

First problem sheet for Simulation Modelling for Computer Science (COMP1216)

January 25, 2022

1 Gaussian elimination

Consider the system

$$\begin{aligned}6x + y + z &= 11 \\2x + 3y - z &= 5 \\x - y - 2z &= -7\end{aligned}$$

and solve analytically using Gaussian elimination.

2 Jacobi iteration

Consider the linear system

$$\begin{aligned}5x + y &= 1 \\2x + 3y &= 1.\end{aligned}$$

Solve this system exactly and write down the equations to solve this system via Jacobi iteration. Is Jacobi iteration valid for this system? If so, can you find an exact solution for x_n – the output after the n th iteration using Jacobi iteration?

3 Numerical root finding – 1

Consider the equation $x^3 = 0$ and apply Newton's method to solve the equation, starting at $x_0 = 1$. How many iterations does it take you to get within $\epsilon = 10^{-5}$ of the true solution? What can you say about the speed of convergence when applying Newton's method for this problem?

4 Numerical root finding – 2

Consider finding numerical solutions to the the equation $x^2 - 3x = -2$. Is it possible to find the roots using a standard fixed point iteration scheme?

5 Numerical root finding – 3

Apply the multidimensional Newton method to a linear system $Ax = b$ with $x, b \in \mathbb{R}^d$. How many iteration steps does the multidimensional Newton method require to solve this problem?