clear all

close all

nList = 1:40

nListLength = length(nList);

eigenValueCollection = zeros(nListLength,2);

**for** ii = 1:nListLength

[eigenValueCollection(ii,1), eigenValueCollection(ii,2)] = eigenA(nList(ii));

**end**

figure;

plot(nList, eigenValueCollection(:,1))

hold on

plot(nList, eigenValueCollection(:,2))

title("Eigen value against n");

xlabel("n");

ylabel("Eigen value")

legend(["min","max"])

**function** [minEigen, maxEigen] = eigenA(n)

A = Amatrix(n);

[V,D] = eig(A);

d = diag(D);

minEigen = min(d);

maxEigen = max(d);

**end**

**function** A = Amatrix(n)

*% A is a (2,2)-tensor(rank 4), with Following properties:*

*% A\_{i,j}^{i+1,j } = 1/h^2;*

*% A\_{i,j}^{i-1,j } = 1/h^2;*

*% A\_{i,j}^{i ,j+1} = 1/h^2;*

*% A\_{i,j}^{i ,j-1} = 1/h^2;*

*% A\_{i,j}^{i ,j } = -4/h^2;*

*% With the formalizm of:*

*% \Delta u = u\_xx + u\_yy = f, Numerically derivated as (mersh aera to n\*n)*

*% \Delta u = \frac{ u\_{i+1,j} + u\_{i-1,j} + u\_{i,j+1} + u\_{i,j-1} - 4u\_{i,j} }{h^2}*

*% Corresponding to the vectorized order:*

*% u'=[u\_11, u\_21, u\_31,...,u\_n1, u\_12, u\_22, ..., u\_nn]*

*% f'=[f\_11, f\_21, f\_31,...,f\_n1, f\_12, f\_22, ..., f\_nn]*

*% Au = f*

*% The A(n^2 by n^2) Matrix column and rows correspond to tensor script (n by n by n by n) by:*

*% A\_{ii,jj}^{kk,ll} = A( kk+ll\*(n-1), ii+jj\*(n-1) )*

**try**

assert(n>0 && round(n)==n )

**catch**

error('MyComponent:incorrectInput',*...*

'Error.\n n should be a positive interger instead of %f', n);

**end**

A = zeros(n\*n,n\*n);

**for** ii = 1:n

**for** jj = 1:n

**if** ii+1 + n\* (jj -1)<n\*n+1 && ii + n\* (jj -1) < n\*n+1 && ii+1 + n\* (jj -1)>0

A(ii+1 + n\* (jj -1), ii + n\* (jj -1) ) = 1;

**end**

**if** ii-1 + n\* (jj -1)<n\*n+1 && ii + n\* (jj -1) < n\*n+1 && ii-1 + n\* (jj -1)>0

A(ii-1 + n\* (jj -1), ii + n\* (jj -1) ) = 1;

**end**

**if** ii + n\* (jj+1 -1)<n\*n+1 && ii + n\* (jj -1) < n\*n+1 && ii + n\* (jj+1 -1)>0

A(ii + n\* (jj+1 -1), ii + n\* (jj -1) ) = 1;

**end**

**if** ii + n\* (jj-1 -1)<n\*n+1 && ii + n\* (jj -1) < n\*n+1 && ii + n\* (jj-1 -1)>0

A(ii + n\* (jj-1 -1), ii + n\* (jj -1) ) = 1;

**end**

A(ii + n\* (jj -1), ii + n\* (jj -1) ) = -4;

**end**

**end**

*% A = A/h;*

**end**

