COMP220: Graphics & Simulation

5: Textures and models

FALMOUTH
UNIVERSITY

Learning outcomes

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

Basic texture mapping

Loading textures from a file

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  - Bind the texture with `glBindTexture`

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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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- *u* axis is horizontal and ranges from 0 (left) to 1 (right)
- *v* axis is vertical and ranges from 0 (bottom) to 1 (top)
- (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
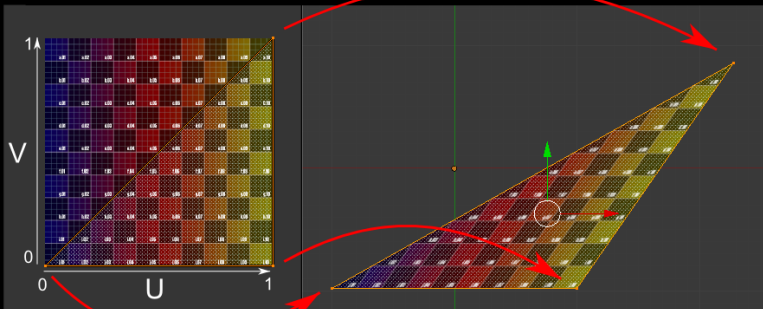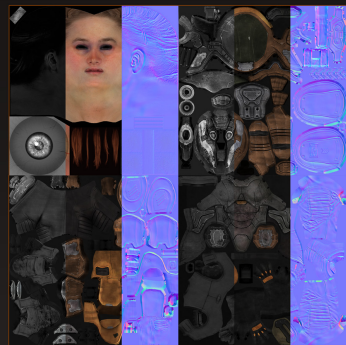
Specular/Diffuse/Normal

UV layout/Masking maps

SHIH-KAI CHANG   SHIHKAICHANG@HOTMAIL.COM
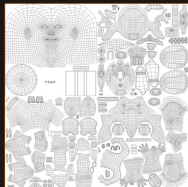
Textures in GLSL

Fragment shader:

```glsl
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, ←
    GL_LINEAR);
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- **Mip-mapping** pre-calculates scaled down versions of the texture — improves quality but costs memory

Transparency

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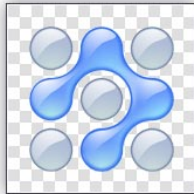# Alpha

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Use of Alpha Channel to create Transparent Image
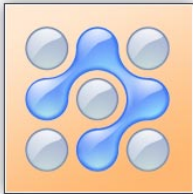
Original Image
RGB - 24 bpp
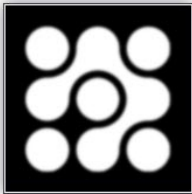
Alpha Channel
A - 8 bpp

Transparent Image
RGBA - 32 bpp

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glEnable(GL_BLEND);
glBlendFunc(GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA);
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```
glEnable(GL_BLEND);
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- 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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- ▶ But if the object in front is (semi-)transparent, we want to see the object behind it!
- ▶ 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/`
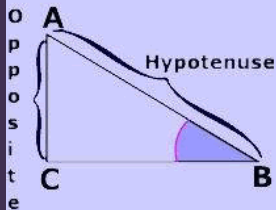
More meshes
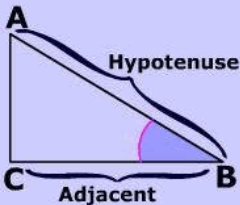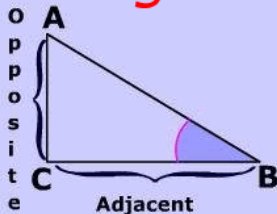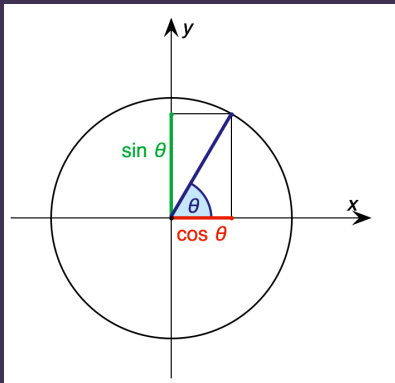
SOH CAH TOA

Drawing a circle
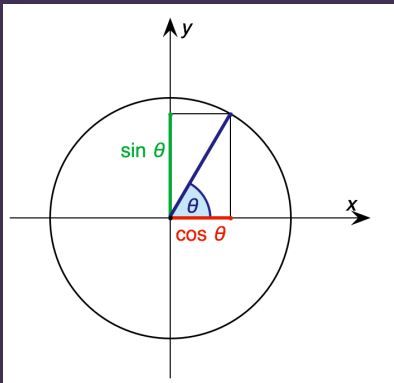
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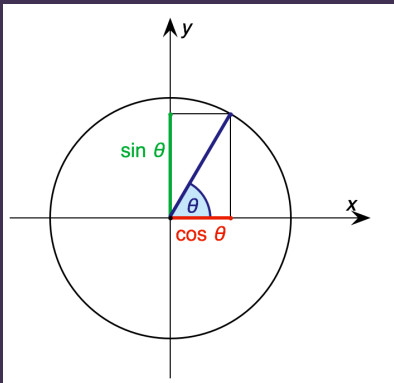Circle of **radius** r
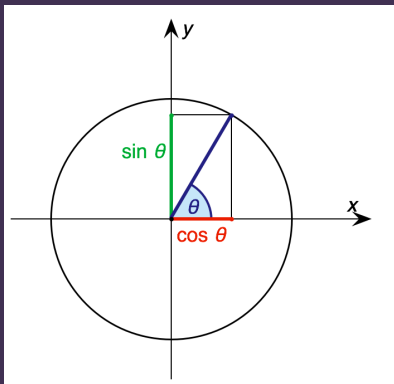
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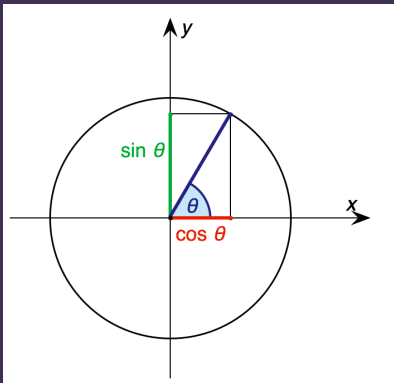
$\therefore$ hypotenuse $= r$

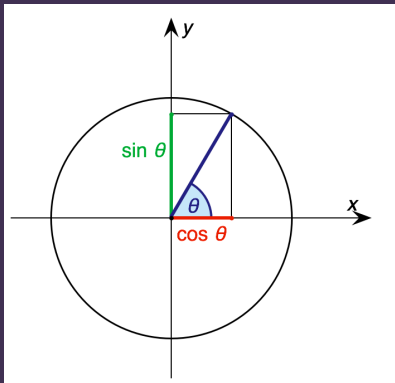$$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{x}{r}$$

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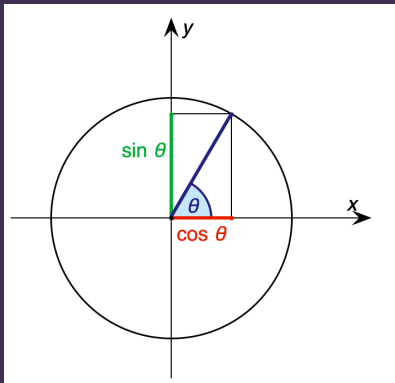$\therefore x = r\cos\theta$

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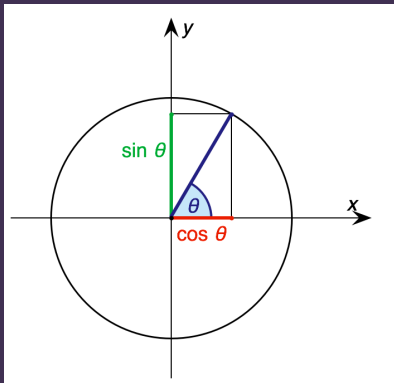$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{y}{r}$

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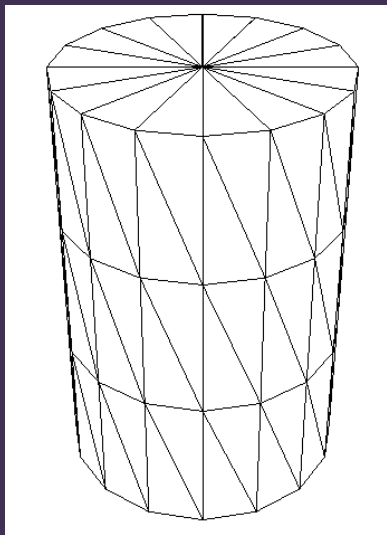
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NB: this works even if $\cos\theta$ and/or $\sin\theta$ are negative (i.e. if θ is not between 0° and 90°)

Drawing a cylinder

Drawing a sphere