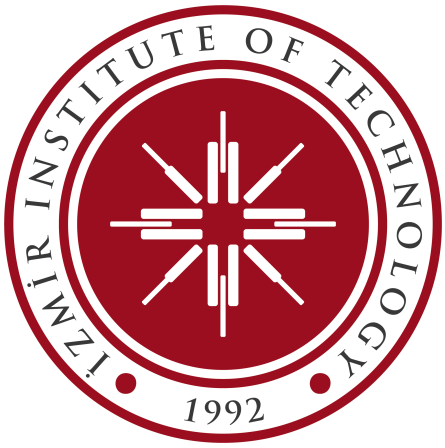

İzmir Institute of Technology

Numerical Methods in Engineering

CE301

Assignment #2

Section B

Mert Emrem - 250203015

Mechanical Engineering

Summer 2021

Linear system of equations given:

$$\begin{aligned} 1.6x - 4.2y - \quad 8z &= 22 \\ 2x - \quad 9y + 2.4z &= 18 \\ 7.5x - 1.8y + 2.2z &= 15 \end{aligned}$$

The matrix A obtained from the linear system of equations above satisfies the diagonal dominance criteria after switching rows 1-3, as shown below:

$$\left[\begin{array}{ccc|c} 1.6 & -4.2 & \boxed{-8} & 22 \\ 2 & \boxed{-9} & 2.4 & 18 \\ \boxed{7.5} & -1.8 & 2.2 & 15 \end{array}\right] \begin{array}{l} \leftarrow \\ \\ \leftarrow \end{array}$$

$$\begin{aligned} |7.5| &\geq |-1.8| + |2.2| \\ |-9| &\geq |2| \quad\quad + |2.4| \\ |-8| &\geq |-4.2| + |1.6| \end{aligned}$$

To compare for error, back division solution:

$$\begin{aligned} x &\approx 1.9326 \\ y &\approx -1.9305 \\ z &\approx -1.3499 \end{aligned}$$

The MATLAB code (see Appendix A.1) output is as follows:

```
x, y, and z values, respectively:

----> error < 0.01  : 1.9362, -1.9315, -1.3487
----> error < 0.001 : 1.9321, -1.9303, -1.3502
----> error < 0.0001: 1.9326, -1.9305, -1.3487
```

Appendix

A.1 Computer Code

```
%%%%%%%%%%%%%%%%%%%%%%    Mert Emrem - 250203015    %%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%    CE301 - Assignment #2     %%%%%%%%%%%%%%%%%%%%%%
% NOTE: Error (epsilon) is interpreted as absolute error.

clc; clear all;

% A = [1.6 -4.2  -8][x]   [22]
%     [  2   -9 2.4][y] = [18]  Switch rows 1-3, to make A diag. dom.
%     [7.5 -1.8 2.2][z]   [15]

% A = [7.5 -1.8 2.2][x]   [15]
%     [  2   -9 2.4][y] = [18]
%     [1.6 -4.2  -8][z]   [22]

[x_1, x_2, x_3, y_1, y_2, y_3, z_1, z_2, z_3, b_1, b_2, b_3] ...
    = deal(7.5, 2, 1.6, -1.8, -9, -4.2, 2.2, 2.4, -8, 15, 18, 22);

maxit = 1000;

A = [x_1 y_1 z_1; ...
     x_2 y_2 z_2; ...
     x_3 y_3 z_3];

B = [b_1; b_2; b_3];

% Back division (X = A\B) calculation results:

true_x =  1.932664292651343;
true_y = -1.930506096902989;
true_z = -1.349951440595662;

iteration = 0; x = 0; y = 0; z = 0;

% Assign variables var + 1 so that the loop is sure to begin


```

```
while 1

    err_goal = 0.01;
    err_x = err_goal + 1; err_y = err_goal + 1; err_z = err_goal + 1;
    C = err_goal + 1;

    while max(C) > err_goal && iteration <= maxit

        iteration = iteration + 1;

        x = (b_1 - y_1*y - z_1*z)/x_1;
        y = (b_2 - x_2*x - z_2*z)/y_2;
        z = (b_3 - x_3*x - y_3*y)/z_3;

        err_x = abs(x  - true_x);
        err_y = abs(y  - true_y);
        err_z = abs(z  - true_z);

        C = [err_x, err_y, err_z];

    end

    if any(isnan(C(:)))
        disp ('---->  Solution is divergent.');
        break
    end

    % Assign results and reset variables

    x_err01 = x; y_err01 = y; z_err01 = z;
    iteration = 0; x = 0; y = 0; z = 0;
    err_goal = 0.001;
    err_x = err_goal + 1; err_y = err_goal + 1; err_z = err_goal + 1;
    C = err_goal + 1;


    while max(C) > err_goal && iteration <= maxit

        iteration = iteration + 1;

        x = (b_1 - y_1*y - z_1*z)/x_1;
        y = (b_2 - x_2*x - z_2*z)/y_2;
        z = (b_3 - x_3*x - y_3*y)/z_3;

        err_x = abs(x  - true_x);
        err_y = abs(y  - true_y);
        err_z = abs(z  - true_z);
```

```
85
86          C = [err_x, err_y, err_z];
87
88      end
89
90      x_err001 = x; y_err001 = y; z_err001 = z;
91      iteration = 0; x = 0; y = 0; z = 0;
92      err_goal = 0.001;
93      err_x = err_goal + 1; err_y = err_goal + 1; err_z = err_goal + 1;
94      C = err_goal + 1;
95
96
97      while max(C) > err_goal && iteration <= maxit
98
99          iteration = iteration + 1;
100
101         x = (b_1 - y_1*y - z_1*z)/x_1;
102         y = (b_2 - x_2*x - z_2*z)/y_2;
103         z = (b_3 - x_3*x - y_3*y)/z_3;
104
105         err_x = abs(x  - true_x);
106         err_y = abs(y  - true_y);
107         err_z = abs(z  - true_z);
108
109         C = [err_x, err_y, err_z];
110
111     end
112
113     x_err0001 = x; y_err0001 = y; z_err0001 = z;
114     iteration = 0; x = 0; y = 0; z = 0;
115     err_goal = 0.001;
116     err_x = err_goal + 1; err_y = err_goal + 1; err_z = err_goal + 1;
117     C = err_goal + 1;
118
119     disp("x, y, and z values, respectively:");
120
121 line_1 = ['----> error < 0.01  : ', num2str(x_err01), ...
122 ', ', num2str(y_err01),', ', num2str(z_err01)];
123
124 line_2 = ['----> error < 0.001 : ', num2str(x_err001), ...
125  ', ',num2str(y_err001),', ', num2str(z_err001)];
126
127 line_3 = ['----> error < 0.0001: ', num2str(x_err0001), ...
128  ', ',num2str(y_err0001),', ', num2str(z_err0001)];
129
130 disp(" ");
131 disp(line_1);
```

```
disp(line_2);
disp(line_3);

break
end
```