Acceptance Problem

Does a DFA $B$ accept string $w$?

$A_{DFA} = \{ <B,w> | \text{DFA $B$ accepts input $w$} \}$

Show $A_{DFA}$ is decidable by constructing a TM $M$ that decides $A_{DFA}$.

$M$: on input $<B,w>$ where $B$ is a DFA and $w$ is a string.

1. simulate $B$ on input $w$.
2. if simulation ends in accept state, accept. Otherwise reject.

```java
boolean DFA_accept(DFA B, String w)
    return simulate(B, w);
```
$A_{NFA} = \{ \langle B, w \rangle \mid B \text{ is an NFA that accepts string } w \}$

$A_{NFA}$ is decidable

$N: \text{ on input } \langle B, w \rangle \text{ where } B$ is an NFA and $w$ is a string.

1. convert NFA $B$ to equiv. DFA $C$.
2. run TM $M$ on $\langle C, w \rangle$
3. If $M$ accepts, accept
   Otherwise, reject.

```java
boolean NFA_accept (NFA B, String w) {
    DFA C = nfa2dfa(B);
    return DFA_accept(C, w);
}
```
Emptiness Testing

\[ E_{DFA} = \{ <A> | A \text{ is a DFA and } L(A) = \emptyset \} \]

\( E_{DFA} \) is decidable

Construct TM \( T \)

\( T \): on input \( <A> \) where

\( A \) is a DFA

1. mark the first state
2. repeat until no new states are marked
   3. mark any state that has a transition from a marked state
4. If no accept states are marked, accept
   Otherwise, reject

1. simulate all strings up to length \( p \)
   \( p = |Q| \)
2. if any string are accepted, reject
   Otherwise, accept