

Team #: _____

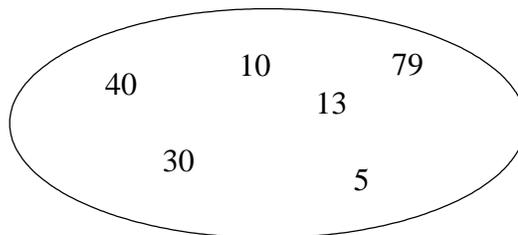
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1. A *priority queue* has the same operations as a regular queue, except the items are NOT returned in the FIFO (first-in, first-out) order. Instead, each item has a priority that determines the order they are removed. A hospital emergency room operates like a priority queue -- the person with the most serious injury has highest priority even if they just arrived.

a) Suppose that we have a priority queue with integer priorities such that the smallest integer corresponds to the highest priority. For the following priority queue, which item would be dequeued next?

priority queue:



b) To implement a priority queue, we could use an unordered Python list. If we did, what would be the worst-case theta ($\Theta(\)$) notation for each of the following methods: (justify your answer)

- enqueue:

- dequeue:

c) To implement a priority queue, we could use a linked list ordered by priorities, e.g., the `OrderedList` class of chapter 7. If we did, what would be the worst-case theta ($\Theta(\)$) notation for each of the following methods: (justify your answer)

- enqueue:

- dequeue

2. A common implementation of a priority queue is to use a *binary heap*. A binary heap is a special type of binary tree that is efficient at finding and deleting the smallest (*min heap*) item (similarly, there is also a *max heap*). Binary heaps have the following properties:

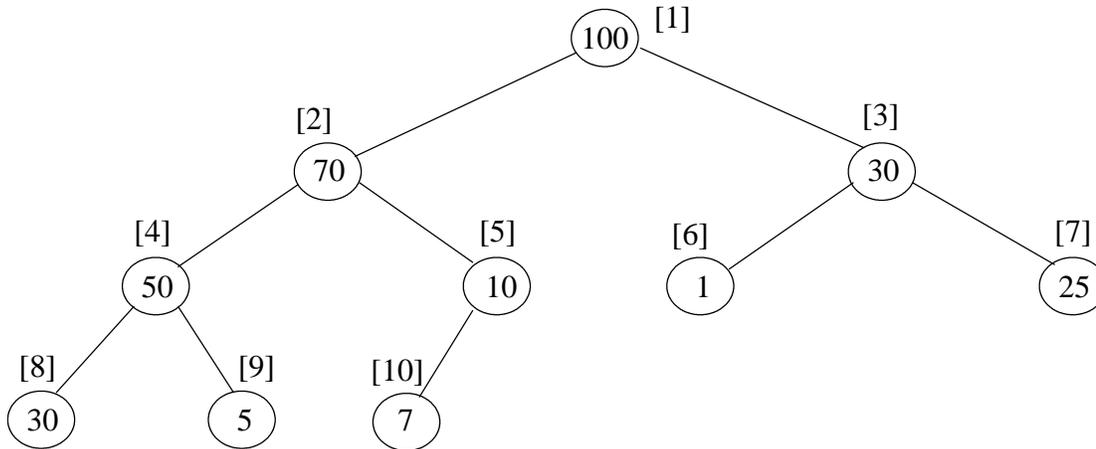
- items are stored conceptually in a *complete tree* (a full tree with any additional leaves as far left as possible)

- the *heap order property*: for every node x with parent p , the key in p is smaller than or equal to the key in x

a) Where would the smallest node in the heap be located?

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3) For the above heap, the list/array indexes are indicated in []'s. For a node at index i , what is the index of:

a) its left child if it exists:

b) its right child if it exists:

c) its parent if it exists:

4) Why aren't arrays used to store general BST's?

5) What would the heap look like after inserting 80?

6) What would be the height of a heap containing n nodes?