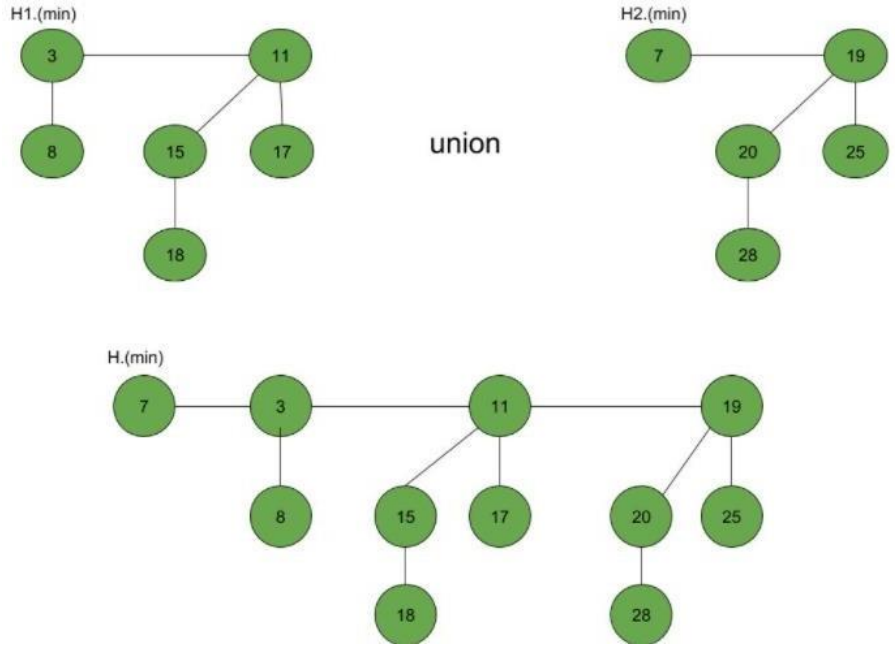
PROGRAM 7: FIBONACCI HEAP IMPLEMENTATION

Aim: To write a program in C++ for implementing Fibonacci Heap.

Description: Fibonacci Heap is a collection of trees with min-heap or max-heap property. In Fibonacci Heap, trees can have any shape even all trees can be single nodes

Insertion:

Union:



Algorithm:

Insertion: To insert a node in a Fibonacci heap H, the following algorithm is followed

1. Create a new node ‘x’.
2. Check whether heap H is empty or not.
3. If H is empty then:
    - Make x as the only node in the root list.
    - Set H(min) pointer to x.
4. Else:
    - Insert x into root list and update H(min).

Union: Union of two Fibonacci heaps H1 and H2 can be accomplished as follows:

1. Join root lists of Fibonacci heaps H1 and H2 and make a single Fibonacci heap H.
2. If H1(min) < H2(min) then:
    - H(min) = H1(min).
3. Else:
    - H(min) = H2(min).

Program:

```
// C++ program to demonstrate building and inserting in a Fibonacci heap
#include <cstdlib>
#include   <iostream>
#include   <malloc.h>
using namespace std;
```

```
 struct node {
    node* parent;
    node* child;
    node* left;
    node* right;
    int key;
};

// Creating min pointer as "mini"
struct node* mini = NULL;

// Declare an integer for number of nodes in the heap
int no_of_nodes = 0;

// Function to insert a node in heap
void insertion(int val)
{
    struct node* new_node = (struct node*)malloc(sizeof(struct node));
    new_node->key = val;
    new_node->parent = NULL;
    new_node->child = NULL;
    new_node->left = new_node;
    new_node->right = new_node;
    if (mini != NULL) {
        (mini->left)->right = new_node;
        new_node->right = mini;
```

```
        new_node->left = mini->left;
        mini->left = new_node;
        if (new_node->key < mini->key)
            mini = new_node;
    }
    else {
        mini = new_node;
    }
}

// Function to display the heap
void display(struct node* mini)
{
    node* ptr = mini;
    if (ptr == NULL)
        cout << "The Heap is Empty" << endl;
    else {
        cout << "The root nodes of Heap are: " << endl;
        do {
            cout << ptr->key;
            ptr = ptr->right;
            if (ptr != mini) {
                cout << "-->";
            }
        } while (ptr != mini && ptr->right != NULL);
        cout << endl
```

```
            << "The heap has " << no_of_nodes << " nodes" << endl;
    }
}
// Function to find min node in the heap
void find_min(struct node* mini)
{
    cout << "min of heap is: " << mini->key << endl;
}

  // Driver code
int main()
{
    no_of_nodes = 7;
    insertion(4);
    insertion(3);
    insertion(7);
    insertion(5);
    insertion(2);
    insertion(1);
    insertion(10);

    display(mini);

    find_min(mini);
    return 0;
}
```

Output:

The root nodes of Heap are:

1-->2-->3-->4-->7-->5-->10

The heap

has 7 nodes

Min of heap

is: 1

Result:

Thus a C++ program has been written and executed for implementingFibonacci Heap.