Computer Science Department

Computer 336

Midterm Exam **Date: 23/11/2017**

Student Name: **No.**

Instructor: Iyad Jaber

Question One [25 Marks]

Finding a missing number

An array of elements contains all but one of the integers from 1 to n+1

1. Give the best algorithm you can for determining which number is missing if the array is sorted, and analyze its asymptotic worst-case running time.

2. Give the best algorithm you can for determining which number is missing if the array is not sorted, and analyze its asymptotic worst-case running time.

Solution:

1. Sorted Array:
   Based on binary search

```
public int getMissingInt(int[] array, int start, int end){
start = 0;
end = array.length - 1;
   if(end == start + 1) return array[end] - 1;
   int pivot = start + (end - right) / 2;
   if(array[pivot] ==array[start]+(array[end]-array[start])/2(end - start)%2)

        return getMissingInt(array, pivot, end);
    else
        return getMissingInt(array, start, pivot);
}
```

Time = O(log n).

2. Unsorted array

```
  public int getMissingNo(int array[], int n){
        int i, total;
        total  = (n+1)*(n+2)/2;
        for ( i = 0; i< n; i++)
           total -= a[i];
        return total;
    }
```

Time = O(n).

Question Two [25 Marks]

Huffman code

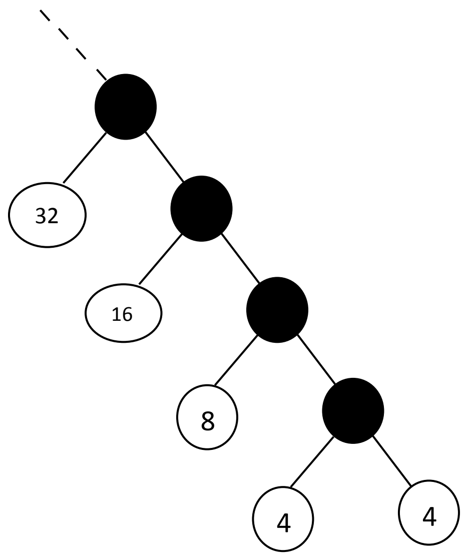
A) Given the frequency series for a Huffman as follows:

$$F(i) = \begin{cases} 4 & i = 1 \\ 2^{i} & i \in \{2 \ldots n\} \end{cases}$$

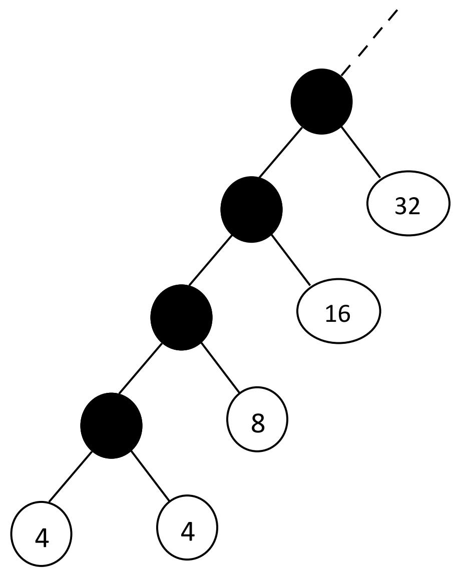
Draw the structure of the Huffman Tree that describes this series.

Solution:

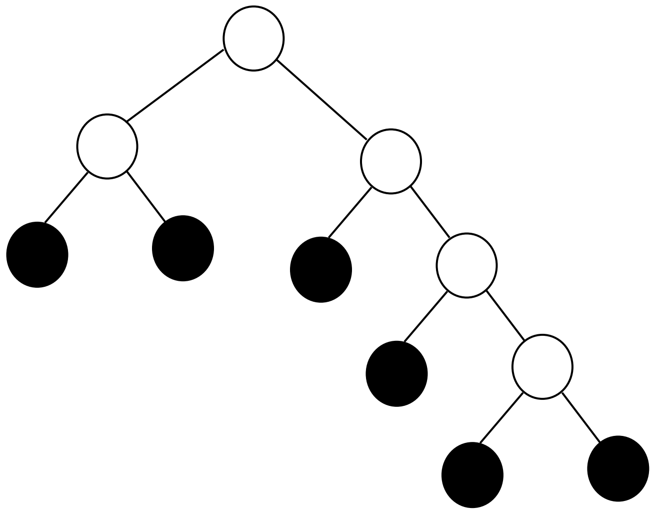
From substitution we get: 4, 4, 8, 16, 32, 64, 128, ……..



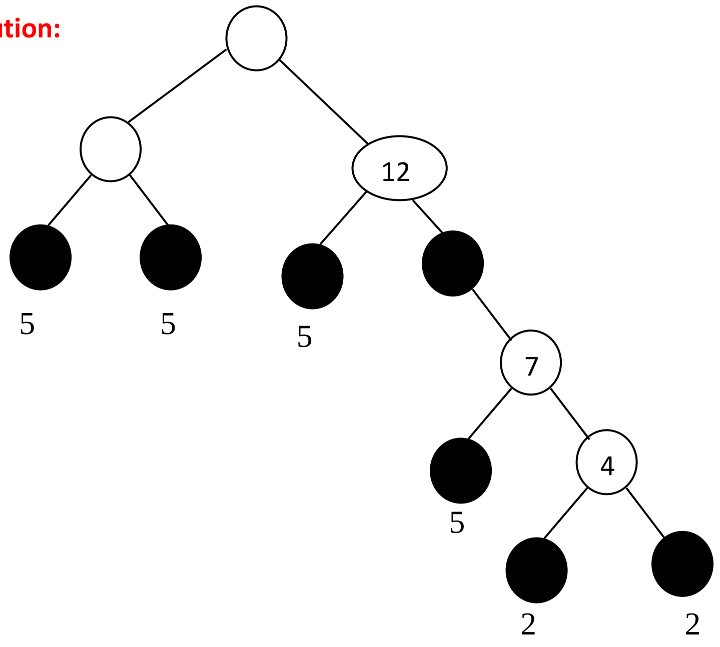
OR



B) Write a frequency list that the Huffman Code of this frequency Would deterministically creat the following structure:



Solution:



Question Three [25 Marks]

(Dynamic Programming) Balanced Partition, You have a set of n integers each in the range 0…k, Partition these integers into two subsets such that (S1- S2 =0), there S1 and S2 denote the sums of the elements in each of the subsets. (The sum of elements in both subsets is same).

Hint: Dynamic Programming $\longrightarrow$

Part[i][j] = true if a subset of $\{arr[0], arr[1], \dots \dots arr[j-1]\}$ has sum equal to i, otherwise false.

If the input

int arr[ ] = {3, 1, 1, 2, 2, 1} ;

Complete the following table:

	{}	{3}	{3, 1}	{3, 1, 1}	{3, 1, 1, 2}	{3, 1, 1, 2, 2}	{3, 1, 1, 2, 2, 3}
0	True	True	True	True	True	True	True
1	False	False	True	True	True	True	True
2	False	False	False	True	True	True	True
3	False	True	True	True	True	True	True
4	False	False	True	True	True	True	True
5	False	False	False	True	True	True	True

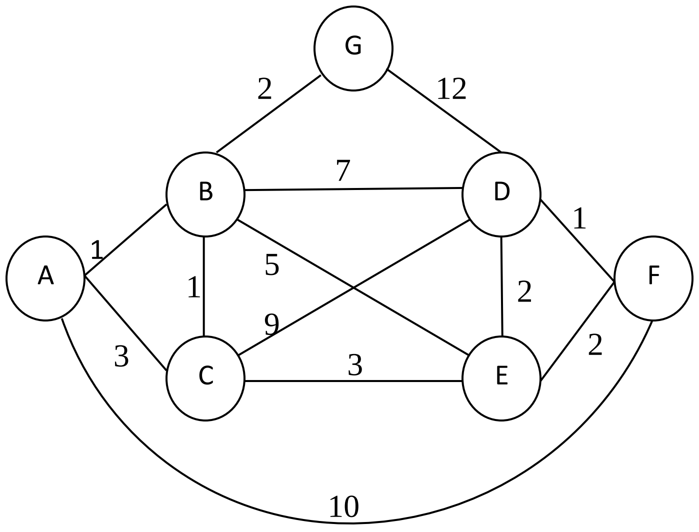
By Maryam Shaheen

Complete the following code:

```
// Returns true if arr[ ] can be partitioned in two subsets of
//equal sum, otherwise false

Boolean findPartion (int arr[ ] , int n){
  int sum = 0;
  int i, j;

// Calculate sum of all elements
 for( i=0 ; i<n ; i++)
   sum += arr[i];

if( sum%2 !=0)
  return false;

Boolean part[sum/2+1][n+1];

//initialize top row as true
for(i=0; i<= n; i++)
part[0][j] = true;

//initialize leftmost column, except part[0][0], as 0
for(i=0; i<= sum/2 ; i++)
part[i][0] = false;

//fill the partition table
for(i=1; i=j ; i++ )
  for( i=1; i<=n ; i++){
     part[i][j] = part[i][j-1];
       if(i> arr[j-1])
          part[i][j] = part[i][j];
    }

Return part[sum/2][n];
}
```

<u>Question Four [25 Marks]</u>

Consider the following undirected, weighted graph:



Step through Dijkstra's algorithm to calculate the single-source shortest paths from A to every other vertex. Show your steps in the table below. Cross out old values and write in new ones, from left to right within each cell, as the algorithm proceeds. Also, list vertices in the order, which you marked them known. Finally, indicate the lowest-cast path from node A to node F.

Solution:

Known vertices (in order marked known): __ __ __ __ __ __ __

Vertex	known	Cost	Path
A	Yes	0	0
B	Yes	1	A
C	Yes	~~3~~ 2	~~A~~ B
D	Yes	~~∞ 8~~ 7	B, E
E	Yes	~~∞ 6~~ 5	~~B~~ C
F	Yes	~~10~~ 7	A, E
G	Yes	~~∞~~ 3	B

Lowest-Cost path from A to F: A B C G E D F Or A B C G E F D

By Maryam Shaheen