Math 341 CLASS EXERCISES **16 March 2017**

1. The matrix A projects all vectors onto the line through the origin and the point $(1, 2)$.

   (a) Give a nonzero vector $\mathbf{u}$ for which you know $A\mathbf{u}$. It is an eigenvector - what is the corresponding eigenvalue?

   (b) Give another nonzero vector $\mathbf{v}$ *that is not a scalar multiple of* $\mathbf{u}$ that is an eigenvector. What is its eigenvalue? (**HINT:** The zero vector is not allowed as an eigenvector, but the number zero *CAN* be an eigenvalue.

   (c) Give the matrices P and D for A, and calculate $A = PDP^{-1}$.

   (d) Test your matrix on a vector that is not on the line.

2. Give bases (the plural of basis) for the column space and null space of $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \end{bmatrix}$.