SKYBOXES AND SKYDOMES: THE INTRODUCTION

OUTLINE

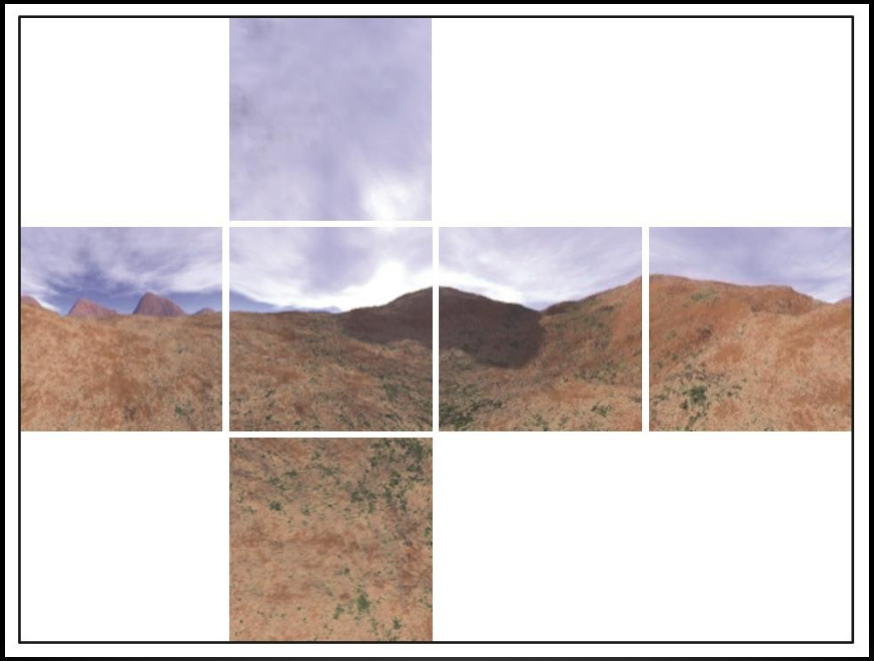
- Skyboxes
- Skydomes
- Implementing a Skybox
- Environment Mapping

SKYBOXES – THE STRATEGY

- Instantiate a cube object
- Texture the cube with the desired scene
- Position the camera inside the cube

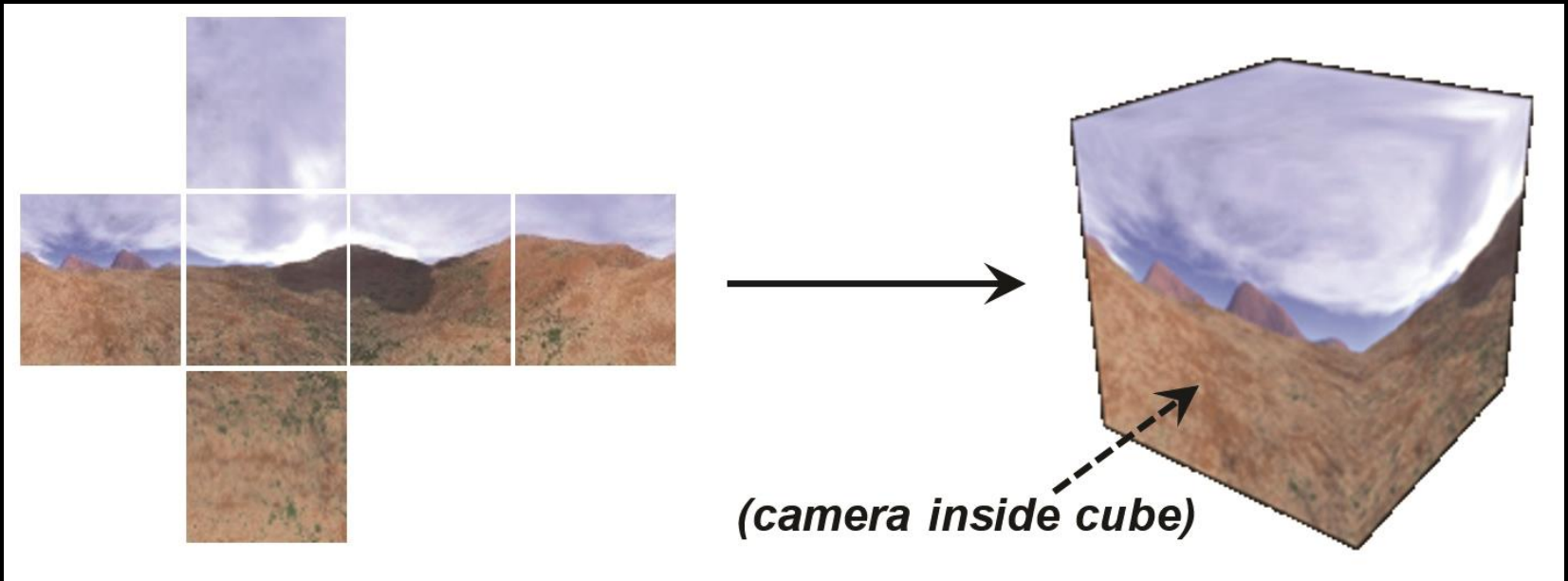
CUBE MAP

- Texture cube map
  - Used to texture all six faces of the cube



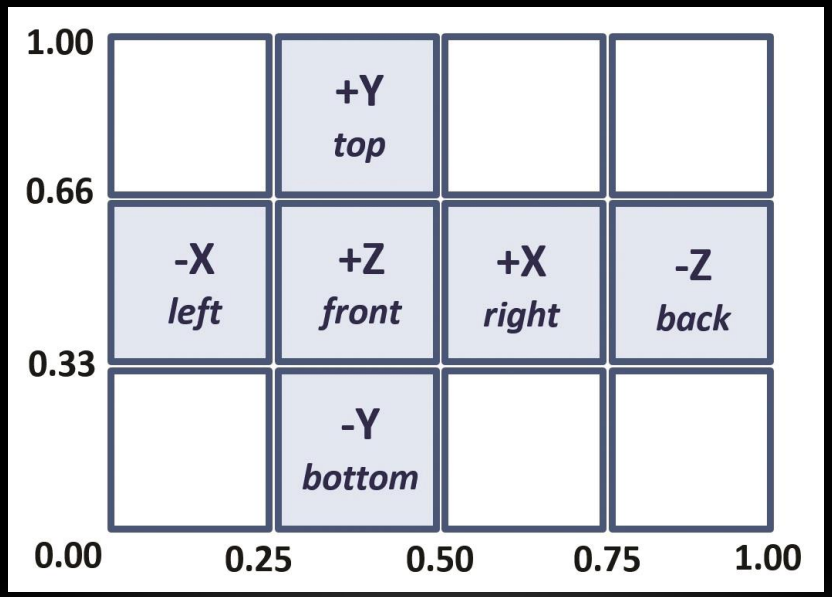
CUBE TEXTURED WITH MAP

- Doesn’t look great from the outside
  - But the camera is placed on the inside



TEXTURE COORDINATES

- Can use appropriate coordinates from below to texture each of the faces



MAKING THE SKYBOX APPEAR DISTANT

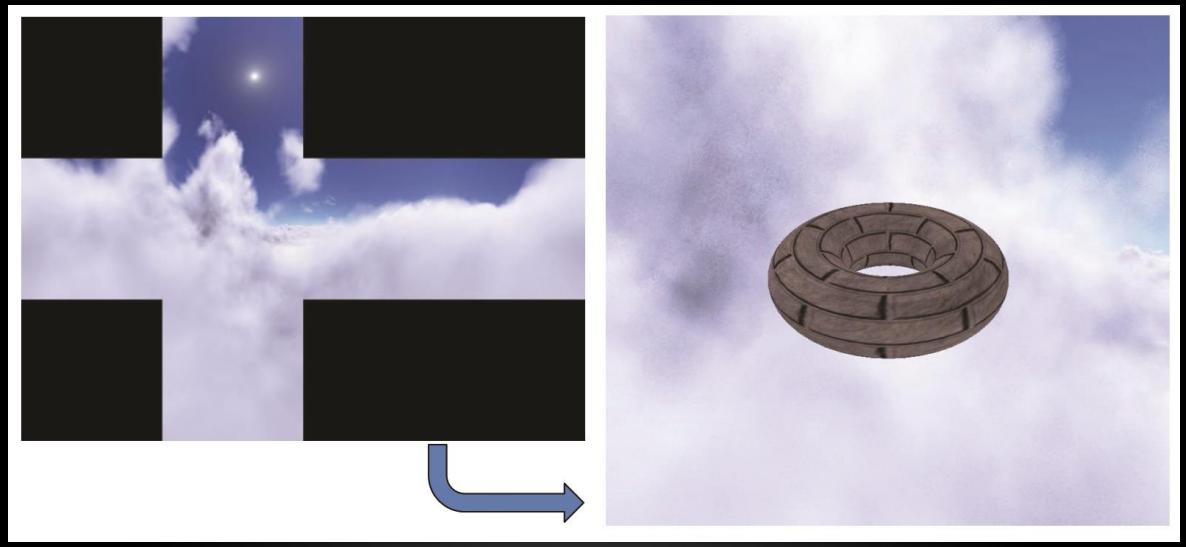
- Making the cube very large ends up distorting texture
- Instead:
  - Disable depth testing
  - Render the skybox
  - Enable depth testing
  - Render other objects in the scene
  - Move the skybox with the camera

  - This assumes you are using a scene that is contained within the 2x2x2 default cube

CREATING THE TEXTURE CUBE MAP

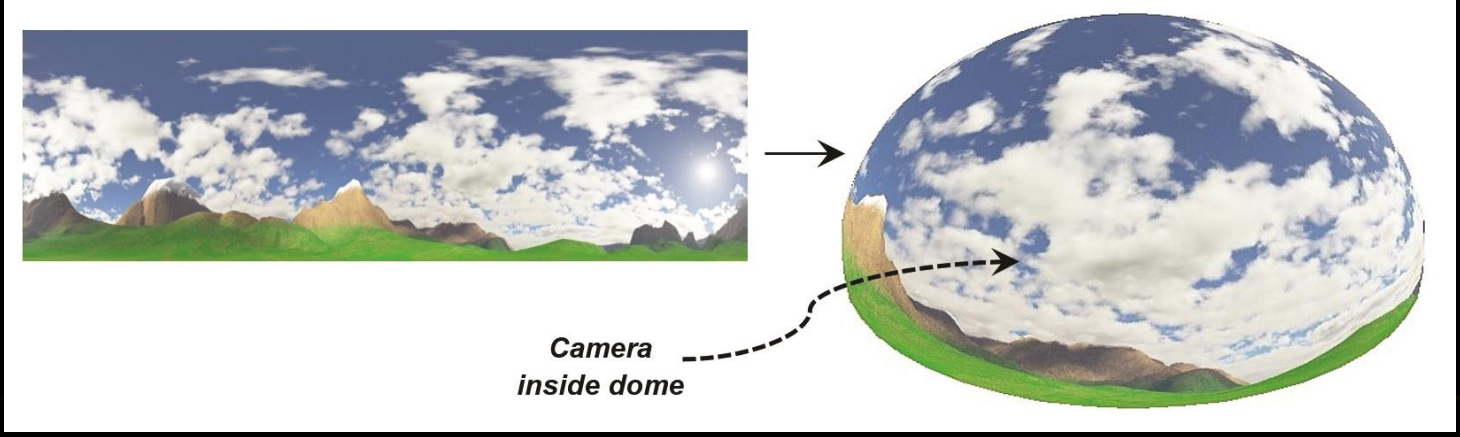
- Use software tools
  - Terragen
  - Autodesk 3ds Max
  - Blender
  - Adobe Photoshop
- Or download / purchase online

EXAMPLE



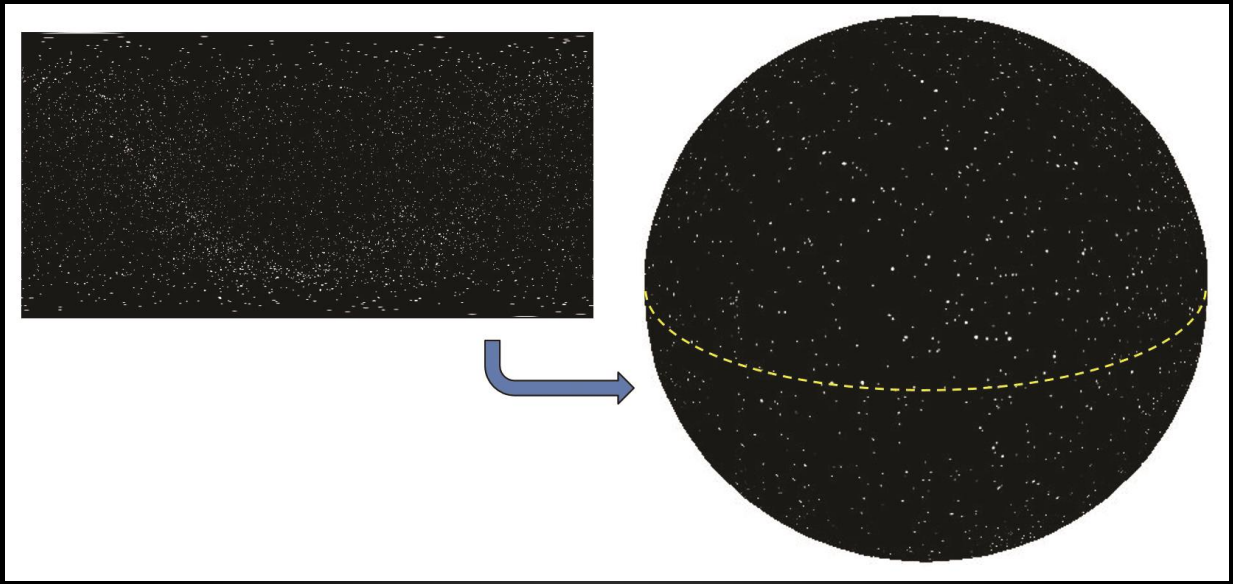
SKYDOME

- Advantage
  - Less susceptible to distortion and seams
    - May have spherical distortion at the poles, though
- Disadvantage
  - Sphere is more complex than cube
    - More computationally expensive



SKYDOME AS A SPHERE

- If ground terrain, makes sense to use a half sphere
- For other scenes, a full sphere makes more sense



IMPLEMENTING A SKYBOX

- Skyboxes used more than skydomes
- More support in OpenGL
  - Which works out well for environment mapping
- Can build one from scratch

- OR

- Can use OpenGL cube maps

BUILDING A SKYBOX FROM SCRATCH

- In display()

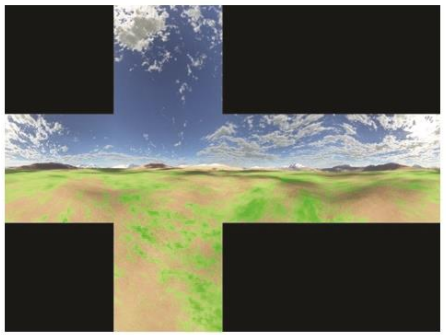
```
//  build the MODEL matrix
m_matrix.setToIdentity();
m_matrix.translate(cameraLoc.getX(),cameraLoc.getY(),
                   cameraLoc.getZ());
…
gl.glEnable(GL_CULL_FACE);
gl.glFrontFace(GL_CCW);// cube is CW, but we are viewing the inside
gl.glDisable(GL_DEPTH_TEST);
gl.glDrawArrays(GL_TRIANGLES, 0, 36);
gl.glEnable(GL_DEPTH_TEST);
```

BUILDING A SKYBOX FROM SCRATCH

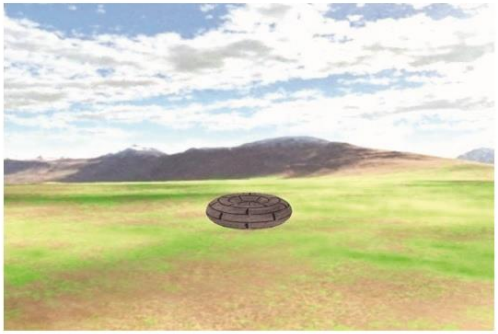
- In setupVertices()

```
float[] cube_texture_coord =
        {.25f,  .666666666f, .25f, .3333333333f, .5f, .3333333333f,     // front face lower left
         .5f, .333333333333f, .5f,  .66666666666f, .25f,  .66666666666f,// front face upper right
         .5f, .3333333333f, .75f, .33333333333f,  .5f,  .6666666666f,   // right face lower left
         .75f, .33333333333f,  .75f,  .66666666666f, .5f,  .6666666666f,// right face upper right
         .75f, .3333333333f,  1.0f, .3333333333f, .75f,  .66666666666f, // back face lower
         1.0f, .3333333333f, 1.0f,  .6666666666f, .75f,  .6666666666f,  // back face upper
         0.0f, .333333333f,  .25f, .333333333f, 0.0f,  .666666666f,     // left face lower
         .25f, .333333333f, .25f,  .666666666f, 0.0f,  .666666666f,     // left face upper
         .25f, 0.0f,  .5f, 0.0f,  .5f, .333333333f,                     // bottom face front
         .5f, .333333333f, .25f, .333333333f, .25f, 0.0f,               // bottom face back
         .25f,  .666666666f, .5f,  .666666666f, .5f,  1.0f,             // top face back
         .5f,  1.0f,  .25f,  1.0f, .25f,  .666666666f };                // top face front
```

SKYBOX RESULTS

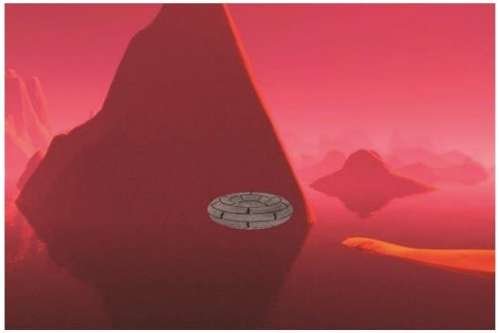


texture cube map (1)



resulting scene with textured skybox

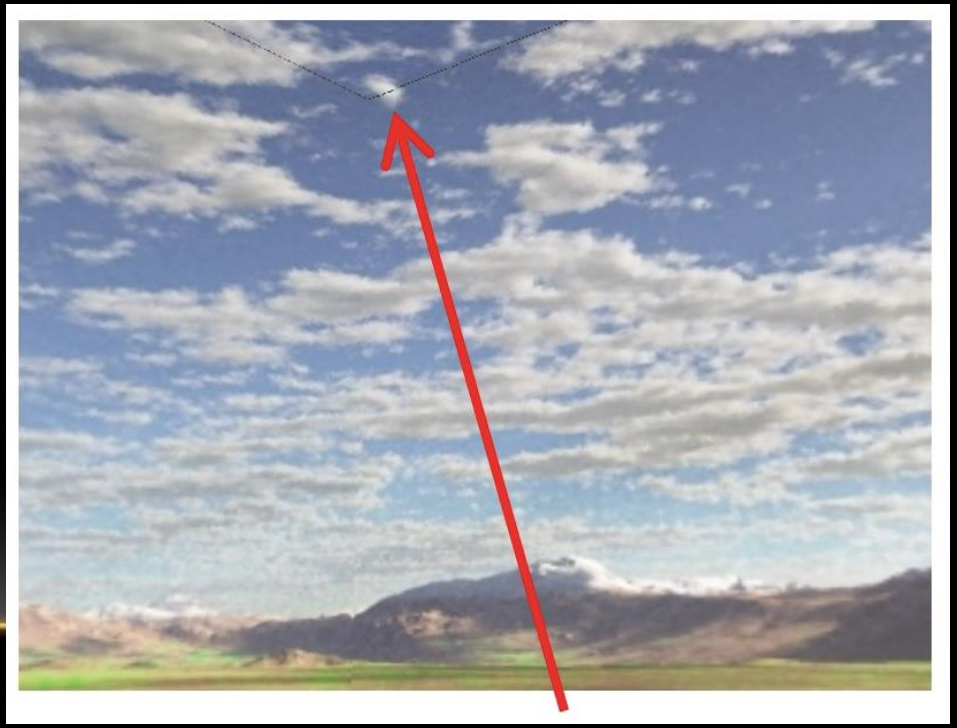
texture cube map (2)



resulting scene with textured skybox

SKYBOX SEAM ARTIFACT

- Visible seams are a potential artifact
  - To avoid this, need to be careful with:
    - Construction of the cube map image
    - Precise texture coordinates



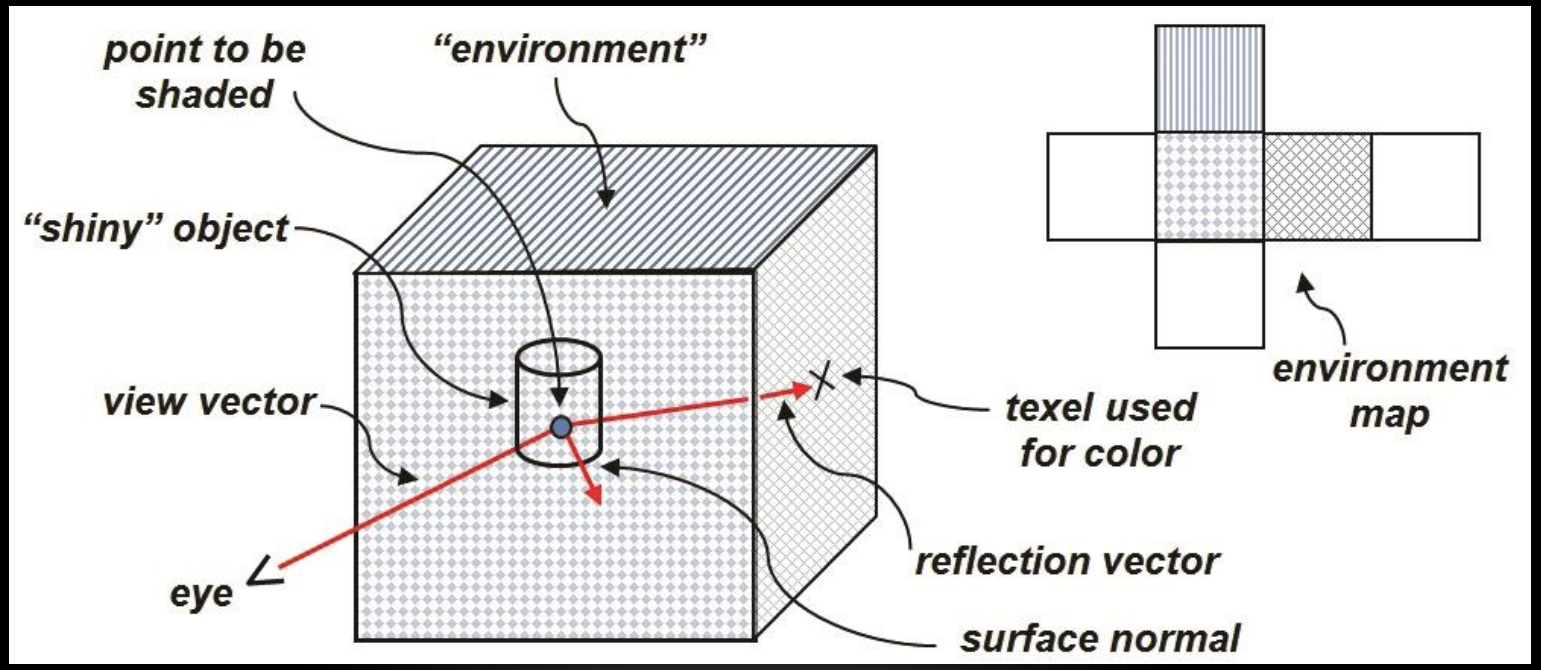
OPENGL CUBE MAPS

- Advantages:
  - Seam reduction
  - Support for environment mapping
- Disadvantage:
  - More complex

OPENGL CUBE MAPS

- Similar to 3D textures (coming soon)
  - Three coordinates, not two
- Texture coordinate (0, 0, 0) is at upper left of texture image
- Six images are read in, one for each face
  - Instead of one image with all faces represented
- Can reduce artifacts by setting texture to GL_CLAMP_TO_EDGE
  - Needs to be done for all three coordinates (s, t and r)
- Enable GL_TEXTURE_CUBE_MAP_SEAMLESS
  - OpenGL will attempt to blend edges

PREVIEW OF ENVIRONMENT MAPPING



ENVIRONMENT MAPPING EXAMPLE

SUMMARY

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- Environment Mapping