Lecture 9: Semantic Parsing

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Couse webpage: https://uclanlp.github.io/CS269-17/

Paper summary

❖ Individual project, due: Sunday 11/18

❖ 1~2 pages: ~1,000 words

❖ Submit your summary at CCLE (pdf format, webpage, etc.)

❖ (optional) provide the link to your summary: https://goo.gl/m2GQ6S

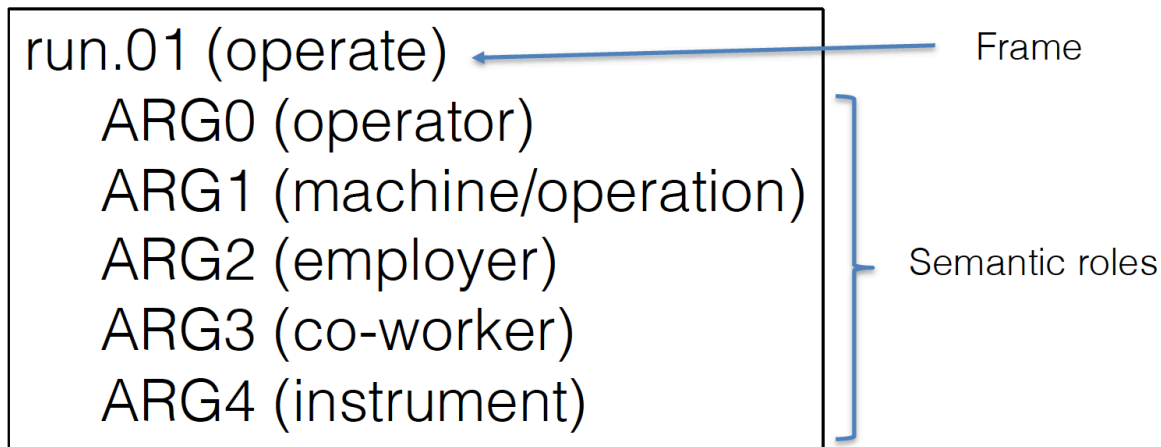❖ (optional) pull request at https://github.com/uclanlp/CS269-17/tree/master/summary

Computational Semantics

❖ Many high-level applications

  ❖ Question answering

  ❖ Information extraction

  ❖ Internet bots

  ❖ Siri/Cortana/Alexa/Google Now

  ❖ Translation

❖ Shallow vs. deep semantics

  ❖ Cheap, fast, low-level techniques v.s. computational expensive, high-level techniques

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Semantic Roles

❖ **Predicates:** some words represent events

❖ **Arguments:** specific roles that involves in the event

❖ PropBank

Several other alternative role lexicons

run.01 (operate) ← Frame
   ARG0 (operator)
   ARG1 (machine/operation)
   ARG2 (employer)
   ARG3 (co-worker)
   ARG4 (instrument)

Semantic roles

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Semantic Roles

> His father would come upstairs and stand self-consciously
> At the foot of the bed and look at his son.

	SRL	SRL	SRL	Nom	father	son	Preposition	Preposition	Preposition
His					relation receptor [A1]				
father				father.01	relation holder [A0]				
would	general modification [AM-MOD]	general modification [AM-MOD]							
come	V: come.01								
upstairs	entity in motion / 'comer' [A1]	thing standing [A1]							
and									
stand		V: stand.01							
self-consciously		manner [AM-MNR]						Governor	
at								Location (at)	
the									
foot			seemer [A0]				Governor	Object	
of		location [A2]					PartWhole (of)		
the									
bed							Object		
and									
look			V: look.02						Governor
at									ObjectOfVerb (at)
his			seemed like, attribute of arg0 [A1]		relation receptor [A1]				
son				son.01	relation holder [A0]				Object

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Semantic Role Labelling

❖ Give a sentence, identify predicate frames and annotate semantic roles

Mr. Stromach wants to resume a more influential role in **running** the company.

ARG0

II. Role labeling

run.01

I. Frame identification

ARG1

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Role Identification

Mr. Stromach wants to resume a more influential role in **running** the company.

ARG0

ARG1

II. Role labeling

run.01

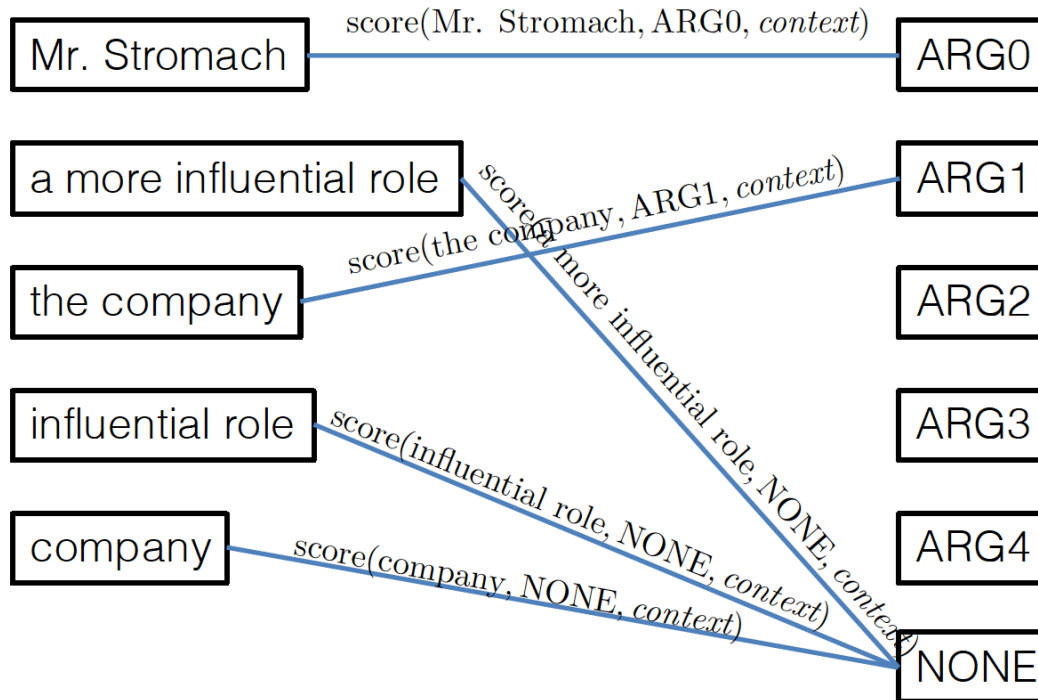I. Frame identification

We can model it as multi-class classification

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Role labeling

Sentence spans:

Potential roles:

| Mr. Stromach | — score(Mr. Stromach, ARG0, *context*) — | ARG0 |

| a more influential role | | ARG1 |

score(the company, ARG1, *context*)

| the company | | ARG2 |

score(a more influential role, NONE, *context*)

| influential role | | ARG3 |

score(influential role, NONE, *context*)

| company | | ARG4 |

score(company, NONE, *context*)

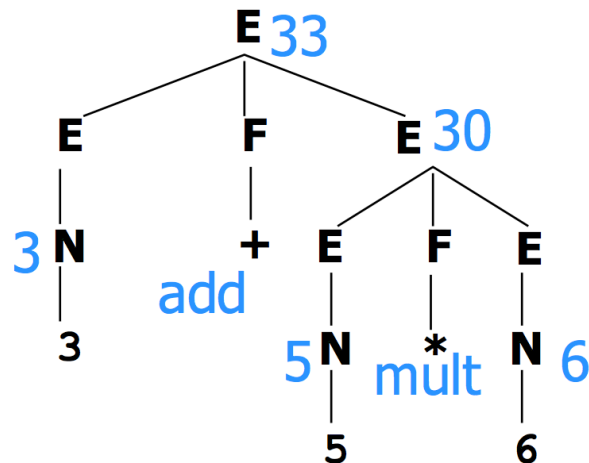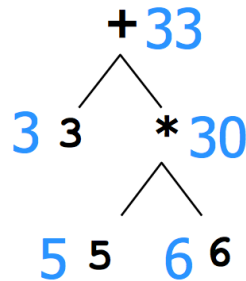| | | NONE |

Best matching between spans and roles

Score can come from any classifier (linear, SVM, NN)

Conduct constrained inference

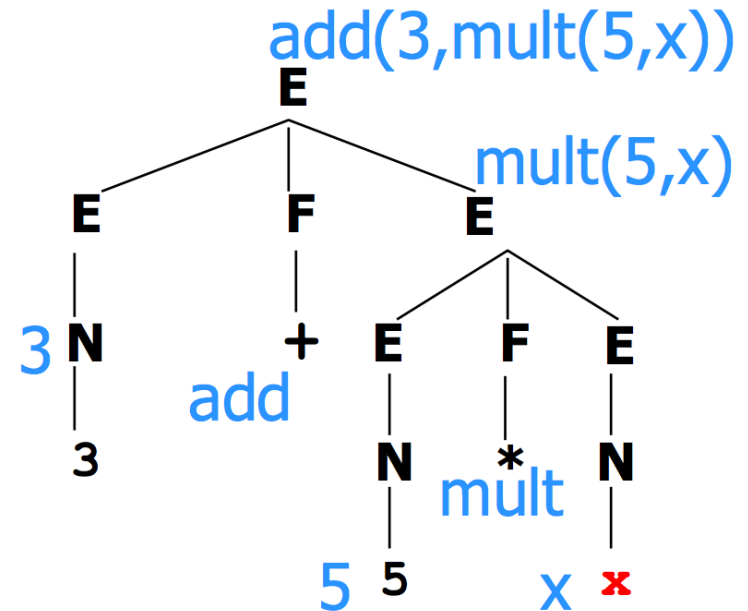# Semantic parsing

❖ Motivation: programming language

  ❖ What is the meaning of 3+5*6

Examples from Chris Manning's NLP course

Semantic parsing

❖ More complex meaning

    ❖ 3+5*x: we don't know x at the compile time

❖ "Meaning" at a node is a piece of code

❖ Form is "rule-to-rule" translation

add(3,mult(5,x))

mult(5,x)

add

mult

We provide a way to form the semantics from bottom-up

Semantic Parsing

❖ Parse a natural language narrative to a machine readable format

❖ Logic form:
John smokes." "Everyone who smokes snores."
$\Rightarrow \forall x.smoke(x) \rightarrow snore(x)$
$smoke(John) \Rightarrow snore(John)$

❖ Equations:
Maria is now four times as old as Kate. Four years ago, Maria was six times as old as Kate. Find their ages now.
$$m = 4 \times n \qquad m - 4 = 6 \times (n - 4)$$

Logic

❖ Boolean: semantic values of sentences

❖ Entities: e.g., objects, times, etc.

❖ Function of various types
A function returning a boolean called "predicate"
e.g., green (x)
Function can return other functions or take functions as arguments

Logic: λ terms

❖ λ terms:

  square = λx x*x, square(3) = 3*3

  even = λx (x mod 2 == 0)   a predicate

❖ Can take multiple arguments:

  λ x.[λ y.times(x,y)]

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Parse tree with associated semantics

Sentence
loves(john,mary)

Noun Phrase
john

Verb Phrase
λx.loves(x,mary)

Name
john

Verb
λy.λx.loves(x,y)

Noun Phrase

"John"
john

"loves"
λy.λx.loves(x,y)

Name
mary

"Mary"
mary

Parse tree node
Display text
Semantic

[start]
my friends who live in [id:12345]}
intersect(friends(me), residents(12345))

[user-head]
my friends
friends(me)

[user-filter]
who live in [id:12345]
residents(12345)

[who]
who
-

[residence-vp]
live in [id:12345]
residents(12345)

[friends-head]
my friends
friends(me)

friends

[live-in-verb]
live in
Residents()

in

{city}
[id:12345]
12345

San Francisco

ML in NLP