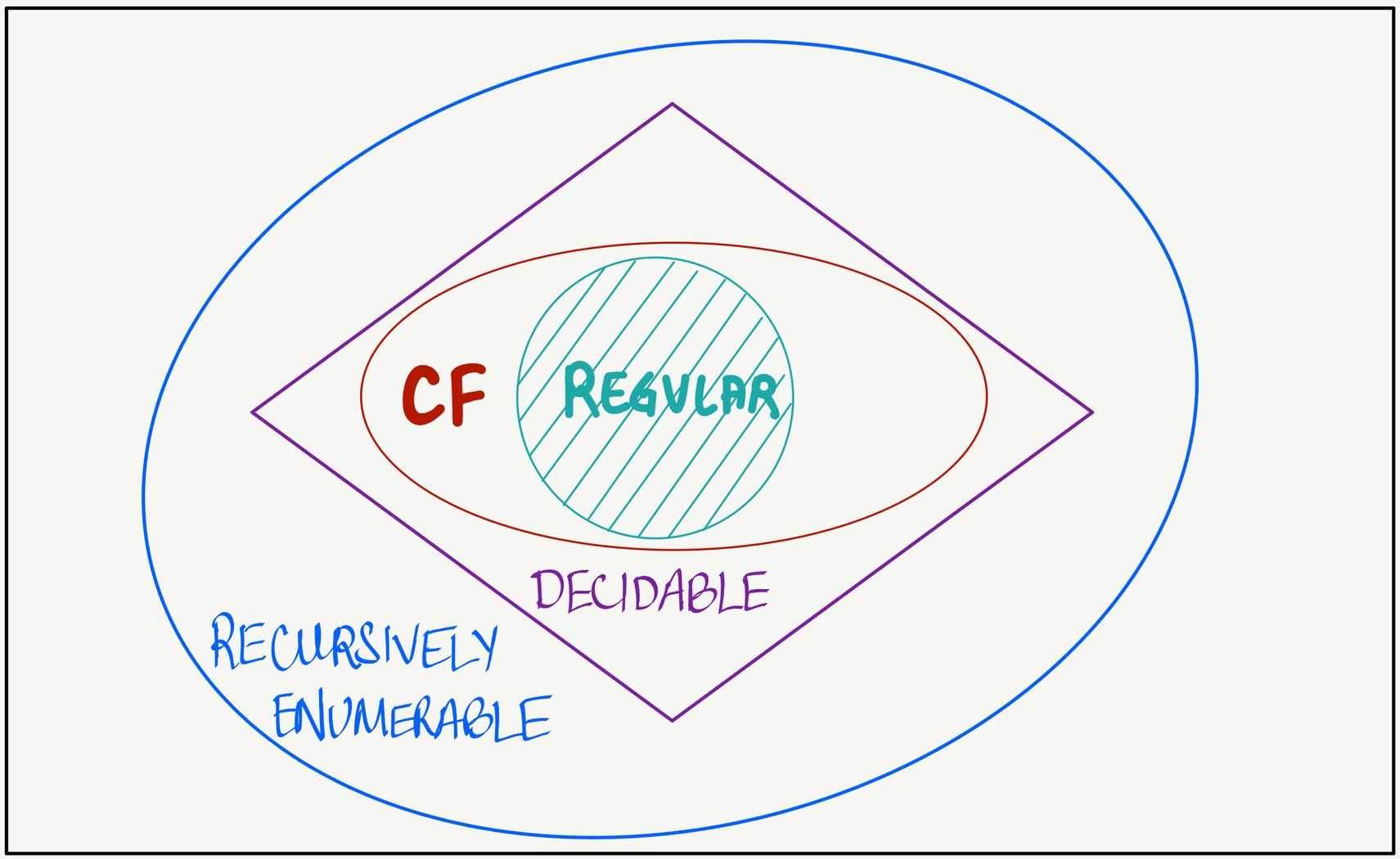
Decidable Languages

Recall: Saw examples of languages that TMs recognize



Saw examples of TMs recognizing a regular and a context-free language

Today: TMs for non-context-free languages

$$L = \{ w\#w \mid w \in \{0,1\}^* \} \subseteq \{0,1\}^*\#\{0,1\}^*$$

$0\#0\#1$

Read first letter (not crossed out) + remember it

Cross it out

Go to the first letter to the right of a hash

If it matches the above, cross it out

Scroll back to the left + repeat

$$L = \{ \omega \# \omega \mid \omega \in \{0,1\}^* \} \subseteq \{0,1\}^* \# \{0,1\}^*$$

Start with the leftmost letter of ω, say 'c'

Replace it by A

Scroll right till a # is found*

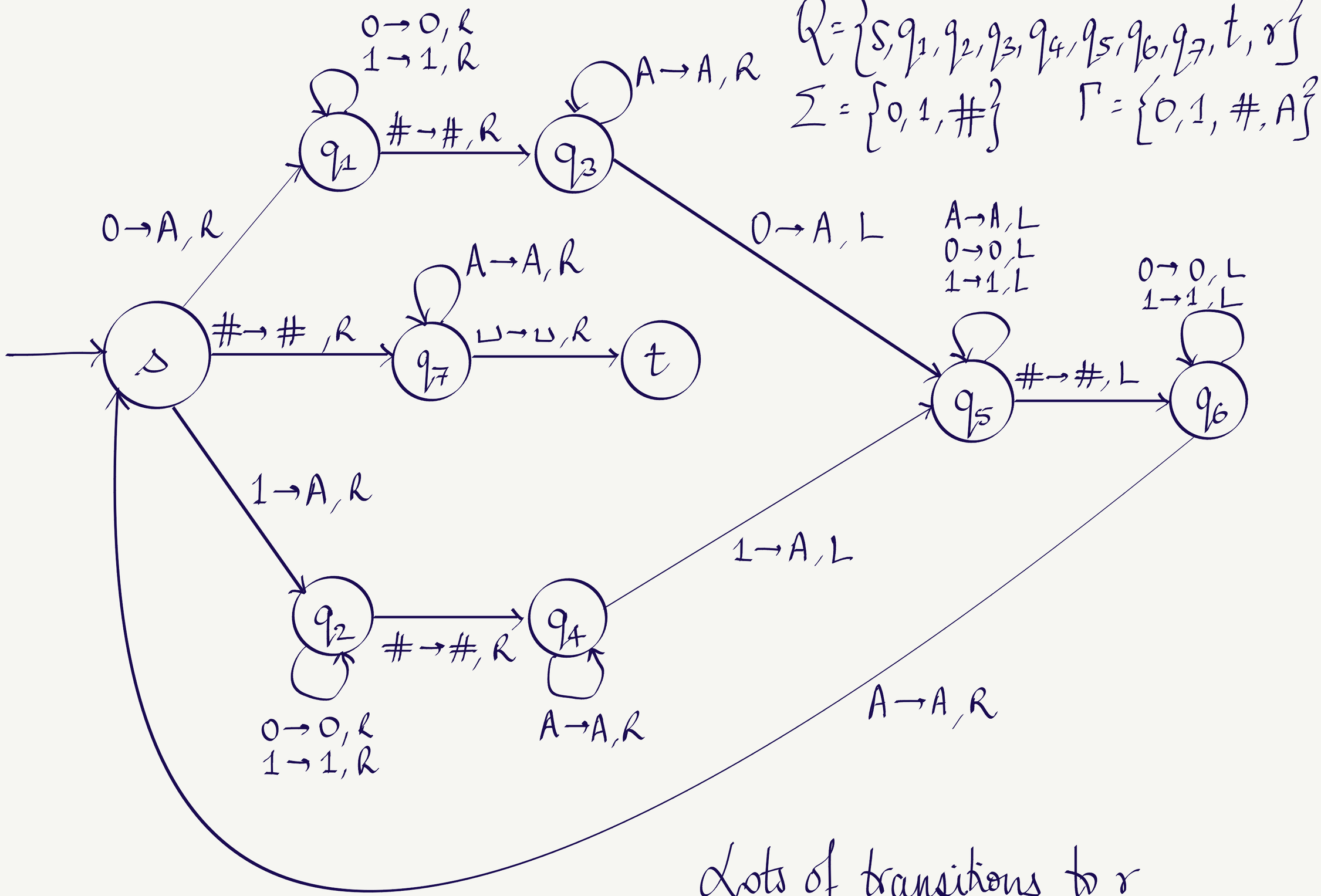
If the symbol to the right of the # is 'c', replace it by A*

Scroll all the way back till the symbol to the left of the head is A

Repeat till the tape only has As followed by a # followed by As*

$Q = \{s, q_1, q_2, q_3, q_4, q_5, q_6, q_7, t, r\}$

$\Sigma = \{0, 1, \#\}$ $\Gamma = \{0, 1, \#, A\}$



Lots of transitions to r
(especially on #) not shown here

$$L = \{0^{2^n} \mid n \geq 0\}$$

Start with the leftmost 0 of the word

Replace every second letter by A till you hit a blank

If only one 0, accept. If >1 odd 0s, reject.

Scroll all the way back till the symbol to the left of the head is A

Repeat till the tape has only As

$$Q = \{s, q_1, q_2, q_3, q_4, t, r\}$$
$$\Sigma = \{0\} \quad \Gamma = \{0, A\}$$