Foundations2
Assignment 2020
Turing Machine multiplier

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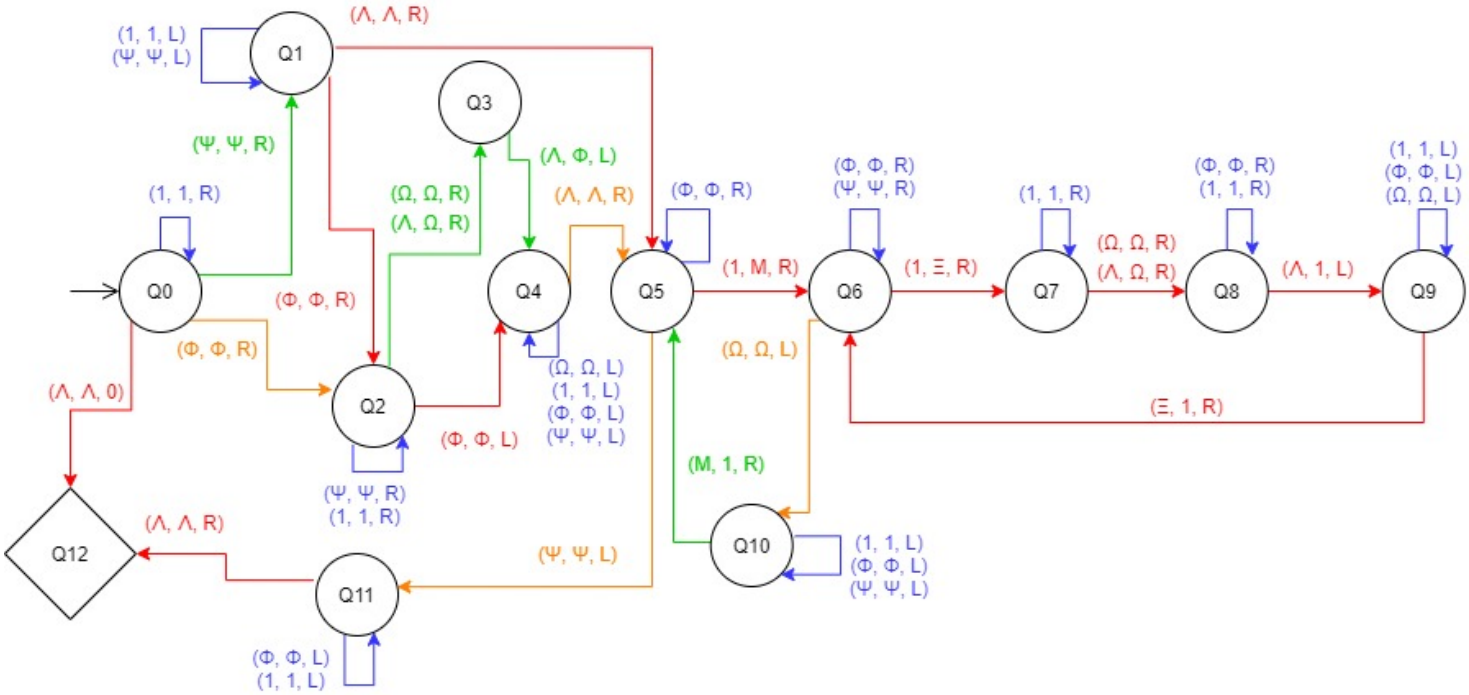
Contents

1 Turing machine multiplication

1.1 Graph



1.2 Formal definition

$States = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, q_{10}, q_{11}, q_{12}\}$
$Symbols = \{\wedge, \Phi, \Psi, \Omega, 1, M, \Xi\}$

$$
\begin{aligned}
M_{mult}(q_0, \wedge) &= (q_{12}, \wedge, 0) & M_{mult}(q_0, 1) &= (q_0, 1, R)\\
M_{mult}(q_0, \Psi) &= (q_1, \Psi, R) & M_{mult}(q_0, \Phi) &= (q_2, \Phi, R)\\
M_{mult}(q_1, 1) &= (q_1, 1, L) & M_{mult}(q_1, \Psi) &= (q_1, \Psi, L)\\
M_{mult}(q_1, \wedge) &= (q_5, \wedge, R) & M_{mult}(q_1, \Phi) &= (q_2, \Phi, R)\\
M_{mult}(q_2, 1) &= (q_2, 1, R) & M_{mult}(q_2, \Psi) &= (q_2, \Psi, R)\\
M_{mult}(q_2, \wedge) &= (q_3, \Omega, R) & M_{mult}(q_2, \Omega) &= (q_3, \Omega, R)\\
M_{mult}(q_2, \Phi) &= (q_4, \Phi, L) & M_{mult}(q_3, \wedge) &= (q_4, \Phi, L)\\
M_{mult}(q_4, \Omega) &= (q_4, \Omega, L) & M_{mult}(q_4, 1) &= (q_4, 1, L)\\
M_{mult}(q_4, \Phi) &= (q_4, \Phi, L) & M_{mult}(q_4, \Psi) &= (q_4, \Psi, L)\\
M_{mult}(q_4, \wedge) &= (q_5, \wedge, R) & M_{mult}(q_5, \Phi) &= (q_5, \Phi, R)\\
M_{mult}(q_5, 1) &= (q_6, M, R) & M_{mult}(q_5, \Psi) &= (q_{11}, \Psi, L)\\
M_{mult}(q_6, \Phi) &= (q_6, \Phi, R) & M_{mult}(q_6, \Psi) &= (q_6, \Psi, R)\\
M_{mult}(q_6, 1) &= (q_7, \Xi, R) & M_{mult}(q_6, \Omega) &= (q_{10}, \Omega, L)\\
M_{mult}(q_7, \Omega) &= (q_8, \Omega, R) & M_{mult}(q_7, \wedge) &= (q_8, \Omega, R)\\
M_{mult}(q_7, 1) &= (q_7, 1, R) & M_{mult}(q_8, \wedge) &= (q_9, 1, L)\\
M_{mult}(q_8, 1) &= (q_8, 1, R) & M_{mult}(q_8, \Phi) &= (q_8, \Phi, R)\\
M_{mult}(q_9, 1) &= (q_9, 1, L) & M_{mult}(q_9, \Phi) &= (q_9, \Phi, L)\\
M_{mult}(q_9, \Omega) &= (q_9, \Omega, L) & M_{mult}(q_9, \Xi) &= (q_6, 1, R)\\
M_{mult}(q_{10}, 1) &= (q_{10}, 1, L) & M_{mult}(q_{10}, \Phi) &= (q_{10}, \Phi, L)\\
M_{mult}(q_{10}, \Psi) &= (q_{10}, \Psi, L) & M_{mult}(q_{10}, M) &= (q_5, 1, R)\\
M_{mult}(q_{11}, 1) &= (q_{11}, 1, L) & M_{mult}(q_{11}, \Phi) &= (q_{11}, \Phi, L)\\
M_{mult}(q_{11}, \wedge) &= (q_{12}, \wedge, R)
\end{aligned}
$$

2 Discussion of graph

2.1 Logic of graph

describe the logic of the graph, why I chose this logical method. consider the correctness.

2.2 States & Symbols

Why I chose these states and symbols blah cut down version here

3 TM functionality

How the graph works, where to start, where you end and dealing with 0, and negative numbers

4 Implementation of Turing machine

Language choice

5 Tests

Tests, inlcuding count of tapes printed, time to complete test

	-1	0	1	2	3	4	5	6	7	8	9	10	11	
...	∧	1	1	∧	∧	1	∧	∧	∧	∧	∧	∧	∧	...
		↑												
		$q0$												

Test tape

6 Efficiency of program

comment on the number of computation sequences produced and the time taked to complete each test

7 Power of 3 machine

asd