Decidable Languages: Some TM exists which will accept any string w that is in L, and reject any string not in L. The TM always halts.

- (p. 194) $A_{DFA} = \{<B,w>| B \text{ is a DFA that accepts } w\}$
- (p. 195) $A_{NFA} = \{<B,w>| B \text{ is an NFA that accepts } w\}$
- (p. 196) $A_{REX} = \{<R,w>| R \text{ is a regex that generates } w\}$
- (p. 196) $E_{DFA} = \{<A>| A \text{ is a DFA where } L(A) = \emptyset\}$
- (p. 197) $EQ_{DFA} = \{<A,B>| A,B \text{ both DFAs & } L(A) = L(B)\}$
- (p. 198) $A_{CFG} = \{<G,w>| G \text{ is a CFG that generates } w\}$
- (p. 199) $E_{CFG} = \{<G>| G \text{ is a CFG & } L(G) = \emptyset\}$
- (p. 200) Every CFL is decidable
- (Prob. 4.3) $ALL_{DFA} = \{<A>| A \text{ a DFA and } L(A)=\Sigma^*\}$
- (Prob. 4.4) $A_{\epsilon_{CFG}} = \{<G>| G \text{ a CFG that generates } \epsilon\}$
- (Prob. 4.10) $INFINITE_{DFA} = \{<A>| A \text{ a DFA, } L(A) \text{ is infinite}\}$
- (Prob. 4.11) $INFINITE_{PDA} = \{<A>| A \text{ a PDA, } L(A) \text{ is infinite}\}$
• **Undecidable Languages**: A decider does not exist.
  - (p. 202) $\text{HALT}_{TM} = \{ <M,w> | \text{M is a TM that halts on } w \}$
  - (p. 207) $\text{A}_{TM} = \{ <M,w> | \text{M accepts } w \}$
  - (p. 217) $\text{E}_{TM} = \{ <M> | \text{M is a TM and } L(M) = \emptyset \}$
  - (p. 218) $\text{REGULAR}_{TM} = \{ <M> | \text{M a TM & } L(M) \text{ is regular} \}$
  - (p. 219) $\text{L}_{P} = \{ <M> | \text{M a TM such that } L(M) \text{ has property } P \}$
  - (p. 220) $\text{EQ}_{TM} = \{ <M_1,M_2> | M_1, M_2 \text{ TMs, } L(M_1) = L(M_2) \}$
  - (p. 222) $\text{A}_{LBA} = \{ <M,w> | \text{M an LBA that accepts } w \}$
  - (p. 223) $\text{E}_{LBA} = \{ <M> | \text{M an LBA where } L(M) \text{ is empty} \}$
  - (p. 225) $\text{ALL}_{CFG} = \{ <G> | \text{G is CFG where } L(G) = \Sigma^* \}$
  - (p. 228) $\text{PCP} = \{ <P> | \text{P instance of Post Correspondence Problem} \}$

• **Recognizable Languages**: Some TM exists which can accept any string $w$ that is in $L$, and will not accept any string not in $L$. No guarantees that TM will even halt for $w$ not in $L$.

• **co-Turing Recognizable Languages**: a TM recognizer exists for the complement of the language
  - (Prob. 4.5) $\text{E}_{TM} = \{ <M> | \text{M is a TM and } L(M) = \emptyset \}$
  - If $L$ is both recognizable and co-Turing recognizable then it is decidable