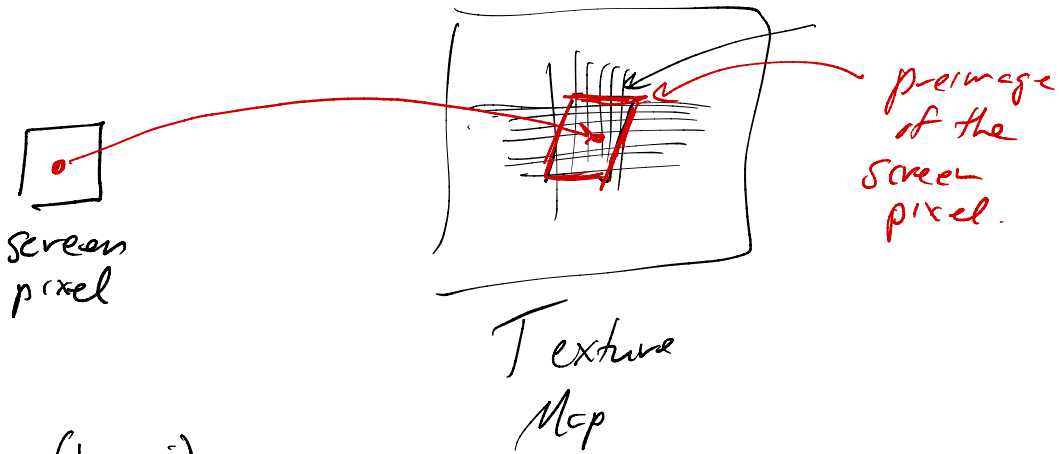
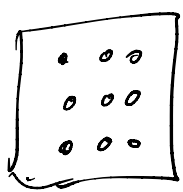
Supersampling:

Goal



Supersampling (basic)

$N \times N$ array of subpixel

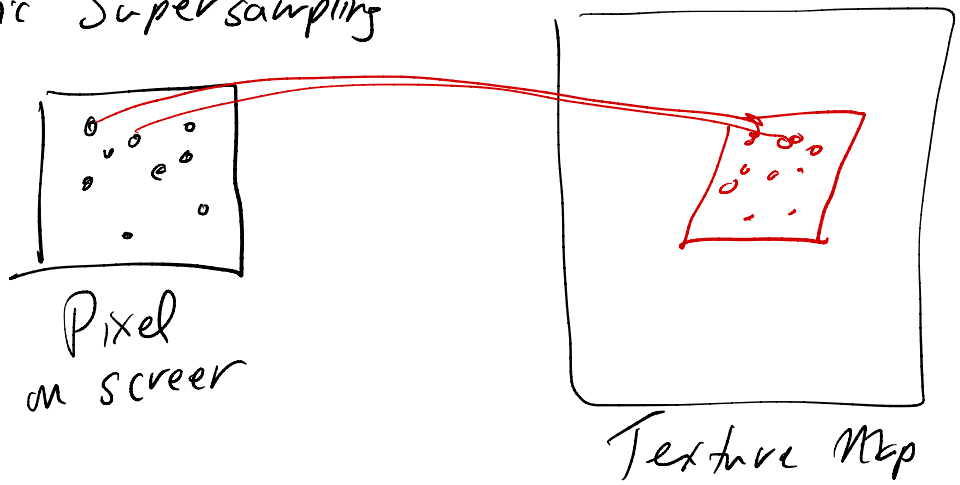


$N=3$

Simple but can still cause aliasing.

Stochastic Supersampling

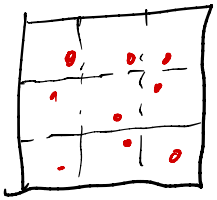
Choose $N^2 = M$ many subpixel location



More noise
But less aliasing.

Jittered Stochastic Subsampling

$N = 3$



Screen pixel

3^2 subpixels

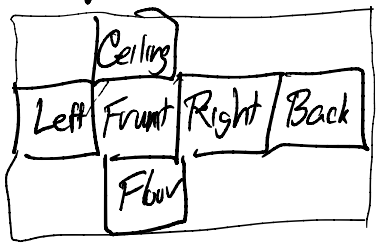
Pick a random location inside each subpixel.

Not much aliasing

Less noise.

Cube map (Environment Mapping)

Typically Six images of the entire surrounding



Texture Map with 6 subimage

Positions in the texture are indexed by directions (3 vector)

OpenGL supports — including mipmapping.

GLSL Usual texture map:

```
uniform sampler2D theTexMap;
:
texture(theTexMap, texCoords);
```

vec2

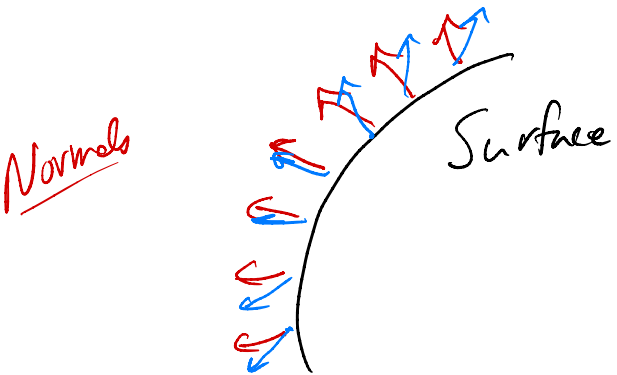
Cube Map:

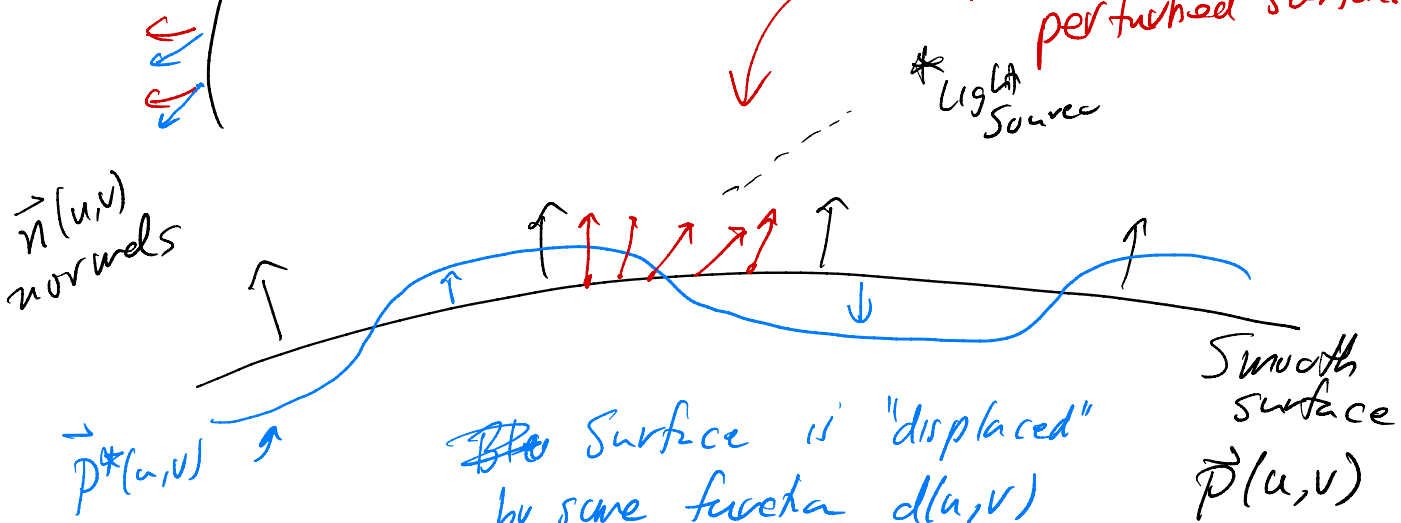
```
uniform samplerCube theCubeMap;
:
texture(theCubeMap, texDirection);
```

vec3

Bump mapping

New normals – used in Phong lighting calculation





~~Bu~~ Surface is "displaced" by some function $d(u,v)$

$$\vec{p}^*(u,v) = \vec{p}(u,v) + d(u,v)\vec{n}(u,v)$$

A texture map holds the values of $d(u,v)$

Color:

2 theories: Trichromatic theory

Palmer Young 1777 / 1801

We see color in 3 components Red, Green, Blue.

Physiological basis

Humans have 3 kinds retinal cells cones and rods (see in low light, don't see color)

Opponent Theory Hering 1878

We see colors in contrasts:

Dark versus light

Yellow versus blue

Red versus green.

Physiology

There are 3 "channel" of neurons to your brain.

In Practice

Additive Colors R, G, B

CRTs, monitors. (Black - add color)

Subtractive Colors Cyan (C), Magenta (M), Yellow (Y)

CMY ⇒ Start with white + subtract color.

R, G, B
C, M, Y $\in [0,1]$

Nominally

$C = 1 - R$
$M = 1 - G$
$Y = 1 - B$

Ink, Paint, ...

Printers CMYK
↑ black

Professional Colors
CMYVOGK
violet
orange
green

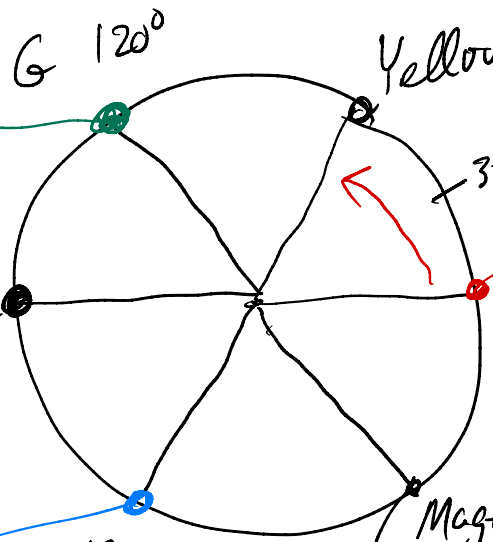
HSL - less physical - intended to more intuitive.

G = R = Max
B - min

Color Wheel.

RGB Value

G is Max.
R, B are min
eg RGB = <0,1,0>
or <1/4, 3/4, 1/4>



Red is Max
Green, Blue min
Eg RGB = <1,0,0>
= <3/4, 1/4, 1/4>

G, B are max
Red is min
<0,1,1>

Blue is Max
Red Green are min
eg. <0,0,1>
<1/4, 1/4, 1/2>
or <1/4, 1/4, 3/4>

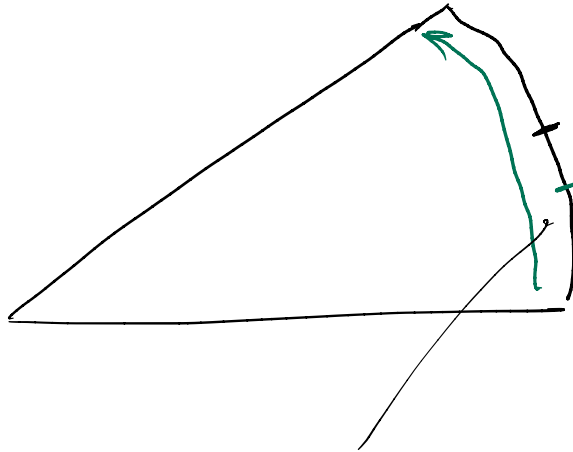
B = R = max
G = min

Hue - color "value"

Saturation -
How much its pure color instead of white

Luminence - Brightness

$R = G = Max \qquad H = 60$



$H = 30$

$R = Max$

$B = Min$

$H = 20$

$G = \frac{R+B}{2}$

$R = Max \qquad H = 0$

$G = B = Min$

$R = Max$

$B = Min$

$G = lerp(Min, Max, 1/3)$