

Performance Evaluation:

Linear:

```
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h linear -m 65537 -a .5
Table size (65537), load factor (0.5)
Open addressing with linear probe sequence
Seed: 113654361
```

```
----- Retrieve driver -----
Trials: 50000
Build table with 32768 random keys
The average number of probes for a successful search = 1.51065
Avg probes for successful search = 1.33333 measured with 3 trials
Avg probes for unsuccessful search = 2.54581 measured with 49997 trials
--- Linear probe sequence performance formulas ---
Expected probes for successful search 1.5
Expected probes for unsuccessful search 2.5
----- End of access driver -----
```

```
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h linear -m 65537 -a .75
Table size (65537), load factor (0.75)
Open addressing with linear probe sequence
Seed: 113654361
```

```
----- Retrieve driver -----
Trials: 50000
Build table with 49152 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 2.54993
Avg probes for successful search = 1 measured with 1 trials
Avg probes for unsuccessful search = 8.69871 measured with 49999 trials
--- Linear probe sequence performance formulas ---
Expected probes for successful search 2.5
Expected probes for unsuccessful search 8.5
----- End of access driver -----
```

```
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h linear -m 65537 -a .9
Table size (65537), load factor (0.9)
Open addressing with linear probe sequence
Seed: 113654361
```

```
----- Retrieve driver -----
Trials: 50000
Build table with 58983 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 5.50487
Avg probes for successful search = 1 measured with 2 trials
Avg probes for unsuccessful search = 50.9296 measured with 49998 trials
--- Linear probe sequence performance formulas ---
Expected probes for successful search 5.5
Expected probes for unsuccessful search 50.5
----- End of access driver -----
```

```

Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h linear -m 65537 -a .95
Table size (65537), load factor (0.95)
Open addressing with linear probe sequence
Seed: 113654361

```

```

----- Retrieve driver -----
Trials: 50000
Build table with 62260 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 10.4633
Avg probes for successful search = 1 measured with 2 trials
Avg probes for unsuccessful search = 238.297 measured with 49998 trials
--- Linear probe sequence performance formulas ---
Expected probes for successful search 10.5
Expected probes for unsuccessful search 200.5
----- End of access driver -----

```

```

Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h linear -m 65537 -a .99
Table size (65537), load factor (0.99)
Open addressing with linear probe sequence
Seed: 113654361

```

```

----- Retrieve driver -----
Trials: 50000
Build table with 64881 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 43.2099
Avg probes for successful search = 1 measured with 2 trials
Avg probes for unsuccessful search = 2265.4 measured with 49998 trials
--- Linear probe sequence performance formulas ---
Expected probes for successful search 50.5
Expected probes for unsuccessful search 5000.5
----- End of access driver -----

```

Double:

```

Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h double -m 65537 -a .5
Table size (65537), load factor (0.5)
Open addressing with double hashing
Seed: 113654361

```

```

----- Retrieve driver -----
Trials: 50000
Build table with 32768 random keys
The average number of probes for a successful search = 1.38971
Avg probes for successful search = 3.66667 measured with 3 trials
Avg probes for unsuccessful search = 1.99336 measured with 49997 trials
--- Double hashing performance formulas ---
Expected probes for successful search 1.38629
Expected probes for unsuccessful search 2
----- End of access driver -----

```



```
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h double -m 65537 -a 75
Table size (65537), load factor (75)
Open addressing with double hashing
Seed: 113654361
```

```
----- Retrieve driver -----
```

```
Trials: 50000
Build table with 4915275 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
build of random table failed code (-1) index (65536) key (717592702)
```

```
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h double -m 65537 -a .9
Table size (65537), load factor (0.9)
Open addressing with double hashing
Seed: 113654361
```

```
----- Retrieve driver -----
```

```
Trials: 50000
Build table with 58983 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 2.56677
Avg probes for successful search = 3.5 measured with 2 trials
Avg probes for unsuccessful search = 10.0014 measured with 49998 trials
--- Double hashing performance formulas ---
Expected probes for successful search 2.55843
Expected probes for unsuccessful search 10
----- End of access driver -----
```

```
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h double -m 65537 -a .95
Table size (65537), load factor (0.95)
Open addressing with double hashing
Seed: 113654361
```

```
----- Retrieve driver -----
```

```
Trials: 50000
Build table with 62260 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 3.17263
Avg probes for successful search = 3.5 measured with 2 trials
Avg probes for unsuccessful search = 19.8809 measured with 49998 trials
--- Double hashing performance formulas ---
Expected probes for successful search 3.1534
Expected probes for unsuccessful search 20
----- End of access driver -----
```

```

Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h double -m 65537 -a .99
Table size (65537), load factor (0.99)
Open addressing with double hashing
Seed: 113654361

----- Retrieve driver -----
Trials: 50000
Build table with 64881 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 4.66288
Avg probes for successful search = 3.5 measured with 2 trials
Avg probes for unsuccessful search = 99.6858 measured with 49998 trials
--- Double hashing performance formulas ---
Expected probes for successful search 4.65169
Expected probes for unsuccessful search 100
----- End of access driver -----

```

Quad

```

Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h quad -m 65536 -a .5
Table size (65536), load factor (0.5)
Open addressing with quadratic probe sequence
Seed: 113654361

----- Retrieve driver -----
Trials: 50000
Build table with 32768 random keys
The average number of probes for a successful search = 1.43796
Avg probes for successful search = 2.33333 measured with 3 trials
Avg probes for unsuccessful search = 2.17035 measured with 49997 trials
--- Quadratic probe sequence performance formulas ---
Expected probes for successful search 1.44315
Expected probes for unsuccessful search 2.19315
----- End of access driver -----

```

```

Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h quad -m 65536 -a .75
Table size (65536), load factor (0.75)
Open addressing with quadratic probe sequence
Seed: 113654361

----- Retrieve driver -----
Trials: 50000
Build table with 49152 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 1.98946
Avg probes for successful search = 2 measured with 1 trials
Avg probes for unsuccessful search = 4.66227 measured with 49999 trials
--- Quadratic probe sequence performance formulas ---
Expected probes for successful search 2.01129
Expected probes for unsuccessful search 4.63629
----- End of access driver -----

```



```
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h quad -m 65536 -a .9
Table size (65536), load factor (0.9)
Open addressing with quadratic probe sequence
Seed: 113654361
```

```
----- Retrieve driver -----
Trials: 50000
Build table with 58982 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 2.90512
Avg probes for successful search = 2 measured with 2 trials
Avg probes for unsuccessful search = 12.0748 measured with 49998 trials
--- Quadratic probe sequence performance formulas ---
Expected probes for successful search 2.85259
Expected probes for unsuccessful search 11.4026
----- End of access driver -----
```

```
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h quad -m 65536 -a .95
Table size (65536), load factor (0.95)
Open addressing with quadratic probe sequence
Seed: 113654361
```

```
----- Retrieve driver -----
Trials: 50000
Build table with 62259 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 3.60613
Avg probes for successful search = 2 measured with 2 trials
Avg probes for unsuccessful search = 23.9848 measured with 49998 trials
--- Quadratic probe sequence performance formulas ---
Expected probes for successful search 3.52073
Expected probes for unsuccessful search 22.0457
----- End of access driver -----
```

```

Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -r -i rand -h quad -m 65536 -a .99
Table size (65536), load factor (0.99)
Open addressing with quadratic probe sequence
Seed: 113654361

---- Retrieve driver ----
Trials: 50000
Build table with 64880 random keys
During random build generated duplicate key (739040870) on trial (34201)
This should be unlikely: if see more than a few you have a problem
During random build generated duplicate key (203529088) on trial (38050)
This should be unlikely: if see more than a few you have a problem
During random build generated duplicate key (165091392) on trial (44264)
This should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 5.32169
Avg probes for successful search = 2 measured with 2 trials
Avg probes for unsuccessful search = 107.958 measured with 49998 trials
-- Quadratic probe sequence performance formulas ---
Expected probes for successful search 5.11017
Expected probes for unsuccessful search 103.615
---- End of access driver ----

```

My Experimental data matches very well with the predicted results. It seems that as load factors were smaller, the experimental data matched better with the predicted results.

2.

Successful Searches	random	sequential	folded	worst
Quadratic $M=2^{16}$	2.4	1	118.75	13297.2
Double M = 65537	3.5	1	8.75	27.8
Linear M = 65537	3.86818	1	13927.5	29842.5

Unsuccessful Searches	random	sequential	folded	worst
Quadratic $M=2^{16}$	8.01016	189.841	188.92	7.15615
Double M = 65537	6.68	19.9062	18.9071	12.356
Linear M = 65537	23.6761	23676.5	23676.5	23758

Some of the performance is $O(1)$ and some of it is $O(n)$ because it is slower and when they are sequential they take more time. If the keys are random then linear probing can work much better.

3. ran equilibrium driver with table size of 10,000

```
[Inferior 1 (process 28963) exited normally]
(gdb) run -e -m 10000
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -e -m 10000
Table size (10000), load factor (0.9)
Open addressing with linear probe sequence
Seed: 113654361

----- Equilibrium test driver -----
Trials: 50000
Build table with 9000 random keys
  The average number of probes for a successful search = 6.44167
Keys added (24914), removed (25086) new size should be (8828) and is (8828)
After exercise, time=888.07
successful searches during exercise=15.2366, trials=25086
unsuccessful searches during exercise=5402.95, trials=24914
After retrieve experiment, time=1614.76
New load factor = 0.8828
Percent empty locations marked deleted = 100
  Measured avg probes for successful search=17.0543, trials=8828
  Measured avg probes for unsuccessful search=10000, trials=49999
  Do deletions increase avg number of probes?
--- Linear probe sequence performance formulas ---
  Expected probes for successful search 4.76621
  Expected probes for unsuccessful search 36.9011
Rehash table
After rehash, time=7.316
  Measured avg probes for successful search=4.45254, trials=8828
  Measured avg probes for unsuccessful search=30.9851, trials=50000
----- End of equilibrium test -----

[Inferior 1 (process 28981) exited normally]
```


ran equilibrium driver with table size of 100,000

```
(gdb) run -e -m 100000
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -e -m 100000
Table size (100000), load factor (0.9)
Open addressing with linear probe sequence
Seed: 113654361

----- Equilibrium test driver -----
Trials: 50000
Build table with 90000 random keys
during random build generated duplicate key (739040870) on trial (34201)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (203529088) on trial (38050)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (165091392) on trial (44264)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (886913934) on trial (85368)
this should be unlikely: if see more than a few you have a problem
during random build generated duplicate key (520960315) on trial (89146)
this should be unlikely: if see more than a few you have a problem
The average number of probes for a successful search = 5.75851
Keys added (24816), removed (25181) new size should be (89635) and is (89635)
After exercise, time=36.731
successful searches during exercise=8.45414, trials=25184
unsuccessful searches during exercise=137.29, trials=24816
After retrieve experiment, time=61.083
New load factor = 0.89635
Percent empty locations marked deleted = 77.0478
Measured avg probes for successful search=10.3768, trials=89635
Measured avg probes for unsuccessful search=216.719, trials=49997
Do deletions increase avg number of probes?
--- Linear probe sequence performance formulas ---
Expected probes for successful search 5.32393
Expected probes for unsuccessful search 47.0405
Rehash table
After rehash, time=19.011
Measured avg probes for successful search=5.39777, trials=89635
Measured avg probes for unsuccessful search=46.2823, trials=49997
----- End of equilibrium test -----
```

As you can see the performance does degrade when the table size gets too large and the trials are substantial. After the rehash you can see the avg successful searches and unsuccessful searches becoming similar to the retrieve driver.

Test Plan:

My first Unit driver 0 tests out simple inserts and deletions and also the print statements. The first thing that is done is that 14 entries are inputted into a table of 15, as you can see one key is

```
START OF TABLE
Index: 0, Key: 15
Index: 1, Key: 16
Index: 2, Key: 17
Index: 3, Key: 18
Index: 4, Key: 19
Index: 5, Key: 20
Index: 6, Key: 21
Index: 7, Key: 22
Index: 8, Key: 23
Index: 9, Key: 24
Index: 10, Key: 25
Index: 11, Key: 26
Index: 12, Key: 27
Index: 13, Key: 28
Index: 14, Key: EMPTY
```

empty as it should be in all hash tables.

The second test is to remove several of the keys from the hash table. In this case, 15, 19, and

```
START OF TABLE
Index: 0, Key: DELETED
Index: 1, Key: 16
Index: 2, Key: 17
Index: 3, Key: 18
Index: 4, Key: DELETED
Index: 5, Key: 20
Index: 6, Key: 21
Index: 7, Key: 22
Index: 8, Key: 23
Index: 9, Key: DELETED
Index: 10, Key: 25
Index: 11, Key: 26
Index: 12, Key: 27
Index: 13, Key: 28
Index: 14, Key: EMPTY
```

24 are deleted from the table.

. The next thing we do is add a couple number back in the list as such to test if the deletions will take in a new key and it does:

```
START OF TABLE
Index: 0, Key: 15
Index: 1, Key: 16
Index: 2, Key: 17
Index: 3, Key: 18
Index: 4, Key: 53
Index: 5, Key: 20
Index: 6, Key: 21
Index: 7, Key: 22
Index: 8, Key: 23
Index: 9, Key: DELETED
Index: 10, Key: 25
Index: 11, Key: 26
Index: 12, Key: 27
Index: 13, Key: 28
Index: 14, Key: 32
```

We again are remained with one empty or deleted entry. We cannot add more to this list because it is full but I attempt to to test it. After I insert more into the list, it does not change anything as expected.

```
START OF TABLE
Index: 0, Key: 15
Index: 1, Key: 16
Index: 2, Key: 17
Index: 3, Key: 18
Index: 4, Key: 53
Index: 5, Key: 20
Index: 6, Key: 21
Index: 7, Key: 22
Index: 8, Key: 23
Index: 9, Key: DELETED
Index: 10, Key: 25
Index: 11, Key: 26
Index: 12, Key: 27
Index: 13, Key: 28
Index: 14, Key: 32
[Inferior 1 (process 31588) exited normally]
```

Test 2:

Unit Driver 1 tests the boundaries such as removing all the entries after adding them and such. The first process is to add 5 entries into a list of 8.


```
START OF TABLE
Index: 0, Key: 32
Index: 1, Key: EMPTY
Index: 2, Key: EMPTY
Index: 3, Key: 4
Index: 4, Key: 52
Index: 5, Key: 53
Index: 6, Key: EMPTY
Index: 7, Key: 15
```

. After adding these we then attempt to delete all the ones that

```
START OF TABLE
Index: 0, Key: DELETED
Index: 1, Key: EMPTY
Index: 2, Key: EMPTY
Index: 3, Key: DELETED
Index: 4, Key: DELETED
Index: 5, Key: DELETED
Index: 6, Key: EMPTY
Index: 7, Key: DELETED
```

were added and it successfully does so. . The last test is to try to delete keys that were already removed from the hash table to see how the program would respond. It responded correctly by not doing anything and acknowledging no keys exist in the

```
START OF TABLE
Index: 0, Key: DELETED
Index: 1, Key: EMPTY
Index: 2, Key: EMPTY
Index: 3, Key: DELETED
Index: 4, Key: DELETED
Index: 5, Key: DELETED
Index: 6, Key: EMPTY
Index: 7, Key: DELETED
```

hash table at that moment.

2. Small even number for double hashing using the retrieve driver gives us this response. It failed to build the code because of the way the math works. The small even number is too small

for it to process in this hashtable.

```
(gdb) run -m 8 -r -h double
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -m 8 -r -h double
Table size (8), load factor (0.9)
Open addressing with double hashing
Seed: 113654361

----- Retrieve driver -----
Trials: 50000
Build table with 7 random keys
build of random table failed code (-1) index (5) key (446929184)
```

This is the response when a small even number table size that is not a power of 2 is used with quadratic probing with the retrieve driver. The avg probes for unsuccessful is higher than when size is power of 2. However there is a big difference in the expected probes for successful and unsuccessful search.

```
Starting program: /home/huzefa/Dropbox/ECE_2230/MP7/lab7 -m 10 -r -h quad
Table size (10), load factor (0.9)
Open addressing with quadratic probe sequence
Seed: 113654361

----- Retrieve driver -----
Trials: 50000
Build table with 9 random keys
The average number of probes for a successful search = 2
Avg probes for unsuccessful search = 6.37084 measured with 50000 trials
--- Quadratic probe sequence performance formulas ---
Expected probes for successful search 2.85259
Expected probes for unsuccessful search 11.4026
----- End of access driver -----
```


START OF TABLE
Index: 0, Key: EMPTY
Index: 1, Key: EMPTY
Index: 2, Key: 19
Index: 3, Key: 11
Index: 4, Key: 12
Index: 5, Key: 5
Index: 6, Key: EMPTY

START OF TABLE
Index: 0, Key: EMPTY
Index: 1, Key: EMPTY
Index: 2, Key: 19
Index: 3, Key: 11
Index: 4, Key: DELETED
Index: 5, Key: DELETED
Index: 6, Key: EMPTY

START OF TABLE
Index: 0, Key: EMPTY
Index: 1, Key: EMPTY
Index: 2, Key: 19
Index: 3, Key: 11
Index: 4, Key: DELETED
Index: 5, Key: 26
Index: 6, Key: EMPTY

3. #7 on the Homework and part a for 3.

```

START OF TABLE
Index: 0, Key: 7
Index: 1, Key: 8
Index: 2, Key: 9
Index: 3, Key: 10
Index: 4, Key: 11
Index: 5, Key: 12
Index: 6, Key: EMPTY

START OF TABLE
Index: 0, Key: DELETED
Index: 1, Key: DELETED
Index: 2, Key: DELETED
Index: 3, Key: DELETED
Index: 4, Key: DELETED
Index: 5, Key: 12
Index: 6, Key: EMPTY

START OF TABLE
Index: 0, Key: 14
Index: 1, Key: DELETED
Index: 2, Key: DELETED
Index: 3, Key: DELETED
Index: 4, Key: DELETED
Index: 5, Key: 12
Index: 6, Key: 13

```

#8 on the homework and part b for 3.

Check For Memory Leaks: None in any
With Default Retrieval Driver:

```

==32155== Memcheck, a memory error detector
==32155== Copyright (C) 2002-2013, and GNU GPL'd, by Julian Seward et al.
==32155== Using Valgrind-3.10.0.SVN and LibVEX; rerun with -h for copyright info
==32155== Command: ./lab7 -r
==32155==
table size (11), load factor (0.9)
Open addressing with linear probe sequence
Seed: 113654361

----- Retrieve driver -----
Trials: 50000
Build table with 9 random keys
The average number of probes for a successful search = 2.11111
Avg probes for unsuccessful search = 3.8263 measured with 50000 trials
--- Linear probe sequence performance formulas ---
Expected probes for successful search 5.5
Expected probes for unsuccessful search 50.5
----- End of access driver -----

==32155==
==32155== HEAP SUMMARY:
==32155==    in use at exit: 0 bytes in 0 blocks
==32155==   total heap usage: 11 allocs, 11 frees, 252 bytes allocated
==32155==
==32155== All heap blocks were freed -- no leaks are possible
==32155==
==32155== For counts of detected and suppressed errors, rerun with: -v
==32155== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
huzefa@huzefa-Precision-M4700:~/Dropbox/ECE_2230/MP7$

```


With Default Equilibrium Driver:

```
==32197== Memcheck, a memory error detector
==32197== Copyright (C) 2002-2013, and GNU GPL'd, by Julian Seward et al.
==32197== Using Valgrind-3.10.0.SVN and LibVEX; rerun with -h for copyright info
==32197== Command: ./lab7 -e
==32197==
Table size (11), load factor (0.9)
Open addressing with linear probe sequence
Seed: 113654361

----- Equilibrium test driver -----
  Trials: 50000
  Build table with 9 random keys
    The average number of probes for a successful search = 2.11111
  Keys added (23471), removed (23476) new size should be (4) and is (4)
  After exercise, time=449.809
    successful searches during exercise=2.21869, trials=23476
    unsuccessful searches during exercise=10.9989, trials=23471
  After retrieve experiment, time=223.161
  New load factor = 0.363636
  Percent empty locations marked deleted = 100
  Measured avg probes for successful search=1, trials=4
  Measured avg probes for unsuccessful search=11, trials=50000
  Do deletions increase avg number of probes?
--- Linear probe sequence performance formulas ---
  Expected probes for successful search 1.28571
  Expected probes for unsuccessful search 1.73469
  Rehash table
  After rehash, time=136.232
  Measured avg probes for successful search=1, trials=4
  Measured avg probes for unsuccessful search=1.62482, trials=50000
----- End of equilibrium test -----

==32197==
==32197== HEAP SUMMARY:
==32197==    in use at exit: 0 bytes in 0 blocks
==32197== total heap usage: 23,484 allocs, 23,484 frees, 94,352 bytes allocated
==32197==
==32197== All heap blocks were freed -- no leaks are possible
==32197==
==32197== For counts of detected and suppressed errors, rerun with: -v
==32197== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

with Default Rehash Driver:

```
==32223== Memcheck, a memory error detector
==32223== Copyright (C) 2002-2013, and GNU GPL'd, by Julian Seward et al.
==32223== Using Valgrind-3.10.0.SVN and LibVEX; rerun with -h for copyright info
==32223== Command: ./lab7 -b
==32223==
Table size (11), load factor (0.9)
Open addressing with linear probe sequence
Seed: 113654361

----- Rehash driver -----
----- Passed rehash driver -----

==32223==
==32223== HEAP SUMMARY:
==32223==    in use at exit: 0 bytes in 0 blocks
==32223== total heap usage: 48 allocs, 48 frees, 992 bytes allocated
==32223==
==32223== All heap blocks were freed -- no leaks are possible
==32223==
==32223== For counts of detected and suppressed errors, rerun with: -v
==32223== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```