

## Textures

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The goal of this assignment is to understand how to use textures inside the OpenGL environment.

## 1 Exercises: Textured polygons

1. Download the source code for this class, and analyze it carefully. Build and run it. You should have an interface with black background:

2. Inside your `render()` function add the following code snippet:

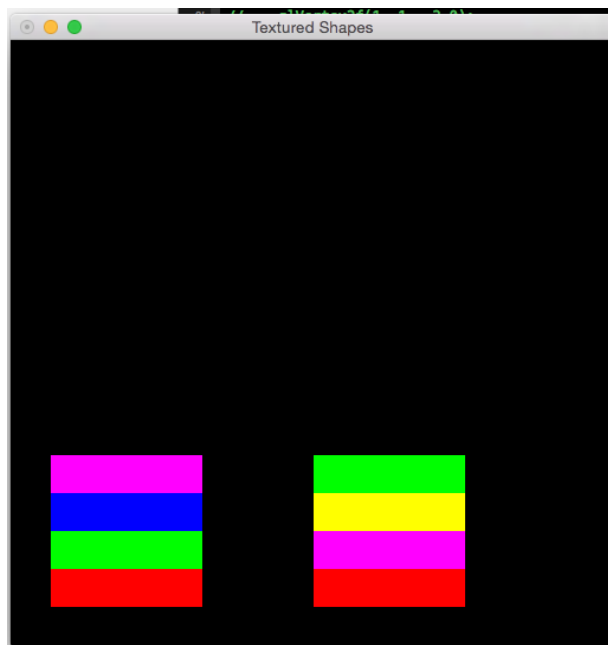
```
glRasterPos3f(0, -1, -2);  
glDrawPixels(imageWidth, 128, GL_RGBA, GL_UNSIGNED_BYTE, Image);
```

Understand and explain the `glRasterPos3f` and `glDrawPixels` functions.

3. Inside the `#if GL_EXT_abgr` pragma insert the following snippet:

```
glRasterPos3f(-1, -1, -2);  
glDrawPixels(imageWidth, imageHeight, GL_ABGR_EXT, GL_UNSIGNED_BYTE, Image);
```

Is there any graphical output difference between this and the aforementioned snippet? To answer this question you should consult the next link <https://www.opengl.org/registry/specs/EXT/abgr.txt>. You should obtain an interface similar to the next figure.



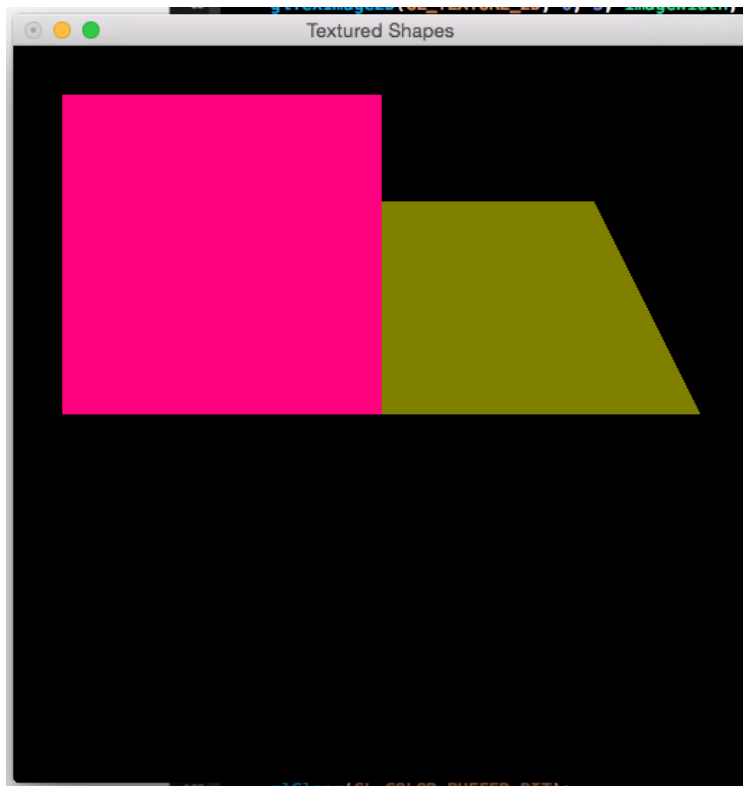
**Figure 1:** Colored polygons.

4. In the `TextureDefinition()` function add the following polygons.

```
#if GL_EXT_abgr
    glBegin(GLPOLYGON);
    glVertex3f(-1.5, 0, -3.0);
    glVertex3f(0, 0, -3.0);
    glVertex3f(0, 1, -2.0);
    glVertex3f(-1, 1, -2.0);
    glEnd();
#endif

    glBegin(GLPOLYGON);
    glVertex3f(1, 1, -3.0);
    glVertex3f(0, 1, -3.0);
    glVertex3f(0, 0, -2.0);
    glVertex3f(1, 0, -2.0);
    glEnd();
```

You should obtain an interface similar to the next figure.



**Figure 2:** Non-textured polygons.

5. In the same function create (specify) your first texture (color texture).

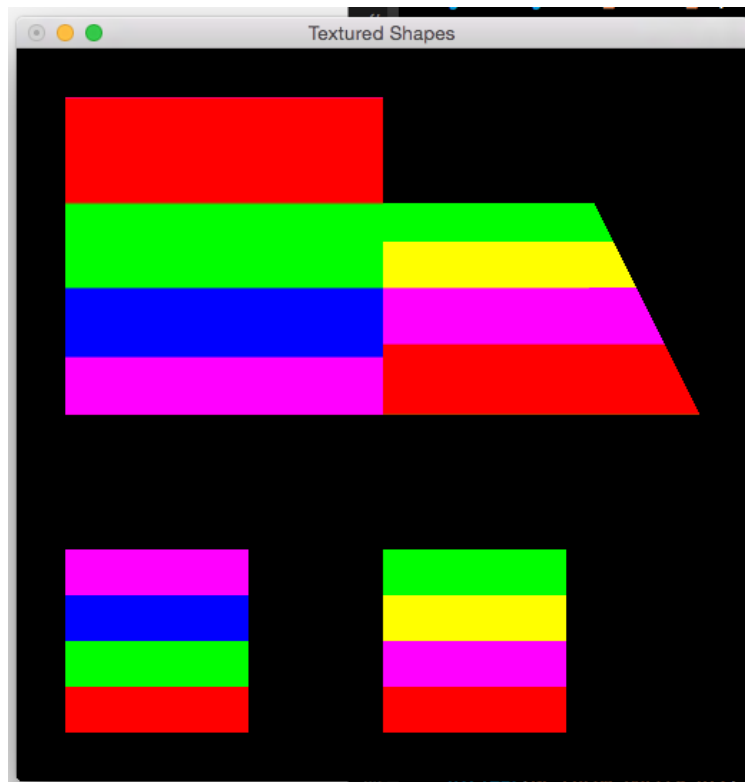
Note that, you need to specify one texture to each polygon.

To create a texture you need to follow the following steps:

- (a) Enable the texture.

- (b) Set the texture parameters.  
<https://www.khronos.org/opengles/sdk/docs/man/xhtml/glTexParameter.xml>
- (c) Set texture environment parameters (Optional step.)  
<https://www.opengl.org/sdk/docs/man2/xhtml/glTexEnv.xml>
- (d) Specify a two-dimensional texture image.  
<https://www.khronos.org/opengles/sdk/docs/man/xhtml/glTexImage2D.xml>  
Note that, when specifying the texture image the *target* = *GL\_TEXTURE\_2D*, *level* = 0, *internalformat* = 3, and *border* = 0.
- (e) Set the current texture coordinates.  
<https://www.opengl.org/sdk/docs/man2/xhtml/glTexCoord.xml>

The textured polygons should look like the next figure:



**Figure 3:** Textured polygons.

## 2 Exercises: Textured cube

1. Use the 02.Texture.c file as your new main file. Build and run it. An interface similar to the next image should render.

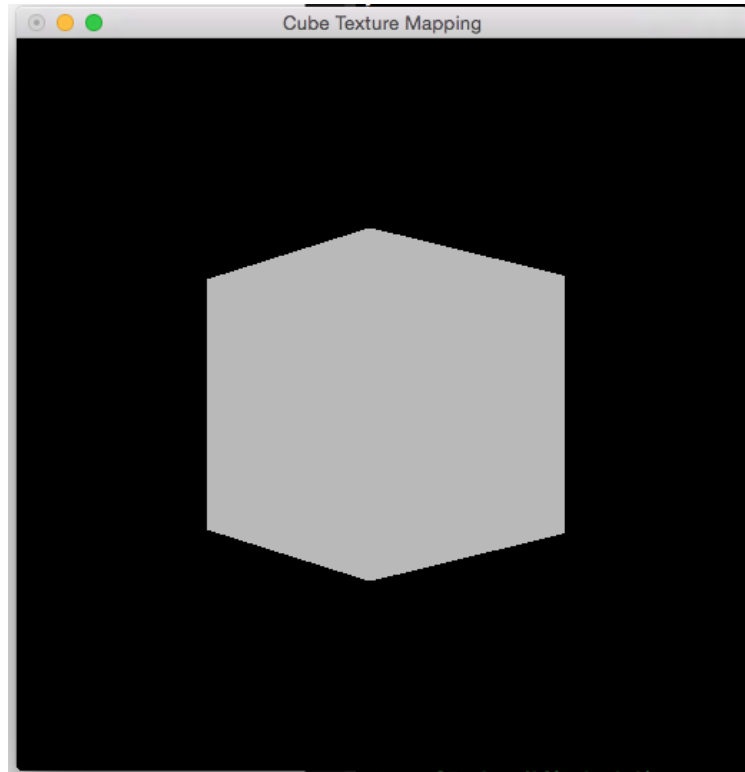
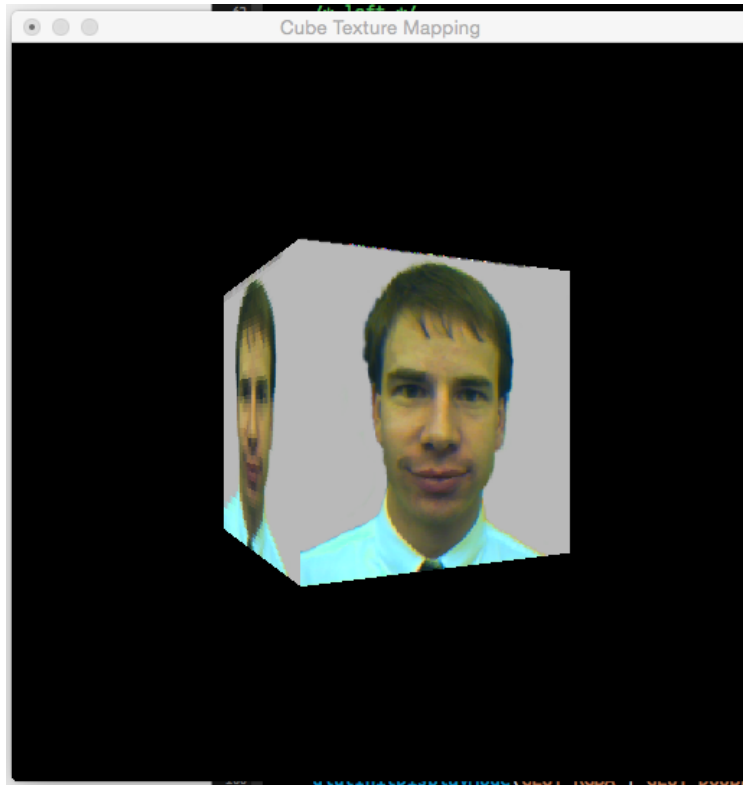


Figure 4: Non textured cube.

2. Add the `unsigned char image[]` texture to the cube. Note that you need to follow similar steps as aforementioned.
  - (a) Enable the texture.
  - (b) Build a two-dimensional mipmap.  
<https://www.opengl.org/sdk/docs/man2/xhtml/gluBuild2DMipmaps.xml>
  - (c) Set the texture parameters.  
<https://www.khronos.org/opengles/sdk/docs/man/xhtml/glTexParameter.xml>
  - (d) Set texture environment parameters (Optional step.)  
<https://www.opengl.org/sdk/docs/man2/xhtml/glTexEnv.xml>
  - (e) Set the current texture coordinates to each cube facet.  
<https://www.opengl.org/sdk/docs/man2/xhtml/glTexCoord.xml>

The textured cube should look like the next figure:

3. You will notice that the textured cube is not rendering flawlessly. When a new facet appears the image is pixelized.  
Correct the rendering using texture parameters.  
<https://www.khronos.org/opengles/sdk/docs/man/xhtml/glTexParameter.xml>

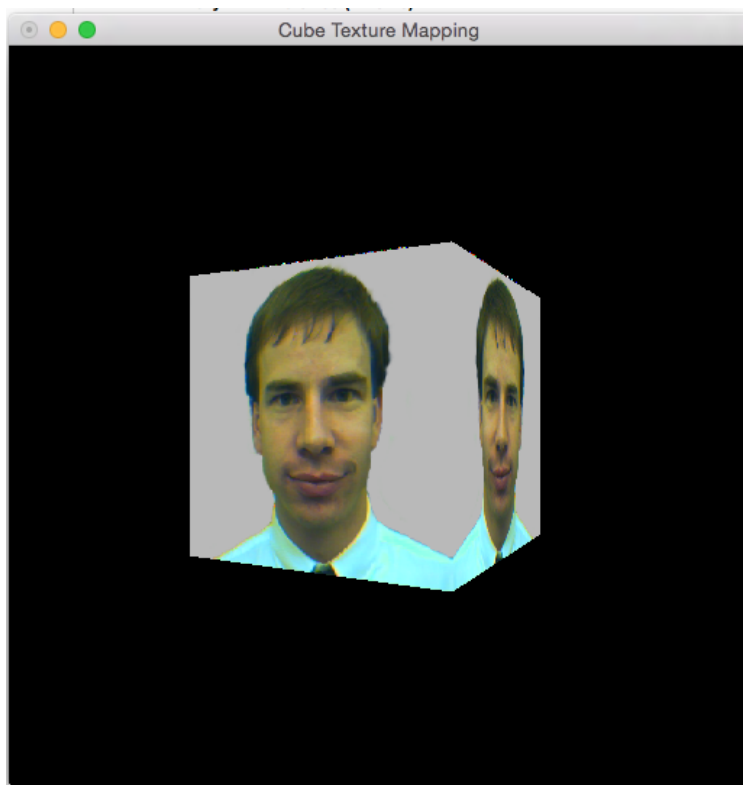


**Figure 5:** Textured cube.

The corrected textured cube should look like the next figure:

## References

- [1] GL\_EXT\_abgr <https://www.opengl.org/registry/specs/EXT/abgr.txt>, last access on 06/05/2015.
- [2] glTexParameterf <https://www.khronos.org/opengles/sdk/docs/man/xhtml/glTexParameter.xml>, last access on 06/05/2015.
- [3] glTexEnv <https://www.opengl.org/sdk/docs/man2/xhtml/glTexEnv.xml>, last access on 06/05/2015.
- [4] glTexImage2D <https://www.khronos.org/opengles/sdk/docs/man/xhtml/glTexImage2D.xml>, last access on 06/05/2015.
- [5] glTexCoord <https://www.opengl.org/sdk/docs/man2/xhtml/glTexCoord.xml>, last access on 06/05/2015.
- [6] gluBuild2DMipmaps <https://www.opengl.org/sdk/docs/man2/xhtml/gluBuild2DMipmaps.xml>, last access on 06/05/2015.



**Figure 6:** Correct textured cube.