1 Labs

We distribute the following system of linear equations

$$
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 \\
-1 & 2 & -1 & 0 & 0 & 0 & 0 \\
0 & \dots & \dots & \dots & 0 & 0 & 0 \\
0 & 0 & -1 & 2 & -1 & 0 & 0 \\
0 & 0 & 0 & \dots & \dots & \dots & 0 \\
0 & 0 & 0 & 0 & -1 & 2 & -1 \\
0 & 0 & 0 & 0 & 0 & -1 & 1
\end{bmatrix}
\begin{bmatrix}
u_0 \\ u_1 \\ \dots \\ u_i \\ \dots \\ u_{N-1} \\ u_N
\end{bmatrix}
=
\begin{bmatrix}
0 \\ 0 \\ \dots \\ 0 \\ \dots \\ 0 \\ h
\end{bmatrix}
\tag{1.1}
$$

into diagonal 2x2 blocks

$$
\begin{bmatrix}
1 & 0 \\
-1 & 1
\end{bmatrix}
\begin{bmatrix}
u_0 \\ u_1
\end{bmatrix}
=
\begin{bmatrix}
0 \\ 0
\end{bmatrix}
\tag{1.2}
$$

$$\dots$$

$$
\begin{bmatrix}
1 & -1 \\
-1 & 1
\end{bmatrix}
\begin{bmatrix}
u_{i-1} \\ u_i
\end{bmatrix}
=
\begin{bmatrix}
0 \\ 0
\end{bmatrix}
\tag{1.3}
$$

$$\dots$$

$$
\begin{bmatrix}
1 & -1 \\
-1 & 1
\end{bmatrix}
\begin{bmatrix}
u_{N-1} \\ u_N
\end{bmatrix}
=
\begin{bmatrix}
0 \\ h
\end{bmatrix}
\tag{1.4}
$$

There are the following JAVA classes implementing the multi-frontal direct solver algorithm for finite difference problem:

- *A.java*

- *A1.java*

- *A2.java*

- *AN.java*

- *Aroot.java*

- *BS.java*

- *E2.java*

- *Eroot.java*

- *Executor.java*

- *Main.java*

- *P1.java*

- *P2.java*

- *P3.java*

- *Production.java*

- *Vertex.java*

Let us focus on the classes *A1.java, A.java, AN.java*. The classes generate element local matrices for one dimensional finite difference method.

Please implement the system (1.2) inside *A1.java*, any of the systems (1.3) inside *A.java* and system (1.4) inside *AN.java*

Hint:

Implementation of the identity matrix system looks like this:

```
1   class A extends Production {
2     A(Vertex Vert,CyclicBarrier Barrier){
3        super(Vert,Barrier);
4     }
5   Vertex apply(Vertex T) {
6     System.out.println(''A'');
7     T.m_a[1][1]=1.0;
8     T.m_a[2][1]=0.0;
9     T.m_a[1][2]=0.0;
10    T.m_a[2][2]=1.0;
11    T.m_b[1]=0.0;
12    T.m_b[2]=0.0;
13    return T;
14    }
15  }
```