Manual Annotation for NLP

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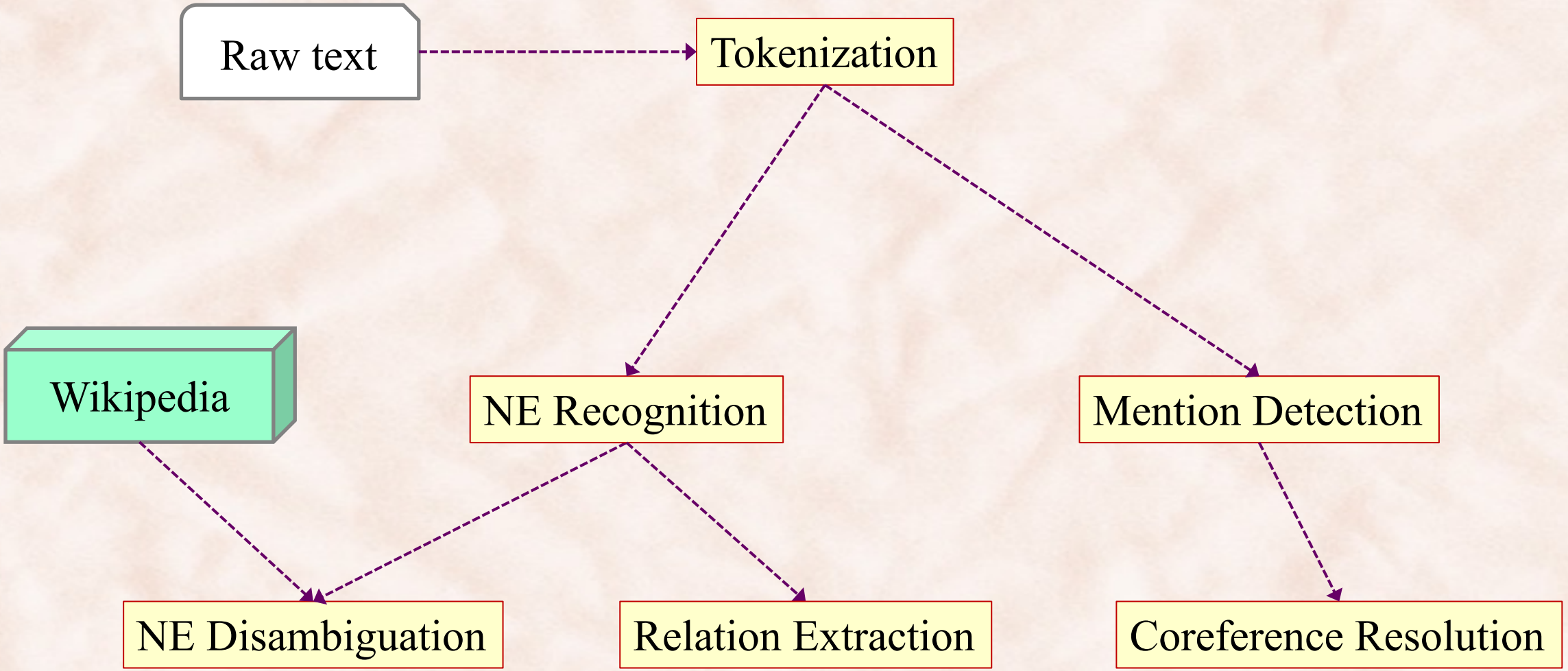
Supervised Learning

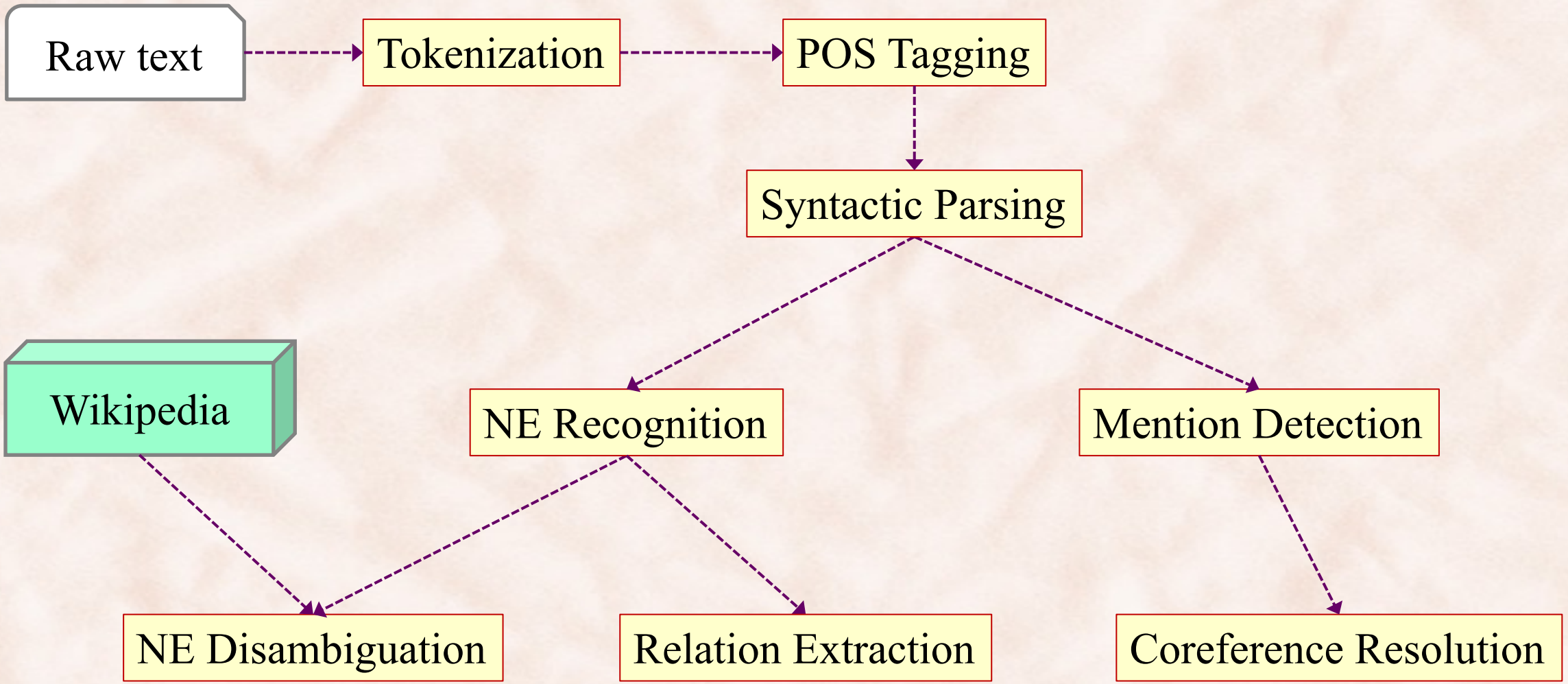
- State-of-the-art performance in NLP is obtained using ML models.
- ML models typically require labeled training examples:
  - For sentiment analysis, need documents ***annotated*** with sentiment labels.
  - Sentiment analysis was modeled as a **classification** task.
  - Many other tasks in NLP can be modeled as classification.

- Information Extraction tasks modeled as classification:
  - Named Entity Recognition (NER).
  - Relation Extraction (RE).
  - Coreference resolution (Coref).
    - Mention Detection.
  - Named Entity Disambiguation (NED) as **ranking** (number classes is variable).

Information Extraction: A Pipeline Approach



Information Extraction: Syntax is Useful



Named Entity Recognition (NER) as Classification

- Protein name recognition:

  Interferon beta was found to upregulate IL-15 in vitro

- Labels for protein name recognition:
  - **B-Prot** indicates a token that starts a protein name.
  - **I-Prot** indicates a token that is inside a protein name.
  - **O** indicates any other token.

B-Prot	I-Prot	O	O	O	O	B-Prot	O	O
Interferon	beta	was	found	to	upregulate	IL-15	in	vitro

Named Entity Recognition (NER)

- Protein name recognition:

B-Prot	I-Prot	O	O	O	O	B-Prot	O	O
Interferon	beta	was	found	to	upregulate	IL-15	in	vitro

- What kind of Boolean features would be useful?
  - Word: Is the current token w_0 the name of a Greek letter?
  - Suffix: Does w_0 end with a number? Does w_0 end with 'gen'? Does w_0 start with an acronym? …
  - Lexicon: Is w_0 an entry in a dictionary of known protein names?

Word features:
- Word identity.
- Prefix/suffix.
- Capitalization.
- Word 'shape'.
- Word clusters.

Context features:
- Words before / after.

Lexicon:
- An entry.
- First token in an entry.

Manual Annotation for NE Recognition

- **Internal** annotation:
  - Insert information in the tokenized text itself to indicate the labels.
  - There are many ways in this can be done:
    1. Use XML tags to indicate names.

<prot>Interferon beta</prot> was found to upregulate <prot>IL-15</prot> in vitro

    2. Use special characters to indicate labels, e.g. / or _:

Interferon_B beta_I was_O found_O to_O upregulate_O IL-15_B in_O vitro_O

Manual Annotation for NE Recognition

- **External** annotation:
  - Assign a unique position to each token (token-level) or character (character-level) in the input text.
  - Indicate the named entity spans as pairs <*begin-position*, *end-position*> for each name, in a separate text file.

B-Prot I-Prot O O O O B-Prot O O

input.txt:

Interferon beta was found to upregulate IL-15 in vitro

token positions → 0 1 2 3 4 5 6 7 8

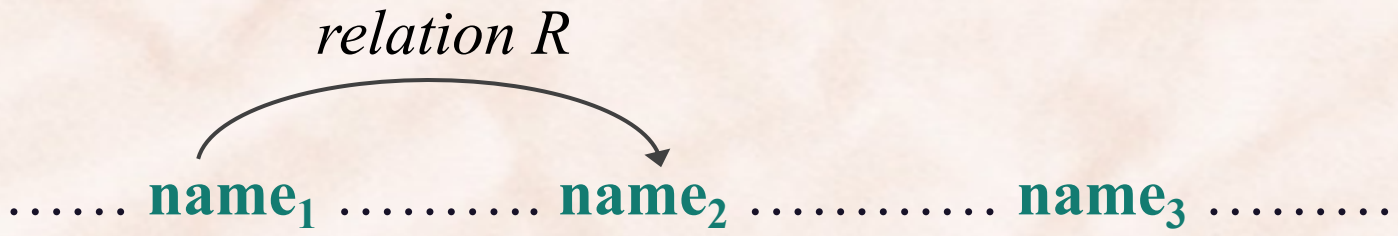
annotation.txt:

0 2

6 7

Relation Extraction (RE) as Classification

- If sentence contains n = 3 names $name_1$, $name_2$, $name_3$ in this order, and only $name_1$ and $name_2$ are annotated to be in a relationship:



  - Create (n choose 2) = 3 relation examples from each pair, one positive and two negative:
    - Label 1: "…… **name$_1$** ……. **name$_2$** …… **name$_3$** ……"
    - Label 0: "…… **name$_1$** ……. **name$_2$** …… **name$_3$** ……"
    - Label 0: "…… **name$_1$** ……. **name$_2$** …… **name$_3$** ……"
  - Create features that depend on the position of the two names in the pair:
    - Does a certain word, e.g. "upregulates", appear between the two names?
    - If syntax available, can create features from path of syntactic dependence between the 2 names.

Manual Annotation for Relation Extraction (RE)

- **Internal** annotation as attributes on entity mention annotations:
  - Use XML tags to indicate names, insert attribute to uniquely identify each name.
  - Use relation name as attribute for the last name in the relationship.

<prot id="1">Interferon beta</prot> was found to upregulate <prot id="2" ppi="1">IL-15</prot> in vitro.

  - ppi =1 indicates this protein name is in a PPI relation with the protein with id 1.

- External annotation by recording pairs of name id's in a separate text file:

input.txt:

<prot id="1">Interferon beta</prot> was found to upregulate <prot id="2">IL-15</prot> in vitro.

annotations.txt

1 2

Manual Annotation for Document Classification

- For sentiment analysis, all examples were included in one file:
  - Label followed by the text of the movie review.

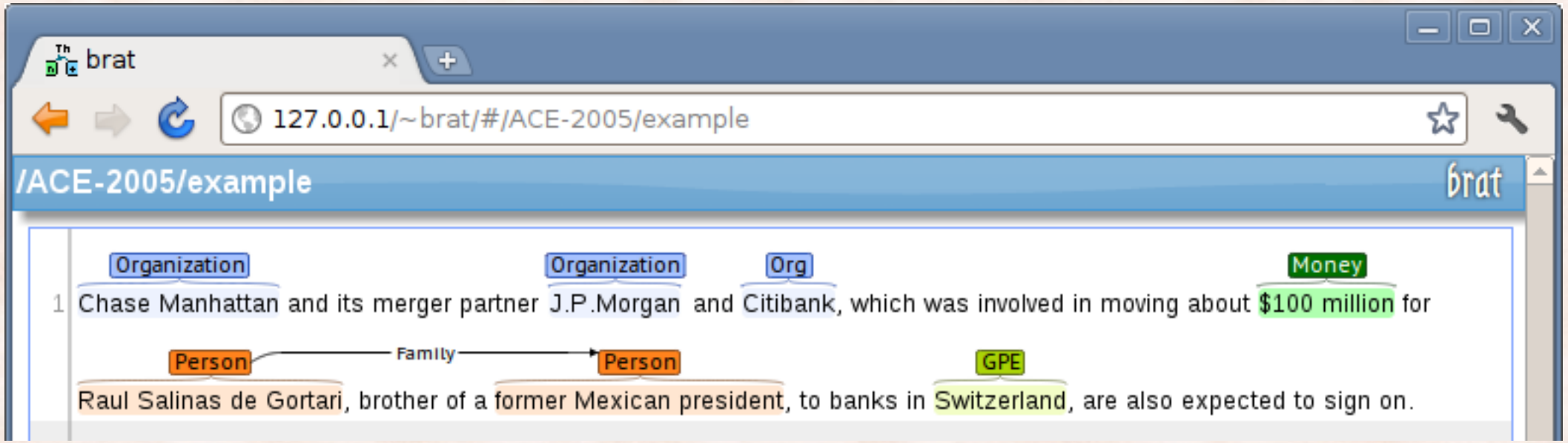
- For general document classification, use external annotation:
  - Leave documents in a folder called *data*.
  - Have a separate file *corpus.txt* that lists for each document its label.
    - Better for large documents, easier to map annotated label to document manually.

data/	corpus.txt
$document_1$	1 $document_1$
$document_2$	0 $document_2$
$document_3$	1 $document_3$
…	…
$document_N$	0 $document_N$

Manual Annotation Tools: Brat

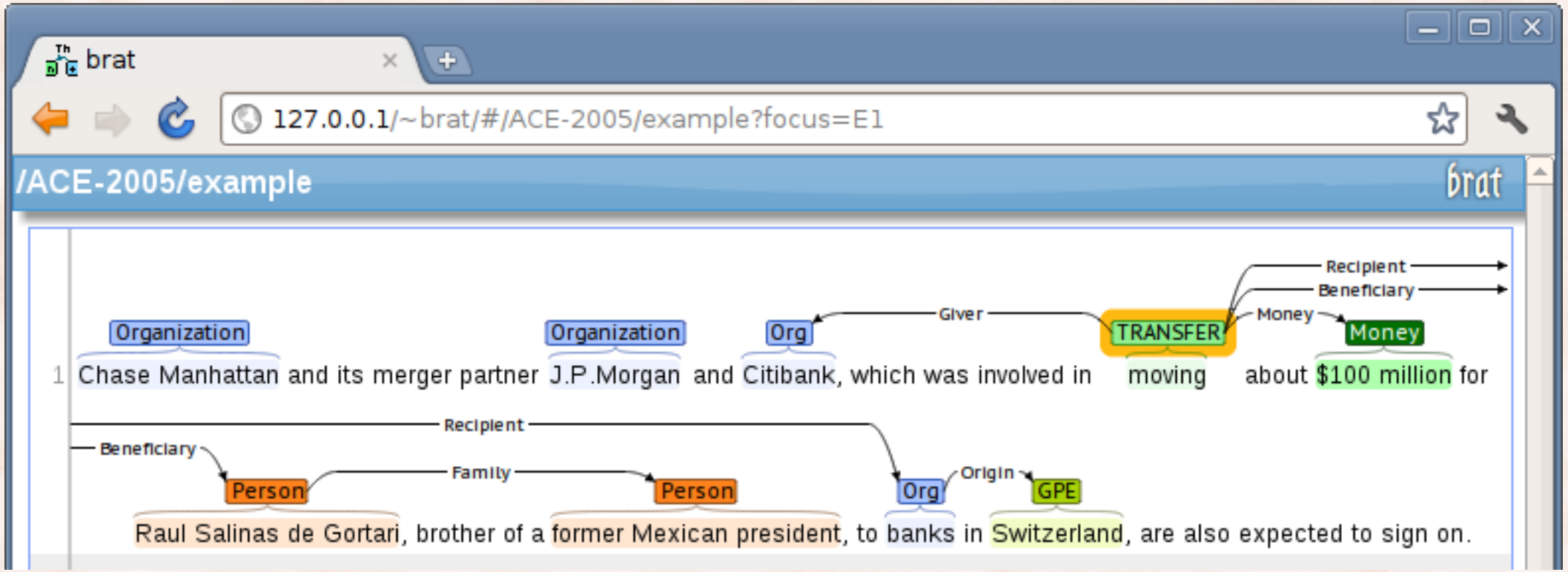
- Brat, WebAnno / INCEpTION, docanno, GATE, Apache UIMA, …
- This paper reviews 78 annotation tools:
  - Neves and Seva, An extensive review of tools for manual annotation of documents, Dec 2019.
- You are free to use any tool you like.
- Some of them are Web-bases, such as Brat:
  - It can be downloaded from https://webpages.charlotte.edu/rbunescu/courses/itcs4111/brat.zip.
  - Instalation instructions are here:
    - Install standalone server > **./install.sh –u**
    - Start standalone server > **python standalone.py** (must be python 2!)
      - Point the browser to the *address:port* shown as output:
        - » Serving brat at http://127.0.0.1:8001

Manual Text Annotation with Brat: NE REcognition



- More details at http://brat.nlplab.org/introduction.html

Manual Text Annotation with Brat: Relation Extraction



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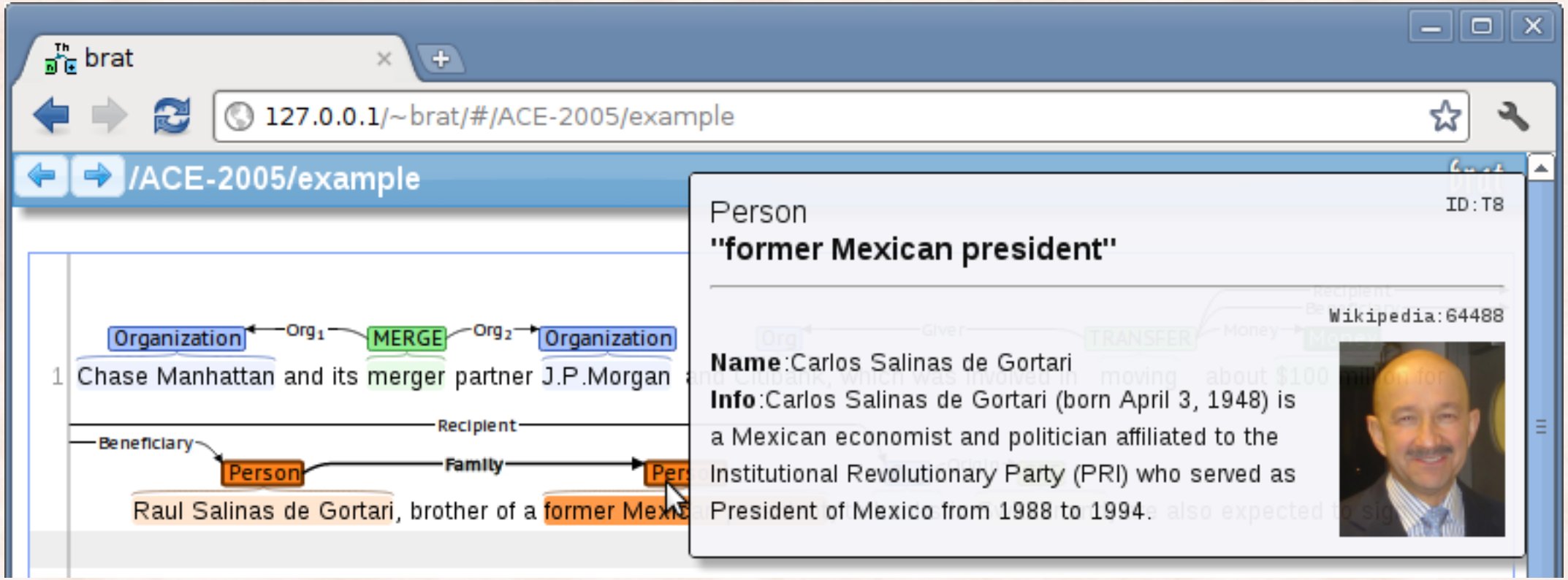
Manual Text Annotation with Brat: NE Disambiguation



- More details at http://brat.nlplab.org/introduction.html

Manual Text Annotation with Brat

- Brat records **external** annotations in an .ann file.
  - See example files in brat/data/tutorials/mytask/
    - **annotation.conf** is edited to include our NE types (school, protein) and RE types (Attend, PPI).
    - markov.txt contains the tokenized input.
    - markov.ann records the external annotations.

```
[entities]

# Definition of entities.

# Format is a simple list with one type per line.

Person
Organization
GPE
Money
School
Protein
```

```
[events]

# Definition of events.

# Format in brief: one event per line, with first space-separated
# field giving the event type and the rest of the line the
# comma-separated arguments in ROLE:TYPE format. Arguments may be
# specified as either optional (by appending "?" to role) or repeated
# (by appending either "*" for "0 or more" or "+" for "1 or more").

# this is a macro definition, used for brevity
<POG>=Person|Organization|GPE

# the "!" before a type specifies that it cannot be used for annotation
# (hierarchy structure only.)
!Life
        Be-born    Person-Arg:Person, Place-Arg?:GPE
        Marry      Person-Arg{2}:Person, Place-Arg?:GPE
        Divorce    Person-Arg{2}:Person, Place-Arg?:GPE
        Die        Person-Arg:Person, Agent-Arg?:<POG>, Place-Arg?:GPE
```

```
[relations]

# Definition of (binary) relations.

# Format in brief: one relation per line, with first space-separated
# field giving the relation type and the rest of the line the
# comma-separated arguments in ROLE:TYPE format. The roles are
# typically "Arg1" and "Arg2".

Located             Arg1:Person, Arg2:GPE
Geographical_part   Arg1:GPE,    Arg2:GPE
Family              Arg1:Person, Arg2:Person
Employment          Arg1:Person, Arg2:GPE
Ownership           Arg1:Person, Arg2:Organization
Origin              Arg1:Organization, Arg2:GPE

Alias               Arg1:Person, Arg2:Person, <REL-TYPE>:symmetric-transitive

Attend_school       Arg1:Person, Arg2:School

PPI                 Arg1:Protein, Arg2:Protein
```

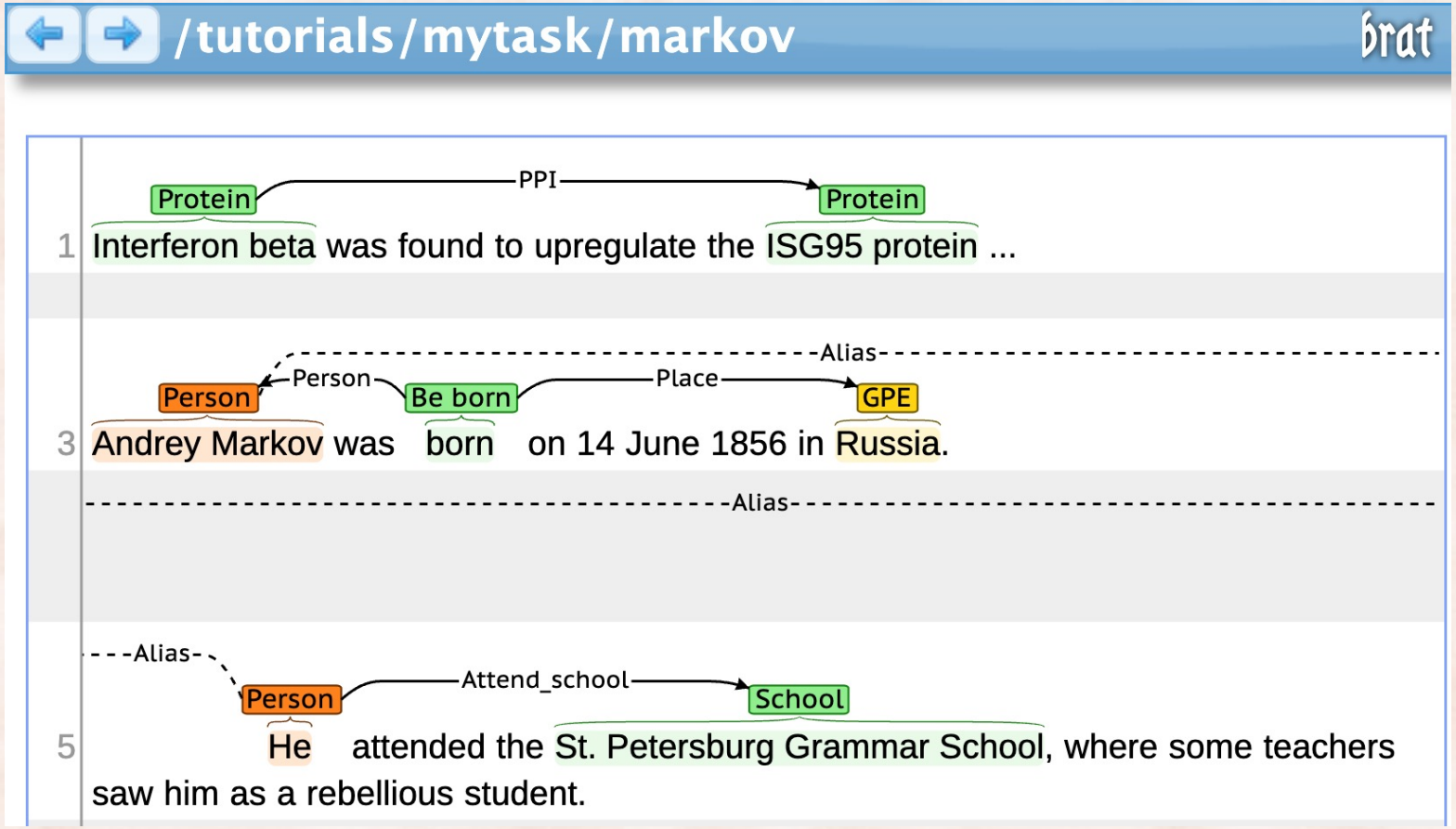
Manual Text Annotation with Brat

- Annotation is done in the browser using the mouse to select and drag text spans.

NER / Mention Detection:
- Protein
- Person
- GPE
- School

RE / Events:
- PPI
- Be born
- Attend school

Coreference relations:
- Alias



Manual Text Annotation with Brat

- Brat records **external** annotations in an .ann file, e.g. **markov.ann**:
  - Spans are recored as character-level positions in the input file, e.g. markov.txt.

```
T1      Protein 0 15    Interferon beta
T2      Protein 44 57   ISG95 protein
R1      PPI Arg1:T1 Arg2:T2
T3      Be-born 81 85   born
E1      Be-born:T3 Person-Arg:T4 Place-Arg:T5
T4      Person 63 76    Andrey Markov
T5      GPE 105 111     Russia
T6      School 130 159  St. Petersburg Grammar School
T7      Person 114 116  He
R2      Attend_school Arg1:T7 Arg2:T6
*       Alias T7 T4
```

Homework Assignment

1. Propose a custom classification task and create a corpus of documents that are annotated for this task.
   - You can use one of the annotation schemes or tools discussed above.
   - There should be at least 300 examples in total.

2. Propose discriminative features to be included in the feature vector representation for the examples in this task and evaluate their utility by training and testing Logistic Regression models.
   - Design at least 2 features that are task specific and demonstrate understanding of the task.

3. Run ablation studies.

4. Plot ROC or PR curves.