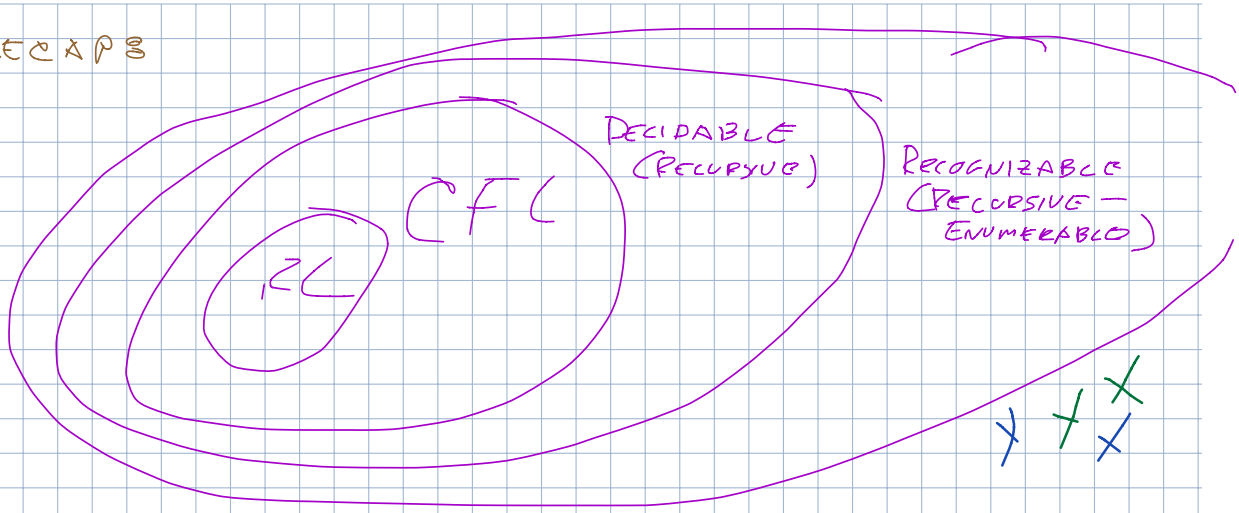
RECAPS



$A_{DFA} = \{\langle B, w\rangle, B \text{ is a DFA that accepts } w\}$

$A_{NFA} = \{ \ldots \}$ → ALWAYS CONVERT AN NFA TO A DFA

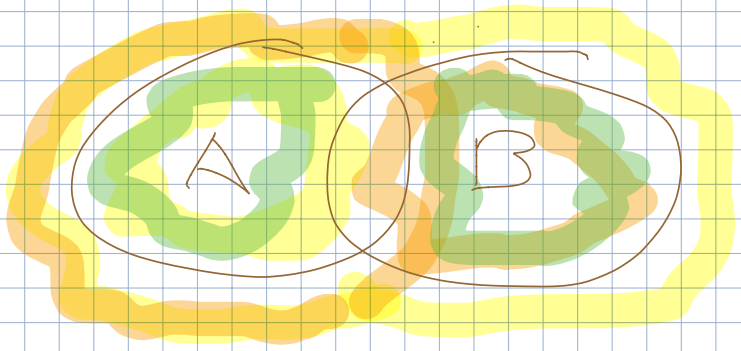
$A_{RE} =$ ⇒ ALWAYS CONVERT AN RE TO A DFA

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

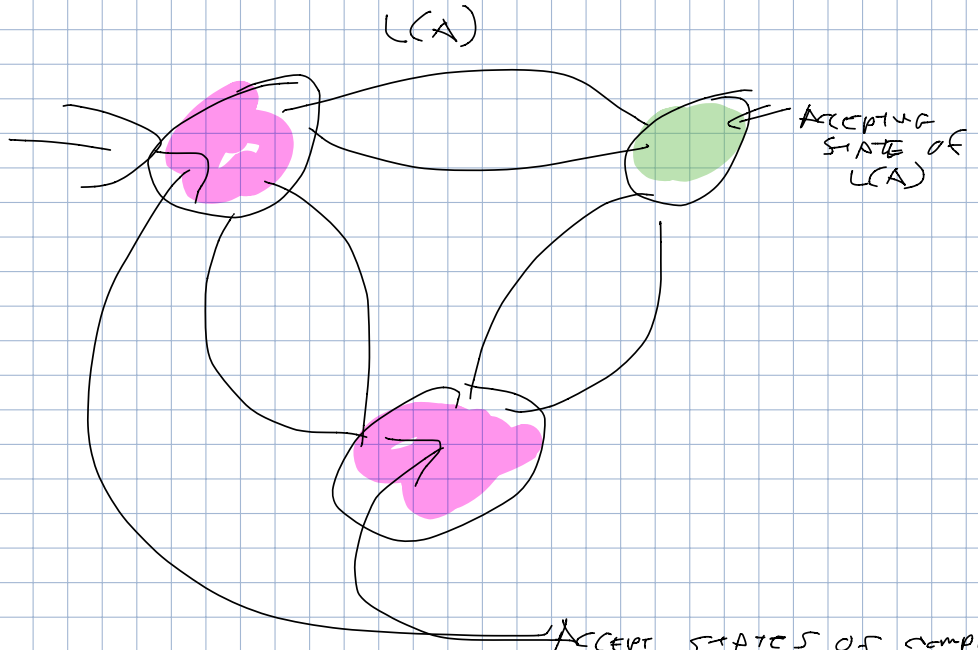
$EQ_{DFA} = \{\langle A, B\rangle \mid A \text{ \& } B \text{ are DFA's and } L(A) = L(B)\}$

$L(C) = (L(A) \cap \overline{L(B)}) \cup (L(B) \cap \overline{L(A)})$ ⇒ EMPTY

↳ $L(A) = L(B)$



Complement of a DFA



+ Intersection of Languages
De Morgans Law

$$A \wedge B = \overline{\bar{A} \cup \bar{B}}$$

CONTEXT-FREE LANGUAGES

$A_{CFG} = \{\langle G, w\rangle \mid G \text{ IS A CFG THAT GENERATES STRING } w\}$

$E_{CFL} = \{\langle G\rangle \mid G \text{ IS A CFG AND } L(G) = \emptyset\}$

$EQ_{CFG} = \{\langle G, H\rangle \mid G \text{ \& } H \text{ ARE CFG'S AND } L(G) = L(H)\}$

EVERY CFG IS DECIDABLE

UNDECIDABILITY

$A_{TM} = \{\langle M, w\rangle \mid M \text{ IS A TM AND } w \text{ IS A STRING } w \text{ the language of } M\}$

$U \rightarrow$ 1) SIMULATE M ON w
2) IF M EVER ENTERS AN ACCEPT STATE $\rightarrow$ ACCEPT
IF M EVER ENTERS A REJECT STATE $\rightarrow$ REJECT

DIAGONALIZATION
- ONE TO ONE $f(a) \neq f(b)$ whenever $a \neq b$
- ONTO, FOR EVERY $b \in B$ there is a $a \in A$ such that $f(a) = b$
- IF A & B A BOTH ONE TO ONE & ONTO then there is a correspondence between A & B
  - A & B ARE the same SIZE
- $|A| > |B|$ IS NOT 1:1 BUT ONTO
- $|A| < |B|$ IF 1:1 BUT NOT ONTO

$\mathbb{R}$ ARE UCT COUNTABLE

SOME LANGUAGES ARE NOT RECOGNIZABLE

$|TM| \leq |L|$

- $|TM|$ IS COUNTABLE
- $|L|$ IS NOT COUNTABLE
  $L \{0, 1\}$
  $0, 1, 00, 01, 10, 11, \ldots$

$|TM| < |L|$

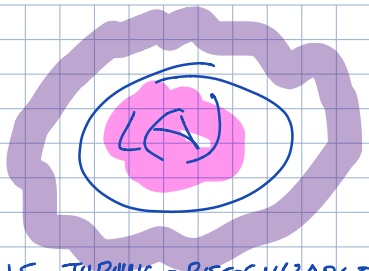
$A_{TM} = \{\langle M, w\rangle \mid M \text{ IS A TM AND } w \text{ IS A STRING THE LANGUAGE OF } w\}$

- THERE ARE STRINGS THAT ARE UCT ACCEPTED BY ANY TM
- CANNOT DECIDE A_{TM}

A NON RECOGNIZABLE LANGUAGE

IF $L(A)$ IS TURING RECOGNIZABLE
IF $\overline{L(A)}$ IS ALSO TURING RECOGNIZABLE

A IS DECIDABLE



A LANGUAGE IS TURING DECIDABLE IFF IT IS TURING-RECOGNIZABLE & IT'S COMPLEMENT IS TURING-RECOGNIZABLE

A_{TM} IS TURING-RECOGNIZABLE
A_{TM} IS NOT TURING DECIDABLE

$\overline{A_{TM}}$ → TURING RECOGNIZABLE
→ CANNOT BE TURING RECOGNIZABLE