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code : CSA0389

course : Data structures

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Assignment no : 02

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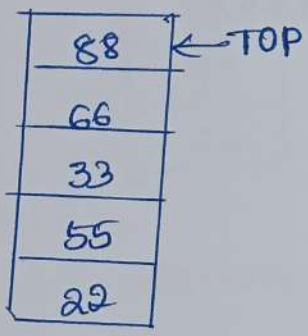
1) Perform the following operations using stack. Assume the size of the stack is 5 and having a value of 22, 55, 33, 66, 88 in the stack from a position to size 1. Now perform the following operations.

1) Invert the elements in the stack, 2 POP[3,3) POP[ ], 3) POP[ ], 4) PUSH [90], 5) Push[36], 6) PUSH[11], 7) PUSH[88], 8] POP[ ], 9) POP[ ]. Draw the diagram of stack and illustrate the above operations and identifying where the top is?

A) Size of the stack : 5

elements in stack (from bottom to top) : 22, 55, 33, 66, 88

Top of stack : 88

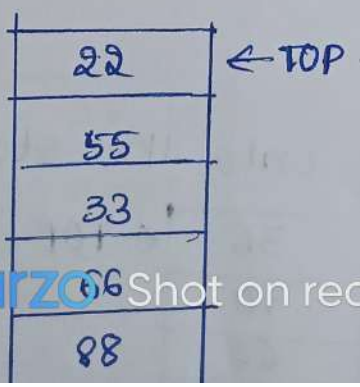


Operations :-

1) Insert the elements in the stack :

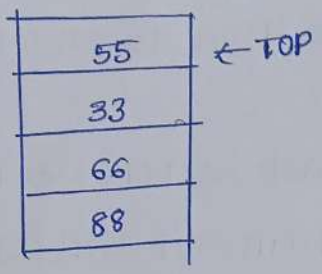
→ The operation will reverse the order of elements in the stack.

→ After inversion, the stack will look like



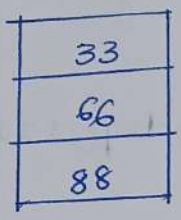
2. POP():

→ remove the top elements (22)



3. POP():

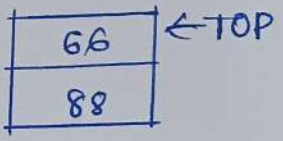
→ remove the elements (55).



4. POP:

→ remove the top elements (33)

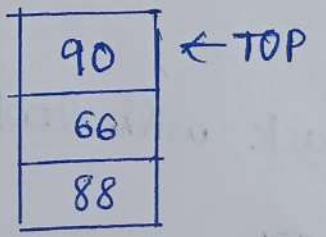
stack after pop



5. PUSH (90):

→ PUSH the elements 90 onto the stack

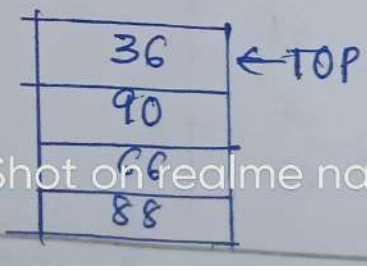
stack after PUSH



6. PUSH (36):

→ PUSH the element 36 onto the stack.

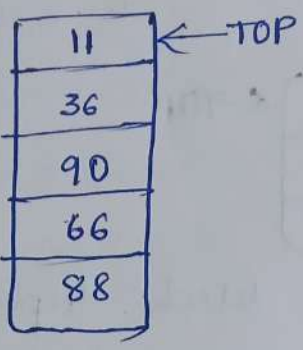
stack after PUSH



7. PUSH(11):

→ PUSH the element 11 onto the stack.

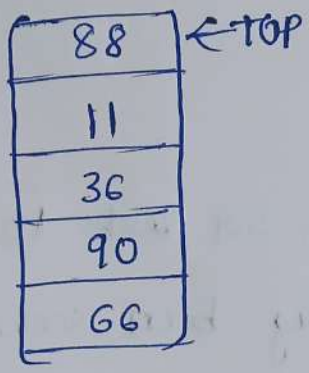
Stack after PUSH



8. PUSH(88):-

→ PUSH the element 88 onto the stack.

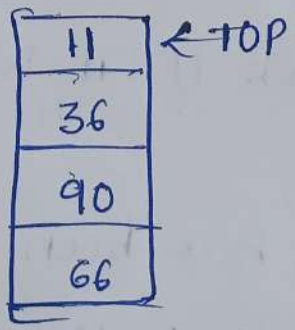
Stack after PUSH



9. POP():

→ Remove the top element (88)

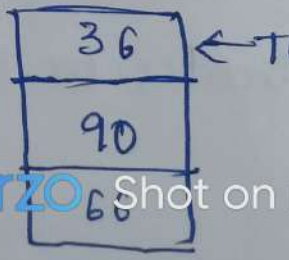
Stack after POP



10. POP():-

→ removes the top element (11)

Stack after POP

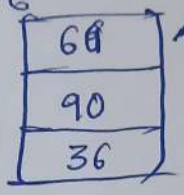


Final stack state:

Size of stack : 5

elements in stack (from bottom to top): 36, 90, 66

Top of stack : 66



2) Develop an algorithm to detect duplicate elements in an unsorted array linear search. Determine the time complexity and discuss how you would optimize this process.

Algorithm:

1) Intialization:

Create an empty set or list to keep track of elements that have already been seen.

2) Linear search:

Iterate through each elements of the array.

- For each element, check if it is already in the set of seen elements.
- If it is, a duplicate has been found.
- If it is found, add it to the set of seen elements.

3) output:

Return the list of duplicates, or simply indicate that duplicates exist.

C code:

```
#include<stdio.h>
#include<stdbool.h>
int main() {
int arr[] = {4,5,6,7,8,5,4,9,10}
int size = size of (arr) / size of (arr[0]);
bool seen[1000] = {false}
for (int i=0; i<size; i++)
if (seen[arr[i]])
printf ("Duplicate found : %d\n", arr[i]);
else
seen [arr[i]] = true;
return 0;
}
```

Time complexity :-

The linear search complexity :-

The time complexity for this algorithm is O(n), where 'n' is the number of elements in the array. This is because each element is checked only once and operations (checking for membership and adding to a set) are on the average.

Space complexity:-

The space complexity is O(n) due to the additional space used by the 'seen' and 'duplicates' sets, which may store upto 'n' elements in the worst case

Optimization:-

Hashing

The use of a set for checking the duplicates is already efficient because sets provide average O(1) time complexity for membership tests and insertions.

Sorting:-

If we are allowed to modify the array, another approach is to sort the array first and then perform a linear scan to find duplicates.

Sorting would take O(nlogn) time, and the subsequent scan would take O(n) time. This approach uses less space (O(1) additional space if sorting in place).