EEE243 – Applied Programming

Basic Programming Concepts

ROYAL MILITARY COLLEGE OF CANADA
ELECTRICAL & COMPUTER
ENGINEERING

GÉNIE ÉLECTRIQUE
ET GÉNIE INFORMATIQUE
COLLÈGE MILITAIRE ROYAL DU CANADA

RMC CMR

Procedural programming

A programming paradigm based upon the concept of the procedure call [1].

Procedures are more commonly called functions and provide a way to organize a program and allows to reuse code without repeating it.

Procedural programming

Other programming paradigm:

- Object-oriented (seen in EEE320)
- Functional

Review of Basic Programming

- These are basic programming concepts you should have seen before
- Refer to the document “Just Enough C” provided for more details on the specific syntax of C
- Refer to the C coding style page on the website

Variables

Unlike in Matlab or Python, one must declare the type of the variable before using it.

Some basic C types:

- int: integers
- char: character
- float: floating point value

Variables

C	Matlab	Python
int x = 10 int y = -120	x = 10 y = -120	x = 10 y = -120
char a_char = 'a'	a_char = 'a'	a_char = 'a'
float a_float = 10 float another_float = 10.0	a_float = 10.0 another_float = 10.0	a_float = 10.0 another_float = 10.0

Scope and Extent

Scope: determines where a variable is visible.

Extent: determines the “duration” of a variable, that is, how long its value will exist for.

```
int a_function (int x, int z){
    int y = x + z;
    for (int i = 0; i < 10; i++) {
        printf("i is %d", i);
    }
    return y;
}
```

Operators

- Normal arithmetic operators have their usual precedence, so the expression 6+3*-7 evaluates to -15 and is equivalent to 6+(3*(-7)).
- Compound assignments: +=, -=, *=
- short form for incrementing and decrementing a variable:++ and --

Operators

- As in most other languages, the comparison operators are as follow:

==	is equal to (a == b is true if a is equal to b)
! =	is not equal to
<	is less than
>	is greater than
<=	is less than or equal to
>=	is greater than or equal to

Operators

- There are three boolean operators:

!	logical not or “negation.” ! a is true if a is not true; ! a is false if a is not false
&&	logical and. a && b is true if a is true and b is also true
||	logical or. a || b is true if a is true or if b is true, including the case where both are true

Control structures

Branching statements

C	Matlab	Python

`if (x <= 10) {`
`  printf("x is smaller`
`  than 10");`
`}`
	`if x <= 10`
	`  disp('x is smaller`
	`  than 10');`
	`end`
		`if x <= 10`
		`  print("x is smaller`
		`  than 10")`

`if (x <= 10) {`
`  printf("x is smaller`
`  than 10");`
`} else {`
`  printf("x is greater`
`  than 10");`
`}`
	`if x <= 10`
	`  disp('x is smaller`
	`  than 10');`
	`else`
	`  disp('x is greater`
	`  than 10');`
	`end`
		`if x <= 10:`
		`  print("x is smaller`
		`  than 10")`
		`else:`
		`  print("x is greater`
		`  than 10")`

Control structures

Branching statements

C	Matlab	Python

`if (x <= 10) {`
`  printf("x is smaller`
`  than 10");`
`} else if (x >= 5) {`
`  printf("x is greater`
`  than 5");`
`} else {`
`  printf("x is not`
`  "between"`
`  "5 and 10");`
`}`
	`if x <= 10`
	`  disp('x is smaller`
	`  than 10');`
	`elseif x >= 5`
	`  disp('x is greater`
	`  than 5');`
	`else`
	`  disp('x is not between`
	`  5 and 10');`
	`end`
		`if x <= 10:`
		`  print("x is smaller`
		`  than 10")`
		`elif x >= 5:`
		`  print(" is greater`
		`  than 5")`
		`else:`
		`  print("x is not`
		`  between 5 and 10")`

Control structures

Branching statements

C	Matlab	Python

`switch (value) {`
`case 5:`
`  printf("The value is five\n");`
`  break;`
`case 10:`
`  printf("The value is ten\n");`
`  break;`
`}`
	`switch value`
	`case 5`
	`  disp('The value is five')`
	`case 10`
	`  disp('The value is ten')`
	`end`
		`if value == 5:`
		`  print("The value is five")`
		`elif value == 10`
		`  print("The value is ten")`

Control structures

Loop statements

```
while (c >  100)
```

condition

```
for (int c = 200; c >  100; c--)
```

initialization condition update

Control structures

Loop statements

C	Matlab	Python

`while(x < 10) {`
`  printf("x is %d\n", x+`
`  +);`
`}`
	`while x < 10`
	`  disp(['x is ',`
	`  num2str(x)]);`
	`  x = x + 1;`
	`end`
		`while x<10:`
		`  print 'x is ', x`
		`  x = x + 1`

`for(int i = 0; i < 10, i++) {`
`  printf("i is %d\n", i);`
`}`
	`for i = 1:10`
	`  disp(['i is’,`
	`  num2str(i)]);`
	`end`
		`for i in range(0, 10):`
		`  print 'i is ', i`

Comments

C	Matlab	Python
/* Some block comments on multiple lines */	%{ Some block comments on multiple lines %}	# Some block comments # on multiple lines
// Some inline comments	% Some inline comments	# Some inline comments

Basic Structure of a C Program

```c
/*
 * This is a demonstration program
 *
 * Author: Adrien Lapointe
 * Version: 28 Sept 2017
 *
 */

#include <stdio.h>
#include <stdlib.h>
#define A_CONST 10

int a_function(int x);

int gobal_var = 10;

int main(void) {
    printf("Hello World!\n");
    printf("A defined constant: %d\n", A_CONST);
    printf("A global variable: %d\n", gobal_var);
    printf("a_funtion returns %d when given %d\n", a_function(3), 3);
    return EXIT_SUCCESS;
}

/*
 * Multiplies the parameter by two and returns the new value.
 *
 * x: a value
 * returns: the modified value
 */

int a_function(int x) {
    x *= 2;
    return x;
}
```

File header comment

Pre-processor instructions

Function declaration

Global variable declaration

main function

Function comment

Function definition

Functions

You could technically write all your code in the main function but you would lose on

- clarity
- readability
- reusability

Bottom line: **<u>Use functions</u>**

Functions

In C, functions need to be declared and defined

```
float a_function(int count, float weight);
```

return type | function name | parameters

Functions

```c
/*
 * This is a demonstration program
 *
 * Author: Adrien Lapointe
 * Version: 28 Sept 2017
 *
 */

#include <stdio.h>
#include <stdlib.h>
#define A_CONST 10

int a_function(int x);

int gobal_var = 10;

int main(void) {
    printf("Hello World!\n");
    printf("A defined constant: %d\n", A_CONST);
    printf("A global variable: %d\n", gobal_var);
    printf("a_funtion returns %d when given %d\n", a_function(3), 3);
    return EXIT_SUCCESS;
}

/*
 * Multiplies the parameter by two and returns the new value.
 *
 * x: a value
 * returns: the modified value
 */

int a_function(int x) {
    x *= 2;
    return x;
}
```

Function declaration

function call

Function definition

Functions

- Use functions to make your code more clear

- Give them names that are meaningful:
  - Ex.: `convert_mark` instead of `function1`

Functions

C	Matlab	Python

`char convert_marks(int mark) {`
`  if (mark>=50){`
`  return 'P';`
`  } else {`
`  return 'F';`
`  }`
`}`
	`function letter =`
	` convert_marks(mark)`
	`  if mark>=50`
	`  letter = 'P';`
	`  else`
	`  letter = 'F';`
	`  end`
	`end`
		`def convertMarks(mark):`
		`  if mark >= 50:`
		`  return 'P'`
		`  else:`
		`  return 'F'`

Coding Convention

This is a summary, refer to the website for more details

- Use proper indentation and line length
- All blocks must be surrounded by braces
- Include file comments AND function comments

Coding Convention

Names:

- Names must always be chosen to clearly indicate the purpose of the item named.
- **Variables and function parameter names:** lower-case, words separated with underscores, usually nouns `student_name`
- **Functions:** lower-case, words separated with underscores `average_grade`

  `update_student_record`

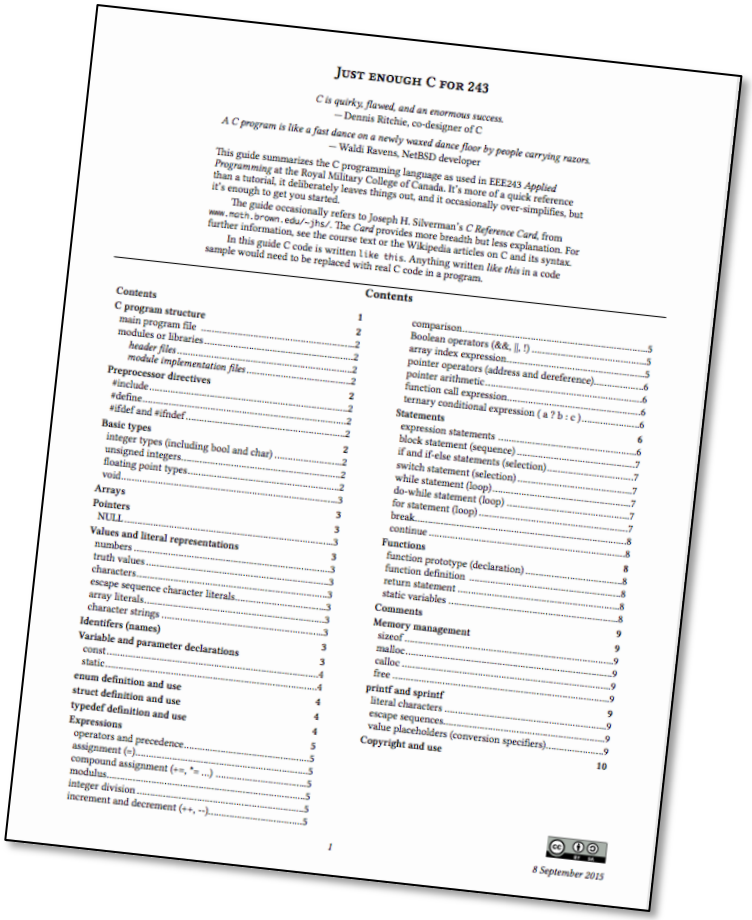
Coding Convention

Names:

- **constants and macros:** upper-case, words separated with underscores `TICKS_PER_CM`

Resources

- On the lab page of the website
- Just Enough C
- C Reference Card



Just enough C for 243

C is quirky, flawed, and an enormous success.
— Dennis Ritchie, co-designer of C

A C program is like a fast dance on a newly waxed dance floor by people carrying razors.
— Waldi Ravens, NetBSD developer

This guide summarizes the C programming language as used in EEE243 *Applied Programming* at the Royal Military College of Canada. It's more of a quick reference than a tutorial, it deliberately leaves things out, and it occasionally over-simplifies, but it's enough to get you started.

The guide occasionally refers to Joseph H. Silverman's *C Reference Card*, from `www.math.brown.edu/~jhs/`. The *Card* provides more breadth but less explanation. For further information, see the course text or the Wikipedia articles on C and its syntax.

In this guide C code is written `like this`. Anything written *like this* in a code sample would need to be replaced with real C code in a program.

Contents

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8 September 2015

Questions?

References

[1] Procedural programming, Wikipedia, accessed 21 August 2017, https://en.wikipedia.org/w/index.php?title=Procedural_programming&oldid=776455885