Research (What is it about?)	**Goal programming without weights problem**
UNN authors	*Sergeyev Ya.*
We find (The result)	It is shown that a multi-objective optimization problem can be reduced to a new single-objective one by using a smart numerical approach to working with infinities and infinitesimals without finding a set of multiple objective weights
Abstract	Engineering applications often lead to optimization problems where several objectives should be satisfied (goal programming tasks). An important class of problems of this kind are ***lexicographic multi-objective problems*** where the first objective is incomparably more important than the second one which, in turn, is incomparably more important than the third one, etc. In case each of the objectives is represented by a linear function under linear constraints, Lexicographic Multi-Objective Linear Programming (***LMOLP***) problems are considered. Traditional ways for *LMOLP* problems are to solve a sequence of single-objective linear programming problems with variable constraints or to transform a *LMOLP* into a single-objective problem by using a weighted sum of the objectives. The first way is time consuming, in the second one, it is difficult to find the weights and it is also time consuming at best. We find that a smart application of infinitesimal weights allows one to construct a single-objective problem avoiding the necessity to determine finite weights. In this approach, objectives can be ranked by successive powers of the new numeral ***grossone,*** which is defined as the infinite integer being the number of elements of the natural numbers set. The equivalence between the original multi objective problem and the new single-objective one is proved. A simplex-based algorithm working with finite and infinitesimal numbers is proposed and implemented. Results of some numerical experiments are provided.

Representative articles 2017-2018, quartiles	1. *Marco Cococcioni, Massimo Pappalardo, Yaroslav D. Sergeyev.* Lexicographic multi-objective linear programming using grossone methodology: Theory and algorithm. Appl. Math & Comput. **318**. 298-311 (2018).	Q1
	Q-index (Qi) for the result	**4**
		high blue

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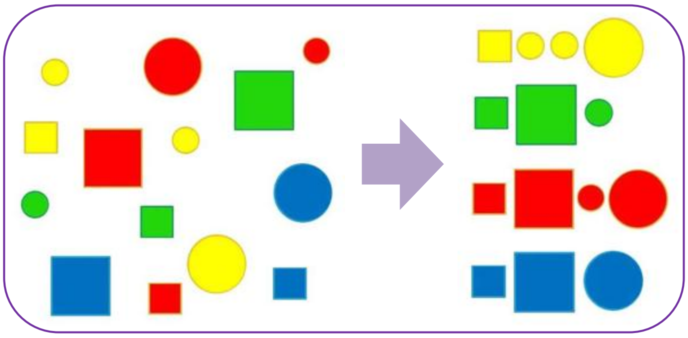
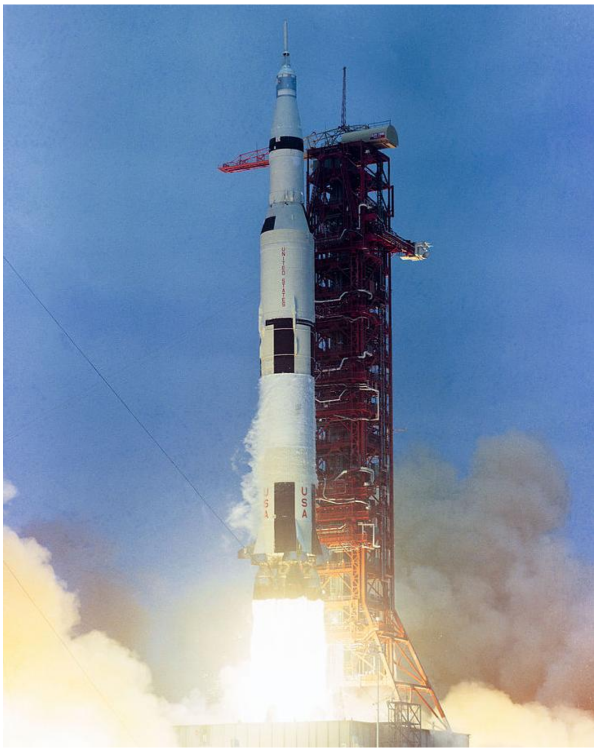
The simplest tasks of goal programming:

2017-12-03	→	2017-05-26
2019-03-15		2017-12-03
2017-05-26		2019-03-15





The first engineering application of goal programming, was the design and placement of the antennas employed on the second stage of the ***Saturn V*** rocket.

Max $\mathbf{c} \cdot \mathbf{x}$

s.t. $\{ \mathbf{x} \in R^n : \mathbf{Ax = b}, \mathbf{x} > 0 \}$

where

$\mathbf{c} = \sum_{i=1}^{r} \mathbf{c}^i \, M^{-i+1}$

?

Mathematic formulation of *LMOLP* task and the weights finding problem.

If the number of elements of the natural numbers set is defined as new numeral ***grossone***…

1, 2, 3, 4, … 666, …, ①

① Grossone designation

…then ***grossone***-based formulation

$$\begin{aligned} \text{Max} \quad & \tilde{\mathbf{c}}\mathbf{x} \\ \text{s.t.} \quad & \{\mathbf{x} \in \mathbb{R}^n : \mathbf{Ax} = \mathbf{b},\ \mathbf{x} \geqslant 0\}, \end{aligned}$$

It does not involve any unknown.

where $\tilde{\mathbf{c}}$ is a row-wise *gross*-vector having n *gross*-scalar components:

$$\tilde{\mathbf{c}} = \sum_{i=1}^{r} \mathbf{c}^i ①^{-i+1}$$

gives the solution of *LMOLP* task.