MATH 290, Linear Algebra
Spring 2007

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Contents

1 Introduction

The prerequisite for this course is MATH 181 (Old number: 122), second semester calculus. This means you should already be familiar with the basic methods and techniques for thinking about and solving mathematical problems. Although this is a course in algebra that focusses on "linear spaces" (and calculus focusses on a different area of mathematics – analysis), we will see that there are many examples of linear spaces from the differential and integral calculus. In fact there are examples of linear algebra almost everywhere you look: physics, chemistry, economics, and computer science to name just a few. Unfortunately most of our time will be spent learning linear algebra with only a little for exploring these applications.

For an official description of this course, see MATH 290 Syllabus[4].

Linear algebra is the first "proof-based" course offered in the University of Puget Sound mathematics' curriculum and serves as the gateway course to upper-division mathematics. In addition, it meets the university's "Writing in the Major" requirement. This means there will be at least as much focus on providing **detailed written explanations** of why the mathematical tools of linear algebra work as on the problem-solving strategies used to determine when, where and how to use these strategies. Hence, you are expected to provide clear justifications for each and every logical step in your Writing Projects. I go into more detail about these projects, which are actually writing assignments, in the grading rubric below.

By the end of the semester, you should have learned to

- read a mathematical text for content and deep understanding (see "How to Study" [5] for an excellent description of how to read mathematics and other efficient ways to study),
- analyze a given problem to determine which tools should be used in its solution,
- use a variety of strategies to determine and prove a solution of the given problem, and
- follow accepted mathematical style to present an accurate and carefully written formal proof of your solution.

During a normal class day we will work to achieve these goals by discussing new material, addressing questions that arise from reading the text, and working on homework problems on which there are difficulties. When we discuss new material, we will look at these ideas in their simplest form to highlight how they fit together into the logical whole that is the "big picture" and will save discussion of the details and refinements necessary for a deeper understanding for a second (or third) pass through the material. You are to prepare outside of class for these detailed discussions by carefully reading the text and working on the assigned problems. Then, during class, we will address these deeper refinements by responding to questions on the reading and the problems that you bring to class. Hence, you are expected to participate in class by being present (and alert), by responding to questions I pose, and by asking the questions that you have. You should expect me to ask for ideas on how to proceed in a given problem or develop a new concept and should develop the habit of contributing to the discussion even if you are not confident your idea will work out. (See "How to Study" [5] for an excellent description of how to effectively study mathematics.)

Below is an outline for one way to run this course. I have used this structure before and it has worked well, but it might not be the best one for this particular class. So read it over and see if the tests, homework, reading expectations, et cetera are set up in a way that will help you learn the material. We can discuss making changes during the first week of class. Hopefully we can find a course structure that will work well for everyone.

2 Course Information

2.1 Textbook

The textbook is *A First Course in Linear Algebra, version 1.0,* by Robert A, Beezer, ©2006, and is published by Professor Beezer under the GNU Free Documentation License rather than by a commercial publishing house.

This means many things that will benefit you, the first is that a PDF (hyperlinked) copy of the entire book can be found online at (Professor Beezer's web page) (be sure to grab the correct version!) and a second is that you can purchase a printed copy from Lulu.com for around $25.00 plus shipping. I **strongly** discourage you from printing your own copy from the PDF file.

Since this is likely to be your first exposure to proof-based mathematics, you should also consider buying one of the many books on "how to do proofs". I recommend "The Nuts and Bolts of Proofs" but one of the other books listed below might appeal to your learning style better. The links point to Amazon.com but you might find better prices elsewhere on the web.

- "The Nuts and Bolts of Proofs", Antonella Cupillari [8]
- "How to Read and do Proofs", Solow [10]
- "Thinking Mathematically", Mason/Burton/Stacey [9]
- "Mathematical Thinking: Problem-Solving and Proofs", West and D'Angelo [12]
- "How to Prove It: A Structured Approach", Velleman [11]
- "Proofs and Fundamentals: A First Course in Abstract Mathematics", Bloch [7]

2.2 Calculator

I require a calculator for this course. It must be able to perform the following matrix operations: row operations, reduced row echelon form, transpose, determinant, and eigenvalues/eigenvectors. I will allow the calculator to be used on examinations but will not allow its use for some problems.

I do not care what calculator you use but I am most familiar with Texas Instrument machines, particularly the TI-86. If you do not have a manual for your calculator, you should be able to find one on the internet – for example at
`http://education.ti.com/us/product/tech/86/guide/86guideus.html`. [6] Be sure to see the department's Calculator Policy [3] for more information on calculator use.

2.3 Basic Information

You can find information pertinent to all of my classes at the link below and, once there, information specific to this class by clicking on the Math 290 link.

http://math.ups.edu/ bryans/ [1]

2.3.1 Logistics

Because of the construction on Thompson Hall, the rooms for my office and our class might change during the semester. Currently those rooms are as listed below.

Professor Bryan Smith	(Temp) Temp. Bldg E, Room 2	879-3562	bryans[at]ups.edu
Office Hours		Monday	2:00 - 2:50 P.M
		Tuesday	9:30 - 10:30 A.M.
		Wednesday	2:30 - 3:20 P.M.
		Friday	10:00 - 10:50 A.M.
Classroom / time	Jones 206	M,T,W,F	11:00 - 11:50 A.M.

I am also available for appoinments at other times.

2.4 Day to Day Structure

We will be moving through the material at the approximate rate of five sections every two weeks.

Monday, Wednesday, Friday These days will be standard class days as outlined in the introduction of this document.

Monday On test weeks, Monday during class will be a review session.

Tuesday All examinations are scheduled for Tuesday.

On weeks when there is no examination, Tuesday either be used to provide applications of the material or to catch up if we are behind the syllabus. The class weeks will typically be structured as follows.

2.5 Examinations

There will be five (5) 100 point, in-class examinations that will run from 11:00 to 12:30. I will drop the lowest score. Make-up examinations are occasionally granted but require that arrangements are made well before the exam. You **should not** expect all examination questions to closely mimic textbook examples or assigned homework problems. On the other hand, you should expect some exam questions to be similar to material that can be found in the textbook.

Examination One	Tuesday	January 30
Examination Two	Tuesday	February 20
Examination Three	Tuesday	March 27
Examination Four	Tuesday	April 17
Examination Five	Monday	May 7, 12:00 P.M. (With the Final Exam.)

2.6 Final Examination: Monday, May 7 Friday at 12:00 P.M.

The final examination and the fifth regular examination will both take place during this two (or three) hour period. The final examination portion will be comprehensive. The final cannot be rescheduled so do not plan plane flights (or anything else) that will conflict with it.

2.7 Writing Projects

There will be a writing project assigned for each week we don't have an examination. These projects are designed to help you both better understand the current topic and develop the writing skills necessary to meet the university's Writing in the Major requirement. They will be graded both for mathematical content and for written presentation using the grading rubric on the last page of this document. I will collect these projects at the beginning of class on Friday. Note:

- Feel free to use (or not) any technology that you like (e.g., calculators, *Mathematica*, MATLAB, etc.).
- You may work with others in solving these problems but there is to be **no collaboration on the written exposition of the solutions.**
- You must include a reference paragraph at the beginning of your paper either affirming the work is completely yours or citing each resource you use: names of participants in discussions (other than the in-class discussions), technological tools, reference texts employed, and anything else other than your own thoughts. Failure to include references is intellectual theft!

2.8 Homework

I expect you to work a large number of the homework exercises in the textbook. I will provide feedback on these exercises during our scheduled discussion sessions but, since I will not be collecting them, I am making it **your responsibility** to work enough exercises and ask enough questions to ensure you understand the material.

2.9 Reading

It is very important that you read the material at least twice. Once before and once after it is discussed in class. It is also important that you read correctly. Mathematics requires that you read **slowly** and with a pencil and paper at hand. (See "How to Study"[5] on the course webpage for more details.)

There are reading questions at the end of each section of the book. After a week or two of practicing reading carefully, you should find these questions quite straightforward to answer and should be reasonably adept at pinpointing the material where you have further questions.

2.10 Course Information Updates

If you wish, I will post (and update) a grade report on your current standing in the class on my university web page. You should keep track of your grades on the various assignments and check them against these reports. If there are any discrepancies they should be dealt with immediately.

To have your information posted you need to print your name, the class (MATH 290), and a code on a sheet of paper. Then sign the paper and physically hand it to me. The code is to be a sequence of up to 23 symbols I can type on a keyboard.

2.11 Total Points

Writing Projects	40%
Examinations	48%
Final Examination	12%

2.12 First Graded Homework Assignment

(Due Friday September 1 at 5:00 P.M.)

1. Look over both my university web page `http://math.ups.edu/~bryans/` [1] and the course webpage for MATH 290 you'll find there.
2. Send an e-mail message to me at bryans [at] ups.edu that contains the information below. Make sure the course number, 290, and your name are in the "Subject" line.

(a) Tell me your major, if you have one. If not, mention those subjects that interest you the most.

(b) Write a paragraph or two detailing your personal learning style. Include any classroom techniques you have found that enhance or block your learning.

(c) Tell me how much time you expect to spend each week studying for this class.

References

[1] Bryan Smith's Homepage
`http://math.ups.edu/~bryans/`

[2] Math 290A Course Webpage
`http://math.ups.edu/~bryans/Current/Spring_2007/290Index_Spring2007.html`

[3] Department Calculator Policy
`http://www.math.ups.edu/info/calcpolicy.pdf`

[4] Department Syllabus for MATH 290
`http://www.math.ups.edu/~matthews/Syllabi/MA290Syllabus.pdf`

[5] William Rapaport's "How to Study"
`http://www.cse.buffalo.edu/~rapaport/howtostudy.html`

[6] TI-86 Manual
`http://education.ti.com/us/product/tech/86/guide/86guideus.html`

[7] "Proofs and Fundamentals: A First Course in Abstract Mathematics", Bloch
`http://www.amazon.com/exec/obidos/ASIN/0817641114/`

[8] "The Nuts and Bolts of Proofs", Antonella Cupillari
`http://www.amazon.com/exec/obidos/tg/detail/-/0120885093/`

[9] "Thinking Mathematically", Mason/Burton/Stacey
`http://www.amazon.com/exec/obidos/ASIN/0201102382/`

[10] "How to Read and Do Proofs", Solow
`http://www.amazon.com/exec/obidos/ASIN/0471406473/`

[11] "How to Prove It: A Structured Approach", Velleman
`http://www.amazon.com/exec/obidos/ASIN/0521446635/`

[12] "Mathematical Thinking: Problem-Solving and Proofs", West and D'Angelo
`http://www.amazon.com/exec/obidos/ASIN/0130144126/`

3 Math 290 Writing Projects Grading Rubric

Points	Logic and Mathematics
5	Arguments are correct, complete and without inappropriate material.
4	Arguments have one minor error, omission or inappropriate inclusion.
2	Arguments have two minor errors, omissions or inappropriate inclusions.
0	Arguments are more seriously flawed.

Points	Use of Terminology and Notation
3	All technical terms, concepts and notation are used correctly.
2	Arguments have one lapse in terminology and notation
1	There are minor problems with terminology or concepts.
0	There are major problems with terminology or concepts.

Points	Written Presentation
2	Follows citation requirements and all other writing guidelines.
1	Follows almost all of the guidelines with only one or two minor lapses.
0	Has more lapses in following the guidelines.

3.1 Writing Guidelines

It is best to think of these writing projects as officially assigned papers in which you completely explain and justify your analyses of the problems. You may work with others in solving these problems but there is to be **no collaboration on the written exposition of the solutions.** In addition I expect your papers to be

- Fully documented – specifically:

  1. You must include a reference paragraph at the beginning of your paper either affirming the work is completely yours or listing each resource you use: names of participants in discussions (other than the in-class discussions), technological tools, reference texts employed, and anything else other than your own thoughts.
  2. Any idea obtained during brainstorm sessions or in discussions is cited in-line.
  3. All textbook results (theorems, propositions, and lemmas) are cited in-line and include the name of the result.
  4. Any use of technology is cited in-line.

- Carefully handwritten in ink or written with a word processor. (I can show you how to use Scientific Notebook in the labs or you can use Microsoft Word. Please check with me before using any other program.)
- Written using complete, accurately punctuated sentences.
- Presented in active voice, the first person plural and with a clear, easy-to-follow expository style.
- Targeted at an audience consisting of students not in this class but with an equivalent mathematical background – say those currently in another section of this course.