

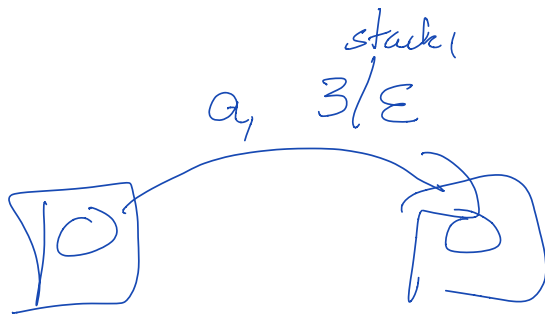
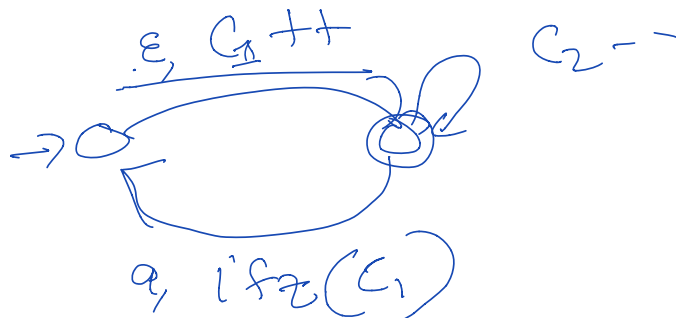
# Recap

- 2 stack automata.
- 3 counter automata
- 2 counter automata (Minsky machines)

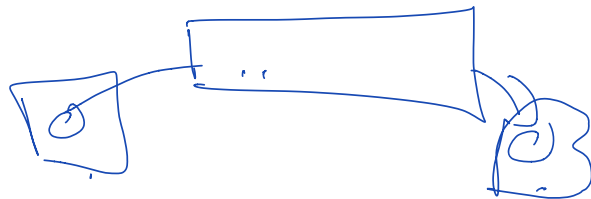
$(l, m, n)$

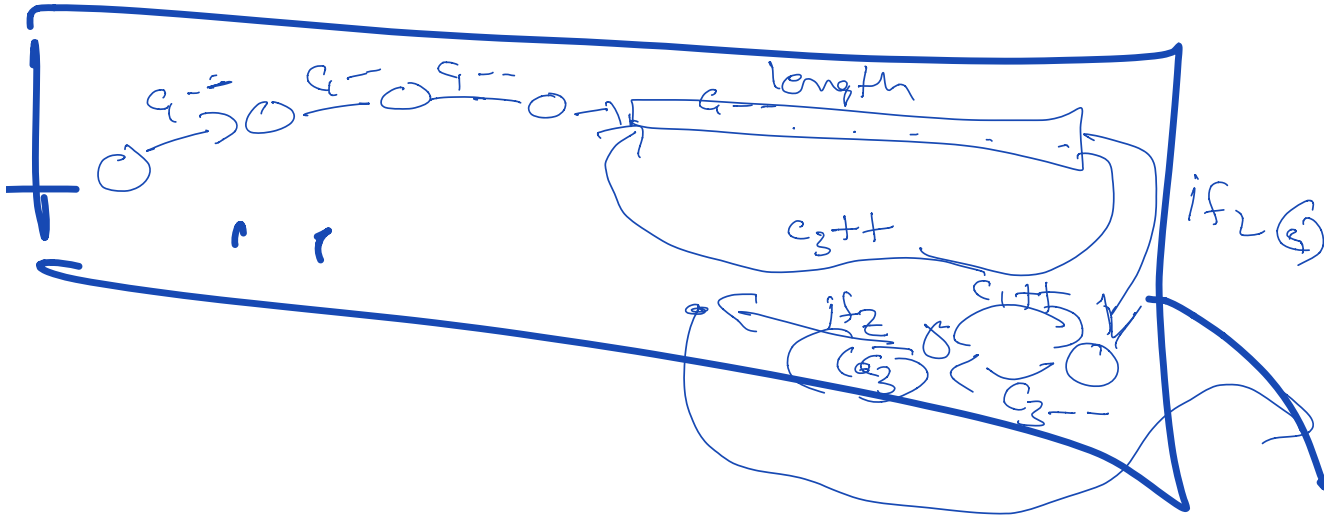
2, 3, 5

$$2^l \times 3^m \times 5^n$$

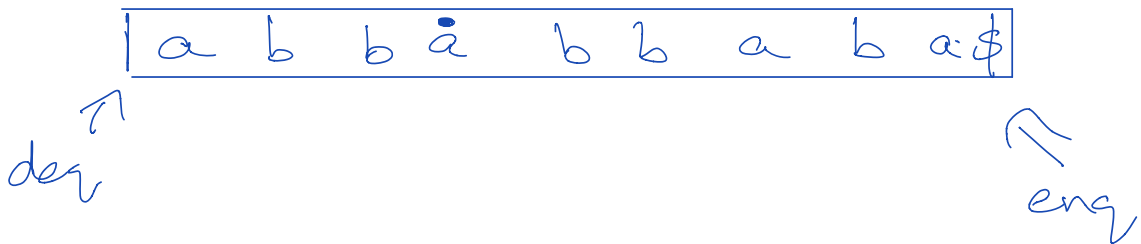


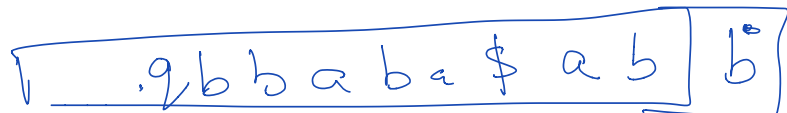
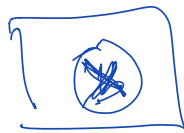
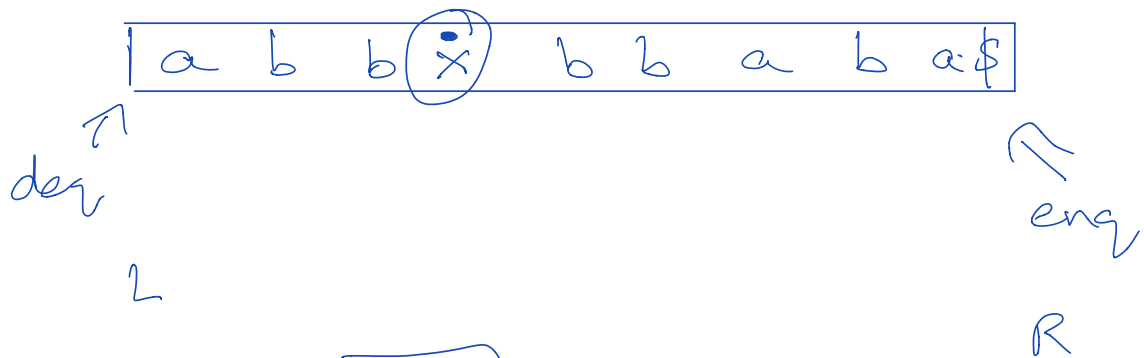
U





Queue Automata





$\uparrow$  VQ (states of Queue machine)

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Post's Correspondence Problem

PCP

Input :  $(u_1, v_1) (u_2, v_2) (u_3, v_3) \dots$   
 $(u_k, v_k)$

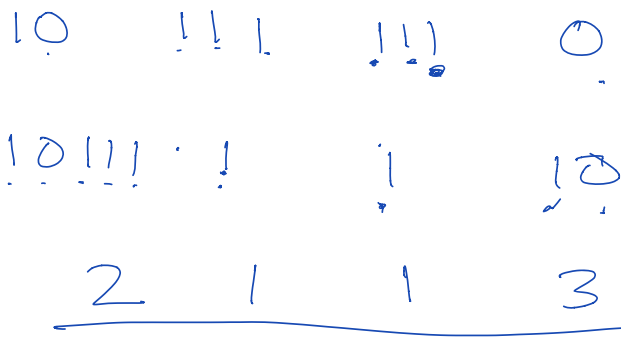
$Q_n : \exists i_1 i_2 \dots i_n \in \{1, \dots, k\}^+$

$u_{i_1} u_{i_2} u_{i_3} \dots u_{i_n}$

$= v_{i_1} v_{i_2} v_{i_3} \dots v_{i_n}$

$\cdot \uparrow \dots \dots$

$i$	$u_i$	$v_i$
1	(1, 111)	
2	(10111, 10)	
3	(10, 0)	



PCP

i/p. morphisms  $h, g: \Gamma \rightarrow \Sigma^*$

$\exists n: \exists w \in \Gamma^+$  s.t.

$$h(w) = g(w) ?$$

[same thing as above

$$h(i) = u_i$$

$$g(i) = v_i$$

PCP is undecidable.

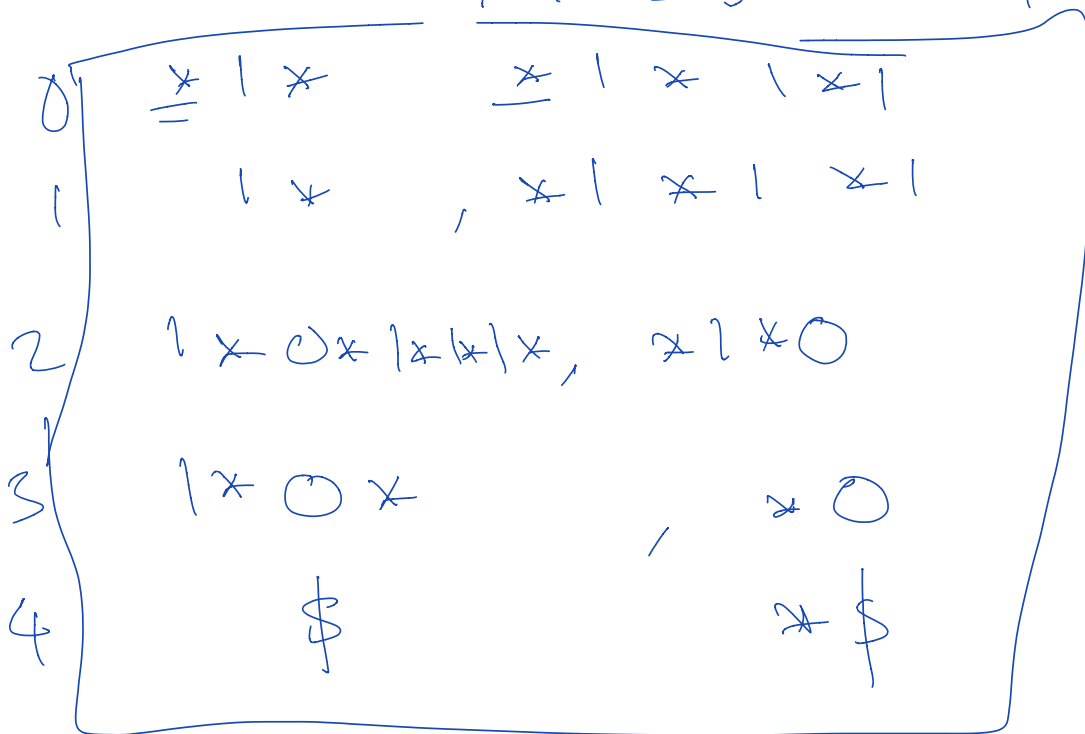
Modified PCP (MPCP)

Input:  $(u_1, v_1) (u_2, v_2) (u_3, v_3) \dots$   
 $(u_k, v_k)$

$Q_n = \exists i_1 i_2 \dots i_n \in \{1, \dots, k\}^*$

$u_{i_1} u_{i_2} u_{i_3} \dots u_{i_n}$

$= v_{i_1} v_{i_2} v_{i_3} \dots v_{i_n}$



$$MPCP \leq PCP$$

Modified PCP is undecidable

$$MP \leq MPCP$$

Given

$$M \neq w$$

construct tiles for MPCP instance

$$(\# , \#q_0w\#)$$

$$(A , A)$$

for all  
 $A \in \Gamma$

$$(\# , \#)$$

$$(q_i A , B_p)$$

if

$$\delta(q_i, A) = (p_j, B_j, R)$$

$$(x q_i A , p_j x B_j)$$

$$\delta(q_i, A) = (p_j, B_j, L)$$

$$(q\#, Ap\#)$$

$$(Xq\#, pXA\#)$$

$$\delta(q, U) = (p, A, R)$$

$$\delta(q, U) = (p, A, L)$$

⊥

$$\underline{\# \omega} \quad \underline{p \#}$$