HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY **SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING** **Sample no.: 1 Pages: 6**		**FINAL EXAM OF SEMESTER I/2022-2023** **Module: DATA STRUCTURES AND ALGORITHMS (ET2101E)** **Date: Mar/16/2023 - 12:30** **Duration: 90 minutes** *(Paper documents allowed. Write directly on this sheet.)*
Signatures	Lecturer in charge:	Group leader:

Student name: ..... Student ID: ..... Signature: .....

(Number of questions: 60)

1. In the software development process, in which step(s) are algorithms used?

a) Analysis

b) Design

c) Testing

d) Evolution

e) Implementation

2. Given an array [13, 14, 12, 11, 16, 15]. Rewrite the values of this array after make it a Max Heap.

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3. How many swap operations does the Bubble Sort algorithm need to sort the array [26, 34, 27, 32, 20, 24, 28, 22, 30, 21] in ascendant order?

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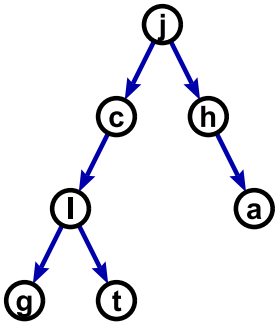
4. Given a tree as in the figure. Which node is visited right after node g when traversing the tree with DFS method in LVR order?



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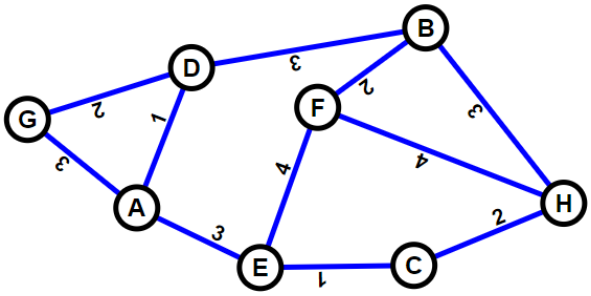
5. Is this graph cyclic?



a) True

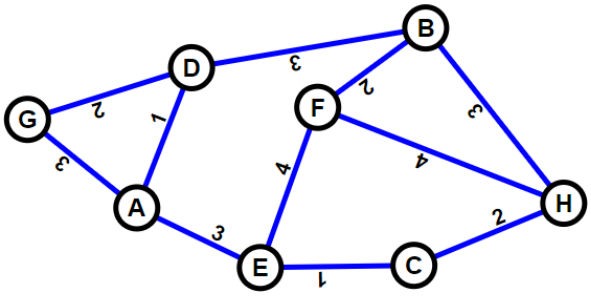
b) False

6. If edge <i,j> is present in a directed graph G, then edge <j,i> also is?

a) True

b) False

7. List the first 5 visited nodes in order when traversing this graph starting from G using Dijkstra algorithm



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8. There may exist only one spanning tree for a graph?

a) True

b) False

9. After 4 steps of the Selection Sort algorithm in ascendant order, an array becomes [21, 22, 23, 24, 30, 27, 29, 26, 28]. Rewrite the values of this array after 3 next step(s).

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10. Given two elements a and b in a linked list, write the expression to check if a is the previous element of b

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11. Given a stack with the elements added in the following order: <2, 7, 8, 3, 4, 7>. Rewrite the elements of this stack after doing Pop 2 times, then Push 5 and 9 respectively.

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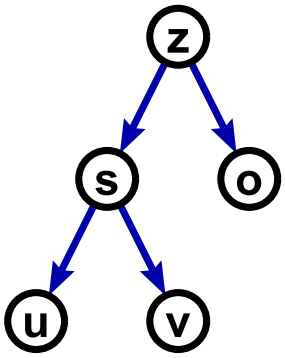
12. Linked lists are more efficient than arrays in accessing a random element?

a) True

b) False

13. What is the depth of the following tree?



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14. The constant complexity for a problem with size of n is

a) O(n^2)

b) O(n)

c) O(1)

15. Write the expression to check if a given element e is not the 2nd last element

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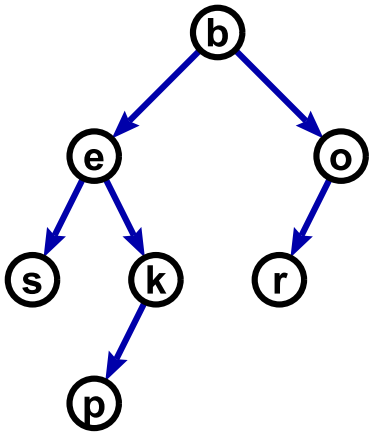
16. Given a tree as in the figure. Which node is visited right before node k when traversing the tree with DFS method in LRV order?



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17. What is the asymptotic complexity of finding the next element (assumed existing) of a given element in a singly-linked list?

a) O(i^2)

b) O(n)

c) O(1)

d) O(i)

e) O(n+i)

f) O(n^2)

18. The linear complexity for a problem with size of n is

a) O(1)

b) O(n^2)

c) O(n)

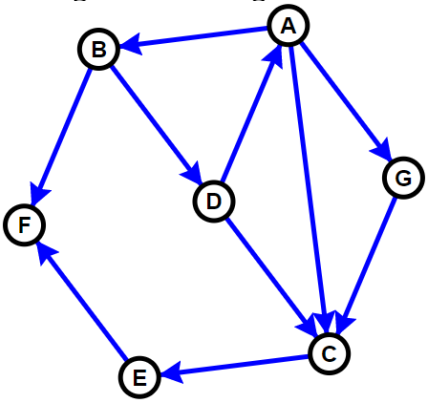
19. What is needed to traverse a graph using the iterative DFS method?

a) A stack

b) A queue

c) A linked list

20. Which one(s) of the following sequences is/are possibly visited when traversing this graph starting from D using BFS method?



a) D A C G E B F

b) D A F G B E C

c) D A C G B F E

d) D A C G B E F

21. In a queue, the Dequeue operation allows to

a) Remove the element at the tail

b) Add an element to the tail

c) Remove the element at the head

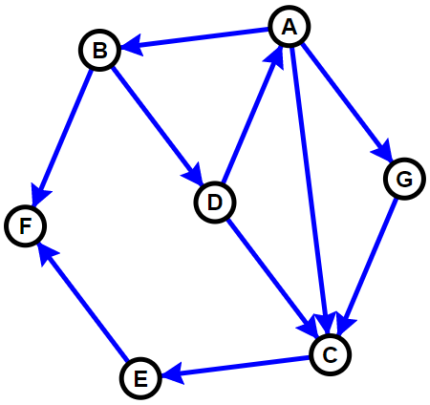
d) Add an element to the head

22. In a Hash Table, the keys of elements must not duplicate?

a) True

b) False

23. List all the nodes that are reacheable from D



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24. At most, how many iterations are needed to find a value in an array of 200 elements using the Binary Search algorithm?

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25. What is the asymptotic complexity of finding the previous element (assumed existing) of a given element in a singly-linked list?

a) O(n)

b) O(n^2)

c) O(n+i)

d) O(i^2)

e) O(i)

f) O(1)

26. What is the asymptotic complexity of an algorithm with 2n^2 + 3log(m) operations?

a) O(log(m))

b) O(n^2)

c) O(n^2 + log(m))

27. What is the memory asymptotic complexity of the in-place (not using auxiliary memory) Merge Sort algorithm?

a) O(n^2)

b) O(log(n))

c) O(n)

d) O(1)

28. The number of hash values

a) Can be determined by the programmer

b) Equals the number of elements

c) Is fixed by the algorithm

29. Given a Self Organizing List [21, 18, 22, 19, 17, 23, 20] using the Move-to-Front method. Rewrite the values of this list after respectively searching the following values: 21, 18, 20, 18, 17.

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30. Which one(s) of the following operations are of a stack?

a) Enqueue

b) Push

c) Dequeue

d) Pop

31. Nút lá của cây là nút

a) Has the most number of children

b) Does not have any child

c) Has the most number of parents

d) Does not have parent

32. Which complexity(-ies) does an algorithm with 13n^2 + 14n operations satisfy?

a) O(2n^2)

b) O(n^2 + n)

c) O(n)

d) O(n^2)

e) O(2^n)

33. Which data structure is last-in-first-out (LIFO)?

a) Linked list

b) Stack

c) Tree

d) Hash table

e) Queue

34. What pairs of elements are examined by the Bubble Sort algorithm?

a) Pairs of two adjacent elements

b) Pairs of two arbitrary elements

35. What is the asymptotic complexity of accessing the i-th element in a linked list?

a) O(n)

b) O(i+n)

c) O(i)

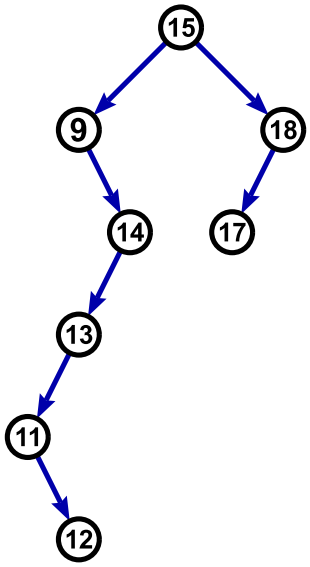
d) O(1)

36. The elements of a linked list are contiguously in memory?

a) True

b) False

37. Given a Binary Search Tree as in the figure. Write the nodes visited in order when searching for the value 12.



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38. For a given array of values, there are many Binary Search Trees that can be established?

a) True

b) False

39. What is needed to traverse a tree using the iterative BFS method?

a) A queue

b) A linked list

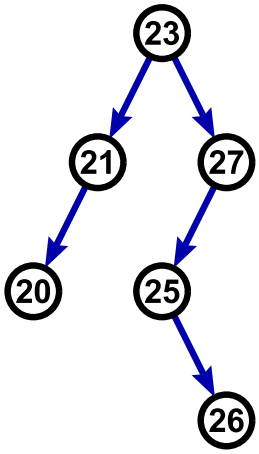
c) A stack

40. There can be many leaf nodes in a tree?

a) True

b) False

41. Given a Binary Search Tree as in the figure. How many nodes are visited to find the value 25?



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42. What is the memory asymptotic complexity of the standard (using auxiliary memory) Merge Sort algorithm?

a) O(n)

b) O(n^2)

c) O(log(n))

d) O(1)

43. Does the Linear Search algorithm require the array to be sorted first?

a) True

b) False

44. Given two elements a and b in a linked list, write the expression to check if a is the 2nd next element of b

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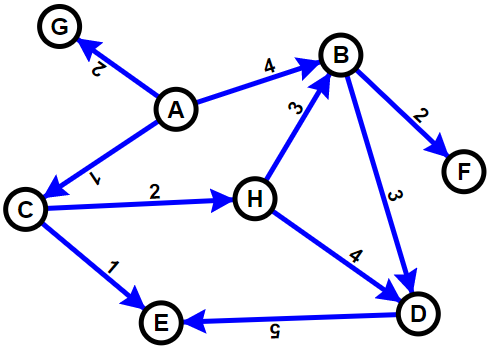
45. List all the nodes that are reacheable from B



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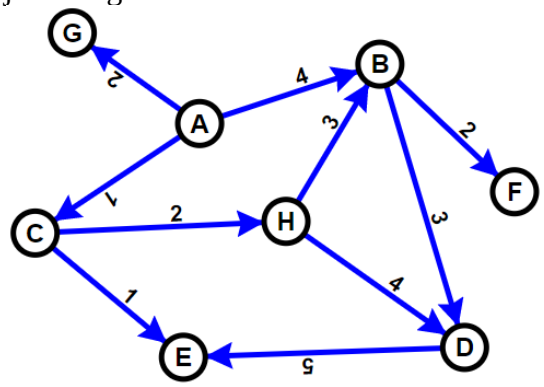
46. List the first 5 visited nodes in order when traversing this graph starting from C using Dijkstra algorithm



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47. What is the asymptotic complexity of traversing a linked list of n elements from the beginning to the end?

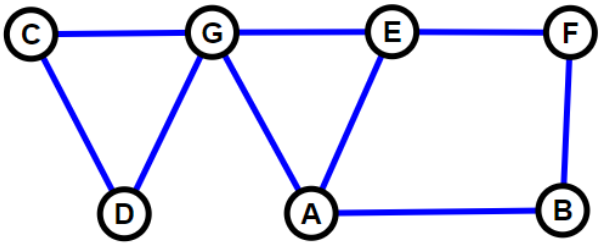
a) O(1)

b) O(log(n))

c) O(n^2)

d) O(n)

48. Which one(s) of the following sequences is/are possibly visited when traversing this graph starting from C using BFS method?



a) C E D G A F A B

b) C G D E A F A B

c) C B D E A A F G

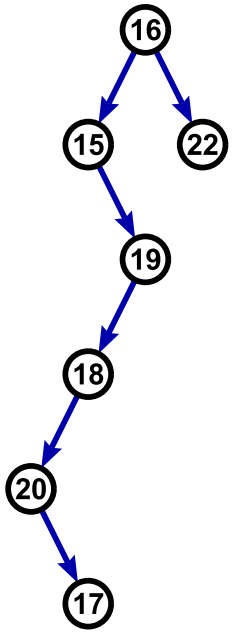
d) C G D E A A F B

49. A Hash Table is used to

a) Improve the efficiency in storing data

b) Improve the efficiency in searching data

50. Is the tree given in the figure a Binary Search Tree?



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51. The root node of a tree

a) Has the most number of children

b) Does not have any child

c) Does not have parent

d) Has the most number of parents

52. When does the Heap Sort algorithm establishes a Max Heap or Min Heap?

a) At every step

b) Only once at the beginning

53. Is a connected acyclic graph a tree?

a) True

b) False

54. There can be many root nodes in a tree?

a) True

b) False

55. What is the time asymptotic complexity of the Quicksort algorithm in the worst case?

a) O(1)

b) O(n^2)

c) O(log(n))

d) O(n)

56. Given a queue with the elements added in the following order: <22, 21, 24, 25>. Rewrite the elements of this queue after doing Dequeue 2 times, then Enqueue a value of 23.

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57. An element in a doubly-linked list

a) Points to the next element

b) Points to the next and the previous elements

c) Points to the previous element

58. After 4 steps of the Insertion Sort algorithm in descendant order, an array becomes [26, 19, 17, 15, 12, 22, 14, 23, 25, 10, 21]. Rewrite the values of this array after 3 next step(s).

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59. Does the Binary Search algorithm require the array to be sorted first?

a) True

b) False

60. Arrays are more efficient than linked lists in using memory?

a) True

b) False

--------- *End* ---------