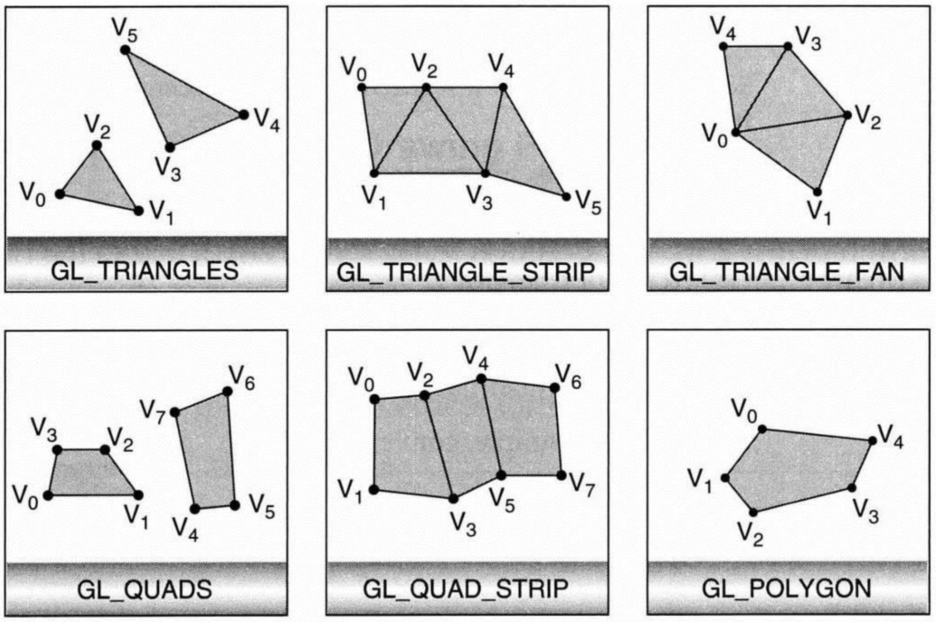
CS3241 Computer Graphics (2019/2020 Semester 1)

Tutorial 2

For Week 4

Please attempt the following questions before you go to your tutorial classes. Some of the questions may be quite open-ended and some may be even ambiguous. In those cases, you are encouraged to make your own (reasonable) assumptions.

(1) OpenGL supports the `GL_TRIANGLES` primitive type. Why do you think that OpenGL also supports `GL_TRIANGLE_FAN` and `GL_TRIANGLE_STRIP`?


GL_TRIANGLES
V_0 V_1 V_2 V_3 V_4 V_5
GL_TRIANGLE_STRIP
V_0 V_1 V_2 V_3 V_4 V_5
GL_TRIANGLE_FAN
V_0 V_1 V_2 V_3 V_4
GL_QUADS
V_0 V_1 V_2 V_3 V_4 V_5 V_6 V_7
GL_QUAD_STRIP
V_0 V_1 V_2 V_3 V_4 V_5 V_6 V_7
GL_POLYGON
V_0 V_1 V_2 V_3 V_4

(2) How does double buffering work? Why do we use it?

(3) What is the use of the GLUT function `glutPostRedisplay()`?

(4) Hidden surface removal is not necessary if we can sort the polygons in a back-to-front order and render these polygons in that order. Is it always possible that any set of polygons can be sorted in a back-to-front order? Show examples.

(5) **(A)** What is an OpenGL viewport? **(B)** How do you specify one? **(C)** Can we have multiple viewports in a window? **(D)** Can a viewport be larger than the window? **(E)** If yes, what will happen? **(F)** When you use `glClear(GL_COLOR_BUFFER_BIT)`, are you clearing the entire window or just the viewport?

(6) Assume we have the following OpenGL function calls:

```
glViewport( u, v, w, h );
...
gluOrtho2D( x_min, x_max, y_min, y_max );
```

Find the mathematical expressions that map a point (x, y) that lies within the clipping rectangle to a point (x_s, y_s) that lies within the viewport.

(7) In many old CRT monitors, the pixels are not square. Let's assume the pixel width-to-height aspect ratio is 4:3. Suppose in the camera coordinate frame, there is a disc in the $z = 0$ plane, centered at (100, 200, 0), and has a radius of 10. You want to draw the entire disc as big as possible inside the window, and it should appear circular and not oval. **(A)** If the window size is 600 × 300 (width × height), how would you set up the viewport and the orthographic projection using OpenGL? **(B)** What if the window size is now 300 × 600? **(C)** What if the window size is now 300 × 320?