Study Week 7 - **NLP** & Computer Vision

Named Entity Recognition : Hidden Markov Model

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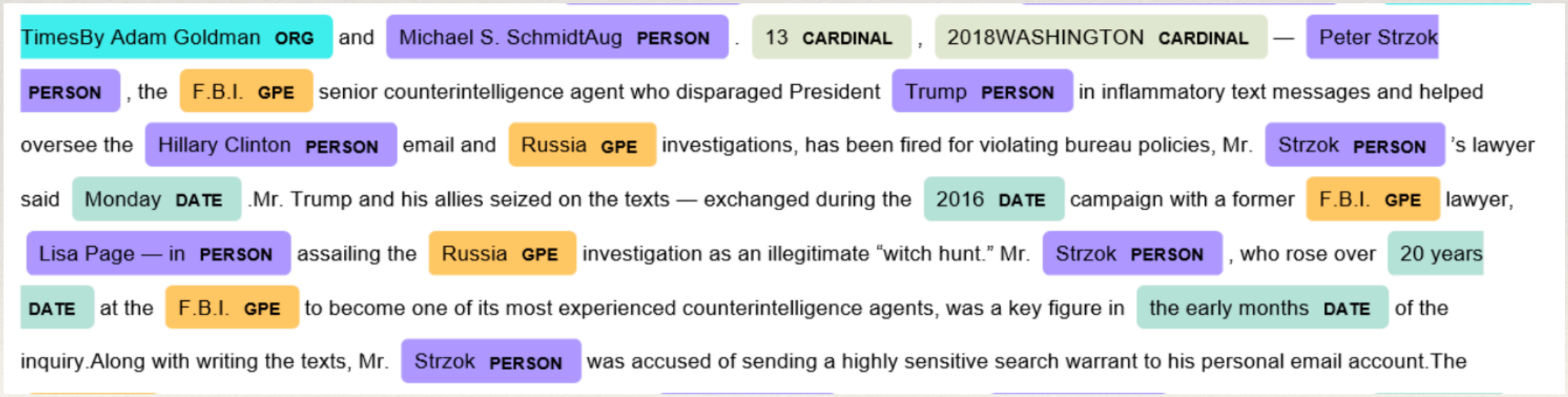
Introduction

- Named Entity Recognition :

  Subtask of information extraction that seeks to locate and classify named entities mentioned in unstructured text into pre-defined categories such as person names, organizations, locations, medical codes, time expressions, quantities, monetary values, percentages, etc.



https://towardsdatascience.com/named-entity-recognition-and-classification-with-scikit-learn-f05372f07ba2

Hidden Markov Model

- Used for variety of sequence labeling tasks such as Speech Recognition, POS tagging, NER, etc.
- Generative model that uses joint probability of paired observation and label sequences.
- Assumes independence of each word from its context (Markov property)
- Quick Learning, global maximization of the joint probability over the whole observation - a complete analysis of input sentence is made before the decision of best sequence of labels.

Markov Chain

$\mathbf{x} = (x_1 x_2 ... x_n)$ Observation sequence of words of length n

$\mathbf{s} = (s_1 s_2 ... s_n)$ Sequence of states that provides for word sequence **x**

$\mathbf{t} = (t_1 t_2 ... t_n)$ Sequence of entity annotation

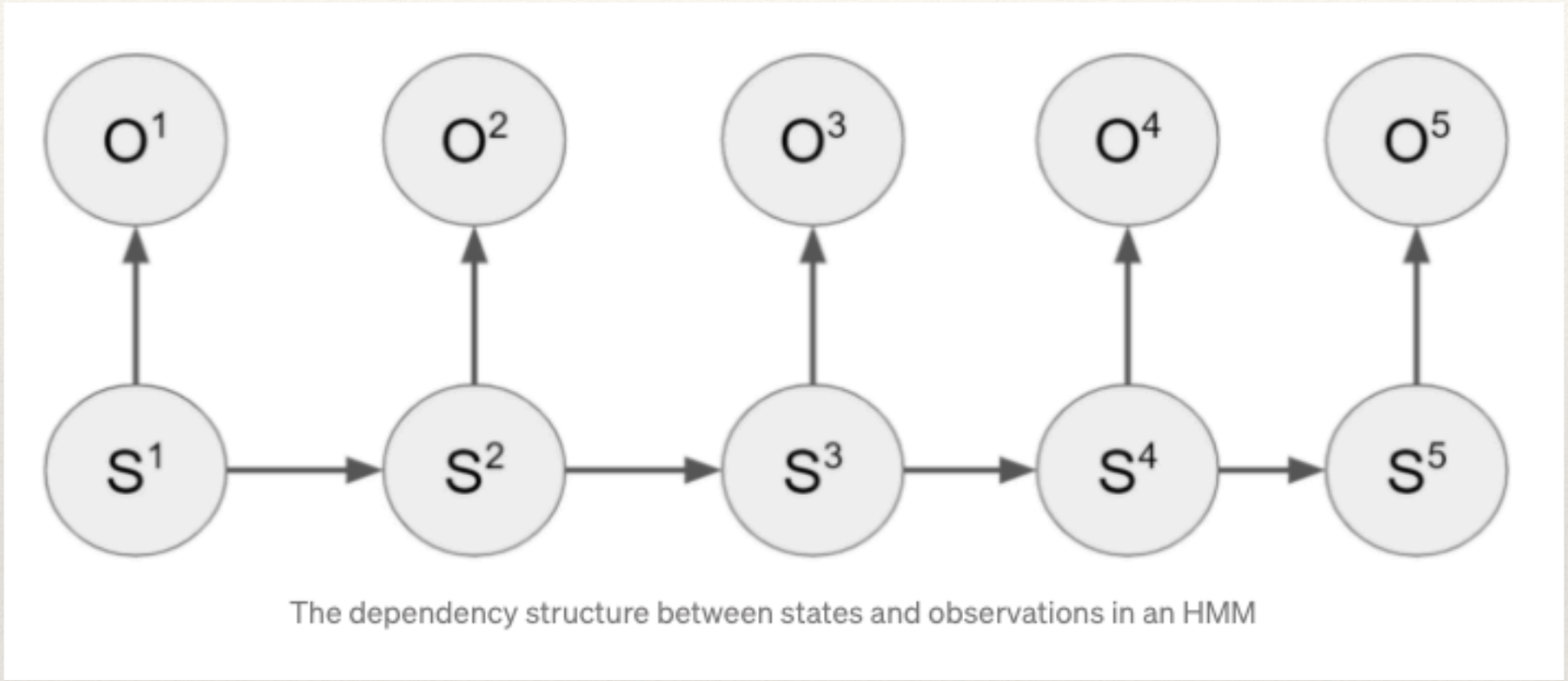
$$P(\mathbf{s}, \mathbf{x}) = P(\mathbf{x}|\mathbf{s})P(\mathbf{s})$$

HMM-based classifier belongs to Naive Bayes classifiers

$$P(\mathbf{s}, \mathbf{x}) = \prod_{i=1}^{n} P(x_i|s_i)P(s_i|s_{i-1})$$

Based on Markov property, state S_i only depends on previous state S_{i-1}. The joint probability of a state sequence is represented above.

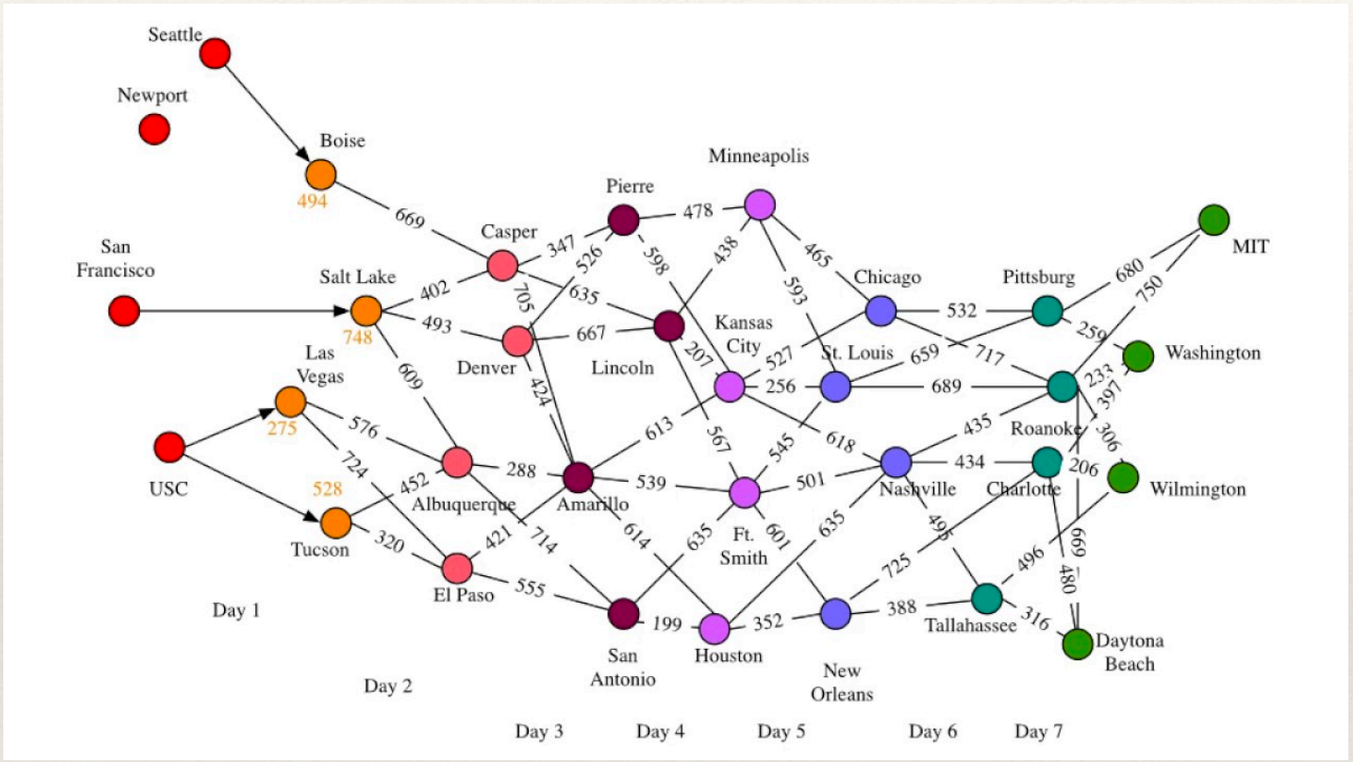
Why ‘Hidden’ Markov Model?



The dependency structure between states and observations in an HMM

Field Cady, Hidden Markov Models - An Overview
(https://towardsdatascience.com/hidden-markov-models-an-overview-98926404da0e)

Viterbi Algorithm

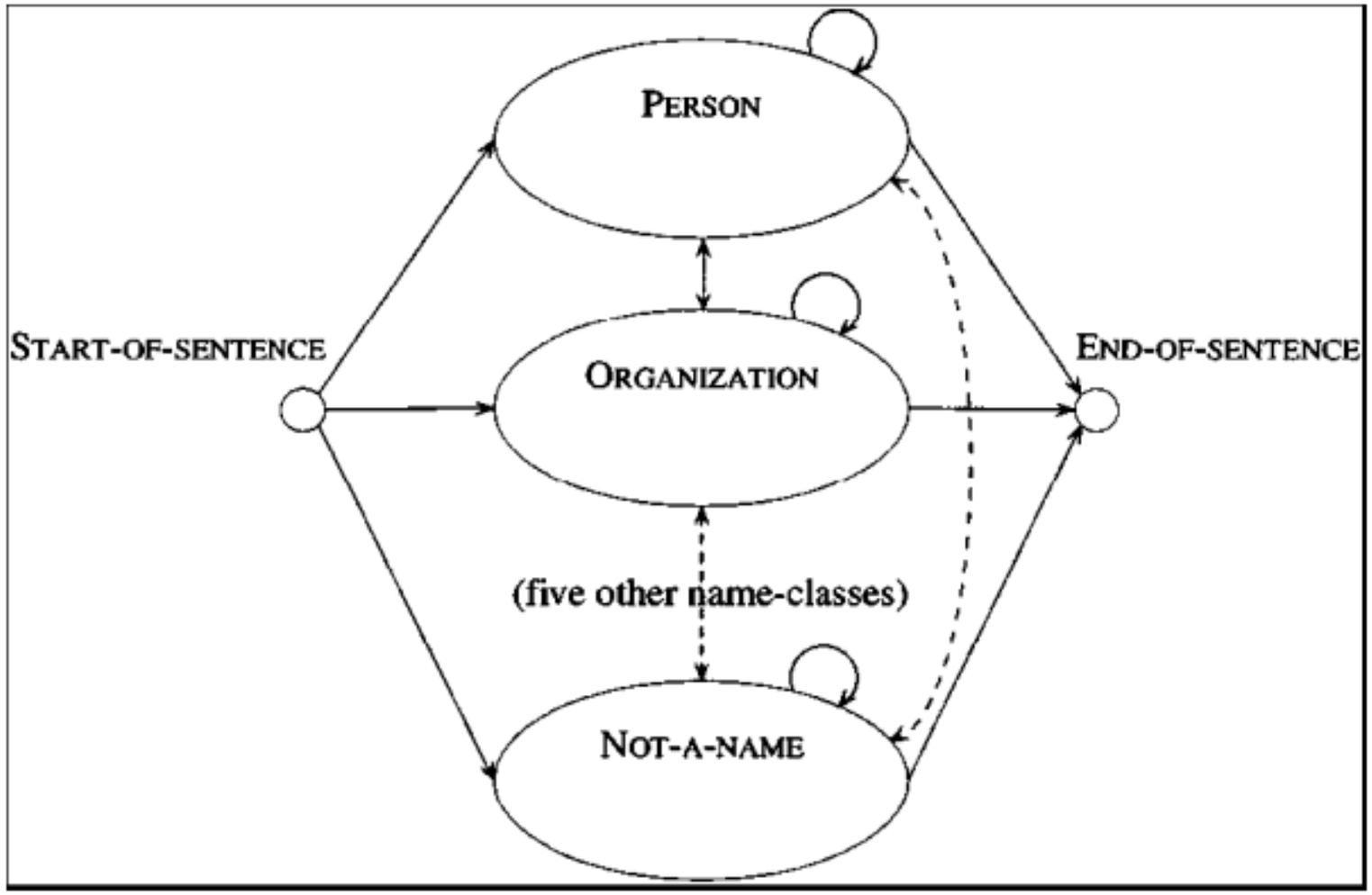


Keith Chugg, Viterbi Algorithm
(https://www.youtube.com/watch?v=6JVqutwtzmo)

Viterbi Algorithm systematically eliminates those paths that cannot be part of the most likely path because they diverge and remerge with another path that has a smaller path metric.

After all n samples have been received, the path with the overall minimum path metric is selected as the most likely path and the input sequence associated with that path is the maximum-likelihood.

Applications



Named Entity Recognition using HMM and MEMM models
(https://www.cse.iitb.ac.in/~cs626-460-2012/seminar_ppts/ner.pdf)

References

1. “Conditional Random Fields vs. Hidden Markov Models in a biomedical Named Entity Recognition task” Natalia Ponomareva, Paolo Rosso, Ferran Pla, Antonio Molina Universidad Politecnica de Valencia

2. Keith Chugg, Viterbi Algorithm (https://www.youtube.com/watch?v=6JVqutwtzmo)

3. Named Entity Recognition and Classification with scikit-learn (https://towardsdatascience.com/named-entity-recognition-and-classification-with-scikit-learn-f05372f07ba2)