

Assignment 1

Code structure

Forward Substitution Function

The forward substitution function was implemented in a relatively simple manner, using the provided template. Due to the functions relatively simple structure and few dependencies, a separate header file was not used for this part of the assignment.

If a slightly larger program/function structure was to be based on it, it would however be ideal to split the functions and main program into separate source files as well as a header file. Additionally, the appropriate Makefile could be created for easier future execution.

Triangular Sylvester Equation

The Sylvester Equation was implemented in a slightly different manner, with a more separated/better structure.

First of all, the header file "matrix.h" was included to define the matrix_t structures. The forward substitution function was also included in a separate source file for the Sylvester Equation to simplify the second step of the algorithm.

Again, if a main program was to be written and compiled, an appropriate Makefile could be included in the program structure.

Numerical test¹

A simple test was run, implementing the functions in a main program and printing the solution to the console, with the following input, α , R , b and C (with α , b being input for the forward substitution function and C being input for the Sylvester function):

$$\alpha = 2.5 \quad R = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 0 & 7 & 8 & 9 & 10 \\ 0 & 0 & 13 & 14 & 15 \\ 0 & 0 & 0 & 19 & 20 \\ 0 & 0 & 0 & 0 & 25 \end{bmatrix} \quad b = \begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{bmatrix} \quad C = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 6 & 7 & 8 & 9 & 10 \\ 11 & 0 & 13 & 14 & 15 \\ 16 & 17 & 18 & 19 & 20 \\ 21 & 22 & 23 & 24 & 25 \end{bmatrix}$$

Producing the following solutions for x and X , respectively:

$$x = \begin{bmatrix} 0.2857 \\ 0.1504 \\ 0.0606 \\ 0.0305 \\ 0.0200 \end{bmatrix} \quad X = \begin{bmatrix} 0.500 & 0.125 & 0.036 & 0.019 & 0.013 \\ 0.625 & 0.3929 & 0.1455 & 0.034 & 0.002 \\ 0.321 & 0.392 & 0.293 & 0.148 & 0.054 \\ 0.194 & 0.273 & 0.302 & 0.239 & 0.140 \\ 0.137 & 0.183 & 0.238 & 0.251 & 0.204 \end{bmatrix}$$

¹ Numerical tests in Appendices. Similar tests were run for checking numerical error and dimension/NULL errors (not included in the appendices).