LULEÅ TEKNISKA UNIVERSITET

KURSKOD / COURSE CODE	PROV / TEST CODE
D0041D	0001

KURSBENÄMNING / COURSE NAME

Datastrukturer och algoritmer

PROVBENÄMNING / TEST NAME

Tentamen

TENTAMENSDATUM / EXAMINATION DATE

2021-06-03

TENTAMENSORT/CITY (för distansstudenter / for off campus students only)

ÅÅÅÅMMDD-XXXX
YYYYMMDD-XXXX

PERSONNUMMER / PERSONAL NUMBER

20000302-5095

NAMN (TEXTA) / FULL NAME

Morgan Nyman

NAMNTECKNING / YOUR SIGNATURE

PROGRAM	INSKR.ÅR/YEAR	ANTAL SIDOR / NO. OF PAGES

Skanningsblad/Scanning Sheet

Behandlat uppgift nr (sätt x) / Mark the questions you answered with an X			Lärarens anteckningar / Teacher's notes
1	X	12	
2	X	2	
3	X	15	
4	X	3,0	
5	X	7,0	
6	—	0	
7	—	0	
8			
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10			
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14			
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18			
	Poängsumma / Points	39	Betyg / Grade: U

23294

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

Utskriven 2021-06-07 kl. 12:45:50

Sida 1
uppgift 1

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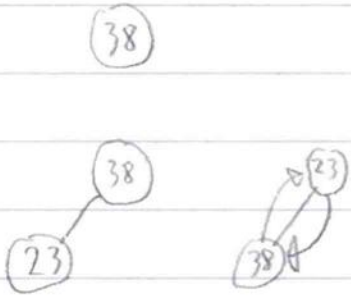
a) min-heap

13	18	23	38	28
0	1	2	3	4

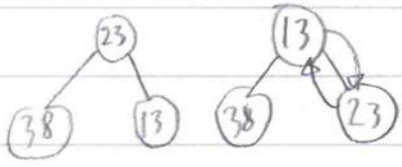


~~38~~, ~~23~~, ~~13~~, ~~38~~, ~~18~~

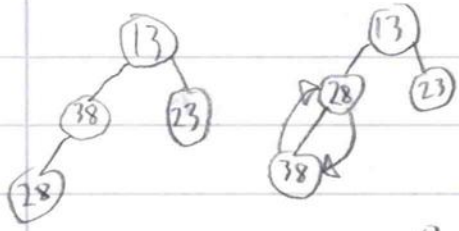
I insert new node at the last index

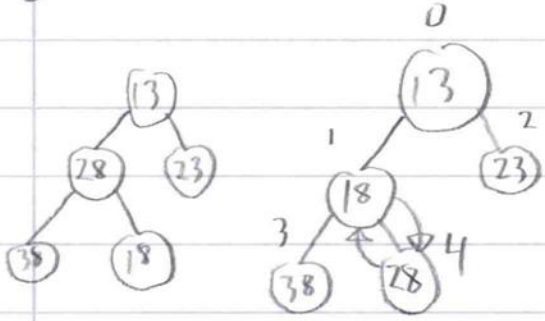
II swap the smallest child node with it's parents all the way up the tree (heapify)

III repeat



(Note: all parent nodes should be less than or equal to their child nodes)





Sida 2
uppgift 1

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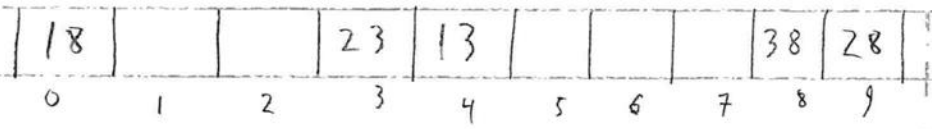
b)



38, 23, 13, 28, 18

I attempt to put the value at the index given by h(x,i) if index is occupied, increment i and run h(x,i) again (linear probing)

$h(x, i) = (x \bmod 10 + i) \bmod 10$

$h(38,0) = 8$ insert

$h(23,0) = 3$ insert

$h(13,0) = 3$ occupied

$h(13,1) = (13 \bmod 10 + 1) \bmod 10 = 4$ insert

$h(28,0) = 8$ occupied

$h(28,1) = (28 \bmod 10 + 1) \bmod 10 = 9$ insert

$h(18,0) = 8$ occupied

$h(18,1) = (18 \bmod 10 + 1) \bmod 10 = 9$ occupied

$h(18,2) = (18 \bmod 10 + 2) \bmod 10 = 0$ insert

-- end --

Sida 3
uppgift 1

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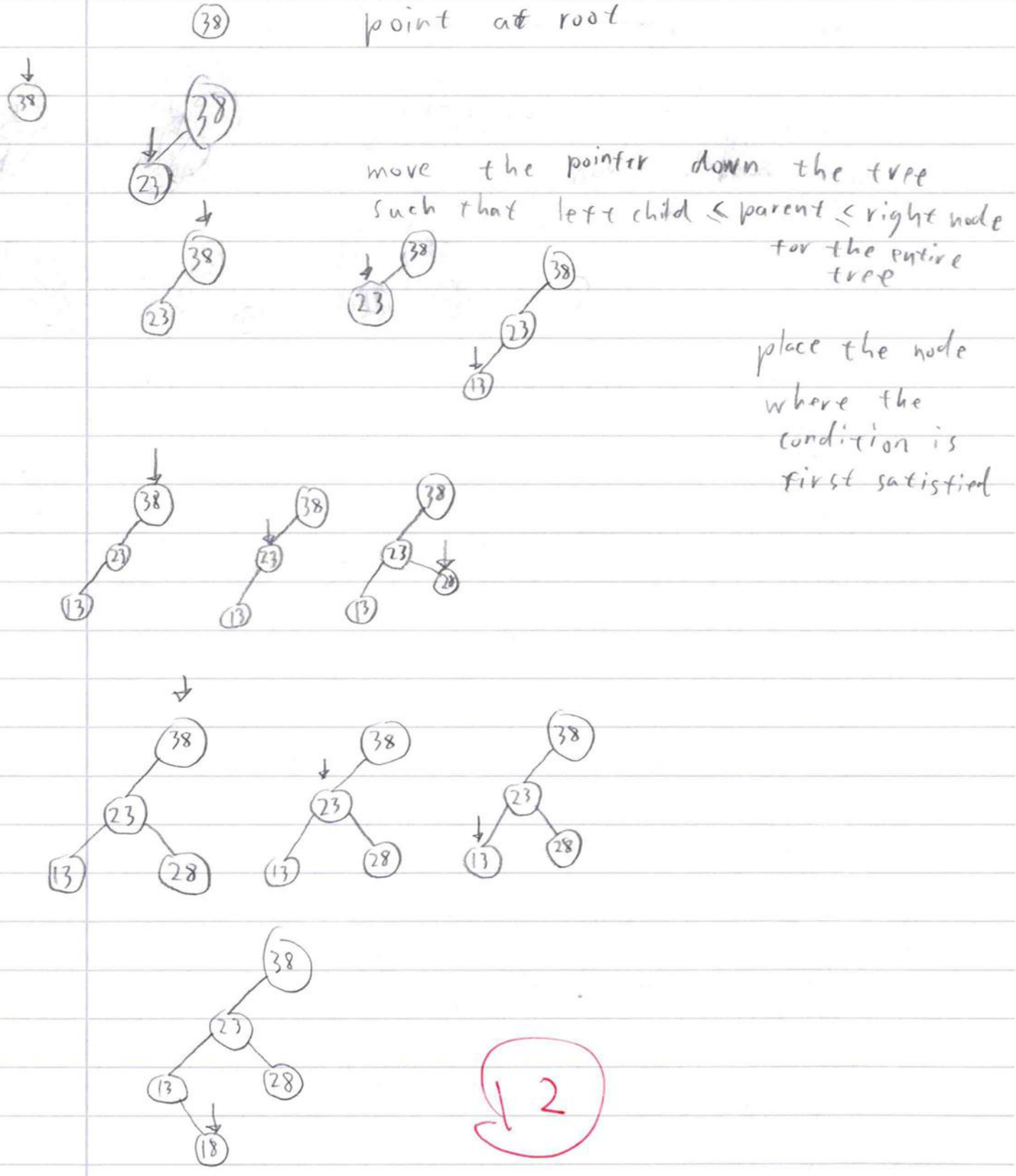
c) binary search tree 38, 23, 13, 28, 18



12

Uppgift 2
sida 4

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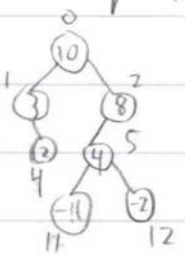
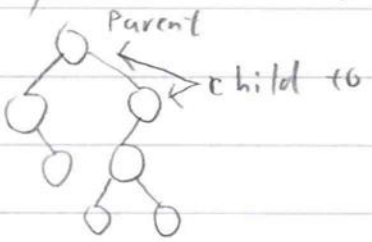
a) (2)

max heap example



not a heap →

binary tree example



-2p traverse the tree T. check that parent of the binary tree T is greater than or equal to it's children (or in array form: index $n \in T$, $n \geq 2n+1$ and $n \geq 2n+2$).
If at least one node return false on the check. T is not a Max heap, if the search ends with all conditions met, you have a max-heap.

b) def isBinSearchTree(T):

-4p X

```
    for n in range(len(T)): # as an array
        if 2*n+1<=n<=2*n+2:
            continue
        else:
            return false
    return true
```

isBinSearchTree(T)

Sida 5
uppgift 3

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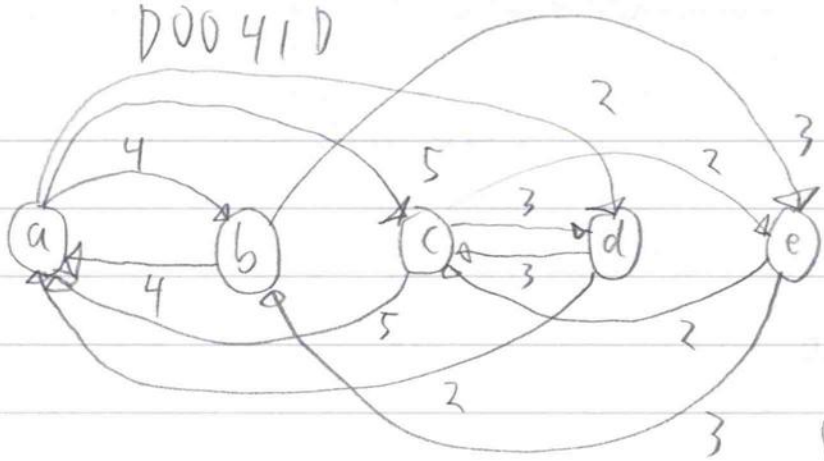
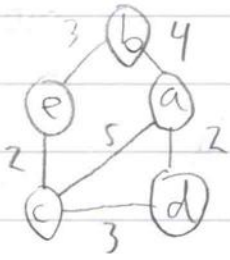
a)



the graph



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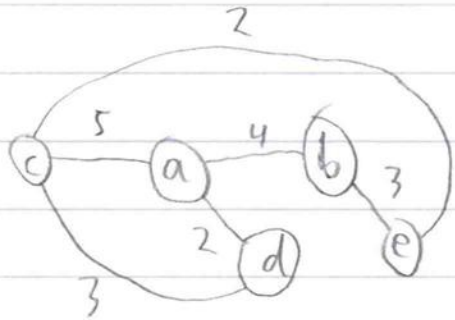
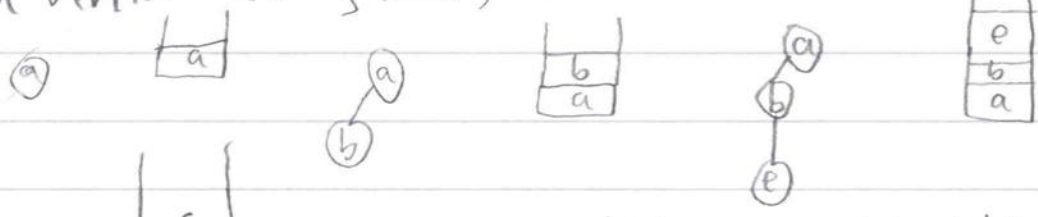
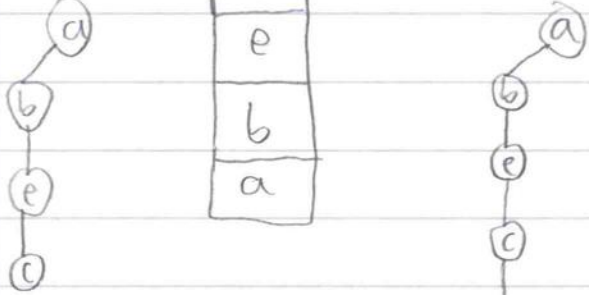
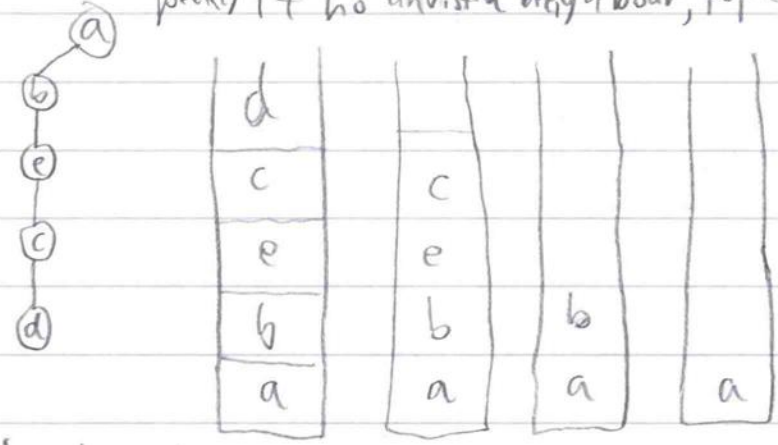


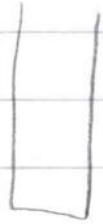
b) add vertice to stack, move to oneof it's neighbour



peek() if no unvisited neighbour, pop()







when all verticies has been popped from the stack the DFS returns the path.

Sida 6
uppgift 3

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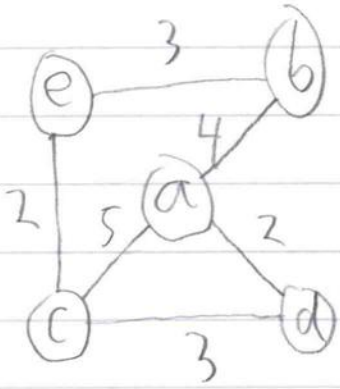
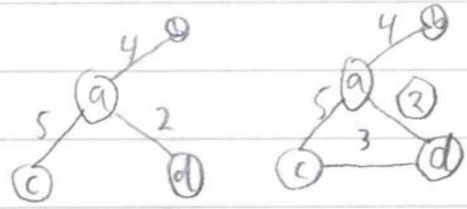
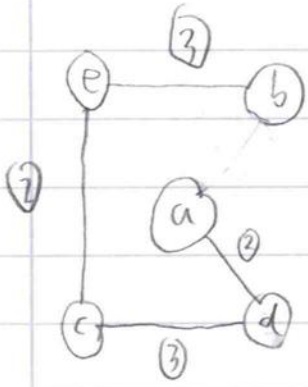
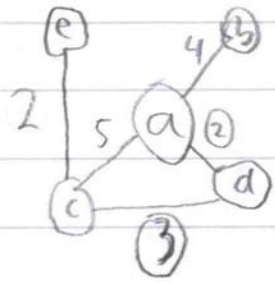
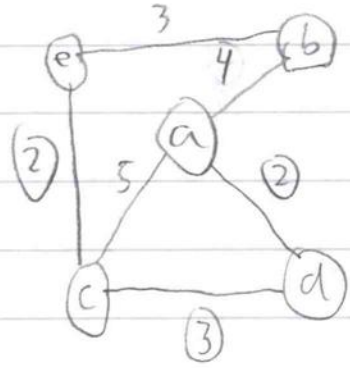
c) i. prims algorithm, start at (a). I add the shortest edge not in to a node that is in the tree. I reveal the new edge cases.











Prim order

order: a-d , d-c , c-e , e-b
0 1 2 3

ii. kruskal's algorithm add the lowest weight edge to the spanning tree. it both of it's neighbour isn't already in the MST

kruskal's order: a-d , c-e , b-e , c-d
0 1 2 3

Sida 7
Uppgift 4

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2021-06-03

3.0

a) False

b) ~~$\Theta(E)$~~ for $G = (V, E)$ — 3p

c) ~~True~~ — 3p

d) ~~$\Theta(n \log n)$~~ — 5p

e) ~~$O(2^n)$~~ in the worst case — 5p

f) ~~True~~ — 3p

g) ~~False~~ and ~~$\Theta(k)$~~ — 5p

h) ~~False~~ — 3p

Sida 8
uppgift 5

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1) c

7.0

2) b

3) ~~c~~ -1p

4) ~~c~~ -1p

5) c