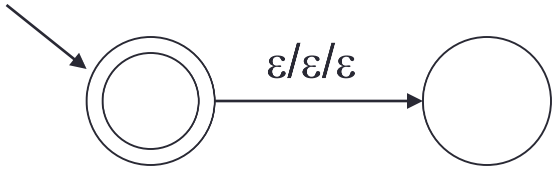
Deterministic PDAs

A PDA *M* is ***deterministic*** iff:

- Δ_M contains no pairs of transitions that compete with each other, and
- Whenever *M* is in an accepting configuration it has no available moves.



M can choose between accepting and taking the ε-transition, so it is not deterministic.

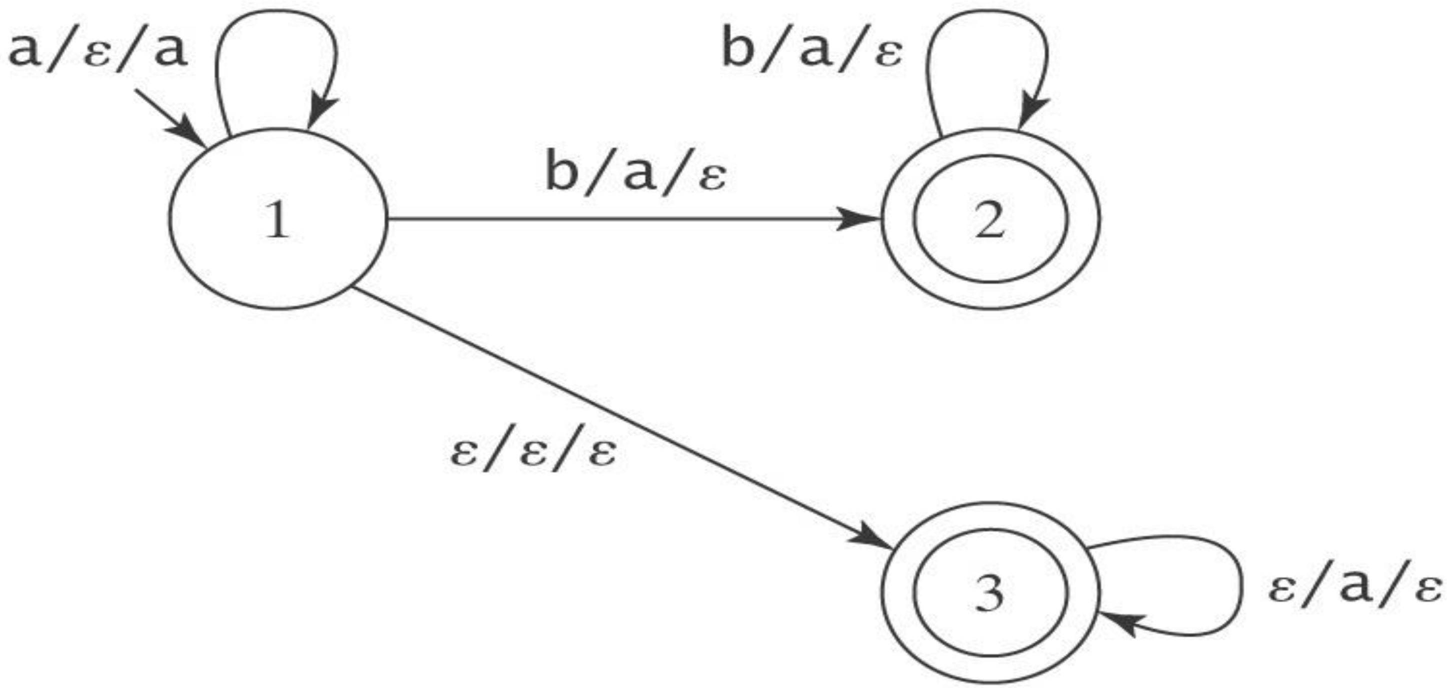
Deterministic CFLs

A language *L* is ***deterministic context-free*** iff *L*$ can be accepted by some deterministic PDA.

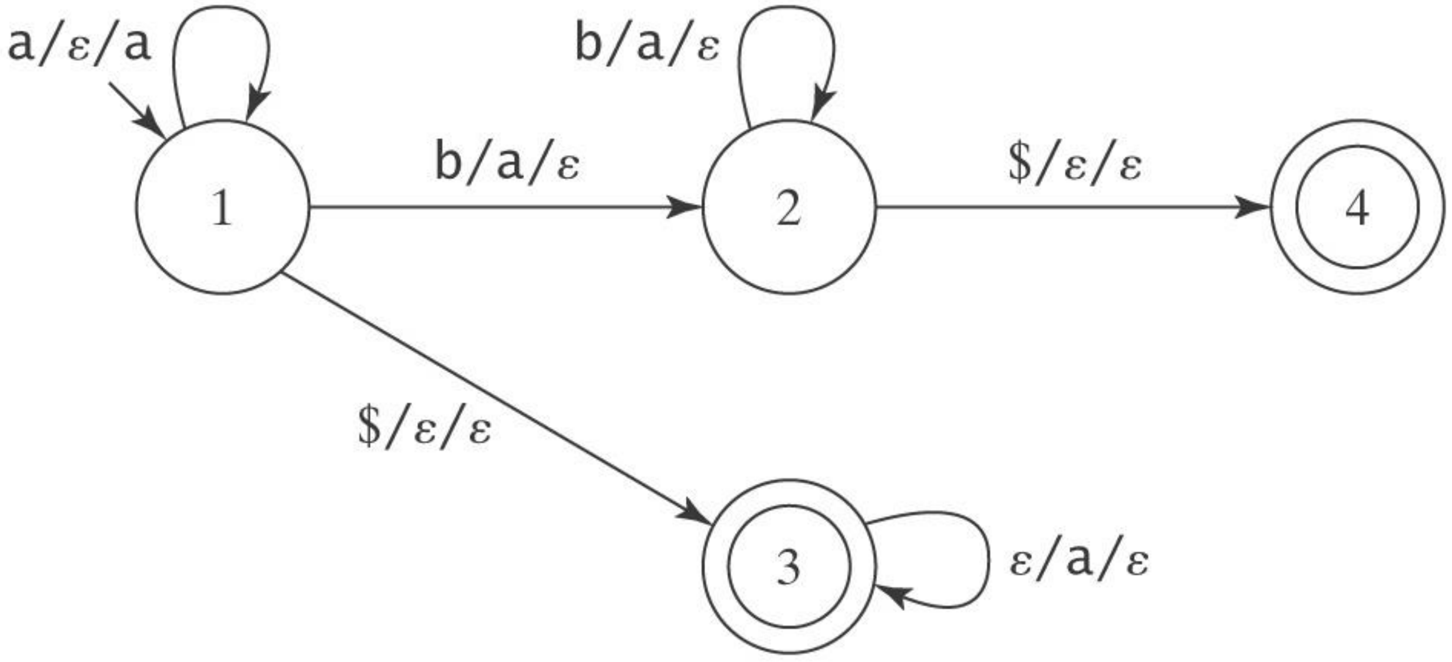
Why $?

Let $L = \mathtt{a}^* \cup \{\mathtt{a}^n\mathtt{b}^n : n > 0\}$.

An NDPDA for $L = a^* \cup \{a^n b^n : n > 0\}$.



An DPDA for $L = a^* \cup \{a^n b^n : n > 0\}$.



Decision problems for DCFL

- The Deterministic CF Languages are Closed Under Complement
- DCFLs are Not Closed Under Union
- DCFLs are Not Closed Under Intersection

Nondeterministic CFLs

Theorem: There exist CLFs that are not deterministic.

Proof: By example. Let $L = \{a^i b^j c^k,\ i \neq j \text{ or } j \neq k\}$. L is CF. If L is DCF then so is:

$L' = \neg L'$.

$= \{a^i b^j c^k,\ i, j, k \geq 0 \text{ and } i = j = k\} \cup$

$\{w \in \{a, b, c\}^* : \text{the letters are out of order}\}$.

But then so is:

$L'' = L' \cap a^*b^*c^*$.

$= \{a^n b^n c^n,\ n \geq 0\}$.

But it isn't. So L is context-free but not deterministic context-free.

This simple fact poses a real problem for the designers of efficient context-free parsers.

The CFL Hierarchy