3. Eigenvalues of symmetric matrices using MATLAB
Eigenvalues of symmetric matrices (External resource)

(1.0 points possible)

Eigenvalues of symmetric matrices

- Recall that a matrix is symmetric if it equals its transpose, i.e. $\mathbf{A} = \mathbf{A}^T$.
- In order to complete the exercise below, you need to know what the symmetric part of a matrix is. Given any square matrix $\mathbf{A}$, its *symmetric part i*s defined as:

$$\mathbf{B} = \frac{1}{2}[\mathbf{A} + \mathbf{A}^T]$$

You should check for yourself that $\mathbf{B}$ is a symmetric matrix.

There is a very useful result in linear algebra which says that the eigenvalues of any symmetric matrix are real. We will provide a proof for your enjoyment at the end of this recitation. However, MATLAB gives you a simple way to test whether or not this is a reasonable claim. MATLAB can be a useful tool for testing out hypotheses, however, you must remember that numerical experiments are never a substitute for a full proof.

Complete the script below to see that the eigenvalues of a randomly generated symmetric matrix are real.

Your Script

Save Reset MATLAB Documentation (https://www.mathworks.com/help/)

```
% Firstly generate a random 100x100 matrix A of numbers randomly chosen between -1
% Note that rand() generates random numbers between 0 and 1, so we've modified the
% by first subtracting 0.5 from each entry to get randomly generated entries betwe
% then multiplying by 20 so that the numbers lie between -10 and 10.

A = (rand(100)-0.5)*20;
% Now calculate the symmetric part of the matrix A. Call this matrix B
B = (A + A') / 2;
% Now calculate the eigenvalues and eigenvectors of A using eig(). Store them in t
[V1, D1] = eig(A);
% Now calculate the eigenvalues and eigenvectors of B using eig(). Store them in t
[V2, D2] = eig(B);
% We will now create a scatter plot of the eigenvalues of A and B from the script
% If you have filled it in correctly, then you should see that the eigenvalues of
% while the eigenvalues of B are all on the real line.
figure(1)
hold on
d1 = diag(D1);
plot(real(d1),imag(d1),'*')
xlabel('Real part')
```

```
ylabel('Imaginary part')
xlim([-max(abs(real(d1))), max(abs(real(d1)))])
ylim([-max(abs(imag(d1))), max(abs(imag(d1)))])
title('Eigenvalues of A')
set(gca,'FontSize', 18);
axis square
%
figure(2)
hold on
d2 = diag(D2);
plot(real(d2),imag(d2),'*')
xlabel('Real part')
ylabel('Imaginary part')
xlim([-max(abs(real(d2))), max(abs(real(d2)))])
ylim([-1, 1])
title('Eigenvalues of B')
set(gca,'FontSize', 18);
axis square
```

▶ Run Script ()

Assessment: Correct

Submit ()

- Symmetric part correct
- Value of V1
- Value of D1
- Value of V2
- Value of D2

Output

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