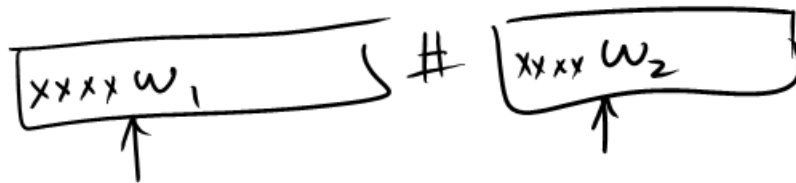


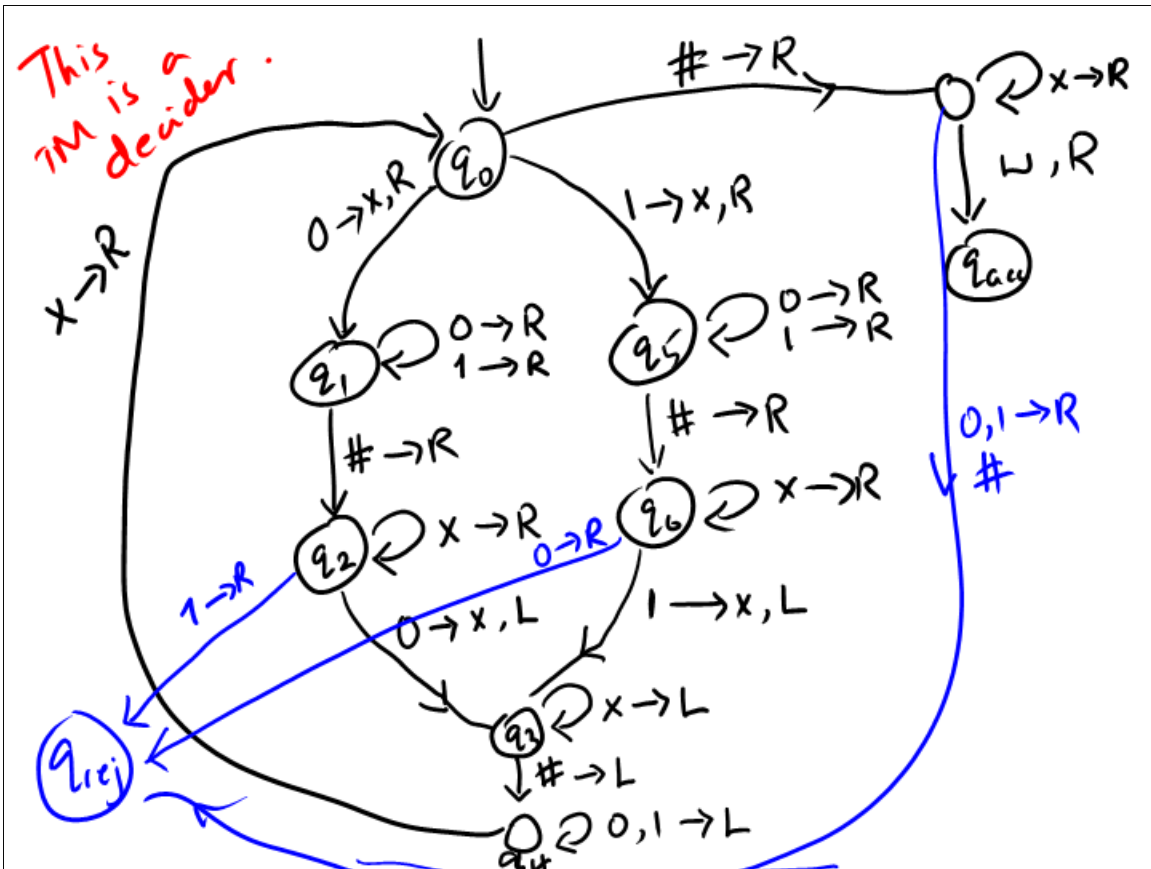
Lecture #13:

More Turing machine examples  
Turing machine variants  
(doubly infinite tape, multitape TMs...)

TM for  $\{w\#w \mid w \in \{0,1\}^*\}$   
 $\Sigma = \{0,1,\#\}$

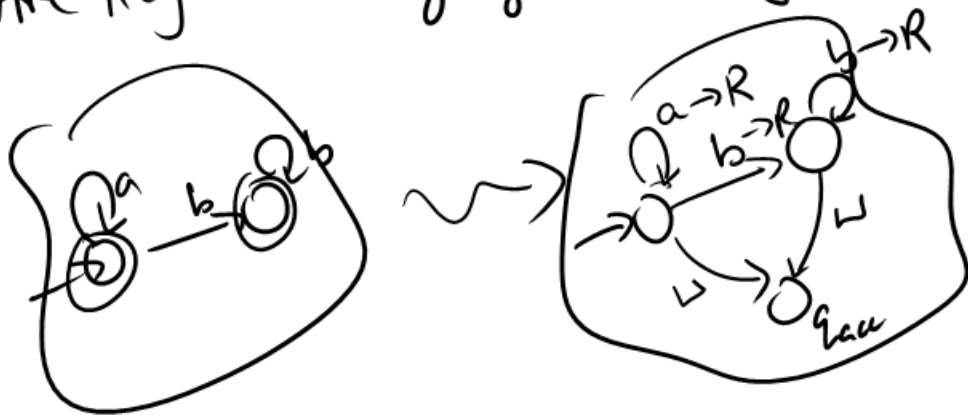
TM =  $(Q, \Sigma, \Gamma, \sqcup, \delta, q_0, q_{acc}, q_{rej})$   
 $\Gamma = \{0,1,\#, \sqcup, x\}$

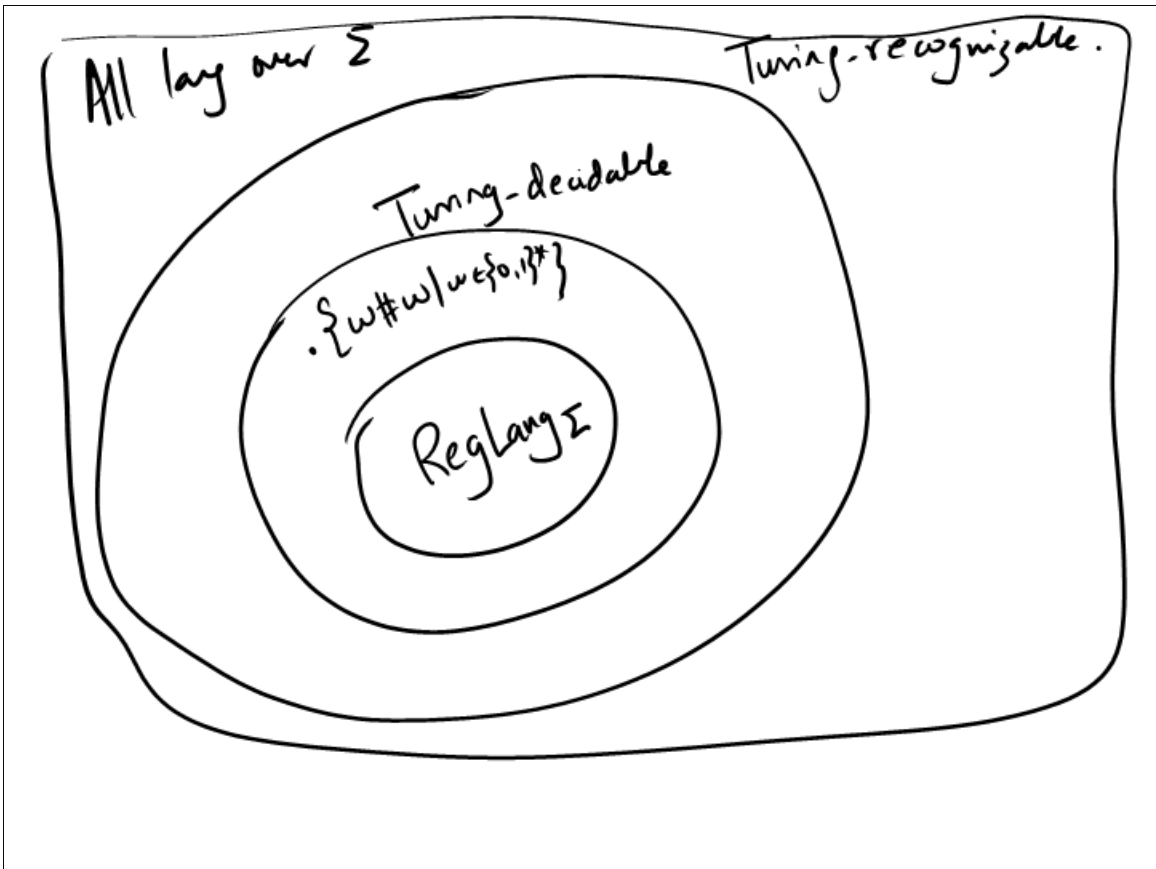




$$\rightarrow \text{O} \stackrel{\text{O}}{\text{L}} \rightarrow \text{R}$$

Are Regular Languages Turing-decidable?

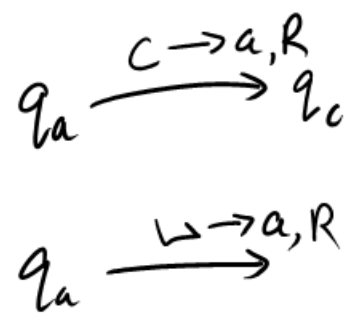
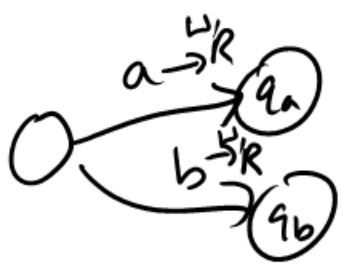


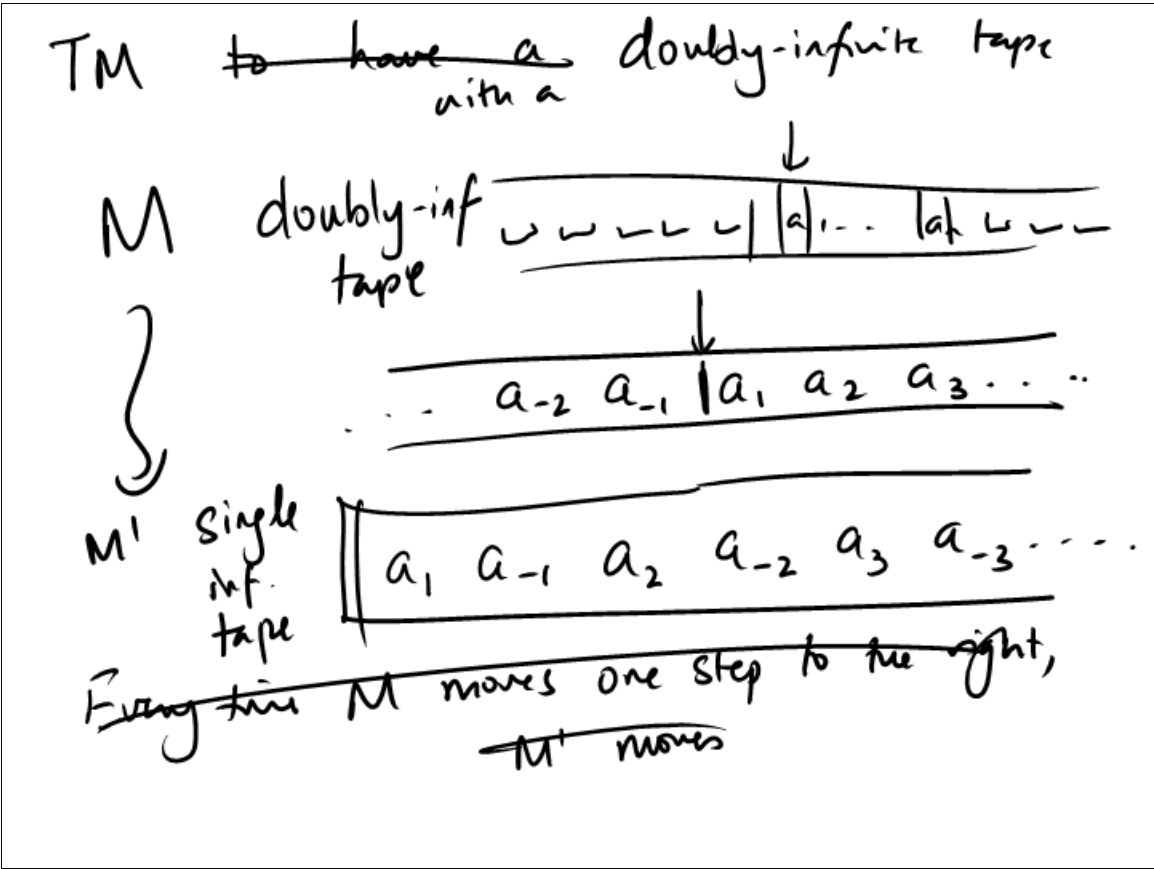


$$L = \{ 0^n \mid \exists m > n \text{ } m \text{ is odd and } m \text{ is a perfect number} \}$$

TM Recogniser :

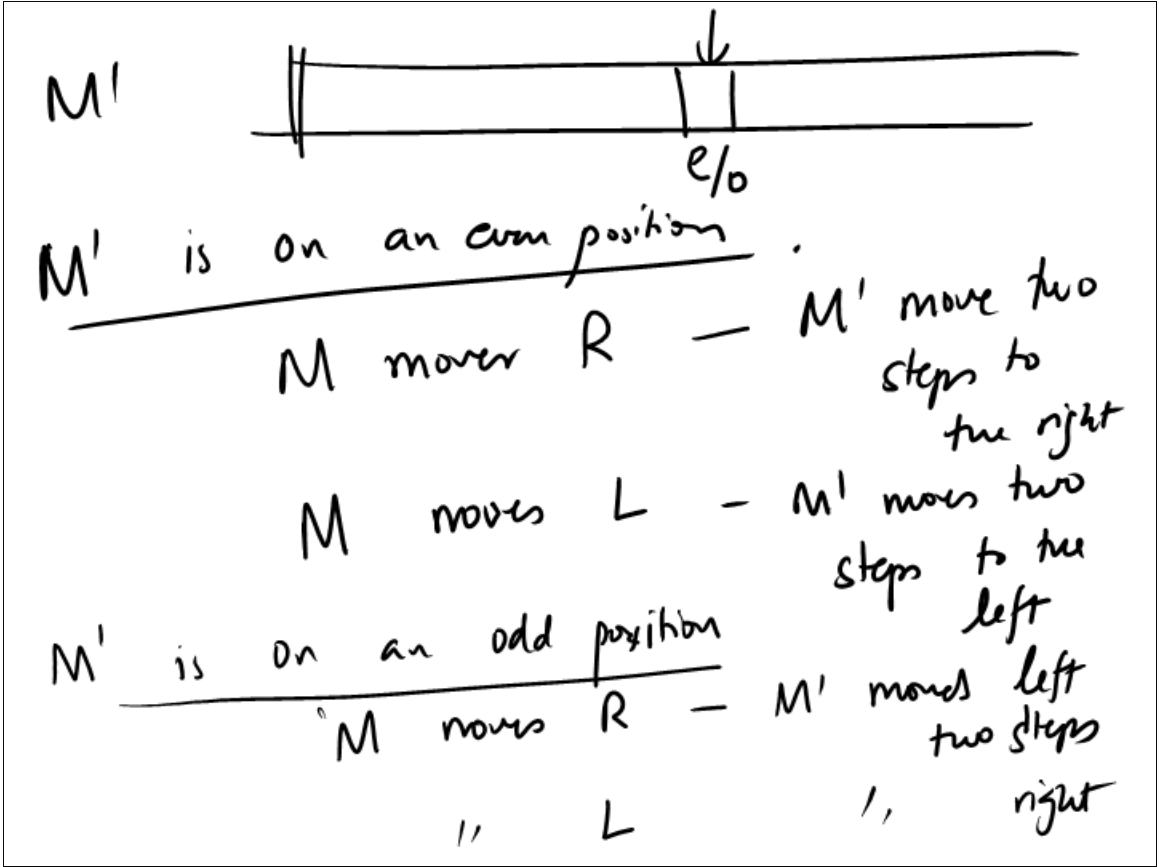
- Input  $0^n$
  - ~~for every number ( $m > n$ )~~
  - for ( $i = m$ ; true,  $i++$ ) {
    - if  $i$  is odd & perfect
    - break & halt & say "YES"
  - else  $i++$ ;
- }



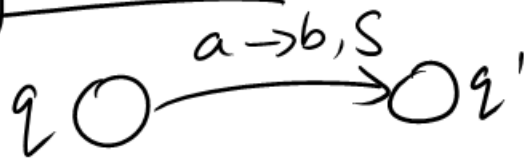




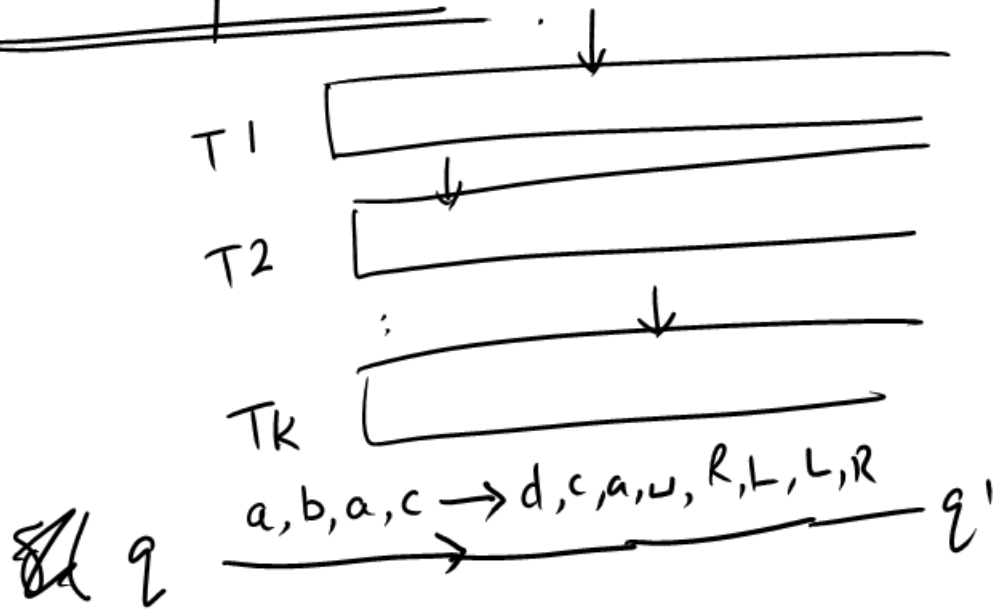




Stay-transitions



# Multi-tape TM



$\$ \underline{T_1} \$ \underline{T_2} \$ \cdot T_3 \$$

$a \in T \quad \hookrightarrow \quad \dot{a} \in T'$

$\| \$ abb\dot{a}abb \$ abb \$ aa \$$

$\circlearrowleft q \rightarrow \epsilon'$

$\$ abbcaabb \$ abb \$ ad\dot{i} \$$

$\begin{pmatrix} aba \\ cbd \\ RLR \end{pmatrix}$

TMs  $\equiv$  TMs with stay-trans  
 $\equiv$  TMs with doubly inf. tape  
 $\equiv$  TMs with multiple tapes  
(  $\equiv$  TMs with 3D tape  
 $\equiv$  TMs with multiple heads  
on a single tape.  
 $\equiv$  Nondet-TM