LEI / LCC
Departamento de Informática
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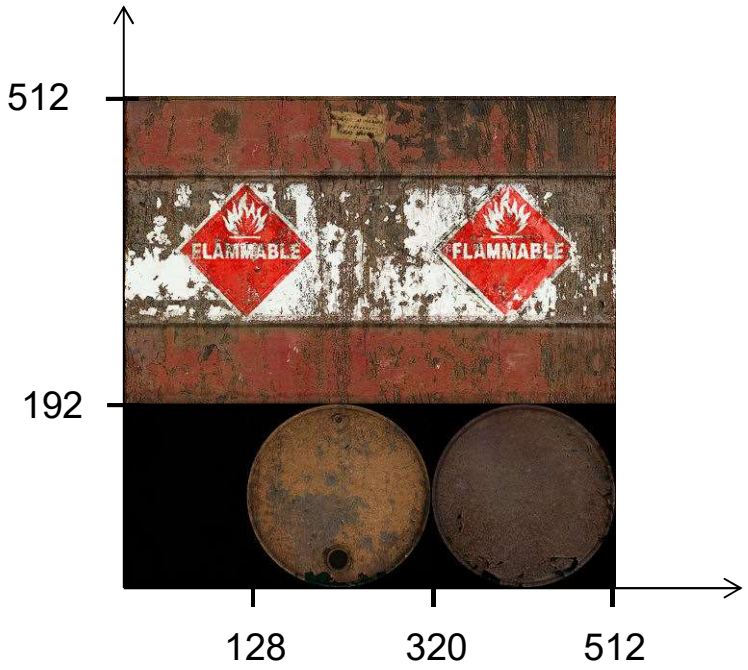
Texturing

Cylinder

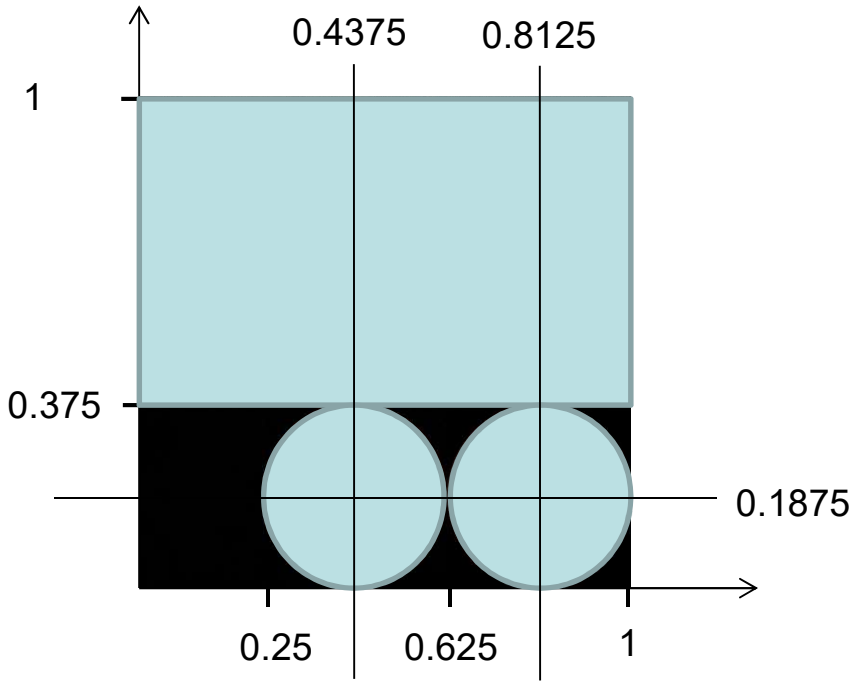
Textured Cylinder

Texture Atlas

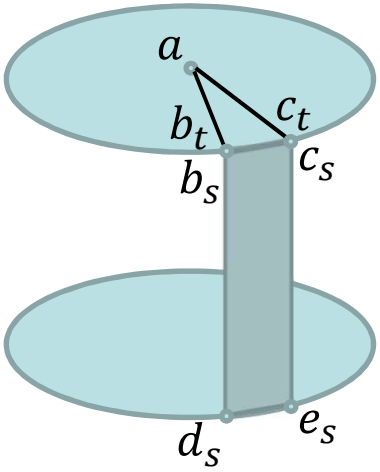
Image space

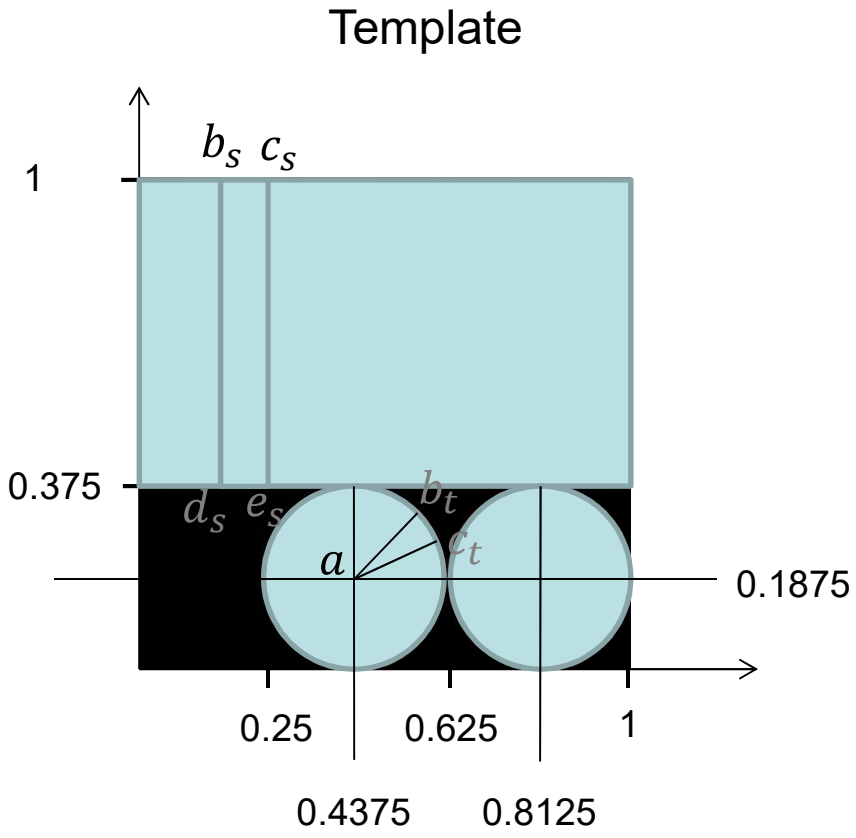


Texture space



Texture Coordinates





DevIL

- Open an image file and define origin of image space in DevIL

```
// setup - done once
ilInit();
ilEnable(IL_ORIGIN_SET);
ilOriginFunc(IL_ORIGIN_LOWER_LEFT);


// for each image …
ilGenImages(1,ima); // unsigned int ima[...]
ilBindImage(ima[0]);
ilLoadImage((ILstring)filename); // char *filename
```

DevIL

- Convert to RGBA

```
ilConvertImage(IL_RGBA, IL_UNSIGNED_BYTE);
```

DevIL

- Get the required info

```
int width = ilGetInteger(IL_IMAGE_WIDTH);

int height = ilGetInteger(IL_IMAGE_HEIGHT);

unsigned char *imageData = ilGetData();
```

Texture Creation in OpenGL

```
// create a texture slot
    glGenTextures(1,&texID);
// bind the slot
    glBindTexture(GL_TEXTURE_2D,texID);

// define texture parameters
          glTexParameteri(GL_TEXTURE_2D,     GL_TEXTURE_WRAP_S,GL_REPEAT);
          glTexParameteri(GL_TEXTURE_2D,     GL_TEXTURE_WRAP_T,GL_REPEAT);

          glTexParameteri(GL_TEXTURE_2D,
                    GL_TEXTURE_MAG_FILTER,GL_LINEAR);
          glTexParameteri(GL_TEXTURE_2D,
                    GL_TEXTURE_MIN_FILTER,GL_LINEAR);

// send texture data to OpenGL
          glTexImage2D(GL_TEXTURE_2D, 0, GL_RGBA, tw, th, 0,
                              GL_RGBA, GL_UNSIGNED_BYTE, texData);
```

Texture Setup

- Code to create a texture from a file (DevIL + OpenGL):

```
unsigned int t, tw, th;
unsigned char *texData;
ilGenImages(1,&t);
ilBindImage(t);
ilLoadImage((ILstring)"Oil_Drum001h.jpg");
tw = ilGetInteger(IL_IMAGE_WIDTH);
th = ilGetInteger(IL_IMAGE_HEIGHT);
ilConvertImage(IL_RGBA, IL_UNSIGNED_BYTE);
texData = ilGetData();

glGenTextures(1,&texID); // unsigned int texID  - variavel global;

glBindTexture(GL_TEXTURE_2D,texID);
glTexParameteri(GL_TEXTURE_2D,      GL_TEXTURE_WRAP_S,          GL_REPEAT);
glTexParameteri(GL_TEXTURE_2D,      GL_TEXTURE_WRAP_T,          GL_REPEAT);

glTexParameteri(GL_TEXTURE_2D,      GL_TEXTURE_MAG_FILTER,      GL_LINEAR);
glTexParameteri(GL_TEXTURE_2D,      GL_TEXTURE_MIN_FILTER,      GL_LINEAR);

glTexImage2D(GL_TEXTURE_2D, 0, GL_RGBA, tw, th, 0,
                GL_RGBA, GL_UNSIGNED_BYTE, texData);
```

Textures

- Activate 2D texturing (init):

```
glEnable(GL_TEXTURE_2D);
```

Setup

- Before drawing:

```
glBindTexture(GL_TEXTURE_2D, texID);
```

- Drawing (VBOs or immediate mode)

- After drawing:

```
glBindTexture(GL_TEXTURE_2D, 0);
```

Render

Tex Coords in immediate mode

- For each vertex define its texture coordinate:

```
glBegin(GL_TRIANGLES);
    glTexCoord2f(s1, t1);
    glVertex3f(x1,y1,z1);
    glTexCoord2f(s2, t2);
    glVertex3f( x2,y2,z2);
    …
glEnd();
```

Textures w/ VBOS - Setup

- Activate arrays:

```
glEnableClientState(GL_VERTEX_ARRAY);
glEnableClientState(GL_NORMAL_ARRAY);
glEnableClientState(GL_TEXTURE_COORD_ARRAY);
```

Textures w/ VBOS - Setup

- Add an array with texture coordinates:
  - Two components per vertex
  - Create an extra VBO;

```
unsigned int vertices, normals, texCoords;
float * v,n,t;
int count; // store the number of vertices
...
glGenBuffers(1, &vertices);
glBindBuffer(GL_ARRAY_BUFFER, vertices);
glBufferData(GL_ARRAY_BUFFER, sizeof(float) * 3 * count, v,     GL_STATIC_DRAW);

glGenBuffers(1, &normals);
glBindBuffer(GL_ARRAY_BUFFER, normals);
glBufferData(GL_ARRAY_BUFFER, sizeof(float) * 3 * count, n,     GL_STATIC_DRAW);

glGenBuffers(1, &texCoords);
glBindBuffer(GL_ARRAY_BUFFER, texCoords);
glBufferData(GL_ARRAY_BUFFER, sizeof(float) * 2 * count, t,     GL_STATIC_DRAW);
```

Textures w/ VBOS - Render

- Semantics:

```
glBindBuffer(GL_ARRAY_BUFFER,vertices);
glVertexPointer(3,GL_FLOAT,0,0);

glBindBuffer(GL_ARRAY_BUFFER,normals);
glNormalPointer(GL_FLOAT,0,0);

glBindBuffer(GL_ARRAY_BUFFER,texCoords);
glTexCoordPointer(2,GL_FLOAT,0,0);
```

- Texture bind and call glDraw*

Assignment

- Compute the texture coordinates for the cylinder and floor and apply the given textures

  - desenhaChao: definir coordenadas de textura para o chão
  - preparaCilindro: definir coordenadas de textura para o cilindro
  - desenhaCilindro: adicionar buffer das coordenadas de textura e a semântica
  - renderScene: fazer bind das texturas