CS 184, Spring 1998
Quiz #1
Professor C.H. Sequin

Problem #1(6 points)

Which of the devices below are calligraphic (vector-drawing)? --> Circle the correct answer.

- YES NO Penplotter.
- YES NO Liquid Crystal Displays.
- YES NO Plasma Panel.

Problem #2(4 points)

Indicate the BEST and the WORST choice among the listed displays for the purpose of displaying animated wire frames:

- Disrec-view storage tube.
- Liquid-Crystal Panel.
- Vector-drawing CRT.
- Raster-display CRT.

Problem #3(10 points)

For each of the objects described below, list the representation that most naturally fits the structure of the object; choose from: Boundary Repr. (BRep)--- Constr. Solids Geometry (CSG) --- Volume Repr. (Octree) -- Procedural genration by sweeping (Sweep) -- Prototype instantiation (Inst.)

- An idealized wedge of Swiss Cheese.
- Magnetic-resonance imaging (MRI) data of a brain.
- An Easter-egg approximated by 9000 triangles.
- Pipes in an oil refinery.
- A turbine wheel with 120 complicated fan blades.
- The surface $z = \sin(x*x + y*y)/(x*x + y*y)$ for $|x|, |y| < 8$.

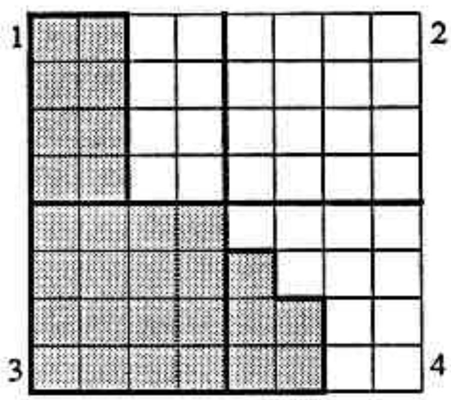
Problem #4(10 points)

Name FOUR logical input device types:

Name the FOUR basic interaction tasks discussed in class:

Problem #5(10 points)

Show a QUAD-TREE representing the geometry in the Figure below. Draw the tree with the children of each node appearing in order {1,2,3,4} from left to right and show the leaf-node values.



Problem #6(10 points)

Circle the correct answer.

- 2D-rotations of homogeneous coordinate triples are described by orthogonal matrices. TRUE | FALSE
- If points P0, Q0, R0 are carried into points P1, Q1, R1, respectively, by a uniform scaling S(c,c,c) for some c > 0, then the angle P0Q0R0 is equal to the angle P1Q1R1. TRUE | FALSE
- To find the result of transforming 100 vectors, Vi, by matrices M,N,P,Q in order, the following indicates an **efficient** plan of computation. TRUE | FALSE

  for i=1 to 100 do wi = (((ViM)N)P)Q);

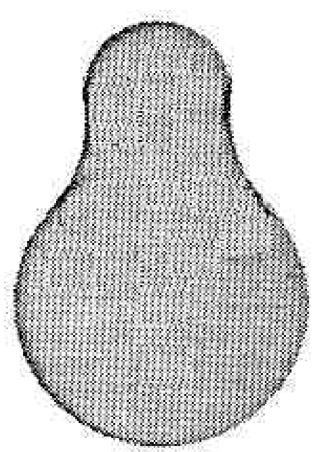
- If we change the viewport, we see the same part of the object drawn on a differnt part of the display. TRUE | FALSE
- In 2-space, rotation around the origin and uniform scaling with respect to the origin are commutative.TRUE | FALSE
- It takes a minimum of three numbers {e.g. (A,B,C)} to specify a line in 2-dimension space. TRUE |

FALSE

- Any combination of rotations and translations will always result in a rigid body transformation.
TRUE | FALSE

Problem #7(10 points)

Given the 2-dimensional pear shown below and a 2-D computer graphics CSG system with only the primitives **unit-square** and **unit-circle**, describe a simple CSG tree that will model the pear below. Minimize the number of elements and boolean operations that you are using. Show your CSG, and the corresponding transformed leaf objects overlayed on the picture of the pear.



Problem #8(15 points)

In World coordinates, a glass pyramid has vertices A=(0,0,-1), B=(2,0,-1), C=(0,-2,-1), D=(2,-2,-1), and E=(1,-1,1), and has all its faces having these points as vertices. A second identical pyramid is balanced upside down on top {in z-direction} of its tip E, having the edges of its square base parallel to the x and y coordinate axes.

Write down a compact hierarchical GLIDE description in the form of a single GLIDE group of this scene. Make sure that the vertices for each face are listed in an order that will appear counter-clockwise when the face is viewed from outside the pyramids.

Problem #9(15 points)

Prove that for the transformations discussed so far in this course, we can transform a straight line segment by transforming its endpoints and then constructing a new straight line segment between the transformed endpoints.

Problem #10(15 points)

Describe with a string of transformations [using the symbols translate: T(dx,dy); scale: S(sx,sy); rotate: R(alpha)] the window-to-viewport transformation that maps the contents of a GLIDE **frustum (a,b,c)(d,e,f)** into part of a **viewport (p,q,*) (s,t,*)** so that the result has **<u>no distortion</u>** and appears **<u>as large as possible</u>** and **<u>centered</u>** in the viewport.

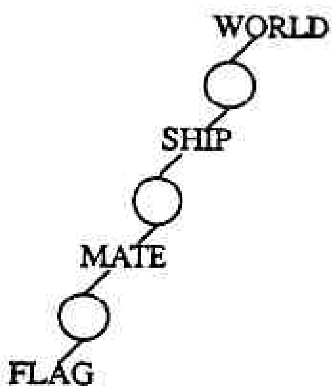
Problem #11(15 points)

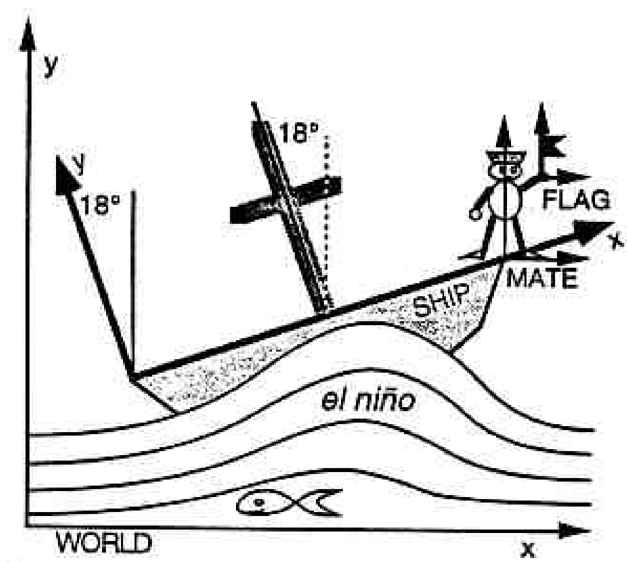
The two-dimensional scene below has the hierarchical structure indicated by the diagram below, where the circles indicate the respective transformation matrices at each instance call. Thus the position of FLAG in WORLD coordinates is given by the compound transformation:

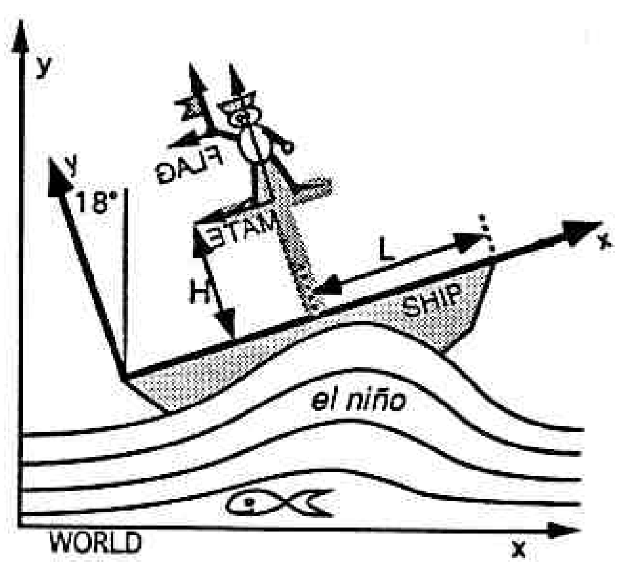
FLAGworld= **FLAG**mate * **MATE**ship * **SHIP**world [denote this as eqn. 1]

assuming the use of homogeneous **ROW** coordinate triples.

We further assume that the current values of these matrices describe the state of the scene on the left below:







Now we want to describe the scene depicted on the right by inserting a few extra matrices into the string of matrices in eqn 1. Write down a suitably modified product of matrices for the new **FLAG**world. Use only the demensions and angles explicitly indicated in the scences above. Use the "CS184 short-hand notations" described in Problem #10 to express additional simple transformations, e.g., T(dx,dy),S(sx,sy), R(alpha).

new_FLAGworld =