School of Computing
National University of Singapore
CS4243 Computer Vision and Pattern Recognition
Semester 1, AY 2013/14

Assignment
(due date: 12noon 13th Sep 2013)

Objectives:

- To experiment with properties of maths learned in class using Python.

Q1 Let a 3x3 matrix A be the following

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

1.1 Print out the determinant of A
hint: Remember to add "import numpy.linalg as la" at the beginning of the program. Then you can use la.det(A) to find out the determinant of A

1.2 Print out the rank of A
hint: la.matrix_rank(A)

1.3 Print out the inverse of A
hint: la.inv(A)

1.4 Print out the following (note that floating point numbers are to be formatted to display up to 4 decimal places as shown below):

cross product between first row and second row of A = x.xxxx x.xxxx x.xxxx
cross product between first row and third row of A = x.xxxx x.xxxx x.xxxx
cross product between second row and third row of A = x.xxxx x.xxxx x.xxxx
cross product between first row and first row of A = x.xxxx x.xxxx x.xxxx
cross product between second and second row of A = x.xxxx x.xxxx x.xxxx
cross product between third row and third row of A = x.xxxx x.xxxx x.xxxx

hint: format your output using eg. print "cross product ... = %8.4f %8.4f %8.4f \n" % (firstFloat, secondFloat, thirdFloat)

Print also the following:

The first and second rows of A are (orthogonal / parallel)* to each other.
The first and third rows of A are (orthogonal / parallel)* to each other.
The second and third rows of A are (orthogonal / parallel)* to each other.

1.5 Print out the eigenvalues of A.
Print out the eigenvectors of A.
hint: la.eig(A)

1.6 Perform a Singular Value Decomposition (SVD) of the matrix A.
Print out the singular values.
Print out the matrix U.
Print out the matrix V.
hint: la.svd(A)

1.7 Print out the following (note that floating point numbers are to be formatted to display up to 4 decimal places as shown below):

dot product between first column and second column of U = x.xxxx
dot product between first column and third column of U = x.xxxx
dot product between second column and third column of U = x.xxxx
dot product between first column and first column of U = x.xxxx
dot product between second column and second column of U = x.xxxx
dot product between third column and third column of U = x.xxxx
dot product between first column and second column of V = x.xxxx
dot product between first column and third column of V = x.xxxx
dot product between second column and third column of V = x.xxxx
dot product between first column and first column of V = x.xxxx
dot product between second column and second column of V = x.xxxx
dot product between third column and third column of V = x.xxxx

* Choose an appropriate answer

Q2 Let a 3x3 matrix A be the following

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

2.1 Repeat steps 1.1 to 1.7 in Q1, except 1.3 and 1.4.

2.2 What is the null space of A?

2.3 If A x = b, and b is a zero vector, what is x ?

Q3 Let a 3x3 matrix A be the following

$$A = \begin{bmatrix} 10 & 0 & 0 \\ 0 & 10 & 0 \\ 0 & 0 & 0.0001 \end{bmatrix}$$

3.1 Print out the determinant of A

3.2 Print out the rank of A using *la.matrix_rank(A)*

3.3 Print out the singular values of A

3.4 Refering to results of 3.2 and 3.3.
For practical purposes, what do you think should be the rank of A ?

Submit the following to IVLE by 13th Sep 2013 12noon:

Softcopy of a directory containing the following:
1. Your Python program.
2. Your answers in a Microsoft Word document.

Remember to use the same naming convention as in our lab.