Math 341 ASSIGNMENT 4, WINTER 2017 **Due at the start of class on Friday, February 3rd**

1. The point of this is to determine a projection matrix $P = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ that projects all vectors onto the line with equation $y = -\frac{3}{2}x$.

   (a) Sketch the line accurately and then give a vector $\mathbf{u}$ (label it as such on your paper!) that is on the line, and a vector $\mathbf{v}$ that is perpendicular to the line.

   (b) Tell what $P\mathbf{u}$ and $P\mathbf{v}$ should be, labeling each as such.

   (c) Multiply $P = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ by your $\mathbf{u}$ and set the result equal to what you said $P\mathbf{u}$ should be. This gives you two linear equations, one in a and b, the other in c and d. Give them both clearly.

   (d) Repeat (b) for the vector $\mathbf{v}$.

   (e) Give the system of two equations for a and b, and **solve for** b **by hand, using the addition method** and giving your answer in exact (fraction) form. This is just to convince me that you can do this!

   (f) Solve the system of two equations for a and b with your calculator or an online tool that will give exact answers. (You can just go to *Wolfram Alpha* and type in the two equations, separated by a comma.)

   (g) Give the system of equations in c and d and its exact solution, again using technology to find it.

   (h) Give the matrix P and test it by letting it act on a few vectors, using the *UCSMP Polygon Plotter* that you used in class on Monday. If it doesn't work as advertised, find and correct your error!

   (i) **Challenge:** Note that the line $y = -\frac{3}{2}x$ goes through the origin and the point $(-2, 3)$. Look for patterns in your matrix P involving those two numbers, and then try giving a matrix P that will project vectors onto a line through the origin and an arbitrary point (a, b).

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