Math 3800 – A2

Nick Cooley

101021174

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Question 1.

We can just pass in the output arguments [L, U] and we can set P to identity. I don’t think we want to do that here.

Suppose we want to find a matrix PA = LU where P may not be the identity matrix. Given to us in MATLAB with the [L, U, P] = lu(A) function, we have P, L\*U given. See Figure 1 for RREF(PA).

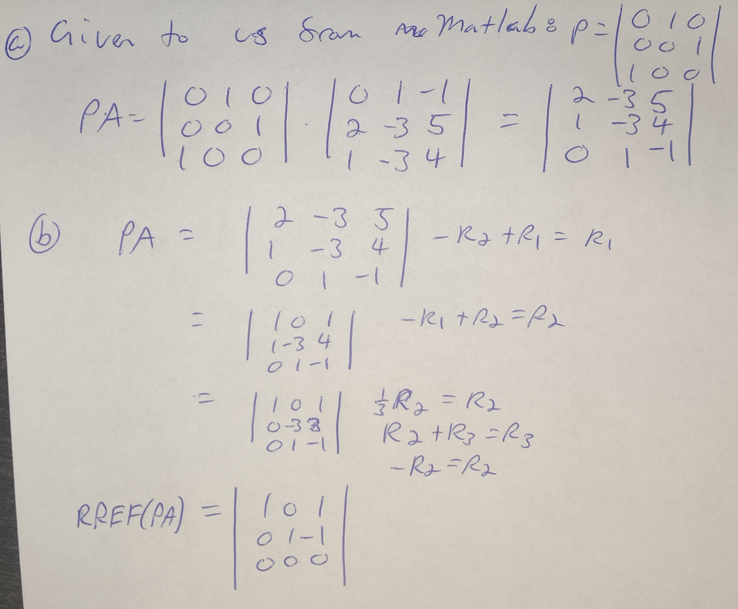


Figure 1. RREF(PA) without row swapping.

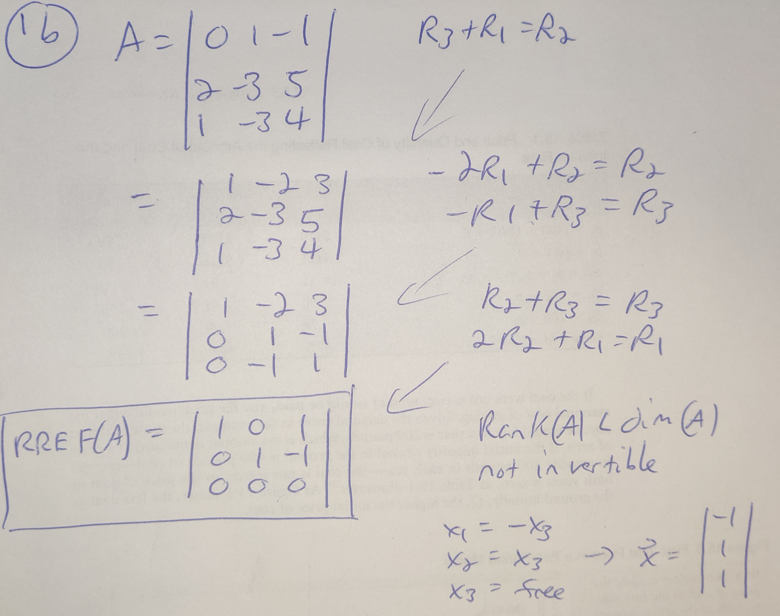


Figure 2. RREF(A) without row swapping.

I was testing a suspicion. We find that RREF(A) = RREF(PA) even when P is not equal to the identity matrix and explicit row swap operations are not performed on both A and PA to find the reduced form.

See next page for question 2.

Question 2.

A screen shot of a graph

Description automatically generated

Figure 3. Expanded view of cobweb.

A screen shot of a graph

Description automatically generated

Figure 4. Cobweb.

The random number generator assigned an initial value that does not converge under this method as shown in figure 3.

The title displays the exponent incorrectly, I have no control over code that is given to me, unless I am supposed to modify it and I can but no instruction is given to do so. My function is correctly implemented. If we are iterating, then we are not vectorized so I don’t need .^ as an exponent symbol. My exponent is correct. I tested some of the other examples with the cobwebmodded library.

See A2of101021174q2.jpg for the exported image showing cobweb in the proper domain.

See Figure 4 for correct bounds. Regardless of the instructions, we cannot upload jpg to Brightspace.

Question 3.

1. See figure 4.

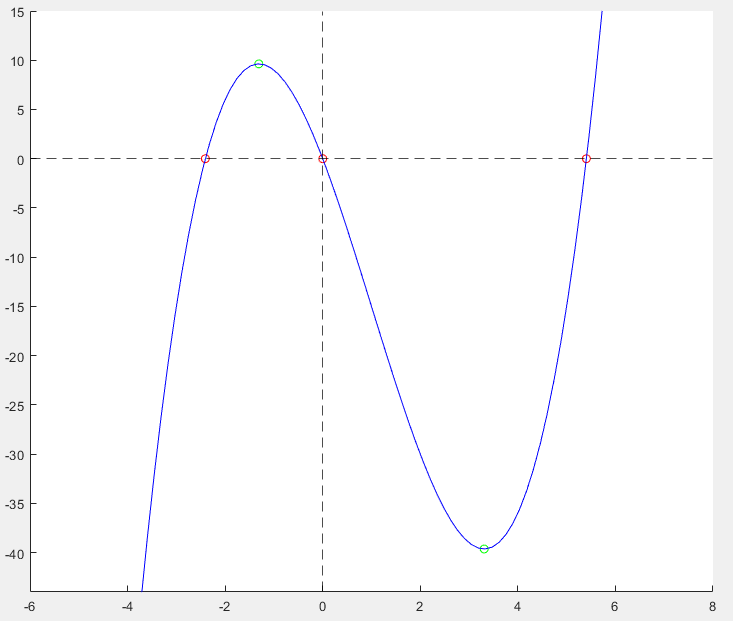


Figure 5. Plot of critical points (green) and roots (red).

Df/dx = 3x^2 – 6x -13

1. From [5] we are provided the exact solutions. Polynomials of degree 3 are solved and known. From there we can infer an exact solution even if their exact representation cannot be expressed as a machine number. Taking the max of the three roots. We have x\_max = (3 + 61^(1/2))/2 = 5.40512484 rounded to 8 decimal places. See Figure 6. For exact solution. Figure 7 is the Wolfram numerical solution given to 8 decimal places.

A screenshot of a math application

Description automatically generated

Figure 6. Wolfram Alpha, exact roots of f = x^3 – 3x^2 – 13x

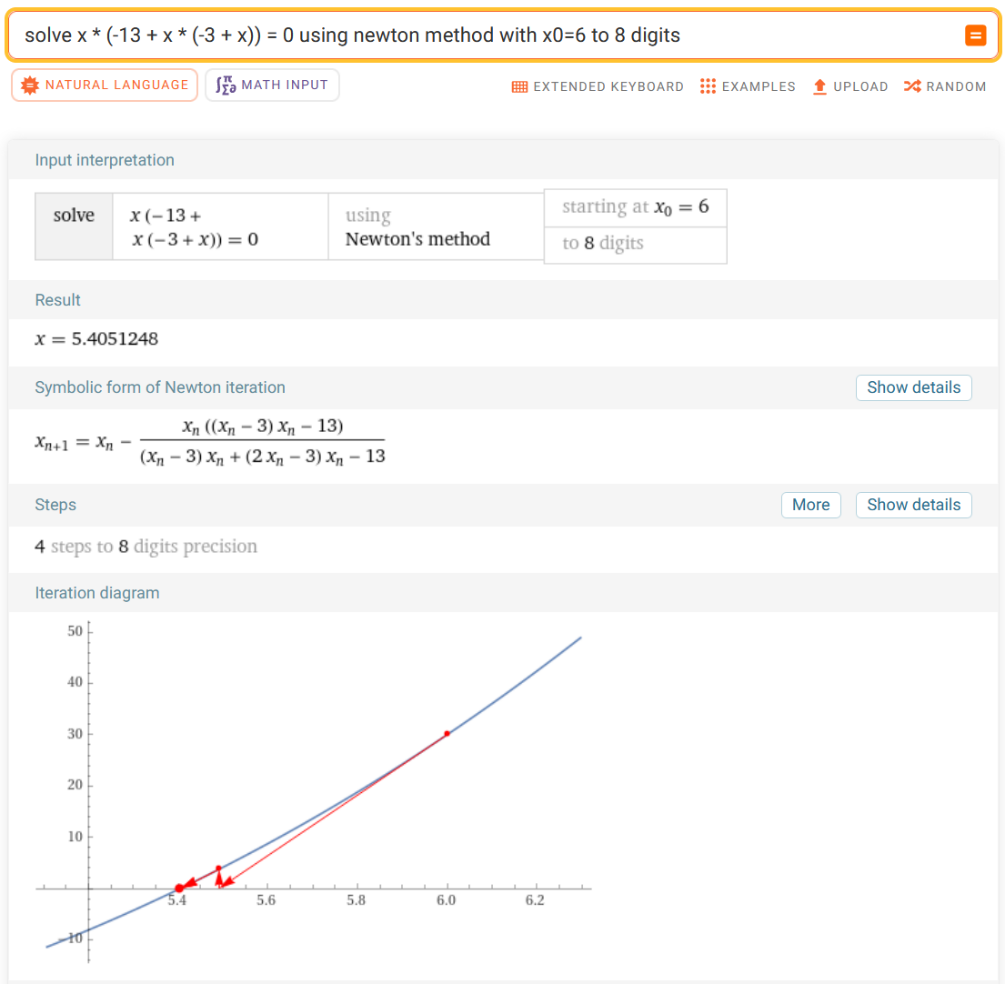


Figure 7. Wolfram Alpha, Newtons method to solve for max root.

1. After 2024 iterations of Steffensen’s method starting at x\_0 = 6, we found f(x\_2024) = -9.601430473710563e-15 which possess an L2 distance of 9.601430473710563e-15 from zero. Essentially is zero. X\_2024 is a very good approximation of one of the roots in part (a).

Question 4.

1. See Figure 7.

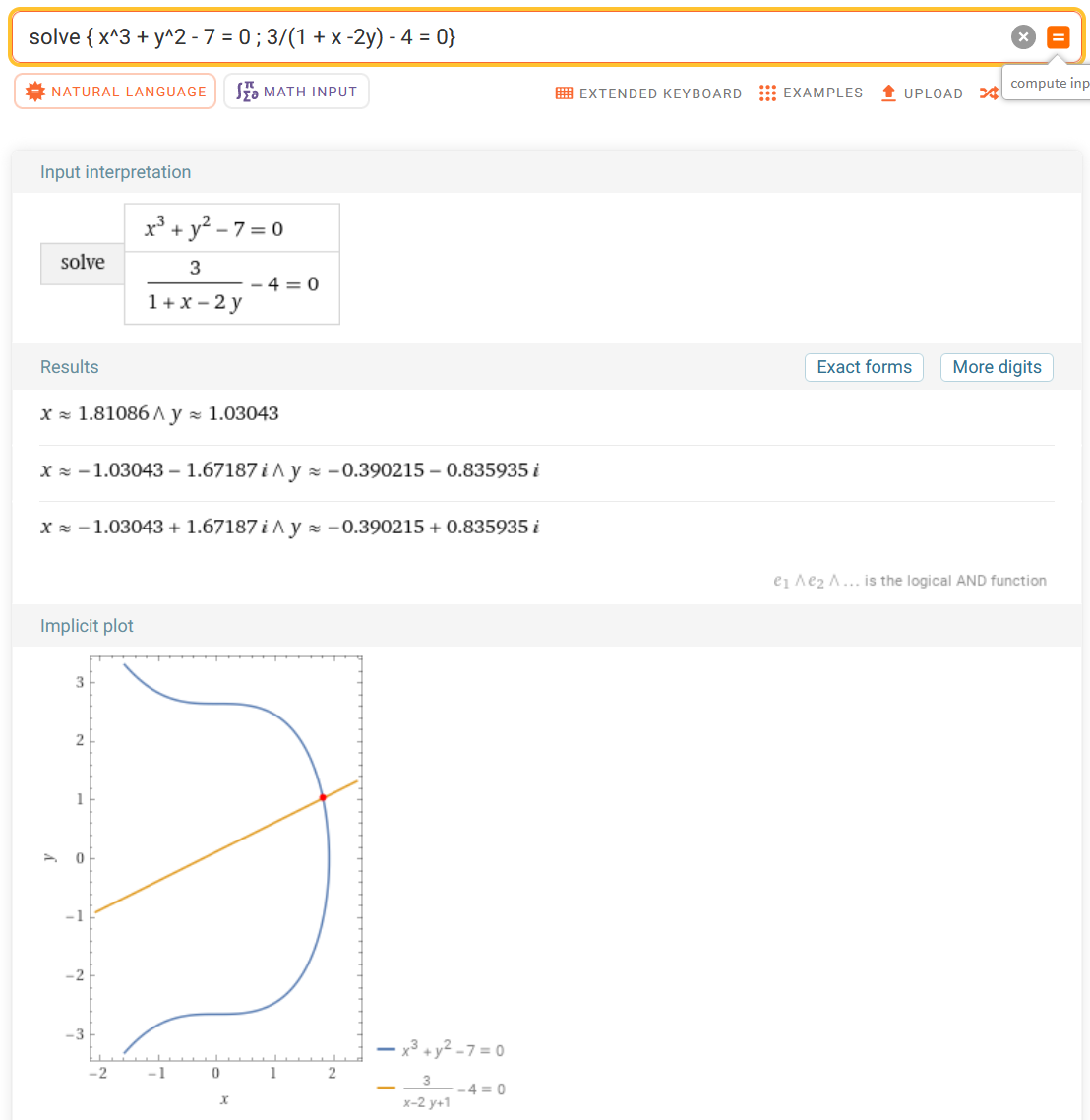


Figure 9. Wolfram Alpha solution to f(x,y)

1. See figure 9.

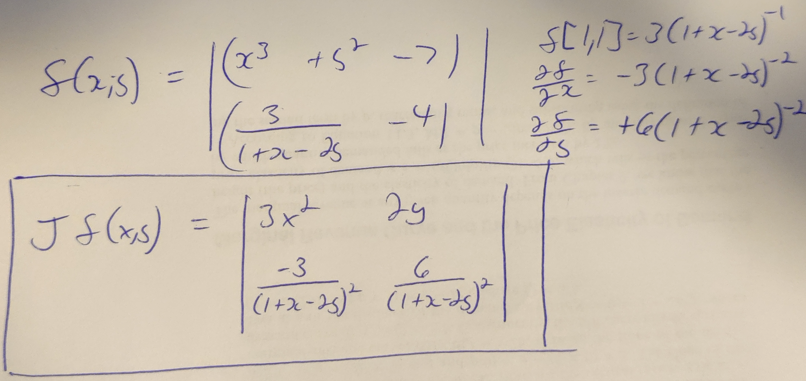


Figure 10. Jacobian of matrix f(x,y).

1. For starting position, I choose [2 ; 1] as its close to the Wolfram Alpha solution so we can consider these integer values as given. No constraints or other direction is provided.

I am not sure what the marking scheme is referring to “if the matrix is 2x2”. The resulting vector should be the same shape as the input vector, and it is.

Anyone is welcome to increase the value after the 1+ (3). This will exceed Wolfram Alpha’s numerical precision.

v\_4 = [1.810852566582489, 1.030483439212598] and more precision can easily be attained.

When comparing the L2 norm of f over v\_3 ( arr(:,:,4) ) we find the L2 norm with respect to the zero vector to be 6.1e-4 while compared to f over the initial vector [2, 1] (arr(:,:,1) ) which is 2.3e0. This shows we have minimized distance by a lot. Further improvements can be made by increasing the number of iterations.

References:

lu() usage.

[1] <https://www.mathworks.com/help/matlab/ref/lu.html>

How to make line for x = 0 = y.

[2] <https://www.mathworks.com/matlabcentral/answers/482669-how-to-add-a-dashed-horizontal-line-at-0-using-plot-function>

Needed reminder how to plot. Having to change between multiple languages between each class.

[3] <https://www.mathworks.com/matlabcentral/answers/1805545-how-to-set-different-marker-and-marker-edgecolor-on-single-line-in-plot>

Methods of root finding available.

[4] <https://www.wolframalpha.com/examples/mathematics/applied-mathematics/numerical-analysis/numerical-root-finding/>

Exact solution to 3.b.

[5] [https://www.wolframalpha.com/input?i=root+%7B+x+\*+%28-13+%2B+x+\*+%28-3+%2B+x%29%29+%3D+0+%7D](https://www.wolframalpha.com/input?i=root+%7B+x+*+%28-13+%2B+x+*+%28-3+%2B+x%29%29+%3D+0+%7D)

Axis adjustments.

[6] <https://www.mathworks.com/help/matlab/ref/axis.html>

Numerical solution to 3.b. Newtons method with decimal approximation.

[7] [https://www.wolframalpha.com/input?i=solve+x+\*+%28-13+%2B+x+\*+%28-3+%2B+x%29%29+%3D+0++using+newton+method+with+x0%3D6+to+8+digits](https://www.wolframalpha.com/input?i=solve+x+*+%28-13+%2B+x+*+%28-3+%2B+x%29%29+%3D+0++using+newton+method+with+x0%3D6+to+8+digits)

Solution to 4.a.

[8] <https://www.wolframalpha.com/input?i=solve+%7B+x%5E3+%2B+y%5E2+-+7+%3D+0+%3B+3%2F%281+%2B+x+-2y%29+-+4+%3D+0%7D>

Predeclared matrix.

[9] <https://www.mathworks.com/matlabcentral/answers/75936-is-there-any-way-to-create-array-of-arrays-or-matrix-of-matrices>