The Mathematics of Optimization

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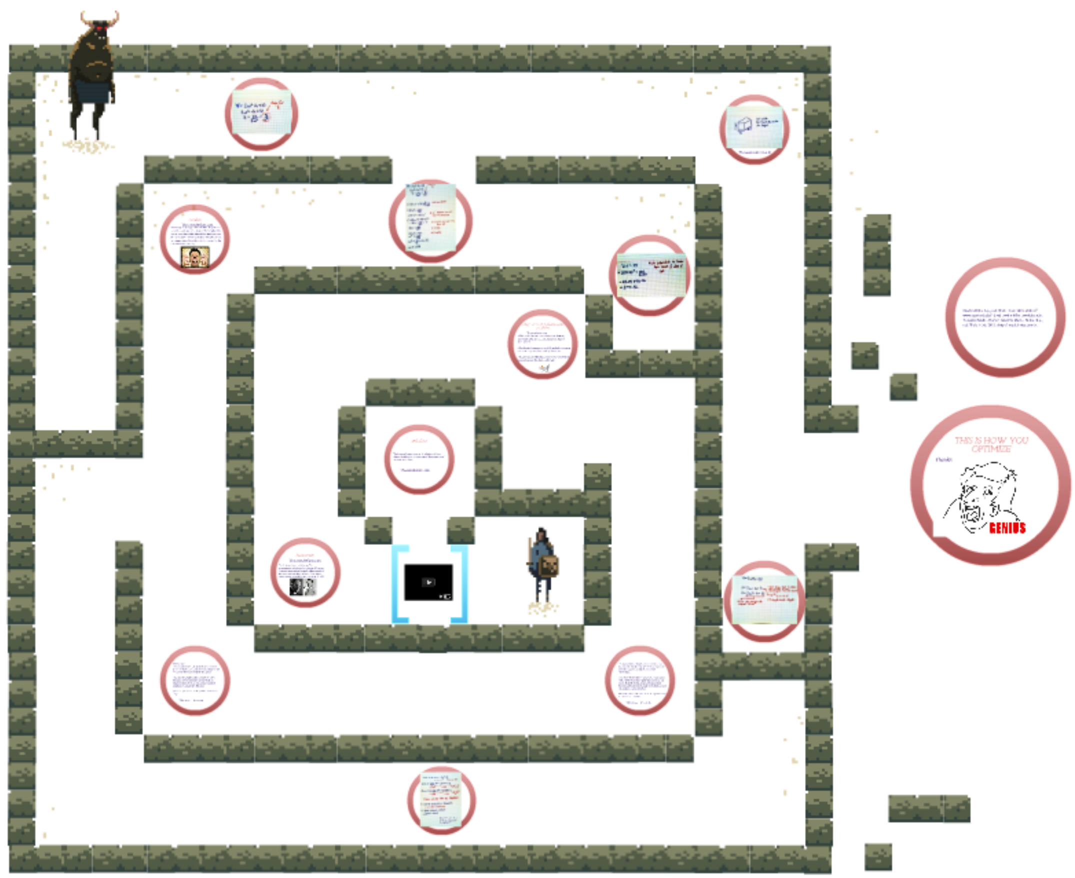

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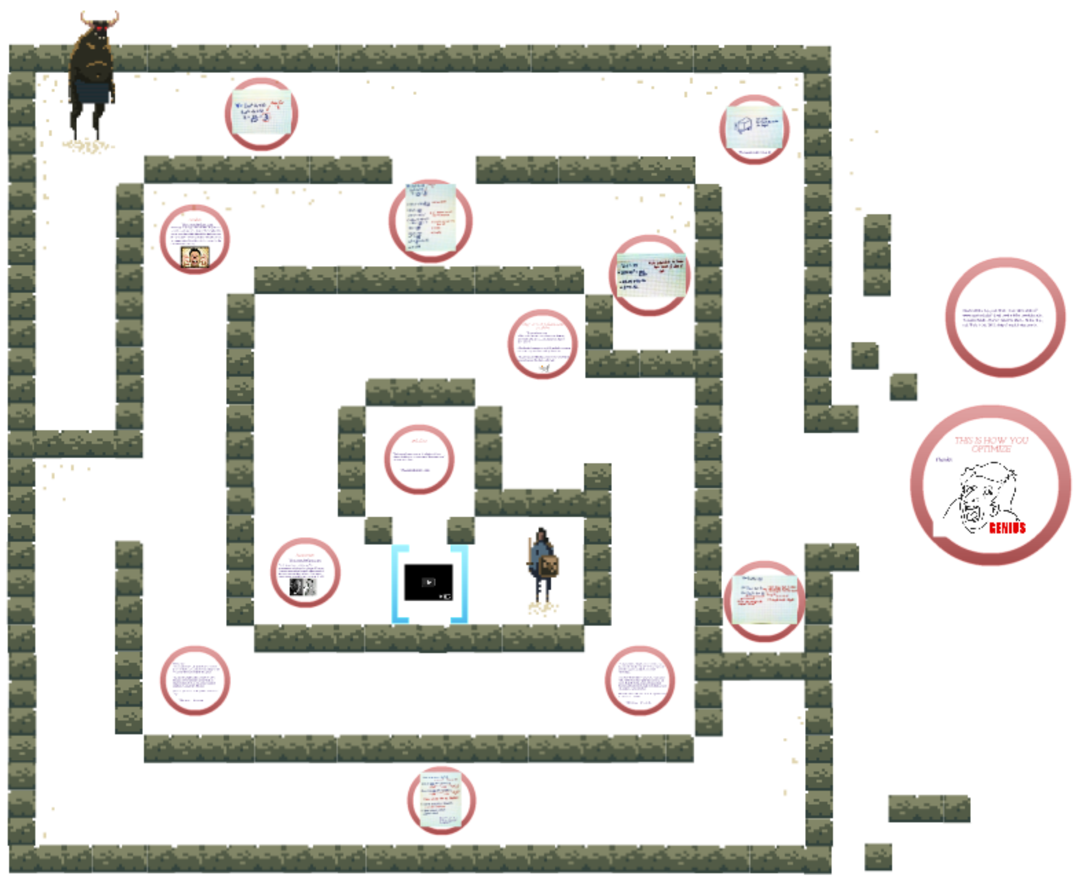

Definition

Mathematical optimization is the selection of a best element (with regard to some criteria) from some set of available alternatives.

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Antecedents

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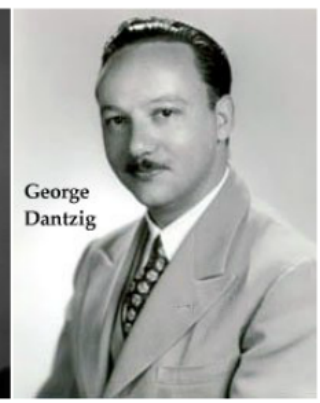
The first term for optimization was "linear programming", which was due to George B. Dantzig (American mathematical scientist), although much of the theory was introduced by Leonid Kantorovich (was a Soviet mathematician and economist) in 1939.



Steps to solve optimization problems

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1. Identify the function type: volume, cost, distance, production/labor, area etc… for which to optimize a measurement.

2.Sketch out a drawing: read carefully and make a drawing as accurate as you can base on the problem data.

3.Determine geographic shapes: determine nested shapes as an aid, separate the shapes on the side.

4.Assign variables to lengths: check for similar lengths because similar lengths have the same variable) and use geometry theorems and definitions to derive relationships.

5.Apply known formulas to the geometry: if you have a right triangle you will use Pythagorean theorem, if you have a trapezoid you will use the trapezoid formula, different figures different formulas; area formulas, surface area formulas, volume formulas.

6.Find the domain of the function: test endpoint and see if its coherent or if it matches.

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7.Differentiate:

- Take first derivative and find the extrema determine where the extrema are located by setting first derivative to zero and that the results are within the domain.

- Take second derivative: plug the result of the first derivative into the second derivative to check the concavity, concavity will let you know if you have a minimum or a maximum at that point.

8.Interpret your answer: are the yielded results within range?

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Problem

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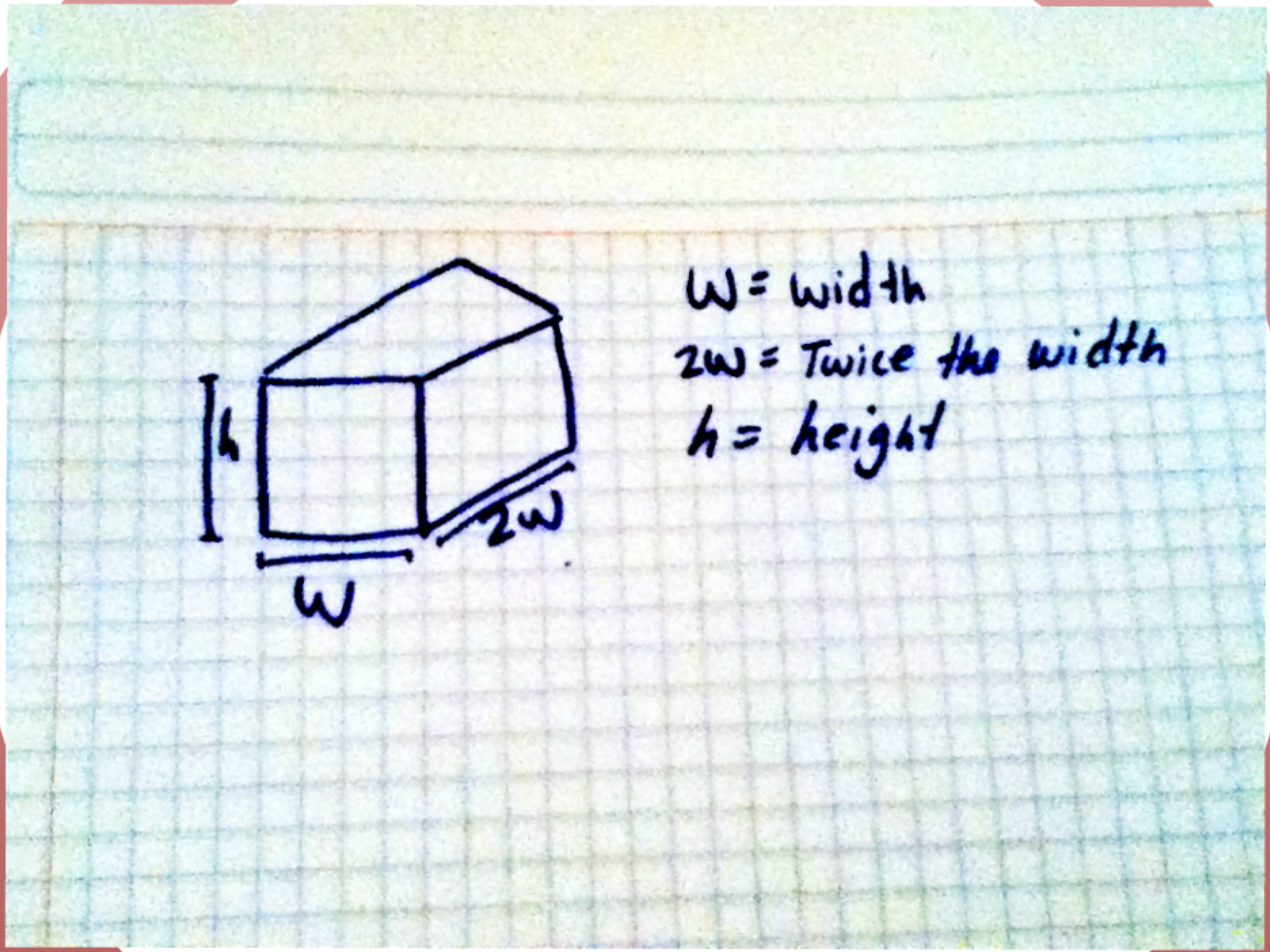
A rectangular storage container with an open top is to have a volume of v=10m^3. The length of it's base is twice the width. Material for the base costs $10 per square meter. Material for the side costs $6 per square meter. Find the cost of materials for the cheapest such container.



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