Athlone Institute of Technology

School of Engineering

Semester 1 Examinations 2017

December Session

Instructions to candidates:
Read all questions carefully.
All questions carry equal marks.
Answer **Three** out of **Four** questions.

Time Allowed: 2 Hours

No. of pages including cover sheet: 5

Q.1. (a)   Explain inheritance in relation to C++.

(2 Marks)

(b)   In general if B::f is a function in the base class then a derived
can take the actions below. Explain, using an example, each
action:

- Extend B::f

(2 Marks)

- Replace B::f

(2 Marks)

- Inherit B::f

(2 Marks)

(c)   Create a UML diagram for the design of a Game Engine for the
following game description. You should also provide a brief
description of the engine with your answer.

You have been tasked with creating a First Person Shooter
(FPS) where the goal is to eliminate all other Non-Player
Characters (NPCs) in an arena. The arena also contains
'friendly' characters. If a 'friendly' is killed the player is
eliminated. The game should have the following features:

- Heads Up Display (HUD)
- Inventory System
    - Health pick-ups
    - Armour
    - Weapons
- Player Stats
    - Health
    - Armour
- Non-Player Characters
    - Enemies
    - Friendly

(12 Marks)

Q.2. (a)   In C++ what is an activation record?

(2 Marks)

(b)   Describe the contents of an activation record.

(4 Marks)

(c)   For the code segment below, show the contents of the run-time stack and value of each variable after:

- The `triangularNumber` function has been called for the last time.

(6 Marks)

- The `printResult` function has been called.

(4 Marks)

```cpp
void printResult (int value)
{
    cout << "Final result is " << value << "\n";
}

int triangularNumber (int it)
{
    if (it <= 1)
    {
        return 1;
    }
    else
    {
        int num = it * triangularNumber(it -1);
        return num;
    }
}

void main()
{
    int iterations = 4;
    int result = triangularNumber(iterations);
    printResult(result);
}
```

(d)   Explain, using an example, the role of the constructor and destructor of an object.

(4 Marks)

Q.3. (a) Compare the Standard Template Library list container and the Standard Template Library vector container in terms of efficiency when:

- Adding/Removing the element at the end of the container.

(4 Marks)

- Getting the kth element in the container.

(4 Marks)

(b) As part of a Role-Playing Game (RPG) you are tasked with creating a data structure which can efficiently handle a large number of inventory items. Inventory items are regularly added/removed to/from a player's inventory.

- Provide a class `InventoryItem` with which instances can be linked forward and backwards to other instances of `InventoryItem`.

(6 marks)

- Implement a method which removes an instance of `InventoryItem` from a linked list of `InventoryItems`.

(6 marks)

[20 Marks]

Q.4. (a)   Describe, using an example, the purpose of a function template.

(5 Marks)

(b)   The function defined below returns the product of the first *n* elements of an array of integers:

```
int calculateProduct(int data[], int n);
```

Provide an implementation for the function.

(2 Marks)

(c)   Alter the function so that it will work with any object that supports the multiplication operator (*).

(5 Marks)

(d)   What are the advantages/disadvantages of operator overloading?

(2 Marks)

(e)   Provide the definition and implementation of a class that represents a 3D space vector i.e. a vector has an x, y, and z component. Overload the following operators for your class:

- Addition operator(+), to add two vectors.

(3 Marks)

- Subtraction operator(-), to subtract one vector from another.

(3 Marks)

[20 Marks]