CS222: Assignment 3 - Heap sort using max heap

1. Submission deadline: Sunday, 21 February at 11:59 pm.
2. Follow good coding practices to gain more marks.
3. Other than the stub given here, no copying among the students or from the Internet or any other source.
4. The assignment can be submitted in groups of size ≤ 3.
5. Submit two `.cpp` files and one `.pdf` file.
6. Write the names and roll numbers of the students at the top of each file.
7. The files should be called

   `heap_firstRollNumber_secondRollNumber_thirdRollNumber.cpp`,

   `heap_firstRollNumber_secondRollNumber_thirdRollNumber.pdf`.
8. Watch the video `https://www.youtube.com/watch?v=t0Cq6tVNRBA` until 3:05 minutes to get an understanding of heap data structure.

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1. :

   (a) Implement the heap data structure as a C++ class. The public methods should include:

```
class maxHeap{
private:
        int* items;
        int size;

        int sift_down(int); //takes an index. Assume all the other
            ↪ items in the sub-tree rooted at the index satisfy the
            ↪ max-heap property. Swap items in the sub-tree rooted
            ↪ at the index, so that the sub-tree rooted at the index
            ↪  is a max-heap.
        int sift_up(int); //takes an index. Assume all the other
            ↪ items in the heap satisfy the max-heap property. Swap
            ↪ items from the root to the index so that the tree
            ↪ satisfies the max-heap property.
        int find_parent(int); //Returns the index of the parent
        int find_lchild(int);//Returns the index of the left child
        int find_rchild(int);//Returns the index of the right child
        bool is_valid_index(int);
public:
        void heapify(); //called by the constructor below to convert
            ↪  the arbitrary array items into a max-heap.
        int get_max (); //peeks into the max-heap and returns the
            ↪ maximum value
        void insert(); //inserts an element into the max heap
        int delete_max(); // returns the maximum value and deletes
            ↪ the item.

               maxHeap(int sz, int arr[]){
               //Constructor that takes an arbitrary array of size
                   ↪ sz and creates a max-heap.
               }
};
```

You may add other private and public methods.

(b) Write a function `heapsort` that sorts an input array using an object of `maxHeap`.

(c) In the main method, create a random array of length 20 and call heapsort on that.

(d) in a pdf file, write:

1. the time complexity of each of the methods in the class `maxHeap`,
2. the time complexity of heapsort,
3. the random array and the output.