Northeastern University
CS 4180/5180 – Reinforcement Learning and Decision Making
Fall 2019, Chris Amato

Self Test

Name: _____

Problem	Points
1. Bayes' Rule	/0
2. Probability Distributions	/0
3. Discrete Expectation	/0
4. Expectation Properties	/0
5. Derivatives	/0
6. Matrices/Linear Equations	/0
7. Matrices	/0
Total	/0

Instructions

- This assignment will not be graded for correctness
- Use this as an opportunity to self-assess your math background and self-study as appropriate.

(0 pts.) 1. Bayes' Rule

The Weatherly app predicts rain tomorrow. In recent years, it has rained only 73 days each year. When it actually rains, the Weatherly app correctly forecasts rain 70% of the time. When it doesn't rain, the app incorrectly forecasts rain 30% of the time. What is the probability that it will rain tomorrow?

Hint: $P(H|D) = \frac{P(H)P(D|H)}{P(D)}$

(0 pts.) 2. Probability Distributions

Given the following probability density function (PDF) of a random variable x ...

$$p(x) = \begin{cases} 4x & 0 \leq x \leq \frac{1}{2} \\ -4x + 4 & \frac{1}{2} \leq x \leq 1 \end{cases}$$

What is the equation and graph of the corresponding cumulative density function (CDF)?

(0 pts.) 3. Discrete Expectation

Calculate the expected value of X, $E[X]$, where X is a random variable representing the outcome of a roll of a trick die. Use the sample space $x \in \{1, 2, 3, 4, 5, 6\}$ (i.e. six-sided die) and let

$$P(X = x) = \begin{cases} \frac{1}{2} & x = 1 \\ \frac{1}{10} & x \neq 1 \end{cases}$$

(0 pts.) 4. Expectation Properties

Use the properties of expectation to show that we can rewrite the variance of a random variable X ...

$Var[X] = E[(X - \mu)^2]$

as ...

$Var[X] = E[X^2] - (E[X])^2$

(0 pts.) 5. Derivatives

Calculate the following derivatives

$e^{x^3+5x^2}$

$3^x \log(x)$

(0 pts.) 6. Matrices/Linear Equations

Consider the following system of equations .....

$2x_1 + x_2 + x_3 = 3$
$4x_1 + 2x_3 = 10$
$2x_1 + 2x_2 = -2$

a. Write the system as a matrix equation of the form $Ax = b$.

b. Write the solution of the system as a column s and verify by matrix multiplication that $As = b$.

c. Write b as a linear combination of the columns in A.

(0 pts.) 7. Matrices

Consider the following matrix ...

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{pmatrix}$$

a. What is the determinant, $det(A)$ or $|A|$, of the matrix?

b. Is the matrix invertible?

c. What is the rank of the matrix?