GATE

DS&AI

Data Structure & Algorithm

Hash Tables and Queues

Q1 Consider the following statements:
Which of the blow statement(s) is/are correct?
(A) First-in-first out types of computations are efficiently supported by STACKS.
(B) Implementing LISTS on linked lists is more efficient than implementing LISTS on an array for almost all the basic LIST operations.
(C) Implementing QUEUES on a circular array is more efficient than implementing QUEUES on a linear array with two indices.
(D) Last-in-first-out type of computations are efficiently supported by QUEUES.

Q2 A queue is implemented using a non-circular singly linked list. The queue has a head referring to first node and a tail referring to last node. Let n denote the number of nodes in the queue. Let 'enqueue' be implemented by inserting a new node at the head, and 'dequeue' be implemented by deletion of a node from the tail.
Which one of the following is the time complexity of the most time-efficient implementation of 'enqueue' and 'dequeue, respectively, for this data structure?
(A) $\Theta(1), \Theta(1)$
(B) $\Theta(1), \Theta(n)$
(C) $\Theta(n), \Theta(1)$
(D) $\Theta(n), \Theta(n)$

Q3 A circularly linked list is used to represent a Queue. A single variable p is used to access the Queue. To which node should p point such that both the operations enQueue and deQueue can be performed in constant time?
(A) rear node
(B) front node
(C) not possible with a single pointer
(D) node next to front

Q4 A queue is implemented using an array such that ENQUEUE and DEQUEUE operations are performed efficiently. Which one of the following statements is CORRECT (n refers to the number of items in the queue)?
(A) Both operations can be performed in O(1) time
(B) At most one operation can be performed in O(1) time but the worst case time for the other operation will be $\Omega(n)$
(C) The worst case time complexity for both operations will be $\Omega(n)$
(D) Worst case time complexity for both operations will be $\Omega(\log n)$

Q5 Let the following circular queue can accommodate maximum six elements with the following data
front = 1 rear = 3
queue = _____; L, M, N, ___, ___
What will happen after ADD O operation takes place?
(A) front = 2 rear = 4
queue = _____; L, M, N, O, ___
(B) front = 3 rear = 5
queue = L, M, N, O, ___
(C) front = 1 rear = 4
queue = _____; L, M, N, O, ___
(D) front = 2 rear = 4
queue = L, M, N, O, ___

Q6 Consider a hash table with 100 slots. Collisions are resolved using Open Addressing. What is the probability that the first 4 slots are unfilled after the first 4 insertions?
(A) $(96 \times 96 \times 96 \times 96)/100^4$
(B) $(96 \times 95 \times 94 \times 93)/100^4$
(C) $(97 \times 96 \times 95 \times 94)/100^4$

(D) $(97 \times 96 \times 95 \times 94)/(4! \times 100^4)$

Q7 Consider a hash table of size 11 that uses open addressing with linear probing. Let h(k) = k mod 11 be the hash function used. A sequence of records with keys
43 36 92 87 11 4 71 13 14
is inserted into an initially empty hash table, the bins of which are indexed from zero to ten. What is the index of the bin into which the last record is inserted?
(A) 2 (B) 4
(C) 6 (D) 7

Q8 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

Q9 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) $h(i) = (12 * i) \bmod 10$

Q10 Consider a hash table with 100 slots. Collisions are resolved using Chaining Method. What is the probability that the first 4 slots are unfilled after the first 4 insertions?
(A) $(96 \times 96 \times 96 \times 96)/100^4$
(B) $(96 \times 95 \times 94 \times 93)/100^4$
(C) $(97 \times 96 \times 95 \times 94)/100^4$
(D) $(97 \times 96 \times 95 \times 94)/(4! \times 100^4)$

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Answer Key

Q1	(B, C)	Q6	(C)
Q2	(B)	Q7	(D)
Q3	(A)	Q8	(B)
Q4	(A)	Q9	(B)
Q5	(C)	Q10	(A)

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Hints & Solutions

Q1 Text Solution:
B&C

Q2 Text Solution:
B

Q3 Text Solution:
A

Q4 Text Solution:
A

Q5 Text Solution:
C

Q6 Text Solution:
C

Q7 Text Solution:
D

Q8 Text Solution:
B

Q9 Text Solution:
B

Q10 Text Solution:
A