Coherent Coreference: Notes

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1 Introduction

Kehler and Rohde (2013) found that coherence relations (Hobbs, 1979; Kehler, 2002) and coreference heuristics (Frederiksen, 1981; Gernsbacher and Hargreaves, 1988) have independent influences on pronominalization decisions. In particular, coreference heuristics are found to mainly reflect the topic of a given text segment. Whereas these findings reflect production choices in an experimental setting, this paper studies the usefulness of coherence relations at predicting pronominalization over broad-coverage corpora.

Both Kehler and Rohde (2013) and Wolf et al. (2004) have found that pronominalization is used by readers to resolve coreference, which suggests that the current work may be informative in designing future models of coreference resolution. Further, coherence relations have largely been determined using philosophy and linguistic theory; however, it may be the case that there are additional coherence relations or it may be that some previously proposed relations are rarely observed in practice. By utilizing broad-coverage corpora, this work hopes to refine our knowledge of how coherence relations manifest in practice.

This work makes use of the C-3 coherence and coreference corpus (Wolf et al., 2003; Nicolae et al., 2010), which is composed of text from the AP Newswire, the Wall Street Journal, and GRE and SAT texts.

2 Method

This work models pronominalization with the following equation (where word i is a referring expression to entity j):

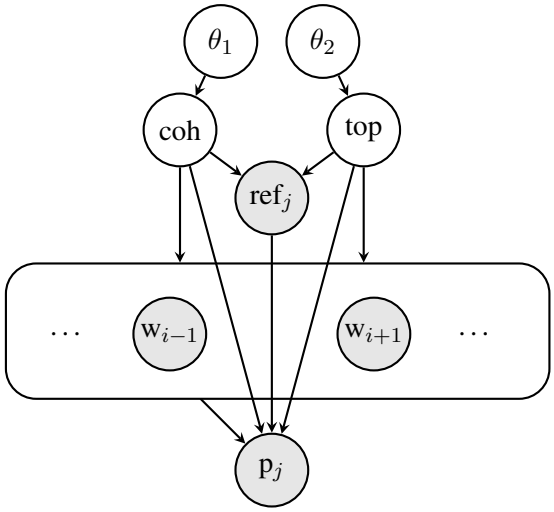

Figure 1: The proposed model

$$P(pro_j \mid ref_j, s_{-i}, coh, top) \cdot P(ref_j \mid coh, top) \cdot P(s_{-i} \mid coh, top) \cdot P(coh \mid \theta_1) \cdot P(top \mid \theta_2) \cdot P(\theta_1) \cdot P(\theta_2) \quad (1)$$

A graphical manifestation of Equation 1 may be seen in Figure 1. The shaded nodes are observable during training.

This work uses ROOTH-LDA (Ó Séaghdha, 2010) to model:

$$P(pro_j, ref_j, s_{-i} \mid coh, top) = P(pro_j \mid ref_j, s_{-i}, coh, top) \cdot P(ref_j \mid s_{-i}, coh, top) \cdot P(s_{-i} \mid coh, top) \quad (2)$$

Since the model treats the choice of ref_j as independent from the context given the topic and the coherence relation, Equation 2 is equivalent to:

$$P(pro_j \mid ref_j, s_{-i}, coh, top) \cdot P(ref_j \mid coh, top) \cdot P(s_{-i} \mid coh, top) \quad (3)$$

Since coh, top, θ_1, and θ_2 are latent, they are internal to ROOTH-LDA, which means the problem may be entirely handled by ROOTH-LDA.

This probability may be computed by the following equations:

$$\text{coh} \sim \text{Dirichlet}(\alpha) \tag{4}$$
$$\text{top} \sim \text{Dirichlet}(\beta) \tag{5}$$
$$\text{ref} \sim \text{Dirichlet}(\rho) \tag{6}$$
$$\text{s} \sim \text{Dirichlet}(\sigma) \tag{7}$$
$$\text{p} \sim \text{Bernoulli}(\phi) \tag{8}$$

where P(p) is smoothed via add-ϕ smoothing

$$\sum_{t \in \text{top}} \sum_{c \in \text{coh}} \left(\frac{f_{ctrsp} + \phi}{f_{ct\cdots} + 2\phi} \cdot \frac{f_{cts} + \sigma}{f_{ct\cdot} + S\sigma} \cdot \frac{f_{ctr} + \rho}{f_{ct\cdot} + R\rho} \right) \cdot \sum_{c \in \text{coh}} \left(\frac{f_{c\theta_1} + \alpha_c}{f_{\cdot\theta_1} + \sum_{c'} \alpha_{c'}} \right) \cdot \sum_{t \in \text{top}} \left(\frac{f_{t\theta_2} + \beta_t}{f_{\cdot\theta_2} + \sum_{t'} \beta_{t'}} \right) \tag{9}$$

Should this not work (as seems likely based on the sparsity of ref_j being represented by $pos(ref_j, sent)$, we can use preprocessing to reformulate ref_j as $pos(ref_j, refs)$. (see the email exchange from around 12/18 for reasons why ref_j is desirable as well as proposed details)

References

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