Antidisciplinary Problem Solving

Example Project-Based Learning Course
2019 MIT Computational Urban Science Workshop

Ira Winder | October 9, 2025 | Chiba Tech | School of Design & Science


Workshop
CAMBRIDGE JOURNAL OF
REGIONS, ECONOMY AND SOCIETY
Explore some of the most downloaded articles from the Cambridge Journal of Regions, Economy and

11.S195 Computational Urban Science Workshop

"I have a secret goal, which is to encourage you to use mathematical play in a computational setting ... to make things that make people think and interact with ideas. In other words, to make art."
- Brandon Martin-Anderson

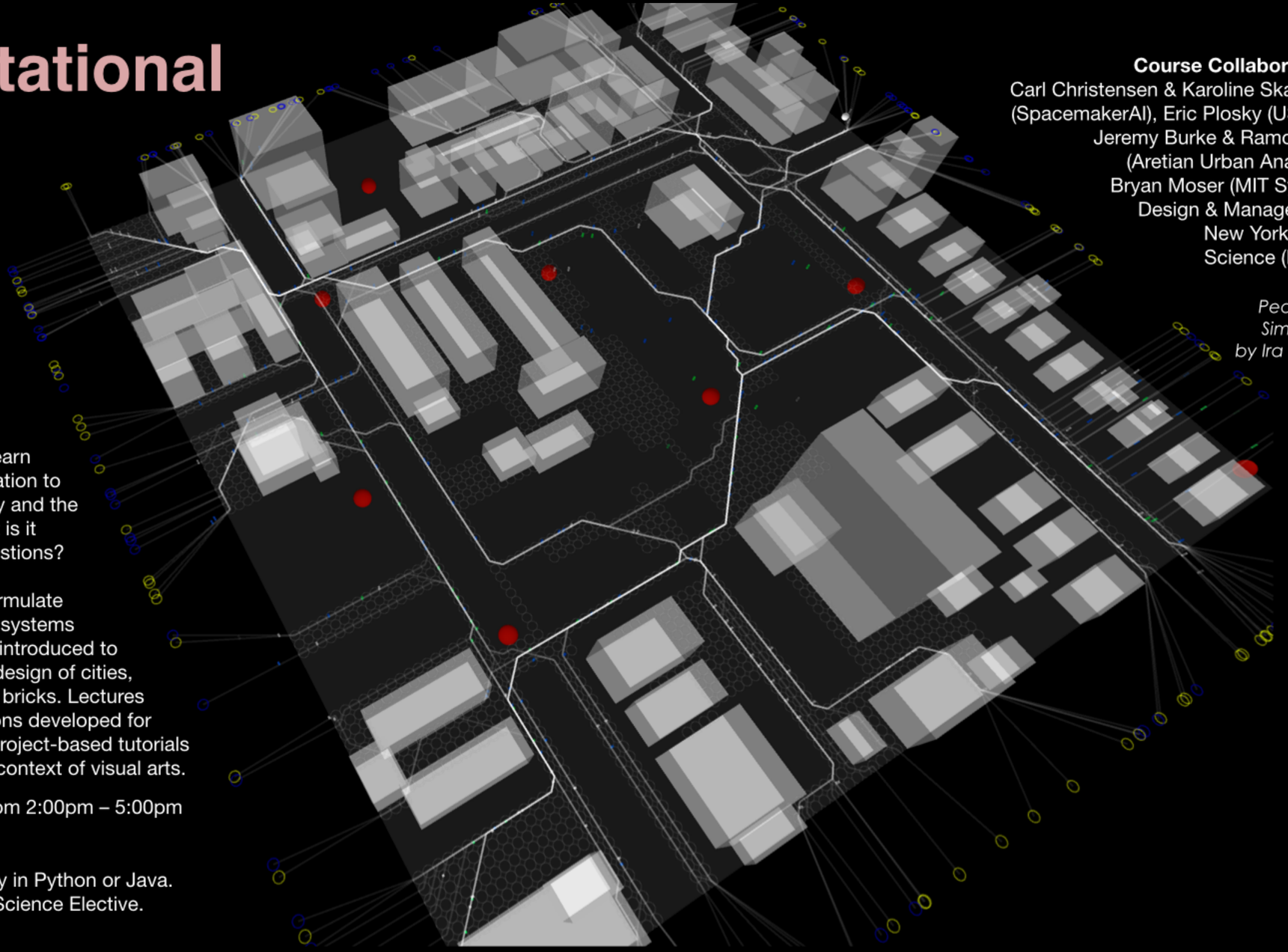
Class Description - Computation permeates nearly every course at MIT. Urban Scientists must uniquely learn to responsibly and playfully wield the tools of computation to solve complex problems at the convergence of society and the built environment. Your algorithm may be efficient, but is it Ethical? Is it Just? Are you even asking the -right- questions?

In this project-based course, students learn how to formulate and develop interactive simulations of complex urban systems representing a diversity of stakeholders. Students are introduced to novel interactive engagement tools for the study and design of cities, blending software with playful mediums such as Lego bricks. Lectures include case studies of real-world interactive simulations developed for research and practice. Seasoned professionals offer project-based tutorials in Processing, a flexible sketchbook for coding in the context of visual arts.

Schedule - The workshop will meet each Thursday from 2:00pm – 5:00pm in Room 9-451 (4th Floor, MIT DUSP).

Requisites - 6.0001 & 6.0002 or equivalent proficiency in Python or Java. Units (3-0-6) Contributes Toward Course 11-6 Urban Science Elective. Preference given to students declared Course 11-6.

Reference Websites -
dusp.mit.edu/subject/spring-2019-11s195
ira.mit.edu & ninalutz.github.io

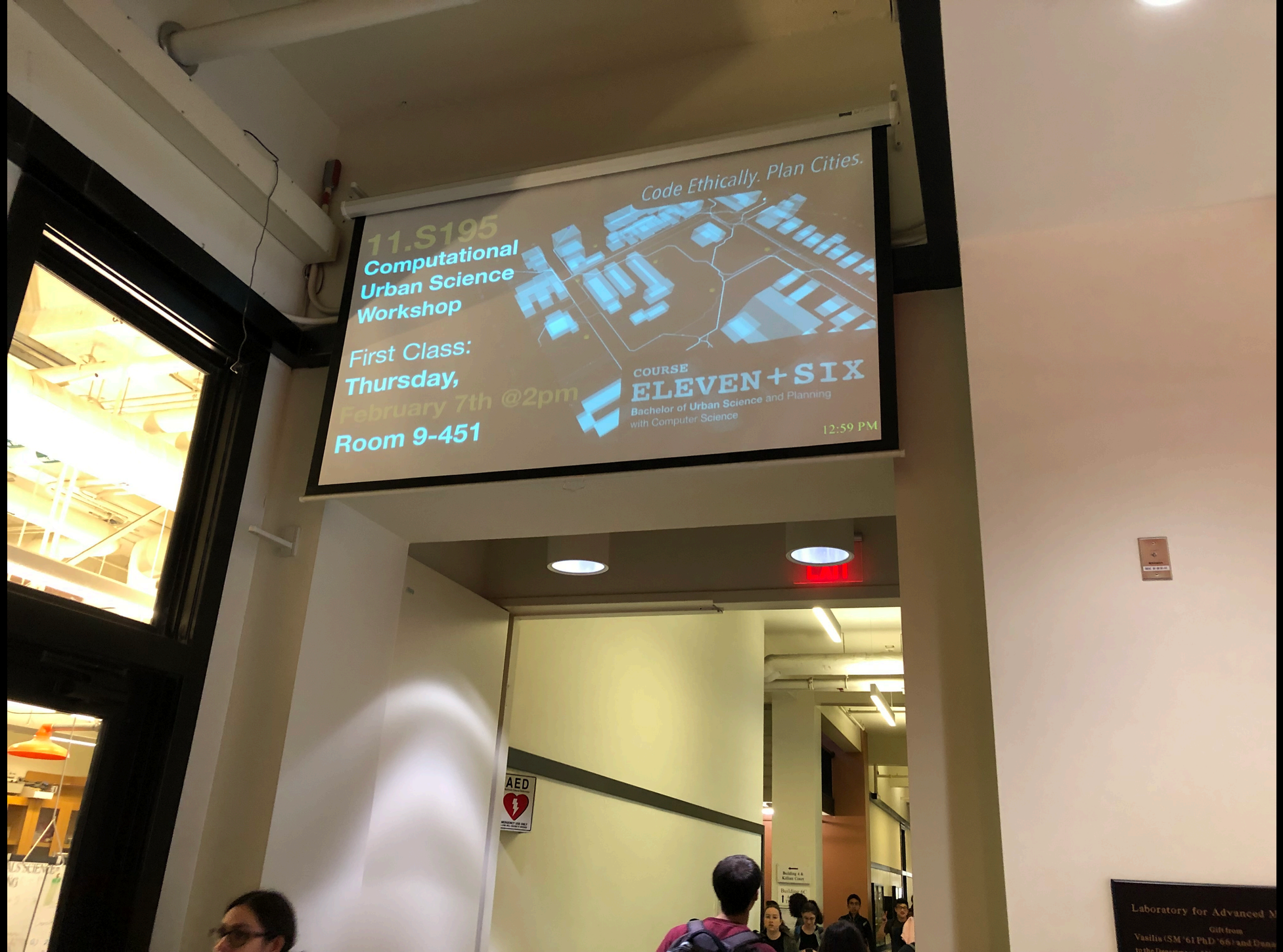


Pedestrian Simulation by Ira Winder

Course Collaborators -
Carl Christensen & Karoline Skatteboe (SpacemakerAI), Eric Plosky (USDOT), Jeremy Burke & Ramos Gras (Aretian Urban Analytics), Bryan Moser (MIT Systems Design & Management), New York Hall of Science (NYSCI)

First Class: Thursday, February 7th at 2:00pm, Room 9-451

Instructors
Ira Winder, jiw@mit.edu
Nina Lutz, nlutz@mit.edu


Code Ethically. Plan Cities.
11.S195
Computational
Urban Science
Workshop
First Class:
Thursday,
February 7th @2pm
Room 9-451
COURSE
ELEVEN+SIX
Bachelor of Urban Science and Planning
with Computer Science
12:59 PM
AED
Laboratory for Advanced M

Computational Urban Planning

Overview

Driving Questions

How can interactive computation help people cooperate when understanding and addressing problems in the built environment?

Lead Instructor: Ira Winder

Hypothetical Student Projects

- “I want to make a model and simulation to test a new design for that might improve the efficiency of the metro system.”
- “I don’t have enough high quality food and exercise in my life.”
- “I want to live with my friends off campus, but don’t know where to look.”
- “I am curious about how autonomous vehicle systems components work together to make a cost-efficient shared economy.

Core Principals

Creative Coding
Collaborator: Ira Winder, Nina Lutz
The use of programming as a tool for artistic expression, interactive media, and generative design, often blending art, design, and technology.

Systems Engineering
Collaborator: Bryan Moser, Olivier de Weck
Understand problems as emergent elements within systems of technology, living-beings (stakeholders), and the environment within which you are trying to intervene.

Urban Design
Collaborator: Ira Winder et al
The planning and shaping of cities, public spaces, and infrastructure to enhance functionality, aesthetics, and livability for communities.

MIT Urban Science **Computational Urban Science Workshop** Spring 2019

Instructor:	Ira Winder, Room 9-547
Web:	ira.mit.edu
Email:	jiw@mit.edu
Office Hours:	dusp.mit.edu/officehours
Teaching Assistant:	Nina Lutz, Room E15-488a
Web:	nlutz.me
Email:	nlutz@mit.edu
Office Hours:	(arrange via email)
Credits:	9 units (3-0-6)
Prerequisite(s):	6.0001 & 2, or equivalent skill in Python or Java with permission of instructor
Class Meetings:	February 7th – May 16th; Thursdays 2-5pm
Room:	9-451
GitHub:	https://github.com/irawinder/cusw-SPR19

Learning Objectives

- *Computation* - Apply computer science skills toward solving problems in Urban Science.
- *Mens et Manus* - Gain the confidence and capability to build computational artifacts for use in practice and advanced research. Deploy exhibitions and interactive models that communicate and teach novel ideas and relationships.
- *Mindful Coding* - Learn to frame meaningful problems lest you become committed to mindless coding.
- *Systems Design* - Understand problems as emergent elements within systems of technology, living-beings (stakeholders), and the environment within which you are trying to intervene.
- *Collaboration* – Learn how to collaborate and share code with GitHub

Project-based Learning

Above all else, this is a project-based course, and we hope you will use the time and space to develop ideas and skills beyond the scope of our tutorials. Project-based learning means that you don't have to be content with spoon-fed techniques. As instructors, we're not going to tell you to "solve such-and-such problem with machine learning." Instead, we're going to ask, "Do you *need* machine learning for the problem you are trying to solve? Yeah? Okay, then let's do this."

Student Deliverables:

- *Class Participation* – Please plan to attend every class unless you receive permission in advance from the instructors for specific dates.
- *Homework Assignments* – Short visual programming exercises in Processing, mostly in the first half of the semester.
- *Mid-term (Due March 21st, 2019)* – A small independent project that incorporates some or all of lessons learned up to now.
- *Final Design Project (Finals)* - complete as individuals or pairs. Teams larger than two people need permission of the instructor.

Readings

Lessons and readings from the following texts will be covered throughout the course. Though you are not required to procure these books, we think they are great placed to start if you would like to have an in-depth familiarity with the field.

- Keeney, Ralph L. and Howard Raiffa. Decisions with Multiple Objectives: Preferences and Value Tradeoffs. Cambridge University Press, 1993.
- Schon, Donald A. and Martin Rein. Frame Reflection: Toward the Resolution of Intractable Policy Controversies. Basic Books 1994.
- Lazar, Jonathan, Jinjuan Heidi Feng, and Harry Hochheiser. Research Methods in Human-Computer Interaction. Morgan Kaufmann, Second Edition, 2017.
- Tutorials and resources from https://processing.org/

Computational Urban Planning

Schedule

Meeting (Week – Date)			Subject Matter	Assignment Given
Wk 1	Thu	Feb 7	Lecture: Urban Science Demo: Processing	
Wk 2	Thu	Feb 14	Lecture: Multi-objective Decisions Tutorial: Interactive Computation	Due: Download Processing
Wk 3	Thu	Feb 21	Lecture: Working with Urban Data Tutorial: Importing Geospatial Data	Due: Interactive Visualization
Wk 4	Thu	Feb 28	Lecture: Working with Urban Data Tutorial: Importing Population Data	Due: Mapping Exercise
Wk 5	Thu	Mar 7	Lecture: Agent-based Modeling Tutorial: Modeling & Simulation	Due: Population Data Exercise
Wk 6	Thu	Mar 14	Guest Speaker: Eric Plosky (USDOT); Working Session	
Wk 7	Thu	Mar 21	**Mid-term Presentation**	Due: Mid-term Projects
	Thu	Mar 28	SPRING BREAK	
Wk 8	Thu	Apr 4	Visual Communication and Graphical User Interfaces	
Wk 9	Thu	Apr 11	Tangible Interaction and Other Alternative Mediums	Due: Final Project Outline
Wk 10	Thu	Apr 18	Working Session	Due: Final Project Proposal
Wk 11	Thu	Apr 25	Working Session	
Wk 12	Thu	May 2	Working Session	
Wk 13	Thu	May 9	Working Session	
Wk 14	Thu	May 16	**Final Presentation**	Due: Final Projects

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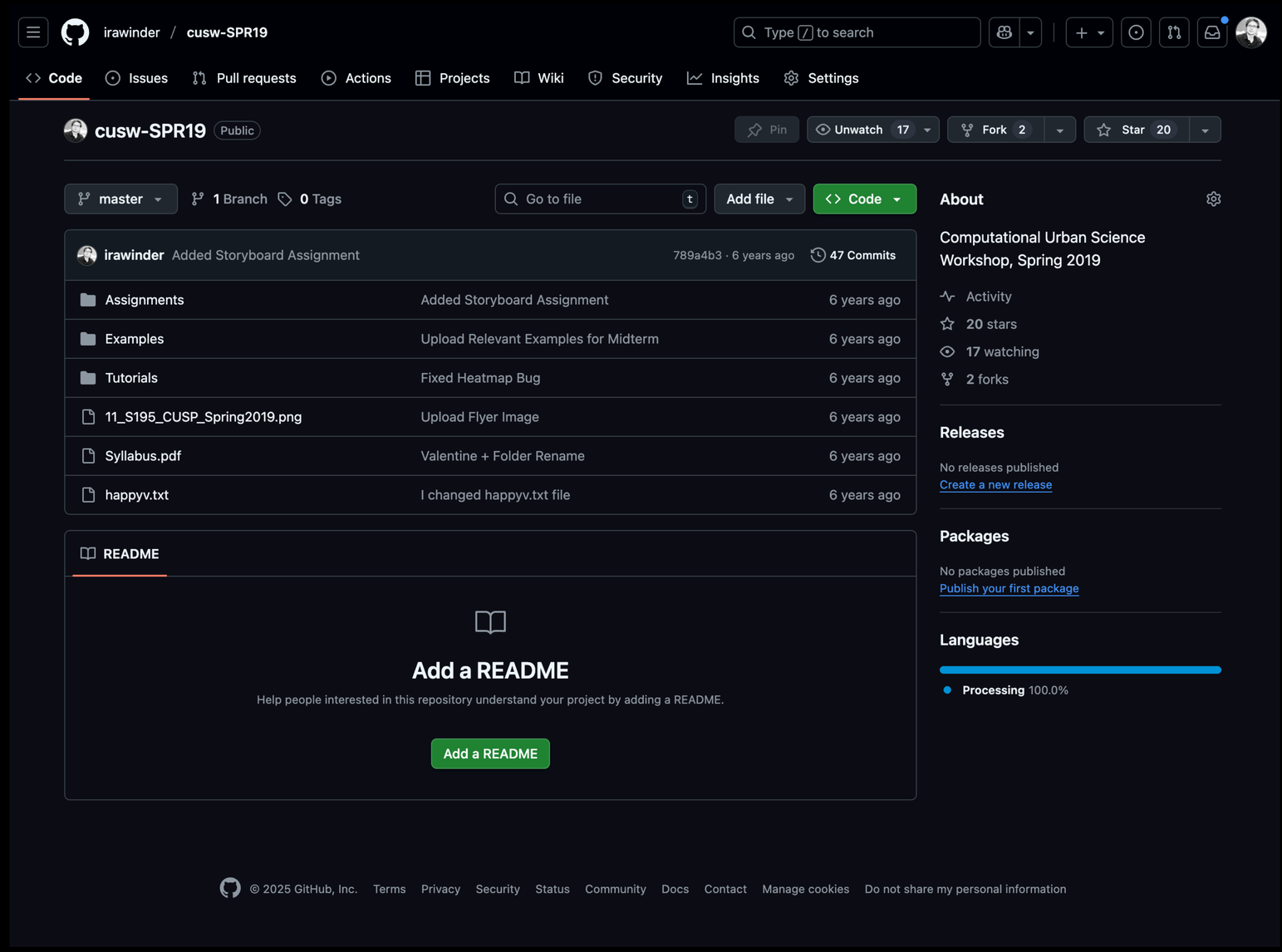
Course Content and Deliverables on Github



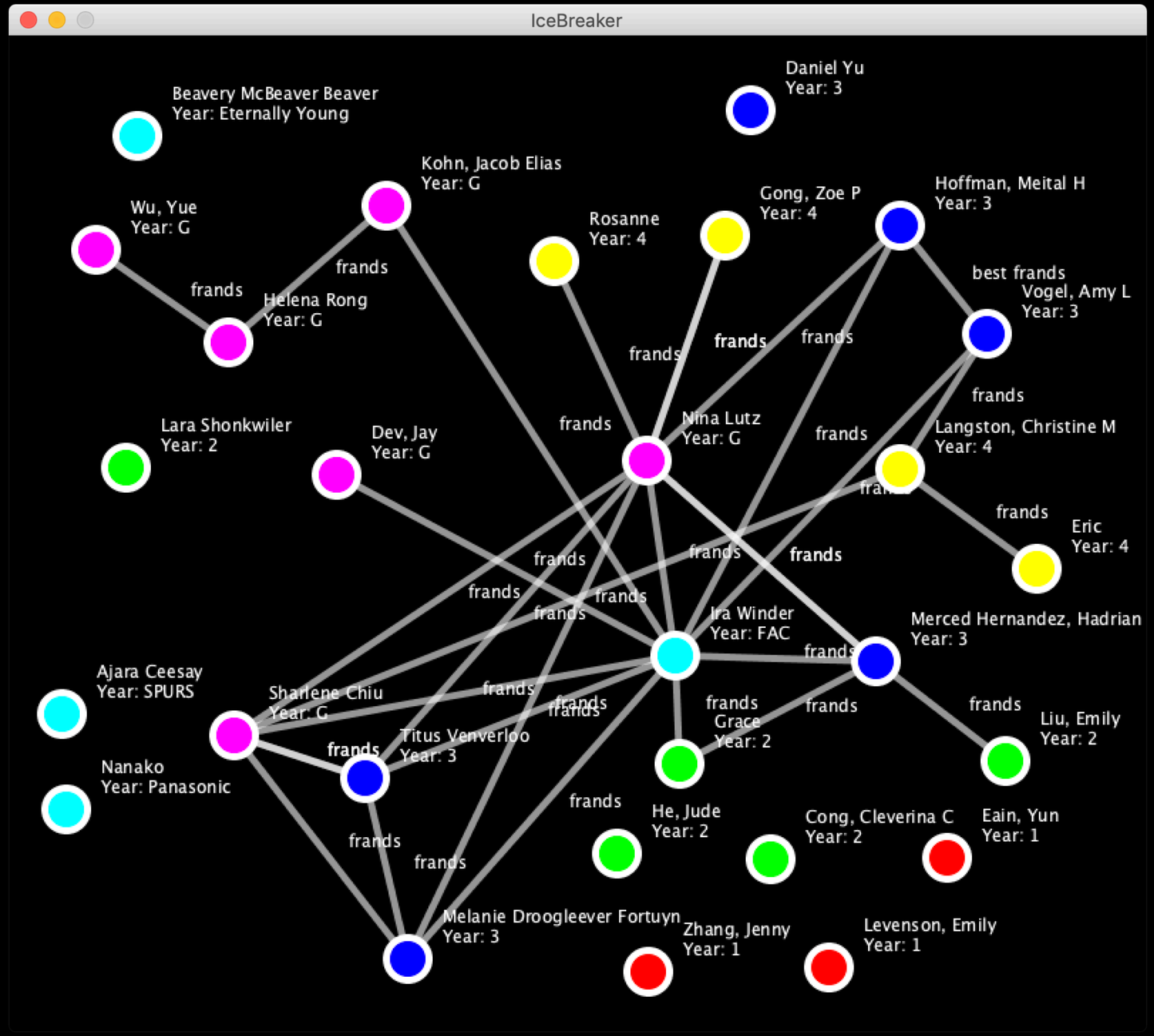
https://github.com/irawinder/cusw-SPR19

Computational Urban Planning

Tutorials

Code | Blame | 156 lines (138 loc) · 5.09 KB

```
/* IceBreaker Network Visualization
 * 11.S195 Computational Urban Science Workshop
 * jiw@mit.edu
 *
 * This script allows you define and manipulate a graph representin
 */

// List of people in Computational Urban Science Workshop (CUSW)
ArrayList<Person> cusw;

// Connection between Frands (i.e. acquaintences)
ArrayList<Connection> frands;

// Connections between students in the same year or cohort
ArrayList<Connection> cohort;

void setup() {

  // Set Screen Size to 800 x 700 pixels
  size(800, 700);

  // Initialize array of People from our class
  Person[] p = new Person[28];
  p[0] = new Person("Zhang, Jenny", "1");
  p[1] = new Person("Levenson, Emily", "1");
  p[2] = new Person("Eain, Yun", "1");
  p[3] = new Person("Cong, Cleverina C", "2");
  p[4] = new Person("He, Jude", "2");
```

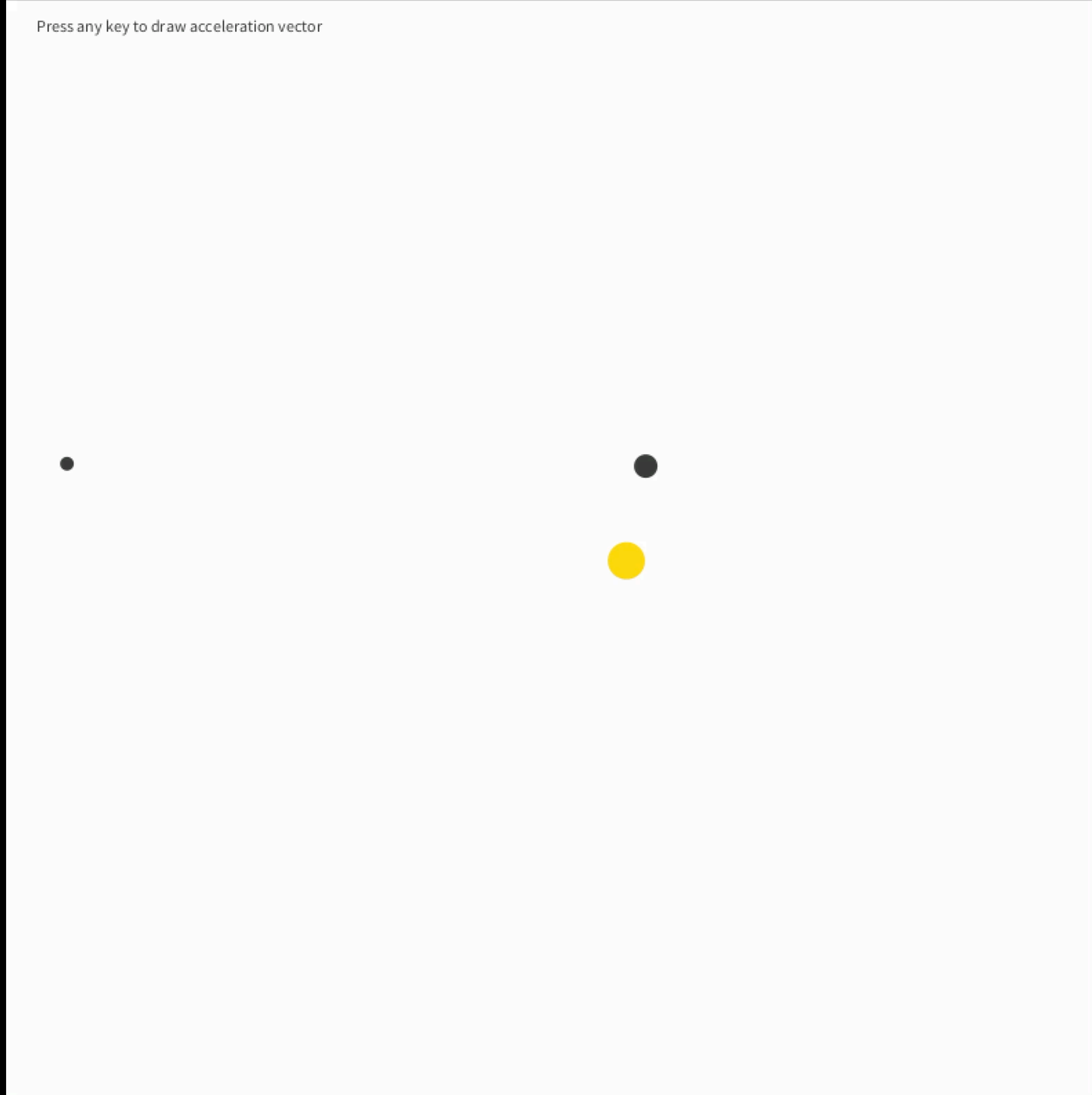


Computational Urban Planning

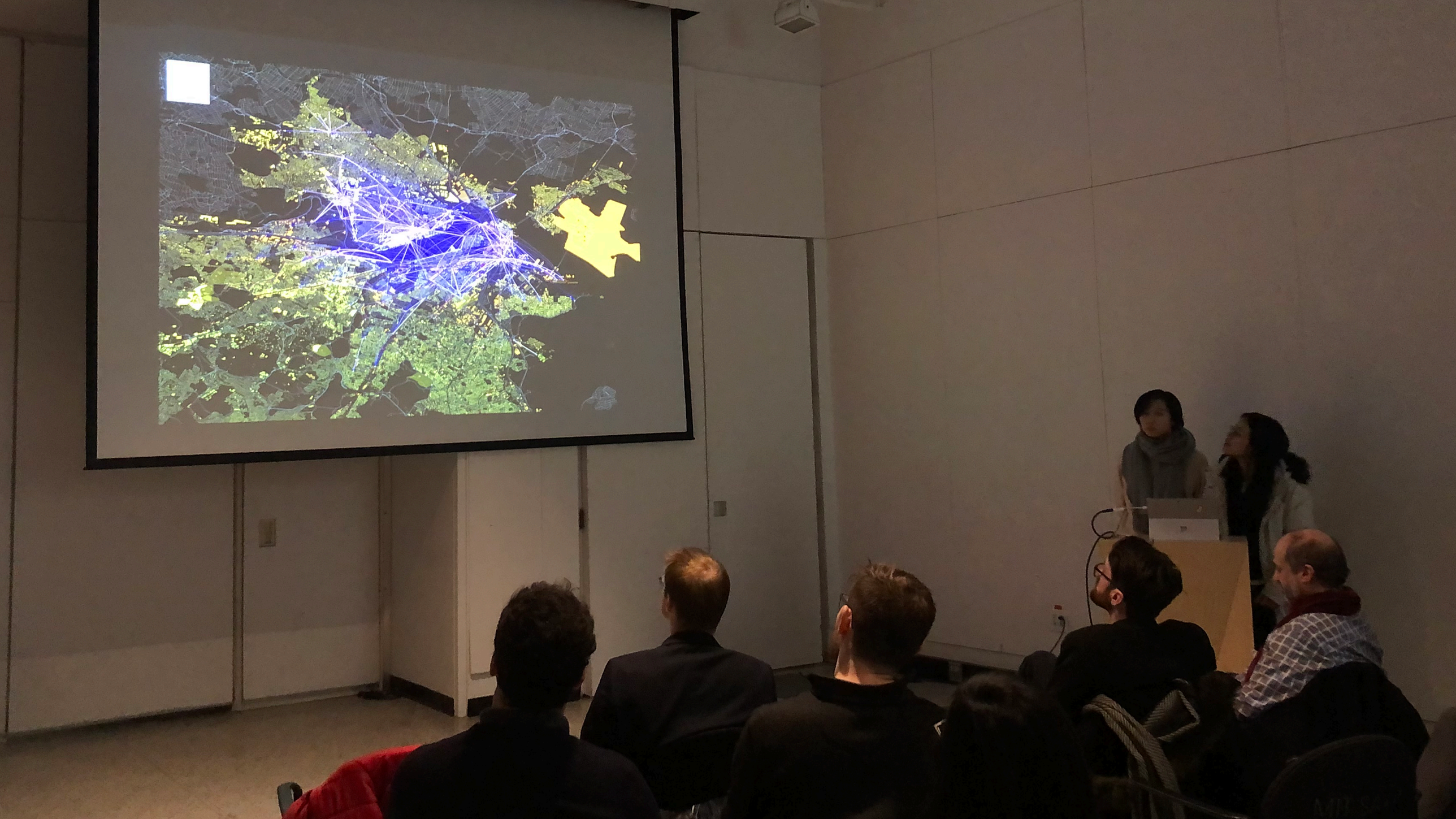
Tutorials

Tutorial_4A_ThreeBody | Body

```
/*
Computational Urban Science Workshop
Ira Winder and Nina Lutz

Script: Ira Winder
Three-body solution with Agent Based Simulation + Euler's Method
*/

// Our three bodies that we wish to simulate
Body planetA, planetB, star;

void setup() {
  size(800, 800);

  // Planet A
  planetA = new Body(100.0);  // Initial Mass
  planetA.location.y += -200; // Initial Location
  planetA.velocity.x += +1.0; // Initial Velocity

  // Planet B
  planetB = new Body(500.0); // Initial Mass
  planetB.location.x += +100; // Initial Location
  planetB.velocity.y += -2.0; // Initial Velocity

  // Planet C
  star = new Body(2000.0);   // Initial Mass
  star.location.x += +000;    // Initial Location
  star.velocity.y += +0.5;    // Initial Velocity
  star.col = color(255, 200, 0, 200); // Yellow

}
```




UI Mock-Up
Fin.



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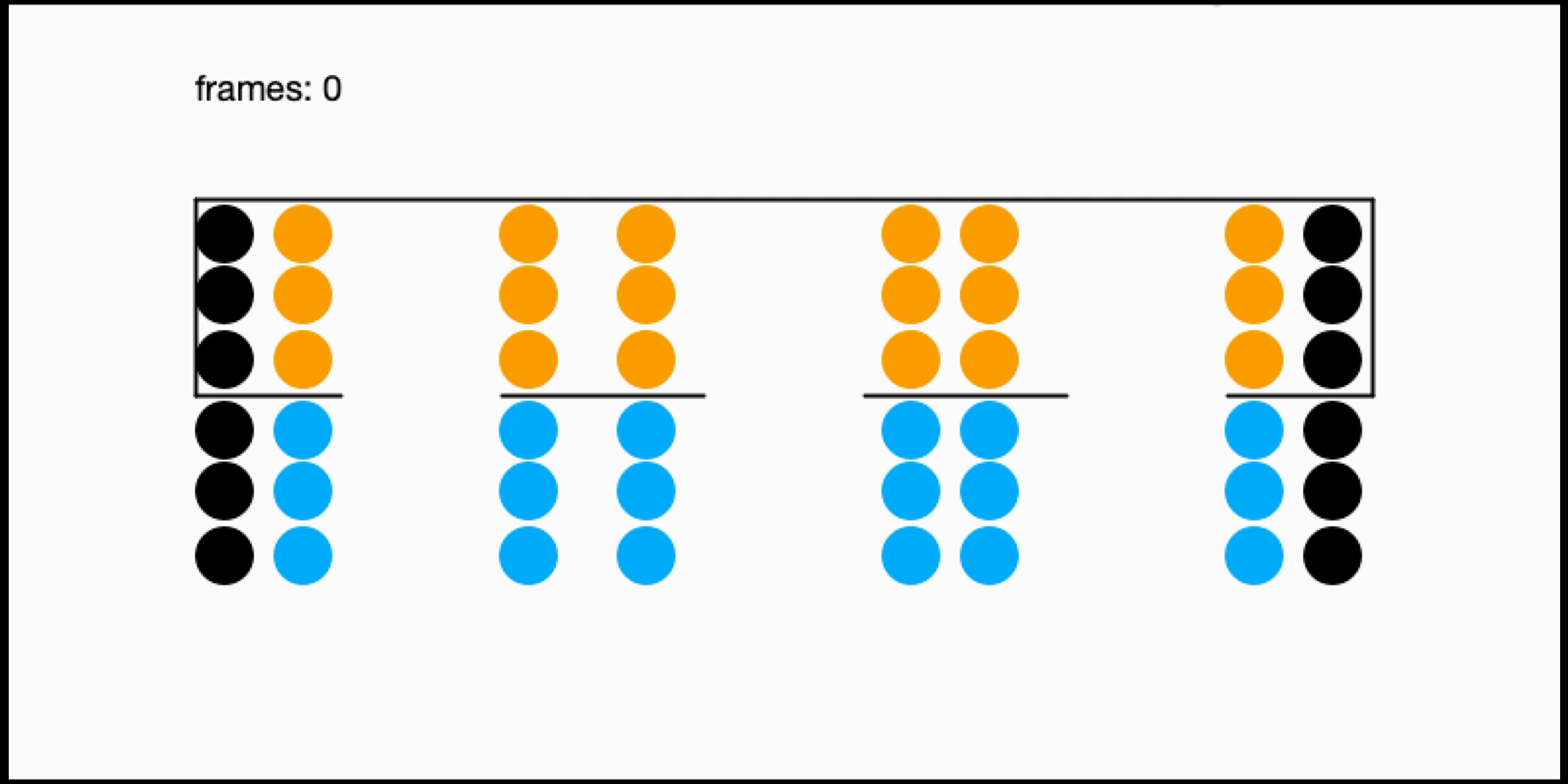
Student Project | Subway Boarding Simulation



https://github.com/withanaitch/cusw-spr19-merced/tree/master/Final