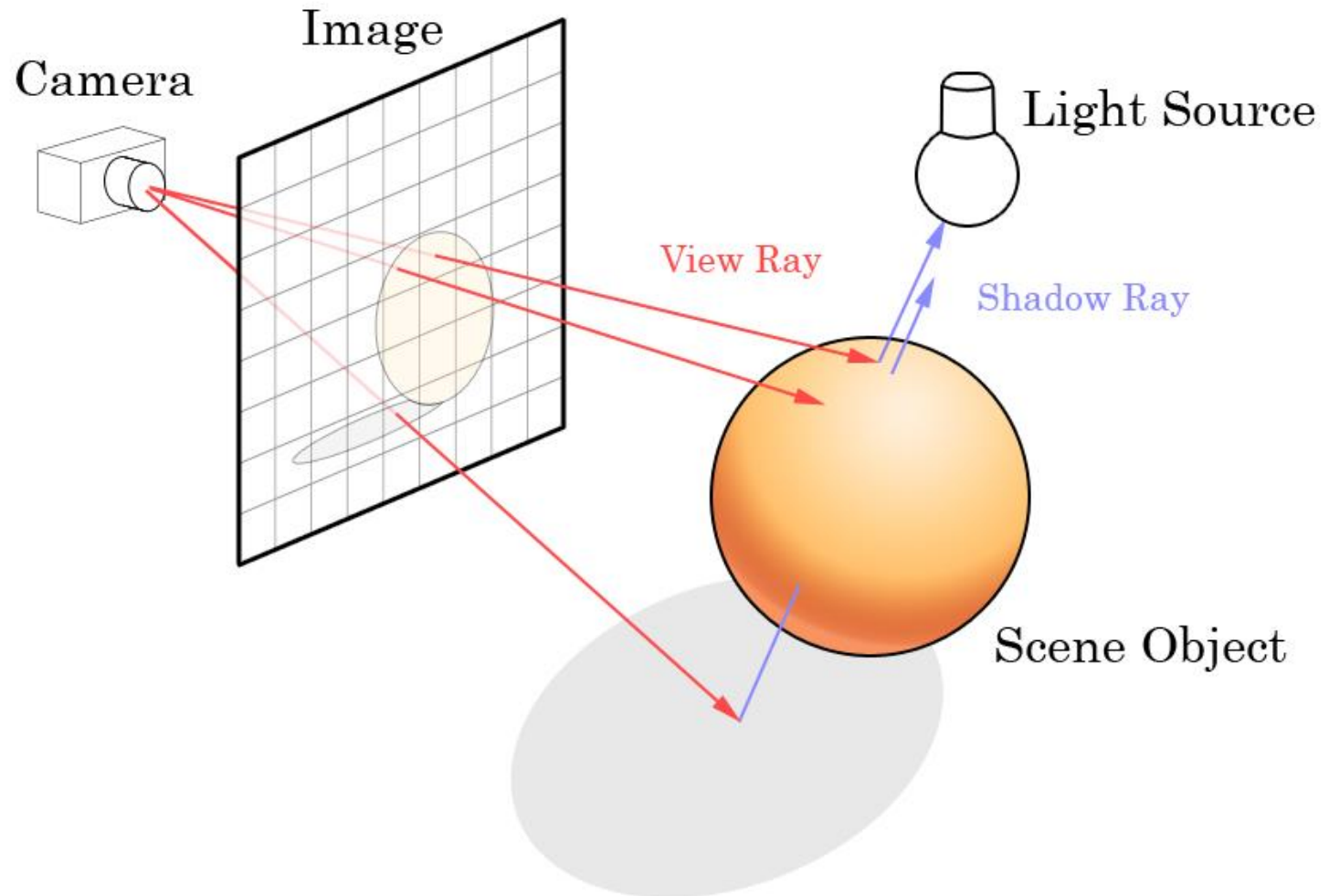# RAY CASTING

Computer Graphics 2

IDE & Vectors

- Visual Studio 2010

- Sharp develop

- Mono develop

- Basic vector operations are implemented
  - * serves as dot product
  - % serves as cross product

Ray Casting

Template

- Read camera parameters and render image
- Image is rendered by casting rays from camera through each pixel
- Pixel color is determined by ray intersection color

Ray

$$r(t) = P + t\boldsymbol{d}$$

- Ray r(t)
- Ray origin P
- Ray direction **d**
- Ray parameter t
- Ray hits an object if t >= 0

Plane

$$(X - Q) \cdot \boldsymbol{n} = 0$$

- X is arbitrary point

- Q is a point on the plane

- **n** is plane normal

- Ray-plane intersection needs to be calculated in order to determine pixel color

Ray – Plane Intersection

$$r(t) = P + t\boldsymbol{d}$$

$$(X - Q) \cdot \boldsymbol{n} = 0$$

$$(P + t\boldsymbol{d} - Q) \cdot \boldsymbol{n} = 0$$

$$t\boldsymbol{d} \cdot \boldsymbol{n} = -(P - Q) \cdot \boldsymbol{n}$$

$$t\boldsymbol{d} \cdot \boldsymbol{n} = (Q - P) \cdot \boldsymbol{n}$$

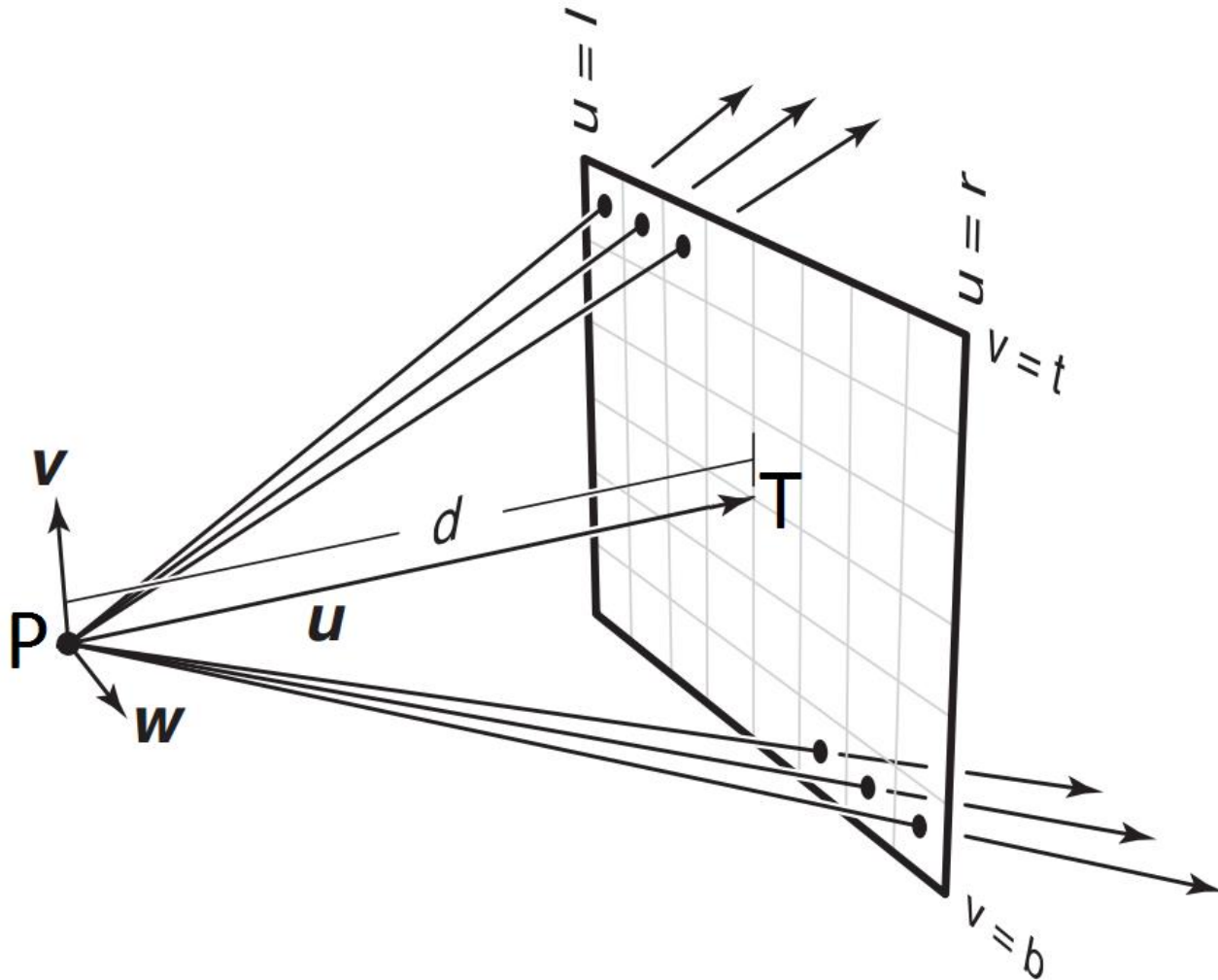$$t = \frac{(Q - P) \cdot \boldsymbol{n}}{\boldsymbol{d} \cdot \boldsymbol{n}}$$

Camera

- P is position of camera
- Camera looks at target T
- Camera up vector:
  $\mathbf{v} = (0, 0, 1)$
- Look at direction of camera:
  $\mathbf{u} = T - P$
- Camera right vector is:
  $\mathbf{w} = \mathbf{u} \times \mathbf{v}$
- Width and height determine screen size and aspect ratio
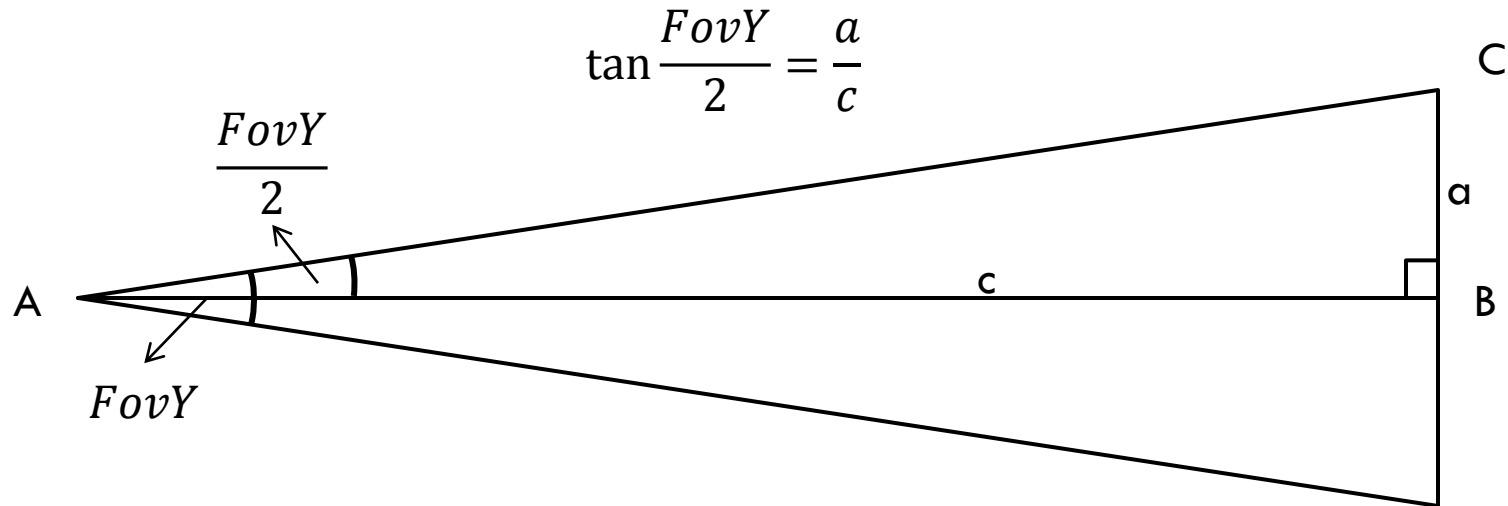- Field of view Y determines visible space
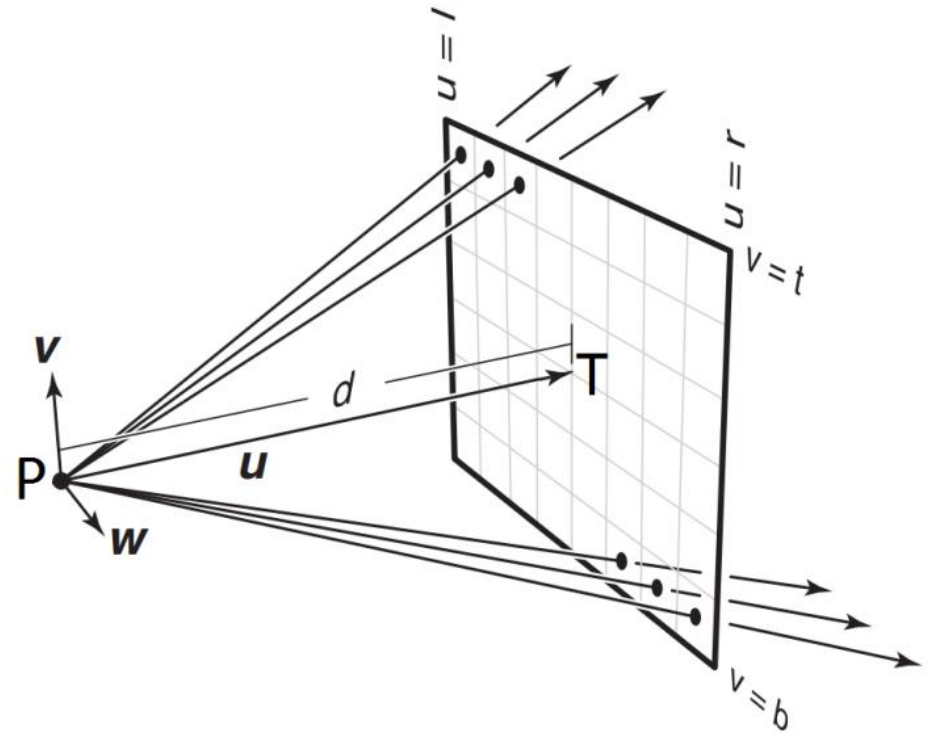
Camera

```
Vector4 dir = (w * W + h * V + U).Normalized;
```

Camera Pixel Translation

$$\tan\frac{FovY}{2} = \frac{a}{c}$$
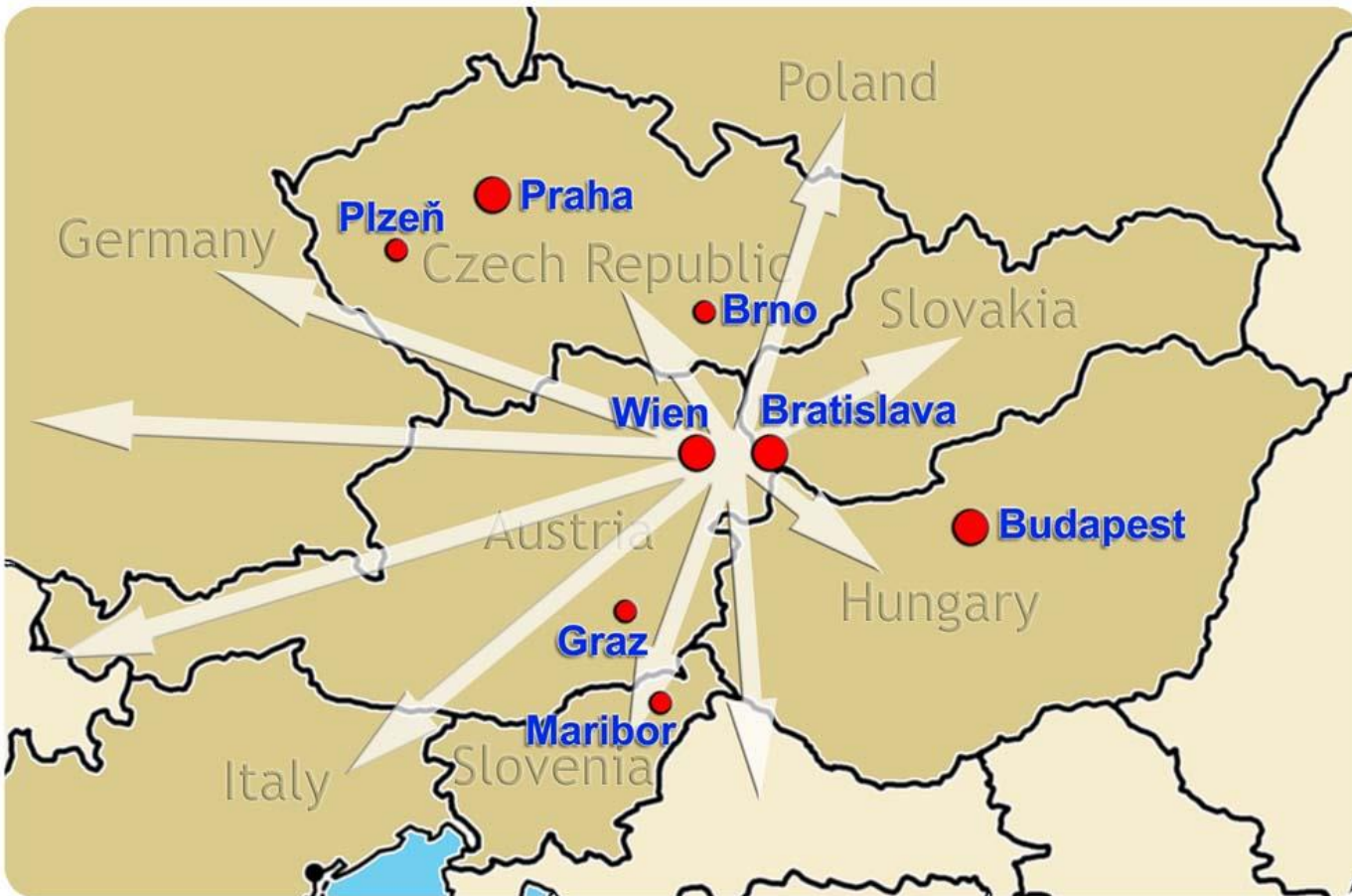
$$\frac{FovY}{2}$$

$FovY$

```
//parameter initialization
Double h = tan;
Double w = -aspect * tan;
//delta computation
Double dx = 2.0 * aspect * tan / (Double)Width;
Double dy = 2.0 * tan / (Double)Height;
//parameter increment
w += dx;
h -= dy;
```

SiSP Sútaž o účasť na CESCG

- **http://www.sccg.sk/sk/sutaz/**

Questions?