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Question 1:

a) DFS

Order of vertex visit: {1,2,3,4,5,6,8,7}

Discovery edges in order of labeling: (1,2), (2,3), (3,4), (4,5), (5,6), (6,8), (5,7)

Back edges in order of labeling: (3,1), (5,3), (6,3), (8,4), (7,4)

b) BFS

Order of vertex visit: {1,2,3,4,5,6,7,8}

Lists Li: L0{(1), L1{(2), (3)}, L2{(4), (5), (6)}, L3{(7), (8)}

Discovery edges in order of labeling: (1,2), (1,3), (3,4), (3,5), (3,6), (4,7), (4,8)

Cross edges in order of labeling: (2,3), (4,5), (5,6), (5,7), (6,8)

Question 2: Dijkstra

a)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| New Vertex | A | B | C | D | E | F | New Edge |
| A | 0 | 5 | ∞ | 10 | ∞ | 4 | --- |
| F | 0 | 5 | ∞ | 9 | ∞ | 4 | (A,F) |
| B | 0 | 5 | 7 | 8 | ∞ | 4 | (A,B) |
| C | 0 | 5 | 7 | 8 | 9 | 4 | (B,C) |
| D | 0 | 5 | 7 | 8 | 9 | 4 | (B,D) |
| E | 0 | 5 | 7 | 8 | 9 | 4 | (D,E) |

b) weight of shortest path spanning tree = 9+7+8+9 = 33

Question 3:

a) Prim-Jarnik algorithm:

Edges in order they are added to MST (direction important): (A,F), (F,D), (D,E), (E,C), (E,B)

Total weight of the MST=14

b) Kruskal’s algorithm

Edges in order they are added to MST: (D,E), (E,C), (C,B), (A,F), (A,B)

Total weight of the MST=14

Question 4:

a) chaining:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  |  | 13 | 3  ->  25 | 15  ->  4 | 5  ->  16 |  |  |  |  |  |

Number of probes to find each key: 5:1, 3:1, 15:1, 25:2, 4:2 , 13:1 , 16:2

Average number of probes to find a key: (10/7) = 1.43

b) quadratic probing:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  |  | 13 | 3 | 15 | 5 | 16 | 25 | 4 |  |  |

Number of probes to find each key: 5:1, 3:1, 15:1, 25:3, 4:3, 13:1, 16:2

Average number of probes to find a key: (12/7) = 1.71

c) double hashing:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 16 |  | 13 | 3 | 15 | 5 |  |  | 28 | 4 |  |

Number of probes to find each key: 5:1, 3:1, 15:1, 25:2, 4:2, 13:1, 16:5

Average number of probes to find a key: (13/7) = 1.86

a) Mergesort tree: (feel free to continue tree in text mode)

45 27 20 25 **⏐** 26 12 40 28 **→** 12 20 25 26 27 28 40 45

1 **→** 1

/ \

45 27 | 20 25->20 25 27 45 26 12 | 40 28->12 26 28 40

/ \ / \

45|27->27 45 20|25->20 25 26|12->12 26 40|28->28 40

/ \ / \ / \ / \

45->45 27->27 20->20 25->25 26->26 12->12 40->40 28->28

b) Quicksort table: (feel free to add more rows)

|  |  |  |
| --- | --- | --- |
| a | b | S |
| - | - | [45, 27, 20, 25, 26, 12, 40, 28] |
| 0 | 7 | [12, 27, 20, 25, 26, 28, 40, 45] |
| 0 | 4 | [12, 25, 20, 26, 27, 28, 40, 45] |
| 0 | 2 | [12, 20, 25, 26, 27, 28, 40, 45] |
| 6 | 7 | [12, 20, 25, 26, 27, 28, 40, 45] |
|  |  | [12, 20, 25, 26, 27, 28, 40, 45] |