COMP2261 ARTIFICIAL INTELLIGENCE / MACHINE LEARNING

Bias vs Variance

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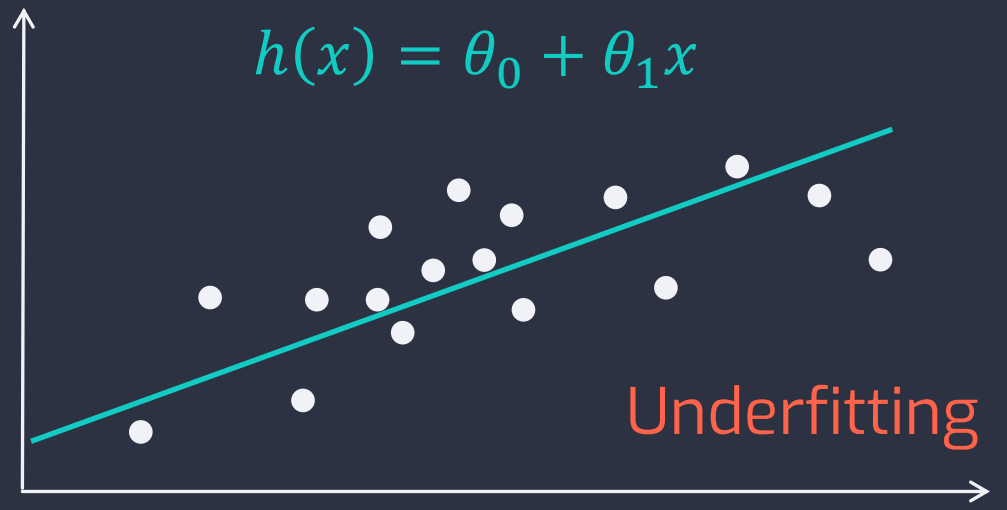
learning lab

Learning Objectives

- Understand the definition of Bias and Variance
- Understand what is a Bias-Variance Trade-off
- Understand how to detect bias (underfit) and variance (overfit)

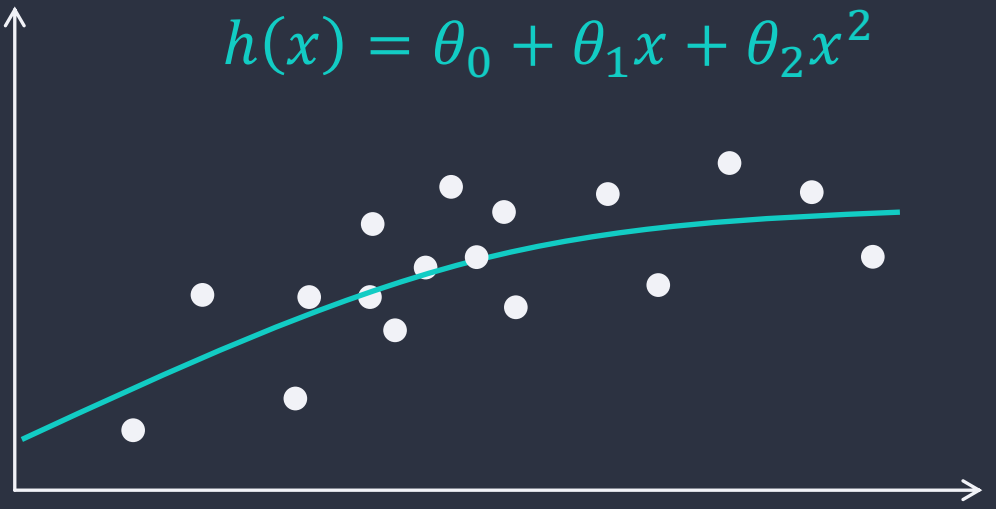
EXAMPLE. annual income to predict happiness

$h(x) = \theta_0 + \theta_1 x$

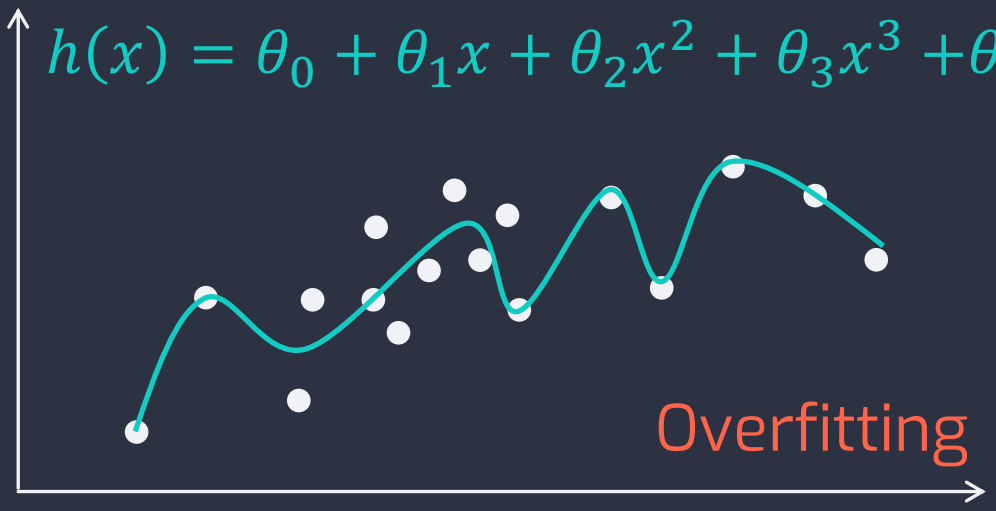


Underfitting / High Bias

$h(x) = \theta_0 + \theta_1 x + \theta_2 x^2$



$h(x) = \theta_0 + \theta_1 x + \theta_2 x^2 + \theta_3 x^3 + \theta_4 x^4$



Overfitting / High Variance

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Bias vs Variance

Low Variance

High Variance

Low Bias

High Bias

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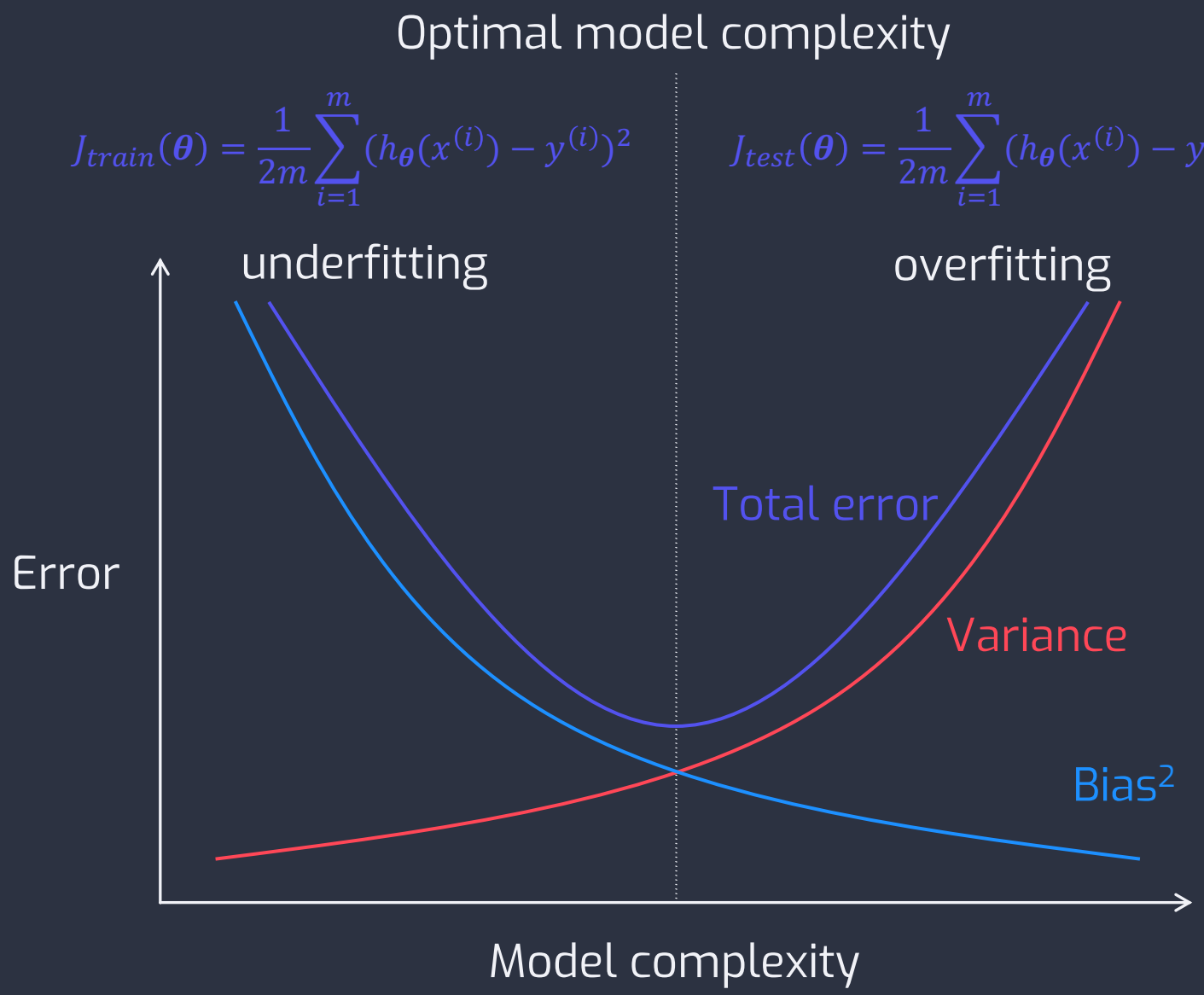
Bias-Variance Trade-off



High bias / underfitting

$J_{train}(\boldsymbol{\theta})$ high $\quad J_{train}(\boldsymbol{\theta}) \approx J_{test}(\boldsymbol{\theta})$

High variance / overfitting

$J_{train}(\boldsymbol{\theta})$ low $\quad J_{train}(\boldsymbol{\theta}) \ll J_{test}(\boldsymbol{\theta})$

Takeaway Points

- Definition of bias and variance
- Causes of bias and variance, model complexity
- Bias-variance trade-off
- Detecting bias and variance