

## LAB ASSIGNMENT

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18MIS7250

Problem:

The steady state of the concentration of two chemical species in an oscillatory chemical system described by the Brusselator model is given by the non-linear system:

$$0 = A + x^2 y - (B + 1)x$$

$$0 = Bx - x^2 y$$

Find the solution for the following values of the parameters,  $A$  and  $B$ :

1)  $A = 1, B = 1.$

2)  $A = 1, B = 3.$

3)  $A = 1, B = 2.$

The screenshot shows the MATLAB environment with the following components:

- Editor:** Contains the script `runningnewtonsysthethod.m`. The code defines the function `NewtonSys(F, J, x0, tol, kmax)` and solves the system for three cases:  $A=1, B=1$ ;  $A=1, B=3$ ; and  $A=1, B=2$ . The results are displayed in the Command Window.
- Workspace:** Lists variables `F`, `F1`, `F2`, `J`, `kmax`, `tol`, `x`, and `x0` with their respective values and classes.
- Command Window:** Shows the output of the script, including the prompt `New to MATLAB? See resources for Getting Started.` and the results of the Newton-Raphson iterations.

```

4 %x=NewtonSys(F,J,x0,tol,kmax)
5
6 %F=inline('x(1)^2+x(2)^2+x(3)^2-1; x(1)^2+x(3)^2-1/4;x(1)^2+x(2)^2-4*x(3)');
7 %J=inline('2*x(1) 2*x(2) 2*x(3); 2*x(1) 0 2*x(3); 2*x(1) 2*x(2) -4');
8 %x0=[1 1 1]; tol=0.00001;kmax=10;
9 %x=NewtonSys(F,J,x0,tol,kmax)
10
11 disp('For A=1 & B=1 the values are')
12 F=inline('1+x(1)^2*x(2)-2*x(1); x(1)-x(1)^2*x(2)');
13 F1=inline('1+x(1)^2*x(2)-4*x(1); 3*x(1)-x(1)^2*x(2)');
14 F2=inline('1+x(1)^2*x(2)-3*x(1); 2*x(1)-x(1)^2*x(2)');
15 J=inline('2*x(1)*x(2) - 2, x(1)^2;1 - 2*x(1)*x(2), -x(1)^2');
16 x0=[1 1]; tol=0.0001;kmax=20;
17 disp('For A=1 & B=1 the values are')
18 x1=NewtonSys(F,J,x0,tol,kmax)
19 disp('For A=1 & B=3 the values are')
20 x1=NewtonSys(F1,J,x0,tol,kmax)
21 disp('For A=1 & B=2 the values are')
22 x2=NewtonSys(F2,J,x0,tol,kmax)
  
```

COMMAND WINDOW

New to MATLAB? See resources for Getting Started.

1 2

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```
11 - disp("For A=1 & B=1 the values are")
12 - F=inline('1+x(1)^2*x(2)-2*x(1); x(1)-x(1)^2*x(2)');
13 - F1=inline('1+x(1)^2*x(2)-4*x(1); 3*x(1)-x(1)^2*x(2)');
14 - F2=inline('1+x(1)^2*x(2)-3*x(1); 2*x(1)-x(1)^2*x(2)');
15 - J=inline('2*x(1)*x(2) - 2, x(1)^2;1 - 2*x(1)*x(2), -x(1)^2')
16 - x0=[1 1]; tol=0.0001;kmax=20;
17 - disp("For A=1 & B=1 the values are")
18 - x=NewtonSys(F,J,x0,tol,kmax)
19 - disp("For A=1 & B=3 the values are")
20 - x1=NewtonSys(F1,J,x0,tol,kmax)
21 - disp("For A=1 & B=2 the values are")
22 - x2=NewtonSys(F2,J,x0,tol,kmax)
```

runningnewtonsysthethod

For A=1 & B=1 the values are

J =

Inline function:

$$J(x) = [2*x(1)*x(2) - 2, \quad x(1)^2; 1 - 2*x(1)*x(2), \quad -x(1)^2]$$

For A=1 & B=1 the values are

1      1      1      0

Newton method has converged

x =

1      1

For A=1 & B=3 the values are

1      1      3      2

iter =

2

2      1      3      0

Newton method has converged

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x1 =

1 3

For A=1 & B=2 the values are

1 1 2 1

iter =

2

2 1 2 0

Newton method has converged

x2 =

1 2