Homework 6

```
clear; clc;
```

Problem 5 (5a, 7a)

```
A = [3 -1 1;
    3 6 2;
    3 3 7];
B = [1; 0; 4];
x_0 = zeros(3, 1);
TOL = 1e-3;

x_Jacobi = JacobiIter(A, B, x_0, TOL);
x_Gauss = GaussSiedel(A, B, x_0, TOL);

sym(x_Jacobi)
```

ans =

$$\begin{pmatrix} 0 & 0.3333 & 0.1429 & 0.0714 & 0.0408 & 0.0368 & 0.0349 & 0.0352 & 0.0350 & 0.0351 \\ 0 & 0 & -0.3571 & -0.2143 & -0.2568 & -0.2313 & -0.2398 & -0.2357 & -0.2373 & -0.2366 \\ 0 & 0.5714 & 0.4286 & 0.6633 & 0.6327 & 0.6640 & 0.6548 & 0.6592 & 0.6574 & 0.6581 \end{pmatrix}$$

```
sym(x_Gauss)
```

ans =

$$\begin{pmatrix} 0 & 0.3333 & 0.1111 & 0.0529 & 0.0396 & 0.0361 & 0.0354 \\ 0 & -0.1667 & -0.2222 & -0.2328 & -0.2360 & -0.2366 & -0.2368 \\ 0 & 0.5000 & 0.6190 & 0.6485 & 0.6556 & 0.6573 & 0.6578 \end{pmatrix}$$

Problem 7

```
syms x1 x2

g1(x1, x2) = (x1^2 + x2^2 + 8)/10;
g2(x1, x2) = (x1*x2^2 + x1 + 8)/10;

a(x1, x2) = [diff(g1, x1);
             diff(g1, x2);
             diff(g2, x1);
             diff(g2, x2);]
```

a(x1, x2) =

$$\begin{pmatrix} 0.2000\,x_1 \\ 0.2000\,x_2 \\ 0.1000\,x_2^2 + 0.1000 \\ 0.2000\,x_1\,x_2 \end{pmatrix}$$

```
a(1.5, 1.5)
```

ans =

$$\begin{pmatrix} 0.3000 \\ 0.3000 \\ 0.3250 \\ 0.4500 \end{pmatrix}$$

```
x_fixed = zeros(2,1);
XO = zeros(2,1);
TOL = 1e-5;
flag = 0;

for k = 1:1000
    for i = 1:2

        x_fixed(i, k) = g1(XO(1), XO(2));
        x_fixed(i, k) = g2(XO(1), XO(2));

        if (max(abs(x_fixed(:, k) - XO)) < TOL)
            max(abs(x_fixed(:, k) - XO));
            x_fixed = sym([zeros(2,1) x_fixed])
            flag = 1;
            break
        end

    end

    if flag == 1
        break
    end

    XO = x_fixed(:, k);
end
```

x_fixed =

$$\begin{pmatrix} 0 & 0.8000 & 0.9312 & 0.9739 & 0.9898 & 0.9959 & 0.9984 & 0.9994 & 0.9997 & 0.9999 & 1.000 & 1.000 & 1.000 \\ 0 & 0.8000 & 0.9312 & 0.9739 & 0.9898 & 0.9959 & 0.9984 & 0.9994 & 0.9997 & 0.9999 & 1.000 & 1.000 & 1.000 \end{pmatrix}$$

```
x_gauss_fixed = zeros(2,1);
```

x_gauss_fixed = 2×1

```
     0
     0
```

```
XO = zeros(2,1);
TOL = 1e-5;
flag = 0;
```

```
for k = 1:1000
    for i = 1:2

        if i == 1
            x_gauss_fixed(i, k) = g1(XO(1), XO(2));
        else
            x_gauss_fixed(i, k) = g2(x_gauss_fixed(1, end), XO(2));
        end

        if (max(abs(x_gauss_fixed(:, k) - XO)) < TOL)
            max(abs(x_gauss_fixed(:, k) - XO));
            x_gauss_fixed = sym([zeros(2,1) x_gauss_fixed])
            flag = 1;
            break
        end

    end

    if flag == 1
        break
    end
    XO = x_gauss_fixed(:, k);
end
```

```
x_gauss_fixed =
```

$$\begin{pmatrix} 0 & 0.8000 & 0.9414 & 0.9821 & 0.9945 & 0.9983 & 0.9995 & 0.9998 & 0.9999 & 1.000 & 1.000 & 1.000 \\ 0 & 0.8800 & 0.9670 & 0.9901 & 0.9969 & 0.9990 & 0.9997 & 0.9999 & 1.000 & 1.000 & 1.000 & 1.000 \end{pmatrix}$$

Problem 8

```
syms x1 x2
F(x1, x2) = [3*x1^2 - x2^2; 3*x1*x2^2 - x1^3 - 1];
x_0 = [1; 1];
TOL = 1e-6;

x_sol_NewtonSystem = NewtonSystem(F, x_0, TOL);
x_sol_Broyden = Broyden(F, x_0, TOL);

sym(x_sol_NewtonSystem)
```

```
ans =
```

$$\begin{pmatrix} 0 & 0.6111 & 0.5037 & 0.5000 & 0.5000 & 0.5000 \\ 0 & 0.8333 & 0.8525 & 0.8660 & 0.8660 & 0.8660 \end{pmatrix}$$

```
sym(x_sol_Broyden)
```

```
ans =
```

$$\begin{pmatrix} 1 & 0.6111 & 0.5229 & 0.4946 & 0.4957 & 0.4996 & 0.5000 & 0.5000 & 0.5000 \\ 1 & 0.8333 & 0.8243 & 0.8407 & 0.8547 & 0.8652 & 0.8660 & 0.8660 & 0.8660 \end{pmatrix}$$