Find a pair with the given difference

Given an unsorted array and a number n, find if there exists a pair of elements in the array whose difference is n.

```
Examples:
Input: arr[] = {5, 20, 3, 2, 50, 80}, n = 78
Output: Pair Found: (2, 80)

Input: arr[] = {90, 70, 20, 80, 50}, n = 45
Output: No Such Pair
```

Source: find pair

The simplest method is to run two loops, the outer loop picks the first element (smaller element) and the inner loop looks for the element picked by outer loop plus n. Time complexity of this method is O(n^2).

We can use sorting and Binary Search to improve time complexity to O(nLogn). The first step is to sort the array in ascending order. Once the array is sorted, traverse the array from left to right, and for each element arr[i], binary search for arr[i] + n in arr[i+1..n-1]. If the element is found, return the pair.
Both first and second steps take O(nLogn). So overall complexity is O(nLogn).

The second step of the above algorithm can be improved to O(n). The first step remain same. The idea for second step is take two index variables i and j, initialize them as 0 and 1 respectively. Now run a linear loop. If arr[j] – arr[i] is smaller than n, we need to look for greater arr[j], so increment j. If arr[j] – arr[i] is greater than n, we need to look for greater arr[i], so increment i. Thanks to Aashish Barnwal for suggesting this approach.

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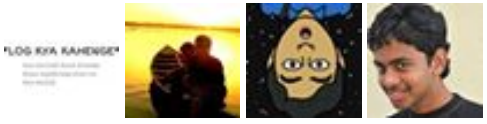

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The following code is only for the second step of the algorithm, it assumes that the array is already sorted.

```
#include <stdio.h>

// The function assumes that the array is sorted
bool findPair(int arr[], int size, int n)
{
    // Initialize positions of two elements
    int i = 0;
    int j = 1;

    // Search for a pair
    while (i<size && j<size)
    {
        if (i != j && arr[j]-arr[i] == n)
        {
            printf("Pair Found: (%d, %d)", arr[i], arr[j]);
            return true;
        }
        else if (arr[j]-arr[i] < n)
            j++;
        else
            i++;
    }

    printf("No such pair");
    return false;
}

// Driver program to test above function
int main()
{
    int arr[] = {1, 8, 30, 40, 100};
    int size = sizeof(arr)/sizeof(arr[0]);
    int n = 60;
    findPair(arr, size, n);
    return 0;
}
```

Output:

```
Pair Found: (40, 100)
```

Hashing can also be used to solve this problem. Create an empty hash table HT. Traverse the

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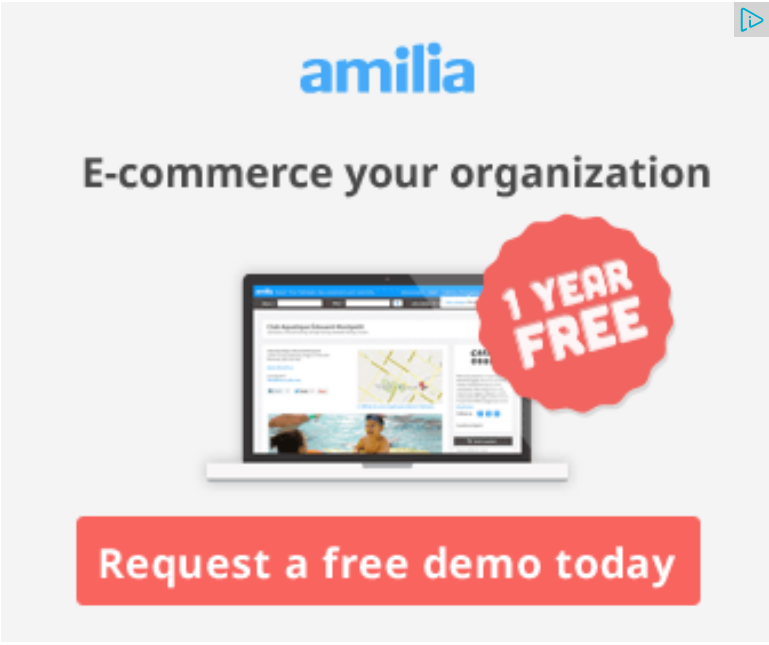
array, use array elements as hash keys and enter them in HT. Traverse the array again look for value n + arr[i] in HT.

Please write comments if you find any of the above codes/algorithms incorrect, or find other ways to solve the same problem.



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Nitin Sharma • a month ago

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@vipulverma and @Pankaj Goyal , i think Pankaj is right here , there should be i<size .vipul="" can="" u="" give="" us="" a="" condition="" where="" i="" excee

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Guest • a month ago

@Vipul Verma and @Pankaj Goyal , i think Pankaj is right here , there should i<size in="" while="" loop.="" vipul="" i="" am="" not="" able="" to="" find="" wh been="" included,="" can="" you="" give="" me="" a="" case="" to="" show="" "

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Swagato Mondal • 8 months ago

```
#include <stdio.h>

#include <stdbool.h>

// The function to find the pair
```

705

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```
bool findPair(int arr[], int size, int n)
{
int i = 0;
int maxElement = 0;
// Search for the maximum element
for(i = 0; i < size; i++) {
if(maxElement < arr[i])
maxElement = arr[i];
```

see more

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Pankaj Goyal • 10 months ago

can sm1 tell me what is the need to write i<size condition in while as &#039i&

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Vipul Verma ➔ Pankaj Goyal • 2 months ago

No, i will not always be less than j. See the code carefully. On what co

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Aman Jain • 11 months ago

A O(n) solution with O(n) Extra space
1. create a difference array of main array.
2. find subarray with sum = given difference in the difference array.

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Ronny ➔ Aman Jain • 11 months ago

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Could you please elaborate on your approach, a source code would be

What I get from your comment is
for the given array is {1,8,30,40,100}

diff[]={7,22,10,60}
and find subarray with sum.

This works for sorted array only.
Consider the given eg

arr[]={8,1,100,40,30}
and difference to be searched is 70.

now the difference array is created as follows
diff[]={7,99,-60,-10}

but no subarray gives sum equal to 70.

see more

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Ronny Ronny • 11 months ago

However the Hashing method gives O(n) solution with O(R) sp

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Nishant Kumar • a year ago

O(n) solution with extra space. We can reduce the size of Hash table using di
requirement.The concept is similar to find pair with given sum in an array. I am
positive numbers however it will also work for negative number with few modif

[sourcecode language="JAVA"]
public static boolean foo(int[] array,int diff){

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```
int MAX=200;
int[] hash=new int[MAX];
boolean found=false;
for(int i=0;i<array.length;i++){
if(hash[array[i]]>0){
System.out.println("Pair: "+hash[array[i]]+" "+array[i]);
found=true;
}
if(array[i]-diff>=0){
hash[array[i]-diff]=array[i];
}
hash[array[i]+diff]=array[i];
```

see more

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Sourabh • 2 years ago

What if the correct answer is given by 1st element -2nd element...I think the st
on whether n is negative or not

• Reply • Share ›

kuldeep singh • 2 years ago

int arr[]={3,5,9,15,12,18};
int n=6;
it will find only one such pair.

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rohit • 2 years ago

> hey can anyone tell me that **if** we are **using** quicksort then the time

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ruchika • 2 years ago

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

#define MAX 50
#define space printf("\n \n ");

void insert(int a[],int size)
{

int i=0;


printf("enter the elements\n");

while(i<size)
{
scanf("%d",&a[i]);
i++;
}
```

see more

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kidult • 2 years ago

Another method of O(n) although it is similar to Hashtable

Step 1: traverse the given array find the maximum number max O(n);

Step 2: create an array S, starting from 0 to max-1; O(1);

Step 3: for each value in the given array arr[i],set S[arr[i]] to be 1; O(n);

Step 4, for each value in the given array arr[i], check whether S[arr[i]+diff] or S

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else continue to the next value arr[i+1]; O(n);
(of course need to check whether the index of S is valid or not)

total time complexity: O(n)

but i think this method is a waste of space, only a few number in the S array is

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Mathan Kumar kidult • 2 years ago

will it work for negative numbers??
again you have to find minimum no. to remove that negative indexing...
And if the maximum number is of order 10^10.. most of the language d
i think..

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

• Reply • Share ›

satish • 2 years ago

another approach which takes o(n) time.
subtract all the element from difference 3 and put the element in new array usi
all indices in new element and using abs value in particular index, get the inde
this one is one pair.

to clarify this, lets take an example.

array is 5, 20, 3, 2, 50, 80 and diff is 78.

so new array is 78-a[i] which is as follows

73 58 75 76 38 -2
lets put this element in proper index in new array.

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a[20] = 58
a[3] = 75
a[2]= 76
a[50] = 38

see more

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viksri ➚ satish • 2 years ago

What if array has negative integers??

eg. array is {5, -20, 3, -2, 50 ,80}

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viksri ➚ satish • 2 years ago

What if given array has negative integers?
eg. {5, -20, 3, -2, 50, 80}

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Ankit Gupta ➚ satish • 2 years ago

That seems identical to the Hash table approach, except that it is restri
with large integer values.

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satish ➚ Ankit Gupta • 2 years ago

we can use map instead of an array.

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

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satish satish • 2 years ago

we can use map instead of an array.

```
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```

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Ankit Gupta satish • 2 years ago

We sure can. But maps are implemented as Red Black
running time instead of a O(1) in case of Hash tables/Ar

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Bhupendra • 2 years ago

A doubt about the correctness. I was asked 3SUM problem in a interview. I prc
the correctness of the algorithm.
In this case if,
a[j]-a[i] >n you are looking for greater a[j] that is greater j
why not smaller a[i] i.e decreasing i. The solution is fine but this is something i

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

• Reply • Share ›

kidult Bhupendra • 2 years ago

Hey Bhupendra

I think it should be a[j]-a[i] <n here, that we need to increase j to find a[j
increasing order
because we start from i=0 and for each i ,we find the all the possible j
value, we have already searched all the possible value for i from 0 to i-

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already considered.

[sourcecode language="C"]
/* Paste your code here (You may delete these lines if not writing code

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Ankit Gupta ➦ Bhupendra • 2 years ago

If a[j]-a[i] > n, then you are looking for a smaller difference than the curr
So you would have to increment i because the increased difference C[
previous step.
Thus there is one way to check if a difference greater than the previous
possible, which is to increment i. (Sorted list)

Reply • Share ›

man • 2 years ago

Hi
What can we say about the space complexity of the hash table solution written
Can we say its O(no of elements in array) ??..though i doubt this.

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

Reply • Share ›

kartik ➦ man • 2 years ago

It all depends upon the use hashing function that is used for hashing.

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whoami • 2 years ago

code is not working for
arr[] ={1, 8, 30, 8, 100};
n = 0;

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check my solution http://geeksforgeeks.org/forum...

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

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GeeksforGeeks ➚ whoami • 2 years ago

The code is only for second step of the algorithm. The second step as
have now added a comment for this. Try code {1, 8, 8, 30, 100} and n
Your solution looks similar to the solution posted by Aashish.

• Reply • Share ›

whoami ➚ GeeksforGeeks • 2 years ago

oh.. didn't notice that.thanks for the clarification.

```
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```

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