2020-06-27 - Handout – Data Structure Design

Q1. Implement Trie (Prefix Tree)

Link:https://leetcode.com/problems/implement-trie-prefix-tree/

Implement a trie with `insert`, `search`, and `startsWith` methods.

Example:

```
Trie trie = new Trie();

trie.insert("apple");
trie.search("apple");   // returns true
trie.search("app");     // returns false
trie.startsWith("app"); // returns true
trie.insert("app");
trie.search("app");     // returns true
```

Note:

- You may assume that all inputs are consist of lowercase letters `a-z`.
- All inputs are guaranteed to be non-empty strings.

Q2.Design In-Memory File System

Link: https://leetcode.com/problems/design-in-memory-file-system/

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"]
```

Operation	Output	Explanation
FileSystem fs = new FileSystem()	null	The constructor returns nothing.
fs.ls("/")	[]	Initially, directory `/` has nothing. So return empty list.
fs.mkdir("/a/b/c")	null	Create directory `a` in directory `/`. Then create directory `b` in directory `a`. Finally, create directory `c` in directory `b`.
fs.addContentToFile("/a/b/c/d","hello")	null	Create a file named `d` with content `"hello"` in directory `/a/b/c`.
fs.ls("/")	["a"]	Only directory `a` is in directory `/`.
fs.readContentFromFile("/a/b/c/d")	"hello"	Output the file content.

Q3. LRU Cache

Link:https://leetcode.com/problems/lru-cache/

Design and implement a data structure for Least Recently Used (LRU) cache. It should support the following operations: `get` and `put`.

`get(key)` - Get the value (will always be positive) of the key if the key exists in the cache, otherwise return -1.
`put(key, value)` - Set or insert the value if the key is not already present. When the cache reached its capacity, it should invalidate the least recently used item before inserting a new item.

The cache is initialized with a **positive** capacity.

Follow up:
Could you do both operations in **O(1)** time complexity?

Example:

```
LRUCache cache = new LRUCache( 2 /* capacity */ );

cache.put(1, 1);
cache.put(2, 2);
cache.get(1);       // returns 1
cache.put(3, 3);    // evicts key 2
cache.get(2);       // returns -1 (not found)
cache.put(4, 4);    // evicts key 1
cache.get(1);       // returns -1 (not found)
cache.get(3);       // returns 3
cache.get(4);       // returns 4
```