

# Natural Language Processing

## Midterm Examination

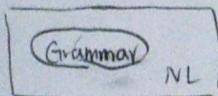
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Date: April 26, 2018

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Time: 14:20-16:20

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

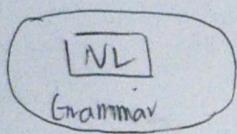


undergenerate

此 Grammar 產生屬於 NL

部份 NL 不能由 Grammar 產生

+10



overgenerate

NL 的語句皆可由此 Grammar

此 Grammar 所產生的不一定屬於 NL

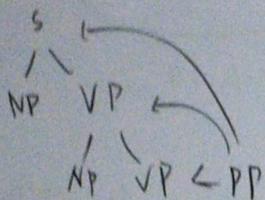
二要依照 NL 給予適當的 Grammar

2. What is part-of speech? Give 5 examples that correspond to 5 different part of speech symbols. (10 points)

5 example 5 different part of symbol

1. lexicon ambiguity
2. structural ambiguity

PP attachment



+2

coordinate

A and B or C

$\rightarrow (A \text{ and } B) \text{ or } C$

$\rightarrow A \text{ and } (B \text{ or } C)$

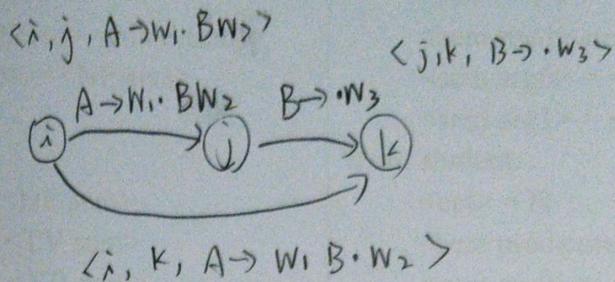
noun - noun compounding

mail box and

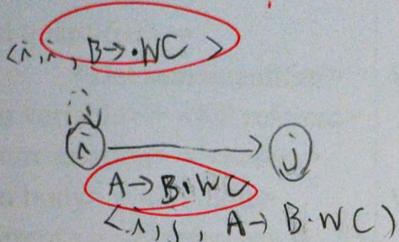
post office

3. What is the data structure Chart? Please specify (1) the fundamental rule and (2) the bottom-up rule using Chart. (15 points)

(1) fundamental



(2) bottom up



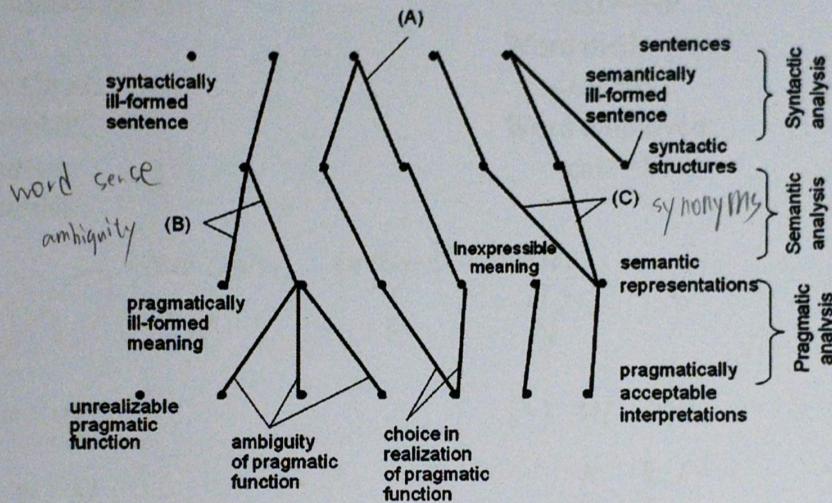
4. Consider the semantic representation of the sentence "Every student majored in a subject." Please reference to the corresponding grammar, and fill in blanks of (A), (B), (C), (D), (E), (F), (G), (H), (I) and (J) in the semantic representation. (10 points)

<p>Rule  <math>S \rightarrow NP VP :</math>  <math>\langle S \text{ sem predicate} \rangle = \langle VP \text{ sem} \rangle</math>  <math>\langle S \text{ sem arg0} \rangle = \langle NP \text{ sem} \rangle.</math></p> <p>Rule  <math>VP \rightarrow TV NP :</math>  <math>\langle VP \text{ sem} \rangle = \langle NP \text{ sem} \rangle</math>  <math>\langle NP \text{ hole} \rangle = \langle TV \text{ sem} \rangle</math>  <math>\langle TV \text{ arg0} \rangle = \langle VP \text{ arg0} \rangle</math>  <math>\langle TV \text{ arg1} \rangle = \langle NP \text{ referent} \rangle</math></p> <p>Rule  <math>NP \rightarrow Det N:</math>  <math>\langle NP \text{ sem quantifier} \rangle =</math>  <math>\quad \quad \quad \langle Det \text{ sem quantifier} \rangle</math>  <math>\langle NP \text{ sem variable} \rangle = \langle NP \text{ referent} \rangle</math>  <math>\langle NP \text{ sem restriction} \rangle = \langle N \text{ sem} \rangle</math>  <math>\langle NP \text{ sem body} \rangle = \langle NP \text{ hole} \rangle</math>  <math>\langle NP \text{ referent} \rangle = \langle N \text{ referent} \rangle</math></p>	<p>Word "majored in":  <math>\langle cat \rangle = TV</math>  <math>\langle sem predicate \rangle = majored\_in</math>  <math>\langle sem arg0 \rangle = \langle arg0 \rangle</math>  <math>\langle sem arg1 \rangle = \langle arg1 \rangle.</math></p> <p>Word student:  <math>\langle cat \rangle = N</math>  <math>\langle sem predicate \rangle = student</math>  <math>\langle sem arg0 \rangle = \langle referent \rangle.</math></p> <p>Word subject:  <math>\langle cat \rangle = N</math>  <math>\langle sem predicate \rangle = subject</math>  <math>\langle sem arg0 \rangle = \langle referent \rangle.</math></p> <p>Word a:  <math>\langle cat \rangle = Det</math>  <math>\langle sem quantifier \rangle = exists.</math></p> <p>Word every:  <math>\langle cat \rangle = Det</math>  <math>\langle sem quantifier \rangle = all.</math></p>
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The semantic representation for the sentence: Every student majored in a subject.

sem : quantifier : (A) All  
variable : (B) X  
restriction : arg0 : (C) X  
+10 predicate : student  
body : quantifier : (D) exists  
variable : (E) Y  
restriction : arg0 : (F) Y  
predicate : (G) a - subject  
body : arg0 : (H) X  
arg1 : (I) Y  
predicate : (J) majored in

5. 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 an example for each case. (15 points)



+15 (A) structure ambiguity

同一個語意但句型不同

ex: 我在公園看到一位小女子

我看到一位小女子在公園

(B) word sense ambiguity

ex: bank 有河岸和銀行

(C) synonyms 同義

6. 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}

$S \rightarrow NP\ VP.$

Rule {transitive verb}

$VP \rightarrow V\ NP.$

Rule {intransitive verb}

$VP \rightarrow V.$

Word Dr Chan:

$<cat>=NP.$

Word nurses:

$<cat>=NP.$

Word MediCenter:

$<cat>=NP.$

Word patients:

$<cat>=NP.$

Word died:

$<cat>=V.$

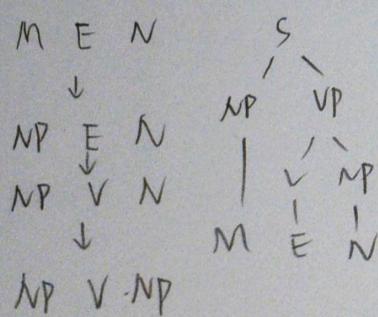
Word employed:

$<cat>=V.$

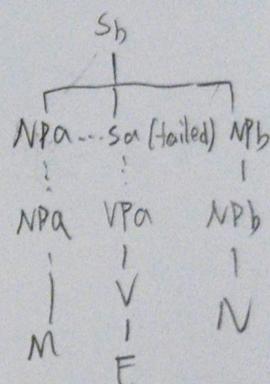
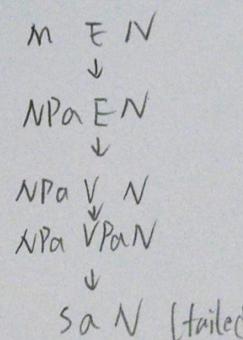
+20

MediCenter    employed    nurses

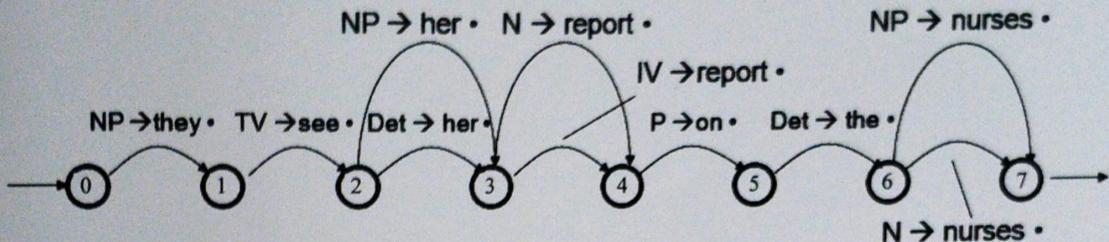
(1) bottom up



(2) top down



7. 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)



Grammar rules:

Rule {simple sentence formation}

$$S \rightarrow NP VP$$

Rule {intransitive verb}

$$VP \rightarrow IV$$

Rule {intransitive verb plus PP complement}

$$VP \rightarrow IV PP$$

Rule {transitive verb}

$$VP \rightarrow TV NP$$

Rule {transitive verb plus PP complement}

$$VP \rightarrow TV NP PP$$

Rule {transitive verb plus VP complement}

$$VP \rightarrow TV NP VP$$

Rule {simple noun phrase}

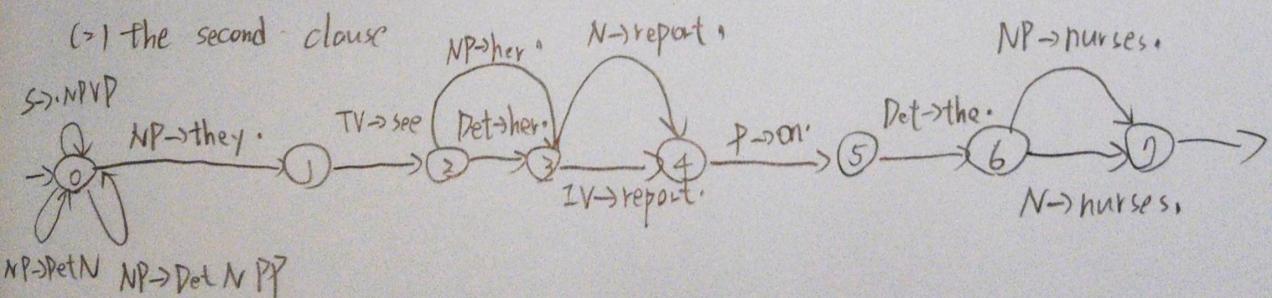
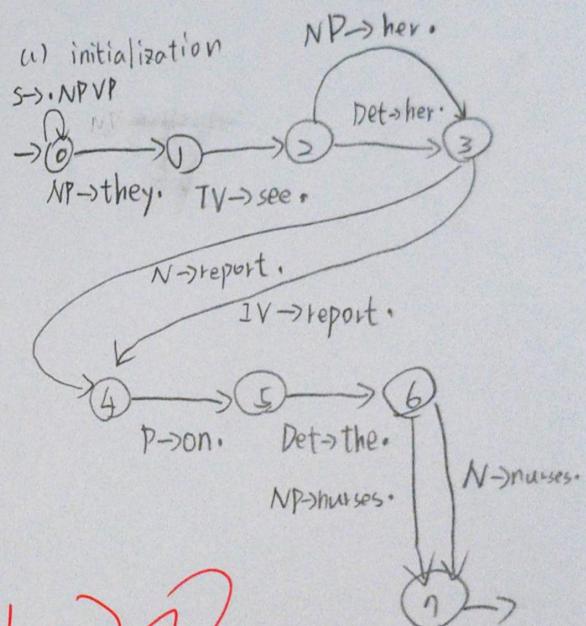
$$NP \rightarrow Det N$$

Rule {noun phrase with PP complement}

$$NP \rightarrow Det N PP$$

Rule {simple prepositional phrase}

$$PP \rightarrow P NP$$



8. 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)

用 why, how, when , where , what

做詢問句, 再依內容做 Query

+ 5