Available online at www.sciencedirect.com
SCIENCE DIRECT®
Electronic Notes in Theoretical Computer Science
ELSEVIER Electronic Notes in Theoretical Computer Science 134 (2005) 33–53
www.elsevier.com/locate/entcs

A System for Virtual Directories Using Euler Diagrams

Rosario De Chiara[1]

ISISlab - Università degli Studi di Salerno
84081, Baronissi (Salerno), Italy

Mikael Hammar[2]

Apptus Technologies AB
IDEON Research Centre
SE-223 70 Lund, Sweden

Vittorio Scarano[1]

ISISlab - Università degli Studi di Salerno
84081, Baronissi (Salerno), Italy

Abstract

In this paper, we describe how to use Euler Diagrams to represent *virtual directories*. i.e. collection of files that are computed on demand and satisfy a number of constraints. We, then, briefly describe the state of VennFS project that is currently modified to include this new capability. In particular, we show a data structure designed to answer queries about a given Euler Diagram and its sets. The data structure *EulerTree* described here is based on the R-Tree (see [29]), a data structure designed for answering *range queries* over a family of shapes in the 2-dimensional space.

Keywords: Euler Diagrams, File Systems, HFS,R-Tree, EulerTree

[1] Email: {dechiara, vitsca}@dia.unisa.it
[2] Email: Mikael.Hammar@apptus.com

doi:10.1016/j.entcs.2005.02.019

1 Introduction

File access and, in general, file management is the most common task in daily use of personal computers. The way in which file accessing and categorization is performed is strongly influenced by how the file system itself is designed. The pattern followed in designing file systems, even modern ones, is the "hierarchical file system", HFS for short, in which files are categorized in folders, and folders can be put inside each other, creating a tree shaped structure.

The idea of categorizing information inside a hierarchy is intuitive and easy to understand even by people not fond of computers. Since the creation of the early versions of HFS, the theoretical design has been garnished with a daily life metaphor that greatly contributed to the diffusion of it: the *office metaphor*.

The metaphor simply uses the concept of a *filing cabinet* to symbolize the mass storage, high-level directories are represented by the drawers, lower-level subdirectories may be represented as file folders within the drawers.

The once inspiring metaphor of the office quickly got old and a limitation [18]: "*The way to advance the interface is not to develop ever-more-faithful imitations of the desktop, but instead to escape the limitations of the desktop.*". A paradigmatic example of this kind of mimicking is the definition of what a directory is (see [8]): *"a directory, catalog, or folder, is an entity in a file system which contains a group of files and other directories"*. This metaphor was not without merit since, as stated in [15], "*The desktop and file & folder metaphor were created so that users could relate their computer-based systems to the paper-based systems they were used to*". Unfortunately, a heavy heritage of this definition is the hierarchy that is imposed on the structure as well as the "*single-inheritance*" for each file: a file can be in one place at a time, like a sheet of paper can be in just in a folder a time.

The use of metaphor helped the diffusion of computers in the 80s when the personal computing entered even in the smallest office. With the evolution from the command line interfaces (CLIs) toward graphical user interfaces (GUIs) the office metaphor has been transposed in the images given to icons indicating folders, trash can and generic files (see Figure 1). Icons evolved in in term of number of colors or resolution, but the semantic of their use never changed at all.

When the HFS idea arose the CPU power was a serious issue so, complex operations on files like managing meta-data or complex directory structures, were nearly impossible. Another element to be considered in understanding the single inheritance limitation is the fact that in the 70s the amount of files managed was extremely small. In recent years mass storage available space