Data Structures

Heap Homework 1

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Problem #1: Max-Heap

- In the lectures, we learned the min-heap
- Change the code to act as a MaxHeap
  - E.g. top returns the max
  - And pop() removes the max
- Test your code thoroughly

Problem #2: Max-Heap

- Can we build a simple MaxHeap of **integers** based on our existing MinHeap code?
- Find a way of using the MinHeap code to build a MaxHeap, without copy-pasting any code

```
class MinHeap:...


class MaxHeap:
    def __init__(self, lst):
        self.minHeap = ...

    def push(self, key):...

    def top(self):...

    def empty(self):...

    def pop(self):...
```

Problem #3: Find smaller values

- Implement **def** smallest_than(self, value):
  - Returns a list of all the values in the minHeap less than this value
  - Order of the returned list doesn't matter

```
lst = [2, 17, 22, 10, 8, 37, 14,
       19, 7, 6, 5, 12, 25, 30]
minHeap = MinHeap(lst)

print(minHeap.smallest_than(10))
# [2, 5, 7, 6, 8]
```

Problem #4: Is Heap

- **def** is_heap(self)
- Extend your MinHeap class with the above function
- It returns a true if the current internal array in the heap is still a min heap

```
lst = [2, 17, 22, 10, 8, 37, 14,
       19, 7, 6, 5, 12, 25, 30]
minHeap = MinHeap(lst)

assert minHeap.is_heap()

minHeap.array[0], minHeap.array[-1] = minHeap.array[-1], minHeap.array[0]
assert not minHeap.is_heap()
```

Problem #5: Heap Sort

- **def** sort_heap(self)
- Extend your MinHeap class with the above function
- It sorts the heap's internal array **in-place** from small to large
  - In-place means this array will be used to do the sort without using/creating another array
  - After the call, the heap array is not heap anymore (just sorted array)
- The function should be O(nlogn)

```
lst = [2, 17, 22, 10, 8, 37, 14,
       19, 7, 6, 5, 12, 25, 30]
minHeap = MinHeap(lst)

minHeap.sort_heap()
# [2, 5, 6, 7, 8, 10, 12, 14,
#   17, 19, 22, 25, 30, 37]

print(minHeap.array)
```

"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."