DSA LAB

Assignment 2

Name: Madhav Jha
Roll no.: 48
Branch: CSE (AI & ML)

ADT Array

AIM:

Use ADT Array with Structures and perform following operations

1. Create an array using dynamic memory allocation function
2. Insert an element in an array at specific position.
3. Insert an element at the end of an array
4. delete an element from array
5. Find maximum number
5. Find minimum number
6. Linear search and binary search
7. Merging to array
8. Array intersection
9. Sum up all the elements in the array
10. Average all the elements of the array
11. Reverse all the elements of the array (Using new array)
12. Reversing array using original array only
13. Insert element in a sorted array
14. Check if array is sorted or not

Code:

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


void error(char e[]) {
    printf("\nERROR: %s!!\n", e);
}

typedef struct
{
    int* arr;
    int maxLen, i;
}Array;

void printArray(Array* a) {
    printf("[ ");
    for (int j = 0;j < (a->i);j++) {
        printf("%d ", (a->arr)[j]);
    }
    printf("]\n");
}
// initiate the Array object
Array* initializeArray(int n) {
    Array* a;
    a = (Array*)malloc(sizeof(Array));
    a->maxLen = n;
    a->i = 0;
    a->arr = (int*)calloc(n, sizeof(int));
    return a;
}

// increase the size of array
void expandArray(Array* a) {
    a->maxLen *= 2;
    a->arr = (int*)realloc(a->arr, (a->maxLen) * sizeof(int));
}

// add element at the end of the array
void push_back(Array* a, int num) {
```

```
    if (a->i >= a->maxLen - 1) {
        expandArray(a);
    }
    (a->arr)[a->i] = num;
    (a->i)++;
}

// return current length of the Array
int len(Array* a) {
    return a->i;
}

// insert at index
void insertAt(Array* a, int index, int num) {
    if (index < 0 || index >= a->i) {
        error("index out of bound");
        return;
    }

    (a->maxLen)++;
    for (int i = a->i;i > index;i--) {
        (a->arr)[i] = (a->arr)[i - 1];
    }
    (a->arr)[index] = num;
    (a->i)++;
}

int linerSearch(Array* a, int num) {
    int index = -1;
    for (int i = 0;i < a->i;i++) {
        if ((a->arr)[i] == num) {
            index = i;
            break;
        }
    }
    return index;
}

void delete(Array* a, int num) {
    int index = linerSearch(a, num);
```

```
    if (index == -1) {
        error("Num not found");
        return;
    }
    for (int i = index;i < a->i;i++) {
        (a->arr)[i] = (a->arr)[i + 1];
    }
    (a->i)--;
}

int minElem(Array* a) {
    int min = INT_MAX;
    for (int i = 0;i < a->i;i++) {
        min = ((a->arr)[i] < min) ? (a->arr)[i] : min;
    }
    return min;
}
int maxElem(Array* a) {
    int max = -1 * INT_MAX;
    for (int i = 0;i < a->i;i++) {
        max = ((a->arr)[i] > max) ? (a->arr)[i] : max;
    }
    return max;
}

int sum(Array* a) {
    int s = 0;
    for (int i = 0;i < a->i;i++) {
        s += (a->arr)[i];
    }
    return s;
}
double avg(Array* a) {
    int s = sum(a);
    return (double)s / (double)(a->i);
}

void reverseNew(Array* a) {
    int* t;
    t = (int*)calloc((a->maxLen), sizeof(int));
```

```
    for (int i = (a->i) - 1, j = 0;i >= 0;i--, j++) {
        t[j] = (a->arr)[i];
    }
    free(a->arr);
    a->arr = t;
}
void reverse(Array* a) {
    int n = a->i, temp = 0;
    for (int i = 0;i < n / 2;i++) {
        temp = (a->arr)[i];
        (a->arr)[i] = (a->arr)[n - 1 - i];
        (a->arr)[n - 1 - i] = temp;
    }
}

void bubbleSort(Array* a) {
    int n = a->i;
    for (int i = 0;i < n;i++) {
        for (int j = 0;j < n;j++) {
            if (a->arr[i] < a->arr[j]) {
                int temp = a->arr[i];
                a->arr[i] = a->arr[j];
                a->arr[j] = temp;
            }
        }
    }
}

int binarySearch(Array* a, int num) {

    // sort
    bubbleSort(a);

    int l = 0, r = a->i - 1, m, index = -1;

    int* arr;
    arr = a->arr;

    while (l <= r) {
        m = (l + r) / 2;
```

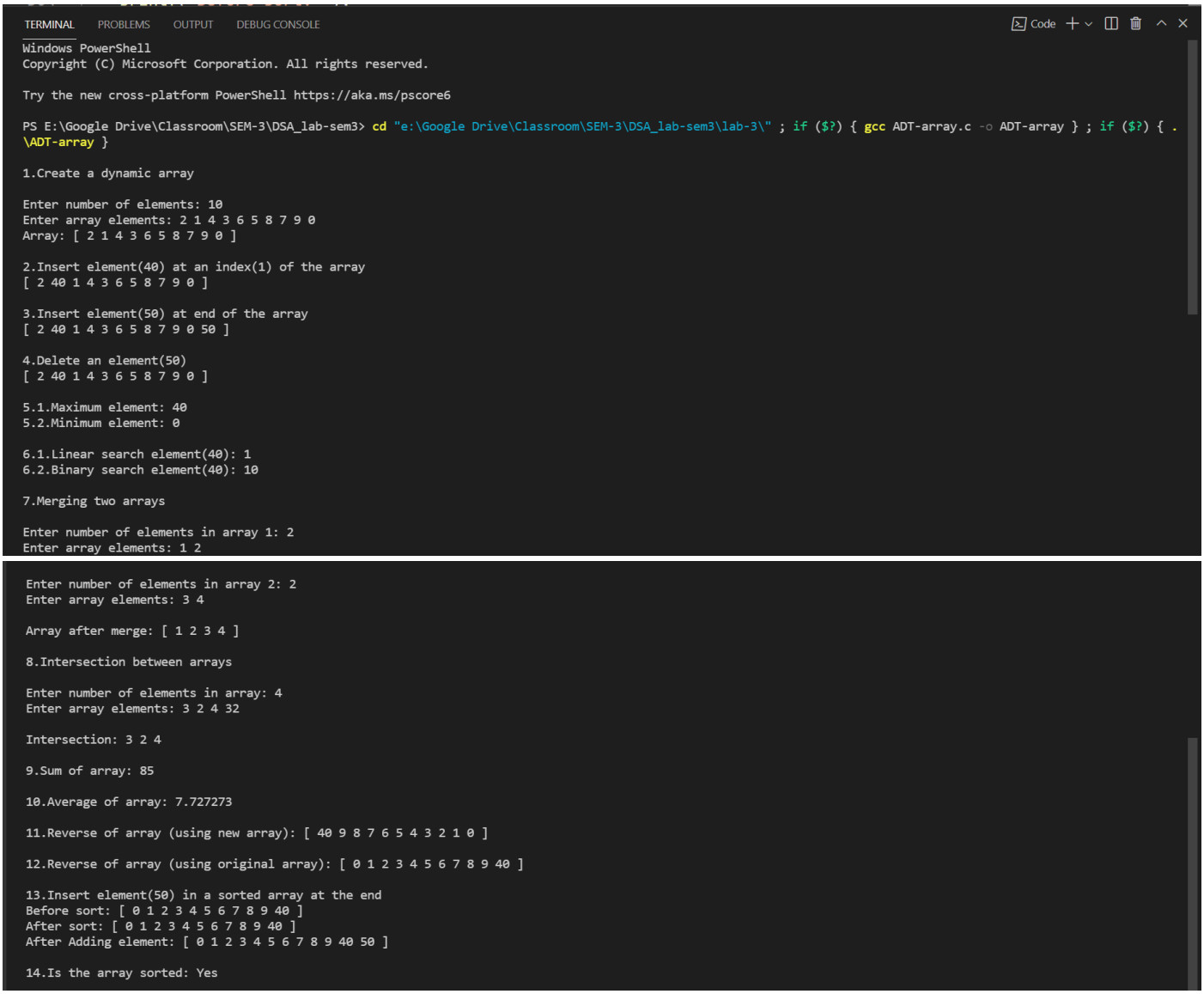
```
        if (arr[m] == num) {
            index = m;
            break;
        }
        else if (arr[m] < num) {
            l = m + 1;
        }
        else {
            r = m;
        }
    }
    return index;
}

int isSorted(Array* a) {
    int flag = 1;
    for (int i = 0;i < a->i - 1;i++) {
        if ((a->arr)[i] > (a->arr)[i + 1]) {
            flag = 0;
            break;
        }
    }
    return flag;
}

void mergeArr() {
    int a1 = 2;
    printf("\nEnter number of elements in array 1: ");
    scanf("%d", &a1);

    int* arr1, * arr2, * arr3;
    arr1 = (int*)calloc(a1, sizeof(int));
    printf("Enter array elements: ");
    for (int i = 0;i < a1;i++) {
        scanf("%d", &arr1[i]);
    }

    int a2 = 2;
    printf("\nEnter number of elements in array 2: ");
    scanf("%d", &a2);
```

```
    arr2 = (int*)calloc(a2, sizeof(int));
    printf("Enter array elements: ");
    for (int i = 0;i < a2;i++) {
        scanf("%d", &arr2[i]);
    }

    int a3 = a1 + a2;
    arr3 = (int*)calloc(a3, sizeof(int));
    for (int i = 0; i < a1; i++)
    {
        arr3[i] = arr1[i];
    }

    for (int i = 0; i < a2; i++)
    {
        arr3[a1 + i] = arr2[i];
    }
    printf("\nArray after merge: ");
    printf("[ ");
    for (int j = 0;j < a3;j++) {
        printf("%d ", arr3[j]);
    }
    printf("]\n");
}

void intersection(Array* a) {
    int a1 = 2;
    printf("\nEnter number of elements in array: ");
    scanf("%d", &a1);

    int arr1[a1];
    printf("Enter array elements: ");
    for (int i = 0;i < a1;i++) {
        scanf("%d", &arr1[i]);
    }

    printf("\nIntersection: ");
    for (int i = 0;i < a1;i++) {
        int index = linerSearch(a, arr1[i]);
```

```
        if (index != -1) {
            printf("%d ", arr1[i]);
        }
    }
    printf("\n");
}


int main() {
    printf("\n1.Create a dynamic array\n");
    int n = 2;
    printf("\nEnter number of elements: ");
    scanf("%d", &n);

    Array* a;
    a = initializeArray(n);

    printf("Enter array elements: ");
    for (int i = 0;i < n;i++) {
        int t;
        scanf("%d", &t);
        push_back(a, t);
    }

    printf("Array: ");
    printArray(a);

    printf("\n2.Insert element(40) at an index(1) of the array\n");
    insertAt(a, 1, 40);
    printArray(a);

    printf("\n3.Insert element(50) at end of the array\n");
    push_back(a, 50);
    printArray(a);

    printf("\n4.Delete an element(50)\n");
    delete(a, 50);
    printArray(a);

    printf("\n5.1.Maximum element: %d\n", maxElem(a));
    printf("5.2.Minimum element: %d\n", minElem(a));
```

```
    printf("\n6.1.Linear search element(40): %d\n", linerSearch(a,
40));
    printf("6.2.Binary search element(40): %d\n", binarySearch(a,
40));

    printf("\n7.Merging two arrays\n");
    mergeArr();

    printf("\n8.Intersection between arrays\n");
    intersection(a);

    printf("\n9.Sum of array: %d\n", sum(a));

    printf("\n10.Average of array: %f\n", avg(a));

    printf("\n11.Reverse of array (using new array): ");
    reverseNew(a);
    printArray(a);

    printf("\n12.Reverse of array (using original array): ");
    reverse(a);
    printArray(a);

    printf("\n13.Insert element(50) in a sorted array at the end\n");
    printf("Before sort: ");
    printArray(a);
    printf("After sort: ");
    bubbleSort(a);
    printArray(a);
    printf("After Adding element: ");
    push_back(a, 50);
    printArray(a);

    printf("\n14.Is the array sorted: %s\n", ((isSorted(a) == 1 ?
"Yes" : "No")));
    printf("\n");
    free(a);
    return 0;
}
```

Output:



```
TERMINAL  PROBLEMS  OUTPUT  DEBUG CONSOLE                                Code

Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell https://aka.ms/pscore6

PS E:\Google Drive\Classroom\SEM-3\DSA_lab-sem3> cd "e:\Google Drive\Classroom\SEM-3\DSA_lab-sem3\lab-3\" ; if ($?) { gcc ADT-array.c -o ADT-array } ; if ($?) { .
\ADT-array }

1.Create a dynamic array

Enter number of elements: 10
Enter array elements: 2 1 4 3 6 5 8 7 9 0
Array: [ 2 1 4 3 6 5 8 7 9 0 ]

2.Insert element(40) at an index(1) of the array
[ 2 40 1 4 3 6 5 8 7 9 0 ]

3.Insert element(50) at end of the array
[ 2 40 1 4 3 6 5 8 7 9 0 50 ]

4.Delete an element(50)
[ 2 40 1 4 3 6 5 8 7 9 0 ]

5.1.Maximum element: 40
5.2.Minimum element: 0

6.1.Linear search element(40): 1
6.2.Binary search element(40): 10

7.Merging two arrays

Enter number of elements in array 1: 2
Enter array elements: 1 2
Enter number of elements in array 2: 2
Enter array elements: 3 4

Array after merge: [ 1 2 3 4 ]

8.Intersection between arrays

Enter number of elements in array: 4
Enter array elements: 3 2 4 32

Intersection: 3 2 4

9.Sum of array: 85

10.Average of array: 7.727273

11.Reverse of array (using new array): [ 40 9 8 7 6 5 4 3 2 1 0 ]

12.Reverse of array (using original array): [ 0 1 2 3 4 5 6 7 8 9 40 ]

13.Insert element(50) in a sorted array at the end
Before sort: [ 0 1 2 3 4 5 6 7 8 9 40 ]
After sort: [ 0 1 2 3 4 5 6 7 8 9 40 ]
After Adding element: [ 0 1 2 3 4 5 6 7 8 9 40 50 ]

14.Is the array sorted: Yes
```