

**RHODES UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE
EXAMINATIONS, JUNE 2001
COMPUTER SCIENCE HONOURS
PAPER 2**

Examiners: Prof S. Bangay
Mr J. Ebden
External: Prof E. Blake

Time: 3 hours
Marks: 100

Instructions to candidates:

- a) This paper consists of two (2) sections, ie. Graphics and Networks. There are 6 questions in Section A and 6 questions in Section B. There are 5 pages. **Please ensure that you have a complete paper.**
 - b) Please answer each section in a separate book.
-

SECTION A: COMPUTER GRAPHICS

[50 marks]

Answer 5 of the following questions.

Question 1

- a) Describe the vectors used when calculating the lighting of a point on a surface, and the way in which they are used to determine the resulting intensity. [5]
- b) List the series of steps required to calculate appropriate normal vectors for a surface defined as a set of triangles. [4]
- c) What is the difference between a local illumination model and a global illumination model. [1]

Question 2

For each of the following, describe briefly what is it (or how it functions), and suggest an appropriate application for it:

- a) Accumulation buffer [2]
- b) Quaternion [2]
- c) HSV colour model [2]

- d) Ray tracing [2]
- e) Dithering [2]

Question 3

- a) What is backface culling, and when can it be used? [1]
- b) How many normal vectors are there for a single triangle, and which one is appropriate for use in backface culling? How is this specific normal vector produced? [1]
- c) Describe the Z Buffer and BSP Tree approaches to hidden surface removal (pseudo-code may be used). For each, identify a situation in which its use would be appropriate. [8]

Question 4

Suggest a strategy using the facilities in OpenGL to achieve the following effects:

- a) Anti-aliasing [2]
- b) Motion blur [2]
- c) Shadows [2]
- d) Transparency [2]
- e) Capping of surfaces clipped by the near view plane [2]

Question 5

- a) What is the advantage of using homogeneous coordinates and 4 x 4 matrices for transformations in OpenGL, rather than 3D coordinates and 3 x 3 matrices? [2]
- b) Relate the series of transformations between object coordinates and screen coordinates to the various transformation matrices provided under OpenGL. [4]
- c) Each astronomical body consists of a sphere with one or more smaller spherical astronomical bodies in orbit around this sphere. This ranges from a solar system consisting of a sun with planets in orbit around it, a planet with moons orbiting it, down to the level of an atomic nucleus with electrons in orbit. Show the series of transformations that could be used to render this recursive assertion. [4]

Question 6

Decide whether each of the following statements is true or false, **explaining** your reasoning:

- a) XYZ is a good choice of colour space because it is perceptually uniform. [1]
- b) Coherence can be used to enhance hidden surface removal using the Painter's algorithm.

- [1]
- c) A random jitter is better than an ordered jitter for anti-aliasing purposes. [1]
 - d) OpenGL texture coordinates are limited to the range [0,1]. [1]
 - e) The vertex normal is at right angles to the face normal. [1]
 - f) Alpha blending is independent of hidden surface removal. [1]
 - g) OpenGL cannot resize the image when the window is resized, because OpenGL has no dependence on the windowing system used. [1]
 - h) Swarming behaviour requires knowledge about the position and velocity of every member of the swarm. [1]
 - i) The naturalist metaphor is best for designing interaction mechanisms in virtual reality systems. [1]
 - j) Bresenham's algorithm is the fastest line drawing method available. [1]

SECTION B: NETWORKS

[50 marks]

All questions carry equal (12,5) marks.

Answer 4 questions, at least two from Section 1.

Section 1

Question 1

Amongst the algorithms that we examined during the course were those for Hamming encoding and jpeg graphic compression. Using an example in each case, compare and contrast these two algorithms, drawing out any similarities of approach and commenting on the efficacy of the end result in each case.

Question 2

If you were to design a routing protocol, what 10 features would be on your "wish-list" and why? Discuss, using OSPF and RIP as case studies.

Question 3

- a) Draw a diagram to illustrate the high-level processing that occurs at the data link layer of a network that uses the OSI model. Explain your diagram. [4]
- b) Write the pseudo-code for a one-bit piggybacked bidirectional sliding window protocol at the datalink layer of an OSI network. Make sure you comment on your code enough (either in-line or at the end) to explain in detail what is happening and why. [8,5]

Section 2

Question 4

Are protocol analyzers and packet sniffers of any use? Justify your answer, using a case study to explain how and why.

Question 5

Imagine that you were a consultant in any two of the following areas of network security. A client consults you in your two areas of specialisation. What is your advice ?

- a) building a firewall (under either Unix or MSWindows),
- b) securing a Unix (OR MSWindows) server (excluding firewalls),
- c) Common Gateway Interface (CGI) security,
- d) intrusion detection technologies, with recommendations,
- e) writing a virus and an anti-virus program that would detect it,
- f) breaking in to a server on the Internet.

Question 6

With respect to Cisco computer network switching technology, discuss any three of the following using as a case study any switch with which you are familiar :

- a) performance,
- b) debugging & diagnostics,
- c) routing issues,
- d) security aspects of the interface,
- e) monitoring and/or management,
- f) configuring a VLAN.