

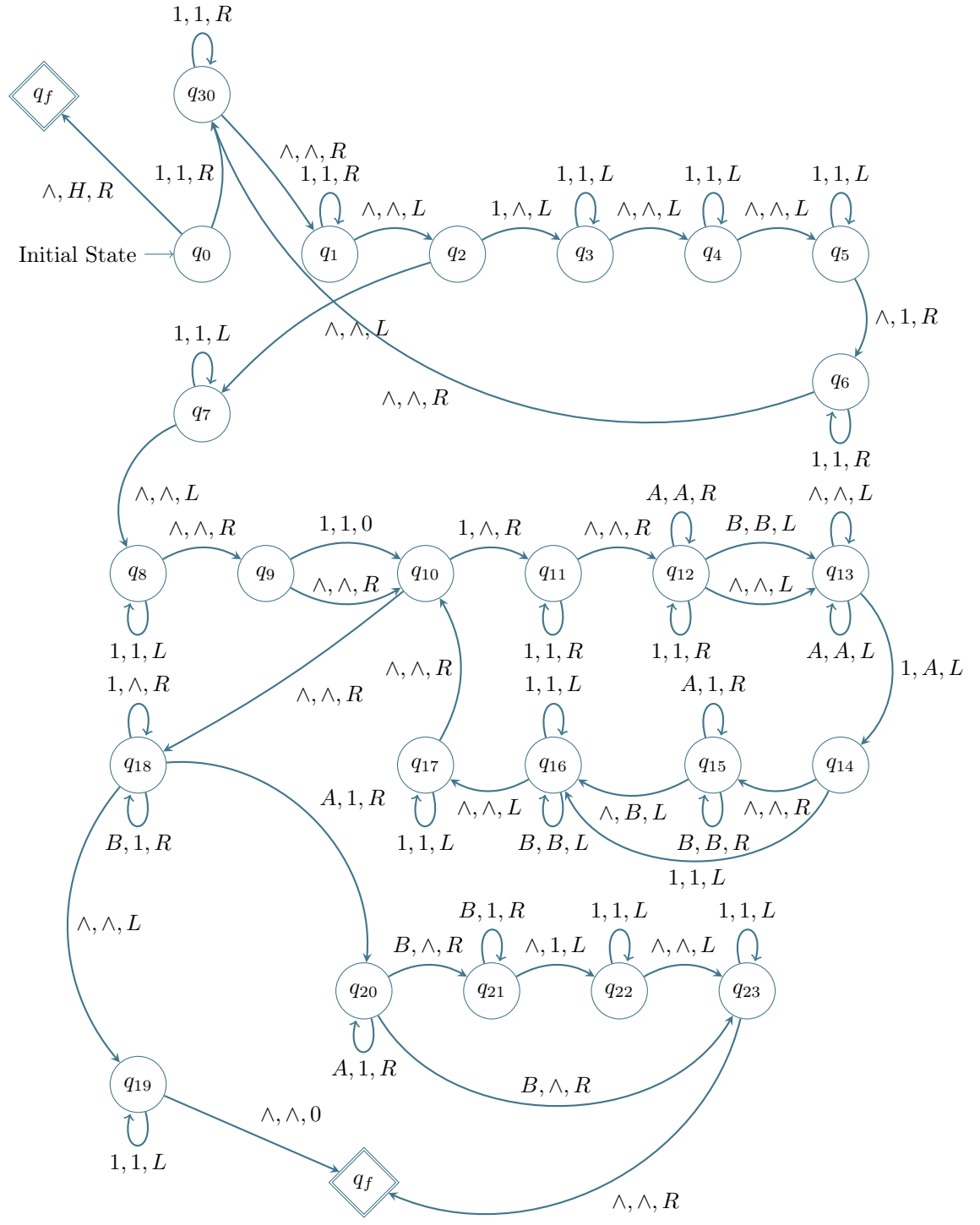
Mod/Div Turing Machine

INDIVIDUAL COURSEWORK
F29FB, SPRING 2022

SUBMITTED BY

H00347035

1 Graph



2 Mathematical Notation

$$s_0 \equiv \wedge, s_1 \equiv 1, s_2 \equiv A, s_3 \equiv B, s_4 \equiv H$$

$$\begin{aligned}
 M_g = \{ & ((q_0, s_0) \rightarrow (q_f, s_4, 0)), \\
 & ((q_0, s_1) \rightarrow (q_{30}, s_1, R)), \\
 & ((q_1, s_1) \rightarrow (q_1, s_1, R)), \\
 & ((q_1, s_0) \rightarrow (q_2, s_0, L)), \\
 & ((q_{30}, s_1) \rightarrow (q_{30}, s_1, R)), \\
 & ((q_{30}, s_0) \rightarrow (q_1, s_0, R)), \\
 & ((q_2, s_0) \rightarrow (q_7, s_0, L)), \\
 & ((q_2, s_1) \rightarrow (q_3, s_0, L)), \\
 & ((q_3, s_1) \rightarrow (q_3, s_1, L)), \\
 & ((q_3, s_0) \rightarrow (q_4, s_0, L)), \\
 & ((q_4, s_1) \rightarrow (q_4, s_1, L)), \\
 & ((q_4, s_0) \rightarrow (q_5, s_0, L)), \\
 & ((q_5, s_1) \rightarrow (q_5, s_1, L)), \\
 & ((q_5, s_0) \rightarrow (q_6, s_1, R)), \\
 & ((q_6, s_1) \rightarrow (q_6, s_1, R)), \\
 & ((q_6, s_0) \rightarrow (q_{30}, s_0, R)), \\
 & ((q_7, s_1) \rightarrow (q_7, s_1, L)), \\
 & ((q_7, s_0) \rightarrow (q_8, s_0, L)), \\
 & ((q_8, s_1) \rightarrow (q_8, s_1, L)), \\
 & ((q_8, s_0) \rightarrow (q_9, s_0, R)), \\
 & ((q_9, s_1) \rightarrow (q_{10}, s_1, 0)), \\
 & ((q_9, s_0) \rightarrow (q_{10}, s_0, R)), \\
 & ((q_{10}, s_1) \rightarrow (q_{11}, s_0, R)), \\
 & ((q_{10}, s_0) \rightarrow (q_{18}, s_0, R)), \\
 & ((q_{11}, s_1) \rightarrow (q_{11}, s_1, R)), \\
 & ((q_{11}, s_0) \rightarrow (q_{12}, s_0, R)), \\
 & ((q_{12}, s_1) \rightarrow (q_{12}, s_1, R)), \\
 & ((q_{12}, s_2) \rightarrow (q_{12}, s_2, R)), \\
 & ((q_{12}, s_3) \rightarrow (q_{13}, s_3, L)), \\
 & ((q_{12}, s_0) \rightarrow (q_{13}, s_0, L)), \\
 & ((q_{13}, s_0) \rightarrow (q_{13}, s_0, L)), \\
 & ((q_{13}, s_2) \rightarrow (q_{13}, s_2, L)), \\
 & ((q_{13}, s_1) \rightarrow (q_{14}, s_2, L)), \\
 & ((q_{14}, s_0) \rightarrow (q_{15}, s_0, R)), \\
 & ((q_{14}, s_1) \rightarrow (q_{16}, s_1, L)), \\
 & ((q_{15}, s_2) \rightarrow (q_{15}, s_1, R)), \\
 & ((q_{15}, s_3) \rightarrow (q_{15}, s_3, R)), \\
 & ((q_{15}, s_0) \rightarrow (q_{16}, s_3, L)), \\
 & ((q_{16}, s_1) \rightarrow (q_{16}, s_1, L)), \\
 & ((q_{16}, s_3) \rightarrow (q_{16}, s_3, L)), \\
 & ((q_{16}, s_0) \rightarrow (q_{17}, s_0, L)), \\
 & ((q_{17}, s_1) \rightarrow (q_{17}, s_1, L)), \\
 & ((q_{17}, s_0) \rightarrow (q_{10}, s_0, R)), \\
 & ((q_{18}, s_1) \rightarrow (q_{18}, s_0, R)), \\
 & ((q_{18}, s_3) \rightarrow (q_{18}, s_1, R)), \\
 & ((q_{18}, s_2) \rightarrow (q_{20}, s_1, R)), \\
 & ((q_{18}, s_0) \rightarrow (q_{19}, s_0, L)), \\
 & ((q_{19}, s_1) \rightarrow (q_{19}, s_1, L)), \\
 & ((q_{19}, s_0) \rightarrow (q_f, s_0, 0)), \\
 & ((q_{20}, s_2) \rightarrow (q_{20}, s_1, R)), \\
 & ((q_{20}, s_3) \rightarrow (q_{21}, s_0, R)), \\
 & ((q_{20}, s_0) \rightarrow (q_{23}, s_0, L)), \\
 & ((q_{21}, s_3) \rightarrow (q_{21}, s_1, R)), \\
 & ((q_{21}, s_0) \rightarrow (q_{22}, s_1, L)), \\
 & ((q_{22}, s_1) \rightarrow (q_{22}, s_1, L)), \\
 & ((q_{22}, s_0) \rightarrow (q_{23}, s_0, L)), \\
 & ((q_{23}, s_1) \rightarrow (q_{23}, s_1, L)), \\
 & ((q_{23}, s_0) \rightarrow (q_f, s_0, R)), \\
 & \}
 \end{aligned}$$

3 Input (3, 5)

- (i) The TM starts by checking if the head starts at a \wedge (blank) then the divisor is 0 and the ticket is invalidated and the TM halts. Otherwise the divisor is a natural number and the TM goes to the rightmost of the divisor until we reach a blank.
- (ii) Check if there is a dividend (any 1 ,unary input) and go to the rightmost, Otherwise (if blank, \wedge) then go to DIV/MOD part of TM.

q_0 : $\wedge \wedge \wedge @111 \wedge 11111 \wedge \wedge \wedge$
 q_{30} : $\wedge \wedge \wedge 1 @11 \wedge 11111 \wedge \wedge \wedge$
 q_{30} : $\wedge \wedge \wedge 11 @1 \wedge 11111 \wedge \wedge \wedge$
 q_{30} : $\wedge \wedge \wedge 111 @ \wedge 11111 \wedge \wedge \wedge$

q_1 : $\wedge \wedge \wedge 111 \wedge @11111 \wedge \wedge \wedge$
 q_1 : $\wedge \wedge \wedge 111 \wedge 1 @1111 \wedge \wedge \wedge$
 q_1 : $\wedge \wedge \wedge 111 \wedge 11 @111 \wedge \wedge \wedge$
 q_1 : $\wedge \wedge \wedge 111 \wedge 111 @11 \wedge \wedge \wedge$
 q_1 : $\wedge \wedge \wedge 111 \wedge 1111 @1 \wedge \wedge \wedge$
 q_1 : $\wedge \wedge \wedge 111 \wedge 11111 @ \wedge \wedge \wedge$

(iii) a