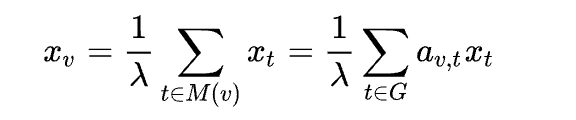
**EIGEN VECTOR CENTRALITY**

* This metric measures the importance of a node in a graph as a function of the importance of its neighbours. If a node is connected to highly important nodes, it will have a higher Eigen Vector Centrality score as compared to a node which is connected to lesser important nodes.
* EVC is its short abbreviation.
* It is the measure of the influence of a node in a network.
* In a network, nodes are connected by edges, and Eigen vector centrality aims to quantify the influence or prominence of a node based on its connections and the centrality of its neighbouring nodes. The underlying assumption is that a node is important if it is connected to other important nodes.
* It assigns relative scores to all the nodes in the network based on the concept that the a node would contribute more to its score if it is connected to high scoring nodes than low scoring nodes.
* We can calculate the EVC of a node from the adjacency matrix of the given network of things.
* —-> For a Graph G(V,E), where |V|: number of vertices in the graph network

A =( a v, t) be the adjacency matrix of the network.

( a v, t)=1 ,if the vertex ‘v’ is directly linked to vertex ‘t’

( a v, t)=0, if the vertex ‘v’ is not directly linked to vertex ‘t’

The relative centrality score of the vertex v can be defined as :

Where M(v) is a set of neighbours of

λ: a constant.

From a small rearrangement, i.e when we multiply both LHS and RHS of the

expression with λ ,then we realise that new RHS part is which is

nothing but the product of the adjacency matrix A with the vector v. i.e Ax.

The LHS part is product of vector x with the scalar constant λ i.e xλ.

So, with a small rearrangement, this expression can be rewritten in the vector

as the Eigen vector equation **Ax=** λ**x**.

—-> Generally, there exist many values of Eigen value λ for which non-zero Eigen

vector solutions exist.

But,according to the **Perron-Frobenius theorem** shows us how a

particular Eigen value should be chosen according to the Adjacency

matrix.

* General Process of Calculating the EVC of a node in the network at any iteration is as follows:
* Find the Adjacency matrix A of the given node network.
* Before the iteration, find the degree of each node(number of nodes to which that particular node is directly connected with) and represent the entire degrees collectively in a 1D column vector .
* Now, the resultant 1D column vector is given by the product of A with .

=A

Each element in the resultant vector represents the centrality scores of the nodes in the network after that particular iteration.

* To calculate the absolute score normalise the Eigen Vector(divide that particular score with the sum of other scores in the vector such that the total sum of absolute is 1).
* The calculated EVC score of the network shows its strength after several iterations.Repeated multiplication makes the EVC score of every node to eventually be a function of or dependent on several degrees of its neighbouring nodes, thereby providing a globally accurate EVC score for each node.Usually the process of multiplying the EVC vector with the adjacency matrix is repeated until the EVC values for nodes in the graph reach an equilibrium or stop showing appreciable change.
* **Applications:**
* Page Rank Algorithm:

Eigen vector centrality is a key component of the PageRank algorithm, widely used by Google and other companies for website ranking. By analysing the web as a directed graph, Eigen vector centrality calculates the importance of web pages based on the number and quality of incoming links. It utilises eigenvectors and eigenvalues to iteratively compute the centrality scores of web pages, resulting in a ranking system that prioritises influential pages. This application has revolutionised web search by providing more accurate and relevant search results to users.

* Social Network Analysis:

Eigen vector centrality is widely used in social network analysis to identify influential individuals within a network. By analysing connections and relationships between individuals, Eigen vector centrality helps uncover key players who have a significant impact on the flow of information or influence within the network.

* Biological Networks:

Eigen vector centrality is applied in biological networks, such as gene regulatory networks or protein-protein interaction networks. It helps identify central genes or proteins that play crucial roles in biological processes, providing insights into the functional importance and potential drug targets within the network.

Eigen Vector Centrality also finds its applications in Recommended Systems, transportation networks mainly in helping the underlying structure and dynamics of complex systems.