Assignment Linear Algebra with Matlab

General Guidance *Answers:* You will be asked to write a single Matlab script, containing the code you used to solve the assignment.

Results: All of your results - figures, plots, solutions done by-hand, and written responses - should be submitted in a single pdf. Please give an answer to each question separately and attach the appropriate figures/data asked for in the question.

Submission date: Students must submit the final assignment on April 12 2019.

Question 1.

1. Use $a = rand(10)$ to create three 10×10 matrices of random entries, name A, C and D.
2. Set up a column matrix B by using the array $b = rand(1, 10)$. Solve the system $AX = B$ by using two different Matlab methods.
3. Find $(AC)^{-1}$ if exists.

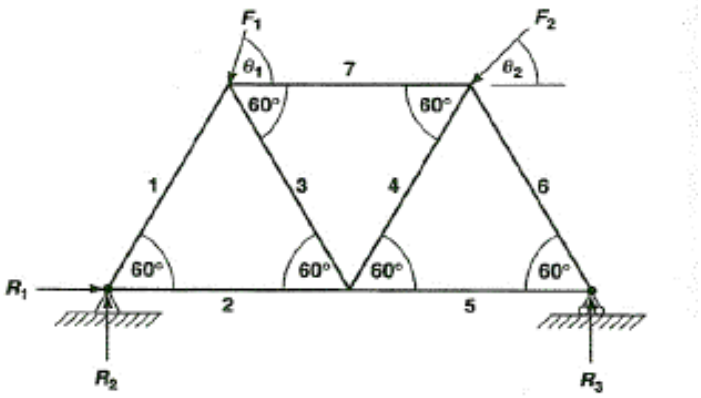
Question 2.

1. Use Matlab to compute $AC, A^{-1}C$ and C^TAC^{-1} if exists.
2. Use Matlab to test whether $CD = DC$ and $(CD)^{-1} = C^{-1}D^{-1}$.
3. Compute $(AD)^{20}$.

Question 3. Suppose we want to use MATLAB to test computationally how to expand $(2A + 3B)^2$ where A and B are $n \times n$ matrices. More precisely, suppose we want to know which of the following formulae are equal to $(2A + 3B)^2$:

1. $(3B + 2A)^2$
2. $4A^2 + 6AB + 6BA + 9B^2$
3. $(2A + 3B)(3B + 2A)$
4. $2A(2A + 3B) + 3B(2A + 3B)$

Hint: To do this, generate two 4×4 matrices with random integer entries. Once you have decided which of the above expressions are likely to be equal to $(2A + 3B)^2$, use the rules of matrix algebra to PROVE mathematical equality for all matrices regardless of size



Question 4.

The figure above shows a truss with known forces acting on it. This type of structure has forces working at every connection point to keep it at static equilibrium. Since we know the outside forces acting on it, we can solve for these internal forces at the joints. There will be two equations at every joint, one in each the x and y directions, so there will be a total of 10 equations. This means there must be ten unknowns as well that need to be solved for in order for the system of linear equations to work. We can see the three reaction forces, $R1$ through $R3$, already on the gure and from statics we know there will be a torque (T) on each of the seven braces giving you a total of ten unknowns. The two forces $F1$ and $F2$ pushing down on the truss at angles of 1 and 2 are given as $F1 = 10,000lb$ at $\theta_1 = 5\pi/12$ and $F2 = 7,000lb$ at $\theta_2 = \pi/4$. With this information we can write our equations for the forces working at each joint. Solve this system for ten unknown variables T_i and R_i.

Question 5.
Suppose we have a business operating in six cities around the Pacific Rim: San Diego, San Francisco, Tokyo, Shanghai, Manila, and Honolulu. We are interested in counting the number of ways we can travel from one city to another with at most n stopovers. We look up all the direct flights and put them in a table:

San Diego →	San Francisco
San Francisco→	San Diego, Tokyo, Shanghai, Manila, Honolulu
Tokyo →	San Francisco, Shanghai, Manila
Shanghai →	San Diego, San Francisco, Tokyo, Manila
Manila →	Tokyo, Shanghai, Honolulu
Honolulu →	San Francisco, Shanghai, Manila.

Let's say we want to get from San Diego to Manila with at most three stops along the way. For example, the trip going from San Diego through San Francisco, then Honolulu, then Shanghai, then Manila is a trip with exactly three stops.

5.1 Use Matlab to list all possible ways to get from San Diego to Manila with exactly three stops.

5.2 Use Matlab to find the number of ways to get from San Francisco to Tokyo with at most four stops. (This is not the same as finding the number of ways with exactly four stops!) Include all of your commands and output in your write-up.

Question 6.
Design a diagram of the directed graph that corresponds the following vertex matrix

$$M = \begin{bmatrix} 0 & 1 & 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}.$$

Use Matlab to compute M^4 and explain significance of different entries.