Math 301 – Introduction to Proofs
Johns Hopkins University
Course Syllabus

Instructor
Erich Goldstein

Email: egolds17@jhu.edu

Office hours: Online, by appointment.

Online Lectures
There will be pre-recorded lectures online, posted each week as videos. There will be live synchronous sessions throughout the class dealing with proof solving strategies. If we are small enough, I will poll the members of the class to find a preferred time. Some of those live meetings will involve an assessment of not only student participation, but more the ability to communicate mathematical ideas.

A link to the online Zoom meeting room where our synchronous sessions take place will be posted in Canvas.

Textbook
An Infinite Descent into Pure Mathematics Clive Newstead, Version 0.5, retrieved from https://infinitedescent.xyz/.

Additional Learning Outcomes:
By the conclusion of this course, you are expected to have gained the ability to:
- State and prove propositions in a variety of mathematical fields using correct notation.
- Prove propositions involving sets, functions of the sets, and cardinalities of the sets, both finite and infinite.
- Perform proofs using induction, contradiction, cases, directly, or using combinations of several techniques.
- Practice using computer assisted proof technology, and consider the implications of such technology or artificial intelligence in the field of mathematics.

Written Response Questions
Written response questions will be posted each week in Canvas. In week one, these are to be answered on paper and then scanned. From week two onward, these are to be answered using LaTeX and students will submit a PDF for grading. These questions will focus on proof rather than calculation.

Note, you will also see practice problems. These are optional and they will not count toward your grade in the course.

Exam
There will be a traditional midterm exam. It will appear in the Exams section of the module. You will have access to it on Monday, July 1. This will be a take-home exam and you can use your

notes and any material in Canvas to complete it. It will be due by 11:59 PM Eastern Time on Sunday, March 7. You are welcome to communicate with each other, but the work you turn in must be your own.

There will be a collaborative final exam the last week of class. We are going to hold a longer meeting that week. Block your schedules now for Thursday, July 25 from 5:30 PM to 7:30 PM Eastern Time. I will give you problems ahead of time so you can prepare before we meet. Each of you will be assigned to "lead" one of the problem discussions. Then you will all work together at our meeting to complete each problem. Your grade will be based on how well you complete the proofs but also on how well you participate and communicate mathematical ideas with one another.

Discussion Forums: Each week in which we do not have an exam will include a discussion question. You are to post your initial response to the discussion by Thursday night and respond to at least one classmate by end of day Sunday.

Grading

Your final grade for the class will be given as a weighted average with the weights given as follows:
- Discussion Forums: 30%
- Written Response Question Sets: 36%
- Natural Number Game: 5%
- In Class Discussions: 15%
- Midterm Exam: 7%
- Final exam: 7%

The letter grades are assigned as follows based on your final weighted average:
- A: 90-100
- B: 80 - 89
- C: 70 - 79
- D: 55 - 69
- F: < 55

"+" and "-" will be determined at the end of the semester.

Here is an indication of how I will grade various items. It is impossible for me to give you a completely rigid rubric. The problem is every proof is different. And each of you might prove the same theorem in a different way. I can't foresee every strategy that each of you might use. So allow me to give some general guidance.

Proofs (Written Response Questions, Midterm Exam, Final Exam)

Here is what I am looking for and what percentage of each problem it is worth:
- Proper proof strategy (15%): Often there are multiple ways to prove the same thing. But some of these are more appropriate than others. For example, it would be inappropriate to use a proof by induction to show that any real number squared is non-negative.
- Logic (20%): Is your proof logically valid? Did you make some huge logical error, like begging the question or assuming something that isn't true?

- Definitions (15%): This is both the use of existing definitions and the pieces that you define.
    - Existing Definitions: Imagine you are using the fact that element *b* is in the image of set *X*. Are you using that correctly? Do you know what that means?
    - Pieces that you define: Say you define a function as part of your proof. Does it really have the domain and codomain you claim it does? Is it defined for every element of the domain?
- Rigor (25%): Does your proof include all the steps that it needs? Is each step thoroughly proven? Are all cases accounted for? Are any cases double counted, but giving different results?
- Readability and Notation (10%): Are you breaking this up into sentences and paragraphs? Are you leaving white space so I can read it? Is your lay out in LaTeX done well? Are you using correct notation for everything? Are your variables all in math mode?
- Elegance (10%): Is this as efficient as it can be, or do you have cases or sections you don't need?
- Punctuality (5%): This is all or nothing. If it was turned in on time, you get the 5%. If it was late, you get none of this 5%.

Discussions

Some parts of the discussion may involve proofs, so look at the section above. But as a broader umbrella I will look at discussions as follows:

- Initial Post (45%): Did you answer the ultimate question correctly? Did you justify your answer appropriately? (Again, this may be a proof, see above.) Can I read it? Is the lay out done well?
- Response Post (40%): Did you answer the response question correctly? Did you justify that appropriately? Can I read it? Is the lay out done well?
- Respectfulness and Professionalism (10%): You are communicating with one another. Was this done in a respectful manner? If asked to give constructive criticism, is it constructive?
- Punctuality (5%): This is all or nothing. If both posts are submitted on time, you get the 5%. If either post is late, you get none of this 5%.

Support

There are many sources of help and support if you are having difficulty with the class, material or anything else. These include:

    - office hours: Online, by appointment
    - The Learning Den: http://www.advising.jhu.edu/
    - Office of Academic Support: http://academicsupport.jhu.edu/- See the support page for more info

Please do not feel shy about asking for help, or just checking that you understand something correctly.

Absences

Attendance at synchronous sessions each week will be required and assessed during weeks 1, 4, and 7 of the course. (You will also be required to attend the final exam on Thursday, July 27 from 5:30 PM to 7:30 PM Eastern Time.) If you have a valid excuse to miss the exam or one of

the other mandatory weeks when you will be presenting, you must provide a letter from the Office of Academic Advising verifying this. In this case, your grade for the exam will be the weighted average of your grades on the written response questions and live sessions. If you miss an exam without a valid excuse, your grade will be zero.

Special Aid
Students with disabilities or other special needs who require classroom accommodations or other arrangements must make this known to me as soon as possible at the beginning of the semester and be registered with the disability coordinator in the Office of Academic Advising.

Collaboration
Collaboration on written response questions is allowed and encouraged. However, each student must write up his/her solutions to the problems individually and in his/her own words - copying from another student's paper is prohibited. Writing proofs is an essential part of learning the course material. Failing to give it proper attention will significantly harm your performance on the exams and your overall grade for the class.

Exam Integrity & Student Identity Verification
This course may require the use of technology and/or software to ensure exam integrity and verify the identity of the student taking the exam. Additional information and directions will be provided in the course website.

Students with Disabilities

Students with documented disabilities or other special needs who require accommodation must register with the Office of Academic Advising. After that, remind the instructor of the specific needs at least one week prior to each exam; the instructor must be provided with the official letter stating all the needs from the Office of Academic Advising. (https://studentaffairs.jhu.edu/disabilities/)

JHU Ethics Statement

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition.

Report any violations you witness to the instructor. You may consult the associate dean of students and/or the chairman of the Ethics Board beforehand. Read the "Statement on Ethics" at the Ethics Board website for more information.