San Diego Visit

Problem Introduction

Summer vacation is quickly approaching. For a student at the Naval Postgraduate School, this time is precious. A student desires to visit San Diego for a one-week trip. Since time is limited and the San Diego venue is abundant…How many events can be visited in a day? How long will it take to visit all these venues?

Design

For this visitation problem, we create a network of nodes and edges (Figure 1) to simulate the possible combinations of locations visited and routes taken. We model the visitation problem based on a trip to San Diego, reducing the scope to a time period of one day.

The San Diego Day Trip Model is created using 17 points of interest as the nodes for the problem graph and possessing a dual start/end node labeled as the Navy lodge. These nodes create a directed cyclic graph. Within the points of interest are nine possible locations where a meal is provided for the trip. Three objectives – The Field Pub, SeaWorld, and the USS Midway Museum - are added because of the interest level to visit.

The edges simulated in this model are the roads between the San Diego venues. The value placed on each edge is the time in minutes required to travel between the points of interest, as exemplified in figure 1.

There are three constraints simulated in the San Diego Day Trip Model. The first of these constraints is the identification of the three required locations to visit, as mentioned above. The second constraint is the minimum time required to be out on the town. This model simulates the visitation window with a start time of 7 a.m. and a return time of no-later-than 10:30 p.m. The third constraint considered is the time spent at each point of interest. For the San Diego Day Trip model, the time spent at a point of interest is governed by the desired/minimum time to complete the visit.

Time on Node (minutes)		Navy Lodge
0	Navy Lodge	-
240	SeaWorld	21
50	Hotel del Coronado	7
210	San Diego Zoo	18
120	Mission Bay Park	21
105	USS Midway Museum	19
150	Naval Base San Diego	16
75	Miramar	30
180	County Fair, Del Mar	34
300	El Cajon Dinner & Concerts	32
45	Greek Islands Café	19
30	Pier Café	19
30	Specialty's Café & Bakery	17
80	The Field Pub	17
90	The Prado Rest. At Balboa Park	18
90	The Grill at Torrey Pines	31
90	Bandar Restaurant	18
60	SWP, pearl street	30

Figure 1: Table of Points of Interest with Associated Time and Cost Constraints

This table identifies the time traveled in minutes between each set of nodes (points of interest highlighted in green). The table is truncated in order to visualize the concept. Additionally, the Time on Node constraint lists the length of time spend at a given locations.

Analysis

The San Diego Day Trip Model is run with a min-cost flow program using the shortest path method. The min-cost flow program identifies the number of points of interest to visit by the minimum time spent on each edge traversed. These points of interest are contained in the San Diego area as depicted in figure 2. The program output identifies a schedule of points of interest visited for the day.

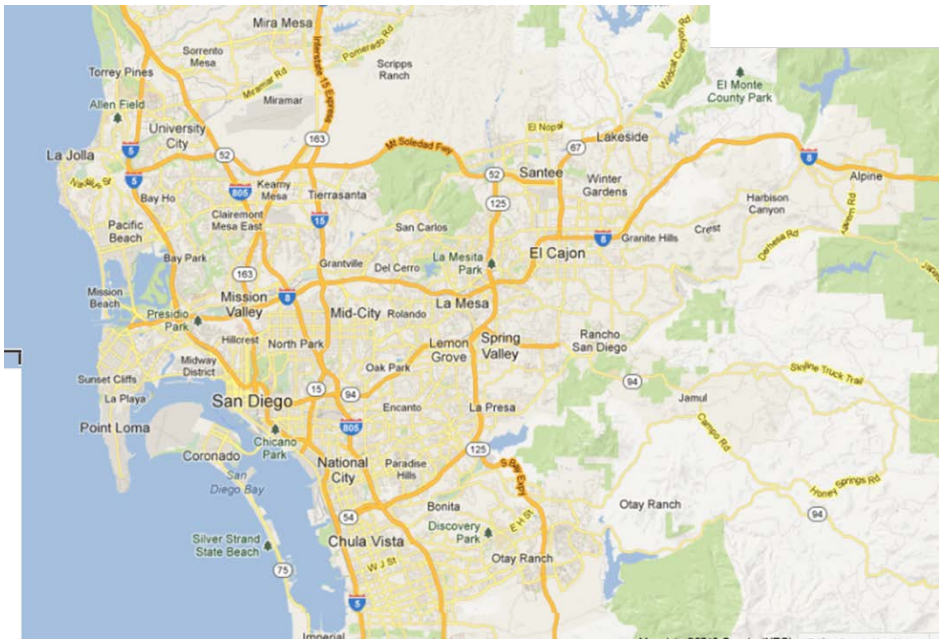

Figure 2: Map of the San Diego Area

This map forms the bases for the interpretive graph utilized in the San Diego Day Trip Model. Nodes are representative of the points of interest visited and edges are the roads connecting the points of interest.

Summary

The San Diego Day Trip Model identified a path taking the traveler to 5 locations in 738 minutes. This met the objective on remaining out for at least 12 hours and no longer than 16 hours. Follow-on aspects to this problem would address a time-layered approach for solving the problem and would take into consideration the maximization of nodes visited within the constraints specified. Additionally, we can take into account attacks on the network. The attacks in this scenario are representative of delays incurred on a given edge in the form of traffic congestion, construction, detours, and/or weather. All attacks increase costs on the edge.

The San Diego Day Trip Model can simulate a commander's visitation schedule, identifying the maximum number of locations visited during a given time period. The model takes into consideration time spent traveling, time spent at a location, and resources consumed. However, from a realistic approach, there are more constraints to take into consideration, such as resource consumption and travel delays and/or restrictions. This visitation problem is generic and relevant across the entire military, whether the commander is for an Air Wing/Squadron, Fleet/Battle Group, or Ground Forces.