2-1

{char, squi, bulb} $\cup$ {jay, libby}

= {char, squi, bulb, jay, libby}

FIN = all finite sets

A string of an alphabet – some finite set

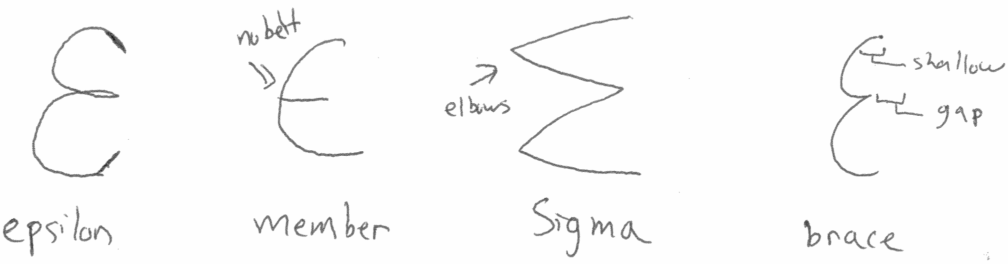
w Σ = Σ^*

ε (epsilon) is a string of Σ

c (where $c \in \Sigma$) is a string of Σ

$x \circ y$ (where x is a string of Σ and so is y) is a str of Σ

$\Sigma = \{a\}$ $\varepsilon \in \Sigma^*$ $a \in \Sigma^*$ $aaaa \in \Sigma^*$



ALL = $P(\Sigma^*)$ (all subsets where elements are strings)

FIN $\subset$ ALL (all <u>finite</u> subsets of Σ^*)

aaa – one string (in Σ^*)

{aaa} – a set of string (in $P(\Sigma^*)$)

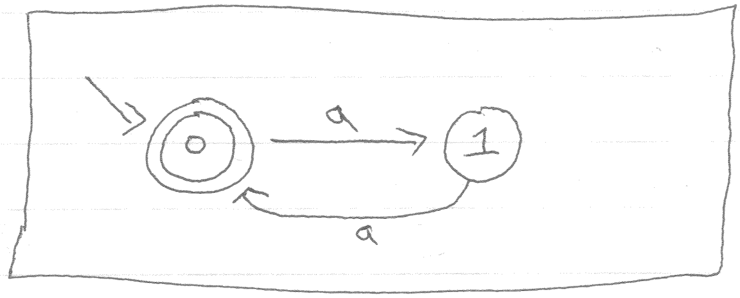
$\in$ FIN $\in$ ALL

2-2

Assume Σ is $\{a\}$ equiv $\{☺\}$

Even $= \{ w \in \Sigma^* \mid$ the length of w is even $\}$

E =



A finite automata or DFA

D is deterministic

○ — states

◎ — accept states

$\gg$○ — start state

○ → ○ — a transition

$x \xrightarrow{c} y$ — from x, to y, on c

$\varepsilon \in E$? Y $a \in E$? N $aaaa \in E$? Y

E works by starting at the start, following transitions on characters in the input, then checking if state is accepting at the end

---

A DFA is a 5-tuple $= (Q, \Sigma, q_0, \delta, F)$

Q — some finite set $\{0, 1\}$

Σ — some alphabet $\{a\}$

$q_0 \in Q$ — the start state 0

$F \subset Q$ — the accept states $\{0\}$

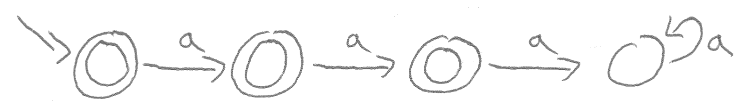
δ — the transitions $Q \times \Sigma \to Q$

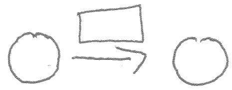
$\{((0, a), 1)$
$((1, a), 0)\}$

	a
0	1
1	0

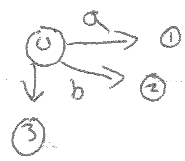
$$E = (\{0, 1\}, \{a\}, 0, \{((0,a),1), ((1,a),0)\}, \{0\})$$

2-3

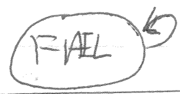
$\{\varepsilon, a, aa\}$ = 

short #1 :  no label = every else

$\Sigma = \{a,b,c,d\}$



0 → 1 on a
0 → 2 on b
0 → 3 on c or d

short #2 : if no arrow
from X on c,
then X → FAIL on C
where 

Intuition	Math
Diagram	5-tuple
∈ algorithm	

what is the language of the DFA?

$L : DFA \to P(\Sigma^*)$ L is for language

$\in : \Sigma^* \to Y/N$ $L(DFA) = \{ w \in \Sigma^* \mid w \in DFA \}$

$w \in DFA$?

$w \in DFA$ iff $\overbrace{[q_0]\, w \to^* [q_f]}^{\text{steps}}$ s.t. $q_f \in F$

the Q_0 from the DFA — F from the DFA

steps is a relation on configurations

$\to^* \subset C \times C$ configuration $= C = Q \times \Sigma^*$

$[q_i]\, w = (q_i, w)$

N $$\frac{[q_i]\, w \to [q_j]\, w' \quad [q_j]\, w' \to^* [q_k]\, w''}{[q_i]\, w \to^* [q_k]\, w''}$$

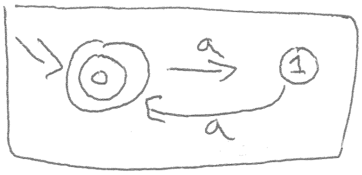
step is a relation of configuration

$\to \subset C \times C$

E $$\frac{}{[q_i]\, \varepsilon \to^* [q_i]\, \varepsilon}$$

δ $$\frac{\delta(q_i, a) = q_j}{[q_i]\, aw \to [q_j]\, w}$$

2-4

E 

$aa \in E$?

iff $[0]aa \to^* [0]$

$[0]aa \to^* [0]\varepsilon$ $\qquad$ $((0,aa),(0,\varepsilon)) \in \to^*$?

$$\text{N}\ \dfrac{\text{δ}\ \dfrac{[0]aa \to [1]a}{\delta(0,a)=1} \qquad \text{N}\ \dfrac{\text{δ}\ \dfrac{[1]a \to [0]\varepsilon}{\delta(1,a)=0} \qquad \text{E}\ \dfrac{[0]\varepsilon \to^* [0]\varepsilon}{}}{[1]a \to^* [0]\varepsilon}}{[0]aa \to^* [0]\varepsilon}$$

$([0]aa \to ([1]a) \to ([0]\varepsilon) \to \checkmark)$

$$\frac{P \quad Q}{R} \qquad P \wedge Q \to R$$

```
int state = 0;
while (char c= getc()) {
 if (state==0) { state=1;}
   else {state=0;}
}
return (state==0);
```

char F[2] = {1, 0};

```
DELTA[2][1] = { {1}, {0} }
int state = 0;
while (char c =getc(); )
   state = DELTA[state][c];
return (state == 0);
```

```
DELTA[ |Q| ][ |Σ| ] = { ... }
int state = q0;      F[|Q|] = {0, 1, ∈F}
while (char c = idx(getc()); )
   state = DELTA[state][c];
return  F[state];
```