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Assignment 4	3.3.7

http://people.tamu.edu/~dmw1435/3_3_7.dvi
http://people.tamu.edu/~dmw1435/3_3_7.pdf

Sketch the vector fields in $\mathbf{R}^2$. (Pick at least 4 diverse points $\vec{r}$ and draw the arrow $f(\vec{r})$ with its tail at $\vec{r}$. Choose the field of view as $-1 \geq x \geq 2$, $-1 \geq y \geq 2$.)

$$\text{(a) } F_A(x,y) = \begin{pmatrix} x \\ y \end{pmatrix} \qquad \text{(b) } F_B(x,y) = \begin{pmatrix} y \\ x \end{pmatrix} \qquad \text{(c) } F_C(x,y) = \begin{pmatrix} -y \\ x \end{pmatrix}$$

For this problem, we define $\vec{F}(x,y) = \vec{F}(\vec{r})$, where
$$\vec{r} = \begin{pmatrix} x_1 & y_1 \\ x_2 & y_2 \\ \vdots & \vdots \\ x_{12} & y_{12} \end{pmatrix} = \begin{pmatrix} -0.5 & -0.5 \\ -0.5 & 0 \\ -0.5 & 0.75 \\ -0.25 & -0.25 \\ -0.25 & 0.25 \\ 0 & -0.5 \\ 0 & 1 \\ 0.25 & -0.25 \\ 0.25 & 0.25 \\ 1 & -0.5 \\ 1 & 0 \\ 1 & 1 \end{pmatrix}.$$

Part (a)

For this first function, the vectors of the field have the same direction and magnitude as the position vector for the given point. The vector field is given in Figure 1.

$$\vec{F}_A(\vec{r}) = \begin{pmatrix} -0.5 & -0.5 \\ -0.5 & 0 \\ -0.5 & 0.75 \\ -0.25 & -0.25 \\ -0.25 & 0.25 \\ 0 & -0.5 \\ 0 & 1 \\ 0.25 & -0.25 \\ 0.25 & 0.25 \\ 1 & -0.5 \\ 1 & 0 \\ 1 & 1 \end{pmatrix}$$

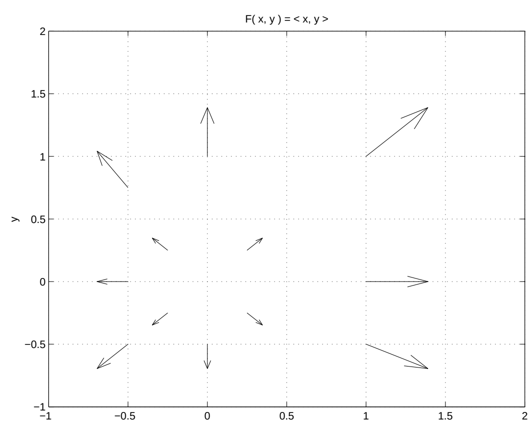

Figure 1 - Vector Field A

Part (b)

For the second function, the vectors of the field have the same magnitude as the position vector for the point of origin. The horizontal and vertical dimensions have been swapped from that of the original position vector, however. Figure 2 shows the vector field.

$$\vec{F}_B(\vec{r}) = \begin{pmatrix} -0.5 & -0.5 \\ 0 & -0.5 \\ 0.75 & -0.5 \\ -0.25 & -0.25 \\ 0.25 & -0.25 \\ -0.5 & 0 \\ 1 & 0 \\ -0.25 & 0.25 \\ 0.25 & 0.25 \\ -0.5 & 1 \\ 0 & 1 \\ 1 & 1 \end{pmatrix}$$

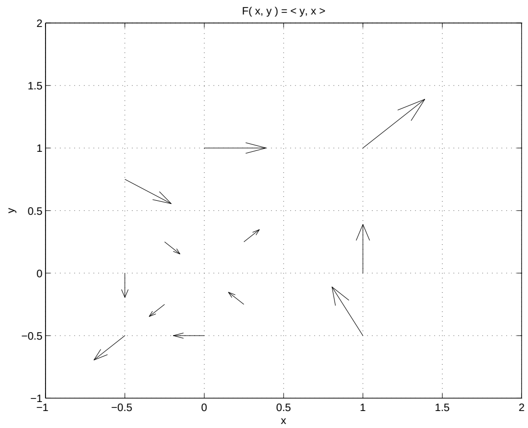

Figure 2 - Vector Field B

Part (c)

The third function produces vectors that are orthogonal to their original position vectors, with counter-clockwise orientations. Figure 3 shows the appropriate vector field.

$$\vec{F}_C(\vec{r}) = \begin{pmatrix} 0.5 & -0.5 \\ 0 & -0.5 \\ -0.75 & -0.5 \\ 0.25 & -0.25 \\ -0.25 & -0.25 \\ 0.5 & 0 \\ -1 & 0 \\ 0.25 & 0.25 \\ -0.25 & 0.25 \\ 0.5 & 1 \\ 0 & 1 \\ -1 & 1 \end{pmatrix}$$

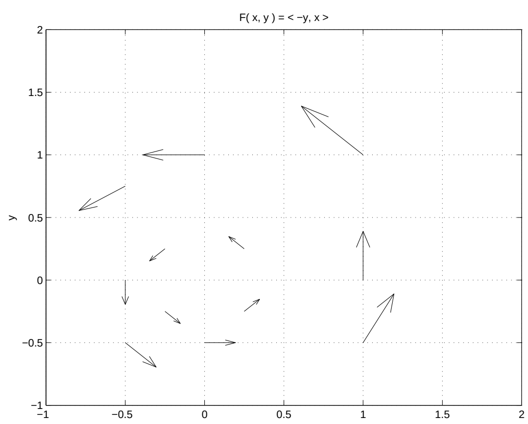

Figure 3 - Vector Field C