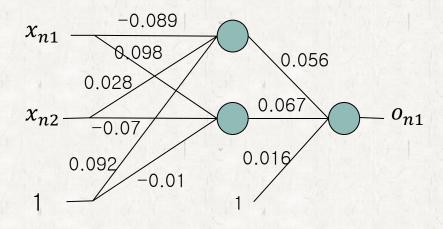
Example of Error Back Propagation

Example of Error Back Propagation (1)

Example : XOR

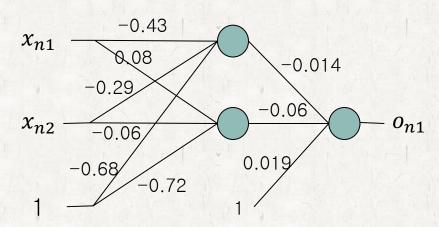
Iteration: 0

x_{n1}	x_{n2}	t_{n1}	o_{n1}
1	1	0	0.52
1	0	1	0.50
0	1	11/	0.52
0	0	0	0.55



Iteration: 1000

x_{n1}	x_{n2}	t_{n1}	o_{n1}
1		0	0.50
1	0	1	0.48
0	1	11	0.50
0	0	0	0.52

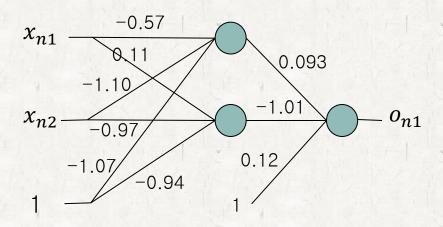


Example of Error Back Propagation (2)

Example : XOR

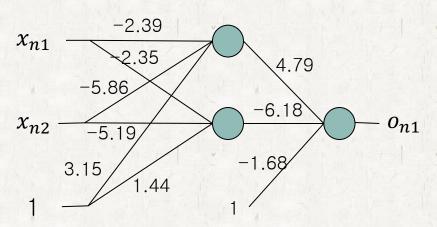
Iteration: 2000

x_{n1}	x_{n2}	t_{n1}	o_{n1}
1	1	0	0.53
1	0	1	0.48
0	1	11/	0.50
0	0	0	0.48



Iteration: 3000

x_{n1}	x_{n2}	t_{n1}	o_{n1}
1	1_{rn}	0	0.30
1	0	1	0.81
0	1	1	0.81
0	0	0	0.11

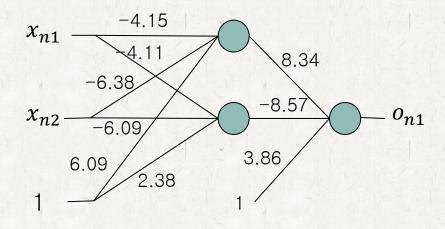


Example of Error Back Propagation (3)

Example : XOR

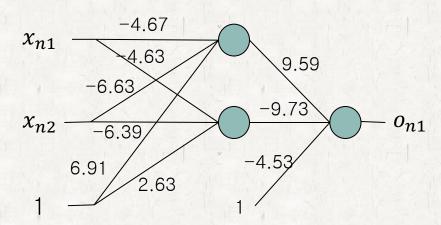
Iteration: 5000

x_{n1}	x_{n2}	t_{n1}	o_{n1}
1	1	0	0.05
1	0	110	0.96
0	1	11/	0.96
0	0	0	0.03



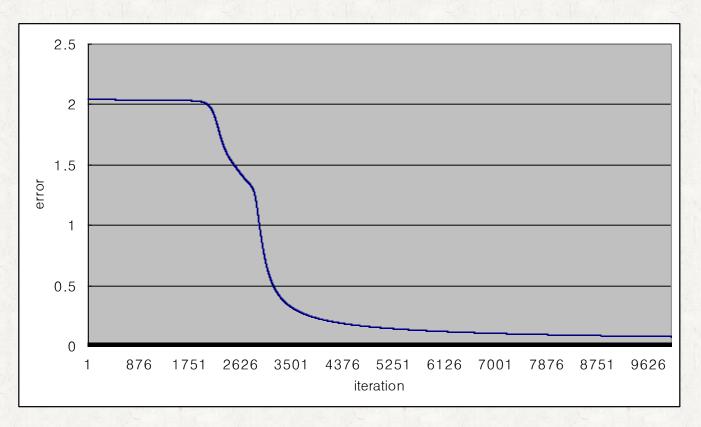
Iteration: 10000

x_{n1}	x_{n2}	t_{n1}	o_{n1}
1		0	0.02
1	0	1	0.98
0	1	11	0.98
0	0	0	0.02



Example of Error Back Propagation (4)

- Example : XOR
 - Error graph



Example of Error Back Propagation (5)

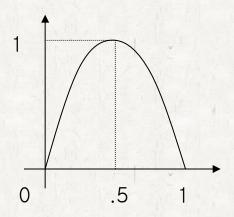
• Example2:

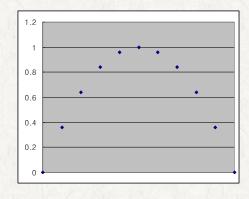
Hidden nodes: 4

Iteration: 500,000

Learning rate: 0.7

$$f(x) = 4x * (1-x)$$

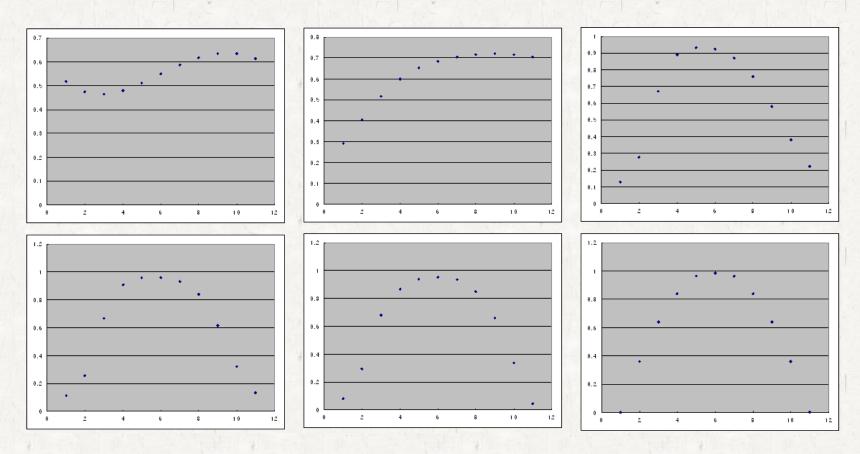




Input	Output
0.00	0.00
0.10	0.36
0.20	0.64
0.30	0.84
0.40	0.96
0.50	1.00
0.60	0.96
0.70	0.84
0.80	0.64
0.90	0.36
1.00	0.00

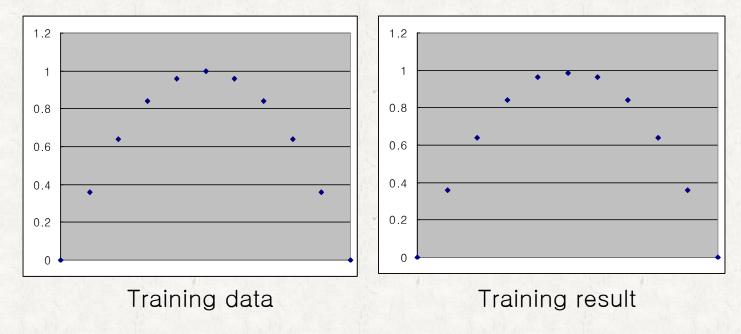
Example of Error Back Propagation (6)

Example 2



Generalization and Overfitting (1)

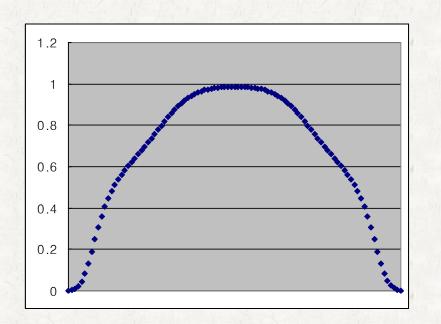
- We gave only 11 points
 - A NN learned only that 11 points

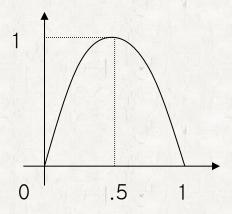


Can the NN answer to the un-learned points?

Generalization and Overfitting (2)

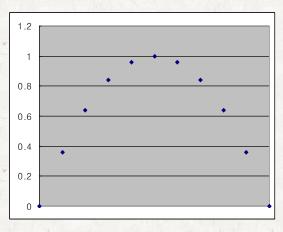
Yes, NNs generalize what they have learned



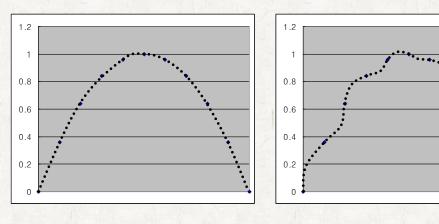


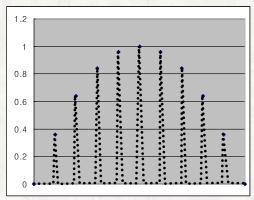
Generalization and Overfitting (3)

Which one is better?



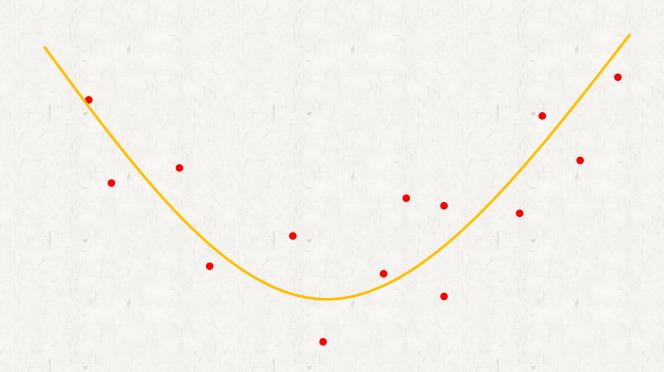
Training data





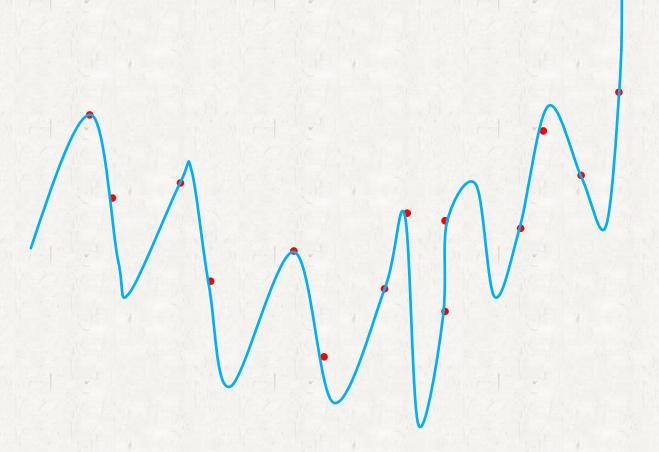
Generalization and Overfitting (4)

Which is Better?



Generalization and Overfitting (5)

Which is Better?



Generalization and Overfitting (6)

- To increase generalization accuracy
 - Find the optimal number of neurons
 - Find the optimal number of training iterations
 - Use regularization
 - Use more training data