COM3404

UNIVERSITY OF EXETER

SCHOOL OF ENGINEERING, COMPUTER SCIENCE
AND MATHEMATICS
Department of Computer Science

Modelling and Animation

TWO HOURS

Answer question 1, and two out of the four other questions.
Question 1 is worth 40 marks. Other questions are worth 30 marks each.

Candidates are advised to spend FORTY-FIVE minutes on question 1
and THIRTY-FIVE minutes on other questions.

No electronic calculators of any sort are to be used during the course of this
examination.

COM3404 (2006)

Compulsory question

1. (a) List and briefly summarise the main stages of the *render pipeline*, which would generally be worked through in the production of an animated sequence or film.

    (12 marks)

    (b) Describe the differences between the following lighting types, and give an example of the type of light each could be used to represent:

        i. Spot light,
        ii. Directional light,
        iii. Ambient light.

    (9 marks)

    (c) Explain the difference between *solid* and *surface* modelling in 3D computer graphics and explain the reasons for choosing to use one over the other.

    (4 marks)

    (d) Describe the technique of *motion path* animation and contrast this with a description of **one** other commonly used animation technique.

    (5 marks)

    (e) What is the purpose of *pre production*? Outline **one** technique commonly used in pre production.

    (4 marks)

    (f) What happens during the *compositing* process? Describe its purpose, and explain the function of each of the following operators:

        i. Over operator,
        ii. Inside operator,
        iii. Set operator.

    (6 marks)

    (Total 40 marks)

    Please Turn Over

2. (a) Describe the differences between a *particle system* and a *flocking system* and briefly define each of the following terms:

   i. Cohesion,
   ii. Separation,
   iii. Alignment.

   (9 marks)

(b) A scene is being created which will involve a *waterfall* located in a valley. Nearby to the base of the waterfall, *smoke* rises from a campfire.

   Explain in detail how you would model and animate the main elements in this scene. Your answer should include an account the techniques you choose and should describe the key control parameters that can be employed.

   (21 marks)

   (Total 30 marks)

3. (a) Describe one application area which is particularly suited to *surface modelling*, and explain how 3D computer modelling is used in this area.

(5 marks)

(b) Describe one application area which is particularly suited to *solid modelling*, and explain how 3D computer modelling is used in this area.

(5 marks)

(c) Describe an appropriate technique for modelling each of the following objects. In each case discuss how the technique would be applied, including a rough sketch:

  i. A coil spring.

  ii. A bottle.

  iii. The fuselage of an aeroplane.

(12 marks)

(d) Compare and contrast the Bezier curve and B-Spline representations, giving an example of an instance for which you would use each.

(8 marks)

(Total 30 marks)

4. (a) A room contains three balls (one red, one blue and one green), located on a matte white surface. The room is lit using three lights: a *point* light from a table lamp, a *directional* light through the window, and an *ambient* light.

Explain in detail, with the aid of diagrams if necessary, how:

    i. a simple *ray-casting* algorithm is used to render this scene;

    ii. a *radiosity lighting model* would affect the final render.

Discuss the main advantages and disadvantages of these techniques.

(21 marks)

(b) Explain the types of path which may be taken by a ray of light which is incident on an object.

Describe the role of the surface normal in determining the light path and its importance in the lighting model.

(9 marks)

(Total 30 marks)

Please Turn Over

5. (a) Describe in detail the techniques and strategies used to animate the following aspects of a car model, providing sketches as appropriate to illustrate your ideas:

  i. A wheel,
  ii. A door,
  iii. The car itself.

(10 marks)

(b) Give a description and briefly distinguish between the following techniques:

  i. Hierarchical animation,
  ii. Forward kinematics,
  iii. Inverse kinematics.

Give **one** example of an appropriate application for each of these methods.

(9 marks)

(c) An animation of balls bouncing down a flight of stairs is to be generated. Give a detailed description of a technique that could be used to animate this successfully and efficiently. Explain your choice of technique by contrasting it with other animation techniques.

(11 marks)

(Total 30 marks)

End of Paper