SNLP Assignment 5

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1. Context Free Grammars

1.1. POS-Tags
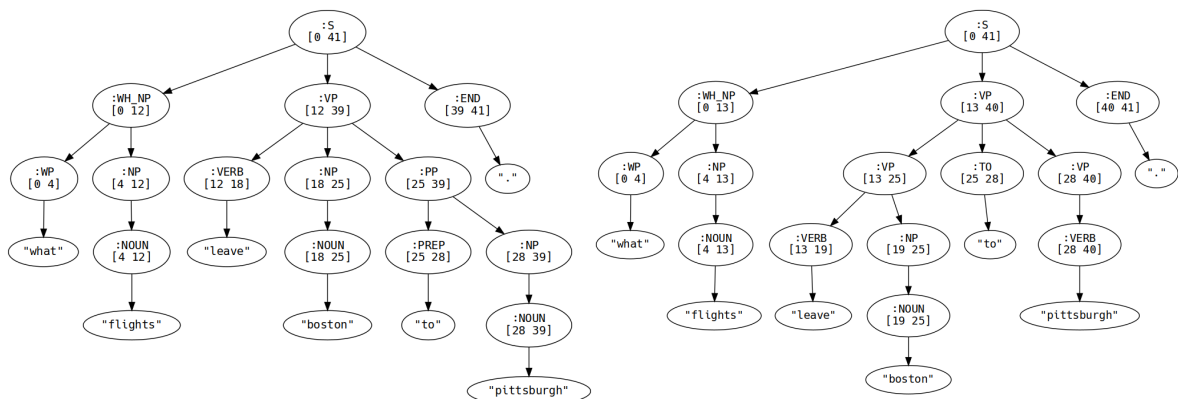
- `what_WDT flights_NNS leave_VBP boston_NN to_TO pittsburgh_NN ._.`
- `what_WDT flights_NNS leave_VBP los_NNS angeles_NNS arriving_VBG in_IN minneapolis_NN ._.`
- `what_WDT flights_NNS are_VBP available_JJ between_IN chicago_NNP and_CC indianapolis_NNP ._.`
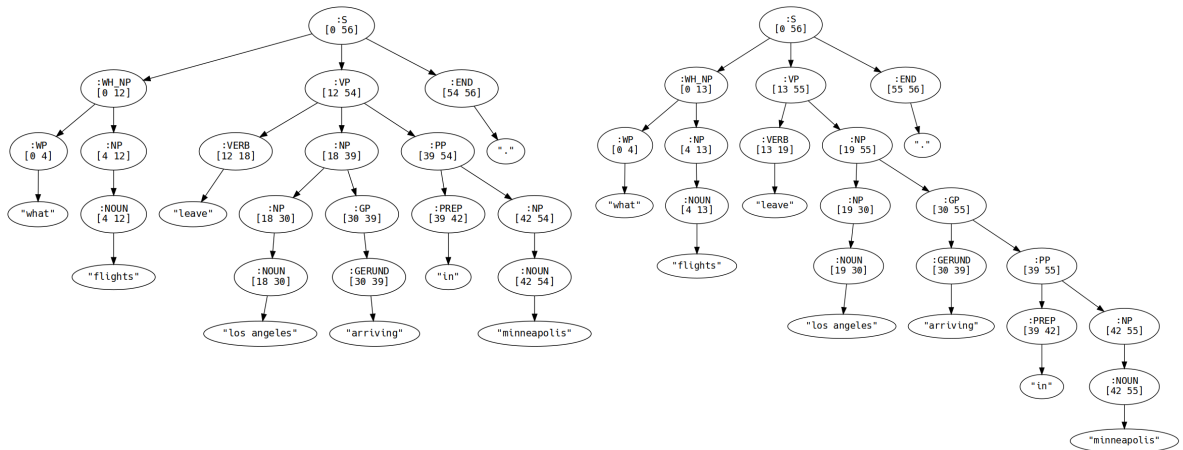
1.2. Context Free Grammar

```
S ::= NP VP END | VP END | WH_NP VP END
NP ::= NOUN | NP GP | NP CC NP
VP ::= VERB | VERB NP | VERB PP | VERB NP PP | BE GP | BE AP | VP TO VP | VP CC VP
GP ::= GERUND | GERUND NP | GERUND PP | GERUND NP PP
AP ::= ADJ | ADJ PP
WH_NP ::= WP NP
PP ::= PREP NP
WP ::= 'what'
CC ::= 'and'
NOUN ::= 'flights' | 'boston' | 'pittsburgh' | 'los angeles'
       | 'minneapolis' | 'chicago' | 'indianapolis'
VERB ::= 'leave' | 'pittsburgh' | 'indianapolis'
GERUND ::= 'arriving'
BE ::= 'are'
TO ::= 'to'
PREP ::= 'in' | 'to' | 'between'
ADJ ::= 'available'
END ::= '.' | '?'
```
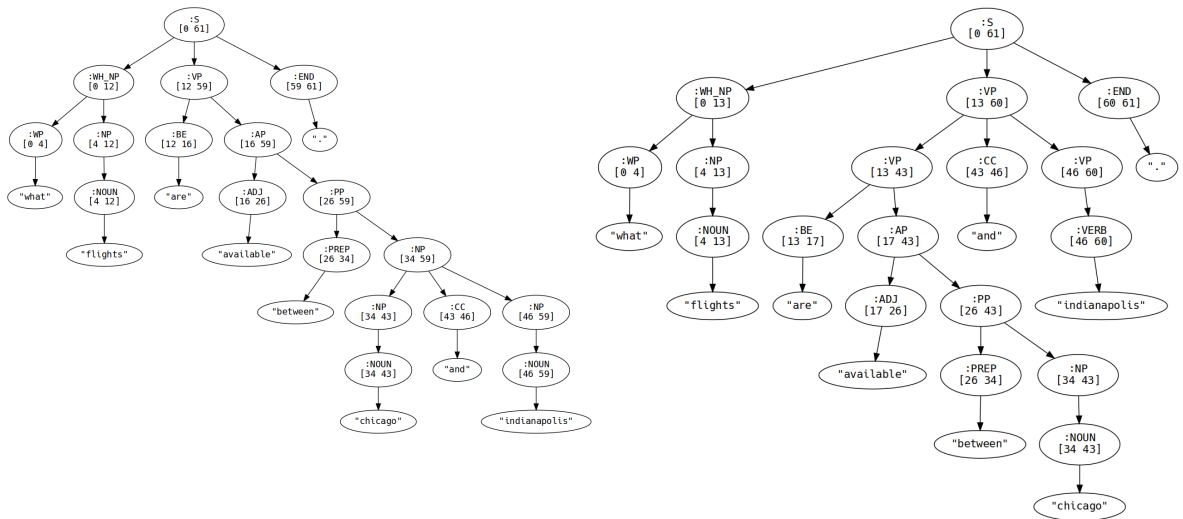
1.3. CFG Parse Trees

- `what flights leave boston to pittsburgh .`

- what flights leave los angeles arriving in minneapolis .

- what flights are available between chicago and indianapolis .

1.4. Chomsky Normal Form
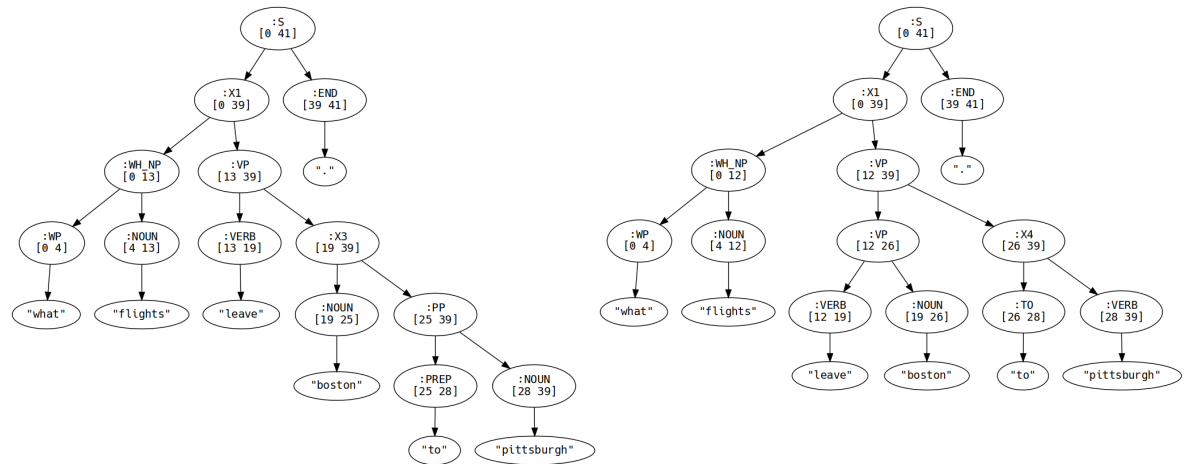
1.4.1. CNF Grammar

```
S   ::= X1 END | VP END | VERB END
X1  ::= NP VP | NOUN VP | WH_NP VP | NP VERB | NOUN VERB | WH_NP VERB
NP  ::= NP GP | NP X2 | NOUN GP | NOUN X2 | NP GERUND | NOUN GERUND
X2  ::= CC NP | CC NOUN
VP  ::= VERB NP | VERB NOUN | VERB PP | VERB X3 | BE GP | BE GERUND
        | BE AP | BE ADJ | VP X4 | VERB X4
X3  ::= NP PP | NOUN PP
X4  ::= TO VP | TO VERB | CC VP | CC VERB
GP  ::= GERUND NP | GERUND PP | GERUND X3
AP  ::= ADJ PP
WH_NP ::= WP NP | WP NOUN
PP  ::= PREP NP | PREP NOUN
WP  ::= 'what'
CC  ::= 'and'
NOUN ::= 'flights' | 'boston' | 'pittsburgh' | 'los angeles'
         | 'minneapolis' | 'chicago' | 'indianapolis'
VERB ::= 'leave' | 'pittsburgh' | 'indianapolis'
GERUND ::= 'arriving'
BE  ::= 'are'
TO  ::= 'to'
PREP ::= 'in' | 'to' | 'between'
ADJ ::= 'available'
END ::= '.' | '?'
```
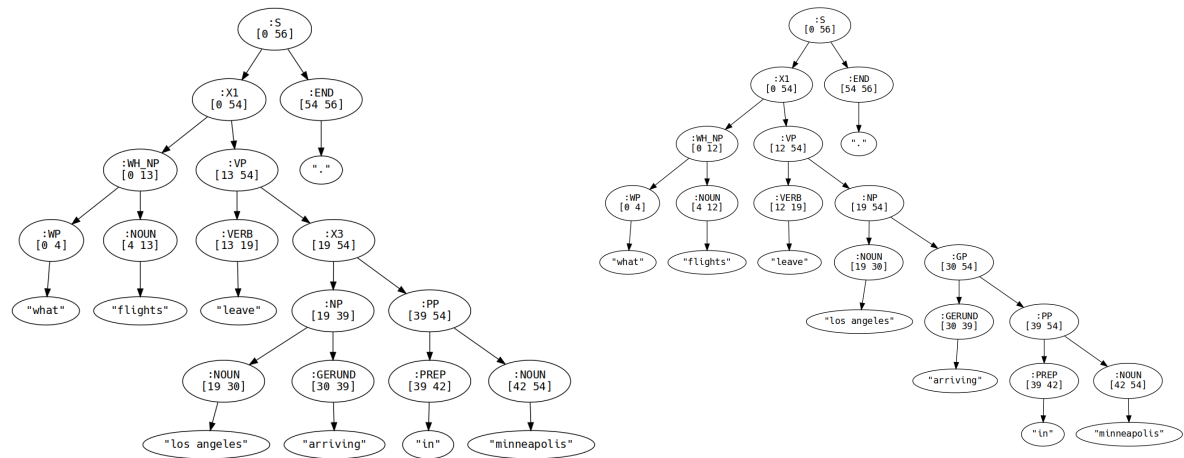
1.4.2. CNF Parse Trees

- what flights leave boston to pittsburgh .

- what flights leave los angeles arriving in minneapolis .

- what flights are available between chicago and indianapolis .