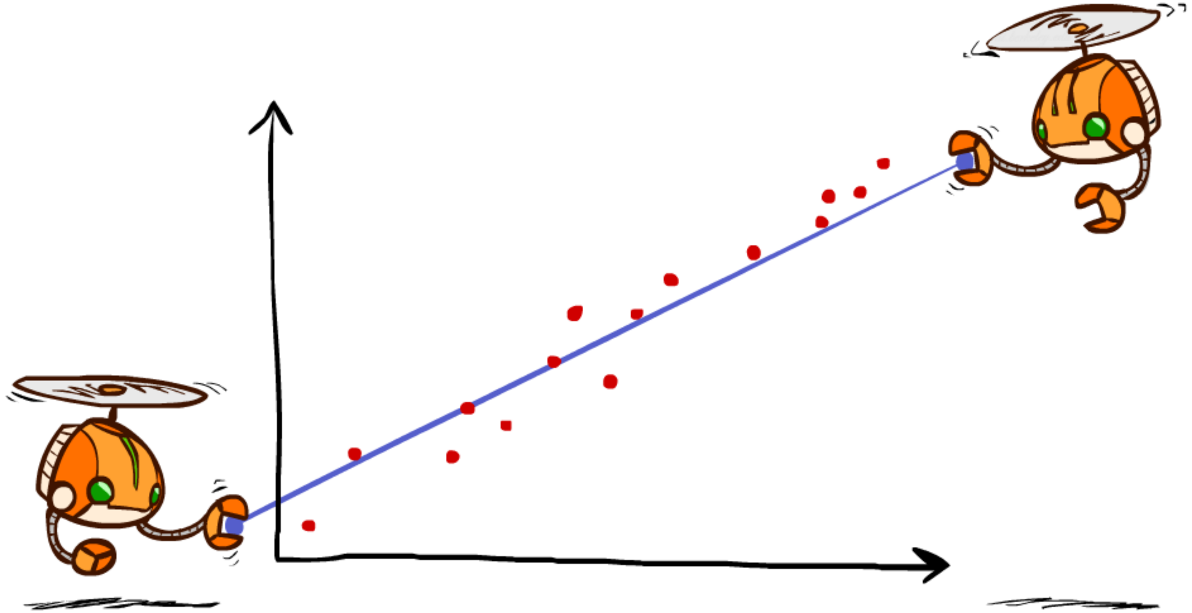
Advanced Topics in AI

Q-Learning and Least Squares



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Leibniz University Hannover

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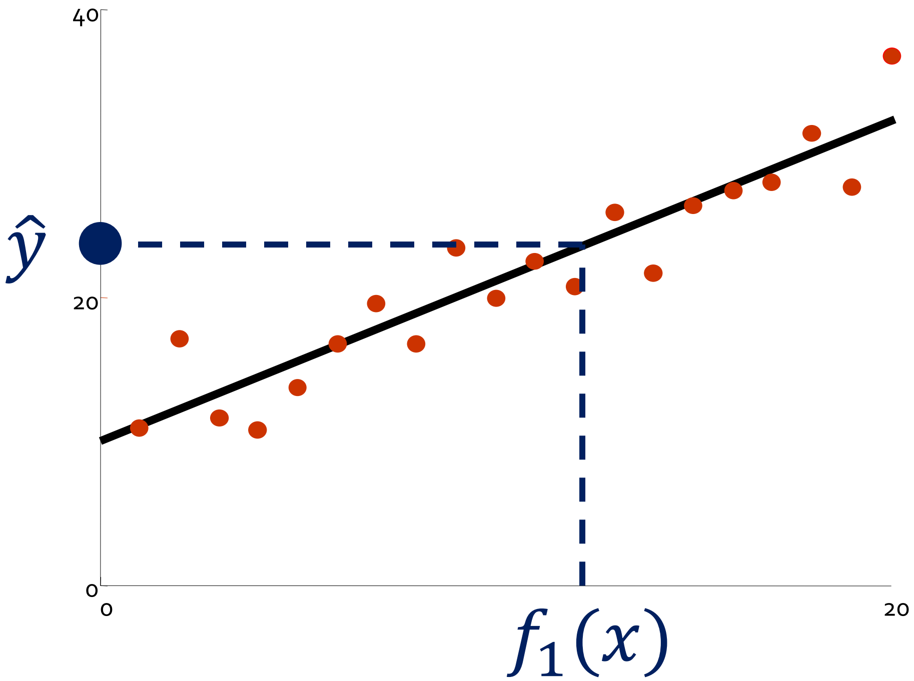
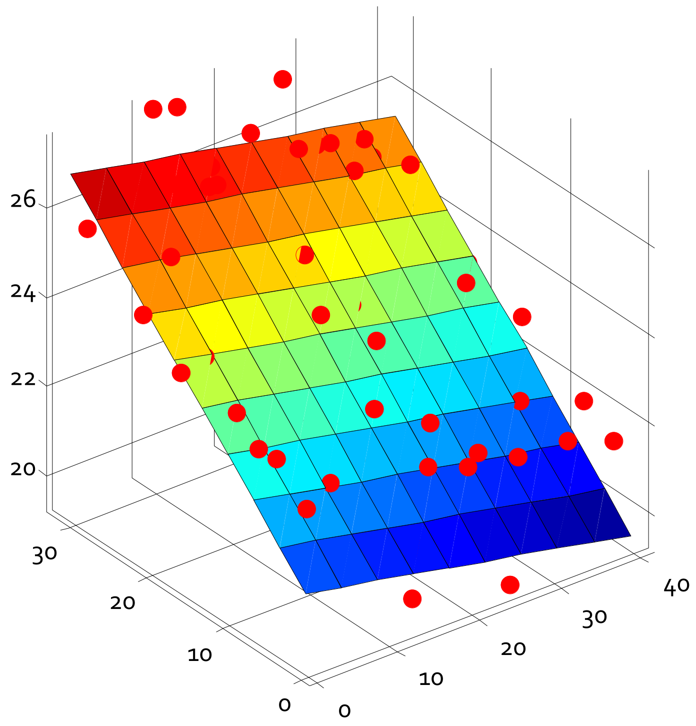
[These slides were created by Dan Klein and Pieter Abbeel for CS188 Intro to AI at UC Berkeley. All materials are available at http://ai.berkeley.edu.]

Linear Approximation: Regression





Prediction:

$$\hat{y} = w_0 + w_1 f_1(x)$$

Prediction:

$$\hat{y}_i = w_0 + w_1 f_1(x) + w_2 f_2(x)$$

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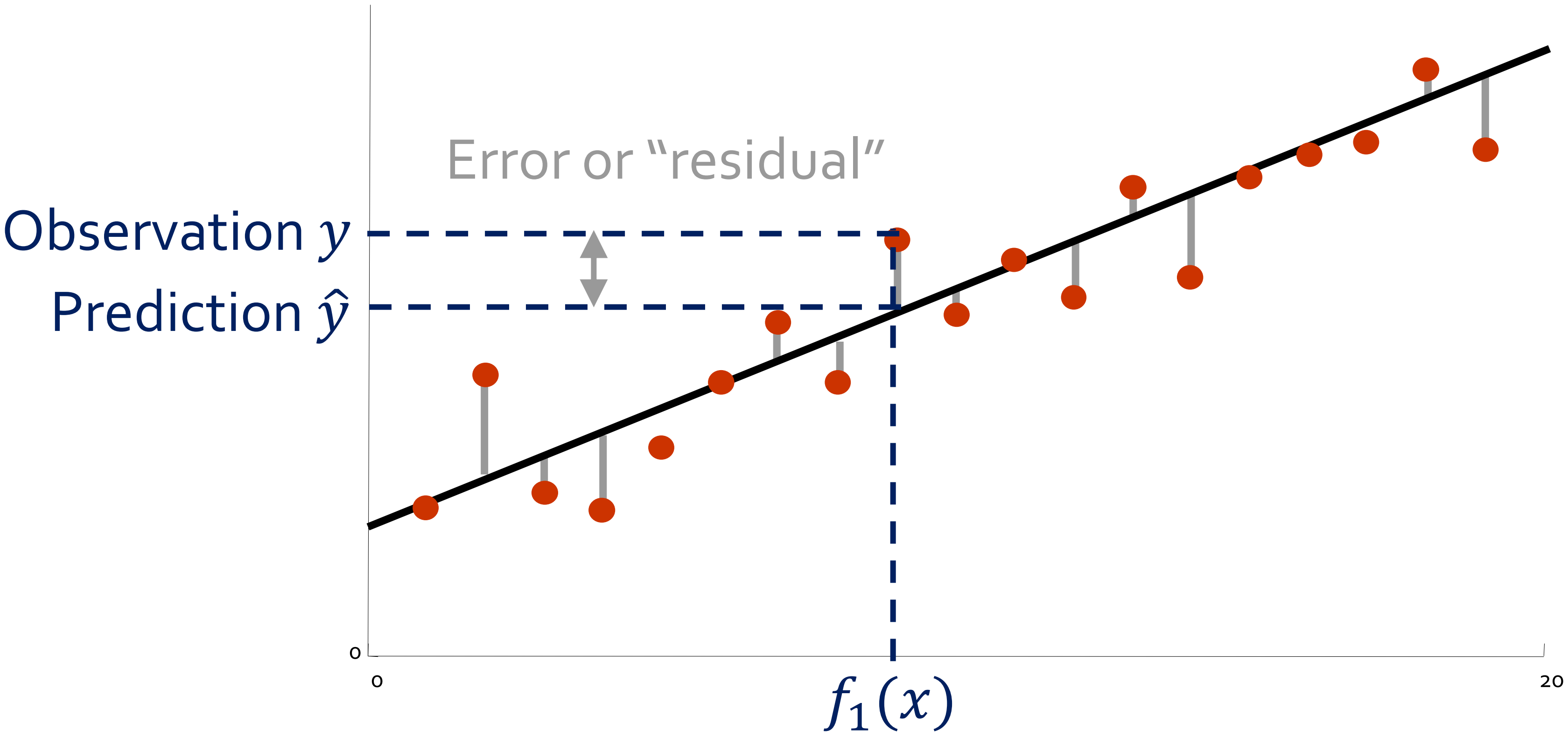
Optimization: Least Squares

$$\text{total error} = \sum_i \left(y_i - \hat{y}_i\right)^2 = \sum_i \left(y_i - \sum_k w_k f_k(x_i)\right)^2$$



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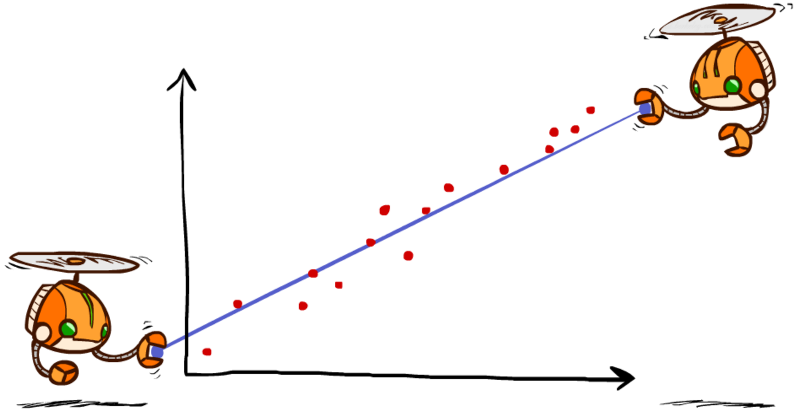
Minimizing Error

Imagine we had only one point x, with features f(x), target value y, and weights w:

$$\text{error}(w) = \frac{1}{2}\left(y - \sum_k w_k f_k(x)\right)^2$$

$$\frac{\partial \text{error}(w)}{\partial w_m} = -\left(y - \sum_k w_k f_k(x)\right) f_m(x)$$

$$w_m \leftarrow w_m + \alpha \left(y - \sum_k w_k f_k(x)\right) f_m(x)$$



Approximate q update explained:

$$w_m \leftarrow w_m + \alpha \left[r + \gamma \max_a Q(s', a') - Q(s, a) \right] f_m(s, a)$$

"target" "prediction"

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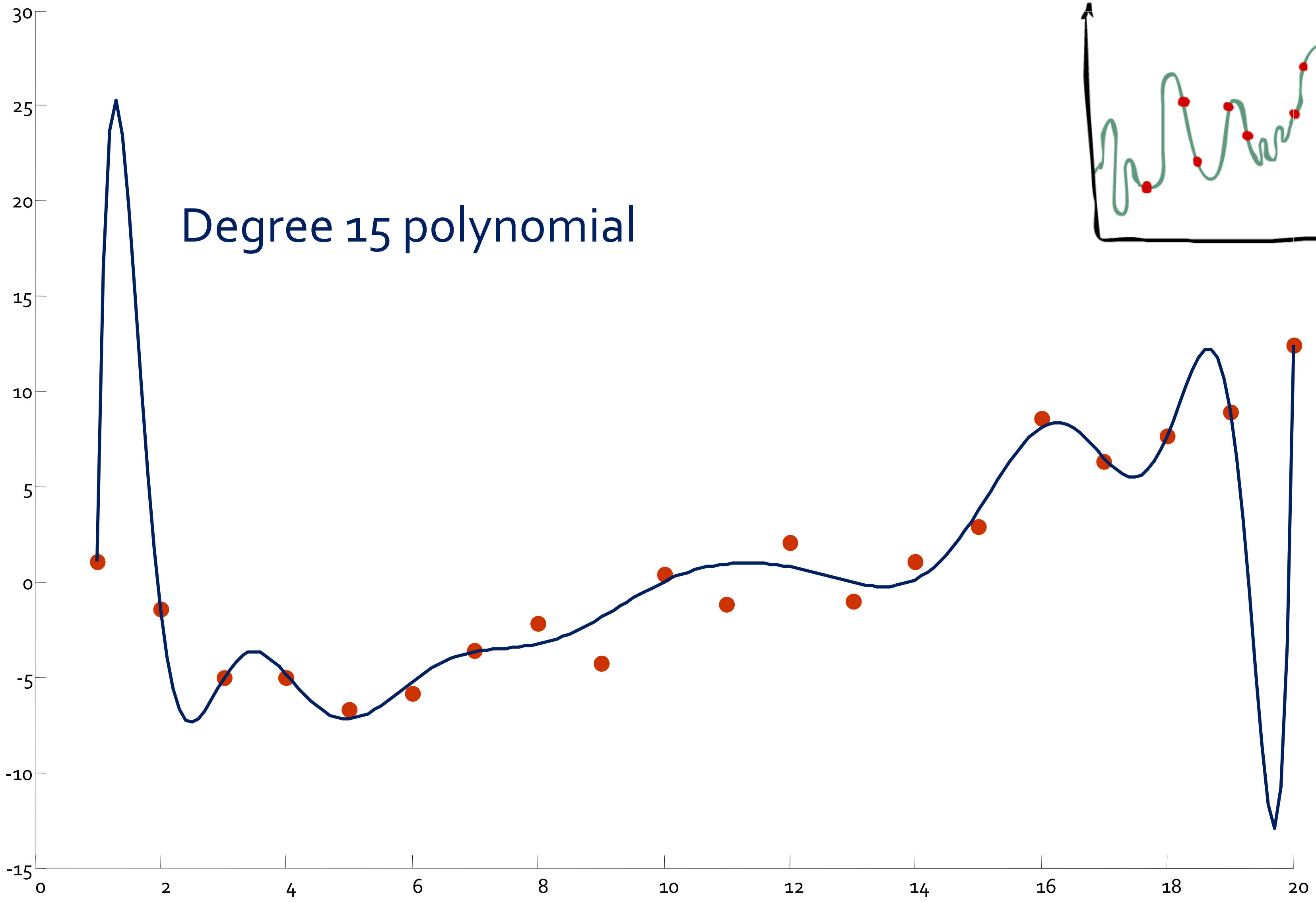
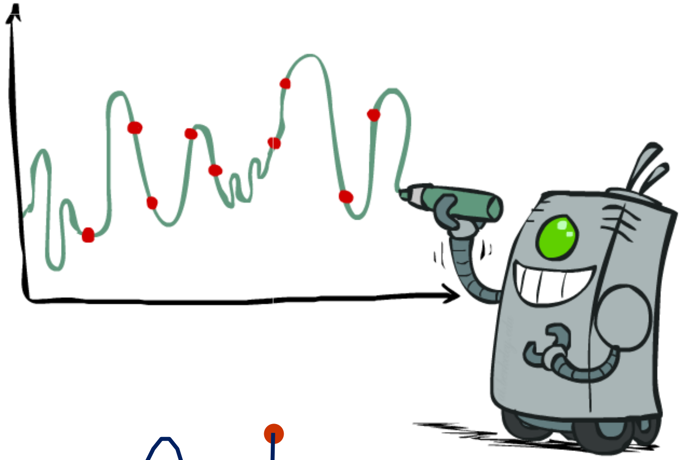
Overfitting: Why Limiting Capacity Can Help





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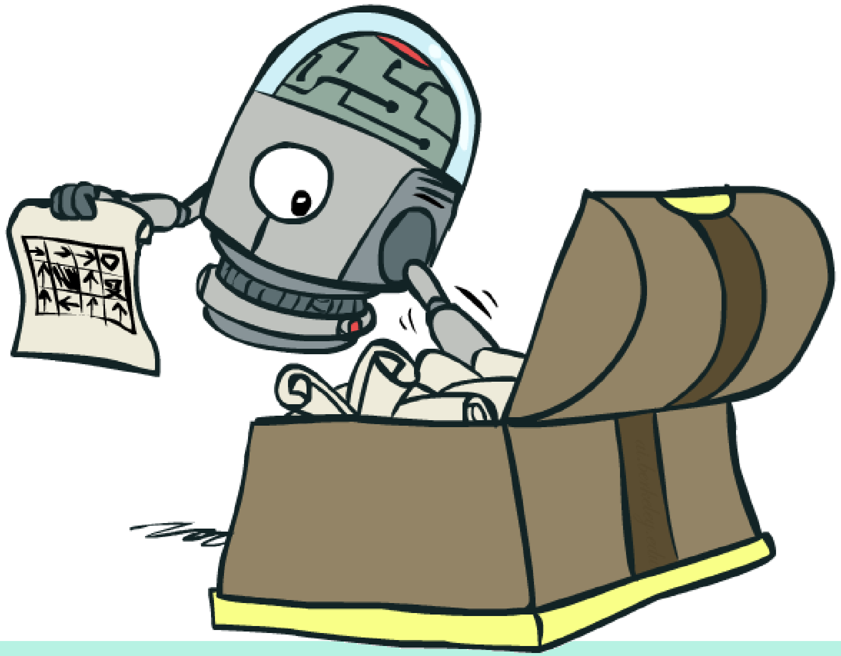
Next: Policy Search



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