

MAE 8 - Spring 2022

Homework 2

Instructions: Follow the homework solution template. Put all answers in a MATLAB script named **hw2.m**. Submit **hw2.m** in CANVAS before 10 PM on Friday 4/15/2022. Use double precision unless otherwise stated.

Problem 1: Perform the following exercises.

- Create a 5 x 5 matrix **p1a** with a value of 5 for every element.
- Copy the matrix in part a into a new matrix **p1b**. Modify the matrix **p1b** such that all elements on the second column have a value of 0.
- Transpose the matrix in part (b) and put the answer in **p1c**.
- Rotate the matrix in part (b) 90° counterclockwise 3 times and put the answer in **p1d**.
- Are the matrices in part (c) and (d) the same? Put the answer in **p1e**. Do not use function **isequal** for this problem.

Problem 2:

- Create the following matrix and put the answer in **p2a**. Do not input element by element.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 2 & 0 & 0 & 2 & 0 & 0 & 2 & 0 & 0 & 2 & 0 \\ 0 & 0 & 3 & 3 & 0 & 0 & 0 & 0 & 3 & 3 & 0 & 0 \\ 0 & 0 & 4 & 4 & 0 & 0 & 0 & 0 & 4 & 4 & 0 & 0 \\ 0 & 5 & 0 & 0 & 5 & 0 & 0 & 5 & 0 & 0 & 5 & 0 \\ 6 & 0 & 0 & 0 & 0 & 6 & 6 & 0 & 0 & 0 & 0 & 6 \\ 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 2 & 0 & 0 & 2 & 0 & 0 & 2 & 0 & 0 & 2 & 0 \\ 0 & 0 & 3 & 3 & 0 & 0 & 0 & 0 & 3 & 3 & 0 & 0 \\ 0 & 0 & 4 & 4 & 0 & 0 & 0 & 0 & 4 & 4 & 0 & 0 \\ 0 & 5 & 0 & 0 & 5 & 0 & 0 & 5 & 0 & 0 & 5 & 0 \\ 6 & 0 & 0 & 0 & 0 & 6 & 6 & 0 & 0 & 0 & 0 & 6 \end{bmatrix}$$

- Extract the 4-by-4 submatrix on the upper left corner of the matrix and put the answer in **p2b**.
- Extract the 4-by-4 submatrix on the upper right corner of the matrix and put the answer in **p2c**.
- Extract the 4-by-4 submatrix on the lower right corner of the matrix and put the answer in **p2d**.
- Extract all the elements that are on the middle six rows and middle six columns into a 6-by-6 matrix **p2e**.
- Extract the first, third, fifth, seventh, eighth and last rows of the matrix and put them into a 6-by-12 matrix **p2f**.
- Extract the four elements at the four corners of the matrix and put them into a 2-by-2 matrix **p2g**.

Problem 3:

Let $\mathbf{x} = \mathbf{1:10}$ and $\mathbf{y} = \mathbf{10:10:100}$. Evaluate the following expressions using element-wise operations:

- (a) \mathbf{xy} . Put the answer in **p3a**.
- (b) $x^{\log_{10}(y)}$. Put the answer in **p3b**.
- (c) $\frac{\sin(y^x)}{e^{y/x}}$. Put the answer in **p3c**.
- (d) $\frac{x+e^{-y^x}}{y+\ln(xy)}$. Put the answer in **p3d**.

Problem 4:

Find the sum of the first 100 terms of the following series:

$$-1 + \frac{1}{3} - \frac{1}{5} + \frac{1}{7} - \frac{1}{9} + \dots$$

Put the answer in **p4**.

Hint: (a) Create a row vector **tmp1** having 100 elements with alternating values of -1 and 1; (b) Create a row vector **tmp2** containing the first 100 odd positive integer numbers; (c) Use function **sum** with the vectors in part (a) and (b) to obtain the sum of the series. You are not required to use this method.

Problem 5:

In the following exercises, you will use the matrices below to perform matrix algebra. The matrices have N x M dimensions, meaning N rows and M columns. Inner matrix dimensions need to match in order for the matrices to be multiplied. If MATLAB gives an error for the question asked, your answer should be a string 'error' (for example, p4a = 'error').

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \quad B = \begin{bmatrix} 7 & 8 \\ 9 & 10 \end{bmatrix} \quad C = \begin{bmatrix} 1 & 3 & 11 \\ 2 & 7 & 4 \end{bmatrix} \quad D = \begin{bmatrix} 9 & 4 \\ 8 & 5 \\ 3 & 2 \end{bmatrix}$$

- a) Compute A^2 and put the result in **p5a**.
- b) Compute $A * B$ and put the result in **p5b**.
- c) Compute $A * C$ and put the result in **p5c**.
- d) Compute $A * D$ and put the result in **p5d**.
- e) Compute $B * A$ and put the result in **p5e**.
- f) Compute $D * B$ and put the result in **p5f**.
- g) Compute $B * C$ and put the result in **p5g**.
- h) Compute $C * B$ and put the result in **p5h**.
- i) Compute D^2 and put the result in **p5i**.

j) Is $C * D$ equal to $D * C$? Put the answer in **p5j**. The answer should be a logical, look up in MATLAB **help isequal**.

Problem 6: Explore different ways to solve a linear system of equations by typing **help inv** and **help ** in command window, and then perform the following exercises.

a) Create a 3 x 3 matrix **A** with the following values and set **p6a=A**.

$$A = \begin{bmatrix} 9 & 8 & 7 \\ 6 & 9 & 7 \\ 1 & 7 & 4 \end{bmatrix}$$

b) Create a 3-element column vector **b** with values of 1, 3 and 5. Set **p6b=b**.

c) Using **** operator, solve the system of equations **Ax=b** for **x**. Set **p6c=x**.

d) Using function **inv**, solve the system of equations **Ax=b** for **x**. Set **p6d=x**.

e) Is the answer in part (c) and part (d) the same? Put the answer in **p6e**. Hint: Check by setting them equal.

f) Compute the difference between part (c) and (d) and put the answer in **p6f**.