

Illinois-Profiler: Knowledge Schemas at Scale

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Cognitum

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Comprehension

(ENGLAND, June, 1989) – Christopher Robin is alive and well. He lives in England. He is the same person that you read about in the book, Winnie the Pooh. As a boy, Chris lived in a pretty home called Cotchfield Farm. When Chris was three years old, his father wrote a poem about him. The poem was printed in a magazine for others to read. Mr. Robin then wrote a book. He made up a fairy tale land where Chris lived. His friends were animals. There was a bear called Winnie the Pooh. There was also an owl and a young pig, called a piglet. All the animals were stuffed toys that Chris owned. Mr. Robin made them come to life with his words. The places in the story were all near Cotchfield Farm. Winnie the Pooh was written in 1925. Children still love to read about Christopher Robin and his animal friends. Most people don't know he is a real person who is grown now. He has written two books of his own. They tell what it is like to be famous.

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This is an Inference Problem

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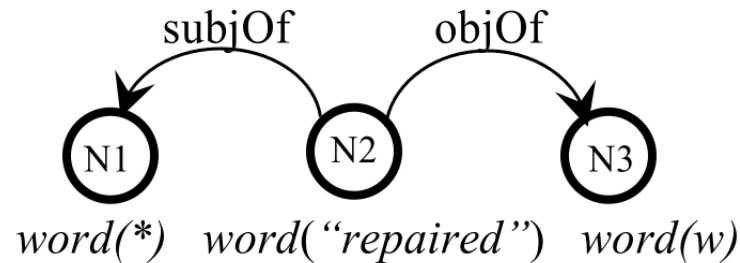
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Structured Knowledge

- Jimbo arrested Robert because he stole an elephant

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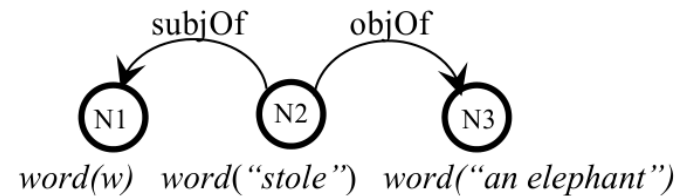
vs.

Robert stole an elephant

Structured Knowledge

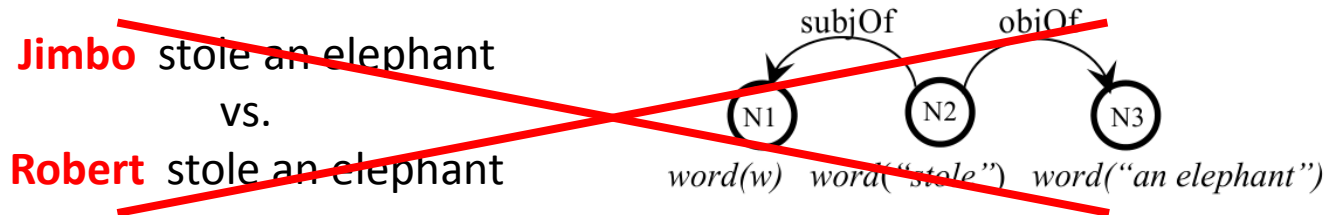
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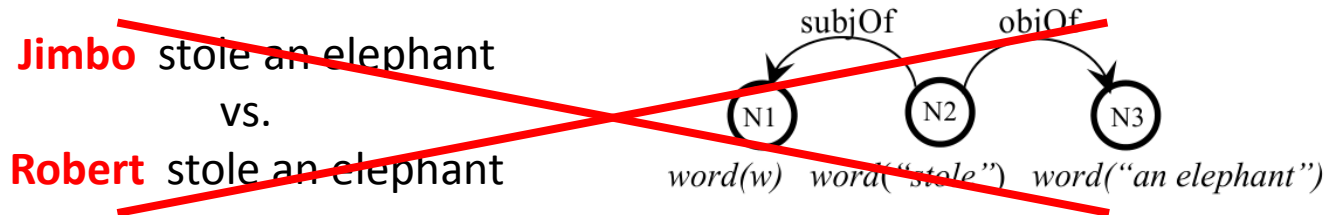
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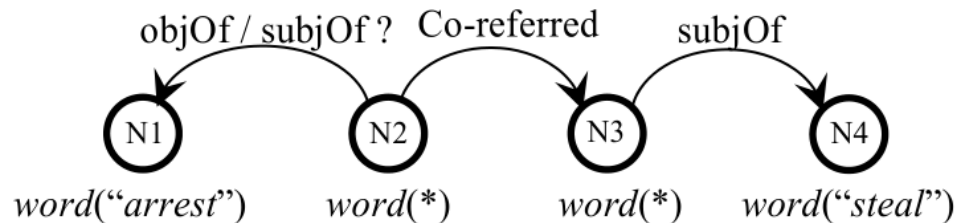
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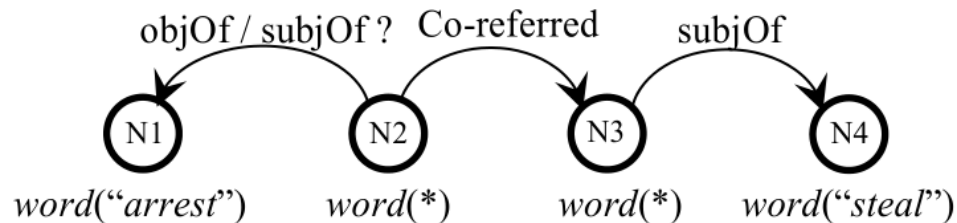
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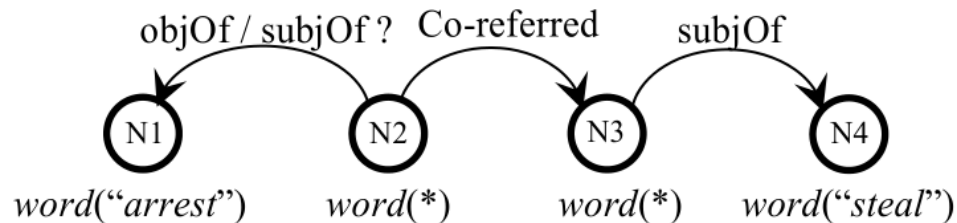
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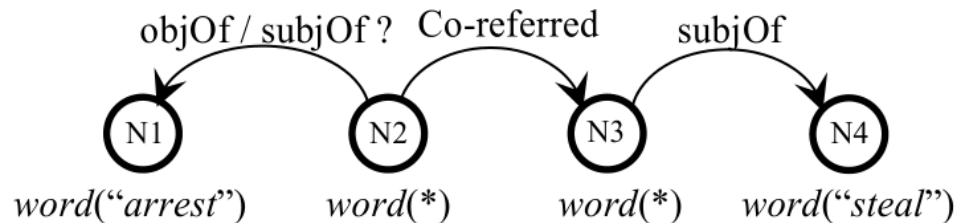
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- The **subject** of “**stole**” is more likely to be the **object** of “**arrest**” than the **subject** of “**arrest**”.

Knowledge for Many Tasks

- [Larry Robbins], founder of Glenview Capital Management, bought shares of [Endo International Plc] ...”

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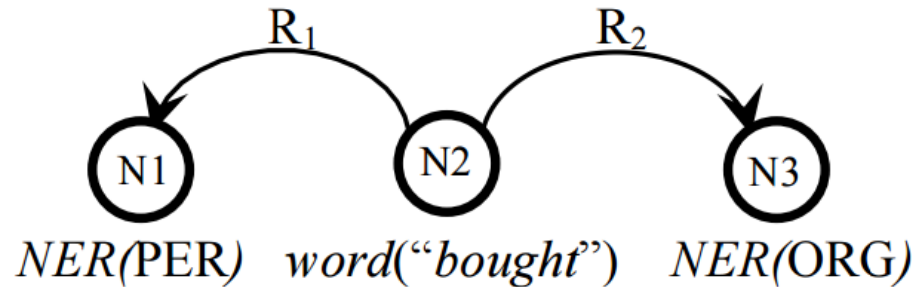
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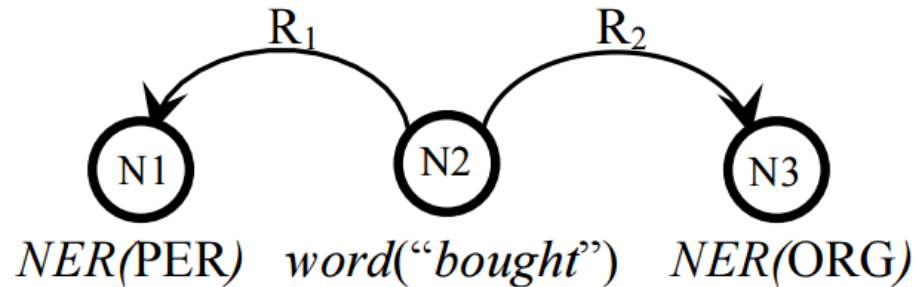
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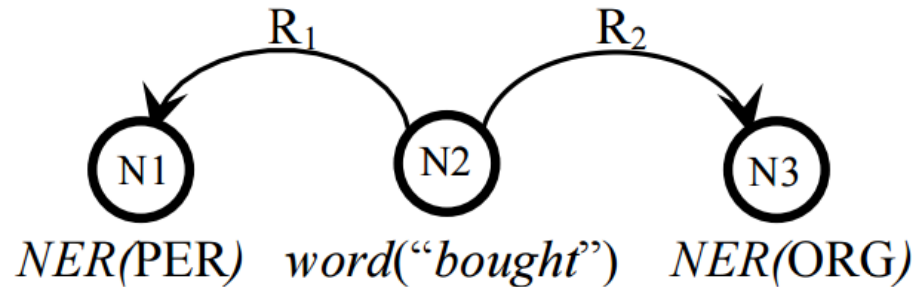


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NER TAGS = {PERSON, LOCATION, ORGANIZATION, ...}

- Organization is more likely than a location to be the **subject** of “fire”.

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- This work:
- Graph-based formulation for modelling knowledge schemas
 - The necessity of disambiguation
 - The acquisition process
- Profiler as a public resource
 - Contains pre-computed statistics
 - Many concepts/entities; many knowledge schemas

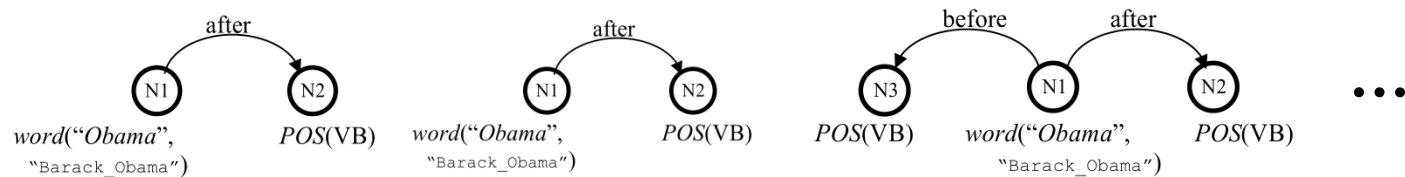
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- **Schema**: A way to define a structure and, consequently, semantics, specified by a template.

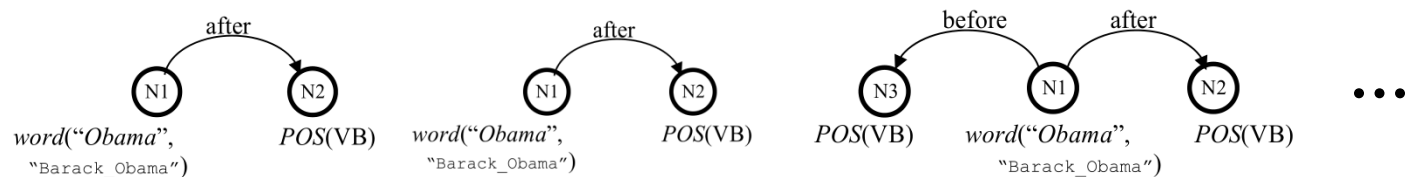
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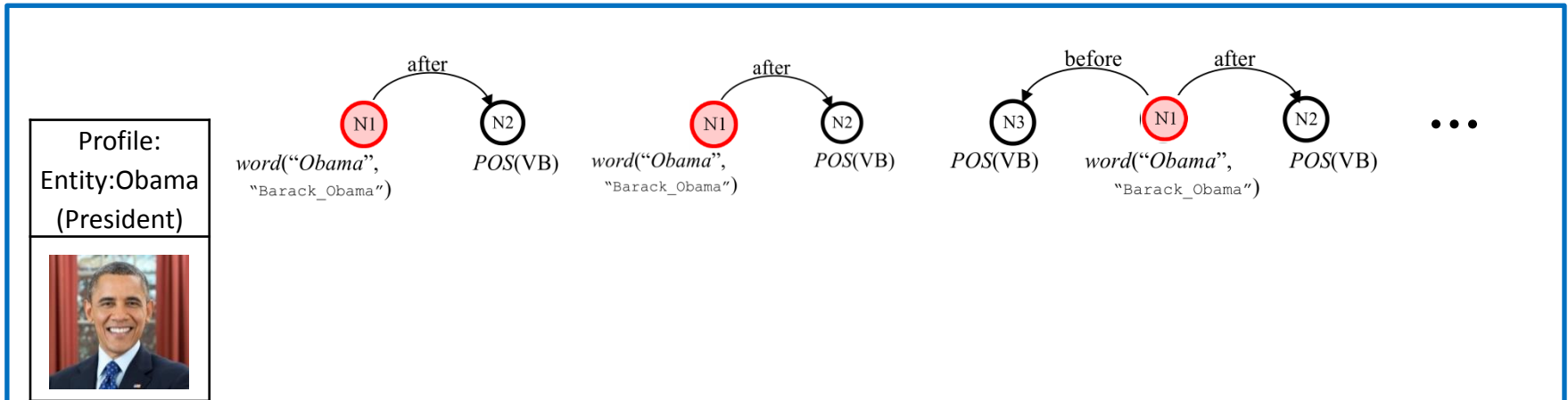
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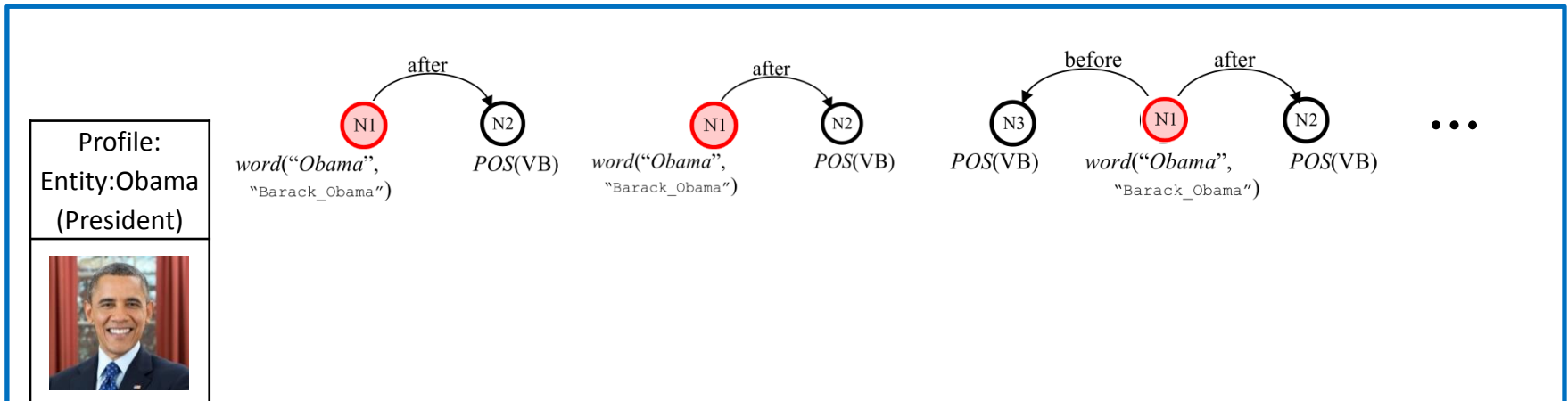
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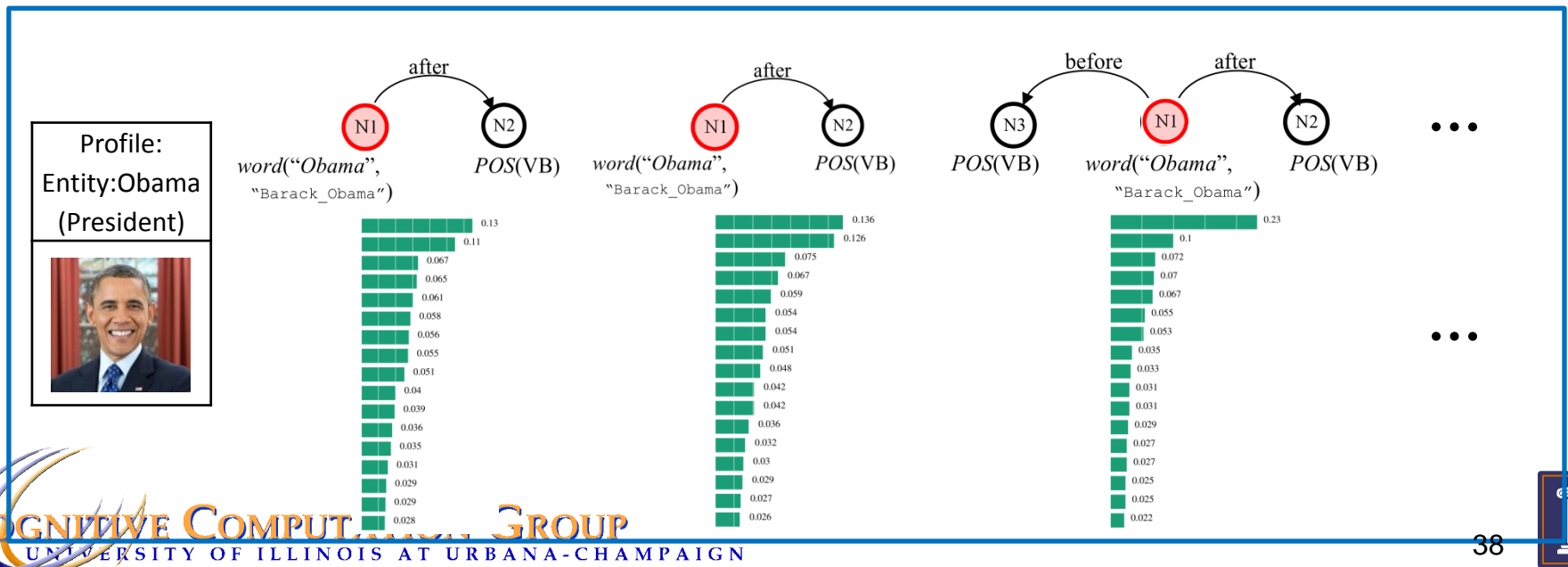
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 - Instantiated schema, with statistics



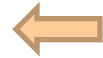
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The airport is located south of **Seattle**.

Seattle played well today!

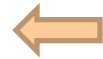
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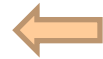


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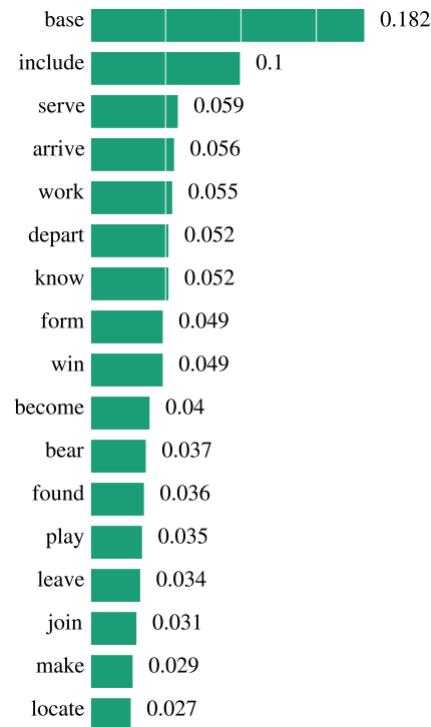
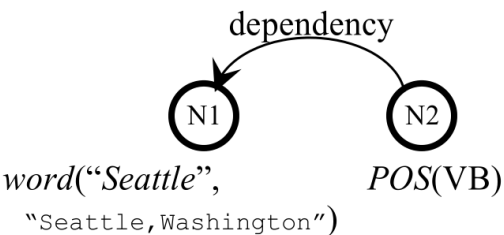


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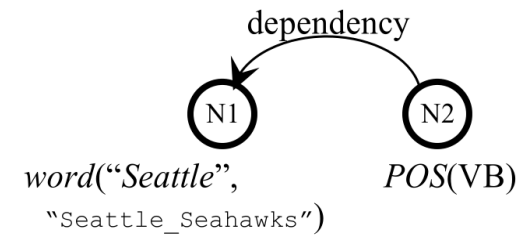
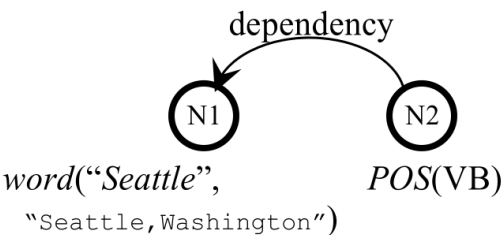
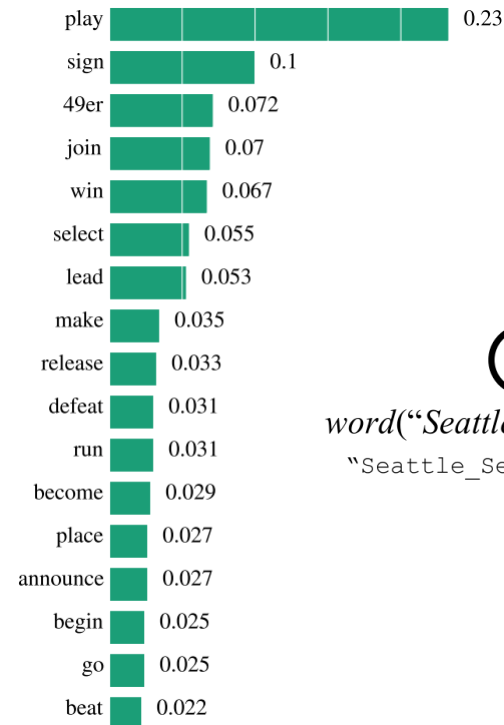
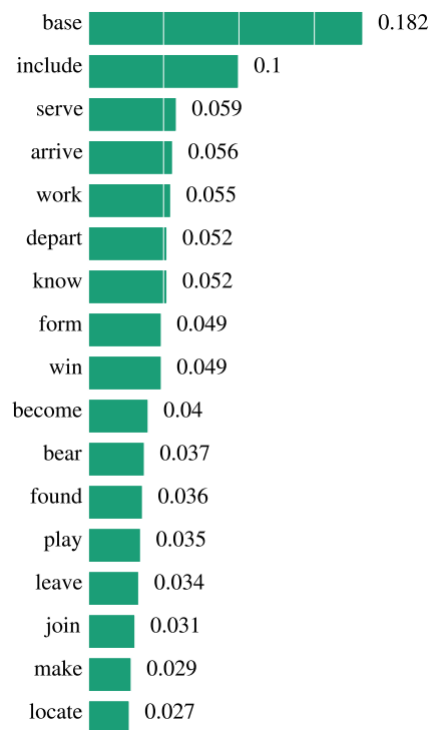


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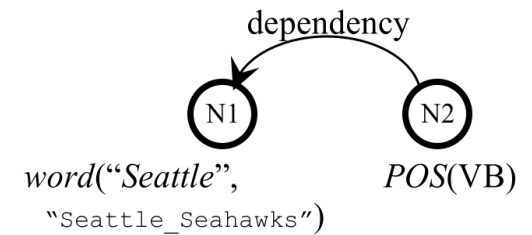
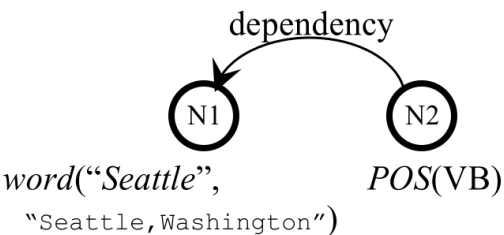
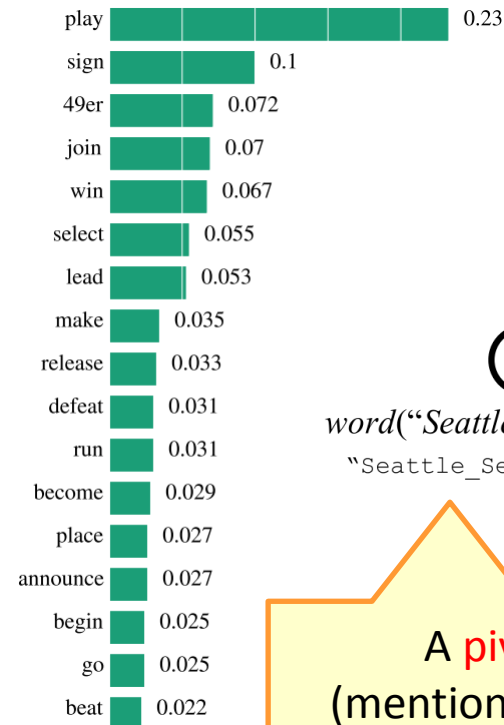
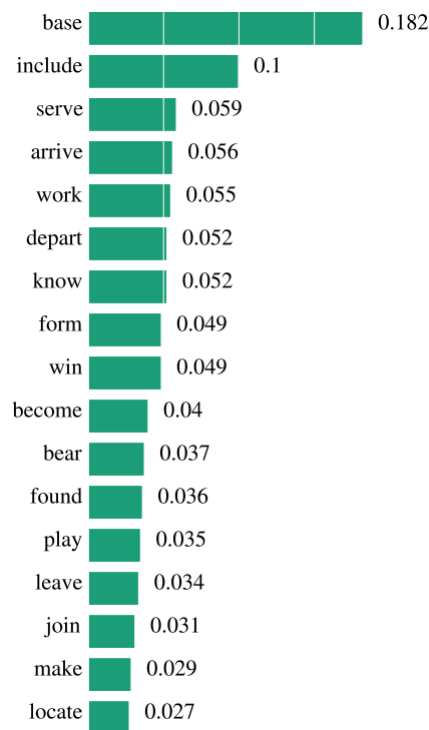


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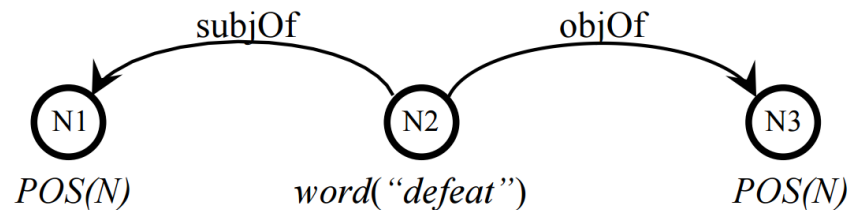
A **pivot** is a pair:
(mention, Wikipedia URL)

Knowledge Schema as a Graph

■ Knowledge as graph:

- Generalization of Feature Description Logic (Cumby & Roth, '02,'03)
- Assumes a structured (relational) representation of the data.

■ Definition:



- **Attribute:** type of value on each node $\mathcal{A} = \{a_1, a_2, a_3, \dots\}$
 - **In the example:** $\mathcal{A} = \{\text{POS}, \text{raw} - \text{text}\}$
- **Values:** possible values each attribute take $\mathcal{V} = \{v_1, v_2, v_3, \dots\}$
 - **In the example, the values of POS are** $\mathcal{V} = \{N, VP, NP, \dots\}$
- **Roles (Relation):** connection between nodes $\mathcal{R} = \{r_1, r_2, r_3, \dots\}$
 - **In the example, we have** $\mathcal{R} = \{\text{subjOf}, \text{objOf}, \dots\}$

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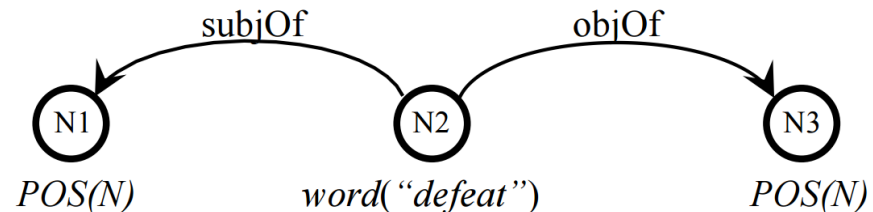
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■ Basic rules:

- For an attribute $a \in \mathcal{A}$ and a value $v \in \mathcal{V}$, $a(v)$ is a description, and it represents the set of $x \in \mathcal{X}$ for which $a(x, v)$ is True.

- Example:

word(*“defeat”*)
POS(N)

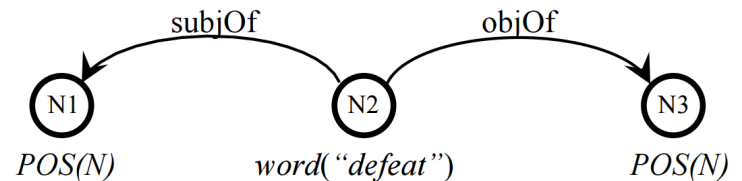


Knowledge Schema Descriptions (3)

■ Basic rules (continued):

- For a description D and a role $r \in \mathcal{R}$, $(r D)$ is a description. Such description represents the set $x \in \mathcal{X}$ such that $r(x, y)$ is True, where $y \in \mathcal{X}$ is described by D .

`(subjectOf word("defeat"))`
`(objectOf word("defeat"))`



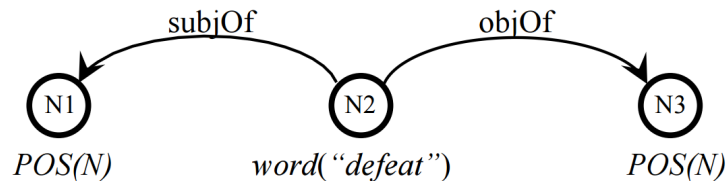
- For given descriptions $D^{(1)}, \dots, D^{(k)}$ then $(AND D^{(1)}, \dots, D^{(k)})$ is a description, which represents a conjunction of all elements described by each description.

`(AND (POS(N)) (subjectOf word("defeat")))`
`(AND (POS(N)) (objectOf word("defeat")))`

Knowledge Schema Descriptions (4)

■ Basic rules (continued):

- Denote the description of node i with D_i .



$$D_1 = (\mathbf{AND} (\text{POS}(\text{N})) (\text{subjectOf word}(\text{"defeat"})))$$

$$D_2 = \{\text{word}(\text{"defeat"})\}$$

$$D_3 = (\mathbf{AND} (\text{POS}(\text{N})) (\text{objectOf word}(\text{"defeat"})))$$

- Denote the description of nodes i_1, \dots, i_k with D_{i_1, \dots, i_k} .

- The description of the whole graph can be found with:

$$D_{1,2,3} = D_1 \otimes D_2 \otimes D_3$$

- This is the set of all instances matching the pattern defined by the schema graph.

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 - See a talk on:

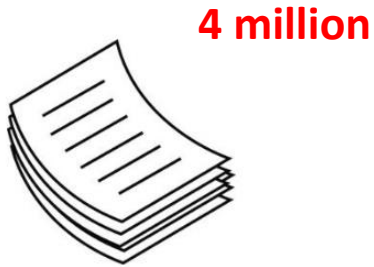
Saul: Towards Declarative Learning Based Programming

Parisa Kordjamshidi, Hao Wu, Dan Roth

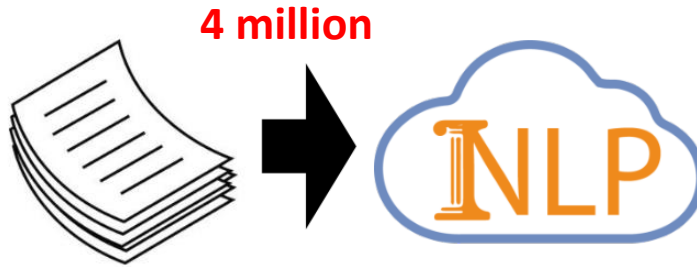
Presented on Tuesday, July 28; 9:40 Relational Learning Session

The Acquisition Procedure

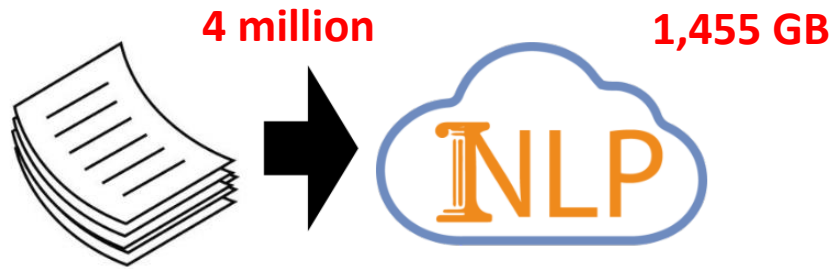
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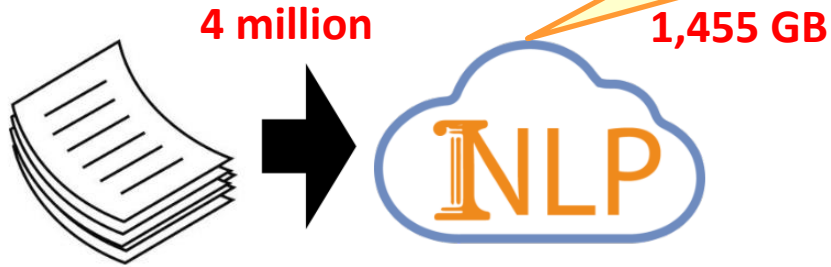


The Acquisition Procedure



The Acquisition Procedure

Illinois CloudNLP: a suite of state-of-the-art NLP tools. Made available also on AWS.



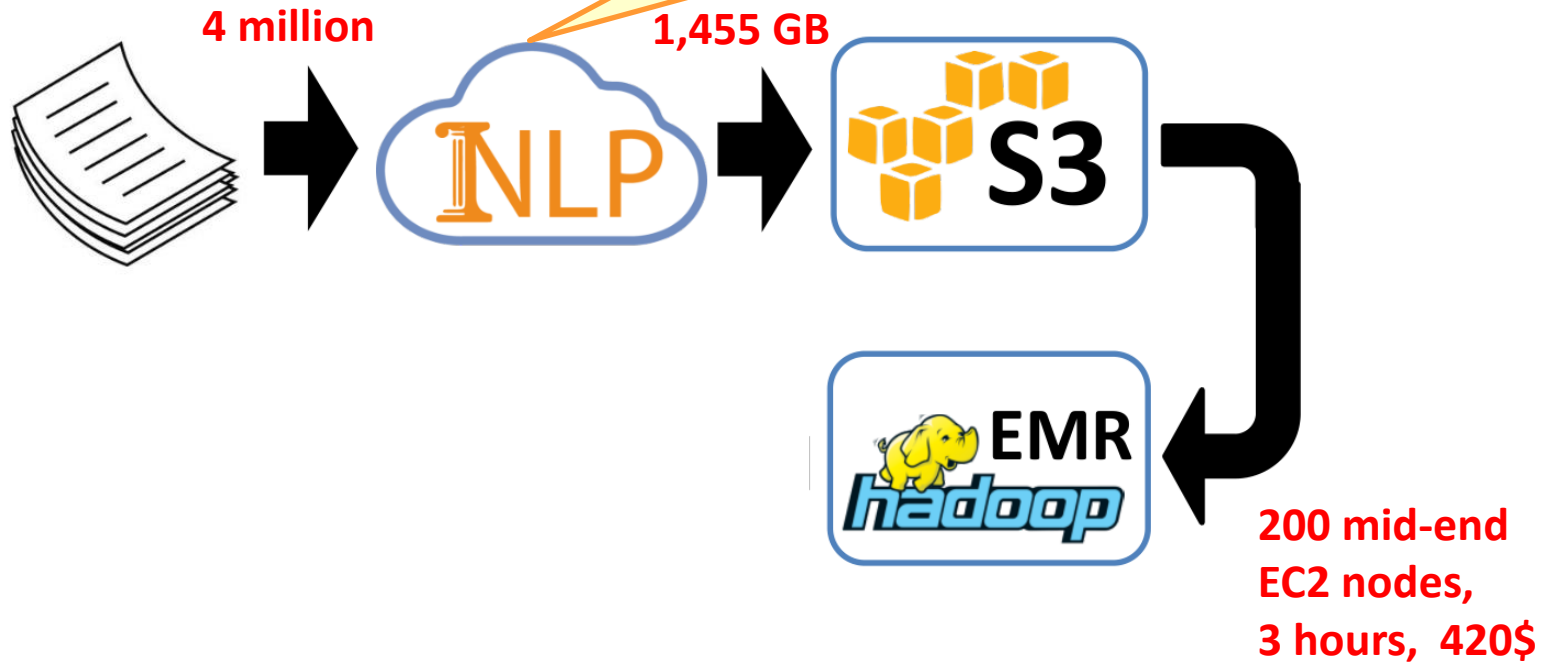
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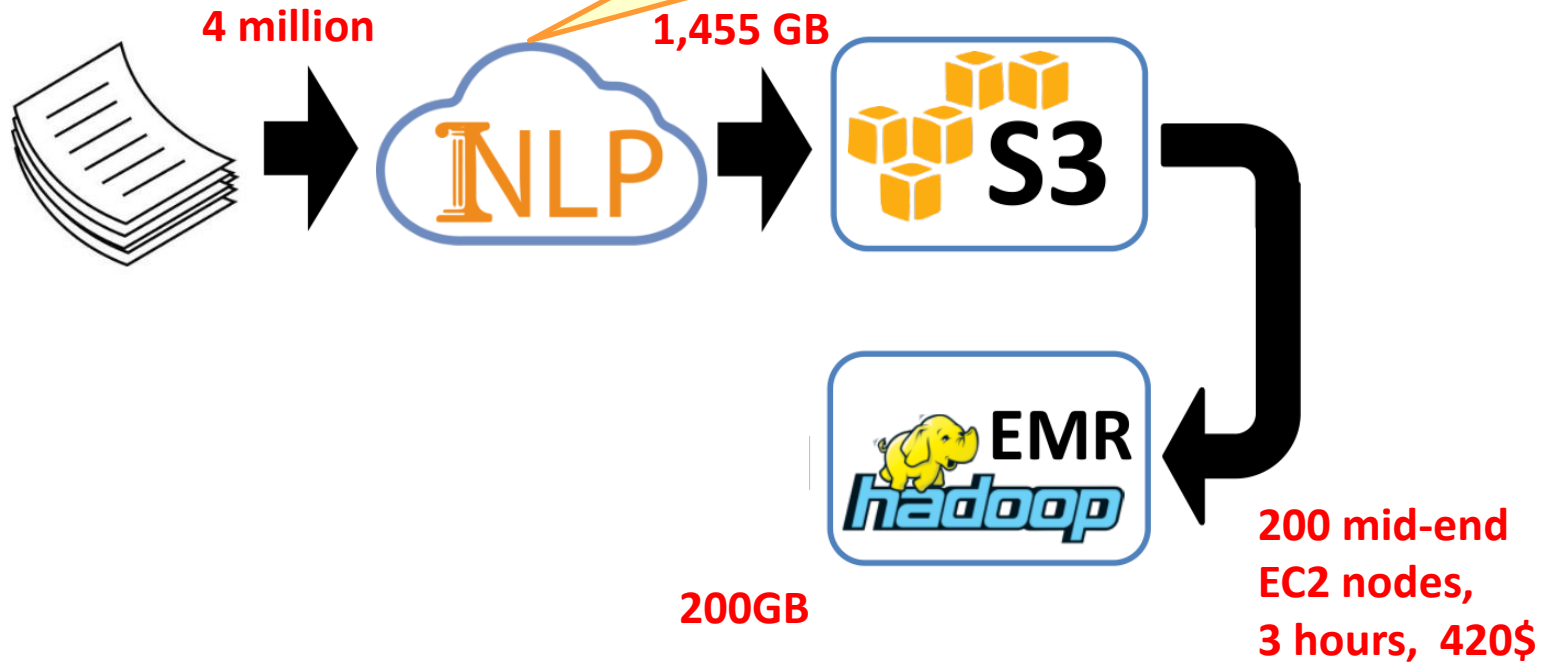
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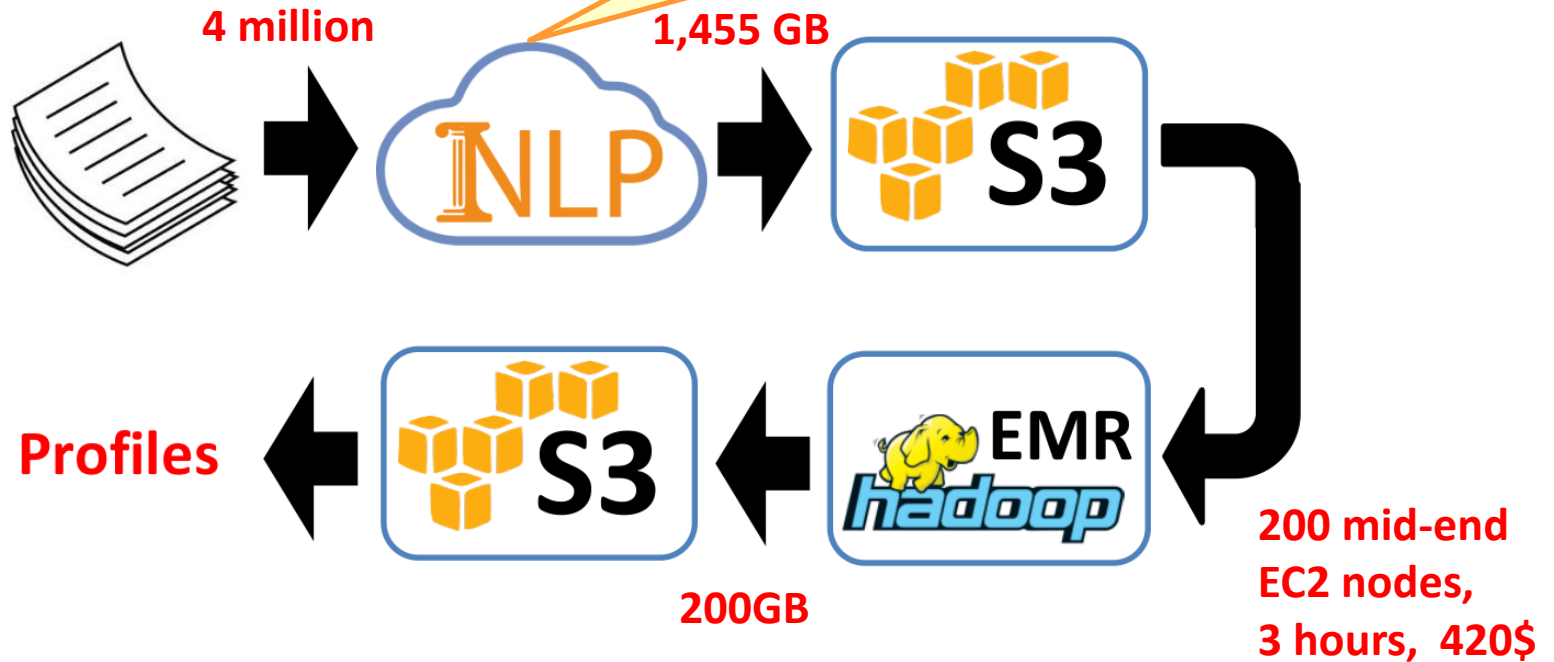
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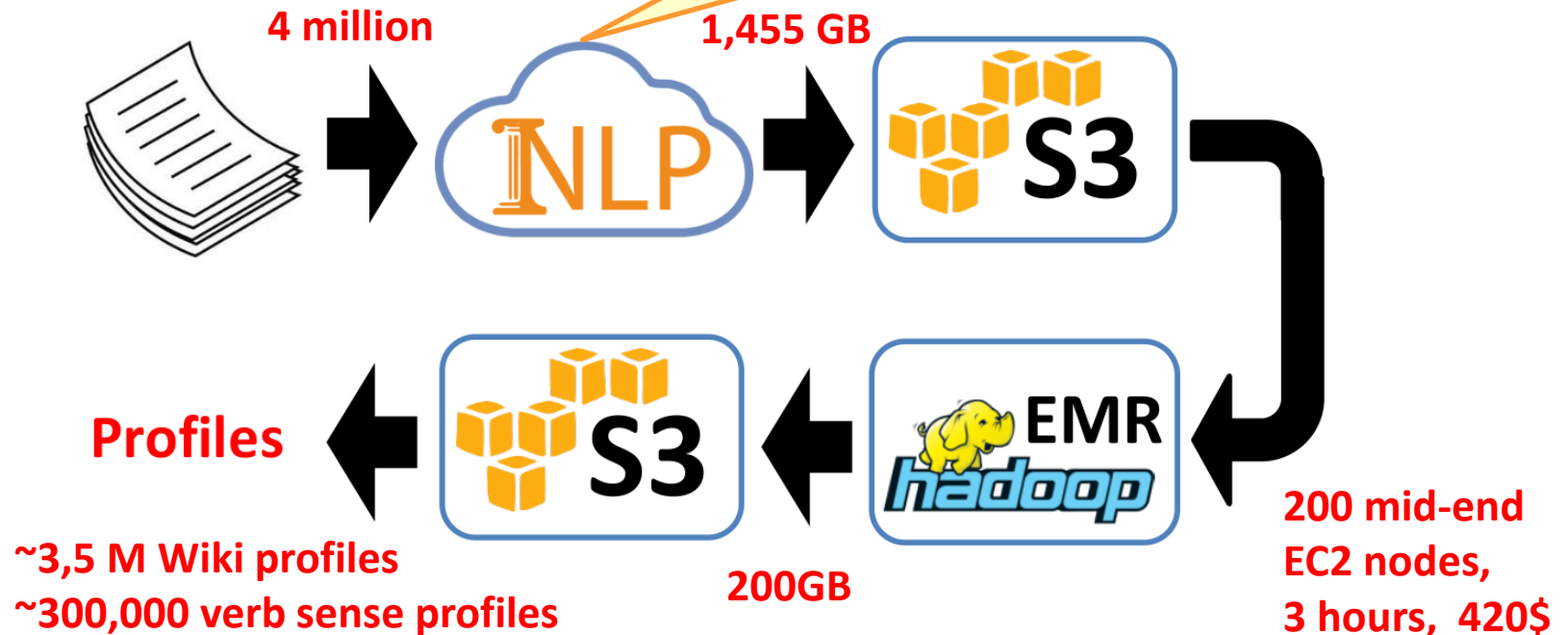
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Knowledge Schema as a Graph

- The annotations used in the current system:
 - Attribute & values; Roles


Attributes (\mathcal{A})	Values (\mathcal{V})
Word	Raw text
Lemma	Raw text
POS	labels from Penn Treebank
NER	{ PER, ORG, LOC, MISC }
Wikifier	Wikipedia urls
Verbsense	Verb sense from Verbnet

Roles (\mathcal{R})
Before
After
NearestBefore
NearestAfter
AdjacentToBefore
AdjacentToAfter
ExclusiveContaining
HasOverlap
DependencyPath(l)
Co-referred
SubjectOf
ObjectOf

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Wikification: The Reference Problem

Blumenthal (D) is a candidate for the U.S. Senate seat now held by Christopher Dodd (D), and he has held a commanding lead in the race since he entered it. But the Times report has the potential to fundamentally reshape the contest in the Nutmeg State.

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Richard Blumenthal

From Wikipedia, the free encyclopedia

Democratic Party (United States)

From Wikipedia, the free encyclopedia

United States Senate

From Wikipedia, the free encyclopedia

[Blumenthal](#) ([D](#)) is a candidate for the [U.S. Senate](#) seat now held by [Christopher Dodd](#) ([D](#)), and he has held a commanding lead in the race since he entered it. But the [Times](#) report has the potential to fundamentally reshape the contest in [the Nutmeg State](#).

Chris Dodd

From Wikipedia, the free encyclopedia

The New York Times


From Wikipedia, the free encyclopedia

Connecticut

From Wikipedia, the free encyclopedia

Who is Alex Smith?

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* If you wish to cite this work, please cite the following publications: (1) Retinov et. al. and (2) Cheng and Roth.

The Chiefs didn't trade for Alex Smith this offseason solely because they wanted a smart game manager who wouldn't kill their offense with turnovers. They acquired him because they needed a quarterback who knows how to win. Sometimes that requires him to do what he's done for most of this season: throw the safe pass, make the key play when necessary and use his feet to keep the chains moving when his arm can't get the job done. These days it means Smith has to show people more of what he revealed in Sunday's 41-38 loss to San Diego -- that he can elevate his game when his team is in dire straits.

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From the sounds of it, Bengals tight end Alex Smith might be gone for the season. The veteran tight end suffered a wrist injury in the third quarter during the regular season finale against Baltimore. Bengals head coach Marvin Lewis described the injury as a "wrist dislocation". also said during the postgame radio interview on 700 WLW with Dave Lapham that "it looks like we lost" Smith, all but confirming an eventuality. More will be known this week, so hold off on declaring him done. On the other hand, Lewis confirmed that the Bengals should have tight ends Tyler Eifert and Jermaine Gresham for the next game. Both were out Sunday against the Ravens.

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Quarterback of the Kansas City Chief

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Tight End of the Cincinnati Bengals

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Tight End of the Cincinnati Bengals

San Diego: The San Diego Chargers (A Football team)

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Tight End of the Cincinnati Bengals

Ravens: The Baltimore Ravens (A Football team)

San Diego: The San Diego Chargers (A Football team)

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Tight End of the Cincinnati Bengals


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Contextual Disambiguation

Middle Eastern Politics



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Over and over again I'd hear these **perorations** from certain **Jewish** circles arguing that there is no difference between **Fatah** and **Hamas**, or between **Mahmoud Abbas** and **Khaled Maashal**. I would cringe at such comments, while knowing full well that **Abu Mazen** was hardly the perfect **interlocutor**. I'm a strong believer in identifying the threats to **Israel** without pulling any **punches**. But I also believe that it is important to give peace a chance, to search for signs that the **Palestinians** are open to change from the destructive and self-destructive path they have **pursued** for decades. **Hamas** was and is a hopeless **proposition**. It not only rejects **Israel's** existence on **extremist religious** grounds but it is anti-Semitic to the extreme. Its **charter** sounds like the "**Protocols of the Learned Elders of Zion**," blaming **Jews** for all the world's ills since the **French Revolution**. Its leaders have denied the **Holocaust** and blamed the **financial crisis** on **Jewish control**.


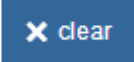
Middle Eastern Politics



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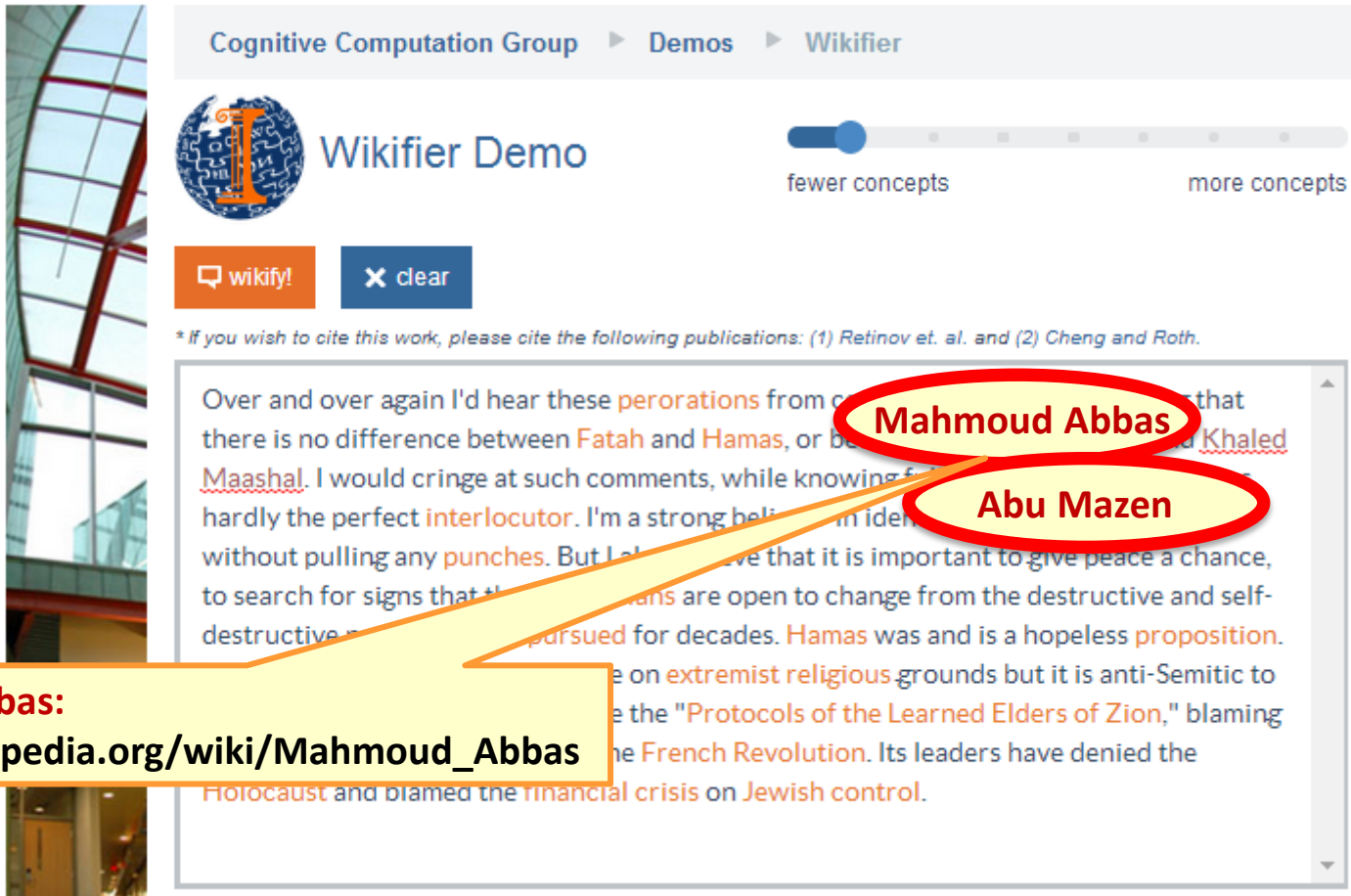
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Middle Eastern Politics



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Mahmoud Abbas:
http://en.wikipedia.org/wiki/Mahmoud_Abbas

Middle Eastern Politics



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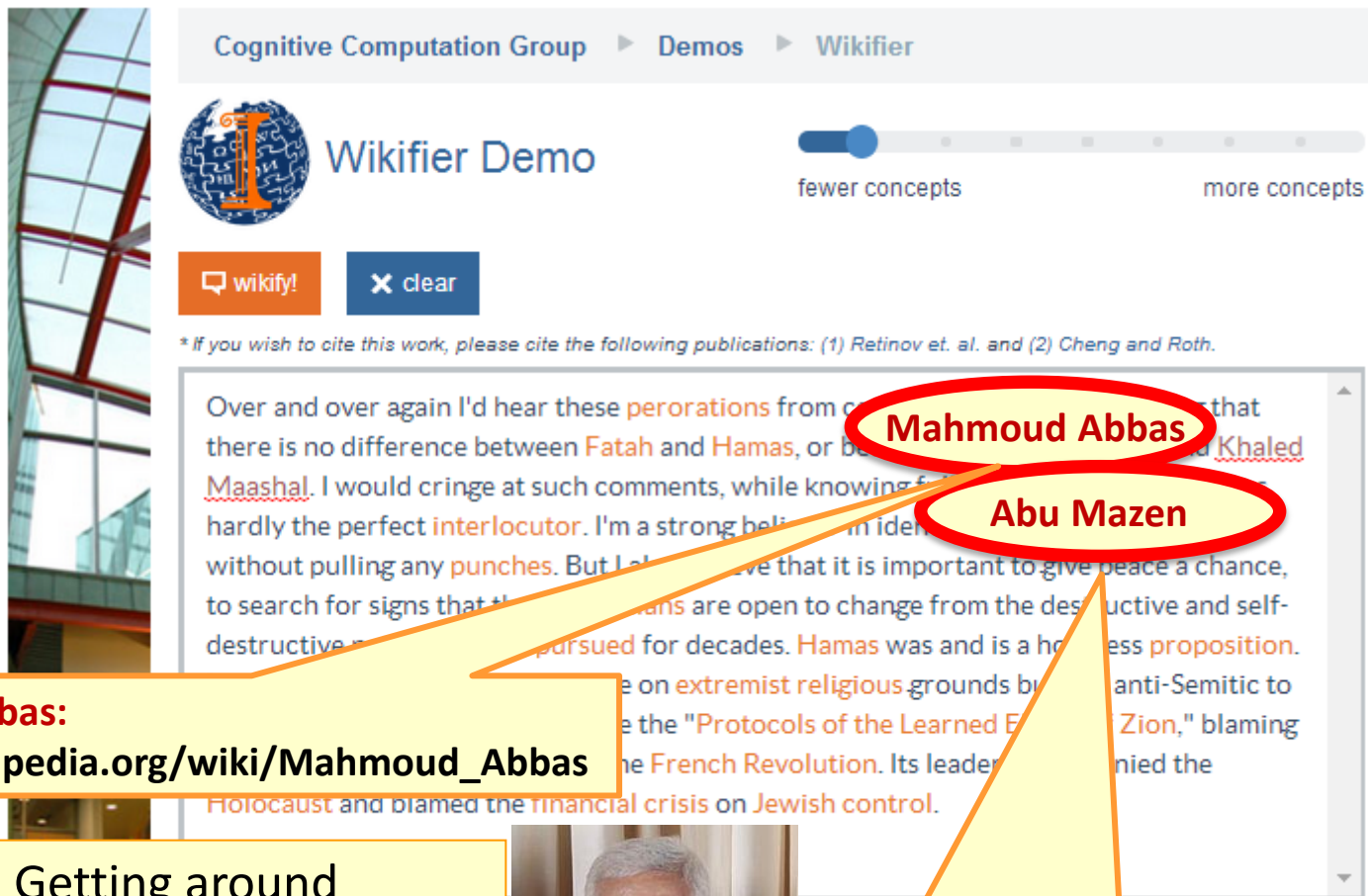
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Mahmoud Abbas:

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Variability: Getting around multiple **surface representations**.
Co-reference resolution within & across documents, **with grounding**

Abu Mazen:

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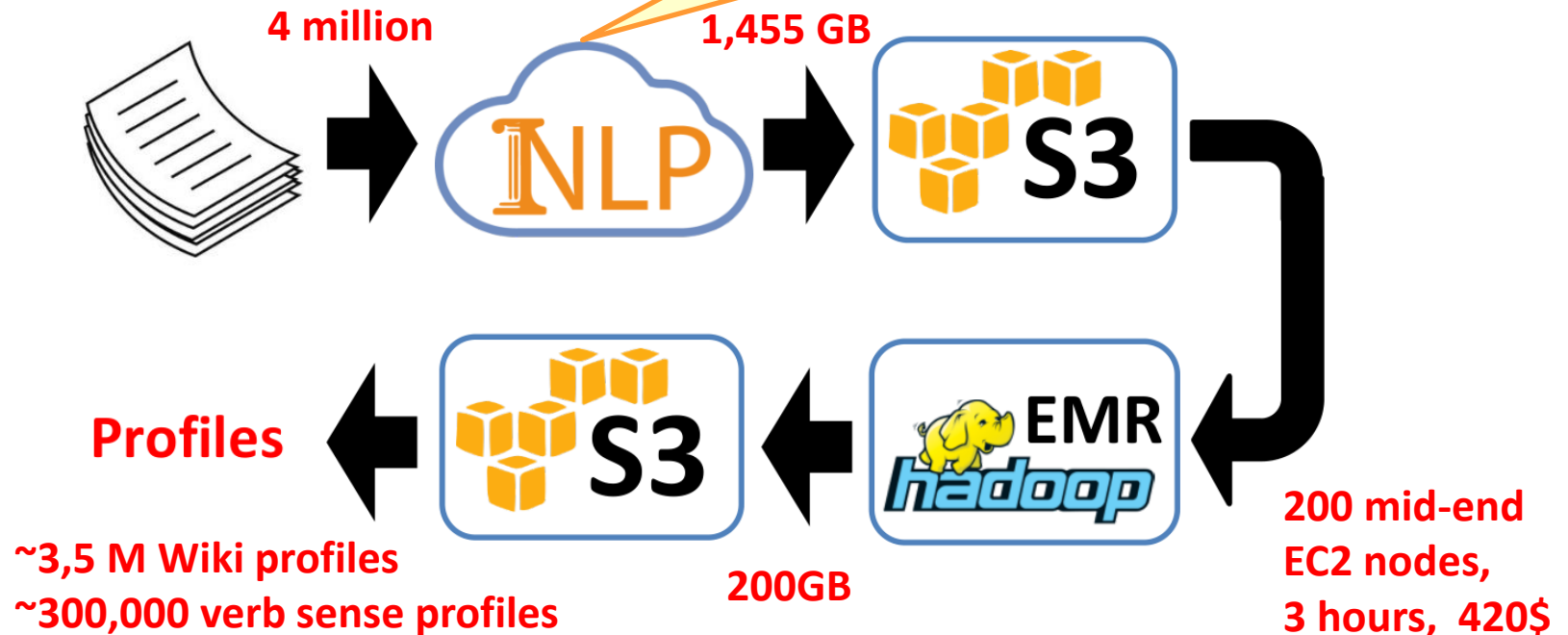


The Profiler DB

- Each entry corresponds to a **disambiguated** entity/Concept
- Mapping to Wikipedia grounds entities in the “world” and allow us to profile unique entities, rather than “mentions” in text.
- In particular, we have **distinct entries** for:
- Clinton (Bill), Clinton (Hilary), Clinton (lake), Clinton (Illinois),.....

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Experimental Evidence

- We are at early stages of experimental validation (and refinement) of the acquisition and inference with the profiler.
- Co-reference Resolution
- Identifying Attributes of Entities
 - Profession

Experiment 1: Co-reference Resolution

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- We build upon our previous work (Peng et al, 2015).

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Jack threw the bags of John into the water since he mistakenly asked him to carry his bags.

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Jack threw the bags of John into the water since he mistakenly asked him to carry his bags.

- Schemas are converted automatically, given an instance, into constraints that are used in an Integer Linear Programming formulation.

Experiment 1: Co-reference Resolution

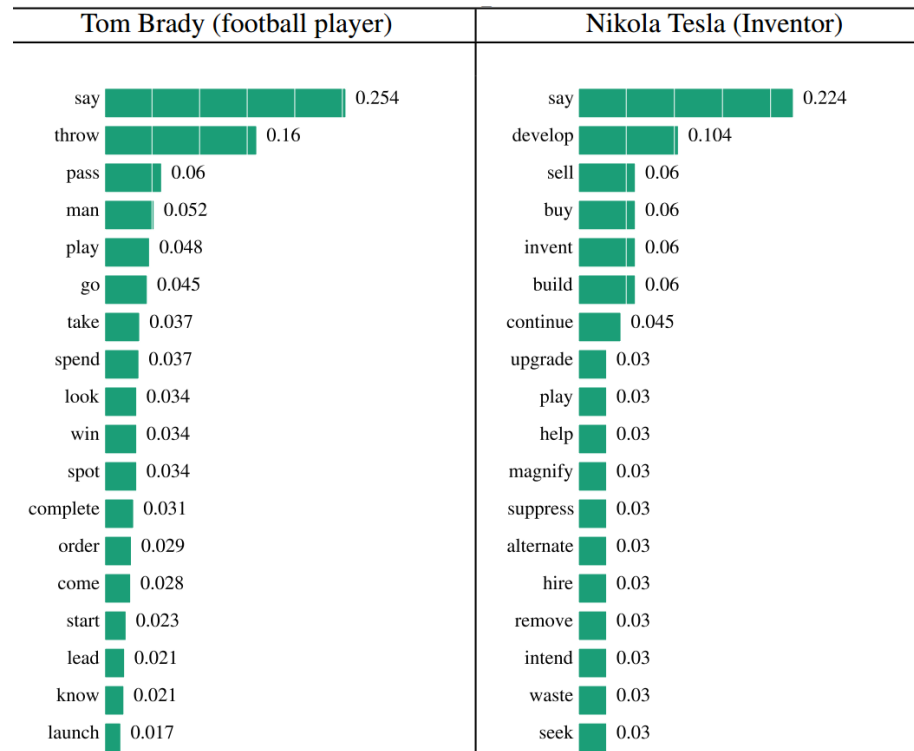
■ Metrics:

- Precision for Winograd dataset
- AntePre for WinoCored dataset:
 - **Consider all the binary decisions of connecting pronouns to nominal mentions**
 - **AntePre is the ratio of correct binary decisions to the total decisions**

Dataset	Winograd	WinoCoref
Metric	Precision	AntePre
(Rahman & Ng, 2012)	73.05	----
(Peng et al, 2015)	76.41	89.32
Our paper	77.16	89.77

Experiment 2: Classifying occupations

- Observations: Profiles of people contain information about their occupation.



Experiment 2: Classifying occupations

- Created a dataset of People-Profession based on Wikipedia
- Steps:

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J. K. Rowling



Quentin Tarantino



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Peter Jackson



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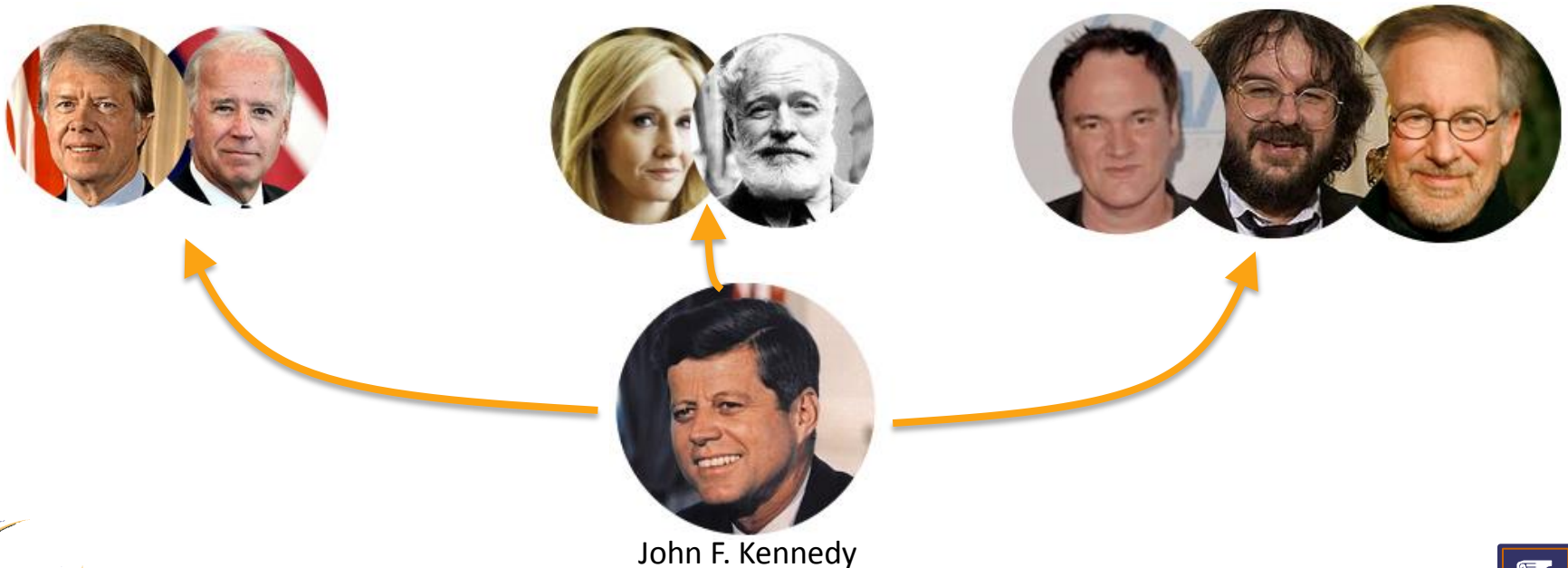
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72.1% of the test cases, the correct answer is among the top-5

John F. Kennedy

Future Directions

■ Extensions of the Profiler

- Richer set of schemas
- Richer annotations
- More data
- Incorporating the profiler as a part of feature extraction system, within a learning framework
 - **Profiler, beyond a resource, but as a tool to engineer knowledge.**

■ Inference

- How to best use the profiles

■ Experiments

- Different tasks need to be explored.

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- (Peng et al, 2015): Solving Hard Coreference Problems. *Haoruo Peng**, *Daniel Khashabi** and *Dan Roth*. NAACL 2015.
- (Rahman &Ng, 2012): “Resolving Complex Cases of Definite Pronouns: The Winograd Schema Challenge”, Altaf Rahman, Vincent Ng, EMNLP, 2012.
- (Cumby&Roth, 2003) “Learning with feature description logics”. *Cumby, Chad M., and Dan Roth*, ILP. Springer, 2003. 32-47.