COM4013 – Introduction to Software Development
Week 11 – Intro to Algorithms in C++

*Always select "**Enable Editing**" if prompted by Microsoft Word*

Lab Exercises – Do them in Python or C++ whatever you're comfortable with

Always refer to the lecture notes for examples and guidance.
Also look at your previous work, many exercises are similar.

There are two "stages" marked in the lab sheet. Stage 1 is the *absolute minimum* point you should reach. Hopefully, you can reach it in the lab session. Reaching stage 2 suggests you are on target for a top-class mark for the module. Set your goals sensibly - do not just aim for the minimum or you may struggle to pass the module.

I use the term integer, string and float, and Boolean to infer what the input/output looks like. Unlike many other languages C++ does expect a data type before the variable names.

So if I ask that you declare an integer num1 to value of 1, then do as follows:

```
int num1 = 1;
```

For declaring a string and assigning the value hello

```
string greeting = "hello";
```

For floats we can declare it like this

```
float money = 2.50;
```

For doubles (more accurate floating-point number) we can declare it like this

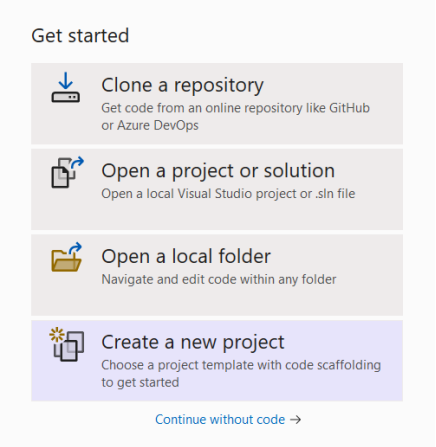
```
double money = 2.50;
```

For Booleans (bool) we can declare it like this

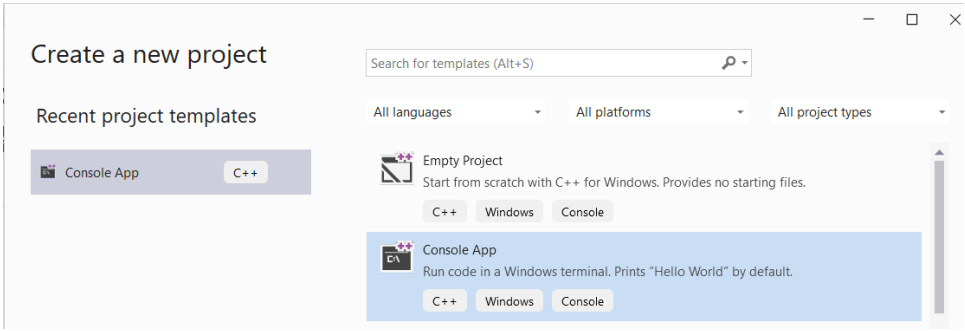
```
bool isHeavy = true;
```

Prepare C++ IDE

- Download Visual Studio 2022 Community Edition
- Once downloaded, open the application, and click "Create a new project".



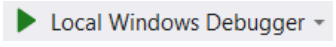
- Click on Console App, name your application “Lab 11”, and press Create.



- Delete all the comments and you should be left with this

```
#include <iostream>

int main()
{
    std::cout << "Hello World!\n";
}
```

- Beneath #include <iostream> (iostream being a library) write using namespace std (look at the slides for an example of this).
- Remove the std:: from the cout (console out – print) statement.
- Press  or press (ctrl+F5) or (FN+F5).

Some Syntactical Differences Between Python and C++

Read through the following differences.

Variable Declaration and Initialization

- C++: int x = 10;
- Python: x = 10

Print Statement

- C++: cout << "Hello, World!" << endl;
- Python: print("Hello, World!")

Comments

- C++: // Single-line comment or /* Multi-line comment */
- Python: # Single-line comment or ''' Multi-line comment '''

Indentation

- C++: Uses braces {} for block structure.
- Python: Uses indentation for block structure.

Function Definition

- C++: int add(int a, int b) { return a + b; }
- Python: def add(a, b): return a + b

List/Array Initialization

- C++: int arr[] = {1, 2, 3, 4};
- Python: arr = [1, 2, 3, 4]

Class Definition

- C++: class MyClass { public: /* members and methods */ };
- Python: class MyClass: # members and methods

Dynamic Memory Allocation

- C++: int* ptr = new int; delete ptr;
- Python: Python manages memory automatically; no explicit allocation/deallocation.

Conditional Ternary Operator

- C++: int result = (x > 0) ? 1 : -1;
- Python: result = 1 if x > 0 else -1

First Program

- Type (do not copy) this code into the IDE

```
#include <iostream>
using namespace std;

int main()
{
    int a;
    int b;
    int result;

    a = 4;
    b = 6;
    result = a * b;

    cout << "The result is ";
    cout << result << endl;
}
```

- Now compile and run the program.
- Compilation and debugging are the same in C++ as in the Python environment.
- Notice that "main" has a lower case 'm'. It also has an integer return type, unlike Python.
- We should really return a value from "main". It's not actually necessary in this program, or indeed many of the programs you'll write in this module. However, main should return a value of 1 for success.
- The most important change from Python is the treatment of input and output in C++. Output is obtained using the "cout" class.
- Notice the use of the chevrons: "<<". Access to keyboard input and monitor output in C++ is given through the use of this line of code:

```
#include <iostream>
```

- In other respects, the code should look similar to what you're familiar with.
- You will need to put a semi colon after ever line of code (;) that is not the start of a block of code.

Programming Exercise 1

Use a for loop to write out the 2 times table. Your program needs to output the following to the screen:

1 times 2 = 2

2 times 2 = 4

3 times 2 = 6

4 times 2 = 8

5 times 2 = 10

6 times 2 = 12

7 times 2 = 14

8 times 2 = 16

9 times 2 = 18

10 times 2 = 20

11 times 2 = 22

12 times 2 = 24

You must use a for loop. You are not allowed to use any other type of loop construct.

Keyboard input

- In C++ you get input from the keyboard using the "cin" command.
- Notice that the chevrons are the opposite way around from when you used "cout".
- In the following code you can also see the how C++ implements a string.

```
#include <iostream>
#include <string> // You don’t have to call this if you don’t want to

using namespace std;

int main()
{
    string name;
    cout << "What is your name?" << endl;
    cin >> name;
    cout << "Hello " << name << endl;
 }
```

More Programming Exercises

- Write a program which prompts the user a number and then outputs the square of the number (the square of a number is the number mulitplied by itself).

- The length of a string can be found by using the "length" method, e.g. if we had a string variable called "word" then the length of the string would be given by the following code:

```
int result;
result = name.length();
```

- Write a program which prompts the user for their name and then tells them how many letters there are in their name.

Drawing Squares

- Write a program that prompts the user for an integer value. Using this value draw a square made out of asterisks the size of the value given, e.g. a value of 1 would give:

```
*
```

- A value of 4 would give:

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

Type No to End

- Write a while loop which prints out the message "Type 'no' to end", and then only ends if the user does indeed enter the word "no". Make sure you carefully test your program with both "no" and some other words.

Age If Statements

- This repeats a question from one of the worksheets. Use it to test your understanding of setting up a C++ project and writing C++ code.
- Start a new project. Write a program which asks the user for their age. Display a different message depending on whether they are a child, adult or pensioner. You can decide the age ranges.

Output Number of Characters

- Set up a while loop so that program reads in character values from the keyboard until an asterix is entered. You will need to count the number of characters entered. Do not include the asterix in your count.
- Output the number of characters entered.

Guess the Secret Number

- Write a program that initialises a "secret" number to a value between 1 and 10. Ask the user to enter a number between 1 and 10 in order to guess what the number is. If the number entered is correct, output "Well done, you guessed it!" or words to that effect. If the guess is incorrect, output "Wrong, try again" or similar. The program should terminate when they guess the number.
- Now modify the program so that it gives the user a clue as to guessing the number by outputting "No it is higher than that" or "No it is lower than that".

Nested For Loop

- Use a nested loop to create and display the following 3 by 3 matrix

  1 2 3

  4 5 6

  7 8 9

Advanced Tasks

- Here are some tasks for those who want to stretch themselves.
- Functions in C++ look much the same as in Python. The big differences are that you must provide the return type, then the function name, followed by the list of parameters (parameter types must also be provided in the function definition):

```
#include <iostream>
#include <string>
using namespace std;

int main()
{
	string name;
	cout << "What is your name?" << endl;
	cin >> name;
	cout << "Hello " << name << endl;
}
```

Cube of a Number

- Obtaining the cube of a number. Write a function called cubed which takes a single integer as a parameter and then returns the cube (n * n * n) of the number.

Min Function

- Write a function which, given two integers, discovers the smaller of the two integers and then returns this value.

Max Function

- Write a function which will return the maximum of three given integer values.

Area of a Cricle

- Calculating the area of a circle. The area of a circle is calculated using pi (3.14) times the square of the radius:

  area = 3.14 * radius * radius

- Write a function which calculates the area of a circle. The function takes one parameter of type float and returns a value of type flat.
- Include some error checking (try-catch not try-except) in your code. If the value of the variable passed over to the function is negative, then produce an error message and return a value of -1.

Advanced Tasks – (PORTFOLIO PIECE IN PYTHON)

Calculator Tool

- Throughout the previous semester, we extensively covered the topic of calculators. As a continuation of our exploration, I task you with creating a sophisticated console-based scientific calculator.
- Start by incorporating the fundamental operations such as addition (+), subtraction (-), multiplication (*), division (/), and modulus (%).
- Then incorporate advanced functions like factorials and exponentiation (squared, cubed).
- Feel free to organise it with a calculator class, a user-friendly menu system for efficiency, and some level of input validation.
- Draw inspiration from your PC's scientific calculator for additional features.

THAT IS ALL FOR NOW