

Hash Table Lab

"What I cannot create, I do not understand."

After finishing each part of the lab, copy your entire project and work on the copy for the next part!

Part 3: Load Factor.

Do this once at program start up:

- Create an *ArrayList* of *Strings*, with an initial size of 50K.
- Open the "Large Data Set.txt" – called *store* below (50K records)
- Read a line in the text file & add the string to the *ArrayList*
 - Repeat to the end of the file
- Close the file.
- Build similar *ArrayList* objects for the "Successful Search Records.txt" file and the "Unsuccessful Search Records.txt" file

For each test run, do the following:

1. Given an input file of 50k records, build a table sized for the load factor to be profiled
 - e.g, for an $\alpha = 0.50$, the table size should be ~100K
 - e.g, for an $\alpha = 0.67$, the table size should be ~75K
 - Use the following α values: 0.1, 0.5, 0.8, 0.9, 1.0

--- Measure insertion time ---

2. Start "Build Table" timer
 - `long start = System.currentTimeMillis();`
3. For each record in the "Large Data Set.txt" (large file)
 - Parse the record
 - Build *key* and *value* objects to be inserted in the table
 - Insert it into the hash table
 - ~~i. For open hashing (chaining with a linked list)~~
 - ~~• If first insertion, create list & add to list~~
 - ~~• If collision occurs, increment collision counter & add to list at that location~~
 - ii. For closed hashing (linear, quadratic, random)
 - Increment collision counter for each unsuccessful probe
4. Stop "Build Table" timer
 - `long stop = System.currentTimeMillis();`

--- Measure time for finding items in table ---

5. Start "Successful Search" timer
6. For each record in "Successful Search" data set
 - Parse the record
 - Build a *key* object
 - Search the table – get number of probes needed to find the entry
 - i. I.e., count number of objects checked before correct object is found

7. Stop “Successful Search” timer

--- *Measure time search for items NOT in table* ---

8. Start “Unsuccessful Search” timer

9. For each record in “Unsuccessful Search” data set

- Parse the record
- Build a *key* object
- Search the table – get number of probes needed to determine the record isn’t in the table
 - i. I.e., count number of objects checked before reaching a null entry (closed hashing) ~~or~~
~~the end of the hashed list (open hashing)~~

10. Stop “Unsuccessful Search” timer

11. Print a report to a text file containing:

- Type of hashing used (e.g., linear probing, chaining)
- Hash function used (your descriptive designation)
- Number of records added to the table, table size, and load factor
- Average insertion time
- Number of table insertion collisions
- Number of collisions vs. number of insertions (expressed as %)
- ~~For open hashing, print average list length~~
 - i. ~~(number of insertions) / (number of insertions — number of collisions)~~
- Average time & number of probes needed to find table entry
- Average time & number of probes needed to determine entry is not in table

Note: it’s not required, but you may find it convenient to output test run results to a text file. If you output data in CSV format, you can open the file directly in Excel. The `PrintWriter` class is the easiest way to output text.

Results Spreadsheet.

Transfer data from the program output text file to Excel – yes, use Excel!

Make the following charts:

1. 2D line chart: for building the table,
 - a. Number of probes vs. load factor α
 - b. Average insertion time vs. load factor α
 - c. Do the average time results tell you the same story as the number of probes results?
2. 2D line chart: for *successful* search,
 - a. average time vs. load factor α
 - b. number of probes vs. load factor α
 - c. Do the average time results tell you the same story as the number of probes results?
3. 2D line chart: for *UNsuccessful* search,
 - a. average time vs. load factor α
 - b. number of probes vs. load factor α
 - c. Do the average time results tell you the same story as the number of probes results?