האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

Determinantal Point Processes - 80949

Last update 06-08-2019

HU Credits: 1

Degree/Cycle: 2nd degree (Master)

Responsible Department: Mathematics

Academic year: 0

Semester: 1st Semester

Teaching Languages: English

Campus: E. Safra

Course/Module Coordinator: Prof Maurice Duits

Coordinator Email: jbreuer@math.huji.ac.il

Coordinator Office Hours: By Appointment

Teaching Staff:

Prof Jonathan Breuer

Course/Module description:

This course is given in English.

The aim of the course will be to give an overview of the large activity of the past two decades on the theory of determinantal processes and their appearance in various important models of probability and statistical mechanics. Determintantal point processes are random point processes where the random points have a particular repulsive interaction. Even though we break the independence that is characteristic to the classical and more well-known Poissonian processes, there is still a beautiful mathematical structure that allows one to study the quantities of interest. At the same time, many important models from probability and statistical mechanics lead to determinantal point processes. Because of their relevance and mathematical elegance, they have been studied with great intensity in the past 20 years. The development of the techniques for sturdying determinantal point processes were crucial in proving long standing conjectures on, for example, the longest increasing subsequence of a random permutation and universality for eigenvalues of random matrices, and played an important role in studying the asymptotic behavior of random tilings of large planar domains and random growth processes. Applications of determinantal point processes are numerous and go as far as wireless communication and machine learning. The course will first deal with the foundations of determinantal point processes, but quickly turn to the study of several important models from mathematics and statistical physics. These will include, eigenvalues of random Hermitian matrices, longest increasing subsequence, the Schur process and random tilings of planar domains. Some of the highlights of the course will be

-- Sine universality
-- Tracy-Widom distribution
-- Central limit Theorems for linear statistics
-- arctic circle for the domino tilings of the Aztec diamond
-- limit shapes and the Gaussian free eld for random tilings

A good knowledge of probability and analysis is recommended. Some of the technical aspects of the course will require knowledge of complex analysis.

Course/Module aims:

After the course, the student should have a developed a broad overview of how determinantal processes appear in various models of statistical physics and mathematics. The student should also have developed sufficient competences to study technical papers in the field and even be sufficiently prepared to start a research project in the area.

Learning outcomes - On successful completion of this module, students should be able to:

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how determinantal processes appear in various models of statistical physics and mathematics. The student should also have developed sufficient competences to study technical papers in the field and even be sufficiently prepared to start a research project in the area.

Attendance requirements(%):

none

Teaching arrangement and method of instruction: lectures during the first two weeks of February

Course/Module Content:

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Required Reading:

none

Additional Reading Material:

Course/Module evaluation:

End of year written/oral examination 0 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 100 %

Assignments 0 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information: