Introduction to Algorithm Engineering

Homework-1

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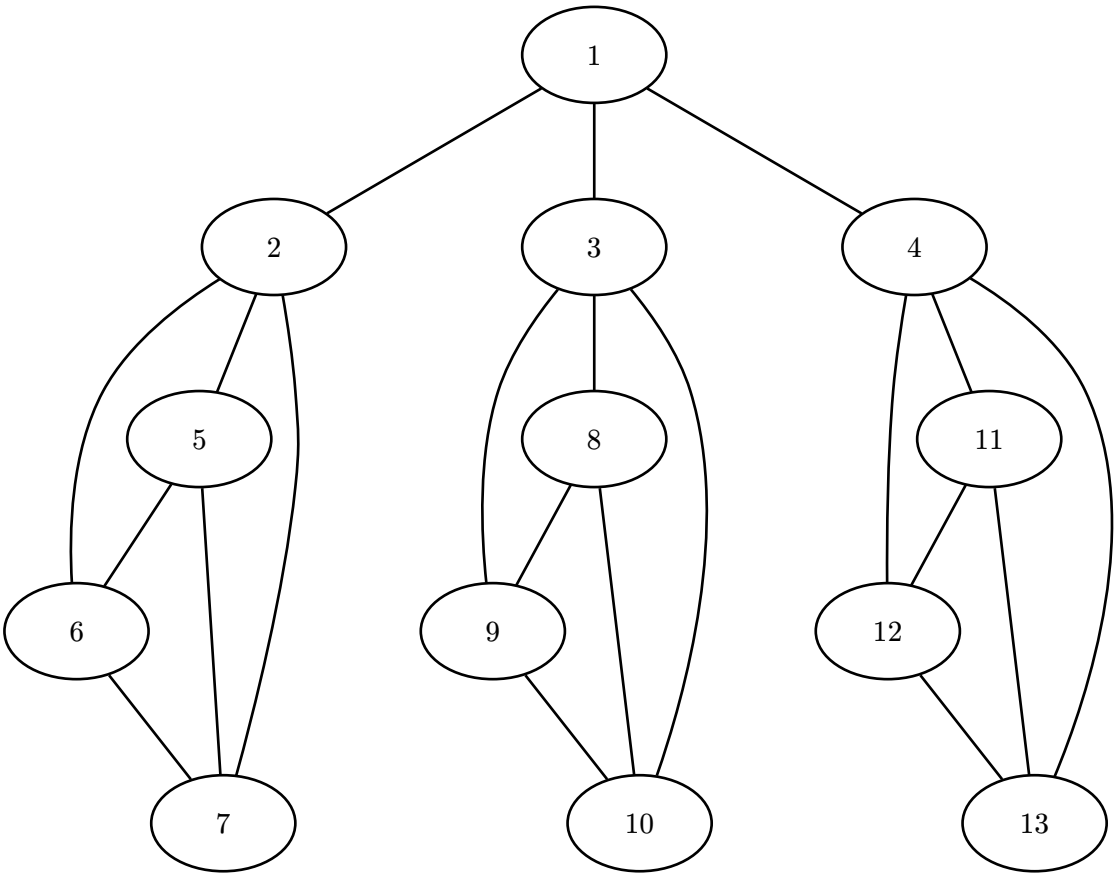
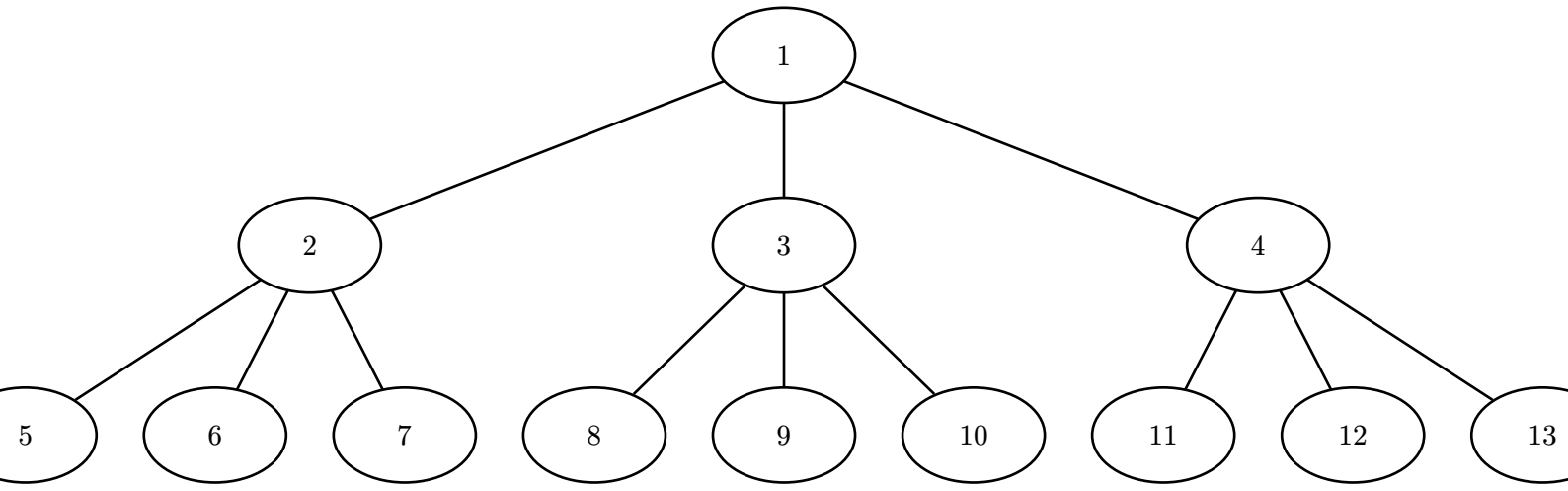
Question 1



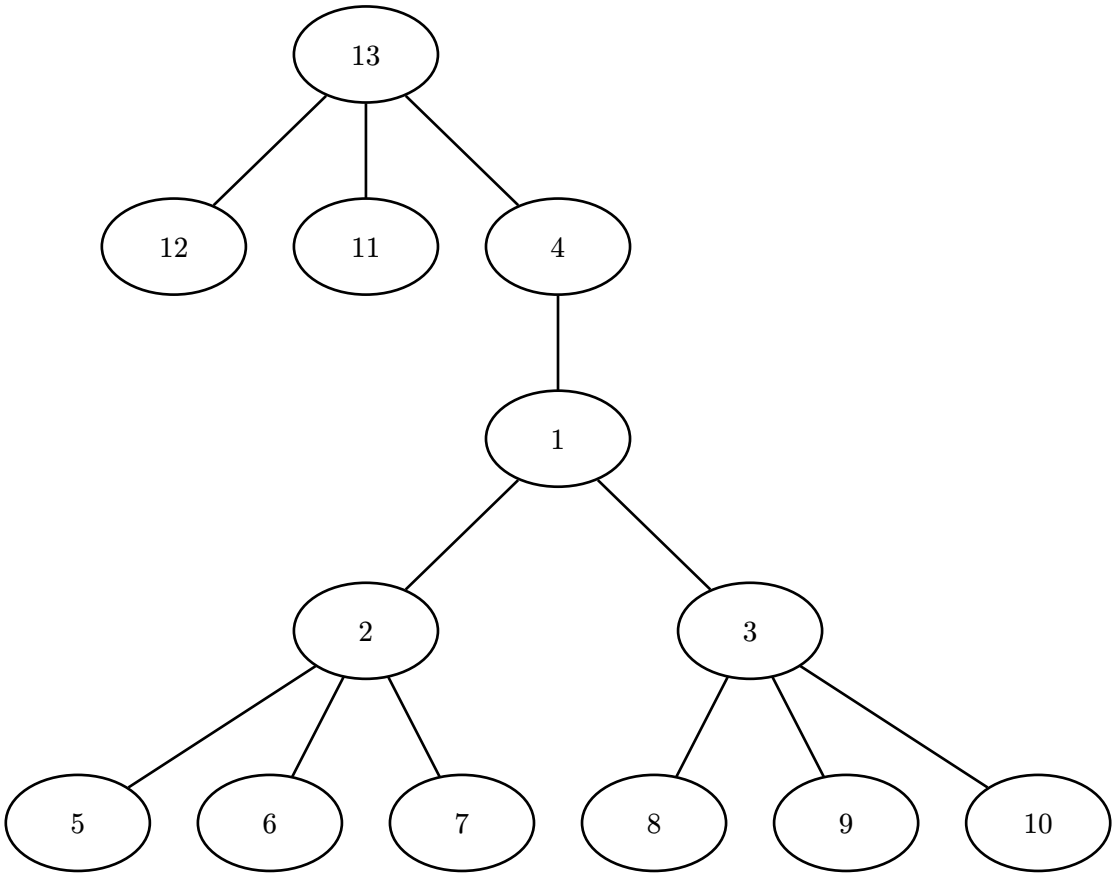
Let us choose node 1 to be the vertex u. We get the following BFS Tree



$\text{ecc}(u) = 2, F_0 = \{1\}, F_1 = \{2, 3, 4\}, F_2 = \{5, 6, 7, 8, 9, 10, 11, 12, 13\}, i = 2, \text{lb} = 2, \text{ub} = 4$

Let us start the BFS traversals from the bottom right

First, we perform BFS on node 13, and get the following BFS tree



$$\text{ecc}(13) = 4 > 2 * (i - 1), \text{since } i = 2$$

Thus, we terminate the BFS and find that the diameter is 4.

We required a total of 2 BFS calls in this example.

Question 2

Commands used:

- `lscpu`
- `dmidecode`

CPU

Architecture	x86_64
Op Modes	32-bit, 64-bit
Address sizes	48-bits physical, 48-bits virtual
Byte order	Little Endian
CPUs	16

VendorID, Model Name	AuthenticAMD, AMD Ryzen 7 5800H
CPU Family	25
Model	80
Threads per core	2
Cores per socket	8
Sockets	1
Max MHz	4463
Min MHz	400
Cache size KB	512

Cache

	L1_Data	**L1_Instruction**	**L2**	**L3**
Size	8x 32 KB	8x 32 KB	8x 512 KB	16 MB
Associativity	8-Way Set Associative	8-Way Set Associative	8-Way Set Associative	16-Way Set Associative
Access Times	1.67ns	1.67ns	10.1ns	75.7ns

RAM

Type	DDR4
Size	16 GB
DRAM Frequency	1600 MHz

Question 3

The pseudocode for transposing an $n \times n$ matrix A and storing it in B is as follows

```
MatrixTranspose(A, B, N)
Begin
  for i = 1 to N do
    for j = 1 to N do
      B[j][i] = A[i][j]
    end-for
  end-for
End
```

Since we are reading matrix A in row-order, we get $\frac{N^2}{B}$ cache-misses while reading

Since we are writing to matrix B, the I/O operations is N^2 writes

Thus, the total number of I/O operations is $N^2 + \frac{N^2}{B}$