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Teaching Philosophy

Comfort is the first thing I try to instill in my students, both in the classroom and with the course material. When a student feels comfortable in a math class, she is more likely to ask questions; moreover, she is better equipped to accurately assess what exactly it is that she may be struggling with, leading her to ask more pointed questions. I have witnessed many students attempt to counter the daunting nature of mathematics with an artillery of shortcuts and algorithms that lack context. When I discuss this approach with a student, he will often confess to a low level of comfort with the material. A sense of comfort with the concepts not only typically leads to correctly fitting two puzzle pieces of a problem together, but also to a broader view of the puzzle.

Learning in the classroom should be interactive. A rapport between teacher and students is what makes classroom teaching valuable, as opposed to reading a textbook or watching a video. The first thing I do to foster a sense of comfort with the students is to break down the fourth wall before it can ever exist. From the outset I encourage questions, and I ask the students questions as well. Building this dialogue allows me to maintain a read on the class and gauge the degree to which I may need to expound on a given point. Merely asking the students to speak up when they do not understand is not enough; I try to create an atmosphere in which students have the comfort and confidence to ask a question. I openly discuss potential stumbling blocks to certain problems. I try to relate to students on a human level; by consistently reminding students of my office hours and my availability to meet by appointment, by encouraging and responding promptly to emails, and by making light of a situation when appropriate, I create a comfortable learning environment. In such an environment, the student/teacher dynamic is not unlike the dynamic a doctor wishes to create when she tries to put a patient at ease. A comfortable student can then focus his attention on the math at hand.

Creating a positive classroom environment lays the foundation for effective teaching. While teaching, I always keep in mind the conceptual understanding that I would like a student to have at the end of a unit. When designing a unit, I start at the end with this conceptual understanding and work backwards to ensure that students build the foundation necessary to support this final framework. When teaching calculus, I introduced logical implications and interval notation at the beginning of the course so that students could use this language as a tool for the rest of the course. Keeping the end in mind also prevents me from taking shortcuts. For example, rather than rushing through a difficult problem at the end of class, I will take my time, even if it means reintroducing and revisiting the problem next class and possibly coming up with a handout I did not initially intend to make.

Regardless of the teacher, a student will not maximize her potential without hard work of her own. Through my experiences as a learner and an instructor, I have found that genuine interest in the material is the best initiator for sustained effort. After working an example in class, I point out how the example illustrates the concepts we are learning, and present the example as evidence for the utility and elegance of the theory. Throughout the course, I share historical anecdotes about the math we cover, and I thread in real-life applications of the material as well as more advanced mathematics that has its origins in our course material.
The same lecture will not give each student the same understanding of the material. In hopes of reaching as many students as possible, I ask students to fill out an anonymous mid-semester evaluation in which I seek feedback about the course up to that point and suggestions for improvement going forward. In a typical class, I stop at least once for a few minutes to let the students work out an example on their own. This forces each student to actively engage in the material, and the results give me a sense of which students are responding well to my teaching, and which students could benefit from further explanation. Time permitting, I am happy to present an explanation in a different light in hopes of reaching more students. For students who readily take to the concepts, I offer problems that go beyond the scope of the course. When I taught my own calculus course for the first time, I had planned on sticking with an already-established curriculum that did not include extra credit problems; however, when a couple of students approached me about extra credit, I took the opportunity to challenge them. From the second week on, I offered an extra credit homework assignment in addition to the regular homework.

Ultimately, I want a student to walk away with the ability to confidently articulate the big-picture ideas of the course. An understanding of the details is important, but those details have little use if a student cannot recognize an appropriate context in which to apply them. A big-picture understanding of calculus, for example, enables a student to identify that an engineering problem involving rates of change can be solved using calculus. If the problem ends up involving an integral the student does not remember, he can always look it up; however, the student who has memorized a table of integrals in a vacuum is unable to even begin solving the problem. In hopes of achieving this end, I discuss the ideas behind an algorithm or technique when I introduce it in lecture. For example, when teaching linear algebra, I illustrated the utility of orthonormal bases in projections before explaining the Gram-Schmidt process that produces an orthonormal basis. I push for a broader understanding in office hours by asking a student to explain the context in which their question lies. In lectures, when a student gives a correct answer, I will often follow up with one or more simple “Why’s?”, each of which push the original question up one level of generality. By speaking with an encouraging, supportive tone, even when a student gives an incorrect answer, and by filling in gaps in a student’s explanation when necessary, I aim to create a forum in which students can respond to my questions with confidence.

Math is supposed to be challenging, but the challenge should be braved from a comfortable vantage point. I continually reflect on the level of success I am having at creating such a vantage point for each student. The dialogue I build with the students contributes to the comfortable environment I strive to create while simultaneously serving as feedback that allows me to see how effectively I am meeting this end.
Teaching Experience and Development

Teaching Experience

Instructor

- **Analytic Geometry and Calculus**
  - Spring 2014
  This course covers the second half of a traditional introductory calculus course. It is intended for students who could benefit from concurrent precalculus revision. I am teaching the lone section of this course. I will be setting the curriculum, assignments, exams, and grades myself for a class of at most 20 students.

- **Linear Algebra, Brown University**
  - Fall 2012
  I taught one of three sections of the course, the other two being taught by another graduate student and a professor. In coordination with the other instructors, I designed the assignments, exams, and curriculum within a framework set by the professor. This class had 26 students.

- **Introduction to Calculus, Brown University**
  - Spring 2012
  I taught this course independently. I set the curriculum, assignments, exams, and grades myself. The class had 34 students, ranging from freshman to seniors.

- **Introduction to Calculus, Brown University**
  - Summer 2010
  I also had complete autonomy over this course. Approximately half of the 18 students were high school students taking classes at Brown over the summer.

Teaching Assistant

- **Elementary Number Theory**
  - Summer 2011
  This was a three week summer course for high school students. For half of each daily three hour class, I came in and helped students with group work.

- **Second Semester Calculus, Brown University**
  - Spring 2011
  I held weekly discussion sections with occasional quizzes.
Teaching Portfolio

-Multivariable Calculus, Northwestern University  
Spring 2008

I held weekly discussion sections with occasional quizzes. I was part of Northwestern’s inaugural group of undergraduate teaching assistants.

Teaching Development

I have completed Certificate programs I, III, and IV (expected May 2014) at the Sheridan Center for Teaching and Learning at Brown University.

Certificate I: Reflective Teaching

Through a series of lectures, discussion groups, and assignments, participants develop and reflect on their teaching practice through an introduction to the fundamental components of reflective teaching. For example, after reading an article on, and listening to a lecture about persuasive communication, I analyzed the communication techniques in a TED Talk of my choosing. The communication skills I developed have made me a more effective instructor. Another element of the program that has proven to be helpful is course design. We discussed and read about how certain assignments and curricula cater to certain learning styles. With this in mind, I designed a mock assignment and a mock syllabus. We received feedback from both our peers and the program leaders on all assignments and presentations.

Certificate III: Professional Development Seminar

Organized around the development of the Teaching Portfolio and designed to help participants prepare for the academic job market, the yearlong Professional Development Seminar teaches participants to document the scholarship of their teaching. Writing with purpose and clarity is an emphasis in this program; the pieces I wrote (e.g. teaching philosophy statement, syllabus, cover letter) were critiqued in detail by peers as well as the seminar leader. My oral communication skills also improved, as we discussed the elements of an effective presentation, and gave short speeches to an audience about our research. In this program, I thought critically about my development as a teacher and how I can continue to grow.

Certificate IV: The Teaching Consultation Program

Participants develop and practice peer observation and feedback skills, and gain expertise in leadership and discussion facilitation. Certificate IV centers on the principles for effective communication, the creation of an environment for inclusive learning, and the continued development of a reflective and reflexive teaching practice to promote improvement of teaching and collegial exchange about teaching and learning. By the end of this program, I will have done eight teaching observations, in which myself and another participant observe a lecture and then meet with the lecturer to provide both written and oral feedback.
Course Materials

Below appears a syllabus I have written for an Introduction to Linear Algebra Course. The syllabus is roughly based on the one that I used when I taught this course at Brown in the fall of 2012. Having learned from the experience of teaching the course, this syllabus incorporates changes I would make if I were to teach the course again.

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Linear Algebra

Math 520, Fall 2012

Instructor Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Jonah Leshin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>B12, Kassar House</td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:JLeshin@math.brown.edu">JLeshin@math.brown.edu</a></td>
</tr>
<tr>
<td>Phone</td>
<td>401-863-7956</td>
</tr>
</tbody>
</table>

Course Information

<table>
<thead>
<tr>
<th>Meeting Time</th>
<th>T, Th 1-2:20, Barus and Holley 159</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office Hours</td>
<td>Mon 11-12:30, Wed 5-6:30</td>
</tr>
<tr>
<td>Course Website</td>
<td><a href="http://www.math.brown.edu/~jleshin/teaching.html">http://www.math.brown.edu/~jleshin/teaching.html</a></td>
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<tr>
<td>Textbook</td>
<td>Introduction to Linear Algebra, by Gilbert Strang</td>
</tr>
</tbody>
</table>

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We can solve a system of linear (all variables appearing with exponent one) equations like $2x+y=3$, $x-y=1$ by substitution or by adding the equations to eliminate $y$. But how can we systematically find all solutions to a linear system of $m$ equation and $n$ unknowns, for any $m$ and $n$?

Given two vectors $\mathbf{v}$ and $\mathbf{w}$ in three-dimensional place, how can we produce two new vectors $\mathbf{v}'$ and $\mathbf{w}'$ so that $\mathbf{v}'$ and $\mathbf{w}'$ are perpendicular, but still generate the same plane that $\mathbf{v}$ and $\mathbf{w}$ do? How would we solve the analogous problem with three vectors in four dimensional space?

Linear algebra gives us a framework to solve these sorts of problems. It also has applications in probability, statistics, engineering, and economics, some of which we will cover. In addition to learning the necessary tools to solve such problems, a broader aim of this course is for you to integrate your previous knowledge of mathematics (e.g. calculus, vectors) and mathematically related fields (e.g. physics) into a new understanding that includes the language of linear algebra. Along the way, you will be exposed to a few mathematical proofs, and you will sharpen your mathematical reasoning skills.

Math 520 is an introduction to linear algebra. There are no formal prerequisites for the course, although we may see examples from calculus that illustrate certain linear algebra concepts. Course specifics appear below, and a detailed outline of the assignments and topics we will cover begins on page 5.

Office Hours
I will have drop-in office hours Mondays 11-12:30 in my office and Wednesdays 5-6:30 in Kassar 105. Please use these office hours to help clarify material that you don’t understand, or just drop in to listen to questions that others may have. If you would like to meet with me outside of class at a different time, please speak with me to schedule a time.

Course Website
Announcements, homework assignments, and resources for the course are posted on the course website. I will also post my lecture notes and other documents relevant to our section on the website.

Calculator
Linear algebra is probably more conceptual than the math courses you have previously taken. Calculators may be helpful for certain computations (in fact, calculators/computers are often necessary when doing complicated “real world” examples), but they will not be necessary for the homework and will not be allowed on exams.
Grading

<table>
<thead>
<tr>
<th>Attendance / Participation</th>
<th>See Below*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm I: October 11, in class</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm II: November 8, in class</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam: December 21, 9-12 am</td>
<td>40%</td>
</tr>
</tbody>
</table>

Attendance/Participation
Not everything that we will cover in lectures will be in the textbook. Furthermore, lectures give you a visual and aural presentation of the material, and serve as a forum for you to ask questions. There is a strong correlation between success in Math 520 and regular attendance at the lectures. I expect you to arrive on time to class and stay for the duration of the class. Be prepared to participate in class with, at least, your full attention, and hopefully, your questions and participation in occasional brief class discussions.

*There will be a 5% grade for attendance/participation that I will apply by removing 5% from your lowest grade among homework, the midterms, and the final exam, if this replacement improves your overall grade.

Homework
Completing the homework is essential to your understanding of the material (and doing well in this class)! Homework will be collected in class every Tuesday. Each Tuesday, we will spend some time going over problems from the assignment that was just turned in. The homework for the section(s) of the book covered during a particular lecture should be attempted as soon as possible in order to stay current in the class (see the "Tips" below). Late homework may be turned in, but it will not be graded. I will look at it at the end of the semester in the event that your final grade is borderline. Working on homework with other students is perfectly fine; however, each student must write up his/her own solutions.

When writing up your homework, make sure you:

1. Write your name and the assignment number at the top of your first page.
2. Write out each question before answering it.
3. Explain your step-by-step mathematical reasoning clearly with words in addition to computations, and leave yourself enough space to do so.
4. Number each page and staple all pages together.

Exams
The final exam is scheduled for Friday, December 21, 9-12 am, location to be determined. The midterms will be held in class on Thursday, October 11 and Thursday, November 8. Everyone is expected to take the midterms and the final exam at the specified times. If you
have an absolutely unavoidable conflict, you must let me know at least one week in advance, and the sooner the better. This is especially important for the final exam, as its date and time are out of our control. All exams are to be done without a calculator or any outside material—textbook, notes, etc.

**Tips for success**

1. Like all mathematics courses, the material builds on the previous work. The small thing that you failed to understand in Week 2 may have repercussions in your performance throughout the course. Keeping up with the material is vital.

2. We will move quickly through a lot of material. Each class, I will assume you are up to date on all the material up to that point. Reviewing class notes on your own between each lecture goes a long way toward keeping up with the material. If you’re struggling to keep up, I strongly encourage you to come to office hours and/or take advantage of the additional resources (see below).

3. Read the textbook and attempt the examples in the textbook on your own before looking at the solutions. You will be required to understand the concepts of linear algebra and apply them in a variety of settings. This course is **not** just about learning problem solving techniques. The way to learn new ideas is to read and think about them, and then to attempt to solve the problems. If you like to work with others on homework, be sure that you also work alone. Students who never solve problems totally on their own are often surprised by their inability to solve problems during the exams.

**Additional Resources**

1. The Math Resource Center (MRC) offers drop-in homework help from 8-10 pm Mon-Th in Kassar 105.

2. There are lecture videos, summary notes, and problem solving videos available online from linear algebra classes taught at MIT that used the same textbook. You can find links to these on the course website.

**Academic Honesty**

Strict academic honesty is required of all students. A student’s name on any written exercise is regarded as an assurance that it is a product of the student’s own thought and study, stated in his or her own words and produced without assistance, except as quotation marks, references and footnotes acknowledge the use of other sources. Infringement of the academic code in written work entails penalties ranging from failure in a particular exercise or in a particular course to dismissal.

**Learning Accommodations**
Brown University offers equal educational opportunities and reasonable accommodations for the needs of qualified students with disabilities. If you could benefit from special accommodation because of a learning disability, please speak with me in private.

**Feedback**

In addition to the university’s critical review at the end of the semester, you will have an opportunity to provide feedback about the course in a mid-semester evaluation. I am open to informal feedback about my lectures, assignments, or anything else related to the course throughout the semester.

I’m looking forward to a great semester!

*The following homework schedule is subject to change throughout the semester.*

<table>
<thead>
<tr>
<th>Calendar</th>
<th>Material Covered</th>
<th>Homework Assignments (* indicates answer is in back of book)</th>
</tr>
</thead>
</table>
| Week One    | Vectors, Linear Combinations, Dot Products, Matrices, Linear Equations | **Due 9/11**  
1.1: 1*, 18, 23  
1.2: 8, 19, 21*, 27  
1.3: 3 |

----------------------------------------

Etc.
Handout on Sin(1/x) for Introduction to Calculus Class

I made this handout to help my students understand the behavior of \( \sin(1/x) \) near \( x = 0 \). I had drawn the graph of \( \sin(1/x) \) near \( x = y \) in class as an example of a limit that does not exist. The students grasped the intuition behind the non-existence of the limit, but when I explained it using precise mathematical language, they seemed lost. I made this handout so that the students could see a rigorous mathematical argument written out in more detail than I’d had time to give in class. I encouraged the students to read through it slowly and come to me with questions. I made it clear that I did not expect them to be able to make this kind of argument on their own and that if they felt comfortable with the material through the paragraph beginning with “Aswwwu” that would be sufficient for the purposes of this class.

\[
\lim_{x \to 0} \frac{\sin 1}{x}
\]

Let’s take a closer look at the function \( \sin(1/x) \) and try to see why

\[\lim_{x \to 0} \frac{\sin 1}{x}\]

does not exist.

Let \( f(x) = \sin(1/x) \). For any integer \( n \),

- \( f(1/n\pi) = \sin(1/(1/n\pi)) = \sin n\pi = 0 \),
- \( f(2/(4n+1)\pi) = \sin\left(\frac{1}{2(4n+1)\pi}\right) = \sin\left(\frac{(4n+1)\pi}{2}\right) = \sin\left(\frac{4\pi}{2} + \frac{\pi}{2}\right) = \sin\frac{\pi}{2} = 1 \), and
- \( f(2/(4n+3)\pi) = \sin\left(\frac{1}{2(4n+3)\pi}\right) = \sin\left(\frac{(4n+3)\pi}{2}\right) = \sin\left(\frac{4\pi}{2} + \frac{3\pi}{2}\right) = \sin\frac{3\pi}{2} = -1 \).

As we take larger and larger values of \( n \), \( \frac{1}{n\pi} \), \( \frac{2}{(4n+1)\pi} \), and \( \frac{2}{(4n+3)\pi} \) all approach 0, so we see that \( f(x) \) attains the values 0, 1, and \(-1\) infinitely many times as \( x \) approaches zero (in fact, one can show that \( f(x) \) attains all values between \(-1\) and 1 infinitely many times as \( x \) approaches zero). In other words, in any interval containing zero, there are an infinite number of \( x \) in that interval such that \( f(x) = 0 \), an infinite number of \( x \) in that interval such that \( f(x) = 1 \), and an infinite number of \( x \) in that interval such that \( f(x) = -1 \).

With this information in hand, let’s show why the limit of \( \sin 1/x \) as \( x \to 0 \) does not exist.

Suppose this limit did exist, so it is equal to some number, which we call \( L \). Then by the definition of a limit, we can make \( \sin(1/x) \) as close to \( L \) as we like as long as \( x \) is sufficiently close to 0. So let’s say we want to make \( \sin(1/x) \) within \( \frac{1}{2} \) of \( L \) i.e. we want

\[|\sin\frac{1}{x} - L| < \frac{1}{2} \tag{1}\]

If our limit is indeed \( L \), then we should be able to find a sufficiently small interval, call it \( J \), containing 0 such that \( (1) \) holds whenever \( x \) is in the interval \( J \) and \( x \neq 0 \). But we have seen that in any interval \( I \) containing 0, there are (infinitely many) \( x \) in \( I \) such that \( \sin(1/x) = 1 \) and also (infinitely many) \( x \) in \( I \) such that \( \sin(1/x) = -1 \). Therefore, we can not find our desired interval \( J \) because it is impossible for a number, in particular the number \( L \), to be within \( \frac{1}{2} \) of both 1 and \(-1\).
Evidence of Effective Teaching

Brown Online Course Evaluation

The following are direct quotations from students in my Spring 2010 Introductory Calculus class. They are from Brown’s anonymous online course evaluations. They highlight my flexibility in creating a comfortable environment, and my investment in student learning.

- “The teacher really cared about each student learning...I was impressed by his teaching style and responses to student questions. If you actually want to learn math, take his section.”
- “One of the best professors I have had so far from my classes taken at brown. Coherent & articulate in lectures, Jonah is also great at taking useful feedback from his students and promptly responds by altering aspects which the students might think is beneficial. He sets a good standard for his students whilst being approachable.”
- “Jonah was a great lecturer. He was always very clear and always made sure there were no questions before moving on to the next topic. He was also helpful during office hours.”
- “Jonah’s pace and integration of material from the book were very smoothly done. The homework assignments also accurately reflected what we learned in class and what we were tested on. He also allowed us to try examples on the board before giving us the answer, which was helpful.”
- “Jonah was very effective in communicating the material to the class and made sure that everybody in the class was comfortable with material. He used effective examples in class and had a good sense of humor when it was called-for.”
- “Great notes, great lecturer, effective during office hours, quick to answer e-mails, friendly and approachable.”
- “I thought he taught the class well and approached topics with thought and planning, integrating concepts together fluidly.”
Unsolicited Student Emails

I have pasted unsolicited emails that students have sent me at the conclusion of courses I have taught. The first message is from a student in my linear algebra class in the fall of 2012, and the second message is from a student in the calculus class for which I was a teaching assistant in the spring of 2011.

“I just wanted to tell you that it was great having you as the instructor for linear algebra. You were always available to meet whenever something wasn’t clear to me. Also, you have displayed the most exceptional distribution of material on a black board that I have ever seen from a math instructor at Brown.”

“Thank you so much for all of your help this semester in Math 0100. You were always so clear and helpful. Your enthusiasm for math motivated me to work hard and made me really like the subject, too!”