

Prep Work 3 - NFAs and Regexes

CS 234

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1. NFAs

1. In your own words, what does an NFA do differently than a DFA?

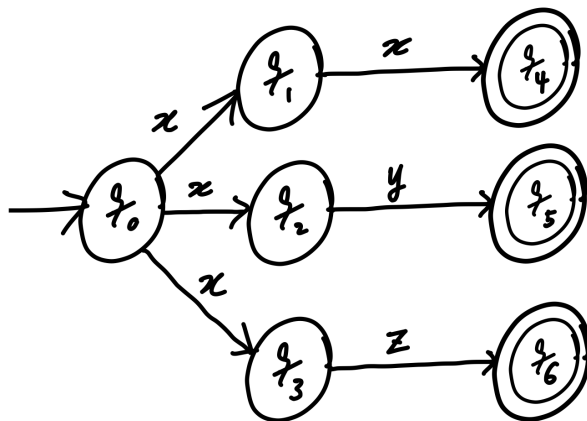
Unlike DFA, NFA does not need to have transitions to other states for all possible inputs over the language. Also, NFA can have a state that has transitions to multiple states with the same input.

2. What is the type (domain and codomain) of an NFA's transition function?

Domain: $Q \times \Sigma$, where Q is the set of states and Σ is the input alphabet.

Codomain: $P(Q)$, which is the power set of the set of states.

3. Draw your own NFA diagram with at least 3 (labelled) states. It should take an input alphabet of at least 2 letters, and 1 or 2 of the states should be final (accepting). It should also have at least 1 state with multiple transitions for the same letter and 1 state with no transitions for some letter.

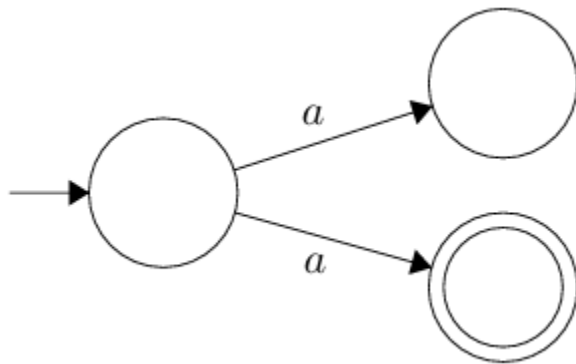


4. Provide a string that your NFA accepts and name the states it goes through, in order, to end at a final state.

xy

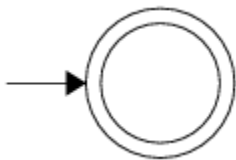
$q_0 \rightarrow q_2 \rightarrow q_5$

5. Does this automaton accept or reject the string a?



The automaton accepts the string a. It accepts the string a because there is an existing path for it from the start state to an accepting state.

6. What is the language of this automaton?



$L = \emptyset$

7. In your own words, what does an ϵ NFA (λ NFA) do differently than a DFA or NFA?

Unlike DFA, ϵ NFA has the features that NFA possesses, including no need for denoting all possible inputs over the language and availability to have a state that has transitions to multiple states with the same input.

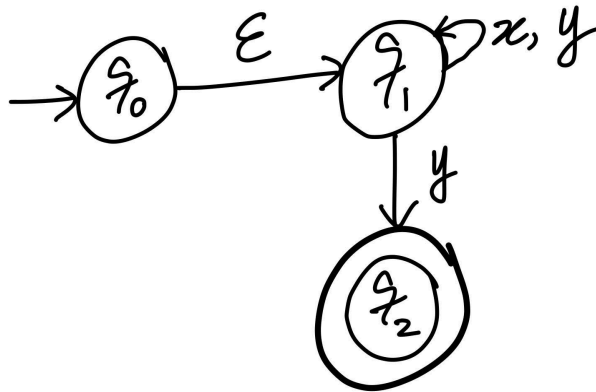
Unlike NFA, ϵ NFA can have an ϵ as the input and includes transitions based on the ϵ as the input.

8. What is the type (domain and codomain) of an ϵ NFA's transition function?

Domain: $Q \times (\Sigma \cup \{\epsilon\})$, where Q is the set of states and Σ is the input alphabet.

Codomain: $P(Q)$, which is the power set of the set of states.

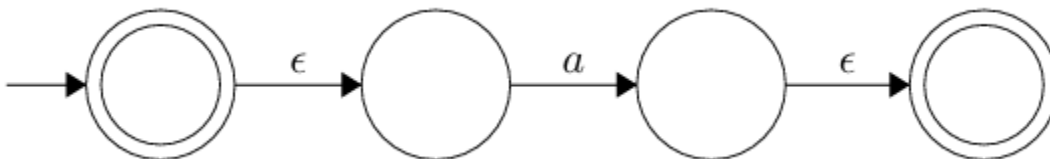
9. Draw your own ϵ NFA diagram with at least 3 (labelled) states. It should take an input alphabet of at least 2 letters, and 1 or 2 of the states should be final (accepting). It should also have at least 1 ϵ (λ) transition.



10. Provide a string that goes through your ϵ transition to get accepted. Name the states it goes through, in order, to end at a final state.

xy
 $q_0 \rightarrow q_1 \rightarrow q_2$

11. What is the language of this automaton?



$L = \{ s : s \in \{\epsilon, a\} \text{ and } |s| \leq 1 \}$

2. Regexes

1. What set does \emptyset represent as a regex? In this class, we may also write this set as 0.

The set \emptyset .

2. What set does ϵ (λ) represent as a regex? In this class, we may also write this set as 1.

The set $\{\lambda\}$.

3. What set does a represent as a regex, where a is some letter?

The set $\{a\}$

4. What set does $u+v$ represent as a regex, where u and v are regexes for the sets U and V respectively?

The set $L(u) \cup L(v)$.

5. What set does $u \cdot v$ represent as a regex, where u and v are regexes for the sets U and V respectively?

The set $\{s_1 \cdot s_2 : s_1 \in L(u) \wedge s_2 \in L(v)\}$.

6. What set does u^* represent as a regex, where u is the regex for the set U ?

The set $\{s_1 s_2 s_3 \dots s_n : n \geq 0 \wedge s_1, s_2, s_3, \dots, s_n \in L(u)\}$

7. Name 3 elements of the set represented by $(ab+c)^*$.

c, ab, abc

8. Give a regex representing the set of words over the alphabet $\{a, b, c\}$ with only doubled letters. For example, $ccaabb$ is such a word. Recall that this set can be written as $\{x^2 \mid x \in \{a, b, c\}\}^*$.

$(aa+bb+cc)^*$

9. Give a regex representing the set of words over the alphabet $\{a, b, c\}$ containing exactly 2 c s. For example, $cbac$ is such a word. Recall that this set can be written as $\{xcycz \mid x, y, z \in \{a, b\}^*\}$.

$c(a+b)(a+b)c$