**Textbook:**

**OpenStreetMap:**

- This program will read the input lines in *where.data* and for each line check to see if it is already in the database. If we don’t have the data for the location, it will call the geocoding API to retrieve the data and store it in the database, essentially functioning as a local cache  
A screen shot of a computer

Description automatically generated  
- You can visualize the data using the *geodump.py* program. This program reads the database and writes the file where.js with the location, latitude, and longitude in the form of executable JavaScript code  
A screenshot of a computer

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- The file *where.html* consists of HTML and JavaScript to visualize a Google map. It reads the most recent data in where.js to get the data to be visualized.  
- This is a JavaScript variable that contains a list of lists. The syntax for JavaScript list constants is very similar to Python, so the syntax should be familiar to you.  
A computer screen shot of a computer code

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**Visualizing Networks and Interconnections:**

- In this application, we will perform some of the functions of a search engine.   
1. We will first spider a small subset of the web   
2. Then run a simplified version of the Google page rank algorithm to determine which pages are most highly connected  
3. Lastly, we will visualize the page rank and connectivity of our small corner of the web.

- The first program *spider.p*y program crawls a web site and pulls a series of pages into the database *spider.sqlite*, recording the links between pages  
A computer screen shot of a computer code

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- If you restart the program and tell it to crawl more pages, it will not re-crawl any pages already in the database. Upon restart it goes to a random non-crawled page and starts there.  
A screen shot of a computer

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- If you want to dump the contents of the *spider.sqlite* file, you can run *spdump.py*.   
- This shows the number of incoming links, the old page rank, the new page rank, the id of the page, and the url of the page. The *spdump.py* program only shows pages that have at least one incoming link to them.  
A group of white text on a black background

Description automatically generated

- Once you have a few pages in the database, you can run page rank on the pages using the *sprank.py* program. You simply tell it how many page rank iterations to run.  
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- You can dump the database again to see that page rank has been updated  
A screenshot of a computer

Description automatically generated

- A search engine usually runs both the crawling and ranking programs all the time.  
- You can run *sprank.py* as many times as you like and it will simply refine the page rank each time you run it. You can even run *sprank.py* a few times and then go spider a few more pages with *spider.py* and then run *sprank.py* to reconverge the page rank values.  
- For each iteration of the page rank algorithm it prints the average change in page rank per page.  
- The network initially is quite unbalanced and so the individual page rank values change wildly between iterations. But in a few short iterations, the page rank converges. You should run *sprank.py* long enough that the page rank values converge.

- To visualize the current top pages in terms of page rank, run *spjson.py* to read the database and write the data for the most highly linked pages in JSON format to be viewed in a web browser.  
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Description automatically generated

- You can view this data by opening the file *force.html* in your web browser. This shows an automatic layout of the nodes and links. You can click and drag any node and you can also double-click on a node to find the URL that is represented by the node.  
A network of lines and dots

Description automatically generated

**Visualizing Mail Data:**

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