

Data Structures

Heap Homework 1

Mostafa S. Ibrahim

Teaching, Training and Coaching since more than a decade!

Artificial Intelligence & Computer Vision Researcher

PhD from Simon Fraser University - Canada

Bachelor / Msc from Cairo University - Egypt

Ex-(Software Engineer / ICPC World Finalist)



Problem #1: Max-Heap

- In the lectures, we learned the min-heap
- Change the code to act as MaxHeap
 - E.g. top return max
 - And Pop remove the max
- Test your Code

Problem #2: Max-Heap

- Can we build a simple MaxHeap of integers based on the available MinHeap?
- Find a simple trick that allows just using the MinHeap instead of copy-paste the code
- Provide the same constructors and heap functions (top, push, pop, empty)

```
7+ class MinHeap {  
91  
92+ class MaxHeap {  
93 private:  
94     MinHeap heap;  
95  
96 public:  
97+     MaxHeap() {  
98     }  
99  
10+     MaxHeap(const vector<int> &v)  
11     }
```

Problem #3: Find smaller values

- `void print_less_than(int val, int parent_pos = 0)`
- Extend your MinHeap class with the above function
- It prints all the values that are $<$ value in the heap
 - We can do that by simply iterating on the whole array
 - Try to do better
- E.g. if we inserted in heap: 2, 17, 22, 10, 8, 37, 14, 19, 7, 6, 5, 12, 25, 30
- `heap.print_less_than(10);` \Rightarrow 2 5 8 6 7
 - Order of output doesn't matter

Problem #4: Is Heap

- `bool is_heap_array(int *p, int n)`
- Extend your MinHeap class with the above function
- It takes a pointer to array and its length to verify its content represents a heap or not
- E.g. 2, 5, 12, 7, 6, 22, 14, 19, 10, 17, 8, 37, 25, 30
 - Is a heap

Problem #5: Heap Sort

- Add member function to the MinHeap
- void heap_sort(int *p, int n)
- Which takes an array and perform **in-place** sort for its content from small to large
 - In-place means this array will be used to do the sort without using/creating other array

```
const int SZ = 14;
int arr[SZ] { 2, 17, 22, 10, 8, 37, 14, 19, 7, 6, 5, 12, 25, 30};
MinHeap heap;

heap.heap_sort(arr, SZ);

for (int i = 0; i < SZ; ++i)
    cout << arr[i] << " ";
cout << "\n";
//2 5 6 7 8 10 12 14 17 19 22 25 30 37
```

“Acquire knowledge and impart it to the people.”

“Seek knowledge from the Cradle to the Grave.”