Graph Network Security

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1   Introduction

The point of this project is to make algorithms to "attack" graph networks. The algorithms will look at removing nodes or edges and trying to reduce the total connectivity or flow through the network.

2   Task 1: Find Data Set

First, we need to find a data set of a graph network. This is the test network we will use our "attack" algorithms on. Example types of networks could be electrical lines, roads, etc. really anything that has a nice graph structure to it! Would be nice to be modeled as a flow network like electrical generators to different houses or something for some models.

3   Task 2: Develop Algorithms

In this section, we will develop different types of algorithms for solving more and more complex graph network structures – weights, directed, etc. – based on "attacking" different parts of the graph – nodes, edges, nodes and edges. We can separate algorithms based on different types of "attacks": maximum flow reduction, minimizing connectivity, etc.

Network Connectivity: Induce a graph network with at least k connected components.
Flow Reduction: Reduce the maximum flow through the network to the value less than or equal to k.

⋆ Note that many of these problems may be NP-Complete! Write a proof of NP-Completeness and write some semi-optimal heuristics!

3.0.1   Part 1: Delete Unweighted Nodes

Algorithm tries to destabilize the network by removing nodes of the same weight. This is equivalent to removing the minimal number of nodes to best "attack"

the graph network based on some metric.

reduce the maximum flow through the network to the value less than or equal to k.

3.0.2 Part 2: Delete Unweighted Edges

3.0.3 Part 3: Delete Unweighted Nodes or Edges

Algorithm can remove either nodes or edges with the same weight. We want to minimize the number of nodes and edges removed.

3.0.4 Part 4: Delete Weighted Nodes

3.0.5 Part 5: Delete Weighted Edges

3.0.6 Part 6: Delete Weighted Nodes or Edges

4 Task 3: Test Algorithms on Data Set

We will now test the algorithms we develop on the data set we chose. We can compare the algorithms we built against certain test metrics to see how they perform. We can also analyze the structure of the network to suggest improvements or point out the failures of the network.

4.1 Part 1: Performance Metrics

We need to determine or create performance metrics to see how our algorithms perform compared to each other.

4.2 Part 2: Run Algorithms

This just requires us to run the algorithms on the network.

4.3 Part 3: Compare Algorithms

Compare the algorithms based on our performance metrics.

4.4 Part 4: Analyze Results and Graph

Analyze the results of our algorithms and the comparisons against them. Analyze what the structure of the graph tells us about the performance of our algorithms.

5 Task 4: Conclusion

Write a summary of our results and key decision choices made. We have now completed the project once you have hit this stage! That is very exciting! :)