CS 4731 – A '02 – Midterm Exam

Name:

Instructions: Read questions carefully before answering. Do not hesitate to ask for clarifications. Show all work. Partial credits are given, so do not leave anything blank! Use the back of the pages for extra paper as needed. Good luck!
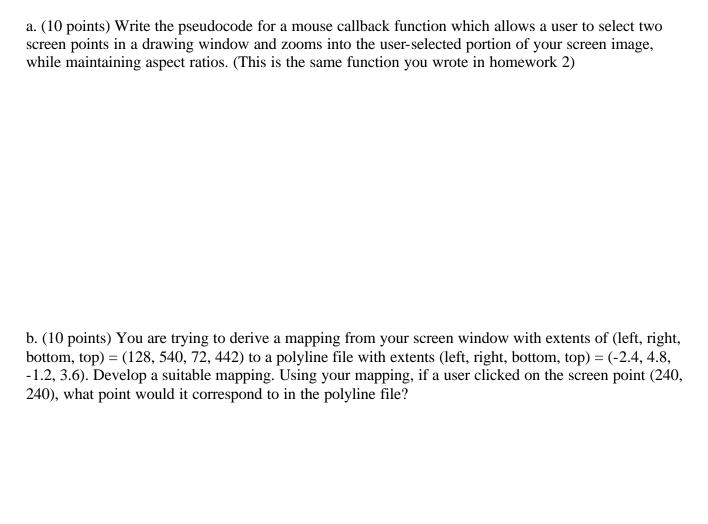
Question 1: Basic definitions

a. Define the following terms and give two examples of each:

    i.   (3 points) Input device

    ii.   (3 points) Output device

b. (8 points) Give the OpenGL code to draw a five-sided polygon with vertices (0,0), (5.878, 0), (6, 3), (4,5) and (1, 2)

c. What are the GLUT calls to:

    i.   (3 points) Register a mouse callback function

    ii.   (3 points) Register a reshape callback function

Question 2: Window-to-Viewport Mapping

a. (10 points) Write the pseudocode for a mouse callback function which allows a user to select two screen points in a drawing window and zooms into the user-selected portion of your screen image, while maintaining aspect ratios. (This is the same function you wrote in homework 2)

b. (10 points) You are trying to derive a mapping from your screen window with extents of (left, right, bottom, top) = (128, 540, 72, 442) to a polyline file with extents (left, right, bottom, top) = (-2.4, 4.8, -1.2, 3.6). Develop a suitable mapping. Using your mapping, if a user clicked on the screen point (240, 240), what point would it correspond to in the polyline file?

Question 3: Cohen-Sutherland Clipping

a. (12 points) You decided to implement the Cohen-Sutherland algorithm in homework 2. You got the algorithm working. Then, your roommate decided to play a prank on you and deleted the tests for trivial accept and trivial reject in the Cohen-Sutherland clipping algorithm while you were away. You continued to work on the program without knowing (since it compiled okay) and turned it in. Will the algorithm still perform correctly without these tests? Why? Describe in some details the effects of this attempted sabotage on your program.

b. Given a rectangular clipping window bounded by points (4, 2) and (12, 8), what are the results of clipping the following edges:

   a. (4 points) (6,10) to (13, 15)

   b. (4 points) (-1, 3) to (8, 6)

Question 4: Fractals/Mandelbrot Set

a.(2 points) What is the Mandelbrot set?

b. (8 points) Name four applications of fractals

c. An IFS uses the function $f(s) = s^2 + c$. What are the first four terms using the following complex numbers? Is this a converging series?

   i. (5 points) $s = 0$, $c = 0.4 + 0.7i$

ii.   (5 points) s = 0, c = 0.3 + 0.25i

Question 5: Vectors/affine transforms

Write out the 4x4 affine transform matrices, M, to transform a point, P = (Px, Py, Pz) to a new point, Q=(Qx, Qy, Qz). i.e. Q=MP:

a. (4 points) Rotate by 30 degrees about the y-axis

b. (4 points) Scale by factor S = (Sx, Sy, Sz) = (0.5, 2.0, 0.6)

c. (4 points) Translate point P by T = (3, 5, 9)

d. (8 points) combined transform matrix for a 65 degrees rotation about the z-axis followed by a scaling by (0.5, 0.3, 7), then a translation by (2,-1,4)