CS321 - Notes

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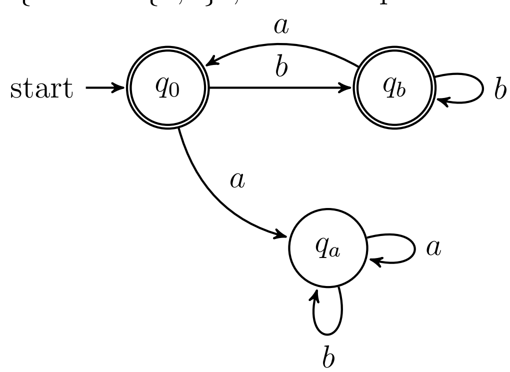
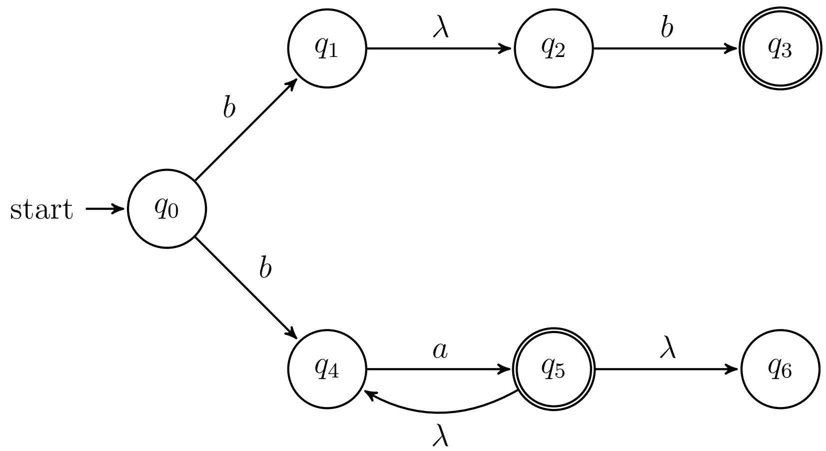
DFAs

$L = \{w : w \in \{a, b\}^*$, each a is preceeded by a $b\}$.



NFAs (Non-deterministic Finite Acceptors)

Quantum computers at a first level of approximation, you solve a problem by trying all possible solutions at the same time. This is sorta what non-determinism is.



Acceptance Criterial for Strings

$L(N)$ what is the language for an NFA N?
NFAs accept a string w only if:

1. w can be completely read in.

2. w ends up a in an accept state.

Since we are working with NFAs, w can take all paths at once. In order for w to be accepted by the NFA, only one of the paths has to end in an accept state.

Examples

- $w = abb$, reject.

- $w = baa$, accept, though the NFA can also reject it.

- $w = bbb$, reject, because the NFA will never read in a 3rd b after q_3.

Powersets

Let Q be a set. The power set of Q (written 2^Q) is a set that contains all subsets of Q.

Example

$$Q = \{1, 2, 3\}.$$
$$2^Q = \{\emptyset, \{1\}, \{2\}, \{3\}, \{1, 2\}, \{2, 3\}, \ldots\}.$$

NFA as a 5-Tuple

An NFA is a 5-tuple. It can be written as:

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

where Q, Σ, q_0, and F are as for DFA, and

$$\delta : Q \times (\Sigma \cup \{\lambda\}) \to 2^Q.$$

The transition function is: $\delta(q, a) = Q'$. Given the state q, and the string a, $Q' \subseteq Q$, where Q is all possible states - as with DFAs.

Examples

$$\delta(q_0, b) = \{q_1, q_4\}$$
$$\delta(q_0, a) = \emptyset$$
$$\delta(q_5, \lambda) = \{q_4, q_6\}$$

$\delta^*(q, w)$ is the set of states that are reachable starting from q and reading *all* of w.

$$\delta^*(q_0, \lambda) = \{q_0\}$$
$$\delta^*(q_1, \lambda) = \{q_1, q_2\}$$
$$\delta^*(q_2, \lambda) = \{q_2\}$$
$$\delta^*(q_0, b) = \{q_1, q_2, q_4\}$$
$$\delta^*(q_1, bbb) = \emptyset$$