ENEE 434 Spring 2003
To Do #4

1. Use the Matlab functions [pn,meanp,stdp] = prestd(p) and [ptrans,transMat] = prepca(pn,0.01) on the following training set:

$$p1=\begin{bmatrix}1.1\\5.3\\-0.7\\0.3\\2.4\end{bmatrix}, p2=\begin{bmatrix}-1.1\\-5.3\\-0.7,\\0.3\\2.4\end{bmatrix}, p3=\begin{bmatrix}2.4\\0.3\\-0.7\\5.3\\1.1\end{bmatrix}, p4=\begin{bmatrix}-2.4\\-0.3\\-0.7\\5.3\\1.1\end{bmatrix}, p5=\begin{bmatrix}3.2\\-3.2\\0.7\\1.5\\-1.5\end{bmatrix}, p6=\begin{bmatrix}-3.2\\3.2\\0.7\\1.5\\-1.5\end{bmatrix}, p7=\begin{bmatrix}0.2\\0.5\\0.7\\0.9\\-1.1\end{bmatrix}$$

Then apply the transMat to the following vectors to be considered as data to be classified:

$$p1=\begin{bmatrix}1.5\\5.6\\-0.8\\0.3\\2.4\end{bmatrix}, p2=\begin{bmatrix}-1.1\\-5.3\\-0.8,\\0.4\\1.4\end{bmatrix}, p3=\begin{bmatrix}2.9\\0.7\\-0.7\\4.4\\-1.3\end{bmatrix},$$

Also perform a singular valued decomposition on the matrix P=[p1,p2,p3,p4,p5,p6,p7].

2. For the following matrix

$$A=\begin{bmatrix}1&-1&0&0&0\\-1&1&-1&0&0\\0&-1&1&-1&0\\0&0&-1&1&-1\\0&0&0&-1&1\end{bmatrix}$$

a. Find the SVD (singular valued decomposition)
b. Is A symmetric? Positive semidefinite?
c. Prove that A is singular. What is the rank of A?
d. Throw away the zero singular values and write the matrix as a product of three matrices with the middle one diagonal with no zero diagonal entries.

3. Change all diagonal entries of A to 2 and call the result A_5. For A_5 find the svd. Note that this matrix is nonsingular (for those interested it is the Cartan matrix A_5 of simple Lie algebra theory). In A_5 change the –1 in the last row to –2 and call the result C_5 and find the svd (for those interested it again is a Cartan matrix).

4. Let

$$A_2=\begin{bmatrix}2&-1\\-1&2\end{bmatrix}, A_3=\begin{bmatrix}2&-1&0\\-1&2&-1\\0&-1&2\end{bmatrix}, A_4=\begin{bmatrix}2&-1&0&0\\-1&2&-1&0\\0&-1&2&-1\\0&0&-1&2\end{bmatrix}$$

$$A_n = \begin{bmatrix} A_{n-1} & \begin{bmatrix} \underline{0} \\ -1 \end{bmatrix} \\ \begin{bmatrix} \underline{0} & -1 \end{bmatrix} & 2 \end{bmatrix}$$

Find the SVD for several of these in order and see if there is a pattern.

See if there is a means to find the SVD of A_n from that of A_{n-1}. How about for C_n from A_{n-1} where

$$C_n = \begin{bmatrix} A_{n-1} & \begin{bmatrix} \underline{0} \\ -1 \end{bmatrix} \\ \begin{bmatrix} \underline{0} & -2 \end{bmatrix} & 2 \end{bmatrix}?$$

5. Find the SVD for the following matrices:

$$A = \begin{bmatrix} 0 & 2.2 & -1.1 & -3.3 & -4.4 \\ 1.1 & 3.3 & -2.2 & 4.4 & 5.5 \end{bmatrix}, \quad B = A' = \text{transpose of } A$$