ECE 250 *Algorithms and Data Structure*
Department of Electrical and Computer Engineering
University of Waterloo

Please send any comments or criticisms to dwharder@alumni.uwaterloo.ca
with the subject ECE 250 Questions 9.7.
Assistances and comments will be acknowledged.

9.7*a* Linear probing allows the size of the hash table to be arbitrarily large: the number of bins need not be powers of two. What feature of instruction sets on processors makes it never-the-less desirable for hash tables to be powers of two?

9.7*b* In the order given, insert the following values into the hash table of size 10 using linear probing using the least-significant digit as the hash value:

532, 574, 831, 899, 990, 379, 583, 779, 710

0	1	2	3	4	5	6	7	8	9

9.7*c* Given the following hash table, remove the following values from the hash table of size 10 using linear probing using the least-significant digit as the hash value:

821, 636, 594, 399

0	1	2	3	4	5	6	7	8	9
219	821	981	388	594	192	636	144	170	399

9.7*d* Using the prime number $p = 2654435769$[1], the following list of hash values are given using the multiplicative method to generate digits on the range 0 to 15:

Integer	Hash Value
1	13
2	11
3	9
4	7
5	5
6	3
7	1
8	15
9	13
10	11
11	8
12	6
13	4
14	2
15	0
16	14

Insert these values into a hash table of size $n = 16$.

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

[1] See Bruno Pruno Preiss, *Data Structures and Algorithms with Object-Oriented Design Patterns in C++*, 1997.

9.7*e* Using the prime number p = 2654435769, the following list of hash values are given using the multiplicative method to generate digits on the range 0 to 15:

Integer	Hash Value
17	12
18	10
19	8
20	6
21	3
22	1
23	15
24	13
25	11
26	9
27	7
28	5
29	3
30	1
31	14
32	12

Insert these values into a hash table of size n = 16.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
32	22	30	21	29	28	20	27	19	26	18	25	17	24	32	23

From this table, remove the values 17, 23, and 22, in that order.

9.7*f* Implement a member function `void fill_hole( Type *array, int k, int n )` that searches forward attempting to find the next item that should fit into a hole at location k. The array is of size n. You may assume that you can access the hash value of the objects by calling `hash( array[j] )`.

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9.7*g* Which of the following are valid hash tables using linear probing where the hash value is the least-significant digit?

0	1	2	3	4	5	6	7	8	9
538	581		493	553	175		397	884	888

0	1	2	3	4	5	6	7	8	9
549		352	553	492	395	590	487	938	909

0	1	2	3	4	5	6	7	8	9
590	171	498	593	924	135	326	447	499	488