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THE UNIVERSITY OF BIRMINGHAM

Degree of B.Sc.
Artificial Intelligence and Computer Science. Second Examination
Computer Science/Software Engineering. Second Examination
Computer Science/Software Engineering with Business Studies. Second Examination

Joint Honours Degree of B.Sc.
Mathematics and Computer Science. Second Examination

General and Combined Degree of B.A.
Arts and Computer Science. Second Examination

MSc in Computer Science

06 02504

SEM 226
Graphics 1

Monday 24th May 1999 2.00 pm - 3.30 pm

[Answer **TWO** Questions]

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1. In a colour raster scan system, numerical colour codes can be stored in the frame buffer in two ways, either by direct mapping, or using a colour look-up table.

   (a) Describe and compare these two ways of storing colour codes, stating any advantages or disadvantages in each case of the method. [15%]

   (b) For most graphics applications using the HSV colour model, it is generally considered sufficient to provide 128 hues, 8 saturation levels and 16 value settings, giving a maximum of 16384 possible colours.

   Outline the major features of this colour model and discuss how graphics memory and a colour look-up table could be set up to allow 256 colours out of a palette of 16384 colours to be simultaneously displayed. [25%]

   (c) If the 16384 colours were to be represented using the RGB colour model, instead what would be the minimum number of bits required for each primary (R,G,B) in the colour look-up table? Justify your answer. [10%]

2. (a) Describe the technique known as halftoning and illustrate how it is approximated in computer graphics. [25%]

   (b) Using ordered dithering with the 3x3 matrix show the patterns produced for the following 8 bits per pixel image.

Dithering matrix $\begin{bmatrix} 7 & 2 & 6 \\ 4 & 0 & 1 \\ 3 & 8 & 5 \end{bmatrix}$

250	250	160	250	220
80	80	80	2	135
189	50	2	194	194
250	189	189	165	250
80	132	194	80	80

[25%]

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3. A Bezier curve is generated from a set of control points by forming a set of polynomial functions which vary smoothly within a convex hull defined by these points

(a) Derive the equation of a 3-point Bezier curve defined by the following set of 3 control points:

$$(0,0)\ (2,3)\ (4,0)$$

[25%]

(b) Evaluate co-ordinates in steps of $\Delta u = 0.2$ and sketch the resulting curve together with the convex hull formed by the control points.

[25%]

The necessary definitions are given below.

Bezier function $P(u)$ in parametric form:

$$P(u) = \sum_{k=0}^{n} p_k B_{kn}(u)$$

Blending functions:

$$B_{kn}(u) = C(n,k)u^k(1-u)^{n-k}$$

where $C(n,k) = \dfrac{n!}{k!(n-k)!}$

$$n! = n.(n-1)\ldots1, \quad 0! = 1$$