Theory of Computation

G-4

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Construct a TM for language

$$\{w \mid w \in \mathbb{B}^*, \text{contains an equal number of 0s and 1s}\} \quad (1)$$

$$\delta(z_0, 0) = (z_1, X, R)$$

$$\delta(z_1, 0 \text{ or } X) = (z_1, 0 \text{ or } X, R) \iff z_1 \text{ searches for the matching 1}$$

$$\delta(z_1, 1) = (z_3, X, L) \iff z_3 \text{ goes all the way left}$$

$$\delta(z_3, 0 \text{ or } 1 \text{ or } X) = (z_3, 0 \text{ or } 1 \text{ or } X, L)$$

$$\delta(z_3, B) = (z_0, B, R)$$

$$\delta(z_0, X) = (z_0, X, R) \iff \text{skips all the } X$$

$$\delta(z_0, 1) = (z_2, X, R)$$

$$\delta(z_2, 1 \text{ or } X) = (z_2, 1 \text{ or } X, R) \iff z_2 \text{ searches for the matching 0}$$

$$\delta(z_2, 0) = (z_3, X, L)$$

finally $\delta(z_0, B) = (z_{\text{accept}}, B, L)$

What about reject?..

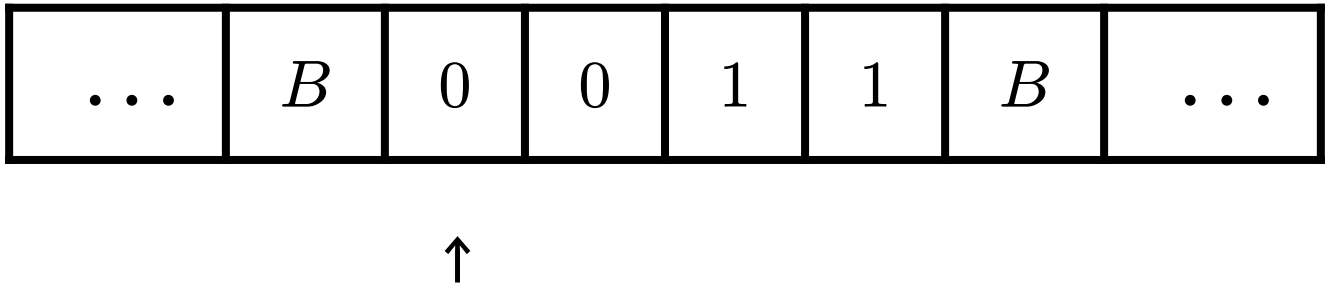
$$\delta(z_1, B) = (z_{\text{reject}}, B, L)$$
$$\delta(z_2, B) = (z_{\text{reject}}, B, L) \tag{2}$$

z_1 searches for the matching 1

z_2 searches for the matching 0

if they read B while searching, it means that there is no matching symbol..

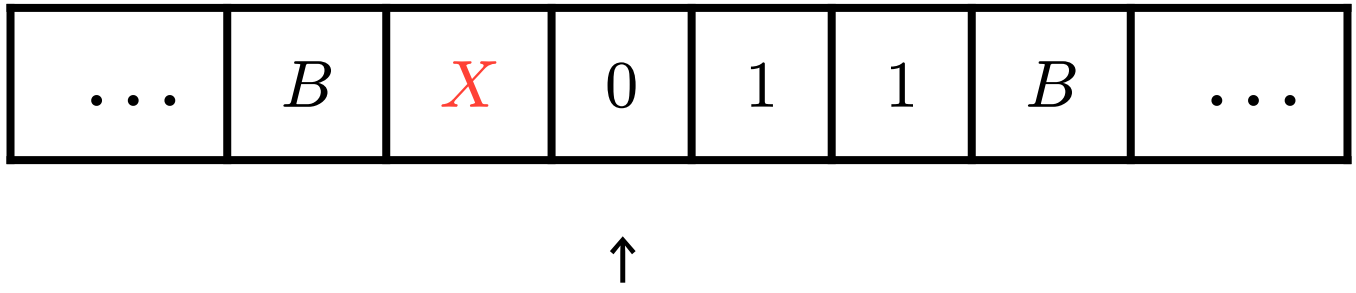
Example



$$\delta(z_0, 0) = (z_1, X, R) \tag{3}$$

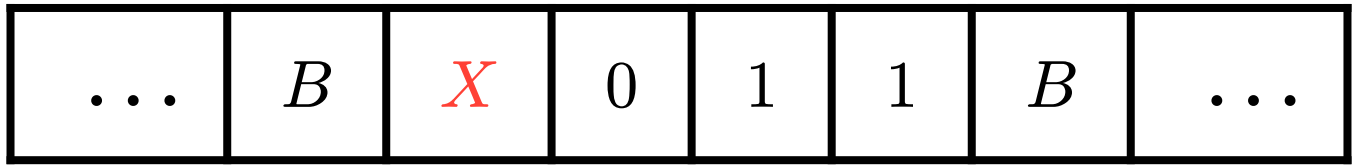
z_1 starts to search for a matching 1

Example



$$\delta(z_1, 0 \text{ or } X) = (z_1, 0 \text{ or } X, R) \tag{4}$$

Example

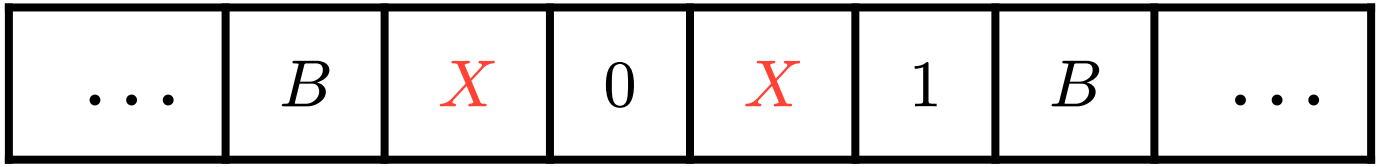


$$\delta(z_1, 1) = (z_3, X, L) \tag{5}$$

z_1 found a matching 1, it marks it as X and goes all the way to the left..

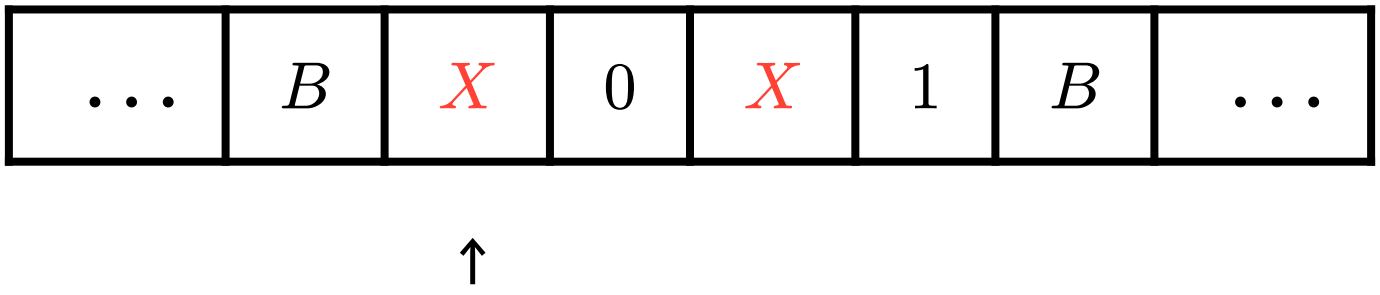
using z_3 which has only one job to go left until B

Example



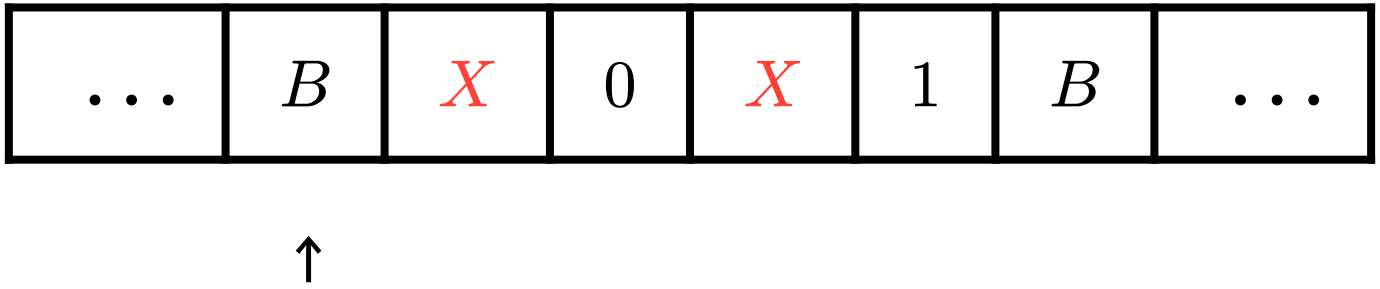
$$\delta(z_3, 0 \text{ or } 1 \text{ or } X) = (z_3, 0 \text{ or } 1 \text{ or } X, L) \tag{6}$$

Example



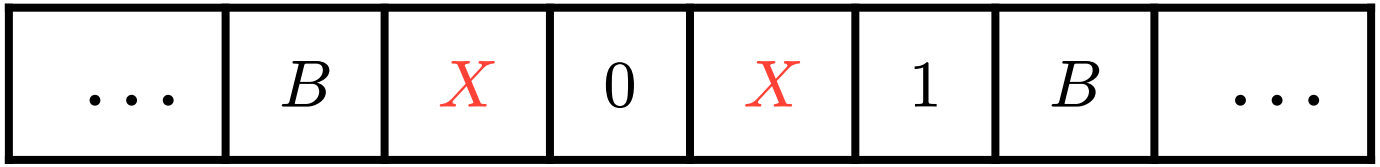
$$\delta(z_3, 0 \text{ or } 1 \text{ or } X) = (z_3, 0 \text{ or } 1 \text{ or } X, L) \tag{7}$$

Example



$$\delta(z_3, B) = (z_0, B, R) \tag{8}$$

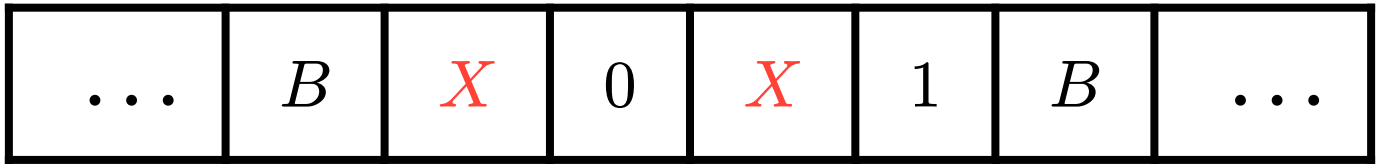
Example



$$\delta(z_0, X) = (z_0, X, R) \tag{9}$$

z_0 skips all the X and moves to the right

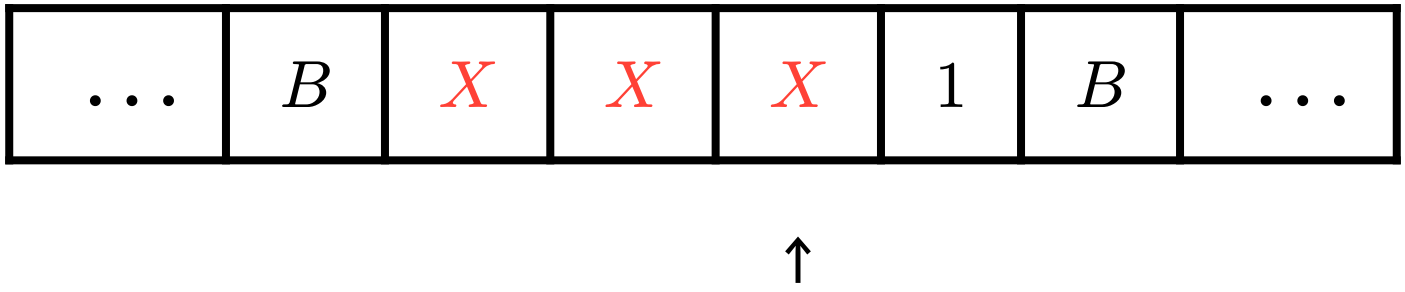
Example



$$\delta(z_0, 0) = (z_1, X, R) \tag{10}$$

z_1 again starts to search for a matching 1

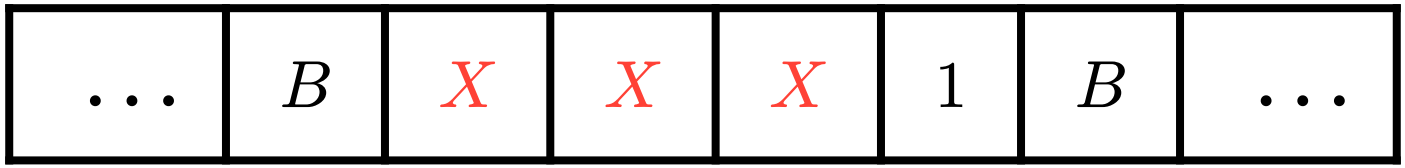
Example



$$\delta(z_1, 0 \text{ or } X) = (z_1, 0 \text{ or } X, R) \tag{11}$$

z_1 ignores 0s and Xs and moves to the right

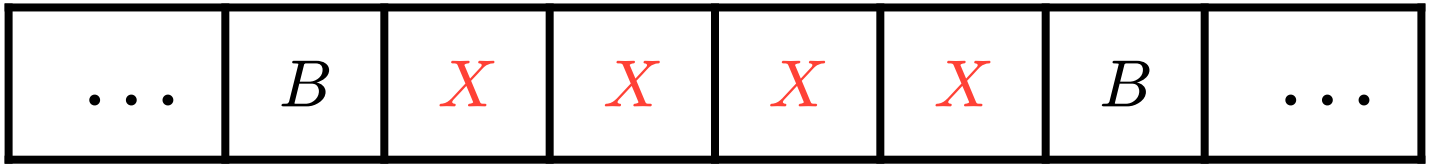
Example



$$\delta(z_1, 1) = (z_3, X, L) \tag{12}$$

Found a matching one, time to go all the way left..

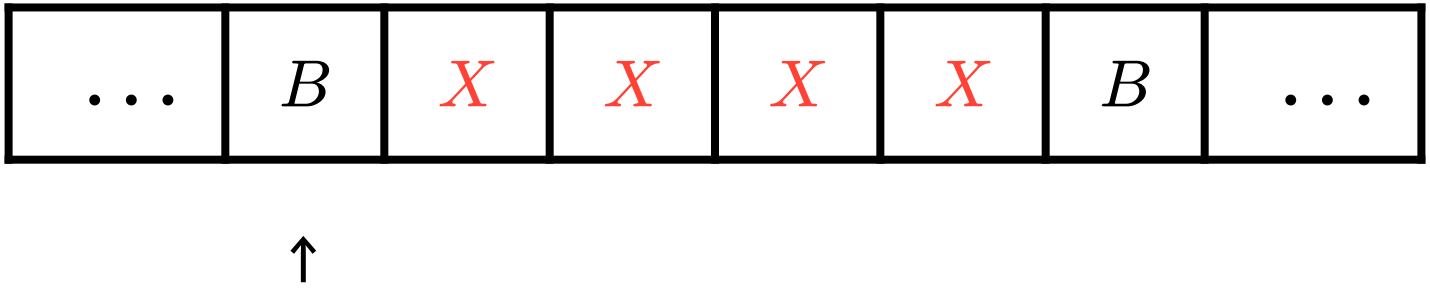
Example



$$\delta(z_3, 0 \text{ or } 1 \text{ or } X) = (z_3, 0 \text{ or } 1 \text{ or } X, L) \tag{13}$$

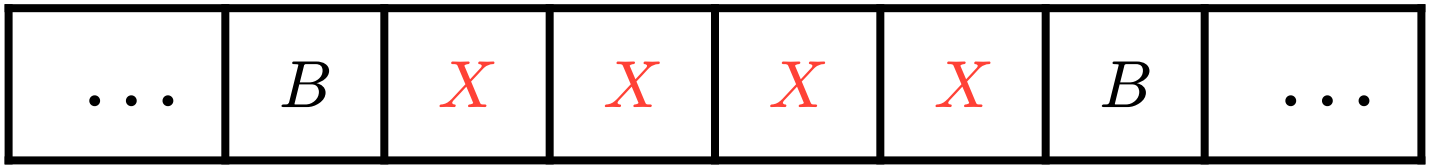
Example

Example



$$\delta(z_3, B) = (z_0, B, R) \tag{14}$$

Example

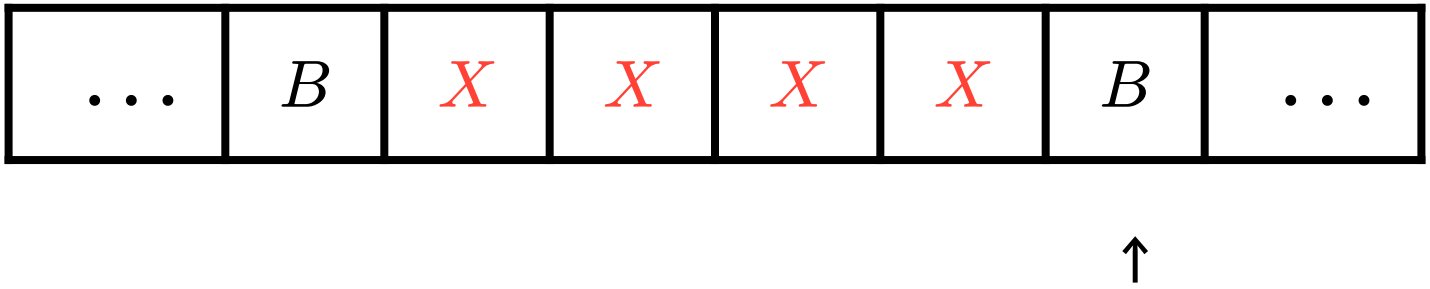


$$\delta(z_0, X) = (z_0, X, R) \tag{15}$$

skips all the Xs and moves to the right

Example

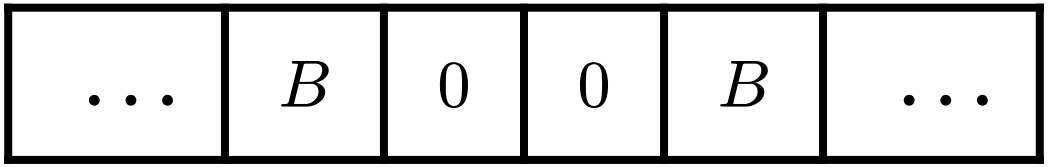
Example



$$\delta(z_0, B) = \left(z_{\text{accept}}, B, L\right) \tag{16}$$

it accepts..

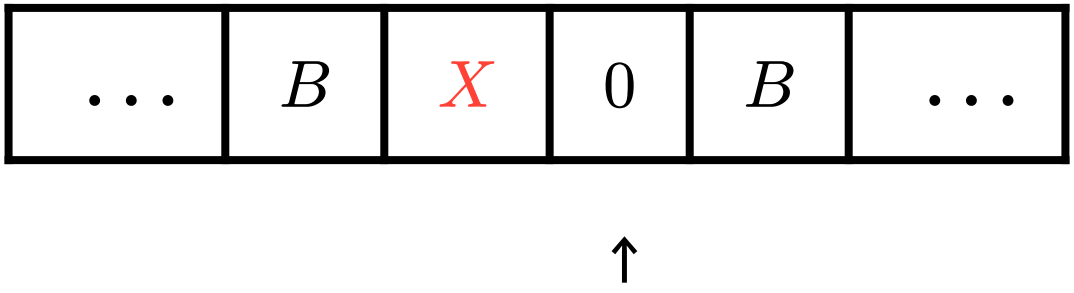
Another example



$$\delta(z_0, 0) = (z_1, X, R) \tag{17}$$

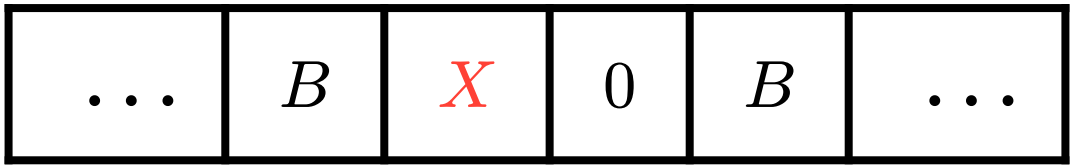
z_1 starts searching

Another example



$$\delta(z_1, 0 \text{ or } X) = (z_1, 0 \text{ or } X, R) \tag{18}$$

Another example



$$\delta(z_1, B) = \left(z_{\text{reject}}, B, L\right) \tag{19}$$

z_1 couldnt find the matching 1 so it rejects..