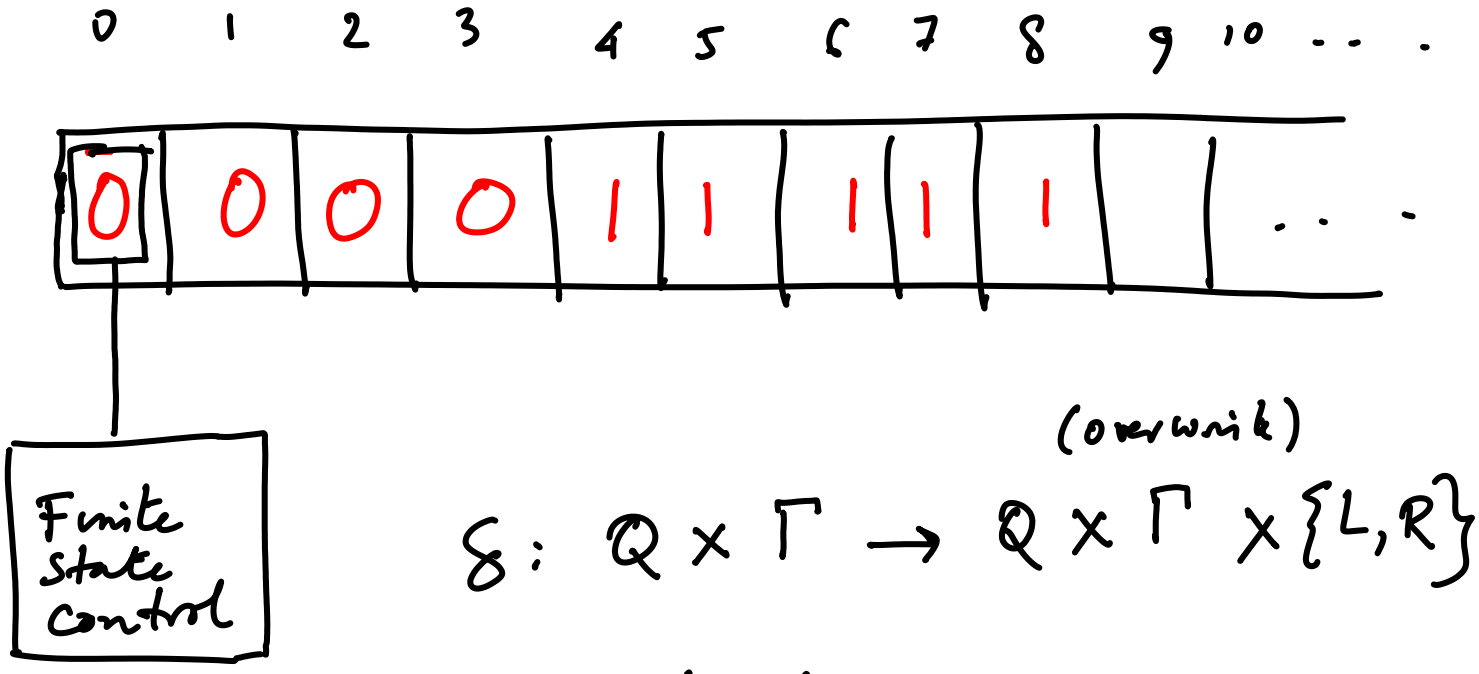
COL 352 Lecture 25,26 March 18,20



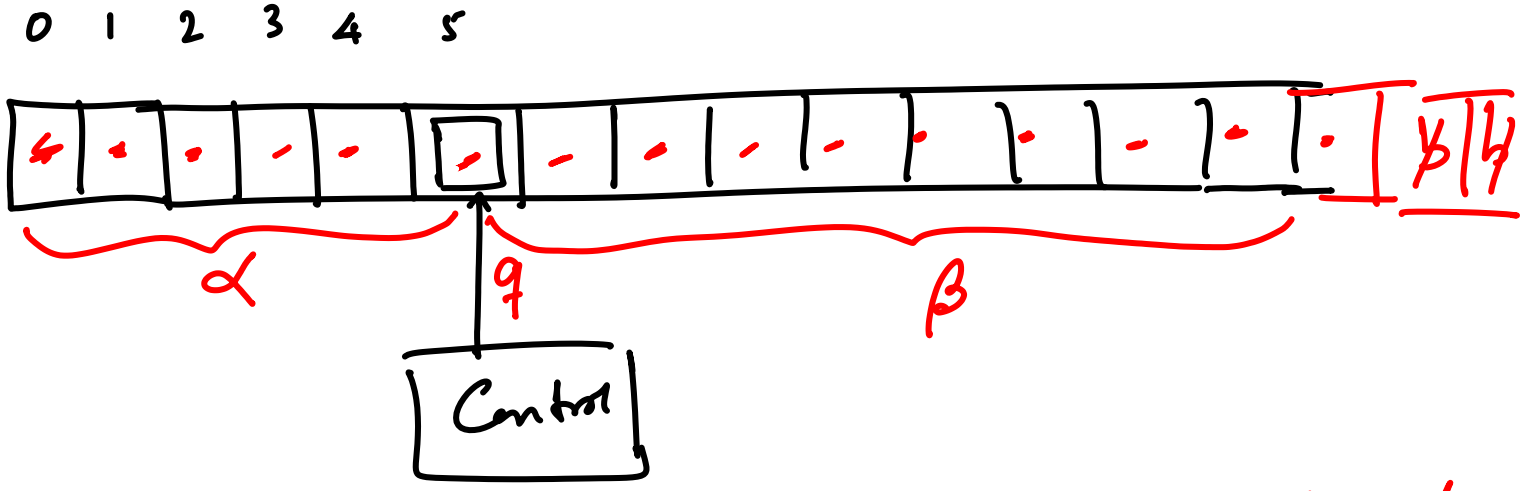
(overwrite)

$$\delta : Q \times \Gamma \rightarrow Q \times \Gamma \times \{L, R\}$$

Γ : tape alphabet
contains Σ : input alphabet as well as some additional symbols including $\not b$

The machine keeps executing until
① the next move is undefined
② It reaches a final state $q_f \in F$

Initially the machine is in state q_0 and the tape head is on the left most cell



$\alpha q \beta$ contains all the necessary information for the computation till a certain juncture

q is positioned on the leftmost symbol of β

$\alpha, \beta \in \Gamma^*$

$q \in Q$ $\quad \alpha q \beta$ represent the instantaneous description of Turing Machine

Initially the I.D.

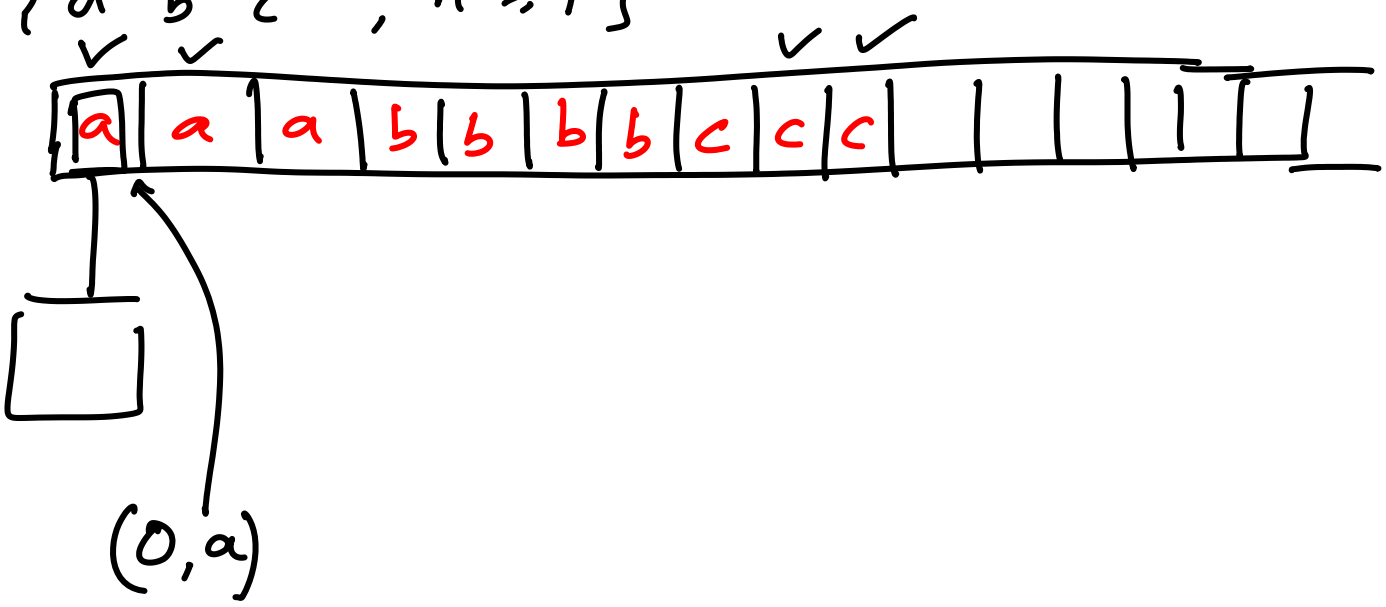
(ϵ, q_0, I_n) $\quad I_n$: input of length n

$\alpha_i q_i \beta_i \vdash \alpha_{i+1} q_{i+1} \beta_{i+1} \vdash \cdots$

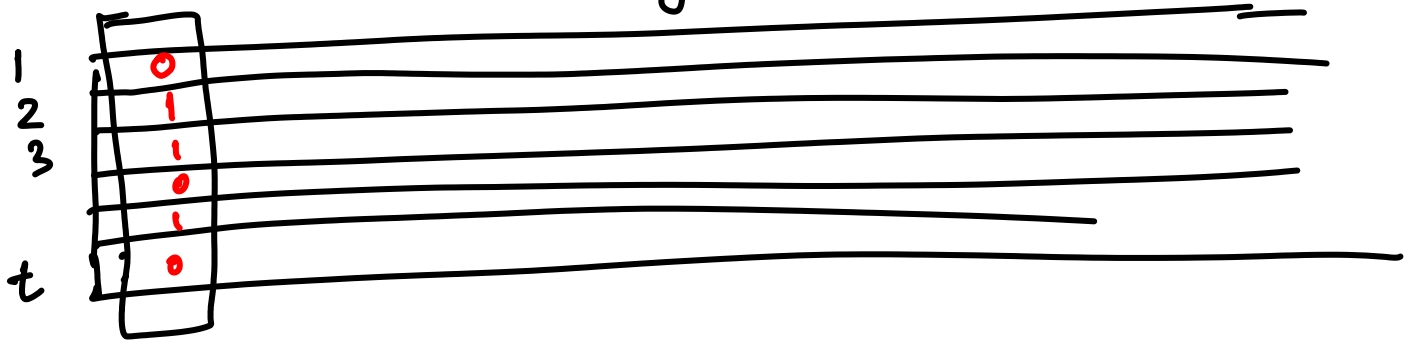
Suppose $00 q_2 101 \vdash 0 q_3 0001$

$\delta(q_2, 1)$ contains $(q_3, 0, L)$

$L = \{ a^n b^n c^n , n \geq 1 \}$



Multitrack Turing Machine

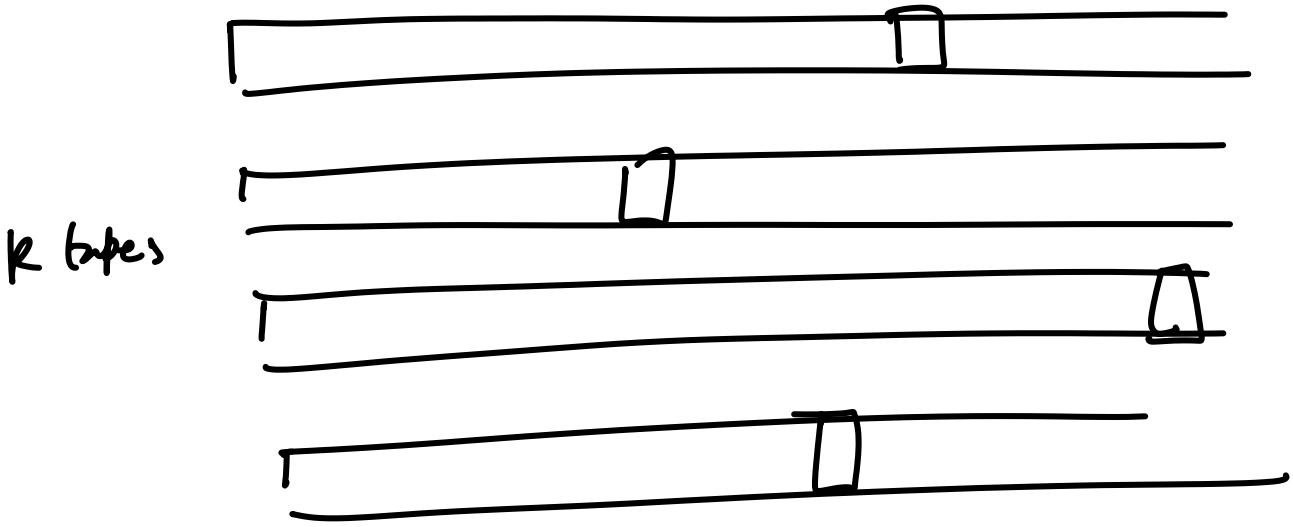


$$\delta : \quad Q \times \underbrace{\Gamma^1 \times \Gamma^2 \times \ldots \Gamma^t}_{\Gamma^t} \rightarrow Q \times \Gamma^1 \times \Gamma^2 \ldots \times \Gamma^t \times \{L, R\}$$

Claim Multitrack can be simulated by a Normal 1 track machine.

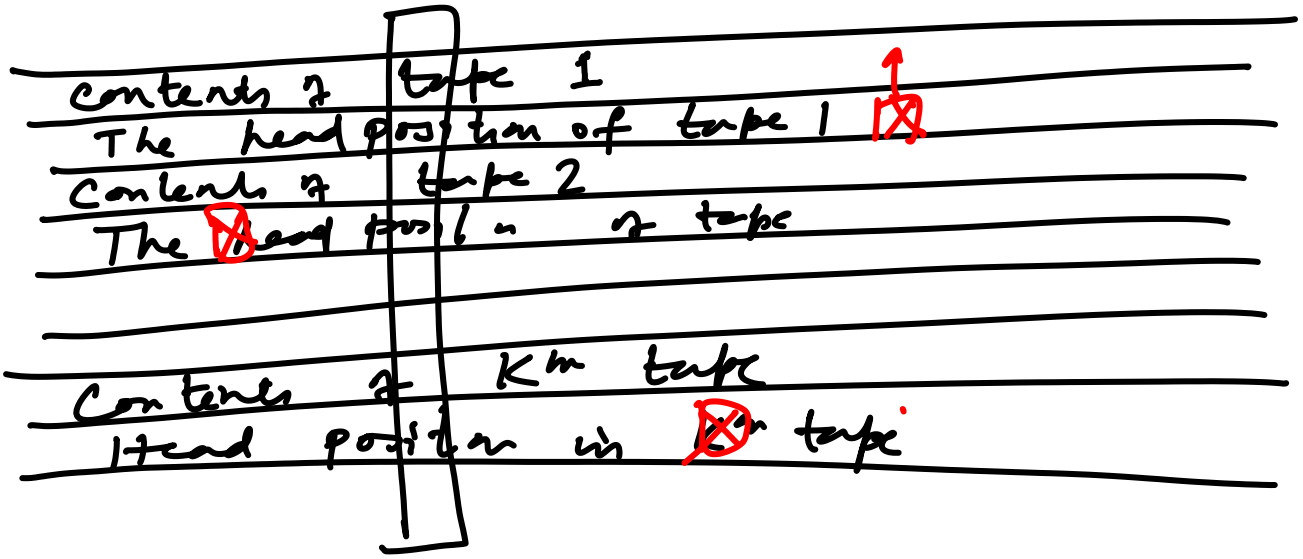
(by blowing up the tape alphabet)

Multihead Turing Machine



$$\delta : Q \times \underbrace{\Gamma \times \Gamma \times \Gamma}_{k} \to Q \times \underbrace{\Gamma \times \Gamma \times \Gamma \times \cdots \times \Gamma}_{k} \times \{L, R\}^k$$

Simulate a k-multitape TM by a multitrack $2k$-track TM



The head scans from leftmost cell till it has counted k markers (must be done using some special states)

2nd scan: it replaces the symbols according the δ function of the multitape machine

How do we remember the # head markers as we scan from left to right. The state space of the multitrack machine can be as follows

[↑, 0/1, , , , ,] ← we have counted the head on the i^{th} track

scanning for head position/replacing the tape symbols

Suppose the multitape TM takes T steps

How many steps (in O notation) will the simulation take?

about $O(T^2)$