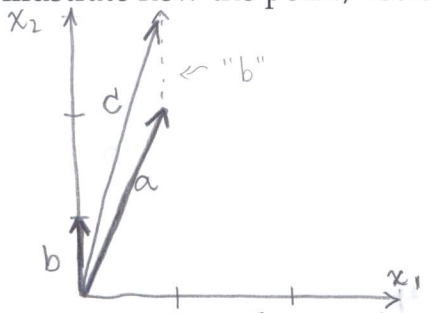
Worksheet - Lecture 3

Matrix Arithmetic

$c = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$

1. On a coordinate plane, draw the vectors $\mathbf{a} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ and then draw $\mathbf{c} = \mathbf{a} + \mathbf{b}$. Make dotted lines which illustrate how the point/vector $\mathbf{c}$ can be reached by connecting the vectors a and b "tail-to-head".



note: the picture you draw could be slightly different. here, I assume the horizontal axis is corresponding to first entry in vector, but this choice is arbitrary I could switch axis for a mirrored picture.

2. Use the following vectors to answer the questions:

$$\mathbf{v} = \begin{pmatrix} 6 \\ -1 \end{pmatrix} \quad \mathbf{u} = \begin{pmatrix} -2 \\ 1 \end{pmatrix} \quad \mathbf{x} = \begin{pmatrix} 4 \\ 2 \\ 1 \end{pmatrix} \quad \mathbf{y} = \begin{pmatrix} -1 \\ -2 \\ -3 \end{pmatrix} \quad \mathbf{e} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

a. Compute the following linear combinations, if possible:

$2\mathbf{u} + 3\mathbf{v} = 2\begin{pmatrix} -2 \\ 1 \end{pmatrix} + 3\begin{pmatrix} 6 \\ -1 \end{pmatrix} = \begin{pmatrix} 14 \\ -1 \end{pmatrix}$

$\mathbf{u} + \mathbf{e} =$ not possible

$\mathbf{x} - 2\mathbf{y} + \mathbf{e} = \begin{pmatrix} 4 \\ 2 \\ 1 \end{pmatrix} - 2\begin{pmatrix} -1 \\ -2 \\ -3 \end{pmatrix} + \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 7 \\ 7 \\ 8 \end{pmatrix}$

$-2\mathbf{u} - \mathbf{v} + \mathbf{e} =$ not possible

b. Compute the following inner products, if possible:

$\mathbf{u}^T\mathbf{v} = -13$ $\quad$ $\mathbf{x}^T\mathbf{u} =$ not possible $\quad$ $\mathbf{v}^T\mathbf{x} =$ not possible

$\mathbf{x}^T\mathbf{x} = 21$ $\quad$ $\mathbf{x}^T\mathbf{e} = 7$ $\quad$ $\mathbf{e}^T\mathbf{v} =$ not possible

$\mathbf{e}^T\mathbf{y} = -6$ $\quad$ $\mathbf{y}^T\mathbf{e} = -6$

c. What happens when you multiply a vector by $\mathbf{e}$?

* The result is the sum of elements in that vector *

d. What happens when you take the inner product of a vector with itself (as in $\mathbf{x}^T\mathbf{x}$)?

* The result is the sum of squared elements in that vector *