

Ph.D. Comprehensive Examination

Computer Science Department
University of Miami

January 14, 2022

Student Name:

Student Number:

Problem number	Points (10 max)
1	
2	
3	
Total:	

1. I.D Software engineering

From the software engineering point of view, any software development process can be divided into several sub-disciplines:

- (a) Requirement Analysis
- (b) Functional Specification
- (c) Architectural Design
- (d) Implementation
- (e) Testing and Evaluation
- (f) Maintenance

Choose three sub-disciplines or tasks within these sub-disciplines that involve a mathematical approach, and illustrative them with examples.

2. I.E Systems

Compare and contrast (i) hierarchical, (ii) network, (iii) the relational, and (iv) object-oriented data models.

3. III.C Discrete Structures

A **permutation** of a set A is an *ordered* arrangement of the elements in A . An ordered arrangement of just r elements from A is called an r -permutation of A . For non-negative integers $r \leq n$, $P(n, r)$ denotes the number of r -permutations of a set with n elements.

What is $P(n, r)$? This is about counting.