Text Data in Business and Economics

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1. Overview

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- Economics:
  - Relate text data to metadata to understand economic/political/social forces
  - e.g., analyze the motivations and decisions of public officials through their writings and speeches
  - Assess the real-world impacts of language on government and the economy

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Learning Materials

Course Content Overview

Schedule

- 10 lectures (5 meetings, with 2 lectures each):
- Course Syllabus:
  - https://docs.google.com/document/d/1FDIEEsO_v2Lwm_Kkkf_T17lj8jsQr_FohZBIxtTyt9Q/edit?tab=t.0
- Course Repo:
  - https://github.com/BenjaminArold/Course_Text_Data_2024

Course Communication

- Course announcements will be done via email (if you have not been getting emails from me already, let me know)

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Course Bibliographies

- Bibliography of references:
  - reference readings on tools/methods
  - not required, but useful to complement the slides

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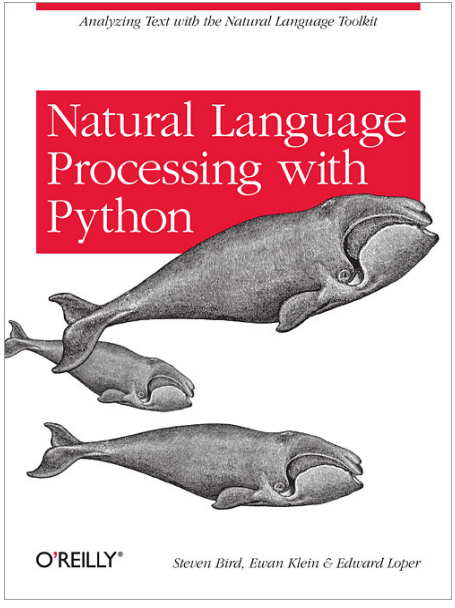
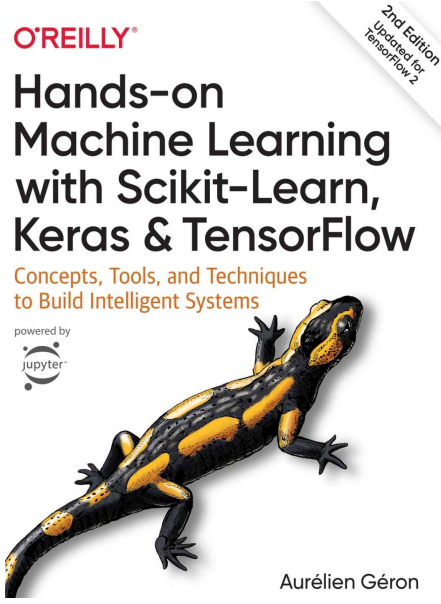
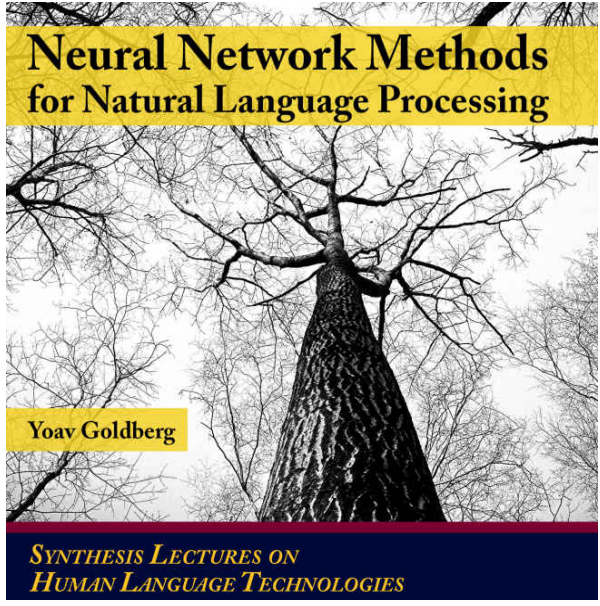
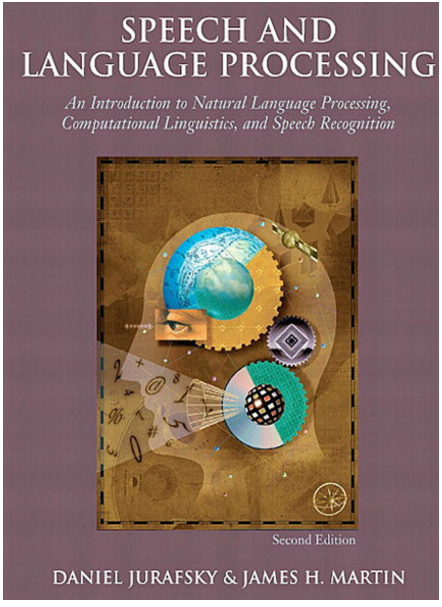
- Bibliography of applications:
  - economics application papers, for class presentations


Analyzing Text with the Natural Language Toolkit
Natural Language Processing with Python
O'REILLY®
Steven Bird, Ewan Klein & Edward Loper


O'REILLY
2nd Edition
Updated for TensorFlow 2
Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow
Concepts, Tools, and Techniques to Build Intelligent Systems
powered by
jupyter
Aurélien Géron


Neural Network Methods
for Natural Language Processing
Yoav Goldberg
Synthesis Lectures on
Human Language Technologies


SPEECH AND
LANGUAGE PROCESSING
An Introduction to Natural Language Processing,
Computational Linguistics, and Speech Recognition
Second Edition
DANIEL JURAFSKY & JAMES H. MARTIN


Cambridge Elements
Quantitative and Computational Methods for the Social Sciences
Images as Data for Social Science Research
Nora Webb Williams, Andreu Casas and John D. Wilkerson

Main Python packages for NLP

- Python 3 is ideal for text data and natural language processing
  - Can use Anaconda or download the packages we need to a pip environment
    - nltk – broad collection of pre-neural-nets NLP tools
    - scikit-learn – ML package with nice text vectorizers, clustering, and supervised learning
    - xgboost – gradient-boosted machines for supervised learning
    - gensim – topic models and embeddings
    - spaCy – tokenization, NER, parsing, pre-trained vectors
    - huggingface – pre-trained transformer models
    - tensorflow / keras – deep learning-based text/image/audio analysis
    - librosa - library for audio analysis

Coding Practice and Assignments

Main Coding Examples on GitHub (discussed in class):`https://github.com/BenjaminArold/Course-Text-Data-24/tree/main/notebooks`

Additional Assignments on GitHub (not discussed in class): `https://github.com/BenjaminArold/Course-Text-Data-24/tree/main/assignments`

Discussant Presentations

- At the end of most lectures, we will have one discussant presentations on one of the economics articles listed in the syllabus
- Please sign up here:

  https://docs.google.com/spreadsheets/d/1ASbOxEPEwhZeDo6JefnZZGUxBGdYbMjRwdnESTCZUvM/edit#gid=0
- Critical presentations are up to 15 minutes, should present and critique:
  - research question
  - text-image-audio-analysis methods
  - empirical methods
  - results
  - contribution

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Topics Covered

Text-as-Data:

- Dictionaries, Tokenization, and Document Distance
- Topic Models and ML with text, Word Embeddings and Linguistic Parsing
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Audio-as-Data:

- Classical ML, Recurrent Neural Nets, Ethical Considerations

Text is high-dimensional

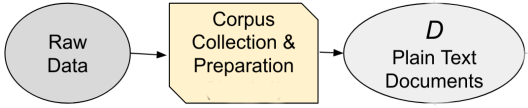
- sample of documents, each n_L words long, drawn from vocabulary of n_V words
- The unique representation of each document has dimension $n_V^{n_L}$
  - e.g., a sample of 30-word Twitter messages using only the one thousand most common words in the English language
    - $\rightarrow$ dimensionality $= 1000^{30} = 10^{32}$

"Text as Data", GKT 2017

Summarize analysis in three steps:

- convert raw text D to numerical array $\boldsymbol{C}$
  - The elements of $\boldsymbol{C}$ are counts over tokens (words or phrases)
- map $\boldsymbol{C}$ to predicted values $\hat{\boldsymbol{V}}$ of unknown outcomes $\boldsymbol{V}$
  - Learn $\hat{\boldsymbol{V}}(\boldsymbol{C})$ using machine learning
  - e.g. supervised learning for some labeled $\boldsymbol{C}_i$ and V_i
  - or unsupervised learning of topics/dimensions just from $\boldsymbol{C}$
- use $\hat{\boldsymbol{V}}$ for subsequent descriptive or causal analysis

Corpora



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- The set of documents is the corpus, which we will call D.

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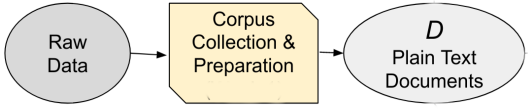

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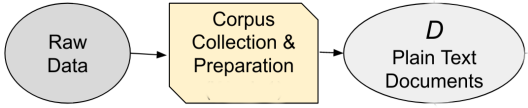

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- Text data is **unstructured**:
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- All text data approaches will throw away some information:
  - The trick is figuring out how to retain valuable information

This course is about relating documents to metadata

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- e.g., measuring positive-negative sentiment Y in political speeches
  - not that meaningful by itself
- but how about sentiment Y_{ijkt} in speech i by politician j on topic k at time t:
  - how does sentiment vary over time t?
  - does politician from party p_j express more negative sentiment toward topic k?

What counts as a document?

The unit of analysis (the "document") will vary depending on your question

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E.g., what should we use as the document in these contexts?

1. predicting whether a judge is right-wing or left-wing in partisan ideology, from their written opinions
2. predicting whether parliamentary speeches become more emotive in the run-up to an election