“Answers were to be guessed not given” – Bilbo Baggins from J.R.R. Tolkien’s *The Hobbit*.

Fall 2016 – Introduction to Proofs – Course Syllabus

1 Just the essentials

<table>
<thead>
<tr>
<th>COURSE</th>
<th>Math 23B section 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREDITS</td>
<td>3</td>
</tr>
<tr>
<td>SCHEDULE OF CLASSES</td>
<td>M-W-TH 09:00AM-09:50AM in Goldsmith 300</td>
</tr>
<tr>
<td>PROFESSOR</td>
<td>Dr. Avraham Bourla <a href="mailto:abourla@brandeis.edu">abourla@brandeis.edu</a></td>
</tr>
<tr>
<td>OFFICE</td>
<td>Goldsmith 205</td>
</tr>
<tr>
<td>OFFICE HOURS</td>
<td>Mon, Tue 2:30PM–4PM and by appointment</td>
</tr>
</tbody>
</table>
| GRADING SCHEME    | class work 10%  
|                   | homework 25%  
|                   | midterm exams 2x15% =30%  
|                   | group project 10%  
|                   | final exam 25%  
|                   | total: 100% |
| TA (TBA)          | Thu 9/8 last day to add classes  
|                   | Tue 10/11 last day to drop a class  
|                   | Thu 10/13 first exam in class  
|                   | Thu 11/10 last day to withdraw a class  
|                   | Mon 11/21 second exam in class |
2 About this class

Prerequisites: Math15a, 20a or 22a, or instructor permission.

Description: This course is a bridge between introductory mathematics classes, which are primarily based on computation and advanced mathematics classes which are primarily based on proofs. Our goal is to learn how to construct the stream of logical statements that construe a rigorous mathematical proof. We will begin by studying the underlying set theory and the language of logic which can be viewed as the grammar rules for proof writing. The rich field of discrete mathematics will supply us with many problems which are both diverse in nature and conceptually simple. However, we will also prove a few basic theorems in the continuum relating to the convergence of sequences. We will cover chapters 1–3, 5,6 and 8 in class and will have an independent group project on a part of chapters 9 and 10.

Goals: At the end of this class you should be able to:

- Develop familiarity with reading mathematics independently, understanding abstract definitions and using supporting examples and counterexamples.
- Be familiar with basic set theory operations and explore the notion of cardinality on infinite sets.
- Illustrate the concepts of set relations and functions, including equivalence relations, injections, surjections and inverse functions.
- Successfully apply logical connectives and quantifiers to produce meaningful and logically sound arguments.
- Recognize the various proof techniques: direct, contrapositive, by contradiction and by induction.
- Critically analyze mathematical arguments for correctness, thoroughness and neatness.
- successfully apply the euclidean algorithm and prove the fundamental theorem of arithmetic.
- establish basic facts on the divisibility of numbers.
- Better understand the notion of a limit and establish $\epsilon-N$ proofs for the convergences of sequences.
- independently research a popular mathematical topic, write analysis on existing theory and orally present mathematical ideas.
3 Graded Components

Class work: This component consists on completing and presenting the worksheets. While we will work in groups, you will need to submit your own worksheet independently for grading. Of course, you cannot gain credit for this component when absent.

Homework: The weekly homework sets will usually be due in my mailbox on Monday night. While you are allowed (in fact, encouraged) to collaborate on the homework with your classmates, you must submit your own work for grading, handwritten neatly using a pencil and stapled.

Group project Towards the end of the class, students will be divided into small groups and assigned a research project. The project will include an essay, solution of a problem set and a short in-class presentation. Grades are uniform per group.

Midterm and final: Oral makeup for the midterm will only be considered in extreme cases, let me know as soon as possible if you cannot attend an exam for a legitimate reason. You can only makeup the midterm due to an emergency or illness with a doctor’s note, that is, a note written specifically to you and signed by a person with the suffix M.D. or equivalent. There will be no makeup for the final exam; failure to show up to the final for any reason will result in an incomplete grade. The possible accommodation for a makeup during the next semester will be handled on a case by case basis.

Extra credit: No extra credit opportunities are planned for this class.

4 Class policies

Caveman classroom: We will only use emails and the Latte system for communication of logistic nature. In class we will strive not to use any technology, not even calculators. Please bring the book at every class and take your notes using a pencil. I will post all the announcements at the beginning of each class as well as hand in person all printed material.

In class behavior: I expect all students to arrive on time and, once in the classroom, act respectfully. This means no phones, gadgets, music players, chattering, bubble gums, dozing etc. We will end the class on time and you are requested to leave only after I dismissed the class. If you have to leave early, let me know before the class starts.

Communications: If you need to contact me with a math question, come see me in person during office hours. Alternatively, send me an email requesting an appointment if the posted office hours do not work for you. I do not answer math questions via email. Whenever you send me an email, write our class number and your full name in the subject line e.g. subject: Math 23b-2 – John Smith
Students with disabilities and student athletes: Any student in this class who has a documented disability that may prevent him/her from demonstrating the full extent of his/her abilities should contact me personally as soon as possible so we can arrange suitable accommodations. If you are a student athlete, note that you are in charge of letting me know as soon as possible of any classes you might miss during the semester. Your academic advisor should contact me with regards to missing any exams.

5 Academic integrity

You are expected to be familiar with, and to follow, the University’s policies on academic integrity, please consult Brandeis University policies on academic integrity for more information. In this class, academic misconducts apply only to the group project and the in-class exams. The content of the project must be shared among the members of the group with all references correctly cited. In the exams, every step of the solution process for every question should be entirely your own. I will act in all severity if I catch you imposing as someone else, looking at another student’s exam or otherwise unlawfully obtaining or distributing answers to exams questions. In addition to a zero grade on that exam, I will file a formal complaint to the dean with consequences that include failing the class or even being permanently and dishonorably expelled from this school.

If you have a doubt, don’t do it!

During exams, we will observe the following rules:

1. Bring your AU ID to the first two midterm exams.
2. You may not leave the classroom for any reason, including going to the bathroom.
3. No hoods, hats or sunglasses.
4. Your desk should be clear of anything except for the cheat sheet, your id, two pencils, an eraser, a pencil sharpener and a clear bottle of water.
5. Do not share anything with other students including scrap paper and calculators without my permission.
6. All books, notebooks and gadgets must remain in your backpack.
7. I can assign your sit without offering any explanations.
8. I reserve the right to ask you any question appearing on the exam in person and regrade your exam appropriately.
6 How do I ace this class?

Success in this four-credit course is based on the expectation that students will spend a minimum of 9 hours of study time per week in preparation for class. If you want to succeed, you will need to:

1. Read the sections we are going to cover in advance and prepare by trying to answer some of the basic problems. Turn off your phone when you read and write.

2. Show up on time to every class alert and ready to work.

3. Apply critical thinking; do not assume something is true just because you read or heard it. Work to convince yourself of the validity of each argument.

4. Do not be shy; ask as many questions as you need to understand.

5. Be proactive; if you do not understand something or miss a class, catch up on the material as soon as possible.

6. Surround yourself with people who care for your success. Have at least one classmate to turn to for help and be ready to provide help to this person.

7. Do your homework and exam preparation in pairs or small groups (no more than four students). Be a team player, adopting a mix of academic, leadership and social roles which is best suits your nature.

8. Plan to finish the HW at least a day before it is due so that you will have time for questions.

9. Come to office hours and attend the review sessions.

10. Have a positive attitude and a desire to learn. Avoid distractions, use your time effectively and appreciate the opportunities are are given.

Work hard, Be nice, Have fun!

Good Luck!
Tentative schedule:

<table>
<thead>
<tr>
<th>WEEK</th>
<th>DATES</th>
<th>MATERIAL</th>
<th>ANNOUNCEMENTS</th>
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<tbody>
<tr>
<td>1</td>
<td>Th 8/25</td>
<td>Introduction</td>
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</tr>
<tr>
<td>2</td>
<td>M 8/29, W 8/31, Th 9/1</td>
<td>1.1–1.3</td>
<td>HW0 due M 8/29 worksheet1 due Th 9/1</td>
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<tr>
<td>3</td>
<td>W 9/7, Th 9/8</td>
<td>1.4–1.5</td>
<td>HW1 due M 9/5 worksheet2 due Thu 9/8</td>
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<td>4</td>
<td>M 9/12, W 9/14, Th 9/15</td>
<td>1.6, 2.1–2.2</td>
<td>HW2 due M 9/12 worksheet3 due Th 9/15</td>
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<td>5</td>
<td>M 9/19, W 9/21, Th 9/22</td>
<td>2.3, 3.1–3.2</td>
<td>HW3 due M 9/19 worksheet4 due Th 9/22</td>
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<tr>
<td>6</td>
<td>M 9/26, W 9/28, Th 9/29</td>
<td>3.3–3.5</td>
<td>HW4 due M 9/26 worksheet5 due Th 9/29</td>
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<tr>
<td>7</td>
<td>W 10/5, Th 10/6</td>
<td>5.1–5.2</td>
<td>HW5 due M 10/3 worksheet6 due Th 10/6</td>
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<tr>
<td>8</td>
<td>M 10/10, Th 10/13</td>
<td>makeup and review</td>
<td>HW6 due M 10/10 midterm on Th 10/13</td>
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<td>9</td>
<td>W 10/19, Th 10/20</td>
<td>5.3, 5.4</td>
<td>worksheet7 due Th 10/27</td>
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<td>10</td>
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<td>6.1–6.2</td>
<td>HW7 due M 10/30 worksheet8 due Thu 11/2</td>
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<td>11</td>
<td>M 10/31, W 11/1, Th 11/2</td>
<td>6.3–6.4</td>
<td>HW8 due M 11/7 worksheet9 due Thu 11/10</td>
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<td>12</td>
<td>M 11/7, W 11/9, Th 11/10</td>
<td>8.1–8.3</td>
<td>HW9 due M 11/14 worksheet10 due Th 11/17</td>
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<tr>
<td>14</td>
<td>M 11/21</td>
<td></td>
<td>group project assigned</td>
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<tr>
<td>15</td>
<td>M 11/28, W 11/30, Th 12/1</td>
<td>chapters 9,10</td>
<td>group project presentations</td>
</tr>
<tr>
<td>16</td>
<td>M 12/5, W 12/7</td>
<td>chapters 9,10</td>
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HW0 – to submit in person during office hours by the end of the add/drop period.

Disclaimer: I have carefully read this syllabus and agree to comply with all its regulations and procedures.

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Brandeis ID</th>
<th>Signature</th>
<th>Date</th>
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</thead>
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1. Where are you from? Why did you choose Brandeis? What is your age, year in school and major?

2. What college mathematics classes have you already taken?

3. Why are you taking this class?

4. What do you expect to gain from this class?
5. Is mathematics a useful subject for you to learn? Briefly explain why or why not.

6. What do you think about the statement “I do not need to learn what machines can already do faster and better”?