Turing Machine Automata Theory Machine Learning Computer Programming

What is the difference between a finite-state machine and a Turing machine?

7 Answers

Joshua Engel, worked at The Rude Mechanicals
Answered Apr 18, 2014 · Upvoted by Yuval Feinstein and Jeff Nelson, Invented Chromebook, #Xoogler

A finite state machine is just a set of states and transitions. The only memory it has is what state it is in. Thus, the number of memory states is... finite.

A Turing machine is a finite state machine plus a tape memory. Each transition may be accompanied by an operation on the tape (move, read, write). Its total possible configurations is arbitrarily large, regardless of the size of the program; it expands towards infinity.

In between the two is a stack machine, which is like a Turing machine except that the operations are limited to pushing and popping onto the stack.

A FSM can recognize only regular expressions. A stack machine can recognize context-free languages. A Turing machine can recongize all recursively enumerable languages. This is called the Chomsky hierarchy ; the article contains a nice table of the types of grammar.

Type	Name	Allowable Productions	Example Language	Example Grammar	Example Use	Recognizing Automaton	Storage Required	Parsing Complexity
0	Type 0	Unrestricted				Turing Machine	Infinite Tape	Undecidable
1	Context Sensitive	$\alpha \rightarrow \beta$ where $\lvert\alpha\rvert \leq \lvert\beta\rvert$ $\alpha \in V^*NV^*$ $\beta \in V^+$	$a^nb^nc^n$	$S \rightarrow aSBC$ $S \rightarrow aBC$ $CB \rightarrow BC$ $aB \rightarrow ab$ $bB \rightarrow bb$ $bC \rightarrow bc$ $cC \rightarrow cc$		Linear Bounded Automaton	Tape a linear multiple of input length	NP Complete
2	Context Free	$A \rightarrow \alpha$ $A \in N$ $\alpha \in V^*$	a^nb^n	$S \rightarrow aSb$ $S \rightarrow ab$	Arithmetic Expression $x = a + b * c$	Pushdown Automaton	Pushdown Stack	$O(n^3)$
3	Regular Right Linear Finite Automaton Recognizable	$A \rightarrow xB$ $A \rightarrow x$ $A, B \in N$ $x \in T^*$	a^nb	$S \rightarrow ab$ $S \rightarrow aS$	Identifier VECTOR7	Finite Automaton	Finite Storage	$O(n)$

(Chart courtesy http://www.cs.utexas.edu/users/n...)

17.5k Views · 134 Upvotes

Related Questions

More Answers Below

What is the difference between a finite state machine and a pushdown automaton?

How does a pushdown automaton differ from a Turing machine?

If finite state machines are generalized to have infinite number of states, would they be equivalent to Turing machines?

If we can model the control unit of CPU using a Finite-State Machine, then why do we need a Turing Machine? Aren't Finite-State Machines power...

What else is a finite state machine used for except language parsing?

Related Questions

What is the difference between a finite state m and a pushdown automaton?

How does a pushdown automaton differ from machine?

If finite state machines are generalized to hav number of states, would they be equivalent to machines?

If we can model the control unit of CPU using Finite-State Machine, then why do we need a Machine? Aren't Finite-State Machines power

What else is a finite state machine used for e language parsing?

What is the relation between a computer and machine ?

What are the delay factors in a finite state ma

What is an alternating Turing machine?

Why did Turing develop the Turing Machine? the purpose of the Turing Machine?

What is a non-deterministic Turing machine?