Course Description

The world around us is abundant with complex phenomena – phenomena involving modeling complex systems.

Lecturer:
Dr. Eran Sheriff  eran.sheriff@runi.ac.il

Teaching Assistant:
Mr. David Freud  david.freud@post.runi.ac.il

Course program and reading list
Semester 2 Year 2023

School: Arison School of Business B.A

modeling complex systems

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Course Requirements:
Final Paper

Group Code: 232350000

Language: English

Prerequisites

Prerequisite:
1905 - machine learning methods I

Students who took one of the courses listed below will not be allowed to register to the course modeling complex systems (3500):
3635 - modeling complex systems

Course Description

The world around us is abundant with complex phenomena – phenomena involving
“systems” of numerous interacting parts. In fact, the vast majority of physical, biological, and socio-economic phenomena are complex. Such phenomena are commonly referred to as complex systems.

Modeling is likely the most effective tool known to mankind for the exploration of and gaining insight into complex systems. A significant part of the scientific and technological achievements of mankind over the past centuries can be attributed to our ability to develop and apply models. Modeling allows us to deepen our understanding of the way systems operate, thus enabling us to acquire a deeper understanding of their dynamics and the factors that affect and control their behavior.

This course focuses on approaches to modeling complex systems and specific methods that allow us to explore systems of numerous interacting parts. It demonstrates how mathematical (analytical) and numerical techniques, including agent-based, discrete event simulations, can be used to model complex systems and reproduce various phenomena observed in such systems. It shows how models allow us to explore the dynamics of complex systems and gain insight into phenomena observed in such systems, such as the emergence of long-tailed distributions, the formation of spatial patterns, and the development of collective behaviors.

Students learn to recognize complex phenomena, define and implement models simulating such phenomena, validate numerical simulations, and apply various techniques to analyze synthetic data that such simulations generate. Emphasis is placed on socio-economic systems that underlie the phenomena we encounter in the realms of societies in general and businesses in particular, thus allowing students to develop the skills necessary to model and analyze them.

While the course touches on some fundamental theoretical aspects behind modeling, for the most part, it adopts a practical approach that allows students to gain initial experience in modeling.

main topics covered:

- modeling – an introduction
- modeling spread and propagation
- a brief introduction to ODEs
- the main steps in developing a model
- observing complex systems - from signal to distribution to insight
- heavy-tailed distributions and their implications
- modeling networks
- dynamics on networks
- incorporating spatiality (location-dependent effects) into models

Course Goals
Upon successfully completing the course, students should be able to:

- recognize complex phenomena in the socio-economic and business realm,
- define and implement models simulating such phenomena,
- validate numerical simulations of models,
- apply various techniques to analyze synthetic data that such simulations generate.

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**Grading**

Grades are based on a weighted mean of the grades attained in the assignments given during the course. Expect approximately 5 assignments during the semester (50%) + a final assignment (50%).

Some of the assignments are to be submitted in groups. Group membership will be determined by the teacher. For additional details see the course’s Moodle page.

NOTE: Class attendance is mandatory. Exemptions will be given only in accordance with Reichman University's bylaws. Students who do not comply will not pass the course.

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**Lecturer Office Hours**

Officially: Sunday 15:45-16:45 (by appointment)

Unofficially: If we’re on campus, I’m at my office nearly daily and am happy to meet any time, as long as I don’t have prior commitments. If we’re off-campus, I can be reached by mail. Zoom meetings will be scheduled for issues that can be better handled that way.

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**Teaching Assistant**

By appointment

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**Reading List**

For the most part, this course is self-contained and doesn't require additional reading. However, various topics will require students to conduct their own research and self-study to complement the material discussed in class and gain the knowledge and skills required in order to successfully carry out the assignments.

Some external references, mainly for enrichment, will be given during the course.