In order to run m iteration steps, run the following function:

```
function u = jacobi(A,b,u0,m)
  u = u0;
  for j = 1:m
    u = Jacobi2(A,b,u);
  end
end
```

Example 10.1. Consider the linear system

$$\begin{pmatrix} 2 & -1 & 0 & 0 \\ -1 & 2 & -1 & 0 \\ 0 & -1 & 2 & -1 \\ 0 & 0 & -1 & 2 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix} = \begin{pmatrix} 25 \\ -24 \\ 21 \\ -15 \end{pmatrix}.$$

We check immediately that the solution is

$$x_1 = 11,\ x_2 = -3,\ x_3 = 7,\ x_4 = -4.$$

It is easy to see that the Jacobi matrix is

$$J = \frac{1}{2}\begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{pmatrix}.$$

After 10 Jacobi iterations, we find the approximate solution

$$x_1 = 10.2588,\ x_2 = -2.5244,\ x_3 = 5.8008,\ x_4 = -3.7061.$$

After 20 iterations, we find the approximate solution

$$x_1 = 10.9110,\ x_2 = -2.9429,\ x_3 = 6.8560,\ x_4 = -3.9647.$$

After 50 iterations, we find the approximate solution

$$x_1 = 10.9998,\ x_2 = -2.9999,\ x_3 = 6.9998,\ x_4 = -3.9999,$$

and After 60 iterations, we find the approximate solution

$$x_1 = 11.0000,\ x_2 = -3.0000,\ x_3 = 7.0000,\ x_4 = -4.0000,$$

correct up to at least four decimals.

It can be shown (see Problem 10.6) that the eigenvalues of J are

$$\cos\left(\frac{\pi}{5}\right),\ \cos\left(\frac{2\pi}{5}\right),\ \cos\left(\frac{3\pi}{5}\right),\ \cos\left(\frac{4\pi}{5}\right),$$