机器学习
统计学习方法

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第一章补充 线性回归预测

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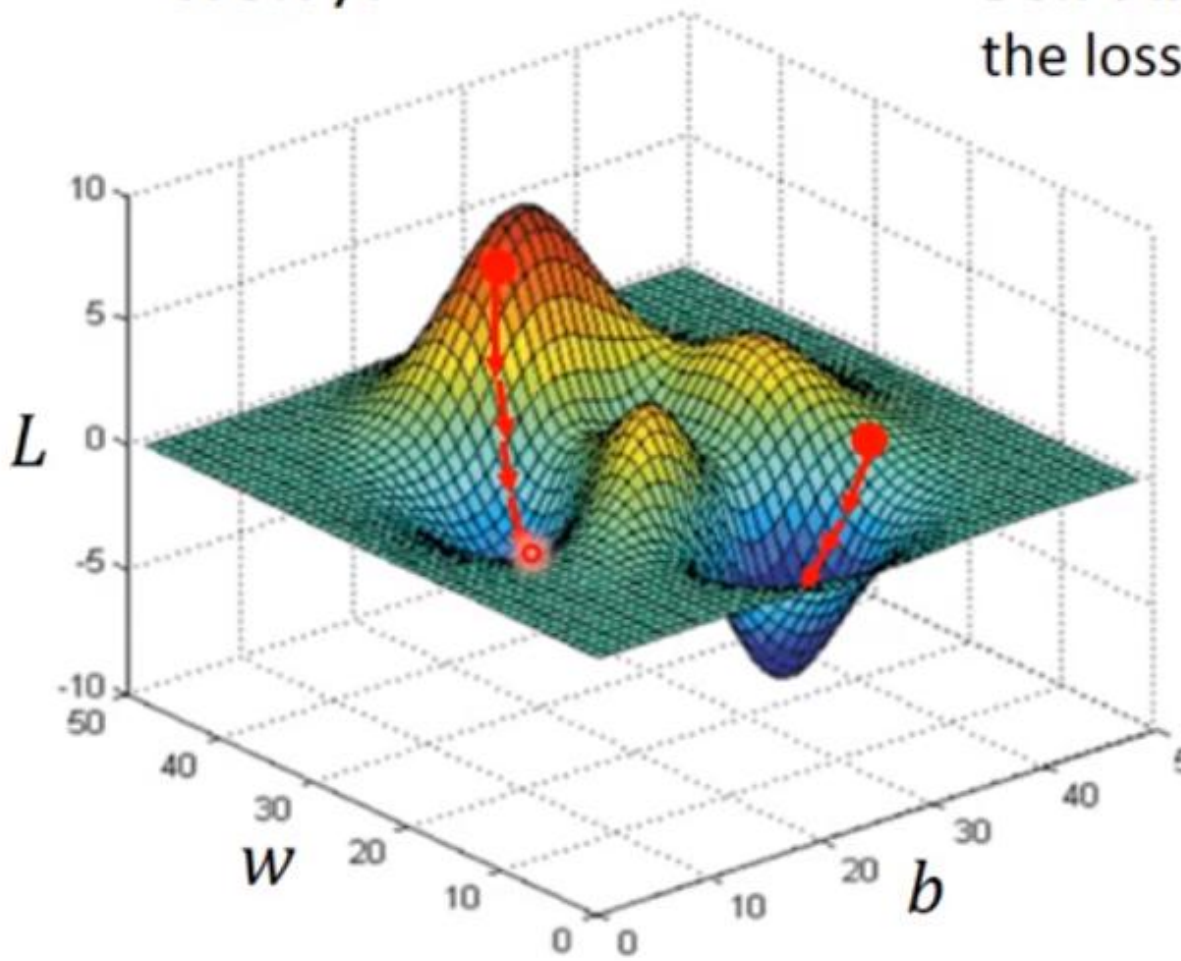
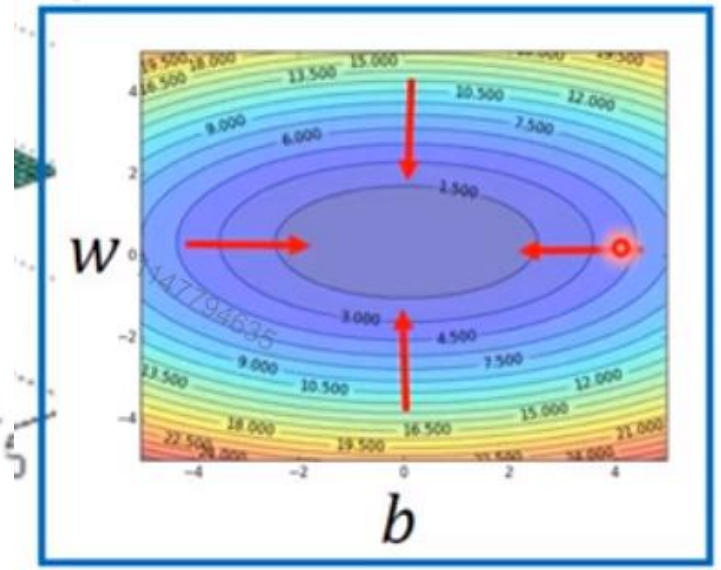
Step 3: Gradient Descent

- Worry?

Don't worry. In linear regression, the loss function L is convex.



No local optimal

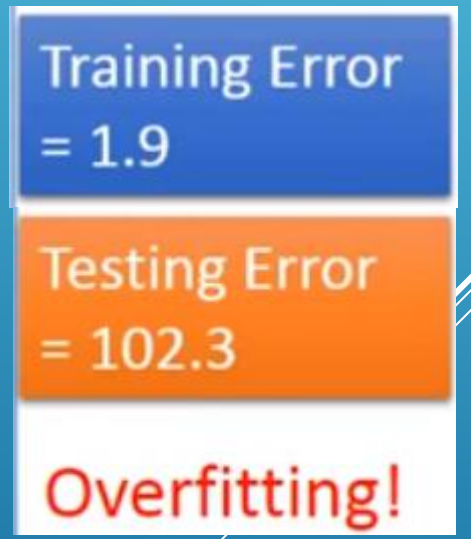


How can we do better?

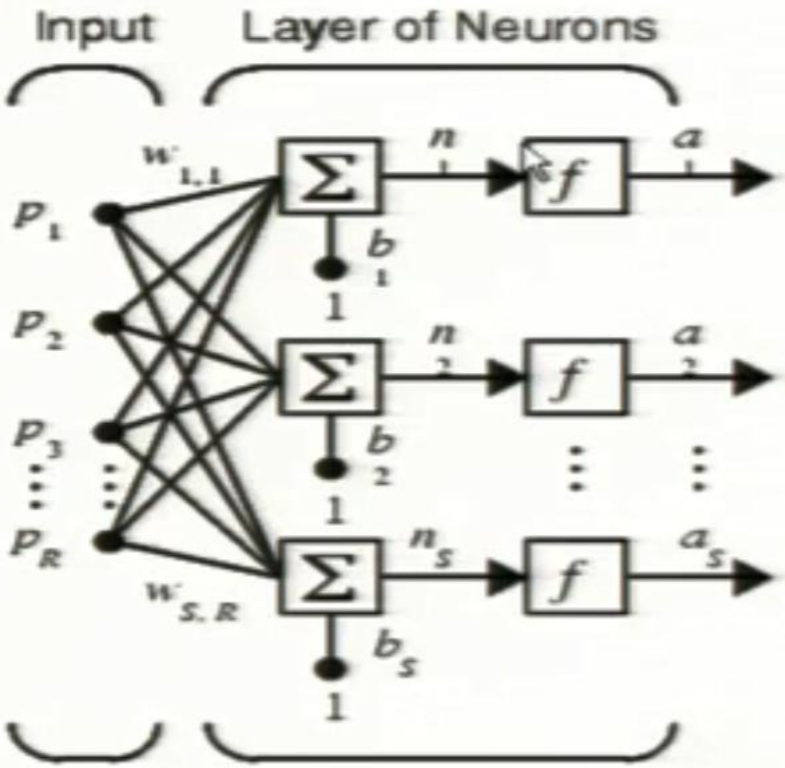
Select suitable model

	Training	Testing
1	31.9	35.0
2	15.4	18.4
3	15.3	18.1
4	14.9	28.2
5	12.8	232.1

→ Select suitable model

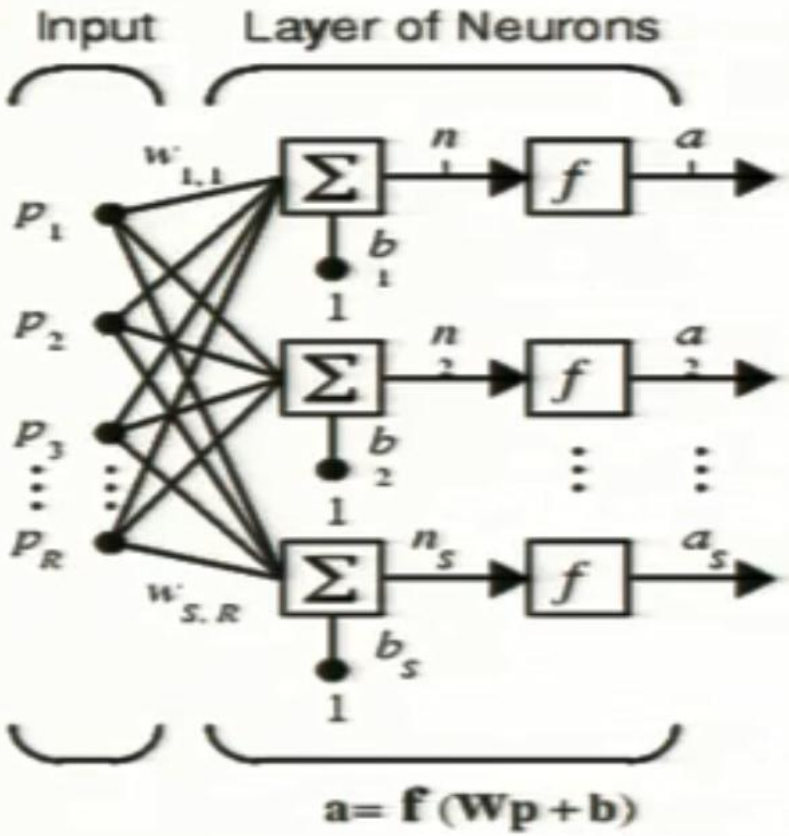

Training Error
= 1.9
Testing Error
= 102.3
Overfitting!

Single-Layer Network（单层网络）



$$\mathbf{a} = \mathbf{f}(\mathbf{W}\mathbf{p} + \mathbf{b})$$

Single-Layer Network（单层网络）



- R: number of input
- S: number of neuron (node) in a layer ($R \neq S$)
- Input vector **p** is a vector of length R
- Bias vector **b** and output vector **a** are vectors of length S
- Weight matrix **W** is an $S \times R$ matrix

$$\boldsymbol{W} = \begin{bmatrix} w_{11} & w_{12} & \cdots & w_{1R} \\ w_{21} & w_{22} & \cdots & w_{2R} \\ \vdots & \vdots & \ddots & \vdots \\ w_{S1} & w_{S2} & \cdots & w_{SR} \end{bmatrix}$$

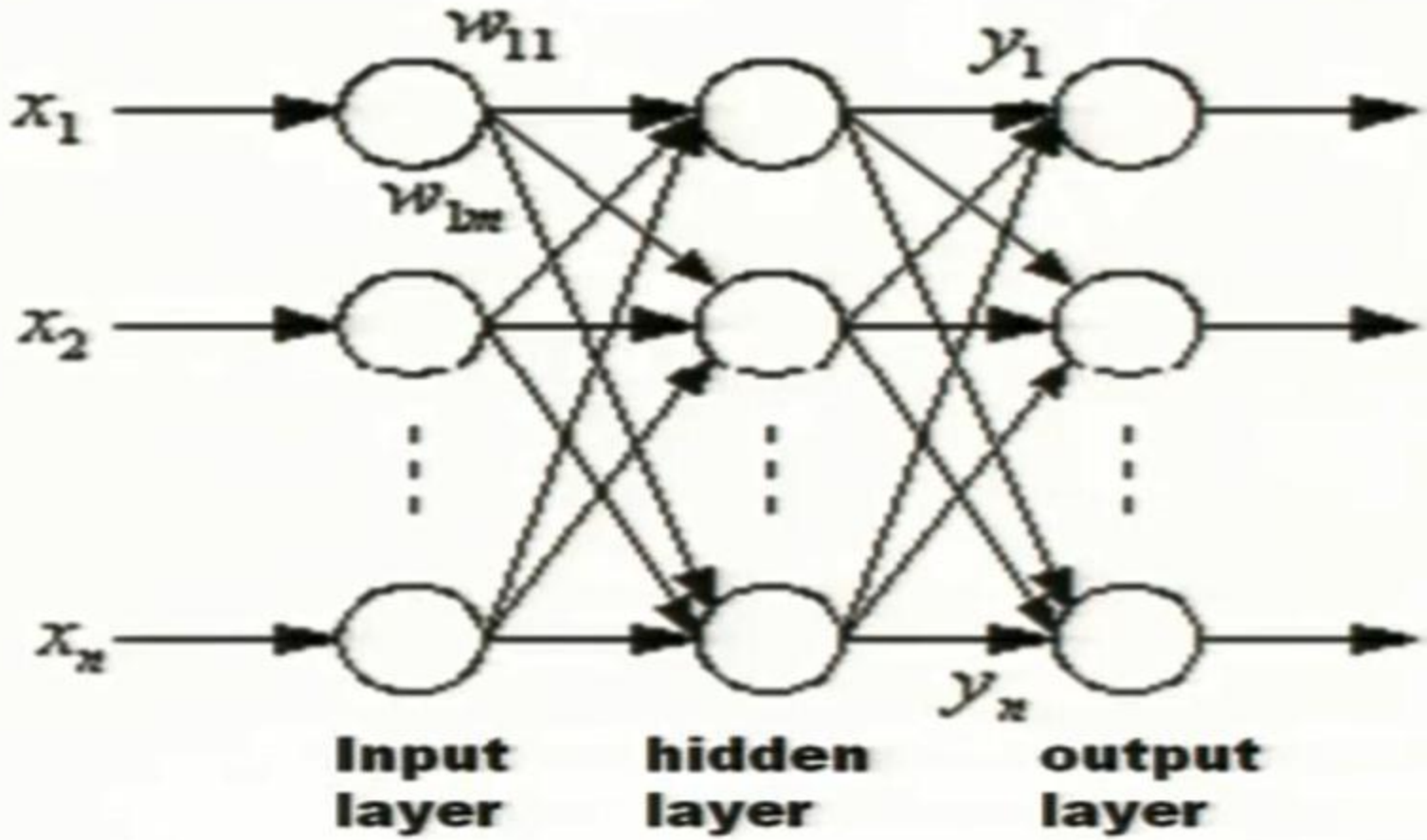
Network Structures

- The layer that receives inputs is called the ***input layer***.
- The outputs of the network are generated from the ***output layer***.

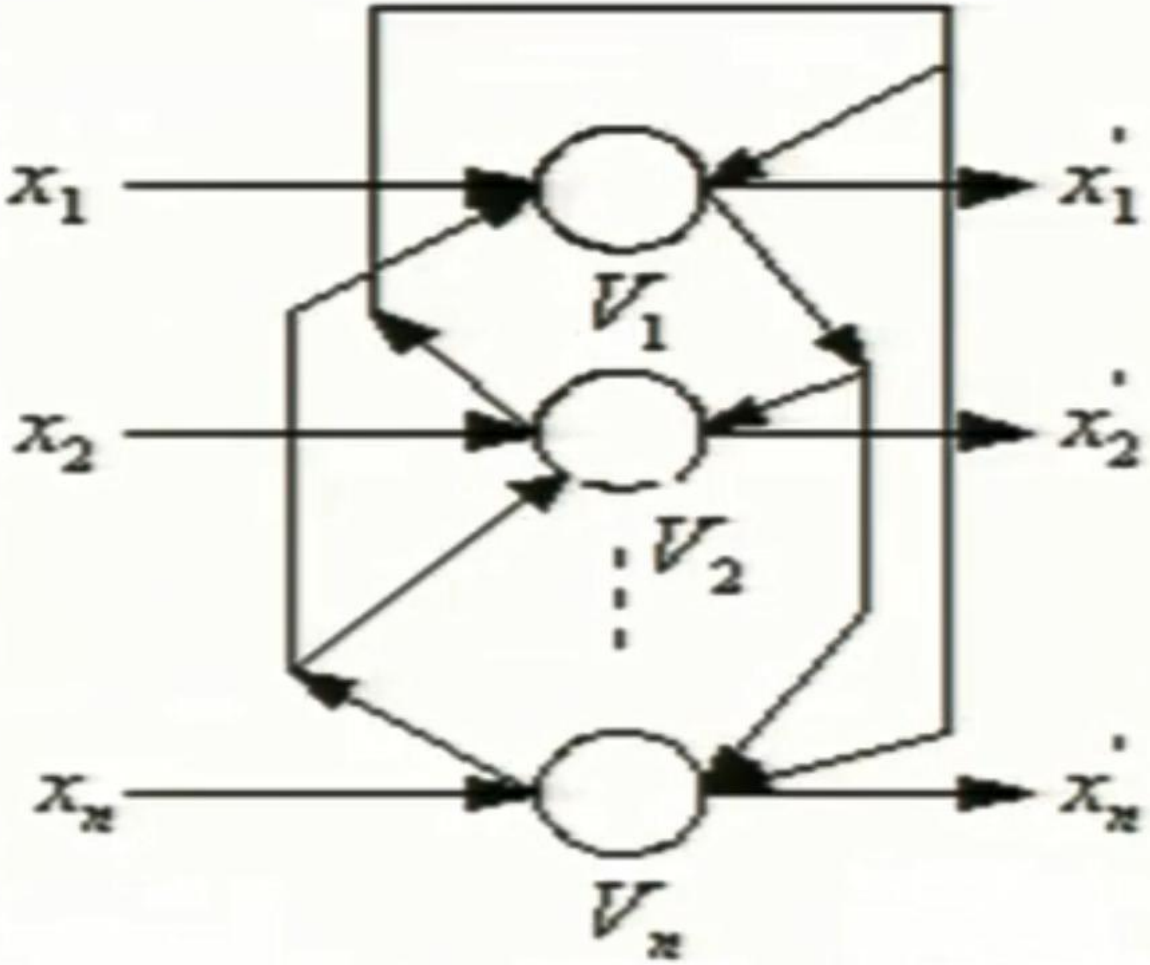
Network Structures—Topology
神经网络的拓扑结构

- When no node output is an input to a node in the same layer or preceding layer, the network is a ***feedforward network(前馈网络)***.
- When outputs are directed back as inputs to same- or preceding-layer nodes, the network is a ***feedback network（反馈网络）***.
- Feedback networks that have **closed loops** are called ***recurrent networks（递归网络）***.

feedforward network(前馈网络).



- **feedback network(反馈网络).**



How to Pick an Architecture

Problem specifications help define the network in the following ways:

1. **Number of network inputs** = number of problem inputs
2. **Number of neurons in output layer** = number of problem outputs
3. **Output layer transfer function** choice at least partly determined by problem specification of the outputs.