

Data Structures

Due	No due date	Points	56	Questions	38	Time Limit	None
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Instructions

Questions to test your knowledge and understanding of basic data structures. For each question only the best solution will be graded as correct, and as usual grading is case sensitive. Note that you should be able to show your work to solve all of these problems, you should not just ask the internet for the answer. Note that this is one of the quizzes that is used for the MS admissions process. If you need to refresh your memory on any topics, see the following for links to resources: [Data Structures and Algorithms](https://cs.indstate.edu/wiki/index.php/Algorithms_and_Data_Structures_-_Getting_Started) [↗\(https://cs.indstate.edu/wiki/index.php/Algorithms_and_Data_Structures_-_Getting_Started\)](https://cs.indstate.edu/wiki/index.php/Algorithms_and_Data_Structures_-_Getting_Started).

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	98 minutes	49 out of 56

Submitted Mar 22 at 3:38am

Question 1

1 / 1 pts

What is the worst-case running time for the lookup operation for the following data structure: array (sorted) (in the way that makes the most sense for this data structure)

☐ $O(2^n)$

☐ $O(n^3)$

☐ $O(n \log(n))$

☐ $O(n!)$

☐ $O(1)$

Correct!

☒ $O(\log(n))$

☐ $O(n^2)$ ☐ $O(n)$ **Question 2****1 / 1 pts**

What is the worst-case running time for the insert operation for the following data structure: array (sorted) (in the way that makes the most sense for this data structure)

☐ $O(n!)$ ☐ $O(n \log(n))$ **Correct!**☒ $O(n)$ ☐ $O(1)$ ☐ $O(n^2)$ ☐ $O(2^n)$ ☐ $O(n^3)$ ☐ $O(\log(n))$ **Question 3****1 / 1 pts**

What is the average-case running time for the following algorithm: selection sort

☐ $O(n!)$ ☐ $O(\log(n))$ ☐ $O(n^3)$

☐ $O(2^n)$ ☐ $O(1)$ ☐ $O(n \log(n))$

Correct!

☒ $O(n^2)$ ☐ $O(n)$ **Question 4**

0 / 1 pts

What is the average-case running time for the lookup operation for the following data structure: array (unsorted) (in the way that makes the most sense for this data structure)

Correct Answer

☐ $O(n)$ ☐ $O(n!)$ ☐ $O(n^2)$ ☐ $O(n^3)$

You Answered

☒ $O(1)$ ☐ $O(n \log(n))$ ☐ $O(\log(n))$ ☐ $O(2^n)$ **Question 5**

1 / 1 pts

What is the best-case running time for the lookup operation for the following data structure: stack (in the way that makes the most sense

for this data structure)

- ☐ $O(n^2)$
- ☐ $O(n!)$
- ☐ $O(n \log(n))$
- ☐ $O(n)$
- ☐ $O(\log(n))$
- ☐ $O(n^3)$
- ☐ $O(2^n)$
- ☒ $O(1)$

Correct!

Question 6

1 / 1 pts

What is the worst-case running time for the insert operation for the following data structure: stack (in the way that makes the most sense for this data structure)

- ☒ $O(1)$
- ☐ $O(n!)$
- ☐ $O(\log(n))$
- ☐ $O(n^2)$
- ☐ $O(2^n)$
- ☐ $O(n^3)$
- ☐ $O(n)$
- ☐ $O(n \log(n))$

Correct!

Question 7**1 / 1 pts**

What is the worst-case running time for the insert operation for the following data structure: queue (in the way that makes the most sense for this data structure)

☐ $O(n!)$ ☐ $O(n^2)$ ☐ $O(2^n)$ ☐ $O(n^3)$ ☐ $O(n)$ **Correct!**☒ $O(1)$ ☐ $O(n \log(n))$ ☐ $O(\log(n))$ **Question 8****1 / 1 pts**

What is the worst-case running time for the insert operation for the following data structure: array (unsorted) (in the way that makes the most sense for this data structure)

Correct!☒ $O(1)$ ☐ $O(2^n)$ ☐ $O(n \log(n))$ ☐ $O(\log(n))$ ☐ $O(n^2)$

☐ $O(n^3)$ ☐ $O(n!)$ ☐ $O(n)$ **Question 9****1 / 1 pts**

What is the best-case running time for the lookup operation for the following data structure: binary tree (balanced) (in the way that makes the most sense for this data structure)

☐ $O(2^n)$ ☐ $O(\log(n))$ ☐ $O(n \log(n))$ **Correct!**☒ $O(1)$ ☐ $O(n!)$ ☐ $O(n^3)$ ☐ $O(n^2)$ ☐ $O(n)$ **Question 10****1 / 1 pts**

What is the worst-case running time for the lookup operation for the following data structure: linked list (doubly linked) (in the way that makes the most sense for this data structure)

☐ $O(n \log(n))$

Correct!

- ☒ $O(n)$
- ☐ $O(n!)$
- ☐ $O(\log(n))$
- ☐ $O(n^3)$
- ☐ $O(1)$
- ☐ $O(n^2)$
- ☐ $O(2^n)$

Question 11**1 / 1 pts**

What is the worst-case running time for the insert operation for the following data structure: binary heap (in the way that makes the most sense for this data structure)

- ☐ $O(2^n)$
- ☐ $O(n \log(n))$
- ☐ $O(n!)$
- ☐ $O(n^3)$
- ☐ $O(n^2)$
- ☐ $O(1)$
- ☐ $O(n)$

Correct!

- ☒ $O(\log(n))$

Question 12**1 / 1 pts**

What is the average-case running time for the following algorithm:
insertion sort

☐ $O(n \log(n))$

☐ $O(1)$

☐ $O(n!)$

☐ $O(\log(n))$

Correct!

☒ $O(n^2)$

☐ $O(2^n)$

☐ $O(n)$

☐ $O(n^3)$

Question 13

1 / 1 pts

What is the average-case running time for the following algorithm:
binary search

☐ $O(n!)$

☐ $O(n)$

☐ $O(1)$

☐ $O(n \log(n))$

Correct!

☒ $O(\log(n))$

☐ $O(n^2)$

☐ $O(2^n)$

☐ $O(n^3)$ **Question 14****1 / 1 pts**

What is the worst-case running time for the lookup operation for the following data structure: queue (in the way that makes the most sense for this data structure)

☐ $O(n^2)$ **Correct!**☒ $O(n)$ ☐ $O(1)$ ☐ $O(2^n)$ ☐ $O(n \log(n))$ ☐ $O(n^3)$ ☐ $O(\log(n))$ ☐ $O(n!)$ **Question 15****1 / 1 pts**

What is the average-case running time for the following algorithm: linear search

☐ $O(n \log(n))$ ☐ $O(n^2)$ ☐ $O(n^3)$ ☐ $O(1)$

☐ $O(n!)$ ☐ $O(\log(n))$ ☐ $O(2^n)$

Correct!

☒ $O(n)$ **Question 16****1 / 1 pts**

What is the best-case running time for the insert operation for the following data structure: binary tree (balanced) (in the way that makes the most sense for this data structure)

☐ $O(n \log(n))$ ☐ $O(n)$ ☐ $O(n^3)$ ☐ $O(n^2)$

Correct!

☒ $O(\log(n))$ ☐ $O(2^n)$ ☐ $O(n!)$ ☐ $O(1)$ **Question 17****1 / 1 pts**

What is the best-case running time for the lookup operation for the following data structure: binary heap (in the way that makes the most sense for this data structure)

Correct!

- ☐ $O(2^n)$
- ☒ $O(1)$
- ☐ $O(n^3)$
- ☐ $O(n)$
- ☐ $O(n^2)$
- ☐ $O(n!)$
- ☐ $O(n \log(n))$
- ☐ $O(\log(n))$

Question 18**1 / 1 pts**

What is the best-case running time for the insert operation for the following data structure: array (sorted) (in the way that makes the most sense for this data structure)

Correct!

- ☐ $O(1)$
- ☐ $O(2^n)$
- ☒ $O(\log(n))$
- ☐ $O(n)$
- ☐ $O(n^2)$
- ☐ $O(n \log(n))$
- ☐ $O(n^3)$
- ☐ $O(n!)$

Question 19**1 / 1 pts**

What is the best-case running time for the lookup operation for the following data structure: array (sorted) (in the way that makes the most sense for this data structure)

Correct!

- ☐ $O(n)$
- ☐ $O(n^3)$
- ☒ $O(1)$
- ☐ $O(n!)$
- ☐ $O(2^n)$
- ☐ $O(n^2)$
- ☐ $O(n \log(n))$
- ☐ $O(\log(n))$

Question 20**1 / 1 pts**

What is the best-case running time for the following algorithm: selection sort

Correct!

- ☐ $O(n)$
- ☐ $O(n \log(n))$
- ☐ $O(\log(n))$
- ☐ $O(n^3)$
- ☒ $O(n^2)$
- ☐ $O(1)$

☐ $O(2^n)$ ☐ $O(n!)$ **Question 21****2 / 2 pts**

Given the following sequence of operations to a stack, what are the final contents of the stack?

[('push', 27), ('push', 7), ('push', 11), ('push', 16), ('push', 23), ('push', 11), ('push', 34), ('push', 39), ('pop',), ('push', 8)]

Specify your answer by separating the values by commas and with the left being the "bottom", so that ('push', 3), ('push', 1), ('push', 10) would have correct answer: 3, 1, 10.

Correct!

27, 7, 11, 16, 23, 11, 34, 8

Correct Answers

27, 7, 11, 16, 23, 11, 34, 8

Question 22**2 / 2 pts**

Given the following sequence of operations to a stack, what are the final contents of the stack?

[('push', 48), ('push', 6), ('push', 12), ('pop',), ('push', 30), ('push', 25), ('pop',), ('push', 7), ('pop',), ('push', 24)]

Specify your answer by separating the values by commas and with the left being the "bottom", so that ('push', 3), ('push', 1), ('push', 10) would have correct answer: 3, 1, 10.

Correct!

48, 6, 30, 24

Correct Answers

48, 6, 30, 24

Question 23**2 / 2 pts**

Given the following sequence of operations to a stack, what are the final contents of the stack?

[('push', 24), ('push', 7), ('push', 49), ('push', 23), ('push', 45), ('pop',), ('push', 30), ('push', 25), ('push', 15), ('push', 28)]

Specify your answer by separating the values by commas and with the left being the "bottom", so that ('push', 3), ('push', 1), ('push', 10) would have correct answer: 3, 1, 10.

Correct!

24, 7, 49, 23, 30, 25, 15, 28

Correct Answers

24, 7, 49, 23, 30, 25, 15, 28

Question 24

2 / 2 pts

Given the following sequence of operations to a queue, what are the final contents of the queue?

[('enqueue', 15), ('enqueue', 46), ('enqueue', 23), ('enqueue', 16), ('enqueue', 36), ('dequeue',), ('enqueue', 14), ('dequeue',), ('enqueue', 18), ('enqueue', 17)]

Specify your answer by separating the values by commas and with the left being the "front", so that ('enqueue', 3), ('enqueue', 1), ('enqueue', 10), ('dequeue') would have correct answer: 1, 10.

Correct!

23, 16, 36, 14, 18, 17

Correct Answers

23, 16, 36, 14, 18, 17

Question 25

2 / 2 pts

Given the following sequence of operations to a queue, what are the final contents of the queue?

[('enqueue', 50), ('enqueue', 32), ('enqueue', 47), ('enqueue', 26), ('enqueue', 9), ('dequeue',), ('dequeue',), ('enqueue', 11), ('enqueue', 33), ('dequeue',)]

Specify your answer by separating the values by commas and with the

left being the “front”, so that ('enqueue', 3), ('enqueue', 1), ('enqueue', 10), ('dequeue') would have correct answer: 1, 10.

Correct!

26, 9, 11, 33

Correct Answers

26, 9, 11, 33

Question 26**2 / 2 pts**

Given the following sequence of operations to a queue, what are the final contents of the queue?

[('enqueue', 48), ('enqueue', 11), ('enqueue', 19), ('enqueue', 31), ('dequeue',), ('enqueue', 18), ('enqueue', 35), ('dequeue',), ('enqueue', 0), ('dequeue',)]

Specify your answer by separating the values by commas and with the left being the “front”, so that ('enqueue', 3), ('enqueue', 1), ('enqueue', 10), ('dequeue') would have correct answer: 1, 10.

Correct!

31, 18, 35, 0

Correct Answers

31, 18, 35, 0

Question 27**2 / 2 pts**

Given the following sequence of operations to a list, what are the final contents of the list?

[('insert', 0, 9), ('insert', 0, 31), ('insert', 2, 29), ('insert', 3, 37), ('insert', 3, 6), ('delete', 3), ('insert', 0, 12), ('insert', 5, 11), ('insert', 4, 2), ('insert', 2, 23)]

Specify your answer by separating the values by commas and with the left being the index 0 (and the “head”), so that ('insert', 5, 0), ('insert', 10, 1), ('insert', 20, 0) would have correct answer: 20, 5, 10.

Correct!

12, 31, 23, 9, 29, 2, 37, 11

Correct Answers

12, 31, 23, 9, 29, 2, 37, 11

Question 28**2 / 2 pts**

Given the following sequence of operations to a list, what are the final contents of the list?

[('insert', 0, 31), ('insert', 0, 48), ('insert', 0, 19), ('insert', 0, 48), ('delete', 1), ('insert', 1, 11), ('delete', 2), ('insert', 2, 46), ('insert', 4, 19), ('insert', 4, 20)]

Specify your answer by separating the values by commas and with the left being the index 0 (and the "head"), so that ('insert', 5, 0), ('insert', 10, 1), ('insert', 20, 0) would have correct answer: 20, 5, 10.

Correct!

48, 11, 46, 31, 20, 19

Correct Answers

48, 11, 46, 31, 20, 19

Question 29**2 / 2 pts**

Given the following sequence of operations to a list, what are the final contents of the list?

[('insert', 0, 13), ('insert', 0, 9), ('insert', 0, 14), ('delete', 0), ('insert', 1, 12), ('insert', 0, 3), ('insert', 3, 20), ('insert', 2, 43), ('insert', 0, 29), ('insert', 7, 38)]

Specify your answer by separating the values by commas and with the left being the index 0 (and the "head"), so that ('insert', 5, 0), ('insert', 10, 1), ('insert', 20, 0) would have correct answer: 20, 5, 10.

Correct!

29, 3, 9, 43, 12, 20, 13, 38

Correct Answers

29, 3, 9, 43, 12, 20, 13, 38

Question 30**2 / 2 pts**

Given the following sequence of operations to a binary search tree, what are the final contents of the tree?

[('add', 49), ('add', 47), ('add', 7), ('add', 13), ('add', 30), ('delete', 30), ('add', 36), ('delete', 7), ('add', 39), ('add', 38)]

Specify your answer by separating the values by giving the contents of the tree by level, so that a full BST with 3 levels containing the numbers 1 to 7 would be listed like this: 4; 2, 6; 1, 3, 5, 7. For the delete operation, you should do the following: if the node is a leaf just remove it, else if the node only has one child then redirect its parent to its child, else replace the node's value with the next larger value in the tree (its left-most descendent on its right)

Correct!

49; 47; 13; 36; 39; 38

Correct Answers

49; 47; 13; 36; 39; 38

Question 31

0 / 2 pts

Given the following sequence of operations to a binary search tree, what are the final contents of the tree?

[('add', 47), ('add', 33), ('add', 13), ('add', 30), ('delete', 33), ('add', 44), ('add', 50), ('add', 29), ('add', 35), ('add', 4)]

Specify your answer by separating the values by giving the contents of the tree by level, so that a full BST with 3 levels containing the numbers 1 to 7 would be listed like this: 4; 2, 6; 1, 3, 5, 7. For the delete operation, you should do the following: if the node is a leaf just remove it, else if the node only has one child then redirect its parent to its child, else replace the node's value with the next larger value in the tree (its left-most descendent on its right)

You Answered

47; 13, 50; 4, 30; 29, 44; 35; 4

Correct Answers

47; 13, 50; 30, 44; 4, 29; 35

Question 32

2 / 2 pts

Given the following sequence of operations to a binary search tree, what are the final contents of the tree?

[('add', 24), ('add', 11), ('add', 5), ('add', 15), ('delete', 5), ('add', 27), ('add', 5), ('add', 48), ('add', 43), ('delete', 24)]

Specify your answer by separating the values by giving the contents of the tree by level, so that a full BST with 3 levels containing the numbers 1 to 7 would be listed like this: 4; 2, 6; 1, 3, 5, 7. For the delete operation, you should do the following: if the node is a leaf just remove it, else if the node only has one child then redirect its parent to its child, else replace the node's value with the next larger value in the tree (its left-most descendent on its right)

Correct!

27; 11, 48; 5, 15, 43

Correct Answers

27; 11, 48; 5, 15, 43

Question 33

2 / 2 pts

Given the following sequence of operations to a hash table with linear probing, what are the final contents of the table?

[('add', 12), ('add', 5), ('add', 20), ('delete', 5), ('add', 7), ('add', 4), ('delete', 12), ('add', 9), ('delete', 9), ('add', 10)]

Give the contents of the array starting from index 0 and using "-" for empty cells. For delete, when an item is deleted put "del" in that cell (inserts/adds can put into an empty or "del" spot). So the answer might look like this: 5, 7, 3, -, 4, del

Use an initial hash table size of 10, hash function $h(\text{value}, \text{table_size}) = \text{value} * 3 \% \text{table_size}$, and only grow the table if it is completely full.

Correct!

20, 7, 4, 10, -, del, del, del, -, -

Correct Answers

20, 7, 4, 10, -, del, del, del, -, -

Question 34

2 / 2 pts

Given the following sequence of operations to a hash table with linear probing, what are the final contents of the table?

[('add', 10), ('add', 16), ('add', 4), ('add', 5), ('delete', 4), ('add', 1), ('delete', 10), ('add', 11), ('add', 8), ('add', 6)]

Give the contents of the array starting from index 0 and using "-" for empty cells. For delete, when an item is deleted put "del" in that cell (inserts/adds can put into an empty or "del" spot). So the answer might look like this: 5, 7, 3, -, 4, del

Use an initial hash table size of 10, hash function $h(\text{value}, \text{table_size}) = \text{value} * 3 \% \text{table_size}$, and only grow the table if it is completely full.

Correct!

del, -, del, 1, 11, 5, 8, -, 16, 6

Correct Answers

del, -, del, 1, 11, 5, 8, -, 16, 6

Question 35

2 / 2 pts

Given the following sequence of operations to a hash table with linear probing, what are the final contents of the table?

[('add', 7), ('add', 6), ('add', 12), ('add', 20), ('add', 1), ('add', 4), ('delete', 20), ('add', 14), ('add', 2), ('add', 11)]

Give the contents of the array starting from index 0 and using "-" for empty cells. For delete, when an item is deleted put "del" in that cell (inserts/adds can put into an empty or "del" spot). So the answer might look like this: 5, 7, 3, -, 4, del

Use an initial hash table size of 10, hash function $h(\text{value}, \text{table_size}) = \text{value} * 3 \% \text{table_size}$, and only grow the table if it is completely full.

Correct!

del, 7, 4, 1, 14, 11, 12, 2, 6, -

Correct Answers

del, 7, 4, 1, 14, 11, 12, 2, 6, -

Question 36

0 / 2 pts

Given the following sequence of operations to a max heap, what are the final contents of the heap?

[('insert', 11), ('insert', 41), ('insert', 43), ('insert', 2), ('insert', 42), ('insert', 2), ('insert', 50), ('insert', 7), ('remove max',), ('insert', 6)]

Specify your answer by giving the heap in order from top to bottom and left to right, separated by commas. A heap with 3 levels containing the numbers 1 to 7 would be listed like this: 7, 5, 6, 1, 2, 4, 3 (assuming that is what the heap ended up looking like after the operations).

You Answered

43, 11, 41, 2, 42, 2, 7, 6

Correct Answers

43, 42, 41, 7, 11, 2, 2, 6

Question 37

0 / 2 pts

Given the following sequence of operations to a max heap, what are the final contents of the heap?

[('insert', 16), ('insert', 10), ('insert', 40), ('insert', 12), ('insert', 28), ('insert', 27), ('insert', 40), ('remove max',), ('insert', 28), ('remove max',),)]

Specify your answer by giving the heap in order from top to bottom and left to right, separated by commas. A heap with 3 levels containing the numbers 1 to 7 would be listed like this: 7, 5, 6, 1, 2, 4, 3 (assuming that is what the heap ended up looking like after the operations).

You Answered

28,26,27,12,16,10

Correct Answers

28, 27, 28, 10, 12, 16

Question 38

2 / 2 pts

Given the following sequence of operations to a max heap, what are the final contents of the heap?

[('insert', 13), ('insert', 22), ('insert', 13), ('insert', 49), ('insert', 17),

('remove max',), ('insert', 36), ('insert', 41), ('remove max',), ('remove max',,)]

Specify your answer by giving the heap in order from top to bottom and left to right, separated by commas. A heap with 3 levels containing the numbers 1 to 7 would be listed like this: 7, 5, 6, 1, 2, 4, 3 (assuming that is what the heap ended up looking like after the operations).

Correct!

22, 17, 13, 13

Correct Answers

22, 17, 13, 13