Exercise 4

4.1 Hello World^n

Compile and run the following program

```c
#include <stdio.h>

int main()
{
    int n;
    for (n=0; n<10; n++)
    {
        printf("Hello World %d\n" , n);
    }
    return 0;
}
```

- What does it do?
- Adapt the program, so that it prints "Hello World .." 20 times
- Adapt the program, so that the user can input (using scanf) how many times "Hello World" should be printed

4.2 Throwing a stone

You are standing at a lake and throwing a stone with angle alpha and velocity v. You are throwing the stone from starting position x=0, y=2m. Air resistance can be ignored. Write a program that

- asks reads alpha and $|v|$,
- informs the user about nonsense-input,
- prints out the position of the stone (x, y) in a 1-second interval (or an interval of your choice) until the stone hits the water,
- calculates at what point in time and space the stone hits the lake surface (y=0).

Before hitting the keys, think about how you solve the problem with physics and maths.

4.3 Interest

(Words: interest = Zins, compound interest = Zinseszins.)

- Read in three values representing:

```
- a capital sum
- a rate of interest in percent ("rate")
- a number of years
```

- Compute the values of the capital sum with compound interest added over the given period of years.
- Evaluate the difference with respect to a situation where the initial capital and the number of years are the same, but the interests are paid every six month at a "rate/2" interest rate.

- Adapt the program so that the user can also input in what intervals the interest is paid out, for example 4 times a year with interest rate/4, 12 times a year with interest rate/12 etc. This will lead you to the principle of continuous compounding (stetige verzinsung). If you do this exercise, insert a very high value for the intervals ($n > 1000$), a rate of 100%, a capital of 1, and 1 year for the interest period. You will find a number which you should know very well.

4.4 Prime Numbers

- Write a program which reads a positive integer number from the user, and then determines if the number is a prime number. (Hint: You can check the remainder ("Rest" in German) of a division with the modulo operator: 11 % 4 will give 3)
- Extend the program, so that the user can give a maximum number, and the program then prints out all prime numbers up to this value.

  At some point, you might get some ideas of how to optimize the code. For example it makes no sense to check if an even number is a prime number (except for the number 2, of course.)

4.5 Jumping ball

Imagine the stone from Exercise 2 being a football ball jumping off a football field over and over again (This time, we kick the ball from point x=0,y=0).

- Implement this using the assumption that it is inelastic scattering, with the ball loosing 20% of it's energy each time it hits the field, without changing the ratio between $|vx|$ and $|vy|$.
- The program should output t, x, y for each given step in time (you choose) until the energy is 1% of the initial energy.