CSE 5522 Homework 1: Math + Python Review

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Problem 1 (2 points)

Consider the following function:

$$f(x) = \frac{1}{1 + e^{-x}}$$

(a)

Draw a plot of $f(x)$ - what are the minimum and maximum values of f. What values of x result in the largest or smallest values of $f(x)$?

(b)

Show that the derivative of $f(x)$ can be written simply in terms of the function's value like so:

$$\frac{df(x)}{dx} = f(x)(1 - f(x))$$

Hint: start by computing the derivative of $f(x)$ using the chain rule, then re-arrange terms to get the result into the form of the answer.

Problem 2 (1 point)

Assume the following joint distribution for $P(A, B)$:

$$\begin{aligned} P(A=0, B=0) &= 0.2 \\ P(A=0, B=1) &= 0.2 \\ P(A=1, B=0) &= 0.6 \\ P(A=1, B=1) &= 0.0 \end{aligned}$$

(a) What is the marginal probability of $P(B=0)$?

(b) What is $P(A=1|B=0)$?

(c) What is $P(A=B)$?

Problem 3 (1 point)

Assume X is conditionally independent of Y given Z. Which of the following statements are always true?

(a) $P(X,Y) = P(X) + P(Y) - P(Z)$

(b) $P(X,Y,Z) = P(X) + P(Y) + P(Z)$

(c) $P(X,Y) = \sum_{c \in \mathcal{X}_Z} P(X,Y,Z=c)$

(d) $P(X,Y|Z) = P(X|Z)P(Y|Z)$

(e) $P(X,Y) = P(X)P(Y)$

Problem 5 (1 point)

Consider the following matrix, M and vector, v:

$$M = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 0 \\ 1 & 3 & 3 \end{bmatrix}, v = \begin{bmatrix} 3 \\ 0 \\ 2 \end{bmatrix}$$

Compute the following matrix-vector and vector-vector products explaining how you arrived at each answer (show your work):

(a)

$M \cdot v =$

(b)

$v^T \cdot M =$

(c)

$v^T \cdot v =$

Problem 6 (5 points)

Install Python (`https://www.python.org/`) on your machine and complete the Unix / Python / Autograder tutorial available here: `http://aritter.github.io/courses/5522_hw/project0.html`. Print out your files (`addition.py`, `buyLotsOfFruit.py` and `shopSmart.py`), in addition to a log of your shell session running the autograder to turn in with answers to the written questions above.

Survey

(a) What is your favorite programming language?

(b) What programming languages do you feel comfortable using?

(c) Are there any specific topics you would like to see covered in the class?