Assignment - 02.

Data Structure

CSA0389

Name := G. Harshitha

Registration No := 192324250

Department := CSE(AI&DS)

Course Name := Data structure

Course Code := CSA0389

29/07/2024 - Starting date.

31/07/2024 - Date of submission.

① Describe the concept of Abstract data type (ADT) and how they differ from convert data structures. Design an ADT for a stack and implement it using arrays and linked list in c. Include operations like push, pop, peek, is empty, is full and peek.

A) ## Abstract Data type (ADT) :-

An Abstract data type (ADT) is a theoretical model that defiues a set of operations and the semantrics (behaviour) of those operations on a data structures, without specifying how the data structure should be implemented. It provides a high level description of what operations can be performed on the data and what Coustrains apply to those operations.

Characterstics of ADTS :-

* Operations :- Defines a set of operations that can be performed on the data structure.

* Semantics :- Specifies the behaviour of each operation.

* Encapsulation :- Hides the implementation details, focusin on the interface Provided to the User.

ADTS for Stack :-

A stack is a fundamental data structure that follows the last In, first out (LIFO) principle. It Supports the following operations.

- push :- Adds on element to the top of the stack
- pop :- Removes and returns the element from the top of the stack.
- peek :- Returns the element from the top of the stack without removing it.
- Is empty :- checks if the stack is empty.
- Is full :- checks if the stack is full.

Coucrete Data Structures :-

The implementations using array and linked lists are specific ways of implementing the stack of ADT in C.

How ADT differ from Coucrete data structures :-

ADT focuses on the operations and their behaviour while Coucrete data structures focus on how those operations are realised using specific programming Coustructs (arrays are linked list).

Advantages of ADT :-

By Separating the ADT, from its implementation, you archeive modularity, encapsulation, and flexibity in designing and using data stuctures in programs. This Separation allows for easier maintainence, code reuse, and abstraction of the complex operations.

Implementation in cuing

#include csidioh>
#define max-size 100
type def stuct {

Implementation in c using Array :-

```c
# include < stdio.h >
# define max. size  100
  type def struct {
  int item (MAX-size]:
   int top;
  } Stack Array;
  int main(){
  Stack Array stack;
  Stack top = -1;
  Stack ·items [ ++Stack ·top] =10;
  Stack· items [++ stack .top] = 20;
  Stack · items [++ stack . top] = 30;
   if ( stack ·top ! = -1){
Printf ("top element : %d\n", stack ·items (stack ·top])),
  } else{
Printf ("stack is empty : \n");
   }
if( stack ·top ! = -1){
Printf( "Popped element : %d\n", stack· items(stack·top-1])
  } else {
Printf ("stack Underflow ! \n");
   }
if ( stack · top ! = -1){
Printf ("Popped element: %d \n", stack ·items( stack ·top-i
Printf ("stack Underflow ; \n")
```

```c
    }
    if (stack -top == -1){
    Printf("Top element after Pop: %d\n", stack; Items
                                            (stack -top]);

        }else {
        Printf("stack is empty :\n");

        }
        return 0;
        }.
```

Implementation in c Using linked list :-

```c
#include <stdio.h>
#include <stdio.h>
type def struct node {
    int data;
    Struct Node * next;
    }
    Node ;
int main(){
Node *top =Null;
Node * newnode = (Node*) malloc (size of (Node));
    if (newNode ==Null){
    Printf(* memory allocation failed ;\n");
    return 1;
    }
New Node -> data =10;
New Node -> next =top;
    }
    else {
top = newnode ;
```

```
newNode =(node * )malloc(size of (Node));
   if (NewNode = Null){
   Print f("Memory allocation failed \n");
     return 1;
   }
   newnode -> Data = 20;
   New Node -> next = top;

      top = newNode;
      Newnode = (Node *) malloc (size of (Node));
       if (NewNode ==Null){
   Printf("Memory allocation failed :\n");

      return 1;
      }
      New node -> data = 30;
      newNode -> next = top;
      top == newnode;
      if (top ! = Null)
   printf(" Top element : % d \n", top -> data);
      } else {
      Printf ("stack is empty :\n");
      }
      if (top ! = Null){
      Node * temp = top;
      Print f (" popped element : %d \n", temp -> data);
      top = top -> next;
       free (temp);
```

```c
    } else {
    printf(" stack is empty ! \n");
    }
    while (top != NULL) {
        Node * temp = top;
        top = top -> next;
        free (temp);
    }
    return 0;
}
```

(a)

The University announced the selected candidates register number of Placement training. The student xxx, reg no: 2042010 wishes to check whether his name is listed or not. The list is not sorted in any order. Identify the searching technique that can be applied and explain the searching Steps with the Suitable procedure list 2014 2015, 20142033, 2014 2011, 20142017, 20142010, 2014 2056, 20142003.

linear Search :-

linear search works by checking each element in the list One by one untill the desired element is found or the end of the list is reached. It is a simple searching technique that doesn't require any pair sorting of the data.

Steps for linear Search :-

* Start from the first element.
* Check if the current element is equal to the target element.
* If the current element is not the target element is move the next element in the list.
* Continue this process untill either the target element is found or you reach the end of the list.

If the target is found, return its position. It is the end of the list is reached and the element has not been found, indicate that element is not present.

Procedure :-

Given the list :
"
2014 2016, 2014 2033, 2014 2011, 20142017, 20142010,

20142056, 20142003."

* Start at the first element of the list.
* Compare '20142010' with '20142015'(first element); 20142033.
  (second element), '20142011'(third element); '20142017'
  (fourth element) these are not equal.
* Compare '20142010' with '20142010'(fifth element)
  They are equal.
* The element '20142010' is found at the fifth position
  index in the list.

C code for linear Search :-

```
#include < stdio.h >
int main() {
int regNumbers [ ] = { 20142015 , 20142033 , 20142011 ,
20142017 , 20142010 , 20142056 , 20142023 } ;
   int target = 20142010 ;
   int n = size of (reg Numbers) (size of ( reg Numbers(0)) ;
      int found = 0 ;
      int i ;
   for ( i=0; i<n; i++) {
   if( regNumbers [i] == target) {
   Printf(" Registration number % d found at index %d'\n",
                                    target , i);

       found = 1 ;
       break ;
    } }
    if( ! found ) {
    Printf ("Registration number % d not found in list.\n
                                    tarcetii'
```

```
        }
    return 0;
    }.
```

Explanation of the Code :-

* The `reg numbers` array Contains the list of registration numbers.

* Target is the reg number we are searching for.

* `n` is the total number of elements in array.

* Iterate through each element of the array.

* If the Current element matches the `target`, print its index and set the `found` flag to `1`.

* If the loop Completes without finding the target, print that the registration number is not found.

* The Program will print the index of the found registration number or indicate that the registration is no Present.

Output :- Registration number 20142010 found a find exy.

A)   1) Initialize stack ();
     Initialize necessary variable or structures to represent the
     Stack.

     2) Push (element):
        if stack is full:
         Print "Stack Overflow"
        else:
        add element to the top of the stack
        increment top pointer

   3) pop ():
      if stack is empty:
      Print ("stack Underflow")
    return null (or appropriate error value)
    else:
   remove and return element from the top of the stack
   decrement end pointer.

4) peek ():
     if stack is empty:
     Print "stack is empty".
   return null (or appropriate error value)
   else:
   return element at the top of the stack (without removing
                                                            it)

5) is empty();

return true if top is -1 (Stack is empty)

Otherwise, return false

6) is full();

return true, if top is equal to max-size -1 (stack is full)

Otherwise, return false.

Explanation of the pseudocode :-

* Initialize the necessary variable or data structure to represent a stack.

* Adds an element to the top of the stack, Checks if the stack is full before pushing.

* Removes and returns the element from the top of the stack. Checks if the stack is empty before popping.

* Returns the element at the top of the stacks. Check if the stack is empty before peeking.

* checks if the stack is empty by inspecting the top pointer or Equivalent variable.

• checks if the stack is full by comparing the top pointer or Equivalent variable to the maximum size of the stack.