COMP220: Graphics & Simulation

5: Textures and models

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

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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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- *u* axis is horizontal and ranges from 0 (left) to 1 (right)
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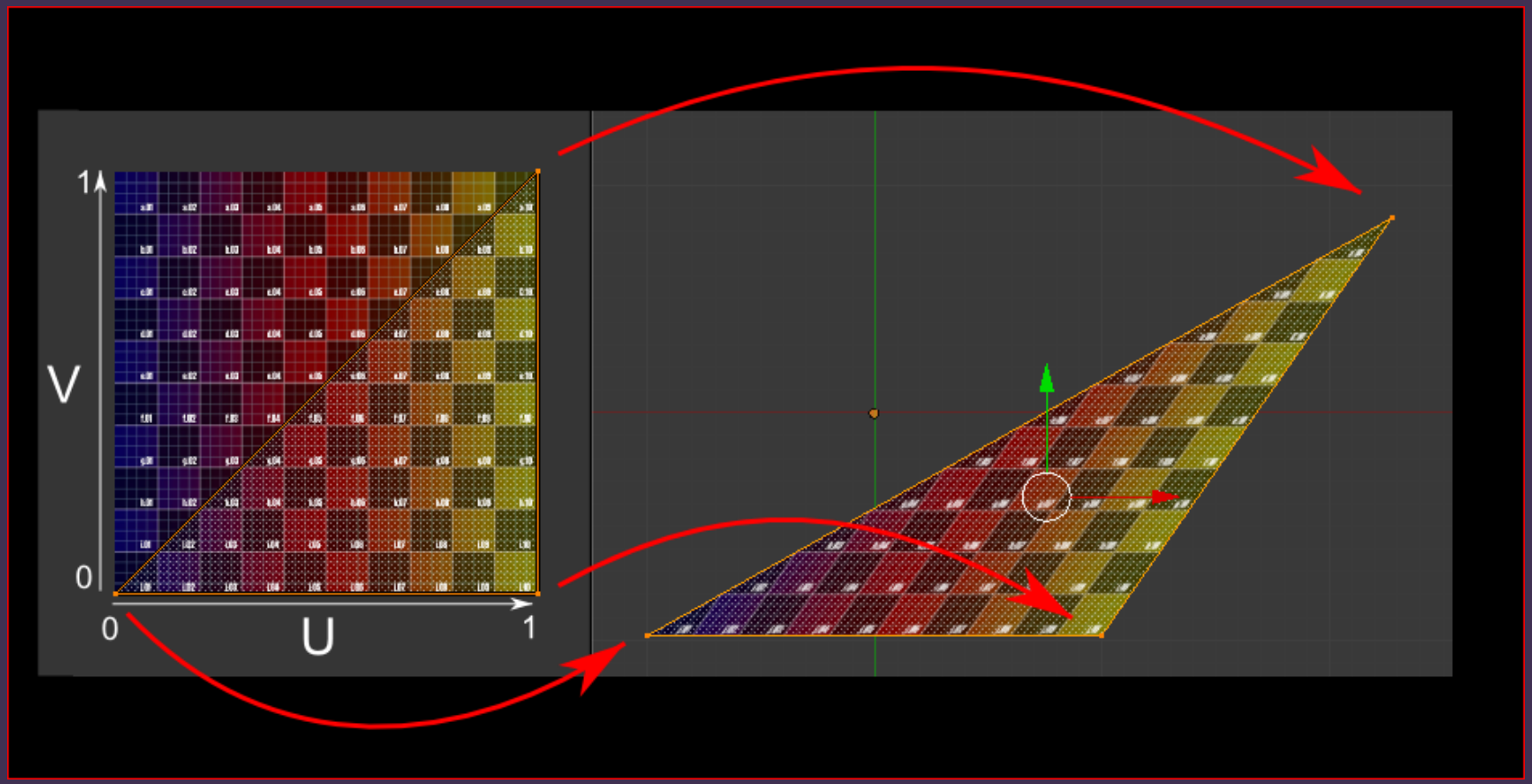
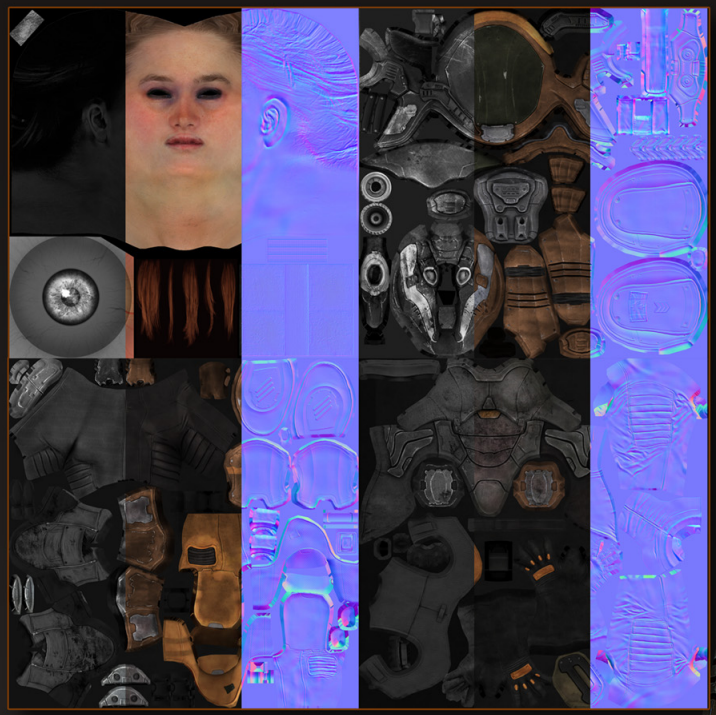
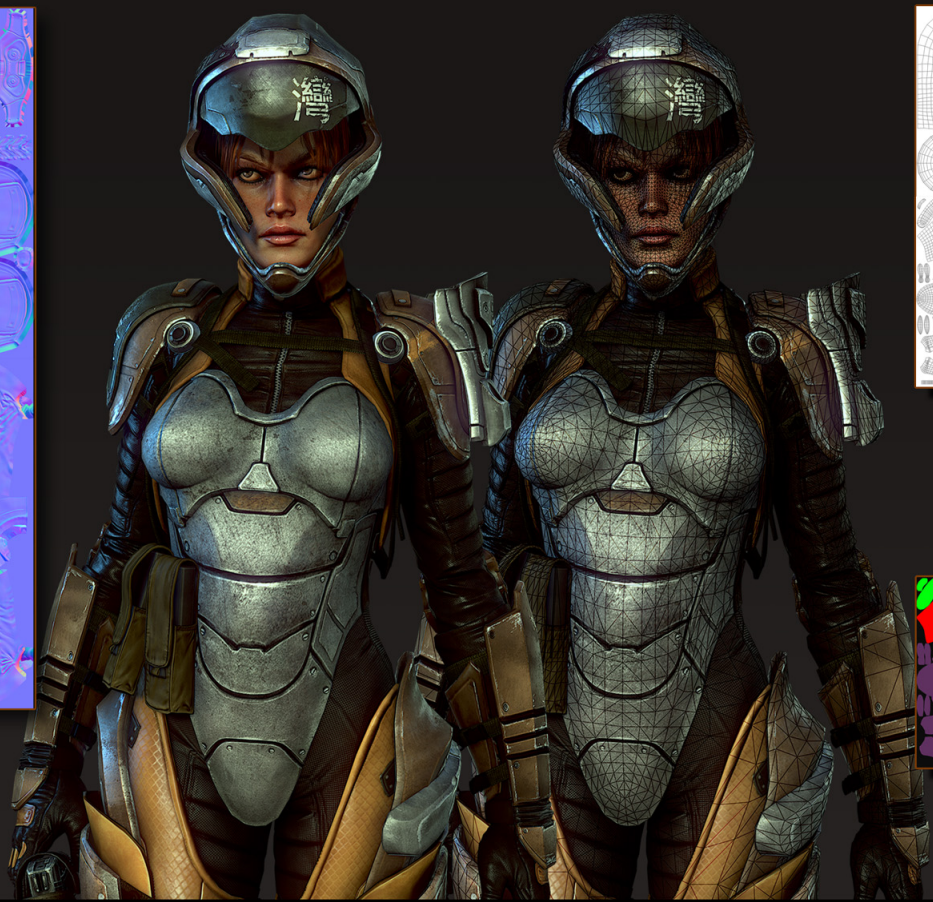
- (So really just another name for *xy* coordinates in texture space)
- Basic idea of texture mapping: give each vertex a *uv* coordinate, and interpolate across the triangle

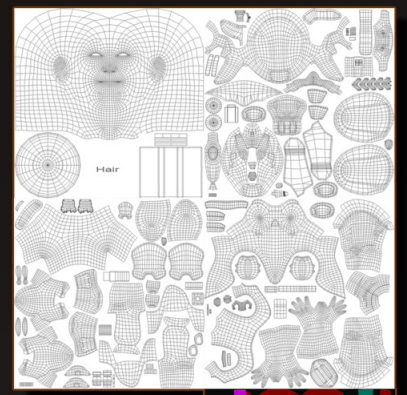
UV coordinates

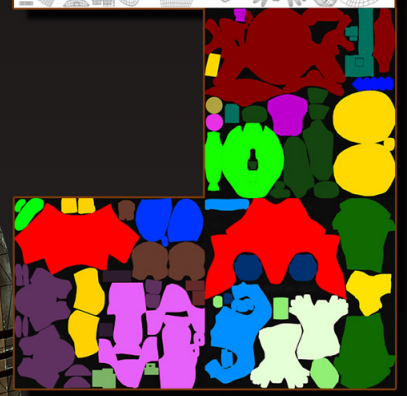




Specular/Diffuse/Normal







UV layout/Masking maps

SHIH-KAI CHANG SHIHKAICHANG@HOTMAIL.COM

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

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Transparency

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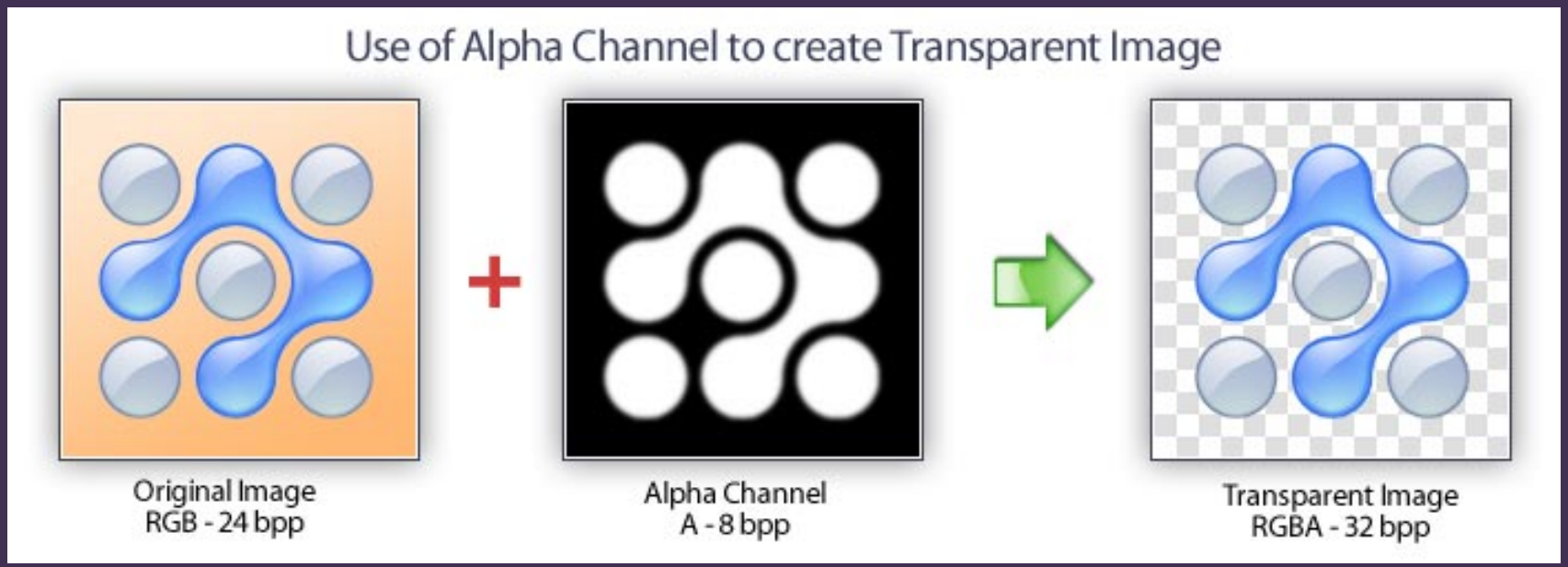

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- Other values can be passed to `glBlendFunc` for special effects (e.g. **additive blending** is often used for particle effects simulating light, fire, explosions etc.)

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- 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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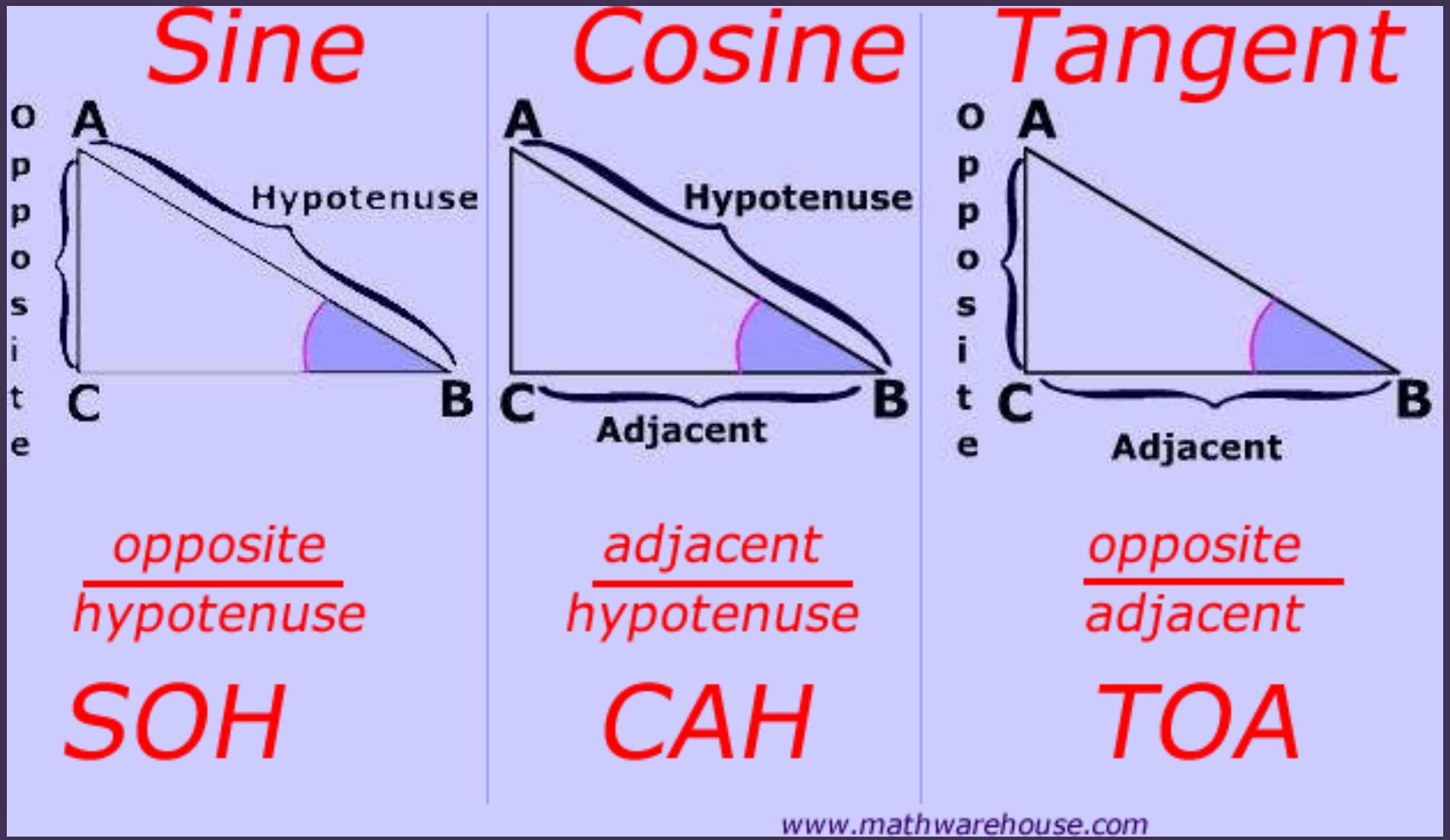
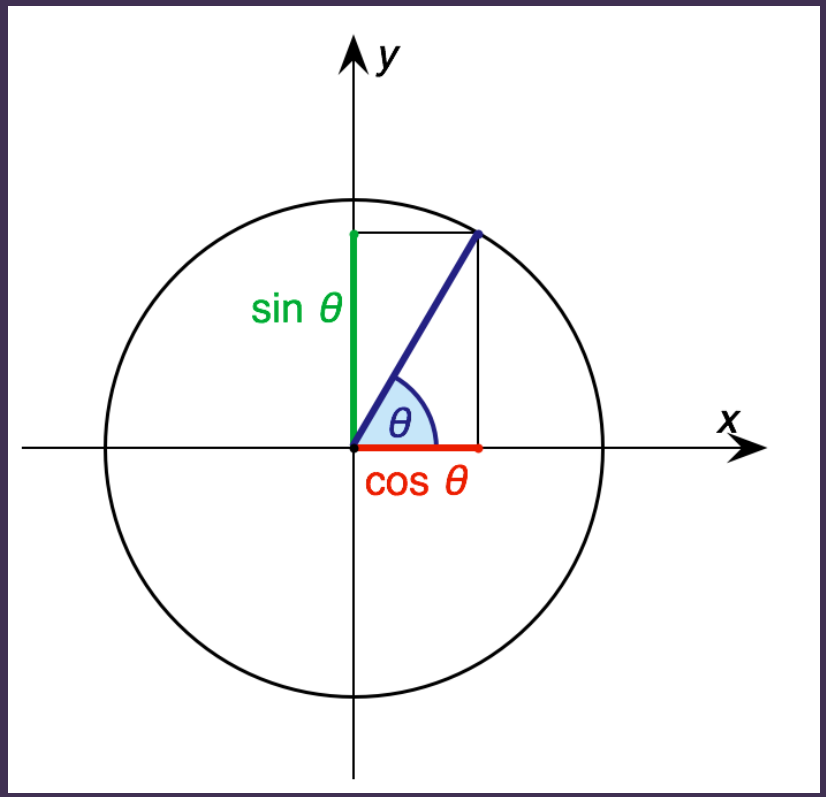
More meshes

SOH CAH TOA

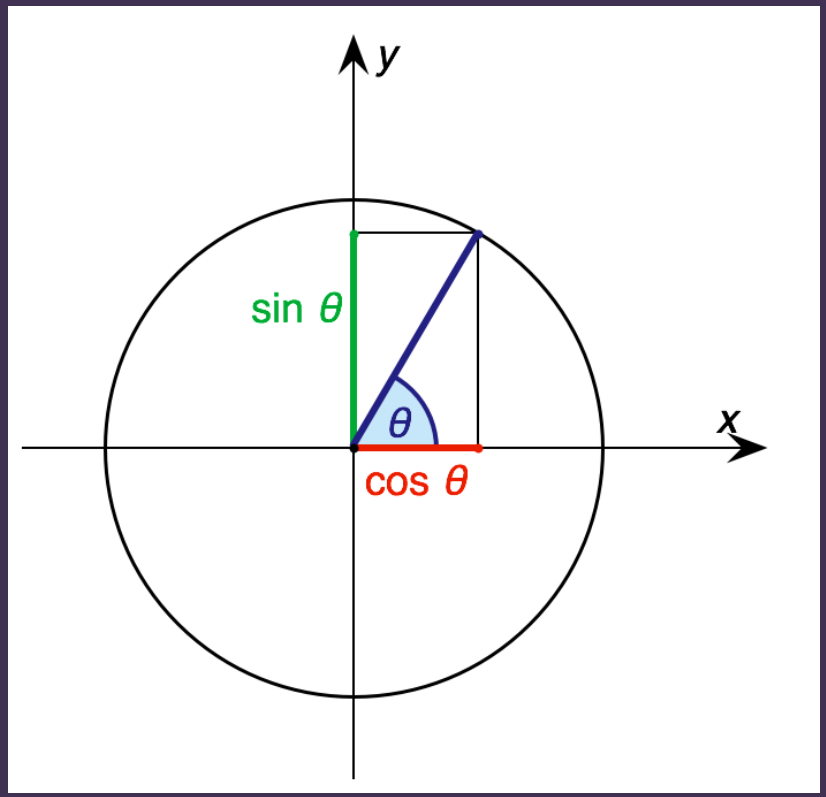

Sine
Cosine
Tangent
opposite
A
C
B
Hypotenuse
Adjacent
opposite / hypotenuse
adjacent / hypotenuse
opposite / adjacent
SOH
CAH
TOA
www.mathwarehouse.com

Drawing a circle



Drawing a circle

Circle of **radius** *r*



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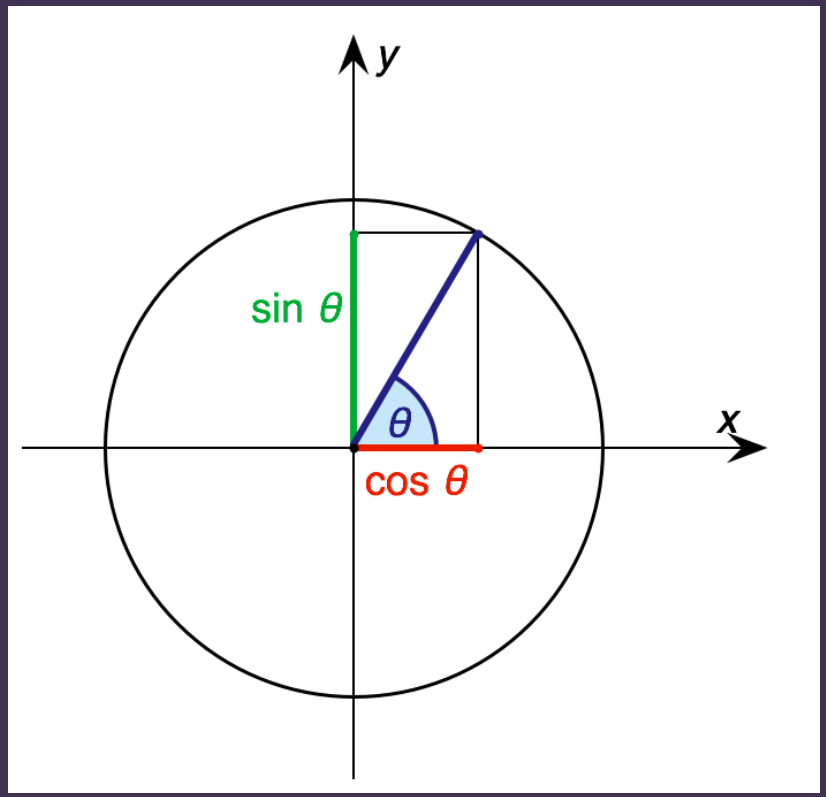

Circle of **radius** r

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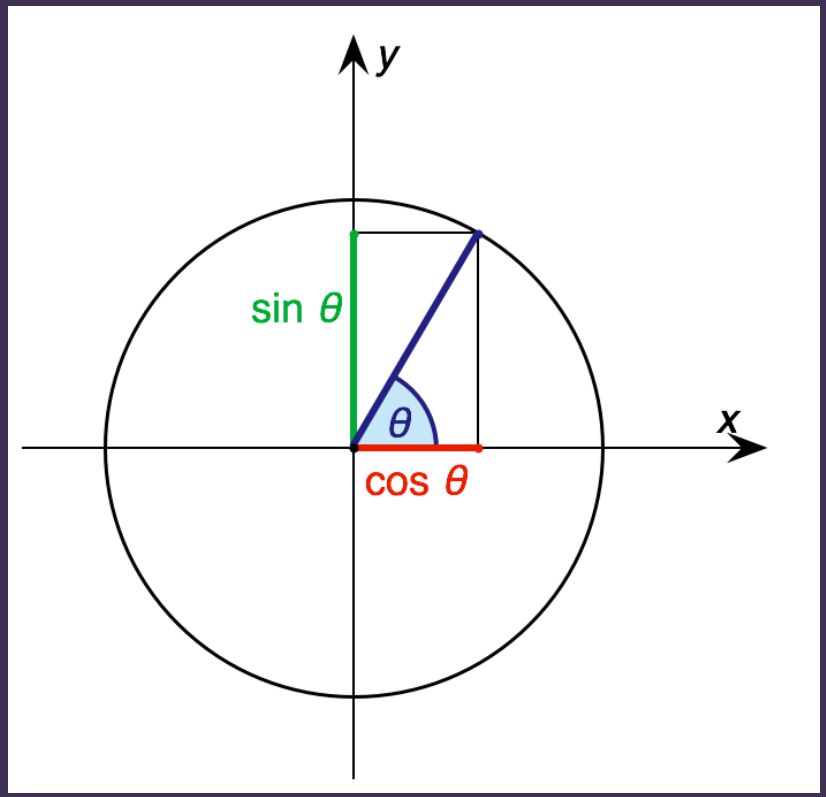

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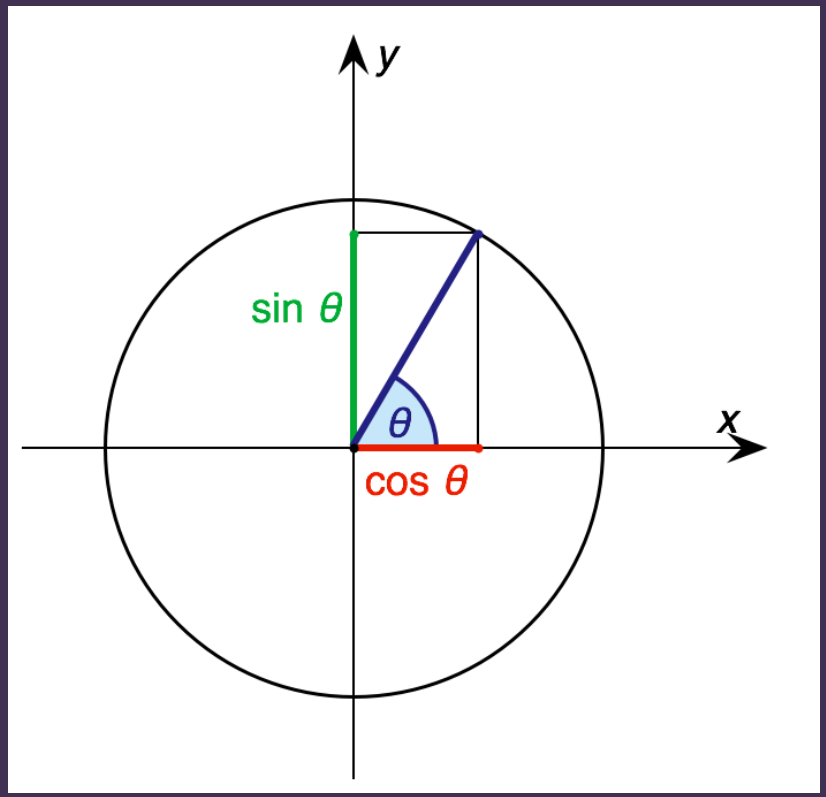

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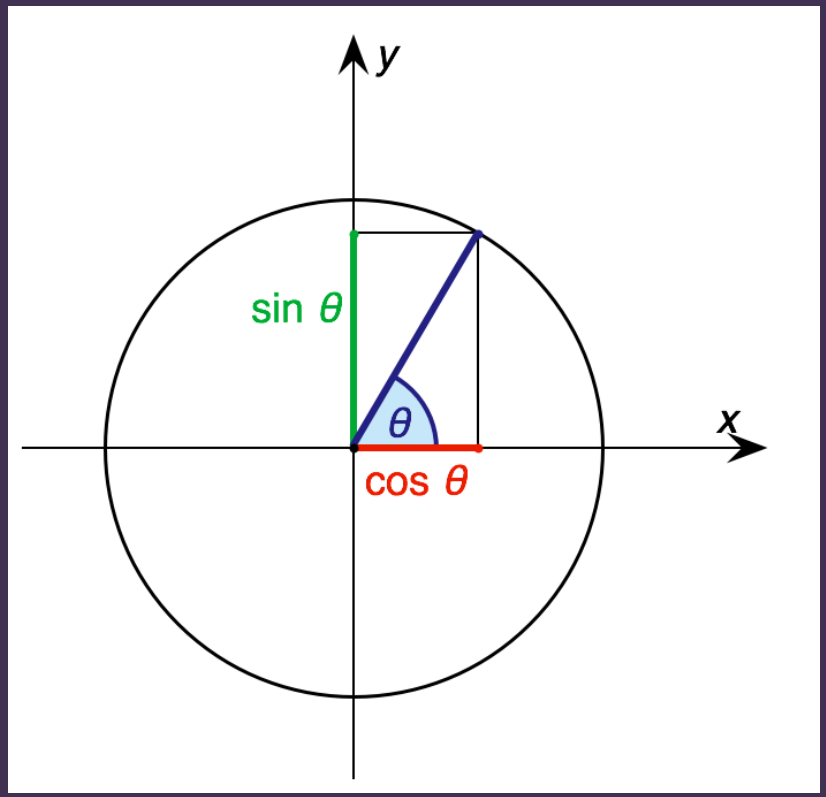

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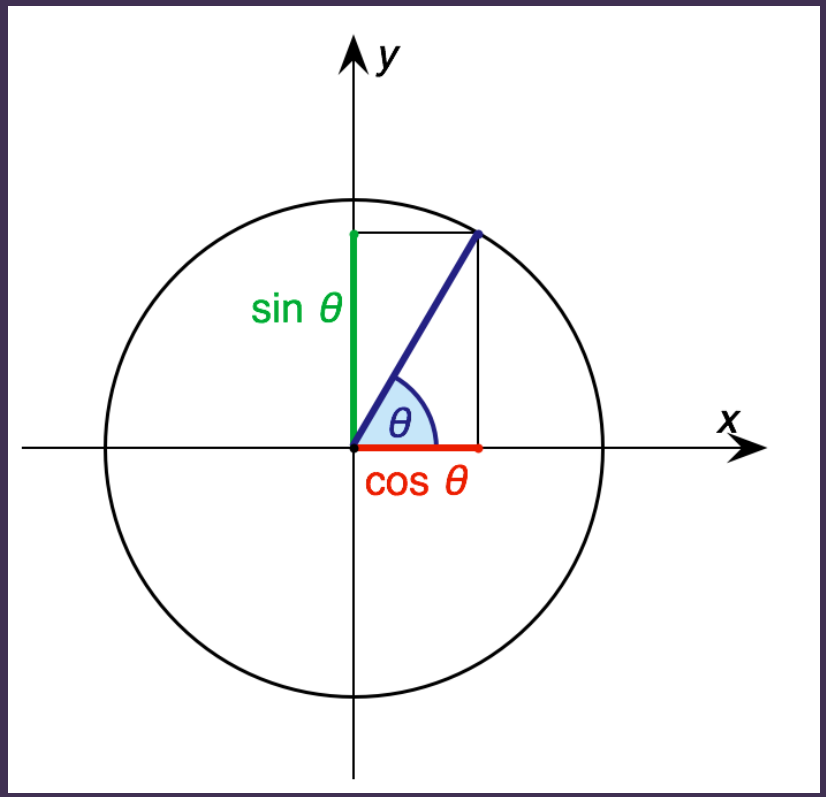

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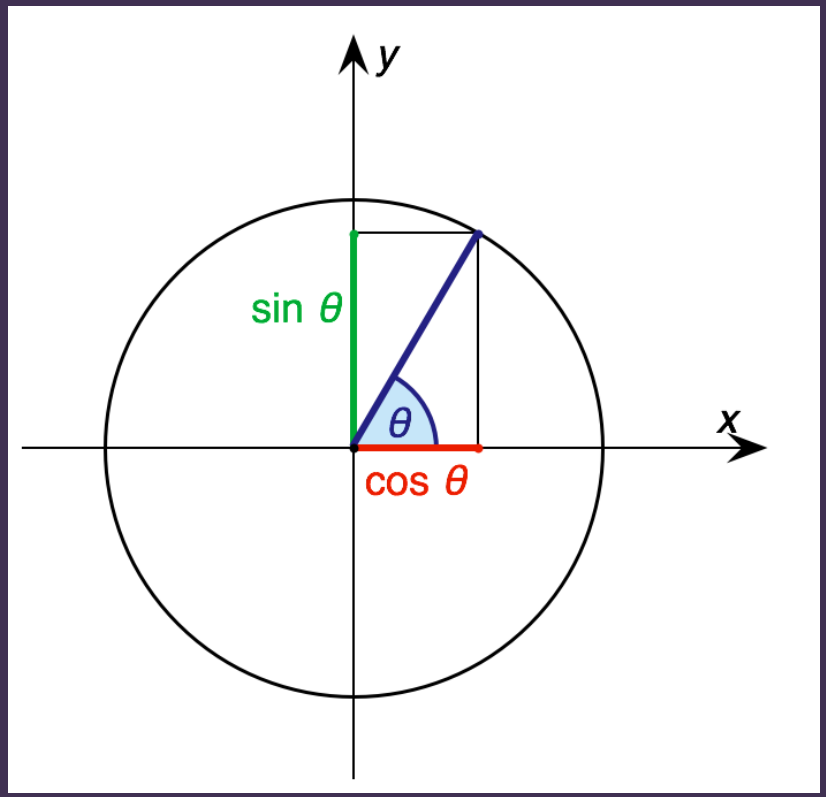

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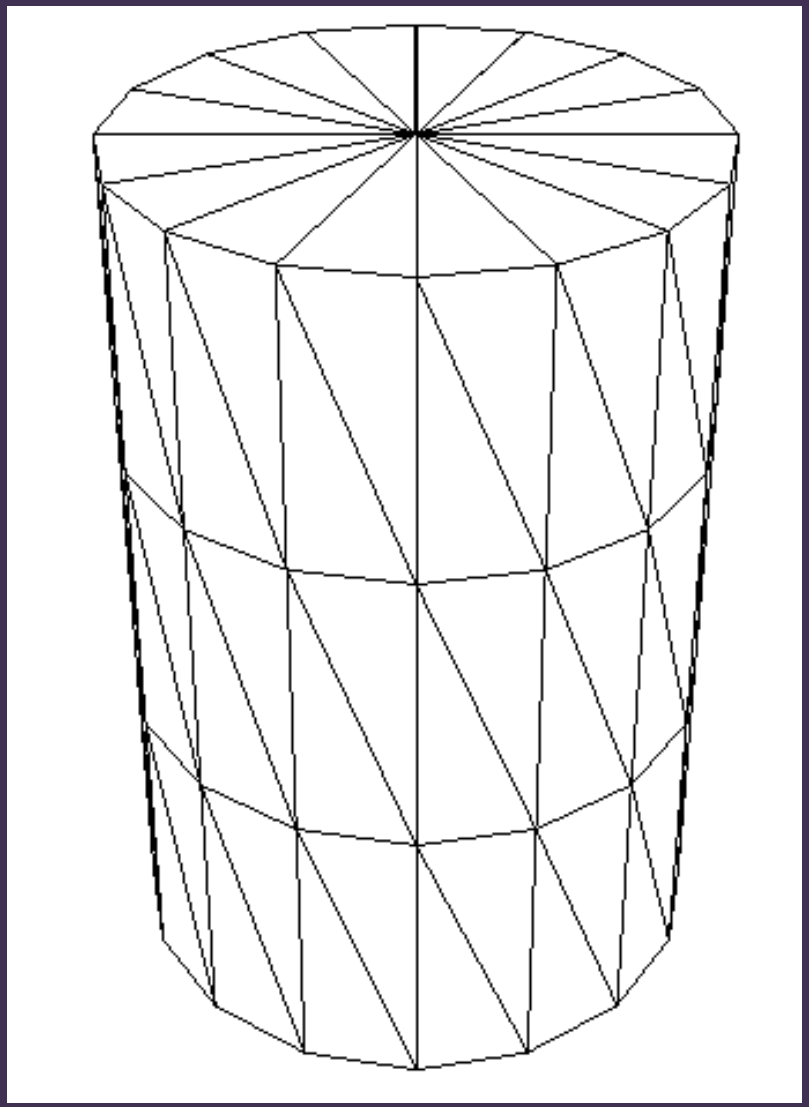
NB: this works even if $\cos\theta$ and/or $\sin\theta$ are negative (i.e. if θ is not between 0° and 90°)

Drawing a cylinder



Drawing a sphere