



|  |                                    |
|--|------------------------------------|
| KURSKOD / COURSE CODE<br><b>D 0 0 4 1 D</b>  | PROV / TEST CODE<br><b>0 0 0 1</b> |
| KURSBENÄMNING / COURSE NAME<br><b>Datastrukturer och algoritmer</b>                          |                                    |
| PROVBENÄMNING / TEST NAME<br><b>Tentamen</b>   |                                    |
| TENTAMENSDATUM / EXAMINATION DATE<br><b>2 0 1 9 - 0 5 - 2 7</b>                              |                                    |
| TENTAMENSORT/CITY (för distansstudenter / for off campus students only)<br><b>Skellefteå</b> |                                    |

AAAAMMDD-XXXX  
YYYYMMDD-XXXX



|         |               |                               |
|---------|---------------|-------------------------------|
| PROGRAM | INSKR.ÅR/YEAR | ANTAL SIDOR /<br>NO. OF PAGES |
|         |               | <b>07</b>                     |

### Skanningsblad/Scanning Sheet

Behandlat  
uppgift nr (sätt x) /  
Mark the questions you  
answered with an X

Lärarens anteckningar / Teacher's notes

|    |                      |      |                |
|----|----------------------|------|----------------|
| 1  | X                    | 20   |                |
| 2  | X                    | 4    |                |
| 3  | —                    | 0    |                |
| 4  | X                    | 9.5  |                |
| 5  | X                    | 10   |                |
| 6  | X                    | 8    |                |
| 7  | X                    | 5    |                |
| 8  |                      |      |                |
| 9  |                      |      |                |
| 10 |                      |      |                |
| 11 |                      |      |                |
| 12 |                      |      |                |
| 13 |                      |      |                |
| 14 |                      |      |                |
| 15 |                      |      |                |
| 16 |                      |      |                |
| 17 |                      |      |                |
| 18 |                      |      |                |
|    | Poängsumma<br>Points | 56.5 | Betyg<br>Grade |
|    |                      |      | 3              |

35065

Tentamensomslag skall alltid inlämnas även om ingen uppgift behandlats  
Examination cover should always be submitted even if no questions are answered



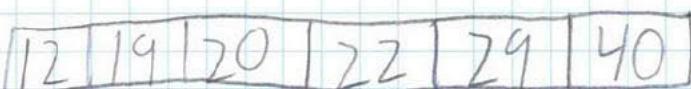
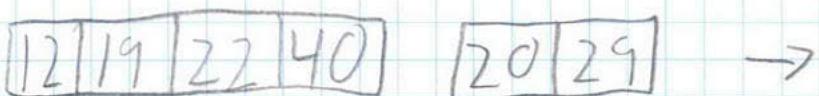
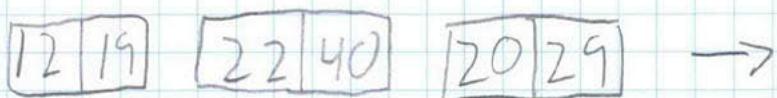
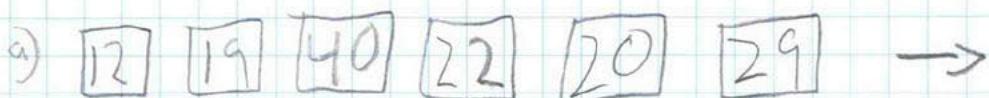
Uppgift nr:

1

Poäng:

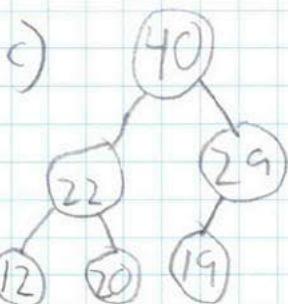
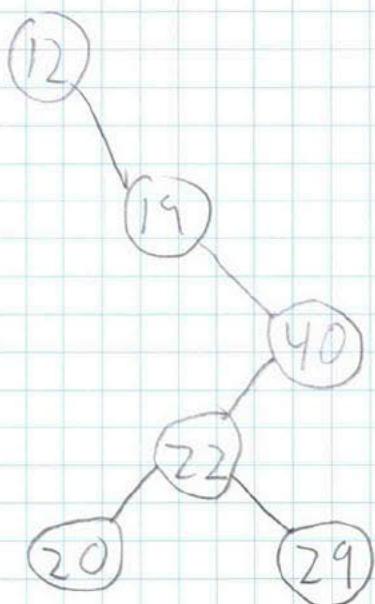
20

Lärarens  
anteckning:



Not the top-down  
mergesort.

b)



d)

|    |   |                                |
|----|---|--------------------------------|
| 40 | 0 | $x = \text{position in table}$ |
| 20 | 1 | $a = \text{element}$           |
| 12 | 2 | $i = \text{times}$             |
| 22 | 3 | $\text{collision has}$         |
| 29 | 4 | $\text{been encountered}$      |
|    | 5 |                                |
|    | 6 |                                |
|    | 7 | $x = (a + i) \bmod 10$         |
|    | 8 |                                |
|    | 9 |                                |
| 19 |   |                                |

Uppgift nr:

2

Poäng:

4

Lärarens  
anteckning:

a) True, as if  $f(n)$  has a runtime of  $O(g(n))$ , and  $g(n)$  is faster than  $h(n)$ , then  $f(n)=O(h(n))$  must also be true. incomplete. - Ip

$$g(n) = \frac{1}{5} h(n) < h(n)$$

b) ~~True~~, as  $f(n) < h(n)$  essentially means the same thing as  $f(n)=O(h(n))$ , and  $f(n)=O(g(n))$  essentially means  $f(n) < g(n)$ . X

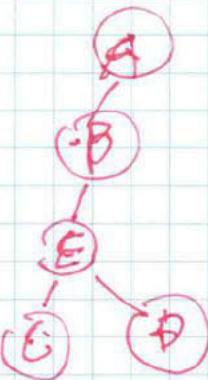
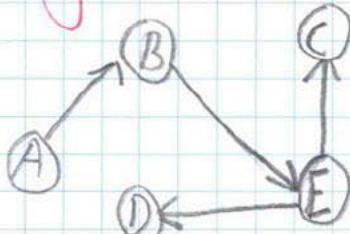
9) ABCDE  
A - 6 - 7 -  
B - - 5 8 - 4  
C - - 2 - - -  
D - - - 4 - -  
E - - 7 9 -

A: B, C  
B: C, D, E  
C: B  
D: C  
E: C, D

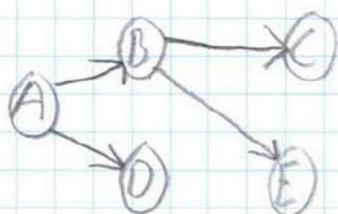
linked lists.  
- 0.5p

array

5) Depth-first;



Breadth-first:



6) ~~has an infinite amount of topological order~~, because there exists cycles within the graph.

No topo. orderings

Uppgift nr:

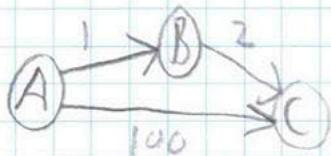
5

Poäng:

10

Lärarens  
anteckning:

3) False. For example, a graph that looks like this:



Would have a different shortest path from A to C if 1000 was added to every edge.

4) True, as the amount of edges will always be the same, and the shortest edges will still be the shortest. Taking the graph from 3), 1001 and 1002 are still both smaller than 1100.

Uppgift nr:

6

Poäng:

Lärarens  
anteckning:The Algorithm (Array A)  
{ $\text{UpperLimit} = n, \quad // n = A \text{ size}$  $\text{LowerLimit} = 1$  $\text{Midpoint} = \frac{\text{Upperlimit}}{2}$ while ( $\text{LowerLimit} \leq \text{UpperLimit}$ )

{

if ( $A[\text{Midpoint}] = \text{Midpoint}$ )  
    return true;else if ( $A[\text{Midpoint}] < \text{Midpoint}$ )

LowerLimit = Midpoint + 1

else if ( $A[\text{Midpoint}] > \text{Midpoint}$ )

UpperLimit = Midpoint - 1

 $\text{Midpoint} = (\text{UpperLimit} + \text{LowerLimit}) / 2$ 

}

return false

}

Test:

$$A = \{-5, -2, -1, 4, 12, 13, 15, 17, 20, 30\}$$

$$\text{UpperLimit} = 10$$

$$\text{LowerLimit} = 1$$

$$\text{Midpoint} = 5$$

$$A[5] = 12 \rightarrow \text{Upperlimit} = 4 \rightarrow \text{Midpoint} = 3 \Rightarrow$$

$$A[3] = -1 \rightarrow \text{Lowerlimit} = 4 \rightarrow \text{Midpoint} = 4 \Rightarrow$$

$$A[4] = 4 \rightarrow \text{Return true}$$

Correctness?

→ 2 p

Uppgift nr:

7

Poäng:

5

Lärarens  
anteckning:

The Algorithm (float x) array A)  
{

i = 1

j = 1

n = A.size

While (j ≤ n)

{

if ( $\sum_{k=i}^j A[k] = x$ )

return true

else if ( $\sum_{k=i}^j A[k] < x$ )  
j++

else if ( $\sum_{k=i}^j A[k] > x$ )  
{

if (j > i)

i++

else

j++, i++  
}

}

return false

}

Some more details (computation)  
are needed in order to  
obtain a solution ~~with~~ a  
linear running time

- 5 p