CSE/IT **Batch:English**

Data Structure & Programming

Hashing

DPP

[NAT]

1. Consider a hash table H with 512 slots. If 128 keys areto be stored in H, the load factor of H is ________________.

[NAT]

2. Consider a hash function that distributes keys uniformly. The hash table size is 2024. After hashing of how many keys will the probability that any new key hashed collides with an existing one exceed 0.75? ___________

[MCQ]

3. Suppose we are given n keys, m hash table slots, and two simple uniform hash functions h_1 and h_2. Further suppose our hashing schemes uses h_1 for the even keys and h_2 for the odd keys. What is the expected number of keys in a slot?

(a) $\frac{n}{m}$ (b) $\frac{m}{n}$
(c) $\frac{2n}{m}$ (d) $\frac{m}{2n}$

[NAT]

4. A hash table contains 9 buckets and uses linear probing to resolve collisions. The key values are integers and the hash function used is key % 9. If the values 41, 157, 72, 76, 31 are inserted in the table, in what location would the last key be inserted? ________________.

[MCQ]

5. 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 2024?

(a) $h(i) = (12 * i) \bmod 10$
(b) $h(i) = (11 * i^2) \bmod 10$
(c) $h(i) = i^3 \bmod 10$
(d) $h(i) = i^2 \bmod 10$

[NAT]

6. Consider a double hashing scheme in which the primary hash function is $h_1(k) = k \bmod 17$, and the secondary hash function is $h_2(k) = 1 + (k \bmod 13)$. Assume that the table size is 17. Then the addressreturned by probe 2 in the probe sequence (assume thatthe probe sequence begins at probe 0) for key value k = 127 is____________.

[MCQ]

7. Consider a hash table with 11 slots. The hash function is h(k) = k mod 11. The collisions are resolved by chaining. The following 11 keys are inserted in the order: 28, 19, 15, 20, 33, 30, 42, 63, 60, 32, 43. The maximum, minimum, and average chain lengths in the hash table, respectively, are-

(a) 3, 0, 1 (b) 3, 3, 3
(c) 3, 0, 2 (d) 4, 0, 1

[MCQ]

8. A hash table of length 8 uses open addressing with hashfunction h(k)= 2 + k mod 8, and linear probing. After inserting 5 values into an empty hash table, the table isas shown below.

0	
1	
2	64
3	41
4	57
5	72
6	
7	29

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

(a) 10 (b) 9
(c) 15 (d) 8

Answer Key

1. **(0.25)**
2. **(1518)**
3. **(a)**
4. **(7)**
5. **(c)**
6. **(13)**
7. **(a)**
8. **(c)**

Hints and Solutions

1. (0.25)

Load factor = $\frac{128}{512}$

2. (1518)

Let x be the number of keys after which any new key hashed collides with an existing one exceed $\frac{3}{4}$

$$\frac{1}{2024} \times x = \frac{3}{4}$$

$x = 1518$

3. (a)

If h_1 is used for the even keys and h_2 for the odd keys, the expected number of keys in a slot is still equivalent to $\frac{n}{m}$

4. (7)

41 mod 9 =5

157 mod 9 = 4

72 mod 9 = 0

76 mod 9 = 4

Since 157 occupies 4 and 41 occupies 5, 76 is hashed to 6

31 mod 9 = 4

Since 157 occupies 4, 41 occupies 5, 76 occupies 6, 31 is hashed to 7

5. (c)

$h(i) = i^3$ mod 10 will distribute keys most uniformly over 10 buckets numbered 0 to 9 for i ranging from 0 to 2024.

6. (13)

D-Hashing (k, probe) = (h_1(k) + probe × h_2(k)) mod m

Where, probe = 0 to m – 1

m = Number of empty slots in hash table)

D-Hashing (127, 2) = (127 mod 17 + 2 × (1 + 127 mod 13)) mod 17

= (8 + 2 × (1 + 10)) mod 17 = 13

7. (a)

28 mod 11 = 6

19 mod 11 = 8

15 mod 11 = 4

20 mod 11 = 9

33 mod 11 = 0

30 mod 11 = 8

42 mod 11 = 9

63 mod 11 = 8

60 mod 11 = 5

32 mod 11 = 10

43 mod 11 = 10

Maximum chain length = 3

Minimum chain length = 0

Average chain length = 11/11 = 1

8. (c)

64 is hashed to 2.

41 is hashed to 3.

57 is too hashed to 3. To avoid collision, 57 is hashed in 4.

Similarly, 72 and 29 are also dependent.

Order:

(i) 64 41 $\downarrow$ 57 single place

(ii) 41 64 $\downarrow$ 57 2 place

$\therefore$ After 57: (1) 64 41 57

(2) 41 57 64

(3) 41 34 57

(iii) 72.

(i) 64 41 57 $\downarrow$ 72 1 way $\Downarrow$ After 72

(ii) 41 57 64 $\downarrow$ 1 way

(iii) 41 64 57 $\downarrow$ 1 way

(i) $\underbrace{64\ \ 41\ \ 57\ \ 72}_{\text{After 29}}$ $\Downarrow$ 5ways

(ii) $\underbrace{41\ \ 57\ \ 64\ \ 72}_{\text{5 ways}}$

(iii) $\underbrace{41\ \ 64\ \ 57\ \ 72}_{\text{5 ways}}$

$\therefore$ Total = 15 ways