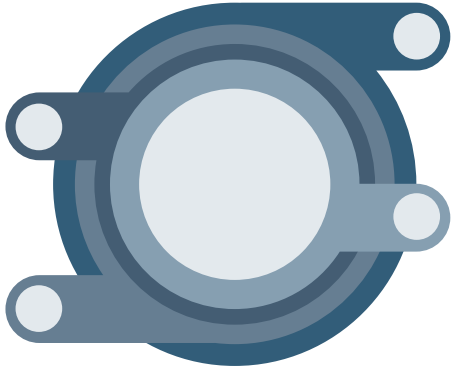
ZBY1 Virus Tracer

Providing tracing intuition from Day Zero

Overview



Design Process

- What should high level strategies be?
- How do we determine the likelihood of infection given various interactions?
- How do we represent various interactions?
- What is the virus transmission rate?
- Total number of students is ~600, how fast does our code need to run given these constraints? O(|P|^2) is sufficient

Processes & Tasks

Processes

- Pair programming
- API Design
- UI Design

Task Breakdown

- Object Representation
- Exposure Tracking Functionality
- Time-Stepping Functionality
- Visualizing Tool
- Charting Tool

Our Design

- Parsing → Pandas
- Data model → ExposureChance, Person
- Visualization → Matplotlib, PyGame
- Simulation
- Highly Configurable via Command Line

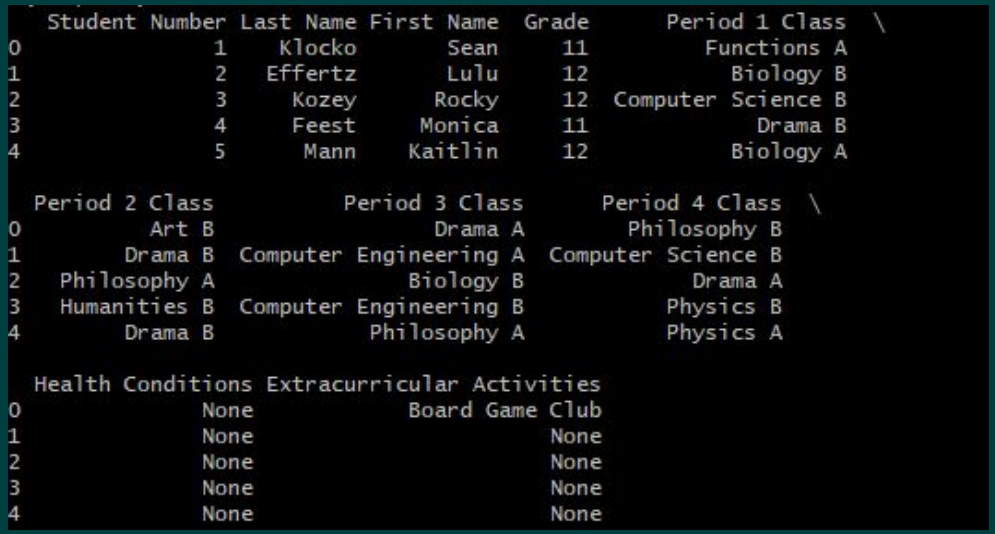
Usage

```
python main.py [--students] [--teachers] [--tas] [--infects] [-v|--visualize]
```

Architecture, In Depth

Data Parsing

- Excel and CSV are very closely related
- Pandas is an excellent python library
- Makes parsing data trivial
- Different pandas dataframe for each file



	Student Number	Last Name	First Name	Grade	Period 1 Class	Period 2 Class	Period 3 Class	Period 4 Class	Health Conditions	Extracurricular Activities
0	1	Klocko	Sean	11	Functions A	Art B	Drama A	Philosophy B	None	Board Game Club
1	2	Effertz	Lulu	12	Biology B	Drama B	Computer Engineering A	Computer Science B	None	None
2	3	Kozey	Rocky	12	Computer Science B	Philosophy A	Biology B	Drama A	None	None
3	4	Feest	Monica	11	Drama B	Humanities B	Computer Engineering B	Physics B	None	None
4	5	Mann	Kaitlin	12	Biology A	Drama B	Philosophy A	Physics A	None	None

Object Representation

Person

- Stateful representation of a person (including their information and virus exposure)

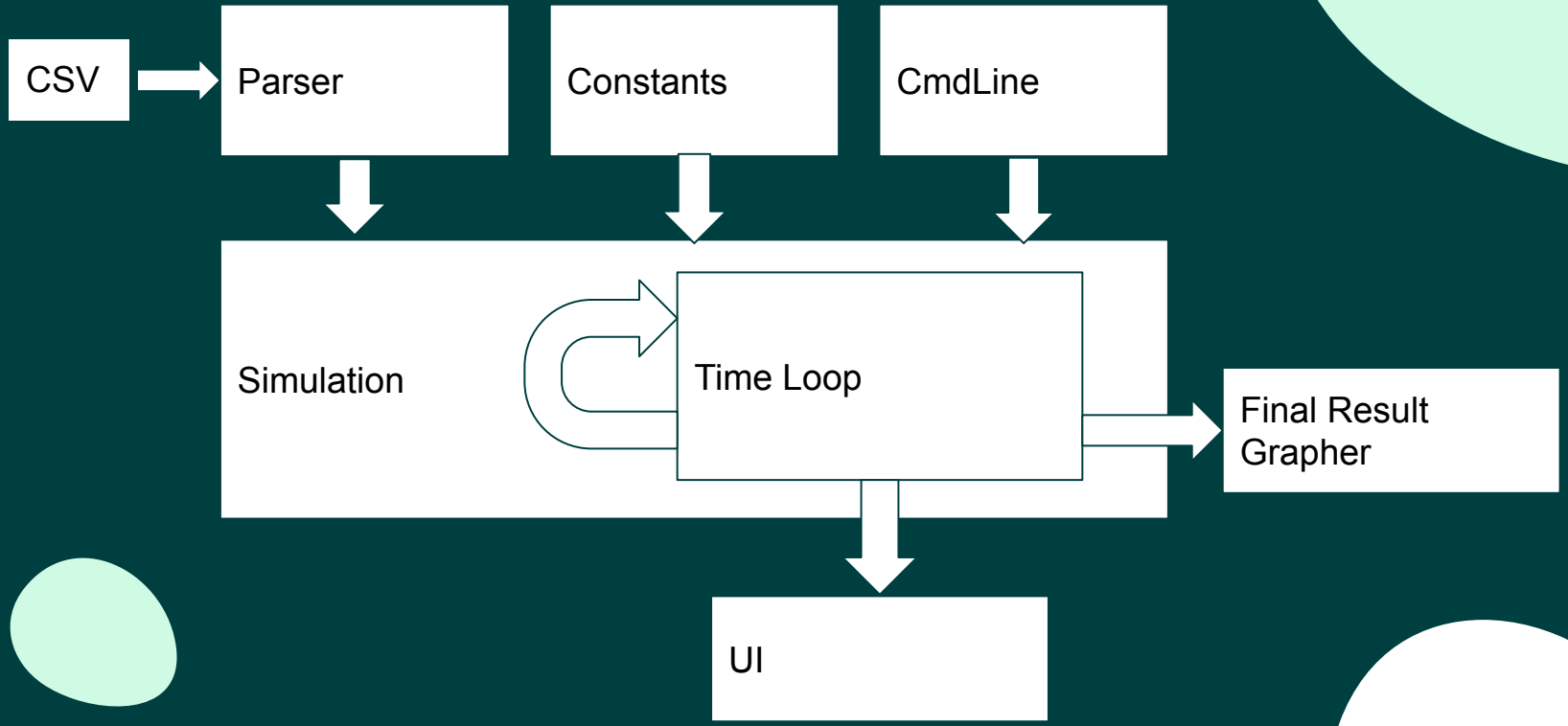
Exposure Chance

- Stateless model that provides a utility to update the virus exposure for a set of people

Visualization

- PyGame for visualizing student movements between classes
- MatPlotLib for graphical visualizations

Solution Overview



Virus Spreading Logic

- Expose people to each other probabilistically
- 6 ‘periods’ → 4 classes, lunch, ecs
- 7 ‘transition periods’ → includes before and after school
- Expose everyone in the same areas
- Considered many subtleties → details in code walkthrough!

Design Justification

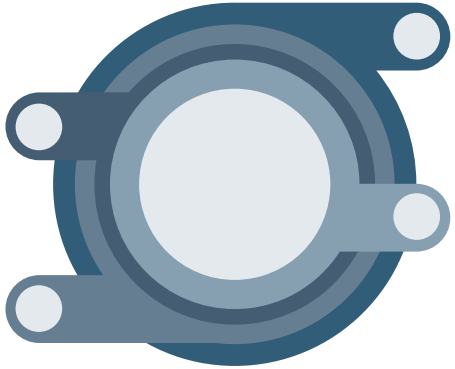
- Separating major components of the project allows for low coupling and high cohesion
- Developed a highly configurable system to handle complex virus transmission properties

Debugging

- People tracer
- Specify a list of people
- Trace their exposure value at each time step
- See how much each person contributed to their exposure increase

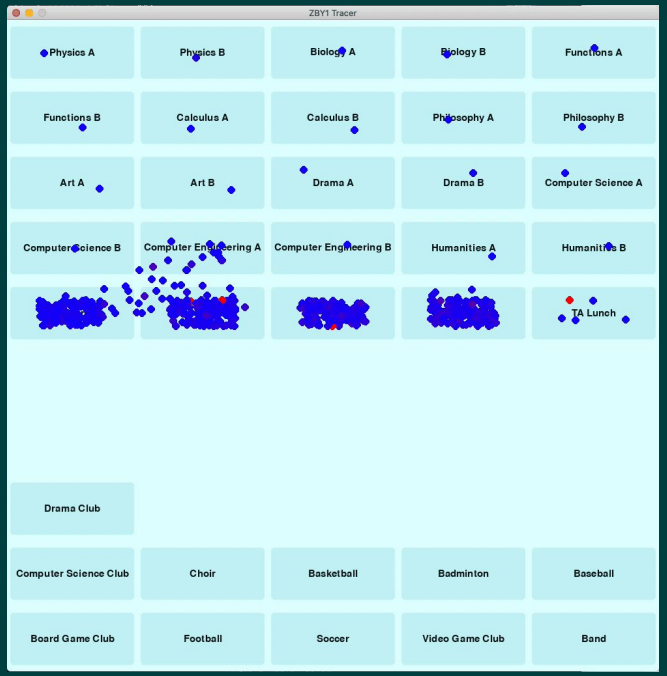
```
Time Period 12 | Exposure: 0.9027364908086618
    Deontae Russel: 0.03790617593906487
    Geo Connelly: 0.03329531384334927
    Amanda Pfannerstill: 0.022506733758956066
    Sean Klocko: 0.024820948124640307
    Fred Abshire: 0.02228892602122201
    Gregory McGlynn: 0.018738870903411087
    Mikel Windler: 0.020176547894157904
    Zion Schulist: 0.017793504756963396
    Haylee Jakubowski: 0.015257266131098013
    Bridget Schimmel: 0.015021626976832958
    Mariam Kling: 0.012899464397467253
    Philip Deckow: 0.008832752020972556
    Karson Douglas: 0.009955240957811529
    Sheila Douglas: 0.033129190934250596
    Carole Douglas: 0.00922550397855304
Time Period 13 | Exposure: 0.913688547757778
    Deontae Russel: 0.03790617593906487
    Geo Connelly: 0.03329531384334927
    Amanda Pfannerstill: 0.022506733758956066
    Sean Klocko: 0.024820948124640307
    Fred Abshire: 0.02228892602122201
    Gregory McGlynn: 0.018738870903411087
    Mikel Windler: 0.020176547894157904
    Zion Schulist: 0.017793504756963396
    Haylee Jakubowski: 0.015257266131098013
    Bridget Schimmel: 0.015021626976832958
    Mariam Kling: 0.012899464397467253
    Philip Deckow: 0.008832752020972556
    Karson Douglas: 0.009955240957811529
    Sheila Douglas: 0.033129190934250596
    Carole Douglas: 0.00922550397855304
```

Results



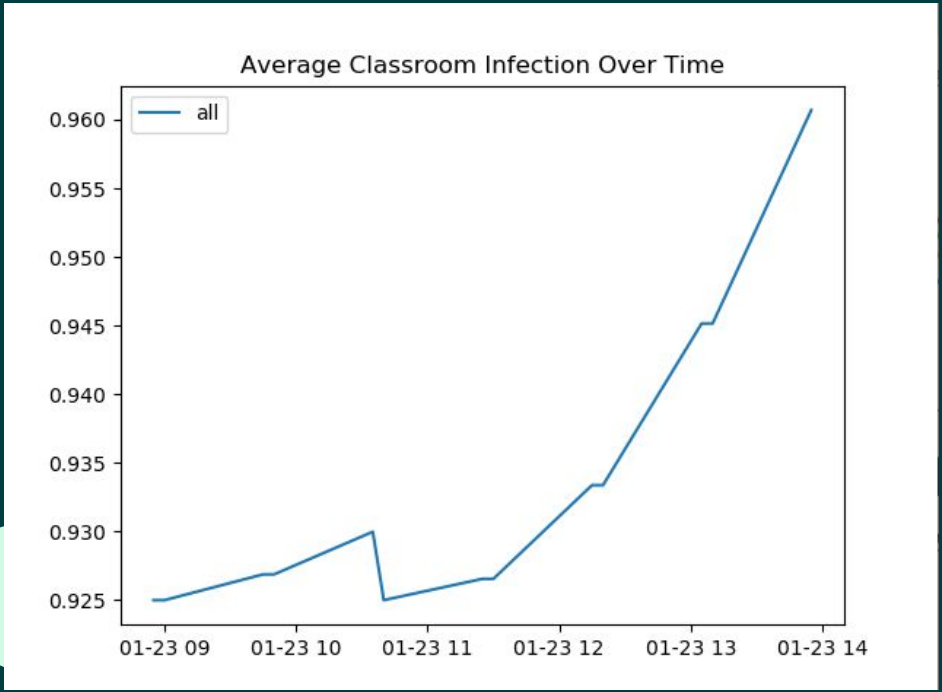
Visualization

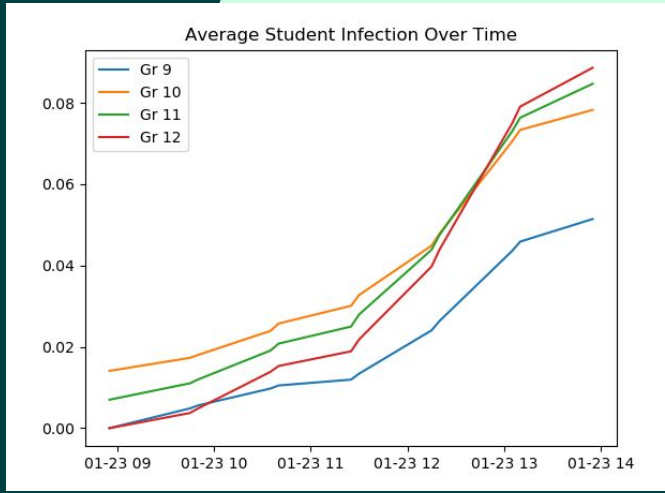
- BASELINE_EXPOSURE_FACTOR = 0.3

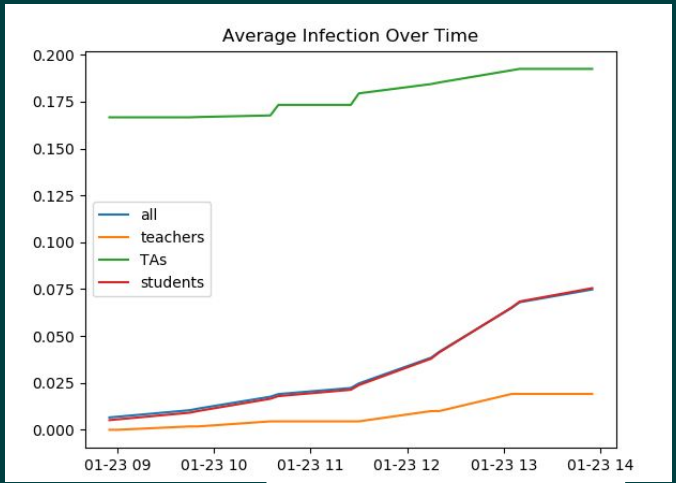


Graphs

BASELINE_EXPOSURE_FACTOR = 0.1

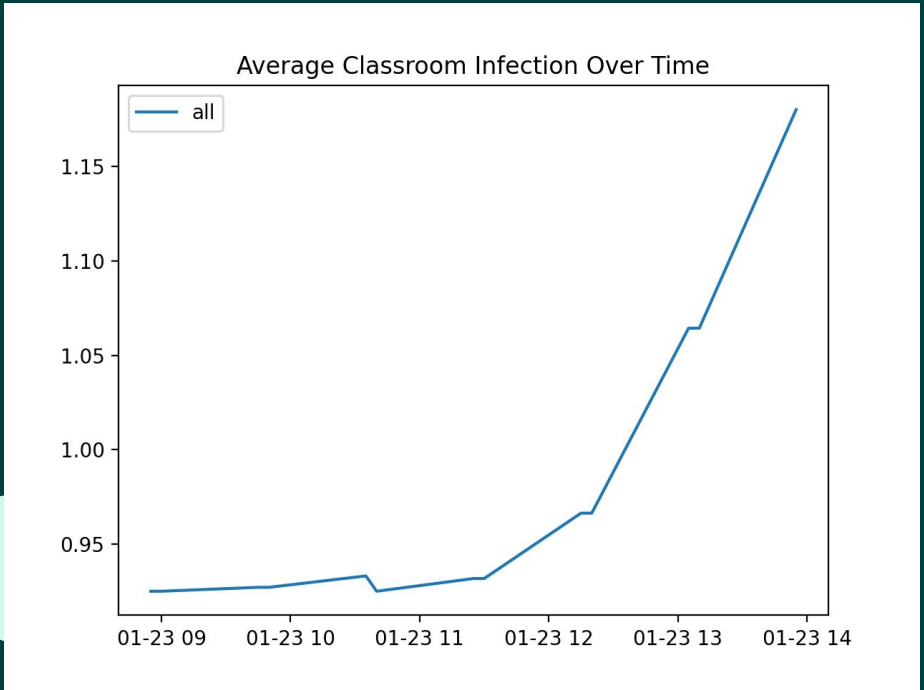


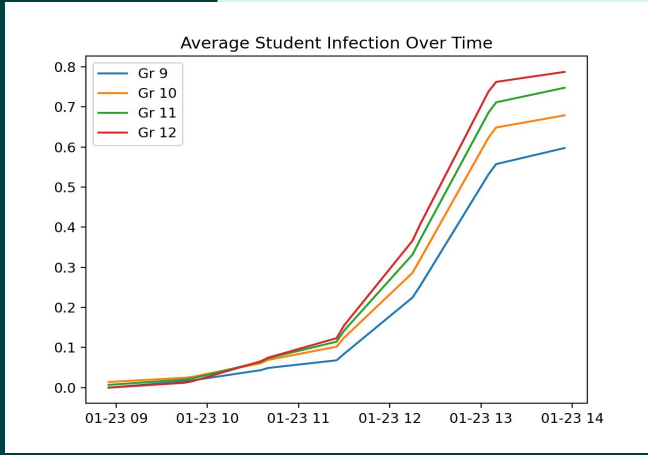


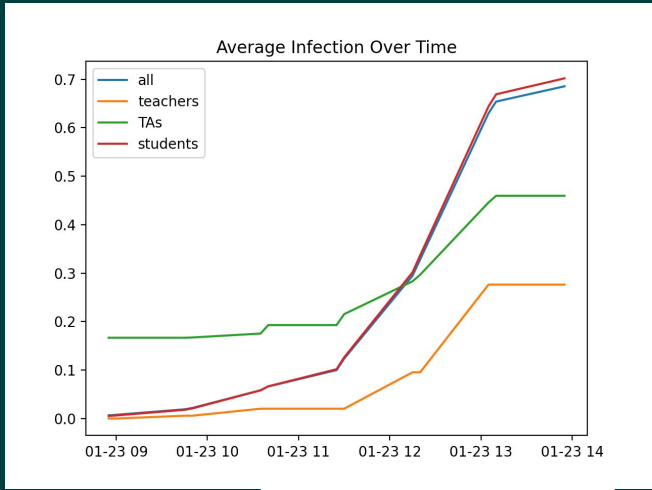


Graphs

BASELINE_EXPOSURE_FACTOR = 0.3

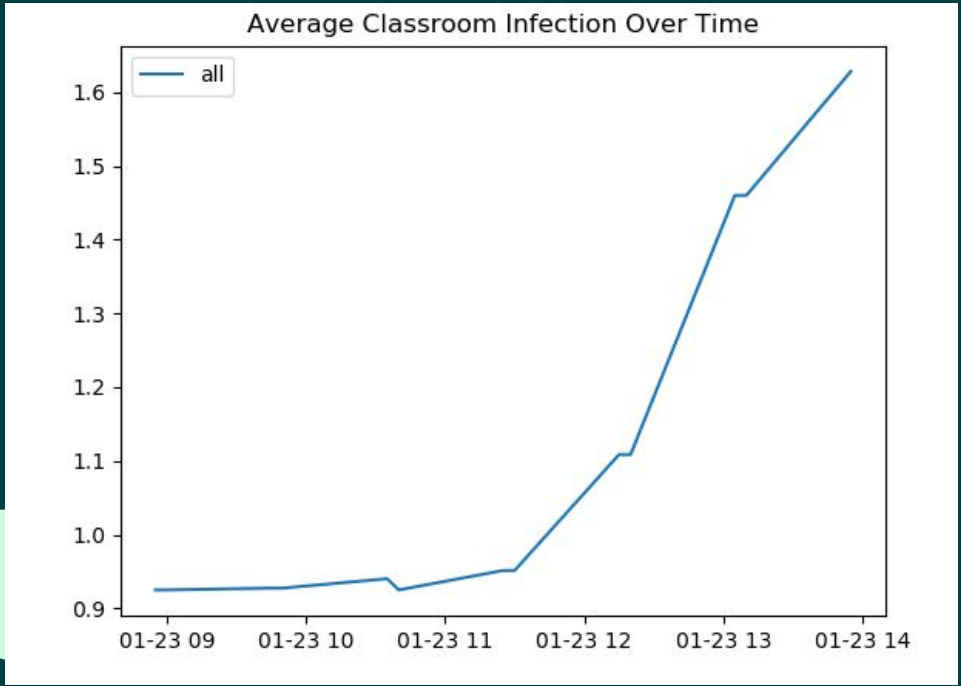


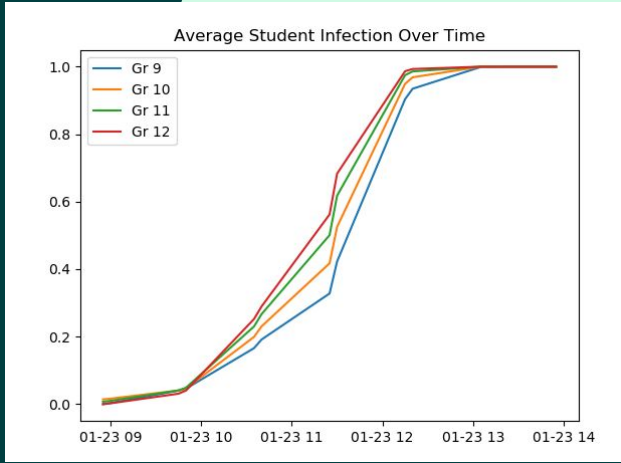


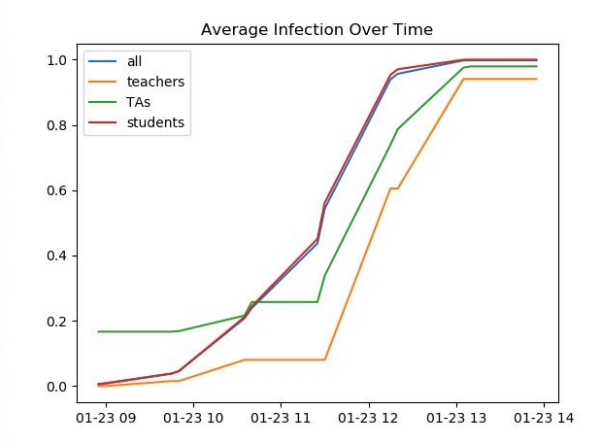


Graphs

BASELINE_EXPOSURE_FACTOR = 0.7

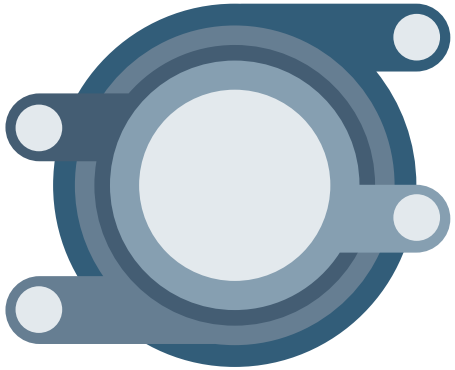






Demo

Work



Time Log

Total Man Hours (4 * 7-8 hrs = 28-32 hrs)

- Group Architecture Discussion (1 hour, 4 teammates)
- Parsers (1 hour, 1 teammate)
- Time Loop (3 hour, 1 teammate)
- Virus Exposure Logic (2 hour, 1 teammate)
- PyGame UI (5-6 hours, 1 teammate)
- Matplotlib Charts (2 hour, 1 teammate)
- Debugging (1-2 hour, 4 teammates)
- Presentation (1 hour, 4 teammates)

References & Citations

Resources

K. Zimmer, “Why R0 Is Problematic for Predicting COVID-19 Spread,” The Scientist Magazine®. [Online]. Available: https://www.the-scientist.com/features/why-r0-is-problematic-for-predicting-covid-19-spread-67690. [Accessed: 23-Jan-2021].

Tools

Matplotlib 3.1.2 (https://matplotlib.org/)
Numpy 1.18.1 (https://numpy.org/)
Pandas 1.1.5 (https://pandas.pydata.org/)
PyGame 2.0.1 (https://www.pygame.org/)
SlidesGo (https://slidesgo.com/theme/endocrinology-breakthrough)

Thank you!