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Course Outline
MATH 426/529: Extremal Combinatorics

Territory Acknowledgement

We acknowledge and respect the Lekwungen peoples on whose traditional territory the university stands and the Songhees, Esquimalt and WSÁNEĆ peoples whose historical relationships with the land continue to this day. The First Peoples House is a social, cultural and academic centre for Indigneous students at UVic and serves as a safe and welcoming place that encourages the building of communinity. More information can be found at `https://www.uvic.ca/services/indigenous/house/index.php`.

1 Course Information

1. **Basic information:** Department of Mathematics and Statistics. Course title: Extremal Combinatorics. Course numbers and sections: Math 426 Section A01 (undergraduate). Math 529 Section A01 (graduate).

2. **Unit Value:** 1.5

3. **Contact Hours:** 3 hours of instruction per week.

4. **Course Schedule:** TWF at 10:30am to 11:20am in HHB 110. Lectures can also be viewed remotely; see Brightspace for details: `https://bright.uvic.ca`. A schedule of lecture topics is on the course webpage `https://extremalcombinatorics.com`.

5. **Pre-requisites:** For UVic students, MATH 222 or equivalent is the only prerequisite. At least one of MATH 320, MATH 322 or MATH 352 is recommended.

   This course is being offered to students outside UVic as a PIMS Network Wide Graduate Course `https://courses.pims.math.ca/` through the Western Dean's Agreement. The prerequisite for students from outside of the University of Victoria are an undergraduate course on discrete mathematics, combinatorics or graph theory. It is recommended that students have taken at least two such courses.

2 Course Instructor Information

1. **Instructor:** Jonathan Noel (he/him/his).

2. **Office Hours and location:** As posted on Brightspace.

3. **Contact:** Available by e-mail at `noelj@uvic.ca` at most times of day.

3 Teaching and assessment modality

1. **Modality:** Lectures take place in-person and are simultaneously streamed online for remote viewing. See Brightspace `https://bright.uvic.ca` for details on remote

viewing. Assignments in this course are submitted online through Crowdmark at `https://app.crowdmark.com/sign-in/university-of-victoria`.

2. **Equipment Needed:** You will require a device capable of accessing Crowdmark and uploading your assignment and final exam solutions to it. You will also need to have access to e-mail and Brightspace in order to submit the written project and receive important announcements. Remote students will need to be able to view the lectures on Zoom or YouTube.

4 Learning and teaching technologies

1. **Teaching Technology:** The lectures will take place in a multi-access classroom equipped with ceiling mounted cameras and microphones for the purpose of streaming to Zoom and YouTube. The room also has televisions and speakers to make remote participants visible and audible. The course will be taught primarily on chalkboard.

2. **Disclaimer on Technology Used:** This course makes use of the UVic-approved technologies of Zoom, Crowdmark, Brightspace, Echo360 and Outlook.

   The course webpage has been registered at WHC.ca, a Canadian company, and data on the webpage is stored on servers in Canada.

   Data related to the YouTube livestreams may be stored outside of Canada. The YouTube livestream has been set up in a way to minimize the possibility that students will be visible or audible in order to avoid any personal information of students appearing. Please contact the instructor if there is any information that you would like to be removed and it will be addressed as soon as possible.

3. **Permissible digital tools:** Please see the undergraduate/graduate policies documents attached to this course outline.

5 Course structure and description

1. **Aim and Assessment:** The goal of this course is to learn about extremal combinatorics and related topics. Students will be assessed on their understanding of the course material via assignments, a written project and a final exam.

2. **Class expectations:** Students are expected to attend lectures 3 hours per week in-person or online or watch recordings, read the course notes, work hard on assignment problems, read and understand the primary source for your written project, study for the final exam, discuss the course with others and come to office hours for help if they need it.

3. **Recordings:** Classes will be recorded and recordings will appear on Echo360 (available through Brightspace) and YouTube. Students may be audible and visible in some of the Echo360 recordings. However, an effort will be made to avoid them being audible or visible in the YouTube recordings.

6 Course topics

Possible topics include intersecting families, sunflowers, VC-dimension, downward closed families, chains and antichains, Littlewood–Offord Problem, shadows, Turán-type problems, Erdős–Stone Theorem, extremal numbers for bipartite graphs, stability, supersaturation, Szemerédi Regularity Lemma, triangle removal lemma, independent sets, Shannon capacity, permanents and counting perfect matchings.

See the course webpage for the schedule of topics `https://extremalcombinatorics.com`.

7 Course-level learning outcomes

1. **Aim and Assessment:** The goal of this course is to learn about extremal combinatorics and related topics. Students will be assessed on their understanding of the course material via assignments, a written project and a final exam.

2. **Required Components:** Students are required to complete a written project and final exam and achieve a mark of at least 35% on each of them in order to receive a passing grade. If you do not submit the written project or final exam, then you may receive a grade of 'N.'

   Retroactive withdrawals are available to students who are able to provide their Associate Dean with documentation showing that accident, illness, or affliction has prevented them from making a serious attempt at the course. The policies on Academic Concessions in the undergraduate/graduate policies documents attached to this course outline apply to this course.

3. **Expectations:** To successfully complete the course, students should demonstrate their ability understand standard concepts, results and proof methods in extremal combinatorics and use their knowledge to give complete and correct solutions to problems on the assignment and final exam, and provide a well-informed summary of a research paper in their written project.

8 Assessment methods, including grading and exams

1. **Description of work:** Assignments are designed to encourage you to actively engage with the definitions, theorems and proof methods presented in the course by asking you to use them to solve problems at various difficulty levels.

   Discussing exercises with classmates, including assignment problems to be submitted for marks, is a useful and mathematically healthy practice. Collaboration on solving assignment problems is encouraged. I particularly encourage you to find ways to involve remote students in your collaborations. However, any work that you submit for marks, including solutions found during collaborative work, must be written independently, in your own words, and reflect your understanding. The written project and

final exams are purely individual assessments and collaboration on them is not allowed. Please review the sections on academic integrity in the undergraduate/graduate policies documents attached to this course outline.

The written project involves reading a research paper, or small collection of papers, related to extremal combinatorics and writing a summary. It provides an opportunity for you to explore a topic related to the course in greater depth and to practice their mathematical exposition. Graduate students enrolled in Math 529, including remote graduate students, are expected to present more substantial work on their written projects.

The final exam will test basic understanding of the ideas presented in the course. For example, definitions, theorem statements, implications between theorems, short proofs from the course, tight examples to theorems and assignment-type questions of low to moderate difficulty.

2. **Assessment details:** There are 6 assignments due every two weeks on Tuesdays: Sep 24, Oct 8, Oct 22, Nov 5, Nov 19, Dec 3. The assignments are available on the course webpage `https://extremalcombinatorics.com`. Only 5 assignments will count, each worth 10% of your final grade. Normally, a student's best 5 assignments are counted toward their grade. If a student receives a 0 on an assignment due to an academic integrity violation, then this assignment will be included among their 5 assignments which count towards the grade.

   The written project is due on Dec 9. Details can be found on the course webpage `https://extremalcombinatorics.com`.

   The final exam will be a take-home test during the UVic exam period. Details will be made available later.

   Only your best 5 out of 6 assignments will be counted towards your final grade. Therefore, you may miss one assignment without any penalty. Students should not expect any concessions to be made for additional late or missing assignments. Instances of additional late or missing assignments with justification will be dealt with on a case-by-case basis. Late assignments or projects without justification will be penalized at a rate of 10% per day. Missed assignments without sufficient justification count as 0. If you do not submit the written project or final exam, then you may receive a grade of 'N.'

   Adding and recording mistakes in grading can be fixed at any time. Please bring questions about marking to the attention of the instructor within seven calendar days of when the work is returned to the class. The instructor reserves the right to not reconsider the grading of term work after the seven day notice period has expired.

3. **Assessment weighting:** Your final percentage grade will be computed according to the following scheme.

Assignments (6, only 5 count)	Written Project	Final Exam
50%, equally weighted	25%	25%

   Percentage scores will be converted to letter grades according to the university-wide standard table `https://web.uvic.ca/calendar/undergrad/info/regulations/grading.html#`.

4. **Assessment Modality:** The assignments and final exam can be handwritten or typeset. They must be submitted online through Crowdmark. The written project must be typeset, preferably in LaTeX.

5. **Equipment requirements:** Students must be able to access Crowdmark and upload assignment and final exam solutions to it.

6. **Alternative assessments:** Only 5 out of 6 assignments count. Students who underperform on one assignment have the option of submitting all 6 assignments to increase their grade. By default, there are no alternative assessments available. Extraordinary cases with sufficient justification will be dealt with on a case-by-case basis at the instructor's discretion.

7. **Attendance:** Attendance is not compulsory but is strongly recommended.

8. **Other required components:** None.

9. **Academic integrity:** See the undergraduate/graduate policies documents attached to this course outline.

9 Required learning materials

Lecture notes are freely available on the webpage `https://extremalcombinatorics.com`.

10 Other Policies

The policies in the undergraduate/graduate policies documents attached to this course outline are deemed to be part of this course outline.