1SL1000 – CIP - Convergence, Integration and Probabilities

Instructors: Alexandre Richard
Department: DÉPARTEMENT MATHÉMATIQUES
Language of instruction: ANGLAIS, FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 60
On-site hours (HPE): 39,00

Description

The objective is to have students master the mathematical concepts and formalisms of the modelling of complex systems, through
• the analysis of integro-differential models ; the techniques of approximation and their convergence;
• the construction of transforms to solve problems;
• the deep knowledge of measure theory, as the basis of the modern framework of probability, necessary to describe fluctuating phenomena, and of data processing.
This theoretical framework will allow to tackle the techniques of signal processing and the statistical study of data in common core courses. In second year, students will be able to confort these bases by studying stochastic processes and nonlinear phenomena in advanced courses.

Quarter number
SG1 and ST2

Prerequisites (in terms of CS courses)
None

Syllabus

Topology
Metric spaces
Normed vector spaces
Hilbert spaces
Measured spaces
Construction of the integral with respect to a measure
L^p spaces
Interchanging limits and integrals
Probability, random variables

Product measures, probability on R^N, independence
Convolution, Fourier transform and characteristic functions
Gaussian vectors
Convergence of sequences of random variables
Conditional expectation
Random walks

Class components (lecture, labs, etc.)
Several tracks are proposed within this course, depending on choices and selection of students.
Students will be assigned in one of the following 3 tracks:

Track 1 : classroom setting in French
Lectures and tutorials in classroom in French (several level groups, limited number of places)
• Lectures : 12 slots of 1.5 hrs (18 HPE / 27 HEE) in classroom
• Tutorials : 12 slots of 1.5 hrs (18 HPE / 27 HEE) in classroom

Some students will be assigned in moderate track with reinforcement (selection) :
• 2 groups of 25 students in French and 2 groups of 25 students in English,
• 10 supplementary slots of 1.5 hrs for reinforcement.

Track 2 : blended in French
Lectures are online, prerecorded videos in French (choice of the language by students). Tutorials happen in classroom in the same language as the lectures. The course content is transmitted via prerecorded video sequences. Interaction with the teachers takes place during the scheduled tutorials and through digital means. This track allows students to adapt their learning pace, especially when the concepts are more difficult to grasp.
• Lectures, 12 slots of 1.5 hrs (18 HPE / 27 HEE): online videos;
• Tutorials: 12 slots of 1.5 hrs (18 HPE / 27 HEE): in class with a quiz at the beginning of each session.

Track 3 : blended in English
Lectures and tutorials in English (choice of the language by students). Part of the content of the lectures is transmitted via prerecorded video sequences. The rest of the lectures happens in class. This track allows students to adapt their learning pace, especially when the concepts are more difficult to grasp.
• Lectures, 12 slots of 1.5 hrs (18 HPE / 27 HEE): online video (30 minutes approx..), 1 hour in class starting with a quiz;
• Tutorials: 12 slots of 1.5 hrs (18 HPE / 27 HEE): in class.

Math Libre 1 :
In place of the traditional CIP class, a small group of selected students will follow a special class directed by Erick Herbin. The advanced topics and pedagogical approach of this class will be detailed by Erick Herbin in the beginning of September.

Important : Students assigned to groups where the teaching takes place in a classroom setting will make an honorary commitment to be present at all sessions.

Grading
Ongoing evaluation of varying form depending on the group, and one final exam of 3 hrs common to all groups.
Documents and electronic devices are not allowed during the evaluations

Except for students of reinforcement groups, the weighting between the different evaluation will be as follows:
Ongoing evaluation [CC]: 30%
Final Exam [EF]: 70%
so that the 1st session grade is max(0,3*CC + 0,7*EF, EF).

For students of reinforcement groups, an additional evaluation will take place inside within the reinforcement sessions.
For reinforcement groups, the weighting will be:
Specific evaluation [MR] : 10%
Ongoing evalution : 20%
Final Exam : 70%
so that the 1st session grade is max(0,1*MR + 0,2*CC + 0,7*EF, EF).

Note that presence in class is taken into account in the valuation of the reinforcements and that students who are registered in reinforcement cannot leave it without the agreement of the professor in charge of this course.

The evaluation of students from the Free Math 1 group will consist only of their grade in the final exam.

Course support, bibliography
Printed Lecture Notes (in English) and an extensive bibliography (books, electronic documents, exercise book)

Resources
• Teaching staff (instructor(s) names):

Julien Bect, Philippe Bouafia, John Cagnol, Ludovic Goudenège,
Ioane Muni Toke - lectures in French
Alexandre Richard - lectures in English
Erick Herbin - special classes Math Libre 1 in French

• Maximum enrollment: 17 tutorial groups of between 25 and 80 students, depending on level groups
• Software, number of licenses required: None
• Equipment-specific classrooms (specify the department and room capacity): 0

Description of the skills acquired at the end of the course
C1.1 (1st milestone)
Analyze the scientific aspects of the overall behavior of a small-scale system (e.g., isolated part of a complex system), including the identification of factors that influence its behavior.

C1.3 (1st milestone)
Solve: solve a problem with a practice of approximation.