

## Workshop 8 – Week 9 – Worksheet 8

**Question 8.1** Construct a max binary heap from the following keys.

8 7 16 10 5 13 5 11 15 12 1 17

1. Construct a max binary heap using the top-down approach.

8
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8											
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To Insert: 7 16 10 5 13 5 11 15 12 1 17

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8  
7

8	7										
---	---	--	--	--	--	--	--	--	--	--	--

To Insert: 16 10 5 13 5 11 15 12 1 17

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16  
7 8

16	7	8									
----	---	---	--	--	--	--	--	--	--	--	--

To Insert: 10 5 13 5 11 15 12 1 17

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16  
10 8  
7

16	10	8	7								
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To Insert: 5 13 5 11 15 12 1 17

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16  
10 8  
7 5

16	10	8	7	5							
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To Insert: 13 5 11 15 12 1 17

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16  
 10 13  
 7 5 8

16	10	13	7	5	8						
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To Insert: 5 11 15 12 1 17

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16  
 10 13  
 7 5 8 5

16	10	13	7	5	8	5					
----	----	----	---	---	---	---	--	--	--	--	--

To Insert: 11 15 12 1 17

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16  
 11 13  
 10 5 8 5  
 7

16	11	13	10	5	8	5	7				
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To Insert: 15 12 1 17

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16  
 15 13  
 11 5 8 5  
 7 10

16	15	13	11	5	8	5	7	10			
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To Insert: 12 1 17

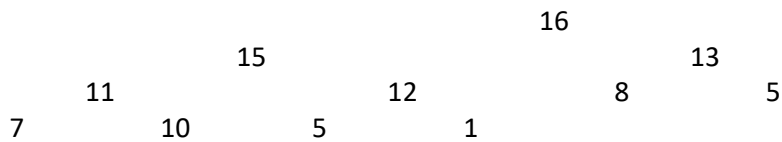
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16  
 15 13  
 11 12 8 5  
 7 10 5

16	15	13	11	12	8	5	7	10	5		
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To Insert: 1 17

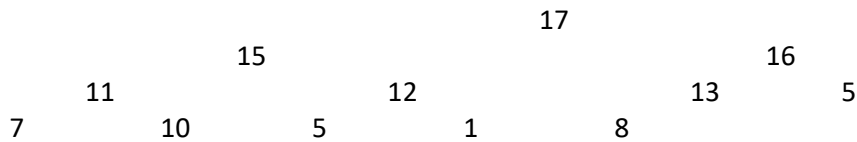
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16	15	13	11	12	8	5	7	10	5	1	
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To Insert: 17

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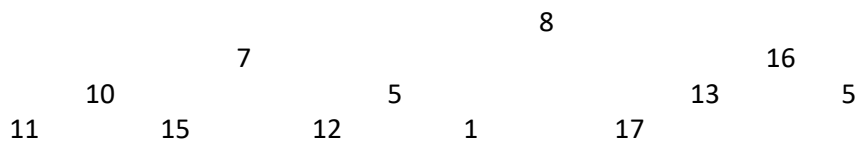
17	15	16	11	12	13	5	7	10	5	1	8
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Done.

- Now construct a max binary heap from the same keys, using the bottom-up "heapify" method.

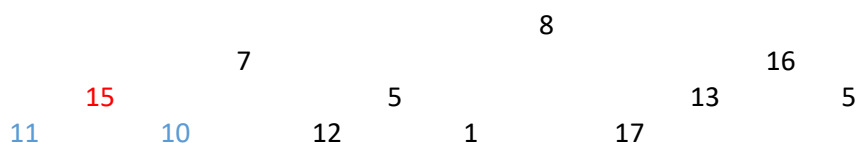
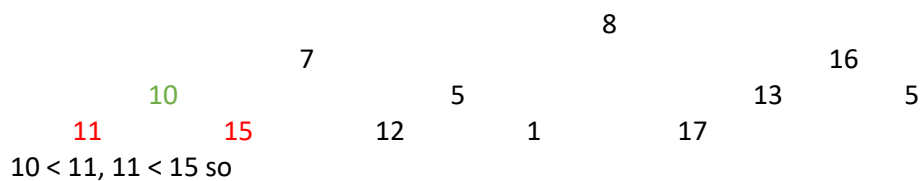
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8 7 16 10 5 13 5 11 15 12 1 17

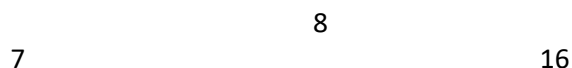


8	7	16	10	5	13	5	11	15	12	1	17
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First we start from the bottom level, both 11 and its children and 15 and its children are proper heaps.



15 and its children is a proper heap. Repeating the same process for 5 and its children;



For 7,

So,

For 16,

So finally for 8,

And finally after the last downheap

17	15	16	11	12	13	5	7	10	5	1	8
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3. What is the complexity of each method? Did the time it took you to do the exercise on paper correlate (roughly) with the theoretical complexity?

Method 1:  $O(n \log n)$

Method 2:  $O(n)$