

Data Science Course Entrance Exam

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Question 1

For a positive integer n , the factorial of n is defined as the product

$$n! = n \cdot (n - 1) \dots 2 \cdot 1.$$

We also define $0! = 1$. Write a function that, given a non-negative integer n returns $n!$.

Question 2

Write a function that given two arrays A and B with integer entries returns an array

$$[(a, b) \mid a \in A \text{ and } b \in B]$$

of all pairs of elements with first element coming from array A and second element coming from array B .

For example, if $A = [1, 2]$ and $B = [10, 20, 30]$, your function should return $[(1, 10), (1, 20), (1, 30), (2, 10), (2, 20), (2, 30)]$ (or a permutation, the returned list doesn't have to be sorted in any particular way).

Question 3

Two strings are anagrams if one can be obtained from the other by a rearrangement of the order of their letters, regardless of capitalization. For example, "art" and "rat" are anagrams, as are "Debit card" and "Bad credit".

Write a function that given two strings P and Q returns **True** if they are anagrams of each other, and **False** otherwise. You may assume the strings P and Q are comprised of letters and spaces.

Question 4

Given an array **A** of real (floating point) numbers, write a function **mean(A)** returning the mean of the elements of **A**, and a function **std(A)** returning the standard deviation of the elements of **A**.

Recall that the mean of elements $A = \{A_1, \dots, A_N\}$ is given by

$$\mu_A = \frac{1}{N} \sum_{i=1}^N A_i$$

and that the standard deviation is given by

$$\sigma_A = \sqrt{\frac{1}{N} \left(\sum_{i=1}^N (A_i - \mu_A)^2 \right)}.$$

Question 5

Let **A** be an array consisting of N non-negative integers. The entry **A**[*i*] in slot $i \in \{0, \dots, N-1\}$ designates the number of observations of some event in the period between i seconds and $(i+1)$ seconds. For example, if $N = 3$ and

$$\mathbf{A}[0] = 2, \mathbf{A}[1] = 3, \text{ and } \mathbf{A}[2] = 1$$

there are 2 observations in the period between 0s and 1s, there are 3 observations in the period between 1s and 2s, and there is 1 observation in the period between 2s and 3s.

Write a function that given an array **A** as above returns an array **L** of length N such that for each $i \in \{0, \dots, N-1\}$, the entry **L**[*i*] designates the total number of events observed in the period from 0s up to $(i+1)$ s. For the array **A** given in the example above, your method should therefore return the array **L** such that

$$\mathbf{L}[0] = 2, \mathbf{L}[1] = 5, \text{ and } \mathbf{L}[2] = 6.$$