

CS256 ASSIGNMENT-3  
UNIX AND SHELL SCRIPTING LAB  
ROLL NO -422151  
SEC-A

Create shell scripts for generating static and dynamic libraries.

*→here in first example we are demonstrating using binary search tree with four functions for insertion,search,deletion,in order traversal*

**bst\_functions.h**

```
#ifndef BST_FUNCTIONS_H
```

```
#define BST_FUNCTIONS_H
```

```
typedef struct TreeNode {
```

```
    int key;
```

```
    struct TreeNode* left;
```

```
    struct TreeNode* right;
```

```
} TreeNode;
```

```
TreeNode* insert(TreeNode* root, int key);
```

```
TreeNode* deleteNode(TreeNode* root, int key);
```

```
TreeNode* search(TreeNode* root, int key);
```

```
void printInorder(TreeNode* root);  
#endif /* BST_FUNCTIONS_H */
```

### **bst\_insert.c**

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

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

```
#include "bst_functions.h"
```

```
TreeNode* insert(TreeNode* root, int key) {
```

```
    if (root == NULL) {
```

```
        TreeNode* newNode =  
(TreeNode*)malloc(sizeof(TreeNode));
```

```
        if (newNode == NULL) {
```

```
            printf("Memory allocation failed\n");
```

```
            exit(EXIT_FAILURE);
```

```
        }
```

```
        newNode->key = key;
```

```
        newNode->left = NULL;
```

```
        newNode->right = NULL;
```

```
        return newNode;
```

```
    }
```

```
    if (key < root->key) {
```

```
        root->left = insert(root->left, key);
    } else if (key > root->key) {
        root->right = insert(root->right, key);
    }

    return root;
}
```

### **bst\_search.c**

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

```
#include "bst_functions.h"
```

```
TreeNode* search(TreeNode* 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);
}
```

### **bst\_delete.c**

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

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

```
#include "bst_functions.h"
```

```
TreeNode* minValueNode(TreeNode* node) {
```

```
    TreeNode* current = node;
```

```
    while (current && current->left != NULL) {
```

```
        current = current->left;
```

```
    }
```

```
    return current;
```

```
}
```

```
TreeNode* deleteNode(TreeNode* 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) {
        TreeNode* temp = root->right;
        free(root);
        return temp;
    } else if (root->right == NULL) {
        TreeNode* temp = root->left;
        free(root);
        return temp;
    }

    TreeNode* temp = minValueNode(root->right);
    root->key = temp->key;
    root->right = deleteNode(root->right, temp->key);
}

return root;
}

```

## **bst\_print.c**

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

```
#include "bst_functions.h"
```

```
void printInorder(TreeNode* root) {  
    if (root == NULL) {  
        return;  
    }  
    printInorder(root->left);  
    printf("%d ", root->key);  
    printInorder(root->right);  
}
```

### **main.c**

```
#include <stdio.h>  
  
#include "bst_functions.h"  
  
int main() {  
    TreeNode* root = NULL;  
  
    // Inserting some nodes into the BST  
    root = insert(root, 50);  
    insert(root, 30);  
    insert(root, 20);  
    insert(root, 40);  
    insert(root, 70);  
    insert(root, 60);  
    insert(root, 80);  
}
```

```

// Searching for a node in the BST
TreeNode* searchResult = search(root, 40);
if (searchResult != NULL) {
    printf("Node with key 40 found in the BST.\n");
} else {
    printf("Node with key 40 not found in the BST.\n");
}

// Delete a node from the BST
root = deleteNode(root, 30);

// Print the BST
printf("Inorder traversal of the BST after deletion:\n");
printInorder(root);

return 0;
}

```

## **build\_and\_run.sh**

```

# Compiling the BST source files into object files
gcc -c bst_insert.c bst_delete.c bst_search.c bst_print.c
if [ $? -ne 0 ]; then

```

```
    echo "Error: Compilation of BST source files failed."
    exit 1
fi

# Create static library
ar rcs libbst_functions.a bst_insert.o bst_delete.o
bst_search.o bst_print.o
if [ $? -ne 0 ]; then
    echo "Error: Creation of static library failed."
    exit 1
fi

# Create dynamic library
gcc -shared -o libbst_functions.so bst_insert.o bst_delete.o
bst_search.o bst_print.o
if [ $? -ne 0 ]; then
    echo "Error: Creation of dynamic library failed."
    exit 1
fi

# Set library path
export LD_LIBRARY_PATH=$(pwd):$LD_LIBRARY_PATH
```



```
# Compile main program with static library
gcc main.c -L. -lbst_functions -o main_static
if [ $? -ne 0 ]; then
    echo "Error: Compilation of main program with static
library failed."
    exit 1
fi
```

```
# Compile main program with dynamic library
gcc main.c -L. -lbst_functions -o main_dynamic
if [ $? -ne 0 ]; then
    echo "Error: Compilation of main program with dynamic
library failed."
    exit 1
fi
```

```
# Execute main programs
echo "Executing main program with static library..."
./main_static
if [ $? -ne 0 ]; then
    echo "Error: Execution of main program with static library
failed."
    exit 1
```

fi

echo "Executing main program with dynamic library..."

./main\_dynamic

if [ \$? -ne 0 ]; then

    echo "Error: Execution of main program with dynamic library failed."

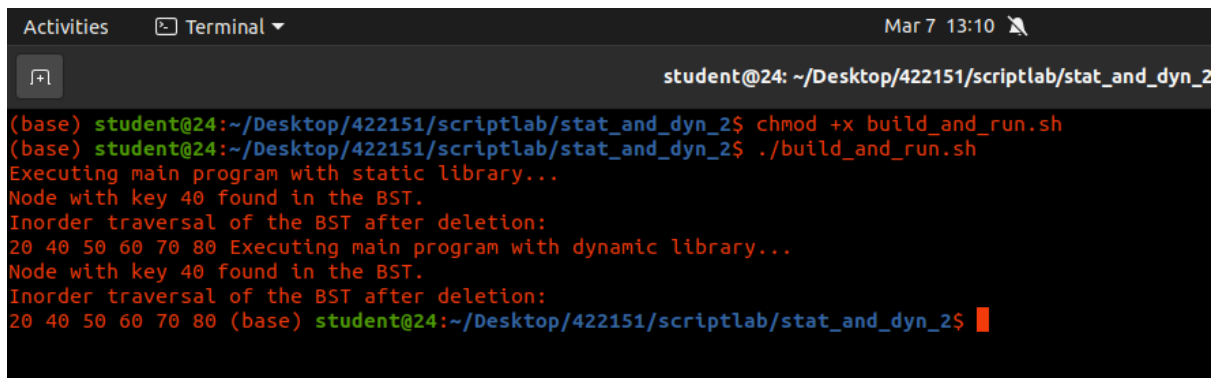
    exit 1

fi

# Clean up object files and executables

rm \*.o libbst\_functions.a libbst\_functions.so main\_static  
main\_dynamic

## output



```
Activities Terminal Mar 7 13:10
student@24: ~/Desktop/422151/scriptlab/stat_and_dyn_2
(base) student@24:~/Desktop/422151/scriptlab/stat_and_dyn_2$ chmod +x build_and_run.sh
(base) student@24:~/Desktop/422151/scriptlab/stat_and_dyn_2$ ./build_and_run.sh
Executing main program with static library...
Node with key 40 found in the BST.
Inorder traversal of the BST after deletion:
20 40 50 60 70 80 Executing main program with dynamic library...
Node with key 40 found in the BST.
Inorder traversal of the BST after deletion:
20 40 50 60 70 80 (base) student@24:~/Desktop/422151/scriptlab/stat_and_dyn_2$
```

→ here in second example we are demonstrating using three functions from tutorial material

## **head.h**

```
int factorial(int num);  
int sumOfDigits(int num);
```

## **main.c**

```
#include <stdio.h>  
#include "head.h"  
  
void main() {  
    int num=12;  
    factorial(num);  
    sumOfDigits(num);  
}
```

## **fact.c**

```
#include<stdio.h>  
  
int factorial(int n) {  
    if (n == 0 || n == 1) {  
        printf("Factorial of %d is %d\n", n, 1);  
        return 1;  
    } else {  
        int result = n * factorial(n - 1);  
        printf("Factorial of %d is %d\n", n, result);  
        return result;  
    }  
}
```

## **sum.c**

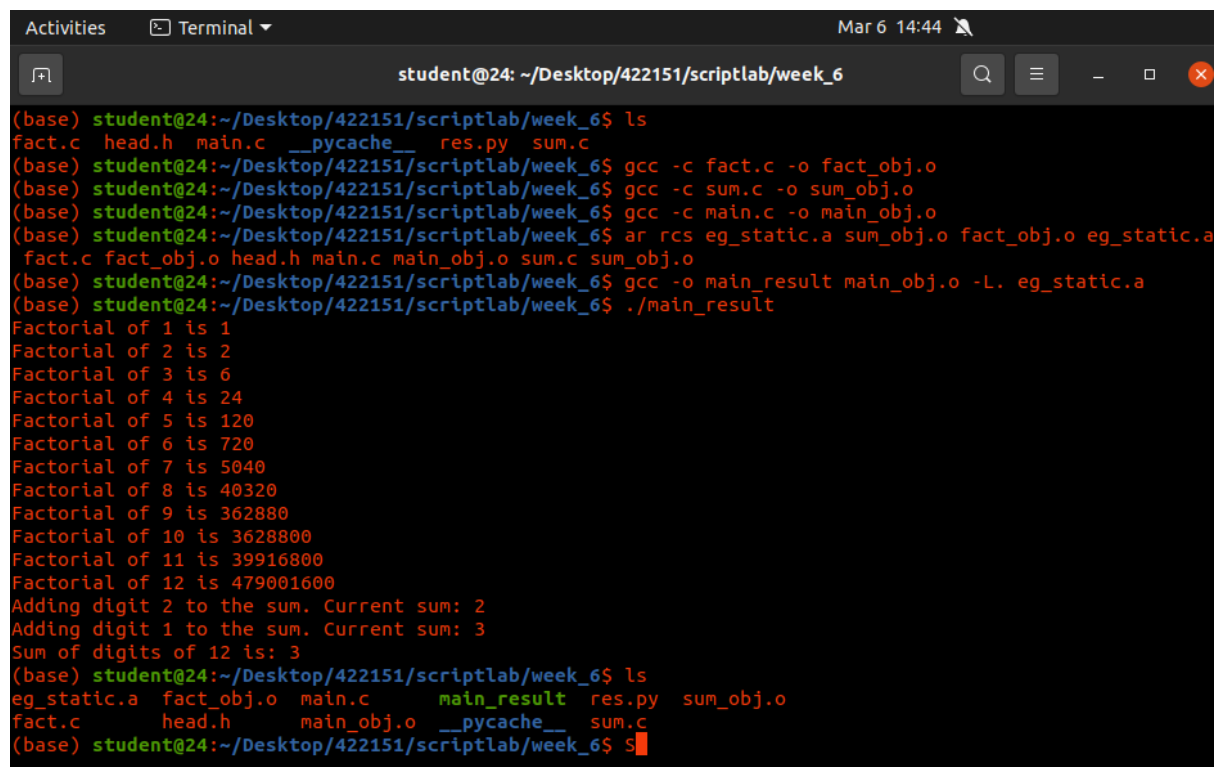
```
#include<stdio.h>  
int sumOfDigits(int num) {  
    int sum = 0;  
    int originalNum = num;  
  
    while (num != 0) {  
        int digit = num % 10;  
        sum += digit;  
        printf("Adding digit %d to the sum. Current  
sum: %d\n", digit, sum);  
    }  
}
```

```

        num /= 10;
    }
    printf("Sum of digits of %d is: %d\n",
originalNum, sum);
}

```

## Output with static libraries:



```

Activities Terminal Mar 6 14:44
student@24: ~/Desktop/422151/scriptlab/week_6

(base) student@24:~/Desktop/422151/scriptlab/week_6$ ls
fact.c  head.h  main.c  __pycache__  res.py  sum.c
(base) student@24:~/Desktop/422151/scriptlab/week_6$ gcc -c fact.c -o fact_obj.o
(base) student@24:~/Desktop/422151/scriptlab/week_6$ gcc -c sum.c -o sum_obj.o
(base) student@24:~/Desktop/422151/scriptlab/week_6$ gcc -c main.c -o main_obj.o
(base) student@24:~/Desktop/422151/scriptlab/week_6$ ar rcs eg_static.a fact_obj.o eg_static.a
fact.c fact_obj.o head.h main.c main_obj.o sum.c sum_obj.o
(base) student@24:~/Desktop/422151/scriptlab/week_6$ gcc -o main_result main_obj.o -L. eg_static.a
(base) student@24:~/Desktop/422151/scriptlab/week_6$ ./main_result
Factorial of 1 is 1
Factorial of 2 is 2
Factorial of 3 is 6
Factorial of 4 is 24
Factorial of 5 is 120
Factorial of 6 is 720
Factorial of 7 is 5040
Factorial of 8 is 40320
Factorial of 9 is 362880
Factorial of 10 is 3628800
Factorial of 11 is 39916800
Factorial of 12 is 479001600
Adding digit 2 to the sum. Current sum: 2
Adding digit 1 to the sum. Current sum: 3
Sum of digits of 12 is: 3
(base) student@24:~/Desktop/422151/scriptlab/week_6$ ls
eg_static.a  fact_obj.o  main.c  main_result  res.py  sum_obj.o
fact.c      head.h      main_obj.o  __pycache__  sum.c
(base) student@24:~/Desktop/422151/scriptlab/week_6$ S

```

## Output with dynamic libraries:

```
Activities Terminal
student@24: ~/Desktop/422151/scriptlab/week_6

(base) student@24:~/Desktop/422151/scriptlab/week_6$ ls
eg_static.a  fact.c  fact_obj.o  head.h  main.c  main_obj.o  main_result
__pycache__  res.py  sum.c  sum_obj.o
(base) student@24:~/Desktop/422151/scriptlab/week_6$ gcc *.o -shared -o eg_dynamic.so
(base) student@24:~/Desktop/422151/scriptlab/week_6$ ls
eg_dynamic.so  eg_static.a  fact.c  fact_obj.o  head.h  main.c  main_obj.o
main_result  __pycache__  res.py  sum.c  sum_obj.o
(base) student@24:~/Desktop/422151/scriptlab/week_6$ gcc -o main_result main_obj.o -L. eg_dynamic.so
(base) student@24:~/Desktop/422151/scriptlab/week_6$ ./main_result
./main_result: error while loading shared libraries: eg_dynamic.so: cannot open shared object file: No such file or directory
(base) student@24:~/Desktop/422151/scriptlab/week_6$ sudo cp eg_dynamic.so /usr/lib
[sudo] password for student:
(base) student@24:~/Desktop/422151/scriptlab/week_6$ ./main_result
Factorial of 1 is 1
Factorial of 2 is 2
Factorial of 3 is 6
Factorial of 4 is 24
Factorial of 5 is 120
Factorial of 6 is 720
Factorial of 7 is 5040
Factorial of 8 is 40320
Factorial of 9 is 362880
Factorial of 10 is 3628800
Factorial of 11 is 39916800
Factorial of 12 is 479001600
Adding digit 2 to the sum. Current sum: 2
Adding digit 1 to the sum. Current sum: 3
Sum of digits of 12 is: 3
```

```
student@24: ~/Desktop/422151/scriptlab/week_6
(base) student@24:~/Desktop/422151/scriptlab/week_6$ sudo rm /usr/lib/eg_dynamic.so
(base) student@24:~/Desktop/422151/scriptlab/week_6$ pwd
/home/student/Desktop/422151/scriptlab/week_6
(base) student@24:~/Desktop/422151/scriptlab/week_6$ export LD_LIBRARY_PATH=:
/home/student/Desktop/422151/scriptlab/week_6
(base) student@24:~/Desktop/422151/scriptlab/week_6$ ./main_result
Factorial of 1 is 1
Factorial of 2 is 2
Factorial of 3 is 6
Factorial of 4 is 24
Factorial of 5 is 120
Factorial of 6 is 720
Factorial of 7 is 5040
Factorial of 8 is 40320
Factorial of 9 is 362880
Factorial of 10 is 3628800
Factorial of 11 is 39916800
Factorial of 12 is 479001600
Adding digit 2 to the sum. Current sum: 2
Adding digit 1 to the sum. Current sum: 3
Sum of digits of 12 is: 3
(base) student@24:~/Desktop/422151/scriptlab/week_6$ ls
eg_dynamic.so  eg_static.a  fact.c  fact_obj.o  head.h  main.c  main_obj.o  main_result  __pycache__  res.py  sum.c  sum_obj.o
(base) student@24:~/Desktop/422151/scriptlab/week_6$ ldd main_result
linux-vdso.so.1 (0x00007ffc299d6000)
eg_dynamic.so (0x00007f11c8c40000)
libc.so.6 => /lib/x86_64-linux-gnu/libc.so.6 (0x00007f11c8a35000)
/lib64/ld-linux-x86-64.so.2 (0x00007f11c8c4c000)
(base) student@24:~/Desktop/422151/scriptlab/week_6$
```