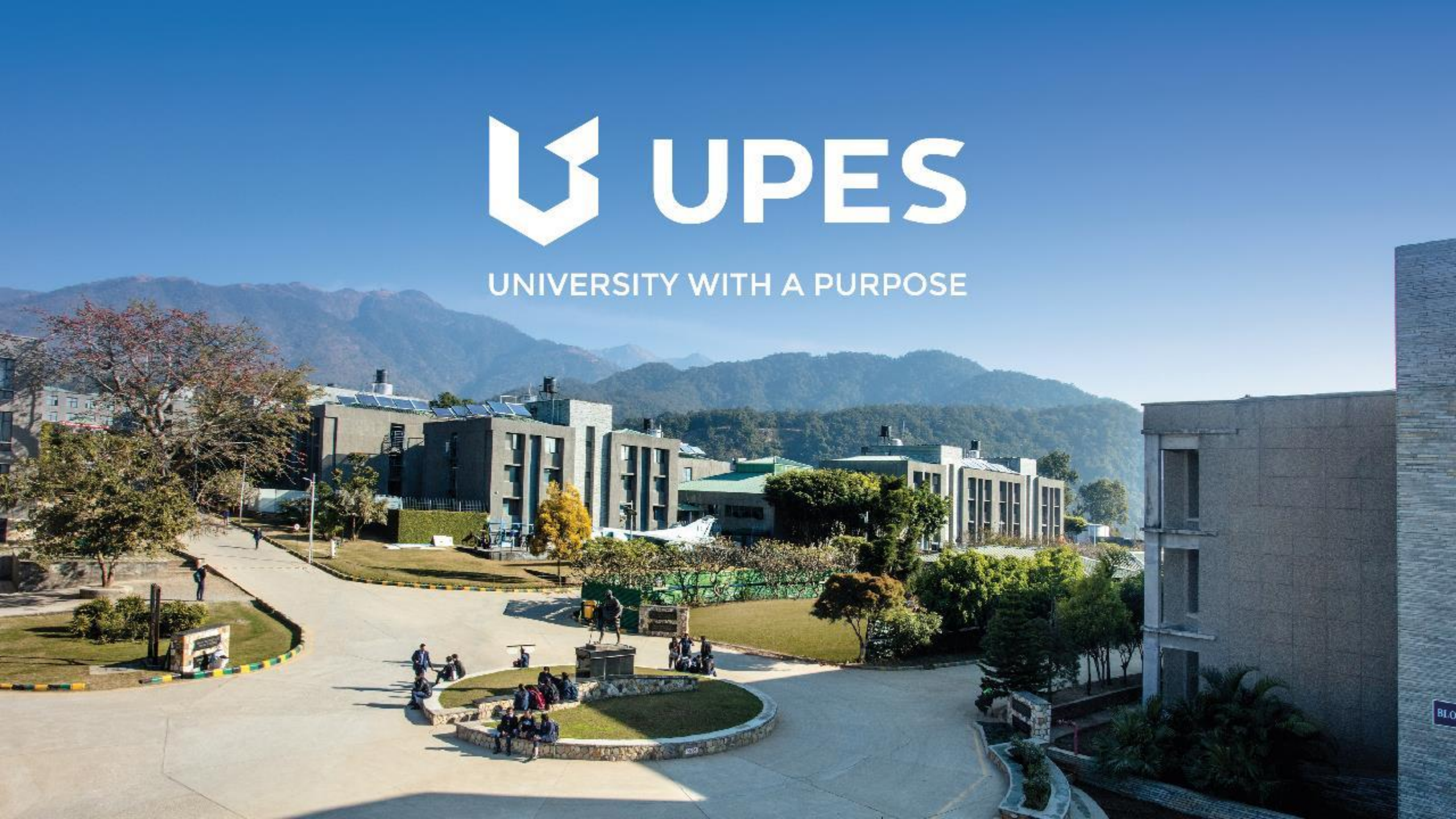
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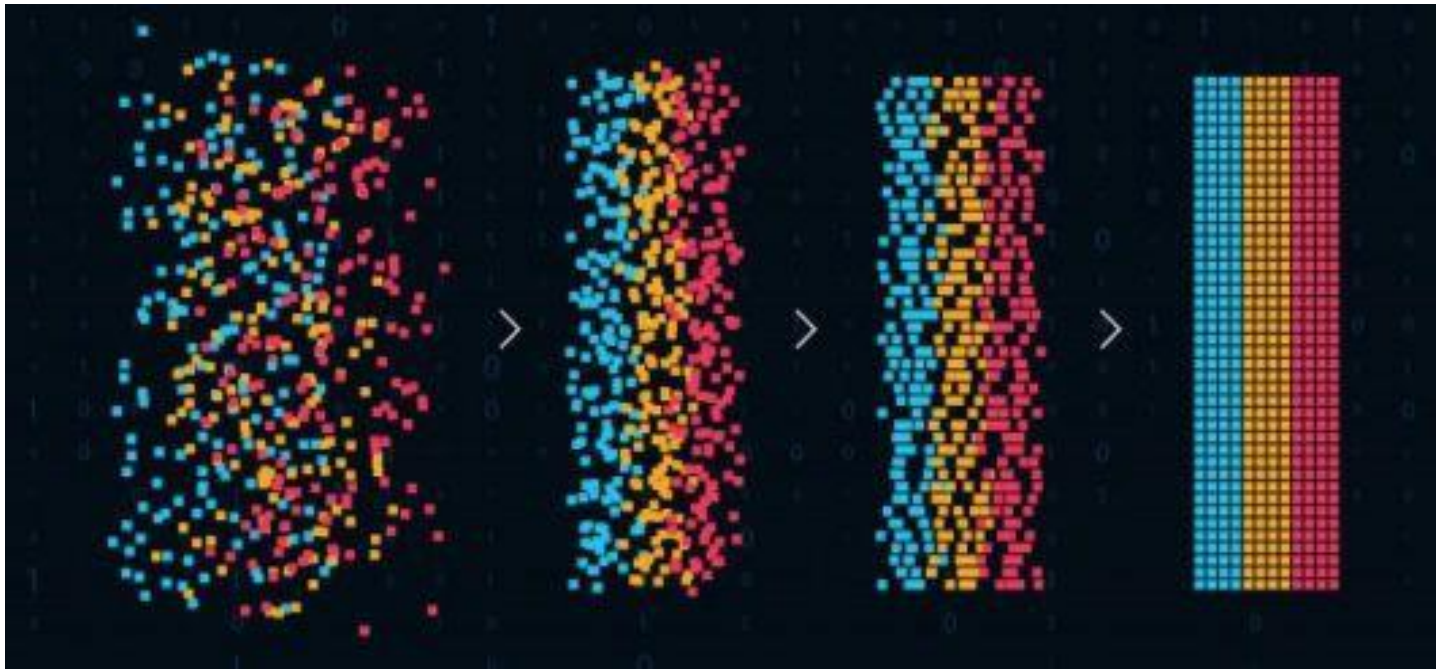
Pattern and Anomaly Detection



Source: Edureka

B. Tech., CSE + AI/ML

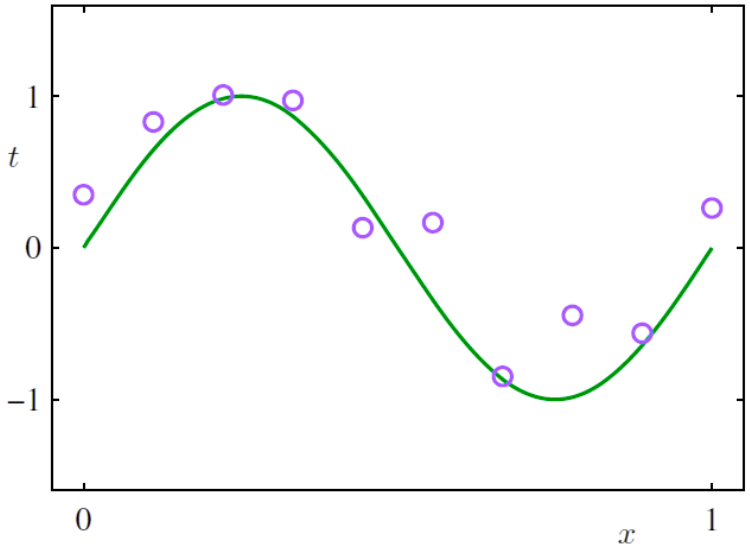
Dr Gopal Singh Phartiyal

9/08/2021

Context: Regression

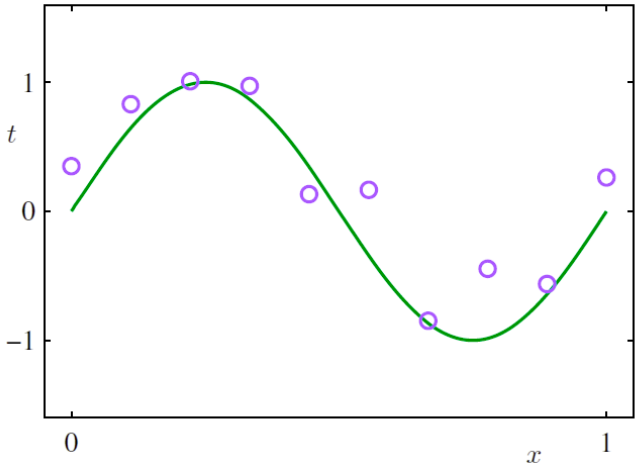
- Observe a real-valued variable (input) *(x)*
- Using this observation to predict the value of a real-valued target variable *(t)*
- Create some data using function Sin(2p*x)*
- Add random noise to target variable
- We have N observations

$$\mathbf{x} = (x_1, x_2, \ldots\ldots x_N)^T$$
$$\mathbf{t} = (t_1, t_2, \ldots\ldots t_N)^T$$



Let say N = 10, x varies from 0 to 10, t is computed using Sin(2p*x)* and then adding Gaussian noise.

Context: Regression



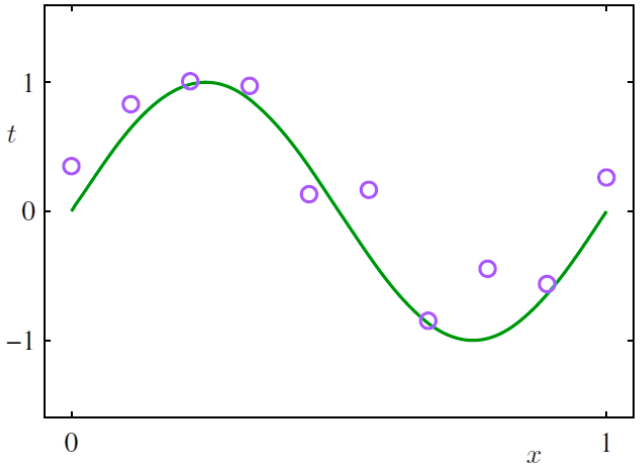
- **Goal**: Use training data to make better predictions of for some new *x*.
- Implicitly trying to discover the underlying function.
- **Problem**: Generalize from finite data, corrupted with noise (nature unknown).
- Solution approach: Curve fitting

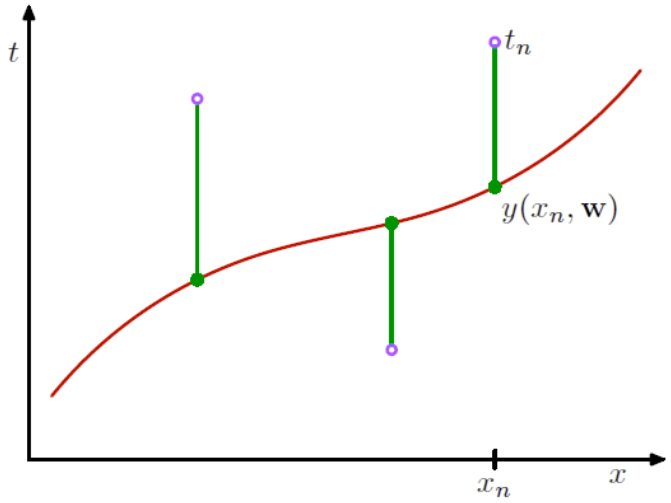
$$y(x, \mathbf{w}) = w_0 + w_1 x + w_2 x^2 + \ldots + w_M x^M = \sum_{j=0}^{M} w_j x^j$$

- Function is non-linear in *x* but linear in **w**. Therefore such functions are called **linear models.**

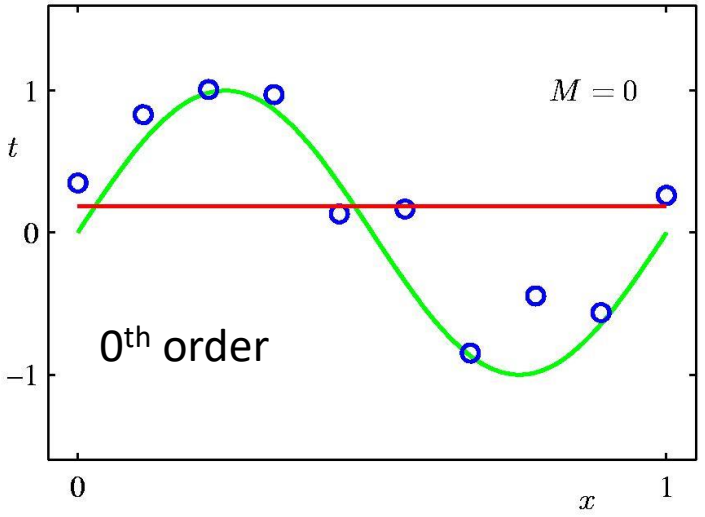
Context: Regression

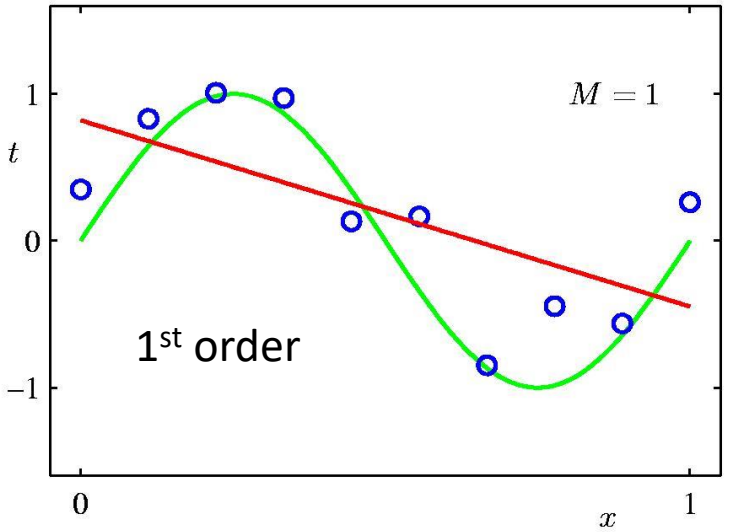
- Error function $$E(\mathbf{w}) = \frac{1}{2}\sum_{n=1}^{N}\{y(x_n, \mathbf{w}) - t_n\}^2$$
- Change **w** so as to minimize E(**w**).
- Change M to change model.

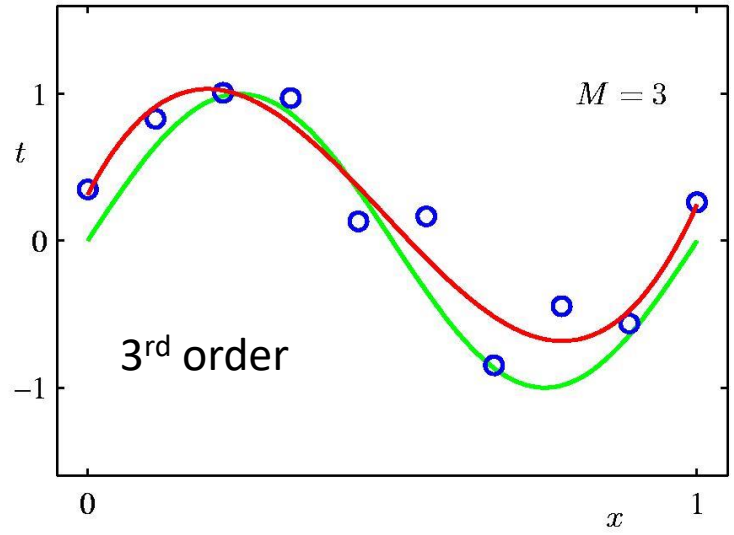


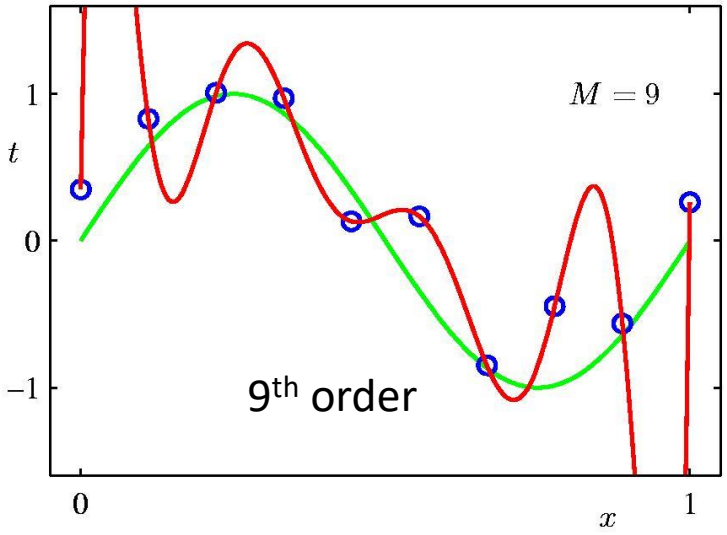


Different models and weight parameters



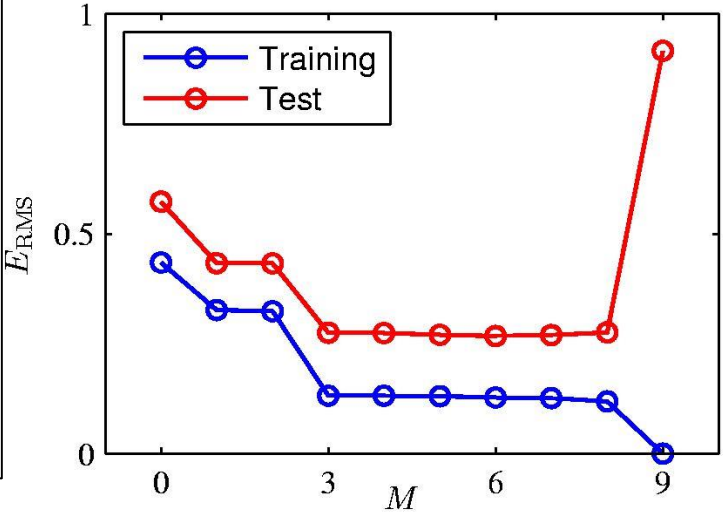




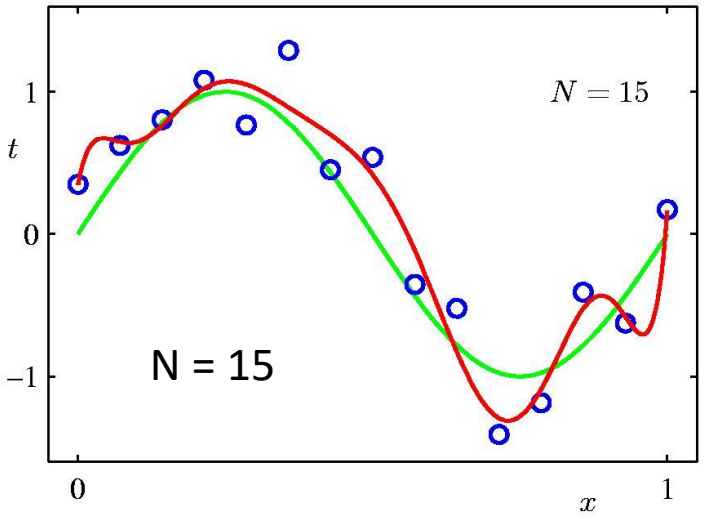


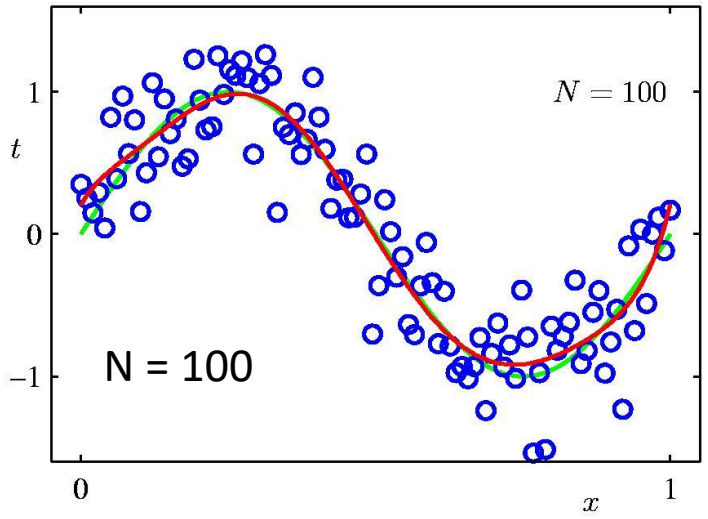
	$M=0$	$M=1$	$M=3$	$M=9$
$w_0^\star$	0.19	0.82	0.31	0.35
$w_1^\star$		-1.27	7.99	232.37
$w_2^\star$			-25.43	-5321.83
$w_3^\star$			17.37	48568.31
$w_4^\star$				-231639.30
$w_5^\star$				640042.26
$w_6^\star$				-1061800.52
$w_7^\star$				1042400.18
$w_8^\star$				-557682.99
$w_9^\star$				125201.43

Overfitting



Impact of data samples





Thank You