

## Heap in C++

```
#include <iostream>
#include <vector>

using namespace std;

class MinHeap {
    vector<int> arr;
    int size;
    int capacity;

public:
    MinHeap(int c) {
        size = 0;
        capacity = c;
        arr.resize(c);
    }

    int left(int i) {
        return 2 * i + 1;
    }

    int right(int i) {
        return 2 * i + 2;
    }

    int parent(int i) {
        return (i - 1) / 2;
    }

    void show() {
        for (int i = 0; i < size; i++) {
            cout << arr[i] << " ";
        }
        cout << endl;
    }

    void insert(int x) {
        if (size == capacity) {
            return;
        }
        size++;
        arr[size - 1] = x;
        int i = size - 1;
        while (i != 0 && arr[parent(i)] > arr[i]) {
            swap(arr[i], arr[parent(i)]);
            i = parent(i);
        }
    }
};

int main() {
    MinHeap h(9);
    h.insert(10);
    h.insert(20);
    h.insert(15);
    h.insert(40);
    h.insert(50);
    h.insert(100);
    h.insert(25);
    h.insert(45);
}
```

### Initial Setup

- We create a **MinHeap** of capacity 9.
- Insert sequence: 10, 20, 15, 40, 50, 100, 25, 45

### 🧠 What is a MinHeap?

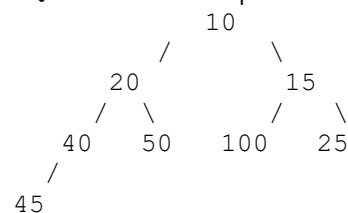
A MinHeap is a **complete binary tree** where:

- Every parent node is **less than or equal to** its children.
- Insertions maintain this structure by "bubbling up" the inserted value if it violates the heap property.

### ▼ Step-by-Step Dry Run Table

Step	Inserted Value	Heap Before Insert	Heap After Insert + Bubble Up
1	10	[ ]	[10]
2	20	[10]	[10, 20]
3	15	[10, 20]	[10, 20, 15]
4	40	[10, 20, 15]	[10, 20, 15, 40]
5	50	[10, 20, 15, 40]	[10, 20, 15, 40, 50]
6	100	[10, 20, 15, 40, 50]	[10, 20, 15, 40, 50, 100]
7	25	[10, 20, 15, 40, 50, 100]	[10, 20, 15, 40, 50, 100, 25]
8	45	[10, 20, 15, 40, 50, 100, 25]	[10, 20, 15, 40, 50, 100, 25, 45]

### 🔍 Final MinHeap Tree Representation:



- The heap property is maintained at each

<pre>h.show();  return 0; }</pre>	<p>step.</p> <ul style="list-style-type: none"><li>• No bubbling up required beyond one level in most cases.</li></ul> <p>✓ Output of <code>h.show()</code> ; 10 20 15 40 50 100 25 45</p>
10 20 15 40 50 100 25 45	