Why

Often we care about multiple criteria at once.[1]

Definition

A *multiobjective optimization problem* is a pair $(X, f : X \to \mathbf{R}^d)$. As before, X is the *constraint set* and f is called the *objective function*. Since f is vector valued, and there is no natural order on $\mathbf{R}^d$, there may exist $x \in X$ with non-comparable images under f.

Scalarization

The $\alpha \in \mathbf{R}^d$ *scalarization* of a multiobjective optimization problem (X, f) is the optimization problem (X, g) where $g : X \to \mathbf{R}$ is defined by $g(x) = \alpha^\top f(x)$. We call g the *scalarized objective*.

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[1] Future editions will modify.

Multiplication Optimization Problems

Coordinated Orders • Matrix Transpose

Multivariate Functions

Vectors as Matrices

Real Inner Product • Real Matrices

Real Norm • Real Linear Equations

Optimization Problems • N-Dimensional Space • Space Inner Product • Real Vectors • Linear Functions • Arrays

Extended Real Numbers • Right Triangle Sides Relation • Distance • Plane Inner Product • Space Norm • Space Vectors • Plane Vector Sums and Differences

Optimizers • Real Squares • Real Limits • Space Distance • Plane Norm • Plane Vectors

Real Arithmetic • Absolute Value

Greatest Lower Bounds • Real Functions • Real Multiplication Inverses • Plane Distance • Interval Length

Intervals • Real Products • Real Space

Orders • Square Numbers • Real Line • Real Addition Inverses • Real Sequences • Real Plane • Real Summation • Natural Summation

Squares • Integral Line • Real Order • Rational Arithmetic • Real Sums • Rational Multiplication Inverses • Sequences

Geometry • Rational Order • Computation • Rational Numbers • Real Numbers • Rational Products • Set Numbers • Direct Products

Integer Order • Rational Sums • Finite Sets

Integer Arithmetic • Inverse Elements • Natural Equations • Equivalent Sets • Family Operators

Integer Products • Natural Addition Identity • Natural Multiplication Identity • Rational Functions • Function Inverses • Family Unions and Intersections

Integer Sums • Identity Elements • Natural Arithmetic • Element Functions • Equations • Function Images • Function Composites • Families

Natural Powers • Integer Numbers • Operations • Concave Relations • Equivalence Relations • Surjections

Natural Products • Rational Order • Natural Sums • Relations

Recursion Theorem • Ordered Pair Projections

Peano Axioms

Natural Induction • Set Products

Natural Numbers • Set Powers • Successor Sets • Unordered Triples • Set Dualities • Generalized Set Dualities • Intersection of Empty Set • Set Partitions • Set Unions and Intersections

Set Symmetric Differences

Ordered Pairs • Set Complements • Pair Unions

Set Differences • Set Unions • Pair Intersections • Set Intersection

Unordered Pairs • Empty Set

Set Specification

Set Equality

Set Inclusion

Deductions

Quantified Statements

Logical Statements

Statements

Sets • Identities

Names

Letters • Objects