Max Kramer

I affirm that I have adhered to the honor code on this assignment. I also acknowledge working with Sara Aragaki on the week 4 assignments.

*Hello again, scientist! I'll write in italics, and problems for you will always be in **bold**. As a general rule, I expect you to do at least as much writing as I do. Code should be part of your solution, but I expect variables to be clear and explanation to involve complete sentences. Cite your sources; if you work with someone in the class on a problem, that's an extremely important source.*

Problem 4.1.

***Prove or disprove the following statement.** If A is a matrix for which A^2 = 0, then at least one of the entries of A must be 0.*

```
syms a b c d;
A = [a b; c d];
A_sq = A ^ 2

B = subs(A,d,-a);
B = subs(B,b,-a^2/c);
B = subs(B,c,-a^2/b);
B
B_sq = B ^ 2;

C = subs(B,[a b],[2 6])
C ^ 2
```

```
A_sq =

[ a^2 + b*c, a*b + b*d]
[ a*c + c*d, d^2 + b*c]


B =

[       a,   b]
[ -a^2/b, -a]


C =

[    2,   6]
[ -2/3, -2]


ans =

[ 0, 0]
[ 0, 0]
```

Consider the matrix [a b; c d] defined above. By squaring the matrix to arrive at A and then factoring, we find b(a+d) = 0 and c(a+d) = 0. Therefore we know d must be equal to -a to end with 0s in those positions (2,1) & (1,2). The remaining two positions are a^2+bc and -a^2+bc. By setting b and c equal to -a^2/b and -a^2/c respectively, we arrive at the matrix B that is [a b; -a^2/b -a] that when squared is the zero matrix regardless of the values of a or b.

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