CENG 280

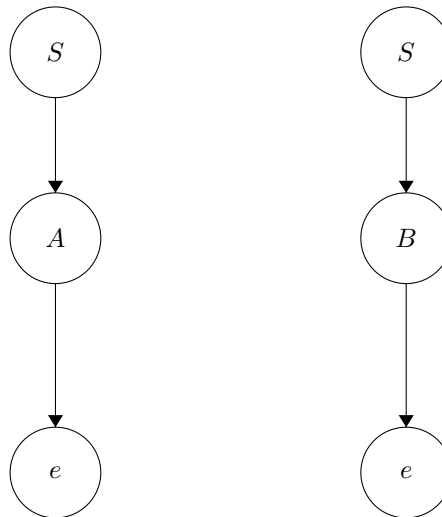## Formal Languages and Abstract Machines

Spring 2022-2023

Homework 5

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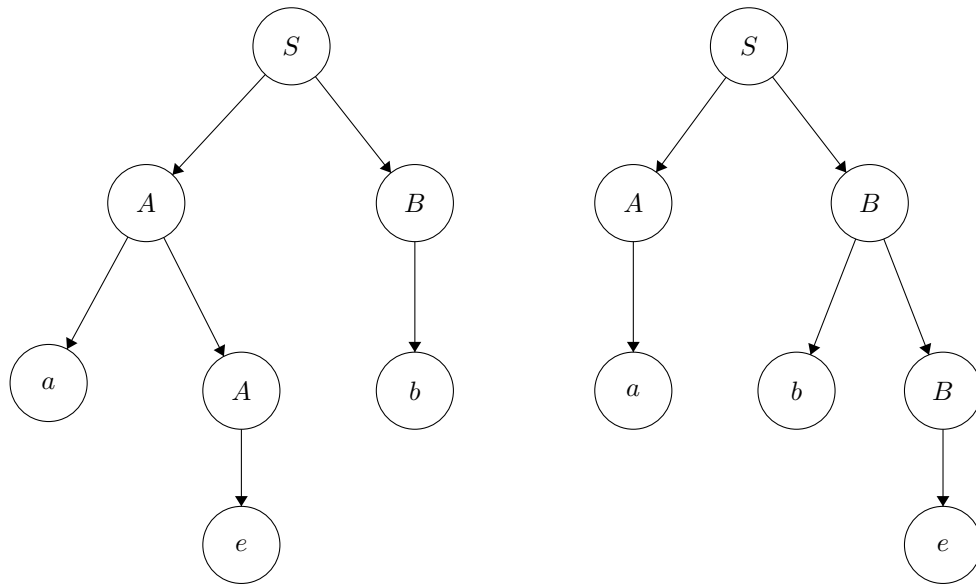Student ID: 2644409

Answer for Q1

a) G_1 is the context-free language consisting equal number of $a's$ and $b's$ in the form of $1^n 0^n$ or $0^n 1^n$.

b) G_1 is ambiguous. We can derive empty string using two different parse trees. $S \rightarrow A \rightarrow e$ and $S \rightarrow B \rightarrow e$.

Answer for Q2

a) Since we have two different parse trees for the same string, CFG is ambiguous.
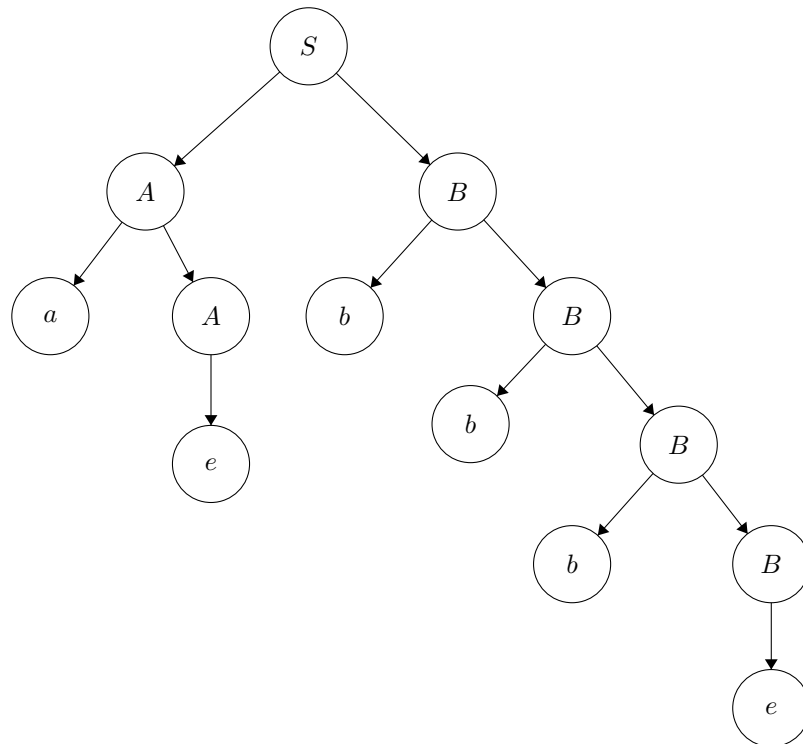
b) $S \rightarrow AB$
$A \rightarrow aA|e$
$B \rightarrow bB|e$

c) $S \rightarrow AB \rightarrow aAB \rightarrow aB \rightarrow abB \rightarrow abbB \rightarrow abbbB \rightarrow abbb$

Answer for Q3

a)

i) A language is a deterministic CFL iff $L\$$ can be accepted by a deterministic PDA. $L_1\$$ can be written as follows:
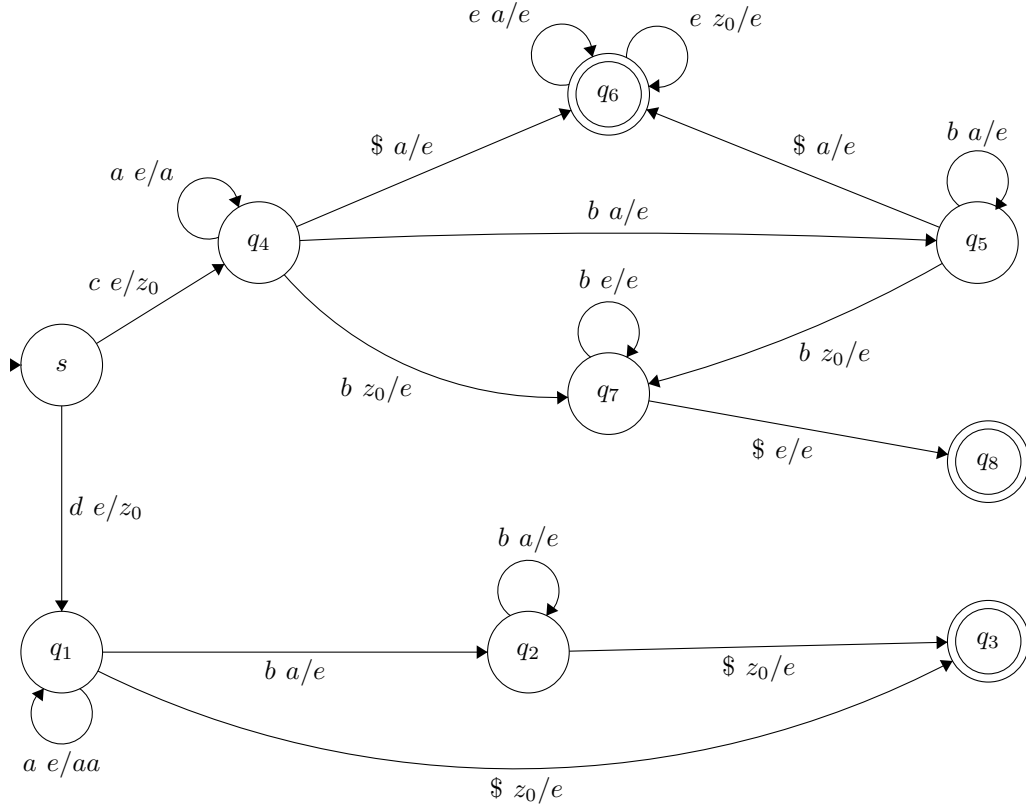
$M = (K, \Sigma, \Gamma, \Delta, s, F)$
$K = \{s, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8\}$
$\Sigma = \{a, b, \$\}$
$\Gamma = \{a, z_0\}$
$F = \{q_3, q_6, q_8\}$

**ii) A language is a deterministic CFL iff $L\$$ can be accepted by a deterministic PDA.
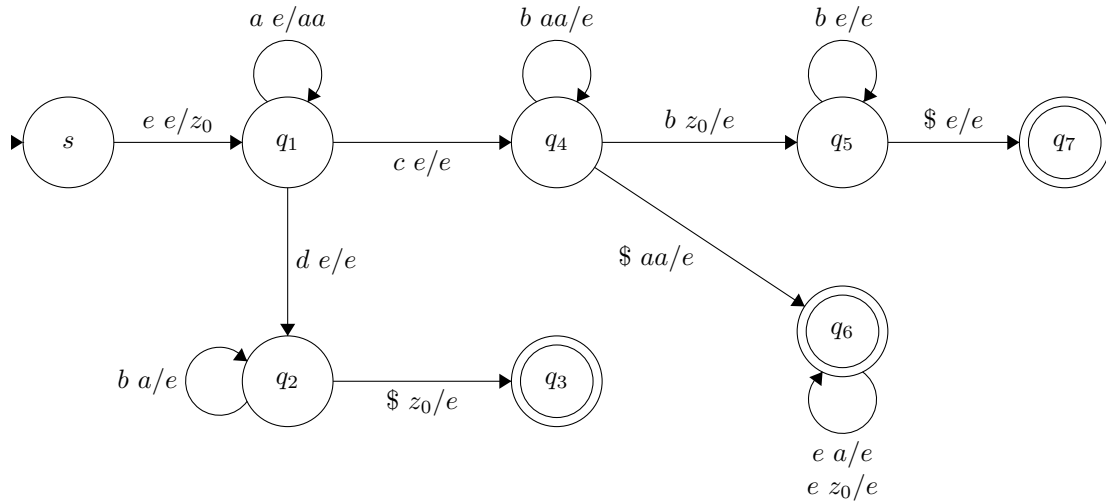$L_2\$$ can be written as follows:**

$$M = (K, \Sigma, \Gamma, \Delta, s, F)$$
$$K \;=\; \{s, q_1, q_2, q_3, q_4, q_5, q_6, q_7\}$$
$$\Sigma \;=\; \{a, b, \$\}$$
$$\Gamma \;=\; \{a, z_0\}$$
$$F \;=\; \{q_3, q_6, q_7\}$$

Answer for Q4

1. Regular

2. Context-free

3. The class of the complements of context-free languages

4. Deterministic context-free

3

1 4

2

5