Lesson 2
Introduction to C

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Topic of this week

- C programming language
  - Class Lecture Review
    - C language structure
    - compiling and running programs
    - keywords
  - Programming Exercises

What is a computer program?

- A sequence of processor instructions designed to achieve a specific purpose.
- The instructions are executed sequentially.
- Each instruction has a numerical code.

Examples of instructions

- Load data (from an address in the memory)
- Store data (in an address)
- Add two numbers
- If two numbers are equal, jump to another part of the program
- Instructions are numbers!

C Language Structure

- General format

```
#include <stdio.h>
#include <……>

main() {

  [function-body];

}
 ⋮
type func() {

  [function-body];

}
```

Begin

End

Semicolon

Preprocessor / Library include

Function main:
[declaration-list] + [statement-list]

Function func:
[declaration-list] + [statement-list]

C Language Structure

- The first C program (hello.c)

```
#include <stdio.h>
int main() {
  printf("Hello CP\n");
  return 0;
}
```

C Language Structure

- #include <stdio.h>
  - To declare using the standard I/O library. Other libraries: string, time, math…
- int main()
  - To declare the main() function. An C program must declare only one main() function. The first line in the main() will implement when the proram starts.
- { … }
  - The syntax to open and close a block of codes.
- printf
  - the printf() function sends the output to standard output (monitor). This function will be taught in the next week.
- return 0;
  - Stop the program.

C Language Structure

- Another example C code

```
#include <stdio.h>
main() {
   int sum;     /* Variable declaration */
                /* sum is a variable hold the
                   sum of two integer */
   sum = 75 + 25;   /* Value assignment */
   printf("The sum of 75 and 25 is %d\n", sum);
}
```

```
The sum of 75 and 25 is 100
```

Keywords of C

- Flow control (6) – `if, else, return, switch, case, default`
- Loops (5) – `for, do, while, break, continue`
- Common *types* (5) – `int, float, double, char, void`
- *structures* (3) – `struct, typedef, union`
- Counting and sizing things (2) – `enum, sizeof`
- Rare but still useful *types* (7) – `extern, signed, unsigned, long, short, static, const`
- Evil keywords which we avoid (1) – `goto`
- Wierdies (3) – `auto, register, volatile`

Compiling with gcc

- GNU C Compiler
- Available in the OS Linux
- Perform one or more of the following
  - C pre processing
  - Compilation
  - Linking

Basic gcc examples

- `gcc hello.c` (compile hello.c produce executable a.out)
- `gcc -o hello hello.c` (compile hello.c produce executable hello)
- `gcc -o hello hello.c other.c` (compile hello.c and other.c produce executable hello)

Using intermediate files

- From any source file, you can produce an object file to be linked in later to an executable

```
gcc -c hello.c

gcc -c other.c

gcc -o hello hello.o other.o
```

Other important gcc options

- -g: include debugging symbols in the output
- -l<name>: include a library

- For example, to use mathematic library of ANSI C: gcc -lm

Exercise 2.1

- *Use gcc to compile* the file hello.c in previous exercise last week.

- To view what the program do, run:

```
./a.out
```

If the Program has an Error

```
/* Your name - your class */
/* This is my first program in C */
#include <stdio.h>
main(                no closing ')'
{
  printf("Welcome to C Programming Introduction.\n");
}
```

- If this program is compiled, we get the message:
- `hello.c : in function 'main'`
- `hello.c:4: parse error before '}'`

Line number

How to correct the mistake?

- Open the "hello.c" in emacs
- Identify the errors, and fix them
- Save the modified file
- Compile it again and then run it

Exercise 2.2

- *Use gcc to compile* the file hello.c in previous exercise to an executable program named `sayhello`

- Run the sayhello:

```
./sayhello
```

Exercise 2.3

- Use emacs to modify hello.c as follow. Then save file with the name hello1.c

```
/* Your name – your class */
/* This is my second program in C */

#include <stdio.h>
main()
{
   printf("Welcome to C");
   printf("Programming Introduction.\n");
}
```

- Use gcc to compile hello1.c to a file named hello1.
- Run this file and view if the result is different with hello?

Exercise 2.4

- Write a program as below then compile it to a executable file and run to view the result:

```
/* Your name – your class */
/* This is my second program in C */

#include <stdio.h>
main()
{
   printf("Welcome to C\n");
   printf("Programming Introduction.\n");
}
```

Exercise 2.5

- Now try to write yourself a program that print a sentence that introduce your self. And say hello to the user.
- For example:

```
************************
My name is Binh Nguyen.
Nice to meet you.
Hope you will have happy time

************************
```

Exercise 2.6

- Edit the following program and save it as pi.c. Compile it to pi.out and run. Place all the files into your directory **week2**. Check that you understand the purpose and output of this program.

```
#include <stdio.h>
#define PI 3.142

main()
{
  double r, c, ac, as, v;
  r = 5.678;
  printf("Radius = %f\n", r);
  c = 2.0 * PI * r;
  printf("Circle's circumference = %f\n", c);
  ac = PI * r * r;
  printf("Circle's area = %f\n", ac);
  as = 4.0 * PI * r * r;
  printf("Sphere's area = %f\n", as);
  v = 4.0/3.0 * PI * r * r * r;
  printf("Sphere's volume = %f\n", v);
}
```

Exercise 2.7

1. Write a program that writes a program that writes the name of the person sitting next to you.
2. compile and run your program; redirect its output to neighbor.c

Compiling inside Emacs

- Create a shell in Emacs and then type the compiling commands just like in the console screen.

```
M-x shell

gcc …
```

- or

```
M-x term
```

Stop and quit the shell

- Stop: `C-c C-c` (like Ctrl – c in console)
- `C-x b` Enter

- Quit: `C-c C-z` or `C-c C-\`

Compiling inside Emacs

- Using compile command

```
M-x compile gcc –o hello hello.c
```

Home work 2.1

- Write a program that output your student card. All the details must be displayed except the HUST's logo and your picture

Home work 2.2

- Write and compile a program named:

Emacs_Instruction that displays a help about all Emacs commands you have learnt the first week.

The output is similar the form belows:

```
========= Emacs Commands Tutor ==========

========   Author : Your Name  ==========

Created as exercise of C Programming Introduction Course
```

C-x C-f: Find a existent file and open/ Or open a newfile

C-x C-s: Save buffer's content to file

Homework 2.3

- By Studying the exercise 2.6 at the class. Try to write a program that calculate the area, circumference, and the volume of a square (and the cube corresponding).
- The size of square's edge is 10.