

1. Consider the following production rules for a grammar G :

$$E \rightarrow E \ \&\& \ F \mid E \ \parallel \ F \mid F$$

$$F \rightarrow (E) \mid \neg F \mid V$$

$$V \rightarrow 1 \mid 0$$

- (a) What are the terminals of G ?
 - (b) What are the non-terminals of G ?
 - (c) Show the parse tree of the string $\neg(1 \parallel 0)$ under G .
 - (d) Show the left-most derivation of the string $(1 \ \&\& \ \neg 1)$ under G .
2. Draw PDAs for the following languages:
- (a) $\{w \mid w \in \{[,]\}^*, w \text{ has balanced brackets}\}$
 - (b) $\{w \mid w \in \{0,1\}^*, w \text{ starts with 1 and has an equal number of 1s and 0s}\}$
3. Design the production rules for a context-free grammar for the languages described in 2. You do not need to refer to your PDAs to design your grammar.