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## **Tagged Hierarchical Navigation For Files and Directories**

### **ABSTRACT**

Filesystems for computer storage enable users to organize files in a hierarchy of directories and to label files with descriptive tags separate from the filename. Search and navigation of the filesystem via the hierarchical organization or the tags can be useful to find a collection of related files. However, in current systems, users can use only one of the two approaches at a time which makes it difficult to perform tasks that require a combination of the two approaches. This disclosure describes an augmented filesystem that enables users to perform operations using a combination of depth based drilldown of the filesystem hierarchy and cross-cutting breadth-based approach using the tags. Tags associated with child directories/ files are added to those for the parent directory. Files and directories are displayed with their associated tags and full paths to allow for easy disambiguation.

### **KEYWORDS**

- Operating system
- Cloud storage
- Online storage
- Tagged storage
- Directory search
- File search
- Tag search
- Filesystem navigation

## BACKGROUND

Computer storages, e.g., local storage on a computer, tablet, or phone, and remote storage, e.g., server-based storage, cloud storage, etc., enables users to store and organize various types of files (documents, spreadsheets, images, videos, etc.) in a filesystem. Such storage systems or services support organization of files into a hierarchy of directories or folders, anchored at the root directory of the filesystem. Navigation within the filesystem requires the user to specify the folder/directory to view. Navigation through hierarchical directories requires users to examine the content of directories at each hierarchical level beginning with the root and drilling down deeper within the hierarchy until the file or directory of interest is reached. Some systems offer search features that can enable users to specify a search term and identify files/directories that match the search term based on their names or content.

Some storage systems allow users to label files with descriptive tags apart from the filename. Users can use the tags for organization and to improve search across the filesystem hierarchy. For instance, searching for documents tagged with a specific label can be used to generate a single collection of documents across multiple directories at disparate places within the filesystem hierarchy. Tagging can thus be used as a way to search and navigate across the breadth of the filesystem hierarchy to obtain a collection of items of interest.

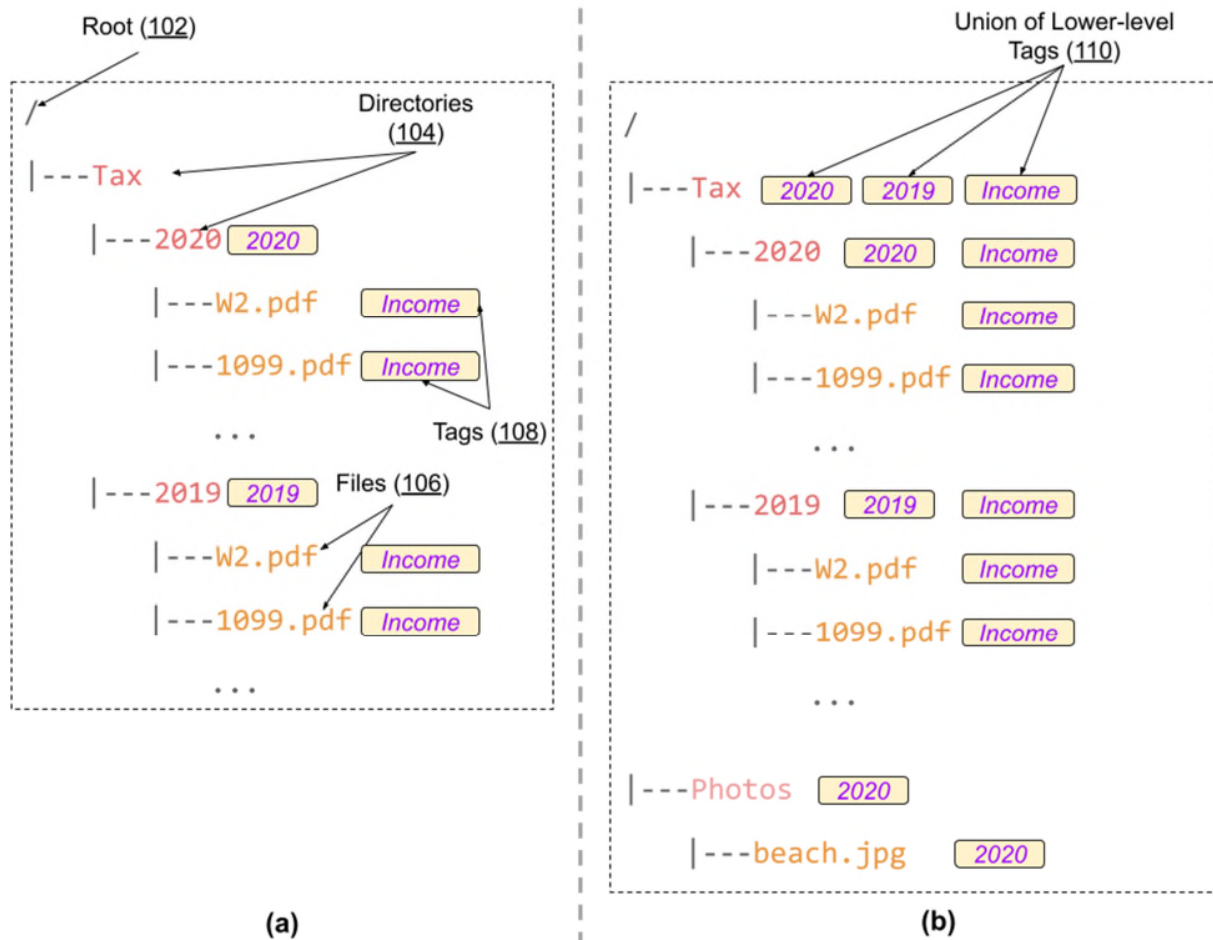
Search and navigation via the hierarchical organization of the filesystem or via labeled tags can be useful for finding and viewing a collection of related files. However, in current systems, users can use only one of the two approaches at a time which makes it difficult to perform tasks that require a combination of the two approaches. For example, a user can access the “/tax/2020” directory in the filesystem to obtain a collection of all files for the 2020 tax year, including wage-related documentation for that tax year. Similarly, the user can collect all

documents labeled with the tag “wages” to generate a collection of wage-related documents across multiple tax years stored in different directories across the filesystem hierarchy. However, the latter collection may include multiple files with the same filename, with no mechanism to distinguish between individual files by tax year using the hierarchical structure of the filesystem as is feasible in the former case.

### DESCRIPTION

This disclosure describes techniques to augment a typical filesystem on user devices with organization capabilities that include a directory hierarchy in combination with labeled tags. Each directory and file within the augmented filesystem is associated with optional labeled tags on top of the hierarchical organization of the filesystem. The set of tags for a directory is a union of its own tags with those of its children - the directories and files contained within it.

The augmented filesystem as described above enables users to perform various typical operations related to directories and files within the filesystem (e.g., search, navigation, etc.) using a combination of depth-based drilldown of the filesystem hierarchy and cross-cutting breadth-based approach using the labeled tags, along with using either approach individually as with current filesystems. For instance, a user can search for a tag to yield all directories and files with that tag in the filesystem. The search operation can also be limited to items contained in a specific directory.



**Fig. 1: Filesystem with tags that propagate up the hierarchy**

Fig. 1(a) shows a portion of the filesystem on a user device with directories (104) for tax documents, organized by year under the filesystem root (102). The directory for each tax year contains multiple files (106), each with a tag (108) that indicates the file is about “income.” In this case, if the user searches for files tagged as “income,” the results include the two files named “W2.pdf” and the two files labeled “1099.pdf” without the user having a way to discern the tax year associated with each of the files. On the other hand, searching or navigating based on a specific tax year (e.g., 2020) misses relevant files for the other tax years.

Fig. 1(b) shows an example of a filesystem augmented with tags that propagate up the hierarchy, per the techniques described in this disclosure. The augmented filesystem shown in Fig. 1(b) propagates the tags up the filesystem hierarchy such that each directory is associated with the union of all tags of directories and files it contains (110). Further, each directory may also have its own tags in addition to the rolled up tags from its children.

In this case, searching for the tag “income” within the directory “Tax” displays the four income-related files for the two tax years 2020 and 2019, along with the tags for each file. However, the tags can help discern the tax year for each file. Similarly, searching for a specific filename (e.g., “W2.pdf”) within the directory “Tax” can be used to collect files related to similar types of income across tax years that are distinguished based on the tags and/or directory names. The user can limit the search to the directory “Tax” and thereby avoid unrelated files with the same tag (e.g., “2020”) from being captured in the search results.

If the user permits, relevant tags can be suggested for each item whenever an item, such as a directory or a file, is added to the filesystem or the contents of an item are modified. The addition of an item can occur as a result of any relevant operation, such as new creation, copying from another device, downloading from the network, etc. Additionally, applications or features that list filesystem contents can be augmented to display the tags associated with a directory or file, thus facilitating user discovery of items with the use of the tags. Further, the displayed tags for a directory can be sorted according to various criteria, such as number of items tagged with the label, alphabetical order, frequency of use, etc. The default sorting order can be set by the developers and/or specified by the users and/or determined at runtime as appropriate.

The techniques described in this disclosure can be implemented for files and directories in any type of data storage that offers search and/or navigation features, e.g., local storage on a

computer or other device, server-based storage, cloud storage, etc. Search and navigation for content covering any type of data, such as documents, photos, videos, application executables, etc. can be supported. Implementation of the techniques can enhance the user experience (UX) of common filesystem operations, such as browsing, navigating, searching, tagging, organizing, etc.

## CONCLUSION

This disclosure describes an augmented filesystem that enables users to perform operations using a combination of depth based drilldown of the filesystem hierarchy and cross-cutting breadth-based approach using the tags. Tags associated with child directories/ files are added to those for the parent directory. Files and directories are displayed with their associated tags and full paths to allow for easy disambiguation.