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Pancake sorting

Given an an unsorted array, sort the given array. You are allowed to do only following operation on array.

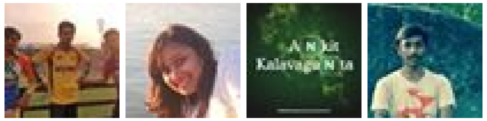
```
flip(arr, i): Reverse array from 0 to i
```

Unlike a traditional sorting algorithm, which attempts to sort with the fewest comparisons possible, the goal is to sort the sequence in as few reversals as possible.

The idea is to do something similar to Selection Sort. We one by one place maximum element at the end and reduce the size of current array by one.

Following are the detailed steps. Let given array be arr[] and size of array be n.
1) Start from current size equal to n and reduce current size by one while it’s greater than 1. Let the current size be curr_size. Do following for every curr_size
……a) Find index of the maximum element in arr[0..curr_szie-1]. Let the index be ‘mi’
……b) Call flip(arr, mi)
……c) Call flip(arr, curr_size-1)

See following video for visualization of the above algorithm.



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```
/* A C++ program for Pancake Sorting */
#include <stdlib.h>
#include <stdio.h>

/* Reverses arr[0..i] */
void flip(int arr[], int i)
{
    int temp, start = 0;
    while (start < i)
    {
        temp = arr[start];
        arr[start] = arr[i];
        arr[i] = temp;
        start++;
        i--;
    }
}

/* Returns index of the maximum element in arr[0..n-1] */
int findMax(int arr[], int n)
{
   int mi, i;
   for (mi = 0, i = 0; i < n; ++i)
       if (arr[i] > arr[mi])
              mi = i;
   return mi;
}
```

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```
// The main function that sorts given array using flip operations
int pancakeSort(int *arr, int n)
{
    // Start from the complete array and one by one reduce current siz
    for (int curr_size = n; curr_size > 1; --curr_size)
    {
        // Find index of the maximum element in arr[0..curr_size-1]
        int mi = findMax(arr, curr_size);

        // Move the maximum element to end of current array if it's no
        // already at the end
        if (mi != curr_size-1)
        {
            // To move at the end, first move maximum number to beginn
            flip(arr, mi);

            // Now move the maximum number to end by reversing current
            flip(arr, curr_size-1);
        }
    }
}

/* A utility function to print an array of size n */
void printArray(int arr[], int n)
{
    for (int i = 0; i < n; ++i)
        printf("%d ", arr[i]);
}

// Driver program to test above function
int main()
{
    int arr[] = {23, 10, 20, 11, 12, 6, 7};
    int n = sizeof(arr)/sizeof(arr[0]);

    pancakeSort(arr, n);

    puts("Sorted Array ");
    printArray(arr, n);

    return 0;
}
```

Output:

```
Sorted Array
```

Data Packing

Intersection point of two Linked Lists

Lowest Common Ancestor in a BST.

Check if a binary tree is BST or not

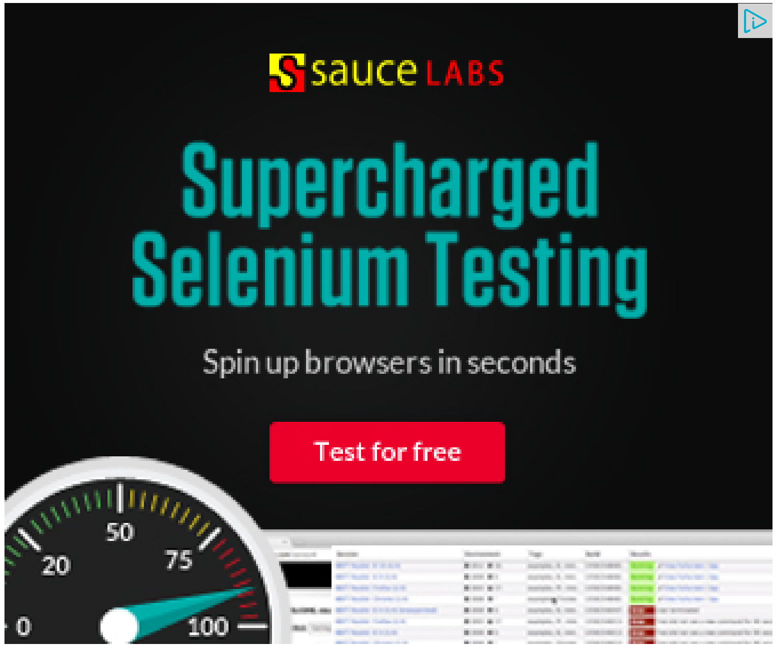
Sorted Linked List to Balanced BST

```
6 7 10 11 12 20 23
```

Total O(n) flip operations are performed in above code. The overall time complexity is O(n^2).

References:
http://en.wikipedia.org/wiki/Pancake_sorting

Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above.



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Curious Wanderer • 7 months ago

I think Bill Gates came up with pancake sorting algorithm.

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rakitic • 10 months ago

@geeks...for each elements , we are considering two flips and one maximum

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Ronny ➦ rakitic • 9 months ago

@rakitic

But these are happening independent of each other.
O(n)+O(n)+O(n) = O(n)
O(n) for each of the element
So complexity is O(n^2) only

Reply • Share ›

rakitic • 10 months ago

for each elements , we consider two flips and one maximum ..should'nt be tot

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MITTAL • 10 months ago

My code is working as insertion sort and the complexity is O(n2)..

if not able to follow the code plz comment..

```
[sourcecode language="C++"]
/*
if(arr[0]>arr[1])
{
arr[0]^=arr[1];
arr[1]^=arr[0];
arr[0]^=arr[1];
}
for(int i=2;i<arr.size();i++)
{
if(arr[i]<arr[i-1])
{
flip(arr,i-1);
flip(arr,i);
flip(arr,i-1);
flip(arr,i-2);
i=i-2;
}
} */
```

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Jinyao Xu • a year ago

I don&#039t think your solution can find the optimized sorting steps(fewest flip

1 • Reply • Share ›

Prateek Sharma • a year ago

Python Code.......

```
def flip(a,ArrayIndex):
    reverseList =[]
    for i in range(ArrayIndex,-1,-1):
        reverseList.append(a[i])
    for i in range(len(reverseList)):
        a[i] = reverseList[i]

def pancakeSorting(a):
    arraylist =[]
    while len(a)>1:
        maxIndex = a.index(max(a))
        flip(a,maxIndex)
        flip(a,len(a)-1)
        arraylist.insert(0,a[-1])
        a.pop()
    print arraylist
def main():
    array= [45,7,3,89,123,56]
    pancakeSorting(array)
if __name__ == '__main__':
    main()
```

• Reply • Share ›

Theopaul • a year ago

I think 2 flips are enough
Array : 23, 10, 20, 11, 12, 6, 7
Consider the array sorted halfway.

Sorted array for 3 elements

10 , 20 , 23

Now we have to insert 11.

The binary search index will return position 1 (20)

flip from 20 to end ie (23)

The array becomes: 10 , 23 , 20 , 11 ....

Now flip from 23 to 11.

The resulting array would be: 10 , 11 , 20 , 23 similarly 12 comes we need to fl

Array becomes: 10 , 11 , 23 , 20 , 12

see more

^ | ⌄ • Reply • Share ›

gautam kumar ➦ Theopaul • a year ago

Read the definition of flip carefully.

```
/* Paste your code here (You may delete these lines if not wr
```

^ | ⌄ • Reply • Share ›

viki • a year ago

@Kumar: Will you please write the solution you just have proposed...:D

^ | ⌄ • Reply • Share ›

Kumar • a year ago

The above code runs in O(n^2) even after assuming that
flip operation runs in O(1), otherwise it will run in O(n^3).

Suppose flip operation runs in O(1) Can we do better ?
Can we make the above code to be run in O(nlogn) ??

Yes, We need to think of insertion sort using binary search rather than selectio

```
for(i=0;i<(a.size-1);i++) <---- O(n)
{
int key = a[i+1];
index = BinarySearch(a,key,0,i); <---- O(logn)
/* now we can apply flip operation here, think about it */
/* hint there will be three flip operation */
/* Let me know if you won&#039t get */
}
```

Since all flip operation will take O(1) by assumption
Total running time will be O(nlogn)

Reply • Share ›

kartik ➦ Kumar • a year ago

I have written solution using 4 flips.

```
 /* A C program for Pancake Sorting */
#include <stdlib.h>
#include <stdio.h>



/* A Binary Search based function to get index of ceiling of x
int ceilSearch(int arr[], int low, int high, int x)
{
  int mid;

  /* If x is smaller than or equal to the first element,
    then return the first element */
  if(x <= arr[low])
    return low;

  /* If x is greater than the last element, then return -1 */
```

see more

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Kumar kartik • a year ago

Thanks KArthik,

I haven't tested but I'm sure it will work, thanks for coding it.

• Reply • Share ›

itreallyismE kartik • a year ago

Just a quick doubt. Doesn't binary search work for sorted array case?

• Reply • Share ›

itreallyismE itreallyismE • a year ago

Sorry about that. Got it.

• Reply • Share ›

viki Kumar • a year ago

@Kumar: How r u thinking dude ? Pancake sort runs in O(n^2) time ev
in O(n) time in worst case. correct yourself......

• Reply • Share ›

rakitic viki • 10 months ago

two flips each time = n^2 , max each time = n , no of elements

• Reply • Share ›

Kumar viki • a year ago

I said, if we assume that flip operation runs in O(1) then sorting
flip operation takes O(n) time) then sort will run take O(n^3).... p

Regarding implementation, I'll definitely send, let me code it firs

```
/* Paste your code here (You may delete these lines if
```

Reply • Share ›

gokul ➜ Kumar • a year ago

viki is correct on pointing it out... its O(n^2) even if flip ta
Please you understand the code carefully

```
/* Paste your code here (You may delete these li
```

Reply • Share ›

kartik ➜ gokul • a year ago

The problem mentioned by Kumar is different from the p
mentioned, imagine a hypothetical machine where flip ta
the flip operation takes O(1), you can actually sort the a

Reply • Share ›

kartik ➜ Kumar • a year ago

Goof question @Kumar, we will be publishing it as a separate post.

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saurabh ➜ kartik • a year ago

Goof ;)

1 • Reply • Share ›

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