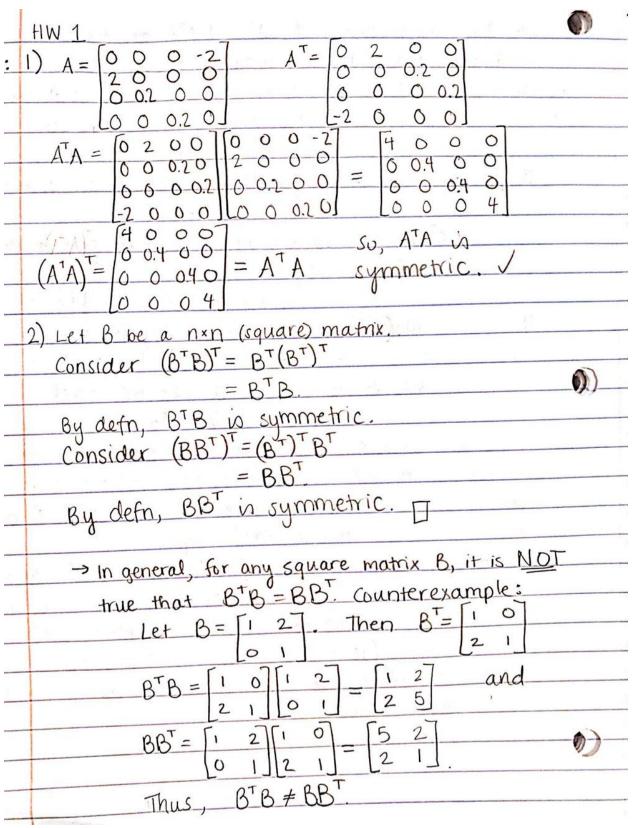
Erin Obermayer Computational Math - HW1

Problem 1:

- 1. The graph does not converge. It oscillates in an odd behavior approximately between numbers slightly greater than 0 and -1.
- 2. Plot (see code attached).
- 3. After checking the eigenvalues of A using the eig MATLAB function, I see that all of the eigenvalues are imaginary. I would guess that having imaginary eigenvalues causes the oscillatory behavior of the algorithm. The Power Iteration Algorithm probably doesn't work with imaginary numbers.

Problem 2:

By Hand: (on paper)



3. I think the spectrum of BB^T and B^TB is the same. I am guessing that the symmetry of these matrices has something to do with this.

Using MATLAB:

- 1. (See code attached).
- 2. What I Observe
 - a. Both converge to 4. This differs from Problem 1 because it actually converges to a real number rather than oscillating.
 - b. This may suggest that although these two matrix productions use a matrix with imaginary eigenvalues (A), taking the products creates matrices with real eigenvalues. Also, since both converge to 4, that means both have a dominant eigenvalue of 4. This shows that they share at least one eigenvalue in common.

By Hand: (on paper)

(.	Thm: The spectrum of AAT and ATA are the same.
	Proof: Let A be a square matrix.
_2.	Assume 2 is an eigenvalue of ATA with
	corresponding eigenvector x, so:
	$(A^{T}A)X = \lambda X$
_3.	We can left multiply by A on both sides: $A(A^{T}A)x = A\lambda x$
	Since I is a scalar, we can pull it to the
	left on the RHS:
	$A(A^{T}A)x = \lambda Ax$
4.	Now, we can group terms:
	$AA^{T}(Ax) = \chi(Ax)$
	We know Ax is a vector, call it v =
	$AA^{T}V = \lambda V$
	This shows that I is an eigenvalue
	of AAT with corresponding eigenvector
	v. Thus, the eigenvalues of ATA and
	AAT are equal. [
7	-> The eigenvectors of ATA and AAT are NOT
	equal. From our proof, we see that for
	ATA. 2 has corresponding eigenvector x.
	while for AA, a has corresponding eigen-
	ATA, 2 has corresponding eigenvector x, while for MM, 2 has corresponding eigen-vector v. We can't assume that x and v
	are equal,

Problem 3:

The eigenvalues of C are 3,1, and 2 (given by eig MATLAB function).

1	Drald	200 3:
	Pron	em 3: converges to/behavior
	M	Corner des 101 Del lavio.
		() ()
	0	
	1.25	(w) some oscillations)
	1.49	(w) some oscillations)
-	1.5	oscillating 6 twn 0.95 and 1.05
	1.51	2 (w/ converging oscillations)
	2.49	12 1 2 2
	2.5	oscillating bother -1.9 and 2.7
	2.51	1.3 (w/ increasing converging oscillations)
	5	1 - 3
2.	M=1.	5 and $\mu=2.5$. don't seem to
	conv	erge. These values are exactly between
	the	actual eigenvalues of C. I think having
	u ex	actly between 2 eigenvalues confuses the 1thm, so it doesn't know which 2 to se. Also, I noticed these values are equal of the diagonal entries in C. That
	algor	14hm, so it doesn't know which a to
	choo	se. Also, I noticed these values are equa
	to 112	2 of the diagonal entries in C. That
1	mean	ns the subtraction C-UI will produce
	comp	O values which could execute an issue
2	10 115	ing this method to find all eigenvalues of
سال	a IMa	tox, you could face difficulty in chassis a
	11 1/0	lues that work & don't broak the ande
	A VI	ing this method to find all eigenvalues of this, you could face difficulty in choosing lues that work & don't break the code. would be hard if you don't know the values beforehand, but that is the point of the thm, so it does not seem like a practical method.
_	JK112-0	alues before hard but that in the point -0 11
	eigen	thm so it does not com live a proster