

Contents

List of Figures	vii
List of Tables	xiii
1 Introduction	1
1.1 Diffusion under organic dynamics	2
1.2 Diffusion under adversarial dynamics	7
1.3 Controlling negative diffusion	9
1.4 Controlling negative diffusion in the presence risk behavior changes . . .	12
1.5 Overview	16
2 Diffusion under organic dynamics	17
2.1 Preliminaries	18
2.2 The triangulation: Discovery through push	19
2.2.1 Upper bound	19
2.2.2 Lower bound	25
2.3 The two-hop walk: Discovery through pull	26
2.3.1 Upper bound	26
2.3.2 Lower bound	30
2.4 Two-hop walk in directed graphs	30
2.5 Conclusion	34
3 Diffusion under adversarial dynamics	37
3.1 Model and problem statement	38
3.2 Related work	39
3.3 Lower bound for online token-forwarding algorithms	41

CONTENTS

3.4	Subquadratic time offline token-forwarding algorithms	46
3.4.1	An $O(\min\{n\sqrt{k\log n}, nk\})$ round algorithm	49
3.4.2	An $(O(n^\epsilon), \log n)$ -approximation algorithm	53
3.5	Conclusion and open questions	55
4	Controlling negative diffusion	57
4.1	Related Work	58
4.2	Model and Definitions	60
4.3	Nash equilibria	61
4.3.1	The local infection model: $d = 1$	61
4.3.2	The global infection model: $d = \infty$	64
4.3.3	The d -neighborhood infection model: $d > 1$	66
4.4	Optimizing social welfare: NP-completeness and approximation algorithms	70
4.4.1	NP-completeness of computing the social optimum	70
4.4.2	Approximating the social optimum	73
4.4.2.1	An LP Formulation	73
4.4.2.2	Solving the LP and partial rounding and filtering	74
4.4.2.3	Final rounding	75
4.5	Experimental results	75
4.5.1	Convergence times for best response strategies	76
4.5.2	Structural properties of NE	77
4.5.3	Empirical performance of approximation algorithms	78
4.6	Conclusion	81
5	Controlling negative diffusion in the presence of risk behavior changes	83
5.1	Models	84
5.2	Perversity and sidedness	85
5.2.1	Proof of Theorem 39	89
5.3	Randomized vs. targeted vaccinations	93
5.4	Simulations	94
5.5	Conclusion	97

CONTENTS

6 Conclusion	107
6.1 Enable positive diffusion	107
6.2 Control negative diffusion	108
References	109