

# The Aleph Data Relation in Structured Data, A Tree within a Tree Visualization

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## Abstract

In visualization, tree structures and databases are fundamental. Yet, our understanding of tree structures derived from databases is held in check by two factors: 1) by the fixed screen size, and 2) by the number of database attributes this screen can display. The paper introduces a primitive tree structure derived from the database that broadens our perspective on tree structures on the computer by taking an inward direction. The Aleph is an abstract data relation that represents parent/child data relations constructed between the database and the graphic display. By modeling data relations according to Mark Burgin's theory of named sets, a pure mathematics, the Aleph's uniform patterns took shape and were visible. The Aleph is modeled by a well-formed query that narrows retrieval operations to a pair of table attributes: one is input and the other is output. This simple expression establishes a new level of abstraction that binds a data condition on an input attribute to output from a single attribute. To instantiate this parent/child relationship, it is necessary that the data condition *self-references* the input attribute in order to generate data output. In notation, 'SELECT  $A_{output}$  FROM table WHERE  $A_{input} = v \rightarrow t$ , where  $v \in A_{input}$ ,  $t \in A_{output}$  and  $\{ A_{input}$ ,

$A_{output}\} \subset$  table. This SQL statement asserts that input data  $v$  implies output  $t$ . It is a deterministic relationship that produces either a *simple one-to-one* mapping between input and output data, or a *complex* mapping, i. e. *one-to-many*, when output yields more than one data value. In either case, both take the form of parent/child relationships displayed on screen. As such, the Aleph is a building block in the Database Taxonomy interface, a visualization of relational data that transforms its tabular organization into a monolithic tree structure that end-users navigate to locate information managed by the system. The taxonomy's tree structure is defined recursively by the Aleph; it is a tree within a tree. More importantly, it exists throughout ordinary database applications. And now, its ubiquitous pattern can be modeled, surveyed and measured. Like its name sake in the short story by Jorge Luis Borges (1898-1986) every tree structure in the database universe can now be seen from this point on. In practical terms, the Aleph presents a new modeling capability that bypasses today's screen limitations by displaying the most basic tree form, parent/child data, and by building on it to enable taxonomic navigation on screens as small as the smart watch.