Data Structures Test Bank 2015

Data Structures Hash

Question 1

A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing.

0	
1	
2	42
3	23
4	34
5	52
6	46
7	33
8	
9	

After inserting 6 values into an empty hash table, the table is as shown below.
Which one of the following choices gives a possible order in which the key values could have been inserted in the table?

A 46, 42, 34, 52, 23, 33

B 34, 42, 23, 52, 33, 46

C 46, 34, 42, 23, 52, 33

D 42, 46, 33, 23, 34, 52

Question 1 Explanation:

See question 2 of http://www.geeksforgeeks.org/data-structures-and-algorithms-set-24/

Question 2

How many different insertion sequences of the key values using the same hash function and linear probing will result in the hash table shown above?

- A 10
- B 20
- C 30
- D 40

Question 2 Explanation:

See question 3 of http://www.geeksforgeeks.org/data-structures-and-algorithms-set-24/

Question 3

The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function h(k) = k mod 10 and linear probing. What is the resultant hash table?

	(A)	(B)	(C)	(D)
0				
1				
2	2	12	12	12, 2
3	23	13	13	13, 3, 23
4			2	
5	15	5	3	5, 15
6			23	
7			5	
8	18	18	18	18
9			15	

- A A
- B B
- C C
- D D

Question 3 Explanation:

To get the idea of open addressing concept, you can go through below lines from Wikipedia. Open addressing, or closed hashing, is a method of collision resolution in hash tables. With this method a hash collision is resolved by probing, or searching through alternate locations in the array (the probe sequence) until either the target record is found, or an unused array slot is found, which indicates that there is no such key in the table. Well known probe sequences include: *linear probing* in which the interval between probes is fixed--often at 1. *quadratic probing* in which the interval between probes increases linearly (hence, the indices are described by a quadratic function). *double hashing* in which the interval between probes is fixed for each record but is computed by another hash function.

Question 4

Consider a hash table of size seven, with starting index zero, and a hash function (3x + 4)mod7. Assuming the hash table is initially empty, which of the following is the contents of the table when the sequence 1, 3, 8, 10 is inserted into the table using closed hashing? Note that '_' denotes an empty location in the table.

A 8, _, _, _, _, _, 10

B 1, 8, 10, _, _, _, 3

C 1, _, _, _, _, _,3

D 1, 10, 8, _, _, _, 3

Question 4 Explanation:

Please see http://lcm.csa.iisc.ernet.in/dsa/node38.html for closed hashing and probing. Let us put values 1, 3, 8, 10 in the hash of size 7. Initially, hash table is empty

```
    -    -    -   -   -   -   -
    0    1    2   3   4   5   6
```

The value of function (3x + 4)mod 7 for 1 is 0, so let us put the value at 0

```
    1    -    -   -   -   -   -
    0    1    2   3   4   5   6
```

The value of function (3x + 4)mod 7 for 3 is 6, so let us put the value at 6

```
    1    -    -   -   -   -   3
    0    1    2   3   4   5   6
```

The value of function (3x + 4)mod 7 for 8 is 0, but 0 is already occupied, let us put the value(8) at next available space(1)

```
    1    8    -    -    -    -    3

    0    1    2    3    4    5    6
```

The value of function (3x + 4)mod 7 for 10 is 6, but 6 is already occupied, let us put the value(10) at next available space(2)

```
    1    8    10    -    -    -    3

    0    1    2     3    4    5    6
```

Question 5

Given the following input (4322, 1334, 1471, 9679, 1989, 6171, 6173, 4199) and the hash function x mod 10, which of the following statements are true? i. 9679, 1989, 4199 hash to the same value ii. 1471, 6171 has to the same value iii. All elements hash to the same value iv. Each element hashes to a different value (GATE CS 2004)

A. i only

B. ii only

C. i and ii only

D. iii or iv

Question 5 Explanation:

```
Hash function given is mod(10).
9679, 1989 and 4199 all these give same hash value i.e 9
1471 and 6171 give hash value 1
```

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Question 6

Consider a hash table with 100 slots. Collisions are resolved using chaining. Assuming simple uniform hashing, what is the probability that the first 3 slots are unfilled after the first 3 insertions?

A $(97 \times 97 \times 97)/100^3$

B $(99 \times 98 \times 97)/100^3$

C $(97 \times 96 \times 95)/100^3$

D $(97 \times 96 \times 95)/(3! \times 100^3)$

Question 6 Explanation:

Simple Uniform hashing function is a hypothetical hashing function that evenly distributes items into the slots of a hash table. Moreover, each item to be hashed has an equal probability of being placed into a slot, regardless of the other elements already placed.
(Source: https://en.wikipedia.org/wiki/SUHA_%28computer_science%29).

```
Probability that the first 3 slots are unfilled after the first 3 insertions =
                (probability that first item doesn't go in any of the first 3 slots)*
                (probability that second item doesn't go in any of the first 3 slots)*
                (probability that third item doesn't go in any of the first 3 slots)

                 = (97/100) * (97/100) * (97/100)
```

Question 7

Which one of the following hash functions on integers will distribute keys most uniformly over 10 buckets numbered 0 to 9 for i ranging from 0 to 2020?

A $h(i) = i^2 \bmod 10$

B $h(i) = i^3 \bmod 10$

C $h(i) = (11 * i^2) \bmod 10$

D $h(i) = (12 * i) \bmod 10$

Question 7 Explanation:

Since mod 10 is used, the last digit matters. If you do cube all numbers from 0 to 9, you get following

Number	Cube	Last Digit in Cube
0	0	0
1	1	1
2	8	8
3	27	7
4	64	4
5	125	5
6	216	6
7	343	3
8	512	2
9	729	9

Therefore all numbers from 0 to 2020 are equally divided in 10 buckets. If we make a table for square, we don't get equal distribution. In the following table. 1, 4, 6 and 9 are repeated, so these buckets would have more entries and buckets 2, 3, 7 and 8 would be empty.

Number	Square	Last Digit in Cube
0	0	0
1	1	**1**
2	4	**4**
3	9	**9**
4	16	**6**
5	25	5
6	36	**6**
7	49	**9**
8	64	**4**
9	81	**1**

Question 8

Given a hash table T with 25 slots that stores 2000 elements, the load factor α for T is __________

A 80

B 0.0125

C 8000

D 1.25

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Question 8 Explanation:

load factor = (no. of elements) / (no. of table slots) = 2000/25 = 80

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