APPM 4600 - HW #6 Gustav Cedergrund

1) Solving nonlinear system:

$$\begin{cases} f(x,y) = x^2+y^2-4=0 \\ g(x,y) = e^x+y-1=0 \end{cases}$$

for initial guesses: i) (1,1) ii) (1,-1) iii) (0,0)

Attached is iteration results for 2 quasi-newton methods, as well as, Newton for comparison.

Performance is worse than Newtons, which makes sense as Quasi-Newton methods are, by definition, approximations of Newton's Method that are less computationally expensive.

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2) Consider nonlinear system:

$$x+\cos(xyz)-1=0$$
$$(1-x)^{1/4}+y+0.05z^2-0.15z-1=0$$
$$-x^2-0.1y^2+0.01y+z-1=0$$

Attached is output for approximating solution w/ 3 methods outlined

Testing various initial guesses, I have seen Newton's method converge fastest generally, but steepest → Newton's doesn't take many more iterations and sometimes converges as quickly as Newton. Again, this makes sense as Newton is very fast, but expensive at each iteration. Thus, using steepest descent, or running steepest descent and then Newtons, is a bit slower, but is also less expensive in computational cost, so the trade-off is worthwhile. For a larger system, I really enjoy the idea of using steepest descent first into Newton at the end to get more accuracy near the root.