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BIPARTITE GRAPH MATCHING IN DONOR-RECIPIENT USING ENHANCED HOPCROFT KARP ALGORITHM FOR LIVER TRANSPLANTATION

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Abstract

A matching consists of pairs or parameters between donor to recipient is considered as important for liver transplantation. By using the maximum and minimum matching able to find out the exact or relevant parameters between the donor to recipient matching. Divide the set of parameters as donor sets and recipient sets using bipartite graph. Donor to Recipient Hopcroft Karp matching used for the final relevant pair of matching between the donor to recipient. Each set of parameters is assign as nodes for the donor to recipient set of pairs. Bipartite graph visualization shows the important donor to recipient matching. In this paper, analysis the important of the nodes for the donor recipient matching using the bipartite centrality and each

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features or parameters are considered as the node which improves the ability of optimal allocation of liver transplantation.

1. Introduction

The matching of donor to recipient using bipartite graph which means that divided the pairs (Donor to Recipient) by bipartite graph. In this, donor is one set of pairs and recipient is another set of pairs connected by edges and each edge is incident on according to the matching. Bipartite graph matching with the python library NetworkX.

Matching of Bipartite Graphs: In order to find the matching between the nodes in the bipartite graph, donor and recipient is divided as set of nodes and each and every node is connected with each other. According to the attributes, the matching pairs can be obtained. In a bipartite graph matching, there is no two edges meets the common vertices.

Maximum Bipartite Matching: In this graph, maximum number of edges is connected between the donor to recipient nodes. By using maximum bipartite matching, the comparisons of each and edges can be possible and take relevant matching from maximum matching bipartite graph.

Maximum Cardinality Matching: In order to find the maximum cardinality matching, the Hopcroft-Karp algorithmcan be used for matching. A library based on Hopcroft Karp's Algorithm and it takes as input a graph might have more than one maximum matching, it is worth noting that the algorithm may output any one of all possible maximum matchings.

Maximum Weight Matching: A maximum weight matching can be calculated by sum of the weight is maximised. A Python 3 graph implementation of the Hungarian Algorithm (Kuhn-Munkres algorithm), an O(n^3) solution for the assignment problem or maximum/minimum-weighted bipartite matching problem.

Minimum Weight Matching: In minimum weight matching can be found with sum of weights of the matching is minimised. Rabin-Karp algorithm can used for matching patterns in the text using a hash function.

Bipartite graph applications: Bipartite graph matching can be used many applications such as data science and computational biology, mathematical theory, etc.

2. Related works

In paper [1], graph theory and basic formula for the bipartite graph which is used to analysis the basic information of the bipartite graph. In paper [2], brief introduction about the bipartite graph and maximum, minimum matching, cardinality matching. In paper [3], given the basic concept of digraph, directed graph (paths and walks), colouring and connectivity. In paper [4], describes about the matching and theorem condition and also mathematical concept for bipartite graph. In paper [5], matching algorithm which is used to solve the graph matching problem in graph theory. In paper [6], NetworkX is to identify the sets and use a node attribute named bipartite with values 0 or 1 and also identify which belongs to each node. In paper [7], a general purpose network analysis is Stanford Network Analysis Platform and graph mining library which can be used for data collection. In paper [8], describes about the community detection, path finding, centrality in graph algorithm. In paper [9], identify proteins to proteins interaction by a simple galactose selection. In paper [10], bipartite graphs can solve the challenging of biological problems. In paper [11], gender difference in donor quality is considered as important factor in liver transplantation. In paper [12], identify the most important factors for the survival of liver patient after transplantation. In paper [13], using the Evolutionary Multi Objective Artificial Neural Networks which can predict the survival of the liver patient. In paper [14], ANN which is used to prolong the survival rate of the liver patients. In paper [15], for predicting the best outcome of patients of the liver transplantation.

3. Research Methodology

3.1 Data Collection

The UCI datasets is a multi organ datasets since 1987 from which extracted the liver patient record which consists of male and female liver patient records. Datasets accessed from UCI ML Repository. Data gathering about patient records, Information about data fields. Statistical information about numerical columns is also available in the datasets.

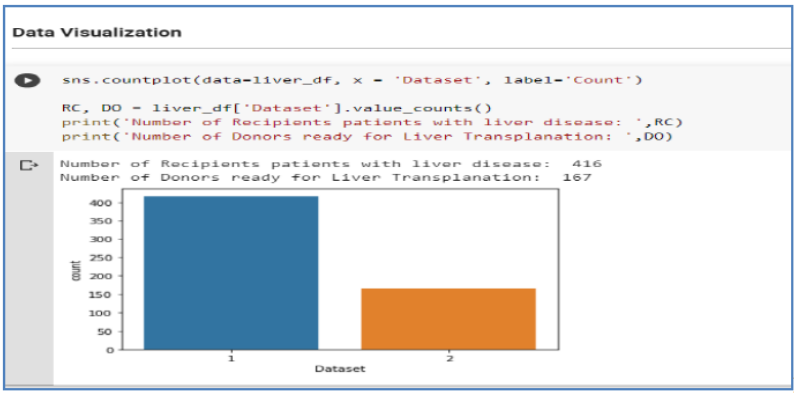

Figure 1. Donor-Recipient Datasets Visualization.

3.2 Data Preprocessing

Load the Features which is available in the datasets. Read the datasets. Checking Null value or Missing value. Extracting the missing value. Filling the null value with the mean value of that particular feature. Checking whether null value is changed or not.

4. Dimensionality Reduction

In this, reduce the random variables and used the Data Extraction and Data Analysis are followed with Correlation method.

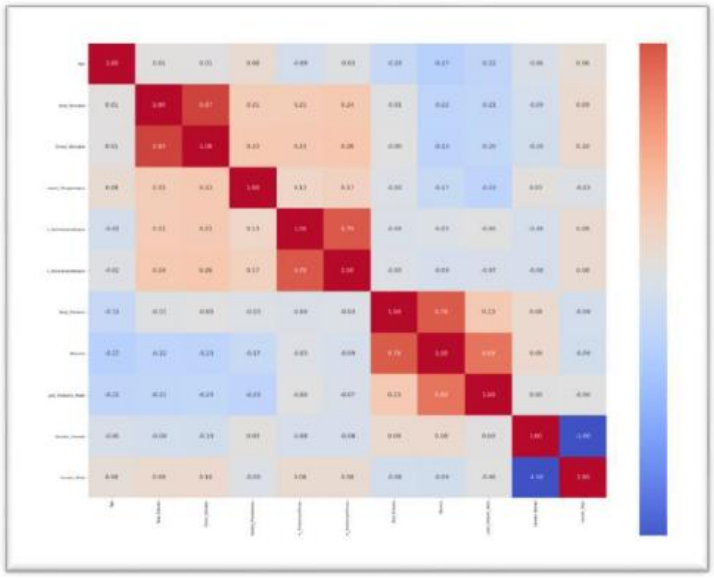

Figure 2. Correlation for Data analysis.

4.1 Feature Extraction

Refer to the process of extracting useful information or features or data from existing data. The number of recipient patients with liver disease. The number of donors ready for liver transplantation.

4.2 Feature Analysis

From the above Correlation map, we find that, there is a direct relationship between the following features are Total_Protiens, Albumin, Albumin and Globulin_Ratio,Albumin,Direct_Bilirubin,Total_Bilirubin, Aspartate_Aminotransferase,Alamine_Aminotransferase. Hence, Both the features are similar, it will give similar performance. The following data or features alone for futher matching process using bipartite graph which is used to divide the pair D-R matching. All the donors are connected to the respective recipient by bipartite matching. Further, these are taken for the D-R Hopcroft Karp matching in order to give each pair individual matching.

5. Experimental Results

For matching these features that is D-R matching such as Total_Protiens,

Albumin_and_Globulin_Ratio,Albumin,Total_Bilirubin,Alamine_Aminotransferaseconsidered as an important parameters and each parameters are assigned as nodes and connected with edges using networkx library.

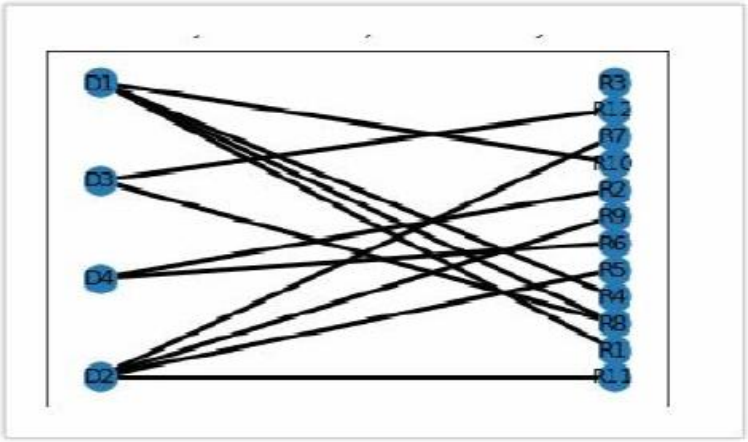

Figure 3. D-R Bipartite. Matching.

D-R Hopcroft Karp matching are used to predict the exact Donor availability of the parameters for recipient.

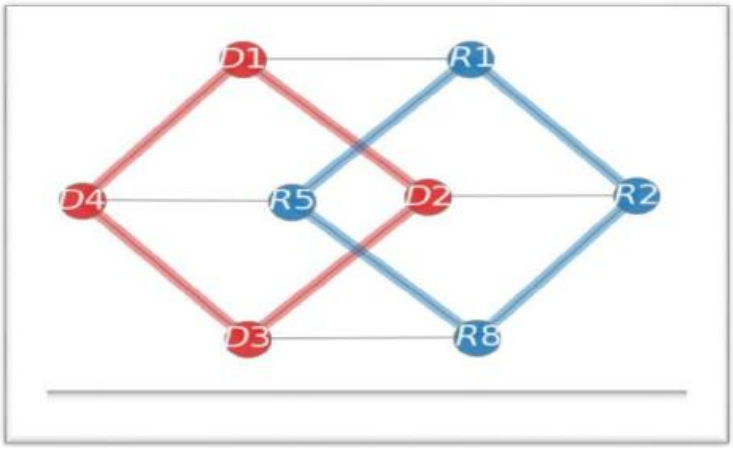

Figure 4. D-R Hopcroft Karp Matching.

6. Conclusion

To predict the matching for the donor to recipient using bipartite graph

which divides the D-R matching. In bipartite graph, there is no two set of edges can share the same endpoint. Hopcroft Karp algorithm which is used to takes input in a bipartite graph and produces as output a maximum cardinality matching. Hopcroft karp algorithm can predict the individual pair matching for the long term survival of the liver patients. It is also compare the following donor-recipient matching parameters with the correlation method which is used to find the donor to recipient matching to reduces the number of parameters. These are the features or data used for matching in the bipartite graph with hopcroft karp matching algorithm used for the donor to recipient matching with the attributes and improves the long term survival of the liver transplantation.

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