

# The Welkin Standard

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## Abstract

Welkin is an information language. Welkin stores three independent structures: a tree of nodes, a hypergraph between nodes, and a tree of node labels. An Information Graph has a unique encoding. Using this encoding, the original Information Graph may be recovered. This document “bootstraps” Welkin to provide a finitistic basis for all information.

## Conventions

- Artifacts must be copied **identically**. They are listed below.
  - `bootstrap.welkin` is located in Appendix A.
  - `derivation.welkin` is located in Appendix B.
- We write  $(n)$  for the  $n$ -th line in the bootstrap file.
- Every definition is explicitly written. **Every definition MUST exclude Peano Arithmetic.**

## Syntax

### Terminals

- Logic
- Symbols (1): 0, 1
- Concatenation  $\cdot$
- Implication  $\Rightarrow$
- Table of US-ASCII:

| Symbol | Encoding |
|--------|----------|
| {      | 173      |
| }      | 175      |

- A **word** is recursively defined.
  - Base case (5):
    - 0 is a word.
    - 1 is a word.
  - Recursion (6): let  $w$  be a word.
    - $w \cdot 0$  is a word.
    - $w \cdot 1$  is a word.

### Atoms

- Strings are words with delimiters:  $d_1.w.d_2$ , where  $d_1 \not\subset w$  and  $d_2 \not\subset w$ .

- Identifiers are strings without white space.
- Numbers are a subset of strings with an injective function  $q : \text{NUMBER} \rightarrow Q$ .
  - $Q$  is set of strings formed by scientific notation.

## Grammar

- LALR
  - Not ambiguous
- Welkin Grammar:

## Semantics

### Equality on Terms

- Two strings are equal if they contain the same strings, in order.
- Two numbers are equal if  $q(a) = q(b)$ .

### Valid Strings

- No relative members at toplevel (with length 2).
- No duplicate members, graphs, or connections.

### Welkin Information Graphs

A **Welkin Information Graph (WIG)** is a structure  $G = (T, H, L)$  with:

- A tree  $T$ ,
- A hypergraph  $H$ ,
- A tree  $L$  isomorphic to  $T$  called the **label tree**.

### AST ()

- Units:
- Members are words of units
- Connections are WIGs with
- Graphs are WIGs with
  - Derived terms as children
  - Ordered triples are arcs.

### Encoding

The **encoding**  $E(G)$  of the WIG  $G$  is the unique string where

- All nodes are listed in breadth-first order
- Leaves are terms ending with “#”
- Edges are enumerated, starting from 0. They are included in nodes:
  - $s$  means source,
  - $c$  means connector,
  - $t$  means target.

### Bootstrap

**Theorem.** The Bootstrap File (Appendix A) has the encoding

.

We prove this in the following calculations:

$$(1) 0, 1 \Rightarrow \{0, 1\}$$

$$(3) \text{ start} - \{0, 1\} \rightarrow \text{word} \Rightarrow (\text{start}, \{0, 1\}, \text{word})$$

## **Appendix A: Bootstrap File**