CISS380: Computer Graphics
Quiz q2101

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Open `main.tex` and enter answers (look for `answercode`, `answerbox`, `answerlong`). Turn the page for detailed instructions. To rebuild and view pdf, in bash shell execute `make`. To build a gzip-tar file, in bash shell execute `make s` and you'll get `submit.tar.gz`.

Q1. Write a program that displays your own 3D model of a cube: https://photos.app.goo.gl/D6xYhqagXPH5scVT9 There's a text that is always on the top face of the cube (and follows the top face during any rotation of the cube). Initially the cube is rendered using immediate mode quads. Create your own 3D model of a cube in 4 ways:

- Quads. The displayed text is "immed quad".
- One triangle strip (using immediate mode). The displayed text is "immed trimesh".
- Client-side vertex array using one triangle strip (use an array that intertwines vertices and normal vectors) and using `glDrawArrays`. The displayed text is "client-side vert arr gldrawarrays".
- As above but using `glDrawElements`. The displayed text is "client-side vert arr gldrawelements".
- Display list of one triangle strip (you can use immediate mode or client-side vertex array). The displayed text is "display list".

Initially immediate mode quad is selected. The user press "w" (memory aid: "which") to go through the options is a cycle.

Hints/guide

1. Here's a demo. https://photos.app.goo.gl/9iK2UA6bNNGPAFqd7. I've added 3d text to the program – you don't have to do that.
2. Download the solution to q09 and use it. Note that the solution allows you to test all side of the cube by using keys r,R,s,S,t,T. To help with comparing your cube using client side vertex arrays, you might want to keep the q09 solution and toggle between that and your client side arrays with a key press.
3. Use the diagram in the notes to help with the design, the picture with the cube unrolled that I drew in class (see section 21.3.3). Label the coordinates of every point and for each point write down the normal vector. Look at the notes in sections 19.8 and 19.9. In 19.7, the example has an array of vertex-color data. Check 19.9 on changing color to normal vector.
4. Using glDrawArrays draw the top face using a triangle strip. In the array, you should have vertex-normal-vertex-normal-vertex-normal-vertex-normal. (There are 4 points on the top face). Test it using r,R,s,S,t,T.
5. Next add data to your array for the front face (there are four vertex-normal pairs). The top and front are two different strips. So you need to add "extra vertex-normal" (two) just like the example I talked about in class to stitch up two strips – you need to duplicate the last vertex-normal of the top face and the first vertex-normal of the front face. If you do it right, you will see a sharp change in shading between the top face and the front face. If you don't add the two "extra vertex-normal pairs", you most likely won't get a sharp change in the shading between the top and front fact.
6. Repeat step 4 until you have the whole cube.

Instructions

In `main.tex` change the email address in

```
\renewcommand\AUTHOR{jdoe5@cougars.ccis.edu}
```

yours. In the bash shell, execute "`make`" to recompile `main.pdf`. Execute "`make v`" to view `main.pdf`. Execute "`make s`" to create `submit.tar.gz` for submission.

For each question, you'll see boxes for you to fill. You write your answers in `main.tex` file. For small boxes, if you see

```
1 + 1 = \answerbox{}.
```

you do this:

```
1 + 1 = \answerbox{2}.
```

`answerbox` will also appear in "true/false" and "multiple-choice" questions.

For longer answers that needs typewriter font, if you see

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
\end{answercode}
```

you do this:

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
int x;
\end{answercode}
```

`answercode` will appear in questions asking for code, algorithm, and program output. In this case, indentation and spacing is significant. For program output, I do look at spaces and newlines.

For long answers (not in typewriter font) if you see

```
What is the color of the sky?
\begin{answerlong}
\end{answerlong}
```

you can write

```
What is the color of the sky?
\begin{answerlong}
The color of the sky is blue.
\end{answerlong}
```

For students beyond 245: You can put LaTeX commands in `answerlong`.

A question that begins with "T or F or M" requires you to identify whether it is true or false, or meaningless. "Meaningless" means something's wrong with the statement and it is not well-defined. Something like "$1+_2$" or "$\{2\}^{\{3\}}$" is not well-defined. Therefore a question such as "Is $42 = 1+_2$ true or false?" or "Is $42 = \{2\}^{\{3\}}$ true or false?" does not make sense. "Is $P(42) = \{42\}$ true or false?" is meaningless because $P(X)$ is only defined if X is a set. For "Is $1 + 2 + 3$ true or false?", "$1 + 2 + 3$" is well–defined but as a "numerical expression", not as a "proposition", i.e., it cannot be true or false. Therefore "Is $1 + 2 + 3$ true or false?" is also not a well-defined question.

When writing results of computations, make sure it's simplified. For instance write 2 instead of $1 + 1$. When you write down sets, if the answer is $\{1\}$, I do not want to see $\{1, 1\}$.

When writing a counterexample, always write the simplest.

Here are some examples (see `instructions.tex` for details):

1. T or F or M: $1 + 1 = 2$ ..... T
2. T or F or M: $1 + 1 = 3$ ..... F
3. T or F or M: $1+^2 =$ ..... M
4. $1 + 2 =$ 3
5. Write a C++ statement to declare an integer variable named `x`.

   ```
   int x;
   ```

6. Solve $x^2 - 1 = 0$.

   Since $x^2 - 1 = (x - 1)(x + 1)$, $x^2 - 1 = 0$ implies $(x - 1)(x + 1) = 0$. Therefore $x - 1 = 0$ or $x = -1$. Hence $x = 1$ or $x = -1$.

7. Which is true? C
   (A) $1 + 1 = 0$
   (B) $1 + 1 = 1$
   (C) $1 + 1 = 2$
   (D) $1 + 1 = 3$
   (E) $1 + 1 = 4$