

UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN  
Facultad de Ingeniería Mecánica y Eléctrica

Homework 1

Due date: Mon 05-Feb-2024 18:00

Course: **Selected Topics on Optimization**

Semester: Spring 2024

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**Answer each question.**

1. Formally define an optimization problem.

R= Is a formal mathematical representation of a task where the goal is to find the best solution among a set of possible solutions, typically within a specified set of constraints. It involves defining an objective function that needs to be either maximized or minimized, subject to certain constraints or conditions.

2. Formally define a linear optimization problem (also called linear programming problem).

R= is a specific type of optimization problem where both the objective function and the constraints are linear functions of the decision variables.

3. Formally define an integer optimization problem (also called integer programming problem).

R= is an extension of linear programming in which some or all of the decision variables are required to take integer values. The general form of an integer programming problem is similar to that of linear programming but includes the additional requirement that certain or all decision variables must be integers.

4. What is the method typically used for solving linear programming problems (of any size)?

R= The simplex method

5. What is the method typically used for solving integer programming problems?

R= The branch and bound method systematically explores the solution space by branching into subproblems, discarding subproblems that cannot lead to an optimal solution

6. What is the main difference between a linear programming problem and an integer programming problem?

R= The main difference between a linear programming (LP) problem and an integer programming (IP) problem lies in the nature of the decision variables. In a linear programming problem, the decision variables can take any real values within a specified range, whereas in an integer programming problem.

7. When do we say that an optimization problem is “easy” to solve?

R= Optimization problems with linear or convex structures are often easier to solve than those with non-linear or non-convex structures. Linear programming, for example, is a class of optimization problems that can be efficiently solved in polynomial time.

8. When do we say that an optimization problem is “hard” to solve?

R= Certain problem structures, such as non-convexity or combinatorial nature, can contribute to the hardness of optimization problems. Combinatorial optimization problems, which involve discrete decision variables and

9. What is a heuristic method for optimization problems?

R= A heuristic method for optimization problems is an approach that uses practical and intuitive strategies to find reasonably good solutions, often in a timely manner, without guaranteeing optimality

10. What is an exact method for optimization problems?

R= Is an algorithmic approach that guarantees finding the optimal solution within a specified mathematical or computational framework. Unlike heuristic methods, exact methods aim to systematically explore the entire solution space and provide a solution with a proven optimality property. These methods are typically employed when the problem size is relatively small or when it is crucial to obtain the globally optimal solution.

11. What is a brute-force method for optimization problems?

R= brute-force method for optimization problems is a straightforward and exhaustive approach that systematically evaluates all possible solutions in the solution space to find the optimal one. This method essentially involves trying every possible combination of decision variables within the problem's constraints and evaluating the objective function for each combination.

12. What are the main reasons heuristic methods are used?

R= Heuristic methods are employed for optimization problems for several reasons, as they offer practical and efficient approaches to finding satisfactory solutions, especially in situations where exact methods may be computationally expensive or impractical.

13. What is a combinatorial optimization problem?

R= A combinatorial optimization problem is a type of mathematical optimization problem where the goal is to find the best solution from a finite set of possible solutions. The term "combinatorial" arises because these problems involve selecting a combination of elements from a discrete set, often subject to certain constraints, to optimize a specified objective function.

**Note:** You must submit a PDF file (named: **HW1-Firstname\_Lastname.pdf**) typeset electronically with your answers to both: [roger@yalma.fime.uanl.mx](mailto:roger@yalma.fime.uanl.mx) and [rz.rios@utexas.edu](mailto:rz.rios@utexas.edu) by the due date.

