Theory of Computation

Deterministic Finite Automaton (DFA)

machine == automaton

↳ one = automaton (tekil)

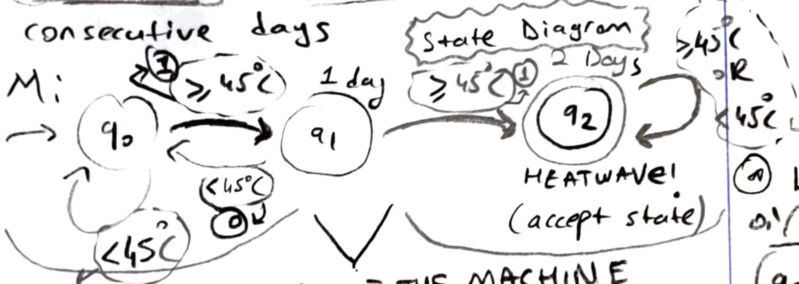
↳ two = automata (çoğul)

Example: Did a heatwave occur?

Input: String of weather data

* Heatwave: temperature $\geq 45°C$ for 2 consecutive days

M:



LANGUAGE OF THE MACHINE

$L_M = \{$ all strings containing 11 $\}$

M accepts 11,

Also M accepts 110, 0110, 1011, 1010110

WHY we call deterministic?

↳ Because the next steps are all determined.

Formal Definition of $M = (Q, \Sigma, \delta, q_0, F)$

- Q is the set of states (q_0, q_1, q_2)
- Σ is the alphabet $\Sigma = \{1, 0\}$
- δ is the transition function

	1	0
q_0	q_1	q_0
q_1	q_2	q_1
q_2	q_2	q_2

↳ q_0: Start State

↳ F: set of accept/final states $= \{q_2\}$

Regular Language

A language recognized by some finite automaton

SUMMARY

• DFAs are 5-tuples $(Q, \Sigma, \delta, q_0, F)$

•  = This means accept state

• L_M is set of all accepted strings

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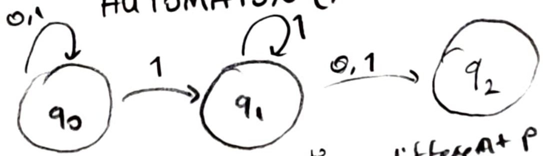
NONDETERMINISTIC FINITE AUTOMATON (NFA)



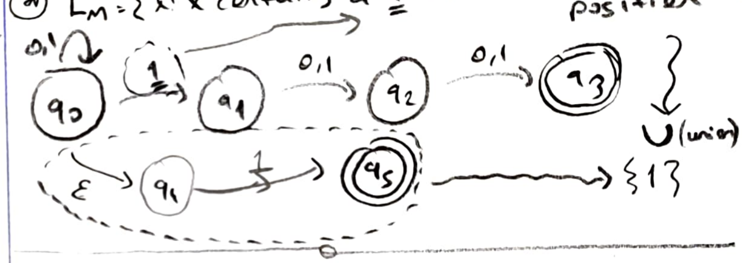
INPUT: 11 = goes to two different path.

The NFA still accepts the string, because there is a path to an accept state.

Input = 01

Notice there is an empty string in here

* $L_M = \{x : x$ contains a 1 in the third final position $\}$



$M = (Q, \Sigma, \delta, q_0, F)$ ↗ delta

$\{q_0, q_1, q_2, q_3, q_4, q_5\}$

$\delta : Q \times \Sigma_\varepsilon \to P(Q)$

↳ $\Sigma \cup \{\varepsilon\}$

$\Sigma = \{1, 0\}$

q_0: start

$F: \{q_3, q_5\}$

* "δ" gives a set of possible states, instead of just 1

δ:

	0	1	ε
q_0	$\{q_0\}$	$\{q_0, q_1\}$	$\{q_4\}$

NFA can only do as much as DFA can so DFA is more powerful

SUMMARY

• NFAs are 5-tuples $(Q, \Sigma, \delta, q_0, F)$

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= That means set of possible states

• Languages recognized by an NFA are regular languages