LaTeX trees

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Abstract

LaTeX trees, are not to be confused with rubber trees which give latex. This article is about the mathematical concept called tree, and how it can be embedded into LaTeX documents.

1 Trees

A **tree** is an important graph mathematical concept, which has a huge range of applications. In mathematics, and more specifically in graph theory, a tree is an undirected graph in which any two vertices are connected by exactly one path. In other words, any connected graph without simple cycles is a tree. A tree is a mathematical structure that can be viewed as either a graph or as a data structure. The two views are equivalent, since a tree data structure contains not only a set of elements, but also connections between elements, giving a tree graph. The points of connection are known as forks and the segments as branches. Final segments and the nodes at their ends are called tree leaves. A tree with two branches at each fork is called a binary tree.

1.1 Representing trees

In view of its importance and usefulness in many application areas, trees need to be documented and anlysed often. There are many different approaches to representing/documenting trees depending on the end purpose for such representation. In our present case, we will study how to use LaTeX to represent trees and include trees in documents. There is, in fact, a large number of LaTeX packages for drawing trees [6].

2 Package qtree

LaTeX package `qtree`[7]. Is a simple but efficient tool for drawing trees. It helps you to create and embed trees in a LaTeX document. Besides, it gives various facilities for adjusting and personalising the look of the trees created. A useful extension to package `qtree` is the package `tree-dvips`. The arrow-drawing capabilities of the package `tree-dvips` (written by Emma Pease) can be used with trees drawn with `qtree`. The two packages are fully compatible.

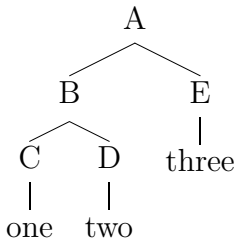
Package `qtree` is a tool for a high level depiction of trees. It avoids the need to use cumbersome low level descriptors like pstricks, TikZ, or PGF.

3 Using qtree

Although a tree is a mathematical abstraction, it is often useful to visualise it graphically. The `qtree` package helps you to visualise trees graphically.

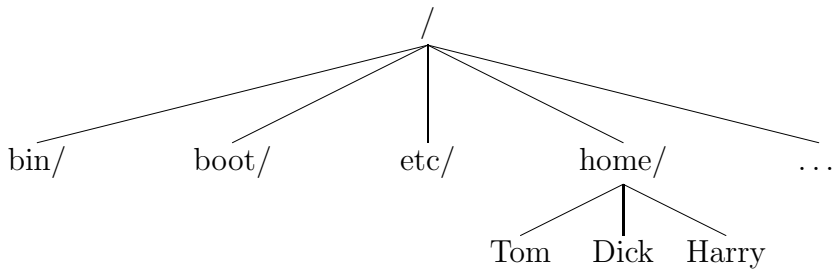
Here is a simple tree made with the `qtree` command :

```
\Tree [.A [.B [.C one ] [.D two ] ].B [.E three ] ].A
```



The front end of `qtree` reads a tree description written in the familiar (to linguists) bracket notation. The syntax is similar to that of lists in the Prolog programming language. Each subtree is denoted by a list of tree node lables. Each subtree is delimited by a [ ] pair, like in Prolog lists. Tree node labels are delimited by whitespace. The subtree is defined by the label of the parent (beginning with a dot) followed by the labels of the children. There is however a limit of 5 for the fanout i.e no more than 5 children per parent. A child can have children (subtrees). A maximum depth of 20 generations (tree depth) is the limit in `qtree`.

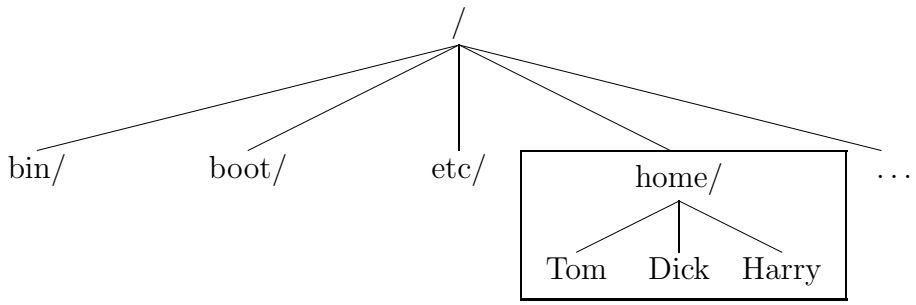
We use `qtree` for drawing a part of the Linux file hierarchy on this machine. The actual, complete Linux file hierarchy tree is VERY VERY BIG.



The above tree was made using

```
\Tree [./ bin/ boot/ etc/  [.home Tom Dick Harry ] {\dots}]
```

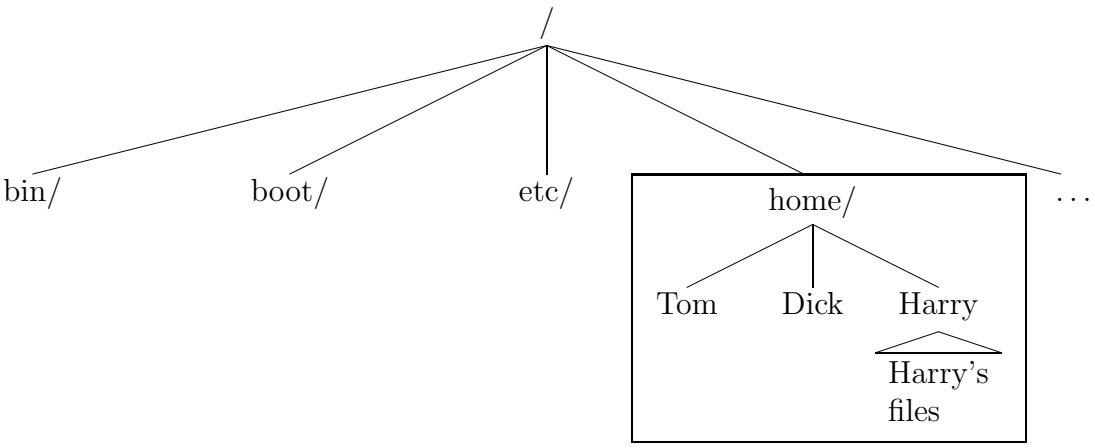
You can **highlight a part of the tree** by adding a box (frame) around the part you are interested, using `\qframesubtree`



The above boxed tree was made using ::

```
\Tree[./ bin/ boot/ etc/ [.home/ Tom Dick Harry ]!{\qframesubtree}{~~~\dots}]
```

Or, you can add a child node with a roof :



The roofed node could be used as annotation of nodes, or as a pointer to another subtree. In the above example, *Harry's files* could be a separate tree of Harry's directories structure. This feature helps us to display and study a large tree by breaking it into smaller, manageable parts.

4 Concluding remarks

This document is a part of tutorials and demonstrations documents created by the author. The entire collection can be found on the web [5].

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This is a LaTeX document, created under Linux, using Kile. You can get the LaTeX source of this document from drpartha@gmail.com. Please mention the Reference Code, and Version code, given at the top of this document. Please follow the "basic rules of decency" explained in [2].

If you found this article useful, please send a note to `drpartha@gmail.com`

As always, suggestions and constructive comments are always welcome. The author operates by Crocker's Rules [3], and believes in Radical Honesty [4] , so do not hesitate to speak plainly and frankly. Honest and frank opinion is more constructive than polite and diplomatic silence.

5 About the author

Parthasarathy is a teacher and an aggressive supporter of FOSS. He is based in Secunderabad, India. He teaches discrete mathematics, and preaches LaTeX and Linux, to students of Computer Science. He would be happy to assist anyone, particularly students, teachers, and institutions, who are genuinely interested in these topics. His tutorials, usually made with LaTeX , are accessible freely from the w-w-web. His contact address is : drpartha@gmail.com

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