

CS4710 - HMW3

Exercise 1 (3 pts)

Consider the following context-free grammar G defined by the productions:

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

Describe $L(G)$ informally.

Exercise 2 (3 pts)

Consider the following context-free grammar G defined by the productions:

$$S \rightarrow AS \mid \epsilon$$
$$A \rightarrow 0A1 \mid A1 \mid 01$$

Describe $L(G)$ informally.

Exercise 3 (12 pts)

Give context-free grammars that generate the following languages over the alphabet $\{0,1\}$:

- $\{w \mid w \text{ contains at least four 0s}\}$
- $\{w \mid w \text{ starts and ends with the same symbol}\}$
- $\{w \mid w \text{ has an equal number of 1s and 0s}\}$
- $\{w \mid w = w^R\}$

Exercise 4 (12 pts)

Give a context-free grammar that generates each of the following languages

- The set of strings over the alphabet $\{a, b\}$ with twice as many a 's as b 's
- The set of strings over the alphabet $\{0,1, \#\}$ defined by:
 $\{w \# x \mid \text{for } w \text{ and } x \text{ strings in } \{0,1\}^* \text{ and } w \text{ substring of } x\}$
- The set of strings over the alphabet $\{a, b, c\}$ defined by $\{a^i b^j c^k \mid i, j, k \geq 0 \text{ and either } i=j \text{ or } j=k\}$