

Chapter 3.2 Practice Key

Given the following partial specification of a Turing Machine, state which of the following are configurations of a Turing Machine. If they are not, state why they are not configurations.

$$\text{TM } M = \{Q = \{q_1, q_2, q_3, q_{accept}, q_{reject}\}, \Sigma = \{0, 1\}, \Gamma = \{0, 1, \sqcup\}, q_0 = q_1\}$$

1. $0q_{reject}1011\sqcup\sqcup$ - This is a possible configuration.
2. $\sqcup q_2 \sqcup$ - This is a possible configuration.
3. $q_001001\sqcup$ - This is not a possible configuration. q_0 is not a state in this TM.
4. $01001\sqcup$ - This is not a possible configuration. There is no state listed in this TM for this configuration.

Show, step by step, how the following Turing Machine M removes any c's from the strings below consisting of: Σ^* where $\Sigma = \{a, b, c\}$. Make sure you show what is happening at each step.

$$\text{TM } M = \text{"on inputs } w \in \{a, b, c\}^*\text{"}$$

- i. Scan the tape if no c is found, accept.
- ii. Scan left to start.
- iii. Scanning to the right. If a c is found, move one cell to the right, place this symbol into the cell one cell to the left. If this symbol is the blank symbol, accept. If not, mark this symbol. If no c is found, accept.
- iv. Move two cells to the right, if this cell is non-blank, place this symbol into the cell one cell to the left. Repeat this step.
- v. If the symbol is the blank symbol, place this symbol into the cell one cell to the left. Move left to the marked cell.

vi. Unmark the symbol in this cell, move to Step iii.”

5. String abccbacac

| | | |
|-------------------------------|--------------------------------------|--------------------------------------|
| Start | abebaca <u>a</u> c | abbaca <u>a</u> c |
| <u>abccbacac</u> | abebaca <u>a</u> c | abb <u>a</u> c <u>ac</u> c |
| <u>abccbacac</u> | abebac <u>a</u> cc | abb <u>a</u> c <u>ac</u> cc <u>L</u> |
| <u>abccbacac</u> | abebac <u>a</u> cc <u>L</u> | abb <u>a</u> cac |
| <u>abc<u>c</u>bacac</u> | abc <u>c</u> bacac | abba <u>a</u> ac |
| <u>ab<u>c</u>cbacac</u> | abc <u>b</u> acac | abba <u>a</u> ac |
| <u>abe<u>c</u>cbacac</u> | ab <u>b</u> bbacac | abba <u>a</u> cc |
| <u>abe<u>c</u>bbacac</u> | ab <u>b</u> bb <u>a</u> cac | abba <u>a</u> cc <u>L</u> |
| <u>abe<u>bb</u>bacac</u> | ab <u>b</u> ba <u>a</u> cac | abba <u>a</u> c <u>L</u> |
| <u>abe<u>bb</u>bacac</u> | ab <u>b</u> ba <u>a</u> cac | abba <u>a</u> cc <u>L</u> |
| <u>abe<u>ba</u>aacac</u> | ab <u>b</u> ba <u>a</u> cac | abba <u>a</u> cc <u>L</u> <u>L</u> |
| <u>abe<u>ba</u>aacac</u> | ab <u>b</u> ba <u>a</u> ccac | accept |
| <u>abe<u>bac</u>ccac</u> | ab <u>b</u> acc <u>a</u> c | |
| abe <u>bac</u> ccac <u>—↑</u> | ab <u>b</u> aca <u>a</u> c <u>—↑</u> | |

6. String ccc

| | | |
|----------------------------|-------------------------------------|----------------------------|
| Start | <u>e</u> <u>c</u> <u>c</u> | <u>e</u> <u>c</u> <u> </u> |
| <u>c</u> <u>c</u> <u>c</u> | <u>e</u> <u>c</u> <u>c</u> <u> </u> | <u>c</u> <u> </u> |
| <u>c</u> <u>c</u> <u>c</u> | <u>c</u> <u>c</u> | <u>c</u> <u> </u> |
| <u>e</u> <u>c</u> <u>c</u> | <u>c</u> <u>c</u> | accept |
| <u>e</u> <u>c</u> <u>c</u> | —↑ | <u>e</u> <u>c</u> —↑ |