Nested loops

Loops of loops
Mid-term test review, Q10

Write in your own words: what does the following function do?

```python
# Given: array of integers
def f(a):
    b = 0
    c = 0
    for i in range(len(a)):
        if c < a[i]:
            b = i
            c = a[i]
    return b
```
Mid-term test review, Q2

What does the following piece of code print out?

```python
array = [2, 4, 9, 0, -1, 5, -1]
print(array[array[1]])
```
Mid-term test review, Q3

What will the following program output?

```python
x = 1
def f(x):
    x+=1
    print(x)
f(x)
print(x)
```
Nested for-loops

for variable1 in list1:
    statements1
    for variable2 in list2:
        statements2
    statements1

for i in [1,2,3]:
    for j in [4,5,6]:
        print(i*j)
    print()
Nested while-loops

while condition1:
    statements1
    while condition2:
        statements2
    statements1

i = 1
while i <= 3:
    j = 4
    while j <= 4:
        print(i*j)
        j += 1
    print()
    i += 1
Example

Create a function `all_different`, which checks whether all elements in a given array `a` are different.

Input: array `a`
Output: boolean value (True or False)
Matrices

- Matrix is a list of lists:
  \[ a = \begin{bmatrix}
  [1, 2, 3], & [4, 5, 6], & [7, 8, 9]
  \end{bmatrix} \]

- Getting the row:
  >>> a[1]
  \[ [4, 5, 6] \]

- Getting the element:
  >>> a[1,2]
  \[ 6 \]
Looping over a matrix

```python
a = [[1,2,3], [4,5,6], [7,8,9]]
for i in range(len(a)):
    for j in range(len(a[i])):
        print(a[i][j], end=" ")
print()
```
Example

How many rows in a matrix contain only positive values?
Example

How many columns in a matrix contain only positive values?
Data structures

• Primitive types: values cannot be decomposed into smaller units. For example: `int, float, bool`.

• Non-primitive types (data structures): contain other values in a structured way. For example: `list, str`.

• Possibilities to construct new data structures are endless. For example: list of lists of lists etc.
Other common data structures

• Tuple. Like an array but nonmutable.
  \[ t = (6, -2, 3) \]

• Set. Collection of unique elements where order is unimportant.
  \[ s = \{2, 4, 6\} \]

• Dictionary. Set of key-value pairs.
  \[ d = \{'day': 14, 'month': 11, 'year': 2018\} \]
Algorithms and data structures

• Data structures represent „passive part“ of programming. They describe how data is organized.
• Algorithms represent „active part“ of programming. They describe what needs to be done with data.
• Good program has both parts implemented in efficient way.
Exercises

https://courses.cs.ut.ee/2018/nkp/fall/Main/During10