

[Recall] A computation by a [multitape] TM  $M$  on an input  $x \in \Sigma^n$  is a sequence of instantaneous descriptions:

$$I_0 = I_0(x) \vdash_M I_1 \vdash_M I_2 \vdash \dots \vdash_M I_{t-1} \vdash_M I_t$$

Each  $I_j$  consists of  $\langle q, \vec{w}, \vec{h} \rangle$    
 where  $q$  is the current state,  $\vec{w}$  is the contents of tapes (maybe not including read-only input), and  $\vec{h}$  are head positions on all tapes.   
 The final state  $q$  is either  $q_{acc}$  or  $q_{rej}$ .

Only point we care about is that a computation can be encoded as a single string  $\vec{c}$ .   
 Fact:  $|\vec{c}| \leq O(t^2)$  (really meaning  $O((n+t)^2)$ ), where  $n = |x|$ .   
 The time  $t$  of the computation is not the same as the bit length of  $\vec{c}$ .   
 Ignorable if  $t \geq n+1$ .

Def<sup>n</sup>: The Kleene T-Predicate is  $T(M, x, \vec{c})$  meaning that  $\vec{c}$  is a valid  $\left\{ \begin{array}{l} \text{halting} \\ \text{accepting} \end{array} \right.$  computation of  $M$  on input  $x$ .   
 Allows  $M$  to be nondeterministic.

Fact: This predicate is decidable — in time  $O(|M| + n + |\vec{c}|)$