

ITS64304 Theory of Computation

School of Computer Science
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Lecture 5: Non-deterministic Turing Machines

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TM Examples

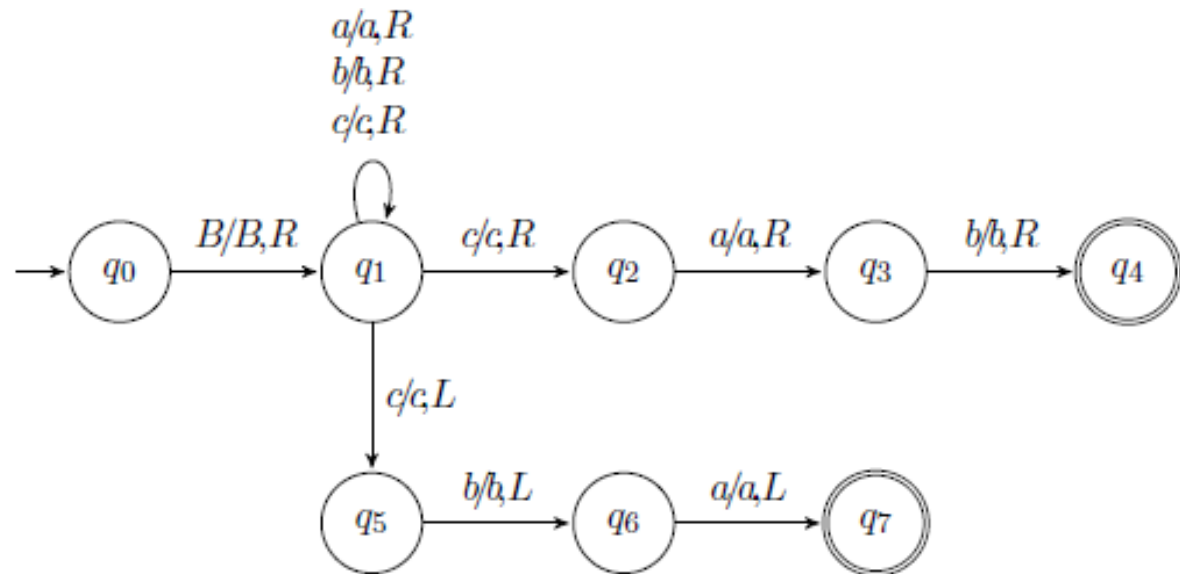
- Recognize the language $\{a^i b^i \mid i \geq 0\}$
- Recognize the language $\{a^i b^i c^i \mid i \geq 0\}$
- Recognize the language $\{a^i b^i c^i d^i \mid i \geq 0\}$
- Reverse, copy, concatenate, erase and input string
- Solve the Travelling Salesman Problem
- Encrypt/decrypt using RSA
- Check whether a number is prime
- Add, multiply, divide, square etc...

Nondeterministic TM

- NTM allows a finite number of transitions to be specified for a given configuration (current state and tape symbol)
- meaning more than one action for a given configuration
- $\delta(q_i, x) = \{(q_j, y, d), (q_k, z, e)\}$

NTM contd...

- NTM for strings with a c preceded or followed by ab



- Maximum n different transitions for state symbol pair

NTM contd...

- Derivations for a string $acab$, sequence $(1,1,1,1,1)$, $(1,1,2,1,1)$, $(2,2,3,3,1)$

$q_0BacacB$	1	$q_0BacacB$	1	$q_0BacacB2$
$\vdash Bq_1acabB$	1	$\vdash Bq_1acabB$	1	$\vdash Bq_1acabB2$
$\vdash Baq_1cabB$	1	$\vdash Baq_1cabB$	2	$\vdash Baq_1cabB3$
$\vdash Bacq_1abB$	1	$\vdash Bacq_2abB$	1	$\vdash Bq_5acabB$
$\vdash Bacaq_1bB$	1	$\vdash Bacaq_3bB$	1	
$\vdash Bacabq_1B$		$\vdash Bacabq_4B$		

- Acceptance in NTM can be final state or halting
- NTM may produce multiple computations for a single input string

Conclusion



- Non-determinism does not increase the capabilities of TM
- Languages accepted by NTM are precisely those accepted by deterministic machines
- Follow any one of the variations that you wish



Read your lesson materials
Please complete your Tutorials on TMs...