<https://leetcode.ca/all/588.html>

Design an in-memory file system to simulate the following functions:

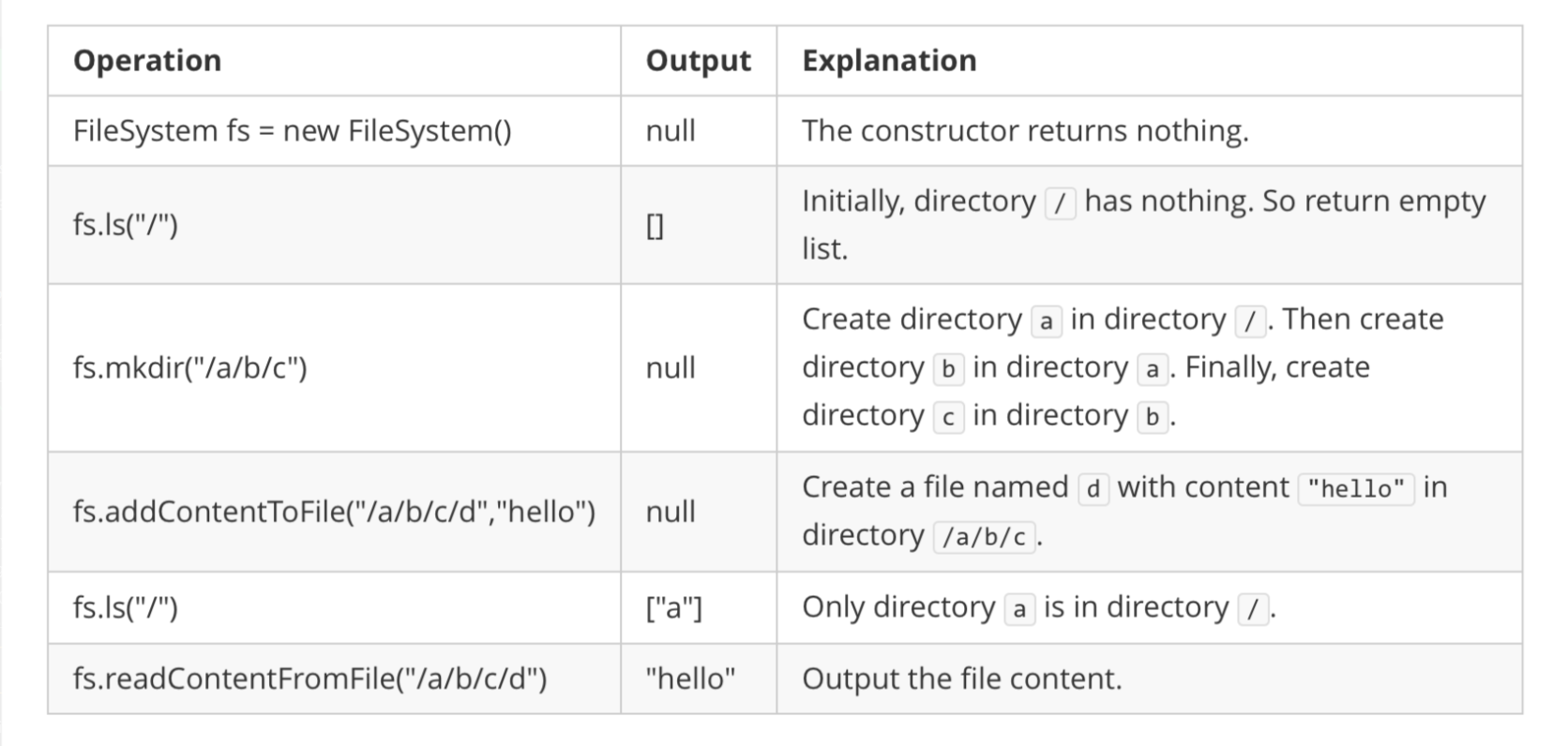
ls: Given a path in string format. If it is a file path, return a list that only contains this file's name. If it is a directory path, return the list of file and directory names **in this directory**. Your output (file and directory names together) should in **lexicographic order**.

mkdir: Given a **directory path** that does not exist, you should make a new directory according to the path. If the middle directories in the path don't exist either, you should create them as well. This function has void return type.

addContentToFile: Given a **file path** and **file content** in string format. If the file doesn't exist, you need to create that file containing given content. If the file already exists, you need to **append** given content to original content. This function has void return type.

readContentFromFile: Given a **file path**, return its **content** in string format.

**Example:**



Input

["FileSystem", "ls", "mkdir", "addContentToFile", "ls", "readContentFromFile"]

[[], ["/"], ["/a/b/c"], ["/a/b/c/d", "hello"], ["/"], ["/a/b/c/d"]]

Output

[null, [], null, null, ["a"], "hello"]

Explanation

FileSystem fileSystem = new FileSystem();

fileSystem.ls("/"); // return []

fileSystem.mkdir("/a/b/c");

fileSystem.addContentToFile("/a/b/c/d", "hello");

fileSystem.ls("/"); // return ["a"]

fileSystem.readContentFromFile("/a/b/c/d"); // return "hello"

Note:

* 1 <= path.length, filePath.length <= 100
* path and filePath are absolute paths which begin with '/' and do not end with '/' except that the path is just "/".
* You can assume that all directory names and file names only contain lowercase letters, and the same names will not exist in the same directory.
* You can assume that all operations will be passed valid parameters, and users will not attempt to retrieve file content or list a directory or file that does not exist.
* 1 <= content.length <= 50
* At most 300 calls will be made to ls, mkdir, addContentToFile, and readContentFromFile.

**Attempt 1: 2023-08-16**

**Solution 1: (360min)**

public class FileSystem {

class Node {

Map<String, Node> dirs;

Map<String, String> files;

public Node() {

this.dirs = new HashMap<>();

this.files = new HashMap<>();

}

}

Node root;

public FileSystem() {

this.root = new Node();

}

/\*\*

\* ls: To test 'ls' method it is better to finish 'mkdir' and 'addContentToFile' first

\* @param path Given a path in string format.

\* @return If it is a file path, return a list that only contains this file’s name.

\* If it is a directory path, return the list of file and directory names in this directory.

\* Your output (file and directory names together) should in lexicographic order.

\*/

public List<String> ls(String path) {

Node node = root;

List<String> result = new ArrayList<>();

if(!path.equals("/")) {

String[] p = path.split("/");

// All previous sections (split path with '/') before the last section belongs

// to 'directory', to reach the most nested 'directory' we can traverse level

// by level, just make sure before the last section since that might be the 'file'

// which cannot treat same as 'directory'

// Start with i = 1 because initial root '/' will result an empty section by default

// e.g path = "/a/b/c/d" will split into {"", "a", "b", "c", "d"}

for(int i = 1; i < p.length - 1; i++) {

node = node.dirs.get(p[i]);

}

// Now the node comes to the last section of 'directory', this node might contain

// 'file', we can check if any 'file' present, if not then its penultimate ‘directory’,

// we have to move one more step to reach the last 'directory'

// e.g create file with "/a/b/c/d" + (d="hello") and "/a/b/e" + (e="TEST")

// ls("/a/b") -> for directory "b" suppose return a contained directory as "c" and

// a contained file "e"

if(node.files.containsKey(p[p.length - 1])) {

result.add(p[p.length - 1]);

// If it is a file path, return a list that only contains this file’s name

return result;

} else {

node = node.dirs.get(p[p.length - 1]);

}

}

// If it is a directory path, return the list of file and directory names in this directory

result.addAll(new ArrayList<>(node.dirs.keySet()));

result.addAll(new ArrayList<>(node.files.keySet()));

// Your output (file and directory names together) should in lexicographic order

Collections.sort(result);

return result;

}

/\*\*

\* mkdir:

\* @param path a directory path

\* Given a directory path that does not exist, you should make a new directory according to the path.

\* If the middle directories in the path don’t exist either, you should create them as well.

\* This function has void return type.

\*/

public void mkdir(String path) {

Node node = root;

String[] p = path.split("/");

// Start with i = 1 because initial root '/' will result an empty section by default

// e.g path = "/a/b/c/d" will split into {"", "a", "b", "c", "d"}

for(int i = 1; i < p.length; i++) {

if(!node.dirs.containsKey(p[i])) {

node.dirs.put(p[i], new Node());

}

node = node.dirs.get(p[i]);

}

}

/\*\*

\* addContentToFile:

\* @param filePath Given a file path in string format.

\* @param content Given a file content in string format.

\* If the file doesn’t exist, you need to create that file containing given content.

\* If the file already exists, you need to append given content to original content.

\* This function has void return type.

\*/

public void addContentToFile(String filePath, String content) {

Node node = root;

String[] p = filePath.split("/");

// Traverse all 'directory' sections and reach last section as 'file'

// e.g filePath = "/a/b/c/d" -> i traverse from 1 to 3

// -> node = "a"(i=1) => "b"(i=2) => "c"(i=3)

for(int i = 1; i < p.length - 1; i++) {

node = node.dirs.get(p[i]);

}

// Last section is a 'file' not a 'directory'

// e.g "c"(i=3).files = {"d", content}

node.files.put(p[p.length - 1], node.files.getOrDefault(p[p.length-1], "") + content);

}

public String readContentFromFile(String filePath) {

Node node = root;

String[] p = filePath.split("/");

for(int i = 1; i < p.length - 1; i++) {

node = node.dirs.get(p[i]);

}

return node.files.get(p[p.length - 1]);

}

public static void main(String[] args) {

FileSystem fs = new FileSystem();

List<String> ls\_result = fs.ls("/");]

fs.mkdir("/a/b/c");

fs.addContentToFile("/a/b/c/d", "hello");

fs.addContentToFile("/a/b/e", "TEST");

List<String> ls\_result1 = so.ls("/a/b");

String s = fs.readContentFromFile("/a/b/c/d");

System.out.println(s);

}

}

**Refer to**

<https://grandyang.com/leetcode/588/>

这道题让我们设计一个内存文件系统，实现显示当前文件，创建文件，添加内容到文件，读取文件内容等功能，感觉像是模拟一个terminal的一些命令。这道题比较tricky的地方是ls这个命令，题目中的例子其实不能很好的展示出ls的要求，其对文件和文件夹的处理方式是不同的。由于这里面的文件没有后缀，所以最后一个字符串有可能是文件，也有可能是文件夹。比如a/b/c，那么最后的c有可能是文件夹，也有可能好是文件，如果c是文件夹的话，ls命令要输出文件夹c中的所有文件和文件夹，而当c是文件的话，只需要输出文件c即可。另外需要注意的是在创建文件夹的时候，路径上没有的文件夹都要创建出来，还有就是在给文件添加内容时，路径中没有的文件夹都要创建出来。论坛上这道题的高票解法都新建了一个自定义类，但是博主一般不喜欢用自定义类来解题，而且感觉那些使用了自定义类的解法并没有更简洁易懂，所以这里博主就不创建自定义类了，而是使用两个哈希表来做，其中dirs建立了路径和其对应的包含所有文件和文件夹的集合之间的映射，files建立了文件的路径跟其内容之间的映射。

最开始时将根目录”/“放入dirs中，然后看ls的实现方法，如果该路径存在于files中，说明最后一个字符串是文件，那么我们将文件名取出来返回即可，如果不存在，说明最后一个字符串是文件夹，那么我们到dirs中取出该文件夹内所有的东西返回即可。再来看mkdir函数，我们的处理方法就是根据”/“来分隔分隔字符串，如果是Java，那么直接用String自带的split函数就好了，但是C++没有Java那么多自带函数，所以只能借助字符串流类来处理，处理方法就是将每一层的路径分离出来，然后将该层的文件或者文件夹加入对应的集合中，注意的地方就是处理根目录时，要先加上”/“，其他情况都是后加。下面来看addContentToFile函数，首先分离出路径和文件名，如果路径为空，说明是根目录，需要加上”/“，然后看这个路径是否已经在dirs中存在，如果不存在，调用mkdir来创建该路径，然后把文件加入该路径对应的集合中，再把内容加入该文件路径的映射中。最后的读取文件内容就相当简单了，直接在files中返回即可，参见代码如下：

class FileSystem {

public:

FileSystem() {

dirs["/"];

}

vector<string> ls(string path) {

if (files.count(path)) {

int idx = path.find\_last\_of('/');

return {path.substr(idx + 1)};

}

auto t = dirs[path];

return vector<string>(t.begin(), t.end());

}

void mkdir(string path) {

istringstream is(path);

string t = "", dir = "";

while (getline(is, t, '/')) {

if (t.empty()) continue;

if (dir.empty()) dir += "/";

dirs[dir].insert(t);

if (dir.size() > 1) dir += "/";

dir += t;

}

}

void addContentToFile(string filePath, string content) {

int idx = filePath.find\_last\_of('/');

string dir = filePath.substr(0, idx);

string file = filePath.substr(idx + 1);

if (dir.empty()) dir = "/";

if (!dirs.count(dir)) mkdir(dir);

dirs[dir].insert(file);

files[filePath].append(content);

}

string readContentFromFile(string filePath) {

return files[filePath];

}

private:

unordered\_map<string, set<string>> dirs;

unordered\_map<string, string> files;

};

**Refer to**

<https://wentao-shao.gitbook.io/leetcode/data-structure/588.design-in-memory-file-system>

设计内存文件系统模拟实现如下功能：

ls：给定路径字符串，若对应一个目录，则输出其中包含的目录和文件（字典序）；若对应一个文件，则只输出该文件名

mkdir：创建目录，若目录不存在，则递归创建缺少的目录

addContentToFile：在文件中追加内容，若文件不存在，则新建

readContentFromFile：从文件中读取内容并返回

**注意：**

* 你可以假设文件和目录的路径均为绝对路径，以/开始，并且结尾不包含/，除非路径就是"/"本身
* 你可以假设所有操作均合法，用户不会常识读取一个不存在的文件，或者ls一个不存在的目录
* 你可以假设所有目录名称和文件名称都只包含小写字母，并且在同一目录下不会存在同名的目录或者文件

树形结构（Tree）

目录节点Node包含两个字段dirs和files，分别存储其中包含的子目录节点和文件内容

### Approach #1 Using separate Directory and File List

Time: O(m+n) && Space: O(m+n)

class FileSystem {

class Dir {

HashMap<String, Dir> dirs = new HashMap();

HashMap<String, String> files = new HashMap();

}

Dir root;

public FileSystem() {

root = new Dir();

}

public List<String> ls(String path) {

Dir t = root;

List<String> files = new ArrayList();

if (!path.equals("/")) {

String[] d = path.split("/");

for (int i = 1; i < d.length - 1; i++) {

t = t.dirs.get(d[i]);

}

if (t.files.containsKey(d[d.length-1])) {

files.add(d[d.length-1]);

return files;

} else {

t = t.dirs.get(d[d.length - 1]);

}

}

files.addAll(new ArrayList<>(t.dirs.keySet()));

files.addAll(new ArrayList<>(t.files.keySet()));

Collections.sort(files);

return files;

}

public void mkdir(String path) {

Dir t = root;

String[] d = path.split("/");

for (int i = 1; i < d.length; i++) {

if (!t.dirs.containsKey(d[i])) {

t.dirs.put(d[i], new Dir());

}

t = t.dirs.get(d[i]);

}

}

public void addContentToFile(String filePath, String content) {

Dir t = root;

String[] d = filePath.split("/");

for (int i = 1; i < d.length - 1; i++) {

t = t.dirs.get(d[i]);

}

t.files.put(d[d.length - 1], t.files.getOrDefault(d[d.length-1], "") + content);

}

public String readContentFromFile(String filePath) {

Dir t = root;

String[] d = filePath.split("/");

for (int i = 1; i < d.length - 1; i++) {

t = t.dirs.get(d[i]);

}

return t.files.get(d[d.length -1]);

}

}

/\*\*

\* Your FileSystem object will be instantiated and called as such:

\* FileSystem obj = new FileSystem();

\* List<String> param\_1 = obj.ls(path);

\* obj.mkdir(path);

\* obj.addContentToFile(filePath,content);

\* String param\_4 = obj.readContentFromFile(filePath);

\*/

**Approach #2 Using unified Directory and File List**

public class FileSystem {

class File {

boolean isfile = false;

HashMap < String, File > files = new HashMap < > ();

String content = "";

}

File root;

public FileSystem() {

root = new File();

}

public List < String > ls(String path) {

File t = root;

List < String > files = new ArrayList < > ();

if (!path.equals("/")) {

String[] d = path.split("/");

for (int i = 1; i < d.length; i++) {

t = t.files.get(d[i]);

}

if (t.isfile) {

files.add(d[d.length - 1]);

return files;

}

}

List < String > res\_files = new ArrayList < > (t.files.keySet());

Collections.sort(res\_files);

return res\_files;

}

public void mkdir(String path) {

File t = root;

String[] d = path.split("/");

for (int i = 1; i < d.length; i++) {

if (!t.files.containsKey(d[i]))

t.files.put(d[i], new File());

t = t.files.get(d[i]);

}

}

public void addContentToFile(String filePath, String content) {

File t = root;

String[] d = filePath.split("/");

for (int i = 1; i < d.length - 1; i++) {

t = t.files.get(d[i]);

}

if (!t.files.containsKey(d[d.length - 1]))

t.files.put(d[d.length - 1], new File());

t = t.files.get(d[d.length - 1]);

t.isfile = true;

t.content = t.content + content;

}

public String readContentFromFile(String filePath) {

File t = root;

String[] d = filePath.split("/");

for (int i = 1; i < d.length - 1; i++) {

t = t.files.get(d[i]);

}

return t.files.get(d[d.length - 1]).content;

}

}

/\*\*

\* Your FileSystem object will be instantiated and called as such:

\* FileSystem obj = new FileSystem();

\* List<String> param\_1 = obj.ls(path);

\* obj.mkdir(path);

\* obj.addContentToFile(filePath,content);

\* String param\_4 = obj.readContentFromFile(filePath);

\*/

**Refer to**

<https://www.cnblogs.com/Dylan-Java-NYC/p/16514312.html>

It is like Tire.

For each DirNode, it contains a map to children directories DirNode, and a map to children files StringBuilder.

ls has one corner case that when path is "/".  since "/".split("/") is empty array. arr[arr.length - 1] will have index out of bound exception.

Time Complexity: ls, O(m + klogk). m = path.length(). k is number of items in the res.

mkdir, O(m).

add, O(m).

readContentFromFile, O(m).

Space: O(n). size of DirNode tree.

AC Java:

class FileSystem {

DirNode root;

public FileSystem() {

root = new DirNode();

}

public List<String> ls(String path) {

DirNode cur = root;

List<String> res = new ArrayList<>();

if(!path.equals("/")){

String [] arr = path.split("/");

for(int i = 1; i < arr.length - 1; i++){

cur.dirs.putIfAbsent(arr[i], new DirNode());

cur = cur.dirs.get(arr[i]);

}

if(cur.files.containsKey(arr[arr.length - 1])){

res.add(arr[arr.length - 1]);

return res;

}

cur.dirs.putIfAbsent(arr[arr.length - 1], new DirNode());

cur = cur.dirs.get(arr[arr.length - 1]);

}

res.addAll(cur.dirs.keySet());

res.addAll(cur.files.keySet());

Collections.sort(res);

return res;

}

public void mkdir(String path) {

DirNode cur = root;

String [] arr = path.split("/");

for(int i = 1; i < arr.length; i++){

cur.dirs.putIfAbsent(arr[i], new DirNode());

cur = cur.dirs.get(arr[i]);

}

}

public void addContentToFile(String filePath, String content) {

DirNode cur = root;

String [] arr = filePath.split("/");

for(int i = 1; i < arr.length - 1; i++){

cur.dirs.putIfAbsent(arr[i], new DirNode());

cur = cur.dirs.get(arr[i]);

}

cur.files.putIfAbsent(arr[arr.length - 1], new StringBuilder());

cur.files.get(arr[arr.length - 1]).append(content);

}

public String readContentFromFile(String filePath) {

DirNode cur = root;

String [] arr = filePath.split("/");

for(int i = 1; i < arr.length - 1; i++){

cur.dirs.putIfAbsent(arr[i], new DirNode());

cur = cur.dirs.get(arr[i]);

}

return cur.files.get(arr[arr.length - 1]).toString();

}

}

class DirNode{

Map<String, DirNode> dirs = new HashMap<>();

Map<String, StringBuilder> files = new HashMap<>();

}

/\*\*

\* Your FileSystem object will be instantiated and called as such:

\* FileSystem obj = new FileSystem();

\* List<String> param\_1 = obj.ls(path);

\* obj.mkdir(path);

\* obj.addContentToFile(filePath,content);

\* String param\_4 = obj.readContentFromFile(filePath);

\*/