1. Using projection find the best solution of the following system of equations: $Ax = b$ where $A = \begin{pmatrix} 2 & 1 & 0 \\ 4 & 2 & 0 \\ 2 & -4 & -1 \\ 1 & -2 & 2 \end{pmatrix}$, $b = (10, 5, 13, 9)^T$

   Notice that the columns of A are perpendicular. How bad is your solution (i.e. compute $b - Ax$)?

   The least squares method is often used when the errors are small – but it is hard to compute with such systems with pen and paper. Is the solution the same as the solution of the system $A^T Ax = A^T b$?

2. Determine a basis of the orthogonal complement of the row space of the matrix $A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 4 & 1 \end{pmatrix}$.

3. Intro to determinants – geometric intuition, why is there the sign needed, definition.

   Computing determinants of 2×2 matrices and the influence of row operations. Geometric intuition in the plane.

4. Compute determinants of following real matrices:

   $\begin{pmatrix} 4 & 1 & 2 \\ 0 & -1 & 1 \\ 1 & 2 & 1 \end{pmatrix}$

   $\begin{pmatrix} 3 & 2 & -1 \\ -1 & 1 & 2 \\ 2 & -1 & 3 \end{pmatrix}$

   $\begin{pmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$

   $\begin{pmatrix} 18 & 11 & 11 \\ 11 & 11 & 11 \\ 11 & 11 & 24 \end{pmatrix}$

(5 points) Program fitting by a degree two polynomial using the least squares method and run it on the data from: `https://drive.google.com/open?id=19p-lmqeS07-EKXbqNNWjWVyKu_JizmRGh9PstdJQQcY`

More precisely using the least squares method find parameters α, β, γ such that MASS $= \alpha\text{HEIGHT}^2 + \beta\text{HEIGHT} + \gamma$.

Send me both the source code and the result (with the input data). If possible indicate how you compile your program on linux (e.g. I use `clang++ -std=c++14 -Wall lsm.cpp -o lsm.out` or I use Netbeans IDE, I run it using python3) or indicate how you compile on Windows.

The data can be downloaded in an CVS format. You can use any programming language you want, but you should program matrix operations yourself. You can use for example: C, C++, Pascal, Java, C#, Python, Haskell... (without libraries). Please do not use: Sage, Octave, Mathematica, R, Julia, ...