

# DAT630

## Entity linking II.

09/11/2016

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## Recap

- Entity linking is task of linking **free text** to **entities**
- Entity linking is generally performed in a pipeline of three steps:
  - Mention detection:** identifying candidate mention-entity pairs
  - Entity ranking:** ranking entities of each mention
  - Disambiguation:** selecting one entity or none for a mention

## Entity linking evaluation

### Mid-level evaluation:

- Only for evaluating the first two steps
- Rank based metrics: Recall@k, P1, MAP, etc.

### End-to-end evaluation

- Set based metrics: Precision, recall, F-measure

Entity linking performance is evaluated using set-based metrics.

## Entity linking evaluation

### ground truth $\hat{A}$

Košice is the biggest city in eastern Slovakia and in 2013 was the European Capital of Culture together with Marseille, France. It is situated on the river Hornád at the eastern reaches of the Slovak Ore Mountains, near the border with Hungary.

### system annotation A

Košice is the biggest city in eastern Slovakia and in 2013 was the European Capital of Culture together with Marseille, France. It is situated on the river Hornád at the eastern reaches of the Slovak Ore Mountains, near the border with Hungary.



## Entity linking evaluation

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## Entity linking evaluation

### Matching criteria

- Both mention and entity should be considered
- There are two variations:
  - Perfect match:** linked entity and the mention offsets must match
  - Relaxed match:** the linked entity must match, it is sufficient if the mention overlaps with the gold standard

## Entity linking evaluation

### Matching criteria:

- Both mention and entity should be considered
  - Perfect match:** the linked entity and the mention must exactly match the gold standard
  - Relaxed match:** the linked entity must match, it is sufficient if the mention overlaps with the gold standard

### Aggregation:

- metrics are computed over a collection of documents
  - Micro-averaged:** aggregated across mentions
  - Macro-averaged:** aggregated across documents

## Evaluation metrics

### Micro-averaged:

- computed across all the mention-entity pairs

$$P_{mic} = \frac{|A_D \cap \hat{A}_D|}{|A_D|} \quad R_{mic} = \frac{|A_D \cap \hat{A}_D|}{|\hat{A}_D|}$$

### Macro-averaged:

- computed for each document and then averaged over all documents

$$P_{mac} = \sum_{d \in D} \frac{|A_d \cap \hat{A}_d|}{|A_d|} / |D| \quad R_{mac} = \sum_{d \in D} \frac{|A_d \cap \hat{A}_d|}{|\hat{A}_d|} / |D|$$

### F1 score:

$$F1 = \frac{2 \times P \times R}{P + R}$$

# Exercise



Entity linking evaluation

## Text 1

Ground truth:

Mention	Entity
mpla	<wikipedia:MPLA>
angola	<wikipedia:Angola>
1992 elections	<wikipedia:Angolan_presidential_election,_1992>
multiparty democracy	<wikipedia:Multi-party_system>

System output:

Mention	Entity
1992 elections	<wikipedia:Philippine_general_election,_1992>
angola	<wikipedia:Angola>
multiparty democracy	<wikipedia:multiparty_democracy>

## Text 1

Ground truth:

Mention	Entity
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System output:

Mention	Entity
1992 elections	<wikipedia:Philippine_general_election,_1992>
angola	<wikipedia:Angola>
multiparty democracy	<wikipedia:multiparty_democracy>

## Text 2

Ground truth:

Mention	Entity
sweet potato	<wikipedia:Sweet_potato>
bell pepper	<wikipedia:Bell_pepper>
tomato	<wikipedia:Tomato>

System output:

Mention	Entity
potato	<wikipedia:Sweet_potato>
perennials	<wikipedia:Perennial_plant>

## Text 2

Ground truth:

Mention	Entity
sweet potato	<wikipedia:Sweet_potato>
bell pepper	<wikipedia:Bell_pepper>
tomato	<wikipedia:Tomato>

System output:

Mention	Entity
potato	<wikipedia:Sweet_potato>
perennials	<wikipedia:Perennial_plant>

## Macro-averaged metrics

1. What is Precision for Text 1?  $\frac{1}{3} = 0.33$
2. What is Precision for Text 2?  $\frac{1}{2} = 0.5$
3. What is  $P_{macro}$ ?  $(\frac{1}{3} + \frac{1}{2})/2 = 0.41$
4. What is Recall for Text 1?  $\frac{1}{4} = 0.25$
5. What is Recall for Text 2?  $\frac{1}{3} = 0.33$
6. What is  $R_{macro}$ ?  $(\frac{1}{4} + \frac{1}{3})/2 = 0.29$
7. What is  $F1_{macro}$  score?  $\frac{2 * 0.41 * 0.29}{0.41 + 0.29} = 0.17$

## Micro-averaged metrics

1. What is  $P_{micro}$ ?  $\frac{1+1}{2+3} = 0.4$
2. What is  $R_{micro}$ ?  $\frac{1+1}{3+4} = 0.28$
3. What is  $F1$  score?  $\frac{2 * 0.4 * 0.28}{0.4 + 0.28} = 0.15$

## Entity linking in practice



# TAGME system

- A very popular entity linking system
- Designed for annotating short texts
- Method:
  - **Mention detection:** builds dictionary from Wikipedia; keyphraseness for filtering
  - **Entity ranking:** uses relatedness weighted by commonness
  - **Disambiguation:** Pruning by threshold



Accessible at <http://tagme.di.unipi.it/>

# TAGME system

Input Text  
Italiano - English

British expatriates brought football to Argentina in the 19th century. The rivalry between the England and Argentina national football teams, however, is generally traced back to the 1966 FIFA World Cup.

Tagged text Topics

British expatriates brought football to Argentina in the 19th century. The rivalry between the England and Argentina national football teams, however, is generally traced back to the 1966 FIFA World Cup.

Australia national rugby union team

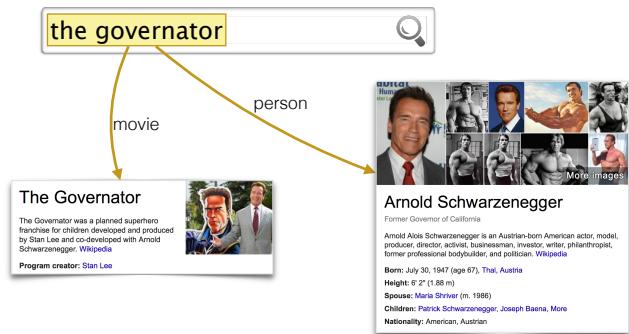
The Australian national rugby union team is the representative side of Australia in rugby union. The national team is nicknamed the Wallabies and competes annually with New Zealand, South Africa and A...

Many links Few links Reset TAGME

## Entity linking in queries



## Entity linking in queries



## Entity linking in queries



## Entity linking in queries



## Entity linking in queries

Detecting entity linking *interpretations* of the query, where each interpretation consists of a set of mention-entity pairs.

### Input:

- Search queries (short and noisy text fragments)
- Limited (or even no) context is provided

### Requirements:

- Should be done fast
- Multiple interpretations

## Approach

Similar pipeline approach



- Should consider between **efficiency** and **effectiveness**
- **Entity ranking** step plays an important role
- Entity relatedness features are less important here
  - each query mostly contain one or two entities
  - textual similarity features are more effective

# Evaluation

ground truth $\hat{I}$	system annotation $I$
France, FIFA world cup	France, FIFA world cup
France football team, FIFA world cup	FIFA world cup

# Evaluation

## Evaluating a single query:

$$P = \frac{|I \cap \hat{I}|}{|I|} \quad R = \frac{|I \cap \hat{I}|}{|\hat{I}|} \quad F = \frac{2 \cdot P \cdot R}{P + R}$$

## Evaluating multiple queries:

$$P_{macro} = \sum_{q \in Q} \frac{|I \cap \hat{I}|}{|I|} / |Q| \quad F1 = \frac{2 \cdot P_{macro} \cdot R_{macro}}{P_{macro} + R_{macro}}$$
$$R_{macro} = \sum_{q \in Q} \frac{|I \cap \hat{I}|}{|\hat{I}|} / |Q|$$