Computer Exercise 2.3.6

The following program will solve $\mathbf{Ax} = \mathbf{b}$ for 50 different values of $\mathbf{b}$ where each $\mathbf{b}$ is a different cyclic permutation of $[1, 2, \ldots, 49, 50]^T$ and $\mathbf{A}$ is a 50×50 tridiagonal matrix given by:

$$\begin{bmatrix} 5 & -1 & & & & \\ -1 & 5 & -1 & & & \\ & -1 & 5 & -1 & & \\ & & \ddots & \ddots & \ddots & \\ & & & -1 & 5 & -1 \\ & & & & -1 & 5 \end{bmatrix}$$

Only the first ten elements of each solution $\mathbf{x}_i$ for each $\mathbf{b}_i$ $(1 \leq i \leq 50)$ will be displayed

```
%initiate values
n = 50;
a = -1*ones(n, 1);
d = 5*ones(n, 1);
c = -1*ones(n, 1);

b = (1:n);
X = zeros(n, n);
%permute b and store x in X
for i = 1:n
    b = circshift(b, i);
    X(i, :) = tri(n, a, d, c, b);
end

%each row of X is a solution x_i
%display first 10 elements for each x_i
for i = 1:n
    array = X(i, 1:10);
    fmt=['first 10 elements of x%d: ' repmat(' %3.3f ',1,numel(array)) '\n'];
    fprintf(fmt, i, array)
end
```

```
first 10 elements of x1:  10.505  2.526  1.124  1.096  1.353  1.671  2.001  2.334  2.667  3.000
first 10 elements of x2:  12.610  15.051  13.647  3.182  1.261  1.124  1.359  1.672  2.001  2.334
first 10 elements of x3:  11.938  14.689  15.507  15.847  15.727  13.788  3.211  1.267  1.125  1.359
first 10 elements of x4:  10.884  13.419  14.212  14.641  14.994  15.327  15.640  15.875  15.733  13.789
first 10 elements of x5:  9.565  11.825  12.561  12.978  13.329  13.666  14.000  14.333  14.666  14.999
first 10 elements of x6:  7.982  9.912  10.579  10.982  11.330  11.666  12.000  12.333  12.667  13.000
first 10 elements of x7:  6.136  7.681  8.267  8.653  8.997  9.333  9.667  10.000  10.333  10.667
first 10 elements of x8:  4.026  5.130  5.624  5.991  6.331  6.666  7.000  7.333  7.667  8.000
first 10 elements of x9:  1.652  2.261  2.652  2.997  3.333  3.667  4.000  4.333  4.667  5.000
first 10 elements of x10:  12.197  14.987  15.738  15.704  13.783  3.210  1.267  1.125  1.359  1.672
first 10 elements of x11:  9.301  11.506  12.230  12.645  12.996  13.332  13.666  14.000  14.333  14.666
first 10 elements of x12:  6.136  7.681  8.267  8.653  8.997  9.333  9.667  10.000  10.333  10.667
first 10 elements of x13:  2.707  3.536  3.973  4.328  4.665  5.000  5.333  5.667  6.000  6.333
first 10 elements of x14:  12.197  14.987  15.738  15.704  13.783  3.210  1.267  1.125  1.359  1.672
first 10 elements of x15:  8.246  10.231  10.909  11.314  11.663  11.999  12.333  12.667  13.000  13.333
first 10 elements of x16:  4.026  5.130  5.624  5.991  6.331  6.666  7.000  7.333  7.667  8.000
first 10 elements of x17:  12.610  15.051  13.647  3.182  1.261  1.124  1.359  1.672  2.001  2.334
first 10 elements of x18:  7.982  9.912  10.579  10.982  11.330  11.666  12.000  12.333  12.667  13.000
```

```
first 10 elements of x19:  2.971  3.855  4.303  4.660  4.999  5.333  5.667  6.000  6.333  6.667
first 10 elements of x20:  10.884  13.419  14.212  14.641  14.994  15.327  15.640  15.875  15.733  13.789
first 10 elements of x21:  5.345  6.724  7.276  7.655  7.997  8.333  8.667  9.000  9.333  9.667
first 10 elements of x22:  12.610  15.051  13.647  3.182  1.261  1.124  1.359  1.672  2.001  2.334
first 10 elements of x23:  6.664  8.318  8.927  9.318  9.663  9.999  10.333  10.667  11.000  11.333
first 10 elements of x24:  0.333  0.667  1.000  1.333  1.667  2.000  2.333  2.667  3.000  3.333
first 10 elements of x25:  6.927  8.637  9.258  9.651  9.997  10.333  10.667  11.000  11.333  11.667
first 10 elements of x26:  10.505  2.526  1.124  1.096  1.353  1.671  2.001  2.334  2.667  3.000
first 10 elements of x27:  6.136  7.681  8.267  8.653  8.997  9.333  9.667  10.000  10.333  10.667
first 10 elements of x28:  11.938  14.689  15.507  15.847  15.727  13.788  3.211  1.267  1.125  1.359
first 10 elements of x29:  4.290  5.449  5.955  6.324  6.665  7.000  7.333  7.667  8.000  8.333
first 10 elements of x30:  9.565  11.825  12.561  12.978  13.329  13.666  14.000  14.333  14.666  14.999
first 10 elements of x31:  1.388  1.942  2.321  2.664  2.999  3.333  3.667  4.000  4.333  4.667
first 10 elements of x32:  6.136  7.681  8.267  8.653  8.997  9.333  9.667  10.000  10.333  10.667
first 10 elements of x33:  10.620  13.100  13.882  14.309  14.661  14.998  15.328  15.640  15.875  15.733
first 10 elements of x34:  1.652  2.261  2.652  2.997  3.333  3.667  4.000  4.333  4.667  5.000
first 10 elements of x35:  5.609  7.043  7.606  7.987  8.331  8.666  9.000  9.333  9.667  10.000
first 10 elements of x36:  9.301  11.506  12.230  12.645  12.996  13.332  13.666  14.000  14.333  14.666
first 10 elements of x37:  12.610  15.051  13.647  3.182  1.261  1.124  1.359  1.672  2.001  2.334
first 10 elements of x38:  2.707  3.536  3.973  4.328  4.665  5.000  5.333  5.667  6.000  6.333
first 10 elements of x39:  5.609  7.043  7.606  7.987  8.331  8.666  9.000  9.333  9.667  10.000
first 10 elements of x40:  8.246  10.231  10.909  11.314  11.663  11.999  12.333  12.667  13.000  13.333
first 10 elements of x41:  10.620  13.100  13.882  14.309  14.661  14.998  15.328  15.640  15.875  15.733
first 10 elements of x42:  12.610  15.051  13.647  3.182  1.261  1.124  1.359  1.672  2.001  2.334
first 10 elements of x43:  1.388  1.942  2.321  2.664  2.999  3.333  3.667  4.000  4.333  4.667
first 10 elements of x44:  2.971  3.855  4.303  4.660  4.999  5.333  5.667  6.000  6.333  6.667
first 10 elements of x45:  4.290  5.449  5.955  6.324  6.665  7.000  7.333  7.667  8.000  8.333
first 10 elements of x46:  5.345  6.724  7.276  7.655  7.997  8.333  8.667  9.000  9.333  9.667
first 10 elements of x47:  6.136  7.681  8.267  8.653  8.997  9.333  9.667  10.000  10.333  10.667
first 10 elements of x48:  6.664  8.318  8.927  9.318  9.663  9.999  10.333  10.667  11.000  11.333
first 10 elements of x49:  6.927  8.637  9.258  9.651  9.997  10.333  10.667  11.000  11.333  11.667
first 10 elements of x50:  6.927  8.637  9.258  9.651  9.997  10.333  10.667  11.000  11.333  11.667
```

```
function b = tri(n, a, d, c, b)
   for i = 2:n
       xmult = a(i-1)/d(i-1);
       d(i) = d(i) - (xmult*c(i-1));
       b(i) = b(i) - (xmult*b(i-1));
   end
   b(n) = b(n)/d(n);
   for i = (n-1):-1:1
       b(i) = (b(i) - c(i)*b(i+1))/d(i);
   end
end
```