CS 498VR: Virtual Reality Spring 2019
In-class Worksheet

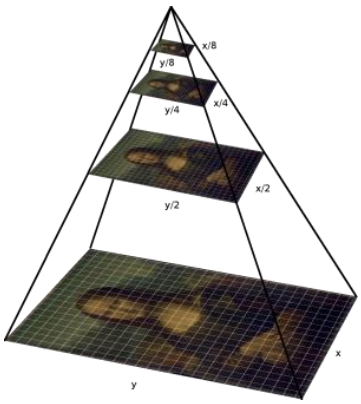
Rendering and Physics Engines

1. **Latency and Image Error**
   Let d = 40 be the pixels per degree (pixel density) in the HMD
   Let ω = 50 /s be the angular velocity of the head,
   Let the latency l = 0.02 s be the time to update the display
   How wrong is the image before the update can occur?

2. **Anti-aliasing Textures**

   a. Suppose we are mapping T texels onto N fragments. When do we need to perform texture minification?

   b. Suppose we are mapping T texels onto N fragments. When do we need to perform texture magnification?



   c. Are mipmaps generally used for texture magnification or minification?

   d. Is bilinear filtering usually used for texture magnification or minification?

   e. Suppose we start out with a 2048x2048 texel texture. How many mipmap levels would be generated?

3. Physics Engine

A particle begins at

$$\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

and is moving with velocity

$$\begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix} \text{ per second,}$$

and acceleration

$$\begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix} \text{ per second per second.}$$

a. Use the second integral of the acceleration to compute the position after 5 seconds. The update equation you should use is:

$$p' = p + \dot{p}t + \ddot{p}\frac{t^2}{2}$$

b. Calculate the position using 5 time steps of 1 second each using the update equations below.

$$p' = p + \dot{p}t \qquad \dot{p}' = \dot{p} + \ddot{p}t$$

c. What is the error? Explain why it happens