The purpose of the *Math Major Survival Guide* is to help math majors succeed in their math classes during two traditionally difficult transitional periods: the transition from high school math classes to college computation classes and the transition from computation classes to proof classes. The content of the booklet is based off experiences and observations of the author as well as research.
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Purpose and Introduction

The purpose of the Math Major Survival Guide is to help math majors succeed in their math classes during two traditionally difficult transitional periods: the transition from high school math classes to college computation classes and the transition from computation classes to proof classes. The content of the booklet is based off experiences and observations of the author as well as research.

The booklet is organized into eight chapters. The first three chapters contain information about how computation and proof classes are different than high school math classes, the math major at UMD, and administrative topics. Look in these chapters if you would like to learn about what a proof is, the classes math majors take, what you can do with a math degree, why a syllabus is useful, and time management.

Chapter four provides strategies on how to make the most of in-class time. Here, you can learn about effective notetaking methods, paying attention in class, and discussion sections. Chapter five outlines how to use your time outside the classroom with hints for completing homework assignments, reading textbooks and studying for quizzes and exams.

Chapter six discusses MATLAB, a programming language you will need to use in many of your classes, and the importance of building your programming skills. Chapter seven provides a list of resources for students in both computation and proof classes including information about the various tutoring services at UMD, how to make office hour visits productive, and Help Sessions for proof classes. Finally, chapter eight has a list of opportunities for research, being a tutor, finding an internship, and joining math related clubs.

If you take advantage of the strategies provided in this guide and apply them to your classes, you should do quite well.*

Acknowledgements

This guide started out as the final project for my technical writing class, and I would not have been able to turn the guide into a real resource without Dr. Crane’s advice and encouragement. I would like to thank Ms. Chan and Dr. Levy for meeting with me and discussing how to go about reworking the document. A big thanks to Ankur Patel and Meghan Chulock for their quotes and taking the time to look over the guide, make comments, and discuss their feedback with me. Their suggestions helped significantly improve the content. I appreciate that Dr. Fibich allowed me to use a past syllabus and Dr. Levermore let me use the MATH 410 webpage in the guide.

*Not all strategies will work for everyone. Try out tips you think may be helpful.
1 A Heads Up About . . .

1.1 Computation Classes

Congratulations on deciding to major in math! If you are reading this booklet for the first time as a freshman, congratulations on your acceptance to UMD! You should be proud of your accomplishments and excited for the next four years.

Your first college math classes are calculation based; however, they will be very different from your high school math classes. College math classes are taught at a faster pace, exams cover weeks of material, and finals are generally cumulative. You will have to understand the big picture behind the methods introduced to you rather than how to solve specific problems. Oftentimes, you will be asked on an exam to apply something you have learned to a problem or scenario you have never seen before. So, you will need a good grasp of the material and the ability to adapt what you know to solve new problems.

Much of your learning will take place outside of the classroom. You can’t rely on your professors to teach you everything; they are more of a guide in college. Many of the strategies you used in high school to do well in your math classes, like cramming the night before a test, may no longer serve you. You may need to spend two hours (or more) for every hour that you are in class to master the material (Zucker).

1.2 Proof Classes

Once you complete your introductory classes, you are ready for your next challenge, proof classes. Your proof classes, beginning with MATH 310 Introduction to Mathematical Proofs, will be extremely different from any math class you taken thus far.

What is a mathematical proof? A proof is a logical argument that illustrates why a mathematical statement is true. You may remember writing two column proofs occasionally in high school geometry. These proofs were fairly simple to complete as they involved one given or hypothesis and the format was always the same. The proofs you wrote probably went something like this:

```
Given: \ell \text{ is parallel to } m
Prove: \angle 1 \cong \angle 8

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. \ell \text{ is parallel to } m</td>
<td>1. Given</td>
</tr>
<tr>
<td>2. \angle 1 \cong \angle 5</td>
<td>2. \text{ parallel lines give corresponding angles } \cong</td>
</tr>
<tr>
<td>3. \angle 5 \cong \angle 8</td>
<td>3. \text{ vertical angles are } \cong</td>
</tr>
<tr>
<td>4. \angle 1 \cong \angle 8</td>
<td>4. \text{ transitive property of } \cong</td>
</tr>
</tbody>
</table>
```

In the proof classes you are taking now or are about to take, you will learn how to read and write proofs that are much more complicated than the ones you wrote in geometry.

Computation courses present a fair number of proofs to explain the reasoning behind the calculations. Even though you
are not tested on proofs in these classes, it is important to pay attention to and try to understand them when they come up in class and your textbooks. The more experience with proofs you can get, the better. Math is really all about proofs, and to complete the math major you will need to take a number of upper level proof classes.

Hopefully you have taken or are taking MATH 310. It is important to take this class to gain some experience understanding and writing proofs before you are thrust into MATH 410 Advanced Calculus I, a class required for all majors. Even if you are exempt from MATH 310 (exemption explained on p. 9), it is still a good idea to take the class because your previous experience in math is not enough to prepare you for proof heavy courses.

In your proof classes, you will learn how to be a communicator of mathematics rather than a user of mathematics, as you were in your computation classes. So, you must learn the language of mathematics and how to use it clearly and effectively. There a number of mathematical symbols and expressions as well as writing conventions that you will need to become familiar with. You will need to be able to justify to others through proofs that your ideas are correct.

Check out chapters 0-5 of the MATH 310 textbook, *Mathematical Proofs: A Transition to Advanced Mathematics* by Chartrand, Polimeni, and Zhang, to learn proof writing techniques. Also, *The Nuts and Bolts of Proofs* by Cupillari has some good advice and practice problems for writing proofs. Look in the UMD library catalog for these two books.

Proofs may not come naturally to you at first, but with practice you will improve at reading, writing and understanding proofs.
2.1 UMD Math Major

There are four tracks you can take as a math major: traditional, statistics, applied mathematics, or secondary education. Each track starts out with the same sequence of introductory computation courses:

- MATH 140 Calculus I
- MATH 141 Calculus II
- MATH 241 Calculus III
- MATH 240 Linear Algebra
- MATH 246 Differential Equations

All math majors must take a computer science class. Additionally, students following the traditional, statistics, or applied mathematics tracks must take a three course supporting sequence in an area other than mathematics. Students completing the secondary education track must take a two course supporting sequence. Computer science and supporting sequence options can be found on the next two pages.
Computer Science Options

- CMSC 122 Introduction to Computer Programming via the Web
- CMSC 106 Introduction to C Programming
- CMSC 131 Object-Oriented Programming I
- CMSC 132 Object-Oriented Programming II
- ENAE 202 Aerospace Computing
- ENEE 150 Intermediate Programming Concepts for Engineers
- PHYS 165 Introduction to Programming in the Physical Sciences
- AOSC 358L Computing and Data Analysis: Deciphering Climate Change Clues

All majors, regardless of track, take MATH 310 Introduction to Mathematical Proofs, a class designed to prepare students for the MATH 410 Advanced Calculus I requirement, unless exempted due to earning A grades in MATH 240 and 241. However, it is strongly recommended that exempted students take 310 for success in MATH 410.

While computation classes provide some exposure to proofs (and it is a good idea to pay attention to them when presented), they are not intended to prepare you for the rigors of proof courses. It is a good idea to gain some experience with proofs in MATH 310. All students in MATH 410 are expected to know the material covered in MATH 310 from the start of class.

The tracks diverge after MATH 410. Each track requires eight upper level classes, many of which involve proofs, to complete the major. Some of these classes overlap between the tracks. Most math majors take two upper level classes a semester. More information about each track can be found here and information about course planning here.

2.2 What can you do with a math degree?

Math majors often attend graduate school in mathematics or any subject that relies on mathematics like engineering, physics, economics, or chemistry. Others pursue careers in fields that use mathematics such as teaching, actuarial science, computer science, operations research, biomathematics, cryptography, and finance. These careers require problem solving and logical reasoning skills, which mathematics students learn to excel at.

The Mathematical Association of America claims that Mathematician was the number one job in 2014. Furthermore, statistician and actuary, other professions that use math, were ranked third and fourth respectively. By studying mathematics, you are setting yourself up for many career options and a good chance of finding a job that you will enjoy.

Check out these two sites for more information on careers that use math:
http://www.math.umd.edu/undergraduate/opportunities.html?id=104
http://www.math.duke.edu/major/whyMajor.html

When you graduate as a math major

π

Do you get a degree or a radian
This section covers information on syllabi, course websites, time management, and UMD’s Honor Code. Understanding your classes’ and UMD’s policies as well as how to stay organized is key to your success.

### 3.1 Navigating the Syllabus

The policies and procedures students and teachers must abide by are outlined in the syllabus. In order to do well in your math classes, you need to know what the policies are and follow them.

For example, understanding what the procedure is for requesting a make-up exam is extremely important. If you are too ill to take an exam, you must follow the policies stated in the syllabus to schedule a make-up exam. If you don’t, you will receive a zero on the exam.

Additionally, syllabi contain other important details like where the offices of your teachers and TAs, graduate students who serve as teaching assistants, are and when you can visit them for help. Every syllabus will have information on what material you are responsible for learning and when you must learn it by. Sometimes there may be important instructions on formatting homework assignments (you may lose points if you don’t follow them). So, read and make sure you understand your syllabi; they will help you do well in your classes!
Let’s look for key information together:

3.11 Office Hours and Contact Information

Office hours are times when students can visit their teachers and TAs for help. The times and locations for office hours are usually posted at the top of the syllabus. Some professors have more than one office, so double check ahead of time that you are going to the right one. If office hours conflict with your schedule, oftentimes you can arrange an alternate meeting time with your professor. The best way to do so is by email. If you speak to a teacher after class about meeting later, you should promptly send them an email about the conversation. Instructors include their email address in the syllabus and encourage students to contact them with questions or concerns. Some provide a phone number. Visit the Resources section to learn how to get the most out of office hours.

3.12 Class Materials

Information on the textbook and any other resources like a solutions guide are usually included in syllabi. You will need access to the textbook to read along with the lecture material and to complete homework assignments.

3.13 Grades

Teachers usually post standard grade cutoffs in their syllabi such as A 90-100, B 80-89, and so on. These cutoffs are approximate or ideal. More often than not, the grade cutoffs are readjusted at the end of the semester based on the class’s overall performance. Sometimes the grading scheme for individual assignments, like exams, will be adjusted to provide a more even distribution of grades. If the grading scheme is unclear or you have any questions about it, talk to your instructor.
3.14 Exams and Quizzes

Exam and quiz dates are usually included in syllabi. They are major grading events. It is important not to miss an exam or quiz. If you do, you will need to look in the syllabus for any policies on making up exams. Be on the lookout for suggested study materials in syllabi. This syllabus has a link to practice exams.


These will serve as practice exams for our class.

**Exam dates:**
- Tuesday, February 10
- Tuesday, March 10
- Tuesday, April 21

**Exam dates:**
- Thursday, February 19
- Thursday, April 5

Uniform final exam: Thursday, May 14, 1:30-3:30pm at a location to be announced later.

Make-up policy: There will be no make-ups for in-class exams or quizzes. In the case of an absence due to illness, religious observance, participation in a University activity at the request of University authorities, or other compelling circumstances, your blank grade will be replaced by the average of your other in-class exams (respectively, quizzes).

The major grading events for this class are the three in-class exams and the final. I will accept a self-signed note which acknowledges valid reasons for missing one exam, but will require formal written documentation (such as from a medical provider) for subsequent absences.

After each in-class exam or quiz students have one week from when the exam is returned to appeal the grading. Appeals for the final grade must be made in writing. No appeals for regrading work done during the semester (including the third exam), can be made after the day of the final exam.

On exams students must write by hand and sign the following pledge:
I pledge on my honor that I have not given or received any unauthorized assistance on this examination.

During exams, students are expected to apply the ideas they learn to some problems that are significantly different from the examples and homework they have seen.

3.15 Class and Homework Schedules

The class and homework schedule are usually combined in some way. In this syllabus, there is a homework schedule. However, you can deduce what topics will be covered in each class period from the assigned homework. Some schedules are organized by week, such as the one below. Others may be organized by day. Usually the topics covered correspond to sections in the textbook, so you can easily look up information and read ahead before coming to class. Look at the syllabus to see what material will be covered on quizzes and exams.

The following problems from the on-line notes by Dr. Levermore will assigned, but should not be turned in. You should keep your work in a notebook, and check your answers against the ones in the notes. Some of these problems will appear on quizzes and in-class exams.

**Problems for February 4**
- I.1 (3)-(6)
- I.2 : (1 a, b, f), (3), (4), (6), (7), (8), (12), (15), (16)
- I.3 : (1), (7), (6), (7), (10), (12), (13), (15), (17)
- I.4 (2), (3), (6)

**Problems for February 11**
- I.5 (1), (2), (3), (4), (6)
- I.6 (9), (6), (7), (8), (15)

**Problems for February 25**
- I.7 (2), (3), (4), (10)

**Problems for March 4**
- I.8 (1), (3), (6), (8), (12), (18)
- I.9 : Not covered.
- II.1 : (8)
- II.3 : (1a), (1b), (3a), (4a), (11)

**Problems for March 25**
- II.2 : (1), (3), (7), (8), (11), (16), (18), (20), (31), (32)

**Problems for April 1**
- II.4 : (1)-(4), (6), (8), (10), (11), (15), (17), (33), (35), (37), (40)
- II.5 : (2), (5), (9), (10)
- II.6 : (2)-(5), (13), (15), (19)

**Problems for April 8**
- II.6 : (21)-(22), 25, 26
- II.7 (1), (2), (4), (23)
3.2 Course Websites

Some teachers opt for a course website instead of a syllabus. Some websites are more complicated than others. Here is an example of a site that contains a lot of information but is well organized.

Office Hours

Office hour information is displayed at the top. Take note that the instructor has two offices. Email addresses for the teacher and TA are provided as well.

Announcements

Important announcements are displayed in the middle, including an update to the notes and the date and time of the final exam. Since websites can be updated any time, it is important to keep checking the site for changes and announcements.

Resources

Links to other pages provide greater detail on the topics listed below. The Office Hours link explains the instructors schedule for his two offices. Class Notes and Homeworks are useful resources for completing homework and studying for exams.

Website for MATH 410, Section 0201
Advanced Calculus I, Fall 2015

This website contains the official syllabus for the course.

Lectures: 9:30am - 10:45am Tuesdays and Thursdays in MTH 3104
Website: http://www.taropoorna.utexas.edu/~korn/2015-2016:F/Classes/Math410.shtml

Instructor: Professor David Levene
Office: SS 4309 and MTH 3133
Phone: 301-405-3127 and 301-405-508; respectively (If I am not there then use e-mail)
Email: korn@math.umd.edu (Please include "MATH 410" in the subject heading)

Grades: Scott Schumacher
Office: MTH 4113
Email: scott@math.umd.edu (Please include "MATH 410" in the subject heading)

The Headlines

- Eleventh Homework is due on Tuesday, 17 November.
- Twelfth Homework is due on Tuesday, 24 November.
- Thirteenth Homework is due on Tuesday, 1 December.
- Fourteenth Homework is due on Tuesday, 8 December.
- Fifteenth Homework is not collected.
- This material is covered on the Final Exam.
- Click below on "Homeworks" for more details.

- A new version of Riemann Integrals and Integrability was posted on 14 November.
- Changes from the 7 November version are minor.
- Click below on "Class Notes" to find them

- Final Exam on Tuesday, 15 December, 8:00am to 10:00am in classroom.
- Click below on "Exams" for more details. GOOD LUCK!

- Class Notes are Available Covering:
  - Real Numbers (7 October version)
  - Functions and Regularity (11 October version)
  - Riemann Integrals and Integrability (7 November version)
- Click below on "Class Notes" to find them

- Special Math 410 Help Sessions
- Click below on "Help Sessions" for more details.

- Calculus Review Notes are available
- Click below on "Calculus Notes" for more details.

The Details

- Office Hours
- Help Sessions
- Class Notes
- Texts and other Resources
- Calculus Review Notes
- Description and Prerequisites
- Syllabus
- Exams
- Homeworks
- Grading Policies
- Attendance and Drop Policies
3.3 Time Management

Math classes are challenging and require a great deal of time to master the material. It is important that you manage your time so you can complete your homework, study, and have fun.

Try to start assignments as early as possible so that you have more time to get help if you need it. For computation classes, strive to complete the assigned homework problems the day the corresponding topic is covered in class. Waiting any longer puts you at risk of falling behind. For proof classes, brainstorm ideas about how you might use what you learned in class that day to solve any homework problems.

It is important to review daily. Having a plan to complete your math assignments as well as assignments in your other classes will keep you organized and prevent you from forgetting to do an assignment or falling behind.

Two strategies you can use are making a weekly schedule of tasks you need to accomplish each day and a semester calendar, which provides a big picture of the semester. The semester calendar will let you see into the future and plan out your weekly schedule more effectively. Sometimes your weekly schedule can be extracted directly from the semester calendar. It is a good idea to make a digital weekly schedule and semester calendar so that you can easily make an update if the date of an assignment is changed.

It may take some time to figure out the level of detail you need for your schedule. A list of tasks for each day works for some, and others may need to plan out each hour of the day.

3.4 Honor Code and Academic Honesty

Every student at UMD is charged with upholding the university’s honor code. This means that students do not cheat or plagiarize on their homework, examinations, or quizzes. In math classes, you will sign the honor pledge after taking an exam.

Honor Pledge:
I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination.
4.1 Coming to Class

It might seem obvious that you should go to class if you want to learn; however, many students skip their classes. As the introductory classes are in large lecture halls for 200+ students, students realize that their presence, or lack thereof, will not be noted by the instructor. Some do not attend because of laziness. Or, they think that they already know it all.

Proof classes are much smaller than your computation classes. Instead of sharing a lecture hall with around 200 other students, you are in a small classroom of around 20-25 students. The professor is much more likely to know your name and make an effort to get to know you. Your professor will know if you are not present in class. Coming to class shows the teacher that you value his or her class and are putting in the effort to do well.

Some students may have trouble following the lecture and think because they are not learning in class, they should no longer attend. However, the material can be extremely difficult to learn on one’s own, and many students end up putting it off. This results in poor grades on homework and exams. If this is the case for you, the solution is not to stop going to class but to use some of the strategies outlined in the guide like reading the textbook before coming to class to take more efficient notes during class.

Every bit of exposure you can receive on the material will help you learn. Going to class enables you to ask questions in the moment of confusion. Also, sometimes teachers give pop-quizzes in class or extra credit opportunities, and you don’t want to miss those.

While attendance is not mandatory in the sense that part of your grade is attendance, it is mandatory if you want to do well in the class. A 2010 study on college students’ class attendance found that class attendance is a better predictor of grades than studying skills and amount of time spent studying (Credé et al 2010). So, go to class!

4.2 Paying Attention

- Sit towards the front in the center. Your computational classes will be in large lecture halls in the Armory. The chalkboards in the Armory are long, and if you sit at the end of a front row you may have difficulty seeing the other side of the board. For proof classes, it is still a good idea to sit towards the front in the center. There will be less to distract you if you sit up front. Also, the
teacher will be more likely to see you raise your hand if you have a question and call on you. It is best for visual learners to sit in the front (Nolting 52).

- If you prefer to sit in the back, try to sit in the middle to have a better view of the board. Sit in the back, middle section if you are an auditory learner (Nolting 52).
- Put your phone away! Classes move quickly, and if you are not devoting your full attention to the lecture, you will fall behind. Also, phones can be a distraction to others around you.

- Put your laptop away! Take notes with pencil and paper. It is difficult to take math notes on a computer. If you take notes on a tablet, make sure you discipline yourself not to leave the notes application. The only exception to this rule is if the teacher provides online lecture notes and you would like to refer to the notes as he or she goes through the lecture. Make sure that you are not surfing the web during class!

4.3 Taking Notes
4.31 Notetaking Advice for Computation Classes

This section provides some general notetaking tips for computation classes and two notetaking methods. It is a good idea to create your own shorthand or abbreviations to save time writing. Color coding with pens and highlighters may help you organize your notes; however, it is usually best to take notes in pencil in case you or the professor makes a mistake. Here are some times when you should definitely take notes (Nolting 56):

- The professor says a problem is difficult or that a problem like it will be on an exam.
- The professor does multiple examples of a similar problem type.
- The professor provides a summary of an idea or what he or she just covered.
- The professor lists steps or information and repeats the information many times.

There are two notetaking methods useful for taking notes in computation classes: the Cornell method and the outline method. Examples of each method are provided on the next two pages. Experiment to see which one you like best or is more natural to you.
**Cornell Method**

Big ideas and questions go in the smaller left column. Notes go in the larger right column. A summary goes at the end. You can write this after class to review your notes. When you go back to study the notes, you can read the summary to refresh your memory.

**Outline Method**

Notes and important information are arranged in an outline format. The order is based on how the material is presented in class.
4.32 Notetaking Advice for Proof Classes

When students leave their proof classes having understood very little, it is generally because they are not taking notes the right way. In your computation classes, you probably wrote down everything your professor wrote on the board and had no trouble following along with what your teacher was saying. In proof courses, it is very difficult to take word for word notes and listen at the same time. It takes a lot of concentration to copy down properly the symbols and theorems teachers write on the board. While you are writing the information down, you are likely missing the important details about the logic behind a proof’s steps or what a theorem means. Later, when you go back to look at your notes, there may be information that you do not understand.

If you are having difficulty keeping up with the lecture and taking detailed notes at the same time, it might be best to preview the material to be covered ahead of time by reading relevant sections in the textbook. Reading ahead before class will allow you to not only get a head start on the material but also allow you to determine what topics you should especially listen to for clarification in lecture (Saltzman and Coffin 4). Check out the section on reading your textbook for some tips. If you aren’t sure what will be covered in the next class, you can always ask.

Then, in the next lecture, you should definitely take notes on whatever topics that were confusing you. You don’t have to take detailed notes, but you should write down at least a comment that helps further your understanding.

It might help to bring your textbook to class and follow along in your book. While it is a good idea to write down examples or information not included in the book, you can still take notes on material covered in the book. You may not want to copy everything down again, but making an outline of what was covered and noting comments your teacher makes about the material can help remind you what you did in class and give you the big picture of how it all goes together (Saltzman and Coffin 4).

Sometimes teachers mention that they are covering material that is not in the textbook. If this is the case, it is important to pay extra attention and take the best notes that you can. You might want to add some extra detail.

Some teachers provide online notes for their classes. You can print them out and bring them to class or use your laptop or tablet to view them during class. It may also be helpful to read the notes before coming to class like you would do with your textbook. You can still make notes in your notebook or on the printed notes to emphasize certain points the professor makes or to add anything that he or she shares in class but does not include in the notes.
4.4 Discussion Sections

Discussion sections are extra class periods, for introductory classes, led by TAs to review course material. They are required for your success in the course because they provide extra assistance on and review of the material.

Discussion sections can be organized a number of ways. Sometimes discussion is a review of the week’s material. The TA overviews what was covered and asks the students if they have any questions. These kinds of discussions are useful to you because you can clear up any areas of confusion you may have. In some discussions, TAs will go over any questions you have on homework problems. So, it is important to do the homework problems before you attend discussion.

In other discussions, you will work on quizzes or worksheets. It is especially important not to miss these discussions as the assignments are factored into your grade. Furthermore, worksheets provide extra practice on the material that will greatly benefit you. Worksheets are usually done in groups, and you can meet potential study buddies by working on the worksheets. Whichever way discussions are organized, they are designed to help you, so take advantage of them!

4.5 Summer Classes

Summer is a great time to get ahead or catch up on completing your math requirements. If you plan on taking a summer class, it is important to keep in mind that summer classes are intense, requiring an hour or more of class time Monday-Friday for 6 to 10 weeks. To do well in a summer class, you must stay on top of your work and remedy confusions as soon as they come up. Visiting office hours daily, if available, may be necessary.

5 At Home

5.1 Reading the Textbook

5.11 Reading for Computation Classes

You may have never read your high school math textbooks. Perhaps you looked at a couple of examples in the text when you had difficulty with a homework problem. In college, you will need to read your math textbooks in order to learn the material. Many teachers provide only an outline of the material in class. It is your responsibility to fill in the gaps by reading the textbook.

You may need to read a section in the textbook more than once. In fact, it is quite helpful to first skim the section to see what it covers and then complete a close reading or readings (Saltzman and Coffin 2).

Reading a math textbook effectively requires three steps (Draper 34):

1. Previewing:
   Before you begin reading, you should think about what you already know about the material and articulate to yourself what you would like to learn from the reading.

2. Reading:
   Evaluate your grasp of the material by paraphrasing what you have read. Think about how what you are reading fits into your existing knowledge.
3. **Post-reading:**
   After you have finished reading, summarize what you have read and try to apply the information to some problems.

### 5.12 Reading for Proof Classes

In addition to the tactics for textbook reading described above, a few more strategies that work well for proof classes are listed here:

- Read your textbook at least twice. During your first reading, it is a good idea to look at the theorems, lemmas, and propositions and how they might all fit together. In your second and subsequent readings, you should try to understand what the theorems, lemmas, and propositions mean (Tomforde).

- Your proof textbooks provide a mathematical narrative or story. It is your job to follow along and read all the parts of the story including the examples and pictures. You should think about how the examples and pictures contribute to the mathematical narrative (Tomforde).

- You may get stuck between steps in proofs. If this happens, pause and think about why the steps make sense and attempt to fill in the gaps (Saltzman and Coffin 2). It helps to rewrite the proof and missing steps on a clean piece of paper.

### 5.2 Homework

#### 5.21 Homework for Computation Classes

The only way to learn math is to practice solving problems. You should make studying a part of your homework. This means before diving into the problems, you should review and reflect on your notes. If you forget something when solving a problem, you can refer to your notes. This will further solidify the concept in your mind.

It may be useful to make notecards on the challenging homework problems. You can write the problem on one side of the notecard and the solution on the other. This will help you remember how to do the hard problems. You can then review the notecards and think about how you would solve the problems. Thinking about how to solve difficult problems will help you solve problems more quickly on exams.

There are two kinds of homework assignments in computation classes: WebAssign and ungraded assignments. This section describes both types of assignments and how to complete them.

#### 5.21.1 WebAssign

WebAssign is an online homework system that is used in MATH 140 Calculus I and MATH 141 Calculus II. Questions ask you to type in a number or expression. You are allowed three tries per question. If you are wrong each of your three tries, the correct answer is not displayed. For this reason, it is a good idea to work with someone else or in a group on the assignments. You can work through the problems together and
discuss the processes for solving the problems. If you don’t get the right answer and your partner or partners do, they can point you in the right direction.

Also, the assignments are usually due two days after the material is covered in class. It is important to start the assignments as soon as possible so that you have enough time to complete them and ask for help if you need it.

5.21.2 Ungraded Assignments

You will have ungraded assignments in MATH 241 Calculus III, MATH 246 Differential Equations, and MATH 240 Linear Algebra. The trouble many students have with ungraded homework assignments is that they put off doing them. This is a major mistake! When an exam comes around, they remember that they should do the problems and are shocked to find they have accumulated a long list of problems. Unfortunately, they will likely not have enough time to complete and master them all to the level one needs to be successful on the exam.

The hardest part about completing ungraded homework assignments is making it a priority to do them. Every day you have lecture, you should try to complete the problems that pertain to the material you learned that day. Doing so will help you retain the concepts and keep you disciplined. Also, starting the problems sooner rather than later will allow you plenty of time to ask for help with difficult questions.

5.22 Homework for Proof Classes

In your proof classes, unlike your computational classes, you will have problem sets due about every week for a grade. There will be many times where you first read a problem and think to yourself, “I have no idea how to do that!” The hardest part of many proof homework problems is figuring out what the question is saying and how to start. Have no fear! This guide is here to provide some suggestions on how to get started on these difficult problems.

Before attempting to write a proof you should think about what definitions, properties, theorems, and lemmas you may need to write it. You should make a list of all the information you need and write out the statements in full.

Many times writing out the definitions of the hypotheses makes the proof jump out at you from the page. Other times, you might need to use a fancy trick like creating an equation from existing equations, constructing a sequence, or combining expressions using inequalities. Recognizing when to use a trick and implementing one takes practice.

Also, if you can’t figure out how to prove a statement directly, you can try proving it by contradiction. A proof by contradiction starts with assuming the hypotheses are true and conclusions are false. Then, you show that it is impossible for one of the assumptions or (false) conclusions to hold.
5.3 Studying for Assessments

There are three types of assessments in computation and proof classes: quizzes, midterms and final exams.

5.31 Quizzes

The number of quizzes you may have in a class varies. You might have between 14 and 15 quizzes a semester, which means there is about one quiz a week. Usually the best 10 quiz scores are counted, so if you don’t do so well on a few quizzes, it isn’t a big deal. Or, there could be as few as 3 quizzes and all count. Sometimes quizzes are scheduled during discussion; other times quizzes will either be scheduled or randomly given during class time.

The best way to prepare for quizzes is to complete all of the assigned homework problems. Usually quizzes have problems directly from the homework or problems similar to ones on the homework.

5.32 Midterm Exams

You will have 3 to 4 midterms in your computation classes. Proof classes usually have 2 midterms. To prepare for them, you should gather together and review the relevant homework problems, practice exams, and quizzes. If your teacher does not provide you with practice exams, the Test Bank section in Resources explains how you can find some. Studying with others is also useful. When studying if you come across something you do not understand, ask for help.

It is especially important to do well on the first exam, as this exam covers the easiest material and can serve as an insurance policy if you do not do as well on future exams (Nolting 8). It is much harder to improve your grade at the end of the semester than consistently putting forth a good effort throughout the semester.

5.33 Extra Study Tips for Proof Exams

Here are some general studying strategies for proof classes (Stout):

- As you complete your homework problems, you should make an effort to learn not only what the definitions, theorems, propositions, and lemmas say but also what

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Proof by Contradiction

Prove that if $n$ is an even integer, then $3n+5$ is odd.

Proof: Assume to the contrary that $n$ is an even integer and $3n+5$ is even. As $n$ is even, $n = 2k$ for some integer $k$ (by the definition of even). Next, by substituting in $n$ to the second equation and some factoring, we get $3n+5 = 3(2k)+5 = 6k+5 = 2(3k+2)+1$. Since $3k+2$ is an integer, $3n+5$ must be odd. This is a contradiction because we assumed that $3n+5$ is even. Therefore, the above statement is true.
they mean. The sooner you understand them, the easier it will be for you to study for exams. To learn the meanings, it may help to make up your own examples.

- To help you learn all the mathematical statements, you should examine each of the hypotheses individually to determine how they work together and how the statements would fall apart if any of them are missing. Once you understand each hypothesis, you will have a complete understanding of the statement.

- Practice negating statements. You will need to use negated statements in proofs by contrapositive and contradiction. Furthermore, your professor may have question on an exam asking you to negate a statement.

- Creating an outline of how mathematical statements relate to one another can help you see the bigger picture and make proof writing easier. You can do this every time you have to write a proof for homework. If you do this enough times, come exam day, you will have a good idea of how the theorems and definitions fit together. Here is an example of an outline:

**Lipschitz Continuity**

1. Uniform Continuity
2. Continuity
3. Convergence
4. Archimedean Property
5. Completeness Axiom

- Once you figure out how to write a proof, try to write it in a different way. If you are able to prove something more than one way, you will prove to yourself that you really understand the material.

- The worst thing you can do is to start studying the night before the exam. You need to make studying a priority when you complete your homework assignments. If you start early and are diligent, you will do well.
5.34 Final Exams

Math final exams are challenging because they are usually cumulative and worth a significant part of your grade. Therefore, you should gather together and review all of your midterm exams, quizzes, homework problems, and midterm and final practice exams. You can find additional practice exams using the Test Bank. Details about the Test Bank can be found in the Resources section. Studying with others is also useful. When studying if you come across something you do not understand, ask for help.

Introductory math classes usually have their final exams on the first day of final exam week. It is extremely important that you begin studying for the final exam as soon as possible. Final exam times for proof classes vary.

If you are taking two introductory courses, you will need to talk to your math professors about taking one final at an alternate time. As many students are in this position each semester, this is usually not difficult to arrange. It is important, however, to let your teachers know that you are taking more than one math class early so that they can accommodate you more easily. Usually you take the higher numbered class at the designated time and reschedule the lower numbered one.

5.4 Taking Assessments

Studying for a quiz or exam is only half the battle. You also need to know how to take an assessment to maximize your score. Here is a list of test taking tips (Saltzman and Coffin 8-9):

- Scan over the test and identify the problem type of each question. Start with the question you think is the easiest or worth the most points.
- Since you will be working very quickly to solve all the problems, you will evidently make some small mistakes. Check your work!
- If you get stuck on a problem, make a note of it and move on. You can come back to it later if you have time. If you don’t have time, you will get some partial credit and the points for the other problems you complete.
- If the wording of question is unclear, ask. (There may be typos!)
- Write down any equations you think are relevant to the problem, even if you are not sure how to use them. You will likely get some partial credit.
- If you get stuck, write down the relevant hypotheses, definitions, and theorems. Many times having all of the information in front of you will lead to a proof. If you can’t figure it out, it’s ok, you will likely get a good amount of partial credit for knowing the information related to the problem.
6.1 What is MATLAB? How will I use it?

MATLAB (MATrix LABoratory) is a programming language that helps you visualize solutions in 2D and 3D plots as well perform computational procedures. You can use MATLAB to do many things like solve equations, find the inverse of a matrix, take a derivative, produce the QR factorization of a matrix, and plot a vector field.

There are a number of equations that are either difficult or impossible to solve by hand, and with MATLAB we can find the solutions or approximations to the solutions much more easily. Sometimes you can draw conclusions about a function’s behavior from a plot. MATLAB can even be useful for checking your work.

MATLAB is used many math courses including Calculus III, Differential Equations, Linear Algebra, Computational Methods, and Introduction to Numerical Analysis I. Many of these classes assign a few MATLAB projects to reinforce or further explore class material. Sometimes you may have MATLAB quizzes and MATLAB project material may be covered on exams. You usually do not have to write MATLAB code on the exams, but you need to have an understanding of how to use particular procedures and what they do.

Some classes will provide you with instructions or commands, while others will leave it up to you. If you need to find out how to perform a particular operation in MATLAB, visit the documentation site.

Everyone will need to learn how to use MATLAB. It is a good idea to take MATH 206 Introduction to MATLAB before taking Calculus III to gain some familiarity with the program.

You can obtain a free academic license for MATLAB at https://terpware.umd.edu/ under the Analysis and Modeling tab.

MATH 206 Introduction to MATLAB:

According to the Schedule of Classes, MATH 206 is a one credit online course intended to prepare students for subsequent courses requiring computation with MATLAB. It covers basics of MATLAB including simple commands, variables, solving equations, graphing, differentiation and integration, matrices and vectors, functions, M-files and fundamentals of programming in the MATLAB environment. The class is offered year round.
6.2 More Programming Languages to Learn

For all math majors, and even more so for those interested in applied mathematics and statistics, taking courses in computer science at UMD or learning programming languages on your own is important. Everyone takes one computer science course and AMSC 460/466, but mathematics and computer science are so integrated that it is extremely beneficial to build your programming skills and learn as much as you can. To gain more experience with computer science you can do a double major, a minor, or follow the computer science sequence. Adding the minor is easy after completing the three course sequence.

For those interested in statistics, UMD offers STAT 430 Introduction to Statistical Computing with SAS to teach students about the statistical analysis program.

You can also look into learning some new languages by taking some online courses or watching videos on YouTube.

Online Learning Sites

- Coursera
- EdX
- Udemy

Many internship and job postings state that experience with programming or knowledge of a particular language is preferred or even required. So, it is important to research what languages are important to know for your future career path.

Some languages to learn

- R
- SQL
- C
- C++
- Java
- Perl
- LaTeX
- JavaScript
- PHP
- Ruby
- Python
- OCaml
- And more!
7 Resources

7.1 Office Hours

In order to make the most out of your office hour visit to your professor or TA, you need to come prepared with the questions you want to ask. Make a list of all the questions you have so that you won’t forget to ask them. You can also rank your questions in order of importance or urgency in case office hours are busy and you don’t have enough time to ask all of your questions. Bring any materials relevant to your question like the textbook or list of homework problems.

If you are confused about a concept try to pinpoint exactly what about the concept is causing the confusion. Instead of saying that you don’t understand the entire concept, determine the line in your notes or the textbook where your understanding falters, and ask for an explanation from there. The more specific you can be about your confusion, the better your teacher or TA can help you.

Before going to ask for help with a homework problem, make sure that you have put in your best effort at solving the problem. You can explain the steps you took and the reasoning behind them to your professor or TA. Sharing your thought process will enable him or her to point you in the right direction and fill in any gaps in your knowledge.

If he or she works through the solution to a problem with you, sometimes it is a good idea to copy the main ideas rather than the whole solution. When you go back to work on the problem you will learn more by attempting to reproduce the
solution than rewriting it.

Remember that professors and TAs have office hours to help you; there are no dumb questions. Don’t feel embarrassed if you are confused. One last piece of advice: always thank your professor or TA for his or her help at the end.

7.2 Tutoring

There are both free and private tutoring (for a fee) options available at UMD. It will take a bit of effort to find a private tutor. In order to prepare for a tutoring session, you should determine what your questions are and bring the relevant materials to the session. Utilize your tutor as a source to help you understand the material not as a way to get your homework done. A number of useful links for tutoring and other resources can be found here.

7.21 Free Tutoring Services

7.21.1 Tutoring Room

Walk-in tutoring for lower level computational classes is available in MTH 0301. Tutors are graduate students who TA for the classes.

7.21.2 Office of Multi-ethnic Student Education

OMSE Walk-in tutoring in 1101 Hornbake Library by undergraduate and graduate students is mainly for lower level computational classes, but some tutors are available to assist with upper level proof classes. As the tutoring schedule can vary, check the OMSE website for tutor availability.

7.21.3 MATLAB Tutoring

MATLAB tutoring is available to assist with MATLAB projects for MATH 206, 240, 241, 246, and 461. Times for each class vary by day, so consult the schedule below. MATLAB tutoring is in MTH 0203, the Math Building Computer Lab.

7.22 Private Tutoring

The Math Department keeps a list of names of those willing to tutor for a fee and updates it every semester. You will need to contact the math advisors to obtain the list. The list will have the names and contact information of the tutors as well as subjects they are able to assist in. The tutors are graduate students in mathematics. When you receive the list, look for all the tutors who are willing to tutor for your class or classes.
and make your own list with those tutors. Then, you can send an email requesting tutoring to as many or as few people on your list as you’d like. The hourly rates of these tutors vary, so make sure to ask yourself how much you are willing to spend and check with each potential tutor how much they charge.

### 7.3 Math Success

**Math Success** is a free service that assists students, mainly in lower level classes, complete homework assignments and study for exams. Students are assisted by math coaches, undergraduates talented in mathematics. You can also work with other students under the guidance of a math coach in a collaborative study group.

**When:** 6 pm- 9 pm Sunday through Thursday  
**Where:** Oakland Hall’s Academic Enrichment Center

### 7.4 Help Sessions

**Help Sessions**, run by Dr. Bhatia, are for solving problems in some upper level math classes including Math 310, 402, 406 and 410. Dr. Bhatia can help explain how to use different strategies to solve homework problems and clarify concepts. He asks that you email him with the topics you need help with at least 24 hours in advance of the Help Session you would like to attend. Help Sessions are extremely useful for students transitioning from computational classes to proof classes in MATH 310 and 410. Help Sessions train students to become better at writing proofs.

### 7.5 Test Bank

The math department **Test Bank** is a compilation of midterms and final exams of all UMD’s math classes. Some classes may only have final exams posted. Sometimes solutions are provided for the exams.

Many teachers provide sample exams to prepare you for exams. In that case, the Test Bank can be an extra resource. Other teachers do not provide samples, so the Test Bank can give you an idea of the topics and problems that may be on your exams.

The Test Bank is organized by class. So, first find your class, and then look for your teacher to see their past exams. If you do not see your teacher listed, it is still helpful to see what kinds of problems and concepts are tested on exams.

### 7.6 Other Students

Your peers are excellent resources. You can work on homework assignments and study for exams with them. Many MATLAB projects can be done in groups, and working in a group to complete the projects can help you complete them faster. Working with others does not mean that you copy their solutions or rely on them to help you understand the material. Copying is considered cheating and academic dishonesty. Furthermore by copying solutions you are cheating yourself out of understanding the concepts and will likely perform poorly on exams, which are weighted more heavily for your
grade. You are responsible for your own learning, but you can help each other be successful.

Try to seek out other math majors in your introductory or proof classes. Also, try to find majors who are a few semesters ahead of you. They can give you advice on what classes to take and share who their favorite teachers are.

7.7 Online Resources

You can find a number of other resources online. A search for similar courses at colleges and universities can yield class notes, links to textbooks, and practice exams. Here are four helpful sites:

1. YouTube – any math topic
2. Khan Academy – computational topics
3. Wolfram Alpha – computation engine
4. Paul’s Online Math Notes – computational topics

7.8 Learning Assistance Services

Learning Assistance Services is run by the Counseling Center. LAS offers workshops on managing math exam anxiety, preparing for final exams, strategies for math success, and preparing for midterms. The Counseling Center is located in the Shoemaker Building.

7.9 Advisors

You can meet with the math department advisors, Ida and Kate, if you have any concerns about how you are doing in your classes, would like to discuss career or graduate school plans, or just talk. You are welcome to drop by their offices during the times listed here. Ida and Kate may be able to recommend further resources other than those outlined in this booklet or direct you to other programs or areas of interest.

Ida’s email: ichan@math.umd.edu
Kate’s email: rendke@math.umd.edu

Student Suggestion:
Go see the advisors if you are stressed! They are very logical and can help you reason out what you can do to improve in a class or put what’s going on in perspective. — Meghan C.
8 Opportunities

8.1 Directed Reading Program

Do you want to see if research is for you? Are you curious about a particular mathematical topic? Do you want to learn some new math or see how it can be applied to the real world? Well, then the Directed Reading Program (DRP) is for you!

The DRP pairs undergraduate students with graduate student mentors for semester-long independent study projects. Students and their mentors work together to come up with a project idea. Each week during the semester, students spend about four hours reading about their topic and meet with their mentor for about an hour to discuss the reading. The program culminates with each student sharing his or her work in a brief talk. Students of any mathematical ability are welcome to apply. Check out their site to learn more and get inspired by past projects!

8.2 Tutoring

There are a number of opportunities to become a math tutor. You can work as a math coach for Math Success or a tutor for OMSE, the Honors College, the Academic Achievement Program, or WiseGuy.com.

8.3 Teaching

The following teaching descriptions can be found on the CMNS page of Teaching Opportunities.

8.31 Terrapin Teachers

Terrapin Teachers provides students with the opportunity to add teaching to their career options. Through this program, students receive both a content degree in math or science and eligibility for teacher certification. This program prepares students to teach math and science effectively using inquiry and project-based instruction. Undergraduates teach math or science lessons to elementary students beginning in the first course of the program, TLPL 101, Inquiry Approaches to Teaching. For more information, visit http://TerrapinTeachers.umd.edu or contact TerrapinTeachers@umd.edu.

8.32 Noyce Scholars

Freshmen and sophomores with strong math or science backgrounds can tutor students in local middle or high schools. You will earn $15 an hour, and most school sites can be
accessed via the UMD shuttle system. Tutors also get paid to attend a monthly seminar to learn tutoring strategies and share experiences and may attend other Noyce Scholars' activities. For more information and application deadlines, please visit the Noyce Scholars Program website or contact Dr. Jennifer Richards at umdnoyce@gmail.com.

8.33 Strauss TA

A Strauss Teaching Assistant is an advanced undergraduate mathematics student who leads one problem discussion per semester of Math 140 (Calculus I) or Math 141 (Calculus II). This is a one-year commitment, with pay. Duties include teaching, grading, and holding office hours each week. Whether your plans include graduate school or immediate employment upon graduation, the Strauss Teaching Assistantship is a unique opportunity for you to cultivate the communication skills that will enable you to reach your goals. Criteria for a Strauss Teaching Assistant include:

- Math major (or double major)
- Completed Math 410 with a grade of B or higher
- Overall GPA of 3.5 or higher

If you are interested, please leave with the Undergraduate Math Office (Math Building Room 1117): your name, email address, telephone number and a brief paragraph about why you would like to be a Strauss Teaching Assistant. The deadline for applications is March each year.

8.4 Clubs

- Math Club
- Pi Mu Epsilon- UMD Math National Honors Society
- Women In Math

8.5 Research

Check out this link for a list of research opportunities (there are so many that it would be tough to include them all!).

8.6 Honors Program

In addition to H-version math courses available to Honors College students, the math department has an honors program. More information about both can be found here.

8.7 REUs and Internships

Research Experiences for Undergraduates or REUs are programs at various colleges and universities around the country where students work on research projects with faculty mentors and other researchers. REUs give students a taste of what graduate school might be like. Usually, a stipend is provided and sometimes costs for travel and housing are covered too.

Being close to DC provides students with endless internship opportunities. Popular places to intern can be found here and here. Also, check out the UMD Career Center page where you can learn how to write a resume, prepare for an interview, and search for jobs and internships.


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