Course Change Request

New Course Proposal

Date Submitted: 03/14/23 1:07 pm

Viewing: CDS 465 : Modeling Interactive Populations

Last edit: 03/31/23 8:22 am

Changes proposed by: jkinser

In Workflow

1. **CDS Chair**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. Assoc Provost-Undergraduate
5. Registrar-Courses
6. Banner

Approval Path

1. 03/14/23 6:03 pm Jason Kinser (jkinser): Approved for CDS Chair

Are you completing this form on someone else's behalf?

No

Effective Term: Spring 2023

Subject Code: CDS - Computational and Data Sciences

Course Number: 465

Bundled Courses:

Is this course replacing another course? No

Equivalent Courses:

Catalog Title: Modeling Interactive Populations

Banner Title: ModelInteractivePopulations

Will section titles vary by semester? No

Credits: 3

Schedule Type: Lecture

Hours of Lecture or Seminar per week: 2.5

Repeatable: May only be taken once for credit, limited to 2 attempts (N2)

Max Allowable Credits:

6

Default Grade Mode: Undergraduate Regular

Recommended Prerequisite(s):

Recommended Corequisite(s):

Required Prerequisite(s) / Corequisite(s) (Updates only):

CDS 230, CDS 302, or permission of instructor.

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description:

Employs several computational methods to create an agent-based model of an evolving and interactive population. Applied scenarios will include human identification through DNA profiles, community analysis through connected graphs, data generation, virus tracking, and evolution of human traits in time. Software skills developed will include Python, Pandas, and SQL.

Justification:

What: Creating a new course.

Why: Employable skill sets for students earning a CDS degree include projects, team work, solving realistic

problems, and coalescing multiple software platforms. This course will be a culminating experience in which students will develop a large-scale population and provide analysis of that evolving population. Skills learned in the application of the unified system will include Pandas programming, Hidden Markov Models, Hardy-Weinberg statistics, connected graphs, agent-based modeling, Schelling's, model, the Floyd-Warshall algorithm, and eigen-images.

Does this course cover material which crosses into another department? Yes

Impacted Departments:

Department
CS - Computer Science

Learning Outcomes:

Reinforce Python and SQL for modeling and data analysis.
Construct Pandas commands for modeling and data analysis
Understand mechanisms of agent-based modeling as applied to this simulation.
Analyze the population in both short and long range time frames.
Create and evaluate human identification scenarios based on DNA profiles and other metrics.
Modify Schelling's model for migration modeling.
Apply the Floyd-Warshall algorithm for the study of connectedness through agent occupations.
Apply a Hidden Markov Model for the creation of movie titles used in the analysis of connectedness.
Apply eigenimages to create new face images and to perform recognition.

Attach Syllabus
syllabus.pdf

Additional Attachments

Staffing:
Jason Kinser
Possible instructors Anamaria Berea, Arie Croituro, Hoda Bidkhori

Relationship to Existing Programs:
Modeling and simulation are not unique to a single program within Mason. Students from non-CDS majors with the appropriate skills can take this class. The permission of the instructor is requested to ensure that students have the necessary skills to be successful.

Relationship to Existing Courses:
The closest match is perhaps OR 335 Discrete Systems Modeling and Simulation
However, there are significant differences. The proposed course will present applications to the students such as DNA profile matching, connected graphs, Hidden Markov Models, and the tools necessary for creating and evolving a large-scale population. Unlike, OR 335, the proposed course does not use

specialized software, but rather focuses on the tools needed to create the simulation. Students in this course will modify Python scripts to probe and alter the behavior of the algorithms.

Additional Comments:

Reviewer Comments

Key: 18115

Syllabus CDS 465

Title: Modeling Interactive Populations
Instructor: Jason M. Kinser

Description:

In this course, you will study various aspects of modeling an evolving population. You will create an island with cities, and you will use provided scripts to generate an evolving population. This course will assume that you know Python and SQL, and it will introduce Pandas. Using this tool, you will perform analysis of the growing population, solve given scenarios, modify the evolution, and eventually allow your population to immigrate onto islands of other students. By the end of the semester, your island should have several hundred thousand occupants. Furthermore, these occupants will have personality profiles, DNA profiles, employment, and possibly viruses.

Along the way, you will study various algorithms used to create and analyze the population. Assignments will require that you understand the algorithms, can employ the algorithms, and can analyze your island's population.

Expectations:

Students are expected to have access to a computer capable of running Anaconda Python (or equivalent). Students will greatly benefit by bringing laptops to the classroom.

Students should have working skills in Python, SQL, statistics, linear algebra, and trigonometry.

Course Grading:

The grades will be based on class participation and assignments throughout the semester. These assignments will include knowledge of the algorithms, employment of the algorithms, performance of modified scripts, and even the interaction of the populations.

The scores from the projects and homework will be scaled and added. The following is the breakdown for the letter grade.

- A+: 97% of the available points.
- A: 93.3% of the available points.
- A-: 90.0% of the available points.
- B+: 86.7% of the available points.
- B: 83.3% of the available points.
- B-: 80.0% of the available points.
- C+: 77% of the available points.
- C: 73.3% of the available points.
- C-: 70.0% of the available points.
- D: 60.0% of the available points.
- F: Less than 60% of the available points.

Schedule:

Week 1: Introduction to the course; review of Python and SQL skills; Introduction to the “Cardinal” and “Detective” databases

Week 2: ABM theory; Creating an Island; Intro to Pandas with basic queries

Week 3: Pandas compound and aggregate queries; Candidate selection from database; Population analysis

Week 4: Introduction to human DNA profiles; Hardy-Weinberg statistics; Scenario creation; Scenario solution through “Detective” database.

Week 5: Methods of updating Pandas dataframes; More “Cardinal” analysis; Initializing populations; Interacting with SQLite and pandas.

Week 6: Mapping a population; Methods of advancing the population by one month; Methods for marriages and mating.

Week 7: Methods used in breeding, birthing, and divorce; Reports from students on the development of their populations.

Week 8: Adaptation of Schelling’s model; Methods in death, migration, immigration, and others; Reports from students on the development of their populations.

Week 9: Basic theory and metrics of connected graphs; Implementation in Python; Hidden Markov Models; Generation of occupations; Floyd-Warshall; Analysis of the population; Reports from students on the development of their populations.

Week 10: Theory of propagating viruses and implementation; Analysis of virus spread and mitigations; Reports from students on the development of their populations.

Week 11: Reports from students on the development of their populations; recessive genes; Altering functions; Reports from students on the development of their populations.

Week 12: Theory of eigenfaces; Create face images for siblings; Migration of student populations to other student islands; Reports from students on the development of their populations.

Week 13: Invasion analysis; Reports from students on the development of their populations.

Week 14: Remaining analysis; Final from students on the development of their populations.

Assistances:

Below are just of few support services available to students. The full list is at: https://stearnscenter.gmu.edu/knowledge-center/knowing-mason-students/student-support-resources-on-campus/

IT Support:

If you are having difficulties with your Mason network account, or with software on the Mason network, please contact IT support: support@gmu.edu . Or pay them a visit in Innovation Hall: ITS Support Center, Innovation Hall, Room 226. You can also call them: 703-993-8870.

Academic Integrity:

It is expected that students adhere to the George Mason University Honor Code as it relates to integrity regarding coursework and grades. The Honor Code reads as follows: "To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the University Community have set forth this: Student members of the George Mason University community pledge not to cheat, plagiarize, steal and/or lie in matters related to academic work." More information about the Honor Code, including definitions of cheating, lying, and plagiarism, can be found at the Office of Academic Integrity website at http://oai.gmu.edu/honor-code/.

Accommodations:

If you are a student who needs academic accommodations, please contact Disability Services (DS) at 703-993-2474. All academic accommodations must be arranged through DS.

Digital Communication:

Privacy is important for faculty and student communications. Students are required to use their Mason email when communicating their instructors. Instructors, being employees of the State of Virginia, are required to use their Mason email when communicating with students.

Freedom:

This course will encourage students to respectfully present their thoughts. At Mason, we have a wonderful diversity of students providing a rich resource of education, thoughts, and growth. Through this unique Mason community, we can learn more about ourselves and our world then we could in almost every other university. https://www2.gmu.edu/1stAmendment

Respect for Diversity:

Mason is a great example of a diverse society, where students and faculty can embrace the knowledge and relationships gained from being in an academic environment with people from a large variety of countries, backgrounds, experiences, heritages, and so on. All students are expected to respect people within this diverse population, and they could greatly benefit from its riches by immersing in the Mason experience. Disrespect will not be tolerated in this class.

Title IX:

Notice of Mandatory Reporting of Sexual Assault, Interpersonal Violence and Stalking: As a faculty member, I am designated as a "Responsible Employee," and must report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per University Policy 1412. If you wish to speak with someone confidentially, please contact one of Mason's confidential resources, such as the Student Support and Advocacy Center (SSAC) at 703-

380-1434 or Counseling and Psychology Services (CAPS) at 703-993-2380. You may also seek assistance from Mason's Title IX Coordinator by calling 703-993-8730 or emailing cde@gmu.edu