2017 Introduction to Massive Data Analysis

Assignment 2

✧ **Deadline: 2017/4/14 (Fri.) 23:59**

Questions: PageRank

Given a big matrix M. Specifically the column-normalized adjacency matrix where each column represents a webpage (vertex) and where it links to the non-zero entries.

Write a MapReduce program in Hadoop that calculate Google Matrix *A*:

$$A = \beta M + (1-\beta)\left[\frac{1}{N}\right]_{N\times N}$$

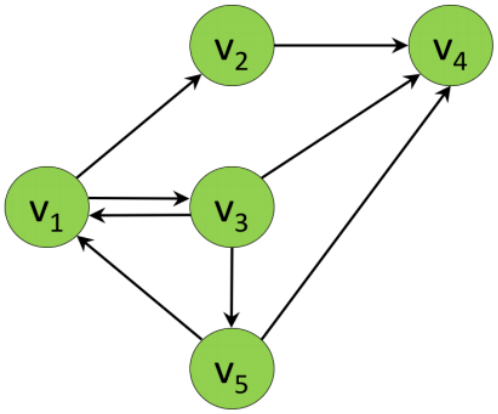
With PageRank equation [Brin-Page, '98]

$$r_j = \sum_{i\to j} \beta \frac{r_i}{d_i} + (1-\beta)\frac{1}{N}$$

forming recursive problem: $\boldsymbol{r}=\boldsymbol{A}\cdot\boldsymbol{r}$

NOTE: Please set β =0.8, and initial PageRank value = 1 in this homework.

A simple example:



V={1,2,3,4,5} and E={(1,2),(1,3),(2,4),(3,1),(3,4),(3,5),(5,1),(5,4)}

If we set β =0.85 and run a single round of PageRank, we get the following values:

i	1	2	3	4	5
r_i^1	0.858	0.575	0.575	1.708	0.433

If we run the algorithm until the ranks for all the vertices change by less than 0.001 compared to the previous round, we arrive at round 10 and the following values:

i	1	2	3	4	5
r_i^{10}	0.332	0.291	0.291	0.580	0.233

Structure:

[Mapper] Anode passes its PageRank "contributions" to the nodes it is connected to.

[Reducer]Each node sums up all PageRank contributions that have been passed to it and updates its PageRank score.

Data format

Input:

A file that contains one line for each link, and each line contains a pair of numbers that represent the vertices that are connected by the link.

1	2
1	3
2	4
3	1
3	4
3	5
5	1
5	4

Download here

https://snap.stanford.edu/data/p2p-Gnutella04.html

Output:

There should be one line for each vertex, and each line should contain the vertex identifier and the PageRank values.

4	0.580
1	0.332
2	0.291
3	0.291
5	0.233

Report Requirements:

a. Final output. (We require **20** iterations result)

PS. In addition, you could run processes until convergence (value at nodes no longer change) and present the result in your report.

NOTE: Please show the top ten vertices sorted by rank.

b. Explain how you design your mapper and reducer.