(1)

Start Chapter 3: Turing Machines ...

Why? ...

skipped for now

	Ch 1		Ch 2		Ch 3 – 9
Machines	DFA		DFA + Stack		TM (Turing Machines)
Languages	Regular	$\subset$	Context free	$\subset$	P, NP (\$$10^6$), PSPACE ... Turing recognizable; " decidable
Today:	Small Neat Business		Large Business	new	Part of CPSC 421

Chapter 2 save for the last week of the class

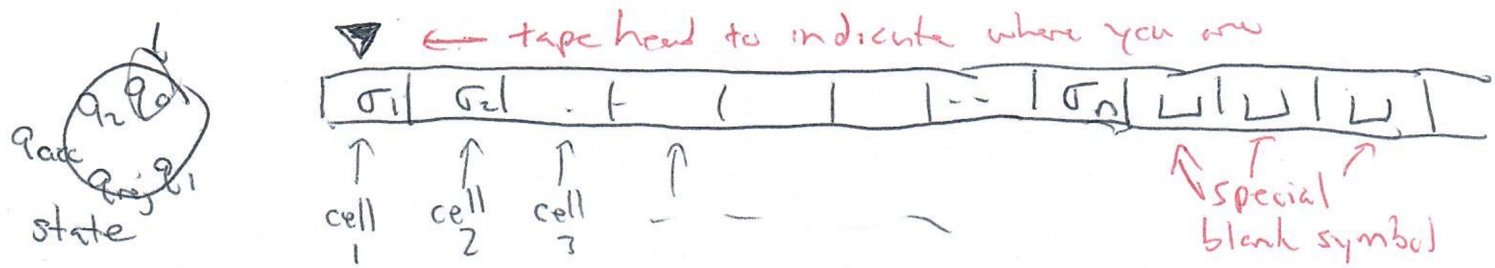
Turing Machines:

finite set, alphabet, elements of Q

Formally $(Q, \Sigma, \Gamma, \delta, q_0, q_{accept}, q_{reject})$

tape symbols (finite)

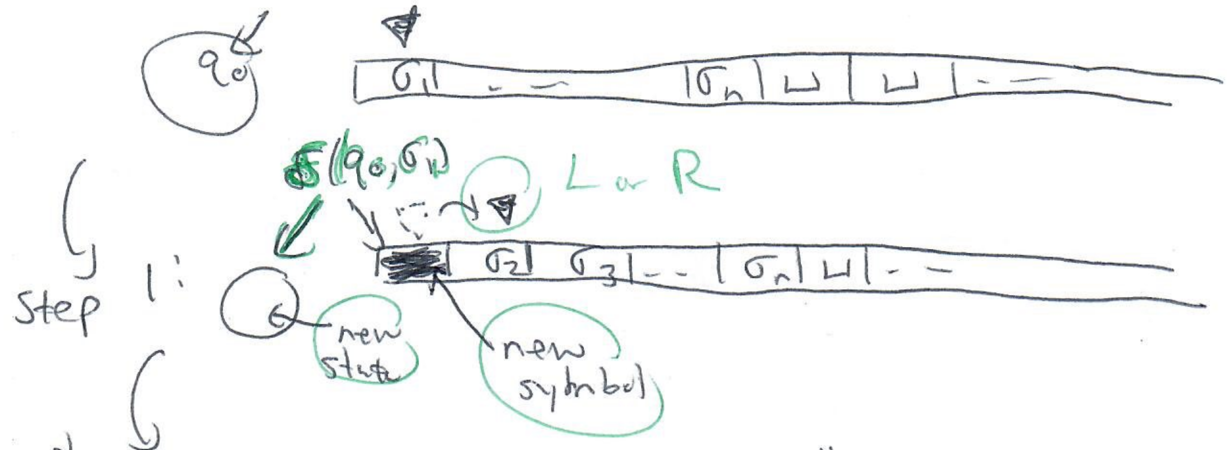
and have a tape: input word in Σ, $w = \sigma_1 \cdots \sigma_n$



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

Rules Γ = "tape alphabet" contains "$\sqcup$" and Σ $(\sqcup \notin \Sigma)$

"Initial configuration"



step 2

- $\delta(q, \gamma)$ tells you
  (1) new state
  (2) symbol from Γ write on the cell where you were
  (3) "move Left" or "move Right"

- Eventually we may hit q_{accept} ⟵ stepping stops, "accept" input
- " -- -- -- q_{reject} ⟵ " " , "reject" input
- We may keep stepping forever ⟵ "looping", i.e. machine never halts

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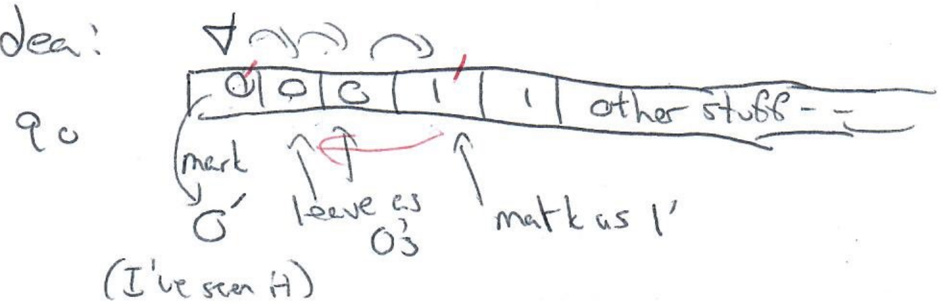
We say a Turing machine accepts input $w \in \Sigma^*$ if we reach state q_{accept}. We say that this TM <u>recognizes</u> L ($\subseteq \Sigma^*$) is $w \in L \iff$ TM stops and accepts L.

<u>Example:</u>

Let $L = \{0^n 1^n \mid n \in \mathbb{Z}_{\geq 0}\}$ (not regular)

Idea:



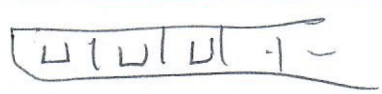
States: q_0 = start

$q_{0\to1} \leftrightarrow q_{\text{I've just seen 0, now marching to see a 1}}$

$q_{0\leftarrow1} \leftrightarrow q$ " " " 1, " " (left) " " " 0

q_{acc}, q_{rej}

$\boxed{\Gamma = \{0, 1, \sqcup, 0', 1',}$

$\delta(q_0, \sqcup) = (q_{accept}, \text{irrelevant}, \text{irrelevant})$ q_0 

$\delta(q_0, 0) = (q_{0\to1}, 0', R)$

$\delta(q_0, 1) = (q_{reject}, -, -)$

$\delta(q_{0\to1}, 0) = (q_{0\to1}, 0, R)$ | $\delta(q_{0\to1}, 1) = (q_{0\leftarrow1}, 1', L)$

$\delta(q_{0\to1}, \sqcup) = (q_{reject}, -, -)$

$\delta(q_{0\leftarrow1}, 0) = (q_{0\leftarrow1}, 0, L)$

$\delta(q_{0\leftarrow1}, 0') = ($ ~~$q_{0\leftarrow1}, 0'$~~ $(q_0, 0', R)$

To be continued with a nicer depiction ...