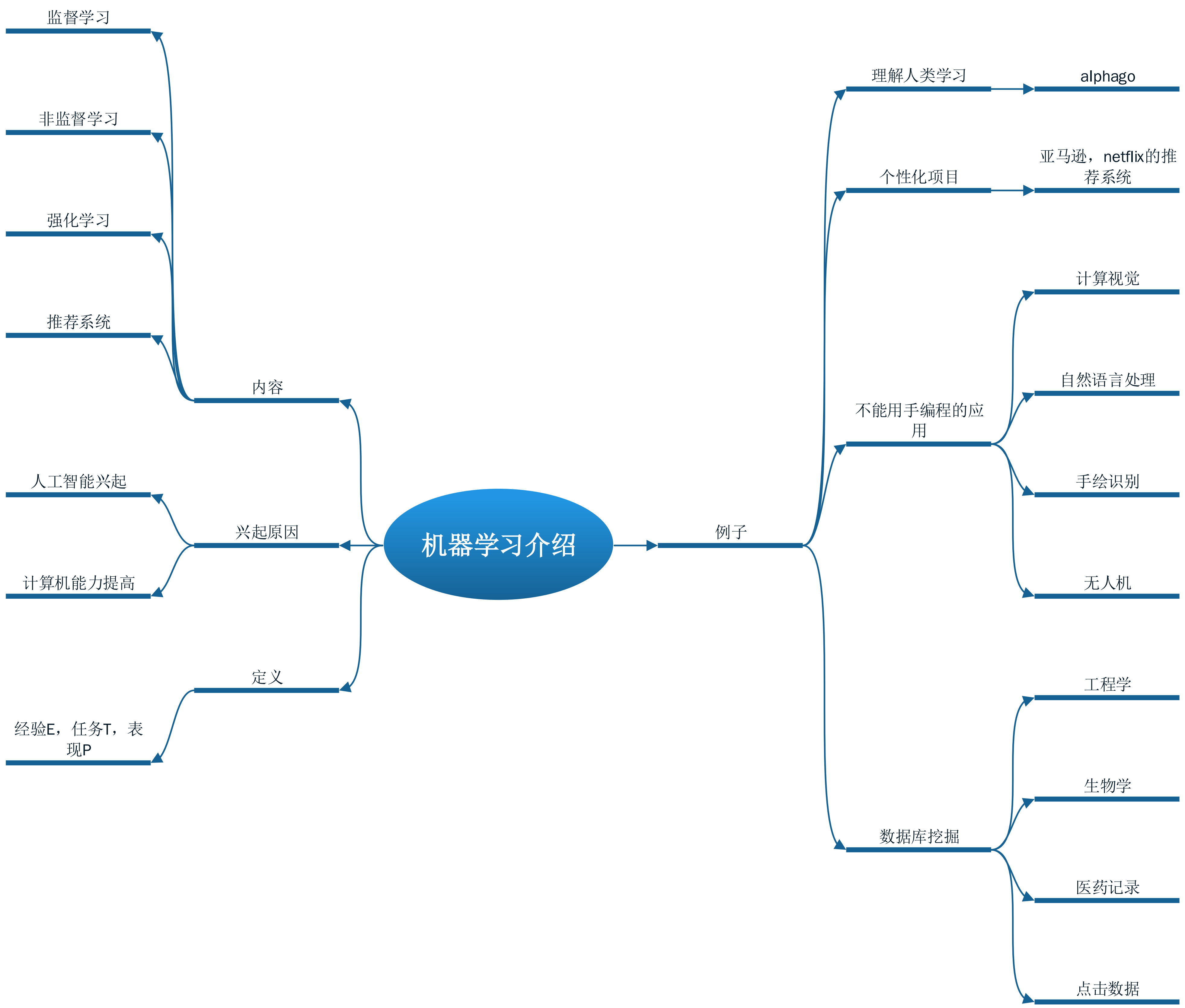
机器学习介绍
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强化学习
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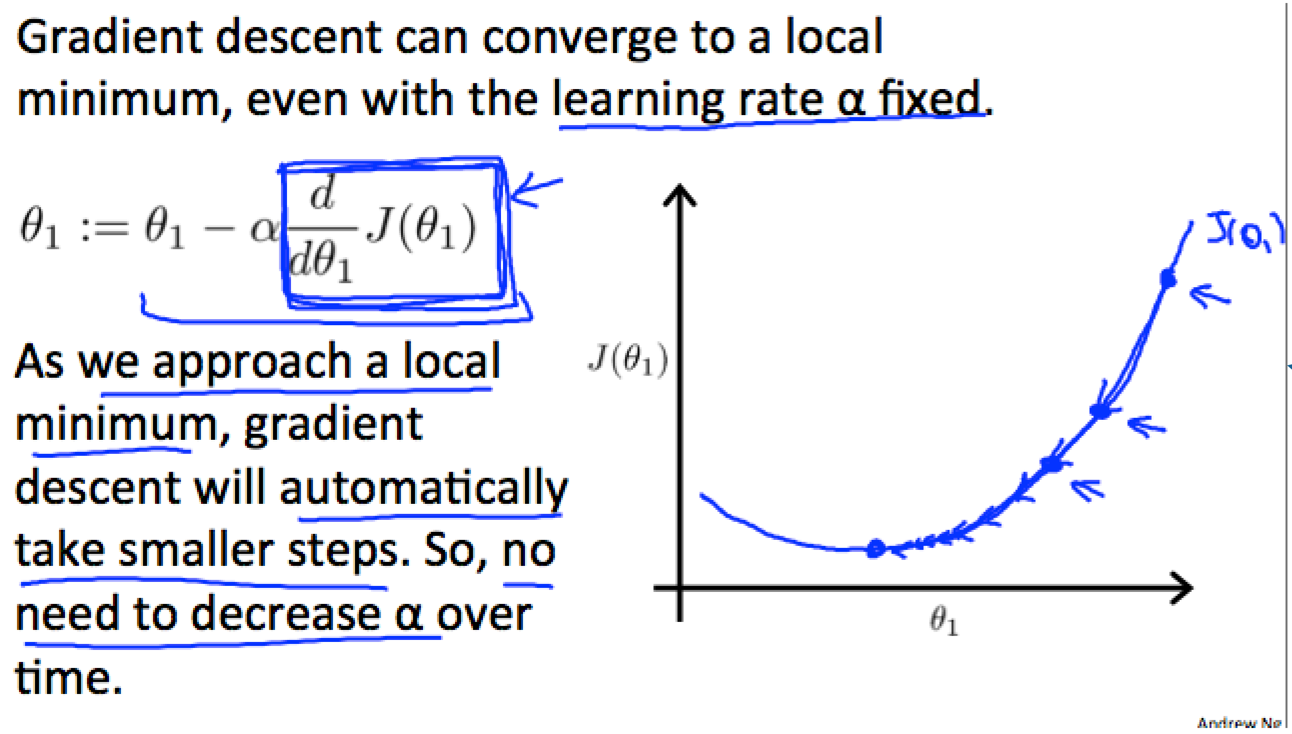
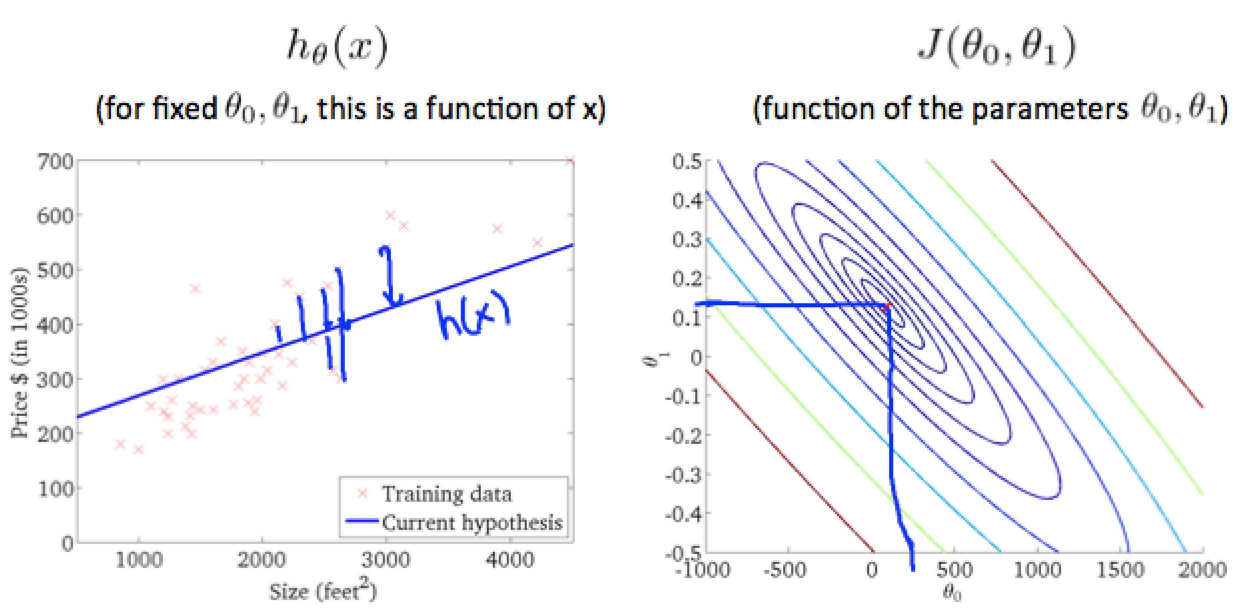
单变量回归

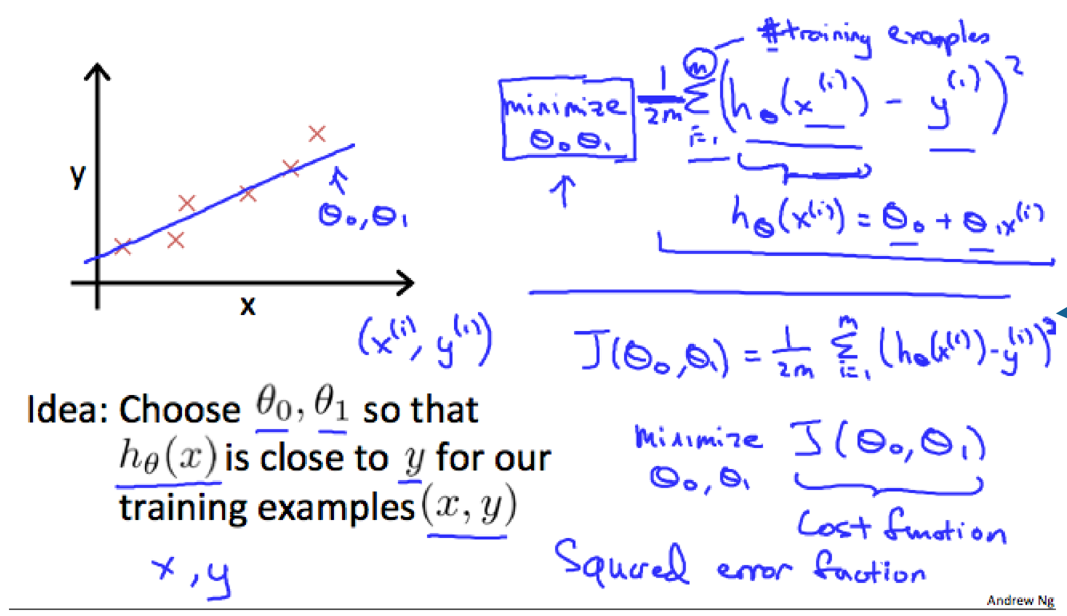
- 梯度下降直观



- 代价方程直观2



- 代价方程



- 线性回归的梯度下降

$$
\begin{aligned}
\frac{\partial}{\partial\theta_j}J(\theta) &= \frac{\partial}{\partial\theta_j}\frac{1}{2}(h_\theta(x)-y)^2 \\
&= 2\cdot\frac{1}{2}(h_\theta(x)-y)\cdot\frac{\partial}{\partial\theta_j}(h_\theta(x)-y) \\
&= (h_\theta(x)-y)\cdot\frac{\partial}{\partial\theta_j}\left(\sum_{i=0}^{n}\theta_i x_i - y\right) \\
&= (h_\theta(x)-y)\,x_j
\end{aligned}
$$

- 梯度下降

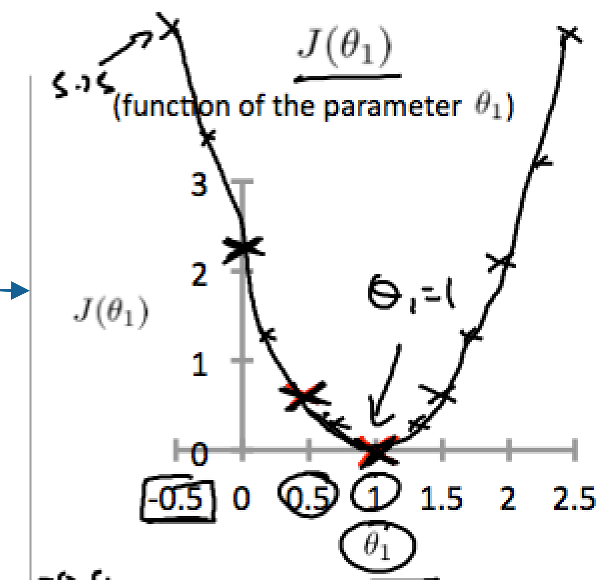
Correct: Simultaneous update

$\text{temp0} := \theta_0 - \alpha\frac{\partial}{\partial\theta_0}J(\theta_0,\theta_1)$
$\text{temp1} := \theta_1 - \alpha\frac{\partial}{\partial\theta_1}J(\theta_0,\theta_1)$
$\theta_0 := \text{temp0}$
$\theta_1 := \text{temp1}$

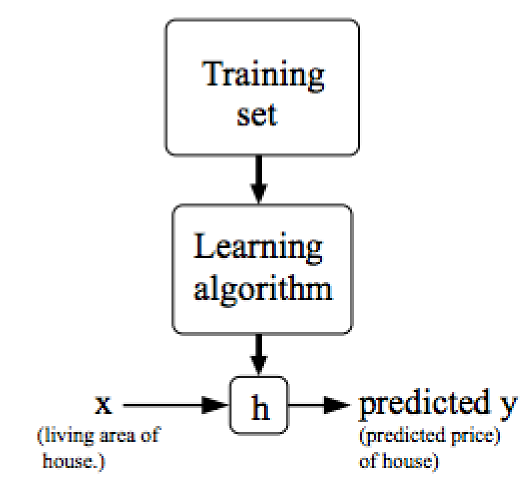
Incorrect:

$\text{temp0} := \theta_0 - \alpha\frac{\partial}{\partial\theta_0}J(\theta_0,\theta_1)$
$\theta_0 := \text{temp0}$
$\text{temp1} := \theta_1 - \boxed{\alpha\frac{\partial}{\partial\theta_1}J(\theta_0,\theta_1)}$
$\theta_1 := \text{temp1}$

- 代价方程直观1
  - 当theta_0为0的时候



- 模型表示



线性代数复习

转置矩阵

Matrix Transpose

Example: $A = \begin{bmatrix} 1 & 2 & 0 \\ 3 & 5 & 9 \end{bmatrix}$ 2x3 $\qquad B = A^T = \begin{bmatrix} 1 & 3 \\ 2 & 5 \\ 0 & 9 \end{bmatrix}$ 3x2

Let A be an m x n matrix, and let $B = A^T$.
Then B is an n x m matrix, and

$$B_{ij} = A_{ji}.$$

同一矩阵（identity matrix）

Identity Matrix $\quad$ I is identity

Denoted I (or $I_{n \times n}$).
Examples of identity matrices:

$[1]$ 1x1 $\quad \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ 2x2 $\quad \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ 3x3 $\quad \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ 4x4

For any matrix A,

$$\underset{m\times n}{A} \cdot \underset{n\times n}{I} = \underset{m\times m}{I} \cdot \underset{m\times n}{A} = \underset{m\times n}{A}$$

$I_{m\times n}$

矩阵加法

$$\begin{bmatrix} 1 & 0 \\ 2 & 5 \\ 3 & 1 \end{bmatrix} + \begin{bmatrix} 4 & 0.5 \\ 2 & 5 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 5 & 0.5 \\ 4 & 10 \\ 3 & 2 \end{bmatrix}$$

3x2 matrix $\quad$ 3x2 $\quad$ 3x2

$$\begin{bmatrix} 1 & 0 \\ 2 & 5 \\ 3 & 1 \end{bmatrix} + \begin{bmatrix} 4 & 0.5 \\ 2 & 5 \end{bmatrix} = \text{error}$$

3x2 $\quad$ 2x2

矩阵元素

Matrix Elements (entries of matrix)

$$A = \begin{bmatrix} 1402 & 191 \\ 1371 & 821 \\ 949 & 1437 \\ 147 & 1448 \end{bmatrix}$$

$A_{ij} =$ "i, j entry" in the i^{th} row, j^{th} column.

向量

Vector: An n x 1 matrix.

$$y = \begin{bmatrix} 460 \\ 232 \\ 315 \\ 178 \end{bmatrix}$$

n = 4 $\quad$ ← 4-d

$y_i = i^{th}$ element

逆矩阵

Not all numbers have an inverse. $\quad 0 \ (0^{-1})$ undefined

Matrix inverse: $\quad$ square matrix (#rows = #columns) $\quad A^{-1}$ $\quad A = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

If A is an m x m matrix, and if it has an inverse,

$$A(A^{-1}) = A^{-1}A = I.$$

e.g. $\underbrace{\begin{bmatrix} 3 & 4 \\ 2 & 16 \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} 0.4 & -0.1 \\ -0.05 & 0.075 \end{bmatrix}}_{A^{-1}} = \underbrace{\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}}_{A^{-1}A} = I_{2\times 2}$

Matrices that don't have an inverse are "singular" or "degenerate"

矩阵乘法

A * B * C = D * C = A * E（D = A * B, E = B*C）

A * B != B * A

$$A \times x = y$$

m x n matrix (m rows, n columns) $\quad$ n x 1 matrix (n-dimensional vector) $\quad$ m-dimensional vector

Details:

$$A \times B = C$$

m x n matrix (m rows, n columns) $\quad$ n x o matrix (n rows, o columns) $\quad$ n x 1 $\quad$ m x o matrix

The i^{th} column of the matrix C is obtained by multiplying A with the i^{th} column of B. (for i = 1,2,…,o)

矩阵scalar

real number

$$3 \times \begin{bmatrix} 1 & 0 \\ 2 & 5 \\ 3 & 1 \end{bmatrix} = \begin{bmatrix} 3 & 0 \\ 6 & 15 \\ 9 & 3 \end{bmatrix} =$$

3x2 $\quad$ 3x2

$$\begin{bmatrix} 4 & 0 \\ 6 & 3 \end{bmatrix} / 4 = \frac{1}{4}\begin{bmatrix} 4 & 0 \\ 6 & 3 \end{bmatrix}$$