

CSC236 Worksheet 8 Solution

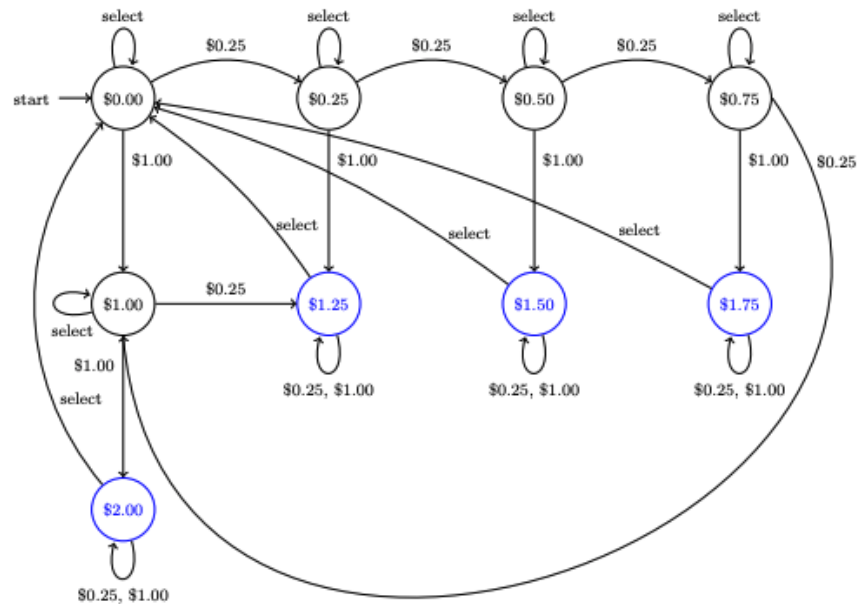
Hyungmo Gu

May 12, 2020

Question 1

Notes:

- **Deterministic Finite State Automaton (DFSA):** is a mathematical method of machine which, given any input string x , **accepts** or **rejects** x .
- Applications of DFSA
 1. Vending Machine



2. Protocol analysis
3. Text parsing
4. Video game character behavior

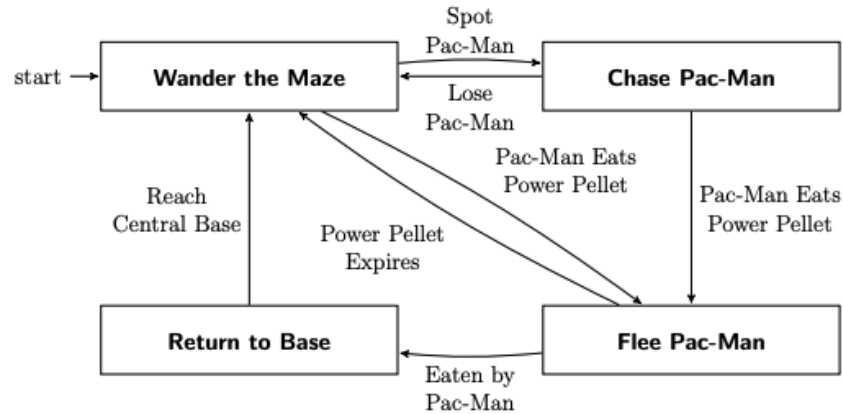
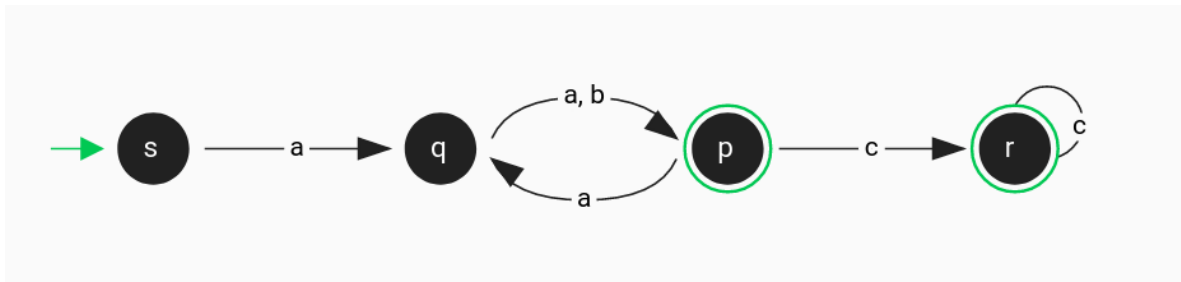


Figure 3: Behavior of a Pac-Man Ghost

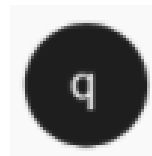
5. Security Analysis
6. CPU control units (**)
7. Natural Language Processing (**)
8. Speech Recognition (**)

- Definitions and Syntax



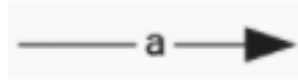
– *DFSA* M is a quintuple $M = (Q, \Sigma, q_0, F, \delta)$, where

- * Q : a finite set of **states**.
 - Represents status of system
 - Is represented by a black circle, i.e. s,q

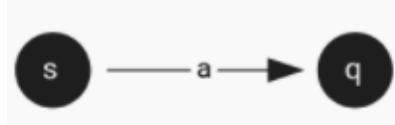


- i.e. automatic sliding door at walmart has two states: either close or open
- i.e. traffic light has three states: red, yellow, green

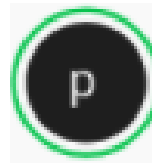
- * Σ : a finite non-empty alphabet
 - is set of symbols in each transition, i.e. a, b, c



- * $q_0 \in Q$: the start or initial state
- * $\delta : Q \times \sigma \rightarrow Q$: a transition function
 - is a connection between two states.
 - is represented by an arrow



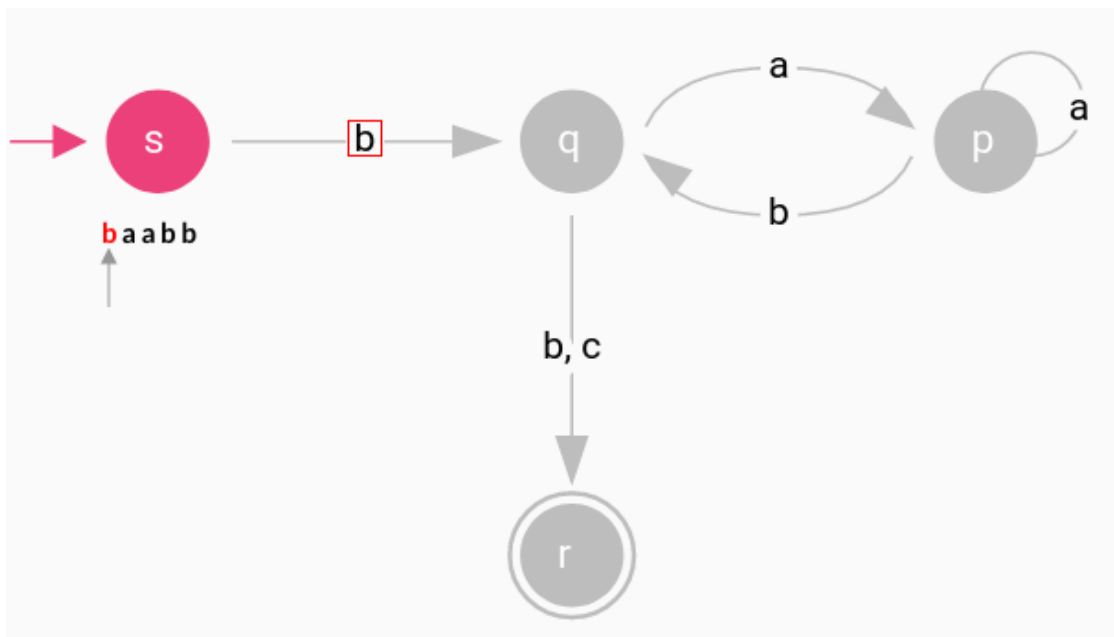
- * $F \subseteq Q$: the set of accepting or final states
 - Is represented by a double circle



- Multiple accepting states may exist
- Purpose: When processing ends, the output is either *accept* or *reject*

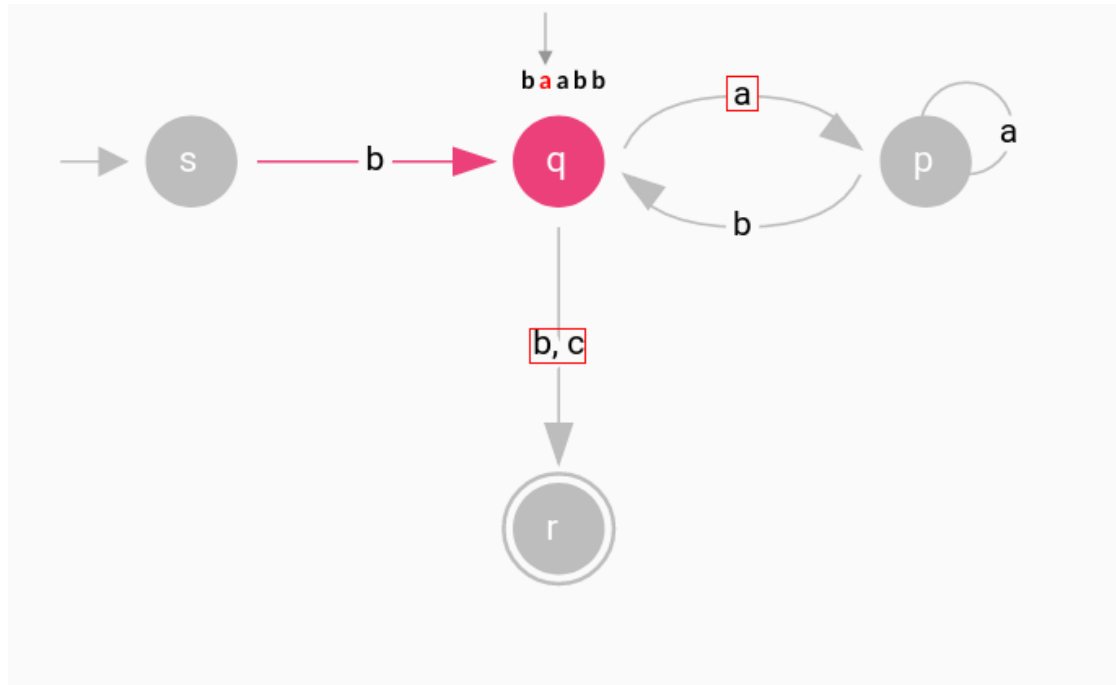
- Simple Example

– Step 1



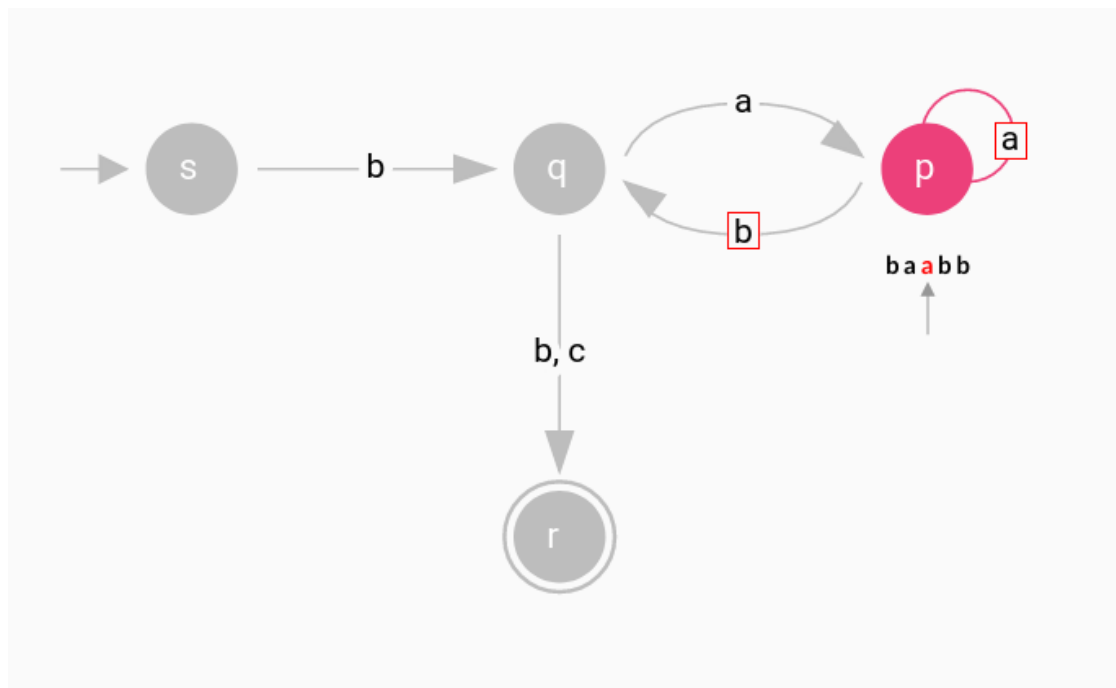
1. First symbol of the input **baabb** is **b** and the current state is *s*.
2. Ask, is there any exiting transition from *s* that contains the symbol **b**?
3. The answer is yes, so move to *q*

– Step 2



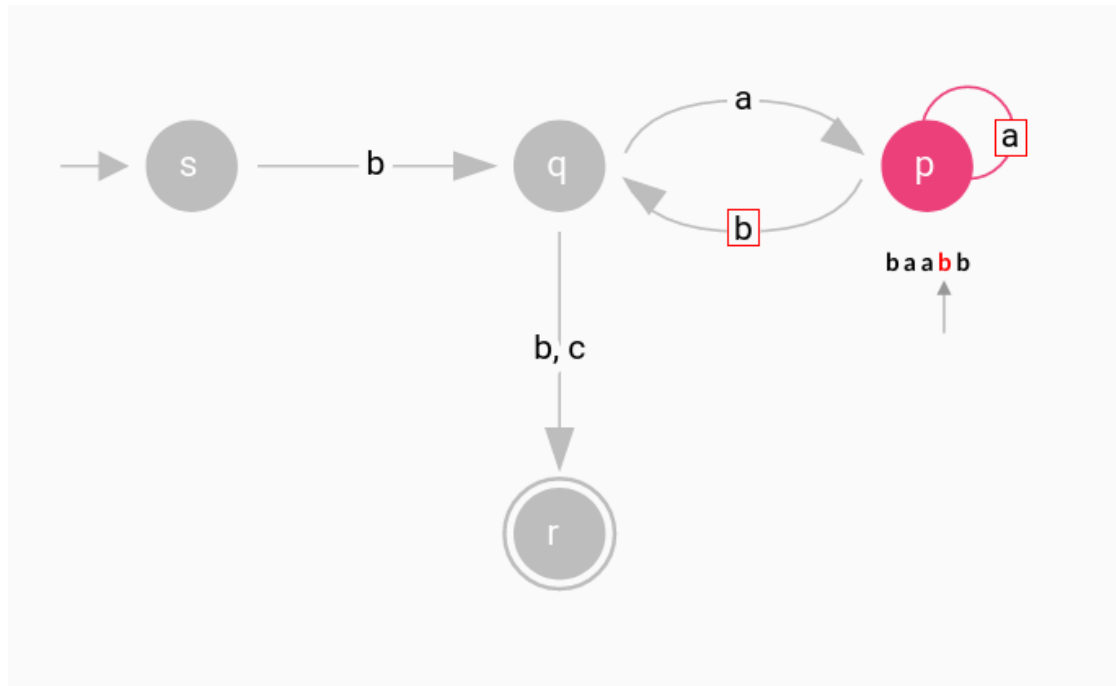
1. Next symbol of the input **baabb** is **a** and the current state is q .
2. Ask, is there any exiting transition from q that contains the symbol **a** or **b,c**?
3. The answer is yes, and it's **a**. So move to p

– Step 3

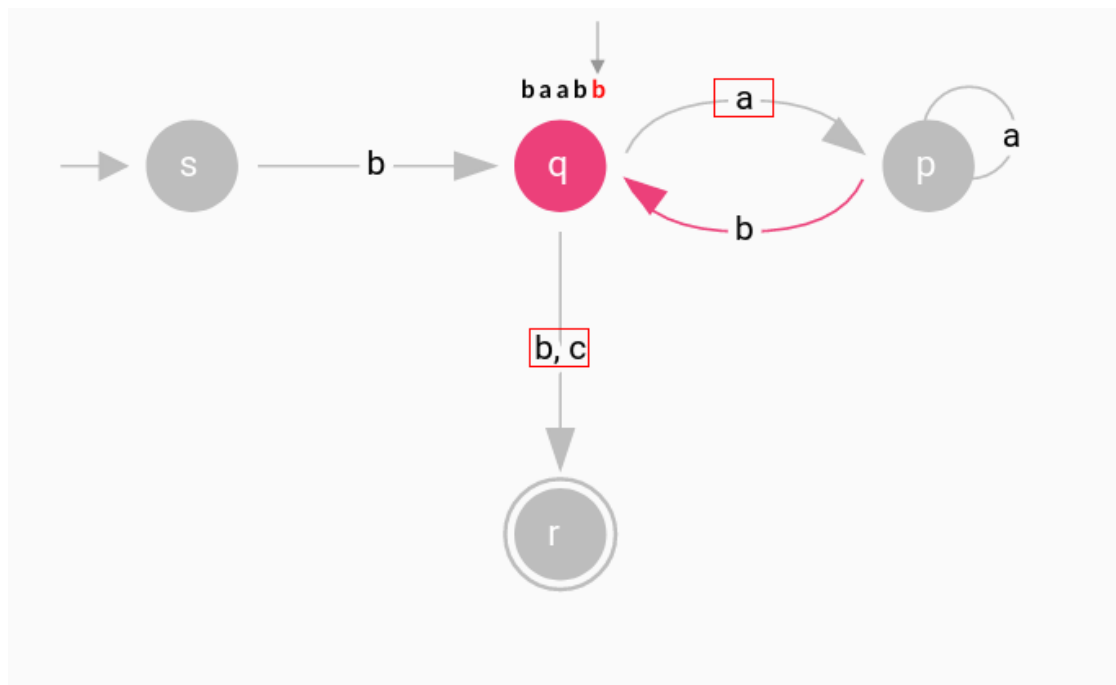


1. Next symbol of the input **baabb** is **a** and the current state is p .

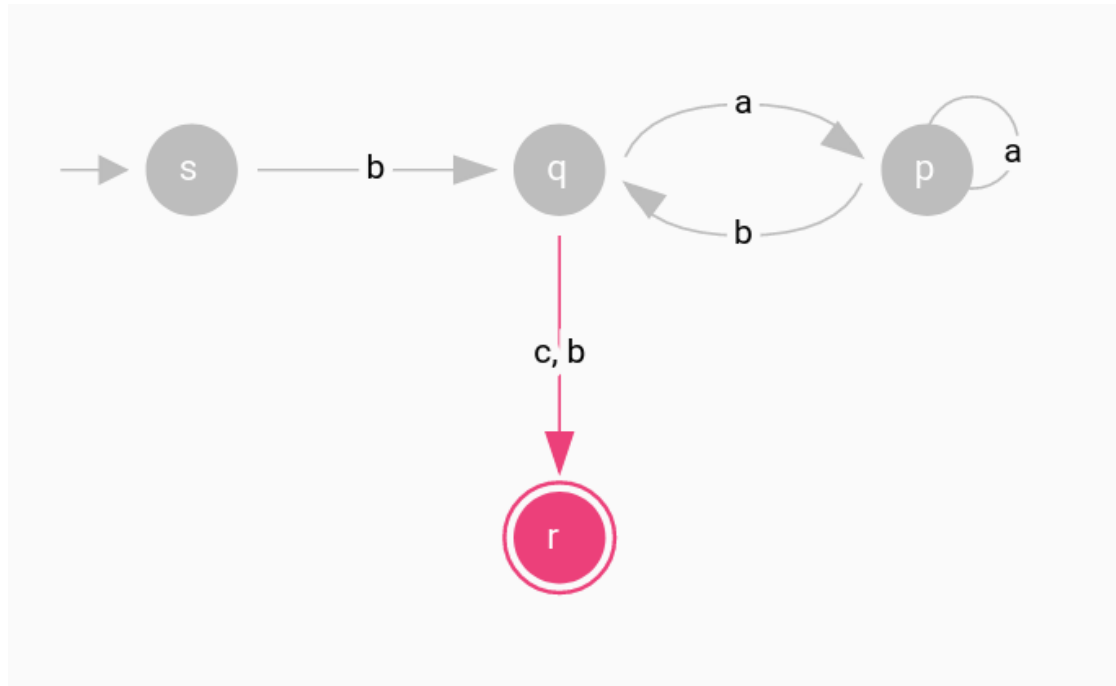
2. Ask, is there any exiting transition from p that contains the symbol **a** or **b**?
 3. The answer is yes, and it's **a**. So move to p
- Step 4



1. Next symbol of the input **baabb** is **b** and the current state is p .
 2. Ask, is there any exiting transition from p that contains the symbol **a** or **b**?
 3. The answer is yes, and it's **b**. So move to q
- Step 5



1. Next symbol of the input **baabb** is **b** and the current state is q .
 2. Ask, is there any exiting transition from q that contains the symbol **a** or **b,c**?
 3. The answer is yes, and it's **b**. So move to r
- Step 6



1. Next symbol of the input **baabb** is **b** and the current state is r .
2. Ask, if it satisfies the accepting or final state (i.e, has the end of string been reached?). If so, the output is accept. Otherwise, it's reject.

- Formal Languages

- is a subset of all possible words Σ^* formed by symbols of alphabet Σ .

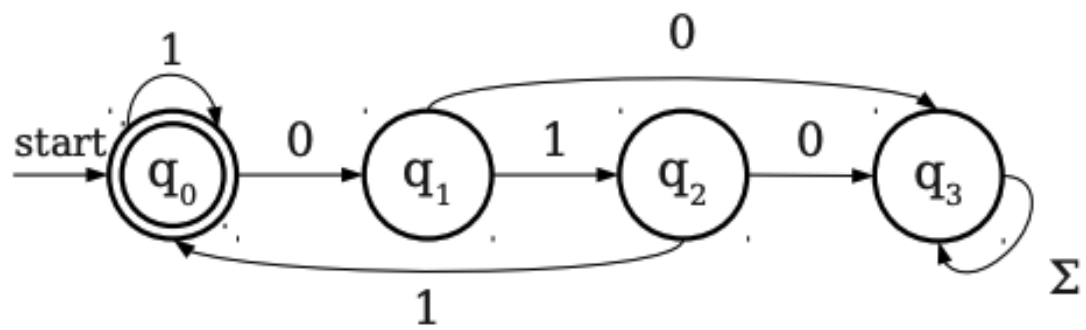
- * Σ^* is set of all possible strings over the alphabet Σ .
- * i.e. $\Sigma = \{a, b\}$, $\Sigma^* = \{a, b, aa, ab, ba, bb, aaa, aab, \dots\}$

- Example

1. $L = \{w \mid w \text{ has at most seventeen 0's}\}$
2. $L = \{w \mid w \text{ has equal number of 0's and 1's}\}$
3. $L = \{x \in \{a, b\}^* \mid \text{the number of a's in } x \text{ is even}\}$
 - * $*$ in $\{a, b\}^*$ means all possible combinations
 - * i.e. $\{a, b, aa, ab, ba, bb, aaa, baa, aba, \dots\}$

- Tabular DFAs

- Example



$$\delta =$$

	0	1
*q_0	q_1	q_0
q_1	q_3	q_2
q_2	q_3	q_0
q_3	q_3	q_3

Note: * means it's an accepting state

- Desining DFA which Accepts Language

—