DEFINITIONS

- A Finite State Automaton (FSA) *A* consists of 4 objects
  - A set *I* called the input alphabet, of input symbols
  - A set *S* of states the automaton can be in;
  - A designated state s_0 called the initial state;
  - A designated set of states called the set of accepting states, or final states;
  - A next-state function N: $S \times I \rightarrow S$ that associates a "next-state" to each ordered pair consisting of a "current state" and "current input". For each state s in *S* and input symbol *m* in *I*, *N(s,m)* is called the state to which *A* goes if *m* is input to *A* when *A* is in state *s*.
- The operation of an FSA is commonly described by a diagram called a (state-)transition diagram. In a transition diagram, states are represented by circles, and accepting states by double circles. There is one arrow that points to the initial state and other arrows between states as follows: There is an arrow from state *s* to state *t* labeled *m* ($\in$I) iff $N(s,m)=t$.
- The next-state table is a tabular representation of the next-state function. In the annotated next-state table, the initial state is indicated by an arrow and the accepting states by double circles.
- The eventual-state function of *A* is the function N^*: $S \times I^* \rightarrow S$ defined as: for any state *s* of *S* and any input string *w* in I^*, $N^*(s,w)$ = the state to which *A* goes if the symbols of *w* are input into *A* in sequence starting when *A* is in state *s*.

AUTOMATA AND REGULAR LANGUAGES

- Let *A* be a FSA with set of input symbols *I*. Let *w* be a string of I^*. Then *w* is accepted by *A* iff $N^*(s_0,w)$ is an accepting state.
- The language accepted by *A*, denoted *L(A)*, is the set of all strings that are accepted by *A*. $L(A) = \{w \in I^* \mid N^*(s_0,w)$ is an accepting state of $A\}$
- Kleene's Theorem: A language is accepted by an FSA iff it can be described by a regular expression. Such a language is called a regular language.
- Theorem 1: Some languages are not regular.
- Theorem 2: The set of regular languages over an alphabet *I* is closed under the complement, union and intersection operators.