Find common elements in three sorted arrays

Given three arrays sorted in non-decreasing order, print all common elements in these arrays.

Examples:

```
ar1[] = {1, 5, 10, 20, 40, 80}
ar2[] = {6, 7, 20, 80, 100}
ar3[] = {3, 4, 15, 20, 30, 70, 80, 120}
Output: 20, 80

ar1[] = {1, 5, 5}
ar2[] = {3, 4, 5, 5, 10}
ar3[] = {5, 5, 10, 20}
Outptu: 5, 5
```

A simple solution is to first find intersection of two arrays and store the intersection in a temporary array, then find the intersection of third array and temporary array. Time complexity of this solution is O(n1 + n2 + n3) where n1, n2 and n3 are sizes of ar1[], ar2[] and ar3[] respectively.

The above solution requires extra space and two loops, we can find the common elements using a single loop and without extra space. The idea is similar to intersection of two arrays. Like two arrays loop, we run a loop and traverse three arrays.
Let the current element traversed in ar1[] be x, in ar2[] be y and in ar3[] be z. We can have following cases inside the loop.
1) If x, y and z are same, we can simply print any of them as common element and move ahead in all three arrays.
2) Else If x < y, we can move ahead in ar1[] as x cannot be a common element 3) Else If y < z, we can move ahead in ar2[] as y cannot be a common element 4) Else (We reach here when x > y and y > z), we can simply move ahead in ar3[] as z cannot be a common element.

Following are implementations of the above idea.

C++

```
// C++ program to print common elements in three arrays
#include <iostream>
```

```
using namespace std;

// This function prints common elements in ar1
int findCommon(int ar1[], int ar2[], int ar3[], int n1, int n2, int n3)
{
    // Initialize starting indexes for ar1[], ar2[] and ar3[]
    int i = 0, j = 0, k = 0;

    // Iterate through three arrays while all arrays have elements
    while (i < n1 && j < n2 && k < n3)
    {
         // If x = y and y = z, print any of them and move ahead
         // in all arrays
         if (ar1[i] == ar2[j] && ar2[j] == ar3[k])
         {   cout << ar1[i] << " ";   i++; j++; k++; }

         // x < y
         else if (ar1[i] < ar2[j])
             i++;

         // y < z
         else if (ar2[j] < ar3[k])
             j++;

         // We reach here when x > y and z < y, i.e., z is smallest
         else
             k++;
    }
}

// Driver program to test above function
int main()
{
    int ar1[] = {1, 5, 10, 20, 40, 80};
    int ar2[] = {6, 7, 20, 80, 100};
    int ar3[] = {3, 4, 15, 20, 30, 70, 80, 120};
    int n1 = sizeof(ar1)/sizeof(ar1[0]);
    int n2 = sizeof(ar2)/sizeof(ar2[0]);
    int n3 = sizeof(ar3)/sizeof(ar3[0]);

    cout << "Common Elements are ";
    findCommon(ar1, ar2, ar3, n1, n2, n3);
    return 0;
}
```

Python

```
# Python function to print common elements in three sorted arrays
```

```
def findCommon(ar1, ar2, ar3, n1, n2, n3):

    # Initialize starting indexes for ar1[], ar2[] and ar3[]
    i, j, k = 0, 0, 0

    # Iterate through three arrays while all arrays have elements
    while (i < n1 and j < n2 and k< n3):

        # If x = y and y = z, print any of them and move ahead
        # in all arrays
        if (ar1[i] == ar2[j] and ar2[j] == ar3[k]):
            print ar1[i],
            i += 1
            j += 1
            k += 1

        # x < y
        elif ar1[i] < ar2[j]:
            i += 1

        # y < z
        elif ar2[j] < ar3[k]:
            j += 1

        # We reach here when x > y and z < y, i.e., z is smallest
        else:
            k += 1

#Driver program to check above function
ar1 = [1, 5, 10, 20, 40, 80]
ar2 = [6, 7, 20, 80, 100]
ar3 = [3, 4, 15, 20, 30, 70, 80, 120]
n1 = len(ar1)
n2 = len(ar2)
n3 = len(ar3)
print "Common elements are",
findCommon(ar1, ar2, ar3, n1, n2, n3)

# This code is contributed by __Devesh Agrawal__
```

Output:

```
Common Elements are 20 80
```

Time complexity of the above solution is O(n1 + n2 + n3). In worst case, the largest sized array may have all small elements and middle sized array has all middle elements.

This article is compiled by **Rahul Gupta** Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above.

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