



DUBLIN INSTITUTE OF TECHNOLOGY

**DT211C BSc. (Honours) Degree in Computer Science
(Infrastructure)**

DT228 BSc. (Honours) Degree in Computer Science

Year 4

WINTER EXAMINATIONS 2015/2016

GAMES ENGINES 1 [CMPU4030]

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THURSDAY 14TH JANUARY

9.30AM - 11.30AM

TWO HOURS

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION 1 (COMPULSORY) AND ANY 2 FROM THE REMAINING QUESTIONS
QUESTION 1 IS WORTH 40 MARKS, THE REMAINING QUESTIONS ARE WORTH 30 MARKS EACH

Question 1

Figure 1 shows a scene from a Unity3D project.

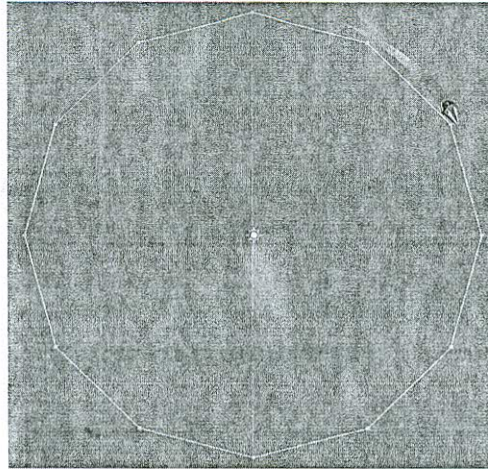


Figure 1

The space ship in the scene follows a clockwise, circular path. Describe in detail how you would construct this scene and create this behaviour. In your solution include:

- (a) How you would create and store the waypoints. (10 marks)
- (b) How you would create the path following behaviour. In your solution, describe how you would implement steering and yaw. (12 marks)
- (c) How you would render appropriate gizmos. (10 marks)
- (d) The ship should fire a projectile every 5 seconds. How would you achieve this? (8 marks)

Question 2

Figure 2 shows a Unity3D scene with a procedurally generated terrain made by sampling Perlin Noise.

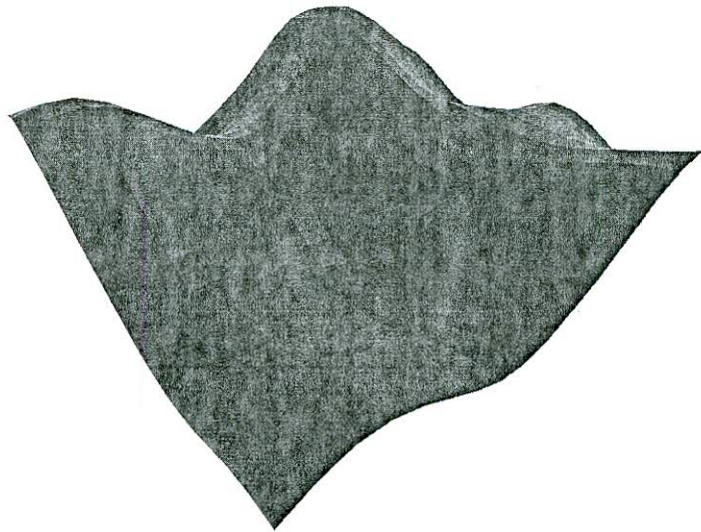


Figure 2

How you would construct a game component in Unity3D to make this procedurally. In your solution include:

- (a) What game components will need to be added. (5 marks)
- (b) What data structures are required and how you would allocate them. (10 marks)
- (c) An algorithm for generating the data to fill those data structures with appropriate data. (15 marks)

Question 3

A game component that encapsulates the fields given in Figure 3 is attached to a character in in a Unity3D scene. The `turnRateDegrees` variable is the rate at which the character rotates and is given in degrees per second. The characters model points down the **positive Z axis** when no rotation is applied.

```
public GameObject initialTarget;
public GameObject endTarget;
Quaternion fromQuaternion = Quaternion.identity;
Quaternion toQuaternion = Quaternion.identity;

[Range(0.0f, 360.0f)]
public float turnRateDegrees = 45.0f;
```

Figure 3

- (a) Construct an algorithm for calculating the characters initial rotation quaternion, so that it orientates facing a character located at the position of `initialTarget`. Use quaternions in your solution.

(10 marks)

- (b) Write the implementation for the characters `Update` method so that it turns to face a character located at the position of `endTarget` whenever the space key is pressed.

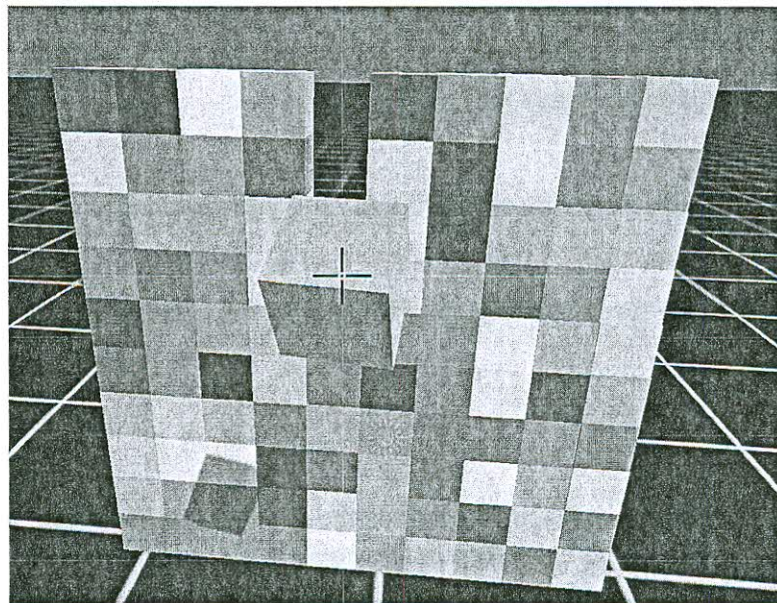
(20 marks)

Question 4

- (a) How do *force* and *torque* affect a rigid body?

(6 marks)

- (b) Figure 4 shows a wall constructed of rigid body cubes in a Unity3D scene



1.

Figure 4

How would you create this procedurally in a Unity3D game component?

(12 marks)

- (c) A *gravity gun* in 3D games allows the player to grab an object and hold it at a point in front of the camera (Figure 4). Design an algorithm in Unity3D to implement a gravity gun system.

(12 marks)