Programming and Data Structures
Active Learning Activity 9: Hash Tables

Activity Objectives

At the end of this activity, students should be able to:

1. Create the generic data structure HashMap
2. Store a simple English dictionary in an instance of HashMap
3. Evaluate the performance of the search method on the hash map
4. Compare the performance of the search operation on a hash map, binary search tree, and linked list

Activity

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1. Use the class **`HashMap`** as seen in class.
2. Use the classes **`LinkedList`** and **`BST`** from ALA 7 and ALA 8 respectively.
3. Create a test program to do the following:
    a. Create an instance of **`HashMap`** for the types <**`String, String`**> with an initial capacity equal to 50,000. Create an instance of **`BST`** and an instance of **`LinkedList`** for type **`String`**.
    b. Read the file "**`dictionary.txt`**" that contains more than 50,000 English words and their definition (one word and its definition per line). Add each word to an array list **`words`**, and the word and its definition to the hash map.
    c. Use the method `java.util.Collections.shuffle()` to randomly shuffle the elements in **`words`**. Then add the words to the bst and the linked list.
    d. Perform 1000 search operations on the hashmap, bst, and linked list for 1000 words randomly selected from the array list **`words`**.
    e. Display the number of iterations of the three search operations for 20 out of the 1000 search operations. Display the average number of iterations for each search operation.

4. Add the method **`collisions()`** to the class **`HashMap`**. The method should return the maximum number of collisions at any index in the hash table (size of the longest linked list).
5. Display the maximum number of collisions in the hash map.
6. Submit the following files on Github: **`HashMap.java`** , **`BST.java`**, **`LinkedList.java`**, and **`Test.java`**.

Here is a sample program output:

```
Word                Linked List         BST             Hash Map
"Firewarden"        46220               25              1
"Fair"              5877                23              1
"Aligerous"         37614               26              1
"M"                 20785               21              1
"Nog"               1266                11              1
"Victimize"         25040               23              1
"Lap-welded"        51178               19              2
"Resinously"        25263               10              2
"Gauge"             4946                14              1
"Field"             1961                19              1
"Lactide"           15019               20              1
"Handkerchief"      43367               21              1
"Forepromised"      42761               23              1
"Gaelic"            31158               19              1
"Undecane"          52626               18              1
"Fishskin"          19143               24              1
"Affect"            7830                21              1
"Flush"             2161                23              1
"Savacioun"         38696               16              1
"Representance"     50551               14              1

Average             18217               18              1


Maximum number of collisions: 5
```