Assignment problem questions pdf

Combinatorial optimization problem The assignment problem is a fundamental problem of combinatorial optimization. In its most common form, the problem is as follows: Given two sets, A and T, of equal size, together with a weight function \( C: A \times T \rightarrow \mathbb{R} \). Find a bijection \( f: A \rightarrow T \) such that the cost function:
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\sum_{a \in A} C_{a,f(a)}
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The problem is linear because the cost function to optimize and the constraints are linear. Algorithms A naïve solution to the assignment problem is to check all assignments and find the best one. However, this approach is inefficient since the number of assignments is \( n! \) (factorial of n), where n is the number of agents or tasks.

A better approach is to use the Hungarian algorithm, which solves the problem in polynomial time. The algorithm works by finding a set of assignments that are all optimal, then iteratively improving the solution. The Hungarian algorithm has a worst-case runtime of \( O(n^3) \), where n is the number of agents or tasks.

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The problem with assignment is to find, in a weighted two-part graph, a match of a given dimension, in which the sum of the edge weights is a minimum. If the number of agents and tasks is the same, the problem is called balanced assignment. Otherwise, it is called unbalanced assignment. If \( n = m \) the total cost of assignment is equal to the sum of the costs of each agent (or each task, which is the same thing in this case), the problem is called linear assignment. Commonly, when we talk about the assignment problem without any additional qualification, we mean the linear assignment problem.

The Hungarian algorithm can be generalized to solve the problem of maximum weight matching. For instance, \( G = (A,T,E) \) is a bipartite graph with two vertex sets A and T, and a set of edges E. The weight function \( w: E \rightarrow \mathbb{R} \) assigns a weight to each edge. The goal is to find a perfect matching with the maximum total weight.

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constraint), using standard methods to solve continuous linear programs. While this formulation also allows fractional variable values, in this special case LP always has an optimal solution in which variable values take integer values. This is because the matrix of fractional LP constants is totally unimodular – it meets the four Hoffman and Gale conditions. This too can be demonstrated directly. Both $x$ is an optimal solution of fractional LP, $x(x)$ and its dual, $y(y)$, meet the number of noninteger variables. If $x(x)$ is done. Otherwise, there is a fractional variable, such as $x _ {i1,j2}$. For similar considerations on $y(y)$, you must see another variable adjacent to it with a fractional value, such as $x _ {i3,j2}$. With similar considerations we move from one variable to another, collecting edges with fractional values. Since the graph is bipartite, at some point we can have a loop. Without loss of generality we can assume that the loop ends at some i, so the last fractional variable in the loop is $x _ {i1,j_{2m}}$. So the number of edges in the loop is $2m$. It must also be the same graph in two parts. Suppose we add a certain constant and all even variables in the first loop, and remove the same constant and all odd variables in the second loop. For each end of this type, the sum of the variables close to each vertex remains the same (i), to the constraints of the vertices are still satisfied. In addition, if x is small, all variables remain between 0 and 1, so even domain constraints are still satisfied. It's only to find one in a larger set that maximizes domain constraints. It's either the smaller difference between a variable and 0, or the variable adjacent to 0 and 1, which we have a variable fractional to be, no (x) decreases by 1. The objective value remains the same, since otherwise we could increase it by selecting x and as positive or negative, in contradiction to the hypothesis that it is maximum. Repeating the process of removing the loop we arrive, after at most n steps, at a solution in which all variables are integer. Other methods and approximation algorithms There are other approaches to the assignment problem and they are examined by Du et al. (2012) (see Table 1). Their work provides an approximation algorithm for the assignment problem (and the more general problem of maximum weight matching), which is performed in linear time for any associated fixed error. Generalization (often formulated as a graph theory problem) Linear Bottleneck Assignment Problem Monge-Kantorovich Transport Problem, a More General Formulation Quadratic Assignment Problem Top Rank Match Stable Marriage Problem Stable Marriage Assignment Problem References and Further Readings ^ a b c d Lyle Ramshaw, Robert G. Tarjan (2012). On minimum cost assignments in unbalanced two-party charts. HP research laboratories. ^ Michael S. Fredman, Robert Tarjan (1987-10-01). Fibonacci heaps and their uses in improved network optimization algorithms. SIAM Journal on Computing. 16 (3): 468–505. doi:10.1137/0216033. ISSN 0097-5397. ^ Duan, Ran; Seth Pettie (2014-01-01). Linear time approximation for maximum weight matching (PDF). ACM journal. 61: 1–23. doi:10.1145/2582726.2582741. ISSN 0097-5397.