Name: Solution

Answer each question in the space provided. Fill in your answers in the spaces provided in this file, and submit your solution to the Curator as an MS Word document.

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1. Consider a hash table consisting of $N = 10$ slots, and suppose integer key values are hashed into the table using the hash function:

$$h(K) = K\%N$$

Suppose that collisions are resolved using quadratic probing. Recall that when quadratic probing is used, it is possible that an insertion will fail, even though the hash table contains empty slots.

The integer key values listed below are to be inserted, in the order given. Show the home slot (the slot to which the key hashes, before any probing) and the probe sequence (if any) for each key, and contents of the hash table in the spaces provided after the following key values have been inserted in the given order:

Key Value	**Home Slot**	**Probe Sequence**
29	9	
23	3	
19	9	0
3	3	4
13	3	4 7
7	7	8
48	8	9 2
33	3	4 7 2 8 7 fails

Final Hash Table:

Slot	0	1	2	3	4	5	6	7	8	9
Contents	19		48	23	3			13	7	29

2. Repeat problem 1, but use linear probing instead of quadratic probing to resolve collisions:

Key Value	Home Slot	Probe Sequence
29	9	
23	3	
19	9	0
3	3	4
13	3	4 5
7	7	
48	8	
33	3	4 5 6

Final Hash Table:

Slot	0	1	2	3	4	5	6	7	8	9
Contents	19			23	3	13	33	7	48	29

3. Given the initial hash table below, show the contents of the hash table after each indicated operation is performed. Be sure to clearly indicate which slots are empty and which are tombstones. Assume the same hash function and probe strategy as for question 2. Recycle tombstones according to the rule given in the specification for the indexing project. (The parts are cumulative.)

Slot	0	1	2	3	4	5	6	7	8	9
Contents	30	97		83	Tomb	34		47	Tomb	17

(a) Insert the key value: 90 Number of slots that were probed: **3** (0, 1, 2)

Slot	0	1	2	3	4	5	6	7	8	9
Contents	30	97	**90**	83	Tomb	34		47	Tomb	17

(b) Delete the key value: 34 Number of slots that were probed: **2** (4, 5)

Slot	0	1	2	3	4	5	6	7	8	9
Contents	30	97	90	83	Tomb	Tomb		47	Tomb	17

(c) Insert the key value: 67 Number of slots that were probed: **10** (7, 8, 9, 0, 1, 2, 3, 4, 5, 6)

Slot	0	1	2	3	4	5	6	7	8	9
Contents	30	97	90	83	Tomb	Tomb		47	**67**	17

4. Construct the 2-3 tree that results from inserting the key values given below in the order they are listed. If you want any partial credit, show the tree after each key insertion.

53 71 39 75 83 25 55 32 43 73