

CS3243 Foundations of Artificial Intelligence (2005/2006 Semester 2) Tutorial 8

1. Given the following grammar:

S	→	NP VP
NP	→	Noun Article Noun NP PP
VP	→	Verb VP NP VP PP
PP	→	Preposition NP
Article	→	the
Noun	→	agent wumpus [1,2]
Verb	→	detects
Preposition	→	at

Consider the sentence “the agent detects the wumpus at [1,2]”. Show two different parse trees of this sentence based on the above grammar, and give the interpretation (in English) of each parse tree.

2. (Modified from Question 22.9 of the textbook) Consider the sentence “someone walked slowly to the supermarket” and the following lexicon:

Pronoun → someone
V → walked
Adv → slowly
Prep → to
Article → the
Noun → supermarket

Which of the following three grammars, combined with the lexicon, generates the given sentence? Show the corresponding parse tree(s).

Grammar A:

S → NP VP
NP → Pronoun
NP → Article Noun
VP → VP PP
VP → VP Adv Adv
VP → Verb
PP → Prep NP
NP → Noun

Grammar B:

S → NP VP
NP → Pronoun
NP → Noun
NP → Article NP
VP → Verb Vmod

Vmod \rightarrow Adv Vmod
Vmod \rightarrow Adv
Adv \rightarrow PP
PP \rightarrow Prep NP

Grammar C:
S \rightarrow NP VP
NP \rightarrow Pronoun
NP \rightarrow Article NP
VP \rightarrow Verb Adv
Adv \rightarrow Adv Adv
Adv \rightarrow PP
PP \rightarrow Prep NP
NP \rightarrow Noun

3. Consider the following context-free grammar that generates sequences of letters:

S \rightarrow a X c
S \rightarrow b X c
S \rightarrow b X e
S \rightarrow c X e
X \rightarrow f X
X \rightarrow g

- (a) Give a trace of the top-down parse on the input *bfgc*
- (b) Give a trace of the bottom-up parse on the same input *bfgc*
- (c) Which approach is better in this case?

4. Give context-free grammars for

- (a) The set of all strings of the form $a^n b^* c^* d^n$ (i.e., n occurrences of a 's followed by any number of b 's, followed by any number of c 's, followed by n occurrences of d)
- (b) The set of palindromes (strings that read the same forward as backward) over alphabet $\{a, b\}$