

APPM4600 Homework 6

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1 Question 1

See GitHub for full code

1.1 i

For initial guess $[x, y] = [1, 1]$:

The approximate solution using Broyden method is $[-1.81626407 \ 0.8373678]$ in 12 iterations
The approximate solution using the Lazy Newton method is $[\text{nan} \ \text{nan}]$ in 499 iterations.

1.2 ii

For initial guess $[x, y] = [1, -1]$:

The approximate solution using Broyden method is $[1.00416874 \ -1.72963729]$ in 6 iterations
The approximate solution using the Lazy Newton method is $[1.00416874 \ -1.72963729]$ in 36 iterations

So the Broyden method is way faster than Lazy Newton, which is expected since you don't have to compute the Jacobian.

1.3 iii

For initial guess $x = 0, y = 0$, the Jacobian is singular so it's impossible to solve via Lazy Newton or Broyden.

2 Question 2

Using initial guess of $[x, y, z] = [0.5, 0.5, 0.5]$

The approximate solution using the Steepest Descent method is $[0.00304809 \ 0.1029706 \ 1.00086192]$ in 5 iterations.

Using this as a new initial guess and then applying Newton's method, the approximate solution is $[-5.22760036\text{e-}08 \ 9.99986414\text{e-}02 \ 9.99989812\text{e-}01]$ in 1 iteration.

So Newton's converges much faster.