

**Columbian College of Arts and Sciences**

**Data Science**

**SPRING 2026**



|                       |                               |
|-----------------------|-------------------------------|
| <b>COURSE NUMBER:</b> | <b>DATS 6401 Section 11</b>   |
| <b>COURSE TITLE:</b>  | Visualization of Complex Data |
| <b>COURSE INFO:</b>   | Wednesday - 6:30 pm - 9:00 pm |
| <b>LOCATION:</b>      | Rome Hall, Room 351           |

**INSTRUCTOR**

**Name:** Anya Mendenhall, D.Eng.

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**Office hours:** Wednesdays 5:30-6:30 pm (before class) and by appointment

**TEACHING ASSISTANT**

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**Office hours:** TBA

**COURSE PREREQUISITES**

Students are expected to have a basic knowledge of statistics and introductory Python.

**COURSE DESCRIPTION**

This course provides a rigorous introduction to data visualization within the broader context of data science. Data visualization is an essential skill in a data-driven world: it enables visual and interactive exploration and the graphical representation of data so that patterns, outliers, and structure become clear—often revealing insights that would otherwise be overlooked. We introduce and apply fundamental design principles and modern visualization technologies that allow students to design, implement, and evaluate persuasive, evidence-based visualizations.

The course builds data literacy—your ability to interpret, construct, and communicate with visual representations—so you can make and defend sound design decisions in professional settings. Instruction combines short lectures, in-class activities, hands-on practice, and individual projects. The technical stack focuses on Tableau Desktop/Prep for dashboarding and data preparation, and Python (Altair + pandas) for authored, reproducible specifications.

## LEARNING OBJECTIVES

By the end of the course, students will be able to:

- Frame problems with Munzner's model: translate a domain question into What (data abstraction), Why (task), and How (encoding/interaction), and justify choices.
- Choose effective encodings: match data types to visual marks/channels and apply expressiveness & perceptual effectiveness.
- Design dashboards that read at a glance: apply Few's principles for layout, density, color, typography, legends, and annotation.
- Build reproducible data pipelines: develop and document Tableau Prep flows (joins/unions/pivots, validation, lineage) that feed consistent analyses.
- Create interactive visuals in Python: author Altair charts with transforms, selections/filters, and linked views; export reproducible artifacts.
- Handle common data modalities: design for temporal, categorical, quantitative, and geospatial data; use correct normalization (rates vs. counts).
- Evaluate and iterate: conduct lightweight evaluations (heuristics, brief think-aloud), capture evidence, and revise designs accordingly.
- Present and defend work: deliver concise presentations/dashboards tailored to target audiences and defend design decisions with theory-backed rationale and documented assumptions.

## COURSE COMPONENTS

### LECTURES

The class meets Thursdays in Rome Hall, Room 351. Each week combines a short lecture with a hands-on lab. Labs are designed to help you master concepts, practice skills on real datasets, and make steady progress on your projects.

**Format:** lecture, in-class lab, activities

**Submission:** labs are completed and submitted before the end of class (see AI policy).

**What to bring:** a laptop with Tableau Desktop, Tableau Prep, and Python (Altair and more) installed.

### REQUIRED RESOURCES

#### Textbooks (Required)

- Munzner, Tamara. Visualization Analysis & Design (1st Edition). CRC Press, 2014. ISBN: 9781466508910
- Few, Stephen. Information Dashboard Design: Displaying Data for At-a-Glance Monitoring (2nd Edition). Analytics Press, 2013. ISBN: 978-1938377006

Note: VAD = Visualization Analysis & Design (Munzner); IDD = Information Dashboard Design (Few)

#### Technology

Students will use the following tools in this course:

- Tableau Desktop (free student license available)
- Tableau Prep Builder (free student license available)
- Python 3.x with Altair and pandas libraries

#### Blackboard

All class announcements, lecture notes, assignments, and exams will be available on Blackboard. Check regularly for updates and changes.

### CHANGES TO SYLLABUS

This syllabus is subject to change as necessary during the semester. If changes occur, they will be addressed during class, communicated via email, and a new version will be posted on Blackboard. It is the student's responsibility to review the updated syllabus.

# GRADING AND ASSESSMENT

## Assessment Components

| Component                                       | Weight |
|---|--------|
| Midterm Exam                                    | 20%    |
| Final Exam                                      | 25%    |
| In-Person Quizzes (5-6 quizzes, lowest dropped) | 15%    |
| In-Class Labs (10 labs)                         | 15%    |
| Project 1: Tableau Dashboard                    | 10%    |
| Project 2: Altair Interactive Visualization     | 10%    |
| Participation & Reading Responses               | 5%     |

### 1. In-Person Written Examinations (45% total)

**Midterm Exam (20%)** - 90 minutes, closed-book

**Format:** Multiple choice 30%, Short answer 40%, Design critique 30%

**Scope:** Visualization theory, design principles, data types, chart selection, perceptual psychology, Tableau fundamentals

**Final Exam (25%)** — Finals Week (May 1); 120 minutes, closed-book

**Format:** Multiple choice 25%, Short answer 35%, Programming/Coding (Altair) 20%, Design case study 20%

**Scope:** Cumulative with emphasis on programming concepts via Altair, interaction design, and advanced techniques

### 2. In-Person Quizzes (15%)

5-6 quizzes throughout the semester (lowest score dropped), 15-20 minutes at start of selected classes; covers prior 2-3 weeks of material. Format: short answers, definitions, Tableau/Altair code snippets, visual analysis.

### 3. In-Class Labs (15%)

10 labs completed during class time and submitted before the end of the session. Mix of Tableau, Tableau Prep, and Altair exercises.

### 4. Individual Projects (20%)

#### Project 1 (10%) — Tableau Dashboard

Individual dashboard on a provided dataset with a reproducible Tableau Prep flow and an accessibility/ethics checklist. In-person defense (5-10 minutes) required where you explain design decisions and data preparation choices. Due: March 3; Defenses: Week 9 (March 12)

#### Project 2 (10%) — Altair Interactive Visualization

Individual, authored Altair specification with transforms, at least one selection/brush or filter, and linked views or details-on-demand. In-person defense (5-10 minutes) required where you walk through your code and explain interaction design. Due: April 25; Defenses: Week 15 (April 23)

### 5. Participation & Reading Responses (5%)

Weekly short commentary on assigned readings (submitted via Blackboard) and active participation in design critique sessions during class.

## GRADING SCALE

| Percentage | Grade |
|------------|-------|
| 93 - 100   | A     |
| 90 - <93   | A-    |
| 87 - <90   | B+    |
| 83 - <87   | B     |
| 80 - <83   | B-    |
| 77 - <80   | C+    |
| 73 - <77   | C     |
| 70 - <73   | C-    |
| <70        | F     |

## PROJECT DETAILS

All project work is individual (no group grading). Each project includes a brief oral defense with design rationale and code/specification walkthrough.

Project 1 (Tableau) focuses on: task fit, encoding effectiveness, dashboard layout (Few's principles), and reproducible data preparation.

Project 2 (Altair) focuses on: authored specifications (encodings, transforms), interaction/coordination, and clear documentation.

Rubrics emphasize: task definition (Why), data abstraction (What), encoding/interaction choices (How), expressiveness & effectiveness (Munzner), at-a-glance dashboard principles (Few), accessibility, uncertainty communication, and evaluation evidence.

**Academic Integrity:** Interim check-ins may include live demos or code inspection. Version control history (Git commits) may be requested.

## TENTATIVE COURSE SCHEDULE

The topic schedule in this syllabus is subject to change. The updated syllabus will be posted on Blackboard, and you will be informed about any changes in class or via email.

**VAD** = Visualization Analysis & Design (Munzner)

**IDD** = Information Dashboard Design (Few)

| Week | Date   | Topics  | Readings/Assignments   |
|------|--------|---|--|
| 1    | Jan 15 | Course Introduction & Syllabus<br>Overview of data visualization<br>Software setup  | Install Tableau, Prep, Python (Altair)<br>VAD Ch. 1<br>IDD Ch. 1                             |
| 2    | Jan 22 | Data & Task Abstraction<br>Mapping to encodings<br>Munzner's What-Why-How Framework<br>Visual perception fundamentals   | VAD Ch. 2-3<br>IDD Ch. 2<br><b>Lab 1 (in-class)</b>  |
| 3    | Jan 29 | Validation Framework<br>Asking good questions<br>Statistical literacy   | VAD Ch. 4<br>IDD Ch. 3-4<br><b>Lab 2 (in-class)</b>  |
| 4    | Feb 5  | Marks & Channels<br>Introduction to Tableau<br>Data types in Tableau<br>Aggregation and granularity<br>Simplicity in design                                       | VAD Ch. 5<br>IDD Ch. 5<br><b>Lab 3 (in-class)</b><br>Quiz 1 (Weeks 1-3)                      |
| 5    | Feb 12 | Design Principles<br>Gestalt Principles<br>Color Theory & Perception<br>Accessibility   | VAD Ch. 6 & 10<br>IDD Ch. 4<br><b>Lab 4 (in-class)</b><br>Reading Response 2 due Sunday      |
| 6    | Feb 19 | Data Preparation with Tableau Prep<br>Data profiling and cleaning<br>Joins, unions, pivots<br>Python data prep (introduction)                                     | VAD Ch. 7<br>IDD Ch. 7-8<br><b>Lab 5 (in-class)</b><br>Quiz 2 (Weeks 4-5)                    |
| 7    | Feb 26 | MIDTERM EXAMINATION<br>90 minutes, closed-book<br>Covers: Weeks 1-6   | Exam: 6:30-8:00 PM<br>Study guide on Blackboard  |
| 8    | Mar 5  | Chart Types & Dashboard Design<br>Bars, lines, heatmaps, histograms<br>Spatial arrangement in dashboards  | VAD Ch. 8<br>IDD Ch. 9-10<br><b>Lab 6 (in-class)</b><br>Quiz 3 (Weeks 6-8)                   |
| 9    | Mar 12 | Python Visualization with Altair - Part I<br>Altair basics: grammar, encodings, marks<br>Data transformations in Altair<br>Basic charts: bar, line, scatter, area | VAD Ch. 11<br>IDD Ch. 11<br>Project 1 Defenses (5-10 min each)<br><b>Project 1 due 03/16</b> |
| 10   | Mar 19 | SPRING BREAK - NO CLASS   |  |

|           |        |   |   |
|-----------|--------|---|---|
| <b>11</b> | Mar 26 | Python Visualization with Altair – Part II<br>Interactive visualizations:<br>Selections, brushing, filtering<br>Tooltips and linked views<br>Multiple coordinated views in Altair | VAD Ch. 12<br>IDD Ch. 12<br><b>Lab 7 (in-class)</b><br>Quiz 4 (Weeks 8-9)         |
| <b>12</b> | Apr 2  | Geographic & Spatial Visualization<br>Choropleth and hex-tile maps<br>Symbol/dot density maps<br>Geographic visualizations in Python/Altair<br>GeoJSON and projections            | VAD Ch. 8 (review spatial)<br>IDD Ch. 9-10<br><b>Lab 8 (in-class)</b>             |
| <b>13</b> | Apr 9  | Temporal Data & Uncertainty<br>Time series visualization<br>Visualizing uncertainty: error bars, bands<br>Time series in Python   | IDD Ch. 13<br><b>Lab 9 (in-class)</b><br>Quiz 5 (Weeks 11-12)                     |
| <b>14</b> | Apr 16 | Critical Visualization & Ethics<br>Misleading visualizations<br>Correlation vs. causation<br>Network visualization  | IDD Ch. 14<br><b>Lab 10 (in-class)</b>  |
| <b>15</b> | Apr 23 | Data Storytelling & Presentations<br>Reports vs. dashboards vs. infographics<br>Presenting to different audiences<br>Future of visualization                                      | IDD Ch. 15<br>Project 2 Defenses (5-10 min each)<br><b>Project 2 due Fri 4/25</b> |
| <b>16</b> | TBD    | FINAL EXAMINATION<br>120 minutes, closed-book, cumulative<br>Emphasis on Weeks 8-15   | Exam: 6:30-8:30 PM  |

## UNIVERSITY POLICIES

### University policy on observance of religious holidays

In accordance with University policy, students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance. For details and policy, see: [provost.gwu.edu/policies-procedures-and-guidelines](http://provost.gwu.edu/policies-procedures-and-guidelines)

### Academic Integrity Code

Academic Integrity is an integral part of the educational process, and GW takes these matters very seriously. Violations of academic integrity occur when students fail to cite research sources properly, engage in unauthorized collaboration, falsify data, and in other ways outlined in the Code of Academic Integrity. Students accused of academic integrity violations should contact the Office of Academic Integrity to learn more about their rights and options in the process. Outcomes can range from failure of assignment to expulsion from the University, including a transcript notation. The Office of Academic Integrity maintains a permanent record of the violation.

More information is available from the Office of Academic Integrity at [studentconduct.gwu.edu/academic-integrity](http://studentconduct.gwu.edu/academic-integrity). The University's "Guide of Academic Integrity in Online Learning Environments" is available at [studentconduct.gwu.edu/guide-academic-integrity-online-learning-environments](http://studentconduct.gwu.edu/guide-academic-integrity-online-learning-environments). Contact information: [rights@gwu.edu](mailto:rights@gwu.edu) or 202-994-6757.

### Use of AI Tools in This Course

Given the nature of this course and the emphasis on individual mastery and academic integrity, the following policies apply:

**In-Class Work:** All labs, quizzes, and exams are completed in-person without AI assistance. Use of AI tools during in-class assessments constitutes academic dishonesty.

**Projects:** Limited AI assistance is permitted for debugging and syntax help, but all design decisions, code architecture, and analysis must be your own work. You must be able to explain every line of code during your defense. Overreliance on AI tools will be evident during the oral defense and will result in grade penalties.

**Reading Responses:** Must reflect your own understanding and analysis. AI-generated responses are not permitted.

## Support for Students Outside the Classroom

### Writing Center

GW's Writing Center cultivates confident writers in the University community by facilitating collaborative, critical, and inclusive conversations at all stages of the writing process. Appointments can be booked online at [gwu.mywconline.com](http://gwu.mywconline.com)

### Academic Commons

Academic Commons provides tutoring and other academic support resources to students in many courses. Students can schedule virtual one-on-one appointments or attend virtual drop-in sessions. Visit [academiccommons.gwu.edu](http://academiccommons.gwu.edu) or contact [academiccommons@gwu.edu](mailto:academiccommons@gwu.edu)

## **Disability Support Services (DSS)**

Any student who may need an accommodation based on the potential impact of a disability should contact Disability Support Services to establish eligibility and to coordinate reasonable accommodations. Visit [disabilitysupport.gwu.edu](http://disabilitysupport.gwu.edu) or call 202-994-8250.

## **Counseling and Psychological Services**

GW's Colonial Health Center offers counseling and psychological services, supporting mental health and personal development. Visit [healthcenter.gwu.edu/counseling-and-psychological-services](http://healthcenter.gwu.edu/counseling-and-psychological-services) or call 202-994-5300.

## **Safety and Security**

- In an emergency: call GYPD 202-994-6111 or 911
- Review the Emergency Response Handbook at [safety.gwu.edu/emergency-response-handbook](http://safety.gwu.edu/emergency-response-handbook)
- In an active violence situation: Get Out, Hide Out or Take Out ([go.gwu.edu/shooterprep](http://go.gwu.edu/shooterprep))
- Stay informed: [safety.gwu.edu/stay-informed](http://safety.gwu.edu/stay-informed)