

Machine and Deep Learning

Holger Schmidt

Supervised Learning

Airplane



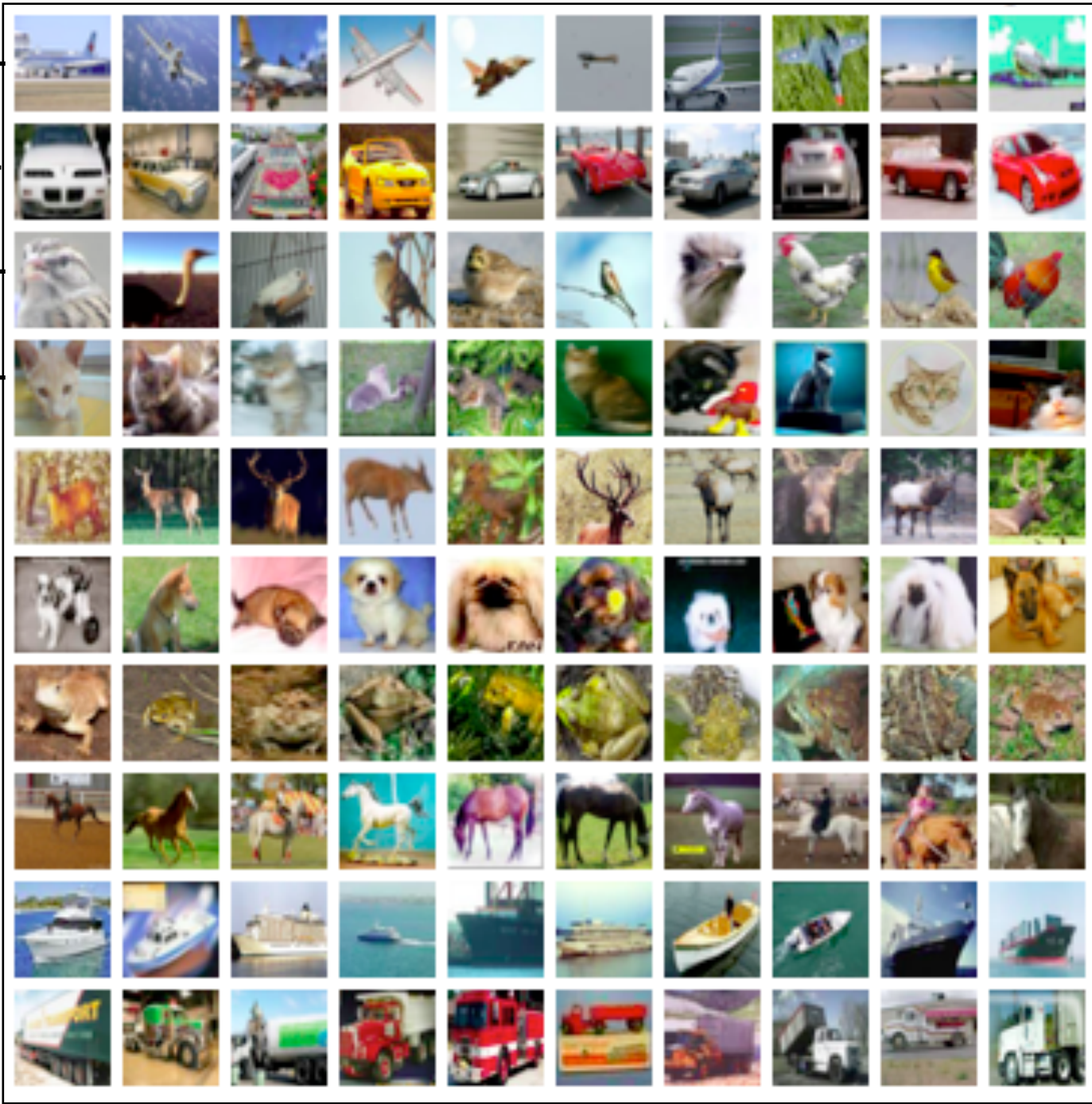
Car



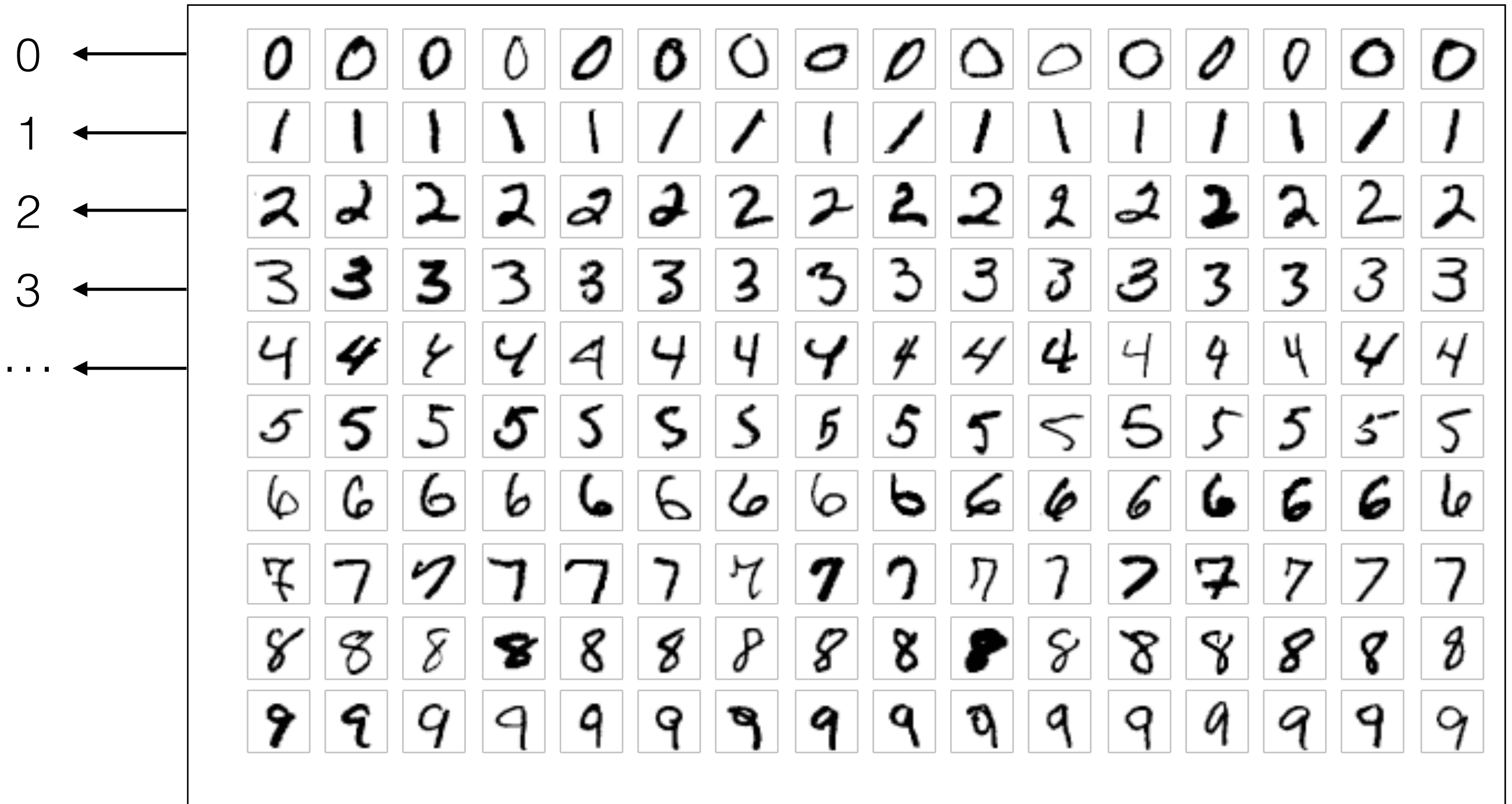
Bird



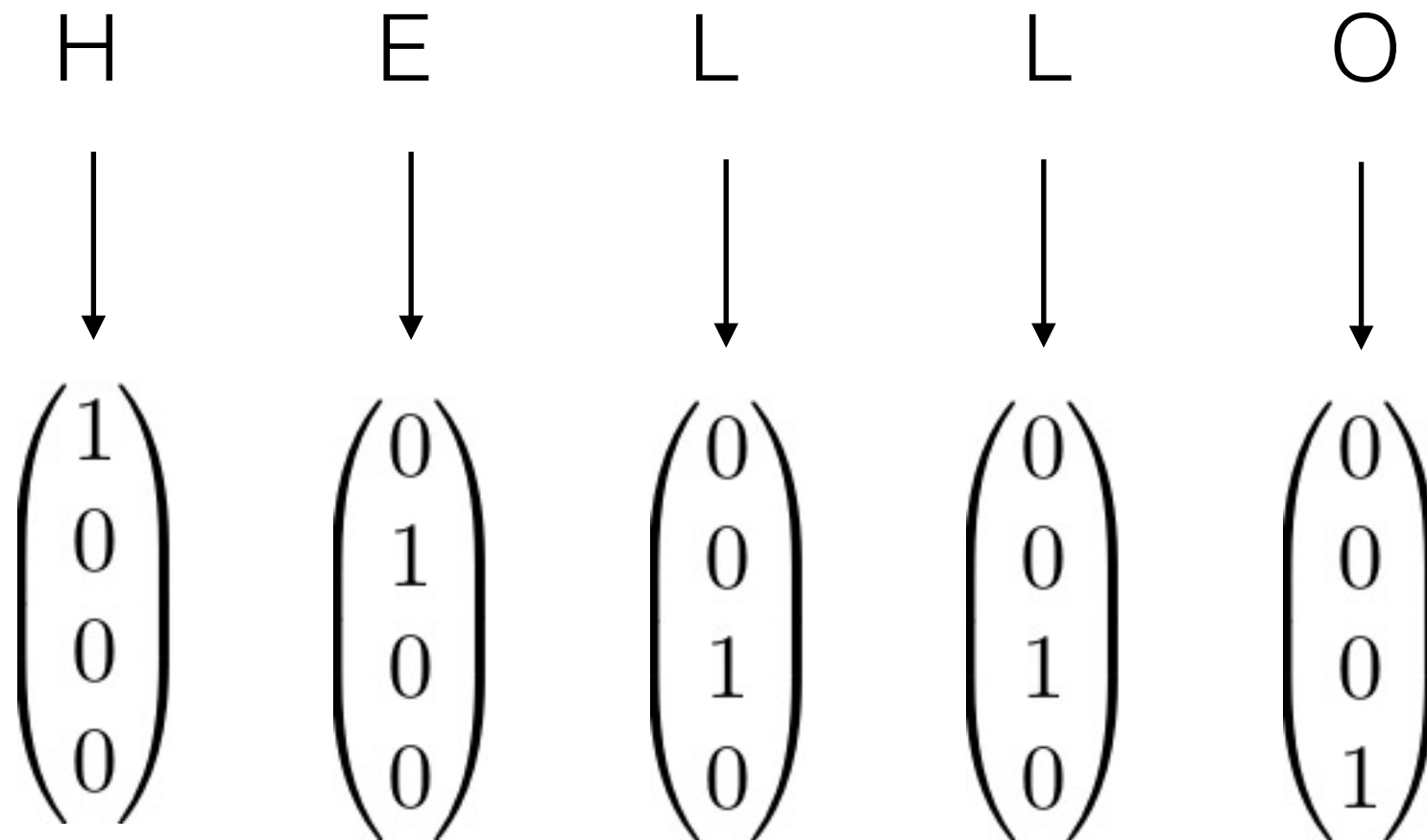
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Supervised Learning

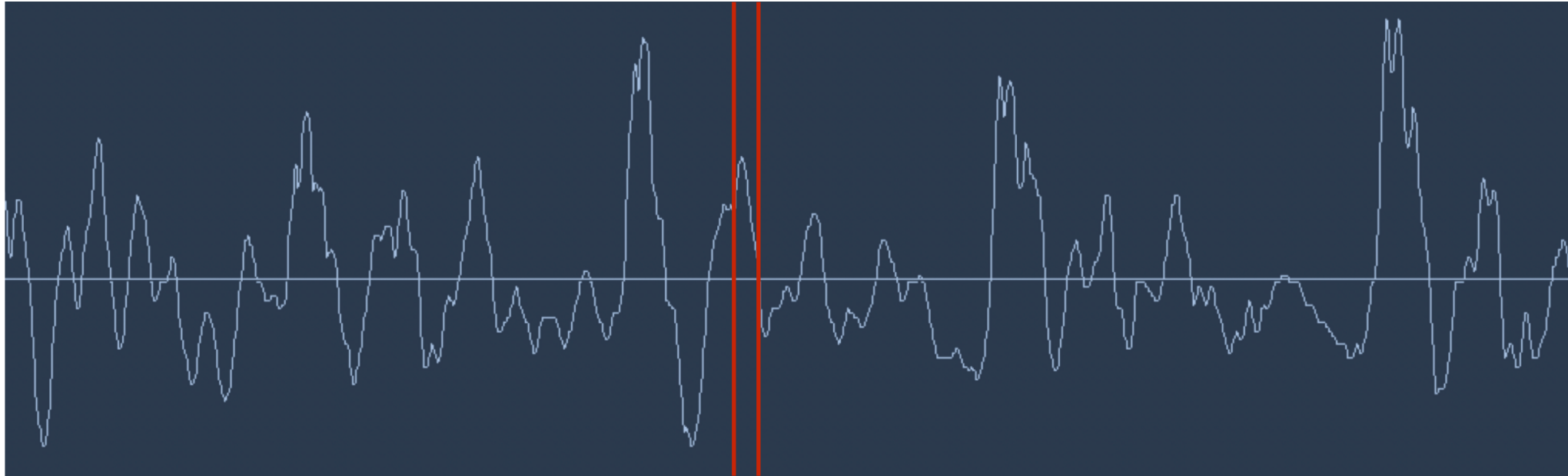


Supervised Learning



Supervised Learning

„Hello“



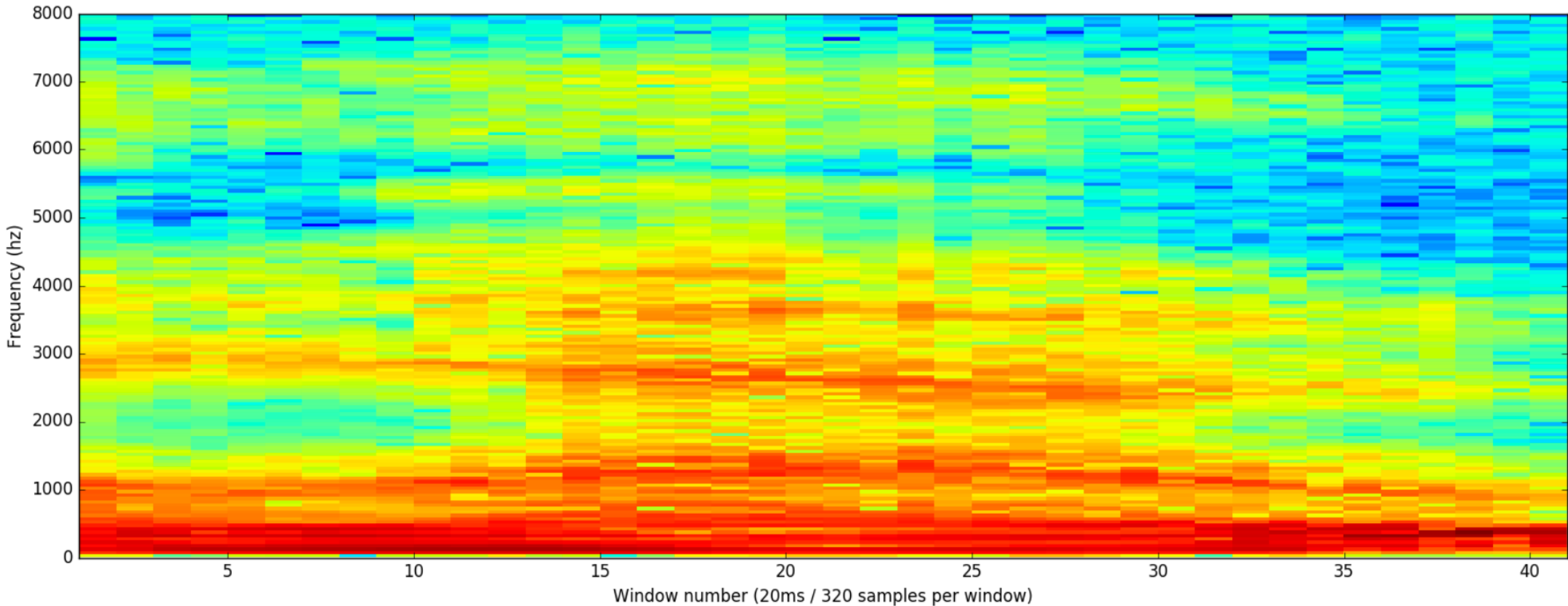
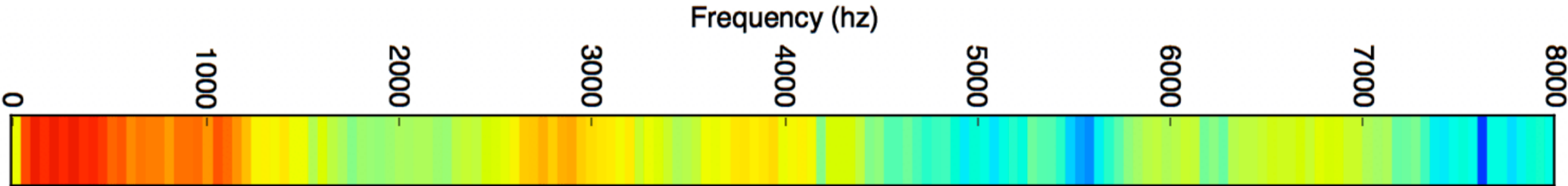
20ms



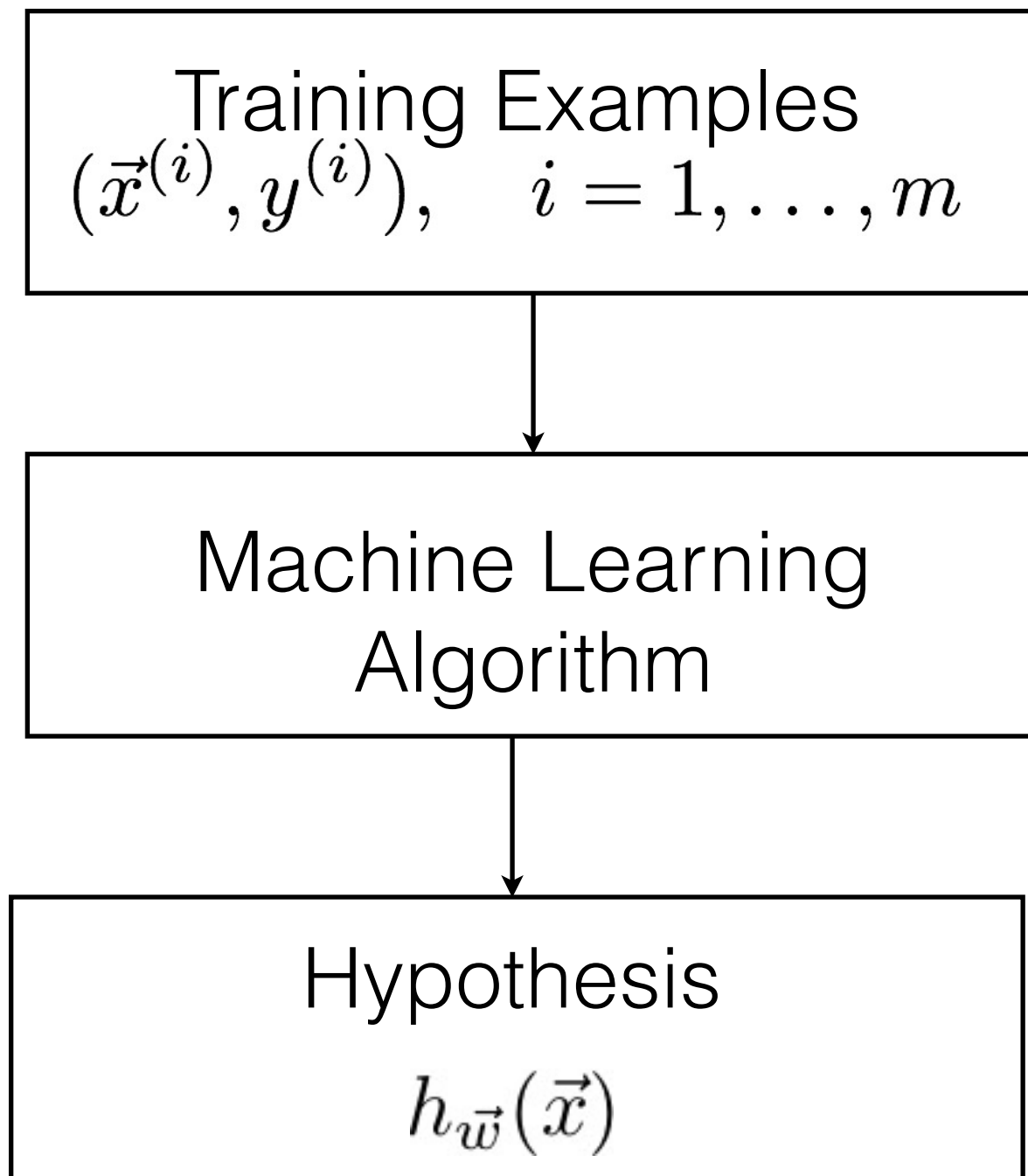
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Supervised Learning

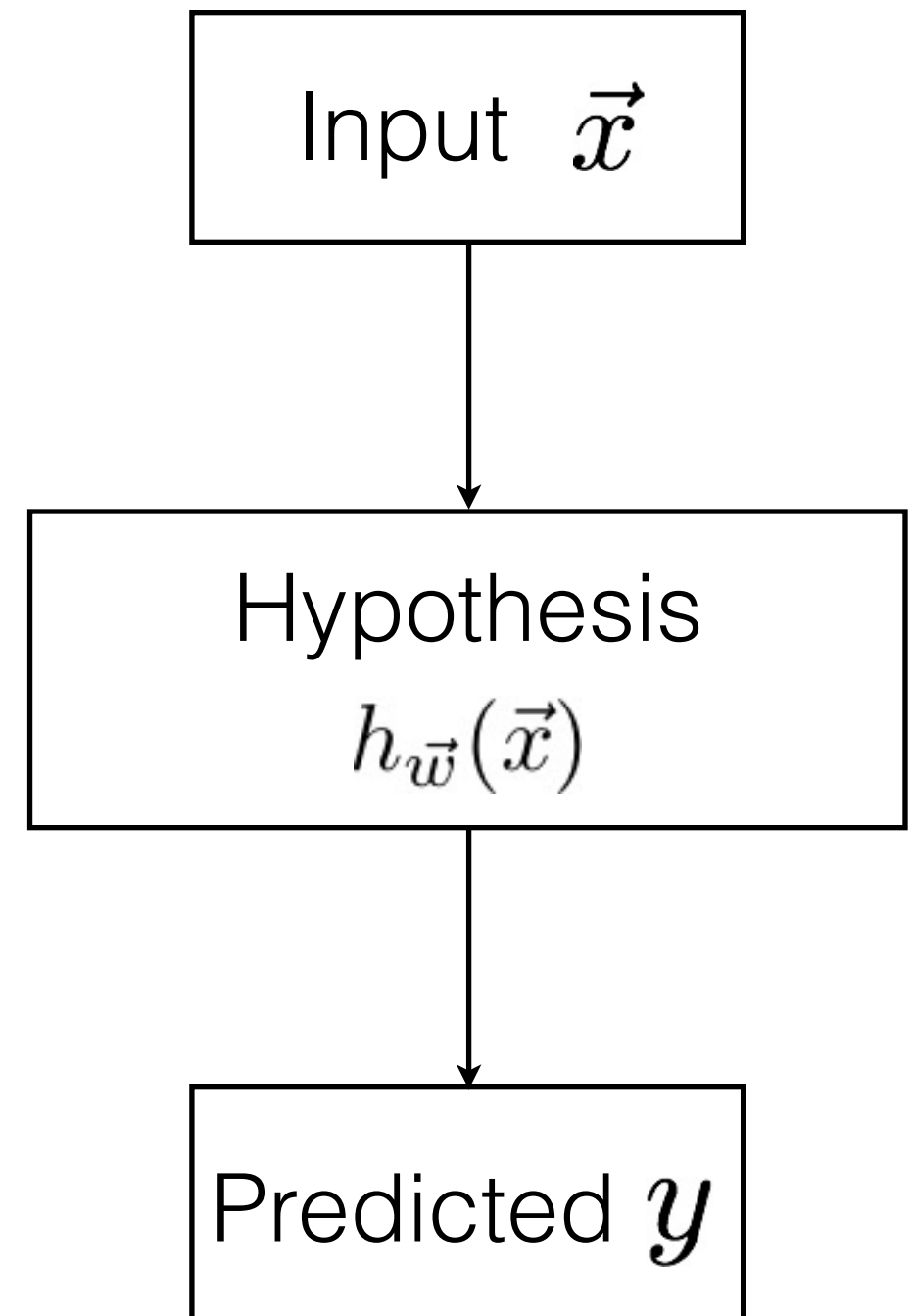
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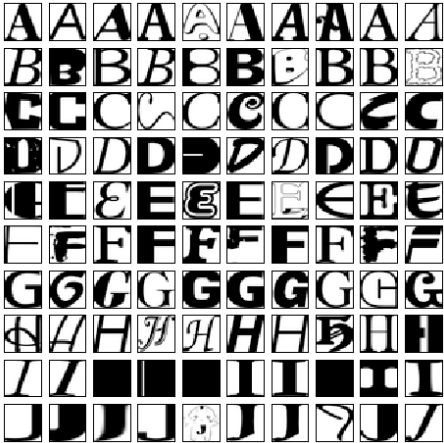
Training



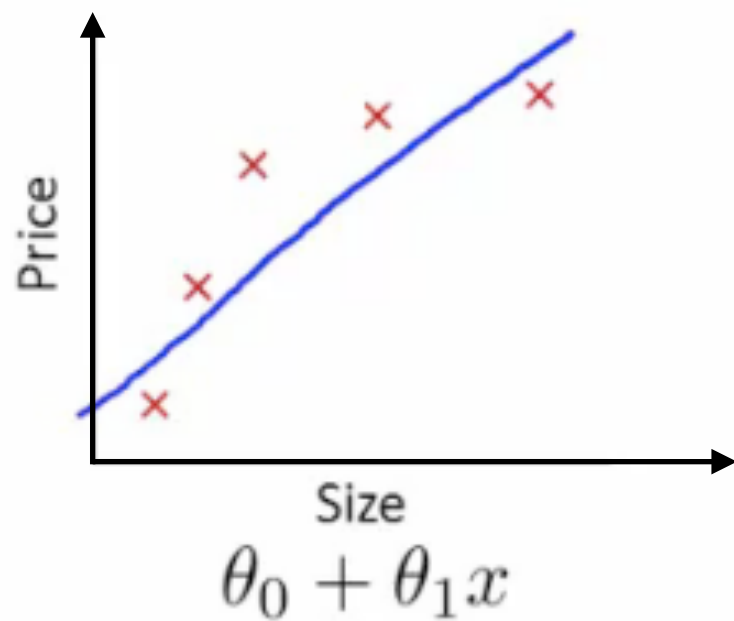
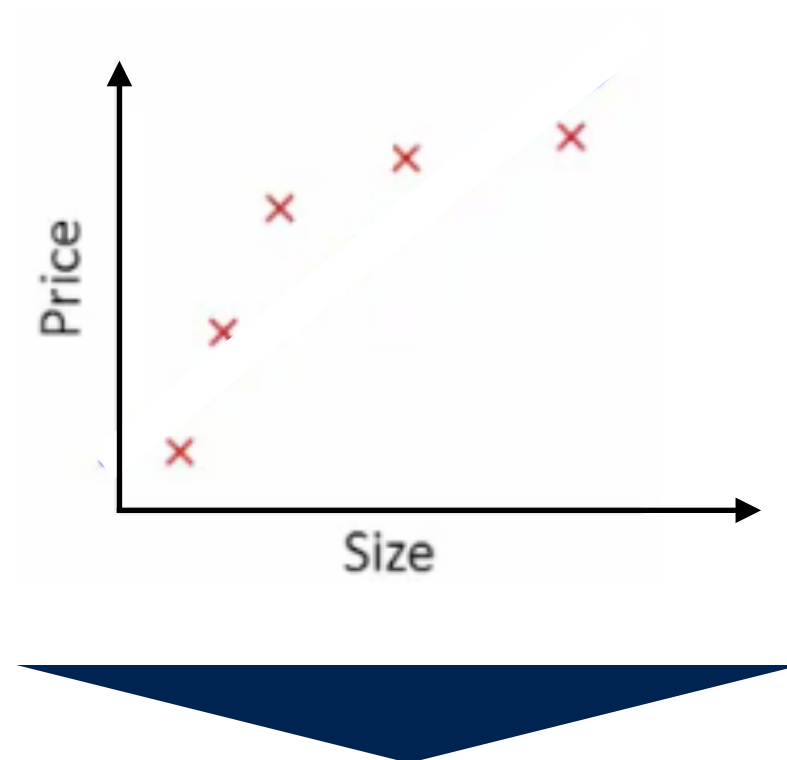
After Training



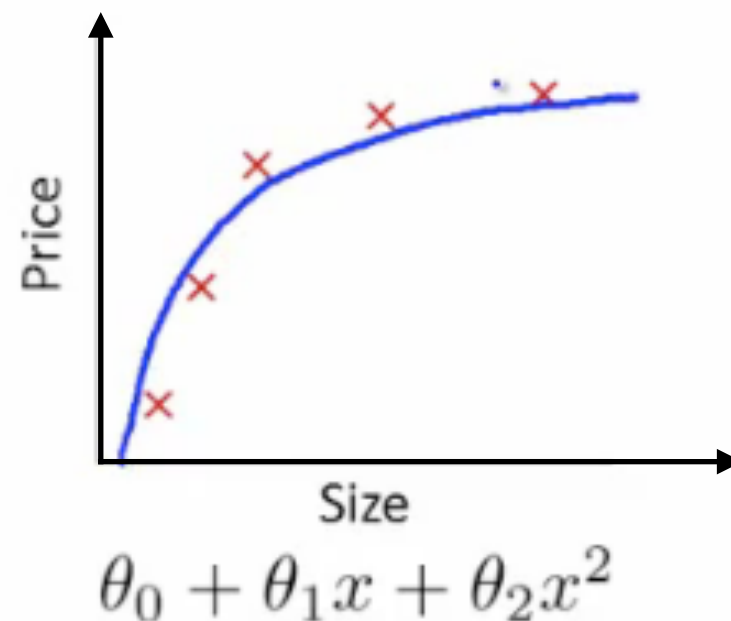
Examples for input and output variables

Input $\vec{x}^{(i)}$		Output $y^{(i)}$
Alter des Kindes $x^{(i)} \in \mathbb{R}$	Größe des Kindes $y^{(i)} \in \mathbb{R}$	Regression
Größe und Anzahl Schlafzimmer eines Hauses $\vec{x}^{(i)} \in \mathbb{R}^2$	Hauspreis $y^{(i)} \in \mathbb{R}$	
Bilder der Buchstaben A bis J (Größe 28x28)  $\vec{x}^{(i)} \in \mathbb{R}^{784}$	Label des Buchstaben $y^{(i)} \in \{0, 1, 2, \dots, 9\}$	Classification

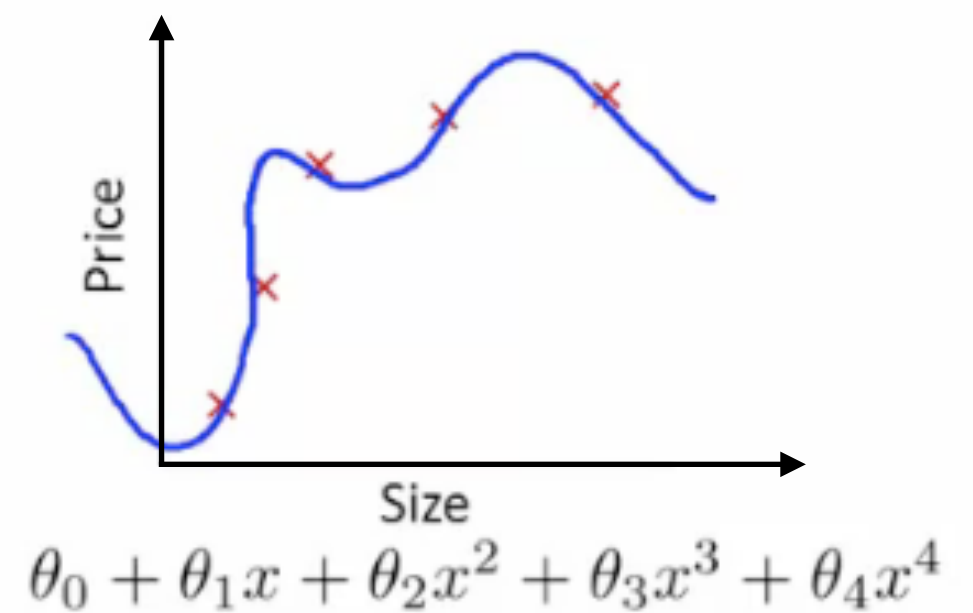
Overfitting and Underfitting



Underfitting



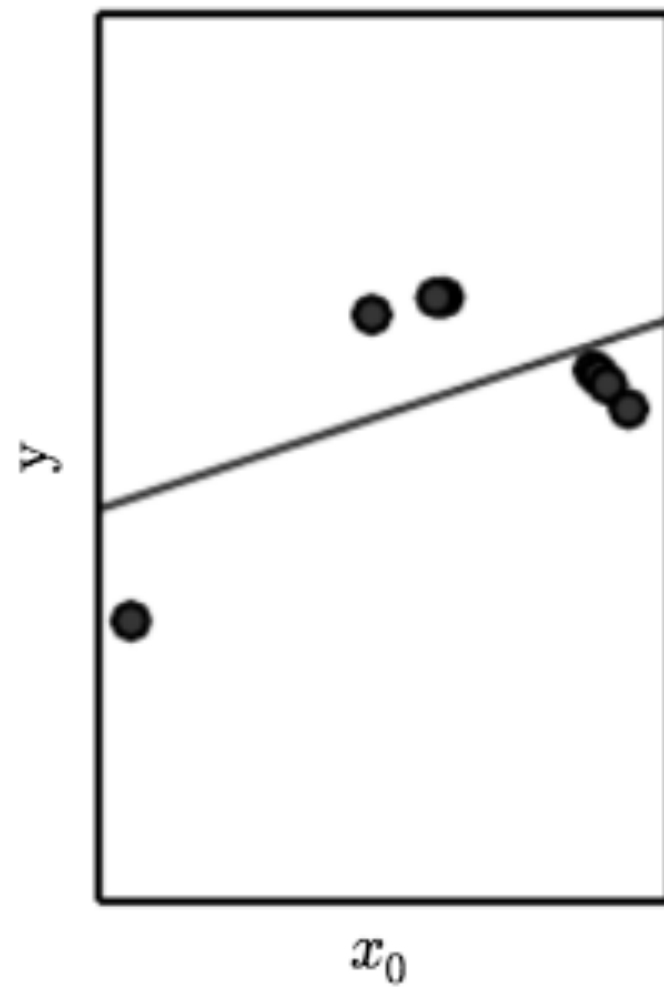
Good fit



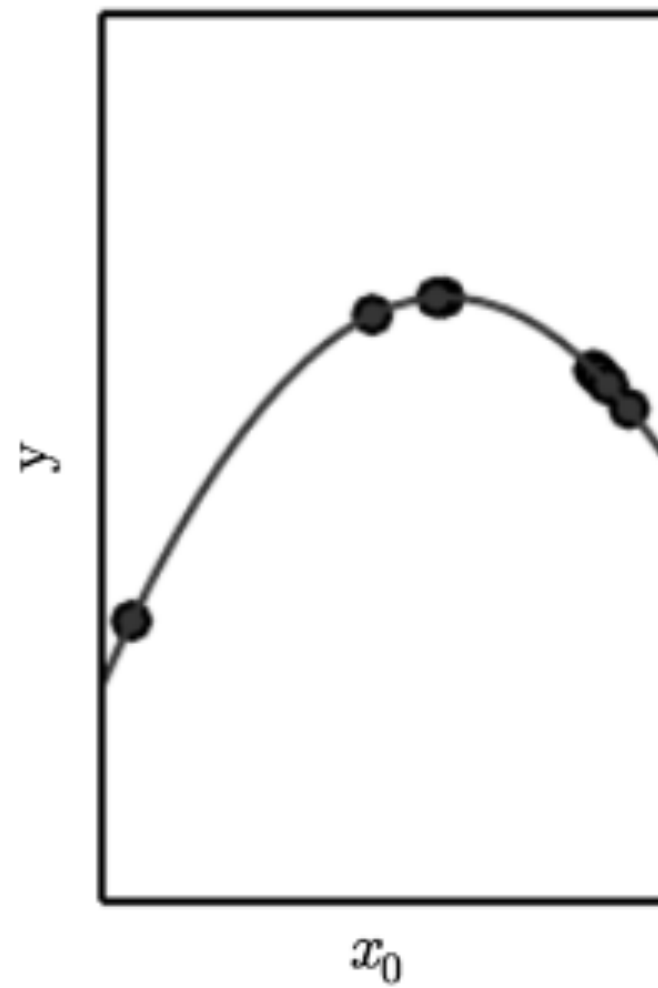
Overfitting

Overfitting and Underfitting

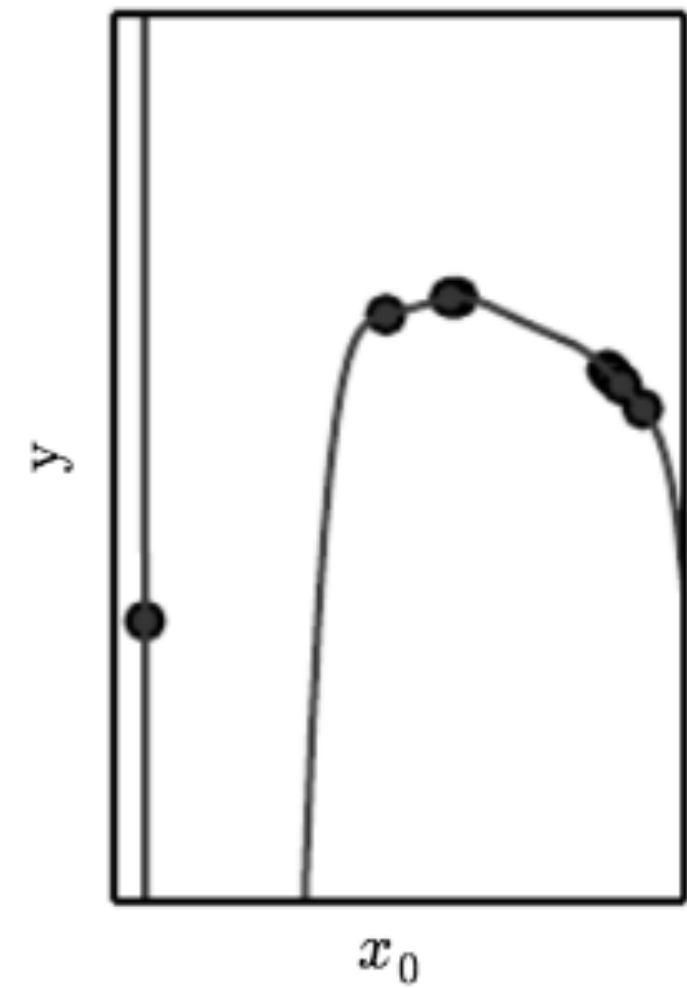
Underfitting



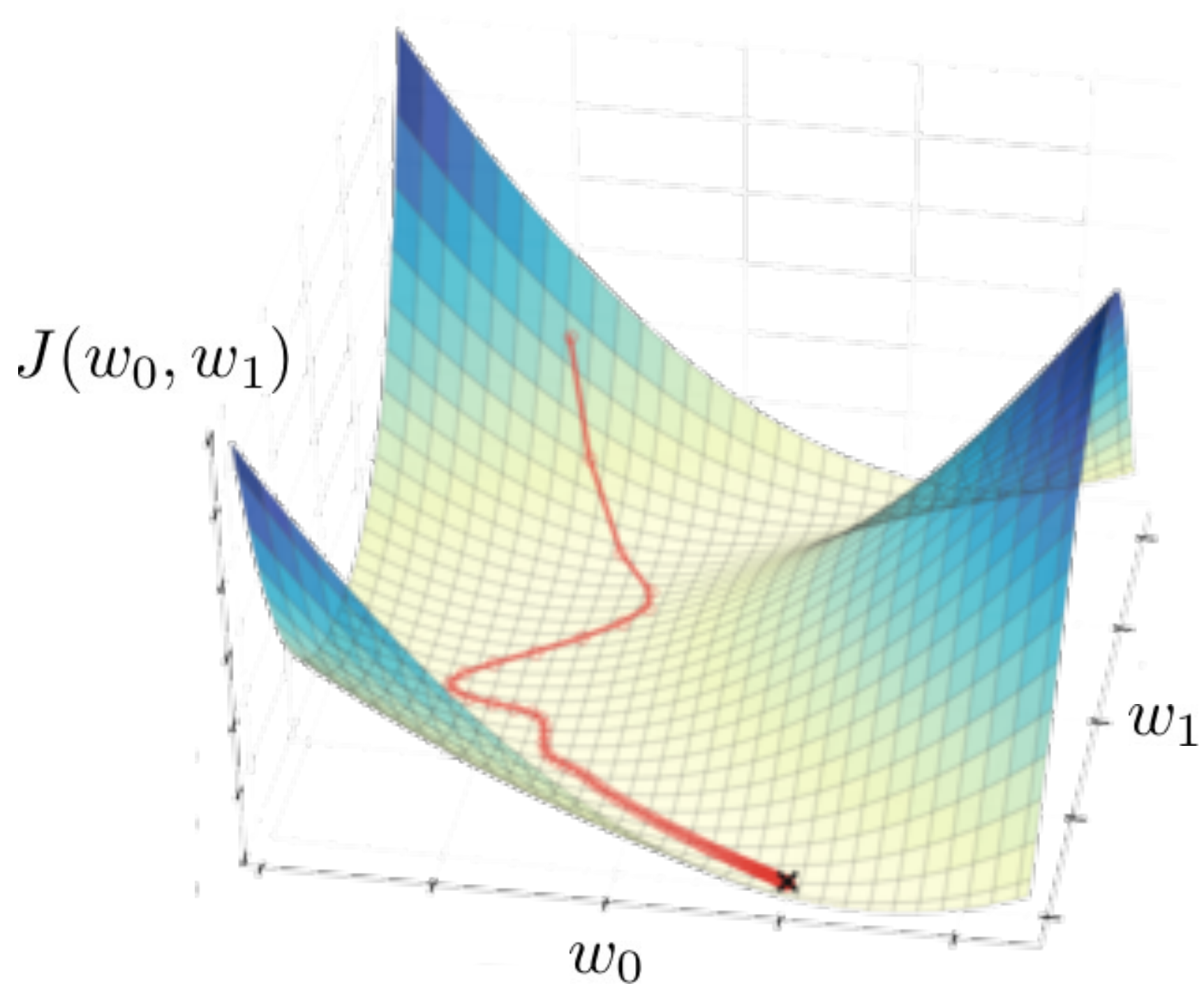
Appropriate capacity



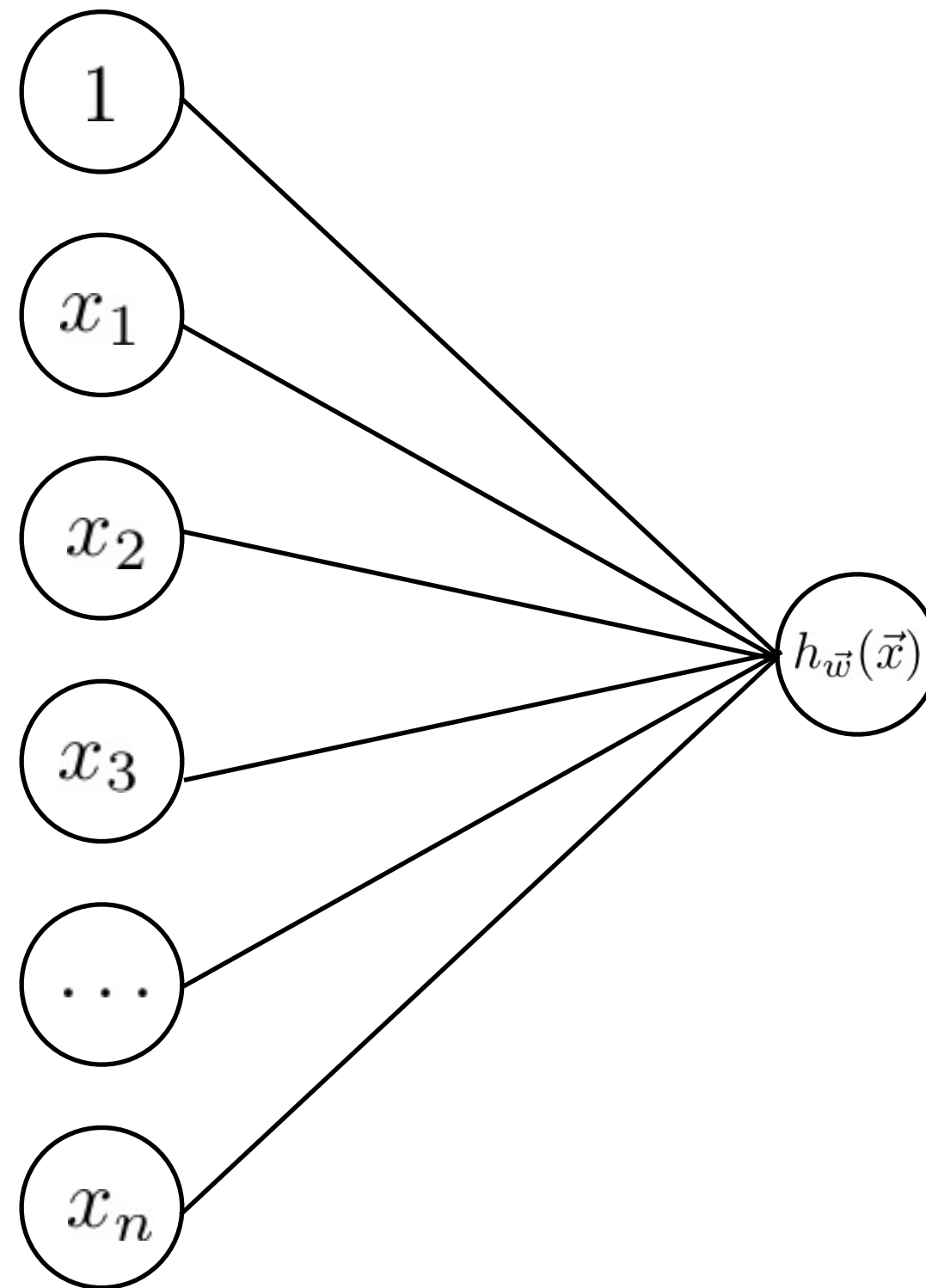
Overfitting



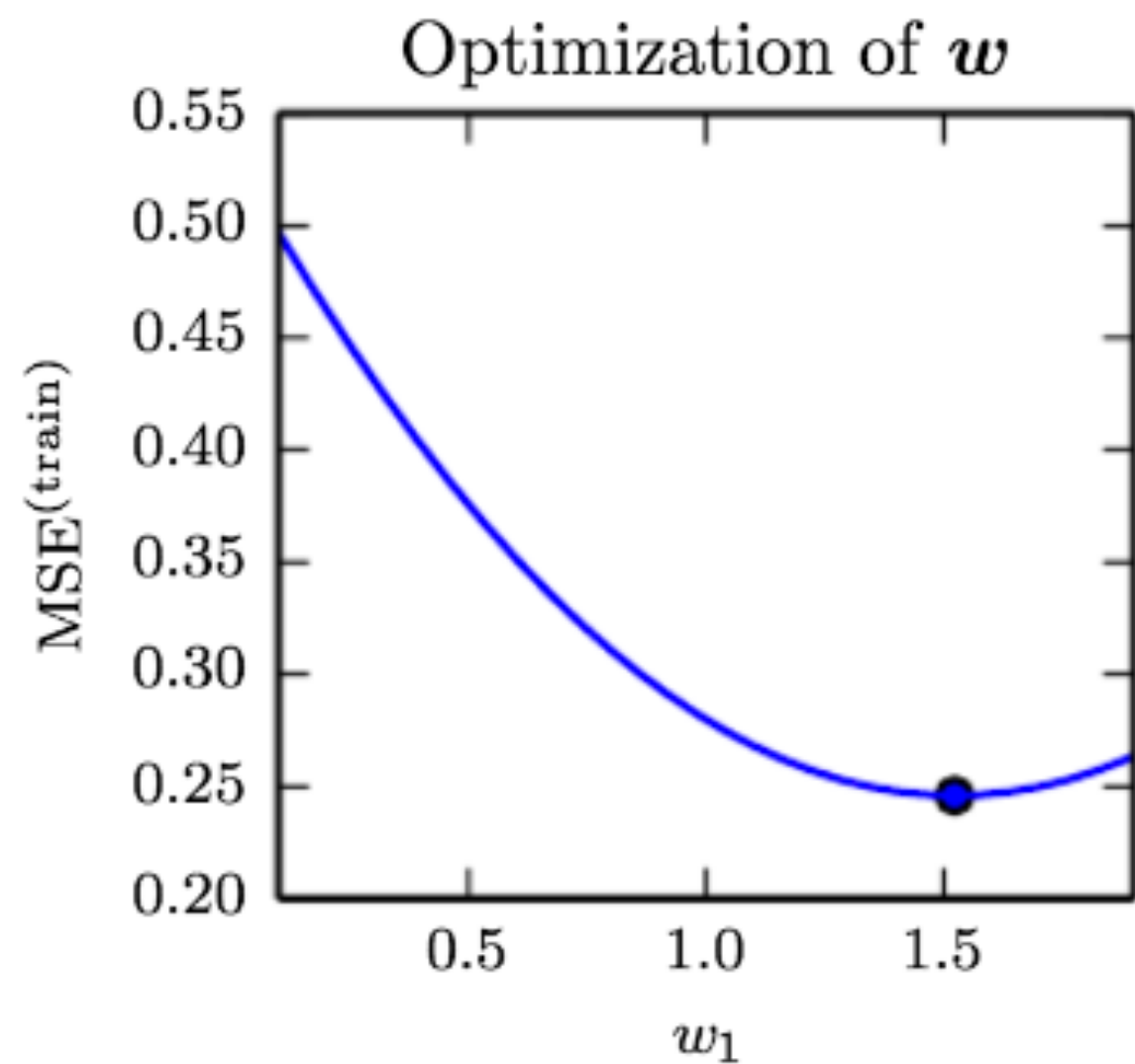
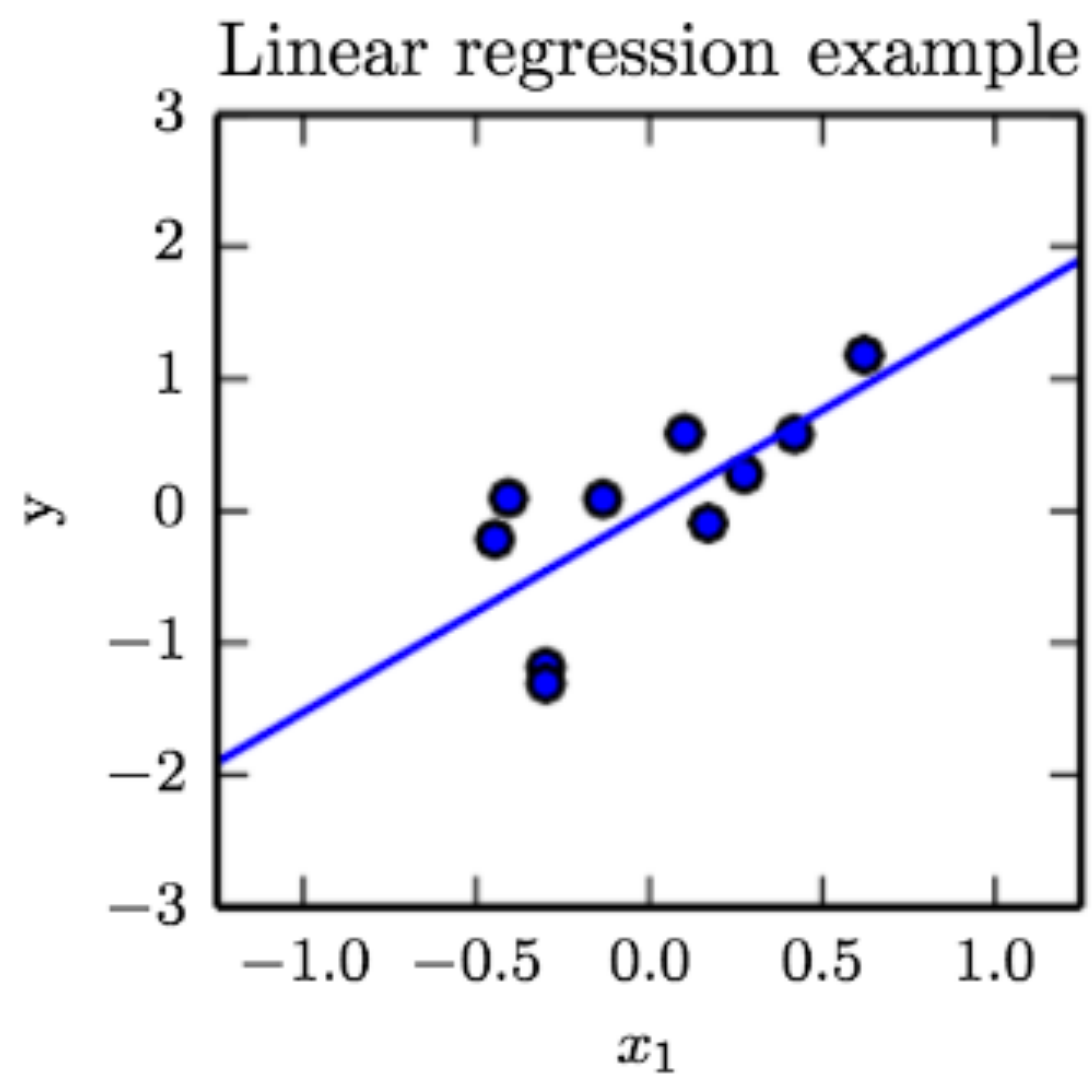
Gradient Descent



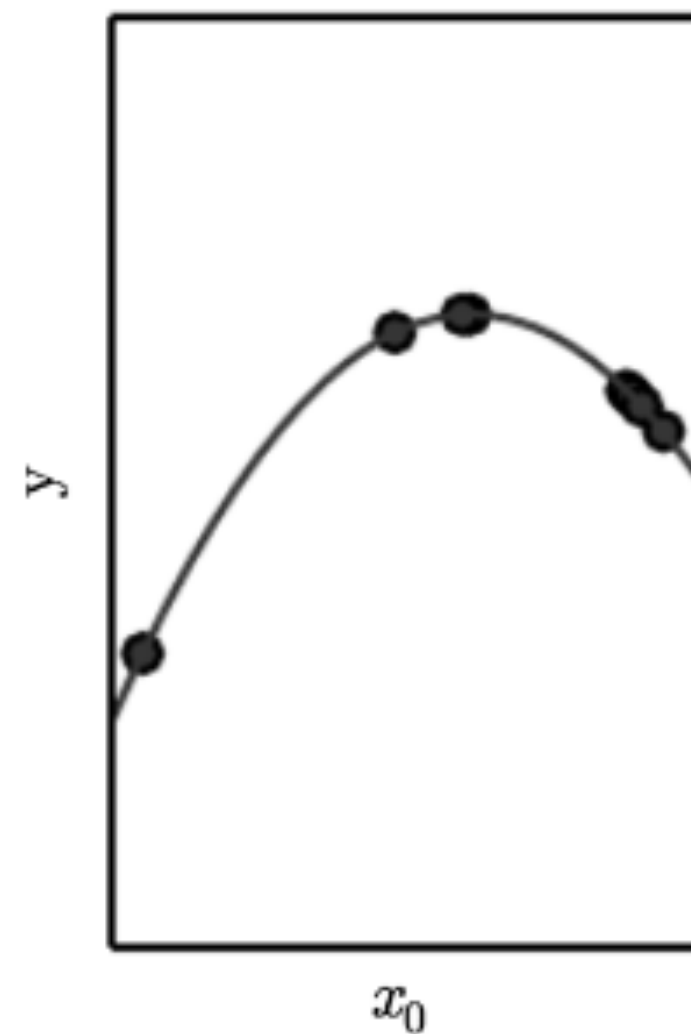
Linear Regression as a simple ANN



Gradient Descent



$$\begin{aligned}h_{\vec{w}}(x) &= w_0 + w_1x + w_2x^2 \\ &= \begin{pmatrix} w_0 \\ w_1 \\ w_2 \end{pmatrix} \cdot \begin{pmatrix} 1 \\ x \\ x^2 \end{pmatrix}\end{aligned}$$



$$R^2 = \frac{\text{ESS}}{\text{TSS}} = \frac{\sum_{i=1}^m (h_{\vec{w}}(\vec{x}^{(i)}) - \bar{y})^2}{\sum_{i=1}^m (y^{(i)} - \bar{y})^2}$$

ESS: Explained Sum of Squares

TSS: Total Sum of Squares

Coefficient of determination R^2

