

Lectures on Data Science, Methods & Applications:

Uncertainty Quantification in a nutshell - The Bayesian framework for inverse problems

June 7-8, 2021

Trainers	Dr. N. Ben Rached, Dr. C. Ben Hammouda
Learning objectives	The Bayesian approach is fundamental in quantifying uncertainty within applications involving the blending of mathematical models with data. This mini-course aims to provide basic knowledge of the mathematical and computational tools related to the formulation and the implementation of the Bayesian approach to inverse problems. We will cover various efficient numerical techniques and algorithms for this class of problems.
Module content	The focus of this course will be on the following topics: <ul style="list-style-type: none"> • Bayesian statistics: Bayes' theorem and marginalization, prior probability, likelihood function, posterior probability, evidence, the evolution of the posterior distribution for different priors, sequential or one-step data analysis (4 hours). • Discrete-time Markov chains: definition (initial distribution, transition matrix, stationary or time-homogeneous transition matrix) (4 hours). • Markov chain Monte Carlo (MCMC) formulation and algorithm, in particular, the Metropolis-Hastings algorithm (2 hours). • Practical MCMC examples (with codes) (2 hours).
Prerequisites	Fundamentals of probability theory and statistics
Language	English
Literature	Relevant literature will be given during the course.
Workload	12 hours
Duration of the module	One and a half day <ul style="list-style-type: none"> - June 7: morning session from 8:00 to 11:00 - June 7: afternoon session from 14:00 to 17:00. - June 8: morning session from 9:00 to 12:00.