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Q1.

1.

2.

3.

4.

Q2.

Q3.

1.

2.

3.

Q4.

1.

2.

3.

4.

Q5.

1.

2.

3.

Q1.

1.



$T_w = 291.6395K$, Iteration = 32

Note that, the root is 291K, which is not between the initial guess(300K, 500K), so changed the initial guess to 200K, 500K and get the result.

2.



$$T_w = 291.6395K, \text{ Iteration} = 13$$

3.



$$T_w = 291.6395K, \text{ Iteration} = 8$$

4.



The performance is shown in the table below, observing iteration number, the Secant method is the most effective.

method	root	iteration
Bisection (initial guess = 200K, 500K)	291.6395	32
Newton	291.6395	13
Secant	291.6395	8

Q2.

Solving non-linear equations	numerical	Iterative	x0, and y0
Bisection	numerical	Iterative	2 value
Newton	numerical	Iterative	1 value
Solving linear equations	analytical	no	no
Gauss elim.	analytical	no	no
Gauss-Jordan	analytical	no	no
Jacobi iteration	numerical	Iterative	a set of valuse
Gauss-Seidel	numerical	Iterative	no

Q3.

1.

$$\text{Third-order: } 2.6720 - 1.5962x + 1.4680x^2 + 0.0103x^3$$

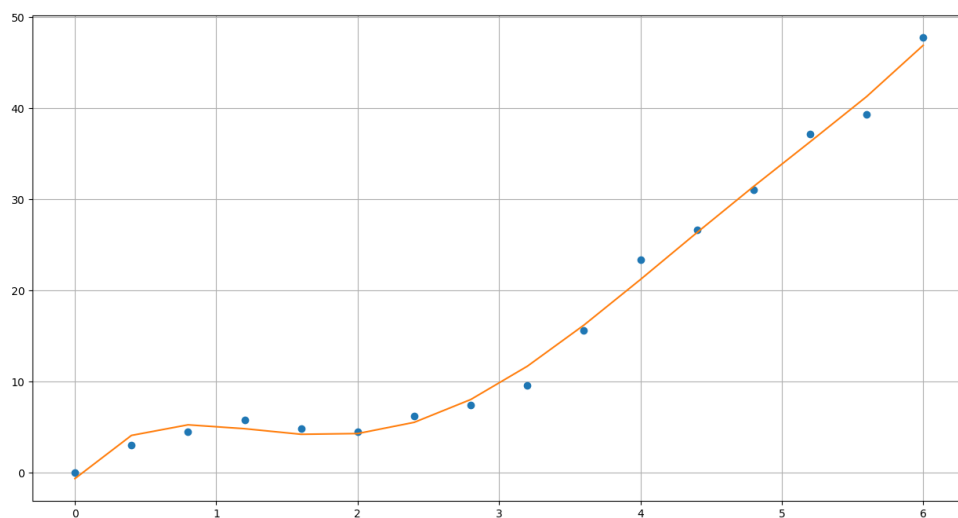
Sixth-order: $0.0755 + 5.7759x + 5.4521x^2 - 9.6601x^3 + 4.3831x^4 - 0.7643x^5 + 0.0464x^6$

Ninth-order: $-1.5840 + 1.3734x - 2.5837x^2 + 3.7359x^3 - 3.1955x^4 + 1.5415x^5 - 4.2736x^6 + 0.6832x^7 - 0.0590x^8 + 0.0021x^9$

2.



There is no Runge's phenomenon observed in the plot.



3.



To solve Runge's phenomenon, we can just use lower-order poly. interpolation such as the spline method.

Q4.

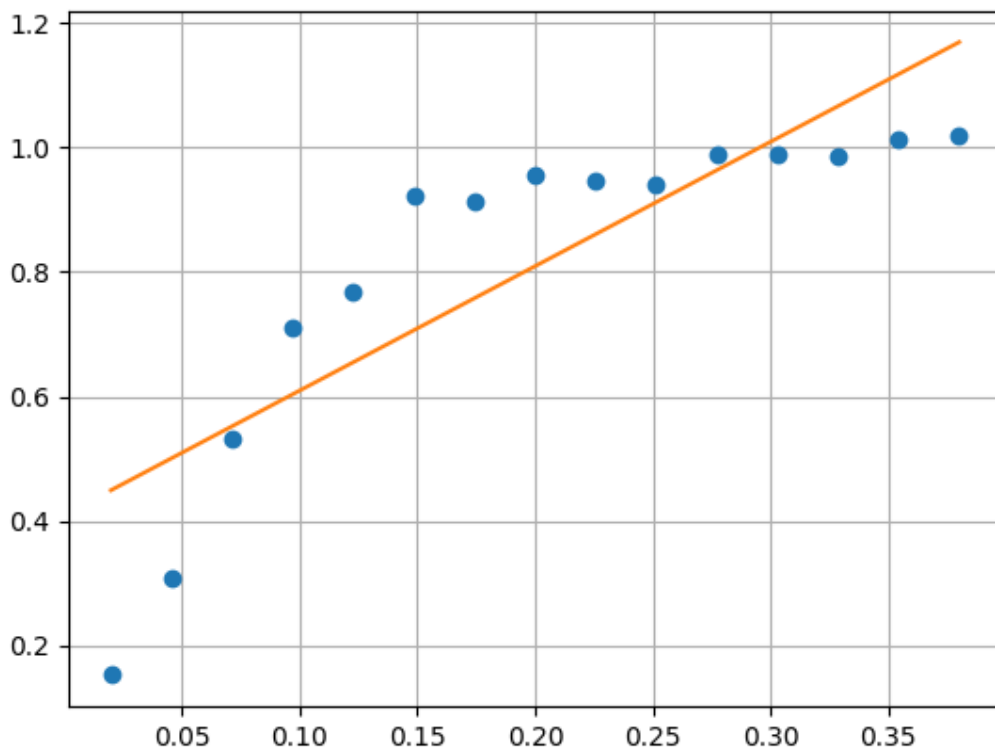
1.



Constant:

$$a_1 = 0.4095 \quad a_2 = 1.9989$$

RMS: 0.139186



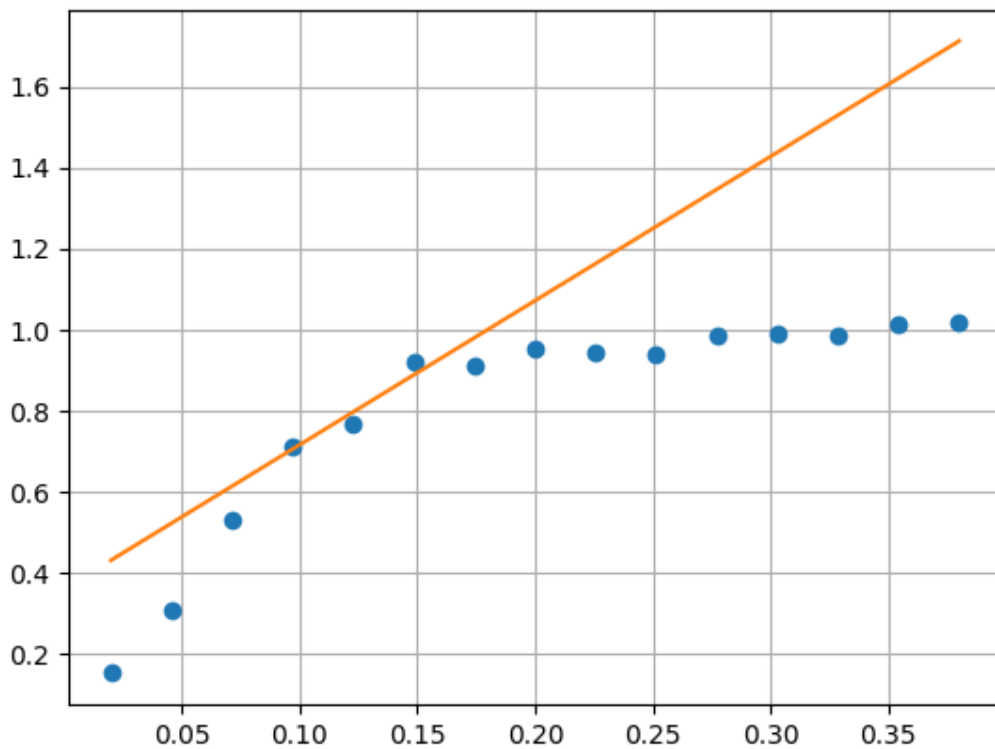
2.



Constant:

$$a_1 = 0.3601 \quad a_2 = 3.5610$$

RMS: 0.344534



3.



Smallest RMS = 0.6003, happened in 8 times(10 + 5)

4.

	Pros	Cons
1.		
2.		
3.		

Q5.

1.

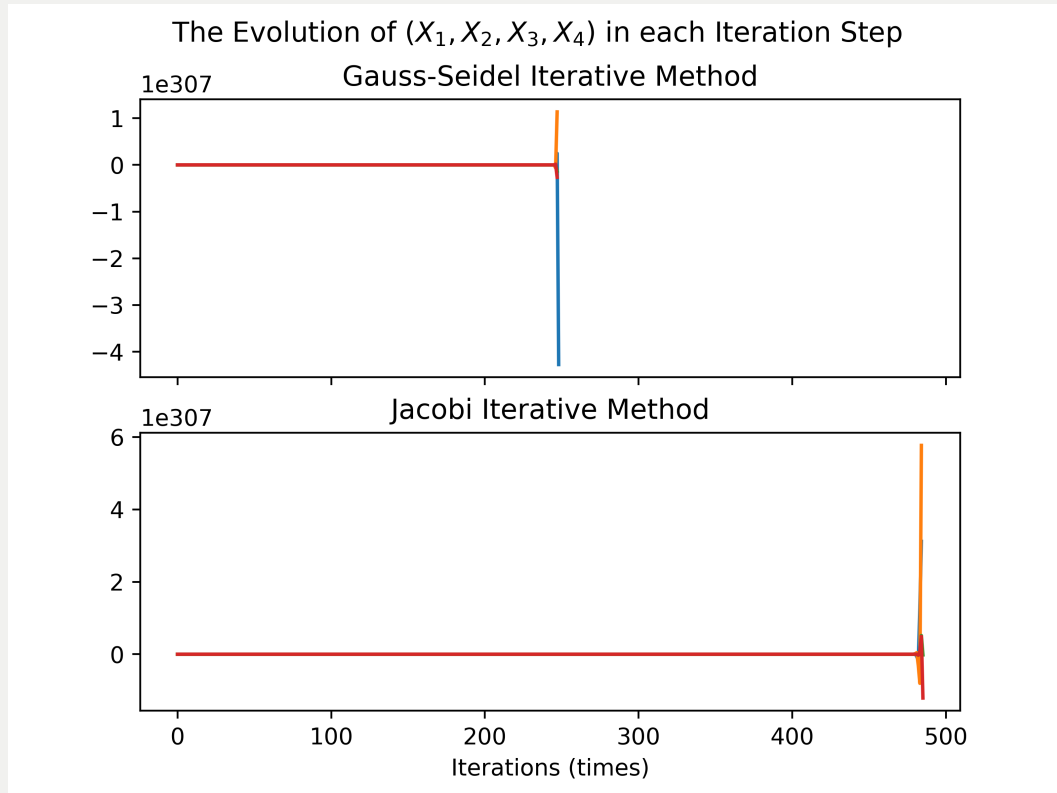
Jacobi Iteration: [5. -2. 2.5 -1.], Iteration = 61

Gauss-Seidel: [5. -2. 2.5 -1.], Iteration = 29

2.



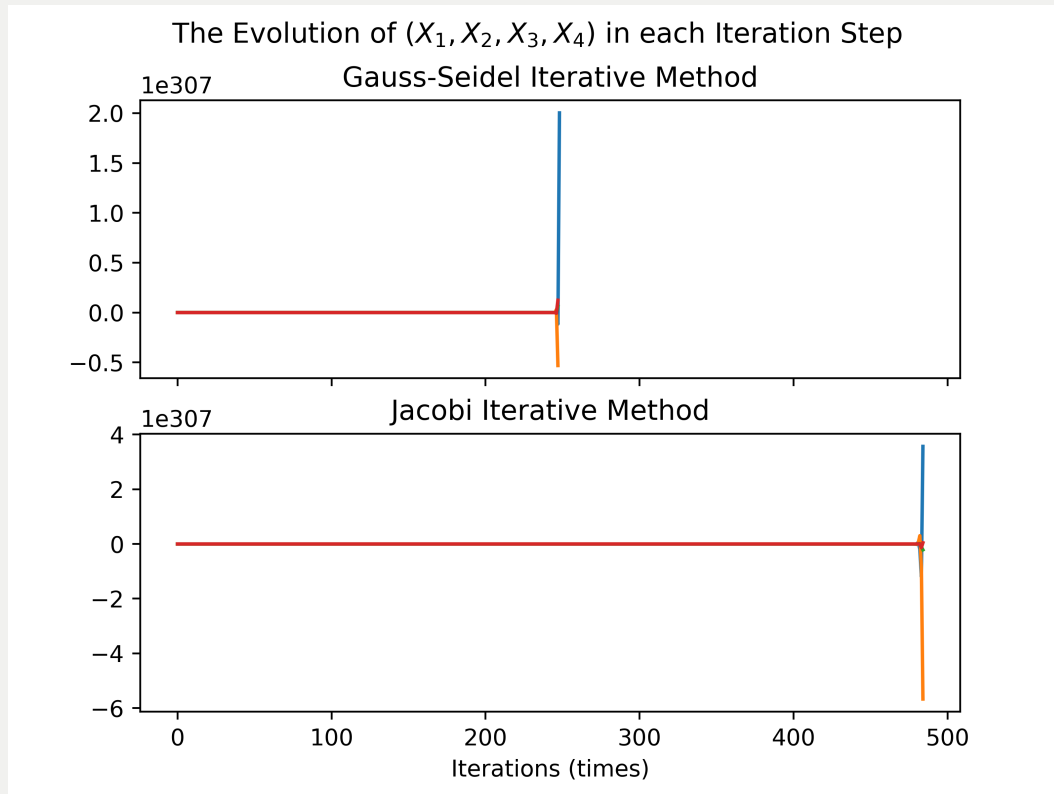
Original





Switch 1st and 2nd row:

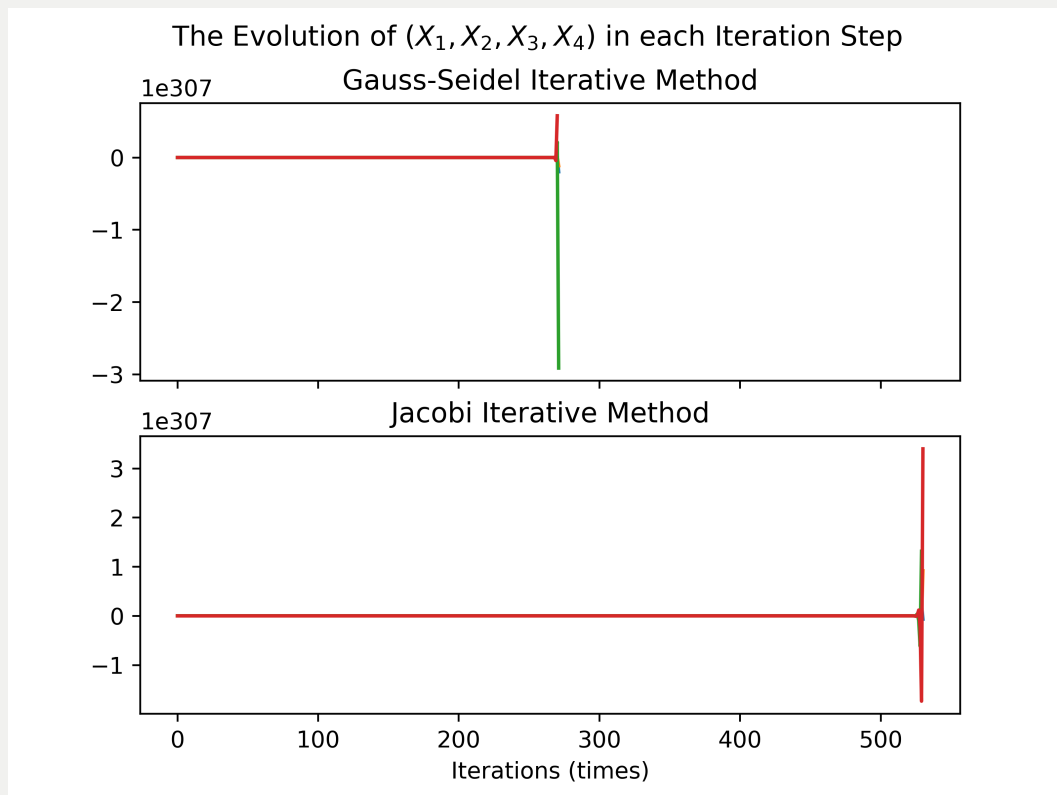
Iteration failed, encountering infinite value.





Switch 3rd and 4th row:

Iteration failed, encountering infinite value.



3.

```
[9, -2, 3, 2],  
[2, 8, -2, 3],  
[-3, 2, 11, -4]  
[-2, 3, 2, 10]]
```

Original Array

According to the figure above, the original matrix is diagonally dominant.

And if switching the first and the second rows, the method failed because encounters infinite value; so does switching the 3rd and 4th rows, proving that the convergence condition needs to be diagonally dominant.

