

Methods and Uses of Graph Demoralization

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Abstract

Moralizing graphs is useful in understanding independence relations in a directed graph and in converting to an undirected graph. However, the method of demoralizing graphs has not been properly addressed. This work presents graph demoralization. It describes the various methods for demoralizing graphs, and addresses applications of demoralization.

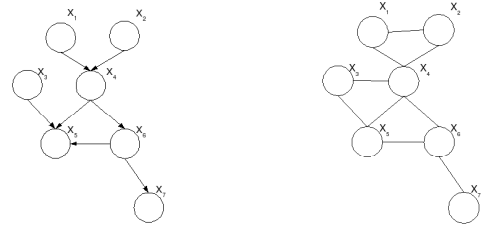
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1 Introduction

Moralization is an important tool in understanding independence relations in graphical models. However, its dual, demoralization, is an underrepresented concept in the research. This work presents three methods for demoralizing graphs: isolation, misdirection, and disbelief propagation. These methods are based on findings in business management or sociology or some other only vaguely related fields, allowing this work to be submitted to a wider range of journals.

2 Preliminaries

2.1 Probabilistic graphical models. Probabilistic models are commonly illustrated using graphs. In a probabilistic graph, random variables are represented by nodes, and dependencies between random variables are represented by directed edges. The typical parent-child relationships between nodes in graph theory apply, and such relations illustrate the dependencies in the graph. For instance, in Figure 1(a), the value of X_3 is dependent on the value of X_1 and X_2 . In a directed graph, only nodes at the receiving end of the edges are dependent on their parents. Parents are independent. More about independencies and such can be found in [6]. For details on inference algorithms, one may consult [2].



(a) Original, immoral graph (b) Moralized graph

Figure 1: **Moralizing a graph.** In the original graph (a), there are two immoralities: that of the parents of X_4 and that of the parents of X_6 . To moralize the graph you marry the parents and remove directions.

2.2 Moralizing Moralization is a method used for independence relations between directed and undirected graphs. A graph immorality occurs when a child has two or more parents that without dependencies between them. Also note that this isn't one of those marriages you only get for tax breaks; there are real dependencies here.¹ This prevents divorcing nodes, which is an even more immoral matter in the language of probabilistic graphical models than illegitimate children. Once parents are married all other directions in the graph must be removed; otherwise you get a hybrid graph of sorts called a PDAG, very thoroughly described in [3].

3 Methods of demoralization

3.1 Misdirecting. Research in social group theory has indicated that groups of agents often become demoralized when they are misdirected [5]. We apply this idea to demoralizing graphs. This is shown in Figure 2, where the edge from node X_4 to X_6 is removed and instead misdirected off the edge of the page. This would cause great confusion in the probability distribution and independence relations in G , thus demoralizing

¹Technically, the parent nodes may still be independent but they act like they're dependent. This commonly occurs in marriages, although not as often as the dual case.

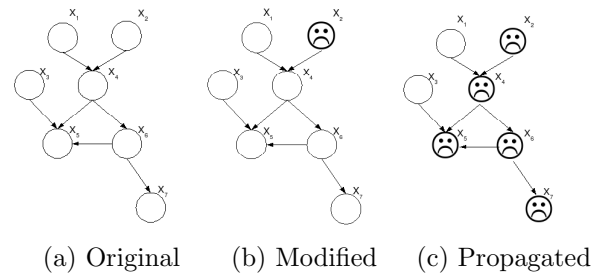
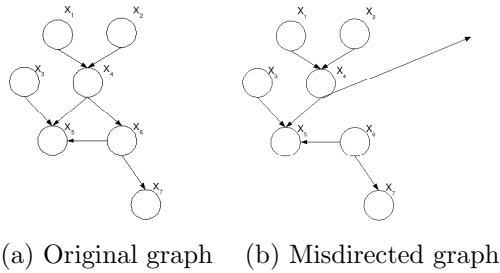


Figure 2: **Graph demoralization through misdirection.** The original graph (a) is modified by removing the edge from X_4 to X_6 and redirecting it off the edge of the figure and into the middle of nowhere(b).

Figure 4: **Graph demoralization through modification and propagation.** The original graph (a) is modified by one node (b), and the modification is propagated over the directed edges through the graph (c).

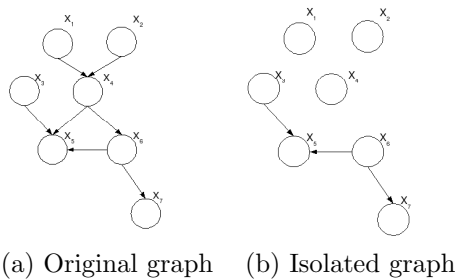


Figure 3: **Graph demoralization through isolation.** The original graph (a) is modified by removing all edges between X_4 and other nodes, severing dependencies in the graph and making inference probably approximately nearly impossible(b).

process, called disbelief propagation, is shown in Figure 4. We show the original graph, the modified graph, and the propagated graph. After propagation the graph is almost fully demoralized. See how sad it looks?

4 Applications of demoralization and discussion on moral state of statistics and statistical machine learning

Demoralization of graphs would seemingly have no applications other than to sate the sadistic susceptibility of statisticians. Sating sadistic statisticians is, of course, an important application that is consistently in use. For instance, simply the word “statistics” is a cruel word to have in the English language, as it is nearly impossible to pronounce, particularly while inebriated—further cruelty lies in that statistics problem sets are most tolerable while in such a state². Another example of sadism in statistics is the long-running turf war between Bayesians and frequentists, that has led to such atrocities as bicycle drive-bys and the bloody showdown that was the rap battle between Emcee MC and The Unbiased M.L.E [1].

the graph.

3.2 Isolation. Social group theory research also indicates that dysfunction by demoralization occurs when members of the group are isolated [5]. This has a natural application to graphs. We simply pick some nodes to isolate, removing coherence and severing dependencies in the graph. This has the potential for great demoralization. This is shown in Figure 3, where node X_4 is isolated. Its ties to all other nodes are severed, making the previously coherent graph into 4 separate graphs. Inference is nearly impossible in such a system. If you were a graph, you’d be pretty damn demoralized at that point.

Another use of demoralization is application to privacy and security: to prevent inferences. Suppose one had a graphical model, but wanted to keep it secret. For instance, suppose one was embarrassed at his shabby tennis serve and did not want other people to know his $P(PlayTennis|Rain = False)$ (a case discussed in depth in [4]). One could demoralize the graph and prevent others from making inferences on the probability distribution.

3.3 Disbelief conditioning and propagation. The third method for demoralizing graphs is to modify one or more nodes in the graph. We begin by conditioning disbelief upon one or more nodes. This method of demoralization may be more efficient if we also propagate this belief conditioning through the graph. This

²Not completed well, mind you, but what sort of expectations can there be when it’s a field that accepts 95% confidence as 100%.

5 Conclusion

This work has demonstrated three methods for demoralization of graphs: misdirecting, isolating, and disbelief propagation. Demoralization is useful for adding to the social references in probabilistic graphical models (among ranks with faithfulness, morality, and swinging couples [3, 7]), for providing statistical machine learning folk amusement, and for applications in data privacy.

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