1 Computing with Formulas

Exercise 1.2 *Write a "Hello, World!" program.*

Almost all books about programming languages start with a very simple program that prints the text "Hello, World!" to the screen. Make such a program in Python. Name of program file: `hello_world.py`.

Exercise 1.6 *Find error(s) in a program.*

Suppose somebody has written a simple one-line program for computing sin(1):

```
x=1; print 'sin(%g)=%g' % (x, sin(x))
```

Type in this program and try to run it. What is the problem?

Exercise 1.7 *Type in program text.*

Type the following program in your editor and execute it. If your program does not work, check that you have copied the code correctly.

```
from math import pi

h = 5.0 # height
b = 2.0 # base
r = 1.5 # radius

area_parallelogram = h*b
print 'The area of the parallelogram is %.3f' % area_parallelogram

area_square = b**2
print 'The area of the square is %g' % area_square

area_circle = pi*r**2
print 'The area of the circle is %8.3f' % area_circle

volume_cone = 1.0/3*pi*r**2*h
print 'The volume of the cone is %.3f' % volume_cone
```

Name of program file: `formulas_shapes.py`.

Exercise 1.8 *Type in programs and debug them.*

Type these short programs in your editor and execute them. When they do not work, identify and correct the erroneous statements.

(a) Does $\boxed{\sin^2(x) + \cos^2(x) = 1}$?

```
from math import sin, cos
```

```
x = pi/4
1_val = sin^2(x) + cos^2(x)
print 1_VAL
```

Name of program file: `sin2_plus_cos2.py`

(b) Work with the expressions for movement with constant acceleration:

```
v0 = 3 m/s
t = 1 s
a = 2 m/s**2
s = v0*t + 1/2 a*t**2
print s
```

Name of program file: `acceleration.py`

(c) Verify these equations:

$$(a+b)^2 = a^2 + 2ab + b^2$$
$$(a-b)^2 = a^2 - 2ab + b^2$$

```
a = 3,3
b = 5,3
a2 = a**2
b2 = b**2
eq1_sum = a2 + 2ab + b2
eq2_sum = a2 - 2ab + b2
eq1_pow = (a + b)**2
eq2_pow = (a - b)**2
print 'First equation:  %g = %g', % (eq1_sum, eq1_pow)
print 'Second equation: %h = %h', % (eq2_pow, eq2_pow)
```

Name of program file: `a_pm_b_sqr.py`

1.1 Advanced Exercises

Exercise 1.5 *Compute the growth of money in a bank.*

Let p be a bank's interest rate in percent per year. An initial amount A has then grown to

$$A\left(1+\frac{p}{100}\right)^n$$

after n years. Make a program for computing how much money 1000 euros have grown to after three years with 5 % interest rate. Name of program file: `interest_rate.py`.

Exercise 1.9 *Evaluate a Gaussian function.*

The bell-shaped Gaussian function,

$$f(x) = \frac{1}{\sqrt{2\pi}s} \exp\left[-\frac{1}{2}\left(\frac{x-m}{s}\right)^2\right], \tag{1}$$

is one of the most widely used functions in science and technology[1]. The parameters m and s are real numbers, where s must be greater than zero. Make a program for evaluating this function when $m = 0$, $s = 2$, and $x = 1$. Verify the program's result by comparing with hand calculations on a calculator. Name of program file: `Gaussian_function1.py`.

[1]The function is named after Carl Friedrich Gauss, 1777–1855, who was a German mathematician and scientist, now considered as one of the greatest scientists of all time. He contributed to many fields, including number theory, statistics, mathematical analysis, differential geometry, geodesy, electrostatics, astronomy, and optics. Gauss introduced the function (1) when he analyzed probabilities related to astronomical data.