IRWS PageRank HITS

Davide Pizzolato - 881347

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1 Introduction

This document is intended to provide a description of how I coded a time and space efficient version of PageRank, HITS and InDegree in c++.

2 Compilation

You can compile the software using the Makefile, it will compile it with the maximum optimizations in C++ 20.

3 Usage

You should call the software with two parameters:

- **Graph Path:** The path of the graph file
- **K:** The top-k nodes to compute

Example: `./IR_Project ./data/web-Stanford.txt 100`

4 Code explanation

4.1 Sorter class

This class divides the input in blocks that can be kept in memory, and then perform a BSBI (it sorts the blocks and then merge the block). The class provide the data like an iterator through the method next();

4.2 writeMatrixFiles()

This method transform the input from the Sorter class in a sparse matrix representation, creating a columns file, a rows file and a dangling nodes file.

4.3 multiply()

This class multiply a sparse matrix by a dense vector.

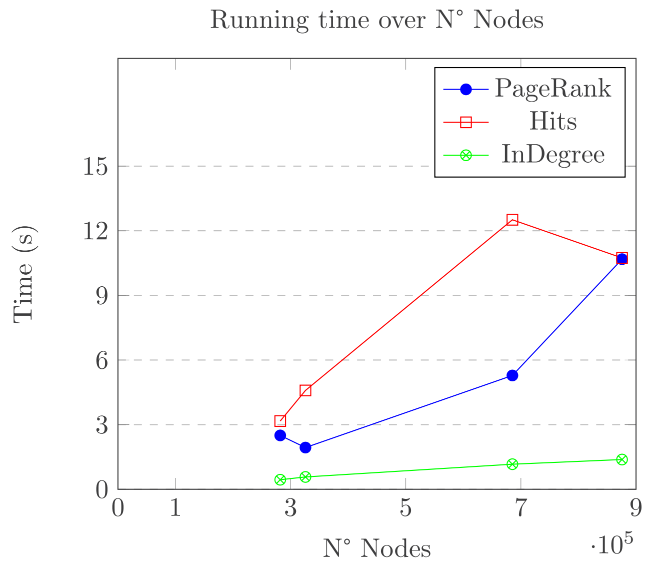
It require a start and an end indexes, implemented in order to parallelize the computation. It also accept a multiplier (that is used to normalize the vector) and a value that is added to every element of the output vector.

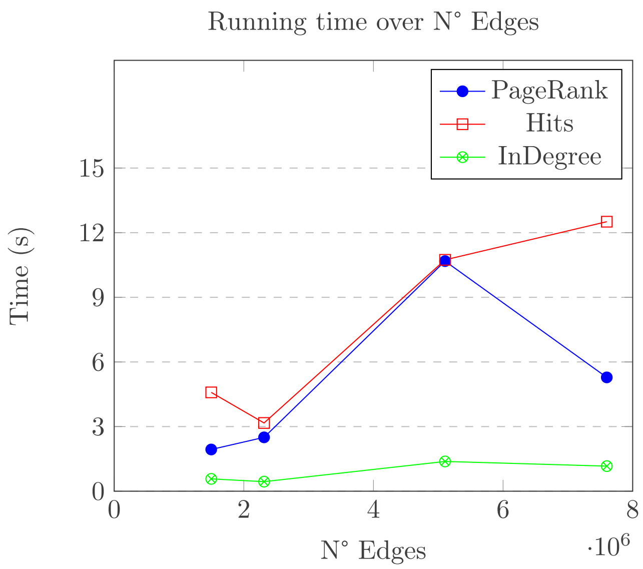
It returns the summation of the output vector.

5 Benchmark

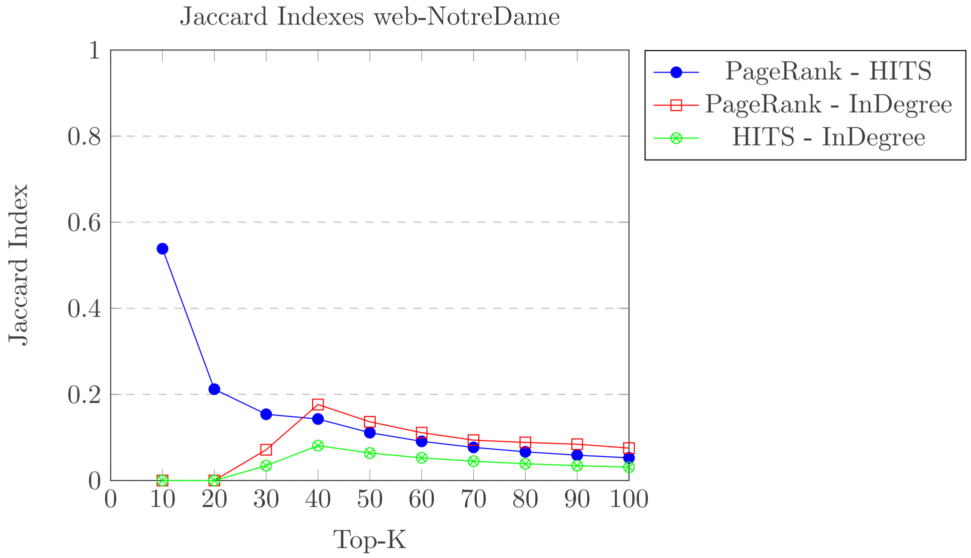
This tests was performed on a VPS with 1 vCore, 2Gb of RAM and Ubuntu 22.04 that at the time was not doing other tasks. With just one core we cannot appreciate the improvement given by the multi-threading but it was the only environment available for the tests.

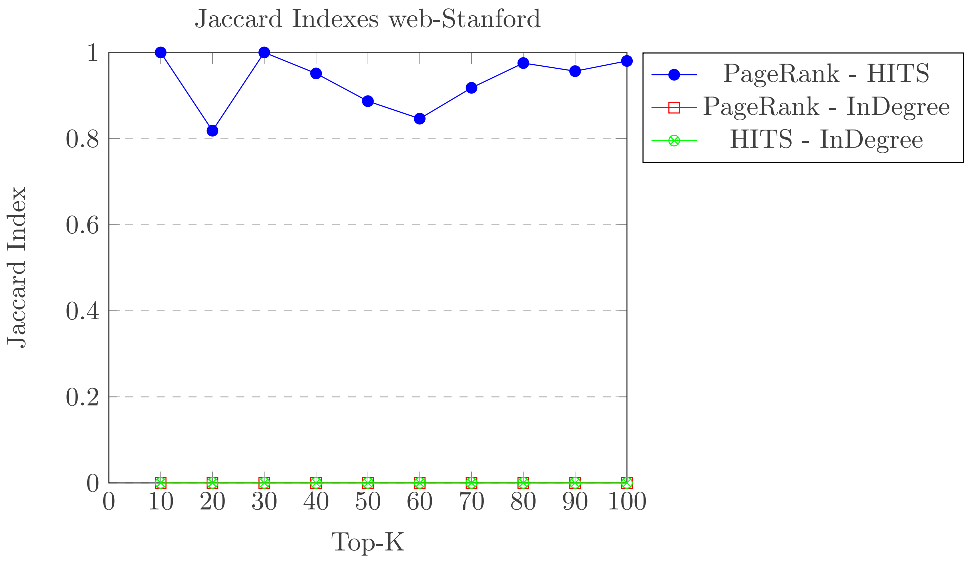
Name	**N° Nodes**	**N° Edges**	**PageRank time (s)**	**HITS time (s)**	**InDegree time (s)**
web-NotreDame	325,729	1,497,134	1.936	4.587	0.572
web-Stanford	281,903	2,312,497	2.500	3.167	0.443
web-Google	875,713	5,105,039	10.680	10.739	1.381
web-BerkStan	685,230	7,600,595	5.283	12.510	1.164

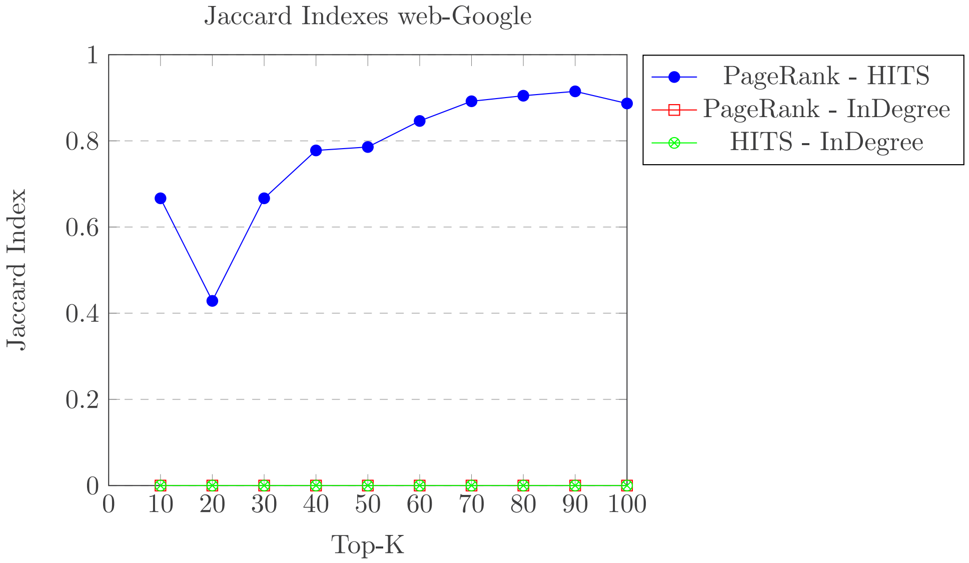

Running time over N° Nodes

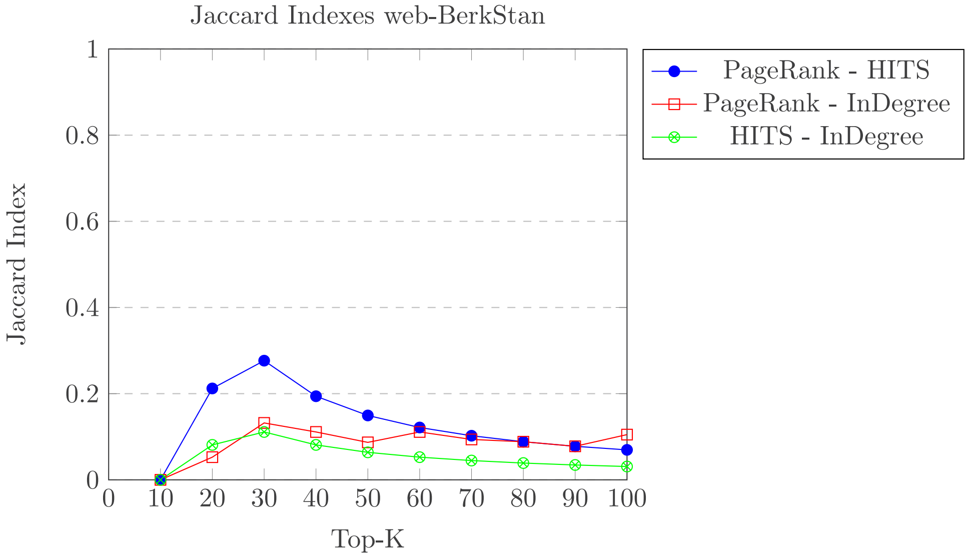

Running time over N° Edges

6 Jaccard Indexes


Jaccard Indexes web-NotreDame


Jaccard Indexes web-Stanford
Jaccard Index
Top-K
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50
60
70
80
90
100
PageRank - HITS
PageRank - InDegree
HITS - InDegree


Jaccard Indexes web-Google
Jaccard Index
Top-K
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50
60
70
80
90
100
PageRank - HITS
PageRank - InDegree
HITS - InDegree


Jaccard Indexes web-BerkStan
Jaccard Index
Top-K
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40
50
60
70
80
90
100
PageRank - HITS
PageRank - InDegree
HITS - InDegree