Creation of an Air Traffic Simulation Using Agent-Based Modeling

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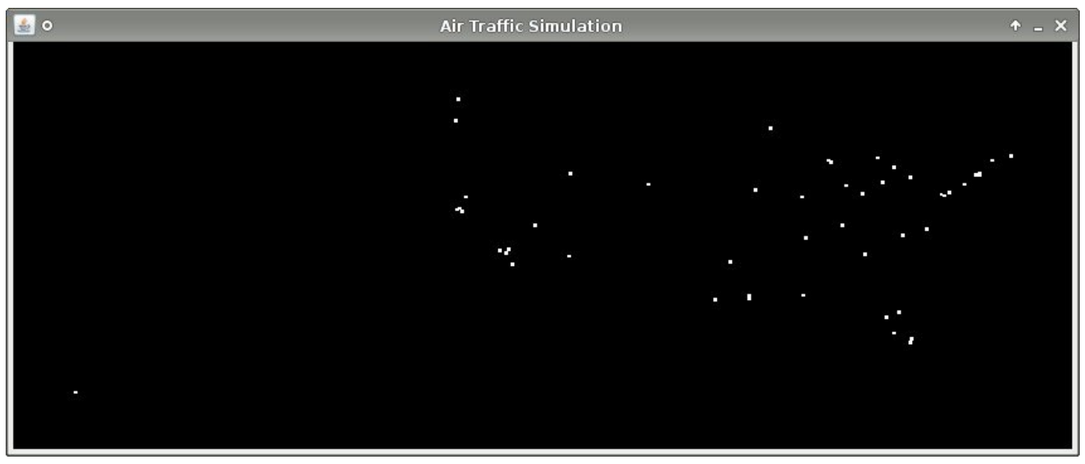
Abstract:

As the skies over the United States become increasingly crowded, airports in the United States are increasingly stressed to adapt to this increased demand. The goal of this project is to visually represent the strain on airports and passengers as a variety of problems generate record delays. By using agent based modeling, along with real air traffic information, this simulation may accurately predict the proliferation of delays through out airports in the United States.

Background:

The purpose of this project is to visually represent the proliferation of a delay throughout a system of airports. By using techiques such as agent based modelling, the simulation will predict actual delays with decent accuracy. Additionally by repeating the simulation multiple times, the simulation generates increasingly accurate results as the number of trials approached infinity. While a simulation such as this would take a human enormous amounts of time, a computer may be able to run a simulation of 24 hours in a matter of minutes. Due to the scale of the problem, efficiency will be key for the computer to run the simulation in a timely matter.



Screenshot of Simulation Interface

Results:

RESULTS GO HERE

Also cutting parts of the Geocoder section and including Embedded Statistical Analysis section

Agent-Based Modeling:

In order to simulate such a large system, this project will use a technique known as agent based modelling. The deveopment of a system using agent based modelling is key for the success of the project. Each agent must interact with other agents in the system in the most realistic way possible in order to generate the most accurate results. One benefit of the agent based modelling is that parameters for interaction between agents define the overall behavior of the system. This allows the programmer to work on much smaller problems with the agent in order to alter the overall system.

Geocoding:

Geocoding is a process by which a formatted address such as 6560 Braddock Rd. Alexandria, VA 22312 is converted to a longitude and latitude. This process is important when dealing with map information that is displayed on a computer. The computer is unable to relate formatted addresses so longitudes and latitudes are used to generate accurate relationships about location. This project uses the process to determine the location of each airport and accurately plot the distance between airports.

Geocoding is a complex process which involves a significant amount of computing power relative to web requests. Due to these requirements for geocoding many companies charge a small fee per request. Alternatively, there are some companies which offer geocoding free of charge but with limitations on the number of geocoder requests per day. I found that Google offered free geocoding with a maximum of 5000 requests per day.

In order to interact with the Google geocoder, each request was done through an HTTP request sent to Google servers. These servers then interpret the parameters in the URL of the request and return the ouput specified by the user. The parameters in a request are as follows:

- q - The formatted address to be geocoded
- output - The desired output format (xml, kml, csv, or json)
- key - Google Maps API key

Sample Request (Key removed for privacy reasons):
http://maps.google.com/maps/geo?q=BWIairport&output=csv&key=API_KEY

```
seberspa@vesuvius ~/techlab $ python geocode.py
Hartsfield-Jackson Atlanta International          Fail(602)   Retrying...
Hartsfield-Jackson Atlanta International          Success
Austin-Bergstrom International                    Fail(602)   Retrying...
Austin-Bergstrom International                    Fail(Invalid latitude or longitude) Skipping...
BWI Airport                                       Success
Logan International                               Success
Charlotte Douglas International                   Success
Chicago Midway Airport                            Success
Chicago O'Hare International                      Success
Cincinnati/Northern Kentucky Intl                 Success
Cleveland Hopkins International                   Success
Port Columbus International                       Success
Dallas/Ft. Worth Intl - DFW Airport               Success
Denver International Airport                      Success
Detroit Metropolitan Wayne County                 Success
Fort Lauderdale/Hollywood International           Success
Southwest Florida International                   Fail(602)   Retrying...
Southwest Florida International                   Success
Bradley International                             Fail(602)   Retrying...
Bradley International                             Success
Hawaii Honolulu International                     Success
George Bush Intercontinental                      Success
William P. Hobby Airport                          Success
Indianapolis International                        Success
Kansas City International                         Success
McCarran International                            Success
LAX Airport                                       Success
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Screnshot of Geocoding Results