CMSC427 Final Practice v2
Fall 2017

This is to represent the flow of the final and give you an idea of relative weighting. No promises that knowing this will predict how you'll do on the final. Some questions are repeated from previous homeworks and test, just as they will be on the final. Some questions are phrased with alternatives – this is practice, so the point is to give a range of possible questions. And some questions don't have much space for answers – also, just practice.

Grade

Section	**Worth**	**Received**
I. Definitions	**25**	
II. Curves and polygons	**25**	
III. Transformations	**25**	
IV. Surfaces and meshes	**25**	
V. Local and global rendering and shading	**25**	
Total	**125**	

Extra credit. Do you really need a practice bonus question?

Section I: Definitions and math (25 pts)

Q1. General definitions (12 pts)

A. CSG stands for (circle the correct one).

i. Cool strategy game | ii. Constructive solid geometry

iii. Computer systematic graphics | iv. Huh?

B. Explain briefly the nature and purpose of the Cornell box.

C. How does a cube map assist in representing a complete scene?

D. Describe the process of capturing a 3D mesh.

Q2. Essential math (13 pts)

A. Find a normal vector to the following triplet of points (doesn't matter if it is out or in relative to the triangle.)

P1=(1,1,1)   P2=(1,0,1)   P3=(1,0,0)

B. Given three points, how do you determine they are collinear given vector operations?

C. Compute the distance from point (1,1) to the line defined by (1,2) and (5,4).

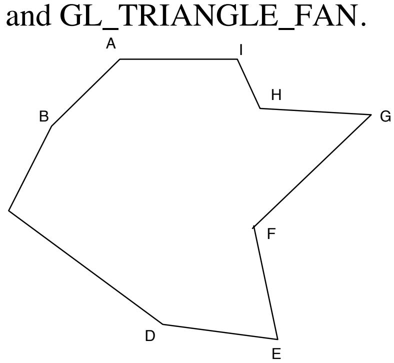
D. Using vector operations, how would you determine if four points P1, P2, P3 and P4 are coplanar?

Section II: Curves and polygons (25 pts)

Q1. Polygons (13 pts)

A. Given a polygon of n points, what's the brute force algorithm to determine if the points represent a convex polygon.

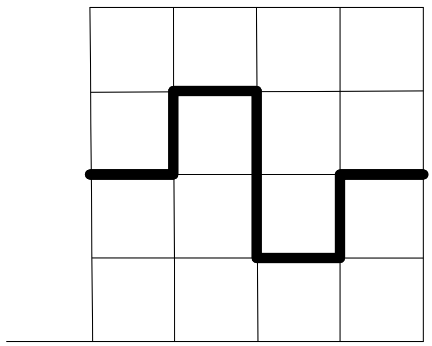
B. Give the sequence of vertices needed to draw this polygon using GL_TRIANGLE_STRIP and GL_TRIANGLE_FAN.



FAN ____

STRIP ____

Q2. Polygons (12 pts)
A. Given the fractal curve below, give (a) an Turtle graphics generator for it and (b) the fractal dimension.



B. Describe the basic process of mid-point displacement fractals.

2D version. Given two points A and B, how you compute a displacement point

3D version. Given three points A, B and C on a triangle that represent part of a terrain surface, how would you compute a displacement and recursively define three new triangles?

Section III: Transformations (25 pts)

Q1. Basic transformations (10 pts)

A. Which of the following pairs of transformations do *not* commute?

i. Non-uniform scale and rotation in 2 or 3D.

ii. Two rotations around the origin in 2D.

iii. Two general rotations in 3D.

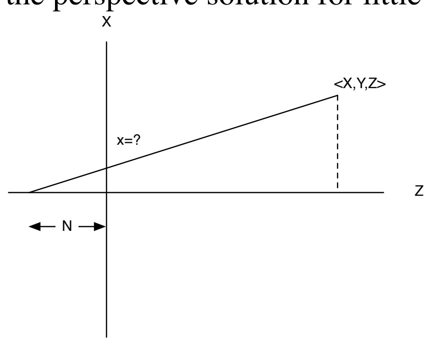
B. Give matrices to rotate and translate a shape around its center of mass. Assume the center of mass is at (x,y), and the rotation is theta. Since it's in 2D the rotation isn't around a specific axis – we're in the xy plane. Give the matrices, and then give the composition of matrices you'd need to perform the operations in the right order. Do not calculate out the final matrix.

Q2. Camera. (8 pts)
A. What happens if the up vector is <0,0,0>?

B. Given the input data below, compute the camera coordinate system xc, yc and zc, and the camera matrix. For full credit give the inverse matrix

at = (1,0,1) lookAt = (1,0,0) up = < 0, 1, 0>

Q3. Perspective (7 pts) From this diagram set up the perspective equation for *x*. Here N is the offset of the eye point back from the origin – useful if you'd like to take the eye point to negative infinity to see what happens. The image plane is the X axis. Give the similar triangle equation, the perspective solution for little x, and the resulting matrix.



Section IV: Surfaces and meshes (25 pts)

Q1. Meshes (12 pts)

A. An indexed polygon mesh data structure maintains three lists, vertices, normals and faces. What information does a face have?

B. What is the difference between facet and true normals, and why we assign normals to each vertex rather than each face?

C. What's the approximate space efficiency for N vertices of using a triangle strip over using triangles, given that the latter requires you to send each vertices multiple times, once for each triangle?

Q2. Surface equations (13 pts)

A. Given the following 2D curve in the x-y plane, give the parametric surface of revolution around the y-axis.

$$P(u) = \left\langle \ \sin 2\pi u \quad u^2 + 1 \quad 0 \ \right\rangle$$

B. Given a 3D parametric surface P(u,v) = < R*cos(v), h*v + d, u^2 >, compute the parametric normal as a function of (u,v).

Section V: Local and global shading (25 pts)

Q1. Basic shading (12 pts)

A What are the differences, in process and effect, between Phong and Gouraud shading? What will the latter miss that the first may catch?

B.. How would you map a texture onto a parametric cylinder?

Q2. Lighting (12 pts)

A. In the basic shading model that we've covered, what's the role of the ambient term? How does it cover up for flaws in how the model approximates lighting in a scene?

B. What is the effect of increasing f in the shading equation (the exponent for the specular component?

C. What are the purposes of the following rays in ray tracing?

a. Shadow ray

b. Reflection ray

c. Refraction (or Transmission) ray