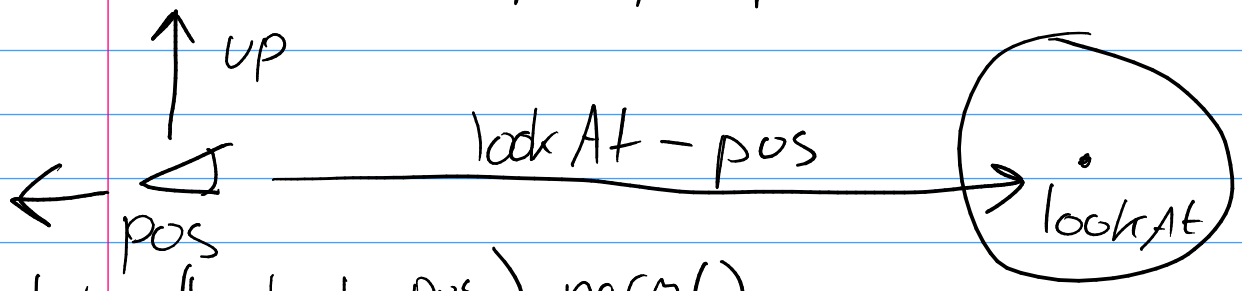
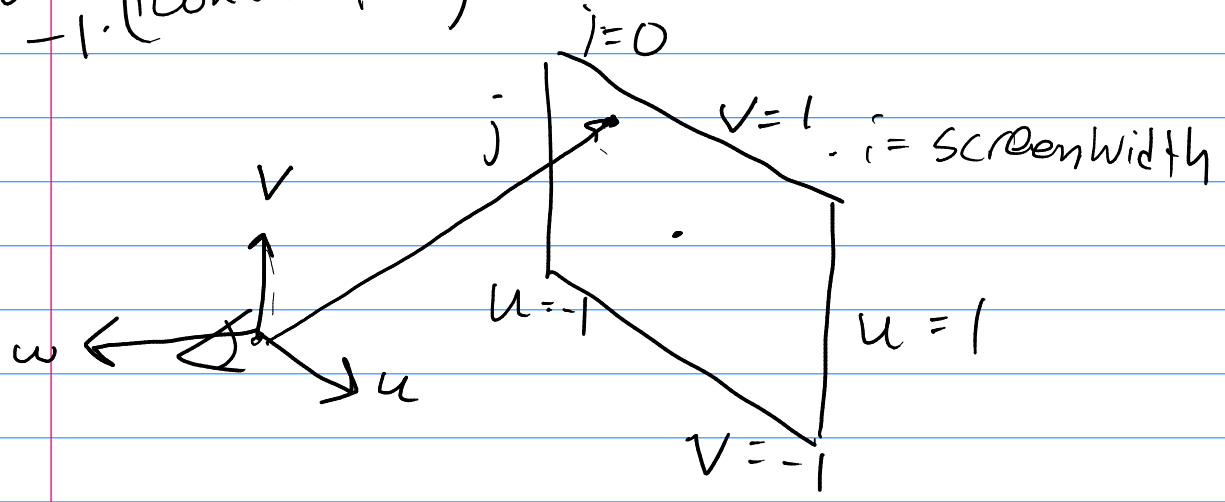
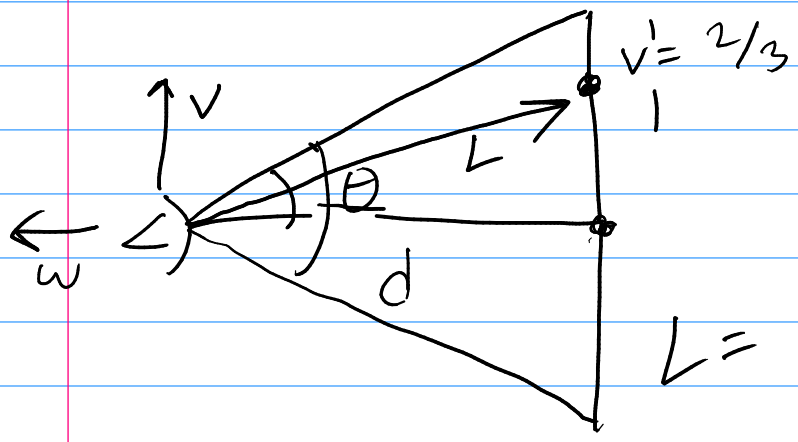
pos, up, lookAt



$w = -1 \cdot (lookat - pos).norm()$





$$d = \tan\left(\frac{\theta}{2}\right)$$

$$L = -\vec{w} \cdot d + \vec{v} \cdot v' + \vec{u} \cdot u'$$

$$u = v \times w$$

$$\hat{L} = \frac{L}{|L|}$$

eye_ray:

1) Convert i, j Coordinates to u, v Coordinates

$u' = 2 \cdot i / screenwidth - 1$

$v' = \ldots$

2) Compute L

3)

Vector.norm(v)

```
return {
    start: this.camera.position,
    dir: Vector.norm(L),
}
```

```
class RayTracer {
    shapes: Shape[] = [];
```

ambient: constant
diffuse: depends on light pos, hit normal
specular:
    light pos,
    hit normal,
    eye pos