An exam question may be similar to a practice question on PGE web page https://cw.fel.cvut.cz/wiki/courses/be5b33pge/practices/code

Specifically, typical exam topics are covered by the paragraphs:

- 1D array problems
- 2D array problems
  (both including complexity questions)

- Recursion I
  - PROBLEMS SET [A]
  - PROBLEMS SET [B]

- Recursive tree processing

More additional examples of exam questions are in this document below.

[1] Write a function in python according to the given specification:

Input parameter

N: integer

Return value:

2D array A of size N×N. The array is filled with values 1,2,...,N in the way illustrated by the examples below.

Examples:

N = 1 A = [1]	N = 2 A = [[2, 1] [1, 1]]	N = 3 A = [[3, 2, 1] [2, 2, 1] [1, 1, 1]]
N = 4 A = [[4, 3, 2, 1] [3, 3, 2, 1] [2, 2, 2, 1] [1, 1, 1, 1]]	N = 5 A = [[5, 4, 3, 2, 1] [4, 4, 3, 2, 1] [3, 3, 3, 2, 1] [2, 2, 2, 2, 1] [1, 1, 1, 1, 1]]	N = k A = [[k, k-1, k-2, k-3, ..., 1] [k-1, k-1, k-2, k-3, ..., 1] [k-2, k-2, k-2, k-3, ..., 1] [k-3, k-3, k-3, k-3, ..., 1] ... [1, 1, 1, 1, ..., 1]]

[2] Write a function in python according to the given specification:

Input parameter

N: integer

Return value:

2D array A of size N×N. The array is filled with values 1,2,...,N in the way illustrated by the examples below.

Examples:

N = 1 A = [1]	N = 2 A = [[1, 1] [1, 2]]	N = 3 A = [[1, 1, 1] [1, 2, 2] [1, 2, 3]]
N = 4 A = [[1, 1, 1, 1] [1, 2, 2, 2] [1, 2, 3, 3] [1, 2, 3, 4]]	N = 5 A = [[1, 1, 1, 1, 1] [1, 2, 2, 2, 2] [1, 2, 3, 3, 3] [1, 2, 3, 4, 4] [1, 2, 3, 4, 5]]	N = k A = [[1, 1, 1, ..., 1, 1] [1, 2, 2, ..., 2, 2] [1, 2, 3, ..., 3, 3] ... ... [1, 2, 3, , k-1, k-1] [1, 2, 3, ..., k-1, k]]

[3] Write a function in python according to the given specification:

Input parameters
A: 2D array of integers (same number of rows and columns)

Return value:
Return value is 1 if and only if each value in any column of A is strictly bigger than all values in the previous column (= the column with index smaller by 1). The values in the first column of A may be arbitrary.
In all other cases the function returns 0.

Examples:

```
A = [
  [6,10,20,32,36]
  [5,17,27,33,34]
  [3,15,25,33,35]
  [2,11,21,32,36]
  [4,16,21,33,37]
  ]
```

Return value: 1

```
A = [
  [6,10,22,29,41]
  [5,10,20,29,42]
  [3,10,20,28,41]
  [2,12,20,21,42]
  [4,10,20,27,41]
  ]
```

Return value: 0
(The value 21 in the 4-th column is smaller than the value 22 in the 3-rd column.)

[4] Write a function in python according to the given specification:

Input parameters
A: 2D array of integers (same number of rows and columns)
K: integer

Return value:
Return value is 1 if and only if all values in A are less or than or equal to K and also each column in A contains only one value (different columns may contain different values).
In all other cases the function returns 0.

Examples:

```
A = [
  [1,4,4,6,4]
  [1,4,4,6,4]
  [1,4,4,6,4]
  [1,4,4,6,4]
  [1,4,4,6,4]
  ]
 K = 7
```

Return value:
1

```
A = [
  [1,3,4,5,2]
  [1,3,4,5,2]
  [1,3,4,5,2]
  [1,3,4,5,2]
  [1,3,4,1,2]
  ]
 K = 3
```

Return value:
0 (the 4-th column contains two different values -- 5 and 1)

[5] Write a function in python according to the given specification:

Input parameters
A: square 2D array of integers (same number of rows and columns)
K, M: integer

Return value:
Return value is 1 if the diagonal contains the value M exactly K times and also the digagonal contains no 0.
In all other cases the function returns 0.

Examples:

```
A = [
  [1,1,4,4,5]
  [1,3,4,4,2]
  [3,2,5,0,7]
  [2,3,1,1,2]
  [1,2,3,3,5]
  ]
 K = 2, M = 5
```

Return value:
1

```
A = [
  [1,1,4,4,5]
  [1,4,4,4,2]
  [3,2,4,0,7]
  [2,3,1,4,2]
  [1,2,3,3,0]
  ]
 K = 3, M = 4
```

Return value:
0 (there is 0 on the diagonal).

[6] Write a function in python according to the given specification:

Input parameters

A: array of integers

Return value:

Two integers representing the index (position) of the first and of the last bi-decimal pairs in A. A bi-decimal pair are two consecutive values in the array which sum is exactly 10.

If there is no bi-decimal pair in A, the function returns -1, -1. The index of a bi-decimal pair is the index of the first value in the pair.

Examples:

A = [2,9,1,7,2,2,2,8,2,0,1]

Return value is 1, 7 (the bi-decimal pairs are 9,1 and 8,2).

A = [1000, 1000, 420, 10, 10]

Return value is -1, -1.

[7] Write a function in python according to the given specification:

Input parameters

A: array of integers

Return value:

Return value is 1 if A contains three consecutive elements which product is smaller than their sum.
Otherwise the return value is 0.

Examples:

A = [3,4,2,1,2,5]
Return value is 1.

A = [8,7,6,3,4,6,5]
Return value is 0.

A = [2,2,2,-2,2]
Return value is 1.

[8] Write a function in python according to the given specification:

Input parameters

A: 2D array of integers

K, M: integer

Return value:

The smallest index of the column which contains value K exactly M times. If such column does not exit the function returns -1.

Example:

```
A = [
  [1,2,4,6,5]
  [1,3,4,2,5]
  [1,2,0,2,5]
  [3,3,4,6,5]
  [1,2,4,2,5]
  ]
K = 2; M = 3
```

Return value:

1

[9] Write a function in python according to the given specification:

Input parameters

A: 2D array of integers, with same number of rows and column

K, L: integer

Return value:

Array A with swapped (exchanged) contents of the K-th and L-th column.

Example:

```
A = [
  [1,2,4,6,5]
  [1,2,4,6,5]
  [1,2,0,6,5]
  [3,2,4,6,5]
  [1,2,4,6,5]
  ]
K = 1; L = 4
```

Return value:

```
A = [
  [1,5,4,6,2]
  [1,5,4,6,2]
  [1,5,0,6,2]
  [3,5,4,6,2]
  [1,5,4,6,2]
  ]
```

[10] Write a function in python according to the given specification:

Input parameters

A: array of integers

Return value:

One integer representing the product of all elements of A which values are not equal to the minimum or to the maximum values in A.

Examples:

A = [2,4,1,7,3,0,2,0,1]

Return value is 48.

A = [1000, 1000, 420, 10, 11]

Return value is 4620.

[11] Write a function in python according to the given specification:

Input parameters

A: array of integers

Return value:

One integer representing the product of the second biggest value in A with the second smallest value in A.

Examples:

A = [-1, -3, -2, -6, -5, -4]
Return value is 10.

A = [50, 60, 70, 80, 10, 20, 30, 40]
Return value is 1400.

[12] Write a function in python according to the given specification:

Input parameters

A: array of integers

Return value:

One integer representing the value in A which is the closest to the average of A.

If there are two different closest values the function returns the smaller one.

(The average value of an array is the average value of all its elements.)

Examples:

A = [8,7,6,5,3,4]

Return value is 5.

A = [10, 20, 40, 80, 160]

Return value is 80.

[13] Write a function in python according to the given specification:

Input parameters

A: array of integers,

K: integer

Return value:

Return value is 1 if A contains two elements which sum is equal to K.

Otherwise the return value is 0.

Examples:

A = [8,7,6,1,4,0,2]

K = 11

Return value is 1.

A = [10, 20, 40, 80, 160]

K = 130

Return value is 0.

[14] Write a function in python according to the given specification:

Input parameters

A: array of integers,

K: integer

Return value:

Return value is 1 if the product of any two elements in A is bigger than K.

Otherwise the return value is 0.

Examples:

A = [8,7,6,3,4,6,5]

K = 10

Return value is 0.

A = [10, 20, 40, 80, 160]

K = 190

Return value is 1.

[15] Write a function in python according to the given specification:

Input parameters

A: array of integers,

K: integer

Return value:

Return value is 1 if the number of elements in A which value is bigger than K

is the same as the number of elements in A which value is less than K.

Otherwise the return value is 0.

Examples:

A = [8,7,6,1,4,0,2]

K = 4

Return value is 1.

A = [10, 20, 40, 80, 160]

K = 100

Return value is 0.

[16] Write a function in python according to the given specification:

Input parameters

A: array of integers,

K, L, M: integers

Return value:

Return value is 1 if the number of elements in A which value is bigger than K and simultaneously smaller than L is equal to M.

Otherwise the return value is 0.

Examples:

A = [8,7,6,1,4,0,2]

K = 3, L = 7, M = 2

Return value is 1.

A = [640, 320, 160, 10, 20, 40, 80]

K = 200, L = 300, M = 1

Return value is 0.

[17] Write a function in python according to the given specification:

Input parameters

A: array of integers,

X, Y: integers

Return value:

Return value is 1

if all elements on even positions 0,2,4,6,... in A are equal to X

and all elements on odd positions 1,3,5,7,... are equal to Y.

Otherwise the return value is 0.

Examples:

A = [4,2,4,2,4,2,4]

X = 4, Y = 2

Return value is 1.

A = [10, 30, 10, 30, 11, 30]

X = 10, Y = 30

Return value is 0.

[18] There is a missing part in the given code.
Fill in the missing part to achieve the declared functionality.

```
# The function decides if the values in the array
# are all mutually different.

def areAllDifferent( arr ):
    all = []
    for i in range(len(arr)):
        all.extend( arr[i] )
    # _____________________________________ # fill in this line
    for i in range( len(all)-1 ):
        if( all[i] == all[i+1] ):
            return False
    return True
```

Example:
[2, 4, 7, 5, 11, 0]   .... True
[2, 4, 7, 5, 11, 4]   .... False

[19] Determine the return value and the total number of executions of the innermost loop statement
when the given function is called
with parameter
a) n=1, b) n=2 c) n=6 d) n = len(a) .

```
def f( a, n ): # a is an array
  if n == 0: return 0
  s = 0
  for i in range( len(a) )
    s += a[i]
  s += f(a, n - 1)
  return s;
}
```

[20] What will be the effect of statement
f(a, 0, len(a))?
Describe in words the changes which will occur in array a.

```
def f( a, i, j ):
  if i >= j return
  x = a[j];  a[j]= a[i];  a[i] = x
  f(a, i + 1, j - 1)
```

[21] Determine the output produced by the statement **`print(recur(15))`**. The function **`recur`** is defined below.

```
def recur( x ):
  if x < 1: return 2
  if x > 9: return recur(x-2) + 3
  return recur(x-3) + recur(x-1)
```

.....

[22] Determine the output produced by the statement **`print(recur(10))`**. The function **`recur`** is defined below.

```
def recur( x ):
  if x < 1: return 3
  if x > 5: return recur(x-3) + 1
  else:
    return recur(x-1) + recur(x-2) + 2
```

[23] There is a missing part in the given code.
Fill in the missing part to achieve the declared functionality.

The function decides if there are at least K values in an integer array which are equal to the average value of all elements in the array.

```
def ff( arr ):
    count = 0
    # _____________________________________ # fill in this line or lines
    for i in range(len(arr)):
        if a[i] == average:
            count += 1
    if count < K:
        return _________________ # complete in this line
    return _____________________ # complete in this line
```

[24] Write a function in python according to the given specification:

Input parameters

A: array of integers,

Return value:

Return value is 1 if A contains a subarray of 4 elements sorted in ascending order (each next one is bigger then the previous one). Otherwise the return value is 0.

Examples:

A = [100,100, 100, 55, 52, 59, 78, 20, 20, 20]
Return value is 1.

A = [52, 53, 54, 35, 36, 37, 21, 22, 23, 10]
Return value is 0.

[25] Function f is defined below:

```
def f(arr, index):
    if not 0 <= index <= len(arr) -1:
        return 0
    c1 = 0
    if arr[index] < 0:
        c1 = 1
    c2 = f(arr, index+1)
    return c1 + c2
```

Two arrays are defined as follows:

```
a = [-2, -3, -4, -5, -6, -7, -7, -7, -8]
b = [ -5, 50, -4, 40, -3, 30, -2, 20, -1, 10, 0]
```

Determine what the statements print:

```
print( f(a, 2) )
print( f(b, 0) )
```

[26] Function f is defined below:

```
def ff( arr, index):
    if not 0 <= index <= len(arr) -1:
        return True
    if index == len(arr)-1:
        return True
    rest = ff(arr, index+1)
    here = arr[index] > arr[index+1]
    return rest and here
```

Two arrays are defined as follows:

a = [-2, -3, -6, -7, -1]

b = [10, 20, 30, 20, -10]

Determine what the statements print:

print(f(a, 0))

print(f(b, 2))

[27] Function f is defined below:

```
def f( arr, index ):
    if len(arr) % 2 != 0:
        return 0
    if index >= len(arr):
        return 0
    x = f(arr, index+2)
    if arr[index]*arr[index+1] == 12:
        x += 1
    return x
```

Two arrays are defined as follows:

```
a = [ 2, 6, 3, 4, -6, -2, -2, -3, 1, 12]
b = [ 1, 12, 12, 12, 2, 3, 6, 10, 2, 6]
```

Determine what the statements print:

```
print( f(a, 0))
print( f(b, 2))
```