



EE441 Data Structures

Example Questions-III

Özgür B. Akan

Department of Electrical & Electronics Engineering
Middle East Technical University

akan@eee.metu.edu.tr

www.eee.metu.edu.tr/~akan



Example Questions



Q1) Consider a 13 element hash table for which $f(\text{key}) = \text{key} \bmod 13$ is used with integer keys. Assuming that linear probing is used for collision resolution, show the table of contents (key and status information) after the following operations are carried out in the given order:

- a) The keys 661, 182, 24, 103 are inserted
- b) The key 24 is deleted;
- c) The keys 103, 24, 1312 are searched- indicate which addresses are probed and what is the search result in each case
- d) What is the final loading factor?



Example Questions



A1)	<u>key</u>	<u>f</u>	a)	<u>location</u>	<u>key</u>
	661	11		0	182
	182	13->0		1	103
	24	11		2	
	103	12		3	
	1312	12		4	
				5	
				6	
c)	103->	probe 12, 0, 1 found		7	
	24->	probe 11, 12, 0, 1, 2 not found		8	
	1312->	probe 12, 0, 1, 2 not found		9	
d)	lf=	3/13		10	
				11	661
				12	24 b)



Example Questions



- Q2)
- a) Show the intermediate states of the data set if QuickSort is applied to sort the following array in ascending order: A:[37,88,2,50,11,27,44]
 - b) Repeat part a) for the array B:[88,50,44,37,27,11,2]
 - c) Show how the elements in this array should be initially organized so that QuickSort succeeds in the shortest possible time



Example Questions



A2)

a) [37,88,2,50,11,27,44]
[2,11,27] 37 [88,50,44]
2 [11,27] 37 [50,44] 88
2, 11, 27, 37, 44, 50, 88

b) [88,50,44,37,27,11,2]
[50,44,37,27,11,2] 88
[44,37,27,11,2] 50,88
[37,27,11,2] 44, 50, 88
[27,11,2] 37, 44, 50, 88
[11,2] 27, 37, 44, 50, 88
2, 11, 27, 37, 44, 50, 88

c) [37,11,2,27,50,44,88]

ÖBA'2004

EE-441 Data Structures

5



Example Questions



Q3) Show schematically the data structure after the following integer keys are inserted into:

a) A Binary Search Tree. (Only the structure after all keys are inserted is required.)

b) A B-Tree of order 3. (Show the structure after the insertion of underlined keys only, i.e., you are required to draw only four B-Trees.)

Data to be inserted, in the sequence below, from left to right:

(30, 40, 50, 20, 60, 80, 70, 10, 35, 55)

ÖBA'2004

EE-441 Data Structures

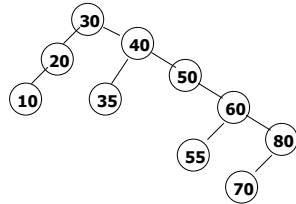
6



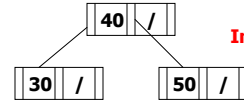
Example Questions



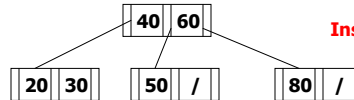
A3) a)



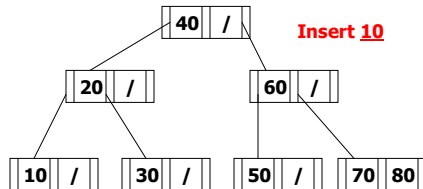
b)



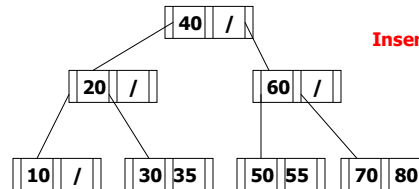
Insert 50



Insert 80



Insert 10



Insert 55

ÖBA'2004

EE-441 Data Structures

7



Example Questions



	key	status
HT 0		
1		
2		
3		
4		
5		
6		

Q4) Consider the hash table HT given above and the hash function $f(\text{key}) = (\text{key} * \text{key}) \bmod 7$. Hash table entries consist of the key value and a status field in which 0=empty, 1=full, -1=deleted.

- a) Show the content of HT after insertion of 3, 7, 1, 5, 6, 4, 8. Assume linear probing in the case of collision.
- b) Repeat part (a) assuming random probing where the pseudo-random number generator PRN returns $\text{PRN}(0)=3, \text{PRN}(3)=5, \text{PRN}(5)=2, \text{PRN}(2)=1, \text{PRN}(1)=4, \text{PRN}(4)=6, \text{PRN}(6)=0$.

ÖBA'2004

EE-441 Data Structures

8



Example Questions



A4)

a)

HT

	key	status
0	7	1
1	1	1
2	3	1
3	6	1
4	5	1
5	4	1
6	8	1

b)

HT

	key	status
0	7	1
1	1	1
2	3	1
3	4	1
4	5	1
5	8	1
6	6	1

ÖBA'2004

EE-441 Data Structures

9



Example Questions



Q5)

```
void Xsort (int &IA[ ], int low, int high)
{
    int lo=low+1;
    int hi=high;
    int elem=IA[low];
    while (True) {
        while (IA[lo]<elem) && (lo<high) {lo++};
        while (IA[hi]>elem) && (low<high) {hi--};
        if (lo<hi) swap(IA[lo],IA[hi]);
        else break;
    }
    swap(IA[low],IA[hi]);
    /* Execution point X */
    if (low<(hi-1)) Xsort(IA,low,hi-1);
    if ((hi+1)<high) Xsort(IA,hi+1,high);
}
```

a) Consider the call Xsort(A,0,6) where

A=[30 12 25 7 9 15 48]

Write the content of the array IA at the execution point X as the function is executed recursively. Indicate also the current values of the variables low and high at that point.

b) Consider the call Xsort(B,0,n-1) where n>8 and

B=[1 2 3 4 ... n-3 n-2 n-1 n]

Write the content of the array IA at the execution point X for the first 3 passes. Indicate also the current values of the variables low and high at that point. How many times will the function Xsort be called to sort B?

ÖBA'2004

EE-441 Data Structures

10



Example Questions



A5)

- a) [30 12 25 7 9 15 48]
[15 12 25 7 9] 30 [48], low=0, high=9
[7 12 9] 15 [25] 30 [48], low=0, high=4
7 [12 9] 15 [25] 30 [48], low=0, high=2
7 [9] 12 15 25 30 [48], low=1, high=2
- b) [1 2 3 4 ... n-3 n-2 n-1 n]
1 [2 3 4 ... n-3 n-2 n-1 n], low=0, high=n-1
1 2 [3 4 ... n-3 n-2 n-1 n], low=1, high=n-1
1 2 3 [4 ... n-3 n-2 n-1 n], low=2, high=n-1