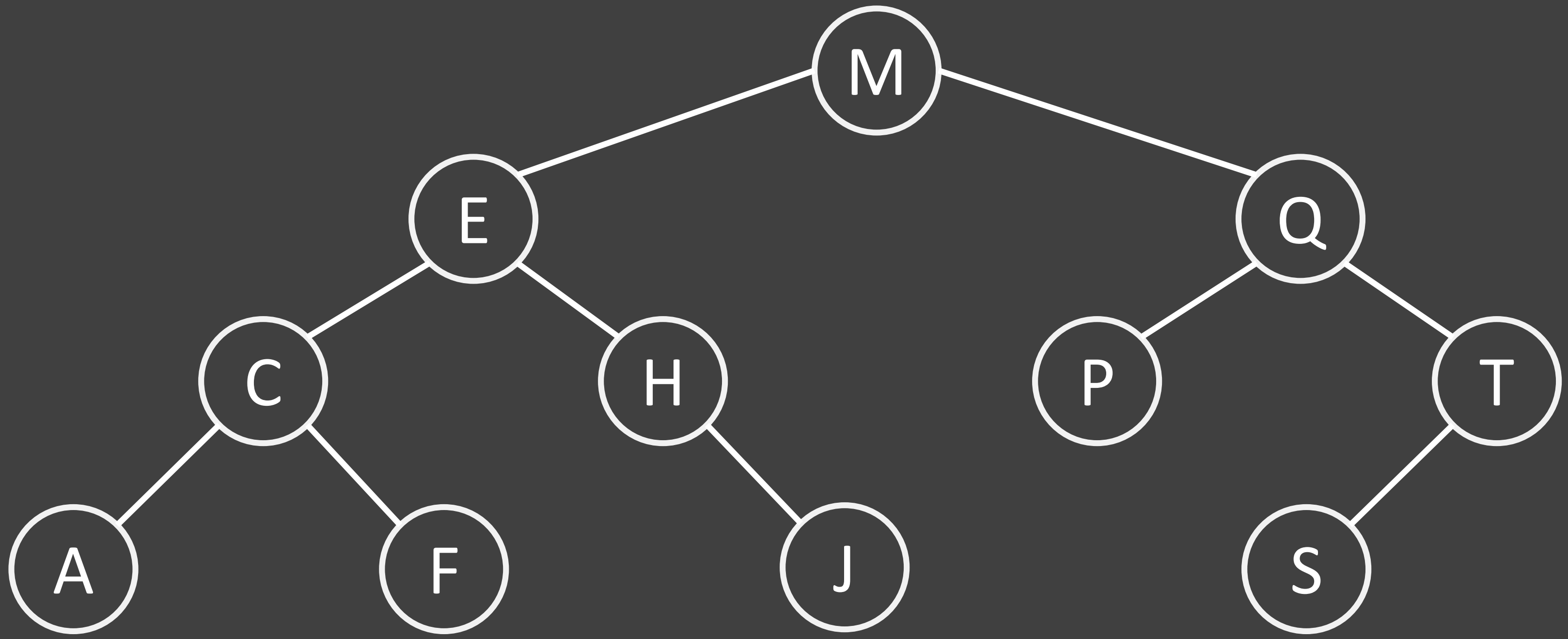
COMP2521 Revision Trivia 1

Question

Perform a pre-order traversal of this tree.



answer

Question

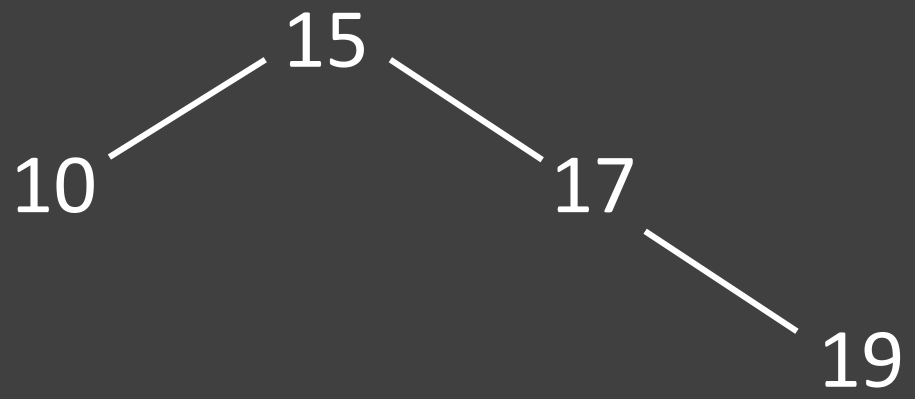
answer

Suppose you are given two sorting programs. You are told that one of them is insertion sort and the other is merge sort, but you are not told which one is which. Describe a test you could run to distinguish them.

Question

answer

Show the result of inserting 1 into the following splay tree

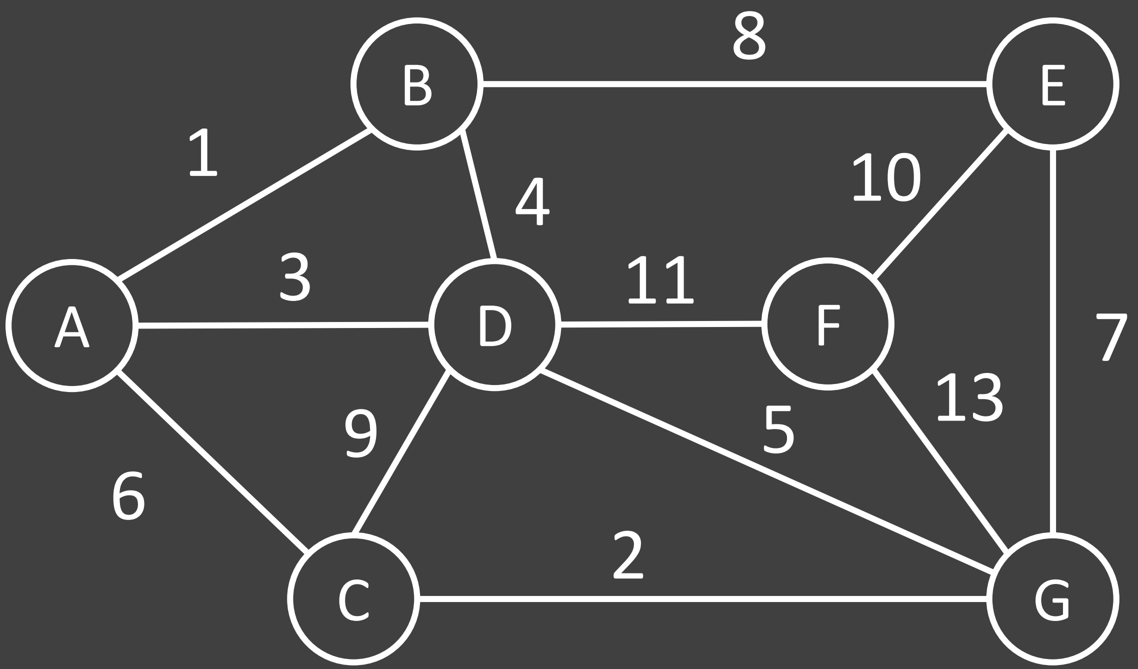


3

Question

answer

Apply Kruskal's algorithm to this graph and show the order that the edges are added to the MST. What is the total cost of the MST?

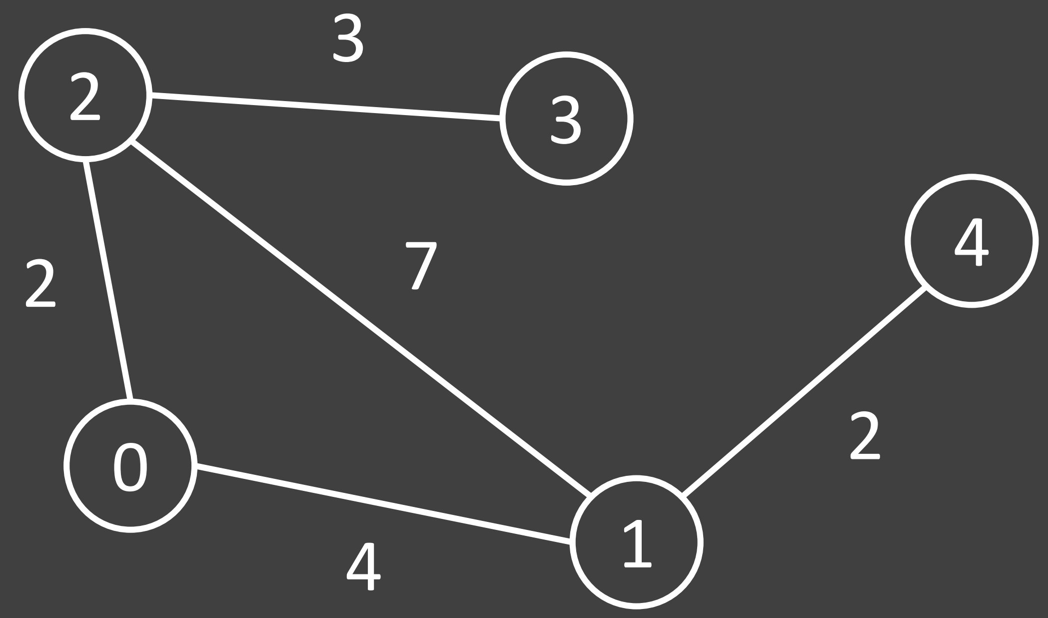


4

Question

Show the pred and dist arrays at each step when performing Dijkstra's algorithm starting from node 3. What is the shortest path from 3 to 4?

answer



Question

answer

a) What is the best case time complexity for inserting *N* elements into a binary search tree?

b) What is the worst case time complexity?

Question

answer

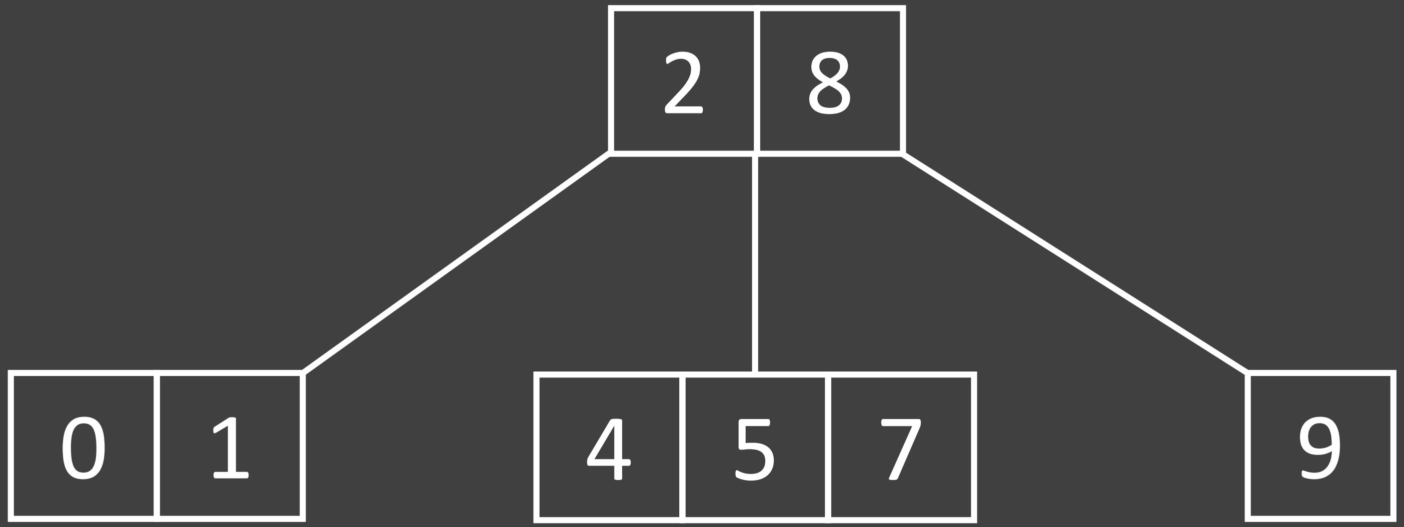
In general, why is it better to choose a random element for the pivot in quick sort, as opposed to always choosing the first or last element?

7

Question

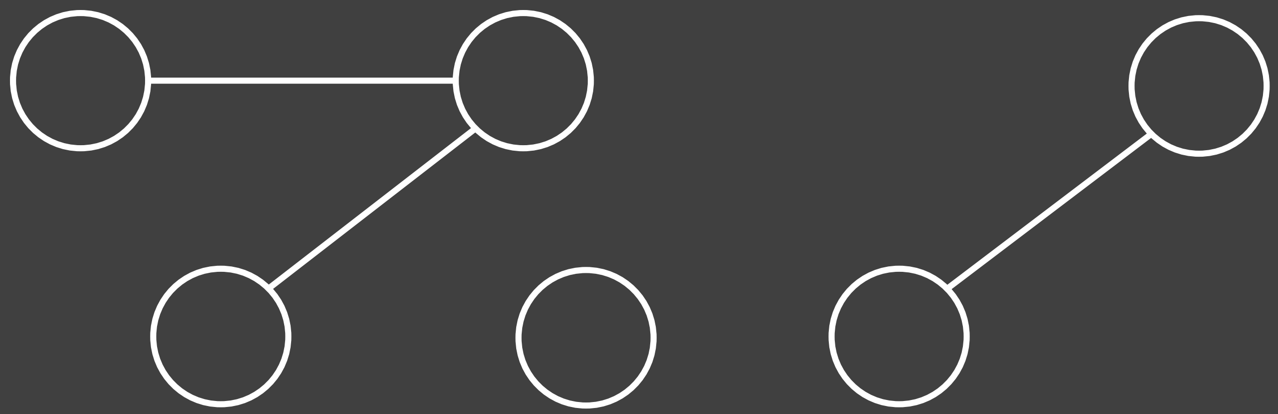
answer

Show the result of inserting a 6 into the following 2-3-4 tree



Question

Suppose that we ran a Minimum Spanning Tree algorithm on a graph, and partway through the algorithm these edges have been added:



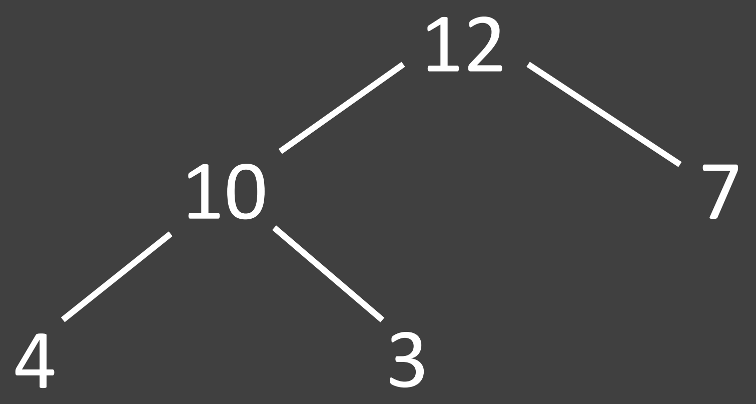
Was Prim’s or Kruskal’s algorithm used? Or could either have been used? Explain.

answer

Question

answer

Consider the following max heap.

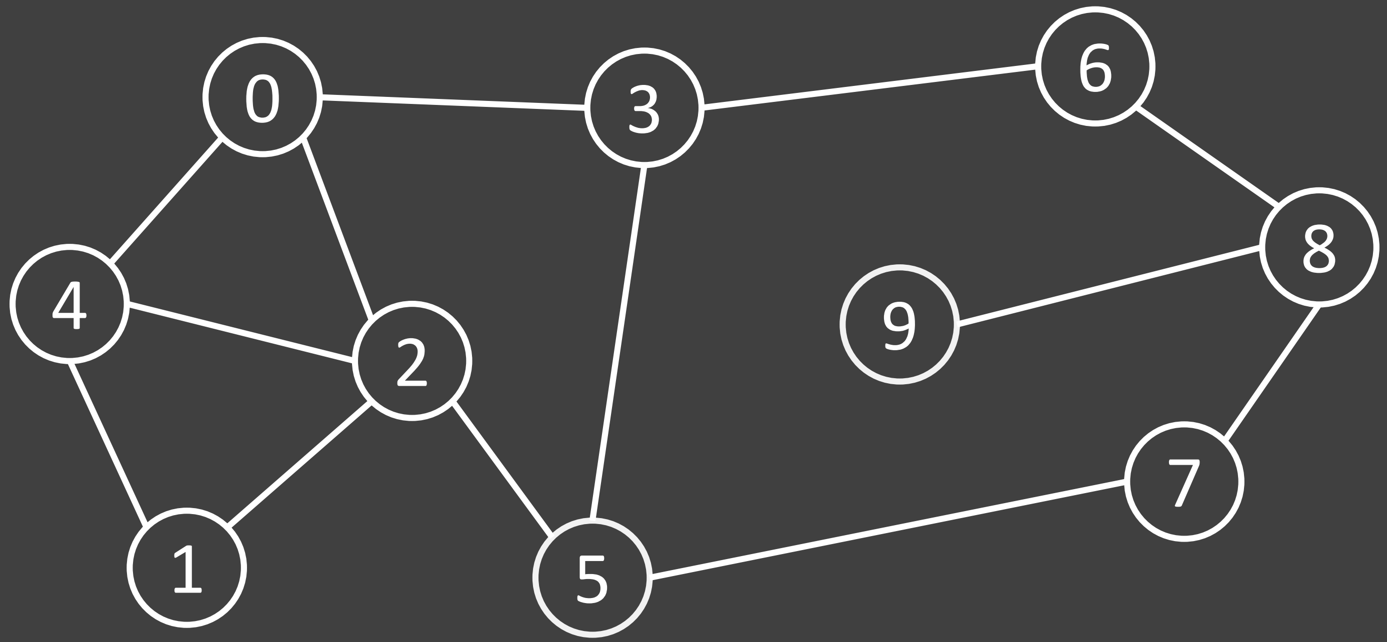


Show the array representation of the heap.

10

Question

Perform a BFS on this graph starting at vertex 0, and list the vertices as they are visited. If a vertex has multiple neighbours, visit the neighbour with the smaller vertex number first.



answer

11

Question

answer

Suppose that the alphabet is { A, B, C, D, E }.
Construct the last occurrence function for this pattern.

E A B A A E D

12

Question

answer

Consider this failure function:

?	?	?	?	?	?	?
0	0	1	0	1	2	3

Come up with a string that would result in this failure function.

Question

Consider the following hash table of size $N = 11$. It uses the hash function $h(x) = x \% 11$, and uses linear probing to resolve collisions.

0	1	2	3	4	5	6	7	8	9	10
	12	2	25	26		17		30	8	21

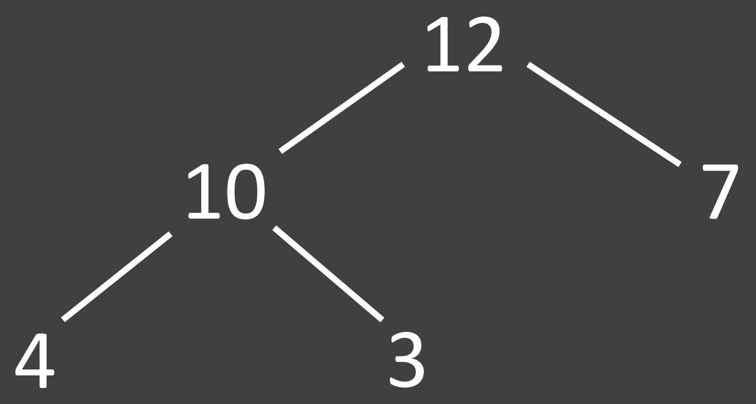
What is the largest number of comparisons that could be made when searching this table for an item? Give an example of such an item. (Note: the item you search for doesn't need to be in the table)

answer

Question

answer

Consider the following max heap.



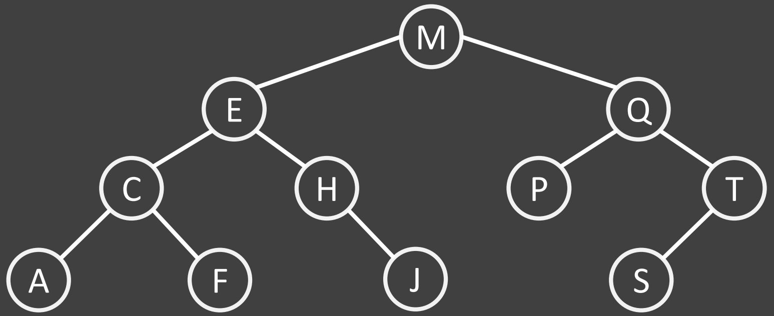
Show the result of inserting 17.

Answers

Answer

question

M E C A F H J Q P T S



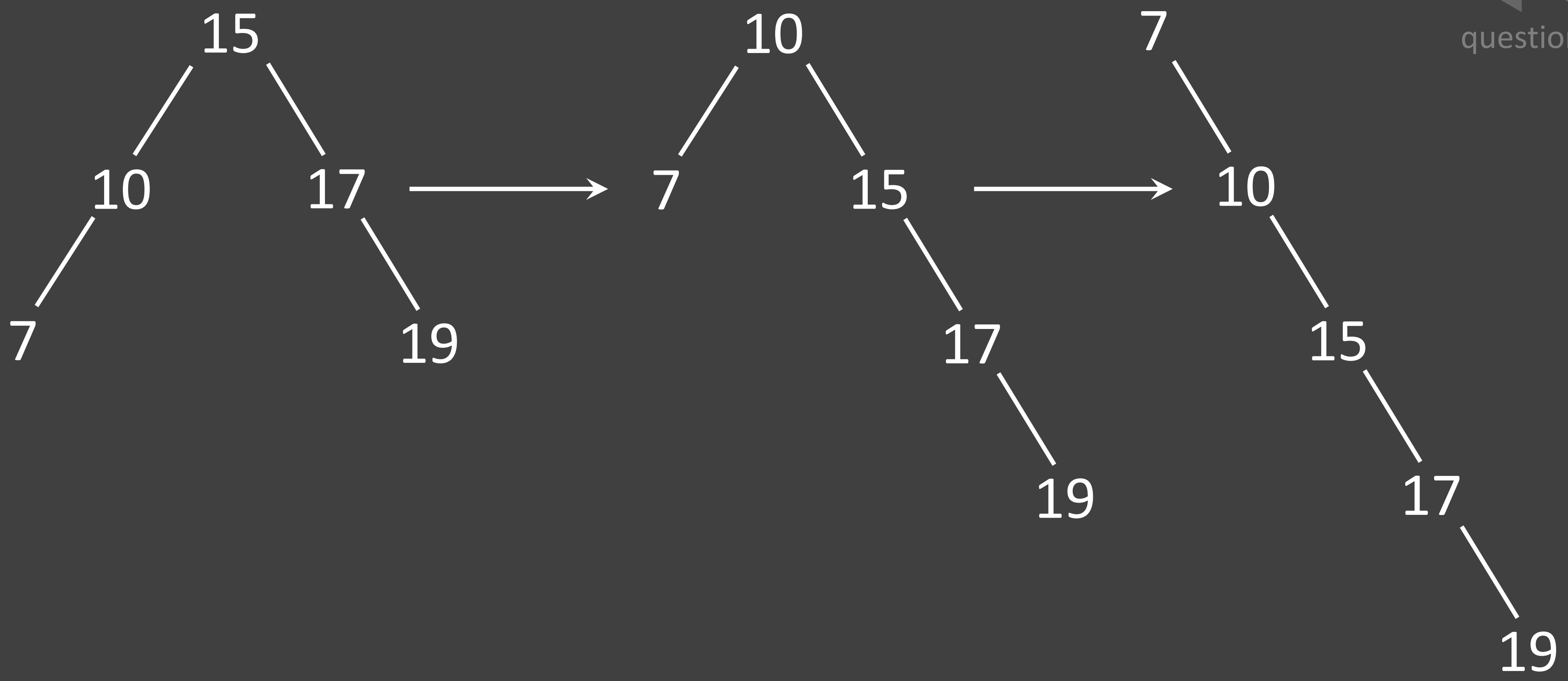
Answer

question

Insertion sort and merge sort differ in their average time complexities – insertion sort is $O(n^2)$ and merge sort is $O(n \log n)$. So you can run timing tests on each sorting program and observe the growth rate of the time taken. The sort that grows faster will be insertion sort.

Answer

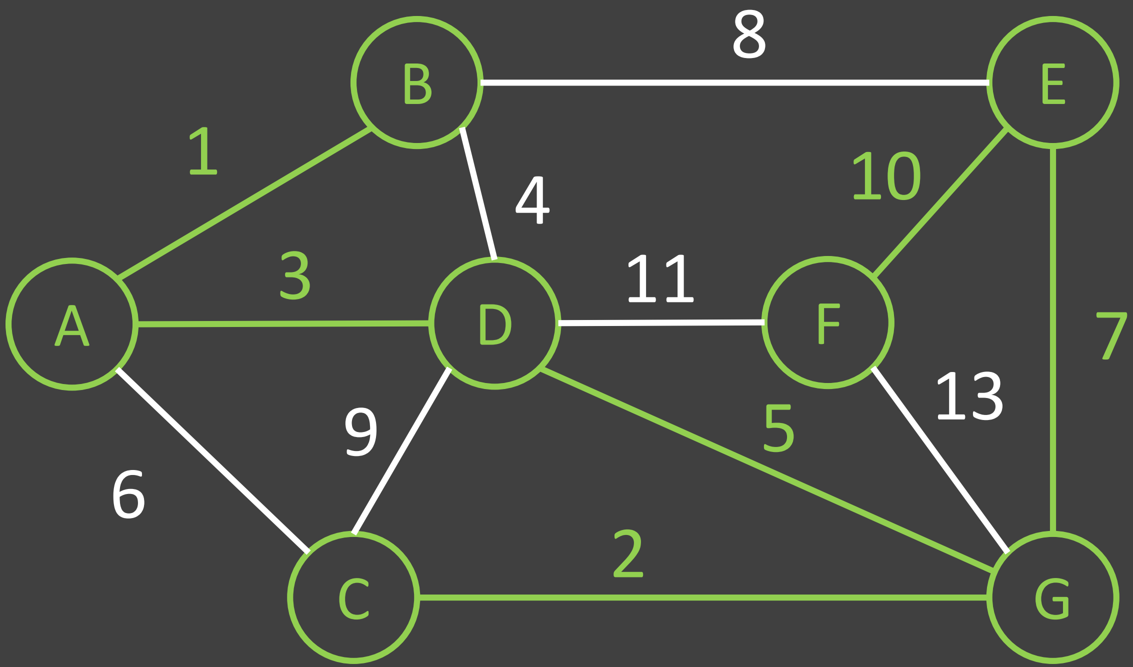
question



Answer

Edges added in order: A-B, C-G, A-D, D-G, E-G, E-F

Total cost: 28



question

Answer

question

	0	1	2	3	4
dist	∞	∞	∞	0	∞
pred	-1	-1	-1	-1	-1

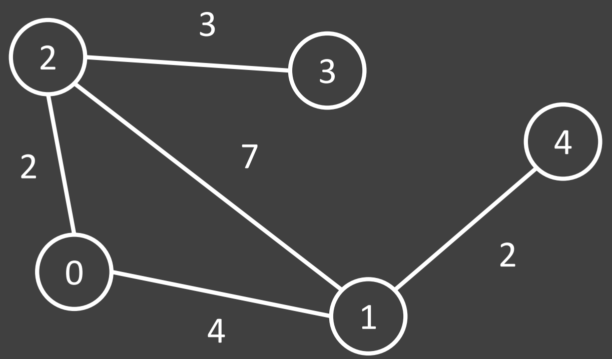
Initial

	0	1	2	3	4
dist	∞	∞	3	0	∞
pred	-1	-1	3	-1	-1

Exploring 3

	0	1	2	3	4
dist	5	10	3	0	∞
pred	2	2	3	-1	-1

Exploring 2



Answer

	0	1	2	3	4
dist	5	9	3	0	∞
pred	2	0	3	-1	-1

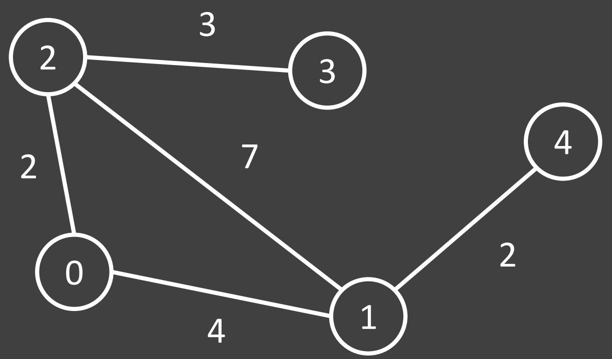
Exploring 0

	0	1	2	3	4
dist	5	9	3	0	11
pred	2	0	3	-1	1

Exploring 1

	0	1	2	3	4
dist	5	9	3	0	11
pred	2	0	3	-1	1

Exploring 4
Final



question

5 (continued)

Answer

question

a)

$O(N \log N)$

b)

$O(N^2)$

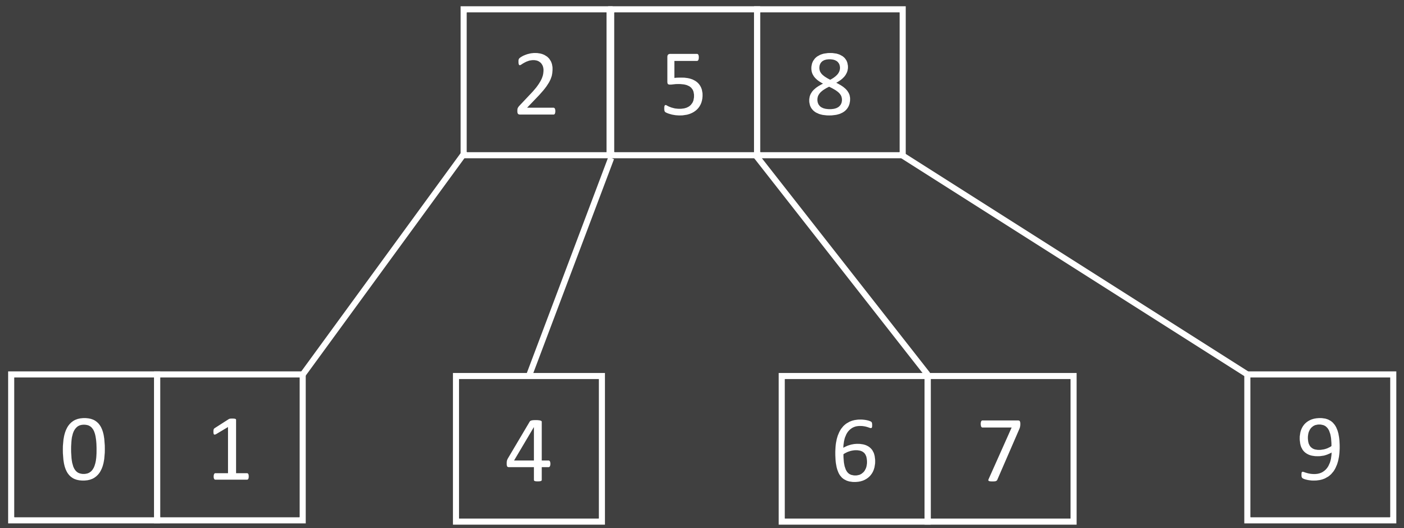
Answer

question

Quick sort performs very poorly ($O(n^2)$) with already-sorted or nearly-sorted input if it always chooses the first or last element as the pivot, due to uneven partitioning. A random pivot solves this problem, and ensures that the algorithm can perform consistently well on any input.

Answer

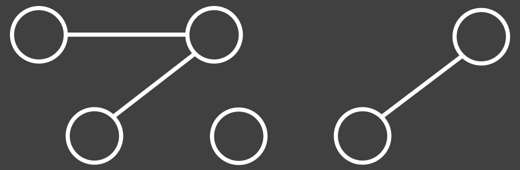
question



question

Answer

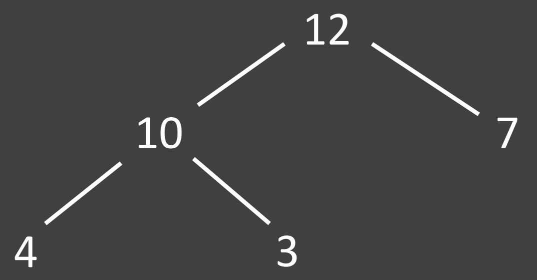
At each step, Prim's algorithm chooses an edge connecting a vertex in the MST to a vertex not yet in the MST, and adds it to the tree. Because it adds edges in this way, the edges in the MST will never be isolated from each other like in the diagram.
So Kruskal's algorithm was used.



Answer

question

	12	10	7	4	3

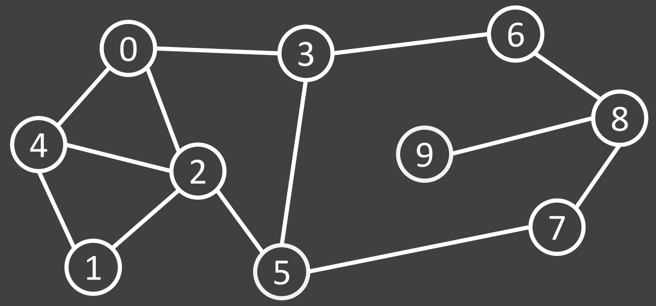


Answer

question

BFS starting at vertex 0:

0 2 3 4 1 5 6 7 8 9



Answer

question

x	A	B	C	D	E
L(x)	4	2	-1	6	5

E A B A A E D

Answer

question

One possible string:

A B A C A B A

?	?	?	?	?	?	?
0	0	1	0	1	2	3

Answer

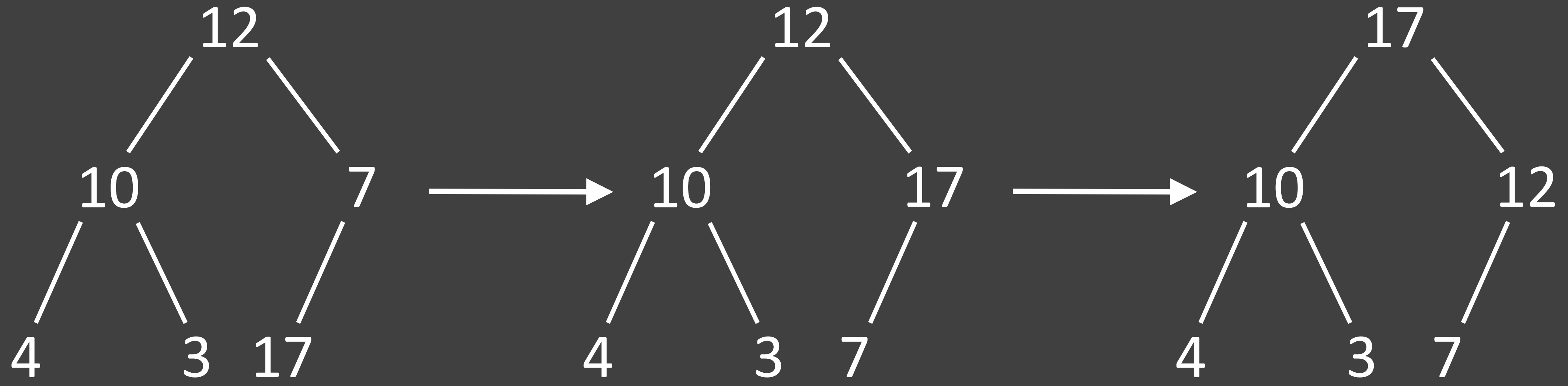
question

The largest number of comparisons that could be made is 4. Some examples that would lead to four comparisons being made are: 23, 34, 45, 56, 67, …

0	1	2	3	4	5	6	7	8	9	10
	12	2	25	26		17		30	8	21

Answer

question



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