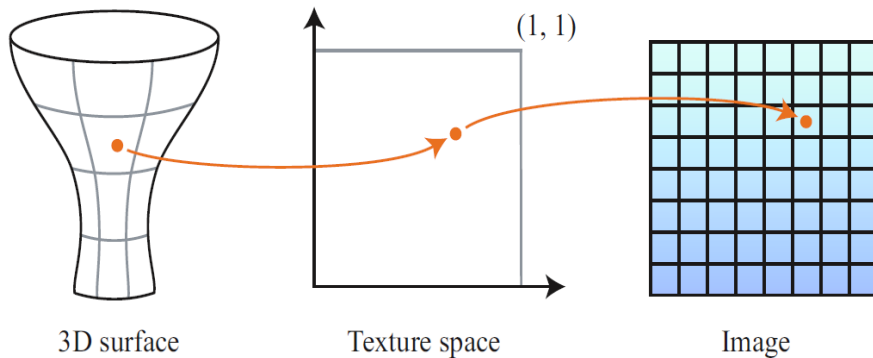


Computer Graphics

Lecture 18

Texture Mapping methods

Several Texture mapping Methods:



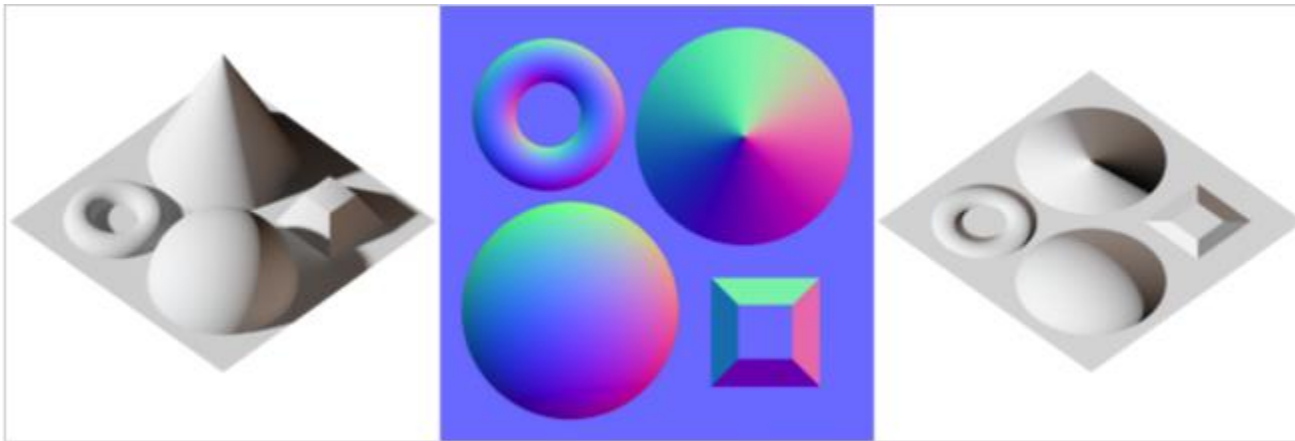
Path way to map the coordinates from image to 3D object surface

- ❖ Bumpmaps
- ❖ Mipmaps
- ❖ Cubemaps
- ❖ Environment Maps
- ❖ Displacement Maps
- ❖ Parallax Maps
- ❖ Skinning

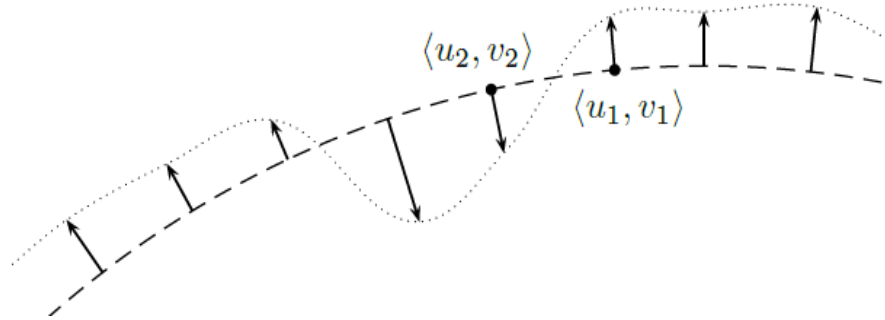
objects a more varied and realistic appearance through complex variations in reflectance that convey textures.

Bumpmaps & Normal Maps

- ❖ Normal maps and Bump maps are used to give a smooth surface the appearance of having bumps or dents.
- ❖ Bump map was first described by (Blinn, 1978)
- ❖ Bump mapping works by using a “height texture” that modifies surface normals
- ❖ Bump map generate by reading black, gray and white surfaces of the image and alter the surface normals of the object accordingly.
- ❖ Bump map generate by reading RGB instead



Normal Map at center calculated from the left and applied to the flat image in the right



The dashed curve represents a cross section of a two-dimensional surface. The surface is imagined to be displaced perpendicularly a distance $d(u, v)$ to form the dotted curve. The outward direction of the surface is upward, and thus the value $d(u_1, v_1)$ is positive and the value $d(u_2, v_2)$ is negative.

The bump map is a texture map of scalar values $d(u, v)$ that represent displacements (by color) in the direction of the normal vector.

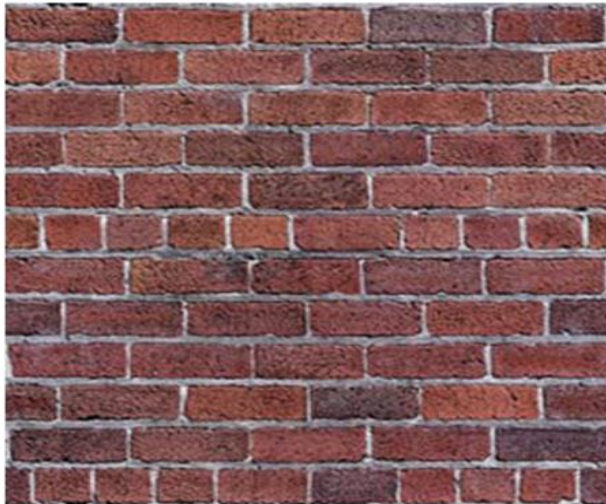
Darker areas consider as dents and lighter as highlights.

[Sample Normal Map](#)

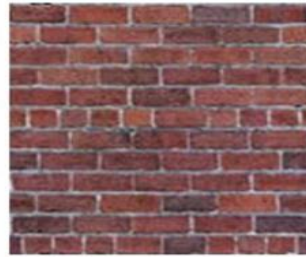
[Bumpmap Interactive Sample](#)

Mipmaps

The term “mipmapping” was coined by (Williams, 1983), who introduced it as a technique of precomputing texture maps of reduced resolution.



256 x 256



128 x 128



64 x 64



32 x 32



16 x 16



8 x 8

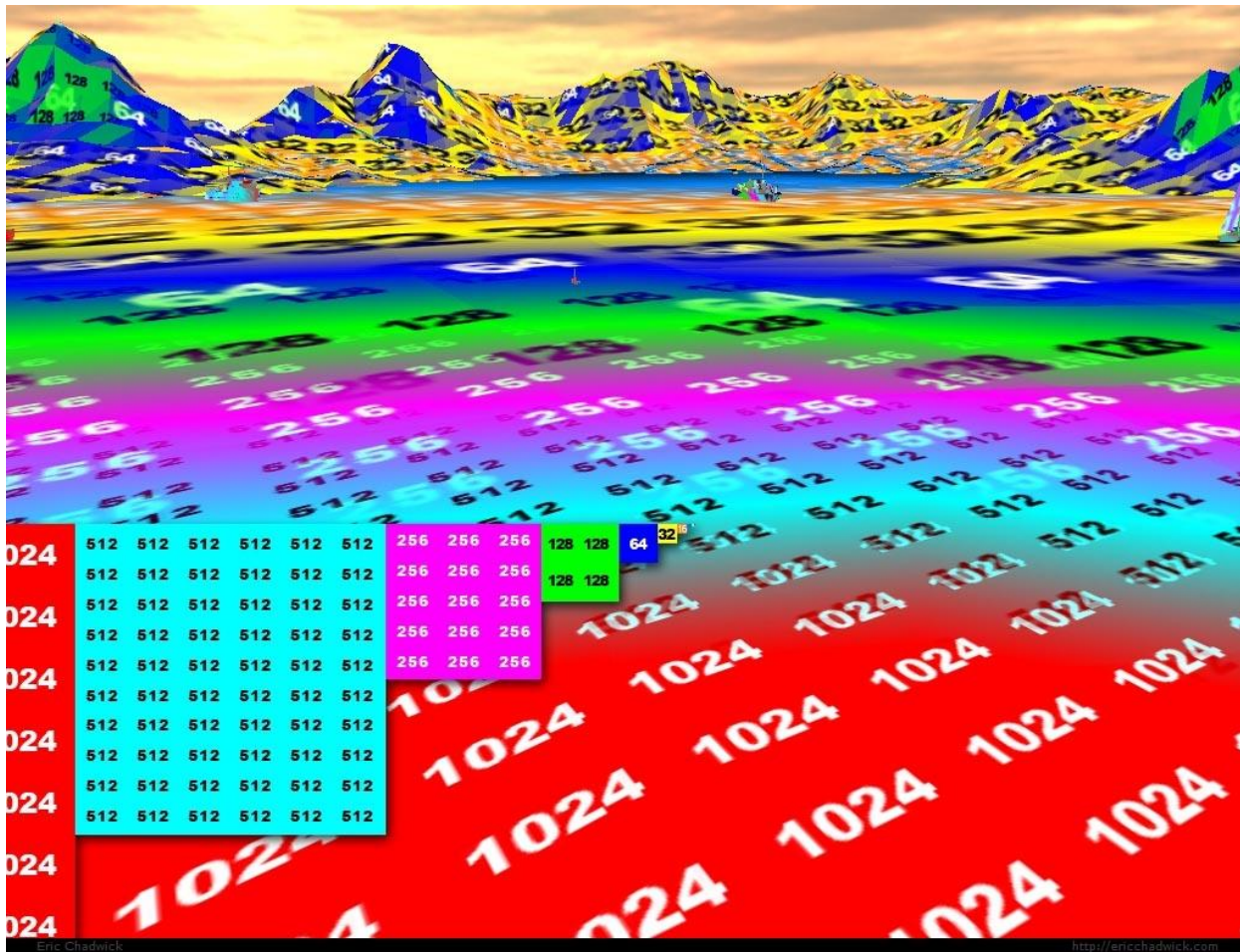
pre-calculated, reduced sequences of images, each of which is a progressively lower resolution representation of the same image.

mipmap texture set containing mipmap levels of the following sizes: 256×256 , 128×128 , 64×64 , 32×32 , 16×16 , 8×8 .

- ❖ Mipmap used as LOD ([Level of Details](#)) technique
- ❖ Motivating idea behind the technique's initial formulation was to increase the quality of the scene by reducing aliasing
- ❖ Mipmaps facilitate Rendering time as well



Level of details decreases by distance



Usage of texture maps along the distance

Memory Usage

How much of a additional memory required to store images.

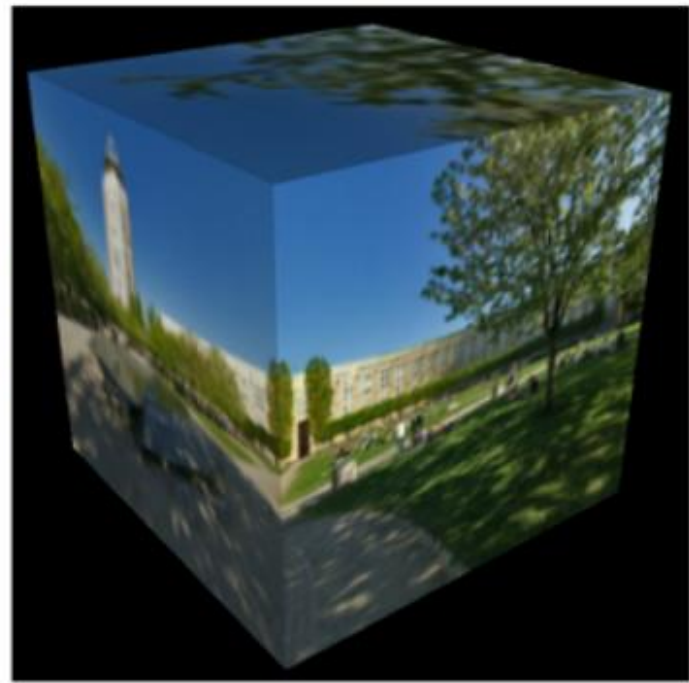
Original image : $256 \times 256 = 65536$ bytes

Rest of the samples: $128 \times 128 + 64 \times 64 + 32 \times 32 + 16 \times 16 + 8 \times 8 = 21814$ bytes

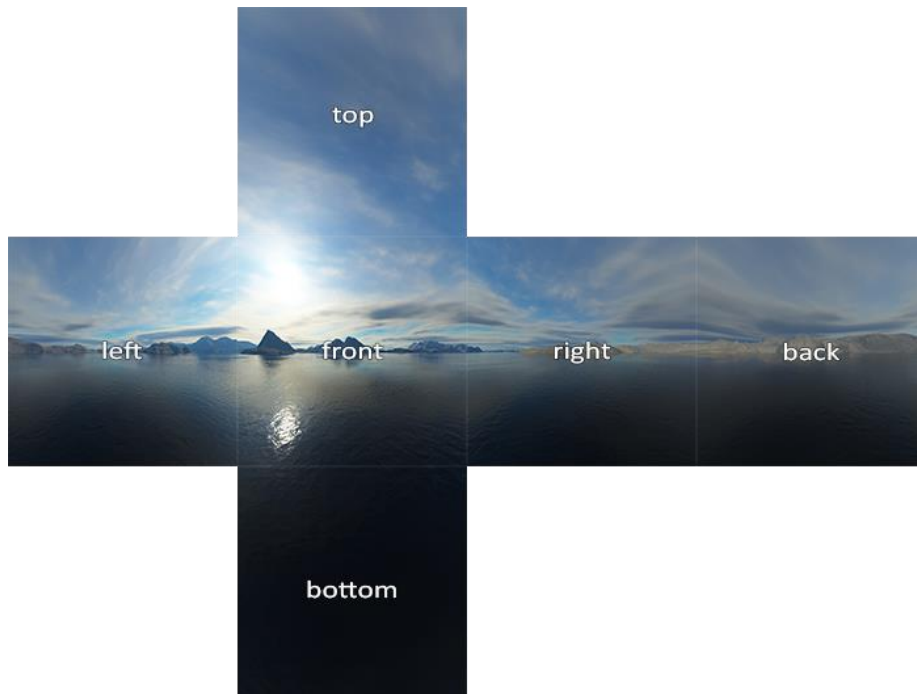
Increase of memory $(21814 / 65536) \times 100 = 33.30\%$

Cubemaps

A cubemap is basically a texture that contains 6 individual 2D textures that each form one side of a cube

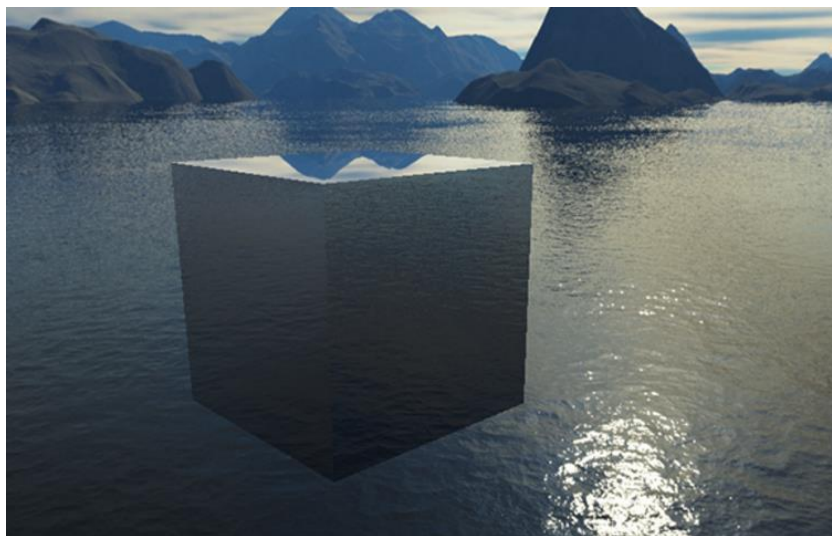
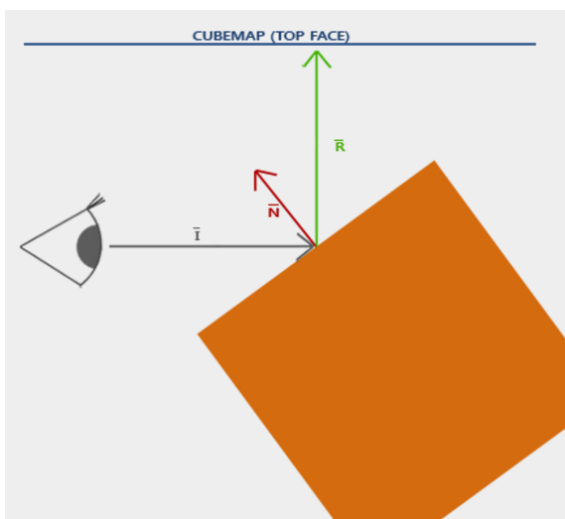


The images must match up along the edges of the cube to form a seamless view of the environment ([SkyBox](#)).

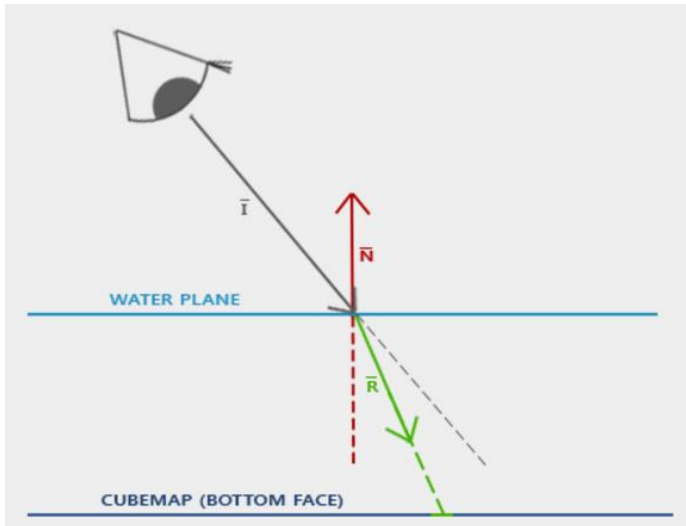


Environment Maps

- ❖ Using environment maps we could give objects reflective or refractive properties.
 - Reflection : Reflection is the property that an object (or part of an object) reflects its surrounding environment
 - The basics of reflection are not that difficult. The following image shows how we can calculate a reflection vector and use that vector to sample from a cubemap

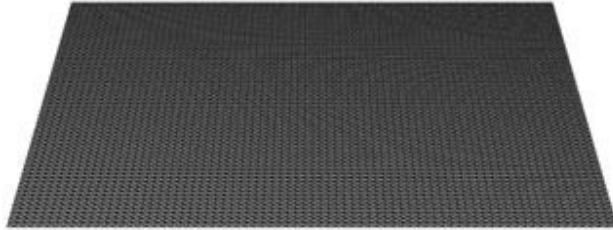


Refraction: Refraction is the change in direction of light due to the change of the material the light flows through.



- ❖ Cube maps are the basis for [dynamic environment mapping](#) and Ray tracing

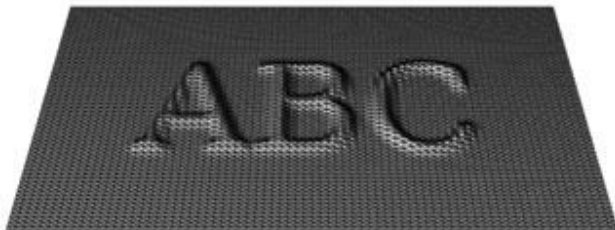
Displacement Maps



ORIGINAL MESH



DISPLACEMENT MAP



MESH WITH DISPLACEMENT

Alternative technique to add details to a model without modeling in the object in detail.

Displacement maps uses the same concept as Bump maps.

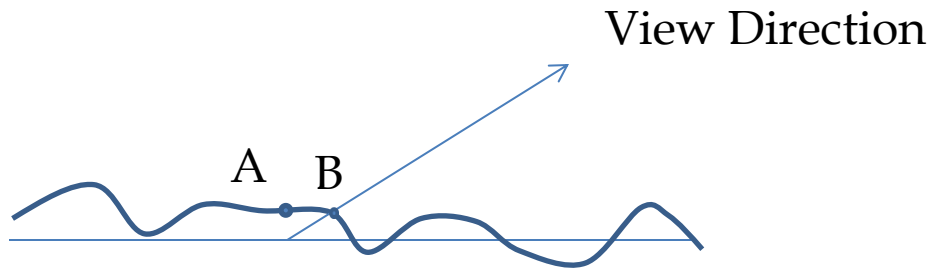
However the displacement map tell the system to Alter the geometry at the time of render.

As a result system takes longer render time and subdivision techniques must be applied.

Interactive [displacement map](#)

Parallax Maps

Alternative for the Displacement Maps



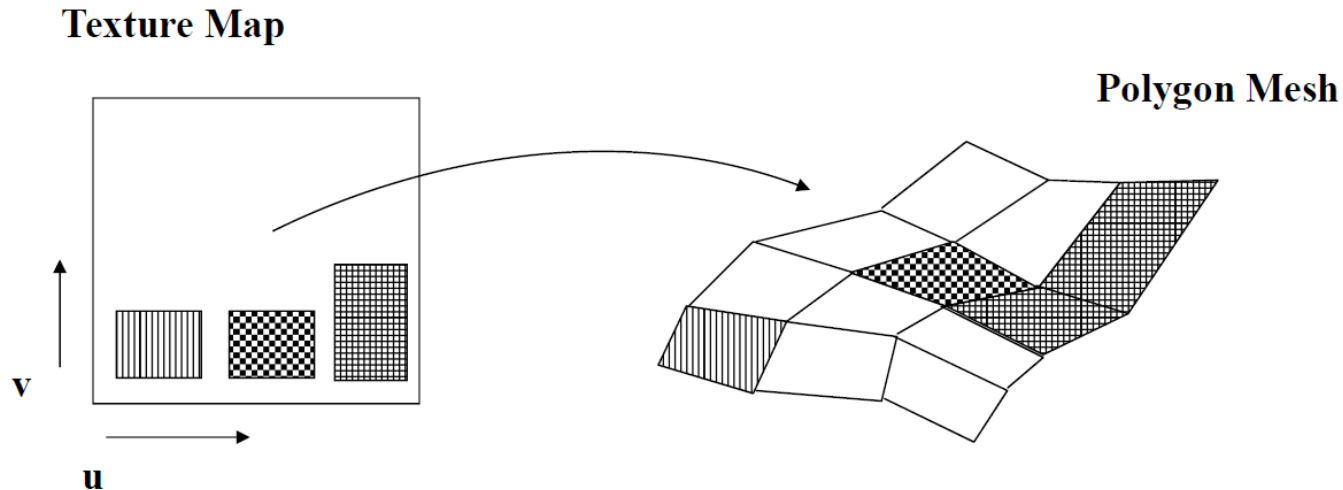
If there is actual displacement user must see point B instead of point A. Therefore replace A point texture coordinate by B point texture coordinate offset

- ❖ Parallax mapping was introduced by Tomomichi Kaneko 2001
- ❖ Good approximation for displacement maps
- ❖ Can be used as a substitute for a additional geometry (sub division)
- ❖ Parallax maps cannot handle sharp changes
- ❖ Breaks down at shallow viewing angles
(when it comes to flat surfaces)

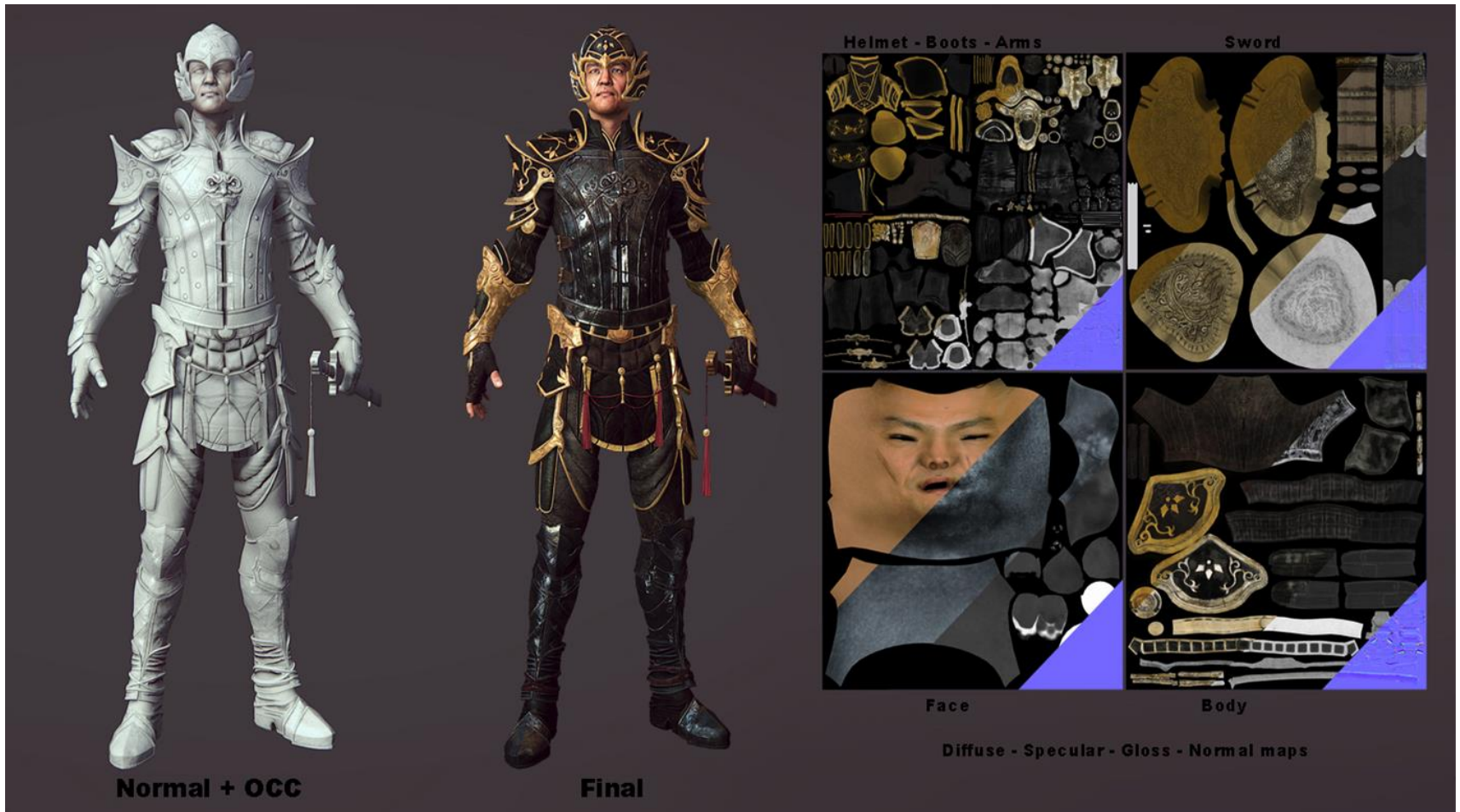
[Sample Parallax Maps](#)

Skinning

- Applying “texture” to 3D models
- Mostly used to detailed outlook for low polygonal character models
- In skinning instead of using multiple polygons, we divide the texture space

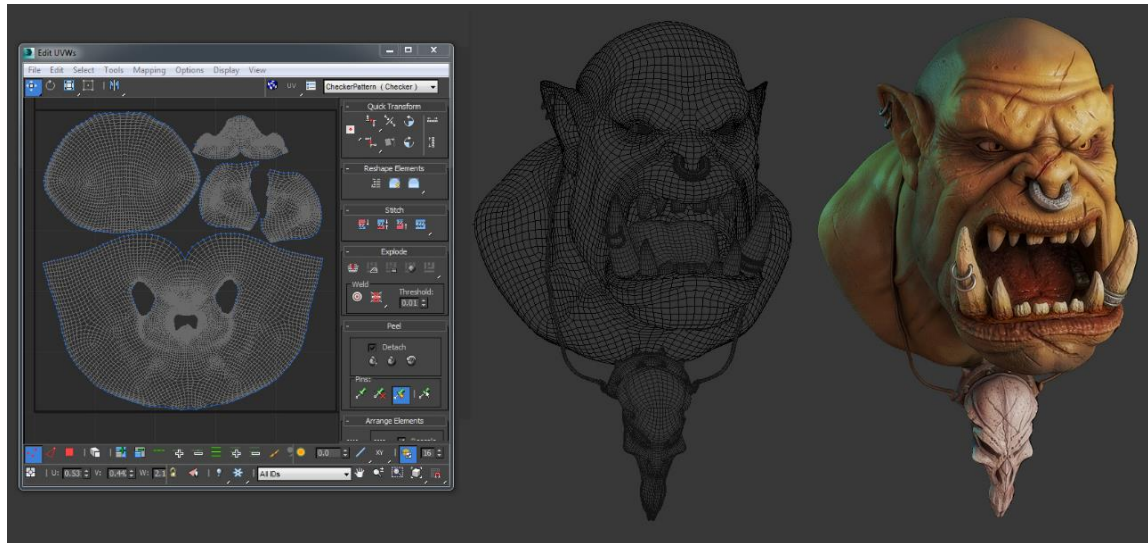


Sample skinning

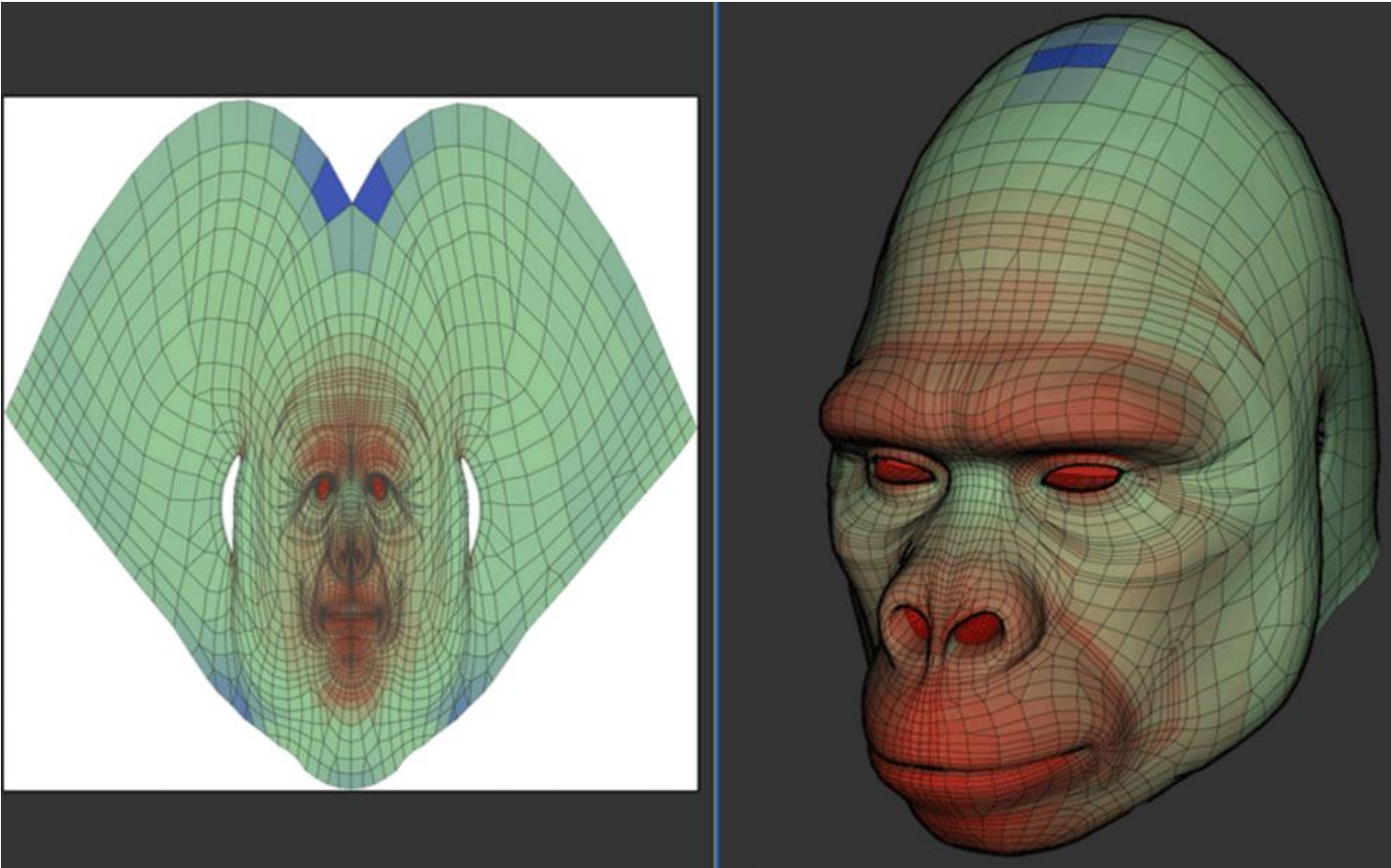


How to make a UVmap

- ❖ Requires creating a complex mapping
- ❖ 2D Model is curved
 - How do we create the texture map?
 - How do we determine the correct mapping?



Solution: Use unwrap techniques to unfold the 3D model



Flatten the model (“*UV Unwrapping*”)

Mapping Process

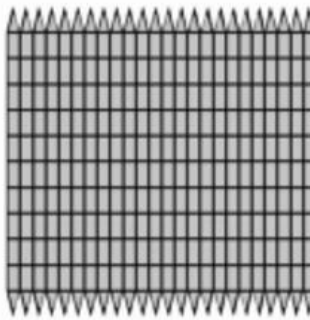
3-D Model



$$p = (x, y, z)$$



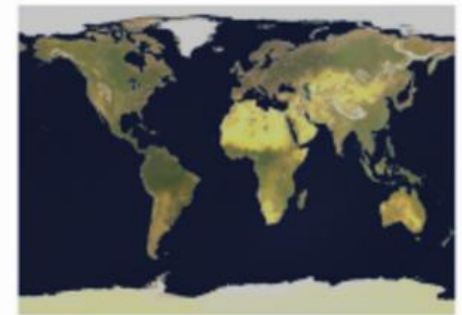
UV Map



$$p = (u, v)$$



Texture



Texture mapping Samples

- [Retrace \(Cars\)](#)
- [Environment Mapping](#)
- [Environment Mapping Sphere](#)
- [Eye Ball Animation \(Environment Maps\)](#)
- [Cube Maps Dynamics](#)