Homework 0

This is a preview of the published version of the quiz

Started: Aug 25 at 12:28pm

Quiz Instructions

These questions should test your knowledge of the necessary prerequisites for the course. If you struggle with these problems, you will likely have trouble with the course material.

Question 1

1 pts

Given vector b, matrix A, and that $b = Ax$, what do we know about vector x?

- $x = b - A$
- We don't know anything
- If A is invertible, then $x = A^{-1}b$
- $x = 0$
- If A is square, then $x = A^{\top}b$

Question 2

1 pts

Define matrix $B = bb^{\top}$, where b is a column vector that is not all zero. Which of the following must be true?

- Some of B's eigenvalues are imaginary.
- All of B's eigenvalues are zero.
- All of B's eigenvalues are nonnegative and real.
- All of B's eigenvalues are imaginary.
- All of B's eigenvalues are positive and real.

Question 3

1 pts

What is the solution to $\min_x 0.5x^2 + 3x$?

- -3
- -4.5
- 1
- -0.5
- 0

Question 4

1 pts

Suppose you have a function $d(x_1, x_2)$ that takes in two entities x_1 and x_2 and outputs a comparison or distance between the two entities. Suppose you have a set of n entities. If computing d takes constant time, what is the computational complexity in running time of computing the distances for all pairs of entities?

- $O(1)$
- $O(2^n)$
- $O(n \log n)$
- $O(n)$
- $O(n^2)$

Question 5

1 pts

What is $\ln(\exp(-1000))$?

- -1000
- 0

- $\frac{1}{1000}$
- The answer is undefined.
- -3

Question 6

1 pts

If you have two standard six-sided dice, each with uniform probability of landing on each counting number from 1 to 6. What is the probability of rolling doubles (both dice landing on the same number)?

- 1/12
- 1/6
- 6
- 1.0
- 1/36

Question 7

1 pts

Consider the following Python code:

```
import numpy as np

n = 10
x = np.zeros((n,1))
for i in range(n):
    for j in range(i, n):
        x[i] = x[i] + 1
```

After the end of this loop, what is the value of x?

- [0 0 0 0 0 0 0 0 0 0]
-

[10 10 10 10 10 10 10 10]

- [1 2 3 4 5 6 7 8 9 10]
- [1 1 1 1 1 1 1 1 1 1]
- [10 9 8 7 6 5 4 3 2 1]

Question 8

1 pts

Rank the following computational cost growth rates from least expensive to most expensive: O(n log n), O(2^n), O(10^n), O(log n), O(n^3), O(1), O(n^2), and O(n).

Least expensive	[Choose]
2nd least expensive	[Choose]
3rd least expensive	[Choose]
4th least expensive	[Choose]
5th least expensive	[Choose]
6th least expensive	[Choose]
7th least expensive	[Choose]
Most expensive	[Choose]

Question 9

1 pts

In (American) roulette, you bet on where a ball will land on a wheel containing 38 numbers, from 1 to 36 and 0 and 00. Each number from 1 to 36 is colored alternating red and black, so that there are 18 red numbers and 18 black numbers. The 0 and 00 are neither color. If you bet on a color and the ball lands on a number with that color, you double your bet. For example, if you bet $5 on red, and the ball lands on 1, which is red, you keep your $5 bet and win an additional $5. If instead the ball lands on 2, which is black, or 0 or 00, which are neither color, you lose the $5 you bet.

You see a billionaire at the table with you place a $1,000,000 bet on black. What is the expected value of their investment?

- They will have an expected loss of $526,315.79
- They will have an expected gain of $473,684.21
- They will have an expected gain of $1,000,000
- They will break even in expectation (a loss or gain of $0)
- They will have an expected loss of $52631.58

Question 10

1 pts

We have two Bernoulli random variables X and Y. Suppose we know that $\Pr(x) = 0.3$, and $\Pr(y) = 0.9$. Given this information, what do we know about $\Pr(X = \text{true} \mid Y = \text{false})$?

- All we know is that it is a valid probability between 0 and 1.0
- $\Pr(X = \text{true} \mid Y = \text{false}) = 0.3 \times 0.1 = 0.03$
- $\Pr(X = \text{true} \mid Y = \text{false}) = 0.3 / 0.1 = 3.0$
- $\Pr(X = \text{true} \mid Y = \text{false}) \leq 0.3$
- $\Pr(X = \text{true} \mid Y = \text{false}) = 0.3$

Question 11

1 pts

Suppose you have a 5 by 4 matrix **x** and a 4 by 1 vector **y**

```
>>> x.shape
(5, 4)
>>> a.shape
(4, 1)
```

Which of these commands computes the inner product between y and the 3rd row of x?

- x[2,:] * a
- x[2,:].dot(a)
- x * y
- np.sum(x * y)
- x[2,:].T * a

Question 12

1 pts

A random variable x in a standard normal distribution has the probability density $p(x) = \frac{1}{\sqrt{2\pi}}\exp(-x^2/2)$. Evaluate the integral $\int_{-\infty}^{\infty} p(x)(ax^2 + bx + c)dx$.

Hint: this is not a calculus question. Think about statistical quantities you have studied.

- 1
- 2a + b
- c
- a + c
- b+c

Not saved

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