18.404 Recitation 1

Sept 4, 2020

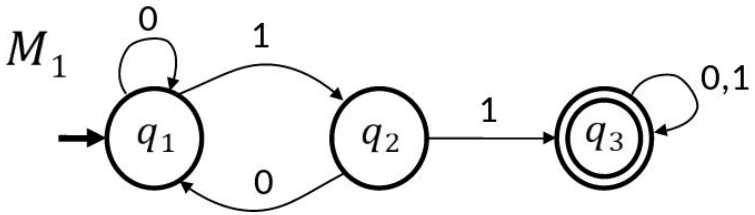
Today's Topics

- Terminology: Finite Automata
- Example: Finite Automata
  - Σ* (Sigma-star)
  - Ø (empty language)
  - {Σ} (single string)
  - {ε} (empty string)
  - Even number of 0s
- Terminology: Regular language
- Theorem: Every finite language is regular
- Theorem: Regular languages are closed under reversal

Terminology: Finite Automata

- Automata States
  - **One** start state
  - **One or Many** accept states
- Automata Transitions
  - Flow follows direction of arrow
  - Every transition consumes one unit from the input. **No going back or re-reading input!**
- 5-Tuple Definition:
  - $(Q, \Sigma, \delta, q_0, F)$

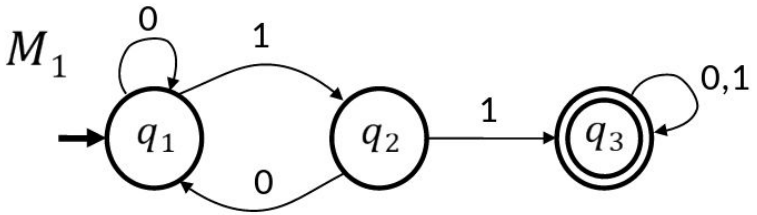
Example Finite Automata



Terminology: Finite Automata (cont.)

- Automata accepts string
  - Given an input string, is there a path of valid transitions such that:
  - When entire string has been fully consumed, current state is an **accept** state.
  - "M_1 accepts S" *or* S ∈ L(M_1)
- Language
  - Set of all strings accepted by M_1

Example Finite Automata



Example: Finite Automata (Σ^*)

- What is Σ?
- What does the * do?

What does the language Σ^* mean in plain English?

Draw out Finite Automata:

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- What is Σ?
- What does the * do?

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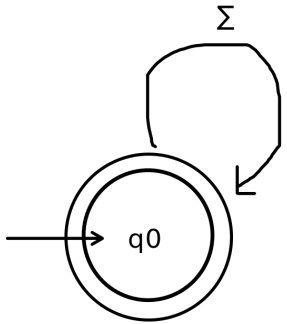
Draw out Finite Automata:



Example: Finite Automata (Ø)

- What is Ø?

What does the language Ø mean in plain English?

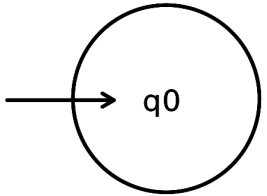
Draw out Finite Automata:

Example: Finite Automata (Ø)

- What is Ø?

What does the language Ø mean in plain English?

Draw out Finite Automata:



Example: Finite Automata ({Σ})

What does the language {Σ} mean in plain English?

Draw out Finite Automata:

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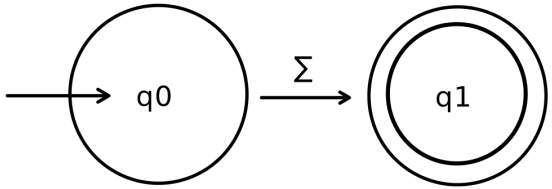
What does the language {Σ} mean in plain English?

Draw out Finite Automata:



Example: Finite Automata ({ε})

What does the language {ε} mean in plain English?

Draw out Finite Automata:

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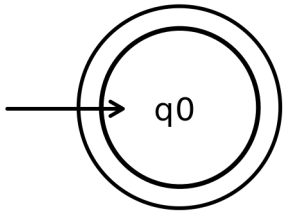
What does the language {ε} mean in plain English?

Draw out Finite Automata:



Example: Finite Automata (Even number of 0s)

Ideas?

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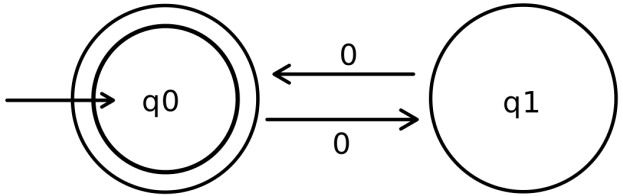


Terminology: Regular Language

Any language for which a valid Finite Automata exists

- Can be a finite language ($|L(M)|$ = some number)
- Can be an infinite language ($|L(M)| = \infty$)

Non-regular languages exists!

- Example in future lecture

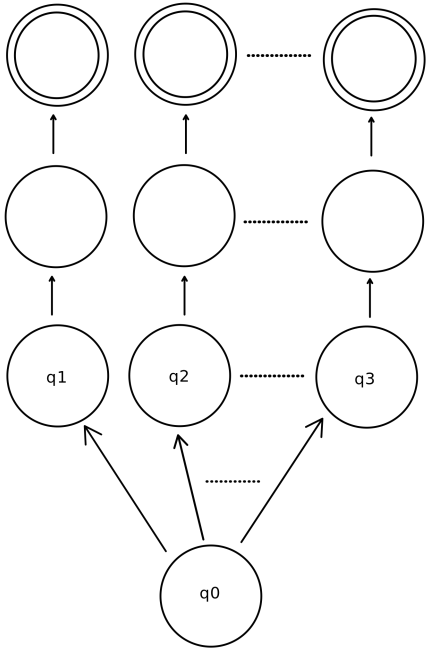
Theorem: Every Finite Language is Regular

Direct construction

Closure under union

Theorem: Every Finite Language is Regular

Direct construction



Closure under union

Theorem: Regular Languages Closed Under Reversal

Ideas?

- Objective is to recognize A^R where A is language of M
  - Formally: $A^R = \{ w \mid w^R \in A \}$ where for $w=w_0w_1...w_n$ and $w^R=w_n...w_1w_0$
- We have the Finite Automata of M
- Need to devise Finite Automata M_{rev}

Theorem: Regular Languages Closed Under Reversal (cont.)

Draw simple conceptual example: