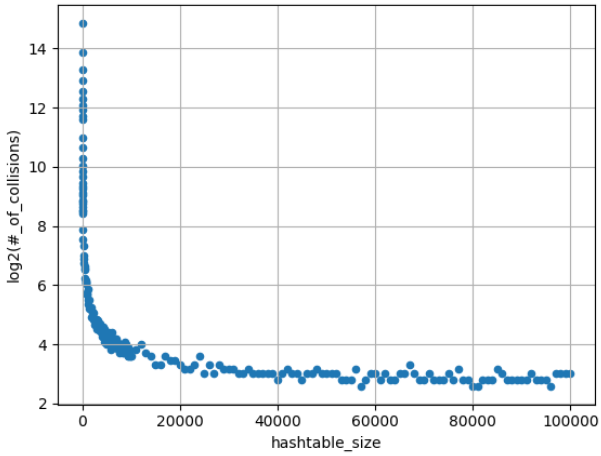
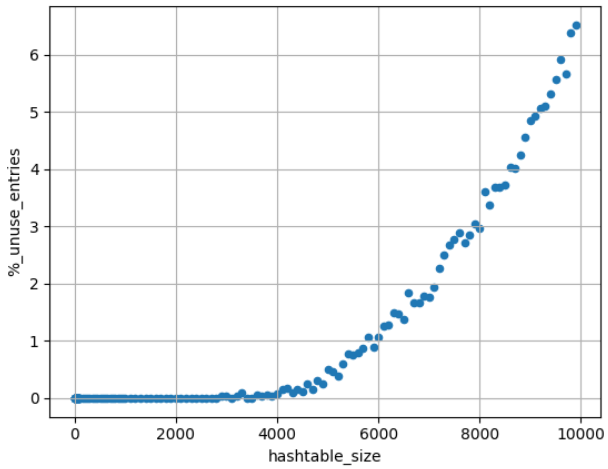
Robert Alvarez
Advance Algorithms, Assignment 4

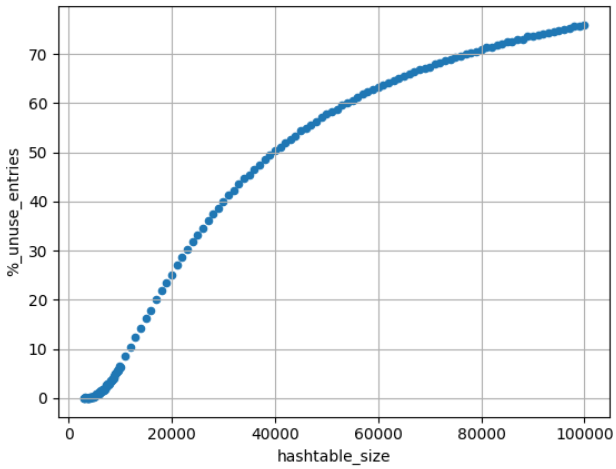
1. Compile the given code found in archive assignment4.tgz, containing the linked list implementations, the hash tables, and the dictionary driver code. Run the code on file sp-en-dictionary.txt. Observe the number of collisions. Modify the code repeatedly to lower the size of the array used for the hash table. Run the code each time, observing the number of collisions. Draw a graph giving the number of collisions (as a percentage of the number of entries) in the function of the size of the hash table. Describe the graph and its overall behavior.
   a. Analysis of the number of collisions.



   i.
   ii. By looking at the number of maximum collisions in a hash table entry for different hash table sizes we can observe that as the hash table size increase the # of collision decrease to no less than 6. Testing was done for sizes above 100,000 and the minimum never went below 6. This is due to the key (Spanish word) distribution.

   b. Analysis of unused entries.

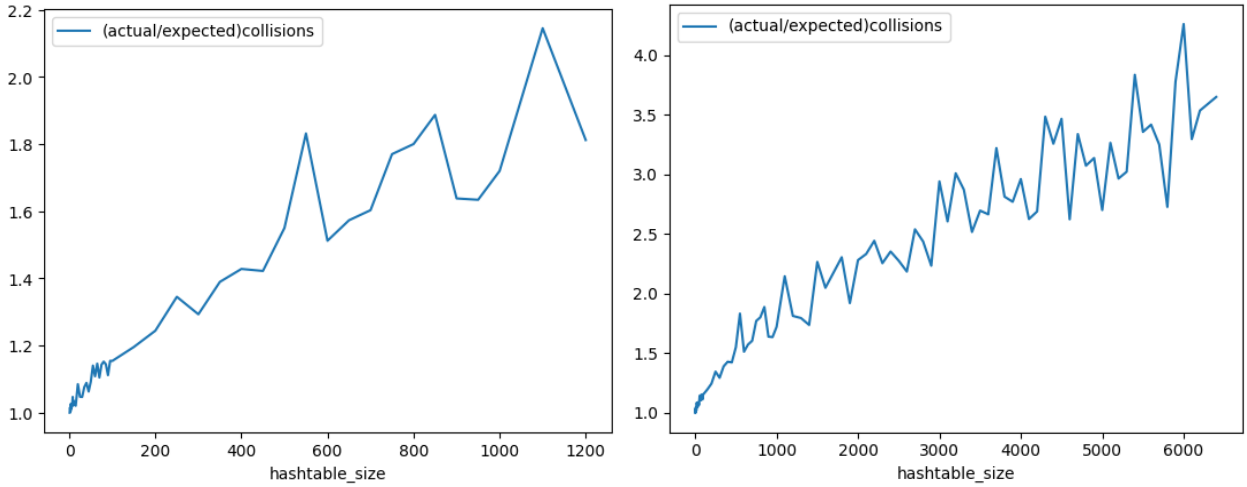




   i.
   ii. This graph shows the memory usage inefficiency for large hash table sizes. So, even if graph (a) keeps decreasing the number of collisions per entry use (to a minimum of 6), the hash table starts to have more and more unused entries with respect to the total number of entries.

c. Analysis of actual vs expected # of collisions.

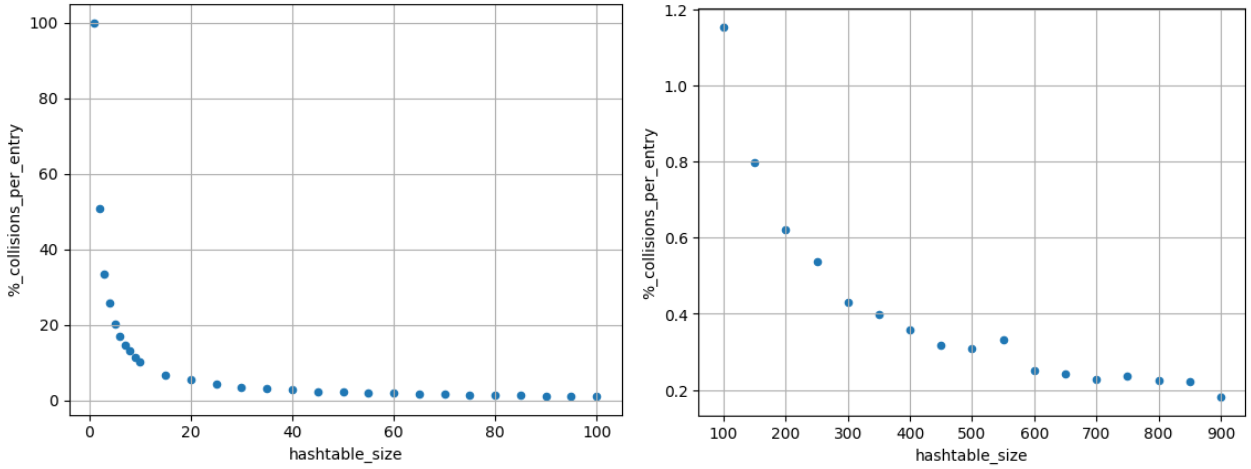
i.



ii. This graph shows that for relatively small hash table sizes the key distribution behaves as a uniform distribution because the ratio between the actual (worst case) and the expected # of collisions is relatively close to 1.0 (perfect hashing in uniform key distribution).

d. Analysis of % of collisions per entry usage.

i.



ii. By analyzing the percentage of collisions per entry we can derive a similar reasoning as in analysis (b) because the % of collisions per entry (worst case) is close to 100/hashtable_size.

2. Compile the given code for the size of an array with 16 entries. Run the code on the mini dictionary sp-en-mini.txt. With the use of gdb, draw the graph of pointers of objects created in memory for this dictionary.