Multi-Task Structured Prediction for Entity Analysis: Search Based Learning Algorithms

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Motivation & Problem

- A NLP system usually solves multiple tasks;
- Some of these tasks are highly interdependent.

We focus on three tasks for Entity Analysis:

- Named Entity Recognition
- Coreference Resolution
- Entity Linking

Properties
- Each task predicts a structural output;
- Task dependency has no ordering.

Challenges
- How to exploit their interdependencies?
- How to control the error propagation?
- How to reduce the inference time complexity?

Tasks Introduction

1. He left Columbia in 1983 with a BA degree, after graduating from Columbia University. He worked as a community organizer in Chicago ...

2. Coref-NER: e.g.: Agreement of NER tags of two coreferent mentions

Coref-Link: e.g.: Relation of KB entries of two coreferent mentions

NER-Link: e.g.: NER tag and Category pair indicator

MTSP Architectures

Pipeline Architecture

Task 1: Use feature \( \phi_1(x, y) \)

Task 2: Use feature \( \phi_2(x, y) \)

Task 3: Use feature \( \phi_3(x, y) \)

\( \phi_1, \phi_2, \phi_3 \) are \( k \) independent models, one after another.

Joint Architecture

Task 1 & 2 & 3: train \( y \rightarrow \text{SSVM Learner} \)

Cyclic Architecture

Step 1: Define a order: Task 1 → Task 2 → Task 3

Step 2: Predict initial outputs: \( y_1', y_2', y_3' \)

Conclusions

1. Formulated the problem of multi-task structured prediction (MTSP) for entity analysis.
2. Applied the search-based learning framework, where structured SVM is employed for training and beam search for inference.
3. Developed the cyclic architecture that performs as good as joint architecture, but with a much faster speed.