
Contents

List of Figures	v
List of Tables	ix
Preface	xi
1 Introduction	1
1.1 Graphs	1
1.2 Probability	7
1.3 Asymptotic Notation and Useful Inequalities	11
1.4 Random Graphs	14
1.5 Tools: First and Second Moment Methods . .	16
1.6 Tools: Chernoff Bounds	21
2 The game of Cops and Robbers	27
2.1 Binomial Random Graphs	32
2.2 Graphs with a Given Cop Number	35
2.3 Properties of Almost All Cop-Win Graphs . .	40
2.4 Properties of Almost All k -Cop-Win Graphs .	43
2.5 Random Geometric Graphs	51
2.6 Percolated Random Geometric Graphs	56
3 Variations of Cops and Robbers	63
3.1 Playing on Edges	63
3.2 Cops and Fast Robbers	67
3.3 Lazy Cops and Robbers	70
3.4 Cops and Falling Robbers	77
3.5 Containment Game	84
4 Zombies and Survivors	93
4.1 The Cost of Being Undead Can Be High . . .	94
4.2 Cycles	96

4.3	Hypercubes	98
4.4	Toroidal Grids	100
5	Large cop number and Meyniel's conjecture	115
5.1	Upper Bounds for $c(n)$	117
5.2	Binomial Random Graphs	121
5.3	Random d -Regular Graphs	130
5.4	Meyniel Extremal Families	134
6	Graph cleaning	143
6.1	Tools: Convergence of Moments Method	148
6.2	Binomial Random Graphs	150
6.3	Tools: Pairing Model	157
6.4	Random Regular Graphs	161
6.5	Tools: Differential Equation Method	163
6.6	DE Method in Graph Cleaning	168
6.7	Game Brush Number	178
7	Acquaintance time	185
7.1	Dense Binomial Random Graphs	186
7.2	Sparse Binomial Random Graphs	188
7.3	Is the Upper Bound Tight?	195
7.4	Hypergraphs	198
7.5	Random Geometric Graphs	205
8	Firefighting	213
8.1	Tool: Expander Mixing Lemma	215
8.2	The $k = 1$ Case	216
8.3	The $k > 1$ Case	220
8.4	Fighting Constrained Fires in Graphs	227
9	Acquisition Number	233
9.1	Binomial Random Graphs	234
9.2	Random Geometric Graphs	241
9.3	Randomly Weighted Path	246

10 Temporal parameters	251
10.1 Capture Time	251
10.2 Overprescribed Cops and Robbers	256
10.3 Deterministic Burning	263
10.4 Random Burning	270
10.5 Cops and Drunk (but Visible) Robbers	274
10.6 Cops and Drunk (and Invisible) Robbers	279
11 Miscellaneous topics	285
11.1 Toppling Number	285
11.2 Revolutionary and Spies	296
11.3 Robot Crawler	303
11.4 Seepage	311
Bibliography	325
Index	341