

Practice work 7 Functions and Procedures in Python

Objective: learning procedures and functions in Python.

know - syntax of procedures and functions, procedure with parameter, local and global variables;

be able to - apply the syntax of procedures and functions when compiling a program; own

- basic skills of working with functions and procedures.

subroutine is a named fragment of the program that can be accessed from another place in the program

Subroutines fall into two categories: procedures and functions.

1. Procedures.

Consider the procedure syntax:

```
def procedure name(Parameter list):
```

```
    Command system
```

The `def` keyword is used to define a procedure, followed by the name of the procedure and, in parentheses, its formal parameters, if any. After the colon is put and commands are indicated from the next line with an indent of 4 spaces.

A procedure is an auxiliary algorithm that performs some actions. The procedure must be defined by the time it is called. The definition of a procedure begins with the service word `def`.

A procedure is called by its name followed by parentheses, such as `Err()`.

One program can have any number of calls to the same procedure.

Using procedures shortens code and improves readability.

procedure with parameters.

Let's look at an example of how procedure parameters are used in Python.

Example.

Write a procedure that prints the specified character (entered from the keyboard) once, each on a new line.

```
def
printChar(s):
print(s)
sim = input('enter character')
printChar(sim) # first call, output the entered character
printChar('*') # second call, output *
def printChar(s):
    print(s)
    sim = input('введите символ: |')
    printChar(sim) # первый вызов, вывод введенного символа
    printChar('*') # второй вызов, вывод *

>>>
введите символ: 41
41
*
```

global variable- if it is assigned a value in the main program (outside the procedure).

local variable(internal) is known only at the procedure level, it cannot be accessed from the main program and from other procedures.

Procedure parameters are local variables.

2. Examples of using local and global variables.

Example 1

x = 3 # global variable

def pr(): # procedure without parameters

print(x) # print the value of the global variable pr()

```
x = 3 # глобальная переменная
def pr(): # процедура без параметров
    print (x) # вывод значения глобальной переменной
pr()
```

Python 3.4.1 Shell

File Edit Shell Debug Options Windows Help

```
Python 3.4.1 (v3.4.1:c0e311e010fc, May 18 2014, 10
tel)] on win32
Type "copyright", "credits" or "license()" for mor
>>> ===== RESTART =====
>>>
3
>>>
```

Example 2

x = 3 # global variable

def pr(a): # procedure with

parameter print (a) # 4

pr(x) # passing parameter to global variable (3)

Python 3.4.1: ex_procedure3.py - C:/Documents and Settings/St
File Edit Format Run Options Windows Help

```
x = 10 # глобальная переменная
def pr(a): # процедура с параметром
    print (a) # 4
pr(x) # передача параметра глобальной переменной (3)
```

Python 3.4.1 Shell

File Edit Shell Debug Options Windows Help

```
Python 3.4.1 (v3.4.1:c0e311e010fc, May 18 2014, 10:3
tel)] on win32
Type "copyright", "credits" or "license()" for more
>>> ===== RESTART =====
>>>
10
>>> |
```

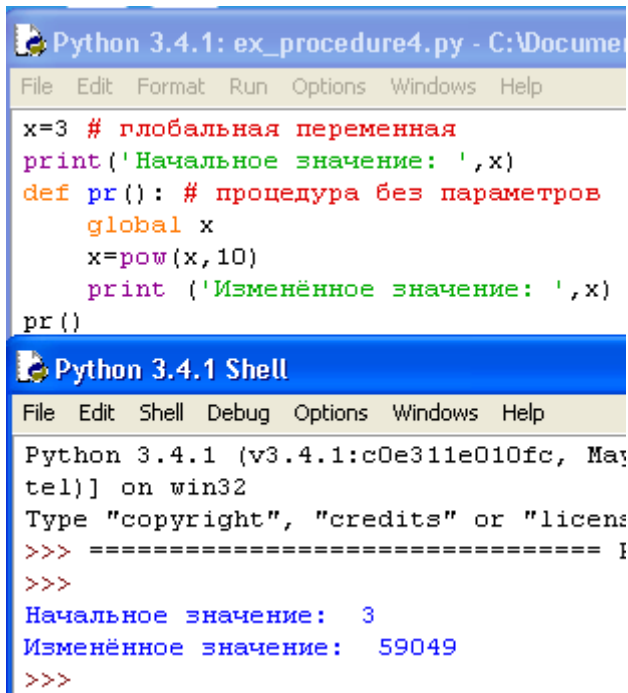
It is possible to change the value of a global variable (without creating a local one). In a procedure using the word global:

x = 3 # global variable

def pr(): # procedure without
parameters global x

x = pow(x,10)

print (x) # print the changed value of the global variable pr()



The screenshot shows two windows from a Python 3.4.1 IDE. The top window, titled 'Python 3.4.1: ex_procedure4.py - C:\Docume', contains the following Python code:

```
x=3 # глобальная переменная
print('Начальное значение: ',x)
def pr(): # процедура без параметров
    global x
    x=pow(x,10)
    print ('Изменённое значение: ',x)
pr()
```

The bottom window, titled 'Python 3.4.1 Shell', shows the output of running the script:

```
Python 3.4.1 (v3.4.1:c0e311e010fc, May
tel)] on win32
Type "copyright", "credits" or "licens
>>> ===== I
>>>
Начальное значение:  3
Изменённое значение:  59049
>>>
```

3. Functions.

A function is a subroutine that can be accessed from elsewhere in the program. To create a function, use the `def` keyword, followed by a name and a list of arguments in parentheses. The body of the function is distinguished in the same way as the body of the condition (or loop): four spaces.

Consider the function syntax:

def function name(Parameter list):

Command

system return

expression

Part of the functions of the Python language are built-in functions that are provided by the syntax of the language itself. For example, `int`, `input`, `randint`.

Let's look at an example of creating custom functions.

Example 1

Calculate the sum of the digits of a number.

```
def sumD(n): # function definition with parameter
sumD = 0
while n!=0:
```

```

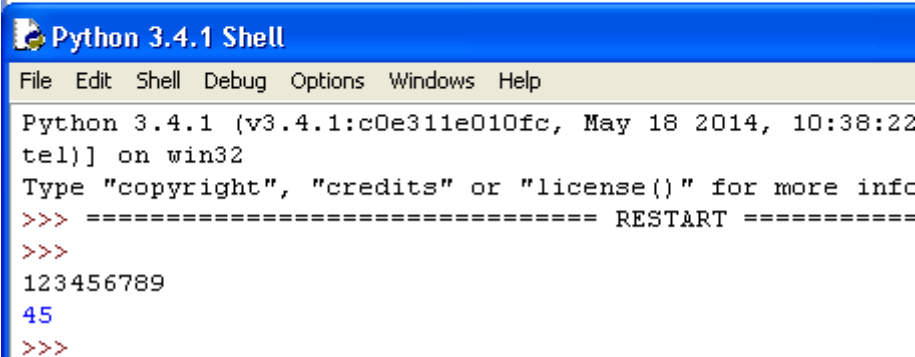
        sumD += n
    % 10 n = n // 10
    return sumD # return function value # main
program
    print (sumD(int(input()))) # function call with parameter

```

```

def sumD(n): # определение функции с параметром
    summa = 0
    while n != 0:
        summa += n % 10
        n = n // 10
    return summa # возврат значения функции
# основная программа
print (sumD(int(input()))) # вызов функции с параметром

```



Python 3.4.1 Shell

File Edit Shell Debug Options Windows Help

Python 3.4.1 (v3.4.1:c0e311e010fc, May 18 2014, 10:38:22
tel)] on win32
Type "copyright", "credits" or "license()" for more info
>>> ===== RESTART =====
>>>
123456789
45
>>>

Task 0.

1. Determine if three triangles are the same area. Enter the lengths of the sides from the keyboard. Use Heron's formula to calculate the area of a triangle. Express the area calculation as a function with three parameters.

Heron formula:

$$S = \sqrt{p(p-a)(p-b)(p-c)},$$

$$where \ p = \frac{a+b+c}{2}$$

Solution:

```

import math
def s(x,y,z):
    p=(x+y+z)/2
    s=math.sqrt(p*(p-x)*(p-y)*(p-z))
    return s
A=[]
for i in range(3):
    print('Введите стороны ',i,'-го треугольника:')
    a=int(input('a:'))
    b=int(input('b:'))
    c=int(input('c:'))
    A.append(s(a,b,c))
for i in range(3):
    print('Площадь ',i,'-го треугольника {:.2f}'.format(A[i]))
if A[0]==A[1]:
    if A[0]==A[2]:
        print('Треугольники равновеликие')
else: print('Треугольники не равновеликие')

```

```

Введите стороны  0 -го треугольника:
a:3
b:4
c:5
Введите стороны  1 -го треугольника:
a:6
b:7
c:8
Введите стороны  2 -го треугольника:
a:9
b:10
c:11
Площадь  0 -го треугольника 6.00
Площадь  1 -го треугольника 20.33
Площадь  2 -го треугольника 42.43
Треугольники не равновеликие

```

2. Enter a one-dimensional array A of length m. Swap the first and last elements in it. Enter the length of the array and its elements from the keyboard. In a program, describe a procedure for replacing elements of an array. Output the original and resulting arrays.

Solution:

```

def zam(X):
    tmp=X[0]
    X[0]=X[len(X)-1]
    X[len(X)-1]=tmp
A=[]
m=int(input('Введите длину массива:'))
for i in range(m):
    print('Введите ',i,'элемент массива')
    A.append(int(input()))
print(A)
zam(A)
print(A)

```

```

Введите длину массива:5
Введите  0 элемент массива
0
Введите  1 элемент массива
1
Введите  2 элемент массива
2
Введите  3 элемент массива
3
Введите  4 элемент массива
4
[0, 1, 2, 3, 4]
[4, 1, 2, 3, 0]

```

Task 1.

1. Write a program to calculate the area of various geometric shapes.
2. Given 3 different arrays of integers (the size of each does not exceed 15). In each array, find the sum of the elements and the arithmetic mean.

Task 2.

1. Calculate the area of a regular hexagon with side a using the triangle area subroutine.
2. The user enters two sides of three rectangles. Bring out their area.

Task 3.

1. The legs of two right triangles are given. Write a function to calculate the length of the hypotenuse of these triangles. Compare and deduce which of the hypotenuses is greater and which is smaller.
2. Convert a string so that the letters of each word in it are sorted alphabetically.

Task 4.

1. Two fractions A/B and C/D are given (A, B, C, D are natural numbers). Write a program for dividing a fraction by a fraction. The answer must be an irreducible fraction. Use a subroutine of the Euclid algorithm to determine the gcd.
2. Given a circle $(x-a)^2 + (y-b)^2 = R^2$ and points $P(p_1, p_2)$, $F(f_1, f_2)$, $L(l_1, l_2)$. Find out and display on the screen how many points lie inside the circle. Checking whether a point lies inside a circle should be done in the form of a procedure.

Task 5.

1. Two fractions A/B and C/D are given (A, B, C, D are natural numbers). Write a program to subtract the second fraction from the first fraction. The answer must be an irreducible fraction. Use a subroutine of the Euclid algorithm to determine the gcd.
2. Write a program that prints all the divisors of the given number in one line, separating them with spaces.

Task 6.

1. Write a program to find the greatest common divisor (GCD) and the least common multiple (LCM) of two natural numbers $LCM(A, B) = (A*B)/GCD(A,B)$. Use a subroutine of the Euclid algorithm to determine the gcd.
2. Write a program to calculate the area of a convex quadrilateral given the lengths of four sides and a diagonal.

Task 7.

1. Numbers X, Y, Z, T are given — the lengths of the sides of the quadrilateral. Calculate it

area if the angle between sides of length X and Y is a right angle. Use two routines to calculate areas: a right triangle and a rectangle.

2. Write a program that converts a non-negative integer given to it into a 10-digit octal code, preserving leading zeros.

Task 8.

1. Find all natural numbers not exceeding the given n that are divisible by each of their digits.

2. Enter a one-dimensional array A of length m. Swap the first and last elements in it. Enter the length of the array and its elements from the keyboard. In a program, describe a procedure for replacing elements of an array. Output the original and resulting arrays.

Task 9.

1. Subtract the sum of its digits from a given number. The sum of its digits was again subtracted from the result, and so on. How many such actions will result in zero?

2. You are given 3 different arrays of integers. In each array, find the product of the elements and the arithmetic mean.

Task 10.

1. On the interval [100, N] ($210 < N < 231$) find the number of numbers composed of the digits a, b, c.

2. Write a program that reverses the sequence of words in a string.

Task 11.

1. Two prime numbers are called "twins" if they differ from each other by 2 (for example, 41 and 43). Print all pairs of "twins" from the segment [n, 2n], where n is a given natural number greater than 2..

2. Given two matrices A and B. Write a program that swaps the maximum elements of these matrices. Finding the maximum element of the matrix to formalize in the form of a procedure.

Task 12.

1. Two natural numbers are called "friendly" if each of them

equals the sum of all divisors (except itself) of another (for example, the numbers 220 and 284). Find all pairs of "friendly" numbers that are not greater than the given number N.

2. Given the lengths of the sides of the triangle a, b, c . Find the medians of a triangle whose sides are the medians of the original triangle. To calculate the median drawn to side a , use the formula Calculate the median in the form of a procedure.

Task 13.

1. A natural number with n digits is called an Armstrong number if the sum of its digits raised to the power of n is equal to the number itself. Find all Armstrong numbers from 1 to k .

2. Three points are given by their coordinates $X(x_1, x_2)$, $Y(y_1, y_2)$ and $Z(z_1, z_2)$. Find and print the coordinates of the point for which the angle between the abscissa axis and the ray connecting the origin with the point is minimal. Calculations to form in the form of a procedure.

Task 14.

1. Write a program to find numbers from the interval $[M, N]$ that have the largest number of divisors.

2. Four points are given by their coordinates $X(x_1, x_2)$, $Y(y_1, y_2)$, $Z(z_1, z_2)$, $P(p_1, p_2)$. Find out which of them are at the maximum distance from each other and display the value of this distance on the screen. Calculate the distance between two points in the form of a procedure.

Task 15.

1. Find all prime natural numbers not exceeding n whose binary notation is a palindrome, i.e. reads the same from left to right and from right to left.

2. Four points are given by their coordinates $X(x_1, x_2, x_3)$, $Y(y_1, y_2, y_3)$, $Z(z_1, z_2, z_3)$, $T(t_1, t_2, t_3)$. Find out which of them are at the minimum distance from each other and display the value of this distance on the screen. Calculate the distance between two points in the form of a procedure.