EM

- sentence; $w_1 \dots w_n$
- vocabulary; $\mathcal{W}$
- modifier; $m \in \{1 \dots n\}$
- head; $h \in \{0 \dots n\}$
- type; $\mathcal{T} = \{\text{TriStop}, \text{Trap}, \text{Tri}\}$
- direction; $\mathcal{D} = \{\text{L}, \text{R}\}$
- span; $s \leq t$
- marginals $p(type, dir, s, t|w, c)$ where $type \in \mathcal{T}$ and $dir \in \mathcal{D}$ and sentence w and counts v

The probabilities

- $p(\text{CONT}|w, dir, \text{ADJ})$; $\text{CONT} \in \{0, 1\}$, $w \in \mathcal{W}$, $\text{ADJ} \in \{0, 1\}$, $dir \in \{0, 1\}$
- $c(\text{CONT}, w, \text{ADJ})$
- $p(u|v, dir, \text{ADJ})$; $\text{CONT} \in \{0, 1\}$, $u, v \in \mathcal{W}$, $\text{ADJ} \in \{0, 1\}$
- $c(u, v, dir, \text{ADJ})$

Estimation Step
Fill in the c charts.

$$c(\text{CONT} = 0, w, dir, \text{ADJ} = 1) \leftarrow \sum_{s \leq t : |s-t|=1} p(\text{TriStop}, dir, s, t)$$

$$c(\text{CONT} = 0, w_s, dir = R, \text{ADJ} = 0) \leftarrow \sum_{s \leq t : |s-t|>1} p(\text{TriStop}, dir, s, t) \quad \forall s \in \{1 \dots n\}$$

$$c(w_t, w_s, dir = R, \text{ADJ}) \leftarrow p(\text{Trap}, R, s, t) \quad \forall s, t \in \{1 \dots n\}$$

Maximization Step

$$p(\text{CONT}|w, dir, \text{ADJ}) \leftarrow \frac{c(\text{CONT}, w, dir, \text{ADJ})}{\sum_{m \in \mathcal{W}} c(m, w, dir, ADJ)}$$

$$p(u|v, dir, \text{ADJ}) \leftarrow \frac{c(u, v, dir, ADJ)}{\sum_{m \in \mathcal{W}} c(m, v, dir, ADJ)}$$