CSC 240
Computer Graphics

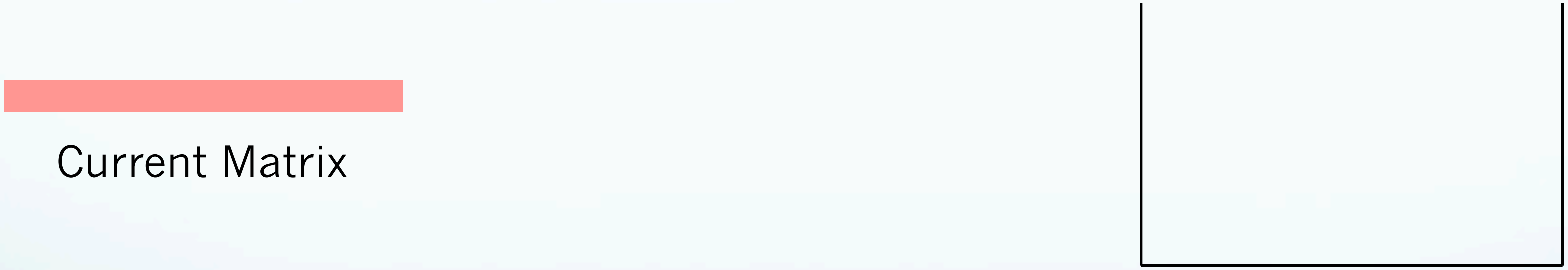
Fall 2015
Smith College

Outline: 11/9

- Stacks revisited
- Shading (using normal vectors)
- Texture Mapping
- Final quiz
- If time: robot with two arms

White background slides from Eitan Mendelowitz

Matrix Stack

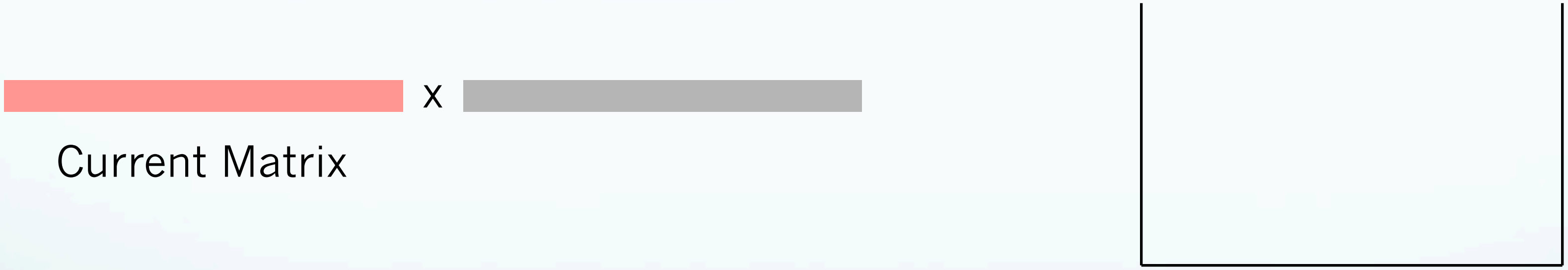


Current Matrix

Matrix Stack

Matrix Stack

Add a transformation: matrix multiplication (right)



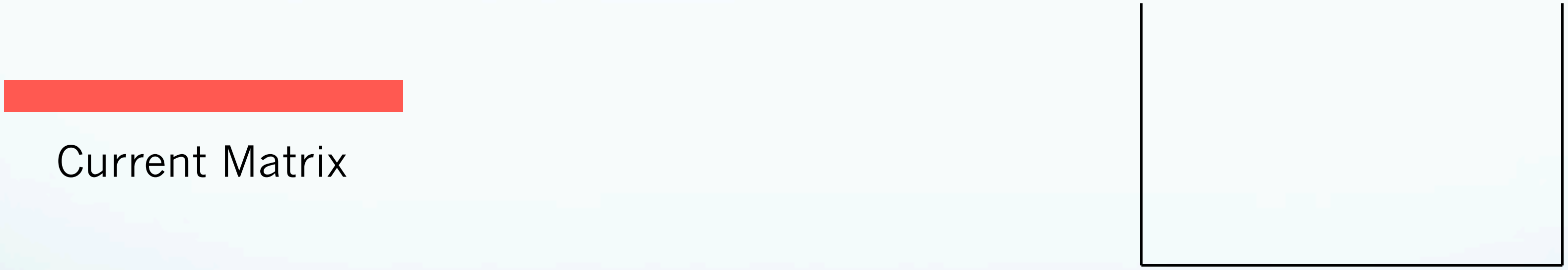
x

Current Matrix

Matrix Stack

Matrix Stack

Replace current matrix with result

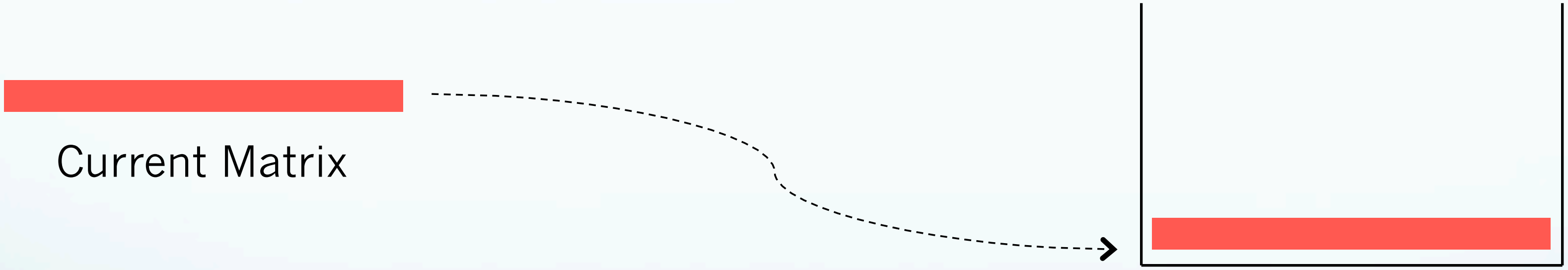


Current Matrix

Matrix Stack

Matrix Stack

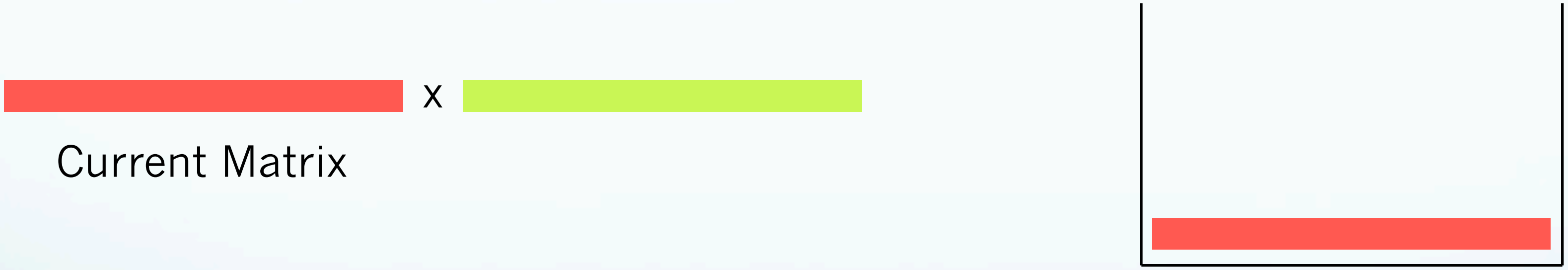
PUSH: Add current matrix to the matrix stack



Matrix Stack

Matrix Stack

Add another transformation: matrix multiplication (right)



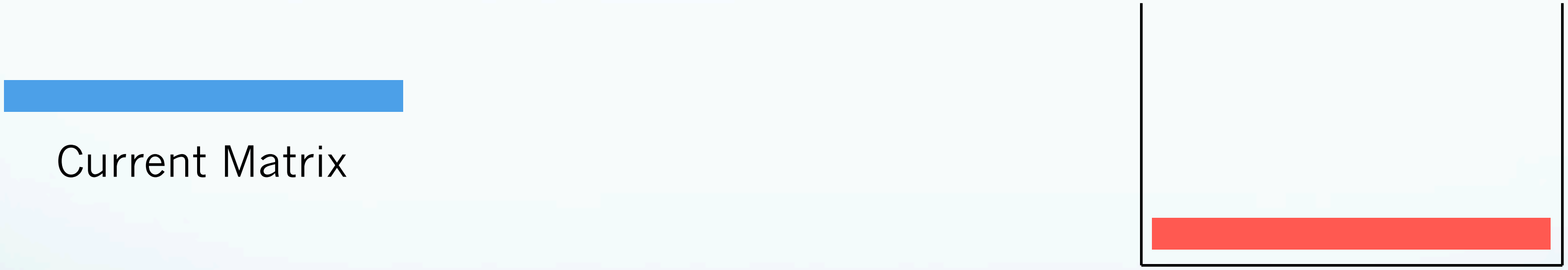
x

Current Matrix

Matrix Stack

Matrix Stack

Replace current matrix with result

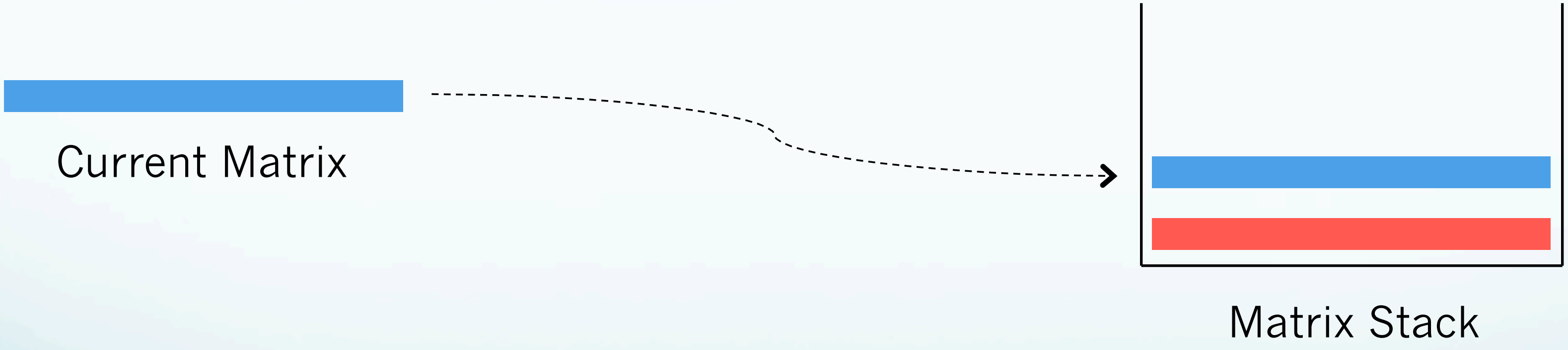


Current Matrix

Matrix Stack

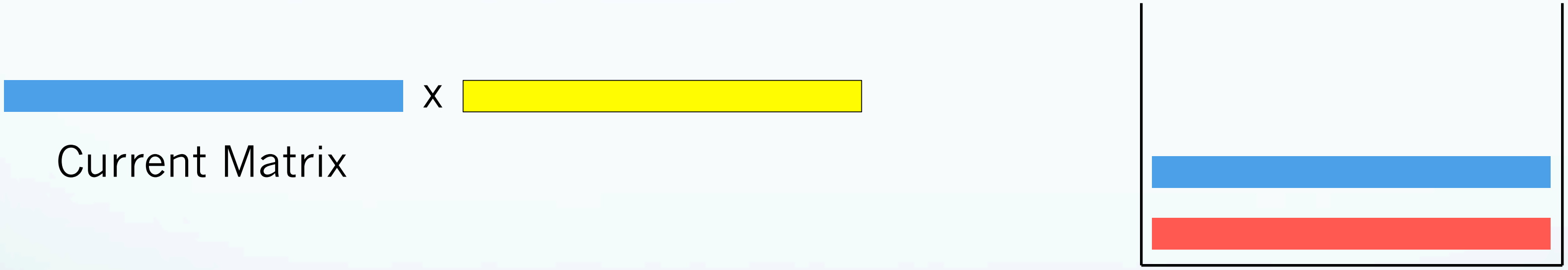
Matrix Stack

PUSH: Add current matrix to the matrix stack



Matrix Stack

Add another transformation: matrix multiplication (right)

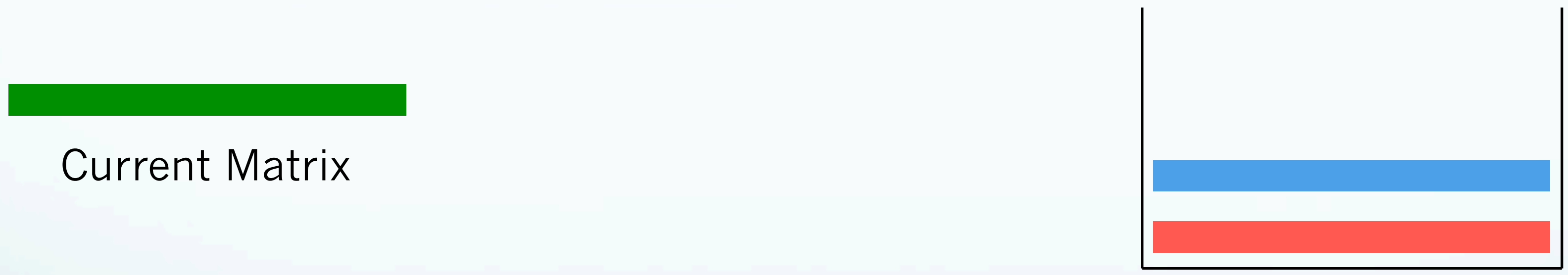


Current Matrix

Matrix Stack

Matrix Stack

Replace current matrix with result

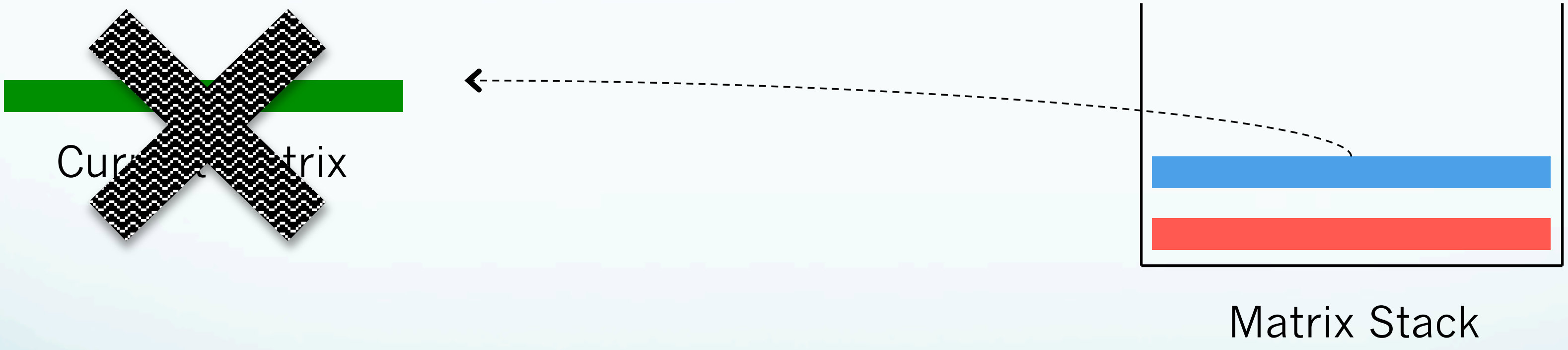


Current Matrix

Matrix Stack

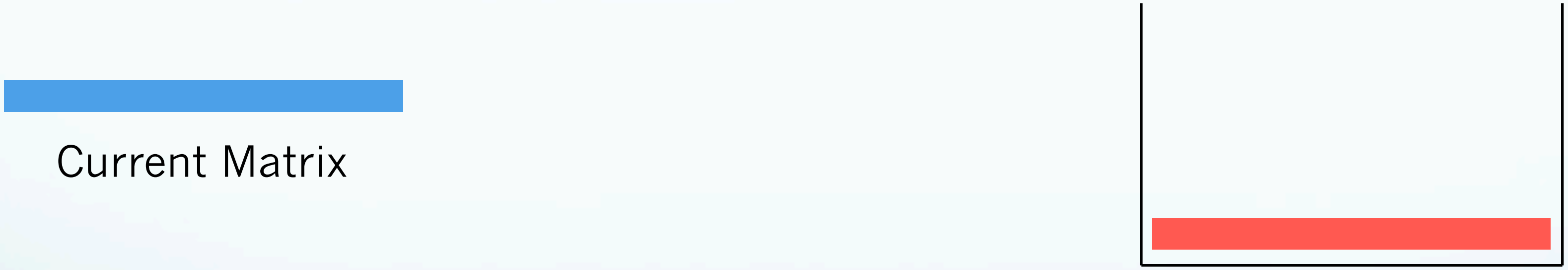
Matrix Stack

POP: Completely get rid of current matrix and pop from the top of the stack



Matrix Stack

Back to where we were before

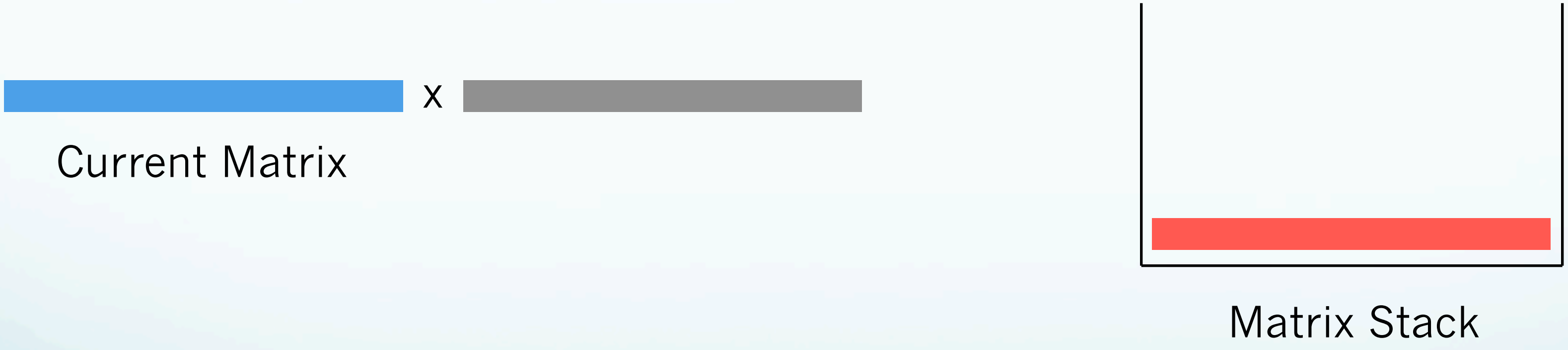


Current Matrix

Matrix Stack

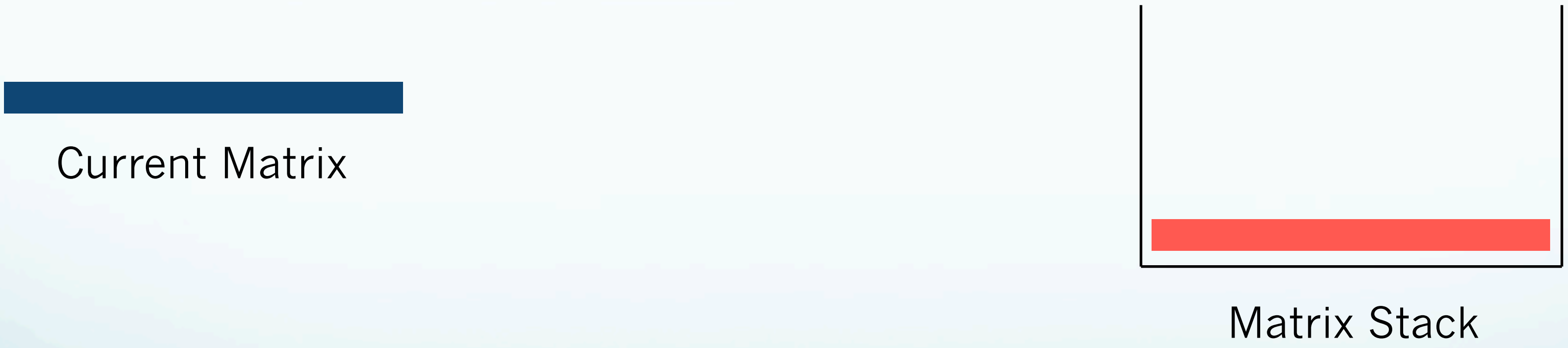
Matrix Stack

Add another transformation: matrix multiplication (right)



Matrix Stack

Replace current matrix with result

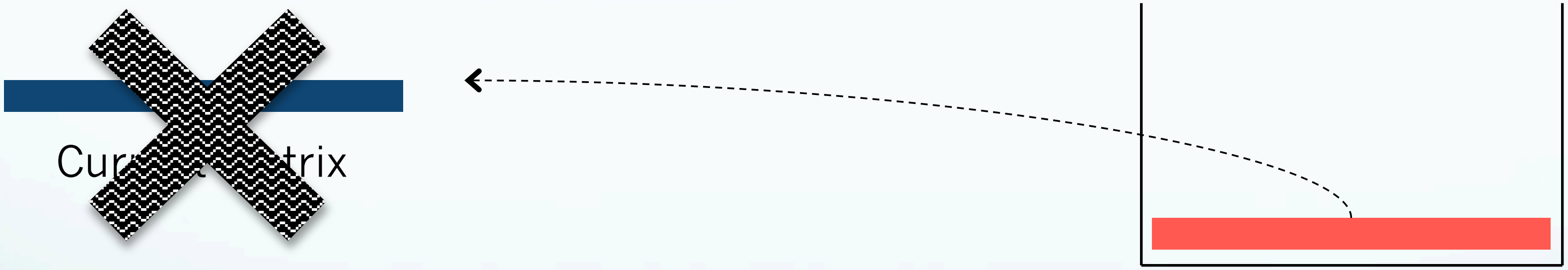


Current Matrix

Matrix Stack

Matrix Stack

POP: Completely get rid of current matrix and pop from the top of the stack

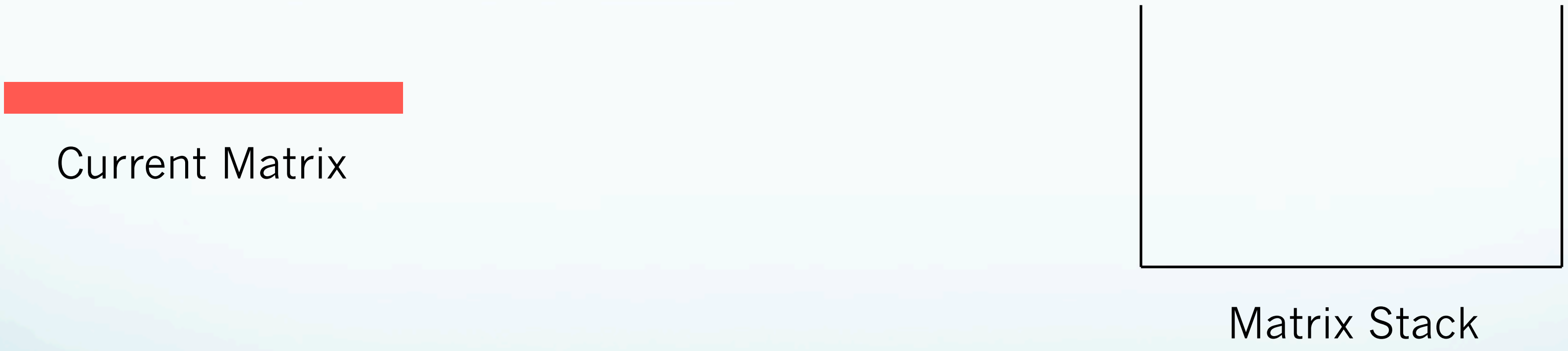


Cur[illegible]trix

Matrix Stack

Matrix Stack

Back to the beginning

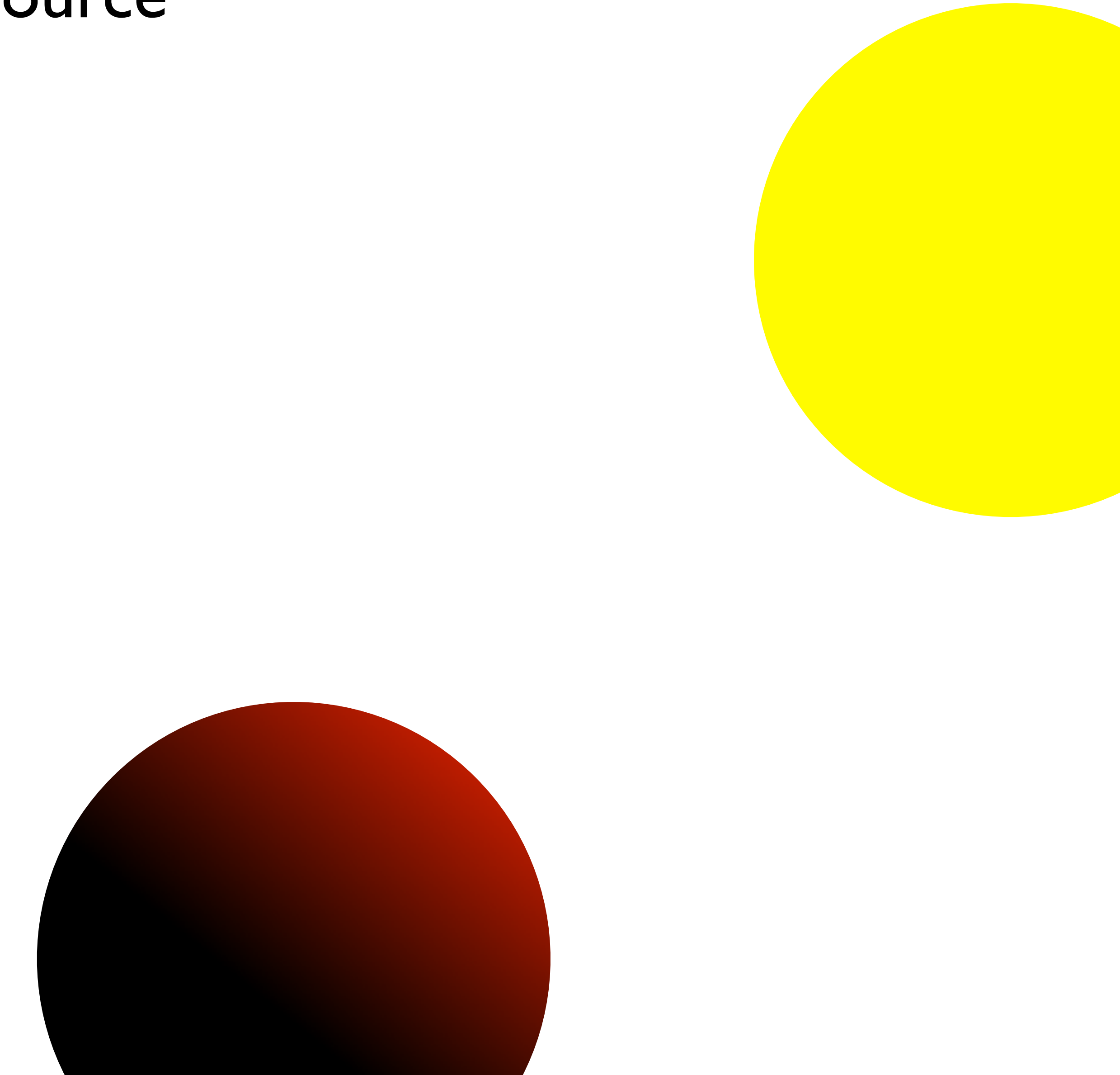


Current Matrix

Matrix Stack

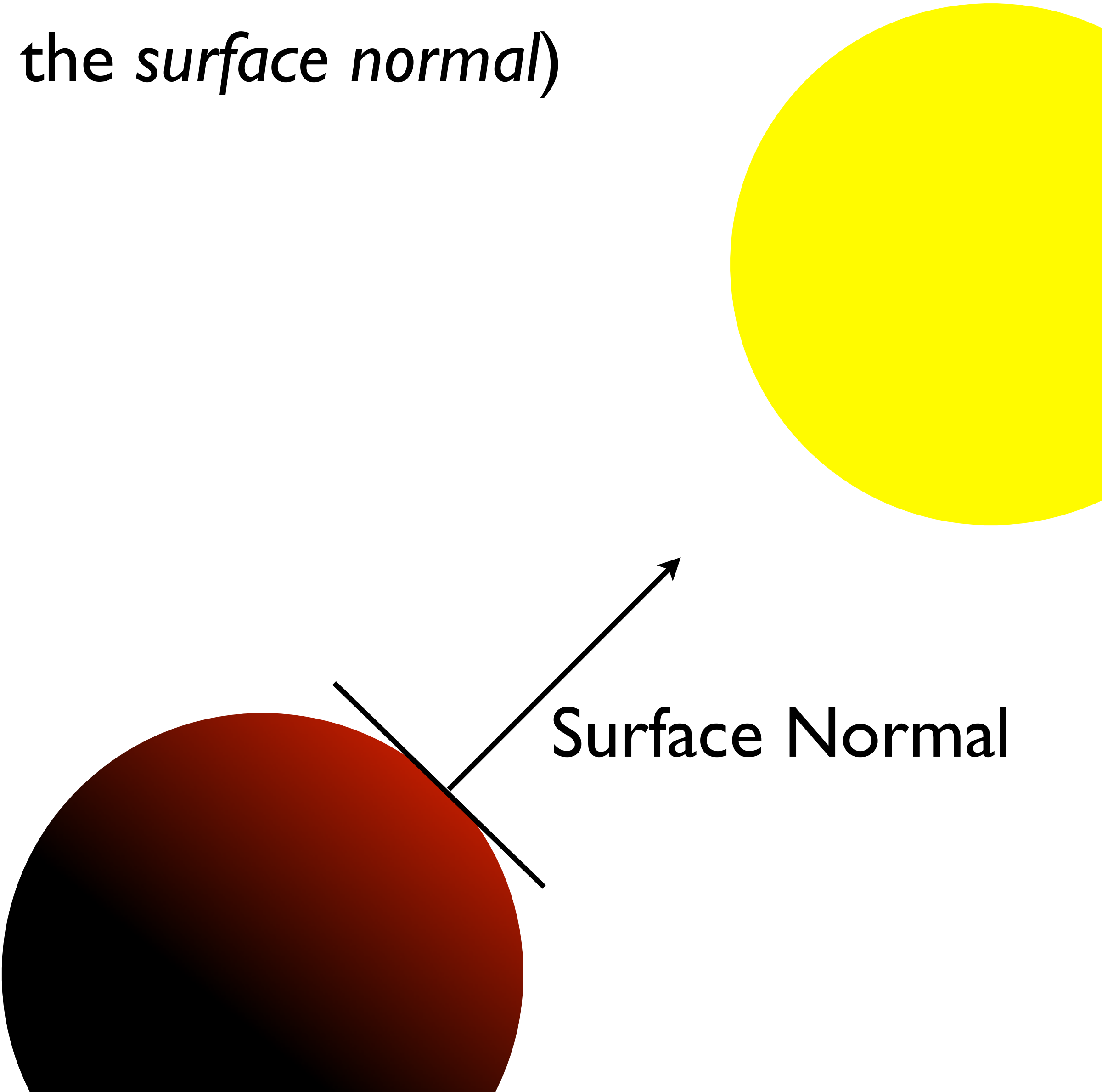
Shading in OpenGL

Lighting is determined by the surface’s angle to the light source



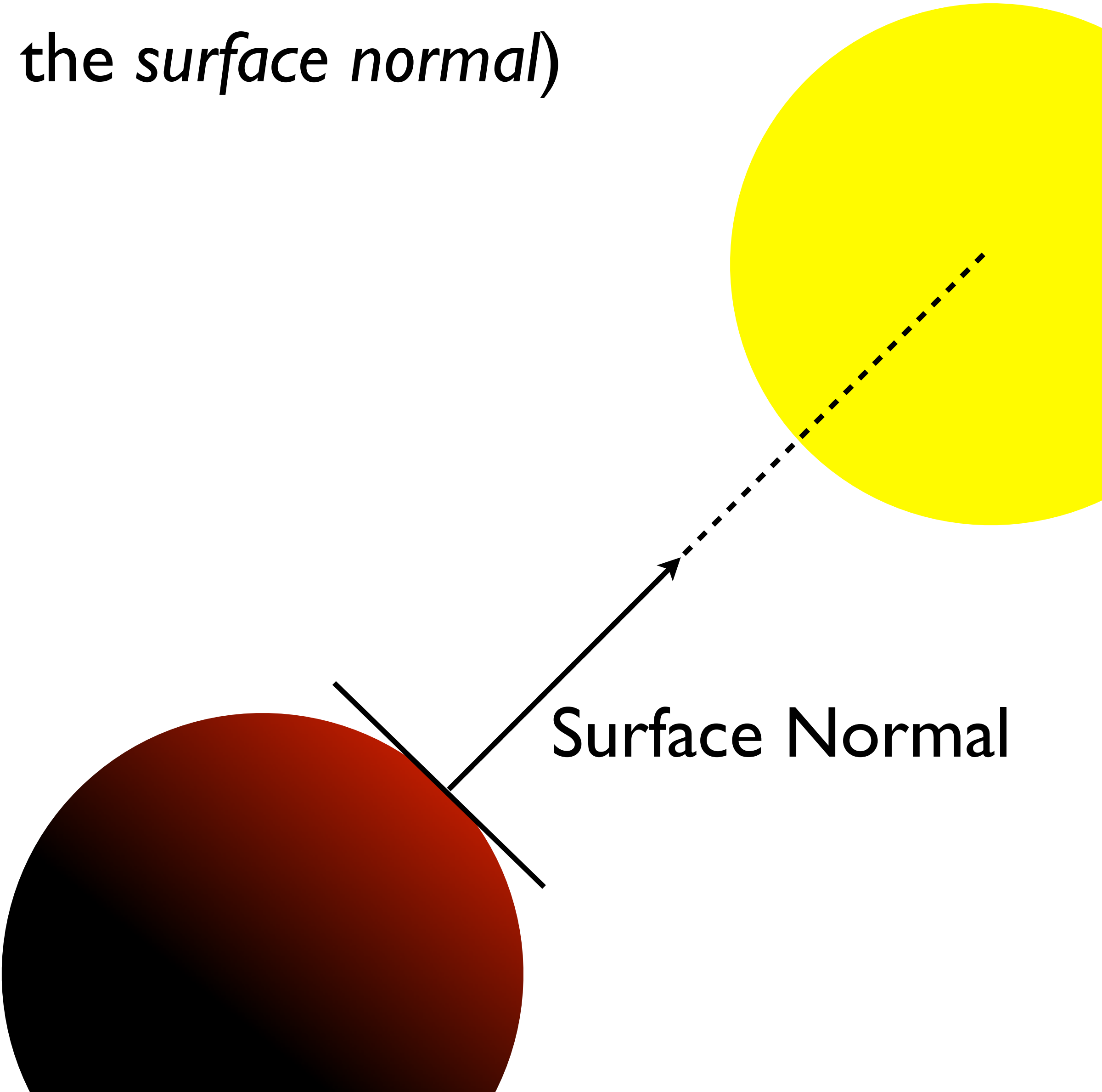
Lighting is determined by the surface's angle to the light source

(as defined by the *surface normal*)



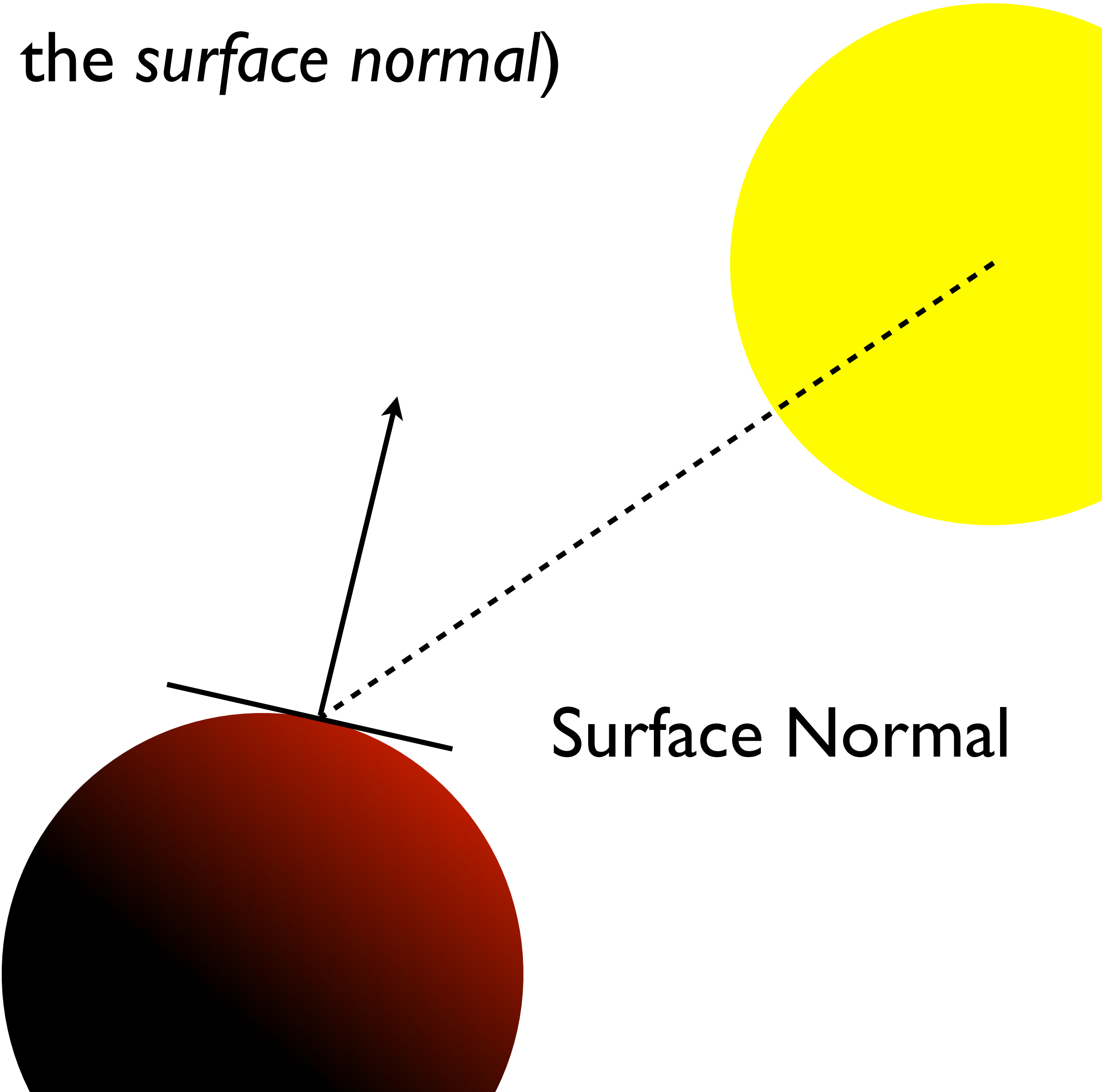
Lighting is determined by the surface's angle to the light source

(as defined by the *surface normal*)



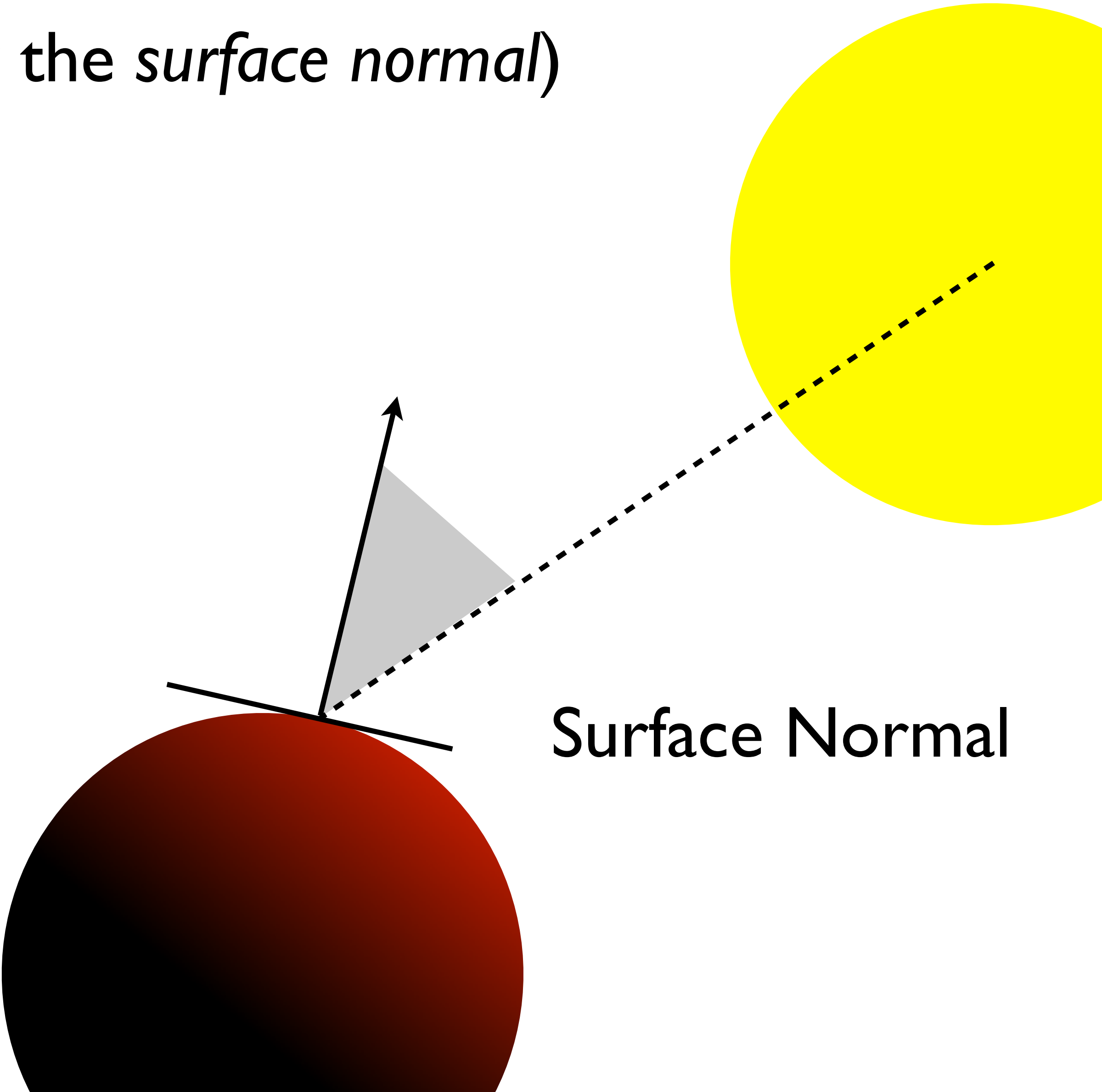
Lighting is determined by the surface's angle to the light source

(as defined by the *surface normal*)



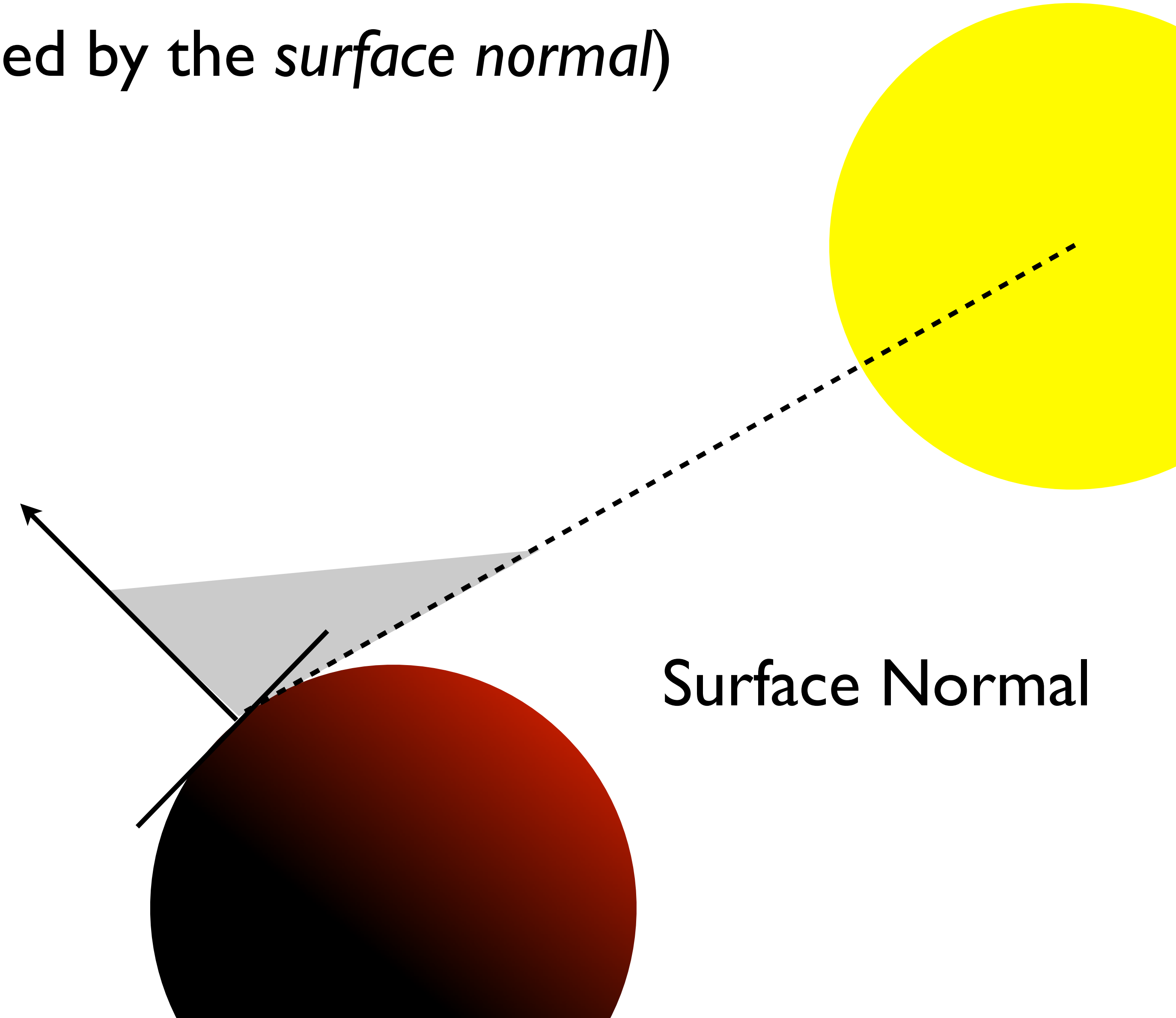
Lighting is determined by the surface's angle to the light source

(as defined by the *surface normal*)

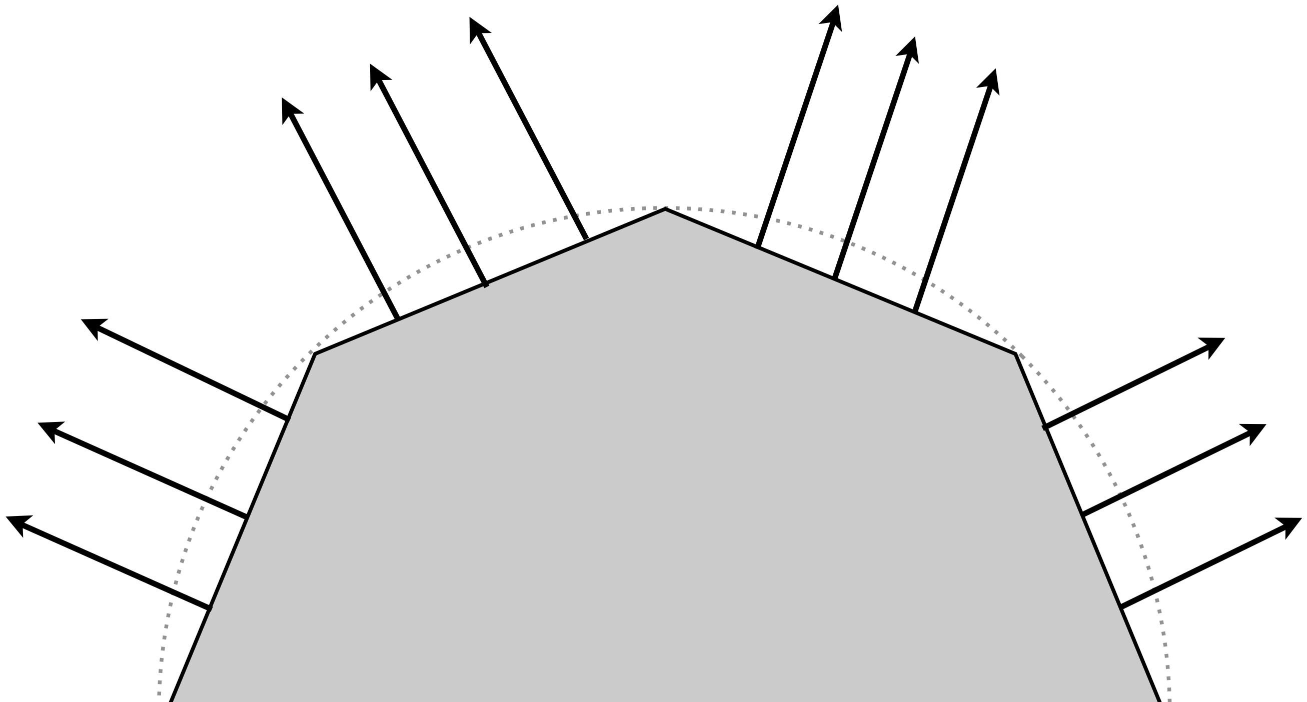


Lighting is determined by the surface's angle to the light source

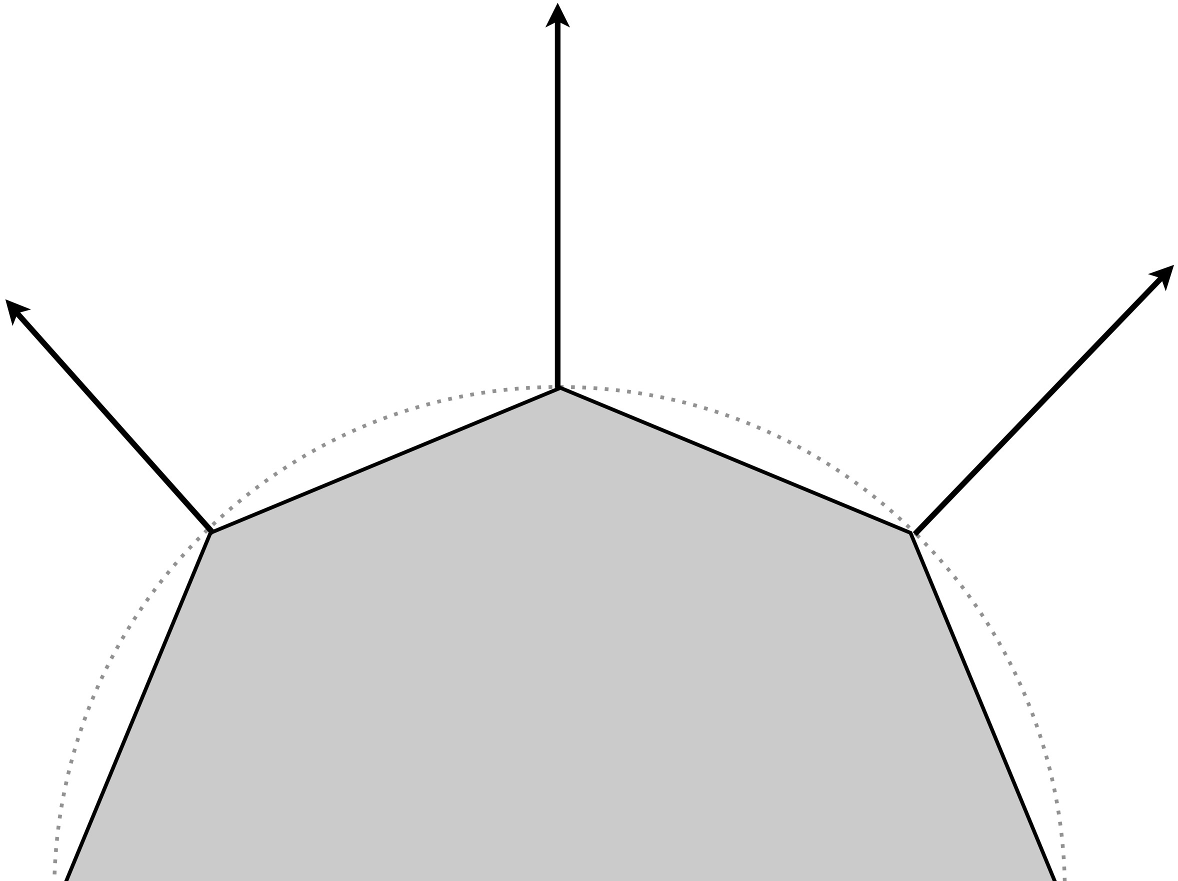
(as defined by the *surface normal*)



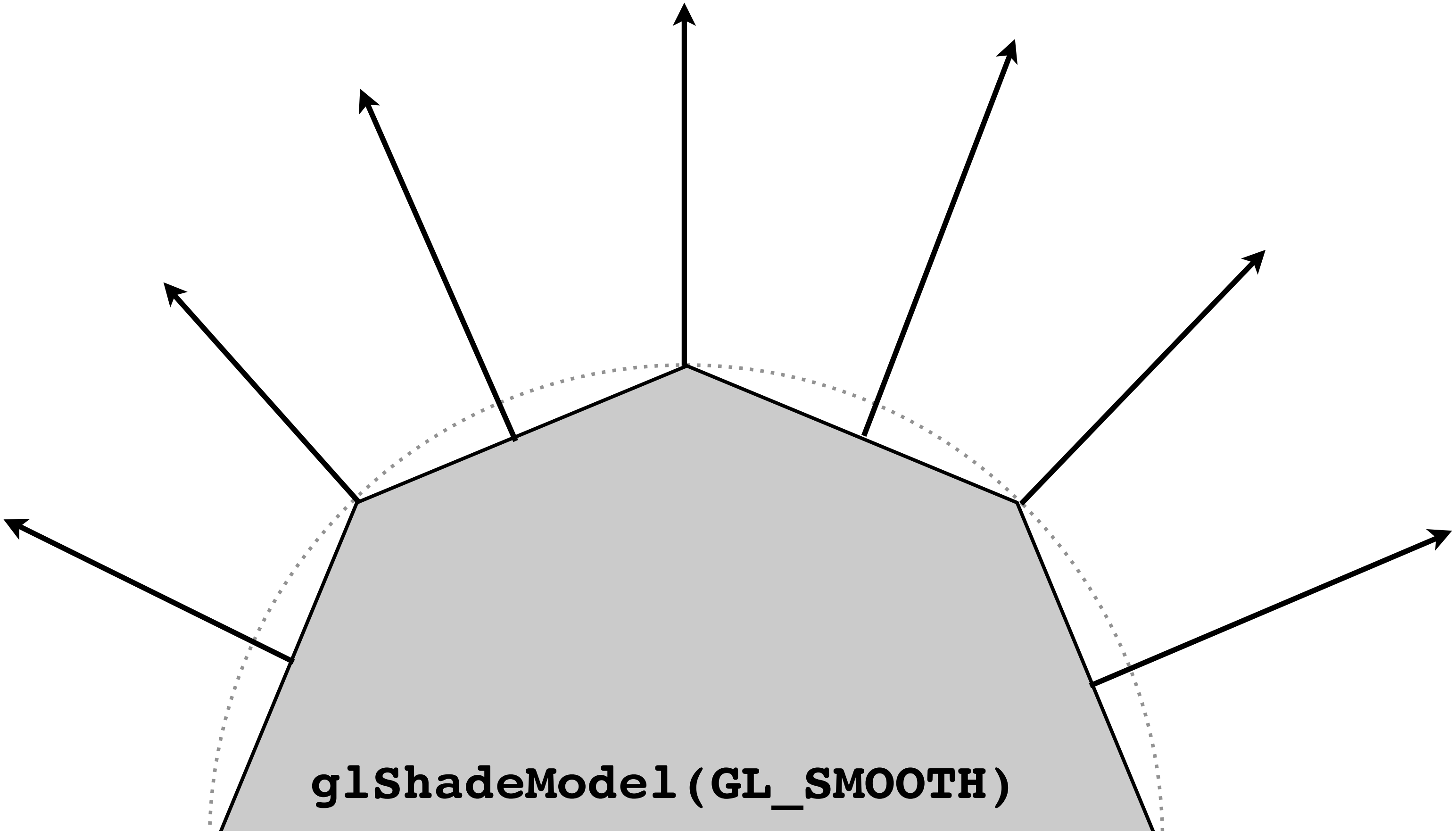
Suppose Poly based Normals



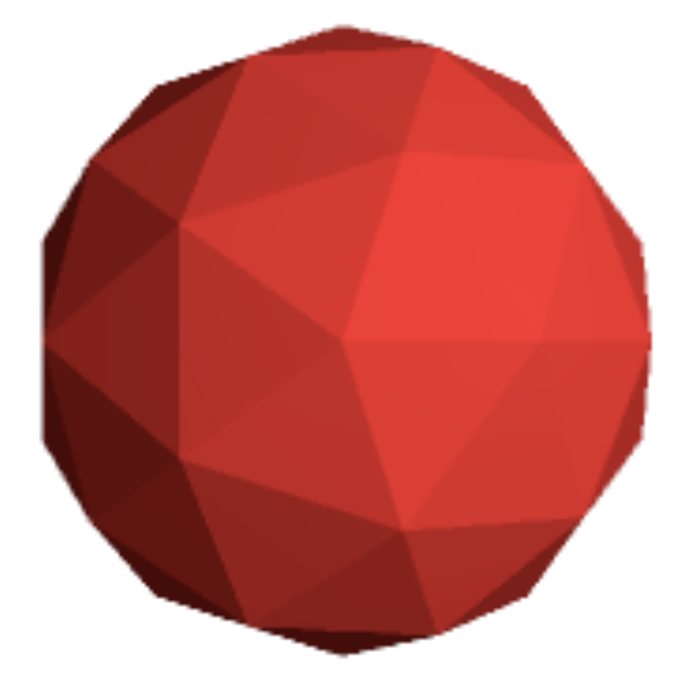
Vertex based Normals



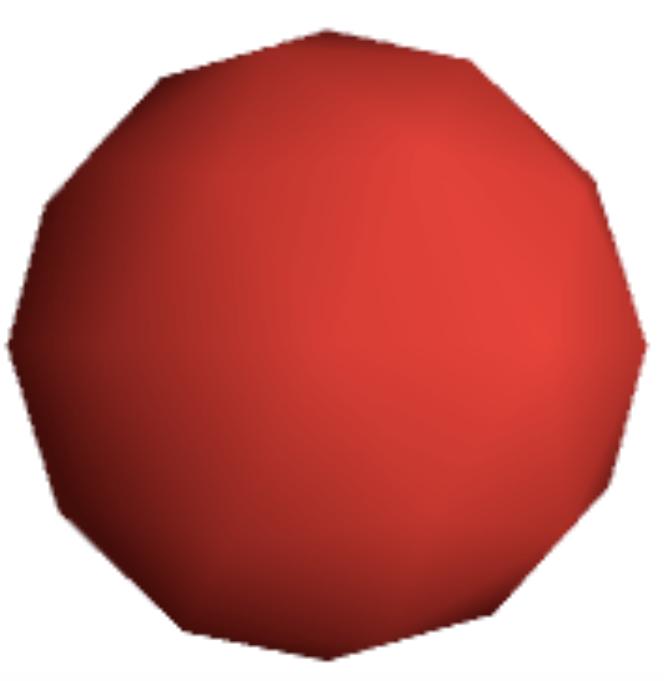
Interpolated Surface Normals



```
glShadeModel(GL_SMOOTH)
```



`glShadeModel(GL_FLAT)`



`glShadeModel(GL_SMOOTH)`

Begin: Texture Mapping

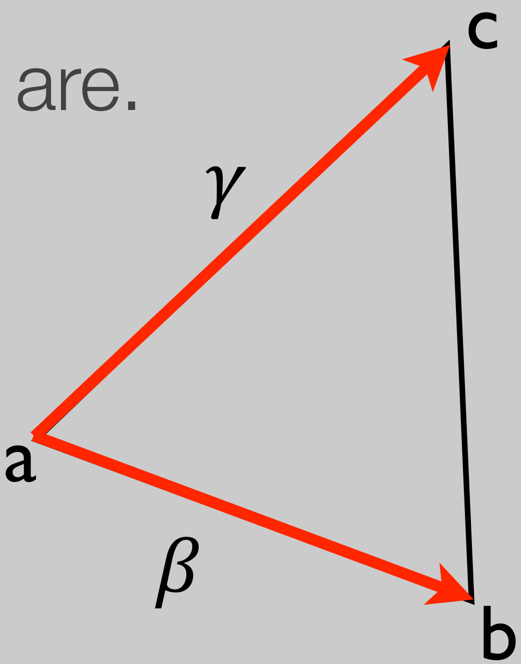
(next time: texture mapping lab)

Texture Mapping

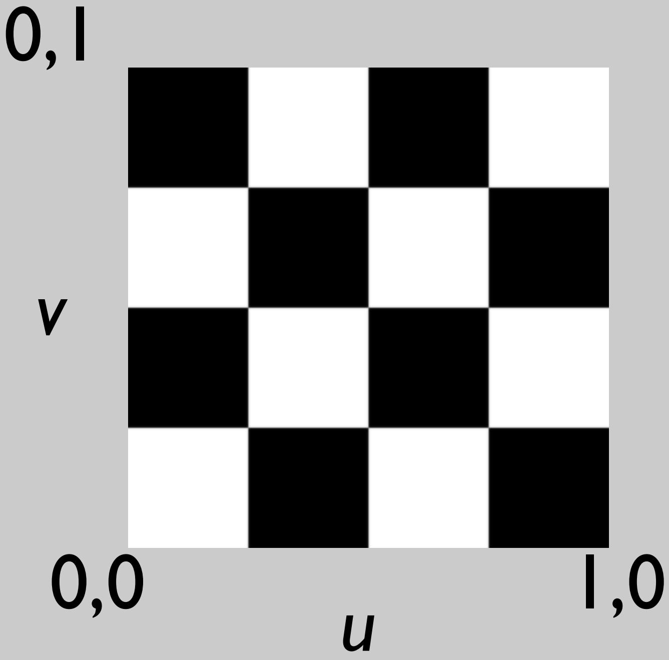
β is how far along AB you are.

γ is how far along AC you are.

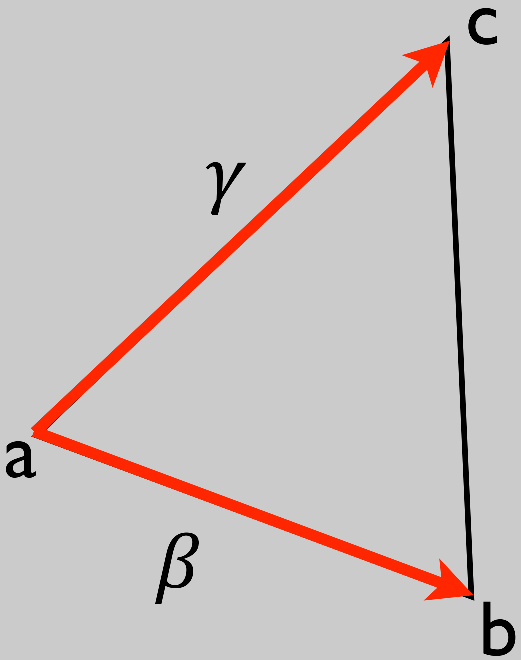
β, γ are [0,1]



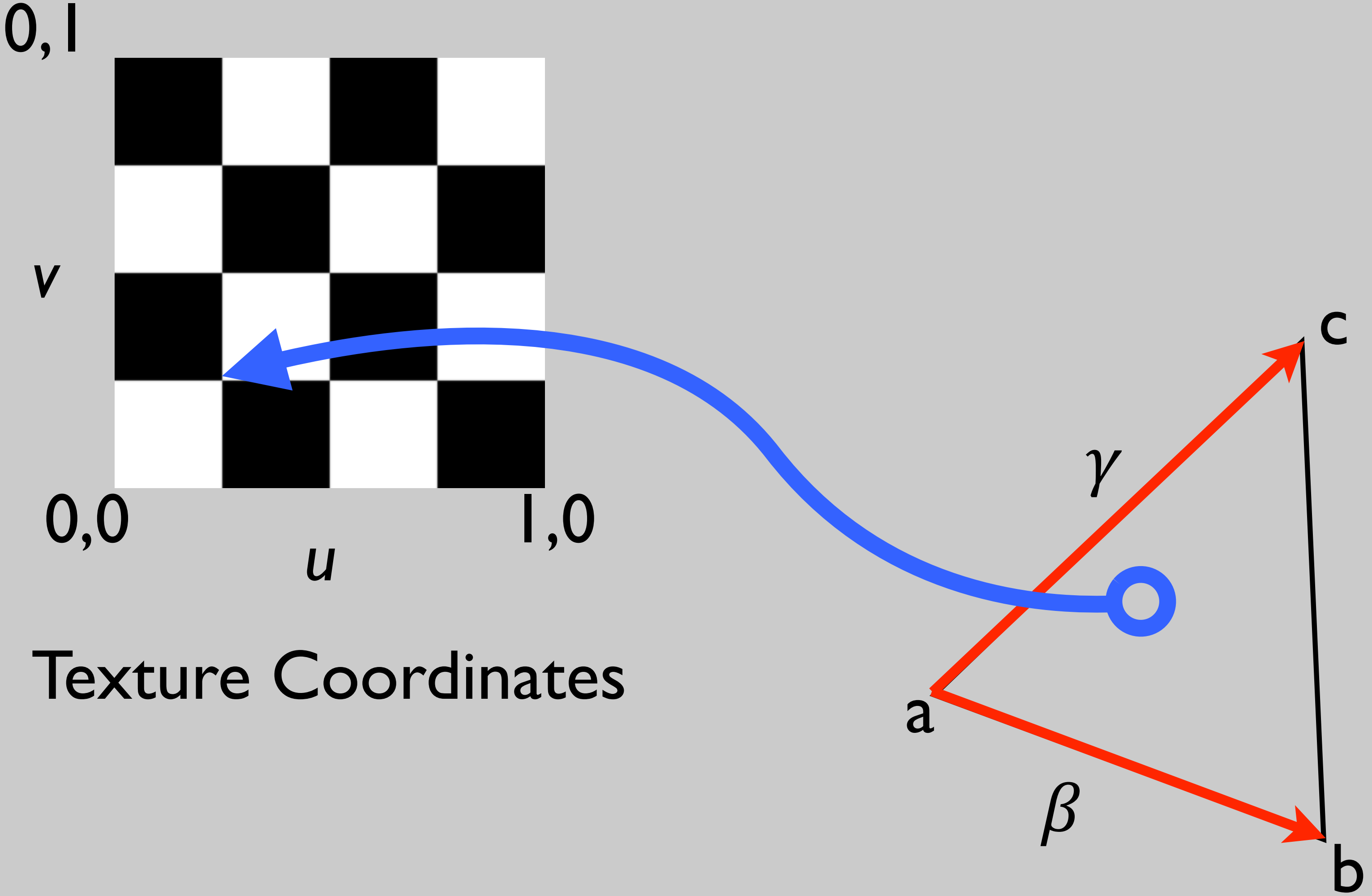
Texture Mapping



Texture Coordinates

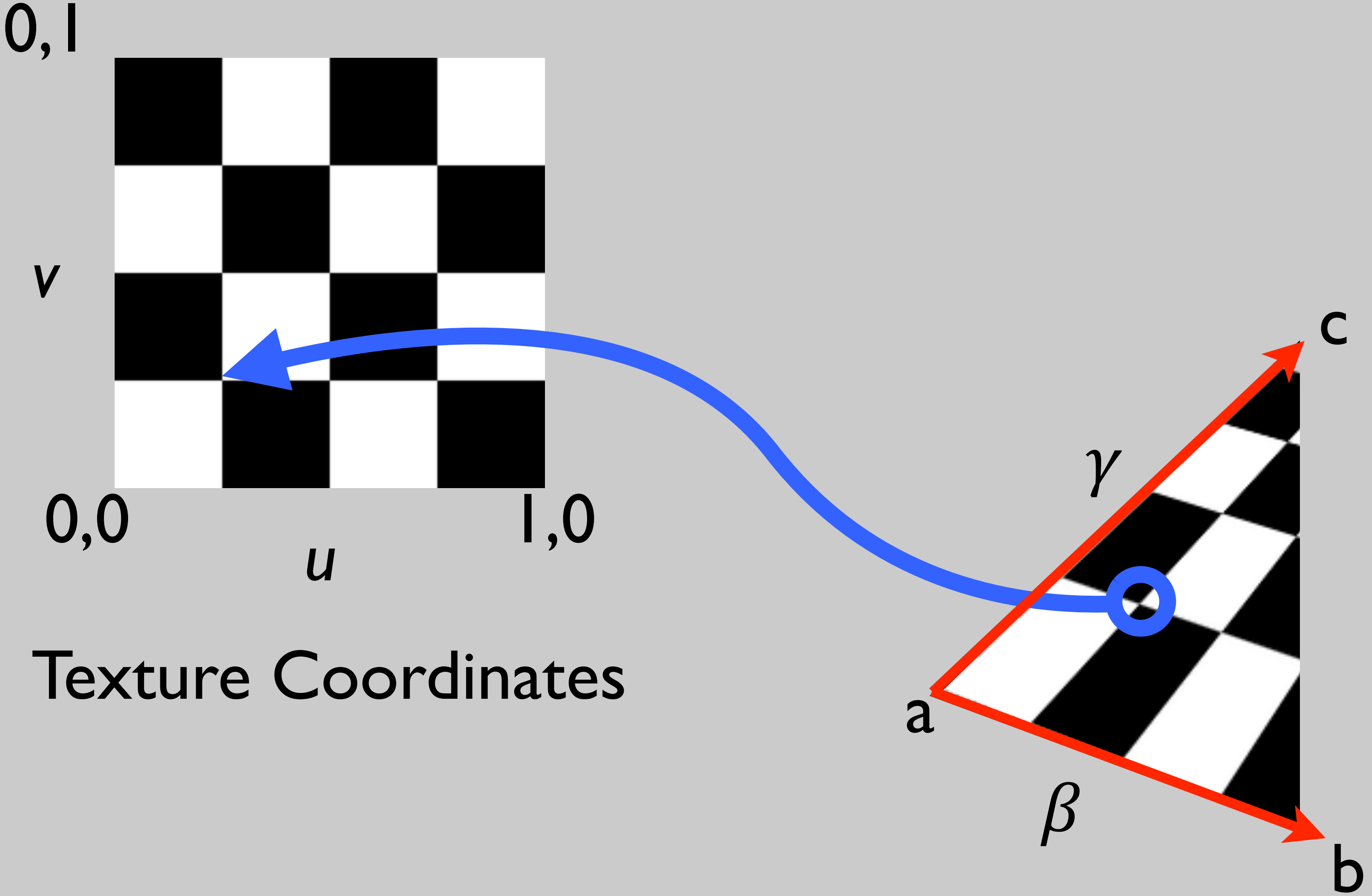


Texture Mapping



Texture Coordinates

Texture Mapping

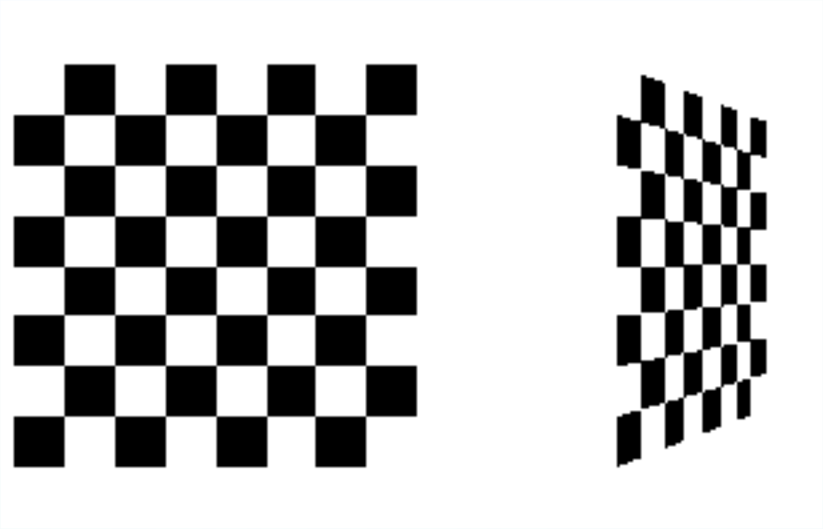


Texture Coordinates

Exercise: what image does this code produce?

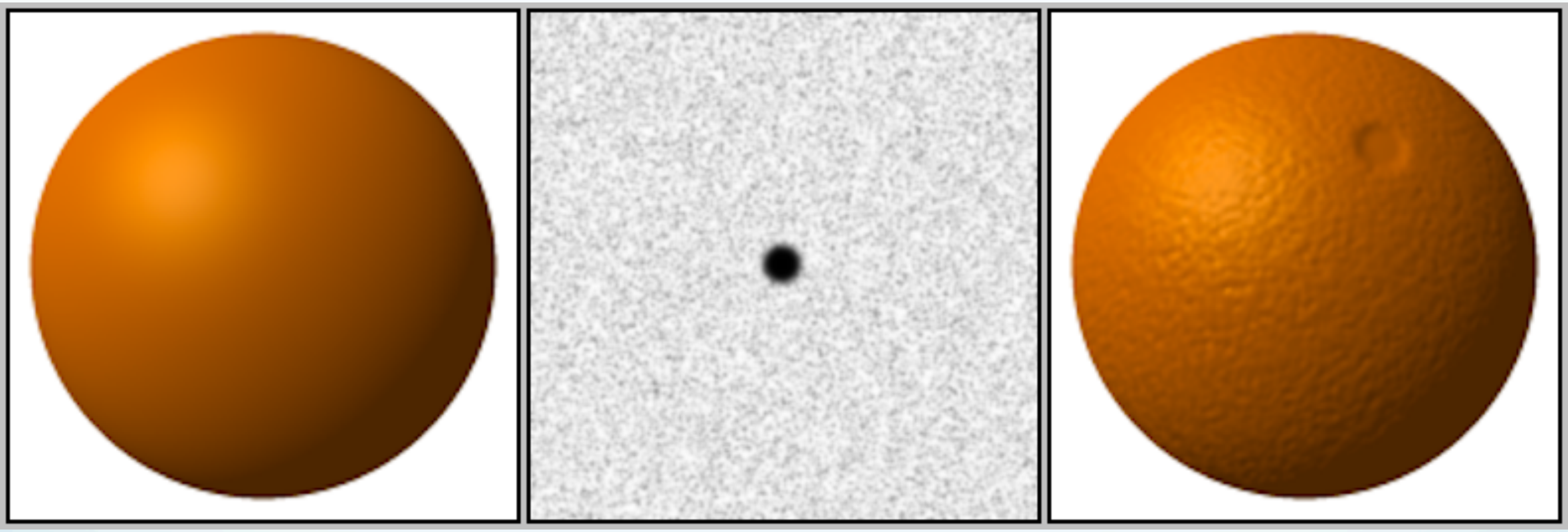
```
void display(void)
{
  glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
  glEnable(GL_TEXTURE_2D);
  glTexEnvf(GL_TEXTURE_ENV, GL_TEXTURE_ENV_MODE, GL_DECAL);
  glBindTexture(GL_TEXTURE_2D, texName);

  glBegin(GL_QUADS);
        glTexCoord2f(0.0, 0.0); glVertex3f(-2.0, -1.0, 0.0);
        glTexCoord2f(0.0, 1.0); glVertex3f(-2.0, 1.0, 0.0);
        glTexCoord2f(1.0, 1.0); glVertex3f(0.0, 1.0, 0.0);
        glTexCoord2f(1.0, 0.0); glVertex3f(0.0, -1.0, 0.0);

        glTexCoord2f(0.0, 0.0); glVertex3f(1.0, -1.0, 0.0);
        glTexCoord2f(0.0, 1.0); glVertex3f(1.0, 1.0, 0.0);
        glTexCoord2f(1.0, 1.0); glVertex3f(2.41421, 1.0, -1.41421);
        glTexCoord2f(1.0, 0.0); glVertex3f(2.41421, -1.0, -1.41421);
  glEnd();

  glFlush();
  glDisable(GL_TEXTURE_2D);
}
```

Image Produced



OpenGL Redbook, Chapter 9, Figure 9-2

Bump Mapping



"Bump-map-demo-full” https://commons.wikimedia.org/

Final quiz

- In-class on Monday 12/14
- One study sheet (hand-written, front and back)
- Focus on the theoretical aspects of the second half of the semester
- Reasons:
  - Quiz earlier so there is time for final project
  - Self-scheduled exam period is very late
  - Helps you study in a focused manner