Array

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Array

- A collection of items stored at contiguous memory locations
- Data structure to store multiple items of the same type

$$\text{arr} : \boxed{1 \mid 2 \mid 3}$$

In Python

```
arr = [1, 2, 3]
```

In C

```
int[] arr = {1, 2, 3};
```

In R

```
arr <- c(1, 2, 3)
```

In Java

```
int[] arr = {1, 2, 3};
```

Exercise 1: Making Book

Statement

Given two numbers A and B, count the number of occurrences of each digit in the range between A and B included

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Representation

0	1	2	3	4	5	6	7	8	9

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0	1	2	3	4	5	6	7	8	9

Example

Input:
10 15
Output:
Case 1: 0:1 1:7 2:1 3:1 4:1 5:1 6:0 7:0 8:0 9:0

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What problems can arise?

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- Can $A > B$?

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- Can $A = B$?

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- Can $A = B$?
- How great can A and B be?

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  $\implies$ Are integers big enough for the solution?

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- How great can the number of occurrences be?
  - $\implies$ Are integers big enough for the solution?
  - $\implies$ What type of array for the solution?

Exercise 1: Making Book

Solution 1: Brute force

```
read A and B on the standard input
if A > B then
    exchange their value

initialize the solution array with 0

foreach page between A and B
    foreach digit in page
        increment the corresponding cell

print the result
```

Exercise 1: Making Book

Solution 2: Arithmetic

read A and B on the standard input
if $A > B$ then exchange their value

diff $\leftarrow B - A + 1$
initialize the solution array with $\lfloor diff/10 \rfloor$

if diff mod $10 \neq 0$ then
    deal with the units

A $\leftarrow \lfloor A/10 \rfloor$
B $\leftarrow \lfloor B/10 \rfloor$
deal with the tens

print the result

Exercise 1: Making Book

More test cases

Input:

10 15
15 104
220 202
912 912
900 999
0

Output:

Case 1: 0:1 1:7 2:1 3:1 4:1 5:1 6:0 7:0 8:0 9:0
Case 2: 0:14 1:19 2:19 3:19 4:19 5:19 6:19 7:19 8:19 9:19
Case 3: 0:10 1:11 2:22 3:2 4:2 5:2 6:2 7:2 8:2 9:2
Case 4: 0:0 1:1 2:1 3:0 4:0 5:0 6:0 7:0 8:0 9:1
Case 5: 0:20 1:20 2:20 3:20 4:20 5:20 6:20 7:20 8:20 9:120

Exercise 2: It's a Murder

Statement

Given an array of integers, for each number sum the previous strictly smaller numbers

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Statement

Given an array of integers, for each number sum the previous strictly smaller numbers

Representation

1	5	3	6	4

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Given an array of integers, for each number sum the previous strictly smaller numbers

Representation

1	5	3	6	4

0				

Exercise 2: It's a Murder

Statement

Given an array of integers, for each number sum the previous strictly smaller numbers

Representation

1	**5**	3	6	4

0				

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Given an array of integers, for each number sum the previous strictly smaller numbers

Representation

1	**5**	3	6	4

0	1			

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Representation

1	5	**3**	6	4

0	1			

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1	5	**3**	6	4

0	1	1		

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Given an array of integers, for each number sum the previous strictly smaller numbers

Representation

| 1 | 5 | 3 | 6 | 4 |

| 0 | 1 | 1 | 9 | 4 |

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Given an array of integers, for each number sum the previous strictly smaller numbers

Representation

1	5	3	6	4

$$\sum$$

0	1	1	9	4

$= 15$

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Given an array of integers, for each number sum the previous strictly smaller numbers

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1	5	3	6	4

$$\sum \begin{array}{|c|c|c|c|c|} \hline 0 & 1 & 1 & 9 & 4 \\ \hline \end{array} = 15$$

Example

Input: Output:

1   15

5

1 5 3 6 4

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Statement

Given an array of integers, for each number sum the previous strictly smaller numbers

What problems can arise?

- What do we know of the data?

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Given an array of integers, for each number sum the previous strictly smaller numbers

What problems can arise?

- What do we know of the data?
  $\implies$ Are integers big enough for the solution?

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Given an array of integers, for each number sum the previous strictly smaller numbers

What problems can arise?

- What do we know of the data?
  - $\Longrightarrow$ Are integers big enough for the solution?
  - $\Longrightarrow$ What type for the solution?

Exercise 2: It's a Murder

Solution: Brute force

read the array *tab* on standard input

result ← 0

foreach value in tab
    result ← result + sum of previous values strictly smaller
      than value

print result

Exercise 2: It's a Murder

More test cases
Input:
2
5
1 5 3 6 4
7
1 3 5 2 6 7 4

Output:
15
40

Exercise 3: Longest Connected Subsequence

Statement

Given a binary sequence and a number $k > 0$ find how long is the longest connected subsequence which contains at most k ones
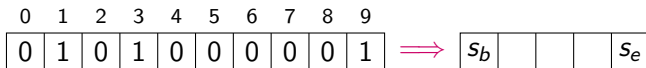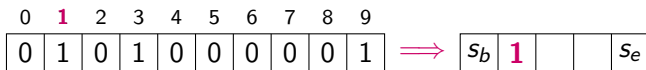
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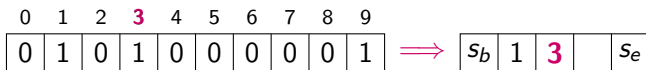| 0	1	2	3	4	5	6	7	8	9
0	1	0	1	0	0	0	0	0	1

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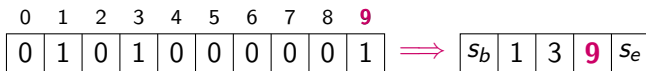
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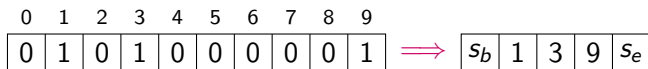
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Representation

0	1	2	3	4	5	6	7	8	9
0	1	0	1	0	0	0	0	0	1

$\implies$

s_b	1	3	9	s_e

Example

Input:

10 1

0101000001

Output:

7

Exercise 3: Longest Connected Subsequence

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What problems can arise?

- What do we know of k?

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Statement

Given a binary sequence and a number $k > 0$ find how long is the longest connected subsequence which contains at most k ones

What problems can arise?

- What do we know of k?
- How great can k be?

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What problems can arise?

- What do we know of k?
- How great can k be?
- How long can the sequence be?

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- What do we know of k?
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  - $\implies$ What type of array for the solution?

Exercise 3: Longest Connected Subsequence

Solution

```
read T on the standard input

foreach test case
    read n and k on the standard input
    read the sequence on the standard input
    create a sparse array that represents the sequence
    max ← 0
    for i from 0 to n − offset
        if max < array[i + offset] − array[i]
            max ← array[i + offset] − array[i]

print max
```

Exercise 3: Longest Connected Subsequence

More test cases

Input:

3

3 1

000

4 2

1111

5 3

01110

Output:

3

2

5