

EECS-376 Practice Quiz 2

Question 1

Describe how to set a breakpoint on Unity using whichever IDE you use.

Answer: see the slide deck.

Question 2

Why do we use triangles to model shapes in 3D?

Answer: because triangles can form any polygon, and polygons allow you to make a piecewise-planar approximation to any surface. Piecewise planarity is nice because planes are linear, and so interpolating across them, computing their intersections, and so on, are all linear. GPUs are good at computing linear functions because they're glorified dot product engines.

Question 3

Here's an equation for the brightness of a pixel given position \mathbf{r} of the patch of surface being imaged, the direction \mathbf{L} of the light ray that's hitting the patch of surface, and the surface normal \mathbf{n} of the patch:

$$\text{brightness} = A + B(\mathbf{L} \cdot \mathbf{n}) + C \left(\mathbf{L} - 2(\mathbf{n}(\mathbf{L} \cdot \mathbf{n})) \right) \cdot \mathbf{r}$$

All vectors here are assumed to be in camera-centered coordinates, and to keep things simple, we're assuming this is just in black and white so the result is one number, a brightness. The three constants A , B , and C control the amount of diffuse, specular, and ambient light. Which one controls which? That is, which of the terms in the above equation are the ambient, diffuse, and specular terms?

Answer: A=ambient, B=diffuse, C=Specular

Question 4

If you're displaying a model using Phong shading and a texture map, what information needs to be specified for each vertex, besides its position in space?

Answer: normal and texture coordinates.

Question 5

Why do we have to draw transparent surfaces from back to front?

Answer: because alpha blending isn't commutative; drawing in different orders yields different results.

Question 6

What is the separating axis theorem? Why do we care?

Answer: it says that if convex objects don't intersect, there has to be an axis (or equivalently, a plane) that separates them. It's the basis of pretty much all collision detection schemes, and it's the reason we have to decompose concave objects into convex parts in order to do collision detection.

Question 7

Give a situation in which static collision detection will miss a collision and continuous detection will detect it.

Answer: small objects moving very fast. They "teleport" past one another, and so static collision detection misses the collision.

Question 8

What coordinate systems (object, world, camera, and screen) do each of the following matrices map? Give your answers in the form "X coordinates to Y coordinates":

- The projection matrix
- The model matrix
- The view matrix

Answer: model: object to world, view: world to camera, and projection: camera to screen.

Question 9

What's a good heuristic function for path planning in 2D?

Answer: Euclidean distance, i.e. normal straight line distance to the goal.

Question 10

In the Spore behavior tree system, what's the difference between the Decide() function and the Tick() function?

Answer: Decide determines whether a node wants to start running. Tick() is called when it's already running and its return value determines whether it should stop running.

Question 11

Your GPU's frame buffer stores the Z coordinate from which every pixel is imaged. Why?

Answer: so that when it draws two surfaces at the same pixel, it can determine which one was in front and which one was in back, and keep the one that's in front.

Question 12

Why is it expensive to switch from one shader to another while rendering.

Answer: we'd accept two answers for this. One is that it's expensive on the CPU side because the CPU has to form a different batch, and because of the internal properties of graphics drivers, batches are expensive. The other is that it's expensive on the GPU side because the whole GPU pipeline has to

empty out before you can switch shaders (otherwise you have parts of the old mesh being drawn with the new shader).

Question 13

Your friend is making a space flight simulator and is representing 3D position as a combination of translational position and a unit vector in the direction the ship is pointed. Why is this not even a valid representation of 3D pose?

Answer: because it's missing a degree of freedom. It doesn't account for rotation about the direction the ship is pointing in.

Question 14

What are the disadvantages of rotation matrices as a representation of rotation?

Answer: (1) they can't be interpolated and (2) they use 9 numbers (or 16 in projective coordinates) to represent a quantity that really only has 3 degrees of freedom.