NLP

Introduction to NLP

NLP Tasks

Part of Speech Tagging

The swimmer is getting ready to run in the final race.

Part of Speech Tagging

The swimmer is getting ready to **run** in the final race.

- Run – verb or noun?
- Final – noun or adjective?
- Race – verb or noun?

Part of Speech Tagging

The candidate is preparing for his **run** for the presidency.
The swimmer is getting ready to **run** in the final race.

Parsing

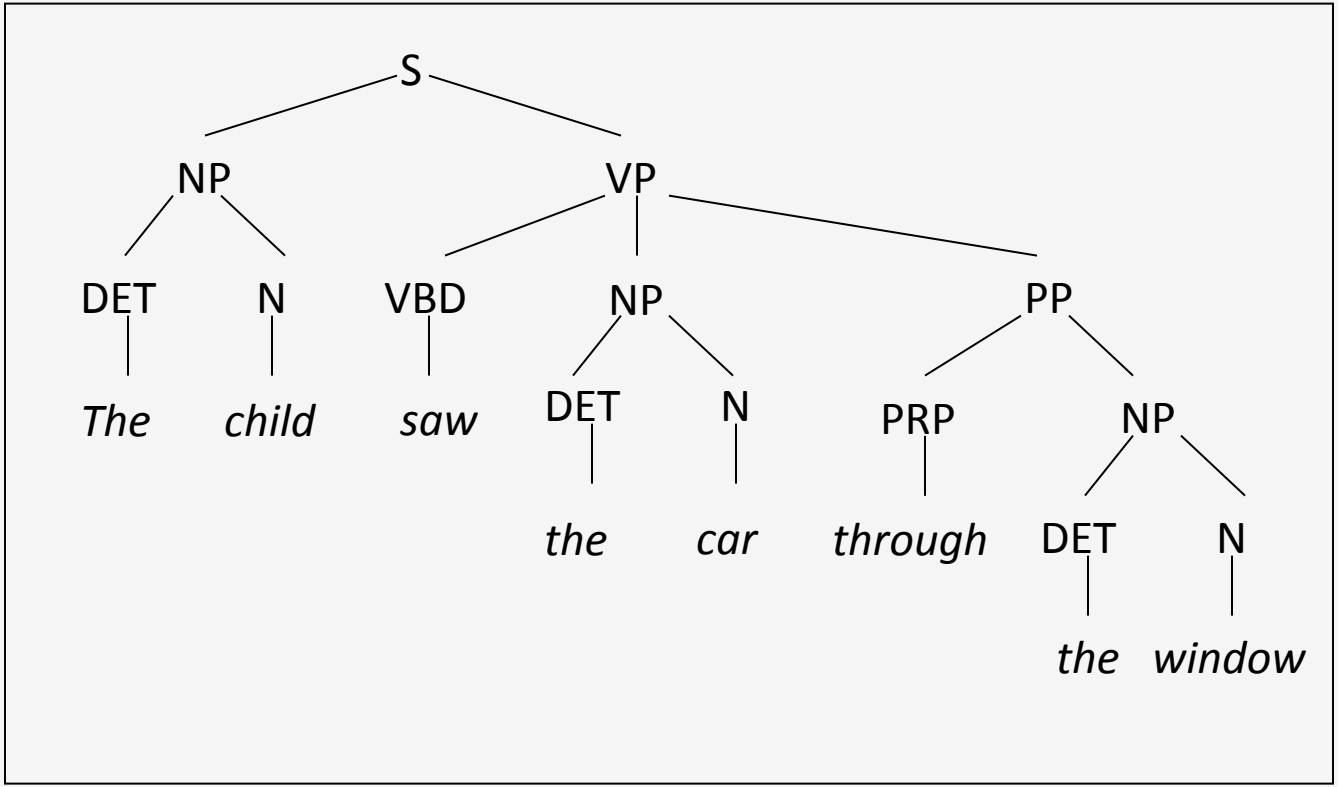
- Myriam slept.
- Myriam wrote a novel.
- Myriam gave Sally flowers.
- Myriam ate pizza with olives.
- Myriam ate pizza with Sally.
- Myriam ate pizza with a fork.
- Myriam ate pizza with remorse.

Phrase-Structure Grammar

```
S  → NP  VP
NP → DET N
NP → NP  PP
VP → VBD
VP → VBD NP
VP → VBD NP NP
VP → VP  PP
PP → PRP NP
```

```
DET → the
DET → that
DET → a
N   → child
N   → window
N   → car
VBD → found
VBD → ate
VBD → saw
PRP → in
PRP → of
PRP → through
```

Parse Trees


S
NP
VP
DET
N
VBD
NP
PP
The
child
saw
DET
N
PRP
NP
the
car
through
DET
N
the
window

Stanford Parser

Parser Output

```
(ROOT
  (S
    (S
      (NP
        (NP (NN Housing) (NNS starts))
        (, ,)
        (NP
          (NP (DT the) (NN number))
          (PP (IN of)
            (NP
              (NP (JJ new) (NNS homes))
              (VP (VBG being)
                (VP (VBN built))))))
        (, ,))
```

```
(VP (VBD rose)
        (NP (CD 7.2) (NN %))
        (PP (IN in)
          (NP (NNP March)))
        (PP (TO to)
          (NP
            (NP (DT an) (JJ annual) (NN rate))
            (PP (IN of)
              (NP (CD 549,000) (NNS units)))))
        (, ,)
        (ADVP (RB up)
          (PP (IN from)
            (NP
              (NP (DT a) (VBN revised) (CD 512,000))
              (PP (IN in)
                (NP (NNP February)))))))
    (, ,)
    (NP (DT the) (NNP Commerce) (NNP Department))
    (VP (VBD said))
    (. .)))
```

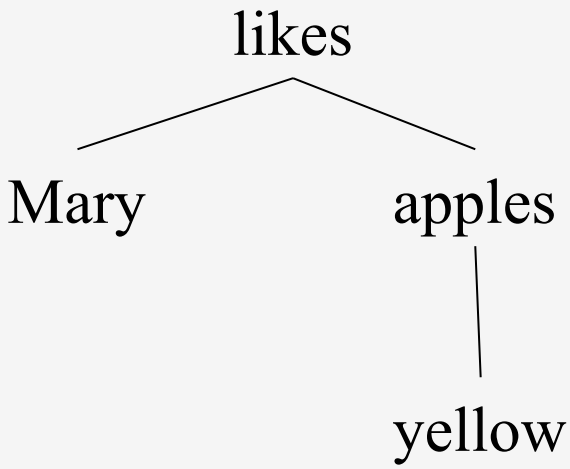
This Problem is Pretty // Easy

- Commercial for a phone company
- Garden path sentences
  - Don't bother coming
  - Don't bother coming early
  - Take the turkey out of the oven at five
  - Take the turkey out of the over at five to four
  - I got canned
  - I got canned peaches for dinner
  - All Americans need to buy a house
  - All Americans need to buy a house is a lot of money
- Can you think of more such examples?

Solution

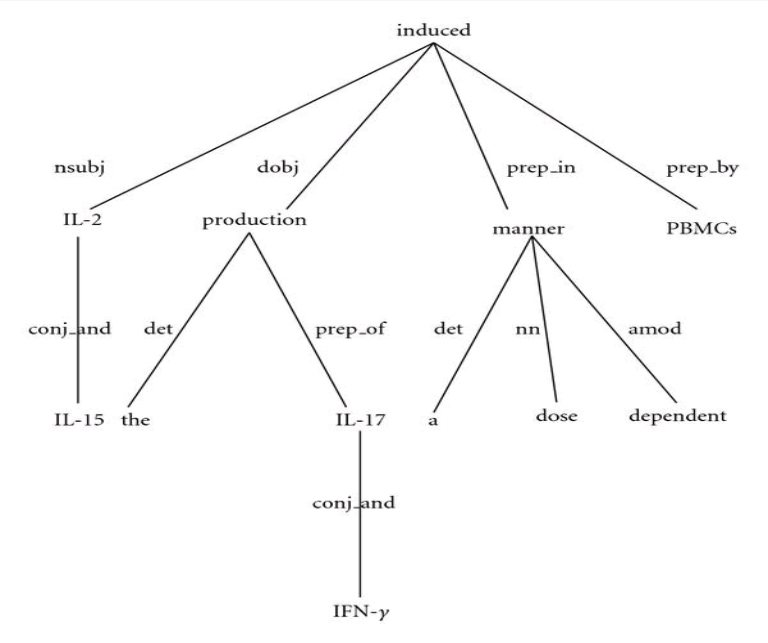
- This problem is pretty // easy
  - http://www.naclo.cs.cmu.edu/problems2007/N2007-HS.pdf
- Criteria
  - The part before // should be a complete sentence
  - The full sentence has a different meaning than the part before //
  - The part before // should not already be ambiguous

Dependency Parsing



Dependency Parsing

IL-2 and IL-15 induced the production of IL-17 and IFN-γ by PBMCs in a dose dependent manner.



Parser Output

nn(starts-2, Housing-1)
nsubj(rose-12, starts-2)
det(number-5, the-4)
appos(starts-2, number-5)
prep(number-5, of-6)
amod(homes-8, new-7)
pobj(of-6, homes-8)
auxpass(built-10, being-9)
partmod(homes-8, built-10)
ccomp(said-36, rose-12)
num(%-14, 7.2-13)
dobj(rose-12, %-14)
prep(rose-12, in-15)
pobj(in-15, March-16)
prep(rose-12, to-17)
det(rate-20, an-18)
amod(rate-20, annual-19)
pobj(to-17, rate-20)
prep(rate-20, of-21)
num(units-23, 549,000-22)
pobj(of-21, units-23)
advmod(rose-12, up-25)
dep(up-25, from-26)
det(512,000-29, a-27)
amod(512,000-29, revised-28)
pobj(from-26, 512,000-29)
prep(512,000-29, in-30)
pobj(in-30, February-31)
det(Department-35, the-33)
nn(Department-35, Commerce-34)
nsubj(said-36, Department-35)

NLP