**Data Science in Cell Imaging**

Department of Software and Information System Engineering, BGU

Course # 37225331

Instructor: Assaf Zaritsky, https://www.assafzaritsky.com/

Spring 2021, Wednesdays 2pm-5pm

The recent explosion in high-content, dynamic and multidimensional imaging data is transforming cell imaging into a "Data Science" field. This course will review the state-of-the-art in visualizing, processing, integrating and mining massive cell image data sets, deciphering complex patterns and turning them into new biological insight. It will include a mix of approaches in machine learning and computer vision (e.g., deep learning) applied to bio-imaging data.

The course is open for all ISE and adjacent departments (e.g., CS, EE) graduate and undergraduate students in their $3^{rd}$ or $4^{th}$ year. Interested students from other departments should contact Assaf (assafzar@gmail.com).

The lectures will be held in English.

Background in mathematics and programming is required. No prior biological knowledge is required; all background will be covered in the lectures. Prior knowledge in machine learning and/or computer vision is highly recommended, but not necessary.

Grade will be determined by single student presentation of an academic paper (20%) and a 1-2 students semester-long project (80%).

Main topics covered in the course:

- Deep learning in microscopy
- Image-based phenotypic profiling
- Advanced representations of cell shapes, intracellular organization and trajectories data
- Spatiotemporal analysis of live cell image data
- Bioimage informatics and computer vision in cell imaging
- Atlases and public data repositories, reusing cell image data
- Data harmonization, integration and fusion across modalities
- Information processing in multicellular systems
- Importing ideas from systems biology

**(Tentative) Course plan**

| Class # | Topic |
|---|---|
| 1 | Introduction to data science in cell imaging |
| 2 | Introduction to cell biology & microscopy |
| 3 | Deep learning in microscopy |
| 4 | Deep learning in microscopy |
| 5 | Deep learning in microscopy |
| 6 | Image-based phenotypic profiling |
| 7 | Image-based phenotypic profiling |
| 8 | Advanced representations of cell shapes, intracellular organization and trajectories data |
| 9 | Atlases and public data repositories |
| 10 | Information processing in multicellular systems |
| 11 | Bioimage informatics, spatiotemporal analysis |
| 12 | Importing ideas from systems biology |
| 13 | Misc. topics |

Misc. topics may include: reusing cell image data, computer vision in cell imaging, data harmonization, integration and fusion, automated microscopy, high content simulations, medical imaging