Canned FS - File Storage on Student Computer Cluster

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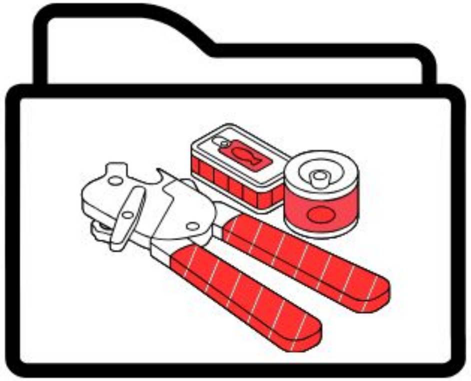
Simple Filesystem

Files separated into chunks stored on disk, some files might share chunks

Queries

- Create: new file is loaded and added to data structure
- Find: request to download file, chunks are found and returned to user
- Delete: file is removed from system, any chunks deleted
- Update: change data within a file
- List: lists the names of existing files in directory
- Move: change the directory of a file



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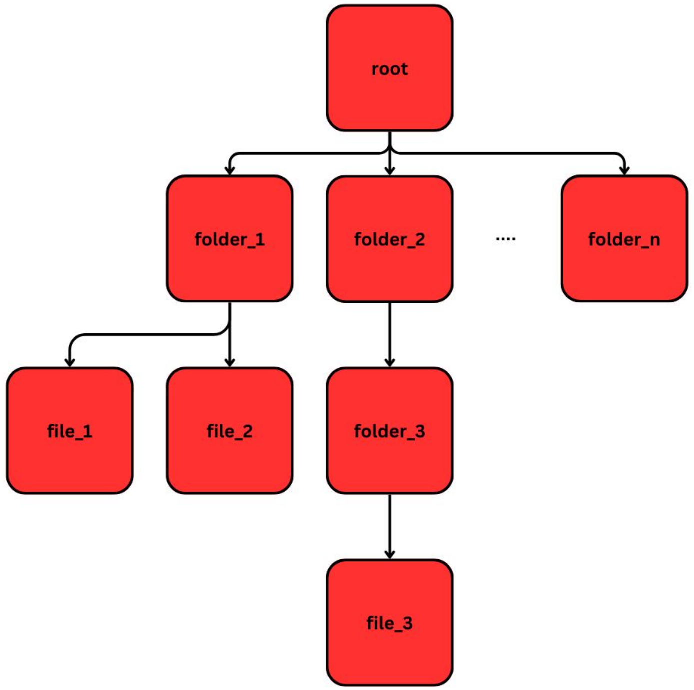
Data Structures for File System

- N-Node Tree for file metadata - indexed by file name
  - Directory location based on tree path
  - Chunk details stored in vector:
    - Start indexes of chunks for each file



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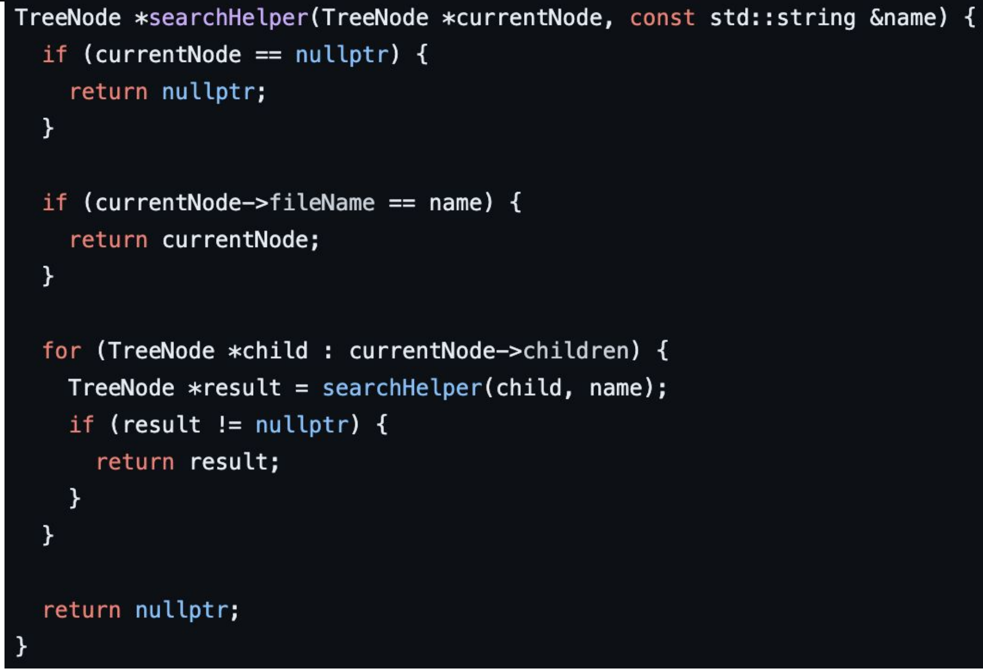
Link to canva

Find File

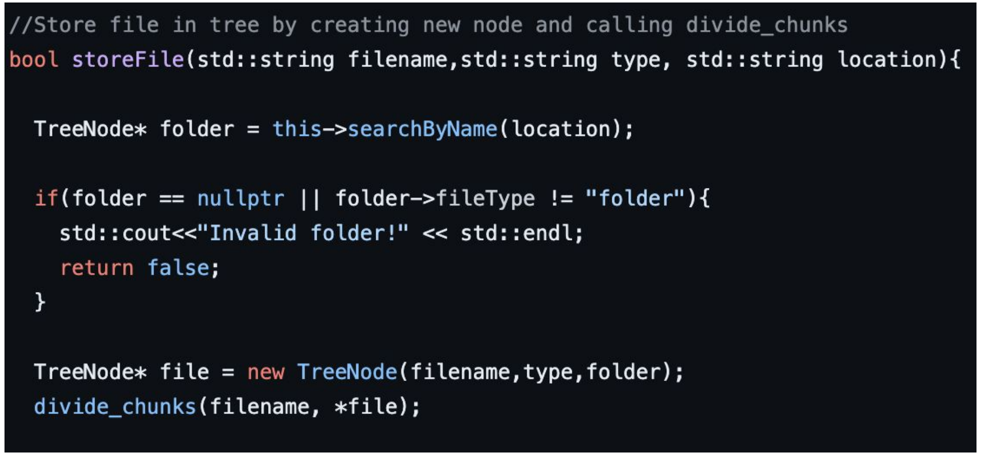
- Implemented with method searchByName
    - Inputs: filename, starting folder
    - Using DFS to search through TreeNodes until file is found
    - Outputs: path to folder
    - O(n)



```
TreeNode *searchHelper(TreeNode *currentNode, const std::string &name) {
  if (currentNode == nullptr) {
    return nullptr;
  }

  if (currentNode->fileName == name) {
    return currentNode;
  }

  for (TreeNode *child : currentNode->children) {
    TreeNode *result = searchHelper(child, name);
    if (result != nullptr) {
      return result;
    }
  }

  return nullptr;
}
```

Create File

- Implemented with method storeFile
    - Inputs: filename, filetype, folder
    - Creates a TreeNode to represent the new file
    - Calls divide_chunks
    - O(n + c)
        - n = # of files in file system
        - c = # of chunks in file



```
//Store file in tree by creating new node and calling divide_chunks
bool storeFile(std::string filename,std::string type, std::string location){

  TreeNode* folder = this->searchByName(location);

  if(folder == nullptr || folder->fileType != "folder"){
    std::cout<<"Invalid folder!" << std::endl;
    return false;
  }

  TreeNode* file = new TreeNode(filename,type,folder);
  divide_chunks(filename, *file);
```

Dividing into Chunks

- Implemented in divide_chunks
    - Inputs: the TreeNode for the given file, the input file name
    - Based on the size of the file, allocates n chunks of 1 kilobyte each and stores their addresses to a vector in the TreeNode

Move

- Implemented with moveFile
  - Inputs: filename, folder name
  - Searches for nodes with filename and folder name
  - Updates parent/children relationships
  - O(n)

Delete

- Implemented with deleteFile
  - Input: file name
  - Finds the node with file name
  - Visit each children/grandchildren with dfs
  - For each visited subfile:
    - Free the storage space, delete Node from Tree

Copy File

- Implemented with copyFile
    - Inputs: original file name, new file name
    - Creates a new TreeNode and copies meta information from original file
    - Copy on Write mechanism: data itself is only copied when one of the files is updated
    - O(n)

Update

- Implemented with updateFile
  - Inputs: original file name
  - Read all the chunks
  - Update the respective chunks and/ or create new chunks
  - Update the chunk information in the vector
  - O(n+c)

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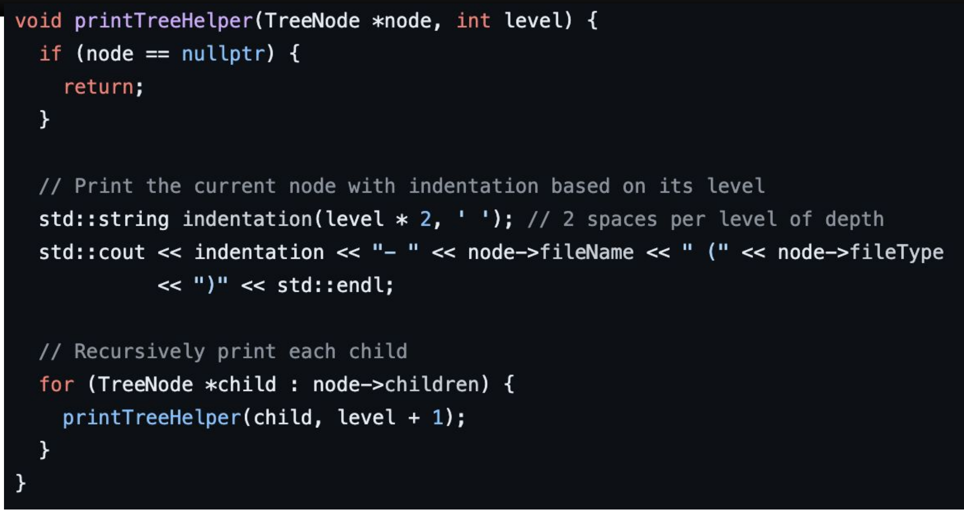
List

- Implemented with method printTree that prints all the files at each level of the file
    - Prints each level with indentation
    - O(n)



```
void printTreeHelper(TreeNode *node, int level) {
  if (node == nullptr) {
    return;
  }

  // Print the current node with indentation based on its level
  std::string indentation(level * 2, ' '); // 2 spaces per level of depth
  std::cout << indentation << "- " << node->fileName << " (" << node->fileType
            << ")" << std::endl;

  // Recursively print each child
  for (TreeNode *child : node->children) {
    printTreeHelper(child, level + 1);
  }
}
```

Further Improvements

- Implement command line UI
  - Allow users to navigate through directories
  - Can create/delete from current directory, don’t need to use searchByName which traverses entire tree
  - createFile: O(n+m) -> O(m)
  - updateFile: O(n+m)->O(m)

How to Run on SCC Using Command Line

```
>> ./CannedFS
>> root created @ address:
>> create myFirstFolder folder
>> change_directory myFirstFolder
>> create myFirstFile txt
>> copy myFirstFile mySecondFile
>> create mySecondFolder folder
>> move mySecondFile mySecondFolder
>> find mySecondFile
>> list
```