# Facilitating Human Intervention in Coreference Resolution with Comparative Entity Summaries

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Presented at ESWC 2014, Crete, Greece

# Coreference resolution

| TimBL |
| --- |
| givenName: “Tim” |
| surname: “Berners-Lee” |
| altName: “Tim BL” |
| type: Scientist |
| gender: “male” |
| isDirectorOf: W3C |

| TBL |
| --- |
| name: “Tim Berners-Lee” |
| type: ComputerScientist |
| type: RoyalSocietyFellow |
| sex: “Male” |
| invented: WWW |
| founded: WSRI |

| Wendy |
| --- |
| fullName: “Wendy Hall” |
| type: ComputerScientist |
| type: RoyalSocietyFellow |
| sex: “Female” |
| birthplace: London |
| founded: WSRI |

# Methods with humans in the loop (or, coordinating “ings”)

- Active learning
- Crowdsourcing
- Pay-as-you-go

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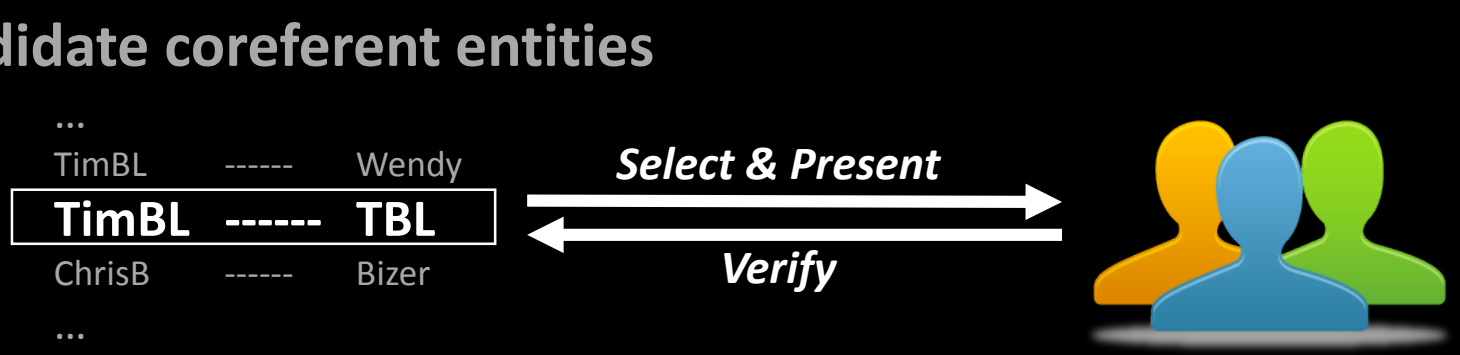

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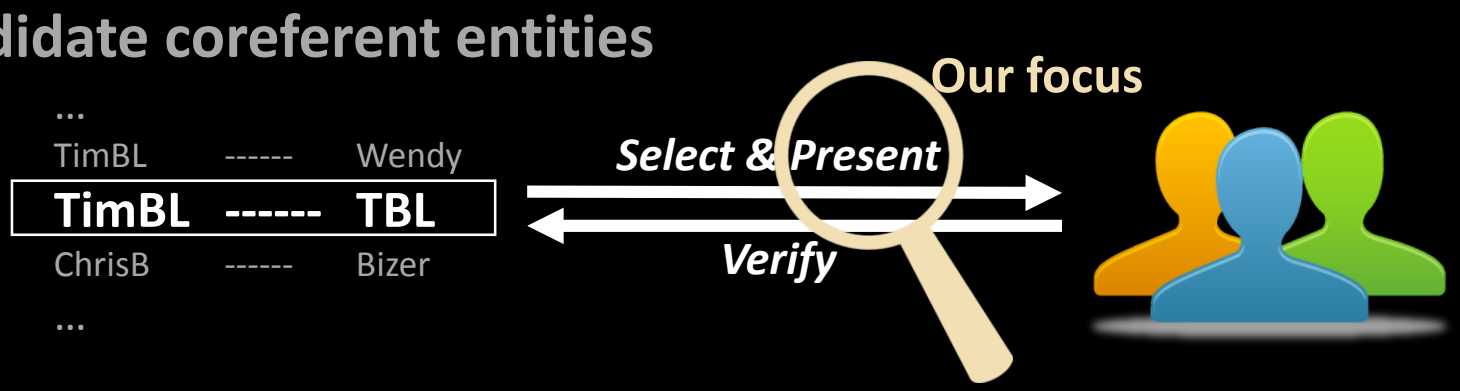
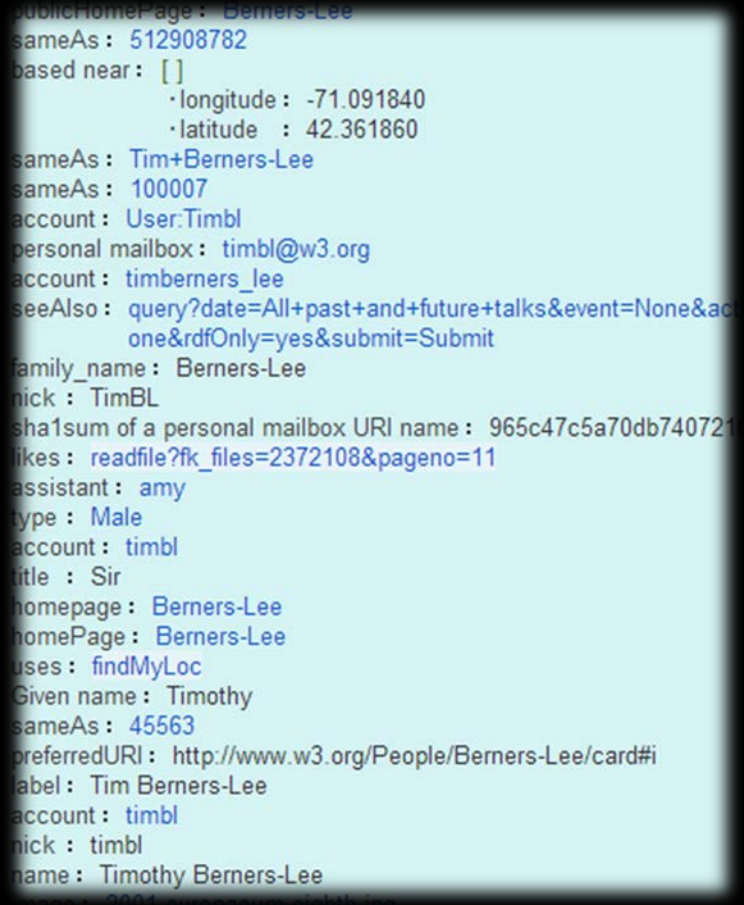
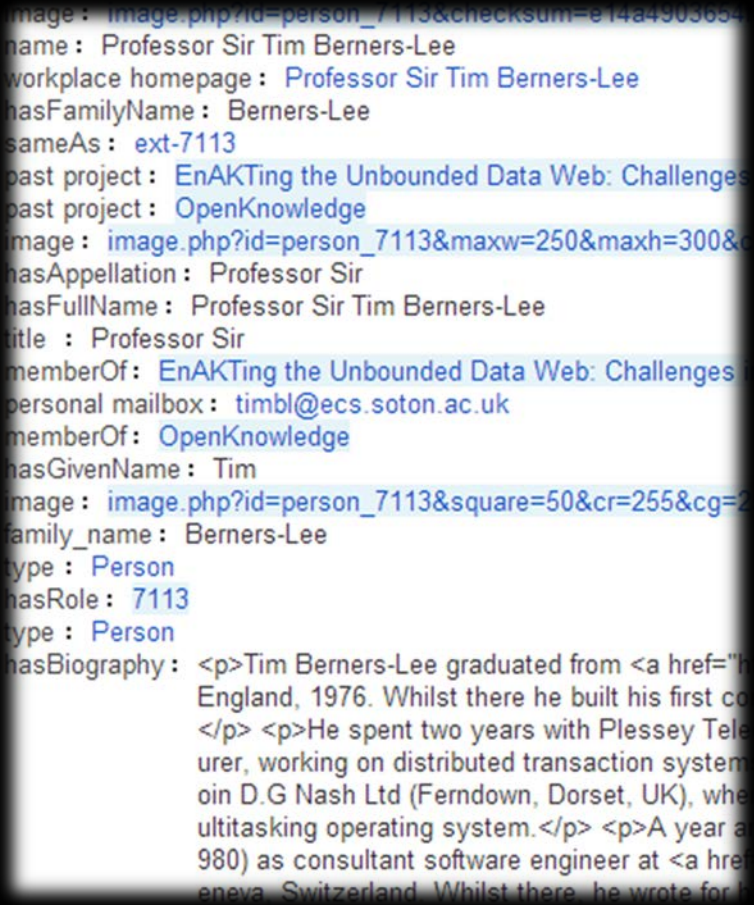
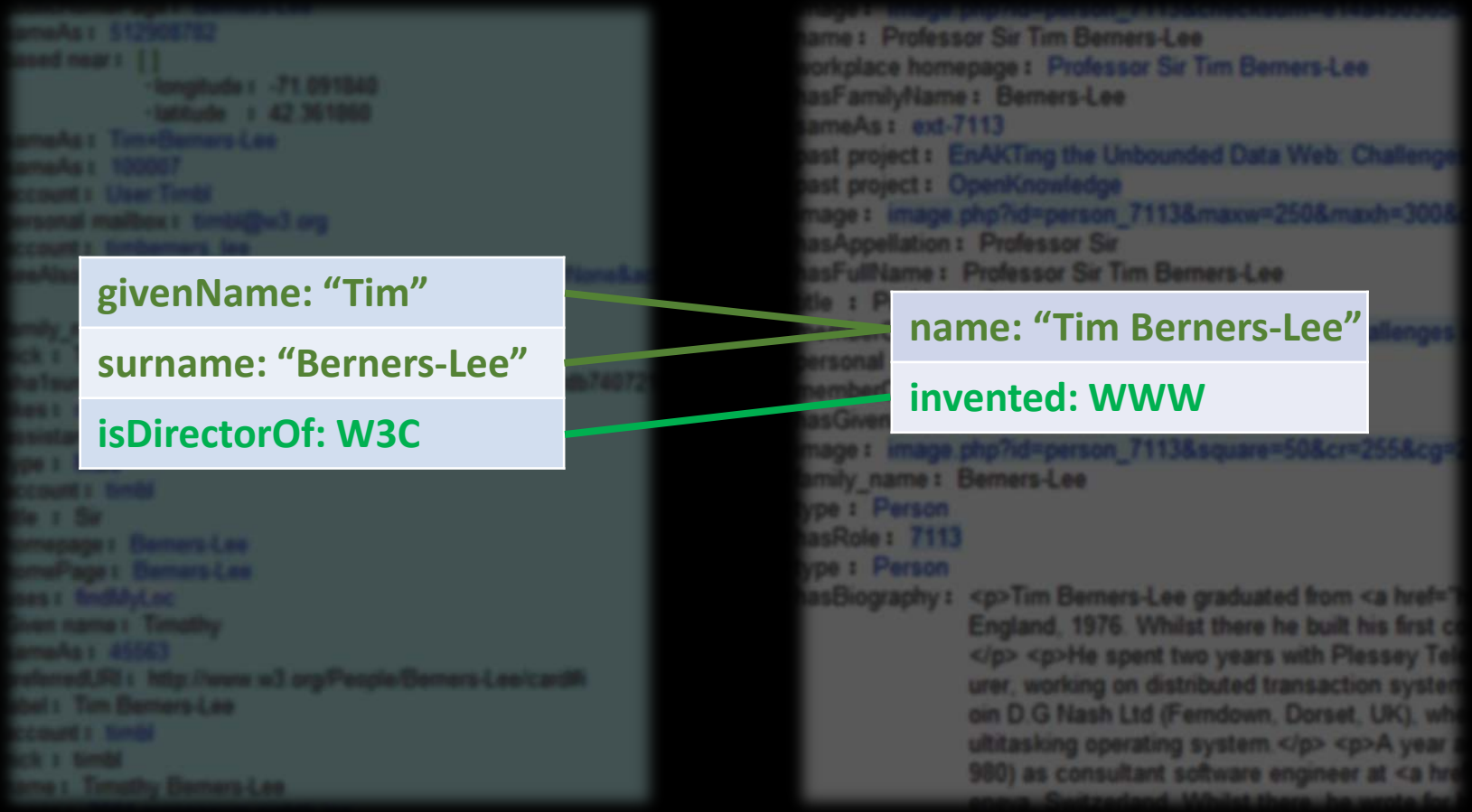


# Present entire entity descriptions?



# Present a compact comparative summary!



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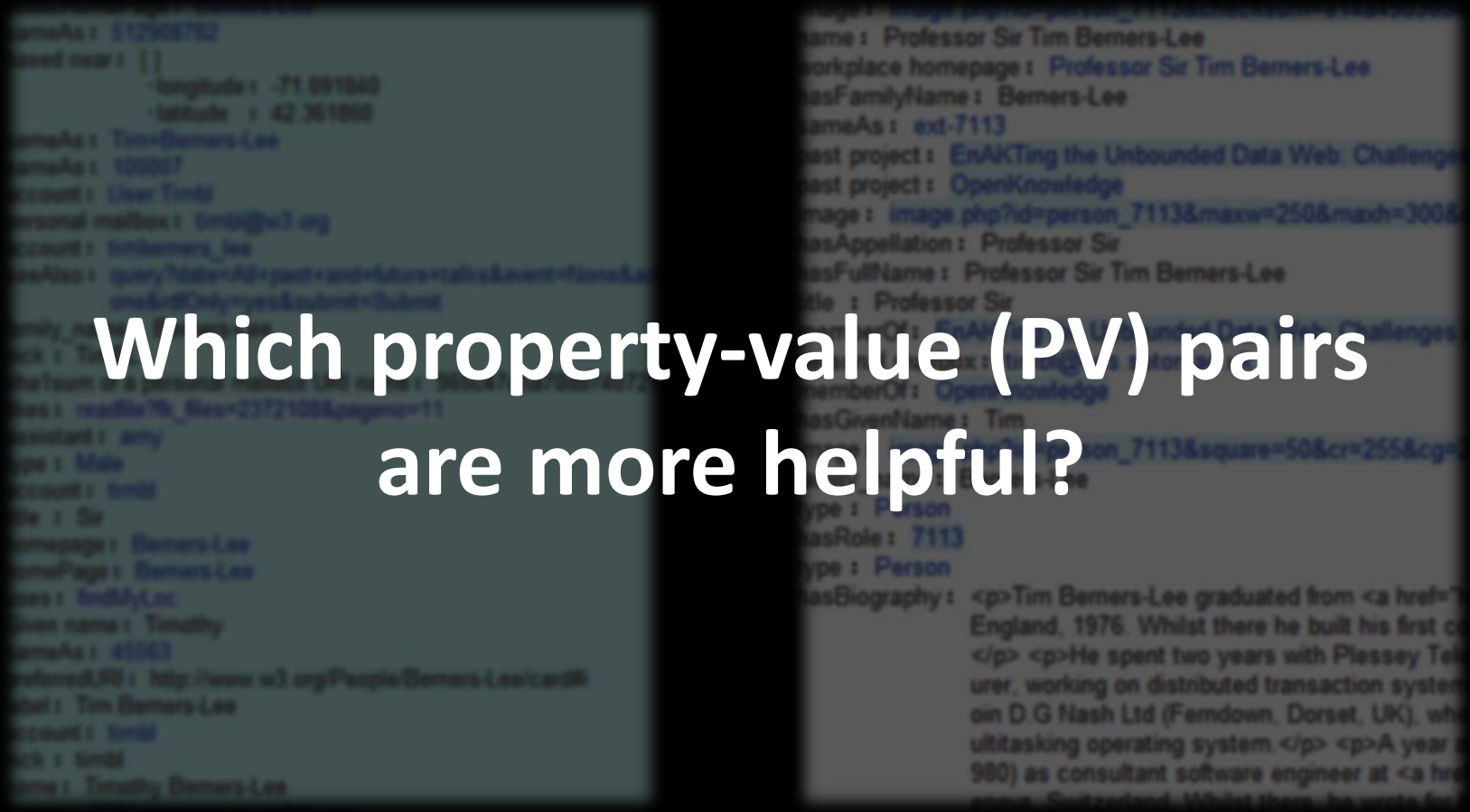
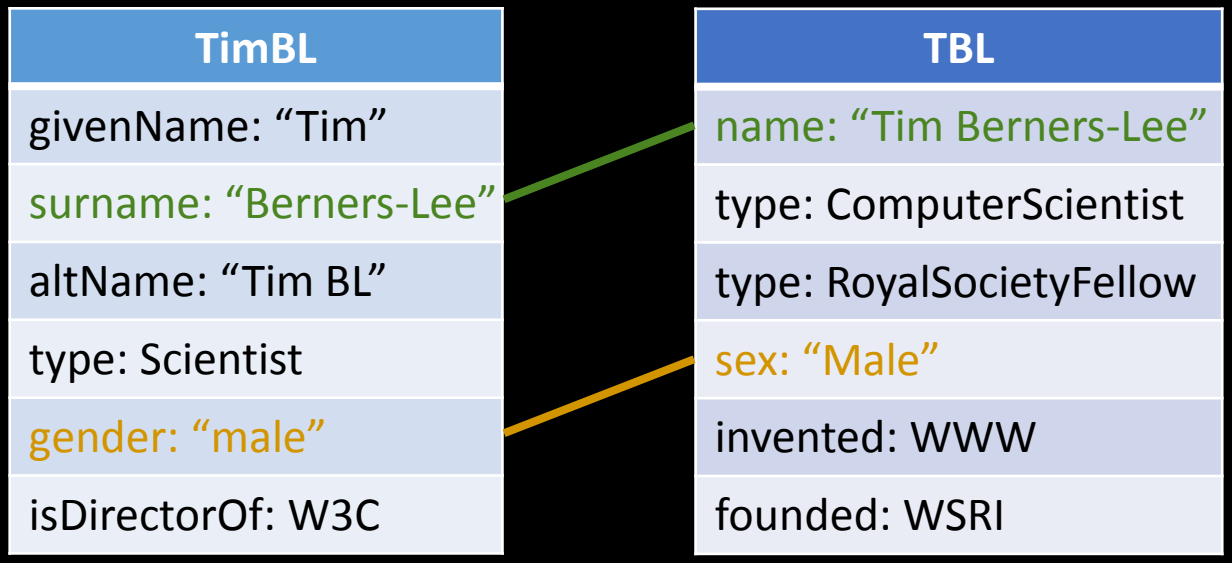


**Which property-value (PV) pairs are more helpful?**

# Four aspects of a good comparative summary

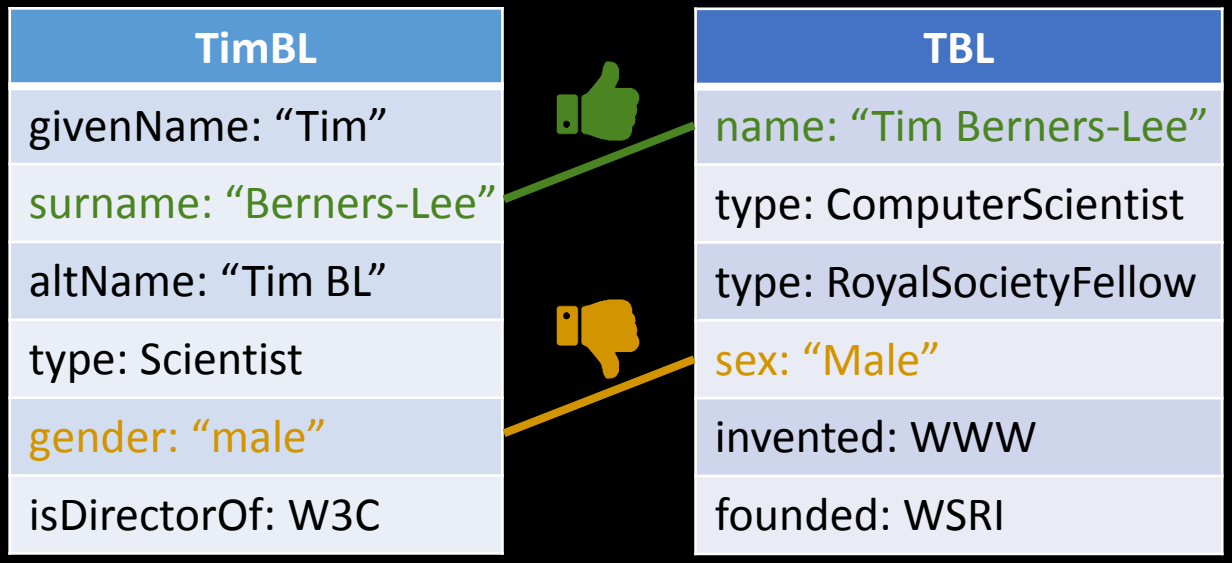
1. Reflecting commonality
2. Reflecting difference
3. Providing information on identity
4. Providing diverse information

# 1. Commonality




- Common PV pairs =
  comparable properties + similar values

# 1. Commonality




- Common PV pairs =
  comparable properties + similar values
- More helpful properties =
  more like an Inverse Functional Property (IFP)

# 1. Commonality (details)

- Comparability between properties
  - Learned from known coreferent entities

    *Comparable properties = Properties having similar values*
  - String similarity

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  - String similarity
- Similarity between values
  - String similarity
- Likeness to an IFP
  - Estimated based on the data set

$$Likeness = \frac{Number\ of\ distinct\ values}{Number\ of\ all\ values}$$

# 1. Commonality (weakness)

- Only reflecting commonality can be misleading.

| TBL |
| --- |
| ~~name: “Tim Berners-Lee”~~ |
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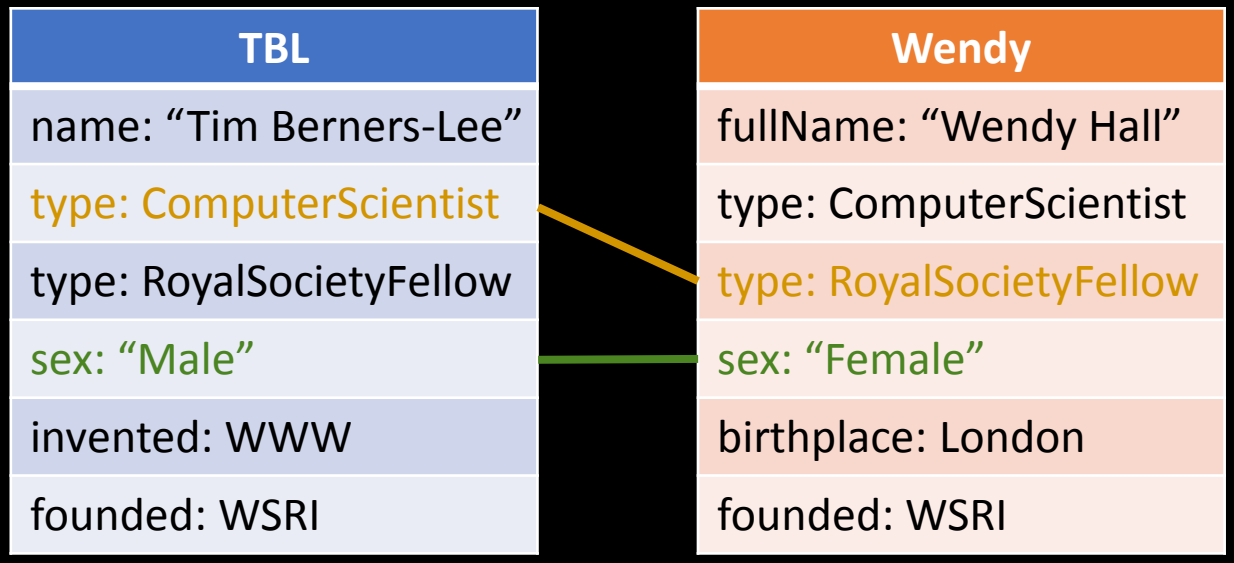
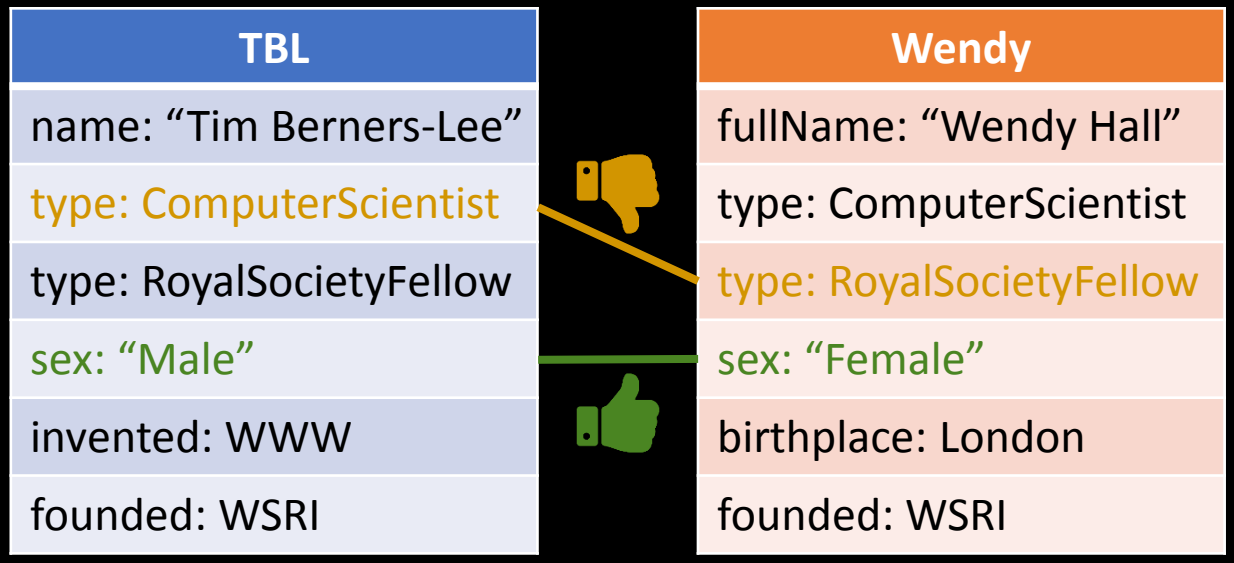
# 2. Difference




- Different PV pairs =
  comparable properties + dissimilar values

# 2. Difference




- Different PV pairs =
  comparable properties + dissimilar values
- More helpful properties =
  more like a Functional Property (FP)

# 2. Difference (details)

- Comparability between properties
  - Learned from known coreferent entities
  - String similarity
- Dissimilarity between values
  - String similarity
- Likeness to a FP
  - Estimated based on the data set

$$Likeness = \frac{Number\ of\ distinct\ subjects}{Number\ of\ all\ subjects}$$

# 3. Information on identity

| TimBL |
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| givenName: “Tim” |
| surname: “Berners-Lee” |
| altName: “Tim BL” |
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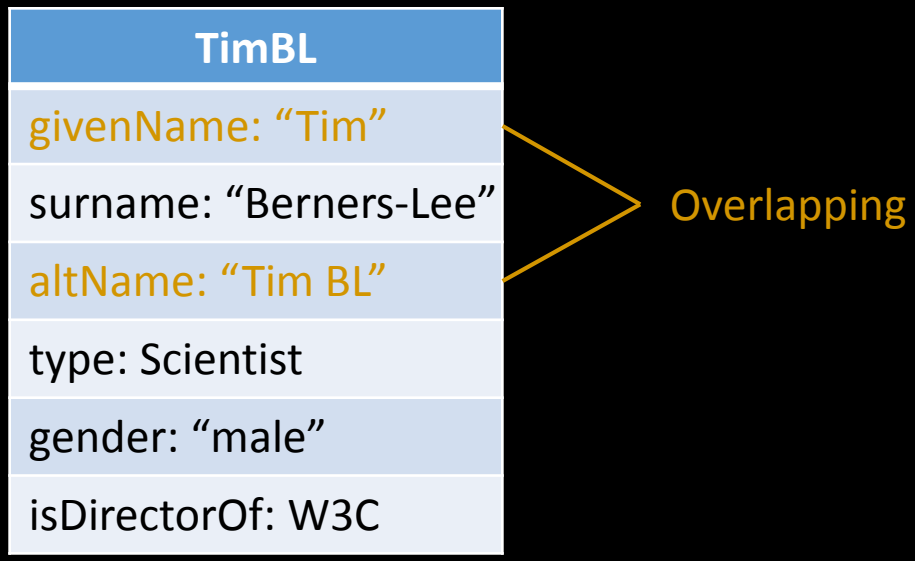
# 3. Information on identity (details)

- Information on identity
  - Estimated based on the data set

$$information = 1 - \frac{\log(Number\ of\ entities\ having\ this\ PV\ pair)}{\log(Number\ of\ all\ entities)}$$

# 4. Diversity of information




- Overlapping PV pairs =
  similar properties or similar values

# To find an optimal summary (or, to find the most helpful PV pairs)

- Maximize
  - Commonality
  - Difference
  - Information on identity
  - Diversity of information
- Subject to
  - A length limit

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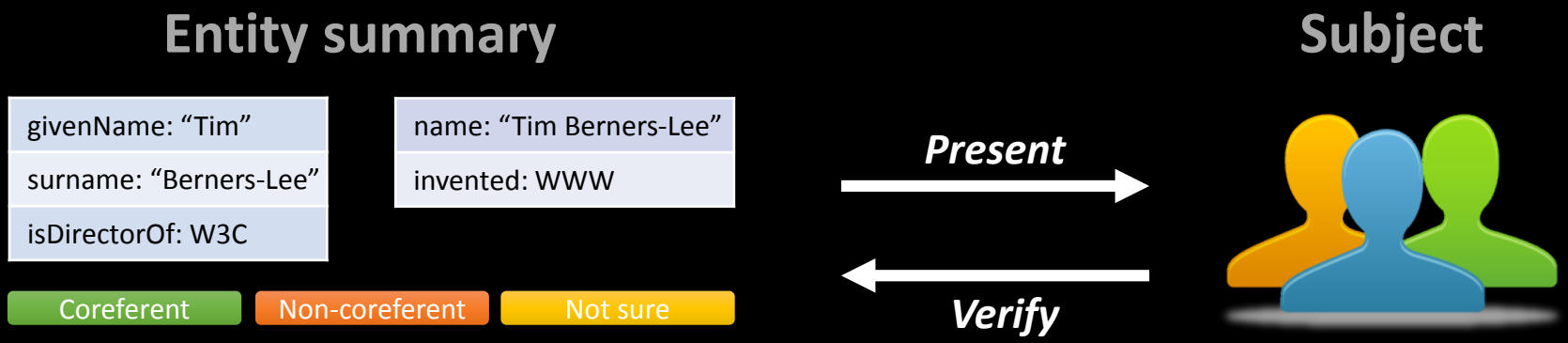
- Formulated as a binary quadratic knapsack problem
- Solved by GRASP-based local search

# Evaluation method




- 4 approaches to be blindly tested
- 20 subjects (university students)
- 24 random tasks for each subject
  - 4 approaches * (3 positive cases + 3 negative cases)
  - Sorted in random order

# Data sets and tasks

- Data sets

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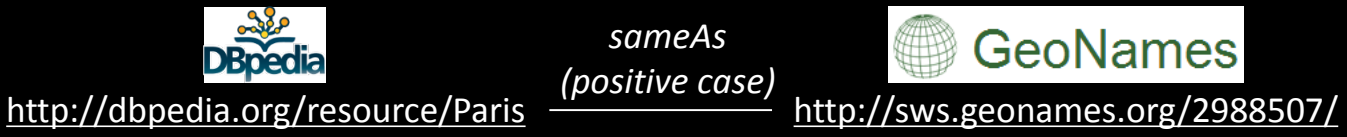
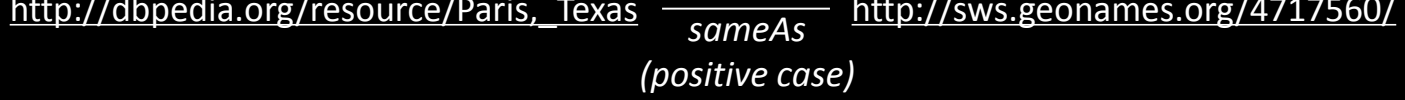
- Tasks



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- Data sets


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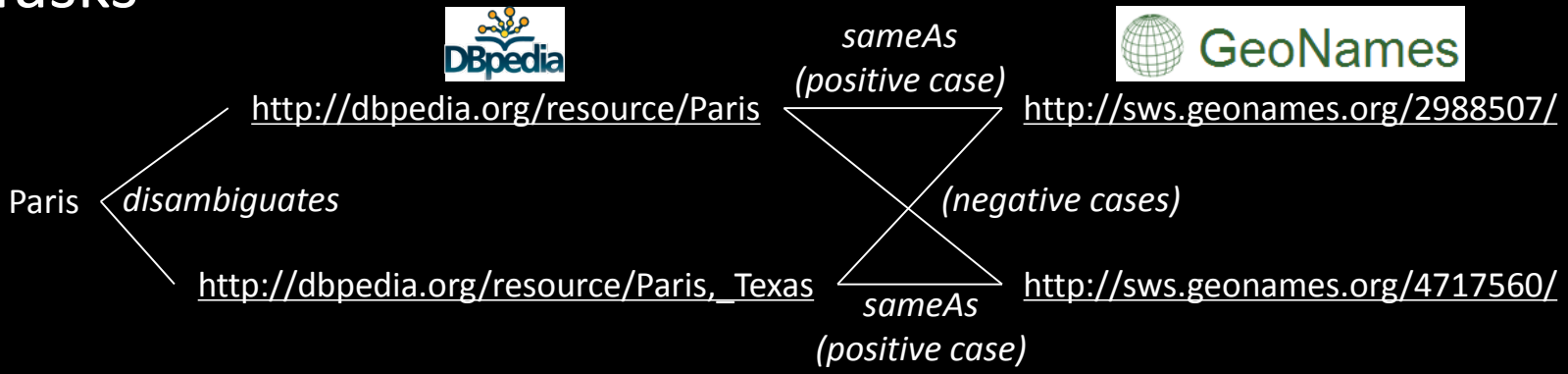


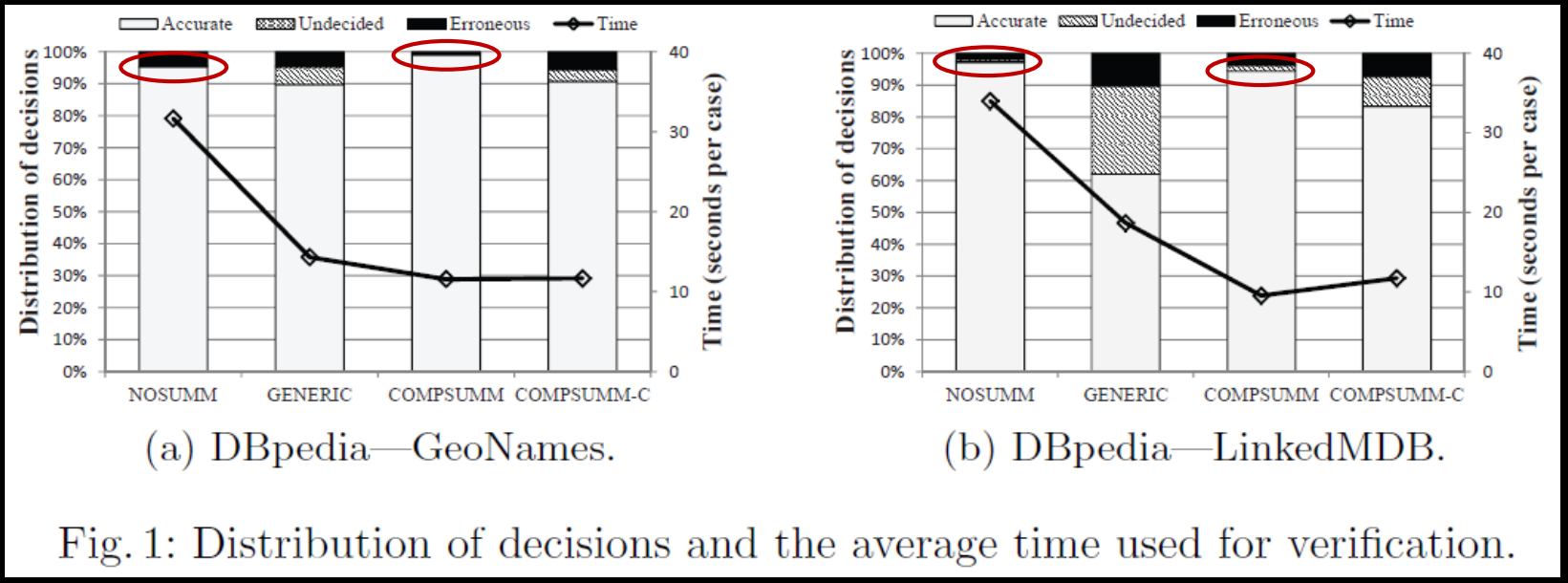
# Approaches

| Approach | Description |
|---|---|
| NOSUMM | Present entire entity descriptions |
| GENERIC | • Information on identity [3]<br>• Diversity of information |
| COMPSUMM | • Commonality<br>• Difference<br>• Information on identity<br>• Diversity of information |
| COMPSUMM-C | • Commonality<br>• ~~Difference~~<br>• Information on identity<br>• Diversity of information |

[3] Gong Cheng et al. RELIN: Relatedness and Informativeness-based Centrality for Entity Summarization (*ISWC 2011*)

# Results (1)

- Accuracy of verification
  - COMPSUMM ≈ NOSUMM
    > COMPSUMM-C
    > GENERIC




(a) DBpedia—GeoNames.

(b) DBpedia—LinkedMDB.

Fig. 1: Distribution of decisions and the average time used for verification.

# Results (2)

- Efficiency of verification
  - COMPSUMM > NOSUMM (2.7—2.9 times faster)

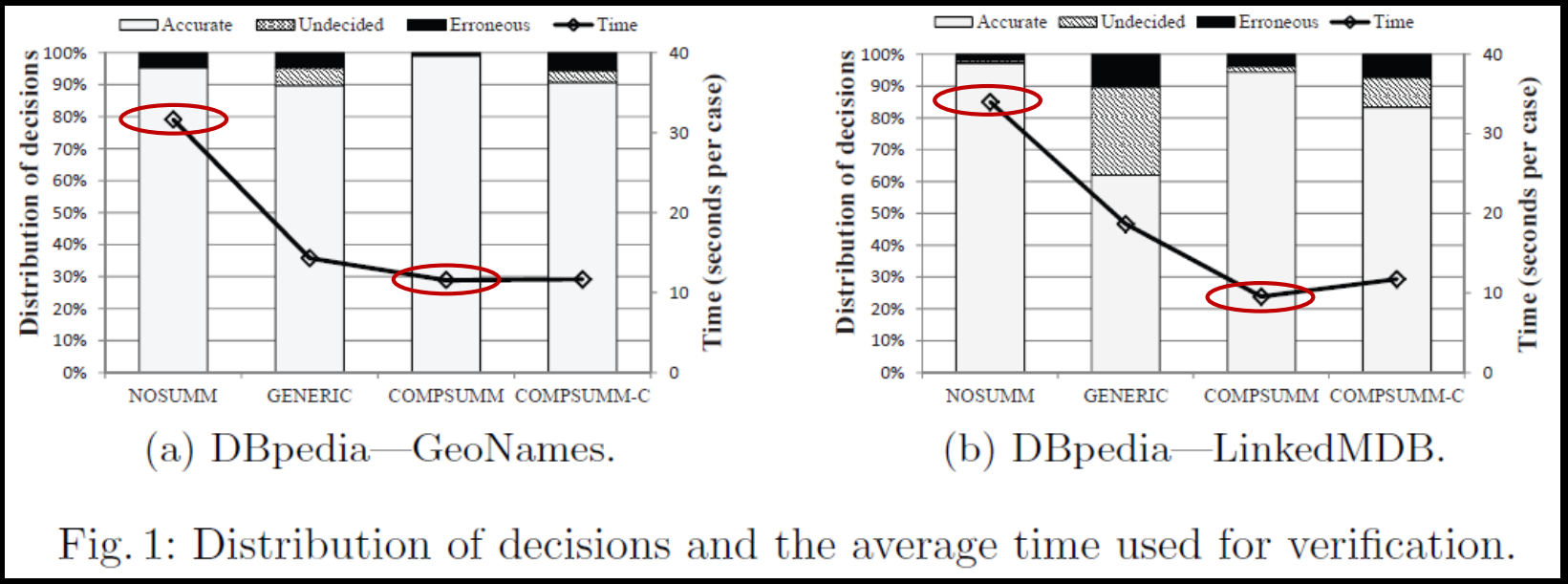



Fig. 1: Distribution of decisions and the average time used for verification.

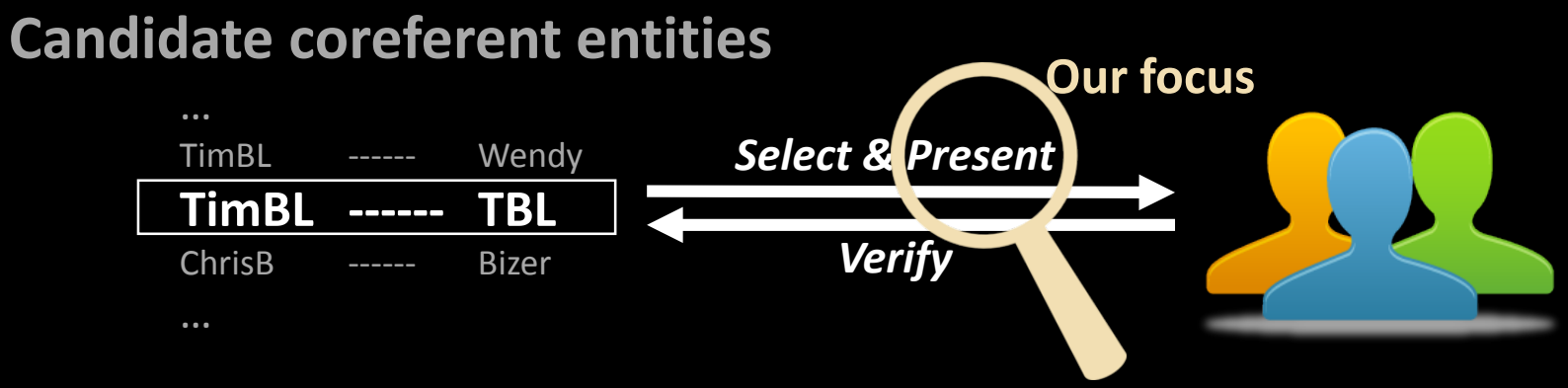
# Take-home messages

- Provide entity summaries for verifying coreference.
  - improves efficiency (2.7—2.9 times faster)
  - without notably affecting accuracy

- Provide comparative (but not just generic) summaries.
- Show both commonality and difference.

# Future work

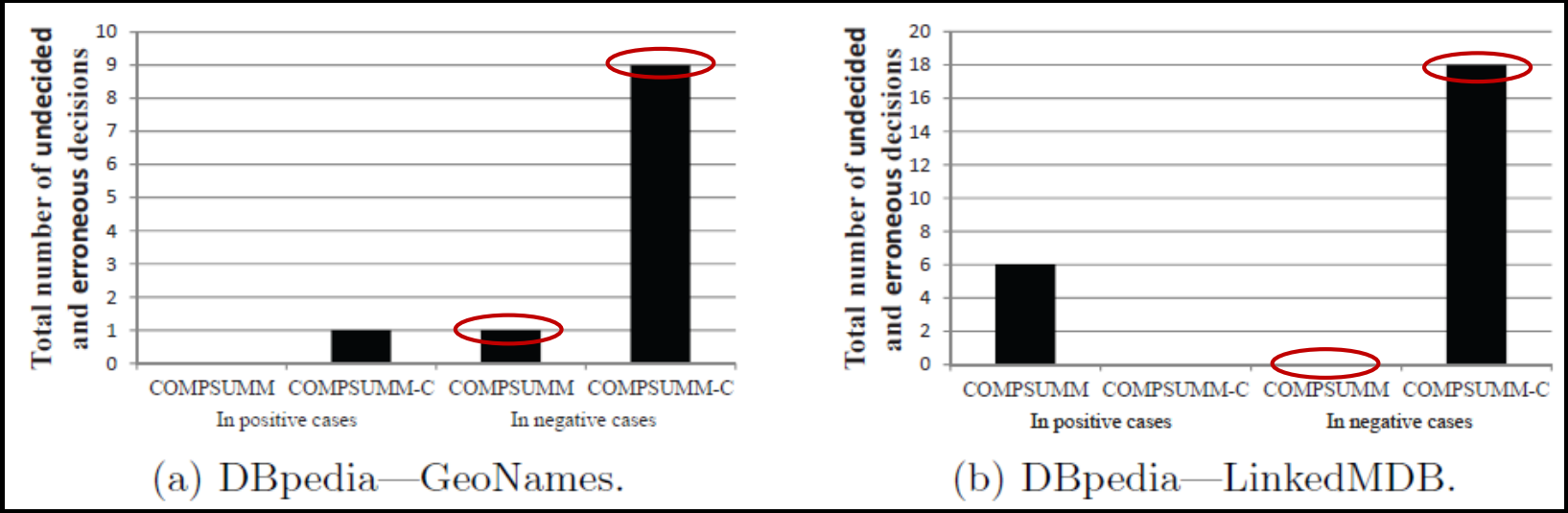
- Present = Summarize + Visualize



Thanks for your attention

# Results (3)

- Erroneous decisions
  - COMPSUMM-C > COMPSUMM (mostly in negative cases)



# Performance testing

- Offline computation
  - Comparability between properties (the learning part)
  - Likeness to an IFP/FP
  - Information on identity

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- ~~Offline computation~~
  - ~~Comparability between properties (the learning part)~~
  - ~~Likeness to an IFP/FP~~
  - ~~Information on identity~~
- Online computation
  - Similarity between properties/values
  - Optimization
- Results
  - Places (DBpedia and GeoNames): 24ms per case
  - Films (DBpedia and LinkedMDB): 35ms per case