EMORY MATHEMATICS DIRECTED READING PROGRAM

Program description

The Emory Math Directed Reading Program (DRP) is a graduate student-run program aiming to pair undergraduate students with graduate students to read and learn material that is not typically offered in a traditional course setting. Undergraduate students are expected to work mostly independently to read the text and attempt exercises, then meet regularly with their graduate student mentor to discuss the material.

Undergraduates must be able to meet once per week for an hour with their graduate student mentors. Meeting times will be arranged prior to the start of the semester. A prerequisite to all courses is a basic understanding of mathematical proofs, such as having taken Math 250: Foundations of Mathematics (or equivalent). Please see the course descriptions below for other prerequisite requirements.

Spring 2021 information

Our Spring 2021 program is virtual and will be held over Zoom! Please see the next page for this semester's course descriptions. Interested undergraduates may apply for the Spring 2021 semester by filling out this short form **due Friday, Jan. 29**. Please note that there are limited spots for this program and only apply if you are certain you will be able to participate in Spring 2021. The form has options to indicate multiple courses and preferences, if desired.

If you have any questions or concerns, or suggestions for future DRP topics, please reach out to the program director Christopher Keyes at christopher.keyes@emory.edu.

Spring 2021 course descriptions

Course name: p-adic numbers
Instructor: Christopher Keyes
Email: christopher.keyes@emory.edu
Text: *p-adic numbers: An introduction*, by F. Gouvea.
Prerequisites: Abstract algebra I/II (Math 421/422), Real analysis I (Math 411). Number theory (Math 328) would help, but isn't required.

Description: In this course, we will study p-adic numbers, which play a central role in modern number theory, laying the foundation for other topics such as class field theory and arithmetic geometry. The p-adic numbers arise from solving integer congruences, and come with interesting algebraic and analytic structures which make them useful to so many mathematicians. We will spend some time constructing and exploring the p-adics, building to key ideas such as Hensel's lemma and local-global principles. Time permitting, we may investigate further topics such as p-adic analysis and Newton polygons.

The course textbook, Gouvea's *p-adic numbers: An introduction*, is a fun and conversational text with exercises sprinkled throughout. It should be an enjoyable read for students with a wide range of experience. The key prerequisite topics are groups, rings, fields, and congruences from algebra, and the basic ideas of metric topology and convergence, which should be covered in an introductory real analysis course. Experience with number theory may be helpful for motivation.

Course name: The Circle Method
Instructor: Alexander Clifton
Email: aclift2@emory.edu
Text: *An invitation to modern number theory*, by Miller and Takloo-Bighash, *Hardy-Littlewood Method*, 2nd ed., by Vaughan
Prerequisites: Number Theory and Complex Analysis (Math 318 and Math 328 or equivalent). It will be good to be familiar with generating functions.

Description: In 1834, Jacobi proved that every positive integer can be written as the sum of four squares. Waring's problem generalizes this to ask how many terms we need in order to write every positive integer as the sum of positive k^{th} powers. More generally, if you choose a set of positive integers, we can ask what the smallest n is such that you can express every positive integer, m, as the sum of n numbers from that set. Goldbach's Conjecture asks whether every even integer greater than 4 can be expressed as the sum of 2 primes. While this question is unresolved, it is known that every sufficiently large odd integer can be expressed as the sum of 3 primes. Developed a century ago by Hardy and Ramanujan, the Circle Method uses techniques from analysis to explore the answers to these seemingly simple questions about integers.