

Overview of Annotation Tasks III

Relation Extraction and Complex Structures

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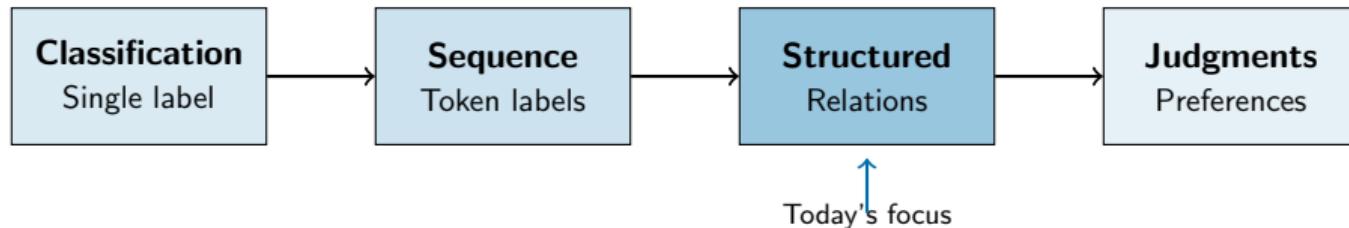
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Today's Agenda

- 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
- located_in
- born_in
- founded_by
- part_of
- spouse_of
- parent_of
- CEO_of

Relation Extraction Pipeline

Typical annotation workflow:

- ① **Entity annotation:** First identify all entities
- ② **Relation annotation:** Then link related entity pairs
- ③ **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”

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_{Agent} gave_{Pred} Mary_{Recipient} a book_{Theme} yesterday_{Time}.”

Common semantic roles:

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

Key resource: PropBank, FrameNet

Typical workflow:

- ① **Identify predicates:** Usually verbs (sometimes nouns)
- ② **Identify arguments:** Spans that fill semantic roles
- ③ **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, B³, 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

- ① **Relation extraction** links entities with semantic relationships
- ② **Coreference resolution** groups mentions of the same entity
- ③ **Semantic role labeling** identifies who did what to whom
- ④ **Event extraction** captures events with their participants
- ⑤ **Cross-sentence annotation** adds complexity and cognitive load
- ⑥ **IAA** for structured tasks requires specialized metrics

Questions?

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Office Hours: Wednesdays 1-3pm, Volen 109

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