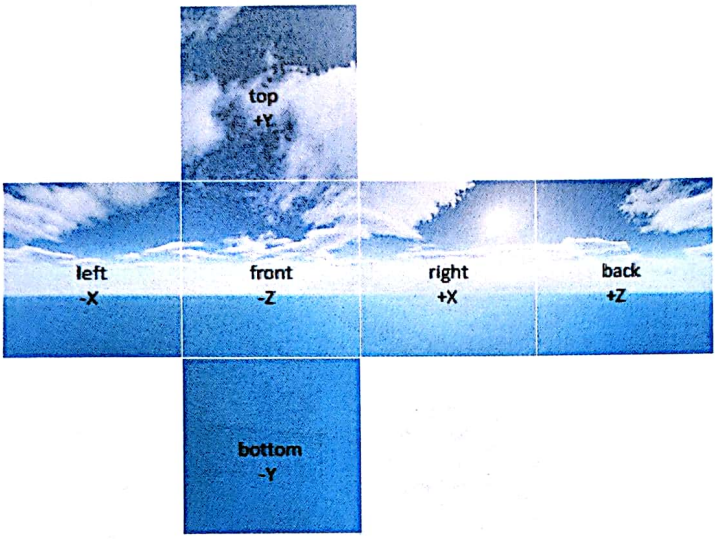
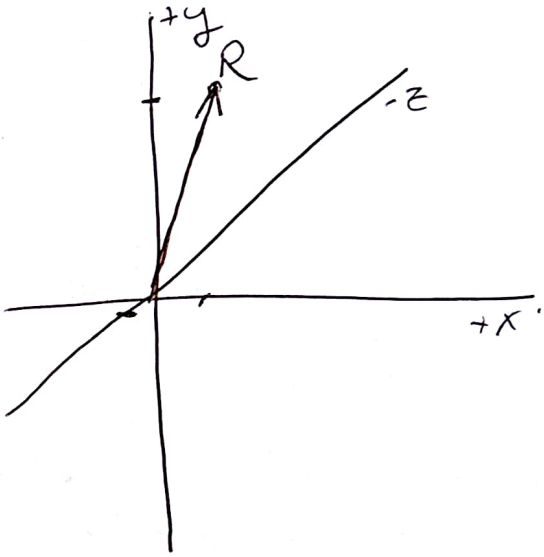
CS 418: Interactive Computer Graphics
In-class Worksheet: Environment Mapping

Spring 2018

Cube Maps

1. Sampling a Cube Map





At run time, a cube map is sampled using a reflection vector.
For this question, use a reflection vector of $R = \langle 2,4,1 \rangle$
This vector is used to:

a. Determine which cube map wall to sample
Which wall in the image above would be sampled using R ?

Normalize R : $\langle 1/2, 1, 1/4 \rangle$

Sample +Y wall

b. Determine what (u,v) coordinates to use when sampling the wall
What (u,v) coordinates are generated using R ?

Shift x & z component

$x = 1/2 + 1/2\,(1/2) = 3/4$

$z = 1/2 + 1/2\,(1/4) = 5/8$

Which is u? x

Which is v? z

2. **Transparency**
Imagine you are writing a shader for a transparent material. You need to write code to calculate a refraction vector which will be used to sample a cube map.

   a. Will the code to calculate the refraction vector be in the vertex shader or fragment shader?

   Vertex Shader

   b. What data are needed to calculate the refraction vector?

   Normal
   View Vector
   iorefr

   c. The GLSL function refract requires a variable `iorefr` representing the index of refraction. If we are simulating light entering water from air, what is the value of `iorefr`?

Speed of Light Relative to the Speed of Light in a Vacuum

Air: 99.97% → air / vacuum
Glass: 52.2% to 59%
Water: 75.19% → water / vacuum
Sapphire: 56.50%
Diamond: 41.33%

$$\frac{\frac{a}{v}}{\frac{w}{v}} = \frac{a}{w}$$

$$\boxed{\frac{99.97}{75.19}}$$

3. **Semi-random Questions**

   a. If you have 2 reflective objects in a scene, how many cube maps are needed?

   2

   b. If a reflective object is moving, how does the movement affect the cube map associated with the object?

   For large movement, the map becomes invalid ... it doesn't show the environment from the new position.

   c. Name a visual effect related to reflection that is not supported by a cube map?

   Inter-reflection, e.g. as shown on a donut-shaped mirror.