**February 2023**



**Crown Programming Language**

**Reference Manual**

Version 1.5.2 – Humble Pig

Developed by Gabriel Margarido

**Resume**

Crown programming language compiler aims to simplify C programming language syntax and built-in features. Such as: string handling, vectors handling, file handling, parser, tokenization and compiler development. Normally we think C programming is hard and complex, this is actually truth. However with Crown programming language, the scenery has been changed, with a syntax near to Ruby, Javascript or Lua, even more people can program in C without programming in C. Using an intermediate C-transpiled language, that supports all C native functions and libraries, it means, you can program for Arduino, C Microcontrollers, desktop and even mobile computers.

Memory isn’t automatic disallocated or manipulated, Crown programming language runs directly on binary code, without a runtime or memory wasting due to a runtime or virtual machine. It’s syntax is easier than C, C++ or even Rust.

Some syntax elements are inherited from Pascal, Go, Ruby, Lua, Javascript and C.

All low-level functionalities are inherited from C programming language.

It’s also a procedural, weak and static typed compiled programming language. Crown does not support classes or inheritance, due to it’s not an object-oriented programming language, like C++ (for instance).

Crown programming language compiles on pure ANSI-C, it means that all computers that has a Standard ANSI-C compiler can run Crown, independently of the operating system or processor architecture.

**Gabriel Margarido,**

**February 2023**

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**Compiling and installing Crown compiler and TinyCC from sources:**

1. Install these softwares first: GNU Make, Node.js 12+, NPM 8+, Wget, GCC

and Clang/LLVM. (And also **Git Bash** if you are running in Windows.)

**Linux**

A1. On Ubuntu or Debian you can run:

sudo apt install clang gcc nodejs npm make wget -y

sudo make linux-node-link

A2. Or try:

sudo apt install clang gcc nodejs npm make wget -y

sudo ln -s /bin/node /usr/local/bin/node

B. (unzip and enter inside the downloaded directory,

next run the following commands)

sudo make all install USE=-DLUA\_USE\_LINUX

**MacOS X**

Install MacPorts: <https://www.macports.org/install.php>

A. On Apple MacOS X you can run:

sudo port install wget

B. Next, install Node.js and NPM: [https://www.nodejs.org](https://www.nodejs.org/)

C. (unzip and enter inside the downloaded directory,

next run the following commands)

sudo make all install USE=-DLUA\_USE\_MACOSX

They’re gonna be installed at:

/usr/local/bin/crown

/usr/local/bin/tcc

/usr/local/bin/lua

/usr/local/bin/luac

/usr/local/bin/king

4. To compile a source file

crown <file>.crown

You can uninstall Crown Compiler by running:

sudo make remove

Visual Studio Code Extension available inside **vscode** directory,

just copy **crown-syntaxhighlight**  to:

**MacOS/Linux: ~/.vscode/extensions/**

**Windows: %USERPROFILE%\.vscode\extensions**

**You can also run the following command from vscode directory to install Crown VSCode Extension:**

MacOS/Linux: **cp -Rfv crown-syntaxhighlight ~/.vscode/extensions/**

Windows:  **xcopy crown-syntaxhighlight %USERPROFILE%\.vscode\extensions\crown /E /H /C /I**

These are all existing datatypes in Crown Programming Language:

|  |  |  |
| --- | --- | --- |
| **Datatype** | **Numeric Value** | **Description** |
| **int** | -32.768 to 32.767 | Integer value |
| **float** | 3,4E-38 to 3.4E+38 | Decimal positive or negative real value |
| **String** | -128 to 127 | Immutable/Standard string |
| **\*String** | -128 to 127 | Mutable string |
| **bool** | 0 or 1 | true or false / 0 or 1 |
| **ulong\_int** | 0 to 4.294.967.295 | Big integer value |
| **long\_int** | -2.147.483.648 to 2.147.483.647 | Big positive or negative integer value |
| **long\_float** | 3,4E-4932 to 3,4E+4932 | Big decimal real value |
| **void** | None | Empty value (most used in function declaration) |
| **mathematical** | None | Mathematical expressions |
| **Macro** | Macro/Constant:  Any datatype. | Create the most optimized constant on memory |

Variable declaration:

int a = 13

float b = 457.89

float bc = -458.76

\*String name = “Maria Juliana”

String surname = “Gomez”

String other\_name[64] = “Mariana Julia Andressa Conda”

bool c = true

bool e = false

ulong\_int my\_number = 409567328

long\_int my\_negative\_number = -45

long\_int my\_big\_negative\_number = -458670382

long\_float my\_big\_negative\_number = -410492230.89045

mathematical my\_expression = “(2\*(34.5+78-12.9)+45)/4”

Macro name = “Gabriel Margarido”

Macro age = 17

Macro salary = 137.56

Macro isOk = true

Macro isOk = false

print(“%s”, name)

print(“%i”, age)

print(“%f”, salary)

float a = 456.70

int b = 4

float c = 2.5

mathematical my\_expression = “(2\*(a\*a+b\*2)+45)/c\*2”

Variable reassignment:

int a = 32

a := 4

float b = 28.5

b := 3.45

\*String c = “Hello world”

c := “Bye world”

bool f = true

f := false

Arrays declaration with automatic size definition:

int[] a = (0, 2, 4, 6, 8, 10, 12, 14)

float[] b = (0.58, 2.47, 6.78, 8.23, 10.50, 12.38)

String[] c = (“Hello world”, “Bye world”, “See you later”)

**Note:** String[] and \*String[] arrays are the same thing. Do not confound with String[] and \*String[] variables!

Arrays declaration with manual size definition:

int[] a[8] = (0, 2, 4, 6, 8, 10, 12, 14)

float[] b[6] = (0.58, 2.47, 6.78, 8.23, 10.50, 12.38)

String[] c[3] = (“Hello world”, “Bye world”, “See you later”)

**Note:** String[] and \*String[] arrays are the same thing. Do not confound with String[] and \*String[] variables!

Every time an array is declared and initialized,

an integer variable named <array\_name>\_size

containing the length of the array is automatically created.

In this case, two variables were created: a\_size and b\_size

We can see these length integer values, by printing them on the screen.

print(“The A size is: %i \n”, a\_size)

print(“The B size is: %i \n”, b\_size)

Showing messages on the screen:

print(“Hello world\n”)

\*String msg = “Hello world\n”

print(“%s”, msg)

Formatted print on the screen:

|  |  |
| --- | --- |
| **Reference** | **Value** |
| %i | int |
| %f | float | mathematical |
| %s | String | \*String |
| %c | String |
| %d | int | decimal |

print(“The selected number was: %i”, my\_number)

print(“My salary is: %f”, my\_salary)

print(“My name is: %s”, my\_name)

Reading data from user:

input(“%s”, name)

print(“Your name is: %s”, name)

Showing arrays on the screen:

dump int -> a

dump float -> b

Removing last element of the array:

drop -> a

drop -> b

Shifting element in the array:

Change value of index [3] (fourth element) in array **b** to 145

shift b -> 145 in 3

Write string to text file:

File myfile = openfile(“testing.txt”, “w”)

io.write(myfile,”%s”,”Hello world from text\n”)

closefile(myfile)

Read from text file:

io.read “testing.txt” -> mybuffer

print(“%s”, mybuffer)

Calculate factorial from an integer number:

int factorial = fat(20)

print(“%i”, factorial)

If-Conditional

if (a > 3) do

print(“First condition”)

elseif (b <= 4) do

print(“Second condition”)

else

print(“None of above”)

end

When-Conditional

while (true) do

when (a > 3) do

print(“First condition”)

break

elsewhen (b <= 4) do

print(“Second condition”)

break

else

print(“None of above”)

break

end

end

Repetition loops

for i in 0..5 do

print(“Here am I”)

end

5 times do

print(“Here am I”)

end

while (a > 3) do

print(“Here am I”)

end

Human-readable operators: is isnot and or  
Machine-readable operators: == != && ||

while (a is 3) do

print(“Here am I”)

end

int a = 4

if (a is 4) do

...

elseif (a isnot 5)

...

end

int b = 7

while (a is 4 and b is 7) do

...

end

Writing mathematical expressions on the screen

float a = 456.70

int b = 4

float c = 2.5

mathematical my\_expression = “(2\*(a\*a+b\*2)+45)/c\*2”

print(“%f”, my\_expression)

Function declaration:

**Function without return**

fn my\_function() -> void do

...

end

**Function with integer return**

fn my\_function() -> int do

...

return 3

end

**Function with float/real return**

fn my\_function() -> float do

...

return 3.67

end

**Function with boolean return**

fn my\_function() -> bool do

...

return true

end

**Function with (mandatory) mutable string return**

fn my\_function() -> \*String do

...

return “Hello world”

end

fn my\_function() -> String do

...

return “Hello world”

end

Function arguments:

**Immutable string argument**

fn my\_function(char name[], char surname[]) -> void do

...

print(“You are: %s %s\n”, name, surname)

end

**Mutable string argument**

fn my\_function(String name, String surname) -> void do

...

print(“You are: %s %s\n”, name, surname)

end

fn my\_function(\*String name, \*String surname) -> void do

...

print(“You are: %s %s\n”, name, surname)

end

**String slicing**

String name = “Jean Brawicz”

String.slice(name,” ”)

print(“%s”, name)

**Non-initialized string declaration: 32 characters of length**

String reg[32] = null

**Extracting substring from string**

String msg = “Hello world”

String substring[128] = null

String.substring msg from 0 to 3 -> substring

**Concatenating strings**

String msg\_first = “Hello ”

String msg\_second = “World”

String.concat(msg\_first, msg\_second)

print(“%s \n”, msg\_first)

**Getting length of string**

String msg\_first = “Hello World”

int length = String.len(msg\_first)

print(“%i \n”, msg\_length)

**Putting string to lowercase**

String msg = “HELLO WORLD”

String lower = String.lowercase(msg)

print(“%s \n”, lower)

**Putting string to uppercase**

String msg = “hello world”

String upper = String.uppercase(msg)

print(“%s \n”, upper)

**Putting string to reverse**

String msg = “hello world”

String rev = String.reverse(msg)

print(“%s \n”, rev)

**Comparing strings I**

String msg = “hello world”

String ex = “Hello world”

String rev = **String**.isEqual(msg)

if (rev **is** true) do

print(“Both strings are equal.”)

else

print(“Strings are not equal!”)

end

**Comparing strings II**

String msg = “hello world”

String ex = “Hello world”

String rev = **String**.isEqual(msg, ex)

String e\_msg = “hello world”

String lw = **String**.isEqual(msg, e\_msg)

if (rev **is** true *and* lw **is** true) do

print(“All strings are equal.”)

else

print(“All strings are not equal!”)

end

**Comparing strings III**

String msg = “hello world”

String ex = “Hello world”

String e\_msg = “hello world”

**equals** msg **and** ex **do**

print(“MSG and EC strings are equal.”)

**elsequals** ex **and** e\_msg **do**

print(“EX and E\_MSG strings are equal”)

**else**

print(“All strings are not equal!”)

**end**

**Assign one string to another - I**

String msg = “hello world”

String second[32] = String.assign(msg)

**Assign one string to another - II**

String msg = “hello world”

String second[32] = null

String.assign(second, msg)

**Run OS Shell Command - I**

String exec = “ls -a”

System.execute(exec)

**Run OS Shell Command - II**

System.execute(“ls -a”)

* **Selecting features on source-code compilation**

1. Start new program overwriting old program (mandatory for correctly working!)

using crown

2A. Use GCC (GNU C Compiler) to compile automatically written source-code.

using gcc

2B. Use Clang (Clang/LLVM) to compile automatically written source-code.

using clang

2C. **Unstable** - Use TinyCC (Tiny C Compiler) to binary compile automatically written source-code.

using tinycc

2D. **Unstable** - Use TinyCC VM (Tiny C Virtual Machine) to bytecode compile automatically written code.

using tinycc\_vm

3. See automatically generated C code from source-code.

using debugging

**Main program structure (with GCC)**

using crown

using gcc

fn main() -> int do

# ”Your program goes here”

...

return 0

end

**Main program structure (with GCC)**

using crown

using gcc

fn main() -> int do

# ”Your program goes here”

...

return 0

end

**Main program structure (with Clang)**

using crown

using clang

fn main() -> int do

# ”Your program goes here”

...

return 0

end

**Main program structure (with TinyCC Compiler)**

using crown

using tinycc

fn main() -> int do

# ”Your program goes here”

...

return 0

end

**Main program structure (with TinyCC Virtual Machine)**

using crown

using tinycc\_vm

fn main() -> int do

# ”Your program goes here”

...

return 0

end

**Import C native library**

Import C native compiler libraries, all libraries below

are automatically imported when program starts.

import “stdio.h”

import “stdlib.h”

import “string.h”

import “ctype.h”

**Import custom external modules**

Import C external module libraries from local path, such as

Lua Programming Language Modules.

**Path: ../lua/src/lua.h**

import\_module “../lua/src/lua.h”

**A. Install and Uninstall modules from the web with King**

Download and install C module libraries from the web and store inside a local repository.

**King’s repository: /usr/local/lib/crown**

king --install <http://example.com/this.h> -o this.h

king --uninstall this.h

**A. Include King installed modules**

Import C external module libraries from king’s local repository.

**King’s repository: /usr/local/lib/crown**

**Path1: /usr/local/lib/crown/this.msk**

**\*Path2: /usr/local/lib/crown/this.h**

include “this”

**B. What is a \*.msk file?**

MSK files are actually, C source-code files with \*.msk extension. You can just write your C file and rename it to MSK, now just include it inside the current Crown source-file.

**thismodule.c** **=** **thismodule.msk**

**B1. Install and Uninstall modules from the web with King**

Download and install C module libraries from the web and store inside a local repository.

**King’s repository: /usr/local/lib/crown**

king --install <http://example.com/this.msk> -o this.msk

king --uninstall this.msk

**B1. Include King installed modules**

Import C external module libraries from king’s local repository.

**King’s repository: /usr/local/lib/crown**

**\*Path1: /usr/local/lib/crown/this.msk**

**Path2: /usr/local/lib/crown/this.h**

include “this”

**Call C native functions**

Call native C functions without changing anything.

system(“ls”)

system(“pause”)

system(“free -h”)

**Create structures**

Create pseudo-classes, then you can

create pseudo-objects from them.

A. Here we are creating the structure

*struct* **Vehicle** do

float weight = null

int year = null

String model[32] = null

bool isRunning = null

endstruct

B. Now, creating the pseudo-objects

Vehicle **toyota** = null

Vehicle **mitsubishi** = null

C1. Next, acessing Toyota pseudo-object

**toyota**.weight = 1.2

**toyota**.year = 2022

**toyota**.model = “Etios”

**toyota**.isRunning = true

C2. Next, acessing Mitsubishi pseudo-object

**mitsubishi**.weight = 2.6

**mitsubishi**.year = 2012

**mitsubishi**.model = “Pajero Sport”

**mitsubishi**.isRunning = false

D. Printing on the screen all properties of pseudo-objects

print(“%f\n”, **mitsubishi**.weight)

print(“%i\n”, **mitsubishi**.year)

print(“%s\n”, **mitsubishi**.model)

print(“%f\n”, **toyota**.weight)

print(“%i\n”, **toyota**.year)

print(“%s\n”, **toyota**.model)

**Acessing command line arguments (CLI args)**

The quantity of passed CLI arguments is stored inside an integer (int) argument counter, called: **argc**

And the passed arguments are stored inside an array of strings, called: **argv**

The first argument **argv[0]** stores the name of the called executable.

The position **argv[1]** stores the first argument.

The position **argv[2]** stores the second argument.

The position **argv[3]** stores the third argument.

And so on...

A. Acessing arguments inside **argv**

print(“Name of the executable: %s\n”, **argv[0]**)

print(“First argument: %s\n”, **argv[1]**)

print(“Second argument: %s\n”, **argv[2]**)

print(“Third argument: %s\n”, **argv[3]**)

...

**Create libraries for Lua Programming Language**

Create libraries in Crown for using inside Lua code.

The function return must be always 1 (this is not an error return code),

it’s just to add one more element to Lua’s Virtual Stack.

You can also use all Lua API functions inside Crown code

without changing any parameter. Such as:

* lua\_pushstring(L, msg)
* lua\_checkstring(L, 1, NULL)
* lua\_setglobal(L, “a”)

And so on…

**\*Remember, in Crown we don’t use semi-column (;) at the end of the line.**

**See more about this at: [https://www.lua.org/manual/5.2/pt/manual.html#luaL\_addchar](https://www.lua.org/manual/5.2/pt/manual.html" \l "luaL_addchar)**

**Compiling Lua shared library:**

**Compiling: crown** mylibrary.crown

**Requiring: require(“mylibrary”)**

using crown

using gcc

using lua

include “lua.h”

include “lauxlib.h”

fn helloworld(lua\_State \*L) -> int do

print(“This is our hello world”)

return 1

end

lua\_Stack lua\_func do

lua\_Reg helloworld

lua\_Reg null

end

**Use in Lua code:**

**require(**“mylibrary”**)**

*mylibrary*.helloworld**()**

**THE END**

**THIS SECTION IS STILL UNDER DEVELOPMENT!**

*WARNING! This is still in development and unstable, do not use this section! Severe bugs may occur…*

**Developing compilers with CDK – Compiler Development Kit**

*WARNING! Still in development, bugs may occur…*

By using CDK, we are able to develop compilers with a built-in development kit.

Here we using **tokenizer** feature with all standard features.

using crown

using tinycc

using debugging

using tokenizer

Then, we’re declaring the reserved function \_\_tokenize.

o*utfile* and *infile* are the input-file variable and the output-file variable.

fn \_\_tokenize() -> void do

\_\_initialize with outfile and infile do

@compiler

equals stack[i] and “my\_special\_token” do

\*String next\_token = stack[i+1}

io.write(outfile, “%s”, next\_token)

end

equals stack[i] and “my\_other\_token” do

\*String next\_token = stack[i+1}

io.write(outfile, “%s”, next\_token)

end

equals stack[i] and “my\_normal\_token” do

\*String next\_token = stack[i+1}

io.write(outfile, “%s”, next\_token)

end

end

free

end

Now we should call \_\_tokenize function inside main function

fn main() -> int do

io.read argv[1] -> source\_file

\_\_tokenize(source\_file)

return 0

end

The equals x and y do instruction is the same thing as do if x == y do, however equals is for comparing strings, and if is for comparing expressions. It’s semantical meaning differs from if instruction. We’re basically comparing if variable or string x is equal to variable or string y, if it’s true do the following condition. Normally, it’s writing the correspondent instruction in the target language to a text file (object code/low-level code).

Here the free instruction frees the allocated memory due to compiler input and output C-I/O. stack[i] variable is related to the current token/symbol, broken by spaces, unless double-quote strings, parenthesis expressions and brackets expressions. So you can see the following sequence of tokens:

**Analyzing rushed expressions: main focus: (first token)**

Here is the following instruction

stack[i] stack[i+1] stack[i+2] stack[i+3] stack[i+4]

This text is “Hello world for all”

stack[i] stack[i+1] stack[i+2] stack[i+3]

if (a > 3 and b < 2 ) do

stack[i] stack[i+1] stack[i+2]

int b = 4

stack[i] stack[i+1] stack[i+2] stack[i+3]

**Analyzing variables: main focus: “=”**

int b = 4

stack[i-2] stack[i-1] stack[i] stack[i+1]

<type> <name> = <value>

stack[i-2] stack[i-1] stack[i] stack[i+1]

**Analyzing arrays: main focus: “=”**

int[] b = [0, 2, 4, ...]

stack[i-2] stack[i-1] stack[i] stack[i+1]

<type> <name> = <value>

stack[i-2] stack[i-1] stack[i] stack[i+1]