York University
CSE 2011 – Assignment 4
Summer 2015 Instructor: Jeff Edmonds

Family Name: ______________________ Given Name: ______________________

Student #: ______________________ CSE Email: ______________________

Family Name: ______________________ Given Name: ______________________

Student #: ______________________ CSE Email: ______________________

1)	70	
2)	20	
3-5)	10	
Total	100	

1. Implement from scratch the Hash functions *put*, *get*, *del*, and *iterate* on the Hash slides pages 37-50. Warning, since lecturing I changed the slides to have $d = (b \times k \bmod q) + 1$. (Do not rehash as on page 54.)

   As your program executes these operations display on the screen, what cells are already full, the order 1,2,3,..., of cells probed, and which cell completed the operation.

2. Run your program on a number of different values and keep track of the average number of probes. Report on your finding and how it compares with the analysis on page 52.

3. What inputs are the worst case?

4. **Expected** value is computed as the sum over all events of the probability that that event occurs times the value when that event does occur. For example, consider playing a lottery. The probability of winning is $\frac{1}{10^7}$. The winning amount is \$$10^6$. This will make you 10 units happier. Losing costs you \$5 for the ticket and leaves you 1 units sadder. Your expected financial gain is $\frac{1}{10^7} \times \$10^6 + (1 - \frac{1}{10^7}) \times (-\$5) = -\$4.90$. Your expected happiness gain is $\frac{1}{10^7} \times 10 + (1 - \frac{1}{10^7}) \times (-1) = -1$. In the analysis on page 52, are the events specified by the input or by the $a \in [1, p-1]$ and $b \in [1, q-1]$. What is the probability of a particular event?

5. Suppose the key universe size and p are both really big compared to N. Suppose that $a \in [1, p-1]$ and $b \in [1, q-1]$ when randomly chosen both happen to equal 1. Suppose that the input happens to insert the sequence of keys $key_0 = 0$, $key_1 = 1Nq$, $key_2 = 2Nq$, $\ldots key_j = jNq$, $\ldots key_{n-1} = (n-1)Nq$. Determine the probe sequence $i_0, i_1, \ldots, i_{n-1}$, for each of these keys. Where will these keys end up in the array? What is the running time for these operations? How does this compare with the analysis on page 52? Is this sequence of keys a worst case input? What is the probability of this particular event? Define the contribution of an event to the expectation to be the probability that that event occurs times the value when that event does occur. What is the contribution of this particular example? How big would the accumulated probability of such bad events happening have to be to make their contribution to the expectated time significant?