

# HASHMAP 2

“

The biggest competition is myself. I am not looking to follow others or pull them down. I'm planning to test my own boundaries.

—  
RAIN

GRACIOUSQUOTES.COM



Good  
Evening

Today's content = pair with given sum

pair with given diff

Subarr sum = k

Distinct Ele in window = k

Q1. Given N array elements, check if there exists a pair  $(i, j)$  such that  $\text{ar}[i] + \text{ar}[j] = k$  &  $(i \neq j)$

$\text{ar}[] :$

|   |   |   |    |   |   |    |    |   |   |
|---|---|---|----|---|---|----|----|---|---|
| 8 | 9 | 1 | -2 | 4 | 5 | 11 | -6 | 7 | 5 |
| 0 | 1 | 2 | 3  | 4 | 5 | 6  | 7  | 8 | 9 |

$$k = 11 \rightarrow \text{ar}[4] + \text{ar}[8] \rightarrow \text{True}$$

$$k = 6 \rightarrow \text{ar}[2] + \text{ar}[9] \rightarrow \text{True}$$

$$k = 22 \rightarrow \text{ar}[6] + \text{ar}[6] * \underline{i \neq j}$$

Ideas → Generate all pairs where  $i \neq j$   
& check if  $\text{sum} = k$

```

for (i=0; i<n; i++)
    for (j=i+1; j<n; j++) {
        if (ar[i] + ar[j] == k) return True;
    }
}
return false;

```

TC:  $O(n^2)$

SC:  $O(1)$

## Idea 2

$$\underline{x} + \underline{y} = k$$

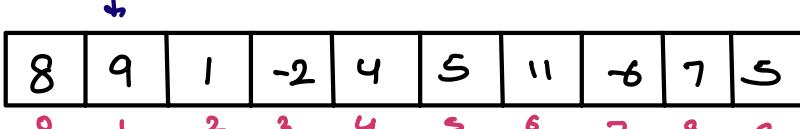
$$A[i], y = k - A[i]:$$

```

for (i=0; i<n; i++)
    x = A[i] . y = k - x
    for (j=i+1; j<n; j++) {
        if (ar[j] == y) return True;
    }
}
return false;

```

Idea 3 → Use HashSet  $\rightarrow$  Can't use HashSet

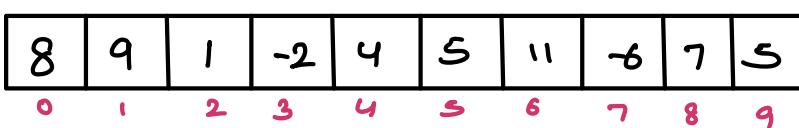
ar [ ] : 

Insert all the elements in HashSet

HashSet:

$$k = 11$$

$$\left\{ \begin{matrix} 8 & 9 & 1 \\ -2 & 4 & 5 \\ 11 & -6 & 7 \end{matrix} \right\} \quad x + y = 11$$

ar [ ] : 

$x$

$y[k-2]$

$y$  is present in hashset or  
not

8

3

3 is not present

9

2

2 is not present

1

10

Not present

-2

13

Not present

4

7

Yes return true

Eg: 2

or [ ] :

|   |   |   |    |   |   |    |    |   |   |
|---|---|---|----|---|---|----|----|---|---|
| 8 | 9 | 1 | -2 | 4 | 5 | 11 | -6 | 7 | 5 |
| 0 | 1 | 2 | 3  | 4 | 5 | 6  | 7  | 8 | 9 |

$$a + b = -4$$

a

b (-4-a)

b is present or not

Hashset:

|    |    |   |
|----|----|---|
| 8  | 9  | 1 |
| -2 | 4  | 5 |
| 11 | -6 | 7 |

8

-12

No

9

-13

No

1

-5

No

-2

-2

Yes. return true

\*



Since we only have one -2  
actual answer should be false

### Q3. Use hashmap to store frequencies

↓

arr [ ] :

|   |   |   |    |   |   |    |    |   |   |
|---|---|---|----|---|---|----|----|---|---|
| 8 | 9 | 1 | -2 | 4 | 5 | 11 | -6 | 7 | 5 |
| 0 | 1 | 2 | 3  | 4 | 5 | 6  | 7  | 8 | 9 |

HM      ↗ Key : Distinct ele of arr  
           ↗ Value : freq of arr elements

$$7 \rightarrow 1$$

$$8 \rightarrow 1$$

$$9 \rightarrow 1$$

$$a + b = -4$$

$$1 \rightarrow 1$$

$$a \quad b (-4-a)$$

b is present in  
HM or not

$$-2 \rightarrow 1$$

$$8 \quad -4-8 = -12$$

No

$$4 \rightarrow 1$$

$$9 \quad -4-9 = -13$$

No

$$5 \rightarrow 2$$

$$1 \quad -4-1 = -5$$

No

$$11 \rightarrow 1$$

$$-2 \quad -4-(-2) = -2$$

if ( $a == b$  &&

$\text{freq}(a) > 1$ )

return True

Move forward & check for other  
values

or [ ] :

|   |   |   |    |   |   |    |    |   |   |
|---|---|---|----|---|---|----|----|---|---|
| 8 | 9 | 1 | -2 | 4 | 5 | 11 | -6 | 7 | 5 |
| 0 | 1 | 2 | 3  | 4 | 5 | 6  | 7  | 8 | 9 |

$$\leftarrow k = 12$$

$$\frac{a+b=12}{a} \quad b = 12-a$$

HM

a      b ( $12-a$ )      b is present

8      4

Yes

$$a \neq b \downarrow$$

7 → 1

8 → 1    4 → 1

9 → 1    5 → X 2

return True

1 → 1    11 → 1

-2 → 1    -6 → 1

boolean pairsum (int [] ar, int k)

HashMap<Integer, Integer> hm;

insert ar[ ] → hm {TODO}

for (i=0; i < n; i++)

    a = ar[i], b = k - a

    if (a == b && hm.search(b) == true && hm.get(a) > 1)  
        return True

    if (a != b && hm.search(b) == true) return True;

}

return False;

TC: O(n)

SC: O(n)

HashSet → {TODO}

Hint → Do not fill your HS completely before solving

## Q2. Pair with given diff

Given an array A of integers & another non negative integer B.

Find if there exists 2 indices i & j such that  $A[i] - A[j] = B$  ( $i \neq j$ )

$$\begin{array}{r} a - b = k \\ - \\ a_r[i] \quad b = a - k \end{array}$$

boolean pairsum (int [] ar, int k)

HashMap<Integer, Integer> hm;

insert ar[] → hm {TODO}

for (i=0; i<n; i++)

$a = ar[i]$ ,  $b = a - k / a + k$

if ( $a == b$  & hm.search(b) == true & hm.get(a) > 1)  
return True

if ( $a \neq b$  & hm.search(b) == false) return True;

}  
return False;

## Q2. Subarr with given sum

Given an arr of positive integers A & an integer B. check if there exist a subarr which adds to K.

Eg:  $A = \{1, 2, 3, 4, 5\}$   $K = 5$  True

$A = \{5, 10, 20, 100, 105\}$   $K = 110$   
↳ False

Q = Find the diff of subarray sums to be equal to K

Pf [A] - pf [B] = K → return true

$A = \{1, 2, 3, 4, 5\}$  on prefix arr  
 $Pf = \{1, 3, 6, 10, 15\} \rightarrow \boxed{x - y = K}$

\* Edge case = what if  $K = arr[i]$   $K=1$

$K=2$

$K=3$

```
{
    if(arr[0] == K) return true
    Pf[0] = arr[0]
    for(i=1 ; i<n ; i++)
        if(arr[i] == K) return true;
        Pf[i] = Pf[i-1] + arr[i];
}
3
```

$$\text{arr} = \{10, 20, \underline{30}, 50\} \quad K = 80$$

find two subarrays sum whose diff is 80

prefix arr

$$\text{Pf} = \{10, 30, \underline{60}, 110\} \quad x - y = 80$$

↳ HashMap = {  
 $10 \rightarrow 1$   
 $30 \rightarrow 1$   
 $60 \rightarrow 1$   
 $110 \rightarrow 1$

$$x \quad y (x - k)$$

|     |                 |                  |
|-----|-----------------|------------------|
| 10  | $10 - 80 = -70$ | No               |
| 30  | $30 - 80 = -50$ | No               |
| 60  | $60 - 80 = -20$ | No               |
| 110 | $110 - 80 = 30$ | Yes, return true |

Q2. Given N elements , calculate no. of distinct elements in every subarray of size k

|           |   |   |   |   |   |   |   |   |    |   |    |   |   |   |   |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|---|---|----|---|----|---|---|---|---|---|---|---|---|---|---|
| arr[10] = | <table border="1"><tr><td>2</td><td>4</td><td>3</td><td>8</td><td>3</td><td>9</td><td>4</td><td>9</td><td>4</td><td>10</td></tr><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr></table> | 2 | 4 | 3 | 8 | 3 | 9 | 4 | 9  | 4 | 10 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2         | 4   | 3 | 8 | 3 | 9 | 4 | 9 | 4 | 10 |   |    |   |   |   |   |   |   |   |   |   |   |
| 0         | 1   | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9  |   |    |   |   |   |   |   |   |   |   |   |   |

$$k=4$$

$$\text{subarr} = [0 \ 3] \rightarrow 4$$

$$[1 \ 4] \rightarrow 3$$

$$[2 \ 5] \rightarrow 3$$

$$[3 \ 6] \rightarrow 4$$

$$[4 \ 7] \rightarrow 3$$

$$[5 \ 8] \rightarrow 2$$

$$[6 \ 9] \rightarrow 3$$

Brute → For every subarr of length k , we can iterate on it & get the no. of distinct ele.

$$\hookrightarrow O(n^2 * k^2)$$

↓ to check if elements are distinct  
To generate all subarr

Optimization 1 → For every subarr of length k , we can store it in hashset & get the no. of distinct ele .

No. of subarr with size = 1  
in arr of length 10  $\rightarrow$  ans = 10

No. of subarr with size = 2  
in arr of length 10  $\rightarrow$  ans = 9

No. of subarr with size = k  
in arr of length = N  $\rightarrow$   $N - k + 1$

TC : No. of subarr of length  $k * k$

TC :  $(N - k + 1) * k$

$$\hookrightarrow_{k=1} (N - 1 + 1) * 1 \asymp O(N)$$

$$\hookrightarrow_{k=N} (N - N + 1) * N \asymp O(N)$$

$$\hookrightarrow_{k=\frac{N}{2}} (N - \frac{N}{2} + 1) * \frac{N}{2} = \underline{\underline{O(n^2)}}$$

SC:  $O(k)$

Q3. Sliding window + HashSet \*

|                   |  |   |   |   |   |   |   |   |    |   |    |   |   |   |   |   |   |   |   |   |   |
|-------------------|--|---|---|---|---|---|---|---|----|---|----|---|---|---|---|---|---|---|---|---|---|
| $\text{ar}[10] =$ | <table border="1"> <tr> <td>2</td><td>4</td><td>3</td><td>8</td><td>3</td><td>9</td><td>4</td><td>9</td><td>4</td><td>10</td> </tr> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td> </tr> </table> | 2 | 4 | 3 | 8 | 3 | 9 | 4 | 9  | 4 | 10 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2                 | 4  | 3 | 8 | 3 | 9 | 4 | 9 | 4 | 10 |   |    |   |   |   |   |   |   |   |   |   |   |
| 0                 | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9  |   |    |   |   |   |   |   |   |   |   |   |   |

$k = 4$

# distinct ele

$$[0 - 3] \longrightarrow \{2, 4, 3, 8\} \quad 4$$

$$[1 - 4] \xrightarrow[\text{ar}[0]}{\text{remove add}} \{4, 3, 8\} \quad 3$$

$$[2 - 5] \xrightarrow[\text{ar}[1]}{\text{remove add}} \{3, 8, 9\} \quad 3$$

$$[3 - 6] \xrightarrow[\text{ar}[2]}{\text{remove add}} \{8, 9, 4\} \quad \text{X} \quad 3$$

### Q3. Use HashMap to store frequency

|                   |  |   |   |   |   |   |   |   |    |   |    |   |   |   |   |   |   |   |   |   |   |
|-------------------|--|---|---|---|---|---|---|---|----|---|----|---|---|---|---|---|---|---|---|---|---|
| $\text{ar}[10] =$ | <table border="1"> <tr> <td>2</td><td>4</td><td>3</td><td>8</td><td>3</td><td>9</td><td>4</td><td>9</td><td>4</td><td>10</td> </tr> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td> </tr> </table> | 2 | 4 | 3 | 8 | 3 | 9 | 4 | 9  | 4 | 10 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 2                 | 4  | 3 | 8 | 3 | 9 | 4 | 9 | 4 | 10 |   |    |   |   |   |   |   |   |   |   |   |   |
| 0                 | 1  | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9  |   |    |   |   |   |   |   |   |   |   |   |   |

$k = 4$

$$[0 - 3] \longrightarrow \{\langle 2, 1 \rangle, \langle 4, 1 \rangle, \langle 3, 1 \rangle, \langle 8, 1 \rangle\} \quad 4$$

$$[1 - 4] \xrightarrow[\text{ar}[0]}{\text{remove add}} \{ \langle 2, 0 \rangle, \langle 4, 1 \rangle, \langle 3, 2 \rangle, \langle 8, 1 \rangle \} \quad 3$$

if freq=0, remove it

|         |                 |              |   |     |
|---------|-----------------|--------------|---|-----|
| [2 - 5] | remove<br>ar[1] | add<br>ar[5] | $\{ \langle 4, 0 \rangle \langle 3, 2 \rangle \langle 8, 1 \rangle \langle 9, 1 \rangle \}$ | 3   |
| [3 - 6] | rem<br>ar[2]    | add<br>ar[6] | $\{ \langle 3, 1 \rangle \langle 8, 1 \rangle \langle 9, 1 \rangle \langle 4, 1 \rangle \}$ | 4   |
| [4 - 7] | rem<br>ar[3]    | add<br>ar[7] | $\{ \langle 8, 0 \rangle \langle 3, 1 \rangle \langle 9, 2 \rangle \langle 4, 1 \rangle \}$ | 3   |
| [5 - 8] | rem<br>ar[4]    | add<br>ar[8] | $\{ \langle 3, 0 \rangle \langle 4, 2 \rangle \langle 9, 2 \rangle \}$                      | 2   |
| [6 - 9] | rem<br>ar[5]    | add<br>ar[9] | $\{ \langle 4, 2 \rangle, \langle 9, 1 \rangle, \langle 10, 1 \rangle \}$                   | = 3 |

void distinct ele ( int [] ar, k )

```
    HashMap < Int , Int > hm;
```

```
    for ( i = 0 ; i < k ; i ++ ) {
```

```
        if ( hm. search ( ar [ i ] ) == true ) {
```

```
            int of = hm. get ( ar [ i ] );
```

```
            hm. insert ( ar [ i ] , of + 1 );
```

```
        3      else {
```

```
            3      hm. insert ( ar [ i ] , 1 );
```

```
print( hm.size() );
```

```
s = 1      e = k
```

```
while ( e < n )
```

```
// get window[s e]    remove ar[s-1]  
                      add   ar[e]
```

```
int of = hm.get(ar[s-1]);  
hm.insert(ar[s-1], of - 1);
```

```
if ( hm.get(ar[s-1]) == 0 ) hm.remove(ar[s-1])
```

```
if ( hm.search(ar[e]) == true ) {
```

```
int of = hm.get(ar[e]);
```

```
hm.insert(ar[e], of + 1);
```

```
}
```

```
else {
```

```
    hm.insert(ar[e], 1);  
}
```

```
print( hm.size() );
```

```
s = s + 1
```

```
e = e + 1
```

```
}
```

```
}
```

TC : O(n)

SC : O(k)