Course:
Computational Analysis of Political Text, Audio, and Images

Fall 2023

Time ⏰:	Fall 2023, Wednesdays 09 🕘 – 12 🕛	
Location 🏫:	1330-038	
Instructor 👨‍🏫:	Mathias Rask (✉ mathiasrask@ps.au.dk)	
Office Hour 🕰:	Friday 09.15-10.15	
Exam 📜:	7-day take-home (December 12 at 09:00 am)	
Course language 🗣:	Danish 🇩🇰	

Course Schedule – Short

Class	Date	Theme	Topic
1	September 6		Introduction
2	September 7	Python	Python lab
3	September 13		Python lab
4	September 20	ML Basics	Learning from data
5	September 27		ML lab
6	October 4		Text basics
7	October 11	Text	Topic models and dictionaries
8	October 25		Embeddings
9	November 1		Audio basics
10	November 1	Audio	Audio measurement
11	November 8		Speech and speaker recognition
12	November 15	Images	Image basics
13	November 22		Image classification and face analysis
14	November 29		Summary and Q&A

* Wednesday, October 18 does not feature any class due to the Autumn break in week 42.

Course Schedule – Detailed

Readings marked by a (∗) are in the curriculum. Supplemental readings are marked by a (▷).

Theme: Python

Class 1: Introduction to course and + Python 🐍

Date: 6, September 2023, 09-12 am
Location: 1330-038

Lecture 🧑‍🏫

1. Course introduction (structure, classes, exam ...)

2. Defining and locating computational social science/computational analysis

3. Good research questions using text, audio, and image data

4. Computational measurement of social science concepts

5. Promises ✔️ and pitfalls ❌ of computational social science

6. Python

Coding Tour 🤓+🛤️

- Getting started with 🐍: local setup (Anaconda), virtual environments, and modules

- Syntax

- Workflow

- Operators

- Data types: numbers, strings, lists, and dictionaries

- Functions: arguments (keyword, positional, and default) and scope

- Control flow: if/else, continue, while, break, pass, ...)

Readings 📕

∗ J. Y. Kim and Y. M. M. Ng, "Teaching computational social science for all," *PS: Political Science & Politics*, vol. 55, no. 3, pp. 605–609, 2022 (number of pages: 4)

∗ Y. Theocharis and A. Jungherr, "Computational social science and the study of political communication," *Political Communication*, vol. 38, no. 1-2, pp. 1–22, 2021 (number of pages: 22)

* J. Grimmer and B. M. Stewart, "Text as data: The promise and pitfalls of automatic content analysis methods for political texts," *Political analysis*, vol. 21, no. 3, pp. 267–297, 2013 (number of pages: 3)

  – **Section 2**

* G. Lin and C. Lucas, "An introduction to neural networks for the social sciences," in *The Oxford Handbook of Methodological Pluralism in Political Science*, Oxford University Press, forthcoming. [Online]. Available: http://christopherlucas.org/files/PDFs/nn_chapter.pdf (number of pages: 4)

  – **Section 1-2**

* W. McKinney, *Python for data analysis: Data wrangling with Pandas, NumPy, and IPython*, 2nd ed. " O'Reilly Media, Inc.", 2017. Accessible through AUL: https://soeg.kb.dk/permalink/45KBDK_KGL/1f0go08/cdi_askewsholts_vlebooks_9781491957639 (number of pages: 52)

  – **Section 1.4**, **Section 2.1**, **Section 2.2 (p. 17-20)**, **Section 2.3 (p. 30-38, 46-50)**, **Chapter 3**

→ Total number of pages: 85

▷ C. A. Bail, "Can generative ai improve social science?," 2023

Resources 🔗

– https://www.youtube.com/watch?v=rfscVS0vtbw

– https://github.com/Akuli/python-tutorial/tree/master

Class 2: Python Lab

Date: 7, September 2023, 12-15 pm
Location: 1323-118

Lecture 🧑‍🏫

1. Class 1 continued ...

Coding Tour 🤓+🛤️

- Loops and comprehensions

- Classes

- Errors

- Reading and writing files

- Go-to 🐍 modules (e.g. NumPy, Pandas)

Lab 🥼+💻

1. Reading and loading files

2. Classes and methods

3. NumPy and Pandas exercises

Readings 📕

* W. McKinney, *Python for data analysis: Data wrangling with Pandas, NumPy, and IPython*, 2nd ed. " O'Reilly Media, Inc.", 2017. Accessible through AUL: `https://soeg.kb.dk/permalink/45KBDK_KGL/1f0go08/cdi_askewsholts_vlebooks_9781491957639` (number of pages: 63)

  – **Chapter 4, 6**

→ Total number of pages: 63

Resources 🔗

– `https://www.dataquest.io/blog/using-classes-in-python/`

– `https://www.kaggle.com/code/themlphdstudent/learn-numpy-numpy-50-exercises-and-solution`

– `https://github.com/guipsamora/pandas_exercises/tree/master`

– `https://www.kaggle.com/code/icarofreire/pandas-24-useful-exercises-with-solutions`

Class 3: Python Lab

Date: 13, September 2023, 09-12 am
Location: 1330-038

Lecture 🧑‍🏫

1. Class 1+2 continued ...

Coding Tour 🤓+🛤️

* Same as Class 1+2

Lab 🥼+💻

* Same as Class 1+2

Readings 📕

* Same as Class 1+2

Resources 🔗

* Same as Class 1+2

Theme: ML Basics

Class 4: Learning From Data

Date: 20, September 2023, 09-12 am
Location: 1330-038

Lecture 🧑‍🏫

1. Learning types: supervised, unsupervised, and transfer learning

2. Model validation

   - Model capacity: Overfitting and underfitting
   - Hyperparameters and validation sets
   - Loss functions and metrics

3. Measurement validation using supervised vs. unsupervised learning

4. Logistic regression and neural networks

5. Principal Component Analysis (PCA) and k-means clustering

Readings 📕

* M. Laurer *et al.*, "Less annotating, more classifying: Addressing the data scarcity issue of supervised machine learning with deep transfer learning and bert-nli," *Political Analysis*, pp. 1–33, 2022 (number of pages: 3)

  – **Section 2.1-2.2**

* Z. Terechshenko *et al.*, "A comparison of methods in political science text classification: Transfer learning language models for politics," *Available at SSRN 3724644*, 2020. DOI: http://dx.doi.org/10.2139/ssrn.3724644 (number of pages: 1)

  – **Section 2**

* I. Goodfellow *et al.*, *Deep learning.* MIT press, 2016. [Online]. Available: https://www.deeplearningbook.org/ Freely accessible at: https://www.deeplearningbook.org/ (number of pages: 39)

  – **Section 5.1-5.3, 5.7-5.8, 5.10**

* M. A. Nielsen, *Neural networks and deep learning.* Determination press San Francisco, CA, USA, 2015, vol. 25 Freely accessible at: http://neuralnetworksanddeeplearning.com/ (number of pages: 35)

  – **Chapter 1 p. 1-35**

* G. Lin and C. Lucas, "An introduction to neural networks for the social sciences," in *The Oxford Handbook of Methodological Pluralism in Political Science*, Oxford University Press, forthcoming. [Online]. Available: http://christopherlucas.org/files/PDFs/nn_chapter.pdf (number of pages: 7)

- **Section 3**

$\rightarrow$ Total number of pages: 85

Resources 🔗

- https://setosa.io/ev/principal-component-analysis/

- https://towardsdatascience.com/beginners-ask-how-many-hidden-layers-neurons-to-use-in-artificial-neural-networks-51466afa0d3e

- https://analyticsindiamag.com/xor-problem-with-neural-networks-an-explanation-for-beginners/

- https://playground.tensorflow.org/

- 3Blue1Brown video on the theory neural networks https://www.youtube.com/watch?v=aircAruvnKk&t=1s

- 3Blue1Brown video on how neural networks learn https://www.youtube.com/watch?v=IHZwWFHWa-w&list=PLZHQObOWTQDNU6R1_67000Dx_ZCJB-3pi&index=2

Class 5: ML Basics Lab

Date: 27, September 2023, 09-12 am
Location: 1330-038

Coding Tour 🤓+🛤️

- Overview of the `scikit-learn` module

- Brief introduction to `PyTorch`

Lab 🥼+💻

- Building your own vanilla neural network classifier using `PyTorch`

- Implement PCA and k-means with `scikit-learn`

Resources 🔗

– Same as Class 4

Theme: Text 📜

Class 6: Text Basics

Date: 4, October 2023, 09-12 am
Location: 1330-038

Lecture 🧑🏽‍🏫

1. Vectorization: Representing text as numbers

2. Preprocessing: Why do we need it?

Coding Tour 🤓+🛤️

- Introduction to SpaCy

Lab 🥼+💻

- Vectorize and preprocess raw text

  - Vectorize: bag-of-words and tf-idf

  - What is a "good" numerical representation of text?

  - Preprocessing: Tokenization, stopwords, special characters, numbers, stemming, lemmatization, lower casing, removing features

  - Word descriptives

Readings 🟥

* J. Grimmer and B. M. Stewart, "Text as data: The promise and pitfalls of automatic content analysis methods for political texts," *Political analysis*, vol. 21, no. 3, pp. 267–297, 2013 (number of pages: 2)

  - **Section 4**

* M. J. Denny and A. Spirling, "Text preprocessing for unsupervised learning: Why it matters, when it misleads, and what to do about it," *Political Analysis*, vol. 26, no. 2, pp. 168–189, 2018 (number of pages: 12)

  - **Section 1-5**

* S. Akuma *et al.*, "Comparing bag of words and tf-idf with different models for hate speech detection from live tweets," *International Journal of Information Technology*, vol. 14, no. 7, pp. 3629–3635, 2022 (number of pages: 1)

  - **Section 3.3**

→ Total number of pages: 15

Resources 🔗

- https://towardsdatascience.com/basics-of-countvectorizer-e26677900f9c

- https://okan.cloud/posts/2021-04-08-text-vectorization-using-python-term-document-matrix/

Class 7: Topic Models and Dictionaries

Date: 11, October 2023, 09-12 am
Location: 1330-038

Lecture 🧑‍🏫

1. What are (unsupervised) topic models and how do they work?

2. What assumptions underlie topic models? What are their strength/weaknesses?

3. What is the core idea of dictionary-based methods?

4. Off-the-shelf vs. creating your own dictionary

Coding Tour 🤓+🛤️

- Introduction to `Gensim`

Lab 🥼+💻

- Implement unsupervised LDA model on a text corpus

Readings 📕

* D. M. Blei, "Probabilistic topic models," *Communications of the ACM*, vol. 55, no. 4, pp. 77–84, 2012. DOI: http://doi.acm.org/10.1145/2133806.2133826

* C. Wratil *et al.*, "Government rhetoric and the representation of public opinion in international negotiations," *American Political Science Review*, pp. 1–18, 2022

* B. C. Silva and S.-O. Proksch, "Politicians unleashed? political communication on twitter and in parliament in western europe," *Political science research and methods*, vol. 10, no. 4, pp. 776–792, 2022

→ Total number of pages: 40

Resources 🔗

– https://rpubs.com/chelseyhill/672546

Class 8: Embeddings

Date: 25, October 2023, 09-12 am
Location: 1330-038

Lecture 👩‍🏫

1. What is the general idea about word embeddings?

2. Word semantics and the distributional hypothesis

3. How do they improve upon bag-of-words and tf-idf representations of text?

4. Using word embeddings as features vs. a measure

Coding Tour 🤓+🛤️

- Word2vec and Doc2vec

- Accessing pretrained language models in Python using transfer learning

Lab 🥼+💻

- Ideological scaling

- Analogies

- Semantic scaling

Readings 📕

* P. L. Rodriguez and A. Spirling, "Word embeddings: What works, what doesn't, and how to tell the difference for applied research," *The Journal of Politics*, vol. 84, no. 1, pp. 101–115, 2022 (number of pages: 14)

* L. Rheault and C. Cochrane, "Word embeddings for the analysis of ideological placement in parliamentary corpora," *Political Analysis*, vol. 28, no. 1, pp. 112–133, 2020 (number of pages: 21)

→ Total number of pages: 35

▷ E. Rudkowsky *et al.*, "More than bags of words: Sentiment analysis with word embeddings," *Communication Methods and Measures*, vol. 12, no. 2-3, pp. 140–157, 2018

▷ T. Mikolov *et al.*, "Distributed representations of words and phrases and their compositionality," *Advances in neural information processing systems*, vol. 26, 2013

▷ A. C. Kozlowski *et al.*, "The geometry of culture: Analyzing the meanings of class through word embeddings," *American Sociological Review*, vol. 84, no. 5, pp. 905–949, 2019

▷ P. L. Rodriguez *et al.*, "Multilanguage word embeddings for social scientists: Estimation, inference and validation resources for 157 languages,"

▷ P. L. Rodriguez *et al.*, "Embedding regression: Models for context-specific description and inference," *American Political Science Review*, pp. 1–20, 2023

▷ C. Barrie *et al.*, "Measuring media freedom," 2023

Theme: Audio 🔊

Class 9: Audio Basics

Date: 1, November 2023, 09-12 am
Location: 1441-210

Lecture 🧑🏽‍🏫

1. Audio vs. text

2. Sound theory: What do we actually measure?

3. Basic concepts: Sampling rate, amplitude, frequency, ...

4. Digital signal processing fundamentals

5. Audio representations: waveform and spectrogram

6. Audio software

Coding Tour 🤓+🛤️

- Colab

- SciPy

- Reading and writing audio

Lab 🥼+💻

- Waveforms

- Spectrograms

Readings 🟥

* L. Rheault and S. Borwein, "Audio as data," in *Elgar Encyclopedia of Technology and Politics*, Edward Elgar Publishing, pp. 86–90 Available: `https://lrheault.g ithub.io/downloads/AudioAsData_RheaultBorwein.pdf` (number of pages: 7)

* F. Camastra and A. Vinciarelli, *Machine learning for audio, image and video analysis: theory and applications.* Springer, 2015 Accessible through AUL: `https://soeg.kb. dk/discovery/fulldisplay?docid=alma99123011568605763&context=L&vid=45K BDK_KGL:KGL&lang=da&search_scope=MyInst_and_CI&adaptor=Local%20Search% 20Engine` (Chapter 2 "Audio Acquisition, Representation and Storage", number of pages: 42)

→ Total number of pages: 49

Resources 🔗

- `https://github.com/YannickJadoul/Parselmouth/tree/stable`

Class 10: Audio Measurement

Date: 1, November 2023, 12-15 am
Location: 1441-210

Lecture 👩‍🏫

1. Supervised vs. unsupervised measurement

2. Time - vs. frequency features

3. Measurement error

4. Acoustic analysis

5. Audio classification

Coding Tour 🤓+🛤️

- `Parselmouth` (Pythonic `Praat` binding)

Lab 🥼+💻

- Pitch estimation

- Visualization of pitch

- Standardization of pitch

Readings 📕

∗ B. J. Dietrich *et al.*, "Pitch perfect: Vocal pitch and the emotional intensity of congressional speech," *American Political Science Review*, vol. 113, no. 4, pp. 941–962, 2019 (number of pages: 21)

∗ D. Knox and C. Lucas, "A dynamic model of speech for the social sciences," *American Political Science Review*, vol. 115, no. 2, pp. 649–666, 2021 (number of pages: 17)

∗ L. Rheault and S. Borwein, "Multimodal techniques for the study of a ect in political videos," Working Paper, Tech. Rep., 2019 Available: `https://polmeth.mit.edu/sites/default/files/documents/RheaultBorwein_PolMeth2019.pdf` (number of pages: 32)

∗ M. Rask and F. Hjorth, "Nonverbal-based measures of elite conflict and polarization," *Working Paper*, pp. 1–25, 2023 (number of pages: 25)

∗ M. Vainio *et al.*, "The power of prosody and prosody of power: An acoustic analysis of finnish parliamentary speech," *arXiv preprint arXiv:2305.16040*, 2023 (number of pages: 4)

→ Total number of pages: 99

Resources 🔗

- No links available

Class 11: Speech and Speaker Recognition

Date: 8, November 2023, 09-12 am
Location: 1330-038

Lecture 👨‍🏫

1. What are automatic speech recognition and diarization?

2. Why is alignment crucial to computational audio analysis?

3. What information is contained in speaker embeddings?

Coding Tour 🤓+🛤️

- Introduce neural diarization with `pyannote.audio`

- ASR using `Faster Whisper` and `Whisper`

Lab 🥼+💻

- Apply diarization and ASR on a political debate

- Visualize speaker embeddings from x-vectors using dimensionality reduction

Readings 📕

* S.-O. Proksch *et al.*, "Testing the validity of automatic speech recognition for political text analysis," *Political Analysis*, vol. 27, no. 3, pp. 339–359, 2019 (number of pages: 20)

* A. Tarr *et al.*, "Automated coding of political campaign advertisement videos: An empirical validation study," *Political Analysis*, pp. 1–21, 2022 (number of pages: 3)

  – **Section 3.2**

* M. Neumann, "Hooked with phonetics: The strategic use of style-shifting in political rhetoric," in *Annual Meeting of the American Political Science Association. Washington, DC*, 2019 Available: `https://markusneumann.github.io/files/Neumann_APSA.pdf` (number of pages: 44)

* M. Rask, "Automated annotation of political speech recordings," *Working Paper*, pp. 1–20, 2023 (number of pages: 20)

→ Total number of pages: 87

Resources 🔗

- `https://github.com/resemble-ai/Resemblyzer`

- `https://huggingface.co/pyannote/speaker-diarization`

Theme: Images 🖼️

Class 12: Image Basics

Date: 15, November 2023, 09-12 am
Location: 1330-038

Lecture 🧑🏾‍🏫

1. Representing images (i.e. pixels) as a matrix

2. Image channels and color spaces

3. Software (`OpenCV`, `scikit-image`)

4. Basic image operations

Coding Tour 🤓+🛤️

- Introduction to `OpenCV`

Lab 🥼+💻

- Conversion of an image to a matrix

- Display an image

- Image processing

- Introduction to `face_recognition` and `py-feat`

Readings 📕

* N. Webb Williams, "What type of data are images?" *Available at SSRN 4012789*, 2023 Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4012 789 (number of pages: 21)

* N. W. Williams *et al.*, *Images as data for social science research: An introduction to convolutional neural nets for image classification.* Cambridge University Press, 2020 (number of pages: 15)

    – **Section 1**, **Section 4.2**

* M. Torres and F. Cantú, "Learning to see: Convolutional neural networks for the analysis of social science data," *Political Analysis*, vol. 30, no. 1, pp. 113–131, 2022 (number of pages: 1)

    – **Section 2.1**

→ Total number of pages: 16

▷ E. P. Bucy, "Politics through machine eyes: What computer vision allows us to see," *Journal of Visual Political Communication*, vol. 10, no. 1, pp. 59–68, 2023

Resources 🔗

- https://scikit-image.org/docs/stable/

- https://docs.opencv.org/4.x/d6/d00/tutorial_py_root.html

- https://github.com/yilangpeng/athec/tree/main

- https://towardsdatascience.com/face-detection-in-2-minutes-using-opencv-python-90f89d7c0f81

Class 13: CNNs and Image Classification

Date: 22, November 2023, 09-12 am
Location: 1330-038

Lecture 👨‍🏫

1. Introduction to convolutional neural networks (CNNs)

2. Transfer learning using CNNs

3. Image classification

Coding Tour 🤓+🛤️

- Fine-tuning of CNN classifier using PyTorch

Lab 🥼+💻

- Classification of hand-written digits using the MNIST dataset

Readings 📕

* M. Torres and F. Cantú, "Learning to see: Convolutional neural networks for the analysis of social science data," *Political Analysis*, vol. 30, no. 1, pp. 113–131, 2022 (number of pages: 18)

* G. Lin and C. Lucas, "An introduction to neural networks for the social sciences," in *The Oxford Handbook of Methodological Pluralism in Political Science*, Oxford University Press, forthcoming. [Online]. Available: http://christopherlucas.org/files/PDFs/nn_chapter.pdf (number of pages: 3)

    – **Section 4.1**

* N. Xi *et al.*, "Understanding the political ideology of legislators from social media images," in *Proceedings of the international aaai conference on web and social media*, vol. 14, 2020, pp. 726–737 (number of pages: 9)

→ Total number of pages: 30

Resources 🔗

- https://towardsdatascience.com/face-detection-in-2-minutes-using-opencv-python-90f89d7c0f81

- https://colab.research.google.com/drive/1KFHwz8wjDdcFfsTmXfo-gwkKc-itN3MS#scrollTo=WXF1RoZFwFOj

Class 14: Summary and Q&A

Date: 29, November 2023, 09-12 am
Location: 1330-038

References

[1]   J. Y. Kim and Y. M. M. Ng, "Teaching computational social science for all," *PS: Political Science & Politics*, vol. 55, no. 3, pp. 605–609, 2022.

[2]   Y. Theocharis and A. Jungherr, "Computational social science and the study of political communication," *Political Communication*, vol. 38, no. 1-2, pp. 1–22, 2021.

[3]   J. Grimmer and B. M. Stewart, "Text as data: The promise and pitfalls of automatic content analysis methods for political texts," *Political analysis*, vol. 21, no. 3, pp. 267–297, 2013.

[4]   G. Lin and C. Lucas, "An introduction to neural networks for the social sciences," in *The Oxford Handbook of Methodological Pluralism in Political Science*, Oxford University Press, forthcoming. [Online]. Available: http://christopherlucas.org/files/PDFs/nn_chapter.pdf.

[5]   W. McKinney, *Python for data analysis: Data wrangling with Pandas, NumPy, and IPython*, 2nd ed. " O'Reilly Media, Inc.", 2017.

[6]   C. A. Bail, "Can generative ai improve social science?," 2023.

[7]   M. Laurer, W. van Atteveldt, A. Casas, and K. Welbers, "Less annotating, more classifying: Addressing the data scarcity issue of supervised machine learning with deep transfer learning and bert-nli," *Political Analysis*, pp. 1–33, 2022.

[8]   Z. Terechshenko *et al.*, "A comparison of methods in political science text classification: Transfer learning language models for politics," *Available at SSRN 3724644*, 2020. DOI: http://dx.doi.org/10.2139/ssrn.3724644.

[9]   I. Goodfellow, Y. Bengio, and A. Courville, *Deep learning*. MIT press, 2016. [Online]. Available: https://www.deeplearningbook.org/.

[10] M. A. Nielsen, *Neural networks and deep learning*. Determination press San Francisco, CA, USA, 2015, vol. 25.

[11] M. J. Denny and A. Spirling, "Text preprocessing for unsupervised learning: Why it matters, when it misleads, and what to do about it," *Political Analysis*, vol. 26, no. 2, pp. 168–189, 2018.

[12] S. Akuma, T. Lubem, and I. T. Adom, "Comparing bag of words and tf-idf with different models for hate speech detection from live tweets," *International Journal of Information Technology*, vol. 14, no. 7, pp. 3629–3635, 2022.

[13] D. M. Blei, "Probabilistic topic models," *Communications of the ACM*, vol. 55, no. 4, pp. 77–84, 2012. DOI: http://doi.acm.org/10.1145/2133806.2133826.

[14] C. Wratil, J. Waeckerle, and S.-O. Proksch, "Government rhetoric and the representation of public opinion in international negotiations," *American Political Science Review*, pp. 1–18, 2022.

[15] B. C. Silva and S.-O. Proksch, "Politicians unleashed? political communication on twitter and in parliament in western europe," *Political science research and methods*, vol. 10, no. 4, pp. 776–792, 2022.

[16] P. L. Rodriguez and A. Spirling, "Word embeddings: What works, what doesn't, and how to tell the difference for applied research," *The Journal of Politics*, vol. 84, no. 1, pp. 101–115, 2022.

[17] L. Rheault and C. Cochrane, "Word embeddings for the analysis of ideological placement in parliamentary corpora," *Political Analysis*, vol. 28, no. 1, pp. 112–133, 2020.

[18] E. Rudkowsky, M. Haselmayer, M. Wastian, M. Jenny, Š. Emrich, and M. Sedlmair, "More than bags of words: Sentiment analysis with word embeddings," *Communication Methods and Measures*, vol. 12, no. 2-3, pp. 140–157, 2018.

[19] T. Mikolov, I. Sutskever, K. Chen, G. S. Corrado, and J. Dean, "Distributed representations of words and phrases and their compositionality," *Advances in neural information processing systems*, vol. 26, 2013.

[20] A. C. Kozlowski, M. Taddy, and J. A. Evans, "The geometry of culture: Analyzing the meanings of class through word embeddings," *American Sociological Review*, vol. 84, no. 5, pp. 905–949, 2019.

[21] P. L. Rodriguez, A. Spirling, B. M. Stewart, and E. M. Wirsching, "Multilanguage word embeddings for social scientists: Estimation, inference and validation resources for 157 languages,"

[22] P. L. Rodriguez, A. Spirling, and B. M. Stewart, "Embedding regression: Models for context-specific description and inference," *American Political Science Review*, pp. 1–20, 2023.

[23] C. Barrie, N. Ketchley, A. Siegel, and M. Bagdouri, "Measuring media freedom," 2023.

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[25] F. Camastra and A. Vinciarelli, *Machine learning for audio, image and video analysis: theory and applications.* Springer, 2015.

[26] B. J. Dietrich, M. Hayes, and D. Z. O'Brien, "Pitch perfect: Vocal pitch and the emotional intensity of congressional speech," *American Political Science Review*, vol. 113, no. 4, pp. 941–962, 2019.

[27] D. Knox and C. Lucas, "A dynamic model of speech for the social sciences," *American Political Science Review*, vol. 115, no. 2, pp. 649–666, 2021.

[28] L. Rheault and S. Borwein, "Multimodal techniques for the study of a ect in political videos," Working Paper, Tech. Rep., 2019.

[29] M. Rask and F. Hjorth, "Nonverbal-based measures of elite conflict and polarization," *Working Paper*, pp. 1–25, 2023.

[30] M. Vainio, A. Suni, J. Šimko, and S. Kakouros, "The power of prosody and prosody of power: An acoustic analysis of finnish parliamentary speech," *arXiv preprint arXiv:2305.16040*, 2023.

[31] S.-O. Proksch, C. Wratil, and J. Wäckerle, "Testing the validity of automatic speech recognition for political text analysis," *Political Analysis*, vol. 27, no. 3, pp. 339–359, 2019.

[32] A. Tarr, J. Hwang, and K. Imai, "Automated coding of political campaign advertisement videos: An empirical validation study," *Political Analysis*, pp. 1–21, 2022.

[33] M. Neumann, "Hooked with phonetics: The strategic use of style-shifting in political rhetoric," in *Annual Meeting of the American Political Science Association. Washington, DC*, 2019.

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