Natural Language Processing
Midterm Examination

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1. Give two issues for evaluating a particular grammar for a language. You should explain for your issues. (10 points)

lexical particular : 同一個單字有多種意思

+2

eg. He has many fans
(扇子、粉絲)

combination particular : 根據句子的前後組合而有不同意思

eg. $A\ (B\ C) \neq (A\ B)\ C$

2. Consider the semantic representation of the sentence "An airline took over every hotel chain." Please reference to the corresponding grammar, and fill in blanks of (A), (B), (C), (D), (E), (F), (G), (H), (I) and (J) in the semantic representation. (10 points)

Rule S → NP VP : <S sem predicate> = <VP sem> <S sem arg0> = <NP sem>. Rule VP → TV NP : <VP sem> = <NP sem> <NP hole> = <TV sem> <TV arg0> = <VP arg0> <TV arg1> = <NP referent> Rule NP → Det N: <NP sem quantifier> = <Det sem quantifier> <NP sem variable> = <NP referent> <NP sem restriction> = <N sem> <NP sem body> = <NP hole> <NP referent> = <N referent>	Word "took over": <cat> = TV <sem predicate> = took_over <sem arg0> = <arg0> <sem arg1> = <arg1>. Word airline: <cat> = N <sem predicate> = airline <sem arg0> = <referent>. Word "hotel chain": <cat> = N <sem predicate> = hotel_chain <sem arg0> = <referent>. Word an: <cat> = Det <sem quantifier> = exists. Word every: <cat> = Det <sem quantifier> = all.

The semantic representation for the sentence: An airline took over every hotel chain.

sem : quantifier : (A) exist

variable : (B) ~~Det~~

restriction : arg0 : (C) X

predicate : airline

body : quantifier : (D) all

variable : (E) ~~Det~~

restriction : arg0 : (F) Y

predicate : (G) hotel chain

body : arg0 : (H) X

arg1 : (I) Y

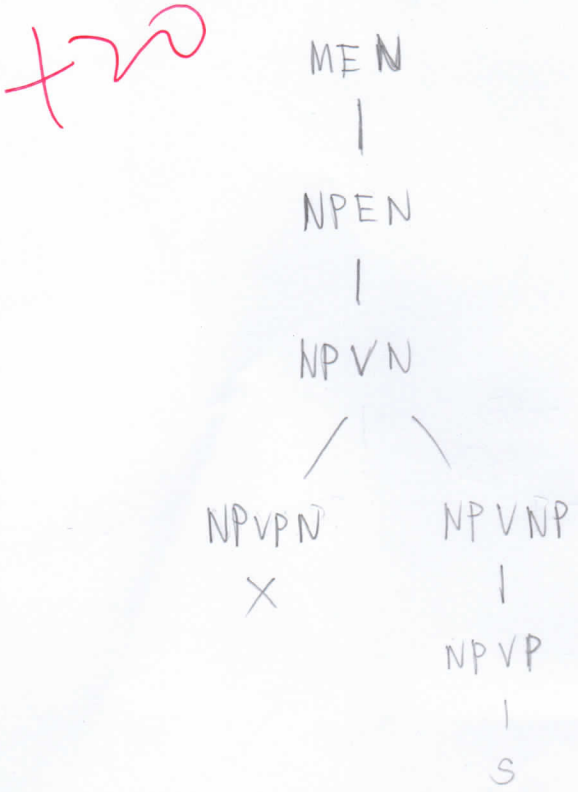
predicate : (J) took over

3. If we have the following grammar, show the parsing tree of "MediCenter employed nurses" using (1) bottom-up parsing and (2) top-down parsing. (20 points)

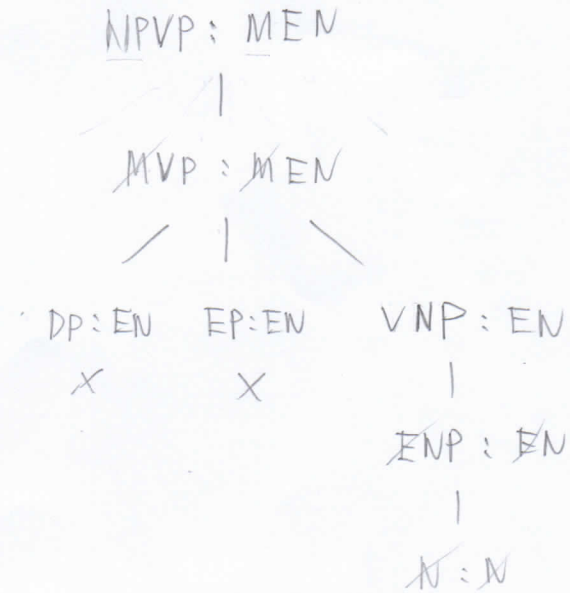
Rule {simple sentence formation}
S→NP VP.
Rule {transitive verb}
VP→V NP.
Rule {intransitive verb}
VP→V.
Word Dr Chan:
<cat>=NP.
Word nurses:
<cat>=NP.
Word MediCenter:
<cat>=NP.
Word patients:
<cat>=NP.
Word died:
<cat>=V.
Word employed:
<cat>=V.

MediCenter employed nurses => MEN

(1) bottom-up parsing



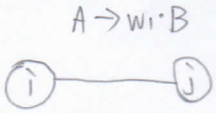
(2) Top-down parsing



4. Specify (1) the fundamental rule and (2) the bottom-up rule using Chart. (10 points)

(1) fundamental rule :

$(i, j, A \rightarrow W_i \cdot B)$



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(2)

5. (1) Please write down Freg's principle.
(2) Explain Freg's principle when given a rule S → NP VP. (10 points)

(1) 一種語法組合的原則

(2) S這個 Sentance 是由 NP 和 VP 組合而成

+10

6. Give four reasons why we should adopt the corpus-based approach to NLP. (10 points)

(1) 簡單

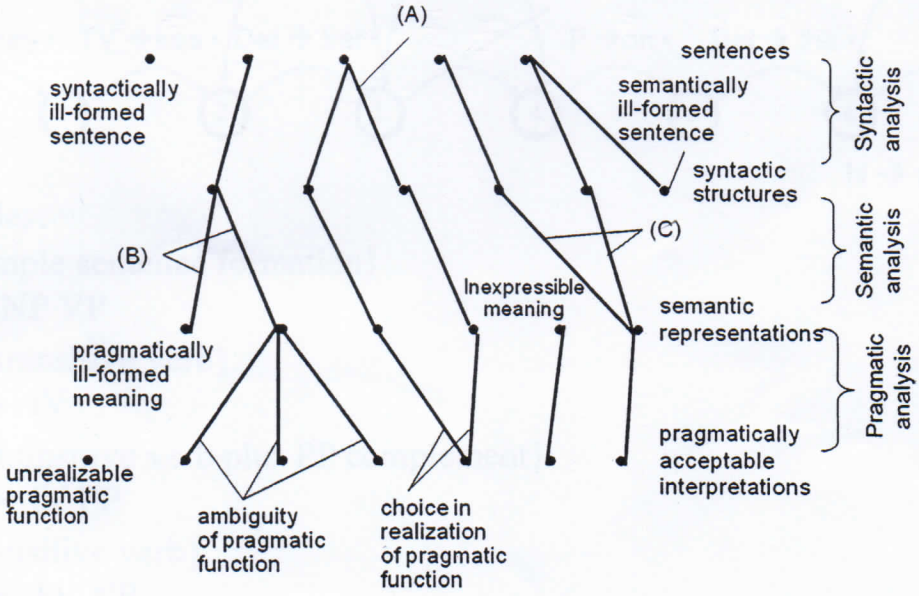
(2) 易讀

(3) 有效率

(4)

+8

7. Consider the following figure. It shows three layers of analysis, including syntactic analysis, semantic analysis and pragmatic analysis. A dot (·) indicates a sentence, a syntactic structure, a semantic representation, or a pragmatically acceptable interpretation depending on the layer of analysis. Some cases have been explained in this figure, and some cases are still left open for your answers. Please fill in (A), (B), and (C). Your answers should include the terminology to describe the linguistic phenomenon and a brief explanation for each case. (10 points)



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(A) structural ambiguity

(B) word sense ambiguity

(C) synonyms

8. What is the top-down strategy in rule invocation for chart data structure? Suppose we have the following chart and the grammar rules, please draw the new charts when adopting the top-down strategy step by step. For simplification, please only add the new edges to the first node (node 0). You don't need to apply to the other 7 nodes. (20 points)

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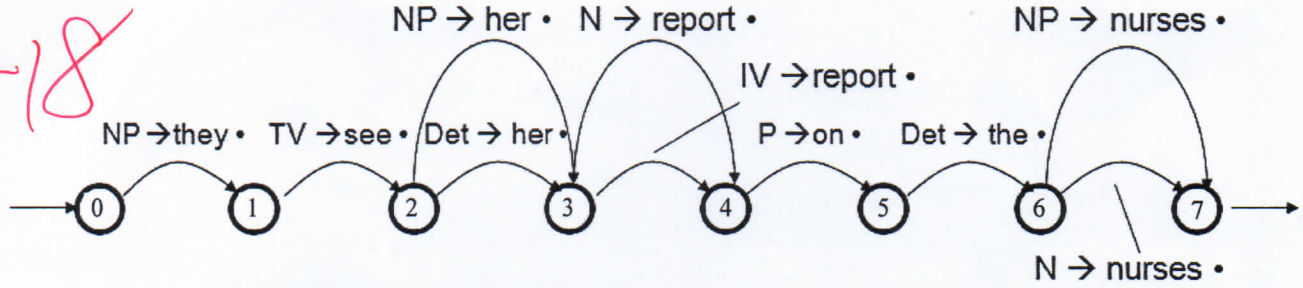


Grammar rules:

Rule {simple sentence formation}
S → NP VP

Rule {intransitive verb}
VP → IV

Rule {intransitive verb plus PP complement}
VP → IV PP

Rule {transitive verb}
VP → TV NP

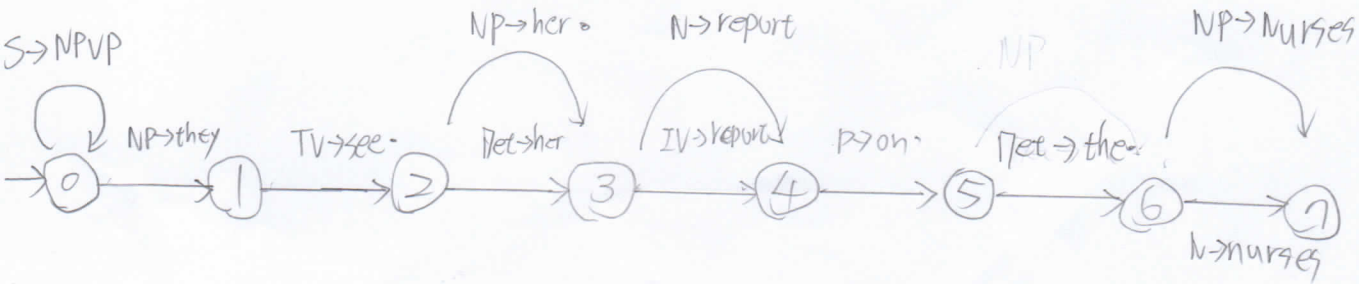
Rule {transitive verb plus PP complement}
VP → TV NP PP

Rule {transitive verb plus VP complement}
VP → TV NP VP

Rule {simple noun phrase}
NP → Det N

Rule {noun phrase with PP complement}
NP → Det N PP

Rule {simple prepositional phrase}
PP → P NP



they see her report on the nurses

9. In question-answering applications, users ask questions with natural language statements, and a system answers the questions based on a database. Suppose you are given the web as the supporting database in your question-answering system. Please propose such a natural language understanding system. (5 points, bonus)

先找出句子中的Who、when、what、how、why等疑問詞，再去分析剩下的文句來解析問題的內容，之後從Database中找出等麼這些問題的Answer作回答

+5