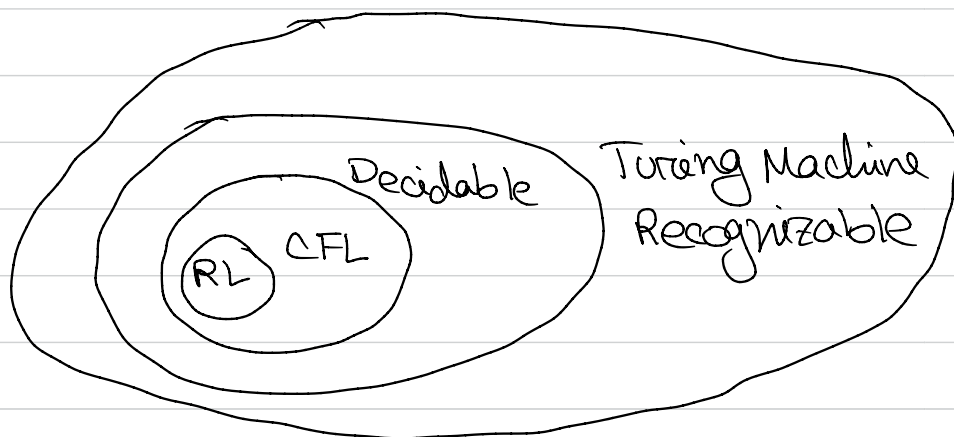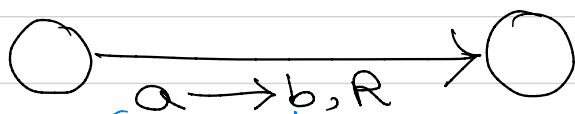# Turing Machine

→ Infinite length tape
→ Symbols from Σ
→ A special blank symbol (---)
→ ↓ current position.
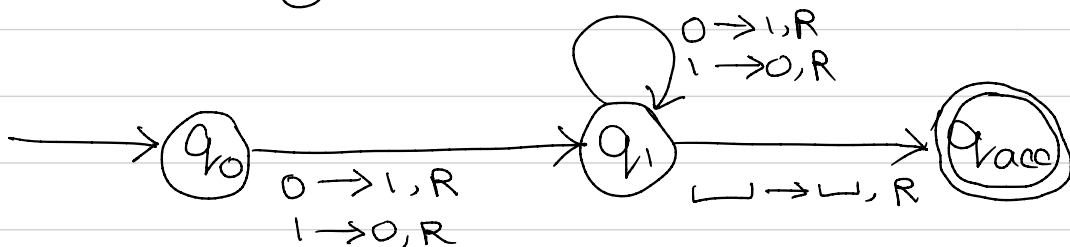 └ can move Left/Right
  can read/write.

Read the current symbol

update/write on the same cell

Direction to move next: L or R

Task1 A turing machine that toggles the input in the tape.

q_0 1 1 0 ⊔

0 q_1 1 0 ⊔

0 0 q_1 0 ⊔

0 0 1 q_1 ⊔

0 0 1 ⊔ q_{acc}

Example2)

Write the formal definition of a Turing machine, that
- When encounters a 1, changes it to 0 and reaches final state.
- If reaches a blank, changes it to 1 and move left.
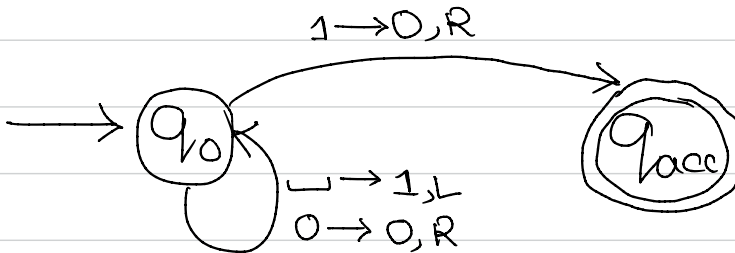
Input Symbols = {0, 1}
Tape Symbols = {0, 1, _}
States = {q_0, q_{acc}}
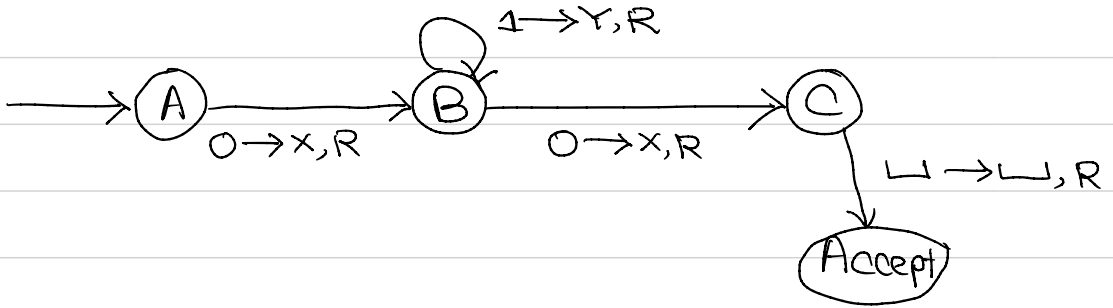Transition Function:
- $\delta(q_0, 0) = (q_0, 0, R)$
- $\delta(q_0, 1) = (q_{acc}, 0, R)$
- $\delta(q_0, \_) = (q_0, 1, L)$

$1 \rightarrow 0, R$

q_0

$\_ \rightarrow 1, L$
$0 \rightarrow 0, R$

q_{acc}

Task

01*0

1→Y,R

→ (A) ──────→ (B) ──────→ (C)
    0→X,R   0→X,R   ⌴→⌴,R

(Accept)

A01110⌴
XA1110⌴
XYB110⌴
XYYB10⌴
XYYYB0⌴
XYYYXC⌴
XYYYX⌴Accept

Example 3) $L = \{ 0^n 1^n \mid n \geq 1 \}$

```
O O O   | | |
X O O   | | |
X O O   Y | |
X X O   Y | |
X X O   Y Y |
X X X   Y Y |
X X X   Y Y Y
```

State diagram:

- Start → q_0
- $q_0 \xrightarrow{0 \to X, R} q_1$
- q_1 self-loop: $0 \to 0, R$; $Y \to Y, R$
- $q_1 \xrightarrow{1 \to Y, L} q_2$
- q_2 self-loop: $Y \to Y, L$; $0 \to 0, L$
- $q_2 \xrightarrow{X \to X, R} q_0$
- $q_0 \xrightarrow{Y \to Y, R} q_3$
- q_3 self-loop: $Y \to Y, R$
- $q_3 \xrightarrow{\ \sqcup \to \sqcup, R\ } q_4$ (accept)