Algoritme dan Struktur Data

Heap Tree

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Heaps

- A heap is a certain kind of complete binary tree.

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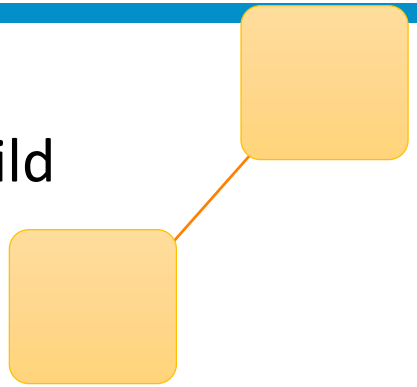
When a complete binary tree is built, its first node must be the root.

Heaps

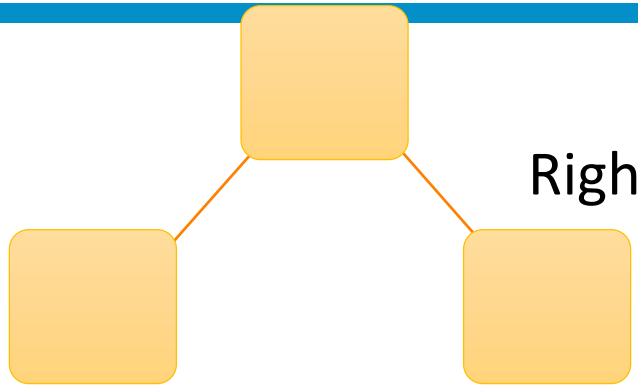
- Complete binary tree.



The second node is always the left child of the root.

Heaps

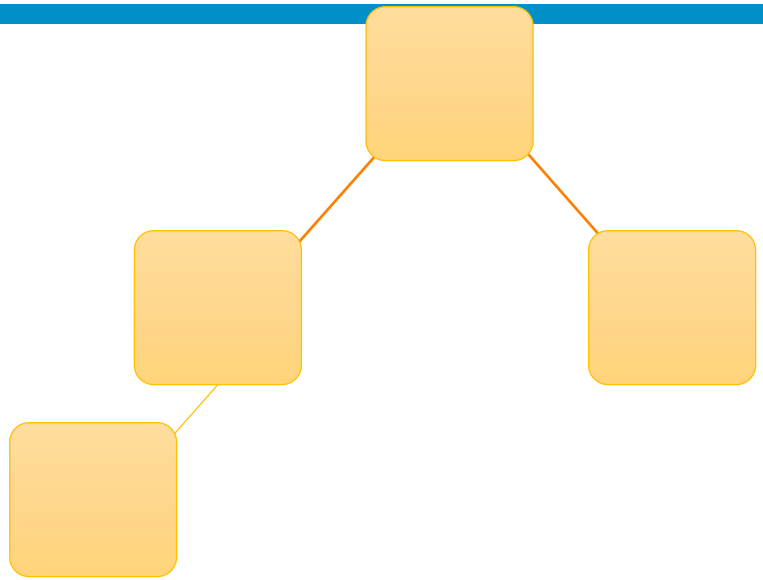
- Complete binary tree.



The third node is always the right child of the root.

Heaps

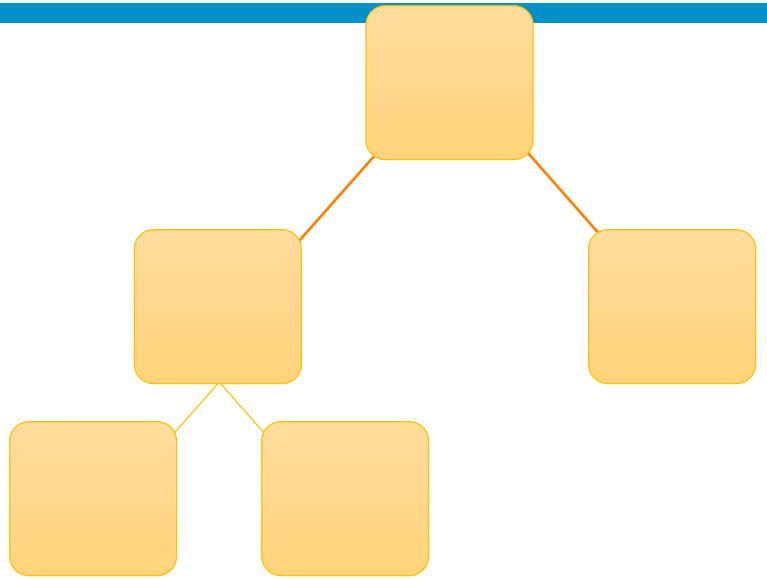
- Complete binary tree.



The next nodes always fill the next level from left-to-right.

Heaps

- Complete binary tree.



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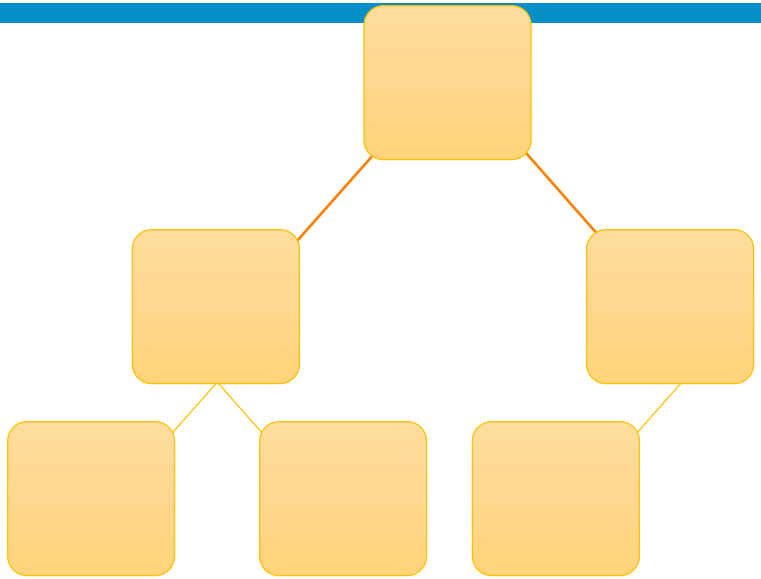

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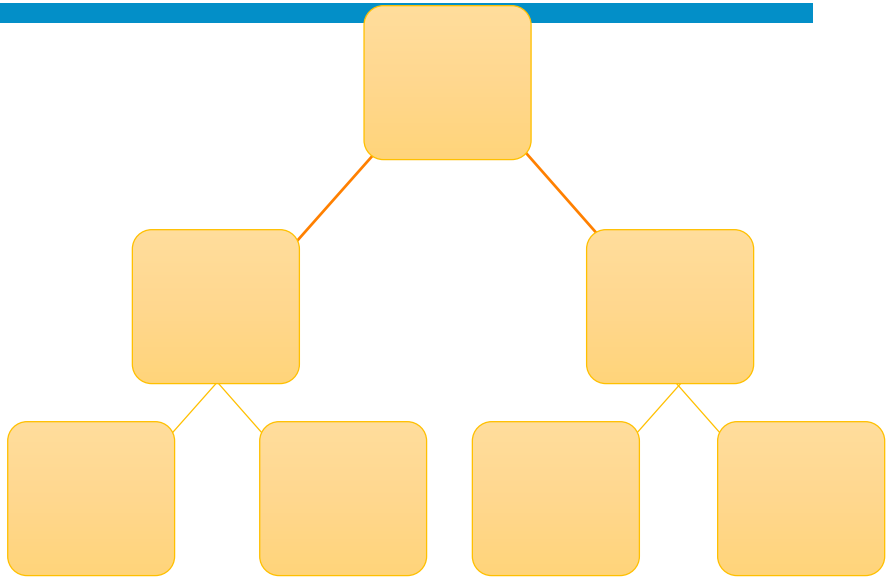

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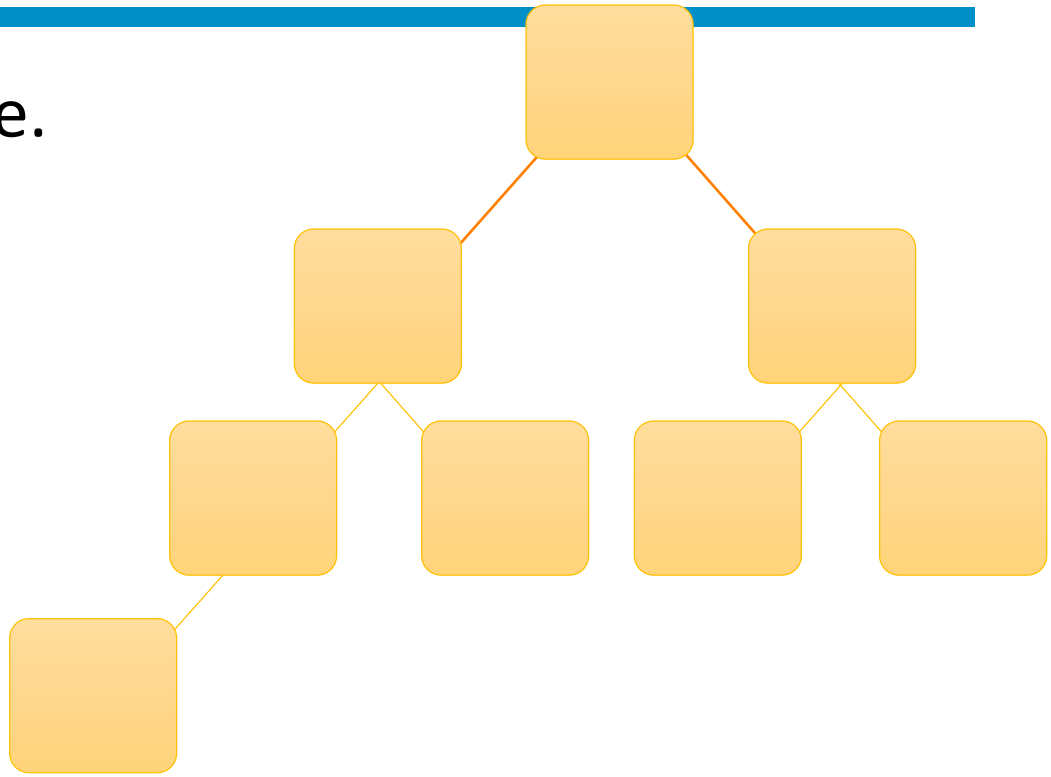
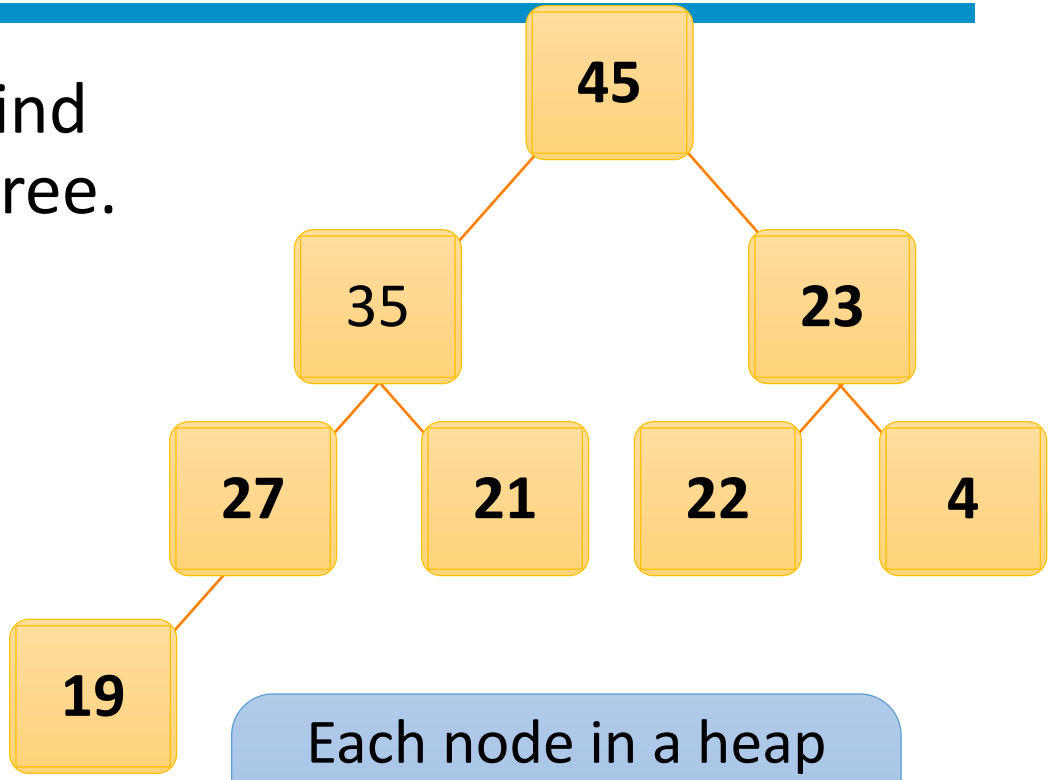


Heaps

- A heap is a certain kind of complete binary tree.



Each node in a heap contains a key that can be compared to other nodes' keys.

Heaps

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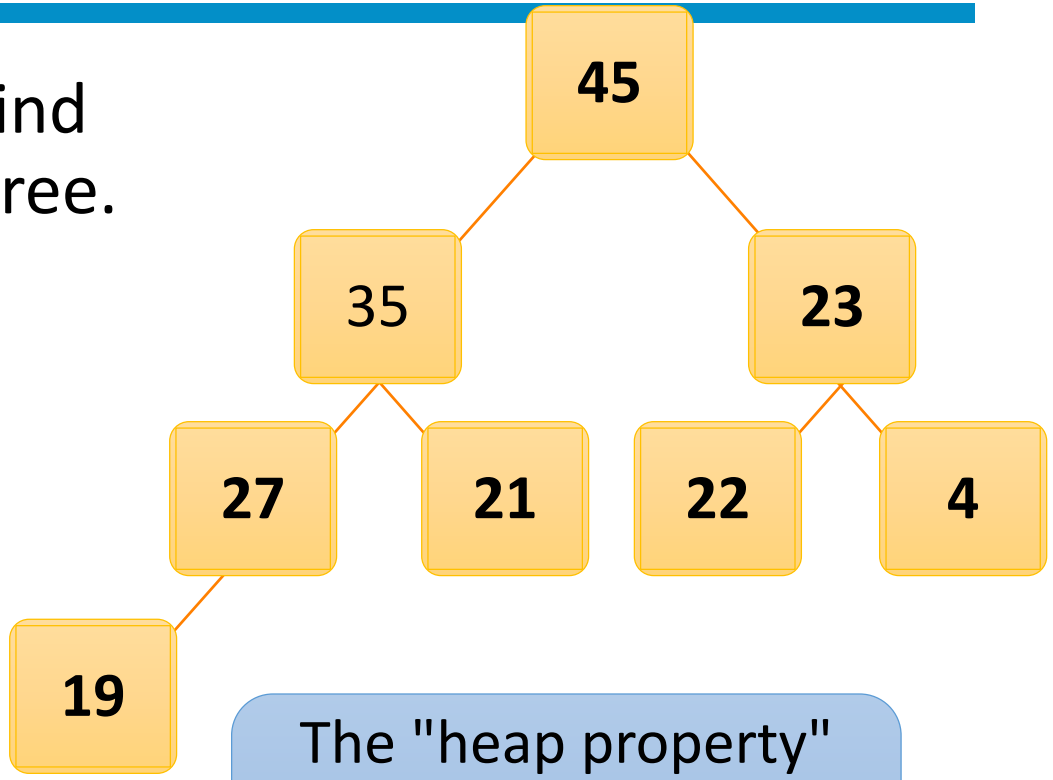
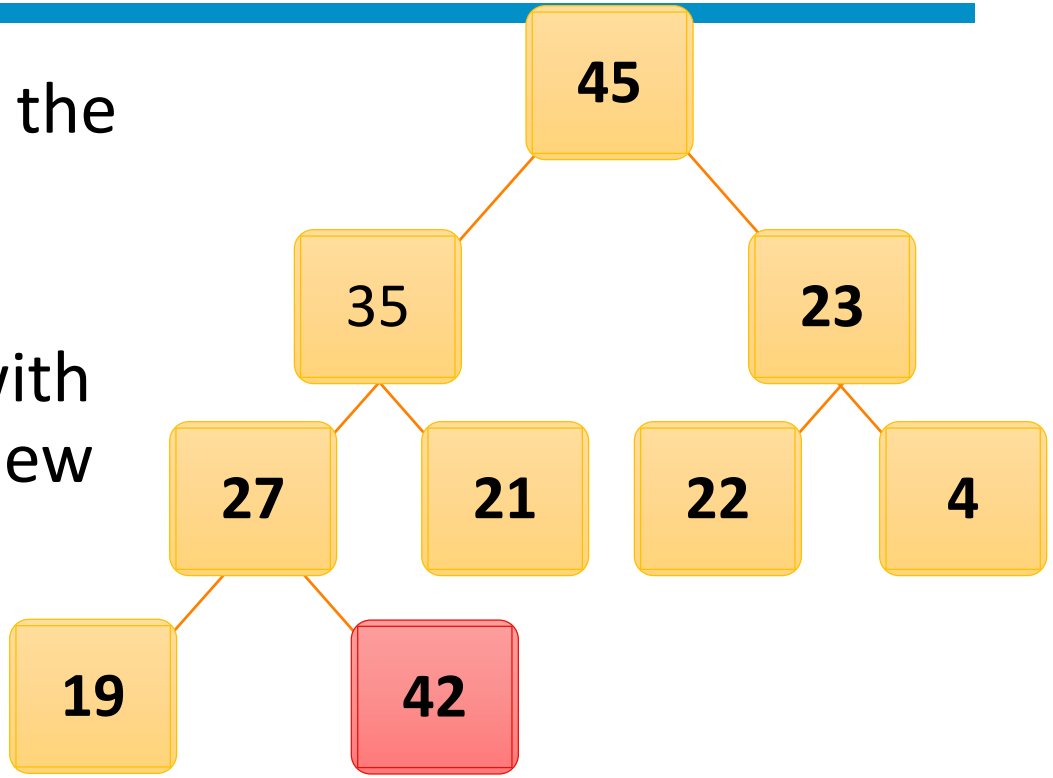


The "heap property" requires that each node's key is >= the keys of its children

Adding a Node to a Heap

- Put the new node in the next available spot.
- Push the new node upward, swapping with its parent until the new node reaches an acceptable location.



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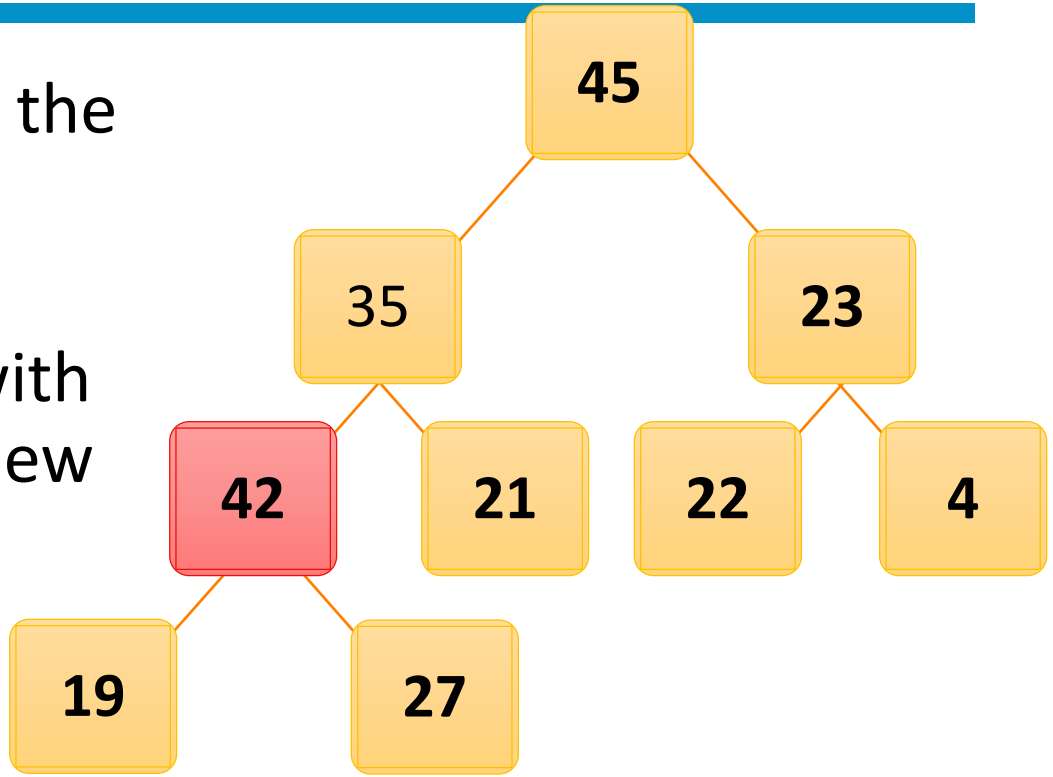

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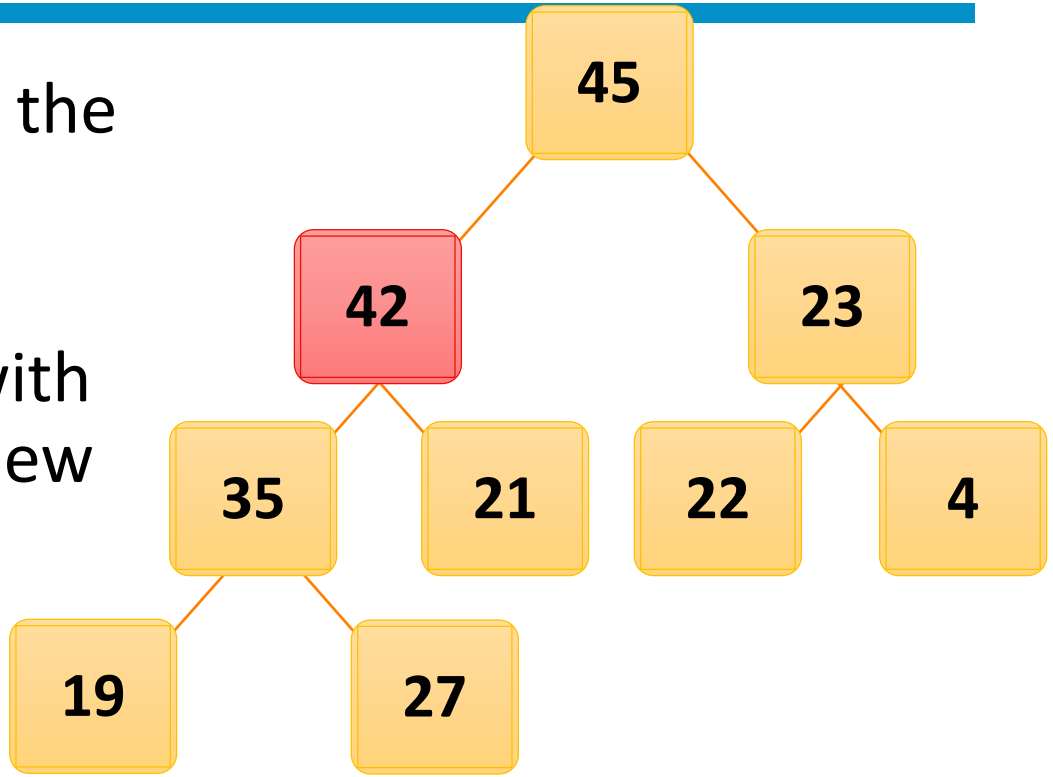
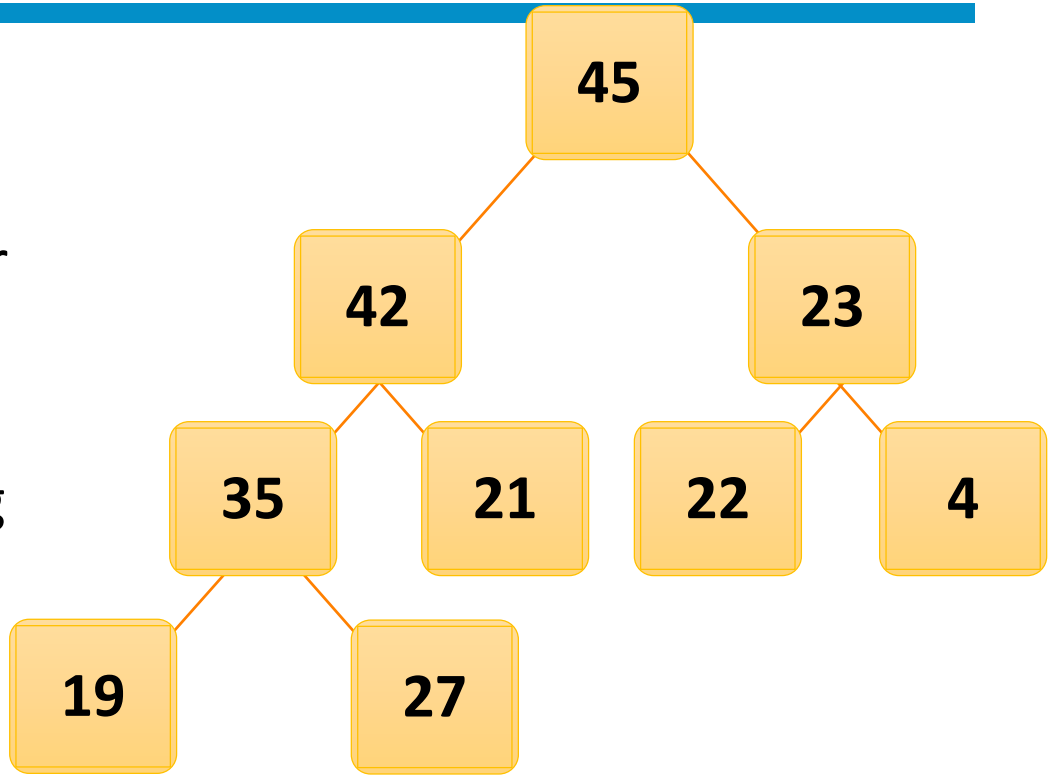


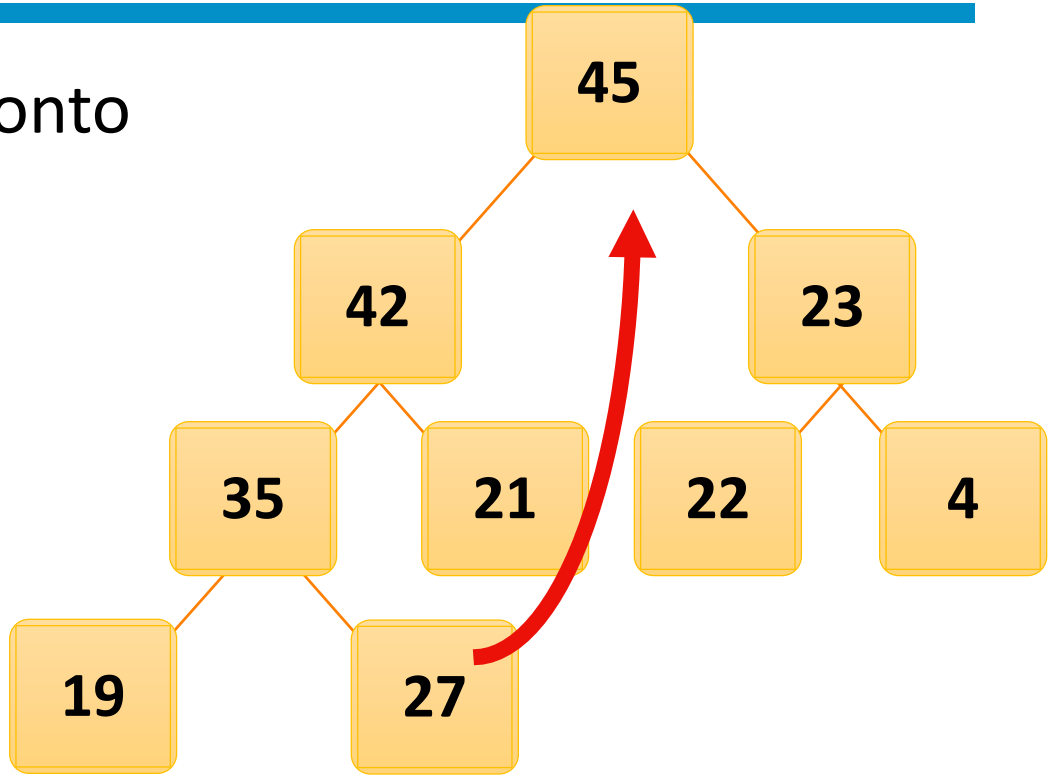
Adding a Node to a Heap

- The parent has a key that is >= new node, or
- The node reaches the root.
- The process of pushing the new node upward is called **reheapification upward**.



Removing the Top of a Heap

- Move the last node onto the root.



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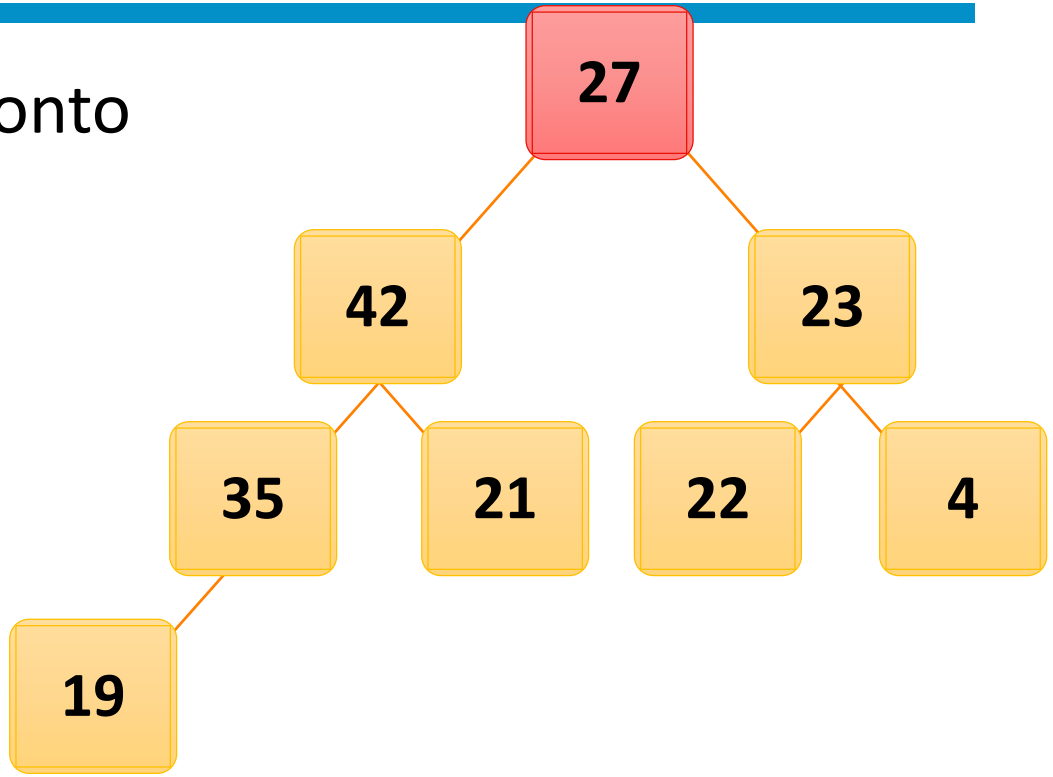
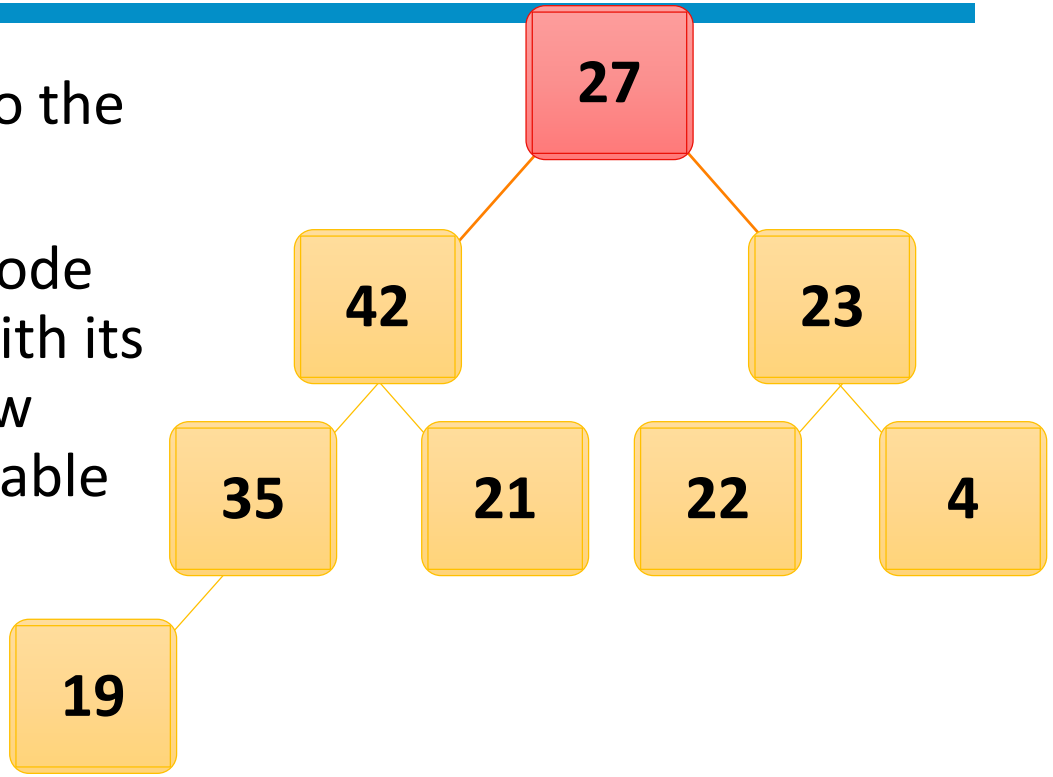


Removing the Top of a Heap

- Move the last node onto the root.
- Push the out-of-place node downward, swapping with its larger child until the new node reaches an acceptable location.



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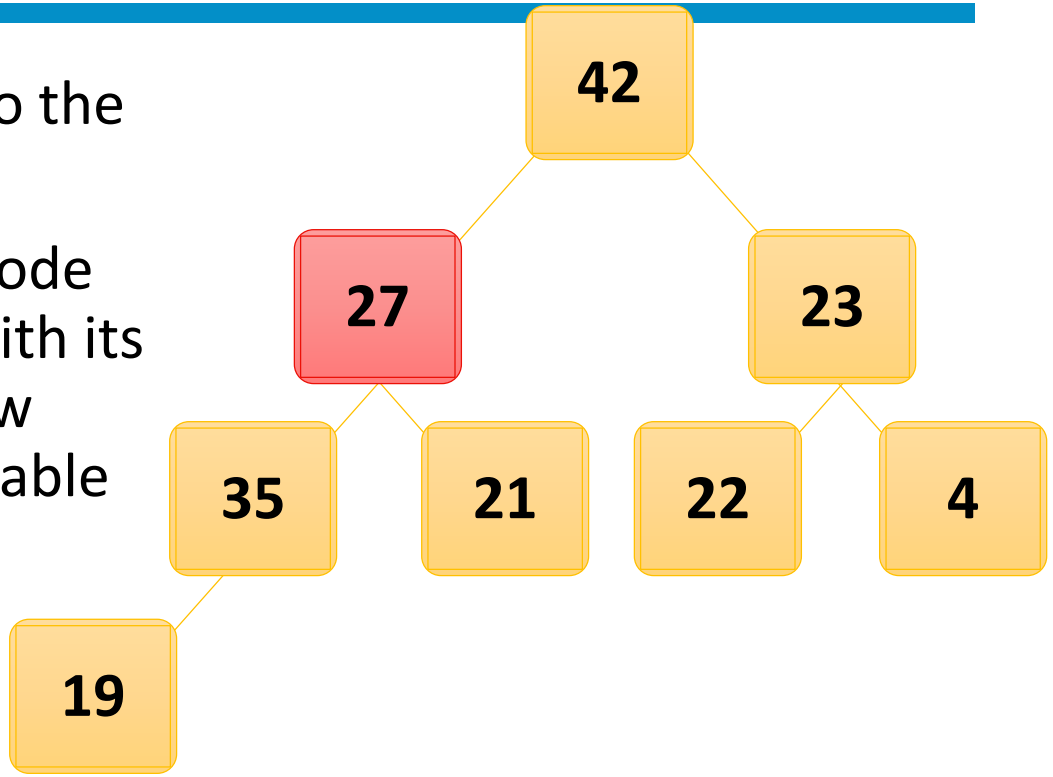

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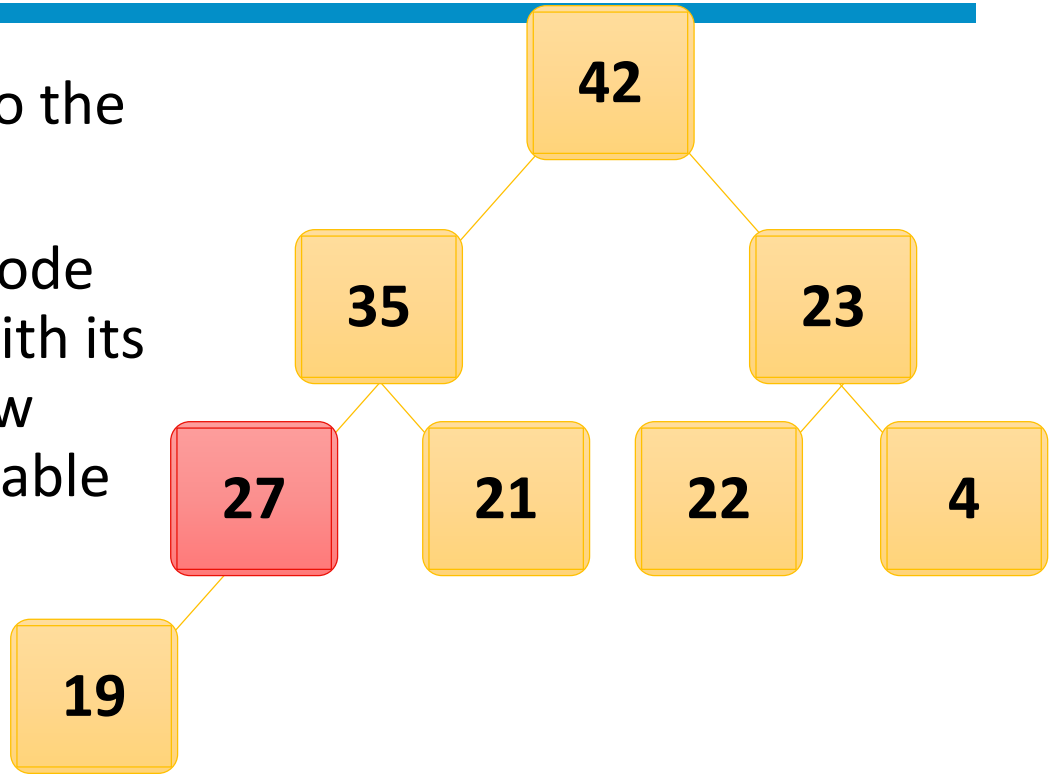
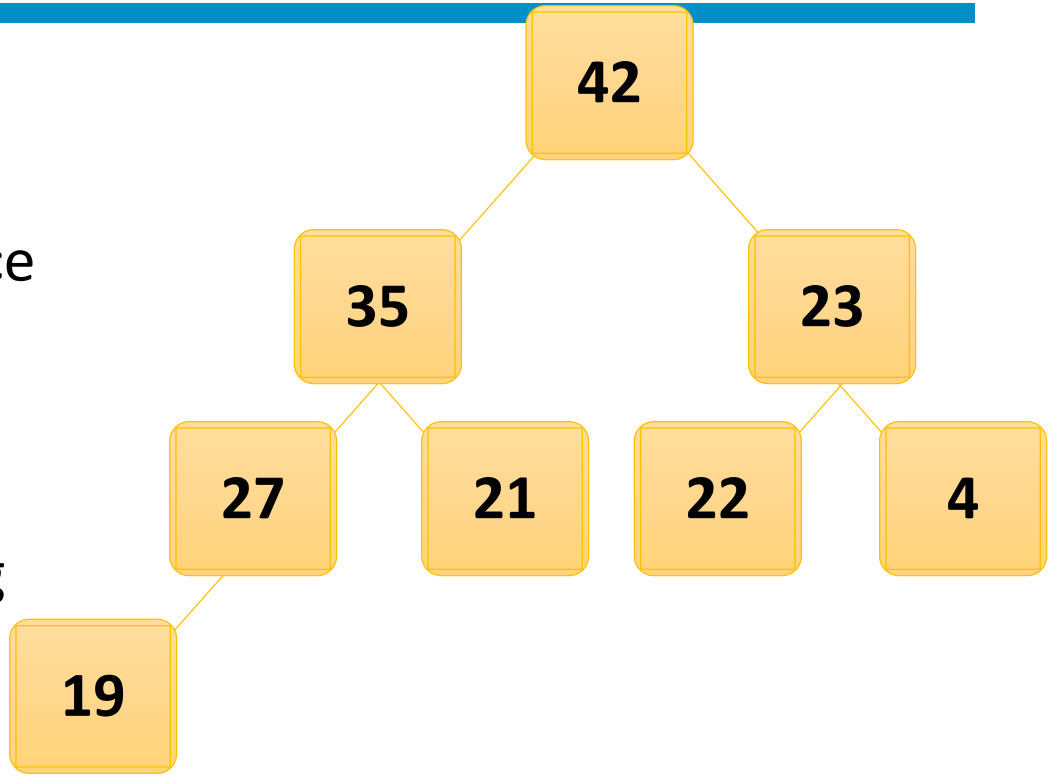


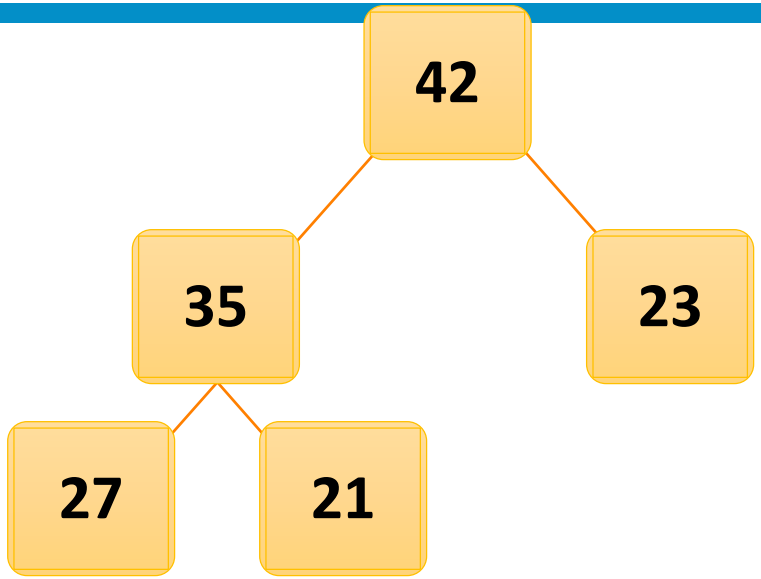
Removing the Top of a Heap

- The children all have keys <= the out-of-place node, or
- The node reaches the leaf.
- The process of pushing the new node downward is called **reheapification downward**.



Implementing a Heap

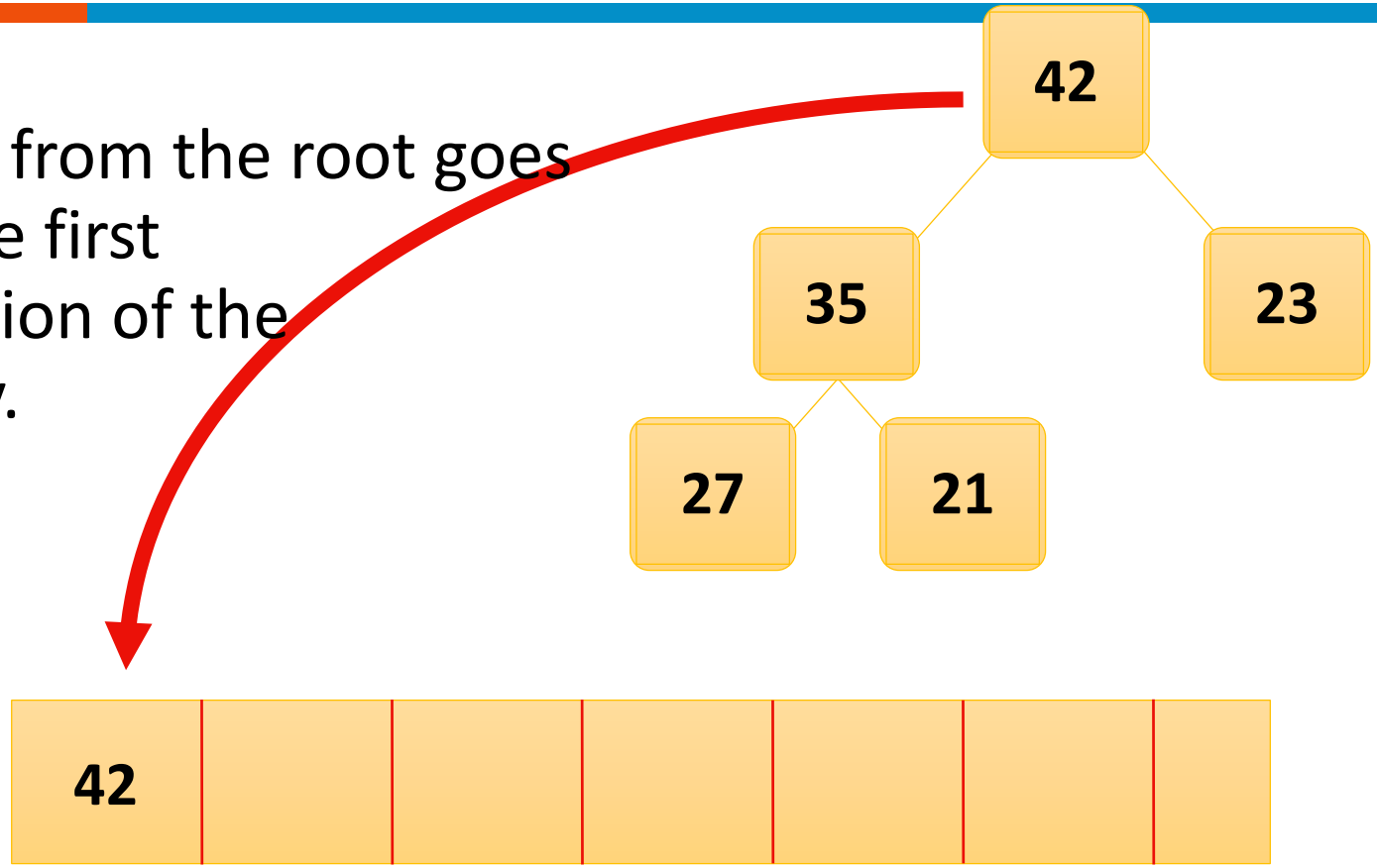
- We will store the data from the nodes in a partially-filled array.



An array of data

Implementing a Heap

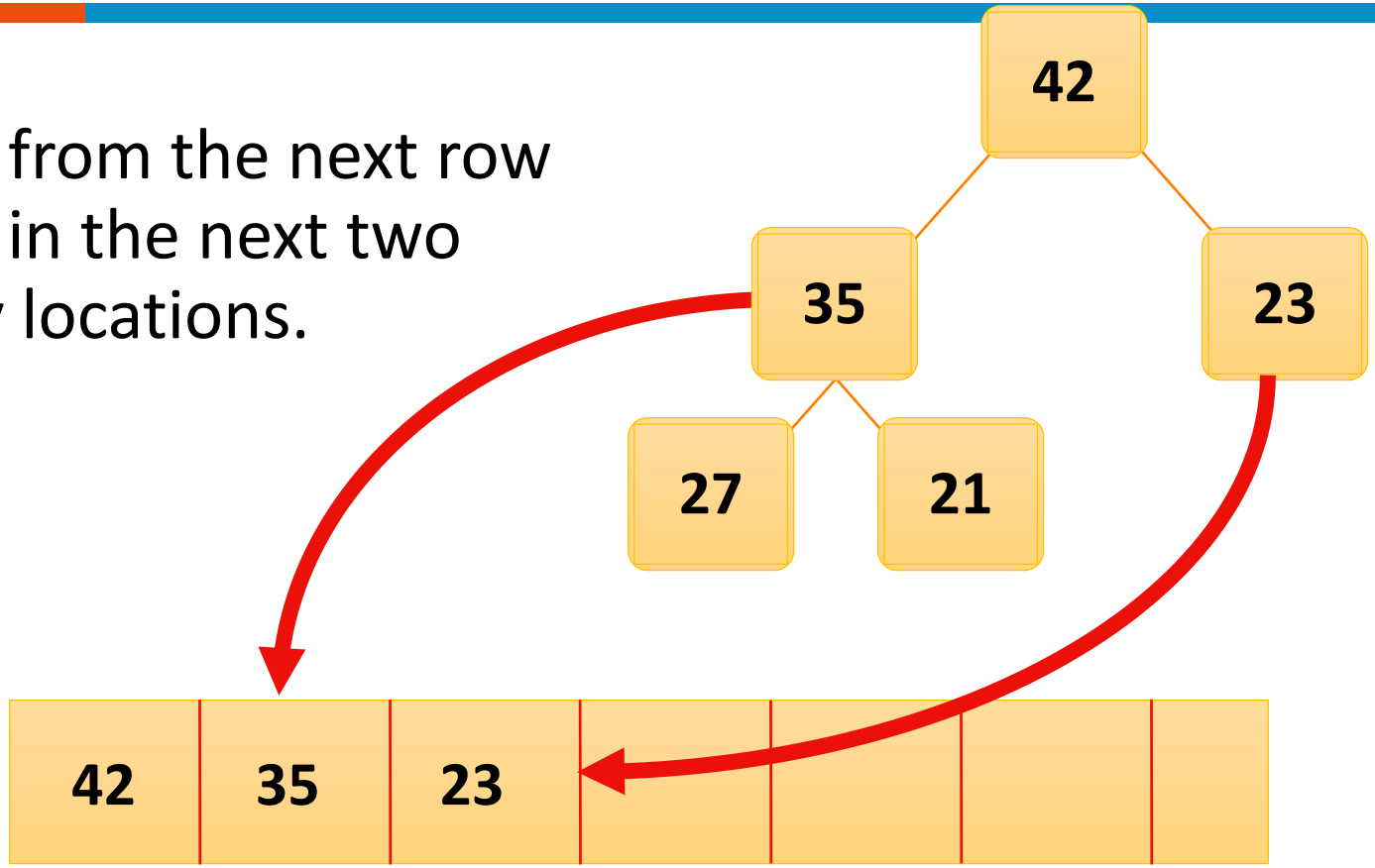
- Data from the root goes in the first location of the array.



An array of data

Implementing a Heap

- Data from the next row goes in the next two array locations.



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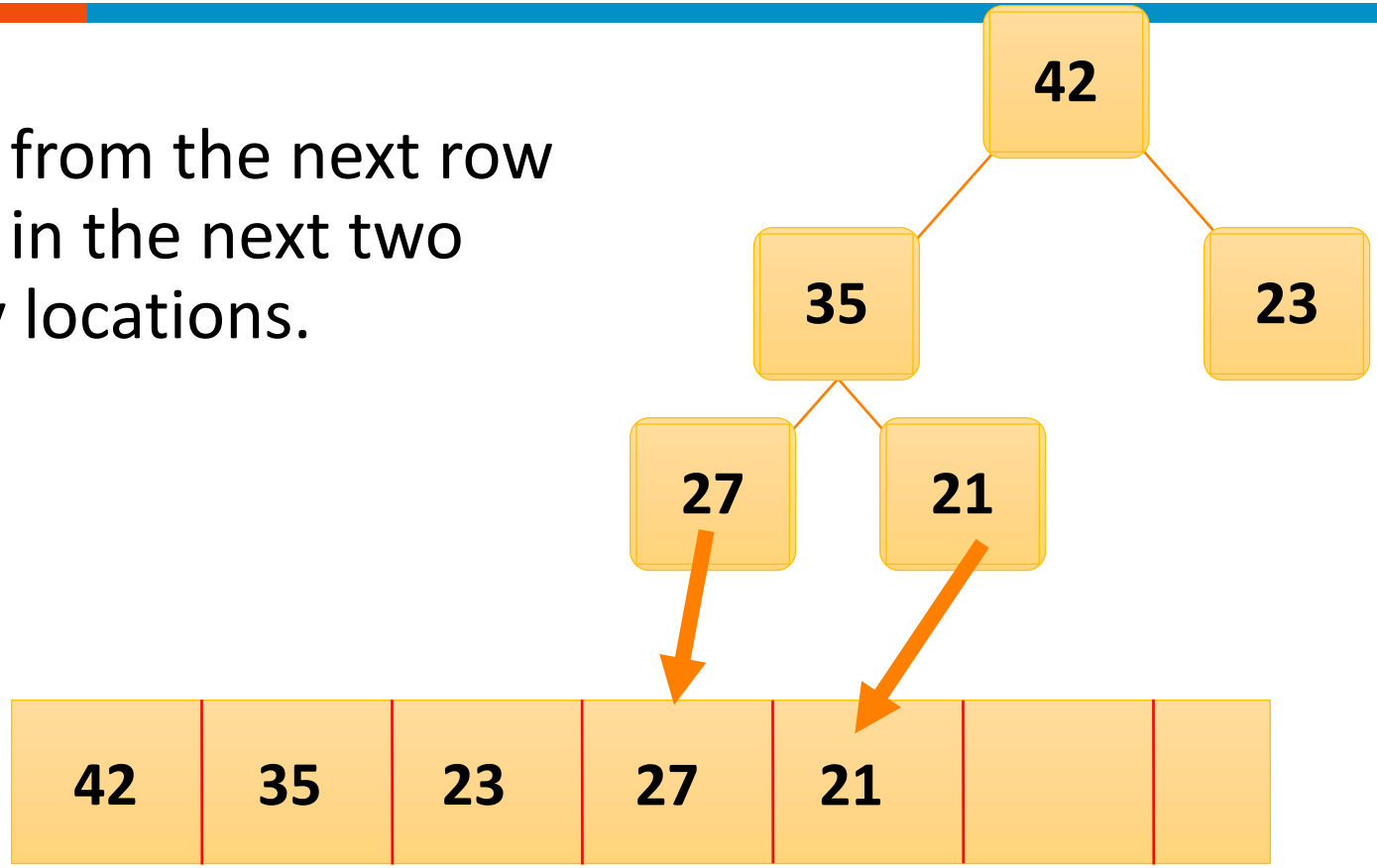

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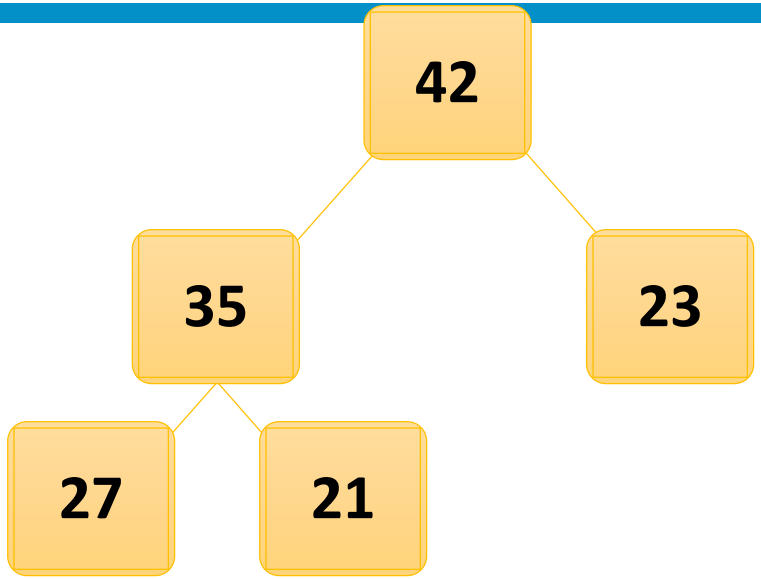
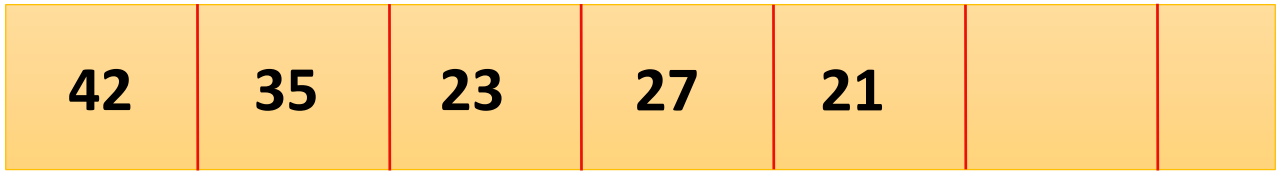


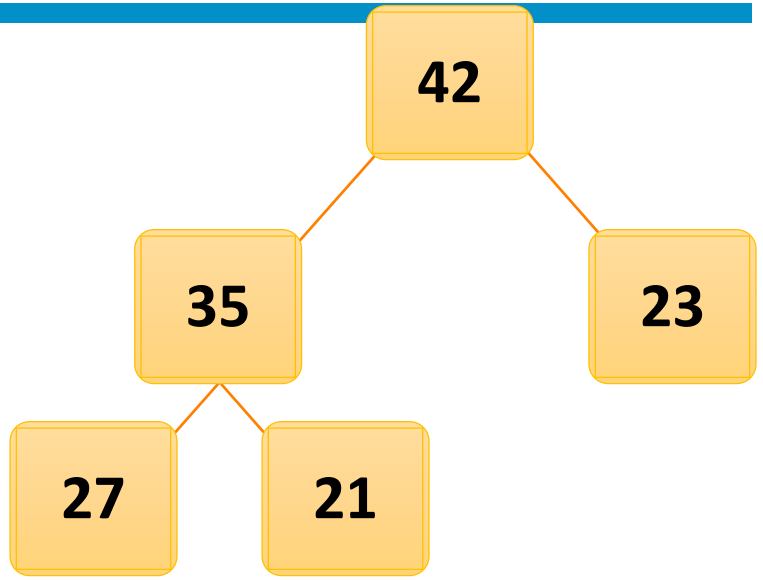


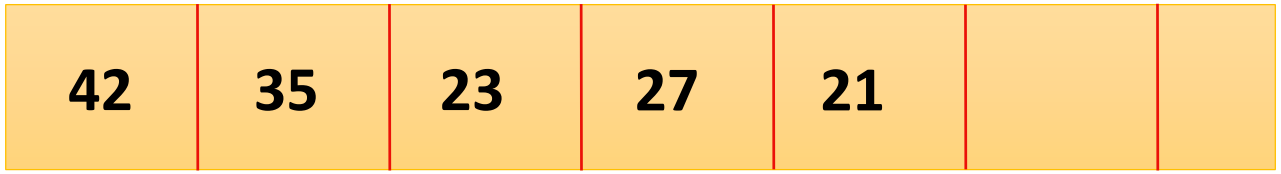
An array of data

We don't care what's in this part of the array.

Important Points about the Implementation

- The links between the tree's nodes are not actually stored as pointers, or in any other way.
- The only way we "know" that "the array is a tree" is from the way we manipulate the data.

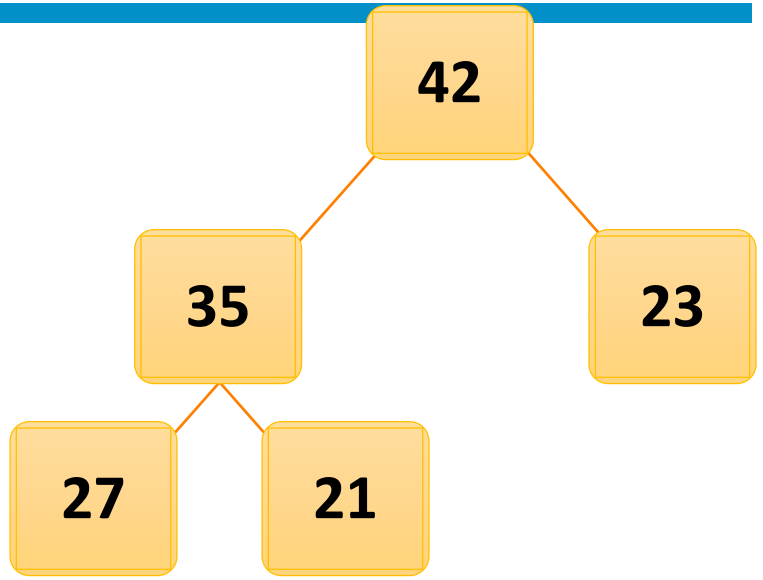


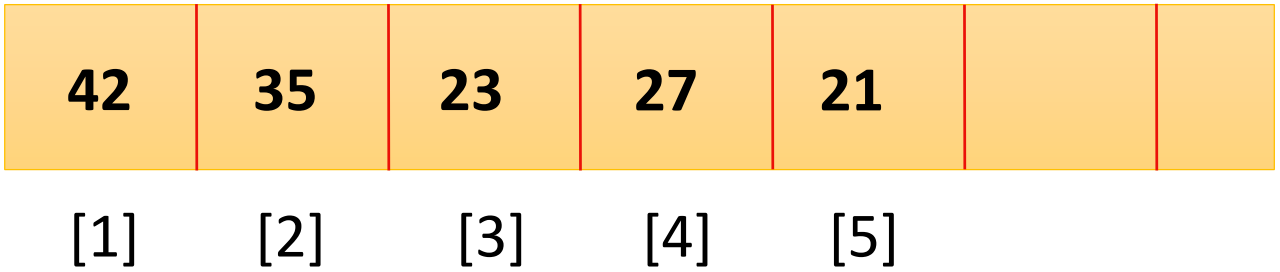


An array of data

Important Points about the Implementation

- If you know the index of a node, then it is easy to figure out the indexes of that node's parent and children. Formulas are given in the book.





Summary

- A heap is a complete binary tree, where the entry at each node is greater than or equal to the entries in its children.
- To add an entry to a heap, place the new entry at the next available spot, and perform a reheapification upward.
- To remove the biggest entry, move the last node onto the root, and perform a reheapification downward.