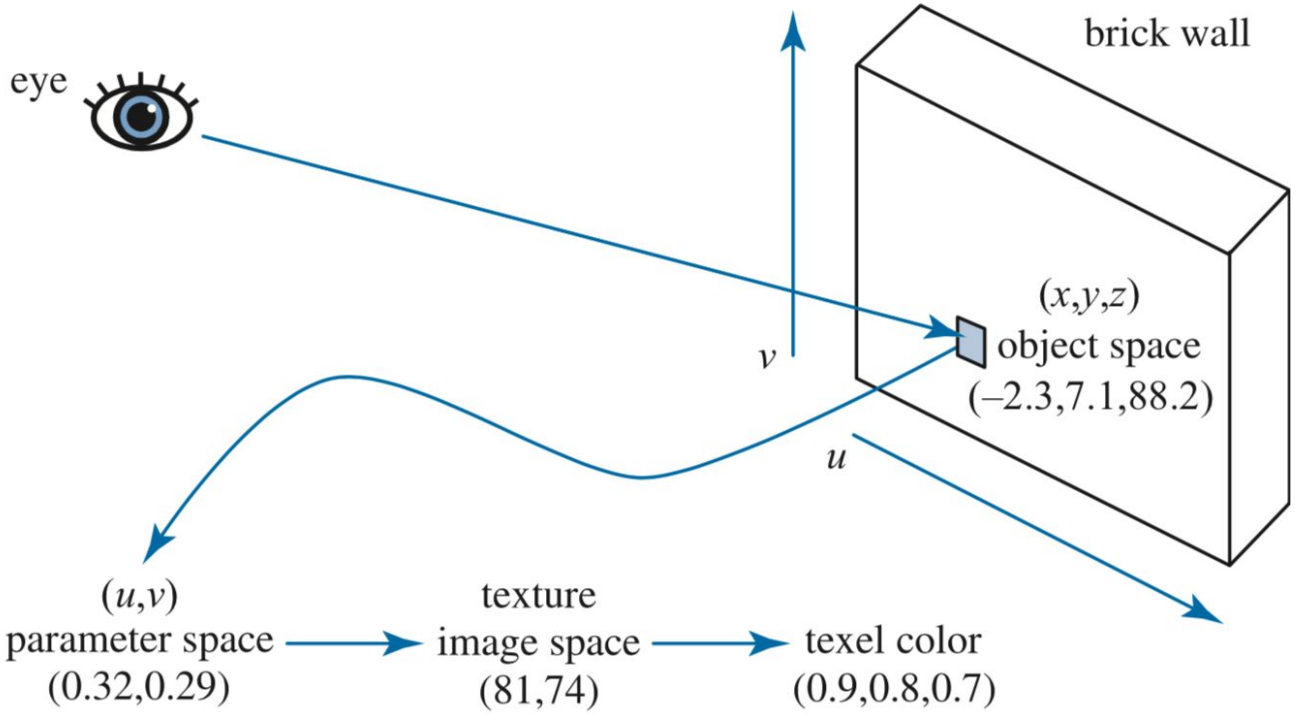
Texturing and Memory

Video Game Graphics AD-011

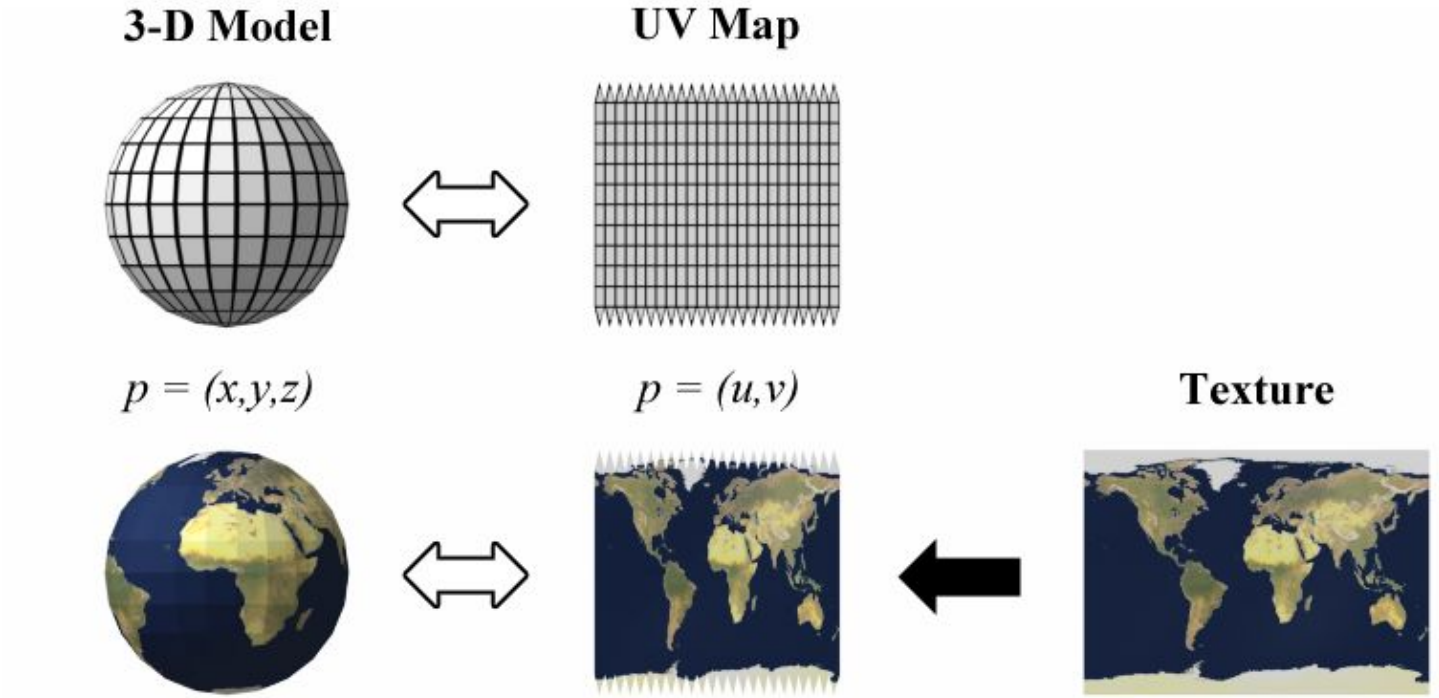
Textures in GPU Memory

- To make a draw call CPU copies all the required assets to GPU memory
- Those assets are mostly meshes and textures
- Meshes are relatively small
- Textures take most of the memory space (80-90%)

Texturing


brick wall
eye
v
(x,y,z)
object space
(–2.3,7.1,88.2)
u
(u,v)
parameter space
(0.32,0.29)
texture
image space
(81,74)
texel color
(0.9,0.8,0.7)

UV mapping



Types of textures

- 2D texture
- Cubemap
- 3D texture
- Megatexture (Sparse texture)

Power Of Two size limitation

- Texture size is required to be a power of 2 - 16, 32, 64, 128, 512, 1024, 2048...
- If texture has different size, it will reserve a POT sized block in memory anyway
- Reasons for limitation are
  - Compression formats
  - Mipmaps
  - Memory allocation algorithms
  - Bitwise operations optimization

Texture formats

- Standard - RGB, RGBA, 8 bit integers
- Single channel - 8 bit
- HDR (High Dynamic Range) - 32 bit floats
- Compressed formats - DXTn, ETC, ASTC, PVRTC

Texture compression

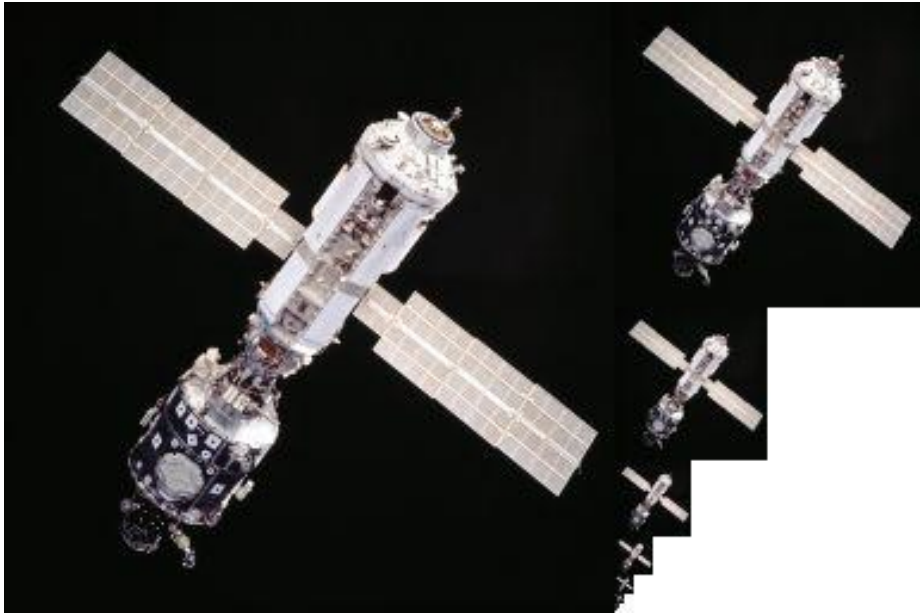
- Specially designed for storing textures for rendering
- Optimized for random access.
- Not the same thing as conventional image compression like JPG or PNG
- Common formats - DXTn, ETC, ASTC, PVRTC
- Reason for POT size limitation

Texture Filtering

- Textures are drawn on the screen in the distorted form
- Different algorithms might be used to maintain quality and speed
- Common filtering algorithms
  - Nearest neighbour - Fastest (pixel graphics)
  - Bilinear - 4 nearest
  - Trilinear - 4 nearest x 2 nearest mipmaps
  - Anisotropic - Best quality (used for realistic floor textures)

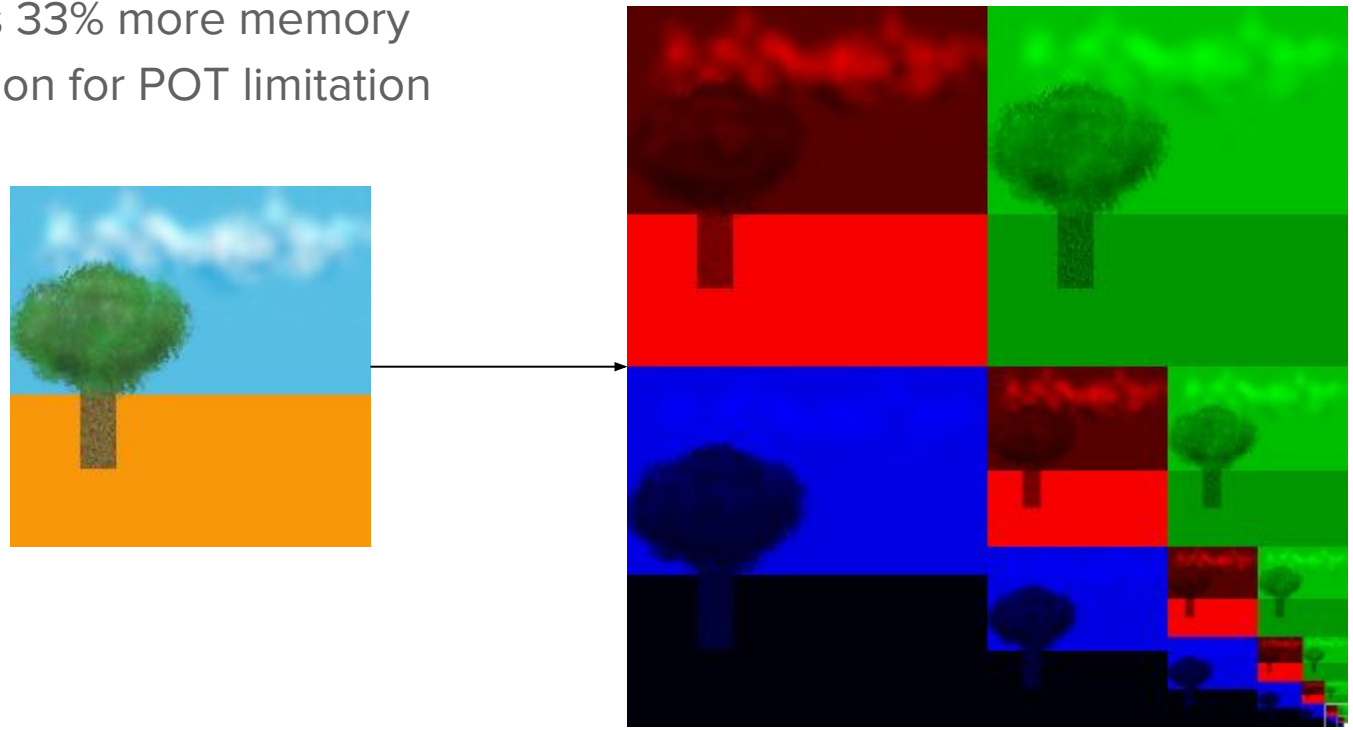
Mipmaps

Different image sizes are stored in memory for filtering optimization



Mipmaps storage

- Uses 33% more memory
- Reason for POT limitation



Wrapping

- What to do when sampling outside the texture?
- Clamp
- Repeat
- Mirrored repeat

Data textures

- Sometimes textures are used for storing data other then graphics
- Compression is usually avoided
- Bitcoin $$$!!!!