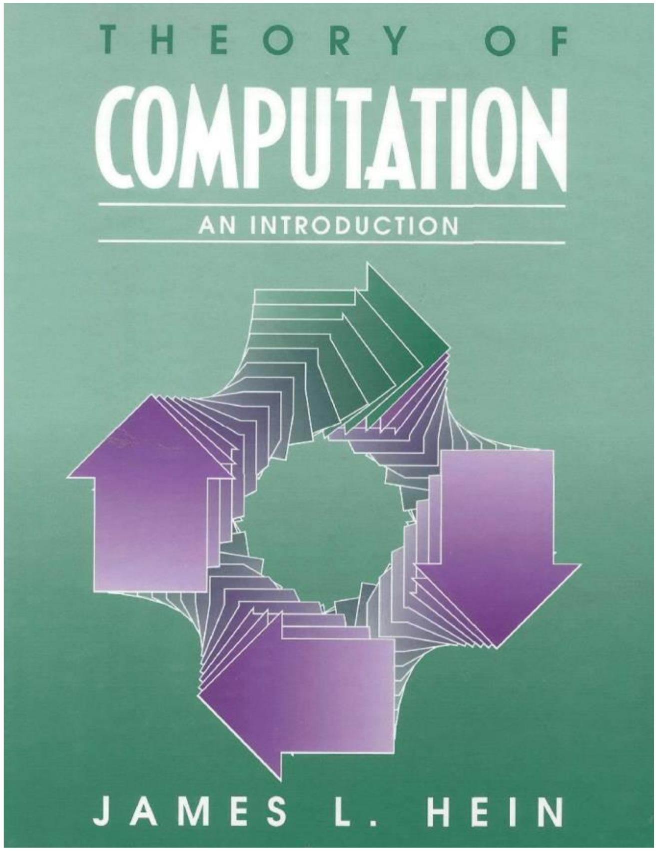
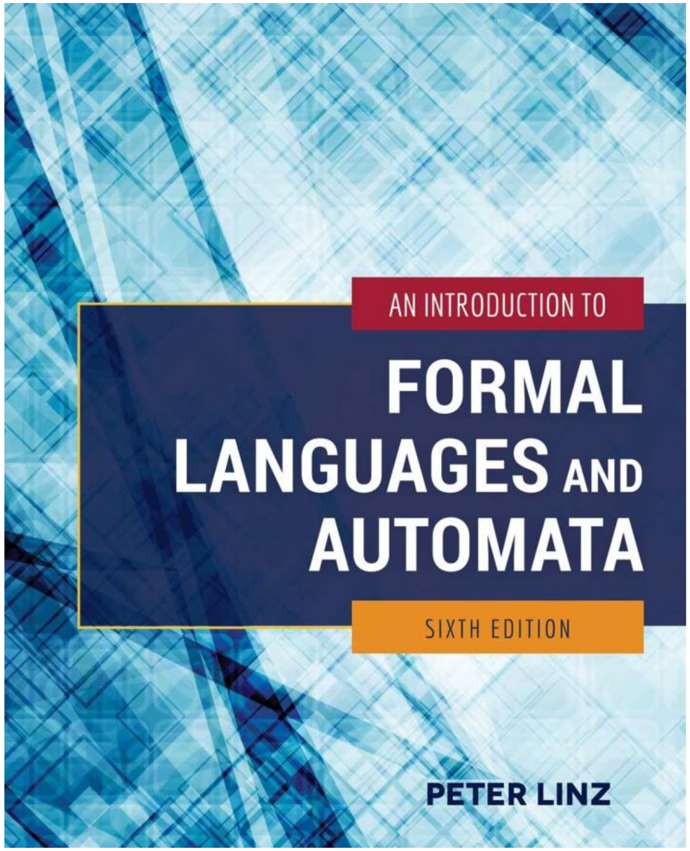
Automata and Formal Languages

Lecture 02

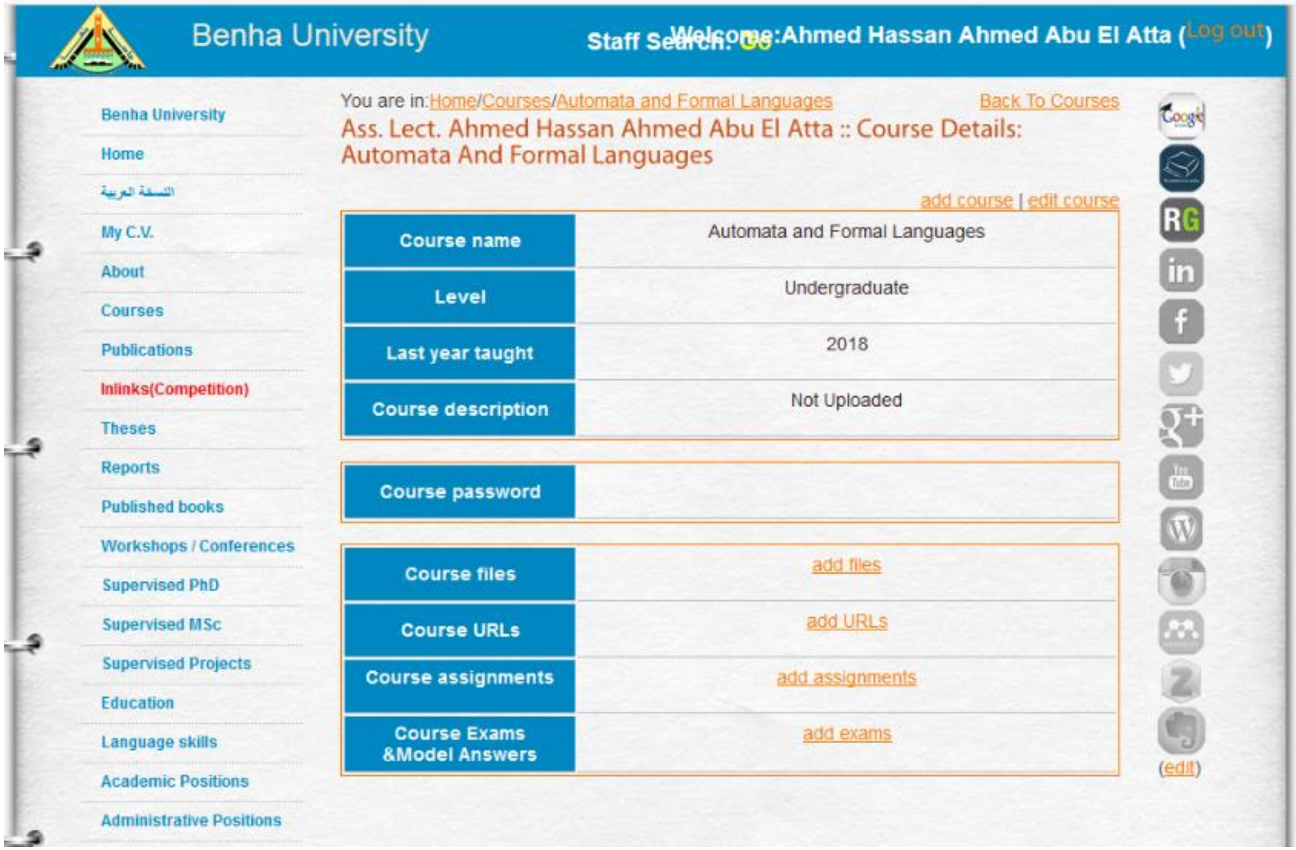
Books


THEORY OF
COMPUTATION
AN INTRODUCTION
JAMES L. HEIN


AN INTRODUCTION TO
FORMAL
LANGUAGES AND
AUTOMATA
SIXTH EDITION
PETER LINZ

PowerPoint

http://www.bu.edu.eg/staff/ahmedaboalatah14-courses/14767



FINITE AUTOMATA

Regular Language

Agenda

- Regular Languages
- Example : Regular Languages
- Finite Automata
- Example Finite Automaton
- Finite Automata (FA) as Accepter
- Transition Function & Transition Table
- Nondeterministic Finite Automata (NFA)
- Example: DFA
- Examples Find DFA & NFA
- Example: What is the language?

Regular Languages

The collection of regular languages over ***A*** is defined inductively as follows:

- *Basis:* ***Φ,*** {Ɛ}, and {a} are regular languages for all a ∈ ***A***.
- *Induction:* If ***L*** and ***M*** are regular languages, then the following languages are also regular: ***L***∪***M***, ***M*** .***L***, and ***L****.

Example : Regular Languages

Regular languages over the alphabet A = (a, b):

Φ,   {Ɛ},   {a},   {b}

{Ɛ, b} = {Ɛ} ∪ {b}

{a, ab} = {a}. {Ɛ, b}

{Ɛ, b, bb, ... , b^n, ... } = {b}*

{a, ab, abb, ... , ab^n,..} = {a} (Ɛ, b, bb, ... , b^n, ... } = {a}.{b}*

{Ɛ, a, b, aa, bb, ... , a^n, b^n, ... } = {a}* ∪ {b}*

Finite Automata

A finite Automata or ***FA*** is defined by the

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

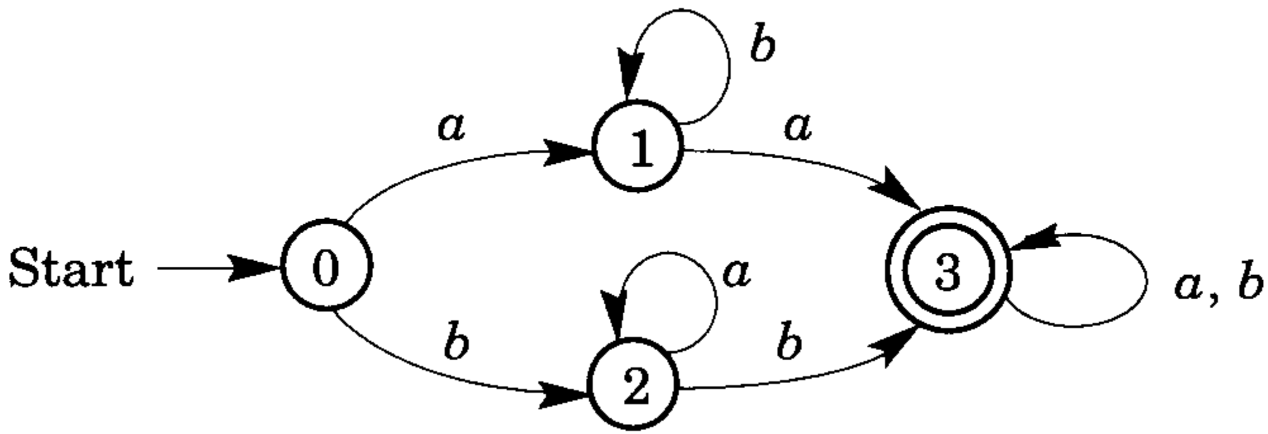
where

- Q is a finite set of states,
- Σ is a finite set of symbols called the input alphabet,
- $\delta : Q \times \Sigma \rightarrow Q$ is a total function called the transition function,
- $q_0 \in Q$ is the initial state,
- $F \subseteq Q$ is a set of final states.

Example Finite Automaton

A path 0, 1, 1, 3 with edges labeled a, *b,* a. Since 0 is the start state and 3 is a final state, we conclude that the FA accepts the string aba.

The FA also accepts the string baaabab by traveling along the path 0, 2, 2, 2, 2, 3, 3, 3.



Finite Automata (FA) as Accepter

- A ***FA*** *accepts* a string ***w*** in ***A**** if there is :
  - a path from the start state to some final state such that ***w*** is the concatenation of the labels on the edges of the path.
  - Otherwise, the ***FA*** *rejects* ***w.***
- The set of all strings accepted by a ***finite Automata M*** is called the *language* of ***M*** and is denoted by ***L(M)***.

Transition Function & Transition Table

$\delta(q_0,a)=q_0$

$\delta(q_0,b)=q_1$

$\delta(q_1,a)=q_2$

$\delta(q_1,b)=q_2$

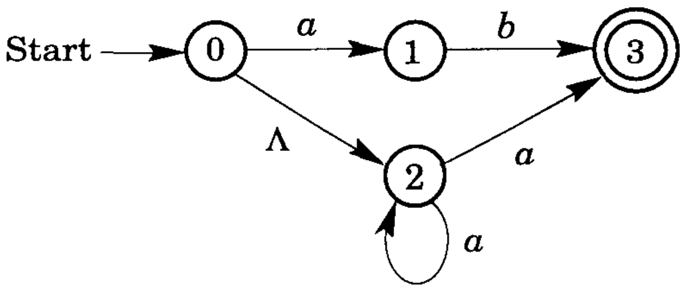
$\delta(q_2,a)=q_2$

$\delta(q_2,b)=q_2$

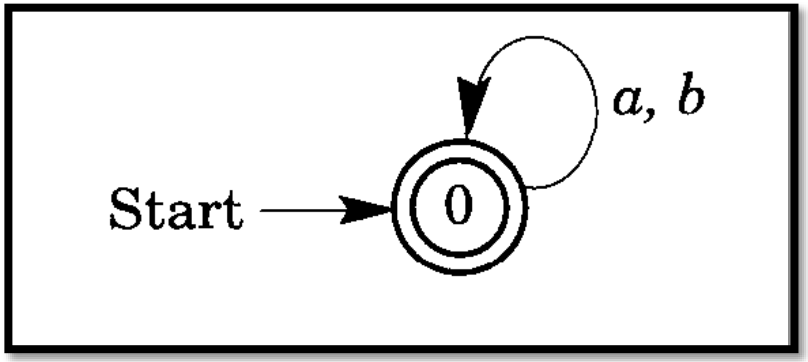
	a	b
q_0	q_0	q_1
q_1	q_2	q_2
q_2	q_2	q_2

Nondeterministic Finite Automata (NFA)

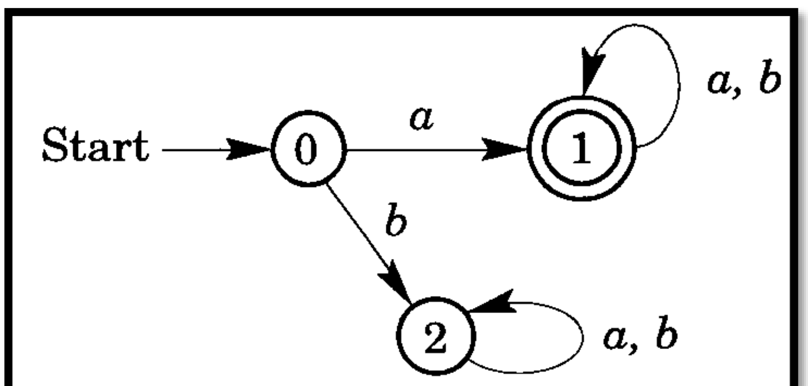
1. Edge with ***ε.***
2. Missing labels
3. Multiply edges start from the same state with the same label



Example: DFA



The set (a, b}* of all strings over {a, b}



The set of all strings over {a, b} that begin with a

Examples Find DFA & NFA

Regular languages over the alphabet A = (a, b):

Φ, {Ɛ}, {a}, {b}

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{Ɛ, a, b, aa, bb, ... , a^n, b^n, ... } = {a}* ∪ {b}*

Example: What is the language?