2021 International Summer Courses on Mathematics and Statistics

Summary Report

China·Nanjing

August, 2021

International Summer School Program at Southeast University

2021 International Summer Courses on Mathematics and Statistics

Overview

This program will select appropriate problem models from the cutting-edge aspects of mathematics and statistics respectively, and introduce the latest research results in the related fields, in order to improve the understanding and utilization of knowledge for students. The emphasis of both theory and application is the highlight of this course. In addition, the reflection of the interdisciplinary cross-integration is also the main goal of this course. The program consists of three 24-hour short online courses with 1 credit for each course.

Course 1 Selected Topics in Modern Mathematics

Hours/Credits: 24 hours/ 1 credit

Lecturer: We will invite the team from University of Luxembourg to teach this course, including: Prof. Dr. Jean-Marc Schlenker, Dr. Fei Pu, Prof. Dr. Antonella Perucca , Prof. Dr. Gabor Wiese, Prof. Dr. Ivan Nourdin and Prof. Dr. Mark Podolskij.

Course 2: Selected Topics in Frontier of Scientific Computation

Part I : Machine Learning and Design optimization under uncertainty

Hours/Credits: 12 hours/ 0.5 credit

Lecturer: Prof. Matin Stynes, Beijing Computational Science Research Center

Part II: Introduction to Numerical Methods for Stochastic Differential Equations

Hours/Credits: 12 hours/ 0.5 credit

Lecturer: Prof. Yanzhao Cao, Department of Mathematics & Statistics, Auburn University

Course 3: Categorical Data Analysis

Hours/Credits: 24 hours/ 1 credit

Lecturer: Prof. Weixin Yao, Department of Statistics, University of California, Riverside

Time Period

Jul. 5 Aug. 1, 2021

Requirements

Mainly for the students who have finished 2nd year undergraduate courses

in math or statistics

Number of Participants

200

Application Deadline

Jun. 15, 2021

Contents

COURSE 1: SELECTED TOPICS IN MODERN MATHEMATICS

Hours/Credits	24 hours(July 5 - August 1, 2021) / 1 credit Wednesday and Friday 14:45 pm - 17:00 pm Platform: Zoom + QQ
Description	"Selected Topics in Modern Mathematics" is a compulsory course for all majors of mathematics. The course content will be selected by the lecturer according to his professional expertise and in combination with the development of modern mathematics, including classical hot topics in analysis, algebra, geometry and other branches. Focusing on several mathematical problems, the lecturer will introduce the research history, study methods and latest advances in detail, to broaden the students' academic vision and enhance the students' interest in mathematics.
Instructor	A teaching team from University of Luxembourg teach this course, including:

Prof. Dr. Jean-Marc Schlenker (**Geometry**)

Dr. Fei Pu (**Analysis**)

Prof. Dr. Antonella Perucca (course 1) (**Algebra**)

Prof. Dr. Gabor Wiese (course 2) (**Algebra**)

Prof. Dr. Ivan Nourdin (course 1) (**Probability and Statistics**)

Prof. Dr. Mark Podolskij (course 2) (**Probability and Statistics**)

PREREQUISITES

Calculus, Linear algebra. It will be helpful if students have preliminary knowledge of Real analysis, Complex analysis, Abstract algebra, Probability and Statistics.

COURSE OBJECTIVES

======== **GEOMETRY** ========

Title: The geometry of polyhedra in Euclidean space

Abstract: We intend to present some classical and more recent results on the geometry of convex polyhedra in Euclidean space, as well as some open problems of current interest. The course could fit over 2 sessions of 135mn. Assessment could be done through a few multiple-choice of numerical-answer questions in a moodle-type test.

======== **ANALYSIS** ========

Title: Basics of Fourier Analysis

Abstract: I am planning to follow Stein's book to present some basic materials on Fourier Analysis and the key words are: Fourier inversion, Plancherel identity, Poisson summation formula, Theta and zeta functions.

======== **ALGEBRA** ========

Title: Finite fields: from the cyclicity of the unit group to Artin's conjecture on primitive roots, Gauss' quadratic reciprocity law, primality tests and the Langlands program

Abstract:

Part 1 -

We start by considering the unit group (Z/pZ)* of the integers modulo a prime number p, and then investigate the multiplicative order and index of an element in this group. By varying the prime number, distribution questions naturally arise, the most famous being the one addre

understand the conjecture and its heuristics we introduce cyclotomic number fields and Kummer extensions. To conclude we present recent results on this topic obtained by mathematicians in Luxembourg.

Part 2 - A primality test, quadratic reciprocity, and more general reciprocity laws (G. Wiese)

From Part 1, we know that half of the elements in (Z/pZ)* are squares and half are non-squares. The famous quadratic reciprocity law conjectured by Euler and proved

July 14 (Wednesday)	Prof. Dr. Antonella Perucca	Algebra
July 16 (Friday)	Prof. Dr. Gabor Wiese	Algebra
July 21 (Wednesday)	Dr Fei Pu	Analysis
July 23 (Friday)	Dr Fei Pu	Analysis
July 28 (Wednesday)	Prof. Dr. Ivan Nourdin	Probability and Statistics
July 30 (Friday)	Prof. Dr. Mark Podolskij	Probability and Statistics

FEEDBACK FROM STUDENTS

COMMENT 1

COMMENT 2

COMMENT 3

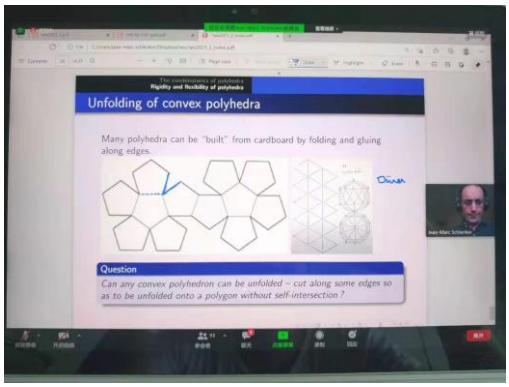
COMMENT 4

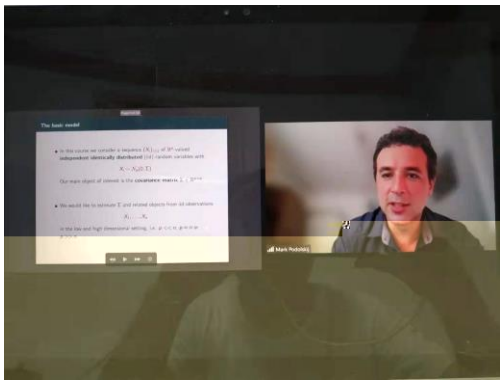
COMMENT 5

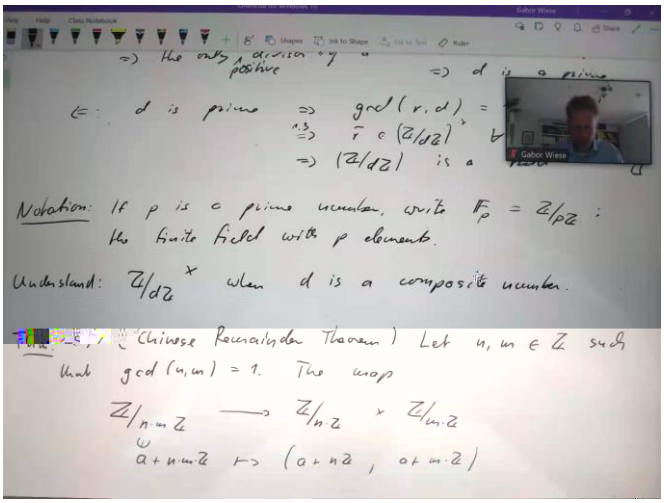
COMMENT 6

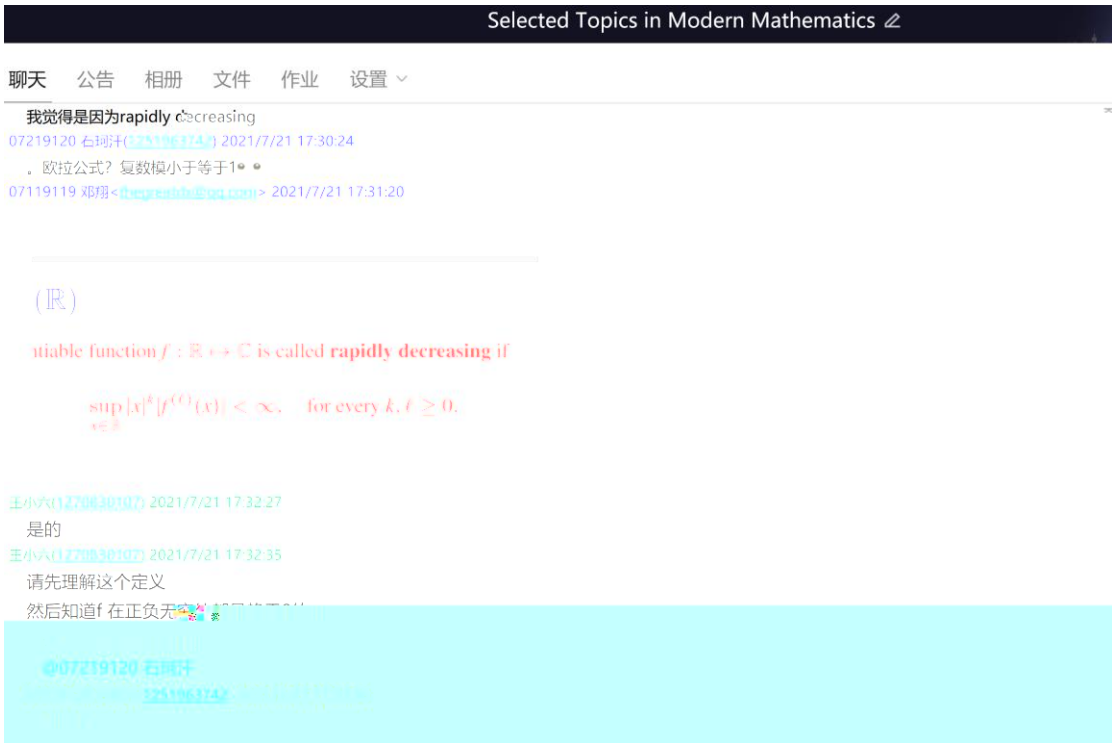
FEEDBACK FROM TEACHERS

ZOOM QQ








Selected Topics in Modern Mathematics
聊天 公告 相册 文件 作业 设置
我觉得是因为rapidly decreasing
07219120 石珂汗(3251963742) 2021/7/21 17:30:24
。欧拉公式？复数模小于等于1
07119119 邓翔<fwgreatbb@qq.com> 2021/7/21 17:31:20
(ℝ)
utiable function $f:\mathbb{R}\to\mathbb{C}$ is called rapidly decreasing if
$$\sup_{x\in\mathbb{R}}|x|^k|f^{(\ell)}(x)|<\infty,\quad \text{for every } k,\ell\geq 0.$$
王小六(1270830107) 2021/7/21 17:32:27
是的
王小六(1270830107) 2021/7/21 17:32:35
请先理解这个定义
然后知道f 在正负无
@07219120 石珂汗
3251963742


Selected Topics in Modern Mathematics
聊天 公告 相册 文件 作业 设置
我布置的作业
2021-7-29 星期四
数学作业
Homework 4
数学作业
数学作业
Homework 1
2021-7-16 星期五
数学作业
Homework 2

Calculus, Linear Algebra, Differential Equations, Numerical Analysis. Students are strongly encouraged to use MATLAB for programming.

COURSE OBJECTIVES

After this course, students should be able to

Understand the background of the convection-diffusion problems

Understand the fundamental theory of the one-dimensional convection- diffusion problems

Master the finite difference method for the one-dimensional convection- diffusion problems and its convergence analysis

CLASS SCHEDULE

Hours 1-2	Introduction to the convection-diffusion problems by some motivating examples
Hours 3-4	Maximum principle and asymptotic

Instructor	Yanzhao Cao (Department of Mathematics & Statistics) Homepage: http://webhome.auburn.edu/~yzc0009/

1983

1996

SIAM J. Numer. Anal.

Numer. Math.

Math. Comp.

IMA J. Numer. Anal.

SIAM J. Numer. Anal.,

PREREQUISITES

Calculus, linear algebra, differential equations and probability. Students are strongly encouraged to use MATLAB for programming.

COURSE OBJECTIVES

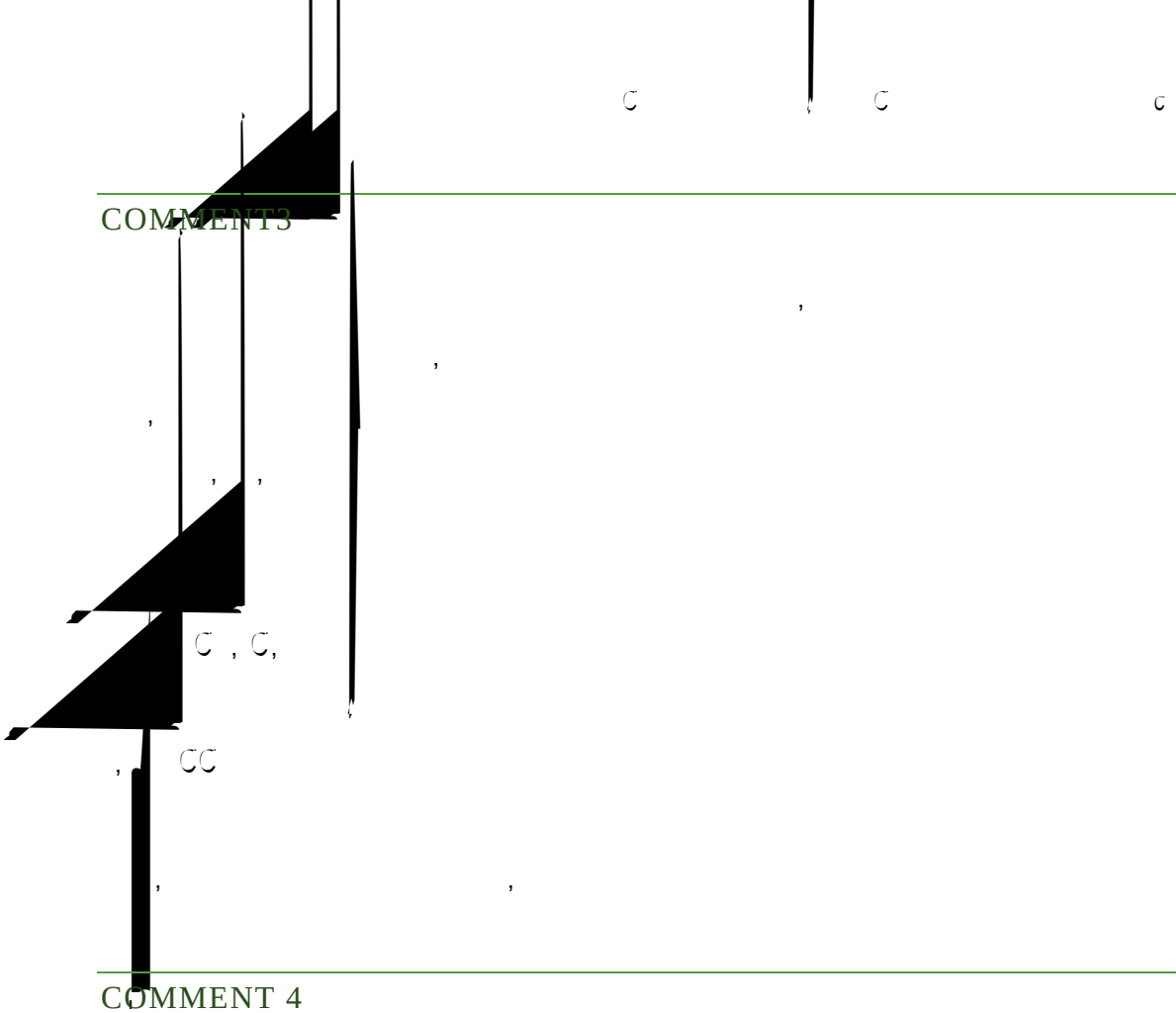
After this course, students should be able to

- Learn the background and application to the mathematical models with random parameters or stochastic disturbance
- Master basic algorithms for solving problems with stochastic disturbance or random parameters
- Learn the algorithms to stochastic computation based on machine learning

CLASS SCHEDULE

Hours 1-2	Introduction to stochastic differential equations, including some motivating examples.
Hours 3-4	Random walk, Brownian motion and stochastic calculus, and stochastic differential equations
Hours 5-6	Strong solutions and its well-posedness
Hours 7-8	Basic concepts of numerical methods for stochastic differential equations, simulation of white and color noises ;

	Numerical methods for linear equations: stability and convergence
Hours 9-10	Numerical methods for nonlinear equations: Stiffness and treatment
Hours 11-12	Parameter estimation or stochastic differential equations
	Numerical experiment training-Euler-type methods
Hours 15-16	Numerical experiment training-Milstein-type methods



COMMENT 3

COMMENT 4

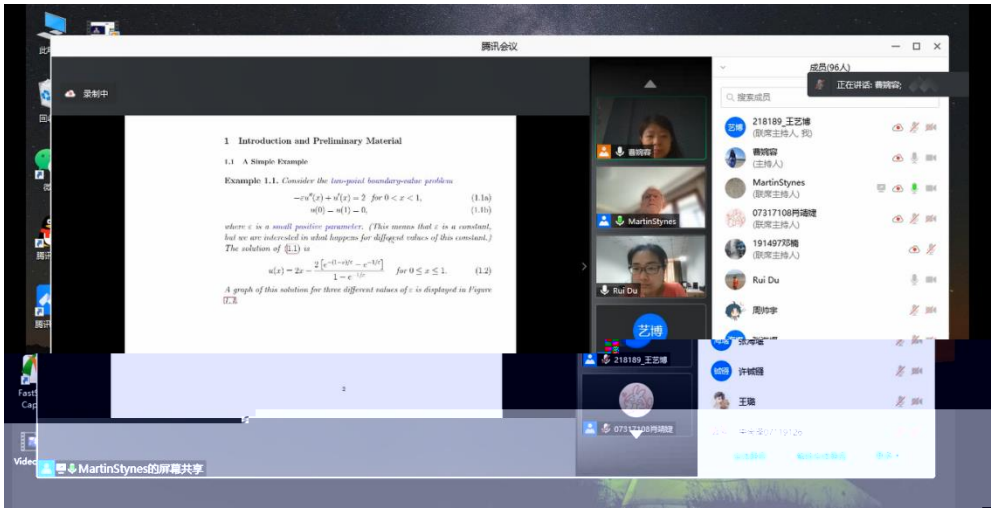
COMMENT 5

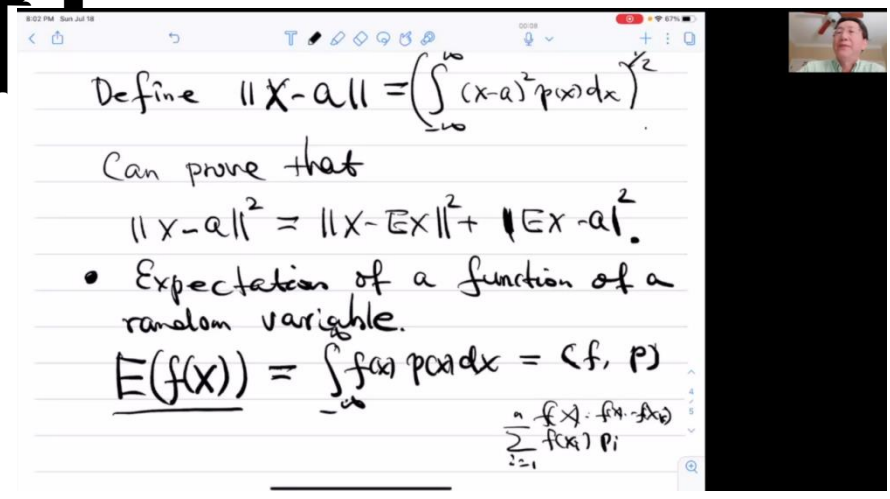
COMMENT 6

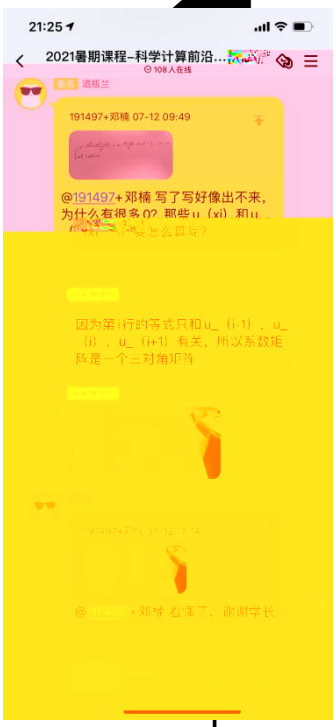
COMMENT 7

COMMENT 8

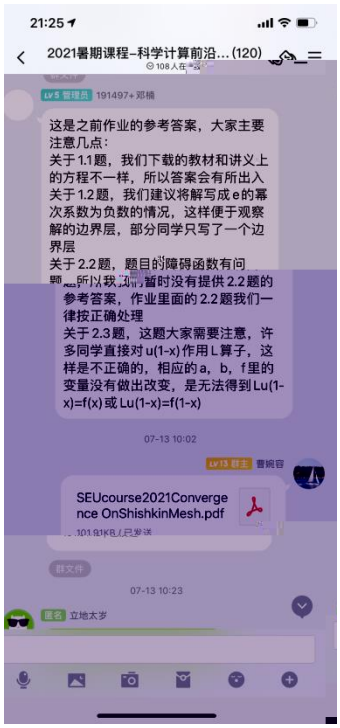
FEEDBACK FROM TEACHERS






21:25
2021暑期课程-科学计算前沿...
108人在线
191497+邓楠 07-12 09:49
@191497+邓楠 写了写好像出不来，为什么有很多0？那些u_(xi)和u_
因为第i行的等式只和u_(i-1)，u_(i)，u_(i+1)有关，所以系数矩阵是一个三对角矩阵
@191497+邓楠 看懂了，谢谢学长


21:25
2021暑期课程-科学计算前沿...(120)
108人在线
匿名 铁圈孔目
老师辛苦了
07-13 10:46
匿名 活闪婆


21:25
2021暑期课程-科学计算前沿...(120)
108人在线
LV5 管理员 191497+邓楠
这是之前作业的参考答案，大家主要注意几点：
关于1.1题，我们下载的教材和讲义上的方程不一样，所以答案会有所出入
关于1.2题，我们建议将解写成e的幂次系数为负数的情况，这样便于观察解的边界层，部分同学只写了一个边界层
关于2.2题，题目的障碍函数有问题，所以我们暂时没有提供2.2题的参考答案，作业里面的2.2题我们一律按正确处理
关于2.3题，这题大家需要注意，许多同学直接对u(1-x)作用L算子，这样是不正确的，相应的a，b，f里的变量没有做出改变，是无法得到Lu(1-x)=f(x)或Lu(1-x)=f(1-x)
07-13 10:02
LV13 群主 曹婉容
SEUcourse2021Convergence OnShishkinMesh.pdf
群文件
07-13 10:23
匿名 立地太岁

COURSE 3: CATEGORICAL DATA ANALYSIS

Hours/Credits	24 hours (July 1 August 1, 2021)/ 1 credit Wednesday and Friday 8:00 am 10:35 am
Description	The content mainly includes semi-parametric and non-parametric statistics, robust statistical models, high-latitude data and statistical analysis of big data, etc. Semi-parametric and non-parametric statistical models have a wide range of applications, and their assumptions are weaker than traditional parametric models, so they are more widely used especially in the era of big data, when statistical inferences tend to be more accurate. The data collected today often have outliers, and traditional statistical inferences such as the least square method for these outliers are very unstable and often lead to false inferences. Robust statistical models are not affected by these outliers and can provide robust and reliable statistical inferences. In the era of big data, a lot of data is high latitude. Traditional statistical analysis methods are often not applicable at this time. This course will introduce a series of high latitude statistical methods and some big data statistical calculation methods.

Instructor

Weixin Yao(University of California, Riverside)
https://faculty.ucr.edu/ ~weixiny/index.html

PREREQUISITES

Calculus, Linear Algebra, Differential Equations, Real Analysis, Complex Analysis, Probability Theory, Mathematical Statistics, Random Processes

COURSE OBJECTIVES

This course will introduce a series of high latitude statistical methods and some big data statistical calculation methods.

CLASS SCHEDULE

Hours 1-2	Introduction to Bayes rules, parameter estimation, and model selection, including some motivating examples.
Hours 3-4	Uncertainty propagation and classic sampling method
Hours 5-6	Classic matching method and Bayesian learning
Hours 7-8	Expressing a priori uncertainty: general principles, reduced dimensions
Hours 9-10	Numerical methods for anti-problems and data assimilation
Hours 11-12	Design optimization under uncertainty
Hours 13-14	Set-up and objectives
Hours 15-16	Decision-theoretic framework for classification
Hours 17-18	Data and ambitions
Hours 19-20	

COMMENT 2

COMMENT 3

COMMENT 4

COMMENT 5

FEEDBACK FROM TEACHERS