Project 1 FYS3150

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CONTENTS

I. INTRODUCTION

One of the most versitile tools in modern science is numerical integration, thus it it simportant to understand its limits. In this paper we have performed numerial integration of a second order differential equation. This was done by discretizing the differential equation, and formulating it as a matrix-vector equation. The matrix-vector equation was then solved using both a general, and specialzed Thomas algorithm, as well as LU-decomposition. Under the pretext of solving a 1D version of Poisson's equation, we have created and tested a numerical solver using the Thomas algorithm. Furthermore, we have compared our results with LU decomposition using the Armadillo librarys solver.

II. FORMALISM

III. IMPLEMENTATION

IV. ANALYSIS
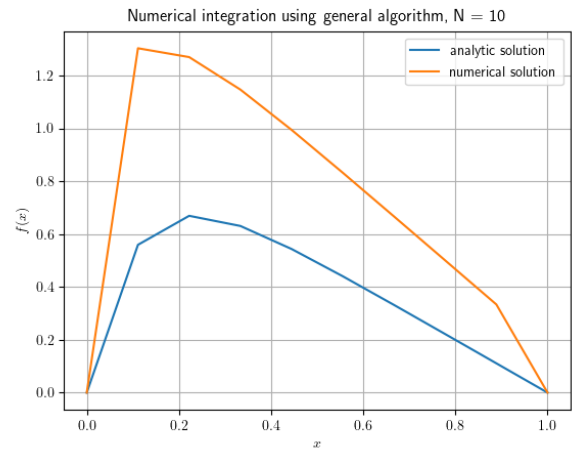
A. Plots of the general Thomas algorithm

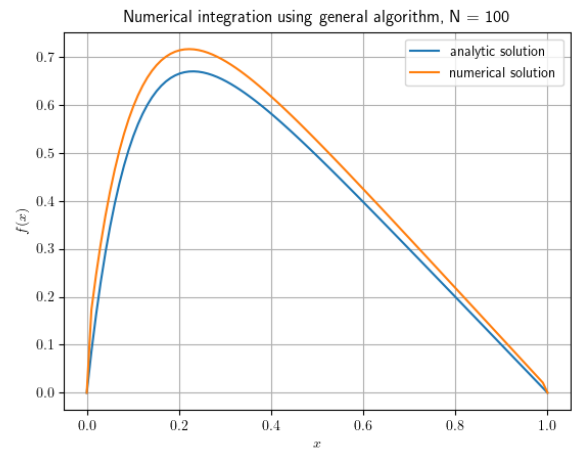Figure 1. Plot of numerical and analytical solution, using the general Thomas algorithm with $N = 10^1$.

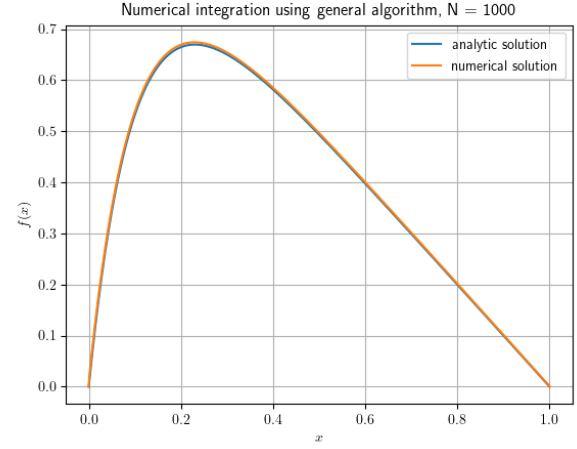Figure 2. Plot of numerical and analytical solution, using the general Thomas algorithm with $N = 10^2$.

Figure 3. Plot of numerical and analytical solution, using the general Thomas algorithm with $N = 10^3$.

B. Relative error for Thomas' algorithms

$\log_{10}(h)$:	ϵ general algorithm	ϵ special algorithm	N
$-1.041\,393$	$3.026\,200 \times 10^{-1}$	$3.601\,314 \times 10^{-1}$	10^1
$-2.004\,321$	$3.426\,303 \times 10^{-2}$	$4.249\,885 \times 10^{-2}$	10^2
$-3.000\,434$	$3.474\,750 \times 10^{-3}$	$4.338\,587 \times 10^{-3}$	10^3
$-4.000\,043$	$3.479\,720 \times 10^{-4}$	$4.347\,831 \times 10^{-4}$	10^4
$-5.000\,004$	$3.480\,179 \times 10^{-5}$	$4.348\,760 \times 10^{-5}$	10^5
$-6.000\,000$	$4.210\,129 \times 10^{-6}$	$4.348\,746 \times 10^{-6}$	10^6
$-7.000\,000$	$1.005\,169 \times 10^{-6}$	$4.343\,971 \times 10^{-7}$	10^7
$-8.000\,000$	$-1.140\,500 \times 10^{-3}$	$3.765\,295 \times 10^{-8}$	10^8

Table I. Table with $\log_{10}$ of relative error for general and special Thomas' algorithms, and $\log_{10}$ of step size h

V. CONCLUSION

Appendix A: Source code

All code for this report was written in C++ and Python 3.8, and the complete set of files can be found at https://github.com/FunkMarvel/FYS3150_Project_1.git