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DS210

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Collaborators: None

Dataset: Google Web Graph | Kaggle

https://www.kaggle.com/datasets/pappukrjha/google-web-graph

For my project, I decided to use the google dataset, which has nodes and edges, with the nodes representing web pages, along with directed edges showing the hyperlinks between these nodes. In this project, I used Rust to implement a visual graph, along with an analysis of such visuals. The code first reads the dataset, constructs a directed graph using a hashmap, and then finally performs different analysis methods on the graph.

To begin with, the code starts by reading about 25% of the dataset, which is still a lot, at about 218928 nodes, I did this as the program runtime was extremely long, the 25% may be adjusted of course depending on the computer power, but I found it optimal for my use, and the vertices still satisfy the minimum requirements. Moving on, the hashmap generates a graph with nodes as the keys and a list of neighbors as its values. I used a parser to extract two nodes, the source along with its destination, and added them in the graph. The graph is generated using plotters, then created as an SVG file in the directory, which can be opened in the browser, although due to the sheer amount of data, the graph itself will look cluttered, hence the need for analysis. (The folder should have the graph on it, running the code also gives the graph anyways)

In the analysis, I first made it such that it generates and outlines the number of vertices and edges, the average degree (number of connections), and degree distribution. Moreover, I also implemented a degree centrality measure, showing the “importance” of each node.

I implemented some helper functions, such as the fn(dfs), which is for the depth-first search, and another function to find the degree of the node. These functions are used as an analysis tool for the most part.

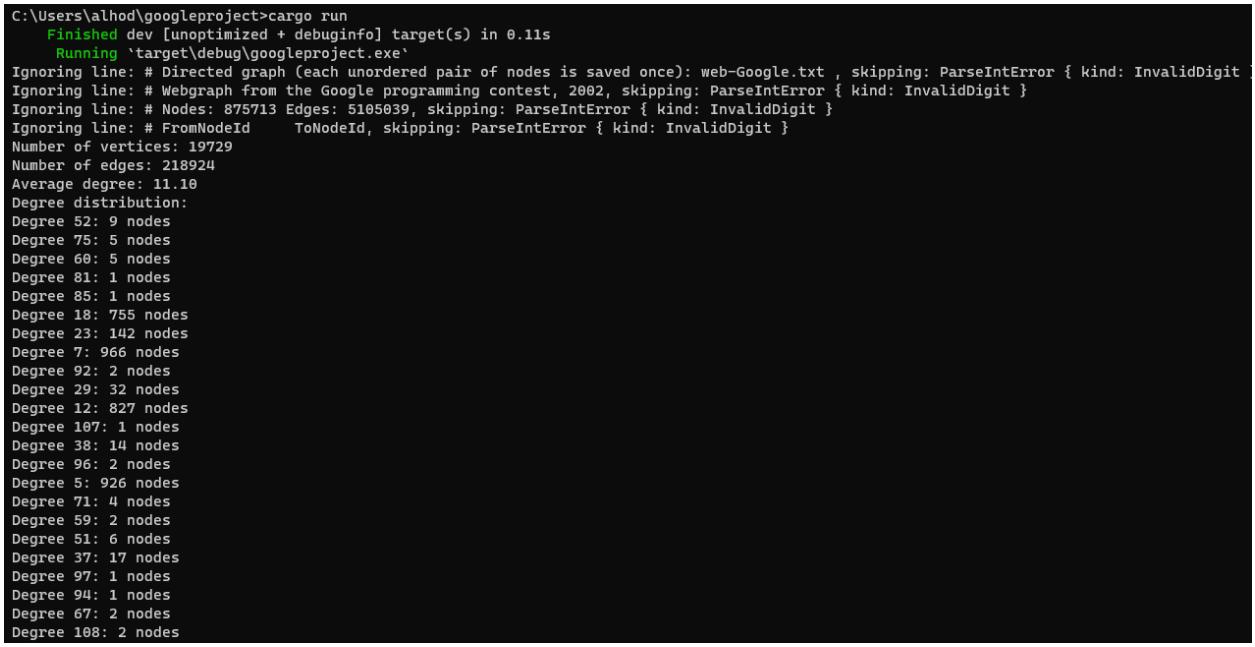
The project also has a separate test.rs file that uses a few functions to test whether our functions in the main.rs work. I will show an image of passed tests below with outputs.

Some drawbacks I had was that, other than the constant errors, I had a few ideas that could not be implemented properly, firstly, I tried to have the centrality measures as a separate table using the prettytable library, but for some reason the version i was using clashed with plotters i think and kept giving me an access violation error, hence why in my code I only display the first 50 values for centrality measure.

RUNNING CODE: I imported the dataset in my code with the assumption that it is in the same directory as the main.rs, meaning, dataset should be placed in the src directory.

Outputs:

Keep in mind, I am taking screenshots of the output, as it is long, I will only have screenshots of the beginning, where it shows a good amount of nodes and information, and the end with the centrality measure.



Node	Degree	Centrality
203748	372	0.018856447688564478
305229	372	0.018856447688564478
768091	330	0.01672749391727494
156950	257	0.013027169505271696
885728	256	0.012976480129764802
685695	248	0.012570965125709651
302733	216	0.010948905109489052
915273	213	0.01079683698296837
285814	210	0.010644768856447688
575171	191	0.009681670721816707
458892	190	0.009630981346309813
512821	175	0.008870640713706407
738994	163	0.008262368207623681
899299	160	0.008110300081103
144662	130	0.006589618815896 1885
595971	128	0.006488240064882401
655155	125	0.00633617193836172
83679	122	0.006184103811841038
665666	116	0.005879967558799676
820130	114	0.005778588807785888
314427	113	0.005727899432278 9946
633292	112	0.00567721005677 21
357952	111	0.005626520681265207
420984	108	0.005474452554744526
766209	108	0.005474452554744526
623655	107	0.005423763179237 6315
206688	102	0.005170316301703163
550067	102	0.005170316301703163
536300	101	0.005119626926196269
869115	101	0.005119626926196269
47823	100	0.005068937550689375
366151	100	0.005068937550689375
58321	100	0.005068937550689375
681352	99	0.005018248175182482
384249	97	0.004916869424168694
763584	96	0.004866180048661801
724176	96	0.004866180048661801
91785	95	0.004815490673154906
233513	94	0.004764801297648013
822200	93	0.004714111922141119 5
368262	92	0.004663422546634225
321966	92	0.004663422546634225
158258	90	0.004562043795620438
472339	86	0.004359286293592863
848635	85	0.004308596918085969
567756	84	0.004257907542579075
510853	84	0.004257907542579075
700787	83	0.004207218167072182
750938	83	0.004207218167072182
128994	82	0.004156528791565288

Test.rs output.

```
C:\Users\alhod\googleproject>cargo test
   Compiling googleproject v0.1.0 (C:\Users\alhod\googleproject)
    Finished test [unoptimized + debuginfo] target(s) in 0.74s
     Running unittests src\main.rs (target\debug\deps\googleproject-96038b945583a42c.exe)

running 2 tests
test tests::test_graph_properties ... ok
test tests::test_dfs ... ok

test result: ok. 2 passed; 0 failed; 0 ignored; 0 measured; 0 filtered out; finished in 0.00s
```

Sources:

- Lecture notes.
- The Rust Programming Language - The Rust Programming Language (rust-lang.org)