

Sample Mid-Term Exam

CMSC 427, Fall 2001

Time Limit: 75 minutes, Maximum Marks: 60

Open book, open notes

Name:

UMD Id:

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Note: This exam has three pages. Please make sure you have all of them .

If the meaning of a question is doubtful, state a meaningful, non-trivial assumption and proceed.

Advice: To maximize partial credit, divide your time as per the minutes shown. Point value of each question equals its recommended time value in minutes.

Important: This is just a sample midterm. The real midterm will have more questions to ensure a better coverage of topics that we have covered in the class. This paper has questions worth 45 minutes instead of the target 60 minutes. The general level of difficulty will be approximately what you see here.

Q.1 [$6 \times 5 = 30$ minutes]

(i) List two components of the graphics pipeline that are typically carried out in fixed-point arithmetic and two that are typically computed in floating-point arithmetic.

(ii) *Interactivity* in 3D graphics has been defined as 20 - 30 frames per second. Where does this number come from? (a) CRT and LCD refresh rate frequencies, (b) Rate at which graphics cards can display 1 million triangles per frame, (c) Both of the above, (d) None of the above.

(iii) Consider a line segment that starts from $(0, 1)$ and ends at $(2, 4)$. Its equation is given by $3x - 2y + 2 = 0$. I decide to verify the Bresenham's line drawing algorithm on this line. Using the slides in Lecture 3, I set $F(x, y) = ax + by + c = 3x - 2y + 2$ and initialize $D = 2F(0, 1) + 2a + b = 4$. Since $D > 0$, I select the East pixel and set $D = D + 6 = 10$.

Since $D > 0$, I again select the East pixel and the new value of D becomes $D = D + 6 = 16$. By now I am beginning to realize that if I continue this D will be always positive and I will be always selecting the East pixel. Clearly I am making a mistake somewhere; the line joining $(0, 1)$ and $(2, 4)$ shouldn't be a horizontal line. What is the mistake?

(iv) Give two reasons why it is a good idea to avoid scan-converting common edges of adjacent polygons twice (once while scan-converting each polygon).

(v) State the transformations, their values (say rotation by x axis by 45°), and their order that the following aggregate matrix in homogeneous coordinates represents? (multiple correct answers are possible, give any one answer).

$$\begin{pmatrix} 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

(vi) Immediate-mode libraries such as OpenGL do not store the graphics datasets in their internal data-structures (with the exception of display lists that we shall ignore for the moment) and therefore cannot perform optimizations that retained-mode libraries can perform. List any two such optimizations that can benefit faster rendering for retained-mode libraries. Assume that the dataset and lights are fixed, only the viewer position is changing from frame to frame.

Q.2 [$1 \times 15 = 15$ *minutes*]

Consider a coordinate system that has its origin at the base of a tower. Give, in the matrix product form (you do not have to multiply or evaluate the individual terms of the matrix) the 4×4 transformation matrices required for viewing such that the viewpoint is at ground-level 1000 feet South-West of the tower, the viewer is looking at the origin (the base of the tower) and the projection has to occur onto a vertical view-plane aligned NorthWest to SouthEast, located at a distance of 500 feet South-West of the tower.