

Lecture 24

Wrapping Up

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In a nutshell

- We have seen **representations**, **datasets**, **models**, and **algorithms** for computationally reasoning about textual language.
 - ▶ Persistent challenges: Zipf's Law, ambiguity & flexibility, variation, context
- **Core NLP tasks** (*judgments about the language itself*): tokenization, POS tagging, syntactic parsing (constituency, dependency), word sense disambiguation, word similarity, semantic role labeling, coreference resolution
- **NLP applications** (*solve some practical problem involving/using language*): spam classification, language/author identification, sentiment analysis, named entity recognition, question answering, machine translation
- Which of these are generally easy, and which are hard?

Language complexity and diversity

- **Ambiguity** and **flexibility** of expression often best addressed with corpora & statistics
 - ▶ Treebanks and statistical parsing
- Grammatical forms help convey meaning, but the relationship is complicated, motivating **semantic** representations
 - ▶ proposed by linguists, or
 - ▶ induced from data
- Typological variation: Languages vary extensively in **phonology**, **morphology**, and **syntax**

Methods useful for more than one task

- annotation, crowdsourcing
- rule-based/finite-state methods, e.g. regular expressions
- classification (naïve Bayes, perceptron)
- language modeling (n-gram or neural)
- grammars & parsing
- sequence modeling (HMMs, structured perceptron, LSTM)
- structured prediction—dynamic programming (Viterbi, CKY)

Models & Learning

- Because language is so complex, most NLP tasks benefit from statistical learning.
- In this course, mostly **supervised learning** with *labeled* data. Exceptions:
 - ▶ **unsupervised learning**: the EM algorithm (e.g. for word alignment, topic models)
 - ▶ language models, distributional similarity/embeddings: supervised learning, but no extra labels necessary—the context is the supervision (“self-supervised”)
- In NLP research, a tension between building a lot of linguistic insights into models vs. learning almost purely from the data.
 - ▶ Current research on neural networks tries to bypass hand-designed features/intermediate representations as much as possible.
 - ▶ We still don’t quite know how to capture “deep” understanding.

Generative and discriminative models

- Assign probability to language AND hidden variable? Or just score hidden variable GIVEN language?
- Independence assumptions: how useful/harmful are they?
 - ▶ “**all models are wrong**, but **some are useful**”
 - ▶ bag-of-words; Markov models
 - ▶ combining statistics from different sources, e.g. Noisy Channel Model
- Avoiding overfitting (smoothing, regularization)
- Evaluation: gold standard? sometimes difficult

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Applications

- Sentiment analysis, machine translation
- Your projects!
- Now that you know the tools in the toolbox, you can



Projects

- **Virtual Presentation Session:** 5/12, 12:30-2:30
 - 5–10 minutes per team, plus questions
 - Send us your project titles
- **Project Report** due 5/19
 - Instructions on Canvas assignment
 - Put code on GitHub (public or shared with instructor/TAs)
- **Peer Evaluations**

Other Administrivia

- TA & course evaluations
<https://eval.georgetown.edu/>

