## Question 1:

To try out the subdivision methods we discussed in class, I wrote a system a system that takes as input a polygon mesh – it assumes that all of the polygons are flat and convex.

For subdivision schemes that require triangles, all polygons are divided into triangles by adding a point in the center of the of the polygon, and making triangles by connecting adjacent edges – so a pentagon gets divided into 5 triangles, a hexagon into 6 triangles, etc.

The system implements the Catmull-Clark, Loop, and Modified Butterfly subdivision schemes as described in class. It works correctly.

A) For a given input mesh, two of the schemes are likely to give similar looking results, while the third is likely to be quite different. Which one will be most different, and why?

B) If the input is a regular triangle mesh with N triangles, how many polygons will there be after 2 rounds of subdivision? (give an answer for each scheme)

C) For all three schemes, there is a special subdivision rule for the boundaries of the mesh. Points on the boundary only depend on other points on the boundary. What is the advantage of such a scheme?

## Question 2:

In this question, we consider resampling an image to make it bigger. We will consider 3 different methods: nearest neighbor interpolation (basically using a box filter), linear interpolation (that is, using a tent filter), and Lanczos interpolation (using a Lanczos filter). The Lanczos filter is a much better approximation to the ideal low-pass filter (sinc) than the linear filter.

I start out with a checkerboard that is light gray and dark gray (the pixel values are 205 and 50). The image is 32x32 pixels, and the checkerboard squares are 4x4.

I resize my checkerboard by a factor of 4 (so the result is 128x128) using each of the three resampling methods (nearest, linear, Lanczos).



Which method is likely to have given the sharp result?

Which method is likely to have given the blurry result?

Which method is likely to have given the result with the light and dark fringes?

For this specific case (scaling the checkerboard by 3), the sharp result looks best (since it is a checkerboard with the same two values as the original). More often, we prefer the methods that produced the blury result to the method that produced the sharp one. Explain why and give an example where blurrier is better.

Question 3:

Please define the following terms concisely – a sentence or two is all that is needed.

Limit Surface –

Shadow Map –

Color Gamut – (in class we just said "Gamut")

## Question 4:

In the picture below, the curve is made of two connected cubic Bezier segments (one using points 1234 and the other using 4567)



In all parts of this question, we consider the continuity at point 4.

For each of the continuity types below, either say "the curve has it" or describe the minimum number of points that must move to create that continuity, and where those points must go. To describe where a point should go, make a labeled point (with a letter) on the picture above. You'll need to mark the letters on the picture above yourself.

Example: C(0) continuity: the curve has it

Example: XXX continuity: point 7 moves to X and point 6 moves to Y (where X was drawn)

- A) C(1) continuity
- B) G(1) continuity
- C) C(2) continuity

Question 5:

Most humans (i.e. those who are not color blind) are tri-chromats. We have 3 different types of photoreceptors (cones).

Like many kinds of birds, ducks are a penta-chromats. They have 5 different types of photo receptors.

Describe a situation where the duck's superior color vision might allow it to distinguish colors that we could not.

If a duck looks at a rainbow (a real rainbow – created by water droplets acting as a prism spreading the white sunlight into its component colors), does it see more colors than us? Explain your answer.

Hint: a rainbow is made up of a series of pure colors (that is, colors of a single wavelength).

## Question 6:

Environment mapping makes some assumptions that allow for the creation of shiny surfaces using standard graphics hardware.

A: Explain what the assumptions are and describe a situation in which Environment mapping works well.

B: Describe a situation where the assumptions of Environment mapping are violated, and it would be a poor approximation of a shiny object.

Question 7:

When doing MIP-MAPPING, tri-linear interpolation is generally better than bi-linear interpolation. Give some reasons why (describe some things that would look worse with bi-linear).

Part of the idea of giving a final exam is to make sure that you do some review/study at the end of the semester to help the material sink in. So, here are some questions that try to check that more directly.

Question 8:

Name a topic that we discussed in the second half of the course that did not appear on the exam:

Question 9:

Give three of the most interesting facts about graphics that you reviewed while studying. (These should be things that you learned in class, either from the lectures or the readings). Please choose things that haven't already been tested on the exam.

9A)

9B)

9C)

Really, the best way to evaluate how much you learned about graphics is to see what you did with your projects. So these questions are to get a sense of what you thought of them. There are no right answers – we'll give you the exam points just for giving an answer, so please answer honestly.

Question 10:

Which project was your favorite? (and why?)

What is the most interesting thing you learned by doing project 4?

Some students like open-ended projects that let them choose what they do. Other students like projects that clearly specify what is required.

This class tends towards the open-ended style.

Which do you prefer?

How do you think we could make the current set of projects more like what you wanted?