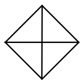


Why

We discuss linear systems of equations using the algebra of matrices.[1]

Discussion

Let $(A \in \mathsf{R}^{m \times n}, b \in \mathsf{R}^m)$ be a linear system of equations. The two-dimensional array A is a matrix. Recall that we want to find $x \in \mathsf{R}^n$ to satisfy the simultaneous equations

$$\begin{aligned} A_{11}x_1 \cdots \quad A_{1n}x_n &= b_1 \\ &\vdots \\ A_{m1}x_1 \cdots \quad A_{mn}x_n &= b_m \end{aligned}$$

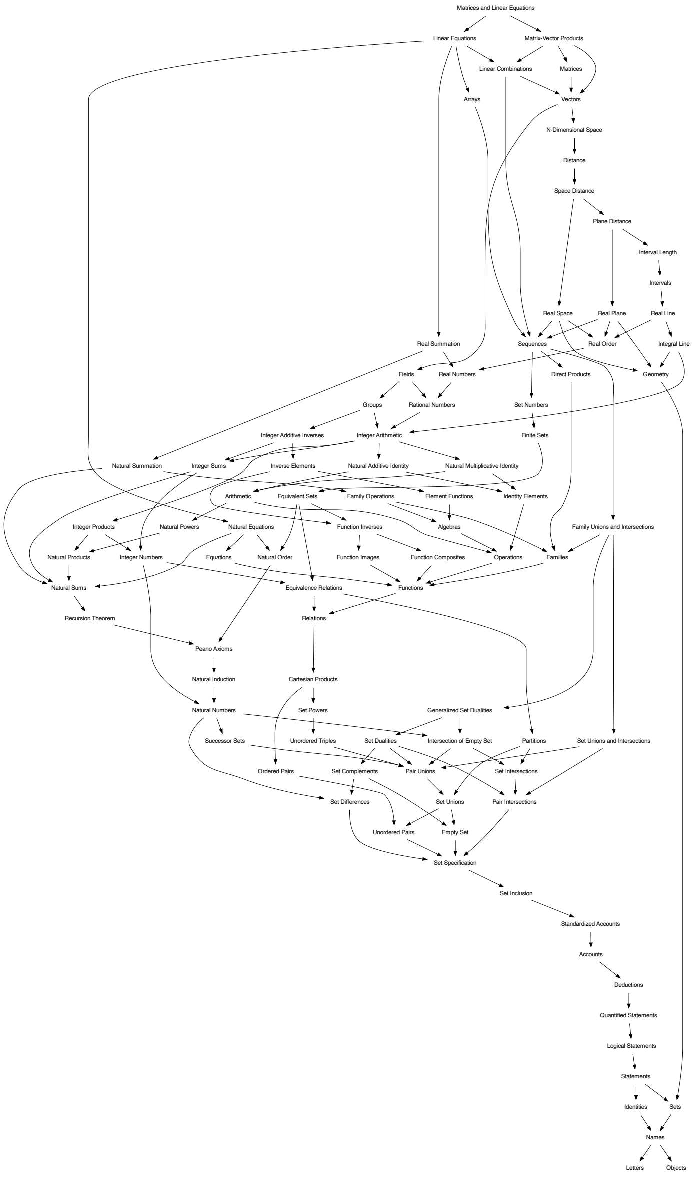
Using the notation for a matrix-vector product, we can compactly write the above as

$$Ax = b.$$

This short statement encodes all m linear equations. For this reason A is often called the *coefficient matrix.*

Moreover it provides an algebraic and geometric interpretation of solving systems of linear equations. The algebraic interpretation is that we are interested in the invertibility of the map $x \mapsto Ax$. In other words, we are interested in the existence of an inverse element of A. The geometric interpretation is that A transforms the vector x.

[1]Future sheets may invert this ordering, and motivate matrices by linear equations.


Matrices and Linear Equations
Linear Equations
Matrix-Vector Products
Linear Combinations
Matrices
Arrays
Vectors
N-Dimensional Space
Distance
Space Distance
Plane Distance
Interval Length
Intervals
Real Space
Real Plane
Real Line
Real Summation
Sequences
Real Order
Integral Line
Fields
Real Numbers
Direct Products
Geometry
Groups
Rational Numbers
Set Numbers
Integer Additive Inverses
Integer Arithmetic
Finite Sets
Natural Summation
Integer Sums
Inverse Elements
Natural Additive Identity
Natural Multiplicative Identity
Arithmetic
Equivalent Sets
Family Operations
Element Functions
Identity Elements
Integer Products
Natural Powers
Natural Equations
Function Inverses
Algebras
Family Unions and Intersections
Natural Products
Integer Numbers
Equations
Natural Order
Function Images
Function Composites
Operations
Families
Natural Sums
Equivalence Relations
Functions
Recursion Theorem
Relations
Peano Axioms
Natural Induction
Cartesian Products
Natural Numbers
Set Powers
Generalized Set Dualities
Successor Sets
Unordered Triples
Set Dualities
Intersection of Empty Set
Partitions
Set Unions and Intersections
Ordered Pairs
Set Complements
Pair Unions
Set Intersections
Set Differences
Set Unions
Pair Intersections
Unordered Pairs
Empty Set
Set Specification
Set Inclusion
Standardized Accounts
Accounts
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Quantified Statements
Logical Statements
Statements
Identities
Sets
Names
Letters
Objects