# *Information Extraction - Introduction*

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# Goal: "machine reading"

**Goal**

*Acquire structured information knowledge from unstructured text*

# Information Extraction

## Information Extraction (IE) Systems

- Find and understand limited relevant parts of texts

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## Goals

- Organize information so that it is useful to people
- Put information in a semantically precise form that allows further inferences to be made by computer algorithms

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- headquarters("BHP Biliton Limited", "Melbourne, Australia")

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We can extract the following information,

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- FounderOf(SergeyBrin, Google Inc.),
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Such information can be used by search engines and database management systems to provide better services to end users.

# Applications in Biomedical domain

## Biomedical domain

- A large amount of scientific publications
- Need to look for discoveries related to particular genes, proteins or other biomedical entities
- Biomedical entities often have synonyms and ambiguous names
- **Critical task:** automatically identify mentions of biomedical entities in text and link them to their corresponding entries in existing knowledge bases.

# Biomedical domain

Involvement of Tumor Necrosis Factor Receptor-associated Protein 1 (TRAP1) in Apoptosis Induced by β-Hydroxyisovalerylshikonin*

IE

| Subject | Relation | Object |
|---|---|---|
| p53 | is_a | protein |
| Bax | is_a | protein |
| p53 | has_function | apoptosis |
| Bax | has_function | induction |
| apoptosis | involved_in | cell_death |
| Bax | is_in | mitochondrial outer membrane |
| Bax | is_in | cytoplasm |
| apoptosis | related_to | caspase activation |
| ... | ... | ... |

textual abstract:
summary for human

structured knowledge extraction:
summary for machine

# Relation Extraction

CHICAGO (AP) — Citing high fuel prices, United Airlines said Friday it has increased fares by $6 per round trip on flights to some cities also served by lower-cost carriers. American Airlines, a unit of AMR, immediately matched the move, spokesman Tim Wagner said. United, a unit of UAL, said the increase took effect Thursday night and applies to most routes where it competes against discount carriers, such as Chicago to Dallas and Atlanta and Denver to San Francisco, Los Angeles and New York.

| Subject | Relation | Object |
|---|---|---|
| American Airlines | subsidiary | AMR |
| Tim Wagner | employee | American Airlines |
| United Airlines | subsidiary | UAL |

# *Relation types*

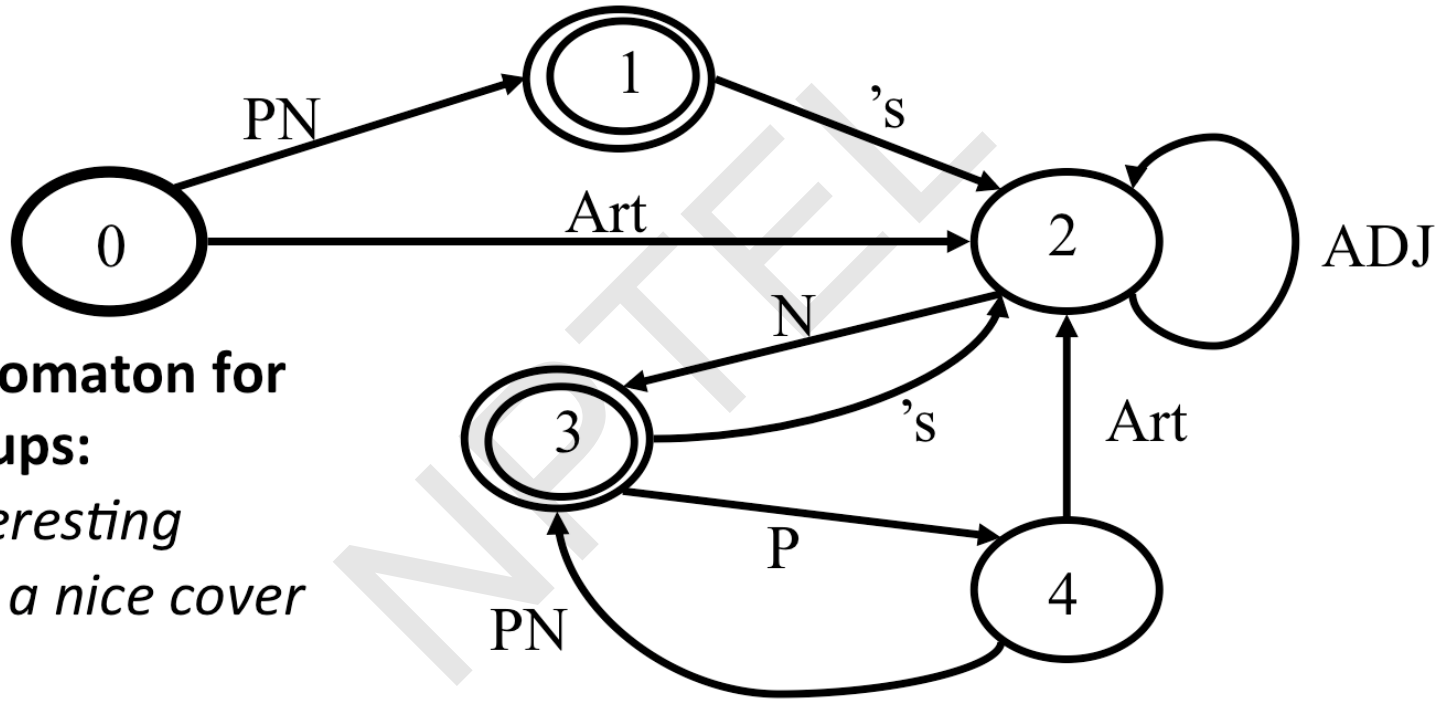
For generic news text ...

| Relations | | Examples | Types |
|---|---|---|---|
| Affiliations | | | |
| | Personal | *married to, mother of* | PER → PER |
| | Organizational | *spokesman for, president of* | PER → ORG |
| | Artifactual | *owns, invented, produces* | (PER \| ORG) → ART |
| Geospatial | | | |
| | Proximity | *near, on outskirts* | LOC → LOC |
| | Directional | *southeast of* | LOC → LOC |
| Part-Of | | | |
| | Organizational | *a unit of, parent of* | ORG → ORG |
| | Political | *annexed, acquired* | GPE → GPE |

# *Relation extraction: 5 easy methods*

- Hand-built patterns
- Bootstrapping methods
- Supervised methods
- Distant supervision
- Unsupervised methods

# Hand-written Information Extraction: use regex




**Finite Automaton for Noun groups:**

*John's interesting book with a nice cover*

# Rule-based Extraction Examples

*Determining which person holds what position in what organization*

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*[person], [position] of [org]*

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*Determining which person holds what position in what organization*

*[person], [position] of [org]*

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*[org] (named, appointed, etc.) [person] Prep [office]*

NATO appointed Wesley Clark as Commander in Chief

# Rule-based Extraction Examples

*Determining where an organization is located*

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*Determining where an organization is located*

*[org] in [loc]*

NATO headquarters in Brussels

# *Rule-based Extraction Examples*

*Determining where an organization is located*

*[org] in [loc]*

NATO headquarters in Brussels

*[org] [loc] (division, branch, headquarters, etc.)*

KFOR Kosovo headquarters

# *Patterns for learning hyponyms*

*Intuition from Hearst (1992)*

Agar is a substance prepared from a mixture of red algae, such as Gelidium, for laboratory or industrial use.

- What is Gelidium?

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# Hearst's lexico-syntactic patterns

## *Automatic Acquisition of Hyponyms*

- $Y$ such as $X((,X)*(,$ and/or) $X)$
- such $Y$ as $X$
- $X$ or other $Y$
- $X$ and other $Y$
- $Y$ including $X$
- $Y$, especially $X$

# Examples of Hearst patterns

| Hearst pattern | Example occurrences |
|---|---|
| X and other Y | ...temples, treasuries, and other important civic buildings. |
| X or other Y | bruises, wounds, broken bones or other injuries... |
| Y such as X | The bow lute, such as the Bambara ndang... |
| such Y as X | ...such authors as Herrick, Goldsmith, and Shakespeare. |
| Y including X | ...common-law countries, including Canada and England... |
| Y, especially X | European countries, especially France, England, and Spain... |

# *Patterns for learning meronyms*

## *Berland and Charniak's patterns*

- Selected initial patterns by finding all sentences in a corpus containing *basement* and *building*

# Patterns for learning meronyms

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| | |
|---|---|
| whole NN[-PL] 's POS part NN[-PL] | ... building's basement ... |
| part NN[-PL] of PREP {the\|a} DET mods [JJ\|NN]* whole NN | ... basement of a building ... |
| part NN in PREP {the\|a} DET mods [JJ\|NN]* whole NN | ... basement in a building ... |
| parts NN-PL of PREP wholes NN-PL | ... basements of buildings ... |
| parts NN-PL in PREP wholes NN-PL | ... basements in buildings ... |