Amelia Rotondo
CWID: 887925113

28

Homework: Chapter 10

5

1. Match the following matrices to the following properties. For each matrix, choose the most descriptive property. Each property can be matched to one or more of the matrices.

magic(4) - Symmetric
hess(magic(4)) - Hessenberg Form
schur(magic(5)) - Schur Form
pascal(6) - Singular
hess(pascal(6)) Hessenberg Form
schur(pascal(6)) Schur Form
orth(gallery(3)) Orthogonal
gallery(5) Defective
gallery('frank',12) Diagonal
[1 1 0; 0 2 1; 0 0 3] Diagonal
[2 1 0; 0 2 1; 0 0 2] Diagonal

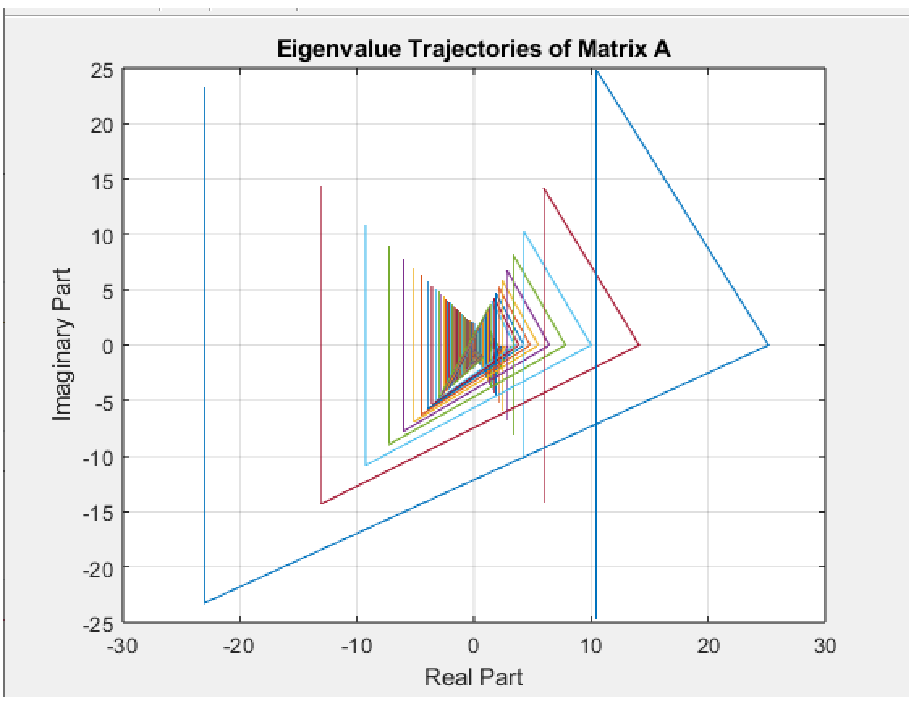
5

4. Do you recognize the resulting curve? Can you guess a formula for the eigenvalues of this matrix?

The resulting curve appears to resemble a phase-shifted sine wave with an amplitude of 2. If I had to guess a formula for the eigenvalues, it'd be: **eigenvalue(k)=2sin(π/101*(k−1/2))**.

2

5. Plot the trajectories in the complex plane of the eigenvalues of the matrix A.



How did you get this?

3

8. Both of the matrices P = gallery('pascal',12) and F = gallery('frank',12) have the property that, if λ is an eigenvalue, so is 1/λ. How well do the computed eigenvalues preserve this property? Use condeig to explain the different behavior for the two matrices.

How can you check that if λ is an eigenvalue, so is $\frac{1}{\lambda}$?

```
% Chapter 10 Homework
% Problem 8:
F = gallery('frank',12);
P = pascal(12);
F_e = eig(F);
F_cn = condeig(F);
P_e = eig(P);
P_cn = condeig(P);
```

After comparing the results of this code, I noticed that the ill-conditioned matrix F has values ranging from ~32.3 to 0.3; However, the pascal matrix P has a very large range of values from 9.36e+05 to 0. When going to examine the condition numbers, I saw that F_cn is incredibly ill-conditioned with a max value of 3.88e+-07; while on the other hand, P_cn represents near-perfect conditioning with a result of entirely 1. This behavior explains the eigenvalues returned, since P having multiple zero-eigenvalue entries depicts it as sparse and more conditioned in contrast to F.

3

9. Compare these three ways to compute the singular values of a matrix.

svd(A)

- This is the most standardized Matlab method to calculate singular values using SVD.
- The values are ordered greatest to least.

sqrt(eig(A'*A))

- This calculates SVDs using the eigenvalues of A_transpose * A.
- The values are about 1.0e-14 less than the SVD values, and roughly that much different from the block matrix.

Z = zeros(size(A)); s = eig([Z A; A' Z]); s = s(s>0)

Why does this give us the singular values ?

- This calculates SVDs using a matrix constructed with zeros to space apart A and A_transpose.
- While one of the roots is exactly the same as the SVD result, the other two roots both vary by about 1.0e-14 from the other two methods.

5 11. Explain any atypical behavior you observe with each of the following. (n = 5)

eigsvdgui(A,'eig')

- Shows a series of 5 squares, 1 in the top-right hand of the graph, and the other 4 in a negative diagonal line from 1.5 on the y-axis to 4 on the x-axis.
- The value at the top increases indefinitely.

eigsvdgui(A,'symm')

- Shows a series of propagating tridiagonal lines from the bottom-right hand of the graph to the top-left hand of the graph.
- This goes on up until the value at the top is 3.

eigsvdgui(A,'svd')

- Shows a series of subdiagonal boxes being moved upwards into the diagonal position. The far-right hand box is instead, descending down into the bottom-right corner of the graph.
- This continues until the number at the top displays zero.

5 12.

a) The primary computation in imagesvd is done by [V,S,U] = svd(X',0) How does this compare with [U,S,V] = svd(X,0)?
   i) The [V,S,U]-method compares to the [U,S,V]-method by being ever-so-slightly more accurate than it. When comparing the differences in the matrix values, I found very slight differences due to the fact that the [V,S,U] values being more exact than the [U,S,V] values.

b) How does the choice of approximating rank affect the visual qualities of the images?
   i) Approximating the rank affects the visual qualities by allowing for more finite details to be passed through. Since the rank of the matrix is larger, there are more values to help determine more exact qualities about the image.