UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 1993/94

April 1994

CSI504 - Pemprosesan Bahasa Tabii
(NATURAL LANGUAGE PROCESSING)

Masa: [3 jam]

ARAHAN KEPADA CALON:

- Sila pastikan bahawa kertas peperiksaan ini mengandungi **EMPAT (4)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.

- Jawab **SEMUA** soalan.

Answer **ALL** questions (there are **3** questions altogether).

1. (a) Consider the following sentence:

   *John gave chocolates to Mary who gave them to Susan
   who gave them to Paul who gave them to Peter*

   (i)   Give a suitable morpho-syntactic structure for this sentence.

   (ii) Define a context free grammar for the sentence such that it produces the tree given in (i) as its representation structure.

   (iii) Write a set of two tree transformational rules, each rule being of the form

   $$X(.....) \rightarrow Y(.....)$$

   and may contain tree variables, such that given the tree in (i) as input, the output is a single tree whose leaves read the following sentence (the internal nodes of the resulting tree need not have any linguistic motivation):

   *Peter who gave them to Paul who gave them to Susan who
   gave them to Mary John gave chocolates to*

   [50/100]

   (b) Discuss very briefly (not exceeding half a page) as to what is fundamentally wrong with the following context free grammar:

   NP → NP S
   NP → n

   [15/100]

   (c) Give as many valid sentences as you can that share the same following logical structure (here **give**, **was given**, **gave**, etc. are classed under **give**):

   give (Max,   book,   John)
       ARGØ ARG1 ARG2

   [15/100]

   (d) Suggest a multilevel structure for the following sentence:

   John asked Mary to call him Superman

   [20/100]

...3/-

2. (a) Given the following context free grammar:

   (1) S → NP VP
   (2) NP → n
   (3) NP → adj NP
   (4) PP → p NP
   (5) VP → v
   (6) VP → v NP
   (7) VP → v PP

   n   : herons , fly , groups
   adj : Green , fly
   p   : in
   v   : fly , groups

   where S is an axiom or start symbol.

   (i) Construct a LR(1) parsing table for the grammar given above using the SLR method.

   (ii) Give a detailed trace of the LR parsing process for the sentence *"Green herons fly in groups $"* based on the table constructed above.

   [60/100]

   (b) Write a DCG grammar to produce the following representation structure for the input sentence *"Every professor wrote a book"*.
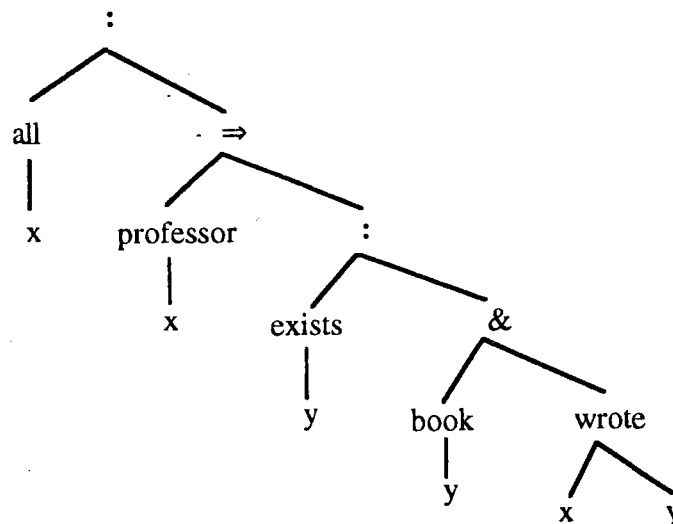
   or in its equivalent parenthesis form :
   all(x): (professor(x) ⇒ exists(y) : (book(y) & wrote(x,y)))

   Note : The DCG must be constructed by augmenting the following CFG

   S → NP VP
   NP → det noun
   VP → verb NP

   det → [every]
   det → [a]
   noun → [professor]
   noun → [book]
   verb → [wrote]

   [40/100]

...4/-

3. (a) Given the following context free grammar:

r_0 : S → NP VP r_6 : v → *verb*
r_1 : VP → v NP r_7 : n → *noun*
r_2 : VP → v AP r_8 : adj → *adjective*
r_3 : NP → AP n
r_4 : NP → n   where *verb*, *noun* and *adjective* are any
r_5 : AP → adj   verb, noun and adjective respectively

Draw the search tree indicating all applicable rules (including those leading to failure) for a bottom-up analysis of the following sentence:

Snakes eat small mice.

[30/100]

(b) (i) Write a transformational grammar consisting of rules of the form (for example):

S(NP($A), VP($B)) → NP($A) VP($B)

with $A and $B being tree variables, to analyse the following sentence:

The big fox ate the small brown chicken

such that the result is a suitable morpho-syntactic structure. Begin your answer by giving this structure.

(ii) Add a control graph to the grammar to ensure that the rules apply in an efficient manner for the given sentence.

(iii) Write an appropriate set of tree transformational rules to transform the morpho-syntactic structure in (i) to the corresponding logical structure (the logical relations ARG are not required). Begin your answer by giving this structure.

[50/100]

(c) Explain briefly (not exceeding half a page) why transformational rules are not very favoured for describing natural languages.

[20/100]

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