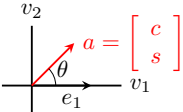## An Example

Definition: The matrix

$$P = \frac{1}{\|a\|^2} aa^T$$

is the matrix that projects vectors (by matrix multiplication) onto the line formed by a. Here is a check. Since $(a, b) = a^T b$,

$$Pb = \frac{1}{\|a\|^2} aa^T b = \frac{1}{\|a\|^2} a(a, b) = \frac{(a, b)}{\|a\|^2} a$$

Ex: Let's find the matrix P_θ that projects vectors in the plane onto a line at angle θ. Note what a is in this case:

$$a = \begin{bmatrix} c \\ s \end{bmatrix} \quad \text{where} \quad \begin{array}{l} c = \cos\theta \\ s = \sin\theta \end{array}$$