CS 550 Homework 4 (25 marks)

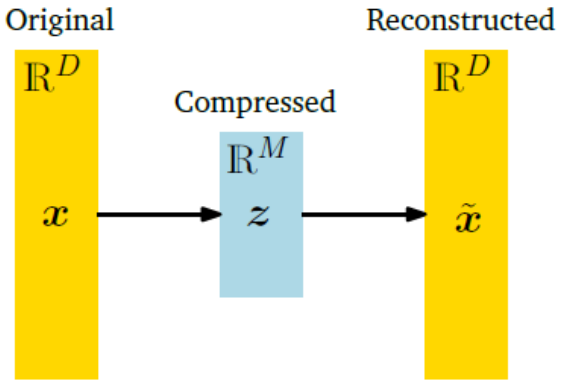
Instructions:

a. Due date is Nov 28 (hardcopy in tutorial @ 5 p.m.)
b. Please type your solutions cleanly. We won't grade hand-written answers or poorly types answers. You can use LaTeX, Word or markdown etc. to do it.
c. Code or Programming based is not acceptable. You can use a calculator.
d. Only individual attempts and original answers will get you the credits. Copying will lead to 0 marks and penalties will be imposed.

1. **(2 marks)** Find the eigenvalues and eigenvectors for $\boldsymbol{A} = \begin{bmatrix} 0.8 & 0.3 \\ 0.2 & 0.7 \end{bmatrix}$. As k increases, what will be the value of $\boldsymbol{A}^k$?
2. **(4 marks)** Suppose S is a $n \times n$ symmetric matrix, i.e., $\boldsymbol{S} = \boldsymbol{S}^T$ with eigenvalues $\lambda_1 \geq \lambda_2 \ldots \geq \lambda_n$ and orthonormal eigenvectors $v_1 \ldots v_n$.

   Then show that the maximum value of $R(x) = \frac{x^T S x}{x^T x} = \lambda_1$
3. **(4 marks)** Let A be a matrix of 4-dimensional data points

$$\boldsymbol{A} = \begin{bmatrix} 1 & 1 \\ 2 & 4 \\ 3 & 9 \\ 4 & 16 \end{bmatrix}$$



   a. Compute Eigenpairs for $\boldsymbol{A}^T\boldsymbol{A}$?
   b. What do you expect the eigenvalues of $\boldsymbol{A}\boldsymbol{A}^T$ to be?
   c. Find the eigenvectors of $\boldsymbol{A}\boldsymbol{A}^T$, using the eigenvalues from part (c).
   d. Write the 1-dimensional and 2-dimensional encodings (**z**) of columns of **A** using **PCA**.
4. **Following questions from Reinforcement Learning Book**
   a. **(3 marks) Ch 2: Exercise 2.2**
   b. **(9 marks) Ch 3: Exercise 3.4, 3.8, 3.22**
   c. **(3 marks) Ch 4: Exercise 4.8**

Note: Only chapters 2-4 of the "Barto Sutton" book are in the syllabus for Tierce 3. Do study the solved exercise problems to get more practice for the exam.