Exercise 1

1. Give a formal definition of this type of TM

The Turing Machine can be defined as a set of 7 tuple:

$$(Q, \Sigma, \Gamma, \delta, q_0, b, F)$$

Q → non empty set of states

Σ → non empty set of input symbols

Γ → Transition function defined as

$$Q \times \Sigma \to \Gamma \times (R/L/U/\Delta) \times Q$$

(R: right, L: left, U: up, Δ: down)

q_0 → Initial State

b → Blank Symbol

F → Set of final states (Accept State & Reject State)

The Production rule of Turing Machine can be written as:

$$\delta(q_0, a) \to (q_1, y, R)$$

or $$\delta(q_0, a) \to (q_1, y, U)$$

or $$\delta(q_0, a) \to (q_1, y, \Delta)$$

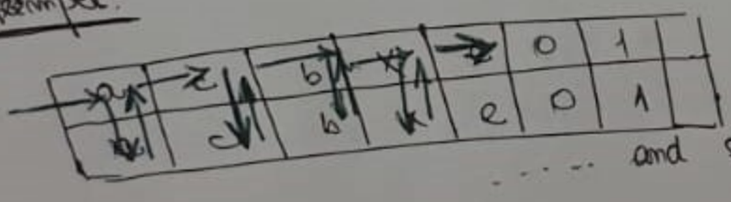
2. This Turing Machine models a machine that is able to operate on 2 tapes. Initially the tapes contain symbols which the machine can read one at the time, using the tape head. The operations are determined by a set of elementary instructions such as: "If in state 37 tape head reads symbol 0, write 1 and move right" or "If in state 3 and tape head reads symbol 1, write 0 and move down".

- The explicit components of this Turing Machine:

Two tapes divided into cells arranged in 2 rows. The symbols of the cells that are on the same column must be identical. The tapes can extend to the right so that the Turing Machine is always supplied with as much tape as it needs for computation. Cells that have not been written before are filled with the blank symbol.

- A head that moves one cell at the time (to left, right, up or down). In this model if the head tape has to move to the right, like in the original model, it must first move one cell downwards, copy the content and only after, move one cell up, and only after is able to commute like in the original way. Same rule applies when moving to left.

example:



..... and so on.

- Finite set of states among these containing the start state and the final states which can be ACCEP or REJECT.