# Semantic tree operations

Let us introduce the *tree tuple* where represents certain node - semantic particle or a subtree.

Here is a tree tuple factor which encodes uniquely the position of the node in the tree.

The following operations are defined for tree tuple factors:

We have a base of tree tuple factors which are defined as distinct strings of fixed number of characters from some alphabet. We have defined an operation which denotes string lexicographic comparison ``, such that . We have an operation `` denoting string concatenation such that:

for any pair

Note that the latter implies that

for any tuple where

Encoding a complete -ary tree of height with the algebraic notation above:

. Further we will assume that .

In general we have:

where

Obviously, we have at most distinct terms which represent nodes i.e. semantic values.

The expression for the tree also can be written as:

where and are the *product factors* given with . The node values are the values ordered in increasing order of . This order corresponds to *level order traversal* of the -ary tree. Note that with appropriately defined operation `\*` we can model different ways of traversing the -ary tree.

Let us have the tree given with the expression

After bracket expansion becomes: