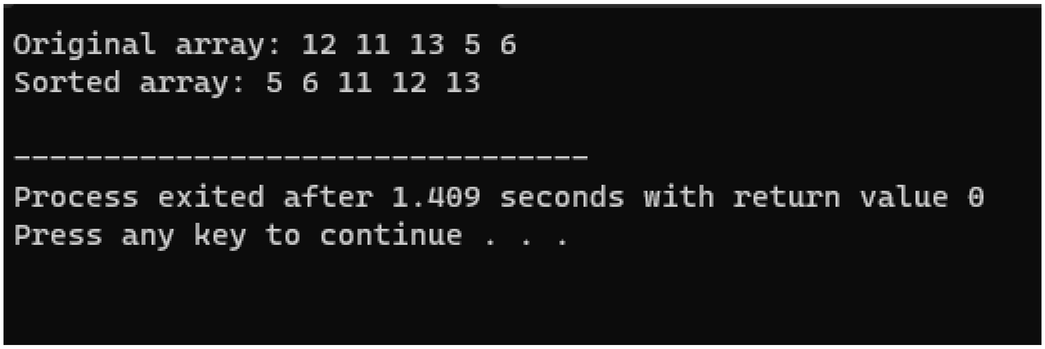
Pratical programs(16-20)

16.write a c program to arrange a series of numbers using insertion sort

```
#include <stdio.h>

void insertionSort(int arr[], int n) {
    for (int i = 1; i < n; i++) {
        int key = arr[i];
        int j = i - 1;

        while (j >= 0 && arr[j] > key) {
            arr[j + 1] = arr[j];
            j--;
        }
        arr[j + 1] = key;
    }
}

void displayArray(int arr[], int n) {
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");
}

int main() {
    int arr[] = {12, 11, 13, 5, 6};
    int n = sizeof(arr) / sizeof(arr[0]);

    printf("Original array: ");
    displayArray(arr, n);

    insertionSort(arr, n);

    printf("Sorted array: ");
    displayArray(arr, n);

    return 0;
}
```

Output:

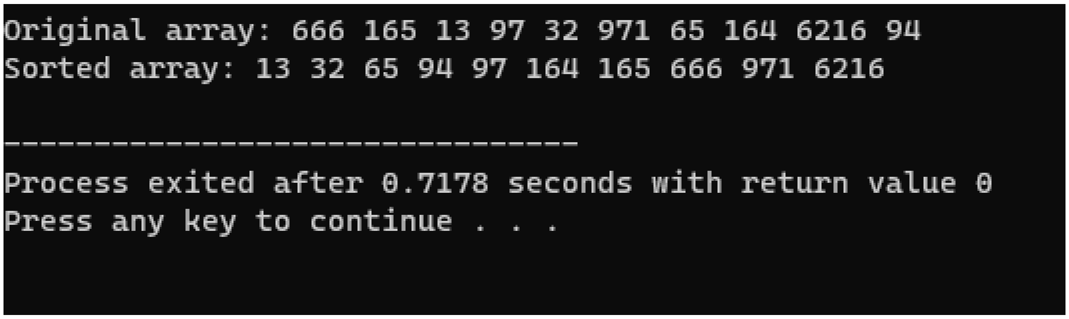


```
Original array: 12 11 13 5 6
Sorted array: 5 6 11 12 13

--------------------------------
Process exited after 1.409 seconds with return value 0
Press any key to continue . . .
```

17.write a c program to arrange a series of numbers using merge sort

```
#include <stdio.h>

void merge(int arr[], int left, int mid, int right) {
    int n1 = mid - left + 1;
    int n2 = right - mid;

    int leftArr[n1], rightArr[n2];

    for (int i = 0; i < n1; i++) {
        leftArr[i] = arr[left + i];
    }
    for (int j = 0; j < n2; j++) {
        rightArr[j] = arr[mid + 1 + j];
    }

    int i = 0, j = 0, k = left;

    while (i < n1 && j < n2) {
        if (leftArr[i] <= rightArr[j]) {
            arr[k] = leftArr[i];
            i++;
        } else {
            arr[k] = rightArr[j];
            j++;
        }
        k++;
    }

    while (i < n1) {
        arr[k] = leftArr[i];
        i++;
        k++;
    }

    while (j < n2) {
        arr[k] = rightArr[j];
        j++;
        k++;
    }
}

void mergeSort(int arr[], int left, int right) {
    if (left < right) {
        int mid = left + (right - left) / 2;

        mergeSort(arr, left, mid);
        mergeSort(arr, mid + 1, right);

        merge(arr, left, mid, right);
    }
}

void displayArray(int arr[], int n) {
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");
}

int main() {
    int arr[] = {12, 11, 13, 5, 6, 7};
    int n = sizeof(arr) / sizeof(arr[0]);

    printf("Original array: ");
    displayArray(arr, n);

    mergeSort(arr, 0, n - 1);

    printf("Sorted array: ");
    displayArray(arr, n);

    return 0;
}
```

Output:

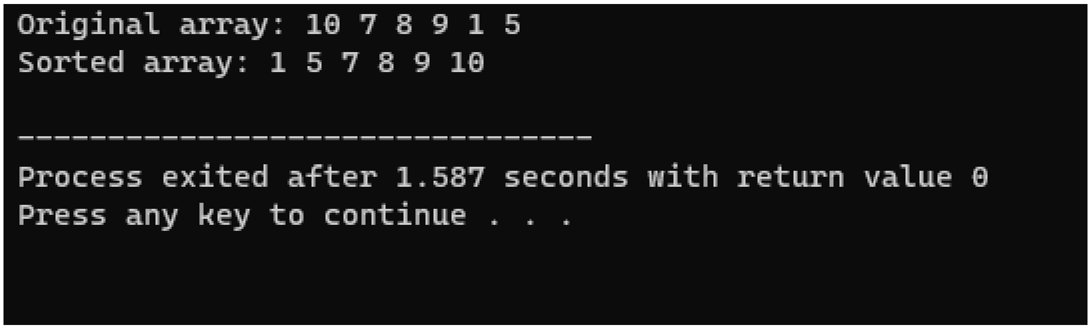


```
Original array: 666 165 13 97 32 971 65 164 6216 94
Sorted array: 13 32 65 94 97 164 165 666 971 6216

--------------------------------
Process exited after 0.7178 seconds with return value 0
Press any key to continue . . .
```

18. write a c program to arrange a series of numbers using quick sort

```
#include <stdio.h>

void swap(int *a, int *b) {
    int temp = *a;
    *a = *b;
    *b = temp;
}

int partition(int arr[], int low, int high) {
    int pivot = arr[high];
    int i = (low - 1);

    for (int j = low; j <= high - 1; j++) {
        if (arr[j] <= pivot) {
            i++;
            swap(&arr[i], &arr[j]);
        }
    }
    swap(&arr[i + 1], &arr[high]);
    return (i + 1);
}

void quickSort(int arr[], int low, int high) {
    if (low < high) {
        int pivotIndex = partition(arr, low, high);

        quickSort(arr, low, pivotIndex - 1);
        quickSort(arr, pivotIndex + 1, high);
    }
}

void displayArray(int arr[], int n) {
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");
}

int main() {
    int arr[] = {10, 7, 8, 9, 1, 5};
    int n = sizeof(arr) / sizeof(arr[0]);

    printf("Original array: ");
    displayArray(arr, n);

    quickSort(arr, 0, n - 1);

    printf("Sorted array: ");
    displayArray(arr, n);

    return 0;
}
```

Output:

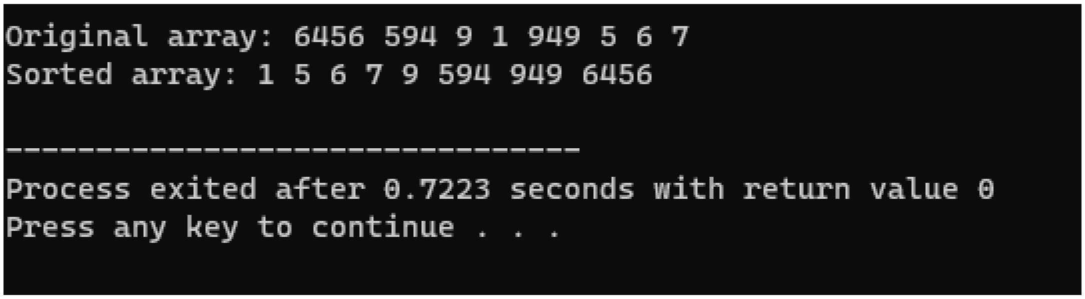


```
Original array: 10 7 8 9 1 5
Sorted array: 1 5 7 8 9 10

--------------------------------
Process exited after 1.587 seconds with return value 0
Press any key to continue . . .
```

19. Write a c program to implement heap sort

```c
#include <stdio.h>

void swap(int *a, int *b) {
    int temp = *a;
    *a = *b;
    *b = temp;
}

void heapify(int arr[], int n, int i) {
    int largest = i;
    int left = 2 * i + 1;
    int right = 2 * i + 2;

    if (left < n && arr[left] > arr[largest]) {
        largest = left;
    }

    if (right < n && arr[right] > arr[largest]) {
        largest = right;
    }

    if (largest != i) {
        swap(&arr[i], &arr[largest]);
        heapify(arr, n, largest);
    }
}

void heapSort(int arr[], int n) {
    for (int i = n / 2 - 1; i >= 0; i--) {
        heapify(arr, n, i);
    }

    for (int i = n - 1; i > 0; i--) {
        swap(&arr[0], &arr[i]);
        heapify(arr, i, 0);
    }
}

void displayArray(int arr[], int n) {
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }
    printf("\n");
}

int main() {
    int arr[] = {6456,594,9,1,949, 5, 6, 7};
    int n = sizeof(arr) / sizeof(arr[0]);

    printf("Original array: ");
    displayArray(arr, n);

    heapSort(arr, n);

    printf("Sorted array: ");
    displayArray(arr, n);

    return 0;
}
```

Output:

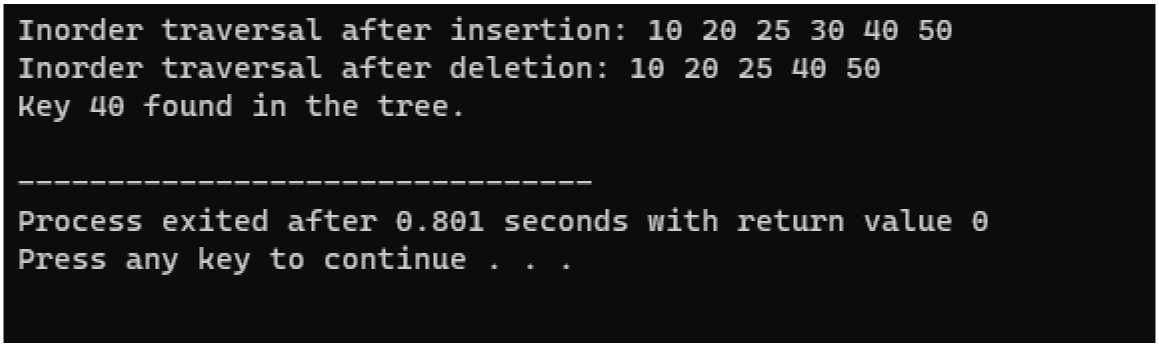


```
Original array: 6456 594 9 1 949 5 6 7
Sorted array: 1 5 6 7 9 594 949 6456

--------------------------------
Process exited after 0.7223 seconds with return value 0
Press any key to continue . . .
```

20. Write a c program to perform the following operations
a)insert an element into avl tree
b)delete an element from a avl tree
c)search for a key element in avl tree

```
#include <stdio.h>
#include <stdlib.h>

struct Node {
    int key;
    struct Node *left;
    struct Node *right;
    int height;
};

int max(int a, int b) {
    return (a > b) ? a : b;
}

int getHeight(struct Node *node) {
    if (node == NULL) {
        return 0;
    }
    return node->height;
}

int getBalance(struct Node *node) {
    if (node == NULL) {
        return 0;
    }
    return getHeight(node->left) - getHeight(node->right);
}

struct Node *newNode(int key) {
    struct Node *node = (struct Node *)malloc(sizeof(struct Node));
    node->key = key;
    node->left = NULL;
    node->right = NULL;
    node->height = 1;
    return node;
}

struct Node *rightRotate(struct Node *y) {
    struct Node *x = y->left;
    struct Node *T2 = x->right;

    x->right = y;
    y->left = T2;

    y->height = max(getHeight(y->left), getHeight(y->right)) + 1;
    x->height = max(getHeight(x->left), getHeight(x->right)) + 1;

    return x;
}

struct Node *leftRotate(struct Node *x) {
    struct Node *y = x->right;
    struct Node *T2 = y->left;

    y->left = x;
    x->right = T2;

    x->height = max(getHeight(x->left), getHeight(x->right)) + 1;
    y->height = max(getHeight(y->left), getHeight(y->right)) + 1;

    return y;
}

struct Node *insert(struct Node *root, int key) {
    if (root == NULL) {
        return newNode(key);
    }

    if (key < root->key) {
        root->left = insert(root->left, key);
    } else if (key > root->key) {
        root->right = insert(root->right, key);
    } else {
        return root;  // Duplicate keys not allowed
    }

    root->height = 1 + max(getHeight(root->left), getHeight(root->right));

    int balance = getBalance(root);

    if (balance > 1 && key < root->left->key) {
        return rightRotate(root);
    }
    if (balance < -1 && key > root->right->key) {
        return leftRotate(root);
    }
    if (balance > 1 && key > root->left->key) {
        root->left = leftRotate(root->left);
        return rightRotate(root);
    }
    if (balance < -1 && key < root->right->key) {
        root->right = rightRotate(root->right);
        return leftRotate(root);
    }
    return root;
}

struct Node *findMin(struct Node *root) {
    while (root->left != NULL) {
        root = root->left;
    }
    return root;
}

struct Node *deleteNode(struct Node *root, int key) {
    if (root == NULL) {
        return root;
    }

    if (key < root->key) {
        root->left = deleteNode(root->left, key);
    } else if (key > root->key) {
        root->right = deleteNode(root->right, key);
    } else {
        if (root->left == NULL || root->right == NULL) {
            struct Node *temp = (root->left) ? root->left : root->right;

            if (temp == NULL) {
                temp = root;
                root = NULL;
            } else {
                *root = *temp;
            }
            free(temp);
        } else {
            struct Node *temp = findMin(root->right);
            root->key = temp->key;
            root->right = deleteNode(root->right, temp->key);
        }
    }

    if (root == NULL) {
        return root;
    }

    root->height = 1 + max(getHeight(root->left), getHeight(root->right));

    int balance = getBalance(root);
    if (balance > 1 && getBalance(root->left) >= 0) {
        return rightRotate(root);
    }
    if (balance > 1 && getBalance(root->left) < 0) {
        root->left = leftRotate(root->left);
        return rightRotate(root);
    }
    if (balance < -1 && getBalance(root->right) <= 0) {
        return leftRotate(root);
    }
    if (balance < -1 && getBalance(root->right) > 0) {
        root->right = rightRotate(root->right);
        return leftRotate(root);
    }

    return root;
}

struct Node *search(struct Node *root, int key) {
    if (root == NULL || root->key == key) {
        return root;
    }

    if (key < root->key) {
        return search(root->left, key);
    }

    return search(root->right, key);
}

void inorderTraversal(struct Node *root) {
    if (root != NULL) {
        inorderTraversal(root->left);
        printf("%d ", root->key);
        inorderTraversal(root->right);
    }
}

int main() {
    struct Node *root = NULL;

    root = insert(root, 10);
    root = insert(root, 20);
    root = insert(root, 30);
    root = insert(root, 40);
    root = insert(root, 50);
    root = insert(root, 25);

    printf("Inorder traversal after insertion: ");
    inorderTraversal(root);
    printf("\n");

    root = deleteNode(root, 30);

    printf("Inorder traversal after deletion: ");
    inorderTraversal(root);
    printf("\n");

    int keyToSearch = 40;
    struct Node *searchResult = search(root, keyToSearch);
    if (searchResult) {
        printf("Key %d found in the tree.\n", keyToSearch);
    } else {
        printf("Key %d not found in the tree.\n", keyToSearch);
    }

    return 0;
}
```

Output:



```
Inorder traversal after insertion: 10 20 25 30 40 50
Inorder traversal after deletion: 10 20 25 40 50
Key 40 found in the tree.

--------------------------------
Process exited after 0.801 seconds with return value 0
Press any key to continue . . .
```