WINTER/AUTUMN EXAMINATIONS AY 2021-2022

MODULE TITLE Games Development

Module Code SWDV 61007
CRN 43979

External Examiner(s):   xxxxxxxxxxxx

Internal Examiner(s):   Dr. Robert Sheehy

Duration: 2 Hours

Instructions to Candidates: Please answer 4 questions

Question 1

(a)   Mathematics and in particular vector mathematics would be used throughout games. Given the following situation:

```
Vector3 Victim = new Vector3(3,2,7);
Vector3 Attacker = new Vector3(7,-2,0);
Vector3 VictimForward = Vector3.normalise( new Vector3 (-2,2,-1));
Vector3 AttackerForward = Vector3.normalise( new Vector3 (2,3,6));
```

   (i)   Find the vector from the attacker to the victim

                                                                          (2 Marks)

   (ii)   How far is the attacker from the victim?

                                                                          (2 Marks)

   (iii)   Calculate VictimForward and AttackerForward

                                                                          (4 Marks)

   (iv)   Use Scalar Products to determine if Attacker is behind victim.

                                                                          (3 Marks)

   (v)   Use Scalar Products to determine if Attacker is facing victim.

                                                                          (3 Marks)

   (vi)   A successful attack is permitted if the distance is less than 10, the attacker is facing the victim and the attacker is behind the victim. Will this attack be successful?

                                                                          (1 Mark)

(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)

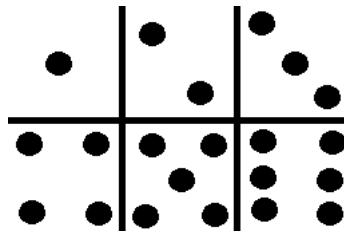   **(ii)**   Illustrate (code or pseudo code) how Frame Rate Independent motion could be implemented

   (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.

   (5Marks)

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

   (10 Marks)

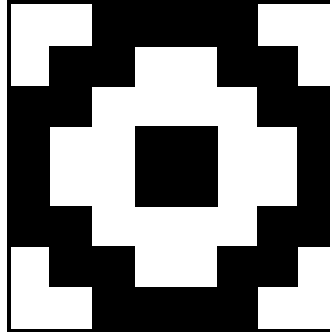**(c)**   Derive the texture co-ordinates and indices for the faces illustrated above.

   (10 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.

36,24,24,24,24,60,102,66

(3 Marks)

(iv) If the top left pixel of the sprite in part (ii) was placed at (200,352) and the sprite from part (iii) was placed at (204,348), 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 4 objects, A,B,C and D. Apply the Sort and sweep algorithm to determine if a collision has occurred.

(10 Marks)

|	A	B	C	D
X	410	130	150	390
+-	10	20	20	15
Y	300	290	295	305
+-	10	10	10	10
Z	500	100	300	600
+-	20	20	5	1

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)

      .

      (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)   Describe 2 ways that the search tree could be optimised.

(2 Marks)

      (v)   Apply the Min/Max algorithm to determine which is the correct next move, show the full tree with filtered weights in your answer.
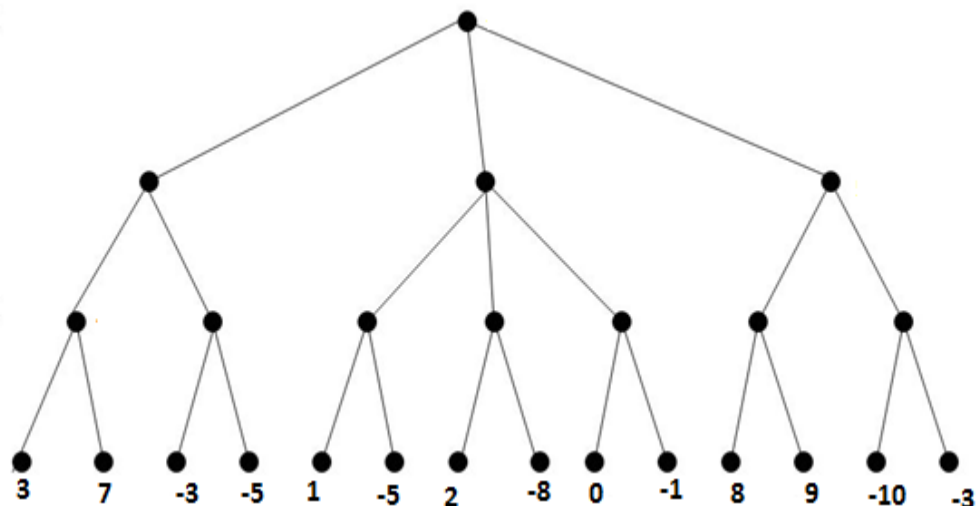
(2 Marks)

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**)   Some of the core concepts of Object Orientated Programming (OOP) are ideal for games development. For each of the following concepts, describe it, **and** give an example of its use, either from the group project this year, or with pseudo-code.

- Inheritance

(3 Marks)

- Polymorphism

(4 Marks)

- Interfaces

(3 Marks)

- Abstract Classes

(3 Marks)