



Vidyavardhini's College of Engineering and Technology

Department of Artificial Intelligence & Data Science

Aim: To implement Page Rank Algorithm

Objective: Develop a program to implement page rank algorithm.

Theory:

PageRank (PR) is an algorithm used by Google Search to rank web pages in their search engine results. PageRank works by counting the number and quality of links to a page to determine a rough estimate of how important the website is. Page Rank Algorithm is designed to increase the effectiveness of search engines and improve their efficiency. It is a way of measuring the importance of website pages. Page rank is used to prioritize the pages returned from a traditional search engine using keyword searching. Page rank is calculated based on the number of pages that point to it. The value of the page rank is the probability will be between 0 and 1. A web page is a directed graph having two important components: nodes and connections. The pages are nodes and hyperlinks are the connections, the connection between two nodes. 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 website are likely to receive more links from other websites. The page rank value of individual node in a graph depends on the page rank value of all the nodes which connect to it and those nodes are cyclically connected to the nodes whose ranking we want; we use converging iterative method for assigning values to page rank. In short page rank is a vote, by all the other pages on the web, about how important a page is. A link to a page count as a vote of support. If there is no link, there is no support.

We assume that page A has pages B..... N which point to it. Page rank of a page A is given as follows:

$$PR(A) = (1 - \beta) + \beta \left(\frac{PR(B)}{out(B)} + \frac{PR(C)}{out(C)} + \dots + \frac{PR(N)}{out(N)} \right)$$

Parameter β is a teleportation factor which can be set between 0 and 1. $out(A)$ is defined as the number of links going out of page A.



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CODE:

```
import java.util.*;
import java.io.*;
public class PageRank {
    public int path[][] = new int[10][10];
    public double pagerank[] = new double[10];
    public void calc(double totalNodes) {
        double InitialPageRank;
        double OutgoingLinks = 0;
        double DampingFactor = 0.85;
        double TempPageRank[] = new double[10];
        int ExternalNodeNumber;
        int InternalNodeNumber;
        int k = 1; // For Traversing
        int ITERATION_STEP = 1;
        InitialPageRank = 1 / totalNodes;
        System.out.printf(" Total Number of Nodes : " + totalNodes + "\t Initial PageRank of All Nodes
        : " + InitialPageRank + "\n");

        // 0th ITERATION _ OR _ INITIALIZATION PHASE //

        for (k = 1; k <= totalNodes; k++) {
            this.pagerank[k] = InitialPageRank;
        }

        System.out.printf("\n Initial PageRank Values , 0th Step \n");
        for (k = 1; k <= totalNodes; k++) {
            System.out.printf(" Page Rank of " + k + " is :\t" + this.pagerank[k] + "\n");
        }

        while (ITERATION_STEP <= 2) // Iterations
        {
            // Store the PageRank for All Nodes in Temporary Array
            for (k = 1; k <= totalNodes; k++) {
                TempPageRank[k] = this.pagerank[k];
                this.pagerank[k] = 0;
            }
        }
    }
}
```



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```
for (InternalNodeNumber = 1; InternalNodeNumber <= totalNodes; InternalNodeNumber++) {
    for (ExternalNodeNumber=1;
ExternalNodeNumber <= totalNodes;
ExternalNodeNumber++) {
        if (this.path[ExternalNodeNumber][InternalNodeNumber] == 1) {
            k = 1;
            OutgoingLinks = 0; // Count the Number of Outgoing Links for each ExternalNodeNumber
            while (k <= totalNodes) {
                if (this.path[ExternalNodeNumber][k] == 1) {
                    OutgoingLinks = OutgoingLinks + 1; // Counter for Outgoing Links
                }
                k = k + 1;
            }
            // Calculate PageRank
            this.pagerank[InternalNodeNumber] += TempPageRank[ExternalNodeNumber] * (1 /
OutgoingLinks);
        }
    }
}

System.out.printf("\n After " + ITERATION_STEP + "th Step \n");

for (k = 1; k <= totalNodes; k++)
    System.out.printf(" Page Rank of " + k + " is :t" + this.pagerank[k] + "\n");

ITERATION_STEP = ITERATION_STEP + 1;
}
// Add the Damping Factor to PageRank
for (k = 1; k <= totalNodes; k++) {
    this.pagerank[k] = (1 - DampingFactor) + DampingFactor * this.pagerank[k];
}

// Display PageRank
System.out.printf("\n Final Page Rank : \n");
for (k = 1; k <= totalNodes; k++) {
    System.out.printf(" Page Rank of " + k + " is :t" + this.pagerank[k] + "\n");
}
```



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```
}  
  
}  
  
public static void main(String args[]) {  
    int nodes, i, j, cost;  
    Scanner in = new Scanner(System.in);  
    System.out.println("Enter the Number of WebPages \n");  
    nodes = in .nextInt();  
    PageRank p = new PageRank();  
    System.out.println("Enter the Adjacency Matrix with 1->PATH & 0->NO PATH Between two  
WebPages: \n");  
    for (i = 1; i <= nodes; i++)  
        for (j = 1; j <= nodes; j++) {  
            p.path[i][j] = in .nextInt();  
            if (j == i)  
                p.path[i][j] = 0;  
        }  
    p.calc(nodes);  
  
}  
}
```



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OUTPUT:

```
C:\Users\User\Downloads>java PageRank
Enter the Number of WebPages:
5
Enter the Adjacency Matrix with 1->PATH & 0->NO PATH Between two WebPages:
0 1 0 0 0
0 0 1 1 0
1 0 0 1 0
0 1 0 0 1
1 0 0 1 0
Total Number of Nodes :5.0      Initial PageRank of All Nodes :0.2

Initial PageRank Values , 0th Step
Page Rank of 1 is :    0.2
Page Rank of 2 is :    0.2
Page Rank of 3 is :    0.2
Page Rank of 4 is :    0.2
Page Rank of 5 is :    0.2

After 1th Step
Page Rank of 1 is :    0.2
Page Rank of 2 is :    0.30000000000000004
Page Rank of 3 is :    0.1
Page Rank of 4 is :    0.30000000000000004
Page Rank of 5 is :    0.1
```

```
After 2th Step
Page Rank of 1 is :    0.1
Page Rank of 2 is :    0.35000000000000003
Page Rank of 3 is :    0.15000000000000002
Page Rank of 4 is :    0.25
Page Rank of 5 is :    0.15000000000000002

Final Page Rank :
Page Rank of 1 is :    0.23500000000000004
Page Rank of 2 is :    0.44750000000000006
Page Rank of 3 is :    0.2775
Page Rank of 4 is :    0.36250000000000004
Page Rank of 5 is :    0.2775

C:\Users\User\Downloads>
```

Conclusion:

In conclusion, the PageRank algorithm is a fundamental and influential algorithm in the field of information retrieval, particularly in web search and ranking. Developed by Larry Page and Sergey Brin while they were at Stanford University, PageRank plays a crucial role in how search engines, such as Google, determine the importance and relevance of web pages in search results.