有限自动机(FA)问题：{ DFA：确定有限自动机
NFA：非确定有限自动机

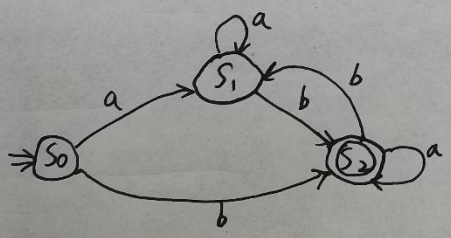
DFA：$M_d = (S, \Sigma, f, S_0, Z)$ → 终态集
- S：有限状态集
- Σ：输入字母表
- f：$S \times \Sigma$ 到 S 的单值映射
- S_0：唯一初态

区别NFA：非空初态集，$S \times \Sigma^*$ 到 S 的子集映射

例1：已知DFA $M_d = (\{S_0, S_1, S_2\}, \{a, b\}, f, S_0, \{S_2\})$，且

$f(S_0, a) = S_1$　$f(S_0, b) = S_2$
$f(S_1, a) = S_1$　$f(S_1, b) = S_2$
$f(S_2, a) = S_2$　$f(S_2, b) = S_1$

求 DFA M_d 的状态转换图与状态转换矩阵



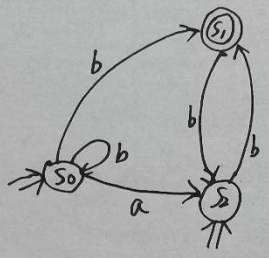
状态 \ 字符	a	b
S_0	S_1	S_2
S_1	S_1	S_2
S_2	S_2	S_1

例2：已知 NFA $M_n=(\{S_0,S_1,S_2\},\{a,b\},f,\{S_0,S_2\},\{S_1\})$ 且

$f(S_0,a)=\{S_2\}$　　$f(S_0,b)=\{S_0,S_1\}$

$f(S_1,a)=\phi$　　$f(S_1,b)=\{S_2\}$

$f(S_2,a)=\phi$　　$f(S_2,b)=\{S_1\}$



状态 \ 字	a	b
S_0	$\{S_2\}$	$\{S_0,S_1\}$
S_1	ϕ	$\{S_2\}$
S_2	ϕ	$\{S_1\}$

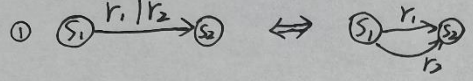
除了使用函数及已知 M_n / M_d

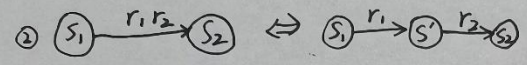
也可正规表达式构造（位于后一章）

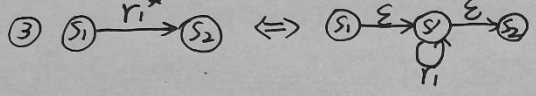
DFA. NFA

正规表达式构造有限自动机：正规式 → NFA → DFA → DFA化简

正则闭包：
$R^+ = R \cdot R^*$

① 

② 

③ 

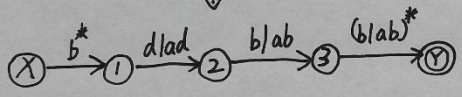
例1：将正规表达式

$b^*(d|ad)(b|ab)^+$ 转化为 NFA M

⇕

$b^*(d|ad)(b|ab)(b|ab)^*$

⇓



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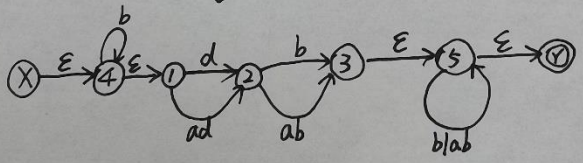

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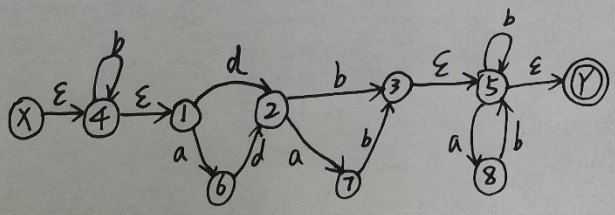
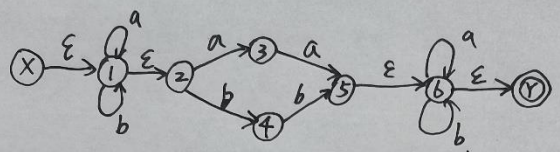


例2：正规表达式 $(a|b)^*(aa|bb)(a|b)^*$ 的 NFA M 如图，将其化为DFA M'



转换表　　需合并经过空串的

I	I_a	I_b
{x, 1, 2}	{1, 2, 3}	{1, 2, 4}
{1, 2, 3}	{1, 2, 3, 5, 6, Y}	{1, 2, 4}
{1, 2, 4}	{1, 2, 3}	{1, 2, 4, 5, 6, Y}
{1, 2, 3, 5, 6, Y}	{1, 2, 3, 5, 6, Y}	{1, 2, 4, 6, Y}
{1, 2, 4, 5, 6, Y}	{1, 2, 3, 6, Y}	{1, 2, 4, 5, 6, Y}
{1, 2, 4, 6, Y}	{1, 2, 3, 6, Y}	{1, 2, 4, 5, 6, Y}
{1, 2, 3, 6, Y}	{1, 2, 3, 5, 6, Y}	{1, 2, 4, 6, Y}

例2中：{x, 1, 2}

x 经过 a　$x \xrightarrow{\varepsilon} 1 \xrightarrow{\varepsilon} 2 \xrightarrow{a} 3$

能到 1, 2, 3

1 经过 a　$1 \xrightarrow{a}$ 到 1

$1 \xrightarrow{\varepsilon} 2 \xrightarrow{a} 3$ 到 2, 3

2 经过 a　$2 \xrightarrow{a} 3$　能到 3

x 经过 b　$x \xrightarrow{\varepsilon} 1 \xrightarrow{\varepsilon} 2 \xrightarrow{b} 4$

能到 1, 2, 3

1 经过 b

$1 \xrightarrow{\varepsilon} 2 \xrightarrow{b} 4$

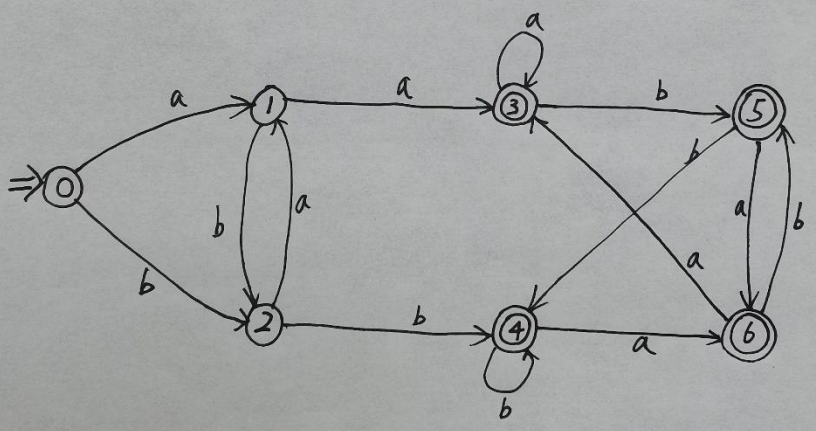
$1 \xrightarrow{b}$

2 经过 b

无可达

状态转换矩阵

S	a	b
0	1	2
1	3	2
2	1	4
3	3	5
4	6	4
5	6	4
6	3	5



确定是否为终态：含有终态Y的状态

非终态集 0,1,2

终态集 3,4,5,6

$\{0,1,2\}_a = \{1,3\}$

$\{0,2\}_b = \{2,4\}$

$\{1\}$ $\{0\}$ $\{2\}$

0,1,2 无法再合并

$\{3,4,5,6\}_a = \{3,6\}$

$\{3,4,5,6\}_b = \{4,5\}$

S	a	b
3	3	5
4	6	4
5	6	4
6	3	5

3,6合并 ⇒

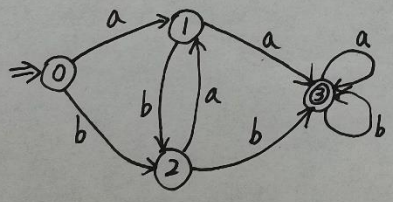
S	a	b
3-6	3-6	5
4	3-6	4
5	3-6	4

4-5合并 ⇒

S	a	b
3-6	3-6	4-5
4-5	3-6	4-5

3-6, 4-5 合并 ⇓

S	a	b
3-4-5-6	3-4-5-6	3-4-5-6



可将3,4,5,6合并为3状态