Projektseminar: NLP/Text Mining for Historical Texts

Winter Term 2008/09

Named Entities: Background

Outline

- Introduction and Motivation
- Learning Methods and Features
- Evaluation

Named Entities

- Entity – something that exists in the real world

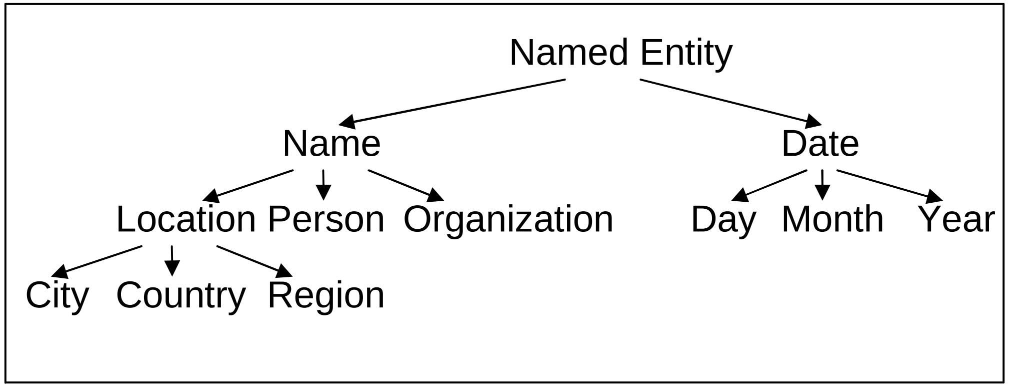
  Dog, president, company, country, month, currency, day, year

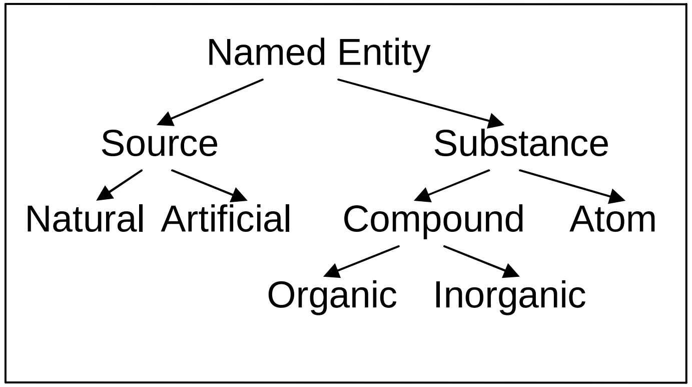
- Named entity – a reference to the entity in the real wold

  Racer, Barack Obama, Bavarian Motor Works, Germany, March, Euro, Wednesday, 2003

Named Entity Types

- How many types are there?
- Different hierarchies with different granularities for different domains exist





Named Entity Recognition

- Identify and classify occurrences of named entities

Jim bought 300 shares of Acme Corp. in 2006.

↓

[Jim]$_{\textit{person}}$ *bought [300]*$_{\textit{quantity}}$ *shares of [Acme Corp.]*$_{\textit{organization}}$ *in [2006]*$_{\textit{date}}$*.*

Applications

- Looking for organizations, products, people in your neighbourhood
- Monitoring news in the huge amount of textual media produced every day
- Simplification of more advanced tasks in NLP (Relation Extraction)

Learning Methods

- Studying of negative and positive examples allows to recognize previously unseen entities

- Hand-crafted rules

  (*if the spelling contains “Mr.” then it is a Person;*

  if the spelling is all capitalized then it is an organization)

- Automatically induced probabilistic models

  (…Mr. Lane…, …Mr. Douglas…, … Mr. Gomez…, …Mr. Reich… – high probability; and also Mr. de Castro)

- There are different types of learning methods depending on the amount of training data

Supervised Learning

- Requires a lot of annotated training data
- Models(sets of rules) don‘t change after the training is finished

…

[Rolls-Royce Motor Cars Inc.]$_{\text{organization}}$ said it expects its [U.S.]$_{\text{nationality}}$ sales to remain steady at about [1,200]$_{\text{quantity}}$ cars in [1990]$_{\text{date}}$.

[ITEL CORP.]$_{\text{organization}}$ reported third-quarter earnings, which were shown in the [Quarterly Earnings Surprises]$_{\text{organization}}$ table in [Monday]$_{\text{date}}$'s edition.

[Liberty National]$_{\text{organization}}$ exchanged about [78.64]$_{\text{quanitity}}$ shares of its common stock for each of [Florence Deposit]$_{\text{organization}}$'s [5,600]$_{\text{quanitity}}$ shares outstanding.

…

↓

[The Procter & Gamble Company]$_{\text{organization}}$ *said* it expects earnings growth for the June quarter.

Daimler AG sees its [Indian]$_{\text{nationality}}$ sales rising 20 percent to around [3,000]$_{\text{quantity}}$ cars in [2008]$_{\text{date}}$ on sustained demand for its luxury Mercedes-Benz cars.

Semi-supervised Learning

- Requires a small amount of data for starting the learning process
- Learning process is repeated several times

[Guatemala]$_{\text{location}}$

↓

Embassy of [Guatemala]$_{\text{location}}$

List of [Guatemala]$_{\text{location}}$ newspapers

Travel information about [Guatemala]$_{\text{location}}$

↓

Embassy of [India]$_{\text{location}}$

Embassy of the [Republic of the Philippines]$_{\text{location}}$

List of [Czech]$_{\text{location}}$ newspapers

List of [American]$_{\text{location}}$ newspapers

Travel information about [Switzerland]$_{\text{location}}$

Travel information about [Belgrade]$_{\text{location}}$

Unsupervised Learning

- No annotated training data available
- Different approaches possible

- Following observation: “(Hypernym of X) such as X“

- Query “such as chair“
  furniture such as chair
  Individual such as chair

- Query “such as a car“
  Vehicle such as a car
  Investment such as a car
  Property such as a car

- Query “such as Belgrade“
  places such as Belgrade
  cities such as Belgrade

- Query “such as Austria“
  states such as Austria
  countries such as Austria
  cultural nation such as Austria

Features

- Features are descriptors or characteristic attributes of words
- Choosing discriminating and independent features is key to any pattern recognition algorithm being successful in classification
- Feature types:

  Boolean (Word is capitalized, Word has length <=3)

  Numeric (Word‘s length, number of capital letters)

  Nominal (Lowercased version of the word)

Feature Levels

- Word-level features
- Case, punctuation, digit, character, morphology, part-of-speech, function
- List lookup features
- General list, entitites list, list of entity cues
- Document features
- Multiple occurences, local syntax, meta information, corpus frequency

Evaluation

- Let’s now hypothesize a system producing the following output for this input:
- Unlike [Robert]$_{\text{person}}$, [John Briggs Jr]$_{\text{person}}$ contacted [Wonderful Stockbrockers Inc]$_{\text{organization}}$ in [New York]$_{\text{location}}$ and instructed them to sell all his shares in [Acme]$_{\text{organization}}$.

↓

- [Unlike]$_{\text{location}}$ Robert, [John Briggs Jr]$_{\text{organization}}$ contacted Wonderful [Stockbrockers]$_{\text{organization}}$ Inc [in New York]$_{\text{person}}$ and instructed them to sell all his shares in [Acme]$_{\text{organization}}$.

Evaluation

- In order to be able to create a good system, one requires a method to measure its quality
- What score should be assigned to the system?

- Unlike → [Unlike]$_{\text{location}}$
- [Robert]$_{\text{person}}$ → Robert
- [John Briggs Jr]$_{\text{person}}$ → [John Briggs Jr]$_{\text{organization}}$
- [Wonderful Stockbrokers Inc]$_{\text{organization}}$ → [Stockbrokers]$_{\text{organization}}$
- [New York]$_{\text{location}}$ → [in New York]$_{\text{person}}$

Simple Evaluation Metrics

- Correct Type(TYPE) – type is predicted correctly and there is an overlap of text boundaries
- Correct Boundaries(TEXT) – boundaries are pridicted exactly, regardless of the type
- Correct Answers(COR) – number of TYPE and TEXT
- Actual System Guesses(ACT)
- Possible Entities in the Solution(POS)
- Recall(R) – COR / POS
- Precision(P) – COR / ACT
- F-Score(F) – 2*P*R / P+R

Powerful Evaluation Metrics

- Start with 100%(perfect system) and penalize system for every mistake (type mistakes, missed entitites) according to the importance of the classes (e.g. person more important than organization)

- Hypothetical final score: 1 – 30.77 – 24.54 – 5.77 – 7.58 = 31.3%

NER for Historical Texts

- Large amount of training data is necessary, but data for other domains is usually not applicable (Different text types, sentence structures, lexicon)
- For historical tasks rich type hierarchies are required (more than 10 PLACE (natural, region, specific location) types or SITE (industrial, monument, religious) types)

- E.g. Lighthouse of Alexandria, University of Heidelberg(university team, university researchers…)
- Great Plains, Rocky Mountains (great play, great interest, great demand, rocky stock market, rocky opening, rocky path…)

Summary

- Named Entity Recognition is an important task in NLP
  - Per se
  - For other applications
- There are different learning methods
  - Supervised learning
  - Semi-supervised learning
  - Unsupervised learning
- Features of various levels are essential for any classification task
- Evaluation of models is necessary in order to improve their quality
- NER for historical tasks is a very challenging task