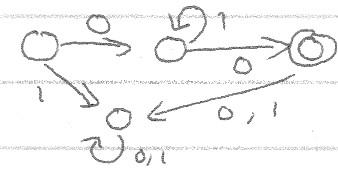
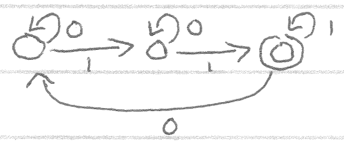
22-1

$A_{DFA} = \{ \langle D, w \rangle \mid$ D is a DFA and w is a string of D's Σ and if D accepts w $\}$

$\langle$ 

, 01110 $\rangle \in A_{DFA}$

$\langle$ 

, 001000 $\rangle \notin A_{DFA}$

Is $A_{DFA} \in \Sigma_0$? This is NOT $DFA \subseteq \Sigma_0$?

Yes. can we compile 1 DFA into 1 Decider

It has 5-tapes

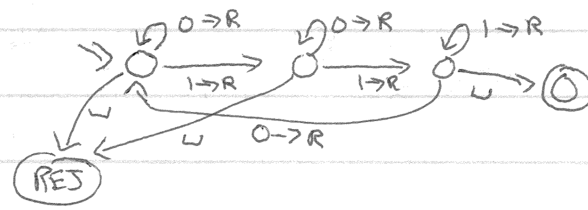
tape 0. input

tape 1. is w

tape 2. is q_{curr}

tape 3. is δ

tape 4. is F



$A_{NFA} = \{ \langle N, w \rangle \mid N \in NFA, w \in \Sigma^*, N \text{ accepts } w \}$

Σ_0: compile N to D then run A_{DFA}

$A_{REX} = \{ \langle R, w \rangle \mid R \in REX, w \in \Sigma^*, R \text{ generates } w \}$

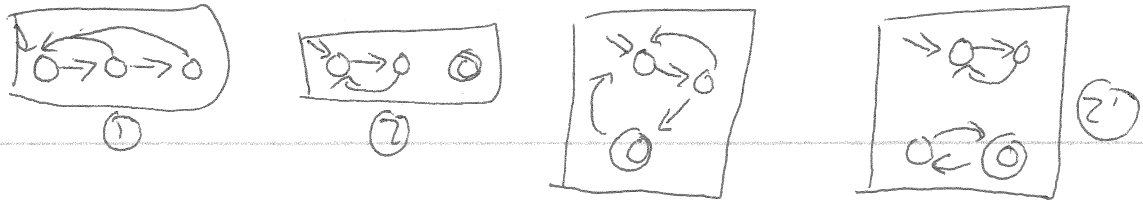
Σ_0: compile R to N then run A_{NFA}

A_X is an "acceptance problem" for X (interpreter for X)

$X \subset \Sigma_0$ (compiler for X)

22-2

$E_{DFA} = \{ \langle D \rangle \mid D \in DFA \text{ and } L(D) = \emptyset \}$

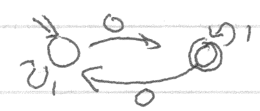
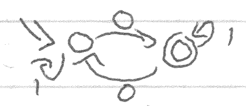


1. Check if F is empty $\Rightarrow$ yes
2. Do a graph search from q_0 and mark everything found as Q_m
3. $Q_m \cap F = \emptyset$, then accept
   o.w. reject

$|Q|$

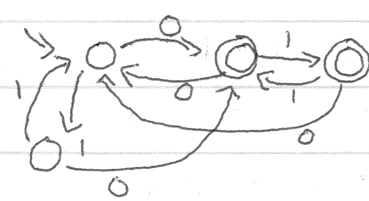
E_X = emptiness on X

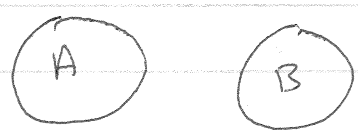
$EQ_{DFA} = \{ \langle A, B \rangle \mid A, B \in DFA, \ L(A) = L(B) \}$

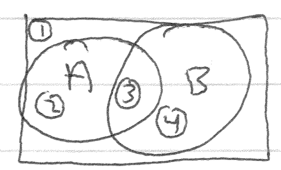
<  ,  > $\in EQ_{DFA}$

= A = A

< A ,  = B > $\notin EQ_{DFA}$

< A ,  = C > $\in EQ_{DFA}$





(2) $= A - B = A \cap \bar{B}$
(1) $= \bar{A} \cup \bar{B}$
(4) $= B - A = B \cap \bar{A}$
(3) $= A \cap B$

$A = B$ then (2) $\cup$ (4) $= \emptyset$

$\underbrace{(A \cap \bar{B}) \cup (\bar{A} \cap B)}_{C} = \emptyset$ then $L(A) = L(B)$

$= \emptyset$

1. make C
2. run E_{DFA} on C

$(|A| \times |B|)^2 \quad (n^2)$

22-3/

$A_{CFG} = \{ \langle G, w \rangle \mid G \in CFG, w \in \Sigma^*, G \text{ generates } w \}$

1. Try all derivations of G, check if = w
2. If G is in Chomsky Normal Form
   if ~~that~~ w is produced, then it is within
   $2 \times |w| - 1$ steps
3. Check up to that amount

$E_{CFG} = \{ \langle G \rangle \mid G \in CFG, L(G) = \emptyset \}$

$S \to AB$
$A \to AB$
$B \to 1$

$|V|^2$

(Vars, Terminating Vars)
T

$(V, T = \emptyset)$
for all $v \in V$
if $V \to AB \in R$
and $A \in T$ and $B \in T$
then $v \in T'$ (and.
if $V \to a \in R$
then $v \in T'$
if $T' \neq T$, do again
o.w. check if $S \in T$

$EQ_{CFG} = \{ \langle A, B \rangle \mid A, B \in CFG, L(A) = L(B) \}$
$\notin \Sigma_0$ no strategy works

$CFL \subset \Sigma_1$ (we can simulate a PDA with a 2-tape TM)

$CFL \in \Sigma_0$
$\downarrow$
$G \Longrightarrow$ "On input w,
run $A_{CFG}(\langle G, w \rangle)$"