

CISC 5800 – Machine Learning

Homework 0

Due September 16, 2015

Highly recommend you complete by September 9, 2015

Much of this homework should be review of concepts you have learned prior to this semester in algebra, probability, and programming. New concepts on calculus and Matlab will be marked with the word **NEW**; questions on new topics are intended to be fairly basic for this homework.

A. Probability:

Consider the following joint probability table:

| A | B | P(A,B) |
|---|---|--------|
| 0 | 0 | 0.3 |
| 0 | 1 | 0.5 |
| 1 | 0 | 0.1 |
| 1 | 1 | 0.1 |

1. What is $P(A=1, B=0)$?
2. What is $P(B=0)$?
3. What is $P(A=0 | B=1)$?
4. What is $P(A=1 \text{ or } B=0)$?

Consider the following joint probability table:

| A | B | C | P(A,B,C) |
|---|---|---|----------|
| 0 | 0 | 0 | 0.02 |
| 0 | 0 | 1 | 0.10 |
| 0 | 1 | 0 | 0.06 |
| 0 | 1 | 1 | 0.02 |
| 1 | 0 | 0 | 0.08 |
| 1 | 0 | 1 | 0.40 |
| 1 | 1 | 0 | 0.24 |
| 1 | 1 | 1 | 0.08 |

5. Are variables A and B independent?
6. Are variables B and C independent?

(Potentially **NEW**)

Consider the multi-valued random variables X and Y, where X is an animal and Y is the attitude of the animal.

- X can take on the values: cat, dog, zebra, pony
- Y can take on the values: hostile, friendly, shy

Which of the following represent a single real value, and which represent a function?

7. $P(Y)$
8. $P(X=\text{dog})$
9. $P(Y|X=\text{pony})$

B. Algebra/Calculus

Express w as a function of z .

Example question: $2z=5w+3$

Example answer: $w = \frac{2z-3}{5}$

1. $z^2-2w=4z+5$
2. $5w=4(2z+w)$
3. $w^2=z^2+2w+w^2$

Consider the function $f(x)=3x-5$.

4. What is the value of $f(x)$ when $x=20$?

Consider the function $g(z)=2(z^2-3)^3$

5. What is the value of $g(z)$ when $z=2$?
6. What is the value of $g(z)$ when $z=-1$?

Calculus questions have been deleted now!

C. Programming:

Use a programming language you know to perform the following tasks. Provide the code and tell me what language you are using. I most recommend you use Matlab, C++, or Python, if you already know one of these languages. If you do not, you must e-mail me for my approval to use another language. The code for questions 2 and 3 each must use at least one loop. Do not call the pre-defined **trace** function in Matlab.

Matlab code is NOT required for this assignment, but is permitted if you wish.

Submit your code before class on September 16 by e-mail.

1. Write a function called **elfDetector** that takes in the height of a creature (in inches). The function will return 1 (meaning “true, this is an elf”) if the height is between 48 and 70 inches. The function will return 0 (meaning, “false, not an elf”) if the height is less than 48 inches (that’s the size of a hobbit) or greater than 70 inches (that’s the size of an ogre).

2. Write a function called **squareSum** that takes in a list/array/vector of numbers and returns the sum of the squares. For example, if you provide the list {2, -2, 4, 5}, the output will be **49** ($2^2+(-2)^2+4^2+5^2=49$) *Note: I earlier incorrectly said the squareSum of {2, -2, 4, 5} was 51. It actually is 49.*

3. Write a function called **trace** that takes in a two-dimensional array/list/matrix and returns the trace – the sum of the elements in the first row, first column; second row, second column; third row, third column; etc. For example, the trace of the list {{1, 2, 3}, {4, 5, 6}, {7, 8, 9}} is 15 ($1+5+9=15$). The trace of the list {{1, 2, 3, 4}, {5, 6, 7, 8}, {9, 10, 11, 12}, {13, 14, 15, 16}} is 34 ($1+6+11+18=34$). *You may assume the maximum size of the input matrix is 10 rows by 10 column.*