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Theory of Computation

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THEORY OF COMPUTATION (TOC)

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INTRODUCTION TO CONCEPT OF AUTOMATA

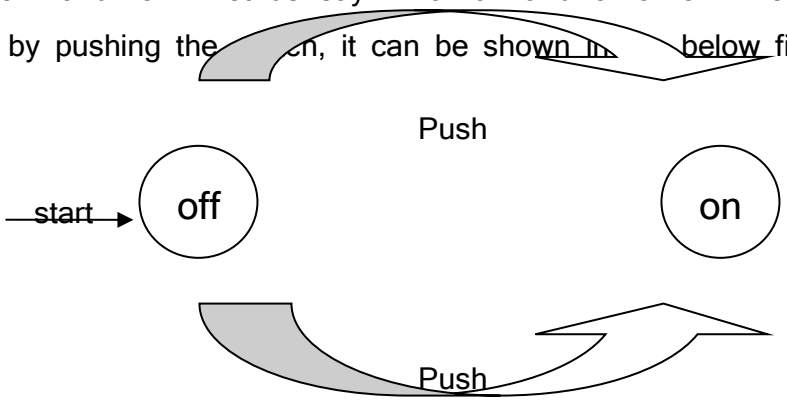
HISTORICAL ASPECT OF AUTOMATA

Automata theory is study of abstract computing devices, or “machines”. Before there were computers, in 1930’s, Alen turing introduced an abstract machine that has all the capabilities of today’s computers, at least as far as in what they could compute. In 1940’s and 1950’s simpler kinds of machines, which we today use“finite-automata”, were studied by a number of researchers. These automata, originally proposed to model bring function, turned out to be extremely useful for a variety of other purposes. Also in the late 1950’s the linguist N. Chomsky began the study of formal “grammars”. While not strictly machines, these grammars have close relation-ships to abstract automata and serve today on the basis of some important software components, including parts of compilers.

In 1969, S. Cook extended turning’s study of what could and what could not be computed. Cook separated those problems that can be solved, efficiently by computer, from those problems that m problems can be solved, but in practice take so much time, that computers are unavailing for all but very small cases of the problem. The later class of problem’s is called “intractable”, or NP-hard. All of this theoretical development bears directly on what Computers Scientists do today.

In computer science we find many examples of finite state system and the theory of finite state systems, and the theory of finite automata as a useful design tool for these systems. A primary example is a switching circuit. A switching circuit is composed of a finite number of gates, each of which can be in one or two conditions, usually denoted by 0 and 1.

We can suppose situation, in case of electric switch only two situation are possible that is "on" and "off". Let us say 1 for on and 0 for off. We can interchange the situation by pushing the switch, it can be shown in below figure.



Automatic is also tempting to view the human brain as a finite state system. The number of brain cell or neurons are little, probably 2^{35} at most. Although there is proof to the opposite, that the state of each neuron can be described by a small number of bits, if so then finite state theory applies to the brain also.

THE STUDY OF AUTOMATA THEORY IS FERTILE AND FUTURISTIC

There are many reasons why the study of automata and difficulty is an important and core part of computer science. In this we will establish many reason which will definitely motivate the computer science students to study automata theory. Let us list out some important features of the automata theory.

1. It plays an important role when we are making software for designing and checking the behavior of digital circuit.
2. The "Lexical analyser" of the typical compiler, that is the compiler component that breaks the input text into logical units, such as identifiers keywords and punctuation.
3. Software for scanning large bodies of text, such as set of web pages, to detect occurance of words, phrases or other patterns.
4. It is key to software for proving system of all types that have a finite number of distinct states, such as communication protocols or protocol for secure exchange of information.
5. It is most useful method of software for natural language processing.

DEVELOP YOUR FEELINGS WITH THE AUTOMATA

Truly ,it is very necessary to understand the subject like automata theory, that you should develop feelings about this subject.

And moreover you must try to implement it in your day life. In the whole book you will read about states so let us develop feelings for this term.

Sometime when you are sitting alone thinking about you previous life. Some events you certainly remember, which plays important role in your life. Some of them are not relevant and it is difficult to you to remember those events. Same theory applies in the case of finite state machines, when we design a system or machine, two kinds of points come into picture, some of them certainly affect the output of the system and others never affect the output of the system. So we can skip these irrelevant points.

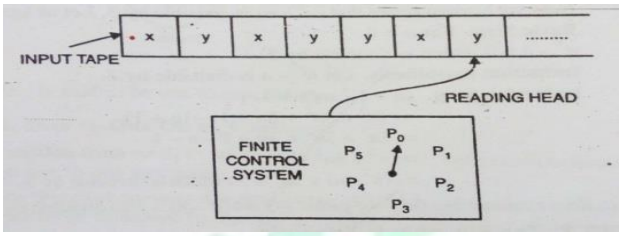
FINITE AUTOMATA

INTRODUCTION

In this chapter, we are discuss the mathematical model of the computers and algorithms. Further we are going to define powerful models of computation, more and more sophisticated device for accepting the generating languages, which are restricted model of the real computers, called finite automata or finite state machine. These machines are close to the Central Processing Unit of a computer. Absence of the memory makes these machines more restricted mode.

Computer is also settled by which we mean that, on reading one particular input instruction, the machine converts itself from the state it was, into some particular other state, where the resolve state is completely fixed by the prior state and the input instruction. Some sequence of instruction may lead to success and some may not. Success is fixed by the sequence of inputs. Either program will work or not.

Before discussing the mathematical model let us discuss the pictorial representation of finite machine. Strings are sustain into device by way of an input tape, which is divided into square, with one symbol in each square. The main part of the device is a “black box”. Which is responsible for all proceedings. Let us say “black box” is the finite control, finite control can serve, that what symbol is written at any position on the input tape by means of a movable head. At first head is placed at the left most square of tape and finite control is set is designated initial state.



TIPS

Finite automation is called “finite” because number of possible states and number of letter in the alphabet are both finite, and “automata” because the change of the state is totally governed by the input. It is deterministic, since, what state is next is automatic not will-full, just as the motion of the hands of the clock is automatic, while the motion of hands of a human is presumably the result of desire and thought.

P_0, P_1, P_2, P_3, P_4, P_5, are state in finite control system x and y are input symbols.

At regular interval the automata reads one symbol from the input tape and then enters in a new state that depends only on the current state and the symbol just read.

After reading an input symbol, reading head moves one square to the right on the input tape, so that on the next move, it will read the symbol in next tape square. This process is repeated again and again.

The automation then indicates approval or disapproval.

If it winds up in one of a set of final states the input strings is considered to be accepted. The language accepted by the machine is the set of strings, it accepts.

DEFINITION OF DETERMINISTIC FINITE AUTOMATA

A deterministic finite automata is a quintuple

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

Where,

- Q : Is a non-empty finite set of a states presents in the finite control. (q_0, q_1, q_2, …….)
- Σ : Is a non-empty finite set of input symbols which can be passed to the finite state machine. (a, b, c , d, e, ….)
- q_0 : Is a starting state, one of the state in Q.
- F : Is a non-empty set of final states or accepting states, set of final states belongs to Q.
- δ : Is a function called transaction function that takes two arguments a state and a input Symbol, it returns a single state.

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