Longest Consecutive Subsequence

Difficulty Level : Medium • Last Updated : 19 Jul, 2022

Given an array of integers, find the length of the longest sub-sequence such that elements in the subsequence are consecutive integers, the consecutive numbers can be in any order.

Examples:

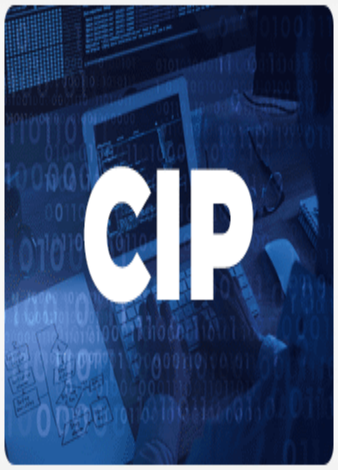
```
Input: arr[] = {1, 9, 3, 10, 4, 20, 2}
Output: 4
Explanation:
```

```
The subsequence 1, 3, 4, 2 is the longest
subsequence of consecutive elements

Input: arr[] = {36, 41, 56, 35, 44, 33, 34, 92, 43, 32, 42}
Output: 5
Explanation:
The subsequence 36, 35, 33, 34, 32 is the longest
subsequence of consecutive elements.
```

Recommended Practice
Longest consecutive subsequence
Try It!

Naive Approach: The idea is to first sort the array and find the longest subarray with consecutive elements.
After sorting the array and removing the multiple occurrences of elements, run a loop and keep a count and max (both initially zero). Run a loop from start to end and if the current element is not equal to the previous (element+1) then set the count to 1 else increase the count. Update max with a maximum of count and max.



C++

```
// C++ program to find longest
// contiguous subsequence
#include <bits/stdc++.h>
using namespace std;

// Returns length of the longest
// contiguous subsequence
int findLongestConseqSubseq(int arr[], int n)
{
    int ans = 0, count = 0;

    // sort the array
    sort(arr, arr + n);

    vector<int> v;
    v.push_back(arr[0]);

    //insert repeated elements only once in the vector
    for (int i = 1; i < n; i++)
    {
        if (arr[i] != arr[i - 1])
            v.push_back(arr[i]);
    }
    // find the maximum length
    // by traversing the array
    for (int i = 0; i < v.size(); i++)
    {

        // Check if the current element is equal
        // to previous element +1
        if (i > 0 && v[i] == v[i - 1] + 1)
            count++;
        // reset the count
        else
            count = 1;

        // update the maximum
        ans = max(ans, count);
    }
    return ans;
}

// Driver code
int main()
{
    int arr[] = { 1, 2, 2, 3 };
    int n = sizeof arr / sizeof arr[0];
    cout << "Length of the Longest contiguous subsequence "
            "is "
         << findLongestConseqSubseq(arr, n);
    return 0;
}
```

Java

```
// Java program to find longest
// contiguous subsequence
import java.io.*;
import java.util.*;

class GFG
{

    static int findLongestConseqSubseq(int arr[],
                                       int n)
    {

        // Sort the array
        Arrays.sort(arr);

        int ans = 0, count = 0;

        ArrayList<Integer> v = new ArrayList<Integer>();
        v.add(10);

        // Insert repeated elements
        // only once in the vector
        for (int i = 1; i < n; i++)
        {
            if (arr[i] != arr[i - 1])
                v.add(arr[i]);
        }
        // Find the maximum length
        // by traversing the array
        for (int i = 0; i < v.size(); i++)
        {

            // Check if the current element is
            // equal to previous element +1
            if (i > 0 &&v.get(i) == v.get(i - 1) + 1)
                count++;
            else
                count = 1;

            // Update the maximum
            ans = Math.max(ans, count);
        }
        return ans;
    }

    // Driver code
    public static void main(String[] args)
    {
        int arr[] = { 1, 9, 3, 10, 4, 20, 2 };
        int n = arr.length;

        System.out.println(
            "Length of the Longest "
            + "contiguous subsequence is "
            + findLongestConseqSubseq(arr, n));
    }
}

// This code is contributed by parascoding
```

Python3

```
# Python3 program to find longest
# contiguous subsequence

# Returns length of the longest
# contiguous subsequence
def findLongestConseqSubseq(arr, n):

    ans = 0
    count = 0

    # Sort the array
    arr.sort()

    v = []

    v.append(arr[0])

    # Insert repeated elements only
    # once in the vector
    for i in range(1, n):
        if (arr[i] != arr[i - 1]):
            v.append(arr[i])

    # Find the maximum length
    # by traversing the array
    for i in range(len(v)):

        # Check if the current element is
        # equal to previous element +1
        if (i > 0 and v[i] == v[i - 1] + 1):
            count += 1

        # Reset the count
        else:
            count = 1

        # Update the maximum
        ans = max(ans, count)

    return ans

# Driver code
arr = [ 1, 2, 2, 3 ]
n = len(arr)

print("Length of the Longest contiguous subsequence is",
       findLongestConseqSubseq(arr, n))

# This code is contributed by avanitrachhadiya2155
```

C#

```
// C# program to find longest
// contiguous subsequence
using System;
using System.Collections.Generic;

class GFG{

static int findLongestConseqSubseq(int[] arr,
                                   int n)
{

    // Sort the array
    Array.Sort(arr);

    int ans = 0, count = 0;

    List<int> v = new List<int>();
    v.Add(10);

    // Insert repeated elements
    // only once in the vector
    for(int i = 1; i < n; i++)
    {
        if (arr[i] != arr[i - 1])
            v.Add(arr[i]);
    }

    // Find the maximum length
    // by traversing the array
    for(int i = 0; i < v.Count; i++)
    {

        // Check if the current element is
        // equal to previous element +1
        if (i > 0 && v[i] == v[i - 1] + 1)
            count++;
        else
            count = 1;

        // Update the maximum
        ans = Math.Max(ans, count);
    }
    return ans;
}
// Driver code
static void Main()
{
    int[] arr = { 1, 9, 3, 10, 4, 20, 2 };
    int n = arr.Length;

    Console.WriteLine("Length of the Longest " +
                      "contiguous subsequence is " +
                      findLongestConseqSubseq(arr, n));
}
}

// This code is contributed by divyeshrabadiya07
```

Javascript

```
<script>

    // JavaScript program to find longest
    // contiguous subsequence

    // Returns length of the longest
    // contiguous subsequence
    function findLongestConseqSubseq(arr, n) {
        let ans = 0, count = 0;

        // sort the array
        arr.sort(function (a, b) { return a - b; })

        var v = [];
        v.push(arr[0]);

        //insert repeated elements only once in the vector
        for (let i = 1; i < n; i++) {
            if (arr[i] != arr[i - 1])
                v.push(arr[i]);
        }
        // find the maximum length
        // by traversing the array
        for (let i = 0; i < v.length; i++) {

            // Check if the current element is equal
            // to previous element +1
            if (i > 0 && v[i] == v[i - 1] + 1)
```

```
                count++;
            // reset the count
            else
                count = 1;

            // update the maximum
            ans = Math.max(ans, count);
        }
        return ans;
    }

    // Driver code

    let arr = [1, 2, 2, 3];
    let n = arr.length;
    document.write(
    "Length of the Longest contiguous subsequence is "
    +findLongestConseqSubseq(arr, n)
    );

 // This code is contributed by Potta Lokesh

</script>
```

Output

```
Length of the Longest contiguous subsequence is 3
```

Complexity Analysis:

- **Time complexity:** O(nLogn).
  Time to sort the array is O(nlogn).
- **Auxiliary space :** O(n).
  As extra space is needed for storing in vector v.

Thanks to Hao.W for suggesting the above solution.

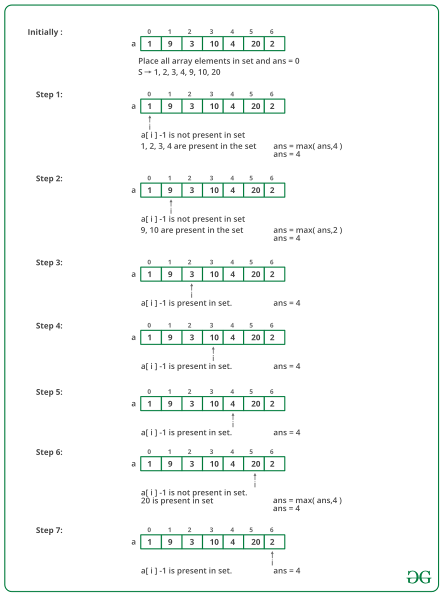
Efficient solution:

This problem can be solved in O(n) time using an **Efficient Solution**. The idea is to use Hashing. We first insert all elements in a Set. Then check all the possible starts of consecutive subsequences.

Algorithm:

1. Create an empty hash.
2. Insert all array elements to hash.
3. Do following for every element arr[i]
4. Check if this element is the starting point of a subsequence. To check this, simply look for arr[i] – 1 in the hash, if not found, then this is the first element a subsequence.
5. If this element is the first element, then count the number of elements in the consecutive starting with this element. Iterate from arr[i] + 1 till the last element that can be found.
6. If the count is more than the previous longest subsequence found, then update this.

Below image is a dry run of the above approach:



Initially :
a 1 9 3 10 4 20 2
Place all array elements in set and ans = 0
S → 1, 2, 3, 4, 9, 10, 20
Step 1:
a[i] -1 is not present in set
1, 2, 3, 4 are present in the set
ans = max(ans,4)
ans = 4
Step 2:
a[i] -1 is not present in set
9, 10 are present in the set
ans = max(ans,2)
ans = 4
Step 3:
a[i] -1 is present in set.
ans = 4
Step 4:
a[i] -1 is present in set.
ans = 4
Step 5:
a[i] -1 is present in set.
ans = 4
Step 6:
a[i] -1 is not present in set.
20 is present in set
ans = max(ans,4)
ans = 4
Step 7:
a[i] -1 is present in set.
ans = 4

Below is the implementation of the above approach:

C++

```
// C++ program to find longest
// contiguous subsequence
```

```
#include <bits/stdc++.h>
using namespace std;

// Returns length of the longest
// contiguous subsequence
int findLongestConseqSubseq(int arr[], int n)
{
    unordered_set<int> S;
    int ans = 0;

    // Hash all the array elements
    for (int i = 0; i < n; i++)
        S.insert(arr[i]);

    // check each possible sequence from
    // the start then update optimal length
    for (int i = 0; i < n; i++)
    {
        // if current element is the starting
        // element of a sequence
        if (S.find(arr[i] - 1) == S.end())
        {
            // Then check for next elements
            // in the sequence
            int j = arr[i];
            while (S.find(j) != S.end())
                j++;

            // update  optimal length if
            // this length is more
            ans = max(ans, j - arr[i]);
        }
    }
    return ans;
}

// Driver code
int main()
{
    int arr[] = { 1, 9, 3, 10, 4, 20, 2 };
    int n = sizeof arr / sizeof arr[0];
    cout << "Length of the Longest contiguous subsequence "
            "is "
         << findLongestConseqSubseq(arr, n);
    return 0;
}
```

Java

```
// Java program to find longest
// consecutive subsequence
import java.io.*;
import java.util.*;

class ArrayElements {
    // Returns length of the longest
    // consecutive subsequence
    static int findLongestConseqSubseq(int arr[], int n)
    {
        HashSet<Integer> S = new HashSet<Integer>();
        int ans = 0;

        // Hash all the array elements
        for (int i = 0; i < n; ++i)
            S.add(arr[i]);

        // check each possible sequence from the start
        // then update optimal length
        for (int i = 0; i < n; ++i)
        {
            // if current element is the starting
            // element of a sequence
            if (!S.contains(arr[i] - 1))
            {
                // Then check for next elements
                // in the sequence
                int j = arr[i];
                while (S.contains(j))
                    j++;

                // update  optimal length if this
                // length is more
                if (ans < j - arr[i])
                    ans = j - arr[i];
            }
        }
        return ans;
    }
    // Driver Code
    public static void main(String args[])
    {
        int arr[] = { 1, 9, 3, 10, 4, 20, 2 };
        int n = arr.length;
        System.out.println(
            "Length of the Longest consecutive subsequence is "
            + findLongestConseqSubseq(arr, n));
    }
}
// This code is contributed by Aakash Hasija
```

Python3

```
# Python program to find longest contiguous subsequence


def findLongestConseqSubseq(arr, n):

    s = set()
    ans = 0

    # Hash all the array elements
    for ele in arr:
        s.add(ele)

    # check each possible sequence from the start
    # then update optimal length
    for i in range(n):

         # if current element is the starting
        # element of a sequence
        if (arr[i]-1) not in s:

            # Then check for next elements in the
            # sequence
            j = arr[i]
            while(j in s):
                j += 1

            # update  optimal length if this length
            # is more
            ans = max(ans, j-arr[i])
    return ans


# Driver code
if __name__ == '__main__':
    n = 7
    arr = [1, 9, 3, 10, 4, 20, 2]
    print ("Length of the Longest contiguous subsequence is ",findLongest

# Contributed by: Harshit Sidhwa
```

C#

```
using System;
using System.Collections.Generic;

// C# program to find longest consecutive subsequence

public class ArrayElements {
    // Returns length of the
    // longest consecutive subsequence
    public static int findLongestConseqSubseq(int[] arr,
                                              int n)
    {
        HashSet<int> S = new HashSet<int>();
        int ans = 0;

        // Hash all the array elements
        for (int i = 0; i < n; ++i) {
            S.Add(arr[i]);
        }

        // check each possible sequence from the start
        // then update optimal length
        for (int i = 0; i < n; ++i)
        {
            // if current element is the starting
            // element of a sequence
            if (!S.Contains(arr[i] - 1))
            {
                // Then check for next elements in the
                // sequence
                int j = arr[i];
                while (S.Contains(j))
                {
                    j++;
                }

                // update  optimal length if this length
                // is more
                if (ans < j - arr[i])
                {
                    ans = j - arr[i];
                }
            }
        }
        return ans;
    }

    // Driver code
    public static void Main(string[] args)
    {
        int[] arr = new int[] { 1, 9, 3, 10, 4, 20, 2 };
        int n = arr.Length;
        Console.WriteLine(
            "Length of the Longest consecutive subsequence is "
            + findLongestConseqSubseq(arr, n));
    }
}

// This code is contributed by Shrikant13
```

Javascript

```
<script>
// Javascript program to find longest
// contiguous subsequence


// Returns length of the longest
// contiguous subsequence
function findLongestConseqSubseq(arr, n) {
    let S = new Set();
    let ans = 0;

    // Hash all the array elements
    for (let i = 0; i < n; i++)
```

```
            S.add(arr[i]);

        // check each possible sequence from
        // the start then update optimal length
        for (let i = 0; i < n; i++)
        {

            // if current element is the starting
            // element of a sequence
            if (!S.has(arr[i] - 1))
            {

                // Then check for next elements
                // in the sequence
                let j = arr[i];
                while (S.has(j))
                    j++;

                // update optimal length if
                // this length is more
                ans = Math.max(ans, j - arr[i]);
            }
        }
        return ans;
    }

    // Driver code
    let arr = [1, 9, 3, 10, 4, 20, 2];
    let n = arr.length;
    document.write("Length of the Longest contiguous subsequence is "
        + findLongestConseqSubseq(arr, n));

        // This code is contributed by gfgking.
    </script>
```

Output

```
Length of the Longest contiguous subsequence is 4
```

Complexity Analysis:

- **Time complexity:** O(n).
  Only one traversal is needed and the time complexity is O(n) under

the assumption that hash insert and search take O(1) time.

- **Auxiliary space:** O(n).

  To store every element in hashmap O(n) space is needed

  Thanks to Gaurav Ahirwar for the above solution.

Another Solution:

This problem can be solved in **O(N log N)** time with another **Method**, this time the Idea is to use Priority Queue.

Algorithm:

1. Create a Priority Queue to store the element
2. Store the first element in a variable
3. Remove it from the Priority Queue
4. Check the difference between this removed first element and the new peek element
5. If the difference is equal to 1 increase count by 1 and repeats step 2 and step 3
6. If the difference is greater than 1 set counter to 1 and repeat step 2 and step 3
7. if the difference is equal to 0 repeat step 2 and 3
8. if counter greater than the previous maximum then store counter to maximum
9. Continue step 4 to 7 until we reach the end of the Priority Queue
10. Return the maximum value

C++

```
// CPP program for the above approach
#include <bits/stdc++.h>
using namespace std;

int findLongestConseqSubseq(int arr[], int N)
{
    priority_queue<int, vector<int>, greater<int> > pq;
    for (int i = 0; i < N; i++) {
        // adding element from
        // array to PriorityQueue
        pq.push(arr[i]);
    }

    // Storing the first element
    // of the Priority Queue
    // This first element is also
    // the smallest element
    int prev = pq.top();
    pq.pop();

    // Taking a counter variable with value 1
    int c = 1;

    // Storing value of max as 1
    // as there will always be
    // one element
    int max = 1;
    while (!pq.empty()) {

        // check if current peek
        // element minus previous
        // element is greater than
        // 1 This is done because
        // if it's greater than 1
        // then the sequence
        // doesn't start or is broken here
        if (pq.top() - prev > 1) {

            // Store the value of counter to 1
            // As new sequence may begin
            c = 1;

            // Update the previous position with the
            // current peek And remove it
            prev = pq.top();
            pq.pop();
        }

        // Check if the previous
        //  element and peek are same
        else if (pq.top() - prev == 0) {
            // Update the previous position with the
            // current peek And remove it
            prev = pq.top();
            pq.pop();
        }

        // If the difference
        // between previous element and peek is 1
        else {

            // Update the counter
            // These are consecutive elements
            c++;

            // Update the previous position
            //  with the current peek And remove it
            prev = pq.top();
            pq.pop();
        }

        // Check if current longest
        // subsequence is the greatest
        if (max < c) {

            // Store the current subsequence count as
            // max
            max = c;
        }
    }
    return max;
}

// Driver Code
int main()
{
    int arr[] = { 1, 9, 3, 10, 4, 20, 2 };
    int n = 7;

    cout << "Length of the Longest consecutive subsequence "
            "is "
         << findLongestConseqSubseq(arr, n);
    return 0;
}
// this code is contributed by Manu Pathria
```

Java

```java
// Java Program to find longest consecutive
// subsequence This Program uses Priority Queue
import java.io.*;
import java.util.PriorityQueue;
public class Longset_Sub
{
    // return the length of the longest
    // subsequence of consecutive integers
    static int findLongestConseqSubseq(int arr[], int N)
    {

        PriorityQueue<Integer> pq
            = new PriorityQueue<Integer>();
        for (int i = 0; i < N; i++)
        {
            // adding element from
            // array to PriorityQueue
            pq.add(arr[i]);
        }

        // Storing the first element
        // of the Priority Queue
        // This first element is also
        // the smallest element
        int prev = pq.poll();

        // Taking a counter variable with value 1
        int c = 1;

        // Storing value of max as 1
        // as there will always be
        // one element
        int max = 1;

        for (int i = 1; i < N; i++)
        {
            // check if current peek
            // element minus previous
            // element is greater than
            // 1 This is done because
            // if it's greater than 1
            // then the sequence
```

```
                // doesn't start or is broken here
                if (pq.peek() - prev > 1)
                {
                    // Store the value of counter to 1
                    // As new sequence may begin
                    c = 1;

                    // Update the previous position with the
                    // current peek And remove it
                    prev = pq.poll();
                }

                // Check if the previous
                //  element and peek are same
                else if (pq.peek() - prev == 0)
                {
                    // Update the previous position with the
                    // current peek And remove it
                    prev = pq.poll();
                }
                // if the difference
                // between previous element and peek is 1
                else
                {
                    // Update the counter
                    // These are consecutive elements
                    c++;

                    // Update the previous position
                    //  with the current peek And remove it
                    prev = pq.poll();
                }

                // Check if current longest
                // subsequence is the greatest
                if (max < c)
                {
                    // Store the current subsequence count as
                    // max
                    max = c;
                }
            }

            return max;
        }
```

```
    // Driver Code
    public static void main(String args[])
        throws IOException
    {
        int arr[] = { 1, 9, 3, 10, 4, 20, 2 };
        int n = arr.length;
        System.out.println(
            "Length of the Longest consecutive subsequence is "
            + findLongestConseqSubseq(arr, n));
    }
}
// This code is contributed by Sudipa Sarkar
```

Python3

```
# Python program for the above approach
import bisect

def findLongestConseqSubseq(arr,N):
    pq = []
    for i in range(N):

        # adding element from
        # array to PriorityQueue
        bisect.insort(pq,arr[i])

    # Storing the first element
    # of the Priority Queue
    # This first element is also
    # the smallest element
    prev = pq[0]
    pq.pop(0)

    # Taking a counter variable with value 1
    c=1

    # Storing value of max as 1
    # as there will always be
    # one element
    max = 1
    while(len(pq)):
        # check if current peek
        # element minus previous
```

```
            # element is greater than
            # 1 This is done because
            # if it's greater than 1
            # then the sequence
            # doesn't start or is broken here
            if(pq[0] - prev > 1):
                # Store the value of counter to 1
                # As new sequence may begin
                c = 1

                # Update the previous position with the
                # current peek And remove it
                prev = pq[0]
                pq.pop(0)

            # Check if the previous
            # element and peek are same
            elif(pq[0] - prev == 0):
                # Update the previous position with the
                # current peek And remove it
                prev = pq[0]
                pq.pop(0)

            # If the difference
            # between previous element and peek is 1
            else:
                # Update the counter
                # These are consecutive elements
                c = c +1
                # Update the previous position
                # with the current peek And remove it
                prev = pq[0]
                pq.pop(0)

            # Check if current longest
            # subsequence is the greatest
            if(max < c):
                # Store the current subsequence count as
                # max
                max = c
        return max

# Driver Code
arr = [1, 9, 3, 10, 4, 20, 2]
n = 7
```

```
print("Length of the Longest consecutive subsequence is {}".format(findLo


# This code is contributed by Pushpesh Raj
```

C#

```
// C# program to implement
// the above approach
using System;
using System.Collections.Generic;

class GFG
{

  // return the length of the longest
  // subsequence of consecutive integers
  static int findLongestConseqSubseq(int[] arr, int N)
  {

    List<int> pq = new List<int>();
    for (int i = 0; i < N; i++)
    {

      // adding element from
      // array to PriorityQueue
      pq.Add(arr[i]);
      pq.Sort();
    }

    // Storing the first element
    // of the Priority Queue
    // This first element is also
    // the smallest element
    int prev = pq[0];

    // Taking a counter variable with value 1
    int c = 1;

    // Storing value of max as 1
    // as there will always be
    // one element
    int max = 1;
    for (int i = 1; i < N; i++)
    {

      // check if current peek
      // element minus previous
      // element is greater than
      // 1 This is done because
      // if it's greater than 1
      // then the sequence
      // doesn't start or is broken here
      if (pq[0] - prev > 1)
      {
        // Store the value of counter to 1
        // As new sequence may begin
        c = 1;

        // Update the previous position with the
        // current peek And remove it
        prev = pq[0];
        pq.RemoveAt(0);
      }

      // Check if the previous
      //  element and peek are same
      else if (pq[0] - prev == 0)
      {

        // Update the previous position with the
        // current peek And remove it
        prev = pq[0];
        pq.RemoveAt(0);
      }

      // if the difference
      // between previous element and peek is 1
      else
      {

        // Update the counter
        // These are consecutive elements
        c++;

        // Update the previous position
        //  with the current peek And remove it
        prev = pq[0];
```

```
          pq.RemoveAt(0);
        }

        // Check if current longest
        // subsequence is the greatest
        if (max < c)
        {

          // Store the current subsequence count as
          // max
          max = c;
        }
      }

      return max;
    }

    // Driver Code
    public static void Main()
    {
      int[] arr = { 1, 9, 3, 10, 4, 20, 2 };
      int n = arr.Length;
      Console.WriteLine(
        "Length of the Longest consecutive subsequence is "
        + findLongestConseqSubseq(arr, n));
    }
  }

// This code is contributed by code_hunt.
```

Output

```
Length of the Longest consecutive subsequence is 4
```

Time Complexity : O(n*logn)

Auxiliary Space: O(n)

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