

Shahjalal University of Science and Technology
Department of Computer Science and Engineering
3rd Year 2nd Semester Final Examination' Dec 2018 (Session: 2015-16)
Course Code: CSE 373 Credits: 3.0
Course Title: Computer Graphics and Image Processing
Time: 3 hrs Total Marks: 100

Group A

[Answer all the questions]

1. Answer any TEN 10*1
 - a) What are the fundamental colors of both RGB and CMY color model?
 - b) What is eight point symmetry? How does it help to reduce the operational complexity of scan conversion of circle?
 - c) Compute the resolution of a 2x2 inch image that has 512x512 pixels.
 - d) Define *view plane* and *center of projection* for standard perspective projection.
 - e) If an image has a height of 2 inches and an aspect ratio of 1.5, what is its width?
 - f) Define resolution of an image.
 - g) Define sampling and quantization.
 - h) If we want to resize a 1024x768 image to one that is 640 pixels wide with the same aspect ratio, what would be the height of the resized image?
 - i) Define scan conversion. How do you scan convert a point (x,y) where x and y are real numbers?
 - j) What are the three major adverse side effects of scan conversion?
 - k) Write a pseudo-code procedure to implement the flood-fill algorithm in the text in its basic form, using the 4-connected definition for region pixels.
 - l) Describe the transformation M_l which reflects an object about a line L .
 - m) How does flood-fill algorithm works?

2. Answer any FOUR 4*5
 - a) 5

The matrix $\begin{pmatrix} 1 & a \\ b & 1 \end{pmatrix}$ defines a transformation called a simultaneous shearing or shearing for short. The special case when $b=0$ is called shearing in the x direction. When $a=0$, we have shearing in the y direction. Illustrate the effect of these shearing transformations on the square A(0,0), B(1,0), C(1,1), and D(0,1) when $a=2$ and $b=3$. Draw suitable diagrams.
 - b) Find the normalization transformation N which uses the rectangle A(1, 1), B(5, 3), C(4, 5), D(0, 3) as a window and the normalized device screen as a viewport. 5
 - c) The coordinates of the vertices of the polygon ABCDEFGH are A(2, 4), B(9, 4), C(9, 7), D(8, 7), E(8, 9), F(4, 9), G(4, 7) and H(2, 7). 2+3
 - (a) Write the initial edge list for the polygon
 - (b) State which edges will be active on scan lines $y=6, 7, 8, 9$ and 10
 - d) Under the standard perspective transformation Per_x , what is the projected image of 2+3
 - (a) a point in the plane $z = -d$
 - (b) the line segment joining $P_1(-1, 1, -2d)$ to $P_2(2, -2, 0)$
 - e) Find the transformation matrix that reflects the diamond-shaped polygon whose vertices are A(-1,0), B(0,-2), C(1,0), and D(0,2) about the horizontal line $y=2$. 5
 - f) Find the instance transformation which places a half-size copy of the square A(0,0), B(1,0), C(1,1), and D(0,1) into a master picture coordinate system so that the center of the square is at (-1,-1). Draw suitable diagrams. 5

3. Answer any TWO 2*10
 - a) Reflect the diamond-shaped polygon whose vertices are A(-1, 0), B(0, -2), C(1, 0) and D(0, 2) about 3+3
 - (a) the horizontal line $y=2$
 - (b) the vertical line $x=2$
 - (c) the line $y=x+2$
 - b) i) Given points $P_1(1, 2, 0)$, $P_2(3, 6, 20)$ and $P_3(2, 4, 6)$ and a viewpoint C(0, 0, -10), determine which points obscure the others when viewed from C. 5
ii) Represent a cube by using polygon listing and explicit edge listing. 5
 - c) i) Derive the equations of parallel projection onto the xy plane in the direction of projection $V = ai + bj + ck$. 5
ii) Find the transformation for mirror reflection with respect to the xy plane. 5

Group B
[Answer all the questions]

4. Answer any TEN

- a) Mention some aliasing effects of scan conversion.
- b) Define geometric and coordinate transformation.
- c) If $L(x_{\min}, y_{\min})$ and $R(x_{\max}, y_{\max})$ are two corner points of a rectangular clipping window then what will be the formulas for clipping any point (x, y) of an object.
- d) Define hidden surface problem.
- e) If intensity level of a 768×640 digital image is 8 what will be the size of the image in kilobyte?
- f) What are the three basic types of functions used frequently for image enhancement?
- g) "Look up table method is less memory consuming than direct coding method." Justify the statement.
- h) Give two examples of application of image processing in each area: Medical imaging, law enforcement and defense.
- i) What is the spatial and gray level resolution of the image $I(x, y)$? Calculate the minimum storage bits required to store
- j) Mathematically how do you determine whether a surface is back facing or front facing?
- k) Find the perspective projection onto the view plane $z=d$ where the center of projection is the origin $(0,0,0)$.
- l) Represent a curve using an explicit vertex list.
- m) What is the maximum number of objects that can be presented by using the Z-buffer algorithm?

5. Answer any FOUR

- a) i) "With the change of slope of a line, approaches for scan converting that line should also be changed for more acceptable scan conversion." --- Justify the statement with suitable cases. 4
 ii) What is a 4-connected region? 1
- b) Let R be the rectangular window whose lower left-hand corner is at $L(-3, 1)$ and upper right-hand corner is at $R(2, 6)$. Find the region codes for the endpoints: $A(-4, 2)$, $B(-1, 7)$, $C(-1, 5)$, $D(3, 8)$, $E(-2, 3)$, $F(1, 2)$, $G(1, -2)$, $H(3, 3)$, $I(-4, 7)$, $J(-2, 10)$ 5
- c) Define *tilting* as a rotation about the x -axis followed by a rotation about the y axis and find the tilting matrix. Does the order of performing the rotation matter? 5
- d) How does the Z-buffer algorithm determine which surfaces are hidden? What is the maximum number of objects that can be handled by using the Z-buffer algorithm? 5
- e) Using the origin as the center of projection, derive the perspective transformation onto the plane passing through the point $R_0(x_0, y_0, z_0)$ and having the normal vector $N = n_x i + n_y j + n_z k$ 5
- f) Given points $P_1(1, 2, 0)$, $P_2(3, 6, 20)$, and $P_3(2, 4, 6)$ and a viewpoint $C(0, 0, -10)$, determine which points obscure the others when viewed from C . 5

6. Answer any TWO

- a) i. Under the standard perspective transformation P_{et} , what is the projected image of 8
 - i) A point $P(2, 3, -d)$ in the plane $z=-d$ and
 - ii) the line segment joining $P_1(-1, 1, -2d)$ to $P_2(2, -2, 0)$.
 Use suitable figures.
- b) i) What are the main differences between perspective and parallel projection? 2
 ii) Describe the transformation M_L which reflects an object about a line L . 5
 iii) Describe the transformation that rotates an object point $Q(x, y)$, θ° about a fixed center of rotation $P(h, k)$. 5
- c) The vertices of a polygon are given in order: $(2, 4)$, $(2, 7)$, $(4, 8)$, $(4, 12)$, $(8, 9)$, $(8, 7)$, $(9, 7)$, $(9, 4)$. 10
 - i) Draw the polygon and label vertices and edges
 - ii) Construct the edge-list to fill the polygon region using Scanline algorithm.
 - iii) Which edges will be active on scan lines $y = 5, 7, 8, 9, 11$?
 Find the clipped portion of the scanline $y=7$.