

Class  $P$ :  $P$  is a class of languages that are decidable in polynomial time on a deterministic single – tape Turing – machine.

$$All_{DFA} = \{ \langle A \rangle \mid A \text{ is a DFA that recognizes } \Sigma^* \}$$

$$E_{DFA} = \{ \langle A \rangle \mid A \text{ is a DFA and } L(A) = \emptyset \}$$
 is determined by a Turing – machine ( $TM$ )

Let  $E$  be the Turing machine that determines  $E_{DFA}$

Let  $R$  be the Turing machine that determines  $All_{DFA}$

The algorithm of  $R$  is as follows:

$R =$  "On input  $\langle A \rangle$ , where  $A$  is a DFA:

1. Construct a DFA  $B$  that recognizes  $\overline{L(A)}$ , by swapping accept and non – accepting states
2. Run the  $TM$   $E$  on input  $\langle B \rangle$ , where  $E$  determines  $E_{DFA}$ .
3. If  $E$  accepts, then accept
4. If  $E$  rejects, then reject."

Clearly the  $TM$ ,  $R$  determines  $All_{DFA}$  in polynomial time.

Therefore,  $All_{DFA}$  is in  $P$ .