

MA 3110: Logic and Proof

Guidelines for Exam 2

Exam 2 covers material in sections 1.5, 1.6, 2.1, and 2.2 of our textbook, as well as any material discussed in class. The exam will consist of two parts: an in-class part and a take-home part.

Part I: In-class exam

The in-class part of Exam 2 will take place on **Wednesday, April 1**. This portion of the exam will test your knowledge of definitions and basic concepts. You should be prepared to generate examples and counterexamples. For example, “provide an example of two sets whose intersection is nonempty;” although, I may ask you to provide examples that are more difficult to come up with. To be successful on the in-class portion of Exam 1 you should

- understand how one goes about writing a *direct proof*, a *proof by contraposition*, a *proof by contradiction*, and a *two-part proof of an if and only if statement* (you will not be required to write proofs on the in-class exam, but I may ask you to evaluate a proposed “proof.”)
- know the definitions of *divisibility of integers*, *even* and *odd* integers, and be able to write proofs or find counter-examples for simple statements involving these concepts
- know how to write a direct proof of statements of the form $(\forall x)P(x)$
- know how to write a proof by contradiction of statements of the form $(\forall x)P(x)$
- know how to write a proof of statements of the form $(\exists x)P(x)$ $(\exists!x)P(x)$
- for statements involving multiple quantifiers, know what manipulations of these quantifiers permit valid deductions (see pages 50–51)
- know definitions of *set*, *element*, *emptyset*, and *power set*
- know what $\mathbb{N}, \mathbb{Z}, \mathbb{Q}, \mathbb{R}$ are
- understand set notation of the form $\{x : P(x)\}$
- know definition of *subset* and be able to write a direct proof that $A \subseteq B$
- know definition of *equality of two sets* and be able to prove that two sets are equal (we had two methods for doing this and you should know both)
- know the statements of and be able to apply Theorems 2.1, 2.2, 2.4, and 2.5
- know and understand the definitions of *union*, *intersection*, and *set difference*
- know definition of *disjoint*
- develop intuition about the statements in Theorem 2.6 (you do not need to memorize this theorem)
- know and understand the definition of *complement* (why do we need to make reference to a universe?)

- know the statements of and be able to apply parts (e) and (f) of Theorem 2.7; develop intuition about the remaining parts of this theorem

Finally, you should be able to call upon your own prodigious mental faculties to respond in flexible, thoughtful, and creative ways to problems that may seem unfamiliar on first glance. (Humans are awesome — I don't care what Doron Zeilberger says.)

Part 2: Take-home exam

The take-home portion of Exam 1 will consist of 5 theorems and you will be required to prove any 3 of them. This half of Exam 1 is due on **Monday, April 6** and the beginning of class (no exceptions). These are the simple rules for the take-home portion of the exam:

1. You are NOT allowed to copy someone else's work.
2. You are NOT allowed to let someone else copy your work.
3. You are allowed to discuss the problems with each other and critique each other's work.

If these simple rules are broken, then the remaining exams will be all in-class with no reduction in their difficulty.