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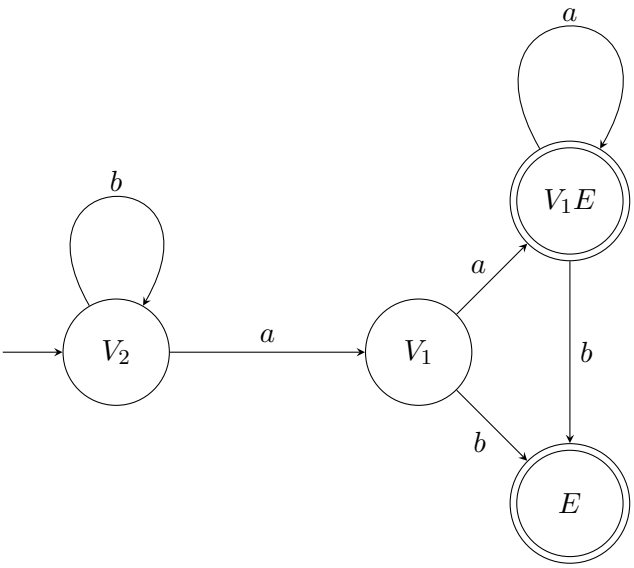
Regular languages, context-free grammars

Exercise 1: Type-3 Grammars

Exercise 2: Type-3 Grammars



Exercise 3: Pumping Lemma

Assume there is a number $n \in \mathbb{N}$ so that for all words $x \in L_3, |x| \geq n$ the word can be written as uvw so that $|v| \geq 1, |uv| \leq n, \forall i \in N_0 : uv^iw \in L_3$. Take the word $x \coloneqq e^n d^{2n}$, so that $|x| \geq n$, so that $x = uv^iw$. Since $|uv| \leq n$ v has to contain only e's because the first n symbols are e's. And because $|v| \geq 1$ it means v contains at least one e. That means one could loop v once more, so $e^{n+|v|}d^{2n}$ would be also in L_3, but that is in contradiction to the definition, that means L_3 is not regular.

Exercise 4: Context-free Grammars

a) S-B-cBb-ccAab-ccBaab-ccbaab

b) $Z = \{z_0\}, \Gamma = \{S, A, B, a, b, c\}, \# \equiv S$

Input	stack	transition
ε	S	pop; push B
ε	B	pop; push b
ε	A	pop; push B; push a
ε	B	pop; push b; push B; push c
ε	B	pop; push a; push A; push c
ε	a	pop
ε	b	pop