

# Overview of Annotation Tasks III

## Relation Extraction and Complex Structures

Jin Zhao

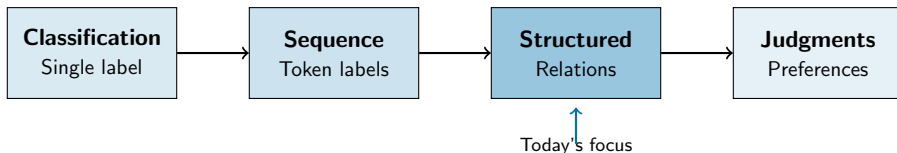
Brandeis University

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# Today's Agenda

- ① Review of task formalization
- ② Relation extraction
- ③ Coreference resolution
- ④ Semantic role labeling
- ⑤ Event extraction
- ⑥ Complex annotation structures
- ⑦ Cross-sentence annotation

# The Task Spectrum



**Structured Annotation:** Capture relationships between text elements

- More complex than sequence labeling
- Multiple valid interpretations possible
- Lower inter-annotator agreement

# Relation Extraction

**Goal:** Identify semantic relationships between entities

## Example

Text: “Tim Cook is the CEO of Apple.”

- Entity 1: Tim Cook (PERSON)
- Entity 2: Apple (ORGANIZATION)
- Relation: CEO\_OF(Tim Cook, Apple)

## Common relation types:

- |              |             |
|--------------|-------------|
| • works_for  | • part_of   |
| • located_in | • spouse_of |
| • born_in    | • parent_of |
| • founded_by | • CEO_of    |

# Relation Extraction Pipeline

## Typical annotation workflow:

- ➊ **Entity annotation:** First identify all entities
- ➋ **Relation annotation:** Then link related entity pairs
- ➌ **Relation typing:** Assign relation labels

## Annotation decisions:

- Which entity pairs to consider? (All pairs? Nearby only?)
- Directed vs. undirected relations?
- Explicit vs. implicit relations?
- Cross-sentence relations?

**Challenge:**  $n$  entities  $\rightarrow n(n-1)/2$  possible pairs to annotate

# Relation Annotation Challenges

## Common difficulties:

- **Implicit relations:**

“Apple, based in Cupertino, announced...”

→ `located_in(Apple, Cupertino)` – stated or implied?

- **Temporal scope:**

“Steve Jobs founded Apple” – is he still founder?

- **Negated relations:**

“Tim Cook is not the founder of Apple”

- **Relation direction:**

`works_for(Person, Org)` vs. `employs(Org, Person)`

# Coreference Resolution

**Goal:** Identify expressions that refer to the same entity

## Example

“Barack Obama was born in Hawaii. He became the 44th president. Obama served two terms.”

Coreference chain: [Barack Obama, He, the 44th president, Obama]

## Types of referring expressions:

- **Named mentions:** “Barack Obama”, “Obama”
- **Pronouns:** “he”, “she”, “it”, “they”
- **Nominal mentions:** “the president”, “the company”

# Coreference Annotation Decisions

## What counts as coreferent?

- **Singleton mentions:** Entities mentioned only once – include?
- **Generic mentions:** “Dogs are loyal” – which dogs?
- **Nested mentions:** “The CEO of Apple” – annotate whole phrase?

## Annotation format options:

- 1 **Pairwise links:** Connect each mention to previous mention
- 2 **Cluster IDs:** Assign same ID to coreferent mentions
- 3 **Chain links:** Link to closest antecedent

**IAA challenge:** Boundary disagreements compound with coreference



# Semantic Role Labeling (SRL)

**Goal:** Identify “who did what to whom”

## Example

“*John*<sub>Agent</sub> *gave*<sub>Pred</sub> *Mary*<sub>Recipient</sub> *a book*<sub>Theme</sub> *yesterday*<sub>Time</sub>.”

## Common semantic roles:

- Agent (doer)
- Patient/Theme (affected)
- Recipient
- Instrument
- Location
- Time
- Manner
- Cause

**Key resource:** PropBank, FrameNet

## Typical workflow:

- ➊ **Identify predicates:** Usually verbs (sometimes nouns)
- ➋ **Identify arguments:** Spans that fill semantic roles
- ➌ **Label roles:** Agent, Patient, etc.

## Challenges:

- Multiple predicates per sentence
- Arguments can be distant from predicate
- Implicit arguments (not stated in text)
- Role ambiguity (is “door” patient or instrument?)

**PropBank approach:** Numbered arguments (Arg0, Arg1, Arg2) with verb-specific definitions

# Event Extraction

**Goal:** Identify events and their participants

## Example

“Apple acquired Beats for \$3 billion in 2014.”

- Event type: ACQUISITION
- Buyer: Apple
- Acquired: Beats
- Price: \$3 billion
- Time: 2014

## Components:

- **Event trigger:** Word that evokes the event (“acquired”)
- **Event arguments:** Participants and attributes
- **Event type:** Category of event

# ISO-Space: A Complex Annotation Example

## Spatial annotation for travel blogs and image captions

### Annotation layers:

- **Locations:** Geographic regions, places
- **Entities:** Objects viewed as spatial objects
- **Paths:** Routes, lines, turns
- **Spatial relations:** inside, near, north of
- **Motion:** Tracking moving objects over time

### Complexity:

- Multiple entity types with many attributes
- Various relation types (topological, directional)
- Motion events linking entities over time
- Requires detailed formal specification (DTD)

# Motion Events: Talmy's Framework

## ISO-Space motion annotation based on Leonard Talmy's typology:

- **FIGURE:** The moving object
- **GROUND:** What the figure moves relative to
- **PATH:** Course followed by the figure
- **MOTION:** The presence of movement
- **MANNER:** How the motion is performed
- **CAUSE:** What originates the motion

### Example:

"John walked from the hotel to the beach."

- **FIGURE:** John
- **PATH:** from hotel to beach
- **MOTION:** walked
- **MANNER:** on foot (implied)

# Cross-Sentence Annotation

**Many tasks require looking beyond sentence boundaries**

## Examples:

- Coreference (pronouns referring to earlier sentences)
- Event relations (cause in one sentence, effect in another)
- Discourse relations (contrast, elaboration, etc.)

## Challenges:

- Larger context to consider
- More cognitive load on annotators
- Annotation tools may have limitations
- Harder for LLMs (context window issues)

**Best practice:** Define clear scope (within paragraph? document?)

## More complex than classification or sequence labeling

### What to measure?

- Entity mention agreement (as for NER)
- Relation existence agreement
- Relation type agreement
- End-to-end agreement (entity + relation)

### Metrics:

- Precision/Recall/F1 between annotator pairs
- Cohen's Kappa on relation decisions
- MUC, B<sup>3</sup>, CEAF for coreference

**Typical targets:** Relation F1 > 0.70, Coreference F1 > 0.75

# LLMs for Structured Annotation

## Most challenging annotation type for LLMs

### Challenges:

- Complex output format
- Multiple interdependent decisions
- Cross-reference between entities
- Long-distance dependencies

### Strategies:

- Break into subtasks (entities first, then relations)
- Use structured output (JSON with schema)
- Provide detailed examples
- Human verification essential

**Current state:** LLMs can assist but rarely replace humans for complex structured annotation



# Next Class: Overview of Tasks IV

## Lecture 10 (Feb 23): LLM-Specific Annotation Tasks

*Note: February Break Feb 16-18*

### Topics:

- Preference annotation for RLHF
- Safety and toxicity annotation
- Instruction-following evaluation
- Multi-turn conversation annotation

**Reading:** Ouyang et al. (2022) – InstructGPT paper

# Key Takeaways

- ➊ **Relation extraction** links entities with semantic relationships
- ➋ **Coreference resolution** groups mentions of the same entity
- ➌ **Semantic role labeling** identifies who did what to whom
- ➍ **Event extraction** captures events with their participants
- ➎ **Cross-sentence annotation** adds complexity and cognitive load
- ➏ **IAA** for structured tasks requires specialized metrics

## Questions?

Office Hours: Wednesdays 1-3pm, Volen 109

✉ [jinzhao@brandeis.edu](mailto:jinzhao@brandeis.edu)