

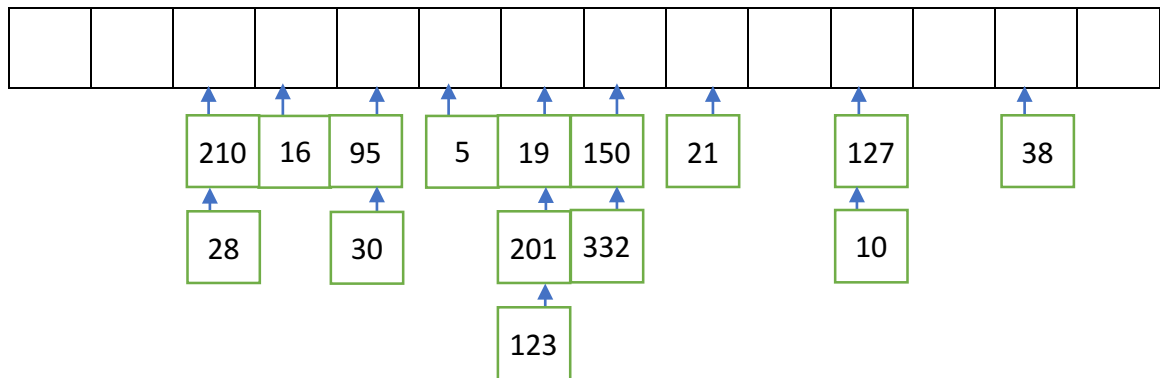
Assignment 4

Rui Zhao 40018813

Writing questions:

Question 1:

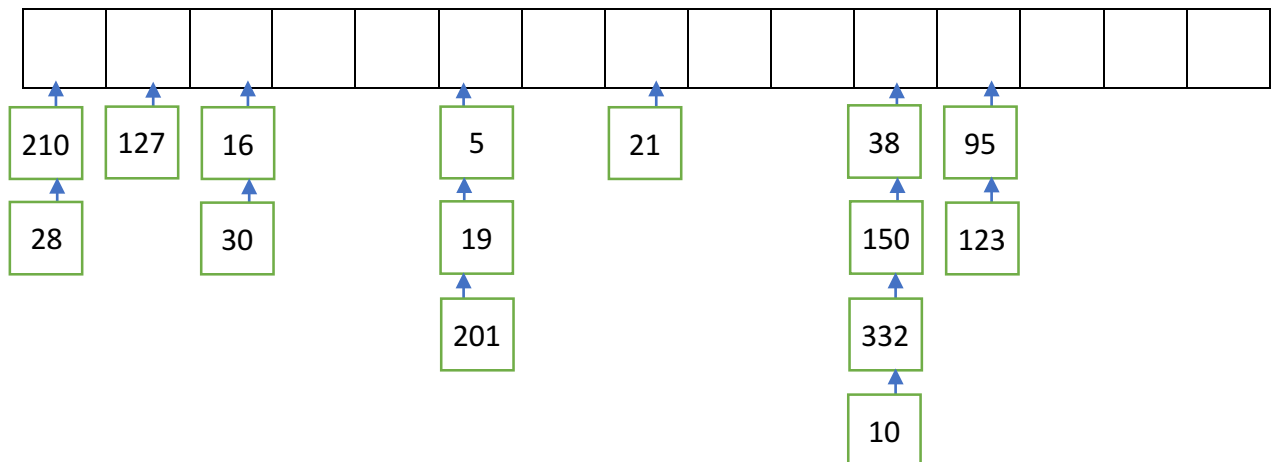
a) 0 1 2 3 4 5 6 7 8 9 10 11 12 13



b) From the graph above, we can see the maximum number of collisions is 3, which happens under index 6.

Question 2:

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14



After using an array of 15 elements, the hash table becomes like above, and we can see the maximum number of collisions increases to 4, instead of decreasing. This modification failed because 15 is not a prime number, and as a result, increasing the length of the array to 15 makes the collision situation even worse than before. If we really want to reduce the collision numbers by increasing the length of the array, we should increase it to the next prime number, which in this case, is 17.

Question 3:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	39		29	42		35				48	35	12				29		18	

K	h(k)	d(k)	Probes	number of collisions
25	6	3	6	0
12	12	2	12	0
42	4	7	4	0
31	12	4	12+4=16	1
35	16	7	$(16+7+7)\%19=11$	2
39	1	3	1 remove 31	0
48	10	1	10 remove 25	0
18	18	3	18	0
29	10	6	10+6=16	1
29	10	6	$(10+6+6)\%19=3$.	2
35	16	7	$(16+7+7+7+7)\%19=6$	4

ii) As shown above, the longest cluster has 3 elements (from index 10 to 12).

iii) The number of occurred collisions is 10.

iv) The load factor is $9/20=0.45$

Question 4:

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

95	\$									29	30	12	32	14	72				
----	----	--	--	--	--	--	--	--	--	----	----	----	----	----	----	--	--	--	--

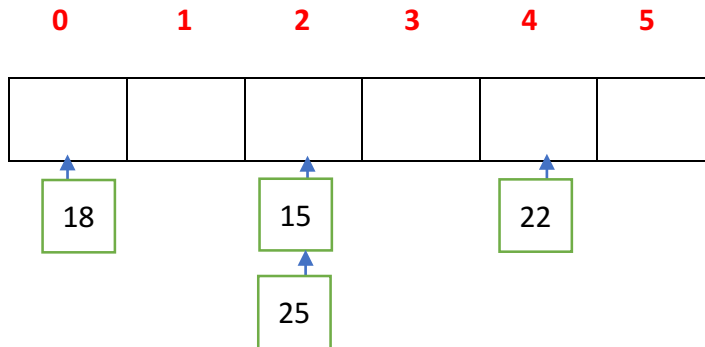
K	h(k)	Probes	number of collisions
29	10	10	0
53	15	15	0
14	14	14	0
95	0	0 remove 53	0
32	13	13	0
19	0	1	1
30	11	11 remove 19	0
12	12	12 remove 32	0
72	15	15	0
32	13	13	0

ii) As shown above, the longest cluster has 6 elements (from index 10 to 15). And the complexity of above insertions is $O(1)$. But in general, to insert an element into the linear probing hash table, the time complexity will be $O(n)$ in the worst case, when we loop through the array and find out that all indices are occupied.

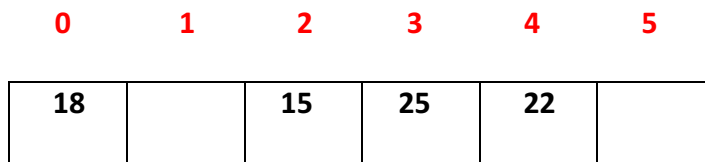
iii) The number of occurred collisions is 1.

Question 5:

a) Separate chaining with $h(k) = (k+2) \bmod 5$



b) Linear probing with $h(k) = (k+2) \bmod 5$



c) Double hashing with $h_1(k) = (k+2) \bmod 5$ and $h_2(k) = 1 + (k \bmod 4)$

