

# Contents MAT 4040: Mathematics Capstone in Differential Geometry

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## 1.1 Catalog Description

MAT 4040 satisfies the general education capstone requirement for mathematics majors with concentrations other than education. Students will explore current, relevant, or advanced undergraduate topics in mathematics and the relationships of mathematics with other fields. Oral and written communication skills are emphasized. Graded on an S/U basis. Prerequisites: either MAT 3110 or MAT 3220, and senior standing in mathematics or permission of the instructor.

## 1.2 Learning Goals, Objectives, Grades, Assignment Types and Capstone Calendar

*understanding responsibilities of community membership*  
*communicating effectively*  
*thinking critically and creatively*  
*making local to global connections*

### Learning Goals

- research, analyze and reflect on discipline-specific materials. The idea is to incorporate different levels and areas as appropriate to investigate mathematical knowledge from MAT 4140 in order to recognize the development of mathematical ideas from the past and the breadth of mathematics covered in MAT 4140, its impact on mathematical study, and its relation to the global mathematical community
- write effectively in formats appropriate to an advanced level of the discipline and practice oral communication
- document correctly in the conventions of the discipline
- reflect on your own development in the areas of thinking critically and creatively, communicating effectively, making local to global connections, and understanding responsibilities of community membership, which are the four general education goals at Appalachian

### Critical and Creative Thinking & Local to Global Connections

We will engage in increasingly sophisticated research activities, which include historical and other connections to the global mathematical community. The readings, homework, reflections and research project will focus on critical thinking and creative products. You will focus on collecting and analyzing information and recognizing scholarly versus other types of sources.

### Communicating Effectively & Understanding the Responsibilities of Community Membership

ASU's General Education Program prepares students to employ various modes of communication. Successful communicators interact effectively with people of both similar and different experiences and values and you will practice oral and written communication by interacting with your peers and me. You will pair with various peers over the course of the semester to discuss items. You will peer review each other's work to help each other. You will also present to your peers in the paired 4140 class and will peer review each other's work to help each other. Sometimes it is only after we present and see other models that we have ideas for improvement on our work. Regardless of gender, political party, race, religion, sexuality, or more this is to be a welcoming environment, and so I want you to be sensitive and respectful to each other in upcoming work with each other. Part of the responsibilities of community membership is to keep an open mind as you engage in our class activities.

## Assignment Types, Capstone Calendar and Grades

Work is due in ASULearn by 11:55pm Thursday unless otherwise noted. Here is a calendar.

Thursday 1/18	<p>Introduction to LaTeX and the course</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> capstone course intro interactive video</li> <li><input type="checkbox"/> LaTeX intro interactive video</li> <li><input type="checkbox"/> read LaTeX software and compile template1.tex</li> <li><input type="checkbox"/> read the syllabus</li> </ul>
Thursday 1/25	<p>Introduction to the capstone project and careers in mathematics</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> examine Appalachian's Career Development Center upcoming events</li> <li><input type="checkbox"/> read the capstone project guidelines</li> <li><input type="checkbox"/> selection of preliminary topic for capstone project: first-come, first-served</li> <li><input type="checkbox"/> introductions and careers (post and reply) forum</li> </ul>
Thursday 2/1	<p>Scholarly peer-reviewed sources</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> finding and evaluating quality sources</li> </ul> <p>(optional but recommended) Make library RAP appointment</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> reflection on finding and evaluating quality sources</li> </ul>
Thursday 2/8	<p>Part 1 of the capstone project</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> instructions and template for part 1 of the course project</li> </ul> <p>(optional but recommended) meet with me to discuss progress and challenges</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> submit PDF of LaTeX'ed part 1 of the course project</li> </ul>
Monday 2/12	Project 1 presentation due in 4140 3–3:50pm
Thursday 2/15	<p>Reflect on “How to Write Mathematics”</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> read “How to write mathematics” by Paul Halmos</li> <li><input type="checkbox"/> reflection on how to write mathematics</li> </ul>
Thursday 2/22	<p>Part 2 of the capstone project</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> instructions and template for part 2 of the capstone project</li> <li><input type="checkbox"/> submit PDF of LaTeX'ed part 2 of the capstone project</li> </ul>
Thursday 2/29	<p>Reflect on “Guidelines for Good Mathematical Writing”</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> read “Some Guidelines for Good Mathematical Writing” by Francis Edward Su</li> <li><input type="checkbox"/> reflection on good mathematical writing</li> </ul> <p>(optional but recommended) meet with me to discuss progress and challenges</p>
Thursday 3/7	<p>Capstone survey</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> read general education courses and goals at Appalachian</li> <li><input type="checkbox"/> capstone survey</li> </ul>
Thursday 3/21	<p>LaTeX symbols and work on first draft</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> skim LaTeX mathematical symbols and test some of them</li> <li><input type="checkbox"/> read through the capstone project rubric</li> <li><input type="checkbox"/> begin work on the first draft by modifying the template in this link</li> </ul>
Wednesday 3/27	Project 2 presentation due in 4140 3–3:50pm
Thursday 3/28	<p>Continue working on first draft</p> <p>(optional but recommended) take a draft to the writing center</p> <p>(optional but recommended) meet with me to discuss progress and challenges</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> submit LaTeX'ed PDF under next week for a preliminary anonymized first draft—you will continue working on your first draft next week, but this will ensure that you have a submission in next week's strict deadline assignment</li> </ul>
Thursday 4/4 <b>strict deadline</b>	<p>First draft is due</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> submit anonymized PDF of final first draft of the capstone project LaTeX'ed</li> </ul>
Thursday 4/11 <b>strict deadline</b>	<p>Peer review and introduction to Beamer</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> peer review a first draft back up where you submitted yours</li> <li><input type="checkbox"/> capstone beamer intro interactive video</li> </ul>

Thursday 4/18	Reflect on communication in mathematics <input type="checkbox"/> read feedback on first draft <input type="checkbox"/> read “How to give a good 20 minute math talk” by William T. Ross <input type="checkbox"/> look through “How to give a Talk” by Tammy Kolda <input type="checkbox"/> in 4140, look back at “How to Create Your Own Universe in Three Easy Steps,” by Lawrence Brenton <input type="checkbox"/> reflect on communication in “How to Create Your Own Universe in Three Easy Steps,” “How to give a good 20 minute math talk” and “How To Give a Talk”
Monday 4/22	Project 3 presentation due in 4140 3–3:50pm
Thursday 4/25	Second draft is due <input type="checkbox"/> second draft is due as a LaTeX’ed PDF. Incorporate feedback to make improvements and de-anonymize. <input type="checkbox"/> begin LaTeX beamer for presentation by modifying the beamer template
Wednesday 5/1	Share your final project idea or title in 4140 3–3:50pm
Monday 5/6	Final presentation due in 4140 by 2pm
Thursday 5/9 <b>strict deadline</b>  <b>strict deadline</b>	Final paper is due <input type="checkbox"/> Final draft that satisfies all items in the rubric is due as a LaTeX’ed PDF. Incorporate feedback to make improvements and de-anonymize. <input type="checkbox"/> to pass the capstone, all items must achieve completion by Thur 5/9 although some items have strict deadlines before then

Assignment details, including the capstone project, are described on ASULearn and turned in there. They are also described in the 4140 class and on <https://www.appstate.edu/~greenwaldsj/class/4040/s24.html>.

We’ll be engaging in standards-based learning, where success is tied to meeting specific learning goals in assignments, rather than a percentage correct or point system. This will allow you (and I) to identify strengths and weaknesses early and you’ll have multiple chances to revise and succeed. We’ll employ Star Wars terminology as a metaphor—Padawans are training to one day become a Jedi. Jedi is a rank within the Jedi Order, referring to Jedi who complete their training and pass the Jedi Trials to become full members.

A course grade of S means that all work has been completed at the Jedi level or higher and is required to pass the capstone.\*\*\*\* A Jedi Master is a leader who has demonstrated exceptional achievement.

	Padawan	Jedi	Jedi Master
	still training		
I can make a good faith effort in readings, homework, and reflections to satisfy learning goals a)–b).			
I can turn in a quality research project in differential geometry to satisfy the capstone project rubric and learning goals a)–c).			
I can complete the course survey to satisfy learning goal d).			

\*\*\*Accommodations in the final grade may be made for extenuating circumstances that are officially documented to prevent you from completing work, including the level of achievements in the learning targets.

### 1.3 Required Resources

- reliable access to technology, software, and high speed connectivity: The work you’re going to do for class you’ll be accessing through your internet connection with a device, so it will be really important to have access to a dependable high-speed internet connection and a good computer that can run everything

we'll need. The software is free, including Maple—any student with a valid Appstate email address can access Maple on their own computer or on campus computers. For optional office hours, we'll use Zoom videoconference software with breakout rooms. Flexible browsers that will play common media formats from various sources such as from webpages, Google Drive, YouTube, and ASULearn, including interactive videos, are also something we'll use. ASULearn components work best from scrolling through the activities themselves on a computer—the Moodle mobile app does not always show everything as designed, both for visibility and for due dates. Online students are expected to have or acquire proficient computer skills and to resolve their own technology problems related to computers or internet access to turn things in before deadlines. Work early and leave yourself enough time before any strict deadlines to allow for technical issues that may arise. For example, ASULearn will typically be undergoing monthly system maintenance on the last Thursday of each month. <https://asulearn.appstate.edu/?redirect=0> announces downtime and <http://Support.appstate.edu> and <https://confluence.appstate.edu/display/ATKB/Appalachian+Technology+Knowledge+Base> can help.

#### 1.4 Course Communication, Office Hours, Where to Get Help, and Additional Policies

- I encourage you to talk to me and your classmates often in and out of class. Outside of class, I can help in office hours on Zoom, internet allowing, Sunday, Tuesday, and Thursday 7–7:45pm and Monday and Wednesday 12:30–1:30pm via the link in the Need Help Forum on ASULearn from <https://asulearn.appstate.edu/course/view.php?id=165708>

Office Hours and ASULearn Forum: My office hours are on Zoom Sunday, Tuesday, and Thursday 7–7:45pm and Monday and Wednesday 8:15–9am via the link in the need help forum on ASULearn.

You can come in to Zoom to work on future assignments, working along and asking questions as they arise, or you can ask me questions about items you already turned in, ask me questions related to course content or structure, or ask me to go over a concept. Keep me informed about any problems and I also want to hear when things are going well! We can both write on a whiteboard and share our screens. You do not need to make an appointment to meet with me in Zoom, just drop by and I am happy to help! During class and in online communication, use standards of professionalism and collegial communication. This course is to be an environment in which everyone feels comfortable asking questions, making mistakes, offering good guesses and ideas, and is respectful to one another.

Please use a salutation of Dr. Sarah, my preferred name, in communications with me. If you can't make it to Zoom, you can contact me with a professional message on the Need Help Forum on ASULearn, which I'll try to answer once a day, including the weekends. If you haven't heard back from me yet, only message again if you are addressing a new and separate issue or retracting a previous message. Private conversations with me should occur during office hours or via the forum, not during class time. In Zoom hours, I can set up individual breakout rooms for private conversation with me. Except for extreme emergencies, all private written communication must be handled through your private forum, with just you and I, on ASULearn rather than e-mail. I prefer that you use the Zoom hours as it is easier to discuss material in person.

If there is some reason you must miss a deadline, then keep me informed, with any appropriate documentation, and turn the work in early or on time, if at all possible. I also encourage you to talk to me often in the 4140 class.

- Academic integrity is a fundamental part of the course, which includes meeting deadlines, regular communication, and giving proper reference where it is due. These are essential to course integrity. Feel free to talk to me or each other if you are stuck, but when writing up work, be sure to give acknowledgment where it is due. Submitting someone else's work as your own (PLAGIARISM) is a serious violation of the University's Academic Integrity Code, which defines: "Plagiarism includes, but is not limited to, borrowing, downloading, cutting and pasting, and paraphrasing without acknowledgement, including from online sources, or allowing an individual's academic work to be submitted as another's work."
- I believe that you have the capability to succeed in this course. In this asynchronous course, you'll have weekly work but you have the flexibility to work ahead to meet the deadlines if that is better for your

schedule: plan to spend 3–4 hours, on average, as per the University-wide Statement on Student Engagement with Courses (while we don't meet for the one credit hour, its time is a part of this computation).

- We adhere to University-wide syllabus and policy statements:  
<https://academicaffairs.appstate.edu/resources/syllabi-policy-and-statement-information>  
and University policies like on [https://policy.appstate.edu/Policy\\_Manual](https://policy.appstate.edu/Policy_Manual)
- I want you to be informed about your choices regarding what you tell me about certain types of sensitive information. In situations where students disclose experiencing an act of interpersonal violence to their instructor, faculty are required to report that to the campus Title IX Coordinator, who then reaches out to the student by email offering support services. I care about you and want you to get the resources you need. I'm happy to talk with you if you decide you want that, but please be aware that if instead you'd like to explore options with someone who can keep your information totally confidential, I highly recommend the Counseling Center at 828-262-3180. They offer walk-in hours as well as after-hours coverage:  
<http://counseling.appstate.edu>.
- Appalachian Cares is a place to find updates about matters of student health and safety  
<http://appcares.appstate.edu/>.
- Belk Library offers a wide array of research services including access to their digital media studio (with assistance available), video and audio recording rooms, Research Advisory Program sessions in which you meet individually to work with a librarian, Library guides, study spaces, and online workshops, like  
<http://library.appstate.edu/gethelp/rap>
- The writing center can help you with drafts of your project  
<https://writingcenter.appstate.edu/>
- Disco Student Learning Center offers academic resources that will complement and enhance classroom experiences by helping students become acquainted with their studies and learn how to learn effectively. For example, you can meet with a study skills specialist to discuss your goals and develop strategies and study plans to meet those goals or arrange for tutoring. "D.D.," or Dauphin Disco, was one of the three people who, in 1899, founded Watauga Academy – known as App State today. The word disco is Latin for learn.  
<https://studentlearningcenter.appstate.edu/students/tutoring-support-services>

## 1.5 Advice from Previous Students

- It is easy to forget about it. Block a regular time in your schedule for homework.
- Make sure the topic you choose for the course project is something you are interested in. If it isn't, you can change it at the end, but it is better to choose something good from the beginning.
- I had fun with the readings and activities. The reflections are as interesting as you make them.
- Remember that some weeks will have less homework than others. Spend any spare time on the course project so that your last weeks of class are not too crazy. The workload overall was fine.
- Dr. Sarah has set up the course project to be completed in steps to help you. Take advantage of these and her help. I hadn't realized that I could bring coding problems in to her office hours.
- Do not procrastinate and keep a regular checking period of the syllabus.

## 1.6 Instructor Bio

I am a full Professor of Mathematics. I am also an affiliate of Gender, Women's and Sexuality Studies (GWS) and the Math and Science Education Center (MSEC), investigating connections between mathematics and society. My PhD in Riemannian geometry is from the University of Pennsylvania. I am married to the bassist Joel Landsberg. In our spare time, we like to travel, hike and conduct genealogy research. In addition to my own personal genealogy, I like to give back to the broader community, and in this context, I am also affiliated with ASU's center for Judaic, Holocaust and Peace Studies. Some of what I like about mathematics is also what I

enjoy about genealogy—the sense of exploration, discovery and aha moments that come with lots of patience and effort.

## **1.7 Acknowledgements**

Star Wars <sup>TM</sup>and © Lucasfilm Ltd., Twentieth Century Fox, Walt Disney and its companies. For educational use only. I adapted the idea from my friend Amy Ksir.