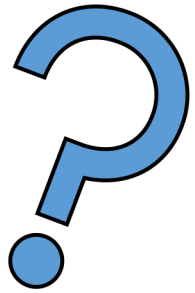
COMP9414 Tutorial

Week 8

News

- Assignment 1 submissions have closed
  - Marks have been released
    - Check them and contact your tutor/lecturer if you have concerns
  - Plagiarism checking is currently happening
    - Hope you renamed those variables

- Assignment 2 has been released
  - Due in week 9
  - Should have everything needed to complete it now



Context-free Grammar

- Basically a set of rules used to rewrite strings
  - $Non\_terminal \rightarrow [terminal, non\_terminal]$

$$A \rightarrow a$$

Example
$S \rightarrow A \cdot B$
A $\rightarrow Hello$
B $\rightarrow There$

Hello There
Hello John
Good bye

Lexicon

- Constituent elements of a particular language
  - Basically the literals

Grammar

$$S \rightarrow NOUN \cdot VERB$$

$NOUN$: $car, dog, train, zebra$

$VERB$: $driving, barking, jumping, walking$

English Language Grammar

Noun Phrase	$NP \rightarrow NOUN \cdot OTHER$
A thing such as a **cat** or a **dog**. Can generally be singular or quantified.	

Verb Phrase	$VP \rightarrow VERB \cdot OTHER$
A doing word such as **running** or **climbing**. Typically applied to a noun.	

English Language Grammar

Prepositional Phrase	$PP \rightarrow PROP \cdot OTHER$	
A modifier to a clause.	**In** time	**Along** the highway
	By singing	**Without** excessive worrying

Adjective Phrase	$ADJP \rightarrow ADJ \cdot OTHER$	
Describe or modify a noun.	**Old** dog	**Sleepy** doctor
	Burnt trees	**Hungry** panda

English Language Grammar

Adverb Phrase	$ADVP \rightarrow ADV \cdot OTHER$	
Describe or modify a verb or adjective.	He sings **loudly**	The race finished **too** quickly
	Ben is **very** tall	I worked **yesterday**

Question 1 – Bottom-up Parsing

Parse each token in the sentence sequentially:

1. Convert the literal into its constituent
   - Add the constituent to the chart

2. Determine if the constituent is the first token in any grammar rule
   - Add that grammar rule as an active arc

3. Check to see if any subsequence of tokens so far corresponds to a rule in the active arc
   - Add the rule to the chart if so

Question 1

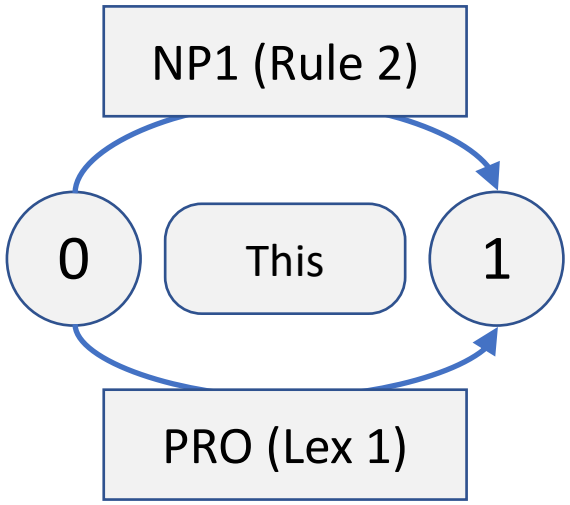
This is the house that jack built

Grammar
$S \rightarrow NP\ VP$
$NP \rightarrow PRO$
$NP \rightarrow ART\ NOUN$
$NP \rightarrow NAME$
$NP \rightarrow NP\ REL\ S$
$VP \rightarrow VERB$
$VP \rightarrow VERB\ NP$

Lexion
This: PRO
is: VERB
the: ART
house: NOUN
that: PRO, REL
Jack: NAME
built: VERB

Question 1

This is the house that jack built

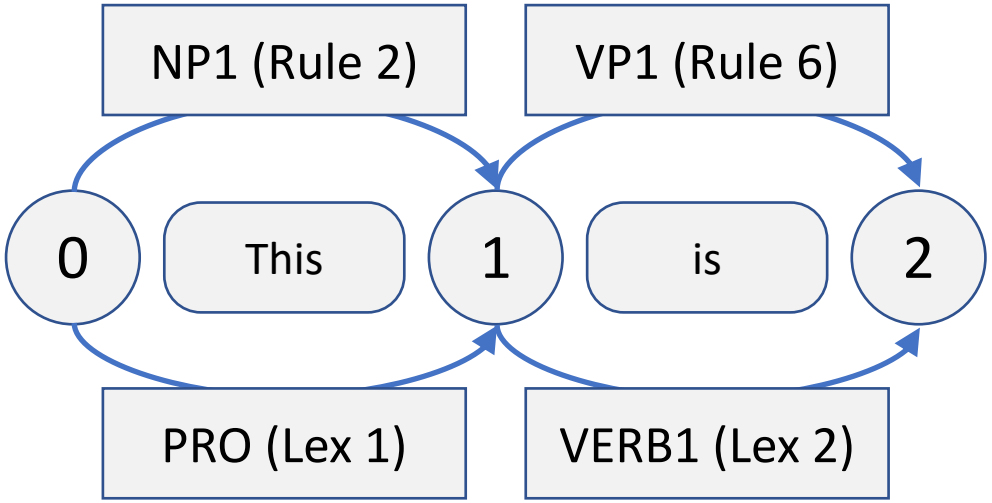


These are the grammar that our current rules start with. For example. NP1 is first in the rule S, which is the same for the rule NP.

Active Arcs
$S \rightarrow NP1\ VP$
$NP \rightarrow NP1\ REL\ S$

Question 1

This is the house that jack built



Active Arcs
$S \rightarrow NP1\ VP$
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$VP \rightarrow VERB1\ NP$

Question 1

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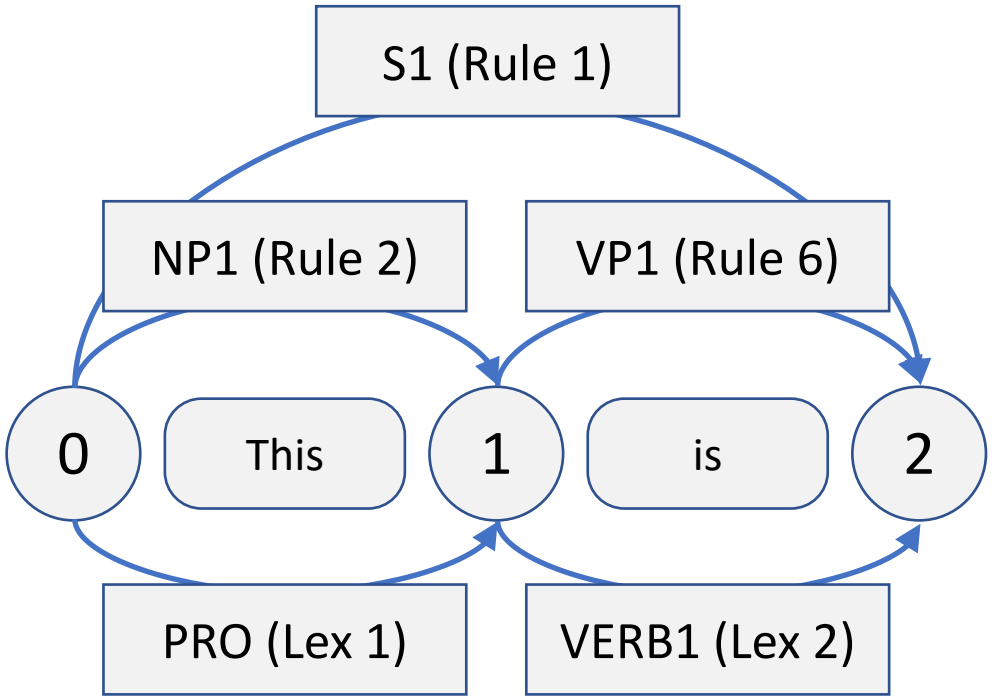

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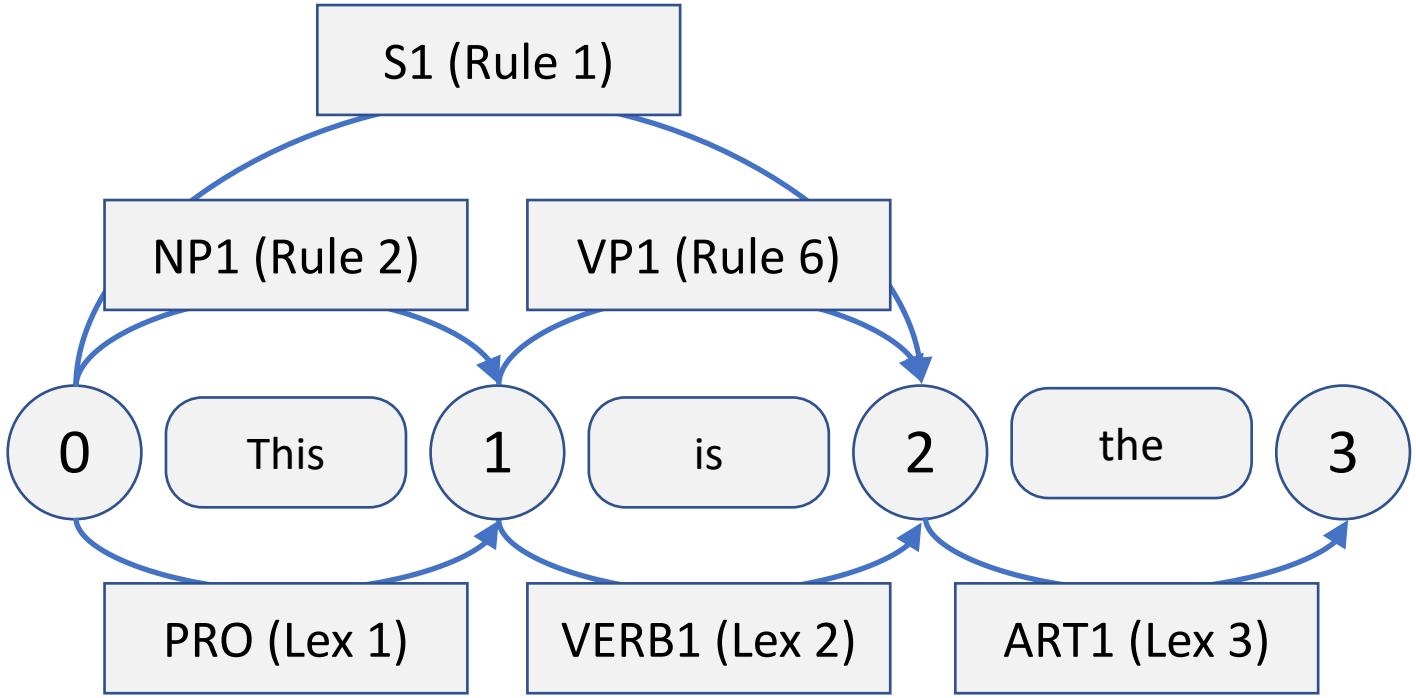
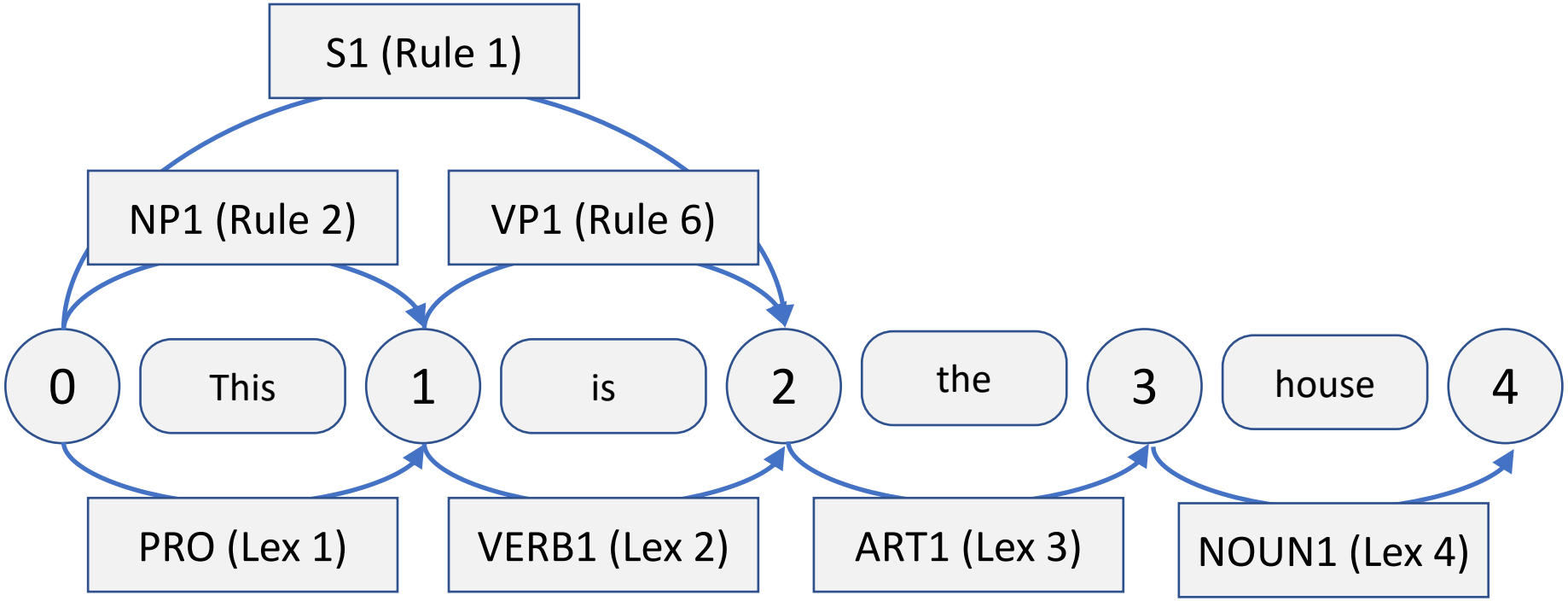


Active Arcs
$S \rightarrow NP1\ VP$
$NP \rightarrow NP1\ REL\ S$
$VP \rightarrow VERB1\ NP$
$NP \rightarrow ART1\ NOUN$

Question 1

This is the house that jack built



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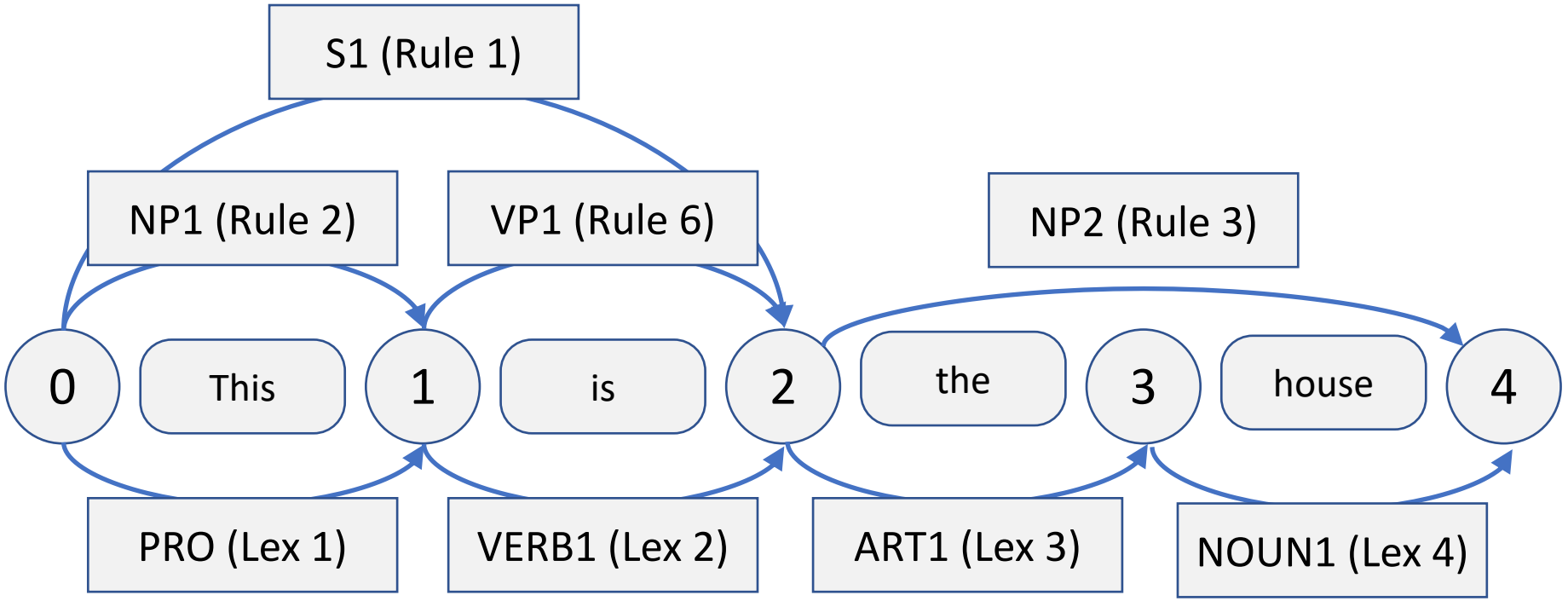

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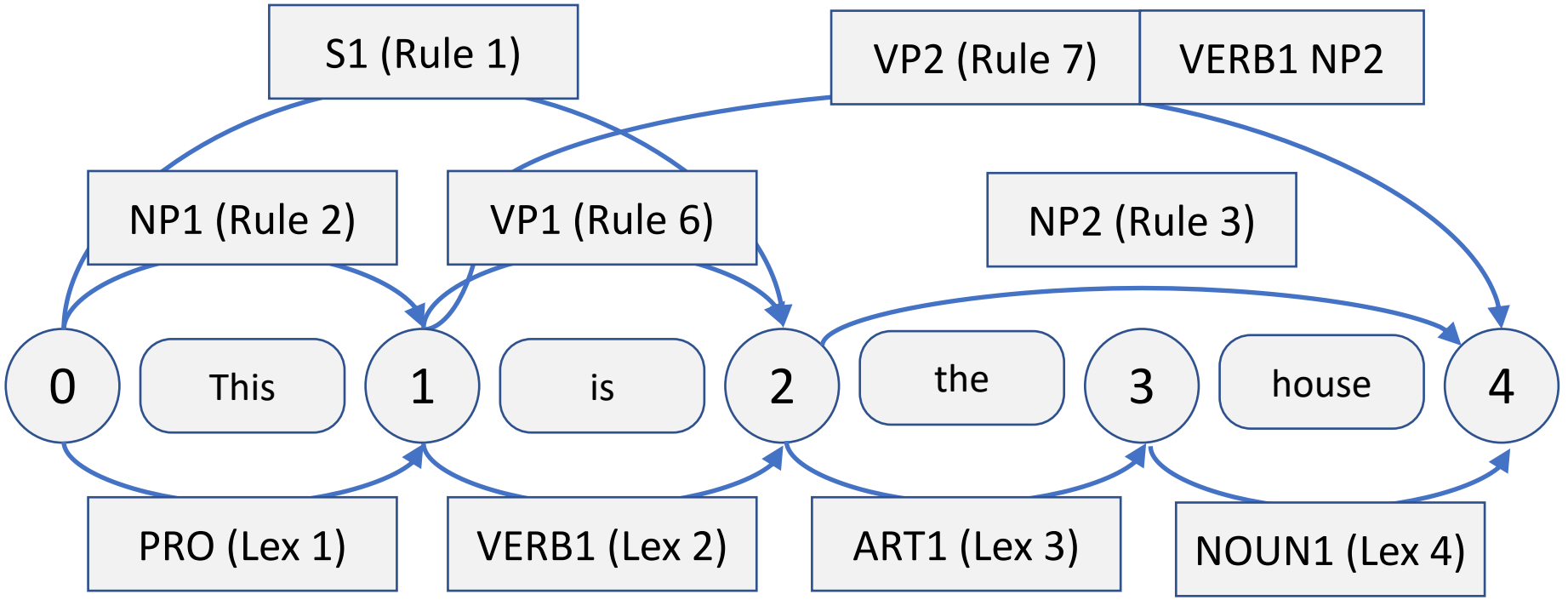

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Active Arcs
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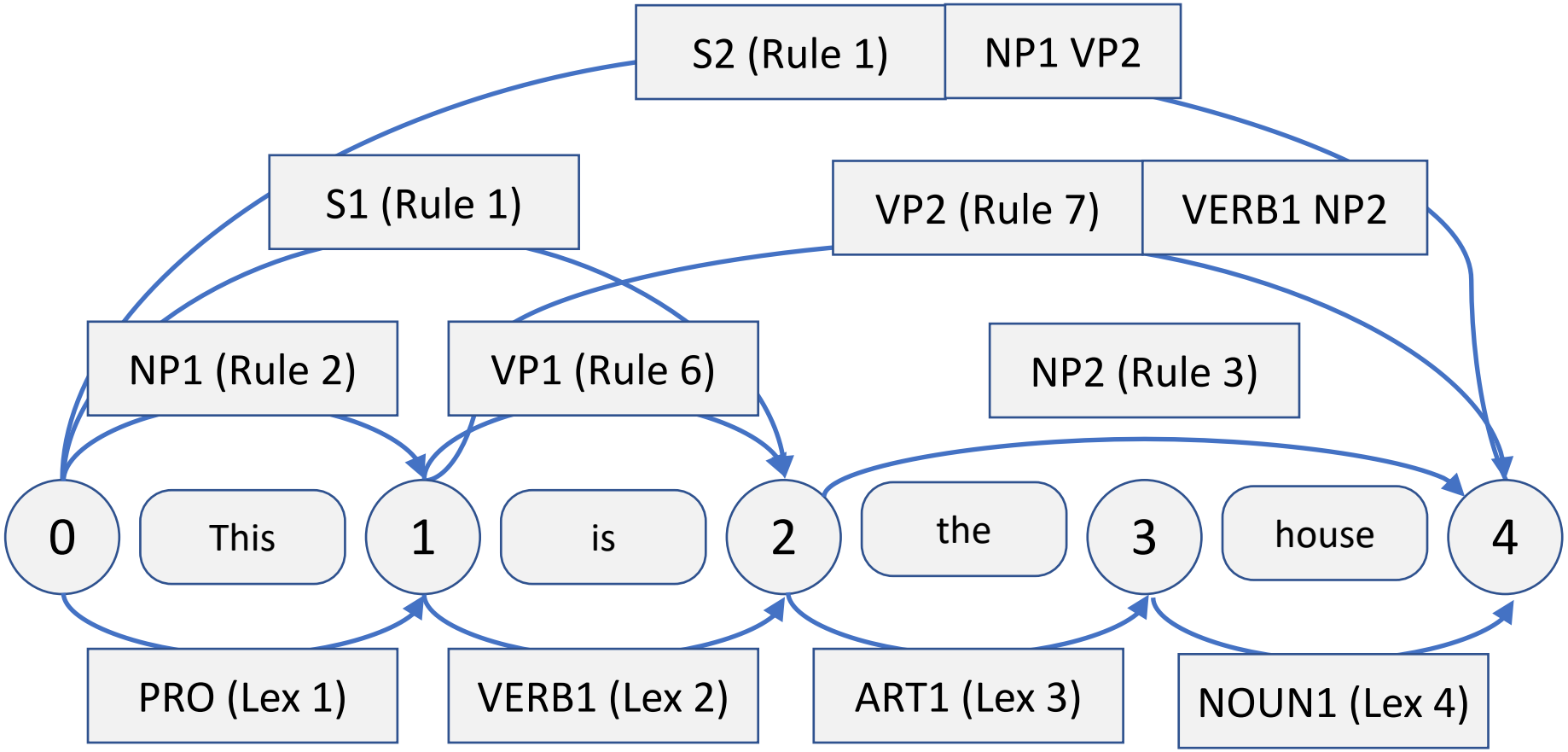

Question 1

This is the house that jack built

Active Arcs
$S \rightarrow NP1\ VP$
$NP \rightarrow NP1\ REL\ S$
$VP \rightarrow VERB1\ NP$
$NP \rightarrow ART1\ NOUN$
$S \rightarrow NP2\ VP$
$NP \rightarrow NP2\ REL\ S$

Question 2i

Phrases	
Today is hot and humid	
NOUN VERB ADJ and ADJ	$ADJP \rightarrow ADJP\ and\ ADJP$

John and Mary went to the beach	
NOUN and NOUN VERB PROP ADJ NOUN	$NP \rightarrow NP\ and\ NP$

Question 2i

Phrases	
John went to the park and Mary went to the beach	
NOUN VERB PROP ADJ NOUN and NOUN VERB PROP ADJ NOUN	$S \rightarrow S\ and\ S$
	$NP \rightarrow NP\ and\ NP$
	$PP \rightarrow PP\ and\ PP$
	$VP \rightarrow VP\ and\ VP$

Question 2i

Phrases	
John went to the park and to the beach	
NOUN VERB PROP ADJ NOUN and PROP ADJ NOUN	$PP \rightarrow PP\ and\ PP$
	$ADJP \rightarrow ADJP\ and\ ADJP$
	$NP \rightarrow NP\ and\ NP$

Question 2i

Phrases	
John talks quickly and in a loud voice	
NOUN VERB ADV and PROP a ADJ NOUN	$ADVP \rightarrow ADVP\ and\ PP$

Question 2i

Grammar Rules
$S \rightarrow S \; and \; S$
$NP \rightarrow NP \; and \; NP$
$VP \rightarrow VP \; and \; VP$
$PP \rightarrow PP \; and \; PP$
$ADJP \rightarrow ADJP \; and \; ADJP$
$ADVP \rightarrow ADVP \; and \; PP$

Question 2ii – Noun/Pronoun Features

Person-view		
First	Second	Third

Number	
Singular	Plural

Gender		
Masculine	Neuter	Feminine

Question 2ii – Noun/Pronoun Features

Case		
Nominative	Denotes the subject of a verb.	
	He went bowling	NOUN VERB VERB
Accusative	Denotes the noun as an object of an action.	
	Good things happened to her	ADJ NOUNS VERB PREP NOUN

Question 2ii

Pronoun	Person	Number	Gender	Case
He	Third	Singular	Masculine	Nominative
She	Third	Singular	Feminine	Nominative
It	Third	Singular	Neuter	Neuter
Him	Third	Singular	Masculine	Accusative
Her	Third	Singular	Feminine	Accusative

Question 2ii

Incorrect sentences
Him and **she** went to the park.
John and Jack **drinks** coffee.
John went to the park **and** drink coffee.
John went to **he**.

Question 2ii

Incorrect sentences	
Him and she went to the park.	$NP(plu, case) \rightarrow NP(case)\ and\ NP(case)$
John and Jack drinks coffee.	
John went to the park and drink coffee.	
John went to he.	

Question 2ii

Incorrect sentences	
Him and she went to the park.	$NP(plu, case) \rightarrow NP(case)\ and\ NP(case)$
John and Jack drinks coffee.	$NP(plu, case) \rightarrow NP(case)\ and\ NP(case)$
John went to the park and drink coffee.	
John went to he.	

Question 2ii

Incorrect sentences	
Him and she went to the park.	$NP(plu, case) \rightarrow NP(case)\ and\ NP(case)$
John and Jack drinks coffee.	$NP(plu, case) \rightarrow NP(case)\ and\ NP(case)$
John went to the park and drink coffee.	$VP(case) \rightarrow VP(case)\ and\ VP(case)$
John went to he.	

Question 2ii

Incorrect sentences	
Him and she went to the park.	$NP(plu, case) \rightarrow NP(case)\ and\ NP(case)$
John and Jack drinks coffee.	$NP(plu, case) \rightarrow NP(case)\ and\ NP(case)$
John went to the park and drink coffee.	$VP(case) \rightarrow VP(case)\ and\ VP(case)$
John went to he.	$PP(acc) \rightarrow PREP\ and\ PP(acc)$

Question 2ii

New Grammar Rules
$S \rightarrow S \; and \; S$
$NP(plu, case) \rightarrow NP(case) \; and \; NP(case)$
$VP(case) \rightarrow VP(case) \; and \; VP(case)$
$PP(case) \rightarrow PP(case) \; and \; PP(case)$
$PP(case) \rightarrow PREP \; and \; PP(case)$
$ADJP \rightarrow ADJP \; and \; ADJP$
$ADVP \rightarrow ADVP \; and \; PP$

Question 2iii – Logical Form

- Slight modification that introduces parameters
  - Takes the form $X \hat{} F$ where X is a parameter and F is a formula
  - "X such that F"

A(X^(F^G)) → B(X^F) ∧ B(X^G)

- Can substitute the parameters for text strings

Question 2iii – Logical Form

$S(P \wedge Q) \rightarrow S(P)\ and\ S(Q)$

John went to the park and Mary went to the beach

P → John went to the park

Q → Mary went to the beach

Question 2iii – Logical Form

$NP(X\text{^}Y\text{^}F) \rightarrow NP(X\text{^}F)\ and\ NP(Y\text{^}F)$

John and Mary went to the beach
X → John
Y → Mary
F → went to the beach

Question 2iii – Logical Form

$VP(X\text{^}F \wedge Y\text{^}G) \rightarrow VP(X\text{^}F)\ and\ VP(Y\text{^}G)$

John went to the park and Mary went to the beach
$X \rightarrow$ went
$Y \rightarrow$ went
$F \rightarrow$ went to the park
$G \rightarrow$ went to the beach

Question 2iii – Logical Form

$PP(X\text{^}(F \wedge G)) \rightarrow PP(X\text{^}F)\ and\ PP(X\text{^}G)$

John went to the park and to the beach
X → to
F → the park
G → the beach

Question 2iii – Logical Form

$ADJP(X\text{^}(F \wedge G)) \rightarrow ADJP(X\text{^}F) and\ ADJP(X\text{^}G)$

John went to the park and to the beach
X → the
F → park
G → beach

Question 2iii – Logical Form

$ADVP(X\text{^}F \wedge Y\text{^}G \rightarrow ADVP(X\text{^}F) and\ ADVP(Y\text{^}G)$

John talks quickly and in a loud voice
X → quickly
F → John talks
Y → loud
G → voice

Question 2iv

And	$A \wedge B$
Conjunction that requires both components to be true or apparent.	

But	$A \wedge \neg B$
Conjunction that requires the first component to be true whilst the second must be false.	

Notes

- Assignment 2 packages are as follows:
  - Preprocessing toolkit:
    - https://www.nltk.org/
  - Modelling toolkit
    - https://scikit-learn.org/stable/