Chapter 15: CFG = PDA

I. Theory of Automata

→ II. Theory of Formal Languages

III. Theory of Turing Machines …

- Theorem1. Given a CFG that generates the language L, there is a PDA that accepts the language L.

- Theorem2. Given a PDA that accepts the language L, there is a CFG that generates the language L.

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Example:

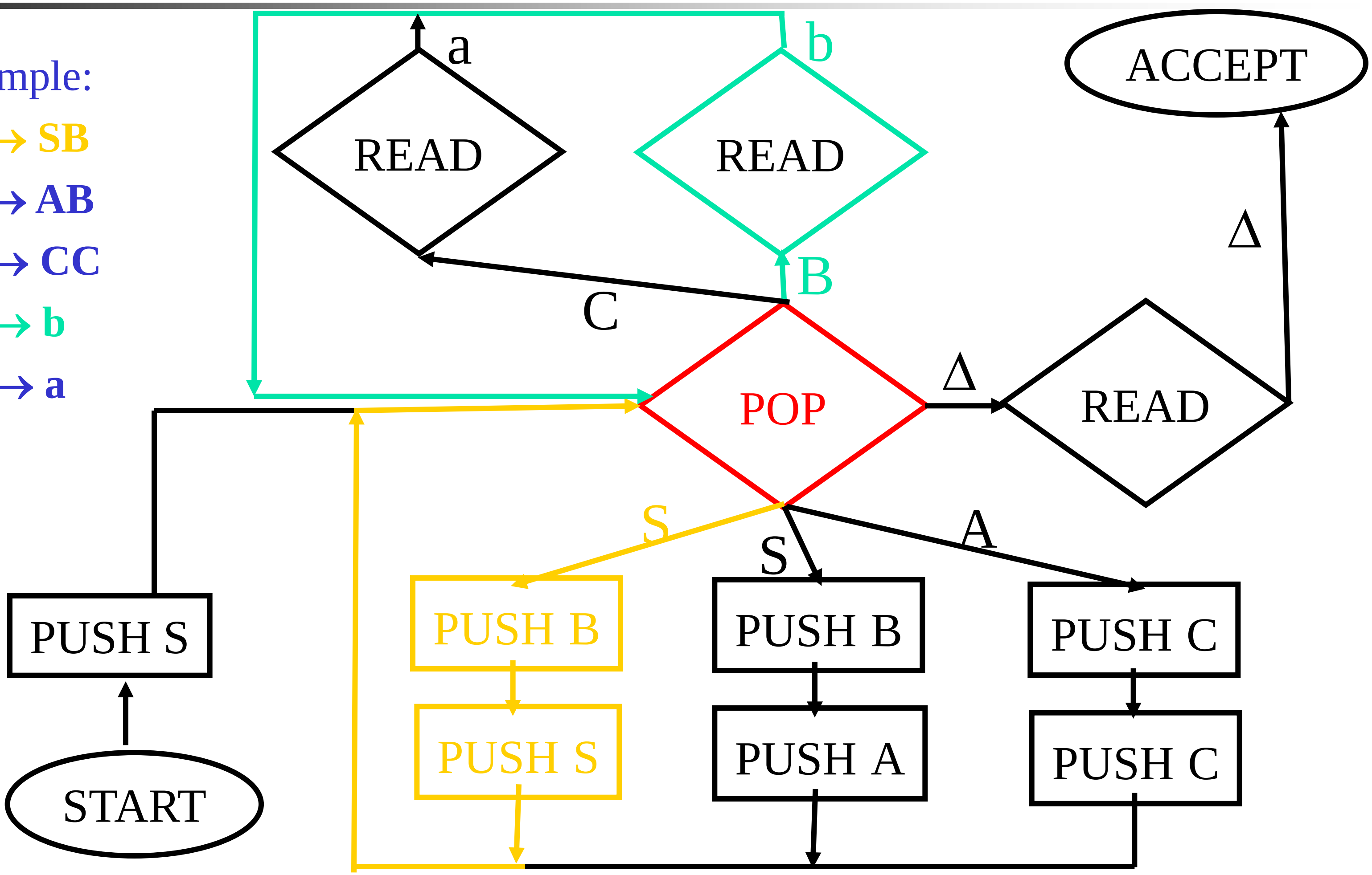
S → SB

S → AB

A → CC

B → b

C → a



- <u>Proof:</u> by constructive algorithm

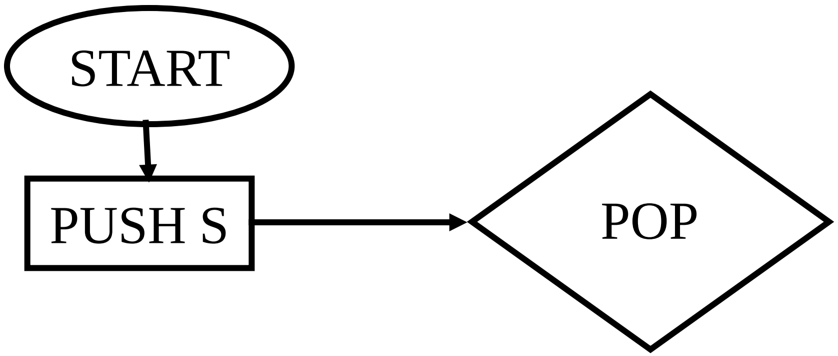
(CFG → PDA)

1. First, transform the grammar to one in Chomsky normal form. All productions are of the form:

   $X_i \rightarrow X_j X_k$

   $X_i \rightarrow x$

2. Add



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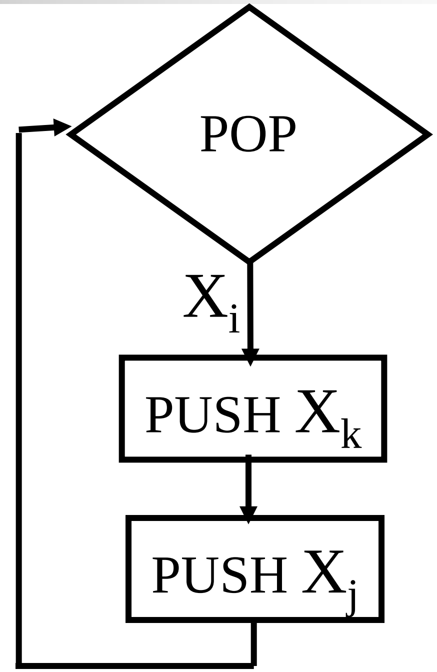
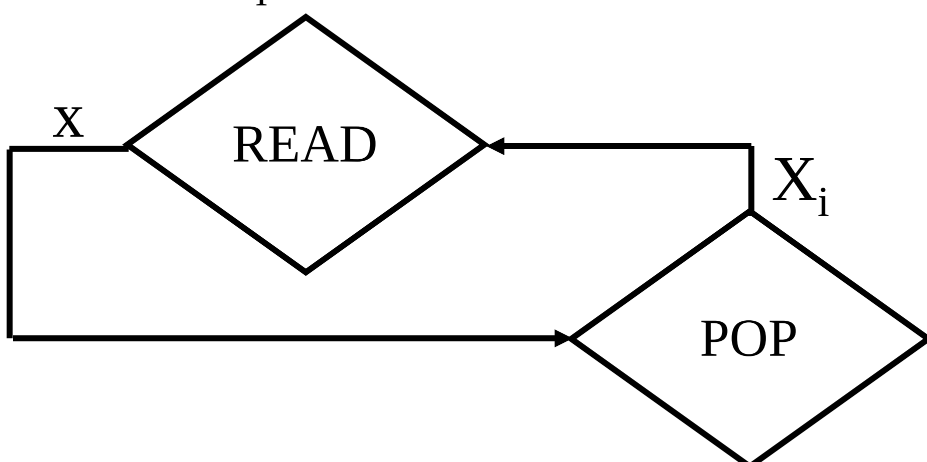
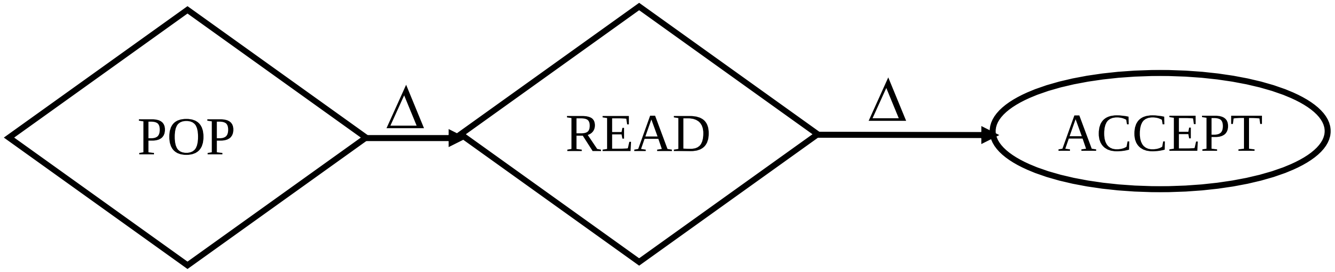
3. For each production of the form $X_i \rightarrow X_j X_k$ add:



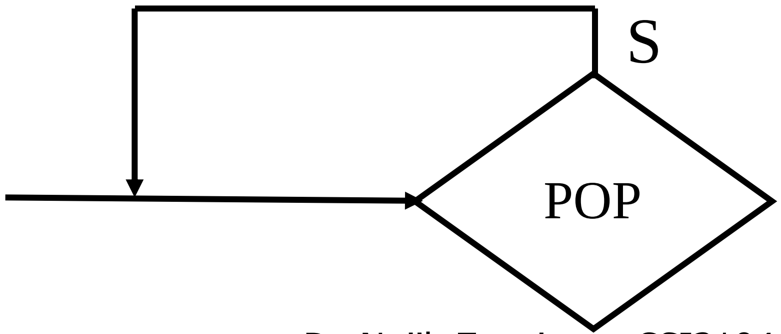
4. For each production of the form $X_i \rightarrow x$ add:



5. Add:

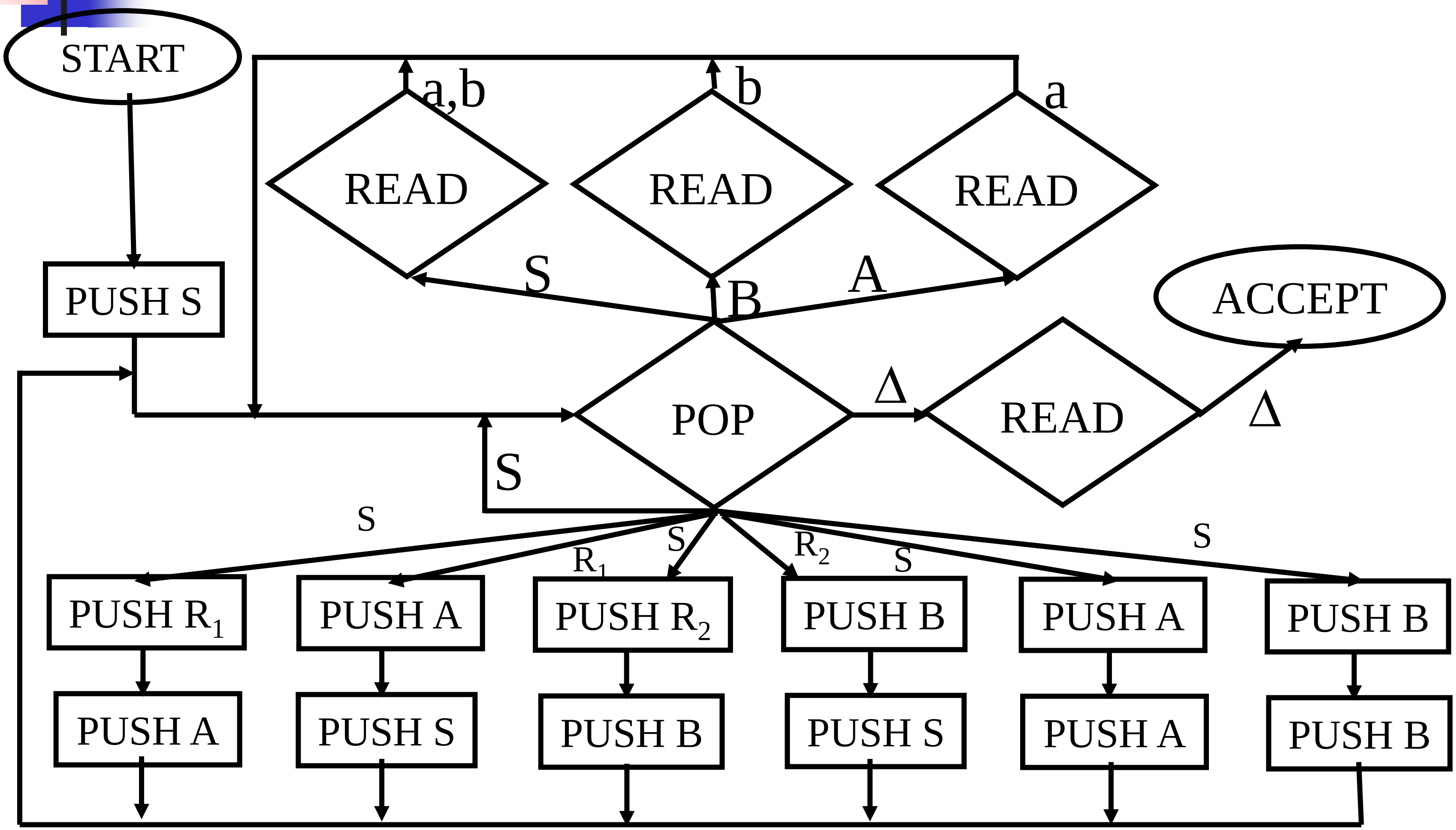


6. If $\Lambda \in L$ ($S \rightarrow \Lambda$), add:



$S \rightarrow AR1 \mid BR2 \mid AA \mid BB \mid a \mid b \mid \Lambda$

$A \rightarrow a \quad B \rightarrow b \quad R1 \rightarrow SA \quad R2 \rightarrow SB$



- Theorem. Given a PDA that accepts the language L, there is a CFG that generates the language L.
  - See the book for the proof

PDA and CFG are equivalent