Matching Algorithm for Operations Management

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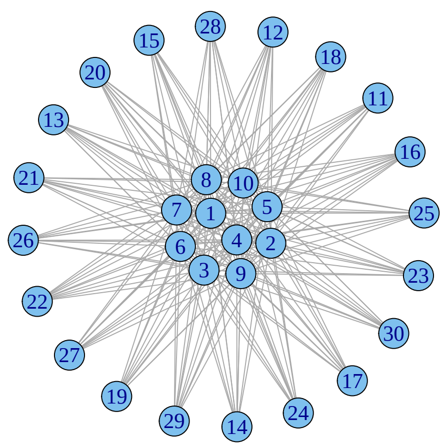

Motivation

There has been a steady increase in the number of companies offering ticketing services. The crowded market-place has forced these service providers to concentrate on providing personalized solutions to their customers. Customers too have started opting for providers who accommodate their ever evolving and rather volatile needs. One such scenario is the problem of optimally allotting tickets for customers, such that every customer obtains their preferred seat(s). With the customers' preferences bound to change erratically over the course of the ticket allotment process, and every delay in the allotment of the right ticket for each customer translating to a potential loss of sale, an efficient and robust matching algorithm is required.

Problem

The seat matching problem can be posed as a weighted bipartite matching problem with the seats being the objects to be matched. The first solution to the problem manifested as what is now known as the Hungarian algorithm. Since then many alternate approaches have been arrived at for solving the same problem.

One of standard approaches employed is a combination of optimization techniques like Bellman-Ford or Djikstra's algorithm in addition to the Hungarian algorithm. Though it solves the simple assignment problem, it does not efficiently solve the problem where the number of assignments is more than one.

A single assignment between two entities does not necessarily translate into a successful seat exchange and is more likely to fail. But if there were additional entities as choices to consider, it is more likely to result in a successful seat exchange.

The weights given to the attributes based on the entity's preferences are dynamic and the type of attributes are sector specific. This resulted in a need to reformulate the problem in a framework which had a provision for changing the entity's preferences, the type of attributes and the number of assignments.

Solution

Since existing greedy algorithms were either unsuitable or in-efficient at solving the problem with the above constraints, it was reformulated as an optimization problem in a binary integer programming framework. This allowed us to handle changes in the entity's preferences, type of attributes and the number of assignments effortlessly.

An assignment between any two entities was associated to have a cost which indicated its likeliness of success. Based on the weights given to the attributes, these costs for all possible assignments between entities were computed and aggregated to form a quotient matrix.

In this bipartite framework, the two clusters of entities are essentially the same. The issue of self-assignment was elegantly handled by the proposed framework, with the quotient value being small resulting in auto-penalization. This ensured that self-matching was less likely to occur.

The framework was also constructed to be indifferent to the types of attributes which could either be categorical or quantitative. Constraint equations of this optimization problem were framed intelligently to identify multiple assignments for every entity. The binary solutions of this optimization were sorted and translated into the assignment between the entities.

The solution is a novel formulation of the problem and finds the best possible matching between the entities. The framework developed can be easily extended to multiple non-related sectors, with **Gyan Data** continuing to provide innovative solutions.