CSE514, Spring 2022, HW 1 Name: JIANJUN WEI Student ID: 501040
Note: This homework is worth a total of 15 points

Q1: Give two examples of the following data types:

Q1a: (2pts) Numerical and Discrete:

① the number of students in a class

② the results of rolling a dice

Q1b: (2pts) Numerical and Continuous:

① A person's weight

② the length of a leaf

Q1c: (2pts) Categorical and Nominal:

① blood type, Like A, B, AB, O

② film genre: Romance, Comedy, Adventure, Drama

Q1d: (2pts) Categorical and Ordinal:

① GPA, Like A, B, C, D $A>B>C>D$

② Educational experience: high school, elementary school, college

Q2: (2pts) Prove that the L0-norm function

$f(x)$: count the number of non-zero values in x

is not a mathematical norm by giving a counter-example to one of the three norm properties:

Q2a: $f(x) > 0$ for $x \in V$ and $x \neq 0$

Q2b: $f(x + y) \leq f(x) + f(y)$ for $x, y \in V$

①

when $P<1$, L-P does not satisfy triangle inequality

since when $P=0.5$ for points $(1,4)$, $(4,1)$, $(1,9)$, $\sqrt[\frac{1}{2}]{1+\sqrt{4}} + \sqrt[\frac{1}{2}]{1+\sqrt{4}} < \sqrt[\frac{1}{2}]{1+\sqrt{9}}$

Q2c: $f(\lambda x) = |\lambda| f(x)$ for all $\lambda \in$ R and $x \in V$

$x = [0, 0, 1]$

$\lambda = 4$

$f(\lambda x) = f([0,0,4]) = 1$

$|\lambda| f(x) = 4 \cdot f([0,0,1]) = 4 \times 1 = 4$

$f(\lambda x) \neq |\lambda| f(x)$

Q3: (5pts) You're fitting a univariate linear regression model using the five samples listed on the right to predict the weight (the response variable) values from height (the input feature variable):

$$f(x) = mx + b$$

Using MSE as your loss function:

$$L(m, b) = \frac{1}{n}\sum_{i=1}^{n}(\,y_i - (mx_i + b)\,)^2$$

You've randomly started your parameter values at

m = 1
b = 10

Use gradient descent to update the two parameter values by one step, using a learning rate of α = 0.01

"Height"	"Weight"
35	38
31	56
29	47
37	36
26	15

$$m_{new} = m_{old} - \frac{\alpha}{n}\sum_{i=1}^{n} -2x_i\left(y_i - (m_{old}x_i + b_{old})\right)$$

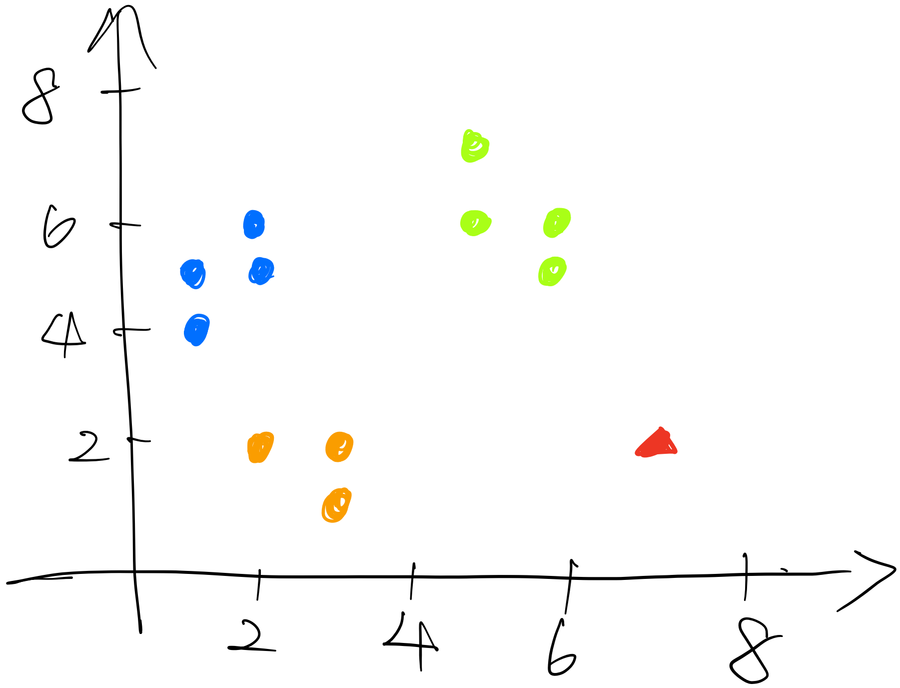
$$= 1 - \frac{0.01}{5}\cdot\sum_{i=1}^{n} -2x_i\left(y_i - (x_i + 10)\right) = -1.004$$

$$b_{new} = b_{old} - \frac{\alpha}{n}\sum_{i=1}^{n} -2\left(y_i - (m_{old}x_i + b_{old})\right)$$

$$= 10 - \frac{0.01}{5}\sum_{i=1}^{n} -2\left(y_i - (x_i + 10)\right) = 9.936$$

Extra Credit on HW1:

which is most similar using dot product?



△ (7,2)

yello: (7,2)·(2,2) = 14+4=18
(7,2)·(3,2) = 21+4=25
(7,2)·(3,1) = 21+2=23

blue: (7,2)·(1,4) = 7+8=15
(7,2)·(1,5) = 7+10=18
(7,2)·(2,5) = 14+10=24
(7,2)·(2,6) = 14+12=26

Green: (7,2)·(6,5) = 42+10=52
(7,2)·(6,6) = 42+12=54
(7,2)·(5,6) = 35+12=47
(7,2)·(5,7) = 35+14=49

Thus point (6,6) is most similar to △ (7,2).