Lab1 – CSI2372A
Thursday/Tuesday 19/24 September 2024
SITE - University of Ottawa
Due ONLINE Tuesday, October 1st at midnight
In groups of no more than two students
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- # Objectives

i) Reserved words, Operators, Basic data types, Type specifiers, Constants, Explicit conversion, Inputs/outputs (cin, cout, cerr and clog), Control structures;
ii) Principles of functions, Default arguments, Overloaded functions, Passing arguments by value and reference, and Scope of variables.
iii) Arrays and `vector` class

I. Review

I.1. Arrays
I.1.a. 1-dimensional arrays

An array allows you to access several data of the same type (vectors) from a single name.
The general definition of an array is as follows: **class type arrayName[size];**

where
- **class** specifies the storage class (extern, auto, static),
- **type** the type of the elements (int, char, float, double, ...),
- **arrayName** the name and
- **size** the number of elements composing this array.

The definition of an array named a of 10 integers will then be done as follows:
int a[10];

The initialization of the array elements can be done during the definition:
int a [10] = {10,9,8,7,6,5,4,3,2,1};

In the case of a character array, this initialization is little different:

char ch[20]="Hello";

The eighth element of this array will be automatically initialized by the end-of-string character \0.

Once defined, each of the elements can be assigned a value. Access to the different elements is done by specifying its index. It should be noted that the first element has an index equal to 0.
The assignment of the first 3 elements is then written:

a[0]=10;
a[l]=9;
...

I.1.b. Multidimensional arrays

The definition of an n (n>1) dimensional array follows the following general syntax:

class type arrayName [size 1][size 2].....[size n];

There are several ways to initialize this type of array. With aa array of 3 rows and 4 columns, we can initialize it as a list or line by line:

int a[3][4]={1,2,3,4,5,6,7,8,9,10,11,12};

or

```
int a[3][4] = {{1,2,3,4},
               {5,6,7,8},
               {9,10,11,12}
               };
```

This initialization is equivalent to the following set of assignments:

a[0][0]=1; a[0][1]=2; a[0][2]=3; a[0][3]=4;
a[1][0]=5; a[1][1]=6; a[1][2]=7; a[1][3]=8;
a[2][0]=9; a[2][1]=10; a[2][2]=11; a[2][3]=12;

I.2. Sorting algorithms

How to sort an array of integers?
find the largest element and place it at the end of the array
find the second largest element and place it in the second to last position
etc.

Sorting algorithms

How to sort an array of integers a?
For lastIndex = a.size()-1 ... 1 do find the index IMAX of the largest element of a between indices 0 to lastIndex.
Swap the elements placed in IMAX and lastIndex.
First select the largest element and place it at the end of the array; then find the second largest and place it in the penultimate place etc.

Selection Function : returns the index of the maximum value of an array passed as a parameter (T).

```
int searchIndex(vector<int> T, int imax) {
	if (T.size() < imax - 1) {
		cout << "Error! array too small ! " << endl;
		return -1;
	}
	int res = 0;
	for (int i = 1; i <= imax; i++)
		if (T[i] > T[res]) res = i;
	return res;
}
```

II. LAB Assignment 1
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Please note: In all the following questions, you are not allowed to modify the *main* program if it is not requested (Ex 2 and 3), nor the signatures of the requested functions. However, you can add functions if you wish and call them in the requested functions.

Exercise 1 (2 MARKS) :

- Complete the source file "myfile1.cpp" so that your program returns to the screen the number of bytes used by the **char**, **int**, **float**, **double**, **unsigned int** and **short int** data types. You will get this information using the ***sizeof*** operator.
- Following this information, declare an integer, a real number and a character that the program will ask you to enter.
- Display the Integer number in decimal, octal, and hexadecimal. Suggest 2 ways to make this display.
- Display the real number with and without power of 10 (scientific notation or not) with 3 significant digits.
- Display the character and its decimal value.

- Submit your file "myfile1.cpp" as well as a file "myfile1.h" which must contain the necessary header files:

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

/*Example of OUTPUT*/

```
Size in bytes of a character:          1
Size in bytes of an Integer:           4
Size in bytes of a float:              4
Size in bytes of a double:             8
Size in bytes of a short Integer:      2
Size in bytes of an unsigned integer:  4

Enter an Integer:         50

 number in decimal     50
 number in octal       62
 number in hexa        32

 number in decimal     50
 number in octal       62
 number in hexa        32

Enter a real number:   12.354
12.354
0x1.8b53f80000000p+3

Enter a character:     Hello
H
48
```

Exercise 2 (4 MARKS : 0.8 for each question) :

1) Explain in a few words what the *main* function given below in Annex A2 does.
2) Write the following two functions called in the *main* function:
   i) The function called *surface* which calculates the surface of a disk, and
   ii) The function called *volume* which calculates the volume of a cylinder.

3) The definition of the two functions must be done outside of the *main* function.
   i) Complete the heather file, myfile2.h, given in Annex A2, including the declaration of these two missing functions.
   ii) Give the final program to be executed.

```
/*Example of Output*/
```

What do you want to do?:
-Calculate the area of a disk from a radius (Press 1)
-Calculate the volume of a cylinder from a radius and a height (Press 2)
-Exit the program (press 3)

Your choice:1
Surface calculation
Enter the radius:2
The surface is: 12.5664

What do you want to do?:
-Calculate the area of a disk from a radius (Press 1)
-Calculate the volume of a cylinder from a radius and a height (Press 2)
-Exit the program (press 3)

Your choice:2
Volume calculation
Enter the radius:1
Enter the height:3
The volume is: 9.42477

What do you want to do?:

-Calculate the area of a disk from a radius (Press 1)
-Calculate the volume of a cylinder from a radius and a height (Press 2)
-Exit the program (press 3)

Your choice:3
Exit the program
The volume function has been executed 1 times
The surface function has been executed 1 times

Exercise 3 (4 MARKS : 2 for each question) :

a) Define the *sort* function in the file myfile3a.cpp given (in the place indicated), to sort in ascending order an array passed as an argument. The array is passed by value. The function returns the sorted array.
The *sort* function must call the searchIndex selection function given above in paragraph I.2.

```
vector<int> sort(vector<int> T) ;
```

b) Define the function sort in the file monfichier3b.cpp given below, to sort an array passed as an argument by reference this time, in ascending order. The function returns nothing.

```
void sort (vector<int>& T) ;
```

```
/*Example of OUTPUT for both programs a) and b)*/
```

Enter the size of your array: 5
Enter the values ??of your array:
val[0] =12
val[1] =3
val[2] =-1
val[3] =0
val[4] =100

My array values are :
12
3
-1
0
100

My sorted array values are :
-1
0
3
12
100

VI. Annexes

Annex A1.

```
/*Heather file: myfile2.h*/
#include <iostream>
#include <iomanip>
#include <process.h>

using namespace std;

const double Pi = 3.14159;

char menu(void);
int volume(double const& ray, double const& height);
int surface(double const& ray);
```

Annex A2. *main()* Function:

```
/*main Function*/

int  main() {
	char choice;
	int nvolume = 0;   //number of times the volume function has been executed
	int nsurface = 0; // number of times the surface function has been executed
	double radius, height;

	while (1)
	{
		choice = menu();
		switch (choice)
		{
		case '1': cout << endl << "Surface calculation" << endl;
			cout << "Enter the radius:";
			cin >> radius;
			nsurface = surface(radius);
			break;

		case '2': cout << endl << "Volume calculation" << endl;
			cout << " Enter the radius:";
			cin >> radius;
			cout << " Enter the height:";
			cin >> height;
			nvolume = volume(radius, height);
			break;

		case '3': cout << endl << "Exit the program" << endl;
			cout << "The volume function has been executed" << nvolume <<
			"times" << endl;
			cout << "The surface function has been executed" << nsurface
			<< "times" << endl;
			exit(0);

		default: break;
		}

	}
}
```

Annex A3.

```
/* menu Function: displays an option menu and returns the chosen option*/

char menu(void) {
	char choice;

	cout << "What do you want to do?:" << endl << endl;
	cout << "\ t-Calculate the area of a disk from a radius (Press 1)" << endl
	<< endl;
	cout << "\ t-Calculate the volume of a cylinder from a radius and a height
	(Press 2)" << endl << endl;
	cout << "\ t-Exit the program (press 3)" << endl << endl;
	cout << "Your choice:";
	cin >> choice;

	return (choice);

	cout << endl;

}
```

Submit your work ONLINE (one zip file only) before Tuesday October 1st at midnight

Instructions

- Create a directory that you will name Assignment1_ID, where you will replace ID with your student number (the one submitting the assignment).
Put all the following files in your compressed directory Assignment1_ID.zip for submission in the Brightspace Virtual Campus.

Files :

- ✓ *README.txt*
- ✓ *myfile1.cpp*
- ✓ *myfile1.h*
- ✓ *myfile2.cpp*
- ✓ *myfile2.h*
- ✓ *myfile3a.cpp*
- ✓ *myfile3b.cpp*

- Don't forget to add comments in each program to explain the purpose of the program, the functionality of each method and the type of its parameters as well as the result.
- In the Assignment1_ID directory, create a text file named README.txt, which should contain **the names of the two students**, as well as a brief description of the content:

Student Name:
Student Number:
Course Code: CSI2372A