AGENCY IN GRAPHICAL MODELS OF CONTAGION

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1. Introduction

Much work has been done to understand graph problems, such as the Firefighter Problem (which we refer to simply as Firefighter), first proposed by Hartnell [2] and surveyed in great detail by Finbow and MacGillivray [1]. This problem and other similar ones, such as The Firebreak Problem (again, referred to as Firebreak) have now enjoyed a plethora of results in a purely graph-theoretic context. However, modelling contagion requires relaxing and adapting some assumptions present in the original formulations of these problems. Such assumptions may be that populations are well-mixed (regular graphs) and we have fully predictable outcomes each turn (non-stochastic behaviour). We propose a number of ways to amend these assumptions in this paper to yield a method for contagion modelling that can provide more realistic and contextualised results with agency-specific attributes for each vertex. This may involve providing a defence rating $d \in [0, 1]$, where 0 represents a vertex with no protection from the contagion and 1 is a vertex that is fully defended.

2. Background

2.1. **Firefighter.**

The following is a decision formulation given by Finbow and MacGillivray for Firefighter on a tree [1]:

Firefighter
Instance: A rooted graph (G, r) and an integer $k \geq 1$.
Question: Is there a finite sequence $d_1, d_2, \ldots d_t$ of vertices of the graph G such that:

i d_i is neither burned nor defended at time i,
ii At time t, no undefended vertex is adjacent to a burning vertex, and
iii At least k vertices are saved at the end of time t?

2.2. **Agency.**

References

[1] S. Finbow and G. MacGillivray, *The firefighter problem: A survey of results, directions and questions*, The Australasian Journal of Combinatorics, 43 (2009).

[2] B. L. Hartnell, *Firefighter! an application of domination*, in 25th Manitoba Conference on Combinatorial Mathematics and Computing, University of Manitoba in Winnipeg, Canada, 1995.

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