• Make a new directory called **lab4**. Write an Android graphics program using OpenGL ES 1X that renders a colored tetrahedron like the one shown below and allows the user to rotate it by dragging the mouse. Then modify your program so that the object can rotate along the x, y or z axis automatically.

As with the android.pdf examples, onTouchEvent() was overridden to allow for rotation using touch:

Here is the modified code from HelloESActivity.java:
class HelloESSurfaceView extends GLSurfaceView {
    private final float TOUCH_SCALE_FACTOR = 180.0f / 320;
    private HelloESRenderer renderer;
    private float previousX;
    private float previousY;

    public HelloESSurfaceView(Context context) {
        super(context);
        // set the renderer member
        renderer = new HelloESRenderer();
        setRenderer(renderer);
        // Render the view only when there is a change
        setRenderMode(GLSurfaceView.RENDERMODE_WHEN_DIRTY);
    }

    @Override
    public boolean onTouchEvent(MotionEvent e) {
        // MotionEvent reports input details from the touch screen
        // and other input controls. Here, we are only interested
        // in events where the touch position has changed.
        float x = e.getX();
        float y = e.getY();
        switch (e.getAction()) {
        case MotionEvent.ACTION_MOVE:
            float dx = x - previousX;
            float dy = y - previousY;
            // reverse direction of rotation above the mid-line
            if (y > getHeight() / 2)
                dx = dx * -1;
            // reverse direction of rotation to left of the mid-line
            if (x < getWidth() / 2)
                dy = dy * -1;
            renderer.angle += (dx + dy) * TOUCH_SCALE_FACTOR;
            requestRender();
            previousX = x;
            previousY = y;
            return true;
        }
    }
}

and
public float angle = 0.0f;
gl.glRotatef(angle, 0.0f, 0.0f, 1.0f);
were both added to HelloESRenderer.java to allow for rotation
For the 2nd part, I modified HelloESRenderer.java to include the following:

```java
SystemClock.sleep ( 1000 ); //delay for 1 second
angle += 30; //increment angle by 30 degrees
```

and depending on which way I wanted it to rotate:

```java
gl.glRotatef(angle, 1.0f, 0.0f, 0.0f);
for automatic x-rotation

gl.glRotatef(angle, 0.0f, 1.0f, 0.0f);
for automatic y-rotation

gl.glRotatef(angle, 0.0f, 0.0f, 1.0f);
for automatic z-rotation
```

**Evaluation:** I successfully completed all parts of the lab and am giving myself 20 points.