COMP220: Graphics & Simulation

5: Textures and models

Learning outcomes

- **Explain** how a 2D texture image can be wrapped onto a 3D model
- **Explain** how a complex 3D model is represented in memory
- **Write** programs which draw textured meshes to the screen

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Basic texture mapping

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  - Load the pixel data into the new texture with `glTexImage2D`
  - Set the texture filtering modes with `glTexParameteri` (more on this later)

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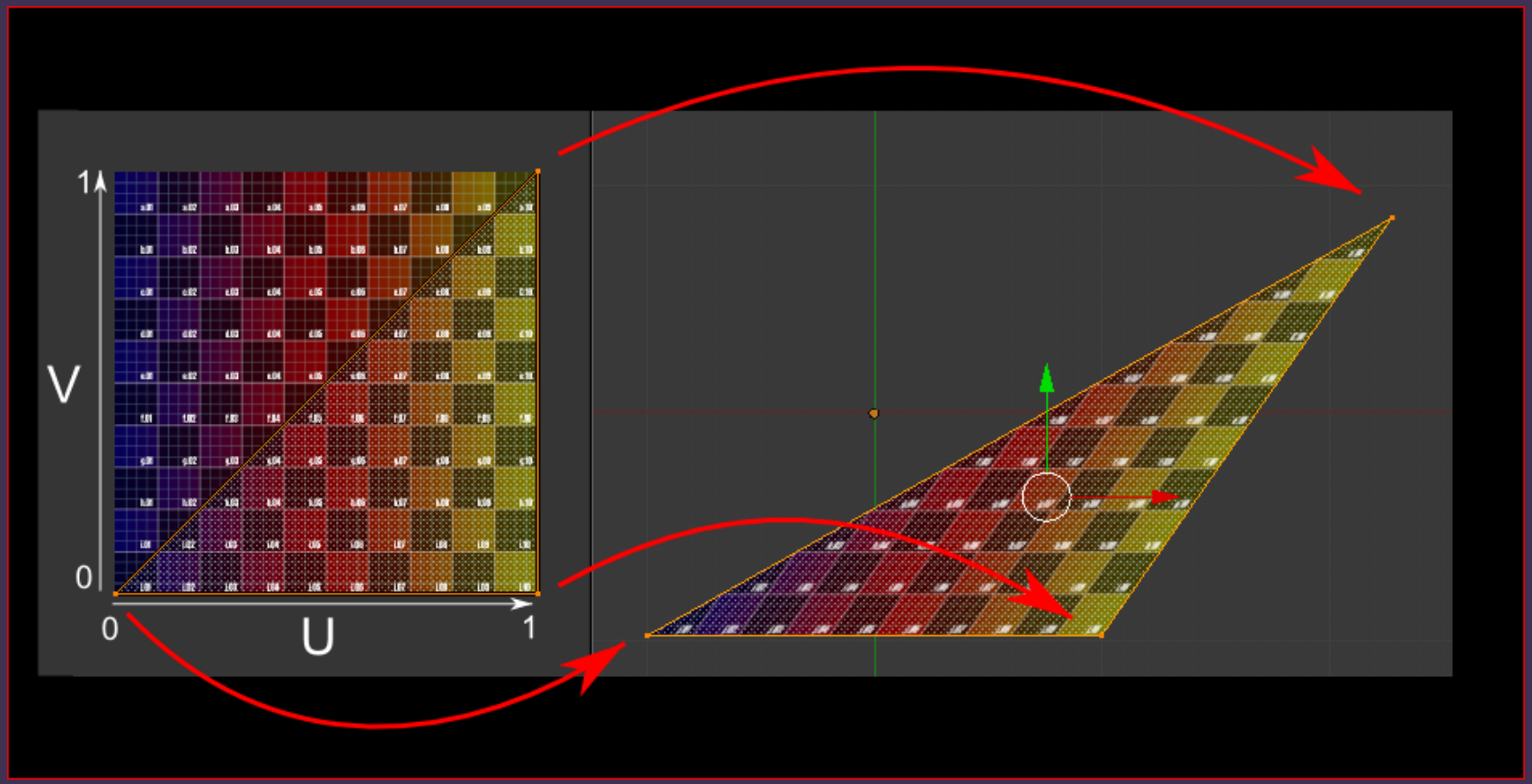
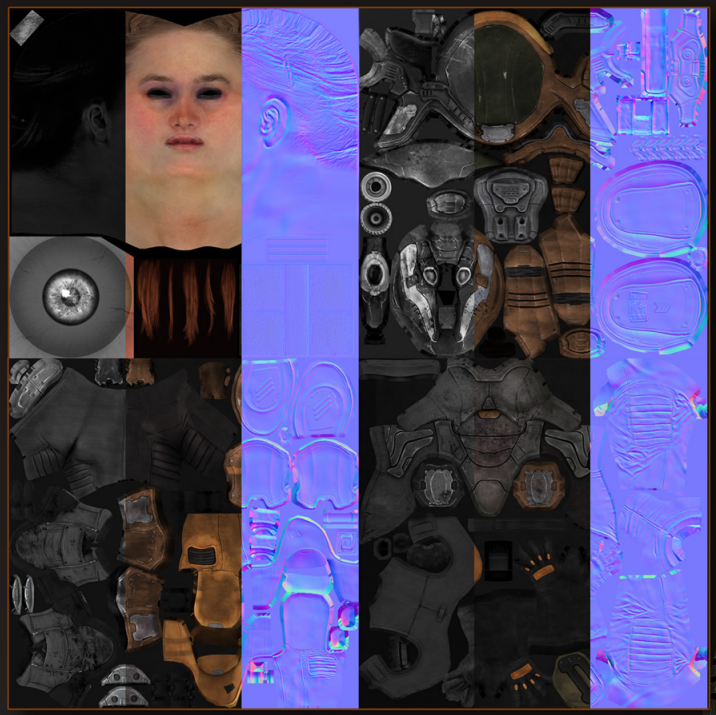
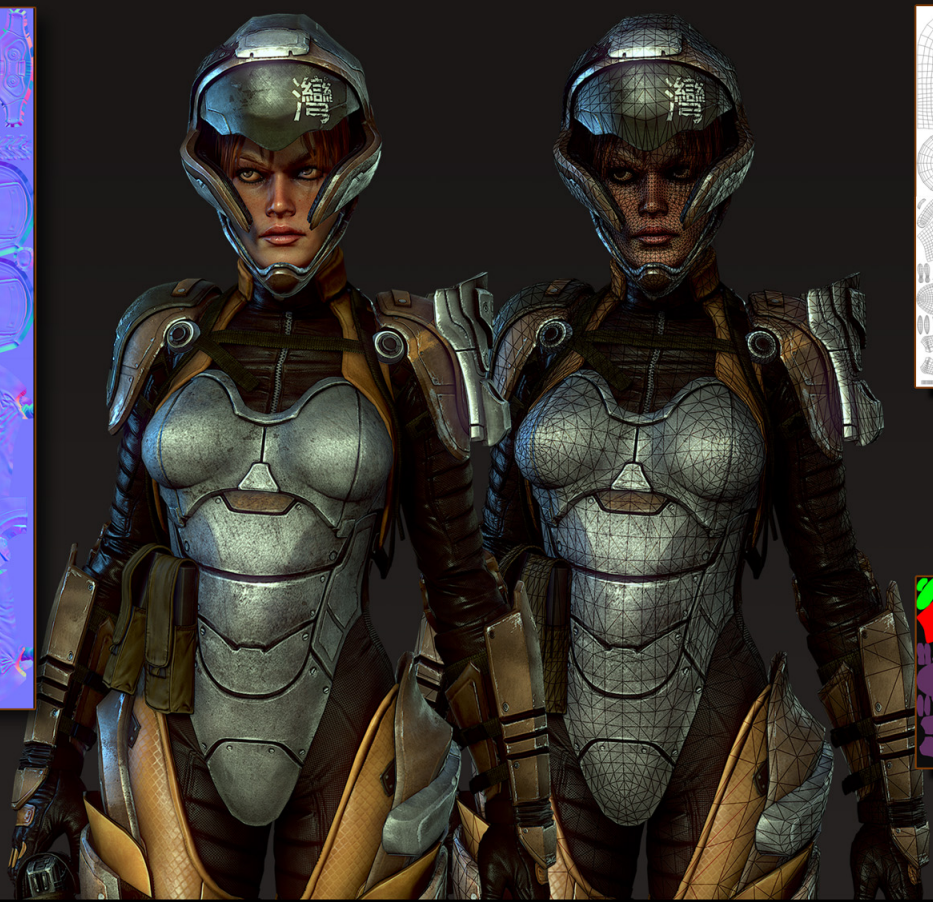
- (So really just another name for *xy* coordinates in texture space)
- Basic idea of texture mapping: give each vertex a *uv* coordinate, and interpolate across the triangle

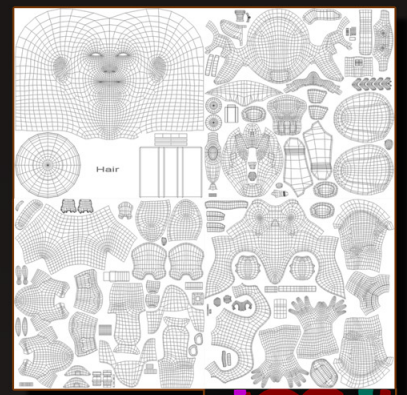
UV coordinates

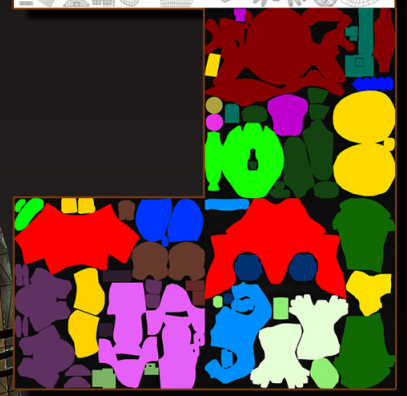




Specular/Diffuse/Normal







UV layout/Masking maps

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Textures in GLSL

Fragment shader:

```
in vec2 textureCoords;
uniform sampler2D textureSampler;

void main()
{
    fragmentColour = texture(textureSampler,
        textureCoords);
}
```

Texture filtering

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glTexParameteri(GL_TEXTURE_2D, GL_TEXTURE_MIN_FILTER,
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- **Mip-mapping** pre-calculates scaled down versions of the texture — improves quality but costs memory

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- Still better to stick to powers of two as some things work better (e.g. mipmapping)
- NB: **rectangular** textures are fine, but **square** textures make UV coordinates saner

Texture Mapping Example

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Transparency

Alpha

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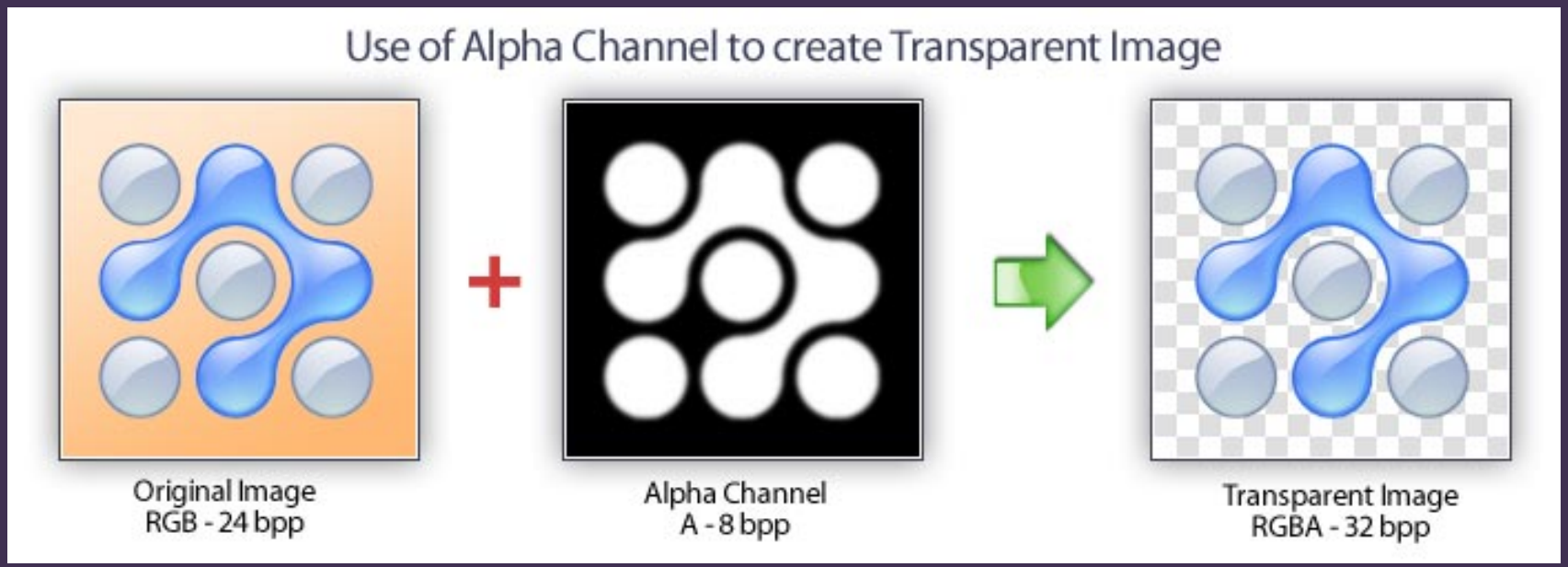

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```
glEnable(GL_BLEND);
glBlendFunc(GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA);
```

- Other values can be passed to `glBlendFunc` for special effects (e.g. **additive blending** is often used for particle effects simulating light, fire, explosions etc.)

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- Solution: draw semi-transparent objects **after** opaque objects, and in **back to front** order
- Further discussion: `http://www.opengl-tutorial.org/intermediate-tutorials/tutorial-10-transparency/`

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More meshes

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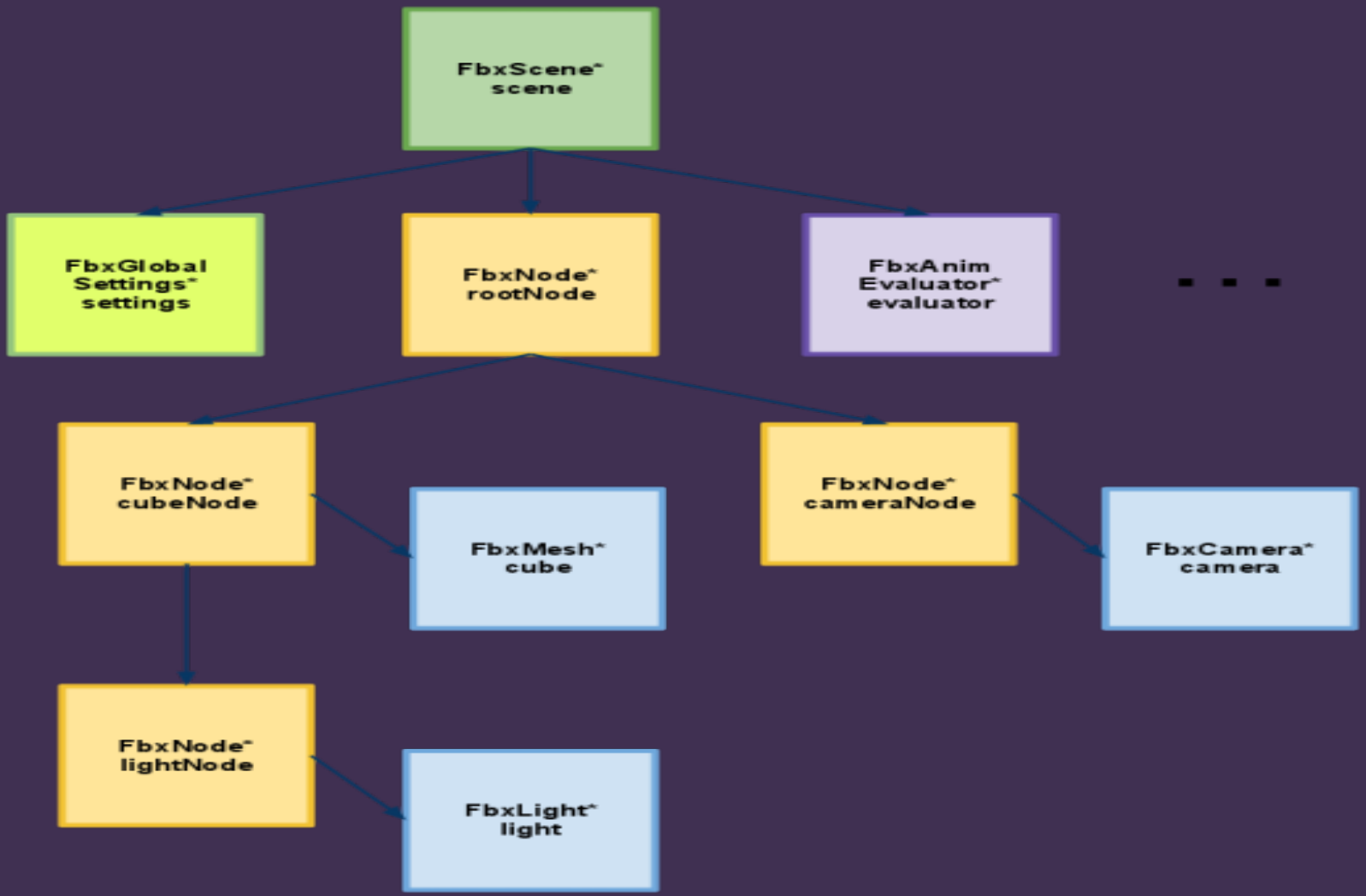
- We are going to use FBX as our model format, this known as an 'interchange' format

Quick Tour of the FBX Format



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  - MD5 (DOOM3)
  - SMD (Half Life 2, Portal etc)

Open Asset Import Library Example

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Exercises

Exercise 1 - Texturing

- Load in a image using SDL Image
- Copy this image into a OpenGL Texture
- Add Texture Coordinates to your Cube or Square
- Map this texture onto the Cube or Square
- Finally change the texture to a transparent texture

Exercise 2 - Model Loading

- Load and display a model using Open Asset Importer
- Change the model so that you load the following
  - Tetrahedron
  - Cube
  - Sphere
  - Cylinder
- `http://assimp.sourceforge.net/howtoBasicShapes.html`
- `https://github.com/assimp/assimp/tree/master/test/models/NFF/NFF`

Exercise 3 - More Complex Scene

- Create a GameObject class which contains the following as member variables
  - Vertex Buffer
  - Element Buffer
  - Vertex Array Object
  - Position, Scale, Rotation Vectors
  - Position, Scale, Rotation, Model Matrices
  - Open GL Texture
  - Number of vertices and Indices
- Add in functions to initialise and get each of these values
- Add in functions to update (calculate the model matrix) and render
- Create an instance of this Game Object and display it on the screen