Use Python and Matlab for all questions below (unless some derivation is required which you can do better by hand). If using Python, use Jupyter notebook to format properly, comment when necessary, and include all required and necessary outputs (Jupyter allows LATEX embedding which would be great if you could use it). Convert the notebook to pdf and upload to blackboard against the assignment. If using MATLAB, use MATLAB publish to convert to pdf. Solution documents should be well commented.

Q1. Consider the vectors

$$\vec{A} = 2\hat{i} - 3\hat{j} + 7\hat{k}$$
$$\vec{B} = -4\hat{i} + \hat{j}$$
$$\vec{C} = 5\hat{i} - \hat{j} + 9\hat{k}$$
$$\vec{D} = 2\hat{k}$$

Find

(a) $\vec{A} \cdot \vec{B}$ and $\vec{C} \cdot \vec{D}$
(b) The angles which $\vec{A} \times \vec{B}$ makes with the x, y, z axes
(c) Unit vector in the direction of $\vec{B} \times \vec{D}$
(d) The vector with the largest magnitude

Useful functions:
python: numpy.linalg.norm, numpy.cross, numpy.arccos, numpy.dot
matlab: norm, cross, acos, dot

Q2. Create two matrices a, b where a has at least 3 rows and at least 3 columns and b has at least 2 rows and at least 2 columns. The matrices should not be square and they should not be zero or identity. Make sure that the sizes of the matrices are such that the matrix multiplication ab can be taken.

(a) Print a, b, ab
(b) Is it possible to do the multiplication aa^T? Why or why not?
(c) Show that $(ab)^T = b^T a^T$
(d) Create two square matrices c, d of equal size and show that $(cd)^{-1} = d^{-1}c^{-1}$
(e) Show that $\left(c^{-1}\right)^T = \left(c^T\right)^{-1}$

Q3. Solve the following system of equations for the variables $x_1, ...x_5$:

$$2x_1 + .7x_2 - 3.5x_3 + 7x_4 - .5x_5 = 2$$
$$-1.2x_1 + 2.7x_2 3 - 3x_4 - 2.5x_5 = -17$$
$$x_1 + x_2 - x_3 - x_4 + x_5 = 5$$
$$2.9x_1 + 7.5x_5 = 0$$
$$1.8x_3 - 2.7x_4 - 5.5x_5 = -11$$

Show that the calculated solution is indeed correct by substituting in each equation above and making sure that the left hand side equals the right hand side.