

1 The power of PDA ~ CFG

$$L = \{ x \mid x \in \{0,1\}^* \text{ and } \#_1 > \#_0 \}$$

CFG



110 101

1110 < 1101
1011

011, 110, 101

$$0^n 1^m \quad n > m$$



0 0 1 1 1

1 0 0 1 1

1 1 0 0 1

1 1 1 0 0

1 0 1 1 1 0
←→
1 1 0 1 1 0
→

1 1 1 1 1 1 -

0 1 1

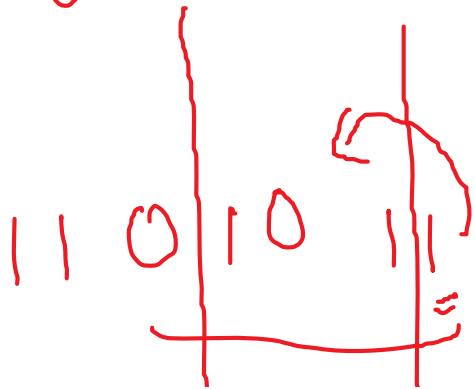
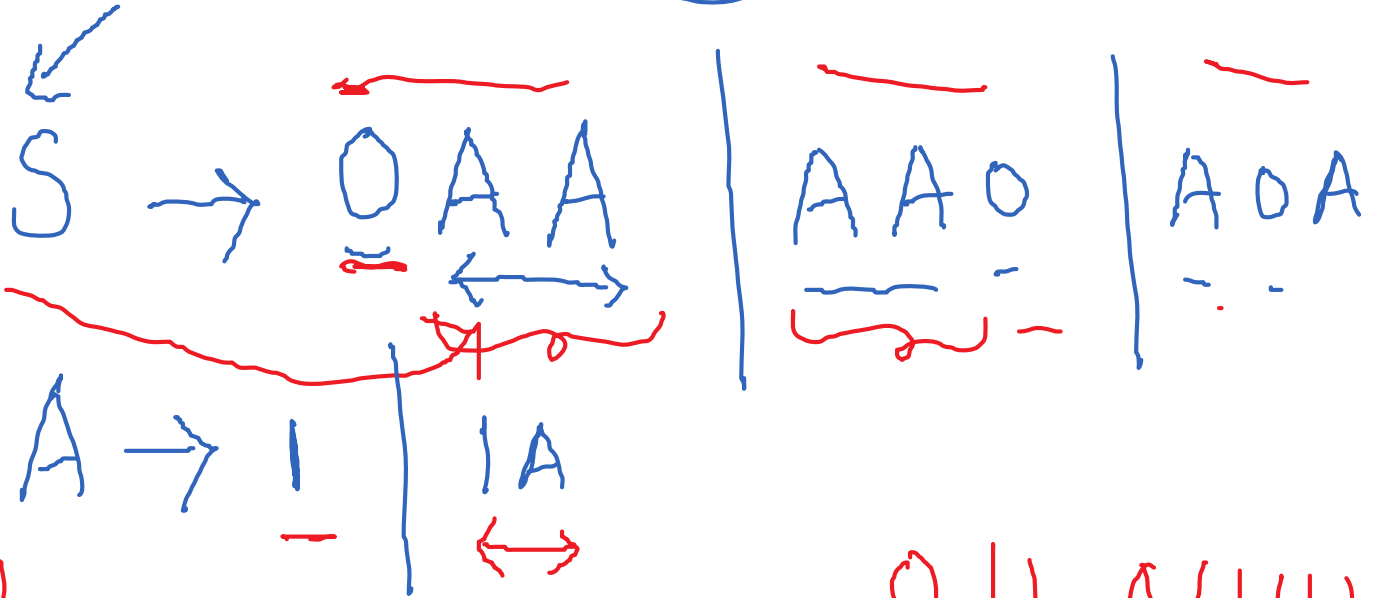
1 1 0

1 0 1

A O A

A A O

O A A



0 1 1, 0 1 1 1 1

$$A \cancel{\rightarrow} \underline{0AA \mid AAO \mid AOA}$$

$$A \rightarrow 1 \mid 1A$$

$$A \rightarrow 0AA$$

$$\rightarrow 011$$

$$\rightarrow 01AA$$

$$\rightarrow 011AA$$

$$\rightarrow 01111$$

$$\begin{array}{l} 0AA \\ \rightarrow 0 \quad \underline{AA} \quad A \end{array}$$

$$\rightarrow 0101A$$

$$\rightarrow 01011A$$

$$\begin{array}{c} \text{AOA} \\ \downarrow \quad \downarrow \\ 1 \quad 1 \end{array}$$

$A \rightarrow \underline{0AA} \mid AA0 \mid A0A$

$A \rightarrow 1 \mid 1A$



$(N = \{A\}, T = \{0, 1\},$

$P, S = \{A\})$

$\#_1 > \#_0$

0 1 1 0 1 1 1 1

$A \rightarrow \underline{0AA}$

$\underline{1A} \underline{0AA}$

1 0 1 1A - 1A, 1A

$A \rightarrow 1A$

$\rightarrow 11A$

$\rightarrow 111$

1 1 1

→ # > #₀

Choose an arb'ty S

0 - 0

— D - A A O

DA A

A O A

AOA

$$\begin{aligned} & \textcircled{0} A A \\ & \quad \quad \quad \rightarrow \textcircled{0} A A \end{aligned}$$

Diagram illustrating the structure of a vector space V over a field F . The diagram shows a sequence of elements: $\leftarrow \begin{matrix} | \\ | \\ | \end{matrix} \rightarrow$, 0 , $\leftarrow \begin{matrix} | \\ | \\ | \end{matrix} \rightarrow$, 0 , $\leftarrow \begin{matrix} | \\ | \\ | \end{matrix} \rightarrow$, 0 . A large bracket underneath groups the first three elements, and another large bracket underneath groups the last three elements.

(111 000 111)


OAA

A hand-drawn diagram of a simple electrical circuit. It consists of a battery (represented by two cells), a switch, and two light bulbs connected in series. The circuit is drawn with red ink on a white background.

$$\#_0 > \#_1 \quad L_1 \quad \left\{ \begin{array}{l} B \rightarrow 1BB \mid BB1 \mid B1B \\ B \rightarrow 0 \mid 0B \end{array} \right.$$

$$\#_1 > \#_0 \quad L_2 \quad \left\{ \begin{array}{l} A \rightarrow 0AA \mid AA0 \mid A0A \\ A \rightarrow 1 \mid 1A \end{array} \right.$$

$$L_1 \cup L_2 = S \rightarrow A \mid B \quad \{x \mid \#_0 \neq \#_1\}$$

$$L = \{ a^n b^n c^n \mid n \geq 1 \}$$


$a^n b^n c^m$
 $a^m b^n c^n$

$$L_1 = \{ a^n b^n \mid n \geq 1 \}$$

$$L_2 = \{ b^n c^n \mid n \geq 1 \}$$

$$L_1 \cap L_2 \neq L$$

$$L_1 = \{ \underline{a^m} \underline{b^n c^n} \}$$

$$L_2 = \{ \underline{a^n b^n} \underline{c^m} \}$$

✓
✓

DFA

L_1 L_2

$L_1 \cap L_2$

$$S \rightarrow AB$$

$$A \rightarrow aA \mid a$$

$$B \rightarrow bBc$$

$$B \rightarrow bc \quad ?$$

PDA

$$S_2 \rightarrow XY$$

$$X \rightarrow xab$$

$$X \rightarrow ab$$

$$Y \rightarrow c \mid cy$$

CF₁

CF₂

$$L_1 \cap L_2 = \{ a^n \underline{b^n c^n} \mid n \geq 1 \} \quad ??$$

$$\{ a^n b^n c^n \mid n \geq 1 \}$$

$a a a b b c c \notin$

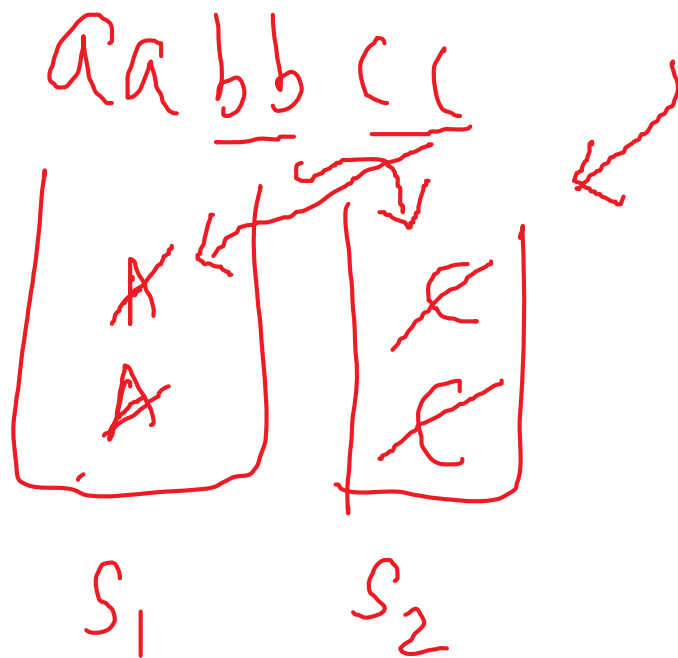
B
B
\$
A
A
A

$a a b b c c$
 \rightarrow ~~B~~

B
\$
A
A

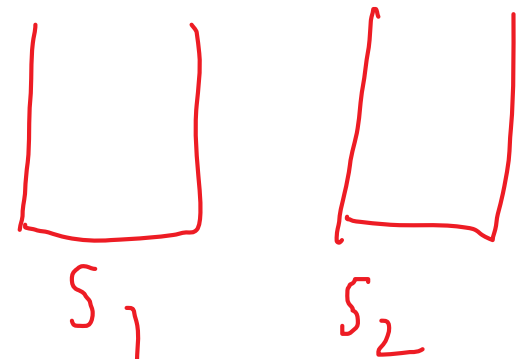
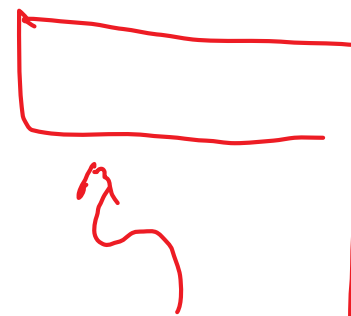
$$L = \{a^n b^n c^n \mid n \geq 1\}$$

PDA + one more
Stack.



$$\#_b = \#_a$$

$$\#_c = \#_a$$



S_1
 $= FA + Queue$
 $PDA - Stack$
 $+ Queue$

1) PDA + one Add Stack \equiv PDA.

2) PDA \equiv FA + Queue

$a^n b^n$

unequal no. of
a's & b's

$a^n b^n$

??

$a^n b^n c^n$??

Meet @ 2pm

