Course Syllabus: COMPSCI 590N
Introduction to Numerical Computing with Python

Course Description: This course is an introduction to computer programming for numerical computing. The course is based on the computer programming language Python and is suitable for students with no programming or numerical computing background who are interested in taking courses in machine learning, natural language processing, or data science. The course will cover fundamental programming, numerical computing, and numerical linear algebra topics, along with the Python libraries that implement the corresponding data structures and algorithms. The course will include hands-on programming assignments and quizzes. No prior programming experience is required. Familiarity with undergraduate-level probability, statistics and linear algebra is assumed. 1 credit.

Required Textbook: We will use the following two freely available materials in this course.

Introduction to Python for Computational Science and Engineering: This text provides a basic overview of python and an introduction to numerical computing issues.
URL: http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf

SciPy Lecture Notes: These organized notes provide an overview of NumPy and SciPy functions as well as a number of useful exercises.
URL: http://www.scipy-lectures.org/

Course Website: The course website will be hosted on Moodle at https://moodle.umass.edu/. The course website will host lecture notes, assignments, and pointers to readings and videos. We will use Piazza (https://piazza.com/) for a course discussion forum.

Grading Plan: Programming assignments (60%). Quizzes (40%).

Accommodation Statement: The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), you

may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.

Academic Honesty Statement: Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst. Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent (http://www.umass.edu/dean_students/codeofconduct/acadhonesty/).

Course Schedule: The course will meet twice per week for the first six weeks of the semester. This schedule may change as the semester progresses.

Week 1: Introduction to Python

- Data types and Assignment
- Basic data structures (lists, tuples, dictionaries)
- Mathematical and logical operators

- Control flow (looping and branching)
- Functions
- Assignment 1

Week 2: Computing with Numbers

- Representing Numbers: Fixed vs Floating Point representations
- Overflow/Underflow, Round-Off Error, Floating point comparisons
- Computing Special Functions (log, exp, sin, cos, sqrt, etc.)
- Assignment 2

Week 3: Computing with Arrays

- Multi-Dimensional Arrays
- Array Indexing and Slicing
- Mathematical and Logical Operators for Arrays
- Broadcasting and Array operations
- Assignment 3

Week 4: Computing with Vectors and Matrices

- Vectors and Matrices
- Basic linear algebra operations (addition, inner/outer products, etc.)
- Advanced linear algebra operations (matrix inversion and decompositions, etc.)
- Assignment 4

Week 5: Computing with Probability

- Counting and Histograms
- Probability mass functions and probability density functions

- Random numbers and simulating random variables
- Assignment 5

Week 6: Documentation, Testing, and Reproducibility

- Documenting Python code and unit testing
- Programming for reproducibility and capturing workflows
- Assignment 6