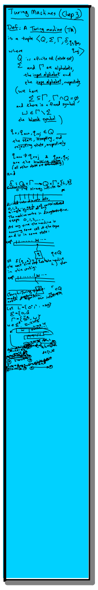

Turing Machines (Chap 3)

Def: A Turing machine (TM) is a tuple $\langle Q, \Sigma, \Gamma, \delta, q_0, q_{acc}, q_{rej} \rangle$ where

Q is a finite set (state set)

Σ and Γ are alphabets, the input alphabet and the tape alphabet, respectively.

(we have $\Sigma \subseteq \Gamma$, $\Gamma \cap Q = \emptyset$, and there is a fixed symbol $\sqcup \in \Gamma \setminus \Sigma$ the blank symbol)

$q_0, q_{acc}, q_{rej} \in Q$ the start, accepting, and rejecting state, respectively

$q_{acc} \neq q_{rej}$ & q_{acc}, q_{rej} are the ~~halting states~~) (all other states are ~~[illegible]~~

and

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

~~Informally~~ 1-way infinite tape

divided into discrete cells, 0, 1, 2, ... each cell containing a single symbol at any

The machine works in discrete time. steps 0, 1, 2, ...

At any time the machine is scanning some cell of the tape and is in some state:

If $\delta(q, a) = \ldots$ the next time step the machine (... L) then in this config:

$q \in Q$

$r \in Q$

Church–Turing thesis: The TM model captures our intuitive notion of algorithm.

Let $L = \{0^n 1^n : n \geq 0\}$

$\Sigma = \{0, 1\}$

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

$w \in \Sigma^*$. Initially:

$d \in \{L, R\}$