COMP3331 Computer Networks and Applications: Programming Assignment

Due on Friday, October 25, 2013

Sanjay Jha 11:59pm

Benjamin James Wright and Lachlan Ford

Contents

Algorithm

We were able to reduce all of the variations of routing: Least Loaded Path, Shortest Hop Path and Shortest Delay Path into formulation of Djikstras algorithm with different cost functions.

Least Loaded Path

The cost function is equivalent to the ratio of the current number of active connections to the capcity of the link.

Shortest Hop Path

Treat all edges of equal weight, this finds the shortest path by number of hops only as each hop costs one it will attempt to minimize this cost thus satisfiying the goal.

Shortest Delay Path

Treats each edges weight as its propigation delay to this end it will find the path with the minimumtotal delay propigation.

Listing 1: The bulk of the Algorithm

```
for unit in workload:
    self.num_vc_requests += 1
    path = self.get_path(unit)
    current_time = unit["time_activated"]
    self.topology.clear_obsolete_connections(current_time)

    if self.topology.valid_connection_path(path):
        self.topology.add_connection_path(path, current_time, unit["time_to_live"])
    else:
        self.num_blocked += 1
```

Datastructures and Architecture

Topology

Our topology is stored as a python dictionary of network links. Each link is indexed by a tuple of vertices e.g. edges[('A','B')]. An link, is an object containing the propogation delay of the link, the maximum capacity of the link and the current active connections on the link. A connection is an object which holds its activation time and its time to live. Since our Topology is stored as a graph, and holds all relevant information, it is very easy to run our dijkstras algorithm on it and update it with new connections as well as remove obsolete connections.

Workload

Our workload is a simple itterable python class. It constructs itself by taking the workload file, and creating a list of "work units", which our algorithm itterates through in order to simulate the network traffic. The workload class is very simple as the bulk of the work happens in our Routing and Topology classes

Routing

The routing class itterates through our constructed workload class and, for each item, runs dijkstras with one of the cost functions to construct a potential path from one host to another. It then tells the Topology to clear any obsolete connections that are currently active (obsolete meaning, its time of activation + its duration is less than the current time). After this, it queries the Topology class to determine if the resultant path is a valid path (i.e. all links in the path have not reached maximum capacity). If the path is valid, is is passed to the Topology class, and the Topology class to add the connections for the specified duration. Otherwise, num_blocked is incremented. This class then outputs the statistics it has kept once all workload items have been processed. The statistics it keeps are, the number of requests, the number of blocked requests, the average number of hops and the average delay. Each of these are updated every time a workload item is processed.

Djikstras

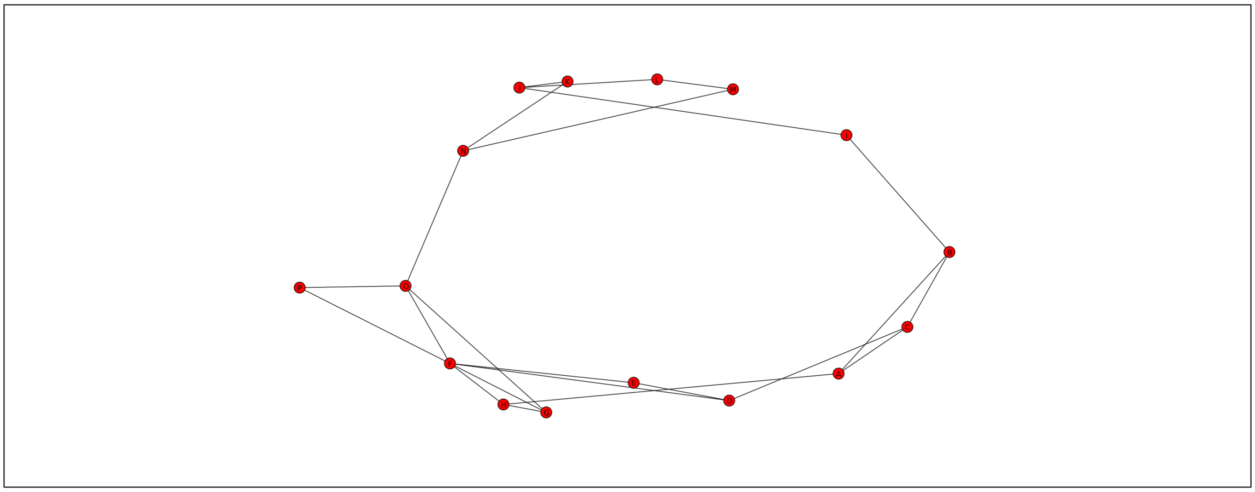
The Disjkstras algorithm itself is stored in our Routing class. Each routing subclass simply implements a different cost function. Our implementation of Dijkstras is the standard implementation and simply returns the shortest path from A to B based on the supplied cost function

Results and Comparisons

Algorithm	Successful to Requested	Average Hops Per Circuit	Average Cumulative Propagation Delay
SHP	5467/5884	3.70955132563	171.010707002
SDP	5340/5884	4.4286199864	141.994051666
LLP	5794/5884	1.52957171992	175.307613868

Explanation Of Results

Graphical Reprentation Of Topology



Explanation

Since all the links in the graph have the same cost in this algorithm, our implementation of always chose the first one in the list. Because of this, these links are quickly saturated which results in a large amount of blocked connections and a high amount of hops per circuit. A better way to implmement this algorithm would be to randomise the list of edges for each vertex before adding them to the open set, as this would allow more edges to be chosen and the connections to be better distributed. Vertex proximity does not ensure a lower propogation delay. As such, the average propogation delay under this algorithm is high. There are also many vertices in which the shortest path is through a single link. Using this algorithm quickly creates a bottleneck which results in many blocked connections. e.g. O - N, I - B.
The average degree of the topology is around 2. Because of this, you cant afford to only utilise 1 edge of the vertex. Because of this, Shortest Delay Path will block the most requests. It will always pick the edge with the shortest propogation delay. If both edges end up at a common vertex, the shortes propogation edge will saturated in a short amount of time and will let no more connections through. A side effect of this is that the connections that are let through will have the smallest total propogation delay possible. The smallest propogation delay does not ensure the least number of hops. If queueing + transmission + processing delay is significant, this is a very bad thing. Although this is a circuit network so its probably not that bad.
Least Loaded Path will get more valid paths as it actually considers how loaded the paths are. Since this is the critereon by which paths are rejected, the algorithm avoids paths which are already saturated. This ends up allowing much more through and distributes them better. However, due to a wider distribution of connections, the connections chosen may not be optimal. This results in a larger average propogation delay than the other algorithms. It di result in a small number of hops per path as the paths were well distributed. This algorithm also avoids bottlenecks where the others do not.