INSTITUTE OF TECHNOLOGY TRALEE

WINTER EXAMINATIONS AY 2018-2019

MODULE TITLE
Games Development

Module Code SWDV 61007
CRN 43978

External Examiner(s): xxxxxxxxxxxx

Internal Examiner(s): Dr. Robert Sheehy

Duration: 2 Hours

Instructions to Candidates: Please answer 4 questions

Question 1

(a) In a game, a Mage will hit a target with a fire ball, if she is facing the target, which in this case means the angle to the target is less than 90 degrees.

```
target.transform.position = new Vector3(10, 7, 46);
mage.transform.position = new Vector3(20, -3, 23);
mage.transform.forward = Vector3.Normalize(new Vector3(2, 3, 6));
```

(i) Find the vector from the Mage to the Target

(2 Marks)

(ii) How far is the Mage from the Target?

(2 Marks)

(iii) Calculate `mage.transform.forward`.

(2 Marks)

(iv) Use Scalar Products to determine if Mage is facing the target.

(3 Marks)

(v) A successful attack is permitted if the distance is less than 80m, and the Mage is facing the target. Will this attack be successful?

(1 Mark)

(vi) What is the direction of for the arrow?

(2 Marks)

(vii) Given the fire ball has a fixed speed of "`fireBallSpeed`" how would you assign the initial velocity to the fire ball.

(3 Marks)

(b) Frame rates are a key consideration when implementing movement, and in particular keeping movement Frame Rate Independent

(i) What are the physical rules governing motions that are used to ensure Frame Rate Independence?

(3 Marks)

(ii) Illustrate (code or pseudo code) how Frame Rate Independent motion could be implemented

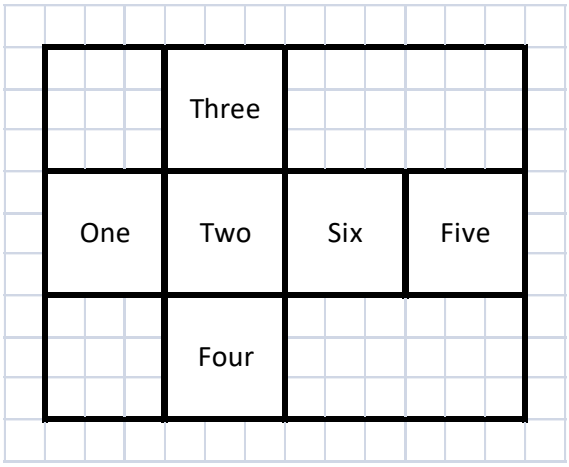
(4 Marks)

(iii) Illustrate how forces could be applied to an object, giving justification with reference to the appropriate physics formula.

(3 Marks)

Question 2

To model a die for a game, a cube is textured with the following bitmap, ensuring that opposite sides always add to 7.



(a) State two of the conventions used in model definition, and explain the rationale behind them.

(5 Marks)

(b) Derive vertex and index lists for the model of this die.

(9 Marks)

(c) What is texturing and how is it implemented?

(2 Marks)

(d) Derive the texture co-ordinates and indices for the faces illustrated above.

(9 Marks)

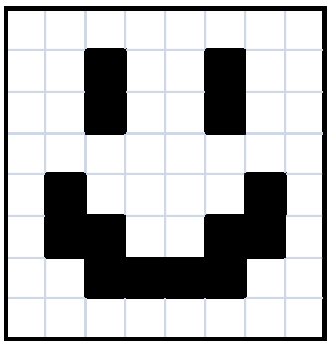
Question 3

(a) BIOT was used to determine collisions between sprites.

(i) What was BIOT?

(1 Mark)

(ii) The following sprite would have been stored in numeric form, derive these numbers.



(3 Marks)

(iii) Draw the sprite represented by the following bytes.

0,60,54,255,192,255,62,60 **(3 Marks)**

(iv) If the top left pixel of the sprite in part (ii) was placed at (32,64) and the sprite from part (iii) was placed at (28,66), illustrate on graph paper whether BIOT would detect a collision between them.

(3 Marks)

(b) Axis Aligned Bounding Boxes (AABB) are not an accurate a means of detecting collisions.

(i) Describe why AABB's are not accurate and outline their use in collision detection within a modern games engine.

(5 Marks)

(ii) The following table outlines the positions and ranges of the AABB's for 3 objects. Apply the Sort and sweep algorithm to determine if a collision has occurred.

(10 Marks)

	Object 1	Object 2	Object 3
X	54	57	63
+-	3	3	3
Y	60	75	23
+-	5	10	6
Z	68	70	30
+-	5	3	6

Question 4

(a) Artifical intelligence (A.I.) can be useful in describing behaviours of Non-Playing Characters (NPC's) in games. The implementation of A.I. is usually separated into sensing, thinking and acting sections. If we intend to implement a Finite State Machine (FSM) to deal with the thinking section…

(i) What is an FSM?

(2 Marks)

(ii) Discuss, with sample code, the implementation of a FSM referring to, with examples, the sensing, thinking and acting phases of the AI.

(6 Marks)

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(iii) What are Hierarchical FSM's and Markov Models? What advantages do these have over FSM's?

(2 Marks)

(b) The AI used in games like Chess and Draughts would be seen as a Search Problem

(i) Classical or theoretical Search problems, use a **Search Tree**, **Utility Function** and the **Min Max Algorithm**. Describe how these work to determine the best move.

(5 Marks)

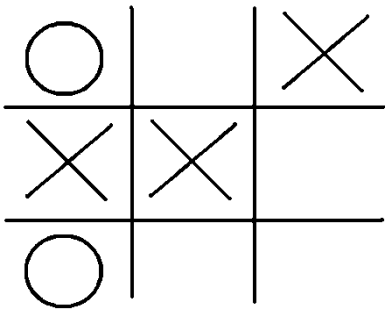
(ii) The classical approach is not feasible in practice, why?

(1 Mark)

(iii) In practice, an **Evaluation Function** is used at a specific **Ply Depth** instead of the utility function, describe how this could be used to determine the best move.

(5 Marks)

(iv) Construct the next layer of the Search Tree for this unfinished game, assuming the AI is playing O's and complete two of the branches. Apply Min/Max to those branches.



(4 Marks)

Question 5

(a) Contributing to, and managing, a group project can be a challenging problem. Describe workflow of a typical setup for a project on a public Git repository. Please address the following.

- Initial Setup.

(4 Marks)

- Typical Work session.

(4 Marks)

- Management of project after completion of work session.

(4 Marks)

(b) Inheritance is one of the core concepts of Object Orientated Programming (OOP).

- What is inheritance?

(1 Mark)

- Give an example of how inheritance may be used in game development.

(3 Marks)

A Unity script, by default, inherits from the Monobehaviour class.

- Discuss, with examples, what that means for typical unity scripts.

(3 Marks)

- Give 3 examples of where code is typically placed in a unity script, outlining when this code is called.

(3 Marks)

- Discuss the ways that game objects can communicate with each other in Unity.

(3 Marks)