Why

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Definition

A sequence of functions $(g_1, \ldots, g_\ell)$ is *composable* if g_i is composible with g_{i-1} for $i = 2, \ldots, \ell$. In this case we write $g_\ell \circ g_{\ell-1} \circ \cdots \circ g_2 \circ g_1$. For example, we write $g_3 \circ g_2 \circ g_1$ for (g_1, g_2, g_3).

A *neural network* (or *feedforward neural network*) from $\mathbf{R}^n$ to $\mathbf{R}^m$ is a sequence of composable functions $(g_1, \ldots, g_\ell)$, dom $g_1 = \mathbf{R}^n$, ran $g_\ell \subset \mathbf{R}^m$, satisfying

$$g_i(\xi) = h_i(A_i\xi + b_i)$$

for some conforming matrices A_i, vectors b_i and functions h_i.

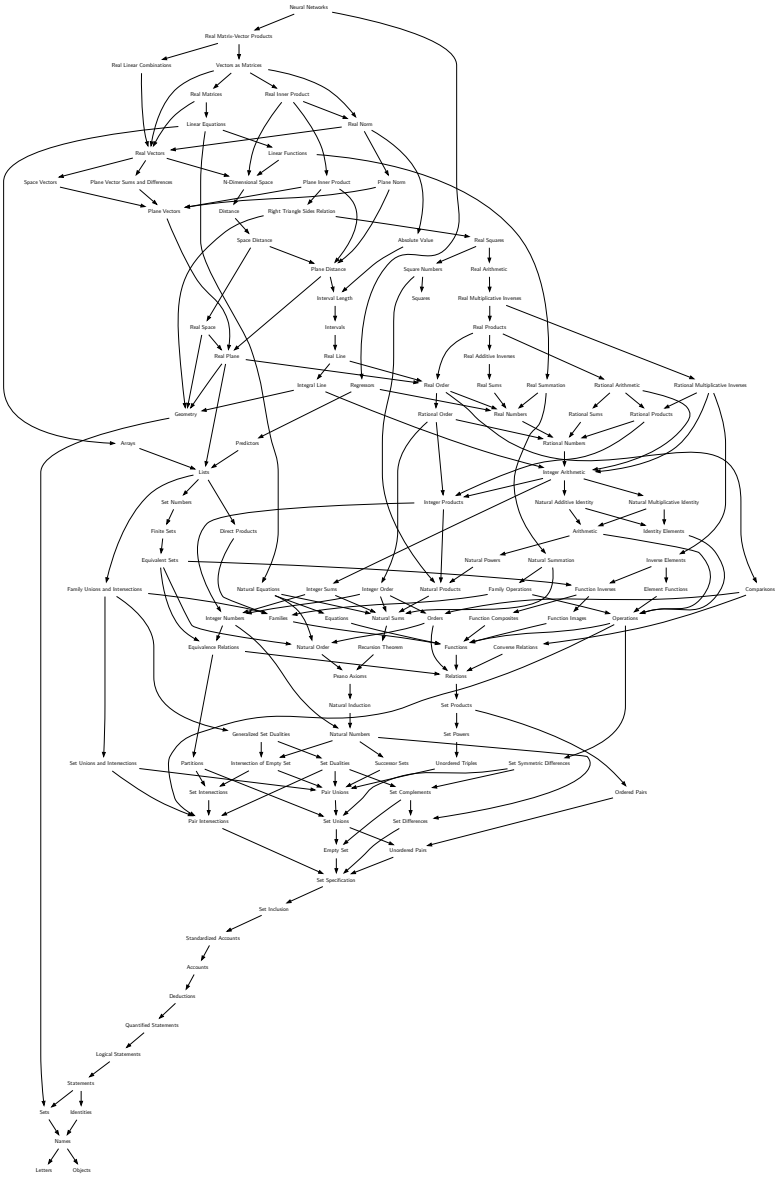
The ith *layer* of the neural network is the ith function g_i. The ith *activation* of the neural network is the function h_i. A *neural network* is called *deep* if its number of layers is larger than 3.

We call the composition of the layers of the neural network the *network predictor* (or just *predictor*). We also call it *the function* of the network.[2]

A *multi-layer perceptron* (*MLP*) is a neural network with 2 layers (1 *hidden layer*) and for which A_i and b_i have unrestricted nonzero entries.

[1] Future editions will include. Future editions may change the name of this sheet to *computation networks*, or may add prerequisite sheet on computation graphs.

[2] Many authorities refer to a neural network as a function. Strictly speaking that is true for us, as well, since a sequence is a function. But the meaning of the common use is in reference to the *network predictor*.


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