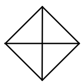


Why

Every matrix $A \in \mathsf{R}^{m \times n}$ maps the unit ball in R^n to an ellipsoid in R^m.

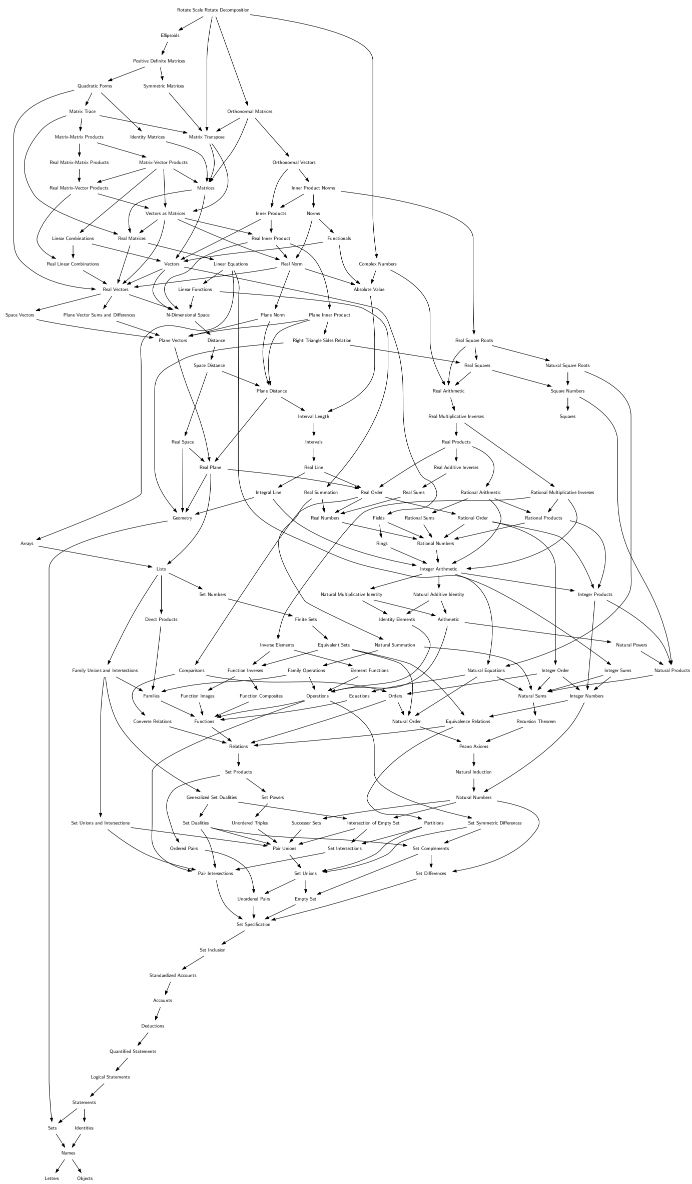
Definition

A *rotate scale rotate decomposition* (or *rotate scale rotate factorization*) of a matrix $A \in \mathsf{R}^{m \times n}$ is an ordered triple (U, S, V) where U and V are orthgonal and S is diagonal decreasing ($S_{11} \geq S_{22} \geq \cdots \geq S_{pp}$, where $p = \min\{m, n\}$) satisfying

$$A = USV^\top.$$

Other (universal) terminology includes the *singular value decomposition* or *SVD* of A. We call diagonal elements of S the *singular values* of A. We call the column vectors of U the *left singular vectors* or *output singular vectors.* We call the column vectors of V the *right singular vectors* or *input singular vectors.* We refer to them collectively as the *singular vectors.*

$$Av_i = \sigma_i u_i.$$


Rotate Scale Rotate Decomposition
Ellipsoids
Positive Definite Matrices
Quadratic Forms
Symmetric Matrices
Matrix Trace
Orthonormal Matrices
Matrix-Matrix Products
Identity Matrices
Matrix Transpose
Real Matrix-Matrix Products
Matrix-Vector Products
Orthonormal Vectors
Real Matrix-Vector Products
Matrices
Inner Product Norms
Vectors as Matrices
Inner Products
Norms
Linear Combinations
Real Matrices
Real Inner Product
Functionals
Real Linear Combinations
Vectors
Linear Equations
Real Norm
Complex Numbers
Real Vectors
Linear Functions
Absolute Value
Space Vectors
Plane Vector Sums and Differences
N-Dimensional Space
Plane Norm
Plane Inner Product
Plane Vectors
Distance
Right Triangle Sides Relation
Real Square Roots
Space Distance
Real Squares
Natural Square Roots
Plane Distance
Real Arithmetic
Square Numbers
Interval Length
Real Multiplicative Inverses
Squares
Real Space
Intervals
Real Products
Real Plane
Real Line
Real Additive Inverses
Integral Line
Real Summation
Real Order
Real Sums
Rational Arithmetic
Rational Multiplicative Inverses
Geometry
Real Numbers
Fields
Rational Sums
Rational Order
Rational Products
Arrays
Rings
Rational Numbers
Lists
Integer Arithmetic
Set Numbers
Natural Multiplicative Identity
Natural Additive Identity
Integer Products
Direct Products
Finite Sets
Identity Elements
Arithmetic
Inverse Elements
Equivalent Sets
Natural Summation
Natural Powers
Family Unions and Intersections
Comparisons
Function Inverses
Family Operations
Element Functions
Natural Equations
Integer Order
Integer Sums
Natural Products
Families
Function Images
Function Composites
Operations
Equations
Orders
Natural Sums
Integer Numbers
Converse Relations
Functions
Natural Order
Equivalence Relations
Recursion Theorem
Relations
Peano Axioms
Set Products
Natural Induction
Generalized Set Dualities
Set Powers
Natural Numbers
Set Unions and Intersections
Set Dualities
Unordered Triples
Successor Sets
Intersection of Empty Set
Partitions
Set Symmetric Differences
Ordered Pairs
Pair Unions
Set Intersections
Set Complements
Pair Intersections
Set Unions
Set Differences
Unordered Pairs
Empty Set
Set Specification
Set Inclusion
Standardized Accounts
Accounts
Deductions
Quantified Statements
Logical Statements
Statements
Sets
Identities
Names
Letters
Objects