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Logic/Set Theory: Combinatorial number theory (MAT6932/4930)

Time and Location

M W F Period 5, LIT 117.

Office Hours

M Period 6, W Period 4, LIT 436, or by appointment.

Description and Goals

Combinatorial number theory is an exciting fast growing field where natural numbers (or more general semigroups) are treated with combinatorics. A multitude of methods from various disciplines can be applied to shed light from different angles, including finite combinatorics, algebra, dynamical systems (of ultrafilters), ergodic theory, probability, and non-standard analysis. We will cover Ramsey's theorem, van der Waerden's theorem (whenever we colour natural numbers by finitely many colours, one colour will contain arbitrarily long arithmetic progressions), its density version Szemerédi's theorem, Hindman's theorem on finite sums and a recently proved density version conjectured by Erdös: every set A of natural number of positive density contains infinite subsets B and C so that B+C is a subset of A. Along the way, we will mention related open problems.

Recommended Reading

Timothy Gowers: *Lipschitz Functions on Classical Spaces*. Europ. J. Comb. (1992) **13**, 141-151.

Stevo Todorčević: *Introduction to Ramsey Spaces*, Annals of Mathematics Studies **174**, Princeton University Press (2010) (Gowers's Theorem is in Section 2.3).

Wang's write up of Furstenberg's proof of Szemerédi's theorem.

Zhao's write up of Furstenberg's proof of Szemerédi's theorem.

(MAT4930/6932) [Spring 2021]

Sets and Logic (MHF3202) [Fall 2020]

Sets and Logic (MHF 3202) [Spring 2020]

AWM Student Chapter at UF

Math Parents Coffee

Math Circle

Ultrafilter proof of van der Wearden's theorem .

Ultrafilter proof of Hindman's theorem.

Dynamical proof of van der Waerden's theorem.

Proofs for #4 on HW 3.

N. Hindman and D. Strauss, Algebra in the Stone-Cech compactification, 1998 (second edition 2012)

J. Nesetril, Ramsey theory, from the Handbook of Combinatorics (Volume 2), 1995

S. Todorcevic, Introduction to Ramsey spaces, 2010

Course Requirements

There will be biweekly homework assigned on Canvas and one presentation during the semester. Homework will be worth 70% and presentation 30% of the grade.

Presentation topics

1. Reformulations, applications, and generalizations of Ramsey's theorem.

2. Multidimensional van der Waerden's theorem.

3. Szemerédi's theorem for arithmetic progressions of length 3.

4. Green-Tao's theorem on arithmetic progressions in primes.

5. Compactness principle.

6. Variations of Hindman's theorem and applications.

7. Dual Ramsey's theorem.

8. Erdös' sumset conjecture.

Diversity, equity, and inclusion statement

It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, religion, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In particular, I will gladly honor your request to address you by an alternate/ preferred name or gender pronoun. Please

advise me of this preference early in the semester so I may make appropriate changes to our records.

Honor code

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code specifies a number of behaviors that are in violation of this code and the possible sanctions. Click here to read the Honor Code. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor in this class.

Class attendance

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies.

Accommodations for students with disabilities

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center. Click here to get started with the Disability Resource Center. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Online evaluations

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Click here for guidance on how to give feedback in a professional and respectful manner. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students here.

Complaints

The official UF policy for filing a complaint about the course may be found here .

Health and wellness

U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit U Matter, We Care website to refer or report a concern and a team member will reach out to the student in distress.

Counseling and Wellness Center: Visit the Counseling and Wellness Center website or call 352-392-1575 for information on crisis services as well as non-crisis services.

Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit the Student Health Care Center website .

University Police Department: Visit UF Police Department website or call 352-392-1111 (or 9-1-1 for emergencies).

UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road,

Gainesville, FL 32608; Visit the UF Health Emergency Room and Trauma Center website

Academic resources

E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.

Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.

Library Support: Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring.

Writing Studio: 2215 Turlington Hall，352-846-1138. Help brainstorming, formatting, and writing papers.

Student Complaints On-Campus: Visit the Student Honor Code and Student Conduct Code webpage for more information.

On-Line Students Complaints: View the Distance Learning Student Complaint Process .