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array.h : Header file containing structure declaration and function prototypes for array data structure.

code:

```
typedef struct array {
    int *arr;
    int size;
    int len;
} array;

void init(array *a, int size);
void append(array *a, int element);
void insert_at_index(array *a, int index , int element);
void remove_at_index(array *a, int index);
void display(array a);
void max_min(array a);
void swap(int arr[], int i, int j);
void reverse(array *a);
array *merge(array a1, array a2);
void populate(array *a, int size);
```

array.c : File containing function definitions for functions associated with array data structure.

Code:

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

// function to initialize an array
void init(array *a, int size) {
    a -> size = size;
    a -> len = 0;
    a -> arr = (int *) malloc(sizeof(int) * size);
    if(!(a -> arr))
        printf("Error: Memory allocation failed!\n");
    return;
}
```

```
// Function to append an element in the array
void append(array *a, int element) {
    if(!a) {
        return;
    }
    if(a->len >= a->size) {
        return;
    }
    (a->arr)[a->len] = element;
    (a->len)++;
    return;
}

// Function to insert an element at specific index in the array
void insert_at_index(array *a, int index , int element) {
    if(index>=a->size-1)
        return;
    int i;
    for(i = a->size-2; i > index; i--)
        a->arr[i+1] = a->arr[i];
    a -> arr[i] = element;
    return;
}

// Function to remove an element from specified index of the array
void remove_at_index(array *a, int index) {
    if(index>=a->size-1 || index < 0)
        return;
    for(int i = index; i < a->size-1; i++)
        a->arr[index] = a->arr[index+1];
    return;
}

// Function to display array
void display(array a) {
    printf("[\t");
    for(int i = 0; i < a.size; i++){
        if(a.arr[i])
            printf("%d,\t", a.arr[i]);
        else
            printf("X,\t");
    }
    printf("]\n");
    return;
}
```

```
// Function to display maximum and minimum element in the array
void max_min(array a) {
    int max = a.arr[0], min = a.arr[0];
    for(int i = 0; i < a.size; i++) {
        if(a.arr[i] > max)
            max = a.arr[i];
        if(a.arr[i] < min)
            min = a.arr[i];
    }
    printf("\nminimum: %d, maximum: %d\n", min, max);
    return;
}

// helper function: swaps two elements in the array
void swap(int arr[], int i, int j) {
    int temp = arr[i];
    arr[i] = arr[j];
    arr[j] = temp;
    return;
}

// Function to reverse an array
void reverse(array *a) {
    for(int i = 0; i < a->size / 2; i++){
        swap(a->arr, i, a->size-i-1);
    }
    return;
}

// Function to merge two arrays
array *merge(array a1, array a2) {
    array* a3;
    a3 = (array *) malloc(sizeof(array));
    if(!a3){
        return NULL;
    }
    a3->size = a1.size + a2.size;
    a3->arr = (int *)malloc(sizeof(int) * a3->size);
    int i;
    for(i = 0; i < a1.size; i++) {
        a3->arr[i] = a1.arr[i];
    }
    for(i = a1.size; i < a3->size; i++){
        a3->arr[i] = a2.arr[i-a1.size];
    }
    a3->len = 0;
    return a3;
}
```

```
// Function to populate the array
void populate(array *a, int size){
    for (int i = 0; i < size; i++)
        a->arr[i] = rand() % 100;
    a->size = size;
    return;
}
```

main.c: contains main execution of the program

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

list l;
int list_ptr = -1;
void view_menu(){
    printf("\n-----------------------------------------\n");
    printf("1. init\n2. append\n3. insert_at_index\n4.
remove_at_index\n5. display\n6. max /min\n7. reverse\n8. merge\n9.
Populate\n10. Exit\n");
    printf("\n -----------------------------------------\n");
}

void read_option(int option) {
    switch(option) {
        case 1: {
            int size;
            array *a = (array *) malloc(sizeof(array));
            printf("Enter size: ");
            scanf("%d", &size);
            init(a, size);
            append_node(&l, a);
            list_ptr++;
            return;
            break;
        }case 2: {
            if(list_ptr == -1){
                printf("Please initialize an array first!");
                return;
            }
            int index, data;
            node *p;
            printf("Enter array no.: ");
            scanf("%d", &index);
            while((index-1) > list_ptr ){
                printf("Enter array no.: ");
                scanf("%d", &index);
            }
```

```
        p = l;
        while(p->next && index-1) {
            p = p->next;
            index--;
        }
        printf("Enter data: ");
        scanf("%d", &data);
        append(p->A, data);
        return;
        break;
    }case 3: {
        if(list_ptr == -1){
            printf("Please initialize an array first!");
            return;
        }
        node* p;
        int data, index, array;
        printf("Array no.: ");
        scanf("%d", &array);
        printf("Enter data: ");
        scanf("%d", &data);
        printf("Enter index: ");
        scanf("%d", &index);
        p = l;
        int i = 0;
        while(p->next && i < array) {
            p = p->next;
            i++;
        }
        insert_at_index(p->A, index, data);
        return;
    }case 4: {
        if(list_ptr == -1){
            printf("Please initialize an array first!");
            return;
        }
        node* p;
        int index, array;
        printf("Array no.: ");
        scanf("%d", &array);
        printf("Enter index: ");
        scanf("%d", &index);
        p = l;
        int i = 0;
        while(p->next && i < array) {
            p = p->next;
            i++;
        }
        remove_at_index(p->A, index);
```

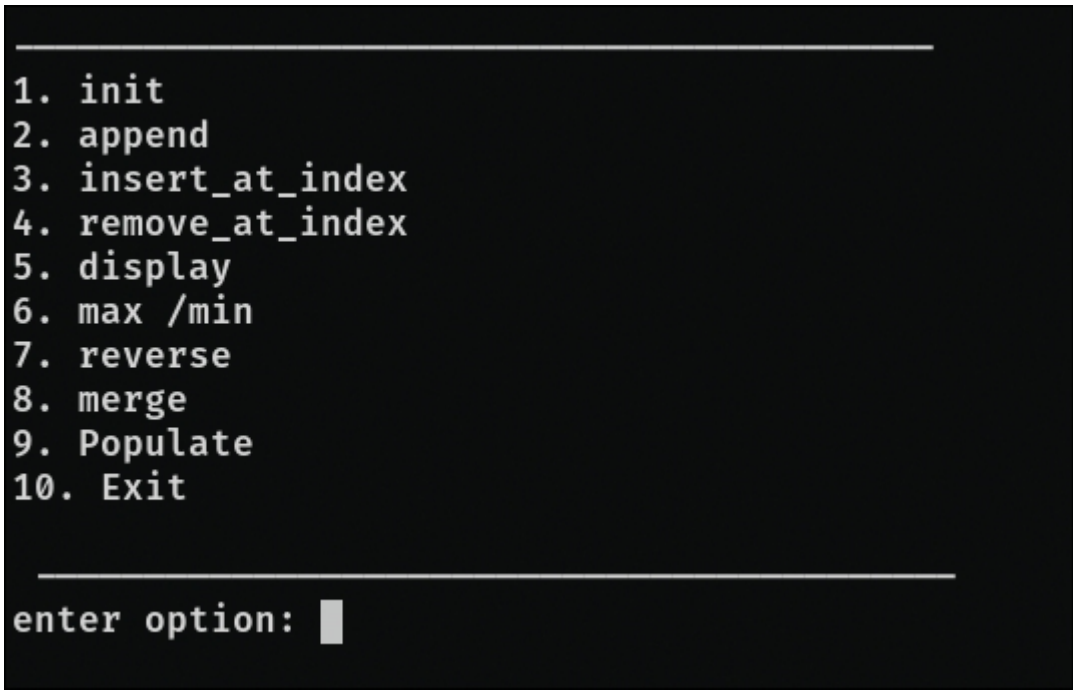
```
    return;
}case 5: {
    if(list_ptr == -1){
        printf("Please initialize an array first!");
        return;
    }
    node *p;
    int array, i =0;
    printf("Array no: ");
    scanf("%d", &array);
    p = l;
    while(p->next && i < array) {
        p = p->next;
        i++;
    }
    display(*(p->A));
    return;
}case 6: {
    if(list_ptr == -1){
        printf("Please initialize an array first!");
        return;
    }
    node *p;
    int array, i =0;
    printf("Array no: ");
    scanf("%d", &array);
    p = l;
    while(p->next && i < array) {
        p = p->next;
        i++;
    }
    max_min(*(p->A));
    return;
}
case 7: {
    int index;
    node *p;
    printf("Enter array no.: ");
    scanf("%d", &index);
    while((index-1) > list_ptr ){
        printf("Enter array no.: ");
        scanf("%d", &index);
    }
    p = l;
    while(p->next && index-1) {
        p = p->next;
        index--;
    }
    reverse(p->A);
```

```
            return;
        }case 8:{
            if(list_ptr < 1) {
                printf("We need at least two arrays to perform
merge..\n");
                return;
            }
            int a1, a2;
            node *p, *q;
            printf("1st array no.: ");
            scanf("%d", &a1);
            printf("2nd array no.: ");
            scanf("%d", &a2);

            p = l;
            q = l;
            while(p-> next && a1-1){
                p = p->next;
                a1--;
            }
            while(q->next && a2-1) {
                q = q->next;
                a2--;
            }
            array *a3 = merge(*(p->A), *(q->A));
            append_node(&l, a3);
            list_ptr++;
            return;

        }
        case 9: {
            if(list_ptr == -1){
                printf("Please initialize an array first!");
                return;
            }
            int index;
            node *p;
            printf("Enter array no.: ");
            scanf("%d", &index);
            while((index-1) > list_ptr ){
                printf("Enter array no.: ");
                scanf("%d", &index);
            }
            p = l;
            while(p->next && index-1) {
                p = p->next;
                index--;
            }
            populate(p->A, p->A->size);
```

```
            return;
        }
        case 10: {
            return;
        }
        default: {
            printf("invalid option!\n");
            break;
        }
    }
}

int main(){
    int option;
    init_list(&l);
    while(1){
        view_menu();
        printf("enter option: ");
        scanf("%d", &option);
        read_option(option);
        if(option == 10){
            break;
        }
        printf("\nArray List: \n");
        display_list(l);
    }
    return 0;
}
```

Output:

1. menu:



2.Init function:

3. Append function:

4. insert at index

```
enter option: 3
Array no.: 1
Enter data: 12
Enter index: 2

Array List:
{
array: 1        [       10,     X,      12,     X,      X,      X,      X,      X,      ]
}
```

5. remove at index

```
enter option: 4
Array no.: 1
Enter index: 2

Array List:
{
array: 1        [       10,     X,      X,      X,      X,      X,      X,      X,      ]
}
```

6. display

```
enter option: 5
Array no: 1
[       10,     X,      X,      X,      X,      X,      X,      X,      ]
```

7.max/min

```
enter option: 6
Array no: 1

minimum: 15, maximum: 93

Array List:
{
array: 1        [       83,     86,     77,     15,     93,     35,     86,     92,     ]
}
```

8. reverse

```
enter option: 7
Enter array no.: 1

Array List:
{
array: 1        [       92,     86,     35,     93,     15,     77,     86,     83,     ]
}
```

9.merge

```
enter option: 8
1st array no.: 1
2nd array no.: 2

Array List:
{
array: 1        [       92,     86,     35,     93,     15,     77,     86,     83,     ]
array: 2        [       49,     21,     62,     27,     ]
array: 3        [       92,     86,     35,     93,     15,     77,     86,     83,     49,     21,     62,     27,     ]
}
```

Use of linked list: Here linked list is being used to keep a track of all initialized arrays. Whenever we initialize a new array a new node is appended in the list and after every operation all initialized arrays are displayed.

List.h: Header file for list contains struct declaration and function prototypes

```
#include "array.h"
typedef struct node {
     array *A;
     struct node *next;
} node;

typedef node * list;
void append_node(list *l, array *array);
void display_list (list l) ;
void init_list(list *l);
```

list.c: Contains function definitions for functions associated with list

```
#include <stdio.h>
#include <stdlib.h>
#include  "list.h"
// Function to initialize new list
void init_list(list *l) {
     *l = NULL;
    return;
}

/* Appends new node to the list, this function is called when new
array is initialized */
void append_node(list *l, array *Array) {
     if(!(*l)) {
        printf("This is first node!\n");
          node *new_node = (node *) malloc(sizeof(node));
          *l = new_node;
          (*l) -> Array = Array;
          (*l) -> next = NULL;
        return;
     }else {
          node *p = *l;
          while(p -> next) {
               p = p -> next;
          }
          node* new_node= (node *) malloc(sizeof(node));
          new_node -> Array = Array;
          new_node -> next = NULL;
        p->next = new_node;
     }
     return;
}
```

```
/* function to display all arrays in the list */
void display_list (list l) {
    if(!l) {
        printf("empty list\n");
        return;
    }
     node *p = l;
     int i = 0;
     while(p) {
         printf("Array %d: ", i);
        if(p -> Array){
            display(*(p->Array));
        }
        else
            printf("array is empty\n");
          i++;
        p = p -> next;
     }
    printf("sizse in display_list: %d\n", l->Array->size);
    printf("\n");
    return;
}
```