Theory of Computation

G-4

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These exercises are not mandatory..

if you have extra time to practice on them, go ahead

Exercises about TMs

1. Construct a regular Turing Machine that tests whether a binary input has exactly one zero

Exercises about TMs

2. Explain what the following Turing Machine does if an input is a string from: $\{x, y, X, Y\}^*$

$$\begin{aligned} \delta(z_0, x) &= (z_0, X, R), & \delta(z_0, X) &= (z_0, X, R), \\ \delta(z_0, y) &= (z_0, Y, R), & \delta(z_0, Y) &= (z_0, Y, R), \\ \delta(z_0, B) &= (z_{\text{acc}}, B, R), \end{aligned} \tag{1}$$

Exercises about TMs

3. Give a description of a Turing Machine that converts binary input to unary

(you dont have to construct it, just the idea)

(use as many tapes as u want)

For example:

$$\begin{aligned} 101 &\longrightarrow 11111 \\ 11 &\longrightarrow 111 \\ \underbrace{111}_{\text{7 in binary}} &\longrightarrow \underbrace{1111111}_{\text{seven 1s}} \end{aligned} \tag{2}$$

Exercises about TMs

4. Now give a description of a Turing Machine that converts unary input to binary

(use as many tapes as u want again)

For example:

$$1111 \longrightarrow 100$$
$$\underbrace{111111}_{\text{six 1s}} \longrightarrow \underbrace{110}_{\text{six in binary}} \tag{3}$$

Exercises about TMs

5. TM is given $M = (\{z_0, z_1, z_2\}, \{0, 1, B\}, \delta, z_0, \{z_2\})$ and transition function:

$$\delta : \{z_0, z_1\} \times \{0, 1, B\} \to \{z_0, z_1, z_2\} \times \{0, 1, B\} \times \{L, N, R\}$$

given by:

$$\delta(z_0, 0) = (z_0, 0, R), \qquad \delta(z_0, 1) = (z_1, 1, R), \qquad \delta(z_0, B) = (z_0, B, N)$$
$$\delta(z_1, 1) = (z_1, 0, N), \qquad \delta(z_1, 1) = (z_2, 1, R), \qquad \delta(z_1, B) = (z_1, B, N) \tag{4}$$

Exercises about TMs

1. Give an example of an accepting computation of M.
   Give an example of a rejecting (not halting) computation of M
2. Describe the language L_M accepted by M
3. Is M n-time bounded? Is M n-space bounded?

Exercises about TMs

YES or NO questions

1. can a turing machine write the blank symbol on its tape?
2. can the tape alphabet be the same as the input alphabet?
3. can a turing machine's head ever be in the same location in two successive steps?

Exercises about TMs

Solutions are here -> https://matias.me/nsfw/