

A stack machine for $\{xx^R \mid x \in \{a,b\}^+\}$

$\underbrace{abaa}_x \underbrace{aaba}_{x^R}$

↑
read this part, push the letters onto the stack.
stack would say aaba

While reading 1st half, push the letters,
... 2nd ... pop them.

Use the S to mark 1st half vs 2nd half.
during 1st half, leave S on top.

<u>read</u>	<u>pop</u>	<u>push</u>	
a	S	Sa	Try abbbba
b	S	Sb	
ϵ	S	ϵ	$(abbbba, S) \mapsto (bbbbba, Sa)$
a	a	ϵ	$\mapsto (bbba, Sba)$
b	b	ϵ	$\mapsto (bba, Sba)$
			$\mapsto (bba, bba) \mapsto (ba, ba)$
			$\mapsto (a, a) \mapsto (\epsilon, \epsilon)$

$$(abaa, S) \mapsto (baa, Sa)$$

$$\mapsto (aa, Sba) \mapsto (a, ba)$$

$$\{X = X^R\}$$

like above, but allows one extra letter in the middle.

abaabaaba

<u>read</u>	<u>pop</u>	<u>push</u>
$\rightarrow a$	S	Sa
b	S	Sb
ϵ	S	ϵ ←
a	a	ϵ
b	b	ϵ
$\rightarrow a$	S	ϵ
b	S	ϵ

} $\rightarrow \delta(a, S) = \cancel{\epsilon}$
{Sa, ϵ }

Stack machines formally!

Def A stack machine is a 4-tuple

$$M = (\Gamma, \Sigma, S, \delta)$$

where Γ is a finite set the stack alphabet

Σ is a finite set the input alphabet

$S \in \Gamma$ (the start symbol)

δ is the transition function

$$\delta: (\underbrace{\Sigma \cup \{\epsilon\}}_{\text{pairs, first part is a letter or } \epsilon, \text{ second part is a stack symbol}}) \times \Gamma \rightarrow \mathcal{P}(\Gamma^*)$$

$\uparrow$
a set of stack strings.

<u>read</u>	<u>pop</u>	<u>push</u>
a	S	S1
b	1	ϵ
ϵ	S	ϵ
ϵ	S	11

Write it formally:

$$M = (\{S, 1\}, \{a, b\}, S, \delta)$$

where

$$\delta(a, S) = \{S1\}$$

$$\delta(b, 1) = \{\epsilon\}$$

$$\delta(\epsilon, S) = \{\epsilon, 11\},$$

$$\delta(x, y) = \emptyset \text{ for all other } (x, y)$$

$$\delta(b, S) = \emptyset$$

$$\delta(a, 1) = \emptyset \quad \delta(\epsilon, 1) = \emptyset$$