

Assignment: Homework 5 Name: Tanner Orndorff

Disclaimer: This is my work, not that of others:

Total Score: 75.0

Problem 2.5,1b,c score: 25

Computer Problem 2.5, 3 score: 25

Problem 2.7, 1a,b score: 25

Computer Problem 2.7, 3 score: 0

2.7, 1a, 1b

(a)

$$F(u, v) = (u^3, uv^3)$$

$$\begin{bmatrix} \frac{\partial f}{\partial u} & \frac{\partial f_1}{\partial v} \\ \frac{\partial f_2}{\partial u} & \frac{\partial f}{\partial v} \end{bmatrix} \text{ or } DF(x) = \begin{bmatrix} 3u^2 & 0 \\ v^3 & 3uv^2 \end{bmatrix}$$

(b)

$$F(u, v) = (\sin uv, e^{uv})$$

$$DF(x) = \begin{bmatrix} \sqrt{u} \cos uv & v \cos uv \\ ve^{uv} & ue^{uv} \end{bmatrix}$$

example, requires about  
number of

$$(1) \begin{bmatrix} 3 & 1 & 1 \\ 1 & 3 & 1 \\ 1 & 1 & 3 \end{bmatrix} \begin{bmatrix} v \\ v \\ w \end{bmatrix} = \begin{bmatrix} 6 \\ 3 \\ 5 \end{bmatrix}$$

$$\begin{bmatrix} u_{k+1} \\ v_{k+1} \\ w_{k+1} \end{bmatrix} = \begin{bmatrix} \frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{3} \end{bmatrix} \left( \begin{bmatrix} 6 \\ 3 \\ 5 \end{bmatrix} - \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} \begin{bmatrix} u_k \\ v_k \\ w_k \end{bmatrix} \right)$$

$$\begin{bmatrix} 6 \\ 3 \\ 5 \end{bmatrix} - \begin{bmatrix} v_k + w_k \\ u_k + w_k \\ u_k + v_k \end{bmatrix} \xrightarrow{u_k + v_k} \begin{bmatrix} 6 \\ v_k + w_k \\ u_k + w_k \end{bmatrix}$$

$$\begin{bmatrix} \frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{3} \end{bmatrix} \left( \begin{bmatrix} 6 - v_k - w_k \\ 3 - u_k - w_k \\ 5 - u_k - v_k \end{bmatrix} \right)$$

$$u_{k+1} = \frac{6 - v_k - w_k}{3}$$

$$v_{k+1} = \frac{3 - u_k - w_k}{3}$$

$$w_{k+1} = \frac{5 - u_k - v_k}{3}$$

$$u_{k+1} = 6 - v_k - w_k$$

$$v_{k+1} = 3 - u_k - w_k$$

$$w_{k+1} = 5 - u_k - v_k$$

$$\begin{bmatrix} u_1 \\ v_1 \\ w_1 \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ \frac{5}{3} \end{bmatrix} \quad \begin{bmatrix} u_2 \\ v_2 \\ w_2 \end{bmatrix} = \begin{bmatrix} \frac{10}{9} \\ -\frac{2}{9} \\ \frac{2}{3} \end{bmatrix}$$

$$\begin{array}{l} u_1 = 2 \\ v_1 = \frac{1}{3} \\ w_1 = \frac{5}{3} \\ \\ u_2 = \frac{2}{9} \\ v_2 = \frac{8}{9} \\ w_2 = \frac{2}{3} \end{array}$$

$$\begin{array}{l}
 \text{computer} \\
 2.5 \quad 1b + 1c, 3, 2.7 \quad 1a, 1b, 3 \quad \text{computer} \\
 \left( \begin{matrix} 1 & 0 \\ -1 & 2 \\ 0 & -1 \end{matrix} \right) \left( \begin{matrix} u \\ v \\ w \end{matrix} \right) = \left( \begin{matrix} 0 \\ 2 \\ 0 \end{matrix} \right) \\
 \left[ \begin{matrix} u_{k+1} \\ v_{k+1} \\ w_{k+1} \end{matrix} \right] = D^{-1}(b - (L+U)x_r) \\
 \left[ \begin{matrix} u_{k+1} \\ v_{k+1} \\ w_{k+1} \end{matrix} \right] = \left[ \begin{matrix} 1/2 & 0 & 0 \\ 0 & 1/2 & 0 \\ 0 & 0 & 1/2 \end{matrix} \right] \left[ \begin{matrix} 0 \\ 2 \\ 0 \end{matrix} \right] - \left[ \begin{matrix} 0 & -1 & 0 \\ -1 & 0 & -1 \\ 0 & -1 & 0 \end{matrix} \right] \left[ \begin{matrix} 0 \\ 1 \\ 0 \end{matrix} \right]
 \end{array}$$

~~Diagonal~~

$$\begin{aligned}
 u_{k+1} &= \frac{v_k}{2} \\
 v_{k+1} &= \frac{u_k + w_k + 2}{2} \\
 w_{k+1} &= \frac{v_k}{2}
 \end{aligned}$$

$\frac{\oplus}{2}$   
 $\cancel{0+0+2}$

$$\begin{array}{ll}
 u_1 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} & u_2 = \begin{bmatrix} 1 \\ 1/2 \\ 1/2 \end{bmatrix} \\
 v_1 = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} & v_2 = \begin{bmatrix} 1 \\ 3/2 \\ 3/4 \end{bmatrix}
 \end{array}$$

$$\begin{aligned}
 u_{k+1} &= \frac{v_k}{2} \\
 v_{k+1} &= \frac{u_k + 1 + w_k + 2}{2} \\
 w_{k+1} &= \frac{v_{k+1}}{2}
 \end{aligned}$$

$\frac{1/2 + 1/2 + 2}{2}$   
 $\frac{3/2 + 1}{2} = \frac{5/2}{2}$

$$\begin{array}{ll}
 u_1 = \begin{bmatrix} 0 \\ 1 \\ 1/2 \end{bmatrix} & u_2 = \begin{bmatrix} 1 \\ 3/2 \\ 3/4 \end{bmatrix} \\
 v_1 = \begin{bmatrix} 0 \\ 1 \\ 1/2 \end{bmatrix} & v_2 = \begin{bmatrix} 1 \\ 3/2 \\ 3/4 \end{bmatrix} \\
 w_1 = \begin{bmatrix} 0 \\ 1 \\ 1/2 \end{bmatrix} & w_2 = \begin{bmatrix} 1 \\ 3/2 \\ 3/4 \end{bmatrix}
 \end{array}$$

```

function x = gausseidel(a,b,k)
n=length(b); % find n
d=diag(diag(a)); u=triu(a,1);l=tril(a,-1);
x=zeros(n,1); % Initialize vector x
for j=1:k % loop for GS iteration
    b1=b-u*x;
    for i=1:n
        x(i)=(b1(i)-l(i,:)*x)/d(i,i);
    end
end

called code:
%2.24
n= [ 3,-1,0,0,0,.5
      -1,3,-1,0,.5,0
      0,-1,3,-1,0,0
      0,0,-1,3,-1,0
      0,.5,0,-1,3,-1
      .5,0,0,0,-1,3];
[a,b] = sparsesetup(n);
x = gausseidel(a,b,5);

```