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# **Crown Programming Language Reference Manual**

Version 1.0 – Humble Pig  
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## 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+, GCC and Clang/LLVM. (And also **Git Bash** if you are running in Windows.)

On Ubuntu or Debian you can run:

```
sudo apt install clang gcc nodejs npm make
```

2. (unzip and enter inside the downloaded directory, next run the following commands)

```
sudo make all install
```

They're gonna be installed at:

```
/usr/local/bin/crown
```

```
/usr/local/bin/tcc
```

4. To compile a source file

```
crown <file>.crown
```

You can uninstall Crown Compiler and TinyCC 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
<code>int</code>	-32.768 to 32.767	Integer value
<code>float</code>	3,4E-38 to 3.4E+38	Decimal positive or negative real value
<code>String</code>	-128 to 127	Immutable/Standard string
<code>*String</code>	-128 to 127	Mutable string
<code>bool</code>	0 or 1	true or false / 0 or 1
<code>ulong_int</code>	0 to 4.294.967.295	Big integer value
<code>long_int</code>	-2.147.483.648 to 2.147.483.647	Big positive or negative integer value
<code>long_float</code>	3,4E-4932 to 3,4E+4932	Big decimal real value
<code>void</code>	None	Empty value (most used in function declaration)
<code>mathematical</code>	None	Mathematical expressions
<code>Macro</code>	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
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 sumner 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] 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
    elseif (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)
```

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

```
using tinycc
```

2D. Use TinyCC VM (Tiny C Virtual Machine) to bytecode compile automatically written source-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 additional 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, such as Lua Programming Language Modules.

```
import_module "lua.h"
```

## 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, accessing Toyota pseudo-object

```
toyota.weight = 1.2
toyota.year = 2022
toyota.model = "Etios"
toyota.isRunning = true
```

C2. Next, accessing 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)
```

### **Accessing 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. Accessing 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])
...
```

**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`.

`outfile` 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
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 `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:

<b>Analyzing rushed expressions:</b>		<b>main focus: (first token)</b>		
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]	

<b>Analyzing variables:</b>		<b>main focus: "="</b>	
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]

<b>Analyzing arrays:</b>		<b>main focus: "="</b>	
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]