SUNY OLD WESTBURY

Department of Mathematics, Computer & Information Science
MODEL THINKING MATH 2040/CS 2040

TEXTBOOKS: None Required.□

TIME AND PLACE: M/W 1-2:30 pm. NAB 2129

FINAL EXAM: 5/17/2017 (Wednesday) at 1 pm.

PROFESSORS:

Dr. Frank Sanacory

Email: Sanacoryf@oldwestbury.edu

Office: NAB 2014

Office Hours: TR: 1-2:30, W 3:50-4:50 (MODIFY THIS)

Dr. Ashok Basawapatna

Email: basawapatnaa@oldwestbury.edu

Office: NAB 1018

Office Hours: M: 3:30-4:30, TR: 10:30-12

PREREQUISITE:

MA 1020: College Algebra. We will use both algebraic representations and algebraic manipulations.

CATALOG DESCRIPTION:

This course is an introduction to models including statistical, logical and computer models and we will apply these models to a variety of disciplines. We will study topics related to models such as aggregation, complexity from simple rules, logical actor, behavioral actors and rule-based actors, tipping points, incorporating many models and path dependency. We will explore four general types of model outcomes: equilibrium, cycle, random or complexity.

Investigating these models gives students an applied introduction to math such as systems thinking, statistics, game theory, and chaotic dynamics. In addition, students with no prior programming experience are provided with an applied gentleslope introduction to computer science wherein they use enduser

programming tools.

COURSE DESCRIPTION:

A prevailing question in both Math and Computer Science is how can we interact with and better understand complex systems. Should we rely on the data analyst or the expert, and if not, how can we empower ourselves to make decisions under complex scenarios? While experience and more data are often helpful, they have limits. One answer is being able to model complex phenomena ourselves through a variety of means. There is evidence supporting that the model thinker outperforms the expert (without a model). And there is evidence to support that the many model thinker outperforms the single model thinker.

Models improve our abilities to make accurate forecasts. They help us make better decisions and adopt more effective strategies. They even can improve our ability to design institutions and procedures.

Some questions we will explore include: Why do revolutions occur?

Will a forest fire spread?□Will the show get a standing ovation?□How should a politician strategize a campaign?□What minimum percentage of a population should be vaccinated in order to prevent an outbreak? How big will China's economy get?□Should I go home for winter break?

We will use a wide variety of standard models including: linear regression, probability (decision trees, Markov chains), dynamics, percolation model, growth model, game theory, replicator dynamics, mechanism design , and auctions among others.

Also, we will understand topics related to models such as aggregation, complexity from simple rules, logical actor, behavioral actors and rule based actors, tipping points, incorporating many models and path dependency. We will explore four general types of model outcomes: equilibrium, cycle, random or complexity.

Investigating these models gives students an applied introduction to math such as systems thinking, statistics, game theory, and chaotic dynamics. In addition, students with no prior programming experience are provided with an applied gentleslope introduction to computer science wherein they use enduser programming tools.□This course is based off of the Coursera course, **Model Thinking,** offered by Professor Scott E. Page of the University of Michigan .

COURSE OBJECTIVES: At the completion of this course students will

- Learn how to create models to draw conclusions and predict. □
- Be able to analyze, assess and use models and their underlying assumptions. □
- Apply basic to more sophisticated math concepts in a novel application to better understand the world around them. □
- Be able to form a hypothesis, express ideas computationally, and visualize the consequences of their thinking. □
- Be able to understand simple systems over time including stability, equilibrium, randomness, and chaos. □

COURSE EVALUATION & GRADING:

Midterm	30%
Final Project□	30%
Homeworks□	15%
Lab/Programs	15%
Participation and daily quizzes/worksheets	10%

Percentile Range	**Letter Grade**
90-100	A
85-89	B+
80-84	B
75-79	C+
70-74	C
65-69	D+
60-64	D
0-59	F

Homeworks can be done on paper and handed in. Labs will involve two components—a programming component that will be accessible online and a written component that will be handed in. Ten Points per week will be deducted for lateness and any homeworks and labs. Any homeworks and labs over three

weeks late will not be accepted and will receive a grade of zero, no exceptions.

STUDENT RESPONSIBILITIES:

You are expected to attend all scheduled class sessions in order to maximize your learning. If you must be absent from a class, it is your responsibility to contact your instructor to obtain all misses assignments. You should also make arrangements to obtain the class notes from another student. You are also expected to do all assigned readings; to complete all homework, laboratory assignments, and projects; to take all required assessments (exams, quizzes) and to come to class prepared to participate in all activities.

ATTENDANCE POLICY:

It is understood that illness or unforeseen circumstances will, on occasion, prevent class attendance. Excessive absences and habitual tardiness in attending class may have an adverse affect on class performance, the final grade for the course, and could result in the student failing the course.

Finally, while in class, students are expected to behave in a manner that is respectful of other students' right to learn. Therefore, disruptive behaviors of any kind (including talking during the lecture) will not be tolerated and such behaviors could affect a student's final grade or result in the student being removed from the class.

MISSED EXAMS:

It is the responsibility of the student, to know when exams are being given. Exams that are missed will not be given a makeup unlessavalidexcuse isgivenfornotbeingpresentfortheexam(avalidexcuseisanunforeseenreasonfornotbeinginattendance, such as an illness, or an accident that makes it impossible for you to attend class. You will need to supply supporting documentation, such as a doctor's note for an illness, or an accident report for an accident). All missed exams will result in a zero for that exam. Only one makeup exam will be given for missed exams. There is no makeup for a makeup.

INCOMPLETE:

A grade of Incomplete (I) may be assigned by the instructor when:

Extenuating circumstances, such as accident or illness, make it impossible for the student to complete the course work by the end of the semester;□The student has completed most of the course work at a passing level;□The instructor expects that the student will be able to complete the remainder of the course requirements by the end of the following semester.

A grade of I remains in effect for one semester. A student must make appropriate arrangements with his/her instructor to complete the course requirements. The instructor will inform the student concerning the specific scope and nature of the work that must be completed. To certify fulfillment of course requirements, the instructor is expected to submit a letter grade by the end of the following semester. If the instructor does not submit a grade, the Registrar will automatically assign a grade of F unless the instructor submits a written request to the Registrar for an extension, or the student has filed an

application for CR/NC, in which case a grade of NC would be assigned. Students who are completing an incomplete should not register for that course in the semester that they are completing the incomplete.

ACADEMIC MISCONDUCT:

The student is expected to complete the coursework on their own. Handing in someone else's work and copying of another student's paper during an exam is a violation of the Student Code of Conduct for the State University of New York at Old Westbury (see policies and definitions below).

ACADEMIC INTEGRITY:

The following policies and definitions were taken from the college catalog of the State University of New York College at Old Westbury:

As is the policy of all SUNY institutions, students are expected to maintain the highest standards of honesty in their college work. Any act which attempts to misrepresent to an instructor or College official the academic work of the student or another student, or an act that is intended to alter any record of a student's academic performance by unauthorized means, constitutes academic dishonesty. Cheating, forgery, and plagiarism are considered serious offenses and are subject to disciplinary action.

Cheating

Cheating is defined as giving or obtaining information by improper means in meeting any academic requirements. Examples of cheating, although not inclusive, include: Unauthorized giving or receiving of information for an examination, paper, laboratory procedure, or computer assignment (file or printout); taking an examination for another student or allowing another student to take an examination for you; altering or attempting to alter a grade either on graded work or in an instructor's records or on any College form or record.

Plagiarism

Plagiarism is defined as the use of material from another author whether intentional or unintentional, without referencing or identifying the source of the material. If students have any questions as to what constitutes plagiarism, it is their responsibility to get clarification by consulting with the appropriate instructor.

ACCOMMODATIONS FOR STUDENTS WITH SPECIAL NEEDS

If you have or suspect you may have a physical, psychological, medical or learning disability that may impact your course work, please contact Dr. Lisa Whitten, Director, The Office of Services for Students with Disabilities (OSSD), Academic Village, D112, Phone: 5169763009, Fax (516) 8763005, TTD: (516) 8763083, w hittenl@oldwestbury.edu. The office will help you determine if you qualify for accommodations and help you get them. All support services are free and all contacts

with the OSSD are strictly confidential. SUNY/Old Westbury is committed to assuring that all students have equal access to all learning activities and to social activities on campus.

EXAMPLE TOPICS TO BE COVERED

Week 1: Introduction to simple math/ get everyone up to speed Your first computer program + How to create

Week 2: Why Model & Segregation/Peer Effects

1. **Course Documentation ▫**
2. **Why Model? ▫**
3. **Segregation and Peer Effects ▫**

Week 3: Aggregation & Decision Models

1. **Aggregation ▫**
2. **Decision Models ▫**
3. **Review ▫**

Week 4: Thinking Electrons: Modeling People & Categorical and Linear Models

1. **Thinking Electrons: Modeling People ▫**
2. **Categorical and Linear Models ▫**
3. **Review ▫**

Week 5: Tipping Points & Economic Growth

1. **Tipping Points ▫**
2. **Economic Growth ▫**
3. **Review ▫**

Week 6: Diversity and Innovation & Markov Processes

1. **Diversity and Innovation ▫**
2. **Markov Processes ▫**
3. **Review ▫**

Week 7: Midterm Exam

Week 8: Lyapunov Functions & Coordination and Culture

1. **Lyapunov Functions ▫**
2. **Coordination and Culture ▫**
3. **Review ▫**

Week 9: Path Dependence & Networks

1. **Path Dependence ▫**
2. **Networks ▫**
3. **Review ▫**

Week 10: Randomness and Random Walks & Colonel Blotto

1. **Randomness and Random Walks ▫**
2. **Colonel Blotto ▫**
3. **Review ▫**

Week 11: Prisoners' Dilemma and Collective Action & Mechanism Design

1. **Prisoners' Dilemma and Collective Action ▫**
2. **Mechanism Design ▫**
3. **Review ▫**

Week 12: Learning Models: Replicator Dynamics & Prediction and the Many Model Thinker

1. **Learning Models: Replicator Dynamics ▫**
2. **Prediction and the Many Model Thinker ▫**
3. **Review ▫**

Week 1314: Final Project▫Week 1516 Buffer (in case we need more time in previous weeks)/Finals

Final Project **Model Thinking MA 2040/CS 2040** **Spring 2017**

- Group project - 3 to 4 people in a group
- Form groups and divide tasks - remember your own strengths and weaknesses
- Define a real world problem that seems to be related to one of our models
- Preliminary - Research problem, get data apply model idea
- Form preliminary model - see if it works or not

* Student Projects Using Human Subjects may require IRB Review.

Report Outline

1. Define your topic, a problem or scenario
    a. What is the topic, describe it in detail
    b. What data or information do have about the problem
2. Define model
    a. What model - describe model in general, what is it, how do you use it, what are its parameters, where has this model been applied previously
        i. Is it a computer based solution? Include what you did.
        ii. Is it math or logic based? Include your calculations and

data. Include your input data and output data.

iii. Is it rule based? Include your rules. Why did you settle on these rules? What variations did you try and why or why not did you include or reject those rules?

b. How did you fit your problem into this model

3. Conclusion
    a. Predictions or insight you gained from this model application
    b. Further work on this topic

Should include a bibliography

Report Submissions due:
Mar 20-22: Have project ideas approved
Apr 26: Rough draft
May 1: return of your marked up draft
May 3: Presentations of your models
May 8: Final paper