Lecture 07 Submission Pranav

1) a) There is 1 feature (ie x)

b) There are 2 parameters that need to be estimated, they are a & b.

c) The activation function is an identity function.

$$\alpha(x) = x.$$

This function $y = ax + b$ is similar to $y = mx + c$ therefore it is an identity function.

d) Loss function for mean squared error.

$$L = \frac{1}{2n} \sum \left(\hat{y}^{[i]} - y^{[i]} \right)^2$$

Solution for 1d

```
def calc_least_square(a, b, list1):
  sum_of_squares = 0
  for [xi, yi] in list1:
    sum_of_squares += (yi - (a * xi + b)) ** 2
  return sum_of_squares / (2 * len(list1))
```

```
val_0_0 = calc_least_square(0, 0, [[2, 1], [3,2], [4,3]] )
```

```
val_0_1 = calc_least_square(0, 1, [[2, 1], [3,2], [4,3]] )
```

```
val_0_2 = calc_least_square(0, 2, [[2, 1], [3,2], [4,3]] )

val_1_0 =calc_least_square(1, 0, [[2, 1], [3,2], [4,3]] )

val_1_1 = calc_least_square(1, 1, [[2, 1], [3,2], [4,3]] )

val_1_2 =calc_least_square(1, 2, [[2, 1], [3,2], [4,3]] )

val_2_0 = calc_least_square(2, 0, [[2, 1], [3,2], [4,3]] )

val_2_1 =calc_least_square(2, 1, [[2, 1], [3,2], [4,3]] )

val_2_2 = calc_least_square(2, 2, [[2, 1], [3,2], [4,3]] )

import pandas as pd

a_0 = pd.Series([val_0_0, val_0_1, val_0_2])

a_1 = pd.Series([val_1_0, val_1_1, val_1_2])

a_2 = pd.Series([val_2_0, val_2_1, val_2_2])

pd.concat([a_0, a_1, a_2] ,axis=1)
```

	0	1	2
0	2.333333	0.5	8.333333
1	0.833333	2.0	12.833333
2	0.333333	4.5	18.333333

Here I wrote a function to calcualte the mean squared error and substituted the values, the rows represent b and the columns represent a, each of them take values 0, 1, 2 and we have 9 combindations

Solution for 1e, Partial derivative with respect to a

Final value is (1 / n) * ((y_hat - y) * x)

Soltuion for 1f, partial derivative with respect to b

f) $y = ax + b$.

$$L = \frac{1}{2n} \Sigma \left(\hat{y}^{[i]} - y^{[i]} \right)^2.$$

Considering it as a Scalar for the purpose of derivation

$$L = \frac{1}{2n} (\hat{y} - y)^2.$$

$$L = \frac{1}{2n} ((ax+b) - y)^2$$

Partially deriving with respect to b.

$$\frac{\partial L}{\partial b} = \frac{\partial}{\partial b} \frac{1}{2n} ((ax+b) - y)^2.$$

Using the chain rule $\left[\frac{d}{dx} f(g(x)) = f'(g(x)) . g'(x) \right]$.

$$= \frac{1}{\cancel{2}n} . \cancel{2} (ax+b - y) . \frac{\partial}{\partial b} (ax + b - y).$$

Since $\frac{d}{dx} x$ is 1 & $\frac{d}{dx}(\text{constant}) = 0$.

$$= \frac{1}{n} (ax + b - y) . 1.$$