MATLAB EXAM 1 PRACTICE PROBLEMS

NOTE: Some of the problems use materials from Chapter 4, which will not be covered in exam 1.

4.1.3 Construct matrices with the following properties. Write None if no such matrix can be constructed and explain why. (Explanation should be in the form of a matrix type equation.)

(a) Column space contains $\begin{pmatrix} 1 \\ 2 \\ -3 \end{pmatrix}$ and $\begin{pmatrix} 2 \\ -3 \\ 5 \end{pmatrix}$, nulspace contains $\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$.

(b) row space contains $\begin{pmatrix} 1 \\ 2 \\ -3 \end{pmatrix}$ and $\begin{pmatrix} 2 \\ -3 \\ 5 \end{pmatrix}$, nulspace contains $\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$.

(c) $A\mathbf{x} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$ has solution and $A^T \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$

(d) Every row is orthogonal to every column. (A is not the zero matrix.)

(e) Columns add up to a column of zeros. Rows add to a row of 1s.

Based on 4.1.32 four fundamental subspaces MATLAB challenge

(a) Suppose you are given nonzero column vectors $\mathbf{r}, \mathbf{n}, \mathbf{c}, \mathbf{l}$ in $\mathbb{R}^2$. Write a MATLAB function that determines if these vectors can form bases for the 4 fundamental subspaces, row space, nullspace, column space and left nullspace respectively, and outputs a matrix with those 4 fundamental subspaces if possible. Hint: Express matrix in terms of the vectors above.

(b) Suppose that I give you 4 matrices whose columns are all vectors in $\mathbb{R}^{10}$. $R = \begin{bmatrix} \mathbf{r}_1 & \mathbf{r}_2 & \cdots & \mathbf{r}_i \end{bmatrix}$, $N = \begin{bmatrix} \mathbf{n}_1 & \mathbf{n}_2 & \cdots & \mathbf{n}_j \end{bmatrix}$, $C = \begin{bmatrix} \mathbf{c}_1 & \mathbf{c}_2 & \cdots & \mathbf{c}_i \end{bmatrix}$, $L = \begin{bmatrix} \mathbf{l}_1 & \mathbf{l}_2 & \cdots & \mathbf{l}_n \end{bmatrix}$. The columns of R form a basis for the row space, the columns of N form a basis for the nullspace, the columns of C form a basis for the column space, and the columns of L form a basis for the left nullspace. Write a MATLAB function that will check that these vectors form the basis for the four fundamental subspaces, and outputs a matrix that has those four subspaces.

(c) Suppose that I give you 4 matrices: $R = \begin{bmatrix} \mathbf{r}_1 & \mathbf{r}_2 & \cdots & \mathbf{r}_i \end{bmatrix}$, $N = \begin{bmatrix} \mathbf{n}_1 & \mathbf{n}_2 & \cdots & \mathbf{n}_j \end{bmatrix}$, $C = \begin{bmatrix} \mathbf{c}_1 & \mathbf{c}_2 & \cdots & \mathbf{c}_m \end{bmatrix}$, $L = \begin{bmatrix} \mathbf{l}_1 & \mathbf{l}_2 & \cdots & \mathbf{l}_n \end{bmatrix}$. The dimensions are not specified. Write a MATLAB function that will check that the column vectors of R form a basis for the row space, the column vectors of N form a basis for the nullspace, the column vectors of C form a basis for the column space, and the column vectors of L form a basis for the left nullspace. If it is possible for these column vectors to form bases for the four fundamental matrices, output a matrix with those fundamental subspaces.