in the name of god

**Computer exercise number 1, statistical pattern recognition lesson**   **Yazd University - Spring 1403**

Answer the following questions in the fileWrite an attachment. Make sure that the answer to each question is in the section related to the same question in the notebook be

written

Pay attention to the explanations written in each section.

1. Write a program that takes the radius of the sphere shown below as input and calculates the volume of the area outside the sphere and inside the cube

Calculate 6 decimal digits and declare as output.
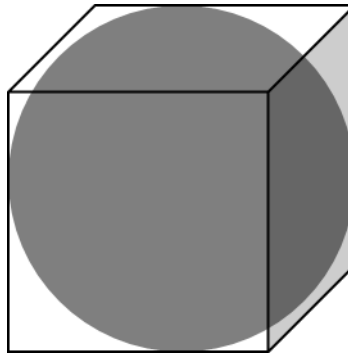
2. Write a program that asks the user to enter a positive integer that is the time in days, and then the program, Convert and

announce the entered time into year, month, week, day and hour.

3. Two matricesAnd again consider Numpy as below and perform the following operations once using library B and A Without

using the ready function of that operation in.do, Numpy

$$\begin{matrix} 6 & 2 & 5 \\ 7 & 6 & = 5 \\ 4 & 6 & 7 \end{matrix} \qquad \begin{matrix} 3 & 2 & 1 \\ 5 & 4 & = 3 \\ 4 & 6 & 7 \end{matrix}$$

A) matrix multiplication between two matricesCompute the for once without using and once using B and A

loops b) Determinants of the matrixGet A

4. Consider the two matrices from the previous section and use the prepared functions

:Numpy a) Calculate the outer product of two matrices b) Calculate the inner product

of two matrices.

c) Inverse of two matricesObtain B and A

d) ValuesObtain B and A for the two eigenvalue matrices

5. Using librariesA sigmoid function for values   between Matplotlib and NumpyDraw 10 to 10 with a distance of 0.2.

6. First, using the sectionNumpy collection of random libraryGenerate 10000 samples of random numbers with Gaussian distribution with mean 10 and variance 1. Then, according to that, write the following programs:

A) Histogram of the numbers produced in the previous section by the library.Plot Matplotlib

b) using the commandSelect two hundred random samples from the first vector in the Numpy sample library c) Draw the histogram of the sampled numbers and discuss its difference with the histogram of part "b".

d) Generate a set of 10,000 samples of random numbers with a uniform distribution between -1 and 1 and draw its histogram. e) Multiply the set of numbers of the first vector and part "d" and draw the resulting histogram. Discuss the distribution of these data.

7. First, using the librarysave Then read according to the dataframe and in a Pandas file books.csv To the mentioned data, implement the requested items.

a) Display the first 5 data.

b) Remove the unnecessary columns and keep only the following columns

isbn, original_publication_year, original_title, authors, ratings_1, ratings_2, ratings_3, ratings_4, ratings_5

c) Change the names of the mentioned columns to the following titles.

ISBN, Publication Year, Original Title, Authors, One Star Reviews, Two Star Reviews, Three Star Reviews, Four Star Reviews, Five Star Reviews

d) Provide a simple overview and analysis of the numeric columns of the data set.

e)Save and the next questions with "book_clean.csv" another with a new .csv title in a dataframe file use of.implement new dataframe

f) The names of the authors in the "column".print "author

g) Determine how many books each author has published.

h) Identify the book that was published earlier than other books.

i) Specify the book that was published later than other books.

j) The total number of comments iname.get the datafr

8. A two-class classification problem with a two-dimensional feature vector x_1, x_2 Consider X = (ω_1 and ω_2 The two mentioned classes ω are

and

$$p(X|\omega_1) \sim N\left(\left[\begin{matrix}1\\-1\end{matrix}\right], \Sigma_1\right)$$

$$p(X|\omega_2) \sim N\left(\left[\begin{matrix}1\\0\end{matrix}\right], \Sigma_2\right)$$

$$p(\omega_1) = p(\omega_2) = \frac{1}{2}$$

so that:

$$\Sigma_2 = \left[\begin{matrix}2 & 2\\3 & 2\end{matrix}\right], \quad \Sigma_1 = \left[\begin{matrix}0 & 1\\1 & 0\end{matrix}\right]$$

Based on the above data, answer the following questions:

a) Calculate the Bayes decision boundary.

b) randomly, 50 samples from each of the conditional densities of two classes ((two class-conditional density). Draw in a 2D feature space. Also draw the decision boundary you obtained in part "A". c) Generate a thousand test patterns from each class and the error ratebased on the boundary obtained in part A. empirical calculate

9. Your botanist friend has found out that you have taken the learning course and therefore he is asking for your help. He has two types

Mushrooms have been found in the forest, one of which is highly poisonous.It contains both poison and an important medicine for the

treatment of an important disease. The difference between these two mushrooms in (Agaric Stimulantus) and the other (Agaric Moribundus).

Their chemical composition. Your friend, a series of indirect and noisy measurements of the amount of chemical substances of these two

mushrooms, i.e. poisonIt provides you with y and the active ingredient x

Based on these measurements, you can calculate the values of the two-class models.which are both Gaussian with p(x, y|2) and p(x, y|1

Calculate the following values.

$\mu_1 = (8,2)$, $\mu_2 = (2.8)$

$p(\omega_1)$, $p(\omega_2)] = [$ $\Sigma_1 = \begin{bmatrix} 0 & 4.3 \\ 3.1 & 0 \end{bmatrix}$ $\Sigma_2 = [$

a) Calculate Bayesian decision boundaries and draw them.

b) posterior probabilitiesCalculate and draw posterior probabilities