

1. Warm Up:

$$w = p - o$$

$$Q' = o + td$$

The projection of  $w$  onto the function  $o + td$  equals the following:

$$\frac{w \cdot d}{\|v\|^2} v$$

$$Q' = P + \frac{w \cdot d}{\|v\|^2} v$$

$$t = \frac{P + \frac{w \cdot d}{\|v\|^2} v - o}{d}$$

2. Tangent space:

i)

$$\beta(P_1 - P_0) + \gamma(P_2 - P_0) = P - P_0$$

$$b = P_1 - P_0$$

$$c = P_2 - P_0$$

$$p = P - P_0$$

$$\beta b + \gamma c = p$$

$$\beta = \frac{p_y c_x - p_x c_y}{b_y c_x - b_x c_y}$$

$$\gamma = \frac{p_y b_x - p_x b_y}{c_y b_x - c_x b_y} = \frac{p_x - \beta b_x}{c_x}$$

$$\alpha = (1 - \beta - \gamma)$$

$$uv = \alpha uv_0 + \beta uv_1 + \gamma uv_2$$

ii)

$$T = P_1 - P_0$$

$$N = T \times (P_2 - P_0)$$

$$B = N \times T$$