

E5 Matrix Assignment 1

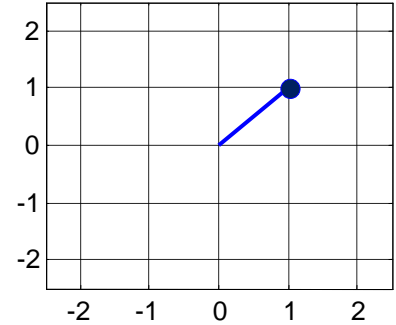
Name: _____

Due Thursday 10/1 in lab.

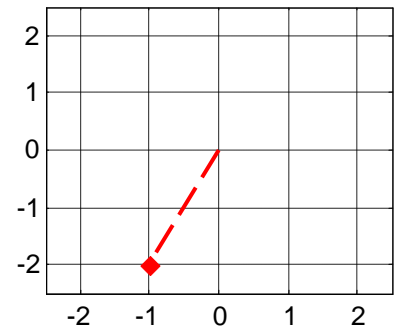
If you need extra room to complete a problem, please attach your work to this sheet

Problem 1) Consider the product $\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} \cos \theta & \sin -\theta \\ \sin \theta & \cos \theta \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$.

- Calculate x' and y' if $x=1$, $y=1$ and $\theta=45^\circ$.
- The plot shows the point (x,y) where $x=1$ and $y=1$. Modify it by adding the point you calculated, (x',y') . Also draw a line from (x',y') to the origin.

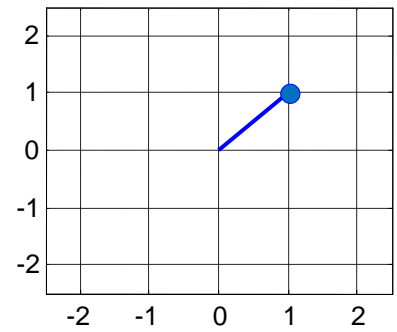


Problem 2) Repeat problem 1 with $x=-1$, $y=-2$ and $\theta=-90^\circ$.

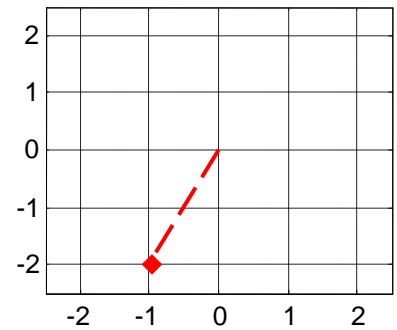


Problem 3) If
$$\begin{bmatrix} x' \\ y' \\ q \end{bmatrix} = \begin{bmatrix} \cos \theta & \sin -\theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

- Calculate x' and y' if $x=1, y=1$ and $\theta=45^\circ$.
- Add (x',y') to plot. Also draw a line from (x',y') to the origin.

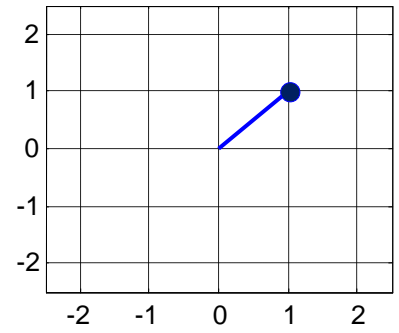


Problem 4) Repeat with $x=-1, y=-2$ and $\theta=-90^\circ$.

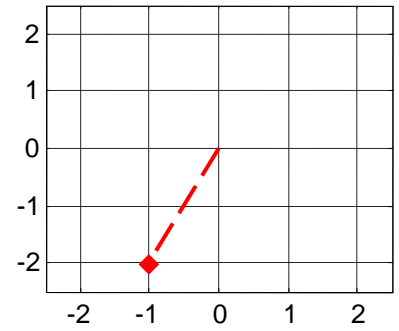


Problem 5) If
$$\begin{bmatrix} x' \\ y' \\ q \end{bmatrix} = \begin{bmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

- a) Calculate x' and y' if $x=1, y=1$ and $t_x=1, t_y=-2$.
- b) Add (x',y') to plot. Also draw a line from (x',y') to the origin.

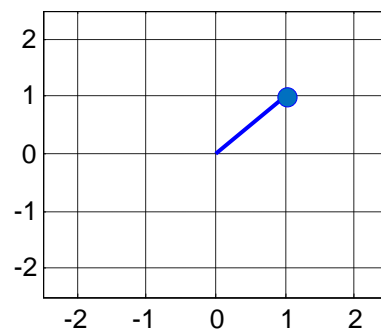


Problem 6) Repeat with $x=-1, y=-2$ and $t_x=1, t_y=1$.

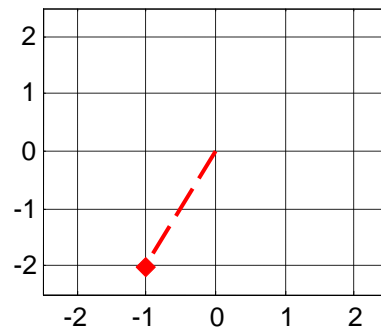


Problem 7)
$$\begin{bmatrix} x' \\ y' \\ q \end{bmatrix} = \begin{bmatrix} \cos \theta & \sin -\theta & t_x \\ \sin \theta & \cos \theta & t_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

- a) Calculate x' and y' if $x=1, y=1$ and $t_x=1, t_y=-2, \theta=45^\circ$.
- b) Add (x',y') to plot. Also draw a line from (x',y') to the origin.



Problem 8) Repeat if $x=-1, y=-2$ and $t_x=1, t_y=1$, and $\theta=90^\circ$.



Problem 9) Examine the results from problems 1 through 8. In these matrix manipulations what do t_x , t_y and θ represent?

Problem 10) This problem shows how several of these transformations can be done simultaneously with matrix multiplication.

$$\text{Consider } \begin{bmatrix} x'_1 & x'_2 \\ y'_1 & y'_2 \\ q_1 & q_2 \end{bmatrix} = \begin{bmatrix} \cos \theta & \sin \theta & t_x \\ -\sin \theta & \cos \theta & t_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 & x_2 \\ y_1 & y_2 \\ 1 & 1 \end{bmatrix}.$$

- Given $x_1=1, y_1=1, x_2=-1, y_2=-2$. and $t_x=0, t_y=0$, and $\theta=45^\circ$, calculate x'_1, y'_1, x'_2 , and y'_2 .
- The plot shows (x_1, y_1) and (x_2, y_2) , modify it by adding (x'_1, y'_1) and (x'_2, y'_2) .

