LULEÅ TEKNISKA UNIVERSITET

KURSKOD / COURSE CODE	PROV / TEST CODE
D0041D	0001

KURSBENÄMNING / COURSE NAME

Datastrukturer och algoritmer

PROVBENÄMNING / TEST NAME

Tentamen

TENTAMENSDATUM / EXAMINATION DATE

2020-03-27

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	9,5	
2	X	8	
3	X	3	
4	X	6	
5	X	3	
6	X	0	
7	X	0	
8	X	0	
9	—	0	
10			
11			
12			
13			
14			
15			
16			
17			
18			
	Poängsumma / Points	29,5	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 2020-04-07 kl. 08:12:33

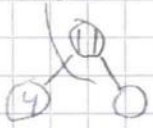
Upp. 1
9.5

4, 11, 7, 2, 8

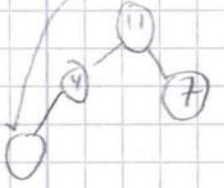
max heap
add first value as root
add next node as children left to right
swap any children with parent if they're larger

11, 7, 2, 8

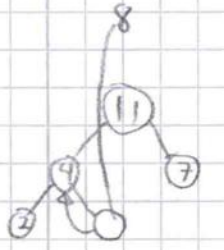
7, 2, 8



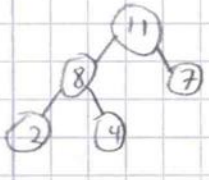
2, 8



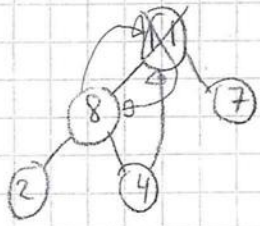
8



Slut!



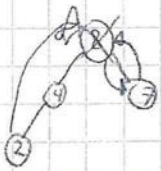
11	8	7	2	4



11	8	7	2	4

delete max

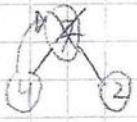
delete the root
replace it with the bottom-right node
swap with children if the parent is smaller



OK

8	4	7	2	11

-0.5p



7	4	2		

4	2			

2				

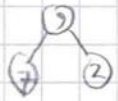
Slut!

Example

merging $2(2^4-1)$ heaps

delete root from heap A, and add to the merged heap

heap A



heap B

merged

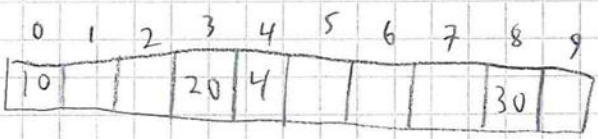
1 c) ——

– 6 p.

10, 20, 4, 30

$h(x,i) = x \bmod 10 + i(1 + x \bmod 9) \bmod 10$

$i = 0, 1, \ldots, 9$



Upp. 2
8

$h(10,0) = 10 \bmod 10 = 0$

$h(20,0) = 20 \bmod 10 = 0$ target

$h(20,1) = 20 \bmod 10 + (1 + 20 \bmod 9) \bmod 10 = 3$

$h(4,0) = 4 \bmod 10 = 4$

$h(30,0) = 30 \bmod 10 = 0$ target

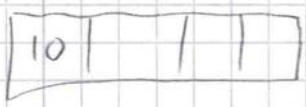
$h(30,1) = 30 \bmod 10 + (1 + 30 \bmod 9) \bmod 10 = 4$ target

$h(30,2) = 30 \bmod 10 + 2(1 + 30 \bmod 9) \bmod 10 = 8$

i $h(x) = x$

ii $h(x) = 2(x \bmod (\frac{m}{2}))$

Example
10, 20, 3, 40



i $h(10) = 10$ out of index

ii $h(10) = 2(10 \bmod 2) = 0$

i $h(20) = 20$ out of index

ii $h(20) = 2(20 \bmod 2) = 0$ taken

– crashes –

consider the sequence $a_1, \ldots a_m$

where $a \bmod (\frac{m}{2}) = b$

as soon as a_n (arbitrary) $\bmod (\frac{m}{2}) = b$

the hash function is stuck

ii). incomplete.
space usage
(odd indexed).
– 2p

3

$f(n) = O(h(n))$

$g(n) = O(h(n))$

$f(n) = O(g(n))$ Answer: ~~a~~

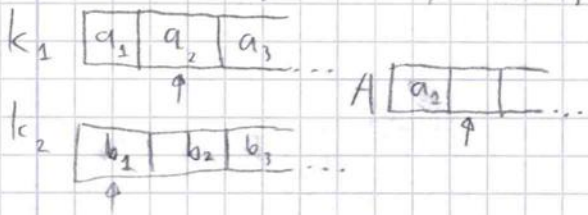
-1p

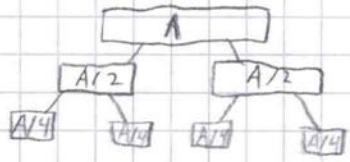
3

k sorted list with n total elements to merge

mergesort would sort in $O(n \log k)$ because it takes linear time two smaller list and that has to be done about $\log k$ times, and there is no need for further division since the smaller lists comes sorted.

merging $O(n)$ times





"A/2" means?

– 2p.

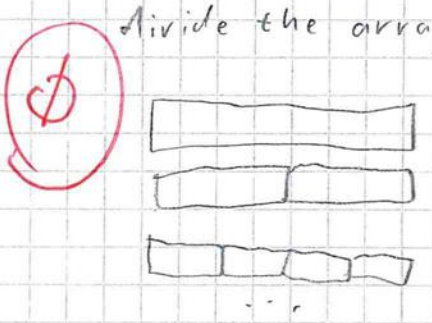
More details are needed.

(divide and conquer).

b) ——

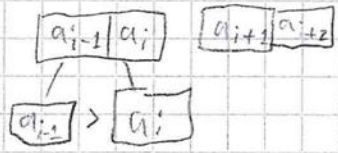
finding $a_{i-1} < a_i > a_{i+1}$

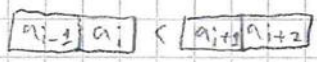
divide the array into subarrays of size 1 $O(\log n)$

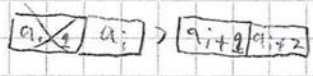


you pair a_{i-1} with a_i, merge and check $a_{i-1} < a_i$

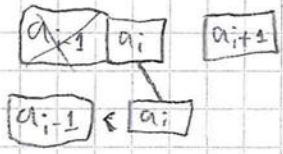
if true:

1 

2. if  found

 delete a_{i-1} from list and move on

else:



move on

comparison

$O(\log n-1) + O(\log n) \Rightarrow$ merge

time: $\Theta(n)$ — 10p

$0, 1, \ldots, n^2 - 1$ pick the first element, set as root

4

1. add the next at the bottom most-right
2. if the added node appears to the
   right: make sure it's larger than parent
   left: make sure it's smaller than parent
   otherwise swap with parent
   if neccessary

repeat until root which at most is the height of the tree operations which is less than n, because it's always $n \geq 1$ nodes per height

X

running time

$>> \Theta(n)$

-10_p

$A = \{a_1, a_2, a_3, \ldots, a_n\}$

$B = \{b_1, b_2, b_3, \ldots, b_n\}$

$SumA - a_i + b_j = Sum_B - b_j + a_i$

$Sum_A = Sum_B - 2(b_j - a_i)$

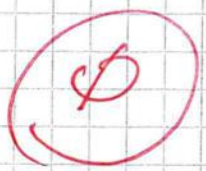
$Sum_A - Sum_B = -2(b_j - a_i)$

$2(a_i - b_j)$

calculate $\frac{Sum_A - Sum_B}{2}$

if $a_i - b_j > \frac{Sum_A - Sum_B}{2} : a_i = a_{i+1}$

$a_i - b_j < \frac{Sum_A - Sum_B}{2} : b_j = b_{j+1}$



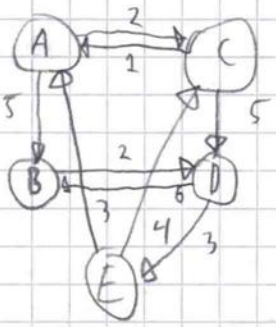
→

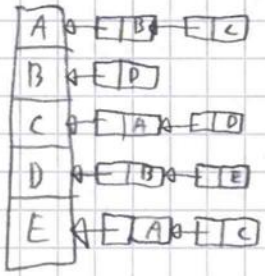
running time:

$\Theta(n^2)$

— δ_p

b) ———





Upp. 4
6.0

Depth first search

E, A, C, D, B 3+2+5+6 = 16

E, C, A, B, D 4+1+5+2 = 12

DFS tree? −2p

discovery/finishing time? −2p

e	a	b	c	d
0	∞	∞	∞	∞
0	3	8	4	9

x -5p