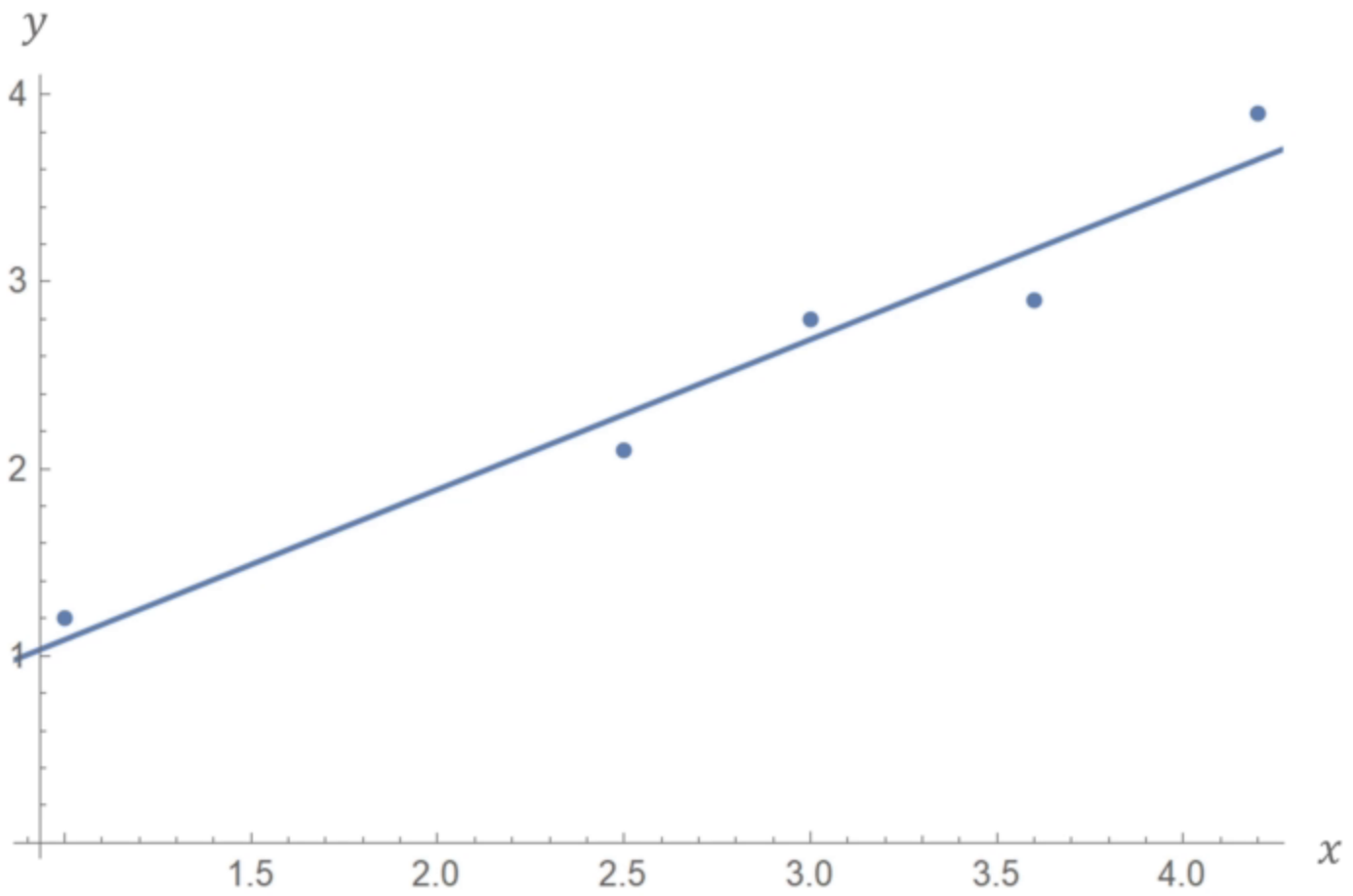
# Interpolation



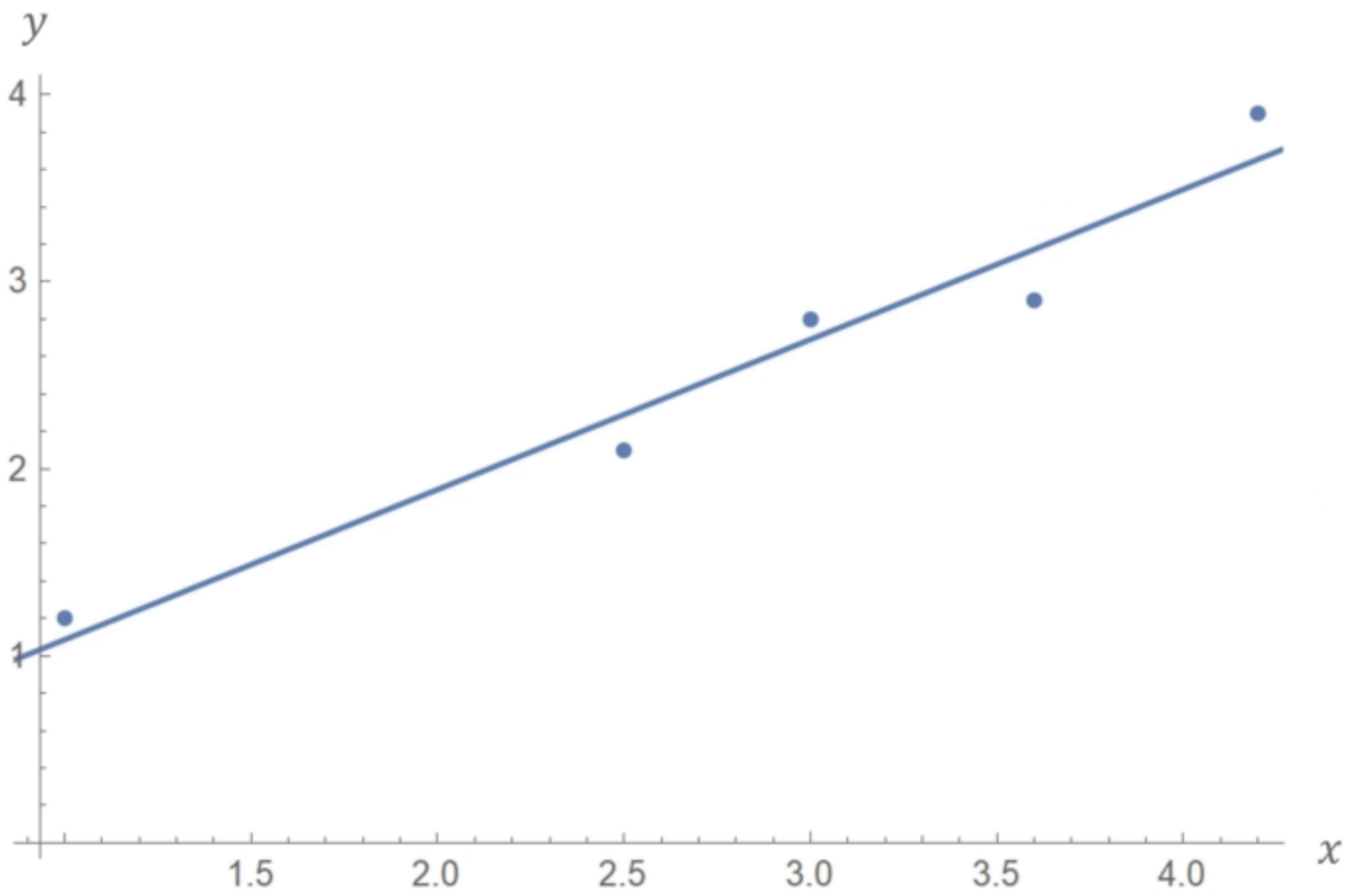

- Find fit

$$y = n + mx$$

- By minimizing error

$$\Delta = \sum_{i=1}^{5} (n + mx^{(i)} - y^{(i)})^2$$

# Interpolation



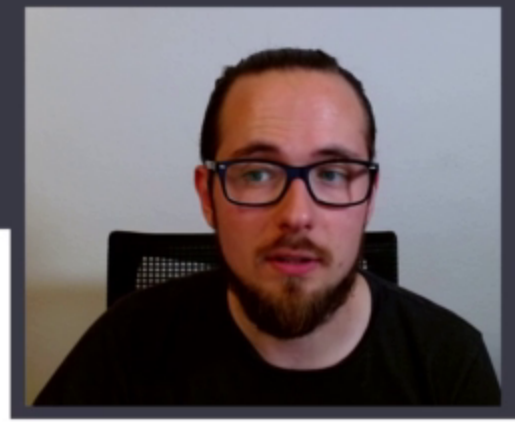

- Find fit

$$y = n + mx$$

- By minimizing error

$$\Delta = \sum_{i=1}^{5} (n + mx^{(i)} - y^{(i)})^2$$

# Interpolation

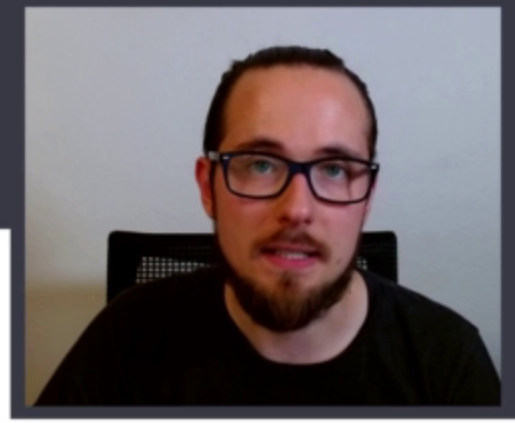


- Problem can be difficult: many variables

| | | |
|---|---|---|
| $x_1$ | Per capita crime rate by town | 0.03237 |
| $x_2$ | Proportion of residential land zoned for lots over 25000 square feet | 0 |
| $x_3$ | Proportion of non-retail business acres per town | 2.18 |
| $x_4$ | Charles River dummy variable (1 if tract bounds river, 0 otherwise) | 0 |
| $x_5$ | Nitrogen oxide concentration (parts per 10 million) | 0.458 |
| $x_6$ | Average number of rooms per dwelling | 6.998 |
| $x_7$ | Proportion of owner-occupied units built prior to 1940 | 45.8 |
| $x_8$ | Weighted mean of distances to five Boston employment centers | 6.0622 |
| $x_9$ | Index of accessibility to radial highways | 3 |
| $x_{10}$ | Full-value property-tax rater per $10000 | 222 |
| $x_{11}$ | Pupil-teacher ratio by town | 18.7 |
| $x_{12}$ | 1000(Bk-0.63)^2 where Bk is the proportion of Black or African-American residents by town | 394.63 |
| $x_{13}$ | Lower status of the population (percent) | 2.94 |

$$y = n + \vec{m} \cdot \vec{x}$$

# Interpolation



- Problem can be difficult: many variables

| | | |
|---|---|---|
| $x_1$ | Per capita crime rate by town | 0.03237 |
| $x_2$ | Proportion of residential land zoned for lots over 25000 square feet | 0 |
| $x_3$ | Proportion of non-retail business acres per town | 2.18 |
| $x_4$ | Charles River dummy variable (1 if tract bounds river, 0 otherwise) | 0 |
| $x_5$ | Nitrogen oxide concentration (parts per 10 million) | 0.458 |
| $x_6$ | Average number of rooms per dwelling | 6.998 |
| $x_7$ | Proportion of owner-occupied units built prior to 1940 | 45.8 |
| $x_8$ | Weighted mean of distances to five Boston employment centers | 6.0622 |
| $x_9$ | Index of accessibility to radial highways | 3 |
| $x_{10}$ | Full-value property-tax rater per $10000 | 222 |
| $x_{11}$ | Pupil-teacher ratio by town | 18.7 |
| $x_{12}$ | 1000(Bk-0.63)^2 where Bk is the proportion of Black or African-American residents by town | 394.63 |
| $x_{13}$ | Lower status of the population (percent) | 2.94 |

$$y = m_0 + m_1 x_1 + \cdots + m_{13} x_{13}$$

# Interpolation

- Problem can be difficult: many variables

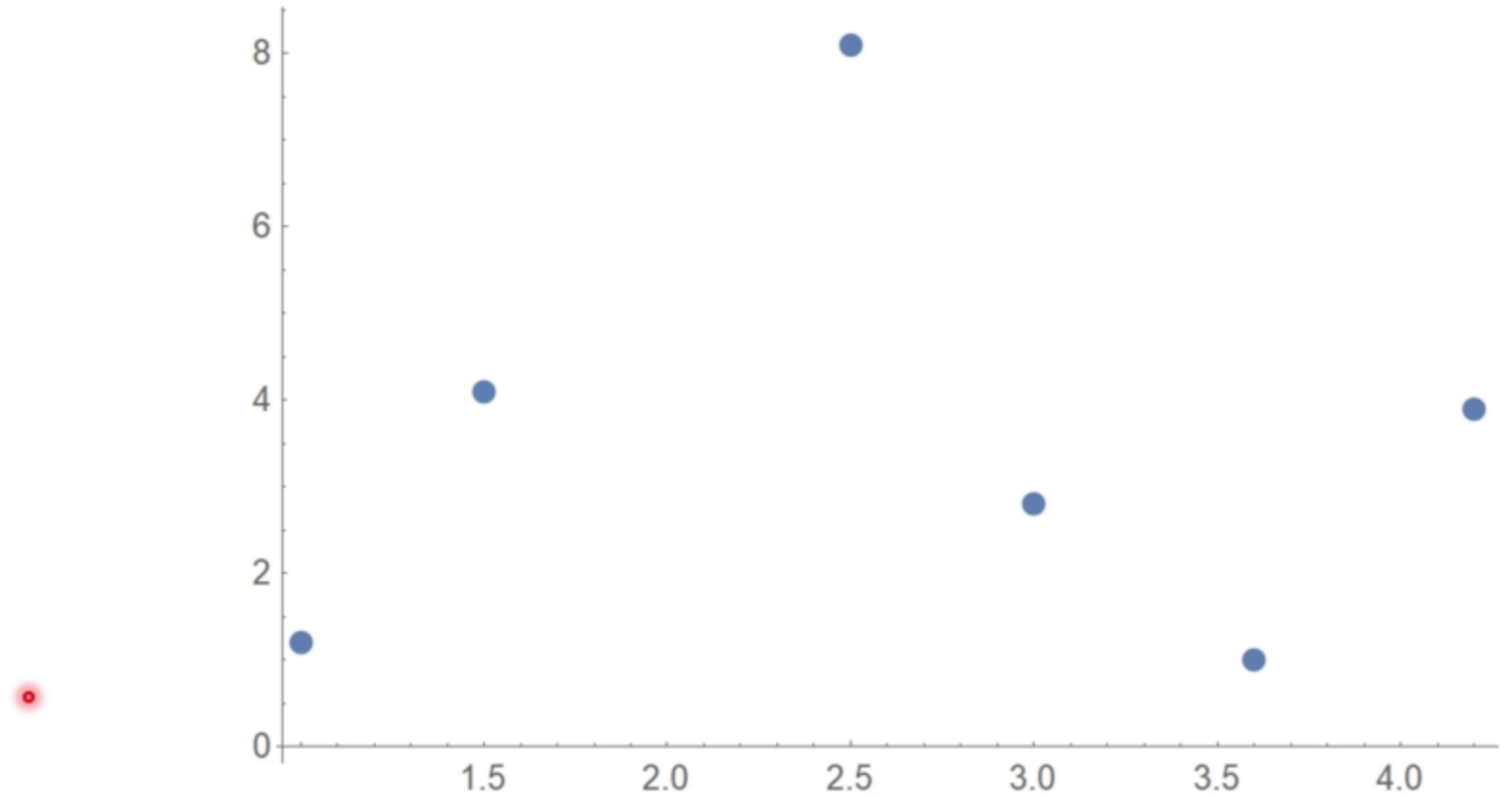
| | | |
|---|---|---|
| $x_1$ | Per capita crime rate by town | 0.03237 |
| $x_2$ | Proportion of residential land zoned for lots over 25000 square feet | 0 |
| $x_3$ | Proportion of non-retail business acres per town | 2.18 |
| $x_4$ | Charles River dummy variable (1 if tract bounds river, 0 otherwise) | 0 |
| $x_5$ | Nitrogen oxide concentration (parts per 10 million) | 0.458 |
| $x_6$ | Average number of rooms per dwelling | 6.998 |
| $x_7$ | Proportion of owner-occupied units built prior to 1940 | 45.8 |
| $x_8$ | Weighted mean of distances to five Boston employment centers | 6.0622 |
| $x_9$ | Index of accessibility to radial highways | 3 |
| $x_{10}$ | Full-value property-tax rater per $10000 | 222 |
| $x_{11}$ | Pupil-teacher ratio by town | 18.7 |
| $x_{12}$ | 1000(Bk-0.63)^2 where Bk is the proportion of Black or African-American residents by town | 394.63 |
| $x_{13}$ | Lower status of the population (percent) | 2.94 |

$$y = m_0 + m_1 x_1 + \cdots + m_{13} x_{13}$$

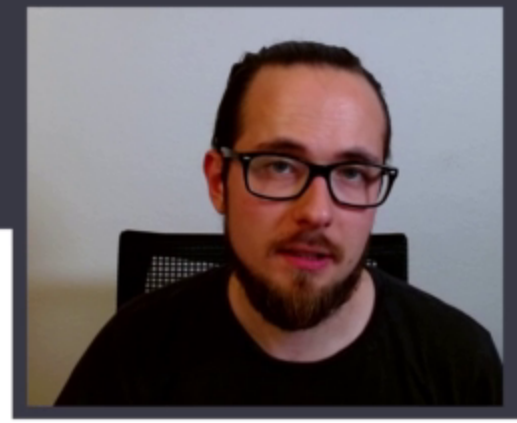
$$\Delta = \sum_{i=1}^{5} (m_0 + m_1 x_1^{(i)} + \cdots + m_{13} x_{13}^{(i)} - y^{(i)})^2$$

# Interpolation

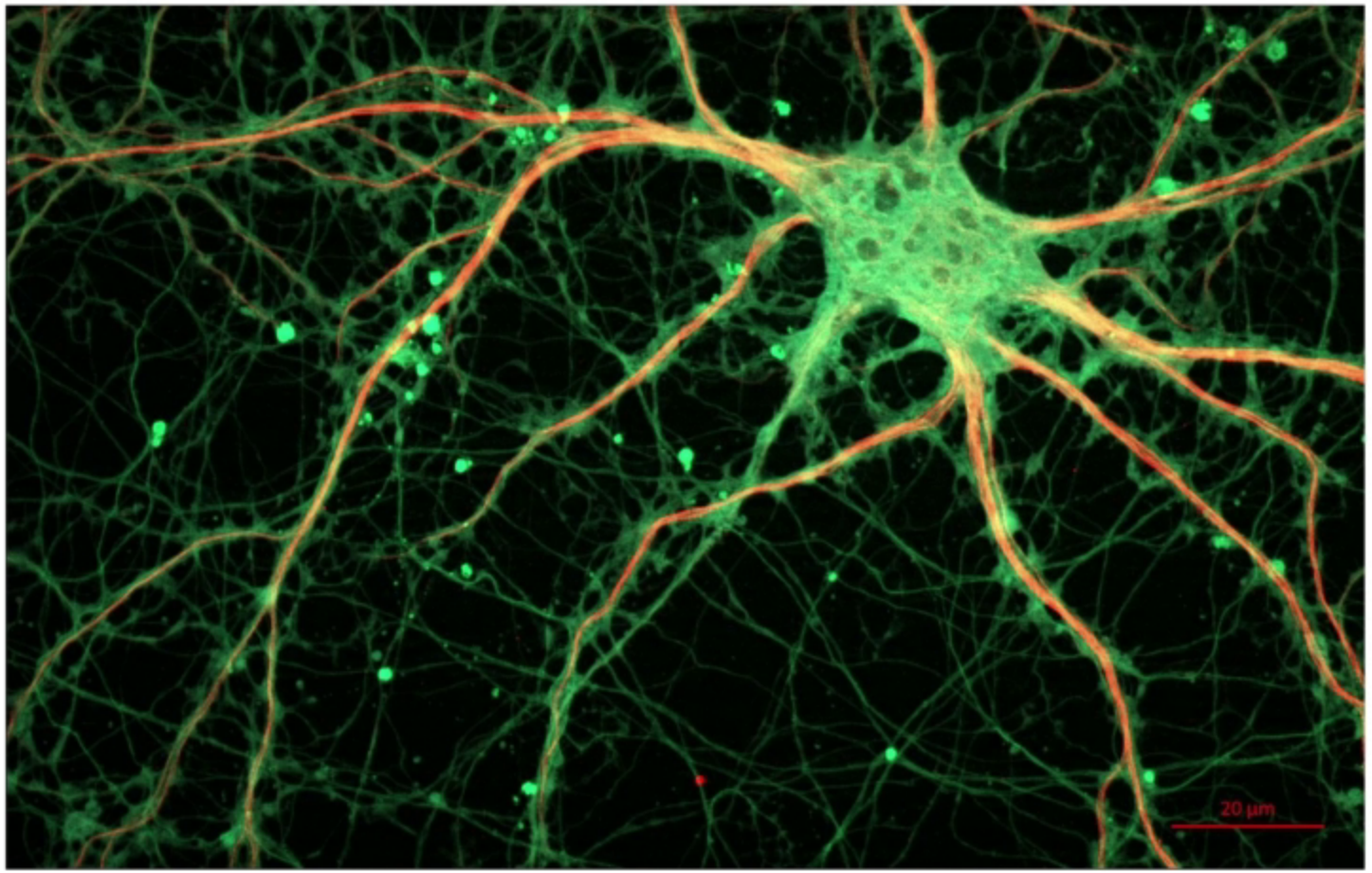
- Problem can be difficult: non-linear behavior



# Neural networks



- Best problem solver: our brain!




https://commons.wikimedia.org/wiki/File:Cultured_Rat_Hippocampal_Neuron_(24327909026).jpg

# Neural networks