

Formal Languages Homework 9

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1 Problem 8.2.1

State	Symbol				
	0	1	X	Y	B
q_0	(q_1, X, R)	—	—	(q_3, Y, R)	—
q_1	$(q_1, 0, R)$	(q_2, Y, L)	—	(q_1, Y, R)	—
q_2	$(q_2, 0, L)$	—	(q_0, X, R)	(q_2, Y, L)	—
q_3	—	—	—	(q_3, Y, R)	(q_4, B, R)
q_4	—	—	—	—	—

Show the ID's of the Turning Machine of Fig. 8.9 if the input tape contains:

1.1 a). 00

$Bq_000B \vdash BXq_10B \vdash BX0q_1B$ The machine then halts because the next move is undefined

1.2 b). 000111

$Bq_0000111B \vdash BXq_100111B \vdash BX0q_10111B \vdash BX00q_1111B \vdash BX0q_20Y11B \vdash BXq_200Y11B \vdash$
 $Bq_2X00Y11B \vdash BXq_000Y11B \vdash BXXq_10Y11B \vdash BXX0q_1Y11B \vdash BXX0Yq_111B \vdash BXX0q_2YY1B \vdash$
 $BXXq_20YY1B \vdash BXq_2X0YY1B \vdash BXXq_00YY1B \vdash BXXXq_1YY1B \vdash BXXXq_1Y1B \vdash$
 $BXXXYYq_11B \vdash BXXXYYq_2YYB \vdash BXXXq_2YYYB \vdash BXXq_2XYYYB \vdash BXXXq_0YYYB \vdash$
 $BXXXYYq_3YYB \vdash BXXXYYq_3YB \vdash BXXXYYYq_3B \vdash BXXXYYYBq_4B$

1.3 c). 00111

$Bq_000111B \vdash BXq_10111B \vdash BX0q_1111B \vdash BXq_20Y11B \vdash Bq_2X0Y11B \vdash BXq_0Y11B \vdash$
 $BXXq_1Y11B \vdash BXXYq_111B \vdash BXXq_2YY1B \vdash BXq_2XYY1B \vdash BXXq_0YY1B \vdash BXXYq_3Y1B \vdash$
 $BXXYYq_31B$

The machine then halts because the next move is undefined

2 Problem 8.2.2

Design Turing machines for the following languages:

2.1 c). $\{ww^R \mid w \text{ is any string of 0's and 1's}\}$

$$M = (\{q_0, q_1, q_2, q_3, q_4, q_5, q_f\}, \{0, 1\}, \{0, 1, B\}, \delta, q_0, B, \{q_f\})$$

1. $\delta(q_0, 0) = (q_1, B, R)$
2. $\delta(q_0, 1) = (q_2, B, R)$
3. $\delta(q_0, B) = (q_f, B, R)$
4. $\delta(q_1, 0) = (q_1, 0, R)$
5. $\delta(q_1, 1) = (q_1, 1, R)$
6. $\delta(q_1, B) = (q_3, B, L)$
7. $\delta(q_2, 0) = (q_2, 0, R)$
8. $\delta(q_2, 1) = (q_2, 1, R)$
9. $\delta(q_2, B) = (q_4, B, R)$
10. $\delta(q_3, 0) = (q_5, B, L)$
11. $\delta(q_4, 1) = (q_5, B, L)$
12. $\delta(q_5, 0) = (q_5, 0, L)$
13. $\delta(q_5, 1) = (q_5, 1, L)$
14. $\delta(q_5, B) = (q_0, B, R)$

3 Problem 8.2.5

Consider the Turing Machine

$$M = (\{q_0, q_1, q_2, q_f\}, \{0, 1\}, \{0, 1, B\}, \delta, q_0, B, \{q_f\})$$

Informally, but clearly describe the language $L(M)$ if δ consists of the following set of rules:

$$3.1 \quad \text{a). } \delta(q_0, 0) = (q_1, 1, R); \delta(q_1, 1) = (q_0, 0, R); \delta(q_1, B) = (q_f, B, R)$$

it accepts strings like this: 0101010, that is, strings that start with 0, end with 1, and alternate between 0 and 1 every symbol

$$3.2 \quad \text{b). } \delta(q_0, 0) = (q_0, B, R); \delta(q_0, 1) = (q_1, B, R); \delta(q_1, 1) = (q_1, B, R); \delta(q_1, B) = (q_f, B, R)$$

Strings of any length that end with a 1

$$3.3 \quad \text{c). } \delta(q_0, 0) = (q_1, 1, R); \delta(q_1, 1) = (q_2, 0, L); \delta(q_2, 1) = (q_0, 1, R); \delta(q_1, B) = (q_f, B, R)$$

Strings that start with a 0, end with a 1, and alternate between 0 and 1

4 Problem 8.4.2

Here is the transition function of a nondeterministic $M = (\{q_0, q_1, q_2\}, \{0, 1\}, \{0, 1, B\}, \delta, q_0, b, \{q_2\})$: Show the ID's reachable from the initial ID if the input is:

δ	0	1	B
q_0	$\{(q_0, 1, R)\}$	$\{(q_1, 0, R)\}$	\emptyset
q_1	$\{(q_1, 0, R), (q_0, 0, L)\}$	$\{(q_1, 1, R), (q_0, 1, L)\}$	$\{(q_2, B, R)\}$
q_2	\emptyset	\emptyset	\emptyset

$$4.1 \quad \text{a). } 01$$

$$\{(q_0, 1, R)\} \vdash \{(q_1, 0, R)\} \vdash \{(q_2, B, R)\}$$

$$4.2 \quad \text{b). } 011$$

$$\{(q_0, 1, R)\} \vdash \{(q_1, 0, R)\} \vdash \{(q_1, 1, R), (q_0, 1, L)\} \vdash \{(q_2, B, R)\} \cup \{(q_0, 1, R)\}$$