School of Computing and Informatics

|BCS362 | Assignment I | Due: Fri 14-09-2018 | 90 Marks|

1. What is data abstraction as used in object oriented programming in C++. [2 Marks]

2. An array and a vector are declared and initialized as

```
array<float, 10> adata {4, 7, 2, 9, 5, 1, 5};
vector<float> vdata(10);
vdata = {4, 7, 2, 9, 5, 1, 5};
```

   i Explain why you would prefer using a vector instead of an array to hold the data in the code above. [2 Marks]

   ii Write 2 lines of code that will use the function **sort()** from **algorithm** library to sort elements of **vdata** in ascending order and **adata** in descending order, respectively. [2 Marks]

   iii Using range-based for loop, write lines of code that will display sorted elements of **adata** and **vdata**. [2 Marks]

   iv Write the output of **adata** and **vdata** as would be displayed after sorting. [2 Marks]

3. A program has the following lines

```
double val[10];
double *valPtr = val;
cout << valPtr << endl;
cout << val << endl;
cout << ++valPtr << endl;
cout << valPtr-- << endl;
cout << val << endl;
```

   What would be the output of line 3, 5, 6, and 7 if line 4 displays **0X70FD28** on a machine that uses 64 bit hexadecimal memory addresses and 32 bits to represent doubles. [4 Marks]

4. A function is defined as

```
int doSomething(int *const p)
{
  return *p **p **&*p;
}
```

   what would be the output of the following code. Explain. [2 Marks]

```
int p = 10;
doSomething(&p);
int b = doSomething(&p);
cout << "p = " << p << endl;
cout << "b = " << b << endl;
```

5. An array is declared an initialised as

```
int array[9] = { 3, 7, 9, 5, 6, 1, 8, 2, 4 };
```

(i) Write a function prototype for a function that receives a pointer to this array, size of an array and a function pointer to a two integer-parameter-function that determines how the elements of the array should be sorted. [2 Marks]

(ii) Write the definition of function that can be passed to the function such that its elements are sorted in ascending order. [2 Marks]

(iii) Write the definition of function that can be passed to the function such that its elements are sorted in ascending order, but with odd numbers coming before even numbers. [3 Marks]

6. Differentiate between vector capacity and size. [2 Marks]

7. A class or a function can be a friend of another class. State **THREEs** rules that restrict this kind of friendship. [3 Marks]

8. A file named *points.txt* contains x and y coordinates of points in an arc as shown below

Points on an arc

```
This file contains x and y coordinates of an arc.
The first value is x-coordinate second value is the y-coordinate.
{[{ 3.142 9.0987
74.9337 200.858
83.8168 220.22
93.4408 239.223
103.579 257.958
115.998 275.153
131.411 289.734
151.816 295.118
173.100 295.446
193.789 290.993
}]}
Above is x and y coordinates
```

(i) Write the definition of a function declared as

```
vector<double> load(string filename);
```

such that it receives the name of a file as a string and reads values of x and y coordinates from this file and store them in a vector, and return this vector. Your function should not read anything before a line that starts with { and should not read anything after a line that starts with }. [4 Marks]

(ii) Write a function that will receive the vector in (i), and write the respective coordinates in a csv file named *arc* such that its content looks like table in Figure 1. [4 Marks]

9. A file named **input.txt** contains a line of text shown below

```
Raphael Kaka 1962 100.750 B
```

Write a complete program that will read this line of text and store it in a string **data** and consequently read the strings, integer, double and character into respective appropriately declared variables. [3 Marks]

10. A class hierarchy is defined as

Point	X-COORD	Y-COORD
1	74.9337	200.858
2	83.8168	220.22
3	93.4408	239.223
4	103.579	257.958
5	115.998	275.153
6	131.411	289.734
7	151.816	295.118
8	173.1	295.446
9	193.789	290.993

Figure 1: File view of output in code need in d (ii)

```
class Person final{
  private:
    string name;
  public:
    virtual void howToMove() final {cout << "Walking"; }
}
class Student:Person{
  public:
    void howToMove() { cout << "Skiing\n"; }
    virtual Student(){ }
}
```

State and explain **THREE** errors in the code above. [3 Marks]

11. A class hierarchy is defined as

```
class Point{
  private:
    int x, y;
  public:
};
class Line:public Point{
  private:
    int a=10, b=20;
  public:
};
```

(i) Write a directive to be included in class **Line** such that it inherits constructors of class **Point**. [2 Marks]

(ii) Assuming class **Line** has a line of code you provided as answer to (i) above, what would be the effect of the following two lines of code? [2 Marks]

```
Line line(2, 4);
Line lone;
```

12. A class **Time** is declared as

```
#ifndef _TIME_
#define _TIME_
#include <iostream>
class Time
{
  private:
    int hour; //hold hour
    int min; //hold minutes
    int sec; //hold seconds
  public:
```

```
};
#endif
```

(i) Define setter functions for Time data members such that their calls can be cascaded. [3 Marks]

(ii) Define three delegate constructors that use a fourth constructor declared as

```
Time(int, int , int);
```

to initialize variables $hour, min,$ and sec. [3 Marks]

(iii) Using member initializer list, write the definition of the constructor in (ii) above. [2 Marks]

(iv) Write the definition of a function that will return current time as a string in the form of **hour:minute:second**. [3 Marks]

(v) Write the definition of a function declared as **void decrement()** such that it subtracts one second from the current time. [2 Marks]

(vi) Using a member function and function defined in (v), overload prefix decrement operator so that it subtracts one second from an object of class **Time** and return a reference to new time. [2 Marks]

(vii) Using a non-member function and function defined in (v), overload postfix decrement operator so that it subtracts one second from an object of class **Time** and return old un-decremented time. [2 Marks]

13. A Person has a name, gender and date of birth. Name consist of salutation, first and last name. Date consist of day, month and year.

(i). Write definition of class **Name**. [3 Marks]

(ii). Write definition of class **Date**. [3 Marks]

(iii). Write the definition of the class Person using objects of class **Name** in (i). and **Date** in question (ii). above for persons name and date of birth respectively. Declare gender as a string. Write getters and setters for persons data members. [3 Marks]

(iv). A Student is a person who has registration number, date of admission and programme in addition to Person's attributes. Write definition of class **student**. [3 Marks]

14. A class hierarchy is defined as

```
class Shape{
  public:
    virtual double area(){return 0.0;}
    double getArea() const {return 0.0;}
};
class Rectangle:public Shape{
  private:
    int length = 10, width = 5;
  public:
    double area(){return length * width;}
    double getArea(){return length * width;}
};
```

What will be the output of the code-segment below. Explain your answers. [3 Marks]

```
Rectangle r;
Shape *s, *sh;
s = &r;
cout << s->area() << endl;
cout << s->getArea() << endl;
cout << sh->area() << endl;
```

15. Class Date is declared as

```
1  class Date{
2    private:
3      static const int months{ 13 };
4      static const int daysPerMonth[months];
5      static int count;
6      int day, month, year;
7    public:
8      void decrement(int);
9      bool endMonth();
10     bool leapYear();
11 };
```

(i) Write lines of code that initialize **count** to **0** and **daysPerMonth** to **{0, 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31}** at global namespace such that they are accessible to all objects of the class Date. [2 Marks]

(ii) Write the definition of the function declared at line 10 such such that it returns true if a year is not a leap year or false otherwise. A leap year is divisible by both 100 and 400 or is divisible by 4. [2 Marks]

(iii) Write definition of function declared at line 9 such that it returns true if current day of the month is not the last day of the month and returns false otherwise. [2 Marks]

(iv) Write definition of function declared at line 8 such that it subtracts number of days passed to it from the current date. [3 Marks]

(v) Using function defined in (iv), overload decrement and assign operator (-=) such that it subtracts number of days it receives from the current date, and return reference of new decremented object. [3 Marks]

16. Briefly explain why it may be important to explicitly provide a virtual destructor in an abstract class. [2 Mark]

17. **Bonus:** The code below executes 5 times and stops once number 6 is found. Re-write the code without using the keyword break such that your code executes 5 times and stop after number 6 is found. [1 Marks]

```
1  int n = 10;
2  while(n >= 0){
3    if (n == 6){
4      cout << n << " Found" << endl;
5      break;
6    }
7    n -= 1;
8  }
```