

## Tutorial V

November 21

**Exercise 1** [*Pointers as arguments of functions*] Write a function called `invert` which has a single parameter and no return value and which inverts a real number. The function shall change the value of the variable used in the function call. Test it.

**Exercise 2** [*Multiple return values*] Write a function which computes the average and the statistical error of a set of  $N$  measurements stored in an array and returns both results.

**Note:** Since a C function can only return a single value, you need an alternative way to return multiple results in C. One solution to this problem is defining the function with extra arguments which are pointers to the variables where the results will be stored. For instance, in the present case the signature of your function could be something like

```
void average_and_error(double *mean, double *error, double *data, int N);
```

**Exercise 3** [*Gaußsches Eliminationsverfahren*] Write a function that finds the solution,  $\mathbf{x}$ , to the linear system  $A\mathbf{x} = \mathbf{b}$ , where  $A$  is an  $N \times N$  matrix and  $\mathbf{b}$  is an  $N$ -component vector, using the *Gaussian elimination* method<sup>1</sup>.

Test your program with a simple case like

$$\begin{bmatrix} 1 & -1 \\ 2 & 2 \end{bmatrix} \mathbf{x} = \begin{bmatrix} 1 \\ 3 \end{bmatrix},$$

which you can easily solve analytically.

Then solve the more complicated  $5 \times 5$  system

$$\begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ -4 & -3 & -3 & 0 & 1 \\ 2 & 2 & 4 & 7 & -\frac{1}{2} \\ 0 & -3 & -2 & \frac{1}{10} & \frac{1}{5} \\ -5 & -4 & -3 & -2 & 10^{-3} \end{bmatrix} \mathbf{x} = \begin{bmatrix} 1 \\ 1 \\ 0 \\ -3 \\ 6 \end{bmatrix},$$

and compare with results obtained by some of your colleagues.

Test your program also with

$$\begin{bmatrix} 0 & 2 & 3 \\ 5 & 1 & -1 \\ 6 & 7 & 8 \end{bmatrix} \mathbf{x} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix},$$

and with

$$\begin{bmatrix} 1 & 0 & -2 \\ 2 & 1 & -4 \\ 0 & 1 & 0 \end{bmatrix} \mathbf{x} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}.$$

Why are these cases special, i.e. what parts of your code are you testing with them?

---

<sup>1</sup>Have a look at the [http://de.wikipedia.org/wiki/Gaussches\\_Eliminationsverfahren](http://de.wikipedia.org/wiki/Gaussches_Eliminationsverfahren), if you need to recall the method.