

PTC (Fall 2021) – Assignment 2

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Grade: 3

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Problem 1

Give context free grammars that generate the following languages, and give a brief description of the functionality of each variable in your grammars (in natural language).

- $\{w \in \{0, 1\}^* \mid w = w^R \text{ and } |w| \text{ is even}\}$
- $\{w \in \{a, b\}^* \mid \text{in } w, \text{ the number of } b = 1 + \text{the number of } a\}$.
- $\{a^i b^j c^k \mid i, j, k \geq 0, \text{ and } i = j \text{ or } i = k\}$

Solution.

- $G = (\{S\}, \{0, 1\}, P, S)$, where P consists of:

$$S \rightarrow 1S1 \mid 0S0 \mid 0 \mid 1$$

Description : S is the start symbol.

- $G = (\{S\}, \{a, b\}, P, S)$, where P consists of:

$$S \rightarrow b \mid abS \mid baS \mid aSb \mid bSa \mid Sab \mid Sba$$

Description : S is the start symbol.

- $G = (\{S, A, B, C, D, E\}, \{a, b, c\}, P, S)$, where P consists of:

$$S \rightarrow A \mid B$$

$$A \rightarrow CD$$

$$B \rightarrow aBc \mid E$$

$$C \rightarrow aCb \mid \epsilon$$

$$D \rightarrow cD \mid \epsilon$$

$$E \rightarrow bE \mid \epsilon$$

Description : S is the start symbol. A 产生 $a^i b^j c^k (i = j)$. B 产生 $a^i b^j c^k (i = k)$. C 产生 $a^i b^j (i = j)$.

D 产生 c^k . E 产生 b^j .