MATH 6xx: Topics in Geometry (Configurations) [3 credits] Fall 201x

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Instructor: Dr. Leah Berman

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Classroom and class meeting times: Reichardt 165, MWF, 10:30 – 11:30 AM.

Office hours: MWF 2–3 PM, Th 10 – 11AM, and by appointment. To make an appointment, just drop me an e-mail. You are also welcome to stop by my office at any time and see if I am free (even without a scheduled appointment); however, there is a possibility that I may be busy/away if you haven't set up an appointment. These office hours are subject to change.

Prerequisites: Graduate standing or permission of instructor. **Recommended**: Linear algebra, undergraduate abstract algebra, geometry.

Course description, goals: A (p_q, n_k) combinatorial configuration is a collection of p objects, called "points" and n collections of points, called "lines", so that each point is contained in q lines, and each line contains k points. If the combinatorial configuration may be constructed so that the "points" are really points in some Euclidean space, typically $\mathbb{E}^2$, and the "lines" are straight lines (or pseudolines) in that space, then the resulting object is a geometric configuration. We will study some of the history of configurations and then focus on recent, active areas of study, especially of geometric (n_k) configurations.

Student Learning Outcomes: Students in this course will

- learn about the history of configurations
- learn about different types of configurations (combinatorial, topological, geometric; balanced and unbalanced)
- learn and apply basic identification techniques for configurations
- determine the automorphism group and symmetry group for configurations
- use remainder figures to analyze automorphisms
- learn and use construction techniques to produce a variety of kinds of geometric configurations
- read and respond to primary sources

Required Text: Branko Grünbaum. *Configurations of Points and Lines* AMS, 2009.

Required Software:

- *The Geometer's Sketchpad*. Available from Key Curriculum Press, `www.keypress.com`
- *LaTeX*. If you use a Macintosh, TeXShop is a great editor, and it's free. For Windows, TeXnicCenter is at least free. Talk to me if you need help.

Recommended Software: Some computer algebra system. *Mathematica* is the software I use. Available from `www.wolfram.com`, and there's student pricing available.

Instructional methods:

Lecture: Class meets three times a week; these will be primarily active lectures, supplemented with the occasional in-class worksheet. You are expected to participate in the lecture by asking questions! I will call on people at random during class.

Homework and labs: Written homework will be assigned on a weekly basis; it will be listed on Blackboard, and you will be responsible for checking on a regular basis. Due dates will be as assigned.

You are **very strongly encouraged** to collaborate with your classmates. However, you are expected to write up solutions to homework problems yourself.

Exams: There will be one mid-semester exam, tentatively scheduled for Friday, October ??, 20?? and one final exam, scheduled from XX:XX – XX:XX on XX, December XX, 20XX (the scheduled final exam period). Both exams will have an in-class component and a take-home component; the take-home exam will emphasize problem solving whereas the in-class exam will emphasize familiarity with definitions, theorems, and basic results. There will be a final project, due by NOON on Wednesday, December 6 (the last day of classes).

The take-home components are open book and open notes, but they are closed classmate and closed internet. If you need to ask questions, please contact the instructor.

Please refer to the UAF Student Code of Conduct: `http://uaf.edu/catalog/current/academics/regs3.html`

Final Project: Your final project consists of two parts:

(1) A paper addressing some interesting question in configurations. You have two options:

A research paper: In this paper, you investigate a constrained problem in configurations, doing original research. Your topic should not be too broad.

An expository paper: For this option, you write a survey paper/expository paper in which you explain other people's work concerning some constrained area of configurations research.

(2) A 10–12 minute presentation, in which you distill the contents of your paper and make it accessible to your peers.

Your final project presentation will occur during the last week of classes. Further details about the final project (e.g., milestones, deliverables, assessment rubrics) are provided at the end of the syllabus.

Tentative schedule:

Week	topics
1	introduction, §1.1 – 1.3
2	§1.4, 1.5
3	§1.6, 1.7, 1.8
4	§2.1, 2.2
5	§2.3 – 2.5
6	geometric constructions of 3-configurations
7	more constructions for 3-configurations
8	4-configurations: §3.1 – 3.3
9	celestial 4-configurations; §3.4 – 3.6
10	highly incident configurations: new construction I
11	highly incident configurations: new construction II
12	floral configurations
13	recent results; project presentations
14	Final Exam

Course Policies:

e-mail: *You are responsible for checking your* `alaska.edu` *e-mail account every day before class.* This is the e-mail address I have access to, and this is what I will use to get in touch with you. If you don't typically check it, then set it up to forward to your main account.

Absences and make-ups: You are expected to attend every class. Missing classes will have an adverse effect on your course grade. *If you miss more than six classes, or if you do not show up to take an exam, I may withdraw you from the course.*

If you must miss class, you are responsible for notifying me ahead of time to make appropriate arrangements. Except in unusual circumstances, make-up quizzes and exams will not be given.

Illness: Please do not come to class if you are possibly contagious. If you are too sick to come to class, please e-mail me **BEFORE CLASS**.

Announcements: From time to time, announcements and comments will be sent out via e-mail. **It is your responsibility to check your e-mail account to receive this information.**

Evaluation:

Homework	40%
Midsemester Exam	20%
Final Exam	25%
Final project	15%

To get a rough sense of how numerical grades correspond to letter grades:

% cutoff	letter grade	% cutoff	letter grade	% cutoff	letter grade	% cutoff	letter grade
60	D-	70	C-	80	B-	90	A-
63	D	73	C	83	B	93	A
67	D+	77	C+	87	B+	97	A+

Note that according to Graduate School policy, "for the purpose of satisfying degree requirements students must earn...a C grade (2.0) or better in each 600 level course".

Support Services: You are strongly encouraged to attend office hours if you have questions, or e-mail/instant message me. I also encourage you to work with other students where appropriate.

Disabilities Services: The Office of Disability Services implements the Americans with Disabilities Act (ADA) and insures that UAF students have equal access to the campus and course materials. I will work with the Office of Disability Services (203 WHIT, 474-7043) to provide reasonable accomodation to students with disabilities. Please come talk to me as soon as possible if you have/need accomodations.

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1. Final project information

Your final project consists of two parts:

(1) A paper addressing some interesting question in configurations. You have two options:

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An expository paper: For this option, you write a survey paper/expository paper in which you explain other people's work concerning some constrained area of configurations research.

(2) A 10–12 minute presentation, in which you distill the contents of your paper and make it accessible to your peers.

2. Milestones:

(1) **no later than Friday, October 31:** talk to me about an area/topic you are thinking about, and whether you are considering a research project or a survey project. I'm happy to help you refine a topic idea or to suggest topics.

(2) **Wednesday, November 12**: one page topic proposal due. You should have found a topic you're interested in and cleared it with me already: here, you are providing a more detailed description of what you hope to accomplish. (You need to know enough about your topic at this point to be able to explain it to me in a way that I can understand.) *200 words or so—keep it short, but understandable.*

(3) **Monday, December 1**, in class: Outline and Literature Review.

Outline: This should be a detailed outline of your project.

For the research project, your outline should include a description of what you hope to accomplish, along with some preliminary experiments or results.

For the expository paper, it should include major results/areas you plan to discuss.

Literature review: An annotated bibliography of potential references for use in your paper and presentation, along with a short description of what each reference is, what the broad content is, and how it will likely be useful to you. You must include at least three sources in addition to the textbook (which you do not need to include; however, if you choose to use things from the textbook, it must be cited). No more than one of the three required references may be a web page (online journal articles do not count as web pages). Despite the fact that Wikipedia is often a good starting place, do not cite Wikipedia. You may include as many sources as you like, above the required 3.

You should also be working on an active draft of your paper at this time!

(4) **Monday, December 8** in class: First[1] draft of paper due. Peer review of papers in class.

[1]It should never be a real first draft. you should have done at least one round of editing yourself!

You should have started working on your presentation by now.

(5) **Friday, December 12** Final Draft of paper due.

(6) **1–3 p.m. Monday, Dec. 15.** Presentations (This is our final exam time.)

3. Evaluation

Your final project is worth 25% of your grade. It is distributed as follows:

Item	% of final grade
Paper	13
Literature review	2
presentation	7
Peer evaluation participation	1
Peer evaluation results	2
total	25

Paper: will be graded on interest of content, mathematical content, clarity of presentation, creativity, style/quality of presentation, and appropriateness to the assignment. You are expected to cite the work of others when you use it (paraphrasing counts too).

If you choose the research paper option, you will **not** be graded on success on the research project (that is, whether you actually discover something new and/or can prove it), but rather on how well you communicate your thinking.

While there is no specific page requirement for the paper, I anticipate that papers will be at least 10 - 15 pages, double-spaced (including graphics and un-annotated bibliography); more than 40 pages and you're probably writing too much.

Presentation: will be graded on clarity, organization, delivery, accuracy in the discussion of the mathematics and presentation of the application.

Peer review of papers: On December 8, you will read each other's papers and suggest comments.

Peer evaluation of presentations: You will be expected to evaluate carefully the presentations of your peers; the aggregate peer evaluation of presentations will be incorporated into each student grade, and completion of evaluations is a required part of the presentation grade.

What grades mean, sort of:

An A paper: takes the assignment and runs with it. It brings a fresh and original approach to the topic, yet thoroughly explains the mathematics under consideration. The language is clear, informative and a real pleasure to read. The paper shows something of the writer's heart: it convinces me that writer is genuinely interested in and cares about the subject matter. The paper is appropriately formatted and contains very, very few basic writing errors and shows evidence of thorough and thoughtful proofreading.

A B paper: has a definite and clearly identified subject, an interesting approach to a topic, and a thorough effort to cover the bases of the assignment. The author uses the source materials to substantiate his/her views and understanding of the material, though it may not contain the most subtle or clear analysis and exposition of ideas. The language of a B paper is clear, clean, and occasionally elegant but not necessarily interesting throughout. It may have a few basic errors in writing and proofreading.

A C paper: has a weakly articulated subject, or lacks focus or clarity about what its subject matter is. It makes a thorough if not completely successful effort to fulfill the assignment. Typically, it over-relies on summary and fails to use textual substantiation in a way that enlightens and edifies

without becoming stilted or boring. Mathematical ideas are communicated poorly or betray significant confusions of the author. The paper makes claims that are insufficiently supported or explained. There are a significant number of basic writing errors.

A D or F paper: has significant flaws that interfere with the reader's ability to appreciate the content of the authors ideas. It lacks a thesis, the paragraphs lack basic organization and the structure of the paper is unclear. The mathematical content of the paper is presented with little, no or inappropriate textual support. There is evidence the author doesn't really understand the mathematics being presented. It trivializes the assignment. The paper is riddled with errors in basic writing and proofreading.