CPS 140 - Mathematical Foundations of CS
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Section: Minimizing Finite Automata (Ch. 2.5) (handout)

**State Minimization (Ch. 2.5)**

Why?

**Algorithm**

- Remove states that are not reachable
- Identify states that are indistinguishable
  These states form a new state

**Definition** Two states p and q are indistinquishable if for all $w \in \Sigma^*$

$$\delta^*(q, w) \in F \Rightarrow \delta^*(p, w) \in F$$
$$\delta^*(p, w) \notin F \Rightarrow \delta^*(q, w) \notin F$$

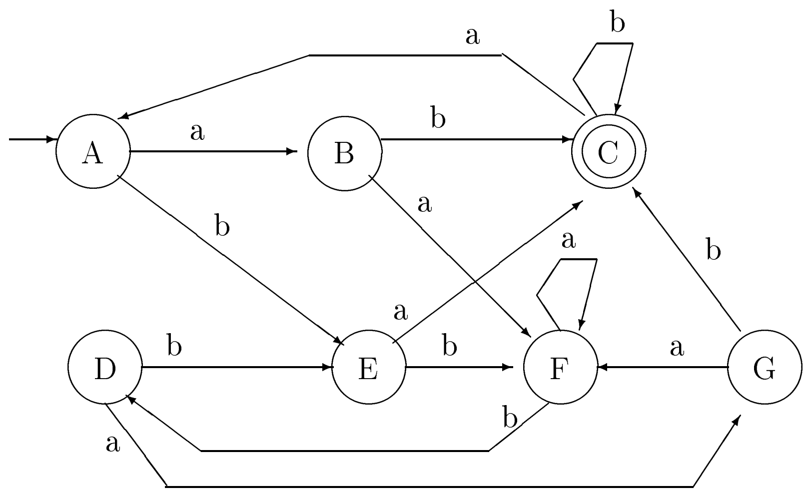
**Definition** Two states p and q are distinquishable if $\exists\ w \in \Sigma^*$ s.t.

$\delta^*(q, w) \in F \Rightarrow \delta^*(p, w) \notin F$ OR
$\delta^*(q, w) \notin F \Rightarrow \delta^*(p, w) \in F$

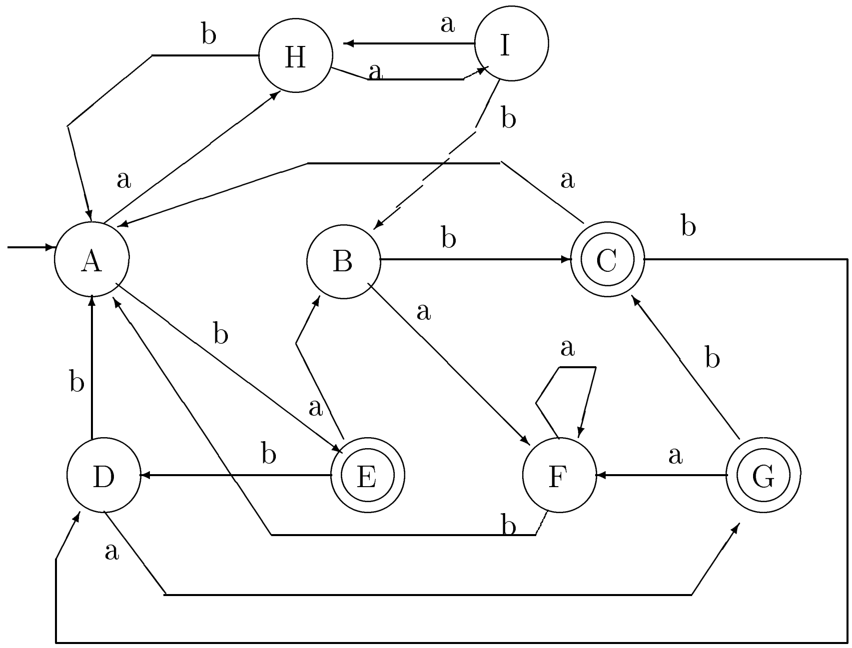
**Algorithm for Minimizing Number of States in DFA**

1. Remove states that are not reachable.
2. Group all nonfinal states together as indistinquishable
3. Group all final states together as indistinquishable
4. Repeat til no more states are distinquishable
   (a) Apply symbol to a group and split group if states are distinquishable

**Example:**



**Example:**



**Analysis of Algorithms: (Ch 2.6)**

1. Given DFA M and string $w$, is $w \in L(M)$?

2. Given NFA M and string $w$, is $w \in L(M)$?

3. Given an NFA $M_1$, create a DFA $M_2$ s.t. L($M_1$) = L($M_2$)

4. Given a DFA $M_1$, create a minimal state DFA $M_2$ s.t. L($M_1$) = L($M_2$)

5. Given a NFA $M_1$, create a minimal state DFA $M_2$ s.t. L($M_1$) = L($M_2$)