Introduction to Computational Science

Course Syllabus
2016 - II

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OFFICE	5 - 112
OFFICE HOURS	Thursday 14:00 - 16:00
E-MAIL ADDRESS	cvera@udem.edu.co
CLASS HOURS	10:00 - 12:00 Tuesday & Thursday

A DESCRIPTION This course is meant to provide a general description of state of the art problems in computational science and some solutions. It emphasizes in developing basic skills to solve problems in many diverse areas included, but not limited to, non-linear dynamics and chaos, machine learning, basic sciences, finances and economy.

B ORGANIZATION We will adopt a lecture-lab methodology, in which topics are introduced by the lecturer at the beginning of each session and the tasks are assigned to the students. The difficulty of each problem determines the number of lectures that will be dedicated to a particular subject, but it is usually never longer than 3 sessions. After this course the students will be prepared to analyze, understand and propose solutions to challenging problems useful in field such as industry, academy and sciences.

C COURSE OBJECTIVES

1. To introduce students to the use of computational tools to solve problems in science and industry
2. To introduce the students to tools for problem solving in such fields
3. To provide students with a wide perspective of the uses and large variety of applications of computational sciences
4. To orient students in the development of an solution to a problem applying skills learned during the course

D COURSE TOPICS The course will cover the following topics

1. Recursive maps
2. Continuous non-linear dynamical systems
3. Chaos theory

4. Random number generation
5. Probability distribution functions
6. Monte Carlo Markov chains
7. Linear programming
8. Quadratic programming
9. Machine learning
10. Neuronal networks
11. Support vector machines

E TEXT

1. Introduction to Computational Science by *Shiflet & Shiflet*
2. Neural Networks And Learning Machines by *Simon Haykin*
3. Chaos, and what to do about it? by *Predrag Cvitanović*

F GRADING PLAN

Course will be evaluated as follows:

1. Midterm (25%) Sept 15/2016
2. Final (25%) Nov 17/2016
3. Project (25%) Nov 15/2016
4. Homework (15%) Sep 06/2016
5. Project report (10%) Oct 06/2016

HOMEWORK A problem in MCMC to uploaded in a git repository. The problem is graded as follows: 20% documentation, 80% execution. The student whose solution executes in the shortest time will be awarded with a +1 in the final exam.

MT & FINAL The final and midterm exams are designed to be completed in two hours. The use of the lab computers is allowed. The network will be offline for the duration of the exam and all local files removed before and after.

PROJECT REPORT A report of the project including an paper and a first numerical test.

PROJECT See below

G PROJECTS This is the list of projects that will be developed during the course

(P1) IMAGE CLASSIFICATION WITH NEURAL NETWORKS

(P2) IDENTIFICATION OF HIGH RISK PATIENTS USING SVM

(P3) CONTROL OF CHAOTIC CARDIAC RHYTHM

(P4) GENERATING INITIAL CONDITIONS FOR GALACTIC DYNAMICS