DUBLIN INSTITUTE OF TECHNOLOGY

DT211C/4 BSc. (Honours) Degree in Computer Science (Infrastructure)
DT228/4 BSc. (Honours) Degree in Computer Science
DT282/4 BSc. (Honours) Degree in Computer Science (International)
DT508/3 BA. (Honours) Degree in Game Design
DT508/4 BA. (Honours) Degree in Game Design
DT8900 International Pre Masters for MSc in Computing

SUMMER EXAMINATIONS 2017/2018

GAMES ENGINES 2 [CMPU 4031]

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TUESDAY 15TH MAY 9.30 A.M. – 11.30 A.M.

2 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

An NPC manager system in a Unity Tank Game has the following rules:

1. There are three possible NPC types and each has an equal probability of being spawned.
2. There should always be 5 NPC's in the scene.
3. NPC's are spawned at a rate of 2 NPC's per second.
4. NPC's are spawned in front of the player at random positions, a minimum of 500 units and a maximum of 2000 units from the player.
5. When an NPC is spawned, it will travel from its spawn point to a random position within a 200 unit radius of the player.
6. If the player comes within 200 units of the NPC, the NPC will shoot at it.
7. When the NPC is hit with a player bullet, it explodes and dies.
8. When an NPC dies, it can respawn at a new location.

Taking each of the rules above, how you would program them in Unity?

(8 x 5 marks)

Question 2

(a) Discuss the entity-component system in Unity. How would you design a Boid system using Unity's entity-component system? What options would you consider to improve performance of the system for large numbers of boids?

(15 marks)

(b) How you would program a character controller for a VR experience that uses an XBOX controller as input so as not to make the player feel motion sick?

(15 marks)

Question 3

(a) Explain in detail the code given in Figure 1. What does this code do?

```
public class Harmonic : SteeringBehaviour {
    public float frequency = 1.0f;
    public float amplitude = 30;
    public float radius = 10;
    public float distance = 15;

    public Axis direction = Axis.Horizontal;
    public enum Axis { Horizontal, Vertical };

    float theta = 0.0f;

    Vector3 target;
    Vector3 worldTarget;

    public override Vector3 Calculate() {
        float n = Mathf.Sin(theta);
        float angle = n * amplitude * Mathf.Deg2Rad;

        Vector3 yawRoll = transform.rotation.eulerAngles;
        yawRoll.x = 0;

        if (direction == Axis.Horizontal) {
            target.x = Mathf.Sin(angle);
            target.z = Mathf.Cos(angle);
            target.y = 0;
            yawRoll.z = 0;
        }
        else {
            target.y = Mathf.Sin(angle);
            target.z = Mathf.Cos(angle);
            target.x = 0;
        }

        target *= radius;

        Vector3 localTarget = target + (Vector3.forward *
    distance);

        worldTarget = transform.position +
    Quaternion.Euler(yawRoll) * localTarget;
        theta += Time.deltaTime * Mathf.PI * 2.0f * frequency;
        return boid.SeekForce(worldTarget);
    }
}
```

Figure 1

(20 marks)

(b) What is Perlin Noise? How would you modify the code in Figure 1 to use Perlin Noise? What effect would this have on the behaviour?

(10 marks)

Question 4

The creatures in the VR game Infinite Forms (Figure 2) can explore their environment without colliding with other creatures, the player or the environment. In relation to this ability:

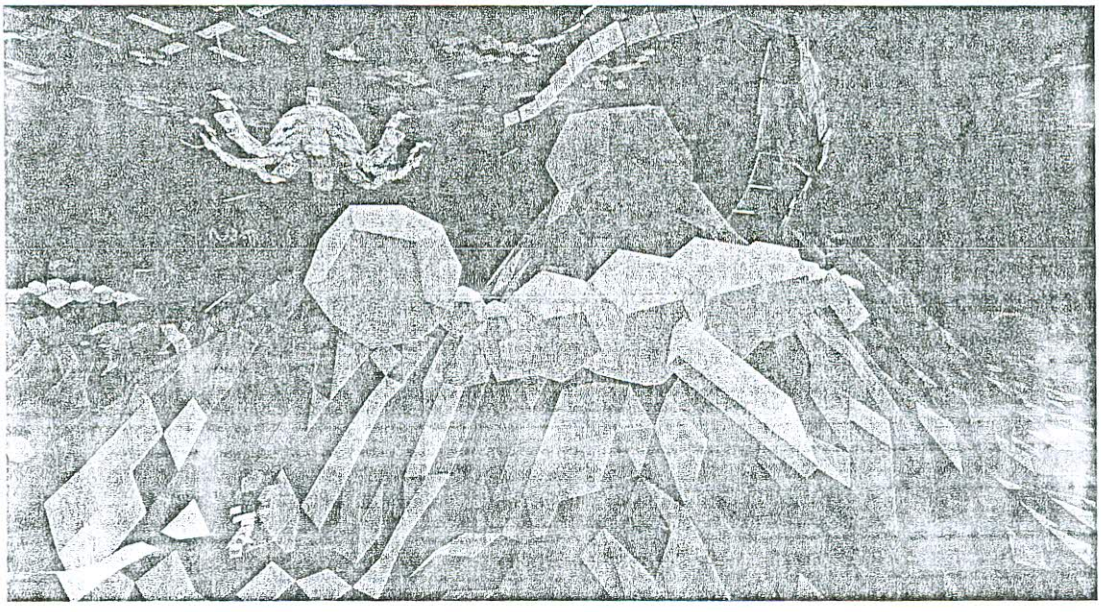

Figure 2

(a) How do the creatures perceive obstacles?

(12 marks)

(b) In what direction do the creatures generate force to steer around obstacles? How is the direction determined? What alternatives are possible? Include diagrams where appropriate.

(12 marks)

(c) How would you improve the creature's obstacle avoidance behaviour?

(6 marks)