**CPS710 – 3-3** DERIVATIONS AND PARSE TREES

## DEFINITIONS

Given a grammar G = (N, T, S, P) and strings $\alpha_1, \alpha_2, \ldots, \alpha_n$ of $(N \cup T)^*$

- $\alpha_1 \Rightarrow \alpha_2$ means that one of the non-terminals of $\alpha_1$ had been replaced in $\alpha_2$ by a sequence of terminals and non-terminals in accordance with one of the productions in P
- $\alpha_1$ **derives** $\alpha_n$ if $\alpha_1 \Rightarrow \alpha_2 \Rightarrow \ldots \Rightarrow \alpha_n$
- $\alpha_1 \Rightarrow \alpha_n$ means that $\alpha_1$ derives $\alpha_n$ in 0 or more steps
- $\alpha_1 \Rightarrow \alpha_n$ means that $\alpha_1$ derives $\alpha_n$ in 1 or more steps

Given a derivation $S \Rightarrow \alpha_n$:

- If $\alpha_n$ contains only terminals, then it is called a **sentence** of G
- If $\alpha_n$ contains some non-terminals, then it is called a **sentential form** of G
- The derivation is a **leftmost derivation** if at every step only the leftmost non-terminal was replaced.
- The derivation is a **rightmost derivation** if at every step only the rightmost non-terminal was replaced.
- A **parse tree** is a graphical representation of a derivation

## PROPERTIES OF GRAMMARS

### Ambiguous Grammars

- A grammar which produces more than 1 parse tree for one of its sentences is said to be **ambiguous**.
- An ambiguous grammar is one that produces more than one leftmost or more than one rightmost derivation for the same sentence.

### Left Recursion

- A grammar is said to be **left-recursive** if it has a non-terminal A s.t. there is a derivation $A \Rightarrow A\alpha$ for some string $\alpha$ of terminals and non-terminals.
- **Immediate** or **simple** left-recursion is when the grammar contains a production of the form $A \rightarrow A\alpha$ for some string $\alpha$ of terminals and non-terminals.