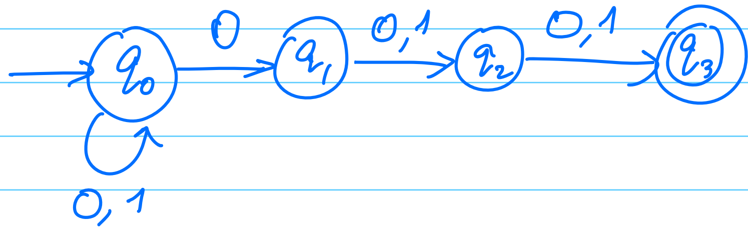
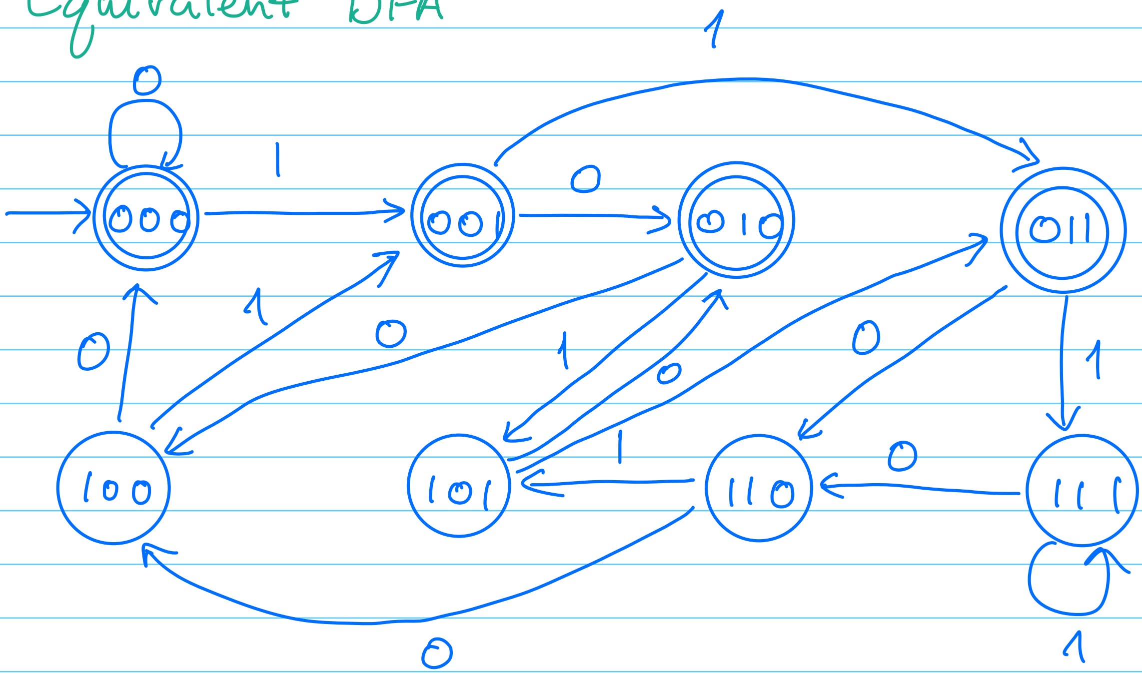
Non-deterministic Finite-State Automata (NFA)

- At a particular state q, on input σ there could be more than one transition possible
- ε-transition - Automaton can instantaneously change state without reading any input.

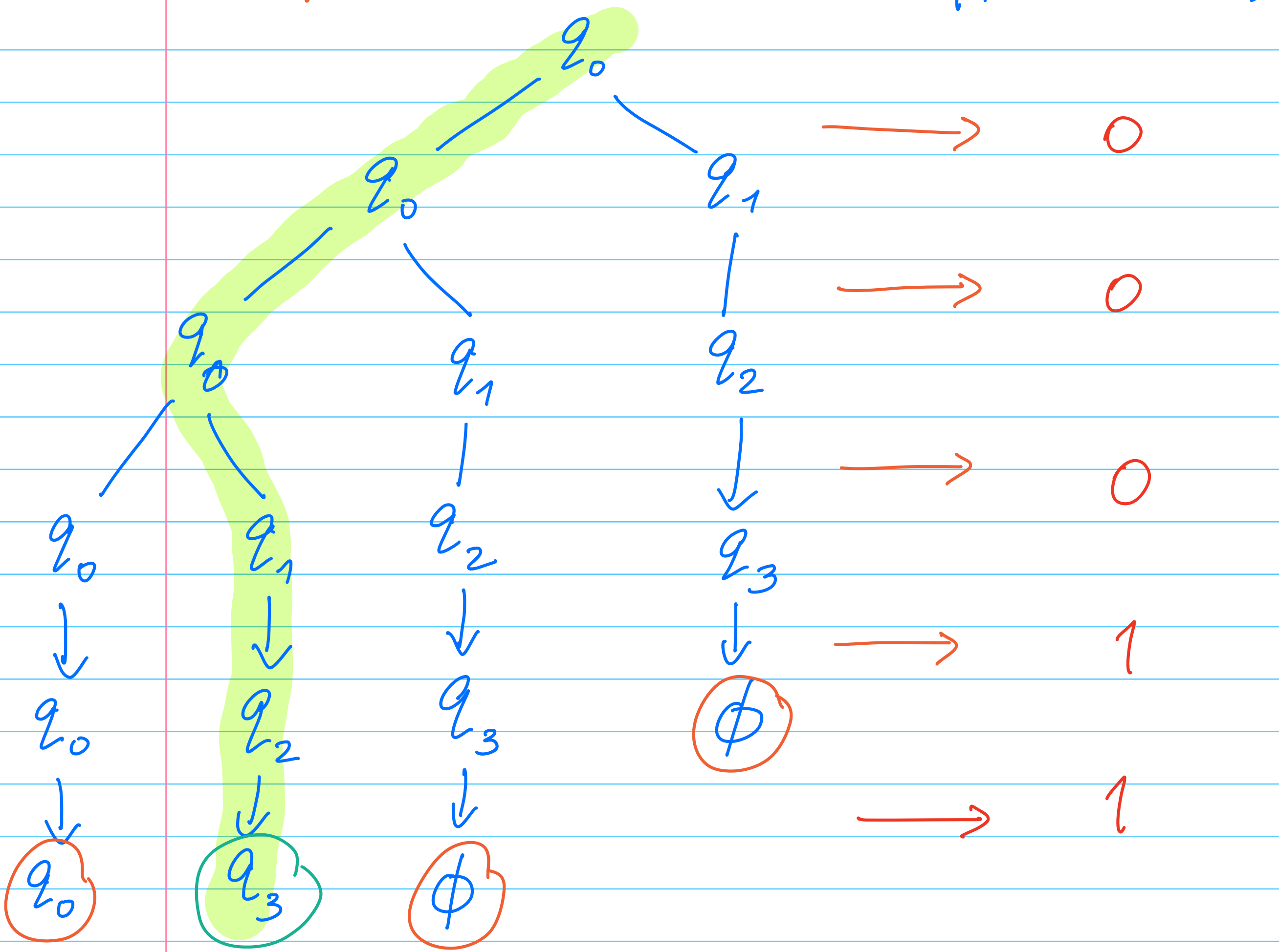
$$L = \{ w \in \{0,1\}^* \mid \text{third last symbol from the right is a } 0 \}$$



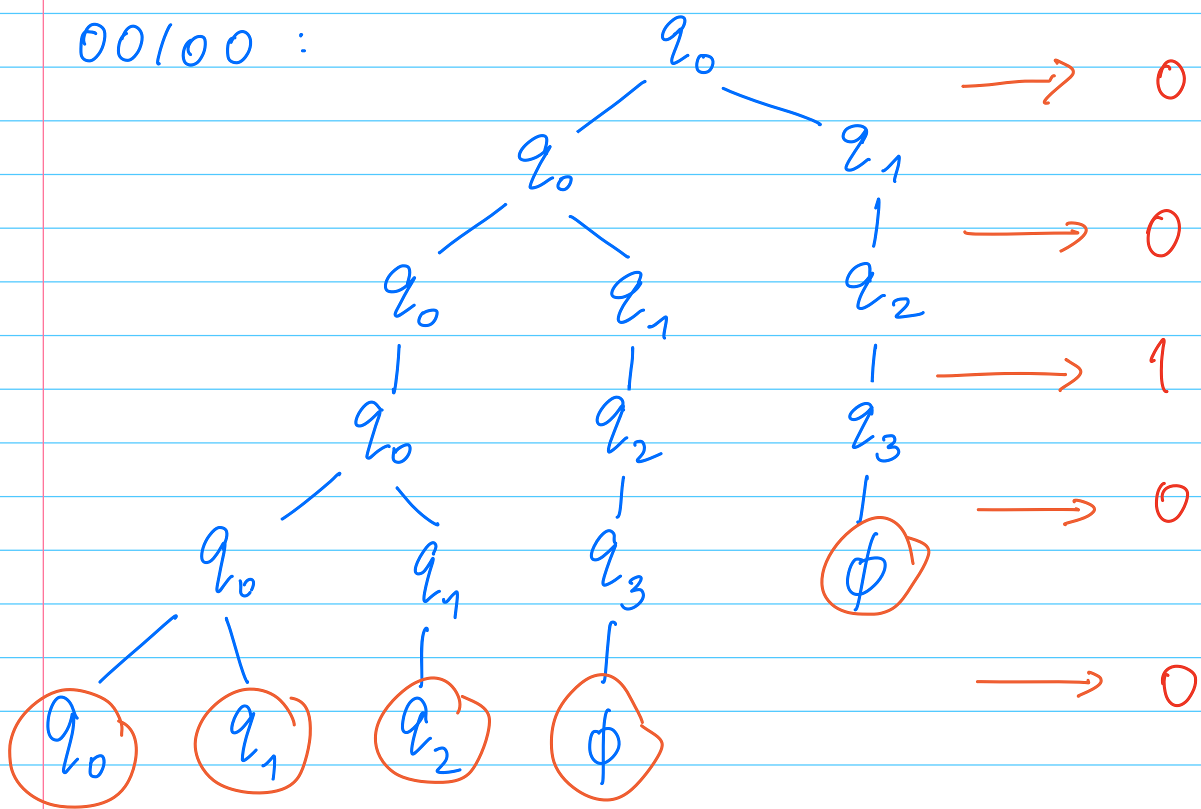
Equivalent DFA



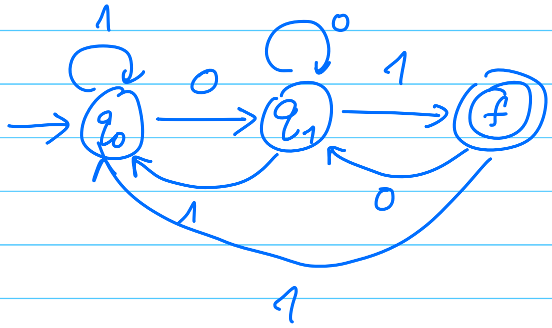
Computation tree: $00011 \in L(N)$



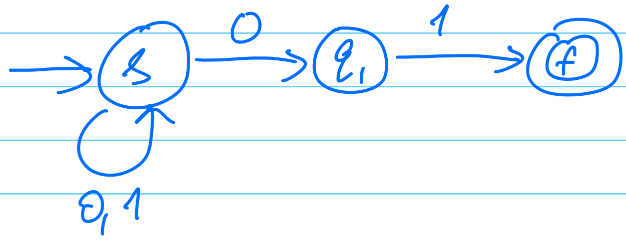
00100 :



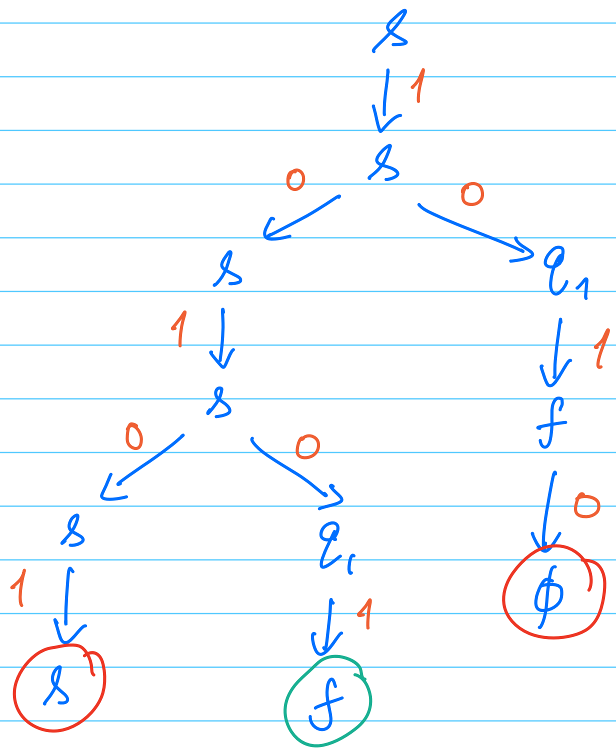
$L = \{ w \in \{0,1\}^* \mid w \text{ ends in } 01 \}$



Corresponding NFA: Guess that the 0 we are seeing is the second-last symbol.



10101



Formal definition : $(Q, \Sigma, \Delta, q_0, F)$

$$\Delta : Q \times \Sigma \to \mathcal{P}(Q)$$

$$\hat{\Delta} : \mathcal{P}(Q) \times \Sigma^* \to \mathcal{P}(Q)$$

- $\hat{\Delta}(A, \epsilon) = A$
- $\hat{\Delta}(A, w\sigma) = \bigcup_{q \in \hat{\Delta}(A,w)} \Delta(q, \sigma)$

$$L(N) = \{ w \in \Sigma^* \mid \hat{\Delta}(q_0, w) \cap F \neq \emptyset \}$$

Remarks:

(1) If there is non-determinism in the transitions, why not in the start state

equivalent: $N = (Q, \Sigma, \Delta, S, F)$

↳ set of start states

This can be converted to one start state using ϵ-transitions