# MTH 403W Senior Project I

Winter 2014

Class Meets MW 3-3:50pm in MNB 130*

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Office hours† : M 1-1:50; W 11-11:50; R 1-1:50 and 4-4:50; F 10-10:50

**Materials:**
Papers and presentations will be created using LaTeX. There is a compiler on the math network or many are free to download.

**Goals:**

- To provide a capstone experience for your mathematics major
- To give you a chance to demonstrate your ability:
  - To read and learn mathematics independently
  - To make rigorous mathematical arguments
  - To precisely articulate (both in writing and orally) complicated and technical arguments.
- To have the experience be challenging, but one that you remember with pride and satisfaction for many years
- To have projects worthy of a professional presentation (esp. the Academic Excellence Showcase in May)

**Course Structure:** The course will closely model the way in which mathematical papers are written and published by professional mathematicians. The main activities are as follows.

- Select, in consultation with the instructor, a suitable topic for a substantial senior paper / thesis / project. Follow the guidelines from the document "Finding a Senior Project Topic."
- Make a short oral presentation of a topic proposal. (This is analogous to the professional mathematician choosing a research area. Presenting a proposal is common in industry and government and when seeking grants. In academia, early stages of a research project are sometimes presented in department colloquia or at meetings. Graduate students also make oral thesis proposals.)

*Class will meet Monday of weeks 1 and 2, both MW during week 4, and I reserve the right to ask you to meet at this time other weeks if necessary. You will also have a regularly scheduled half-hour weekly meeting with me.

†Please feel free to drop by my office during my office hours for help. You do not need to make an appointment to come to office hours. At times other than my listed office hours you are welcome and encouraged to call or email me with questions about the course. If you have direct scheduling conflicts with my office hours and would like further help, please let me know.

- Research: Thoroughly digest the paper(s) or solve the problem selected for the project. This amounts to making a thorough set of informal notes containing the definitions and proofs, with all the details filled in. These notes are absolutely critical and indispensable. (Corresponds to the professional mathematician doing research.)

- Select a journal for publication and consult its guidelines for authors: In our class, there is no journal to choose, but we have "Guidelines for Authors of Senior Papers," listed at the end of this syllabus.

- Writing the paper: Work on the paper/thesis/project all term giving the instructor and peers multiple opportunities to respond to drafts. Write drafts by hand or using a word processor, but writing formulas by hand as necessary. At the draft stage, avoid wasting time on appearance, save that for the final version. *Your final paper in Winter term must be submitted in* LaTeX. **It must be emphasized that you are not to simply paraphrasing the source material. The drafts and the paper you write must be your own work, and must differ substantially in style from the source material. Any other approach is plagiarism.**

- Reporting: At each weekly meeting, submit a written work log, summarizing times worked and what was accomplished during each work period. Enhanced reports also include questions, comments, ah-ha moments and so forth. You will be expected to come to the meeting prepared to orally summarize your work for the week and give reports on any difficulties or triumphs experienced during the week. Such reports are a common practice in some jobs and for some grant funded work. Here they count as part of the grade. A minimum of 6 hours per week is expected, but that will not be sufficient for most weeks.

- On-going Feedback: Each week, beginning with week 5, you should submit a draft of a significant portion of the project. Keep all drafts, revisions, copies of my feedback, etc. in a large folder. Submit the folder and its entire contents each week. If you do not submit a significant amount of work each week, your grade on the project will be reduced. (This corresponds to the professional mathematician doing self-review of the paper or circulating it amongst colleagues for comment.)

- Submitting your final paper: After that lengthy process of writing and review, you will submit the paper at the end of this term. Then, in the jargon of scholarly publication, it will be "refereed." The version you submit should be one which you think needs no more work.

- The referee (in our case, the instructor) will review the paper. The referee's report will be either

  - accept the paper as is (rare),
  - accept the paper subject to revision (during Spring term), or
  - reject the paper (and not pass the course).

  In order to avoid rejection, proof-read and edit the final product carefully and also incorporate the feedback received on the drafts. (This is exactly what happens when professional papers are submitted to a journal.)

- Revising the paper: Most often, the referee's report is that the paper has merit, but needs improvement. The revision will occur during Spring term.
- Speaking about your work: You will speak about your work in a proposal in Winter term, and then at Academic Excellence Showcase in Spring term on Thursday May 29, 2014. If the timing of the conference is appropriate you will be strongly encouraged to give a short talk at the Northwest Undergraduate Mathematics Symposium (NUMS), as this would give you the opportunity to both demonstrate the fruits of your efforts and to meet students and professors of mathematics from other universities (networking is often crucial in a job search), which affords the chance to become part of the wider mathematical community. This process is analogous to the professional mathematician speaking about ongoing or completed work at colloquia and meetings. Finally, in the Spring term you will give a two hour presentation on your topic.

**Schedule**:

- Week 1 – Class meets on Monday. Arrange regular meeting time with instructor.
- Week 2 – Class meets on Monday. Finalize topic choice by the 2nd meeting with instructor. If you choose a problem from the list on the "Finding a Senior Project Topic" document, you must communicate that choice to me ASAP or risk someone else choosing the problem. In the event two people choose the same problem at the same time I will let the person who has done the most work on the problem have the problem.
- Weeks 2-4 – Meet with instructor to discuss precise project content; begin & continue research; make draft outlines of the paper and prepare the oral project proposal presentation.
- Week 4 – Class meets both Monday and Wednesday. Short oral project proposal presentations (during scheduled class times); study "Guidelines for Authors of Senior Papers" and references cited therein.
- Weeks 5-10 – Meet with instructor; continue research and writing; submit drafts EACH week.
- Finals week – Paper due Monday; submit all drafts and feedback along with the paper.

**Grading**:

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| Oral Proposal Presentation | 7% of the grade |
| Attendance and Participation in the Presentations | 3% |
| Work logs | -1% per missed or inadequate submission |
| Drafts | -2% per missed or inadequate submission |
| Senior Paper/Thesis | 90% |

**Appropriate Classroom Behavior**: You are ultimately responsible for your own attendance and performance. It is expected that electronic devices such as cell phones will be turned off during class. Proscribed Conduct for all students is described in the University Catalog.

**Incomplete Policy**: An Incomplete can only be granted for a student who is passing a class and has a documented emergency that prevents them from completing a small component of the course.

**Accommodations**: Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. Please contact the Office of Disability Services at 503-838-8250 to coordinate accommodations. Students needing medical or mental health care can access the Student Health and Counseling Center by calling 503-838-8313, emailing at health@wou.edu, or by walking in to schedule an appointment.

**Veterans and Active Military Personnel**: Veterans and Active Military Personnel with special circumstances are welcome and encouraged to communicate these, in advance if possible, to the instructor.

## Guidelines for Authors of Senior Papers

As is the case in the working world of mathematicians, including teachers, these guidelines are enforced.[‡]

Content and Audience

The senior paper/thesis/project is be an original treatment of material from multiple sources, properly cited. "Original" means it will be presented in the author's own words, which are not overly bound to the style of the sources. In some cases, it may contain original mathematics. It should always contain original examples. All proofs omitted from the source work should be completed, if possible, in the paper, either in the body or in an appendix.

The paper should be sufficiently self-contained and clear as to be accessible to an average senior mathematics major at WOU.

Style

Page and Section Style In the mathematics profession, a journal will usually direct authors to recent issues of the journal with the instructions to use the same style as is used in those issues. Here we will use the style of *The American Mathematical Monthly* (AMM). Your senior paper should look *exactly* like an article in AMM, except that it should be 1.5-spaced instead of single-spaced. You can download the template here: `http://www.maa.org/publications/periodicals/american-mathematical-monthly`. Scroll down to "Submitting to the Monthly" and download both the *Monthly* template and the maa-monthly.sty files.

The senior paper will be divided into labeled sections as in AMM.

Citation Style When you wish to list a book, article, website, personal communication, or whatever in the bibliography, look through recent issues of AMM until you find the same kind of source being used, then copy the style of the bibliography entry. Use issues less than 6 years old, since styles have changed.

There are two acceptable options for citations in the senior paper. One is to number the items in the bibliography and cite them by number, as in AMM. The other acceptable method is to label the bibliography entries with initial(s) of last name(s) of the author(s) and cite them by those initials. For example, the bibliography might contain an entry like

[LP] R. Laubenbacher and D. Pengelley, *Mathematical Expeditions: Chronicles by the Explorers*, Springer-Verlag, New York, 1999.

A citation would look like "W. Bolyai passed his interest in the parallel postulate on to his son [LP, p. 14]." If there are two sources by same author(s), then include the year along with the initial(s), such as [LP1999]. If there are authors of separate items whose names begin with the same letter, use more than the first letter. For instance, if we had Ward and Williams as authors of two separate items, we would label them [Wa] and [Wi].

Whichever style is used, list the page(s) of the source from which the information is obtained (see above example). If citing a theorem, then it is common to cite it by number rather than page, as in [13, Thm. 3.1] or [W, Thm. 3.1].

[‡]For example, in a workshop on grant writing at the Joint Mathematics Meetings in January 2007, it was reported that a very large number of grant applications to major funding agencies like the NSF are never read because guidelines are not observed. Even small things like improper margins can disqualify a proposal. (This anecdote courtesy of Professor C. Beaver.)

Notice that APA style is *not* used. APA is style is not common in math journals (though it is in math education research journals).

Writing

The senior paper is expected to unusually well-written with good sentence structure; easily understood and mature writing style; correct spelling, grammar and punctuation; and smooth transitions. Refer to a standard manual for matters of grammar and punctuation.

Authors should read the following for math-specific writing advice.

L. Gillman, *Writing Mathematics Well: A Manual for Authors*, Mathematical Association of America, 1987. A short, readable guide about writing proofs for publication, but much of it applies to all mathematical writing.

K. P. Lee, *A Guide to Writing Mathematics* accessed 16 September 2005 at `http://ems.calumet.purdue.edu/mcss/kevinlee/mathwriting/` or available in hardcopy from Mike Ward. Seventeen pages of practical advice with examples. Highly recommended.

Typing

Papers, of course, should be typed using 1.5-spacing. Lee's Guide, listed above, has some guidance on typing mathematics. Assistance in learning LaTeX is available upon request.

Summary and Checklist

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| "Original" | |
| Accessible to average WOU senior math major | |
| Divided into labeled sections | |
| Bibliography entries in AMM style | |
| Citations in one of the two formats above | |
| APA style *not* used | |
| Overall paper looks exactly like an AMM article | |
| Well-written in conventional math style (see Lee above) | |
| Typed, 1.5-spacing | |
| Pages *not* stapled together | |
| Expensive paper *not* used (this term) | |