**Brandon Hobbs**

**CS-300**

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**Project 1:**

# Pseudocode

**Main** Function() //Menu Loop

**Read** cmd arguments

**Store** argument as CSV file path

**If** no cmd arguments load default CSV file path

**Loop** while choice is not equal to ‘9’

**Output** menu block

**Get** user input; **Store** in *menuChoice* //what the program is to do

**Get** user input; **Store** in *dataChoice* //what data structure to use

**Validate** user input

**If** choice is not 1-4 or 9 throw an error

**If** choice equals ‘1’

//Call file parser and load data into each data structure

**If** BinarySearchTree

**Call** loadBids and store CSV data in BinarySearchTree *bst*

**Else** **If** vector

**Call** loadBids and store CSV data in vector *courseList*

**Else** **If** HashTable

//loadBids to have a hash function that orders the map in ascending order

**Call** loadBids and store CSV data in HashTable *courseTable*

**Output** number of records in the CSV file

**If** choice equals ‘2’

//Validate the List

**If** BinarySearchTree

**Call** **validateTree**() passing *bst*

**Else** **If** vector

**Call** **validateList**() passing *courseList*

**Else** **If** HashTable

**Call** **validateTable**() passing *courseTable*

**If** choice equals ‘3’

//Search and print course

**Get** user value to search for and **Store** in *userSearch*

**If** BinarySearchTree

**Call** **printCourseTree()** passing *userSearch*

**Else** **If** vector

**Call** **printCourseList()** passing *userSearch*

**Else** **If** HashTable

**Call** **printCourseTable()** passing *userSearch*

**If** choice equals ‘4’

//Print each course in alphabetic order

**If** BinarySearchTree

**Call printTree()**

**Else** **If** vector

**Call** **sortList()**

**Call printList()**

**Else** **If** HashTable

**Call** **sortTable()**

**Call printTable()**

**If** Choice equals ‘9’

**Exit** the application

**Output** ‘Good bye’

**End**

**struct Course {}**

*courseID*

*courseName*

*preCount*

*prelist*

Course() (constructor) {courseID = courseName = ””; preCount = 0; preList = “”}

**Class BinaryTree{}**

-struct *Node*

*Course*

*right* pointer

*left* pointer

-*root*

*+printTree()*

+*BinaryTree()*

**Class HashTable{}**

-struct *bucket*

*Course*

Key

Next pointer

+*hash()*

*+printTable()*

+List<> *hashTable*

**sortList()**

**Get** vector to sort, lowest index of vector and highest index of vector

**If** lowest index if greater than or equal to highest index return nothing

**Call** partition() function

**Set** *lowEndIndex* equal to the value returned by the partition function

Recursively **call** quicksort passing the vector, lowest index, and *lowEndIndex* (from above)

Recursively **call** quicksort passing the vector, *lowEndIndex* (from above) plus one, and highest index

**End**

**partition**()

**Get** the vector to partition, the lowest index and the highest index

Determine the vector element at the midpoint between the lowest and highest index

**Set** pivot equal to this vector element

**Loop** until the lowest index is greater than or equal to the highest index

**Loop** through the vector from lowest index until a vector element larger than the pivot is found

**Overwrite** lowest index with this element’s position

**Loop** through the vector from lowest index until a vector element smaller than the pivot is found

**Overwrite** highest index with this element’s position

**Swap** the vector elements at the new highest and lowest index

**Overwrite** the lowest index by incrementing it one

**Overwrite** the highest index by decrementing it one

**Return** the highest index

**End**

**printList()**

**Loop** through *courseList*

**Output** to console: *courseID, courseName,*

**Loop** 0 to *preCount*

**For each** *Course* in *preList*

**Output** to console: *courseID*

**End**

**printTree**()

**Create** new Node pointer named root

**Set** root to NULL

**Check** if Node is null and if so return

**Call** via recursion Node’s left pointer which will find the left most Node

**Output** to console: *courseID, courseName,*

**Loop** 0 to *preCount*

**For each** *Course* in *preList*

**Output** to console: *courseID*

**Call** via recursion Node’s right pointer which will find the right most Node

**End**

**printTable()**

**Create** a new Node pointer and **Set** to the address of the nodes beginning

**Loop** through the list; starting at the beginning

**Output** *courseID* in Course struct found within *tempCourse* to console

**Output** *courseName* in Course struct found within *tempCourse* to console

**Loop** 0 to *preCount*

**For each** *Course* in *preList*

**Call** p**rintCourse**() passing *prelist*

**End**

# Run Time Analysis

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Vector** | **Hash Table** | **Binary Tree** |
| **Loading Data** | O(1) | O(1) – O(N)  *\*depends on if there are collisions* | O(log N) |
| **Search** | O(n) | O(1) – O(N)  *\*depends on if there are collisions* | O(log N) – O(N)  *\*depends on balance of the tree* |
| **Sort/Print** | O(N log N) *\*using quick sort* | O(N)  *\*assumes the table is created in order* | O(N)  *\*in order traversal* |

# Advantage Analysis

All three data structures have their advantages and disadvantages. Loading data into an unsorted vector using an append method is incredibly fast but sorting it later has the slowest performance.

A hash table in theory could always operate at its average Θ(1) if the hash table were large enough to prevent all collisions. However, since neither time nor memory are infinite the table needs to be able to handle some collisions which would push the hash table somewhere between O(1) – O(N).

The binary tree will tend to operate most consistently at or near O(log N) depending on how the data is read in. That is, if the tree becomes heavily unbalanced, e.g., sorted data is loaded, then the Binary Tree slows down to O(N).

Which data structure to choose depends on how the data will be accessed and how frequently. For example, if the data only needs to be loaded infrequently there are no advantages after the initial load. If the data needs to be searched often the hash table could be better than the binary tree assuming an efficient and well-designed hash function or a very unbalanced tree.

Lastly, the binary tree doesn’t need to be sorted and can be traversed in order which could save some memory if both the sorted and unsorted “lists” do not need to be stored. Moreover, the binary tree and the hash table will perform better and be preferable than sorting the vector.

# Recommendation

It is the assumption that the data will only need to be read into memory sparingly, completely printed infrequently, but searched quite often; thus, the Hash Table should be preferrable. However, this means that the hash function and table size need to be optimized to limit collisions so the code operates closer to O(1) than O(N).