University College Dublin

An Coláiste Ollscoile, Baile Átha Cliath

**SEMESTER II EXAMINATIONS**

**ACADEMIC YEAR 2017/2018**

**Module Code   COMP30540**

**Game Development**

Prof. J. Pitt

Prof. P. Cunningham

Assoc. Prof. A. Cater *

**Time Allowed: 2 Hours**

**Instructions for Candidates**

Answer any three questions. All questions carry 100 marks.
Total marks available: 300

**Instructions for Invigilators**

None

1. (*Behaviour Trees)*
1a.
What are *behaviour trees*? What may a leaf node of a behaviour tree consist of?

[20 marks]

1b.
Describe the most common types of behaviour tree interior node, in their simplest forms.

[20 marks]

1c.
Why are less simple forms of those interior node types sometimes used?

[20 marks]

1d.
So-called *Decorator Nodes* are also sometimes used. Give examples of their role in a behavior tree.

[20 marks]

1e.
Why may errors arise in using behaviour trees, and how are they accommodated?

[20 marks]

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2. (*Animation*)
2a.
What are the processes of *rigging* and *skinning* in 3D character animation?

[20 marks]

2b.
In a looping animation of a 3D character, some of its poses ought to have particular properties. Explain those properties.

[20 marks]

2c.
Give two separate reasons why a character may need to be rendered in a posture that has not been explicitly represented as a keyframe pose.

[20 marks]

2d.
What is the difference between forward kinematics and inverse kinematics?

[20 marks]

2e.
Explain why with inverse kinematics, the *coordinate descent* technique may suffer the "2-bone problem".

[20 marks]

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3. (*Rotation*)
3a.
How is the orientation of an entire 3D object represented using Euler angles?

[15 marks]

3b.
How is the orientation of an entire 3D object represented using an exponential map?

[20 marks]

3c.
How is the orientation of an entire 3D object represented using a normalised quaternion?

[20 marks]

3d.
What are the ideal properties of an angular interpolation algorithm?

[15 marks]

3e.
In what ways do *nlerp* and *slerp* applied to quaternions fall short of having these ideal properties?

[15 marks]

3f.
Why is *nlerp* accepted in practice for angular interpolation of quaternions?

[15 marks]

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4. (*Audio*)
4a.
Digitally sampled audio is used for much of the sound played during games. Explain how features of human hearing, and the Nyquist limit, are used to choose sampling rates for digital sampling.

[25 marks]

4b.
Explain simple processing that can be performed on sampled mono sound to give the illusion of sources being situated in, and/or moving in, a 2D or 3D game level.

[25 marks]

4c.
Discuss briefly how timing and head modelling can be used to provide more convincing 3D audio effects using sampled sound.

[25 marks]

4d.
Discuss how aspects of the simulated world in which sounds travel from source to ear might need to be modelled for a convincing audio experience.

[25 marks]

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5. (*Binary Space Partitioning*)
5a.
Explain how a binary space partitioning tree (BSPT) organizes a set of polygons representing the exterior surface of a solid 3D game object.

[20 marks]

5b.
How is a BSPT used to decide the order of drawing polygons onto a display?

[15 marks]

5c.
Explain how the BSPT for an entire scene can be built by merging BSPTs each representing individual objects and/or the environment in which they are positioned.

[25 marks]

5d.
How does the BSPT organization of polygons assist in determining whether the movement of one object brings it into collision with another object?

[20 marks]

5e.
Why is it preferable to represent the volume of all the polygons represented within a BSPT using a convex hull rather than using an Object-Bounding-Box aligned with the normal to its pivot plane?

[20 marks]

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