Week 1

EMT 101 – Engineering Programming

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What Can You Do with Programming?

- As a database control
- Web based application
- Machine or Electronics control
- Systems control (UAV)
- Software development
- Solve Engineering Problems (Simulation)

What is Programming?

- A computer needs ‘something’ to tell it what to do to perform certain tasks
- The tasks may require precise details and multiple steps
- That ‘something’ is called a computer program.
- The process of developing and executing the computer program is called computer programming.

Computer User versus Computer Programmer

- You can use a computer without doing any programming
- A Facebook user does not need to know how the software has been programmed to be able to use Facebook
- Analogy: You can ride a motorcyle without being a mechanic, operate a TV without being an electrician
- Most computer users may never have to perform programming!

Computer User versus Computer Programmer

- A programmer develops a software(s) for computer users to use
- Programmers not only come from computer engineers or scientists but also other engineering or scientific disciplines
- Programming is a very interesting and rewarding activity: write a computer game with sound and motion
- Programmers fully direct the computer as their slaves to extend their brain capabilities

What is a Program

- Program = Data + Algorithm
- All in source code
- Written in various languages
- High level languages requires:
- 1- Compile
- 2- Link or Build
- 3- Execute

Choices of Programming Language

- Machine language
- Fortran
- C
- C++
- Java

Machine Language

- The most primitive yet the most efficient way of communicating with the computer

- Task:

  1) Move contents of memory location 10000 into location ET

  2) Add the value 3000 from memory location ET

  3) If the outcome is negative, proceed with instruction located in memory location 5432

In machine language the instruction reads:

161 10000 45 3000 127 5432

Fortran Language

- The first high level language developed in 1957, mainly for solving mathematical problems

- In FOTRAN 77 the task now reads:

```
REAL*8 X10000
REAL*8 ET
X10000= 10.d0
ET = X10000 + 3000.d0
IF (ET.LT. 0.d0)
    CALL F(X5432)
ENDIF
```

C, C++ Language

- C developed in 1970 (Dennis Ritchie) followed by C++ in 1980 (Bjaern Stroustrup)

- In C++ the task now reads

```
X10000 = 10.0;
float ET;
ET = X10000 + 3000;
If (ET < 0)
  {
    F(X5432);
  }
```

Differences between these languages

- The machine language is the most ‘direct’ form of communication between human and computer, but it is very difficult to use
- FORTRAN and C/C++ are easier to be understood and used by humans compared to machine language but the computer does not understand it -> needs a compiler to convert them to object file (machine language form)
- Based on current problem (set-up), the difference between C++ and FORTRAN is just the syntax.

Procedural vs. Object Oriented Programming

- Procedural: need to know the details of each part of program to use the code
- Object Oriented (OOP): just need to know at higher level to be able to use the code
- OOP is slightly less efficient in terms of running time versus procedural but easier to manage
- Most research codes and libraries are written in procedural programming

What Scientific Programming can Do?

- Movie 23 - P/H: Below
- Movie 5, - Turning Circle
- Movie 57 - Propeller
- Movie 68 - Rough Sea

First, need to understand

- The Generic approach of Programming to solve scientific or engineering problems -> Flow chart
- Concept of variables, identifiers, data type, C++ library
- Initialization, arrays and memory allocation
- Control structure and loops
- Function, subroutines, structures and classes

A Sample C++ Code

```
#include <iostream>                    //to include C++ library for input and output of values

using namespace std;                   //to be able to use all the standard classes, objects and functions in C++

int main ()                            // start of program body, main is a function with no parameters that
      returns an int. value
{
   int numberOfLanguages;              // define an identifier numberOfLanguages as an integer data type

   cout << “Hello student.\n ";        // program greets the student and go to next line
        << “Welcome to EMT 101.\n”;

   cout << “How many programming languages have you used?  ";  // program asking user to input no of
     languages
   cin >>  numberOfLanguages;                                  // input from user is now saved into
     numOfLanguages

return 0;                              // to return 0 as the integer value of main, most C++ compilers need this
}  // end of program body
```

Exercises

- Write a C++ program to enter your name and your student metric number.