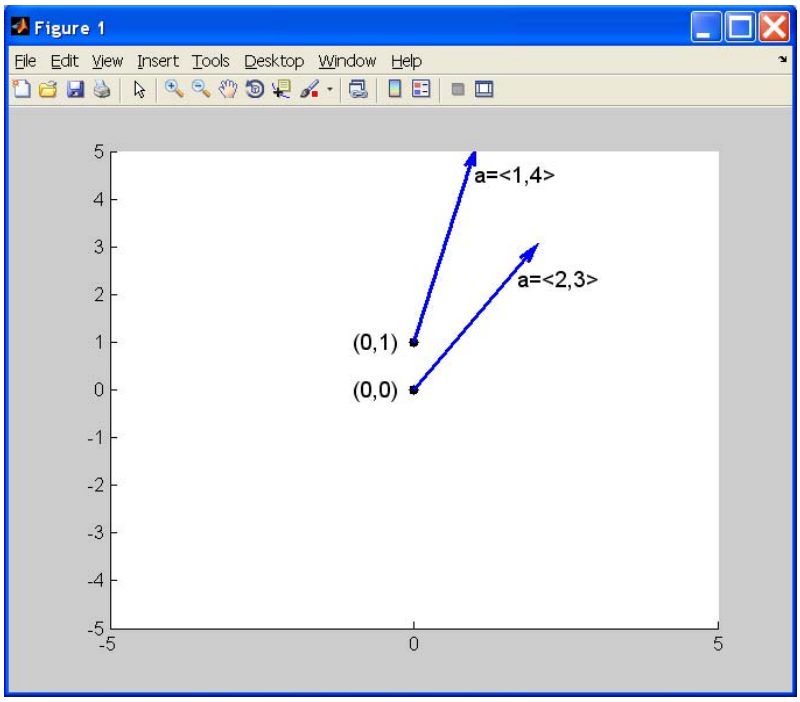
MA 280-Assignment #1: VECTORS AND THE GEOMETRY OF SPACE- Part I

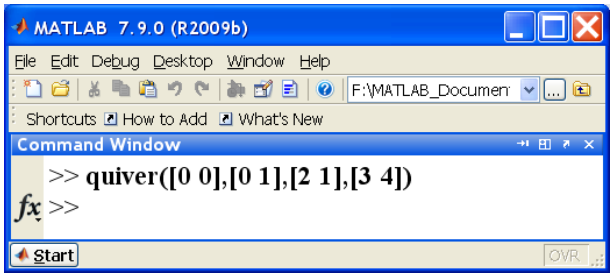
The **quiver** command allows us to draw vectors in the plane R^2:

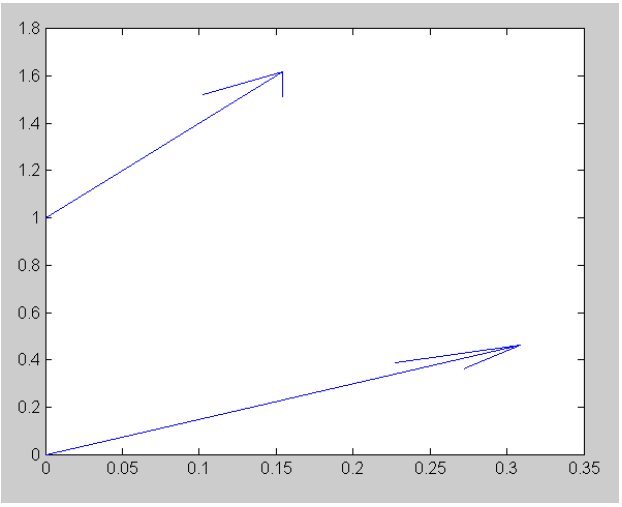


For instance, if we wish to draw the two vectors a $= < 2,3 >$ and $b = < 1,4 >$ and place them at the points $(0, 0)$ and $(0, 1)$ in R^2, then we form the following four matrices:

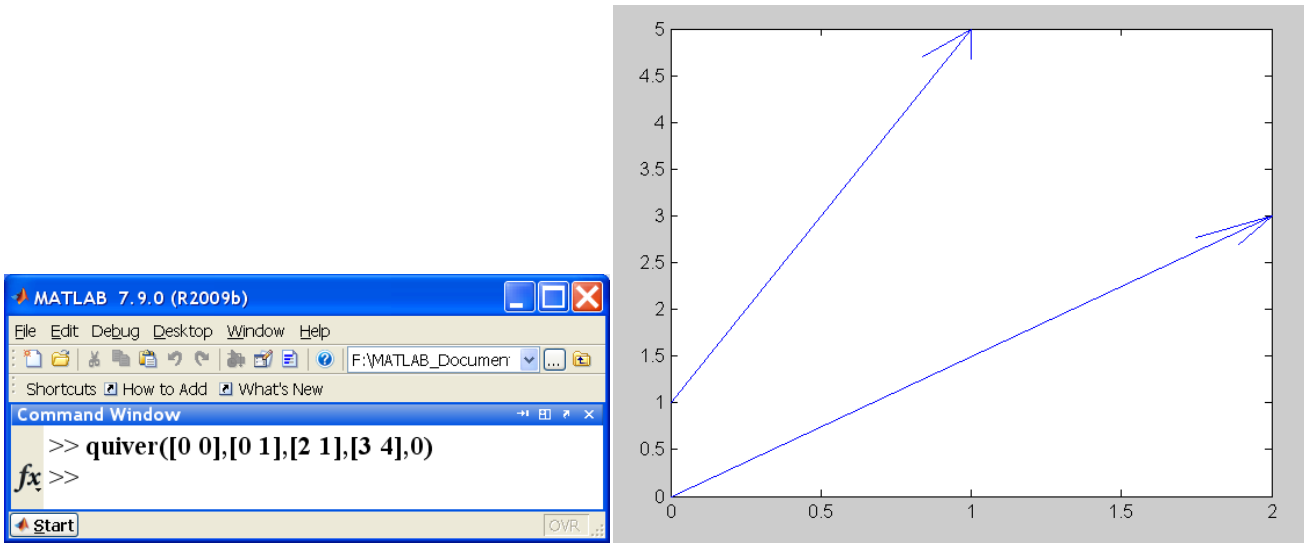
1. The x-positions matrix: [0,0]
2. The y-positions matrix: [0,1]
3. The x-components matrix: [2,1]
4. The y-components matrix: [3,4]

If we type "quiver([0 0],[0 1],[2 1],[3 4])" in the command window, we see



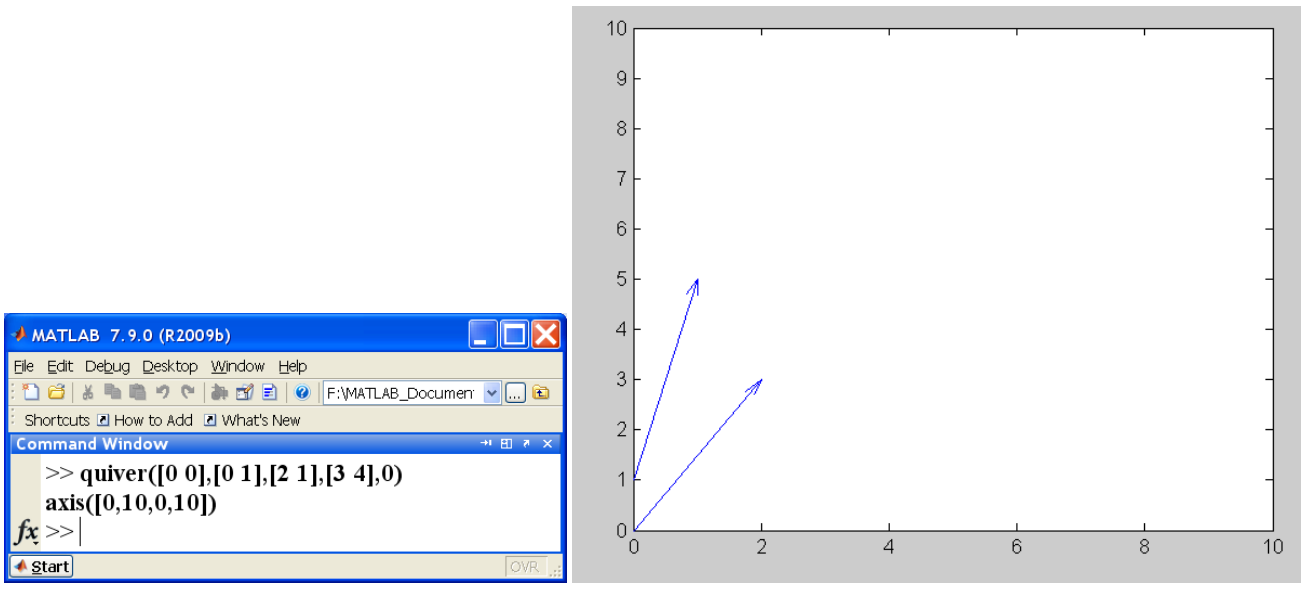


Note that MATLAB automatically scales vectors so that they do not overlap. To prevent MATLAB from scaling vectors we add a zero to the script:

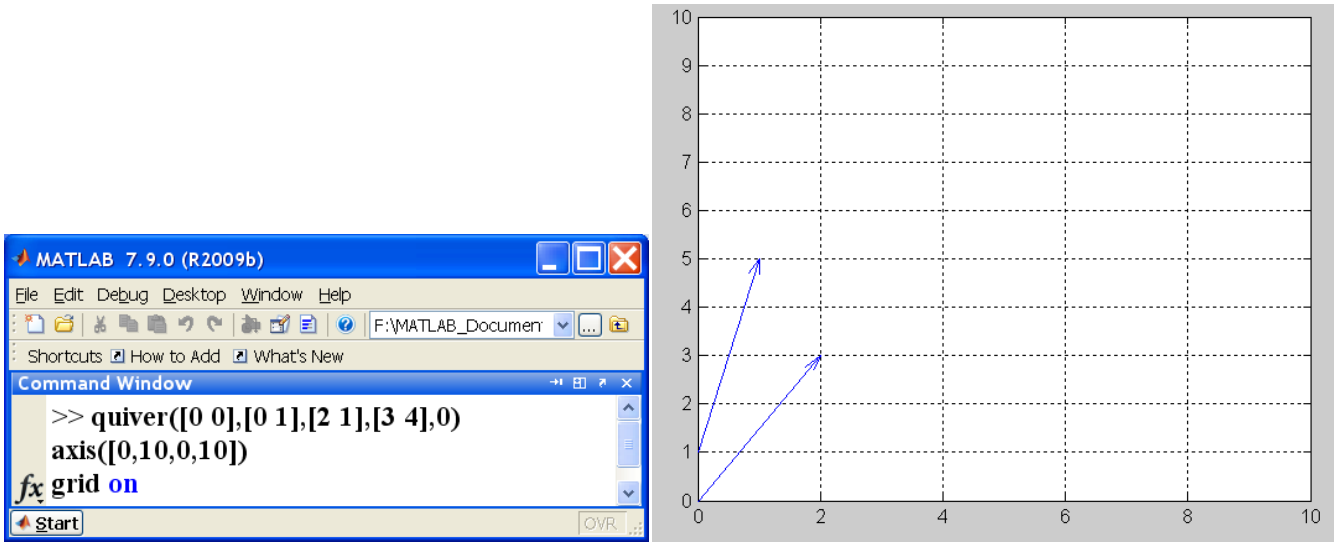


We can use the command axis to request that MATLAB draw the vectors and display them on a specific window.

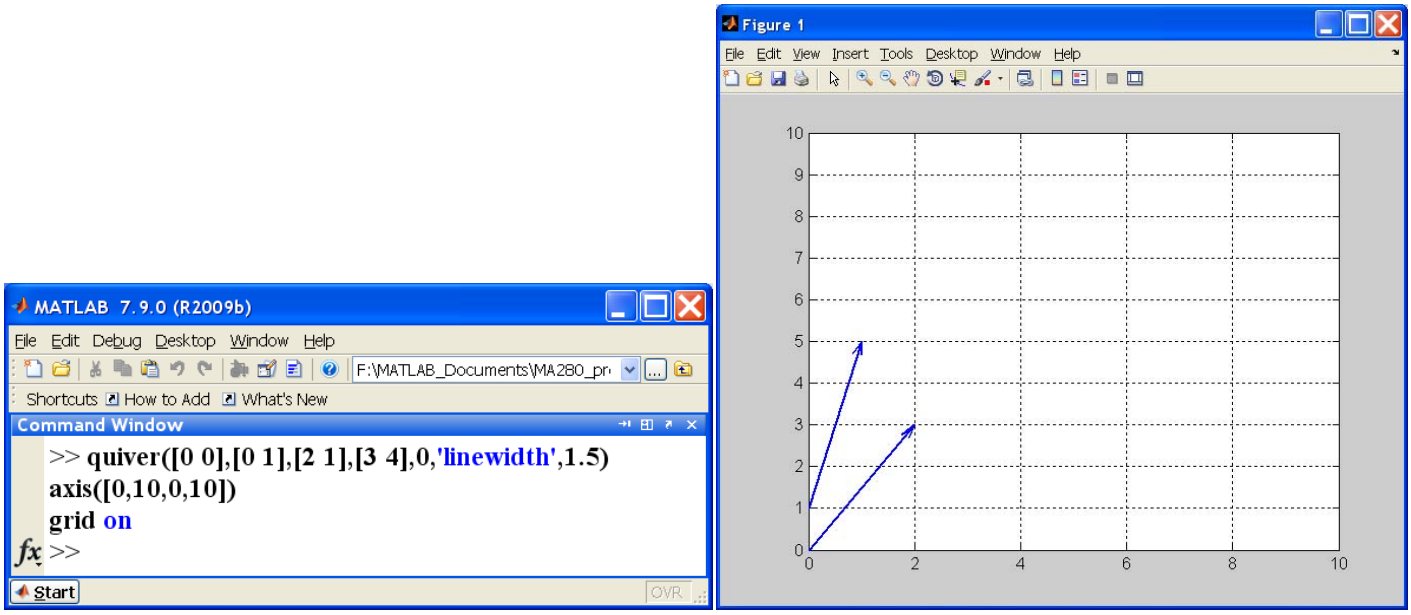
In this example we draw the vectors A and B and display them on the window $0 \leq x \leq 10, 0 \leq y \leq 10$:



To display a grid, simply type "**grid on**":



We can use the command "linewidth" to change the width of the vectors; in this example we multiply the original length by 1.5:



Important Remark

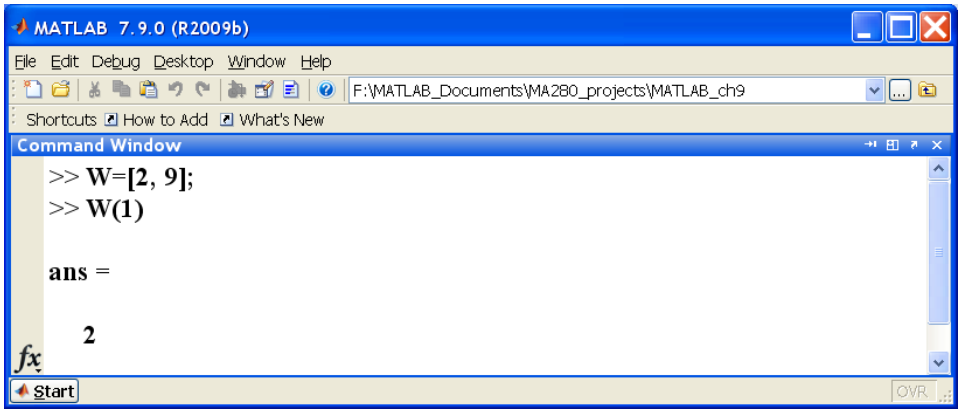
To draw a single vector $a =< a_1, a_2 >$ and place it at the point $x = (x_1, x_2)$, type

$quiver([x_1, x_1], [x_2, x_2], [a_1, a_1], [a_2, a_2])$; that is we draw the vector $a =< a_1, a_2 >$ twice.

Example

Let $A(1,1), B(1,4), C(2,5)$ be three points in R^2. Let $\vec{u}$ be the sum of the vectors $\overrightarrow{AB}$ and $\overrightarrow{AC}$ that is $\vec{u} = \overrightarrow{AB} + \overrightarrow{AC}$. We would like to draw the vectors $\overrightarrow{AB}, \overrightarrow{AC}, and\ \vec{u}$ and display them on the same figure.

First, we note that if $W = [w_1, w_2]$ then MATLAB assumes that $W(1) = w_1\ and\ W(2) = w_2$. As an example, if $W = [2, 9]$ then typing $W(1)$ displays 2 which is the first component of the vector W:

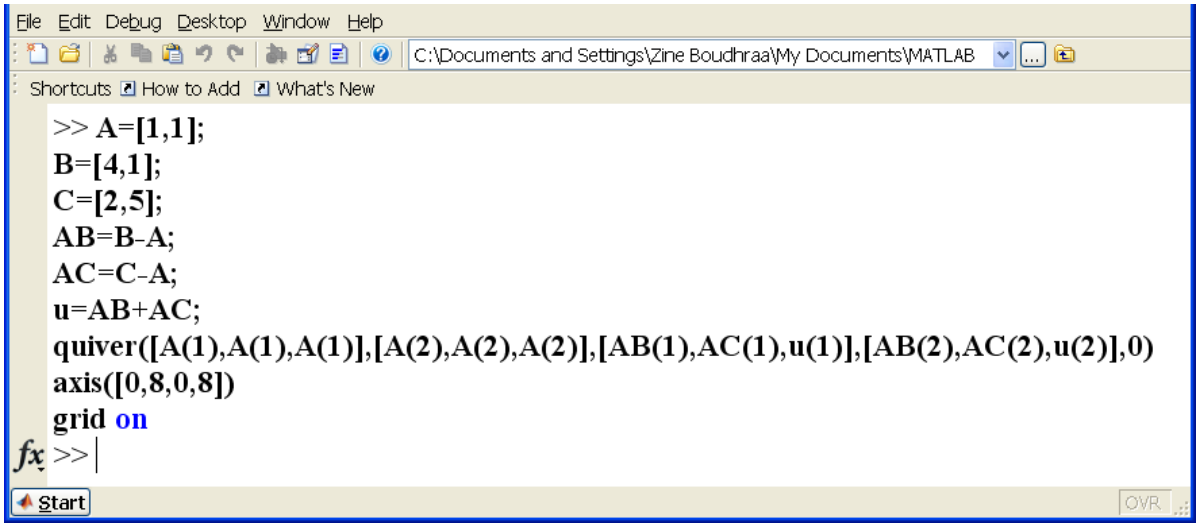


At this point we need to introduce a notation that can be understood by MATLAB. The points $A(1,1)$, $B(1,4)$, and $C(2,5)$ will be introduced to MATLAB by typing A = [1, 1], B = [4, 1], and C = [2, 5].

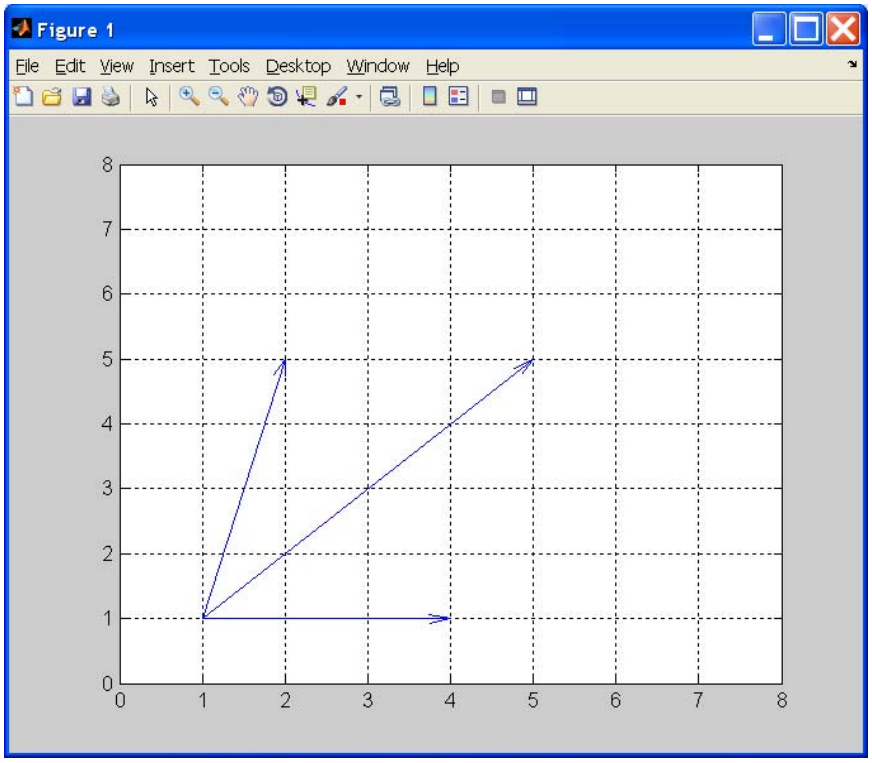
Using this notation, the vectors $\boldsymbol{AB}$ and $\boldsymbol{AC}$ are given by $\boldsymbol{AB} = B - A\ and\ \boldsymbol{AC} = C - A$ respectively.

Next we need to plan for the positions and components matrices.

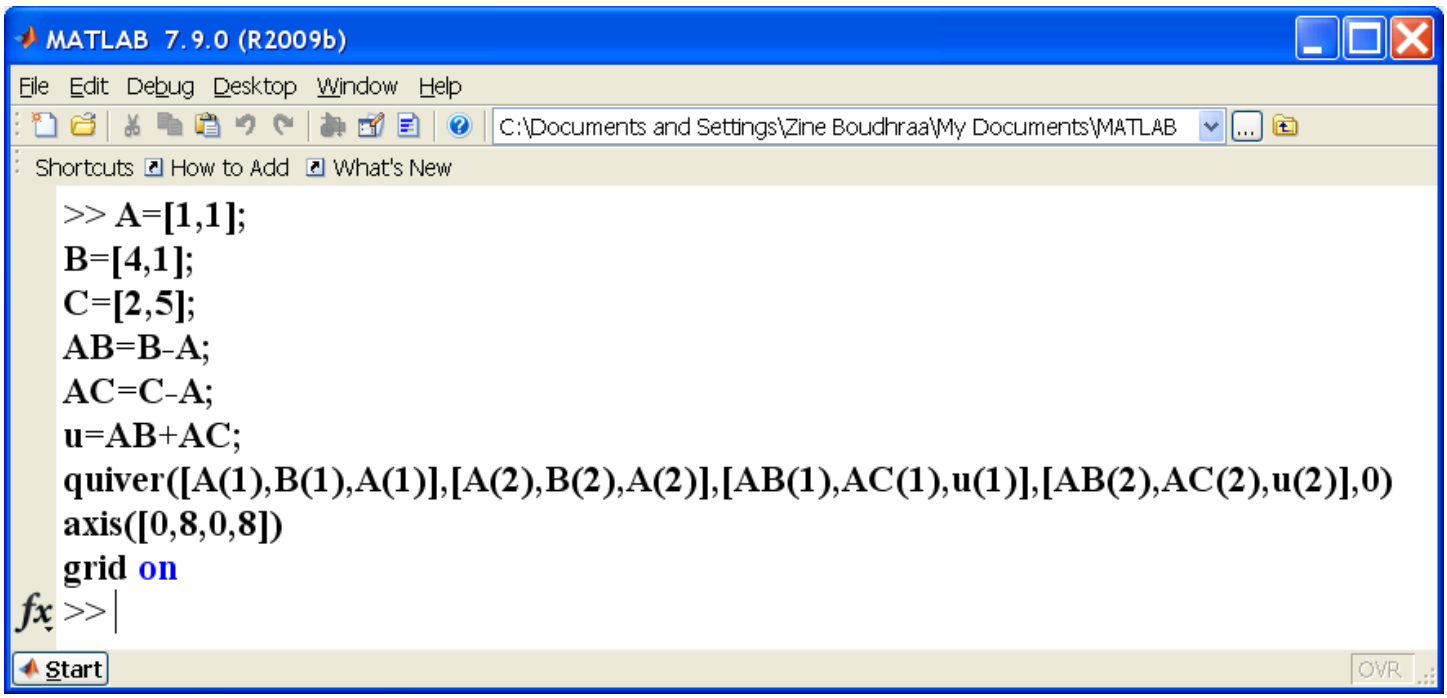
1. The tails of the three vectors $\overrightarrow{AB}, \overrightarrow{AC}, and\ \vec{u}$ is the point $A(1,1) \equiv [1,1]$, hence the x-positions matrix is $[A(1), A(1), A(1)]$.
2. Similarly the matrix of the y-positions is $[A(2), A(2), A(2)]$
3. The x-components matrix is: $[AB(1), AC(1), u(1)]$
4. The y-components matrix is: $[AB(2), AC(2), u(2)]$

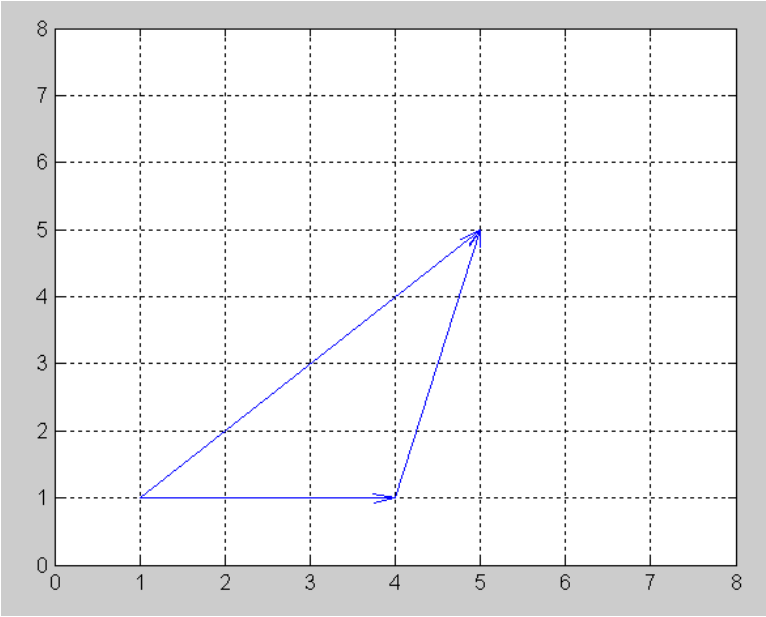


If you run the above script MATLAB will generate the following figure:



Alternatively, we could place the tail of $\overrightarrow{AC}$ at the tip of $\overrightarrow{AB}$ (which is the point B):





Exercise MA 280-1 (Solution at the end of document)

Let $A(1,1), B(1,4), and\ C(2,5)$.

1. Use MATLAB to draw the vectors $\overrightarrow{AB}, \overrightarrow{AC}, and\ \vec{v} = \overrightarrow{AB} - \overrightarrow{AC}$. The three vectors must be placed at the point A.
2. Use MATLAB to draw the vectors $\overrightarrow{AB}, -\overrightarrow{AC}, and\ \vec{v} = \overrightarrow{AB} - \overrightarrow{AC}$. The three vectors must be placed at the point A.
3. Use MATLAB to draw the vectors $\overrightarrow{AB}, \overrightarrow{AC}, and\ \vec{v} = \overrightarrow{AB} - \overrightarrow{AC}$ with the tail of $\vec{v}$ placed at the head of $\overrightarrow{AC}$.