Google Knows Who is Famous Today

Building an Ontology From Search Engine Knowledge and DBpedia

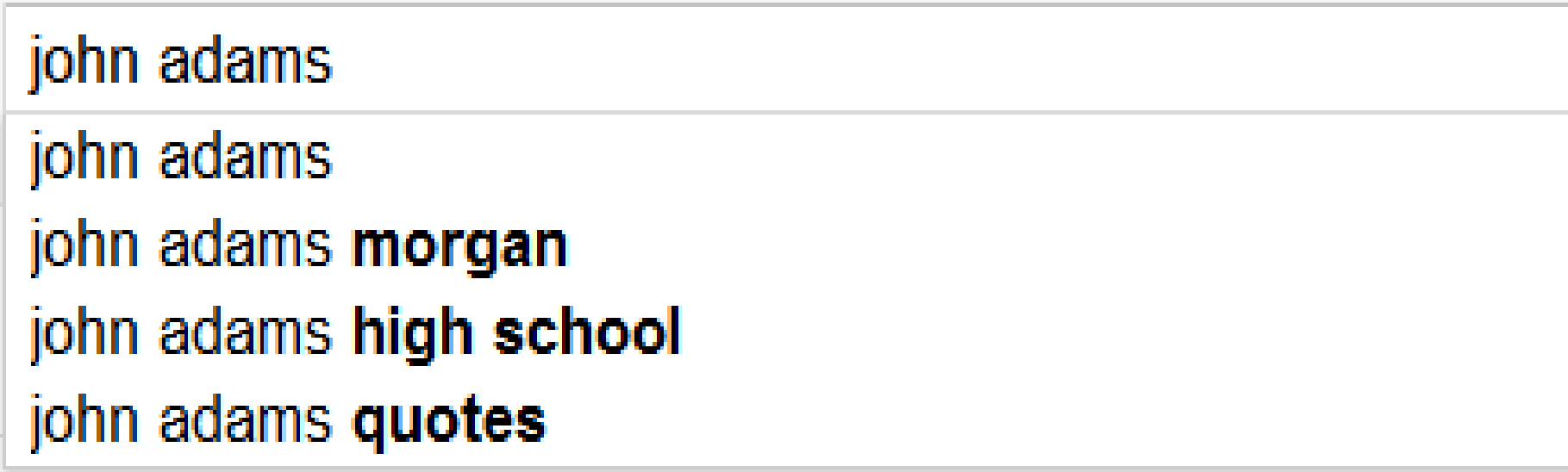
Christopher Ochs, Tian Tian, James Geller
New Jersey Institute of Technology (NJIT)
Newark, NJ, USA

Soon Ae Chun
City University of New York (CUNY)
Staten Island, NY, USA

Overview

- **Background**
- Building an Ontology of Famous People
  - Who are the famous people?
  - Extracting Useful Relationships
- Dynamically Expanding our Ontology
- Conclusions and Future Work

Suggested Completions



Search engines, such as Google, provide **suggested query completions** to users.

Ambiguous Query Suggestions

- Query suggestions are often **ambiguous**.
- What if a user searches for:

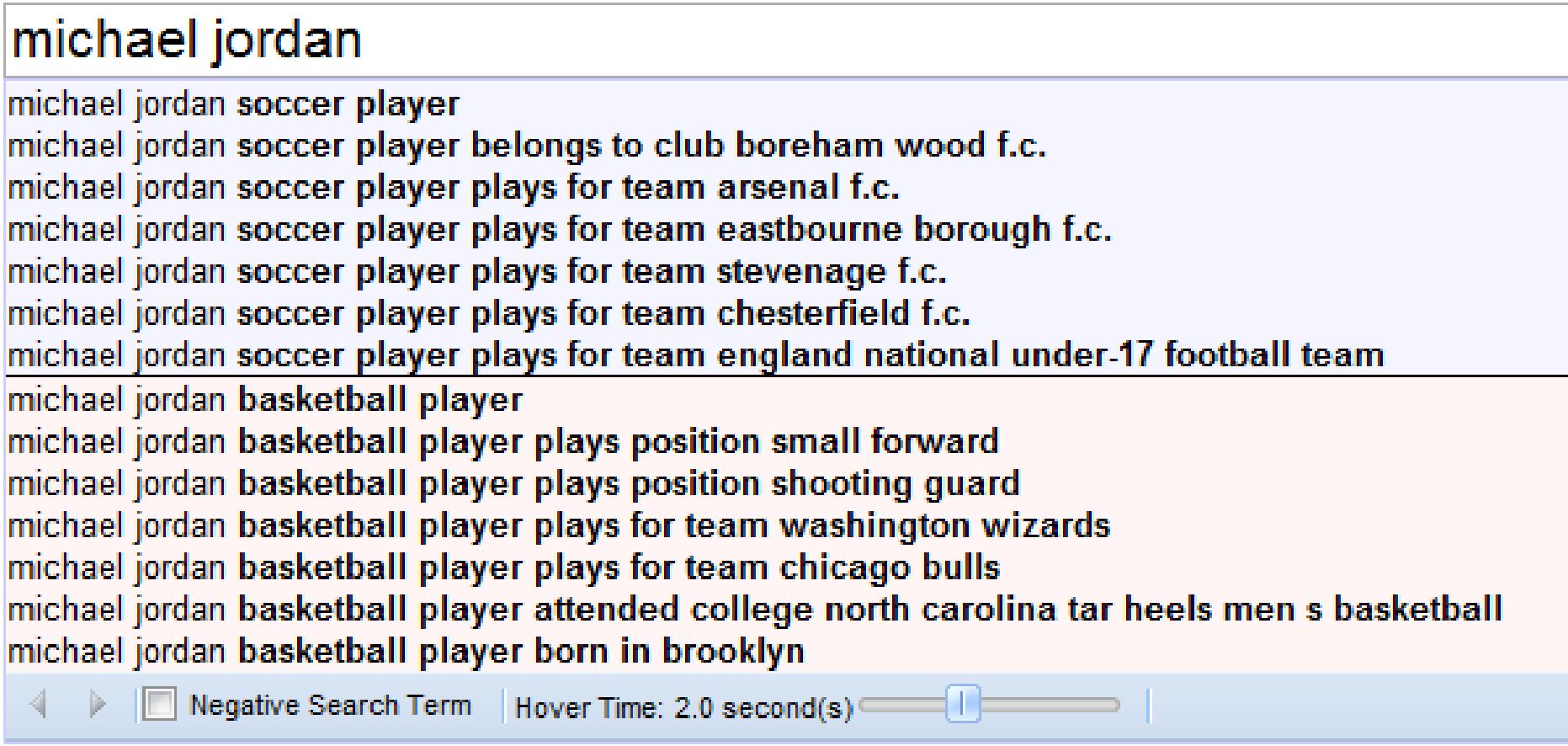
  Penn Station, Paul Simon, George Bush

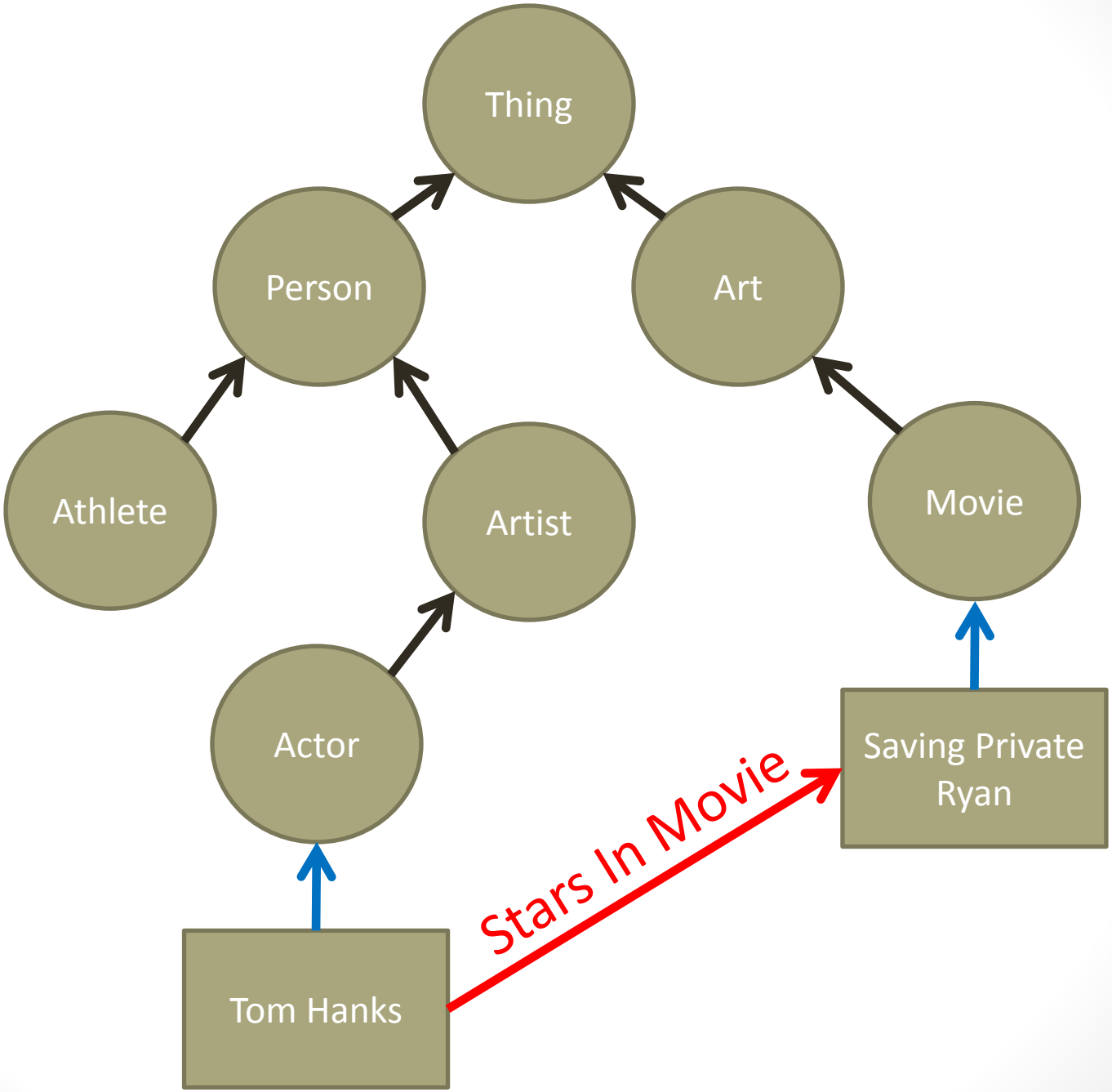
- **Homonyms** present many interesting problems for query suggestions.
- Ambiguous query suggestions will usually lead to results for the **most common or popular** homonym.

Ontology-Supported Web Search (OSWS)

- To address this problem we have been developing the **Ontology-Supported Web Search** (OSWS) System.
- OSWS provides **disambiguated query completions** generated using an **ontology**.
  - [Tian, Geller, Chun. Vienna 2010]
  - [Tian, Geller, Chun. London 2011]

Ontology-Supported Web Search




Thing
Person
Art
Athlete
Artist
Movie
Actor
Saving Private Ryan
Stars In Movie
Tom Hanks

Improving the OSWS Ontology

- The first iteration of the OSWS ontology was **severely limited in domain**.
- It **lacked information** we felt users would find useful; such as:

  Album names, movie titles, teams athletes play on
- To further validate our design, we needed to build a new ontology that covered a **much larger domain**.

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Building an Ontology of Famous People

- We are building a **special purpose ontology** focused on famous people.
- **How do we know somebody is famous**? How do we know someone is **famous right now**?
- ***Google knows who is famous today!*** We define someone as famous if his or her name appears as a **Google query suggestion**.
- If a name is a suggestion it implies many people have searched for it.

Building the A-List

- Used **U.S. Census Data** to find most common first names.
- First we built the **A-List**, the "*most famous*" people.
- Created by querying Google's query suggestion API with **just first names**.
- *John* → John Jay, Johnny Depp, John Deere, etc.
- Using this method we found **5,286** candidates.

The B-List and C-List

- Next we queried in the form "*n1 l1,*" where *l1* is a letter from the alphabet. E.g. **Gary *B***, **Will *F***, **Albert *E***
- This is the **B-List**. It contains **132,896** candidates.
- Finally, we queried "*n1 l1 l2*" where *l2* is another letter. E.g. **Gary *Bu***, **Will *Fe***, **Albert *Ei***
- This set was named the **C-List**. There were nearly **1,000,000** candidates.

Matching Names to People

- The **A-List** was the starting point of our ontology.
- **How** do we determine if a candidate name can refer to person?

  Sam Adams, Sterling Silver, Tian Tian
- **How** will we populate our ontology with relevant information?

DBpedia

- **DBpedia** is one of the world's largest multi-domain ontologies.
- Contains information on over 3.5 million entities, including over 360,000 people.
  - [Bizer et. al 2009]
- DBpedia is built from Wikipedia pages and other ontologies.

Building an Ontology of Famous People

- DBpedia is a fantastic resource, but could not be used "*out of the box*" for OSWS.
- Not structured in a way as to provide good query suggestions.
- Take what DBpedia has and tune it to our own needs.
- We **extracted a subset** of DBpedia and restructured it for our own use.

Finding Famous People

- Our system queried **DBpedia** with the **5,286** names in the **A-List**.
- Class and Wikipedia category information was then analyzed.
- If we found an entity belonging to class "**person**," or Wikipedia categories "***year*_births**" or "***year*_deaths**," we considered them a person.
- Using this method, we found that there were at least **3,241** people in the A-List.

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Classifying Famous People

- For each person in the A-List our system extracted information from DBpedia.
- We used the DBpedia Person Hierarchy. Many entities could be **directly mapped** into our ontology.
- Many names were not found within DBpedia's ontology, or their classification was not specific. E.g. "person"

Yet Another Great Ontology (YAGO)

- YAGO (Yet Another Great Ontology) is based off of **Wikipedia** and **WordNet**.
- Instances are assigned to classes based on their Wikipedia categories.
  - [Suchanek, Kasneci, Weikum. 2007]
- YAGO categories are often ***far too specific*** (“*AmericanPeopleOfCanadianDescent*”), so we go “one level up” the YAGO hierarchy to the more general WordNet synsets and map from there.

Mapping From YAGO

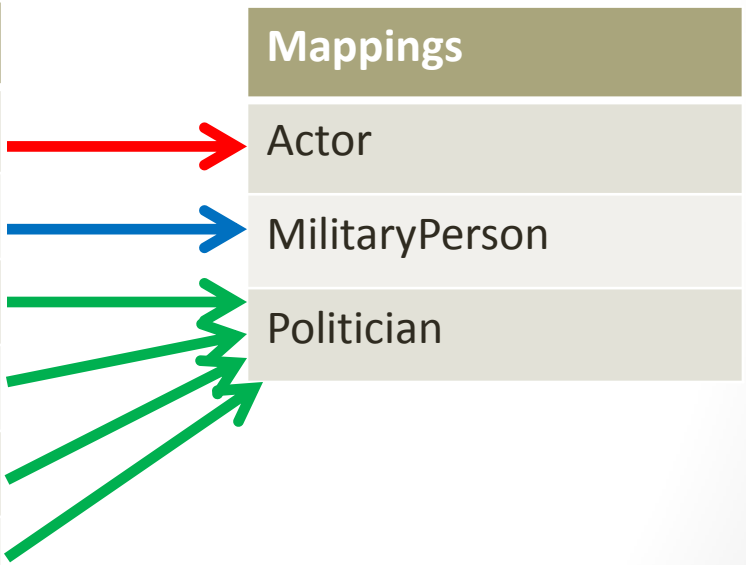
- Analyzed entities in both DBpedia's ontology and YAGO to create a mapping between the ontologies.
- We mapped **the top 85 YAGO classes** in the A-List.

Broader YAGO Class Name	DBpedia Ontology Mapping
Actor	Actor
Anthropologist	Scientist
Blogger	Writer
Drummer	MusicalArtist
Marine	MilitaryPerson

Mapping From YAGO (cont.)

- We map all YAGO classes an instance belongs to, and then choose the most common mapping.
- For example, **Ronald Reagan** would be mapped as:

YAGO Class	WordNet
AmericanFilmActors	Actor
UnitedStatesArmyOfficer	MilitaryOfficer
PresidentsOfTheUS	President
AmericanPoliticiansOfIrish..	Politician
DelegatesToTheRNC	Delegate
GovernorsOfCalifornia	Governor



- This method gave us **67% correlation** and **more specific classification for 16%** of instances.

Other Mapping Methods Used

- Wikipedia adds tags to page names, e.g. John_Adams_**(American_football)**
- Wikipedia pages have an abstract, the first paragraph, usually in the form **x [is|was] a y**, where x is a name and y is a class.
  - Thomas "Tom" Hanks is an American actor, producer, writer, and director.
- Projects such as *Unipedia (ICSC 2010)* use both mapping methods as well.
  - [Kalender, Jiangbo Dang, Uskudarli. 2010]

Choosing The Best Class

- When multiple sources existed we performed **all** of the mapping methods.
- We chose the classification that is lowest in the hierarchy, **the most specific**, to be the class an instance is assigned to.
- For example, if DBpedia gives a classification of "*Musical Artist*" and our YAGO mapping gives a classification of "*Artist*," we use "*Musical Artist*."

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Extracting Useful Relationships

- Previous OSWS ontology was severely lacking in **class-specific relationships and attributes**. [Tian, Geller, Chun. 2010].
- DBpedia has *many* useful attributes & relationships, but had to be organized for search queries.
- OSWS required relationships that were most useful for suggested query completions.
- Next we **identified and extracted** useful relationships and attributes from DBpedia.

Choosing The Best Relationships

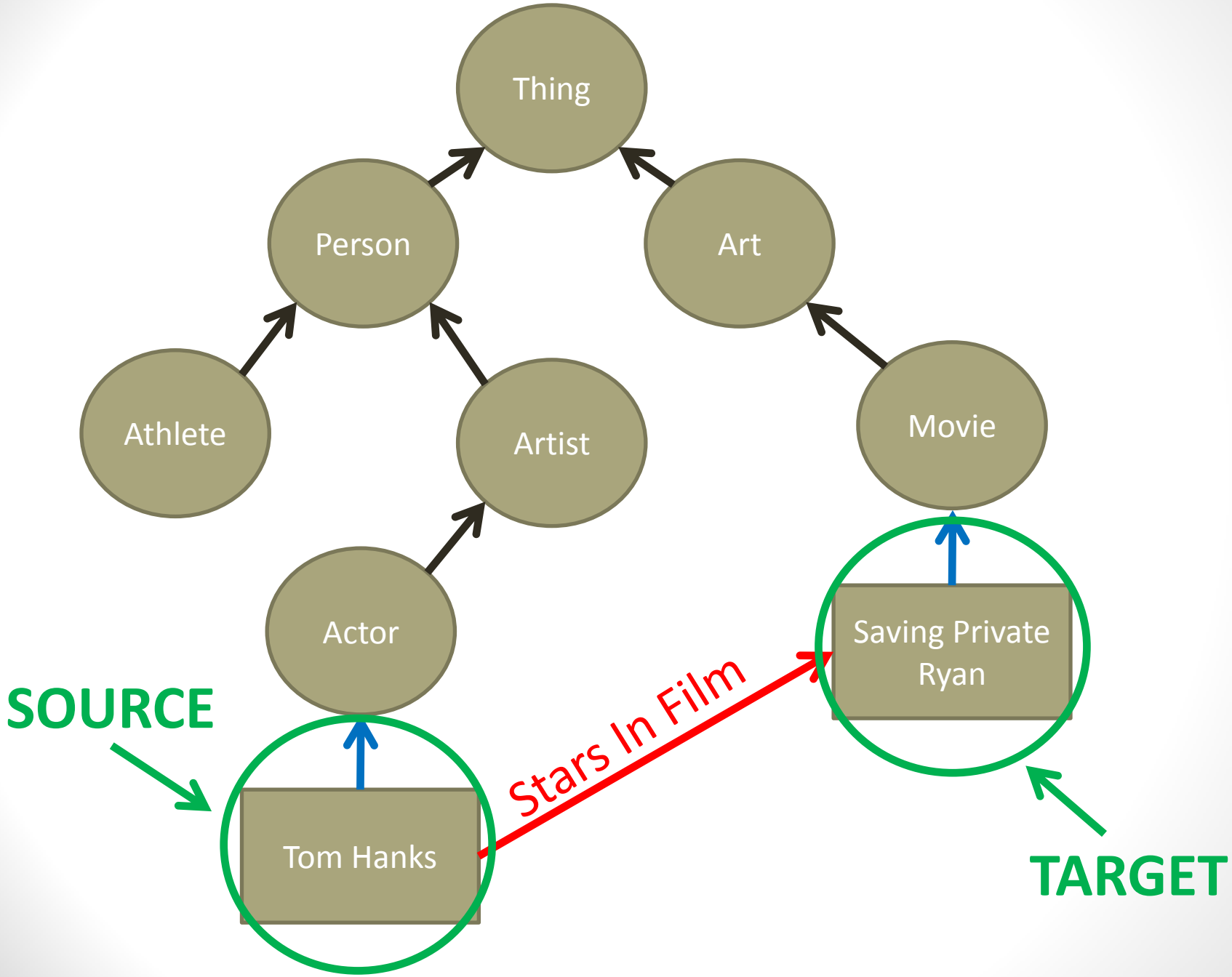
- For each class we counted how often a type of relationship occurred.
- If a type of relationship existed for fewer than 50% of instances of a class, we removed it.
- Removed **the most commonly occurring relationships**.

  E.g. Abstract, image, category, etc.
- Performed a manual review of removals and remaining relationships.

Improving Relationships

- Redundant relationships were fairly common.
- For example: **Tom Hanks** has
  - *dbppedia:starring* **Road to Perdition**
  - *dbpedia-owl:starring* **Road to Perdition**

  Along with many others.
- Redundant relationships were combined into a single relationship, such as *starring*.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Person
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SOURCE
Stars In Film
Tom Hanks
TARGET

Improving Relationships (cont.)

- Some relationships were ambiguous. E.g. "*writer of*" could mean: writer of a song, writer of a television show, writer of a book, etc.
- If a significant portion of relationship targets had different types, **we split the relationship into many relationships of finer granularity**.
- In the above example, we created "*writer of song*," "*writer of book*," "writer of movie," etc.
- Produced, Starring, Performed, Writer, etc.

Reversing Relationships

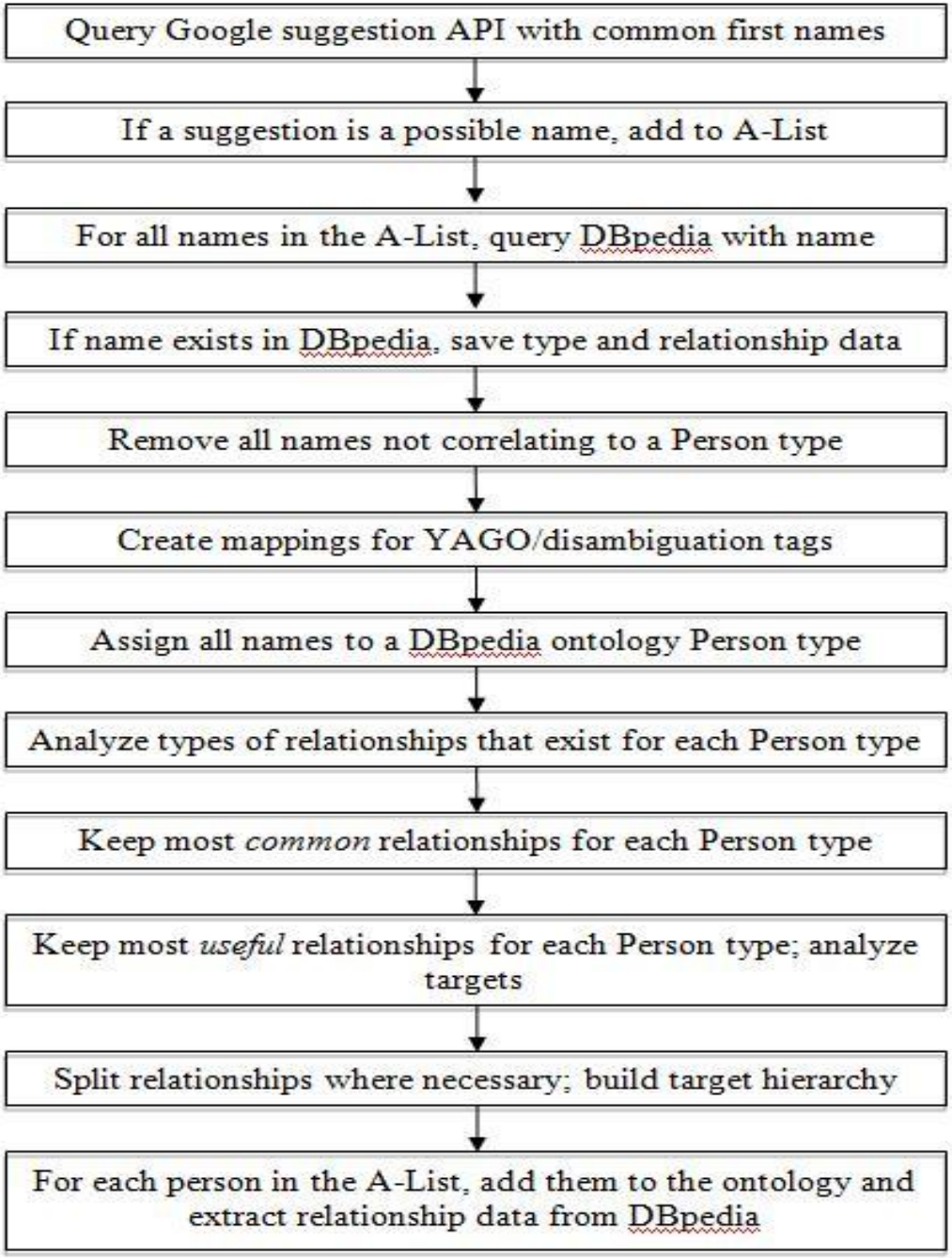
- Our ontology is person-focused, DBpedia isn't.
- All relationships have sources that are people.
- It is common to see relationships in the form **[Movie]** ***starring*** **[Actor]**.
- For many relationships our system reversed the subject and object.
- For example, in DBpedia a relationship is **[Forest Gump] starring [Tom Hanks]**.
- While building an instance our system reversed the relationship to be **[Tom Hanks] stars in film [Forest Gump]**.

Promoting Attributes to Relationships

- Certain **attributes** in DBpedia were promoted **into full relationships**.
- Attributes such as *instruments played* or *genres* were turned into relationships.
- In DBpedia a musician may have the attribute "*plays instrument*" with the value "*piano, keyboard*."
- We split the list at the commas and create multiple relationships.

Relationship Targets

- The targets of **non-interpersonal relationships** were organized into a hierarchy similar to DBpedia.
- For **inter-personal relationships** we had to consider the issue of **recursion**.
- If a target person does not exist in our ontology **then he or she is not considered famous**. However, the target needs to exist to complete the new instance.
- We mark the target person as a "**stub**," an incomplete instance.
- Stubs **are not** provided as query suggestions.


Query Google suggestion API with common first names
If a suggestion is a possible name, add to A-List
For all names in the A-List, query DBpedia with name
If name exists in DBpedia, save type and relationship data
Remove all names not correlating to a Person type
Create mappings for YAGO/disambiguation tags
Assign all names to a DBpedia ontology Person type
Analyze types of relationships that exist for each Person type
Keep most *common* relationships for each Person type
Keep most *useful* relationships for each Person type; analyze targets
Split relationships where necessary; build target hierarchy
For each person in the A-List, add them to the ontology and extract relationship data from DBpedia

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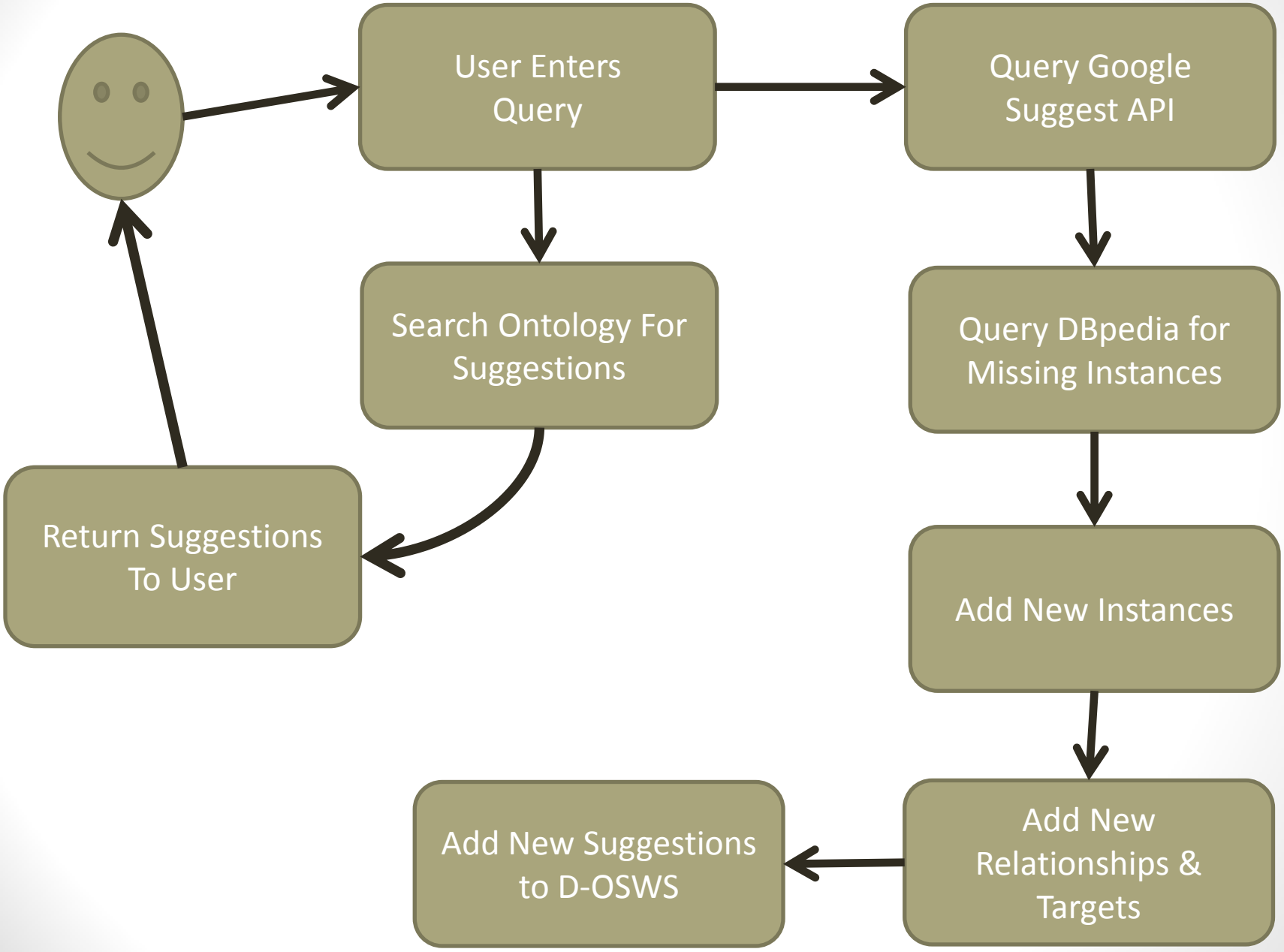
Dynamically Expanding the OSWS Ontology (D-OSWS)

- Keeping an ontology up to date is a labor-intensive and error-prone task.
- Required a way to **dynamically add new instances** while maintaining nearly the same quality as the A-List ontology.
- We created the **Dynamic Ontology-Supported Web Search** (D-OSWS) System.

Dynamic Ontology-Supported Web Search

- **D-OSWS** automatically adds new instances to the ontology during normal use. Uses systems developed for building A-List ontology.
- When a user enters a search term into OSWS, we follow the same process as when we built the A-List.

1. Query Google Suggestion API.
2. Query DBpedia with suggestions.
3. Add any instances NOT in our ontology.
4. Return the new suggestions to the user.


User Enters Query
Query Google Suggest API
Search Ontology For Suggestions
Query DBpedia for Missing Instances
Return Suggestions To User
Add New Instances
Add New Suggestions to D-OSWS
Add New Relationships & Targets

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Conclusions

- OSWS disambiguates query completions in a user-friendly manner by creating suggestions from an ontology.
- We built a new ontology by finding famous people via Google.
- The ontology consists of nearly 22,000 concepts linked by over 90,000 relationships; centered around 3,241 people in the A-List.
- The D-OSWS system dynamically extends the ontology during use.

Future Work

- Higher granularity in person hierarchy
- New data sources & DBpedia Live
- Search What I Mean (SWIM)
  - Do What I Mean (DWIM) [Teitelman]
- Quality assurance mechanisms
- Building the B-List and C-List ontologies
- Filtering search results with ontology

Try It Out!

- The Ontology-Supported Web Search is live right now.
- Feel free to try it out.
- D-OSWS will be live in the near future, including B-List ontology.

http://osws.njit.edu

Thank You!

Questions?