

Sample Syllabus: Introduction to Computational Sociology

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Course Description

In recent decades, computational methods have provided innovation in all subdisciplines of sociology. This class introduces the field of computational sociology by covering the history of the field, fundamental logic behind computational analysis, ethical considerations, basic required mathematics, and computational methods. Students will be introduced to machine learning, natural language processing, computer vision, network science, and agent-based simulation models.

This introductory course is geared towards students without prior knowledge of the topic. No prior coding experience is expected. Students will learn coding from scratch in either Python or R and will be able to innovatively incorporate computational methods in their research by the end of the semester.

Course Objectives

1. Learn the basics of coding using Python or R.
2. Learn the foundational logic, advantages, and disadvantages of computational social science.
3. Learn to successfully apply computational methods to your research projects.

Course Structure and Evaluation

This course is broadly divided into four modules: Introduction to Computational Social Science, Machine Learning, Network Science, and Agent-Based Simulation. The first module will provide an overview of the development of computational social science, methodology, and ethical considerations. Additionally, students without any prior experience in coding will learn the basics of coding using either Python or R. The next modules provide an overview of 3 main subsections of computational social science. Each meeting will include a lecture by the instructor and a lab session.

Grading Policy

Weekly Exercises

Students will be given a total of 11 exercises to practice coding. Students can skip 2 assignments of their choice.

Class participation

Students are expected to attend lectures and participate in class discussions. Attendance is optional for the lab portion of the class.

Final paper

Students are required to submit a final paper using at least one computational method in their analysis. The final paper is divided into four stages to support students:

1. Abstract
 - a. Due on Paper Workshop 1
 - b. Abstract of the project detailing the theoretical background and research question.
 - c. The instructor will support students to identify appropriate datasets and computational methods in the workshop session.
2. Preliminary analysis
 - a. Due on Paper Workshop 2
 - b. Preliminary analysis.
 - c. The instructor will support students to improve their analysis in the workshop session.
3. Final presentation
 - a. The students will present their full project in 10 – 15 minutes presentations.
4. Final paper

Grading

Assignment	Grade
Weekly Assignments x 9	5 x 9 = 45
Final Paper Draft 1	5
Final Paper Draft 2	10
Final Presentation	10
Final Paper	30
Total	100

Additional Resources:

The following resources can provide additional guidance for students during the course:

Books

- “R for Data Science (2e).” <https://r4ds.hadley.nz/>.
- “Introduction to Programming in Python: An Interdisciplinary Approach.” <https://introcs.cs.princeton.edu/python/home/>.
- Grimmer, Justin, Margaret E. Roberts, and Brandon M. Stewart. *Text as Data: A New Framework for Machine Learning and the Social Sciences*. Princeton University press, 2022.
- Barabási, Albert-László, and Márton Pósfai. *Network Science*. Cambridge university press, 2016. Accessible online for free: <http://networksciencebook.com/>
- Chollet, François. *Deep Learning with Python*. Manning, 2018.
- Allaire, J. j. *Deep Learning with R*. Manning Publications Co. LLC, 2018.
- Antiga, Luca Pietro Giovanni. *Deep Learning with PyTorch*. With Eli Stevens and Thomas Viehmann. Manning, 2020.
- Ian Goodfellow, Yoshua Bengio and Aaron Courville. *Deep Learning*. <https://www.deeplearningbook.org/>

Videos

- “The Summer Institutes in Computational Social Science - Learning Materials.” <https://sicss.io/overview>.

- Programming with Mosh, dir. *Python Full Course for Beginners*. 2019. 6:14:06. <https://www.youtube.com/watch?v=uQrJ0TkZlc>.
- Simplilearn, dir. *R Tutorial For Beginners 2022 | R Programming Full Course In 7 Hours | R Tutorial | Simplilearn*. 2020. 6:49:38. <https://www.youtube.com/watch?v=KlsYCECWEWE>.
- 3Blue1Brown, dir. *Vectors | Chapter 1, Essence of Linear Algebra*. 2016. 9:51. https://www.youtube.com/watch?v=fNk_zzaMoSs. – Full playlist

Course Schedule

Module 1: Introduction to Computational Social Science

Week 1: Introductions

What is computational social science? What is computational sociology? What is analytical sociology? Are they any different?

REQUIRED MATERIALS

- Edelman, Achim, Tom Wolff, Danielle Montagne, and Christopher A. Bail. “Computational Social Science and Sociology.” *Annual Review of Sociology* 46, no. Volume 46, 2020 (2020): 61–81. <https://doi.org/10.1146/annurev-soc-121919-054621>.
- Lazer, David M. J., Alex Pentland, Duncan J. Watts, et al. “Computational Social Science: Obstacles and Opportunities.” *Science* 369, no. 6507 (2020): 1060–62. <https://doi.org/10.1126/science.aaz8170>.
- Keuschnigg, Marc, Niclas Lovsjö, and Peter Hedström. “Analytical Sociology and Computational Social Science.” *Journal of Computational Social Science* 1, no. 1 (2018): 3–14. <https://doi.org/10.1007/s42001-017-0006-5>.
- Optional: Programming with Mosh, dir. *Python for Beginners - Learn Coding with Python in 1 Hour*. 2020. 0:40. <https://www.youtube.com/watch?v=kqtD5dpn9C8>.

LAB

1. Learn basic git commands
2. Install necessary software like Python, R, GitHub desktop, etc.
3. Learn basic coding concepts like variables, data types, functions, etc.

Week 2: Research Design & Ethics

How can we use computational methods in sociological research? What are some ethical concerns? Where is computational sociology in the qualitative-quantitative divide?

REQUIRED MATERIALS

- Nelson, Laura K. “Computational Grounded Theory: A Methodological Framework.” *Sociological Methods & Research* 49, no. 1 (2020): 3–42. <https://doi.org/10.1177/0049124117729703>.
- Pardo-Guerra, Juan Pablo, and Prithviraj Pahwa. “The Extended Computational Case Method: A Framework for Research Design.” *Sociological Methods & Research* 51, no. 4 (2022): 1826–67. <https://doi.org/10.1177/00491241221122616>.
- Leslie, David. “The Ethics of Computational Social Science.” In *Handbook of Computational Social Science for Policy*, edited by Eleonora Bertoni, Matteo Fontana,

Lorenzo Gabrielli, Serena Signorelli, and Michele Vespe. Springer International Publishing, 2023. https://doi.org/10.1007/978-3-031-16624-2_4.

- Abramson, Corey M., Jacqueline Joslyn, Katharine A. Rendle, Sarah B. Garrett, and Daniel Dohan. “The Promises of Computational Ethnography: Improving Transparency, Replicability, and Validity for Realist Approaches to Ethnographic Analysis.” *Ethnography* 19, no. 2 (2018): 254–84. <https://doi.org/10.1177/1466138117725340>.

LAB

1. Learn basic coding
 - a. Creating and modifying variables
 - b. For and While loops
 - c. Creating simple functions
 - d. Familiarizing with the concept of libraries/packages

Week 3: Data, Measurement, and Bias

How do we measure “society?” What is data? Are our methods biased?

REQUIRED MATERIALS

- Wagner, Claudia, Markus Strohmaier, Alexandra Olteanu, Emre Kıcıman, Noshir Contractor, and Tina Eliassi-Rad. “Measuring Algorithmically Infused Societies.” *Nature* 595, no. 7866 (2021): 197–204. <https://doi.org/10.1038/s41586-021-03666-1>.
- Obermeyer, Ziad, Brian Powers, Christine Vogeli, and Sendhil Mullainathan. “Dissecting Racial Bias in an Algorithm Used to Manage the Health of Populations.” *Science* 366, no. 6464 (2019): 447–53. <https://doi.org/10.1126/science.aax2342>.
- Introduction - Mohr, John W., Christopher A. Bail, Margaret Frye, et al. *Measuring Culture*. Columbia University Press, 2020.
- Callahan, Molly. “Can We Better Understand Online Behavior? These Researchers Will Dig Deep to Find Out.” *Northeastern Global News*, October 7, 2021. <https://news.northeastern.edu/2021/10/07/exploring-online-behavior/>.

LAB

1. Learn key libraries/packages
 - a. Numpy, Pandas, Matplotlib in Python
 - b. Tidyverse and ggplot2 in R

Week 4: Paper Workshop 1

Final paper abstracts are due.

LAB:

Coding Q/A session

Module 2: Machine Learning

Week 5: Machine Learning

REQUIRED MATERIALS

- 3Blue1Brown, dir. *But What Is a Neural Network? | Deep Learning Chapter 1*. 2017. 18:39. <https://www.youtube.com/watch?v=aircAruvnKk>.

- 3Blue1Brown, dir. *Gradient Descent, How Neural Networks Learn* | *Deep Learning Chapter 2*. 2017. 20:33. <https://www.youtube.com/watch?v=IHZwWFHWa-w>.
- 3Blue1Brown, dir. *Backpropagation, Intuitively* | *Deep Learning Chapter 3*. 2017. 12:46. <https://www.youtube.com/watch?v=Ilg3gGewQ5U>.
- Grimmer, Justin, Margaret E. Roberts, and Brandon M. Stewart. "Machine Learning for Social Science: An Agnostic Approach." *Annual Review of Political Science* 24, no. Volume 24, 2021 (2021): 395–419. <https://doi.org/10.1146/annurev-polisci-053119-015921>.
- Molina, Mario, and Filiz Garip. "Machine Learning for Sociology." *Annual Review of Sociology* 45, no. Volume 45, 2019 (2019): 27–45. <https://doi.org/10.1146/annurev-soc-073117-041106>.

LAB

1. Review key linear algebra concepts such as vectors, vector spaces, and matrices.
2. Learn basic supervised machine learning

Week 6: Text as data 1 (Embeddings, Sentiment, Named Entity Recognition)

REQUIRED MATERIALS

- King, Brayden G, and Laura K. Nelson. "Beyond Protests: Using Computational Text Analysis to Explore a Greater Variety of Social Movement Activities." In *Methodological Advances in Research on Social Movements, Conflict, and Change*, edited by Thomas V. Maher and Eric W. Schoon, vol. 47. Research in Social Movements, Conflicts and Change. Emerald Publishing Limited, 2023. <https://doi.org/10.1108/S0163-786X20230000047002>.
- "Vectoring Words (Word Embeddings) - Computerphile - YouTube." Accessed September 30, 2025. https://www.youtube.com/watch?v=gQddtTdmG_8.
- Mikolov, Tomas, Kai Chen, Greg Corrado, and Jeffrey Dean. "Efficient Estimation of Word Representations in Vector Space." arXiv:1301.3781. Preprint, arXiv, September 7, 2013. <https://doi.org/10.48550/arXiv.1301.3781>.
- Kozlowski, Austin C., Matt Taddy, and James A. Evans. "The Geometry of Culture: Analyzing the Meanings of Class through Word Embeddings." *American Sociological Review* 84, no. 5 (2019): 905–49. <https://doi.org/10.1177/0003122419877135>.
- Nelson, Laura K., Rebekah Getman, and Syed Arefinul Haque. "And the Rest Is History: Measuring the Scope and Recall of Wikipedia's Coverage of Three Women's Movement Subgroups." *Sociological Methods & Research* 51, no. 4 (2022): 1788–825. <https://doi.org/10.1177/00491241211067514>.

LAB:

1. Introduction to text analysis
 - a. Learn text tokenization
 - b. Perform sentiment analysis
 - c. Extract named entities.
 - d. Perform basic arithmetics on word embeddings

Week 7: Text as data 2 (Topic modelling, supervised classification)

REQUIRED MATERIALS

- Summer Institute in Computational Social Science, dir. *An Introduction to Topic Modeling*. 2020. 26:38. <https://www.youtube.com/watch?v=IUAHUEy1V0Q>.
- Blei, David M. *Latent Dirichlet Allocation*. 2003. <https://dl.acm.org/doi/10.5555/944919.944937>
- Grootendorst, Maarten. “BERTopic: Neural Topic Modeling with a Class-Based TF-IDF Procedure.” arXiv:2203.05794. Preprint, arXiv, March 11, 2022. <http://arxiv.org/abs/2203.05794>.
- Nardulli, Peter F., Scott L. Althaus, and Matthew Hayes. “A Progressive Supervised-Learning Approach to Generating Rich Civil Strife Data.” *Sociological Methodology* 45, no. 1 (2015): 148–83. <https://doi.org/10.1177/0081175015581378>.
- Vahabli, Danial. “From the Global South to the Human Rights Stage: A Study of Global Frame Resonance Using a Comparative Case of Women, Life, Freedom and Bloody November in Iran.” *International Journal of Comparative Sociology*, SAGE Publications Ltd, August 20, 2024, 00207152241269783. <https://doi.org/10.1177/00207152241269783>.

LAB

1. Introduction to text analysis
 - a. Sentiment analysis
 - b. LDA and BERTopic topic modelling
 - c. Text classification

Week 8: Beyond Text: Communities, Audio, and Image

REQUIRED MATERIALS

- IBM Technology, dir. *What Are Convolutional Neural Networks (CNNs)?* 2021. 6:20. <https://www.youtube.com/watch?v=QzY57FaENXg>.
- Torres, Michelle, and Francisco Cantú. “Learning to See: Convolutional Neural Networks for the Analysis of Social Science Data.” *Political Analysis* 30, no. 1 (2022): 113–31. <https://doi.org/10.1017/pan.2021.9>.
- Jean, Neal, Marshall Burke, Michael Xie, W. Matthew Alampay Davis, David B. Lobell, and Stefano Ermon. “Combining Satellite Imagery and Machine Learning to Predict Poverty.” *Science* 353, no. 6301 (2016): 790–94. <https://doi.org/10.1126/science.aaf7894>.
- Qian, Sijia, Yingdan Lu, Yilang Peng, Cuihua (Cindy) Shen, and Huacen Xu. “Convergence or Divergence? A Cross-Platform Analysis of Climate Change Visual Content Categories, Features, and Social Media Engagement on Twitter and Instagram.” *Public Relations Review* 50, no. 2 (2024): 102454. <https://doi.org/10.1016/j.pubrev.2024.102454>.
- Nie, Ke. “Disperse and Preserve the Perverse: Computing How Hip-Hop Censorship Changed Popular Music Genres in China.” *Poetics* 88 (October 2021): 101590. <https://doi.org/10.1016/j.poetic.2021.101590>.
- Waller, Isaac, and Ashton Anderson. *Community Embeddings Reveal Large-Scale Cultural Organization of Online Platforms*. <https://www.cs.toronto.edu/~ashton/pubs/cultural-dims2020.pdf>
- Optional: 3Blue1Brown, dir. *But What Is a Convolution?* 2022. 23:00. <https://www.youtube.com/watch?v=KuXjwB4LzSA>.

LAB:

1. Extend the idea of embedding to multimodal data.
2. Learn about Image to Text and Speech to Text models.
3. Learn Convolutional Neural Networks.
4. Familiarize with basic computer vision models such as YOLO
5. Familiarize with basic audio analysis models

Week 9: LLMs

REQUIRED MATERIALS

- 3Blue1Brown, dir. *Large Language Models Explained Briefly*. 2024. 7:57. <https://www.youtube.com/watch?v=LPZh9BOjkQs>.
- Lin, Hao, and Yongjun Zhang. "Navigating the Risks of Using Large Language Models for Text Annotation in Social Science Research." *Social Science Computer Review*, SAGE Publications Inc, August 8, 2025, 08944393251366243. <https://doi.org/10.1177/08944393251366243>.
- Dillion, Danica, Niket Tandon, Yuling Gu, and Kurt Gray. "Can AI Language Models Replace Human Participants?" *Trends in Cognitive Sciences* 27, no. 7 (2023): 597–600. <https://doi.org/10.1016/j.tics.2023.04.008>.
- Davidson, Thomas. "Start Generating: Harnessing Generative Artificial Intelligence for Sociological Research." *Socius: Sociological Research for a Dynamic World* 10 (January 2024): 23780231241259651. <https://doi.org/10.1177/23780231241259651>.

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1. Learn command engineering.
2. Use ChatGPT for text classification.

Week 10: Paper Workshop 2

Final paper drafts are due.

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1. Coding Q/A session

Module 3: Network Science

Week 11: Networks

REQUIRED MATERIALS

- *Chapters 1-3 Network Science* by Albert-László Barabási. n.d. Accessed October 1, 2025. <http://networksciencebook.com/>.
- Granovetter, Mark. "Economic Action and Social Structure: The Problem of Embeddedness." *American Journal of Sociology* 91, no. 3 (1985): 481–510.
- Saetre, Juliette. "How Protests Spread: Diasporas, Wide Bridges, and the Transnational Diffusion of Un Violador En Tu Camino." *American Journal of Sociology*, February 25, 2025, 735430. <https://doi.org/10.1086/735430>.
- Zhao, Linda. "Uneven Mixing, Network Segregation, and Immigrant Integration." *American Sociological Review* 90, no. 3 (2025): 521–59. <https://doi.org/10.1177/00031224251336471>.
- Bruggeman, Jeroen, V. A. Traag, and Justus Uitermark. "Detecting Communities through Network Data." *American Sociological Review* 77, no. 6 (2012): 1050–63. <https://doi.org/10.1177/0003122412463574>.

LAB:

1. Review basic linear algebra concepts.
2. Review basic graph theory concepts.
3. Learn NetworkX in python.
 - a. Create a basic network
 - b. Plot a network

Week 12: Digital Networks

REQUIRED MATERIALS

- Kim, Dasol. “Racialized Beauty, Visibility, and Empowerment: Asian American Women Influencers on YouTube.” *Information, Communication & Society* 26, no. 6 (2023): 1159–76. <https://doi.org/10.1080/1369118X.2021.1994626>.
- Berekméri, Evelin, Imre Derényi, and Anna Zafeiris. “Optimal Structure of Groups under Exposure to Fake News.” *Applied Network Science* 4, no. 1 (2019): 101. <https://doi.org/10.1007/s41109-019-0227-z>.
- Gustafsson, Nils, and Anders Olof Larsson. “RIP #almedalen: The Rise and Fall of the Hashtag of a Swedish Democracy Festival.” *New Media & Society*, SAGE Publications, May 17, 2025, 14614448251336426. <https://doi.org/10.1177/14614448251336426>.

LAB

1. Learn community detection
2. Draw a retweet network
3. Draw a semantic network

Module 4: Agent-Based Simulations

Week 13: Agent Based Simulations

REQUIRED MATERIALS

- Macy, Michael W., and Robert Willer. “From Factors to Actors: Computational Sociology and Agent-Based Modeling.” *Annual Review of Sociology* 28, no. Volume 28, 2002 (2002): 143–66. <https://doi.org/10.1146/annurev.soc.28.110601.141117>.
- Goldberg, Amir, and Sarah K. Stein. “Beyond Social Contagion: Associative Diffusion and the Emergence of Cultural Variation.” *American Sociological Review* 83, no. 5 (2018): 897–932. <https://doi.org/10.1177/0003122418797576>.
- Erikson, Emily, and Hirokazu Shirado. “Networks, Property, and the Division of Labor.” *American Sociological Review* 86, no. 4 (2021): 759–86. <https://doi.org/10.1177/00031224211027893>.

LAB

1. Create an agent-based simulation model for information diffusion

Week 14: Final Presentations