

CSE460 : Switching Theory

Lecture 16 : Deterministic Finite Automata (DFAs) Non-Deterministic Finite Automata (NFAs)

Washington University
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<http://www.arl.wustl.edu/~lockwood/class/cse460/>

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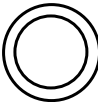
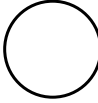
Finite Automata

- Type of Finite State Machine
- Declares inputs to be:
 - Accepted -or-
 - Rejected
- Input : X
- State : S
- State Transitions : δ
- Initial State : S_0
- Accepting States : A

Regular Language

- Regular Language
 - Alphabet: Set of symbols, e.g. $\{0,1\}$ or $\{a,b,c\}$.
 - String: Sequence of symbols in the alphabet
 - $|S|$ = Length of String
 - Empty String: ϵ
 - $|\epsilon| = 0$
 - L: Language = Set of strings
 - $|L|$ = Size of language
 - Can be infinite

Accepted Language / Accepting States

- Accepted Language
 - Input = String
 - Output = Accepted
 - NFA : Non-disjoint next-state transitions
 - Example Markov Chain
- 
- Accepting State
(Output = 1)
- 
- (Output = 0)

DFA / NFA

- **DFA : Deterministic Finite Automation**
 - Next state transitions well-defined
- **NFA : Non-deterministic Finite Automation**
 - Multiple Next-state transitions possible
 - Concise Description
 - Non-physical implementation
- **Example**
 - Graph with states that allow transition to non-singleton set of next-states.

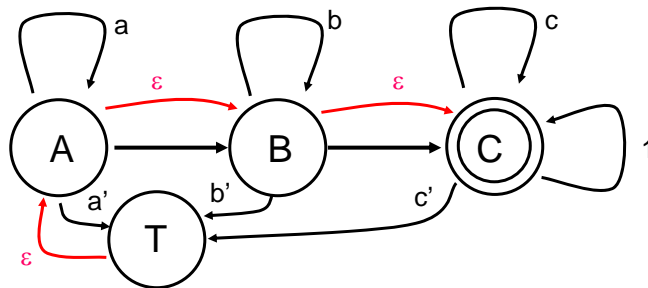
Finite State Transitions

- **Deterministic Finite State Transitions**
 - Consider $(s,x) : X \times S \rightarrow S$
 - Where $t = \delta(s,x) \in S$
- **Non-Deterministic Finite Automata**
 - Some $\delta(s,x)$ map to multiple states
 - For all possible S in S , X in X
 - Consider $(s,x) : X \times S \rightarrow 2^S$
 - Where $T = \delta(s,x) \in 2^S$
- **Complete Deterministic Finite Automata**
 - All possible $\delta(S_i, X_k)$ map to single state
 - For all possible S in S , X in X

NFAs

- Empty Input = ϵ
- State Transitions
 - Initial State
 - $\delta(A,a)=A$, $\delta(A,a')=T$, $\delta(A, \epsilon)=B$
 - Intermediate State
 - $\delta(B,b)=B$, $\delta(B,b')=T$, $\delta(B, \epsilon)=C$
 - Accepting State
 - $\delta(C,c)=C$, $\delta(C,c')=T$, Output = Accepted
 - Trap State
 - T

Transitions of NFA



- Accepting Strings
 - abc
 - aaabbbbcc
 - ac