CSCI, 509, 01W, Introduction to Computational Science

COURSE SYLLABUS: Spring 2019

INSTRUCTOR INFORMATION

Instructor: Derek Harter, Ph.D., Professor
Office Location: Science 355
Office Hours: T, Th 1 – 3:30 pm
University Email Address: Derek.Harter@tamuc.edu
Preferred Form of Communication**:** e-mail

COURSE INFORMATION

Materials – Textbooks, Readings, Supplementary Readings

Most materials, work and readings will be provided as iPython notebooks for students to read and experiment with. Many materials were developed using the following sources. Additional readings from these sources are encouraged for a deeper understanding of the topics:

- Langtangen, H.P. (2012). A Primer on Scientific Programming with Python 3rd ed. Springer.
- Newman, M. (2012). Computational Physics. CreateSpace.

Course Description

Big scientific data sets are growing exponentially both in size and complexity. Extracting meaningful information from this data requires not only programming skills, but also understanding the analysis work-flows and mathematical models and visualization tools that help to condense large amounts of information into a comprehensible story. Computational science is the scientific investigation of problems through modeling, simulation and analysis of physical processes on a computer. Computational science is now considered by most scientists to be on par with the development of scientific theory and the use of experimentation in order to understand more about our world. Computational science is not the same as computer science. Rather, it is an

interdisciplinary blend of scientific models, applied mathematics, computational techniques, and practices. This Introduction to Computational Science course focuses upon simple and intuitive computational models and methods.

Prerequisites: CSCI 515. (3 credit hours)

Student Learning Outcomes

1. Be able to apply numerical solutions to scientific modeling problems.
2. Apply computational techniques to tackling scientific research questions.
3. Familiarize with standard tools of computational science: HPC, R/Python/Numpy/Scipy toolkit stack, markup and documentation systems, plotting and visualization, etc.
4. Understand stochastic models and be able to apply to building simple Monte Carlo simulations.
5. Be familiar with fundamental building blocks of numerical modeling and discrete calculus for computational approximation.
6. Understand importance of series and difference equations for discrete approximations of numerical methods.

Learning outcomes will be measured through mapping assignment and test questions to specific outcome items, as well as through exit surveys of student experiences with the outcome familiarity.

COURSE REQUIREMENTS

This course forms one of the core subjects in the master's degree program in the Computational Sciences. Computational sciences differs from the traditional computer science discipline in several ways, but most importantly as being focused on applying computational methods to solving large scientific problems. Thus this type of scientific data analysis of large complex data sets is both increasingly crucial to scientific research, as well as being in great demand for practitioners who can apply computational analysis and modeling to such data sets. This course directly addresses this area, and forms a cornerstone subject for any student wishing to understand and practice computational science research.

Goals include:

- Understand the scientific process and the philosophy of science.
- Understand the purpose and value of computational science.
- Be exposed to the common tools and practices of working computational scientists.
- Learn to use basic computational simulation and modeling tools, specifically the Python toolkit stack.

The *syllabus/schedule are subject to change.*

- Be exposed to basic data analysis and modeling concepts and practices.
- Learn about common computational algorithms for performing scientific modeling, including computational integration and differentation, random Monte Carlo methods, solutions of ordinary differential equations, etc.

Minimal Technical Skills Needed

Students should be proficient in a high level programming language, like C++, Python or Java.

Instructional Methods

All materials, assignments and tests will be conducted through the D2L MyLeo Online learning system.

Student Responsibilities or Tips for Success in the Course

To plan a minimum of three hours of outside preparation for each hour of class is a safe time allocation for successfully completing the course.

GRADING

Final grades in this course will be based on the following scale:

A = 90%-100%
B = 80%-89%
C = 70%-79%
D = 60%-69%
F = 59% or Below

Assignments: There will be regularly assigned homework problems and programming problems. Assignments will be given and returned via the online MyLeo Online (D2L) system as a convenience to the students and the instructor. I

Assessments

Two Exams: 50% (25% each)
Labs / Programming Assignments (appx. 6-8): 50% (evenly distributed)

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TECHNOLOGY REQUIREMENTS

LMS

All course sections offered by Texas A&M University-Commerce have a corresponding course shell in the myLeo Online Learning Management System (LMS). Below are technical requirements

LMS Requirements:
https://community.brightspace.com/s/article/Brightspace-Platform-Requirements

LMS Browser Support:
https://documentation.brightspace.com/EN/brightspace/requirements/all/browser_support.htm

YouSeeU Virtual Classroom Requirements:
https://support.youseeu.com/hc/en-us/articles/115007031107-Basic-System-Requirements

ACCESS AND NAVIGATION

You will need your campus-wide ID (CWID) and password to log into the course. If you do not know your CWID or have forgotten your password, contact the Center for IT Excellence (CITE) at 903.468.6000 or helpdesk@tamuc.edu**.**

Note: Personal computer and internet connection problems do not excuse the requirement to complete all course work in a timely and satisfactory manner. Each student needs to have a backup method to deal with these inevitable problems. These methods might include the availability of a backup PC at home or work, the temporary use of a computer at a friend's home, the local library, office service companies, Starbucks, a TAMUC campus open computer lab, etc.

COMMUNICATION AND SUPPORT

If you have any questions or are having difficulties with the course material, please contact your Instructor.

Technical Support

If you are having technical difficulty with any part of Brightspace, please contact Brightspace Technical Support at 1-877-325-7778. Other support options can be found here:

https://community.brightspace.com/support/s/contactsupport

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Interaction with Instructor Statement

The instructor's communication response time and feedback on assessments are stated clearly.

COURSE AND UNIVERSITY PROCEDURES/POLICIES

Course Specific Procedures/Policies

Attendance/Lateness, Late Work, Missed Exams and Quizzes and Extra Credit

Syllabus Change Policy

The syllabus is a guide. Circumstances and events, such as student progress, may make it necessary for the instructor to modify the syllabus during the semester. Any changes made to the syllabus will be announced in advance.

University Specific Procedures

Student Conduct

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. The Code of Student Conduct is described in detail in the Student Guidebook.
http://www.tamuc.edu/Admissions/oneStopShop/undergraduateAdmissions/studentGuidebook.aspx

Students should also consult the Rules of Netiquette for more information regarding how to interact with students in an online forum:
https://www.britannica.com/topic/netiquette

TAMUC Attendance

For more information about the attendance policy please visit the Attendance webpage and Procedure 13.99.99.R0.01.
http://www.tamuc.edu/admissions/registrar/generalInformation/attendance.aspx

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/academic/13.99.99.R0.01.pdf

Academic Integrity

Students at Texas A&M University-Commerce are expected to maintain high standards of integrity and honesty in all of their scholastic work. For more details and the definition of academic dishonesty see the following procedures:

Undergraduate Academic Dishonesty 13.99.99.R0.03

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http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/undergraduates/13.99.99.R0.03UndergraduateAcademicDishonesty.pdf

Graduate Student Academic Dishonesty 13.99.99.R0.10

http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/graduate/13.99.99.R0.10GraduateStudentAcademicDishonesty.pdf

Students with Disabilities-- ADA Statement

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services
Texas A&M University-Commerce
Gee Library- Room 162
Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
Email: studentdisabilityservices@tamuc.edu
Website: Office of Student Disability Resources and Services
http://www.tamuc.edu/campusLife/campusServices/studentDisabilityResourcesAndServices/

Nondiscrimination Notice

Texas A&M University-Commerce will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age, genetic information or veteran status. Further, an environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.

Campus Concealed Carry Statement

Texas Senate Bill - 11 (Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in Texas A&M University-Commerce buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal Code (PC) 46.035 and A&M-Commerce Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations.

For a list of locations, please refer to the Carrying Concealed Handguns On Campus document and/or consult your event organizer.

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Web url:
http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployeesAndStudents/34.06.02.R1.pdf

Pursuant to PC 46.035, the open carrying of handguns is prohibited on all A&M-Commerce campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1.

COURSE OUTLINE / CALENDAR

1. Weeks 1-3: Introduction to Computational Science, Introduction to Python and Scientific Libraries (NumPy, SciPy, Matplotlib, Pandas).
2. Weeks 4-6: Numerical representations, Series and Sequences. Introduction to Taylor Series and its expansion.
3. Week 7-9: Review of integral and differential calculus. Integration and Differentiation.
4. Week 9-12: Review of linear algebra. Ordinary Differential Equations and systems of equations.
5. Week 13-16: Review of probability and statistics. Random Numbers and Monte Carlo Simulations.

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