Plymouth State UNIVERSITY

MA 3110: Logic, Proof, and Axiomatic Systems

Guidelines for Exam 3

Exam 3 covers material in sections 2.5, 3.1–3.3, and 4.1 of our textbook, as well as any material discussed in class and any material covered on Exam 1 and Exam 2. In fact, one question on the in-class portion of Exam 3 will be identical or nearly identical to a question from Exam 2. As with the previous two exams, Exam 3 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 3 will take place on **Wednesday, December 3**. This portion of the exam will test your knowledge of definitions and basic concepts. You should be prepared to generate examples (for example, "provide an example of a relation on some set A that is not a function"). To be successful on the in-class portion of Exam 2 you should

- know statements of the PCI and the WOP
- be able to write a proof of statements of the form $(\forall n \in \mathbb{N})P(n)$ that utilizes either the PCI or the WOP
- know definition of *Cartesian product* and be able to work with and generate examples
- develop intuition about the statements in Theorem 3.1 (you do not need to memorize this theorem)
- know definition of a *relation* and be able to work with and generate examples
- know the difference between an element of a set and an ordered pair of elements of a set
- know definition of a *function* and be able to work with and generate examples
- be able to identify *domain*, *codomain*, and *range* of relations and functions
- know definition of the *identity relation/function*
- be able to draw *digraphs* for relations/functions and be able to interpret them
- be able to draw *"bubble" diagrams* for relations/functions and be able to interpret them
- know definition of *inverse relation* and be able to work with them
- know definition of the *composition of two relations* and be able to compute one given two relations
- develop intuition about the statements in Theorems 3.2 and 3.3
- know statement of Theorem 3.3(d)
- know definition of an *equivalence relation* on a set A and be able to show that a given relation is or is not an equivalence relation

- in particular, you should know the definitions of *reflexive*, *symmetric*, and *transitive* and have a working understanding of these concepts
- know definition of *equivalence class* and be able to find them given an equivalence relation
- know the difference between an element of a set and its equivalnce class
- have a working understanding of the equivalence relation $\equiv_m$ on $\mathbb{Z}$ and the resulting equivalence classes (see Theorem 3.4)
- know definition of *partition*
- know statements of Theorems 3.5 and 3.6 (in particular, you should understand the big picture of this section: given an equivalence relation, we obtain a partition; and given a partition, we can obtain an equivalence relation)
- know definitions of *image* and *pre-image* of a function and be able to find them for a given function
- have a working understanding of the following types of functions: *inclusion, constant, characteristic, infinite sequence,* and *canonical map*
- be able to evaluate the validity of a proposed "proof" of a statement involving relevant definitions
- as well as being able to generate examples, you should be able to construct counterexamples to show that a given statement is false

Additionally, 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.) Finally, you should prepare yourself sufficiently that you can read and understand without undue anxiety.

Part 2: Take-home exam

As with the previous exams, the take-home portion of Exam 3 will consist of 5 theorems and you will be required to prove any 3 of them. This half of Exam 3 is due to my office (Hyde 312) by **5 pm on Friday, December 5** (no exceptions). These are the simple rules for the take-home portion of the exam:

1. You may freely use any theorems that we have discussed in class, but you should make it clear where you are using a previous result and which result you are using.
2. You are NOT allowed to copy someone else's work.
3. You are NOT allowed to let someone else copy your work.
4. You are allowed to discuss the problems with each other and critique each other's work.