S228/211C

DUBLIN INSTITUTE OF TECHNOLOGY

BSc. (Honours) Degree in Computer Science

Year 2

SEMESTER 2 EXAMINATIONS 2013-2014

OBJECT ORIENTED PROGRAMMING

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CMPU 2016

Wednesday 14th May 9.30am - 12.30am

Attempt any four questions.

All questions are worth equal marks

Question 1

(a) Distinguish between *classes* and *structs* in a C# program. Provide examples of each in your solution.

(7 marks)

(b) C# supports a concept called *constructor chaining*. Briefly describe what is meant by this concept. Include examples in your solution.

(6 marks)

(c) Men should drink no more than 21 units of alcohol per week. Between 16 and 21 units is considered the "warning zone" and in in excess of 21 units is "dangerous". Write the code for a C# class called `Consumption` that encapsulates the name and alcohol consumption in units for a person. In your solution include:

i. Default and parameterised constructors.

(3 marks)

ii. Properties and fields for the name and alcohol consumption.

(3 marks)

iii. A read-only property for `WarningMessage` that returns an appropriate message string depending on the number of units.

(4 marks)

iv. An appropriate `ToString` method.

(2 marks)

Question 2

Figure 1 shows a screenshot from a Processing sketch that implements a game similar to the popular "Asteroids" game. Figure 2 shows an extract from a base class from the sketch.

Figure 1

```
class GameEntity
{

  PVector position;
  PVector look;
  PVector velocity;

  float scaleF = 1.0f;
  float speed = 100.0f;
  float timeDelta = 1.0f / 60.0f;
  boolean alive;

  GameEntity()
  {
    position = new PVector();
    look = new PVector(0, -1);
    theta = 0.0f;
    alive = true;
  }


  void update()
  {
  }

  void draw()
  {
    }

}
```

Figure 2

(a) Write code for a subclass of `GameEntity` from that encapsulates the behaviour of the player controlled ship from Figure 2 that:

i. Moves in the direction it is heading in response to the W and S keys (3 marks)

ii. Rotates left and right in response to the A and D keys (4 marks)

iii. Is drawn at the correct position and rotation (controlled by the fields `pos` and `rotation`).

(8 marks)

(b) The ship in Figure 1 can fire "lazers" at a rate of 5 bullets per second. Explain in detail how you would achieve this. Assume that bullets get removed from the scene when they go outside the bounds of the screen.

(10 marks)

Question 3

(a) Create an edit-distance (Levenshtein-distance) matrix for the following two strings:

bryan
brendan

(5 marks)

(b) Figure 3 presents an extract from struct that encapsulates a dynamic 2D matrix in C#.

```
struct Matrix2D
{
    private int rows, cols;
    private float[,] elements;

    public float Get(int row, int col)
    {
        return elements[row, col];
    }
    public void Set(int row, int col, float value)
    {
        elements[row, col] = value;
    }

  …
  …
```

Figure 3

(c) Implement the following methods:

i. A constructor that takes the row count and column count

(3 marks)

ii. An appropriate `ToString` method.

(3 marks)

(d) Write the implementation for a method:

```
private static float min3(float a, float b, float c)
```

That returns the minimum of the three float parameters.

(4 marks)

(e) Making use of the `Matrix2D` struct given in Figure 3**Error! Reference source not found.** and the method you wrote in your solution to part (d) write the implementation for the method:

```
public static int MinimumEditDistance(string needle, string
haystack)
```

The purpose of this method is to return the minimum edit distance between the two `string` parameters.

(10 marks)

Question 4

(a) Define *polymorphism* and present a simple example in C# or Processing. What problems can polymorphism solve?

(10 marks)

(b) Figure 4 shows a screenshot from a running Processing sketch that simulates a coin falling from the top of the Empire State building.

Figure 4

Given that the height of the Empire State Building is 381m, Write the Processing code to:

i. Calculate the predicted time and predicted final velocity of the coin. (5 marks)
ii. Simulate and draw the coin as it falls to the ground (5 marks)

(c) What are the main differences between Processing and C#? (5 marks)

Question 5

(a) What is meant by the keyword `static` when applied to a field in a class in C Sharp? (2 marks)

(b) You are required to create a class that manages a simple stack of generic types. Internally, the stack data should be held in an array.

i. Create the class and specify appropriate fields to manage the stack. (3 marks)
ii. Write a constructor that allows the specification of the maximum number of elements the stack can hold. (3 marks)
iii. Write a `Push` method that pushes an element onto the stack. This method should throw an `IndexOutOfBounds` exception if the `Push` method causes the stack to exceed the capacity specified in the parameter to the constructor. (3 marks)

iv. Write a `Pop` method that returns the element from the top of the stack. This method should throw an `IndexOutOfBounds` exception if there are no elements on the stack.
(3 marks)

v. Write a test program that declares an appropriate stack, pushes and pops some elements and catches any exceptions that may be thrown. (5 marks)

(c) Compare the C# `List` and `Dictionary` collection classes. Be sure to discuss the efficiency of each collection in your solution and include a short example of each in your solution.
(6 marks)

Question 6

(a) Create an interface for a logging API in C# that has one method `Log` that takes a parameter of the message to log.
(3 marks)

(b) Create a class that implements the interface from part (a) that prints the message to the console.
(4 marks)

(c) Create a class that implements the interface from part (a) that writes the message to a file.
(5 marks)

(d) A simple encryption algorithm for strings is to reverse the string, while adding an integer (called the cypher) to the ASCII code for each character in the string. In order to decrypt the string, the opposite process is performed. For example, encrypting the following string with a cypher of 1 gives:

Original	**Encrypted**
The best line of code you ever write is the line you didnt have to write	fujsx!pu!fwbi!uoeje!vpz!fojm!fiu!tj!fujsx!sfwf!vpz!fepd!gp!fojm!utfc!fiU

Write an implementation for the following static methods:

i. `static string encrypt(string message, int cypher)`
(4 marks)

ii. `static string decrypt(string message, int cypher)`
(4 marks)

(e) Write an implementation for a `Main` method that declares a string, assigns it a value and then encrypts and decrypts the string using a cypher of 1 by calling the methods you wrote in your solution to part (b).
(3 marks)

(f) What is meant by the statement `using System.Collections.Generic` that can appear at the top of a C# program file.

(2 marks)