CS559 Lecture 19-20: More Texture

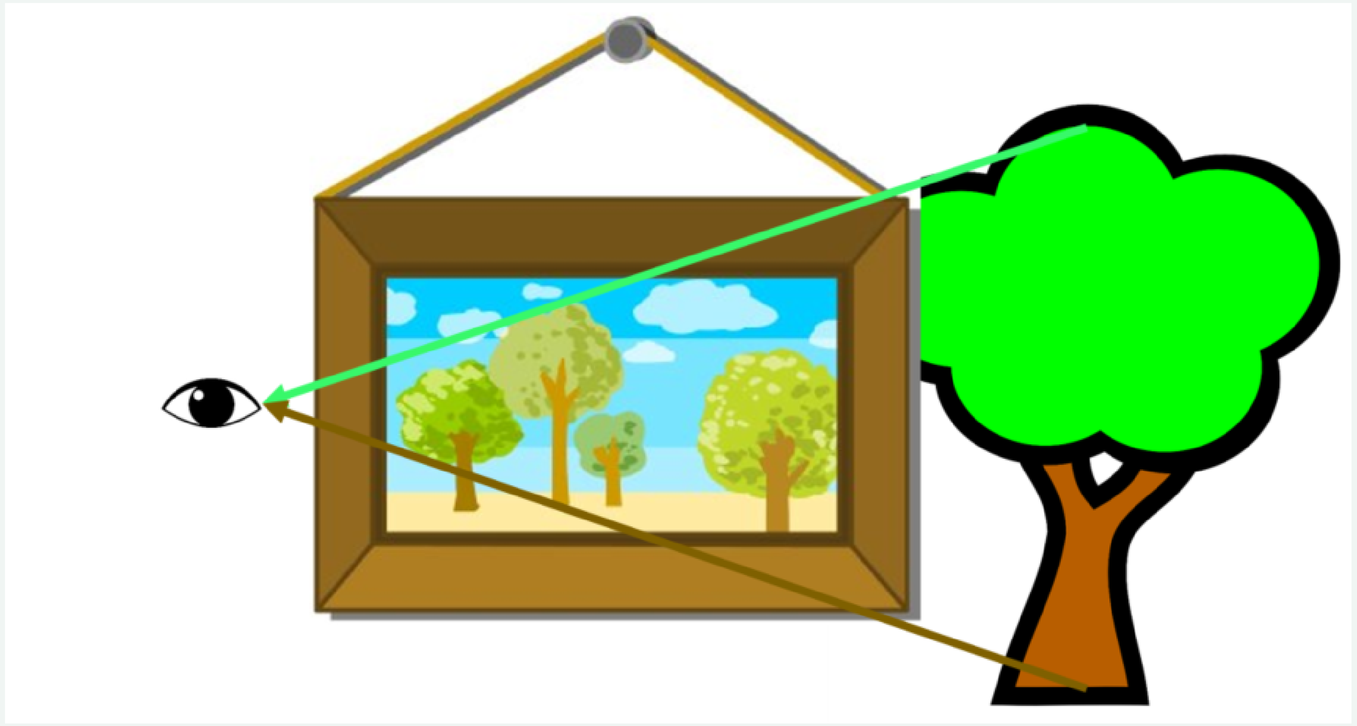
Part 4: SkyBoxes and Environment Maps

How do we fake lighting?

- Fake stuff far away
- Fake reflections by pretending things are far away

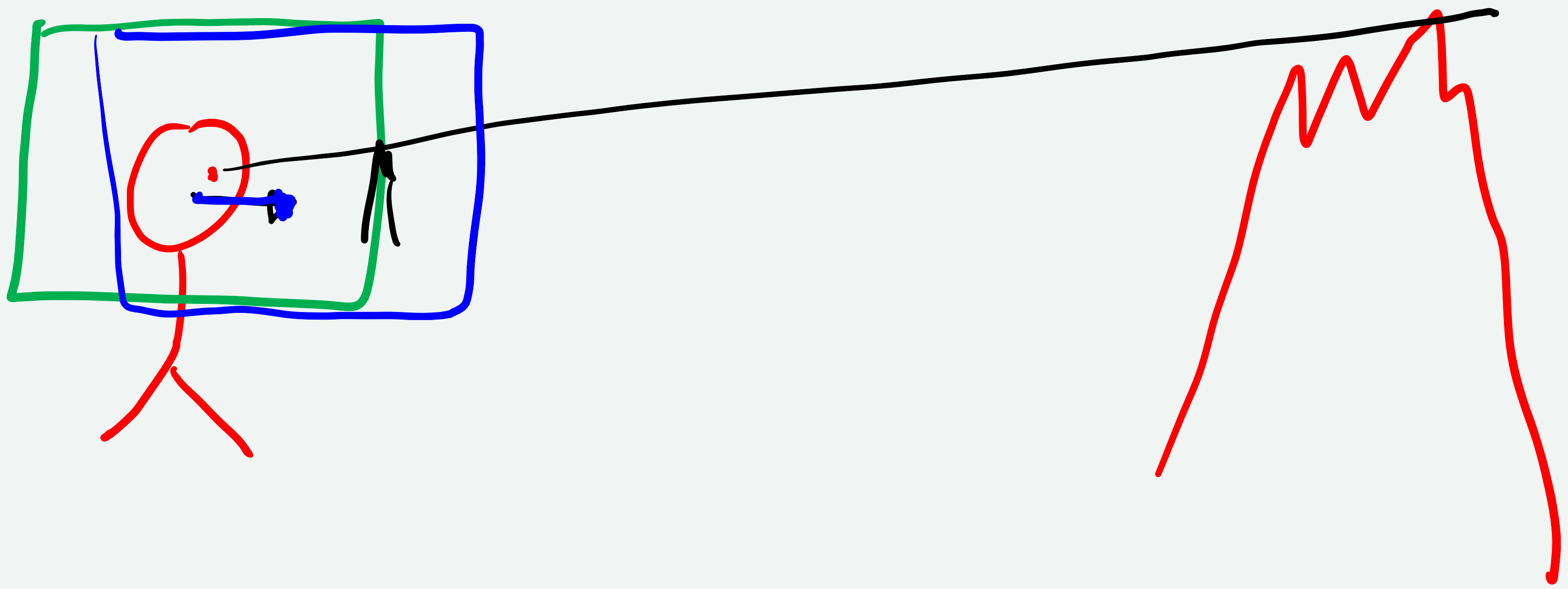
Do we have to draw everything?

Why not use a (pre-computed) picture?

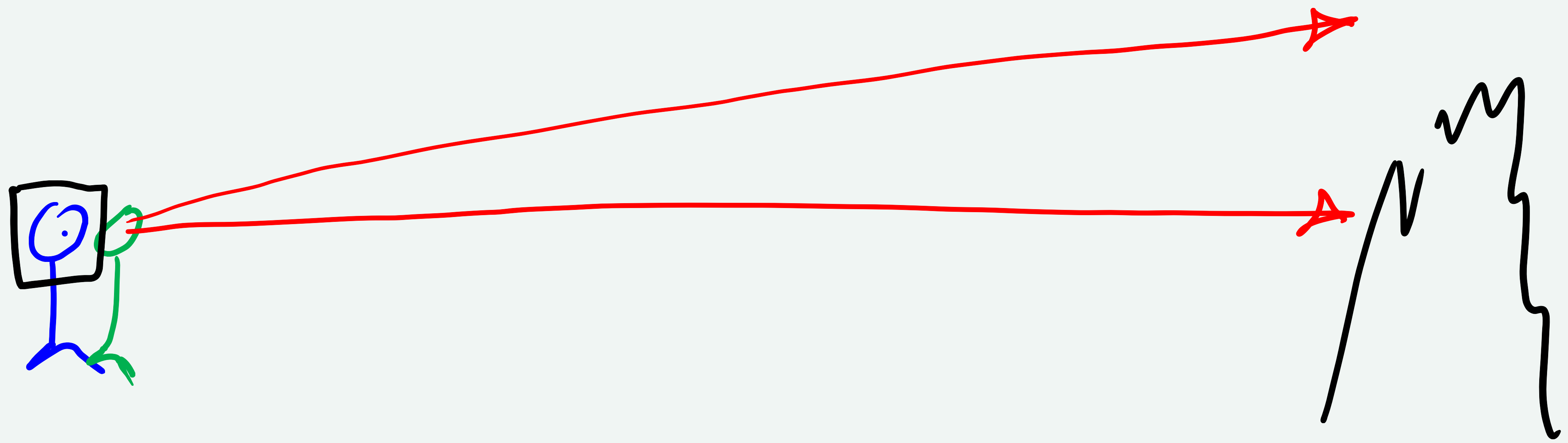


Far Away and Not Changing

Could draw a box around the viewer



Positions do not matter
Orientations do



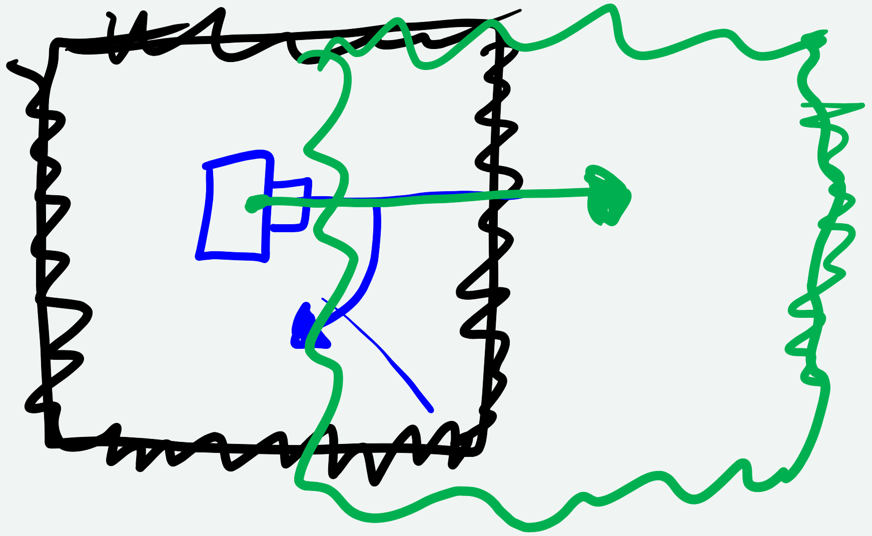
Sky Box

A Box for the "Background"

Always stays centered at the camera

The box moves with the camera)

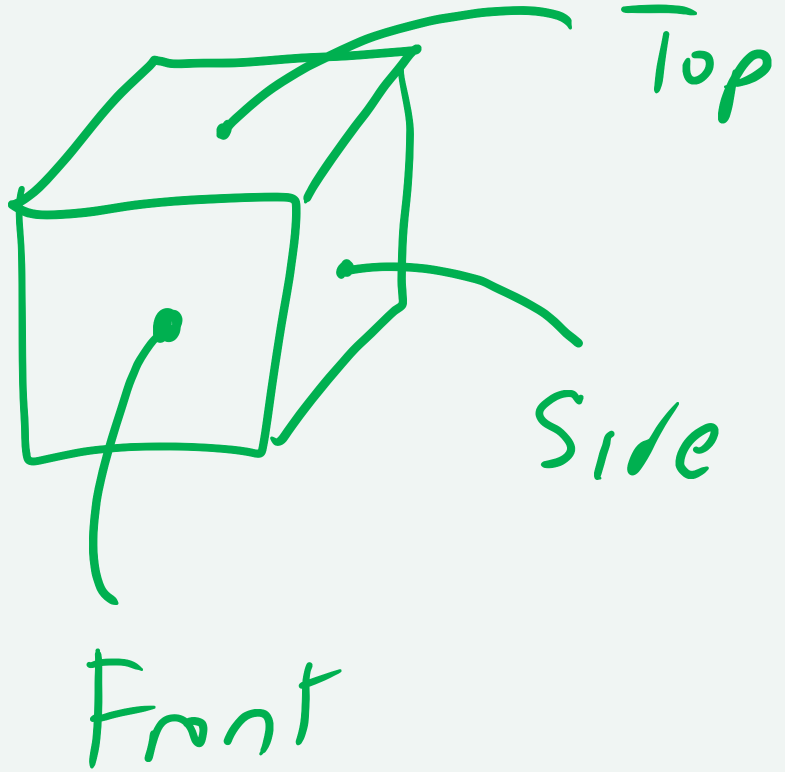
(beware fake sky boxes)



In THREE.js

Sky Box is built in! (no excuse for fake!)

- Cube Texture (6 images)
- `scene.background` = some cube texture

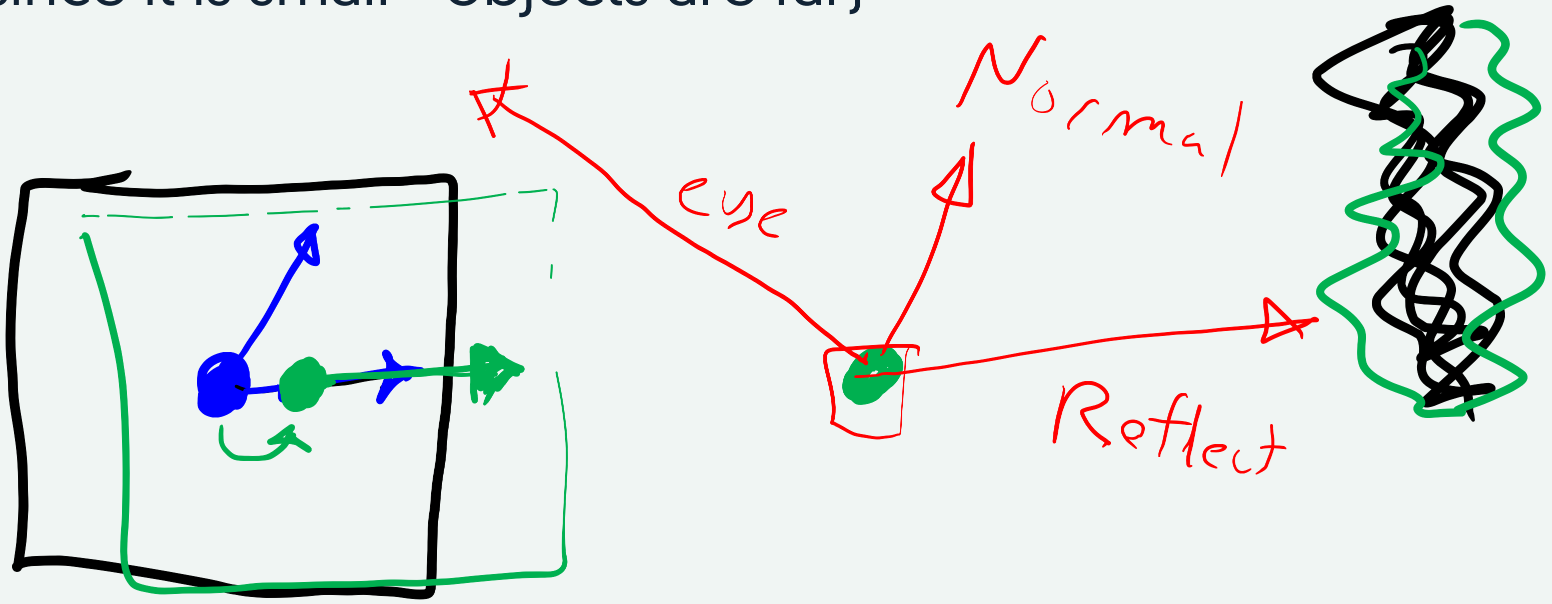


How does this help with reflections?

Assume the objects being looked at are far away (a Sky Box)

Viewing direction matters

Point Position doesn't (since it is small - objects are far)

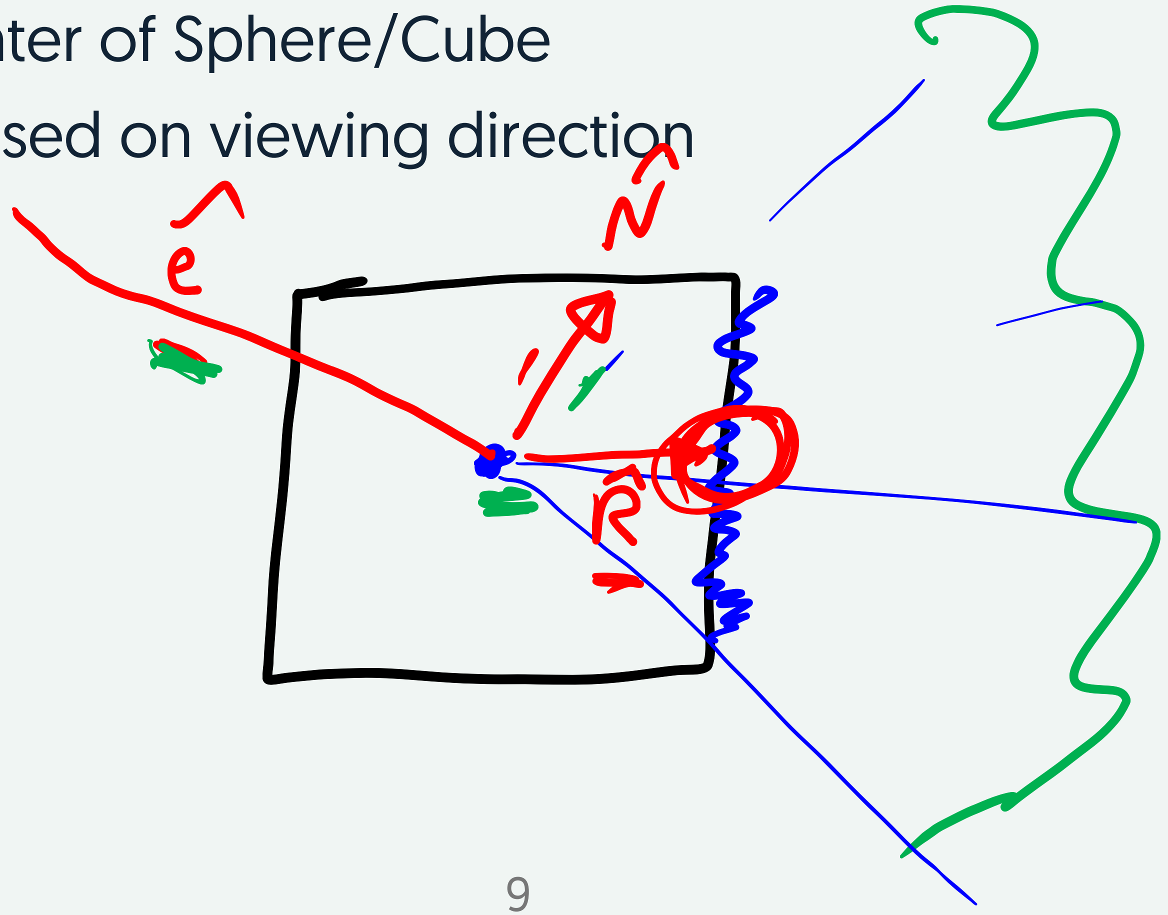


Environment Mapping

A Cube or Sphere texture map (around object)

Assume point is at center of Sphere/Cube

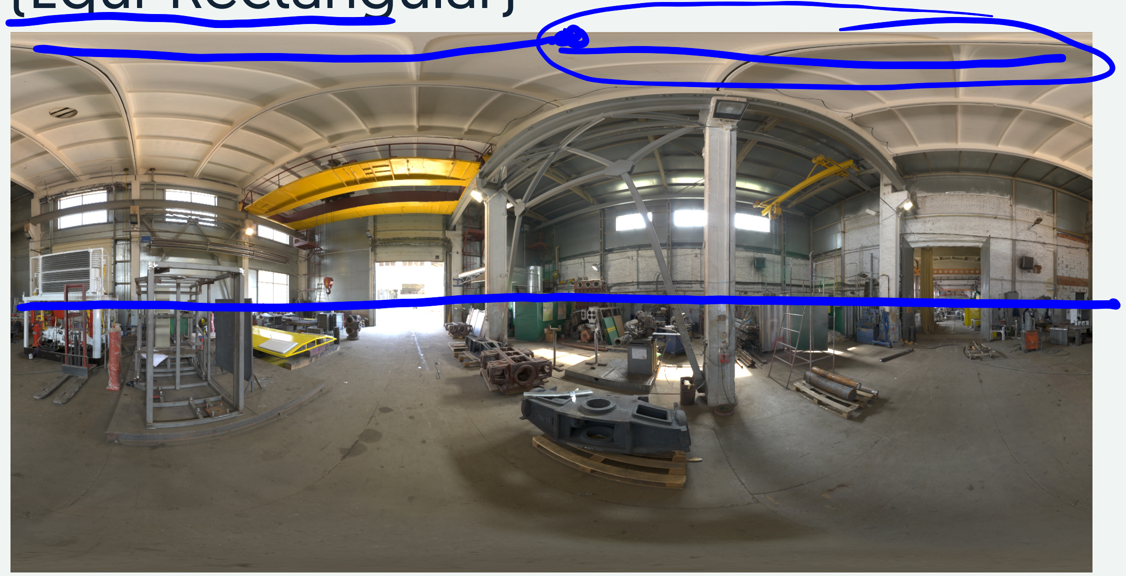
Lookup direction is based on viewing direction



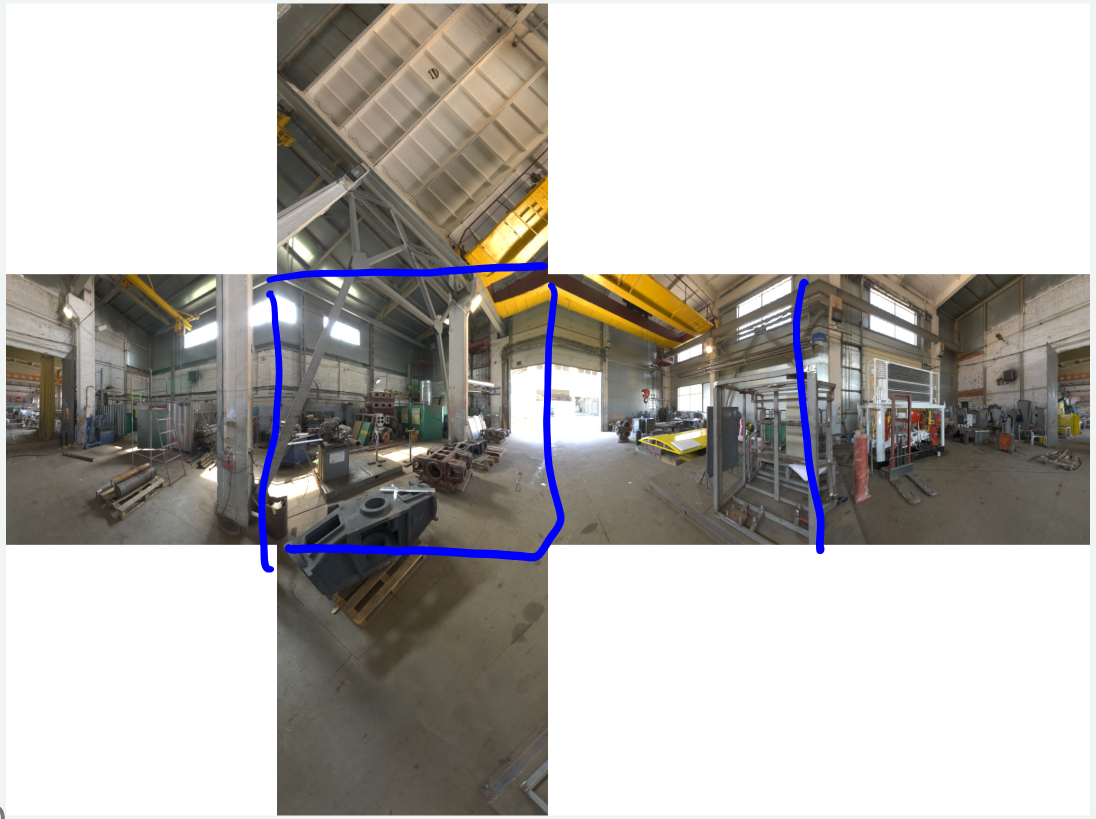
How to store the maps

Sphere Maps

(Equi-Rectangular)



Cube Maps



Representing the Environment

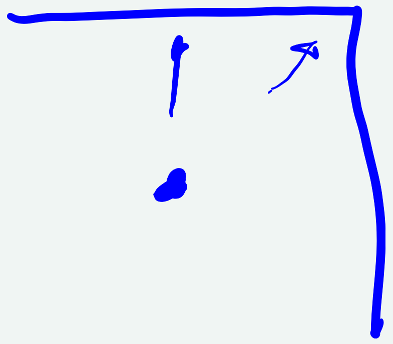
Sphere Maps

- Sampling issues at pole
- Single Images
- Capture in 1 Photograph

Cube Maps

- Sampling Issues in Corners
- Images are human viewable
- Maps nicely to graphics hardware

Tools to convert images between forms



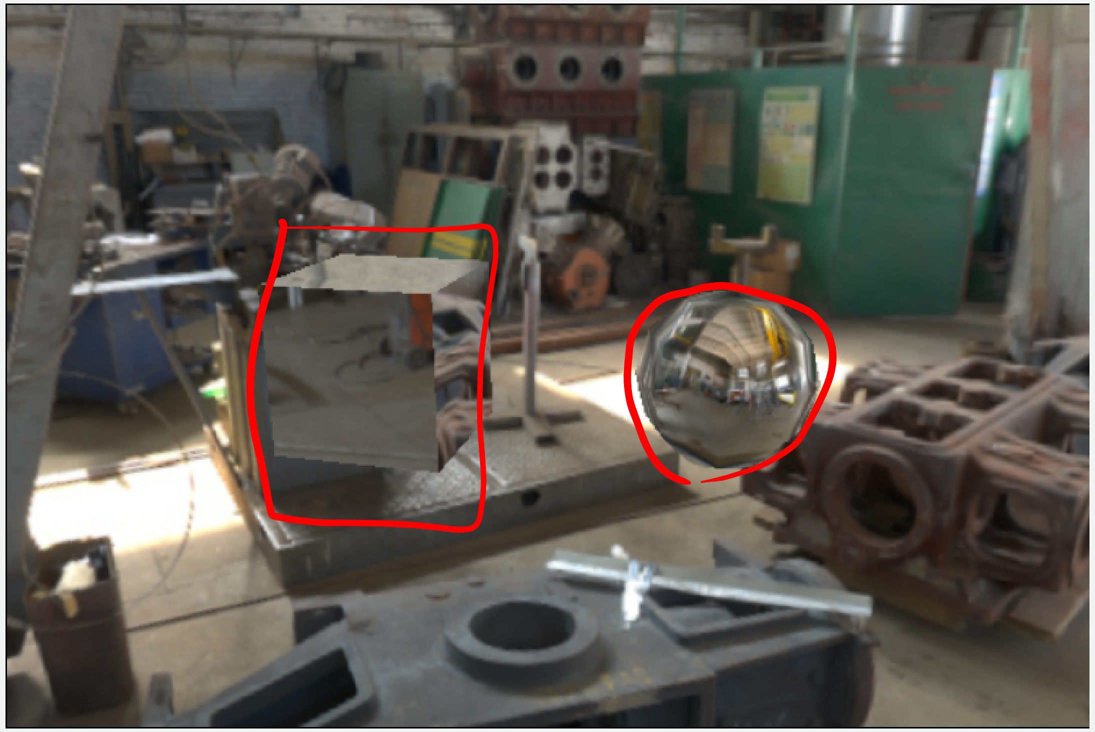
When do Environment Maps Work?

Require assumptions:

- Small Object / Far Environment
- Eye is far (only direction matters)
- Position doesn't matter

Small curvy objects - good

Large flat objects - bad



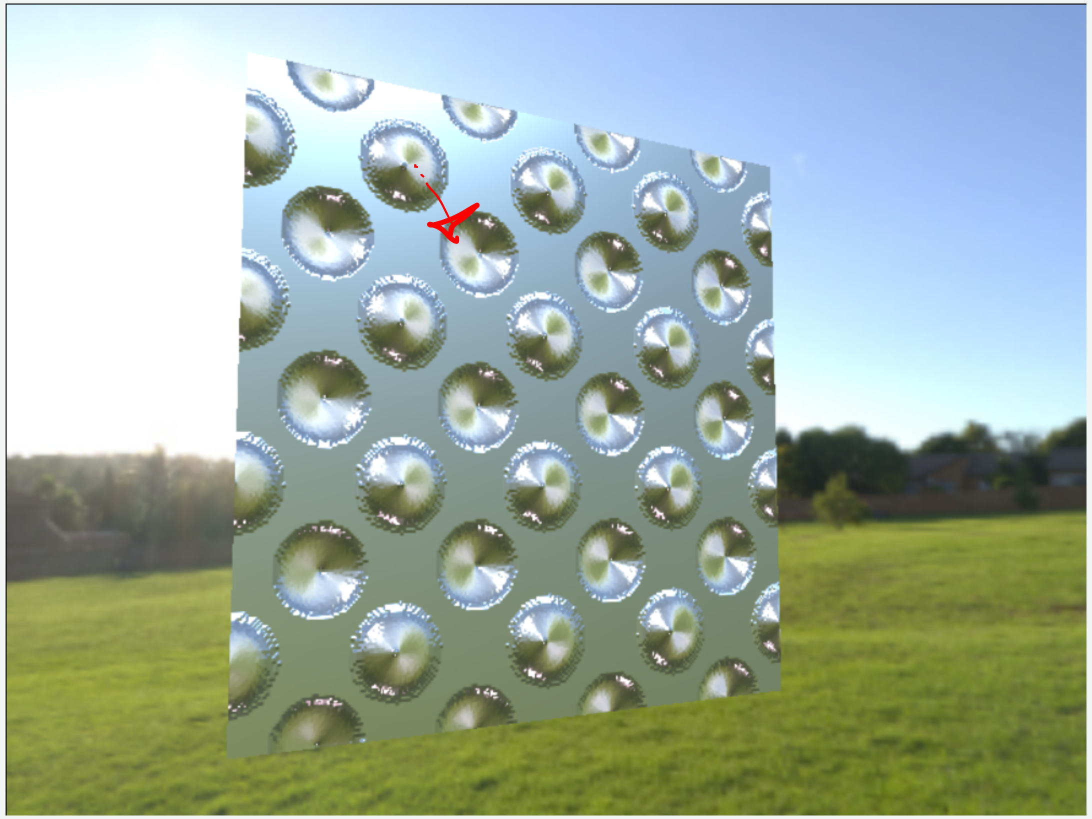
Very easy in THREE

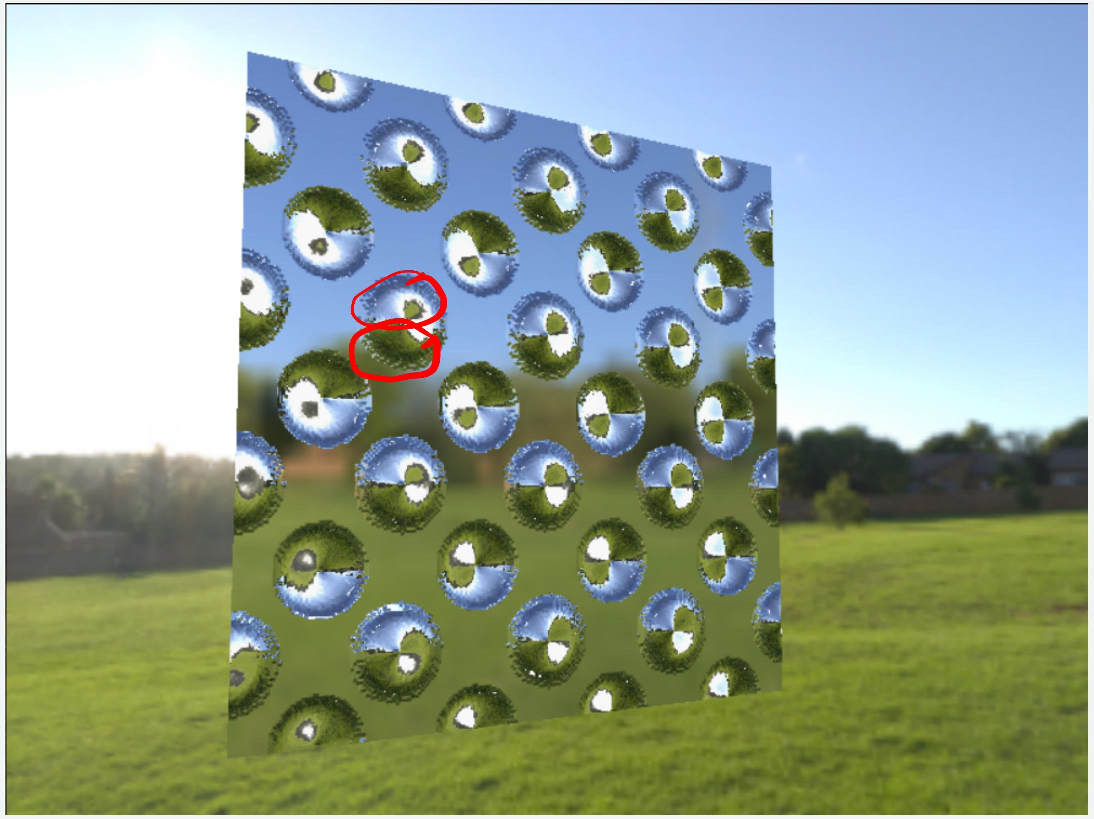
```
// assuming that cubeTexture is a Cubic Texture Map
let mat = new T.MeshBasicMaterial({ envMap: cubeTexture });
```

A lot goes on...

- U,V computed from view direction
- Lookup into cube texture map

Works well with bump maps!



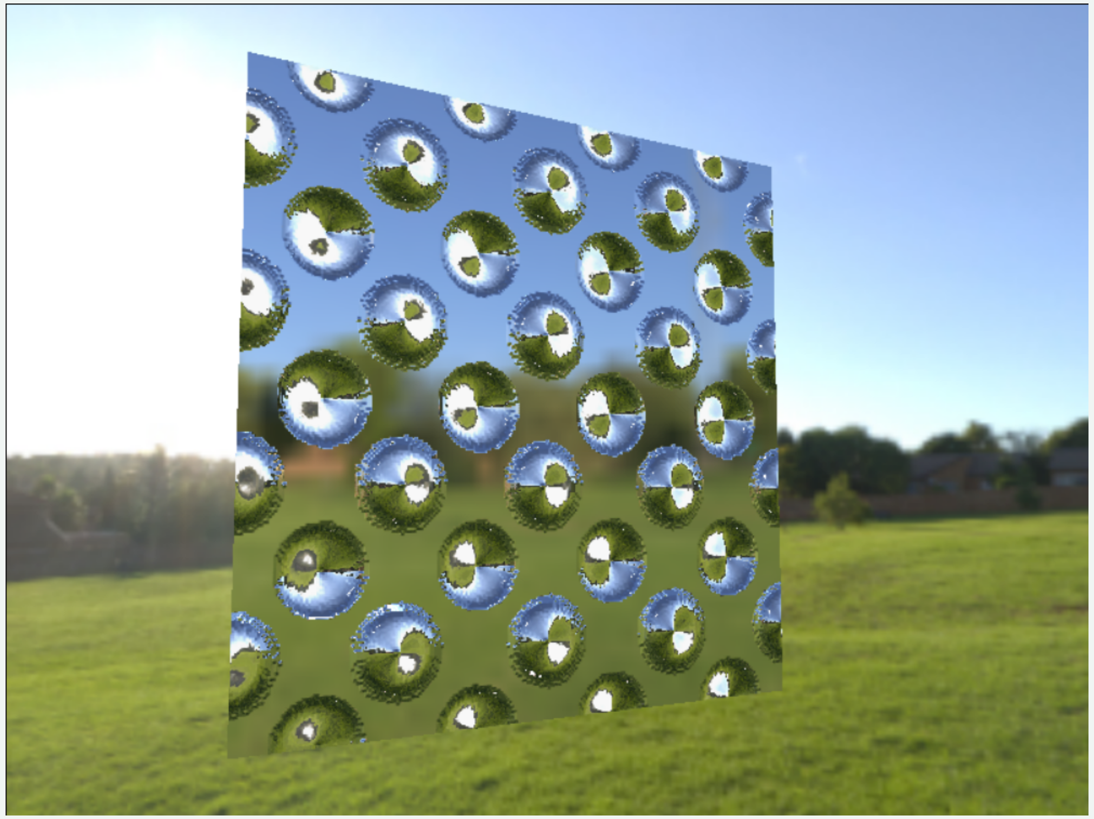


Requires a Shiny Material

Using THREE.js `MeshStandardMaterial`

- metalness 1.0
- Roughness 0.0

(try the demo)

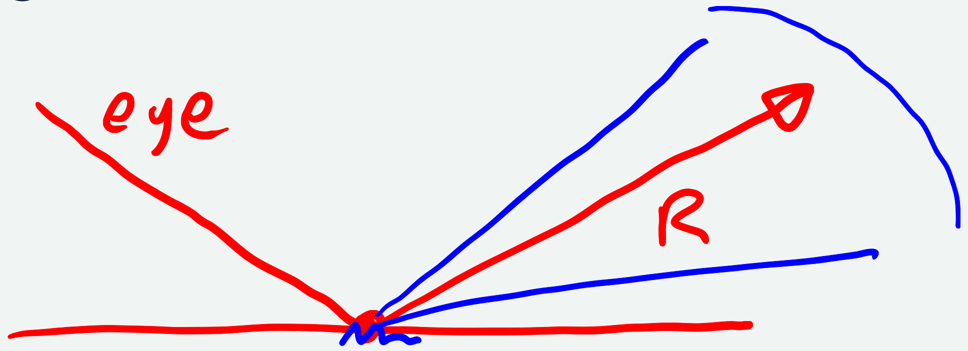


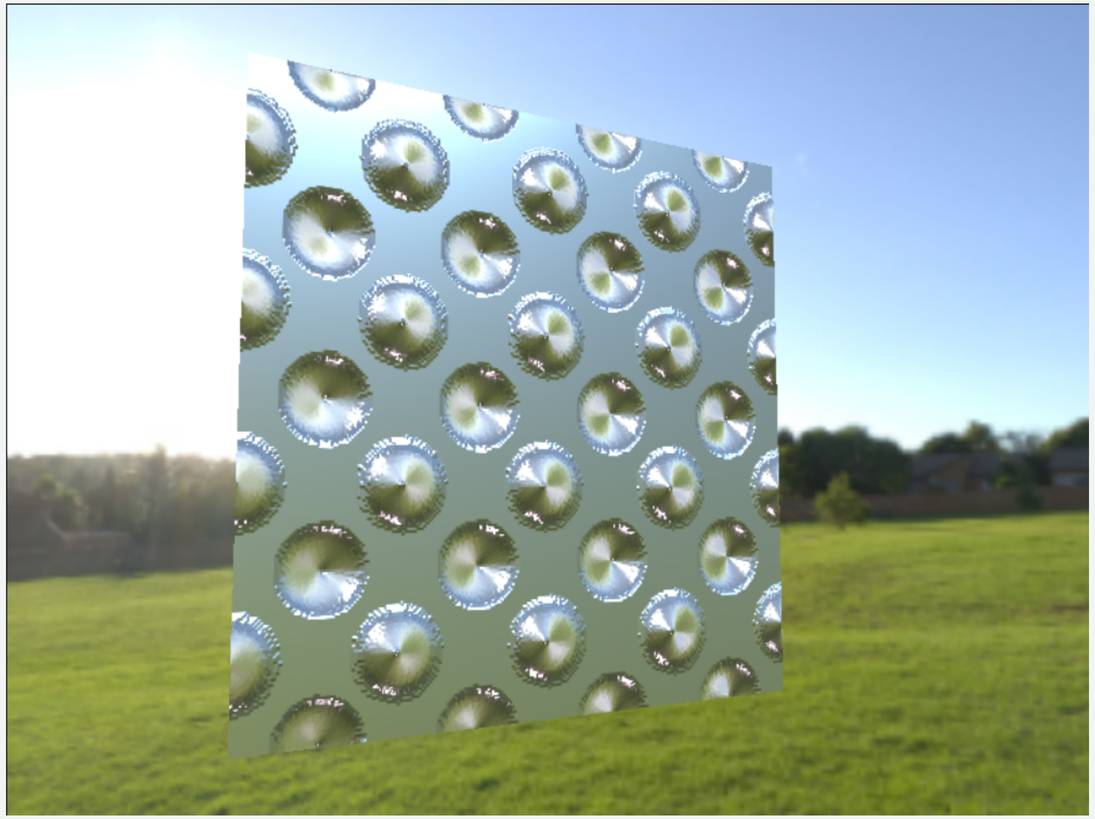
Less "reflective"

How much to mix in "regular lighting"

How much sharp are reflections

Rough materials start to look **diffuse**



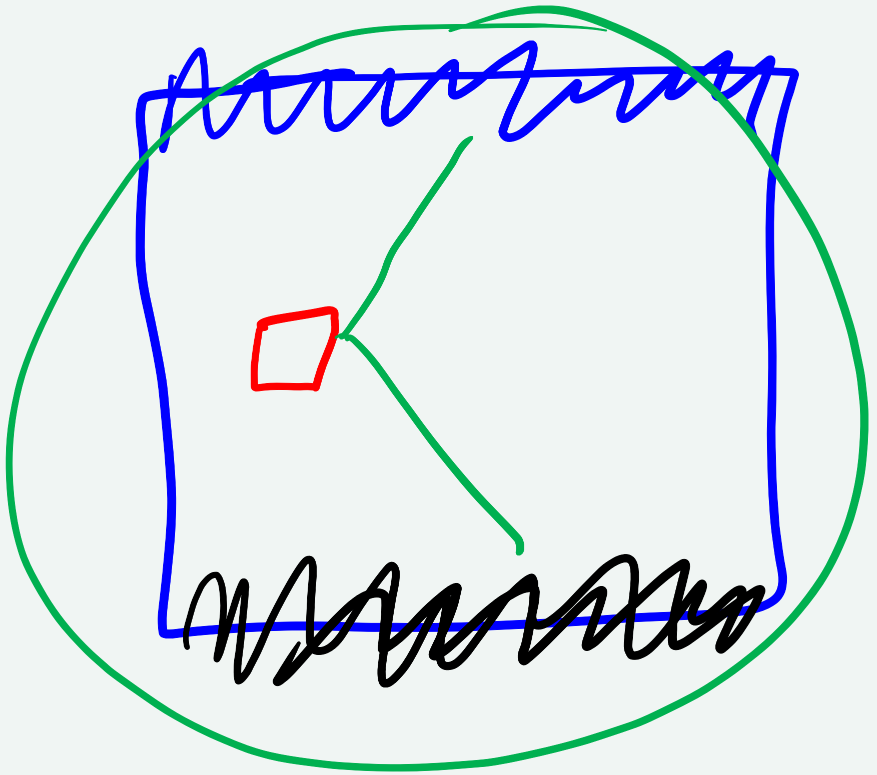


Environment Maps for Lighting

The environment map is light!

Use the real scene to create brightness!

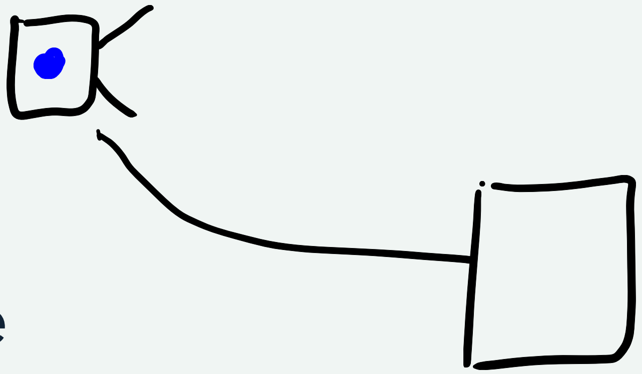
Not limited to a small set of light sources!



But the environment map is static?

Often, pre-compute the environment map ahead of time
(or use a photo)

But: we can draw it ourselves!



- draw the scene with the camera where the object will be
- use a special "cube camera" to take a picture in 6 directions
- (1) take this picture before making the "real" picture 1st
- (2) use this picture as the texture Use 1st picture as texture. when drawing
- **Dynamic Environment Map**

Multi-pass rendering (draw the scene multiple times)