

Homework 5

Daniel Kreuzberger, Lars Kuehmicel, David Weinand

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1 Expression for Gaussian Elimination

We have $Ax = b$ with a tridiagonal matrix A of dimension $N \times N$, so we can start directly without having to reorder the rows. The first row of A will stay the same, so we do an iteration over $N - 1$ other rows:

```
for i := 1 to N-1:
    factor = Ai+1,i / Ai,i
    # calculate the factor with which we have to
    # multiply the previous row and add it to the
    # next row to eliminate the left off-diagonal
    # element
    bi+1 = bi+1 - factor * bi
    # update the vector b so the solution stays the
    # same
    for k := 1 to N:
        Ai+1,k = Ai+1,k - factor * Ai,k
        # update the row i+1
```

With this algorithm, we get an upper right triangular matrix A and an updated vector b . By doing backward substitution, we can get the solution of the linear equation system.

2 Backward Substitution

We have $Ax = b$ with an upper right triangular matrix A of dimension $N \times N$. We have to start with:

$$x_N = b_N / A_{N,N}$$

```
for i := 1 to N-1:
  for k := N-(i-1) to N:
    nN-i = nN-i - AN-i,k * xk
    # since the off-diagonal elements are not
    zero, we have to subtract them times the
    solution x
  xN-i = bN-1 / AN-i,N-i
```

with this algorithm, we get the solution vector x .