3D Graphics and OpenGl

First Steps

Rendering of 3D Graphics

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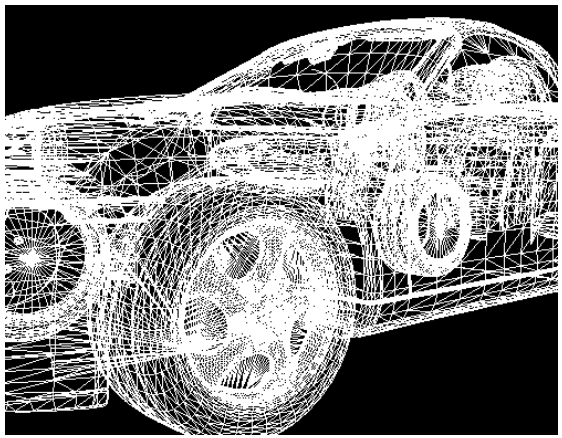

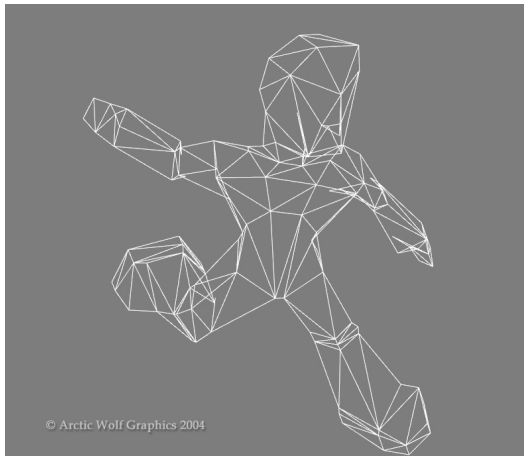

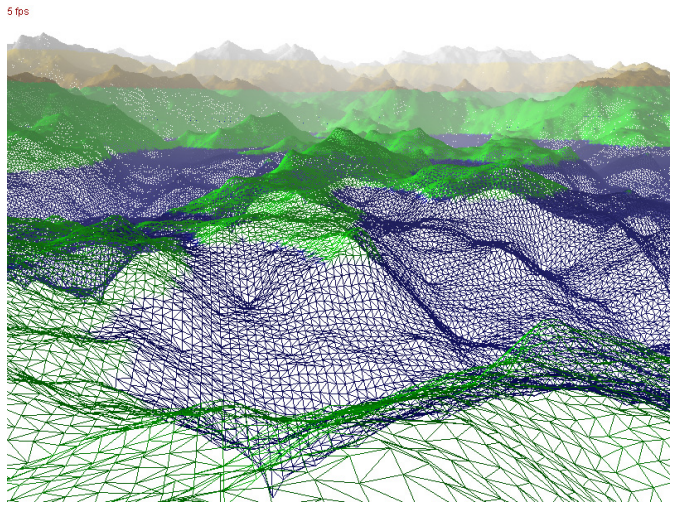

Rendering of 3D Graphics

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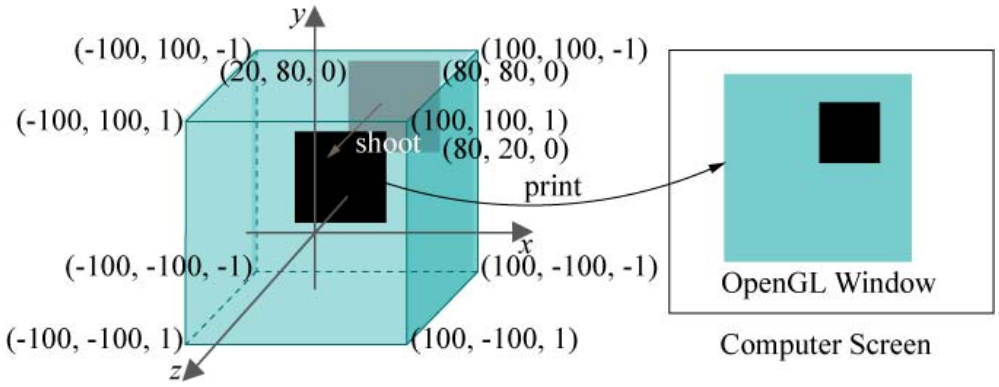

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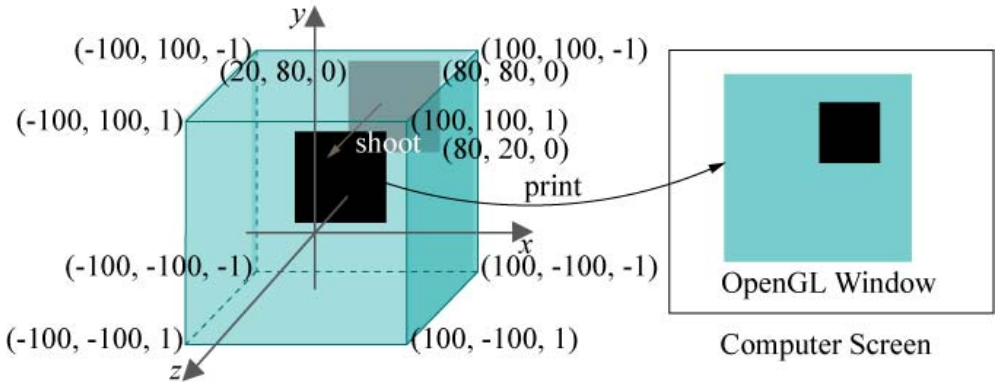
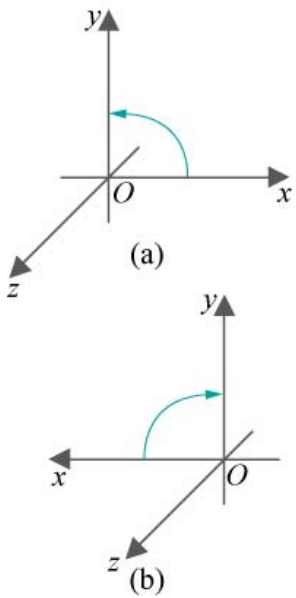
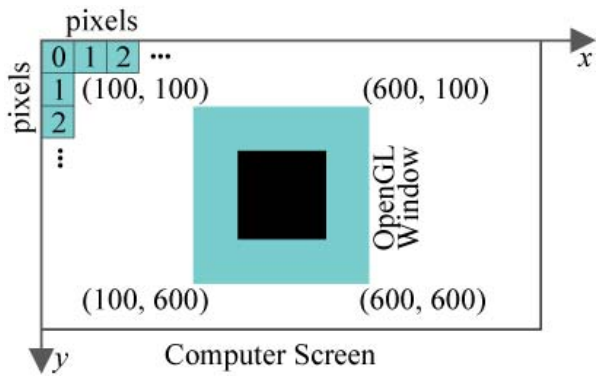


Coordinate systems:



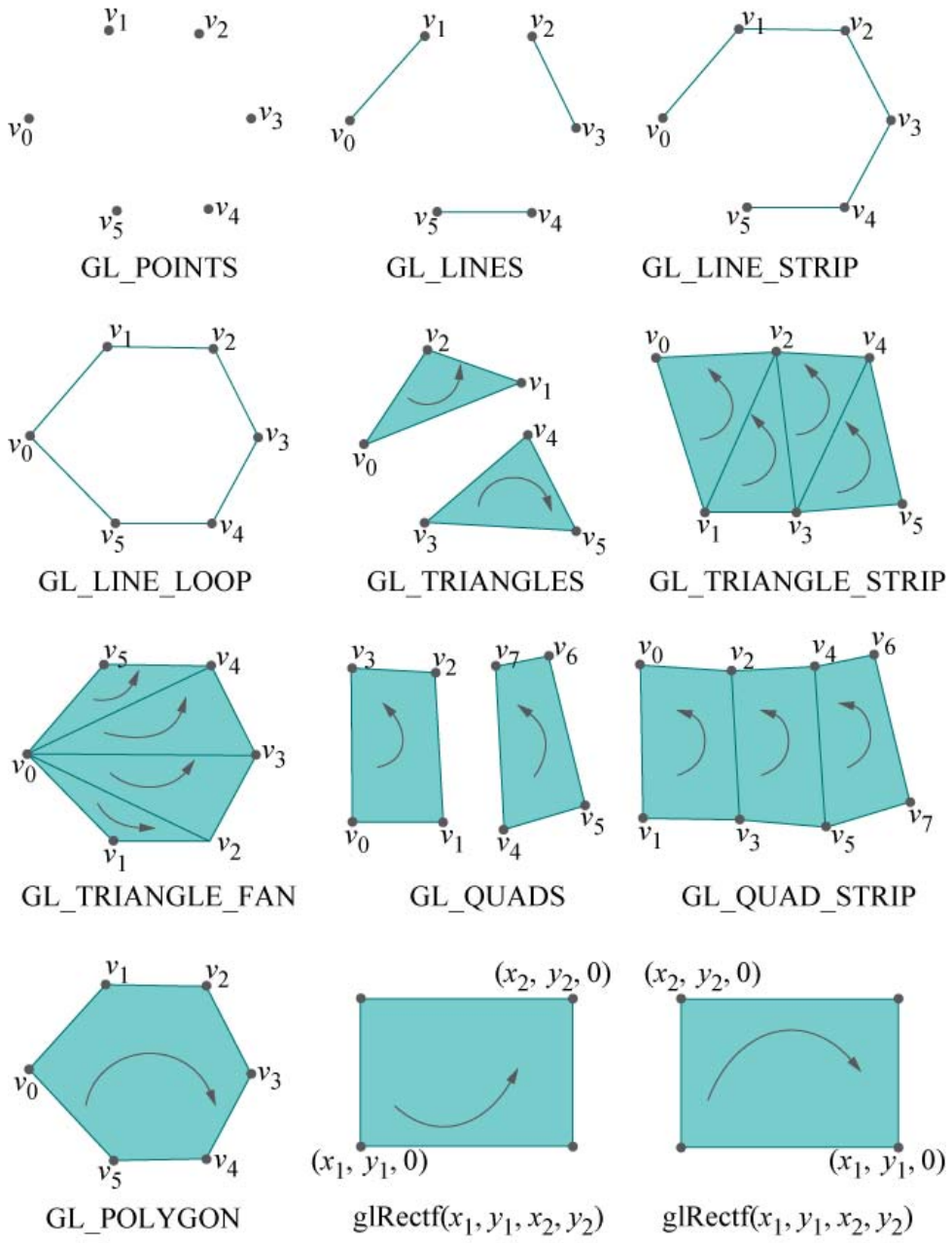


Vertices

Core data: vertices of triangles.

```
glBegin(GL_TRIANGLES);
   glVertex3f(20.0, 20.0, 0.0);
   glVertex3f(80.0, 20.0, 0.0);
   glVertex3f(80.0, 80.0, 0.0);
   .
   .
glEnd();
```

Other OpenGL Primitives



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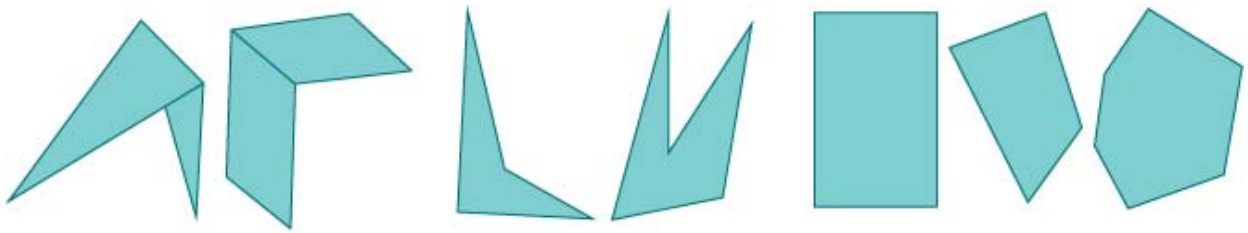

Not planar, not convex Planar, not convex Planar and convex

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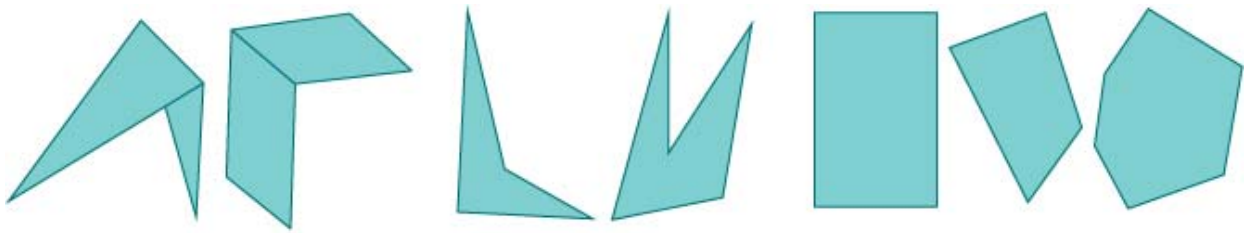

For efficiency, use array lists (single rendering call accessing array of many points) and display lists (precompiled and stored groups of OpenGL commands, including declarations of geometry/primitives). See sections 3.1 and 3.2.

Geometry

Core data: triangles

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- Position
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- Normal vector
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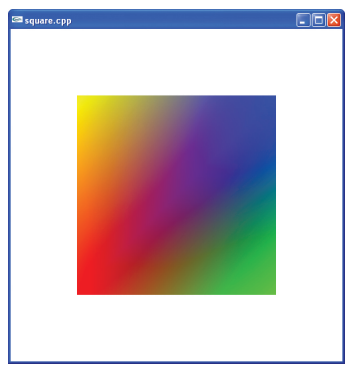

OpenGL has a state

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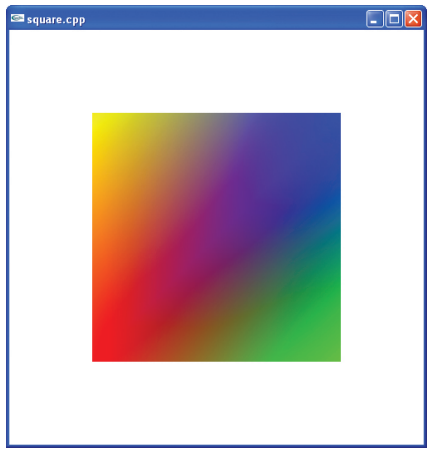
E.g., setting (foreground/vertex) color using `glColor`:

```
glBegin(GL_QUADS);
   glColor3f(1.0, 0.0, 0.0);
   glVertex3f(20.0, 20.0, 0.0);
   glColor3f(0.0, 1.0, 0.0);
   glVertex3f(80.0, 20.0, 0.0);
   glColor3f(0.0, 0.0, 1.0);
   glVertex3f(80.0, 80.0, 0.0);
   glColor3f(1.0, 1.0, 0.0);
   glVertex3f(20.0, 80.0, 0.0);
glEnd()
```



Projections

Transfer (models built of triangles built of vertex) points from 3D space to 2D screen space.

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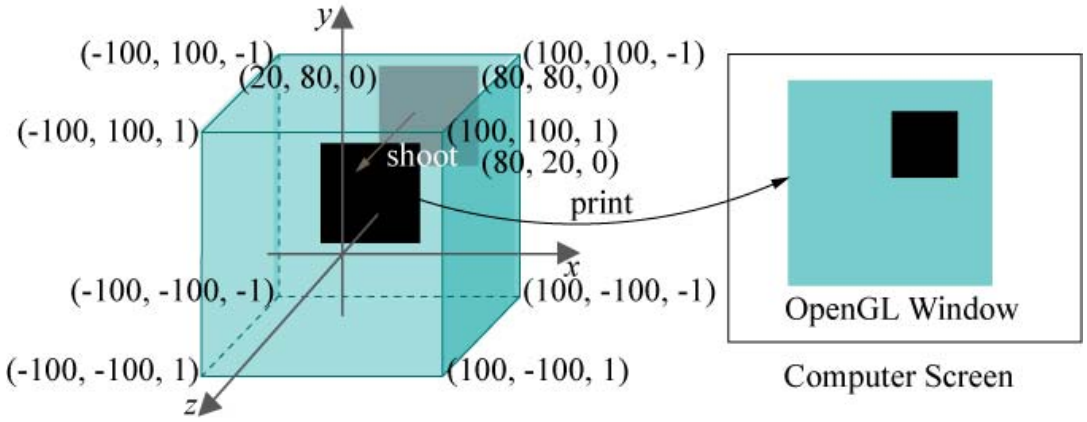
Two types:

- Orthographic
- Perspective

Orthographic Projection



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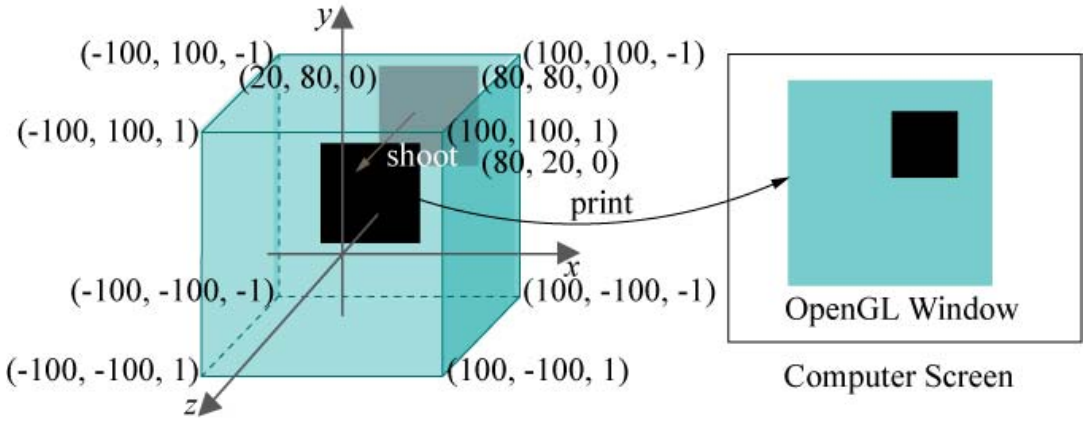
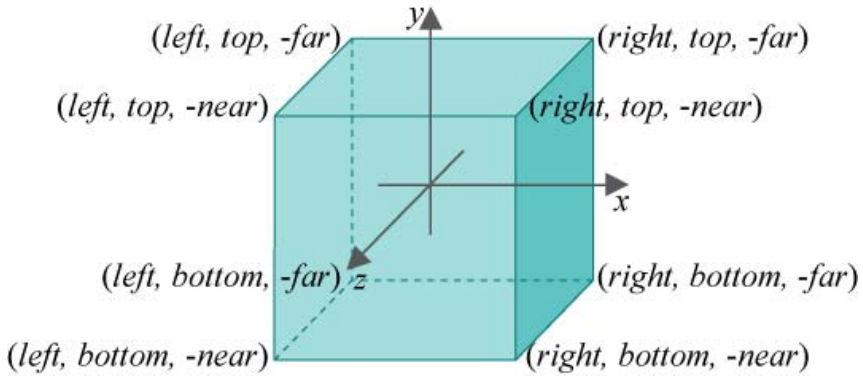
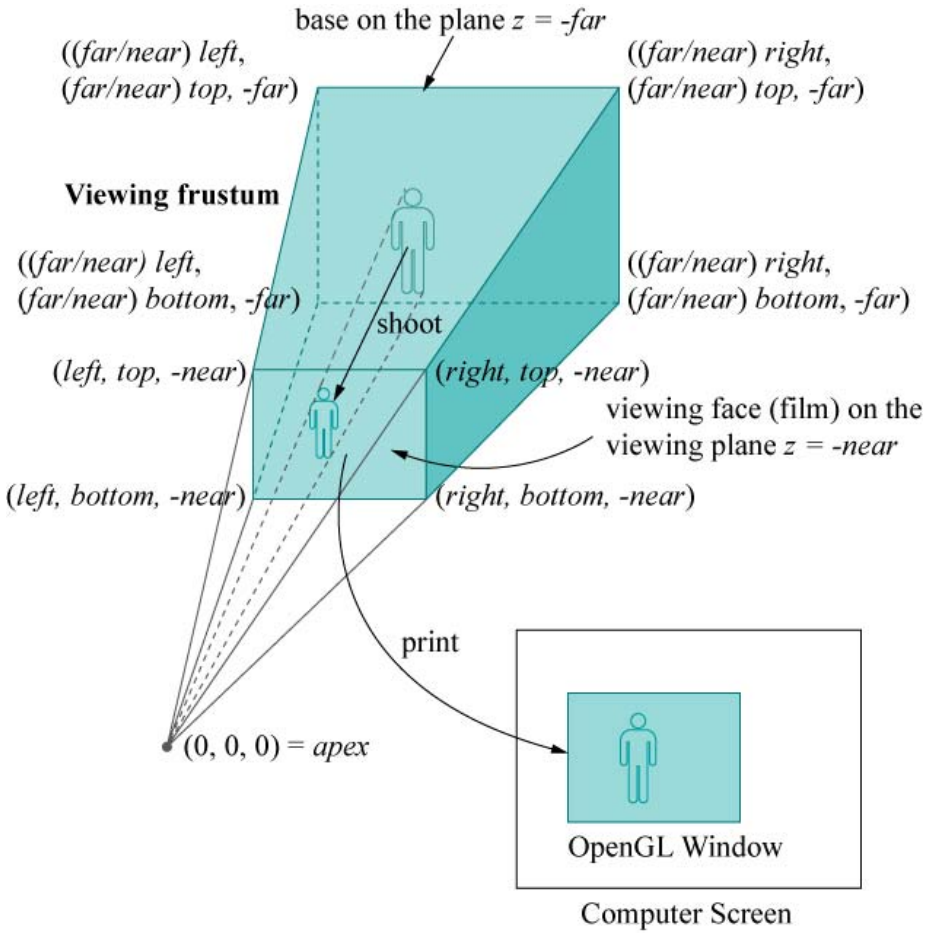




Perspective Projection



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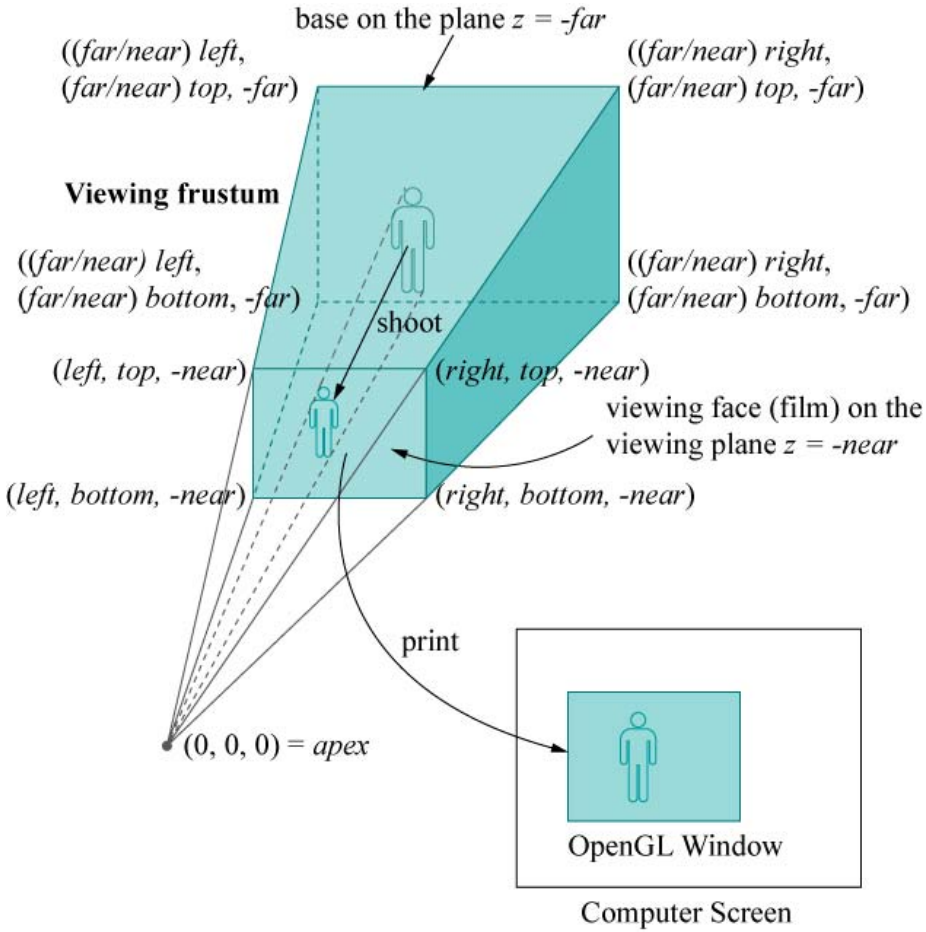
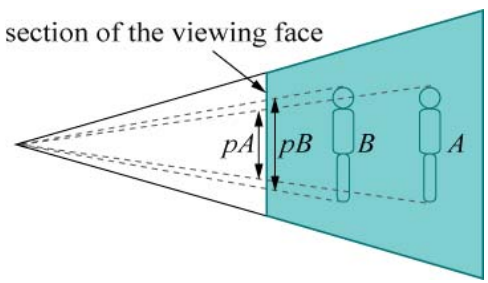
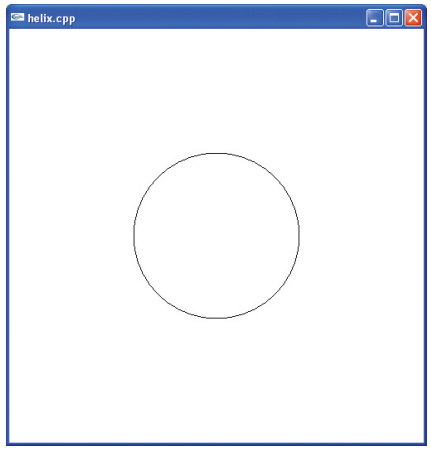


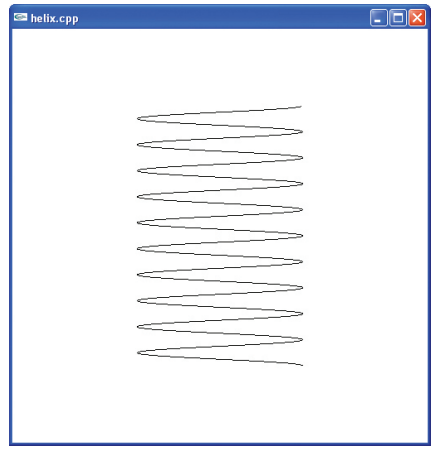


Perspective

Helix curve:

Orthographic:





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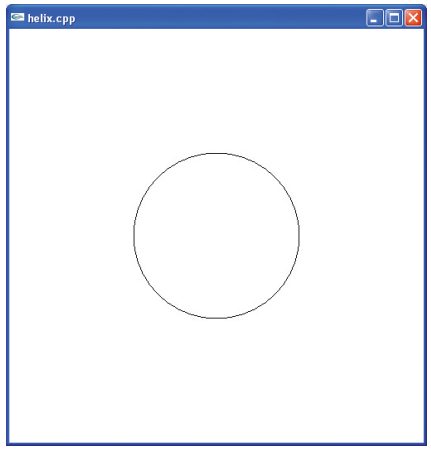
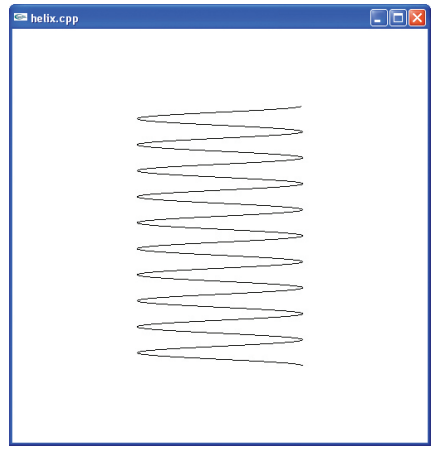
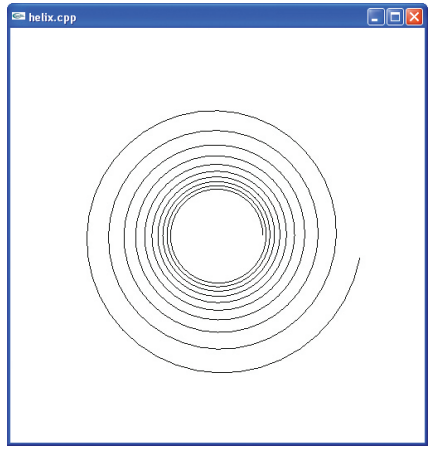
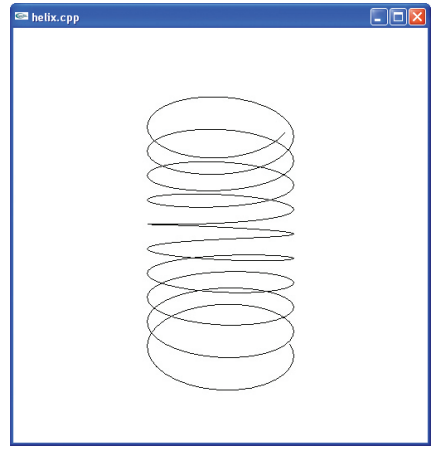




Projective:





Clipping before Projection

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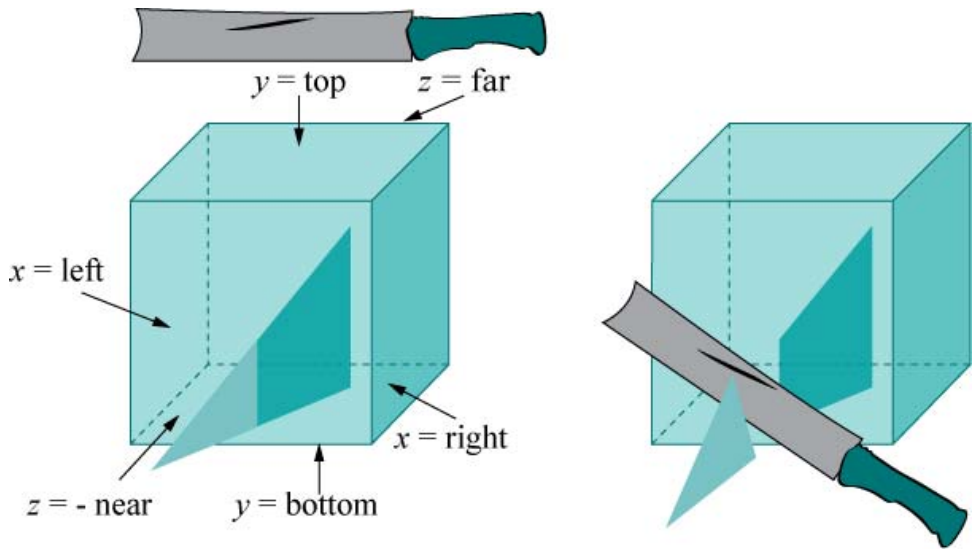
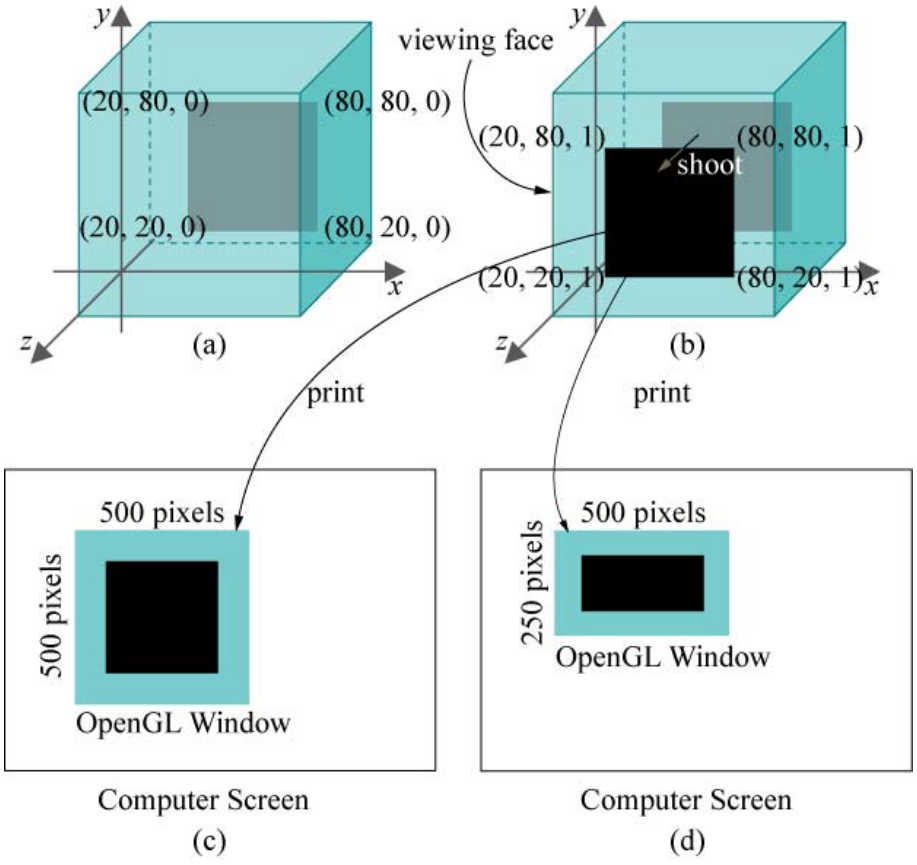


Stretch after Projection

The projected image is stretched to the screen/window size after projection.



OpenGL Buffers

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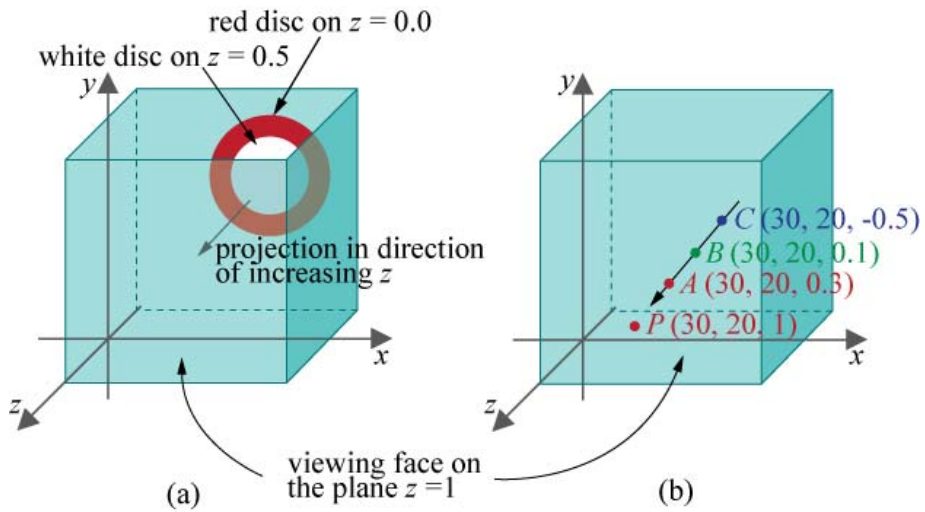

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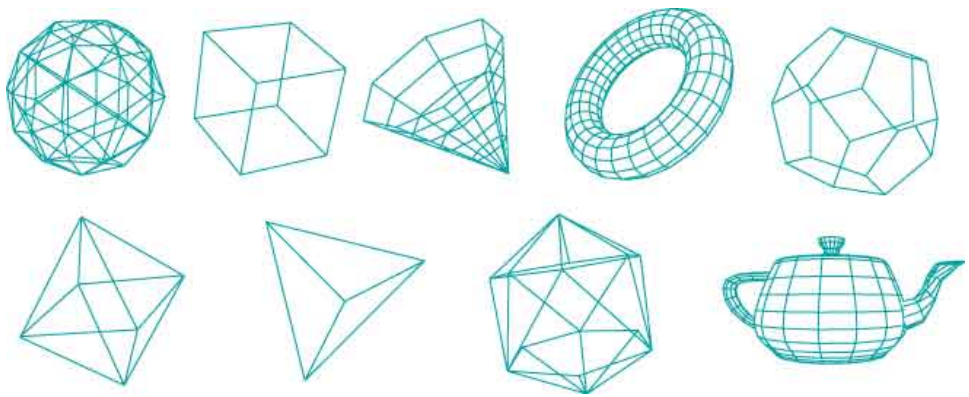
- Commands for triangles for basic models (cube, cone, sphere, torus, teapot,...).



GLU is a lower level utility library (may also appear as command name prefix).