Unit 5 - Week 3 - Linear Equations - 2

Course outline

Assignment 3

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-08-21, 23:59 IST.

Problem 1: Gauss-Siedel: First Iteration

Consider the set of linear equations we considered in the previous assignment:

$5x_1 + 4x_3 + x_4 = -6$

$4x_1 + 5x_2 + 2x_3 = 8$

$4x_1 + 4x_2 + 4x_3 + x_4 = 1$

$x_1 + 2x_2 + 2x_3 + 3x_4 = 2$

In this assignment, we will use Gauss-Siedel method to solve the problem.

One iteration of Gauss-Siedel involves using the above four equations to calculate x_1, x_2, x_3 and x_4. For example, first equation is used to calculate x_1, and so on so that fourth equation is used to calculate x_4.

Please report the values obtained after the complete first iteration of Gauss-Siedel, using "2019" as initial guess, i.e., $x_1 = 2, x_2 = 0, x_3 = 1, x_4 = 9$.

1) Please report the value of x_1 after first Gauss-Siedel Iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -3.85,-3.75

0.25 points

2) Please report the value of x_2 after first Gauss-Siedel Iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 4.2,4.3

0.25 points

3) Please report the value of x_3 after first Gauss-Siedel Iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -2.5,-2.4

0.25 points

4) Please report the value of x_4 after first Gauss-Siedel Iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.7,0.8

0.25 points

Problem 2: Gauss-Siedel: Fifth Iteration

Repeat the Gauss-Siedel Iteration four more times, until you reach fifth iteration. At end of fifth iteration, $x_1 = 0.8865$ and $x_2 = 2.0264$. Please report the other two values below.

5) Please report the value of x_3 after fifth Gauss-Siedel iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -2.91,-2.88

0.5 points

6) Please report the value of x_4 after fifth Gauss-Siedel iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.93,0.96

0.5 points

Problem 3: Jacobi Iterations

In the previous problem, we used Gauss-Siedel method. We now use Jacobi iterations to solve the same set of linear equations as before. Since our aim is only to highlight the difference between G-S and Jacobi, we will only run first iteration of Jacobi.

Please report the values obtained after the complete first Jacobi iteration, using "2019" as the initial guess, i.e.,$x_1 = 2, x_2 = 0, x_3 = 1, x_4 = 9$

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7) Please report the value of x_1 after first Jacobi Iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -3.85,-3.75

0.25 points

8) Please report the value of x_2 after first Jacobi Iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -0.42,-0.38

0.25 points

9) Please report the value of x_3 after first Jacobi Iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -4.01,-3.98

0.25 points

10) Please report the value of x_4 after first Jacobi Iteration

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -0.68,-0.65

0.25 points

Problem 4: Tri-Diagonal Matrix Algorithm

Using the Thomas algorithm, solve the following set of linear equations:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 2 & 1 & 0 \\ 0 & 1 & 2 & 1 \\ 0 & 0 & 0.5 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 5 \\ 16 \\ 12 \\ 3 \end{bmatrix}$$

11) The value of x_1 = ________.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 4.99,5.01

0.25 points

12) The value of x_2 = ________.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 3.7,3.8

0.25 points

13) The value of x_3 = ________.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 3.4,3.6

0.25 points

14) The value of x_4 = ________.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 1.2,1.3

0.25 points

Problem 5: Building an Application Problem

One of the students had asked in our course forum and feedback form that there weren't enough application problems provided in this course. Setting up an application problem and then solving it would be slightly difficult. So, here we will only set up an application problem (which can be solved using TDMA method). Consider a car radiator used to prevent the engine from over-heating. One end of the radiator is at 300 deg C, whereas the other end is at 100 deg C. The radiator loses heat to the surroundings. The overall model is given by:

$T_1 - 300 = 0$

$T_{i-1} - 2T_i + T_{i+1} = 0.25(T_i - 30)$

$T_{51} - 100 = 0$

The above result in a set of 51 linear equations in tri-diagonal form:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & \cdots & 0 & 0 \\ \alpha & \beta & \delta & 0 & \cdots & 0 & 0 \\ 0 & \alpha & \beta & \delta & \cdots & \cdots & \cdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0 & 0 & \gamma \end{bmatrix} \begin{bmatrix} T_1 \\ T_2 \\ T_3 \\ \vdots \\ T_{50} \\ T_{51} \end{bmatrix} = \begin{bmatrix} 300 \\ -7.5 \\ -7.5 \\ \vdots \\ \vdots \\ 100 \end{bmatrix}$$

Please complete the TDMA problem by providing values of α,β,δ,γ in the matrix above.

15) What is the value of α

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 1

0.25 points

16) What is the value of β

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -2.26,-2.24

0.25 points

17) What is the value of δ

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 1

0.25 points

18) What is the value of γ

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 1

0.25 points