



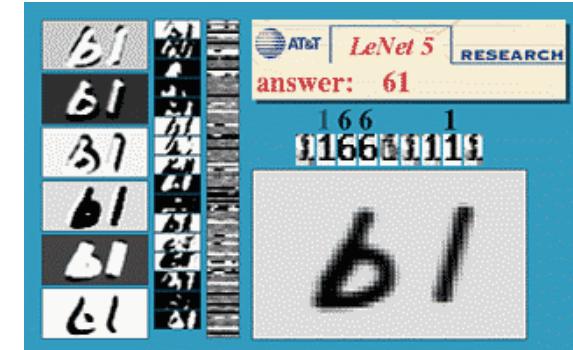
# Neural Networks

Knowledge-based Systems and Artificial Intelligence  
**Laboratory practice**

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(Autonomous driving)



(handwriting recognition)



(Purdue University image/e-Lab)



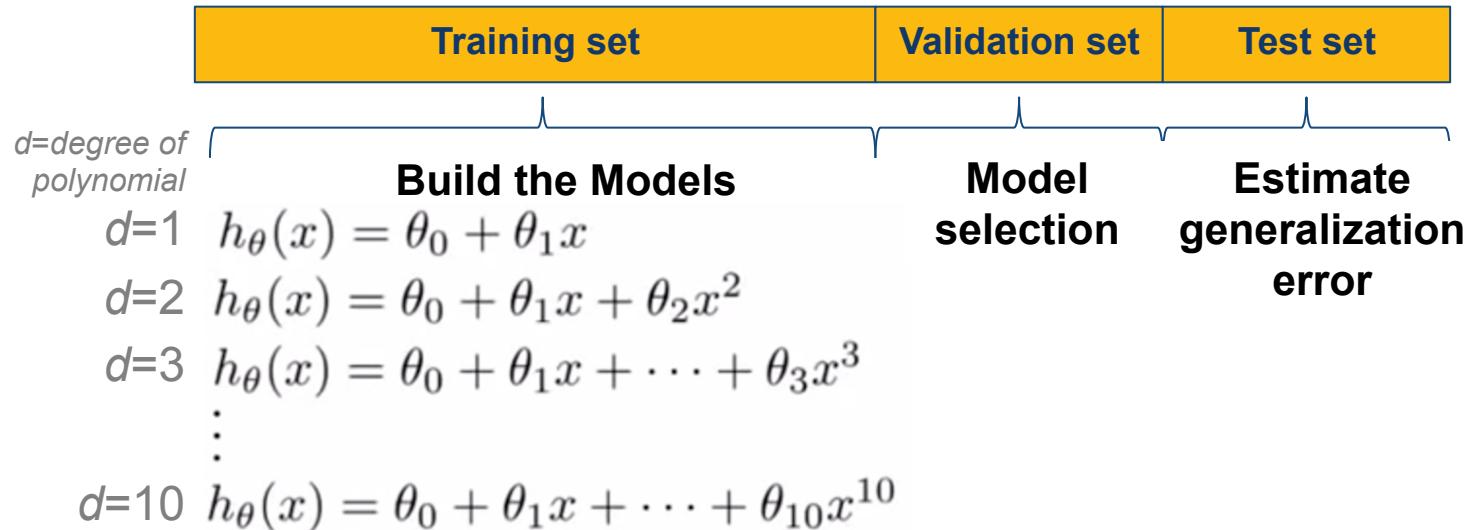
- **Why?**

	Training set	Test set
<i>d=degree of polynomial</i>		
<b>Models</b>		<b>Model selection</b>
$d=1$	$h_{\theta}(x) = \theta_0 + \theta_1 x$	$\rightarrow \text{ModelError}(\text{Model } d=1)$
$d=2$	$h_{\theta}(x) = \theta_0 + \theta_1 x + \theta_2 x^2$	$\rightarrow \text{ModelError}(\text{Model } d=2)$
$d=3$	$h_{\theta}(x) = \theta_0 + \theta_1 x + \dots + \theta_3 x^3$	$\rightarrow \text{ModelError}(\text{Model } d=3)$
:		
$d=10$	$h_{\theta}(x) = \theta_0 + \theta_1 x + \dots + \theta_{10} x^{10}$	$\rightarrow \text{ModelError}(\text{Model } d=10)$

- **How well does model generalize?** Report test set error
- **Problem:** the extra parameter  $d$  is fit to test set.



- Split the dataset into:



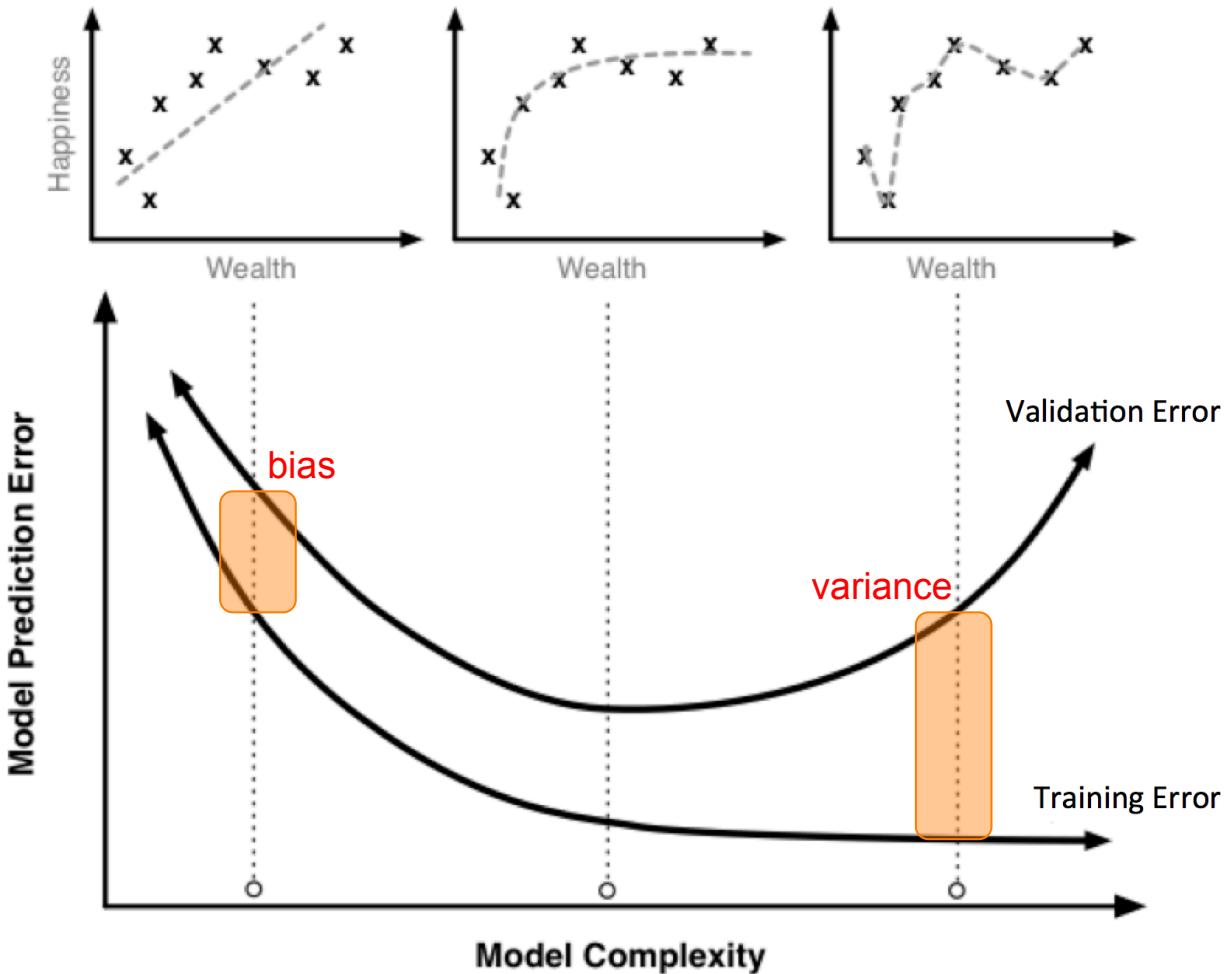


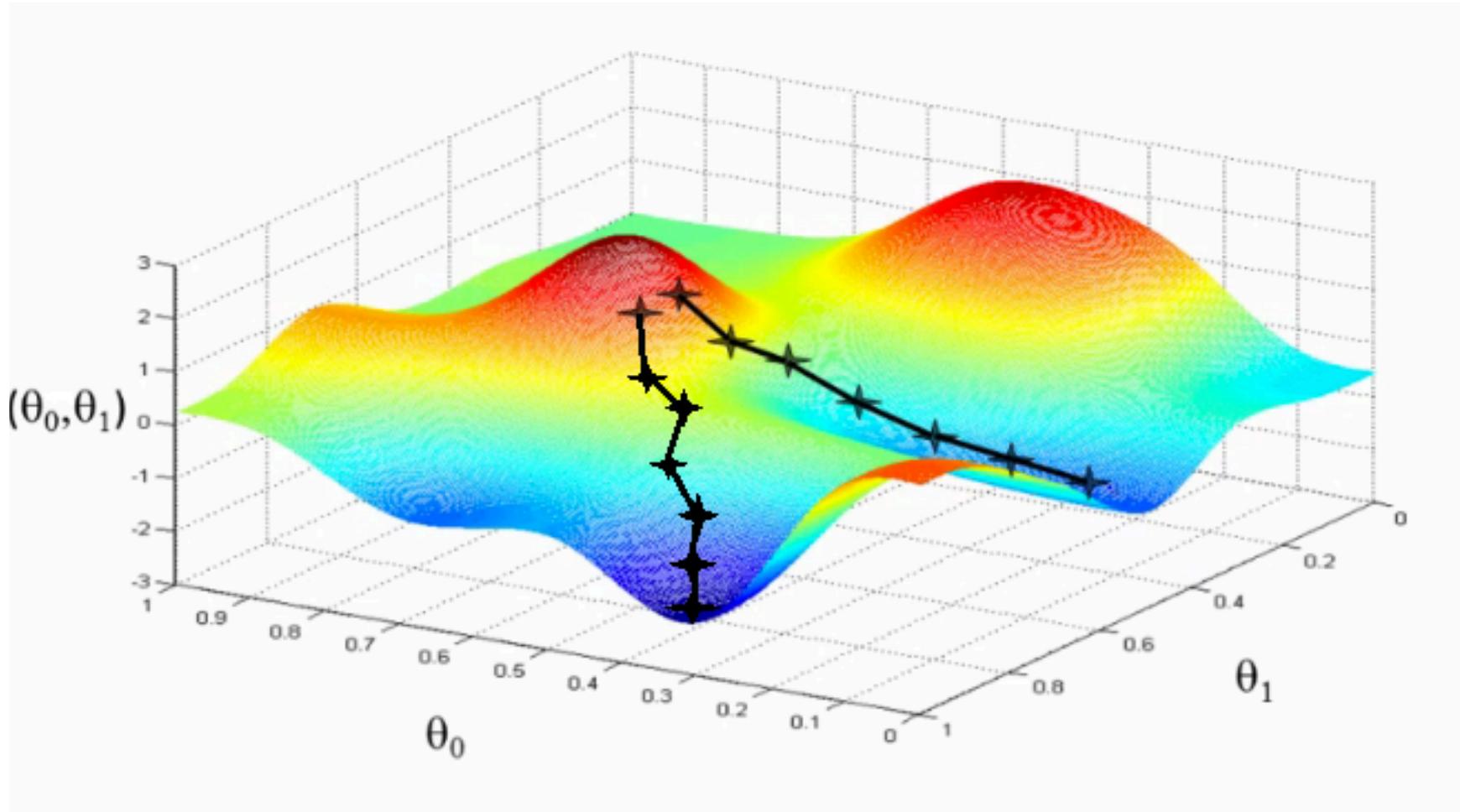
### Bias (underfit)

Training error will be high  
Validation error ~ Training error

### Variance (overfit)

Training error will be low  
Validation error >> Training error







- Deadline:
  - December **19**, 2014
- Resources:
  - Neural Networks Toolbox <http://goo.gl/n1XJpr>
- Send questions to:
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  - attila.fesus@telin.ugent.be