

## Linear Least Squares 2nd Order Derivation

$y = ax^2 + bx + c$  is the definition of a line to the second power. Our goal is given a set of Data, find  $a$ ,  $b$ , and  $c$  to best match the data.

Loss:  $L = \sum_{i=0}^n (y_i - ax_i^2 - bx_i - c)^2$

Partial Derivatives:

$$\frac{\partial L}{\partial a} = \sum_{i=0}^n 2(y_i - ax_i^2 - bx_i - c)(-x_i^2) = \sum_{i=0}^n -2(y_i - ax_i^2 - bx_i - c)(x_i^2)$$

$$\frac{\partial L}{\partial b} = \sum_{i=0}^n 2(y_i - ax_i^2 - bx_i - c)(-x_i) = \sum_{i=0}^n -2(y_i - ax_i^2 - bx_i - c)(x_i)$$

$$\frac{\partial L}{\partial c} = \sum_{i=0}^n 2(y_i - ax_i^2 - bx_i - c)(-1) = \sum_{i=0}^n -2(y_i - ax_i^2 - bx_i - c)$$

We have 3 formulas we can find all 3 unknowns by summing each point in the Data set