COMP 6751 Natural Language Analysis

Project Report 2 **(Demo):**

Developing Context Free Grammar

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ID: 40264066

Expectations of originality:

I, Md Sakib Ullah Sourav (student id 40264066), certify that this submission is my original work and meets the Faculty's Expectations of Originality.

Date: October 12, 2023

Contents

1. Test Scenarios in Validation Data

(To access to my entire code, please visit this link-
https://drive.google.com/file/d/1ps0xa8tx5Zhc_6lke1kPFBuC3Jz_sk8r/view?usp=sharing
And, let me know if the link is not working!)

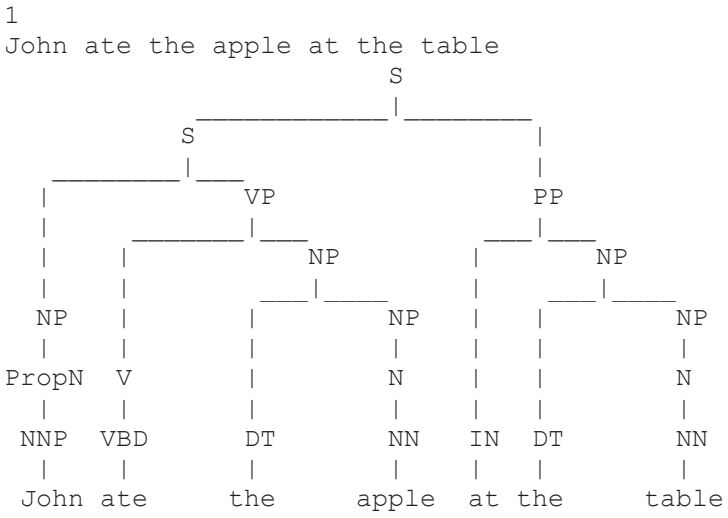
The validation data has been placed into the code as below

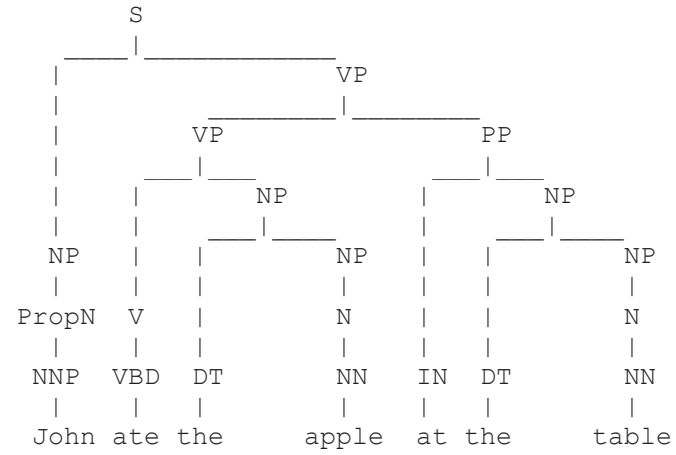
```
input = [
    "John ate the apple at the table.",
    "John, who ate the apple from the fridge, was sick Wednesday.",
    "On Monday, John ate the apple in his office.",
    "Last week, on Monday, John finally took the apple from the fridge to
his office.",
    "Heart rate greater than 90 beats/minute",
    "Body temperature over 38 or under 36 degrees Celsius.",
    "Respiratory rate greater than 20 breaths/minute or partial pressure
     of CO2 less than 32 mmHg",
    "Leukocyte count greater than 12000 or less than 4000 /microliters or
     over 10% immature forms or bands."
  ]
```

1.1 Test Scenario 1

Input: John ate the apple at the table.

Result: The proofreading results and text preprocess pipeline can be delivered, and the programme can operate correctly. Earley parse process results are displayed below.

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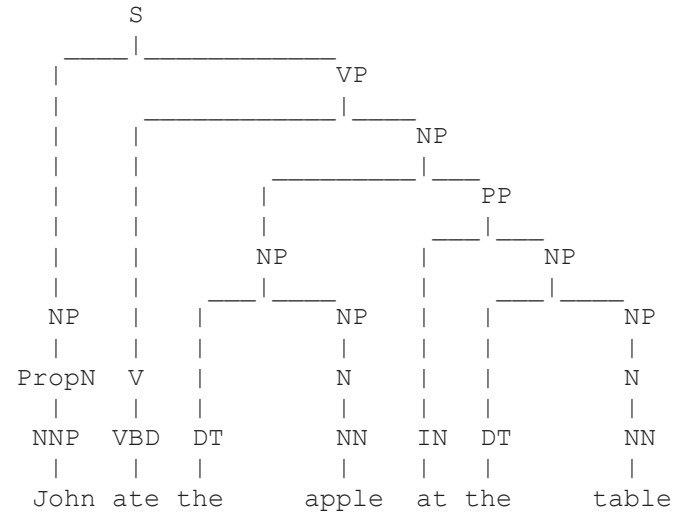
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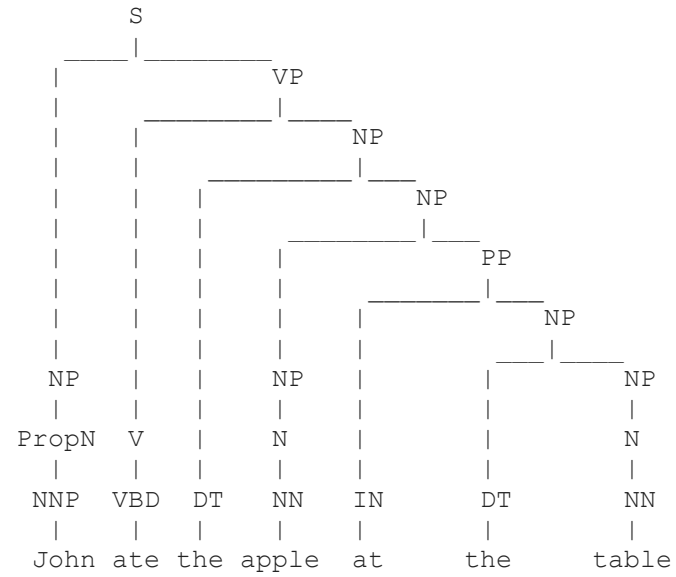
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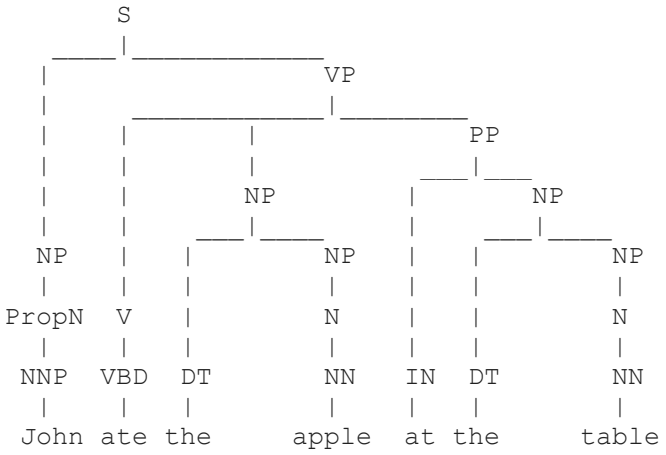
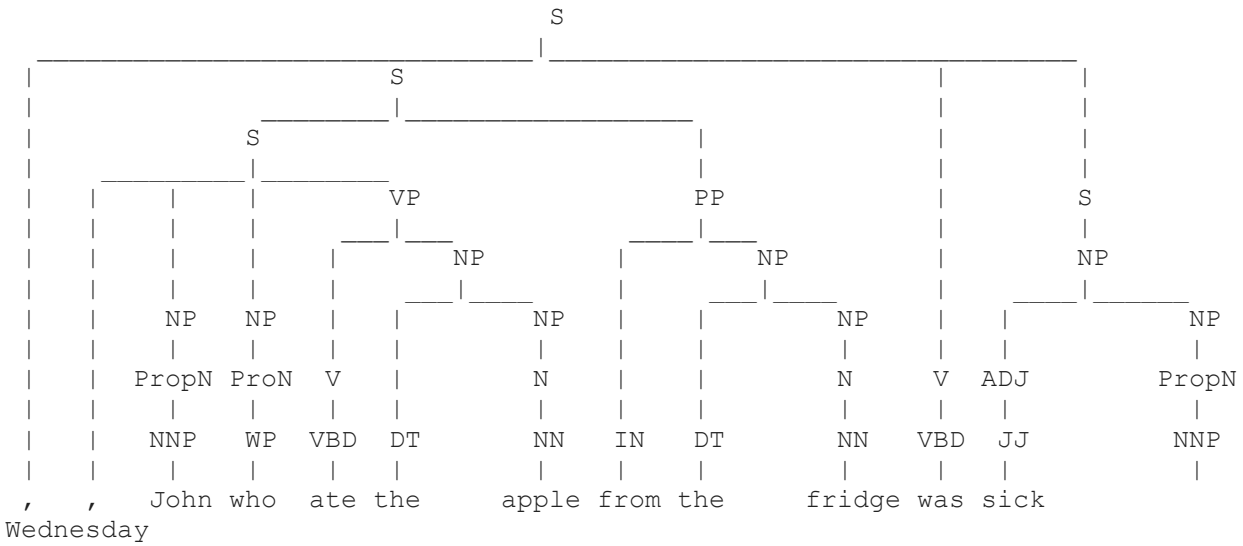
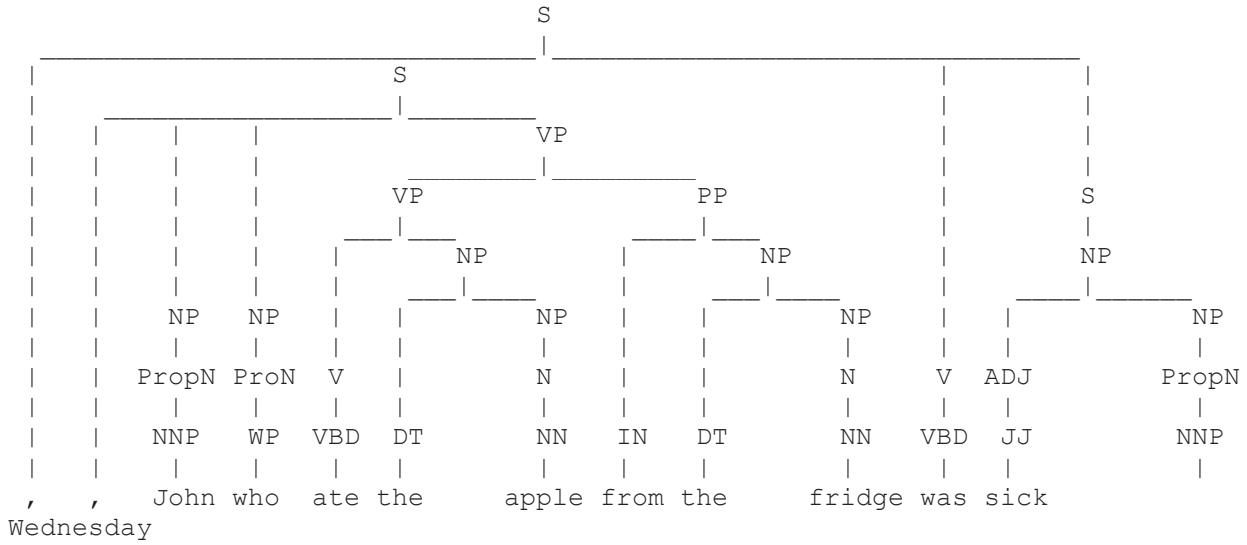


1.2. Test Scenario 2

Input: John, who ate the apple from the fridge, was sick Wednesday.

Result: The proofreading results and text preprocess pipeline can be delivered, and the programme can operate correctly. Earley parse process results are displayed below.

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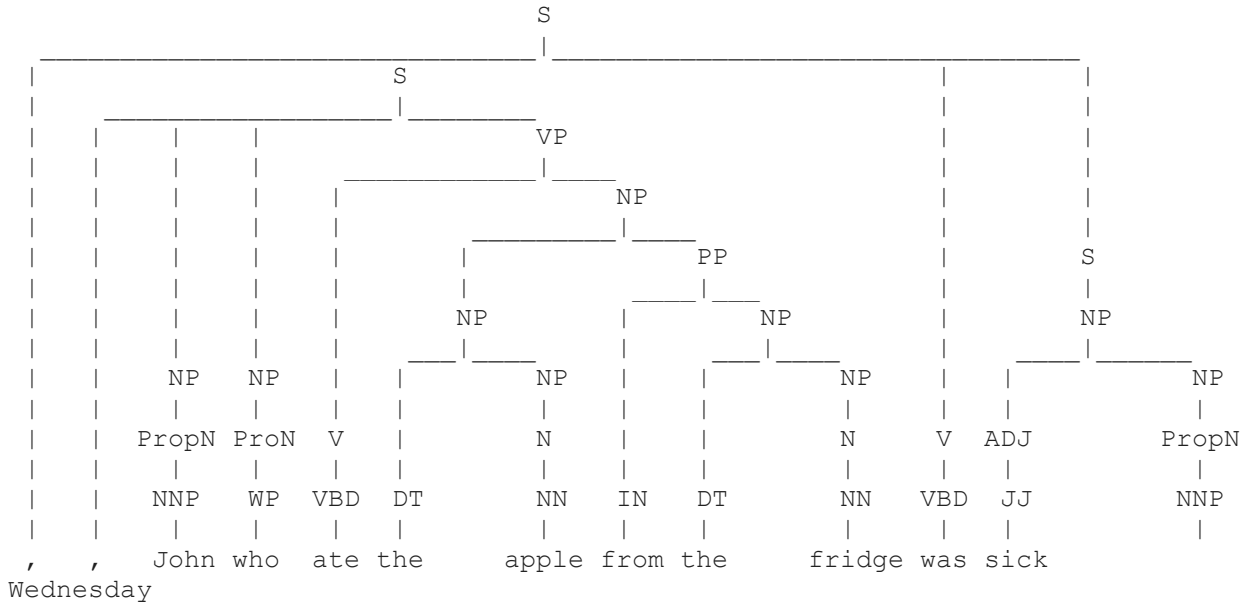
John who ate the apple from the fridge was sick
Wednesday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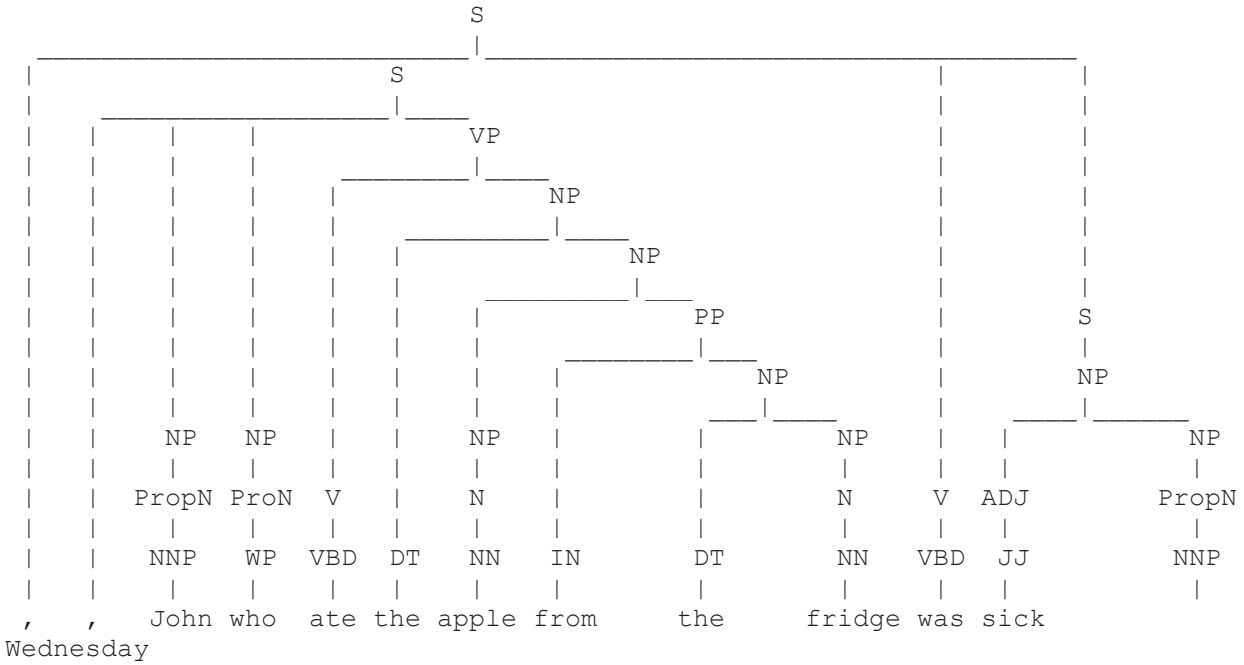
John who ate the apple from the fridge was sick
Wednesday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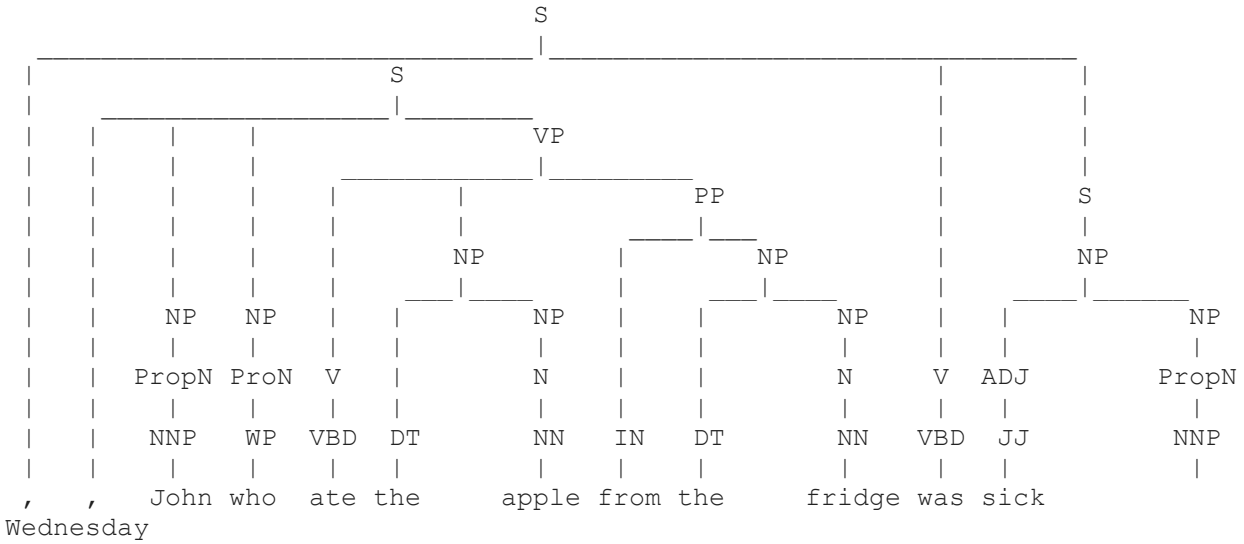
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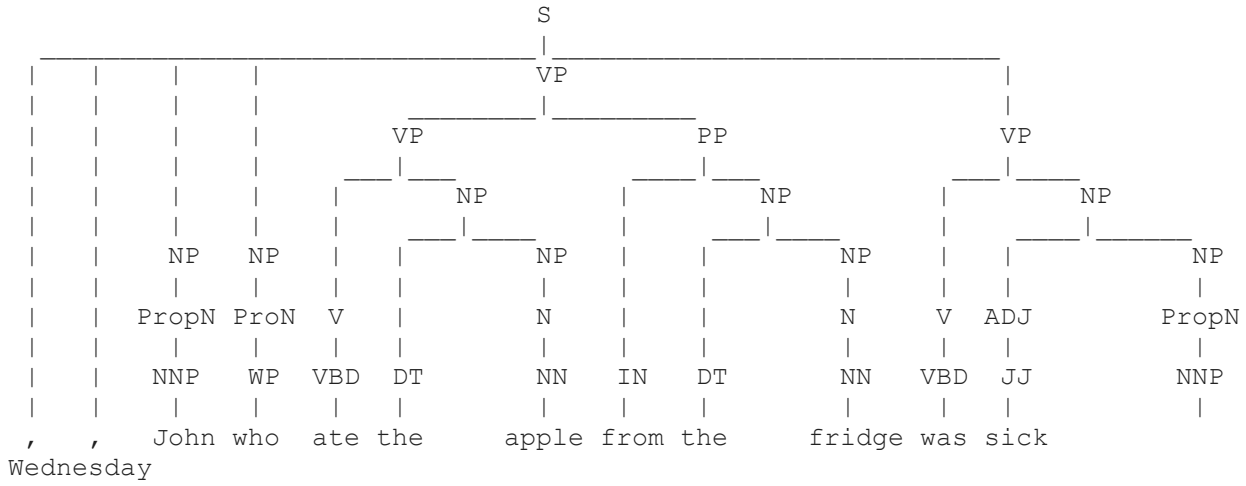
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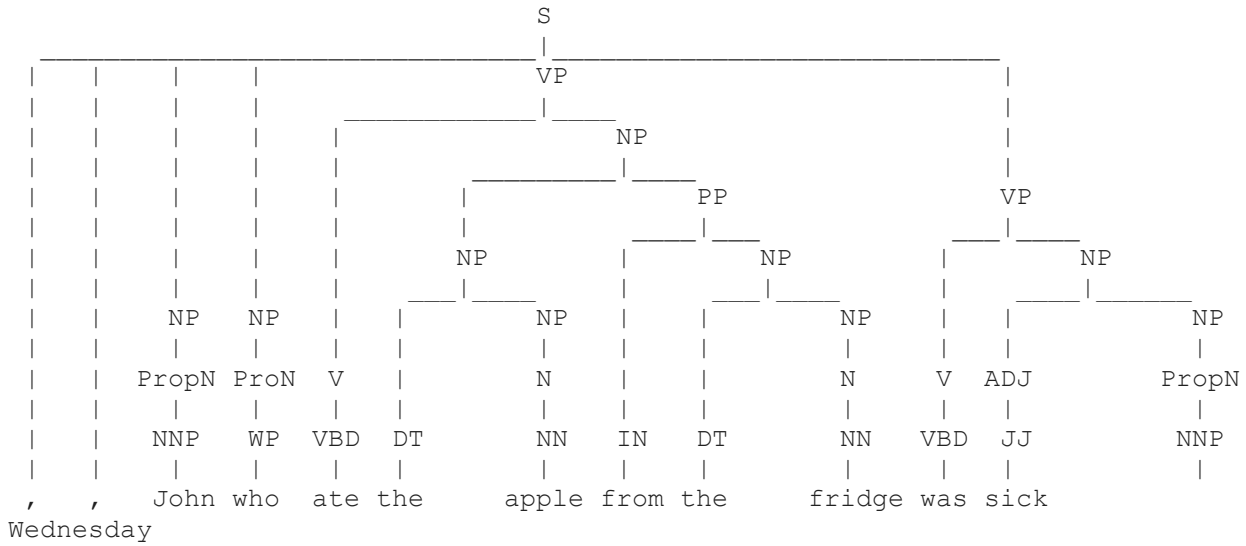
Wednesday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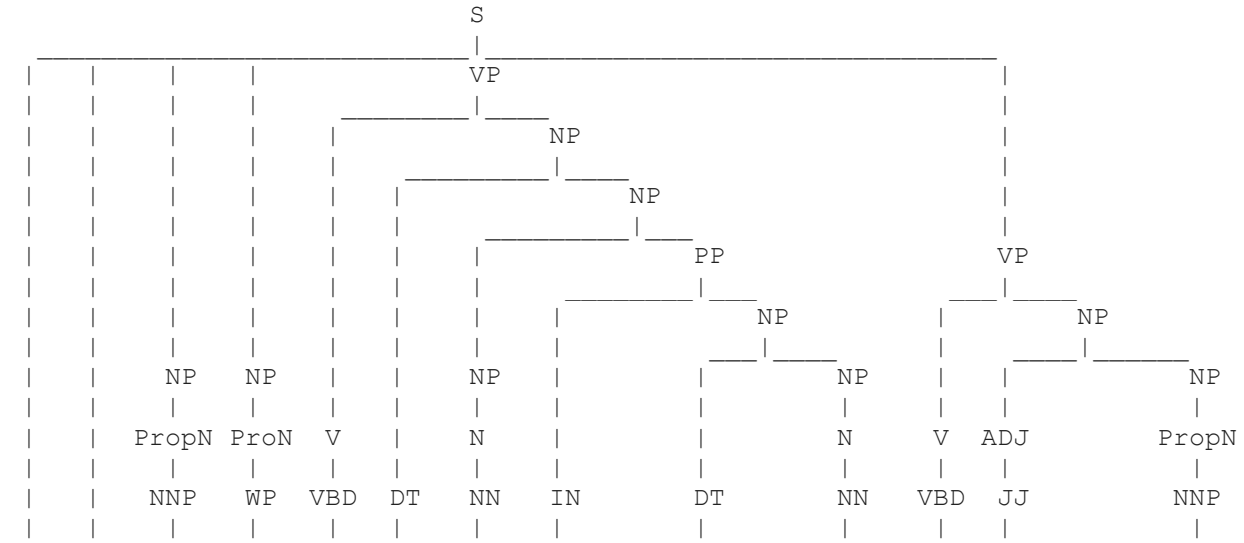
Wednesday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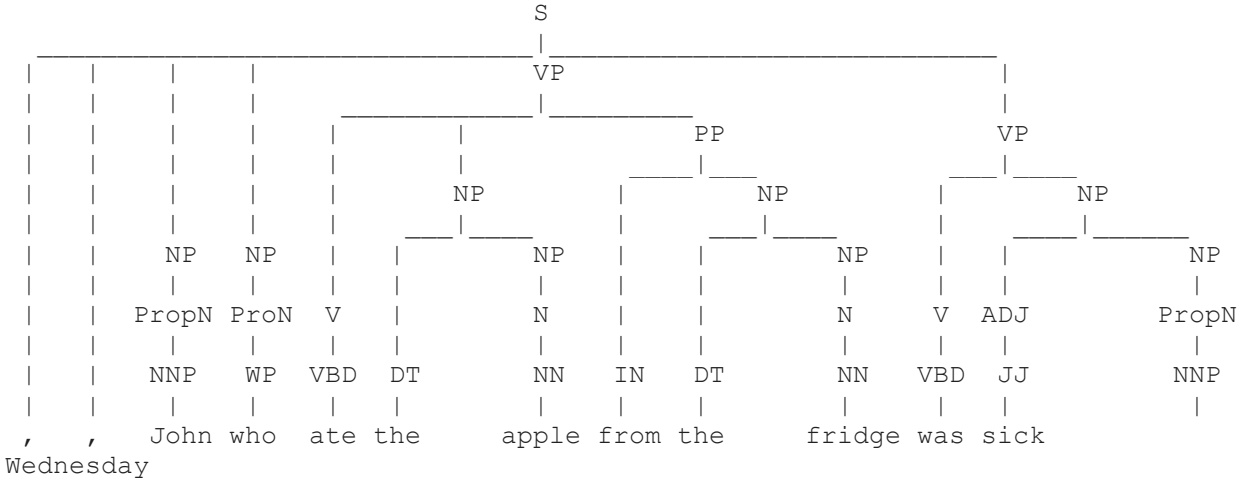
Wednesday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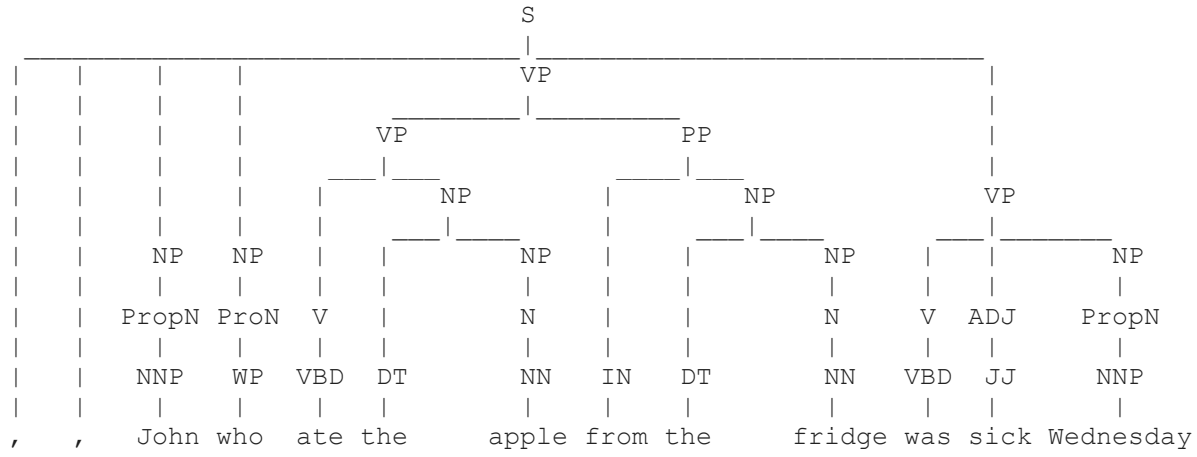
NNP WP VBD DT NN IN DT NN VBD JJ NNP
, , John who ate the apple from the fridge was sick
Wednesday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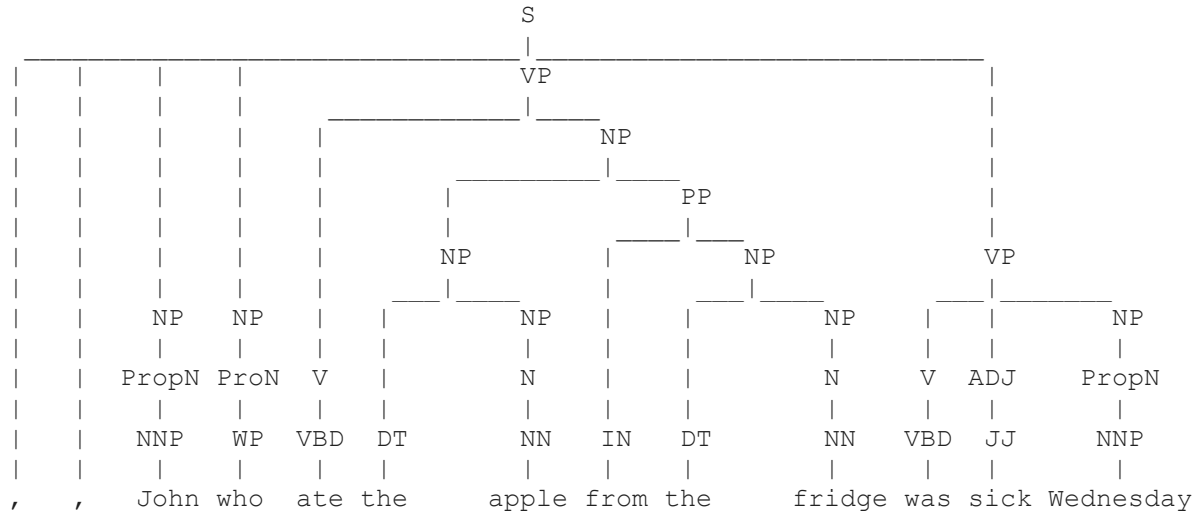
John who ate the apple from the fridge was sick Wednesday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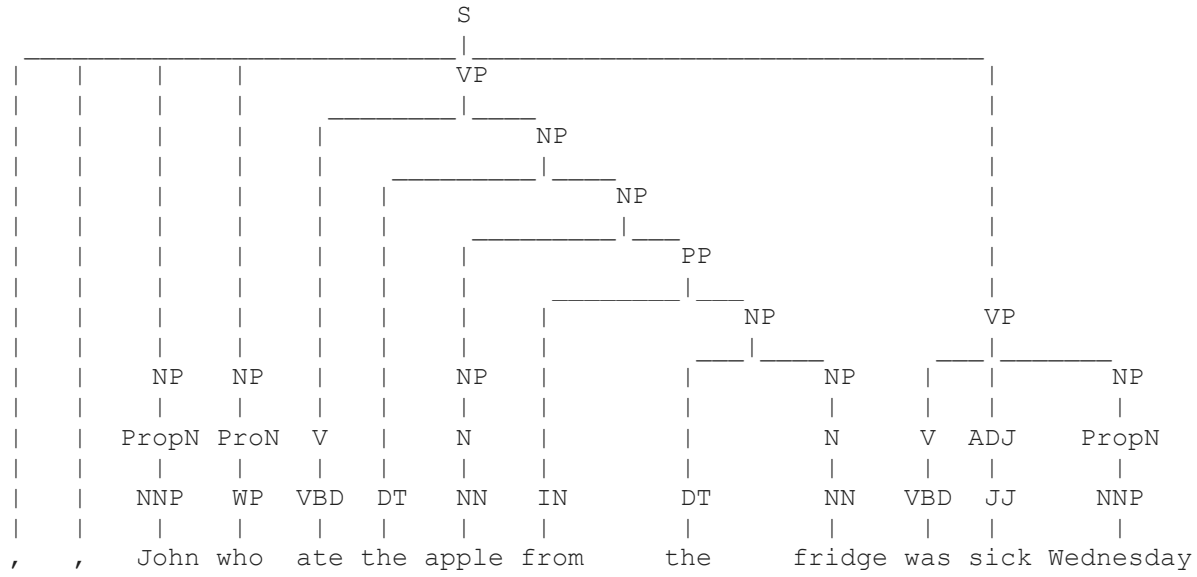
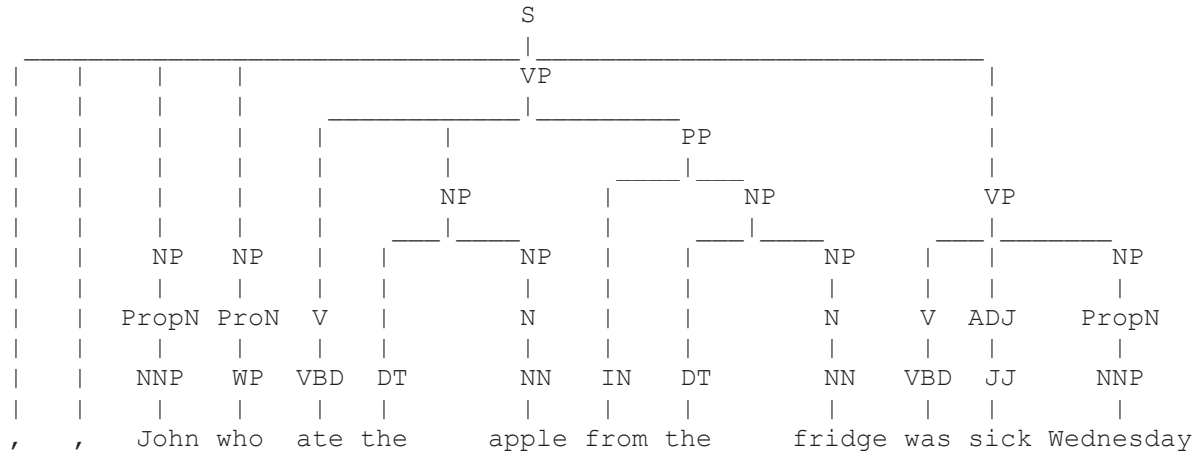
John who ate the apple from the fridge was sick Wednesday





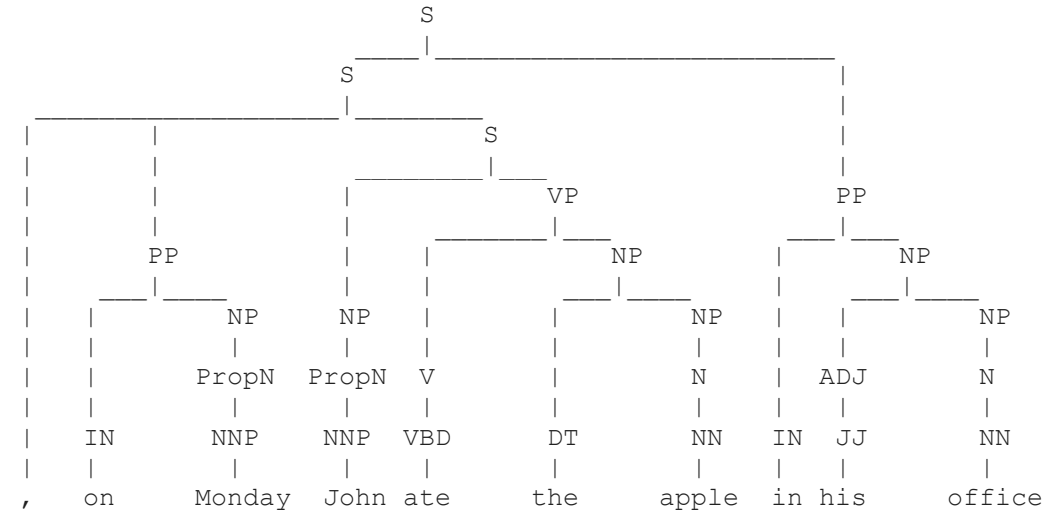
1.3 Test Scenario 3

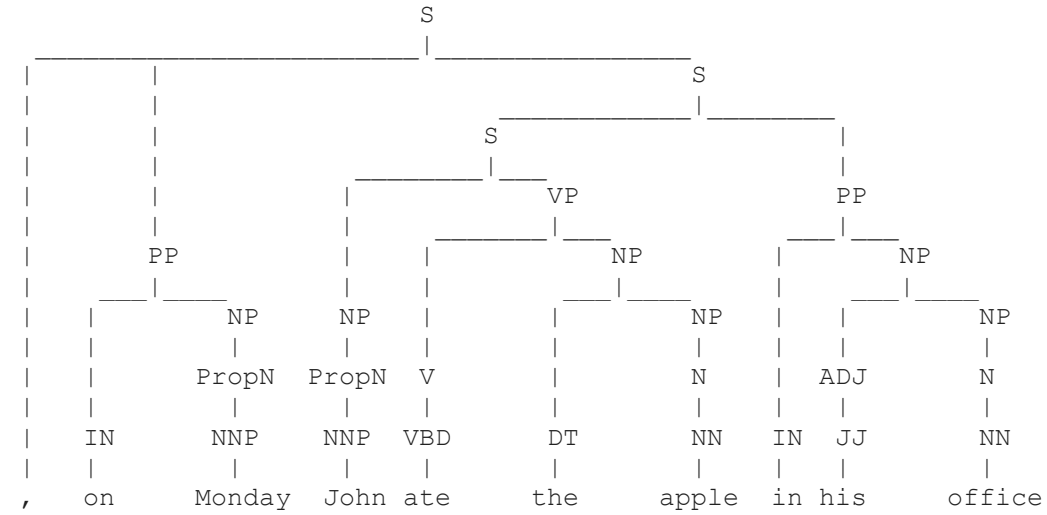
Input: On Monday, John ate the apple in his office.

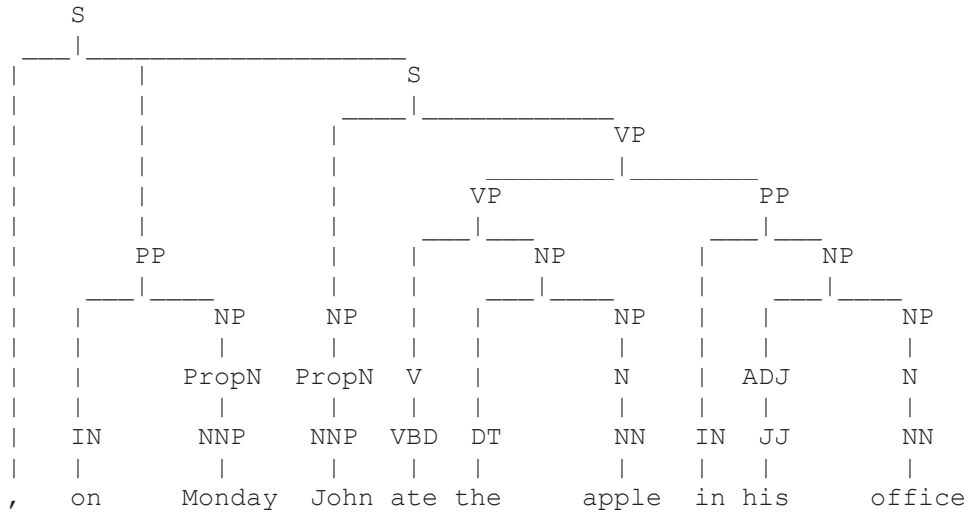
Result: The proofreading results and text preprocess pipeline can be delivered, and the programme can operate correctly. Earley parse process results are displayed below.

1

On Monday, John ate the apple in his office



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John
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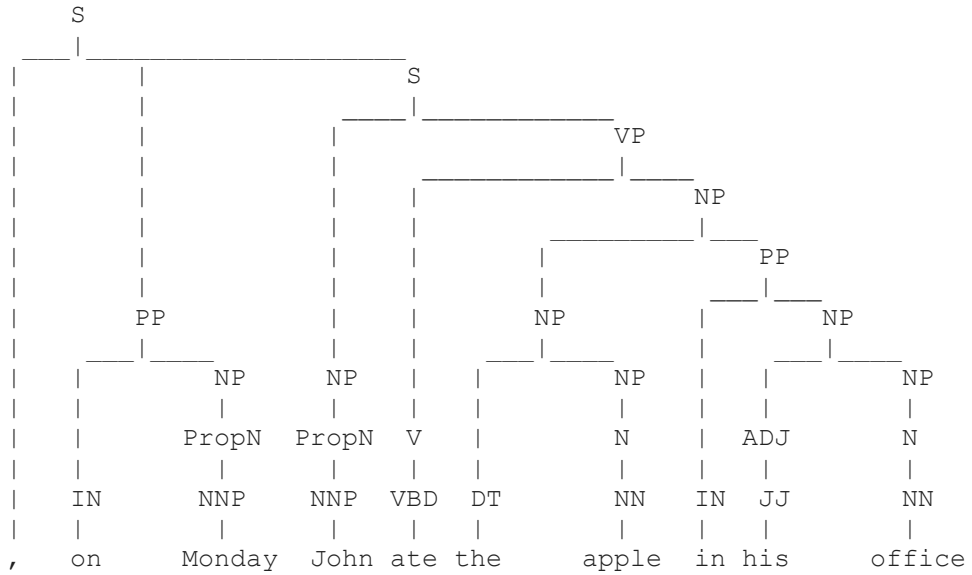
the
apple
in
his
office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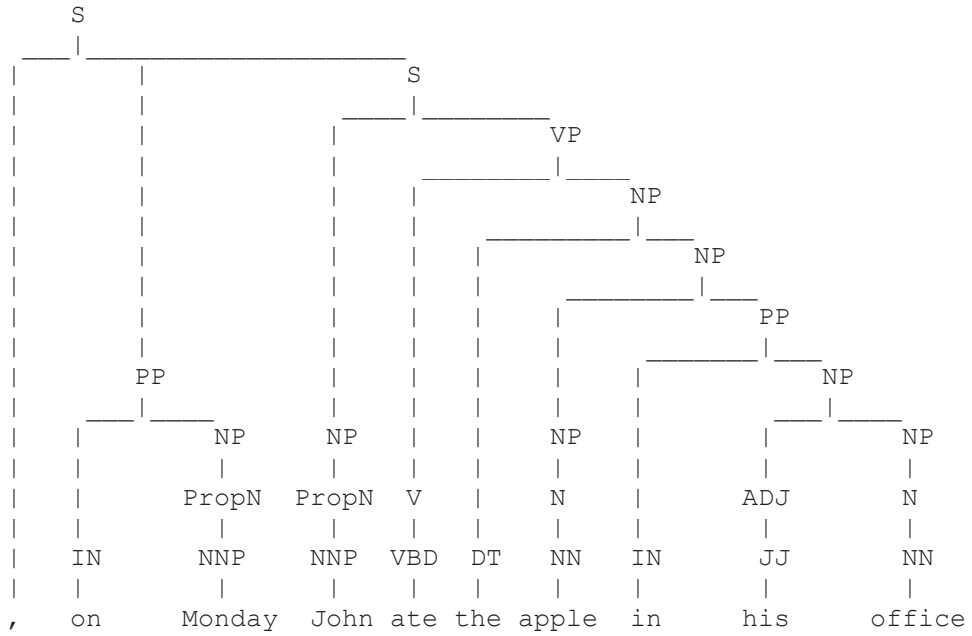
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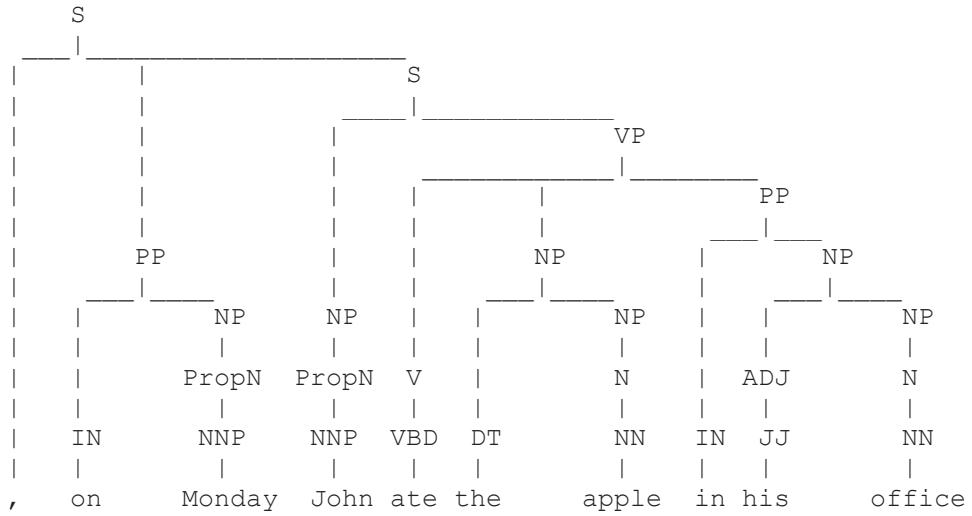
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John
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apple
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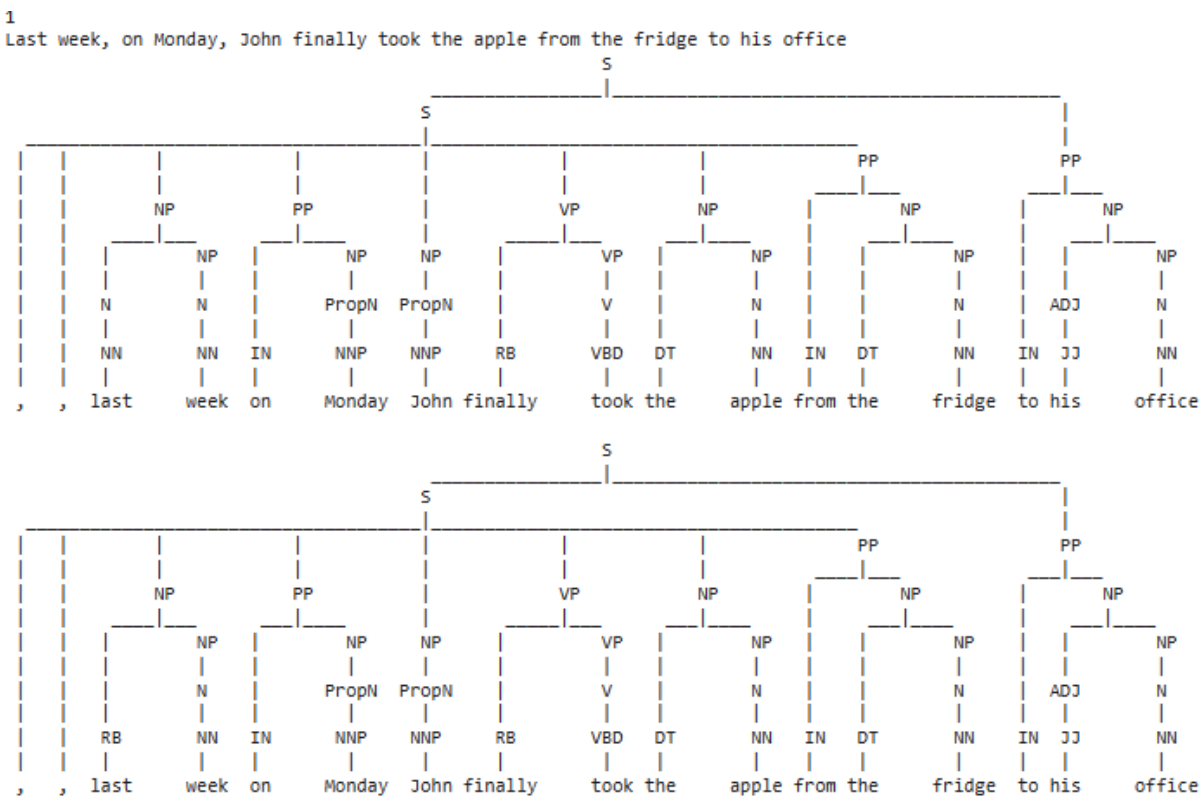
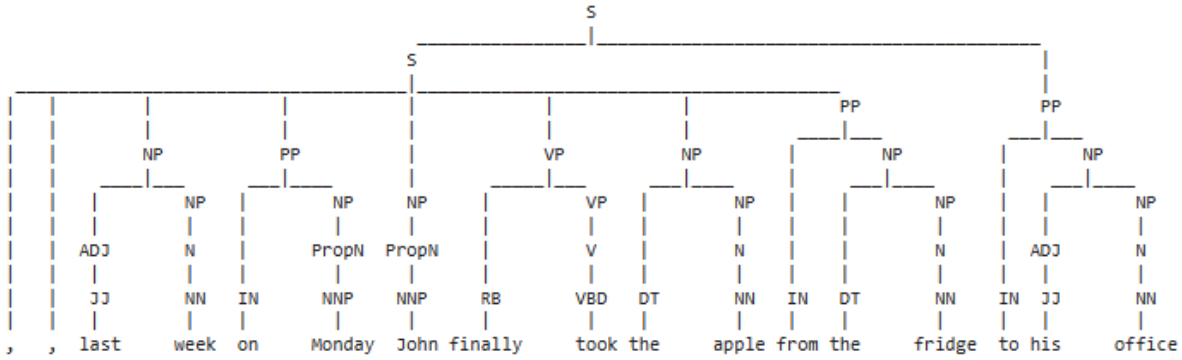
his
office

1.4 Test Scenario 4

Input: Last week, on Monday, John finally took the apple from the fridge to his office.

Result: The proofreading results and text preprocess pipeline can be delivered, and the programme can operate correctly. Earley parse process results are displayed below.

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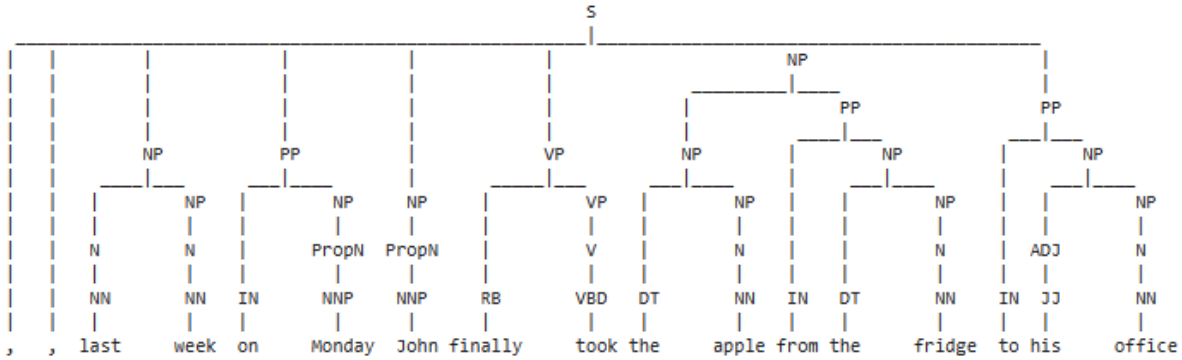
, , last week on Monday John finally took the apple from the fridge to his office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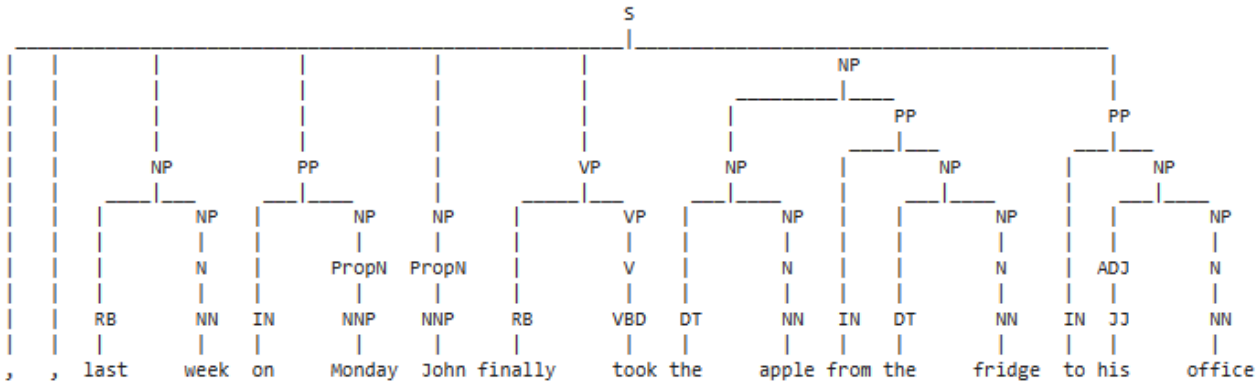
, , last week on Monday John finally took the apple from the fridge to his office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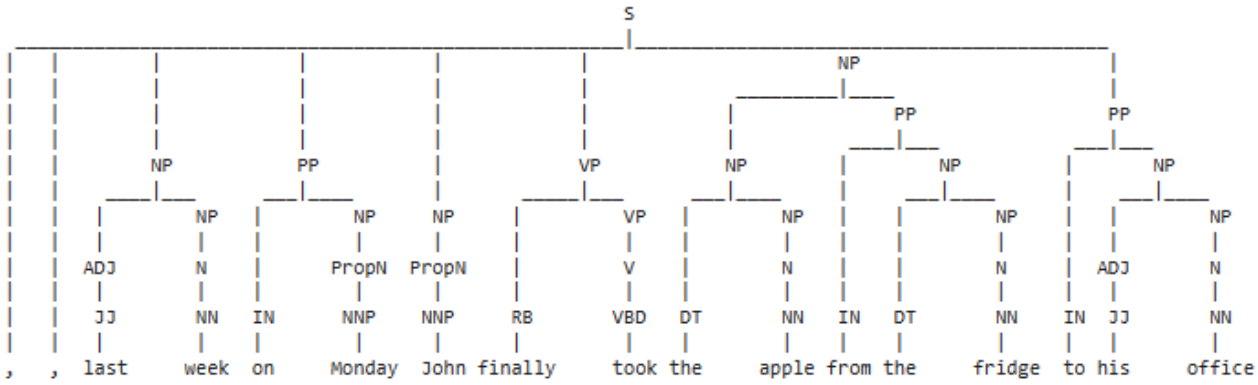
, , last week on Monday John finally took the apple from the fridge to his office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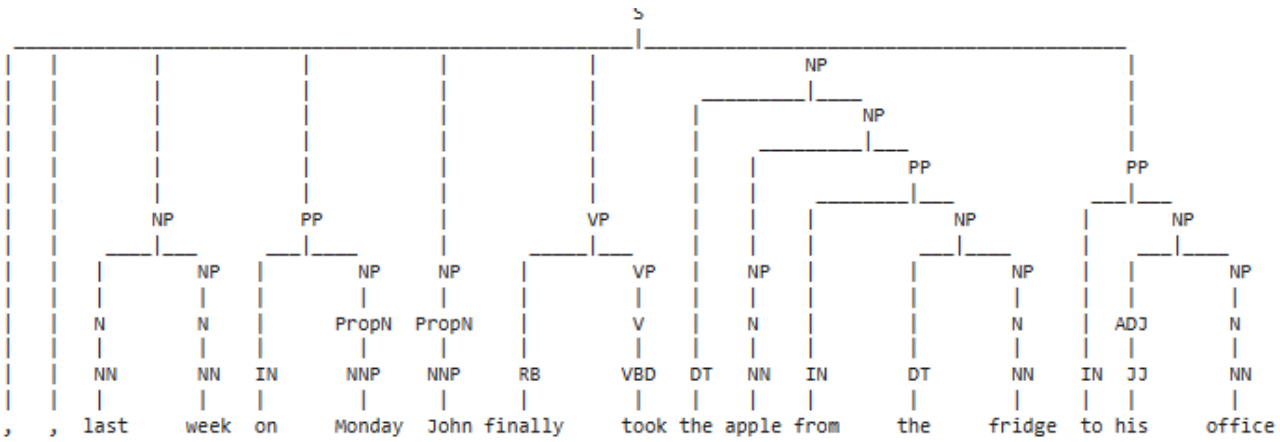
, , last week on Monday John finally took the apple from the fridge to his office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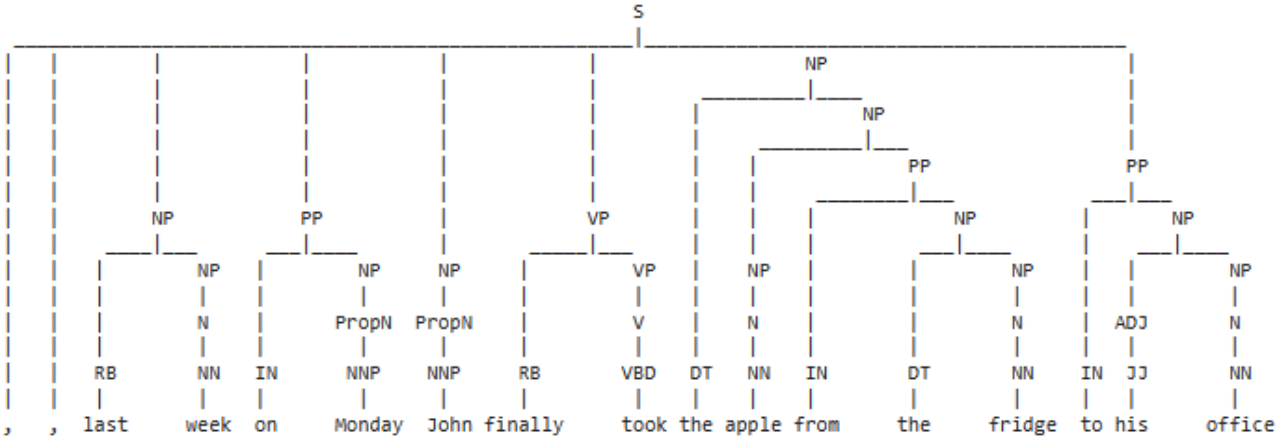
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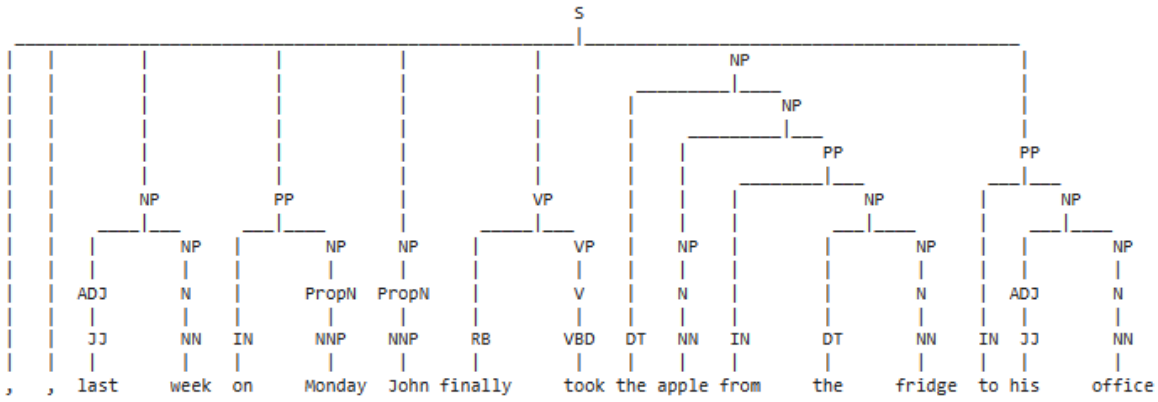
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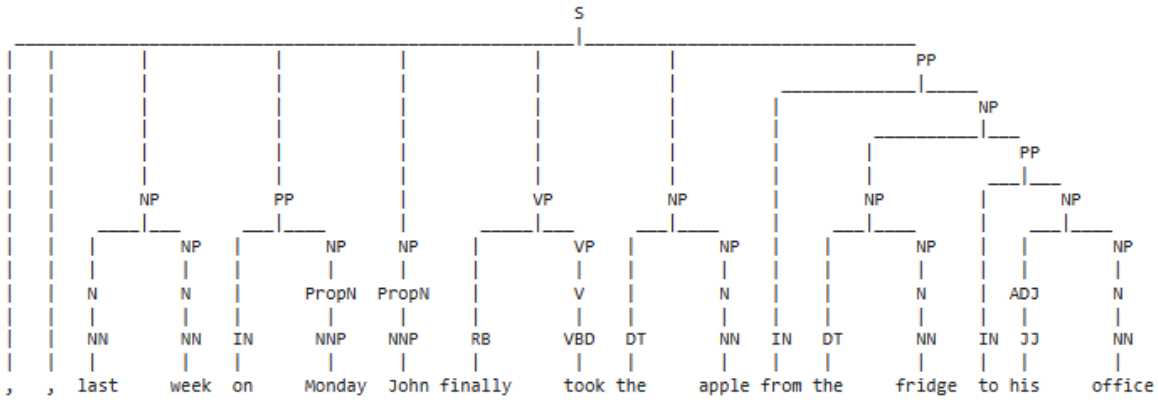
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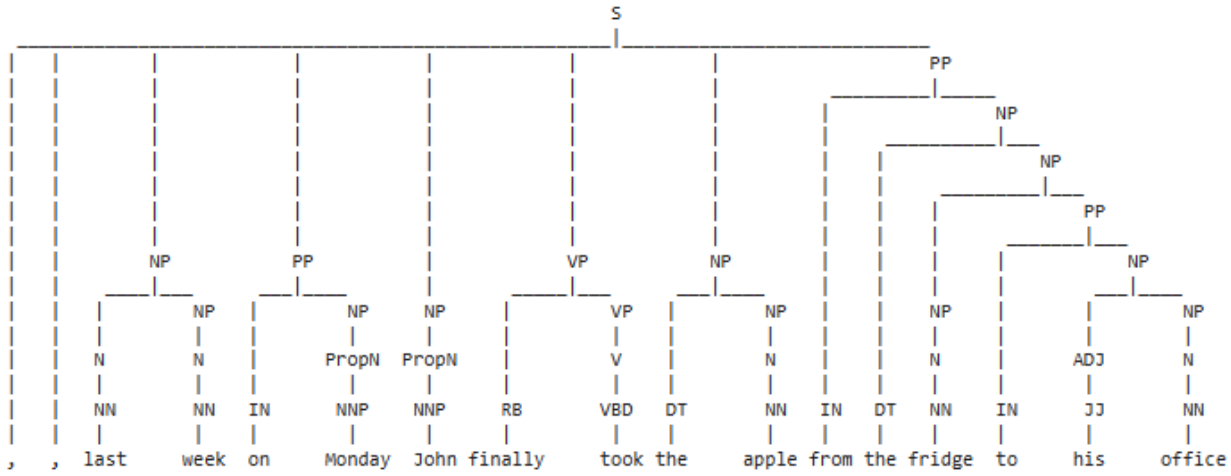
, , last week on Monday John finally took the apple from the fridge to his office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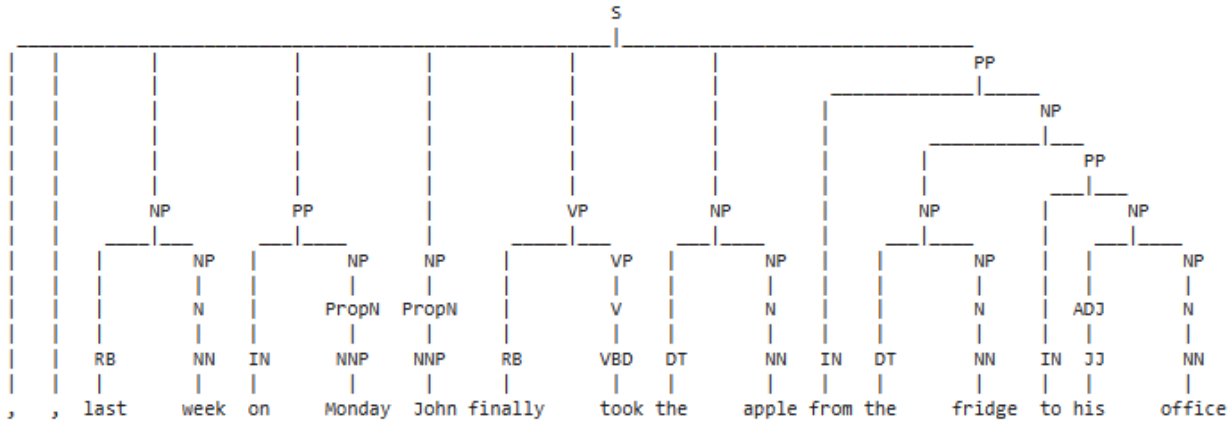
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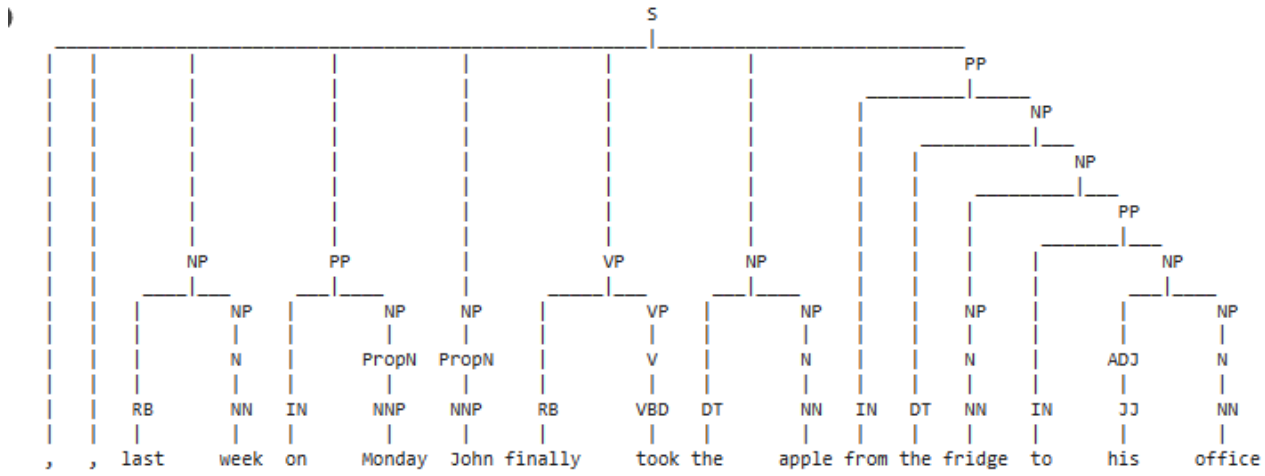
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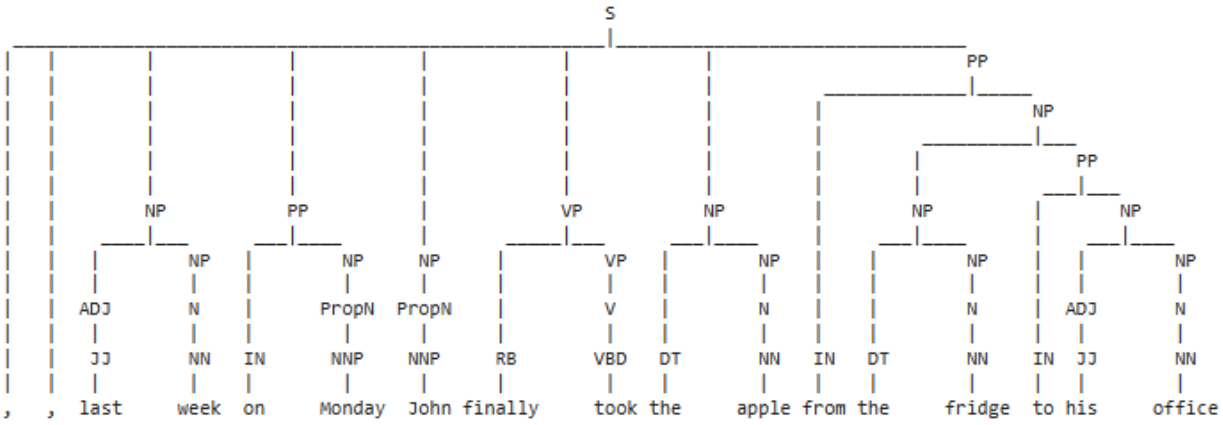
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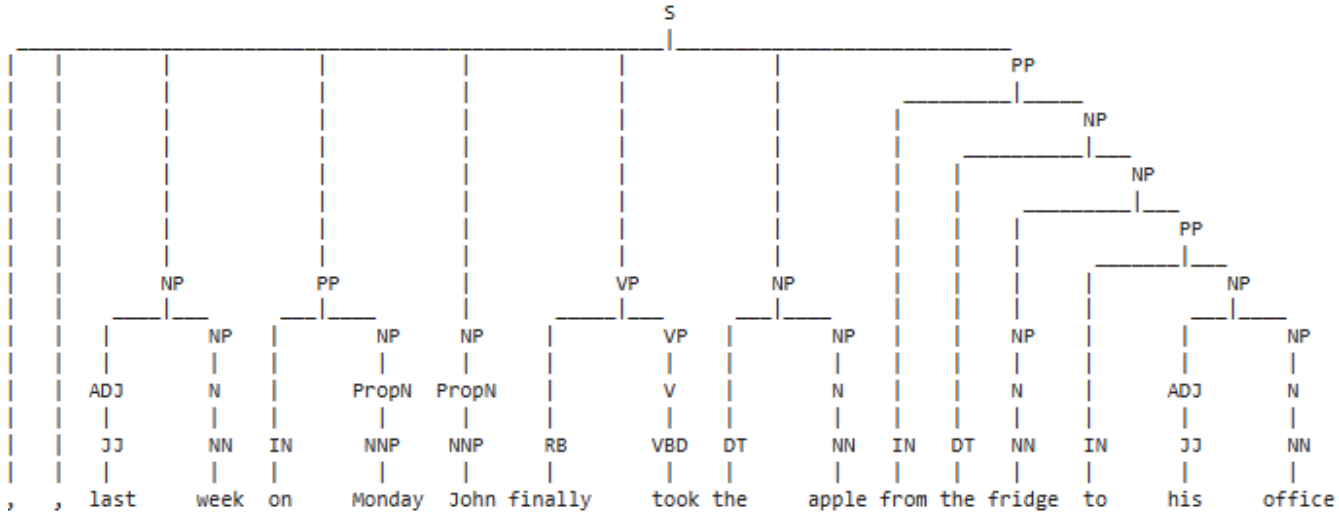
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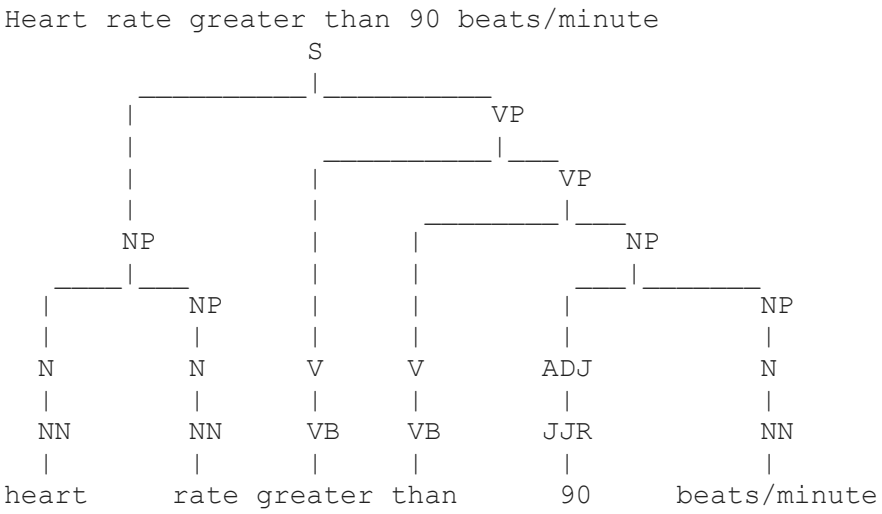
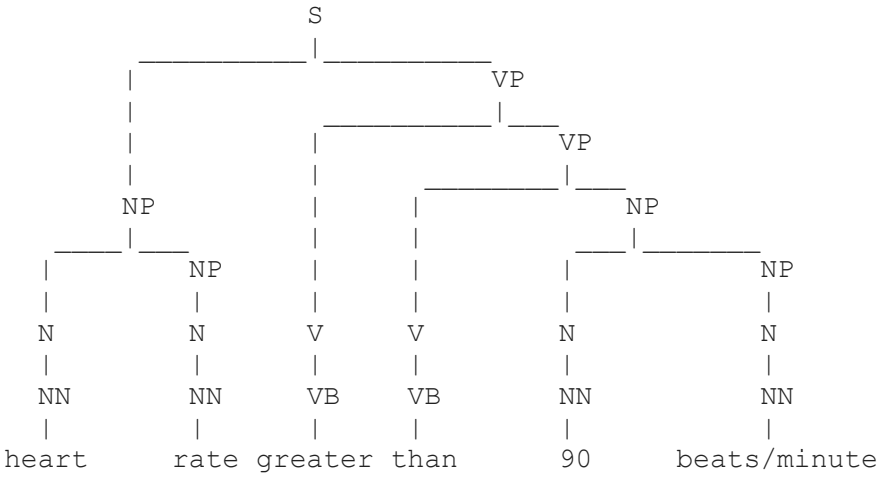
, , last week on Monday John finally took the apple from the fridge to his office

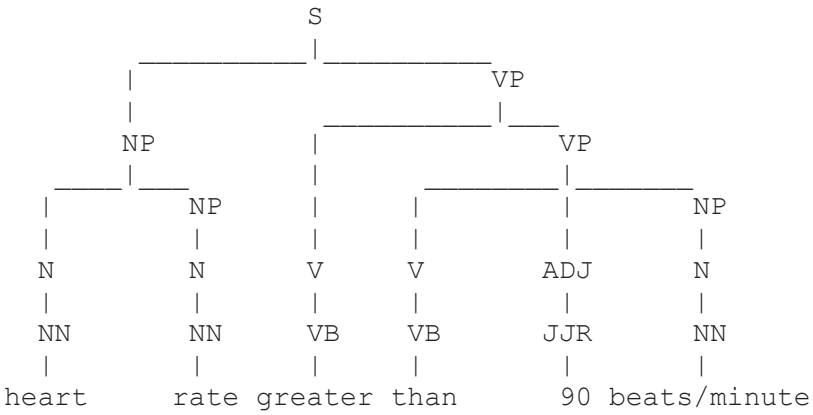
1.5 Test Scenario 5

Input: Heart rate greater than 90 beats/minute

Result: The proofreading results and text preprocess pipeline can be delivered, and the programme can operate correctly. Earley parse process results are displayed below.



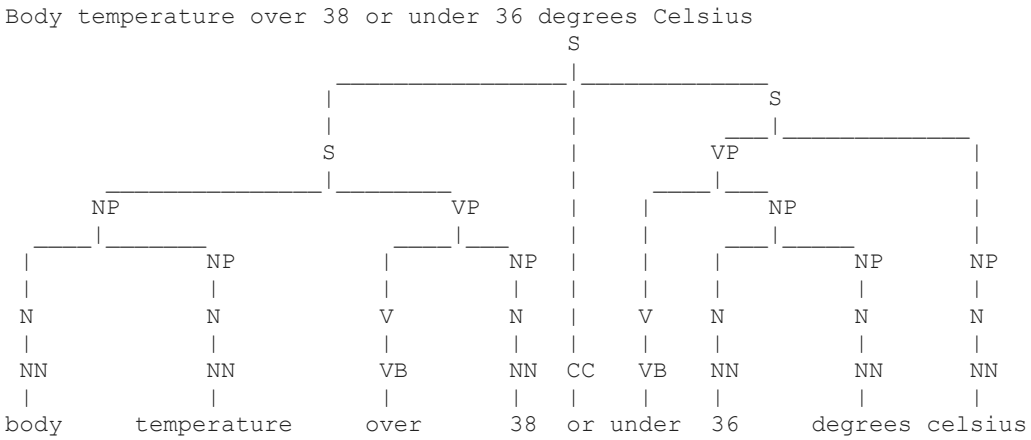


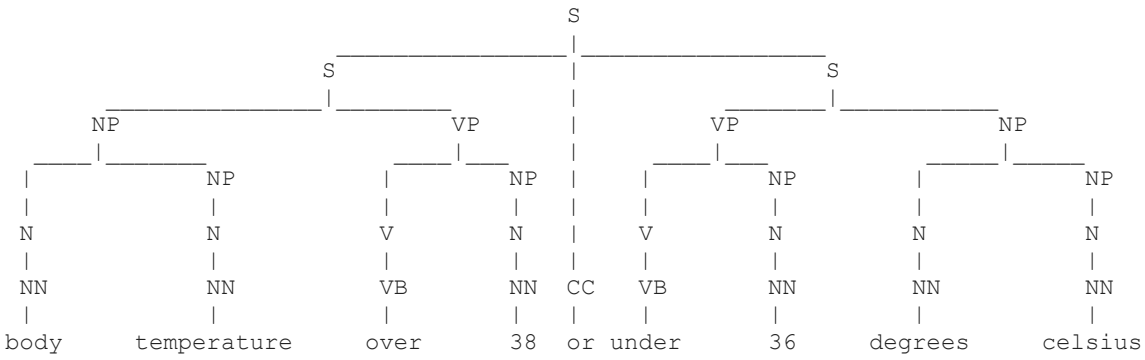


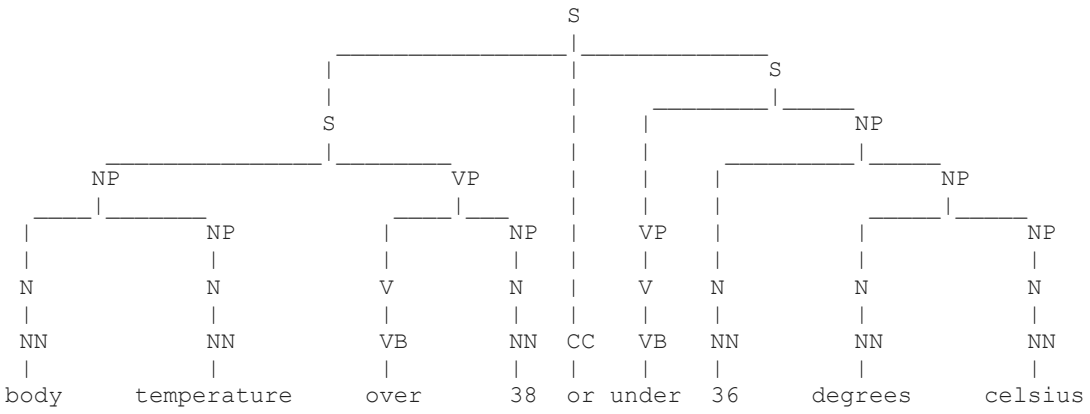
1.6 Test Scenario 6

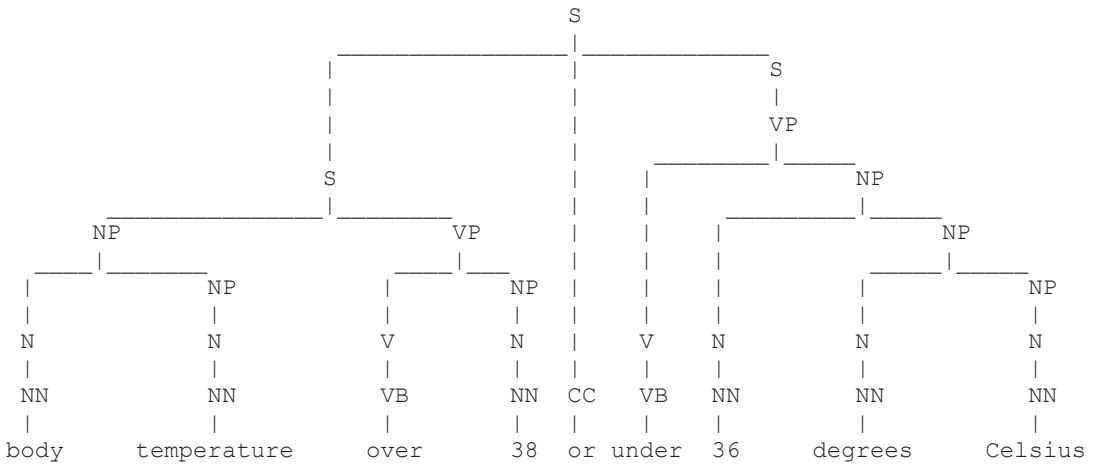
Input: Body temperature over 38 or under 36 degrees Celsius.

Result: The proofreading results and text preprocess pipeline can be delivered, and the programme can operate correctly. Earley parse process results are displayed below.





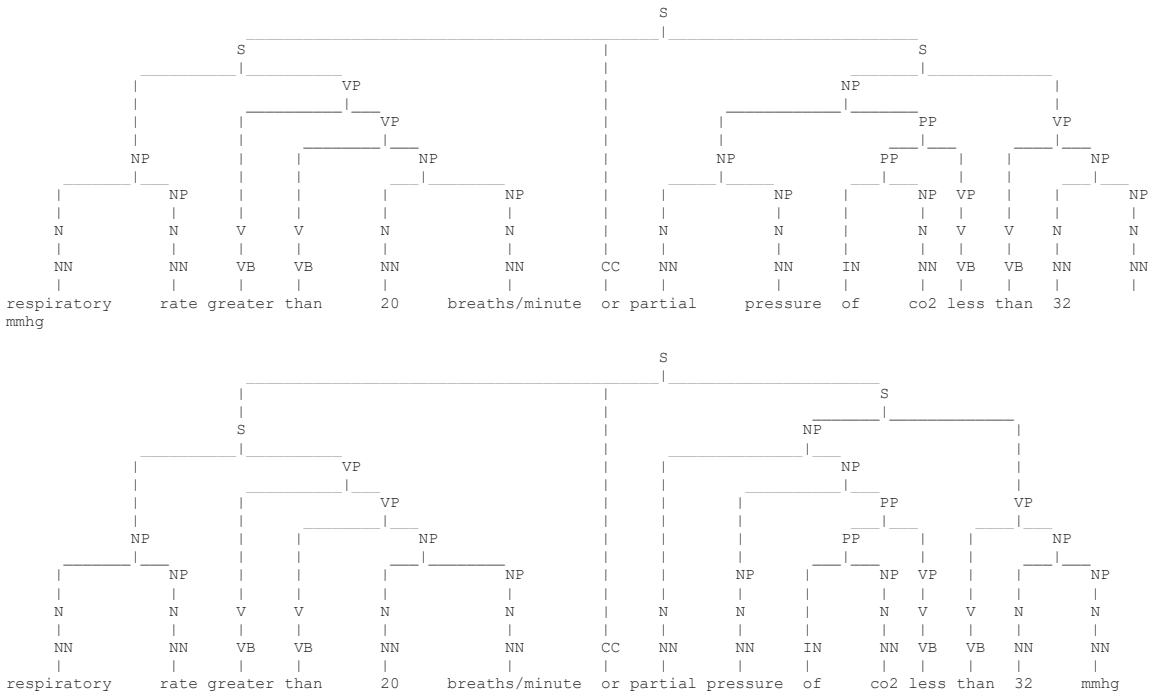


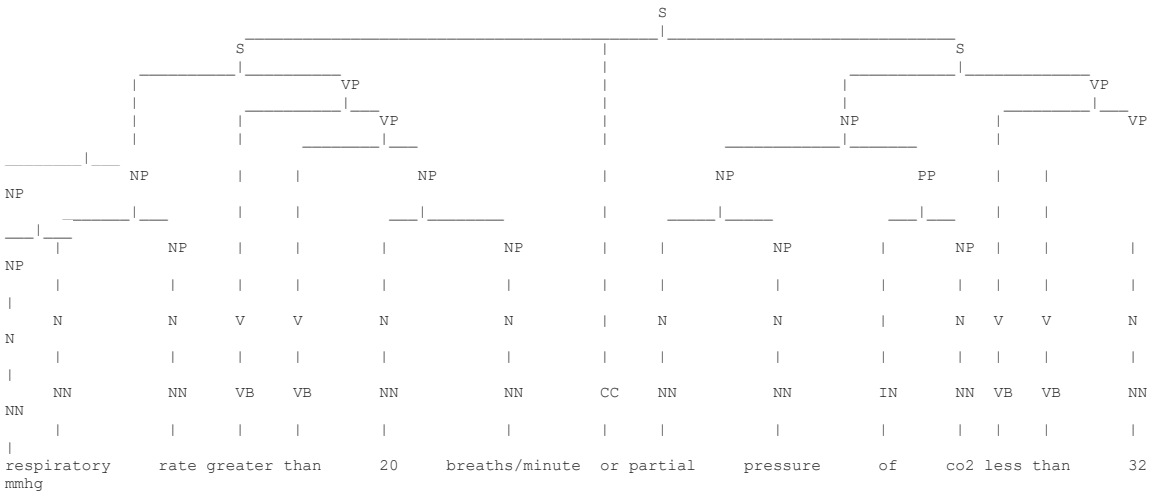


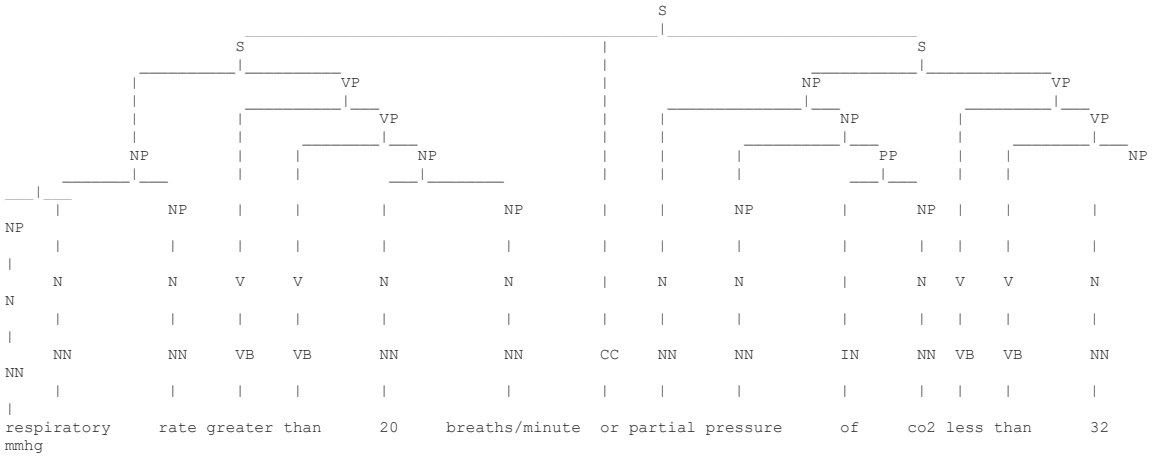
1.7 Test Scenario 7

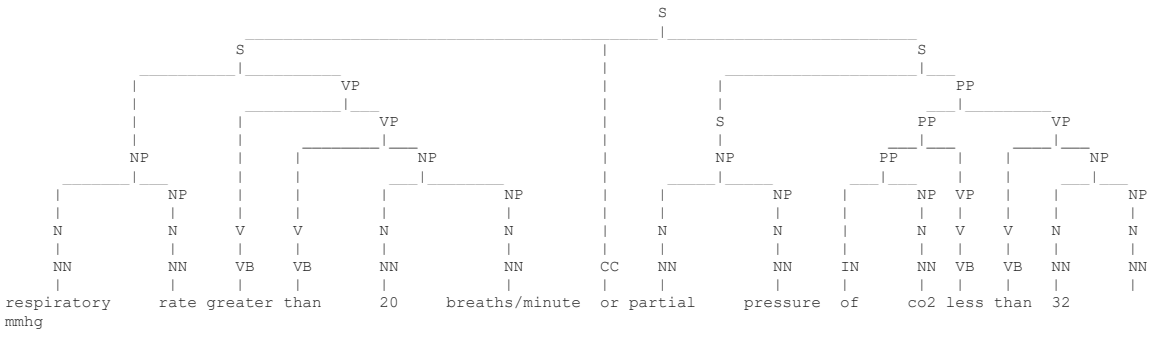
Input: Respiratory rate greater than 20 breaths/minute or partial pressure of CO2 less than 32 mmHg

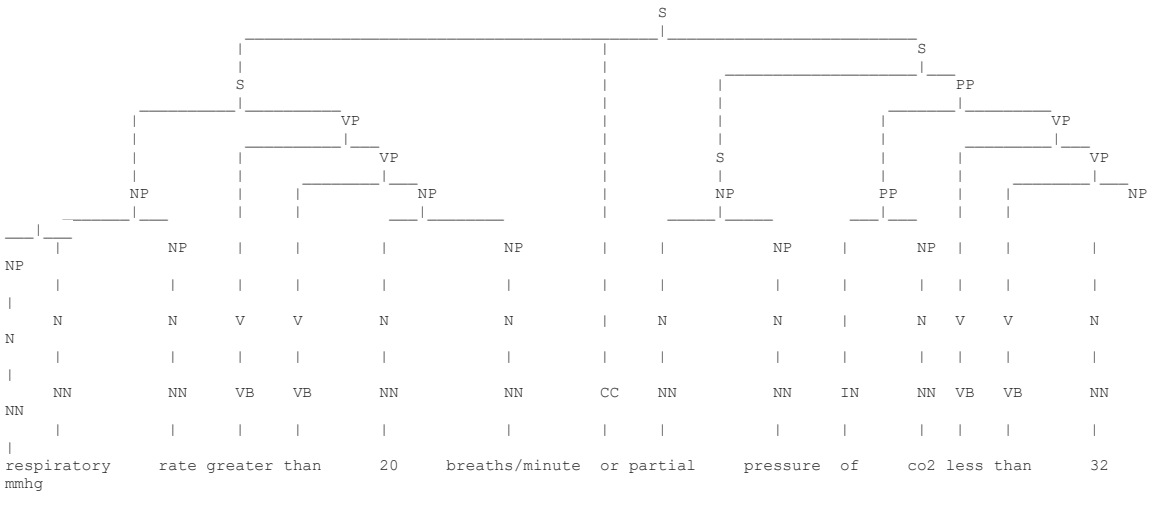
Result: The proofreading results and text preprocess pipeline can be delivered, and the programme can operate correctly. Earley parse process results are displayed below.




respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg


respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg


respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg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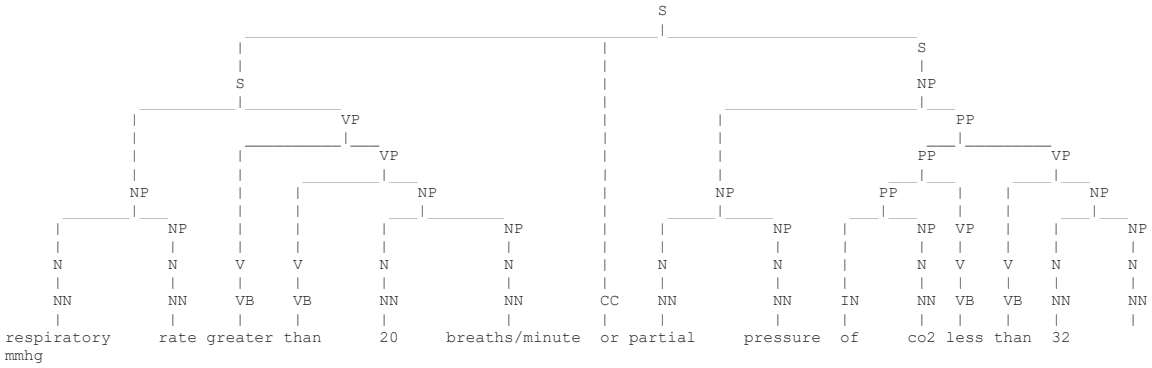
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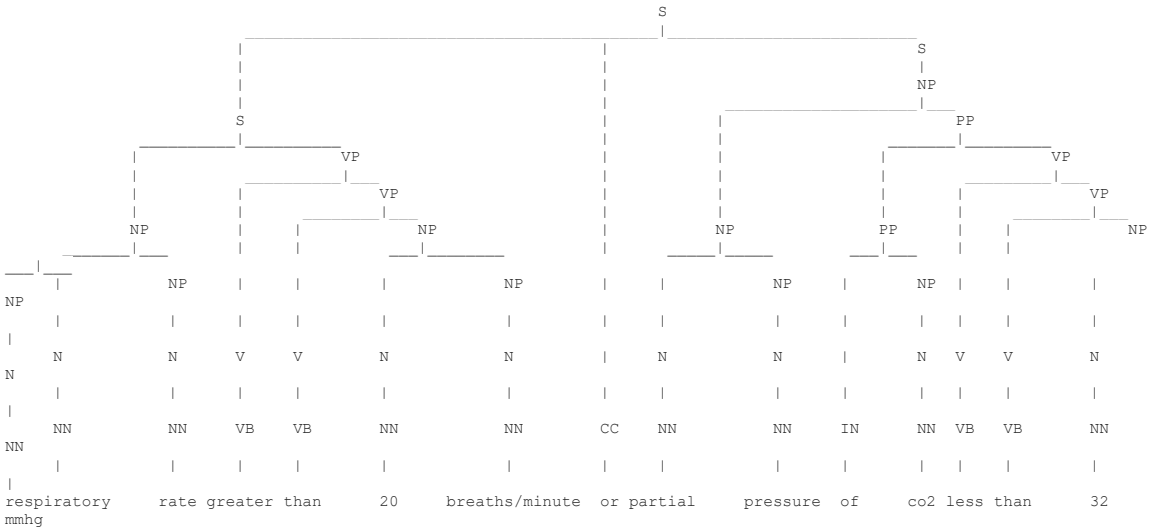
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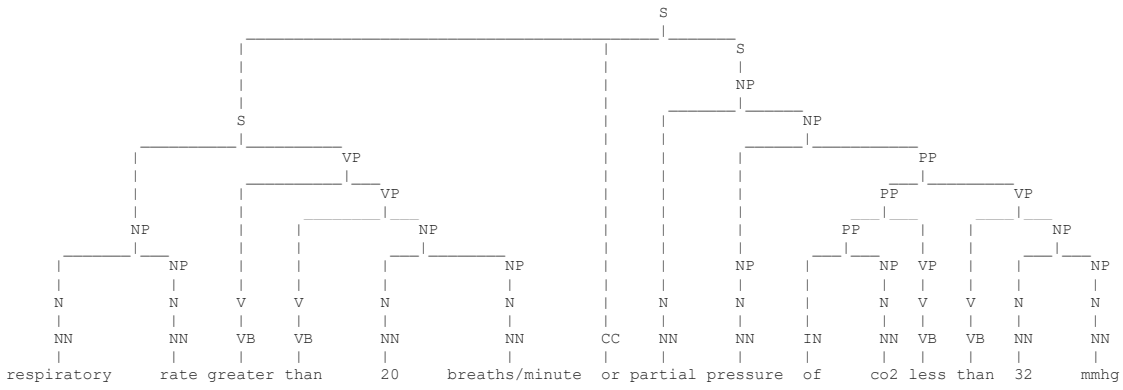
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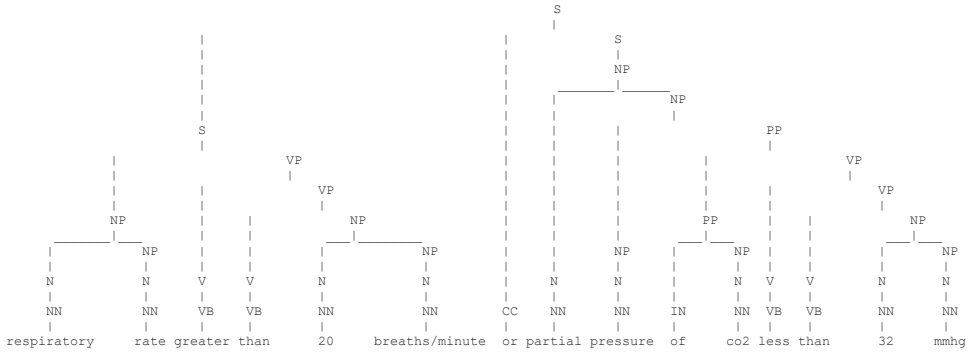
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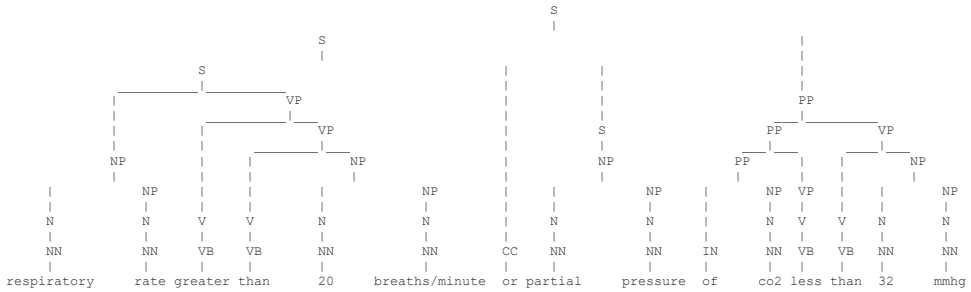
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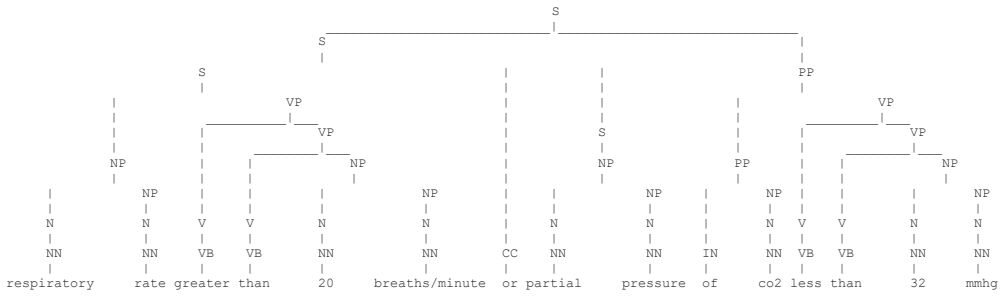
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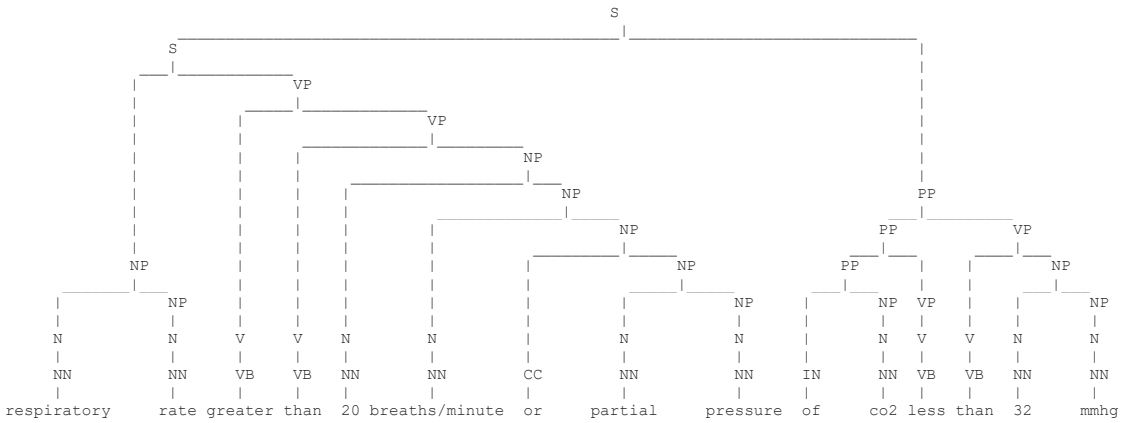
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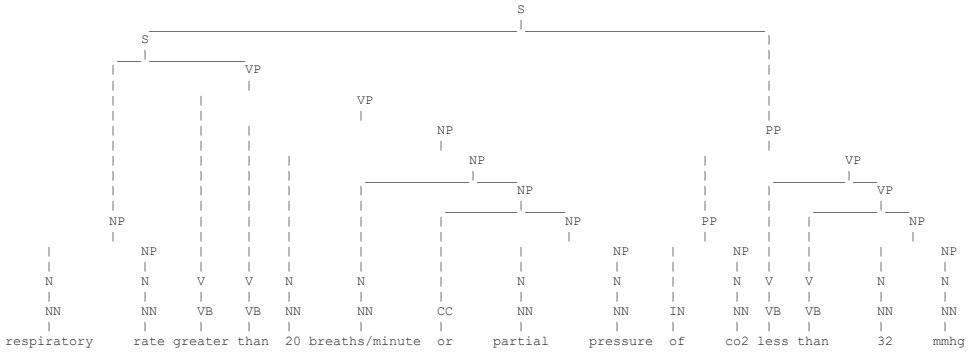
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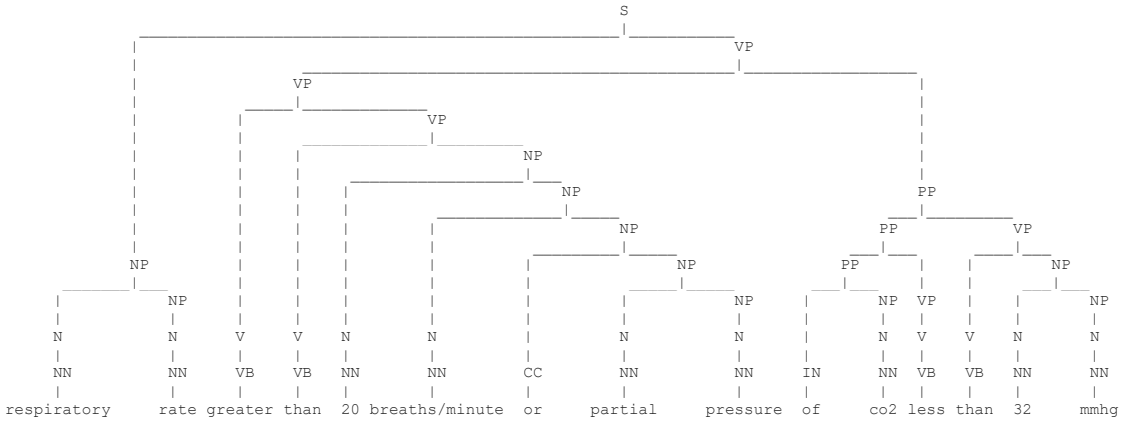
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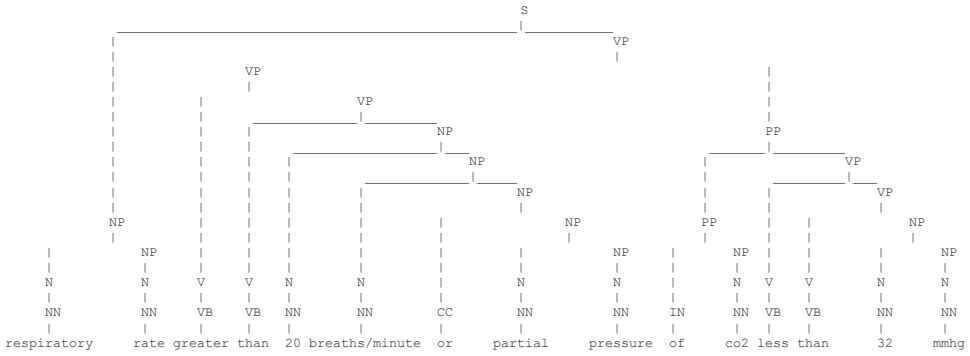
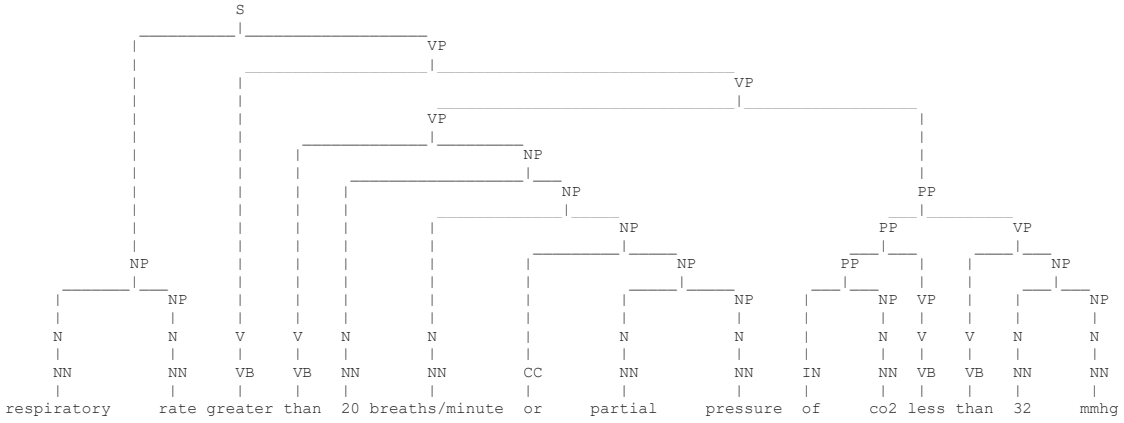
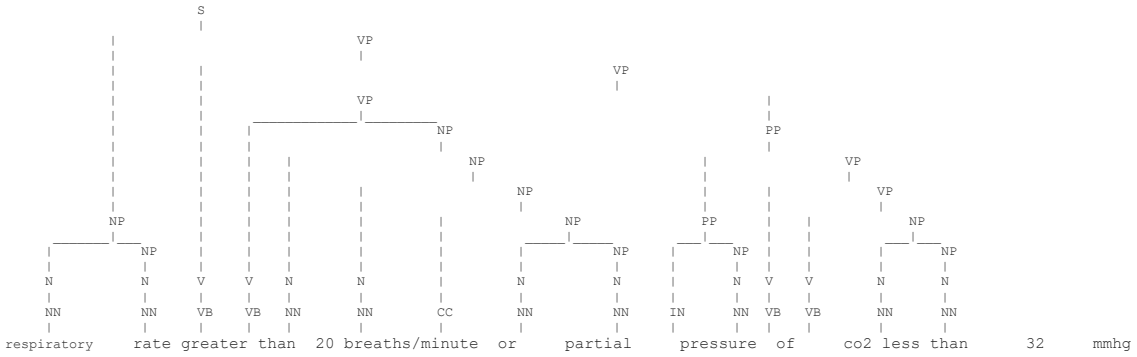
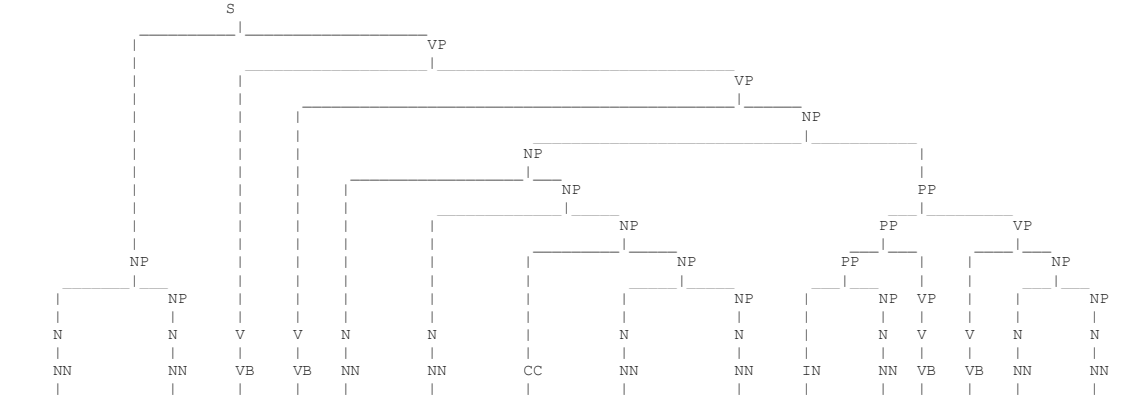
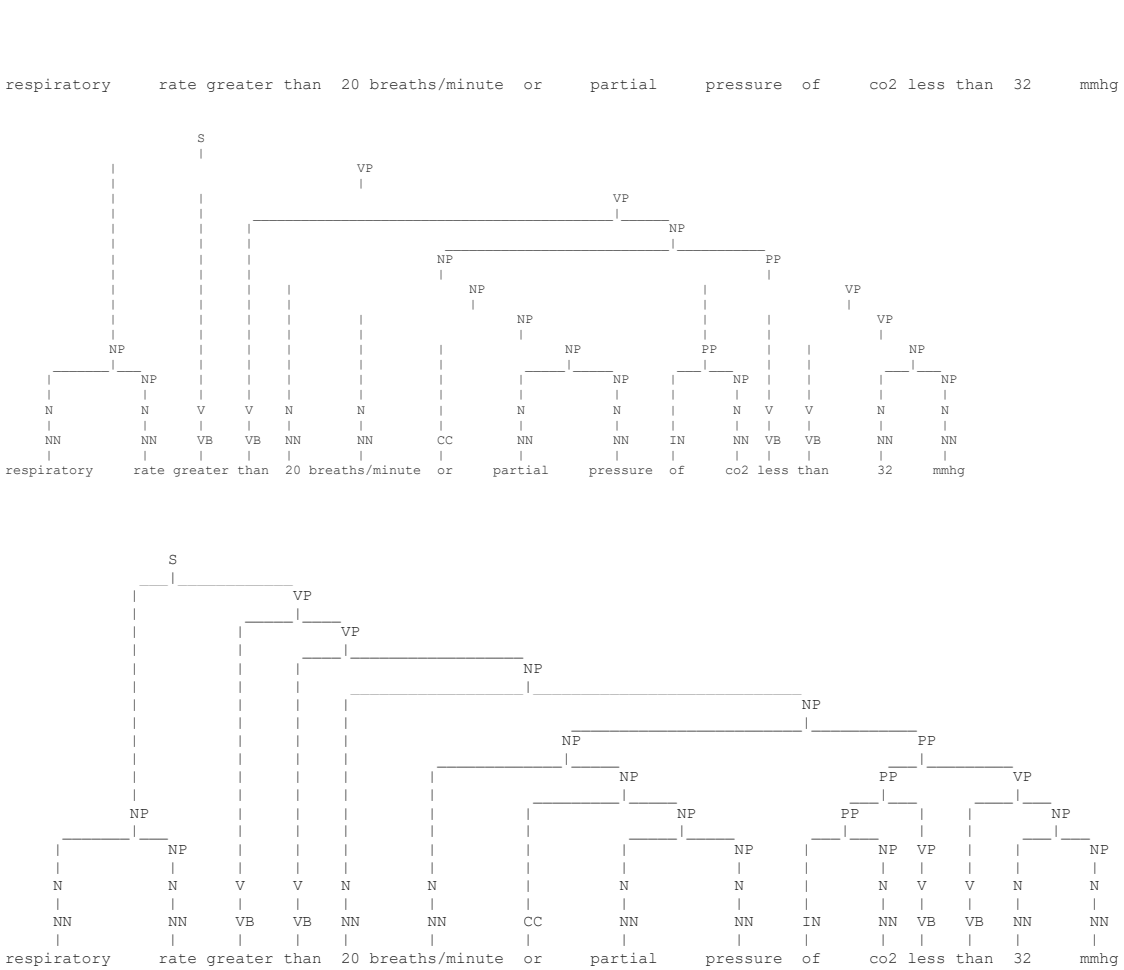

respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg


respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg


respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg




respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg
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respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg
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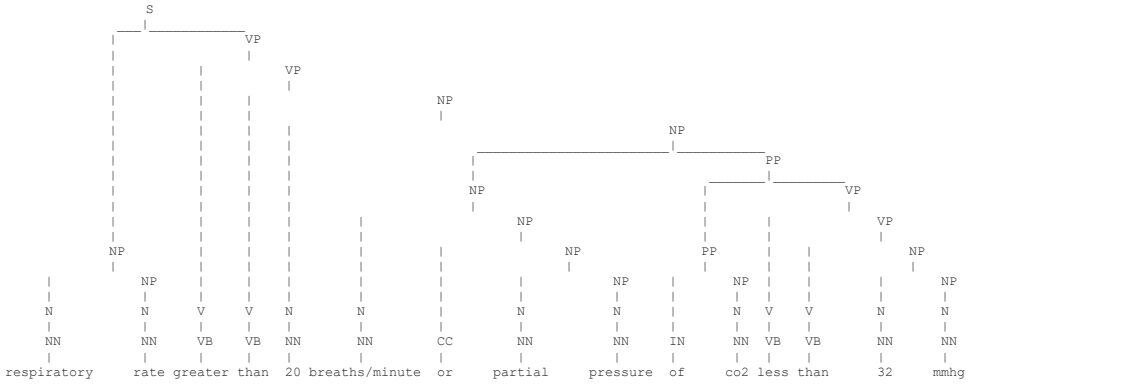
respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg
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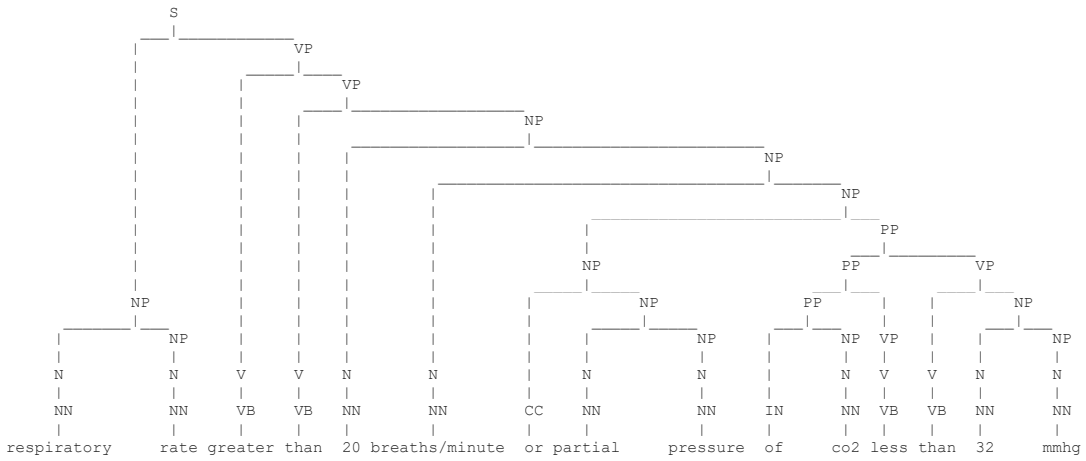
respiratory rate greater than 20 breaths/minute or partial pressure of co2 less than 32 mmhg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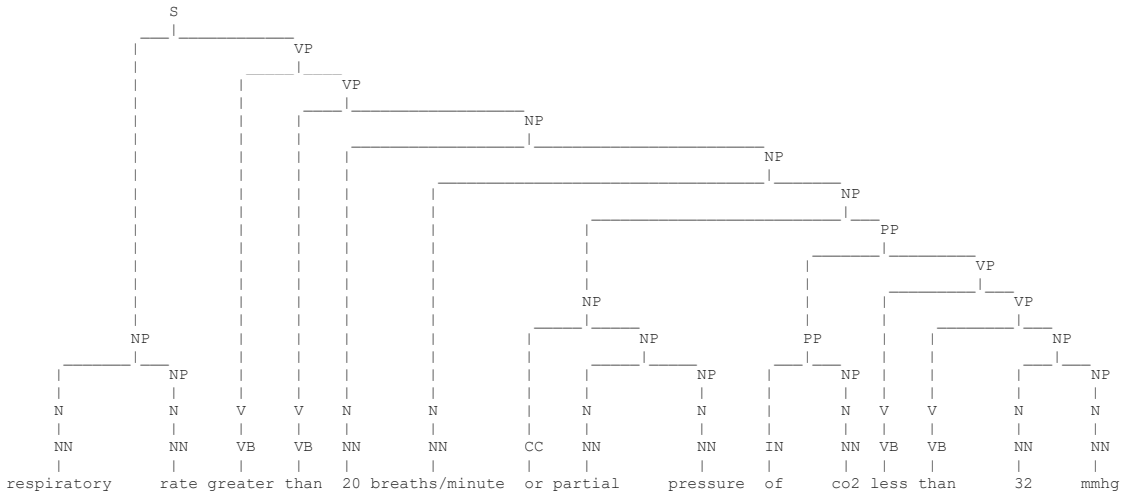
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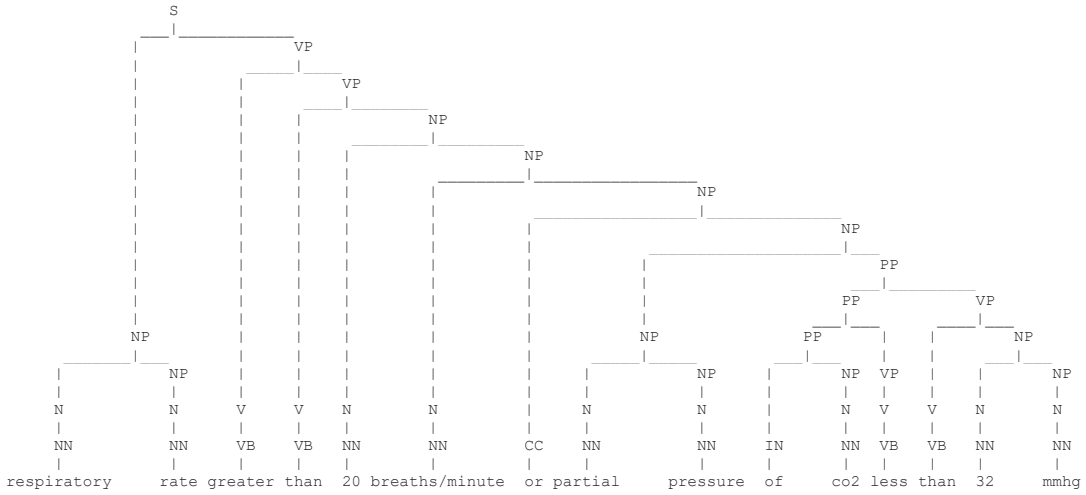
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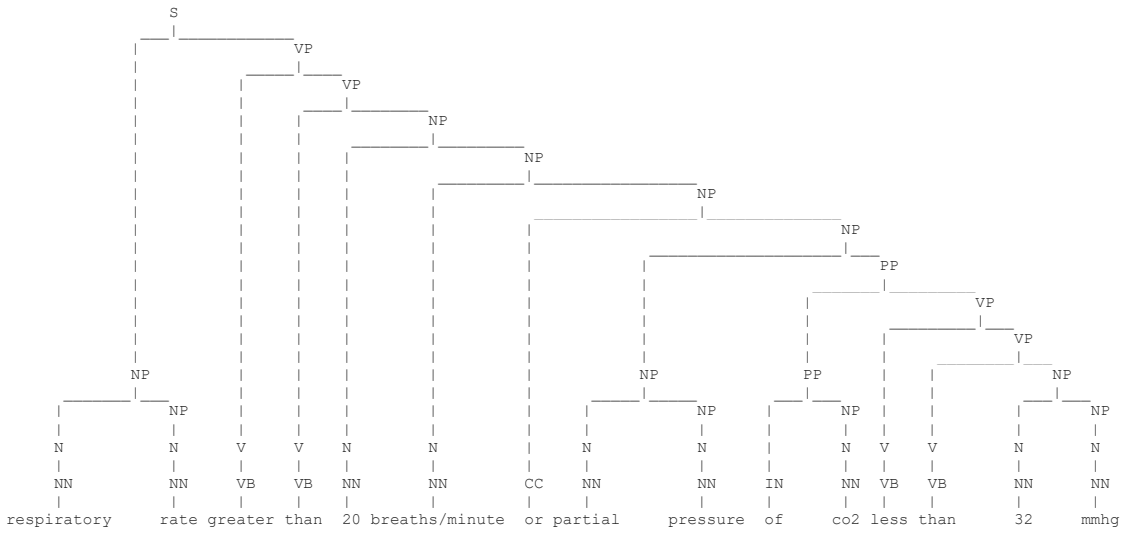
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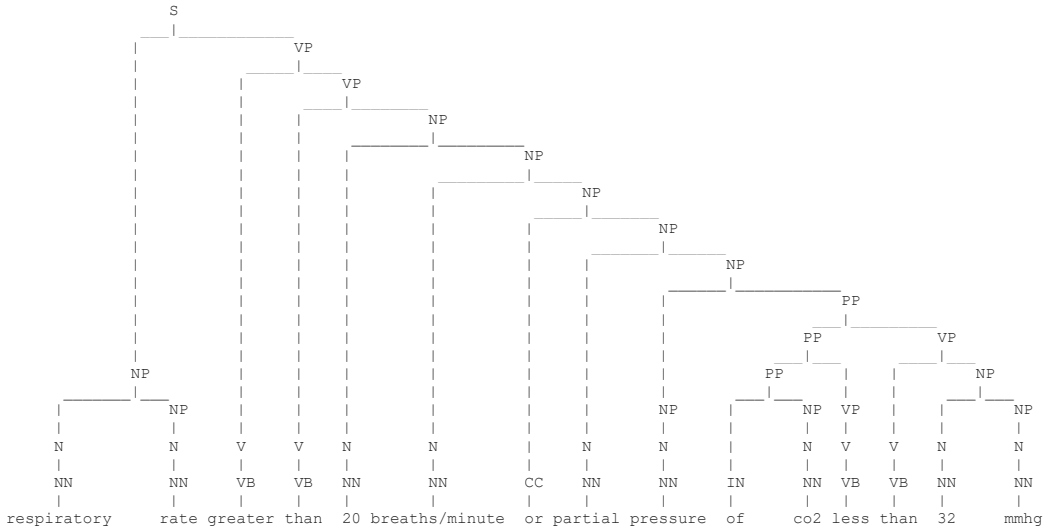
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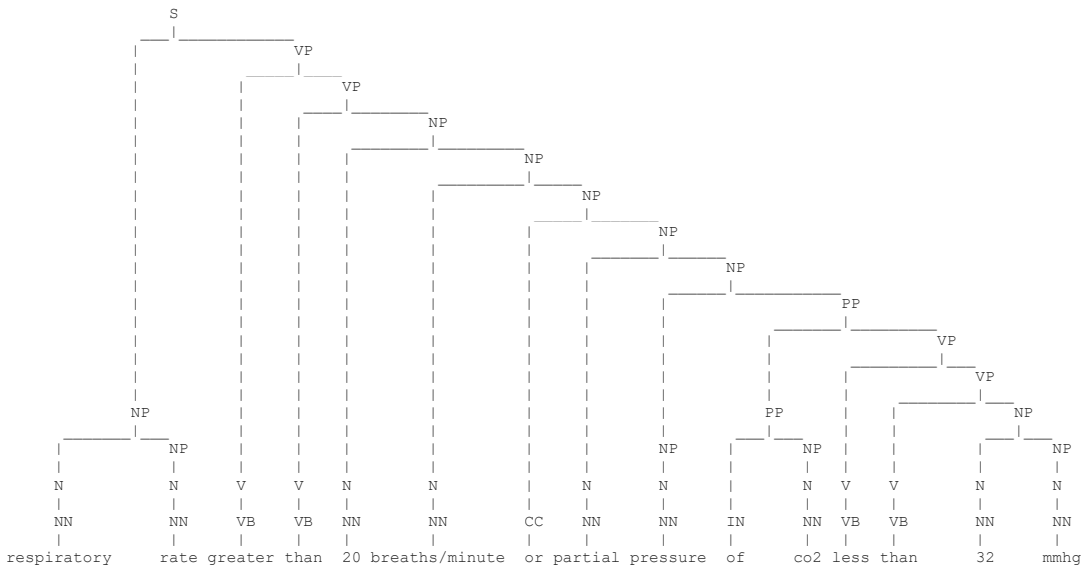
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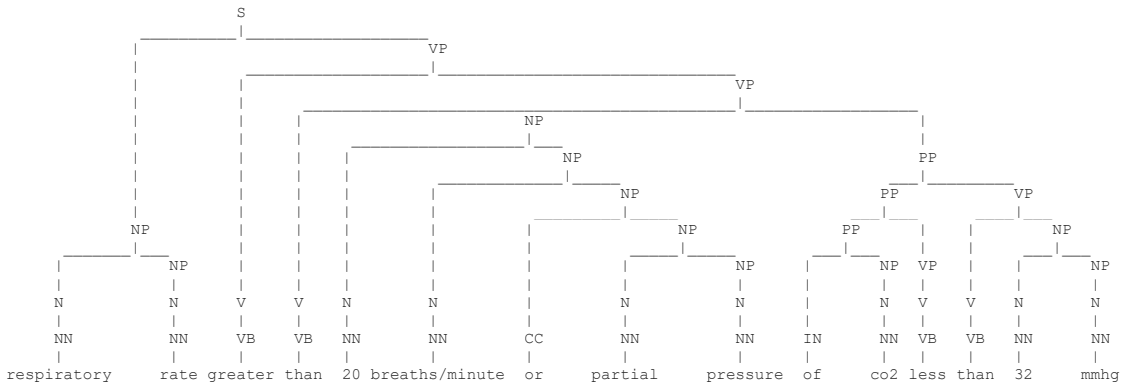

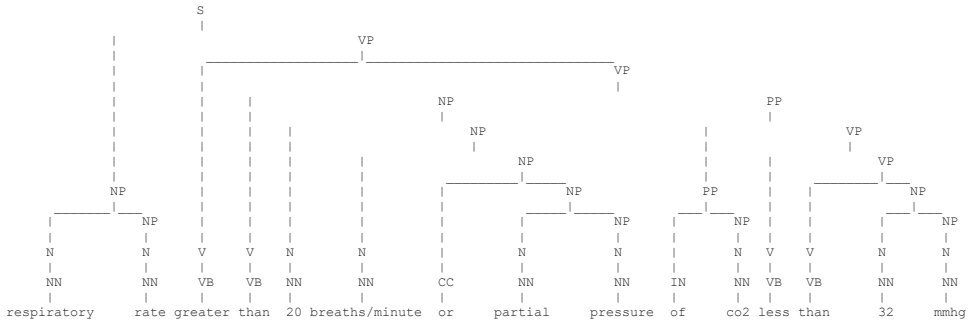

2. Outputs in CoNLL Format

For getting the output of CFG in CoNLL format, I wrote the below code,

```
# Parse and annotate sentences
for sentence in sentences:
    # Process the sentence with spaCy
    doc = nlp(sentence)

    # Extract POS and NE information and annotate with Ent and MeasEnt
    token_index = 1
    for token in doc:
        word = token.text
        pos = token.pos_
        ne = token.ent_type_  # Named Entity (NE) label
        ent = "Ent"  # Entity Type (customize based on your data)
```

```
        meas_ent = "MeasEnt"  # Measured Entity (customize based on your
data)

        # Format and print each token's information in CoNLL format
        print(f"{token_index}\t{word}\t_\t{pos}\t{ne}\t{ent}\t{meas_ent}")
        token_index += 1

    # Print an empty line to separate sentences
    print()
```

The corresponding output in CoNLL format that I get are given below,

John ate the apple at the table.

```
1     John   _     PROPN PERSON     Ent   MeasEnt
2     ate    _     VERB       Ent   MeasEnt
3     the    _     DET        Ent   MeasEnt
4     apple  _     NOUN       Ent   MeasEnt
5     at     _     ADP        Ent   MeasEnt
6     the    _     DET        Ent   MeasEnt
7     table  _     NOUN       Ent   MeasEnt
8     .      _     PUNCT      Ent   MeasEnt
```

John, who ate the apple from the fridge, was sick Wednesday.

```
1     John   _     PROPN PERSON     Ent   MeasEnt
2     ,      _     PUNCT      Ent   MeasEnt
3     who    _     PRON       Ent   MeasEnt
4     ate    _     VERB       Ent   MeasEnt
5     the    _     DET        Ent   MeasEnt
6     apple  _     NOUN       Ent   MeasEnt
7     from   _     ADP        Ent   MeasEnt
8     the    _     DET        Ent   MeasEnt
9     fridge       _     NOUN       Ent   MeasEnt
10    ,      _     PUNCT      Ent   MeasEnt
11    was    _     AUX        Ent   MeasEnt
12    sick   _     ADJ        Ent   MeasEnt
13    Wednesday    _     PROPN DATE  Ent   MeasEnt
14    .      _     PUNCT      Ent   MeasEnt
```

On Monday, John ate the apple in his office.

1	On	_	ADP		Ent	MeasEnt
2	Monday	_	PROPN	DATE	Ent	MeasEnt
3	,	_	PUNCT		Ent	MeasEnt
4	John	_	PROPN	PERSON	Ent	MeasEnt
5	ate	_	VERB		Ent	MeasEnt
6	the	_	DET		Ent	MeasEnt
7	apple	_	NOUN		Ent	MeasEnt
8	in	_	ADP		Ent	MeasEnt
9	his	_	PRON		Ent	MeasEnt
10	office	_	NOUN		Ent	MeasEnt
11	.	_	PUNCT		Ent	MeasEnt

Last week, on Monday, John finally took the apple from the fridge to his office.

1	Last	_	ADJ	DATE	Ent	MeasEnt
2	week	_	NOUN	DATE	Ent	MeasEnt
3	,	_	PUNCT		Ent	MeasEnt
4	on	_	ADP		Ent	MeasEnt
5	Monday	_	PROPN	DATE	Ent	MeasEnt
6	,	_	PUNCT		Ent	MeasEnt
7	John	_	PROPN	PERSON	Ent	MeasEnt
8	finally	_	ADV		Ent	MeasEnt
9	took	_	VERB		Ent	MeasEnt
10	the	_	DET		Ent	MeasEnt
11	apple	_	NOUN		Ent	MeasEnt
12	from	_	ADP		Ent	MeasEnt
13	the	_	DET		Ent	MeasEnt
14	fridge	_	NOUN		Ent	MeasEnt
15	to	_	ADP		Ent	MeasEnt
16	his	_	PRON		Ent	MeasEnt
17	office	_	NOUN		Ent	MeasEnt
18	.	_	PUNCT		Ent	MeasEnt

Heart rate greater than 90 beats/minute

1	Heart	_	NOUN	Ent	MeasEnt
2	rate	_	NOUN	Ent	MeasEnt
3	greater	_	ADJ	Ent	MeasEnt
4	than	_	ADP	Ent	MeasEnt
5	90	_	NUM	Ent	MeasEnt
6	beats	_	NOUN	Ent	MeasEnt
7	/	_	SYM	Ent	MeasEnt
8	minute	_	NOUN	Ent	MeasEnt

Body temperature over 38 or under 36 degrees Celsius.

1	Body	_	NOUN		Ent	MeasEnt	
2	temperature	_	NOUN		Ent	MeasEnt	
3	over	_	ADP		Ent	MeasEnt	
4	38	_	NUM	DATE	Ent	MeasEnt	
5	or	_	CCONJ		Ent	MeasEnt	
6	under	_	ADP		Ent	MeasEnt	
7	36	_	NUM	QUANTITY		Ent	MeasEnt
8	degrees	_	NOUN	QUANTITY		Ent	MeasEnt
9	Celsius	_	NOUN	QUANTITY		Ent	MeasEnt
10	.	_	PUNCT		Ent	MeasEnt	

Respiratory rate greater than 20 breaths/minute or partial pressure of CO2 less than 32 mmHg

1	Respiratory	_	ADJ			Ent	MeasEnt
2	rate	_	NOUN		Ent	MeasEnt	
3	greater	_	ADJ	CARDINAL		Ent	MeasEnt
4	than	_	ADP	CARDINAL		Ent	MeasEnt
5	20	_	NUM	CARDINAL		Ent	MeasEnt
6	breaths	_	NOUN		Ent	MeasEnt	
7	/	_	SYM		Ent	MeasEnt	
8	minute	_	NOUN		Ent	MeasEnt	
9	or	_	CCONJ		Ent	MeasEnt	
10	partial	_	ADJ		Ent	MeasEnt	
11	pressure	_	NOUN		Ent	MeasEnt	
12	of	_	ADP		Ent	MeasEnt	
13	CO2	_	PROPN	CARDINAL		Ent	MeasEnt
14	less	_	ADJ		Ent	MeasEnt	
15	than	_	ADP		Ent	MeasEnt	
16	32	_	NUM	CARDINAL		Ent	MeasEnt
17	mmHg	_	NOUN		Ent	MeasEnt	

Leukocyte count greater than 12000 or less than 4000 /microliters or over 10% immature forms or bands.

1	Leukocyte	_	PROPN	ORG	Ent	MeasEnt	
2	count	_	VERB		Ent	MeasEnt	
3	greater	_	ADJ		Ent	MeasEnt	
4	than	_	ADP		Ent	MeasEnt	
5	12000	_	NUM	DATE	Ent	MeasEnt	
6	or	_	CCONJ		Ent	MeasEnt	
7	less	_	ADJ	CARDINAL		Ent	MeasEnt
8	than	_	ADP	CARDINAL		Ent	MeasEnt
9	4000	_	NUM	CARDINAL		Ent	MeasEnt
10	/microliters	_	NOUN			Ent	MeasEnt
11	or	_	CCONJ		Ent	MeasEnt	
12	over	_	ADP	PERCENT	Ent	MeasEnt	
13	10	_	NUM	PERCENT	Ent	MeasEnt	
14	%	_	NOUN	PERCENT	Ent	MeasEnt	
15	immature	_	ADJ		Ent	MeasEnt	
16	forms	_	NOUN		Ent	MeasEnt	
17	or	_	CCONJ		Ent	MeasEnt	
18	bands	_	NOUN		Ent	MeasEnt	
19	.	_	PUNCT		Ent	MeasE	

3. Limitations

The CFG grammar I developed for this project mostly work for all the validation data in terms of Earley parse output and CoNLL format output. Yet, the 8th sentence which was “Leukocyte count greater than 12000 or less than 4000 /microliters or over 10% immature forms or bands.”, it gave error while producing the Earley parse output. This is because some of the word lexicons in this particular sentence are beyond the capacity of my CFG grammar. Probably in the next project I will attempt to fix it as an extension of this current project.