



UNIVERSITY OF TORONTO FACULTY OF INFORMATION

INF2199H - Special Topics in Information Studies: Critical and Human-Centred Approaches to Information Visualization

Semester: Summer 2019 (May/June Session)

Time: Monday - 9:00-12:00; Wednesday - 16:00-18:00

Location: BL116 (UX Design Studio)

Instructor: Gabby Resch - gabby.resch@utoronto.ca

Office Hours: By appointment

COURSE DESCRIPTION:

This course explores recent efforts to introduce critical, human/user-centred, interpretative, and humanistic methods to the field of information visualization (infovis). Through it, students will acquire the ability to use and understand a number of emerging infovis methods (e.g. 3D visualization), as well as to critically interrogate the application of information visualization technologies in domains where they would not traditionally be encountered (e.g. History). Various critical topics will be addressed, including the use of visualization to lie and mislead; the tension between truth and aesthetic concerns in data design; the recent growth of visualization literacy initiatives; and the introduction of visualization technologies into humanistic research. Additionally, a number of important Python-based visualization tools (e.g. Matplotlib, Plotly) will be introduced through case studies with real-world import, providing students with an opportunity to develop theoretical knowledge through applied work that will enhance their professional portfolios.

PREREQUISITES:

Students are expected to have some familiarity with information technology concepts such as hardware, software, networks, and design. As a prerequisite, students should have taken *INF1340: Programming for Information Systems/Data Science* or have acquired equivalent knowledge through professional or extracurricular experience. Students not in possession of this may make use of introductory courses available at DataCamp, Lynda, etc:

<https://www.datacamp.com/courses/intro-to-python-for-data-science>

<https://www.lynda.com/Python-tutorials/Python-Data-Science-Essential-Training/520233-2.html>

Successful completion of one of these courses, along with approval of the instructor, will satisfy the prerequisite condition.

Throughout this course, we will use Python-based visualization tools. Basic familiarity with the Python data science ecosystem will eventually be necessary, as all assignments and tutorials will use the Jupyter notebook format. While students may make use of popular R and JavaScript libraries (e.g. ggplot2 and D3), or applications such as Tableau, all course instructional content will be Python-based.

COURSE OBJECTIVES:

This course will enable students to develop important knowledge of information visualization methods and themes that they will likely encounter in professional information and data science contexts. Complementing overviews of data analysis methods that students will encounter through courses like INF2210H Human

Values in Data Science and INF2190H Data Analytics, this course is designed to equip students with the ability to address a number of topical visualization-related issues (e.g. the deceptive use of statistics through misleading visualization). Using Python-based tools that students are likely to make use of in their professional careers, along with real-world case studies, it fills a necessary gap in the iSchool's course offerings by providing an introduction to visualization that is both applied and theoretical.

COURSE LEARNING OUTCOMES:

Students who have successfully completed this course should:

1. Have knowledge of a breadth of contemporary infovis methods and topics that are relevant to domains ranging from Data Science to Digital Humanities.
2. Be able to apply critical methods to the study and application of infovis in a variety of research domains.
3. Have the capacity to use Python-based visualization tools to build multimodal strategies for data analysis and research communication.
4. Be able to recognize and respond to epistemic issues resulting from new modes of interaction (e.g. virtual reality) used to visualize information.
5. Be familiar with the rich and diverse history of information visualization, and be capable of responding to trends in their future professional practice brought about by changes in this dynamic space.
6. Understand a variety of problems associated with evaluating information visualization methods in a range of emerging data-driven contexts.
7. Possess the ability to authoritatively assess the social and ethical implications of visualization-based communication and decision making.

RELATIONSHIP BETWEEN COURSE AND PROGRAM LEARNING OUTCOMES:

Students in the Master of Information program should familiarize themselves with the MI student learning outcomes, which can be found here:

<https://ischool.utoronto.ca/areas-of-study/master-of-information/>.

This course aligns with specific learning outcomes for the MI program. Through critical examination of historical and contemporary themes and the application of critical methods related to the deployment of infovis technologies in a diverse array of contexts (CLOs 1, 2, and 5), students will become better equipped to “respond to changing information practices and needs of society” (PLO 1, as demonstrated via class discussion) and “contribute through research and publication” (PLO 3, via course assignments that can serve as portfolio items or early iterations of future research outputs). By developing the capacity to use and evaluate Python-based data science and visualization tools for analysis and communication (CLOs 3 and 6), specifically through the use of Jupyter notebooks for design-based assignment submissions, students will gain a rich understanding of the application of new technological developments to the communication of information (PLO 5). The three intertwined course assignments are designed to give students the opportunity to recognize, assess, and respond to a variety of social, epistemic, and ethical concerns (CLOs 4 and 7) through an applied data design process. In doing so, they provide an opportunity for students to develop values-laden design practices and contribute to a definition of social responsibility in the professional infovis context (PLO 2).

COURSE ORGANIZATION AND CLASS STRUCTURE:

Each class will be comprised of a short lecture providing an overview of important themes, a group discussion, and a collaborative design exercise or in-depth tutorial. Students are expected to read the required readings, attend all classes, contribute to discussion, and participate in all activities. The course structure will mix elements of a graduate seminar with an exploratory design process. We will open each class with a discussion of the course texts and their background. This conversation will generally take up half of each class. Students will help contextualize this discussion by identifying themes and questions from the

readings and relating them to topical issues.

The remaining half of each class will be an opportunity for students to directly engage with the course material and put it into conversation with specific infovis technologies through design exercises and technical tutorials that will be carried out each time we meet. This will provide students with a comprehensive overview of how specific infovis tools operate, as well as how they can be deployed in a variety of information and data science contexts. Students are strongly encouraged to bring a laptop to class. Additional technical resources will be provided courtesy of the Student Tech Fund and the Semaphore Research Cluster, primarily through the use of Studio 307.

WEEKLY READINGS & CLASS SCHEDULE:

There is no required textbook for this course. Digital copies of all readings will be uploaded (or linked to) on Quercus.

Please note that additional readings may be assigned or recommended each week. Students are advised to attend class, read notices on Quercus, and consult the final slide of each week's lecture presentation for information about any additional readings.

Week 1, Class 1

Introduction

Themes: Overview of the course themes; a short history of visualization.

Activity: Unpacking the legend of John Snow's cholera map.

Readings:

- M. Dörk, P. Feng, C. Collins, *et al.*, "Critical infovis: Exploring the politics of visualization," in *CHI'13 Extended Abstracts on Human Factors in Computing Systems*, ACM, 2013, pp. 2189–2198
- M. Friendly, "A brief history of data visualization," in *Handbook of data visualization*, Springer, 2008, pp. 15–56

Week 1, Class 2

Data

Themes: Relationship between data science and infovis; myth of raw data.

Activity: Introduction to Jupyter, Pandas, and the Python data science and infovis ecosystem.

Readings:

- L. Gitelman, *Raw data is an oxymoron*. MIT Press, 2013, Introduction by Lisa Gitelman and Virginia Jackson
- Y. A. Loukissas, "A place for big data: Close and distant readings of accessions data from the arnold arboretum," *Big Data & Society*, vol. 3, no. 2, p. 2053951716661365, 2016

Week 2, Class 1

What is a Graph?

Themes: Definitions; visual perception.

Activity: Introduction to Matplotlib and libraries built on it (seaborn, ggplot, Bokeh, Plotly).

Readings:

- H. Wainer, *Graphic discovery: A trout in the milk and other visual adventures*. Princeton University Press, 2005, Chapter 1
- R. Kosara, "An empire built on sand: Reexamining what we think we know about visualization," in *Proceedings of the Beyond Time and Errors on Novel Evaluation Methods for Visualization*, ACM, 2016, pp. 162–168
- M. W. F. Viégas and M. Wattenberg, *Design and redesign in data visualization*, 2015. [Online]. Available: https://medium.com/@hint_fm/design-and-redesign-4ab77206cf9

Week 2, Class 2

Humanistic Visualization

Themes: Digital Humanities; text analysis and visualization.

Activity: Text visualization.

Readings:

- J. Drucker, "Humanities approaches to graphical display," *Digital Humanities Quarterly*, vol. 5, no. 1, pp. 1–21, 2011
- J. Drucker, *Graphesis*. Harvard University Press, 2014, Intro and Chapters 1 & 2
- L. Manovich, "Visualization methods for media studies," *Oxford Handbook of Sound and Image in Digital Media*, 2014

Week 3, Class 1

Representation in Science

Themes: Scientific visualization; 3D visualization.

Activity: 3D visualization and "data sculpture" using Mayavi, Plotly, and 3D printing.

Readings:

- C. Coopmans, J. Vertesi, M. E. Lynch, *et al.*, *Representation in scientific practice revisited*. MIT Press, 2014, Chapters 3 & 13
- M. Lynch, "Representation is overrated: Some critical remarks about the use of the concept of representation in science studies," *Configurations*, vol. 2, no. 1, pp. 137–149, 1994

Week 3, Class 2

Visualization Fixity

Themes: Portability of graphics; embodied spatial representation.

Activity: Web-based tools for sharing visualization (e.g. Tableau Public).

Readings:

- B. Latour, "Visualization and cognition," *Knowledge and society*, vol. 6, pp. 1–40, 1986
- J. Vertesi, "Mind the gap the london underground map and users' representations of urban space," *Social Studies of Science*, vol. 38, no. 1, pp. 7–33, 2008

Week 4, Class 1

Persuasive Graphics

Themes: Infographics; dashboard design; narrative.

Activity: Infographic and dashboard design/UI principles.

Readings:

- J. Jones, "Information graphics and intuition heuristics as a techne for visualization," *Journal of Business and Technical Communication*, p. 1 050 651 915 573 943, 2015
- A. Sarikaya, M. Correll, L. Bartram, *et al.*, "What do we talk about when we talk about dashboards?,"

Week 4, Class 2

Aesthetics vs. Truth

Themes: Artistic visualization; immersive and multisensory infovis.

Activity: Virtual reality infovis.

Readings:

- L. Manovich, "The anti-sublime ideal in data art," 2002
- L. Wilkinson, *The grammar of graphics*. Springer Science & Business Media, 2006, Chapter 1
- F. B. Viégas and M. Wattenberg, "Artistic data visualization: Beyond visual analytics," in *International Conference on Online Communities and Social Computing*, Springer, 2007, pp. 182–191

Week 5, Class 1

How to Lie with Visualization

Themes: Misleading and deceptive graphics; clarity vs. complexity.

Activity: Reambiguation and counterfactual design.

Readings:

- B. E. Rogowitz, L. A. Treinish, S. Bryson, *et al.*, “How not to lie with visualization,” *Computers in Physics*, vol. 10, no. 3, pp. 268–273, 1996
- M. Monmonier, “Lying with maps,” *Statistical science*, pp. 215–222, 2005
- D. Huff, *How to lie with statistics*. WW Norton & Company, 2010, Chapter 10

Week 5, Class 2

Visualization Literacy

Themes: Statistical and graphical literacy.

Activity: Developing visualization tutorials and pedagogical resources.

Readings:

- J. Gray, L. Bounegru, S. Milan, *et al.*, “Ways of seeing data: Toward a critical literacy for data visualizations as research objects and research devices,” in *Innovative Methods in Media and Communication Research*, Springer, 2016, pp. 227–251
- C. D’Ignazio and R. Bhargava, “Databasic: Design principles, tools and activities for data literacy learners,” *The Journal of Community Informatics*, vol. 12, no. 3, 2016
- B. Alper, N. H. Riche, F. Chevalier, *et al.*, “Visualization literacy at elementary school,” in *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, ACM, 2017, pp. 5485–5497

Week 6, Class 1

Inclusive Data Design

Themes: Accessibility and inclusive design; diverse audiences and users.

Activity: Methods for making screen-based graphics more accessible.

Readings:

- C. D’Ignazio and L. F. Klein, “Feminist data visualization,” in *Workshop on Visualization for the Digital Humanities (VIS4DH)*, Baltimore. IEEE, 2016
- Y. Jansen, P. Dragicevic, P. Isenberg, *et al.*, “Opportunities and challenges for data physicalization,” in *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, ACM, 2015, pp. 3227–3236

Week 6, Class 2

Ethical Infovis

Themes: Infovis for good; ethical infovis; the “hockey stick” controversy.

Activity: Data storytelling presentations.

Readings:

- H. Kennedy and R. L. Hill, “The pleasure and pain of visualizing data in times of data power,” *Television & New Media*, vol. 18, no. 8, pp. 769–782, 2017
- J. Emerson, M. L. Satterthwaite, and A. V. Pandey, “The challenging power of data visualization for human rights advocacy,” *Practice*, vol. 171, p. 97, 2016

COURSE ASSIGNMENTS AND EVALUATION:

There will be three major assignments throughout the course. Each of these assignments is designed to provide deliverables that can be useful toward professional portfolio development. Each assignment will be discussed in detail in class, and sufficient time will be given to work on assignments and solicit feedback from peers and the instructor. Creative interpretations of each assignment are encouraged!

All assignments will be prepared as Jupyter Notebooks. Templates will be provided on a course GitHub repository.

For **Assignment One**, students will *conduct a makeover or redesign of a selected visualization*. All design sketches, prototypes, and notes are to be included in a Jupyter notebook that shows the various stages of redesign and provides a rationale for design decisions. This assignment will be due at the end of Week 3, and will be worth **25% of the final grade**.

For **Assignment Two**, students will *prepare a deceptive or misleading graphic*. Students should strive to convince their audience of something untrue. As a consequence, the graphic's legibility will be important. Merely fudging the axes of an existing graph won't be enough. As with the first assignment, all design sketches, prototypes, and notes are to be included in a Jupyter notebook that shows the various stages of redesign and provides a rationale for design decisions. This assignment will be due at the beginning of Week 5 - Class 2, and will be worth **25% of the final grade**.

For **Assignment Three**, students will *tell a data story or persuade an audience with a narrative-driven illumination of a selected dataset*. To do this, they will need to:

- identify an audience
- describe where they acquired their data from and how they prepared it for visualization
- select an appropriate method for display (e.g. dashboard; infographic)
- make careful choices about whether to use a multimodal approach, combine text and visuals, etc.
- outline how they accounted for accessibility considerations
- be prepared to present a brief synopsis of the data story in class (along the lines of a "3 minute thesis")
- be prepared to receive and respond to peer feedback

As previously, selected design sketches, prototypes, and notes are to be included in a Jupyter notebook that shows the various stages of redesign and provides a rationale for design decisions. This assignment will be due at the end of Week 6 - Class 2, and will be worth **40% of the final grade**.

DISCUSSION:

Participating in discussion is a crucial element of the iSchool experience. For this course, students will be rewarded for contributing meaningfully to discussion, engaging with peers, and fostering a collaborative learning environment. Students will be expected to respond to topical questions either in class, or in a discussion forum which will be hosted on Quercus. Each student will be expected to provide a minimum of five responses throughout the semester in order to earn **10% of the final grade**. Accommodations will be made for a range of learning and communication styles.

LATE ASSIGNMENTS & INCOMPLETE GRADES:

All assignments are to be uploaded on Quercus. Extensions are at the discretion of the instructor. Assignments must be submitted by end-of-day on the due dates indicated above. Late assignments will be deducted 10% of the value of the assignment per week, starting the day after the due date. Without accommodations or granted extensions, assignments will only be accepted up to two classes after the due date. Please note that there are no extensions beyond the last day of class.

CLASS CONDUCT AND EXPECTATIONS:

Students are expected to conduct themselves in a manner respectful of the instructor and fellow students. This includes, at a minimum:

- Taking responsibility for one's experience in the course, including coming to class prepared, being open to criticism and feedback, and being willing to engage creatively with the course themes and materials.
- Arriving on time - class starts at 10 minutes after the hour. If late, please enter the classroom without disruption.

- Turning off cell phone ringers upon arrival, as well as using phones and laptops appropriately.
- Communicating with others as one would expect to be communicated with, including not interrupting or speaking when someone else has the floor, respecting diverse identities, and engaging in civil and mature dialogue.

EMAIL COMMUNICATION:

During the academic year, I receive a considerable amount of email. In order for me to respond efficiently, please follow these guidelines:

1. If you cannot make an appointment to meet with me outside of class, please set aside some time before class and email me to let me know that you would like to meet. I will try to respond as soon as possible, but cannot usually accommodate a meeting with less than 48 hours notice.
2. I usually do not read or reply to email after 5 PM or on weekends.
3. Follow instructions for turning in assignments.
4. Grade inquiries and disputes will not be considered or discussed via email. For all grade inquiries and questions about assignments, please set up an appointment with me.
5. I will not reply to email inquiries regarding course matters (assignment requirements, due dates, exam structure, readings, etc.) that arise from missing class or inattention to the course syllabus and Quercus messages. Inquiries requesting clarification will receive replies, though I would strongly prefer for these inquiries to be made in class or through an appointment.

WRITING SUPPORT:

As stated in the Faculty of Information's Grade Interpretation Guidelines, "work that is not well written and grammatically correct will not generally be considered eligible for a grade in the A range, regardless of its quality in other respects." With this in mind, please make use of the writing support provided to graduate students by the SGS Graduate Centre for Academic Communication. The services are designed to target the needs of both native and non-native speakers, and all programs are free. Please consult the current workshop schedule (<http://www.sgs.utoronto.ca/currentstudents/Pages/Current-Years-Courses.aspx>) for more information.

COPYRIGHT IN INSTRUCTIONAL SETTINGS:

If a student wishes to audio record, photograph, video record, or otherwise reproduce lecture presentations, course notes, or other similar materials provided by instructors, they must obtain the instructor's written consent beforehand. Otherwise, all such reproduction is an infringement of copyright and is absolutely prohibited. In the case of private use by students with disabilities, the instructor's consent will not be unreasonably withheld. For more information on copyright and the University of Toronto, please visit the following page: <https://onesearch.library.utoronto.ca/copyright/resources>.

ACADEMIC INTEGRITY:

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. Please consult the University's site on academic integrity: <http://academicintegrity.utoronto.ca/>. The Faculty of Information has a zero-tolerance policy on plagiarism as defined in section B.I.1.(d) of the University's Code of Behaviour on Academic Matters (<http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/ppjun011995.pdf>). You should acquaint yourself with the Code. All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources.

Please also review the material in “Cite it Right” and, if you require further clarification, consult the following site for information on how not to plagiarize: <http://advice.writing.utoronto.ca/wp-content/uploads/sites/2/how-not-to-plagiarize.pdf>. Cite it Right covers relevant parts of the U of T Code of Behaviour on Academic Matters (1995). It is expected that all Faculty of Information students take the Cite it Right workshop and the online quiz. Completion of the online Cite it Right quiz should be made prior to the second week of classes. To review and complete the workshop, visit the orientation portion of the iSkills site: <https://inforum.library.utoronto.ca/workshops/orientation>.

ACCOMMODATIONS:

Students with diverse learning styles and needs are welcome in this course. If you have a disability or a health consideration that may require accommodations, please feel free to approach Student Services and/or the Accessibility Services Office (<http://www.studentlife.utoronto.ca/as>) as soon as possible. The Accessibility Services staff are available by appointment to assess needs, provide referrals and arrange appropriate accommodations. The sooner you let us know your needs, the quicker we can assist you in achieving your learning goals in this course.

ACADEMIC DATES:

<https://ischool.utoronto.ca/current-students/academic-resources/academic-calendar/>

STATEMENT OF ACKNOWLEDGEMENT OF TRADITIONAL LAND:

For thousands of years, the land on which the University of Toronto operates has been the traditional home of the Huron-Wendat, the Seneca, and the Mississaugas of the Credit River. Today, this meeting place is still home to many Indigenous people, and we are grateful to have the opportunity to work here.