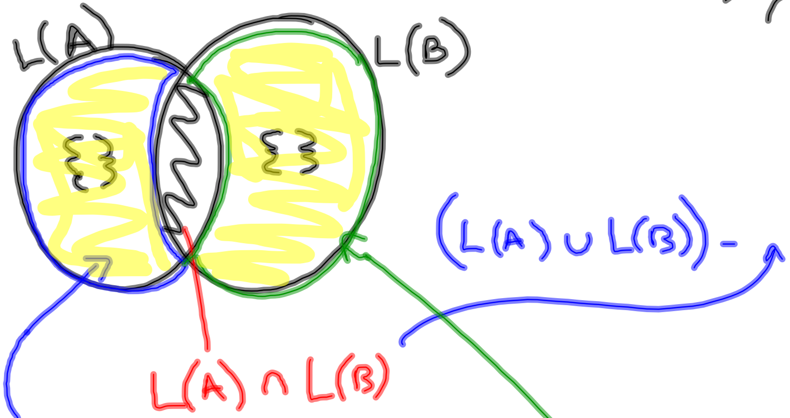
E_{DFA} is decidable (emptiness)

$$EQ_{DFA} = \{\langle A, B\rangle \mid A \text{ and } B \text{ are DFAs and } L(A) = L(B)\}$$



$$L(C) = \left(\left(L(A) \cap \overline{L(B)}\right) \cup \left(L(B) \cap \overline{L(A)}\right)\right)$$

$$L(C) = \emptyset \text{ iff } L(A) = L(B)$$

F: on input $\langle A, B\rangle$

1. construct DFA C for L(C)
2. Run TM T from E_{DFA} on $\langle C\rangle$.
3. If T accepts, accept otherwise reject.

$A_{CFG} = \{\langle G, w\rangle \mid G \text{ is a CFG that generates } w\}$

A_{CFG} is decidable.

if G is in C.N.F.

then any derivation has ~~at most~~ $2n-1$ steps $(n = |w|)$.

$S \rightarrow Sa \mid$

1. convert G to CNF.
2. List all derivations w/ $2n-1$ steps (unless $n=0$, only list 1 step derivations)
3. If any derivation is w, accept. Otherwise, reject.

$S \rightarrow aSa \mid bSb \mid a \mid b \mid \varepsilon$

$S \Rightarrow aSa \Rightarrow abSba \Rightarrow ababa$

$E_{CFG} = \{ \langle G \rangle \mid G \text{ is a CFG and } L(G) = \emptyset \}$

E_{CFG} is decidable

$S \to S$
$A \to a$
$B \to Ba$
$C \to Bd$
$D \to Ad$

1. mark all terminal symbols in the rules of G
2. repeat 3 until no new symbols are marked.
3. mark any variable A where G has the rule $A \to U_1 U_2 U_3 \cdots U_k$ and all $U_1 \cdots U_k$ are marked.
4. if the start variable is not marked, accept otherwise reject.

$$EQ_{CFG} = \{\langle G, H \rangle \mid G, H \text{ are CFG and } L(G) = L(H)\}$$

EQ_{CFG} is <u>not</u> decidable.