage("Message from the first window")
  ok

func setMessage cMessage
  oView.Label1.setText(cMessage)

```

(3) The next classes are added to RingQt

- QPixmap2
- QScrollArea
- QSplitter
- QCompleter
- QCompleter2
- QCompleter3
- QProcess
- QMdiArea
- QMdiSubWindow
- QCursors
- QListWidget
- QDesktopServices

(4) Many constants are defined in qt.rh (loaded by guilib.ring)

(5) New Classes names - Index Start from 1

We added new classes to RingQt - another version of classes where the class names doesn't start with the "q" letter
Also updated methods so the index start from 1 when we deal with the GUI controls like

- ComboBox
- ListWidget
- TableWidget
- TreeWidget

These classes are inside guilib.ring under the package name : System.GUI

To use it

```

load "guilib.ring"

import System.GUI

```

This doesn't have any effect on our previous code, It's just another choice for better code that is consistent with Ring rules.

Also the form designer is updated to provide us the choice between using classes where (index start from 0) or (index start from 1)

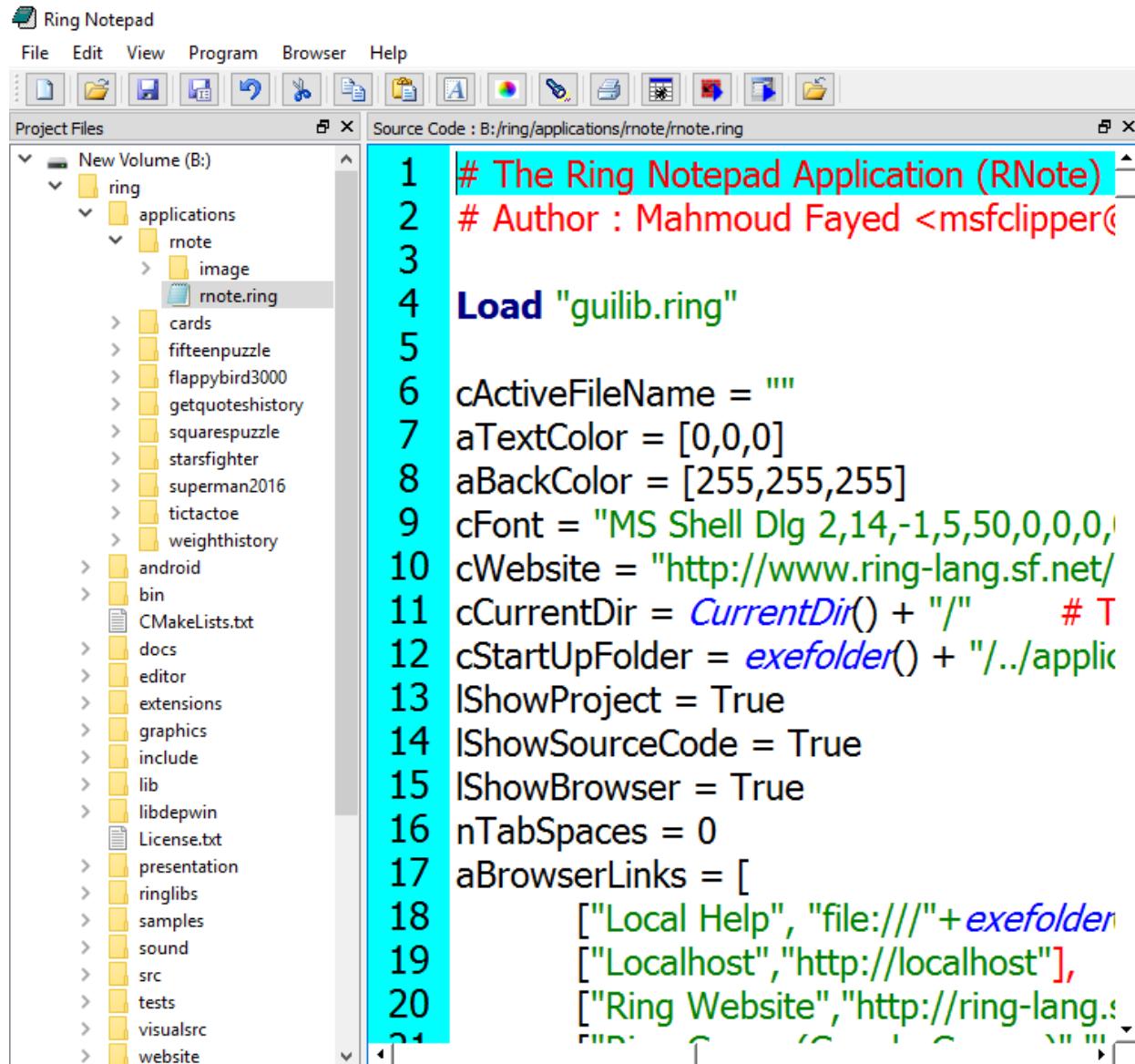
Example (Uses the Form Designer)

- (1) <https://github.com/ring-lang/ring/blob/master/samples/UsingFormDesigner/indexstart/indexstartView.ring>
 - (2) <https://github.com/ring-lang/ring/blob/master/samples/UsingFormDesigner/indexstart/indexstartController.ring>

106.3 Better Ring Notepad

- (1) Using QPlainTextEdit instead of QTextEdit
 - (2) Displaying the line number for each line in the source code file.

Screen Shot:



- (3) Auto-Complete for Ring functions names, classes and words in the opened file.

Source Code

```
1 load "guilib.ring"
2
3 new qApp {
4     new qWid
5         exec() qwidget() {
6             }
```

qwidget_acceptdrops()
qwidget_accessibleDescription()
qwidget_accessibleName()
qwidget_activateWindow()
qwidget_addAction()
qwidget_adjustSize()
qwidget_autoFillBackground()
qwidget_backgroundRole()
qwidget_baseSize()
qwidget_childAt()
qwidget_childrenRect()
qwidget_childrenRegion()

(4) Functions and Methods List

The screenshot shows the Ring Notepad interface. On the left is a project tree with files like ring, applications, mote, and mote.ring. The main window displays a portion of the 'mote.ring' file:

```

1106
1107 Func AutoComplete
1108   oList = new qStringList()
1109   # Create a functions to add Ring List to q
1110   AddItems = func aList,oList {
1111     for Item in aList
1112       oList.Append(Item)
1113     next
1114   }
1115   # Add Ring Keywords
1116   aKeywords = ["again","and","but",
1117                 "changingkeyw",
1118                 "def","do","done",
1119                 "func","get","give",
1120                 "loop","new","nex",
1121                 "package","privat",
1122                 "to","try","while"]
1123   call AddItems(aKeywords,oList)
1124   # Add Ring Functions
1125   Call AddItems(cFunctions(),oList)
1126   # Add Ring Classes

```

To the right is a 'Functions List(58)' panel showing various Ring functions like autocomplete(), displayfunctionslist(), and msgbox(). The status bar at the bottom indicates 'Line: 1107 Column : 1 Total Lines : 1179'.

(5) Output Window

The screenshot shows the Ring Notepad interface with an open output window. The code in the main window is:

```

1 See "What is your name? "
2 Give cname
3 See "Hello " + cname
4

```

The output window shows the results of running this code. It displays the prompt 'What is your name?' followed by the response 'Hello Mahmoud'. An input field at the bottom shows 'Mahmoud'.

(6) Classes List

The screenshot shows the Ring Notepad application interface. On the left is a project tree titled "Ring Notepad" with a "Project Files" section containing various Ring application files like "ring", "applications", "cards", etc. The main area is a code editor titled "Source Code : B:/ring/applications/formdesigner/formdesigner.ring". The code is Ring script, starting with `new qApp {` and defining a class `FormDesignerController` from `WindowsControllerPaser`. To the right of the code editor is a "Classes List" window displaying a long list of Qt widget classes such as `commonattributesmethods`, `formdesigner_qcheckbox`, `formdesigner_qcombobox`, etc.

```

new qApp {
    StyleFusion()
    Open_Window(:FormDesignerController)
    exec()
}

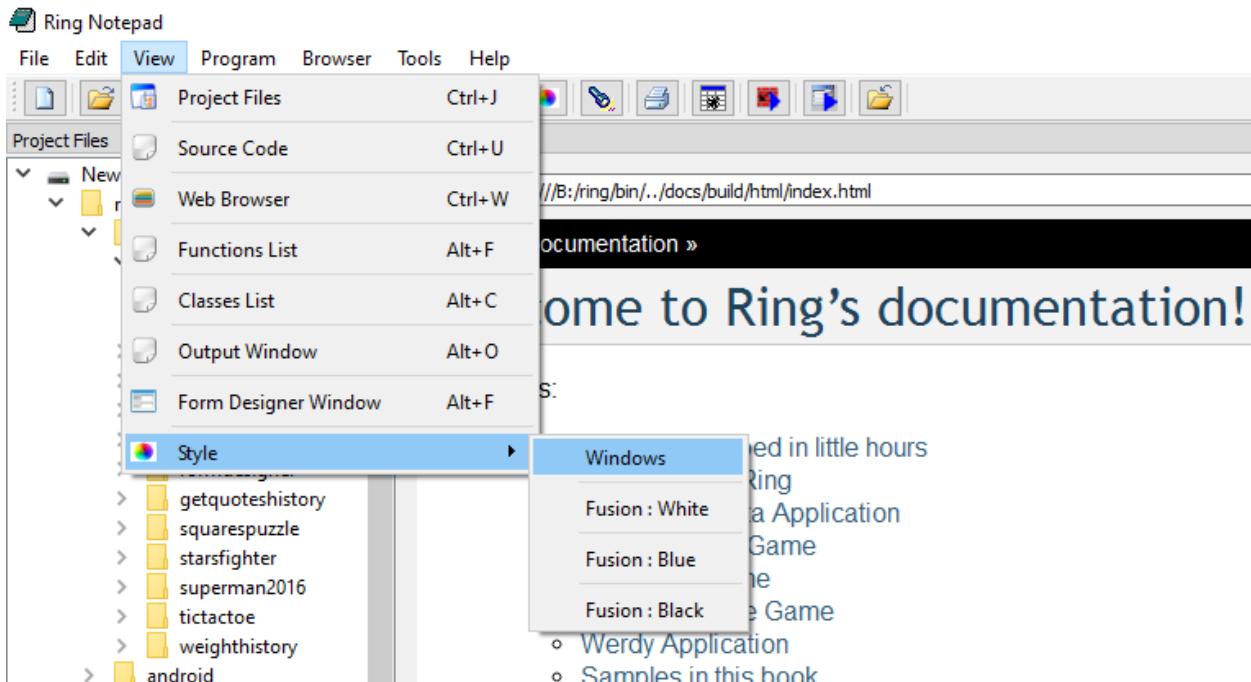
Class FormDesignerController from WindowsControllerPaser

oView = new FormDesignerView
oModel = new FormDesignerModel
oGeneral = new FormDesignerGeneral
oFile = new FormDesignerFileSystem

func Start
    oView.CreateMainWindow(oModel)
    AddObjectsToCombo()
    AddObjectProperties()
    DisplayObjectProperties()
    oView.WindowMoveResizeEvents()

```

(7) Change the Current Style



106.4 Ring mode for Emacs Editor

Ring 1.3 comes with Ring mode for Emacs Editor

Screen Shot:

```

func checkwin ogame
    if oGameState.gameresult return ok
    if oGameState.enemies = 0
        oGameState.gameresult = true
        oGame {
            if oGameState.level < 30
                text {
                    point = 400
                    size = 30
                    file = "fonts/pirulen.ttf"
                    text = "Level Completed!"
                    nStep = 3
                    x = 500 y=10
                    state = func ogame,oself {
                        if oself.y >= 400
                            ogame.shutdown = true
                            oGameState.level++
                            oGameState.enemies = oGameState.level
                            oGameState.gameresult = false
                        ok
                    }
                }
            else
                text {
                    point = 400
                    size = 30
                    nStep = 3
                    file = "fonts/pirulen.ttf"
                    text = "You Win !!!"
                    x = 500 y=10
                }
        }
    }
-\\--- game.ring      77% L304  Git-master  (ring)

```

106.5 Better StdLib

The StdLib is updated to include the next functions

- SplitMany()
- JustFilePath()
- JustFileName()

106.6 Better Loop|Exit Command

The Loop|Exit command is updated to accept Expressions after the command (not only numbers).

The syntax:

Loop|Exit [Number]

Changed to

Loop|Exit [Expression]

Example

```
XLoop = 2      # The outer loop
YLoop = 1      # The first inner loop
for x = 1 to 10
    for y = 1 to 10
        see "x=" + x + " y=" + y + nl
        if x = 3 and y = 5
            exit XLoop
        ok
    next
next
```

106.7 New Functions

- PackageName() function
- Swap() function

Example:

```
aList = [:one,:two,:four,:three]
see aList
see copy("*",50) + nl
swap(aList,3,4)
see aList
```

Output

```
one
two
four
three
*****
one
two
three
four
```

106.8 Return Self by Reference

In this release, using Return Self in class methods will return the object by reference.

Example:

```
mylist = [new mytest() {
    see self
    x = 20
    see self
}]
see mylist
```

(continues on next page)

(continued from previous page)

```
class mytest
    x = 15
    func init
        return self      # Return by reference
```

Output

```
x: 15.000000
x: 20.000000
x: 20.000000
```

106.9 Using ‘<’ and ‘:’ operators as ‘from’ keyword

In this release of the Ring language we can use the ‘<’ and ‘:’ operators as the ‘from’ keyword

Syntax (1):

```
class Cat from Animal
```

Syntax (2):

```
class Cat < Animal
```

Syntax (3):

```
class Cat : Animal
```

106.10 Embedding Ring in Ring without sharing the State

From Ring 1.0 we already have functions for embedding Ring in the C language. Also we can execute Ring code inside Ring programs using the eval() function. In this release we provide functions for embedding Ring in Ring programs without sharing the state.

Advantages:

- (1) Quick integration for Ring programs and applications together without conflicts.
- (2) Execute and run Ring code in safe environments that we can trace.

Example:

```
pState = ring_state_init()
ring_state_runcode(pState, "See 'Hello, World!'+nl")
ring_state_runcode(pState, "x = 10")

pState2 = ring_state_init()
ring_state_runcode(pState2, "See 'Hello, World!'+nl")
ring_state_runcode(pState2, "x = 20")

ring_state_runcode(pState, "see x +nl")
```

(continues on next page)

(continued from previous page)

```
ring_state_runcode(pState2, "see x +nl")

v1 = ring_state_findvar(pState, "x")
v2 = ring_state_findvar(pState2, "x")

see v1[3] + nl
see V2[3] + nl

ring_state_delete(pState)
ring_state_delete(pState2)
```

Output:

```
Hello, World!
Hello, World!
10
20
10
20
```

106.11 RingZip Library

Ring 1.3 comes with the RingZip library for creating, modifying and extracting *.zip files.

Example (1): Create myfile.zip contains 4 files

```
load "ziplib.ring"
oZip = zip_openfile("myfile.zip", 'w')
zip_addfile(oZip, "test.c")
zip_addfile(oZip, "zip.c")
zip_addfile(oZip, "zip.h")
zip_addfile(oZip, "miniz.h")
zip_close(oZip)
```

Example (2): Extract myfile.zip to myfolder folder.

```
load "ziplib.ring"
zip_extract_allfiles("myfile.zip", "myfolder")
```

Example (3): Print file names in the myfile.zip

```
load "ziplib.ring"
oZip = zip_openfile("myfile.zip", 'r')
for x=1 to zip_filescount(oZip)
    see zip_getfilenamebyindex(oZip,x) + nl
next
zip_close(oZip)
```

Example (4) : Using Classes instead of Functions

```

load "ziplib.ring"

new Zip {
    SetFileName("myfile.zip")
    Open("w")
    AddFile("test.c")
    AddFile("zip.c")
    AddFile("zip.h")
    AddFile("miniz.h")
    Close()
}

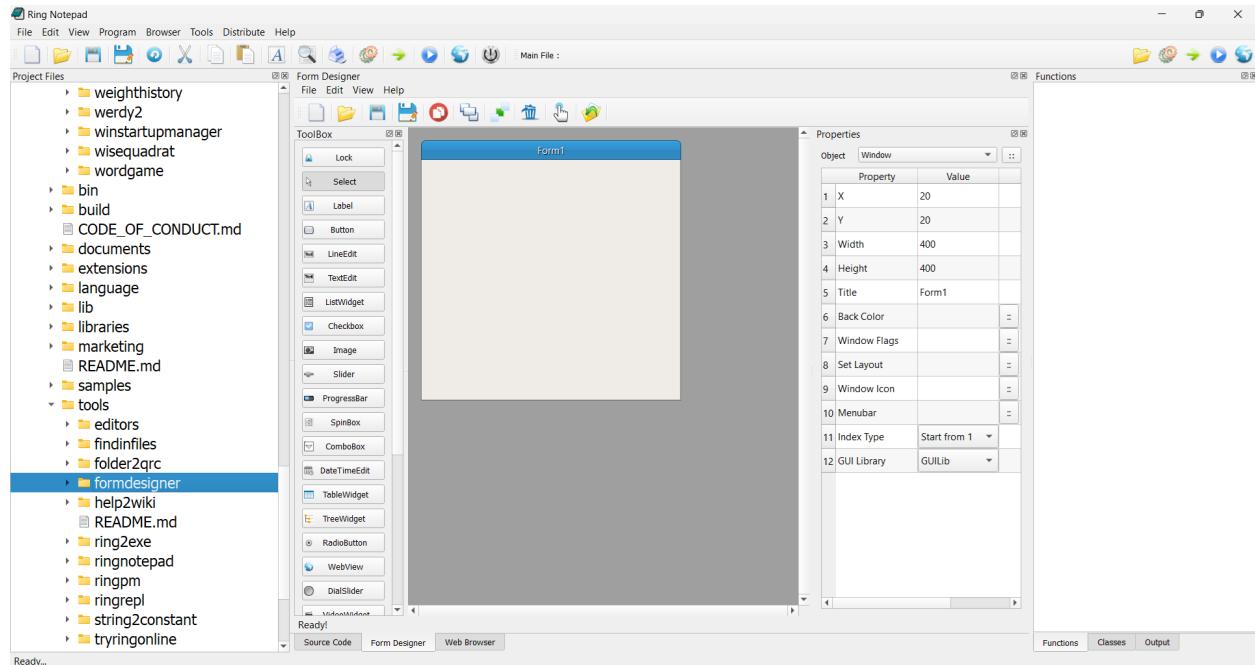
```

106.12 Form Designer

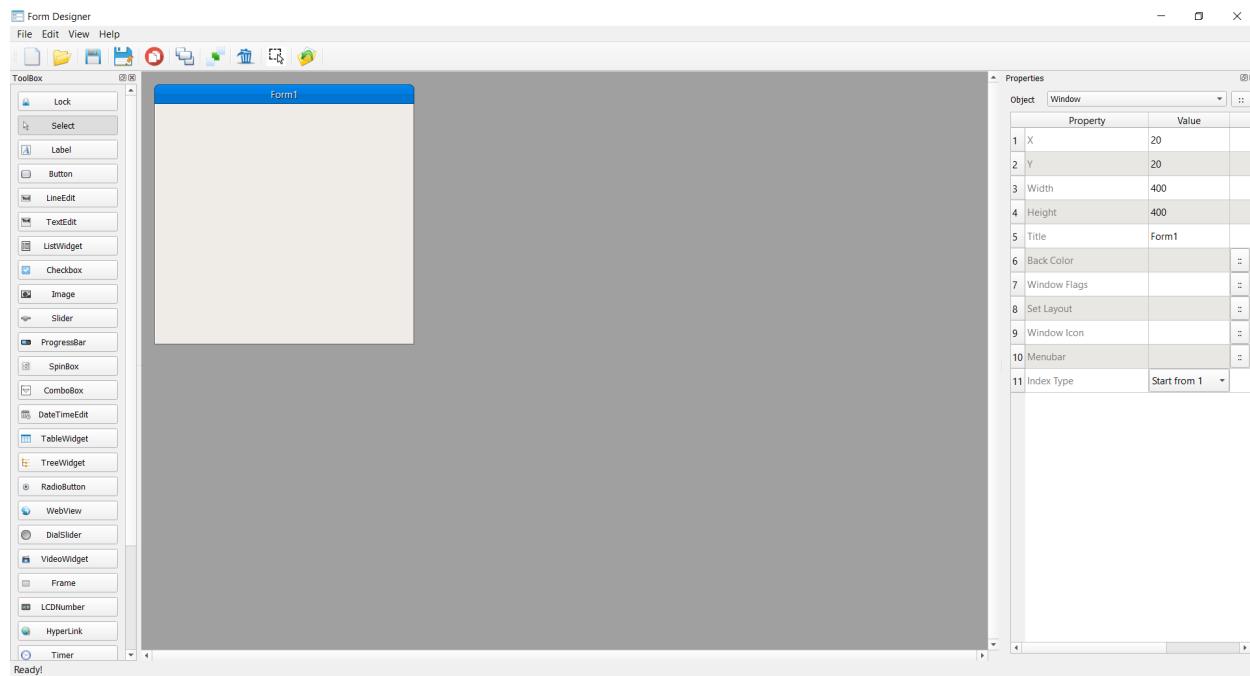
Ring 1.3 comes with the Form Designer to quickly design your GUI application windows/forms and generate the Ring source code.

It's written in Ring (Around 8000 Lines of code) using Object-Oriented Programming and Meta-Programming.

We can run the Form Designer from Ring Notepad



Also we can run the Form Designer in another window.



WHAT IS NEW IN RING 1.4?

In this chapter we will learn about the changes and new features in Ring 1.4 release.

107.1 List of changes and new features

Ring 1.4 comes with many new features

- Change: Basic Extensions are separated from RingVM
- The Natural Library
- New Style is added to Ring Notepad
- RingREPL
- Convert between Numbers and Bytes
- Better StdLib
- Better WebLib
- Better RingQt
- Qt Class Converter

107.2 Change: Basic Extensions are separated from RingVM

In Ring 1.4 the next libraries are separated from RingVM

- RingODBC
- RingMySQL
- RingSQLite
- RingOpenSSL
- RingInternet

To use these libraries, Use the Load command.

```
load "odbc.lib.ring"
# use ODBC Functions
```

```
load "mysql.lib.ring"
# use MySQL Functions
```

```
load "sqlitelib.ring"
# use SQLite Functions
```

```
load "openssllib.ring"
# use OpenSSL Functions ( Hash and Security functions)
```

```
load "internetlib.ring"
# use Internet Functions ( Download() and SendEmail() )
```

If you will use all of these libraries, You can just use stdlib.ring And the stdlib.ring will load odbc.lib.ring, mysql.lib.ring, sqlitelib.ring, openssllib.ring and internetlib.ring files.

```
load "stdlib.ring"
```

107.3 The Natural Library

Ring 1.4 comes with the Natural Library to quickly define a language that contains a group of commands.

We will write the natural code in a Text file, for example program.txt

File: program.txt

```
Welcome to the Ring programming language!
What you are reading now is not comments, I swear!
```

```
After many years of programming I decided to think different about
programming and solve the problems in a better way.
```

```
We are writing commands or code and the Ring language is reading
it to understand us! Sure, What you are seeing now is
just ***part of the code - Not the Complete Program***
You have to write little things before and after this
part to be able to run it!
```

```
It is the natural part of our code where we can write in English,
Arabic or any Natural Language Then we will tell the computer
through the Ring language what must happens! in a way that we can scale
for large frameworks and programs.
```

```
Just imagine what will happens to the world of programming once
we create many powerful frameworks using the Ring language that
uses this way (Natural Programming).
```

```
For example When we say Hello to the Machine, It can reply! and when we
say count from 1 to 5 it will understand us, Also if
we said count from 5 to 1 it will
understand us too! You can see the Output window!
```

```
This Goal is not new, but the Ring language comes
with an innovative solution to this problem.
```

Output:

```
Hello, Sir!
```

```
The Numbers!
```

```
1
```

```
2
```

```
3
```

```
4
```

```
5
```

```
I will count Again!
```

```
5
```

```
4
```

```
3
```

```
2
```

```
1
```

To execute the natural code, We have start.ring

In start.ring we define the language and the commands.

File: start.ring

```
load "stdlib.ring"
load "naturallib.ring"

New NaturalLanguage {
    SetLanguageName(:MyLanguage)
    SetCommandsPath(CurrentDir() + "/../command")
    SetPackageName("MyLanguage.Natural")
    UseCommand(:Hello)
    UseCommand(:Count)
    RunFile("program.txt")
}
```

We defined a language called MyLanguage, We have folder for the language commands.

Each command will define a class that belong to the MyLanguage.Natural package.

We will define two commands, Hello and Count.

So we must have two files for defining the commands in the CurrentDir() + "/..command" folder

File: hello.ring

```
DefineNaturalCommand.SyntaxIsKeyword([
    :Package = "MyLanguage.Natural",
    :Keyword = :hello,
    :Function = func {
        See  "Hello, Sir!" + nl + nl
    }
])
```

File: count.ring

```
DefineNaturalCommand.SyntaxIsKeywordNumberNumber([
    :Package = "MyLanguage.Natural",
    :Keyword = :count,
    :Function = func {
        if not isattribute(self,:count_times) {
            AddAttribute(self,:count_times)
            Count_Times = 0
        }
        if Expr(1) > Expr(2) {
            nStep = -1
        }
        else
            nStep = 1
        }
        if Count_Times = 0 {
            see nl+"The Numbers!" + nl
            Count_Times++
        }
        else
            see nl + "I will count Again!" +nl
        }
        for x = Expr(1) to Expr(2) step nStep {
            see nl+x+nl
        }
        CommandReturn(fabs(Expr(1)-Expr(2))+1)
    }
])
```

107.4 New Style is added to Ring Notepad

In Ring Notepad - From View - Styles - Select the (Modern) Style

Screen Shot:

```

3
4 load "guilib.ring"
5
6 oProcess = NULL
7
8 new qApp {
9     StyleFusionBlack()
10    oProcessWindow = new QWidget() {
11        setWindowTitle("RingREPL (Read - Eval - Print - Loop)")
12        resize(600,500)
13        setwinicon(self,"source.png")
14        oProcessLabel = new QLabel(oProcessWindow) {
15            setText("Ring :")
16        }
17        oProcessText = new QLineEdit(oProcessWindow) {
18            setreturnPressedEvent("pSendProcessData()")
19        }
}

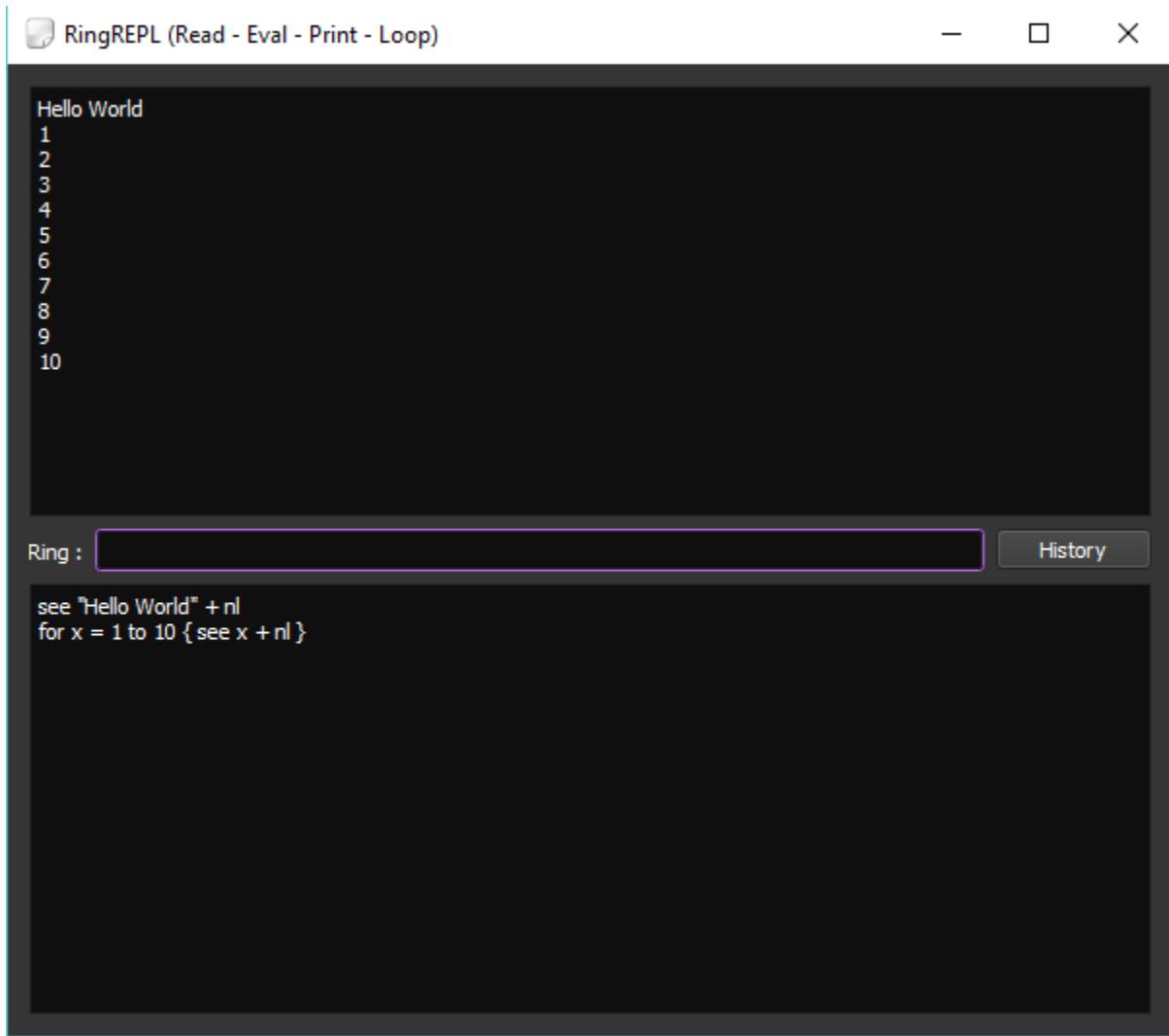
```

107.5 RingREPL

In the application folder, You will find RingREPL (Read-Eval-Print-Loop)

Also you can run it from Ring Notepad (Menubar - Tools)

Screen Shot:



107.6 Convert between Numbers and Bytes

Ring 1.4 comes with the next functions to convert between Numbers and Bytes.

- Int2Bytes()
- Float2Bytes()
- Double2Bytes()
- Bytes2Int()
- Bytes2Float()
- Bytes2Double()

Example:

```

see "Test Int2Bytes() and Bytes2Int() - Value : 77" + nl
r = Int2Bytes(77)
see "Int Size : " + len(r) + nl

```

(continues on next page)

(continued from previous page)

```

see r + nl
see Bytes2Int(r) + nl
see "Test Float2Bytes() and Bytes2Float() - Value 77.12" + nl
r = Float2Bytes(77.12)
see "Float Size : " + len(r) + nl
see r + nl
see Bytes2Float(r) + nl
see "Test Double2Bytes() and Bytes2Double() - Value 9999977.12345" + nl
r = Double2Bytes(9999977.12345)
see "Double Size : " + len(r) + nl
see r + nl
decimals(5)
see Bytes2Double(r) + nl

```

107.7 Better StdLib

The StdLib is updated to include the next functions

- FSize()

The print() function is updated to accept local variables.

```

load "stdlib.ring"

func main
    print("Enter your name : ") ;
    Name = getString() ;
    print( "Hello : #{Name} ") ;
    return ;

```

107.8 Better WebLib

The web library is updated

- Provide better error message
- (1) Error (WebLib-1) : REQUEST_METHOD is empty ! - Run this script from the browser
 - (2) Error (DataLib-1) : Can't connect to the database server!
- Better Template() function - can accept NULL instead of object as the second parameter.

```
html(template("main.rhtml",NULL))
```

- The Form Class is updated to support the “target” attribute.

```

BootStrapWebPage()
{
    Title = "The Ring Programming Language"
    html(template("main.rhtml",NULL))
    div {

```

(continues on next page)

(continued from previous page)

```

classname = :container
div
{
    id = "div3"
    color = "black"
    backgroundcolor = "white"
    width = "100%"
    form
    {
        method = "POST"
        Action = website
        Target = "codeoutput"
        input { type="hidden" name="page" value=1 }
        Table
        {
            style = stylewidth("100%") +
                    stylegradient(3)
            TR
            {

                TD { align="center"
                     WIDTH="10%"
                     text("Code :"))
                }
                TD {
                    html(`<textarea name = "cCode"
rows="5"
style="width : 100%; ">
See "Hello, World!" + nl
</textarea>`)
                }
            }
        }
        Input { type = "submit"
                classname="btn btn-primary btn-block"
                value = "Execute" }
        Table
        {
            style = stylewidth("100%") +
                    stylegradient(34)
            TR
            {

                TD { align="center"
                     WIDTH="10%"
                     text("Output :"))
                }
                TD {
                    html(`<iframe name="codeoutput"
width="100%"`)
                }
            }
        }
    }
}

```

(continues on next page)

(continued from previous page)

```

        style="background-color:white;">
        </iframe>`)
    }
}

}

}

html(template("footer.rhtml",NULL))
}

```

107.9 Better RingQt

The next functions are added to RingQt

- SetDialogIcon(cIconFile)
- MsgInfo(cTitle,cMessage)
- ConfirmMsg(cTitle,cMessage)
- InputBox(cTitle,cMessage)
- InputBoxInt(cTitle,cMessage)
- InputBoxNum(cTitle,cMessage)
- InputBoxPass(cTitle,cMessage)

The next classes are added to RingQt

- QToolButton
- QSerialPort
- QSerialPortInfo

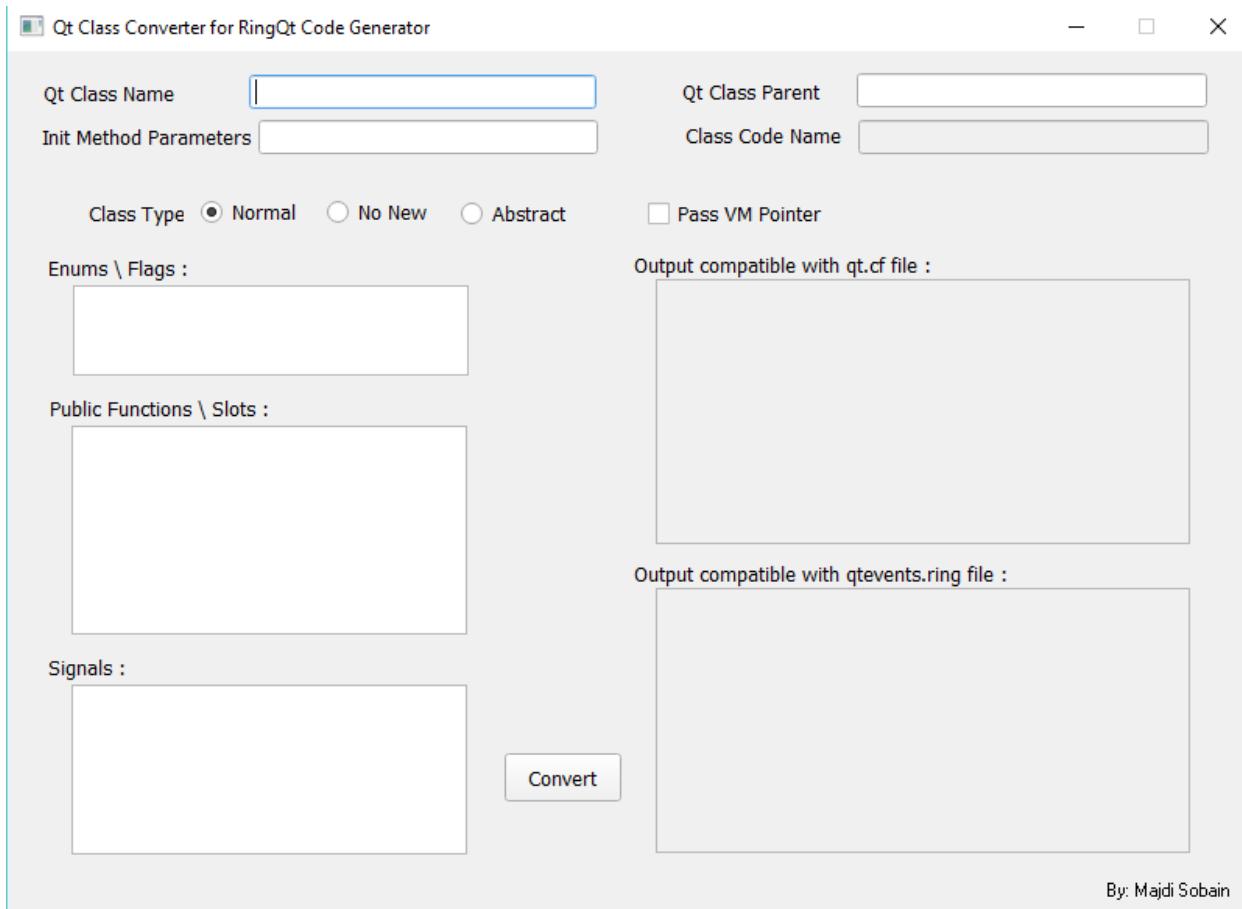
107.10 Qt Class Converter

Ring 1.4 comes with a simple tool that help in porting Qt classes to RingQt.

You will find it in ring/extensions/ringqt/converter

Online : <https://github.com/ring-lang/ring/tree/master/extensions/ringqt/converter>

Screen Shot:



107.11 What is new in Ring 1.4.1?

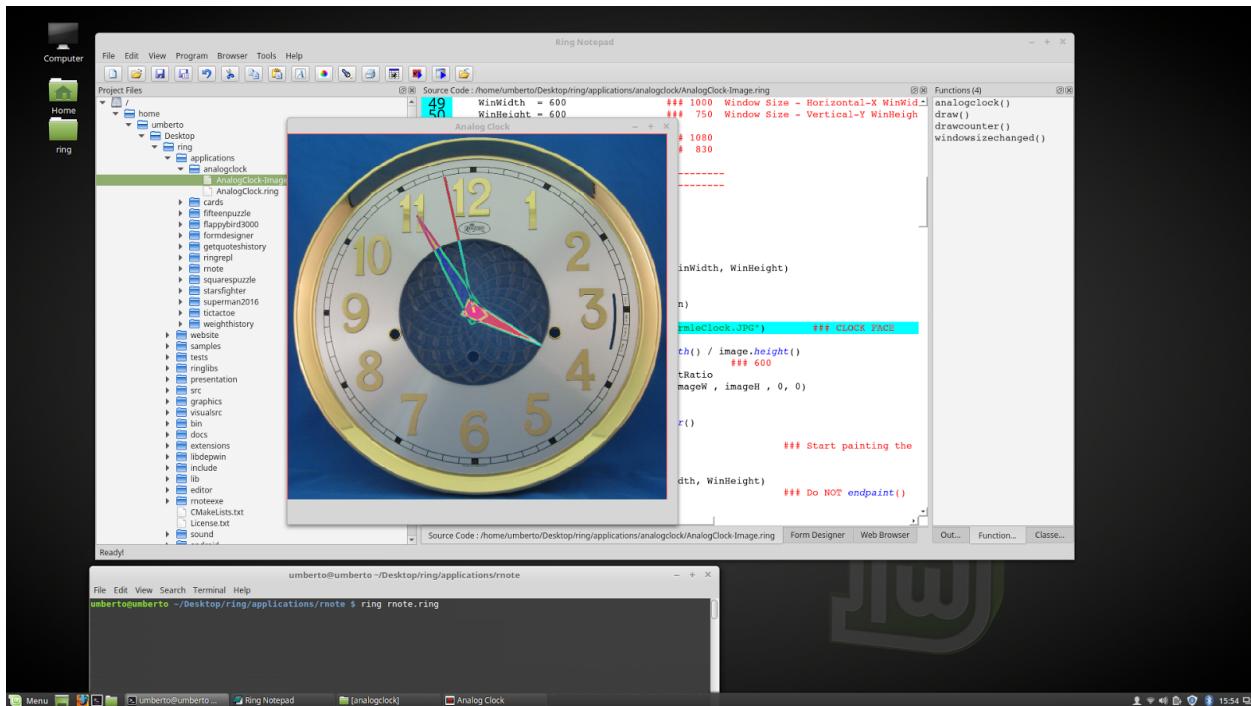
Ring 1.4.1 comes with the next changes

- Better Scripts for Building from Source Code
- Better Colors for the Modern Style in Ring Notepad
- Better StdLib
- Better RingQt
- New Sample : Sixteen Puzzle

The scripts are updated for building from source code.

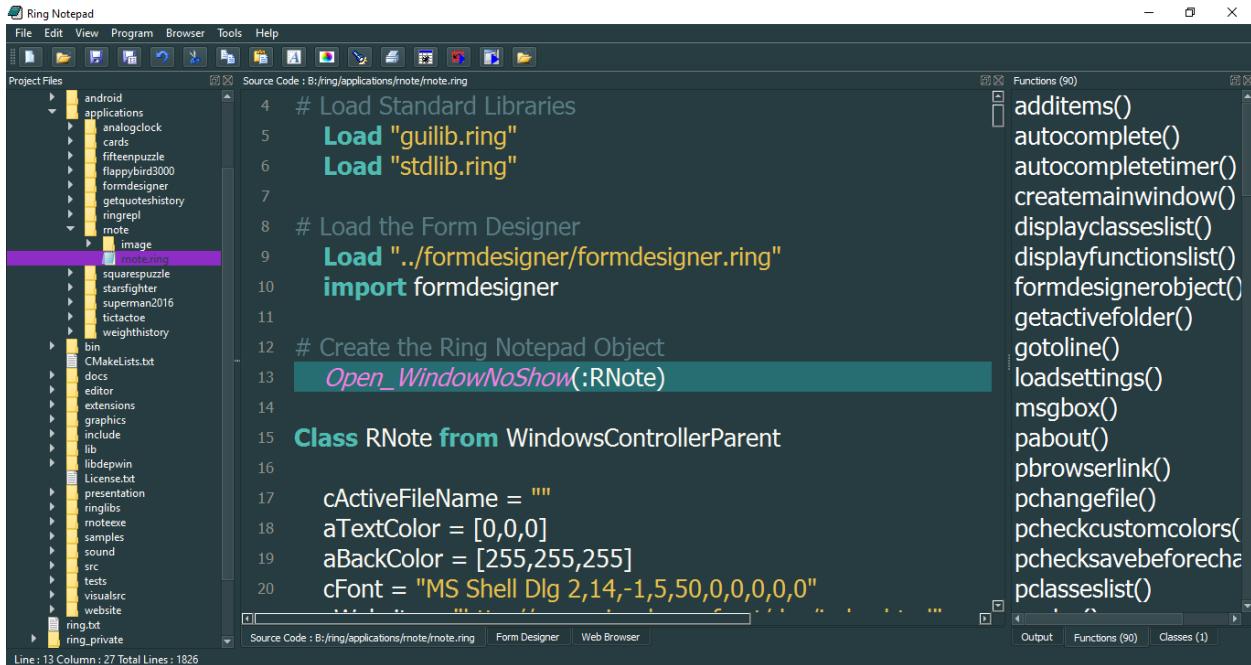
Tested using Windows, Ubuntu Linux, Linux Mint and MacOS X.

Screen Shot:



In Ring Notepad - the (Modern) Style colors are updated

Screen Shot:



The StdLib is updated to include the next functions

- TrimLeft()
- TrimRight()
- TrimAll()
- EpochTime()

The next functions are updated to display the dialogs on the top of other windows.

- SetDialogIcon(cIconFile)
- MsgInfo(cTitle,cMessage)
- ConfirmMsg(cTitle,cMessage)
- InputBox(cTitle,cMessage)
- InputBoxInt(cTitle,cMessage)
- InputBoxNum(cTitle,cMessage)
- InputBoxPass(cTitle,cMessage)

The Sixteen Puzzle is added to the Applications folder.

Screen Shot:



WHAT IS NEW IN RING 1.5?

In this chapter we will learn about the changes and new features in Ring 1.5 release.

108.1 List of changes and new features

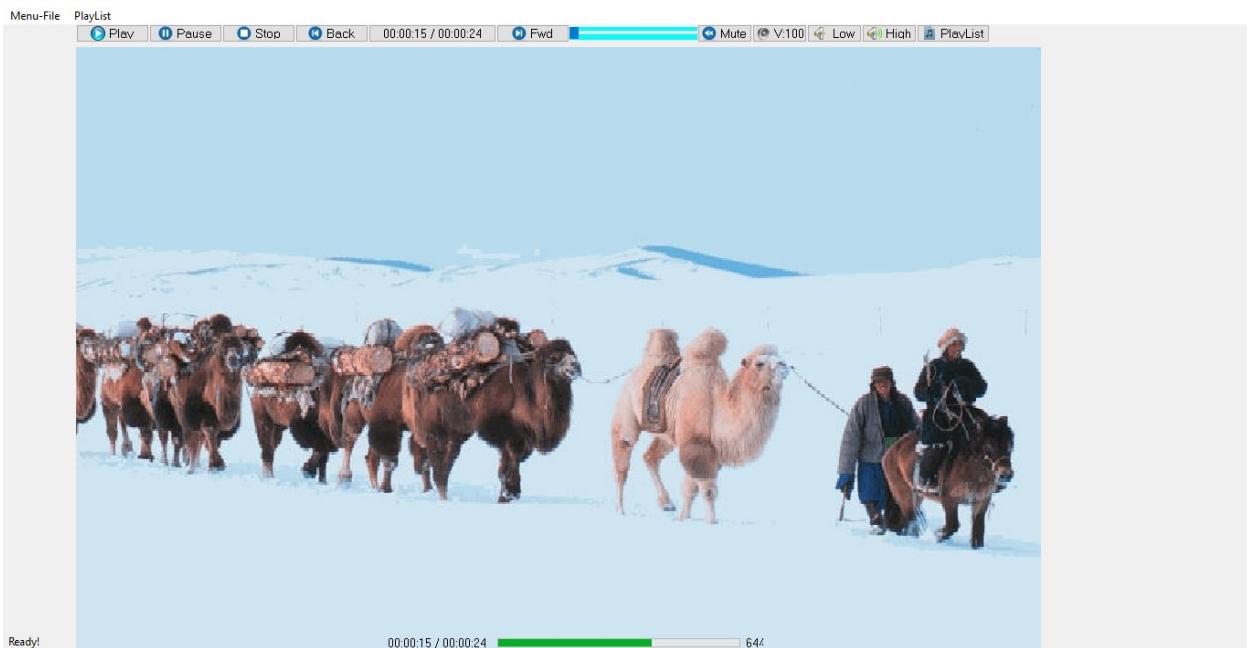
Ring 1.5 comes with many new features!

- Video-Music-Player Application
- Windows StartUp Manager Application
- Calculator Application
- Better Ring Notepad
- Better StdLib
- Better WebLib
- Better RingQt
- Better Objects Library
- RingFreeGLUT Extension
- RingOpenGL Extension
- Better Code Generator for Extensions
- Better Documentation Generator for Extensions
- Ring VM - Tracing Functions
- Trace Library and Interactive Debugger
- More Syntax Flexibility
- Type Hints Library
- Better Quality

108.2 Video-Music-Player Application

The Video-Music-Player application is added to the Applications folder.

Screen Shot:

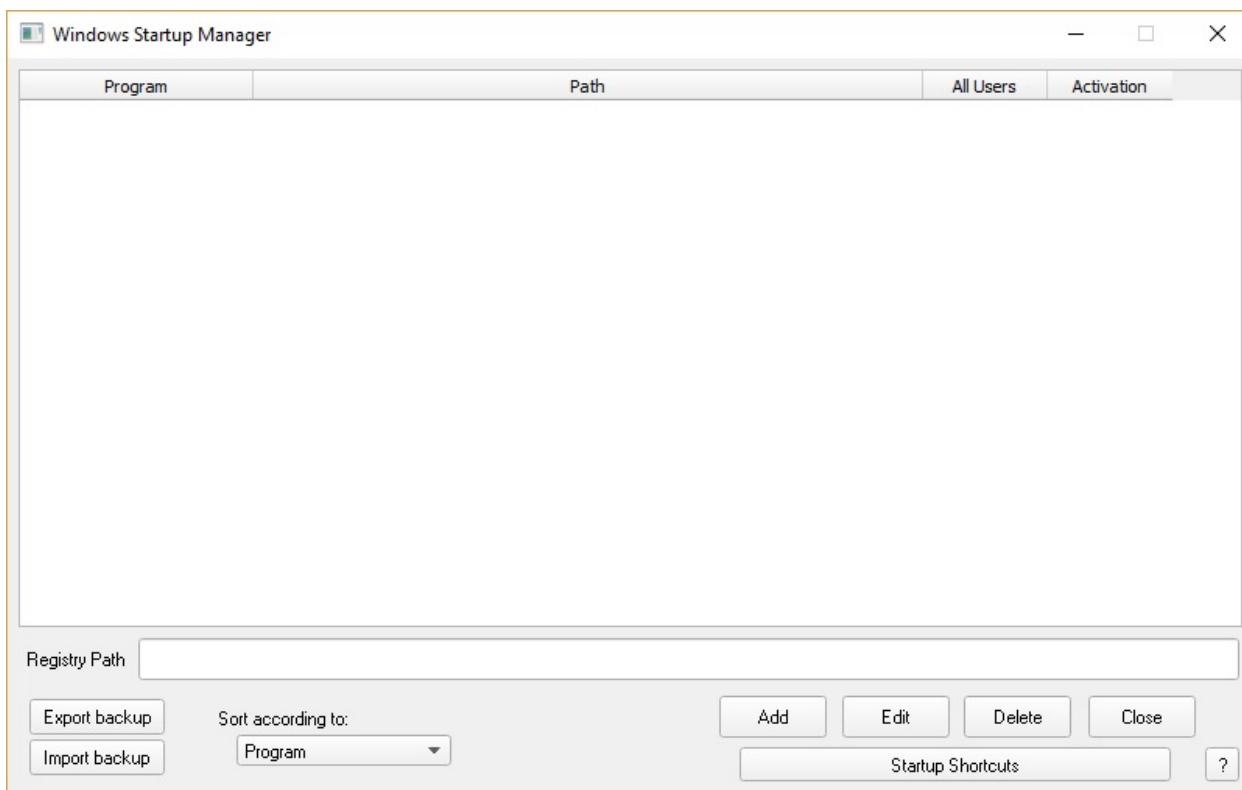


108.3 Windows StartUp Manager Application

The Windows StartUp Manager

URL : <https://github.com/ring-lang/WinStartupManager>

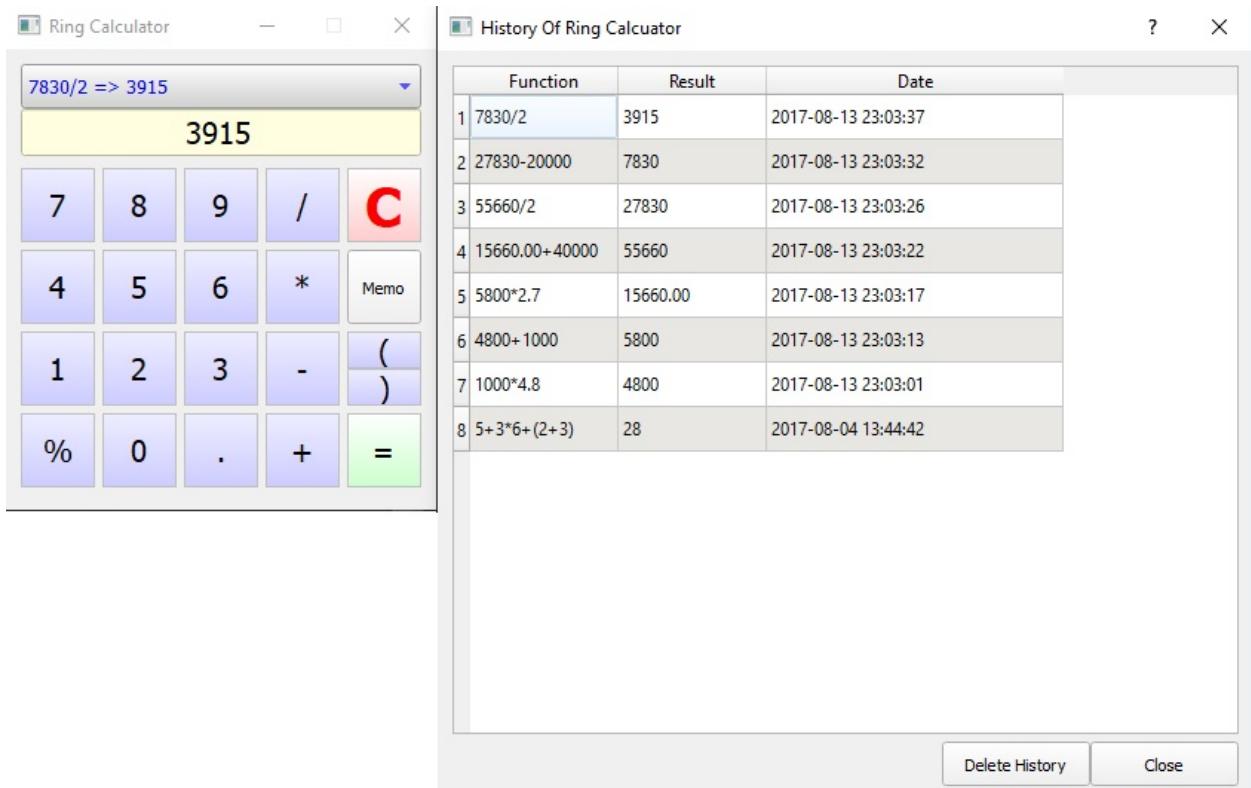
Screen Shot:



108.4 Calculator Application

The Calculator application is added to the Applications folder.

Screen Shot:



108.5 Better Ring Notepad

(1) Ring Notepad is updated to include some new styles and the Main File ToolBar

The idea of the Main File ToolBar is to determine the main file in the project When the project contains many source code files

This way you can run the project (Main File) at any time while opening other files in the project without the need to switch to the Main File to run the project.

To quickly use this feature

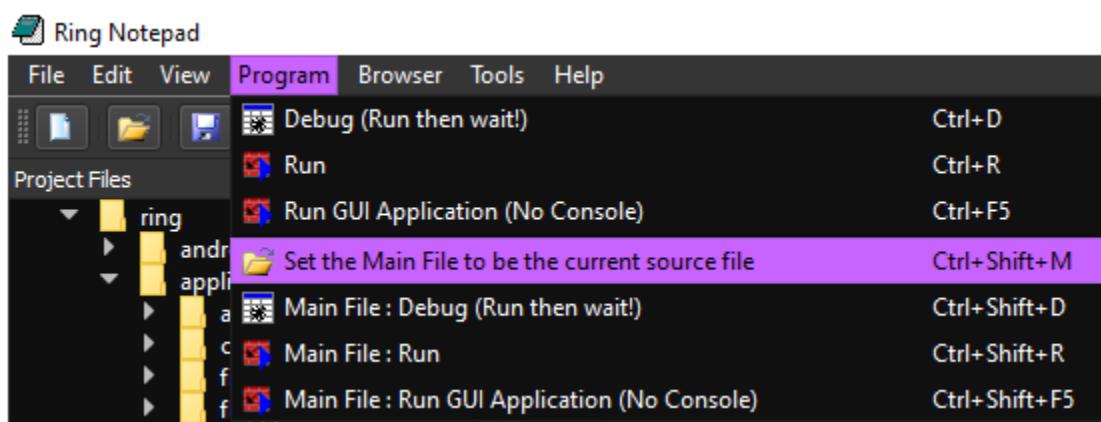
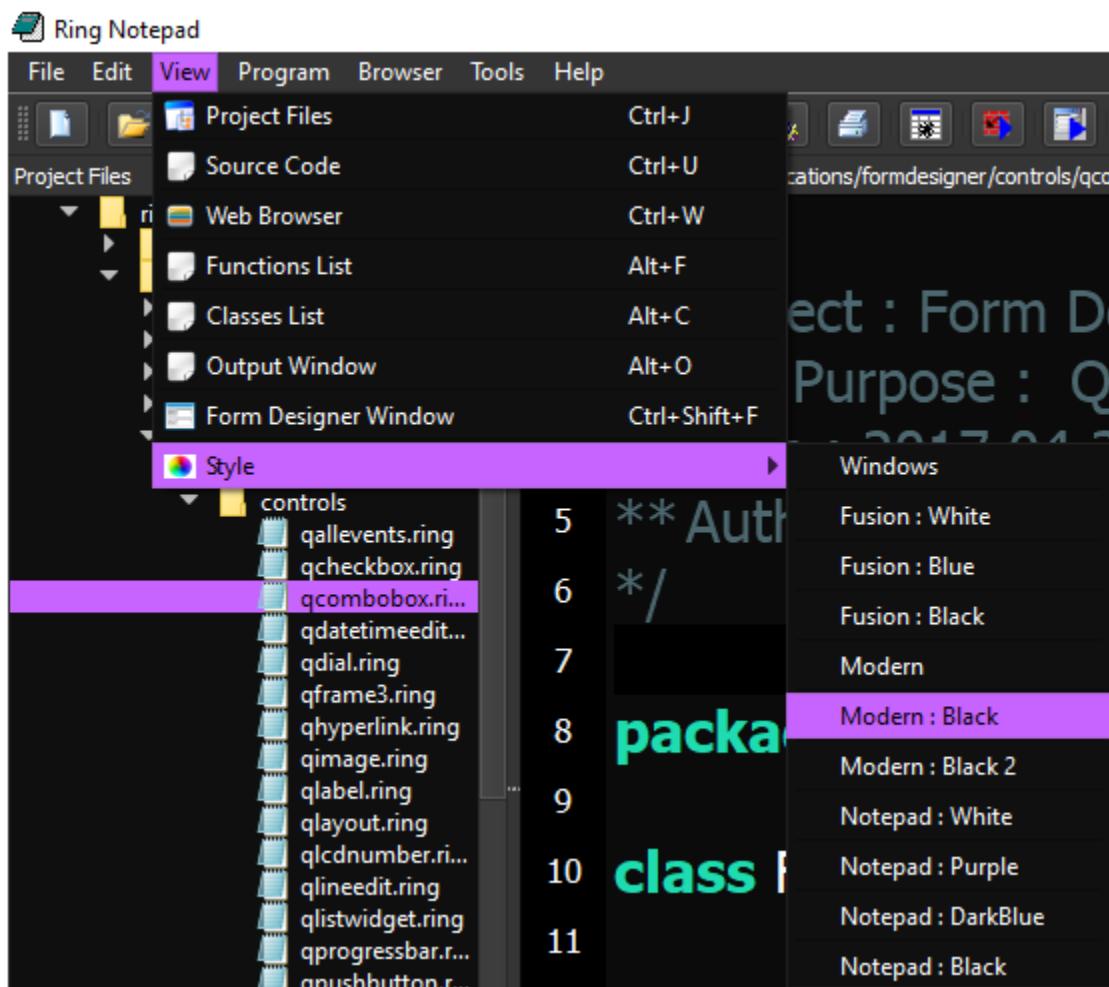
(Open the project main file)

Press Ctrl+Shift+M to set the current source code file as the main file

Open and modify other source code files in the project

To run the project (Main File) at any time press Ctrl+Shift+F5 (GUI) or Ctrl+Shift+D (Console)

Screen Shots:



```

1 /*
2 ** Project : Form Designer
3 ** File Purpose : QComboBox Control
4 ** Date : 2017.04.29
5 ** Author : Mahmoud Fayed <msfclipper@yahoo.com>
6 */
7
8 package formdesigner
9
10 class FormDesigner_QComboBox from QComboBox
11
12     CreateCommonAttributes()
13     CreateMoveResizeCornersAttributes()
14
15     cItems = ""
16     ccurrentIndex = ""

```

(2) The output window is updated to display the new lines correctly and contains the “Clear” button.

Screen Shot:

```

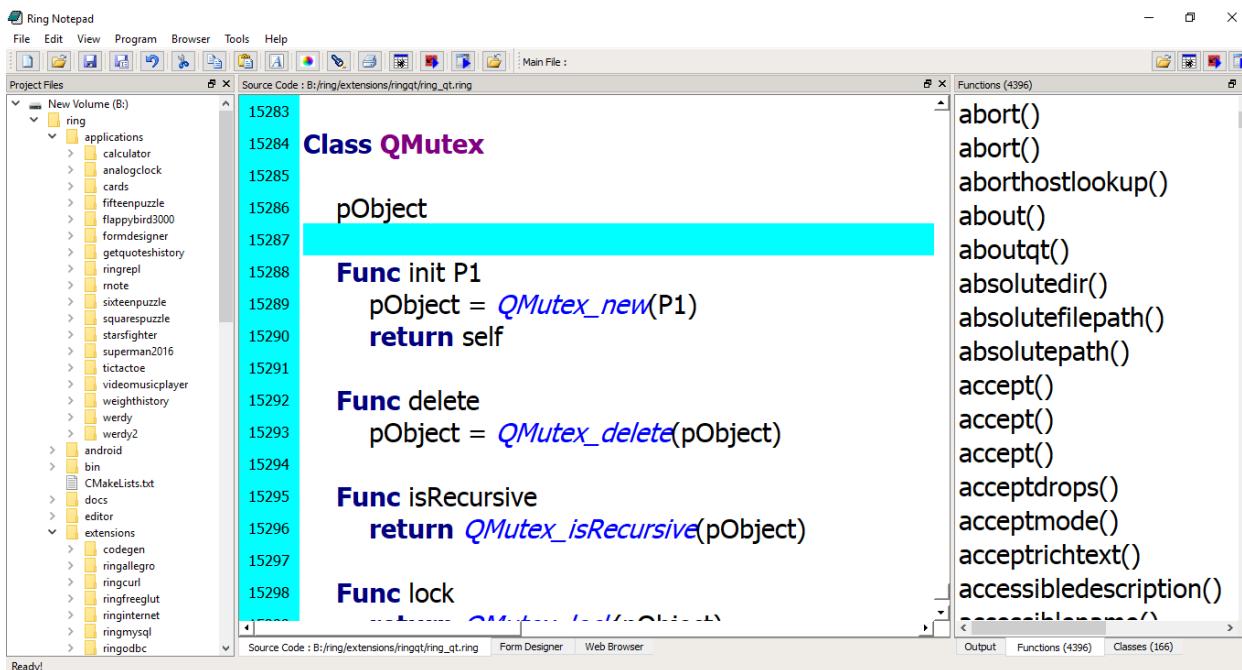
1 see "Date : " + date() + nl +
2     "Time : " + time() + nl

```

Date : 14/08/2017
Time : 02:22:14

(3) The Ring Notepad is updated to quickly open and switch between large files while preparing the functions/classes lists in the background.

Screen Shot:



108.6 Better StdLib

New Functions

- Print2Str()
- ListAllFiles()
- SystemCmd()

(1) The Print2Str() is a new function added to the StdLib

Example:

```

load "stdlib.ring"

world = "World!"
mystring = print2str("Hello, #{world} \nIn Year \n#{2000+17} \n")

see mystring + nl

```

Output:

```

Hello, World!
In Year
2017

```

(2) The ListAllFiles() is a new function added to the StdLib

Using this function we can quickly do a process on a group of files in a folder and it's sub folders.

Example:

```
load "stdlib.ring"
aList = ListAllFiles("c:/ring/ringlibs","ring") # *.ring only
aList = sort(aList)
see aList
```

Example:

```
load "stdlib.ring"
see listallfiles("b:/ring/ringlibs/weplib", "") # All Files
```

(3) The SystemCmd() is a new function added to the StdLib

The function will execute a system command like the System() function but will return the output in a string.

Example:

```
cYou = SystemCmd("whoami")
See "SystemCmd: whoami =====" + nl + cYou +nl
```

Output:

```
SystemCmd: whoami =====
desktop-umberto\umberto
```

108.7 Better WebLib

The WebLib is updated to include the HTMLPage class

Using this class we can create HTML documents without printing the output to the standard output

So instead of using the WebLib in Web Applications only

We can use it in Console/GUI/Mobile Applications too

Example:

```
load "stdlib.ring"
load "weplib.ring"

import System.Web

func main

    mypage = new HtmlPage {
        h1 { text("Customers Report") }
        Table
        {
            style = stylewidth("100%") + stylegradient(4)
            TR
            {
                TD { WIDTH="10%" text("Customers Count : ") }
                TD { text (100) }
            }
        }
    }
```

(continues on next page)

(continued from previous page)

```

Table
{
    style = stylewidth("100%") + stylegradient(26)
    TR
    {
        style = stylewidth("100%") + stylegradient(24)
        TD { text("Name" ) }
        TD { text("Age" ) }
        TD { text("Country" ) }
        TD { text("Job" ) }
        TD { text("Company" ) }
    }
    for x = 1 to 100
        TR
        {
            TD { text("Test" ) }
            TD { text("30" ) }
            TD { text("Egypt" ) }
            TD { text("Sales" ) }
            TD { text("Future" ) }
        }
    next
}

write("report.html",mypage.output())

```

Using this feature we can create reports quickly using WebLib & GUIlib together

Example:

```

load "stdlib.ring"
load "weplib.ring"
load "guilib.ring"

import System.Web
import System.GUI

new qApp {
    open_window(:CustomersReportController)
    exec()
}

class CustomersReportController

    oView = new CustomersReportView

    func Start
        CreateReport()

    func CreateReport

```

(continues on next page)

(continued from previous page)

```

mypage = new HtmlPage {
    h1 { text("Customers Report") }
    Table
    {
        style = stylewidth("100%") + stylegradient(4)
        TR
        {
            TD { WIDTH="10%"
                 text("Customers Count : " ) }
            TD { text (100) }
        }
    }
    Table
    {
        style = stylewidth("100%") + stylegradient(26)
        TR
        {
            style = stylewidth("100%") +
                stylegradient(24)
            TD { text("Name" ) }
            TD { text("Age" ) }
            TD { text("Country" ) }
            TD { text("Job" ) }
            TD { text("Company" ) }
        }
        for x = 1 to 100
            TR
            {
                TD { text("Test" ) }
                TD { text("30" ) }
                TD { text("Egypt" ) }
                TD { text("Sales" ) }
                TD { text("Future" ) }
            }
            next
        }
    }
    write("report.html",mypage.output())

func PrintEvent
    printer1 = new qPrinter(0) {
        setoutputformat(1)
        setoutputfilename("report.pdf")
    }
    oView {
        web.print(printer1)
        web.show()
    }
    system ("report.pdf")

class CustomersReportView

```

(continues on next page)

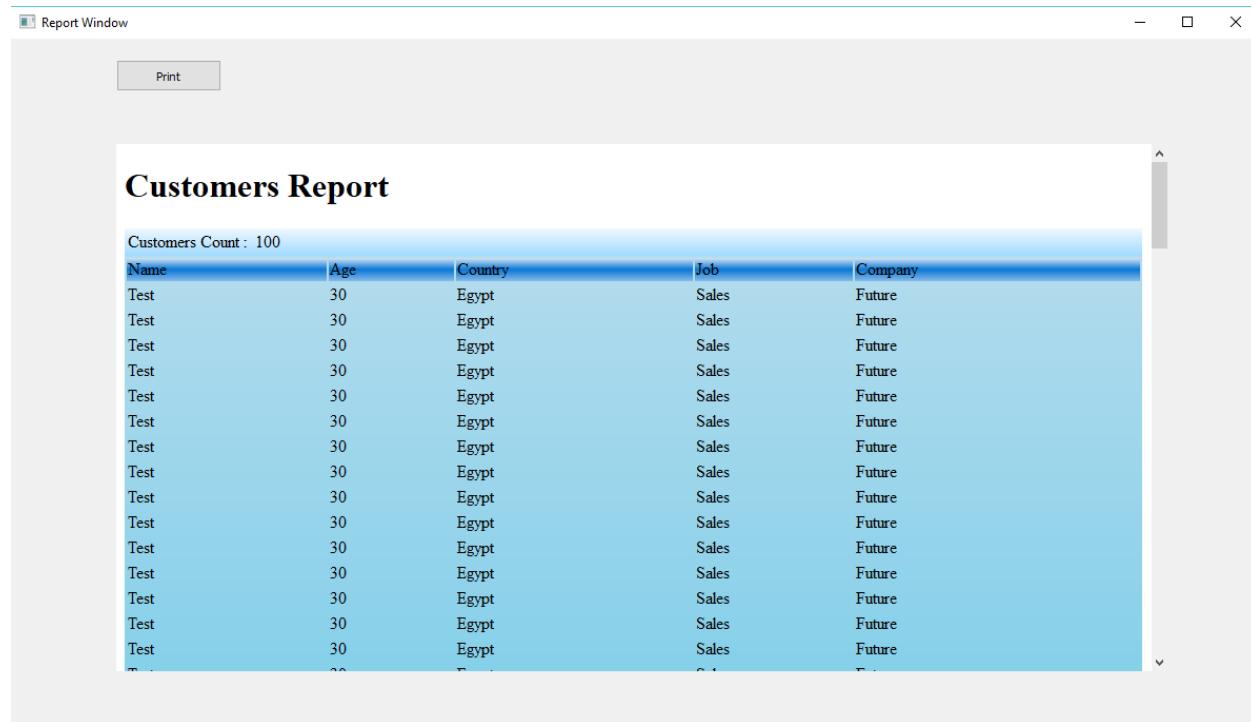
(continued from previous page)

```

win = new window() {
    setWindowTitle("Report Window")
    setGeometry(100,100,500,500)
    web = new webview(win) {
        setGeometry(100,100,1000,500)
        loadpage(new qurl("file:///"+
        currentdir() + "/report.html"))
    }
    new pushbutton(win) {
        setGeometry(100,20,100,30)
        setText("Print")
        setclickevent(Method(:PrintEvent))
    }
    showMaximized()
}

```

Screen Shot:



108.8 Better RingQt

New classes added to RingQt :

- QStringRef
- QMutex
- QMutexLocker
- QBuffer

- `QBluetoothAddress`
 - `QBluetoothDeviceDiscoveryAgent`
 - `QBluetoothDeviceInfo`
 - `QBluetoothHostInfo`
 - `QBluetoothLocalDevice`
 - `QBluetoothServer`
 - `QBluetoothServiceDiscoveryAgent`
 - `QBluetoothServiceInfo`
 - `QBluetoothSocket`
 - `QBluetoothTransferManager`
 - `QBluetoothTransferReply`
 - `QBluetoothTransferRequest`
 - `QBluetoothUuid`

Example:

```

### Submits your car VIN - Vehicle Id Number - to the Web Site - vpic.nhtsa.dot.gov
### Parses XML data returned
### Prints out the car info result

load "libcurl.ring"
load "guilib.ring"
load "stdlib.ring"

curl = curl_easy_init()

# request = "3G1JC5248YS251015?format=xml"    ### VIN - Chevrolet
request = "3GYFK62847G247323?format=xml"    ### VIN - Cadillac

call_type    = "decodevinvalues/"
url         = "https://vpic.nhtsa.dot.gov/api/vehicles/"
url_request = url + call_type + request

See "URL Request: "+ url_request +nl

curl_easy_setopt(curl, curlopt_url, url_request)
response = curl_easy_perform_silent(curl);

See nl +"Response Raw: "+ response +nl +nl

curl_easy_cleanup(curl)

xml = new QDomStreamReader()
xml.addData_2(response)

x = new QStringRef()
while not xml.atEnd()
    if xml.error()

```

(continues on next page)

(continued from previous page)

```

        see xml.errorstring() see nl
        exit loop
ok

x = xml.text()
if not x.length() = 0
    see "Length: " see x.length() +" --- "
    see "Value: " see x.tostring() see nl
ok

xml.readnext()
end

get x

###-----
### Results
#
# ==>Value: 115
# ==>Value: Results returned successfully
# ==>Value: VIN(s): 3G1JC5248YS251015
# ==>Value: 3G1JC5248YS251015
# ==>Value: Sedan/Saloon
# ==>Value: 4
# ==>Value: 2200.0
# ==>Value: 134.25223700841
# ==>Value: 2.2
# ==>Value: 4
# ==>Value: LN2
# ==>Value: CHEVROLET
# ==>Value: GENERAL MOTORS LLC
# ==>Value: Cavalier
# ==>Value: 2000
# ==>Value: Ramos Arzipe
# ==>Value: PASSENGER CAR
# ==>Value: 4
# ==>Value: In-Line
# ==>Value: 1st Row (Driver & Passenger)
# ==>Value: Sequential Fuel Injection (SFI)
# ==>Value: Mexico
# ==>Value: NA
# ==>Value: Manual
# ==>Value: Body Type: Sedan, 4-6 Window, Notchback (GM codes: 19, 69)
# ==>Value: Name Plate: Chevrolet, Pontiac
# ==>Value: 0 - VIN decoded clean. Check Digit (9th position) is correct
# ==>Value: LAN
# ==>Value: 984
#
###-----

```

108.9 Better Objects Library

The function Open_WindowInPackages() is added to the Objects library.

The Open_WindowInPackages() function is the same as Open_Window() but takes an extra list that determine the packages to import before opening the window.

Syntax:

```
Open_WindowInPackages(cClassName, aPackagesList)
```

Example:

The next example from the Form Designer source code, Open the Window Flags window using the open_windowInPackages() function.

We determine the class name “WindowFlagsController” and the packages name.

The Window Flags window uses the FormDesigner and System.GUI packages.

```
open_windowInPackages(:WindowFlagsController, [
    "formdesigner",
    "System.GUI"
])
```

108.10 RingFreeGLUT Extension

Ring 1.5 comes with RingFreeGLUT extension to support the FreeGLUT library

Example:

```
/*
    This sample is based on C Tutorials
    from : http://www.lighthouse3d.com/tutorials/glut-tutorial/
*/

load "freeglut.ring"
load "opengl21lib.ring"

// angle of rotation for the camera direction
angle = 0.0

// actual vector representing the camera's direction
lx=0.0 lz=-1.0

// XZ position of the camera
x=0.0 z=5.0

// the key states. These variables will be zero
//when no key is being presses
deltaAngle = 0.0
deltaMove = 0
x0Origin = -1
```

(continues on next page)

(continued from previous page)

```
// Constant definitions for Menus
C_RED = 1
C_GREEN = 2
C_BLUE = 3
C_ORANGE = 4

C_FILL = 5
C_LINE = 6

// Pop up menu identifiers
fillMenu=NULL
fontMenu=NULL
mainMenu=NULL
colorMenu=NULL

// color for the nose
red = 1.0
blue=0.5
green=0.5

// scale of snowman
scale = 1.0

// menu status
menuFlag = 0

// default font
font = GLUT_BITMAP_TIMES_ROMAN_24

C_INT GLUT_BITMAP_8_BY_13 = 7
C_INT GLUT_BITMAP_9_BY_15 = 8
C_INT GLUT_BITMAP_TIMES_ROMAN_10 = 9
C_INT GLUT_BITMAP_TIMES_ROMAN_24 = 10
C_INT GLUT_BITMAP_HELVETICA_10 = 11
C_INT GLUT_BITMAP_HELVETICA_12 = 12
C_INT GLUT_BITMAP_HELVETICA_18 = 13

// width and height of the window
h = 0
w = 0

// variables to compute frames per second
frame=0
time=0
timebase=0
s = ""

func changeSize
    w = glutEventWidth()
    h = glutEventHeight()
```

(continues on next page)

(continued from previous page)

```

// Prevent a divide by zero, when window is too short
// (you cant make a window of zero width).
if h = 0
    h = 1
ok

ratio = w * 1.0 / h

// Use the Projection Matrix
glMatrixMode(GL_PROJECTION)

// Reset Matrix
glLoadIdentity()

// Set the viewport to be the entire window
glViewport(0, 0, w, h)

// Set the correct perspective.
gluPerspective(45.0, ratio, 0.1, 100.0)

// Get Back to the Modelview
glMatrixMode(GL_MODELVIEW)

func drawSnowMan

    glScalef(scale, scale, scale)
    glColor3f(1.0, 1.0, 1.0)

    // Draw Body
    glTranslatef(0.0, 0.75, 0.0)
    glutSolidSphere(0.75, 20, 20)

    // Draw Head
    glTranslatef(0.0, 1.0, 0.0)
    glutSolidSphere(0.25, 20, 20)

    // Draw Eyes
    glPushMatrix()
    glColor3f(0.0, 0.0, 0.0)
    glTranslatef(0.05, 0.10, 0.18)
    glutSolidSphere(0.05, 10, 10)
    glTranslatef(-0.1, 0.0, 0.0)
    glutSolidSphere(0.05, 10, 10)
    glPopMatrix()

    // Draw Nose
    glColor3f(red, green, blue)
    glRotatef(0.0, 1.0, 0.0, 0.0)
    glutSolidCone(0.08, 0.5, 10, 2)

    glColor3f(1.0, 1.0, 1.0)

```

(continues on next page)

(continued from previous page)

```

func renderBitmapString x,y,z,font,string
    glRasterPos3f(x, y,z)
    for c in string
        glutBitmapCharacter(font,ascii(c))
    next

func renderStrokeFontString x,y,z,font,string
    glPushMatrix()
    glTranslatef(x, y,z)
    glScalef(0.002, 0.002, 0.002)
    for c in string
        glutStrokeCharacter(font, Ascii(c));
    next
    glPopMatrix()

func restorePerspectiveProjection

    glMatrixMode(GL_PROJECTION)
    // restore previous projection matrix
    glPopMatrix()

    // get back to modelview mode
    glMatrixMode(GL_MODELVIEW)

func setOrthographicProjection

    // switch to projection mode
    glMatrixMode(GL_PROJECTION)

    // save previous matrix which contains the
    //settings for the perspective projection
    glPushMatrix()

    // reset matrix
    glLoadIdentity()

    // set a 2D orthographic projection
    gluOrtho2D(0, w, h, 0)

    // switch back to modelview mode
    glMatrixMode(GL_MODELVIEW)

func computePos deltaMove

    x += deltaMove * lx * 0.1
    z += deltaMove * lz * 0.1

```

(continues on next page)

(continued from previous page)

```

func renderScene

    if deltaMove
        computePos(deltaMove)
    ok

    // Clear Color and Depth Buffers
    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)

    // Reset transformations
    glLoadIdentity()

    // Set the camera
    gluLookAt(      x, 1.0, z,
                    x+lx, 1.0, z+lz,
                    0.0, 1.0, 0.0)

    // Draw ground

    glColor3f(0.9, 0.9, 0.9)
    glBegin(GL_QUADS)
        glVertex3f(-100.0, 0.0, -100.0)
        glVertex3f(-100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, 100.0)
        glVertex3f( 100.0, 0.0, -100.0)
    glEnd()

    // Draw 9 SnowMen
    for i = -3 to -1
        for j = -3 to -1
            glPushMatrix()
            glTranslatef(i*10.0, 0.0, j * 10.0)
            drawSnowMan()
            number = (i+3)*3+(j+3)
            renderBitmapString(0.0, 0.5, 0.0, font ,""+number)
            glPopMatrix()
        next
    next

    // Code to compute frames per second
    frame++

    time=glutGet(GLUT_ELAPSED_TIME)
    if time - timebase > 1000
        s = "RingFreeGLUT - FPS: " + (frame*1000.0/(time-timebase))
        timebase = time
        frame = 0
    ok

    // Code to display a string (fps) with bitmap fonts
    setOrthographicProjection()

```

(continues on next page)

(continued from previous page)

```

glPushMatrix()
glLoadIdentity()
renderBitmapString(5, 30, 0, GLUT_BITMAP_HELVETICA_18, s)
glPopMatrix()

restorePerspectiveProjection()

glutSwapBuffers()

// -----
//          KEYBOARD
// -----
func processNormalKeys
    key = glutEventKey()
    xx = glutEventX()
    yy = glutEventY()

    switch key
        on 27
            glutDestroyMenu(mainMenu)
            glutDestroyMenu(fillMenu)
            glutDestroyMenu(colorMenu)
            glutDestroyMenu(fontMenu)
            Shutdown()
        off

func pressKey

    key = glutEventKey()
    xx = glutEventX()
    yy = glutEventY()

    switch key
        on GLUT_KEY_UP
            deltaMove = 0.5
        on GLUT_KEY_DOWN
            deltaMove = -0.5
    off

func releaseKey

    key = glutEventKey()

    switch key
        on GLUT_KEY_UP
            deltaMove = 0
        on GLUT_KEY_DOWN
            deltaMove = 0

```

(continues on next page)

(continued from previous page)

```

off

// -----
//      MOUSE
// -----


func mouseMove
    xx = glutEventX()
    yy = glutEventY()

    // this will only be true when the left button is down
    if xOrigin >= 0

        // update deltaAngle
        deltaAngle = (xx - xOrigin) * 0.001

        // update camera's direction
        lx = sin(angle + deltaAngle)
        lz = -cos(angle + deltaAngle)
    ok

func mouseButton

    button = glutEventButton()
    state = glutEventState()
    xx = glutEventX()
    yy = glutEventY()

    // only start motion if the left button is pressed
    if button = GLUT_LEFT_BUTTON
        // when the button is released
        if state = GLUT_UP
            angle += deltaAngle
            xOrigin = -1
        else
            // state = GLUT_DOWN
            xOrigin = xx
        ok
    ok

// -----
//      MENUS
// -----


func processMenuStatus

    status = glutEventStatus()

    if status = GLUT_MENU_IN_USE

```

(continues on next page)

(continued from previous page)

```

        menuFlag = 1
    else
        menuFlag = 0
    ok

func processMainMenu

    // nothing to do in here
    // all actions are for submenus

func processFillMenu

    option = glutEventValue()

    switch option

        on C_FILL
            glPolygonMode(GL_FRONT, GL_FILL)
        on C_LINE
            glPolygonMode(GL_FRONT, GL_LINE)
    off

func processFontMenu

    option = glutEventValue()

    switch (option) {
        on C_INT GLUT_BITMAP_8_BY_13
            font = GLUT_BITMAP_8_BY_13
        on C_INT GLUT_BITMAP_9_BY_15
            font = GLUT_BITMAP_9_BY_15
        on C_INT GLUT_BITMAP_TIMES_ROMAN_10
            font = GLUT_BITMAP_TIMES_ROMAN_10
        on C_INT GLUT_BITMAP_TIMES_ROMAN_24
            font = GLUT_BITMAP_TIMES_ROMAN_24
        on C_INT GLUT_BITMAP_HELVETICA_10
            font = GLUT_BITMAP_HELVETICA_10
        on C_INT GLUT_BITMAP_HELVETICA_12
            font = GLUT_BITMAP_HELVETICA_12
        on C_INT GLUT_BITMAP_HELVETICA_18
            font = GLUT_BITMAP_HELVETICA_18
    off

func processColorMenu

    option = glutEventValue()

    switch option
        on C_RED

```

(continues on next page)

(continued from previous page)

```

        red = 1.0
        green = 0.0
        blue = 0.0
    on C_GREEN
        red = 0.0
        green = 1.0
        blue = 0.0
    on C_BLUE
        red = 0.0
        green = 0.0
        blue = 1.0
    on C_ORANGE
        red = 1.0
        green = 0.5
        blue = 0.5
off

func createPopupMenu

    fontMenu = glutCreateMenu(:processFontMenu)

    glutAddMenuEntry("BITMAP_8_BY_13 ",C_INT GLUT_BITMAP_8_BY_13 )
    glutAddMenuEntry("BITMAP_9_BY_15",C_INT GLUT_BITMAP_9_BY_15 )
    glutAddMenuEntry("BITMAP_TIMES_ROMAN_10 ",C_INT GLUT_BITMAP_TIMES_ROMAN_10 )
    glutAddMenuEntry("BITMAP_TIMES_ROMAN_24",C_INT GLUT_BITMAP_TIMES_ROMAN_24 )
    glutAddMenuEntry("BITMAP_HELVETICA_10 ",C_INT GLUT_BITMAP_HELVETICA_10 )
    glutAddMenuEntry("BITMAP_HELVETICA_12",C_INT GLUT_BITMAP_HELVETICA_12 )
    glutAddMenuEntry("BITMAP_HELVETICA_18",C_INT GLUT_BITMAP_HELVETICA_18 )

    fillMenu = glutCreateMenu(:processFillMenu)

    glutAddMenuEntry("Fill",C_FILL)
    glutAddMenuEntry("Line",C_LINE)

    colorMenu = glutCreateMenu(:processColorMenu)
    glutAddMenuEntry("Red",C_RED);
    glutAddMenuEntry("Blue",C_BLUE);
    glutAddMenuEntry("Green",C_GREEN);
    glutAddMenuEntry("Orange",C_ORANGE);

    mainMenu = glutCreateMenu(:processMainMenu)

    glutAddSubMenu("Polygon Mode", fillMenu)
    glutAddSubMenu("Color", colorMenu)
    glutAddSubMenu("Font", fontMenu)
    // attach the menu to the right button
    glutAttachMenu(GLUT_RIGHT_BUTTON)

    // this will allow us to know if the menu is active
    glutMenuStatusFunc(:processMenuStatus)

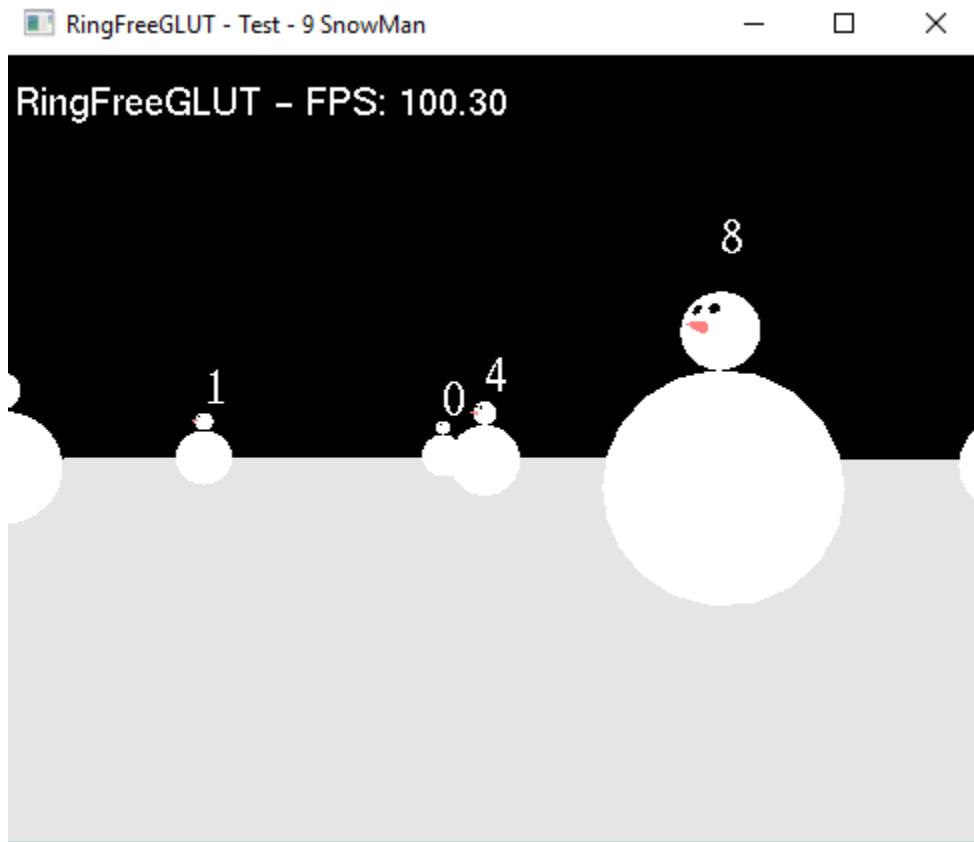
```

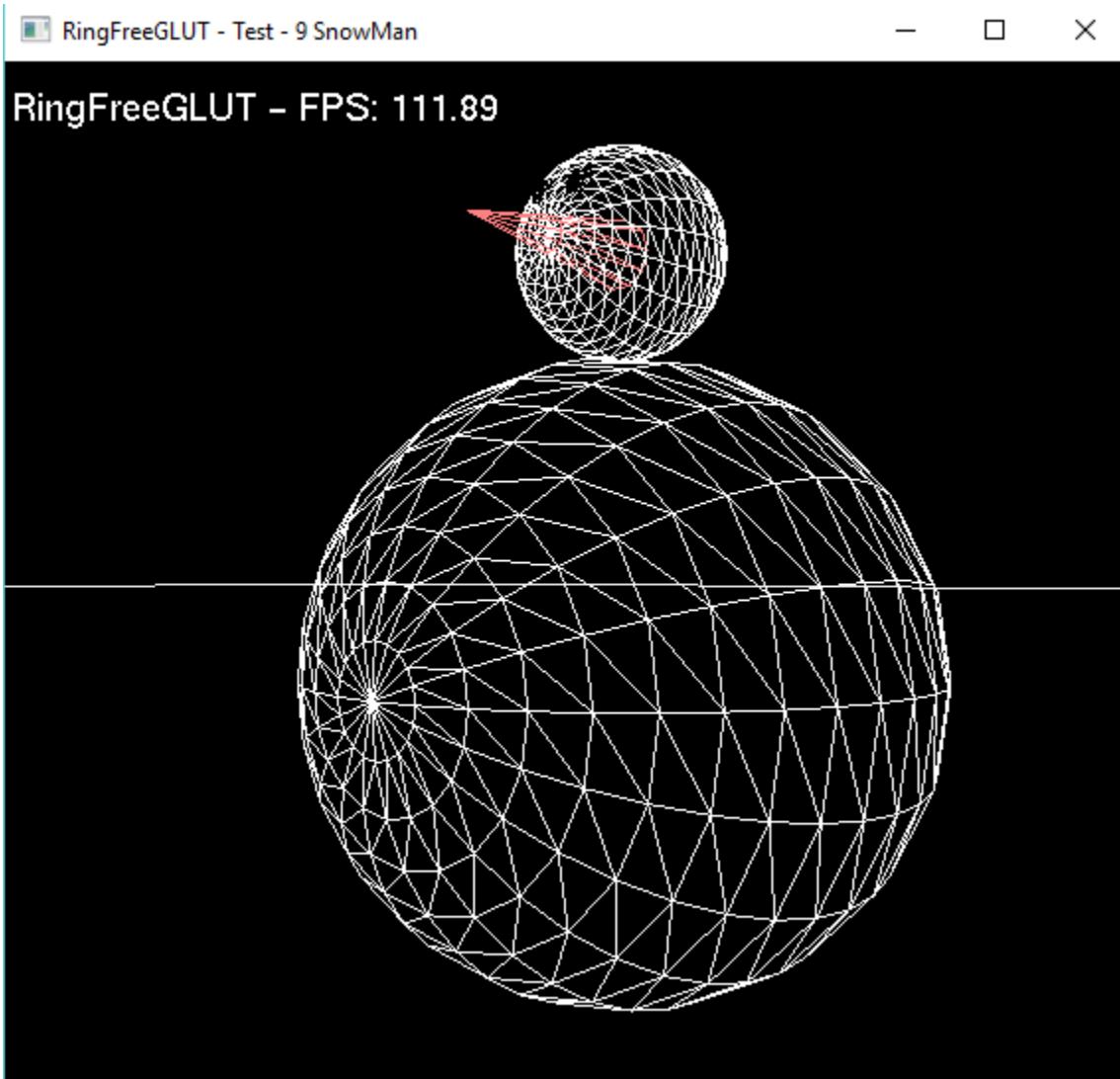
(continues on next page)

(continued from previous page)

```
// -----
//          MAIN
// -----  
  
func main  
  
    // init GLUT and create window  
    glutInit()  
    glutInitDisplayMode(GLUT_DEPTH | GLUT_DOUBLE | GLUT_RGBA)  
    glutInitWindowPosition(100,100)  
    glutInitWindowSize(320,320)  
    glutCreateWindow("RingFreeGLUT - Test - 9 SnowMan")  
  
    // register callbacks  
    glutDisplayFunc(:renderScene)  
    glutReshapeFunc(:changeSize)  
    glutIdleFunc(:renderScene)  
  
    glutIgnoreKeyRepeat(1)  
    glutKeyboardFunc(:processNormalKeys)  
    glutSpecialFunc(:pressKey)  
    glutSpecialUpFunc(:releaseKey)  
  
    // here are the two new functions  
    glutMouseFunc(:mouseButton)  
    glutMotionFunc(:mouseMove)  
  
    // OpenGL init  
    glEnable(GL_DEPTH_TEST)  
    glEnable(GL_CULL_FACE)  
  
    // init Menus  
    createPopupMenus()  
  
    // enter GLUT event processing cycle  
    glutMainLoop()
```

Screen Shots:





108.11 RingOpenGL Extension

Ring 1.5 comes with RingOpenGL and support for the next versions

- OpenGL 1.1
- OpenGL 1.2
- OpenGL 1.3
- OpenGL 1.4
- OpenGL 1.5
- OpenGL 2.0
- OpenGL 2.1
- OpenGL 3.0
- OpenGL 3.2

- OpenGL 3.3
- OpenGL 4.0
- OpenGL 4.1
- OpenGL 4.2
- OpenGL 4.3
- OpenGL 4.4
- OpenGL 4.5
- OpenGL 4.6

Example:

```
/*
    This sample is based on C Tutorials
    from :
        http://www.wikihow.com/Make-a-Cube-in-OpenGL
*/

load "freeglut.ring"
load "opengl21lib.ring"

// -----
// Global Variables
// -----
rotate_y=0
rotate_x=0

// -----
// display() Callback function
// -----
func display

// Clear screen and Z-buffer
glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)

// Reset transformations
glLoadIdentity()

// Rotate when user changes rotate_x and rotate_y
glRotatef( rotate_x, 1.0, 0.0, 0.0 )
glRotatef( rotate_y, 0.0, 1.0, 0.0 )

//Multi-colored side - FRONT
glBegin(GL_POLYGON)

glColor3f( 1.0, 0.0, 0.0 )    glVertex3f( 0.5, -0.5, -0.5 )    # P1 is red
glColor3f( 0.0, 1.0, 0.0 )    glVertex3f( 0.5, 0.5, -0.5 )    # P2 is green
glColor3f( 0.0, 0.0, 1.0 )    glVertex3f( -0.5, 0.5, -0.5 )   # P3 is blue
glColor3f( 1.0, 0.0, 1.0 )    glVertex3f( -0.5, -0.5, -0.5 )  # P4 is purple

glEnd()
```

(continues on next page)

(continued from previous page)

```

// White side - BACK
glBegin(GL_POLYGON)
glColor3f( 1.0, 1.0, 1.0 )
glVertex3f( 0.5, -0.5, 0.5 )
glVertex3f( 0.5, 0.5, 0.5 )
glVertex3f( -0.5, 0.5, 0.5 )
glVertex3f( -0.5, -0.5, 0.5 )
glEnd()

// Purple side - RIGHT
glBegin(GL_POLYGON)
glColor3f( 1.0, 0.0, 1.0 )
glVertex3f( 0.5, -0.5, -0.5 )
glVertex3f( 0.5, 0.5, -0.5 )
glVertex3f( 0.5, 0.5, 0.5 )
glVertex3f( 0.5, -0.5, 0.5 )
glEnd()

// Green side - LEFT
glBegin(GL_POLYGON)
glColor3f( 0.0, 1.0, 0.0 )
glVertex3f( -0.5, -0.5, 0.5 )
glVertex3f( -0.5, 0.5, 0.5 )
glVertex3f( -0.5, 0.5, -0.5 )
glVertex3f( -0.5, -0.5, -0.5 )
glEnd()

// Blue side - TOP
glBegin(GL_POLYGON)
glColor3f( 0.0, 0.0, 1.0 )
glVertex3f( 0.5, 0.5, 0.5 )
glVertex3f( 0.5, 0.5, -0.5 )
glVertex3f( -0.5, 0.5, -0.5 )
glVertex3f( -0.5, 0.5, 0.5 )
glEnd()

// Red side - BOTTOM
glBegin(GL_POLYGON)
glColor3f( 1.0, 0.0, 0.0 )
glVertex3f( 0.5, -0.5, -0.5 )
glVertex3f( 0.5, -0.5, 0.5 )
glVertex3f( -0.5, -0.5, 0.5 )
glVertex3f( -0.5, -0.5, -0.5 )
glEnd()

glFlush()
glutSwapBuffers()

// -----
// specialKeys() Callback Function

```

(continues on next page)

(continued from previous page)

```

// -----
func specialKeys

    key = glutEventKey()

    // Right arrow - increase rotation by 5 degree
    switch Key

        on GLUT_KEY_RIGHT
            rotate_y += 5

        // Left arrow - decrease rotation by 5 degree
        on GLUT_KEY_LEFT
            rotate_y -= 5

        on GLUT_KEY_UP
            rotate_x += 5

        on GLUT_KEY_DOWN
            rotate_x -= 5

        off

    // Request display update
    glutPostRedisplay()

```



```

// -----
// main() function
// -----
func main

    // Initialize GLUT and process user parameters
    glutInit()

    // Request double buffered true color window with Z-buffer
    glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB | GLUT_DEPTH)

    // Create window
    glutCreateWindow("Awesome Cube")

    // Enable Z-buffer depth test
    glEnable(GL_DEPTH_TEST)

    // Callback functions
    glutDisplayFunc(:display)
    glutSpecialFunc(:specialKeys)

    // Pass control to GLUT for events
    glutMainLoop()

```

(continues on next page)

(continued from previous page)

```
// Return to OS
```

Screen Shot:

```

22  glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
23
24 // Reset transformations
25 glLoadIdentity()
26
27 // Rotate when user changes rotate_x and rotate_y
28 glRotatef(rotate_x, 1.0, 0.0, 0.0)
29 glRotatef(rotate_y, 0.0, 1.0, 0.0)
30
31 //Multi-colored side - FRONT
32 glBegin(GL_POLYGON)
33
34 glColor3f( 1.0, 0.0, 0.0 )    glVertex3f( 0.5, -0.5, -0.5 )    # P1 is red
35 glColor3f( 0.0, 1.0, 0.0 )    glVertex3f( 0.5, 0.5, -0.5 )    # P2 is green
36 glColor3f( 0.0, 0.0, 1.0 )    glVertex3f( -0.5, 0.5, -0.5 )   # P3 is blue
37 glColor3f( 1.0, 0.0, 1.0 )    glVertex3f( -0.5, -0.5, -0.5 )  # P4 is purple
38

```



108.12 Better Code Generator for Extensions

The Code Generator is updated to support <constant> type, So we can have constants other than numbers, for example : Strings and Pointers.

When we have pointers we can determine the pointer type. To use this feature, before <constant> and </constant> we can use

```
$nDefaultConstantType = C_CONSTANT_TYPE_POINTER
$cDefaultConstantPointerType = "void *"
```

The next example from the RingFreeGLUT extension

```
<runcode>
    $nDefaultConstantType = C_CONSTANT_TYPE_POINTER
    $cDefaultConstantPointerType = "void"
</runcode>
<constant>
    GLUT_STROKE_ROMAN
    GLUT_STROKE_MONO_ROMAN
    GLUT_BITMAP_9_BY_15
    GLUT_BITMAP_8_BY_13
    GLUT_BITMAP_TIMES_ROMAN_10
    GLUT_BITMAP_TIMES_ROMAN_24
    GLUT_BITMAP_HELVETICA_10
    GLUT_BITMAP_HELVETICA_12

```

(continues on next page)

(continued from previous page)

```
GLUT_BITMAP_HELVETICA_18
</constant>
```

108.13 Better Documentation Generator for Extensions

The documentation generator for extensions is updated to generate a list of constants in the generated documentation. The previous versions provides the functions prototype only. Now we have the list of constants too.

108.14 Ring VM - Tracing Functions

In Ring 1.5 the next functions are added to Ring VM

- RingVM_SetTrace(cCode)
- RingVM_TraceData() -> aDataList
- RingVM_TraceEvent() -> nTraceEvent
- RingVM_TraceFunc() -> cCode
- RingVM_ScopesCount() -> nScopes
- RingVM_EvalInScope(nScope,cCode)
- RingVM_PassError()
- RingVM_HideErrorMsg(lStatus)
- RingVM_CallFunc(cFuncName)

Example:

```
load "tracelib.ring"

ringvm_settrace("mytrace()")

see "Hello, world!" + nl
see "Welcome" + nl
see "How are you?" +nl
mytest()
new myclass { mymethod() }

func mytest
    see "Message from mytest" + nl

func mytrace
    see "===== The Trace function is Active =====" + nl +
        "Trace Function Name : " + ringvm_TraceFunc() + nl +
        "Trace Event : "
    switch ringvm_TraceEvent()
        on TRACEEVENT_NEWLINE          see "New Line"
        on TRACEEVENT_NEWFUNC          see "New Function"
        on TRACEEVENT_RETURN           see "Return"
```

(continues on next page)

(continued from previous page)

```

on TRACEEVENT_ERROR           see "Error"
on TRACEEVENT_BEFOREFUNC     see "Before C Function"
on TRACEEVENT_AFTERFUNC      see "After C Function"

off
see nl +
    "Line Number : " + ringvm_tracedata() [TRACEDATA_LINENUMBER] + nl +
    "File Name   : " + ringvm_tracedata() [TRACEDATA_FILENAME] + nl +
    "Function Name : " + ringvm_tracedata() [TRACEDATA_FUNCNAME] + nl +
    "Method or Function : "
    if ringvm_tracedata() [TRACEDATA_METHODORFUNC] =
        TRACEDATA_METHODORFUNC_METHOD
        see "Method"
    else
        if ringvm_tracedata() [TRACEDATA_FUNCNAME] = NULL
            see "Command"
        else
            see "Function"
    ok
ok
see nl + Copy("=", 42) + nl

class myclass
    func mymethod
        see "Message from mymethod" + nl

```

Output:

```

===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : After C Function
Line Number : 3
File Name   : test1.ring
Function Name : ringvm_settrace
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 5
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
Hello, world!
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 6
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
```

(continues on next page)

(continued from previous page)

```
Welcome
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 7
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
How are you?
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 8
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Function
Line Number : 8
File Name   : test1.ring
Function Name : mytest
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 12
File Name   : test1.ring
Function Name : mytest
Method or Function : Function
=====
Message from mytest
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 14
File Name   : test1.ring
Function Name : mytest
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Return
Line Number : 8
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
===== The Trace function is Active =====
```

(continues on next page)

(continued from previous page)

```
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 9
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 43
File Name   : test1.ring
Function Name :
Method or Function : Command
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Before C Function
Line Number : 9
File Name   : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : After C Function
Line Number : 9
File Name   : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Function
Line Number : 9
File Name   : test1.ring
Function Name : mymethod
Method or Function : Method
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 44
File Name   : test1.ring
Function Name : mymethod
Method or Function : Method
=====
Message from mymethod
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Return
Line Number : 9
```

(continues on next page)

(continued from previous page)

```
File Name : test1.ring
Function Name :
Method or Function : Command
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Before C Function
Line Number : 9
File Name : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : After C Function
Line Number : 9
File Name : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : Before C Function
Line Number : 9
File Name : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : After C Function
Line Number : 9
File Name : test1.ring
Function Name : ismethod
Method or Function : Function
=====
===== The Trace function is Active =====
Trace Function Name : mytrace()
Trace Event : New Line
Line Number : 11
File Name : test1.ring
Function Name :
Method or Function : Command
=====
```

108.15 Trace Library and Interactive Debugger

Ring 1.5 comes with the Trace Library and the Interactive Debugger

Using this library we can trace events, execute programs line by line, open the Interactive Debugger when an error happens or at breakpoints.

Example:

The next example uses a Breakpoint to open the Interactive Debugger!

```
load "tracelib.ring"

test1()

func test1
    x = 10
    see :test1 + nl
    t = 12
    BreakPoint()
    see "After breakpoint!" +nl
    see "t = " + t + nl
    see "End of program!" + nl
```

Screen Shots:

We have the Interactive Debugger at the Breakpoint!

```
5 # BreakPoint
6
7 load "tracelib.ring"
8
9 test1()
10
11 func test1
12     x = 10
13     see :test1 + nl
14     t = 12
15     BreakPoint()
16     see "After breakpoint!" +nl
17     see "t = " + t + nl
18     see "End of program!" + nl
19
20
```

C:\WINDOWS\system32\cmd.exe - B:\ring\applications\rnote\batch\run "B:\ring\ringlibs\tracelib\samples\sample6.ring"

test1

=====
Interactive Debugger
=====
Command (Exit) : End Program
Command (Cont) : Continue Execution
Command (Locals) : Print local variables names
Command (LocalsData) : Print local variables data
Command (Globals) : Print global variables names
Command (CallStack) : Print call stack
We can execute Ring code
=====

code:> ■

We can print the variables values

```

6 load "tracelib.ring"
7
8
9 test1()
10
11 func test1
12     x = 10
13     see :test1 + nl
14     t = 12
15     BreakPoint()
16     see "After breakpoint!" +nl
17     see "t = " + t + nl
18     see "End of program!" + nl
19
20

```

=====
Command (Exit) : End Program
Command (Cont) : Continue Execution
Command (Locals) : Print local variables names
Command (LocalsData) : Print local variables data
Command (Globals) : Print global variables names
Command (CallStack) : Print call stack
We can execute Ring code
=====

code:> localsdata

Variable : x	Type : NUMBER	Value : 10
Variable : t	Type : NUMBER	Value : 12

code:> -

We can change the variables values then continue execution

```

5 # BreakPoint
6
7 load "tracelib.ring"
8
9 test1()
10
11 func test1
12     x = 10
13     see :test1 + nl
14     t = 12
15     BreakPoint()
16     see "After breakpoint!" +nl
17     see "t = " + t + nl
18     see "End of program!" + nl
19
20

```

code:> localsdata

Variable : x	Type : NUMBER	Value : 10
Variable : t	Type : NUMBER	Value : 12

code:> x = 100

code:> t = 200

code:> cont

After breakpoint!
t = 200
End of program!

We can run the Interactive Debugger in the Output Window

Ring Notepad

File Edit View Program Browser Tools Distribute Help

Project Files: My Work (B:)

- ring
 - samples
 - UsingTraceLib
 - sample1.ring
 - sample2.ring
 - sample3.ring
 - sample4.ring
 - sample5.ring
 - sample6.ring
 - sample7.ring
 - sample8.ring
- Algorithms
- AQuickStart
- DataStructure
- Drawing
- General
- Language
- ProblemSolving
- README.md
- UsingArabic
- UsingBigNumber
- UsingBingChat
- UsingCSVLib
- UsingFastPro
- UsingFormDesigner
- UsingFoxRing
- UsingFreeGLUT
- UsingGameEngine

Source Code: B:\ring\samples\UsingTraceLib\sample6.ring

Output

=====
Interactive Debugger
=====
Command (Exit) : End Program
Command (Cont) : Continue Execution
Command (Locals) : Print local variables names
Command (LocalsData) : Print local variables data
Command (Globals) : Print global variables names
Command (CallStack) : Print call stack
We can execute Ring code
=====

code:> localsdata

Variable : x	Type : NUMBER	Value : 10
Variable : t	Type : NUMBER	Value : 12

code:> t=100

code:> cont

After breakpoint!
t = 100
End of program!

Input : |

Functions (1) Classes (0) Output

108.16 More Syntax Flexibility

- Using braces { } in Packages/Classes/Functions

Example:

```
load "stdlib.ring"

import mypackage

new myclass {
    myfunc()
}

package mypackage
{
    class myclass
    {
        func myfunc
        {
            print("Hello, World!\n")
        }
    }
}
```

- Using ‘end’ keyword after Packages/Classes/Functions

Example:

```
import mypackage

new myclass {
    myfunc()
}

package mypackage
    class myclass
        def myfunc
            put "Hello, World!"
        end
    end
end
```

- Using ‘endpackage’/‘endclass’/‘endfunc’ keywords after Packages/Classes/Functions

Example:

```
import mypackage

new myclass { myfunc() }

package mypackage
    class myclass
        func myfunc
            see "welcome" + nl
```

(continues on next page)

(continued from previous page)

```
    endfunc
  endclass
endpackage
```

108.17 Type Hints Library

Ring 1.5 comes with the Type Hints library

Using this library we can add the type information to the source code which will be very useful for tools like

- Code Editors
- Static-Analysis

Example:

```
load "typehints.ring"

see sum(3,4) + nl ;
see sayHello("Mahmoud");

int func sum(int x,int y) {
    return x+y ;
}

string func sayHello(string name) {
    return "Hello " + name ;
}
```

The library is very powerful and support the User types (Classes) automatically!

Example:

```
load "typehints.ring"

import mypackage

test() { main(:one,:two,:three) }

myclass func test() {
    see "Testing User Types!" + nl
    return new myclass
}

package mypackage {
    public class myclass {
        public static void func main(list args) {
            see "welcome" + nl
            see args
        }
    }
}
```

Also You can use the types inside the code (not only the function prototype)

Example:

```
load "typehints.ring"

int      sum = sum(3,4)
string   msg = sayHello("Mahmoud")

see "Sum = " + sum + nl + msg + nl

int func sum(int x,int y) {
    return x+y ;
}

string func sayHello(string name) {
    return "Hello " + name ;
}
```

Rules:

- To use the types in the function prototype, You must use ‘(’ and ‘)’ around parameters
- To use the types in the function code, You must set the variable value (Assignment).

Note: Ring is a dynamic language, No type checking will be done by the compiler.

108.18 Better Quality

Based on Ring usage every day in practical projects

Ring 1.5 is more stable and more productive!

We are adding features based on clear vision and practical needs.

Also the documentation is better.

108.19 What is new in Ring 1.5.1?

- Better Documentation
- StdLib - Factorial() function update
- RingVM - Better code for clearing the stack in the Class Region.
- Sample : 3D Cube (OpenGL) + Texture Image using GameLib (RingAllegro)

Source Code:

```
load "gamelib.ring"
load "opengl21lib.ring"

func main
```

(continues on next page)

(continued from previous page)

```

new GraphicsApp {
    start()
}

class GraphicsApp from GraphicsAppBase

    TITLE = "Ring Cube"

    bitmap texture

    xrot = 0.0
    yrot = 0.0
    zrot = 0.0

    func loadresources

        bitmap = al_load_bitmap("ring.bmp")
        texture = al_get_opengl_texture(bitmap)

    func destroyResources

        al_destroy_bitmap(bitmap)

    func drawScene

        w = 800 h = 600
        ratio = w / h

        glViewport(0, 0, w, h)
        glMatrixMode(GL_PROJECTION)
        glLoadIdentity()

        gluPerspective(45,ratio,1,100)
        glMatrixMode(GL_MODELVIEW)
        glLoadIdentity()

        glEnable(GL_TEXTURE_2D)
        glShadeModel(GL_SMOOTH)
        glColor3f(0.0, 0.0, 0.0, 0.5)
        glClearDepth(1.0)
        glEnable(GL_DEPTH_TEST)
        glEnable(GL_CULL_FACE)
        glDepthFunc(GL_LEQUAL)
        glHint(GL_PERSPECTIVE_CORRECTION_HINT, GL_NICEST)

        glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT)
        glLoadIdentity();
        glTranslatef(0.0,0.0,-5.0);

        glRotatef(xrot,1.0,0.0,0.0);

```

(continues on next page)

(continued from previous page)

```

glRotatef(yrot, 0.0, 1.0, 0.0);
glRotatef(zrot, 0.0, 0.0, 1.0);

glBindTexture(GL_TEXTURE_2D, texture)

glBegin(GL_QUADS)
    // Front Face
    glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, -1.0, 1.0)
    glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, -1.0, 1.0)
    glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, 1.0)
    glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, 1.0)
    // Back Face
    glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0, -1.0)
    glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
    glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)
    glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0, -1.0)
    // Top Face
    glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
    glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, 1.0, 1.0)
    glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, 1.0, 1.0)
    glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)
    // Bottom Face
    glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, -1.0, -1.0)
    glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, -1.0, -1.0)
    glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0, 1.0)
    glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0, 1.0)
    // Right face
    glTexCoord2f(1.0, 0.0) glVertex3f( 1.0, -1.0, -1.0)
    glTexCoord2f(1.0, 1.0) glVertex3f( 1.0, 1.0, -1.0)
    glTexCoord2f(0.0, 1.0) glVertex3f( 1.0, 1.0, 1.0)
    glTexCoord2f(0.0, 0.0) glVertex3f( 1.0, -1.0, 1.0)
    // Left Face
    glTexCoord2f(0.0, 0.0) glVertex3f(-1.0, -1.0, -1.0)
    glTexCoord2f(1.0, 0.0) glVertex3f(-1.0, -1.0, 1.0)
    glTexCoord2f(1.0, 1.0) glVertex3f(-1.0, 1.0, 1.0)
    glTexCoord2f(0.0, 1.0) glVertex3f(-1.0, 1.0, -1.0)
glEnd()

xrot += 0.3
yrot += 0.2
zrot += 0.4

class GraphicsAppBase

    display event_queue ev timeout
    timer   redraw   = true

    FPS          = 60

    SCREEN_W     = 800
    SCREEN_H     = 600

```

(continues on next page)

(continued from previous page)

```

KEY_UP          = 1
KEY_DOWN        = 2
KEY_LEFT         = 3
KEY_RIGHT        = 4

Key = [false, false, false, false]

TITLE = "Graphics Application"

func start

    SetUp()
    loadResources()
    eventsLoop()
    destroy()

func setup

    al_init()
    al_init_image_addon()
    al_set_new_display_flags(ALLEGRO_OPENGL)
    display = al_create_display(SCREEN_W, SCREEN_H)
    al_set_Window_title(display, TITLE)
    al_clear_to_color(al_map_rgb(0, 0, 0))
    event_queue = al_create_event_queue()
    al_register_event_source(event_queue,
        al_get_display_event_source(display))
    ev = al_new_allegro_event()
    timeout = al_new_allegro_timeout()
    al_init_timeout(timeout, 0.06)
    timer = al_create_timer(1.0 / FPS)
    al_register_event_source(event_queue,
        al_get_timer_event_source(timer))
    al_start_timer(timer)
    al_install_mouse()
    al_register_event_source(event_queue,
        al_get_mouse_event_source())
    al_install_keyboard()
    al_register_event_source(event_queue,
        al_get_keyboard_event_source())

func eventsLoop

    while true
        al_wait_for_event_until(event_queue, ev, timeout)
        switch al_get_allegro_event_type(ev)
        on ALLEGRO_EVENT_DISPLAY_CLOSE
            exit
        on ALLEGRO_EVENT_TIMER
            redraw = true
        on ALLEGRO_EVENT_MOUSE_AXES

```

(continues on next page)

(continued from previous page)

```

mouse_x = al_get_allegro_event_mouse_x(ev)
mouse_y = al_get_allegro_event_mouse_y(ev)
on ALLEGRO_EVENT_MOUSE_ENTER_DISPLAY
    mouse_x = al_get_allegro_event_mouse_x(ev)
    mouse_y = al_get_allegro_event_mouse_y(ev)
on ALLEGRO_EVENT_MOUSE_BUTTON_UP
    exit
on ALLEGRO_EVENT_KEY_DOWN
    switch al_get_allegro_event_keyboard_keycode(ev)
        on ALLEGRO_KEY_UP
            key[KEY_UP] = true
        on ALLEGRO_KEY_DOWN
            key[KEY_DOWN] = true
        on ALLEGRO_KEY_LEFT
            key[KEY_LEFT] = true
        on ALLEGRO_KEY_RIGHT
            key[KEY_RIGHT] = true
    off
on ALLEGRO_EVENT_KEY_UP
    switch al_get_allegro_event_keyboard_keycode(ev)
        on ALLEGRO_KEY_UP
            key[KEY_UP] = false
        on ALLEGRO_KEY_DOWN
            key[KEY_DOWN] = false
        on ALLEGRO_KEY_LEFT
            key[KEY_LEFT] = false
        on ALLEGRO_KEY_RIGHT
            key[KEY_RIGHT] = false
        on ALLEGRO_KEY_ESCAPE
            exit
    off
off
if redraw and al_is_event_queue_empty(event_queue)
    redraw = false
    drawScene()
    al_flip_display()
ok
callgc()
end

func destroy

    destroyResources()
    al_destroy_timer(timer)
    al_destroy_allegro_event(ev)
    al_destroy_allegro_timeout(timeout)
    al_destroy_event_queue(event_queue)
    al_destroy_display(display)

func loadresources

func drawScene

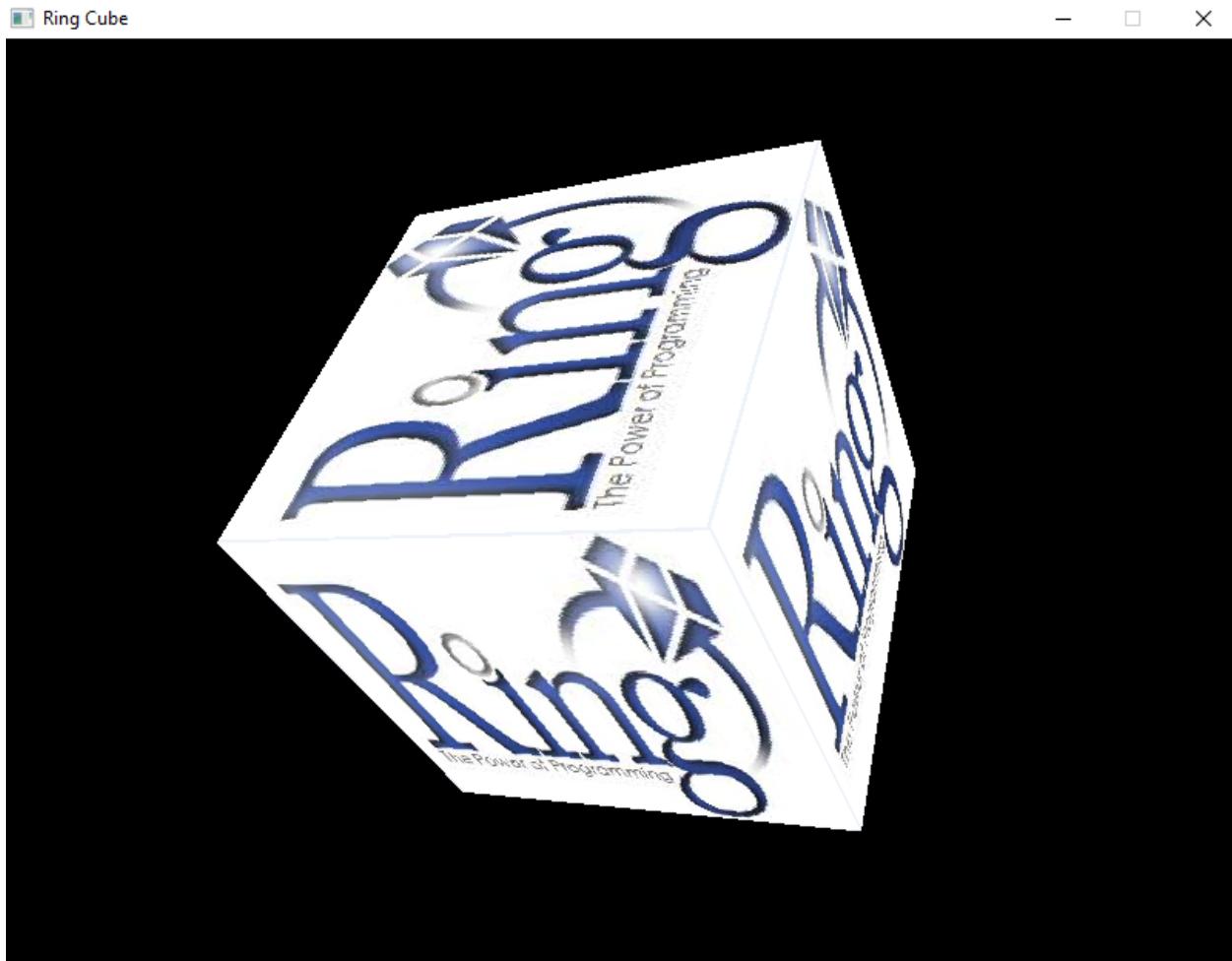
```

(continues on next page)

(continued from previous page)

```
func destroyResources
```

Screen Shot:

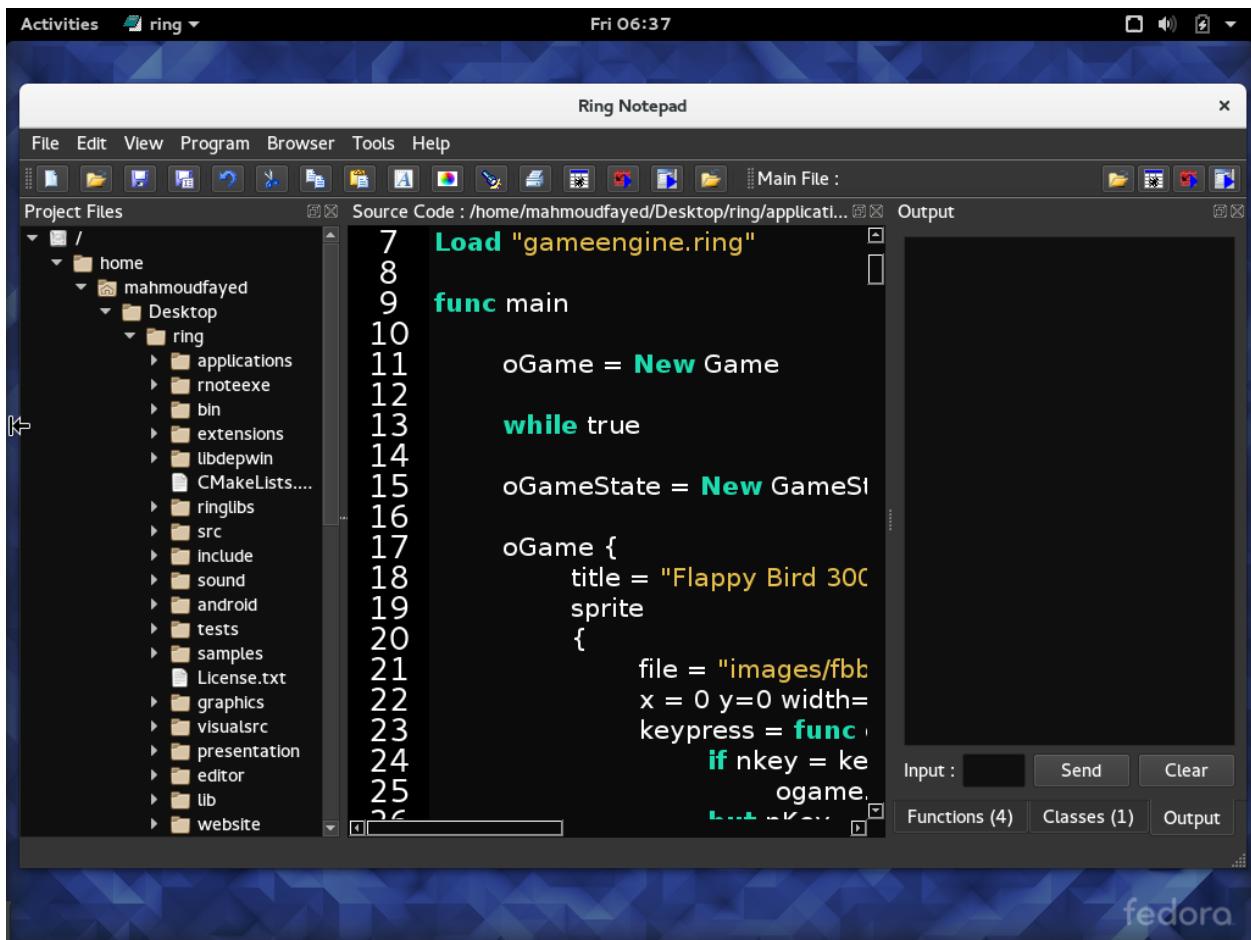


108.20 What is new in Ring 1.5.2?

- Documentation - Chapter “Applications developed in little hours” is updated
- Ring Notepad - Display programs output in the output window on all platforms
- Form Designer - Help Menu - Open CHM/PDF files without displaying the console window
- Form Designer - Better response to Resize/Move Events when moving the Mouse quickly
- Form Designer - New/Open/Save As, will open the Controller class in Ring Notepad
- Form Designer - Added “Close Form” option to the file menu
- Ring Notepad - Run, will save the current file (Also the opened Form) automatically
- GetQuotesHistory Application - Updated to work on MacOS X and Qt 5.2
- Calculator Application - Updated to include more features!

- RingVM - Classification for Environment Errors (Check Chapter : Language Reference)
- RingQt - New methods added to QAllEvents for faster Events execution
- RingQt - Fusion Black Style - Better colors for disabled controls
- Scripts - For building Ring on Fedora Linux (Check Chapter : Building From Source Code)

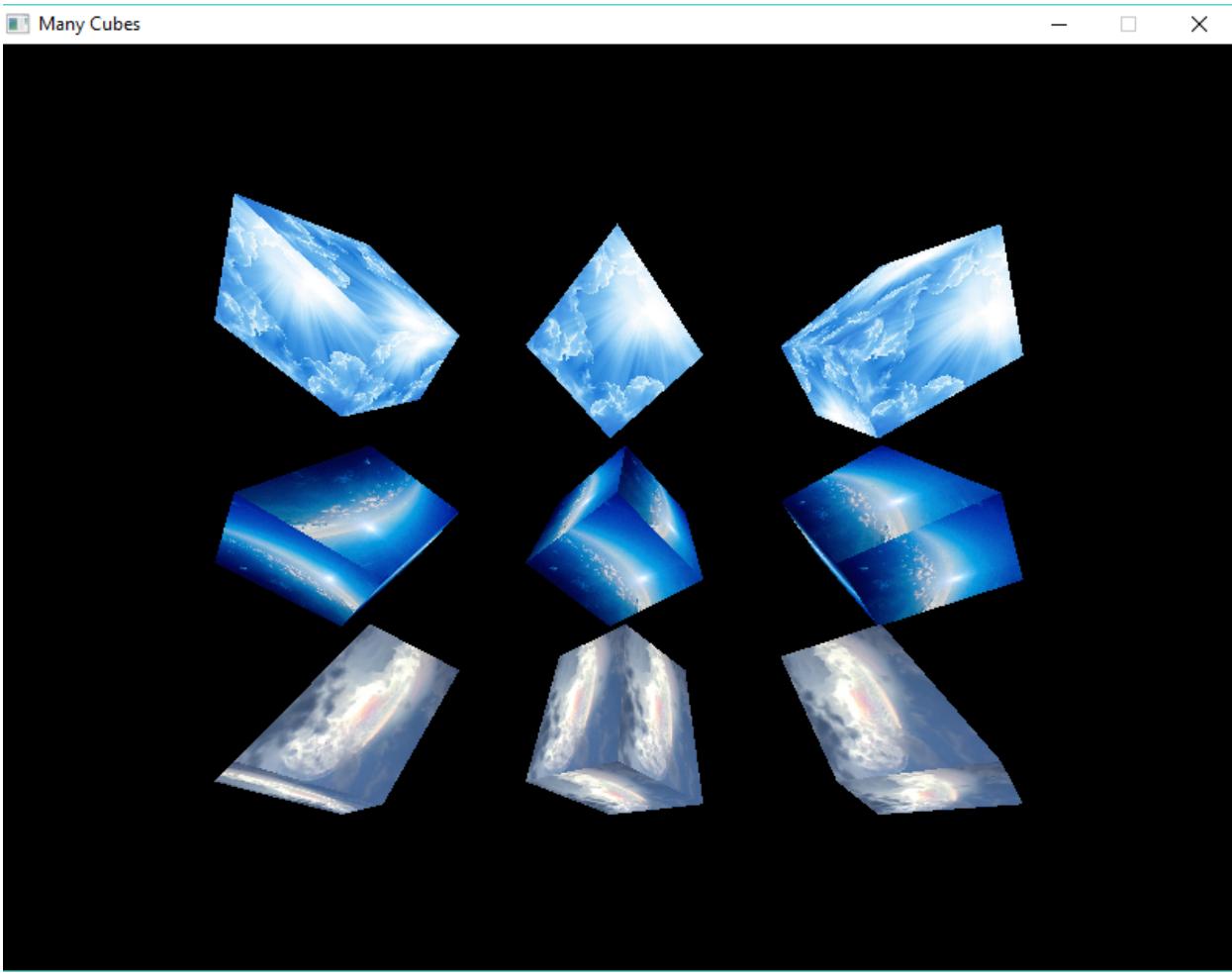
Screen Shot:



108.21 What is new in Ring 1.5.3?

- Form Designer : Close Action will notify Ring Notepad to be able to open the Form again
- Form Designer : Save Action will open the controller class in Ring Notepad
- Form Designer : Keep current control selected when selecting many controls using CTRL Key
- Form Designer : Nice form back color when used in Ring Notepad (Style: Modern Black)
- RingOpenSSL : Updated to support newer versions like OpenSSL 1.1
- Building Scripts : Updated to work on Fedora 26 (64bit)
- OpenGL : New Sample - Many Cubes (samples/3D/manycubes)

Screen Shot:



- RingQt : Add QDateTime Class
- RingQt : New methods added to QMenu and QCursor Classes

Example:

```
load "guilib.ring"

new qApp {
    win = new QWidget() {
        setWindowTitle("Context Menu")
        resize(400,400)
        myfilter = new QAllEvents(win) {
            setContextMenuEvent("mymenu()")
        }
        installEventFilter(myfilter)
        show()
    }
    exec()
}

func mymenu
```

(continues on next page)

(continued from previous page)

```

new qMenu(win) {
    oAction = new qAction(win) {
        settext("new")
        setClickEvent("See :New")
    }
    addaction(oAction)
    oAction = new qAction(win) {
        settext("open")
        setClickEvent("See :Open")
    }
    addaction(oAction)
    oAction = new qAction(win) {
        settext("save")
        setClickEvent("See :Save")
    }
    addaction(oAction)
    oAction = new qAction(win) {
        settext("close")
        setClickEvent("See :Close")
    }
    addaction(oAction)
    oCursor = new qCursor()
    exec(oCursor.pos())
}

```

- Compiler : Support using _ in numbers

Example:

```

x = 1_000_000
see type(x)+nl
see x+1+nl

```

Output:

```

NUMBER
100000001

```

- Compiler : Support using f after numbers

Example:

```

x = 19.99f
see type(x) + nl

```

Output:

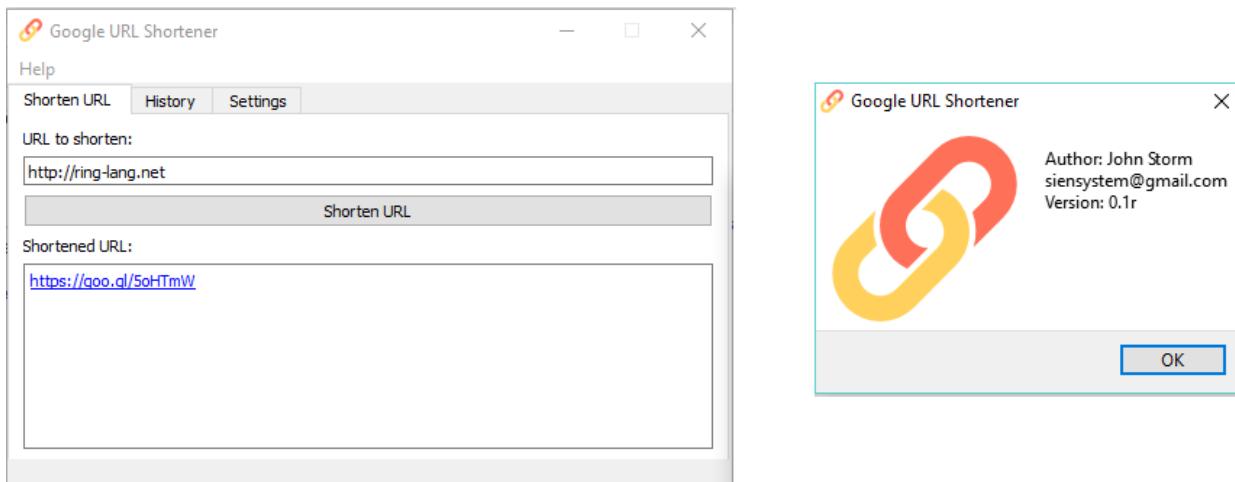
```

NUMBER

```

- Google API Shortener Application

Screen Shots:



- TicTacToe 3D Game

Screen Shot:



108.22 What is new in Ring 1.5.4?

- CalmoSoft Fifteen Puzzle Game 3D
- Ring Notepad - New Styles
- Ring Notepad - Better Toolbar Style
- Ring Notepad - View Modes
- Ring Notepad - QPlainTextEdit - don't set back color for the scroll bars
- Ring Notepad - Style Fusion (White) - use Silver color for comments
- Ring Notepad - Tab and Shift-Tab - Indent multiple lines
- Form Designer - Better Toolbar Style
- Form Designer - Nice backcolor for Window Flags and Menubar Designer
- Form Designer - Default back color for controls
- RingQt - Added grab() and windowHandle() methods to QWidget class
- RingQt - Added new methods to QPixmap Class
- **RingQt - Added Classes :-**
 - QScreen
 - QWindow
 - QGuiApplication
 - QTextBrowser
- Code Generator for Extensions - Nnew Option - Support Parent Class
- Ring VM - Internal Implementation - Pass state to Strings and Lists objects
- Ring VM - Garbage Collector - Memory Pool for Small Objects
- Ring VM - Better code for Saving/Restoring the State

WHAT IS NEW IN RING 1.6?

In this chapter we will learn about the changes and new features in Ring 1.6 release.

109.1 List of changes and new features

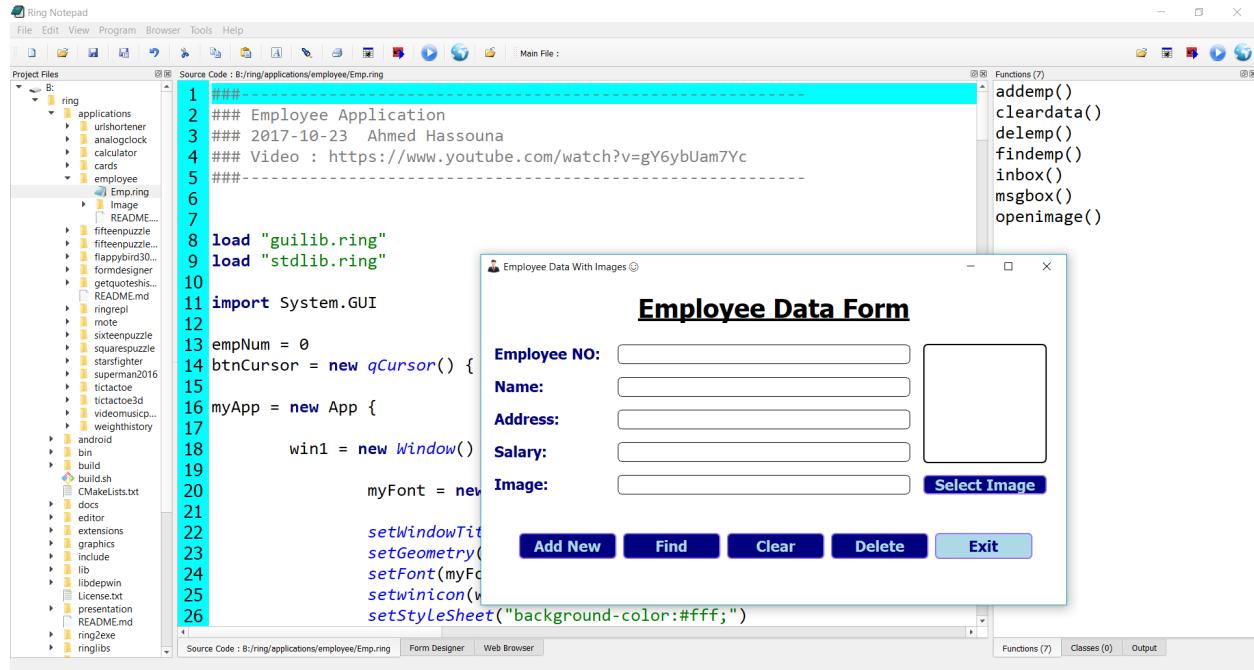
Ring 1.6 comes with many new features!

- Employee Application
- New Tool: Ring2EXE
- Better Ring For Android
- New Tool : Folder2qrc
- Better Scripts for building Ring
- RingConsoleColors Extension
- RingMurmurHash Extension
- Better Ring Notepad
- Better RingQt
- Better StdLib
- Better RingVM
- Better RingREPL
- Using Tab instead of char(9)
- Using CR as Carriage return
- Using the ! operator as not
- Using && and || operators
- Using ? to print expression then new line

109.2 Employee Application

The Employee application is added to ring/applications

Developer: Ahmed Hassouna



109.3 New Tool: Ring2EXE

In Ring 1.6 we have a nice tool called Ring2EXE (Written in Ring itself)

Using Ring2EXE we can distribute applications quickly for Windows, Linux, macOS and Mobile devices

Read the chapter “Distributing Ring Applications using Ring2EXE” for more information!

109.4 Better Ring For Android

Ring For Android (using RingQt) is updated to use the Ring Object File (*.ringo) instead of using many source code files (*.ring)

The next screen shot is an example of building the cards game for Android

We are using cards.ringo instead of cards.ring

If you have large project (many *.ring files) it will use only one *.ringo file.

```

67 }
68
69 int main(int argc, char *argv[])
70 {
71     QApplication a(argc, argv);
72
73     QString path ;
74     path = QStandardPaths::writableLocation(QStandardPaths::GenericDataLocation) ;
75     QDir::setCurrent(path);
76
77     // Delete the application files
78     ringapp_delete_file(path,"cards.ringo");
79
80     // Copy Ring Object File (cards.ringo) from Resources to Temp Folder
81     QString path2 ;
82     path2 = path+"/cards.ringo";
83     QFile::copy(":/cards.ringo",path2);
84
85     // Call Ring and run the Application
86     RingState *pRingState;
87     pRingState = ring_state_new();
88     ring_vm_funcregister("loadlib",ring_loadlib);
89     ring_vm_funcregister("ismobileqt",ring_ismobileqt);
90     ring_state_runobjectfile(pRingState,"cards.ringo");
91     ring_state_delete(pRingState);
92
93     return 0;
94
95 }

```

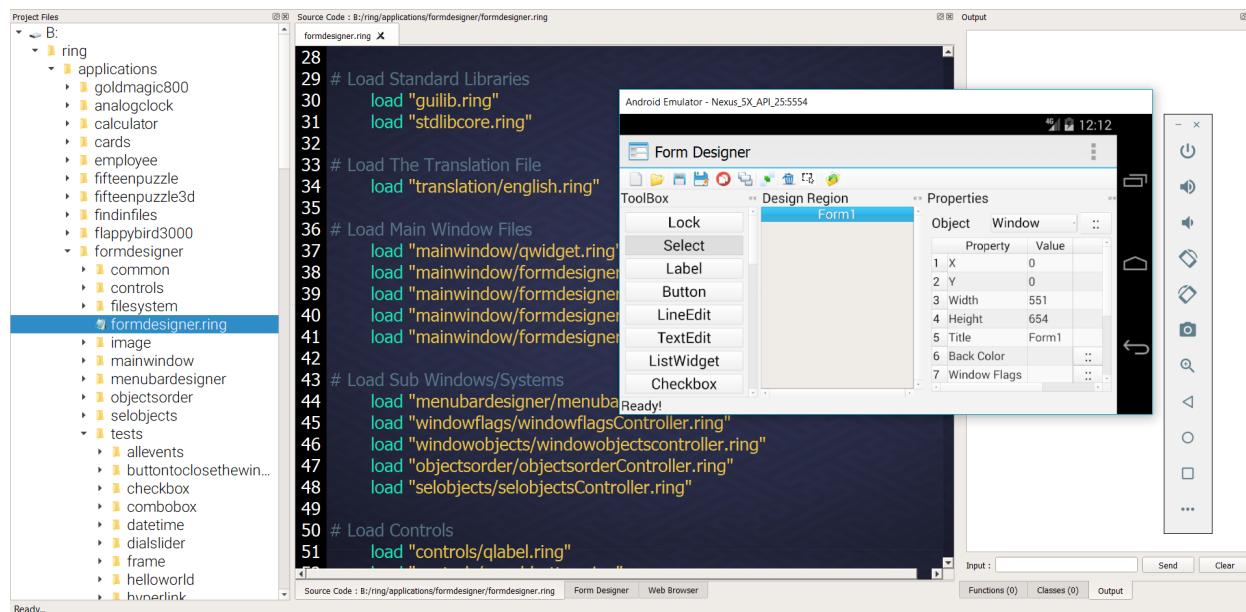
To prepare Qt project to distribute RingQt application for Mobile use Ring2EXE

Example

```
ring2exe cards.ring -dist -mobileqt
```

Example (2)

```
ring2exe formdesigner.ring -dist -mobileqt
```



109.5 New Tool: Folder2qrc

When we have large RingQt project that contains a lot of images and files, We need to add these files to the resource file (*.qrc) when distributing applications for Mobile devices.

Instead of adding these files one by one, Ring 1.6 comes with a simple tool that save our time, It's called Folder2qrc.

Example:

```
folder2qrc formdesigner.ring
```

We determine the main source file while we are in the application folder, and Folder2qrc will check all of the files in the current folder and sub folders, Then add them to the resource file after the mainfile.ringo (In our example this will be formdesigner.ringo)

The output file will be : project.qrc

You can open it and remove the files that you don't need in the resources!

109.6 Better Scripts for building Ring

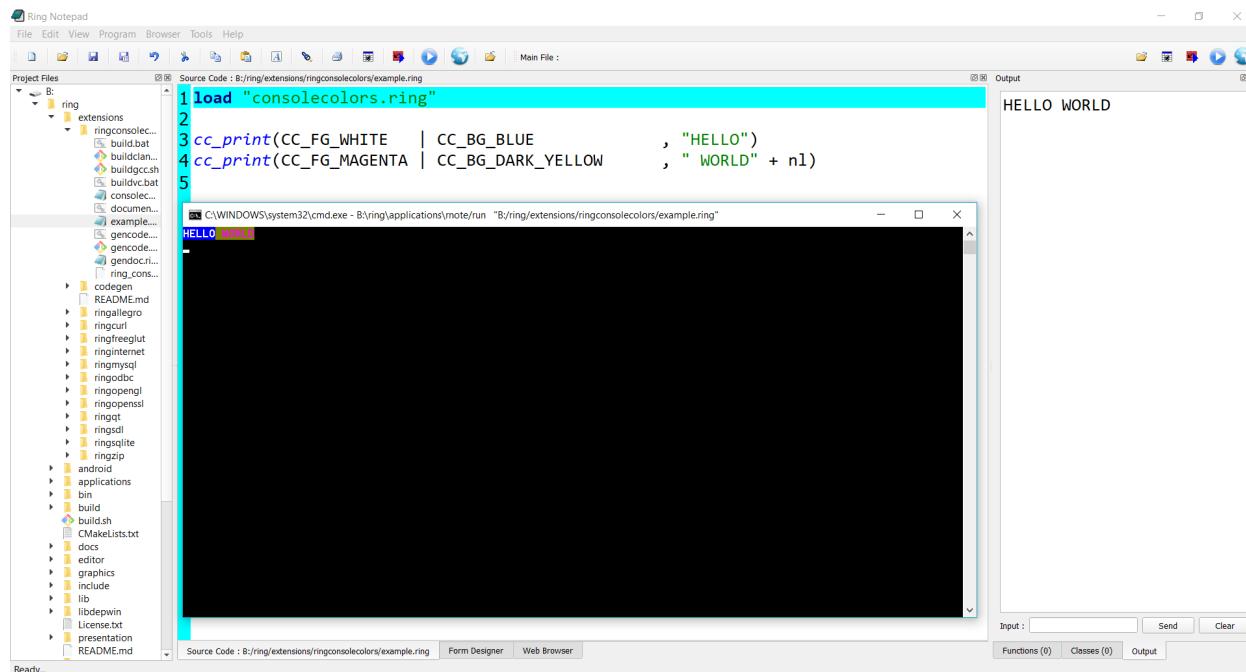
Ring 1.6 comes with better scripts for building Ring from source code.

The updates are tested on 32bit and 64bit systems on Windows, Linux (Ubuntu,Fedora) and macOS.

The scripts for Windows are updated to find the Visual C/C++ compiler based on your Visual Studio version.

109.7 RingConsoleColors Extension

Using the RingConsoleColors extension we can easily change the colors used in our console applications



For more information check the RingConsoleColors chapter in the documentation.

109.8 RingMurmurHash Extension

Ring 1.6 comes with the RingMurmurHash extension!

Developer: Hassan Ahmed

Example:

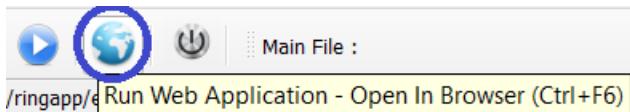
```
load "murmurhashlib.ring"
key = "Ring Language"
see murmurhash3_x86_32(key, 0, 0) + nl // Output: 1894444853
see murmurhash3_x86_32(key, 0, 1) + nl // Output: 70eaef35
```

For more information check the RingMurmurHash chapter in the documentation.

109.9 Better Ring Notepad

Ring Notepad comes with the next updates

- (1) Automatic setting for the Main File when we Run the application (using the Main file buttons).
- (2) Main File - Automatic save before running.
- (3) When we run GUI application - don't change the focus to the text box used for the input in the Output Window.
- (4) A button and option to run web applications



For Windows users, Ring 1.6 comes with Apache Web server!

We can run any web application from any folder directly without doing any configuration.

The screenshot shows the Ring Notepad interface. On the left is the source code editor with the following Ring script:

```

Source Code : C:/Users/samir/Desktop/mytest.ring
1 #!ring -cgi
2
3 Load "weblib.ring"
4
5 Import System.Web
6
7 func main
8     New Page
9     {
10         Text("Hello, World!") newline()
11         Text("Welcome to web development using Ring!")
12         newline()
13         for x = 1 to 5 {
14             TEXT("Number: " + x) newline()
15         }
16         text("Enjoy!")
17     }
18
19

```

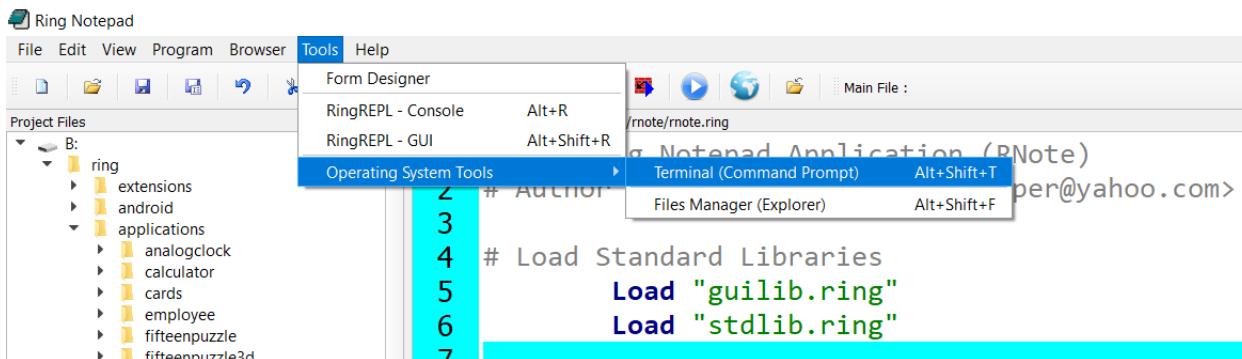
On the right, a browser window titled "Test" is displayed at "localhost:8080/mytest.ring". The page content is:

```

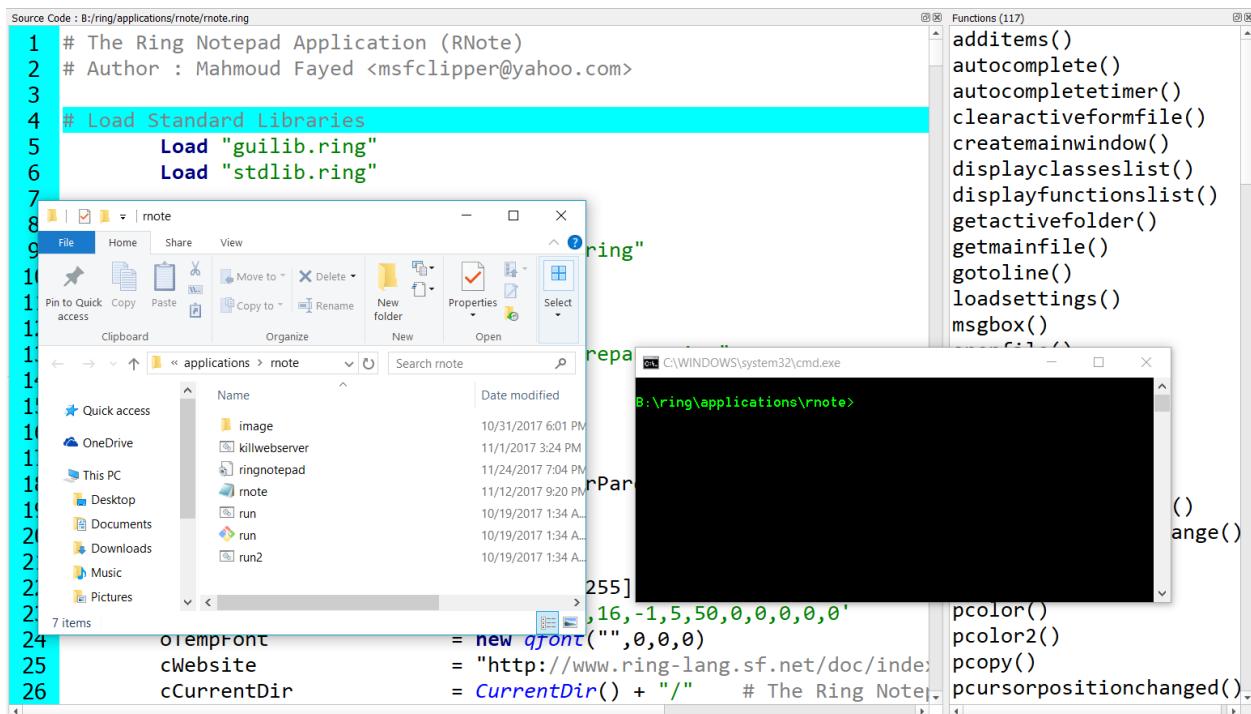
Hello, World!
Welcome to web development using Ring!
Number: 1
Number: 2
Number: 3
Number: 4
Number: 5
Enjoy!

```

(5) Tools - Operating System - Terminal (Command Prompt) & Files Manager (Explorer).

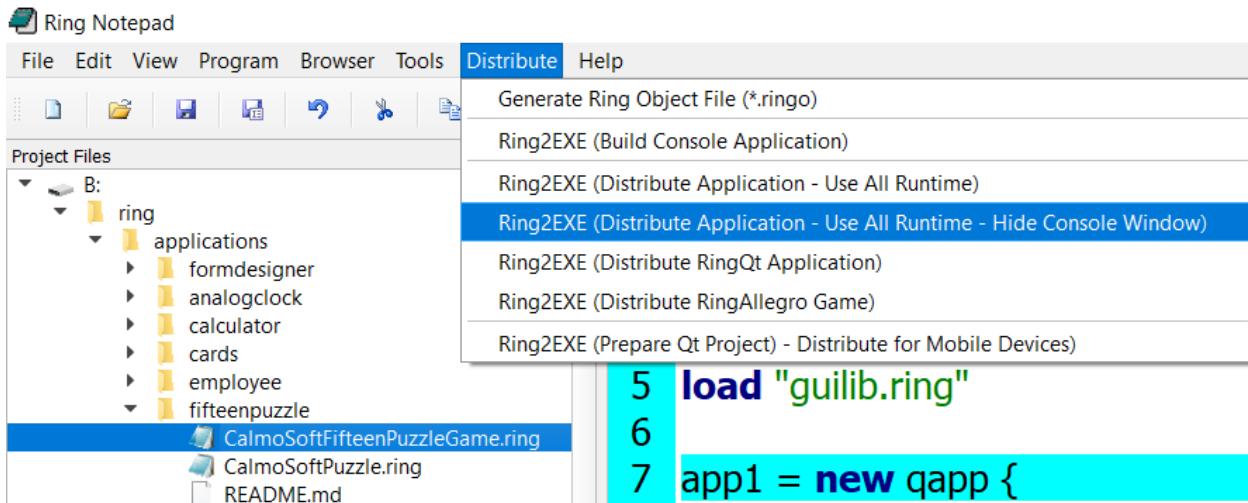


So we can quickly open the Command Prompt or the Explorer at the application folder.



(6) Support *.**sh** & *.**bat** extensions.

(7) New Menu: Distribute



109.10 Better RingQt

RingQt comes with the next updates

- (1) QAllEvents - getkeytext() Method
- (2) QSqlQuery - exec_2() Method
- (3) QDockWidget Events
- (4) AppFile() Function

- (5) IsMobile() Function
- (6) QRegion Class
- (7) QCoreApplication class

109.11 Better StdLib

StdLib comes with the next updates

- (1) Factors() function is updated (Return the output instead of printing it)
- (2) Palindrome() function is updated (Return the output instead of printing it)
- (3) Using stdlibcore.ring we can use the StdLib functions (Without Classes)

Also this is useful when developing standalone console applications

Because using stdlib.ring (functions & classes) will load libraries like RingLibCurl, RingOpenSSL, etc.

(4) New Functions

- SystemSilent(cCommand) Function : Execute system commands without displaying the output.
- OSCreateOpenFolder(cFolder) : Create folder then change the current folder to this new folder
- OSCopyFolder(cParentFolder,cFolderNameToCopy) : Copy folder to the current directory
- OSDeleteFolder(cFolder) : Delete Folder
- OSCopyFile(cFileName) : Copy File to the current directory
- OSDeleteFile(cFileName) : Delete File
- OSRenameFile(cOldFileName,cNewFileName) : Rename file

109.12 Better RingVM

RingVM comes with the next updates

- (1) Support using many getter methods in Expressions
- (2) Support using this & self in setter/getter/normal methods without calling setter/getter methods.
- (3) TempName() function is updated (Better Code)
- (4) ExeFileName() function is updated (Better Code)
- (5) Private Attributes - Support re-usage in the class region (After the keyword private)
- (6) Ring API : ring_scanner_runobjstring()
- (7) ring_state_setvar() function

109.13 Better RingREPL

RingREPL comes with the next updates

- (1) RingREPL will get command line parameters to determine the style.
- (2) Setting RingREPL Style based on Ring Notepad Style.

109.14 Using Tab instead of char(9)

The variable Tab is defined to be used instead of char(9)

Example (1):

```
see :one + nl + tab + :two + nl + tab + tab + :three
```

Output:

```
one
    two
        three
```

You can change the variable to another value

Example (2):

```
tab = " "
see :one + nl + tab + :two + nl + tab + tab + :three
```

Output:

```
one
    two
        three
```

109.15 Using CR as Carriage return

The next example count from 1 to 10 in the same line during 10 seconds

```
load "stdlibcore.ring"
for x = 1 to 10 see x sleep(1) see cr next
```

109.16 Using the ! operator as not

We have = and != in the Ring language

But for the logical operators we have and, or & not

Now we can use the ! operator as not

Example:

```
if ! false
    see "True!" + nl
ok
```

Output

```
True!
```

109.17 Using && and || operators

In Ring we have the next keywords for the logical operations

- and
- or
- not

Now we have also the next operators

- &&
- ||
- !

Example:

```
if one() and two()
    see "Test1 - Fail" + nl
else
    see "Test1 - Pass" + nl
ok

if two() or one()
    see "Test2 - Pass" + nl
else
    see "Test2 - Fail" + nl
ok

if one() && two()
    see "Test3 - Fail" + nl
else
    see "Test3 - Pass" + nl
ok
```

(continues on next page)

(continued from previous page)

```

if two() || one()
    see "Test4 - Pass" + nl
else
    see "Test4 - Fail" + nl
ok

func one return True

func two return False

```

Output:

```

Test1 - Pass
Test2 - Pass
Test3 - Pass
Test4 - Pass

```

109.18 Using ? to print expression then new line

It's common to print new line after printing an expression, We can use the ? operator to do that!

Example:

```

? "Hello, World!"
for x = 1 to 10
    ? x
next

```

Output:

```

Hello, World!
1
2
3
4
5
6
7
8
9
10

```

WHAT IS NEW IN RING 1.7?

In this chapter we will learn about the changes and new features in Ring 1.7 release.

110.1 List of changes and new features

Ring 1.7 comes with many new features!

- New Command: Load Package
- ringvm_see() and ringvm_give() functions
- ring_state_new() and ring_state_mainfile() functions
- Better Trace Library
- Better Ring Notepad
- Better RingQt
- Better Ring2EXE
- Better RingZip
- Better Documentation
- Better Ring VM
- RingLibuv Extension

110.2 New Command: Load Package

Using the ‘load’ command we can use many ring source files in the same project

But all of these files will share the same global scope

Now we have the “Load Package” command too

Using “Load Package” we can load a library (*.ring file) in new global scope

This is very useful to create libraries that avoid conflicts in global variables

Example:

File: loadpackage.ring

```
x = 100
? "Hello, World!"
load package "testloadpackage.ring"
```

(continues on next page)

(continued from previous page)

```
? x
test()
```

File: testloadpackage.ring

```
? "Hello from testloadpackage.ring"
x = 1000
test()
func test
    ? x
```

Output:

```
Hello, World!
Hello from testloadpackage.ring
1000
100
1000
```

110.3 ringvm_see() and ringvm_give() functions

Using the ringvm_see() function we can redefine the behavior of the See command

Also we can use ring_see() to have the original behavior

Example:

```
see "Hello world" + nl
see 123 + nl
see ["one", "two", "three"]
see new point {x=10 y=20 z=30}

func ringvm_see t
    ring_see("We want to print: ")
    ring_See(t)

class point x y z
```

Output:

```
We want to print: Hello world
We want to print: 123
We want to print: one
two
three
We want to print: x: 10.000000
y: 20.000000
z: 30.000000
```

Using the ringvm_give() function we can redefine the behavior of the Give command

Also we can use ring_give() to have the original behavior

Example:

```
see "Name: " give name
see "Hello " + name

func ringvm_give
    see "Mahmoud" + nl
    return "Mahmoud"
```

Output:

```
Name: Mahmoud
Hello Mahmoud
```

110.4 ring_state_new() and ring_state_mainfile() functions

Using ring_state_new() and ring_state_mainfile() we can run Ring programs from Ring programs

But unlike ring_state_main(), Here we can control when to delete the Ring state!

This is important when we run GUI programs from GUI programs

Because they will share the GUI Library (RingQt), And In this case the caller will call

qApp.Exec()

So the sub program, will not stop and will return to the Main program

Here deleting the State of the sub programs will lead to a problem when we run the sub program events

So keeping the state is important for sub GUI programs hosted in GUI programs.

110.5 Better Trace Library

The Trace library is updated, In the Debugger at break points we have now the “callstack” command

This command will print the functions call stack.

Example:

```
load "tracelib.ring"

func main
    ? "Hello from main!"
    test1()

func test1
    ? "Hello from test1!"
    test2()

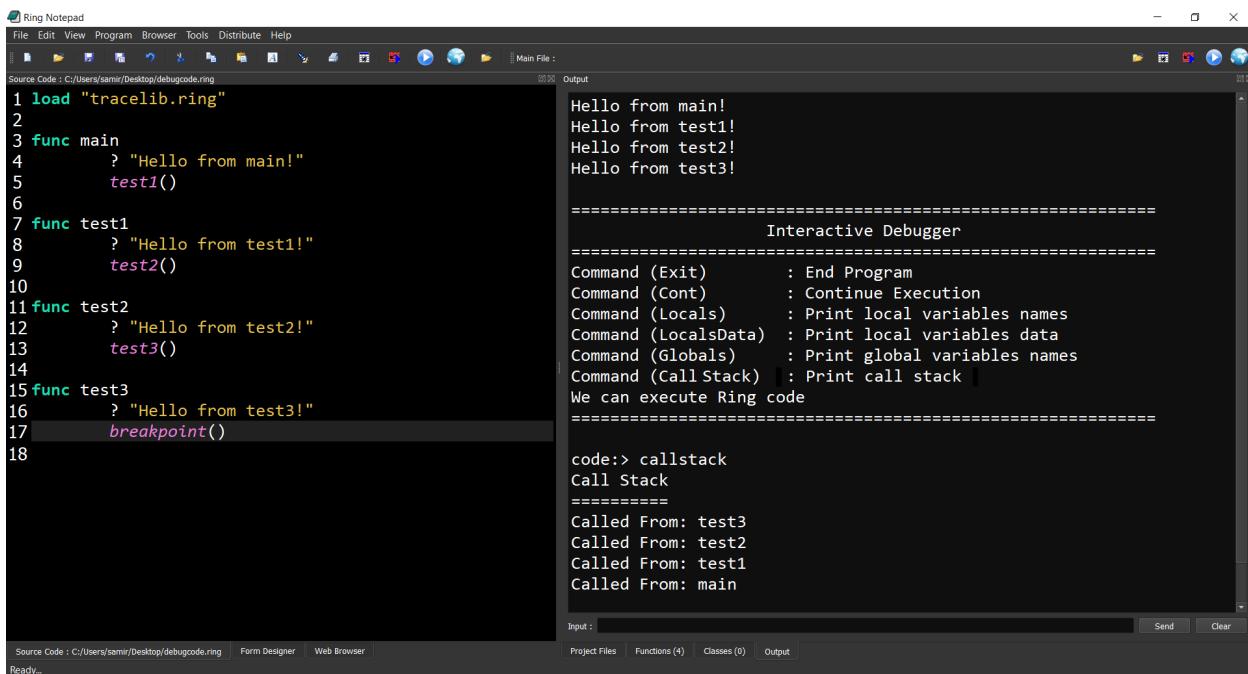
func test2
```

(continues on next page)

(continued from previous page)

```
? "Hello from test2!"
test3()

func test3
    ? "Hello from test3!"
    breakpoint()
```



110.6 Better Ring Notepad

Ring Notepad comes with the next updates

- (1) Support *.cf extension
- (2) Using Hash function (SHA256) for better “Save Changes?” message
- (3) Ring Notepad - X Button - Ask for saving changes?

110.7 Better RingQt

The next classes are added to RingQt

- (1) QStackedWidget
- (2) QCalendarWidget
- (3) QOpenGLFunctions
- (4) QOpenGLContext
- (5) QSurfaceFormat
- (6) QOpenGLWidget

- (7) QOpenGLVersionProfile
- (8) QOpenGLFunctions_3_2_Core
- (9) QVector2D
- (10) QVector3D
- (11) QVector4D
- (12) QQuaternion
- (13) QMatrix4x4
- (14) QOpenGLPaintDevice
- (15) QPaintDevice
- (16) QOpenGLTimerQuery
- (17) QOpenGLDebugLogger
- (18) QOpenGLFramebufferObject
- (19) QOpenGLVertexArrayObject
- (20) QOpenGLBuffer
- (21) QOpenGLShaderProgram
- (22) QOpenGLShader
- (23) QOpenGLTexture

110.8 Better Ring2EXE

Ring2EXE is updated to works as expected when we don't have a C/C++ compiler
Where we can distribute applications and get (exe file and ringo file) in this case.

110.9 Better RingZip

The library is updated to support extracting files contains sub folders!

110.10 Better Documentation

- (1) RingQt Classes Chapter - The classes are sorted.

110.11 Better Ring VM

- (1) Better Error Message
- (2) List2Str() function support lists contains numbers
- (3) Correct support for numbers contains _ as separator
- (4) Creating lists without variables (statement -> Expression -> List)
- (5) IsNULL() - Not case sensitive - treat Null and null like NULL
- (6) Support adding the Self object to an attribute in this object
- (7) Using `:` operator then keyword will create lower case literal
- (8) Printing objects - respect decimals() function
- (9) When literal is not closed - determine the start of the literal
- (10) Better message when printing objects contains lists
- (11) VarPtr() - Support getting a pointer to variables in the local scope
- (12) replace performance instructions with normal instructions when creating new threads

110.12 RingLibuv Extension

Ring 1.7 comes with the RingLibuv extension

Libuv is a multi-platform support library with a focus on asynchronous I/O.

Example (Events Loop):

```
load "libuv.ring"

counter = 0
idler = NULL

func main
    idler = new_uv_idle_t()
    uv_idle_init(uv_default_loop(), idler)
    uv_idle_start(idler, "wait()")
    ? "Idling..."
    uv_run(uv_default_loop(), UV_RUN_DEFAULT);
    uv_loop_close(uv_default_loop());
    destroy_uv_idle_t(idler)

func wait
    counter++
    if counter >= 100000
        uv_idle_stop(idler)
    ok
```

Output:

Idling...

Example (Server):

```

load "libuv.ring"
load "objectslib.ring"

? "Testing RingLibuv - Server Side - Using Classes"

open_object(:MyServer)

class MyServer from ObjectControllerParent

    DEFAULT_PORT      = 13370
    DEFAULT_BACKLOG = 1024

    addr   = new_sockaddr_in()
    server = NULL
    client = NULL
    myloop = NULL

    func start
        myloop = uv_default_loop()
        server = new_uv_tcp_t()
        uv_tcp_init(myloop, server)
        uv_ip4_addr("127.0.0.1", DEFAULT_PORT, addr)
        uv_tcp_bind(server, addr, 0)
        r = uv_listen(server, DEFAULT_BACKLOG, Method(:newconnection) )
        if r
            ? "Listen error " + uv_strerror(r)
            return 1
        ok
        uv_run(myloop, UV_RUN_DEFAULT)
        destroy_uv_tcp_t(server)
        destroy_uv_sockaddr_in(addr)

    func newconnection
        ? "New Connection"
        aPara  = uv_Eventpara(server,:connect)
        nStatus = aPara[2]
        if nStatus < 0
            ? "New connection error : " + nStatus
            return
        ok
        client = new_uv_tcp_t()
        uv_tcp_init(myloop, client)
        if uv_accept(server, client) = 0
            uv_read_start(client, uv_myalloccallback(),
                          Method(:echo_read))
        ok

    func echo_read
        aPara = uv_Eventpara(client,:read)
        nRead = aPara[2]
        buf   = aPara[3]
        if nRead > 0
            req = new_uv_write_t()

```

(continues on next page)

(continued from previous page)

```

        wrbuf = uv_buf_init(get_uv_buf_t_base(buf), nread)
uv_write(req, client, wrbuf, 1, Method(:echo_write))
? uv_buf2str(wrbuf)
message = "message from the server to the client"
buf = new_uv_buf_t()
set_uv_buf_t_len(buf, len(message))
set_uv_buf_t_base(buf, varptr("message", "char *"))
uv_write(req, client, buf, 1, Method(:echo_write))
ok

func echo_write
    aPara = uv_Eventpara(client,:read)
    req   = aPara[1]

```

Output:

When we run the client, We will see the message “New Connection”

Then the message “hello from the client”

```

Testing RingLibuv - Server Side - Using Classes
New Connection
hello from the client

```

Example (Using Threads):

```

load "libuv.ring"
load "objectslib.ring"

? "Testing RingLibuv - Threads - Using Classes"

open_object(:MyThreads)

class MyThreads from ObjectControllerParent

    func Start
        one_id = new_uv_thread_t()
        two_id = new_uv_thread_t()
        uv_thread_create(one_id, Method(:One))
        uv_thread_create(two_id, Method(:Two))
        uv_thread_join(one_id)
        uv_thread_join(two_id)
        destroy_uv_thread_t(one_id)
        destroy_uv_thread_t(two_id)

    func one
        ? "Message from the First Thread!"

    func Two
        ? "Message from the Second Thread!"

```

Output:

```
Testing RingLibuv - Threads - Using Classes
Message from the First Thread!
Message from the Second Thread!
```

For more information about this extension (RingLibuv) check the chapter: [Using RingLibuv](#)

WHAT IS NEW IN RING 1.8?

In this chapter we will learn about the changes and new features in Ring 1.8 release.

111.1 List of changes and new features

Ring 1.8 comes with the next features!

- Better Performance
- Find in files Application
- String2Constant Application
- StopWatch Application
- More 3D Samples
- Compiling on Manjaro Linux
- Using This in the class region as Self
- Default value for object attributes is NULL
- The For Loops uses the local scope
- Merge binary characters
- FoxRing Library
- Better Form Designer
- Better Cards Game
- Better RingQt
- Better Code Generator For Extensions
- Better Ring Compiler and VM
- Notes to extensions creators

111.2 Better Performance

Ring 1.8 is faster than Ring 1.7

The performance gain is between 10% and 100% based on the application.

Check the 3D samples in this release to get an idea about the current performance.

For more information check the Performance Tips chapter.

111.3 Find in files Application

Ring 1.8 comes with Find in files application

The screenshot shows the 'Find in files' application window. At the top, there is a search bar with 'Find' and a placeholder 'find'. Below it are buttons for 'Search' and 'Browse'. A 'Match Case' checkbox is checked. The main area is a table with columns 'File', 'Line', and 'Text'. The table lists 17 matches across 2 files:

	File	Line	Text
1	B:\ring\applications\findinfiles\findinfilesController.ring	1	# Application : Find in files
2	B:\ring\applications\findinfiles\findinfilesController.ring	5	load "findinfilesView.ring"
3	B:\ring\applications\findinfiles\findinfilesController.ring	11	open_window(:findinfilesController)
4	B:\ring\applications\findinfiles\findinfilesController.ring	16	class findinfilesController from WindowsControllerParent
5	B:\ring\applications\findinfiles\findinfilesController.ring	18	oView = new findinfilesView
6	B:\ring\applications\findinfiles\findinfilesController.ring	32	cText = txtFind.text()
7	B:\ring\applications\findinfiles\findinfilesController.ring	121	parent().FindInFilesSelect(cFile,nRow)
8	B:\ring\applications\findinfiles\findinfilesView.ring	14	new findinfilesView { win.show() }
9	B:\ring\applications\findinfiles\findinfilesView.ring	19	class findinfilesView from WindowsViewParent
10	B:\ring\applications\findinfiles\findinfilesView.ring	23	setWindowTitle("Find in files")
11	B:\ring\applications\findinfiles\findinfilesView.ring	27	lblfind = new label(win) {
12	B:\ring\applications\findinfiles\findinfilesView.ring	35	setText("Find")
13	B:\ring\applications\findinfiles\findinfilesView.ring	49	txtFind = new lineedit(win) {

At the bottom left, it says '17 matches across 2 files'. There is a 'Close' button at the bottom right.

111.4 String2Constant Application

Ring 1.8 comes with String2Constant application

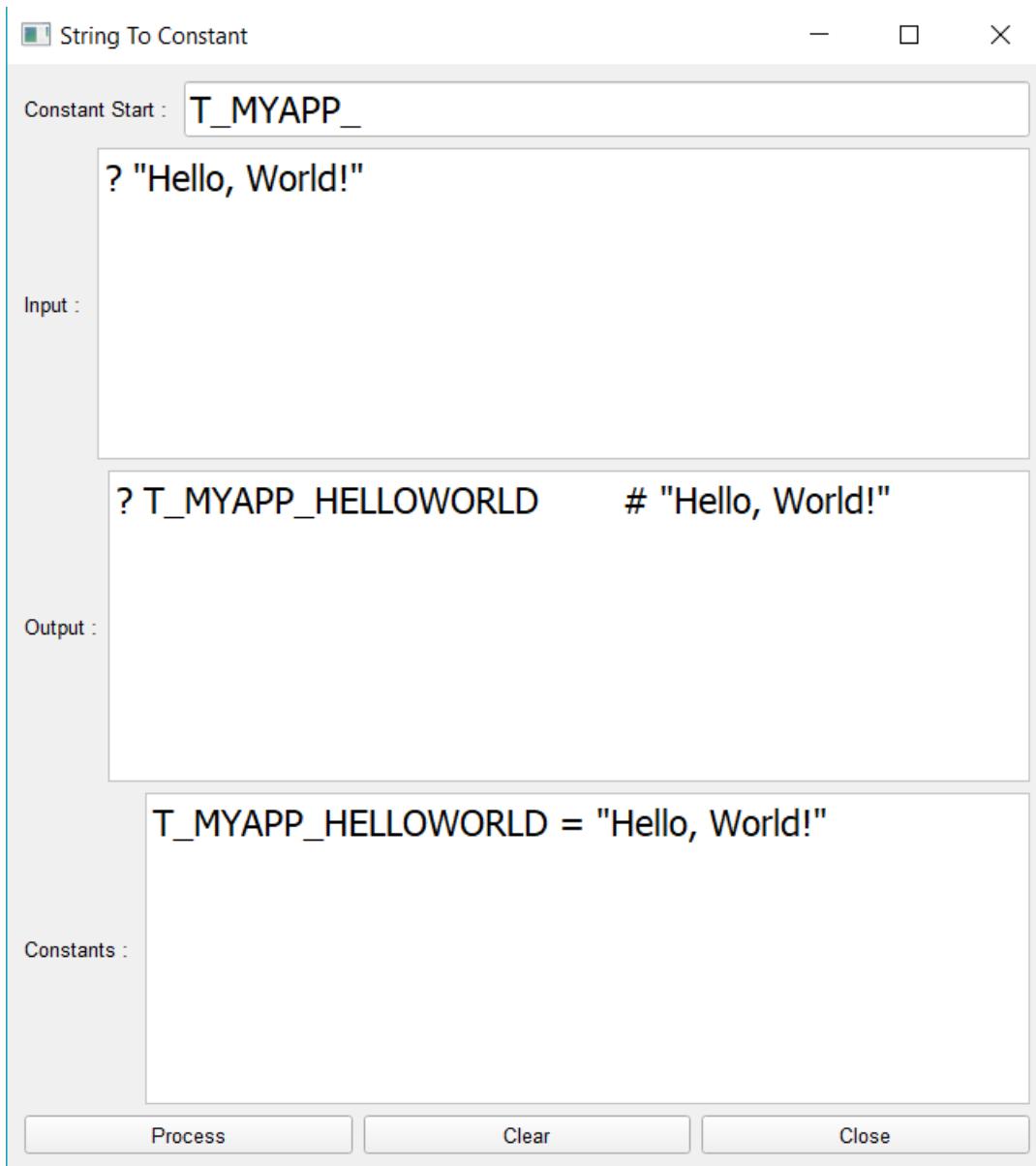
Using this tool we can convert the source code to be based on constants instead of string literals

Then we can store constants in separate source code files that we can translate to different languages

Where we can have special file for each language, like (English.ring, Arabic.ring and so on)

Using this simple tool, the Form Designer is translated to the Arabic language.

For more information check the Multi-language Applications chapter.



111.5 StopWatch Application

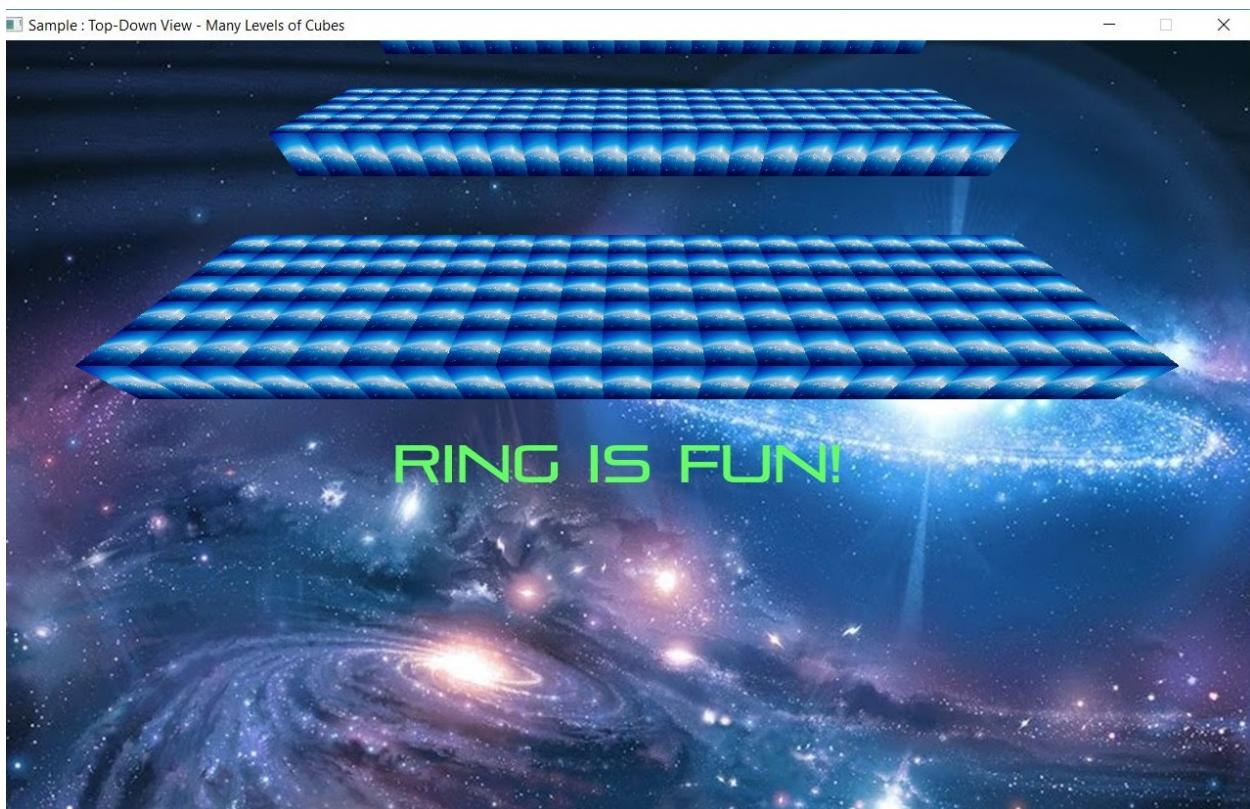
Ring 1.8 comes with StopWatch application



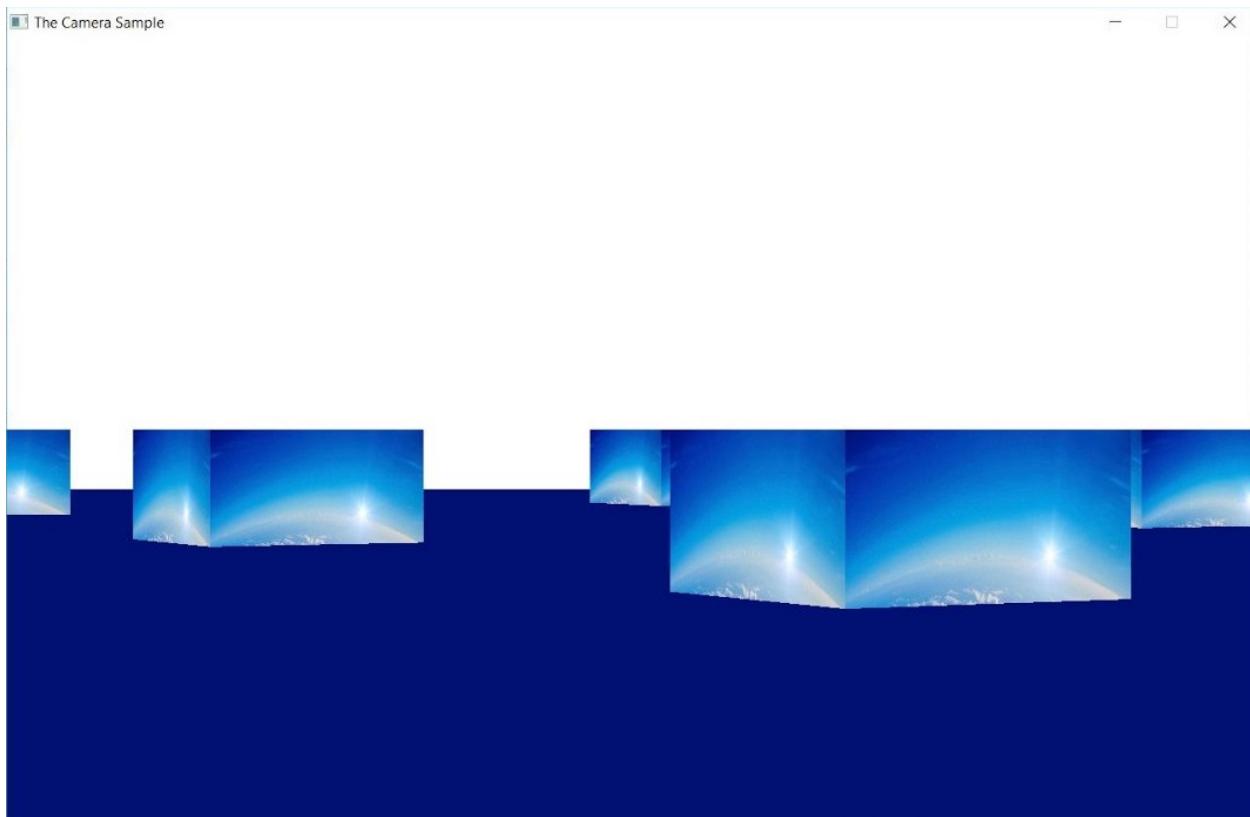
111.6 More 3D Samples

Ring 1.8 comes with more 3D Samples

The next screen shot for the Top-Down view - Many levels of cubes sample

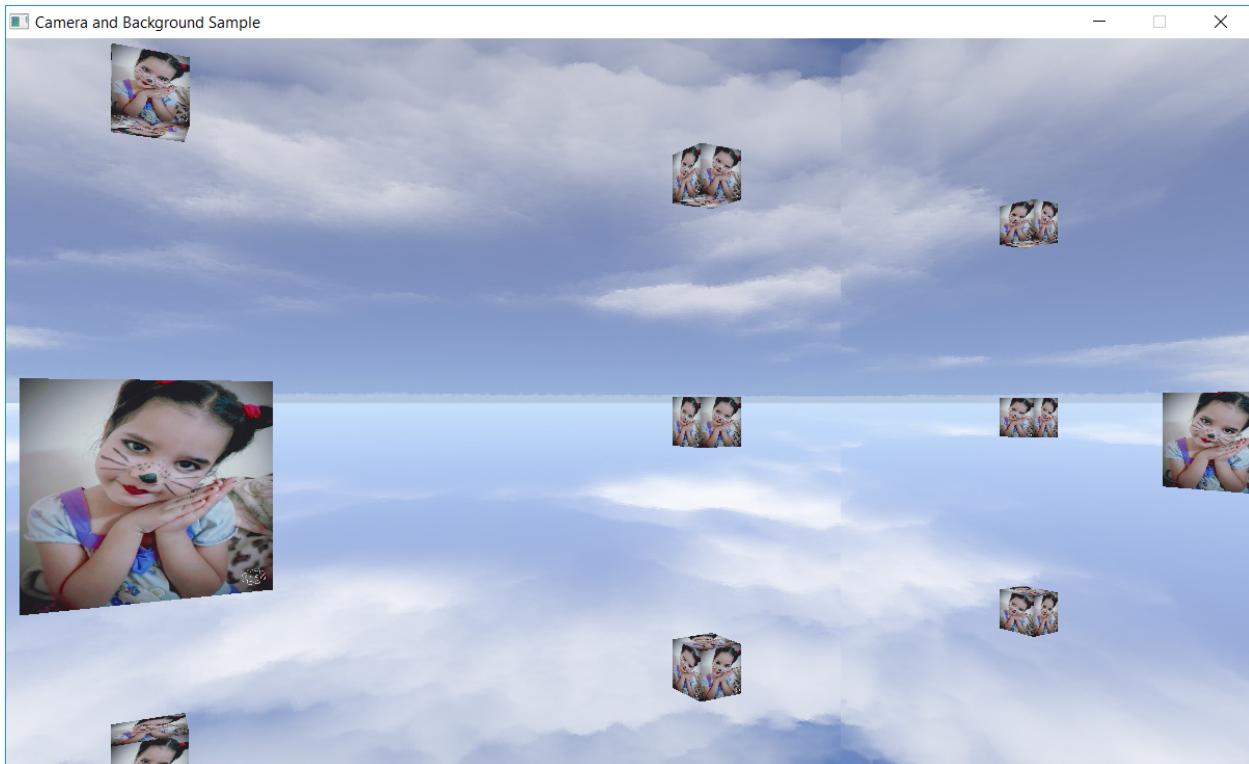


The next screen shot for the Camera Sample



The next screen shot for the Camera and background sample

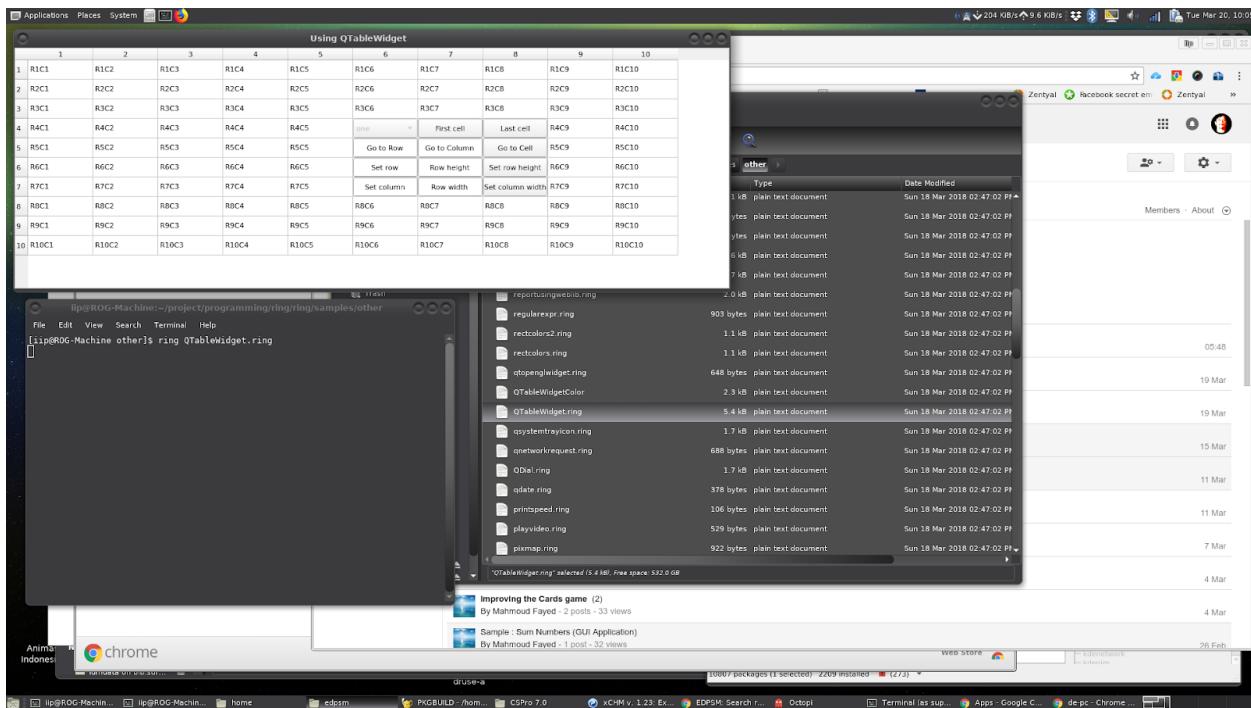
Developer : Azzeddine Remmal



111.7 Compiling on Manjaro Linux

Ring 1.8 is tested on Manjaro Linux too

Tests by : Iip Rifai



111.8 Using This in the class region as Self

The class region is the region that comes after the class name and before any method.

Now we can use This in the class region as Self.

Example:

```
func main

    o1 = new program {
        test()
    }

    ? o1

class program

    this.name = "My Application"
    this.version = "1.0"
    ? name ? version

    func test
        ? "Name      = " + name
        ? "Version = " + version
```

Output

```
My Application
1.0
```

(continues on next page)

(continued from previous page)

```
Name      = My Application
Version  = 1.0
name: My Application
version: 1.0
```

Note: When we use braces to change the current active object, Using This we can still point to the class.

Tip: The difference between This and Self is that Self point to the current active object that we can change using braces.

Remember that in most cases we don't need to use This or Self in the class region

We can write

```
class program name version
```

Or

```
class program name="My Application" version="1.0"
```

Note: We use This or Self in the class region just to avoid conflict with global variables that are defined with the same name.

111.9 Default value for object attributes is NULL

Starting from Ring 1.8 the default value for object attributes is NULL

In Ring, the NULL value is just an empty string or a string that contains “NULL”

We can check for NULL values using the isNULL() function

Example:

```
oProgram = new Program
? oProgram.name
? oProgram.version
? isNULL(oProgram.name)
? isNULL(oProgram.version)
oProgram { name="My Application" version="1.0" }
? isNULL(oProgram.name)
? isNULL(oProgram.version)
? oProgram

class program
    name
    version
```

Output:

```
NULL
NULL
1
1
0
0
name: My Application
version: 1.0
```

In previous versions of Ring, trying to access the object attribute before assigning a value to it

Will lead to runtime error and you can't check it using isnull()

The only way was assigning a value or using try/catch/end

We changed this behavior so we can have full control in seamless way.

111.10 The For Loops uses the local scope

In Ring 1.8, when the For Loop defines new identifier (variable) it will define it in the local scope.

Example:

```
x = 10
? x          # Print 10
test1()
? x          # Print 10
test2()
? x          # Print 10

func test1
    for x = 1 to 5
    next
    ? x      # Print 6

func test2
    list = 1:5
    for x in list
    next
    ? x      # Print NULL (The "For In" loop will kill the reference after the loop)
```

Output:

```
10
6
10
NULL
10
```

111.11 Merge binary characters

From Ring 1.0 we can create binary strings and do operations on these strings.

Now in Ring 1.8, we can get individual characters from these strings and merge them together using the ‘+’ operator.

Example:

```
cStr = "Welcome"
? cstr[1] + cstr[2] + cStr[5]
v = cstr[1] + cstr[2] + cStr[5]
? v
? len(v)
c1 = cStr[1]
? c1
aList = [1,2,3]
cStr = ""
for item in aList
    cStr += int2bytes(item)
next
? "All String"
? len(cStr)
? "First Part"
n1 = cStr[1] + cStr[2] + cStr[3] + cStr[4]
? len(n1)
? "Second Part"
n2 = cStr[5] + cStr[6] + cStr[7] + cStr[8]
? len(n2)
? "Third Part"
n3 = cStr[9] + cStr[10] + cStr[11] + cStr[12]
? len(n3)
? "All String"
cString = cStr[1] + cStr[2] + cStr[3] + cStr[4] +
    cStr[5] + cStr[6] + cStr[7] + cStr[8] +
    cStr[9] + cStr[10] + cStr[11] + cStr[12]
? len(cString)
? ascii(cStr[1])
? len(cStr[2])
```

Output:

```
Weo
Weo
3
W
All String
12
First Part
4
Second Part
4      }
Third Part
4
All String
```

(continues on next page)

(continued from previous page)

```
12
1
1
```

111.12 FoxRing Library

Developer: Jose Rosado

A class with some of the functions I used in FoxPro

Example:

```
Load "foxring.ring"

mf = new frFunctions
? mf.frAbs(-45)
? mf.frAbs(10-30)
? mf.frAbs(30-10)

? mf.frTransform("    Ring is a good language    ",
                 "@! !!!!!!!!!!!!!!!!!!!!!!!")
? mf.frAllTrim("    Ring is a good language    ", Null)
```

Output:

```
45
20
20
    RING IS A GOOD LANGUAGE
Ring is a good language
```

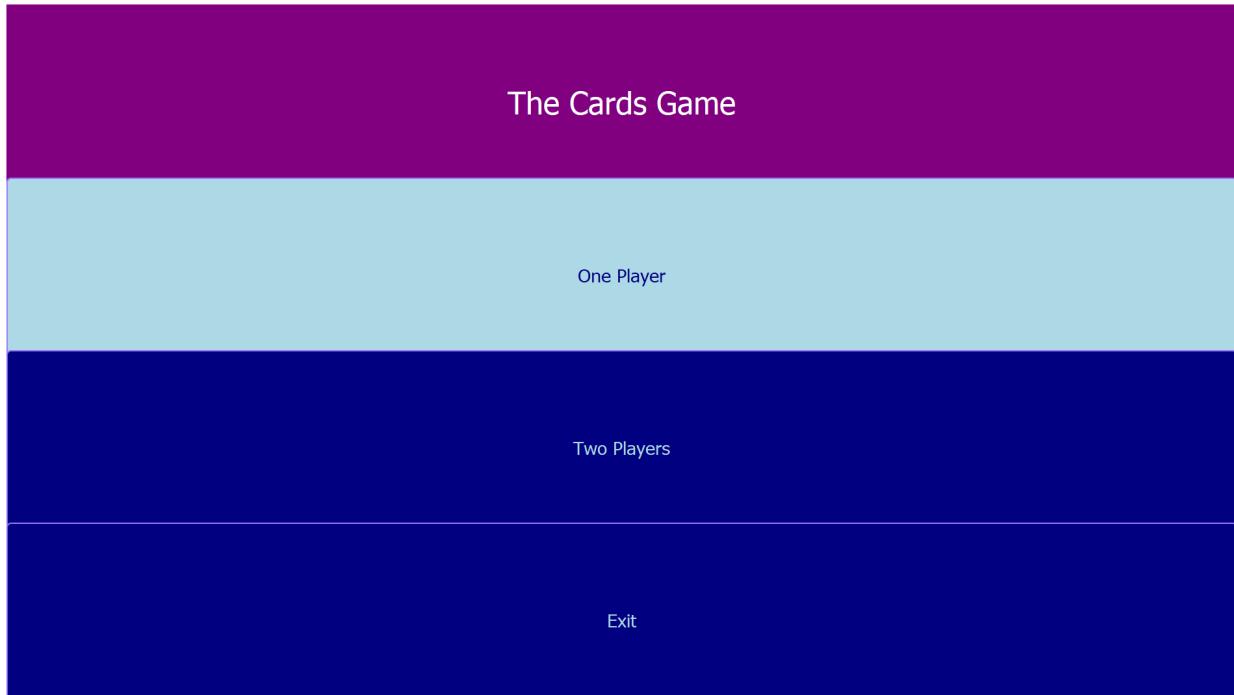
111.13 Better Form Designer

- (1) Layout Control - Display the control name when loading forms.
- (2) Button Control - Display the button images written using relative path.
- (3) Table Control - Display the control name when loading forms.
- (4) Better behavior in “Bring to front” and “Send to back” operations.
- (5) New buttons are added to the toolbar (Duplicate, Bring to front, Send to back, Delete).
- (6) Using layouts in (Menubar designer, Window Flags window, Selecting Objects window).
- (7) Better behavior for displaying the properties window when changing the selected objects.
- (8) New buttons are added to move and resize multiple selection of objects.
- (9) Window Properties - Add button to select the layout.
- (10) Opening forms and switching between files is faster.
- (11) Objects Order window.

- (12) Select Objects window.
- (13) When we change the control name, the name will be updated in layout objects.

111.14 Better Cards Game

The Cards game is updated and we can play with the Computer



111.15 Better RingQt

- The next classes are added to RingQt
 - (1) QTabBar
 - (2) QFile
 - (3) QFileDevice
 - (4) QStandardPaths
 - (5) QDir
 - (6) QQuickWidget
 - (7) QQmlError
 - (8) QScrollBar
- RingQt for Android is updated to support modern versions of Qt

Tested using

- (1) Qt 5.5.1

- (2) Qt 5.9.5
- (3) Qt 5.11.0
 - In RingQt for Android, The Ring Object File (ringo) will be executed directly from resources.

111.16 Better Code Generator For Extensions

New Option: StaticMethods

Starting from Ring 1.8 the code generator support the staticmethods option.

So the code generator can know that the class doesn't need an object to call the methods.

Example:

```
<class>
name: QStandardPaths
para: void
nonew
staticmethods
</class>

QString displayName(QStandardPaths::StandardLocation type)
QString findExecutable(QString executableName, QStringList paths))
```

111.17 Better Ring Compiler and VM

- (1) Better loading for files in relative paths
- (2) Code Optimization for eval() function
- (3) Better Memory Pool
- (4) When embedding Ring in Ring, the error in the hosted environment will not close the host

Example:

```
? "Start the test!"

pState = ring_state_init()

ring_state_runcode(pState, " ? 'Let us try having an error' ? x")

ring_state_delete(pState)

? ""
? "End of test!"
```

Output:

```
Start the test!
Let us try having an error
```

(continues on next page)

(continued from previous page)

```
Line 1 Error (R24) : Using uninitialized variable : x
in file Ring_EMBEDDEDCode
End of test!
```

- (5) The compiler will ignore new lines after keywords that expect tokens after it

Example:

```
see
"
    Hello, World!
"
test()

func
#=====#
    Test
#=====#

?

"
Hello from the Test function

"
```

Output:

```
Hello, World!

Hello from the Test function
```

- (6) Better code (faster) for the main loop, special loop for eval() function.
- (7) Better code (faster) for tracking C pointers to avoid using NULL pointers.
- (8) Better code (faster) for getting the self object using braces.

111.18 Notes to extensions creators

If you have created new extensions for Ring in the C/C++ languages.

You have to rebuild your extension (Generate the DLL file again using Ring 1.8 header files) before usage with Ring 1.8

Because we changed the internal structure of the VM, but no changes to the code are required. just rebuild.

WHAT IS NEW IN RING 1.9?

In this chapter we will learn about the changes and new features in Ring 1.9 release.

112.1 List of changes and new features

Ring 1.9 comes with the next features!

- New Game : Gold Magic 800
- More Games
- Better Ring Notepad
- Better StdLib
- BigNumber Library
- RingPostgreSQL Extension
- Deploying Web applications in the Cloud
- Better RingQt
- Better Memory Management
- Better Code Generator for Extensions
- More Improvements

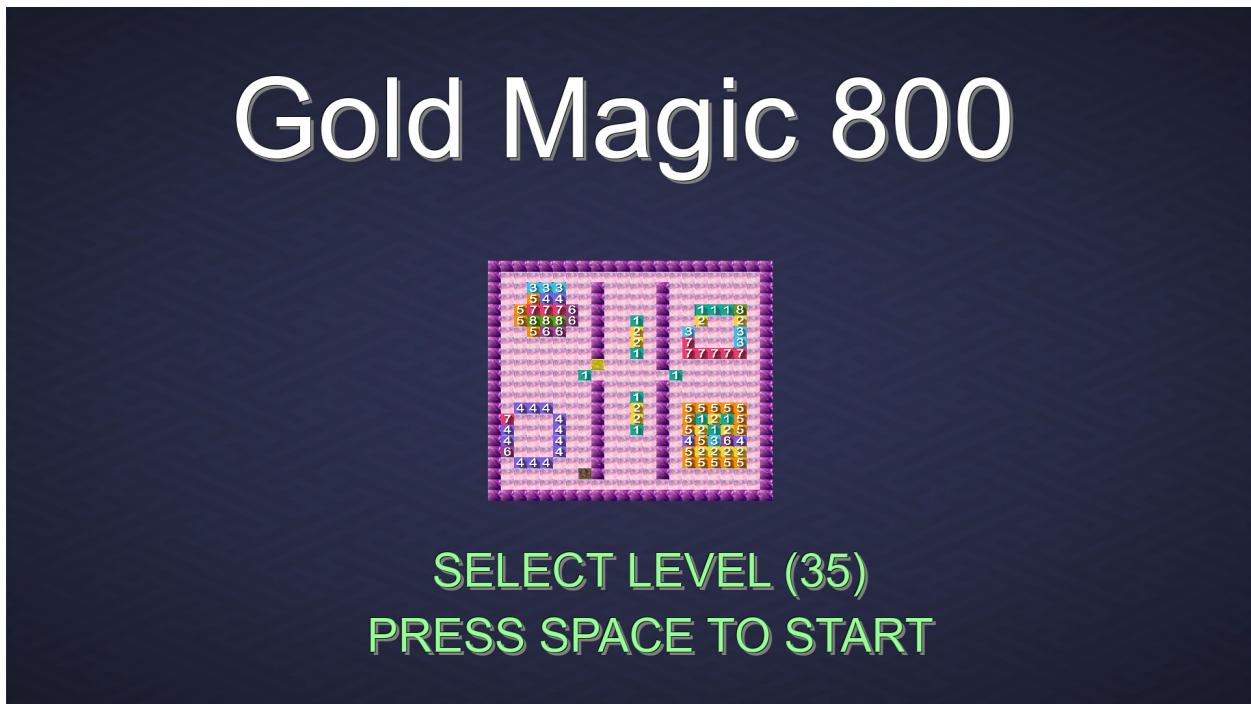
112.2 New Game : Gold Magic 800

The Gold Magic 800 is a new puzzle game.

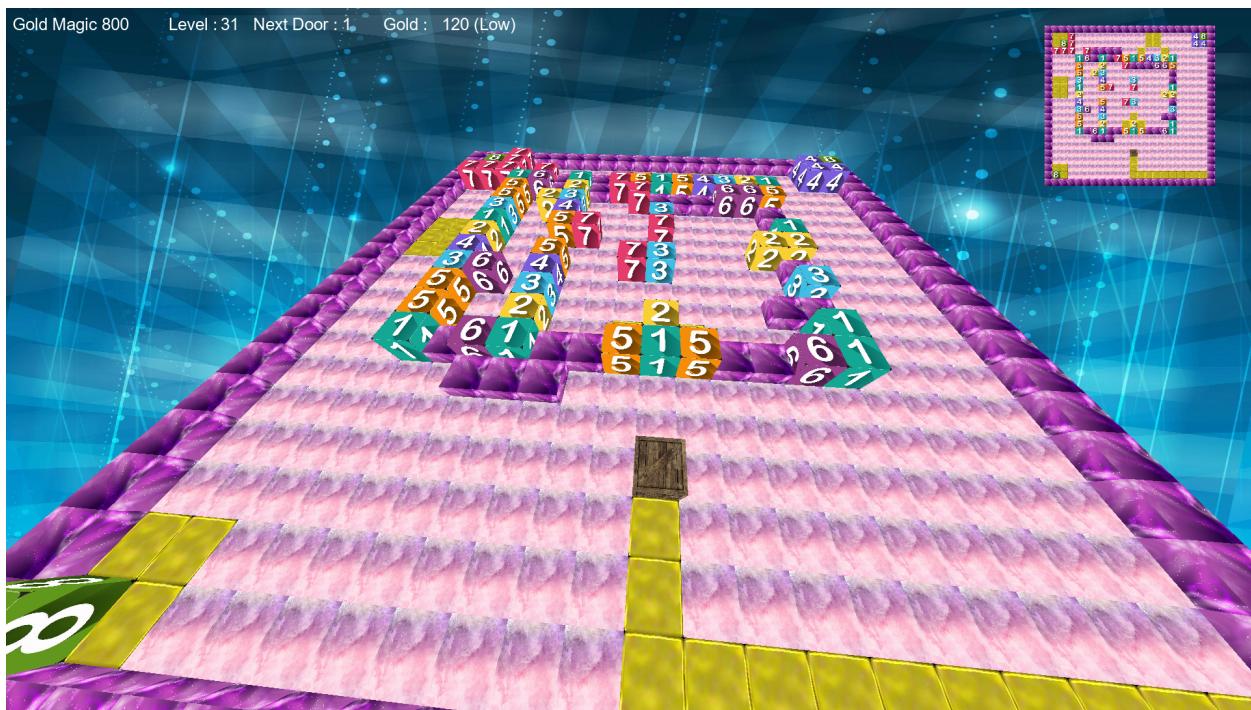
Ring 1.9 comes with the Demo Version (18 Levels) and the game source code.

Steam Page (44 Levels) : https://store.steampowered.com/app/939200/Gold_Magic_800/

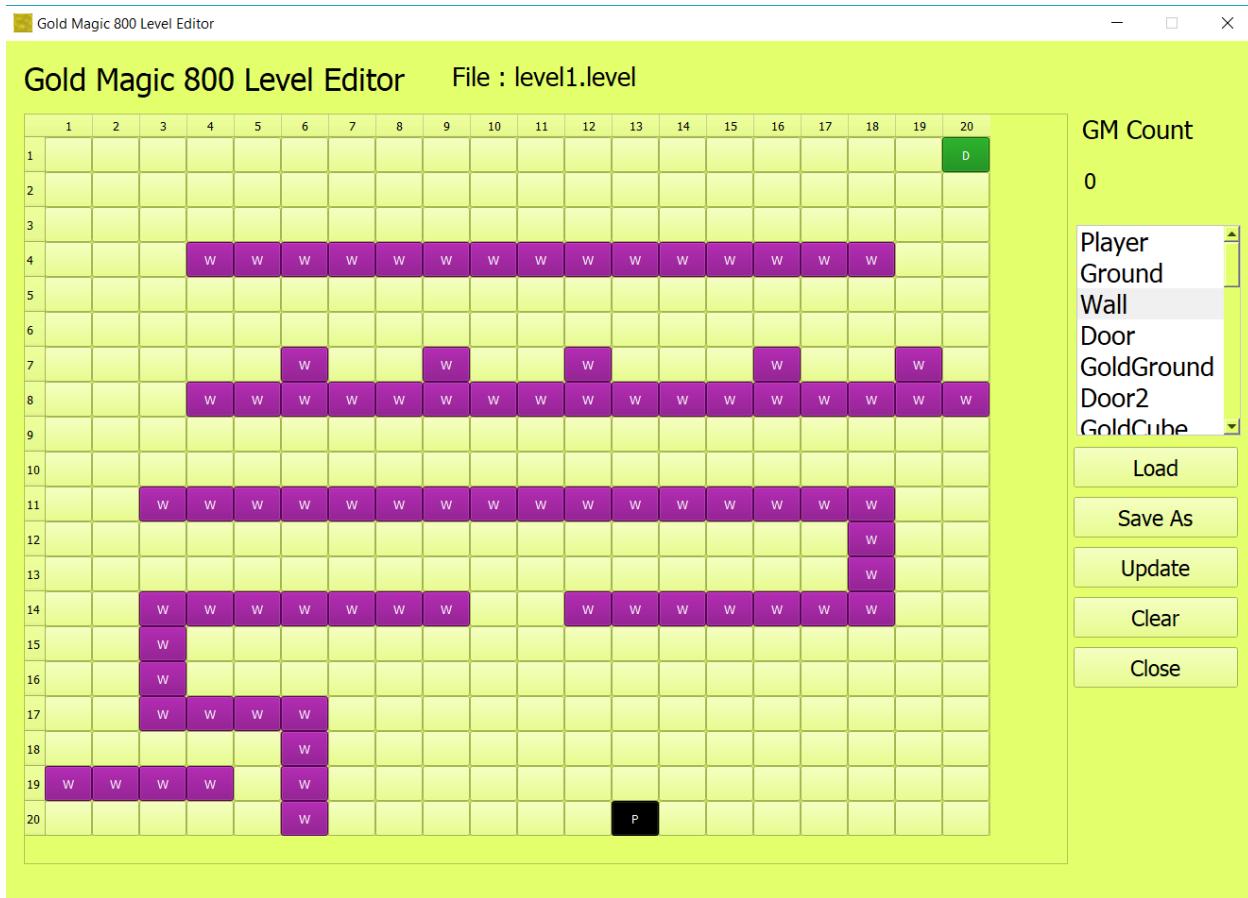
We can select the level



The next screen shot for level (1)



The Gold Magic 800 Level Editor



112.3 More Games

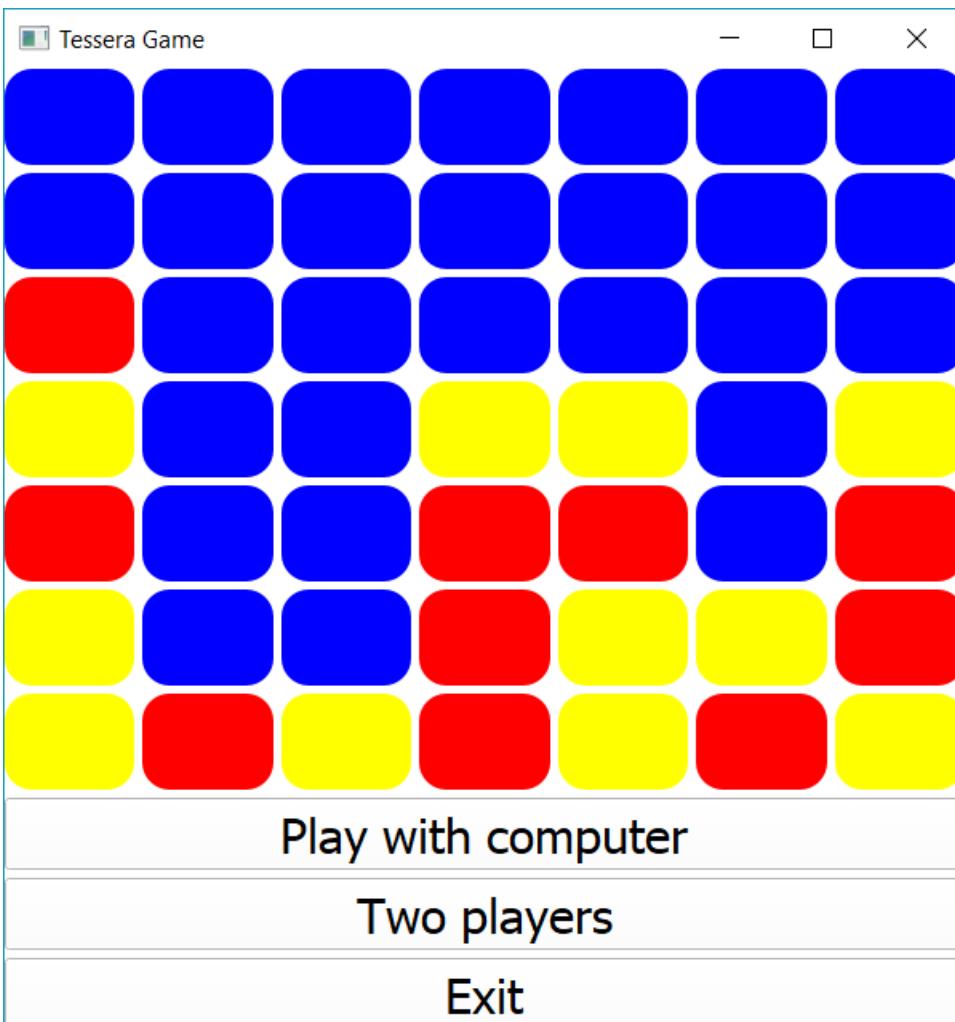
The next games are added to Ring Applications

- (1) The 2048 Game
- (2) The Memory Game
- (3) The Wise Quadrat Game
- (4) The Tessera Game
- (5) The Othello Game

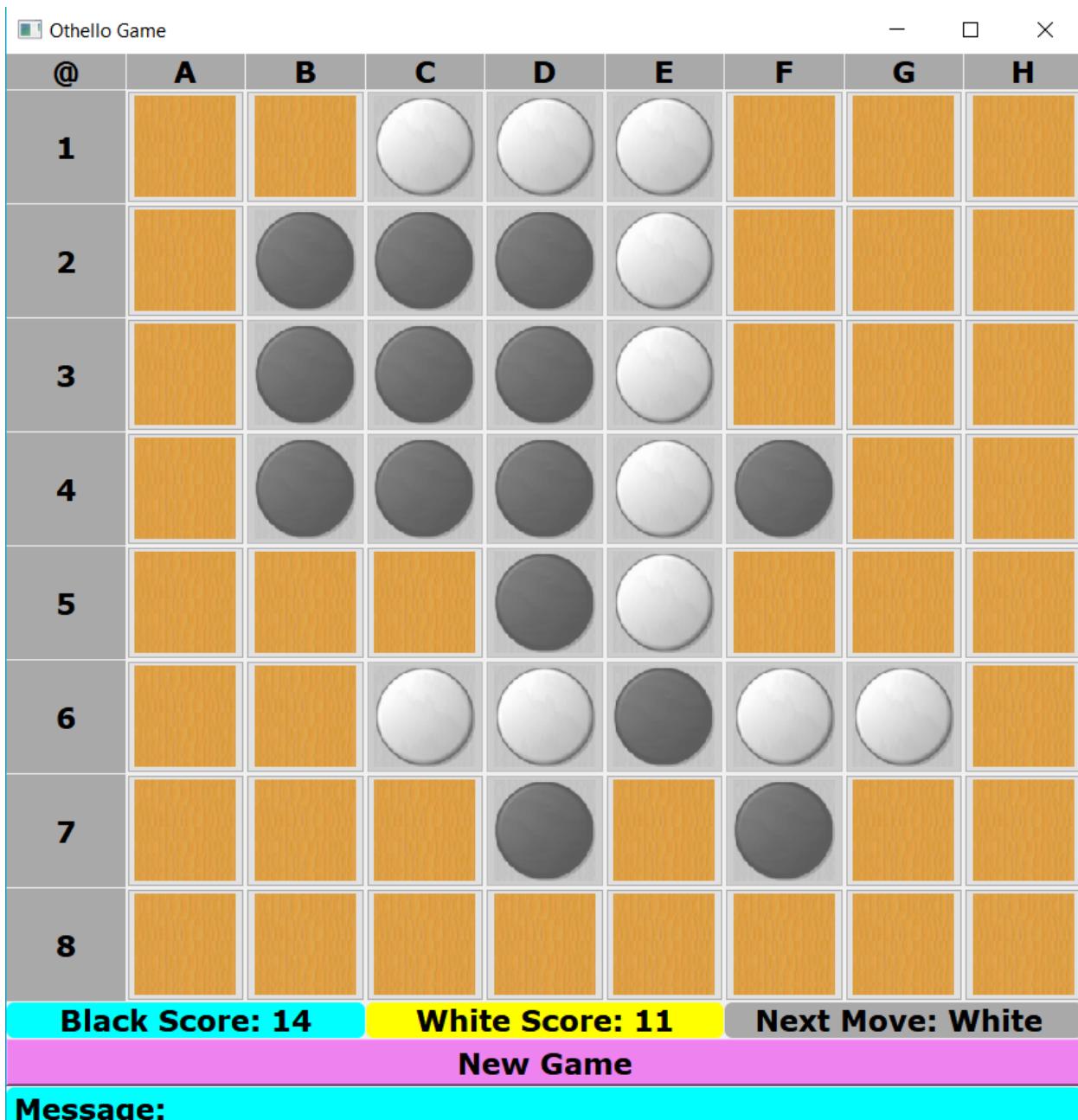
The next screen shot for the 2048 game on Android



The next screen shot for the Tessera game

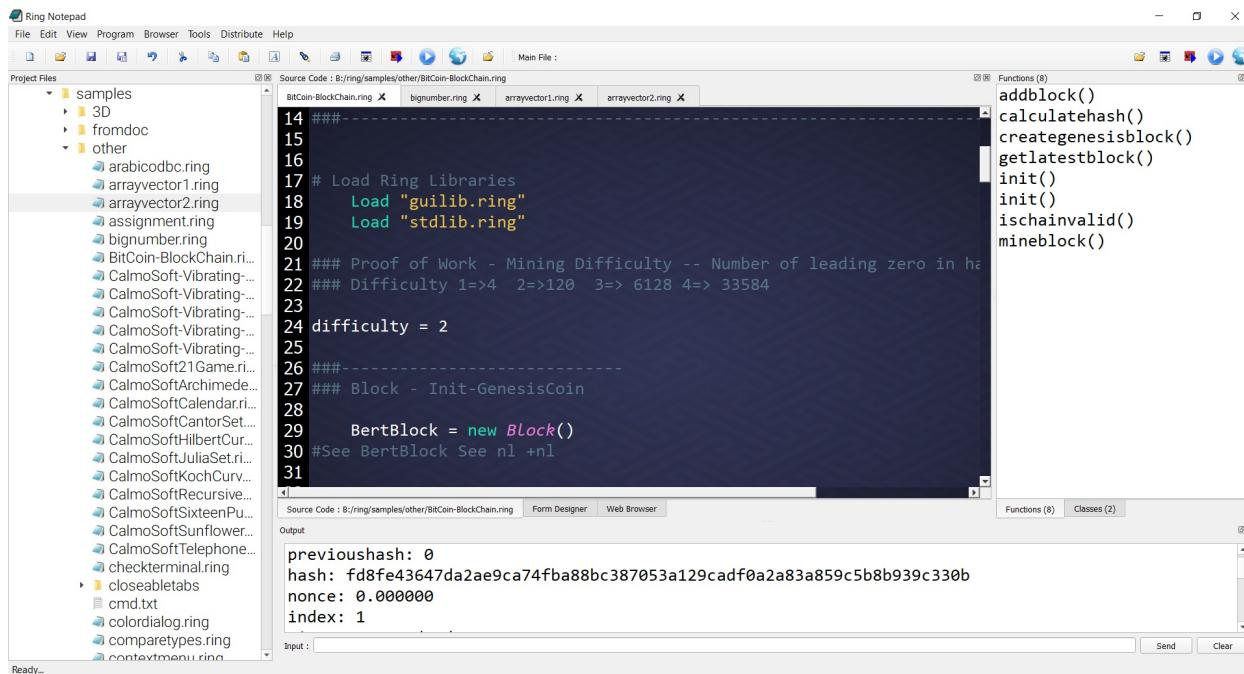


The next screen shot for the Othello game



112.4 Better Ring Notepad

- (1) New Style
- (2) New Mode
- (3) Tabs for opened files
- (4) Support executing batch files



112.5 Better StdLib

(1) The List2Code() function is added to the StdLib

This function converts a Ring list during runtime to Ring source code that we can save to source files.

The list may contain strings, numbers or sub lists.

Example:

```
load "stdlibcore.ring"
aList = 1:10
? list2Code(aList)
```

Output:

```
[1,2,3,4,5,6,7,8,9,10]
```

(2) The Str2ASCIIList() and ASCIIList2Str() are added to the StdLib

Using these functions we can convert between string of bytes and a list of numbers where each item represents the ASCII code of one byte in the string.

So we may convert a string of bytes to ASCII List then do some operations on the list numbers (Like XOR)

Example:

```
load "stdlibcore.ring"
cStr = "MmMm"
```

(continues on next page)

(continued from previous page)

```
aList = Str2ASCIIILIST(cStr)
? aList

cStr2 = ASCIIIList2Str(aList)
? cStr2
? len(cStr2)
```

Output:

```
77
109
77
109

MmMm
4
```

112.6 BigNumber Library

Using the BigNumber library we can do arithmetic operations on huge numbers.

Example:

```
load "bignumber.ring"

num1 = "62345678901234567891678345123456789"      ### Big
num2 = "1237894567890123419871236545"              ### Small
num3 = "64"                                            ### Divide Small
num4 = "765432"                                         ### Power
num5 = "3"                                              ### Power

? "Add big numbers:"
a1 = new BigNumber(num1)      a1.Print()
a2 = new BigNumber(num2)      a2.Print()
a3 = a1 + a2                a3.Print() ? nl

? "Substract big numbers:"
a1 = new BigNumber(num1)      a1.Print()
a2 = new BigNumber(num2)      a2.Print()
a3 = a1 - a2                a3.Print() ? nl

? "Multiply big numbers:"
a1 = new BigNumber(num1)      a1.print()
a2 = new BigNumber(num2)      a2.print()
a3 = a1 * a2                a3.print() ? nl

? "Divide big numbers:"
a1 = new BigNumber(num1)      a1.print()
a2 = new BigNumber(num2)      a2.print()
a3 = a1 / a2                a3.print() ? nl
```

(continues on next page)

(continued from previous page)

```
? "Divide big numbers: by very small number"
a1 = new BigNumber(num1)      a1.print()
a2 = new BigNumber(num3)      a2.print()
a3 = a1 / a2                a3.print() ? nl

? "Power of big number:"
a1 = new BigNumber(num1)      a1.print()
a2 = new BigNumber(num5)      a2.print()
a3 = a1 ^ a2                a3.print() ? nl
```

Output:

Add big numbers:
62345678901234567891678345123456789
1237894567890123419871236545
62345680139129135781801764994693334

Substract big numbers:
62345678901234567891678345123456789
1237894567890123419871236545
5234568766334000000155492525220244

Multiply big numbers:
62345678901234567891678345123456789
1237894567890123419871236545
77177377243260150103462178714197454736432472780119682305154005

Divide big numbers:
62345678901234567891678345123456789
1237894567890123419871236545
50364288

Divide big numbers: by very small number
62345678901234567891678345123456789
64
974151232831790123307474142554012

Power of big number:
62345678901234567891678345123456789
3
242336636261471172092347146031727004 (Output continue in next line)
371698195628343934238988256152289508 (Output continue in next line)
493964611043228971692389860897069

For more information check the BigNumber Library Chapter in the documentation

112.7 RingPostgreSQL Extension

Ring 1.9 provide native support for PostgreSQL database using the RingPostgreSQL Extension.

Example:

```
load "postgresql.lib.ring"

conninfo = "user=postgres password=sa dbname = mahdb"

exit_nicely = func conn {
    PQfinish(conn)
    shutdown(1)
}

conn = PQconnectdb(conninfo)

if (PQstatus(conn) != CONNECTION_OK)
    fputs(stderr, "Connection to database failed: "+PQerrorMessage(conn))
    call exit_nicely(conn)
ok

res = PQexec(conn, "
    DROP DATABASE mahdb;
")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Remove failed: " + PQerrorMessage(conn))
    PQclear(res)
ok
PQclear(res)

res = PQexec(conn, "CREATE DATABASE mahdb;")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Create database failed: " + PQerrorMessage(conn))
    PQclear(res)
ok

res = PQexec(conn, "
CREATE TABLE COMPANY (
    ID INT PRIMARY KEY      NOT NULL,
    NAME      TEXT      NOT NULL,
    AGE       INT      NOT NULL,
    ADDRESS   CHAR(50),
    SALARY    REAL );
")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Create Table failed: " + PQerrorMessage(conn))
    PQclear(res)
ok
PQclear(res)
```

(continues on next page)

(continued from previous page)

```

res = PQexec(conn, "
    INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY)
    VALUES  (1, 'Mahmoud' , 31, 'Jeddah', 10.00 ),
            (2, 'Ahmed'   , 27, 'Jeddah', 20.00 ),
            (3, 'Mohammed' , 33, 'Egypt'  , 30.00 ),
            (4, 'Ibrahim' , 24, 'Egypt'  , 40.00 );
")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Insert Table failed: " + PQerrorMessage(conn))
    PQclear(res)
ok
PQclear(res)

res = PQexec(conn, "
    select * from COMPANY
")
if PQresultStatus(res) != PGRES_TUPLES_OK
    fputs(stderr, "Select failed: " + PQerrorMessage(conn))
    PQclear(res)
    call exit_nicely(conn)
ok

nFields = PQnfields(res)
for i = 1 to nFields
    ? PQfname(res, i-1)
next

? copy("*",60)

for i = 1 to PQntuples(res)
    for j=1 to nFields
        see PQgetvalue(res, i-1, j-1) + " "
    next
    see nl
next

PQclear(res)

PQfinish(conn)

```

Output:

```

id
name
age
address
salary
*****
1 Mahmoud 31 Jeddah 10
2 Ahmed    27 Jeddah 20
3 Mohammed 31 Egypt 30

```

(continues on next page)

(continued from previous page)

4 Ibrahim	24	Egypt	40
-----------	----	-------	----

For more information check the PostgreSQL Chapter in the documentation

112.8 Deploying Web applications in the Cloud

We created a new project and tutorial to explain how to deploy Ring web applications in the Cloud using Heroku

Project : <https://github.com/ring-lang/RingWebAppOnHeroku>

Heroku Website : <https://www.heroku.com/>

ID	Name	Salary	Options
12	Lena	110	Select Option...
13	Ayoub	120	Select Option...
14	Fares	130	Select Option...
7	Maged	80	Select Option...
9	Samir	100	Select Option...

For more information check the Deploying Web Applications In The Cloud chapter in the documentation.

112.9 Better RingQt

(1) The next classes are added to RingQt

- QDrag
- QMimeData
- QDropEvent
- QDragMoveEvent
- QDragEnterEvent
- QDragLeaveEvent

- QClipboard
- QChildEvent
- QGeoPositionInfo
- QGeoCoordinate
- QGeoAddress
- QGeoAreaMonitorInfo
- QGeoAreaMonitorSource
- QGeoCircle
- QGeoPositionInfoSource
- QGeoRectangle
- QGeoShape
- QGeoSatelliteInfo
- QGeoSatelliteInfoSource
- QNmeaPositionInfoSource
- QAxWidget
- QTextStream
- QPrinterInfo
- QPrintPreviewWidget
- QPrintPreviewDialog
- QPageSetupDialog
- QAbstractPrintDialog
- QPrintDialog

(2) The next classes are updated

- QAllEvents Class : New Events (ChildAdded, ChildPolished, ChildRemoved).
- QPainter Class : Updated Methods (drawConvexPloygon, drawPoints, drawPolyline) Accept Ring list of points.
- QVariant : More versions that accept different parameters when creating the object.
- QAxBASE : Different versions for the dynamicCall() and querySubObject() methods.

The next example for using the QPrintPreviewDialog class

Example:

```
load "guilib.ring"

new qApp {
    win1 = new QWidget() {
        setWindowTitle("Printer Preview Dialog")
        setGeometry(100, 100, 800, 880)
        printer1 = new QPrinter(0)
        show()
        oPreview = new QPrintPreviewDialog(printer1) {
```

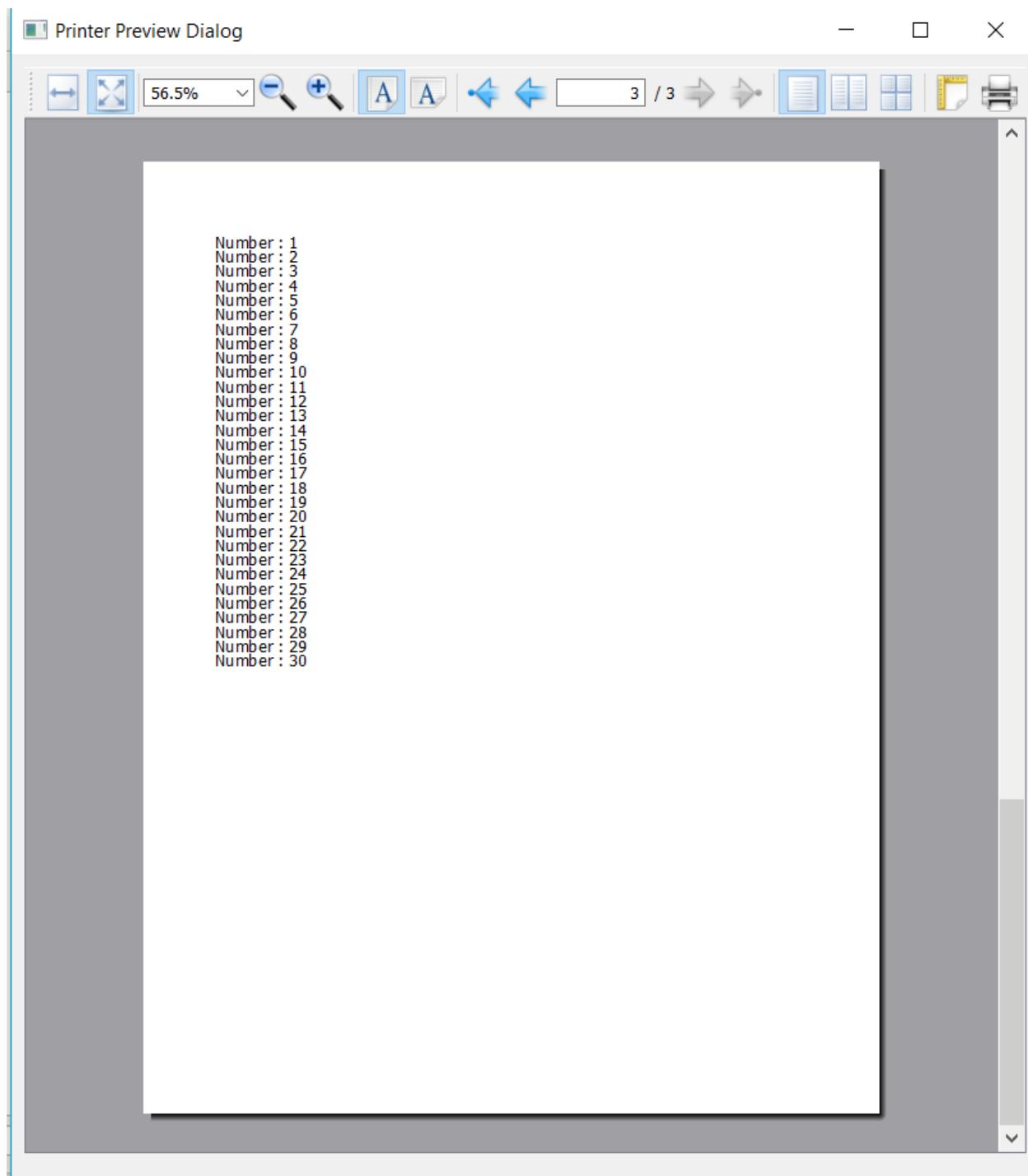
(continues on next page)

(continued from previous page)

```
        setParent(win1)
        move(10,10)
        setPaintrequestedevent("printPreview()")
        exec()
    }
}
exec()
```

```
func printPreview
    printer1 {
        painter = new qpainter() {
            begin(printer1)
            myfont = new qfont("Times",50,-1,0)
            setfont(myfont)
            drawtext(100,100,"Test - Page (1)")
            printer1.newpage()
            drawtext(100,100,"Test - Page (2)")
            printer1.newpage()
            myfont2 = new qfont("Times",14,-1,0)
            setfont(myfont2)
            for x = 1 to 30
                drawtext(100,100+(20*x),"Number : " + x)
            next
            endpaint()
        }
    }
```

Screen Shot:



112.10 Better Memory Management

The Ring API is updated to include RING_API_RETMANAGEDCPOINTER()

Using RING_API_RETMANAGEDCPOINTER() the Ring extensions written in C/C++ languages can return a managed pointer to Ring. This pointer can be controlled by the Ring VM using reference counting.

This is important to avoid the need to write code that free the unmanaged resources like QPixMap objects in RingQt.

Also the Code Generator for extensions is updated to automatically use RING_API_RETMANAGEDCPOINTER() based on need.

Syntax:

```
RING_API_RETMANAGEDCPOINTER(void *pValue, const char *cPointerType,
                           void (* pFreeFunc)(void *,void *))
```

For more information about RING_API_RETMANAGEDCPOINTER()

See the “Extension using the C/C++ languages” Chapter in the documentation

112.11 Better Code Generator for Extensions

- (1) The code generator for extensions is updated to support the <loadfile> command

```
<loadfile> filename.cf
```

This is useful to separate the extension configuration file to many files

Example:

The file : qt_module_network.cf in the RingQt Extension

```
<comment>
                               Module (network)
</comment>

<loadfile> qabstractsocket.cf
<loadfile> qnetworkproxy.cf
<loadfile> qtcpsocket.cf
<loadfile> qtcpserver.cf
<loadfile> qhostaddress.cf
<loadfile> qhostinfo.cf
<loadfile> qnetworkrequest.cf
<loadfile> qnetworkaccessmanager.cf
<loadfile> qnetworkreply.cf
```

- (2) The code generator support the <managed> option when defining classes.

Using this option, the generator will use RING_API_RETMANAGEDCPOINTER() to return the C pointer.

So the Garbage Collector will manage these C pointers.

Example

```
<class>
name: QFont
para: QString, int, int, bool
managed
</class>
```

112.12 More Improvements

- (1) Ring Compiler - The Rule (Factor -> ‘-’ Expr) changed to (Factor -> ‘-’ Factor).
- (2) Ring VM - Better Error Message.
- (3) Better code for IsNULL() function - updated to check pointers too.
- (4) Better code for ringvm_evalinscope() function - used by the Trace Library.
- (5) Better code for Space() function.
- (6) Better code for Hex() and Dec() functions.
- (7) Better code for Download() function.
- (8) Better code for SubStr() function.
- (9) Better code for the Unsigned() function.
- (10) Better code for Chdir() function.
- (11) Better code for Tempname() function.
- (12) Better code for HashTable - New Key (using ring_strdup() instead of strdup() function).
- (13) New Function : SRandom() - Initialize random number generator.
- (14) New Function : IsPointer().
- (15) IsList() will not return True for C Pointers, we have now the IsPointer() function.
- (16) The ? Operator is updated to respect the ringvm_see() function.
- (17) Scripts to run Ring tests on Linux and macOS (Not only Windows).
- (18) RingAllegro is Updated from Allegro 5.1 to Allegro 5.2.
- (19) Shader Functions are added to RingAllegro.
- (20) Joystick Functions are added to RingAllegro.
- (21) Network functions are added to RingLibSDL.
- (22) Game Engine for 2D Games - Text Class - Check the font object before usage.
- (23) Game Engine for 2D Games - Automatic support for Joystick.
- (24) RingLibCurl is updated to automatically use CURLOPT_COPYPOSTFIELDS when needed.
- (25) Ring Notepad - Find Previous Feature.
- (26) Ring Notepad - Default Style.
- (27) Ring Notepad - Support using Non-English language (Like Arabic) in file names.
- (28) Form Designer - Nice Alignment for Toolbox Icons.
- (29) Form Designer - QAllEvents Class - Mouse Double Click Event.

- (30) Find in Files - Replace and Replace All options.
- (31) Qt Class Converter is updated for better conversion results.
- (32) More samples are added to ring/samples/other folder.
- (33) Code Refactoring for Ring Notepad, RingQt, Game Engine for 2D Games.
- (34) Better Documentation - Many images are updated to reflect the current state of Ring Environment.
- (35) Better Documentation - More chapters are added to the documentation.

WHAT IS NEW IN RING 1.10?

In this chapter we will learn about the changes and new features in Ring 1.10 release.

113.1 List of changes and new features

Ring 1.10 comes with the next features!

- Chess Game
- Minesweeper Game
- Knight Tour Game
- Game of Life Game
- Pong Game
- Snakes and Ladder Game
- More Games
- Ring Extension for Visual Studio Code
- The Ring Package Manager (RingPM)
- Better Tests
- More Improvements

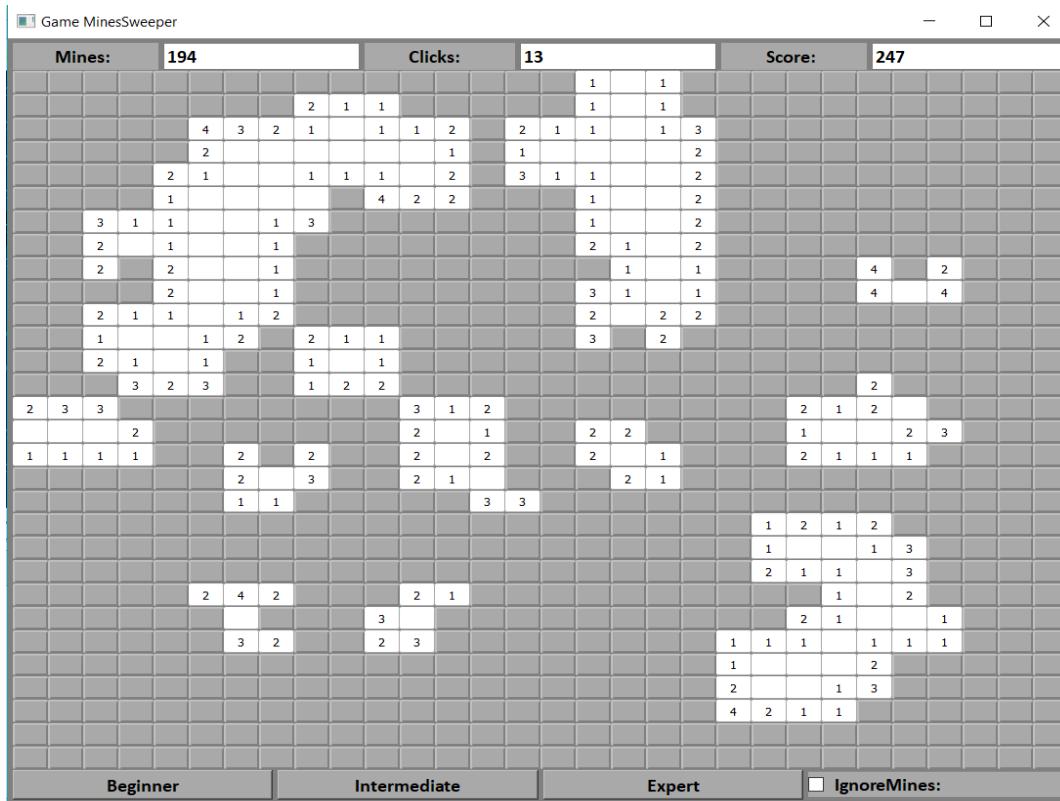
113.2 Chess Game

Chess Game (2 Players)



113.3 Minesweeper Game

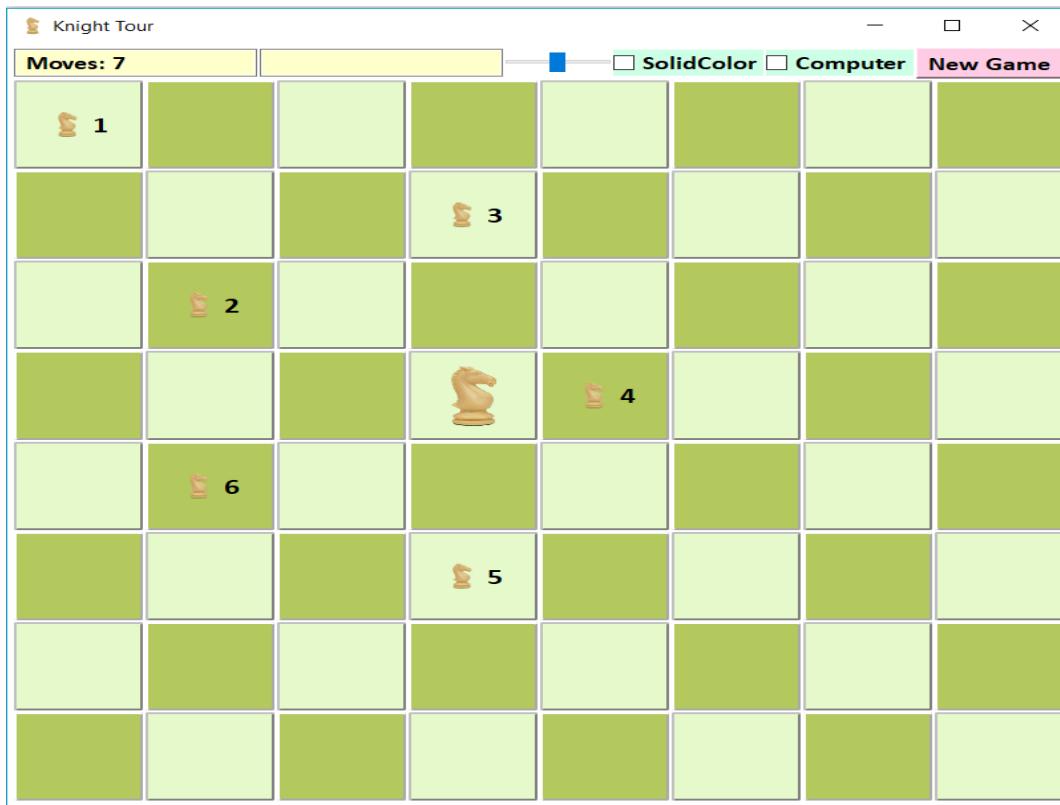
The objective of the game is to clear a rectangular board containing hidden “mines” or bombs without detonating any of them.



113.4 Knight Tour Game

Move to every square on the chess board, using only the moves of a knight.

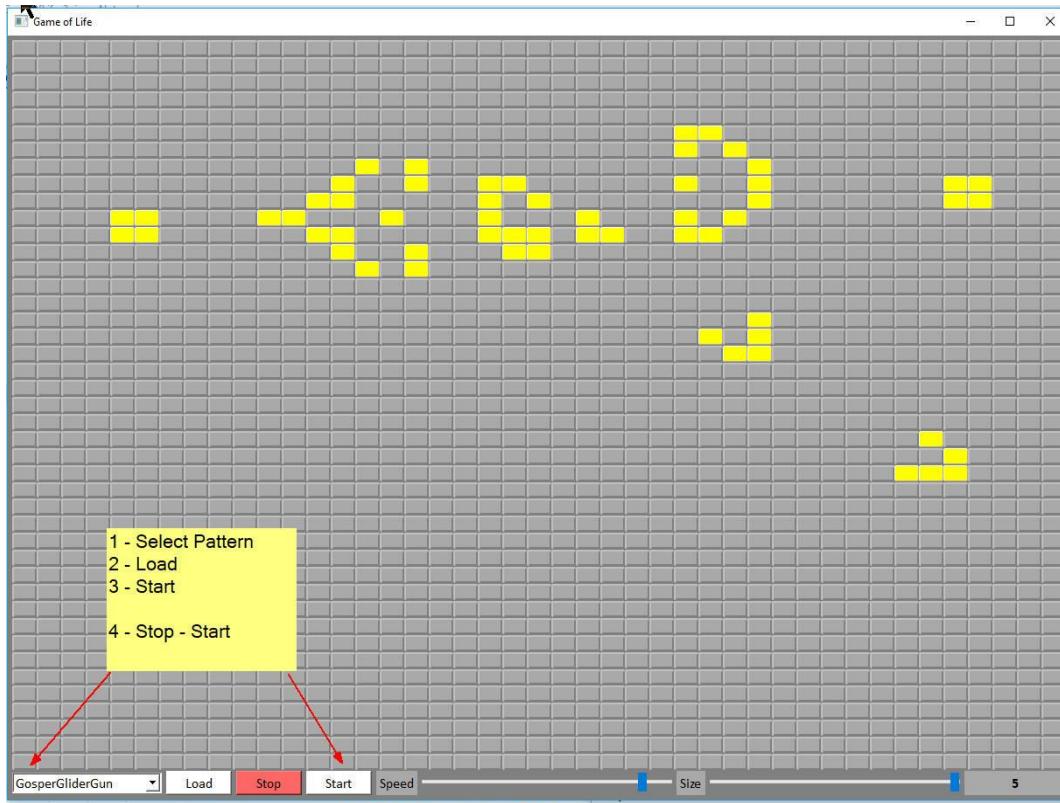
Can you visit every square in just 63 moves?



113.5 Game of Life Game

The game is a zero-player game, meaning that its evolution is determined by its initial state, requiring no further input.

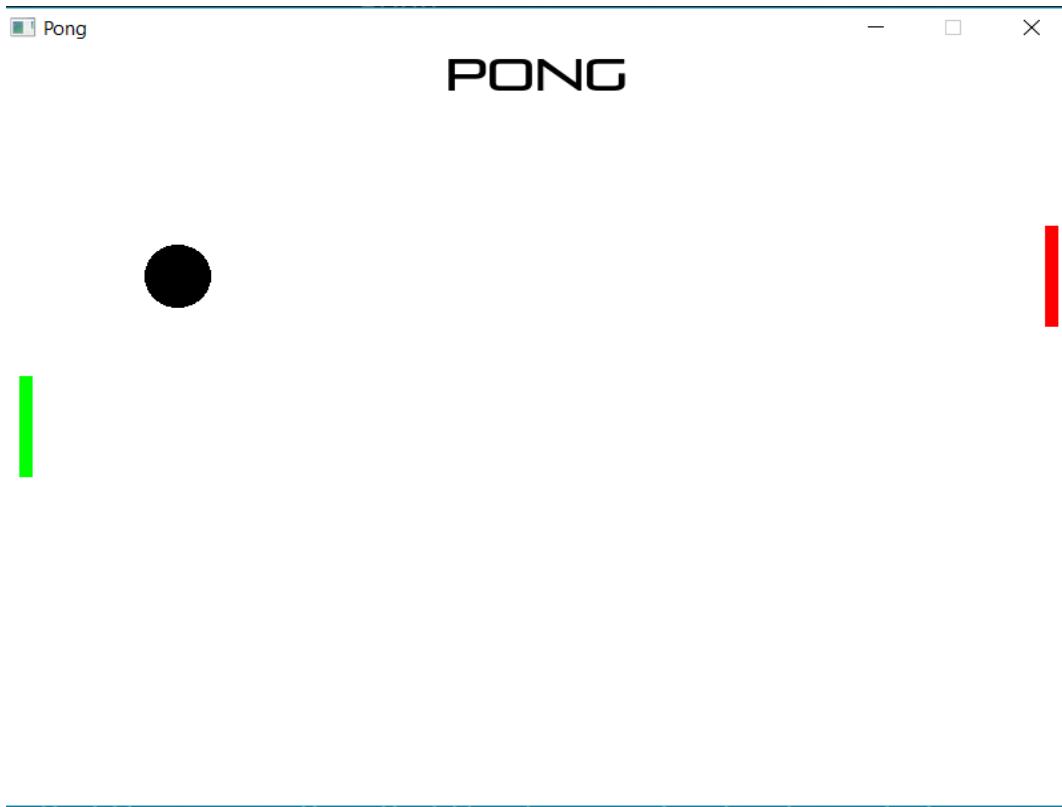
One interacts with the Game of Life by creating an initial configuration and observing how it evolves, or, for advanced players, by creating patterns with particular properties.



113.6 Pong Game

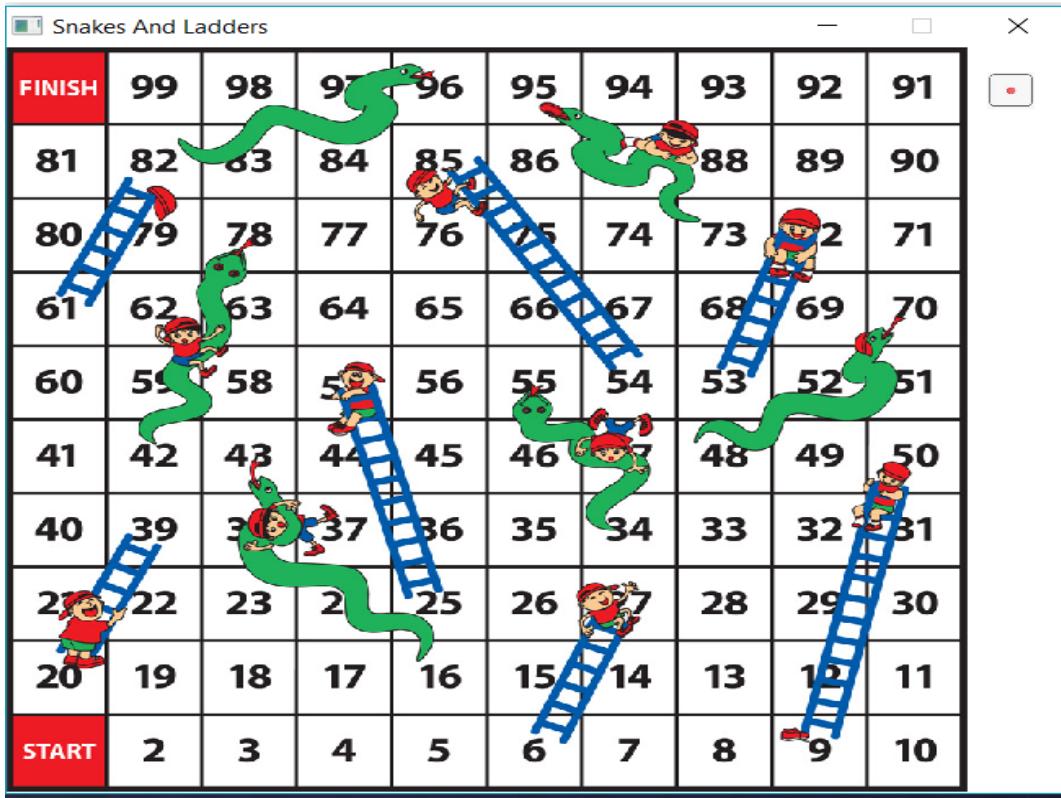
Simple “tennis like” game features two paddles and a ball.

The goal is to defeat your opponent once the opponent misses a ball.



113.7 Snakes And Ladder Game

The Snakes and Ladder Game using Ring Game Engine for 2D Games

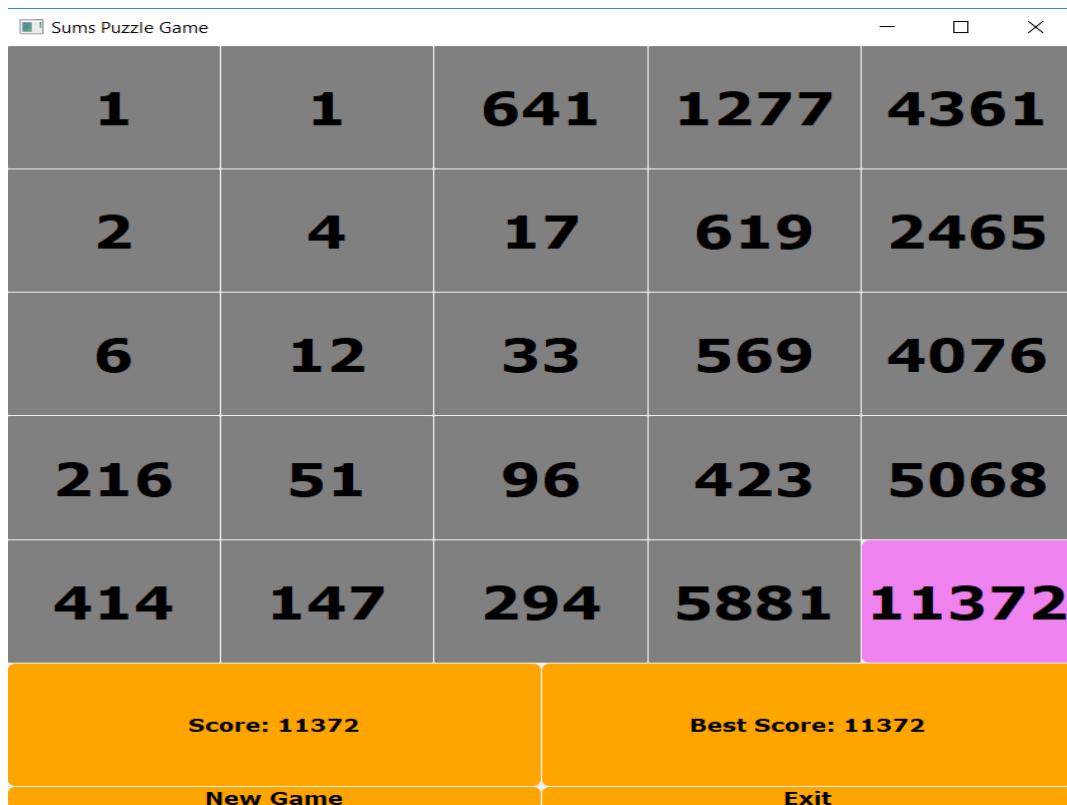


113.8 More Games

The next games are added to the application folder

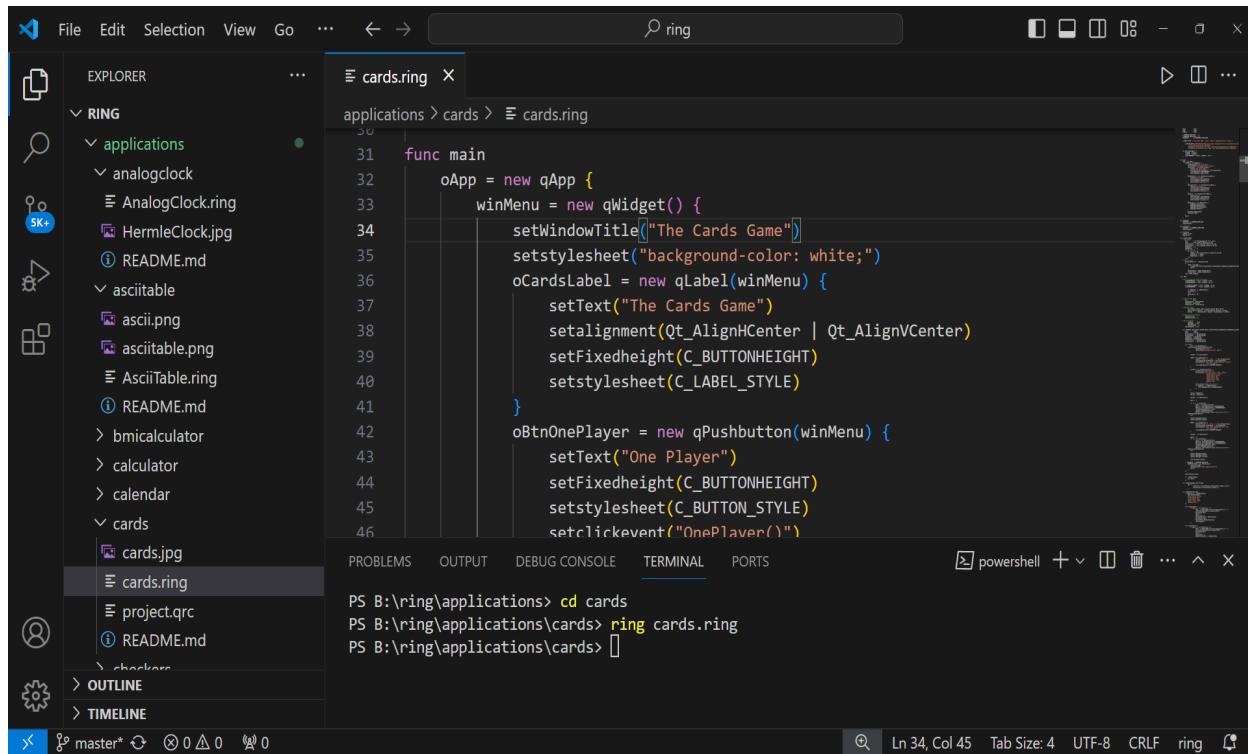
- Lights Out Game
- Dots and Boxes Game
- Magic Four Game
- Sum Puzzle Game

The next screen shot for the Sum Puzzle Game



113.9 Ring Extension for Visual Studio Code

This extension support the Ring programming language in Visual Studio Code



113.10 The Ring Package Manager (RingPM)

Ring comes with a package manager (RingPM) that we can use to install, update and remove packages.

The Package Manager uses Semantic Versioning to check compatibility between packages

The Package Manager comes with the next options

```
=====
Usage   : ringpm [command]
Command : search  [keywords...]
Command : refresh : Update the Registry (Packages List)
Command : install [ <packagename> [from <UserName>] [branch <branchname>] ]
Command : list    [-u : Check updates]
Command : run     [packagename]
Command : update  <packagename>
Command : remove  <packagename>
Command : format  : Delete All Packages
Command : new     <packagename>
Command : package : Create package in the current folder
=====
```

113.11 Better Tests

New framework for Ring programming language tests that test the language.

```
B:\ring\tests>test
=====
Tests Count : 307
=====

Test (1)   : Hello World Program (Using See)           --- PASS
Test (2)   : Hello World Program (Using See and nl)    --- PASS
Test (3)   : Hello World Program (Using Put)          --- PASS
Test (4)   : Hello World Program (Using Put and nl)    --- PASS
Test (5)   : Testing Procedural Programming (Part 1)  --- PASS
Test (6)   : Testing Procedural Programming (Part 2)  --- PASS
Test (7)   : Testing Procedural Programming (Part 3)  --- PASS
Test (8)   : Testing Procedural Programming (Part 4)  --- PASS
Test (9)   : Testing Procedural Programming (Part 5)  --- PASS
Test (10)  : Testing Procedural Programming (Part 6)  --- PASS
Test (11)  : Testing Procedural Programming (Part 7)  --- PASS
Test (12)  : Testing Procedural Programming (Part 8)  --- PASS
Test (13)  : Testing Object Oriented Programming (Part 1) --- PASS
Test (14)  : Testing Object Oriented Programming (Part 2) --- PASS
Test (15)  : Testing Object Oriented Programming (Part 3) --- PASS
Test (16)  : Testing Object Oriented Programming (Part 4) --- PASS
Test (17)  : Testing Object Oriented Programming (Part 5) --- PASS
Test (18)  : Testing Object Oriented Programming (Part 6) --- PASS
Test (19)  : Testing Object Oriented Programming (Part 7) --- PASS
Test (20)  : Testing Object Oriented Programming (Part 8) --- PASS
```

113.12 More Improvements

- (1) Ring Compiler : Better support for (Operator Operator) to avoid checking the first operator when it's a literal.
- (2) Ring Compiler : When we load a file that doesn't exist, display the caller file name in the error message.
- (3) Ring Compiler : Support source code files with one line of comment without end of line.
- (4) Ring Compiler : change nNoAssignment attribute in Parser Structure to nNewObject.
- (5) Ring VM : Better support for the (Return) command inside braces that access new objects.
- (6) Ring VM : Dir() Function - Don't add “.” and “..” to the output
- (7) Ring VM : Dir() Function - Correct output for the item type (file|directory) on Linux and macOS.
- (8) Ring VM : ICO_LISTSTART - Clean pVM->a SetProperty when setting an object attribute.
- (9) Ring VM : ICO_NEWOBJECT - Clean pVM->a SetProperty when setting an object attribute.
- (10) Ring VM : Better code for Setter and Getter methods support.
- (11) Ring2EXE: The libraries information are stored in separated files in ring/ring2exe/libs folder.
- (12) WebLib : Separate the library to many source code files.
- (13) StdLib : IsVowel() function - Better Code.
- (14) RingQt : Count(), Left(), Mid() and Right() methods are added to QString class.

(15) Better Read Me File

WHAT IS NEW IN RING 1.11?

In this chapter we will learn about the changes and new features in Ring 1.11 release.

114.1 List of changes and new features

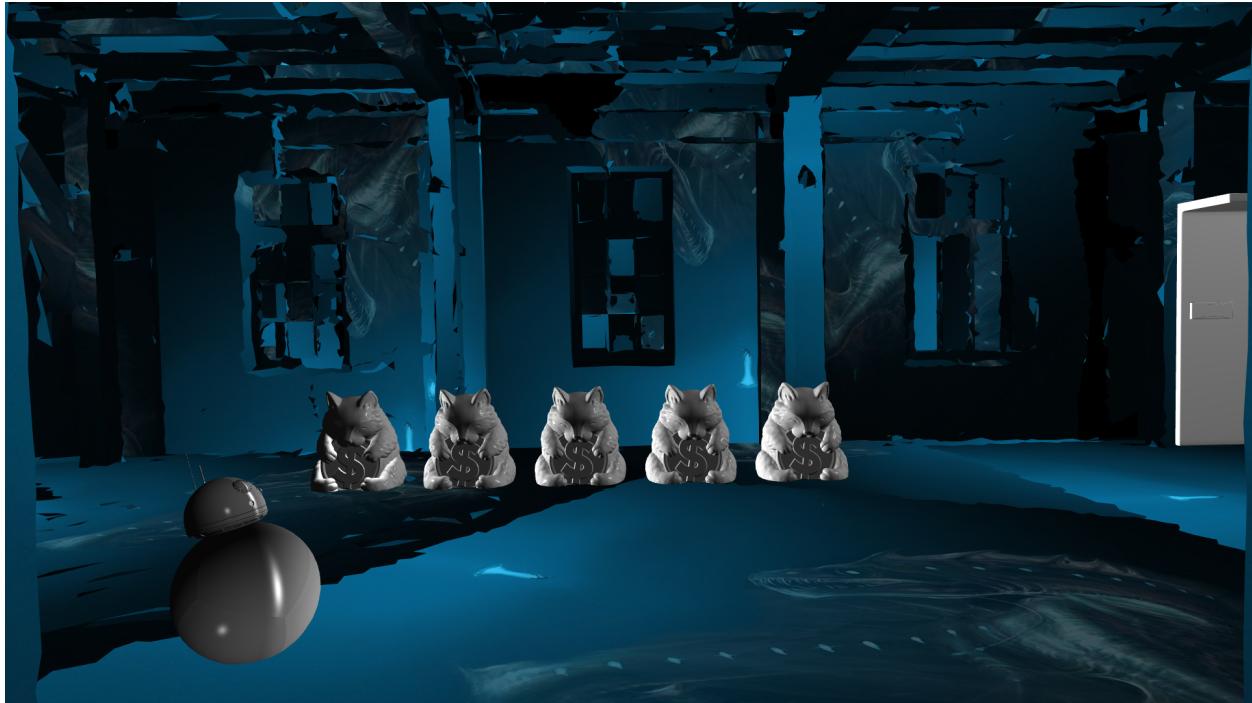
Ring 1.11 comes with the next features!

- More 3D Samples
- Checkers Game
- Sokoban Game
- Maze Game
- Snake Game
- Sudoku Game
- Desktop Screen Shot Application
- Text To Speech Application
- RingRayLib Extension
- ZeroLib Library
- StdLib - More Functions
- Better RingQt
- Better Performance
- Better Documentation
- More Improvements

114.2 More 3D Samples

Ring 1.11 comes with more 3D samples based on Qt3D

- Folder : ring/samples/other/UsingQt3D (Contains 18 samples)



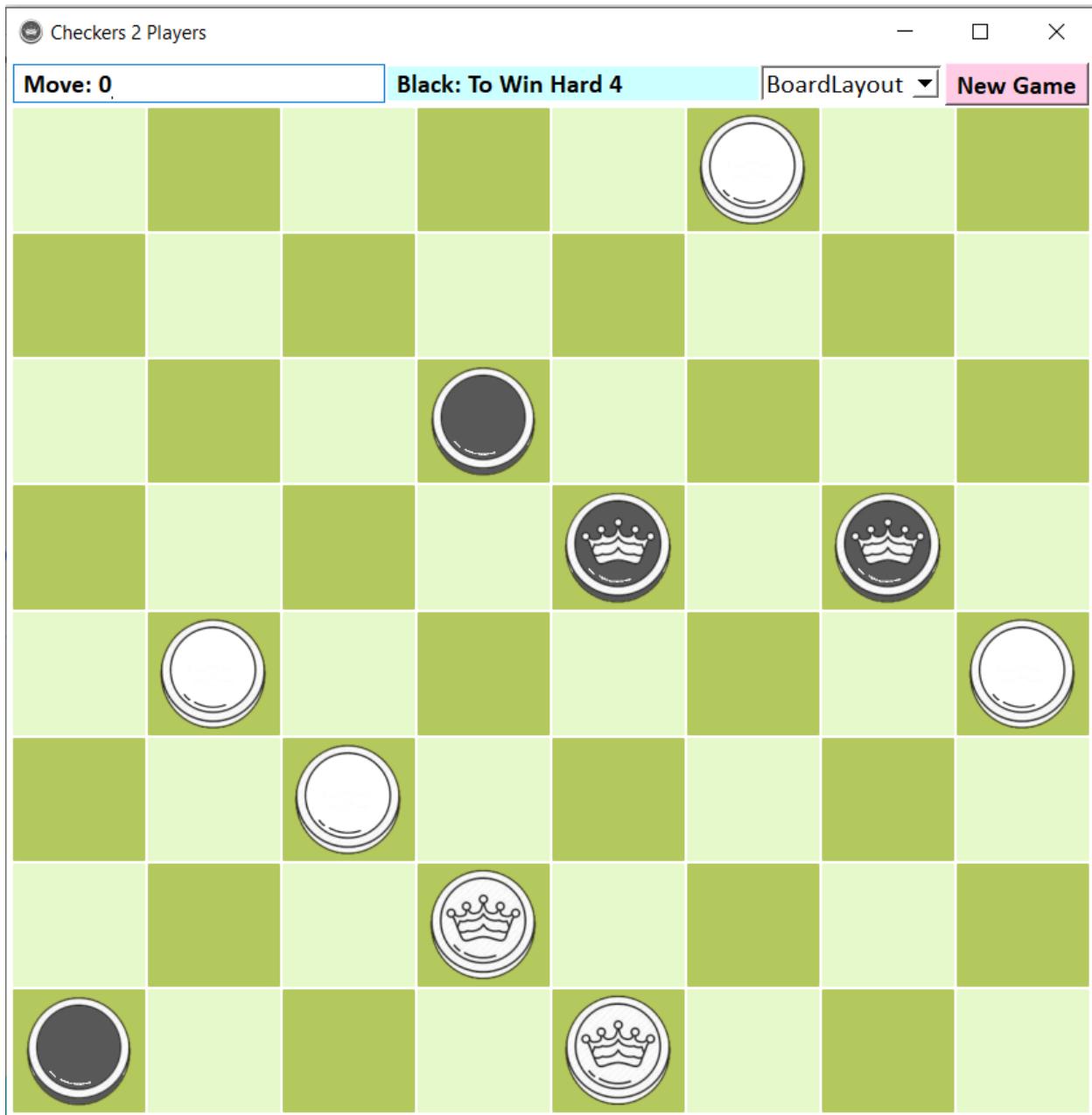
114.3 Checkers Game

It plays the - Must Jump - version of Checkers, The International Rules

It handles various invalid moves, invalid jumps, and must jumps.

The squares are colored to reflect errors.

The squares are colored to show source and destination of the move or jump.



114.4 Sokoban Game

A quick implementation for the Sokoban Game

Developed using Ring Game Engine for 2D Games in 2 hours (Less than 300 lines of code)

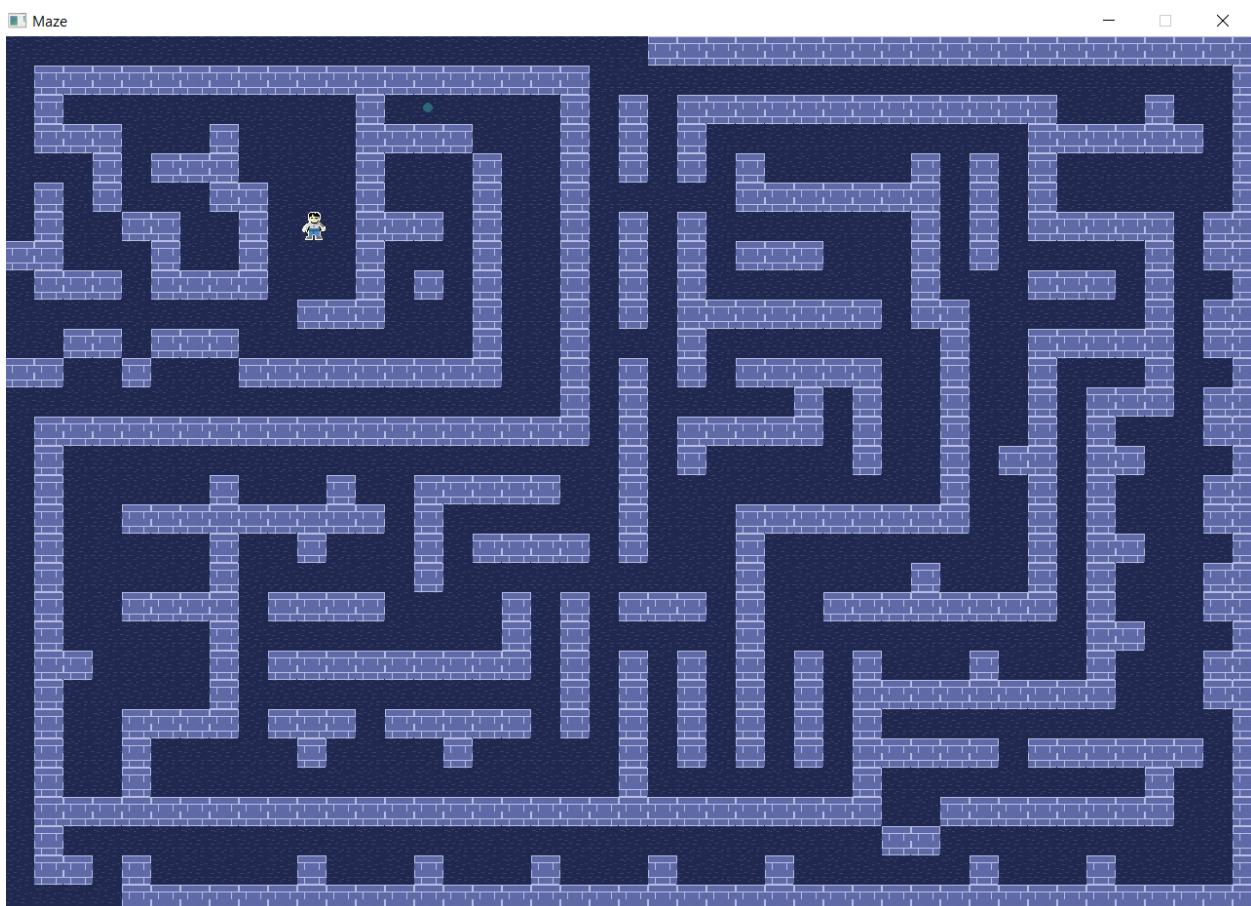


114.5 Maze Game

A quick implementation for the Maze Game

Developed using Ring Game Engine for 2D Games (Around 100 lines of code)

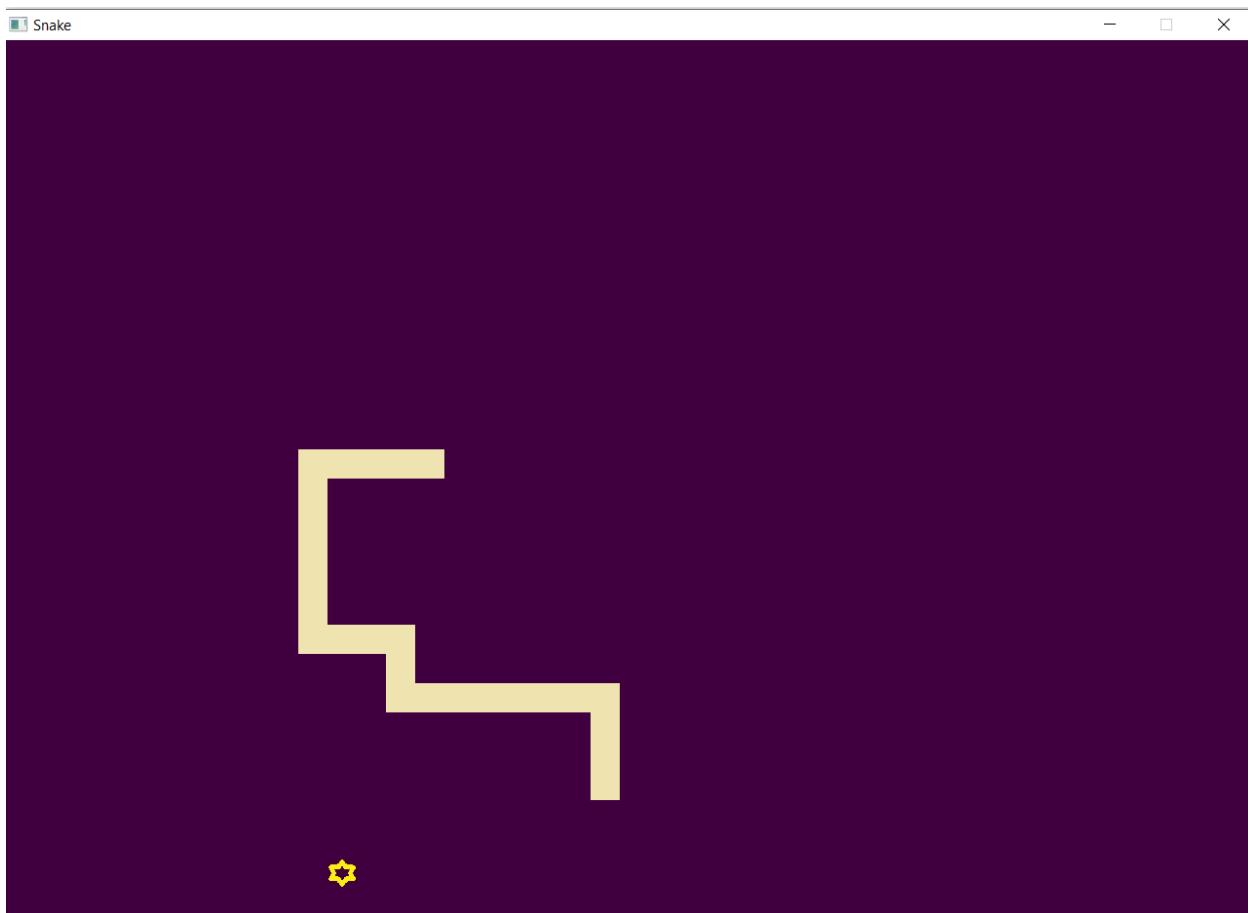
Also the game comes with a level designer (Developed in 10 minutes, 37 Lines of code)



114.6 Snake Game

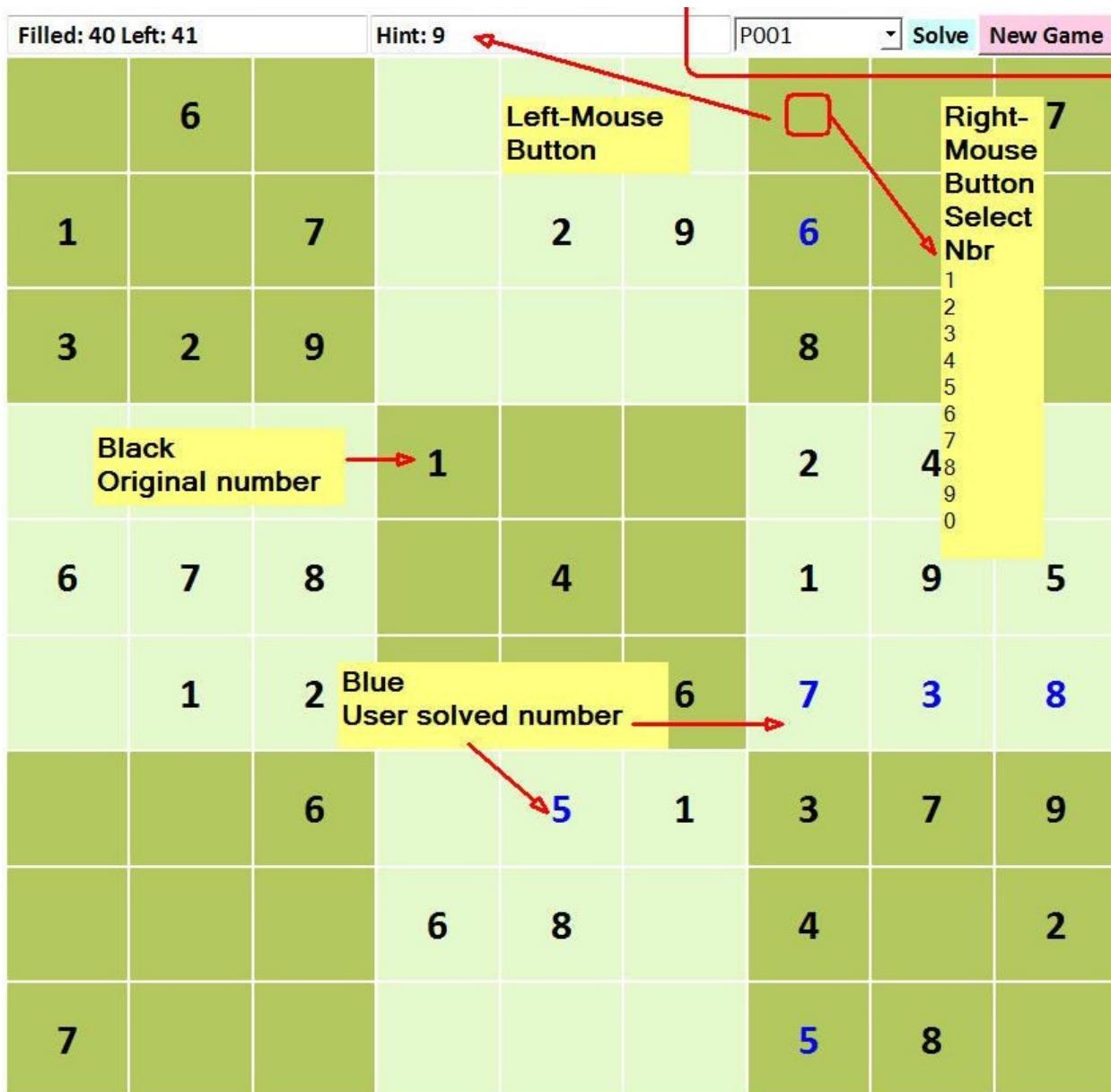
A quick implementation for the Snake Game

Developed using Ring Game Engine for 2D Games (Around 200 lines of code)

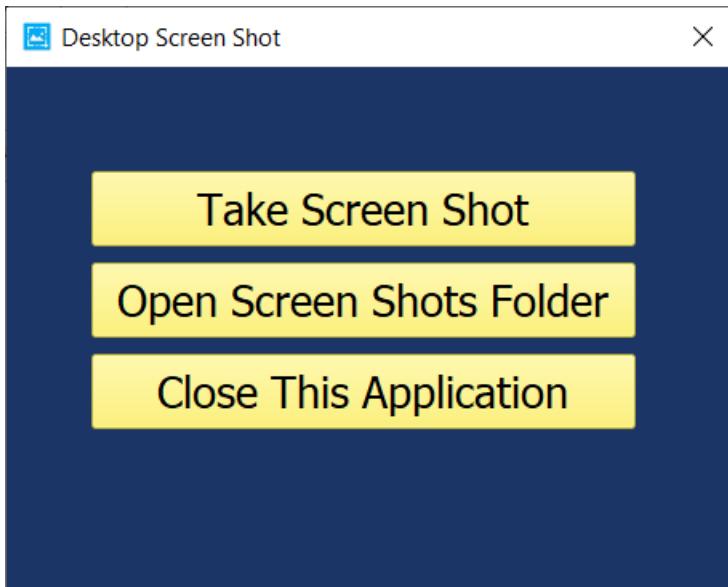


114.7 Sudoku Game

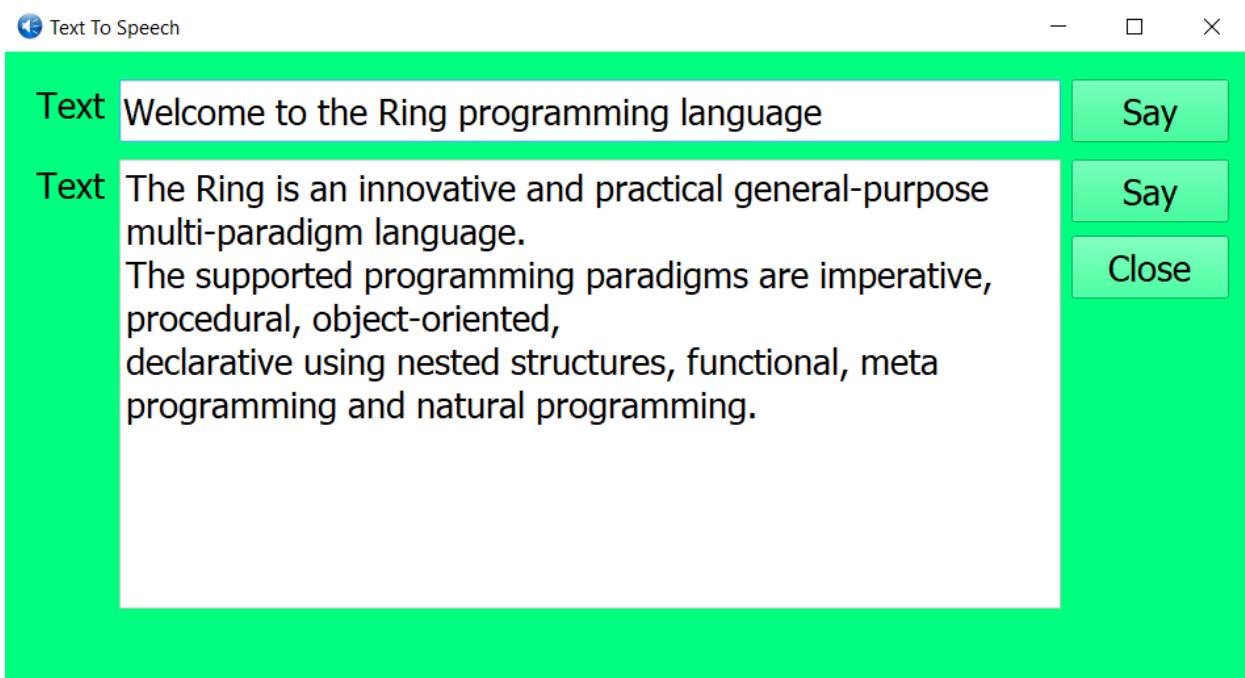
Fill a 9×9 grid with digits so that each column, each row, and each of the nine 3×3 subgrids that compose the grid contain all of the digits from 1 to 9.



114.8 Desktop Screen Shot Application



114.9 Text To Speech Application



114.10 RingRayLib Extension

Ring 1.11 comes with new extension to support the RayLib game programming library

Example:

```
load "raylib.ring"

 screenWidth      = 800
 screenHeight    = 450

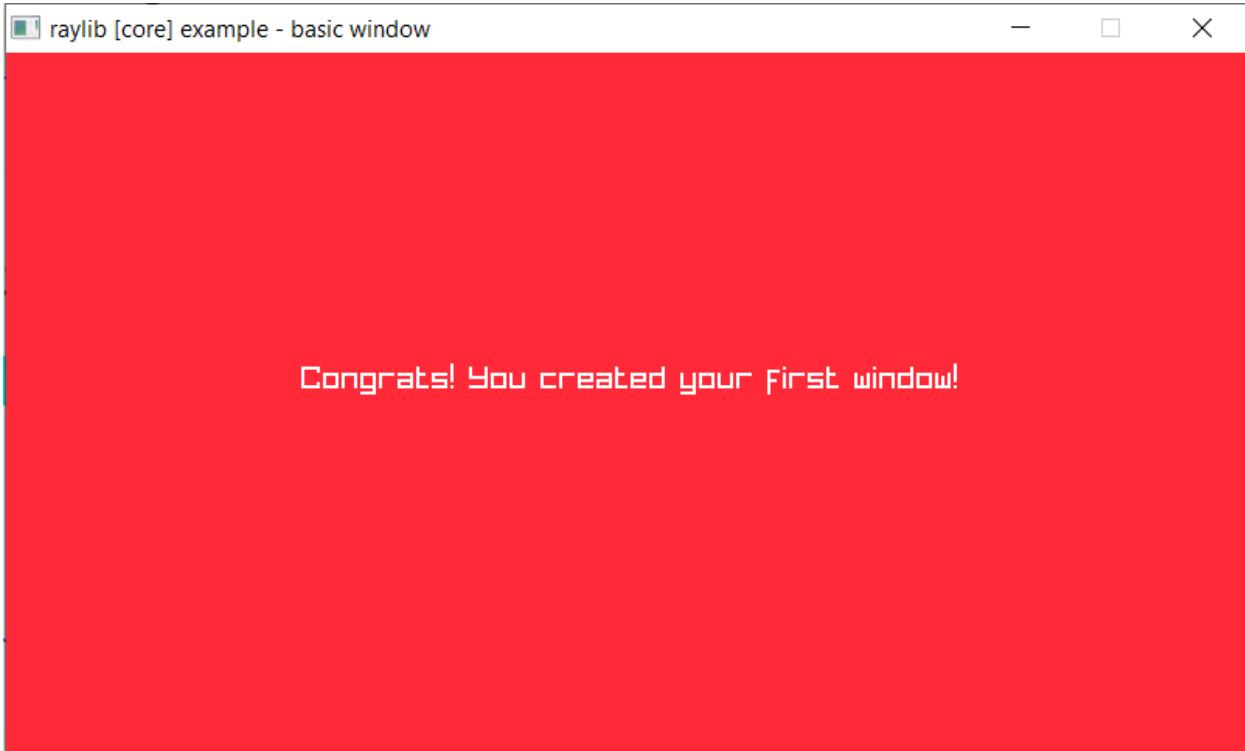
 InitWindow(screenWidth, screenHeight, "raylib [core] example - basic window")

 SetTargetFPS(60)

 while !WindowShouldClose()
     BeginDrawing()
     ClearBackground(RED)
     DrawText("Congrats! You created your first window!", 190, 200, 20, WHITE)
     EndDrawing()
 end

 CloseWindow()
```

Output:



Example:

```
load "raylib.ring"
```

(continues on next page)

(continued from previous page)

```

screenWidth = 800
screenHeight = 450

InitWindow(screenWidth, screenHeight, "raylib [shapes] example - basic shapes drawing")

SetTargetFPS(60)

while !WindowShouldClose()

    BeginDrawing()

    ClearBackground(RAYWHITE)

    DrawText("some basic shapes available on raylib", 20, 20, 20, DARKGRAY)
    DrawCircle(screenWidth/4, 120, 35, DARKBLUE)
    DrawRectangle(screenWidth/4*2 - 60, 100, 120, 60, RED)
    DrawRectangleLines(screenWidth/4*2 - 40, 320, 80, 60, ORANGE)
    DrawRectangleGradientH(screenWidth/4*2 - 90, 170, 180, 130, MAROON, GOLD)

    DrawTriangle(Vector2(screenWidth/4*3, 80),
                 Vector2(screenWidth/4*3 - 60, 150),
                 Vector2(screenWidth/4*3 + 60, 150), VIOLET)

    DrawPoly(Vector2(screenWidth/4*3, 320), 6, 80, 0, BROWN)

    DrawCircleGradient(screenWidth/4, 220, 60, GREEN, SKYBLUE)

    DrawLine(18, 42, screenWidth - 18, 42, BLACK)
    DrawCircleLines(screenWidth/4, 340, 80, DARKBLUE)
    DrawTriangleLines(Vector2(screenWidth/4*3, 160),
                      Vector2(screenWidth/4*3 - 20, 230),
                      Vector2(screenWidth/4*3 + 20, 230), DARKBLUE)
    EndDrawing()

end

CloseWindow()

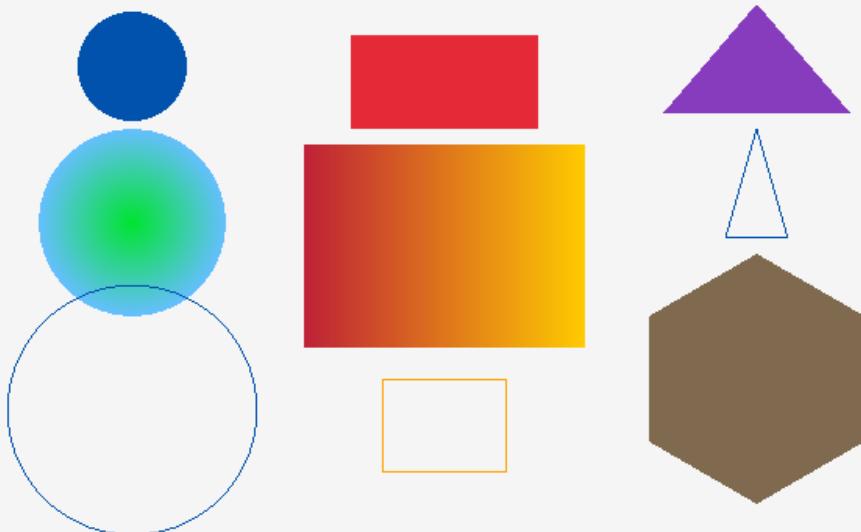
```

Output:

 raylib [shapes] example - basic shapes drawing



some basic shapes available on raylib



114.11 ZeroLib Library

Ring 1.11 comes with the ZeroLib library that contains classes for Lists and Strings where the index starts from 0.

Example:

```
load "zerolib.ring"

? "Using List - Index start from 0"
List = Z( [1,2,3] )
List.Add(4)
List.Add(5)
? List[0]
? List[1]
? List[2]
? List[3]
? List[4]
nIndex = List.find(2)
? "Find(2) = " + nIndex
List.delete(0)
? "After deleting the first item : List[0]"
? "Now List[0] = " + List[0]

? "Using String - Index start from 0"
String = Z( "Welcome" )
? String[0]
? String[1]
? String[2]
```

(continues on next page)

(continued from previous page)

```
? String[3]
? String[4]
? String[5]
? String[6]
```

Output:

```
Using List - Index start from 0
1
2
3
4
5
Find(2) = 1
After deleting the first item : List[0]
Now List[0] = 2
Using String - Index start from 0
W
e
l
c
o
m
e
```

114.12 StdLib - More Functions

The next functions are added to the StdLib

- IsListContainsItems(aParent,aChild)
- IsBetween(nNumber,nMin,nMax)
- TimeInfo(cInformation)

Example:

```
load "stdlibcore.ring"
? "Using the IsListContainsItems() function"
aList1 = "a":"z"
aList2 = [:h,:l,:p,:u]
? IsListContainsItems(aList1,aList2)
? "Using the IsBetween() function"
? isBetween(1,3,4)
? isBetween(4,1,6)
? "Using the TimeInfo() function"
? timeInfo(:date)
? timeInfo(:year)
? timeInfo(:time)
? timeInfo(:hour_12)
```

Output:

```
Using the IsListContainsItems() function
```

```
1
```

```
Using the IsBetween() function
```

```
0
```

```
1
```

```
Using the TimeInfo() function
```

```
05/24/19
```

```
2019
```

```
15:30:33
```

```
03
```

For more information about these functions, see the StdLib functions chapter.

114.13 Better RingQt

- Building RingQt using Qt 5.12.3
- RingQt for Android - project file is updated to include webview module when we have it
- QString Class - New Methods
 - compare()
 - contains()
 - indexOf()
 - insert()
 - isRightToLeft()
 - remove()
 - repeated()
 - replace()
 - startsWith()
 - endsWith()
 - toHtmlEscaped()
 - clear()
 - isnull()
 - resize()
 - fill()
- QAxBase & QVariant - Better API
- The next classes are added to RingQt
 - QQuickView Class
 - QPrintDialog Class
 - QAxWidget2 Class
 - QTextToSpeech Class
 - QGraphicsView Class

- [QAbstractAspect Class](#)
- [QNode Class](#)
- [QEntity Class](#)
- [QTransform Class](#)
- [QAspectEngine Class](#)
- [QTorusMesh Class](#)
- [QConeMesh Class](#)
- [QCylinderMesh Class](#)
- [QCuboidMesh Class](#)
- [QPlaneMesh Class](#)
- [QSphereMesh Class](#)
- [QPhongMaterial Class](#)
- [QForwardRenderer Class](#)
- [Qt3DWindow Class](#)
- [QAbstractCameraController Class](#)
- [QFirstPersonCameraController Class](#)
- [QTextureMaterial Class](#)
- [QExtrudedTextMesh Class](#)
- [QText2DEntity Class](#)
- [QSkyBoxEntity Class](#)
- [QConeGeometry Class](#)
- [QOrbitCameraController Class](#)
- [QDiffuseSpecularMaterial Class](#)
- [QGoochMaterial Class](#)
- [QMetalroughMaterial Class](#)
- [MorphPhongMaterial Class](#)
- [QPervertexColorMaterial Class](#)
- [QInputAspect Class](#)
- [QFrameAction Class](#)
- [QLogicAspect Class](#)
- [QCamera Class](#)
- [QCameraLens Class](#)
- [QMesh Class](#)
- [QTechnique Class](#)
- [QMaterial Class](#)
- [QEffect Class](#)

- QRRenderPass Class
- QSceneLoader Class
- QPointLight Class
- QRRenderAspect Class
- QTextureLoader Class
- QObjectPicker Class
- QCameraSelector Class
- QCullFace Class
- QDepthTest Class
- QViewPort Class

114.14 Better Performance

Ring 1.11 is faster than Ring 1.10

The performance gain is between 10% and 30% based on the application.

114.15 Better Documentation

The next chapters are added to the documentation

- Tutorial : Ring Extensions in C/C++
- Using Qt3D
- Using ZeroLib
- Using RingRayLib

114.16 More Improvements

- New Samples
 - samples/other/ModuloTimesTableCircle folder
 - samples/other/saveimage folder
 - samples/other/UsingQML folder
 - samples/other/myguicontrol.ring
 - samples/other/qcalendarwidget.ring
 - samples/other/qcalendarwidget2.ring
 - samples/other/sudoku-KL02.ring
 - samples/other/sudoku-KL02-longproblem.ring
 - samples/other/zerobasedlist.ring
 - ringlibs/gameengine/lesson17.ring (Using Buttons)

- samples/other/SQLTutorial/SQL-Tutorial.ring
- samples/other/DrawFourier/AA-Draw-Fourier.ring
- samples/other/SmartPhoneEmulator/ejemploKey.ring
- samples/other/DiscreteFourierTransform/DiscreteFourierTransform.ring
- samples/other/phonedatabase/PhoneDatabase.ring
- Gold Magic 800 - More levels (44 Levels)
- Fifteen Puzzle Game 3D - Better Code (Animation Speed)
- Flappy Bird 3000 - change the Bird direction to be looking down when we have game over
- Ring Notepad - Keyboard shortcuts for the Dockable Windows Mode
- Ring Notepad - When displaying functions list, don't avoid functions that contains the “_” character
- Ring Notepad - Output Window - Send Data - Better Code
- Ring Notepad - Find and Replace Window - Better Code
- Ring Notepad - Edit Menu - Insert Text Window
- Ring Notepad - Edit Menu - Lower Case and Upper Case options
- Ring Notepad - Edit Menu - Capitalize option
- Ring Notepad - Edit Menu - Comment Lines and Comment Block of lines
- Ring Notepad - File Tabs - Context Menu (Close other files, Close Active file and Close All files)
- RingPM - When updating a package - don't reinstall the dependency again
- Ring Game Engine for 2D Games - Added : GE_FULLSCREEN, GE_SCREEN_W and GE_SCREEN_H
- Ring Game Engine for 2D Games - Added : name property to game objects
- Ring Game Engine for 2D Games - Added : find() method to game class (find an object by name)
- Ring Game Engine for 2D Games - Support oGame[:ObjectName] to access an object
- Natural Library - Better Performance
- FoxRing - Added: frCTOD() function
- Code generator for extensions - generate functions that use managed pointers to new structures
- Ring VM - Error codes for Ring Object File errors
- Ring VM - Eval() function - Better Code (Better Performance)
- Ring VM - State Management - Better Code
- Ring VM - the “>” operator and operator overloading - Better Code
- Ring VM - Assignment and calling object methods - Better Code
- Ring VM - OOP - Getter Methods - Better Performance
- Ring API - Supporting RING_API_ISLIST() in C Extensions
- Ring Compiler - Supporting new lines after numbers and literals when writing conditions
- Ring Compiler - Supporting semi-colon (;) in the start of the line
- Ring Compiler - Prevent using Loop and Exit commands from outside loops

WHAT IS NEW IN RING 1.12?

In this chapter we will learn about the changes and new features in Ring 1.12 release.

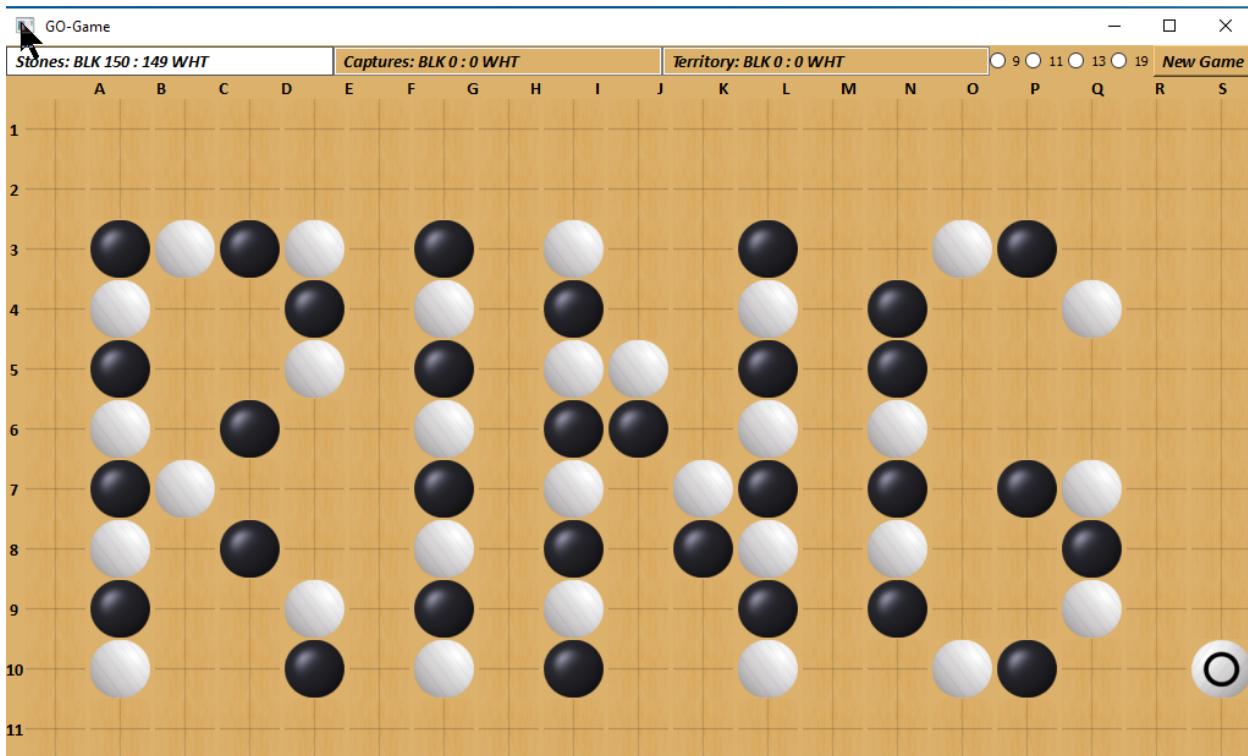
115.1 List of changes and new features

Ring 1.12 comes with the next features!

- Go Game
- ASCII Table application
- BMI Calculator application
- Calendar application
- Julian Day Calendar application
- Tutorial: Number to Words
- Load Again Command
- `ring_state_filetokens()` function
- Embedded Ring Object File
- Better RingRayLib
- More Improvements

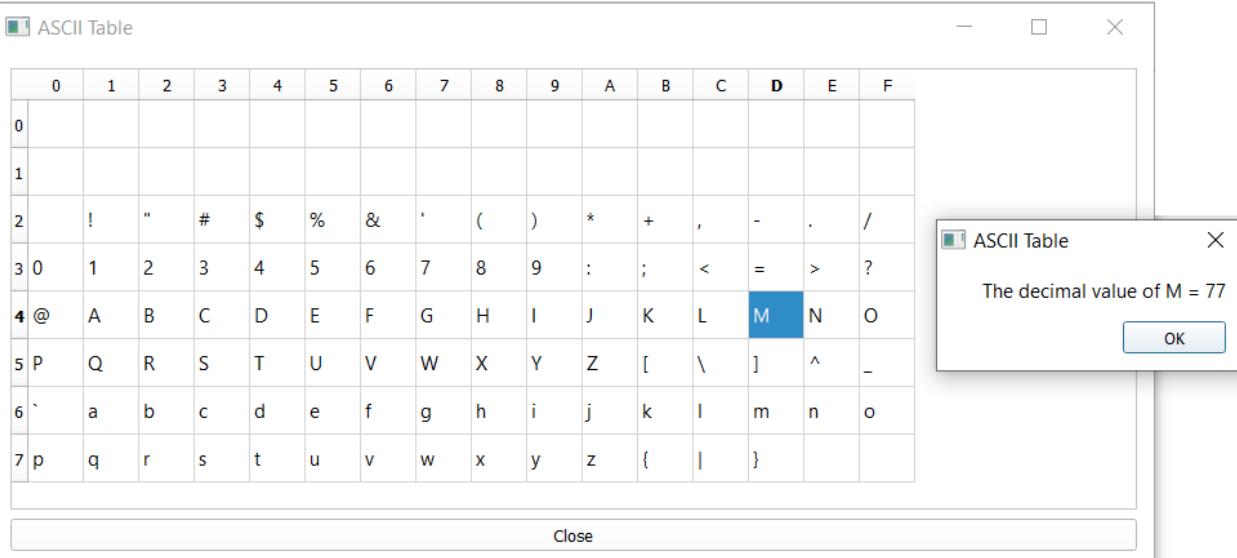
115.2 Go Game

An implementation for the Go Game



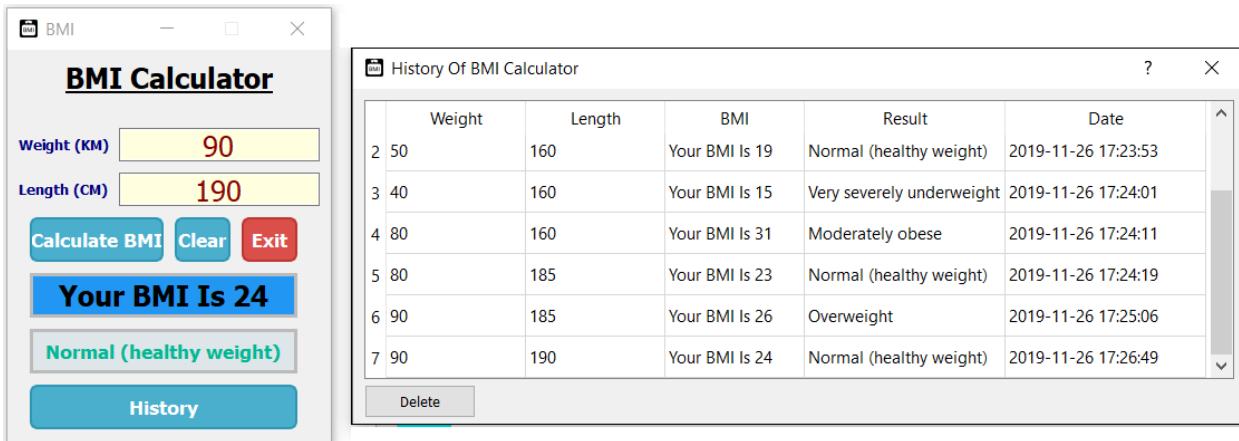
115.3 ASCII Table application

Simple application for displaying the ASCII table



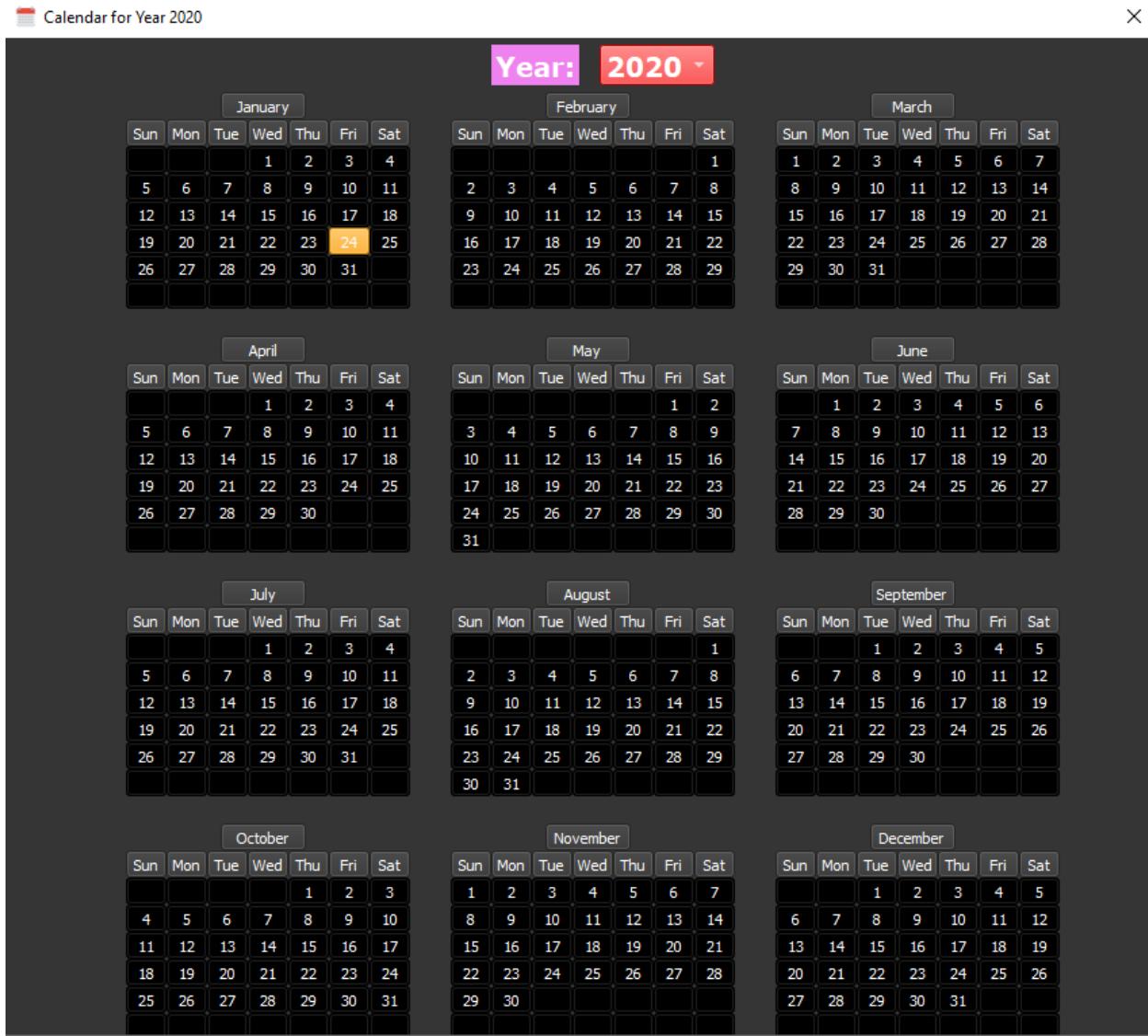
115.4 BMI Calculator application

Simple application for calculating the BMI



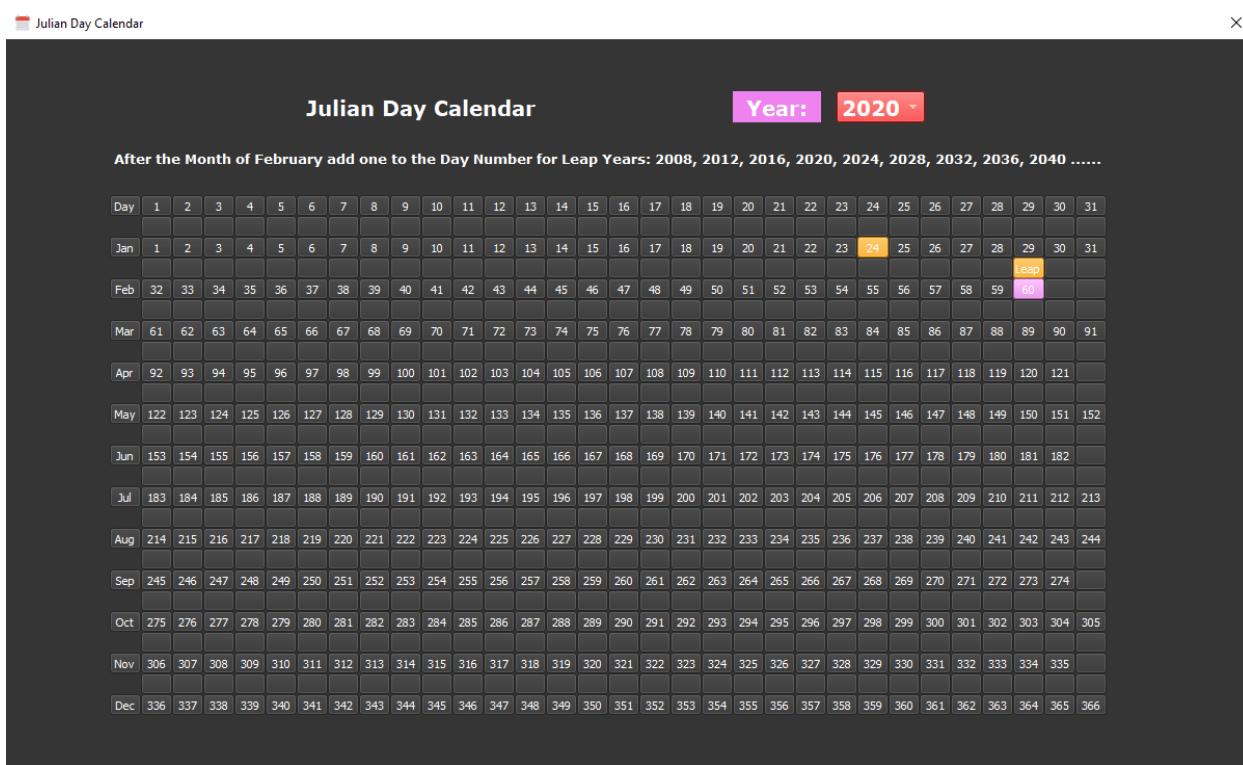
115.5 Calendar application

The Calendar for Year 2020



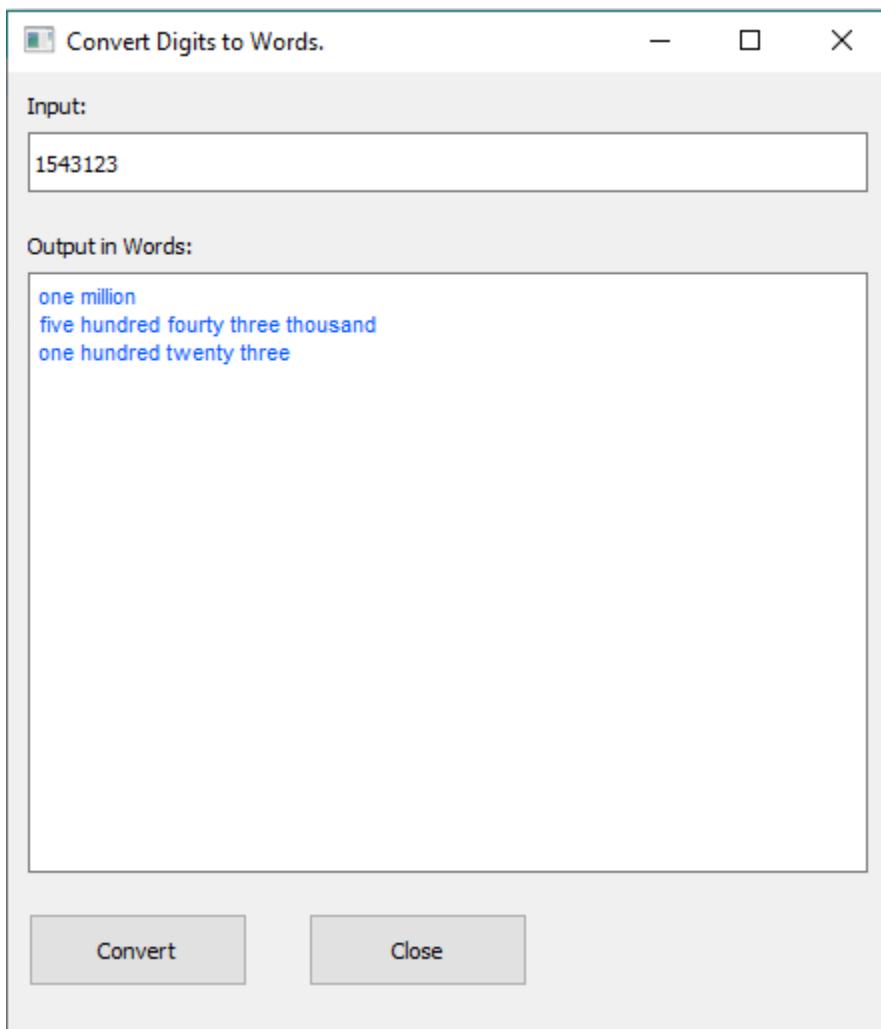
115.6 Julian Day Calendar application

The Julian Day Calendar application



115.7 Tutorial: Number to Words

Folder : ring/samples/other/number2words



115.8 Load Again Command

Ring 1.12 comes with the Load Again command

Using this command we can load the Ring source file which contains constants more than one time.

This is useful when using Ring source files for translations through global constants.

Example:

The next function is part from a project which support Arabic and English languages

The files english.ring and arabic.ring contains constants for translation

One of these files is loaded in the start of the program

Loading the same file again using the (Load) command is not possible

Because the (Load) command load the same source file only for the first time and ignore next times.

So we have to use the (Load Again) command.

Where we can use these files again during the runtime as in the next code

```
func setLang nLanguage
    if C_ENV_DEFAULT_LANG = nLanguage
        return
    ok
    C_ENV_DEFAULT_LANG = nLanguage
    # Change the language
    switch nLanguage
        on C_TRANSLATION_ENGLISH
            load again "translation/english.ring"
        on C_TRANSLATION_ARABIC
            load again "translation/arabic.ring"
    off
```

115.9 ring_state_filetokens() function

Using the ring_state_filetokens() function we can get all the tokens in the ring source code file.

```
C_FILENAME      = "test_tokens.ring"
C_WIDTH         = 12

# write the file
write(C_FILENAME, '
    see "Hello, World!"
    ? 3*2+3
    Name = "Ring"
    ? Name
')

# Token Type
C_KEYWORD       = 0
C_OPERATOR      = 1
C_LITERAL       = 2
C_NUMBER        = 3
C_IDENTIFIER    = 4
C_ENDLINE       = 5

# Keywords List
aKEYWORDS = ["IF", "TO", "OR", "AND", "NOT", "FOR", "NEW", "FUNC",
"FROM", "NEXT", "LOAD", "ELSE", "SEE", "WHILE", "OK", "CLASS", "RETURN", "BUT",
"END", "GIVE", "BYE", "EXIT", "TRY", "CATCH", "DONE", "SWITCH", "ON", "OTHER", "OFF",
"IN", "LOOP", "PACKAGE", "IMPORT", "PRIVATE", "STEP", "DO", "AGAIN", "CALL", "ELSEIF",
"PUT", "GET", "CASE", "DEF", "ENDFUNC", "ENDCLASS", "ENDPACKAGE",
"CHANGERINGKEYWORD", "CHANGERINGOPERATOR", "LOADSYNTAX"]

pState = ring_state_new()
aList = ring_state_filetokens(pState, C_FILENAME)
PrintTokens(aList)
ring_state_delete(pState)

func PrintTokens aList
    for aToken in aList
```

(continues on next page)

(continued from previous page)

```

switch aToken[1]
on C_KEYWORD
    ? Width("Keyword",C_WIDTH) + ":" + aKeywords[0+aToken[2]]
on C_OPERATOR
    ? Width("Operator",C_WIDTH) + ":" + aToken[2]
on C_LITERAL
    ? Width("Literal",C_WIDTH) + ":" + aToken[2]
on C_NUMBER
    ? Width("Number",C_WIDTH) + ":" + aToken[2]
on C_IDENTIFIER
    ? Width("Identifier",C_WIDTH) + ":" + aToken[2]
on C_ENDLINE
    ? "EndLine"
off
next

func Width cText,nWidth
    return cText+copy(" ",nWidth-len(cText))

```

Output:

```

EndLine
Keyword      : SEE
Literal       : Hello, World!
EndLine
Operator     : ?
Number        : 3
Operator     : *
Number        : 2
Operator     : +
Number        : 3
EndLine
Identifier   : name
Operator     : =
Literal       : Ring
EndLine
Operator     : ?
Identifier   : name
EndLine

```

115.10 Generate Embedded Ring Object File

We can generate embedded object file (C source code) from the source code file (*.ring) using -geo option

Command:

```
ring test.ring -geo
```

This command will generate at least three files

```
test.c  
ringappcode.c  
ringappcode.h
```

More files could be generated based on the project size

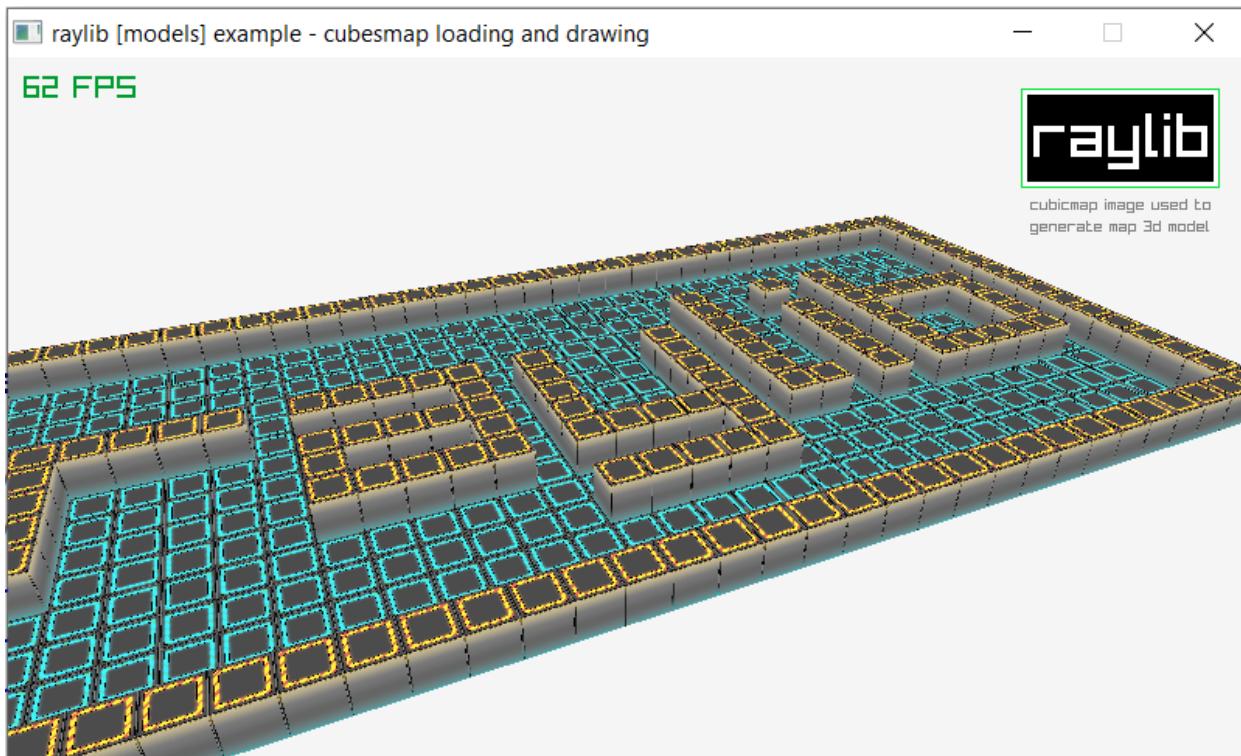
The generated files will pass the byte code to Ring VM to be executed

115.11 Better RingRayLib

More Samples are added to RingRayLib

- Sound Loading Playing
- Texture Source
- Music Playing Streaming
- Rectangle scaling
- Colors Palette
- Following Eyes
- Collision Area
- Bezier Lines
- Images Generation
- Fifteen Puzzle Game
- Cubic Map

Screen Shot:



115.12 More Improvements

- New Samples
 - ring/samples/other/Hex2UTF8.ring
 - ring/samples/other/CalmoSoftPrimesTable.ring
 - ring/samples/other/CalmoSoftTicTacToeGame.ring
 - ring/samples/other/CalmoSoftSimpleGoGame.ring
 - ring/samples/other/arabicmysql.ring
 - ring/samples/other/CalmoSoftExtraCube.ring
 - ring/samples/other/DynamicCode/anonfunc.ring
 - ring/samples/other/DynamicCode/deletethisfile.ring
 - ring/samples/other/DynamicCode/modifythisfile.ring
 - ring/samples/other/changesyntax/ArabicDemo.ring
 - ring/samples/other/changesyntax/EnglishDemo.ring
 - ring/samples/other/changesyntax/ChangeKeywordsArabic.ring
 - ring/samples/other/changesyntax/ChangeKeywordsEnglish.ring
 - ring/samples/other/changesyntax/pascal.ring
 - ring/samples/other/hijridate.ring
- Ring Notepad - Project Files - set minimum width based on desktop screen width

- Ring Notepad - Output Window - Move the Cursor to the end of text
- Ring Notepad - Output Window - Correct displaying for line breaks
- Form Designer - Better Style - Controls colors and size
- VideoMusicPlayer is updated to work as expected after RingQt update
- FlappyBird3000 - Fast response on Android
- Snake Game : Change the default window size (800x600)
- Maze Game : Change the default window size (800x600)
- Maze Game : Move the camera with the player
- Maze Game : Restarting the game will hide the (You Win) message
- Game Engine : display error message when we can't create the game window
- Ring Tests : Added File build.sh for building on Linux and macOS
- RingQt : Updated to Qt 5.12.6
- RingQt : Added QQMLEngine class
- RingQt : Added files for building RingQt without Bluetooth support
- RingQt : The size of the events code is changed from 100 characters to 200 characters
- RingQt : Correct links for Qt documentation in RingQt classes chapter
- RingQt for Android : Better code for executing the ring object file (ringo)
- Ring2EXE configuration files are updated for RingQt to correctly distribute RingQt apps
- Code Generator : Convert function names to lower case when generating the functions for structures
- OSCopyFolder() function is updated to copy the files in sub folders too
- fgetpos() function is updated to work as expected
- IsFunction() function is updated to be not case sensitive
- Space() function is updated to clear the output string with spaces
- Ring Compiler : Added file buildclang.bat for building on Windows using Clang compiler
- Ring VM - Internal hash function is updated
- Ring VM - Better Code for setting pVM->a SetProperty when creating new objects
- Ring VM - Better Code for state management

WHAT IS NEW IN RING 1.13?

In this chapter we will learn about the changes and new features in Ring 1.13 release.

116.1 List of changes and new features

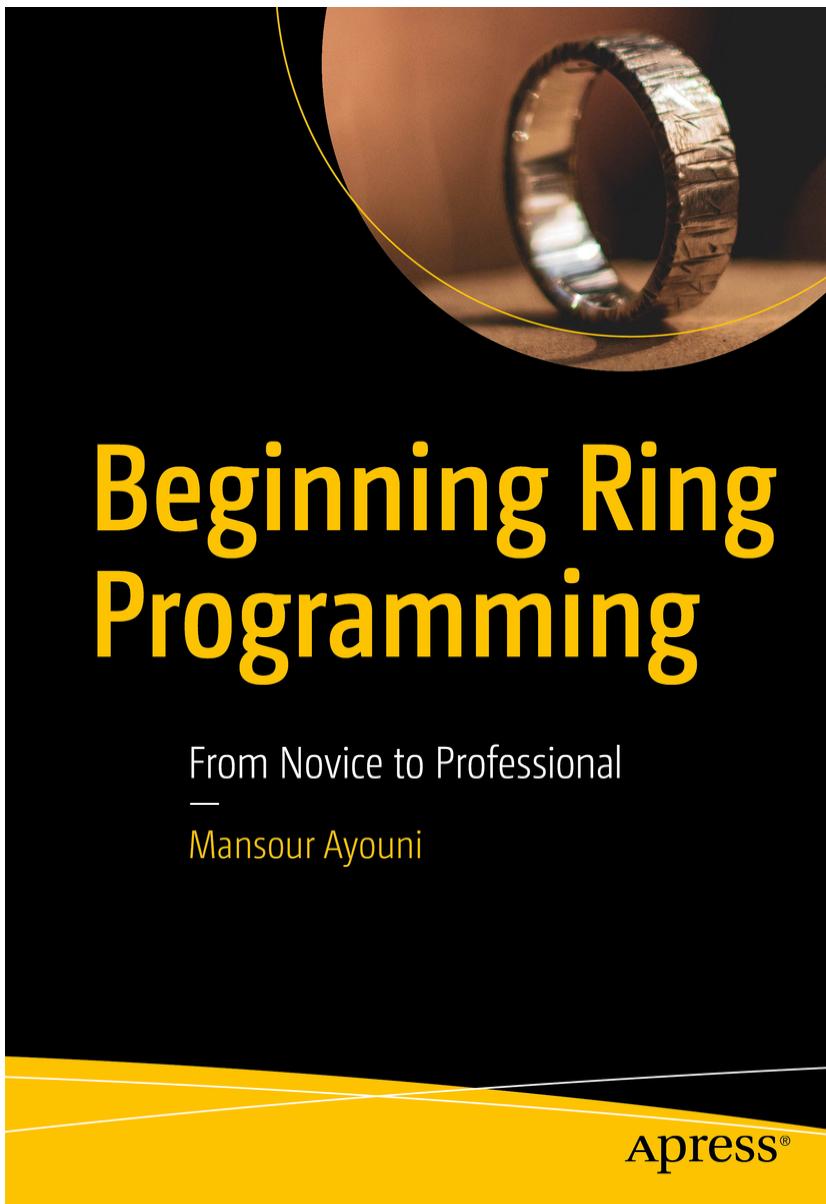
Ring 1.13 comes with the next features!

- New Book by Apress
- Ring For WebAssembly
- Better Threads Support
- Laser Game
- Magic Balls Game
- MoneyBoxes Game
- Matching Game
- Pairs Game
- Word Game
- Tetris Game
- Escape Game
- Hassouna Course Samples
- Ring support in SpaceVim
- Better RingQt
- Better RingRayLib
- RingStbImage Extension
- More Low Level Functions
- Better Organization
- More Improvements

116.2 New Book by Apress

Apress: Beginning Ring Programming (From Novice to Professional)

URL: <https://www.apress.com/gp/book/9781484258323>



Gain a gentle introduction to the world of Ring programming with clarity as a first concern using a lot of practical examples.

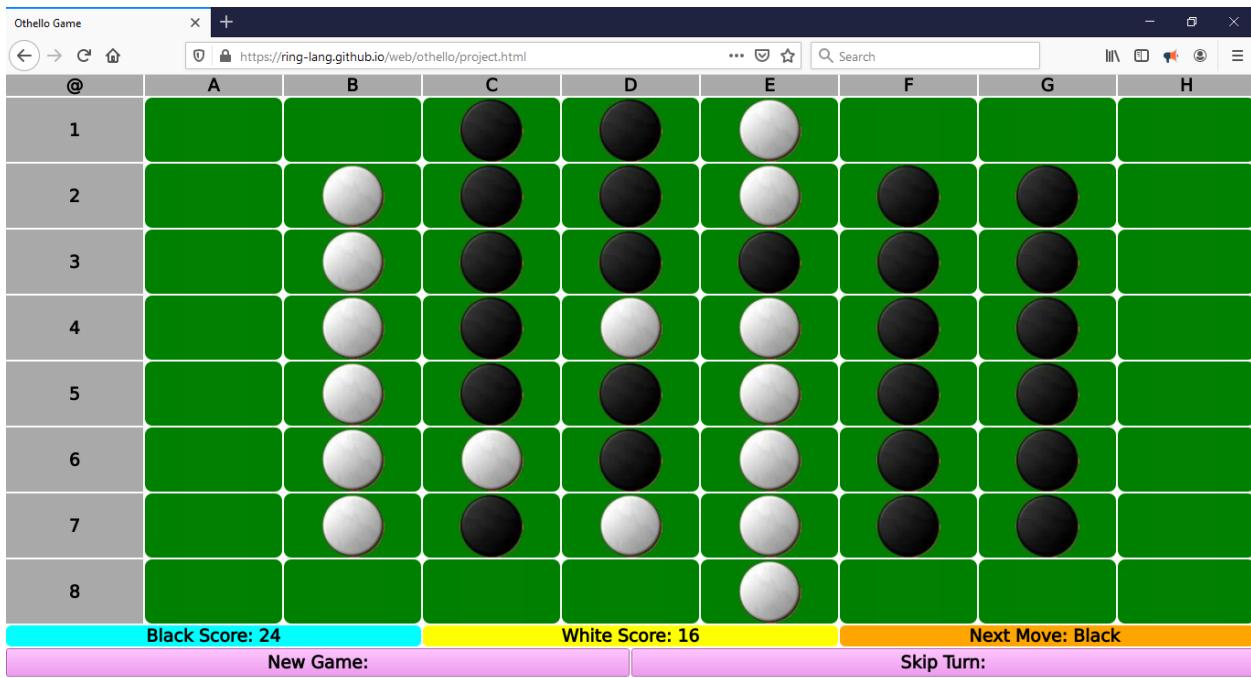
What You Will Learn

- Get started with Ring and master its data types, I/O, functions, and classes
- Carry out structural, object-oriented, functional, declarative, natural, and meta programming in Ring
- Use the full power of Ring to refactor program code and develop clean program architectures
- Quickly design professional-grade video games on top of the Ring game engine

116.3 Ring for WebAssembly

Ring support distributing applications for WebAssembly (Using Qt for WebAssembly)

- Hello World : <https://ring-lang.github.io/web/helloworld/project.html>
- Matching Game : <https://ring-lang.github.io/web/matching/project.html>
- Pairs Game : <https://ring-lang.github.io/web/pairs/project.html>
- Othello Game : <https://ring-lang.github.io/web/othello/project.html>
- Game of Life : <https://ring-lang.github.io/web/gameoflife/project.html>
- Online Form Designer : <https://ring-lang.github.io/web/formdesigner/project.html>



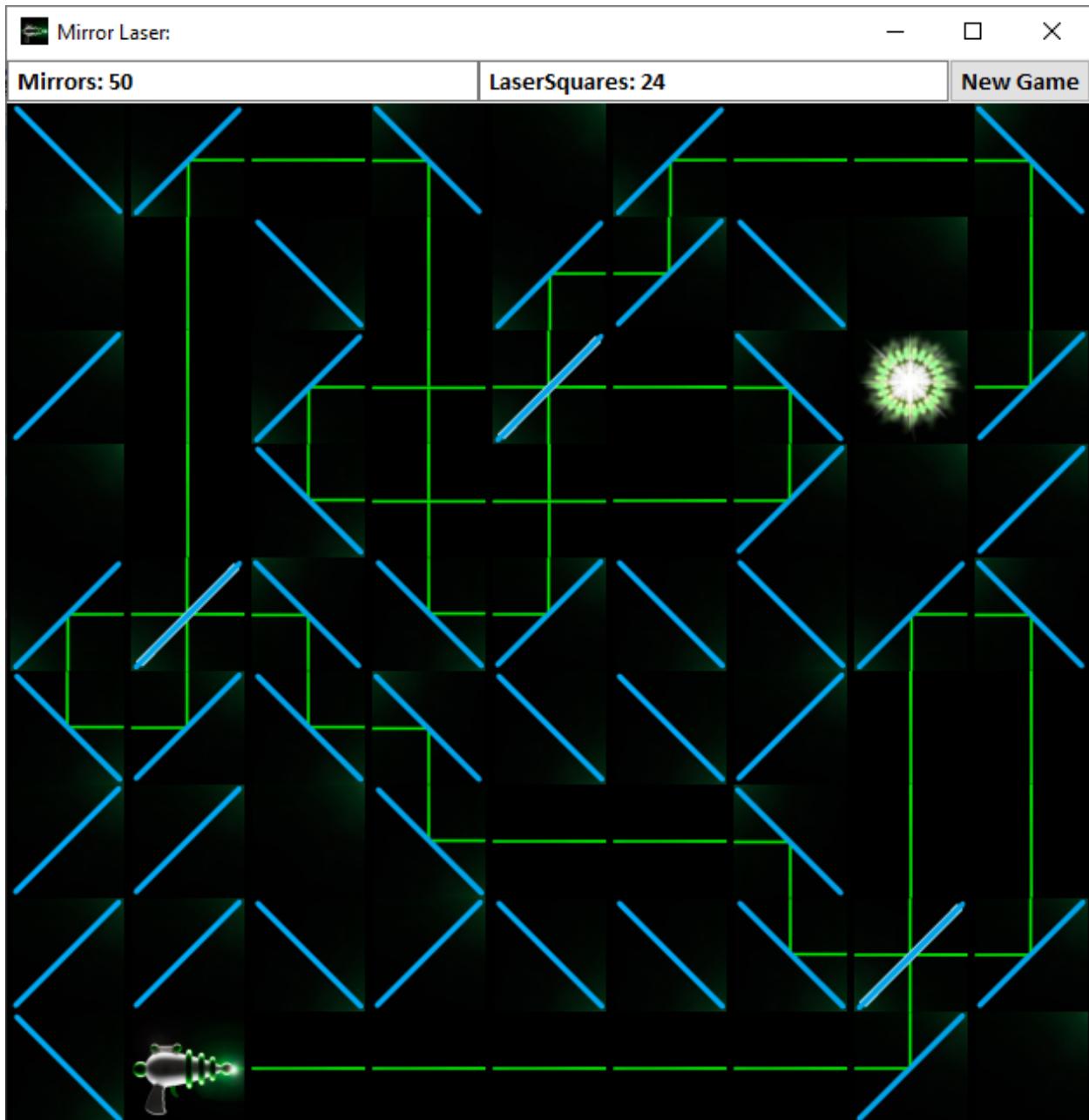
116.4 Better Threads Support

Ring 1.13 provides better support for threads

- (1) Ring VM is updated to use a memory pool for each thread (Faster)
- (2) More tests for RingAllegro threads functions
- (3) RingLibUV is updated to be thread safe when using callback functions

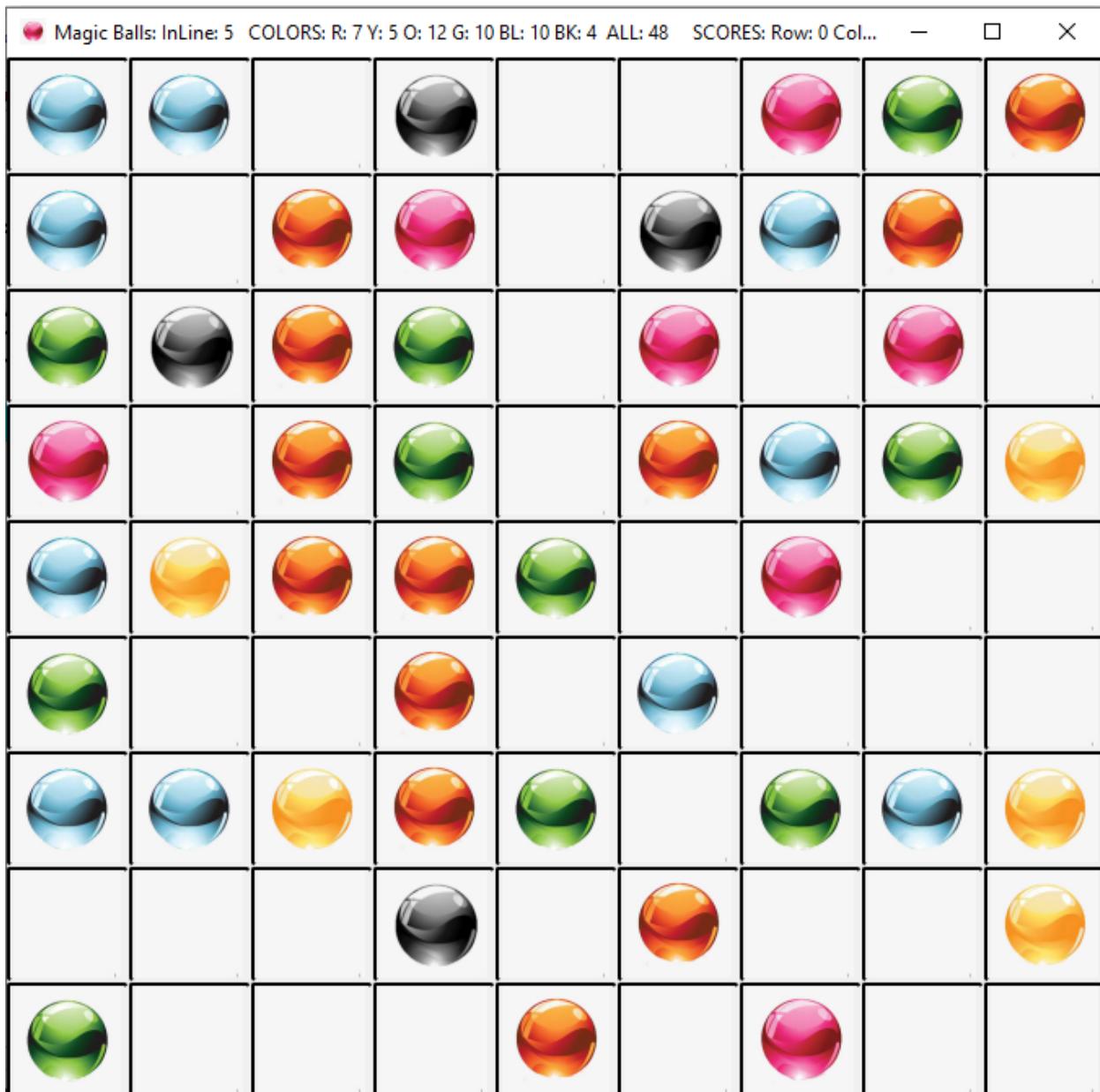
116.5 Laser Game

An implementation for the Laser Game



116.6 Magic Balls Game

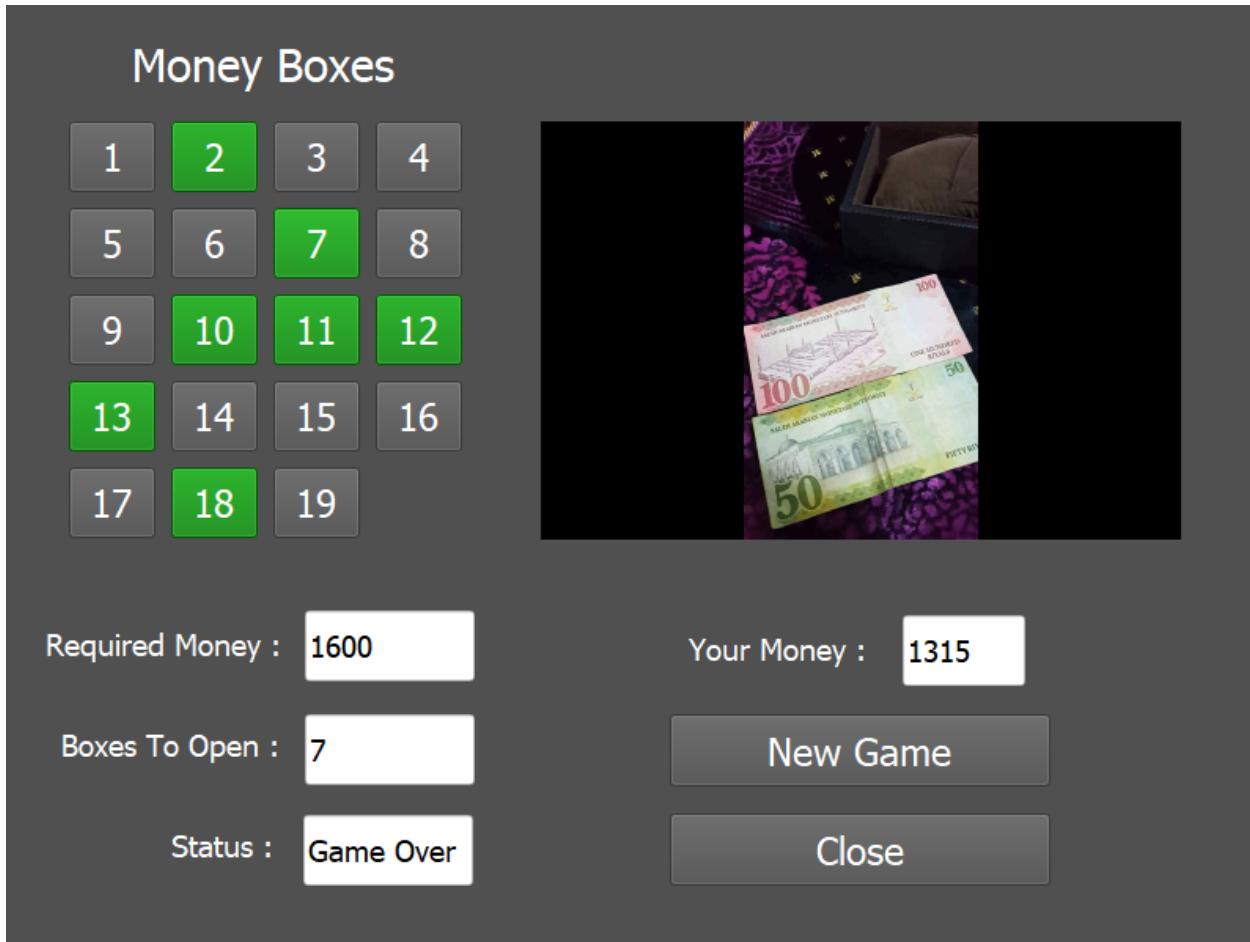
An implementation for the Magic Balls Game



116.7 Money Boxes Game

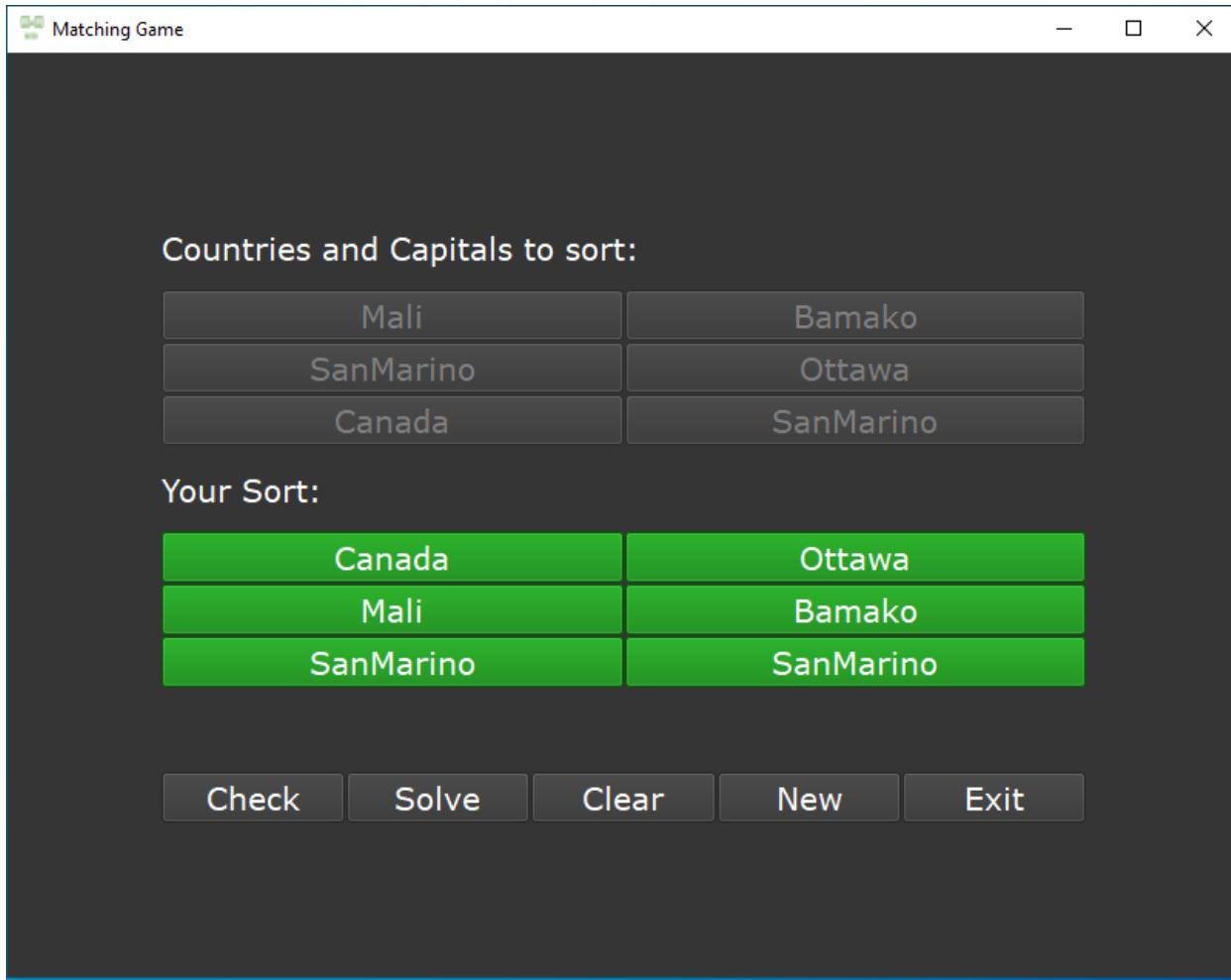
See if you can collect the required amount of money by opening boxes!

```
ringpm install moneyboxes
```



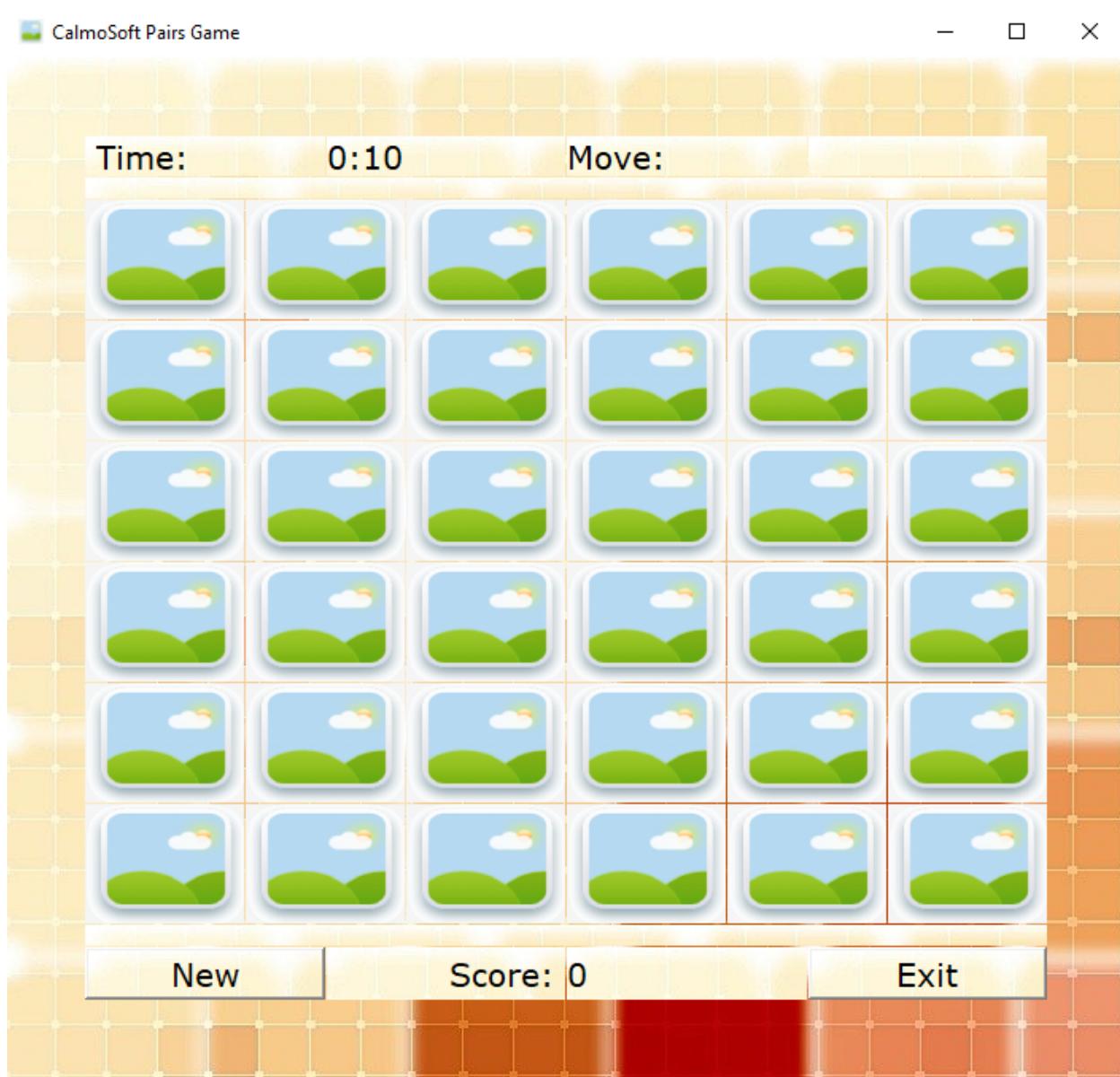
116.8 Matching Game

An implementation for the Matching Game



116.9 Pairs Game

An implementation for the Pairs Game



116.10 Word Game

An implementation for the Word Game

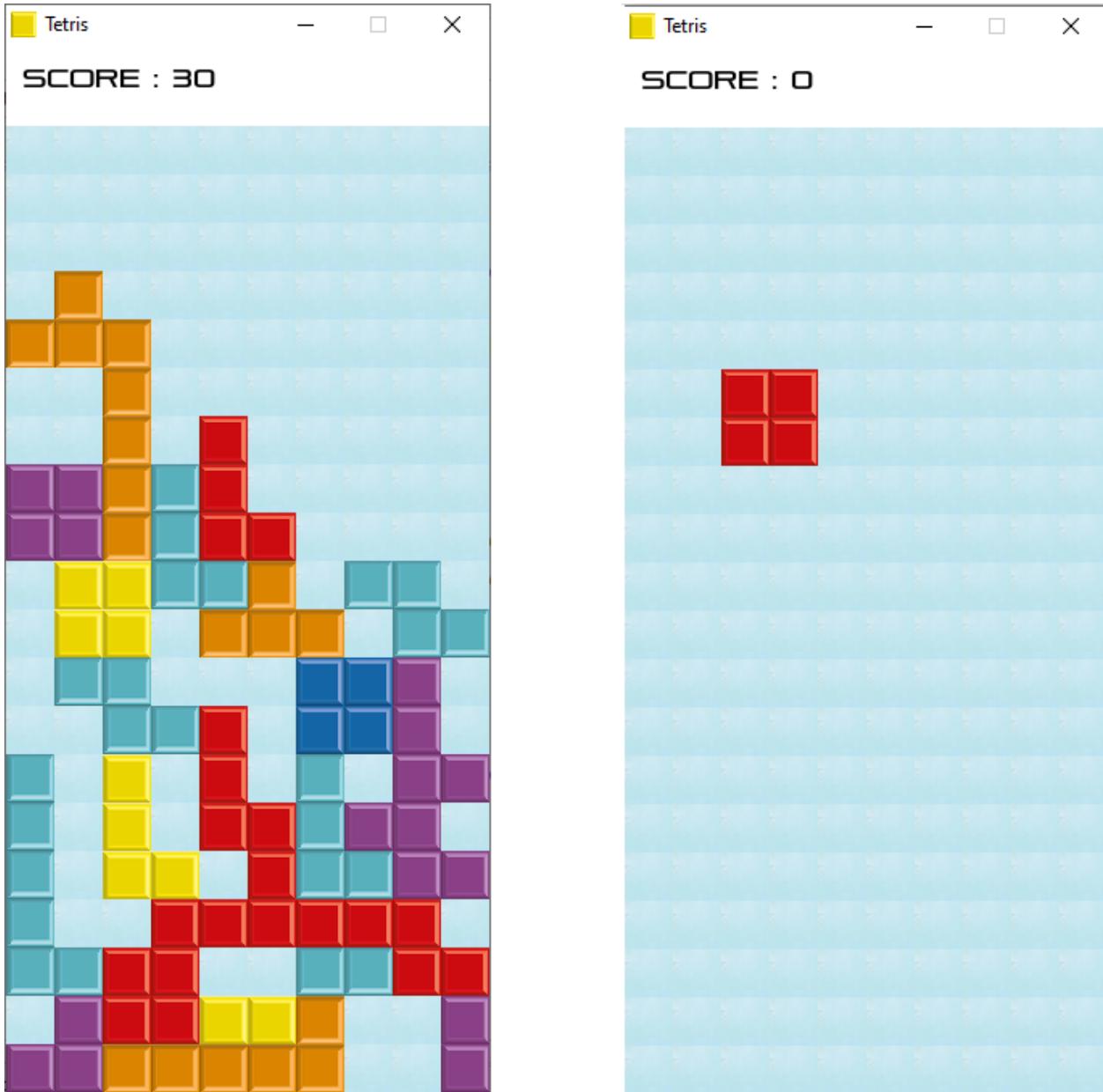


116.11 Tetris Game

An implementation for the Tetris Game

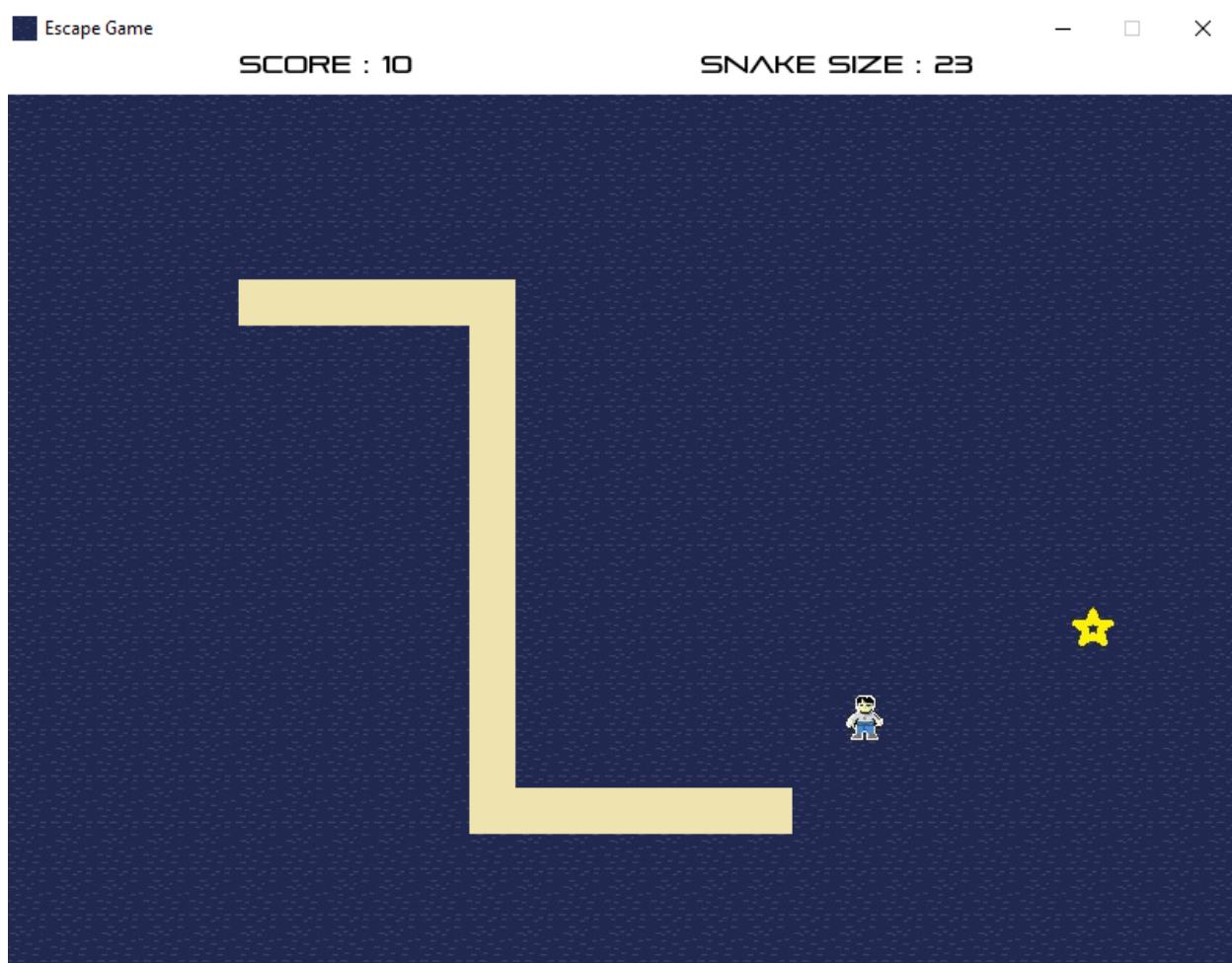
Features

- New Shapes are selected in random way (Different Shape, Color & Position)
- You can move and rotate the shapes, increase the speed.
- Score: You get 10 points when completing a row (The game check for nested rows completion as expected)
- The game is designed to work forever without user interaction (After Game Over, the Game restarts automatically)



116.12 Escape Game

Escape from the Snake and collect the Stars to prevent it from growing!

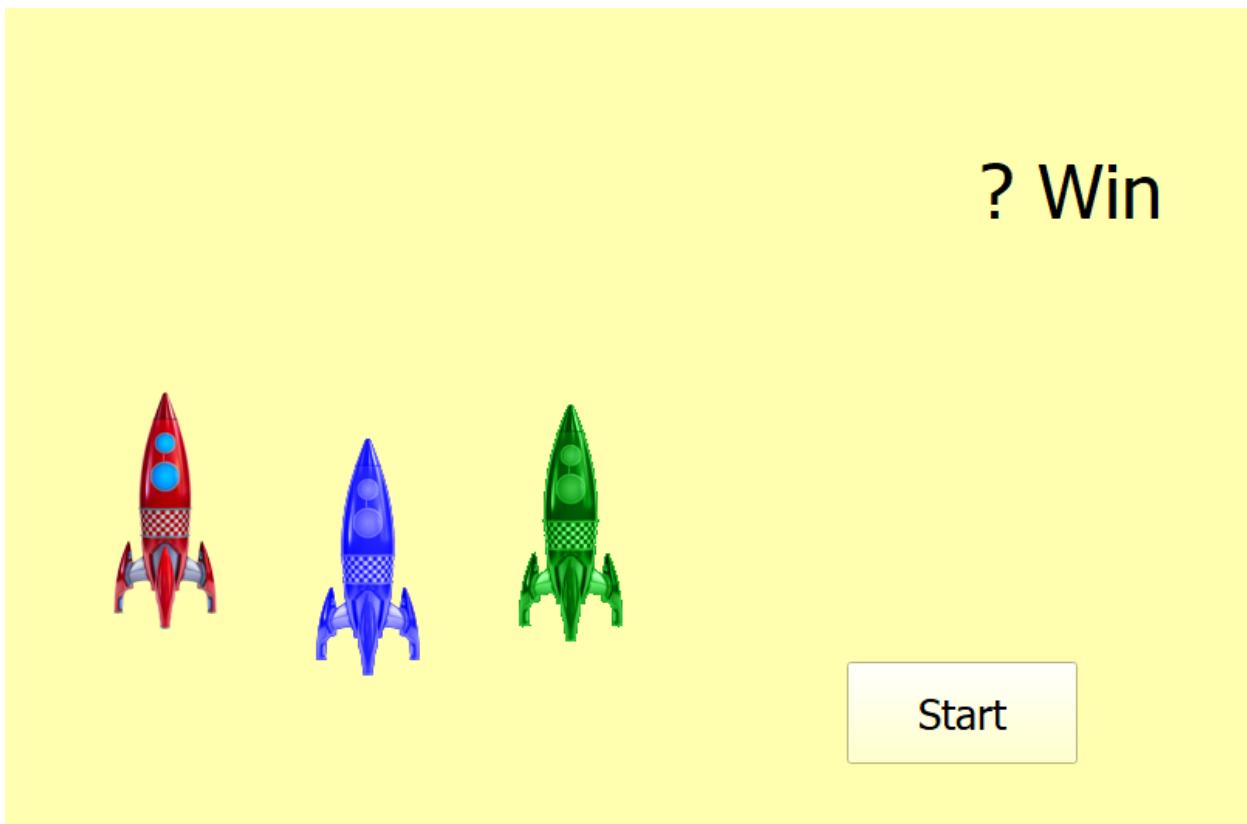


116.13 Hassouna Course Samples

URL (YouTube): <https://www.youtube.com/watch?v=6VIHMyrEilw&list=PLHIfW1KZRIfl6KzfLziFl650MmThnQ0jT>

The course samples are added to ring/samples/UsingArabic/HassounaCourse folder

The Rockets sample



116.14 Ring support in SpaceVim

URL: <https://github.com/SpaceVim/SpaceVim>

Screen Shot:

The screenshot displays the SpaceVim interface. On the left, a code editor shows a Ring script named `test.ring`. The script contains the following code:

```

1 /*
2  Program Name : My first program using Ring
3  Year        : 2017
4 */
5
6 see "What is your name? "    # print message on screen
7 give cName                  # get input from the user
8 see "Hello " + cName        # say hello!
9
10 // See "Bye!"
11

```

On the right, a file browser titled "Buffers" shows the project structure:

- [in]: -/SpaceVim/vim-ring/
 - ftdetect/
 - syntax/
 - ring.vim
 - LICENSE
 - README.md

Below the code editor and file browser is a terminal window. The title bar of the terminal says "252 bytes test.ring ring". The terminal output shows:

```

[Running] ring C:\Users\wsd jeg\Desktop\test.ring

-----
What is your name?
Hello wsd jeg

[Done] exited with code=0 in 5.751047 seconds

```

At the bottom of the terminal window, there is a "Runner" tab.

116.15 Better RingQt

(1) The next classes are added to RingQt

- QAbstractAxis
- QAbstractBarSeries
- QAbstractSeries
- QAreaLegendMarker
- QAreaSeries
- QBarCategoryAxis
- QBarLegendMarker
- QBarSeries
- QBarSet
- QBoxPlotLegendMarker
- QBoxPlotSeries
- QBoxSet
- QCandlestickLegendMarker
- QCandlestickModelMapper
- QCandlestickSeries
- QCandlestickSet
- QCategoryAxis
- QChart
- QChartView
- QDateTimeAxis
- QHBarModelMapper
- QHBoxPlotModelMapper
- QHCandlestickModelMapper
- QHPieModelMapper
- QHXYModelMapper
- QHorizontalBarSeries
- QHorizontalPercentBarSeries
- QHorizontalStackedBarSeries
- QLegend
- QLegendMarker.
- QLineSeries
- QLogValueAxis
- QPercentBarSeries

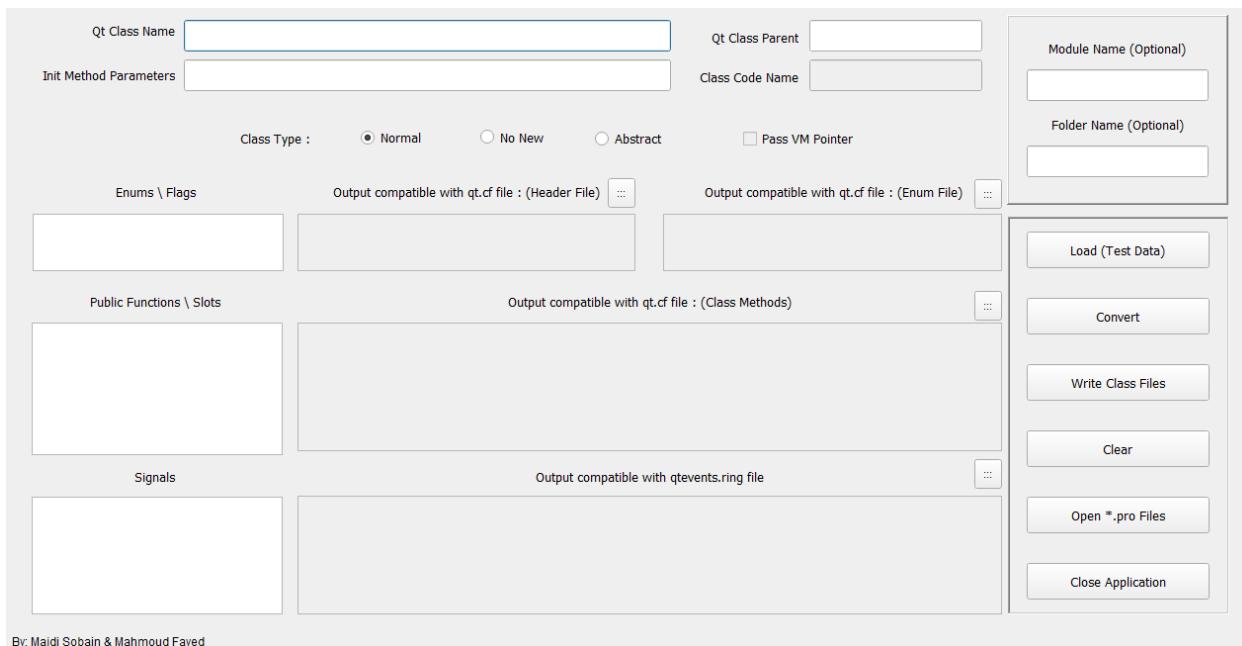
- QPieLegendMarker
- QPieSeries
- QPieSlice
- QPolarChart
- QScatterSeries
- QSplineSeries
- QStackedBarSeries
- QVBarModelMapper
- QVBoxPlotModelMapper
- QVCandleStickModelMapper
- QVPieModelMapper
- QVXYModelMapper
- QValueAxis
- QXYLegendMarker
- QXYSeries
- QGraphicsScene
- QMovie

(2) Better QtConverter application

This application is used for preparing Qt classes for the Ring Code Generator

Then using the Ring Code Generator we generate RingQt classes

The application user interface is updated for better productivity!

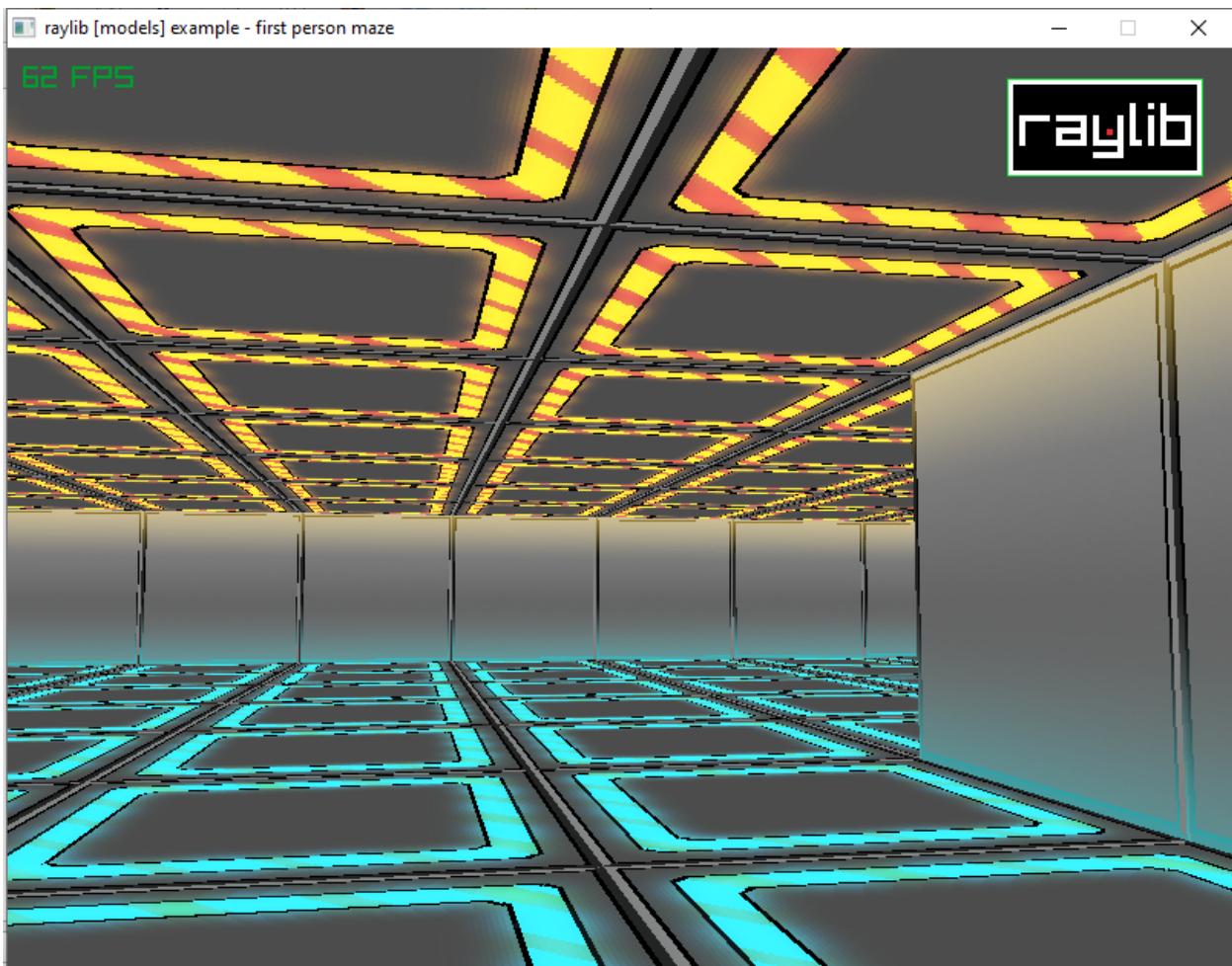


(3) RingQt for Android - Qt Project - Special folders for Ring and RingQt

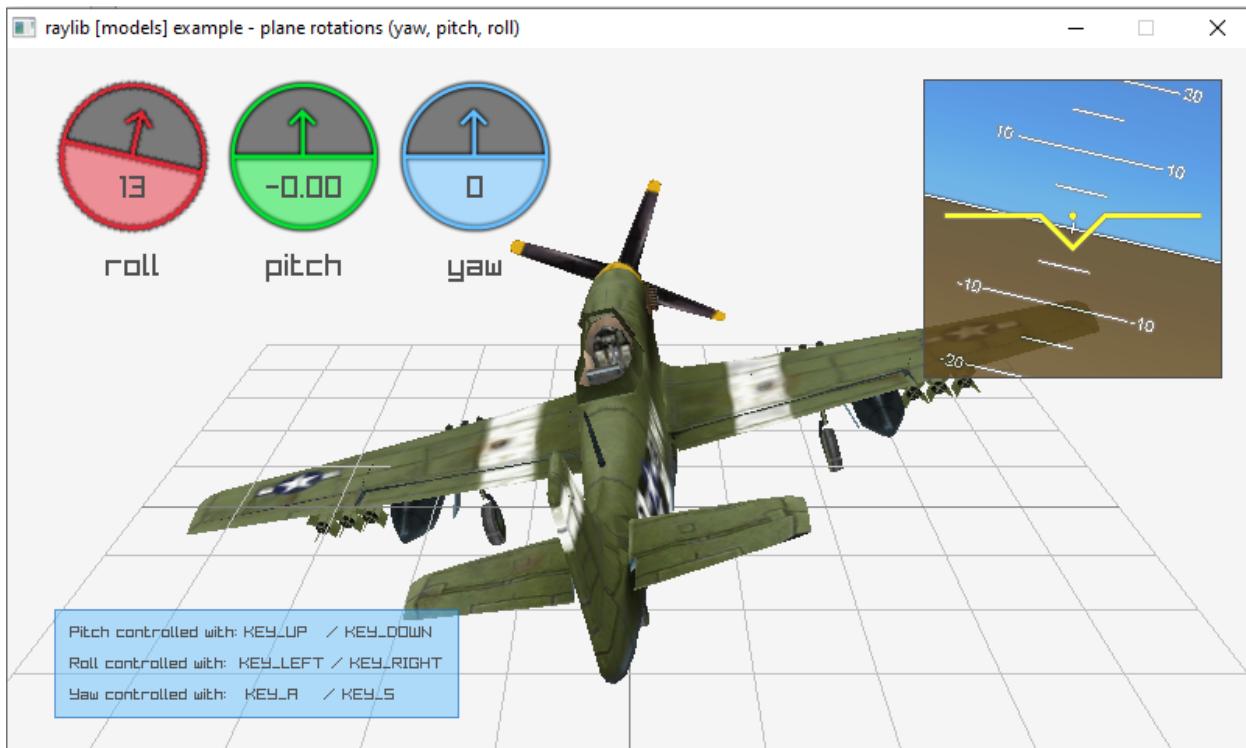
- (4) Using Qt 5.15.0

116.16 Better RingRayLib

- (1) All functions return objects instead of pointers
- (2) Support RayMath library functions
- (3) More Samples are ported from RayLib to RingRayLib
 - Scissor Test
 - Input Gestures Detection
 - Bouncing Ball
 - Rectangle Rounded
 - Draw Circle Sector
 - RayLib Logo Animation
 - First Person Maze



- Plane Rotations



116.17 RingStbImage Extension

New extension support the stb_image library

Example:

```
# Load the library
load "stbimage.ring"
# Image Information
width=0 height=0 channels=0
# Ring will Free cData automatically in the end of the program
cData = stbi_load("ring.jpg",:width,:height,:channels,STBI_rgb)
# Display the output
? "Size (bytes): " + len(cData)
? "Width : " + width
? "Height: " + height
? "Channels: " + channels
```

Output:

```
Size (bytes): 557371
Width : 563
Height: 330
Channels: 3
```

116.18 More Low Level Functions

The next functions are added to the Low Level functions

For more information see the Low Level Functions chapter in the documentation

```
setpointer(pointer,nNewAddress)
getpointer(pointer) ---> nAddress
pointer2string(pointer,nStart,nCount) ---> cString
memcpy(pDestinationPointer,cSourceString,nSize)
```

116.19 Better Organization

We have better organization for the project folders and source code files

- (1) A folder called (Language) contains the source code and the visual source of the Compiler and the Virtual Machine
- (2) The (Extensions) folder (Bindings for C/C++ libraries) - contains also the (libdepwin, android & webassembly folders)
- (3) The (Libraries) folder - contains Ring libraries written in Ring itself, contains now (GuiLib & ObjectsLib) too
- (4) The (Tools) folder - contains development tools - contains now (Editors, RingNotepad, FormDesigner, etc)
- (5) The (Samples) folder - contains Ring samples - a lot of organization is done in this folder

116.20 More Improvements

- **More Applications**

- Towers of Hanoi
- Questions Game
- Money Case Game
- Rock Paper Scissors Game
- Lottery Game
- Nim Game
- Eight Queens Game
- Typing Quiz
- Pong 2 Game
- Space Shooter Game

- **More Samples**

- ring/samples/Language/HelloWorld folder
- ring/samples/Language/ChangeIsNULL folder
- ring/samples/Language/Console/customsee.ring
- ring/samples/Language/Numbers/decimalscount.ring

- ring/samples/Language/EvalInScope/swap.ring
 - ring/samples/Language/EvalInScope/global.ring
 - ring/samples/Language/EvalInScope/enum.ring
 - ring/samples/Language/Endian/endian.ring
 - ring/samples/Language/VariablePointer/varptr4.ring
 - ring/samples/Language/VariablePointer/varptr5.ring
 - ring/samples/Language/DebugCode folder
 - ring/samples/Language/ClassMethods folder
 - ring/samples/Language/Lists/CheckHashTableAttribute.ring
 - ring/samples/Language/RingFileTokens folder (Ring Compiler - Scanner Output)
 - ring/samples/ProblemSolving/Fib folder
 - ring/samples/ProblemSolving/ArrayPathDest/solveArrayPathDest.ring
 - ring/samples/ProblemSolving/PegSolitaire/peg-soli.ring
 - ring/samples/General/RosettaCode/uniquecharacters.ring
 - ring/samples/General/RosettaCode/similarcharacters.ring
 - ring/samples/General/RandomLatinSquares folder
 - ring/samples/General/FactorialRecursion folder
 - ring/samples/UsingArabic/RightToLeft folder (Set Layout Direction)
 - ring/samples/UsingWebLib/Unicode folder
 - ring/samples/UsingQt/InputMask folder
 - ring/samples/UsingQt/PlayGif folder
 - ring/samples/UsingQt/TableWidget folder
 - ring/samples/UsingQt/ButtonSizeInLayout folder
 - ring/samples/UsingQt/DateTimeEditFormat folder (Date Picker Control)
 - ring/samples/UsingQML/sample10 folder (Charts Samples)
 - ring/samples/UsingQML/sample11 folder (Data Visualization Samples)
 - ring/samples/UsingQtWASM/colordialog folder
 - ring/samples/UsingQtWASM/fontdialog folder
 - ring/samples/UsingQtWASM/filedialog folder
 - ring/samples/UsingQtWASM/filecontent folder (Download/Upload Files)
 - ring/samples/UsingRayLib/more/ex4_levelsofcubes.ring
 - ring/samples/UsingOpenGL/cubeongpu/cubeongpu.ring
 - ring/samples/UsingOpenGL/cubeongpu2/cubeongpu.ring
- Ring Notepad - Output Window - set the buffer size to 1 MB
 - Ring Notepad - View Menu - Source Code (Full Screen)
 - Ring Notepad - Keyboard shortcuts for different styles

- Ring Notepad - Support saving files in folders contains the dot character
- Ring Notepad - Browser Window - Set colors based on the current style
- Ring Notepad - Functions List - Display functions defined using “def”
- Ring Notepad - Distribute Menu - Distribute for Web Browser using WebAssembly (RingQt)
- Form Designer - ToolBox - Larger width in Windows style
- Form Designer - ToolBar - New icon for the (Select Objects) button
- Gold Magic 800 - Level Editor - Decrease the window size
- Super Man 2016 - Increase speed of (Game Over) message animation
- Super Man 2016 - Better code for collision detection between SuperMan and Walls
- Game Engine - Game Class - Icon property (set the window icon)
- Set the window icon for many games developed using the Ring game engine
- Type Hints library - Better Code
- StdLib - IsMainSourceFile() function - Better Code
- StdLib - TimeInfo() function - All TimeList() information are now available
- StdLib - Map() & Filter() functions - Support accessing the global scope
- StdLib - NewList() function is no longer required - Use the List() function
- WebLib - Template() function - Support accessing the global scope
- Objects Library - Better API
- Natural Library - Better Code
- RingLibSDL - Update LibSDL version from 2.0.10 to 2.0.12
- RingOpenGL - Better Code (Added GLEW functions)
- RingFreeGLUT - Better Code (Added many functions)
- RingLibUV - Better Code - Samples that uses the VarPtr() function
- RingPM - Support terminals that pass the executable name using UPPER case
- Ring2EXE - Distribute for Web Browser using WebAssembly (RingQt)
- Ring2EXE - Delete the executable file if we have it in the target folder
- Ring2EXE - Always copy files listed in the resources file to the target folder
- Ring2EXE - Distribute for Android - Copy Ring and RingQt folders
- Ring Tests - Display report summary after running all of the tests
- CodeGen - Add Option: PassNullBeforeVMPointer (For C++ Classes)
- CodeGen - Using RING_API_ISCPOINTER() instead of RING_API_ISPOINTER()
- Ring Compiler - ChangeRingKeyword - Support comments and many commands in the same line
- Ring Compiler - ChangeRingOperator - Support comments and many commands in the same line
- Ring Compiler - ring_parser.c - Better Code
- Ring Compiler - ring_stmt.c - Better Code
- Ring Compiler - ring_expr.c - Better Code

- Ring Compiler - ring_state.c - Flag for the (Not Case Sensitive) feature
- Ring Compiler - Load Command - Support loading libraries from ring/bin/load folder
- Ring Compiler - LoadSyntax Command - Support loading libraries from ring/bin/load folder
- Ring Compiler - Command: ? <expr> - Clear error message when the expression is missing
- Ring Compiler - Better Error Messages
- Ring VM - Using lists during definition - Support using the list itself (not only items)
- Ring VM - List() Function - Support List(nRow,nCols) to create 2D lists
- Ring VM - List() Function - Better Performance
- Ring VM - Object File - Save/Restore the files list
- Ring VM - ring_vexpr.c - Better Code - Avoid magic numbers
- Ring VM - ring_state_filetokens() - Optional parameter for the (Not Case Sensitive) feature.
- Ring VM - ring_state_setvar() - Better Code
- Ring VM - int2bytes(), float2bytes() & double2bytes() uses sizeof() function
- Ring VM - fclose() function - Display error message if the FILE pointer is NULL
- Ring VM - Extensions API - Support local scope of the caller when getting integer pointer

WHAT IS NEW IN RING 1.14?

In this chapter we will learn about the changes and new features in Ring 1.14 release.

117.1 List of changes and new features

Ring 1.14 comes with the next features!

- MyCoffee (Web Application)
- Web Development Samples
- More Samples
- Erlang B Formula
- Customers Form
- RingTilengine Extension
- RingLibui Extension
- RingSockets Extension
- RingThreads Extension
- Better RingOpenSSL
- More Functions
- Better Functions
- Better Performance For Strings
- Better Handling For Numbers
- Using CLOC (Count Lines of Code)
- More Improvements

117.2 MyCoffee (Web Application)

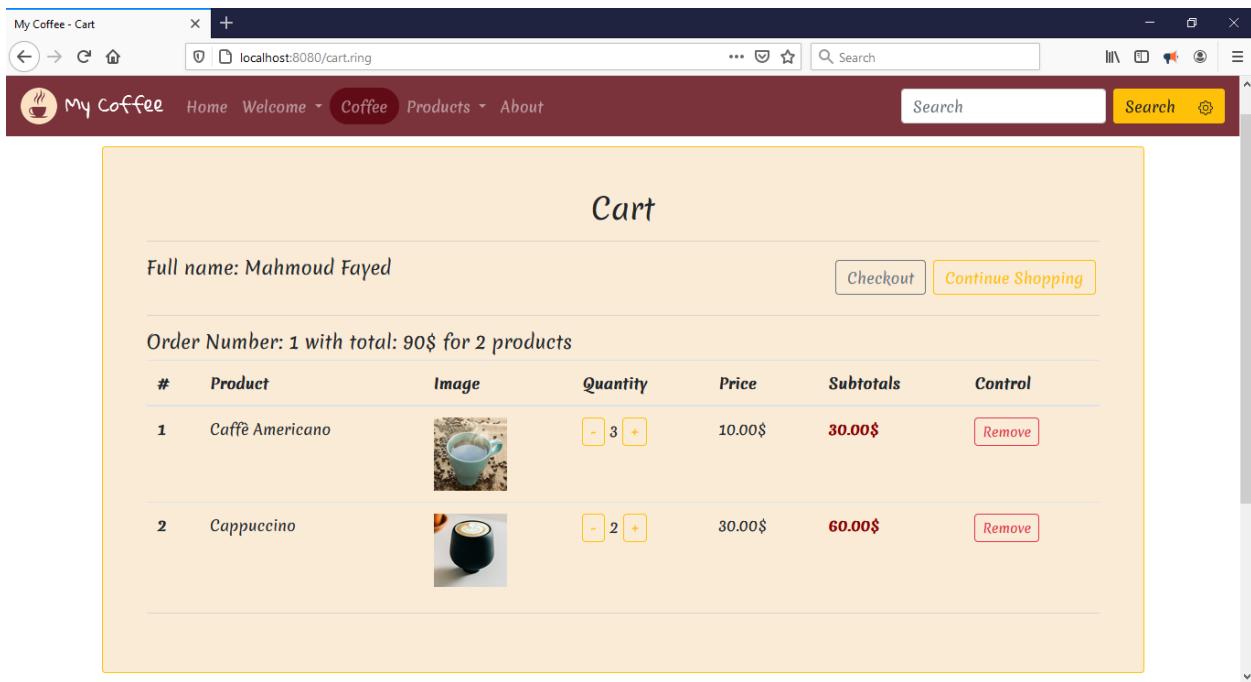
A web application that uses the WebLib library and PostgreSQL database

Screen Shots:

The screenshot shows the home page of the My Coffee web application. The title bar says "My Coffee - Home Page" and the address bar shows "localhost:8080/index.ring". The header includes a logo, navigation links for "Home", "Join us", "Coffee" (which is highlighted in yellow), "Products", and "About", and a search bar. Below the header, the text "Latest products" is displayed above three product cards. Each card contains an image, the product name, a brief description, and a "Show Details" button.

Product	Description	Action
Caffè Americano	Caffè Americano is a type of ...	Show Details
Café Latte	Café Latte is a coffee drink m...	Show Details
Cappuccino	Cappuccino is an espresso-b...	Show Details

The screenshot shows a product detail page for a coffee drink. The title bar says "My Coffee - Product" and the address bar shows "localhost:8080/product.ring?pro_id=1". The header is similar to the home page. A modal window titled "Choose Quantity" is open in the foreground, prompting the user to enter a quantity (with "3" already entered) and providing "Close" and "Confirm" buttons. The background shows a large image of a coffee cup and beans, along with text about the product's preparation and a "Add To Cart" button.



117.3 Web Development Samples

Starting from lesson 301, the Hassouna Course provides lessons about web development.

These lessons uses the WebLib library for Back-end web development.

Special YouTube playlist for these lessons:

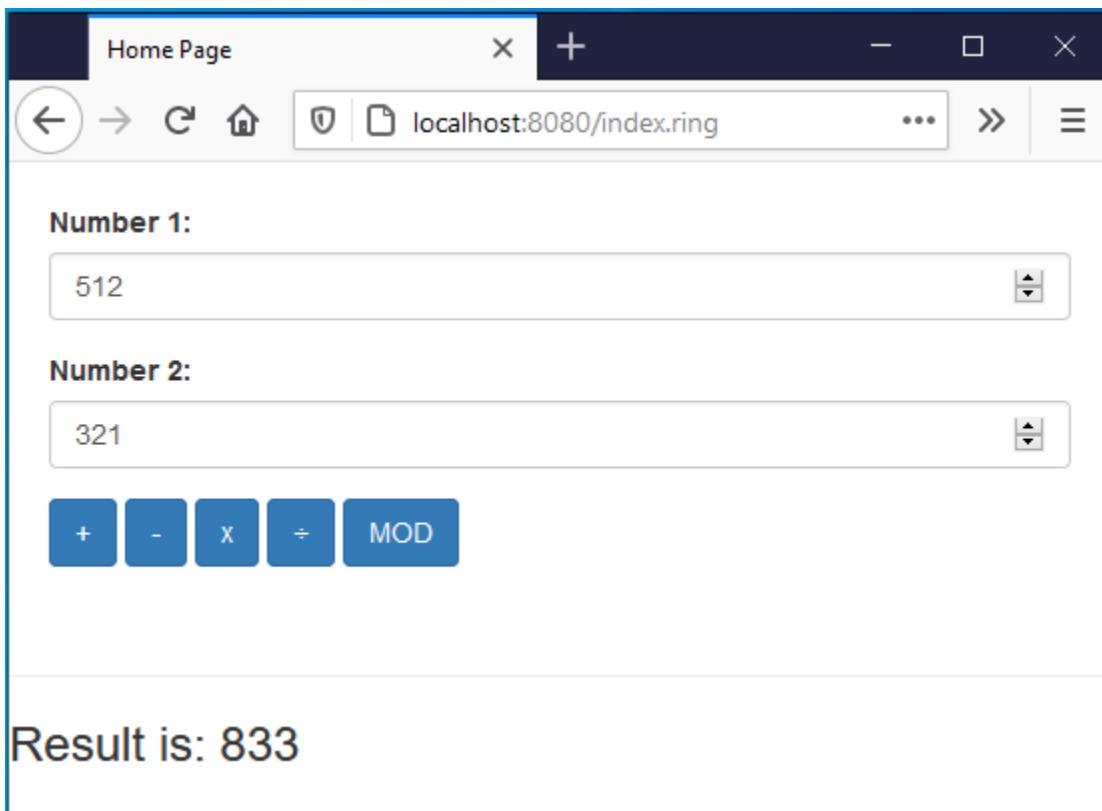
- <https://www.youtube.com/watch?v=a3ZYjssAvbI&list=PLHIfW1KZRIfn1cs2BupsdJ7dzCQ7wmHFk>

The samples are added to this folder:

- <https://github.com/ring-lang/ring/tree/master/samples/UsingArabic/HassounaCourse/WebDevelopment>

Screen Shot:

- Calculator Sample

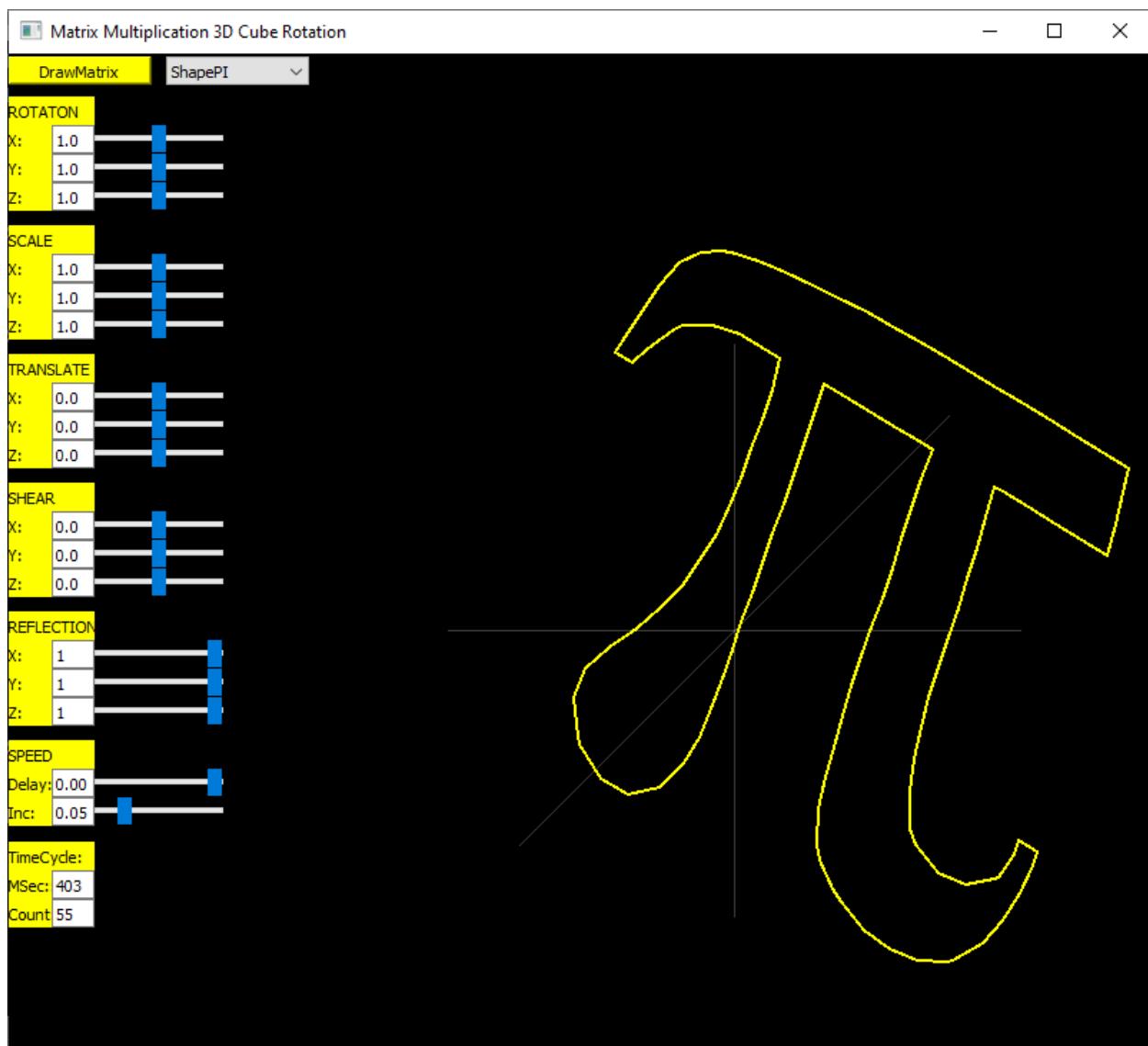


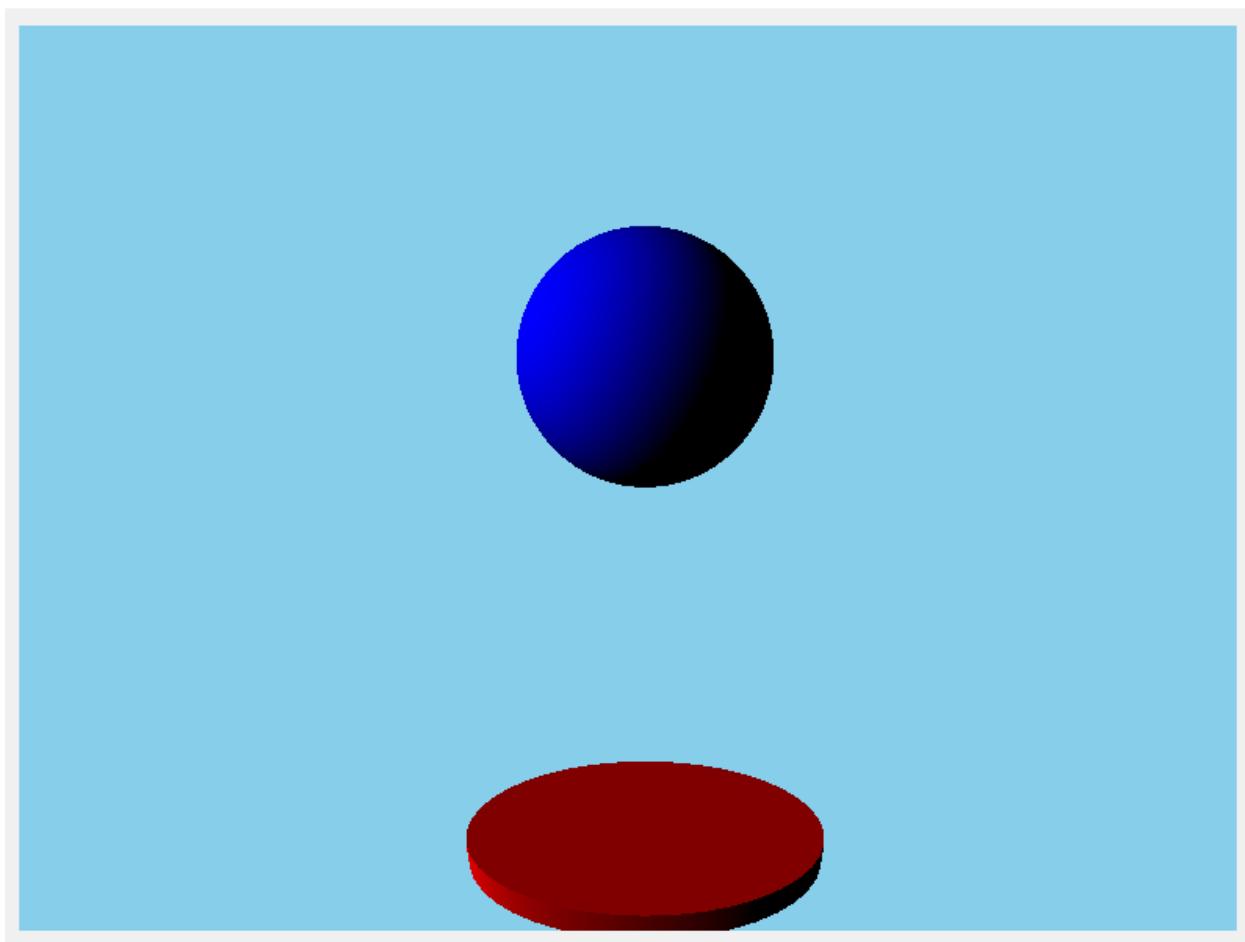
117.4 More Samples

The next samples are added to the samples folder

- ring/samples/UsingQML/sample12 folder
- ring/samples/General/TimeServer folder
- ring/samples/General/BinarokuGame folder
- ring/samples/Language/EnumGenerator folder
- ring/samples/Language/DynamicObject folder
- ring/samples/Drawing/MatrixMultiply3DRotationCube

Screen Shots:





117.5 Erlang B Formula

An application that uses the Erlang B Formula (Circuit Switching Systems)

Erlang B Formula

N	32
A (Min.)	20
A (Max)	40
Step	1
Calculate	
Close	

	A	B	J	K	Q
1	20	0.00	0.07	19.93	0.62
2	21	0.01	0.13	20.87	0.65
3	22	0.01	0.22	21.78	0.68
4	23	0.02	0.33	22.67	0.71
5	24	0.02	0.49	23.51	0.73
6	25	0.03	0.68	24.32	0.76
7	26	0.04	0.91	25.09	0.78
8	27	0.05	1.17	25.83	0.81
9	28	0.07	1.46	26.54	0.83
10	29	0.08	1.78	27.22	0.85
11	30	0.10	2.12	27.88	0.87
12	31	0.11	2.47	28.53	0.89
13	32	0.13	2.83	29.17	0.91
14	33	0.15	3.20	29.80	0.93
15	34	0.16	3.56	30.44	0.95
16	35	0.18	3.93	31.07	0.97
17	36	0.20	4.29	31.71	0.99
18	37	0.21	4.65	32.35	1.01
19	38	0.23	5.00	33.00	1.03
20	39	0.24	5.35	33.65	1.05
21	40	0.26	5.68	34.32	1.07

Erlang B Formula

$$P_b = \frac{\frac{A^N}{N!}}{\sum_{X=0}^N \frac{A^X}{X!}}$$

J = A * B

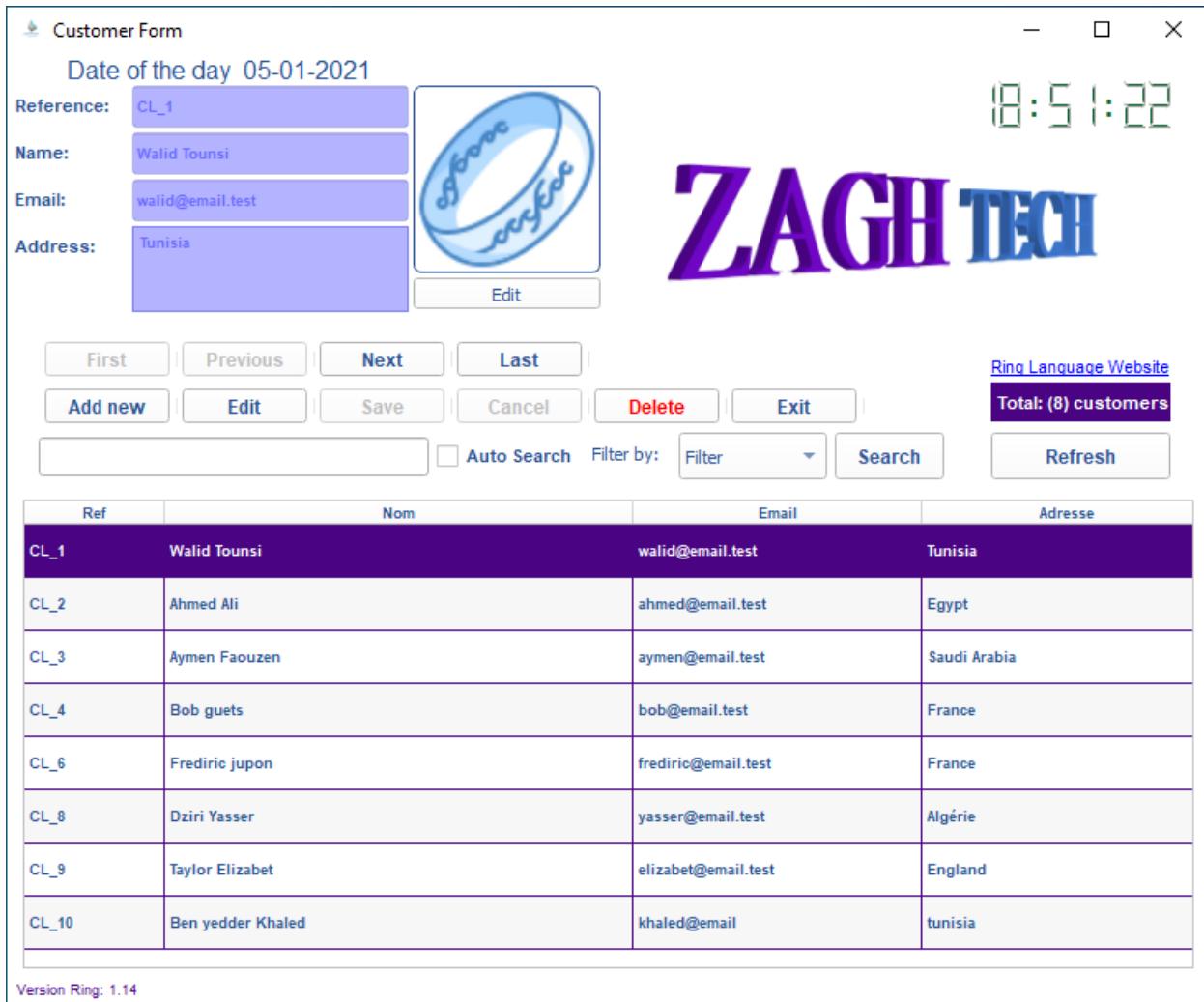
K = A - J

Q = K / N

117.6 Customers Form

An application that uses SQLite and TableWidget

The Use Interface is provided in Arabic, English & French



117.7 RingTilengine Extension

This extension provides support for Tilengine - The 2D retro graphics engine with raster effects

Example:

```
load "tilengine.ring"

TLN_Init(400, 240, 1, 0, 0)
TLN_SetLoadPath("assets\sonic")
foreground = TLN_LoadTilemap ("Sonic_md_fg1.tmx", NULL)
TLN_SetLayerTilemap(0, foreground)

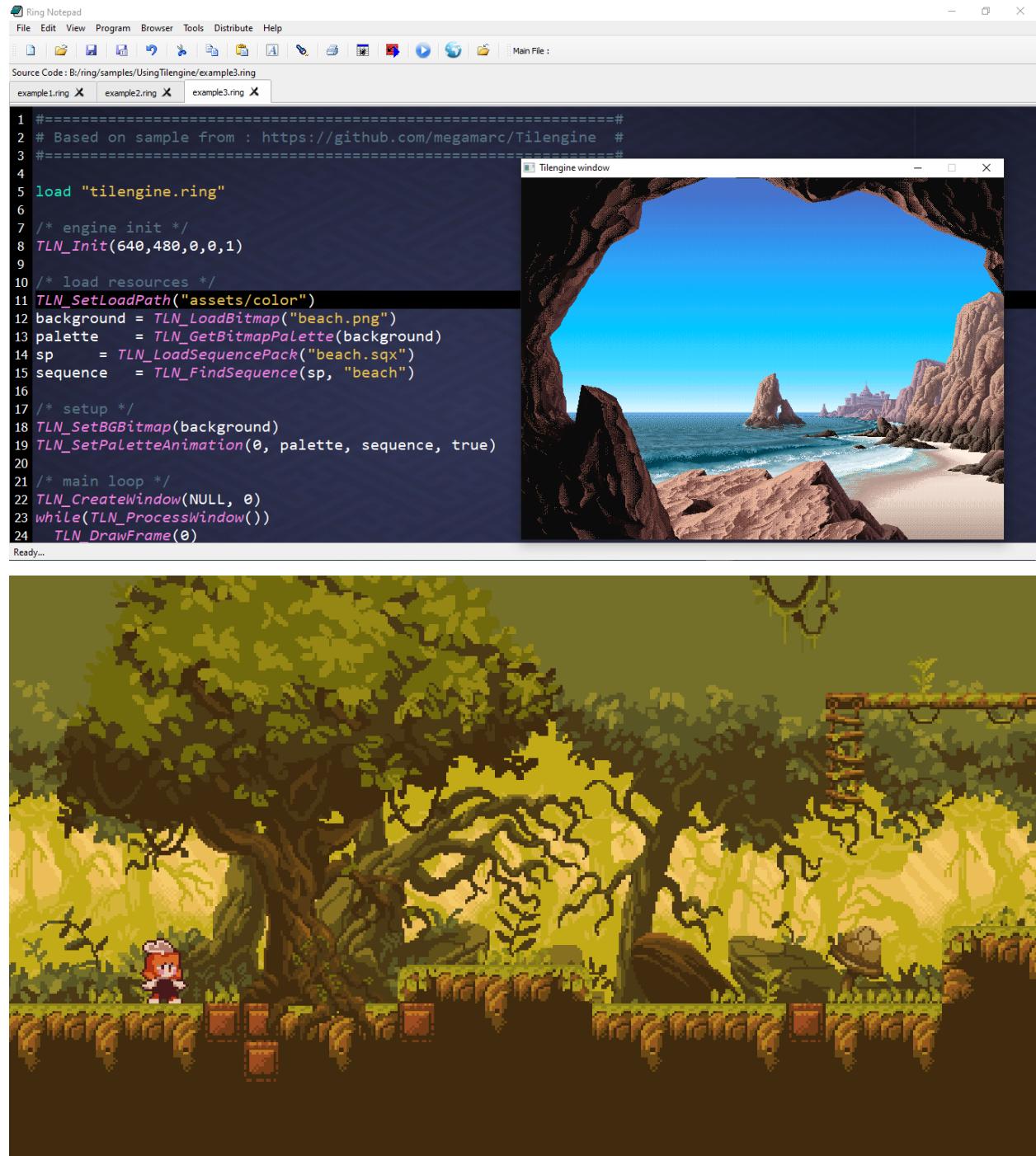
TLN_CreateWindow(NULL, 0)
while TLN_ProcessWindow()
    TLN_DrawFrame(0)
end
```

(continues on next page)

(continued from previous page)

```
TLN_DeleteTilemap(foreground)
TLN_Deinit()
```

Screen Shots:





117.8 RingLibui Extension

This extension provides complete support for Libui

Using this extension we can develop and distribute lightweight GUI Applications using Ring (Less than 1 MB)

Runtime files and their size

- Ring.dll (448 KB)
- Libui.dll (210 KB)
- Ring_Libui.dll (633 KB)
- Total : 1,291 KB without compressing the files
- After compressing the files (To ZIP file) - Total : 504 KB

Example:

```
load "libui.ring"

oWindow = uiNewWindow( "Say Hello", 500, 80, True)
uiWindowOnClosing(oWindow,"closeApp()")

lbl1 = uiNewLabel("Name: ")
text1 = uiNewEntry()

btn1 = uiNewButton("SayHello")
uiButtonOnClicked(btn1,"sayHello()")

btn2 = uiNewButton("Close")
uiButtonOnClicked(btn2,"closeApp()")

lbl2 = uiNewLabel("")

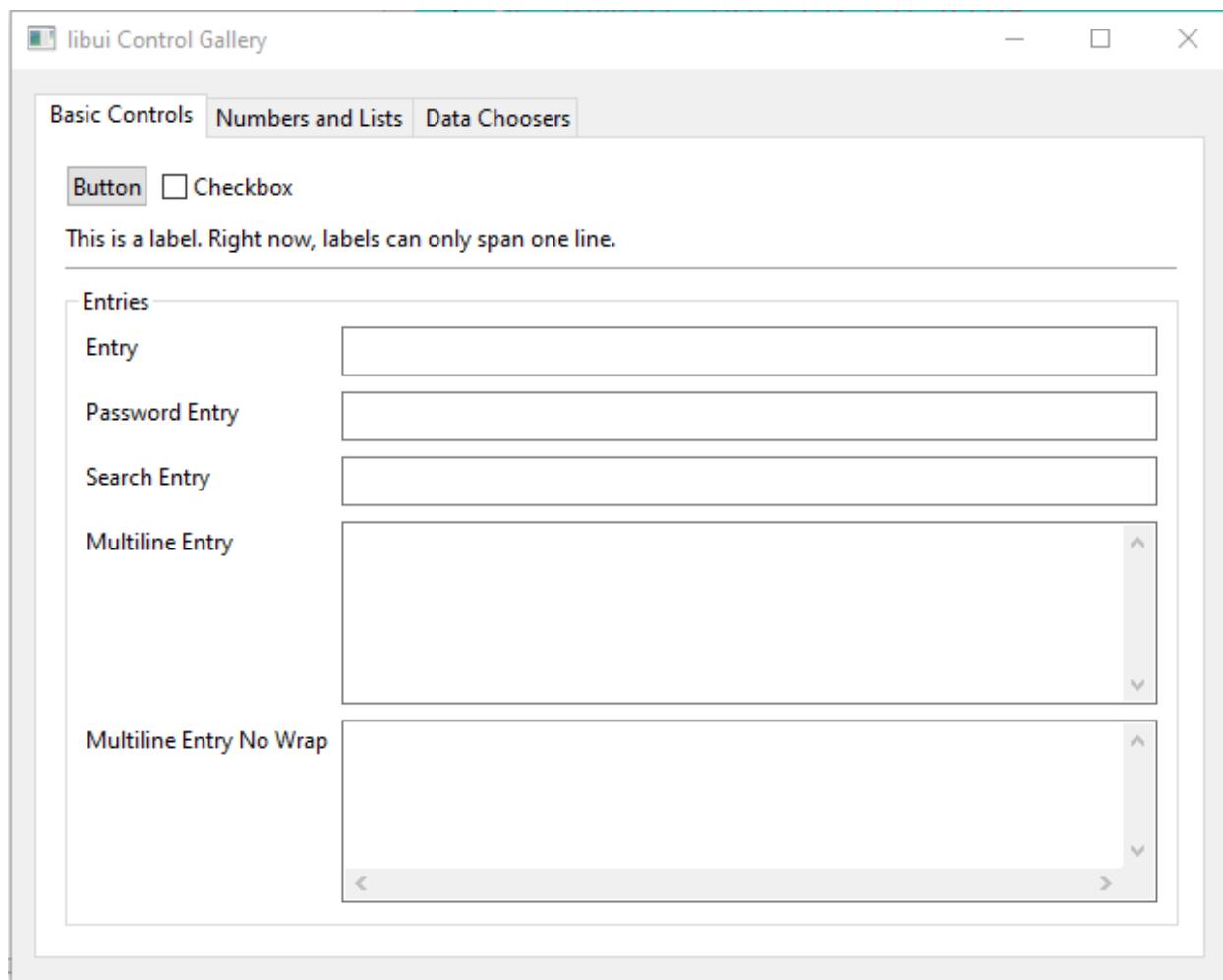
g = uiNewGrid() uiGridSetPadded(g, 1) uiWindowSetChild(oWindow, g)
uiGridAppend(g, lbl1, 0, 0, 2, 1, 1, uiAlignCenter, 0, uiAlignCenter)
uiGridAppend(g, text1, 1, 0, 2, 1, 1, uiAlignFill, 0, uiAlignFill)
uiGridAppend(g, btn1, 0, 1, 1, 2, 1, uiAlignFill, 0, uiAlignFill)
uiGridAppend(g, btn2, 2, 1, 1, 1, 1, uiAlignFill, 0, uiAlignFill)
uiGridAppend(g, lbl2, 0, 3, 2, 1, 1, uiAlignCenter, 0, uiAlignCenter)

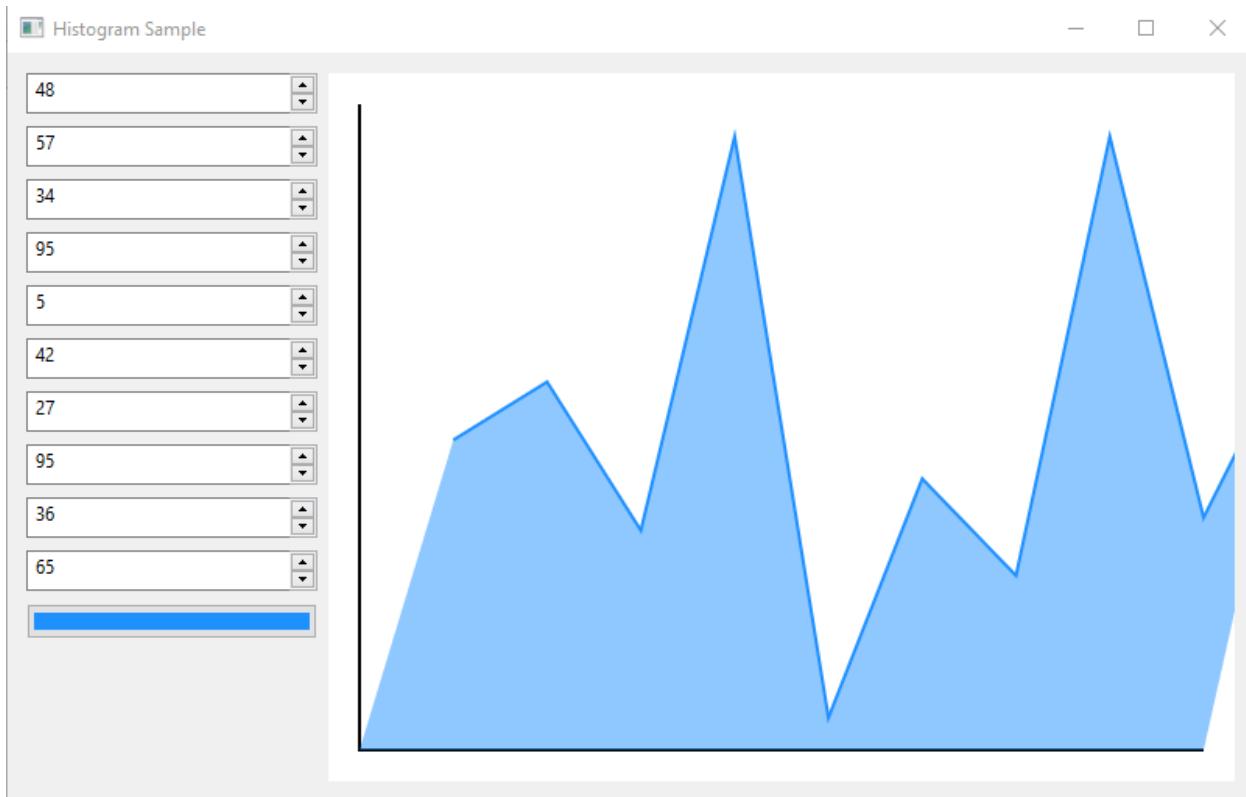
uiControlShow( oWindow )
uiMain()

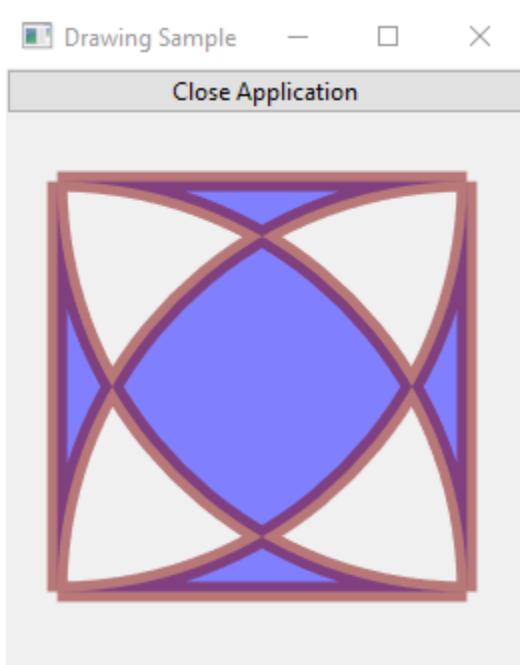
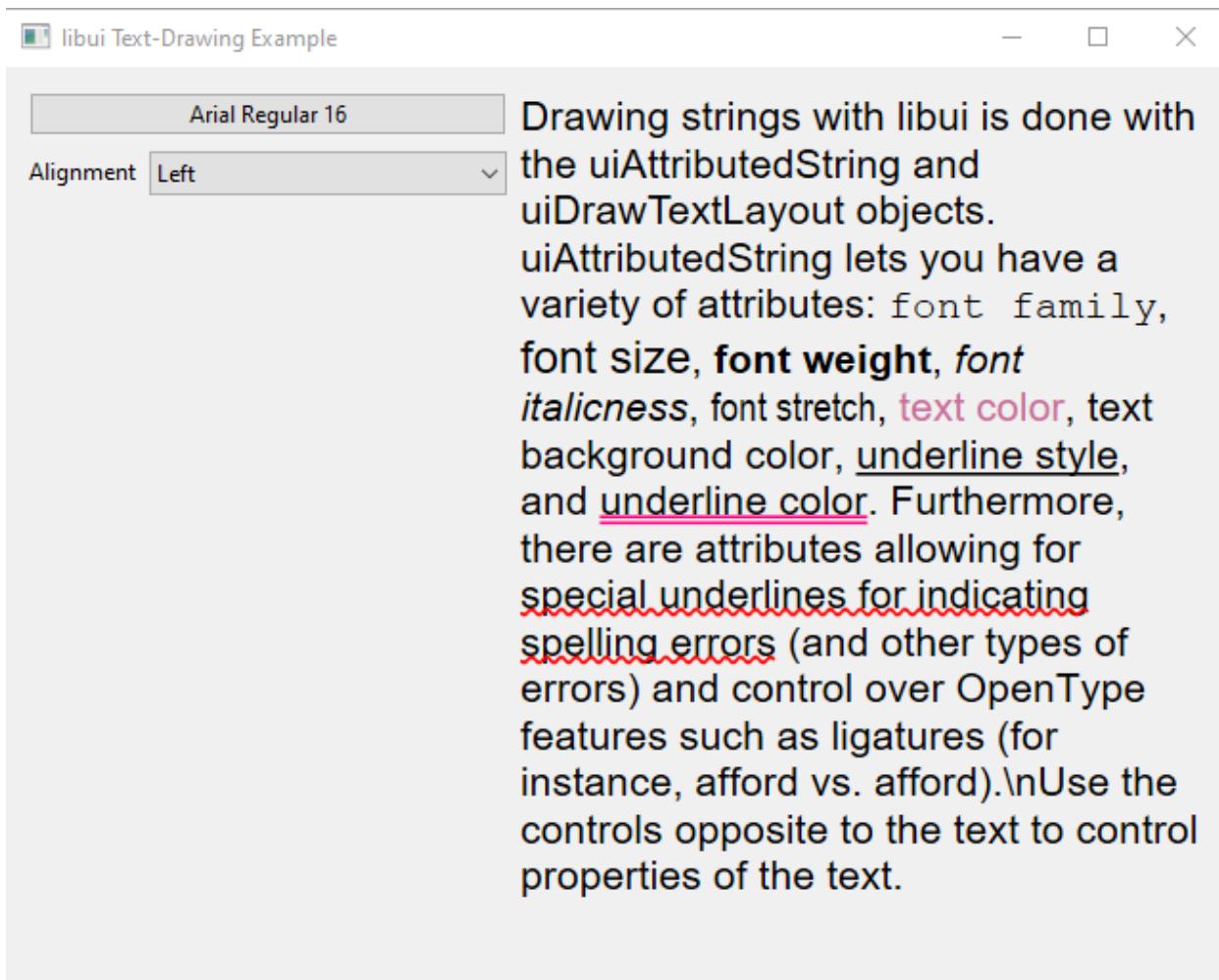
func sayHello
    uiLabelSetText(lbl2,"Hello " + uiEntryText(text1))

func closeApp
    uiQuit()
```

Screen Shots:







117.9 RingSockets Extension

In Ring, We have sockets using different extensions like RingQt, RingLibuv and RingLibSDL

In this release we provide a special extension for sockets

This will be useful if your application doesn't use the previous libraries

Example (Server Code)

```
# TCP SERVER

load "sockets.ring"

sock = socket(AF_INET, SOCK_STREAM, 0)
bind(sock, "127.0.0.1", 5050)
listen(sock, 5)
ns = accept(sock)
send(ns, "Hello Client")
msg = recv(ns, 1024)
? "Client Say >> " + msg
close(sock)
? "Socket connection closed"
```

Example (Client Code)

```
# TCP Client

load "sockets.ring"

sock = socket(AF_INET, SOCK_STREAM)
connect(sock, "127.0.0.1", 5050)

send(sock, "Hello Server")
msg = recv(sock, 1024)
? "Server Say >> " + msg

close(sock)
? "Socket connection closed"
```

117.10 RingThreads Extension

In Ring, We have threads using different extensions like RingQt, RingLibuv and RingAllegro

In this release we provide a special extension for threads

This will be useful if your application doesn't use the previous libraries

Example:

```
load "threads.ring"

func main
```

(continues on next page)

(continued from previous page)

```

nThreads = 2
aList = list(nThreads)

for x=1 to nThreads
    aList[x] = new_thrd_t()
    thrd_create(aList[x], "Hello(\"+x+)\")"
next

for x=1 to nThreads
    res= 0
    thrd_join(aList[x], :res)
next

? :Done
shutdown()

func Hello x

for r=1 to 100
    ? "Message from the Hello(\"+x+)\") function"
next

```

117.11 Better RingOpenSSL

The next functions are added to the RingOpenSSL extension

These functions compute the hash of large files/data without the need to load all of the content in a single string.

```

md5init() -> MD5_CTX
md5update (MD5_CTX, string) -> 1 for success or 0 for failure
md5final (MD5_CTX) -> string

sha1init() -> SHA_CTX
sha1update (SHA_CTX, string) -> 1 for success or 0 for failure
sha1final (SHA_CTX) -> string

sha224init() -> SHA224_CTX
sha224update (SHA224_CTX, string) -> 1 for success or 0 for failure
sha224final (SHA224_CTX) -> string

sha256init() -> SHA256_CTX
sha256update (SHA256_CTX, string) -> 1 for success or 0 for failure
sha256final (SHA256_CTX) -> string

sha384init() -> SHA384_CTX
sha384update (SHA384_CTX, string) -> 1 for success or 0 for failure
sha384final (SHA384_CTX) -> string

sha512init() -> SHA512_CTX
sha512update (SHA512_CTX, string) -> 1 for success or 0 for failure
sha512final (SHA512_CTX) -> string

```

117.12 More Functions

- DirExists() Function

```
DirExists(cDirPath) ---> returns 1 if the directory exists
```

- GetPathType() Function

```
GetPathType(cPath) ---> 0 if the path doesn't exists
                           1 if it corresponds to existing file
                           2 if it corresponds to existing directory
                           -1 if the path exists but has
                               an unknown type (e.g. a pipe)
```

- SysSet() Function

We can set environment variables using the SysSet() function

```
SysSet(cVariable, cValue) ---> Returns 1 for success and return 0 for failure
```

- SysUnset() Function

We can delete an environment variables using the SysUnset() function

```
SysUnset(cVariable) ---> Returns 1 for success and return 0 for failure
```

- GetArch() Function

We can detect the architecture of the Ring executable using the GetArch() function

Syntax:

```
GetArch() ---> cString (The name of the architecture of the Ring executable)
```

Example:

```
switch getarch()
on "x86"
    ? "x86 32bit architecture"
on "x64"
    ? "x64 64bit architecture"
on "arm64"
    ? "ARM64 64bit architecture"
on "arm"
    ? "ARM 32bit architecture"
other
    ? "Unknown architecture"
off
```

- NofProcessors() Function

We can detect the number of processors using the NofProcessors() Function

Syntax:

```
NofProcessors() ---> nProcessors
```

Example:

```
? NofProcessors()
```

117.13 Better Functions

- Log() Function

The functions is updated to support calculating the logarithm to any base

Syntax:

```
Log(nNumber)      --> logarithm of nNumber to the base of e
Log(nNumber,nBase) --> logarithm of nNumber to the base of nBase
```

Example:

```
? log(10)        # 2.30
? log(2)         # 0.69
? log(10,10)    # 1
? log(2,2)       # 1
? log(100,10)   # 2
```

117.14 Better Performance For Strings

- Ring 1.14 is 3x Faster in programs that have strings with long and fixed size

Example:

```
load "openssllib.ring"
f = fopen(exefilename(), "rb")
h = SHA256Init()
while true
  s = fread(f, 4096)
  if isstring(s)
    SHA256Update(h, s)
  else
    exit
  ok
end
digest = SHA256Final(h)
fclose(f)
? digest
```

Output:

```
4e677154639dae3baa048ce5ae0b04b63bcd33316e2d2041297dcee85604d778
```

- Ring 1.14 is 60x Faster when adding strings to other strings

Example:

```
t1 = clock()
test = "My Ring"
for x = 1 to 20000
    test += x
next
? "Time : " + ((clock()-t1)/clockspisecond()) + " seconds"
```

Output:

```
Time : 0.01 seconds
```

- These improvements increased the performance of Ring Code Generator for Extensions (4x Faster)

117.15 Better Handling For Numbers

(1) Using Hexadecimal Values

Example:

```
x = 0x10
? x          # 16
x = 0xff
? x          # 255
x = 0x0A
? x          # 10
? 0xFFFF      # 65535
? 0x0A + 1   # 10+1 = 11
```

(2) Printing large double value

Example:

```
c = 999999999999999
for i = 1 to 13
    c *= 999999999999999
next
? "c = " + c
```

Output:

```
c = 9.
99999999999862032924046117813879019544782068185773946275755888189234614925384380788550958e+209
```

(3) Using String() and Number() with large double values

Example:

```
c1 = 999999999999999
for i = 1 to 13
    c1 *= 999999999999999
next

s = string(c1) ? "c1 = " + s
```

(continues on next page)

(continued from previous page)

```
c2 = number(s) ? "c2 = " + c2
? "c2 - c1 = " + (c2 - c1)

str1 = "-2222044646462"
c = Number(str1)
str2 = String(c)

if str1 = str2
? "Strings Identical"
else
? "Strings Mismatch!"
ok
```

Output:

```
c1 = 9.
→999999999999862032924046117813879019544782068185773946275755888189234614925384380788550958e+209
c2 = 9.
→999999999999862032924046117813879019544782068185773946275755888189234614925384380788550958e+209
c2 - c1 = 0
Strings Identical
```

117.16 Using CLOC (Count Lines of Code)

Usage:

```
ringcloc <application_folder_path>
```

Example(1):

```
ringcloc c:\ring\tools\ringnotepad
```

Output:

```
47 text files.
47 unique files.
11 files ignored.

github.com/AlDanial/cloc v 1.88 T=1.18 s (39.0 files/s, 3212.2 lines/s)
-----
Language           files      blank     comment      code
-----
Ring                33       273        139       3186
Bourne Shell        4        22          9         88
DOS Batch           4         3          7         20
INI                 1         0          0          15
C                   1         0          1          10
Markdown            2         4          0           8
Windows Resource File  1         0          0           1
```

(continues on next page)

(continued from previous page)

SUM:	46	302	156	3328
------	----	-----	-----	------

Example(2):

```
ringcloc c:\ring\tools\formdesigner
```

Output:

54 text files.				
54 unique files.				
13 files ignored.				
github.com/AlDanial/cloc v 1.88 T=1.54 s (34.5 files/s, 7122.4 lines/s)				

Language	files	blank	comment	code

Ring	52	1306	567	9071
Markdown	1	5	0	7

SUM:	53	1311	567	9078

117.17 More Improvements

- Ring Compiler - Pass new lines after the FUNC keyword in anonymous functions
- Ring Compiler - Pass new lines after the function parameters in anonymous functions
- Ring Compiler - Pass new lines after the access of the list items
- Ring Compiler - Pass new lines after the access of the object attribute
- Ring Compiler - Support numbers of 97 digits
- Ring Compiler - Support Statement → Expression → '()''
- Ring Compiler - Support Statement → Expression → '(Expression ')' '.' Attribute|Method
- Ring Compiler - Better error message when literal is not closed
- Ring VM - Str2Hex() function - Better Performance
- Ring VM - Hex2Str() function - Better Performance
- Ring VM - SubStr() function - Better Code
- Ring VM - Dec() function - Better Code
- Ring VM - String() function - Better Code
- Ring VM - Number() function - Better Code
- Ring VM - Decimals() function - Allows a range between 0 and 90
- Ring VM - Comparing between binary strings - Better Code
- Ring VM - IsWindows64() function - Better Code

- Ring VM - Unsigned() function - Better Code
- Ring VM - Function Call - Better Management for Lists & Nested Lists state
- Ring VM - AddAttribute() - The default type of the new attribute will be a STRING
- Ring VM - Dir() function - Better Code
- Ring VM - Copy() function - Better Code (Ignore Negative Numbers)
- Ring VM - Restore the step value when we use exit from more than one loop
- Ring VM - After (For-In Loop) - Delete the reference but keep a copy of the value
- Ring VM - Better Code when working with many threads
- Ring VM - Better Code when restoring the state after Try/Catch/Done
- Ring VM - Better Code when using Raise() in nested calls after Try/Catch/Done
- Ring VM - Better format when printing instructions during execution
- Ring VM - Support using the & Operator to return the String Character Reference
- Ring VM - Call command - function name - not case sensitive
- Ring Compiler/VM Source Code - Better Format
- Ring Compiler/VM Source Code - Code Refactoring
- Ring Compiler/VM - New instruction: ICO_FREETEMPLISTS
- RingPM - New Package: GUILib (Separate package for the GUILib classes)
- RingPM - New Package: ObjectsLib (Separate package for the ObjectsLib classes)
- RingPM - New Package: CLOC (Count Lines of Code)
- RingQt - QWebEngineView Class - Added: Print(QPrinter,cEventCode) Method
- RingQt - QCombobox Class - Added: setCurrentText() and addItems() methods
- RingQt - Added: QLocale Class
- RingQtRuntime Package: Using GUILib & ObjectsLib packages
- GameEngine - Add the delay function to the Graphics Library: gl_delay() function
- GameEngine - Using the Resources Class when loading the Window Icon
- RingAllegro - Better Code
- RingMurmurHash - Better Code
- RingOpenSSL - RandBytes() function - Better Code
- RingZip - GetFileNameByIndex() function - Better Code
- RingLibSDL - Building using LibSDL version 2.0.14

WHAT IS NEW IN RING 1.15?

In this chapter we will learn about the changes and new features in Ring 1.15 release.

118.1 List of changes and new features

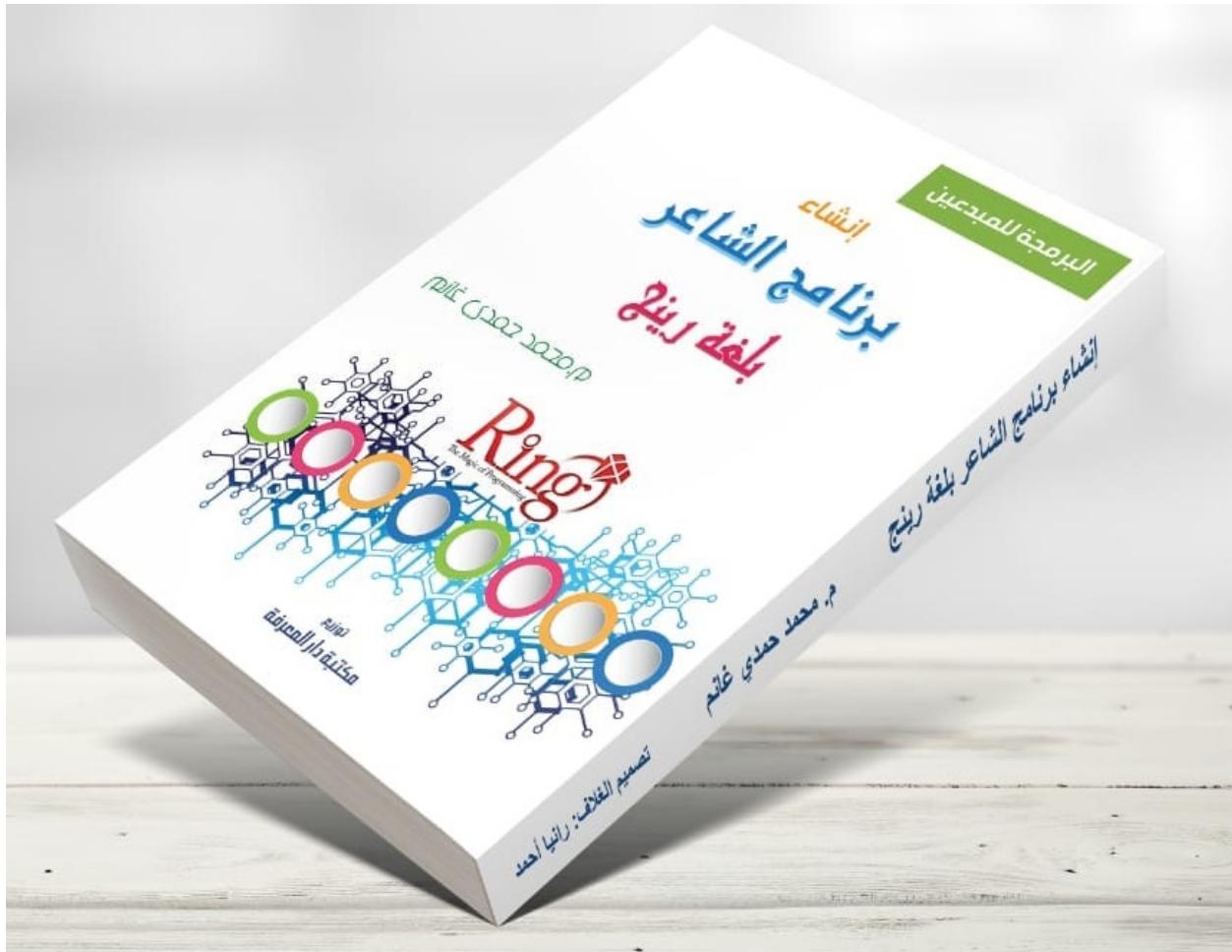
Ring 1.15 comes with the next features!

- New Arabic Book
- Chess Endgame Application
- Chess 3D (Qt3D Sample)
- Better Ring Notepad
- Better StdLib
- Better RingQt
- Better RingLibCurl
- Heroku (Better support)
- Using ‘.’ then Numbers
- More Samples
- More Improvements

118.2 New Arabic Book

We have a new printed book (Written in Arabic Language)

The Book is a about building a project using Ring to analysis the Arabic Poetry



118.3 Chess Endgame Application

Chess Endgame data set visualization

Also the application provides game result prediction using Microsoft Azure Machine Learning

Screen Shots:

Chess Endgame Data Set

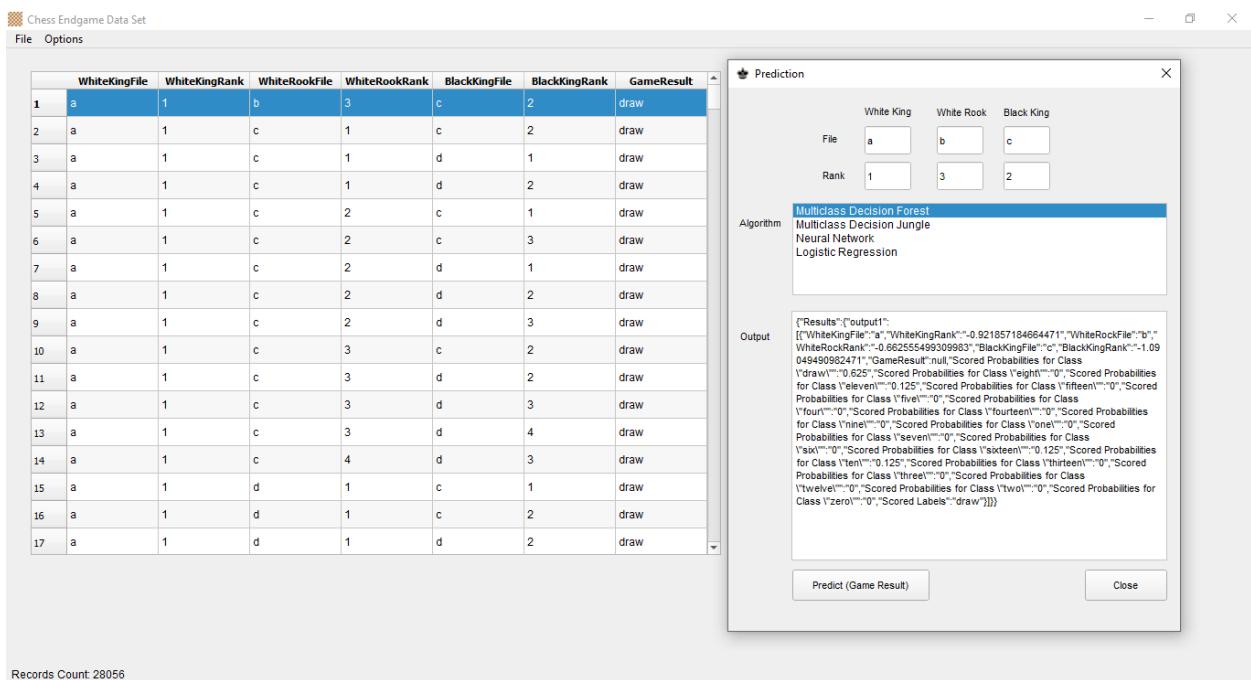
File Options

	WhiteKingFile	WhiteKingRank	WhiteRookFile	WhiteRookRank	BlackKingFile	BlackKingRank	GameResult
1	a	1	b	3	c	2	draw
2	a	1	c	1	c	2	draw
3	a	1	c	1	d	1	draw
4	a	1	c	1	d	2	draw
5	a	1	c	2	c	1	draw
6	a	1	c	2	c	3	draw
7	a	1	c	2	d	1	draw
8	a	1	c	2	d	2	draw
9	a	1	c	2	d	3	draw
10	a	1	c	3	c	2	draw
11	a	1	c	3	d	2	draw
12	a	1	c	3	d	3	draw
13	a	1	c	3	d	4	draw
14	a	1	c	4	d	3	draw
15	a	1	d	1	c	1	draw
16	a	1	d	1	c	2	draw
17	a	1	d	1	d	2	draw

Records Count: 28056

Statistics

	Game Result	Count	Percentage
1	draw	2796	9.97%
2	zero	27	0.10%
3	one	78	0.28%
4	two	246	0.88%
5	three	81	0.29%
6	four	198	0.71%
7	five	471	1.68%
8	six	592	2.11%
9	seven	683	2.43%
10	eight	1433	5.11%
11	nine	1712	6.10%
12	ten	1985	7.07%
13	eleven	2854	10.17%
14	twelve	3597	12.82%
15	thirteen	4194	14.95%
16	fourteen	4553	16.23%
17	fifteen	2166	7.72%
18	sixteen	390	1.39%



118.4 Chess 3D (Qt3D Sample)

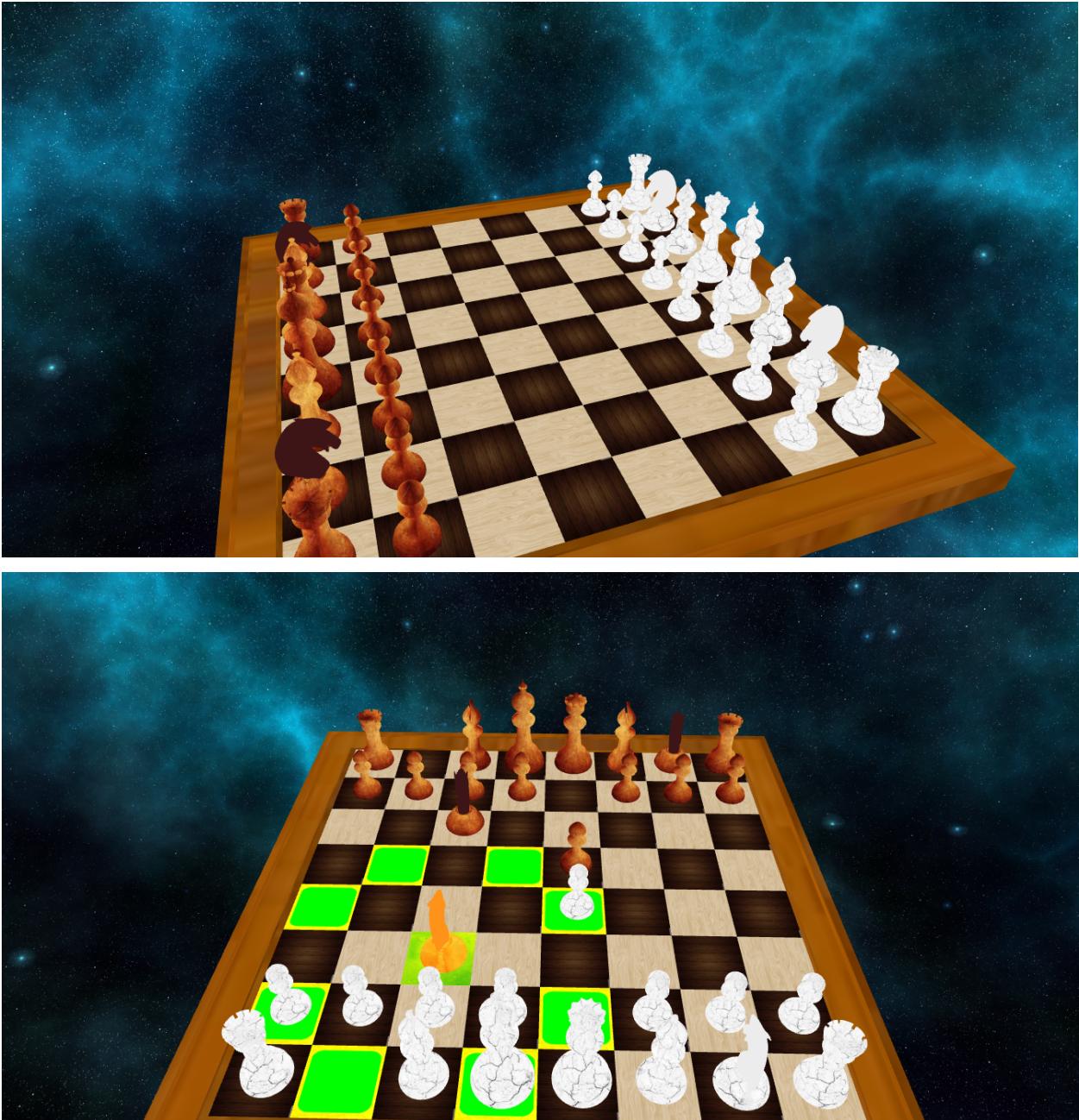
It's an example about using Qt3D

- We can move the board
- Select a Piece and move it
- Castle - King Rook side
- En-Passant capture
- Pawn promotion to Queen

To Install the sample using the Ring Package Manager

```
ringpm install Chess3D-Qt3D
ringpm run Chess3D-Qt3D
```

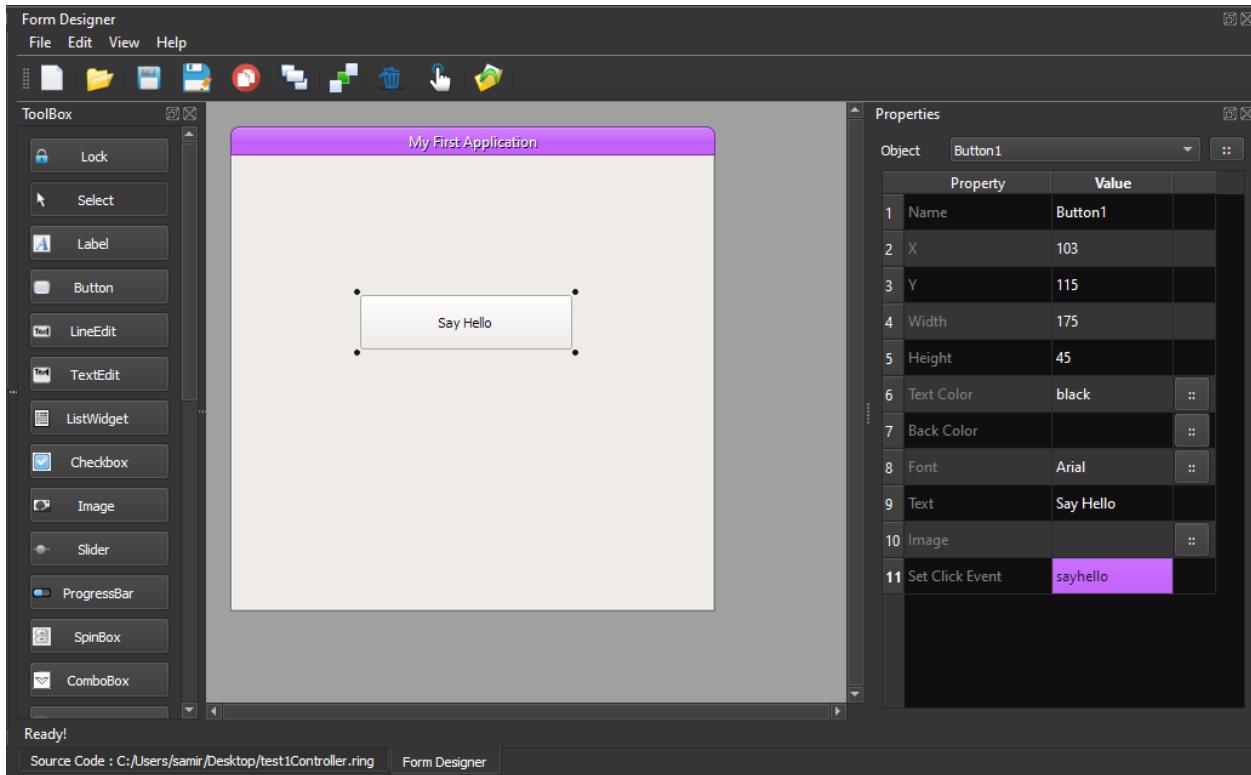
Screen Shots:



118.5 Better Ring Notepad

(1) Automatic generation for the Event Function

In the Form Designer, When we determine the name of the Event Function



Ring Notepad will generate the function code automatically

```

Source Code : C:/Users/samir/Desktop/test1Controller.ring
test1Controller.ring X
1 # Form/Window Controller - Source Code File
2
3 load "test1View.ring"
4
5 import System.GUI
6
7 if IsMainSourceFile() {
8     new App {
9         StyleFusion()
10        openWindow(:test1Controller)
11        exec()
12    }
13 }
14
15 class test1Controller from windowsControllerParent
16
17     oView = new test1View
18
19     func sayhello
20         oView {
21
22     }
23

```

Source Code : C:/Users/samir/Desktop/test1Controller.ring | Form Designer

118.6 Better StdLib

(1) RandomList() function

Syntax:

```
RandomList(aList) --> List contains the same items using Random order
```

Example:

```
load "stdlib.ring"
aList = 1:5
? RandomList(aList)
```

(2) RandomItem() function

Pick an item from a list (Random Choice)

Syntax:

```
RandomItem(aList) --> Item
```

Example:

```
load "stdlib.ring"
aList = 1:5
? RandomItem(aList)
```

(3) List2Code() function

- Support double quotation in list strings
 - Better Format - Add tabs before the items
- (4) StdLib - Split() function - Support using an empty string as delimiter
- (5) StdLib - StdFile Class - FTell() function - Better Code

118.7 Better RingQt

- QApp Class - Clipboard() method
- QString2 Class - More Methods
- QMessageBox Class - setIcon() Method
- QByteArray Class - Append() Method - Support Binary Data
- QByteArray Class - Replace() Method - Multiple versions and better code
- QTabWidget Class - TabBar() Method
- QVector3D Class - Project() and UnProject() Methods
- QPainter Class - DrawHSVFList() and DrawRGBFList() Methods
- RingQt For WebAssembly - Download File - Support Binary File
- QCompleter4 Class
- Event Code size changed from 99 characters to 255 characters
- Clear Error Message if the Event Code is larger than the allowed size

Example (Using Clipboard):

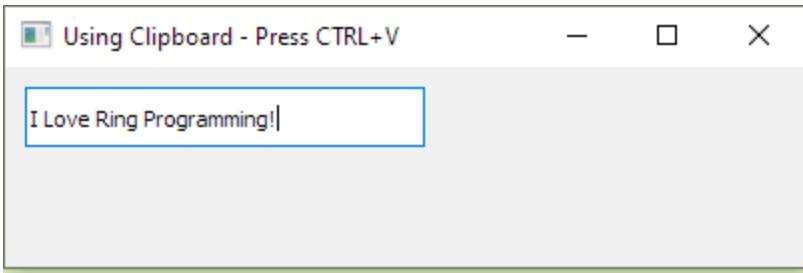
```
load "guilib.ring"

oApp = new qapp {
    w = new QWidget() {
        setWindowTitle("Using Clipboard - Press CTRL+V")
        resize(400,100)
        new QLineEdit(w) {
            move(10,10)
            resize(200,30)
        }
        show()
    }

    oApp.clipboard().setText("I Love Ring Programming!",0)

    exec()
}
```

Screen Shot:



Example (Using Strings):

```
load "guilib.ring"

o1 = new QString2()
o1.append("Ring")

oChar = new QChar(61)
? o1.leftJustified(20,oChar,False)
? o1.rightJustified(20,oChar,False)
```

Output:

```
Ring=====
=====Ring
```

118.8 Better RingLibCurl

- curl_easy_setopt() support passing (CURLLIST *) as the third parameter

Example (From ChessEndGame Application)

URL: <https://github.com/ring-lang/ring/blob/master/applications/chessendgame/predictionController.ring#L67>

```
# Header
mylist = curl_slist_append(null,'accept-encoding: identity')
mylist = curl_slist_append(mylist,'authorization: Bearer ' + my_api_key )
mylist = curl_slist_append(mylist,'connection: close')
mylist = curl_slist_append(mylist,'content-length: ' + len(my_body) )
mylist = curl_slist_append(mylist,'content-type: application/json')
curl_easy_setopt(curl, CURLOPT_HTTPHEADER, mylist)
```

118.9 Heroku (Better support)

From Ring 1.8 We can run Ring Web Applications in the Cloud using Heroku

In Ring 1.15 We updated the packages to use a modern Ring version

Also to avoid all of the reported problems during installation

URL: <https://github.com/ring-lang/RingWebAppOnHeroku>

118.10 Using ‘:’ then Numbers

Ring 1.15 support using ‘:’ then Numbers to define literals

Example:

```
? Type( :1234 )

aList = [ :1 = "One",
          :2 = "Two"]

? aList[:1]
? aList[:2]
```

Output:

```
STRING
One
Two
```

118.11 More Samples

The next samples are added to the samples folder

- samples/Language/AnonFunctions/anonfunc1.ring
- samples/Language/AnonFunctions/anonfunc2.ring
- samples/Language/AnonFunctions/anonfunc3.ring
- samples/Language/AnonFunctions/anonfunc4.ring
- samples/Language/AnonFunctions/anonfunlib.ring
- samples/Language/Numbers/powfunc.ring
- samples/Language/Strings/trim.ring
- samples/Language/Strings/trim2.ring
- samples/Language/Loops/loopcommand.ring
- samples/General/NumberTripletsGame/NumberTripletsGame.ring
- samples/General/Elevator/elevator.ring
- samples/General/SmallExamples/ParametersOrder/parametersorder.ring
- samples/UsingArabic/WriteArabicFile/using_QFile_write.ring
- samples/UsingArabic/WriteArabicFile/using_QFile_read.ring
- samples/UsingRayLib/more/ex6_jump_player2D.ring
- samples/UsingRayLib/more/ex7_jump_player3D.ring
- samples/UsingRayLib/more/ex8_Aiming_at_3D_moving_targets.ring
- samples/UsingRayLib/more/ex9_jump_player3D_collision_detection.ring
- samples/UsingRayLib/more/ex10_jump_player3D_long_way.ring

- samples/UsingQt/String/QCharUnicodeValue.ring
- samples/UsingQt/String/QCharUnicodeValue2.ring
- samples/UsingQt/String/QStringJustified.ring
- samples/UsingQt/Clipboard/QTextEditClipboard.ring
- samples/UsingQt/Clipboard/UsingQClipboard.ring
- samples/UsingQt/Time/timemillisecond.ring
- samples/UsingQt/ByteArray/Base64.ring
- samples/UsingWebLib/PathInfo/pathinfo.ring
- samples/Drawing/ColorWheel/ColorWheel-Animate.ring
- samples/Drawing/ColorWheel/ColorWheel-FastDraw.ring

Screen Shot:



118.12 More Improvements

- Form Designer - Better Translation
- Customers Application - New translation file (Portuguese Language)
- Code Generator for Extensions - Function prototype - Trim spaces in the output type
- Code Generator for Extensions - Return objects of types that have classes without init
- Code Generator for Extensions - Correct parameter number when freeing unassigned pointers

- RingLibUV - Better Code (When using threads)
- Ring VM - Better Code (When terminating threads)
- Ring VM - Support converting NULL to Zero when we compare between Number and NULL
- Ring VM - ring_state_stringtokens() function
- Ring VM - ring_state_scannererror() function
- Ring VM - Clean error message when we have infinite recursions
- Ring VM - TempName() Function - Better Code!
- Ring VM - SubStr() Function - Better Code!
- Ring VM - Random() & Randomize() Functions - Better Code!
- Ring VM - ICO_FRETEMPLISTS Instruction - Better Implementation
- Ring VM - ICO_NEWOBJ/ICO_SETSCOPE - State Management - Better Code!
- Ring VM - RING_API_RETLISTBYREF - Better Code!
- Ring VM - Respect Decimals() function when printing numbers inside Lists & Objects
- Ring VM - Convert the String to a Number when using (=) or (!=) operators
- Ring VM - ICO_INCPJUMPSTEP1 and ICO_JUMPVARPLENUMSTEP1 - Better Code
- Ring VM - ring_vm_newfunc() function - Better Code
- Ring Compiler - For-In Loop - Always access string characters by reference
- Ring Compiler - For-In Loop - The iterator value after the loop is processed
- Ring Compiler - Do-Again Loop - Avoid unnecessary JUMP instruction when using (Loop) command
- Ring Compiler - When Embedding Ring in Ring - Always keep Ring keywords (Not Case Sensitive)
- Ring Compiler - Scanner - Option (Comments as Tokens)
- Ring Compiler - Hexadecimal Numbers - Support many zeros in the start of the number
- Ring Compiler - Support Setter/Getter when using (++) and (--) operators
- Ring Compiler - Display Warning (unrecognized option) when we pass wrong options to the Compiler

WHAT IS NEW IN RING 1.16?

In this chapter we will learn about the changes and new features in Ring 1.16 release.

119.1 List of changes and new features

Ring 1.16 comes with the next features!

- Light GUIlib
- UTF-8 File Names in Microsoft Windows
- Nested Methods Call in Separate Lines
- Code Runner Extension support Ring
- Zero and Strings
- Better Installation Scripts
- Better Documentation
- MDI Windows Sample
- More Improvements

119.2 Light GUIlib

A lot of RingQt applications uses only QtCore, QtGui & QtWidgets modules

These applications could use

```
load "lightguilib.ring"
```

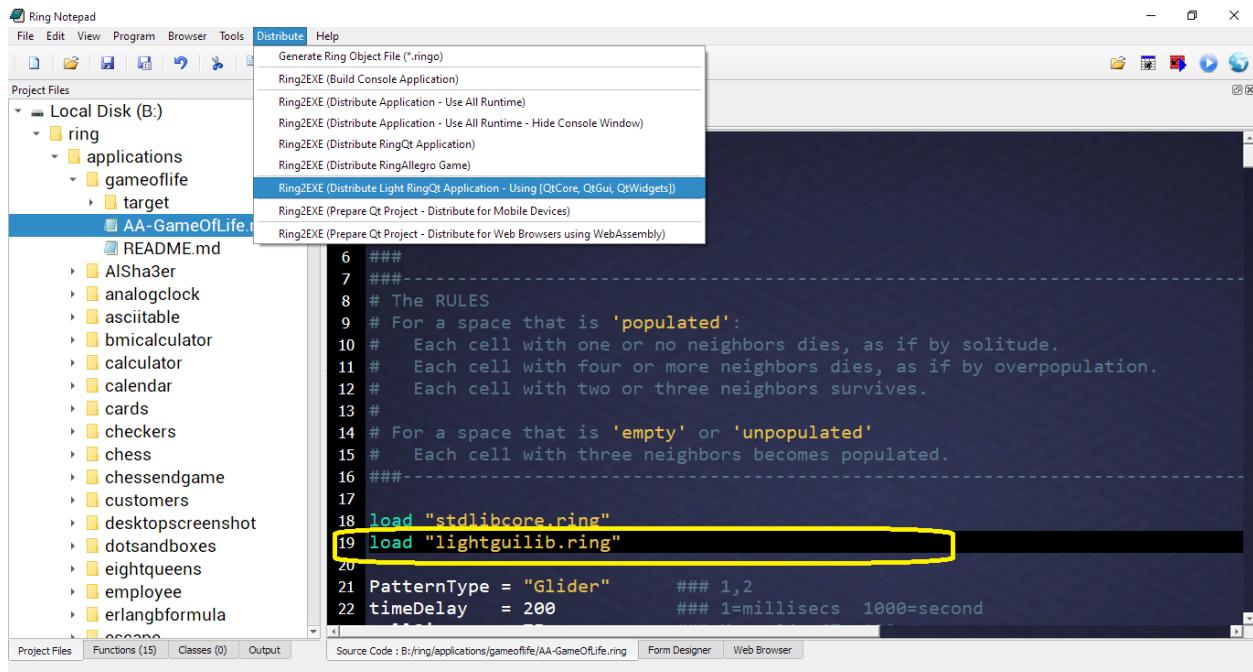
Instead of

```
load "guilib.ring"
```

Also Ring Notepad, Distribute menu comes with a new option : Distribute light RingQt application

Using this option we can distribute lightguilib applications

For example, Distributing (Game of Life) using this option provides : target/windows folder



- Size : 35 MB (Uncompressed)
- Size : 13 MB (zip)
- Size : 9 MB (exe) compressed using 7zip

So we can distribute these GUI applications using an installer less than 10 MB

Tip: if you need something smaller than that (1 MB) then switch to other libraries like LibUI

119.3 UTF-8 File Names in Microsoft Windows

In Ring 1.16, The Load command support using UTF-8 in the file name.

For example, We can write Arabic letters in the File Name!

Also the next functions support this feature

```
read()
write()
fopen()
```

119.4 Nested Methods Call in Separate Lines

In Ring 1.16, the Compiler support adding new lines after the method call and before the dot operator

Example:

```
myobj = new Start
myobj.one()
    .two()
    .three()
    .go()

class start
    func one
        ? "One"
        return new one

class one
    func two
        ? "Two"
        return new two

class two
    func three
        ? "Three"
        return new three

class three
    func go
        ? "Go!"
```

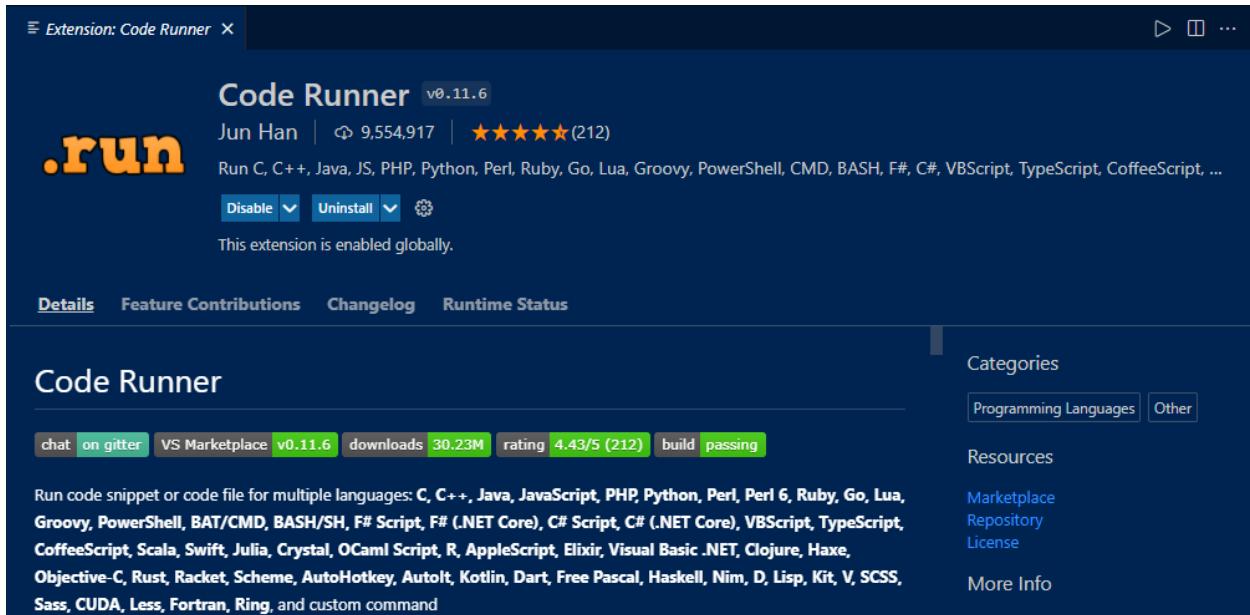
Output:

```
One
Two
Three
Go!
```

119.5 Code Runner Extension support Ring

If you are using Microsoft Visual Studio Code, We have good news for you!

The Code Runner Extension added support for the Ring programming language



After installing Code Runner

It's recommended to modify this file :

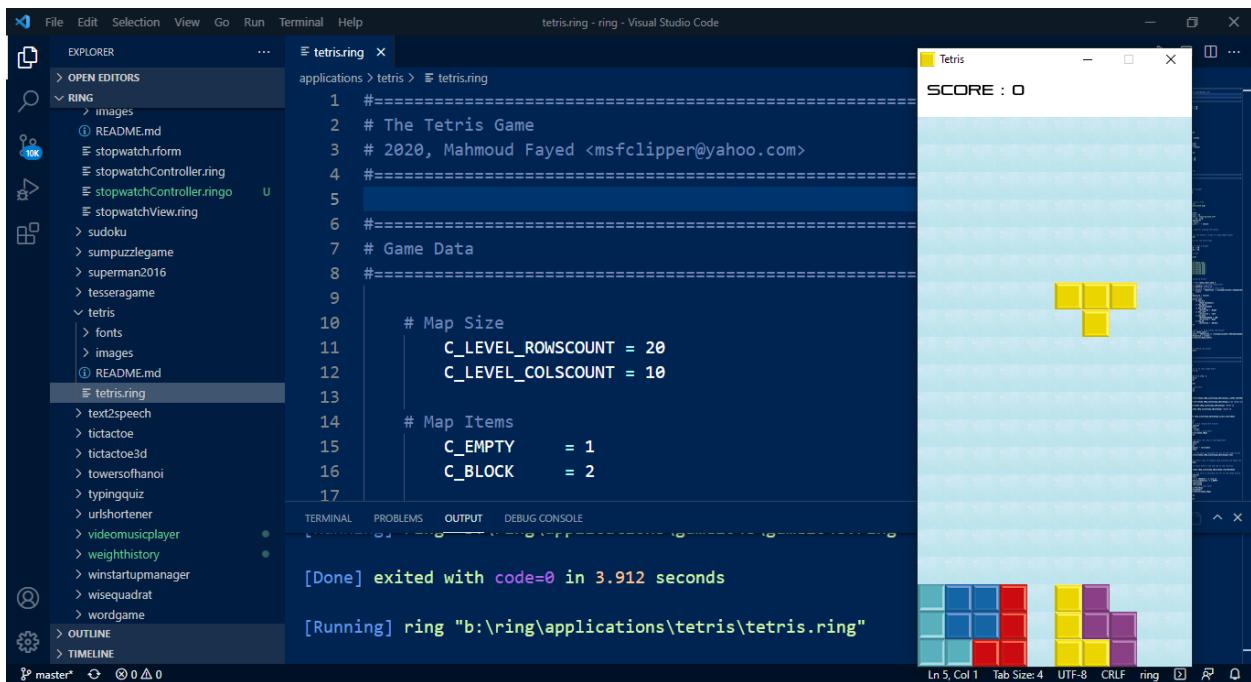
C:/Users/YOURUSERNAME/.vscode/extensions/formulahendry.code-runner-0.11.6/package.json

Set the property (code-runner.fileDirectoryAsCwd) to (True)

So Code Runner can move to the file directory when we run it using (Ctrl+Alt+N)

```
"code-runner.fileDirectoryAsCwd": {
    "type": "boolean",
    "default": true,
    "description": "Whether to use the directory of the file to be executed as the working directory.",
    "scope": "resource"
},
```

Tip: Check ring/tools/editors/vscode folder to support Ring in VSCode



119.6 Zero and Strings

From Ring 1.0, the language do implicit conversion between numbers and strings

This is useful when we mix them in some situations like printing something on the screen

```
x = 10          # Number
? "x = " + x    # x converted from Number to String
```

Also we can do arithmetic operations

```
x = "10"        # String
? 5 + x         # x converted from String to Number
```

The question is What happens if x content is not a number?

The answer : The result of the conversion will be (Zero)

```
x = "Test"      # String - The content is not a number
? 5 + x         # print (5) - x converted from String to Number (Zero)
```

The other operators like “=” and “!=” do the conversion too

Starting from Ring 1.16, They will be careful when we compare things to Zero

Example:

```
x = "Test"
? 0 = x          # The result will be FALSE
? 0 != x         # The result will be TRUE
```

This is useful when we compare between values inside Empty Lists and Strings

```
aList = list(10)      # 10 items - Each item is Zero
? aList[1] + 5        # print (5)
? aList[1] = "Test"    # False
? aList[1] = 0         # True
```

The other values (Not Zero) will follow the normal conversion rules

```
x = "5"
? 5  = x            # True
? 6 != x            # True
```

119.7 Better Installation Scripts

Ring 1.16 comes with better installation scripts on Linux and macOS

- install.sh - Force creation of symlinks in case they already exist
- install.sh - Remove quarantine flag
- uninstall.sh - Delete symlinks from /usr/local accordingly

119.8 Better Documentation

All of the documentation chapters are revised and improved

119.9 MDI Windows Sample

The next sample is added to the samples folder

- samples/UsingQt/MDIWindows mdi_windows.ring



119.10 More Improvements

- Sample: samples/AQuickStart/GUILib/gui1.ring - Better Code
- Form Designer - Set the Button Event (If it's Empty) from the Button Text
- Form Designer - Order the controls based on the position (Not the Creation Order)
- Form Designer - File System - File Name Encoding
- Form Designer - Properties Window - Property Name Column - Better Colors

- StdLib - IsPrime() Function - Better Code
- RingQt - QListWidget Class - AddItem() Method - Convert Number to String
- RingQt - More Qt constants are defined
- Ring2EXE - Display usage information
- Ring2EXE - Support Creating folders when copying files
- Ring VM - ring_vm_error() - Better Code
- Ring Compiler - Don't display (Unrecognized Option) if we have a source code file

WHAT IS NEW IN RING 1.17

In this chapter we will learn about the changes and new features in Ring 1.17 release.

120.1 List of changes and new features

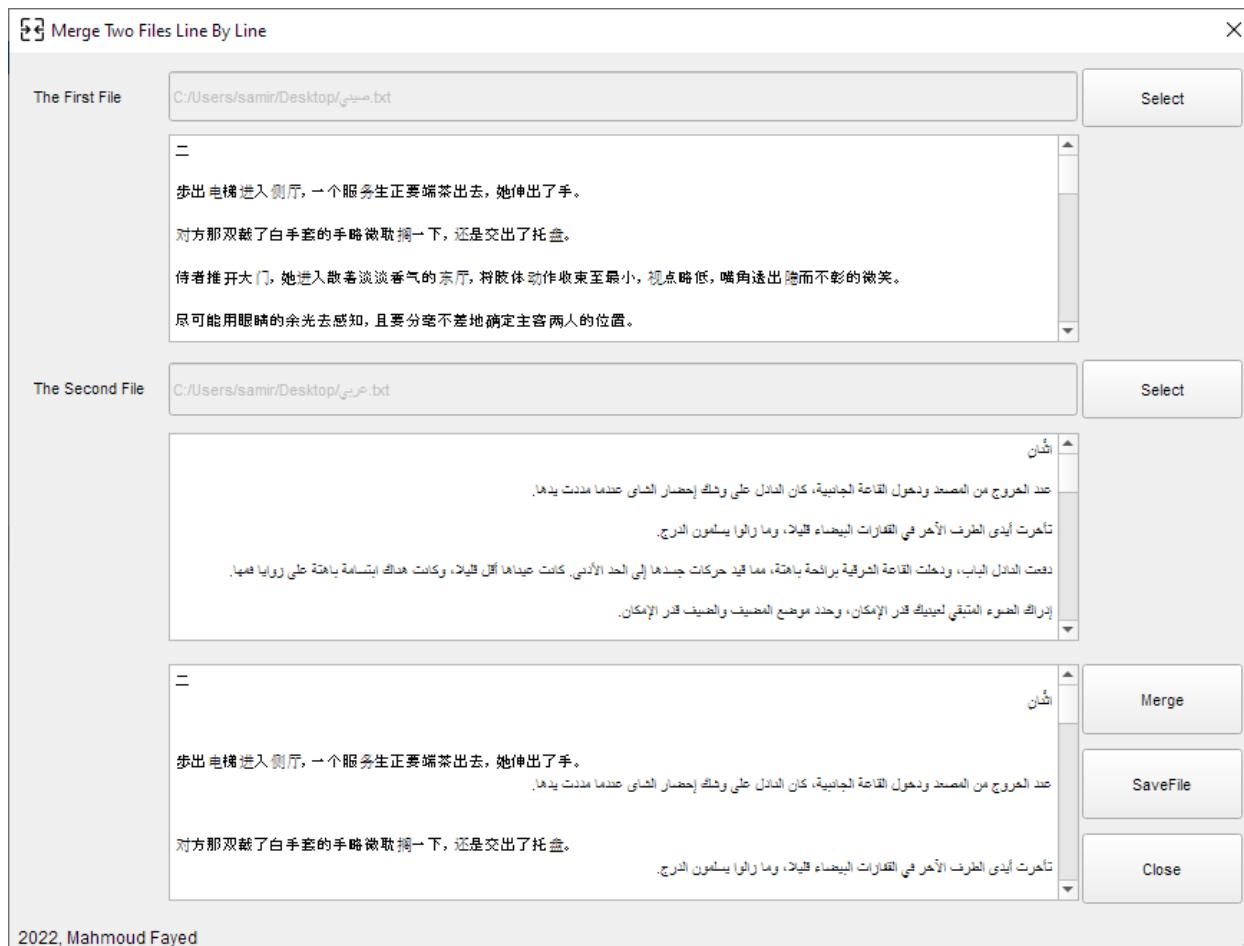
Ring 1.17 comes with the next features!

- Merge Two Files
- Poetry Analysis
- Citations Prediction
- TokensLib Library
- CSVLib Library
- JSONLib Library
- HTTPLib Library
- Better GUILib
- Better RingOpenSSL
- Better RingWinAPI
- Better Syntax Flexibility
- Better I/O functions
- Better Ring API
- Better Code Generator for Extensions
- More Improvements

120.2 Merge Two Files

An application to merge two text files line by line

Development Time: 30 minutes (Includes user interface design, coding, testing and distribution)



2022, Mahmoud Fayed

120.3 Poetry Analysis

An application to analysis the Arabic poetry

The application is over 4000 lines of Ring code

The source code is explained in a printed book about the subject



120.4 Citations Prediction

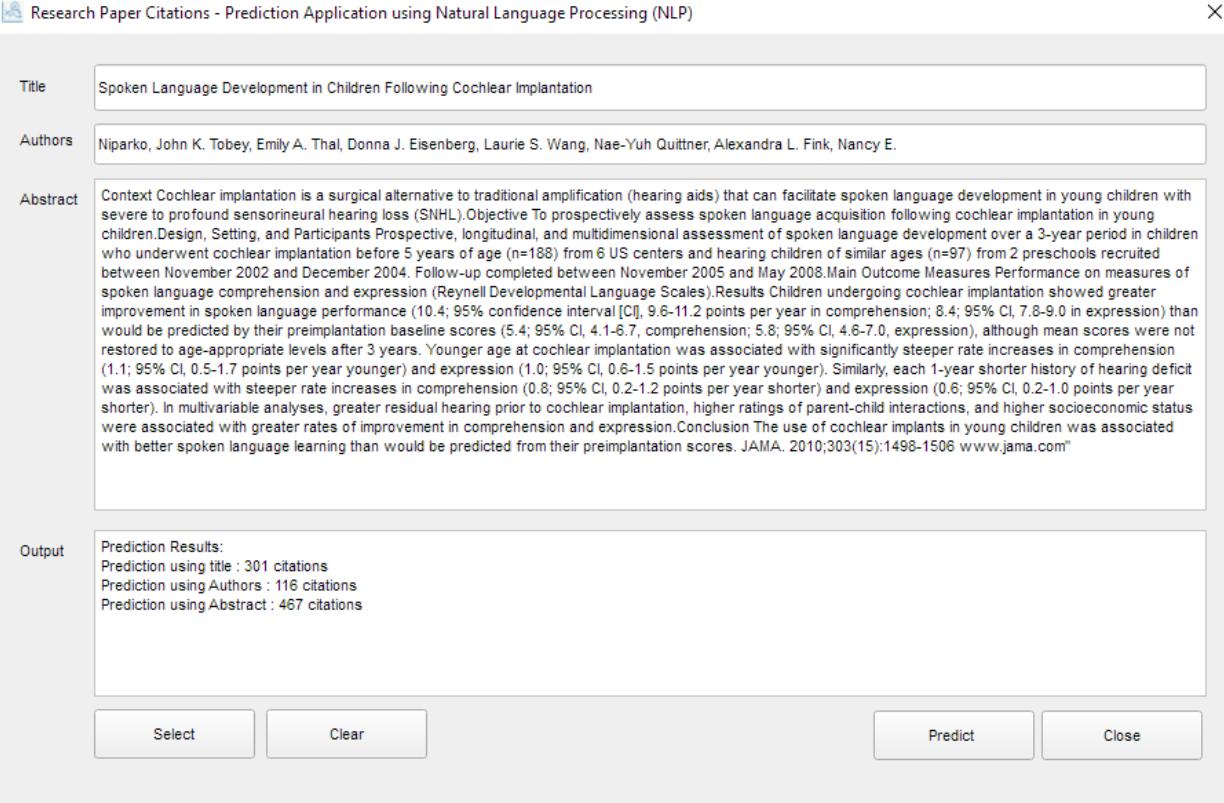
An applicaiton to predict the research paper citations using title, abstract or authors.

The applications uses Microsoft Azure Machine Learning for the Models

The Models are trained using a Dataset for a specific domain and specific journal

This application comes with 3 samples to see how it works!

It's an example about using Ring, RingQt, RingLibCurl and JSONLib

A screenshot of a software application window titled "Research Paper Citations - Prediction Application using Natural Language Processing (NLP)". The window contains four main sections: "Title" (Spoken Language Development in Children Following Cochlear Implantation), "Authors" (Niparko, John K. Tobey, Emily A. Thal, Donna J. Eisenberg, Laurie S. Wang, Nae-Yuh Quittner, Alexandra L. Fink, Nancy E.), "Abstract" (A detailed paragraph about a study on spoken language development in children following cochlear implantation, mentioning 188 participants, 6 US centers, and follow-up from 2002 to 2008. It discusses improvements in comprehension and expression over 3 years, comparing preimplantation scores to postoperative performance. Factors like age at implantation, history of hearing deficit, and socioeconomic status were analyzed. The conclusion states that implants are associated with better language learning than preimplantation scores. Reference: JAMA. 2010;303(15):1498-1506 www.jama.com"), and "Output" (Prediction Results: Prediction using title : 301 citations, Prediction using Authors : 116 citations, Prediction using Abstract : 467 citations). At the bottom are buttons for "Select", "Clear", "Predict", and "Close".

120.5 TokensLib Library

Using this library we can get Ring tokens from source code files or strings.

Example:

```
load "tokenslib.ring"

func main
    oTokens = new RingTokens {
        fromFile("hello.ring")
        PrintTokens()
        ? Copy("=", 50)
        fromString("? 1+1")
        PrintTokens()
    }
```

Output:

```
Keyword      : SEE
Literal      : Hello, World!
EndLine
=====
Operator    : ? (23)
Number      : 1
Operator    : + (1)
```

(continues on next page)

(continued from previous page)

Number : 1
EndLine

120.6 CSVLib Library

Using this library we can generate and read CSV files

Functions:

List2CSV(aList) --> cCSVString
CSV2List(cCSVString) --> aList

Example:

```
load "csvlib.ring"

aList = [ ["number", "square"] ]

for t=1 to 10
    aList + [ t, t*t ]
next

write( "squares.csv", list2CSV(aList) )
```

Output:

	A	B	C	D	E	F
1	number	square				
2	1	1				
3	2	4				
4	3	9				
5	4	16				
6	5	25				
7	6	36				
8	7	49				
9	8	64				
10	9	81				
11	10	100				
12						

Example (2)

```
load "csvlib.ring"

if ! fexists("squares.csv")
    ? "The file squares.csv doesn't exist! - Run writeSquaresTable.ring to create it"
    return
ok

aList = CSV2List( read("squares.csv") )

for subList in aList
    ? "" + subList[1] + " - " + subList[2]
next
```

Output:

```
number - square
1 - 1
2 - 4
3 - 9
4 - 16
```

(continues on next page)

(continued from previous page)

5 - 25
6 - 36
7 - 49
8 - 64
9 - 81
10 - 100

120.7 JSONLib Library

Using this library we can generate and read JSON files

Functions:

List2JSON(aList) --> cJSONObject
JSON2List(cJSONObject) --> aList

Example (1):

File: sample.json

{
"firstName": "John",
"lastName": "Smith",
"age": 20,
"address": {
"streetAddress": "21 2nd Street",
"city": "New York",
"state": "NY",
"postalCode": "10021"
},
"phoneNumbers": [
{ "type": "home", "number": "212 555-1234" },
{ "type": "fax", "number": "646 555-4567" }
]
}

Ring Code:

load "jsonlib.ring"
func main
aList = JSON2List(read("sample.json"))
? aList[:FirstName]
? aList[:LastName]
? aList[:Age]
? aList[:Address][:city]
? aList[:phoneNumbers][1][:Type]
? aList[:phoneNumbers][1][:Number]
? aList[:phoneNumbers][2][:Type]
? aList[:phoneNumbers][2][:Number]

Output:

```
John
Smith
20
New York
home
212 555-1234
fax
646 555-4567
```

Example (2):

```
load "jsonlib.ring"

func main

    aList = [
        :name = "Ring",
        :year = 2016
    ]

    ? List2JSON(aList)
```

Output:

```
{
    "name": "Ring",
    "year": 2016
}
```

JSONLib uses RingCJSON to read JSON files at high-performance

This RingCJSON extension support the CJSON library

CJSON URL: <https://github.com/DaveGamble/cJSON>

120.8 HTTPLib Library

This library provides support for HTTP based on cpp-httplib

URL: <https://github.com/yhirose/cpp-httplib>

Example:

```
load "httplib.ring"

oServer = new Server {
    ? "Try localhost:8080/hi"
    route(:Get, "/hi", :mytest)

    ? "Listen to port 8080"
    listen("0.0.0.0", 8080)
```

(continues on next page)

(continued from previous page)

```

}

func mytest
    oServer.setContent("Hello World!", "text/plain")

```

The other examples exist in this folder: ring/samples/UsingHTTPLib

See the (Using HTTPLib) chapter for more information.

120.9 Better GUIlib

- (1) Many deprecated methods are removed from RingQt
- (2) Added: AddList() method to the TableWidget class

Tip: TableWidget class is a subclass of QTableWidget class

Note: To use TableWidget class, import system.gui after loading guilib.ring or lightguilib.ring

Example:

Source code: <https://github.com/ring-lang/ring/tree/master/samples/UsingQt/TableWidget/AddRingList>

```

class addRingListController from windowsControllerParent

    oView = new addRingListView

    aList = [[ "one", "two" ],
              [ "three", "four" ],
              [ "five", "six" ],
              [ 7, 8 ],
              [ "I", "Love", "Ring", "Programming" ]]

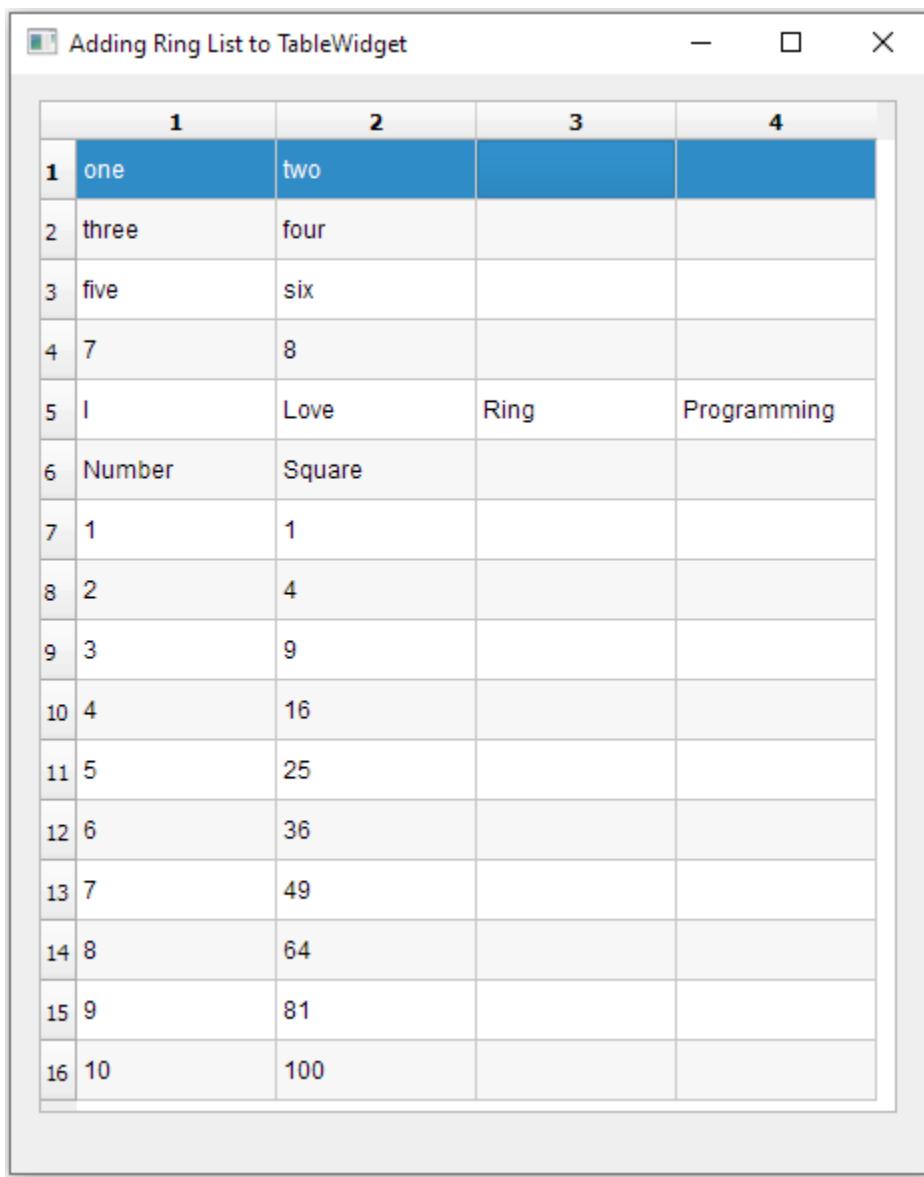
    oView.tablewidget1.addList(aList)

    aList = [[ "Number", "Square" ]]
    for t = 1 to 10
        aList + [ t, t*t ]
    next

    oView.tablewidget1.addList(aList)

```

Screen Shot:



(3) Added: `toList()` method to the `TableWidget` class

Example:

```
aList = oView.tablewidget1.toList()
? aList
```

(4) Added: `AddList()` method to the `ListWidget` class

Tip: `ListWidget` class is a subclass of `QListWidget` class

Note: To use `ListWidget` class, import `system.gui` after loading `guilib.ring` or `lightguilib.ring`

Example:

```
aList = [ 1:10, "one", "two", "three"]
oView.listWidget1.addList(aList)
```

(5) Added: toList() method to the ListWidget class

Example:

```
aList = oView.listwidget1.toList()
? aList
```

120.10 Better RingOpenSSL

- Enhancements to support all cipher algorithms
- New Functions:

```
rsa_generate(nBits[,nPublicExponent]) ---> a random RSA key pair
rsa_export_params(pRsaKey) ---> list of the key parameters
rsa_import_params(pParamsList) ---> a new RSA key
rsa_export_pem(pRsaKey) ---> string encoding of the key in PEM format
rsa_import_pem(cStrPEM) ---> a new RSA key
rsa_is_privatekey(pRsaKey) ---> Bool
rsa_encrypt_pkcs(pRsaKey,cPlainData) ---> String
rsa_decrypt_pkcs(pRsaKey,cEncryptedData) ---> String
rsa_encrypt_oaep(pRsaKey,cPlainData[,nHashAlgorithm]) ---> String
rsa_decrypt_oaep(pRsaKey,cEncryptedData[,nHashAlgorithm]) ---> String
rsa_encrypt_raw(pRsaKey,cPlainData) ---> String
rsa_decrypt_raw(pRsaKey,cEncryptedData) ---> String
rsa_sign_pkcs(pRsaKey,cData) ---> String
rsa_signhash_pkcs(pRsaKey,cHashValue) ---> String
rsa_verify_pkcs(pRsaKey,cData,cSignature) ---> Bool
rsa_verifyhash_pkcs(pRsaKey,cHashValue,cSignature) ---> Bool
rsa_sign_pss(pRsaKey,cData,nHashAlgorithm[,nSaltLength]) ---> String
rsa_signhash_pss(pRsaKey,cHashValue[,nSaltLength]) ---> String
rsa_verify_pss(pRsaKey,cData,cSignature,nHashAlgorithm[,nSaltLength]) ---> Bool
rsa_verifyhash_pss(pRsaKey,cHashValue,cSignature[,nSaltLength]) ---> Bool
openssl_versiontext() ---> String
openssl_version() ---> List
```

120.11 Better RingWinAPI

- Better Code
- New functions for resources, temp files and uuid

```
rGetTempFileName(LPCSTR lpPathName, LPCSTR lpPrefixString, UINT uUnique)
rwaCreateUUID() ---> a string containing the value of the generated UUID
rwaReadBinaryResource(modulePath, resourceName, resourceType) ---> String (Bytes)
```

120.12 Better Syntax Flexibility

The next keywords are added to the language

- endif
- endfor
- endwhile
- endswitch
- endtry
- function
- endfunction
- break
- continue

Example:

```
for t=1 to 10
    ? t
    if t=3
        ? :three
    endif
endfor
```

120.13 Better I/O Functions

The next functions can be used without the need to load stdlib.ring

- print(cString)
- print2str(cString) -> cString
- puts(cString)
- getstring() -> cString
- getnumber() -> nNumber

They are written in the C language to provide better performance

Example:

```
puts("Hello, World!")
puts(2022)
puts("one\n\ttwo\n\tthree")
puts("one\n\ttwo\n\tthree")
age = 6
puts("Ring is #{age} years old!")
puts("I know that 2+2=#{2+2} and 3+3=#{3+3}")
happy()

func happy
```

(continues on next page)

(continued from previous page)

```

new myclass {x=10 y=20 z=30 test()
? :done

class myclass
    name = "Ring"
    x y z
    func test
        puts("Language Name = #{name}")
        puts("x=#{x}\ny=#{y}\nz=#{z}")

```

Output:

```

Hello, World!
2022
one
two
three
one
    two
            three
Ring is 6 years old!
I know that 2+2=4 and 3+3=6
Language Name = Ring
x=10
y=20
z=30
done

```

120.14 Better Ring API

The next functions are added to Ring API

- RING_LIBINIT
- RING_API_REGISTER(cFunctionName,pFunction)
- RING_API_MALLOC(nSize)
- RING_API_CALLOC(nItems,nItemSize)
- RING_API_REALLOC(pPointer,nSize)
- RING_API_FREE(pPointer)
- RING_API_FREEFUNC

The next example demonstrates using RING_LIBINIT and RING_API_REGISTER

```

#include "ring.h"
#include "stdlib.h"

RING_FUNC(ring_myfunction)
{
    printf("Hello, World!");

```

(continues on next page)

(continued from previous page)

```

}

RING_LIBINIT
{
    RING_API_REGISTER("myfunction",ring_myfunction);
}

```

120.15 Better Code Generator for Extensions

The code generator is updated to include the next features

- Better output messages
- Avoid generating the delete method twice
- Using codegenlib.ring for common functions
- Use casting in functions that destroy the structures
- Clean error message when we can't parse a line
- Support C/C++ strings in structures

Example from RingHTTPLib extension

```

<struct>
MultipartFormData {string name,string content,string filename,string content_type}
</struct>

```

120.16 More Improvements

- Ring Notepad (Web Browser) - Support URLs without "http" in the start
- Form Designer - Default TextColor is Empty (Better when changing styles)
- Form Designer - Generating Code - Form Height - Better Code
- Many documents and samples are revised (Better English)
- Documentation - Language Reference - Functions - Parameters & Output
- Many applications are updated to use LightGUILib
- Calendar application - Better code to detect the current year
- JulianDayCalendar application - Better code to detect the current year
- 2048 Game - Added window icon
- Added: samples/Drawing/Mandelbrot/Mandelbrot_Fast.ring
- Added: samples/AQuickStart/MySQL/mysql10.ring
- Added: samples/UsingQt/Process/processoutput.ring
- Added: samples/UsingObjectsLib/test1.ring
- Added: samples/UsingObjectsLib/test2.ring

- Added: samples/UsingObjectsLib/test3.ring
- StdLib - AppPath() function - Better Code
- StdLib - New Function: IsAppCompiled()
- StdLib - New Function: AppArguments()
- StdLib - New Function: CheckEquality()
- ObjectsLib - New Function: GetWindowByID()
- RingLibSDL - LibSDL version is updated from 2.0.14 to 2.0.20
- RingAllegro - Allegro version is updated from 5.2.4 to 5.2.7.1
- RingLibCurl - Better support for Ring2EXE
- RingLibUI - The function uiFreeText() is removed from the library API
- RingLibUI - Better implementation for functions that require uiFreeText()
- RingSockets - Better Code
- RingWinCReg - Better Code
- RingQt - QString Class - Another version for the Replace() Method
- RingQt - QLabel Class inherits the QFrame Class
- RingQt - Added: QStyle class
- RingQt - QApplication Class - Added more methods
- Ring Object File - ring_objfile_writeCfile() - Better Code
- Eval() function - Return NULL if the Return command is not used
- SetPointer()/GetPointer() functions - Better Code
- Fexists() function - Support UTF-8 file names
- GetFileSize() function - Get the file size without requiring any I/O
- ringvm_codelist() function - Return the Byte Code of the current program
- Ring VM - Better code when copying lists
- Ring VM - ICO_JUMPZ Instruction - Treat empty lists as Zero
- Ring VM - ICO_JUMPZ Instruction - Treat empty strings (NULL) as Zero
- Ring VM - The result of using the Not (!) operator then List will be False
- Ring VM - ring_vm_catch() function - Better Code
- Ring VM - ring_vm_showererrormessage() function - Better Code
- Ring VM - State Management - Better Code - ring_vm_newobjectstackpointer()
- Ring VM - State management - Better Performance (when creating new objects)
- Ring VM - Adding binary strings to the Stack - Better Code
- Ring VM - ring_vm_loadindexaddress() function - Better Code
- Ring VM - ring_vm_range() function - Better Code
- Ring VM - ring_vm_string_assignment() function - Better Code
- Ring VM - ring_vm_notequal() function - Better Code

- Ring VM - ring_item_getnumber() - support different types (int,double)
- Ring Compiler - Better Code - Using ring_general_addosfileseparator()
- Ring Compiler - Better Code - Using ring_general_folderexistinfilename()
- Ring Compiler - ring_scanner_checktoken() - Faster & Better Code
- Ring Source Code - Better Format
- Ring Source Code - Check out of memory at the Callee side instead of the Caller
- Update: language/src/locatevc.bat - Support VS 2022

WHAT IS NEW IN RING 1.18

In this chapter we will learn about the changes and new features in Ring 1.18 release.

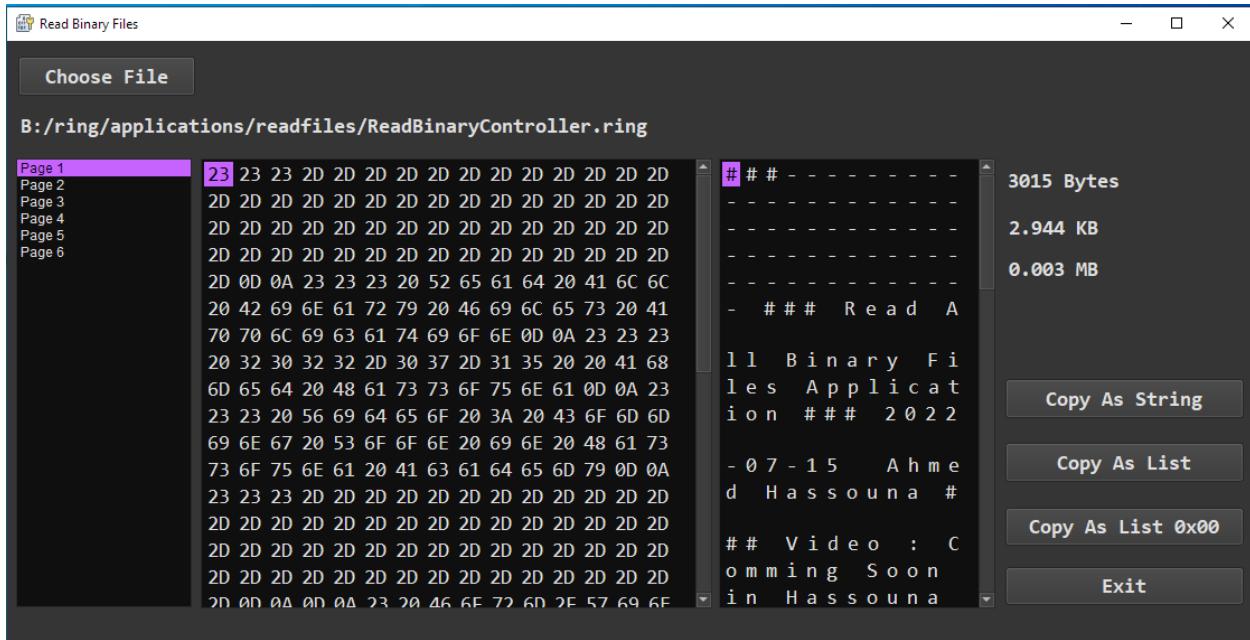
121.1 List of changes and new features

Ring 1.18 comes with the next features!

- Read Files application
- Random User application
- Better CitPre application
- Better Tools
- More Samples
- Syntax Files
- The Power Operator
- Using References
- Ring for MS-DOS
- Faster (For-In) Loop
- Faster BraceError()
- Better RingRayLib
- Better RingSockets
- Heroku (Better support)
- Command: New From
- ImportPackage() function
- More Low Level functions
- Better WebLib
- Better Ring API
- Better Documentation
- MatrixLib Library
- More Improvements

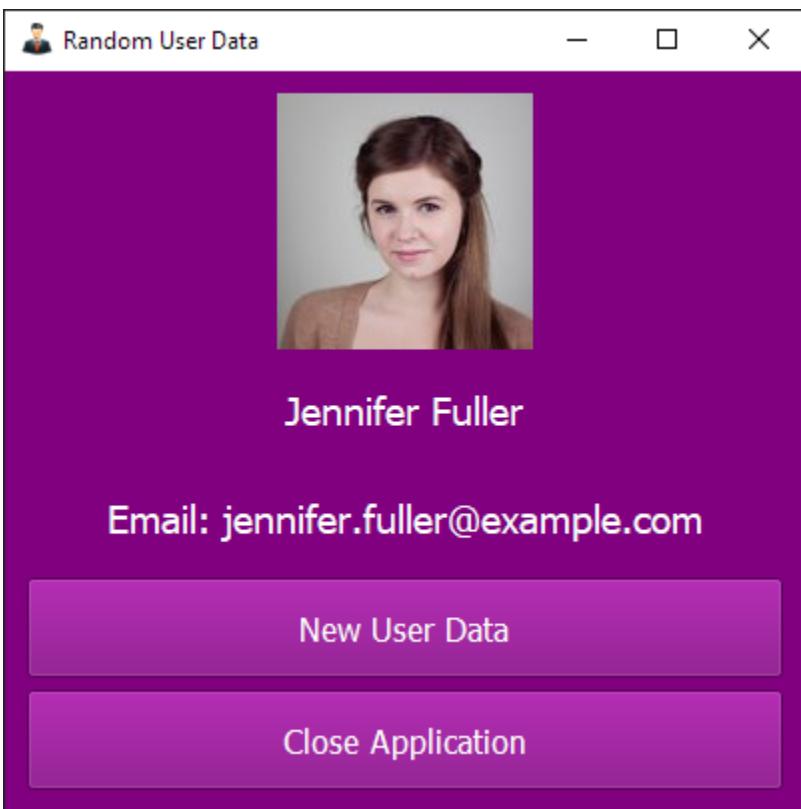
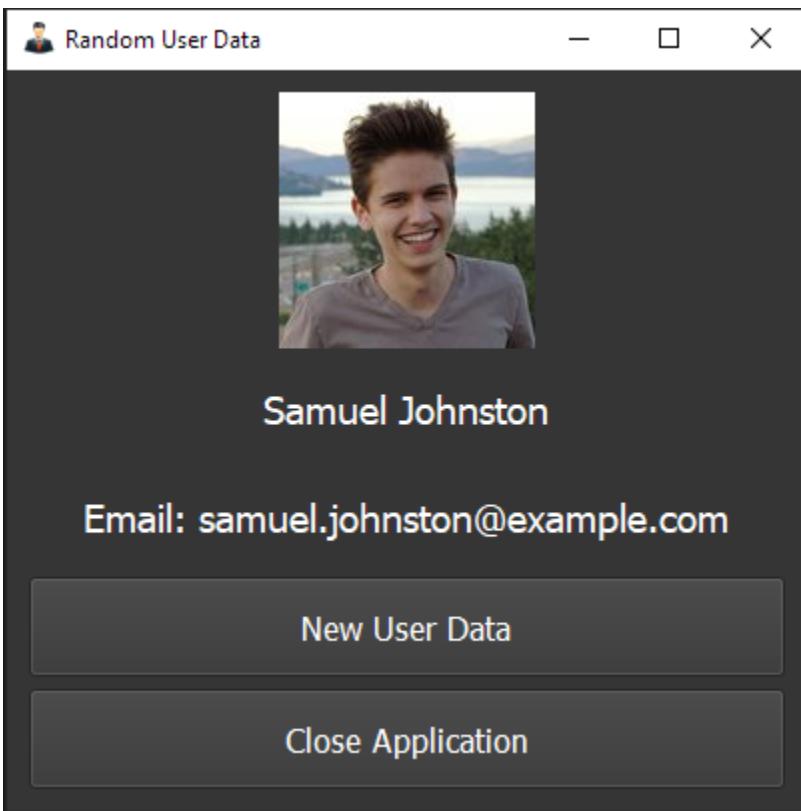
121.2 Read Files application

Using this application we can display text/binary files using Hexadecimal



121.3 Random User application

A simple application as an example about using GUILib, InternetLib & JSONLib



121.4 Better CitPre application

In Ring 1.18 the Citations Prediction application is updated

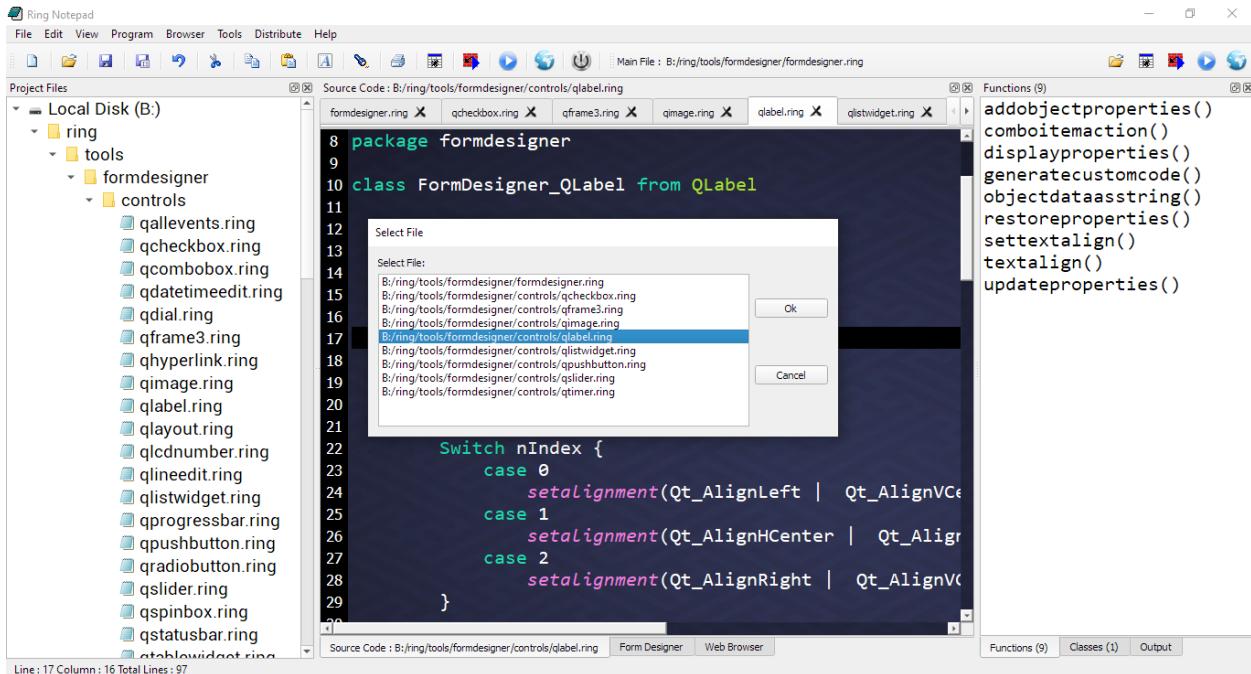
- (1) The application comes with 500 samples
- (2) Journal Paper (HTML): <https://www.hindawi.com/journals/bmri/2022/2239152/>
- (3) Journal Paper (PDF): <https://downloads.hindawi.com/journals/bmri/2022/2239152.pdf>

DataSet Rows				
	Title	Authors	Abstract	Total Citations
49	Blamey, Peter Artieres, ...	Factors Affecting Auditor...	Objective: To update a 15-year-old study of 800 ...	189
50	Snik, AFM Mylanus, EAM ...	Consensus statements...	After more than 25 years of clinical experience, the BAHA ...	190
51	Nadol, JB Shiao, JY Burgess,...	Histopathology of ...	The insertion of an intrascalar electrode array during cochle...	190
52	Papsin, Blake C	Cochlear implantation i...	OBJECTIVES/HYPOTHESIS: To evaluate outcomes after ...	181
53	Pisoni, DB Cleary, M	Measures of working ...	Large individual differences in spoken word recognition ...	183
54	Stakhovskaya, Olga Sridhar, ...	Frequency map for the ...	The goals of this study were to derive a frequency-position ...	186
55	Gstoettner, W Kiefer, J ...	Hearing preservation in ...	Objective-To evaluate the possibility of preservation of low-...	178
56	Robbins, AM Koch, DB ...	Effect of age at cochlear...	Objectives: To investigate the effect of age at cochlear ...	173
57	Geers, Ann E. Moog, Jean S. ...	Spoken Language Scor...	This study investigated three questions: Is it realistic to expe...	181
58	Kirk, KI Miyamoto, RT Lento, ...	Effects of age at ...	This study examined the effects of age at implantation on the...	183
59	Brown, CJ Hughes, ML Luk, ...	The relationship betwe...	Objective: The objective of this study was to determine the ...	166
60	Kral, Andrej Eggermont, Jos J.	What's to lose and what...	Sensory and environmental manipulations affect the ...	175

121.5 Better Tools

- Ring2EXE: Better code when distributing GUI applications
- Form Designer: Correct drawing for new controls after moving Ring Notepad
- Ring Notepad: Output Window - Correct cursor position while using unicode
- Ring Notepad: Set the default font when opening the Font dialog
- Ring Notepad: Preserve editing history after text insertion
- Ring Notepad: New button to clear the output and stop the running program
- Ring Notepad: Goto Line - Support files contains UTF-8 characters
- Ring Notepad: Find/Replace - Support files contains UTF-8 characters
- Ring Notepad: Avoid hiding the cursor when pressing TAB
- Ring Notepad: Reset the dockable window title when closing all opened files
- Ring Notepad: Translation files (English/Arabic)
- Ring Notepad: New option to build GUI application using Ring2EXE
- Ring Notepad: View menu - Navigate options

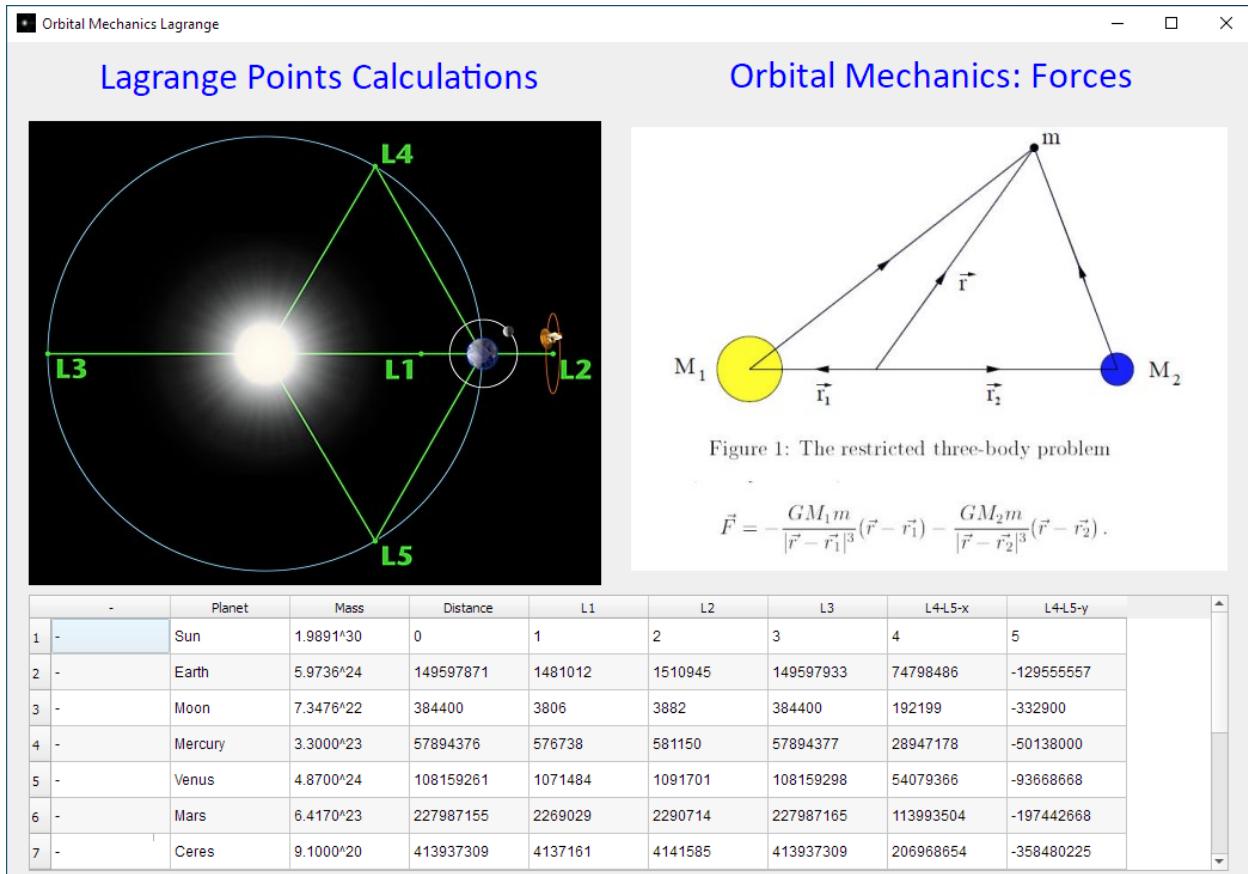
- Ring Notepad: View menu - Apperance options (Checkboxes)
- Ring Notepad: Check if we have web application before running
- Ring Notepad: Better icon for closing the application
- Ring Notepad: Select file window (Quick navigation between opened files)



121.6 More Samples

- Added: samples/General/OrbitalMechanics
- Added: samples/UsingBingChat (Code generated by AI)
- Added: samples/General/QuizMarks/QuizMarks.ring
- Added: samples/UsingQt/TabActivate/simpleExample.ring
- Added: samples/UsingQt/TabActivate/TabActivateController.ring
- Added: samples/UsingFormDesigner/centerwindow
- Added: samples/AQuickStart/MySQL/mysql11.ring
- Added: samples/UsingQt3D/ex19_sceneKeyboard.ring
- Added: samples/Algorithms/path_finding_bfs_usingref.ring
- Added: samples/General/SmallExamples/Random/random100.ring
- Added: samples/General/SmallExamples/Conjecture/knuthconjecture.ring
- Added: samples/General/SmallExamples/SendMoreMoney/SendMoreMoneyMonteCarlo.ring
- Added: samples/General/SmallExamples/MatrixMulti/Matrix-Func.ring
- Added: samples/UsingFreeGLUT/test17.ring, test18.ring & test19.ring
- Added: samples/ProblemSolving/Cryptogram/Cryptogram.ring

- Added: samples/UsingArabic/ArabicSyntax
- Added: samples/UsingQt/Painter/test.ring & test2.ring
- Added: samples/UsingJSONLib - From test5.ring to test9.ring
- File: samples/AQuickStart/GUILib/gui44.ring - Better Code
- File: samples/UsingWebLib/Demo/datalib.ring - Better Code
- File: samples/UsingWebLib/Demo/bootstrap.ring - Better Code
- File: samples/UsingStbImage/test2.ring - Better Code
- Folder: samples/UsingLibSDL - Better Code



121.7 Syntax Files

Ring 1.18 provide another step towards better syntax flexibility

- Support running source code files with any extension
- Automatic loading for (ringsyntax.ring) file that exist in the current folder

For example in the the next screen shot

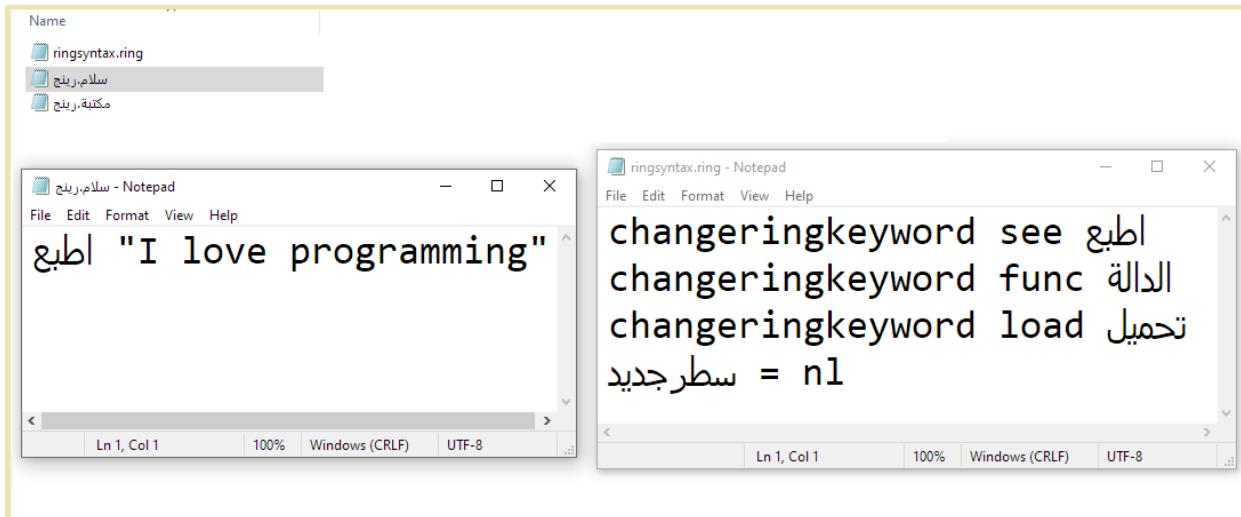
We have (ringsyntax.ring) that translate some of the Ring keywords to Arabic language

When we execute the file with Arabic name which means in English (hello.ring)

Ring will automatically execute (ringsyntax.ring) using Load Syntax command

Each Folder in the program could have it's optional (ringsyntax.ring) file

We can mix styles in the same project



121.8 The Power Operator

Ring 1.18 Support (***) and (^^) as the power operator

Example:

```
? 3***4          # 81.00
? 3^^4          # 81.00
? 256^^^(1/4)   # 4
? 3.4^^4.5      # 246.41
? 256^^^(1/3)   # 6.35
? 129.6^^^(1/5) # 2.65
? 5.9736*(10^^6) # 5973600.00
? 7.3476*(10^^(-5)) # 0.0000734760
```

121.9 Using References

Ring as a language is designed to reduce references usage

The assignment operator (=) copy lists/objects by value

This release comes with the next functions to create and use managed references

```
ref(aList|oObject)    ---> aList|oObject (Reference) # Short name
reference(aList|oObject) ---> aList|oObject (Reference) # Long name
refcount(variable) ---> Number (References Count)
```

Example:

```
aList = [ 10,20,30, ref(aList) ]      # Circular Reference
? aList[4][1]                          # Print 10
```

(continues on next page)

(continued from previous page)

```
? aList[4][4][4][4][4][2]          # Print 20
? refcount(aList)                 # Print 2
```

We added this feature to use Ring in teaching Data Structures & Design Patterns.

Check the chapter (Using References) to learn more about using this feature!

121.10 Ring for MS-DOS

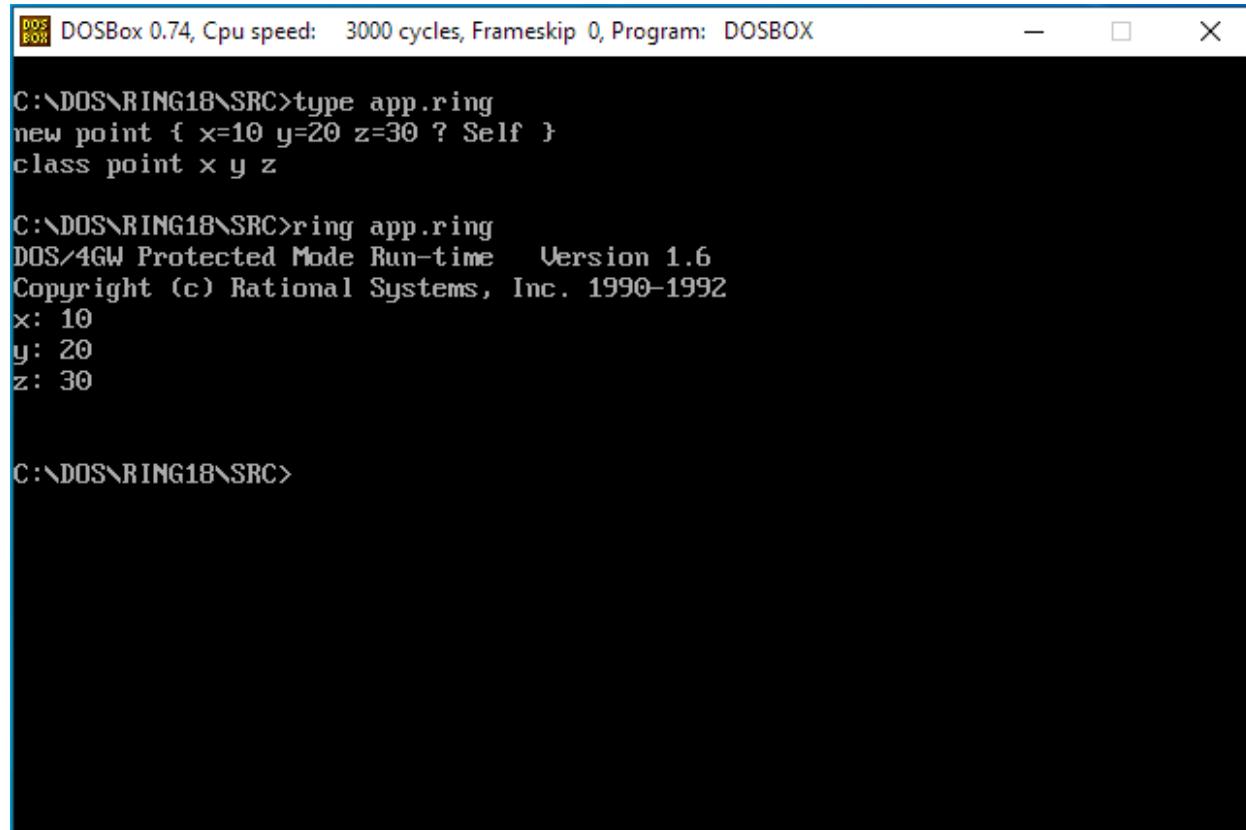
Starting from Ring 1.18, We can build Ring Compiler/VM on MS-DOS

Tested using

- Watcom C 386 9.01 (1992)
- Borland C 3.1 (1992)
- DOSBox-x 0.83.22 (2022)
- DOSBox 0.74

Tip: We use Watcom C 386 as our formal compiler on this platform

Note: Ring uses DOS/4GW (32-bit DOS extender) to eliminate the 640 KB conventional memory limit



The screenshot shows a DOSBox window running on MS-DOS. The window title bar reads "DOSBox 0.74, Cpu speed: 3000 cycles, Frameskip 0, Program: DOSBOX". The command prompt is at the top: "C:\DOS\RING18\SRC>". The user types "type app.ring" which outputs the following Ring code:

```
new point { x=10 y=20 z=30 ? Self }
class point x y z
```

Then, the user runs "ring app.ring" which outputs:

```
DOS/4GW Protected Mode Run-time Version 1.6
Copyright (c) Rational Systems, Inc. 1990-1992
x: 10
y: 20
z: 30
```

The command prompt returns to "C:\DOS\RING18\SRC>".

121.11 Faster (For-In) Loop

The (For-In) Loop implementation is revised in Ring 1.18

It's six times (6x) faster than Ring 1.17

Example:

```
aList = list(1_000_000)
t1 = clock()
for x in aList
next
t2 = clock()
? (t2-t1)/clockspersisecond()
```

Time using Ring 1.18: 0.4 second

Time using Ring 1.17: 2.6 seconds

Tip: The normal (For Loop) is faster than (For-In Loop) by 25%

Example:

```
aList = list(1_000_000)
t1 = clock()
for t=1 to 1_000_000
    x = aList[t]
next
t2 = clock()
? (t2-t1)/clockspersisecond()
```

Time using Ring 1.18: 0.28 second

Time using Ring 1.17: 0.28 second

121.12 Faster BraceError()

Using BraceError() we can handle errors that happens inside braces

In Ring 1.18 - Calling BraceError() is faster and we can return values from this method

Example:

```
new points {
    first { x=10   y=20   z=30   }
    second { x=100  y=200  z=300  }
    third { x=1000 y=2000 z=3000 }
    print()
}

class points

aPoints = []
```

(continues on next page)

(continued from previous page)

```

func braceerror
    aPoints + new point
    return aPoints[len(aPoints)]

func print
    ? aPoints

class point x y z

```

Output:

```

x: 10
y: 20
z: 30
x: 100
y: 200
z: 300
x: 1000
y: 2000
z: 3000

```

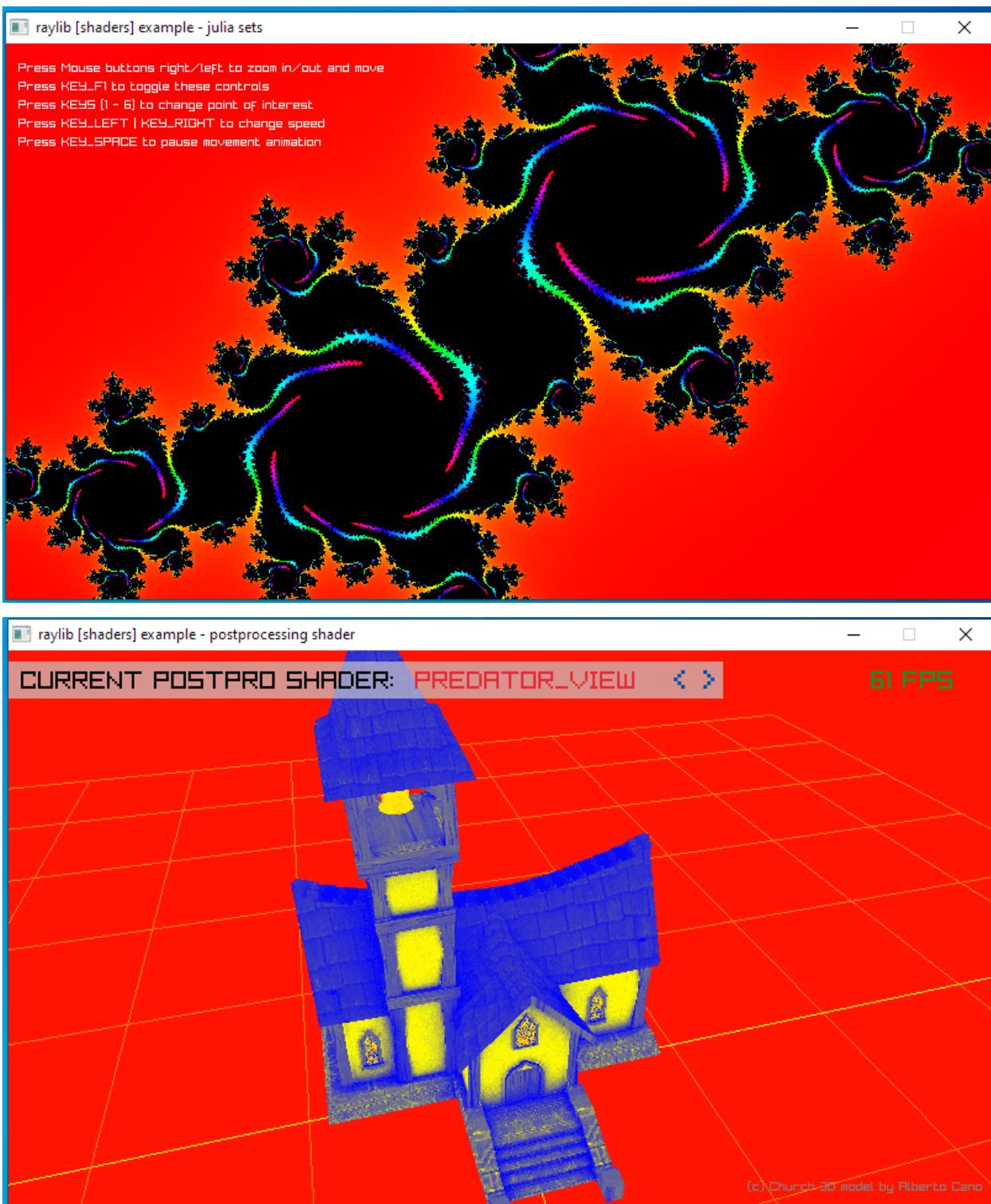
121.13 Better RingRayLib

The next functions are added to the extension

- SetShaderInt(shader, Location, nValue)
- SetShaderFloat(shader, Location, nValue)
- SetShaderVec2(shader, Location, aValue)
- SetShaderVec3(shader, Location, aValue)
- SetShaderVec4(shader, Location, aValue)
- SetShaderIVec2(shader, Location, aValue)
- SetShaderIVec3(shader, Location, aValue)
- SetShaderIVec4(shader, Location, aValue)
- SetModelMaterialShader(model, nID, shader)

The next samples are ported from RayLib to RingRayLib

- ring/samples/UsingRayLib/shader/custom_uniform.ring
- ring/samples/UsingRayLib/shader/julia_set.ring
- ring/samples/UsingRayLib/shader/model_shader.ring
- ring/samples/UsingRayLib/shader/postprocessing.ring
- ring/samples/UsingRayLib/shader/shapes_textures.ring
- ring/samples/UsingRayLib/shader/waves.ring



121.14 Better RingSockets

The next functions are added to the extension

- inet_pton(AdressFamily, IP) -> packed_address
- inet_ntop(AdressFamily, packed_address) -> IP
- socketsCleanup()

121.15 Heroku (Better support)

In Ring 1.18 We updated the packages to use a modern Ring version

The project is tested using Heroku-22 (Ubuntu 22.04)

URL: <https://github.com/ring-lang/RingWebAppOnHeroku>

121.16 Command: New From

Using (new) we can create a new object from a specific class

In Ring 1.18 we have (new from) where we provide a variable which contains the class name

Using this command we can avoid using Eval() for this common case

Example:

```
cClassName = "myclass2"
myobj = new from cClassName

cClassName = "myclass"
myobj = new from cClassName

class myclass
    ? :hello

class myclass2
    ? :wow
```

Output:

```
wow
hello
```

121.17 ImportPackage() Function

Instead of using the import command we can use the importpackage() function

This function get the package name through a string or variable

This is useful if the package name will be known only during the runtime

Syntax:

```
importpackage(cPackageName)
```

Example:

```
importpackage(:mypackage)
new myclass { myfunction() }

package mypackage
  class myclass
    function myfunction
      ? "Hello, World!"
```

121.18 More Low Level Functions

The next functions are added to the Low Level functions

- ringvm_ismempool()
- ringvm_runcode(cCode)

These functions could be helpful for writing tests!

The ringvm_ismempool() tell us if the memory pool still active or not.

The ringvm_runcode(cCode) execute code using Eval() & the Main Loop

See the chapter (Low Level Functions) for more information.

121.19 Better WebLib

(1) HTTP Post - Better Code

(2) Application Class - More Methods:

- Redirect()
- NoJavaScript()

(3) Application Class - Attributes for JavaScript Libraries

- cJSjQueryPath
- cJSBootstrapPath
- cCSSBootstrapPath
- lNoJavaScript

(4) Page Class - More Methods:

- theadStart(aOptions)
- theadEnd()
- tbodyStart(aOptions)
- tbodyEnd()
- tfootStart(aOptions)
- tfootEnd()

(5) WebPage Class - Support (THead, TBody & TFoot)

121.20 Better Ring API

- Added: RING_API_GETFLOATPOINTER(nParameter)
- Added: RING_API_ACCEPTEFLOATVALUE(nParameter)
- Added: RING_API_GETCHARPOINTER(nParameter)
- RING_API_GETINTPOINTER - Better code when passing integer pointer
- RING_API_ISLIST - Don't accept empty strings (NULL) from Ring code
- Sample: extensions/tutorial/integerpointer
- Sample: extensions/tutorial/stringpointer

Example (C Code):

```
#include "ring.h"
#include "stdlib.h"

void changeValue(char *var)
{
    strcpy(var,"Hello from C Code");
}

RING_FUNC(ring_changevalue)
{
    if (RING_API_PARACOUNT != 1)
    {
        RING_API_ERROR(RING_API_BADPARACOUNT);
        return;
    }

    if (!RING_API_ISSTRING(1))
    {
        RING_API_ERROR(RING_API_BADPARATYPE);
        return;
    }

    char *p1 = RING_API_GETCHARPOINTER(1);
    changeValue(p1);
```

(continues on next page)

(continued from previous page)

```

}

RING_LIBINIT
{
    RING_API_REGISTER("changevalue",ring_changevalue);
}

```

Example (Ring Code):

```

? "Loading Library"
loadlib("mylib.dll")

cString = space(100)
changevalue(:cString)
? cString

```

Output:

```

Loading Library
Hello from C Code

```

121.21 Better Documentation

The next chapters are improved!

- (1) Building RingQt applications for Mobile
- (2) Building RingQt applications for WebAssembly
- (3) How to compile Ring from source code?

121.22 MatrixLib Library

Ring 1.18 comes with the MatrixLib library (Contains the Matrix functions).

The source code exist in the ring/libraries/matrixlib folder

The samples exist in the ring/samples/UsingMatrixLib folder

The library comes with the next functions

```

1 MatrixMulti(A,B)           // Exists, aka MatrixMultiply(U,V)
2 MatrixTrans(A)             // Exists, aka MatrixTranspose(U)
3 MatrixPrint(U)
4 MatrixFlatPrint(U)
5 DotProduct(U,V)
6 MatrixAdd(U,V)
7 MatrixSub(U,V)
8 ScalarMultiply(k,U)
9 VectorAngle(U,V)
10 CrossProduct(U,V)
11 MatrixCofactor(U)

```

(continues on next page)

(continued from previous page)

```

12 MatrixAdjoint(U)
13 MatrixInverse(U)
14 MatrixDetCalc(U)          // Calls MatrixDeterminantReduce(U)
15 MatrixDeterminantReduce(U) // Any 2x2 to 10x10 Recursive
16 Determinant(U)           // Calls 16a-16e Determinant2x2,3x3,4x4,5x5,6x6
17 MatrixProjection(U,V)    // ProjvU = (U.V)/(V.V)xV
18 MatrixOrthoDistance(U,V)
19 VectorLength(U)
20 VectorNorm(U)            // Same as VectorLength - different name
21 VectorUnit(U)            // Vector Norm to a Unit Matrix
22 VectorDistance(U,V)
23 MatrixOrthoNormal2(U,V)   // Gram-Schmidt method for 2 Vectors in R2 Space
24 MatrixOrthoNormal3(V1,V2,V3) // Gram-Schmidt method for 3 Vectors in R3 Space
25 MatrixLuDecompose(U)     // LU Decompose Matrix to Lower and Upper Matrix
26 SyntheticFactor(Eq)      // Find Factors of Quartic Equation
27 SyntheticDiv(Eq,Factors) // Synthetic Division using Factors
28 QuadSolve(Eq)            // Quadratic equation solve format x^2 + x + c
29 CubicSolve(Eq)           // Cubic equation solve format x^3 + x^2 + x + c
30 QuarticSolve(Eq)         // Solve Quartic equation format x^4 + x^3 + x^2 + x + c
31 QuinticSolve(Eq)         // Solve Quintic equation format x^5 x^4 + x^3 + x^2 + x
31 PolyMultiply(A,B)        // Polynomial Multiple [A]*[B] ascending powers left to right
32 PolyAdd(A,B)             // Polynomial Add [A]+[B] ascending powers left to right
33 PolySub(A,B)             // Polynomial Subtract [A]-[B] ascending powers left to right
34 CharEquation(N)          // Characteristic Polynomial of 4x4 Matrix
34 EigenValueN)             // Find EigenValues 2x2, 3x3, 4x4 Matrix
35 EigenVectors(A)          // Find EigenVectors 2x2, 3x3 Matrix

```

121.23 More Improvements

- NaturalLib - RunString() Method - Ignore braces inside commands
- FindInFiles Application: Better Code (Check Read() function output)
- GetQuotesHistory Application: Better Style
- Chess/Checkers Games: Looks more nice on small screen resolutions
- KnightTour Game: Avoid unnecessary invalid move message
- Tessera Game: Add the window icon
- SpaceShooter Game - Added: applications/spaceshooter/Resources.ring
- StdLib - Tree Class - Use the ref() function
- StdLib - Matrixmulti() function - Better Code
- StdLib - Added: Reduce() function
- RingAllegro: Use Allegro 5.2.8 instead of Allegro 5.2.7.1
- RingSQLite: Use SQLite 3.39.2.
- RingHTTPLib: Use cpp-httplib 0.10.9

- RingZip: Use zip 0.2.4
- RingCJSON: Update the CJSON version
- RingCJSON: Better support for arrays and nested arrays
- RingQt: Added QTextOption class
- RingQt: Set the environment variable QT_QPA_PLATFORM_PLUGIN_PATH
- RingQt: QMediaPlayer Class - Remove currentNetworkConfiguration() Method
- RingQt: QString2 Class - Added lastIndexOf() method
- RingQt: RingCodeHighlighter Class - Added setUseDefaultKeywords() Method
- RingQt: RingCodeHighlighter Class - Added setCustomKeywords() Method
- Ring Functions - SetEnv()/UnSetEnv() - Better Code
- Ring Functions - Print()/Puts() - Better Code
- Ring Functions - Eval() - Better Code
- Ring Compiler/VM Source Code - Better File Names
- Ring Compiler/VM Source Code - Define RING_MSDOS
- Ring Compiler/VM Source Code - Many structures updated to use unsigned int/char
- Ring Compiler/VM Source Code - Added: vmerror.c, vmeval.c & vmthreads.c
- Ring Compiler/VM Tests - Better names for output files
- Support building Ring on windows using Tiny C Compiler
- Ring Object File - Better support for classes that exist inside packages
- Ring Compiler - Support larger number of function/method parameters
- Ring Compiler - ring_parser_epsilon() function - Better Code
- Ring Compiler - Support running source code files with any extension
- Ring VM - Memory Functions - Display the size when the memory allocation fail
- Ring VM - Support calling private methods from the class region
- Ring VM - Fixed count for ByteCode items for the ICO_FUNC instruction
- Ring VM - Better code for dynamic change between function/method calls inside braces
- Ring VM - Check string range when we access strings after calling functions directly
- Ring VM - Get pointer as string when we access the pointer address
- Ring VM - Don't create more than one temp. list per VM instruction
- Ring VM - Using RING_VM_IR_GETLINENUMBER & RING_VM_IR_SETLINENUMBER(x)
- Ring VM - Faster code when creating new threads
- Ring VM - Better numbers format when printing lists and objects
- Ring VM - Range Operator - return list reference instead of a copy
- Ring VM - Pointer2Object() function - return list/object reference instead of a copy
- Ring VM - ObjectID() function - Support Lists too
- Ring VM - Increase the Stack size to 1K

- Ring VM - Error System - Display recursion depth
- Ring VM - ICO_FREESTACK instruction - Don't delete temp. lists in global scope
- Ring VM - ICO_FREEEMPLISTS instruction - Delete temp. lists in global scope (Thread Safe)
- Ring VM - ICO_SETSCOPE instruction - Better implementation
- Ring VM - List Functions - Using (unsigned int) for the list index & size
- Ring VM - Using Braces - Save/Restore the State - Better Code
- Ring VM - Divide Operator - Display error message - Better Code
- Ring VM - Try/Catch/Done - Better code for memory management
- Ring VM - Using lists during definition - Protect the list (Prevent deleting it)
- Ring VM - The default RING_POOLMANAGER_ITEMSIZE value is 40 (instead of 64)
- Ring VM - Better code when loading the VM instructions (Uses less memory)
- Ring VM - Max. parameters for each VM instruction is three (3)
- Ring VM - New instruction: ICO_EXTRAPARA (For instructions that need more parameters)
- Ring VM - Delete the Intermediate Code list after having the Byte Code
- Ring VM - Better format when displaying the Byte Code
- Ring VM - Memory defragmentation before Byte Code execution

WHAT IS NEW IN RING 1.19

In this chapter we will learn about the changes and new features in Ring 1.19 release.

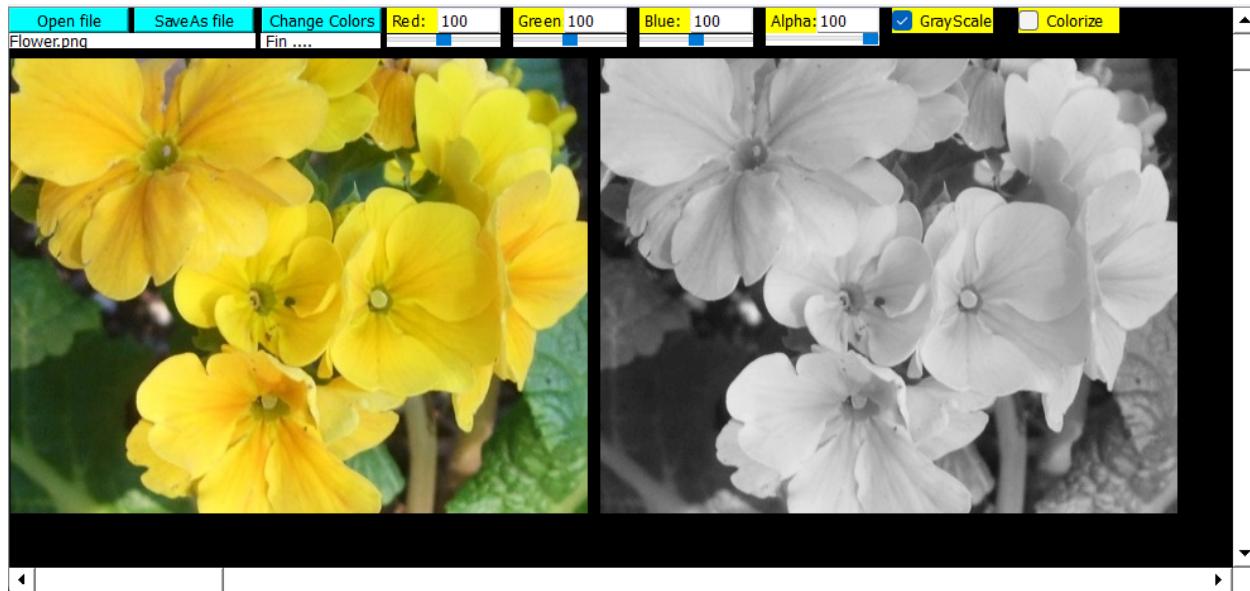
122.1 List of changes and new features

Ring 1.19 comes with the next features!

- Image Pixel application
- Hours Counter application
- Planetary Orbits application
- Listen to Quran application
- More Samples
- Ring for Windows 64bit
- Better batch files for building Ring
- For Loop - Better Performance
- Calling Functions - Better Performance
- Using Objects During Definition
- Nothing() function
- OptionalFunc() function
- ParentClassName() function
- FastPro Extension
- Better TypeHints
- Better RingRayLib
- Better RingStbImage
- Better Extensions Generator
- Better Documentation
- More Improvements

122.2 Image Pixel application

An example about processing an image pixels.



122.3 Hours Counter application

This is a simple calculator for teaching hours

Teaching Hours Counter

Select Type:

Type	Count	Hours
1 Undergraduate - Lecture	0	0
2 Undergraduate - Exercise	0	0
3 Undergraduate - Lab	0	0
4 Undergraduate - Project 1	0	0
5 Undergraduate - Project 2	0	0
6 Master - Lecture	0	0
7 Master - Project 1	0	0
8 Master - Project 2	0	0
9 Master - Research Plan	0	0
10 Master - Thesis	0	0
11 PhD - Lecture	0	0
12 PhD - Independent Study 1	0	0
13 PhD - Independent Study 2	0	0
14 PhD - Research Plan	0	0
15 PhD - Thesis	0	0

Hours: 0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

0 ..

AddHours

Undergraduate (Lectures, Exercise and Labs): 0

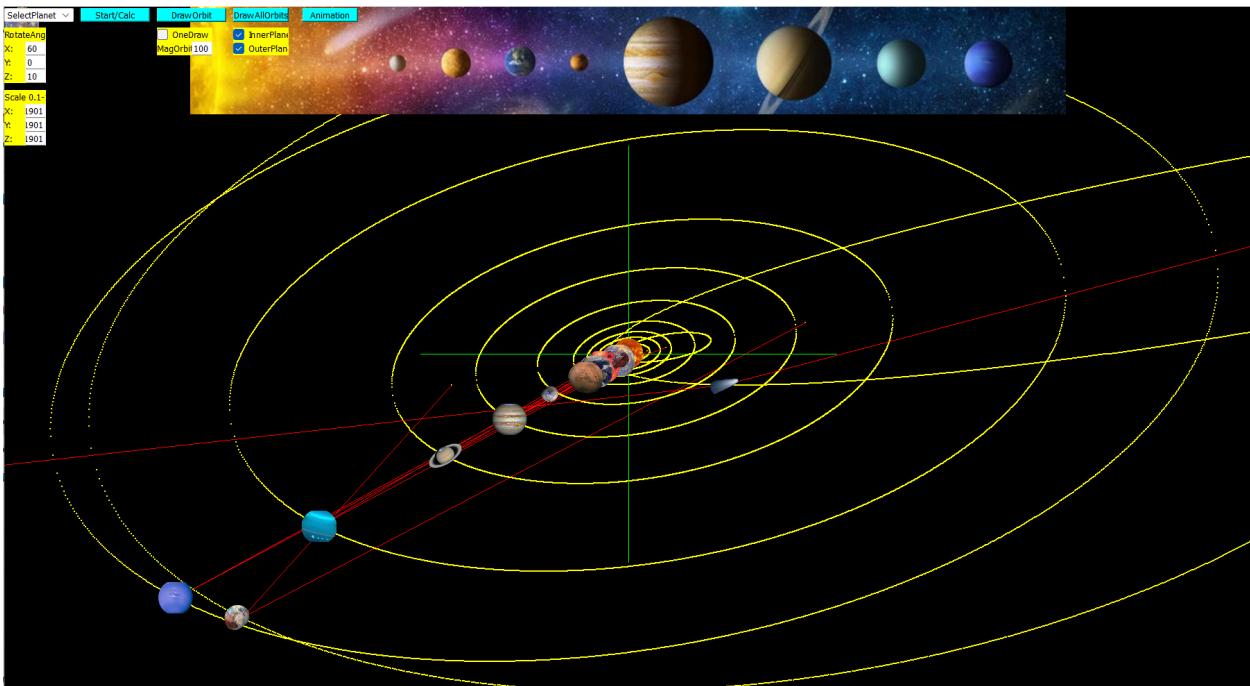
Total Hours: 0

Reset (Clear Data)

Close Application

122.4 Planetary Orbits application

An example about drawing and using the Matrix library

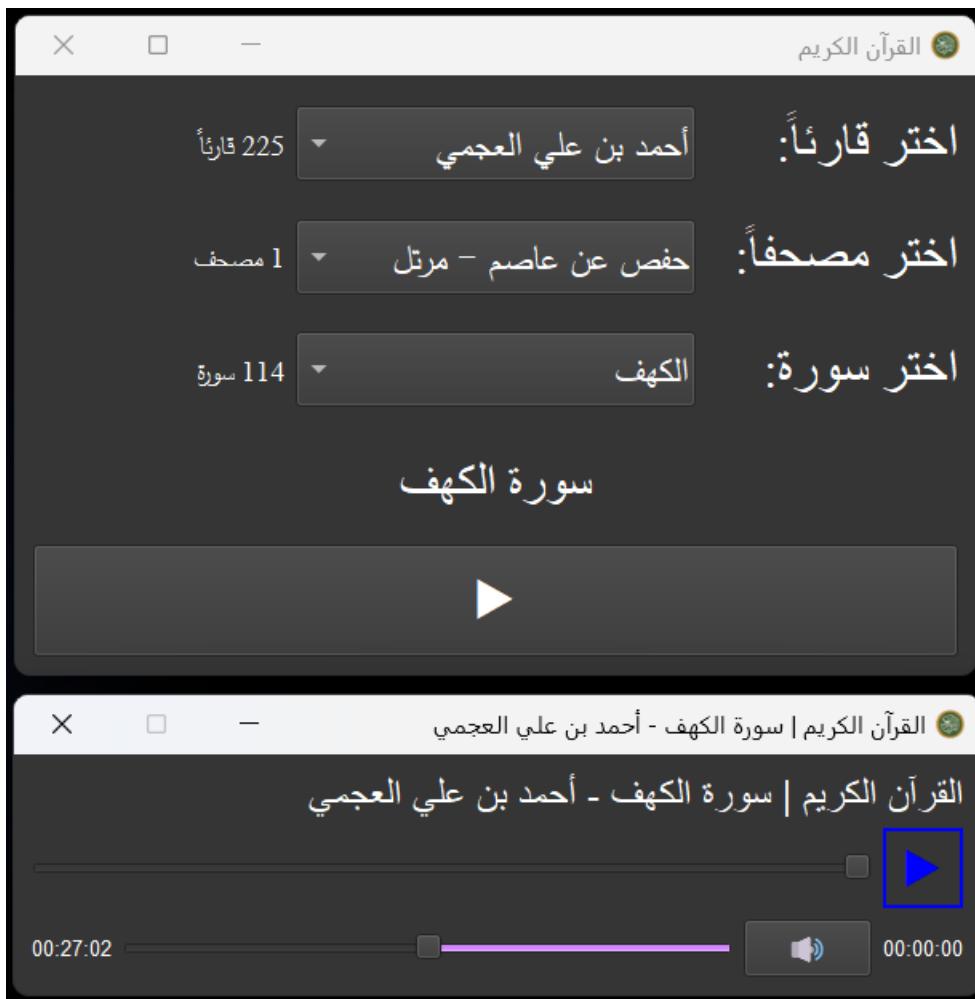


122.5 Listen to Quran application

Arabic application that can be used to listen to Quran.

We can install and run the application using the Ring Package Manager (RingPM).

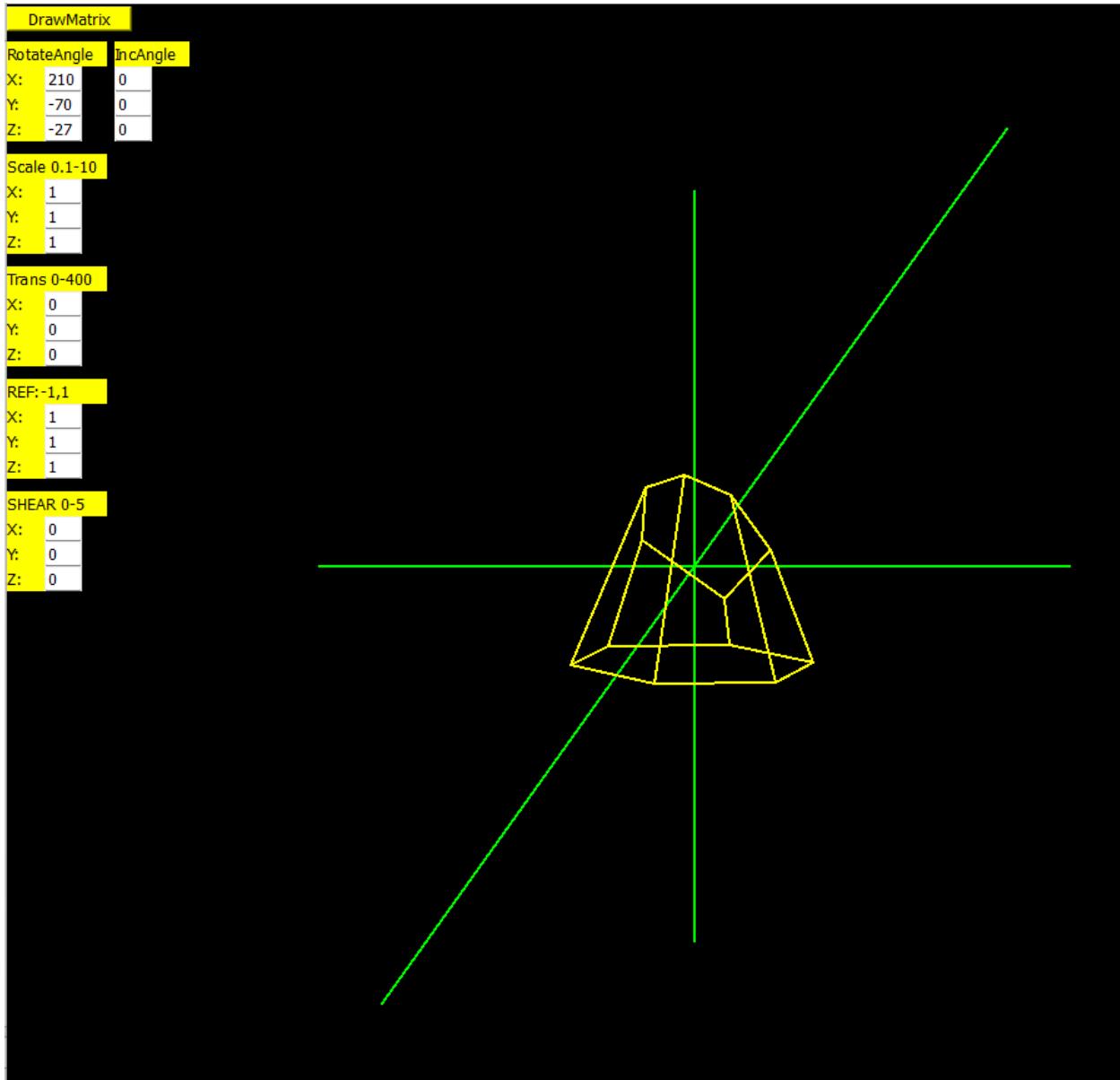
```
ringpm install listentoquran
ringpm run listentoquran
```



122.6 More Samples

- Added: samples/UsingFastPro
- Added: samples/Language/Constants
- Added: samples/UsingTypeHints/test6.ring
- Added: samples/UsingQt/CustomDragAndDrop/customdraganddrop.ring
- Added: samples/UsingQt/PrintPreview/simplereport.ring
- Added: samples/UsingArabic/ArabicInCommandPrompt/DisplayArabic.ring
- Added: samples/UsingMatrixLib/59-Matrix-Transform-Draw-Rotation.ring
- Added: samples/UsingRayLib/more/ex5_wavingcubes_withoutthreads.ring
- Added: samples/Language/OptionalFunc/Question.ring
- Added: samples/Language/OptionalFunc/Answer.ring
- Added: samples/General/Performance/emptyloop.ring
- Added: samples/General/Performance/print.ring

- Added: samples/General/Performance/math.ring
- Added: samples/General/Performance/createlists.ring
- Added: samples/General/Performance/len.ring
- Added: samples/General/Performance/methods.ring
- Added: samples/General/Performance/manylistitems.ring
- Added: samples/General/Performance/search.ring



122.7 Ring for Windows 64bit

Starting from Ring 1.19 we provide 64bit version of Ring for Windows.

This provide access to more memory. Also, most of our tests indicates an increase of performance from 15% to 25%

This increase of performance is measured when we compare Ring 1.19 (32bit) and Ring 1.19 (64bit)

This is different from comparing Ring 1.19 (32bit) and Ring 1.18 (32bit) to see how much the new release is faster

122.8 Better batch files for building Ring

Using ring/buildvc.bat and ring/buildvc_x64.bat we can build everything (Ring Compiler/VM, Extensions, Tools, etc.) for Windows 32bit or 64bit

Ring comes with all of the dependencies except Qt

These batch files assume that we have Qt 5.15.16 (We can change the used Qt 5.15 version using the environment variables).

122.9 For Loop - Better Performance

The For Loop in Ring 1.19 is three times (3x) faster than Ring 1.18.

Tested using Victus Laptop [13th Gen Intel(R) Core(TM) i7-13700H, Windows 11]

Example:

```
t1= clock()
for t=1 to 100_000_000 next
t2 = clock()
? (t2-t1)/clocksperssecond()
```

Time using Ring 1.18 (32bit) : 3.78 seconds

Time using Ring 1.19 (32bit) : 1.31 seconds

Time using Ring 1.19 (64bit) : 1.12 seconds

122.10 Calling Functions - Better Performance

Calling functions written in Ring code in Ring 1.19 is three times (3x) faster than Ring 1.18.

While calling functions written in C code in Ring 1.19 is four times (4x) faster than Ring 1.18.

Example:

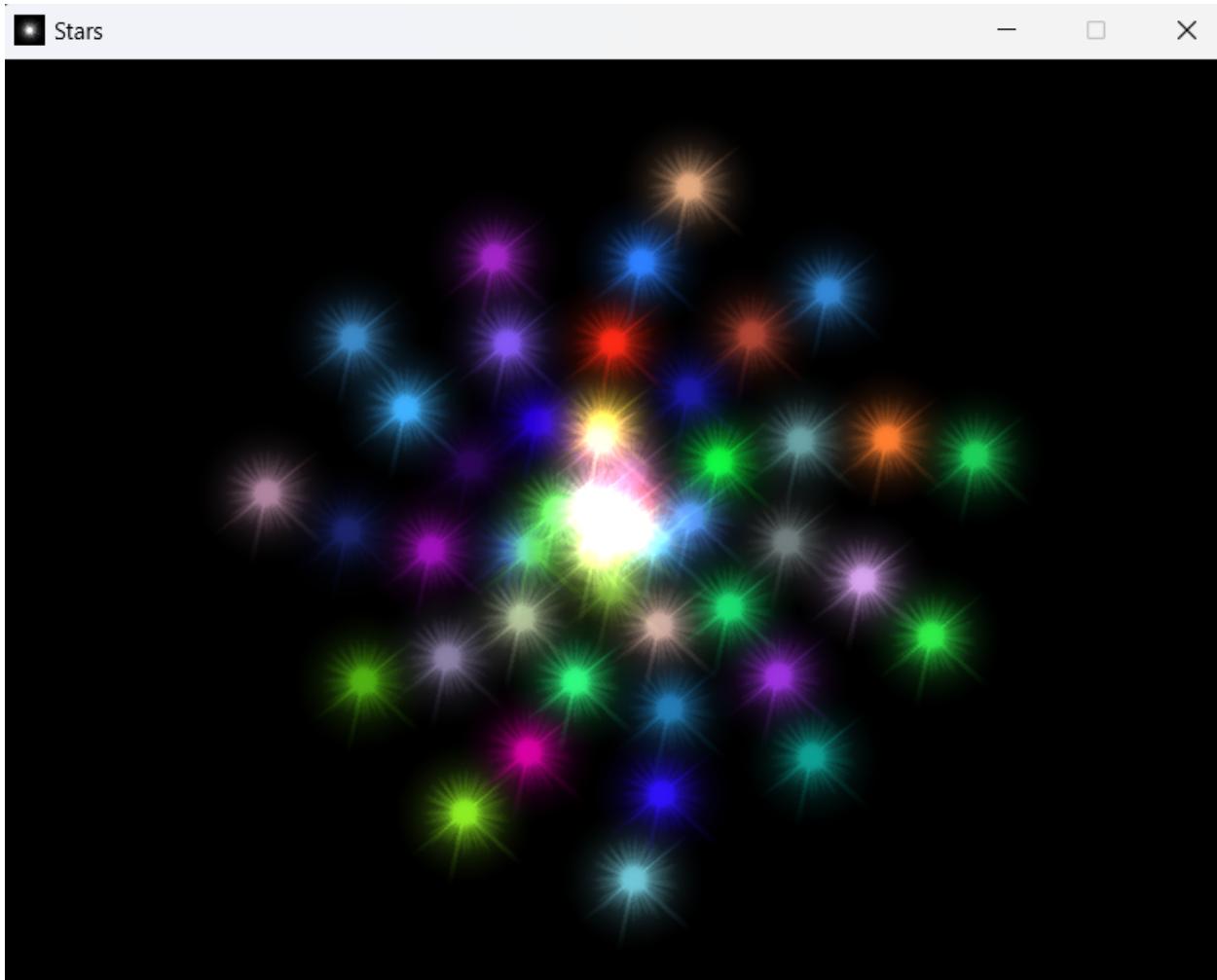
```
t1=clock()
for t=1 to 1_000_000
    result = max(t,t*2)
next
? result
t2 = clock()
? (t2-t1)/clocksperssecond()
```

Time using Ring 1.18 (32bit) : 1.45 seconds

Time using Ring 1.19 (32bit) : 0.32 seconds

Time using Ring 1.19 (64bit) : 0.25 seconds

These improvements let the Stars animation sample works at 2350 FPS in Ring 1.19 instead of 500FPS in Ring 1.18



122.11 Using Objects During Definition

This release provides better support for using objects during definition where we can mix between this feature and other features like operator overloading without missing the output

Example:

The screenshot shows a Ring IDE interface with two panes. The left pane contains a list of variables:

```

OBJECT
x: 10
y: 20
z: 30

NUMBER
11

```

The right pane shows a script named "Test.ring" with the following code:

```

1 myVar = new Point { x=10 y=20 z=30 print(myVar) } + 1
2 ? Type(myVar)
3 ? myVar
4 ? myVar
5
6 class point x y z func print oObj ? Type(oObj) ? oObj
7     func operator cOp,vValue
8         if cOp = "+" return x + vValue ok

```

- The new point object will be stored directly in myVar during definition
- We can pass myVar as parameter to the print() method
- Using + 1 will call the operator() method
- The operator() method output will be stored in myVar

This means that the Assignment operation is executed TWO TIMES!

The first Assignment is executed to support (Using objects during definition) where myVar is an object contains the new point while in the second time, the Assignment is executed to support storing the Operator Overloading output.

Note: RingQt samples uses this feature to quickly pass the parent window object to the other widgets.

122.12 Nothing() function

This function does nothing and can accept any number/type of parameters. The output will be Zero.

Some of the Use Cases

- (1) Performance measurements, where we can test the performance of calling functions written in C and we can change the number of parameters during tests.
- (2) In places of code that you want to write a function name, and it's not defined yet.
- (3) To disable some feature/code by just changing the function name to nothing without changing the parameters or commenting the code.
- (4) In small programs, where you want to write a function that you can override from a Test program.

122.13 OptionalFunc() function

Using this function we can define functions similar to Nothing() but with a different name.

Syntax:

```
OptionalFunc(cFunctionName)
```

Example:

File: Question.ring

```
optionalFunc(:reply)
? "I love Programming, What about you?"
reply()
? "Ok, Thanks!"
```

Output:

```
I love Programming, What about you?
Ok, Thanks!
```

File: Answer.ring

```
load "Question.ring"

func reply
    ? "Me too!"
```

Output:

```
I love Programming, What about you?
Me too!
Ok, Thanks!
```

122.14 ParentClassName() Function

We can know the parent class name of an object using the parentclassname() function

Syntax:

```
parentclassname(object) --> Returns the parent class name of the object class
```

Example:

```
new Child { test() }
class Parent

class Child from Parent
    func test
        ? "Parent: " + parentClassName(self)
```

Output:

```
Parent: parent
```

122.15 FastPro Extension

This new extension comes with the next functions

- Bytes2List(cBytes,nWidth,nHeight,nChannels) —> aList // [[R,G,B],...]
- List2Bytes(aList,nChannels) —> cBytes // “RGBA....”
- updateList(aList,cCommand,cSelection,nPara1,[nPara2],[nPara3])
- updateColumn(aList, [cCommand,nPara1,[nPara2],[nPara3]],...)
- updateBytesColumn(cBytes, nColumns, nCount, nDiv, [cCommand,nPara1,nPara2,[nPara3]],...) —> cNewBytes
- addBytesColumn(cBytes, nColumns, nCount) —> cNewBytes

Using the updateColumn() function we can update the list columns in one function call

We have a similar function called updateBytesColumn() that process bytes directly instead of using Bytes2List() and List2Bytes() functions.

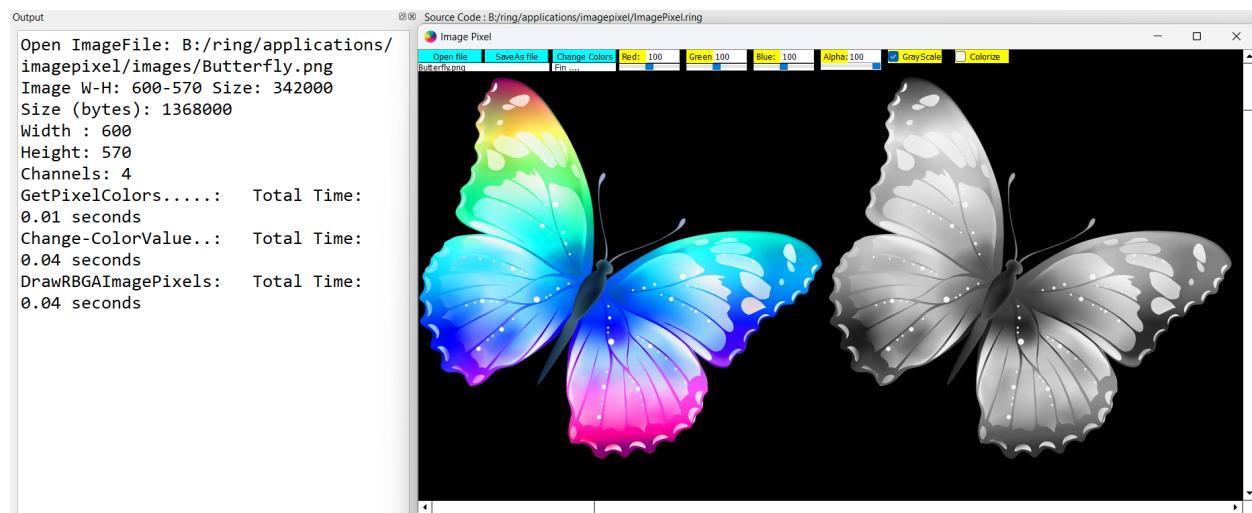
Example from the ImagePixel application that convert the image to Gray

```

384 //=====
385 // GRAY SCALE -- Display Color RGB in GRAY Scale
386 // Average looks better brighter than Gamma Corrected
387 // Color corrected is for eye sensitivity Red 30%, Green 59% Blue 11%.
388
389 elseif lGray
390
391     MCOrig = updateBytesColumn(MCOrig,nImageChannels,nImageWidth*nImageHeight,255,
392                                 :mul,RVALUE,0.3,           # R *= 0.3
393                                 :mul,GVALUE,0.59,          # G *= 0.59
394                                 :mul,BVALUE,0.11,          # B *= 0.11
395                                 :merge,RVALUE,GVALUE,      # R += G
396                                 :merge,RVALUE,BVALUE,      # R += B
397                                 :copy,RVALUE,GVALUE,       # G = R
398                                 :copy,RVALUE,BVALUE)        # B = R
399
400 ok
401

```

This also provides better performance compared to calling updateList() many times.



122.16 Better TypeHints

Added the next definitions:

- Byte
- Boolean
- @override

Example:

```
load "typehints.ring"

o = new MyNewLib {
    ? isGreaterThanTwo(10)
    ? isGreaterThanTwo(1)
}

class MyLib {
    boolean func isGreaterThanTwo(int x) {
        if x > 2
            return true
        else
            return false
        ok
    }
}

class MyNewLib < MyLib {
    @override
    boolean func isGreaterThanTwo(int x) {
        ? "Using override"
        return x > 2
    }
}
```

Output:

```
Using override
1
Using override
0
```

122.17 Better RingRayLib

The next functions are added to the RingRayLib extension

```
* vec2() --> Vector2
* vec2set(Vector2 vec,double x,double y)
* vec2getx() --> double
* vec2setx(double)
* vec2gety() --> double
```

(continues on next page)

(continued from previous page)

```
* vec2sety(double)
* vec3() --> Vector3
* vec3set(Vector3 vec,double x,double y,double z)
* vec3getx() --> double
* vec3setx(double)
* vec3gety() --> double
* vec3sety(double)
* vec3getz() --> double
* vec3setz(double)
* vec4() --> Vector4
* vec4set(Vector4 vec,double x,double y,double z,double w)
* vec4getx() --> double
* vec4setx(double)
* vec4gety() --> double
* vec4sety(double)
* vec4getz() --> double
* vec4setz(double)
* vec4getw() --> double
* vec4setw(double)
* getcamera3dposx() --> double
* setcamera3dposx(double)
* getcamera3dposy() --> double
* setcamera3dposy(double)
* getcamera3dposz() --> double
* setcamera3dposz(double)
* getcamera3dtarx() --> double
* setcamera3dtarx(double)
* getcamera3dtary() --> double
* setcamera3dtary(double)
* getcamera3dtarz() --> double
* setcamera3dtarz(double)
* getcamera3dupx() --> double
* setcamera3dupx(double)
* getcamera3dupy() --> double
* setcamera3dupy(double)
* getcamera3dupz() --> double
* setcamera3dupz(double)
* getcamera3fovy() --> double
* setcamera3fovy(double)
* getcamera3type() --> double
* setcamera3type(double)
```

122.18 Better RingStbImage

The extension is improved to support the next features

- Support UTF-8 file names on Windows
- Added functions for writing images

```
int stbi_write_png(char const *filename, int w, int h, int comp, const void *data, int ↴
→stride_in_bytes)
int stbi_write_bmp(char const *filename, int w, int h, int comp, const void *data)
int stbi_write_tga(char const *filename, int w, int h, int comp, const void *data)
int stbi_write_jpg(char const *filename, int w, int h, int comp, const void *data, int ↴
→quality)
void stbi_flip_vertically_on_write(int flag)
```

Also, When using Strings that contains bytes, we supported updating a character using a numeric value which will be converted to (char) without the need to use the Ring char() function.

This provide better performance (3x faster, i.e. 300%) when generating images.

This feature could be used to update the images quickly while treating them as bytes without the need to convert them to Lists.

Example:

```
load "stbimage.ring"

width    = 640
height   = 480
channels = 3
cData    = space(width*height*channels)

? "Creating the image..."
t1 = clock()
nIndex=0
for x=1 to height
    for y=1 to width
        cData[nIndex++] = x*x
        cData[nIndex++] = x*y
        cData[nIndex++] = x*2
    next
next
t2 = clock()

# Write the image
? "Writing mynewimage.bmp"
stbi_write_bmp("mynewimage.bmp", width, height, channels, cData)
t3 = clock()

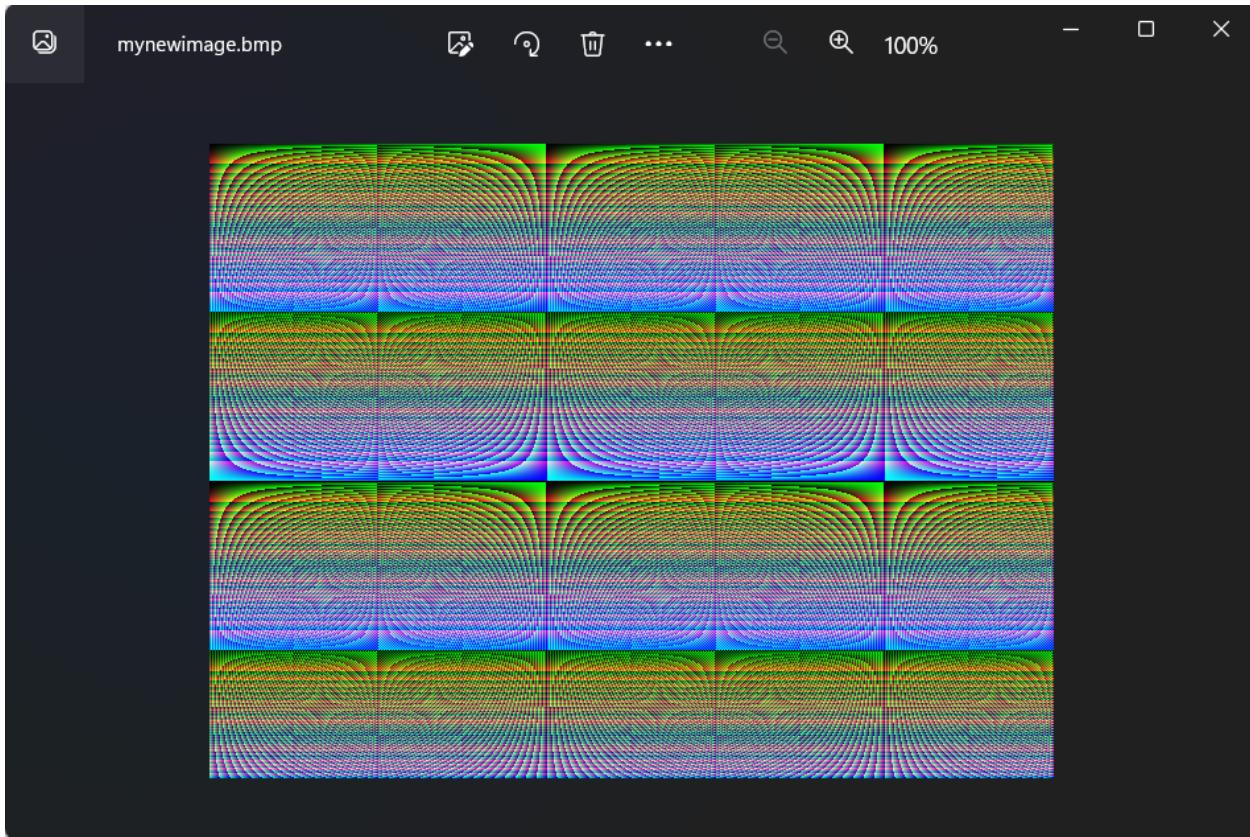
? "Time to create the image : " + ((t2-t1)/clockspersecond()) + " seconds"
? "Time to save the image   : " + ((t3-t2)/clockspersecond()) + " seconds"

system("mynewimage.bmp")
```

Output:

```
Creating the image...
Writing mynewimage.bmp
Time to create the image : 0.12 seconds
Time to save the image : 0.00 seconds
```

Screen Shot:



122.19 Better Extensions Generator

The code generator for C/C++ extensions is updated and support defining extra names for functions

Using the predefined list (aExtraFunctionName) we can define the extra names

Example:

To define vec2() as another name for raylib_new_managed_vector2()

```
<runcode>
aExtraFunctionName + ["vec2","raylib_new_managed_vector2"]
aExtraFunctionName + ["vec2setx","raylib_set_vector2_x"]
aExtraFunctionName + ["vec2sety","raylib_set_vector2_y"]
</runcode>
```

122.20 Better Documentation

The CHM file is updated to support search

We added a new chapter: Using FastPro Extension

Also, The next chapters are revised and improved

- Introduction
- Performance Tips
- Syntax Flexibility
- The Type Hints Library
- Building From Source Code
- Extension using C/C++ languages
- Tutorial: Ring Extensions in C/C++
- Object Oriented Programming (OOP)
- Frequently Asked Questions (FAQ)

122.21 More Improvements

- Ring Notepad - Close Button - Force closing the web browser
- Ring Notepad - Projects Files - Larger width
- FindInFiles application - Replace Button - Check line selection
- WinStartupManager application - Use extensions that comes with Ring
- AnalogClock application - Set the image width to be like the window width
- AnalogClock application - Draw the Clock directly once the window appears
- EightPuzzleGame3D game - Better Code
- SpaceShooter game - Better Code to close the game using the main menu
- Pong2 game - Using CloseAudioDevice()
- SuperMan2016 game - Reset FPS, energy value and player speed
- GoldMagic800 game - Reset FPS and player speed
- Sokoban game - higher speed
- TowersOfHanoi simulation - higher speed
- samples/AQuickStart/ODBC - Better Code
- samples/UsingOpenGL/LevelsOfCubes - Reset FPS
- samples/UsingOpenGL - Set the window icon
- samples/General/TimeServer - Replace RingThreads with GameLib
- samples/UsingQt/Widget/listwidgetitemvalue.ring - Better Code
- samples/UsingOpenGL/stars - Using al_exit() function
- samples/Drawing - Many samples are revised to use the Quit() method

- samples/UsingQt/PrintPreview/printpreivewdialog.ring - Better Code
- extensions/tutorial - filterlist() updated to use ring_list_deleteitem_gc()
- Better Qt3D samples - Use Quit() method when closing the application
- Better RingPostgreSQL samples
- Better RingMySQL sample - samples/AQuickStart/MySQL/mysql7.ring
- Form Designer - Better behavior when displaying the MenuBar editor
- StdLib - OSCopyFolder() - Better Implementation
- StdLib - OSCopyFile() - Better Implementation
- MatrixLib - Added: RowReduceEchelonForm() function
- MatrixLib - Added: MatrixTransform() function
- BigNumber - Better code for the power function
- ObjectsLib - Better Code when opening new windows
- GameEngine - Support playing many sound files at the same time
- RingQt - QPainter class - Added: drawRGBFListAtXY(), drawHSVFListAtXY() & drawBytes()
- RingQt - Qt version is updated to Qt 5.15.16
- Number() function - Don't produce an error when the input is already a number
- String() function - Don't produce an error when the input is already a string
- Low Level Functions - ringvm_calllist() - Better Output
- Ring2EXE - Better Output
- Batch Files - locatevc.bat - Support working from the “C:/Program Files (x86)” folder
- Ring API - Added: RING_API_STATE to get a pointer to Ring State
- Ring API - Added: RING_API_NEWTUSINGBLOCKS1D(int nItems) -> List
- Ring API - Added: RING_API_NEWTUSINGBLOCKS2D(int nRows,int nColumns) -> List
- Ring Compiler - Remove unnecessary ICO_FREESTACK after For-Loops
- Ring Compiler - When we run ringsyntax.ring don't load the same file again
- Ring Compiler - Support using braces { } after (expr)
- Ring Compiler/VM - Better performance when using (for-in) loops and large strings
- Ring Compiler/VM - Revise (Using objects during definition) implementation
- Ring Compiler/VM - Check the path limit (4096 characters) before execution
- Ring Compiler/VM - Items structure functions - Better Performance
- Ring Compiler/VM - HashTable - Better default parameters
- Ring VM - For-Loop will produce a runtime error if used with wrong data-type
- Ring VM - Function Call - Replace some Ring lists with C Structures
- Ring VM - Use ICO_LOADFUNCP when loading C functions
- Ring VM - Memory Pool - Three levels based on the allocation size
- Ring VM - Memory Pool - Allocate 1,000,000 items at startup for level 1

- Ring VM - Byte Code - Added: Flag Register
- Ring VM - Byte Code - Added: Integer Register
- Ring VM - Use ring_list_genarray() with global scope variables When using threads
- Ring VM - Remove aAddressScope from VM structure
- Ring VM - New instructions (ICO_PUSH2N, ICO_PUSH3N & ICO_PUSH4N)
- Ring VM - Byte Code items count is changed to 4
- Ring VM - ICO_LOADFUNC instruction support replacing C function with Ring function
- Ring VM - Better performance when deleting a scope - Avoid: ring_vm_gc_checkreferences()
- Ring VM - Better format when printing the byte code
- Ring VM - Variables - Reduce the required memory to store a variable
- Ring VM - Arguments - Reduce the required memory to pass a value
- Ring VM - ring_state_calloc() - Use the memory pool if possible
- Ring VM - Better implementation for using (Return This)
- Ring VM - Support adding items to a list during assignment using plus operator
- Ring VM - Don't allow deleting the Super variable (Used to access the parent class methods)
- Ring VM - Operator Overloading - Don't produce an error when it's not necessary

WHAT IS NEW IN RING 1.20

In this chapter we will learn about the changes and new features in Ring 1.20 release.

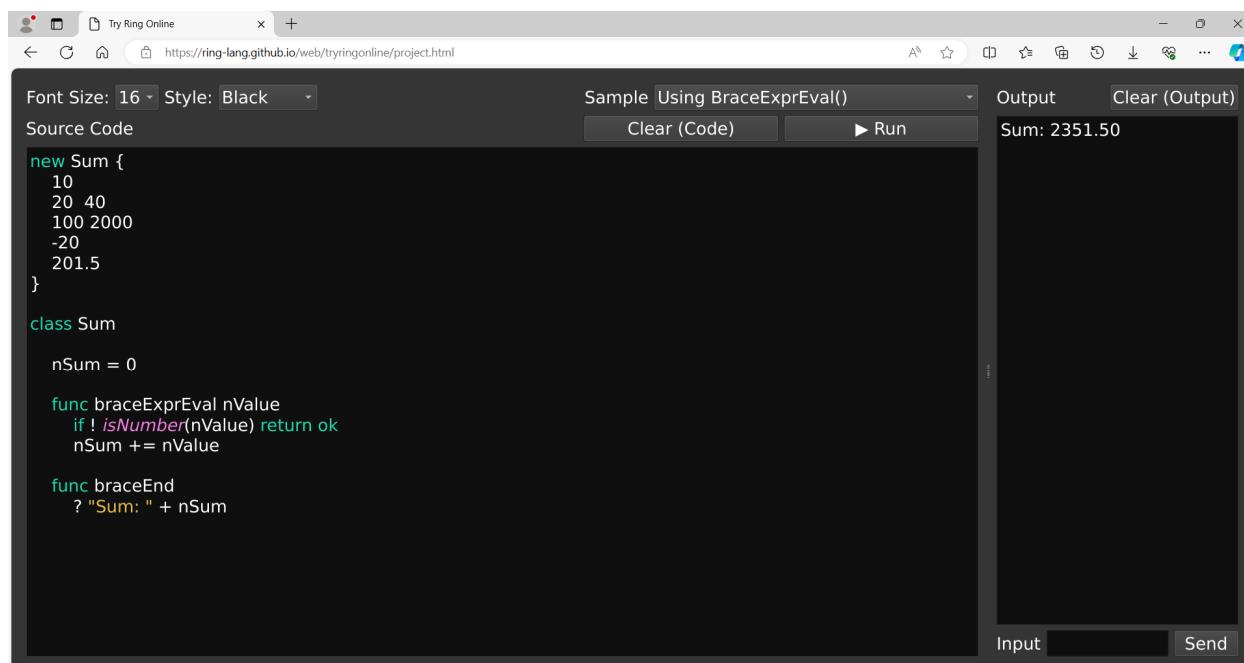
123.1 List of changes and new features

Ring 1.20 comes with the next features!

- Try Ring Online (WebAssembly)
- Better Samples and Applications
- Better Functions
- Enable/Disable Hash Comments
- Better Files for Loading the StdLib
- Better Performance when using Braces
- Better Support for Threads
- RingRogueUtil Extension
- Pause/Resume Embedded Ring VM
- Better Scripts for Building Ring
- Improving Ring Compiler/VM Source Code
- Better Tools and Extensions
- Better Documentation
- More Improvements

123.2 Try Ring Online (WebAssembly)

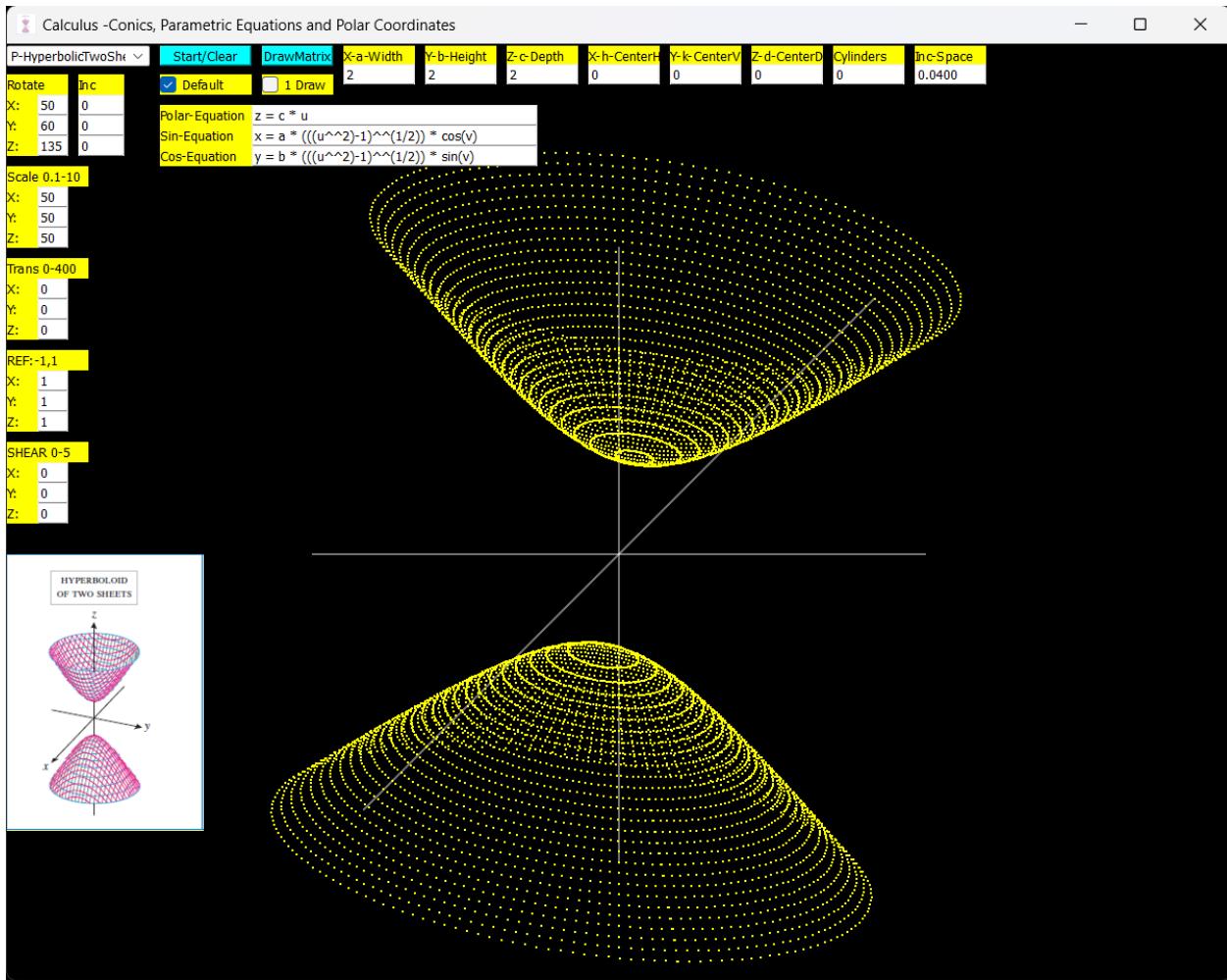
Using Ring we developed an application to try Ring online using RingQt for WebAssembly



The screenshot shows a web-based Ring IDE interface. At the top, there's a toolbar with icons for user profile, file operations, and a link to "Try Ring Online". Below the toolbar, the URL <https://ring-lang.github.io/web/tryringonline/project.html> is displayed. The main area is divided into several sections:

- Font Size:** 16, **Style:** Black.
- Source Code:** A code editor containing Ring script. The code defines a class `Sum` with methods `braceExprEval` and `braceEnd`. The `braceExprEval` method adds a value to a sum if it's a number. The `braceEnd` method returns the sum.
- Sample:** A dropdown menu set to "Using BraceExprEval()".
- Output:** A text box showing the result "Sum: 2351.50".
- Buttons:** "Clear (Code)", "Run", "Clear (Output)".
- Input/Output:** A large dark input field labeled "Input" and a "Send" button.

123.3 Better Samples and Applications



- Added: samples/UsingGemini
- Added: samples/General/NeuralNetwork
- Added: samples/Drawing/CalculusConics
- Added: samples/UsingQt/PDF/CreatePDF.ring
- Added: samples/AQuickStart/GameLib/delay.ring
- Added: samples/UsingFastPro/updatelist5.ring
- Added: samples/UsingFastPro/DestCol.ring
- Updated: samples/UsingRayLib/more/ex5_wavingcubes_threads.ring - Better code
- Updated: samples/AQuickStart/Files - Using CurrentDir() and EXEFolder() functions
- Updated: samples/AQuickStart/GUILib/gui25.ring - Using relative path
- Updated: samples/UsingLibUI/test8.ring - Better code
- Calculator application - Using sqlite.lib.ring and stdlibcore.ring
- Customers application - Better digital_clock.ring code

- Calendar application - Better controls size
- Words game - Better window size
- SnakesAndLadders game - Better window title
- WiseQuadrat game - Better code to display the winner
- Memory game - Reduce delay time from 3 seconds to 1 second
- ring/applications - Added the window icon for many applications and games
- ring/applications - Using list() instead of newlist() in many applications
- ring/applications - Using stdlibcore.ring instead of stdlib.ring in many applications
- ring/applications - Using lightguilib.ring instead of guilib.ring in many applications
- ring/applications - Using openWindow() instead of open_window() in Controller classes

123.4 Better Functions

- isWindows64() function - Better Code
- print() function - Better code to handle apostrophe inside text
- random() function - Produce numeric output when the parameter is a negative number or zero
- reverse() function - Beside supporting lists, the function now support strings too
- add() function - when adding a list support adding each item alone
- list2str() function - Support more parameters: list2str(aList,[nStart],[nEnd])
- isDigit(), isAlpha(), isAlnum(), etc. will return False if the input is an empty string
- number() function - Produce runtime error if the string contains invalid number
- input() function - If the size is not passed as parameter it will read a line
- locals() function - Usage in global scope will not return predefined globals like NL, True, etc.
- swap() function - Support swaping any two Lists/Objects
- filename() function - Better implementation
- sleep() function (from stdlibcore.ring) - Better implementation
- ring_state_mainfile() function - Support Ring Object Files
- updateList() function (from fastpro.ring) - support dest. column as six parameter

Example (1):

```
cStr = "Welcome to Ring"
? reverse(cStr)          # gniR ot emocleW
```

Example (2):

```
aList = 1:3
add(aList,4:6)           # Add the list as one item
? len(aList)              # 4

aList = 1:3
```

(continues on next page)

(continued from previous page)

```
add(aList,4:6,True)           # Add each item alone
? len(aList)                  # 6
? aList
```

Example (3):

```
aList = 1:10
cStr  = list2str(aList,6,10)
? cStr                         # 6 7 8 9 10
```

Example (4):

```
aList1 = 4:6
aList2 = 1:3
swap(aList1,aList2)
? aList1                      # 1 2 3
? aList2                      # 4 5 6

aList = [ 4:6 , 1:3 ]
? aList                        # 4 5 6 1 2 3
swap(aList[1], aList[2])
? aList                        # 1 2 3 4 5 6

aList = [ 4:6 , 1:3 ]
? aList                        # 4 5 6 1 2 3
swap(aList,1,2)
? aList                        # 1 2 3 4 5 6
```

Example (6):

```
load "fastpro.ring"

aList = [
    [10,20,0],
    [30,40,0],
    [50,60,0]
]

updateList(aList,:mul,:col,1,10,3)

? aList                         # 10 20 100 30 40 300 50 60 500
```

123.5 Enable/Disable Hash Comments

We added the next two commands to the Ring Scanner

- EnableHashComments
- DisableHashComments

Example:

```
DisableHashComments
#define = 10
EnableHashComments
# Just a comment
DisableHashComments
? #define
EnableHashComments
# End of program
```

123.6 Better Files for Loading the StdLib

Using stdlib.ring will load stdlib functions, classes and some extensions too like RingLibCurl, RingOpenSSL, etc.

Using stdlibcore.ring we can only load stdlib functions.

In this release we provide stdlibclasses.ring that can only load stdlib classes without loading stdlib functions or extensions.

Example:

```
load "stdlibclasses.ring"

oStack = new Stack {
    push("A")
    push("B")
    push("C")
    push("D")
    push("E")
    pop()
    pop()
    print()
}
```

Output:

```
C
B
A
```

Note: Also, we improved the files that load the library to load it in separate global scope.

Tip: To load a library in separate global scope use the Load Package command.

123.7 Better Performance when using Braces

Using braces to access objects is faster in Ring 1.20 than Ring 1.19

The speed up factor could be from (2.2 to 2.6 times)

Tested using Victus Laptop [13th Gen Intel(R) Core(TM) i7-13700H, Windows 11]

Using normal functions or using the dot operator still faster than using braces, but this update is a step forward towards reducing the gap.

Example:

```
oPoint = new Point

t1 = clock()
for t=1 to 100000
    oPoint {
        # Access object attributes/methods
    }
next
? (clock()-t1)/clocksPerSecond()

class point x y z
```

- Time using Ring 1.20: 0.05 second
- Time using Ring 1.19: 0.13 second
- Time using Ring 1.18: 0.38 second

Note: We have written this example in this slow way to do the test

A very fast version of the sample will could be written by using braces before the loop

```
oPoint = new Point

t1 = clock()
oPoint {
    for t=1 to 100000
        # Access object attributes/methods
    next
}
? (clock()-t1)/clocksPerSecond()

class point x y z
```

123.8 Better Support for Threads

- Better code inside Ring VM for starting new threads
- Better code for sharing the Memory Pool information between threads
- Each thread have it's copy from predefined globals like NL, True, etc.
- Share multiple global scopes created using the Load Package command
- Ring lists that wraps C pointers will not use internal dynamic cache
- Ring lists created using List() will not use internal dynamic cache if size is not changed
- RingThreads - Better code for creating the Mutex

Note: Ring Lists that avoid internal dynamic cache provide safe reading from many threads because accessing lists for reading will not include implicit writing to the internal cache.

123.9 RingRogueUtil Extension

Using this extension we can create text-based user interfaces (TUI) and console-based games

The extension support Windows, Linux and macOS

Also, we added support for Mouse events (Mouse move, Click, and Scroll)

Example:

```
load "rogueutil.ring"

setConsoleTitle("Using PrintXY()")

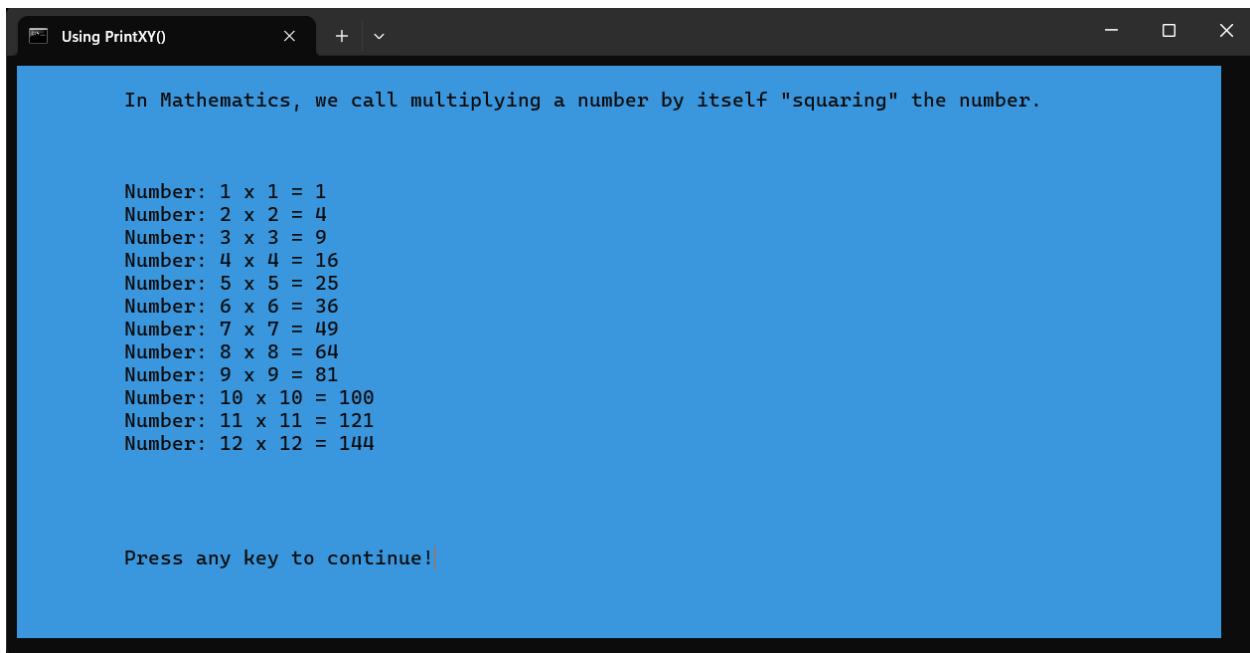
setColor(Black)
setBackgroundColor(Cyan)

cls()

printXY(10,2,'In Mathematics, we call multiplying a number by itself "squaring" the_
↪number.')

for t=1 to 12
    printXY(10,10+t, "Number: " + t + " x " + t + " = " + (t*t) )
next

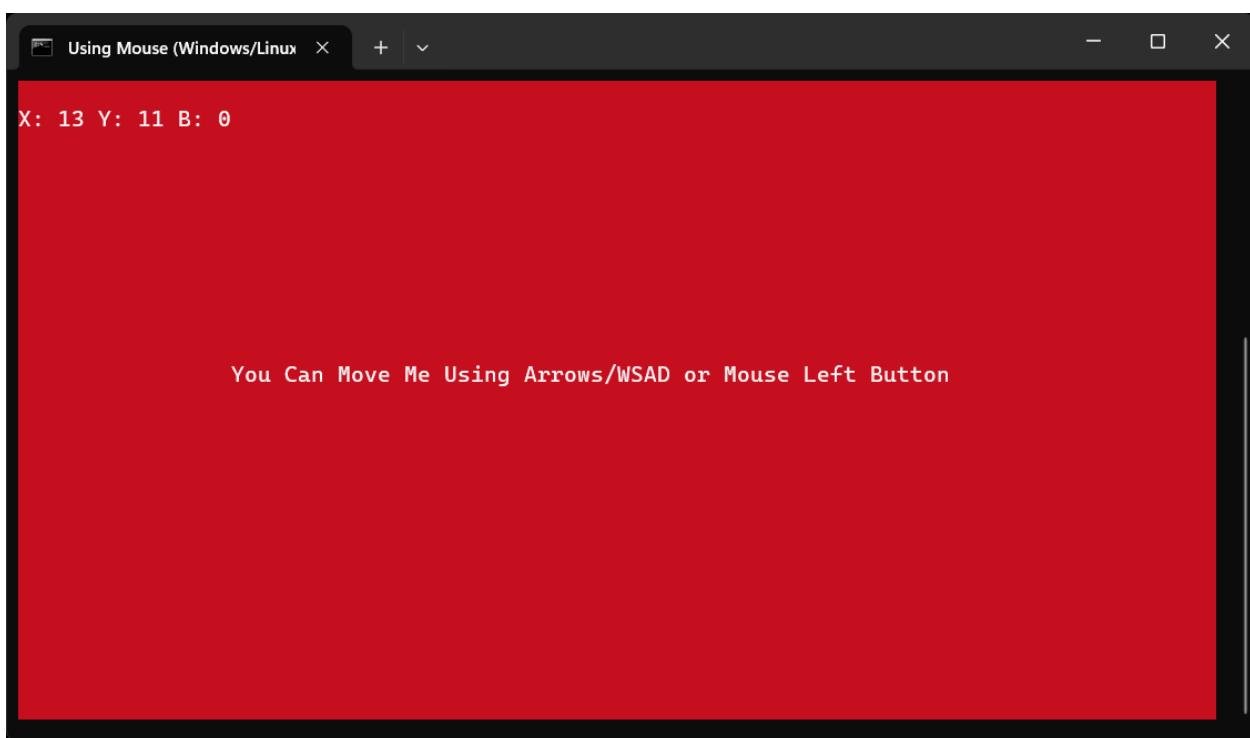
getch()
```



In Mathematics, we call multiplying a number by itself "squaring" the number.

```
Number: 1 x 1 = 1
Number: 2 x 2 = 4
Number: 3 x 3 = 9
Number: 4 x 4 = 16
Number: 5 x 5 = 25
Number: 6 x 6 = 36
Number: 7 x 7 = 49
Number: 8 x 8 = 64
Number: 9 x 9 = 81
Number: 10 x 10 = 100
Number: 11 x 11 = 121
Number: 12 x 12 = 144
```

Press any key to continue!



X: 13 Y: 11 B: 0

You Can Move Me Using Arrows/WSAD or Mouse Left Button

123.10 Pause/Resume Embedded Ring VM

Ring already supports embedding Ring VM in Ring programs to be able to execute Ring code in isolated Ring state.

Starting from Ring 1.20 we can pause/resume the embedded Ring VM

To pause the VM, just use the (Bye) command which as expected will end the execution but will store the nPC value (Program Counter) so using ring_state_resume() we can continue the execution at any time starting from this nPC value.

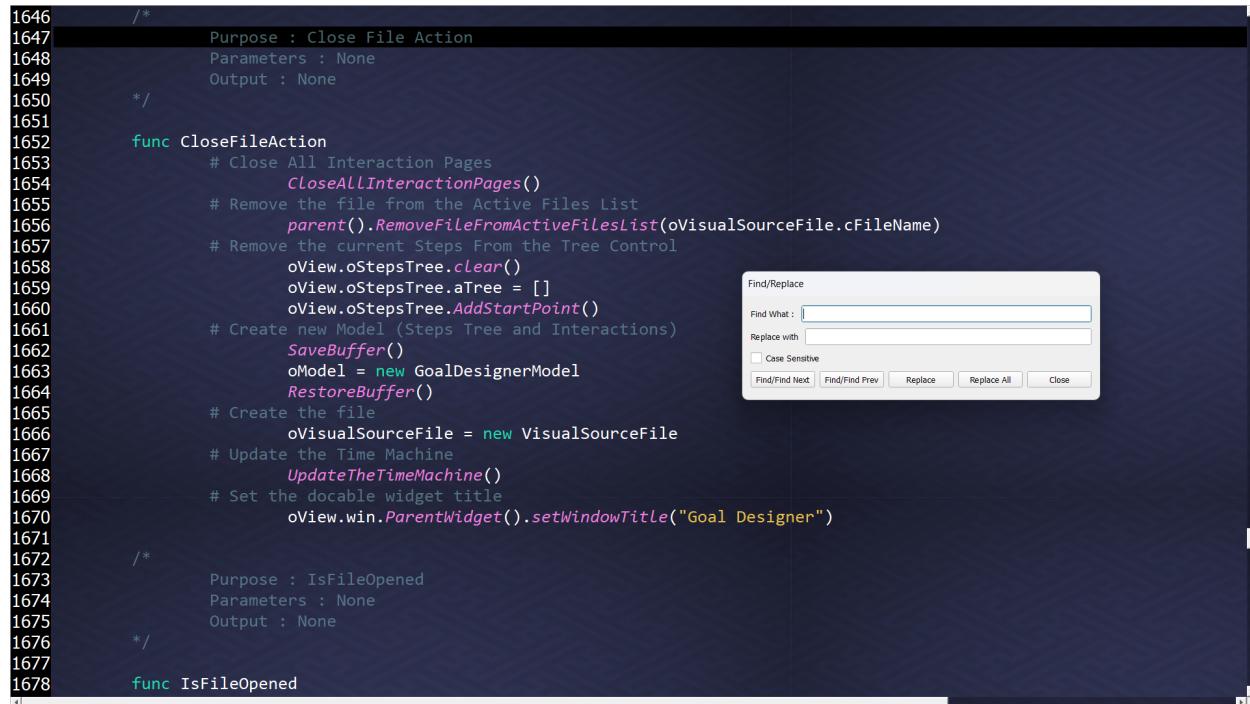
Syntax:

```
ring_state_resume(oState, [cPara|nPara], [lUseReturn])
```

To learn more about this feature check the chapter: Embedding Ring in Ring

123.11 Better Tools and Extensions

- Ring Notepad - Full Screen Mode - Added support for opening Find/GoTo/SetTabWidth windows
- Ring Notepad - Activate source code window after the end of Full Screen mode
- Ring Notepad - Select the Font Family based on the operating system
- Ring Notepad - Using Load command will list the common libraries

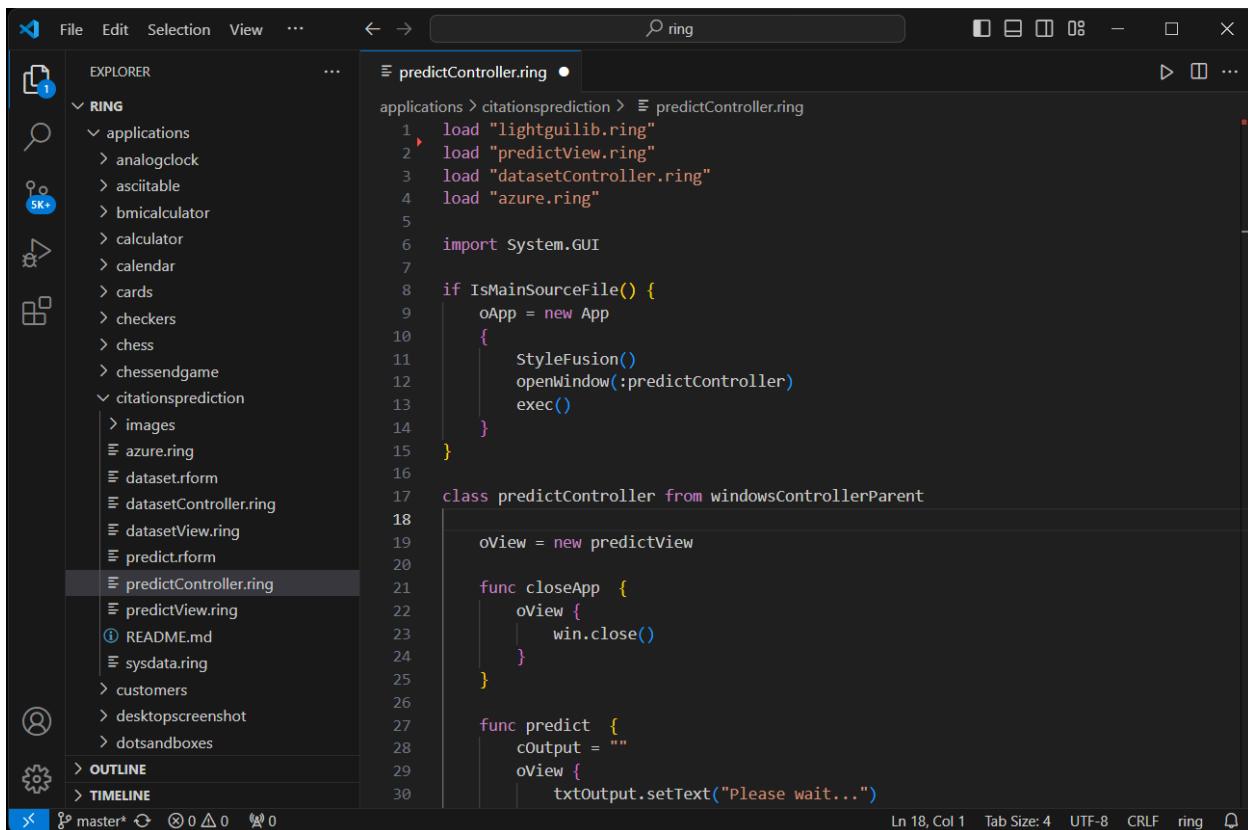


```

1646     /*
1647      Purpose : Close File Action
1648      Parameters : None
1649      Output : None
1650   */
1651
1652 func CloseFileAction
1653     # Close All Interaction Pages
1654     CloseAllInteractionPages()
1655     # Remove the file from the Active Files List
1656     parent().RemoveFileFromActiveFilesList(oVisualSourceFile.cFileName)
1657     # Remove the current Steps From the Tree Control
1658     oView.oStepsTree.clear()
1659     oView.oStepsTree.aTree = []
1660     oView.oStepsTree.AddStartPoint()
1661     # Create new Model (Steps Tree and Interactions)
1662     SaveBuffer()
1663     oModel = new GoalDesignerModel
1664     RestoreBuffer()
1665     # Create the file
1666     oVisualSourceFile = new VisualSourceFile
1667     # Update the Time Machine
1668     UpdateTheTimeMachine()
1669     # Set the docable widget title
1670     oView.win.ParentWidget().setWindowTitle("Goal Designer")
1671
1672 /*
1673      Purpose : IsFileOpened
1674      Parameters : None
1675      Output : None
1676   */
1677
1678 func IsFileOpened

```

- RingQt - Added: QComponent class (Qt3DCore)
- RingQt - Correct parent class name for the QMaterial & QLogicAspect classes
- Ring2EXE - Set the stack size for executable files
- Ring extension for VSCode is updated to support modern versions of VSCode



The screenshot shows the Ring IDE interface. The left sidebar (EXPLORER) lists project files under 'RING' and 'applications'. The main area displays the source code for 'predictController.ring'. The code includes imports, a main function block, and a class definition for 'predictController'.

```

load "lightguilib.ring"
load "predictView.ring"
load "datasetController.ring"
load "azure.ring"
import System.GUI
if IsMainSourceFile() {
    oApp = new App
    {
        StyleFusion()
        openWindow(:predictController)
        exec()
    }
}
class predictController from windowsControllerParent
{
    oView = new predictView

    func closeApp {
        oView {
            win.close()
        }
    }

    func predict {
        cOutput = ""
        oView {
            txtOutput.setText("Please wait...")
        }
    }
}

```

123.12 Better Scripts for Building Ring

- Scripts for building Ring Compiler/VM are moved to ring/language/build folder
- Scripts for building Ring, Extensions and Tools are moved to ring/build folder
- Files that install dependencies on Linux/macOS are moved to ring/build folder
- Added: libqt5multimedia5-plugins to ring/build/installdepubuntu.sh
- Added: ring/language/build/buildzig.bat
- Added: ring/build/buildgcc.sh
- Added: ring/build/buildclang.sh

123.13 Improving Ring Compiler/VM Source Code

- Better Format
- Using constants
- Use Bit Fields in structures
- Structures Members - Better names
- Structures Members - Better order
- Functions Parameters - Better names

- language/src/os_e.c - randomize() - Better code
- language/src/expr.c - ring_parser_ppmm() - Better code
- language/src/rstring.c - ring_string_set2_gc() - Better code
- language/src/vmlists.c - ring_vm_listpushv() - Avoid stack pop
- language/src/vmfuncs.c - ring_vm_isstackpointertoobjstate() - Using simple condition

123.14 Better Documentation

The next chapters are revised and improved

- Operators
- Embedding Ring in Ring
- Building From Source Code
- Language Specification (Ring VM instructions)

123.15 More Improvements

- Ring VM - Avoid infinite for loops when the step value is zero
- Ring VM - Remove old code related to lAddSubListsByMove and lAddSubListsByFastCopy in VM structure
- Ring VM - Return command - Better code when we return an object passed to the function as parameter
- Ring VM - Return command - Better code when we return class attribute by reference
- Ring VM - Better support for try/catch and different operators
- Ring VM - Better support for try/catch when creating new object and the parent class doesn't exist
- Ring VM - When we compare between a string and a number take in mind if the string contains extra characters
- Ring VM - Treat lists that wrap C pointers as FALSE if the C pointer value is NULL
- Ring VM - Loop N command inside For-In loop will execute implicit Exit N-1 command then Loop
- Ring VM - Better format when displaying error messages
- Ring VM - Correct file name in the error message when the error happens at function arguments
- Ring VM - Temp. lists created using the Range operator will be added to the temp. memory

WHAT IS NEW IN RING 1.21

In this chapter we will learn about the changes and new features in Ring 1.21 release.

124.1 List of changes and new features

Ring 1.21 comes with the next features!

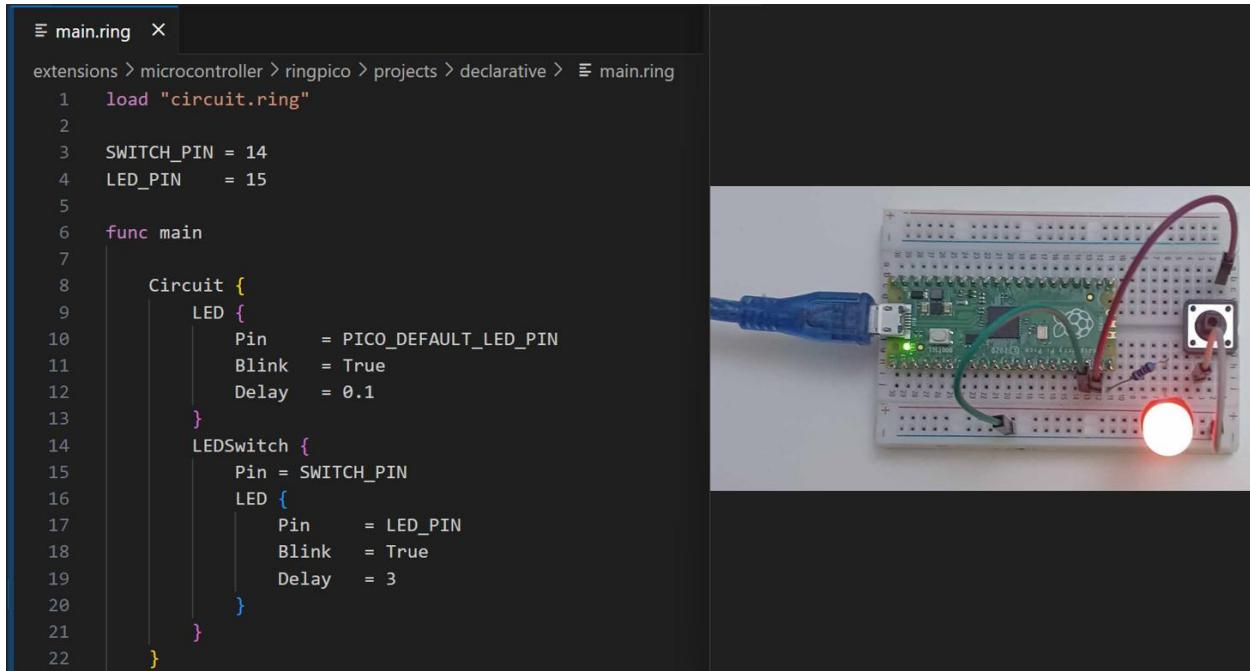
- Ring for Raspberry Pi Pico
- Lectures Tracker application
- RingPDFGen Extension
- Better MatrixLib
- Better RingQt
- Better RingRayLib
- More Samples
- Faster Function Call
- Faster Arithmetic Operations
- Faster Compiler
- Reducing Memory Usage
- ForEach Keyword
- NumOrZero() Function
- Better Operator Overloading
- Syntax Highlighting for Vim/nano
- New VM Instructions
- More Improvements

124.2 Ring for Raspberry Pi Pico

In this release we present a new extension that supports Raspberry Pi Pico

Using this extension we can write Ring programs that runs on the RP2040 Microcontroller

For more information check the chapter: Using Ring for Raspberry Pi Pico Microcontroller



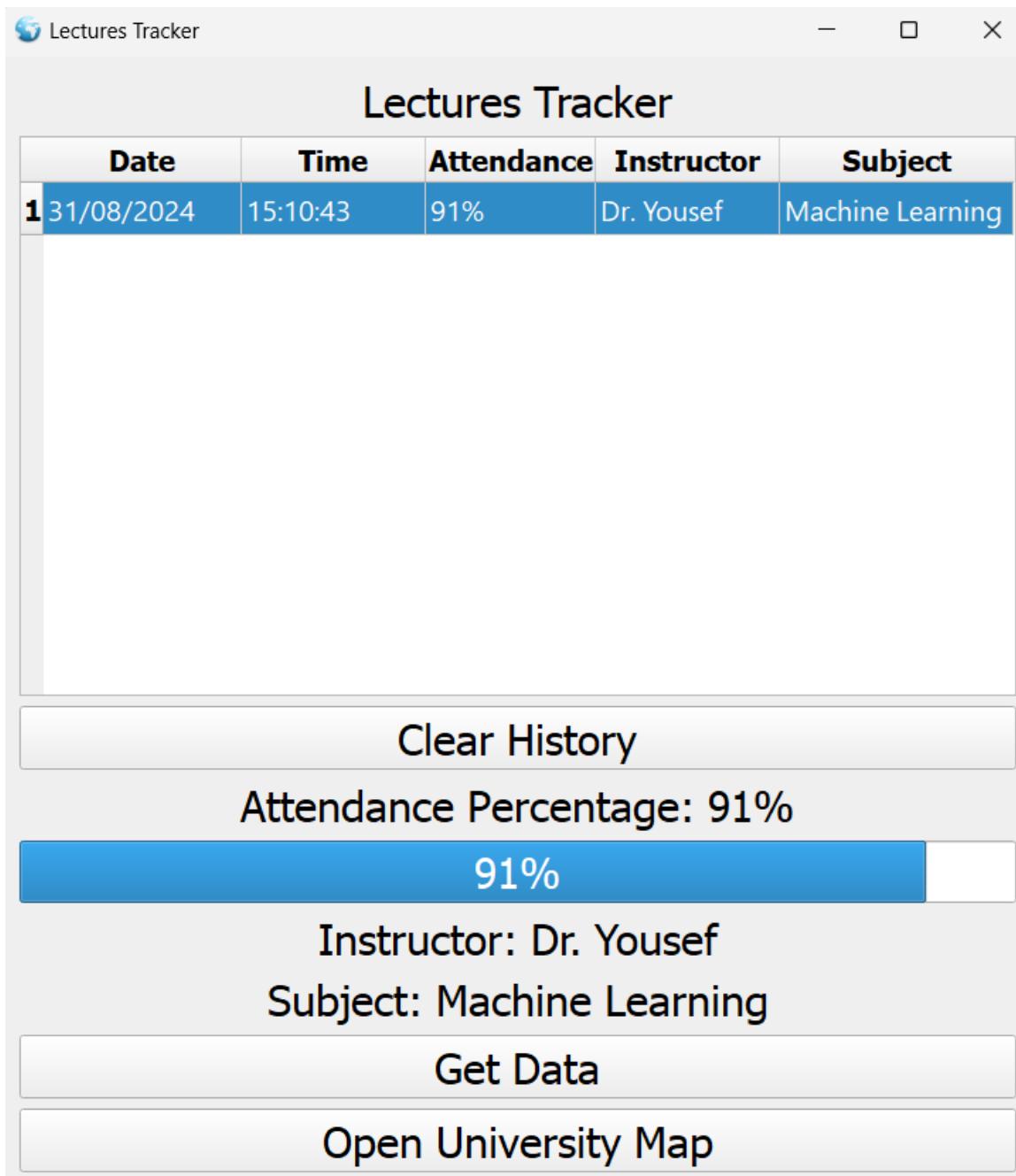
124.3 Lectures Tracker application

A simple Desktop/Mobile application that connects to a Web API to get some data.

The application is developed using Ring & RingQt.

To test the application

- (1) Run ring/applications/lecturestracker/webserver/server.ring
- (2) Run ring/applications/lecturestracker/mobileapp/lecturestracker.ring



124.4 RingPDFGen Extension

This extension support the PDFGen library

The extension exist in the ring/extensions/ringpdfgen folder

The supported functions and constants exist in the Using RingPDFGen chapter

Example:

```

load "pdffgen.ring"

cPDFFFileName = "output.pdf"

pdf = pdf_create(PDF_A4_WIDTH, PDF_A4_HEIGHT, [
    :creator  = "My software",
    :producer = "My software",
    :title   = "My document",
    :author   = "My name",
    :subject  = "My subject",
    :date     = "Today"
] )

pdf_set_font(pdf, "Times-Roman")
pdf_append_page(pdf)

pdf_add_text(pdf, NULL, "This is text", 12, 50, 20, PDF_BLACK)
pdf_add_line(pdf, NULL, 50, 24, 150, 24, 0, 0)
pdf_add_text(pdf, NULL, "This is text", 24, 250, 20, PDF_BLUE)

for t=1 to 30
    pdf_add_text(pdf, NULL, "Number: " + t, 14, 250, 50+(20*t), PDF_RED)
next

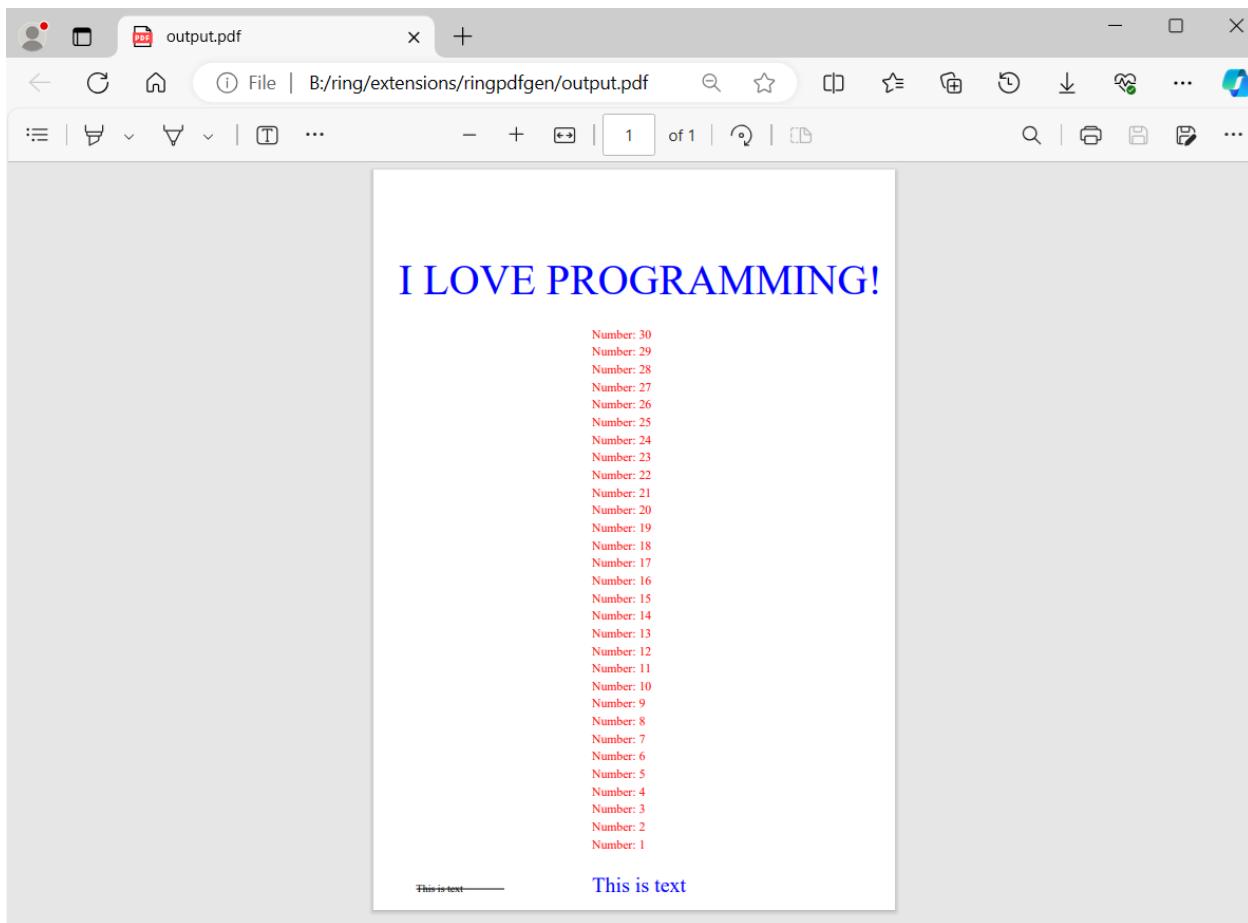
pdf_add_text(pdf, NULL, "I LOVE PROGRAMMING!", 48, 30, 700,PDF_BLUE)

pdf_save(pdf, cPDFFFileName)
pdf_destroy(pdf)

system(cPDFFFileName)

```

Output:



124.5 Better MatrixLib

The next functions are added to the library

<code>MatrixScalarProjection(U,V)</code>	<code>// Scalar Projection A onto B = (A.B) / B </code>
<code>MatrixCopyCol(U-Array, Start, End)</code>	<code>// Create new smaller V-array from U-array</code>

Example

```

Load "stdlibcore.ring"
Load "matrixlib.ring"

Func Main()

    A = [[ 1],[ 6],[ 18]]
    B = [[ 42],[-69],[ 98]]

    See "A" MatrixPrint(A)
    See "B" MatrixPrint(B)

    SP = MatrixScalarProjection(B,A)
    See "Scalar projection of B onto A = 73.26 => "+ SP +nl

```

(continues on next page)

(continued from previous page)

```

SP = MatrixScalarProjection(A,B)
See "Scalar projection of A onto B = 10.96 => "+ SP +nl

A = [[ 3],[ 4]]
B = [[ 1],[ 2]]

See "A " MatrixPrint(A)
See "B " MatrixPrint(B)

SP = MatrixScalarProjection(A,B)
See "Scalar projection of A onto B = 4.9193 => "+ SP +nl

```

Output:

```

A      MatrixPrint: 3x1
| 1 |
| 6 |
| 18 |

B      MatrixPrint: 3x1
| 42 |
| -69 |
| 98 |

Scalar projection of B onto A = 73.26 => 73.26
Scalar projection of A onto B = 10.96 => 10.96
A      MatrixPrint: 2x1
| 3 |
| 4 |

B      MatrixPrint: 2x1
| 1 |
| 2 |

Scalar projection of A onto B = 4.9193 => 4.92

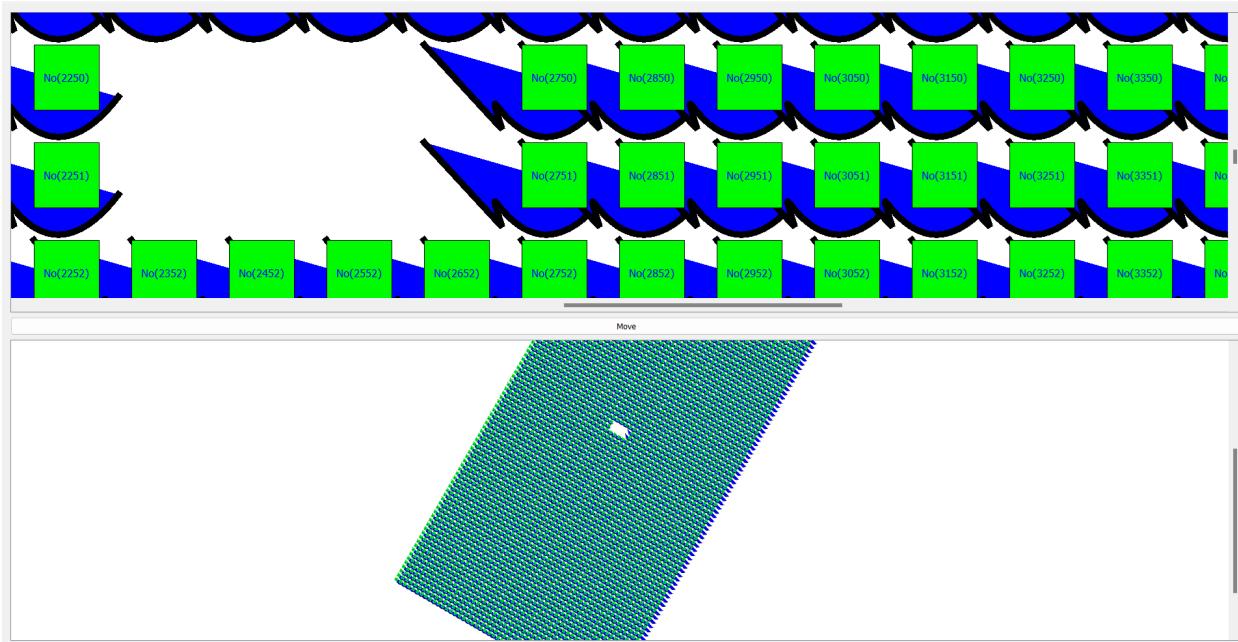
```

124.6 Better RingQt

- (1) Qt library is updated from Qt 5.15.16 to 5.15.17
- (2) QDateTimeEdit - Added Class Events
- (3) Using (load “qtcore.ring”) we can load the QtCore library
- (4) The next classes are added to RingQt
 - QAbstractGraphicsShapeItem
 - QAudioOutput
 - QGraphicsAnchor
 - QGraphicsAnchorLayout

- [QGraphicsEffect](#)
- [QGraphicsEllipseItem](#)
- [QGraphicsGridLayout](#)
- [QGraphicsItem](#)
- [QGraphicsItemGroup](#)
- [QGraphicsLayout](#)
- [QGraphicsLayoutItem](#)
- [QGraphicsLineItem](#)
- [QGraphicsLinearLayout](#)
- [QGraphicsObject](#)
- [QGraphicsPathItem](#)
- [QGraphicsPixmapItem](#)
- [QGraphicsPolygonItem](#)
- [QGraphicsProxyWidget](#)
- [QGraphicsRectItem](#)
- [QGraphicsSceneContextMenuEvent](#)
- [QGraphicsSceneDragDropEvent](#)
- [QGraphicsSceneEvent](#)
- [QGraphicsSceneHelpEvent](#)
- [QGraphicsSceneHoverEvent](#)
- [QGraphicsSceneMouseEvent](#)
- [QGraphicsSceneMoveEvent](#)
- [QGraphicsSceneResizeEvent](#)
- [QGraphicsSceneWheelEvent](#)
- [QGraphicsSimpleTextItem](#)
- [QGraphicsSvgItem](#)
- [QGraphicsTextItem](#)
- [QGraphicsWidget](#)
- [QLibraryInfo](#)
- [QLineF](#)
- [QModelIndex](#)
- [QRectF](#)
- [QRegExp](#)
- [QStyleOptionGraphicsItem](#)
- [QTransform2](#)
- [QTransform3](#)

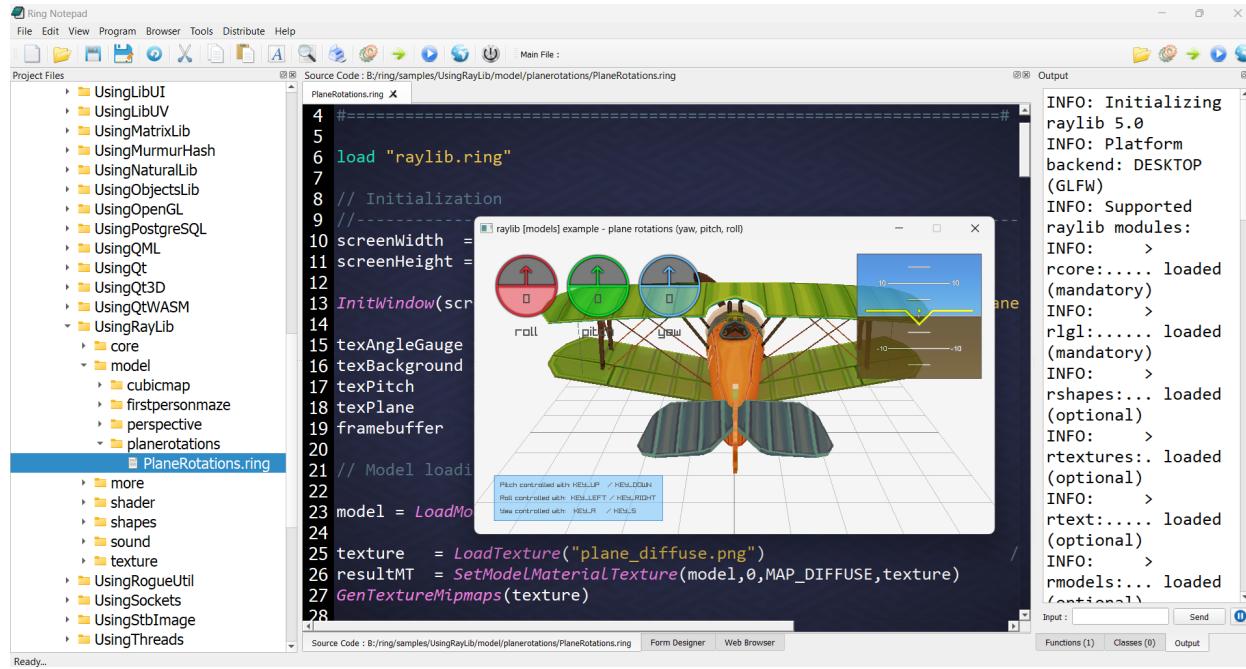
- QVersionNumber



124.7 Better RingRayLib

The RayLib version is updated from 2.5 to 5.0

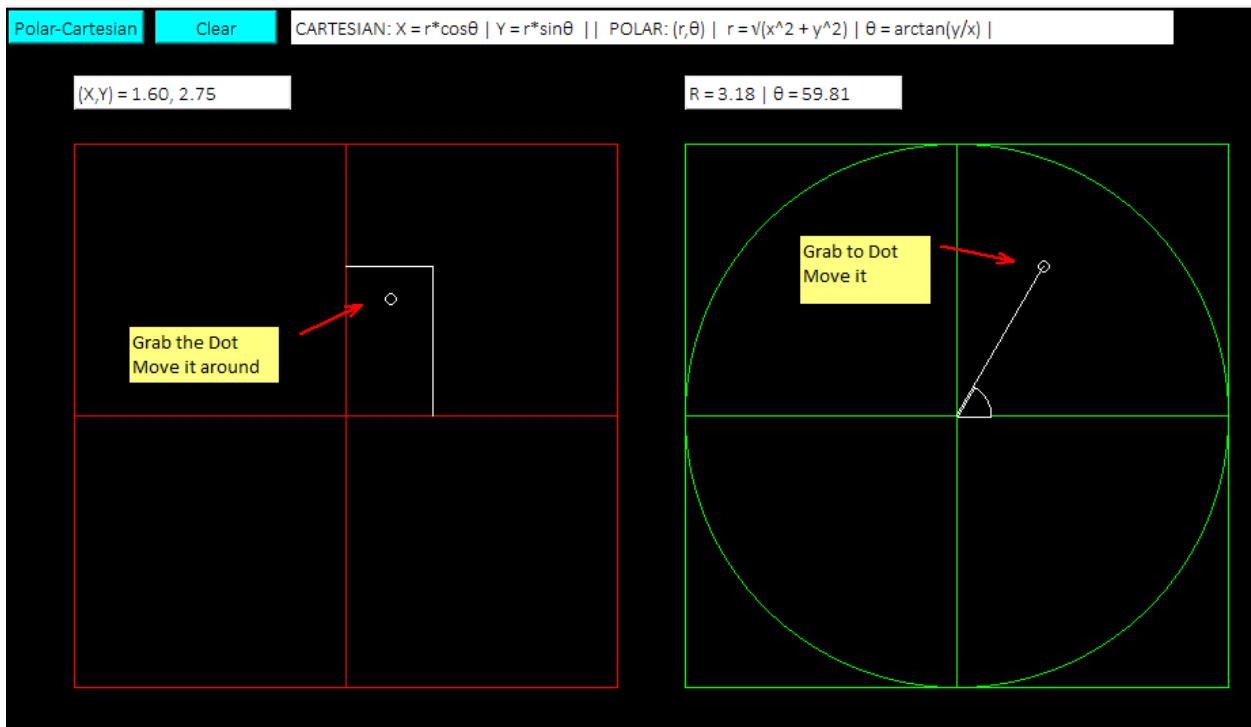
Also, all of the samples and applications that uses RingRayLib are revised and updated.



124.8 More Samples

The next samples are added to the ring/samples folder

- ring/samples/General/NetworkFlow/Matrix-Networks.ring
- ring/samples/General/Matrix/MatrixThreePointsOnCircle.ring
- ring/samples/Drawing/PolarCartesian/AA-Draw-Polar-Cartesian.ring
- ring/samples/UsingMatrixLib/60-Matrix-Test-Scalar-Projection.ring
- ring/samples/UsingMatrixLib/61-BundlesOfRice.ring
- ring/samples/UsingQt/GraphicsView/graphicsview.ring
- ring/samples/UsingQt/Painter/test3.ring



124.9 Faster Function Call

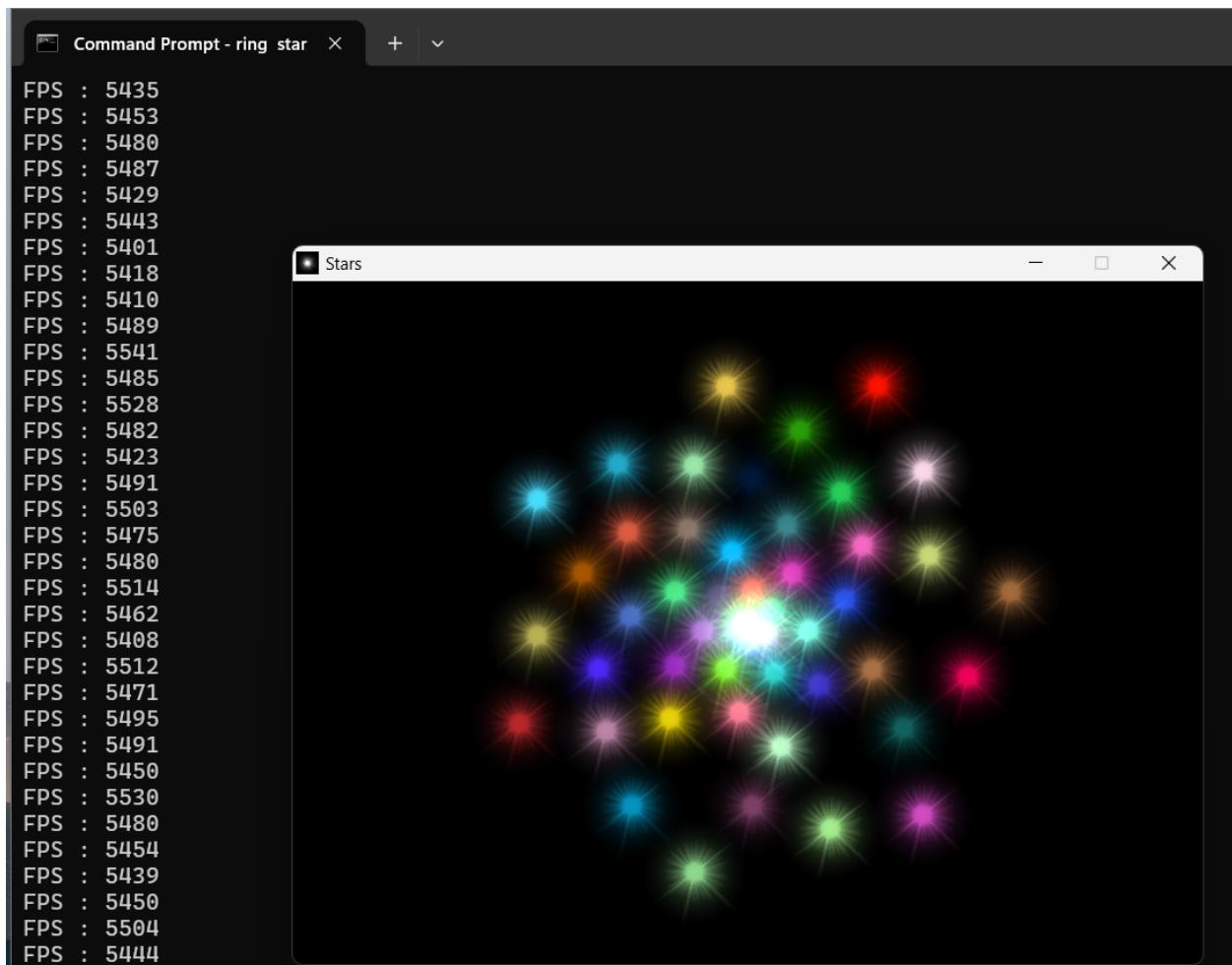
We improved how Ring VM manage the functions scope/arguments through pre-allocation to provide performance improvements.

As a result, the stars animation sample works at 5400 FPS (instead of 2350 FPS in Ring 1.20)

Tested using Victus Laptop [13th Gen Intel(R) Core(TM) i7-13700H, Windows 11]

Results:

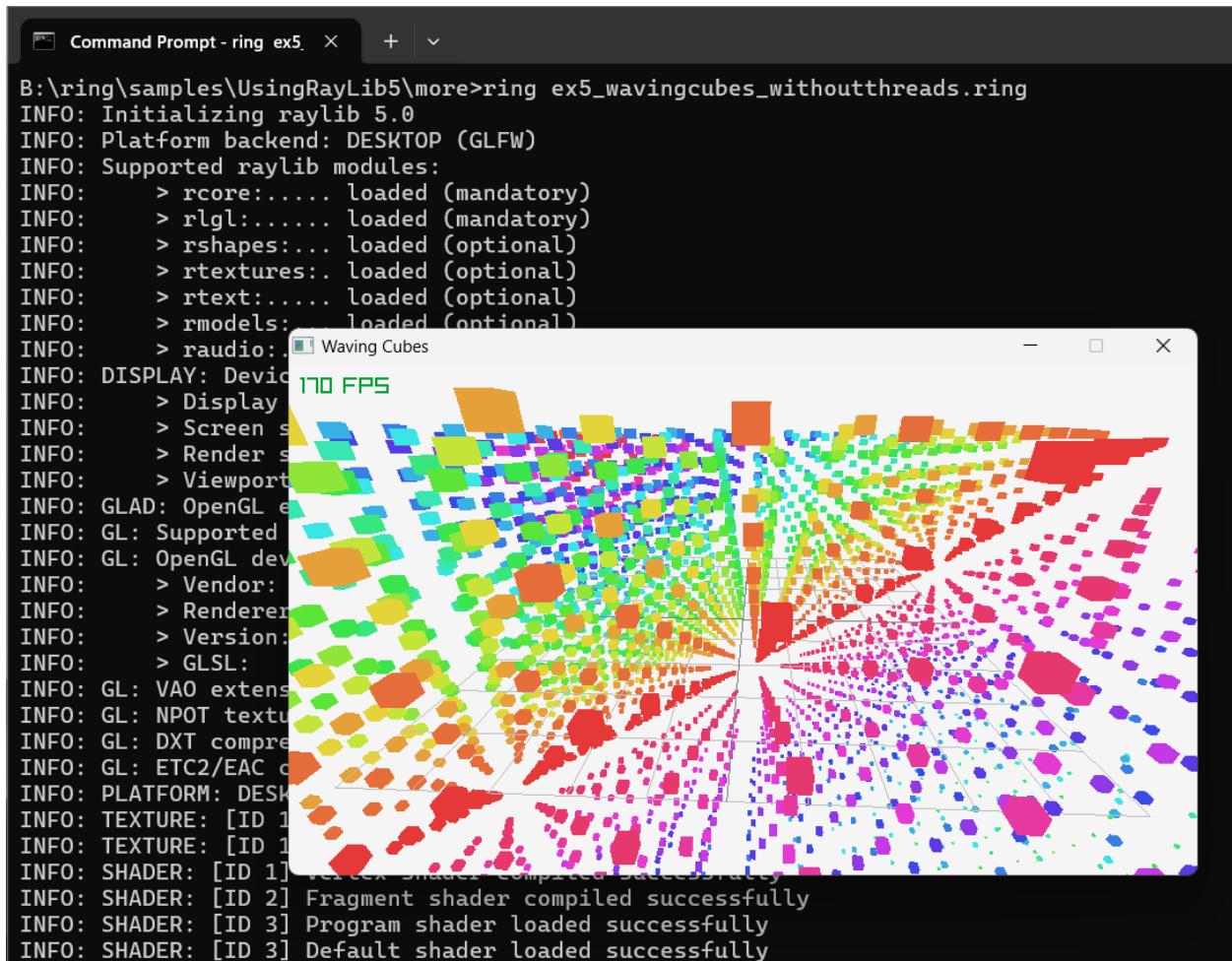
```
Ring 1.21 --> 5400 FPS
Ring 1.20 --> 2350 FPS
Ring 1.19 --> 2350 FPS
Ring 1.18 --> 500  FPS
```



The waving cubes sample works at 170 FPS (instead of 40 FPS in Ring 1.20)

Tip: This is faster than the Python 3.11 version which works at 85 FPS

Note: The C version of this sample works at 480 FPS



124.10 Faster Arithmetic Operations

We introduced some new VM instructions that merge common instructions into one.

This lead to speed improvements with respect to arithmetic operations.

Example:

```
decimals(3)
t1=clock()
for t=1 to 1_000_000 r=max(t,t^2) next
t2 = clock()
? r
? (t2-t1)/clockspisecond()
```

Output:

```
2000000
0.073
```

Results:

```
Time using Ring 1.21    --> 73 ms
Time using Python 3.11  --> 83 ms
Time using VFP 9.0 SP2  --> 94 ms
Time using Python 2.7   --> 108 ms
Time using Harbour 3.2  --> 110 ms
Time using Ring 1.20    --> 244 ms
```

124.11 Faster Compiler

This release provides better performance when compiling large projects

These projects could have huge number of classes and methods

For example, PWCT2 compile time is reduced from 1100 ms to 790 ms

Also, SoftanzaLib compile time is reduced from five seconds to one second

124.12 Reducing Memory Usage

We did the next updates to reduce the memory usage

- (1) The ByteCode registers count is reduced from four to two
- (2) Setter/Getter/OperatorOverloading - Don't use ring_vm_eval()
- (3) Using GC functions when using strings in the VM stack
- (4) Using the VM Stack when passing arguments to C functions
- (5) Reducing memory required by RING_API_REGISTER to support C functions
- (6) The pre-allocated memory pool items count is reduced from 1M to 100K

124.13 ForEach Keyword

This release support using the ForEach keyword in For-in loops

Example:

```
aList = 1:10
ForEach x in aList
    ? x
Next
```

124.14 NumOrZero() Function

This is a new function added to stdlibcore.ring

Using this function we get a number as output (No runtime errors)

Example:

```
load "stdlibcore.ring"

? numorzero(10)
? numorzero("10")
? numorzero("10.2")
? numorzero("10.2 abc")
? numorzero("What")
? numorzero([10])
? numorzero(new point)

class point
```

Output:

```
10
10
10.20
0
0
0
0
```

124.15 Better Operator Overloading

We support operator overloading from the first release of the Ring language

When using an object inside an expression and this object define the operator method, this method will be called if the object comes first.

```
object operator value
myobj + 10
myobj + "test"
myobj + [1,2,3]
```

In this release we support that the value could come first before the object and the operator() method will be called but the letter 'r' will comes before the operator (i.e. r+ instead of +)

Example:

```
? f(2)

mylist = new List([1,2,3])

f(mylist).print()
```

(continues on next page)

(continued from previous page)

```

func f x
    return 2+x*x      # Here 2 comes before x and x could be an object

class List

aList = []

func init vValue
    aList = vValue

func operator cOperator,vValue

    if cOperator = "r+"
        cOperator = "+"
    ok

    switch cOperator
        on "+"
            if isNumber(vValue) {
                for t in aList
                    t += vValue
                next
            but isObject(vValue)
                for t = 1 to len(aList)
                    aList[t] += vValue[t]
                next
            ok
        on "*"
            if isNumber(vValue) {
                for t in aList
                    t *= vValue
                next
            but isObject(vValue)
                for t = 1 to len(aList)
                    aList[t] *= vValue[t]
                next
            ok
        on "[]"
            return aList[vValue]
        on "len"
            return len(aList)
    off
    return self

func print
    ? aList

```

Output:

6
3
6

(continues on next page)

(continued from previous page)

11

Note: the numbers(3,6,11) are the result of applying the function f to the list items [1,2,3]

124.16 Syntax Highlighting for Vim/nano

Check the folders: ring/tools/editors/vim and ring/tools/editors/nano

```
GNU nano 8.1
#####
### Create Array -- Dimensions Any Size: 3D, 4D, 5D etc (Really a LIST)
### There are 3 Ways to Call | Populate and Display

// First
aDim  = [3,4,5,6]           // 1- Multi-Dim-Array of Rows, Cols, Blocks
mArray = newArray(aDim)      // 2- Create the Multi-Dim-Array (Really a LIST))

Populate(aDim)
See "Print aDim: 3,4,5,6: "+nl Print(aDim)

// Second
mArray = newArray([6,5,4,3])    // 1- Populate array using number indexes

Populate([6,5,4,3])
See "Print [6,5,4,3]: "+nl Print([6,5,4,3])

// Third
a=4  b=3  c=6  d= 5          // 1- Assign number to letter
mArray = newArray([a,b,c,d])    // 2- Populate array using letter reference to indexes

Populate([a,b,c,d])
See "Print [a,b,c,d] 4,3,6,5: "+nl Print([a,b,c,d])
```

124.17 New VM Instructions

The next instructions are added to the Ring Virtual Machine

- ICO_STEPMFROMREG - Set the For-Loop step value
- ICO_PUSHNL - Push new line to the stack
- ICO_LISTITEMN - Add number to the current list
- ICO_LISTITEMC - Add string to the current list

- ICO_RETURNN - Return a number from a function
- ICO_PUSHARG - Quickly access function arguments
- ICO_PUSHNTHENJUMP - Push number to the stack then jump

Also, we added the next arithmetic instructions

- ICO_SUMN
- ICO_SUBN
- ICO_MULN
- ICO_DIVN
- ICO_MODN
- ICO_POWN

124.18 More Improvements

- Ring Notepad - Toolbar - Better icons
- NaturalLib - Using (stdlibcore.ring) instead of (stdlib.ring)
- AddAttribute() - Produce runtime error if the attribute is already defined
- AddMethod() - Produce runtime error if the method is already defined
- RingInternetLib - Set CURLOPT_USERAGENT in Download() function
- Ring API - Implementation through functions that get a pointer to the VM structure
- Better scripts for building Ring on Linux
- Ring Compiler - Add new lines between error messages
- Ring Compiler - Check argument duplication during function definition
- Ring Compiler - Call command - Better error messages
- Ring Compiler - ICO_SETPROPERTY - No arguments are required
- Ring Compiler - ICO_NEWLINE instruction - Check if the previous instruction is ICO_NEWLINE
- Ring Compiler - Don't use ICO_BEFOREEQUAL instruction for the common case (Equal)
- Ring Compiler - Don't pass spaces inside multi-characters operators
- Ring Compiler/VM - String structure - Store small strings in the structure
- Ring VM - Better support for list items of new objects when using lists during defintion
- Ring VM - List() function - Use blocks only if the list size is greater than 30 items
- Ring VM - Better code when deleting lists created using the List() function
- Ring VM - Set the loop variable when using for-in and NULL string
- Ring VM - Better implementation when using the for-in loop and new objects
- Ring VM - Better implementation for deleting the item reference inside the for-in loop variable
- Ring VM - Check the sub list size when using string index (The size must be two [:key = value])
- Ring VM - ring_vm_freetemplists() - Avoid unnecessary lock/unlock when using threads

- Ring VM - Low level function - ringvm_codelist() - Better implementation
- Ring VM - File vmthreads.c renamed to vmthread.c
- Ring VM - FuncCall structure - Removed unused member (nTempMemSizeAtStart)
- Ring VM - ring_vm_stepnumber() and ring_vm_sum() - Use: RING_VM_RETURNIFACTIVECATCH
- Ring VM - ring_state_runcode() - Reset pVM->nPC to instructions count before code eval/executio
- Ring VM - Hash Table - Better performance when using many variables
- Ring VM - Object Attributes - Better performance when checking setter/getter methods
- Ring VM - BraceError() method - Support using This and runtime error messages
- Ring VM - ring_state_free() - Better code for threads support
- Ring VM - ring_vm_eval() - Better code for deleting the byte code
- Ring VM - ring_vm_eval() - Avoid deleting the code when defining new packages
- Ring VM - Eval() - Return NULL (Empty String) if the return command is not used
- Ring VM - Produce runtime error when using a negative value in shift operations
- Ring VM - ring_vm_createtemplist() implementation - Take in mind the PC and OPCode
- Ring VM - Share information about different levels of the memory pool when creating new thread
- Ring VM - ICO_SETREFERENCE - Check the variable list size
- Ring VM - The ICO_FUNCEXE and ICO_ENDFUNCEXE instructions are removed
- Ring VM - The ICO_PRINT and ICO_GIVE instructions are removed
- Ring VM - Produce specific runtime error when using Return inside the function parameters
- Ring VM - Produce runtime error if the list item is not an object and accessed by dot operator
- Ring VM - ring_vm_jumpfor() function - Better code to check if we need to terminate the for loop
- File (meta_e.c) is separated to (meta_e.c) and (vminfo_e.c)

124.19 What is new in Ring 1.21.1?

- Version() function - Optional parameter to display the patch number

Example:

```
? version()
? version(True)
```

Output:

```
1.21
1.21.1
```

- Many animation samples are revised to close the application if the window is closed during animation
- Ring2EXE - Revised lib path when distributing the application for Linux/macOS with specific libraries
- Better implementation for the (Using Lists/Objects During Definition) feature
- Ring Source Code - VM Structure - The position of the pCFunction pointer is revised

124.20 What is new in Ring 1.21.2?

- The SysInfo package has been added to the RingPM Registry
- Display old/new package version during package update
- Package name in the RingPM registry is not case sensitive
- Ring Notepad - Distribute Menu - Better description for the options
- Form Designer - Default value (none) for Text Color when generating the source code
- ring/samples/UsingRayLib/more/ex5_wavingcubes_threads.ring - Better Code
- StdLib - SystemCmd() function - Avoid error if the current directory is not writable
- TempName() function - Better implementation for Linux
- ring/build/buildgcc.sh - Better script (callable from any directory)
- ring/tools - Batch Files - Avoid the (-static) option
- Ring VM - Remove old code related to pFuncCallList

WHAT IS NEW IN RING 1.22

In this chapter we will learn about the changes and new features in Ring 1.22 release.

125.1 List of changes and new features

Ring 1.22 comes with the next features!

- Research Article
- PWCT 2.0 (Free Software)
- More Projects
- Better Samples
- Better Functions
- Better RingFastPro Extension
- Return Attribute by Reference
- Better Compiler
- More Improvements

125.2 Research Article

URL: <https://doi.org/10.3390/electronics13234627>



electronics



Article

Ring: A Lightweight and Versatile Cross-Platform Dynamic Programming Language Developed Using Visual Programming

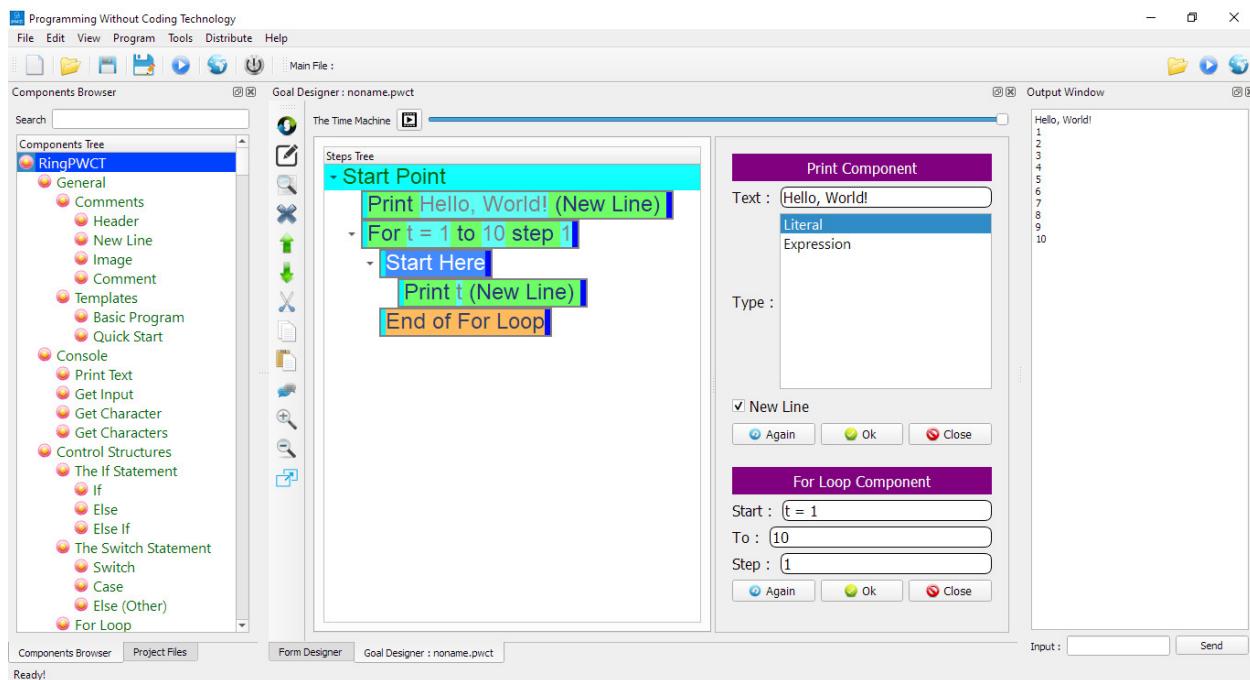


<https://doi.org/10.3390/electronics13234627>

125.3 PWCT 2.0 (Free Software)

Programming Without Coding Technology 2.0 is free software available on the Steam platform.

URL: https://store.steampowered.com/app/1953110/Programming_Without_Coding_Technology_20/



125.4 More Projects

- EpochTime application (ring/applications folder)
- DirSize - Directory Size Analyzer (GitHub project)
- GitHub Action - Build Ring Project (GitHub project)
- Ring Syntax Highlighting for Sublime Text 4 (GitHub project)
- Ring Syntax Highlighting for Lite XL editor (ring/tools/editors folder)

```

> UsingNaturalLib          test1_FirstThread.rin | test2_TwoThreads.rin | test9_DetachedThr... | test8_ThrdExit.rin | test7_MutexTryLoc... | test6_ConditionVa... | test5_MutexLock.rin
> UsingObjectsLib
> UsingOpenGL
> UsingPostgreSQL
> UsingQML
> UsingQt
> UsingQt3D
> UsingQtWASM
> UsingRaylib
> UsingRogueUtil
> UsingSockets
> UsingStbImage
> UsingThreads
>   RingAllegro
>   RingLjlibv
>   RingThreads
>     test1_FirstThread.rin
>     test2_TwoThreads.rin
>     test3_ThreadJoin.rin
>     test4_ManyThreadJo...
>     test5_MutexLock.rin
>     test6_ConditionVaria...
>     test7_MutexTryLock...
>     test8_ThrdExit.rin
>     test9_DetachedThr...
>     test10_ThrdPools.v
> UsingTilengine
> UsingTokensLib
> UsingTraceLib
> UsingTypeHints
> UsingWebLib

1 #include "stdlibcore.ring"
2 #include "threads.ring"
3
4 res = 0
5 # the initial balance is 0
6 balance = 0
7 # mutex variable
8 mutex = new_mtx_t()
9
10 # the deposit amounts... the correct total afterwards should be 500
11 deposit1 = 300
12 deposit2 = 200
13
14 func main
15   # output the balance before the deposits
16   before = read_balance()
17   ?"Before: " + before
18   # we'll create two threads to conduct a deposit using the deposit function
19   thread1 = new_thrd_t()
20   thread2 = new_thrd_t()
21   # initialize the mutex
22   mtx_init(mutex, res)
23   # create threads to run the deposit function with these deposit amounts
24   thrd_create(thread1, "deposit(deposit1)")
25   thrd_create(thread2, "deposit(deposit2)")
26   # join the threads
27   thrd_join(thread1, :res)
28   thrd_join(thread2, :res)
29   # destroy the mutex
30   destroy_mtx_t(mutex)
31   # output the balance after the deposits
32   after = read_balance()
33   ? "After : " + after
34
35 # A simple Bank account function that allows us to read and write

```

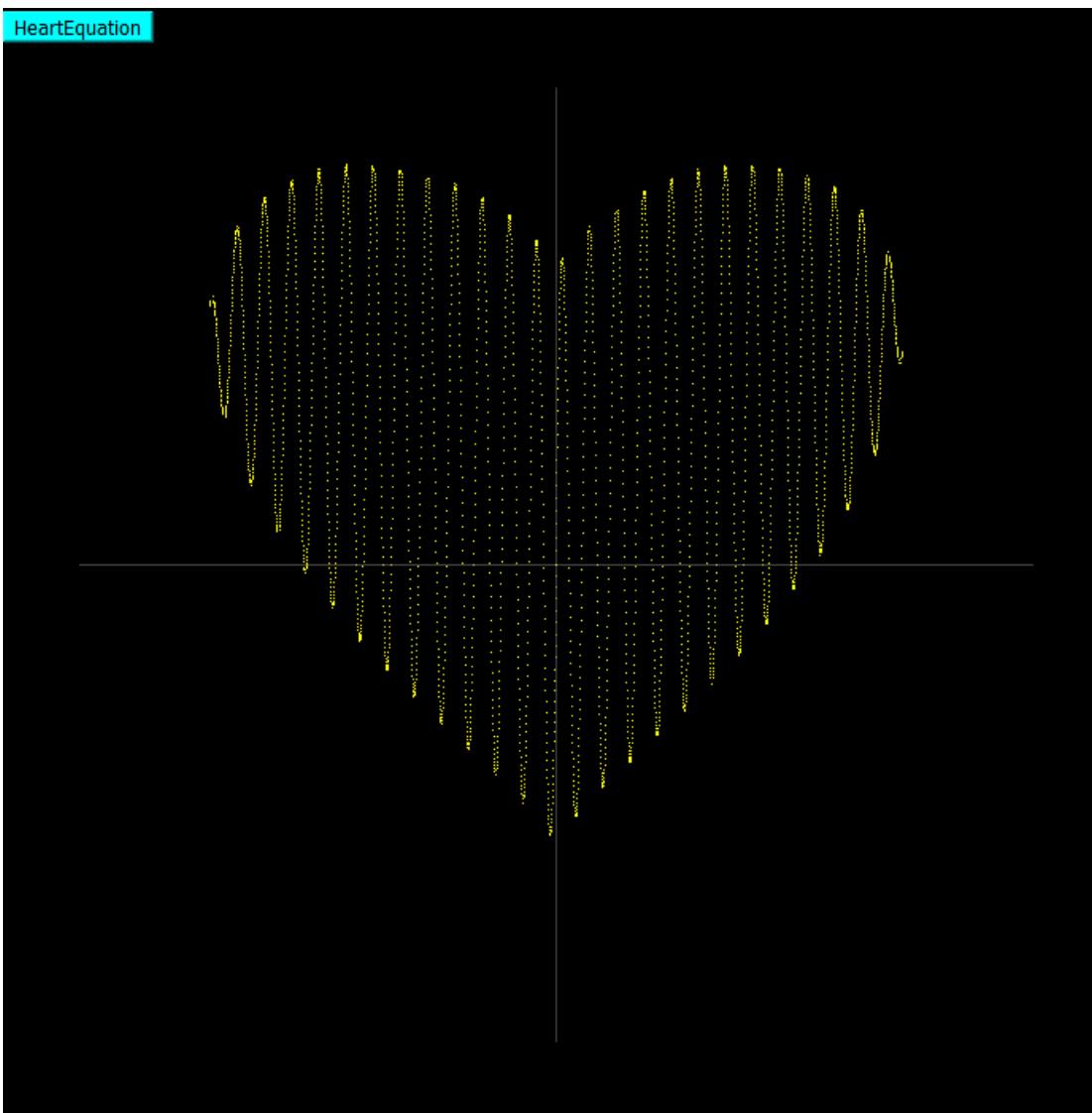
The screenshot shows a code editor with a dark theme. The left sidebar lists various sample files under categories like 'UsingNaturalLib', 'UsingThreads', etc. The main pane displays a Ring script named 'test5_MutexLock.rin'. The script demonstrates the use of threads and mutexes to manage a bank account balance. It includes comments explaining the purpose of each section, such as initializing the mutex, creating threads, and joining them. The code uses standard Ring syntax with functions like 'new_mtx_t()', 'thrd_create()', and 'thrd_join()'. The status bar at the bottom right indicates 'tabs: 2' and '150 lines LF'.

125.5 Better Samples

The next samples are added:

- samples/UsingJSONLib/test11.ring
- samples/General/TriangleLib/TriangleLibrary.ring
- samples/Drawing/HeartEquation/HeartEquation.ring
- samples/Language/ChangeSyntax/swapkeywordandoperator.ring
- samples/ProblemSolving/GetQuotesHistory/Curl-YahooHistory-JSON.ring
- samples/UsingStbImage/test15.ring - Fast Animation
- samples/UsingBingChat/examples/chat13.ring
- samples/UsingFastPro/test2.ring
- samples/UsingFastPro/test3.ring
- samples/UsingFastPro/test4.ring
- samples/UsingFastPro/test5.ring
- samples/UsingFastPro/test6.ring

The following screenshot is from the Heart Equation sample:



The next applications and samples are revised:

- Sokoban - Code Format.
- HoursCounter - User Interface.
- GetQuotesHistory - Better implementation.
- GoldMagic800 - Draw background based on level number.
- Othello - Better colors and images.
- samples/UsingStbImage/test12.ring
- samples/UsingStbImage/test15.ring
- tools/tryringonline/samples.ring

125.6 Better Functions

- StdLib - Split() function - Better implementation.
- StdLib - OSCopyFile() function - Better support for Linux.
- StdLib - OSCopyFolder() function - Better support for Linux.
- StdLib - Factorial() function - Better performance.
- StdLib - Fibonacci() function - Better performance.
- RingQt - QString Class - Added: size()/length() methods.
- ringvm_calllist() function - Added the parameters count and the line number to the output.

Example:

The next Ring code defines a SumRows class that processes and sums rows of numbers given within curly braces. The braceExprEval() method evaluates each value, updating the sum for the current row and printing the sum when the row changes. The braceEnd() method prints the sum of the last row.

```
new SumRows {
    10 20 30          # 60
    10                # 10
    400 100           # 500
    30 40             # 70
}

class SumRows

    nSum      = 0
    nLastRow = 0

    func braceExprEval  value

        aCallList = ringvm_calllist()
        nLine     = aCallList[len(aCallList)-1][7]

        if nLastRow == 0      nLastRow = nLine            nSum = value return ok
        if nLastRow != nLine nLastRow = nLine ? nSum   nSum = value return ok

        nSum += value

    func braceEnd

        ? nSum
```

125.7 Better RingFastPro Extension

- The build script is revised to use the ring/lib directory.
- updateList()/updateColumn() functions - Support Serial/Pow/Rem options.

Example:

The next code begins by loading the RingFastPro extension and initializing a 5x5 list called aList. It then updates this list with values incremented by 5 in each column. After printing a row of 20 asterisks, the code iterates through the list, printing each element with hyphens between them, except for the last element in each row.

```
load "fastpro.ring"

aList = [
    list(5),
    list(5),
    list(5),
    list(5),
    list(5)
]

updateList(aList,:serial,:col,1,0)
updateList(aList,:serial,:col,2,5)
updateList(aList,:serial,:col,3,10)
updateList(aList,:serial,:col,4,15)
updateList(aList,:serial,:col,5,20)

? copy("*",20)

for x=1 to 5
    for y=1 to 5
        print(aList[x][y])
        if y != 5 print ("-") ok
    next
? ""
next
```

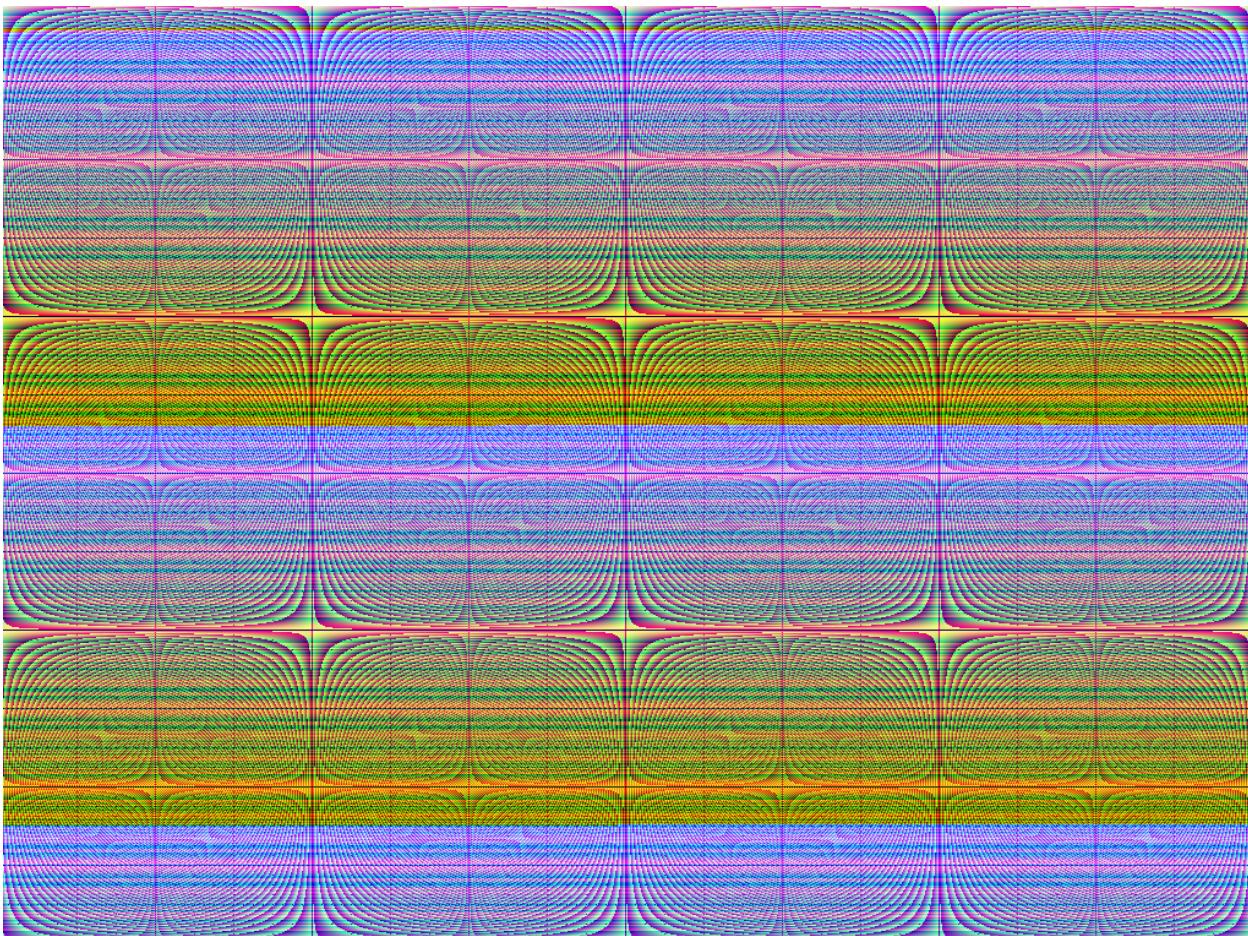
Output:

The output displays a row of asterisks followed by the elements of the list arranged in a structured format.

```
*****
1-6-11-16-21
2-7-12-17-22
3-8-13-18-23
4-9-14-19-24
5-10-15-20-25
```

The following screenshot is from the Fast Animation sample:

The sample uses RingFastPro extension to generate 1024x768 image (Over 60 FPS)



125.8 Return Attribute by Reference

In early Ring releases, returning an attribute that contains a List/Object would return a shared reference to this List/Object. This release supports advanced cases for using this feature, allowing nested method calls before returning the List/Object.

Note: For advanced usage of references with full customization, refer to the ‘Using References’ chapter, which explains the Ref() / Reference() function.

Example:

```
o = new myclass  
  
o.getObject().x = 1000  
o.getObject().y = 2000  
o.getObject().z = 3000  
  
? o.aList
```

(continues on next page)

(continued from previous page)

```

class myclass

    aList = [ new point {x=10 y=20 z=30} ,
              new point {x=100 y=200 z=300}  ]

    func getObject
        return myMethod()

    func myMethod
        return aList[myIndex()]

    func myIndex
        return 2

class point x y z

```

Output:

```

x: 10
y: 20
z: 30
x: 1000
y: 2000
z: 3000

```

125.9 Better Compiler

- Lists - Support trailing comma.
- Support (+) operator before numbers.
- Logical AND have higher precedence than Logical OR.

Example:

```

aList = ["one",
         "two",
         "three",
         ]

nNum1 = +10
nNum2 = -10

lRes  = True OR False AND False
lRes2 = True || False && False

? aList
? nNum1
? nNum2
? lRes
? lRes2

```

Output:

```
one
two
three

10
-10
1           # True
1           # True
```

125.10 More Improvements

- Better documentation - Chapter: Program Structure.
- Form Designer - Copy object style when using the Duplicate button.
- Form Designer - Avoid name duplication when using the Duplicate button.
- Better vscode extension - Ring build system and snippets.
- Better RingQt for Android/WebAssembly - RING_API_REGISTER usage is revised.
- Output the RingPDFGen library to the ring/lib directory and install it accordingly.
- File: buildgccstatic.sh - Make the Ring executable fully static.
- File: marketing/presentation/Ring.pptx - Use https in the website URL.
- File: language/CMakeLists.txt - Use /etc/os-release to get the Distro name.
- Ring Compiler/VM source code - Revise exit() function usage.
- Ring Compiler/VM source code - language/src/stmt.c - Revise comments.
- Ring Compiler/VM source code - language/src/vm.c - Organize the instructions.
- Ring Compiler/VM source code - List structure - Rename members (Use shorter names).
- Ring Visual Source - Added: language/visualsrc/ring_hashlib.ssf

USING OTHER CODE EDITORS

We have extensions for the next editors:

- Notepad++
- Geany
- nano
- Atom
- Sublime Text 2
- Visual Studio IDE
- Emacs
- Visual Studio Code (VSCode)
- SpaceVim
- Lite XL

126.1 Using Notepad++

Folder : ring/tools/editors/notepad_plus_plus

- Open Notepad++
- Open the “Language” menu
- Select “Define your language...”
- Click “Import...”
- select *Ring.xml*
- Select “OK” on the “Import successful” dialog and close the “User Defined Language” dialog/panel
- You may need to restart notepad++

The screenshot shows the Notepad++ interface with the following details:

- Title Bar:** D:\Programmeing_Prog\RingProgramming\Fayed_Ring_1.0_win32_binary_release\bin\note.ring - Notepad++
- Menu Bar:** File, Edit, Search, View, Encoding, Language, Settings, Macro, Run, Plugins, Window, ?
- Toolbar:** Standard file operations (New, Open, Save, Print, Find, Replace, Cut, Copy, Paste, etc.)
- Code Editor:** The main window displays Ring programming code for a GUI application. The code includes:
 - File handling: Load "guilib.ring", Save, Open.
 - User interface: A QMainWindow with a central QWidget containing three QPushButton instances.
 - Properties: Set window title to "Ring Notepad", set geometry to 100x100, 400x400.
 - Buttons:
 - New File button: Image "image/new.png", Click event "pNew()", Tool tip "New File".
 - Open File button: Image "image/open.png", Click event "pOpen()", Tool tip "Open File".
 - Save File button: Image "image/save.png", Click event "pSave()", Tool tip "Save".
- Status Bar:** User Define File - Ring, length: 19238, lines: 773, Ln: 17, Col: 19, Sel: 0 | 0, Dos\Windows, UTF-8, INS

126.2 Using Geany

Folder : ring/tools/editors/geany

- Run Geany editor
 - Click on “Tools -> configuration files -> filetypes_extensions.conf” menu
 - Add this line “Ring=*.ring;” without quotes after [Extensions]
 - In Ubuntu copy file “filetypes.Ring.conf” to folder “/home/USERNAME/filetypes.Ring.conf”
 - You can run your files by pressing F5 button

The screenshot shows two windows. The top window is a code editor titled "new.ring - /home/magdy/ring - Geany". It contains the following Ring script:

```
1 see "What is your name? "
2 give cName
3 see "Hello " + cName + nl
4 #comment
5 /* comment open */
```

The bottom window is a terminal titled "Terminal". It displays the output of running the script:

```
What is your name? Magdy
Hello Magdy

-----
(program exited with code: 0)
Press return to continue
```

126.3 Using nano

Folder : ring/tools/editors/nano

Check the ReadMe file for installation instructions.

```

GNU nano 8.1
#####
### Create Array -- Dimensions Any Size: 3D, 4D, 5D etc (Really a LIST)
### There are 3 Ways to Call | Populate and Display

// First
aDim = [3,4,5,6]           // 1- Multi-Dim-Array of Rows, Cols, Blocks
mArray = newArray(aDim)      // 2- Create the Multi-Dim-Array (Really a LIST))

Populate(aDim)
See "Print aDim: 3,4,5,6: "+nl Print(aDim)

// Second
mArray = newArray([6,5,4,3])    // 1- Populate array using number indexes

Populate([6,5,4,3])
See "Print [6,5,4,3]: "+nl Print([6,5,4,3])

// Third
a=4  b=3  c=6  d= 5          // 1- Assign number to letter
mArray = newArray([a,b,c,d])    // 2- Populate array using letter reference to indexes

Populate([a,b,c,d])
See "Print [a,b,c,d] 4,3,6,5: "+nl Print([a,b,c,d])

```

126.4 Using Atom

Folder : ring/tools/editors/atom

Just Copy the folder atom-language-ring to the next path

"C:\Users\{UserName}\.atom\Packages"

```

186 {
187     script(scriptredirection(cPDF))
188 }
189
190
191 Package System.Web
192
193 Class Application
194
195     cStart = ""
196     cCookies = ""
197     cOutput = ""
198     cCSS = ""
199     Title = "Test"
200     cBody = ""
201
202     lBootstrap = False
203
204     Func DecodeString cstr
205         cStr = cStr + "&"
206         aOutput = []
207         aRes = []

```

126.5 Using Sublime Text 2

Folder : ring/tools/editors/sublime text 2

In the folder Sublime_Text_2 you will find the next three files

- 1 - ring.json-tmlanguage
- 2 - ring.sublime-build
- 3 - ring.tmlanguage

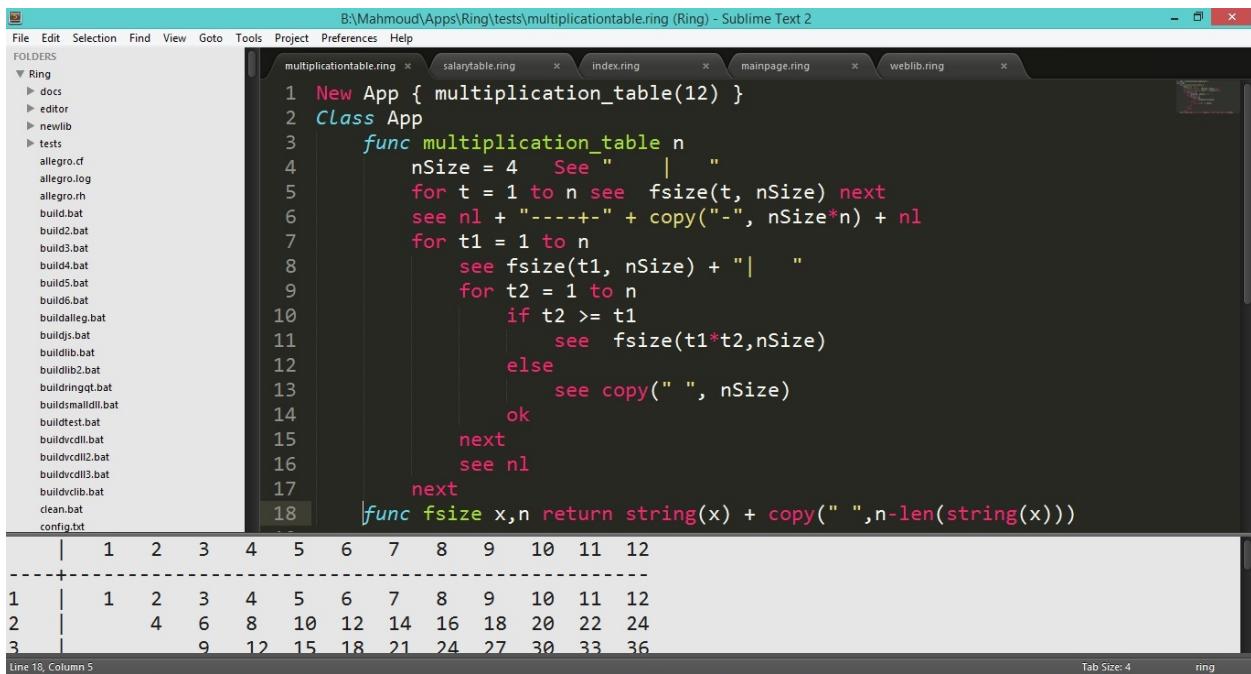
Just Copy the files to the next path

```
"C:\Users\{UserName}\AppData\Roaming\Sublime Text 2\Packages\User\"
```

The file ring.sublime-build includes the next line

```
"cmd": ["B:\\ring\\bin\\ring.exe", "$file"],
```

You can modify it according to the ring.exe path in your machine



The screenshot shows a Sublime Text 2 window with multiple tabs open. The active tab contains Ring script for generating a multiplication table. The code uses a class named App with a function multiplication_table that prints a 12x12 multiplication table. A helper function fsize is defined to calculate the string length of a number. The output pane below the editor shows the generated multiplication table.

```

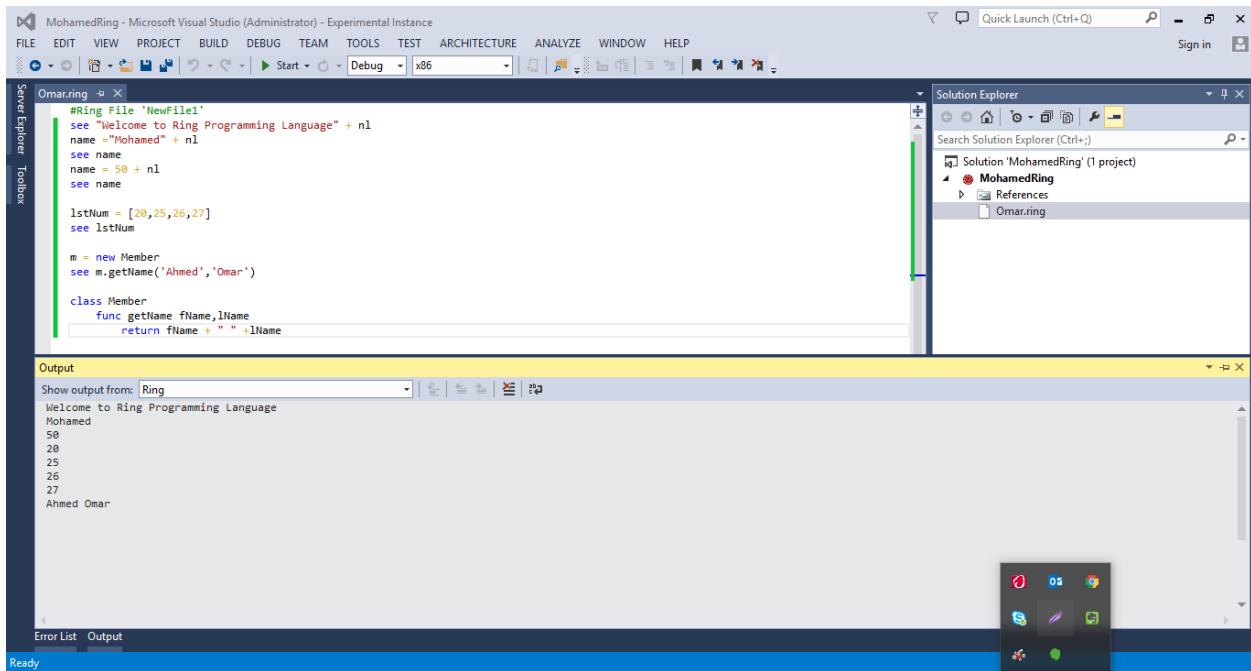
B:\Mahmoud\Apps\Ring\tests\multiplicationtable.ring (Ring) - Sublime Text 2
File Edit Selection Find View Goto Tools Project Preferences Help
FOLDERS
▼ Ring
  ► docs
  ► editor
  ► newlib
  ► tests
  allegro.c
  allegro.log
  allegro.h
  build.bat
  build2.bat
  build3.bat
  build4.bat
  build5.bat
  build6.bat
  build7.bat
  buildalleg.bat
  buildls.bat
  buildlib.bat
  buildlib2.bat
  buildringqt.bat
  buildsmallib.bat
  buildtest.bat
  buildvcl1.bat
  buildvcl2.bat
  buildvcl3.bat
  buildvcl4.bat
  clean.bat
  config.txt
multiplicationtable.ring x salarytable.ring x index.ring x mainpage.ring x weblib.ring x
1 New App { multiplication_table(12) }
2 Class App
3   func multiplication_table n
4     nSize = 4 See " | "
5     for t = 1 to n see fsize(t, nSize) next
6     see nl + "----+" + copy("-", nSize*n) + nl
7     for t1 = 1 to n
8       see fsize(t1, nSize) + " | "
9       for t2 = 1 to n
10         if t2 >= t1
11           see fsize(t1*t2,nSize)
12         else
13           see copy(" ", nSize)
14         ok
15       next
16       see nl
17     next
18   func fsize x,n return string(x) + copy(" ",n-len(string(x)))
| 1 2 3 4 5 6 7 8 9 10 11 12
-----+
1 | 1 2 3 4 5 6 7 8 9 10 11 12
2 | 4 6 8 10 12 14 16 18 20 22 24
3 | 9 12 15 18 21 24 27 30 33 36
Line 18, Column 5
Tab Size: 4

```

126.6 Using Visual Studio IDE

Folder : ring/tools/editors/visualstudio

Check the ReadMe file for installation instructions.



The screenshot shows Microsoft Visual Studio running a Ring application named 'MohamedRing'. The code editor displays a simple Ring script that prints a welcome message and a list of numbers. The output window shows the executed results. The Solution Explorer panel shows the project structure with a file named 'Omaring'.

```

MohamedRing - Microsoft Visual Studio (Administrator) - Experimental Instance
FILE EDIT VIEW PROJECT BUILD DEBUG TEAM TOOLS TEST ARCHITECTURE ANALYZE WINDOW HELP
Server Explorer Toolbox
Omaring - x
#Ring File 'NewFile1'
see "Welcome to Ring Programming Language" + nl
name = "Mohamed" + nl
see name
name = 50 + nl
see name

lstNum = [20,25,26,27]
see lstNum

m = new Member
see m.getName('Ahmed','Omar')

class Member
  func getName fName,lName
    return fName + " " + lName
  endfunc
endclass

Output
Show output from: Ring
Welcome to Ring Programming Language
Mohamed
50
20
25
26
27
Ahmed Omar

Error List Output
Ready

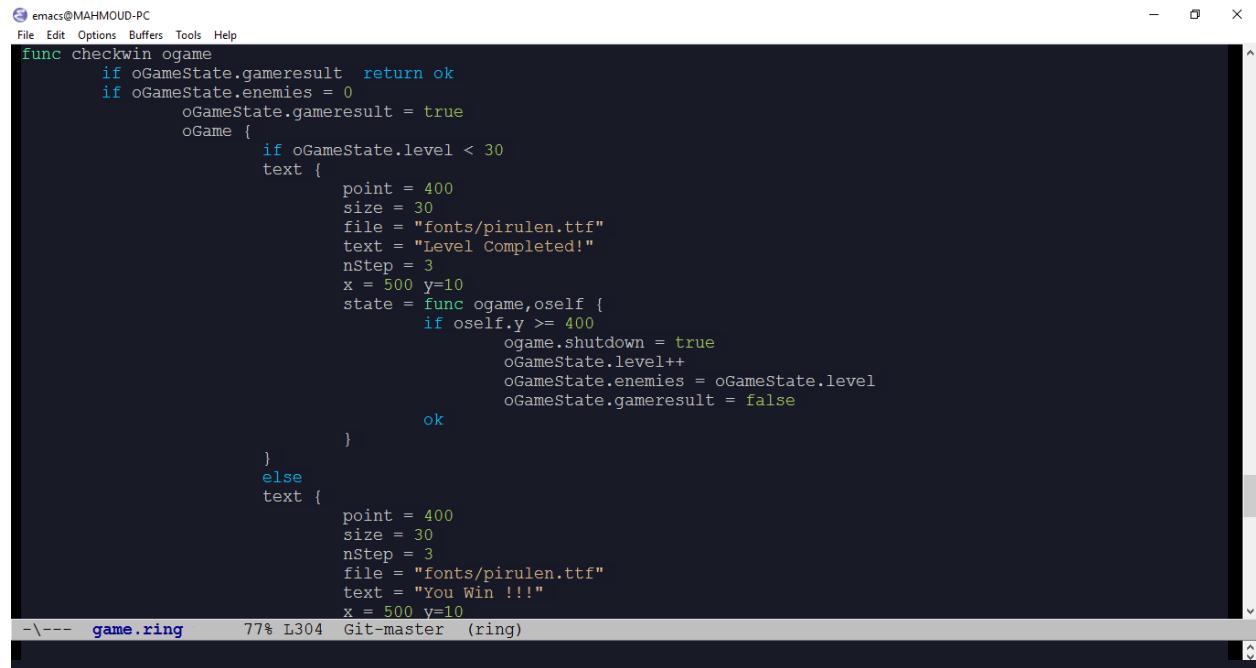
```

126.7 Using Emacs Editor

Folder : ring/tools/editors/emacs

Check the ReadMe file for installation instructions.

Screen Shot:



```

emacs@MAHMOUD-PC
File Edit Options Buffers Tools Help
func checkwin ogame
    if oGameState.gameresult return ok
    if oGameState.enemies = 0
        oGameState.gameresult = true
        oGame {
            if oGameState.level < 30
            text {
                point = 400
                size = 30
                file = "fonts/pirulen.ttf"
                text = "Level Completed!"
                nStep = 3
                x = 500 y=10
                state = func ogame,oself {
                    if oself.y >= 400
                        ogame.shutdown = true
                        oGameState.level++
                        oGameState.enemies = oGameState.level
                        oGameState.gameresult = false
                    ok
                }
            }
            else
            text {
                point = 400
                size = 30
                nStep = 3
                file = "fonts/pirulen.ttf"
                text = "You Win !!!"
                x = 500 y=10
        }
    }
-\\--- game.ring    77% L304  Git-master  (ring)

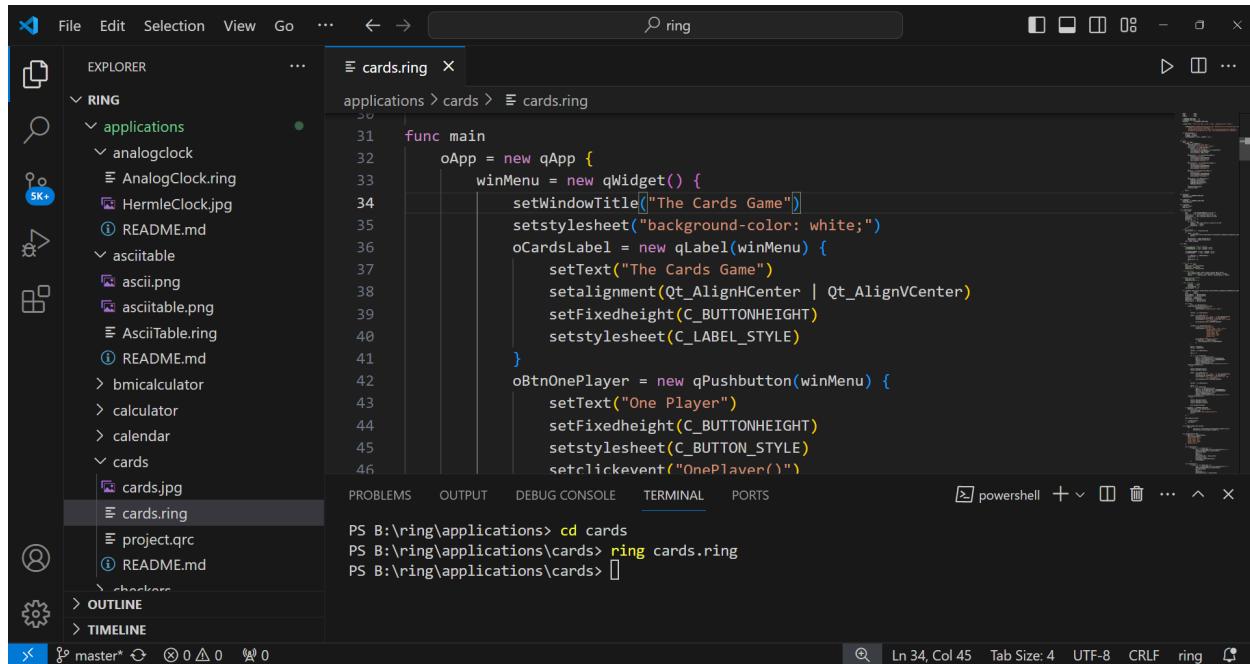
```

126.8 Visual Studio Code

Folder : ring/tools/editors/vscode

Check the ReadMe file for installation instructions.

Screen Shot:



126.9 SpaceVim

URL: <https://github.com/SpaceVim/SpaceVim>

Screen Shot:

The screenshot shows the SpaceVim interface with multiple buffers. The left pane displays a Ring script named 'test.ring' with code that prints 'Hello' and 'Bye!' messages. The right pane shows a terminal buffer where the script is being run. The terminal output shows the program asking for a name ('What is your name?'), receiving input ('Hello wsdjeg'), and then exiting ('[Done] exited with code=0 in 5.751047 seconds'). The status bar at the bottom indicates the terminal is running on 'unix|utf-8' and has two tabs open, with the current tab labeled 'defx'.

```

1 /* 
2  Program Name : My first program using Ring
3  Year        : 2017
4 */
5
6 see "What is your name? "    # print message on screen
7 give cName                  # get input from the user
8 see "Hello " + cName        # say hello
9
10 // See "Bye!"
11

```

126.10 Lite XL

Folder: ring/tools/editors/lite-xl

Screen Shot:

```

1 load "stdlibcore.ring"
2 load "threads.ring"
3
4
5 res = 0
6 # the initial balance is 0
7 balance = 0
8 # mutex variable
9 mutex = new_mtx_t()
10 # the deposit amounts... the correct total afterwards should be 500
11 deposit1 = 300
12 deposit2 = 200
13
14 func main
15 # output the balance before the deposits
16 before = read_balance()
17 ?"Before: " + before
18 # we'll create two threads to conduct a deposit using the deposit function
19 thread1 = new_thrd_t()
20 thread2 = new_thrd_t()
21 # initialize the mutex
22 mtx_init(mutex, res)
23 # create threads to run the deposit function with these deposit amounts
24 thrd_create(thread1,"deposit(deposit1)")
25 thrd_create(thread2,"deposit(deposit2)")
26 # join the threads
27 thrd_join(thread1, :res)
28 thrd_join(thread2, :res)
29 # destroy the mutex
30 destroy_mtx_t(mutex)
31 # output the balance after the deposits
32 after = read_balance()
33 ? "After :" + after
34
35 # A simple Bank account function that allows us to read and write

```

tabs: 2 | 150 lines | LF

FREQUENTLY ASKED QUESTIONS (FAQ)

127.1 Why do we need Yet Another Programming Language (YAPL)?

The language comes with better support for natural language programming and declarative programming. The innovation comes in supporting these paradigms with new practical techniques on the top of object-oriented programming and functional programming. Ring provides the programmers with the tools required to build a natural language like Supernova or a declarative language like REBOL and QML without the need to know anything about (compilers and parsing). You get the language constructs ready for use to create domain-specific languages in a fraction of time.

Take a look at the Supernova programming language, in this language you can type: (I want window and the window title is hello world.) and it will create a GUI window with “Hello, World!” as the window title. When I created Supernova language in 2010, i discovered that using the natural code can be (similar to English and without limits and we can use the power of human language in programming) but to implement that you need a new language that has:

- (1) General Purpose
- (2) Practical
- (3) Can create natural languages very quickly.

So we can get a system that can increase ease of use and productivity to the maximum level.

So I created Ring because it was the best way to achieve this goal.

Supernova was just a test of the idea, it helped getting a better view of the advantages and the disadvantages of the idea. And After testing the new ideas you are provided with something practical. So now we have Ring after Supernova. A story that is maybe similar to having Python after ABC. Where Python avoids the problems of ABC, but keeps the advantages of ABC. Also, Ring learns from Ruby and ROR’s story. The language power could appear in frameworks better than the direct usage as a general purpose language. Also Ring comes with a clear goal/motivation; (Creating a new version of the PWCT Software) something that was learned from the design the C language in a certain way to create the Unix Operating System. In other words, you have a goal that directs you in each design decision.

You will understand the value of our decisions once you start trying to solve the problem that we will use Ring to solve. The questions is: could you enable any one in the world without knowledge about computer programming concepts to create very powerful software? Scientifically the answer is (visual Programming) and (natural Programming). In practice we are still away from switching to these paradigms without introducing other problems. Ring is designed to solve this problem. It is designed to provide natural programming in a practical way. And to create a powerful visual programming tool. Ring is designed to be a new world of programming after 10 years of research in visual programming and natural languages.

The Ring Programming Language (Compiler+VM) is developed 100% using visual programming without writing a single line of code. I used my tool (Programming Without Coding Technology) to design everything and get the C code generated for me.

Advantages ?

- (1) Faster

- (2) No Syntax Errors
- (3) Easy to understand and manage the code because the abstraction level is higher
- (4) No critical disadvantages because you can control everything as writing your code.

Using my experience in using visual programming for 10 years and natural programming for 5 years, I designed Ring to move the knowledge to mainstream programmers by providing a practical language that supports these ideas.

I agree that each programmer/developer has the freedom to form his opinions about any software including programming languages. Ring is not an exception but you may miss the idea behind the language. It is innovative and may help you to think differently about how to solve your problems. Maybe this is not clear to many programmers because It is a practical language and includes many features known to programmers and when a programmer looks at the language they might think that nothing new because it's familiar. I created Ring to solve problems in a different way. Where I will start programming just by describing the software using new natural interfaces that I will implement later when I move from the design stage to the implementation stage. (I don't determine the time to switch between stages, You are free to use Agile methods). Since Ring is a new language you have 3 options:

- (1) To not care at all for now.
- (2) Think of the future of the language and help us if you understand the idea and want to contribute.
- (3) Wait and come back again in the future to use it.

Summary:

- Ring is designed based on a need to develop a new version of the PWCT software.

Once we finish PWCT 2.0 we will have good and large software developed using Ring.

- We will push declarative and natural paradigms many steps forward. Also in next versions

we have a plan to present a new paradigm for network programming and concurrency. We tested this new paradigm through simple prototypes during the last years and we will integrate it with Ring in future releases.

127.2 Which of 3 coding styles are commonly used or recommended by the community?

- (1) **Just select any style of them but don't mix between the different styles in the same project**
or at least in the same context (Implementation, Tests, Scripts, etc)

Note: State the rules in the start of each project and follow it.

- (2) You can create your style (by changing keywords) - The idea is about customization and freedom.

Note: It's better to change keywords and create new style only for a clear reason like using another natural language (Arabic, French, etc.)

- (3) **The First style is better (IMHO) for questions, tutorials and small applications/programs (Less than 5,000 LOC)**
Example : Ring Book, Most of Ring Samples and Applications.
- (4) The Third style is better(IMHO) for large applications and mainstream programmers
Example (Form Designer) : <https://github.com/ring-lang/ring/tree/master/tools/formdesigner>

127.3 What is the Ring Architecture?

We have the next architecture

- (1) Ring Applications (Your Code) - Written in Ring - See folder : ring/applications
- (2) Ring Libraries (StdLib, WebLib, GameEngine, etc) - Written in Ring - See folder : ring/libraries
- (3) Ring Extensions (RingAllegro, RingQt, etc) - Written in C/C++ (may include Ring code) - See folder : ring/extensions
- (4) Ring Virtual Machine (Ring VM) - Written in C language
- (5) Operating System (Current Platform) - (Windows, Linux, macOS, Android, etc)

The extensions are just dynamic libraries (DLL, So, Dylib) You can update the extensions without the need to update your code.

Folder (ring/extensions/libdepwin) =====> C libraries used for building Ring Extensions (written in C) on Windows platform

Folder (ring/libraries) =====> Ring libraries written in Ring itself (StdLib, WebLib, GameEngine, etc)

Folder (ring/language/visualsrc) =====> The Visual Source Code of the Ring Compiler & Ring VM developed using Programming Without Coding Technology (PWCT)

We use the term Ring Library —> When the library code is written in Ring We use the term Ring Extension —> When the library code is Written in C or C++

127.4 What about Memory Management in Ring?

- (1) When we call function, we get a new scope for this function, inside this scope we store variables.

Also we get Temp. memory for this function. Inside this temp. memory we store temp. lists

All of this will be deleted directly after the end of the function call (end of scope)

- (2) In Ring to delete memory, you have the next options

2.1 Wait until the end of the function scope

2.2 Use the Assignment operator

2.3 Use callgc() function (delete temp. lists only)

- (3) Ring Garbage Collector uses Escape Analysis and Reference Counting

In 90% of cases, the Escape Analysis is used so we don't waste time in running the garbage collector We directly know what will be deleted and what will remain in the memory.

https://en.wikipedia.org/wiki/Escape_analysis

In 10% of cases (or less than that) Ring may use Reference Counting.

For example when we pass a list and sub list to a function Ring will pass the lists by reference, but what will happens if we deleted the Parent List? In this case, the Sub List will use reference counting, and when deleting the Parent List, it will stay in memory until the end of the function.

Remember that Ring encourage us to avoid using references, and the Assignment Operator will copy lists by value, so Ring usage of reference counting is very limited to special cases and in most cases the Escape Analysis is enough which is very fast.

Starting from Ring 1.9 we extended the Reference Counting support to Ring Extensions and low level C pointers. So we don't have to care about using `fclose()` when we use `fopen()` for example. and the same for other extensions like RingODBC, RingSQLite, RingMySQL, RingQt, etc.

All of the allocated resources will be cleaned by the Garbage Collector when we finish using it (when we lost the last reference).

127.5 What about Data Representation in Ring?

(1) In Ring, The String is just (Array of bytes)

Ring is 8-bit clean, Each character in the string is 8 bits (1 byte)

So these functions (`Int2Bytes()`, `Float2Bytes()` and `Double2Bytes()`) just return a string.

Also we can store binary data in strings

```
mystring = read("myfile.exe")
```

(2) Remember this, when you think about variables

- Value —> What we have (What we are storing in the computer memory as data) - Low Level Concept
- Type —> What we can do with what we have or how we do things with what we have (Just a Logical Concept)

Computer memory —> Just store [Bytes] - Each byte is 8-bit - (Here we avoid the memory word concept)

These bytes could be grouped together when moved between the memory and the processor registers. Here we have (The register size) and things like 32-bit and 64-bit for example. Also we have the bytes order.

Programming Languages —> Add Types (Just as a concept) to these bytes so we can determine what to do with them and how operations should be done.

And programming language could allow (Type Conversion) —> Because the Type is a logical concept in most cases, What we really have is just data (Bytes, Bytes Count, Bytes Order, etc)

Ring Strings —> You have these bytes (each byte is 8-bit) and Ring know the string size (stored as number in the String structure)

So we don't check the NULL character or add it to the end of the string (Not Required)

All operations inside Ring VM, will check the Ring size and deal with the string as binary data (each character is 8-bit)

In the C language —> The normal case is adding NULL character (0) to the end of each string

And the string functions check this character, This is not suitable for binary data.

Signed vs Unsigned —> Is a logical concept which is important when you do arithmetic operations on the data, but when storing the data, if you will include all of the (8-bits) and will not ignore any of them —> Then don't care.

In Ring, don't think about these details, we are hiding it from you, so you can focus on your application and what you will do.

Think in C when you write C code which could be (based on need) low level code to have control on everything.
—> Good for performance and memory management

Think in Ring when you write Ring code which let you ignore a lot of details and concentrate only on the result —> Good for productivity and delivering software quickly

The good news (We can mix between Ring and C in our projects)

(3) The functions `Int2Bytes()`, `Float2Bytes()` and `Double2Bytes()`

These function take input as (Number) —> Convert it to group of bytes based on the number type (int|float|double) —> Then return a Ring string that contains these bytes

Int2Bytes() —> Ring string (Group of bytes) and the string size = sizeof(int)

Float2Bytes() —> Ring string (Group of bytes) and the string size = sizeof(float)

Double2Bytes() —> Ring string (Group of bytes) and the string size = sizeof(double)

Example:

```
? len( int2bytes(1) )
? len( float2bytes(1) )
? len( double2bytes(1) )
```

Output:

```
4
4
8
```

(4) Storing Numbers

When we use a number, Ring always use the (Double) data type for representing these numbers in memory. This is important to know when we do arithmetic operations on numbers.

But when we convert the number to a String using “” + number or using string(number) we get a string where each digit is represented in 1 byte (Not good idea for storage, but useful for string processing)

If you need the number to be represented in specific size (int|float|double) for storage then use bytes2int(), bytes2float() and bytes2double() when writing the data to binary files.

Ring Number (double) —> int2bytes() - will cast the number from double to int then return the bytes —> 4 bytes (Ring String)

Ring Number (double) —> float2bytes() - will cast the number from double to float then return the bytes —> 4 bytes (Ring String)

Ring Number (double) —> double2bytes() - will use the number (double) to return the bytes —> 8 bytes (Ring String)

The (int) type is used only for internal Ring operations, but Ring applications|code will use only the (double) type for numbers.

(5) The Unsigned() Function

The function unsigned() expect the first and the second parameters as numbers

```
unsigned(nNumber1,nNumber2,cOperator)
```

We can use the bytes2int() function to convert the bytes to a number

Example:

```
B = list(4)

for k=1 to 4
{
    B[k]= Space(4)
    for kk=1 to 4 { B[k][kk]= char(60+4*k +kk) }
    ? " B" +k +"": " +B[k]
}
```

(continues on next page)

(continued from previous page)

```

A12= Space(4)      A12= bytes2int(B[1]) ^ bytes2int(B[2])
? "A12: " +string(A12)
A34= Space(4)      A34= bytes2int(B[3]) ^ bytes2int(B[4])
? "A34: " +string(A34)
A12= space(4)      A12= Unsigned(bytes2int(B[1]),bytes2int(B[2]),"^")
? "unsigned A12: " +A12
A34= space(4)      A34= Unsigned(bytes2int(B[3]),bytes2int(B[4]),"^")
? "unsigned A34: " +A34

```

Output:

```

B1: ABCD
B2: EFGH
B3: IJKL
B4: MNOP
A12: 201589764
A34: 470025220
unsigned A12: 201589764
unsigned A34: 470025220

```

127.6 Why is Ring weakly typed?

Because it's faster and more natural, and this is important for the language's goals. One of the rules is: the data type at the beginning affects the final result. For example, when you type "Print : " + 5 , The String comes first, so 5 will be converted to a String. While when you type 5 + "10" The number comes first so "10" will be converted to 10. This helps a lot to quickly convert between numbers and strings using the same operator. If you want to prevent conversion (Write code that prevent conversion) In these cases you will notice that what you are writing is less code (And can be removed).

Weakly typed = automatic conversion and *automatic* is *good thing* and is better than *manual* if you know how to use it correctly.

127.7 What are the advantages to using Ring over Lisp or Smalltalk?

Smalltalk and Lisp are GREAT languages. I like many of the concepts behind them but I'm sure that selecting the right programming language is based on the problem and comes after the problem's definition. I have a problem that I want to solve and these GREAT languages are not ideal for this problem so I designed Ring.

When you design a new language, You can learn from the past but you must look forward and live in the future. What you know about natural programming maybe based on the *old knowledge* about the power of these paradigms in the practical world and I agree with you but I see other techniques that can be applied to get this to work in practice. What you miss about *natural language* is that they are *context sensitive* and this means we can use it and think differently about how we can express our ideas.

Example : I want window contains 3 buttons.

In one sentence I created 4 objects (The window and the three buttons) and added the buttons to the window. The idea of natural programming is to get many things done like that.

127.8 Why is Ring largely focused on UI creation?

Yes UI creation is one of the important things in the language features because it is designed to create a visual programming tool. But the language is a multi-paradigm language where we can select the programming paradigm based on the problem.

127.9 Is Ring some sort of an improvement of PHP?

Ring is not designed to replace PHP, Lua or Smalltalk. Ring's support for declarative programming and natural language programming is very innovative and much better than staying with procedural, object-oriented and functional languages. Ring see the future in programming without code (using natural languages) and is designed to support that.

127.10 What are the advantages of using Ring over native C or C++?

Ring provides a better way to mix between different programming paradigms in solving problems.

The different programming paradigms play well together in the same language.

(1) It's easy to switch from one programming paradigm to another one because the language constructs use similar syntax for similar concepts.

(2) The paradigms are provided to interact and used together in different layers in the software.

for example you can create a game engine using object-oriented programming but write the game code using declarative programming or natural programming and behind the scenes your declarative or natural code will use the object-oriented classes.

(3) Ring is more productive and natural than C/C++.

(4) Ring is a dynamic language. We can generate and execute code during the runtime. Ring is dynamically typed and weakly typed for flexibility.

(5) The Garbage collector is generational (escape analysis) and also uses reference counting. it's very fast and still provides control to the programmer who can delete memory at any time.

(6) Ring's compiler and virtual machine are just 20,000 lines of ANSI C code that can be compiled and used in any platform.

(7) You can use C/C++ libraries and Ring comes with code generator to create wrappers from C functions or C++ classes. so when you need more performance or when you need to use more libraries you can easily do that.

127.11 What is the difference between Ring and Python? And is Ring Open Source?

Yes the language is Open Source (MIT license)

In general I like Python and Ruby but I was looking for a language more suitable for creating the next version of the Programming Without Coding Technology (PWCT) software so I started the Ring design.

Some simple changes that matters for my goal are

(1) Not case sensitive

(2) The list index start from 1

- (3) You can call functions before definition
- (4) Don't use Python syntax like (indentation, using self, :, pass & _)
- (5) Weakly typed (convert automatically between types based on context)
- (6) The programs follow simple and constant structure (Statements then functions then packages and classes)
- (7) Using the '=' operator for assignment and for testing values

Critical changes are

- (1) Small Language : The Ring compiler + Virtual Machine = 15K lines of C code , the other 500K lines are related to libraries and are optional when we go for using the language in C/C++ programs.
- (2) The Garbage collector : Uses Escape Analysis/Reference counting and give the programmer the ability to determine when to delete memory using the assignment operator
- (3) Compact Syntax : Ring is not line sensitive, you don't need to write ; or press ENTER to separate between statements
- (4) Using { } to access the object then using the object attributes and methods directly
- (5) Natural Programming : It's very easy to create natural interfaces using Ring based on OOP
- (6) Declarative Programming using Nested Structure

The Ring programming language is designed based on my experience from using many other languages like C, C++, C#, Lua, PHP, Python, Ruby, Harbour, Basic and Supernova And the language comes with innovative features added to achieve the language goal

- Applications programming language.
- Productivity and developing high quality solutions that can scale.
- Small and fast language that can be embedded in C/C++ projects.
- Simple language that can be used in education and introducing Compiler/VM concepts.
- General-Purpose language that can be used for creating domain-specific libraries, frameworks and tools.
- Practical language designed for creating the next version of the Programming Without Coding Technology software.

127.12 What are the advantages to using Ring over Perl, PHP, Python or Ruby?

- (1) Ring is New and Innovative. The language will let you think different about programming.
- (2) Ring is Smaller. (Lessons learned from the Lua language)
- (3) Ring is Simple. (Lessons learned from the BASIC and Clipper/Harbour languages)
- (4) Ring is more Natural. (Lessons learned from the Supernova language)
- (5) Ring is more Declarative. (Lessons learned from REBOL and QML languages)
- (6) Ring Implementation is Transparent, Visual and comes with Rich Features.

127.13 What are the advantages to using Ring over Tcl or Lua?

- (1) Clean Code (More Natural)
- (2) More Features (A lot of useful programming paradigms)

127.14 What are the advantages to using Ring over C# or Java?

- (1) Compact Code (Clean and Natural), More Productivity and Flexibility.
- (2) Better support for Declarative Programming and Natural Programming

127.15 The documentation says functional programming is supported, but then this happens?

The question was about this code

```
f = func {
    a = 42
    return func { return a }
}

innerF = call f()
call innerF()
```

Output:

```
Using uninitialized variable : a In function _ring_anonymous_func_16601()
```

The Answer:

- It's Anonymous Functions, i.e. Not Closures.
- Many developers asked about supporting Closures and during language development we may add new features that doesn't go against the language goals or spirit.
- You can use classes and objects when you want to merge between the state and functions to provide a clear solution.
- You can use Lists and put the anonymous function inside the List then return the list that contains the state and the function. Pass the list to the function when you use it.
- You can use eval() and substr() to add the variable value directly to the anonymous function before return.
- We protect you from other scopes when you define the function. In Ring we provided the Three Scopes Rule where at each point you have only at maximum three scopes (Global, Object Scope and Local Scope).
- We don't get everything from everywhere to be like others! We don't need to do that. If we will think like that then we will create a very complex language or we will save our time and use other languages.
- When you think about learning or studying a new language concentrate about (What is new?) and (What is better in this language?) to know when to use it. Don't compare a new language just released little months ago with languages started many years ago and expect to find everything that you used to have.

- Each programming language miss features in other languages. The idea is not the Features. it's the spirit and ability behind all of the features together.

127.16 Why the ability to define your own languages Instead of parsing?

It's innovation - You create natural statements without the need to learn about parsing. You just use Classes which is intelligent decision (where later we can mix between classes to support more statements based on the context - We can change and translate the defined statements and many more!). Also the statements are added in Ring World where you can use any Ring statement.

127.17 Why you can specify the number of loops you want to break out of?

The language supports programming in the small and programming in the large. The selection of what features to use is based on what are you going to do. Any programmer can write poorly code in any language if he/she wants to do that. The idea is what must be done in the language design to prevent errors without causing other problems like killing flexibility.

Read some source code in the Linux Kernel and Ruby Implementation for example, You will find good usage for GOTO as a practical example that General Rules are not for All Use Cases and great programmers know when to break the rules. I'm not saying go and use GOTO or saying Ring add things like that. But the ability to break more than one loop and/or the ability to break the loop from sub functions is practical for small programs.

Anyway these are some of the small new things added by the language (Not the big idea).

127.18 Why Ring uses ‘See’, ‘Give’, ‘But’ and ‘Ok’ Keywords?

See and Give are selected not to be “opposite actions” but to reflect what I want to do as a programmer.

When I want to see something on the screen I use ‘See’.

When I want to give some input to the program I use ‘Give’.

My selection of “but” and “ok” is based on selecting keywords that can be written quickly.

Also using “but” is easy to remember than elseif/elif/elsif where each language select a different keyword.

In Ring 1.1 and later versions All of this is just an option.

You can use ‘Put’ and ‘Get’ instead of ‘See’ and ‘Give’

You can use ‘elseif’ and ‘end’ instead of ‘But’ and ‘Ok’

It’s your choice. In Ring we have syntax flexibility where we provide more than one style.

Also you can change the language keywords and operators.

Also you can define new natural languages too.

127.19 What is the philosophy behind data types in Ring?

The Ring programming language is designed to be SMALL. The language provides the basic constructs that you need to do anything! One of the goals is to keep the basic constructs simple and small as possible.

Using Lists in Ring you can

- Create Arrays (one data type)
- Create Lists (Mix of data types)
- Create Tree (Nested arrays)
- Use String Index (Looks like Dictionary/Hash Table)

The same principle is applied to Numbers

- You can use the number for int value
- You can use the number for double value
- You can use the number for Boolean value (True/False)

The sample principle is applied for Strings

- You can use the string for storing one character
- You can use the string for storing text (one or many lines)
- You can use the string for storing binary data
- You can use the string for storing date
- You can use the string for storing time
- You can use the string for storing NULL values (empty strings)

And we have Object Oriented Support + Operator Overloading where the programmer can define new data types and use them as default types defined by the language

So We have

- A small and simple language that someone can pick in little days
- A fast language that provide primitive types (String - Number - List - Object)
- A flexible language that can be extended using OOP to add new types according to the application domain

127.20 What about the Boolean values in Ring?

You can use true for 1 and false for 0

when you test the result of Boolean expressions in your code.

Just when you print the value using the see command you will see 1 for (true) and 0 for (false)

Why ?

Because Ring contains only 4 types of variables

- (1) Number
- (2) String
- (3) List

(4) Object

The first type (Number) is used to represent int, double and Boolean values.

The second type (String) is used to represent char, array of characters, date and time.

The third type (List) is used to represent Arrays of one type, Arrays of more than one type, Hash (Dictionary), Tree, etc.

The object can be an object created from a Ring class (Any Class) or just a C Pointer that we get from calling a C/C++ function/method.

Why ?

The Ring is designed to give the programmer/developer the most simple constructs that can be used to do everything. The programmer/developer can customize the language by creating new classes (and use operator overloading) to get more types that he care about according to the problem domain.

Why ?

Because simple is better, and easy to learn and remember! And this provide flexibility to convert between high level types that can be represented using the same basic type

127.21 What is the goal of including the “Main” function in Ring?

The main function is very important, you need it when you want to write statements that uses local variables instead of the Global scope.

Example:

```
x = 10
myfunc()
See "X value = " + X # here I expect that x will be (10)
# but I will get another value (6) because myfunc() uses x !
Func myfunc
  for x = 1 to 5
    See x + nl
  next
```

Output:

```
1
2
3
4
5
X value = 6
```

Now using the Main function

```
Func Main
x = 10
myfunc()
See "X value = " + X

Func myfunc
  for x = 1 to 5
```

(continues on next page)

(continued from previous page)

See `x + nl`
next

Output

```
1
2
3
4
5
X value = 10
```

127.22 Why the list index start from 1 in Ring?

It's about how we count in the real world, when we have three apples in our hand

we say 1 2 3

We don't start from 0

The question must be why the other languages start from 0 ?

The answer is, because this is related to the machine and how we deal with values and memory address.

Example

we have array called myarray[5]

In memory : myarray will have an address

The first item will be stored in that address

The second item will come after that address and so on

Now when we need to point to the first item we need the address of myarray

So we type myarray[0] because myarray + 0 result will still point to the first item

for the second item myarray[1] because myarray + 1 result will point to the second item and so on

In Low Level languages or languages near to the machine it's good to be like this

But for high level language designed for applications it's better to be natural

Example

```
mylist = [1,2,3,4,5]
for x = 1 to len(mylist)
    see x + nl
next
```

In the previous example we start from 1 to the length of the array if the index starts from 0 we will write

```
for x = 0 to len(mylist)-1
```

or remember the for loop in other languages

```
for(x=0 ; x<nMax ; x++ )
```

You will use the < operator !

127.23 Why Ring is not case-sensitive?

- (1) To be more human-friendly
- (2) Like Ada, SQL, Pascal, Delphi, Visual Basic, Visual FoxPro, etc.
- (3) To help in supporting Natural Language Programming.
- (4) To be able to select your favorite style when writing the language keywords

`see "lower case!"`

`SEE "UPPER case!"`

`See "First Letter is UPPER case!"`

- (5) To avoid getting error message when writing quick tests then type “variable” instead of “Variable”.
- (6) To avoid getting error message when you type “Dosomething()” instead of “doSomething()”
- (7) In Ring, No conflict between Variables, Method Names & Classes Names

We can write person as variable name and Person as class name.

```
person = new Person
class Person
    name address phone
```

127.24 Why the Assignment operator uses Deep Copy?

“Because it’s a poor tradeoff to add complexity for dubious performance gains, a good approach to deep vs. shallow copies is to prefer deep copies until proven otherwise.”

, Steve McConnell, Code Complete

- (1) It’s more natural, When you use the assignment operator, You expect a deep copy.
- (2) If you don’t need a deep copy, Just don’t use it!
- (3) The Ring language is designed to reduce references usage as much as possible.
- (4) The Ring language is designed to make using references simple and possible in special cases where this make sense.
- (5) **We have references when this is natural, like passing lists and objects to functions,**
creating objects (Like GUI Objects) from a C/C++ library, returning an object stored inside a list.
- (6) **It is a feature, We can use it to create pure functions. The Value() function in the**
stdlib uses this feature to pass lists & objects by value when we need this.
- (7) When we need references, It’s recommended to create a class that manage sharing lists and objects.
- (8) It’s more safe at the application level to avoid many logical errors.

- (9) **In Ring, we start without thinking about the little details and concentrate on the application, You**
don't have to write the type (Dynamic Typing), You don't have to write explicit conversions between numbers and strings (Weakly Typed) and you don't have to select between using values or references, You don't have to write the scope (Lexical Scoping).
- (10) **In Ring, we have smart garbage collector (Simple & Fast), We can delete the memory directly**
at any time using the Assignment operator too. Reducing references usage or using them through managers helps a lot to achieve this goal. by doing this we have full control.
- (11) **If you want to create unmanaged pointers and avoid creating a manager,**
You can use Object2Pointer() and Pointer2Object() functions But It's not the Ring way "Spirit" to do things.
- (12) Starting from Ring 1.18, Ring comes with the Ref() function that can be used to create safe references.

127.25 Is there constructor methods in Ring?

When you create new object for example

```
new point
```

- 1 - Ring will allocate dynamic memory space to be used for the new object attributes that Ring doesn't know anything about them.
- 2 - Ring will change the current local scope and the current object scope to use the object state created in step (1)
- 3 - Ring will move the execution to the class Region (After the class name and before any methods)
- 4 - Any Instructions/Code in the class region will be executed as any Ring code
- 5 - Control is moved from the class region to the location of (new point) once we reach the end of the class region or we uses a Return command.

So All attributes that added to the object are dynamic attributes, this mean that you can control what attributes will be added through the runtime.

Example:

```
$3D = False
see new point
$3D = True
see new point

class point
    x y
    if not $3D return ok
    z
```

Output:

```
x: NULL
y: NULL
x: NULL
y: NULL
z: NULL
```

You have an option to call init() method directly when you create a new object

This method can do anything with the object attributes as it will be called after creating the object and executing the class region code.

```
p1 = new point3d(100,200,300)
see p1

class point3d
    x y z
    func init p1,p2,p3
        x=p1 y=p2 z=p3
```

127.26 What happens when we create a new object?

- 1- When you create an object, the class region code will be executed and you will have the object attributes based on the code in that region
- 2- Ring don't care about the object methods until you start calling a method
- 3- When you call a method, Ring will check the object class and the class parent (if you are using inheritance) and will collect the methods for you to be used now or later from any object that belong to the same class.
- 4- Since methods are dynamic and each object get the method from the class, you can after creating objects, add new methods and use it with the object or any object created or will be created from the same class.

Example:

```
o1 = new point {x=10 y=20 z=30}
o2 = new point {x=100 y=200 z =300}

addmethod(o1, "print", func { see x + nl + y + nl + z + nl } )

o1.print()
o2.print()

class point x y z
```

Output:

```
10
20
30
100
200
300
```

127.27 Can we use the attributes by accessing the Getter and Setter methods?

Yes we can, The setter/getter methods are called automatically when you start using the attributes from outside the class Also you can call the methods instead of using the attributes. It's your choice.

Example:

```

o1 = new Developer
o1.name = "Mahmoud"  see o1.name + nl
o1 { name = "Gal"   see name }
o1 { name = "Bert"  see name }

o1.setname("Marino")
see o1.getname()

Class Developer

    name language = "Ring Programming Language"

    func setname value
        see "Message from SetName() Function!" + nl
        name = value + " - " + language

    func getname
        see "Message from GetName() Function!" + nl + nl
        return "Mr. " + name + nl

```

Output

```

Message from SetName() Function!
Message from GetName() Function!

Mr. Mahmoud - Ring Programming Language

Message from SetName() Function!
Message from GetName() Function!

Mr. Gal - Ring Programming Language
Message from SetName() Function!
Message from GetName() Function!

Mr. Bert - Ring Programming Language
Message from SetName() Function!
Message from GetName() Function!

Mr. Marino - Ring Programming Language

```

127.28 Why should a search of global names be made while defining the class attributes?

The question is why we don't avoid conflicts with global variable names when we define the class attributes ?

At first remember that using the optional \$ mark in the global variables names solve the problem. Also using the Main function and avoiding global variables may help.

The Answer:

Ring is a dynamic language

We can in the run-time determine the class attributes (Add/Remove)

We can execute (any code) while defining the class attributes

Example (1)

```
oPerson = new Person
Class Person
See "Welcome to the Ring language"
```

Example (2)

Customize attributes based on global variable value

```
$debug = true
oPerson = new Person
see oPerson
Class Person
if $debug date=date() time=time() ok
```

In the previous example when we have the \$debug flag set to true, we will add the Date and Time attributes to the object state.

Example (3)

Store the object index based on global variable

```
$ObjectsCount = 0
oPerson = new Person
see oPerson
oPerson2 = new Person
see oPerson2
Class Person
$ObjectsCount++
nIndex = $ObjectsCount
```

Output:

```
nindex: 1.000000
nindex: 2.000000
```

Common Example:

- Connect to the database then get table columns (Using global Variable/Object).
- Create class attributes based on the column names.
- Later when you modify the database - you may don't need to modify your code.

It's flexibility but remember that power comes with great responsibility.

127.29 Why Ring doesn't avoid the conflict between Global Variables and Class Attributes Names?

In this use case we have

- 1 - Global Variable defined without a special mark like \$
- 2 - Class contains Attributes defined using a special syntax (where we type the attribute name directly after the class)
- 3 - The Attributes are defined in the class region that allows writing code and using global variables

If I will accepted your proposal about changing how Ring find variables in the class region I must break one of the previous three features which will lead to more problems.

I don't like changing the feature number (1) because I would like to keep Ring code more clean and let the programmer decide when to use \$ or not.

I don't like changing the feature number (2) because I like this feature and I don't like forcing the programmer to type self.attribute

I don't like changing the feature number (3) because it's very important in many applications to access global variables in the class region.

So what was my decision ?

I decided to leave this case for the programmer who will decide what to do to avoid this special case

- 1 - The programmer can avoid using global variables (Better) and can use the Main function (Optional)
- 2 - The programmer can use \$ before the variable name or any mark like **global_** or **g_**
- 3 - The programmer can use self.attribute after the class name to define the attributes
- 4 - Ring have a nice feature through the (load package) command which load a Ring source file in a new global scope different from the global scope used by the caller.

In general, for small programs you can use global variables and functions. For large programs, use classes and objects and small number of global variables or avoid them at all.

127.30 Where can I write a program and execute it?

Run the Ring Notepad where you can write/execute programs.

If you want to run programs using the command line

Add Ring/bin folder to the path then

```
ring <filename.ring>|<filename.ringo>
```

127.31 How to get the file size using `fseek()` and `fseek()` functions?

The next function can be used to get the file size without reading the file!

```
func getFileSize fp
    C_FILESTART = 0
    C_FILEEND = 2
    fseek(fp, 0, C_FILEEND)
    nFileSize = ftell(fp)
    fseek(fp, 0, C_FILESTART)
    return nFileSize
```

Note: The previous function take the fp (file pointer) as parameter, We can get the fp from opening the file using `fopen()` function.

```
fp = fopen("filename", "r")
see "File Size : " + getFileSize(fp) + nl
```

Another solution (Read the file)

```
see len(read("filename"))
```

127.32 How to get the current source file path?

We can use the next function to get the current source file path then we can add the path variable to the file name

```
cPath = CurrentPath()
func currentpath
    cFileName = filename()
    for x = len(cFileName) to 1 step -1
        if cFileName[x] = "/"
            return left(cFileName, x-1)
        ok
    next
    return cFileName
```

Note: We can use the function `JustFilePath()` from the `stdlibcore.ring`

127.33 What about predefined parameters or optional parameters in functions?

if you want to use predefined parameters or optional parameters Just accept a list that works like hash/dictionary

Example

```
sum([ :a = 1, :b = 2])
sum([ :a = 1 ])
sum([ :b = 2 ])
func sum pList
    if plist[:a] = NULL pList[:a] = 4 ok
    if plist[:b] = NULL pList[:b] = 5 ok
    see pList[:a] + pList[:b] + nl
```

Output

```
3
6
6
```

127.34 How to print keys or values only in List/Dictionary?

If you want to print keys only or values only just select the index of the item (one or two).

Example

```
C_COUNTRY = 1
C_CITY = 2
mylist = [
    :KSA = "Riyadh" ,
    :Egypt = "Cairo"
]

for x in mylist
    see x[C_COUNTRY] + nl
next

for x in mylist
    see x[C_CITY] + nl
next
```

Output

```
ksa
egypt
Riyadh
Cairo
```

127.35 Why I get a strange result when printing nl with lists?

In the next code

```
list = 1:5      # list = [1,2,3,4,5]
see list + nl
```

New Line will be added to the list then the list will be printed, the default print of the lists will print a newline at the end, You added new newline and You have now 2 newlines to be printed.

See <Expr>

The see command just print the final result of the expression, the expression will be evaluated as it

```
nl = char(13) + char(10) # just a variable that you can change to anything !
```

The + is an operator

```
string + string ---> new string
string + number ---> new string
number + number ---> new number
number + string ---> new number
```

list + item —> nothing new will be created but the item will be added to the same list

Exception

number + nl -> New String

This exception is added to easily print numbers then new line.

No need for this with printing lists because after printing the last item we already get a new line.

127.36 Could you explain the output of the StrCmp() function?

At first remember that you can check strings using '=' operator directly.

```
see strcmp("hello","hello") + nl +
strcmp("abc","bcd") + nl +
strcmp("bcd","abc") + nl
```

if the two strings are the same then it returns 0

abc and bcd aren't the same. in the second line it returns -1 and in the third line it returns 1

In the second line we compare between "abc" and "bcd"

Not equal because the first letter in "abc" = "a" and the first letter in "bcd" = "b"

So we have "a" != "b" and "a" < "b"

So we get output = -1

In the third line we have "bcd" and "abc"

the first letter in "bcd" is "b" and the first letter in "abc" is "a"

So we have "b" != "a" and "b" > "a"

So we get output = 1

Note: ASCII("a") = 97 and ASCII("b") = 98 So "a" < "b" because 97 < 98

127.37 How to use many source code files in the project?

Example:

I have the next folder

```
C:\LRing
```

Contains the next files

```
C:\LRing\t1.ring
C:\LRing\mylib.ring
C:\LRing\libs\mylib2.ring
```

The file t1.ring contains the next code

```
load "mylib.ring"
load "libs\mylib2.ring"
myfunc()
test()
```

The file mylib.ring contains the next code

```
func myfunc
    see "message from myfunc"+nl
```

The file libsmylib2.ring contains the next code

```
func test
    see "message from test" + nl
```

from the folder C:LRing

If Ring is not added to the path you can add it or use the next command

```
set path=%path%;c:\ring\bin;
```

Where c:ring is the Ring folder

Now run

```
Ring t1.ring
```

Output

```
message from myfunc
message from test
```

127.38 Why this example use the GetChar() twice?

The GetChar() function accept one character from the keyboard buffer

In this example

```
While True
    See "
        Main Menu
        (1) Say Hello
        (2) Exit
    "
    Option = GetChar()
    GetChar() GetChar() # End of line
# the previous two lines can be replaced with the next line
# Give Option

    if Option = 1
        see "Enter your name : " give cName
        see "Hello " + cName
    else
        bye
    ok
End
```

We uses GetChar() Three times

The first time we get the user option

```
Option = GetChar()
```

But in the second and the third times (We accept the new line characters from the buffer)

```
GetChar() GetChar() # End of line
```

Example : when the user select the option number 1 then press ENTER

We have Three Characters

- The first character is : Number 1
- The second character is : CHAR(13)
- The third character is : CHAR(10)

Because Windows uses CHAR(13) and CHAR(10) for each new line (i.e. CR+LF)

127.39 How to use NULL and ISNULL() function?

when we try to use uninitialized variable in the Ring programming language, we get a clear runtime error message

Example

See x

Output

```
Line 1 Error (R24) : Using uninitialized variable : x
in file tests\seeuninit.ring
```

The same happens when you try to access uninitialized attributes

Example

```
o1 = new point
see o1
see o1.x
class point x y z
```

Output

```
x: NULL
y: NULL
z: NULL
```

```
Line 3 Error (R24) : Using uninitialized variable : x
in file tests\seeuninit2.ring
```

if you want to check for the error, just use Try/Catch/End

```
Try
    see x
Catch
    See "Sorry, We can't use x!" + nl
Done
```

Output

```
Sorry, We can't use x!
```

Now we will talk about NULL and ISNULL()

Since we get error message when we deal with uninitialized variables

We can check these errors using Try/Catch/Done, So we uses NULL and ISNULL() for dealing with Strings.

NULL is a variable contains an empty string

ISNULL() is a function that returns true (1) if the input is an empty string or just a string contains “NULL”

This because we need to test these values (empty strings) and strings contains “NULL” that sometimes come from external resource like DBMS.

Example

```
See IsNull(5) + nl +      # print 0
IsNull("hello") + nl +    # print 0
IsNull([1,3,5]) + nl +    # print 0
IsNull("") + nl +         # print 1
IsNull("NULL")            # print 1
```

127.40 How to print lists that contains objects?

In this example we will see how we can print a list contains objects.

```
aList = [[1,2,3] , new point(1,2,3), new point(1,2,3)]
see "print the list" + nl
see alist
see "print the item (object)" + nl
see alist[2]
class point x y z
    func init p1,p2,p3 x=p1 y=p2 z=p3
```

Output

```
print the list
1
2
3
x: 1.000000
y: 2.000000
z: 3.000000
x: 1.000000
y: 2.000000
z: 3.000000
print the item (object)
x: 1.000000
y: 2.000000
z: 3.000000
```

127.41 How to insert an item to the first position in the list?

To insert an item we can use the insert(aList,nIndex,Value) function.

```
aList = 1:5
insert(aList,0,0)
See aList # print numbers from 0 to 5
```

127.42 How to print new lines and other characters?

To print new line we can use the nl variable.

```
See "Hello" + nl
```

or we can use multi-line literal as in the next example

```
See "Hello
```

```
"
```

if we want to print other characters we can use the char(nASCII) function

```
See char(109) + nl +      # print m
      char(77)           # print M
```

127.43 Why I get Calling Function without definition Error?

Each program follow the next order

1 - Loading Files 2 - Global Variables and Statements 3 - Functions 4 - Packages, Classes and Methods

So what does that mean ?

- (1) **** No Functions comes After Classes ****
- (2) **** No command is required to end functions/methods/classes/packages ****

Look at this example

```
See "Hello"
test()
func test
    see "message from the test function!" + nl
class test
```

In the previous example we have a function called test() so we can call it directly using test()

In the next example, test() will become a method

```
See "Hello"
test()    # runtime error message
class test
    func test # Test() now is a method (not a function)
        see "message from the test method!" + nl
```

The errors comes when you define a method then try calling it directly as a function.

The previous program must be

```
See "Hello"
new test { test() }    # now will call the method
class test
    func test # Test() now is a method (not a function)
        see "message from the test method!" + nl
```

127.44 Can Ring work on Windows XP?

Ring can work on Windows XP and load extensions without problems.

Just be sure that the extension can work on Windows XP and your compiler version support that (modern compilers requires some flags to support XP)

Check this topic <https://blogs.msdn.microsoft.com/vcblog/2012/10/08/windows-xp-targeting-with-c-in-visual-studio-2012/>

For example, We added

```
/link /SUBSYSTEM:CONSOLE,"5.01"
```

To the batch file to support Windows XP

See : <https://github.com/ring-lang/ring/blob/master/language/src/buildvc.bat>

127.45 Why we don't use () after the QApp class name?

When we use RingQt to create GUI application, we uses () after the class name when we create new objects for example.

```
new QWidget() { setWindowTitle("Hello World") resize(400,400) show() }
```

but before doing that we create an object from the qApp class and we don't use () after that

```
Load "guilib.ring"
app = new qApp
{
    win=new QWidget()
    {
        setWindowTitle(:test)
        show()
    }
    exec()
}
```

Using () after the class name means calling the init() method in the class and passing parameters to this method.

If we used () while no init() method in the class we get the expected error message.

The class qApp don't have this method while the other classes have it because they need it to create an object using a function that return a pointer to that object and this pointer will be stored in an attribute called pObject, for more information see ring_qt.ring file which contains the classes.

127.46 Why the window title bar is going outside the screen?

When we write the next code

```
Load "guilib.ring"
app = new qApp
{
    win=new QWidget()
```

(continues on next page)

(continued from previous page)

```

        setWindowTitle(:test)
        setGeometry(0,0,200,200)
        show()
    }
    exec()
}

```

I would expect that the window will run at the point (0,0) with (200,200) size but the actual result is that the window title bar is going outside the screen.

This is related to the behavior of Qt framework.

The next code will avoid the problem

```

load "guilib.ring"
new qApp {
    new QWidget() {
        move(0,0)
        resize(200,200)
        show()
    }
    exec()
}

```

127.47 How to create an array of buttons in GUI applications?

Check the next example:

```

Load "guilib.ring"

App1 = new qApp {

    win1 = new QWidget() {
        move(0,0)
        resize(500,500)
        new QPushButton(win1)
        {
            settext("OK")
            setclickevent("click()")
        }
        btn1 = new QPushButton(win1)
        {
            setgeometry(100,100,100,30)
            settext("Button1")
        }

        btn2 = new QPushButton(win1)
        {
            setgeometry(200,100,100,30)
            settext("Button2")
        }
    }
}

```

(continues on next page)

(continued from previous page)

```

        button = [btn1, btn2]
        show()
    }

    exec()

}

func click

    button[1] { settext ("Button3") }
    button[2] { settext ("Button4") }

```

127.48 How to Close a window then displaying another one?

This example demonstrates how to close a window and show another one

```

Load "guilib.ring"

app=new qApp
{
    frmBefore=new QWidget()
    {
        setWindowTitle("before!")
        resize(300,320)
        move(200,200)

        button=new QPushButton(frmBefore)
        {
            setText("Close")
            setClickEvent("frmBefore.close() frmMain.show()")
        }

        show()
    }

    frmMain=new QWidget()
    {
        setWindowTitle("After!")
        resize(300,320)
        move(200,200)
    }

    exec()
}

```

127.49 How to create a Modal Window?

This example demonstrates how to create a modal window

```

load "guilib.ring"
app=new QApplication()
{
    frmStart=new QWidget()
    {
        setWindowTitle("The First Window")
        resize(300,320)
        move(200,200)

        button=new QPushButton(frmStart)
        {
            setText("Show Modal Window")
            resize(200,30)
            setClickEvent("frmModal.show()")
        }

        new QPushButton(frmStart)
        {
            setText("Close Window")
            move(0,50)
            resize(200,30)
            setClickEvent("frmStart.Close()")
        }

        show()
    }

    frmModal =new QWidget()
    {
        setWindowTitle("Modal Window")
        resize(300,320)
        move(200,200)
        setParent(frmStart)
        setWindowModality(true)
        setWindowFlags(Qt.Dialog)
    }

    exec()
}

```

Related Documents

- <http://doc.qt.io/qt-5/qtwidgets-widgets-windowflags-example.html>
- <http://doc.qt.io/qt-5/qt.html#WindowType-enum>
- <http://doc.qt.io/qt-5/qwindow.html#setParent>
- <http://doc.qt.io/qt-5/qt.html#WindowModality-enum>

127.50 How can I disable maximize button and resize window?

Use the method setWindowFlags()

```

Load "guilib.ring"
app1 = new qapp {
    win1 = new qwidget() {
        setwindowtitle("First")
        setgeometry(100,100,500,500)

        new qpushbutton(win1) {
            setgeometry(100,100,100,30)
            settext("close")
            setclickevent("app1.quit()")
        }

        new qpushbutton(win1) {
            setgeometry(250,100,100,30)
            settext("Second")
            setclickevent("second()")
        }

        showmaximized()
    }
    exec()
}

func second
    win2 = new qwidget() {
        setwindowtitle("Second")
        setgeometry(100,100,500,500)
        setwindowflags(Qt_dialog)
        show()
}

```

127.51 Why setClickEvent() doesn't see the object methods directly?

setClickEvent(cCode) take a string contains code. The code will be executed when the event happens.

Ring support Many Programming Paradigms like Procedural, OOP, Functional and others.

But when you support many paradigms at the language level you can't know which paradigm will be used so you have two options

- (1) Provide General Solutions that works with many programming paradigms.
- (2) Provide Many Specific solutions where each one match a specific paradigm.

setClickEvent() and others belong to (General Solutions that works with many programming paradigms).

You just pass a string of code that will be executed without any care about classes and objects.

This code could be anything like calling a function, calling a method and setting variable value.

Some other languages force you to use OOP and call methods for events. Also some other languages uses anonymous functions that may get parameters like the current object.

Now we have the general solution (not restricted with any paradigm), In the future we may add specific solutions that match specific paradigms (OOP, Functional, Declarative and Natural).

127.52 How to extend RingQt and add more classes?

You have many options

In general you can extend Ring using C or C++ code

Ring from Ring code you can call C Functions or use C++ Classes & Methods

This chapter in the documentation explains this part in the language <https://ring-lang.github.io/doc1.16/extension.html>

For example the next code in .c file can be compiled to a DLL file using the Ring library (.lib)

```
#include "ring.h"

RING_FUNC(ring_ringlib_dlfnc)
{
    printf("Message from dlfnc");
}

RING_API void ringlib_init(RingState *pRingState)
{
    ring_vm_funcregister("dlfunc",ring_ringlib_dlfnc);
}
```

Then from Ring you can load the DLL file using LoadLib() function then call the C function that called dlfnc() as any Ring function.

```
See "Dynamic DLL" + NL
LoadLib("ringlib.dll")
dlfunc()
```

Output

```
Dynamic DLL
Message from dlfnc
```

When you read the documentation you will know about how to get parameters like (strings, numbers, lists and objects)

And how to return a value (any type) from your function.

From experience, when we support a C library or C++ Library

We discovered that a lot of functions share a lot of code

To save our time, and to quickly generate wrappers for C/C++ Libraries to be used in Ring

We have this code generator

<https://github.com/ring-lang/ring/blob/master/extensions/codegen/parsec.ring>

The code generator is just a Ring program < 1200 lines of Ring code

The generator take as input a configuration file contains the C/C++ library information

like Functions Prototype, Classes and Methods, Constants, Enum, Structures and members , etc.

Then the generator will generate

- *.C File for C libraries (to be able to use the library functions)
- *.CPP File for C++ libraries (to be able to use C++ classes and methods)
- *.Ring File (to be able to use C++ classes as Ring classes)
- *.RH file (Constants)

To understand how the generator work check this extension for the Allegro game programming library

<https://github.com/ring-lang/ring/tree/master/extensions/ringallegro>

At first we have the configuration file

<https://github.com/ring-lang/ring/blob/master/extensions/ringallegro/allegro.cf>

To write this file, i just used the Allegro documentation + the Ring code generator rules

Then after executing the generator using this batch file

<https://github.com/ring-lang/ring/blob/master/extensions/ringallegro/gencode.bat>

or using this script

<https://github.com/ring-lang/ring/blob/master/extensions/ringallegro/gencode.sh>

I get the generated source code file

https://github.com/ring-lang/ring/blob/master/extensions/ringallegro/ring_allegro.c

The generated source code file (ring_allegro.c) is around 12,000 Lines of code (12 KLOC)

While the configuration file is less than 1 KLOC

To build the library (create the DLL files)

<https://github.com/ring-lang/ring/blob/master/extensions/ringallegro/buildvc.bat>

Also you can check this extension for the LibSDL Library

<https://github.com/ring-lang/ring/tree/master/extensions/ringsdl>

After this know you should know about

- 1 - Writing the configuration file
- 2 - Using the Code Generator
- 3 - Building your library/extension
- 4 - Using your library/extension from Ring code

Let us move now to you question about Qt

We have RingQt which is just an extension to ring (ringqt.dll)

You don't need to modify Ring.

- (1) You just need to modify RingQt
- (2) Or extend Ring with another extension based on Qt (but the same Qt version)

For the first option see the RingQt extension

<https://github.com/ring-lang/ring/tree/master/extensions/ringqt>

Configuration file

<https://github.com/ring-lang/ring/blob/master/extensions/ringqt/classes/qt.cf>

To generate the source code

<https://github.com/ring-lang/ring/blob/master/extensions/ringqt/gencode.bat>

<https://github.com/ring-lang/ring/blob/master/extensions/ringqt/gencode.sh>

<https://github.com/ring-lang/ring/blob/master/extensions/ringqt/gencodeandroid.bat>

To build the DLL/so/Dylib files

<https://github.com/ring-lang/ring/blob/master/extensions/ringqt/buildmingw32.bat>

<https://github.com/ring-lang/ring/blob/master/extensions/ringqt/buildgcc.sh>

<https://github.com/ring-lang/ring/blob/master/extensions/ringqt/buildclang.sh>

Study RingQt

Learn about the options that you have

(1) wrapping a Qt class directly

(2) Creating a new class then wrapping your new class

For the second option (in the previous two points or in the two points before that)

You will create new classes in C++ code

Then you merge these classes to RingQt or provide special DLL for them (your decision)

If your work is general (will help others) just put it to RingQt.

If your work is special (to specific application) just put it in another extension.

127.53 How to add Combobox and other elements to the cells of a QTableWidget?

Check the next code

```
Load "guilib.ring"
New qApp
{
    win1 = new QMainWindow() {
        setGeometry(100,100,1100,370)
        setWindowTitle("Using QTableWidget")

        Table1 = new QTableWidget(win1) {
            setRowCount(10) setColumnCount(10)
            setGeometry(0,0,800,400)
            setSelectionBehavior(QAbstractItemView_SelectRows)

            for x = 1 to 10
                for y = 1 to 10
                    item1 = new QTableWidgetItem("R"+X+"C"+Y)
                    setItem(x-1,y-1, item1)
                next
            next
        }
    }
}
```

(continues on next page)

(continued from previous page)

```

cmb = new QComboBox(Table1) {
    alist = ["one","two","three","four","five"]
    for x in aList additem(x,0) next
}
setCellWidget(5, 5, cmb)
}

setcentralwidget(table1)
show()
}
exec()
}

```

127.54 How to perform some manipulations on selected cells in QTableWidget?

Check the next sample

```

Load "guilib.ring"

New qApp {
    win1 = new qMainWindow() {
        setGeometry(100,100,800,600)
        setWindowTitle("Using QTableWidget")
        Table1 = new qTableWidget(win1) {
            setRowCount(10) setColumnCount(10)
            setGeometry(10,10,400,400)
            for x = 1 to 10
                for y = 1 to 10
                    item1 = new QTableWidgetItem("10")
                    setItem(x-1,y-1,item1)
                next
            next
        }
        btn1 = new qPushButton(win1) {
            setText("Increase")
            setGeometry(510,10,100,30)
            setClickEvent("pClick()")
        }
        show()
    }
    exec()
}

func pClick
    for nRow = 0 to Table1.rowCount() - 1
        for nCol = 0 to Table1.columnCount() - 1
            Table1.item(nRow,nCol) {
                if isSelected()
                    setText( "" + ( 10 + text()) )

```

(continues on next page)

(continued from previous page)

```

        ok
    }
next
next

```

127.55 How to use SQLite using ODBC?

In Ring 1.1 and later versions we have native support for SQLite, so you don't need to use it through ODBC.

Also we can access SQLite through RingQt.

The answer to your question

```
pODBC = odbc_init()
odbc_connect(pODBC,"DRIVER=SQLite3 ODBC Driver;Database=mydb.db;LongNames=0;" +
             "Timeout=1000;NoTXN=0;SyncPragma=NORMAL;StepAPI=0;")
odbc_execute(pODBC,"create table 'tel' ('ID','NAME','PHONE');")
odbc_execute(pODBC,"insert into 'tel' values ('1','Mahmoud','123456');")
odbc_execute(pODBC,"insert into 'tel' values ('2','Ahmed','123456');")
odbc_execute(pODBC,"insert into 'tel' values ('3','Ibrahim','123456');")
odbc_execute(pODBC,"select * from tel") + nl
nMax = odbc_colcount(pODBC)
See "Columns Count : " + nMax + nl
while odbc_fetch(pODBC)
    See nl
    for x = 1 to nMax
        see odbc_getdata(pODBC,x)
        if x != nMax see " - " ok
    next
end
odbc_disconnect(pODBC)
odbc_close(pODBC)
```

Output:

```
Columns Count : 3
```

```
1 - Mahmoud - 123456
2 - Ahmed - 123456
3 - Ibrahim - 123456
```

The program will create the file : mydb.db

Note : when I print the odbc drivers I see the long list that includes

```
SQLite3 ODBC Driver - UsageCount=1
SQLite ODBC Driver - UsageCount=1
SQLite ODBC (UTF-8) Driver - UsageCount=1
```

And I'm using “SQLite3 ODBC Driver”.

127.56 Can I connect to dbase/harbour database?

You can connect to any database using ODBC

To connect to xbase files (*.DBF)

```
See "Using DBF Files using ODBC" + nl
pODBC = odbc_init()
See "Connect to database" + nl
odbc_connect(pODBC,"Driver={Microsoft dBase Driver (*.dbf)};"+
             "datasource=dBase Files;DriverID=277")
See "Select data" + nl
odbc_execute(pODBC,"select * from tel.dbf")
nMax = odbc_colcount(pODBC)
See "Columns Count : " + nMax + nl
while odbc_fetch(pODBC)
    See "Row data:" + nl
    for x = 1 to nMax
        see odbc_getdata(pODBC,x) + " - "
    next
end
See "Close database..." + nl
odbc_disconnect(pODBC)
odbc_close(pODBC)
```

Output

```
Using DBF Files using ODBC
Connect to database
Select data
Columns Count : 3
Row data:
Ahmad - Egypt - 234567 - Row data:
Fady - Egypt - 345678 - Row data:
Shady - Egypt - 456789 - Row data:
Mahmoud - Egypt - 123456 - Close database...
```

Also you can connect to a Visual FoxPro database (requires installing Visual FoxPro driver)

```
See "ODBC test 6" + nl
pODBC = odbc_init()
See "Connect to database" + nl
odbc_connect(pODBC,"Driver={Microsoft Visual FoxPro Driver};"+
             "SourceType=DBC;SourceDB=C:\PWCT19\ssbuild\PWCTDATA\CH1\Data\mydata.dbc;")
See "Select data" + nl
see odbc_execute(pODBC,"select * from t38") + nl
nMax = odbc_colcount(pODBC)
See "Columns Count : " + nMax + nl
while odbc_fetch(pODBC)
    See "Row data:" + nl
    for x = 1 to nMax
        see odbc_getdata(pODBC,x) + " - "
    next
end
```

(continues on next page)

(continued from previous page)

See "Close database..." + nl
odbc_disconnect(pODBC)
odbc_close(pODBC)

BUILDING FROM SOURCE CODE

The Ring programming language is a free open source product (MIT License).

You can build Ring Compiler/VM using CMake or using Scripts (Batch Files or Shell Scripts).

The next steps explains building (Compiler/VM, Extensions & Tools) using scripts.

The Complete build will build everything.

The Custom build contains steps that demonstrates building Ring and some of the Ring extensions as example.

There are more extensions in ring/extensions folder like RingCJSON, RingHTTPLib, etc. You can build any of these extensions based on your choice if you would like to have a custom build.

128.1 Building using Microsoft Windows

Get the source code

Using HTTP

```
git clone http://github.com/ring-lang/ring.git
```

Or using SSH

```
git clone git@github.com:ring-lang/ring.git
```

128.2 Complete Build (Compiler/VM, Extensions, Tools, etc.)

Install Qt 5.15.17 (in C:/Qt) so we have the folder (C:/Qt/5.15.17)

If you have another version from Qt 5.15 (like Qt 5.15.2) - Or Qt is installed in another folder

The next batch files uses environment variables (RING_QT_DIR & RING_QT_VERSION) to set the path

To build 32bit version:

```
ring/build/buildvc.bat
```

To build 64bit version:

```
ring/build/buildvc_x64.bat
```

Add ring/bin folder to your system path

Run Ring Notepad

```
ringpm run ringnotepad
```

128.3 Custom Build for Windows (64bit)

The next steps for custom build demonstrates how to build the 32bit version

To build the 64bit version add _x64 to the batch file name (i.e. use buildvc_x64.bat instead of buildvc.bat)

Also, use ring/bin/install_x64.bat instead of ring/bin/install.bat

128.4 Custom Build for Windows (32bit)

Build Ring (Compiler/VM)

```
cd ring/language/build  
buildvc.bat  
buildvcw.bat
```

Build Ring2EXE

```
cd ring/tools/ring2exe  
build.bat
```

Generate RingConsoleColors Source Code and Build

```
cd ring/extensions/ringconsolecolors  
gencode.bat  
buildvc.bat
```

Build RingInternet

```
cd ring/extensions/ringinternet  
buildvc.bat
```

Generate RingLibCurl Source Code and Build

```
cd ring/extensions/ringcurl  
gencode.bat  
buildvc.bat
```

Generate RingZip Source Code and Build

```
cd ring/extensions/ringzip  
gencode.bat  
buildvc.bat
```

Build RingPM

```
cd ring/tools/ringpm  
build.bat
```

Build RingREPL

```
cd ring/tools/ringrepl  
build.bat
```

Build Folder2QRC

```
cd ring/tools/folder2qrc  
build.bat
```

Build RingODBC

```
cd ring/extensions/ringodbc  
buildvc.bat
```

Build RingMySQL

```
cd ring/extensions/ringmysql  
buildvc.bat
```

Build RingSQLite

```
cd ring/extensions/ringsqlite  
buildvc.bat
```

Build RingPostgreSQL

```
cd ring/extensions/ringpostgresql  
gencode.bat  
buildvc.bat
```

Build RingOpenSSL

```
cd ring/extensions/ringopenssl  
buildvc.bat
```

Build RingMurmurHash

```
cd ring/extensions/ringmurmurhash  
buildvc.bat
```

Generate RingAllegro Source Code and Build

```
cd ring/extensions/ringallegro  
gencode.bat  
buildvc.bat
```

Generate RingLibuv Source Code and Build

```
cd ring/extensions/ringlibuv  
gencode.bat  
buildvc.bat
```

Generate RingFreeGLUT Source Code and Build

```
cd ring/extensions/ringfreeglut
gencode.bat
buildvc.bat
```

Generate RingOpenGL Source Code and Build

The ringopengl folder contains many sub folders for different OpenGL versions

Starting from OpenGL 1.1 to OpenGL 4.6

```
cd ring/extensions/ringopengl/opengl21
gencode.bat
buildvc.bat
```

Generate RingQt Source Code and Build

Tested using Qt 5.15

Install Qt 5.15 : <https://www.qt.io/blog/qt-5.15-released>

```
cd ring/extensions/ringqt
gencode_light.bat
buildvc_light.bat
gencode_nobluetooth.bat
buildvc_nobluetooth.bat
```

To Copy the Qt runtime files to ring/bin folder

```
cd ring/extensions/ringqt/binupdate
installqt515.bat
```

To be able to call ring from any folder

```
cd ring/bin
install.bat
```

Add Ring/bin to System path

```
Hit "windows key".
Type "Edit the System environment variables"
Select "Advanced" tab.
Click on "Environment Variables..."
Double click on "Path"
Add at the end the new path separated by semicolon.
;C:\Ring\Bin
```

Run Ring Notepad

```
ringpm run ringnotepad
```

128.5 Building using Ubuntu Linux

This version is tested using Ubuntu 24.04 LTS

Upgrade the packages

```
sudo apt-get update && sudo apt-get upgrade
```

Install Git

```
sudo apt-get install git
```

Get the source code

Using HTTP

```
git clone http://github.com/ring-lang/ring.git
```

Or using SSH

```
git clone git@github.com:ring-lang/ring.git
```

Install Libraries

```
cd ring/build  
./installdepubuntu.sh
```

128.6 Complete Build for Ubuntu Linux

This will build everything (Compiler/VM, Extensions, Tools, etc.)

Also, will call ring/bin/install.sh

```
cd ring/build  
./buildgcc.sh
```

Run Ring Notepad

```
ringpm run ringnotepad
```

128.7 Custom Build for Ubuntu Linux

Build Ring (Compiler/VM)

```
sudo ./buildgcc.sh
```

Build Ring2EXE

```
cd ring/tools/ring2exe  
sudo ./build.sh
```

Generate RingConsoleColors Source Code and Build

```
cd ring/extensions/ringconsolecolors  
./gencode.sh  
./buildgcc.sh
```

Build RingInternet

```
cd ring/extensions/ringinternet  
./buildgcc.sh
```

Generate RingLibCurl Source Code and Build

```
cd ring/extensions/ringcurl  
./gencode.sh  
./buildgcc.sh
```

Generate RingZip Source Code and Build

```
cd ring/extensions/ringzip  
./gencode.sh  
./buildgcc.sh
```

Build RingPM

```
cd ring/tools/ringpm  
sudo ./build.sh
```

Build RingREPL

```
cd ring/tools/ringrepl  
sudo ./build.sh
```

Build Folder2QRC

```
cd ring/tools/folder2qrc  
sudo ./build.sh
```

Build RingODBC

```
cd ring/extensions/ringodbc  
./buildgcc.sh
```

Build RingMySQL

```
cd ring/extensions/ringmysql  
./buildgcc.sh
```

Build RingSQLite

```
cd ring/extensions/ringsqlite  
./buildgcc.sh
```

Build RingPostgreSQL

```
cd ring/extensions/ringpostgresql  
gencode.sh  
buildgcc.sh
```

Build RingOpenSSL

```
cd ring/extensions/ringopenssl  
.buildgcc.sh
```

Build RingMurmurHash

```
cd ring/extensions/ringmurmurhash  
.buildgcc.sh
```

Generate RingAllegro Source Code and Build

```
cd ring/extensions/ringallegro  
.gencode.sh  
.buildgcc.sh
```

Generate RingLibuv Source Code and Build

We will build Libuv first

```
cd ring/extensions/ringlibuv/libuv  
sudo apt-get install libtool m4 automake  
sh autogen.sh  
.configure  
make  
make check  
sudo make install
```

Then we will build RingLibuv

```
cd ring/extensions/ringlibuv  
.gencode.sh  
.buildgcc.sh
```

Generate RingFreeGLUT Source Code and Build

```
cd ring/extensions/ringfreeglut  
.gencode.sh  
.buildgcc.sh
```

Generate RingOpenGL Source Code and Build

The ringopengl folder contains many sub folders for different OpenGL versions

Starting from OpenGL 1.1 to OpenGL 4.6

```
cd ring/extensions/ringopengl/opengl21  
gencode.sh  
buildgcc.sh
```

Generate RingQt Source Code and Build

```
cd ring/extensions/ringqt
./gencode_light.sh
./buildgcc_light.sh
./gencode.sh
./buildgcc.sh
```

To be able to call ring from any folder

```
cd ring/bin
sudo ./install.sh
```

Run Ring Notepad

```
ringpm run ringnotepad
```

128.8 Building using MacOS X

This version is tested using macOS Catalina (version 10.15)

Get the source code

Using HTTP

```
git clone http://github.com/ring-lang/ring.git
```

Or using SSH

```
git clone git@github.com:ring-lang/ring.git
```

Install homebrew (follow the directions on homebrew's homepage). Install Libraries

```
cd ring/build
./installdepmac.sh
```

128.9 Complete Build for macOS

This will build everything (Compiler/VM, Extensions, Tools, etc.)

```
cd ring/build
./buildclang.sh
```

To be able to call ring from any folder

```
cd ring/bin
sudo ./install.sh
```

Run Ring Notepad

```
ringpm run ringnotepad
```

128.10 Custom Build for macOS

Build Ring (Compiler/VM)

```
./buildclang.sh
```

Build Ring2EXE

```
cd ring/tools/ring2exe  
sudo ./build.sh
```

Generate RingConsoleColors Source Code and Build

```
cd ring/extensions/ringconsolecolors  
./gencode.sh  
./buildclang.sh
```

Build RingInternet

```
cd ring/extensions/ringinternet  
./buildclang.sh
```

Generate RingLibCurl Source Code and Build

```
cd ring/extensions/ringcurl  
./gencode.sh  
./buildclang.sh
```

Generate RingZip Source Code and Build

```
cd ring/extensions/ringzip  
./gencode.sh  
./buildclang.sh
```

Build RingPM

```
cd ring/tools/ringpm  
sudo ./build.sh
```

Build RingREPL

```
cd ring/tools/ringrepl  
sudo ./build.sh
```

Build Folder2QRC

```
cd ring/tools/folder2qrc  
sudo ./build.sh
```

Build RingODBC

```
cd ring/extensions/ringodbc  
./buildclang.sh
```

Build RingMySQL

```
cd ring/extensions/ringmysql  
./buildclang.sh
```

Build RingSQLite

```
cd ring/extensions/ringsqlite  
./buildclang.sh
```

Build RingPostgreSQL

```
cd ring/extensions/ringpostgresql  
gencode.sh  
buildclang.sh
```

Build RingOpenSSL

```
cd ring/extensions/ringopenssl  
./buildclang.sh
```

Build RingMurmurHash

```
cd ring/extensions/ringmurmurhash  
./buildclang.sh
```

Generate RingAllegro Source Code and Build

```
cd ring/extensions/ringallegro  
./gencode.sh  
./buildclang.sh
```

Generate RingLibuv Source Code and Build

```
cd ring/extensions/ringlibuv  
./gencode.sh  
./buildclang.sh
```

Generate RingFreeGLUT Source Code and Build

```
cd ring/extensions/ringfreeglut  
./gencode.sh  
./buildclang.sh
```

Generate RingOpenGL Source Code and Build

The ringopengl folder contains many sub folders for different OpenGL versions Starting from OpenGL 1.1 to OpenGL 4.6

```
cd ring/extensions/ringopengl/opengl21  
./gencode.sh  
./buildclang.sh
```

Generate RingQt Source Code and Build

```
cd ring/extensions/ringqt  
./gencode_light.sh
```

(continues on next page)

(continued from previous page)

```
./buildclang_light.sh  
./gencode.sh  
./buildclang.sh
```

To be able to call ring from any folder

```
cd ring/bin  
sudo ./install.sh
```

Run Ring Notepad

```
ringpm run ringnotepad
```

128.11 Building using CMake

This will build the Ring compiler and Ring Virtual Machine

```
cmake .  
make
```

HOW TO CONTRIBUTE?

Ring is a free-open source project, Everyone is welcome to contribute to Ring.

Project Home : <https://github.com/ring-lang/ring>

To editing on web browser without Git client, when login GitHub then click pencil icon in target file. Then, sends pull request.

You can help in many parts in the project

- Documentation
- Testing
- Samples
- Applications
- Editors Support
- Libraries in Ring
- Extensions in C/C++
- Compiler and Virtual Machine (VM)
- Ideas and suggestions

129.1 Special thanks to contributors

Throughout the creation of this project, Ring relied heavily on contributions from experts along with college students. Their input was invaluable, and we want to take a moment to thank them and recognize them for all of their hard work.

Ring Team: <https://ring-lang.github.io/team.html>

129.2 Documentation

You can modify anything in the documentation, by updating the text files (*.txt) in this folder : <https://github.com/ring-lang/ring/tree/master/documents/source>

The documentation is created using Sphinx : <http://www.sphinx-doc.org/en/stable/>

129.3 Testing

You can write new tests in this folder

<https://github.com/ring-lang/ring/tree/master/language/tests/scripts>

129.4 Samples

You can add new samples to this folder

<https://github.com/ring-lang/ring/tree/master/samples>

129.5 Applications

You can add new applications to this folder

<https://github.com/ring-lang/ring/tree/master/applications>

129.6 Editors Support

You can help in supporting Ring in different code editors

Check the next folder

<https://github.com/ring-lang/ring/tree/master/tools/editors>

129.7 Libraries in Ring

You can update and add libraries to this folder

<https://github.com/ring-lang/ring/tree/master/libraries>

129.8 Extensions in C/C++

You can add and update extensions in this folder

<https://github.com/ring-lang/ring/tree/master/extensions>

129.9 Compiler and Virtual Machine (VM)

- Source Code (C Language) : <https://github.com/ring-lang/ring/tree/master/language/src>
- Visual Source (PWCT) : <https://github.com/ring-lang/ring/tree/master/language/visualsrc>

LANGUAGE SPECIFICATION

In this chapter we will learn about

- Scanner Commands
- Language keywords
- Language Functions
- Compiler Errors
- Runtime Errors
- Environment Errors
- Language Grammar
- Virtual Machine (VM) Instructions

130.1 Scanner Commands

Commands Count: 5

- ChangeRingKeyword
- ChangeRingOperator
- DisableHashComments
- EnableHashComments
- LoadSyntax

Grammar:

```
Command ---> 'changeringkeyword' <OldKeyword> <NewKeyword>
Command ---> 'changeringoperator' <OldOperator> <NewOperator>
Command ---> 'EnableHashComments'
Command ---> 'DisableHashComments'
Command ---> 'loadsyntax' <Literal>
```

130.2 Language Keywords

Keywords Count: 56

- again
- and
- but
- bye
- call
- case
- catch
- class
- def
- do
- done
- else
- elseif
- end
- exit
- for
- foreach
- from
- func
- get
- give
- if
- import
- in
- load
- loop
- new
- next
- not
- off
- ok
- on
- or

- other
- package
- private
- put
- return
- see
- step
- switch
- to
- try
- while
- endfunc
- endclass
- endpackage
- endif
- endfor
- endwhile
- endswitch
- endtry
- function
- endfunction
- break
- continue

130.3 Language Functions

Functions Count: 255

Note: Some functions could be used with different parameters type/count

```
acos(x) ---> The principal value of the arc cosine of x, expressed in radians
add(List,Item)
addattribute(Object,cAttributeName|aAttributesList)
adddays(cDate,nDays) ---> Date from cDate and after nDays
addmethod(Object,cNewMethodName,cMethodName|AnonymousFunction)
ascii(character) ---> ASCII Code
asin(x) ---> The principal value of the arc sine of x, expressed in radians
assert(condition)
atan(x) ---> The principal value of the arc tangent of x, expressed in radians
```

(continues on next page)

(continued from previous page)

atan2(y,x) ---> The principal arc tangent of y/x, in the interval [-pi,+pi] radians
 attributes(object) ---> Returns a list contains the object attributes
 binarysearch(List,ItemValue) ---> Item Index
 binarysearch(List,ItemValue,nColumn) ---> Search in nColumn, returns the Item Index
 bytes2double(cBytes) ---> nNumber
 bytes2float(cBytes) ---> nNumber
 bytes2int(cBytes) ---> nNumber
 callgarbagecollector()
 callgc()
 ceil(x) ---> The smallest integer value greater than or equal to x
 cfunctions() ---> a list contains functions names
 char(ASCII Code) ---> character
 chdir(cNewPath)
 checkoverflow(lFlag)
 classes() ---> a list contains classes names
 classname(object) ---> Returns the object class name
 clearerr(FileHandle)
 clock() ---> The number of clock ticks from program start
 clockspersecond() ---> Number of clocks in one second
 closelib(pDLL)
 copy(string,nCount) ---> string replicated nCount times
 cos(x) ---> The cosine of an angle of x radians
 cosh(x) ---> The hyperbolic cosine of x radians
 currentdir() ---> String contains the path of the current directory
 date() ---> String represent the date "dd/mm/yyyy"
 dec(hexadecimal) ---> decimal
 decimals(n) ---> Determine the decimals digits after the point in float/double numbers
 del(list,index)
 difffdays(cDate1,cDate2) ---> number of days (Date1 - Date2)
 dir(cFolderPath) ---> List contains files & sub folders.
 direxists(cDirPath) ---> returns 1 if the directory exists
 double2bytes(nNumber) ---> cBytes
 eval(cCode)
 exefilename() ---> String contains the Ring executable file name
 exefolder() ---> String contains the Ring executable path
 exp(x) ---> The value of e raised to the xth power
 fabs(x) ---> The absolute value of x
 fclose(FileHandle)
 feof(FileHandle) ---> returns 1 if EOF and 0 if not
 ferror(FileHandle) ---> returns 1 if error and 0 if not
 fexists(cFileName) ---> returns 1 if the file exists
 fflush(FileHandle)
 fgetc(FileHandle) ---> returns character or EOF
 fgetpos(FileHandle) ---> position handle
 fgets(FileHandle,nSize) ---> string
 filename() ---> String contains the active source file name
 find(List,ItemValue) ---> Item Index
 find(List,ItemValue,nColumn) ---> Search in nColumn, returns the Item Index
 find(List,ItemValue,nColumn,cAttribute) ---> Item Index
 float2bytes(nNumber) ---> cBytes
 floor(x) ---> The largest integer value less than or equal to x
 fopen(cFileName,cMode) ---> FileHandle

(continues on next page)

(continued from previous page)

```

fputc(FileHandle,cChar)
fputs(FileHandle,cString)
fread(FileHandle,nSize)
freopen(cFileName,cMode,file handle) ---> FileHandle
fseek(FileHandle,nOffset,nWhence) ---> zero if successful
fsetpos(FileHandle,PositionHandle)
ftell(FileHandle) ---> file position as number
functions() ---> a list contains functions names
fwrite(FileHandle,cString)
getarch() ---> cString (The name of the architecture of the Ring executable)
getattribute(oObject,cAttributeName) ---> Attribute Value
getchar() ---> Character
getfilesize(cFilePath) ---> nSize
getnumber() ---> Number
getpathtype(cPath) ---> nStatus
getpointer(pointer) ---> nAddress
getptr(pointer) ---> nAddress
getstring() ---> String
globals() ---> a list contains variables names in the global scope
hex(decimal) ---> hexadecimal
hex2str(Hexadecimal string) ---> string
importpackage(cPackageName)
input(nCount) ---> string
insert(List,Index,Item)
int2bytes(nNumber) ---> cBytes
intvalue(cVariableName)
isalnum(value) ---> 1 if the value is digit/letter or 0 if not
isalpha(value) ---> 1 if the value is a letter or 0 if not
isandroid() ---> Returns 1 if the operating system is Android, Returns 0 if it's not
isattribute(object,cAttributeName) ---> Bool
iscfunction(cFunctionName) ---> returns 1 if the C function is defined
isclass(cClassName) ---> returns 1 if the Class is defined
iscntrl(value) ---> 1 if the value is a control character or 0 if not
isdigit(value) ---> 1 if the value is a digit or 0 if not
isfreebsd() ---> Returns 1 if the operating system is FreeBSD, Returns 0 if it's not
isfunction(cFunctionName) ---> returns 1 if the Ring function is defined
isglobal(cVariableName) ---> returns 1 if the variable is defined in the global scope
isgraph(value) ---> 1 if the value can be printed (Except space) or 0 if not
islinux() ---> Returns 1 if the operating system is Linux, Returns 0 if it's not
islist(value) ---> 1 if the value is a list or 0 if not
islocal(cVariableName) ---> returns 1 if the variable is defined in the local scope
islower(value) ---> 1 if the value is lowercase letter or 0 if not
ismacosx() ---> Returns 1 if the operating system is Mac OS X, Returns 0 if it's not
ismethod(object,cMethodName) ---> Returns True if the object class contains the method
ismsdos() ---> Returns 1 if the operating system is MS-DOS, Returns 0 if it's not
isnull(value) ---> 1 if the value is NULL or 0 if not
isnumber(value) ---> 1 if the value is a number or 0 if not
isobject(variable) ---> Returns True if it's an object, False if it's not
ispackage(cPackageName) ---> returns 1 if the Package is defined
ispackageclass(cPackageName,cClassName) ---> returns 1 if the Class is defined
isppointer(vPara) ---> True|False
isprint(value) ---> 1 if the value occupies a printing position or 0 if not

```

(continues on next page)

(continued from previous page)

```

isprivateattribute(object,cAttributeName) ---> lResult
isprivatemethod(object,cMethodName) ---> lResult
ispunct(value) ---> 1 if the value is a punctuation character or 0 if not
isspace(value) ---> 1 if the value is a white-space or 0 if not
isstring(value) ---> 1 if the value is a string or 0 if not
isunix() ---> Returns 1 if the operating system is Unix, Returns 0 if it's not
isupper(value) ---> 1 if the value is an uppercase alphabetic letter or 0 if not
iswindows() ---> Returns 1 if the operating system is Windows
iswindows64() ---> Returns 1 if the operating system is Windows64
isxdigit(value) ---> 1 if the value is a hexadecimal digit character or 0 if not
left(string,count) ---> Get characters starting from the left
len(string) ---> String length
len(List) ---> The list size
lines(string) ---> Number of lines inside the string
list(nSize) ---> aList
list(nRows,nCols) ---> aList
list2str(list) ---> string contains the list items
loadlib(cDLLFileName) ---> pDLL
locals() ---> a list contains the variables names in the current scope
log(x) ---> The natural logarithm of x (the base of e)
log(x,b) ---> The logarithm of x to the base of b
log10(x) ---> The common logarithm (base-10 logarithm) of x
lower(string) ---> convert string letters to lower c
max(nNumber1,nNumber) ---> Maximum number
max(aList) ---> Maximum number inside the list
memcpy(pDestinationPointer,cSourceString,nSize)
memorycopy(pDestinationPointer,cSourceString,nSize)
mergemethods(cClassNameDestination,cClassNameSource)
methods(object) ---> Returns a list contains the object methods
min(nNumber,nNumber2) ---> Minimum number
min(aList) ---> Minimum number inside the list
murmur3hash(cString,nNumber) ---> nNumber
newlist(nSize) ---> aList
newlist(nRows,nCols) ---> aList
nofprocessors() ---> nProcessors
nothing(Any number/type of parameters) ---> Zero (0)
nullpointer() ---> pPointer
nullptr() ---> pPointer
number(string) ---> Number
obj2ptr(List|Object) --> Low Level Object ( C Pointer )
object2pointer(List|Object) --> Low Level Object ( C Pointer )
objectid(object) ---> Returns the object id
optionalfunc(cFuncName)
packageclasses() cPackageName) ---> a list contains classes names inside the package
packagename() ---> Returns the package name of the latest successful import
packages() ---> a list contains packages names
parentclassname(object) ---> Returns the parent class name of the object class
perror(cErrorMessage)
pointer2object(Low Level Object) ---> List|Object
pointer2string(pointer,nStart,nCount) ---> cString
pointercompare(oObject1,oObject2) ---> lResult
pow(x,y) ---> x raised to the power of y

```

(continues on next page)

(continued from previous page)

```

prevfilename() ---> String contains the previous source file name.
print(cString)
print2str(cString) ---> String
ptr2obj(Low Level Object) ---> List|Object
ptr2str(pointer,nStart,nCount) ---> cString
ptrcmp(oObject1,oObject2) ---> lResult
puts(cString)
raise(cErrorMessage)
random(x) ---> A random number in the range [0,x]
randomize(nNumber) ---> nNumber
read(cFileName) ---> String contains the file content
ref(aList|oObject) ---> List/Object reference
reference(aList|oObject) ---> List/Object reference
refcount(aList|oObject) ---> References Count
remove(cFileName)
rename(cOldFileName,cNewFileName) ---> Zero for Success or -1 for Error
reverse(List|String) ---> Reversed List|String
rewind(FileHandle)
right(string,count) ---> get characters starting from the right
ring_give(cVariable)
ring_see(cMessage)
ring_state_delete(oState)
ring_state_filetokens(oState,cRingFileName) ---> aTokens
ring_state_findvar(oState,cVariableName) ---> aVariableList
ring_state_init() ---> oState
ring_state_main(cRingFileName)
ring_state_mainfile(oState,cRingFileName|cRingoFileName)
ring_state_new() ---> oState
ring_state_newvar(oState,cVariableName) ---> aVariableList
ring_state_resume(oState,[cPara|nPara],[lUseReturn])
ring_state_runcode(oState,cCode)
ring_state_runcodeatins(oState,nPC)
ring_state_runfile(oState,cRingFileName)
ring_state_runobjectfile(oState,cRingObjectFileName)
ring_state_scannererror(oState) ---> nStatus
ring_state_setvar(oState,cVariableName,Value)
ring_state_stringtokens(oState,cRingFileName)
ring_state_stringtokens(oState,cRingFileName,lCaseSensitive)
ringvm_callfunc(cFuncName)
ringvm_calllist() ---> List
ringvm_cfunctionslist() ---> List
ringvm_classeslist() ---> List
ringvm_codelist() ---> List
ringvm_evalinscope(nScope,cCode)
ringvm_fileslist() ---> List
ringvm_functionslist() ---> List
ringvm_genarray(aList)
ringvm_give(cVariableName)
ringvm_hideerrmsg(lStatus)
ringvm_info() ---> List of information about the VM structure
ringvm_ismempool() ---> lStatus (Can provide memory or not)
ringvm_memorylist() ---> List

```

(continues on next page)

(continued from previous page)

```

ringvm_packageslist() ---> List
ringvm_passerror()
ringvm_runcode(cCode)
ringvm_scopescount() ---> nScopes
ringvm_see(cMessage)
ringvm_settrace(cCode)
ringvm_tracedata() ---> aDataList
ringvm_traceevent() ---> nTraceEvent
ringvm_tracefunc() ---> cCode
setAttribute(oObject,cAttributeName,Value)
setpointer(pointer,nNewAddress)
setptr(pointer,nNewAddress)
shutdown(nStatus)
sin(x) ---> The sine of an angle of x radians
sinh(x) ---> The hyperbolic sine of x radians
sort(List) ---> Sorted List
sort(List,nColumn) ---> Sorted List based on nColumn
sort(List,nColumn,cAttribute) ---> Sorted List based on Object Attribute
space(nBytesCount) ---> String
sqrt(x) ---> The square root of x
srandom(x) ---> Initialize random number generator
str2hex(string) ---> hexadecimal string
str2hexcstyle(string) ---> hexadecimal string
str2list(string) ---> list contains the string lines
strcmp(cString1,cString2) ---> value = 0 if cString1 = cString2
string(number) ---> String
substr(string,substring) ---> the starting position of substring in string
substr(string,position) ---> Get substring starting from position to end
substr(string,position,count) ---> Get characters starting from position
substr(string,substring,newsubstring) ---> Transformed string (Match case)
substr(string,substring,newsubstring,1) ---> Transformed string (Ignore case)
swap(aList,nItem1,nItem2)
sysget(cVariable)
sysset(cVariable,cValue) ---> Returns 1 for success and return 0 for failure
syssleep(nMilliSecs) ---> Returns 1 for success and return 0 for failure
system(cCommand)
sysunset(cVariable) ---> Returns 1 for success and return 0 for failure
tan(x) ---> Tangent of an angle of x radians
tanh(x) ---> The hyperbolic tangent of x radians
tempfile() ---> FileHandle
tempname() ---> generated file name as string
time() ---> The system time as String
timelist() ---> List contains the time and date information.
trim(string) ---> Remove spaces from right and left
type(value) ---> The Type as String
ungetc(FileHandle,character)
unsigned(nNum1,nNum2,cOperator) ---> Perform operation using unsigned numbers
upper(string) ---> convert string letters to UPPER case
uptime() ---> nTime
variablepointer(cVariableName,cPointerType) ---> Low Level Object (C Pointer)
varptr(cVariableName,cPointerType) ---> Low Level Object (C Pointer)
version([lPatch]) ---> String contains the Ring version

```

(continues on next page)

(continued from previous page)

```
windowsnl() ---> Returns a string contains CR+LF = CHAR(13) + CHAR(10)
write(cFileName,cString)
```

130.4 Compiler Errors

- Error (C1) : Error in parameters list, expected identifier
- Error (C2) : Error in class name
- Error (C3) : Unclosed control structure, 'ok' is missing
- Error (C4) : Unclosed control structure, 'end' is missing
- Error (C5) : Unclosed control structure, next is missing
- Error (C6) : Error in function name
- Error (C7) : Error in list items
- Error (C8) : Parentheses ')' is missing
- Error (C9) : Brackets ']' is missing
- Error (C10) : Error in parent class name
- Error (C11) : Error in expression operator
- Error (C12) : No class definition
- Error (C13) : Error in variable name
- Error (C14) : Try/Catch miss the Catch keyword!
- Error (C15) : Try/Catch miss the Done keyword!
- Error (C16) : Error in Switch statement expression!
- Error (C17) : Switch statement without OFF
- Error (C18) : Missing closing brace for the block opened!
- Error (C19) : Numeric Overflow!
- Error (C20) : Error in package name
- Error (C21) : Unclosed control structure, 'again' is missing
- Error (C22) : Function redefinition, function is already defined!
- Error (C23) : Using '(' after number!
- Error (C24) : The parent class name is identical to the subclass name
- Error (C25) : Trying to access the self reference after the object name
- Error (C26) : Class redefinition, class is already defined!
- Error (C27) : Syntax Error!
- Error (C28) : Expression is expected!
- Error (C29) : Braces are missing to define anonymous function!
- Error (C30) : Argument redefinition, argument is already defined!
- Error (C31) : Parentheses '(' is expected

- Error (S1) : Literal not closed!
- Warning (W1) : Unrecognized option
- Warning (W2) : Duplication in file name
- Warning (W3) : The Compiler command ChangeRingKeyword requires two words as parameters
- Warning (W4) : Compiler command ChangeRingKeyword - Keyword not found!
- Warning (W5) : The Compiler command ChangeRingOperator requires two words as parameters
- Warning (W6) : Compiler command ChangeRingOperator - Operator not found!
- Warning (W7) : Using the EXIT command outside loop!
- Warning (W8) : Using the LOOP command outside loop!

130.5 Runtime Errors

- Error (R1) : Can't divide by zero
- Error (R2) : Array Access (Index out of range)
- Error (R3) : Calling Function without definition
- Error (R4) : Stack Overflow
- Error (R5) : Can't access the list item, Object is not list
- Error (R6) : Variable is required
- Error (R7) : Can't assign to a string letter more than one character
- Error (R8) : Variable is not a string
- Error (R9) : Using exit command outside loops
- Error (R10) : Using exit command with number outside the range
- Error (R11) : Error in class name, class not found
- Error (R12) : Error in property name, property not found
- Error (R13) : Object is required
- Error (R14) : Calling Method without definition
- Error (R15) : Error in parent class name, class not found
- Error (R16) : Using braces to access unknown object
- Error (R17) : Error, using 'Super' without parent class
- Error (R18) : Numeric Overflow
- Error (R19) : Calling function with less number of parameters
- Error (R20) : Calling function with extra number of parameters
- Error (R21) : Using operator with values of incorrect type
- Error (R22) : Using loop command outside loops
- Error (R23) : Using loop command with number outside the range
- Error (R24) : Using uninitialized variable

- Error (R25) : Error in package name, Package not found
- Error (R26) : Calling private method from outside the class
- Error (R27) : Using private attribute from outside the class
- Error (R28) : Using bad data type as step value
- Error (R29) : Using bad data type in for loop
- Error (R30) : Parent class name is identical to child class name
- Error (R31) : Trying to destroy the object using the self reference
- Error (R32) : The CALL command expect a variable contains string
- Error (R33) : Bad decimals number (correct range >= 0 and <= 90)
- Error (R34) : Variable is required for the assignment operation
- Error (R35) : Can't create/open the file
- Error (R36) : The column number is not correct! It's greater than the number of columns in the list
- Error (R37) : Sorry, The command is not supported in this context
- Error (R38) : Runtime Error in loading the dynamic library
- Error (R39) : Error occurred creating unique filename
- Error (R40) : Numeric underflow
- Error (R41) : Invalid numeric string
- Error (R42) : Error in eval() function
- Error (R43) : The variable contains a protected value
- Error (R44) : Maximum nested Eval()
- Error (R45) : Variable is not a list
- Error (R46) : The dynamic library doesn't contain the ringlib_init() function!
- Error (R47) : The function is not supported in this platform
- Error (R48) : Assertion Failed!
- Error (R49) : The Ring VM is not created/ready
- Error (R50) : Object does not support operator overloading
- Error (R51) : Value Error
- Error (R52) : Using Return inside function parameters is not allowed
- Error (R53) : Function redefinition, function is already defined!
- Error (R54) : Object attribute redefinition, attribute is already defined!

130.6 Environment Errors

- Error (E1) : Caught SegFault
- Error (E2) : Out of Memory
- Error (E3) : Deleting scope while no scope!
- Error (E4) : Long VM Instruction!
- Error (E5) : The file type is not correct - the VM expect a ring object file
- Error (E6) : The Ring Object File version is not correct!
- Error (E7) : Internal error in using sscanf() function!
- Error (E8) : Internal error in using fscanf() function!
- Error (E9) : Can't open file

130.7 Language Grammar

Program → {statement}

Statement → ‘package’ <Identifier> { ‘.’ <Identifier> } [‘{’ {statement} ‘}’] [‘end’]’endpackage’]

Statement → ‘class’ <Identifier> [‘from’]’:’<’ <Identifier>] [‘{’ {statement} ‘}’][‘end’]’endclass’]

Statement → ‘func’|‘def’|‘function’ <Identifier> [ParaList] [‘{’ {statement} ‘}’][‘end’]’endfunc’|’endfunction’]

Statement → ‘import’ <Identifier> { ‘.’ <Identifier> }

Statement → ‘private’

Statement → ‘load’ [‘package’]’again’] <Literal>

Statement → ‘see’|‘put’ <Expr>

Statement → ‘give’|‘get’ <Identifier>

Statement → ‘if’ <Expr> [‘{’] {statement} [{‘but’}|‘elseif’ <Expr> {Statement} }] [‘else’ {Statement}] [‘ok’]’end’]’}’|’endif’]

Statement → ‘Switch’ <Expr> [‘{’] { ‘on’}|‘case’ <Expr> {statement} }] [‘other’ {Statement}] [‘off’]’end’]’}’|’endswitch’]

Statement → ‘for’ <Identifier> ‘=’ <Expr> ‘to’ <Expr> [‘step’ <Expr>] [‘{’] {Statement} ‘next’]’end’]’}’|’endfor’

Statement → ‘for’|‘foreach’ <Identifier> ‘in’ <Expr> [‘step’ <Expr>] [‘{’] {statement} ‘next’]’end’]’}’|’endfor’

Statement → ‘while’ <Expr> [‘{’] {statement} ‘end’]’}’|’endwhile’

Statement → ‘do’ {statement} ‘again’ <Expr>

Statement → ‘try’ {statement} [‘{’] ‘catch’ {statement} ‘done’]’end’]’}’|’endtry’

Statement → ‘return’ <Expr>

Statement → ‘bye’

Statement → ‘exit’|‘break’

Statement → ‘loop’|‘continue’

Statement → <Expr>

Statement —> epsilon
 ParaList —> epsilon
 ParaList —> [‘(’] <Identifier> [{ ‘,’} <Identifier> }] [‘)’]
 Expr —> <LogicNot> [{ ‘and’}|‘or’] <LogicNot>]
 LogicNot —> [‘not’] <EqualOrNot>
 EqualOrNot —> [‘=’]|‘!=’] <Compare>
 Compare —> <BitOrXor> [{ ‘<’} | ‘>’ | ‘<=’} | ‘>=’] <BitOrXor> }]
 BitOrXor —> <BitAnd> [{ ‘|’} | ‘^’ <BitAnd> }]
 BitAnd —> <BitShift> [{ ‘&’} <BitShift> }]
 BitShift —> <Arithmetic> [{ ‘<<’} | ‘>>’} <Arithmetic> }]
 Arithmetic —> <Term> [{ ‘+’} | ‘-’ <Term> }]
 Term —> <Range> [{ ‘*’} | ‘/’ | ‘%’} | ‘**’} | ‘^^’ <Range> }]
 Range —> <Factor> [‘:’ <Factor>]
 Factor —> <Identifier> [{Mixer}] [‘=’ <Expr>]
 Factor —> <Number>
 Factor —> <Literal>
 Factor —> ‘:’ <Identifier>
 Factor —> ‘-’ <Factor>
 Factor —> ‘(’ <Expr> ‘)’
 Factor —> <List>
 Factor —> ‘new’ [‘from’] <Identifier>
 Factor —> <AnonymousFunction>
 Factor —> ‘call’ <identifier> { ‘.’ <Identifier> } ‘(’ <Parameters> ‘)’
 List —> ‘[’ [<Expr> { ‘;’ <Expr> }] ‘]’
 Mixer —> { ‘.’ <Identifier> }
 Mixer —> ‘[’ <Expr> ‘]’
 Mixer —> ‘(’ [<Expr> [{ ‘,’ <Expr> }]] ‘)’
 Mixer —> ‘{’ {Statement} ‘}’
 AnonymousFunction —> ‘func’|‘def’|‘function’ [<ParaList>] ‘{’ {Statement} ‘}’

130.8 Virtual Machine (VM) Instructions

Definitions :-

- VM: Virtual Machine
- Stack: VM Stack
- IR: Instruction Register
- PC: Program Counter
- VP: Variable Pointer
- Stack[nSize]: Last Item in the Stack (Last In - First Out)
- VV: Variable Value (We have a Pointer to a variable, And we access this variable value)
- REG1: The first register in the instruction
- REG2: The second register in the instruction

(Stack and Variables)

Operation	Description
ICO_PUSHC	Push string from the IR to the stack
ICO_PUSHNL	Push new line to the stack
ICO_PUSHN	Push number from the IR to the stack
ICO_PUSH2N	Push two numbers from the IR to the stack
ICO_PUSHV	Replace VP in the stack[nSize] with the variable value
ICO_LOADADDRESS	Read variable name from the IR, push VP to the stack
ICO_ASSIGNMENT	Stack[nSize-1] VV = Stack[nSize] VV , POP Stack[nSize]
ICO_INC	Increment Number in Stack[nSize] by 1
ICO_LOADAPUSHV	The same as ICO_LOADADDRESS then ICO_PUSHV
ICO_NEWLINE	Store new line number (debug info)
ICO_FREESTACK	Remove all items from the stack , nSize = 0
ICO_FILENAME	Store the source code file name (debug info)
ICO_FREELOADASCOPE	Free the Scope List of the current Expression

(Jump)

Operation	Description
ICO_JUMP	Set the PC to a new value from the IR
ICO_JUMPZERO	If Stack[nSize] is a number = 0 then Set PC to new value from the IR
ICO_JUMPFOR	End of for loop
ICO_JUMPONE	If Stack[nSize] is a number = 1 then Set PC to new value from the IR
ICO_JUMPZERO2	As ICO_JUMPZERO but add 1 to the stack (required for many 'AND' conditions)
ICO_JUMPONE2	As ICO_JUMPONE but add 1 to the stack (required for many 'OR' conditions)
ICO_PUSHNULLTHENJUMP	Add NULL string to the Stack then set the PC to a new value from the IR
ICO_PUSHNTHENJUMP	Add number from REG1 to the Stack then set the PC to a new value from REG2

(Compare)

Operation	Description
ICO_LESSEQUAL	If stack[nSize-1] <= stack[nSize] , POP stack[nSize], set Stack[nSize-1] = 1 else set Stack[nSize-1] = 0
ICO_EQUAL	If stack[nSize-1] = stack[nSize] , POP stack[nSize], set Stack[nSize-1] = 1 else set Stack[nSize-1] = 0
ICO_LESS	If stack[nSize-1] < stack[nSize] , POP stack[nSize], set Stack[nSize-1] = 1 else set Stack[nSize-1] = 0
ICO_GREATER	If stack[nSize-1] > stack[nSize] , POP stack[nSize], set Stack[nSize-1] = 1 else set Stack[nSize-1] = 0
ICO_GREATEREQUA	If stack[nSize-1] >= stack[nSize] , POP stack[nSize], set Stack[nSize-1] = 1 else set Stack[nSize-1] = 0
ICO_NOTEQUAL	If stack[nSize-1] != stack[nSize] , POP stack[nSize], set Stack[nSize-1] = 1 else set Stack[nSize-1] = 0

(Math)

Operation	Description
ICO_SUM	Stack[nSize-1] = Stack[nSize-1] + Stack[nSize] , POP stack[nSize]
ICO_SUB	Stack[nSize-1] = Stack[nSize-1] - Stack[nSize] , POP stack[nSize]
ICO_MUL	Stack[nSize-1] = Stack[nSize-1] * Stack[nSize] , POP stack[nSize]
ICO_DIV	Stack[nSize-1] = Stack[nSize-1] / Stack[nSize] , POP stack[nSize]
ICO_MOD	Stack[nSize-1] = Stack[nSize-1] % Stack[nSize] , POP stack[nSize]
ICO_POW	Stack[nSize-1] = Stack[nSize-1] ** Stack[nSize] , POP stack[nSize]
ICO_NEG	Stack[nSize] = - Stack[nSize-1]
ICO_PLUSPLUS	Stack[nSize] = Stack[nSize] + 1
ICO_MINUSMINUS	Stack[nSize] = Stack[nSize] - 1
ICO_SUMN	Stack[nSize] = Stack[nSize] + REG1
ICO_SUBN	Stack[nSize] = Stack[nSize] - REG1
ICO_MULN	Stack[nSize] = Stack[nSize] * REG1
ICO_DIVN	Stack[nSize] = Stack[nSize] / REG1
ICO_MODN	Stack[nSize] = Stack[nSize] % REG1
ICO_POWN	Stack[nSize] = Stack[nSize] ** REG1

(Logic)

Operation	Description
ICO_AND	Stack[nSize-1] = Stack[nSize-1] && Stack[nSize] , POP stack[nSize]
ICO_OR	Stack[nSize-1] = Stack[nSize-1] Stack[nSize] , POP stack[nSize]
ICO_NOT	Stack[nSize] = ! Stack[nSize]

(Lists)

Operation	Description
ICO_LISTSTART	Start New List in Temp. Memory
ICO_LISTITEM	Add List Item (Value from the stack)
ICO_LISTITEMN	Add List Item (Number from REG1)
ICO_LISTITEMC	Add List Item (String from REG1)
ICO_LISTEND	End List
ICO_LOADINDEXADDRESS	Stack[nSize-1] = Stack[nSize-1] VV [Stack[nSize]] , POP stack[nSize]

(Functions)

Operation	Description
ICO_LOADFUNC	Find function
ICO_CALL	Call function
ICO_RETURN	Return from function
ICO_RETNULL	Return NULL from function
ICO_RETNULLN	Return Number (REG1) from function
ICO_RETFROMEVAL	Return after eval()
ICO_RETITEMREF	Return the list item reference - not the value
ICO_NEWFUNC	Start new function
ICO_BLOCKFLAG	Flag to determine where to jump later (after ICO_RETURN)
ICO_ANONYMOUS	Anonymous function
ICO_FREETEMPLISTS	Delete temp. lists

(End Program/Loop)

Operation	Description
ICO_BYE	End execution of VM
ICO_EXITMARK	Place to exit to from a loop
ICO_POPENITMARK	Remove exit mark
ICO_EXIT	Break from one loop or more
ICO_LOOP	Continue to next loop
ICO_OPTIONALLOOP	Check if we have optional loop then push 1 to the Stack and call Loop

(For Better Performance)

Operation	Description
ICO_PUSHP	Push pointer to the stack
ICO_INCP	Increment variable value using pointer
ICO_PUSHPV	Push value of variable using variable pointer
ICO_INCJUMP	Increment then jump
ICO_INCPJUMP	Increment using pointer then jump
ICO_LOADFUNCP	Push function pointer
ICO_PUSHPLOCAL	Push pointer to local variable
ICO_PUSHARG	Push pointer to argument variable using argument number (REG1)
ICO_INCLPJUMP	Increment value using pointer to local variable then jump
ICO_INCPJUMPSTEP1	Increment value using variable pointer then jump (for loop step = 1)
ICO_INCLPJUMPSTEP1	Increment value using local variable pointer then jump (for loop step = 1)
ICO_LEN	Remove list from the stack and push the list size

(Try-Catch-Done)

Operation	Description
ICO_TRY	Start try region
ICO_DONE	End try region

(Duplicate and Range)

Operation	Description
ICO_DUPLICATE	Duplicate stack value
ICO_RANGE	Create list from value to value

(OOP)

Operation	Description
ICO_NEWOBJ	Create new object, get class name from the IR, push object pointer to the stack.
ICO_SETSCOPE	Called after creating new object, set the active scope to be the object scope.
ICO_LOADSUBADDRESS	Get object attribute, push the pointer to the stack.
ICO_LOADMETHOD	Find object method
ICO_AFTERCALLTYPE	Used after calling a method - normal case
ICO_AFTERCALLTYPE2	Used after calling a method - second case
ICO_PACKAGE	Start new package
ICO_NECLASS	Start new class region
ICO_BRACESTART	Open brace
ICO_BRACEEND	End brace
ICO_IMPORT	Import package
ICO_NEOLABEL	Start a new section of byte code (Just for organization)
ICO_PRIVATE	Start private attributes region
ICO_SETPROPERTY	Set attribute value - check for setter
ICO_CALLCLASSINIT	Call class init() method
ICO_CHECKBRACEMETHOD	Check if a method exist using braces

(Other)

Operation	Description
ICO_SETREFERENCE	Copy by reference
ICO_KILLREFERENCE	Remove reference
ICO_ASSIGNMENTPOINTER	Determine the left side variable
ICO_BEFOREEQUAL	Determine operators like += , -= , ... etc

(Bitwise Operators)

Operation	Description
ICO_BITAND	Stack[nSize-1] = Stack[nSize-1] & Stack[nSize] , POP stack[nSize]
ICO_BITOR	Stack[nSize-1] = Stack[nSize-1] Stack[nSize] , POP stack[nSize]
ICO_BITXOR	Stack[nSize-1] = Stack[nSize-1] ^ Stack[nSize] , POP stack[nSize]
ICO_BITNOT	Stack[nSize] = ! Stack[nSize]
ICO_BITSHL	Stack[nSize-1] = Stack[nSize-1] << Stack[nSize] , POP stack[nSize]
ICO_BITSHR	Stack[nSize-1] = Stack[nSize-1] >> Stack[nSize] , POP stack[nSize]

(For Step)

Operation	Description
ICO_STEPMNUMBER	Determine step number in for loop (Read step value from stack)
ICO_STEPFROMREG	Determine step number in for loop (Read step value from REG1)
ICO_POPSTEP	POP step number from steps stack
ICO_LOADAFIRST	Load the first address of variable name

(Custom Global Scope)

Operation	Description
ICO_NEWTGLOBALSCOPE	Start new custom global scope - used by 'load package' command
ICO_ENDTGLOBALSCOPE	End of custom global scope - used by 'load package' command
ICO_SETGLOBALSCOPE	Set the current global scope

(More Instructions)

Operation	Description
ICO_NOOP	No operation
ICO_SETOPCODE	Change the operation code of a specific instruction

RESOURCES

In this section you will find resources about the language

131.1 Ring Language Website

For news about the language check the website

URL: <http://ring-lang.net>

131.2 Source Code

Ring is Free-Open Source (MIT License)

URL: <https://github.com/ring-lang/ring>

131.3 Ring Group

If you have any question or would like to send a bug report

URL: <https://groups.google.com/g/ring-lang>

131.4 Ring Team

URL: <http://ring-lang.net/team.html>

INDEX

Symbols

3D Camera
 Using RingRayLib, 745
3D Camera Free
 Using RingRayLib, 747
3D Cube and Texture
 Using RingOpenGL and RingAllegro for 3D Graphics, 843
3D Picking
 Using RingRayLib, 754
64bit version
 Building From Source Code, 2063

A

AbstractAxis Class
 RingQt Classes Reference, 1216
AbstractBarSeries Class
 RingQt Classes Reference, 1219
Access List Items by String Index
 Lists, 108
Access Objects Using Braces
 Object Oriented Programming, 232
Access String Letters
 Strings, 114
Accessing the class attributes from braces inside class methods
 Scope Rules, 310
Add Items
 Lists, 102
addattribute()
 Reflection and Meta-programming, 270
AddBytesColumn()
 Using FastPro, 1546
AddDays()
 Date and Time, 125
Adding code to the generated code
 Code Generator, 1636
Adding Hyperlink to QLabel
 Desktop, WebAssembly and Mobile Development, 439
addmethod()
 Reflection and Meta-programming, 270

Analog Clock
 Applications developed in a few hours, 13
Animate Class
 Game Engine for 2D Games, 688
Animate Events
 Game Engine for 2D Games, 701
Animation
 Game Engine for 2D Games, 694
Animation and Functions
 Game Engine for 2D Games, 695
Anonymous and Nested Functions
 Functional Programming, 253
apparguments() Function
 Stdlib Functions, 356
Application Class
 Web Development (*CGI Library*), 659
Application Database
 Deploying Web Applications in the Cloud, 667
Applications
 How to contribute?, 2074
Applications developed in a few hours
 Analog Clock, 13
 FetchStockData Application, 10
 Fifteen Puzzle Game, 12
 Google API Shortener Application, 10
 Innovative, 22
 Introduction, 1
 Practical, 23
 Quotes about Ring, 2
 Samples in this book, 15
 Squares Puzzle Game, 14
 Video-Music-Player Application, 11
apppath() Function
 Stdlib Functions, 357
Arithmetic Operations
 Performance Tips, 910
Arithmetic Operators
 Operators, 58
ASCII Table application
 What is new in Ring 1.12?, 1852
Ascii()

Data Type, 133	What is new in Ring 1.2?, 1691
ASCIIList2Str() Function	Better GUILib
Stdlib Functions, 375	What is new in Ring 1.17, 1931
Assert()	Better Handling For Numbers
Eval() and Debugging, 167	What is new in Ring 1.14?, 1900
Assignment Operators	Better I/O Functions
Operators, 59	What is new in Ring 1.17, 1934
attributes()	Better Installation Scripts
Reflection and Meta-programming, 267	What is new in Ring 1.16?, 1921
Automatic loading for syntax files	Better Loop Exit Command
Syntax Flexibility, 335	What is new in Ring 1.3?, 1704
B	Better MatrixLib
Basic Shapes	What is new in Ring 1.21, 1990
Using RingRayLib, 760	Better Memory Management
Basic Window	What is new in Ring 1.9?, 1820
Using RingRayLib, 742	Better Natural Language Programming Support
Better batch files for building Ring	What is new in Ring 1.1?, 1679
What is new in Ring 1.19, 1962	Better Objects Library
Better Call Command	What is new in Ring 1.5?, 1735
What is new in Ring 1.2?, 1694	Better Operator Overloading
Better Cards Game	What is new in Ring 1.21, 1998
What is new in Ring 1.8?, 1803	Better Organization
Better CitPre application	What is new in Ring 1.13?, 1878
What is new in Ring 1.18, 1941	Better Performance
Better Code Generator For Extensions	What is new in Ring 1.11?, 1849
What is new in Ring 1.8?, 1804	What is new in Ring 1.8?, 1792
Better Code Generator for Extensions	Better Performance For Strings
What is new in Ring 1.1?, 1688	What is new in Ring 1.14?, 1899
What is new in Ring 1.5?, 1751	Better Performance when using Braces
What is new in Ring 1.9?, 1821	What is new in Ring 1.20, 1979
Better Compiler	Better Quality
What is new in Ring 1.22?, 2012	What is new in Ring 1.2?, 1695
Better Documentation	What is new in Ring 1.5?, 1761
What is new in Ring 1.18, 1953	Better Ring API
What is new in Ring 1.19, 1970	What is new in Ring 1.17, 1935
What is new in Ring 1.20, 1985	What is new in Ring 1.18, 1952
What is new in Ring 1.11?, 1849	Better Ring Compiler and VM
What is new in Ring 1.16?, 1921	What is new in Ring 1.8?, 1804
What is new in Ring 1.1?, 1688	Better Ring FastPro Extension
What is new in Ring 1.7?, 1787	What is new in Ring 1.22?, 2009
Better Documentation Generator for	Better Ring For Android
Extensions	What is new in Ring 1.6?, 1773
What is new in Ring 1.5?, 1752	Better Ring Notepad
Better Extensions Generator	What is new in Ring 1.15?, 1908
What is new in Ring 1.19, 1970	What is new in Ring 1.2?, 1691
Better Files for Loading the StdLib	What is new in Ring 1.3?, 1700
What is new in Ring 1.20, 1979	What is new in Ring 1.5?, 1726
Better Form Designer	What is new in Ring 1.6?, 1776
What is new in Ring 1.8?, 1802	What is new in Ring 1.7?, 1786
Better Functions	What is new in Ring 1.9?, 1811
What is new in Ring 1.20, 1977	Better Ring VM
What is new in Ring 1.14?, 1899	What is new in Ring 1.7?, 1787
What is new in Ring 1.22?, 2008	Better Ring2EXE
	What is new in Ring 1.7?, 1787

- Better RingLibCurl
 - What is new in Ring 1.15?, 1912
- Better RingOpenSSL
 - What is new in Ring 1.17, 1933
 - What is new in Ring 1.14?, 1897
- Better RingQt
 - What is new in Ring 1.21, 1991
 - What is new in Ring 1.11?, 1847
 - What is new in Ring 1.13?, 1873
 - What is new in Ring 1.15?, 1911
 - What is new in Ring 1.2?, 1692
 - What is new in Ring 1.3?, 1696
 - What is new in Ring 1.4?, 1718
 - What is new in Ring 1.5?, 1733
 - What is new in Ring 1.6?, 1778
 - What is new in Ring 1.7?, 1786
 - What is new in Ring 1.8?, 1803
 - What is new in Ring 1.9?, 1817
- Better RingRayLib
 - What is new in Ring 1.18, 1948
 - What is new in Ring 1.19, 1967
 - What is new in Ring 1.21, 1993
 - What is new in Ring 1.12?, 1859
 - What is new in Ring 1.13?, 1876
- Better RingREPL
 - What is new in Ring 1.6?, 1779
- Better RingSockets
 - What is new in Ring 1.18, 1949
- Better RingStbImage
 - What is new in Ring 1.19, 1968
- Better RingVM
 - What is new in Ring 1.6?, 1779
- Better RingWinAPI
 - What is new in Ring 1.17, 1933
- Better RingZip
 - What is new in Ring 1.7?, 1787
- Better Samples
 - What is new in Ring 1.22?, 2007
- Better Samples and Applications
 - What is new in Ring 1.20, 1974, 1975
- Better Scripts for Building Ring
 - What is new in Ring 1.20, 1984
- Better Scripts for building Ring
 - What is new in Ring 1.6?, 1775
- Better StdLib
 - What is new in Ring 1.15?, 1910
 - What is new in Ring 1.3?, 1704
 - What is new in Ring 1.4?, 1716
 - What is new in Ring 1.5?, 1729
 - What is new in Ring 1.6?, 1779
 - What is new in Ring 1.9?, 1812
- Better Support for Threads
 - What is new in Ring 1.20, 1980
- Better Syntax Flexibility
 - What is new in Ring 1.17, 1933
- Better Tests
 - What is new in Ring 1.10?, 1832
- Better Threads Support
 - What is new in Ring 1.13?, 1864
- Better Tools
 - What is new in Ring 1.18, 1942
- Better Tools and Extensions
 - What is new in Ring 1.20, 1983
- Better Trace Library
 - What is new in Ring 1.7?, 1785
- Better TypeHints
 - What is new in Ring 1.19, 1966
- Better WebLib
 - What is new in Ring 1.18, 1951
 - What is new in Ring 1.4?, 1716
 - What is new in Ring 1.5?, 1730
- Bezier Lines
 - Using RingRayLib, 764
- bignum
 - BigNumber Class, 975
 - BigNumber Functions, 975
 - Examples, 973
 - Introduction, 972
 - Library Source Code, 975
 - Loading the library, 973
- BigNumber Class
 - bignum, 975
- BigNumber Functions
 - bignum, 975
- BigNumber Library
 - What is new in Ring 1.9?, 1813
- binarydigits() Function
 - Stdlib Functions, 367
- Bitwise Operators
 - Operators, 59
- Blink sample
 - Using Pico, 1661
- BMI Calculator application
 - What is new in Ring 1.12?, 1852
- BraceError() Method
 - Natural Language Programming, 292
- BraceExprEval Method
 - Natural Language Programming, 290
- BraceStart and BraceEnd Methods
 - Natural Language Programming, 290
- Branching
 - Control Structures, 68
 - Control Structures - Second Style, 75
 - Control Structures - Third Style, 79
- BreakPoint
 - The Trace Library and the Interactive Debugger, 344
- Build the extension on different platforms

- Tutorial: Ring Extensions in C/C++, [1591](#)
- Building**
 - Using Pico, [1660](#)
 - Building From Source Code**
 - 64bit version, [2063](#)
 - Building using CMake, [2072](#)
 - Building using MacOS X, [2069](#)
 - Building using Microsoft Windows, [2062](#)
 - Building using Ubuntu Linux, [2065](#)
 - Complete Build, [2062](#)
 - Custom Build, [2063](#)
 - Introduction, [2061](#)
 - Building Games For Android**
 - Building the project, [740](#)
 - Download Requirements and Update the Android SDK, [739](#)
 - Introduction, [738](#)
 - Project Folder, [739](#)
 - Building RingQt Applications for Mobile**
 - Comments about developing for Android using RingQt, [595](#)
 - Download Requirements, [590](#)
 - Install Qt for Android, [590](#)
 - Introduction, [589](#)
 - The Qt project for your Ring application, [591](#)
 - Using Ring2EXE, [591](#)
 - Building RingQt Applications for WebAssembly**
 - Comments about developing for WebAssembly using RingQt, [603](#)
 - Dialogs, [604](#)
 - Download Requirements, [598](#)
 - Introduction, [597](#)
 - Online Applications, [605](#)
 - The Qt project for your Ring application, [600](#)
 - Using Ring2EXE, [599](#)
 - Building standalone console application**
 - Distributing Ring Application using Ring2EXE, [935](#)
 - Building the Cards Game for Mobile using RingQt**
 - Distributing Ring Application using Ring2EXE, [937](#)
 - Building the Form Designer for Mobile using RingQt**
 - Distributing Ring Application using Ring2EXE, [939](#)
 - Building the project**
 - Building Games For Android, [740](#)
 - Building the Weight History Application for Mobile using RingQt
 - Distributing Ring Application using Ring2EXE, [938](#)**
 - Building using CMake**
 - Building From Source Code, [2072](#)
 - Building using MacOS X**
 - Building From Source Code, [2069](#)
 - Building using Microsoft Windows**
 - Building From Source Code, [2062](#)
 - Building using Ubuntu Linux**
 - Building From Source Code, [2065](#)
 - Bytes2List() function**
 - Using FastPro, [1538](#)
- C**
 - Calculator Application**
 - What is new in Ring 1.5?, [1725](#)
 - Calendar application**
 - What is new in Ring 1.12?, [1853](#)
 - Call Functions**
 - Functions - First Style, [86](#)
 - Functions - Second Style, [90](#)
 - Functions - Third Style, [94](#)
 - callgc()**
 - Low Level Functions, [1562](#)
 - Calling a function sharing the name with a method in the current class**
 - Scope Rules for Functions and Methods, [322](#)
 - Calling Functions and Methods**
 - Performance Tips, [911](#)
 - Camera**
 - Using Qt3D, [568](#)
 - Camera First Person**
 - Using RingRayLib, [752](#)
 - Can I connect to dbase/harbour database?**
 - Frequently Asked Questions, [2059](#)
 - Can Ring work on Windows XP?**
 - Frequently Asked Questions, [2049](#)
 - capitalized() Function**
 - Stdlib Functions, [360](#)
 - cfunctions()**
 - Reflection and Meta-programming, [258](#)
 - CGI Support**
 - Command Line Options, [926](#)
 - Change Focus**
 - Desktop, WebAssembly and Mobile Development, [478](#)
 - Change Language Keywords**
 - Syntax Flexibility, [324](#)
 - Change Language Operators**
 - Syntax Flexibility, [325](#)
 - Change the '=' operator to 'is'**
 - Natural Language Programming, [287](#)
 - Change the Console window title**

Using RogueUtil, 1073
 Change the cursor position
 Using RogueUtil, 1074
 Change the Ring Keyword 'And'
 Natural Language Programming, 285
 Change the Ring Operator '+'
 Natural Language Programming, 287
 Change: Basic Extensions are separated from RingVM
 What is new in Ring 1.4?, 1710
 changestring() Function
 Stdlib Functions, 370
 Char()
 Data Type, 134
 ChDir() Function
 System Functions, 163
 Check Character
 Data Type, 129
 Check Data Type
 Data Type, 127
 Check Parameters Count
 Extension, 1618
 Check Parameters Type
 Extension, 1619
 CheckEquality() Function
 Stdlib Functions, 377
 Checkers Game
 What is new in Ring 1.11?, 1836
 Chess 3D (*Qt3D Sample*)
 What is new in Ring 1.15?, 1907
 Chess Endgame Application
 What is new in Ring 1.15?, 1905
 Chess Game
 What is new in Ring 1.10?, 1824
 Circular References
 Using References, 1554
 Citations Prediction
 What is new in Ring 1.17, 1925
 Classes and Objects
 Object Oriented Programming, 230
 Classes and their Methods to use the default events
 Desktop, WebAssembly and Mobile Development, 511
 classes()
 Reflection and Meta-programming, 262
 classname()
 Reflection and Meta-programming, 265
 Clean Natural Code
 Natural Language Programming, 293
 Clearerr()
 Files, 149
 Client Example
 RingLibuv, 1139
 Client Example - Using Classes
 RingLibuv, 1141
 Clock
 Command Line Options, 927
 clock()
 Date and Time, 122
 Close Window Event
 RingLibSDL, 1108
 ClosPerSecond()
 Date and Time, 122
 Code Generator
 Adding code to the generated code, 1636
 Comments in configuration file, 1638
 Configuration file, 1634
 Configuration file for the Allegro library, 1640
 Configuration Files Examples, 1656
 Constants Type, 1639
 Defining Constants, 1637
 Determine Structure Members Types, 1637
 Enum and Numbers, 1638
 Executing code during code generation, 1638
 Extra names for functions, 1656
 Filtering using Expressions, 1639
 function prototype, 1634
 Introduction, 1633
 Loading Files, 1655
 Managed Classes, 1655
 Prefix for Functions Names, 1636
 Qt configuration file, 1644
 Register New Functions, 1637
 Static Methods, 1654
 Threads Support, 1641
 Using configuration file that wrap C++ library, 1643
 Using the tool, 1634
 Wrap structures, 1636
 Wrapping C++ Classes, 1643
 Code Generator for Extensions
 What is new in Ring 1.17, 1936
 Code Runner Extension support Ring
 What is new in Ring 1.16?, 1918
 CodeEditor Class
 RingQt Classes Reference, 1220
 Collision Area
 Using RingRayLib, 765
 Colors Palette
 Using RingRayLib, 770
 Command Line Options
 CGI Support, 926
 Clock, 927
 Generate Embedded Object File, 928
 Generate Object File, 928

Introduction, 912
 No Run, 927
 Printing Final Intermediate Code, 923
 Printing Instruction Operation Code, 927
 Printing Intermediate Code, 920
 Printing Rules, 915
 Printing Tokens, 913
 Comments about developing for Android using RingQt
 Building RingQt Applications for Mobile, 595
 Comments about developing for WebAssembly using RingQt
 Building RingQt Applications for WebAssembly, 603
 Comments about evaluation
 Control Structures - First Style, 74
 Comments in configuration file
 Code Generator, 1638
 Compact Syntax
 Language Design, 1671
 Compiler and Virtual Machine (VM)
 How to contribute?, 2074
 Compiler Errors
 Language Specification, 2084
 Compiling on Manjaro Linux
 What is new in Ring 1.8?, 1797
 Complete Build
 Building From Source Code, 2062
 Composition
 Object Oriented Programming, 233
 Configuration file
 Code Generator, 1634
 Configuration file for the Allegro library
 Code Generator, 1640
 Configuration Files Examples
 Code Generator, 1656
 Configure the Apache web server
 Using XAMPP Apache web server, 606
 Web Development (*CGI Library*), 606
 Conflict between Class Attributes and Local Variables
 Scope Rules, 306
 Conflict between Global Variables and Class Attributes
 Frequently Asked Questions, 2041
 Scope Rules, 305
 Conflict between self inside braces and self in the class region
 Scope Rules, 313
 Constants
 RingStbImage Functions Reference, 1166
 socket, 1015
 Using RingPDFGen, 1549
 Using TokensLib, 998
 Constants Type
 Code Generator, 1639
 Constructor methods in Ring
 Frequently Asked Questions, 2037
 Context Menu
 Desktop, WebAssembly and Mobile Development, 420
 Control Gallery
 libui, 1023
 Control Structures
 Branching, 68
 Looping, 80
 Control Structures - First Style
 Comments about evaluation, 74
 Do Again Loop, 71
 Exit, 72
 Exit from two loops, 72
 For In Loop, 70
 for in to modify lists, 71
 For Loop, 70
 Introduction, 67
 Loop Command, 72
 Looping, 69
 Short-circuit evaluation, 73
 Step Option, 71
 Switch Statement, 68
 While Loop, 69
 Control Structures - Second Style
 Branching, 75
 Exceptions, 78
 For In Loop, 77
 For Loop, 77
 If Statement, 75
 Introduction, 74
 Looping, 76
 Switch Statement, 75
 Control Structures - Third Style
 Branching, 79
 Exceptions, 82
 For In Loop, 82
 For Loop, 81
 If Statement, 79
 Introduction, 78
 Switch Statement, 79
 While Loop, 80
 Conversion
 Data Type, 132
 Conversion Class
 Stdlib Classes, 397
 Convert between Numbers and Bytes
 What is new in Ring 1.4?, 1715
 Convert Letters Case
 Strings, 114

Cookies
 Web Development (*CGI Library*), 619

Copy Lists
 Lists, 107

Copy()
 Strings, 116

Could you explain the output of the StrCmp() function?
 Frequently Asked Questions, 2044

Create Database
 MySQL Functions, 184

Create Executable File
 Getting Started - First Style, 46
 Getting Started - Second Style, 49
 Getting Started - Third Style, 52

Create Lists
 Lists, 101

Create Multi Dimension Array Using List and Recursion
 Lists, 111

Create Package in the Current Folder
 Ring Package Manager (*RingPM*), 949

Create Table
 Tutorial: Ring Extensions in C/C++, 1611

Create Table and Insert Data
 MySQL Functions, 184

Create Window
 RingLibSDL, 1104

Create your first extension
 Introduction, 1657
 Location, 1658
 Steps to create the extension, 1658
 Testing the extension, 1659

Create Zip File
 RingZip, 1065

Creating a Class for each Window in GUI applications
 Scope Rules, 312

Creating Lists
 Performance Tips, 909

Creating Menubar
 Desktop, WebAssembly and Mobile Development, 418

Creating more than one window
 Desktop, WebAssembly and Mobile Development, 460

Creating New Package
 Ring Package Manager (*RingPM*), 946

Creating Reports using the WebLib and the GUILib
 Desktop, WebAssembly and Mobile Development, 518

Creating StatusBar

Desktop, WebAssembly and Mobile Development, 423

Creating the Game Window
 Game Engine for 2D Games, 689

Creating the Qt resource file using Folder2qrc
 Distributing Ring Application using Ring2EXE, 941

Creating Threads
 Threads, 1016

Creating Toolbar
 Desktop, WebAssembly and Mobile Development, 421

Creating Windows Installer
 Distributing Ring Application, 931

CRUD Example using MVC
 Web Development (*CGI Library*), 643

CSVLib Library
 What is new in Ring 1.17, 1927

Cubic Map
 Using RingRayLib, 786

CurrentDir() Function
 System Functions, 162

Custom Build
 Building From Source Code, 2063

Customers Form
 What is new in Ring 1.14?, 1888

D

Data Representation
 Language Design, 1670

Data Type
 Ascii(), 133
 Char(), 134
 Check Character, 129
 Check Data Type, 127
 Conversion, 132
 Dec(), 134
 Hex(), 134
 Hex2str(), 135
 Introduction, 126
 IsAlNum(), 129
 IsAlpha(), 129
 IsCntrl(), 130
 IsDigit(), 130
 IsGraph(), 130
 IsList(), 128
 IsLower(), 131
 IsNULL(), 128
 IsNumber(), 127
 IsPrint(), 131
 IsPunct(), 131
 IsSpace(), 132
 IsString(), 127

IsUpper(), 132
 IsXdigit(), 132
 Number(), 133
 Str2Hex(), 135
 String(), 133
 Type(), 128
Database, ModelBase & ControllerBase
 classes
 Web Development (*CGI Library*), 652
DataType Class
 Stdlib Classes, 396
Date and Time
 AddDays(), 125
 clock(), 122
 ClosPerSecond(), 122
 Date(), 123
 DiffDays(), 125
 EpochTime(), 125
 Introduction, 121
 Time(), 122
 TimeList(), 123
Date()
 Date and Time, 123
DateTime Class
 Stdlib Classes, 392
dayofweek() Function
 Stdlib Functions, 368
Debug Class
 Stdlib Classes, 395
Dec()
 Data Type, 134
Decimals()
 Mathematical Functions, 140
Declarative Programming
 Declarative programming on the top of
 Object-Oriented, 281
 executing code after the end of object
 access, 281
 Introduction, 277
 More Beautiful Code, 283
 Objects inside lists, 278
 Return object by reference, 279
Declarative programming on the top of
 Object-Oriented
 Declarative Programming, 281
Declarative Programming sample
 Using Pico, 1663
Declare parameters
 Functions - First Style, 87
 Functions - Second Style, 91
 Functions - Third Style, 95
Decrypt()
 Security and Internet Functions, 207
Deep Copy

Variables, 56
Default value for object attributes
 Object Oriented Programming, 248
Default value for object attributes is NULL
 What is new in Ring 1.8?, 1799
Define Declarative Languages
 Language Design, 1674
Define Functions
 Functions - First Style, 86
 Functions - Second Style, 90
 Functions - Third Style, 94
Define Natural Statements
 Language Design, 1672
Defined Constants
 Using RogueUtil, 1081
Defining Commands
 Using the Natural Library, 297
Defining commands using classes
 Using the Natural Library, 301
Defining Constants
 Code Generator, 1637
Defining Variables and Variables Access
 Scope Rules, 303
Delete Item From List
 Lists, 103
Deleting All Packages
 Ring Package Manager (*RingPM*), 946
Demo Programs
 Introduction, 168
 Language Shell, 169
 Main Menu, 170
 The Cards Game, 505
Dependency injection
 Using References, 1557
Deploying after updates
 Deploying Web Applications in the Cloud, 667
Deploying Web Applications in the Cloud
 Application Database, 667
 Deploying after updates, 667
 Hello World program, 667
 Introduction, 664, 665
 Local Tests, 667
 Ring source code files and permissions, 666
 Usage, 665
Deploying Web applications in the Cloud
 What is new in Ring 1.9?, 1817
Deployment
 Using Pico, 1661
Designed for a clear goal
 Language Design, 1668
Desktop Screen Shot Application
 What is new in Ring 1.11?, 1841

Desktop, WebAssembly and Mobile Development
 Adding Hyperlink to QLabel, 439
 Change Focus, 478
 Classes and their Methods to use the default events, 511
 Context Menu, 420
 Creating Menubar, 418
 Creating more than one window, 460
 Creating Reports using the WebLib and the GUILib, 518
 Creating StatusBar, 423
 Creating Toolbar, 421
 Dialog Functions, 468
 Display Image using QLabel, 443
 Display Scaled Image using QLabel, 453
 Drawing using QPainter, 455
 Dynamic Objects, 482
 Inheritance from GUI Classes, 474
 KeyPress and Mouse Move Events, 469
 Menubar and StyleSheet Example, 444
 Methods to use Events with Events Filter, 514
 Movable Label Example, 464
 Moving Objects using the Mouse, 470
 New Classes names - Index Start from 1, 516
 Notepad Application, 488
 Other Widgets Events, 448
 Playing Sound, 462
 Printing using QPrinter, 457
 QLineEdit Events and QMessageBox, 446
 QMessageBox Example, 465
 QVideoWidget and QMediaPlayer, 440
 Regular Expressions, 479
 RingQt Classes and their Qt Documentation, 516
 Rotate Text, 476
 Simple Client and Server Example, 480
 TableWidget - AddList() Method, 517
 The Cards Game, 505
 The Difference between Qt and RingQt, 515
 The Events Loop, 408
 The First GUI Application, 406
 Using Layout, 408
 Using QCheckBox, 436
 Using QComboBox Class, 417
 Using QDateEdit, 431
 Using QDesktopWidget Class, 475
 Using QDial, 432
 Using QDockWidget, 424
 Using QFrame, 442
 Using QInputDialog Class, 467
 Using qLCDNumber, 463
 Using QPrintPreviewDialog, 458
 Using QProgressBar, 428
 Using QProgressBar and Timer, 452
 Using QRadioButton and QButtonGroup, 437
 Using QSlider, 429
 Using QSpinBox, 429
 Using QTableWidget, 427
 Using QTabWidget, 425
 Using QTreeView and QFileSystemModel, 414
 Using QTreeWidget and QTreeWidgetItem, 415
 Using QWebView, 435
 Using the QColorDialog Class, 462
 Using the QFileDialog Class, 454
 Using the QListWidget Class, 411
 Using the QTextEdit Class, 410
 Using the QTimer Class, 451
 Weight History Application, 484
 Determine Structure Members Types
 Code Generator, 1637
 Dialog Functions
 Desktop, WebAssembly and Mobile Development, 468
 Dialogs
 Building RingQt Applications for WebAssembly, 604
 DiffDays()
 Date and Time, 125
 Dir()
 Files, 144
 Direxists()
 Files, 151
 Disable BreakPoints
 The Trace Library and the Interactive Debugger, 344
 Discovering Packages
 Ring Package Manager (*RingPM*), 943
 Display Error Message
 Extension, 1619
 Display Image
 RingLibSDL, 1104
 Display Image using QLabel
 Desktop, WebAssembly and Mobile Development, 443
 Display List
 Tutorial: Ring Extensions in C/C++, 1604
 Display PNG Images
 RingLibSDL, 1106
 Display Scaled Image using QLabel
 Desktop, WebAssembly and Mobile Development, 453
 Display Transparent Images
 RingLibSDL, 1107
 Display Warnings Option
 What is new in Ring 1.2?, 1694

Distributing Applications and Games for Mobile	How to contribute?, 2073
Distributing Ring Application, 931	
Distributing Applications for Microsoft Windows	Download Requirements
Distributing Ring Application, 930	Building RingQt Applications for Mobile, 590
Distributing Applications for Mobile using RingQt	Building RingQt Applications for WebAssembly, 598
Distributing Ring Application using Ring2EXE, 937	Download Requirements and Update the Android SDK
Distributing Applications for WebAssembly using RingQt	Building Games For Android, 739
Distributing Ring Application using Ring2EXE, 937	Download()
Distributing Ring Application	Security and Internet Functions, 228
Creating Windows Installer, 931	Draw Gradient
Distributing Applications and Games for Mobile, 931	libui, 1037
Distributing Applications for Microsoft Windows, 930	Draw Office
Introduction, 929	Using Qt3D, 563
Protecting the Source Code, 930	Draw Rectangle
The files ring.ring and ring.ringo, 931	RingLibSDL, 1105
Using C/C++ Compiler and Linker, 931	Draw Ring
Distributing Ring Application using Ring2EXE	Using RingRayLib, 761
Building standalone console application, 935	Drawing Cone
Building the Cards Game for Mobile using RingQt, 937	Using Qt3D, 541
Building the Form Designer for Mobile using RingQt, 939	Drawing Cube
Building the Weight History Application for Mobile using RingQt, 938	Using Qt3D, 533
Creating the Qt resource file using Folder2qrc, 941	Drawing Cylinder
Distributing Applications for Mobile using RingQt, 937	Using Qt3D, 539
Distributing Applications for WebAssembly using RingQt, 937	Drawing Plane
Distributing RingAllegro Applications, 935, 936	Using Qt3D, 543
Example, 934	Drawing Sample
How Ring2EXE works?, 933	libui, 1036
Important Information about Ring2EXE, 941	Drawing Sphere
Introduction, 932	Using Qt3D, 537
Options, 934	Drawing Text
Using Ring2EXE, 933	Game Engine for 2D Games, 690
Distributing RingAllegro Applications	Drawing Torus
Distributing Ring Application using Ring2EXE, 935, 936	Using Qt3D, 535
Do Again Loop	Drawing using QPainter
Control Structures - First Style, 71	Desktop, WebAssembly and Mobile Development, 455
Documentation	Drawing using RingOpenGL
	Using RingOpenGL and RingFreeGLUT for 3D Graphics, 791
	Drawing, Animation and Input
	Graphics and Game Programming, 669
	Dynamic Attributes
	Object Oriented Programming, 241
	Dynamic Objects
	Desktop, WebAssembly and Mobile Development, 482
	Dynamic Typing
	Variables, 56
	E
	Editors Support
	How to contribute?, 2074

Embedding Ring in Ring
 Embedding Ring in Ring, 346
 Embedding Ring in Ring without sharing
 the State, 347
 Pause/Resume the Ring VM, 353
 ring_state_filetokens() function, 351
 ring_state_mainfile() and Ring Object
 File, 352
 ring_state_new() and
 ring_state_mainfile(), 349
 ring_state_setvar(), 348
 Rules, 354
 Runtime Errors when Embedding Ring in
 Ring, 350
 Serial Execution of Programs, 348
 Embedding Ring in Ring without sharing the
 State
 Embedding Ring in Ring, 347
 What is new in Ring 1.3?, 1706
 Embedding Ring Language in C/C++ Programs
 Introduction, 1630
 Ring State, 1631
 Ring State Functions, 1631
 Ring State Variables, 1632
 Employee Application
 What is new in Ring 1.6?, 1772
 Enable/Disable Hash Comments
 Syntax Flexibility, 337
 What is new in Ring 1.20, 1978
 Encourage Organization
 Language Design, 1670
 Encrypt()
 Security and Internet Functions, 207
 ends with() Function
 Stdlib Functions, 364
 Entering Items
 Form Designer, 528
 Enum and Numbers
 Code Generator, 1638
 Environment Errors
 Language Specification, 2086
 EpochTime()
 Date and Time, 125
 EpochTime() Function
 Stdlib Functions, 372
 Equality of functions
 Functional Programming, 255
 Erlang B Formula
 What is new in Ring 1.14?, 1887
 Escape Game
 What is new in Ring 1.13?, 1871
 Eval()
 Eval() and Debugging, 165
 Eval() and Debugging
 Assert(), 167
 Eval(), 165
 Introduction, 164
 Raise(), 166
 Try/Catch/Done, 165
 even or odd() Function
 Stdlib Functions, 365
 Events Code
 Form Designer, 524
 Example
 Distributing Ring Application using
 Ring2EXE, 934
 Files, 152
 FoxRing Functions Reference, 970
 Mathematical Functions, 136
 Natural Language Programming, 284
 Objects Library for RingQt Application,
 577
 RingMurmurHash Functions Reference, 1069
 Security and Internet Functions, 207
 System Functions, 159
 The Type Hints Library, 338
 Using HTTPLib, 981
 Using RingPDFGen, 1548
 Using TokensLib, 997
 Example - The Trace Library
 Low Level Functions, 1583
 Example - Using the Trace Functions
 Low Level Functions, 1579
 Example about Sharing Names between
 Functions and Methods
 Scope Rules for Functions and Methods,
 321
 Examples
 bignum, 973
 PostgreSQL, 195
 Using CSVLib, 976
 Using JSONLib, 979
 Exceptions
 Control Structures - Second Style, 78
 Control Structures - Third Style, 82
 Execute Program Line by Line
 The Trace Library and the Interactive
 Debugger, 344
 Execute Query and Print Result
 ODBC Functions, 177
 executing code after the end of object
 access
 Declarative Programming, 281
 Executing code during code generation
 Code Generator, 1638
 ExeFileName() Function
 System Functions, 162
 ExeFolder() Function

System Functions, 163
E
 Exit
 Control Structures - First Style, 72
 Exit from two loops
 Control Structures - First Style, 72
 Extension
 Check Parameters Count, 1618
 Check Parameters Type, 1619
 Display Error Message, 1619
 Fopen() and Fclose() Implementation, 1621
 Function Prototype, 1620
 Function Structure, 1618
 Get Parameters Values, 1620
 Introduction, 1615
 Memory Functions, 1630
 Module Organization, 1617
 MySQL_Columns() Implementation, 1627
 Return Value, 1620
 RING API - list Functions, 1622
 RING API - String Functions, 1625
 RING_API_STATE, 1624
 ring_ext.c, 1616
 ring_ext.h, 1616
 Shared Libraries, 1628
 Sin() Implementation, 1621
 Using RING_API_RETMANAGEDCPOINTER(), 1629
 Extensions in C/C++
 How to contribute?, 2074
 Extra names for functions
 Code Generator, 1656
 Extract Zip File
 RingZip, 1065
 Extruded Text
 Using Qt3D, 557

F

Facebook Login
 RingLibCurl, 1001
 factorial() Function
 Stdlib Functions, 361
 factors() Function
 Stdlib Functions, 366
 Fast Enough For Many Applications
 Language Design, 1678
 Faster (For-In) Loop
 What is new in Ring 1.18, 1946
 Faster Arithmetic Operations
 What is new in Ring 1.21, 1996
 Faster BraceError()
 What is new in Ring 1.18, 1947
 Faster Compiler
 What is new in Ring 1.21, 1997
 Faster Function Call
 What is new in Ring 1.21, 1994

FastPro Extension
 What is new in Ring 1.19, 1965
 Fclose()
 Files, 146
 Features
 Introduction, 29
 Ring Package Manager (*RingPM*), 943
 Feof()
 Files, 149
 Ferror()
 Files, 149
 FetchStockData Application
 Applications developed in a few hours, 10
 Fexists()
 Files, 151
 Fflush()
 Files, 146
 Fgetc()
 Files, 149
 Fgetpos()
 Files, 148
 Fgets()
 Files, 150
 fibonacci() Function
 Stdlib Functions, 362
 Fifteen Puzzle Game
 Applications developed in a few hours, 12
 File Class
 Stdlib Classes, 393
 File Hash
 Security and Internet Functions, 208
 file2list() Function
 Stdlib Functions, 363
 Files
 Clearerr(), 149
 Dir(), 144
 Direxists(), 151
 Example, 152
 Fclose(), 146
 Feof(), 149
 Ferror(), 149
 Fexists(), 151
 Fflush(), 146
 Fgetc(), 149
 Fgetpos(), 148
 Fgets(), 150
 Fopen(), 145
 Fputc(), 150
 Fputs(), 150
 Fread(), 150
 Freopen(), 146
 Fseek(), 147
 Fsetpos(), 148
 Ftell(), 148

Fwrite(), 151
Getfilesize(), 152
Getpathtype(), 151
Introduction, 142
Numbers and Bytes, 154
Perror(), 149
Read File using Read(), 144
Remove(), 145
Rename(), 145
Rewind(), 148
Tempfile(), 147
Temppath(), 147
Ungetc(), 150
Write file using Write(), 144
Filter List Items
Tutorial: Ring Extensions in C/C++, 1597
filter() Function
Stdlib Functions, 359
Filtering using Expressions
Code Generator, 1639
Find in files Application
What is new in Ring 1.8?, 1793
Find SubString
Strings, 117
Find() and List of Objects
Object Oriented Programming, 243
First Application using RingLibuv
RingLibuv, 1136
First-Class Functions
Functional Programming, 252
First-Class Lists
Lists, 107
Flappy Bird 3000 Game
Game Engine for 2D Games, 718
Following Eyes
Using RingRayLib, 768
Fopen()
Files, 145
Fopen() and Fclose() Implementation
Extension, 1621
For In Loop
Control Structures - First Style, 70
Control Structures - Second Style, 77
Control Structures - Third Style, 82
for in to modify lists
Control Structures - First Style, 71
For Loop
Control Structures - First Style, 70
Control Structures - Second Style, 77
Control Structures - Third Style, 81
For Loop - Better Performance
What is new in Ring 1.19, 1962
ForEach Keyword
What is new in Ring 1.21, 1997
Form Designer
Entering Items, 528
Events Code, 524
Introduction, 521
Keyboard Shortcuts, 527
Menubar Designer, 527
More Samples and Tests, 532
Objects Order and Layouts, 529
Running Forms, 524
The Designer Windows, 523
The Properties, 523
Using Layouts, 529
What is new in Ring 1.3?, 1708
Window Flags, 528
Form Designer Translation
Multi-language applications, 587
Forms Translation
Multi-language applications, 588
FoxRing functions
FoxRing Functions Reference, 957
FoxRing Functions Reference
Example, 970
FoxRing functions, 957
frAbs() function, 958
frAddBs() function, 959
frALines() function, 965
frAllTrim() function, 964
frAsc() function, 958
frAt() function, 959
frAtC() function, 959
frBetween() function, 968
frChr() function, 960
frEmpty() function, 960
frFile() function, 961
frFileToStr() function, 961
frForceExt() function, 965
frForcePath() function, 963
frIIIf() function, 967
frInList() function, 963
frInt() function, 967
frJustDrive() function, 964
frJustExt() function, 964
frJustFName() function, 965
frJustPath() function, 965
frJustStem() function, 965
frLen() function, 966
frListToString() function, 967
frLTrim() function, 964
frPadL() function, 965
frPadR() function, 966
frProper() function, 966
frReplicate() function, 966
frRTrim() function, 965
frSetIfEmpty() function, 962

- frSetSeparatorTo() function, 968
- frSpace() function, 963
- frStr() function, 961
- frStringToList() function, 967
- frStrTran() function, 967
- frStuff() function, 966
- frSubStr() function, 967
- frTransform() function, 969
- frVal() function, 968
- frVarType() function, 969
- Introduction, 956
- FoxRing Library
 - What is new in Ring 1.8?, 1802
- Fputc()
 - Files, 150
- Fputs()
 - Files, 150
- frAbs() function
 - FoxRing Functions Reference, 958
- frAddBs() function
 - FoxRing Functions Reference, 959
- frALines() function
 - FoxRing Functions Reference, 965
- frAllTrim() function
 - FoxRing Functions Reference, 964
- Frame Action
 - Using Qt3D, 552
- Frames Per Second
 - Using RingOpenGL and RingFreeGLUT for 3D Graphics, 828
- frAsc() function
 - FoxRing Functions Reference, 958
- frAt()
 - FoxRing Functions Reference, 959
- frAtC()
 - FoxRing Functions Reference, 959
- frBetween() function
 - FoxRing Functions Reference, 968
- frChr() function
 - FoxRing Functions Reference, 960
- Fread()
 - Files, 150
- frEmpty() function
 - FoxRing Functions Reference, 960
- Freopen()
 - Files, 146
- Frequently Asked Questions
 - Can I connect to dbase/harbour database?, 2059
 - Can Ring work on Windows XP?, 2049
 - Conflict between Global Variables and Class Attributes, 2041
 - Constructor methods in Ring, 2037
- Could you explain the output of the StrCmp() function?, 2044
- Getter and Setter Methods, 2038
- Goal of including the "Main" function in Ring, 2034
- How can I disable maximize button and resize window?, 2053
- How to add Combobox and other elements to the cells of a QTableWidget?, 2057
- How to Close a window then displaying another one?, 2052
- How to create a Modal Window?, 2052
- How to create an array of buttons in GUI applications?, 2051
- How to extend RingQt and add more classes?, 2055
- How to get the current source file path?, 2042
- How to get the file size using ftell() and fseek() functions?, 2041
- How to insert an item to the first position in the list?, 2048
- How to perform some manipulations on selected cells in QTableWidget?, 2058
- How to print keys or values only in List/Dictionary?, 2043
- How to print lists that contains objects?, 2048
- How to print new lines and other characters?, 2048
- How to use many source code files in the project?, 2045
- How to use NULL and ISNULL() function?, 2046
- How to use SQLite using ODBC?, 2059
- Introduction, 2022
- Is Ring some sort of an improvement of PHP?, 2029
- List index start from 1, 2035
- Philosophy behind data types in Ring, 2032
- Search of global names while defining the class attributes, 2039
- The documentation says functional programming is supported, but then this happens?, 2031
- What about Data Representation in Ring?, 2026
- What about Memory Management in Ring?, 2025
- What about predefined parameters or optional parameters in functions?, 2042
- What about the Boolean values in Ring?, 2038

- 2033
What are the advantages of using Ring over native C or C++?, 2029
What are the advantages to using Ring over C# or Java?, 2031
What are the advantages to using Ring over Lisp or Smalltalk?, 2028
What are the advantages to using Ring over Python and Ruby?, 2030
What are the advantages to using Ring over Tcl and Lua?, 2030
What happens when we create a new object?, 2038
What is the difference between Ring and Python? And is Ring Open Source?, 2029
What is the Ring Architecture?, 2024
Where can I write a program and execute it?, 2041
Which of 3 coding styles are commonly used or recommended by the community?, 2024
Why do we need Yet Another Programming Language (YAPL)?, 2023
Why I get a strange result when printing nl with lists?, 2043
Why I get Calling Function without definition Error?, 2049
Why is Ring largely focused on UI creation?, 2028
Why is Ring weakly typed?, 2028
Why Ring is not case-sensitive, 2036
Why Ring uses 'See', 'Give', 'But' and 'Ok' Keywords?, 2032
Why setClickEvent() doesn't see the object methods directly?, 2054
Why the ability to define your own languages Instead of parsing?, 2032
Why the Assignment operator uses Deep copy?, 2036
Why the window title bar is going outside the screen?, 2050
Why this example use the GetChar() twice?, 2045
Why we don't use () after the QApp class name?, 2050
Why you can specify the number of loops you want to break out of?, 2032
frFile() function
 FoxRing Functions Reference, 961
frFileToStr() function
 FoxRing Functions Reference, 961
frForceExt() function
 FoxRing Functions Reference, 965
frForcePath() function
 FoxRing Functions Reference, 963
frIIIf() function
 FoxRing Functions Reference, 967
frInList() function
 FoxRing Functions Reference, 963
frInt() function
 FoxRing Functions Reference, 967
frJustDrive() function
 FoxRing Functions Reference, 964
frJustExt() function
 FoxRing Functions Reference, 964
frJustFName() function
 FoxRing Functions Reference, 965
frJustPath() function
 FoxRing Functions Reference, 965
frJustStem() function
 FoxRing Functions Reference, 965
frLen() function
 FoxRing Functions Reference, 966
frListToString() function
 FoxRing Functions Reference, 967
frLTrim() function
 FoxRing Functions Reference, 964
frPadL() function
 FoxRing Functions Reference, 965
frPadR() function
 FoxRing Functions Reference, 966
frProper() function
 FoxRing Functions Reference, 966
frReplicate() function
 FoxRing Functions Reference, 966
frRTrim() function
 FoxRing Functions Reference, 965
frSetIfEmpty() function
 FoxRing Functions Reference, 962
frSetSeparatorTo() function
 FoxRing Functions Reference, 968
frSpace() function
 FoxRing Functions Reference, 963
frStr() function
 FoxRing Functions Reference, 961
frStringToList() function
 FoxRing Functions Reference, 967
frStrTran() function
 FoxRing Functions Reference, 967
frStuff() function
 FoxRing Functions Reference, 966
frSubStr() function
 FoxRing Functions Reference, 967
frTransform() function
 FoxRing Functions Reference, 969
frVal() function
 FoxRing Functions Reference, 968

frVarType() function
 FoxRing Functions Reference, 969

Fseek()
 Files, 147

Fsetpos()
 Files, 148

FSize() Function
 Stdlib Functions, 371

Ftell()
 Files, 148

Full Screen
 Using RingRayLib, 756

Function Prototype
 Extension, 1620

function prototype
 Code Generator, 1634

Function Structure
 Extension, 1618

Functional Programming
 Anonymous and Nested Functions, 253
 Equality of functions, 255
 First-Class Functions, 252
 Higher-order Functions, 252
 Introduction, 250
 Pure Functions, 251

Functions
 RingStbImage Functions Reference, 1167
 sockets, 1014
 Using CSVLib, 976
 Using JSONLib, 979
 Using RingPDFGen, 1550

Functions - First Style
 Call Functions, 86
 Declare parameters, 87
 Define Functions, 86
 Introduction, 85
 Main Function, 87
 Recursion, 89
 Return Value, 88
 Send Parameters, 87
 Variables Scope, 88

Functions - Second Style
 Call Functions, 90
 Declare parameters, 91
 Define Functions, 90
 Introduction, 89
 Main Function, 92
 Recursion, 93
 Return Value, 92
 Send Parameters, 91
 Variables Scope, 92

Functions - Third Style
 Call Functions, 94
 Declare parameters, 95

Define Functions, 94
Introduction, 93
Main Function, 96
Recursion, 97
Return Value, 96
Send Parameters, 95
Variables Scope, 96

functions()
 Reflection and Meta-programming, 258

Fwrite()
 Files, 151

G

Game Class
 Game Engine for 2D Games, 686

Game Engine Classes
 Game Engine for 2D Games, 685

Game Engine for 2D Games
 Animate Class, 688
 Animate Events, 701
 Animation, 694
 Animation and Functions, 695
 Creating the Game Window, 689
 Drawing Text, 690
 Flappy Bird 3000 Game, 718
 Game Class, 686
 Game Engine Classes, 685
 GameObject Class, 687
 Games Layer, 685
 Graphics Library Bindings, 684
 Interface to graphics library, 684
 Introduction, 683
 Map, 703
 Map Class, 689
 Map Events, 704
 Moving Text, 691
 Object and Drawing, 706
 Playing Sound, 693
 Project Layers, 684
 Sound Class, 689
 Sprite Automatic Movement, 697
 Sprite Class, 687
 Sprite Keypress Event, 698
 Sprite Mouse Event, 699
 Sprite State Event, 700
 Stars Fighter Game, 710
 Super Man 2016 Game, 726
 Text Class, 688
 What is new in Ring 1.1?, 1686

Game of Life Game
 What is new in Ring 1.10?, 1827

GameObject Class
 Game Engine for 2D Games, 687

Games Layer

Game Engine for 2D Games, 685
gcd() Function
 Stdlib Functions, 364
Generate Embedded Object File
 Command Line Options, 928
 What is new in Ring 1.12?, 1858
Generate Image
 Using FastPro, 1543
Generate List
 Tutorial: Ring Extensions in C/C++, 1602
Generate Object File
 Command Line Options, 928
Generate/Execute Ring Object Files (*.ringo)
 What is new in Ring 1.1?, 1680
Generating Pages using Objects
 Web Development (*CGI Library*), 632
Geometric Shapes
 Using RingRayLib, 784
Get Active Source File Name
 System Functions, 161
Get Command Line Arguments
 System Functions, 160
Get List Item
 Lists, 103
Get List Size
 Lists, 102
Get Number of Characters from position
 Strings, 117
Get Parameters Values
 Extension, 1620
Get Request
 RingLibCurl, 1001
Get Stock Data From Yahoo
 RingLibCurl, 1003
Get String Length
 Strings, 114
Get Substring from position to end
 Strings, 117
GetArch() Function
 System Functions, 159
getattribute()
 Reflection and Meta-programming, 272
GetChar()
 Getting Input, 84
Getfilesize()
 Files, 152
getnumber()
 Getting Started - Third Style, 55
Getpathtype()
 Files, 151
getpointer()
 Low Level Functions, 1568
getstring()
 Getting Started - Third Style, 54
Getter and Setter Methods
 Frequently Asked Questions, 2038
Getting Input
 GetChar(), 84
 Getting Started - First Style, 47
 Getting Started - Second Style, 50
 Getting Started - Third Style, 53
 Give Command, 84
 Input(), 85
 Introduction, 83
Getting Started
 tilengine, 872
Getting Started - First Style
 Create Executable File, 46
 Getting Input, 47
 Hello World, 46
 Introduction, 45
 Multi-Line literals, 46
 No Explicit End For Statements, 47
 Not Case-Sensitive, 46
 Run the program, 46
 Using ? to print expression then new
 line, 47
 Writing Comments, 48
Getting Started - Second Style
 Create Executable File, 49
 Getting Input, 50
 Hello World, 49
 Introduction, 48
 Multi-Line literals, 49
 No Explicit End For Statements, 50
 Not Case-Sensitive, 49
 Run the program, 49
 Writing Comments, 50
Getting Started - Third Style
 Create Executable File, 52
 getnumber(), 55
 getstring(), 54
 Getting Input, 53
 Hello World, 52
 Introduction, 51
 Multi-Line literals, 52
 No Explicit End For Statements, 53
 Not Case-Sensitive, 52
 print(), 54
 Print2Str() Function, 54
 Run the program, 52
 Writing Comments, 53
Give Command
 Getting Input, 84
globals()
 Reflection and Meta-programming, 257
Go Game
 What is new in Ring 1.12?, 1851

- Goal of including the "Main" function in Ring
Frequently Asked Questions, 2034
- Google API Shortener Application
Applications developed in a few hours, 10
- Gradient
Web Development (*CGI Library*), 631
- Grant Ring files execution permission
Web Development (*CGI Library*), 607
- Graphics and Game Programming
Drawing, Animation and Input, 669
Introduction, 668
Playing Sound, 677
Scaling and Rotating Images, 678
Threads, 680
Transparent Image, 679
TrueType Fonts, 676
- Graphics Library Bindings
Game Engine for 2D Games, 684
- ## H
- Hash Functions
Web Development (*CGI Library*), 625
- HashTable Class
Stdlib Classes, 386
- Hassouna Course Samples
What is new in Ring 1.13?, 1872
- Hello World
Getting Started - First Style, 46
Getting Started - Second Style, 49
Getting Started - Third Style, 52
libui, 1020
Tutorial: Ring Extensions in C/C++, 1590
- Hello World program
Deploying Web Applications in the Cloud, 667
- Hello World Program using the Web Library
Web Development (*CGI Library*), 608
- Heroku (*Better support*)
What is new in Ring 1.18, 1950
What is new in Ring 1.15?, 1912
- Hex()
Data Type, 134
- Hex2str()
Data Type, 135
- Higher-order Functions
Functional Programming, 252
- Histogram
libui, 1039
- History
Introduction, 28
Natural Language Programming, 284
- Hours Counter application
What is new in Ring 1.19, 1958
- How can I disable maximize button and resize window?
Frequently Asked Questions, 2053
- How Ring find a functions and methods?
Scope Rules for Functions and Methods, 320
- How Ring find the Variable?
Scope Rules, 304
- How Ring2EXE works?
Distributing Ring Application using Ring2EXE, 933
- How to add Combobox and other elements to the cells of a QTableWidgetItem?
Frequently Asked Questions, 2057
- How to Close a window then displaying another one?
Frequently Asked Questions, 2052
- How to contribute?
Applications, 2074
Compiler and Virtual Machine (VM), 2074
Documentation, 2073
Editors Support, 2074
Extensions in C/C++, 2074
Ideas and suggestions, 2075
Introduction, 2072
Libraries in Ring, 2074
Samples, 2074
Special thanks to contributors, 2073
Testing, 2073
- How to create a Modal Window?
Frequently Asked Questions, 2052
- How to create an array of buttons in GUI applications?
Frequently Asked Questions, 2051
- How to extend RingQt and add more classes?
Frequently Asked Questions, 2055
- How to get the current source file path?
Frequently Asked Questions, 2042
- How to get the file size using ftell() and fseek() functions?
Frequently Asked Questions, 2041
- How to insert an item to the first position in the list?
Frequently Asked Questions, 2048
- How to perform some manipulations on selected cells in QTableWidgetItem?
Frequently Asked Questions, 2058
- How to play?
The Gold Magic 800 Game, 868
- How to print keys or values only in List/Dictionary?
Frequently Asked Questions, 2043
- How to print lists that contains objects?
Frequently Asked Questions, 2048

How to print new lines and other characters?	Inheritance
Frequently Asked Questions, 2048	Object Oriented Programming, 240
How to use many source code files in the project?	Inheritance from GUI Classes
Frequently Asked Questions, 2045	Desktop, WebAssembly and Mobile Development, 474
How to use NULL and ISNULL() function?	Innovative
Frequently Asked Questions, 2046	Applications developed in a few hours, 22
How to use SQLite using ODBC?	Input Keys
Frequently Asked Questions, 2059	Using RingRayLib, 743
HTML Lists	Input Mouse
Web Development (<i>CGI Library</i>), 628	Using RingRayLib, 744
HTML Special Characters	Input Multi-touch
Web Development (<i>CGI Library</i>), 624	Using RingRayLib, 750
HTML Tables	Input()
Web Development (<i>CGI Library</i>), 630	Getting Input, 85
HtmlPage Class	Insert()
Web Development (<i>CGI Library</i>), 637, 664	Lists, 106
HTTP Get Example	Install
Web Development (<i>CGI Library</i>), 609	Using Pico, 1660
HTTP POST Example	Install Qt for Android
Web Development (<i>CGI Library</i>), 614	Building RingQt Applications for Mobile, 590
HTTPLib Library	Installing Packages
What is new in Ring 1.17, 1930	Ring Package Manager (<i>RingPM</i>), 944
I Ideas and suggestions	Interactive Debugger
How to contribute?, 2075	The Trace Library and the Interactive Debugger, 343
If Statement	Interface to graphics library
Control Structures - Second Style, 75	Game Engine for 2D Games, 684
Control Structures - Third Style, 79	Internet Class
Ignore new lines after keywords	Stdlib Classes, 404
Syntax Flexibility, 335	Introduction
Image Drawing	Deploying Web Applications in the Cloud, 665
Using RingRayLib, 777	Features, 29
Image Generation	History, 28
Using RingRayLib, 779	Introduction, 24
Image Pixel application	Motivation (1), 25
What is new in Ring 1.19, 1957	Motivation (2), 26
Implementation	Motivation (3), 26
Using RingRayLib, 788	Motivation (4), 26
Implicit Conversion	Motivation (5), 27
Variables, 57	Performance Tips, 907
Important Information about Ring2EXE	Ring and other languages, 27
Distributing Ring Application using Ring2EXE, 941	RingStbImage Functions Reference, 1165
ImportPackage() Function	Using CSVLib, 976
What is new in Ring 1.18, 1950	Using HTTPLib, 981
importpackage() Function	Using JSONLib, 979
Reflection and Meta-programming, 275	Using References, 1552
Improving Ring Compiler/VM Source Code	Using RingRayLib, 742
What is new in Ring 1.20, 1984	Using TokensLib, 997
Increment List Items	Using ZeroLib, 953
Tutorial: Ring Extensions in C/C++, 1596	Is Ring some sort of an improvement of PHP?
	Frequently Asked Questions, 2029

I

- IsAlNum()
 - Data Type, 129
- IsAlpha()
 - Data Type, 129
- IsAndroid() Function
 - System Functions, 159
- isappcompiled() Function
 - Stdlib Functions, 356
- isattribute()
 - Reflection and Meta-programming, 268
- IsBetween() Function
 - Stdlib Functions, 375
- iscfunction()
 - Reflection and Meta-programming, 260
- isclass()
 - Reflection and Meta-programming, 263
- IsCntrl()
 - Data Type, 130
- IsDigit()
 - Data Type, 130
- IsFreeBSD() Function
 - System Functions, 158
- isfunction()
 - Reflection and Meta-programming, 260
- isglobal()
 - Reflection and Meta-programming, 259
- IsGraph()
 - Data Type, 130
- isleapyear() Function
 - Stdlib Functions, 367
- IsLinux() Function
 - System Functions, 158
- IsList()
 - Data Type, 128
- IsListContainsItems() Function
 - Stdlib Functions, 375
- islocal()
 - Reflection and Meta-programming, 259
- IsLower()
 - Data Type, 131
- IsMacOSX() Function
 - System Functions, 158
- ismainsourcefile() Function
 - Stdlib Functions, 370
- ismethod()
 - Reflection and Meta-programming, 269
- IsMSDOS() Function
 - System Functions, 157
- IsNULL()
 - Data Type, 128
- IsNumber()
 - Data Type, 127
- isobject()
 - Reflection and Meta-programming, 266

i

- ispackage()
 - Reflection and Meta-programming, 262
- ispackagesclass()
 - Reflection and Meta-programming, 264
- ispalindrome() Function
 - Stdlib Functions, 366
- ispointer()
 - Low Level Functions, 1567
- isprime() Function
 - Stdlib Functions, 362
- IsPrint()
 - Data Type, 131
- isprivateattribute()
 - Reflection and Meta-programming, 268
- isprivatemethod()
 - Reflection and Meta-programming, 269
- IsPunct()
 - Data Type, 131
- IsSpace()
 - Data Type, 132
- isspecial() Function
 - Stdlib Functions, 360
- IsString()
 - Data Type, 127
- IsUnix() Function
 - System Functions, 158
- IsUpper()
 - Data Type, 132
- isvowel() Function
 - Stdlib Functions, 361
- IsWindows() Function
 - System Functions, 157
- IsWindows64() Function
 - System Functions, 158
- IsXdigit()
 - Data Type, 132

J

- JSONLib Library
 - What is new in Ring 1.17, 1929
- Julian Day Calendar application
 - What is new in Ring 1.12?, 1854

J

- JustFileName() Function
 - Stdlib Functions, 358
- JustFilePath() Function
 - Stdlib Functions, 357

K

- Key Press
 - Using Qt3D, 547
- Keyboard Events and Colors
 - Using RingOpenGL and RingFreeGLUT for 3D Graphics, 797
- Keyboard Shortcuts

- Form Designer, 527
- KeyPress and Mouse Move Events
 - Desktop, WebAssembly and Mobile Development, 469
- Knight Tour Game
 - What is new in Ring 1.10?, 1826
- L**
- Language Design
 - Compact Syntax, 1671
 - Data Representation, 1670
 - Define Declarative Languages, 1674
 - Define Natural Statements, 1672
 - Designed for a clear goal, 1668
 - Encourage Organization, 1670
 - Fast Enough For Many Applications, 1678
 - Introduction, 1667
 - No Global Interpreter (VM) Lock - No GIL, 1678
 - Simple, 1668
 - Smart Garbage Collector, 1677
 - Transparent Implementation, 1675
 - Trying to be natural, 1669
 - Visual Implementation, 1676
 - Why Ring?, 1668
- Language Functions
 - Language Specification, 2078
- Language Grammar
 - Language Specification, 2087
- Language Keywords
 - Language Specification, 2076
- Language Shell
 - Demo Programs, 169
- Language Specification
 - Compiler Errors, 2084
 - Environment Errors, 2086
 - Introduction, 2075
 - Language Functions, 2078
 - Language Grammar, 2087
 - Language Keywords, 2076
 - Runtime Errors, 2085
 - Scanner Commands, 2076
 - Virtual Machine Instructions, 2088
- Large Files Hash
 - Security and Internet Functions, 227
- Laser Game
 - What is new in Ring 1.13?, 1864
- lcm() Function
 - Stdlib Functions, 364
- Lectures Tracker application
 - What is new in Ring 1.21, 1987
- LED and Switch sample
 - Using Pico, 1661
- LEDs sample
 - Using Pico, 1661
- Left()
 - Strings, 115
- Libraries in Ring
 - How to contribute?, 2074
- Library Source Code
 - bignum, 975
- Library Usage with GUI Applications
 - Objects Library for RingQt Application, 576
- libui
 - Control Gallery, 1023
 - Draw Gradient, 1037
 - Drawing Sample, 1036
 - Hello World, 1020
 - Histogram, 1039
 - Introduction, 1019
 - More Drawing Samples, 1050
 - Say Hello, 1022
 - Say Something, 1030
 - Text Drawing, 1044
 - Using the Menubar, 1032
- Light GUILib
 - What is new in Ring 1.16?, 1916
- linecount() Function
 - Stdlib Functions, 361
- Lines()
 - Strings, 116
- Linked list
 - Using References, 1555
- List Class
 - Stdlib Classes, 382
- List index start from 1
 - Frequently Asked Questions, 2035
- List of changes and new features
 - What is new in Ring 1.10?, 1824
 - What is new in Ring 1.11?, 1835
 - What is new in Ring 1.12?, 1851
 - What is new in Ring 1.13?, 1862
 - What is new in Ring 1.14?, 1882
 - What is new in Ring 1.15?, 1904
 - What is new in Ring 1.16?, 1916
 - What is new in Ring 1.17?, 1923
 - What is new in Ring 1.18?, 1939
 - What is new in Ring 1.19?, 1957
 - What is new in Ring 1.1?, 1679
 - What is new in Ring 1.20?, 1974
 - What is new in Ring 1.21?, 1986
 - What is new in Ring 1.22?, 2004
 - What is new in Ring 1.2?, 1690
 - What is new in Ring 1.3?, 1696
 - What is new in Ring 1.4?, 1710
 - What is new in Ring 1.5?, 1723
 - What is new in Ring 1.6?, 1772

What is new in Ring 1.7?, 1783
 What is new in Ring 1.8?, 1792
 What is new in Ring 1.9?, 1806

List of Functions
 Using RogueUtil, 1083

list of functions
 Mathematical Functions, 136

List2Bytes()
 Using FastPro, 1538

List2Code() Function
 Stdlib Functions, 374

list2file() Function
 Stdlib Functions, 363

ListAllFiles() Function
 Stdlib Functions, 372

Listen to Quran application
 What is new in Ring 1.19, 1959

Lists
 Access List Items by String Index, 108
 Add Items, 102
 Copy Lists, 107
 Create Lists, 101
 Create Multi Dimension Array Using List and Recursion, 111
 Delete Item From List, 103
 First-Class Lists, 107
 Get List Item, 103
 Get List Size, 102
 Insert(), 106
 Introduction, 100
 Nested Lists, 106
 Passing Lists to Functions, 108
 Passing Parameters Arguments Using List Array, 110
 Passing Parameters or Arguments Using List, 109
 Return as List or Hash Table, 110
 Reverse(), 105
 Search, 103
 Set List Item, 103
 Sort(), 104
 Swap Items, 113
 Using Lists during definition, 107

Load Again
 Program Structure, 100

Load Again Command
 What is new in Ring 1.12?, 1856

Load Package
 Program Structure, 99

Load Syntax Files
 Syntax Flexibility, 326

Loading Files
 Code Generator, 1655

Loading the library

bignumbers, 973
 PostgreSQL, 195

Loading the Trace library
 The Trace Library and the Interactive Debugger, 342

Local Tests
 Deploying Web Applications in the Cloud, 667

locals()
 Reflection and Meta-programming, 257

Location
 Create your first extension, 1658

Logical Operators
 Operators, 58

Loop Command
 Control Structures - First Style, 72

Looping
 Control Structures, 80
 Control Structures - First Style, 69
 Control Structures - Second Style, 76

Low Level Functions
 callgc(), 1562
 Example - The Trace Library, 1583
 Example - Using the Trace Functions, 1579
 getpointer(), 1568
 Introduction, 1561
 ispointer(), 1567
 memcpy(), 1570
 nullpointer(), 1564
 object2pointer(), 1565
 pointer2object(), 1565
 pointer2string(), 1569
 ptrcmp(), 1567
 ringvm_callfunc(), 1579
 RingVM_CallList(), 1575
 RingVM_CFunctionsList(), 1570
 RingVM_ClasesList(), 1571
 RingVM_CodeList(), 1588
 ringvm_evalinscope(), 1578
 RingVM_FilesList(), 1576
 RingVM_FunctionsList(), 1570
 ringvm_give() function, 1588
 ringvm_hideerrorMsg(), 1578
 ringvm_info(), 1588
 ringvm_ismempool(), 1588
 RingVM_MemoryList(), 1573
 RingVM_PackagesList(), 1572
 ringvm_passerror(), 1578
 ringvm_runcode(), 1588
 ringvm_scopescount(), 1578
 ringvm_see() function, 1587
 ringvm_settrace(), 1577
 ringvm_tracedata(), 1577
 ringvm_traceevent(), 1577

ringvm_tracefunc(), 1578
 setpointer(), 1568
 space(), 1564
 varptr(), 1563

M

Magic Balls Game
 What is new in Ring 1.13?, 1865

Main Function
 Functions - First Style, 87
 Functions - Second Style, 92
 Functions - Third Style, 96

Main Menu
 Demo Programs, 170

Make a Cube using RingOpenGL and RingFreeGLUT
 Using RingOpenGL and RingFreeGLUT for 3D Graphics, 839

makedirs() Function
 Stdlib Functions, 371

Managed Classes
 Code Generator, 1655

Many Cubes
 Using RingOpenGL and RingAllegro for 3D Graphics, 848

Many Objects
 Using Qt3D, 565

Map
 Game Engine for 2D Games, 703

Map Class
 Game Engine for 2D Games, 689

Map Events
 Game Engine for 2D Games, 704

map() Function
 Stdlib Functions, 358

Matching Game
 What is new in Ring 1.13?, 1867

Math Class
 Stdlib Classes, 388

Mathematical Functions
 Decimals(), 140
 Example, 136
 Introduction, 135
 list of functions, 136
 Random(), 138
 SRandom(), 139
 Unsigned(), 139
 Using _ in numbers, 141
 Using f after numbers, 141

MatrixLib Library
 What is new in Ring 1.18, 1953

matrixmulti() Function
 Stdlib Functions, 367

matrixtrans() Function

 Stdlib Functions, 368

Maze Game
 What is new in Ring 1.11?, 1838

MD5()
 Security and Internet Functions, 204

MDI Windows Sample
 What is new in Ring 1.16?, 1921

memcpy()
 Low Level Functions, 1570

Memory Functions
 Extension, 1630

Menu Events
 Using RingOpenGL and RingFreeGLUT for 3D Graphics, 812

Menubar and StyleSheet Example
 Desktop, WebAssembly and Mobile Development, 444

Menubar Designer
 Form Designer, 527

Merge binary characters
 Strings, 120
 What is new in Ring 1.8?, 1800

Merge Two Files
 What is new in Ring 1.17, 1923

mergeMethods()
 Reflection and Meta-programming, 274

Methods to use Events with Events Filter
 Desktop, WebAssembly and Mobile Development, 514

methods()
 Reflection and Meta-programming, 267

Minesweeper Game
 What is new in Ring 1.10?, 1825

Misc Operators
 Operators, 60

Mixing Arithmetic Operators and Types
 Operators, 61

Mixing Assignment Operators and Types
 Operators, 66

Mixing Bitwise Operators and Types
 Operators, 65

Mixing Logical Operators and Types
 Operators, 65

Mixing Relational Operators and Types
 Operators, 63

Model
 Using Qt3D, 559

Model Texture
 Using Qt3D, 561

Module Organization
 Extension, 1617

MoneyBoxes Game
 What is new in Ring 1.13?, 1866

More 3D Samples

Using RingOpenGL and RingAllegro for 3D Graphics, 865	Introduction, 26
What is new in Ring 1.11?, 1835	Motivation (5)
What is new in Ring 1.8?, 1795	Introduction, 27
More Beautiful Code	Mouse Events
Declarative Programming, 283	RingLibSDL, 1108
More Drawing Samples	Using RingOpenGL and RingFreeGLUT for 3D Graphics, 807
libui, 1050	Mouse Wheel
More Examples	Using RingRayLib, 749
Threads, 1016	Movable Label Example
More Functions	Desktop, WebAssembly and Mobile Development, 464
What is new in Ring 1.14?, 1897	Moving Objects using the Mouse
More Games	Desktop, WebAssembly and Mobile Development, 470
What is new in Ring 1.10?, 1830	Moving Text
What is new in Ring 1.9?, 1808	Game Engine for 2D Games, 691
More Improvements	Multi-language applications
What is new in Ring 1.17, 1936	Form Designer Translation, 587
What is new in Ring 1.18, 1954	Forms Translation, 588
What is new in Ring 1.19, 1971	Introduction, 585
What is new in Ring 1.20, 1985	Using String2Constant, 586
What is new in Ring 1.21, 2001	Multi-Line literals
What is new in Ring 1.22, 2013	Getting Started - First Style, 46
What is new in Ring 1.10?, 1833	Getting Started - Second Style, 49
What is new in Ring 1.11?, 1849	Getting Started - Third Style, 52
What is new in Ring 1.12?, 1860	MurmurHash1 functions
What is new in Ring 1.13?, 1878	RingMurmurHash Functions Reference, 1069
What is new in Ring 1.14?, 1902	MurmurHash2 functions
What is new in Ring 1.15?, 1914	RingMurmurHash Functions Reference, 1069
What is new in Ring 1.16?, 1921	MurmurHash3 functions
What is new in Ring 1.9?, 1822	RingMurmurHash Functions Reference, 1069
More Low Level Functions	Music Playing
What is new in Ring 1.18, 1951	Using RingRayLib, 774
What is new in Ring 1.13?, 1877	MyCoffee (<i>Web Application</i>)
More Projects	What is new in Ring 1.14?, 1882
What is new in Ring 1.22?, 2006	MySQL Class
More Samples	Stdlib Classes, 399
tilengine, 873	MySQL Functions
Using HTTPLib, 988	Create Database, 184
What is new in Ring 1.18, 1943	Create Table and Insert Data, 184
What is new in Ring 1.19, 1960	Introduction, 181
What is new in Ring 1.21, 1993	MySQL_AutoCommit(), 190
What is new in Ring 1.14?, 1885	MySQL_Close(), 183
What is new in Ring 1.15?, 1913	MySQL_Columns(), 187
More Samples and Tests	MySQL_Commit(), 190
Form Designer, 532	MySQL_Connect(), 183
More Syntax Flexibility	MySQL_Error(), 183
What is new in Ring 1.5?, 1758	MySQL_Escape_String(), 189
Motivation (1)	MySQL_Info(), 182
Introduction, 25	MySQL_Init(), 183
Motivation (2)	MySQL_Inser_ID(), 185
Introduction, 26	MySQL_Next_Result(), 186
Motivation (3)	MySQL_Query(), 183
Introduction, 26	
Motivation (4)	

MySQL_Result(), 186
 MySQL_Result2(), 188
 MySQL_Rollback(), 190
 Print Query Result, 186
 Restore Image From The Database, 189
 Save Image Inside the Database, 189
 Transaction Example, 190

MySQL_AutoCommit()
 MySQL Functions, 190

MySQL_Close()
 MySQL Functions, 183

MySQL_Columns()
 MySQL Functions, 187

MySQL_Columns() Implementation Extension, 1627

MySQL_Commit()
 MySQL Functions, 190

MySQL_Connect()
 MySQL Functions, 183

MySQL_Error()
 MySQL Functions, 183

MySQL_Escape_String()
 MySQL Functions, 189

MySQL_Info()
 MySQL Functions, 182

MySQL_Init()
 MySQL Functions, 183

MySQL_Inser_ID()
 MySQL Functions, 185

MySQL_Next_Result()
 MySQL Functions, 186

MySQL_Query()
 MySQL Functions, 183

MySQL_Result()
 MySQL Functions, 186

MySQL_Result2()
 MySQL Functions, 188

MySQL_Rollback()
 MySQL Functions, 190

N

Natural Language Programming
 BraceError() Method, 292
 BraceExprEval Method, 290
 BraceStart and BraceEnd Methods, 290
 Change the '=' operator to 'is', 287
 Change the Ring Keyword 'And', 285
 Change the Ring Operator '+', 287
 Clean Natural Code, 293
 Example, 284
 History, 284
 Introduction, 283
 Real Natural Code, 291
 Using Eval() with our Natural Code, 288

Natural Library - Demo Program
 Using the Natural Library, 295

Nested Lists
 Lists, 106

Nested Methods Call in Separate Lines
 What is new in Ring 1.16?, 1917

Nested Ref()
 Using References, 1559

New Arabic Book
 What is new in Ring 1.15?, 1904

New Book by Apress
 What is new in Ring 1.13?, 1862

New Classes names - Index Start from 1
 Desktop, WebAssembly and Mobile Development, 516

New Command: Load Package
 What is new in Ring 1.7?, 1783

New From
 Object Oriented Programming, 249
 What is new in Ring 1.18, 1950

New Functions
 What is new in Ring 1.2?, 1690
 What is new in Ring 1.3?, 1705

New Functions and Changes
 What is new in Ring 1.1?, 1682

New Game : Gold Magic 800
 What is new in Ring 1.9?, 1806

New Style to Ring Notepad
 What is new in Ring 1.4?, 1713

New Tool: Folder2qrc
 What is new in Ring 1.6?, 1774

New Tool: Ring2EXE
 What is new in Ring 1.6?, 1773

New VM Instructions
 What is new in Ring 1.21, 2000

No Explicit End For Statements
 Getting Started - First Style, 47
 Getting Started - Second Style, 50
 Getting Started - Third Style, 53

No Global Interpreter (VM) Lock - No GIL Language Design, 1678

No Run
 Command Line Options, 927

NofProcessors() Function
 System Functions, 164

Not Case-Sensitive
 Getting Started - First Style, 46
 Getting Started - Second Style, 49
 Getting Started - Third Style, 52

Notebook Application
 Desktop, WebAssembly and Mobile Development, 488

Notes to extensions creators
 What is new in Ring 1.8?, 1805

Nothing() function
 Reflection and Meta-programming, 276
 What is new in Ring 1.19, 1964

nullpointer()
 Low Level Functions, 1564

Number()
 Data Type, 133

Numbers and Bytes
 Files, 154

NumOrZero() Function
 Stdlib Functions, 377
 What is new in Ring 1.21, 1997

O

Object and Drawing
 Game Engine for 2D Games, 706

Object Library Source Code
 Objects Library for RingQt Application, 585

Object Oriented Programming
 Access Objects Using Braces, 232
 Classes and Objects, 230
 Composition, 233
 Default value for object attributes, 248
 Dynamic Attributes, 241
 Find() and List of Objects, 243
 Inheritance, 240
 Introduction, 229
 New From, 249
 Operator Overloading, 236
 Packages, 242
 Printing Objects, 242
 Private Attributes and Methods, 235
 Setter and Getter, 234
 Sort() and List of Objects, 244
 Using Objects During Definition, 249
 Using Self.Attribute, 246
 Using This in the class region as Self, 247
 Using This.Attribute and This.Method(), 246

Object Picker
 Using Qt3D, 549

object2pointer()
 Low Level Functions, 1565

objectid()
 Reflection and Meta-programming, 266

Objects inside lists
 Declarative Programming, 278

Objects Library for RingQt
 What is new in Ring 1.2?, 1692

Objects Library for RingQt Application
 Example, 577
 Introduction, 575

Library Usage with GUI Applications, 576
 Object Library Source Code, 585
 openWindowAndLink() Function, 579, 585
 openWindowInPackages() Function, 580
 Using ObjectID() and GetWindowByID(), 580
 Using ObjectID() and OpenWindowAndLink(), 583

Objects Order and Layouts
 Form Designer, 529

ODBC Class
 Stdlib Classes, 398

ODBC Functions
 Execute Query and Print Result, 177
 Introduction, 172
 odbc_autocommit(), 179
 odbc_close(), 174
 odbc_colcount(), 177
 odbc_columns(), 178
 odbc_commit(), 179
 odbc_connect(), 176
 odbc_datasources(), 174
 odbc_disconnect(), 176
 odbc_drivers(), 173
 odbc_execute(), 176
 odbc_fetch(), 177
 odbc_getdata(), 177
 odbc_init(), 173
 odbc_rollback(), 180
 odbc_tables(), 178
 Open and Close Connection, 176
 Print List of ODBC Data Sources, 175
 Print List of ODBC Drivers, 174
 Save and Restore Images, 181
 Transactions and Using Commit and Rollback, 180

odbc_autocommit()
 ODBC Functions, 179

odbc_close()
 ODBC Functions, 174

odbc_colcount()
 ODBC Functions, 177

odbc_columns()
 ODBC Functions, 178

odbc_commit()
 ODBC Functions, 179

odbc_connect()
 ODBC Functions, 176

odbc_datasources()
 ODBC Functions, 174

odbc_disconnect()
 ODBC Functions, 176

odbc_drivers()
 ODBC Functions, 173

odbc_execute()

ODBC Functions, 176
`odbc_fetch()`
 ODBC Functions, 177
`odbc_getdata()`
 ODBC Functions, 177
`odbc_init()`
 ODBC Functions, 173
`odbc_rollback()`
 ODBC Functions, 180
`odbc_tables()`
 ODBC Functions, 178
Online Applications
 Building RingQt Applications for WebAssembly, 605
Open and Close Connection
 ODBC Functions, 176
`openssl_version()`
 Security and Internet Functions, 227
`openssl_versiontext()`
 Security and Internet Functions, 226
`openWindowAndLink()` Function
 Objects Library for RingQt Application, 579, 585
`openWindowInPackages()` Function
 Objects Library for RingQt Application, 580
Operator Overloading
 Object Oriented Programming, 236
Operators
 Arithmetic Operators, 58
 Assignment Operators, 59
 Bitwise Operators, 59
 Introduction, 57
 Logical Operators, 58
 Misc Operators, 60
 Mixing Arithmetic Operators and Types, 61
 Mixing Assignment Operators and Types, 66
 Mixing Bitwise Operators and Types, 65
 Mixing Logical Operators and Types, 65
 Mixing Relational Operators and Types, 63
 Operators Precedence, 60
 Relational Operators, 58
 Unary Positive and Unary Negative, 66
 Using the Natural Library, 300
Operators Precedence
 Operators, 60
OptionalFunc() function
 Reflection and Meta-programming, 276
 What is new in Ring 1.19, 1964
Options
 Distributing Ring Application using Ring2EXE, 934
OSCopyFile() Function
 Stdlib Functions, 374
OSCopyFolder() Function
 Stdlib Functions, 373
OSCreateOpenFolder() Function
 Stdlib Functions, 373
OSDeleteFile() Function
 Stdlib Functions, 374
OSDeleteFolder() Function
 Stdlib Functions, 373
OSRenameFile() Function
 Stdlib Functions, 374
Other Widgets Events
 Desktop, WebAssembly and Mobile Development, 448

P

packagename()
 Reflection and Meta-programming, 275
Packages
 Object Oriented Programming, 242
packages()
 Reflection and Meta-programming, 261
packagesclasses()
 Reflection and Meta-programming, 264
Page Class
 Web Development (*CGI Library*), 659
Pairs Game
 What is new in Ring 1.13?, 1868
ParentClassName()
 What is new in Ring 1.19, 1965
parentclassname()
 Reflection and Meta-programming, 265
Pass Error
 The Trace Library and the Interactive Debugger, 343
Passing Lists to Functions
 Lists, 108
Passing lists to functions
 Using References, 1558
Passing Parameters Arguments Using List Array
 Lists, 110
Passing Parameters or Arguments Using List Lists
 Lists, 109
Pause/Resume Embedded Ring VM
 What is new in Ring 1.20, 1982
Pause/Resume the Ring VM
 Embedding Ring in Ring, 353
Performance Tips
 Arithmetic Operations, 910
 Calling Functions and Methods, 911
 Creating Lists, 909
 Introduction, 906, 907
 Using len() and For Loops, 911
permutation() Function

Stdlib Functions, 368
Perror()
 Files, 149
Philosophy behind data types in Ring
 Frequently Asked Questions, 2032
Planetary Orbits application
 What is new in Ring 1.19, 1958
Play Sound
 RingLibSDL, 1110
Playing Sound
 Desktop, WebAssembly and Mobile Development, 462
 Game Engine for 2D Games, 693
 Graphics and Game Programming, 677
Poetry Analysis
 What is new in Ring 1.17, 1924
pointer2object()
 Low Level Functions, 1565
pointer2string()
 Low Level Functions, 1569
Pong Game
 What is new in Ring 1.10?, 1828
Post Request
 RingLibCurl, 1001
PostgreSQL
 Examples, 195
 Introduction, 194
 Loading the library, 195
 RingPostgreSQL Constants, 198
 RingPostgreSQL Functions, 199
PostgreSQL Class
 Stdlib Classes, 402
Practical
 Applications developed in a few hours, 23
Prefix for Functions Names
 Code Generator, 1636
PrevFileName() Function
 System Functions, 162
Print files in Zip file
 RingZip, 1065
Print List of ODBC Data Sources
 ODBC Functions, 175
Print List of ODBC Drivers
 ODBC Functions, 174
Print Query Result
 MySQL Functions, 186
Print text at specific position
 Using RogueUtil, 1074
print()
 Getting Started - Third Style, 54
Print2Str() Function
 Getting Started - Third Style, 54
Printing Constants
 Using HTTPLib, 982

Printing Final Intermediate Code
 Command Line Options, 923
Printing Instruction Operation Code
 Command Line Options, 927
Printing Intermediate Code
 Command Line Options, 920
Printing List of Installed Packages
 Ring Package Manager (*RingPM*), 945
Printing Objects
 Object Oriented Programming, 242
Printing Rules
 Command Line Options, 915
Printing Tokens
 Command Line Options, 913
Printing using QPrinter
 Desktop, WebAssembly and Mobile Development, 457
Private Attributes and Methods
 Object Oriented Programming, 235
prolist() Function
 Stdlib Functions, 365
Program Structure
 Introduction, 97
 Load Again, 100
 Load Package, 99
 Source Code File Sections, 98
 Using Many Source Code Files, 98
Programming
 Using Pico, 1660
Project Folder
 Building Games For Android, 739
Project Layers
 Game Engine for 2D Games, 684
Protecting the Source Code
 Distributing Ring Application, 930
ptrcmp()
 Low Level Functions, 1567
Pure Functions
 Functional Programming, 251
puts()
 Stdlib Functions, 54
PWCT 2.0 (*Free Software*)
 What is new in Ring 1.22?, 2005

Q

QAbstractAspect Class
 RingQt Classes Reference, 1220
QAbstractButton Class
 RingQt Classes Reference, 1221
QAbstractCameraController Class
 RingQt Classes Reference, 1222
QAbstractGraphicsShapeItem Class
 RingQt Classes Reference, 1222
QAbstractItemView Class

- RingQt Classes Reference, 1222
- QAbstractPrintDialog Class
 - RingQt Classes Reference, 1224
- QAbstractScrollArea Class
 - RingQt Classes Reference, 1224
- QAbstractSeries Class
 - RingQt Classes Reference, 1225
- QAbstractSlider Class
 - RingQt Classes Reference, 1226
- QAbstractSocket Class
 - RingQt Classes Reference, 1227
- QAbstractSpinBox Class
 - RingQt Classes Reference, 1228
- QAction Class
 - RingQt Classes Reference, 1229
- QAllEvents Class
 - RingQt Classes Reference, 1231
- QApp Class
 - RingQt Classes Reference, 1235
- QAreaLegendMarker Class
 - RingQt Classes Reference, 1235
- QAreaSeries Class
 - RingQt Classes Reference, 1236
- QAspectEngine Class
 - RingQt Classes Reference, 1237
- QAudioOutput Class
 - RingQt Classes Reference, 1238
- QAxBase Class
 - RingQt Classes Reference, 1238
- QAxObject Class
 - RingQt Classes Reference, 1239
- QAxWidget Class
 - RingQt Classes Reference, 1239
- QAxWidget2 Class
 - RingQt Classes Reference, 1239
- QBarCategoryAxis Class
 - RingQt Classes Reference, 1239
- QBarLegendMarker Class
 - RingQt Classes Reference, 1240
- QBarSeries Class
 - RingQt Classes Reference, 1240
- QBarSet Class
 - RingQt Classes Reference, 1240
- QBitmap Class
 - RingQt Classes Reference, 1242
- QBluetoothAddress Class
 - RingQt Classes Reference, 1242
- QBluetoothDeviceDiscoveryAgent Class
 - RingQt Classes Reference, 1243
- QBluetoothDeviceInfo Class
 - RingQt Classes Reference, 1243
- QBluetoothHostInfo Class
 - RingQt Classes Reference, 1244
- QBluetoothLocalDevice Class
 - RingQt Classes Reference, 1244
- RingQt Classes Reference, 1244
- QBluetoothServer Class
 - RingQt Classes Reference, 1245
- QBluetoothServiceDiscoveryAgent Class
 - RingQt Classes Reference, 1246
- QBluetoothServiceInfo Class
 - RingQt Classes Reference, 1246
- QBluetoothSocket Class
 - RingQt Classes Reference, 1247
- QBluetoothTransferManager Class
 - RingQt Classes Reference, 1248
- QBluetoothTransferReply Class
 - RingQt Classes Reference, 1249
- QBluetoothTransferRequest Class
 - RingQt Classes Reference, 1249
- QBluetoothUuid Class
 - RingQt Classes Reference, 1249
- QBoxLayout Class
 - RingQt Classes Reference, 1250
- QBoxPlotLegendMarker Class
 - RingQt Classes Reference, 1250
- QBoxPlotSeries Class
 - RingQt Classes Reference, 1251
- QBoxSet Class
 - RingQt Classes Reference, 1252
- QBrush Class
 - RingQt Classes Reference, 1253
- QBuffer Class
 - RingQt Classes Reference, 1253
- QButtonGroup Class
 - RingQt Classes Reference, 1254
- QByteArray Class
 - RingQt Classes Reference, 1254
- QCalendarWidget Class
 - RingQt Classes Reference, 1257
- QCamera Class
 - RingQt Classes Reference, 1258
- QCameraImageCapture Class
 - RingQt Classes Reference, 1259
- QCameraLens Class
 - RingQt Classes Reference, 1260
- QCameraSelector Class
 - RingQt Classes Reference, 1260
- QCameraViewfinder Class
 - RingQt Classes Reference, 1261
- QCandlestickLegendMarker Class
 - RingQt Classes Reference, 1261
- QCandlestickModelMapper Class
 - RingQt Classes Reference, 1261
- QCandlestickSeries Class
 - RingQt Classes Reference, 1261
- QCandlestickSet Class
 - RingQt Classes Reference, 1263
- QCategoryAxis Class

- RingQt Classes Reference, 1265
- QChar Class
 - RingQt Classes Reference, 1265
- QChart Class
 - RingQt Classes Reference, 1267
- QChartView Class
 - RingQt Classes Reference, 1269
- QCheckBox Class
 - RingQt Classes Reference, 1270
- QChildEvent Class
 - RingQt Classes Reference, 1270
- QClipboard Class
 - RingQt Classes Reference, 1270
- QColor Class
 - RingQt Classes Reference, 1271
- QColorDialog Class
 - RingQt Classes Reference, 1273
- QComboBox Class
 - RingQt Classes Reference, 1274
- QCompleter Class
 - RingQt Classes Reference, 1276
- QCompleter2 Class
 - RingQt Classes Reference, 1277
- QCompleter3 Class
 - RingQt Classes Reference, 1277
- QCompleter4 Class
 - RingQt Classes Reference, 1277
- QComponent Class
 - RingQt Classes Reference, 1277
- QConeGeometry Class
 - RingQt Classes Reference, 1278
- QConeMesh Class
 - RingQt Classes Reference, 1278
- QCoreApplication Class
 - RingQt Classes Reference, 1279
- QCuboidMesh Class
 - RingQt Classes Reference, 1280
- QCullFace Class
 - RingQt Classes Reference, 1281
- QCursor Class
 - RingQt Classes Reference, 1281
- QCylinderMesh Class
 - RingQt Classes Reference, 1281
- QDate Class
 - RingQt Classes Reference, 1282
- QDateEdit Class
 - RingQt Classes Reference, 1283
- QDateTime Class
 - RingQt Classes Reference, 1283
- QDateTimeAxis Class
 - RingQt Classes Reference, 1284
- QDateTimeEdit Class
 - RingQt Classes Reference, 1284
- QDepthTest Class
 - RingQt Classes Reference, 1284
- RingQt Classes Reference, 1286
- QDesktopServices Class
 - RingQt Classes Reference, 1286
- QDial Class
 - RingQt Classes Reference, 1286
- QDialog Class
 - RingQt Classes Reference, 1287
- QDiffuseSpecularMaterial Class
 - RingQt Classes Reference, 1288
- QDir Class
 - RingQt Classes Reference, 1288
- QDockWidget Class
 - RingQt Classes Reference, 1290
- QDrag Class
 - RingQt Classes Reference, 1291
- QDragEnterEvent Class
 - RingQt Classes Reference, 1291
- QDragLeaveEvent Class
 - RingQt Classes Reference, 1292
- QDragMoveEvent Class
 - RingQt Classes Reference, 1292
- QDropEvent Class
 - RingQt Classes Reference, 1292
- QEfect Class
 - RingQt Classes Reference, 1293
- QEntity Class
 - RingQt Classes Reference, 1293
- QEvent Class
 - RingQt Classes Reference, 1293
- QExtrudedTextMesh Class
 - RingQt Classes Reference, 1293
- QFile Class
 - RingQt Classes Reference, 1294
- QFile2 Class
 - RingQt Classes Reference, 1295
- QFileDialog Class
 - RingQt Classes Reference, 1295
- QFileInfo Class
 - RingQt Classes Reference, 1297
- QFileSystemModel Class
 - RingQt Classes Reference, 1299
- QFirstPersonCameraController Class
 - RingQt Classes Reference, 1300
- QFont Class
 - RingQt Classes Reference, 1300
- QFontDialog Class
 - RingQt Classes Reference, 1302
- QFontMetrics Class
 - RingQt Classes Reference, 1303
- QForwardRenderer Class
 - RingQt Classes Reference, 1304
- QFrame Class
 - RingQt Classes Reference, 1304

- RingQt Classes Reference, 1304
- QFrame2 Class
 - RingQt Classes Reference, 1305
- QFrame3 Class
 - RingQt Classes Reference, 1305
- QFrameAction Class
 - RingQt Classes Reference, 1305
- QGeoAddress Class
 - RingQt Classes Reference, 1305
- QGeoAreaMonitorInfo Class
 - RingQt Classes Reference, 1306
- QGeoAreaMonitorSource Class
 - RingQt Classes Reference, 1306
- QGeoCircle Class
 - RingQt Classes Reference, 1307
- QGeoCoordinate Class
 - RingQt Classes Reference, 1307
- QGeoPositionInfo Class
 - RingQt Classes Reference, 1307
- QGeoPositionInfoSource Class
 - RingQt Classes Reference, 1308
- QGeoRectangle Class
 - RingQt Classes Reference, 1308
- QGeoSatelliteInfo Class
 - RingQt Classes Reference, 1309
- QGeoSatelliteInfoSource Class
 - RingQt Classes Reference, 1310
- QGeoShape Class
 - RingQt Classes Reference, 1310
- QGoochMaterial Class
 - RingQt Classes Reference, 1310
- QGradient Class
 - RingQt Classes Reference, 1310
- QGraphicsAnchor Class
 - RingQt Classes Reference, 1311
- QGraphicsAnchorLayout Class
 - RingQt Classes Reference, 1311
- QGraphicsEffect Class
 - RingQt Classes Reference, 1312
- QGraphicsEllipseItem Class
 - RingQt Classes Reference, 1312
- QGraphicsGridLayout Class
 - RingQt Classes Reference, 1312
- QGraphicsItem Class
 - RingQt Classes Reference, 1314
- QGraphicsItemGroup Class
 - RingQt Classes Reference, 1319
- QGraphicsLayout Class
 - RingQt Classes Reference, 1319
- QGraphicsLayoutItem Class
 - RingQt Classes Reference, 1319
- QGraphicsLinearLayout Class
 - RingQt Classes Reference, 1321
- QGraphicsLineItem Class
 - RingQt Classes Reference, 1321
- QGraphicsObject Class
 - RingQt Classes Reference, 1321
- QGraphicsPathItem Class
 - RingQt Classes Reference, 1322
- QGraphicsPixmapItem Class
 - RingQt Classes Reference, 1322
- QGraphicsPolygonItem Class
 - RingQt Classes Reference, 1323
- QGraphicsProxyWidget Class
 - RingQt Classes Reference, 1323
- QGraphicsRectItem Class
 - RingQt Classes Reference, 1323
- QGraphicsScene Class
 - RingQt Classes Reference, 1324
- QGraphicsSceneContextMenuEvent Class
 - RingQt Classes Reference, 1326
- QGraphicsSceneDragDropEvent Class
 - RingQt Classes Reference, 1326
- QGraphicsSceneEvent Class
 - RingQt Classes Reference, 1327
- QGraphicsSceneHelpEvent Class
 - RingQt Classes Reference, 1327
- QGraphicsSceneHoverEvent Class
 - RingQt Classes Reference, 1327
- QGraphicsSceneMouseEvent Class
 - RingQt Classes Reference, 1328
- QGraphicsSceneMoveEvent Class
 - RingQt Classes Reference, 1328
- QGraphicsSceneResizeEvent Class
 - RingQt Classes Reference, 1328
- QGraphicsSceneWheelEvent Class
 - RingQt Classes Reference, 1329
- QGraphicsSimpleTextItem Class
 - RingQt Classes Reference, 1329
- QGraphicsSvgItem Class
 - RingQt Classes Reference, 1329
- QGraphicsTextItem Class
 - RingQt Classes Reference, 1330
- QGraphicsVideoItem Class
 - RingQt Classes Reference, 1330
- QGraphicsView Class
 - RingQt Classes Reference, 1331
- QGraphicsWidget Class
 - RingQt Classes Reference, 1333
- QGridLayout Class
 - RingQt Classes Reference, 1335
- QGuiApplication Class
 - RingQt Classes Reference, 1336
- QHBarModelMapper Class
 - RingQt Classes Reference, 1338
- QHBoxLayout Class
 - RingQt Classes Reference, 1339
- QHBoxPlotModelMapper Class
 - RingQt Classes Reference, 1339

RingQt Classes Reference, 1339
QHCandlestickModelMapper Class
 RingQt Classes Reference, 1340
QHeaderView Class
 RingQt Classes Reference, 1342
QHorizontalBarSeries Class
 RingQt Classes Reference, 1345
QHorizontalPercentBarSeries Class
 RingQt Classes Reference, 1345
QHorizontalStackedBarSeries Class
 RingQt Classes Reference, 1345
QHostAddress Class
 RingQt Classes Reference, 1345
QHostInfo Class
 RingQt Classes Reference, 1346
QHPieModelMapper Class
 RingQt Classes Reference, 1341
QHXYModelMapper Class
 RingQt Classes Reference, 1341
QIcon Class
 RingQt Classes Reference, 1347
QImage Class
 RingQt Classes Reference, 1348
QInputAspect Class
 RingQt Classes Reference, 1349
QInputDialog Class
 RingQt Classes Reference, 1349
QIODevice Class
 RingQt Classes Reference, 1346
QJsonArray Class
 RingQt Classes Reference, 1351
QJsonDocument Class
 RingQt Classes Reference, 1352
QJsonObject Class
 RingQt Classes Reference, 1352
QJsonParseError Class
 RingQt Classes Reference, 1353
QJsonValue Class
 RingQt Classes Reference, 1353
QKeySequence Class
 RingQt Classes Reference, 1353
QLabel Class
 RingQt Classes Reference, 1354
QLayout Class
 RingQt Classes Reference, 1355
QLCDNumber Class
 RingQt Classes Reference, 1353
QLegend Class
 RingQt Classes Reference, 1356
QLegendMarker Class
 RingQt Classes Reference, 1357
QLibraryInfo Class
 RingQt Classes Reference, 1358
QLinearGradient Class
 RingQt Classes Reference, 1361
QLineEdit Class
 RingQt Classes Reference, 1358
QLineEdit Events and QMessageBox
 Desktop, WebAssembly and Mobile Development, 446
QLineF Class
 RingQt Classes Reference, 1360
QLineSeries Class
 RingQt Classes Reference, 1361
QListView Class
 RingQt Classes Reference, 1362
QListWidget Class
 RingQt Classes Reference, 1362
QListWidgetItem Class
 RingQt Classes Reference, 1364
QLocale Class
 RingQt Classes Reference, 1365
QLogicAspect Class
 RingQt Classes Reference, 1368
QLogValueAxis Class
 RingQt Classes Reference, 1367
QMainWindow Class
 RingQt Classes Reference, 1368
QMaterial Class
 RingQt Classes Reference, 1369
QMatrix4x4 Class
 RingQt Classes Reference, 1369
QMdiArea Class
 RingQt Classes Reference, 1371
QMdiSubWindow Class
 RingQt Classes Reference, 1372
QMediaObject Class
 RingQt Classes Reference, 1372
QMediaPlayer Class
 RingQt Classes Reference, 1373
QMediaPlaylist Class
 RingQt Classes Reference, 1373
QMenu Class
 RingQt Classes Reference, 1374
QMenuBar Class
 RingQt Classes Reference, 1375
QMesh Class
 RingQt Classes Reference, 1375
QMessageBox Class
 RingQt Classes Reference, 1376
QMessagebox Example
 Desktop, WebAssembly and Mobile Development, 465
QMetalRoughMaterial Class
 RingQt Classes Reference, 1377
QMimeType Class
 RingQt Classes Reference, 1377
QModelIndex Class

- RingQt Classes Reference, [1378](#)
- QMorphPhongMaterial Class
 - RingQt Classes Reference, [1378](#)
- QMovie Class
 - RingQt Classes Reference, [1379](#)
- QMutex Class
 - RingQt Classes Reference, [1380](#)
- QMutexLocker Class
 - RingQt Classes Reference, [1380](#)
- QNetworkAccessManager Class
 - RingQt Classes Reference, [1381](#)
- QNetworkProxy Class
 - RingQt Classes Reference, [1382](#)
- QNetworkReply Class
 - RingQt Classes Reference, [1382](#)
- QNetworkRequest Class
 - RingQt Classes Reference, [1383](#)
- QNmeaPositionInfoSource Class
 - RingQt Classes Reference, [1383](#)
- QNode Class
 - RingQt Classes Reference, [1383](#)
- QObject Class
 - RingQt Classes Reference, [1384](#)
- QObjectPicker Class
 - RingQt Classes Reference, [1385](#)
- QOpenGLBuffer Class
 - RingQt Classes Reference, [1386](#)
- QOpenGLContext Class
 - RingQt Classes Reference, [1386](#)
- QOpenGLDebugLogger Class
 - RingQt Classes Reference, [1387](#)
- QOpenGLFramebufferObject Class
 - RingQt Classes Reference, [1388](#)
- QOpenGLFunctions Class
 - RingQt Classes Reference, [1389](#)
- QOpenGLFunctions_3_2_Core Class
 - RingQt Classes Reference, [1393](#)
- QOpenGLPaintDevice Class
 - RingQt Classes Reference, [1401](#)
- QOpenGLShader Class
 - RingQt Classes Reference, [1401](#)
- QOpenGLShaderProgram Class
 - RingQt Classes Reference, [1402](#)
- QOpenGLTexture Class
 - RingQt Classes Reference, [1405](#)
- QOpenGLTimerQuery Class
 - RingQt Classes Reference, [1407](#)
- QOpenGLVersionProfile Class
 - RingQt Classes Reference, [1408](#)
- QOpenGLVertexArrayObject Class
 - RingQt Classes Reference, [1408](#)
- QOpenGLWidget Class
 - RingQt Classes Reference, [1408](#)
- QOrbitCameraController Class
 - RingQt Classes Reference, [1409](#)
- QPageSetupDialog Class
 - RingQt Classes Reference, [1409](#)
- QPaintDevice Class
 - RingQt Classes Reference, [1410](#)
- QPainter Class
 - RingQt Classes Reference, [1410](#)
- QPainter2 Class
 - RingQt Classes Reference, [1413](#)
- QPainterPath Class
 - RingQt Classes Reference, [1413](#)
- QPen Class
 - RingQt Classes Reference, [1414](#)
- QPercentBarSeries Class
 - RingQt Classes Reference, [1415](#)
- QPerVertexColorMaterial Class
 - RingQt Classes Reference, [1415](#)
- QPhongMaterial Class
 - RingQt Classes Reference, [1415](#)
- QPicture Class
 - RingQt Classes Reference, [1416](#)
- QPieLegendMarker Class
 - RingQt Classes Reference, [1416](#)
- QPieSeries Class
 - RingQt Classes Reference, [1416](#)
- QPieSlice Class
 - RingQt Classes Reference, [1417](#)
- QPixmap Class
 - RingQt Classes Reference, [1420](#)
- QPixmap2 Class
 - RingQt Classes Reference, [1421](#)
- QPlainTextEdit Class
 - RingQt Classes Reference, [1421](#)
- QPlaneMesh Class
 - RingQt Classes Reference, [1423](#)
- QPoint Class
 - RingQt Classes Reference, [1424](#)
- QPointF Class
 - RingQt Classes Reference, [1424](#)
- QPointLight Class
 - RingQt Classes Reference, [1425](#)
- QPolarChart Class
 - RingQt Classes Reference, [1425](#)
- QPrintDialog Class
 - RingQt Classes Reference, [1425](#)
- QPrinter Class
 - RingQt Classes Reference, [1427](#)
- QPrinterInfo Class
 - RingQt Classes Reference, [1428](#)
- QPrintPreviewDialog Class
 - RingQt Classes Reference, [1425](#)
- QPrintPreviewWidget Class
 - RingQt Classes Reference, [1426](#)

RingQt Classes Reference, 1428
QProgressBar Class
 RingQt Classes Reference, 1430
QPushButton Class
 RingQt Classes Reference, 1430
QQmlEngine Class
 RingQt Classes Reference, 1431
QQmlError Class
 RingQt Classes Reference, 1432
QQuaternion Class
 RingQt Classes Reference, 1432
QQuickView Class
 RingQt Classes Reference, 1433
QQuickWidget Class
 RingQt Classes Reference, 1433
QRadioButton Class
 RingQt Classes Reference, 1434
QRect Class
 RingQt Classes Reference, 1435
QRectF Class
 RingQt Classes Reference, 1436
QRegExp Class
 RingQt Classes Reference, 1438
QRegion Class
 RingQt Classes Reference, 1439
QRegularExpression Class
 RingQt Classes Reference, 1439
QRegularExpressionMatch Class
 RingQt Classes Reference, 1440
QRegularExpressionMatchIterator Class
 RingQt Classes Reference, 1441
QRenderAspect Class
 RingQt Classes Reference, 1441
QRenderPass Class
 RingQt Classes Reference, 1441
QScatterSeries Class
 RingQt Classes Reference, 1442
QSceneLoader Class
 RingQt Classes Reference, 1442
QScreen Class
 RingQt Classes Reference, 1442
QScrollArea Class
 RingQt Classes Reference, 1443
QScrollBar Class
 RingQt Classes Reference, 1444
QSerialPort Class
 RingQt Classes Reference, 1444
QSerialPortInfo Class
 RingQt Classes Reference, 1445
QSize Class
 RingQt Classes Reference, 1446
QSkyboxEntity Class
 RingQt Classes Reference, 1446
QSlider Class
 RingQt Classes Reference, 1446
RingQt Classes Reference, 1446
QSphereMesh Class
 RingQt Classes Reference, 1447
QSpinBox Class
 RingQt Classes Reference, 1447
QSplashScreen Class
 RingQt Classes Reference, 1448
QSplineSeries Class
 RingQt Classes Reference, 1448
QSplitter Class
 RingQt Classes Reference, 1449
QSqlDatabase Class
 RingQt Classes Reference, 1449
QSqlDriver Class
 RingQt Classes Reference, 1451
QSqlDriverCreatorBase Class
 RingQt Classes Reference, 1451
QSqlError Class
 RingQt Classes Reference, 1451
QSqlField Class
 RingQt Classes Reference, 1451
QSqlIndex Class
 RingQt Classes Reference, 1452
QSqlQuery Class
 RingQt Classes Reference, 1453
QSqlRecord Class
 RingQt Classes Reference, 1454
QStackedBarSeries Class
 RingQt Classes Reference, 1454
QStackedWidget Class
 RingQt Classes Reference, 1455
QStandardPaths Class
 RingQt Classes Reference, 1455
QStatusBar Class
 RingQt Classes Reference, 1456
QString2 Class
 RingQt Classes Reference, 1456
QStringList Class
 RingQt Classes Reference, 1457
QStringRef Class
 RingQt Classes Reference, 1459
QStyle Class
 RingQt Classes Reference, 1460
QStyleOptionGraphicsItem Class
 RingQt Classes Reference, 1461
QSurfaceFormat Class
 RingQt Classes Reference, 1462
QSystemTrayIcon Class
 RingQt Classes Reference, 1463
Qt Class Converter
 What is new in Ring 1.4?, 1718
Qt configuration file
 Code Generator, 1644
Qt3DCamera Class

- RingQt Classes Reference, 1535
- Qt3DWindow Class
 - RingQt Classes Reference, 1536
- QTabBar Class
 - RingQt Classes Reference, 1463
- QTableView Class
 - RingQt Classes Reference, 1466
- QTableWidget Class
 - RingQt Classes Reference, 1468
- QTableWidgetItem Class
 - RingQt Classes Reference, 1470
- QTabWidget Class
 - RingQt Classes Reference, 1465
- QTcpServer Class
 - RingQt Classes Reference, 1471
- QTcpSocket Class
 - RingQt Classes Reference, 1472
- QTechnique Class
 - RingQt Classes Reference, 1472
- QTest Class
 - RingQt Classes Reference, 1473
- QText2DEntity Class
 - RingQt Classes Reference, 1473
- QTextBlock Class
 - RingQt Classes Reference, 1473
- QTextBrowser Class
 - RingQt Classes Reference, 1474
- QTextCharFormat Class
 - RingQt Classes Reference, 1475
- QTextCodec Class
 - RingQt Classes Reference, 1477
- QTextCursor Class
 - RingQt Classes Reference, 1477
- QTextDocument Class
 - RingQt Classes Reference, 1479
- QTextEdit Class
 - RingQt Classes Reference, 1481
- QTextOption Class
 - RingQt Classes Reference, 1484
- QTextStream Class
 - RingQt Classes Reference, 1484
- QTextStream2 Class
 - RingQt Classes Reference, 1485
- QTextStream3 Class
 - RingQt Classes Reference, 1486
- QTextStream4 Class
 - RingQt Classes Reference, 1486
- QTextStream5 Class
 - RingQt Classes Reference, 1486
- QTextToSpeech Class
 - RingQt Classes Reference, 1486
- QTextureLoader Class
 - RingQt Classes Reference, 1487
- QTextureMaterial Class
 - RingQt Classes Reference, 1487
- RingQt Classes Reference, 1487
- QThread Class
 - RingQt Classes Reference, 1488
- QThreadPool Class
 - RingQt Classes Reference, 1488
- QTime Class
 - RingQt Classes Reference, 1489
- QTimer Class
 - RingQt Classes Reference, 1490
- QToolBar Class
 - RingQt Classes Reference, 1490
- QToolButton Class
 - RingQt Classes Reference, 1491
- QTorusMesh Class
 - RingQt Classes Reference, 1491
- QTransform Class
 - RingQt Classes Reference, 1492
- QTransform2 Class
 - RingQt Classes Reference, 1493
- QTransform3 Class
 - RingQt Classes Reference, 1494
- QTreeView Class
 - RingQt Classes Reference, 1494
- QTreeWidget Class
 - RingQt Classes Reference, 1496
- QTreeWidgetItem Class
 - RingQt Classes Reference, 1498
- Queue Class
 - Stdlib Classes, 385
- Quotes about Ring
 - Applications developed in a few hours, 2
- QUrl Class
 - RingQt Classes Reference, 1500
- QUuid Class
 - RingQt Classes Reference, 1501
- QValueAxis Class
 - RingQt Classes Reference, 1506
- QVariant Class
 - RingQt Classes Reference, 1507
- QVariant2 Class
 - RingQt Classes Reference, 1508
- QVariant3 Class
 - RingQt Classes Reference, 1508
- QVariant4 Class
 - RingQt Classes Reference, 1508
- QVariant5 Class
 - RingQt Classes Reference, 1509
- QVariantDouble Class
 - RingQt Classes Reference, 1509
- QVariantFloat Class
 - RingQt Classes Reference, 1509
- QVariantInt Class
 - RingQt Classes Reference, 1509
- QVariantString Class
 - RingQt Classes Reference, 1509

RingQt Classes Reference, 1509
 QVBarModelMapper Class
 RingQt Classes Reference, 1501
 QVBoxLayout Class
 RingQt Classes Reference, 1502
 QVBoxPlotModelMapper Class
 RingQt Classes Reference, 1502
 QVCandlestickModelMapper Class
 RingQt Classes Reference, 1503
 QVector2D Class
 RingQt Classes Reference, 1509
 QVector3D Class
 RingQt Classes Reference, 1510
 QVector4D Class
 RingQt Classes Reference, 1511
 QVectorQVoice Class
 RingQt Classes Reference, 1512
 QVersionNumber Class
 RingQt Classes Reference, 1512
 QVideoWidget and QMediaPlayer
 Desktop, WebAssembly and Mobile Development, 440
 QVideoWidget Class
 RingQt Classes Reference, 1512
 QVideoWidgetControl Class
 RingQt Classes Reference, 1513
 QViewport Class
 RingQt Classes Reference, 1513
 QVoice Class
 RingQt Classes Reference, 1513
 QVPieModelMapper Class
 RingQt Classes Reference, 1504
 QVXYModelMapper Class
 RingQt Classes Reference, 1505
 QWebEnginePage Class
 RingQt Classes Reference, 1514
 QWebEngineView Class
 RingQt Classes Reference, 1516
 QWebView Class
 RingQt Classes Reference, 1518
 QWidget Class
 RingQt Classes Reference, 1518
 QWindow Class
 RingQt Classes Reference, 1524
 QDomStreamAttribute Class
 RingQt Classes Reference, 1530
 QDomStreamAttributes Class
 RingQt Classes Reference, 1531
 QDomStreamEntityDeclaration Class
 RingQt Classes Reference, 1531
 QDomStreamEntityResolver Class
 RingQt Classes Reference, 1531
 QDomStreamNamespaceDeclaration Class
 RingQt Classes Reference, 1531

QDomStreamNotationDeclaration Class
 RingQt Classes Reference, 1532
 QDomStreamReader Class
 RingQt Classes Reference, 1532
 QDomStreamWriter Class
 RingQt Classes Reference, 1533
 QXYLegendMarker Class
 RingQt Classes Reference, 1528
 QXYSeries Class
 RingQt Classes Reference, 1528

R

Raise()
 Eval() and Debugging, 166
 RandBytes()
 Security and Internet Functions, 209
 Random Image
 Web Development (*CGI Library*), 627
 Random User application
 What is new in Ring 1.18, 1940
 Random()
 Mathematical Functions, 138
 RandomItem() Function
 Stdlib Functions, 377
 RandomList() Function
 Stdlib Functions, 376
 Read File using Read()
 Files, 144
 Read Files application
 What is new in Ring 1.18, 1939
 readline() Function
 Stdlib Functions, 369
 Real Natural Code
 Natural Language Programming, 291
 Rectangle Scaling
 Using RingRayLib, 772
 Recursion
 Functions - First Style, 89
 Functions - Second Style, 93
 Functions - Third Style, 97
 reduce() Function
 Stdlib Functions, 359
 Reducing Memory Usage
 What is new in Ring 1.21, 1997
 ref()
 Using References, 1552
 Ref() and sub lists
 Using References, 1560
 Ref() and temp. lists
 Using References, 1559
 Ref() in left side
 Using References, 1560
 refcount()
 Using References, 1553

Reference	Research Article
Threads, 1018	What is new in Ring 1.22?, 2004
tilengine, 898	
Reflection and Meta-programming	Resources
addattribute(), 270	Introduction, 2093
addmethod(), 270	Ring Group, 2094
attributes(), 267	Ring Language Website, 2094
cfunctions(), 258	Ring Team, 2094
classes(), 262	Source Code, 2094
classname(), 265	
functions(), 258	Respond to keypress events
getattribute(), 272	Using RogueUtil, 1075
globals(), 257	
importpackage() Function, 275	Respond to mouse events (Windows Command Prompt or Linux/macOS Terminal)
Introduction, 255	Using RogueUtil, 1079
isattribute(), 268	
iscfunction(), 260	Respond to mouse events in Windows command prompt
isclass(), 263	Using RogueUtil, 1077
isfunction(), 260	
isglobal(), 259	Restore Image From The Database
islocal(), 259	MySQL Functions, 189
ismethod(), 269	
isobject(), 266	Return as List or Hash Table
ispackage(), 262	Lists, 110
ispackagesclass(), 264	
isprivateattribute(), 268	Return Attribute by Reference
isprivatemethod(), 269	What is new in Ring 1.22, 2011
locals(), 257	
mergemethods(), 274	Return object by reference
methods(), 267	Declarative Programming, 279
Nothing() function, 276	
objectid(), 266	Return Self by Reference
OptionalFunc() function, 276	What is new in Ring 1.3?, 1705
packagename(), 275	
packages(), 261	Return Value
packagesclasses(), 264	Extension, 1620
parentclassname(), 265	Functions - First Style, 88
setattribute(), 273	Functions - Second Style, 92
Register New Functions	Functions - Third Style, 96
Code Generator, 1637	
Regular Expressions	Reverse()
Desktop, WebAssembly and Mobile Development, 479	Lists, 105
Using HTTPLib, 995	
Relational Operators	Reverse() Function
Operators, 58	Strings, 118
Remove Package	Rewind()
Ring Package Manager (<i>RingPM</i>), 946	Files, 148
Remove()	Right()
Files, 145	Strings, 115
Rename()	Ring and other languages
Files, 145	Introduction, 27
Replicate List Items	RING API - list Functions
Tutorial: Ring Extensions in C/C++, 1599	Extension, 1622
	RING API - String Functions
	Extension, 1625
	Ring CGI Hello World Program
	Web Development (<i>CGI Library</i>), 608
	Ring Extension for Visual Studio Code
	What is new in Ring 1.10?, 1831
	Ring for MS-DOS
	What is new in Ring 1.18, 1946
	Ring for Raspberry Pi Pico
	What is new in Ring 1.21, 1986
	Ring for WebAssembly

What is new in Ring 1.13?, 1863
 Ring for Windows 64bit
 What is new in Ring 1.19, 1961
 Ring Group
 Resources, 2094
 Ring Language Website
 Resources, 2094
 Ring mode for Emacs Editor
 What is new in Ring 1.3?, 1703
 Ring Notepad
 Introduction, 32
 Ring Notepad - Creating and running
 your first console application, 34
 Ring Notepad - Creating and running
 your first game, 38
 Ring Notepad - Creating and running
 your first GUI/WebAssembly/Mobile
 application, 36
 Ring Notepad - Creating and running
 your first Web application, 37
 Ring Notepad - Main Window, 33
 The Browser Menu, 43
 The Distribute Menu, 44
 The Edit Menu, 41
 The File Menu, 40
 The Help Menu, 44
 The Main File in the Project, 39
 The Program Menu, 43
 The Tools Menu, 43
 The View Menu, 41
 Ring Notepad - Creating and running your
 first console application
 Ring Notepad, 34
 Ring Notepad - Creating and running your
 first game
 Ring Notepad, 38
 Ring Notepad - Creating and running your
 first GUI/WebAssembly/Mobile
 application
 Ring Notepad, 36
 Ring Notepad - Creating and running your
 first Web application
 Ring Notepad, 37
 Ring Notepad - Main Window
 Ring Notepad, 33
 Ring Package Manager (*RingPM*)
 Create Package in the Current Folder, 949
 Creating New Package, 946
 Deleting All Packages, 946
 Discovering Packages, 943
 Features, 943
 Installing Packages, 944
 Introduction, 942
 Printing List of Installed Packages, 945
 Remove Package, 946
 Run Package, 945
 The Package Description File, 948
 The RingPM Registry File, 952
 Update Package, 946
 Updating the RingPM Registry, 944
 Ring source code files and permissions
 Deploying Web Applications in the Cloud,
 666
 Ring State
 Embedding Ring Language in C/C++
 Programs, 1631
 Ring State Functions
 Embedding Ring Language in C/C++
 Programs, 1631
 Ring State Variables
 Embedding Ring Language in C/C++
 Programs, 1632
 Ring support in SpaceVim
 What is new in Ring 1.13?, 1873
 Ring Team
 Resources, 2094
 Ring VM - Tracing Functions
 What is new in Ring 1.5?, 1752
 RING_API_STATE
 Extension, 1624
 ring_ext.c
 Extension, 1616
 ring_ext.h
 Extension, 1616
 ring_state_filetokens() function
 Embedding Ring in Ring, 351
 What is new in Ring 1.12?, 1857
 ring_state_mainfile() and Ring Object File
 Embedding Ring in Ring, 352
 ring_state_new() and ring_state_mainfile()
 Embedding Ring in Ring, 349
 ring_state_new() and ring_state_mainfile()
 functions
 What is new in Ring 1.7?, 1785
 ring_state_setvar()
 Embedding Ring in Ring, 348
 RingAllegro Functions Reference
 Introduction, 1083
 RingCodeHighlighter Class
 RingQt Classes Reference, 1536
 RingConsoleColors Extension
 What is new in Ring 1.6?, 1775
 RingConsoleColors Functions Reference
 Introduction, 1070
 RingFreeGLUT Extension
 What is new in Ring 1.5?, 1736
 RingFreeGLUT Functions Reference
 Introduction, 1153

RingLibCurl	What is new in Ring 1.5?, 1747
Facebook Login, 1001	
Get Request, 1001	
Get Stock Data From Yahoo, 1003	
Introduction, 1000	
Post Request, 1001	
Save output to string, 1002	
What is new in Ring 1.2?, 1694	
RingLibCurl Functions Reference	
Introduction, 1004	
RingLibSDL	
Close Window Event, 1108	
Create Window, 1104	
Display Image, 1104	
Display PNG Images, 1106	
Display Transparent Images, 1107	
Draw Rectangle, 1105	
Introduction, 1103	
Mouse Events, 1108	
Play Sound, 1110	
Switch Between Two Images, 1105	
Use TTF Fonts, 1106	
What is new in Ring 1.1?, 1685	
RingLibSDL Functions Reference	
Introduction, 1110	
RingLibui Extension	
What is new in Ring 1.14?, 1891	
RingLibuv	
Client Example, 1139	
Client Example - Using Classes, 1141	
First Application using RingLibuv, 1136	
Introduction, 1135	
Server Example, 1137	
Server Example using Classes, 1140	
The Events Loop, 1137	
Threads Example, 1143	
Threads Example - Using Classes, 1143	
RingLibuv Extension	
What is new in Ring 1.7?, 1788	
RingLibuv Functions Reference	
Introduction, 1144	
RingLibZip Functions Reference	
Introduction, 1067	
RingMurmurHash Extension	
What is new in Ring 1.6?, 1775	
RingMurmurHash Functions Reference	
Example, 1069	
Introduction, 1068	
MurmurHash1 functions, 1069	
MurmurHash2 functions, 1069	
MurmurHash3 functions, 1069	
RingOpenGL (OpenGL 3.2) Functions Reference	
Introduction, 1168	
RingOpenGL Extension	
RingPDFGen Extension	What is new in Ring 1.21, 1988
RingPostgreSQL Constants	PostgreSQL, 198
RingPostgreSQL Extension	What is new in Ring 1.9?, 1814
RingPostgreSQL Functions	PostgreSQL, 199
RingQt Classes and their Qt Documentation	Desktop, WebAssembly and Mobile Development, 516
RingQt Classes Reference	
AbstractAxis Class, 1216	
AbstractBarSeries Class, 1219	
CodeEditor Class, 1220	
Introduction, 1215	
QAbstractAspect Class, 1220	
QAbstractButton Class, 1221	
QAbstractCameraController Class, 1222	
QAbstractGraphicsShapeItem Class, 1222	
QAbstractItemView Class, 1222	
QAbstractPrintDialog Class, 1224	
QAbstractScrollArea Class, 1224	
QAbstractSeries Class, 1225	
QAbstractSlider Class, 1226	
QAbstractSocket Class, 1227	
QAbstractSpinBox Class, 1228	
QAction Class, 1229	
QAllEvents Class, 1231	
QApp Class, 1235	
QAreaLegendMarker Class, 1235	
QAreaSeries Class, 1236	
QAspectEngine Class, 1237	
QAudioOutput Class, 1238	
QAxBase Class, 1238	
QAxObject Class, 1239	
QAxWidget Class, 1239	
QAxWidget2 Class, 1239	
QBarCategoryAxis Class, 1239	
QBarLegendMarker Class, 1240	
QBarSeries Class, 1240	
QBarSet Class, 1240	
QBitmap Class, 1242	
QBluetoothAddress Class, 1242	
QBluetoothDeviceDiscoveryAgent Class, 1243	
QBluetoothDeviceInfo Class, 1243	
QBluetoothHostInfo Class, 1244	
QBluetoothLocalDevice Class, 1244	
QBluetoothServer Class, 1245	
QBluetoothServiceDiscoveryAgent Class, 1246	
QBluetoothServiceInfo Class, 1246	

QBluetoothSocket Class, 1247
QBluetoothTransferManager Class, 1248
QBluetoothTransferReply Class, 1249
QBluetoothTransferRequest Class, 1249
QBluetoothUuid Class, 1249
QBoxLayout Class, 1250
QBoxPlotLegendMarker Class, 1250
QBoxPlotSeries Class, 1251
QBoxSet Class, 1252
QBrush Class, 1253
QBuffer Class, 1253
QPushButtonGroup Class, 1254
QByteArray Class, 1254
QCalendarWidget Class, 1257
QCamera Class, 1258
QCameraImageCapture Class, 1259
QCameraLens Class, 1260
QCameraSelector Class, 1260
QCameraViewfinder Class, 1261
QCandlestickLegendMarker Class, 1261
QCandlestickModelMapper Class, 1261
QCandlestickSeries Class, 1261
QCandlestickSet Class, 1263
QCategoryAxis Class, 1265
QChar Class, 1265
QChart Class, 1267
QChartView Class, 1269
QCheckBox Class, 1270
QChildEvent Class, 1270
QClipboard Class, 1270
QColor Class, 1271
QColorDialog Class, 1273
QComboBox Class, 1274
QCompleter Class, 1276
QCompleter2 Class, 1277
QCompleter3 Class, 1277
QCompleter4 Class, 1277
QComponent Class, 1277
QConeGeometry Class, 1278
QConeMesh Class, 1278
QCoreApplication Class, 1279
QCuboidMesh Class, 1280
QCullFace Class, 1281
QCursor Class, 1281
QCylinderMesh Class, 1281
QDate Class, 1282
QDateEdit Class, 1283
QDateTime Class, 1283
QDateTimeAxis Class, 1284
QDateTimeEdit Class, 1284
QDepthTest Class, 1286
QDesktopServices Class, 1286
QDial Class, 1286
QDialog Class, 1287
QDiffuseSpecularMaterial Class, 1288
QDir Class, 1288
QDockWidget Class, 1290
QDrag Class, 1291
QDragEnterEvent Class, 1291
QDragLeaveEvent Class, 1292
QDragMoveEvent Class, 1292
QDropEvent Class, 1292
QEFFECT Class, 1293
QEntity Class, 1293
QEvent Class, 1293
QExtrudedTextMesh Class, 1293
QFileDialog Class, 1294
QFile2 Class, 1295
QFileDevice Class, 1295
QFileDialog Class, 1295
QFileInfo Class, 1297
QFileSystemModel Class, 1299
QFirstPersonCameraController Class, 1300
QFont Class, 1300
QFontDialog Class, 1302
QFontMetrics Class, 1303
QForwardRenderer Class, 1304
QFrame Class, 1304
QFrame2 Class, 1305
QFrame3 Class, 1305
QFrameAction Class, 1305
QGeoAddress Class, 1305
QGeoAreaMonitorInfo Class, 1306
QGeoAreaMonitorSource Class, 1306
QGeoCircle Class, 1307
QGeoCoordinate Class, 1307
QGeoPositionInfo Class, 1307
QGeoPositionInfoSource Class, 1308
QGeoRectangle Class, 1308
QGeoSatelliteInfo Class, 1309
QGeoSatelliteInfoSource Class, 1310
QGeoShape Class, 1310
QGoochMaterial Class, 1310
QGradient Class, 1310
QGraphicsAnchor Class, 1311
QGraphicsAnchorLayout Class, 1311
QGraphicsEffect Class, 1312
QGraphicsEllipseItem Class, 1312
QGraphicsGridLayout Class, 1312
QGraphicsItem Class, 1314
QGraphicsItemGroup Class, 1319
QGraphicsLayout Class, 1319
QGraphicsLayoutItem Class, 1319
QGraphicsLinearLayout Class, 1321
QGraphicsLineItem Class, 1321
QGraphicsObject Class, 1321
QGraphicsPathItem Class, 1322
QGraphicsPixmapItem Class, 1322

QGraphicsPolygonItem Class, 1323
QGraphicsProxyWidget Class, 1323
QGraphicsRectItem Class, 1323
QGraphicsScene Class, 1324
QGraphicsSceneContextMenuEvent Class, 1326
QGraphicsSceneDragDropEvent Class, 1326
QGraphicsSceneEvent Class, 1327
QGraphicsSceneHelpEvent Class, 1327
QGraphicsSceneHoverEvent Class, 1327
QGraphicsSceneMouseEvent Class, 1328
QGraphicsSceneMoveEvent Class, 1328
QGraphicsSceneResizeEvent Class, 1328
QGraphicsSceneWheelEvent Class, 1329
QGraphicsSimpleTextItem Class, 1329
QGraphicsSvgItem Class, 1329
QGraphicsTextItem Class, 1330
QGraphicsVideoItem Class, 1330
QGraphicsView Class, 1331
QGraphicsWidget Class, 1333
QGridLayout Class, 1335
QGuiApplication Class, 1336
QHBarModelMapper Class, 1338
QHBoxLayout Class, 1339
QHBoxPlotModelMapper Class, 1339
QHCandlestickModelMapper Class, 1340
QHeaderView Class, 1342
QHorizontalBarSeries Class, 1345
QHorizontalPercentBarSeries Class, 1345
QHorizontalStackedBarSeries Class, 1345
QHostAddress Class, 1345
QHostInfo Class, 1346
QHPieModelMapper Class, 1341
QHXYModelMapper Class, 1341
QIcon Class, 1347
QImage Class, 1348
QInputAspect Class, 1349
QInputDialog Class, 1349
QIODevice Class, 1346
QJsonArray Class, 1351
QJsonDocument Class, 1352
QJsonObject Class, 1352
QJsonParseError Class, 1353
JsonValue Class, 1353
QKeySequence Class, 1353
QLabel Class, 1354
QLayout Class, 1355
QLCDNumber Class, 1353
QLegend Class, 1356
QLegendMarker Class, 1357
QLibraryInfo Class, 1358
QLinearGradient Class, 1361
QLineEdit Class, 1358
QLineF Class, 1360

QLineSeries Class, 1361
QListView Class, 1362
QListWidget Class, 1362
QListWidgetItem Class, 1364
QLocale Class, 1365
QLogicAspect Class, 1368
QLogValueAxis Class, 1367
QMainWindow Class, 1368
QMateral Class, 1369
QMatrix4x4 Class, 1369
QMdiArea Class, 1371
QMdiSubWindow Class, 1372
QMediaObject Class, 1372
QMediaPlayer Class, 1373
QMediaPlaylist Class, 1373
QMenu Class, 1374
QMenuBar Class, 1375
QMesh Class, 1375
QMessageBox Class, 1376
QMetalRoughMaterial Class, 1377
QMimeType Class, 1377
QModelIndex Class, 1378
QMorphPhongMaterial Class, 1378
QMovie Class, 1379
QMutex Class, 1380
QMutexLocker Class, 1380
QNetworkAccessManager Class, 1381
QNetworkProxy Class, 1382
QNetworkReply Class, 1382
QNetworkRequest Class, 1383
QNmeaPositionInfoSource Class, 1383
QNode Class, 1383
QObject Class, 1384
QObjectPicker Class, 1385
QOpenGLBuffer Class, 1386
QOpenGLContext Class, 1386
QOpenGLDebugLogger Class, 1387
QOpenGLFramebufferObject Class, 1388
QOpenGLFunctions Class, 1389
QOpenGLFunctions_3_2_Core Class, 1393
QOpenGLPaintDevice Class, 1401
QOpenGLShader Class, 1401
QOpenGLShaderProgram Class, 1402
QOpenGLTexture Class, 1405
QOpenGLTimerQuery Class, 1407
QOpenGLVersionProfile Class, 1408
QOpenGLVertexArrayObject Class, 1408
QOpenGLWidget Class, 1408
QOrbitCameraController Class, 1409
QPageSetupDialog Class, 1409
QPaintDevice Class, 1410
QPainter Class, 1410
QPainter2 Class, 1413
QPainterPath Class, 1413

QPen Class, 1414
QPercentBarSeries Class, 1415
QPerVertexColorMaterial Class, 1415
QPhongMaterial Class, 1415
QPicture Class, 1416
QPieLegendMarker Class, 1416
QPieSeries Class, 1416
QPieSlice Class, 1417
QPixmap Class, 1420
QPixmap2 Class, 1421
QPlainTextEdit Class, 1421
QPlaneMesh Class, 1423
QPoint Class, 1424
QPointF Class, 1424
QPointLight Class, 1425
QPolarChart Class, 1425
QPrintDialog Class, 1425
QPrinter Class, 1427
QPrinterInfo Class, 1428
QPrintPreviewDialog Class, 1425
QPrintPreviewWidget Class, 1426
QProcess Class, 1428
QProgressBar Class, 1430
QPushButton Class, 1430
QQmlEngine Class, 1431
QQmlError Class, 1432
QQuaternion Class, 1432
QQuickView Class, 1433
QQuickWidget Class, 1433
QRadioButton Class, 1434
QRect Class, 1435
QRectF Class, 1436
QRegExp Class, 1438
QRegion Class, 1439
QRegularExpression Class, 1439
QRegularExpressionMatch Class, 1440
QRegularExpressionMatchIterator Class, 1441
QRenderAspect Class, 1441
QRenderPass Class, 1441
QScatterSeries Class, 1442
QSceneLoader Class, 1442
QScreen Class, 1442
QScrollArea Class, 1443
QScrollBar Class, 1444
QSerialPort Class, 1444
QSerialPortInfo Class, 1445
QSize Class, 1446
QSkyboxEntity Class, 1446
QSlider Class, 1446
QSphereMesh Class, 1447
QSpinBox Class, 1447
QSplashScreen Class, 1448
QSplineSeries Class, 1448
QSplitter Class, 1449
QSqlDatabase Class, 1449
QSqlDriver Class, 1451
QSqlDriverCreatorBase Class, 1451
QSqlError Class, 1451
QSqlField Class, 1451
QSqlIndex Class, 1452
QSqlQuery Class, 1453
QSqlRecord Class, 1454
QStackedBarSeries Class, 1454
QStackedWidget Class, 1455
QStandardPaths Class, 1455
QStatusBar Class, 1456
QString2 Class, 1456
QStringList Class, 1457
QStringRef Class, 1459
QStyle Class, 1460
QStyleOptionGraphicsItem Class, 1461
QSurfaceFormat Class, 1462
QSystemTrayIcon Class, 1463
Qt3DCamera Class, 1535
Qt3DWindow Class, 1536
QTabBar Class, 1463
QTableView Class, 1466
QTableWidget Class, 1468
QTableWidgetItem Class, 1470
QTabWidget Class, 1465
QTcpServer Class, 1471
QTcpSocket Class, 1472
QTechnique Class, 1472
QTest Class, 1473
QText2DEntity Class, 1473
QTextBlock Class, 1473
QTextBrowser Class, 1474
QTextCharFormat Class, 1475
QTextCodec Class, 1477
QTextCursor Class, 1477
QTextDocument Class, 1479
QTextEdit Class, 1481
QTextOption Class, 1484
QTextStream Class, 1484
QTextStream2 Class, 1485
QTextStream3 Class, 1486
QTextStream4 Class, 1486
QTextStream5 Class, 1486
QTextToSpeech Class, 1486
QTextureLoader Class, 1487
QTextureMaterial Class, 1487
QThread Class, 1488
QThreadPool Class, 1488
QTime Class, 1489
QTimer Class, 1490
QToolBar Class, 1490
QToolButton Class, 1491

QTorusMesh Class, 1491
 QTransform Class, 1492
 QTransform2 Class, 1493
 QTransform3 Class, 1494
 QTreeView Class, 1494
 QTreeWidget Class, 1496
 QTreeWidgetItem Class, 1498
 QUrl Class, 1500
 QUuid Class, 1501
 QValueAxis Class, 1506
 QVariant Class, 1507
 QVariant2 Class, 1508
 QVariant3 Class, 1508
 QVariant4 Class, 1508
 QVariant5 Class, 1509
 QVariantDouble Class, 1509
 QVariantFloat Class, 1509
 QVariantInt Class, 1509
 QVariantString Class, 1509
 QVBarModelMapper Class, 1501
 QVBoxLayout Class, 1502
 QVBoxPlotModelMapper Class, 1502
 QVCandlestickModelMapper Class, 1503
 QVector2D Class, 1509
 QVector3D Class, 1510
 QVector4D Class, 1511
 QVectorQVoice Class, 1512
 QVersionNumber Class, 1512
 QVideoWidget Class, 1512
 QVideoWidgetControl Class, 1513
 QViewport Class, 1513
 QVoice Class, 1513
 QVPieModelMapper Class, 1504
 QVXYModelMapper Class, 1505
 QWebEnginePage Class, 1514
 QWebEngineView Class, 1516
 QWebView Class, 1518
 QWidget Class, 1518
 QWindow Class, 1524
 QDomStreamAttribute Class, 1530
 QDomStreamAttributes Class, 1531
 QDomStreamEntityDeclaration Class, 1531
 QDomStreamEntityResolver Class, 1531
 QDomStreamNamespaceDeclaration Class,
 1531
 QDomStreamNotationDeclaration Class, 1532
 QDomStreamReader Class, 1532
 QDomStreamWriter Class, 1533
 QXYLegendMarker Class, 1528
 QXYSeries Class, 1528
 RingCodeHighlighter Class, 1536
 RingRayLib Extension
 What is new in Ring 1.11?, 1842
 RingREPL

What is new in Ring 1.4?, 1714
 RingRogueUtil Extension
 What is new in Ring 1.20, 1981
 RingSockets Extension
 What is new in Ring 1.14?, 1895
 RingSQLite
 What is new in Ring 1.1?, 1687
 RingStbImage Extension
 What is new in Ring 1.13?, 1877
 RingStbImage Functions Reference
 Constants, 1166
 Functions, 1167
 Introduction, 1164, 1165
 RingThreads Extension
 What is new in Ring 1.14?, 1896
 RingTilengine Extension
 What is new in Ring 1.14?, 1889
 RingTokens Class
 Using TokensLib, 997
 ringvm_callfunc()
 Low Level Functions, 1579
 RingVM_CallList()
 Low Level Functions, 1575
 RingVM_CFunctionsList()
 Low Level Functions, 1570
 RingVM_ClassesList()
 Low Level Functions, 1571
 RingVM_CodeList()
 Low Level Functions, 1588
 ringvm_evalinscope()
 Low Level Functions, 1578
 RingVM_FilesList()
 Low Level Functions, 1576
 RingVM_FunctionsList()
 Low Level Functions, 1570
 ringvm_give() function
 Low Level Functions, 1588
 ringvm_hideerrmsg()
 Low Level Functions, 1578
 ringvm_info()
 Low Level Functions, 1588
 ringvm_ismempool()
 Low Level Functions, 1588
 RingVM_MemoryList()
 Low Level Functions, 1573
 RingVM_PackagesList()
 Low Level Functions, 1572
 ringvm_passerror()
 Low Level Functions, 1578
 ringvm_runcode()
 Low Level Functions, 1588
 ringvm_scopescount()
 Low Level Functions, 1578
 ringvm_see() and ringvm_give() functions

What is new in Ring 1.7?, 1784
ringvm_see() function
 Low Level Functions, 1587
ringvm_settrace()
 Low Level Functions, 1577
ringvm_tracedata()
 Low Level Functions, 1577
ringvm_traceevent()
 Low Level Functions, 1577
ringvm_tracefunc()
 Low Level Functions, 1578
RingZip
 Create Zip File, 1065
 Extract Zip File, 1065
 Introduction, 1064
 Print files in Zip file, 1065
 Using RingZip Classes, 1065
 Zip Class Reference, 1067
 ZipEntry Class Reference, 1067
RingZip Library
 What is new in Ring 1.3?, 1707
Rotate Text
 Desktop, WebAssembly and Mobile Development, 476
rsa_decrypt_oaep()
 Security and Internet Functions, 215
rsa_decrypt_pkcs()
 Security and Internet Functions, 213
rsa_decrypt_raw()
 Security and Internet Functions, 218
rsa_encrypt_oaep()
 Security and Internet Functions, 214
rsa_encrypt_pkcs()
 Security and Internet Functions, 213
rsa_encrypt_raw()
 Security and Internet Functions, 217
rsa_export_params()
 Security and Internet Functions, 209
rsa_export_pem()
 Security and Internet Functions, 211
rsa_generate()
 Security and Internet Functions, 209
rsa_import_params()
 Security and Internet Functions, 210
rsa_import_pem()
 Security and Internet Functions, 212
rsa_is_privatekey()
 Security and Internet Functions, 212
rsa_sign_pkcs()
 Security and Internet Functions, 219
rsa_sign_pss()
 Security and Internet Functions, 223
rsa_signhash_pkcs()
 Security and Internet Functions, 220
rsa_signhash_pss()
 Security and Internet Functions, 224
rsa_verify_pkcs()
 Security and Internet Functions, 221
rsa_verify_pss()
 Security and Internet Functions, 224
rsa_verifyhash_pkcs()
 Security and Internet Functions, 222
rsa_verifyhash_pss()
 Security and Internet Functions, 225
Rules
 Embedding Ring in Ring, 354
 The Type Hints Library, 340
Run Package
 Ring Package Manager (*RingPM*), 945
Run the program
 Getting Started - First Style, 46
 Getting Started - Second Style, 49
 Getting Started - Third Style, 52
Running Forms
 Form Designer, 524
Runtime Errors
 Language Specification, 2085
Runtime Errors when Embedding Ring in Ring
 Embedding Ring in Ring, 350

S

Samples
 How to contribute?, 2074
 Using HTTPLib, 982
Samples in this book
 Applications developed in a few hours, 15
Samples Source (Authors)
 Using RingOpenGL and RingFreeGLUT for 3D Graphics, 789
Save and Restore Images
 ODBC Functions, 181
Save Image Inside the Database
 MySQL Functions, 189
Save output to string
 RingLibCurl, 1002
Say Hello
 libui, 1022
 Tutorial: Ring Extensions in C/C++, 1593
Say Something
 libui, 1030
Scaling and Rotating Images
 Graphics and Game Programming, 678
Scanner Commands
 Language Specification, 2076
Scene
 Using Qt3D, 571
Scope Rules

Accessing the class attributes from braces inside class methods, 310
 Conflict between Class Attributes and Local Variables, 306
 Conflict between Global Variables and Class Attributes, 305
 Conflict between self inside braces and self in the class region, 313
 Creating a Class for each Window in GUI applications, 312
 Defining Variables and Variables Access, 303
 How Ring find the Variable?, 304
 Introduction, 302
 Summary of Scope Rules, 318
 The For Loops uses the local scope, 317
 The Self Object, 304
 Three Scopes, 303
 Using Braces to access objects inside Class Methods, 308
 Using braces to escape from the current object scope, 316
 Using Object.Attribute, 304
 Scope Rules for Functions and Methods
 Calling a function sharing the name with a method in the current class, 322
 Example about Sharing Names between Functions and Methods, 321
 How Ring find a functions and methods?, 320
 Introduction, 319
 Screen Shots
 The Gold Magic 800 Game, 869
 ScriptFunctions Class
 Web Development (*CGI Library*), 662
 Search
 Lists, 103
 Search of global names while defining the class attributes
 Frequently Asked Questions, 2039
 Security and Internet Functions
 Decrypt(), 207
 Download(), 228
 Encrypt(), 207
 Example, 207
 File Hash, 208
 Introduction, 202
 Large Files Hash, 227
 MD5(), 204
 openssl_version(), 227
 openssl_versiontext(), 226
 RandBytes(), 209
 rsa_decrypt_oaep(), 215
 rsa_decrypt_pkcs(), 213
 rsa_decrypt_raw(), 218
 rsa_encrypt_oaep(), 214
 rsa_encrypt_pkcs(), 213
 rsa_encrypt_raw(), 217
 rsa_export_params(), 209
 rsa_export_pem(), 211
 rsa_generate(), 209
 rsa_import_params(), 210
 rsa_import_pem(), 212
 rsa_is_privatekey(), 212
 rsa_sign_pkcs(), 219
 rsa_sign_pss(), 223
 rsa_signhash_pkcs(), 220
 rsa_signhash_pss(), 224
 rsa_verify_pkcs(), 221
 rsa_verify_pss(), 224
 rsa_verifyhash_pkcs(), 222
 rsa_verifyhash_pss(), 225
 SendEmail(), 228
 SHA1(), 204
 SHA224(), 206
 SHA256(), 205
 SHA384(), 206
 SHA512(), 205
 SupportedCiphers(), 206
 Security Class
 Stdlib Classes, 404
 Send Parameters
 Functions - First Style, 87
 Functions - Second Style, 91
 Functions - Third Style, 95
 SendEmail()
 Security and Internet Functions, 228
 Serial Execution of Programs
 Embedding Ring in Ring, 348
 Server Class Methods
 Using HTTPLib, 981
 Server Example
 RingLibuv, 1137
 Server Example using Classes
 RingLibuv, 1140
 Set List Item
 Lists, 103
 setattr()
 Reflection and Meta-programming, 273
 setpointer()
 Low Level Functions, 1568
 Setter and Getter
 Object Oriented Programming, 234
 Setting the shebang line
 Web Development (*CGI Library*), 607
 SHA1()
 Security and Internet Functions, 204

SHA224()
 Security and Internet Functions, 206

SHA256()
 Security and Internet Functions, 205

SHA384()
 Security and Internet Functions, 206

SHA512()
 Security and Internet Functions, 205

Shared Libraries
 Extension, 1628

Short-circuit evaluation
 Control Structures - First Style, 73

Shutdown() Function
 System Functions, 163

sign() Function
 Stdlib Functions, 362

Simple
 Language Design, 1668

Simple Client and Server Example
 Desktop, WebAssembly and Mobile Development, 480

Sin() Implementation
 Extension, 1621

Single: Desktop, 405

Single: Using CSVLib
 Introduction, 975

Single: Using HTTPLib
 Introduction, 980

Single: Using JSONLib
 Introduction, 978

Single: Using Qt3D
 Using Qt3D, 532

Single: Using RingRayLib
 Introduction, 741

Single: Using TokensLib
 Introduction, 996

Single: Using ZeroLib
 Introduction, 952

sleep() Function
 Stdlib Functions, 370

Smart Garbage Collector
 Language Design, 1677

Snake Game
 What is new in Ring 1.11?, 1839

Snakes And Ladder Game
 What is new in Ring 1.10?, 1829

socket
 Constants, 1015

sockets
 Functions, 1014
 Introduction, 1013
 TCP Client, 1014
 TCP Server, 1014

Sokoban Game

What is new in Ring 1.11?, 1837

Sort()
 Lists, 104

Sort() and List of Objects
 Object Oriented Programming, 244

Sound Class
 Game Engine for 2D Games, 689

Sound Loading
 Using RingRayLib, 776

Source Code
 Resources, 2094
 The Gold Magic 800 Game, 870
 Using ZeroLib, 955

Source Code File Sections
 Program Structure, 98

space()
 Low Level Functions, 1564

SpaceVim
 Using Other Code Editors, 2021

Special thanks to contributors
 How to contribute?, 2073

split() Function
 Stdlib Functions, 359

splitmany() Function
 Stdlib Functions, 360

Sprite Automatic Movement
 Game Engine for 2D Games, 697

Sprite Class
 Game Engine for 2D Games, 687

Sprite Keypress Event
 Game Engine for 2D Games, 698

Sprite Mouse Event
 Game Engine for 2D Games, 699

Sprite State Event
 Game Engine for 2D Games, 700

SQLite
 Introduction, 191
 sqlite_close(), 192
 sqlite_execute(), 192
 sqlite_init(), 192
 sqlite_open(), 192

SQLite Class
 Stdlib Classes, 401
 sqlite_close()
 SQLite, 192
 sqlite_execute()
 SQLite, 192
 sqlite_init()
 SQLite, 192
 sqlite_open()
 SQLite, 192

Squares Puzzle Game
 Applications developed in a few hours, 14

SRandom()

Mathematical Functions, 139
Stack Class
 Stdlib Classes, 384
Stars Fighter Game
 Game Engine for 2D Games, 710
startswith() Function
 Stdlib Functions, 363
Static Methods
 Code Generator, 1654
StdBase Class
 Stdlib Classes, 379
StdLib - More Functions
 What is new in Ring 1.11?, 1846
Stdlib Classes
 Conversion Class, 397
 DataType Class, 396
 DateTime Class, 392
 Debug Class, 395
 File Class, 393
 HashTable Class, 386
 Internet Class, 404
 Introduction, 378
 List Class, 382
 Math Class, 388
 MySQL Class, 399
 ODBC Class, 398
 PostgreSQL Class, 402
 Queue Class, 385
 Security Class, 404
 SQLite Class, 401
 Stack Class, 384
 StdBase Class, 379
 String Class, 380
 System Class, 394
 Tree Class, 387
Stdlib Functions
 apparguments() Function, 356
 apppath() Function, 357
 ASCIIList2Str() Function, 375
 binarydigits() Function, 367
 capitalized() Function, 360
 changestring() Function, 370
 CheckEquality() Function, 377
 dayofweek() Function, 368
 endswith() Function, 364
 EpochTime() Function, 372
 evenorodd() Function, 365
 factorial() Function, 361
 factors() Function, 366
 fibonacci() Function, 362
 file2list() Function, 363
 filter() Function, 359
 FSize() Function, 371
 gcd() Function, 364
 Introduction, 355
 isappcompiled() Function, 356
 IsBetween() Function, 375
 isleapyear() Function, 367
 IsListContainsItems() Function, 375
 ismainsourcefile() Function, 370
 ispalindrome() Function, 366
 isprime() Function, 362
 isspecial() Function, 360
 isvowel() Function, 361
 JustFileName() Function, 358
 JustFilePath() Function, 357
 lcm() Function, 364
 linecount() Function, 361
 List2Code() Function, 374
 list2file() Function, 363
 ListAllFiles() Function, 372
 makedir() Function, 371
 map() Function, 358
 matrixmulti() Function, 367
 matrixtrans() Function, 368
 NumOrZero() Function, 377
 OSCopyFile() Function, 374
 OSCopyFolder() Function, 373
 OSCreateOpenFolder() Function, 373
 OSDeleteFile() Function, 374
 OSDeleteFolder() Function, 373
 OSRenameFile() Function, 374
 permutation() Function, 368
 prolist() Function, 365
 puts(), 54
 RandomItem() Function, 377
 RandomList() Function, 376
 readline() Function, 369
 reduce() Function, 359
 sign() Function, 362
 sleep() Function, 370
 split() Function, 359
 splitmany() Function, 360
 startswith() Function, 363
 Str2ASCIIList() Function, 374
 substring() Function, 369
 sumlist() Function, 365
 SystemCmd() Function, 372
 SystemSilent() Function, 373
 TimeInfo() Function, 376
 times() Function, 358
 TrimAll() Function, 371
 TrimLeft() Function, 371
 TrimRight() Function, 372
 value() Function, 358
StdLib functions and classes written in Ring
 What is new in Ring 1.1?, 1683

Step Option
 Control Structures - First Style, 71

Steps to create the extension
 Create your first extension, 1658

Stop the Server
 Using HTTPLib, 995

StopWatch Application
 What is new in Ring 1.8?, 1794

Str2ASCIIList() Function
 Stdlib Functions, 374

Str2Hex()
 Data Type, 135

str2list() and list2str()
 Strings, 119

strcmp()
 Strings, 118

String Class
 Stdlib Classes, 380

String Literals
 Strings, 114

String()
 Data Type, 133

String2Constant Application
 What is new in Ring 1.8?, 1793

Strings
 Access String Letters, 114
 Convert Letters Case, 114
 Copy(), 116
 Find SubString, 117
 Get Number of Characters from position,
 117
 Get String Length, 114
 Get Substring from position to end, 117
 Introduction, 113
 Left(), 115
 Lines(), 116
 Merge binary characters, 120
 Reverse() Function, 118
 Right(), 115
 str2list() and list2str(), 119
 strcmp(), 118
 String Literals, 114
 Substr(), 117
 Transform Substring To Another
 Substring, 118
 Trim(), 116

StyleFunctions Class
 Web Development (*CGI Library*), 662

Substr()
 Strings, 117

substring() Function
 Stdlib Functions, 369

Sudoku Game
 What is new in Ring 1.11?, 1840

Sum List of Numbers
 Tutorial: Ring Extensions in C/C++, 1594

Sum Two Numbers
 Tutorial: Ring Extensions in C/C++, 1592

sumlist() Function
 Stdlib Functions, 365

Summary of Scope Rules
 Scope Rules, 318

Super Man 2016 Game
 Game Engine for 2D Games, 726

SupportedCiphers()
 Security and Internet Functions, 206

Swap Items
 Lists, 113

Switch Between Two Images
 RingLibSDL, 1105

Switch Statement
 Control Structures - First Style, 68
 Control Structures - Second Style, 75
 Control Structures - Third Style, 79

Syntax Files
 What is new in Ring 1.18, 1944

Syntax Flexibility
 Automatic loading for syntax files, 335
 Change Language Keywords, 324
 Change Language Operators, 325
 Enable/Disable Hash Comments, 337
 Ignore new lines after keywords, 335
 Introduction, 323
 Load Syntax Files, 326
 Using "()" around the function
 parameters, 326
 Using \$ and @ in the start of the
 variable name, 328
 Using 'break'/'continue' keywords, 333
 Using 'case' as 'on' in switch
 statements, 332
 Using 'def' as 'func' in
 functions/methods definition, 332
 Using 'end' keyword after
 Packages/Classes/Functions, 334
 Using 'endif'/'endfor'/'endwhile'/'endswitch'/'endtry'
 keywords, 334
 Using 'endpackage'/'endclass'/'endfunc'
 keywords after
 Packages/Classes/Functions, 334
 Using 'function'/'endfunction' keywords,
 334
 Using 'put' and 'get' as 'see' and
 'give', 332
 Using braces { } in
 Packages/Classes/Functions, 333
 Using braces to start and end different
 control structures, 331

Using Semi-colon after and between statements, 328

Using the 'else' keyword as 'other' in switch statement, 329

Using the 'elseif' keyword as 'but' in if statement, 329

Using the 'end' keyword in different control structures, 330

What is new in Ring 1.1?, 1680

Syntax Highlighting for Vim/nano

 What is new in Ring 1.21, 2000

SysGet() Function

 System Functions, 157

SysSet() Function

 System Functions, 157

System Class

 Stdlib Classes, 394

System Functions

 ChDir() Function, 163

 CurrentDir() Function, 162

 Example, 159

 ExeFileName() Function, 162

 ExeFolder() Function, 163

 Get Active Source File Name, 161

 Get Command Line Arguments, 160

 GetArch() Function, 159

 Introduction, 155

 IsAndroid() Function, 159

 IsFreeBSD() Function, 158

 IsLinux() Function, 158

 IsMacOSX() Function, 158

 IsMSDOS() Function, 157

 IsUnix() Function, 158

 IsWindows() Function, 157

 IsWindows64() Function, 158

 NofProcessors() Function, 164

 PrevFileName() Function, 162

 Shutdown() Function, 163

 SysGet() Function, 157

 SysSet() Function, 157

 System() Function, 156

 SysUnset() Function, 157

 Version() Function, 163

 Windowsnl() Function, 160

System() Function

 System Functions, 156

SystemCmd() Function

 Stdlib Functions, 372

SystemSilent() Function

 Stdlib Functions, 373

SysUnset() Function

 System Functions, 157

T

TableWidget - AddList() Method

 Desktop, WebAssembly and Mobile Development, 517

TCP Client

 sockets, 1014

TCP Server

 sockets, 1014

Tempfile()

 Files, 147

Templates

 Web Development (*CGI Library*), 622

Tempname()

 Files, 147

Testing

 How to contribute?, 2073

Testing the extension

 Create your first extension, 1659

Tetris Game

 What is new in Ring 1.13?, 1870

Text 2D

 Using Qt3D, 555

Text Class

 Game Engine for 2D Games, 688

Text Drawing

 libui, 1044

Text To Speech Application

 What is new in Ring 1.11?, 1842

Texture

 Using Qt3D, 545

Texture Source

 Using RingRayLib, 781

The Browser Menu

 Ring Notepad, 43

The Camera

 Using RingOpenGL and RingFreeGLUT for 3D Graphics, 800

The Cards Game

 Demo Programs, 505

 Desktop, WebAssembly and Mobile Development, 505

The Designer Windows

 Form Designer, 523

The Difference between Qt and RingQt

 Desktop, WebAssembly and Mobile Development, 515

The Distribute Menu

 Ring Notepad, 44

The documentation says functional programming is supported, but then this happens?

 Frequently Asked Questions, 2031

The Edit Menu

 Ring Notepad, 41

- The Events Loop
 - Desktop, WebAssembly and Mobile Development, 408
 - RingLibuv, 1137
- The File Menu
 - Ring Notepad, 40
- The files ring.ring and ring.ringo Distributing Ring Application, 931
- The First GUI Application
 - Desktop, WebAssembly and Mobile Development, 406
- The First Triangle
 - Using RingOpenGL and RingFreeGLUT for 3D Graphics, 793
- The First Window using RingFreeGLUT
 - Using RingOpenGL and RingFreeGLUT for 3D Graphics, 790
- The For Loops uses the local scope
 - Scope Rules, 317
 - What is new in Ring 1.8?, 1800
- The Game Story
 - The Gold Magic 800 Game, 868
- The Gold Magic 800 Game
 - How to play?, 868
 - Introduction, 867
 - Screen Shots, 869
 - Source Code, 870
 - The Game Story, 868
 - What will you learn?, 868
- The Help Menu
 - Ring Notepad, 44
- The Main File in the Project
 - Ring Notepad, 39
- The Natural Library
 - What is new in Ring 1.4?, 1711
- The Package Description File
 - Ring Package Manager (*RingPM*), 948
- The Power Operator
 - What is new in Ring 1.18, 1945
- The Program Menu
 - Ring Notepad, 43
- The Properties
 - Form Designer, 523
- The Qt project for your Ring application
 - Building RingQt Applications for Mobile, 591
 - Building RingQt Applications for WebAssembly, 600
- The Ring Package Manager (*RingPM*)
 - What is new in Ring 1.10?, 1832
- The RingPM Registry File
 - Ring Package Manager (*RingPM*), 952
- The Self Object
 - Scope Rules, 304
- The Tools Menu
 - Ring Notepad, 43
- The Trace Library and the Interactive Debugger
 - BreakPoint, 344
 - Disable BreakPoints, 344
 - Execute Program Line by Line, 344
 - Interactive Debugger, 343
 - Introduction, 341
 - Loading the Trace library, 342
 - Pass Error, 343
 - Trace All Events, 342
 - Trace control flow between functions, 342
 - Using the Interactive Debugger, 345
- The Tree Class
 - Using References, 1555
- The Type Hints Library
 - Example, 338
 - Introduction to the Type Hints Library, 337
 - Rules, 340
 - User Types, 338
 - Using Override, 339
 - Using Types inside Code, 339
 - Why Type Hints?, 338
- The View Menu
 - Ring Notepad, 41
- Threads
 - Creating Threads, 1016
 - Graphics and Game Programming, 680
 - Introduction, 1015
 - More Examples, 1016
 - Reference, 1018
- Threads Example
 - RingLibuv, 1143
- Threads Example - Using Classes
 - RingLibuv, 1143
- Threads Support
 - Code Generator, 1641
- Three Scopes
 - Scope Rules, 303
- TicTacToe 3D Game
 - Using RingOpenGL and RingAllegro for 3D Graphics, 854
- tilengine
 - Getting Started, 872
 - Introduction, 871
 - More Samples, 873
 - Reference, 898
 - Using LibSDL and Tilengine, 894
- Time()
 - Date and Time, 122
- TimeInfo() Function
 - Stdlib Functions, 376

TimeList()
 Date and Time, 123

times() Function
 Stdlib Functions, 358

TokensLib Library
 What is new in Ring 1.17, 1926

Trace All Events
 The Trace Library and the Interactive Debugger, 342

Trace control flow between functions
 The Trace Library and the Interactive Debugger, 342

Trace Library and Interactive Debugger
 What is new in Ring 1.5?, 1756

Transaction Example
 MySQL Functions, 190

Transactions and Using Commit and Rollback
 ODBC Functions, 180

Transform Substring To Another Substring Strings, 118

Transparent Image
 Graphics and Game Programming, 679

Transparent Implementation
 Language Design, 1675

Tree Class
 Stdlib Classes, 387

Triangle Rotation
 Using RingOpenGL and RingFreeGLUT for 3D Graphics, 795

Trim()
 Strings, 116

TrimAll() Function
 Stdlib Functions, 371

TrimLeft() Function
 Stdlib Functions, 371

TrimRight() Function
 Stdlib Functions, 372

TrueType Fonts
 Graphics and Game Programming, 676

Try/Catch/Done
 Eval() and Debugging, 165

Trying to be natural
 Language Design, 1669

Tutorial: Number to Words
 What is new in Ring 1.12?, 1855

Tutorial: Ring Extensions in C/C++
 Build the extension on different platforms, 1591

Create Table, 1611

Display List, 1604

Filter List Items, 1597

Generate List, 1602

Hello World, 1590

Increment List Items, 1596

Replicate List Items, 1599

Say Hello, 1593

Sum List of Numbers, 1594

Sum Two Numbers, 1592

Tutorial: Ring Extensions in C/C++, 1589

Update Table, 1607

Two Cubes
 Using RingRayLib, 757

Type Hints Library
 What is new in Ring 1.5?, 1760

Type()
 Data Type, 128

U

Unary Positive and Unary Negative Operators, 66

Ungetc()
 Files, 150

Unsigned()
 Mathematical Functions, 139

Update Package
 Ring Package Manager (*RingPM*), 946

Update Table
 Tutorial: Ring Extensions in C/C++, 1607

UpdateBytesColumn()
 Using FastPro, 1545

UpdateColumn()
 Using FastPro, 1542

UpdateList()
 Using FastPro, 1538

Updating the RingPM Registry
 Ring Package Manager (*RingPM*), 944

Upload Files
 Web Development (*CGI Library*), 616

Uploading Files
 Using HTTPLib, 992

URL Encode
 Web Development (*CGI Library*), 621

Usage
 Deploying Web Applications in the Cloud, 665

Use TTF Fonts
 RingLibSDL, 1106

User Types
 The Type Hints Library, 338

Users registration and Login
 Web Development (*CGI Library*), 645

Using "()" around the function parameters
 Syntax Flexibility, 326

Using ? to print expression then new line
 Getting Started - First Style, 47

 What is new in Ring 1.6?, 1782

Using \$ and @ in the start of the variable name

Syntax Flexibility, 328
Using && and || operators
 What is new in Ring 1.6?, 1781
Using _ in numbers
 Mathematical Functions, 141
Using ':' then Numbers
 What is new in Ring 1.15?, 1912
Using '<' and ':' operators as 'from' keyword
 What is new in Ring 1.3?, 1706
Using 'break'/'continue' keywords
 Syntax Flexibility, 333
Using 'case' as 'on' in switch statements
 Syntax Flexibility, 332
Using 'def' as 'func' in functions/methods definition
 Syntax Flexibility, 332
Using 'end' keyword after Packages/Classes/Functions
 Syntax Flexibility, 334
Using 'endif'/'endfor'/'endwhile'/'endswitch'/'endpackage'/'endclass'/'endfunc' keywords
 Syntax Flexibility, 334
Using 'function'/'endfunction' keywords
 Syntax Flexibility, 334
Using 'put' and 'get' as 'see' and 'give'
 Syntax Flexibility, 332
Using Atom
 Using Other Code Editors, 2017
Using Bootstrap Library using Functions
 Web Development (*CGI Library*), 638
Using Bootstrap Library using Objects
 Web Development (*CGI Library*), 640
Using braces { } in Packages/Classes/Functions
 Syntax Flexibility, 333
Using Braces to access objects inside Class Methods
 Scope Rules, 308
Using braces to escape from the current object scope
 Scope Rules, 316
Using braces to start and end different control structures
 Syntax Flexibility, 331
Using C/C++ Compiler and Linker
 Distributing Ring Application, 931
Using CLOC (*Count Lines of Code*)
 What is new in Ring 1.14?, 1901
Using colors
 Using RogueUtil, 1073
Using configuration file that wrap C++ library
 Code Generator, 1643
Using Cookies
 Using HTTPLib, 991
Using CR as Carriage return
 What is new in Ring 1.6?, 1780
Using CSVLib
 Examples, 976
 Functions, 976
 Introduction, 976
Using Emacs Editor
 Using Other Code Editors, 2019
Using Eval() with our Natural Code
 Natural Language Programming, 288
Using f after numbers
 Mathematical Functions, 141
Using FastPro
 AddBytesColumn(), 1546
 Bytes2List() function, 1538
 Generate Image, 1543
 Introduction, 1537
 List2Bytes(), 1538
 UpdateBytesColumn(), 1545
 UpdateColumn(), 1542
 UpdateList(), 1538
Using Fonts
 Using RingOpenGL and RingFreeGLUT for 3D Graphics, 820
Using Geany
 Using Other Code Editors, 2015
Using HTTP Get
 Using HTTPLib, 982
Using HTTP Post
 Using HTTPLib, 985
Using HTTPLib
 Example, 981
 Introduction, 981
 More Samples, 988
 Printing Constants, 982
 Regular Expressions, 995
 Samples, 982
 Server Class Methods, 981
 Stop the Server, 995
 Uploading Files, 992
 Using Cookies, 991
 Using HTTP Get, 982
 Using HTTP Post, 985
 Using Templates, 994
 Using WebLib, 984
Using JSONLib
 Examples, 979
 Functions, 979

- Introduction, [979](#)
- Using Layout
 - Desktop, WebAssembly and Mobile Development, [408](#)
- Using Layouts
 - Form Designer, [529](#)
- Using len() and For Loops
 - Performance Tips, [911](#)
- Using LibSDL and TiledEngine
 - tiledEngine, [894](#)
- Using Lists during definition
 - Lists, [107](#)
- Using Many Source Code Files
 - Program Structure, [98](#)
- Using nano
 - Using Other Code Editors, [2016](#)
- Using Notepad++
 - Using Other Code Editors, [2014](#)
- Using NULL instead of NULLPointer()
 - What is new in Ring 1.2?, [1694](#)
- Using Object.Attribute
 - Scope Rules, [304](#)
- Using ObjectID() and GetWindowByID()
 - Objects Library for RingQt Application, [580](#)
- Using ObjectID() and OpenWindowAndLink()
 - Objects Library for RingQt Application, [583](#)
- Using Objects During Definition
 - Object Oriented Programming, [249](#)
 - What is new in Ring 1.19, [1963](#)
- Using Other Code Editors
 - Introduction, [2013](#)
 - SpaceVim, [2021](#)
 - Using Atom, [2017](#)
 - Using Emacs Editor, [2019](#)
 - Using Geany, [2015](#)
 - Using nano, [2016](#)
 - Using Notepad++, [2014](#)
 - Using Sublime Text 2, [2018](#)
 - Using Visual Studio IDE, [2019](#)
 - Visual Studio Code, [2020](#)
- Using Override
 - The Type Hints Library, [339](#)
- Using Pico
 - Blink sample, [1661](#)
 - Building, [1660](#)
 - Declarative Programming sample, [1663](#)
 - Deployment, [1661](#)
 - Install, [1660](#)
 - Introduction, [1659](#)
 - LED and Switch sample, [1661](#)
 - LEDs sample, [1661](#)
 - Programming, [1660](#)
- Using Wokwi Simulator, [1666](#)
- Using QCheckBox
 - Desktop, WebAssembly and Mobile Development, [436](#)
- Using QComboBox Class
 - Desktop, WebAssembly and Mobile Development, [417](#)
- Using QDateEdit
 - Desktop, WebAssembly and Mobile Development, [431](#)
- Using QDesktopWidget Class
 - Desktop, WebAssembly and Mobile Development, [475](#)
- Using QDial
 - Desktop, WebAssembly and Mobile Development, [432](#)
- Using QDockWidget
 - Desktop, WebAssembly and Mobile Development, [424](#)
- Using QFrame
 - Desktop, WebAssembly and Mobile Development, [442](#)
- Using QInputDialog Class
 - Desktop, WebAssembly and Mobile Development, [467](#)
- Using qLCDNumber
 - Desktop, WebAssembly and Mobile Development, [463](#)
- Using QPrintPreviewDialog
 - Desktop, WebAssembly and Mobile Development, [458](#)
- Using QProgressBar
 - Desktop, WebAssembly and Mobile Development, [428](#)
- Using QProgressBar and Timer
 - Desktop, WebAssembly and Mobile Development, [452](#)
- Using QRadioButton and QButtonGroup
 - Desktop, WebAssembly and Mobile Development, [437](#)
- Using QSlider
 - Desktop, WebAssembly and Mobile Development, [429](#)
- Using QSpinBox
 - Desktop, WebAssembly and Mobile Development, [429](#)
- Using Qt3D
 - Camera, [568](#)
 - Draw Office, [563](#)
 - Drawing Cone, [541](#)
 - Drawing Cube, [533](#)
 - Drawing Cylinder, [539](#)
 - Drawing Plane, [543](#)
 - Drawing Sphere, [537](#)

Drawing Torus, 535
 Extruded Text, 557
 Frame Action, 552
 Key Press, 547
 Many Objects, 565
 Model, 559
 Model Texture, 561
 Object Picker, 549
 Scene, 571
 Text 2D, 555
 Texture, 545
Using QTableWidget
 Desktop, WebAssembly and Mobile Development, 427
Using QTabWidget
 Desktop, WebAssembly and Mobile Development, 425
Using QTreeView and QFileSystemModel
 Desktop, WebAssembly and Mobile Development, 414
Using QTreeWidget and QTreeWidgetItem
 Desktop, WebAssembly and Mobile Development, 415
Using QWebView
 Desktop, WebAssembly and Mobile Development, 435
Using References
 Circular References, 1554
 Dependency injection, 1557
 Introduction, 1551, 1552
 Linked list, 1555
 Nested Ref(), 1559
 Passing lists to functions, 1558
 ref(), 1552
 Ref() and sub lists, 1560
 Ref() and temp. lists, 1559
 Ref() in left side, 1560
 refcount(), 1553
 The Tree Class, 1555
 What is new in Ring 1.18, 1945
Using Ring2EXE
 Building RingQt Applications for Mobile, 591
 Building RingQt Applications for WebAssembly, 599
 Distributing Ring Application using Ring2EXE, 933
Using RING_API_RETMANAGEDCPOINTER()
 Extension, 1629
Using RingOpenGL and RingAllegro for 3D Graphics
 3D Cube and Texture, 843
 Introduction, 842
 Many Cubes, 848
 More 3D Samples, 865
 TicTacToe 3D Game, 854
Using RingOpenGL and RingFreeGLUT for 3D Graphics
 Drawing using RingOpenGL, 791
 Frames Per Second, 828
 Introduction, 788
 Keyboard Events and Colors, 797
 Make a Cube using RingOpenGL and RingFreeGLUT, 839
 Menu Events, 812
 Mouse Events, 807
 Samples Source (*Authors*), 789
 The Camera, 800
 The First Triangle, 793
 The First Window using RingFreeGLUT, 790
 Triangle Rotation, 795
 Using Fonts, 820
 What is RingFreeGLUT?, 790
 What is RingOpenGL?, 789
 Window Resize Event, 794
Using RingPDFGen
 Constants, 1549
 Example, 1548
 Functions, 1550
 Introduction, 1547
Using RingRayLib
 3D Camera, 745
 3D Camera Free, 747
 3D Picking, 754
 Basic Shapes, 760
 Basic Window, 742
 Bezier Lines, 764
 Camera First Person, 752
 Collision Area, 765
 Colors Palette, 770
 Cubic Map, 786
 Draw Ring, 761
 Following Eyes, 768
 Full Screen, 756
 Geometric Shapes, 784
 Image Drawing, 777
 Image Generation, 779
 Implementation, 788
 Input Keys, 743
 Input Mouse, 744
 Input Multi-touch, 750
 Introduction, 742
 Mouse Wheel, 749
 Music Playing, 774
 Rectangle Scaling, 772
 Sound Loading, 776
 Texture Source, 781
 Two Cubes, 757

Using RingZip Classes
 RingZip, 1065

Using RogueUtil
 Change the Console window title, 1073
 Change the cursor position, 1074

Defined Constants, 1081

Introduction, 1072

List of Functions, 1083

Print text at specific position, 1074

Respond to keypress events, 1075

Respond to mouse events (*Windows Command Prompt or Linux/macOS Terminal*), 1079

Respond to mouse events in Windows command prompt, 1077

Using colors, 1073

Using Self.Attribute
 Object Oriented Programming, 246

Using Self.Attribute in the Class Region to define new attributes
 What is new in Ring 1.1?, 1688

Using Semi-colon after and between statements
 Syntax Flexibility, 328

Using String2Constant
 Multi-language applications, 586

Using Sublime Text 2
 Using Other Code Editors, 2018

Using Tab instead of char(9)
 What is new in Ring 1.6?, 1780

Using Templates
 Using HTTPLib, 994

Using the ! operator as not
 What is new in Ring 1.6?, 1780

Using the 'else' keyword as 'other' in switch statement
 Syntax Flexibility, 329

Using the 'elseif' keyword as 'but' in if statement
 Syntax Flexibility, 329

Using the 'end' keyword in different control structures
 Syntax Flexibility, 330

Using the Interactive Debugger
 The Trace Library and the Interactive Debugger, 345

Using the Menubar
 libui, 1032

Using the Natural Library
 Defining Commands, 297
 Defining commands using classes, 301
 Introduction, 294
 Natural Library - Demo Program, 295
 Operators, 300

Using the QColorDialog Class

Desktop, WebAssembly and Mobile Development, 462

Using the QFileDialog Class
 Desktop, WebAssembly and Mobile Development, 454

Using the QListWidget Class
 Desktop, WebAssembly and Mobile Development, 411

Using the QTextEdit Class
 Desktop, WebAssembly and Mobile Development, 410

Using the QTimer Class
 Desktop, WebAssembly and Mobile Development, 451

Using the tool
 Code Generator, 1634

Using This in the class region as Self
 Object Oriented Programming, 247
 What is new in Ring 1.8?, 1798

Using This.Attribute and This.Method()
 Object Oriented Programming, 246

Using This.Attribute in nested Braces inside the Class Methods
 What is new in Ring 1.1?, 1688

Using TokensLib
 Constants, 998
 Example, 997
 Introduction, 997
 RingTokens Class, 997

Using Types inside Code
 The Type Hints Library, 339

Using Visual Studio IDE
 Using Other Code Editors, 2019

Using WebLib
 Using HTTPLib, 984

Using Wokwi Simulator
 Using Pico, 1666

Using XAMPP Apache web server
 Configure the Apache web server, 606

Using ZeroLib
 Introduction, 953
 Source Code, 955
 Z() function, 953
 ZeroBasedList Class, 953
 ZeroBasedString Class, 954

UTF-8 File Names in Microsoft Windows
 What is new in Ring 1.16?, 1917

V

value() Function
 Stdlib Functions, 358

Variables
 Deep Copy, 56
 Dynamic Typing, 56

Implicit Conversion, 57	Using Bootstrap Library using Objects, 640
Introduction, 55	Web Library Features, 609
Variables Scope	WebLib API, 658
Functions - First Style, 88	WebPage Class, 663
Functions - Second Style, 92	Web Development Samples
Functions - Third Style, 96	What is new in Ring 1.14?, 1884
varptr()	Web Library Features
Low Level Functions, 1563	Web Development (<i>CGI Library</i>), 609
Version() Function	WebAssembly and Mobile Development
System Functions, 163	Introduction, 405
Video-Music-Player Application	WebLib API
Applications developed in a few hours, 11	Web Development (<i>CGI Library</i>), 658
What is new in Ring 1.5?, 1723	WebPage Class
Virtual Machine Instructions	Web Development (<i>CGI Library</i>), 663
Language Specification, 2088	Weight History Application
Visual Implementation	Desktop, WebAssembly and Mobile
Language Design, 1676	Development, 484
Visual Studio Code	What about Data Representation in Ring?
Using Other Code Editors, 2020	Frequently Asked Questions, 2026
W	What about Memory Management in Ring?
Frequently Asked Questions, 2025	
Web Development (<i>CGI Library</i>)	What about predefined parameters or
Application Class, 659	optional parameters in functions?
Configure the Apache web server, 606	Frequently Asked Questions, 2042
Cookies, 619	What about the Boolean values in Ring?
CRUD Example using MVC, 643	Frequently Asked Questions, 2033
Database, ModelBase & ControllerBase	What are the advantages of using Ring over
classes, 652	native C or C++?
Generating Pages using Objects, 632	Frequently Asked Questions, 2029
Gradient, 631	What are the advantages to using Ring over
Grant Ring files execution permission,	C# or Java?
607	Frequently Asked Questions, 2031
Hash Functions, 625	What are the advantages to using Ring over
Hello World Program using the Web	Lisp or Smalltalk?
Library, 608	Frequently Asked Questions, 2028
HTML Lists, 628	What are the advantages to using Ring over
HTML Special Characters, 624	Python and Ruby?
HTML Tables, 630	Frequently Asked Questions, 2030
HtmlPage Class, 637, 664	What are the advantages to using Ring over
HTTP Get Example, 609	Tcl and Lua?
HTTP POST Example, 614	Frequently Asked Questions, 2030
Introduction, 605	What happens when we create a new object?
Page Class, 659	Frequently Asked Questions, 2038
Random Image, 627	What is new in Ring 1.17
Ring CGI Hello World Program, 608	Better GUIlib, 1931
ScriptFunctions Class, 662	Better I/O Functions, 1934
Setting the shebang line, 607	Better Ring API, 1935
StyleFunctions Class, 662	Better RingOpenSSL, 1933
Templates, 622	Better RingWinAPI, 1933
Upload Files, 616	Better Syntax Flexibility, 1933
URL Encode, 621	Citations Prediction, 1925
Users registration and Login, 645	Code Generator for Extensions, 1936
Using Bootstrap Library using Functions,	CSVLib Library, 1927
638	

HTTPLib Library, 1930	Better Performance when using Braces, 1979
JSONLib Library, 1929	Better Samples and Applications, 1974, 1975
Merge Two Files, 1923	Better Scripts for Building Ring, 1984
More Improvements, 1936	Better Support for Threads, 1980
Poetry Analysis, 1924	Better Tools and Extensions, 1983
TokensLib Library, 1926	Enable/Disable Hash Comments, 1978
What is new in Ring 1.18	Improving Ring Compiler/VM Source Code, 1984
Better CitPre application, 1941	More Improvements, 1985
Better Documentation, 1953	Pause/Resume Embedded Ring VM, 1982
Better Ring API, 1952	RingRogueUtil Extension, 1981
Better RingRayLib, 1948	What is new in Ring 1.21
Better RingSockets, 1949	Better MatrixLib, 1990
Better Tools, 1942	Better Operator Overloading, 1998
Better WebLib, 1951	Better RingQt, 1991
Faster (For-In) Loop, 1946	Better RingRayLib, 1993
Faster BraceError(), 1947	Faster Arithmetic Operations, 1996
Heroku (<i>Better support</i>), 1950	Faster Compiler, 1997
ImportPackage() Function, 1950	Faster Function Call, 1994
MatrixLib Library, 1953	ForEach Keyword, 1997
More Improvements, 1954	Lectures Tracker application, 1987
More Low Level Functions, 1951	More Improvements, 2001
More Samples, 1943	More Samples, 1993
New From, 1950	New VM Instructions, 2000
Random User application, 1940	NumOrZero() Function, 1997
Read Files application, 1939	Reducing Memory Usage, 1997
Ring for MS-DOS, 1946	Ring for Raspberry Pi Pico, 1986
Syntax Files, 1944	RingPDFGen Extension, 1988
The Power Operator, 1945	Syntax Highlighting for Vim/nano, 2000
Using References, 1945	What is new in Ring 1.21.1, 2002
What is new in Ring 1.19	What is new in Ring 1.21.2, 2002
Better batch files for building Ring, 1962	What is new in Ring 1.22
Better Documentation, 1970	More Improvements, 2013
Better Extensions Generator, 1970	Return Attribute by Reference, 2011
Better RingRayLib, 1967	What is new in Ring 1.10?
Better RingStbImage, 1968	Better Tests, 1832
Better TypeHints, 1966	Chess Game, 1824
FastPro Extension, 1965	Game of Life Game, 1827
For Loop - Better Performance, 1962	Introduction, 1823
Hours Counter application, 1958	Knight Tour Game, 1826
Image Pixel application, 1957	List of changes and new features, 1824
Listen to Quran application, 1959	Minesweeper Game, 1825
More Improvements, 1971	More Games, 1830
More Samples, 1960	More Improvements, 1833
Nothing() function, 1964	Pong Game, 1828
OptionalFunc() function, 1964	Ring Extension for Visual Studio Code, 1831
ParentClassName(), 1965	Snakes And Ladder Game, 1829
Planetary Orbits application, 1958	The Ring Package Manager (<i>RingPM</i>), 1832
Ring for Windows 64bit, 1961	What is new in Ring 1.11?
Using Objects During Definition, 1963	Better Documentation, 1849
What is new in Ring 1.20	Better Performance, 1849
Better Documentation, 1985	
Better Files for Loading the StdLib, 1979	
Better Functions, 1977	

- Better RingQt, 1847
- Checkers Game, 1836
- Desktop Screen Shot Application, 1841
- Introduction, 1834
- List of changes and new features, 1835
- Maze Game, 1838
- More 3D Samples, 1835
- More Improvements, 1849
- RingRayLib Extension, 1842
- Snake Game, 1839
- Sokoban Game, 1837
- StdLib - More Functions, 1846
- Sudoku Game, 1840
- Text To Speech Application, 1842
- ZeroLib Library, 1845
- What is new in Ring 1.12?
 - ASCII Table application, 1852
 - Better RingRayLib, 1859
 - BMI Calculator application, 1852
 - Calendar application, 1853
 - Generate Embedded Object File, 1858
 - Go Game, 1851
 - Introduction, 1850
 - Julian Day Calendar application, 1854
 - List of changes and new features, 1851
 - Load Again Command, 1856
 - More Improvements, 1860
 - `ring_state_filetokens()` function, 1857
 - Tutorial: Number to Words, 1855
- What is new in Ring 1.13?
 - Better Organization, 1878
 - Better RingQt, 1873
 - Better RingRayLib, 1876
 - Better Threads Support, 1864
 - Escape Game, 1871
 - Hassouna Course Samples, 1872
 - Introduction, 1861
 - Laser Game, 1864
 - List of changes and new features, 1862
 - Magic Balls Game, 1865
 - Matching Game, 1867
 - MoneyBoxes Game, 1866
 - More Improvements, 1878
 - More Low Level Functions, 1877
 - New Book by Apress, 1862
 - Pairs Game, 1868
 - Ring for WebAssembly, 1863
 - Ring support in SpaceVim, 1873
 - RingStbImage Extension, 1877
 - Tetris Game, 1870
 - Word Game, 1869
- What is new in Ring 1.14?
 - Better Functions, 1899
 - Better Handling For Numbers, 1900
- Better Performance For Strings, 1899
- Better RingOpenSSL, 1897
- Customers Form, 1888
- Erlang B Formula, 1887
- Introduction, 1881
- List of changes and new features, 1882
- More Functions, 1897
- More Improvements, 1902
- More Samples, 1885
- MyCoffee (*Web Application*), 1882
- RingLibui Extension, 1891
- RingSockets Extension, 1895
- RingThreads Extension, 1896
- RingTilengine Extension, 1889
- Using CLOC (*Count Lines of Code*), 1901
- Web Development Samples, 1884
- What is new in Ring 1.15?
 - Better Ring Notepad, 1908
 - Better RingLibCurl, 1912
 - Better RingQt, 1911
 - Better StdLib, 1910
 - Chess 3D (*Qt3D Sample*), 1907
 - Chess Endgame Application, 1905
 - Heroku (*Better support*), 1912
 - Introduction, 1903
 - List of changes and new features, 1904
 - More Improvements, 1914
 - More Samples, 1913
 - New Arabic Book, 1904
 - Using ':' then Numbers, 1912
- What is new in Ring 1.16?
 - Better Documentation, 1921
 - Better Installation Scripts, 1921
 - Code Runner Extension support Ring, 1918
 - Introduction, 1915
 - Light GUILib, 1916
 - List of changes and new features, 1916
 - MDI Windows Sample, 1921
 - More Improvements, 1921
 - Nested Methods Call in Separate Lines, 1917
 - UTF-8 File Names in Microsoft Windows, 1917
 - Zero and Strings, 1920
- What is new in Ring 1.17
 - Introduction, 1922
- What is new in Ring 1.17?
 - List of changes and new features, 1923
- What is new in Ring 1.18
 - Introduction, 1938
- What is new in Ring 1.18?
 - List of changes and new features, 1939
- What is new in Ring 1.19
 - Introduction, 1956

- What is new in Ring 1.19?
 List of changes and new features, 1957
- What is new in Ring 1.1?
 Better Code Generator for Extensions, 1688
 Better Documentation, 1688
 Better Natural Language Programming Support, 1679
 Game Engine for 2D Games, 1686
 Generate/Execute Ring Object Files (*.ringo), 1680
 Introduction, 1678
 List of changes and new features, 1679
 New Functions and Changes, 1682
 RingLibSDL, 1685
 RingSQLite, 1687
 StdLib functions and classes written in Ring, 1683
 Syntax Flexibility, 1680
 Using Self.Attribute in the Class Region to define new attributes, 1688
 Using This.Attribute in nested Braces inside the Class Methods, 1688
- What is new in Ring 1.20
 Introduction, 1973
- What is new in Ring 1.20?
 List of changes and new features, 1974
- What is new in Ring 1.21
 Introduction, 1985
- What is new in Ring 1.21.1
 What is new in Ring 1.21, 2002
- What is new in Ring 1.21.2
 What is new in Ring 1.21, 2002
- What is new in Ring 1.21?
 List of changes and new features, 1986
- What is new in Ring 1.22
 Introduction, 2003
- What is new in Ring 1.22?
 Better Compiler, 2012
 Better Functions, 2008
 Better Ring FastPro Extension, 2009
 Better Samples, 2007
 List of changes and new features, 2004
 More Projects, 2006
 PWCT 2.0 (*Free Software*), 2005
 Research Article, 2004
- What is new in Ring 1.2?
 Better Call Command, 1694
 Better Functions, 1691
 Better Quality, 1695
 Better Ring Notepad, 1691
 Better RingQt, 1692
 Display Warnings Option, 1694
- Introduction, 1689
 List of changes and new features, 1690
 New Functions, 1690
 Objects Library for RingQt, 1692
 RingLibCurl, 1694
 Using NULL instead of NullPointerException(), 1694
- What is new in Ring 1.3?
 Better Loop|Exit Command, 1704
 Better Ring Notepad, 1700
 Better RingQt, 1696
 Better StdLib, 1704
 Embedding Ring in Ring without sharing the State, 1706
 Form Designer, 1708
 Introduction, 1695
 List of changes and new features, 1696
 New Functions, 1705
 Return Self by Reference, 1705
 Ring mode for Emacs Editor, 1703
 RingZip Library, 1707
 Using '<' and ':' operators as 'from' keyword, 1706
- What is new in Ring 1.4.1?
 What is new in Ring 1.4?, 1719
- What is new in Ring 1.4?
 Better RingQt, 1718
 Better StdLib, 1716
 Better WebLib, 1716
 Change: Basic Extensions are separated from RingVM, 1710
 Convert between Numbers and Bytes, 1715
 Introduction, 1709
 List of changes and new features, 1710
 New Style to Ring Notepad, 1713
 Qt Class Converter, 1718
 RingREPL, 1714
 The Natural Library, 1711
 What is new in Ring 1.4.1?, 1719
- What is new in Ring 1.5.1?
 What is new in Ring 1.5?, 1761
- What is new in Ring 1.5.2?
 What is new in Ring 1.5?, 1766
- What is new in Ring 1.5.3?
 What is new in Ring 1.5?, 1767
- What is new in Ring 1.5.4?
 What is new in Ring 1.5?, 1770
- What is new in Ring 1.5?
 Better Code Generator for Extensions, 1751
 Better Documentation Generator for Extensions, 1752
 Better Objects Library, 1735
 Better Quality, 1761
 Better Ring Notepad, 1726

- Better RingQt, 1733
 Better StdLib, 1729
 Better WebLib, 1730
 Calculator Application, 1725
 Introduction, 1722
 List of changes and new features, 1723
 More Syntax Flexibility, 1758
 Ring VM - Tracing Functions, 1752
 RingFreeGLUT Extension, 1736
 RingOpenGL Extension, 1747
 Trace Library and Interactive Debugger, 1756
 Type Hints Library, 1760
 Video-Music-Player Application, 1723
 What is new in Ring 1.5.1?, 1761
 What is new in Ring 1.5.2?, 1766
 What is new in Ring 1.5.3?, 1767
 What is new in Ring 1.5.4?, 1770
 Windows StartUp Manager Application, 1724
 What is new in Ring 1.6?
 Better Ring For Android, 1773
 Better Ring Notepad, 1776
 Better RingQt, 1778
 Better RingREPL, 1779
 Better RingVM, 1779
 Better Scripts for building Ring, 1775
 Better StdLib, 1779
 Employee Application, 1772
 Introduction, 1771
 List of changes and new features, 1772
 New Tool: Folder2qrc, 1774
 New Tool: Ring2EXE, 1773
 RingConsoleColors Extension, 1775
 RingMurmurHash Extension, 1775
 Using ? to print expression then new line, 1782
 Using && and || operators, 1781
 Using CR as Carriage return, 1780
 Using Tab instead of char(9), 1780
 Using the ! operator as not, 1780
 What is new in Ring 1.7?
 Better Documentation, 1787
 Better Ring Notepad, 1786
 Better Ring VM, 1787
 Better Ring2EXE, 1787
 Better RingQt, 1786
 Better RingZip, 1787
 Better Trace Library, 1785
 Introduction, 1782
 List of changes and new features, 1783
 New Command: Load Package, 1783
 ring_state_new() and
 ring_state_mainfile() functions, 1785
 RingLibuv Extension, 1788
 ringvm_see() and ringvm_give()
 functions, 1784
 What is new in Ring 1.8?
 Better Cards Game, 1803
 Better Code Generator For Extensions, 1804
 Better Form Designer, 1802
 Better Performance, 1792
 Better Ring Compiler and VM, 1804
 Better RingQt, 1803
 Compiling on Manjaro Linux, 1797
 Default value for object attributes is
 NULL, 1799
 Find in files Application, 1793
 FoxRing Library, 1802
 Introduction, 1791
 List of changes and new features, 1792
 Merge binary characters, 1800
 More 3D Samples, 1795
 Notes to extensions creators, 1805
 StopWatch Application, 1794
 String2Constant Application, 1793
 The For Loops uses the local scope, 1800
 Using This in the class region as Self, 1798
 What is new in Ring 1.9?
 Better Code Generator for Extensions, 1821
 Better Memory Management, 1820
 Better Ring Notepad, 1811
 Better RingQt, 1817
 Better StdLib, 1812
 BigNumber Library, 1813
 Deploying Web applications in the Cloud, 1817
 Introduction, 1805
 List of changes and new features, 1806
 More Games, 1808
 More Improvements, 1822
 New Game : Gold Magic 800, 1806
 RingPostgreSQL Extension, 1814
 What is RingFreeGLUT?
 Using RingOpenGL and RingFreeGLUT for
 3D Graphics, 790
 What is RingOpenGL?
 Using RingOpenGL and RingFreeGLUT for
 3D Graphics, 789
 What is the difference between Ring and
 Python? And is Ring Open Source?
 Frequently Asked Questions, 2029
 What is the Ring Architecture?
 Frequently Asked Questions, 2024
 What will you learn?

- The Gold Magic 800 Game, 868
 Where can I write a program and execute it?
 Frequently Asked Questions, 2041
 Which of 3 coding styles are commonly used
 or recommended by the community?
 Frequently Asked Questions, 2024
While Loop
 Control Structures - First Style, 69
 Control Structures - Third Style, 80
 Why do we need Yet Another Programming
 Language (YAPL)?
 Frequently Asked Questions, 2023
 Why I get a strange result when printing nl
 with lists?
 Frequently Asked Questions, 2043
 Why I get Calling Function without
 definition Error?
 Frequently Asked Questions, 2049
 Why is Ring largely focused on UI creation?
 Frequently Asked Questions, 2028
 Why is Ring weakly typed?
 Frequently Asked Questions, 2028
 Why Ring is not case-sensitive
 Frequently Asked Questions, 2036
 Why Ring uses 'See', 'Give', 'But' and 'Ok'
 Keywords?
 Frequently Asked Questions, 2032
 Why Ring?
 Language Design, 1668
 Why setClickEvent() doesn't see the object
 methods directly?
 Frequently Asked Questions, 2054
 Why the ability to define your own
 languages Instead of parsing?
 Frequently Asked Questions, 2032
 Why the Assignment operator uses Deep copy?
 Frequently Asked Questions, 2036
 Why the window title bar is going outside
 the screen?
 Frequently Asked Questions, 2050
 Why this example use the GetChar() twice?
 Frequently Asked Questions, 2045
 Why Type Hints?
 The Type Hints Library, 338
 Why we don't use () after the QApp class
 name?
 Frequently Asked Questions, 2050
 Why you can specify the number of loops you
 want to break out of?
 Frequently Asked Questions, 2032
Window Flags
 Form Designer, 528
Window Resize Event
- Using RingOpenGL and RingFreeGLUT for
 3D Graphics, 794
Windows StartUp Manager Application
 What is new in Ring 1.5?, 1724
Windowsnl() Function
 System Functions, 160
Word Game
 What is new in Ring 1.13?, 1869
Wrap structures
 Code Generator, 1636
Wrapping C++ Classes
 Code Generator, 1643
Write file using Write()
 Files, 144
Writing Comments
 Getting Started - First Style, 48
 Getting Started - Second Style, 50
 Getting Started - Third Style, 53
- Z**
- Z()** function
 Using ZeroLib, 953
Zero and Strings
 What is new in Ring 1.16?, 1920
ZeroBasedList Class
 Using ZeroLib, 953
ZeroBasedString Class
 Using ZeroLib, 954
ZeroLib Library
 What is new in Ring 1.11?, 1845
Zip Class Reference
 RingZip, 1067
ZipEntry Class Reference
 RingZip, 1067