G52MAL
Machines and Their Languages
Lecture 3
Non-deterministic Finite Automata (NFA)

Henrik Nilsson

University of Nottingham

Recap: Formal Definition of DFA

Formally, a ***Deterministic Finite Automaton*** or ***DFA*** is defined by a 5-tuple

$$(Q, \Sigma, \delta, q_0, F)$$

where

Q	:	***Finite*** set of States
Σ	:	Alphabet (finite set of symbols)
$\delta \in Q \times \Sigma \to Q$	:	Transition Function
$q_0 \in Q$	:	Initial or Start State
$F \subseteq Q$	:	Accepting (or Final) States

Recap: Extended Transition Function

The ***Extended Transition Function*** is defined on a state and a ***word*** (string of symbols) instead of on a single symbol.

For a DFA $A = (Q, \Sigma, \delta, q_0, F)$, the extended transition function is defined by:

$$\begin{aligned} \hat{\delta} &\in Q \times \Sigma^* \to Q \\ \hat{\delta}(q, \epsilon) &= q \\ \hat{\delta}(q, xw) &= \hat{\delta}(\delta(q, x), w) \end{aligned}$$

where $q \in Q$, $x \in \Sigma$, $w \in \Sigma^*$.

Recap: Language of a DFA

The ***language*** $L(A)$ defined by a DFA A is the set or words ***accepted*** by the DFA. For a DFA

$$A = (Q, \Sigma, \delta, q_0, F)$$

the language is defined by

$$L(A) = \{\ w \in \Sigma^* \mid \hat{\delta}(q_0, w) \in F\ \}$$