	Finolex Academy of Management and Technology, Ratnagiri			
	Department of Information Technology			
Subject name: Big Data Lab				Subject Code: ITC801
Class	BE IT	Semester – (CBSGS) VIII		Academic year: 2019-20
Name of Student	**Kazi Jawwad A Rahim**		**QUIZ Score :**	
Roll No	**28**	Assignment/Experiment No.		07
Title: **Implementation of Page rank Algorithm**				

1. Course objectives applicable: COB4.Study Page Rank in Link Analysis and concepts of Handling larger datasets

2. Course outcomes applicable:
CO4-Implement use of combiners to consolidate results and ability to handle larger datasets

3. Learning Objectives:

1. To understand concept of Page rank
2. To understand teleportation factor
3. To program Page rank computation in C/C++
4. To prove that teleportation helps to counteract problems caused by dead ends and spider traps

4. Practical applications of the assignment/experiment: Page rank is used by Google Search engine for indexing of webpages and giving results for search queries

5. Prerequisites:

1. Understanding of Internet Technologies

6. Hardware Requirements:

1. PC with 4GB RAM, 500GB HDD,

7. Software Requirements:

1. Access to C/C++ compiler
2. Internet access if online compiler is used

8. Quiz Questions (if any): (Online Exam will be taken separately batchwise, attach the certificate/ Marks obtained)

1. What is a Page rank?
2. What is Teleportation?
3. What is a dead end?
4. What is Random Surfer?

9. Experiment/Assignment Evaluation:

Sr. No.	Parameters	Marks obtained	Out of
1	Technical Understanding (Assessment may be done based on Q & A **or** any other relevant method.) Teacher should mention the other method used -		6
2	Neatness/presentation		2
3	Punctuality		2

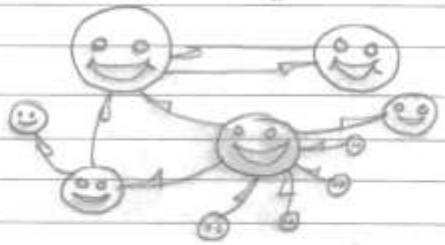
Date of performance (DOP)		**Total marks obtained**		**10**
Date of checking (DOC)		**Signature of teacher**		

Theory:

PageRank (PR) is an algorithm used by Google Search to rank websites in their search engine results. PageRank was named after Larry Page, one of the founder of Google. PageRank is the way of measuring the importance of website pages. According to Google, page rank works by counting the number and quality of links to a page to determine a rough estimate of how important the website is. The underlying assumption is that more important websites are likely to receive more links from other websites. PageRank is a link analysis algorithm and it assigns a numerical weighting to each element of a hyperlinked set of documents, such as the World wide web, with the purpose of "measuring" its relative importance within the set. The algorithm may be applied to any collection of entities with reciprocal quotations and references. The numerical weight that it assigns to any given element E is referred to as the PageRank of E and denoted by PR(E). Other factors like Author Rank can contribute to the importance of an entity.

A page rank results from a mathematical algorithm based on the webgraph, created by all World Wide Web pages as nodes and hyperlinks as edges, taking into considerations particular page. A hyperlink to a page counts as a vote of support. The pagerank of a

page is definitely recursively and depends on the number and PageRank metric of all pages that link to it ("incoming links"). A page that is linked to by many pages with high PageRank receives a high rank itself.
Numerous academic papers concerning PageRank have been published since Page and Brin's original paper. In practice, the pagerank concept may be vulnerable to manipulation. Research has been conducted into identifying falsely influenced PageRank rankings. The goal is to find an effective means of ignoring links from documents with falsely influenced PageRank.
Other link-based ranking algorithms for webpages include the HITS algorithm invented by Jon Kleinberg (used by Teoma and now Ask.com), the IBM CLEVER project, the TrustRank algorithm and the hummingbird algorithm.



Page Rank

Precautions:
1) Calculate the transition matrix accurately as per the web page graph.
2) The value of beta should be 0.8 - 0.9.

12. Installation Steps / Performance Steps –

PageRank Program with Teleportation:

```
#include<iostream>
using namespace std;
int main ()
{
    int i, j, k,n;
    float
A[7][7]={0,0,0,0.33,0,0,0,1,0,0,0,0.5,0,0,0,1,0,0,0.5,1,0,0,0,1,0,0,0,0,0,0,0,0
,0,0,0,0,0,0,0.33,0,0,0,0,0,0,0.33,0,0,1};
    float B[7][1]={0.143,0.143,0.143,0.143,0.143,0.143,0.143};
    float T[7][1],C1[7][1]={0};

     for (i = 0; i < 7; i++)
    {
        for (j = 0; j < 1; j++)
        {
            C1[i][j] = 0;
            for (k = 0; k <7; k++)
            {
                C1[i][j] += ((0.8*A[i][k])+0.03) * B[k][j];
            }
        }
    }

    cout << "\nProduct of matrices ";
    for (i = 0; i < 7; i++)
    {
        for (j = 0; j < 1; j++)
            cout << C1[i][j] << ",  ";

    }

    for(n=0;n<60;n++)
    {
            for (i = 0; i < 7; i++)
            {
                for (j = 0; j < 1; j++)
                {
                    T[i][j] = 0;
                    for (k = 0; k <7; k++)
                    {
                       // T[i][j] +=(A[i][k] * C1[k][j]);

                       T[i][j] += ((0.8*A[i][k])+0.03) * C1[k][j];
                    }
                }

            }

     cout << "\nProduct of matrices ";
    for (i = 0; i < 7; i++)
    {
        for (j = 0; j < 1; j++)
        {
            cout << T[i][j] << ",  ";
            C1[i][j]=T[i][j];
        }
    }

    }

    return 0;

}
```

PageRank without Teleportation:

```
#include<iostream>
using namespace std;
int main ()
{
    int i, j, k,n;
    float
A[7][7]={0,0,0,0.33,0,0,0,1,0,0,0,0.5,0,0,0,1,0,0,0.5,1,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,
0,0,0.33,0,0,0,0,0,0,0.33,0,0,1};
    float B[7][1]={0.143,0.143,0.143,0.143,0.143,0.143,0.143};
    float T[7][1],C1[7][1]={0};

     for (i = 0; i < 7; i++)
    {
        for (j = 0; j < 1; j++)
        {
            C1[i][j] = 0;
            for (k = 0; k <7; k++)
            {
                C1[i][j] += A[i][k] * B[k][j];
            }
        }
    }

    cout << "\nProduct of matrices ";
    for (i = 0; i < 7; i++)
    {
        for (j = 0; j < 1; j++)
            cout << C1[i][j] << ",  ";

    }

    for(n=0;n<60;n++)
    {
            for (i = 0; i < 7; i++)
            {
                for (j = 0; j < 1; j++)
                {
                    T[i][j] = 0;
                    for (k = 0; k <7; k++)
                    {
                       T[i][j] +=(A[i][k] * C1[k][j]);

                      // T[i][j] += ((0.8*A[i][k])+0.03) * C1[k][j];
                    }
                }

            }

     cout << "\nProduct of matrices ";
    for (i = 0; i < 7; i++)
    {
        for (j = 0; j < 1; j++)
        {
            cout << T[i][j] << ",  ";
            C1[i][j]=T[i][j];
        }
    }

    }

  return 0;
}
```

13. Observations

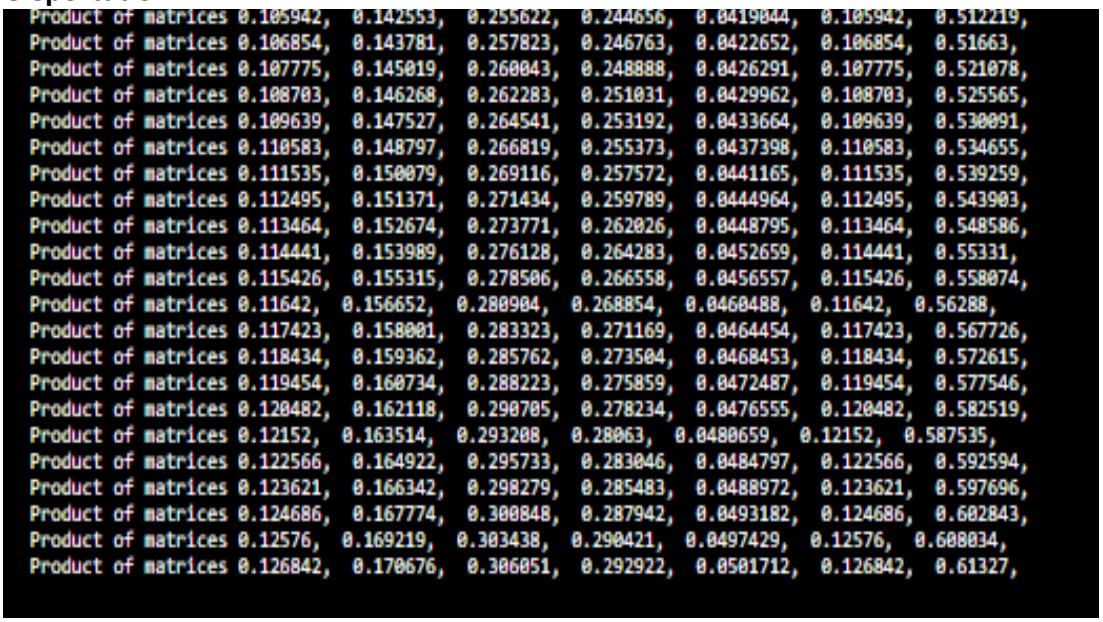
1. The pagerank calculation without teleportation will cause the dead ends have maximum pagerank,

2. In Pagerank calculation with teleportation factor, the values don't converge to one rather they are reflecting actual nature of the page.

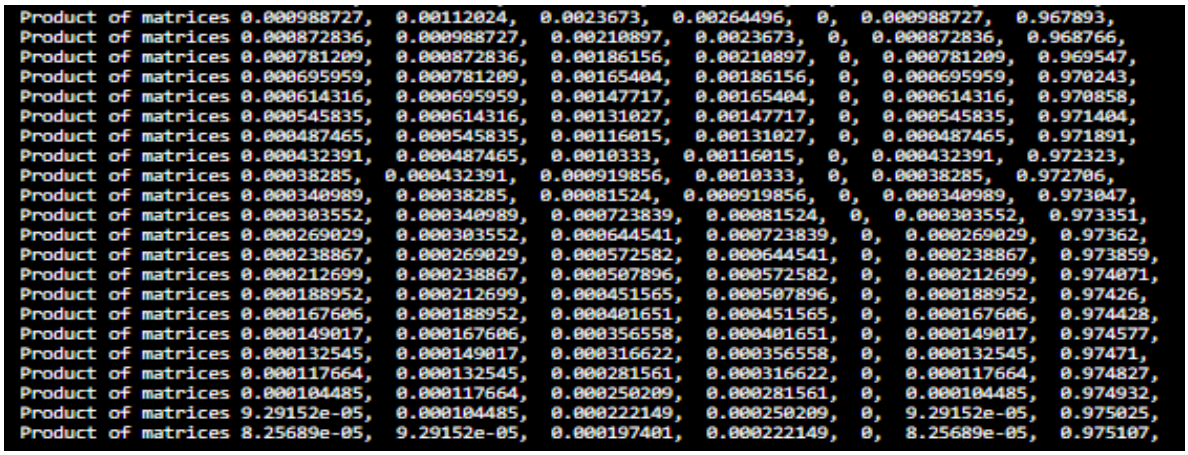
3. Total 100 Iterations were performed.

14. Results:

With Teleportation



Without Teleportatoion



17. References :

[1]"Google Press Center: Fun Facts". www.google.com. Archived from the original on 2001-07-15.
[2]"Facts about Google and Competition". Archived from the original on 4 November 2011. Retrieved 12 July 2014.
[3] Sullivan, Danny. "What Is Google PageRank? A Guide For Searchers & Webmasters". Search Engine Land. Archived from the original on 2016-07-03.
[4]Brin, S.; Page, L. (1998). "The anatomy of a large-scale hypertextual Web search engine" (PDF). Computer Networks and ISDN Systems. 30: 107–117. doi:10.1016/S0169-7552(98)00110-X. ISSN 0169-7552. Archived from the original on 2015-09-27.
[5]Gyöngyi, Zoltán; Berkhin, Pavel; Garcia-Molina, Hector; Pedersen, Jan (2006), "Link spam detection based on mass estimation", Proceedings of the 32nd International Conference on Very Large Data Bases (VLDB '06, Seoul, Korea) (PDF), pp. 439–450, archived (PDF) from the original on 2014-12-03.

Learning Outcomes Achieved:

i) Student have written the program for pagerank calculation.
2) Program for pagerank with teleportation factor was implemented.
3) The program was coded in C/C++ and run for 100 iterations.
4) It was proved that teleportation helps to counteract problems caused by dead ends and spider traps, as the pagerank for dead end was becoming 1 without teleportation and 0.6 with teleportation factor.

Conclusion:

1. Applications of the studied technique in industry-
a. Pagerank is used by leading search engines like google.

2. Engineering Relevance
a. Pagerank is based on random surfer model and suitable for indexing based search engines

3. Skills Developed
a. Implementation of pagerank with and without teleportation.