

## CS314 Assignment 2

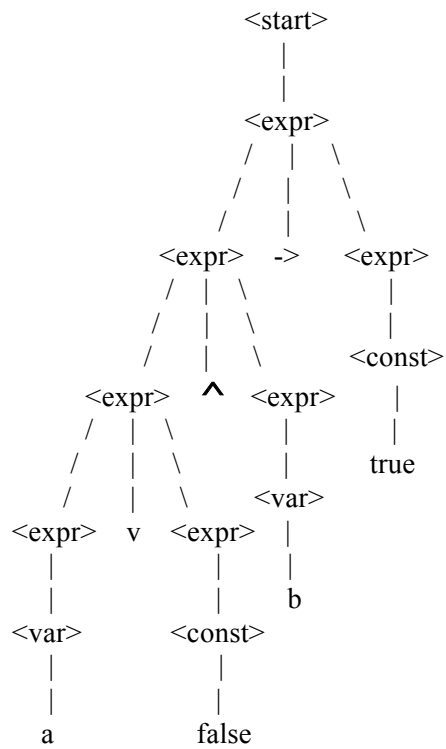
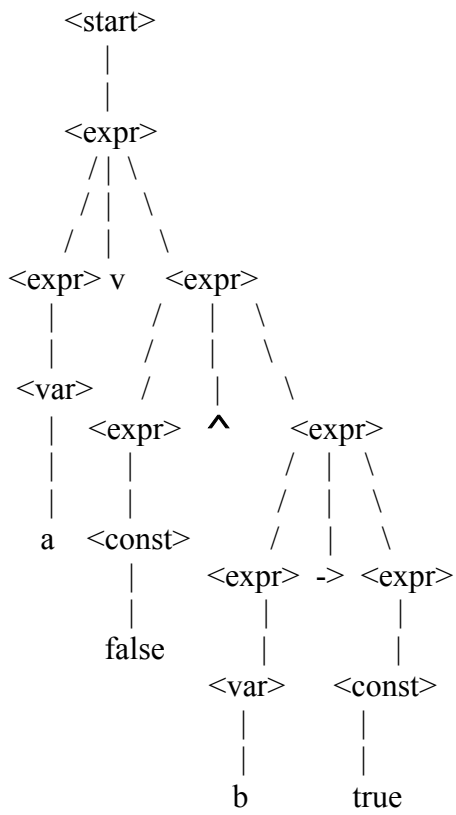
## Problem 1

1.  $\{ a^n b^m c^o \mid m > n \geq 0, o > 0 \}$ , with alphabet  $\Sigma = \{a, b, c\}$   
 $\langle S \rangle ::= \langle A \rangle \langle B \rangle \langle C \rangle$   
 $\langle A \rangle ::= a \langle A \rangle b \mid \epsilon$   
 $\langle B \rangle ::= b \langle B \rangle \mid b$   
 $\langle C \rangle ::= c \langle C \rangle \mid c$
2.  $\{ a^n b^{2n} \mid n \geq 0 \}$ , with alphabet  $\Sigma = \{a, b\}$   
 $\langle S \rangle ::= a \langle S \rangle bb \mid \epsilon$
3.  $\{ ww^R \mid w \in \Sigma^* \text{ and } w^R \text{ is } w \text{ ub reverse} \}$ , with alphabet  $\Sigma = \{a, b\}$   
 $\langle S \rangle ::= a \langle S \rangle a \mid B \langle S \rangle b \mid \epsilon$
4.  $\{ a^n b^m c^m d^n \mid n \geq 0, m \geq 0 \}$ , with alphabet  $\Sigma = \{a, b, c, d\}$   
 $\langle S \rangle ::= a \langle S \rangle d \mid \langle A \rangle \mid \epsilon$   
 $\langle A \rangle ::= b \langle A \rangle c \mid \epsilon$
5.  $\{ w \mid w \text{ has no more than 4 symbols, with alphabet } \Sigma = \{a, b\} \}$   
 $\langle S \rangle ::= \langle A \rangle \langle A \rangle \langle A \rangle \langle A \rangle$   
 $\langle A \rangle ::= a \mid b \mid \epsilon$

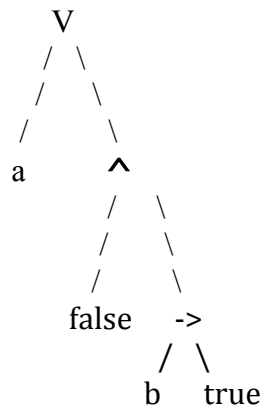
## Problem 2

1.  $\langle \text{start} \rangle$   
 $\rightarrow \text{LM} \quad \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad \langle \text{expr} \rangle V \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad \langle \text{var} \rangle V \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad a V \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad a V \langle \text{expr} \rangle V \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad a V \langle \text{const} \rangle V \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad a V \text{false} V \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad a V \text{false} V \langle \text{expr} \rangle \rightarrow \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad a V \text{false} V \langle \text{var} \rangle \rightarrow \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad a V \text{false} V b \rightarrow \langle \text{expr} \rangle$   
 $\rightarrow \text{LM} \quad a V \text{false} V b \rightarrow \langle \text{const} \rangle$   
 $\rightarrow \text{LM} \quad a V \text{false} V b \rightarrow \text{true}$
- 
- $\langle \text{start} \rangle$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle \rightarrow \langle \text{expr} \rangle$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle \rightarrow \langle \text{const} \rangle$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle \rightarrow \text{true}$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle V \langle \text{expr} \rangle \rightarrow \text{true}$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle V \langle \text{var} \rangle \rightarrow \text{true}$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle V b \rightarrow \text{true}$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle V \langle \text{expr} \rangle V b \rightarrow \text{true}$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle V \langle \text{const} \rangle V b \rightarrow \text{true}$
- 
- $\rightarrow \text{RM} \quad \langle \text{expr} \rangle V \text{false} V b \rightarrow \text{true}$
- 
- $\rightarrow \text{RM} \quad \langle \text{var} \rangle V \text{false} V b \rightarrow \text{true}$
- 
- $\rightarrow \text{RM} \quad a V \text{false} V b \rightarrow \text{true}$

## 2. Parse Trees



## 3. Abstract syntax trees



4. The sentence `A V false ^ -> true` has multiple possible parse trees the grammar is ambiguous.