Reserved Cells

Ex. 1	
Ex. 2	
Ex. 3	
Ex. 4	
Ex. 5	
Ex. 6	
Tot.	

Algorithms and Programming

29 January 2018

Part I: Theory

Register Number _____ Family Name _____ First Name _____

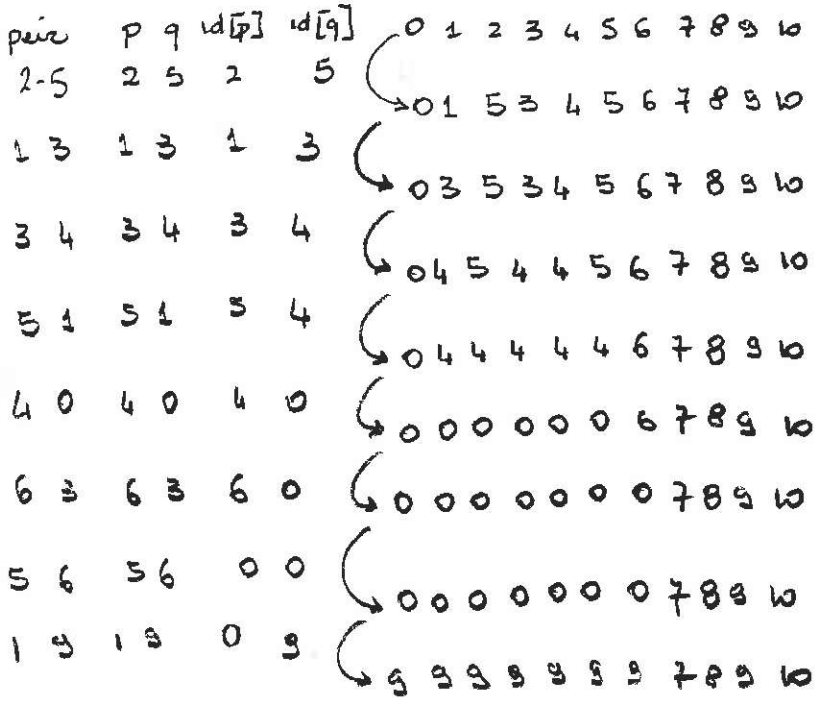
Course: ◯ 01*OGDLP* 10 credit ◯ 02*OGDLM* 12 credit

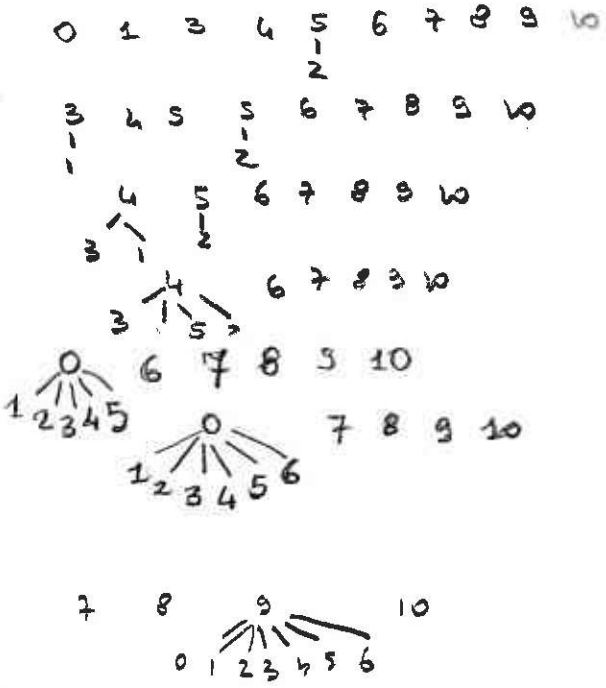
No books or notes are allowed. Solve exercises directly within the reserved space. Added sheets are accepted only when strictly necessary. Examination time: 50 **minutes.**

1. **(2.0 points)**
Given the following sequence of pairs, where the relation i-j means that node i is adjacent to node j:

2-5 1-3 3-4 5-1 4-0 6-3 5-6 1-9

apply an on-line connectivity algorithm with quick find, showing at each step the contents of the array and the forest of trees at the final step. Node names are integers in the range from 0 to 10.





2. (2.5 **points**)

10 **credit course** (01*OGDLP*)

Given the following sequence of integers stored in an array:

1 10 72 41 71 0 8 55 91 14 32 19 13 73 7 3 31

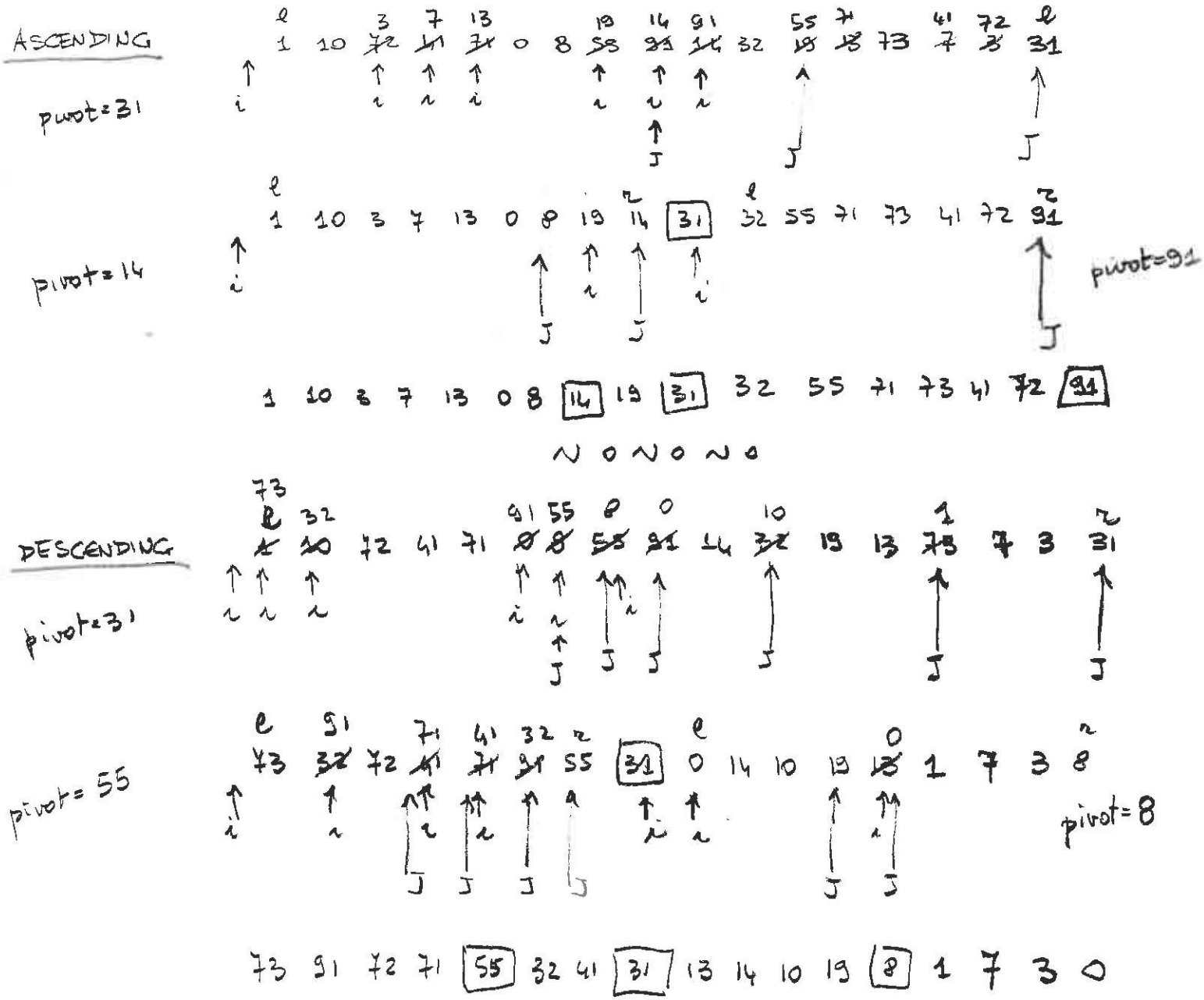
perform the first 2 steps of quick-sort to sort the array in **ascending** order. At each step indicate the pivot element you selected. Steps must be improperly considered in breadth on the recursion tree, rather than in depth. Return as a result the two partitions of the original array and the two partitions of those found at the previous step.

12 **credit course** (02*OGDLM*)

Given the following sequence of integers stored in an array:

1 10 72 41 71 0 8 55 91 14 32 19 13 73 7 3 31

perform the first 2 steps of quick-sort to sort the array in **descending** order. At each step indicate the pivot element you selected. Steps must be improperly considered in breadth on the recursion tree, rather than in depth. Return as a result the two partitions of the original array and the two partitions of those found at the previous step.

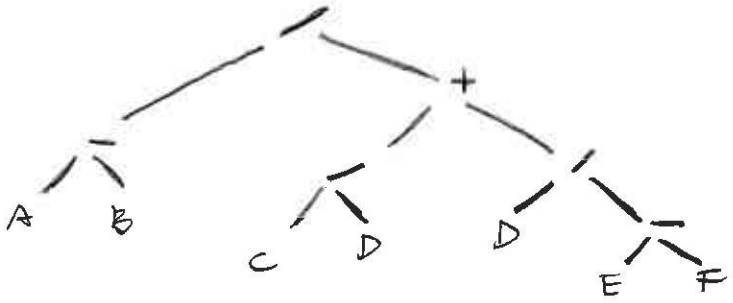


3. (1.0 **point**)
10 **credit course** ($01OGDLP$)
Convert the following expression from in-fix to post-fix notation:

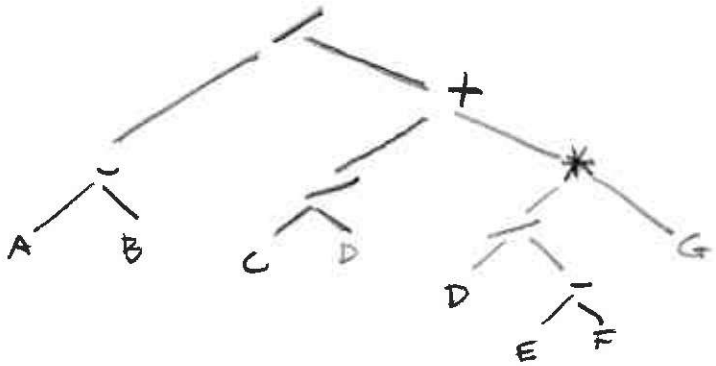
$$(A-B)/\{(C/D)+[(D/(E-F)]\}$$

12 **credit course** ($02OGDLM$)
Convert the following expression from in-fix to post-fix notation:

$$(A-B)/\{(C/D)+[(D/(E-F))*G]\}$$



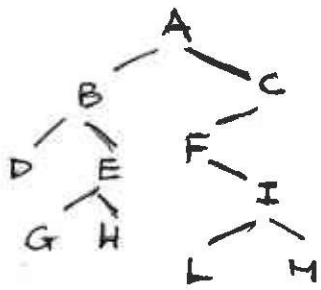
A B - C D / D E F - / + /



A B - C D / D E F - / G * + /

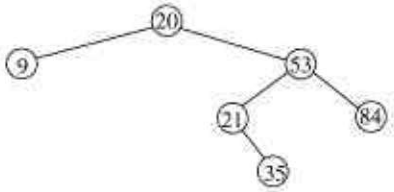
4. (2.0 **points**)
10 **credit course** (01*OGDLP*)
Consider a binary tree with 11 nodes. Its visits return the following sequences:

pre-order:	*A*	*B*	*D*	*E*	*G*	*H*	*C*	*F*	*I*	*L*	*M*
in-order:	*D*	*B*	*G*	*E*	*H*	*A*	*F*	*L*	*I*	*M*	*C*
post-order:	*D*	*G*	*H*	*E*	*B*	*L*	*M*	*I*	*F*	*C*	*A*



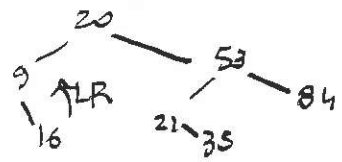
Draw the original binary tree.

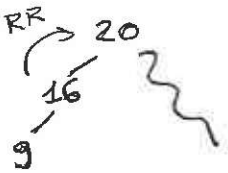
12 **credit course** (02*OGDLM*)
Given the following BST

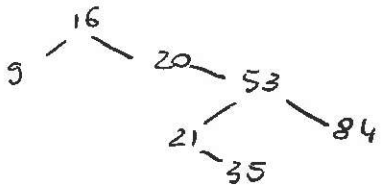


insert in the **root** the keys 16, 19 and 22; then delete the key 19. Redraw the tree at each relevant step.

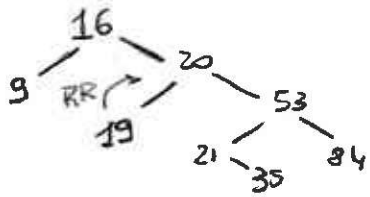
+16

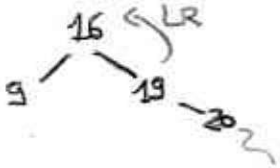


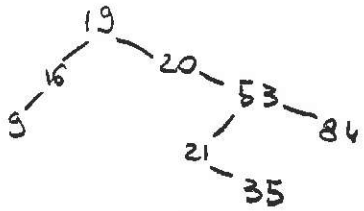




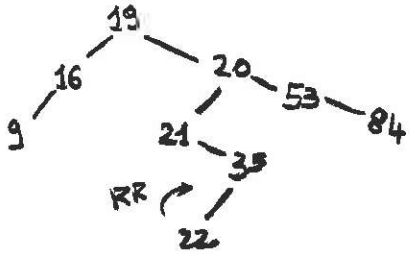
+19

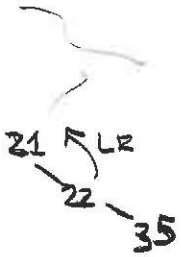


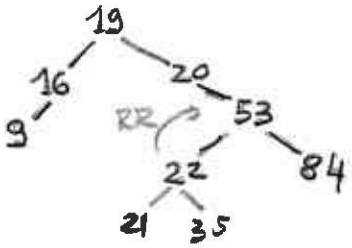


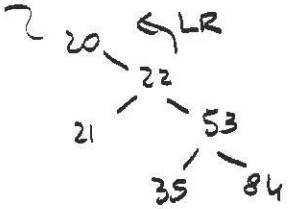


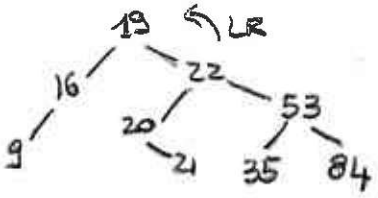
+22

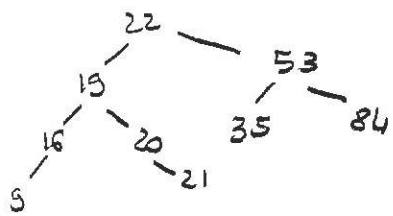






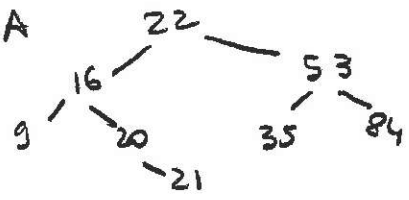




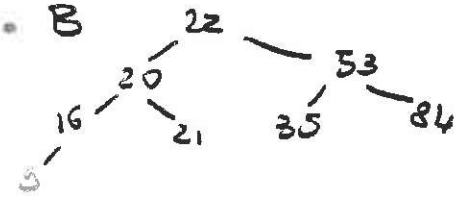


−19

VER. A



VER. B



5. (2.5 **points**)
10 **credit course** (01*OGDLP*)
Suppose to have an initially empty priority queue implemented with a **minimum** heap. Given the following sequence of integers and $\star$ characters:

11 23 5 7 13 25 $\star$ $\star$ 2 31 $\star$ 19 17

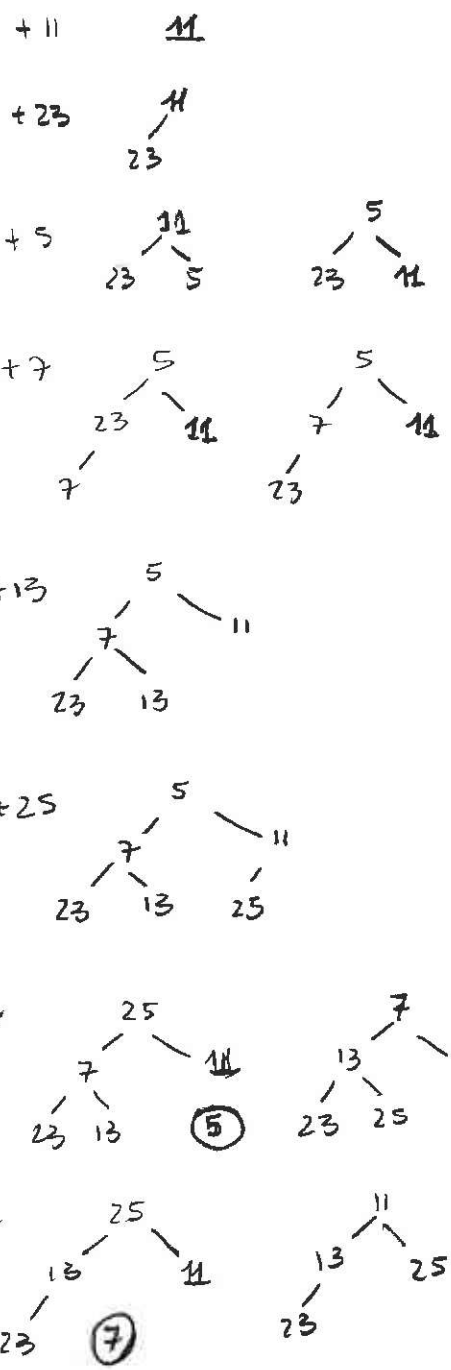
where each integer corresponds to an insertion into the priority queue and each character $\star$ corresponds to an extraction of the maximum, show the priority queue after each operation and return the sequence of extracted values. Finally, change the priority of 17 into 41 and draw the corresponding priority queue.

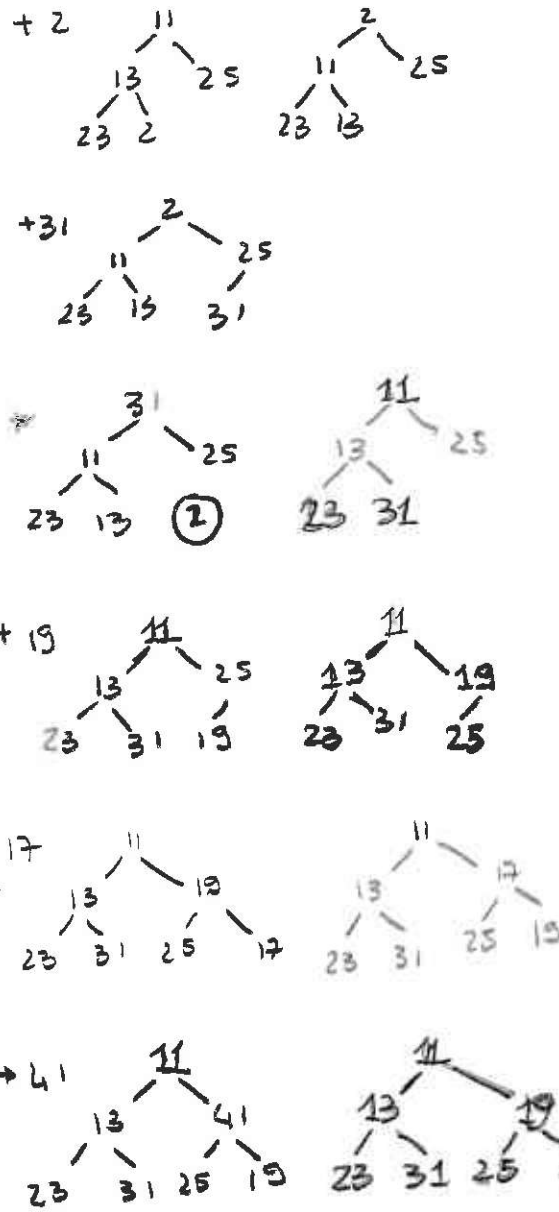
12 **credit course** (02*OGDLM*)
Suppose to have an initially empty priority queue implemented with a **maximum** heap. Given the following sequence of integers and $\star$ characters:

11 23 5 7 13 25 $\star$ $\star$ 2 31 $\star$ 19 17

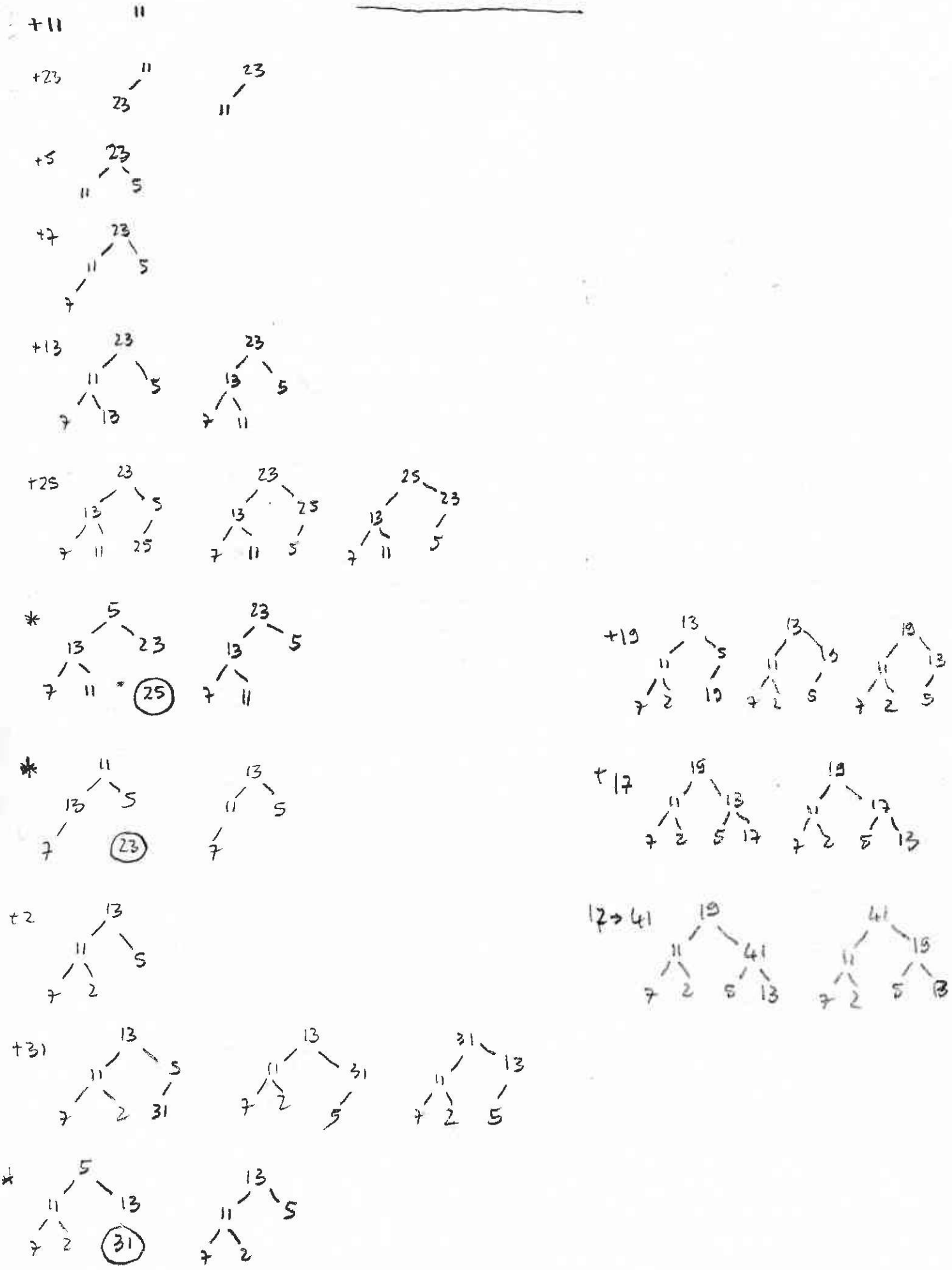
where each integer corresponds to an insertion into the priority queue and each character $\star$ corresponds to an extraction of the minimum, show the priority queue after each operation and return the sequence of extracted values. Finally, change the priority of 17 into 41 and draw the corresponding priority queue.

NEXT PAGE





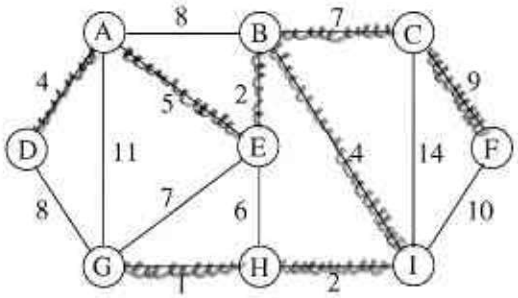
Ex 5 MAX-HEAP



6. (2.0 **points**)

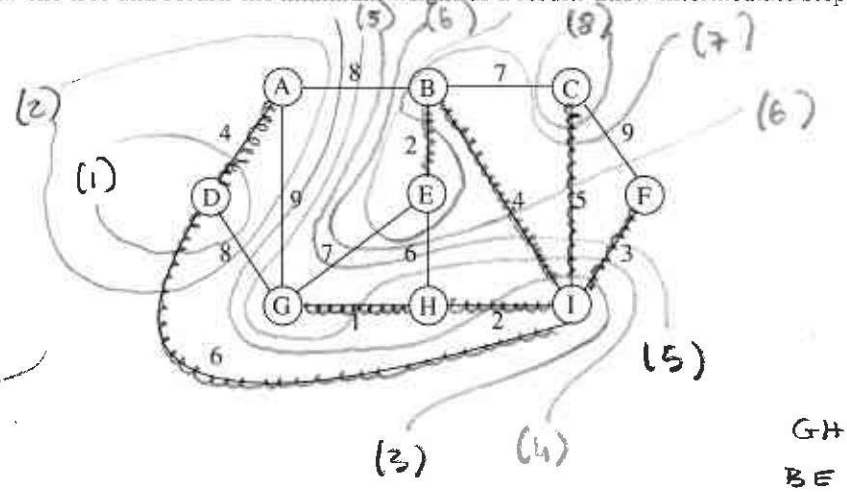
10 **credit course** (01*OGDLP*)

Given the following undirected and weighted graph, find a minimum spanning tree using Kruskal's algorithm, draw the tree and return the minimum weight as a result. Show relevant intermediate steps.



12 **credit course** (02*OGDLM*)

Given the following undirected and weighted graph, find a minimum spanning tree using Prim's algorithm starting from vertex D, draw the tree and return the minimum weight as a result. Show intermediate steps and all generated cuts.



CUT		
(1)	DA	4
(2)	DI	6
(3)	HI	2
(4)	GH	1
(5)	IF	3
(6)	BI	4
	BE	2
	CI	5
		27

GH	1	→	1
BE	2	→	2
HI	2	→	2
AD	4	→	4
BI	4	→	4
AE	5	→	5
EH	6		
BC	7	→	7
GE	7		
AB	8		
DG	8		
CF	9	→	9
IF	10		
AG	11		
CI	14		
			34