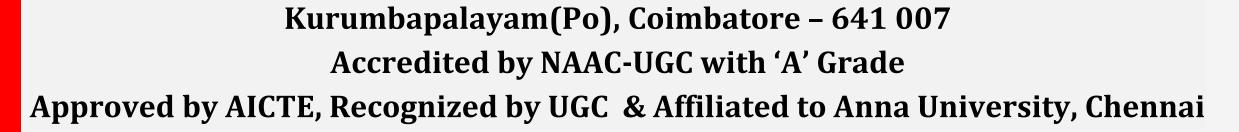




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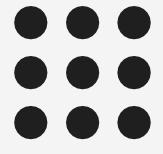
Department of Artificial Intelligence and **Data Science**

Course Name – 19AD601 – Natural Language Processing

III Year / VI Semester

Unit 2 – WORD LEVEL ANALYSIS

Topic 9- Conditional Random Fields





Conditional Random Fields



Conditional Random Fields are a discriminative model, used for predicting sequences. They use contextual information from previous labels, thus increasing the amount of information the model has to make a good prediction.

Assuming we have a sequence of input words X = x1....xn and want to compute a sequence of output tags Y = y1...yn. In an HMM to compute the best tag sequence that maximizes P(Y|X) we rely on Bayes' rule and the likelihood P(X|Y):

$$\hat{Y} = \underset{Y}{\operatorname{argmax}} p(Y|X)$$

$$= \underset{Y}{\operatorname{argmax}} p(X|Y)p(Y)$$

$$= \underset{Y}{\operatorname{argmax}} \prod_{i} p(x_{i}|y_{i}) \prod_{i} p(y_{i}|y_{i-1})$$



Conditional Random Fields



However, the CRF does not compute a probability for each tag at each time step. Instead, at each time step the CRF computes log-linear functions over a set of relevant features, and these local features are aggregated and normalized to produce a global probability for the whole sequence.

$$p(Y|X) = \frac{\exp\left(\sum_{k=1}^{K} w_k F_k(X, Y)\right)}{\sum_{Y' \in \mathcal{Y}} \exp\left(\sum_{k=1}^{K} w_k F_k(X, Y')\right)}$$

$$p(Y|X) = \frac{1}{Z(X)} \exp\left(\sum_{k=1}^{K} w_k F_k(X, Y)\right)$$
$$Z(X) = \sum_{Y' \in \mathcal{Y}} \exp\left(\sum_{k=1}^{K} w_k F_k(X, Y')\right)$$



Conditional Random Fields



$$F_k(X,Y) = \sum_{i=1}^n f_k(y_{i-1}, y_i, X, i)$$

Each of these local features fk in a linear-chain CRF is allowed to make use of the current output token yi, the previous output token yi-1, the entire input string X (or any subpart of it), and the current position i.

This constraint to only depend on the current and previous output tokens yi and yi-1 are what characterizes a linear chain CRF.





THANK YOU