Abstract

We present our Ferrari algorithm for solving linear equations. Our best algorithm runs as $4n$ FLOPS with n the dimensionality of the matrix.

Project 1

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1 Introduction

2 Theory, algorithms and methods

3 Project 1 a)

We are attempting to solve the equation:

$$-u''(x) = f(x), x \in (0,1), u(0) = u(1) = 0$$

which can be approximated as:

$$v_i" \approx -\frac{v_{i-1} - 2v_i + v_{i+1}}{h^2} \tag{1}$$

Assumed $n = 4$, it can be shown that this can be represented as a Toepliz-matrix by setting:

$$\begin{bmatrix} v \end{bmatrix} = \begin{bmatrix} v_1 & v_2 & v_3 & v_4 \end{bmatrix}$$

For which

$$\begin{bmatrix} v_1" \\ v_2" \\ v_3" \\ v_4" \end{bmatrix} \approx -\frac{1}{h^2} \begin{bmatrix} -(v_0 - 2v_1 + v_2) \\ -(v_1 - 2v_2 + v_3) \\ -(v_2 - 2v_3 + v_4) \\ -(v_3 - 2v_4 + v_5) \end{bmatrix}$$

The boundary conditions are set to $v_0 = v_{n+1} = 0$, so the expression becomes:

$$\begin{bmatrix} 2 & -1 & 0 & 0 \\ -1 & 2 & -1 & 0 \\ 0 & -1 & 2 & -1 \\ 0 & 0 & -1 & 2 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \end{bmatrix} = -h^2 \begin{bmatrix} f_1 \\ f_2 \\ f_3 \\ f_4 \end{bmatrix}$$

In which f_i is known.

4 Project 1 b)

5 Project 1 c)

6 Project 1 d)

7 Project 1 e)

8 Conclusion

9 References