419433

UNIVERSITY OF YORK

BA Degree Examinations 2001-2002

Department of Language and Linguistic Science

L433: Introduction to Computational Linguistics

Time allowed: $1\frac{1}{2}$ hours

Answer ALL questions
Total marks: 130

(1) For each of the following

(a) explain what the expression means, and (5 marks)

(b) state what kind of language it defines (5 marks)

(i) $\alpha A\gamma \Rightarrow \alpha\beta\gamma$ where $\beta \neq \epsilon$

(ii) $A \Rightarrow \alpha$

(2) (a) What kind of language is $a^n b^n$? (5 marks)

(b) What kind of language is $a^n b^n c^n$? (5 marks)

(c) Write a grammar to define the language $a^n b^n$. (5 marks)

(d) Is it possible to define the language $a^n b^n c^n$ using a Definite Clause Grammar? (5 marks)

(3) Given the following grammar,

$\mathsf{S} \rightarrow \mathsf{NP\ VP}$	$\mathit{Kim} : \mathsf{N}$
$\mathsf{NP} \rightarrow \mathsf{N}$	$\mathit{a} : \mathsf{D}$
$\mathsf{NP} \rightarrow \mathsf{D\ N}$	$\mathit{man} : \mathsf{N}$
$\mathsf{NP} \rightarrow \mathsf{NP\ PP}$	$\mathit{stick} : \mathsf{N}$
$\mathsf{VP} \rightarrow \mathsf{V\ NP}$	$\mathit{with} : \mathsf{P}$
$\mathsf{VP} \rightarrow \mathsf{VP\ PP}$	$\mathit{hit} : \mathsf{V}$
$\mathsf{PP} \rightarrow \mathsf{P\ NP}$	

(a) Provide one top-down left-to-right derivation for the string *Kim hit a man with a stick*. (10 marks)

(a) Provide one bottom-up left-to-right derivation for the same string. (10 marks)

(c) A top-down, depth-first, left-to-right parser would encounter infinite search while attempting to parse the string *Kim hit a man with a stick* with respect to the above grammar.

(i) Would this problem be alleviated by changing the direction of parsing to right-to-left? Explain. (10 marks)

(ii) Would this problem be alleviated by changing to a bottom-up parser? Explain. (10 marks)

(4) The time complexity of the recognition of Context Free Phrase Structure Languages is $O(kn^3)$.

(a) Explain what this expression means. (10 marks)

(a) What is the time complexity of Context Free *parsing*? (10 marks)

(c) What is the significance of this for the parsing of natural languages? (10 marks)

(5) Given the following grammar,

$\mathsf{S} \rightarrow \mathsf{NP\ VP}$	$\mathit{Kim} : \mathsf{N}$
$\mathsf{NP} \rightarrow \mathsf{N}$	$a : \mathsf{D}$
$\mathsf{NP} \rightarrow \mathsf{D\ N}$	$\mathit{man} : \mathsf{N}$
$\mathsf{VP} \rightarrow \mathsf{V\ NP}$	$\mathit{hit} : \mathsf{V}$

Give a parse of the sentence *Kim hit a man* using a shift-reduce parser, showing the state of the stack and buffer at each stage of the parse. (10 marks)

(6) Rewrite the grammar in question 5 as a Prolog Definite Clause Grammar. (10 marks)

(7) What are the advantages and disadvantages of compiling a parser over a grammar? (10 marks)