

Table of Contents

Abstract vii

General References..... xi

Index of Notation and Terms..... xii

1. Introduction 1

1.1. Families of Combinatorial Structures 1

1.2. Motivation.....4

1.2.1. Designing Useful Algorithms.....4

1.2.2. Discovering General Methods for Algorithm Design.....5

1.2.3. Learning about Combinatorial Structures 5

1.3. Listing Algorithms.....6

1.4. Efficient Listing Algorithms 8

1.5. Synopsis of the Thesis.....10

1.6. Bibliographic Notes 13

2. Techniques for Listing Combinatorial Structures.....16

2.1. Basic Building Blocks 16

2.1.1. Recursive Listing 16

2.1.2. Random Sampling 25

2.2. Using Listing Algorithms for Closely Related Families.....40

2.2.1. The Interleaving Method.....41

2.2.2. The Filter Method43

2.3. Avoiding Duplicates47

2.3.1. Probabilistic Algorithms 47

Example 1: A family of colorable graphs.....50

Example 2: A family of unlabeled graphs52

2.3.2. Deterministic Algorithms 56

Example 1: A family of colorable graphs.....60

Example 2: A family of unlabeled graphs73

3. Applications to Particular Families of Structures 84

3.1. First Order Graph Properties 85

3.2. Hamiltonian Graphs.....93

3.3. Graphs with Cliques of Specified Sizes 95

3.3.1. Graphs with Small Cliques.....96

3.3.2. Graphs with Large Cliques98

vi	Table of Contents
3.3.3. Graphs with Cliques whose Sizes are Between $\log(n)$ and $2\log(n)$	103
3.4. Graphs which can be Colored with a Specified Number of Colors	104
3.4.1. Digression — The Problem of Listing k -Colorings	115
4. Directions for Future Work on Listing	119
5. Related Results	129
5.1. Comparing Listing with other Computational Problems	129
5.2. Evaluating the Cycle Index Polynomial	136
5.2.1. Evaluating and Counting Equivalence Classes	140
5.2.2. The Difficulty of Evaluating the Cycle Index Polynomial	142
5.2.3. The Difficulty of Approximately Evaluating the Cycle Index Polynomial	151
6. Bibliography	155