CS 506 Prerequisites Exam

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1 Calculus

1. The rate of change of $f(x) = 3x$ is constant meaning that at every point the rate of change is the same.
   A. True
   B. False
   C. I don't know
2. The rate of change of a constant function is constant.
   A. True
   B. False
   C. I don't know
3. The rate of change of $f(x) = x^2$ depends on where you are on the function (i.e. it depends on x).
   A. True
   B. False
   C. I don't know

2 Probability

4. What is the probability of seeing 2 Heads in 3 flips of a fair coin?
   A. 5/8
   B. 3/8
   C. 1/2
   D. I don't know
5. You flip a fair coin every second. What is the expected time to the next Heads?

A. 1s

B. 2s

C. 3s

D. I don't know

6. Same scenario as the previous question. To figure out the probability the coin falls on Heads 30 times in a minute, you will need:

   A. The Binomial Distribution

   B. The Normal Distribution

   C. The Poisson Distribution

   D. I don't know

7. Let's say you can flip the coin ultra fast (at infinitessimally small intervals) but the rate is still 30 Heads per minute. To figure out the probability the coin falls on Heads 30 times in a minute, you will need:

   A. The Binomial Distribution

   B. The Normal Distribution

   C. The Poisson Distribution

   D. I don't know

8. You collect the average observed number of Heads every minute. These averages behave like:

   A. A Binomial Distribution

   B. A Normal Distribution

   C. A Poisson Distribution

   D. I don't know

9. A random variable X follows a geometric distribution with success probability p. What is the variance of X?

   A. $\frac{1-p}{p}$

   B. $\frac{1-p}{p^2}$

   C. $\frac{p}{1-p}$

   D. $\frac{1}{p^2}$

   E. I don't know

3 Linear Algebra

10. What is the determinant of the following matrix:

$$\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 3 \\ 3 & 6 & 6 \end{bmatrix}$$

A. 0

B. 1

C. 2

D. I don't know

11. What is the rank of the following matrix:

$$\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 3 \\ 3 & 6 & 6 \end{bmatrix}$$

A. 0

B. 1

C. 2

D. I don't know

12. What is the dimension of the resulting matrix from:

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \end{bmatrix} \times \begin{bmatrix} 4 & 5 \\ 6 & 7 \end{bmatrix}$$

A. 2×2

B. 3×2

C. 2×3

D. 3×3

E. It's just a number (scalar)

F. I don't know

13. Let A be a 3×3 real matrix such that $A^T A = I$, where I is the identity matrix. What can be said about the eigenvalues of A?

A. All eigenvalues are 1 or -1.

B. All eigenvalues lie on the unit circle in the complex plane.

C. Eigenvalues can be any real number.

D. Eigenvalues must all be real and positive.

E. I don't know

4 Programming

14. What is the output of this code?

```
account_balance = 100
if account_balance > 0:
    print("You still have money")
if account_balance < 0:
    print("You are in debt")
else:
    print("You have no money")
```

A. "You still have money"

B. "You are in debt"

C. "You have no money"

D. A and B

E. A and C

F. I don't know

15. What is the output of this code?

```
class Bank:
    def __init__(self, balance):
      self.balance = balance

    def is_overdrawn(self):
      return self.balance < 0

myBank = Bank(100)
if myBank.is_overdrawn :
  print("OVERDRAWN")
else:
  print("ALL GOOD")
```

A. "ALL GOOD"

B. "OVERDRAWN"

C. I don't know

16. What is the output of the following code?

```
def mystery(num):
    count = 0
    prev = 0
    next = 1
    while count <= num:
        prev, next = next, next + prev
        count += 1
    return next

print(mystery(10))
```

A. 10

B. 55

C. 144

D. 233

E. I don't know