Bharatiya Vidya Bhavan's

Sardar Patel Institute of Technology

(Autonomous Institute Affiliated to University of Mumbai)

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Batch: CSE A Batch C

Experiment No.:5

Aim: Binary Tree Creation

Problem:

1-Creation of binary tree given preorder and Inorder

2- display intermediate output using any one traversal

Solution:

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

struct Node {
   int data;
   struct Node *l, *r;
};

struct Node* nodenew(int data) {
   struct Node* node = (struct Node*)malloc(sizeof(struct Node));
   node->data = data;
   node->l = node->r = NULL;
   return node;
}

void preorder(struct Node* root) {
   if (root == NULL)
       return;
   printf("%d ", root->data);
   preorder(root->l);
   preorder(root->r);
}

int getindex(int* arr, int start, int end, int value) {
   for (int i = start; i <= end; i++) {
       if (arr[i] == value)
           return i;
   }
   return -1;
}

struct Node* posttreemaker(int* inorder, int* postorder, int start, int end, int* postgetindex) {
   if (start > end)
       return NULL;

   struct Node* root = nodenew(postorder[*postgetindex]);
   (*postgetindex)--;

   if (start == end)
       return root;

   int ingetindex = getindex(inorder, start, end, root->data);
   root->r = posttreemaker(inorder, postorder, ingetindex + 1, end, postgetindex);
```

```
    root->l = posttreemaker(inorder, postorder, start, ingetindex - 1, postgetindex);

    return root;
}

struct Node* pretreemaker(int* inorder, int* preorder, int start, int end, int* preindex) {
    if (start > end)
        return NULL;

    struct Node* root = nodenew(preorder[*preindex]);
    (*preindex)++;

    if (start == end)
        return root;

    int ingetindex = getindex(inorder, start, end, root->data);
    root->l = pretreemaker(inorder, preorder, start, ingetindex - 1, preindex);
    root->r = pretreemaker(inorder, preorder, ingetindex + 1, end, preindex);

    return root;
}

void inorder(struct Node* root) {
    if (root == NULL)
        return;
    inorder(root->l);
    printf("%d ", root->data);
    inorder(root->r);
}

bool is_skewed(struct Node* root) {
    if (root == NULL)
        return true;
    if (root->l && root->r)
        return false;
    return is_skewed(root->l) && is_skewed(root->r);
}

bool validate_input(int* inorder, int* order, int n) {
    int found[100] = {0};
    for (int i = 0; i < n; i++) {
        found[inorder[i]]++;
        found[order[i]]++;
        if (found[inorder[i]] > 1 || found[order[i]] > 1)
            return false;  // dupes
    }
    return true;
```

```
}

int main() {
   int n;
   printf("total node: ");
   scanf("%d", &n);

   int inorderArr[n], preorderArr[n], postorderArr[n];

   printf("Enter inorder sequence: ");
   for (int i = 0; i < n; i++)
       scanf("%d", &inorderArr[i]);

   int choice;
   printf("1. preorder+inorder\n 2. postorder+inorder\n");
   scanf("%d", &choice);

   struct Node* root2 = NULL;

   if (choice == 1) {
       printf("Enter preorder sequence: ");
       for (int i = 0; i < n; i++)
           scanf("%d", &preorderArr[i]);

       if (!validate_input(inorderArr, preorderArr, n)) {
           printf("invalid input check again plz.\n");
           return 1;
       }

       int preindex = 0;
       root2 = pretreemaker(inorderArr, preorderArr, 0, n - 1, &preindex);

   } else if (choice == 2) {
       printf("Enter postorder sequence: ");
       for (int i = 0; i < n; i++)
           scanf("%d", &postorderArr[i]);

       if (!validate_input(inorderArr, postorderArr, n)) {
           printf("invalid input check again plz.\n");
           return 1;
       }

       int postgetindex = n - 1;
       root2 = posttreemaker(inorderArr, postorderArr, 0, n - 1, &postgetindex);

   } else {
       printf("somethign went wrong.\n");
```

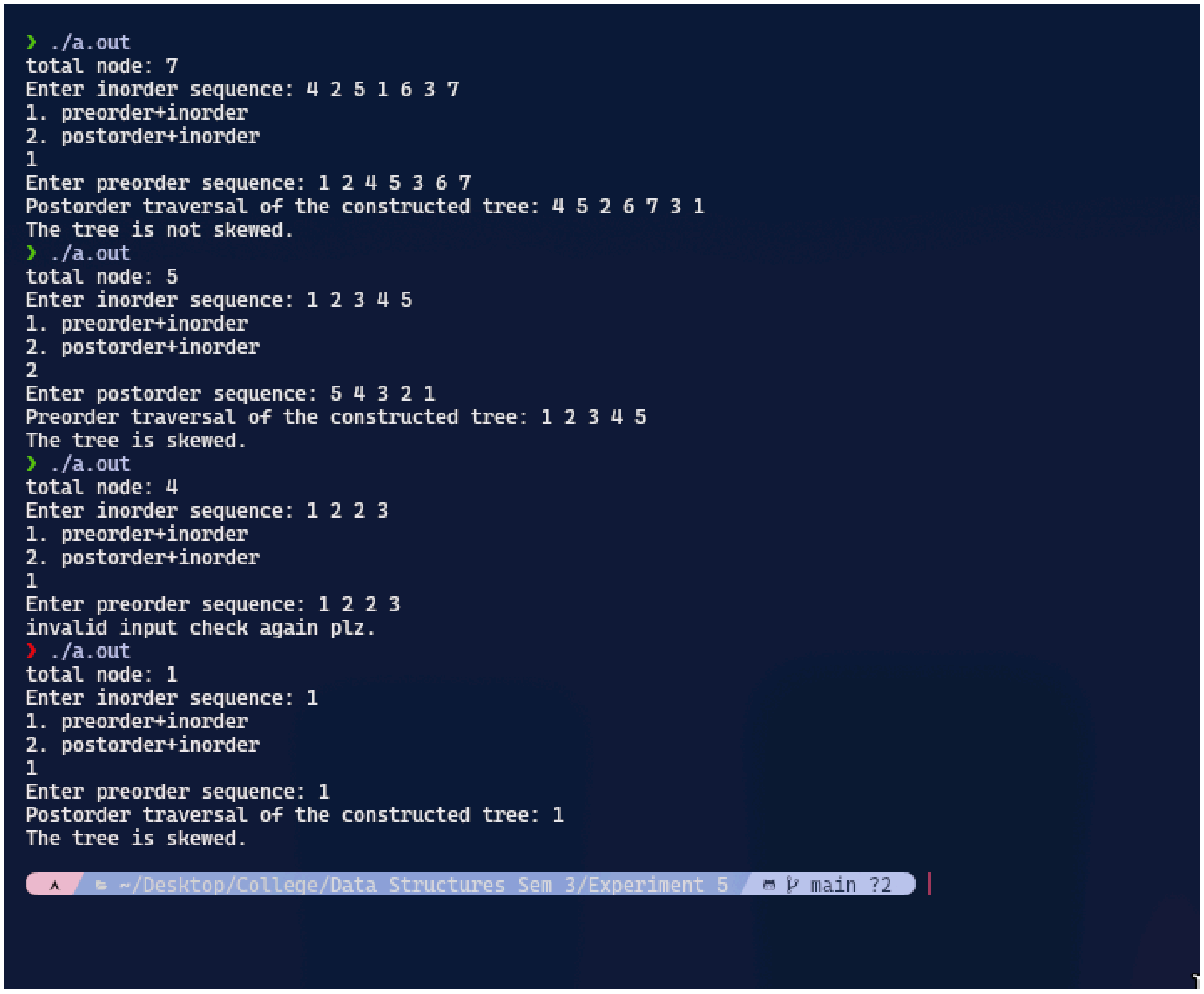
```
        return 1;
    }

    printf("Inorder traversal of the constructed tree: ");
    inorder(root2);
    printf("\n");

    if (is_skewed(root2)) {
        printf("The tree is skewed.\n");
    } else {
        printf("The tree is not skewed.\n");
    }

    return 0;
}
```

OUTPUT:



```
❯ ./a.out
total node: 7
Enter inorder sequence: 4 2 5 1 6 3 7
1. preorder+inorder
2. postorder+inorder
1
Enter preorder sequence: 1 2 4 5 3 6 7
Postorder traversal of the constructed tree: 4 5 2 6 7 3 1
The tree is not skewed.
❯ ./a.out
total node: 5
Enter inorder sequence: 1 2 3 4 5
1. preorder+inorder
2. postorder+inorder
2
Enter postorder sequence: 5 4 3 2 1
Preorder traversal of the constructed tree: 1 2 3 4 5
The tree is skewed.
❯ ./a.out
total node: 4
Enter inorder sequence: 1 2 2 3
1. preorder+inorder
2. postorder+inorder
1
Enter preorder sequence: 1 2 2 3
invalid input check again plz.
❯ ./a.out
total node: 1
Enter inorder sequence: 1
1. preorder+inorder
2. postorder+inorder
1
Enter preorder sequence: 1
Postorder traversal of the constructed tree: 1
The tree is skewed.

 ~/Desktop/College/Data Structures Sem 3/Experiment 5  main ?2
```

top to bottom cases :

1. balanced tree
2. right skewed tree
3. duplicate error showcase
4. single node tree

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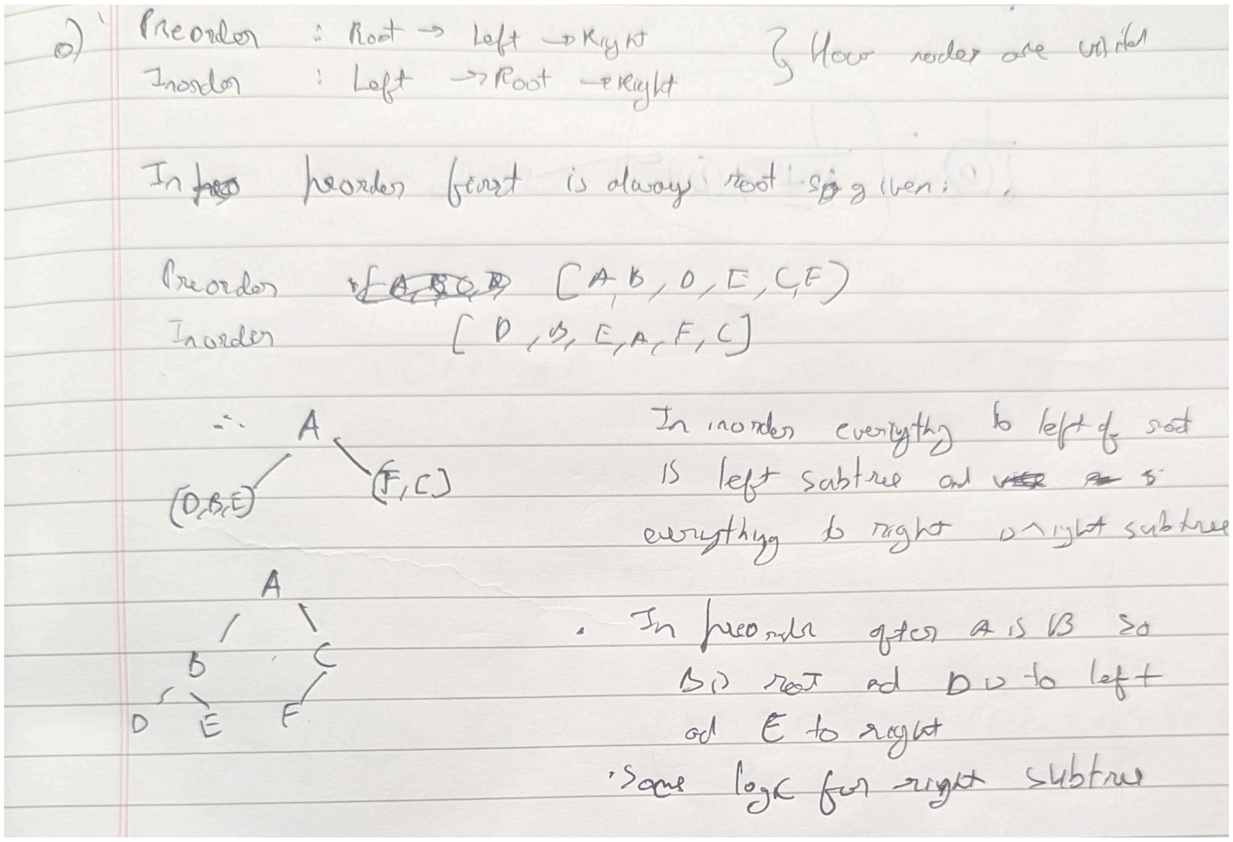
Handwritten assignment :



a) Preorder : Root → Left → Right } How order are visited
Inorder : Left → Root → Right

In ~~pre~~ preorder first is always root so given:

Preorder ~~[A,B,C,D]~~ [A, B, D, E, C, F]
Inorder [D, B, E, A, F, C]

$$\begin{tikzcd} & A \arrow[dl, dash] \arrow[dr, dash] & \\ (D,B,E) & & (F,C) \end{tikzcd}$$

In inorder everything to left of root is left subtree and ~~vice~~ ~~versa~~ everything to right is right subtree

$$\begin{tikzcd} & & A \arrow[dl, dash] \arrow[dr, dash] & \\ & B \arrow[dl, dash] \arrow[d, dash] & & C \arrow[dl, dash] \\ D & E & F & \end{tikzcd}$$

- In preorder after A is B so B is root and D is to left and E to right
- Same logic for right subtree