Hashing Lab

1. Given the following key values, show what the data structures would look like after insertions
   27 53 13 10 138 109 49 174 26 24
   (no preprocessing necessary: p_k = key)

a. Linear array of 10 elements using division hashing and the linear-quotient collision path algorithm
N = 13, 4k+3 prime = **19**

LQHashing:
1. i_p = pk % N
2. q=pk/N
   if (q%N != 0)
      offset = q
   else
      offset = 4k+3 prime
3. While collisions:
      $i_{p'}$ = (i_p + offset) % N
4. Set Array[i_p]=key

Array:

0	13
1	27
2	26
3	49
4	174
5	53
6	109
7	0
8	138
9	0
10	10
11	174
12	24

b. Bucket hashing of 10 elements (N=10)
i_p = (p_k) % N

Array:

0	10
1	
2	
3	53, 13
4	174, 24
5	
6	26
7	27
8	138
9	109, 49

pk	ip	q	offset (q%n)	Array[ip]
27	1	2	2	A[1] = 27
53	(1+4)%13=5	4 4	4 4	There is collision A[5] = 53
13	0	0	0	A[0] = 13
10	10	0	0→4k+3	A[10] = 10
138	8	10	10	A[8] = 138
109	(5+8)%13 = 0 (0+8)%13 = 8 (8+8)%13 = 3 (3+8)%13 = 4 (11+8)%13 = 6	8	8	There is collision There is collision There is collision There is collision There is collision A[6] = 109.
49	~~10~~ (10+3)%13 = 0 (0+3)%13 = 3	3	3	There is collision There is collision A[3] = 49.
174	~~5~~ (5+19)%13 = 11	13	0→4k+3=19.	There is collision A[11] = 174
26	~~0~~ (0+2)%13 = 2	2	2	There is collision A[2] = 26.
24	~~11~~ (11+1)%13 = 12	1	1	There is collision A[12] = 24

PK	ip	q	offset (q%n)	Array[ip]
27	7	2	2	A[7] = 27
53	3	5	5	A[3] = 53
13	~~3~~ (3+1)%10=4	1	1	Collision A[4] = 13.
10	0	0	0→4k+3=19	A[0] = 10
138	8	13	3	A[8] = 138
109	9	10	0→4k+3=19	A[9] = 109.
49	~~9~~ (9+4)%10=3 (3+4)%10=7 (7+4)%10=1	4	4	Collision Collision Collision A[1] = 49.
174	4 (4+7)%10=1 (1+7)%10=8 (8+7)%10=5	17	7	Collision Collision Collision A[5] = 174
26	6	2	2	A[6] = 26
24	4 (4+2)%10=6 (6+2)%10=8 (8+2)%10=0 (0+2)%10=2	2	2	Collision Collision Collision Collision A[2] = 24

2. Fill in the table based on exercise 1

Number of comparisons to retrieve this element

Key	Linear array - (Length of Collision Path +1)	Buckets - (# of elements in linked list compared)
53	1+1 = 2	1
138	0+1 = 1	1
109	5+1 = 6	1
49	2+1 = 3	2
174	1+1 = 2	1
26	1+1 = 2	1