

Textures

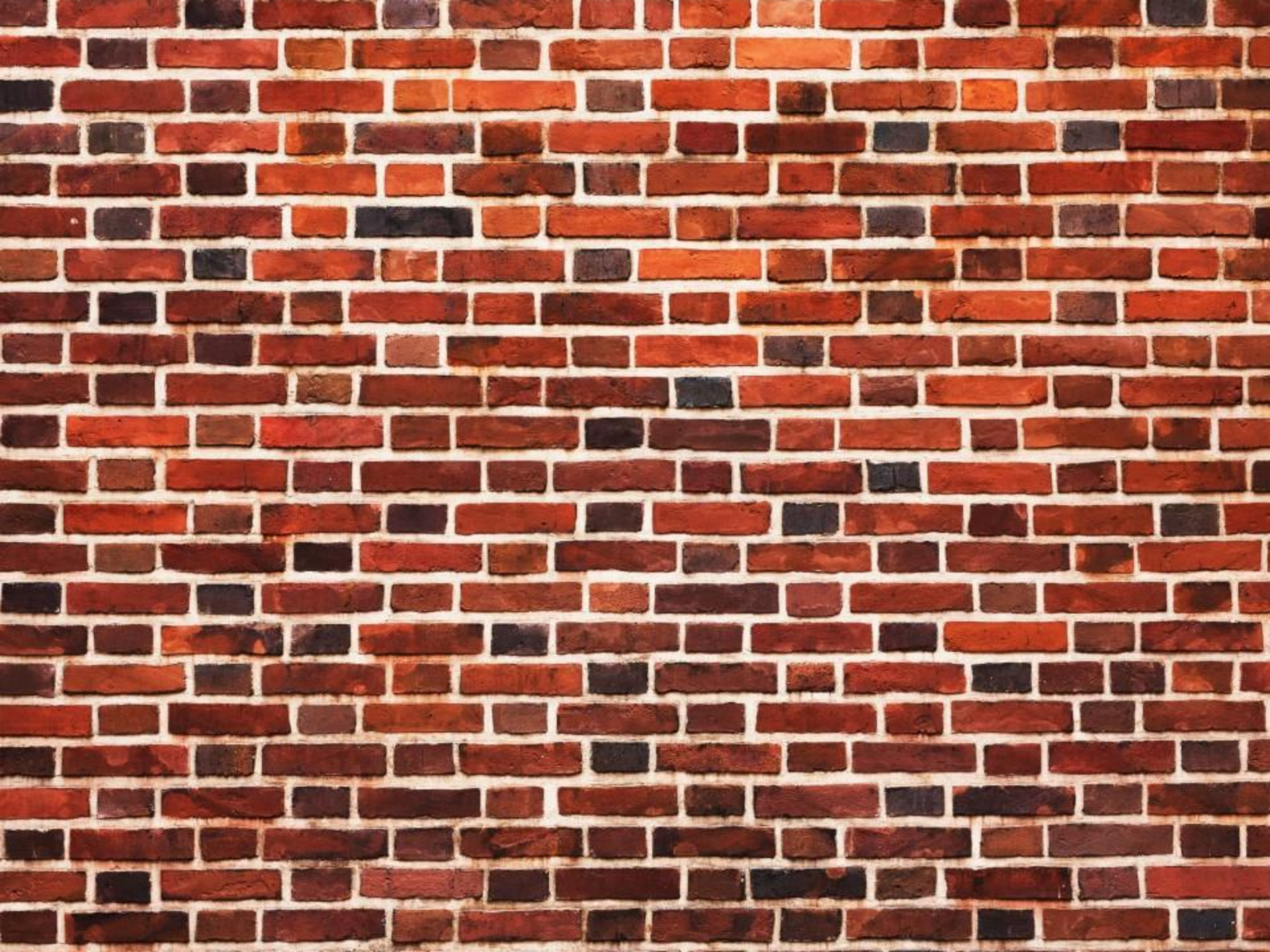
CMSC 161: Interactive Computer Graphics

2nd Semester 2013-2014

Institute of Computer Science

University of the Philippines – Los Baños

Lecture by James Carlo Plaras



Texture

The appearance and feel of a surface

Texture in Computer Graphics

An **image** used to define/describe the
characteristics of a surface

Texture in Computer Graphics

A **image** which is mapped to a
multidimensional space

Texel

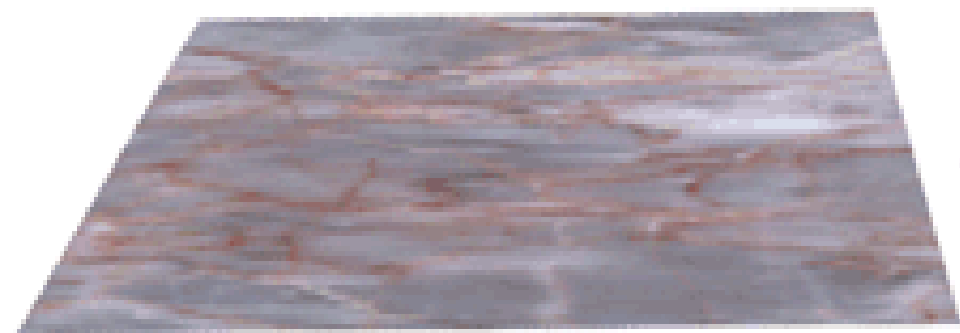
Texture Element or Texture Pixel

Single point in the texture

Texture Mapping

A method for adding detail to the geometry
by displaying an image on the surface

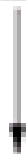
Mapping of the texture and the geometry



2D texture



3D object



2D texture "draped"
over 3D object

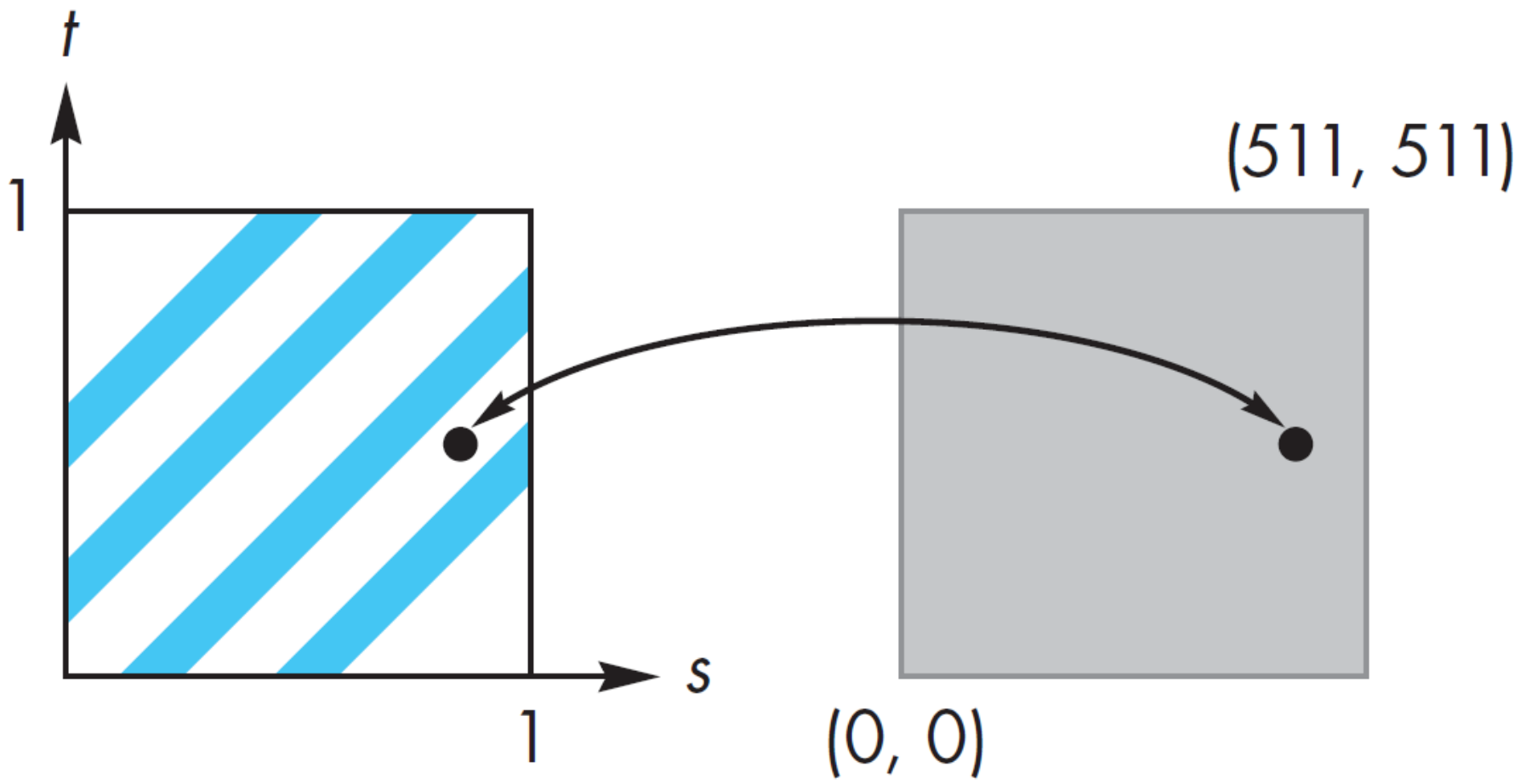


Texture Coordinates

Coordinates used in our texture image

$$(s, t)$$

$$0 \leq s, t \leq 1$$



UV Mapping

Mapping of

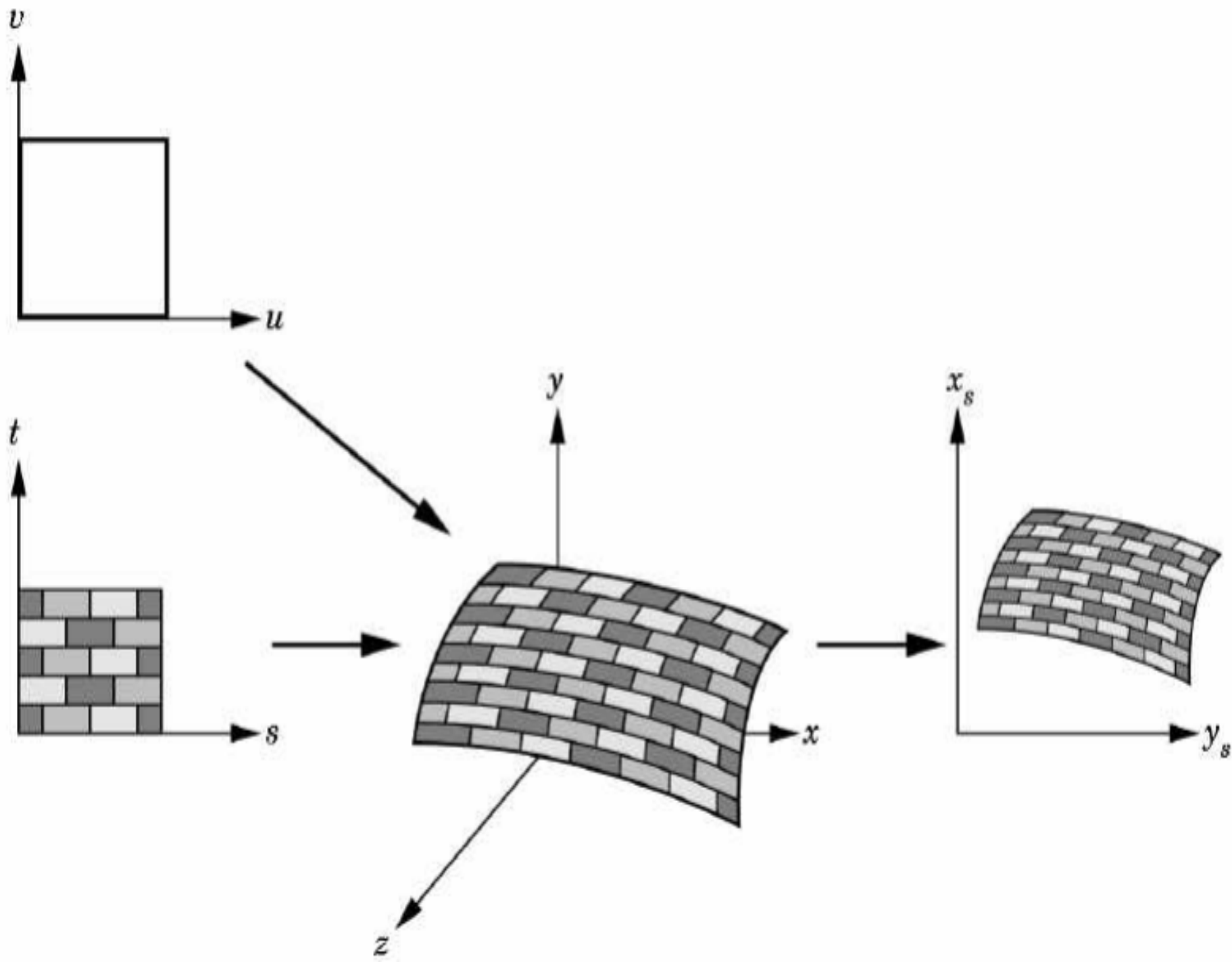
3D space (x,y,z)

to

2D space (u,v)

UV Mapping

This uv-map will be used to map texture elements to 3d objects



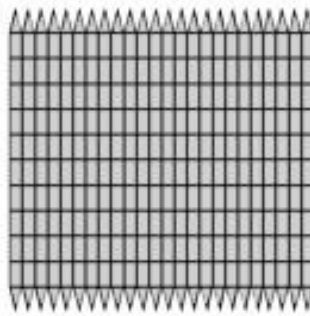
3-D Model



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



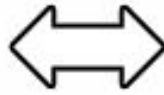
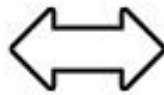
UV Map



$$p = (u, v)$$

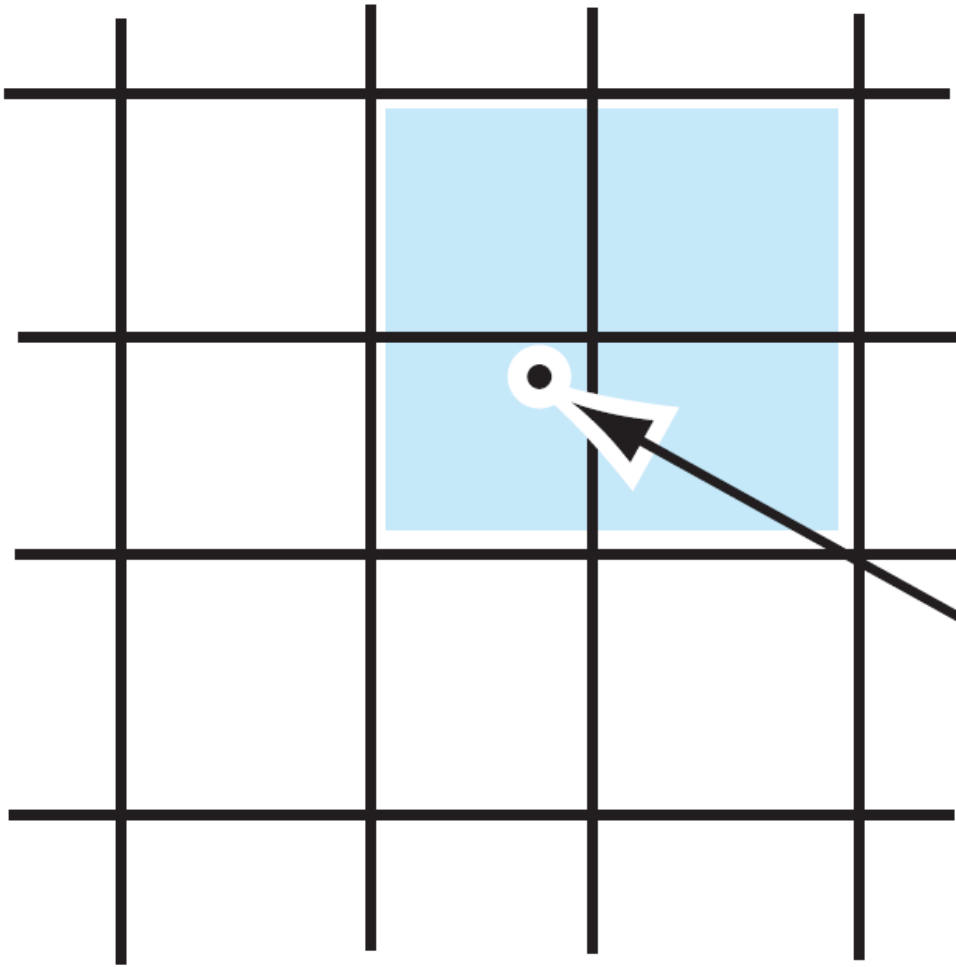


Texture



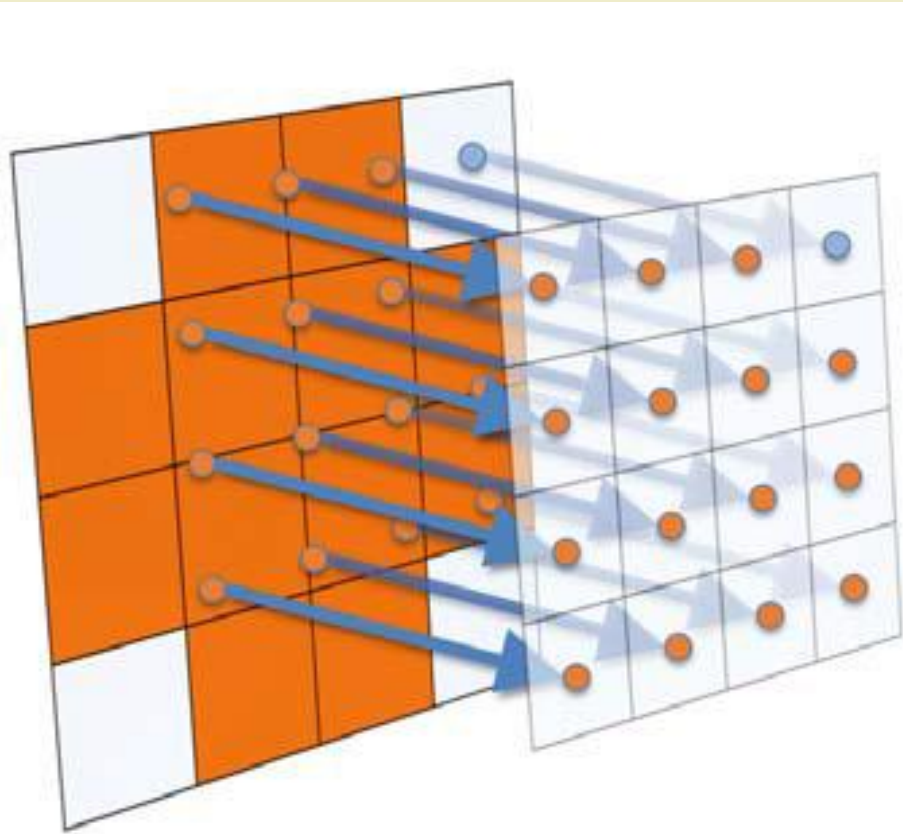
Texture Sampling/ Texture Filtering

Method used to determine the texture color
of mapped point/pixel

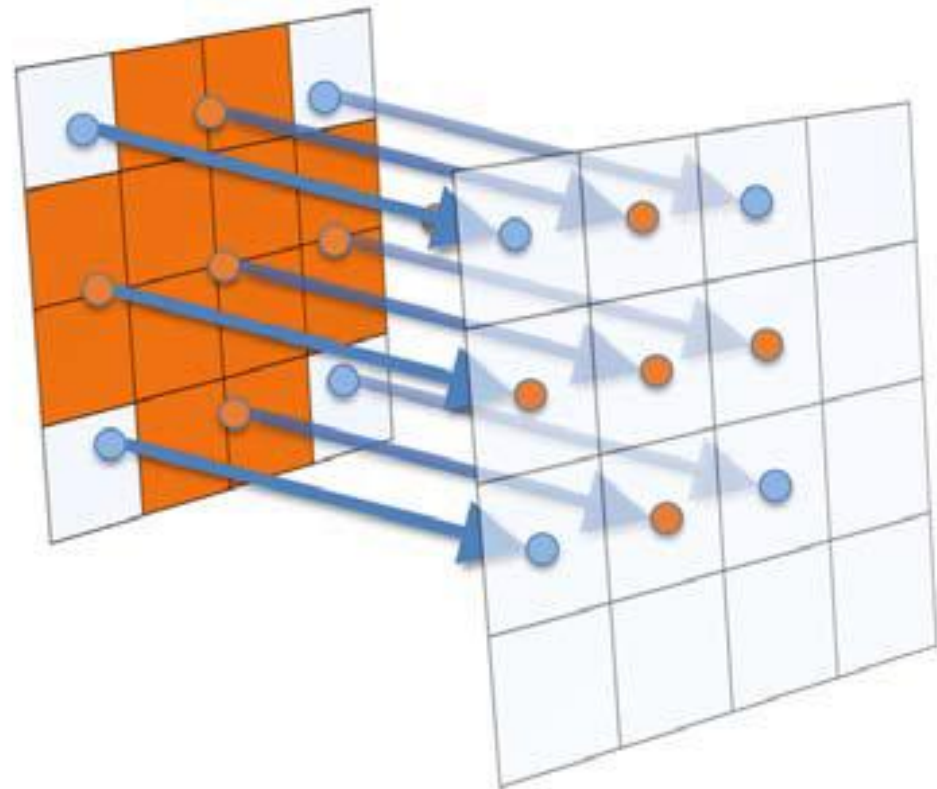


point sample

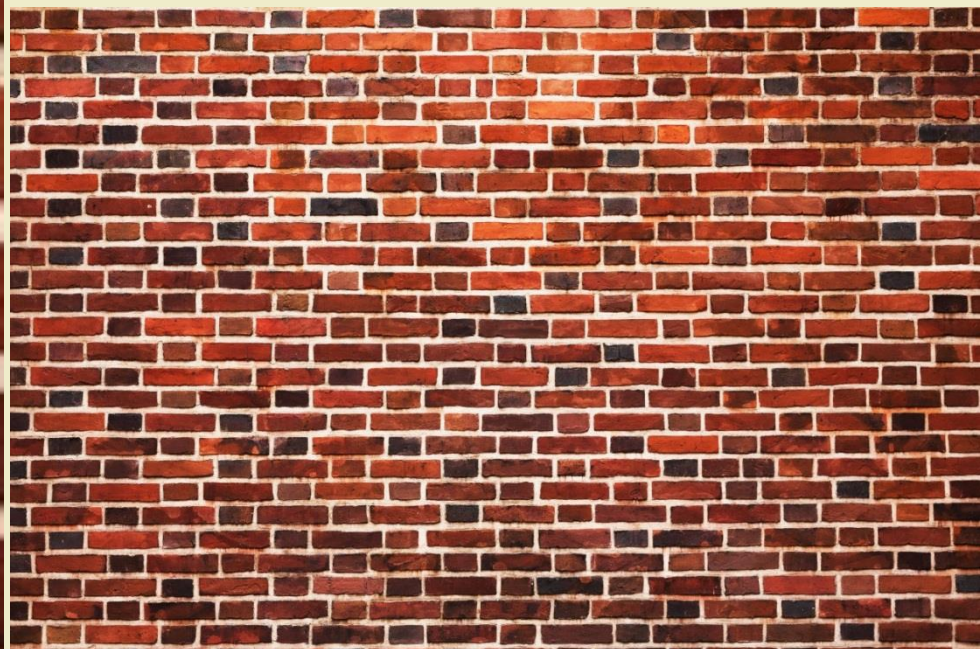
Magnification and Minification



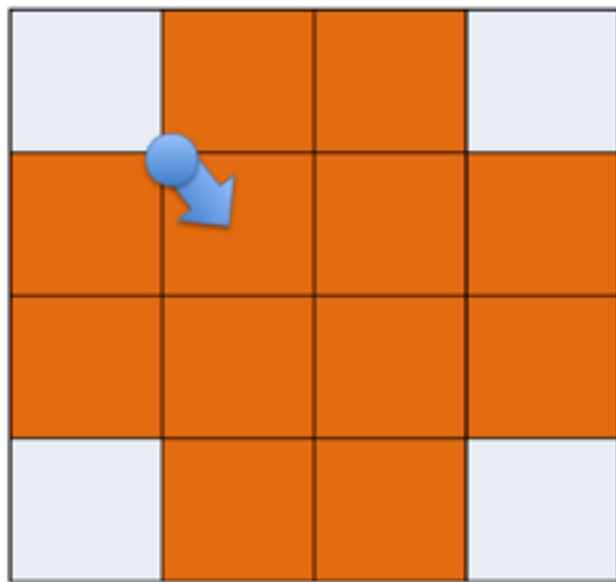
Magnification



Minification



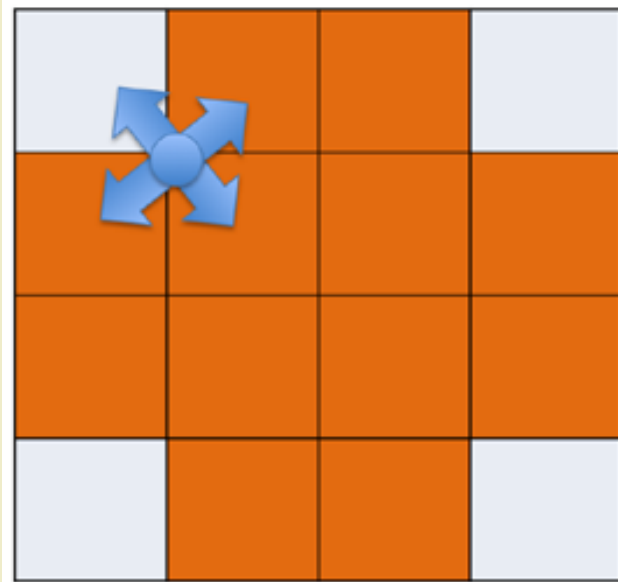
Nearest and Linear



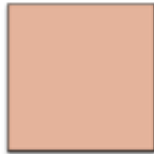
=



gl.NEAREST



=



gl.LINEAR

Mipmapping

MIP Map

Pre-calculated collection of smaller images
based from the main texture

Mipmapping

Hardware chooses the copy of that is *closest* to the size of the geometry on screen



TEXTURE MAPPING





Texture Mapping

Textures not always indicate color

- Bump Mapping by Blinn, 1978 (same guy from Blinn-Phong)
- Transparency maps by Gardner, 1985

Texture Mapping

Textures not always indicate color

Bump Map/Normal Map

Simulates bump and wrinkles on a surface of
an object

Manipulating the surface normal of an object



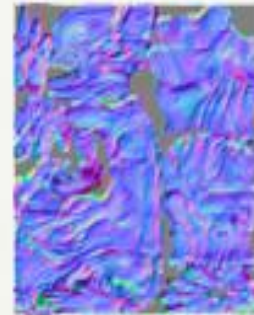
100,000+ polygons

=

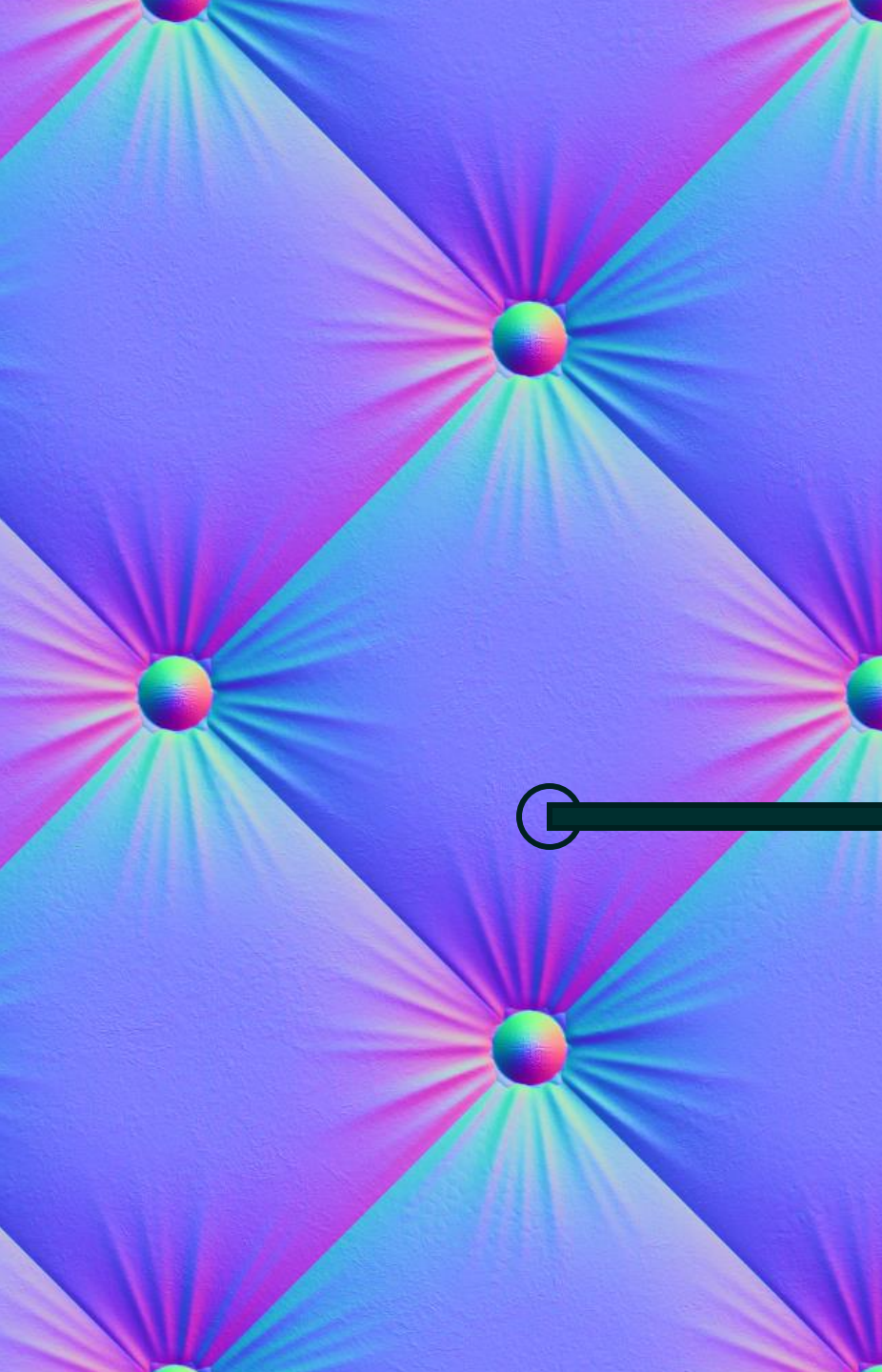


5,000 polygons

+



Normal map



Each texel contains a color (RGB) and values are mapped to a corresponding normal vector



RGB(130,117,254)

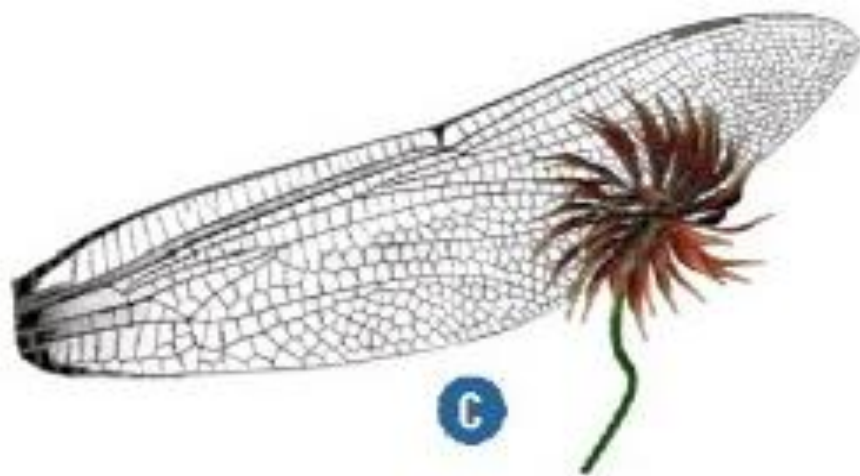
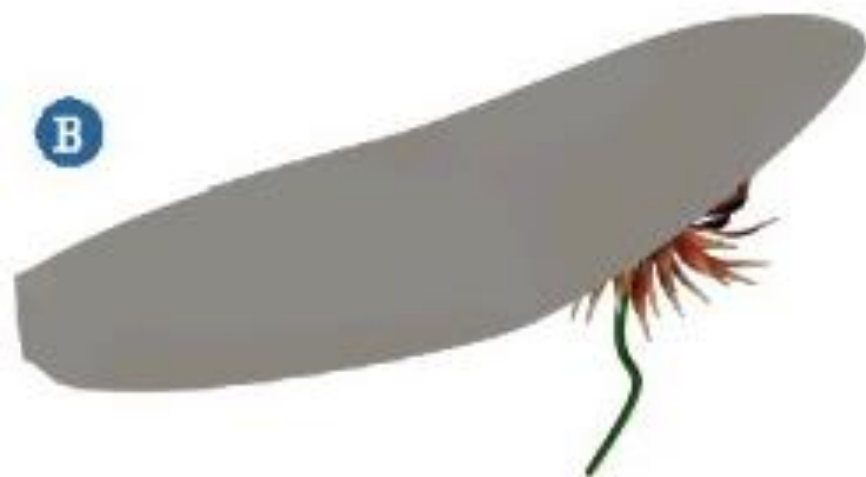
=>

$\langle 0.02, -0.08, 0.99 \rangle$

Transparency Map/Opacity Map

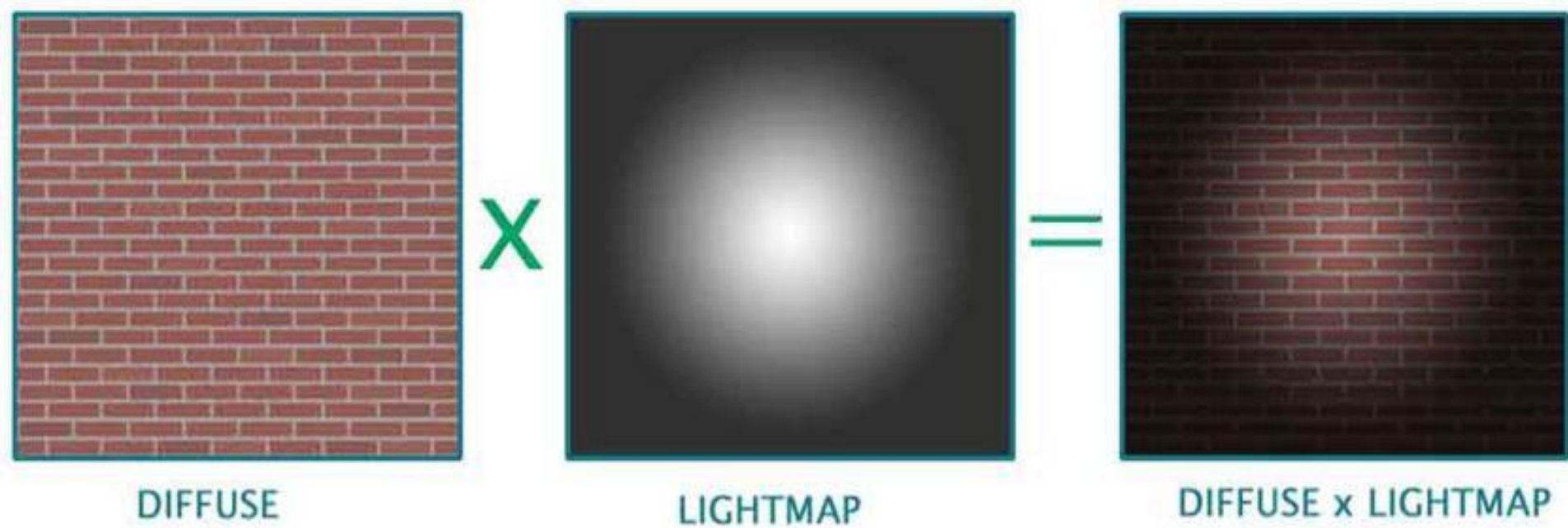
Makes an object's surface transparent or opaque according to the image map

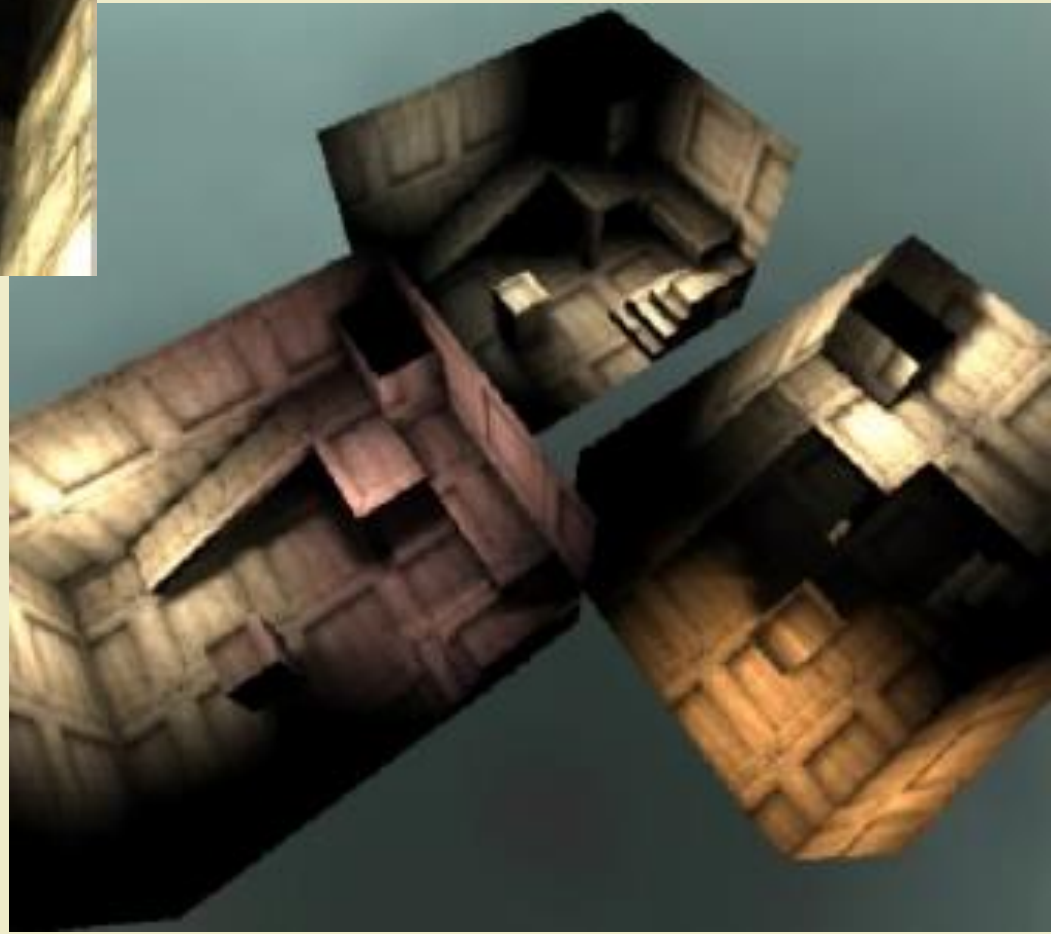
Modifying the transparency of a surface without modifying its geometry



Light Map

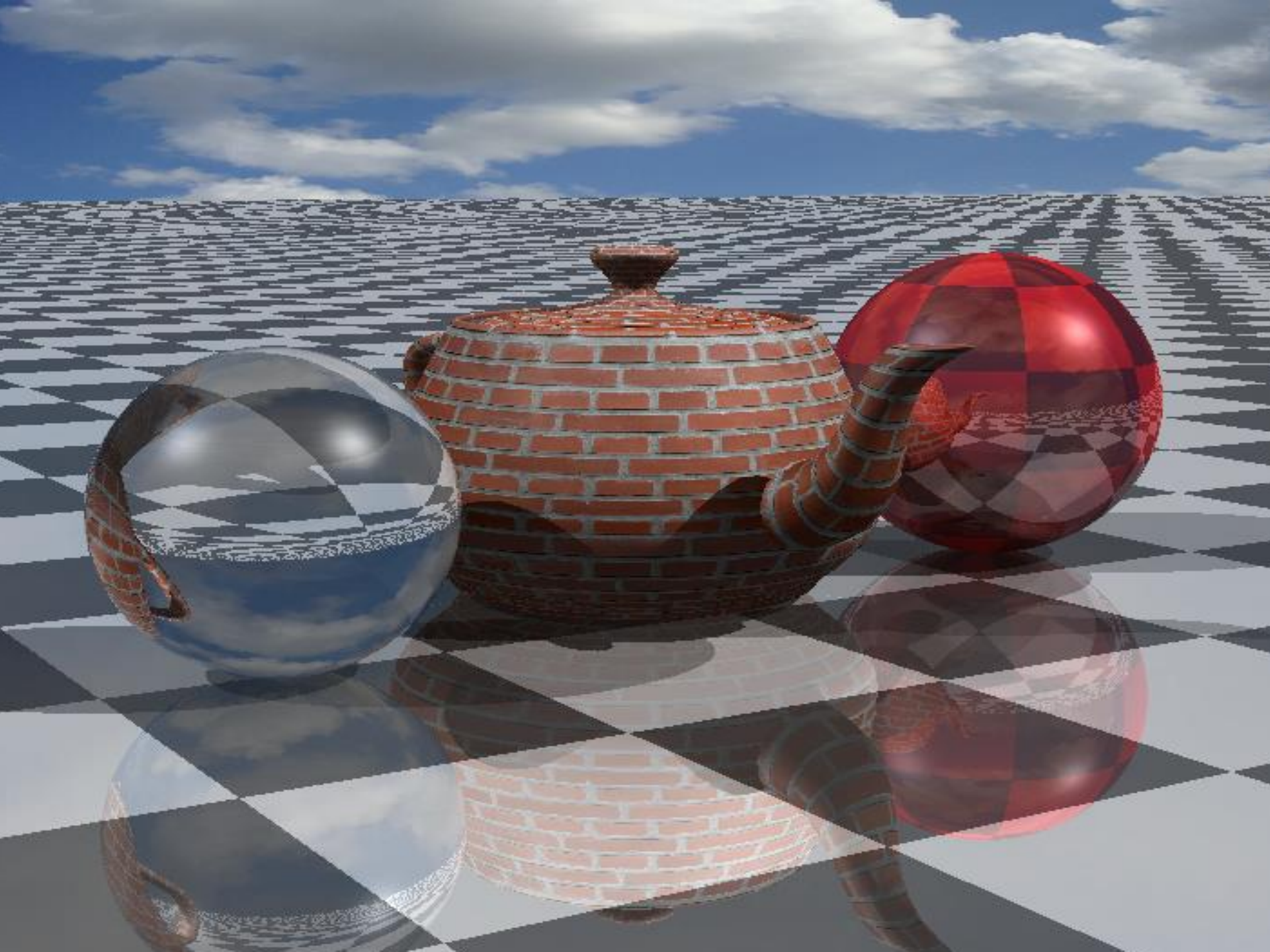
Using image map as a static lighting for an object





Environment Map/Reflection Map

Emulating reflection from an environment
using a precomputed image

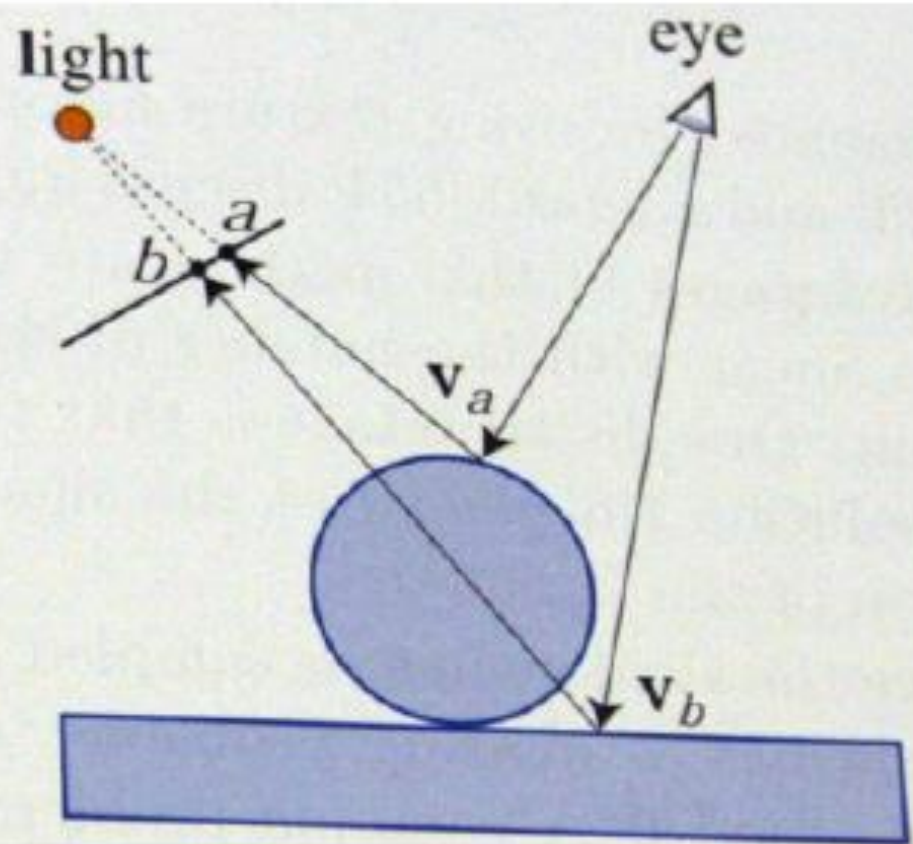
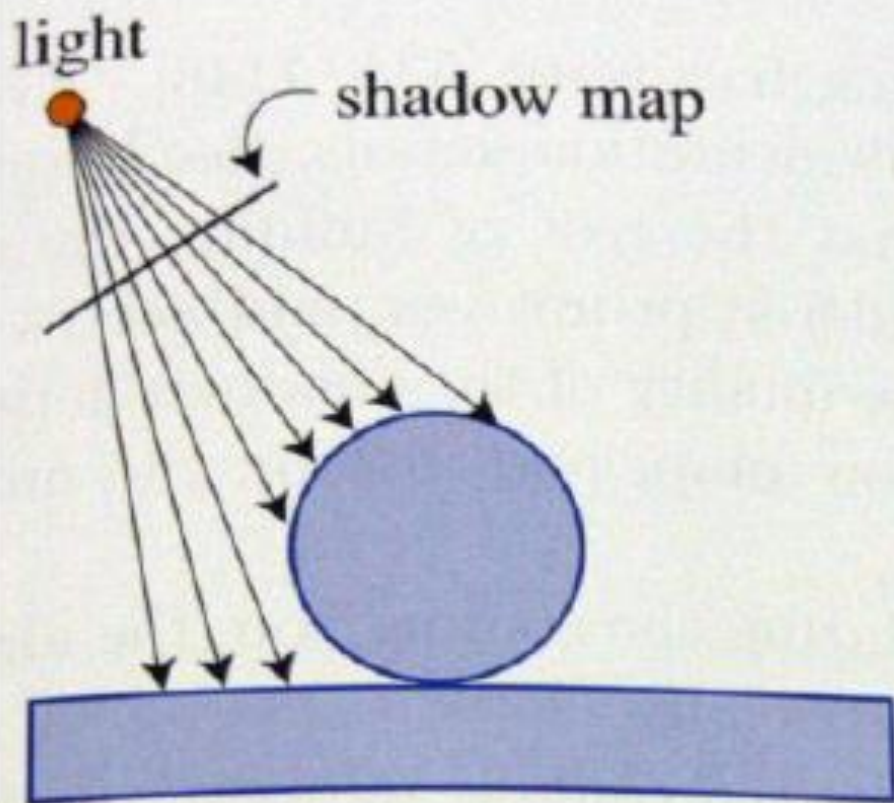


Shadow Map

Mapping to emulate shadows in the scene

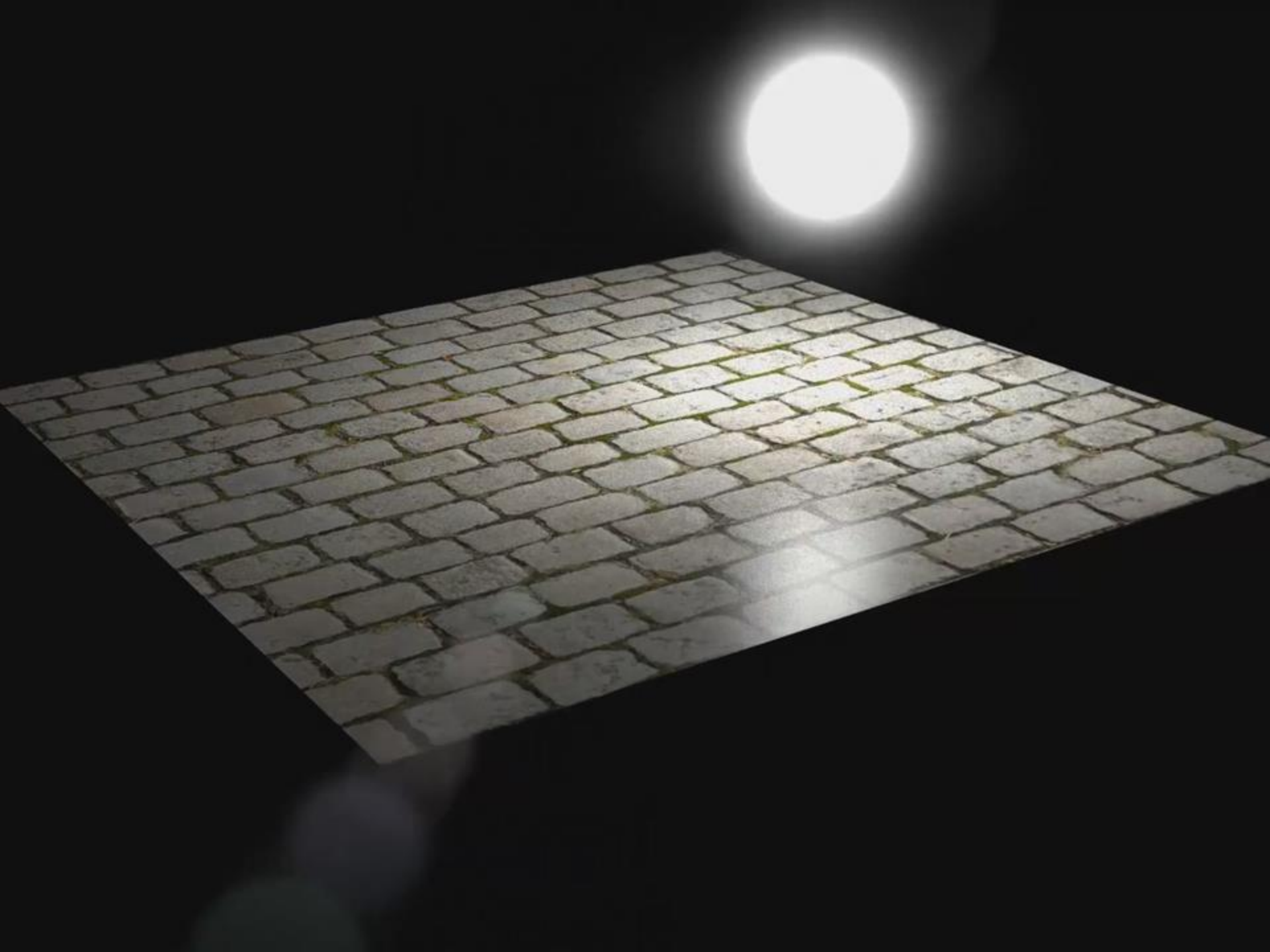
Texture is computed as the rendered image
from the light perspective

- Everything not rendered from the light point of view is a shadow



Poor Texturing

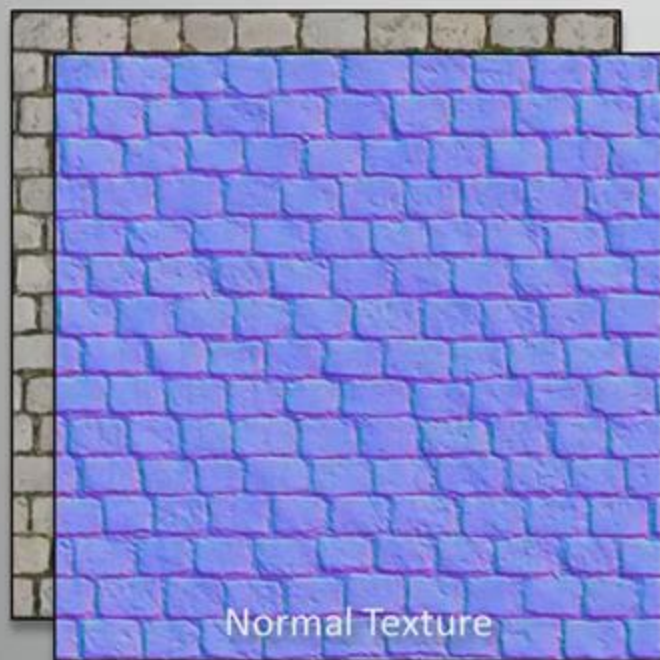




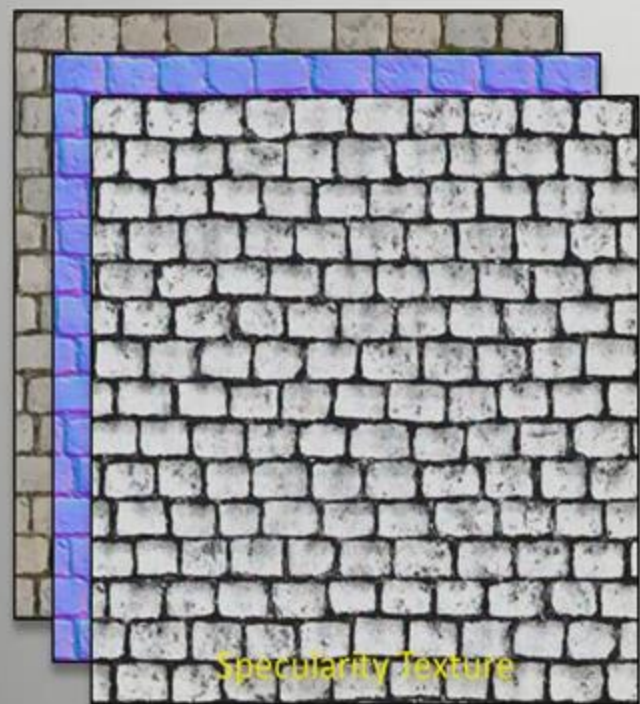
Better Texturing



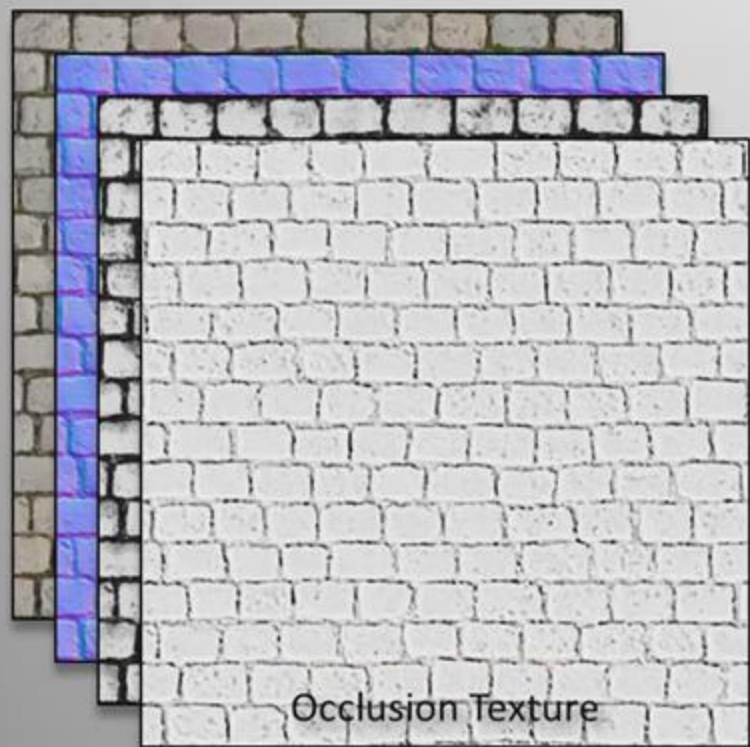
Better Texturing



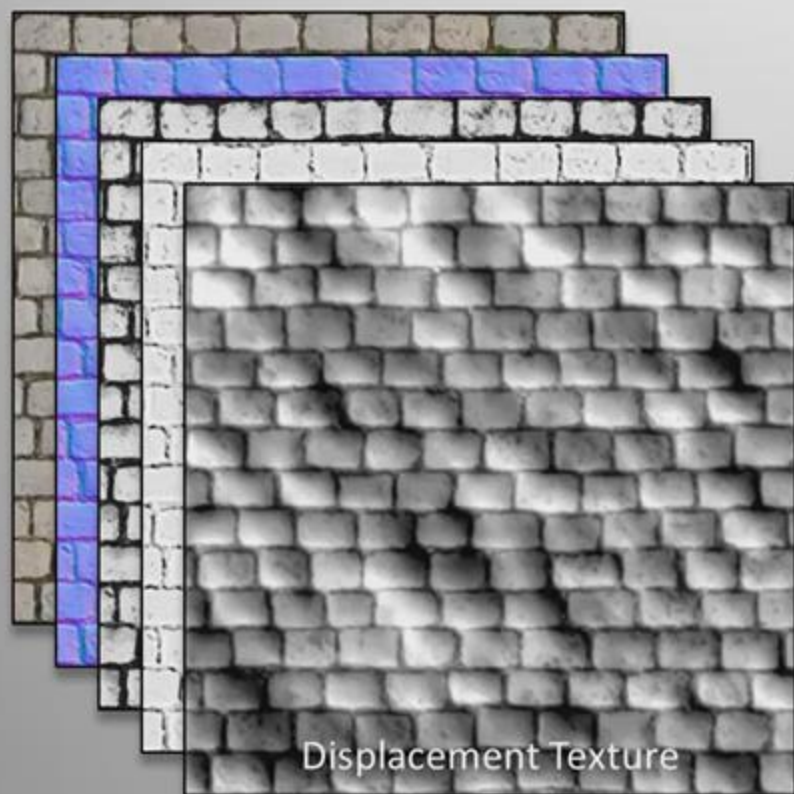
Better Texturing



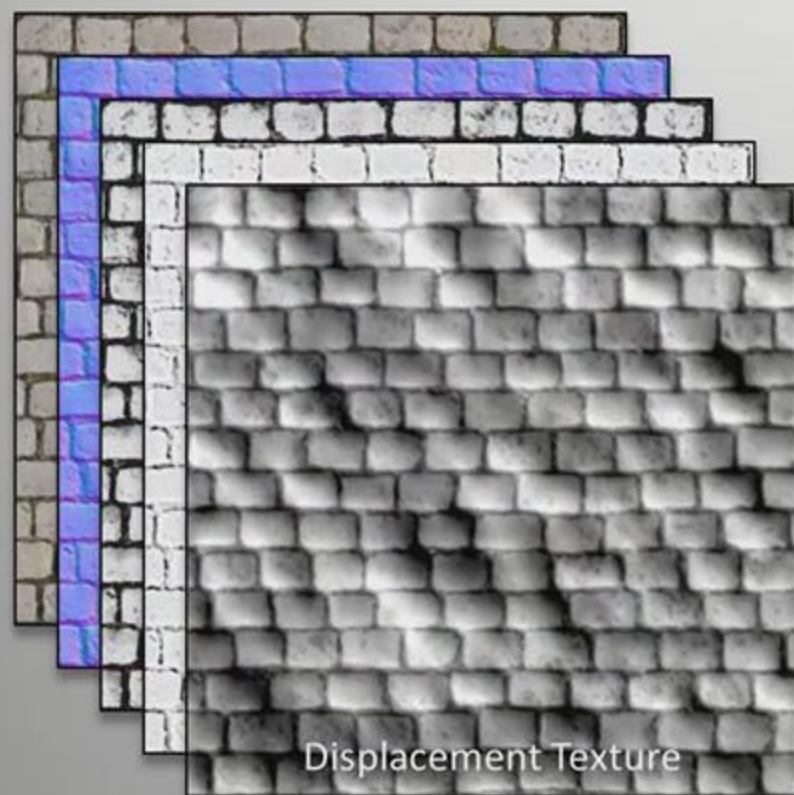
Better Texturing

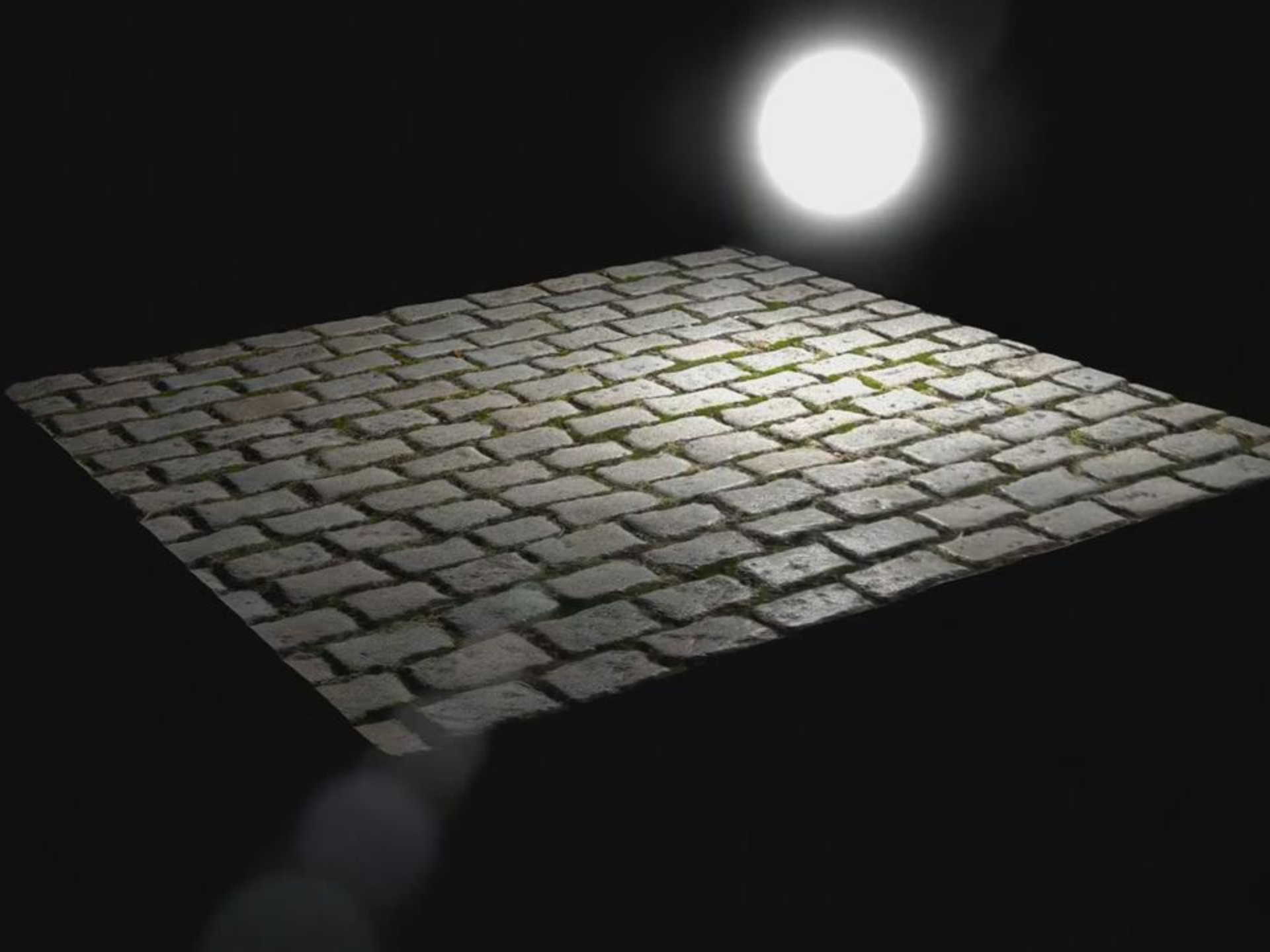


Better Texturing



Better Texturing







References

Books

- ANGEL, E. AND SHREINER, D. 2012. Interactive computer graphics : a top-down approach with shader-based OpenGL. Addison-Wesley. 6. ed. Boston, MA.
- CANTOR, D. AND JONES, B. 2012. WebGL Beginner's Guide. Packt Publishing. Birmingham, UK.
- MATSUDA, K. AND LEA, R. 2013. WebGL Programming Guide: Interactive 3D Graphics Programming with WebGL.. Addison-Wesley. Upper Saddle River, NJ

Lecture Slides

- ALAMBRA, A. CMSC 161 1st Semester 2013-14 Lecture Slides

Images

- <http://www.wildtextures.com/wp-content/uploads/2011/09/wildtextures-Olde-Brick-Wal-Texture-1280x853.jpg>
- <http://en.wikipedia.org/wiki/File:UVMapping.png>
- [http://2.bp.blogspot.com/-4DZbxSZTWUQ/ULI1vc7GKHI/AAAAAAAAAVo/-vuKDtSxUGY/s1600/Well%2BPreserved%2BChesterfield%2B-%2B\(Normal%2BMap_2\).png](http://2.bp.blogspot.com/-4DZbxSZTWUQ/ULI1vc7GKHI/AAAAAAAAAVo/-vuKDtSxUGY/s1600/Well%2BPreserved%2BChesterfield%2B-%2B(Normal%2BMap_2).png)
- http://1.bp.blogspot.com/_486ynOB4OMs/S5VbYJmZV3I/AAAAAAAAAK8/kASr99Y2i5E/s1600-h/TEXMAP.GIF