23/2/'23

CS704

Σ - finite alphabet, $L \subseteq \Sigma^*$, a language.

1) If L is regular - design DFA/NFA for L.

DFA $M = (Q, \Sigma, \delta, q_0, F)$ → final states.

- Q: state
- δ: transition
- q_0: start state

Given an i/p $w \in \Sigma^*$, a run of M on w is

$$q_0 \xrightarrow{a_1} q_1 \xrightarrow{a_2} q_2 \rightarrow \cdots \xrightarrow{a_n} q_n \qquad w = a_1 a_2 \cdots a_n$$

↓

If $q_n \in F$, accept w. Otherwise, reject w.

2) L is a CFL $\Rightarrow$ we can give a NPDA for L.

$$M = (Q, \Sigma, \Gamma, q_0, F, \perp, \delta)$$

$$\delta \subseteq \left((Q \times \Sigma \times \Gamma) \times (Q \times \Gamma^+)\right)$$

$\delta(p, a, X) = (q, y)$

$\downarrow$ $\qquad$ $\downarrow$

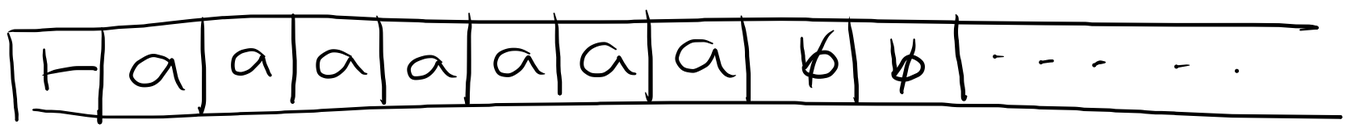
pop X $\qquad$ $y \in \Gamma^*$

push y

Given an i/p $\omega \in \Sigma^*$, a run of a PDA will involve a sequence of state changes, the 'contents' of the stack (for one step, we read the top of the stack), & finally, entering a final state or emptying the stack.

↳ Configuration

Exercise $L = \{a^p / p \text{ is prime}\}$ is recursive.

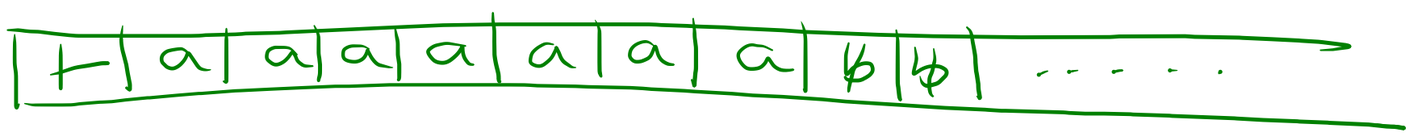


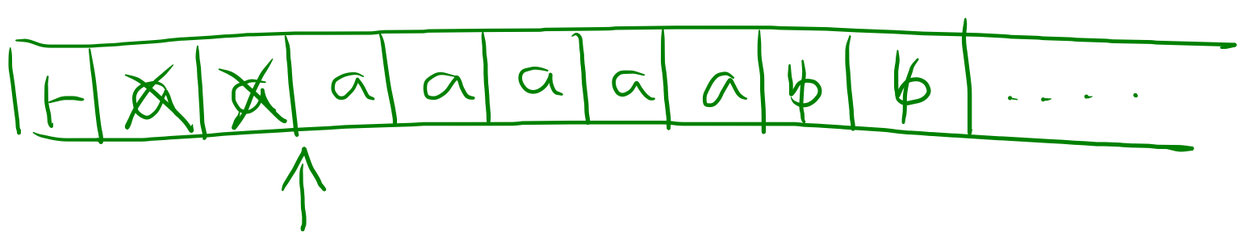
Sieve of Eratosthenes (algorithm):

2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

~~2~~, 3, ~~4~~, ~~5~~, ~~6~~, 7, ~~8~~, ~~9~~, ~~10~~, 11, ~~12~~, 13

i/p





Language	Properties (Req/Spec)	Algorithms (Programs)	Abstract m/c (TM)
$\{a^n / n \geq 0\}$	Non-negative	✓	DFA
$\{a^n / n \text{ is even}\}$	Evenness	✓	DFA
$\{a^p / p \text{ is prime}\}$	Primality	✓	TM
$\{(G,s,t) / \exists$ a path from s to $t\}$	'connectivity'	✓	TM
$\{G,s,t,k / \exists$ a path of (weight) k from s to $t\}$	$(G,s,t,w) / \exists$ a shortest (weight) path from s to $t\}$		