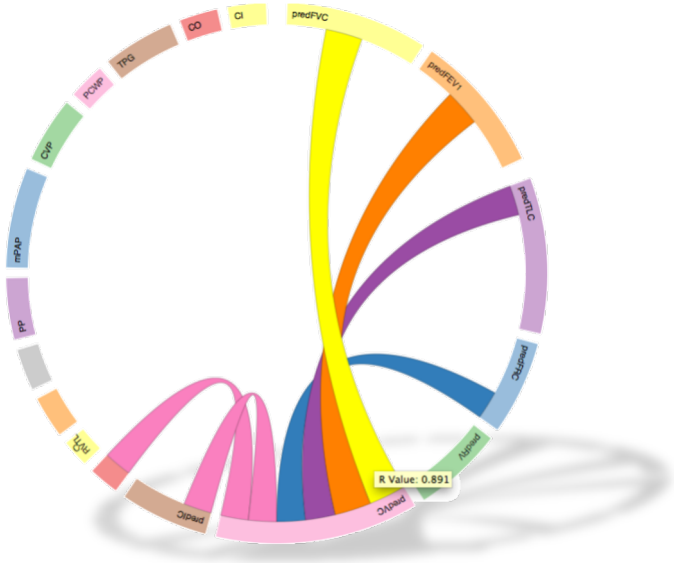
Module #1d:
Introduction to EN.605.662 - Syllabus



EN 605.462

Objectives

1. By the end of the course, students will be able to:
    1. Describe the foundations of the human visual perception and how it relates to creating effective information visualizations.
    2. Understand the design principles for creating effective visualization tools
    3. Evaluate different visualization techniques and identify potential misleading charts and visualizations
    4. Demonstrate familiarity of the visual design process by developing interactive data visualization tools
    5. Understand different data types including tabular, hierarchical, geospatial, textual, and scalar and related visualization techniques to each data type
    6. Show familiarity of existing data visualization tools and programming libraries

Prerequisites

- No prerequisites, however students should
  - Be able to develop software applications in modern programming languages (e.g. Python, R, Javascript, C/C++)
  - Be familiar with the basic concepts of data processing and statistics.
  - Have some background in computer graphics, human computer interaction, or image processing is helpful.

Textbook

- No Required Textbook
- Links to various chapters, papers, and resources will be shared throughout the semester.
- Optional textbooks relevant to this course:
  - Interactive Data Visualization by Matthew Ward, Georges Grinstein, Daniel Keim, AK Peters, 2010.
  - Information Visualization by Chaomei Chen, Springer Verlag, 2004
  - Visualization Analysis and Design by Tamara Munzner A K Peters Visualization Series, CRC Press, 2014
  - The Visual Display of Quantitative Information by Edward Tufte, Graphics Press, 1983.
  - Visual Explanations by Edward Tufte, Graphics Press, 1997.
  - Envisioning Information by Edward Tufte, Graphics Press, 1990.

Academic Integrity

- All written and programming assignments must be done individually unless explicitly instructed otherwise.
- Cheating and plagiarism will be dealt with in accordance with university procedures.
- You are encouraged to discuss with your peers approaches and techniques broadly.

EN.605.662 Modules

- There will be 14 modules

- Each module will consist of:
  - Video lecture
  - Corresponding Slides
  - Reading assignment
  - Online discussion

- The grading of this course will be based on:
  1. 14 Online Discussions / Participation (20% final grade)
  2. 5 Programming Assignment (50% final grade)
  3. Final Project (30% final grade)

Grading

- Distribution:
  1. Programming assignments (50%)
     - 100 points each (total of 500 points)
  2. Class participation (20%)
     - 10 points each (total of 140 points)
  3. Final project (30%)
     - Multiple parts, see description

- Scale: Final grades will be assigned according to the following scale:

  100–98 = A+
  97–94 = A
  93–90 = A−
  89–87 = B+
  86–83 = B
  82–80 = B−
  79–70 = C
  <70 = F

1) Programming Assignments (50%)

- Programming assignments will count for 50% of the final grade.
- Students will use Javascript, Python, C/C++, Tableau and/or other tools to implement their programming assignments..
- Programming assignments related to topics discuss in modules.
- Use online discussion to ask questions about projects.
- Some programming assignments include a written section. Submit written document or a scan of the answers.
- Naming conversion:

```
<your_last_name>_project01.zip
<your_last_name>_project03_part1.pdf
```

1) Programming Assignments (50%)

Generic rubric that will be used to grade programming assignments

Critical Errors Program compiles and/or executes as expected ***(0 to 20 points)***	Program does not compile or runs correctly. Program executes and sometimes terminates with a segmentation fault. *(0 to 15 points)*	Program compiles and runs correctly. Program executes and terminates properly without crashing but produces some run time warnings. *(15 to 20 points)*	Program compiles and runs correctly. Program executes and terminates properly without crashing. *(20 points)*
Submission Error Project submitted following guidelines ***(0 to 10 points)***	Submission is incomplete and does not include all requested files. *(0 to 5 points)*	Submission is mostly complete. Submission includes all requested files and for the most part follows the naming convention. *(5 to 9 points)*	Submission is complete. Submission includes all requested files and follows naming convention. *(10 points)*
Correctness **Implementation logical and correct** ***(0 to 30 points)***	Program does not follow most of the requirements and the technical approach does not seem to be logical and correct. (0 to 14 points)	Program implemented following most of the requirements and the technical approach (with the exception of 1 to 2 components) seems to be logical and correct. *(15 to 25 points)*	Program implemented following requirements and the technical approach seems to be logical and correct. *(25 to 30 points)*
Efficiency & Design: **Quality of Final Product (0 to 30 points)**	Program is not efficient and/or only works with a small set of input images. Overall design is not clear and logical. *(0 to 15 points)*	Program is mostly efficient and most with multiple input images. Overall design is mostly clear, simple, and logical. (15 to 25 points)	Program is efficient and works with multiple input images. Overall design is clear, simple, and logical. *(25 to 30 points)*
Documentation: Program Documentation ***(0 to 10 points)***	The source code is (for the most part) not documented. *(0 to 5 points)*	Source code documentation is not complete or reasonable. *(5 to 8 points)*	Source documentation is sufficient and reasonable. (8-10 points)

Late policy

- Programming projects will be due at 11:59pm on the due date.
- Students may turn **one** homework up to 24 hours late, but must notify the instructor when the special extension is used. Failure to notify the instructor and/or any additional day will result in a 10% penalty of the assignment grade.
- Additional exceptions for emergencies and medical conditions may be given if deemed appropriate.

2) Class participation (20%)

- Most of the discussion of the class will happen online at the discussion board.
- Each module will have a topic / question that students must answer to obtain credit.
- To enable student interaction, students will be also required to reply to at least one comment from another student.
- To receive credit, the discussion of a specific module must happen before the first day of the following module.

2) Class participation (20%)

Generic rubric that will be used to grade class participation.

Criteria	Excellent	Satisfactory	Unsatisfactory
Concise, Critical Thinking/ Reasoning	Student actively stimulates and sustains inquiry by asking or posting thoughtful questions or comments. Student recognizes accuracy, logic, relevance, or clarity of statements. Student has a clear idea of the topic under discussion and sustain inquiry by asking thoughtful questions. Responses are concise and reflect original thinking.	Student posts questions and comments, but relies on momentum of the group to motivate inquiry. Student may be repetitive with comments. Student takes a position but with little evidence or explanation. Responses are somewhat concise and logically organized, and reflect a mixture of original thinking and contributions from others.	Student accepts ideas of others without much thought. Student provides little relevant information or contributes little to the discussion. Student shows little evidence of understanding the topic under discussion. Responses are neither clear nor concise. Little or no original thinking is demonstrated.
Generates learning and engagement among classmates	Post(s) elicit responses and reflections from other learners and responses build upon and integrate multiple views from other learners to take the discussion deeper.	Post(s) attempt to elicit responses and reflections from other learners and responses build upon the ideas of other learners to take the discussion deeper.	Post(s) do not attempt to elicit responses and reflections from other learners and/or responses do not build upon the ideas of other learners to take the discussion deeper.
Demonstrates knowledge of content and applicability to professional practice	Post(s) and responses show evidence of knowledge and understanding of course content and applicability to professional practice, and include other resources that extend the learning of the community.	Post(s) and responses show evidence of knowledge and understanding of course content and applicability to professional practice.	Post(s) and responses show little evidence of knowledge and understanding of course content and applicability to professional practice.
Timeliness and Mechanics	Submits initial response before the end of Day 5 in module week; replies to classmates are meaningful. Posts contain grammatically correct sentences without spelling errors.	Submits initial response before end of Day 6 in module week; replies to classmates are present, but superficial. Posts have one or more grammatical or spelling errors.	Submits initial response after Day 6 in module week; does not respond to classmates. Posts are not in complete sentences and/or contain more than 5 spelling or grammatical errors.

3) Final Project (30%)

The final project is a significant part of the course, it allows students to synthesize the concepts learned throughout the semester and apply them to their own images and/or to their particular area of interest. The final project grades will be based on the following components:

- Draft Proposal (10%)
- Revised Proposal (10%)
- Literature survey (20%)
- Final paper (40%)
- Final program (20%)

3) Final Project (30%)

- **Draft Proposal (10%):** Proposals should be about 1-2 pages long. They should include:
  - A description of your topic
  - A detailed plan of how the project will get done
  - A detailed timeline.

- **Revised Proposal (10%)**

- **Literature survey (20%):** Students are required to submit an annotated bibliography.
  - Create an annotated bibliography containing at least 4 references related to your chosen topic.
  - Write a short (e.g., 3-5 sentence) description of each reference, giving its focus and major contribution. Include a complete citation for each reference.
  - Write a brief introduction to your bibliography to define the topic and scope of your bibliography.

- **Final paper (40%):** The final paper must be submitted by the due date. The final paper should include the following sections:
  - Abstract: paragraph summarizing of the paper
  - Introduction: section introducing the research problem
  - Background: discussing some of the previous work
  - Approach: describes what was accomplished
  - Results: describes the results
  - Conclusion: concludes the paper

3) Final Project (30%)

- **Final program (20%):**
  - Source Code
  - Documentation about how to run the code
  - Sample images that were used to test the system.

Final Project - Rubric

Generic rubric that will be used to grade the Final Project

Project Proposal **Draft Proposal and Revised Project Proposal** ***(0 to 20 points)***	Topic of the proposal not necessarily relevant to the class. Proposal does not include detailed description, project plan, or timeline. Revised proposal does not include some of the suggestions received from instructor. *(0 to 15 points)*	Topic of the proposal relevant to the class. Proposal includes description, project plan, and a rough timeline. Revised proposal does not include some of the suggestions received from instructor. *(15 to 20 points)*	Topic of the proposal relevant to the class. Proposal includes description, project plan, and detailed timeline. Revised proposal include some of the suggestions received from instructor. *(20 points)*
Literature Survey **Annotated Bibliography** ***(0 to 20 points)***	Annotated bibliography that includes less than four references and each reference has a short description of the paper, approach and results. *(0 to 9 points)*	Annotated bibliography that includes at least four references and each reference has a short description of the paper, approach and results. *(10 to 18 points)*	Annotated bibliography that includes at least four references and each reference has a short, but accurate, description of the paper, approach and results. *(18 to 20 points)*
Final Paper **Paper submission with describing final Project** ***(0 to 40 points)***	A paper that describes a good class project, technical approach, and different results. The paper has some grammatical errors or typos and does not include all the suggested sections. (0 to 19 points)	A well-written paper that describes a good class project, technical approach, and different results. The paper includes sections for introduction, background, approach, results, and conclusion. *(20 to 30 points)*	A well-written paper that describes an outstanding and comprehensive class project, technical approach, and different results. The paper includes sections for introduction, background, approach, results, and conclusion. *(30 to 40 points)*
Final Project Code: **Code, images, and data used in final project.** **(0 to 20 points)**	Program that compiles and performs most of what the student described in his/her final paper. The code has some documentation and the project follows most of the required naming convention. *(0 to 14 points)*	Good program that compiles and performs what the student described in his/her final paper. The code has some documentation and the project follows the required naming convention. (10 to 15 points)	Efficient program that compiles and performs what the student described in his/her final paper. The code has good documentation and the project follows the required naming convention. *(15 to 20 points)*

SCHEDULE

Tentative Schedule (Module 1-3)

Module 1	Tu 01/28/2020 –Mon 02/03/2020	Introduction to Data Visualization	**New:** • Reading #1: Tufte, *"Visual and Statistical Thinking: Displays of Evidence for Making Decisions"* • Reading #2: Robinson et al., "*Representation and Misrepresentation: Tufte and the Morton Thiokol Engineers on the Challenge*" • Create Blackboard online profile • Online Discussion #1: Launch of the Challenger • **Project #1:** Visualization Critique
Module 2	Tu 02/04/2020 –Mon 02/10/2020	Introduction to Visualization Techniques	**New:** • Readings #1: Chapter 1 of *"Readings in Information Visualization: Using Vision to Think"*, Card, Mackinlay, and Shneiderman • Online Discussion #2: Find and describe and effective visualization **Due:** • Register online and create a profile • Online Discussion #1
Module 3	Tu 02/11/2020 –Mon 02/17/2020	Human Visual Perception	**New:** • Readings #1: Healey et al. "*Attention and Visual Memory in Visualization*", IEEE TVCG, 18(7), July 2012 • Discussion: Find and describe an optical illusion • **Project #2:** Data Exploration and Design **Due:** • **Project #1:** Visualization Critique • Online Discussion #2

Tentative Schedule (Module 4-6)

Module 4	Tu 02/18/2020 –Mon 02/24/2020	Visualization Design Principles	**New:** • Readings #1: Chapter 4: "*Data-Ink and Graphical Redesign*", In The Visual Display of Quantitative Information. Tufte • Discussion: Provide links of Tutorials about how to use Tableau **Due:** • **Project #1:** Critique visualization used by a classmate in Project #1 (Friday, February 21st 2020) • Online Discussion #3
Module 5	Tu 02/25/2020 –Mon 03/02/2020	Color in Visualization	**New:** • Readings #1: Maureen Stone: "*Choosing Colors for Data Visualization*", • Reading #2: Brewer, C. A. 1999. *"Color Use Guidelines for Data Representation*", Proceedings of the Section on Statistical Graphics, American Statistical Association • Discussion: Color • **Project #3:** Interactive Visualization using Tableau • **Project proposal announced** **Due:** • **Project #2:** Data Exploration and Design • Online Discussion #4
Module 6	Tu 03/03/2020 –Mon 03/09/2020	Interactive Visualization	**New:** • Readings #1: Ji Soo Yi et al. "*Toward a Deeper Understanding of the Role of Interaction in Information Visualization*", IEEE Transactions on Visualization and Computer Graphics 2007 • Discussion: Link to visualizations with interactions **Due:** • Online Discussion #5

Tentative Schedule (Module 7-8)

Module 7	Tu 03/10/2020 –Mon 03/23/2020	Trees, Graphs, and Network Visualization	**New:** • **Readings #1:** *"Graph Visualization and Navigation in Information Visualization: A Survey"*. Ivan Herman, Guy Melancon, M. Scott Marshall. IEEE Transactions on Visualization and Computer Graphics, 2000. • **Reading #2:** "Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data". Danny Holten. InfoVis 2006 • **Discussion:** Provide links to tutorials about how to use D3 • **Project #4:** Interactive Visualization using D3 or R Shiny **Due:** • **Project #3:** Interactive Visualization using Tableau • Online Discussion #6
Module 8	Tu 03/24/2020 –Mon 03/30/2020	Maps and Cartography Visualization	**New:** • **Reading #1:** "Spatial Structures: Maps" (Chapter #4) in "Design for Information: An Introduction to the Histories, Theories, and Best Practices Behind Effective Information Visualizations", Isabel Meirelles, 2013 • **Reading #2:** Madhavan, J., Balakrishnan, S., Brisbin, K., Gonzalez, H., Gupta, N., Halevy, A. Y., ... & McChesney, R. (2012). Big Data Storytelling Through Interactive Maps. IEEE Data Eng. Bull., 35(2), 46-54. • **Reading #3:** Dykes, J., Wood, J. & Slingsby, A. (2010). Rethinking map legends with visualization. IEEE Transactions on Visualization and Computer Graphics, 16(6), pp. 890-899. • **Discussion:** Map Projectors and Cartography - Applications **Due:** • **Project Proposal Due** • Online Discussion #7

Tentative Schedule (Module 9)

Module 9	Tu 03/31/2020 –Mon 04/06/2020	Text Visualization	**New:** • **Reading #1:** Textual Structures" (Chapter #6) in "Design for Information: An Introduction to the Histories, Theories, and Best Practices Behind Effective Information Visualizations", Isabel Meirelles, 2013 • **Reading #2:** Information Visualization for Text Analysis • **Reading #3:** Kostiantyn Kucher and Andreas Kerren. "Text visualization techniques: Taxonomy, visual survey, and community insights", IEEE Pacific Visualization Symposium (PacificVis), 2015 • **Bibliography Announced** • **Revised Project Announced** • **Discussion:** Describe a text analysis visualization tool **Due:** • Online Discussion #8

Tentative Schedule (Module 10-12)

Module	Dates	Topics	Assignments
Module 10	Tu 04/07/2020 –Mon 04/13/2020	Temporal Visualization	**New:** • **Readings #1:** "Temporal Structures: Timelines and Flows" (Chapter #3) in "Design for Information: An Introduction to the Histories, Theories, and Best Practices Behind Effective Information Visualizations", Isabel Meirelles, 2013 • **Reading #2:** "Spatio-Temporal Structures" (Chapter #5) in "Design for Information: An Introduction to the Histories, Theories, and Best Practices Behind Effective Information Visualizations", Isabel Meirelles, 2013 • Discussion: Share Paraview tutorial • **Project #5:** Scientific Visualization using ParaView **Due:** • **Project #4:** Interactive Visualization using D3 • **Revised Project proposal due** • Discussion #9
Module 11	Tu 04/14/2020 –Mon 04/20/2020	Scientific Visualization	**New:** • **Readings #1**: Arie Kaufman and Klaus Mueller, "Overview of volume rendering", (Chapter 7) in The Visualization Handbook by Charles D. Hansen and Chris R. Johnson 2011 • **Discussion:** Share samples of scientific visualizations **Due:** • Online Discussion #10
Module 12	Tu 04/21/2020 –Mon 04/27/2020	Scientific Visualization II	**New:** • **Readings #1**: Arie Kaufman and Klaus Mueller, "Overview of volume rendering", (Chapter 7) in The Visualization Handbook by Charles D. Hansen and Chris R. Johnson 2011 • **Discussion:** Share sample 3D datasets **Due:** • Online Discussion #11 • **Bibliography due**

Tentative Schedule (Module 13-14)

Module 13	Tu 04/28/2020 –Mon 05/04/2020	Isosurfaces and Flow Visualization	**New:** • **Readings #1**: J. Thomas and K. Cook, Illuminating the Path - The Research and Development Agenda for Visual Analytics, IEEE Press, 2005 • **Discussion:** Share link to online visual analytics tool **Due:** • Online discussion #12 • **Project #5 due:** Scientific Visualization using ParaView
Module 14	Tu 05/05/2020 –Mon 05/11/2020	Display Systems and Evaluation	**New:** • **Reading #1:** S. Carpendale, "Evaluating Information Visualizations", in Information Visualization: Human-Centered Issues and Perspectives **Due:** • Online Discussion #13 • **Final Project Due**