ESCUELA POLITÉCNICA NACIONAL

MÉTODOS NUMÉRICOS

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[TALLER 05] GAUSS-JACOBI & GAUSS-SEIDEL

```
import numpy as np
import matplotlib.pyplot as plt
%autoreload 2
from src import gauss_jacobi, gauss_seidel
```

EJERCICIO UNO

Resolver el siguiente sistema de ecuaciones lineales:

$$2x_1+10x_2 \quad ¿16,$$
$$3x_1+2x_2 \quad ¿11$$

Primero generamos la matriz ampliada del sistema de ecuaciones, donde:

$$A=\left[\begin{matrix}2 & 10 & 16\\ 3 & 2 & 11\end{matrix}\right)$$

MÉTODO DE GAUSS-JACOBI con X0=(1,1)

```
A = [[3,2],[2,10]]
b = np.array([11,16],dtype=float)
x0=np.zeros(len(b))
max_iter = 100
tol = 10e-10

x, tray_jacobi= gauss_jacobi(A=A, b=b, x0=(1,1), tol=tol,
max_iter=max_iter)
```

```
[01-25 20:28:02][INFO] i= 0 x: [[1. 1.]]
[01-25 20:28:02][INFO] i= 1 x: [[3.  1.4]]
[01-25 20:28:02][INFO] i= 2 x: [[2.73333333 1.        ]]
[01-25 20:28:02][INFO] i= 3 x: [[3.         1.05333333]]
[01-25 20:28:02][INFO] i= 4 x: [[2.96444444 1.        ]]
[01-25 20:28:02][INFO] i= 5 x: [[3.         1.00711111]]
[01-25 20:28:02][INFO] i= 6 x: [[2.99525926 1.        ]]
[01-25 20:28:02][INFO] i= 7 x: [[3.         1.00094815]]
[01-25 20:28:02][INFO] i= 8 x: [[2.9993679 1.       ]]
[01-25 20:28:02][INFO] i= 9 x: [[3.         1.00012642]]
[01-25 20:28:02][INFO] i= 10 x: [[2.99991572 1.        ]]
[01-25 20:28:02][INFO] i= 11 x: [[3.         1.00001686]]
[01-25 20:28:02][INFO] i= 12 x: [[2.99998876 1.        ]]
[01-25 20:28:02][INFO] i= 13 x: [[3.         1.00000225]]
[01-25 20:28:02][INFO] i= 14 x: [[2.9999985 1.       ]]
[01-25 20:28:02][INFO] i= 15 x: [[3.        1.0000003]]
[01-25 20:28:02][INFO] i= 16 x: [[2.9999998 1.       ]]
```

```
[01-25 20:28:02][INFO] i= 17 x: [[3.         1.00000004]]
[01-25 20:28:02][INFO] i= 18 x: [[2.99999997 1.        ]]
[01-25 20:28:02][INFO] i= 19 x: [[3.         1.00000001]]
[01-25 20:28:02][INFO] i= 20 x: [[3. 1.]]
[01-25 20:28:02][INFO] i= 21 x: [[3. 1.]]
```

MÉTODO DE GAUSS-SEIDEL X0=(1,1)

```
A = [[3,2],[2,10]]
b = np.array([11,16],dtype=float)
x0=np.zeros(len(b))
max_iter = 100
tol = 10e-10

x, tray_seidel= gauss_seidel(A=A, b=b, x0=(1,1), tol=tol,
max_iter=max_iter)
```

```
[01-25 20:29:45][INFO] i= 0 x: [[1. 1.]]
[01-25 20:29:45][INFO] i= 1 x: [[3. 1.]]
```

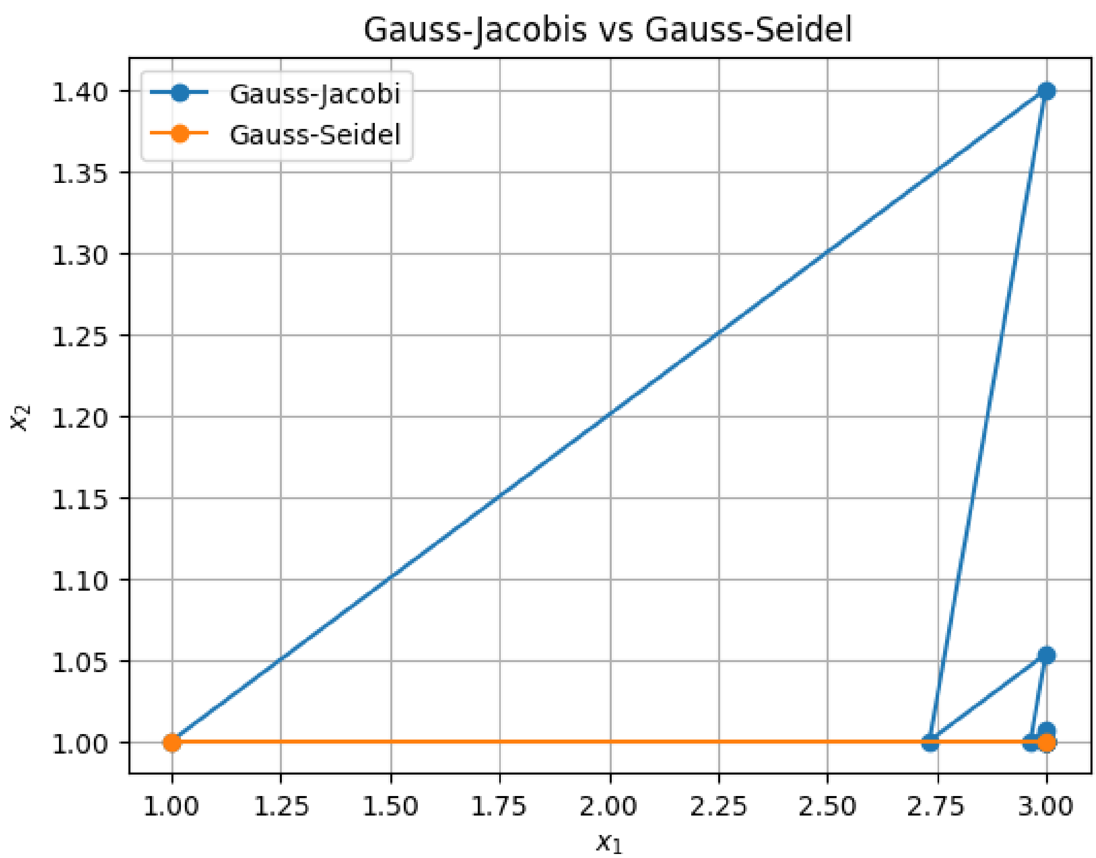
GRAFICA con X0=(1,1)

```
import numpy as np
import matplotlib.pyplot as plt

tray_jacobi = np.squeeze(np.array(tray_jacobi))
tray_seidel = np.squeeze(np.array(tray_seidel))
x1_values_j = tray_jacobi[:, 0]
x2_valuesj_j = tray_jacobi[:, 1]
x3_values_j = tray_seidel[:, 0]
x4_valuesj_j = tray_seidel[:, 1]

# Graficar la relación entre x1 y x2
plt.plot(x1_values_j, x2_valuesj_j, marker='o', label="Gauss-Jacobi",
linestyle='-')
plt.plot(x3_values_j, x4_valuesj_j, marker='o', label="Gauss-Seidel",
linestyle='-')


# Personalizar la gráfica
plt.title("Gauss-Jacobis vs Gauss-Seidel")
plt.xlabel("$x_1$")
plt.ylabel("$x_2$")
plt.grid()
plt.legend()
plt.show()
```



MÉTODO DE GAUSS-JACOBI con X0=(5,-2)

```
A = [[3,2],[2,10]]
b = np.array([11,16],dtype=float)
x0=np.zeros(len(b))
max_iter = 100
tol = 10e-10

x, tray_jacobi= gauss_jacobi(A=A, b=b, x0=(5,-2), tol=tol,
max_iter=max_iter)
```

```
[01-25 20:40:58][INFO] i= 0 x: [[ 5. -2.]]
[01-25 20:40:58][INFO] i= 1 x: [[5.  0.6]]
[01-25 20:40:58][INFO] i= 2 x: [[3.26666667 0.6       ]]
[01-25 20:40:58][INFO] i= 3 x: [[3.26666667 0.94666667]]
[01-25 20:40:58][INFO] i= 4 x: [[3.03555556 0.94666667]]
[01-25 20:40:58][INFO] i= 5 x: [[3.03555556 0.99288889]]
[01-25 20:40:58][INFO] i= 6 x: [[3.00474074 0.99288889]]
[01-25 20:40:58][INFO] i= 7 x: [[3.00474074 0.99905185]]
[01-25 20:40:58][INFO] i= 8 x: [[3.0006321  0.99905185]]
[01-25 20:40:58][INFO] i= 9 x: [[3.0006321  0.99987358]]
[01-25 20:40:58][INFO] i= 10 x: [[3.00008428 0.99987358]]
[01-25 20:40:58][INFO] i= 11 x: [[3.00008428 0.99998314]]
```

```
[01-25 20:40:58][INFO] i= 12 x: [[3.00001124 0.99998314]]
[01-25 20:40:58][INFO] i= 13 x: [[3.00001124 0.99999775]]
[01-25 20:40:58][INFO] i= 14 x: [[3.0000015  0.99999775]]
[01-25 20:40:58][INFO] i= 15 x: [[3.0000015 0.9999997]]
[01-25 20:40:58][INFO] i= 16 x: [[3.0000002 0.9999997]]
[01-25 20:40:58][INFO] i= 17 x: [[3.0000002  0.99999996]]
[01-25 20:40:58][INFO] i= 18 x: [[3.00000003 0.99999996]]
[01-25 20:40:58][INFO] i= 19 x: [[3.00000003 0.99999999]]
[01-25 20:40:58][INFO] i= 20 x: [[3.         0.99999999]]
[01-25 20:40:58][INFO] i= 21 x: [[3. 1.]]
[01-25 20:40:58][INFO] i= 22 x: [[3. 1.]]
```

MÉTODO DE GAUSS-SEIDEL X0=(5,-2)

```
A = [[3,2],[2,10]]
b = np.array([11,16],dtype=float)
x0=np.zeros(len(b))
max_iter = 100
tol = 10e-10

x, tray_seidel = gauss_seidel(A=A, b=b, x0=(5,-2), tol=tol,
max_iter=max_iter)
```

```
[01-25 20:41:00][INFO] i= 0 x: [[ 5. -2.]]
[01-25 20:41:00][INFO] i= 1 x: [[5.  0.6]]
[01-25 20:41:00][INFO] i= 2 x: [[3.26666667 0.94666667]]
[01-25 20:41:00][INFO] i= 3 x: [[3.03555556 0.99288889]]
[01-25 20:41:00][INFO] i= 4 x: [[3.00474074 0.99905185]]
[01-25 20:41:00][INFO] i= 5 x: [[3.0006321  0.99987358]]
[01-25 20:41:00][INFO] i= 6 x: [[3.00008428 0.99998314]]
[01-25 20:41:00][INFO] i= 7 x: [[3.00001124 0.99999775]]
[01-25 20:41:00][INFO] i= 8 x: [[3.0000015 0.9999997]]
[01-25 20:41:00][INFO] i= 9 x: [[3.0000002  0.99999996]]
[01-25 20:41:00][INFO] i= 10 x: [[3.00000003 0.99999999]]
[01-25 20:41:00][INFO] i= 11 x: [[3. 1.]]
[01-25 20:41:00][INFO] i= 12 x: [[3. 1.]]
```

GRAFICA con X0=(5,-2)

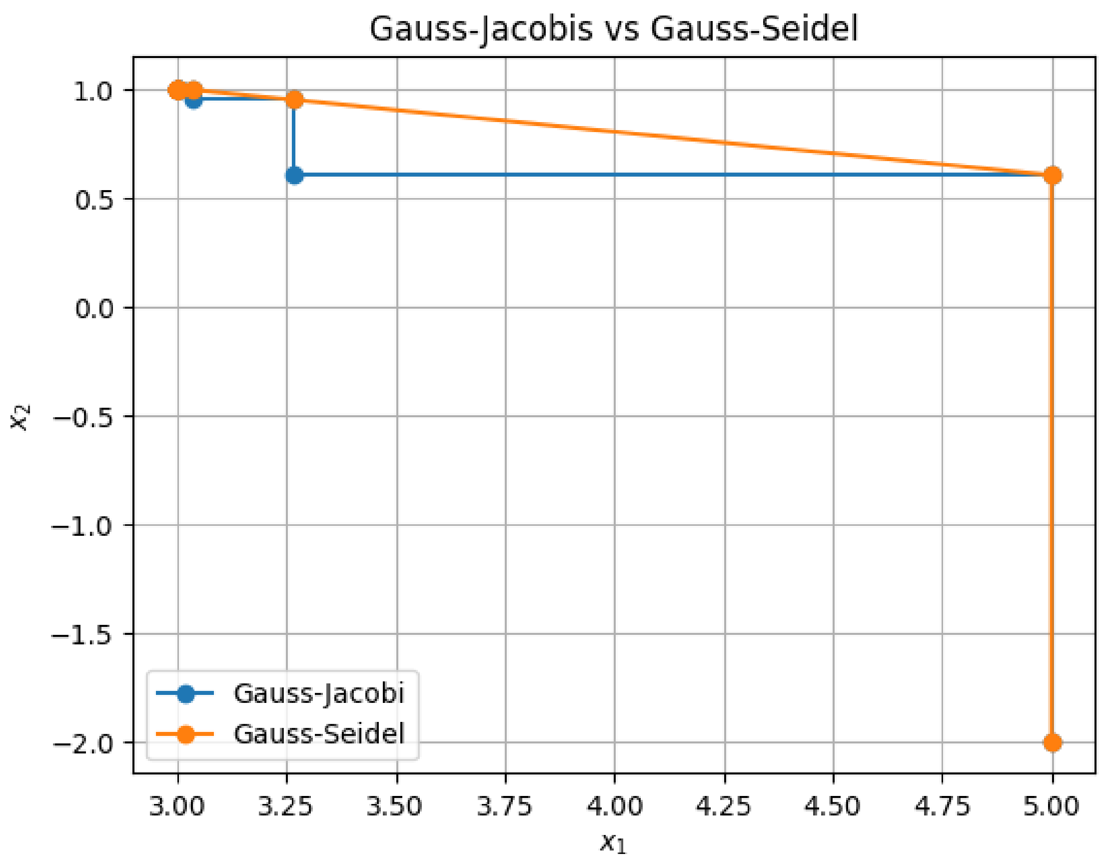
```
import numpy as np
import matplotlib.pyplot as plt

tray_jacobi = np.squeeze(np.array(tray_jacobi))
tray_seidel = np.squeeze(np.array(tray_seidel))
x1_values_j = tray_jacobi[:, 0]
x2_valuesj_j = tray_jacobi[:, 1]
x3_values_j = tray_seidel[:, 0]
x4_valuesj_j = tray_seidel[:, 1]

# Graficar la relación entre x1 y x2
```

```
plt.plot(x1_values_j, x2_valuesj_j, marker='o', label="Gauss-Jacobi",
linestyle='-')
plt.plot(x3_values_j, x4_valuesj_j, marker='o', label="Gauss-Seidel",
linestyle='-')


# Personalizar la gráfica
plt.title("Gauss-Jacobis vs Gauss-Seidel")
plt.xlabel("$x_1$")
plt.ylabel("$x_2$")
plt.grid()
plt.legend()
plt.show()
```



SIN CONVERGENCIA

METODO DE GAUSS-JACOBI con X0=(1,1)

```
A = [[2,10],[3,2]]
b = np.array([16,11],dtype=float)
x0=np.zeros(len(b))
max_iter = 100
```

```
tol = 10e-10

x, tray_jacobi = gauss_jacobi(A=A, b=b, x0=(1,1), tol=tol,
max_iter=max_iter)
```

```
[01-25 20:43:46][INFO] i= 0 x: [[1. 1.]]
[01-25 20:43:46][INFO] i= 1 x: [[3. 4.]]
[01-25 20:43:46][INFO] i= 2 x: [[-12.   1.]]
[01-25 20:43:46][INFO] i= 3 x: [[ 3.  23.5]]
[01-25 20:43:46][INFO] i= 4 x: [[-109.5    1. ]]
[01-25 20:43:46][INFO] i= 5 x: [[  3.   169.75]]
[01-25 20:43:46][INFO] i= 6 x: [[-840.75    1.  ]]
[01-25 20:43:46][INFO] i= 7 x: [[   3.    1266.625]]
[01-25 20:43:46][INFO] i= 8 x: [[-6.325125e+03  1.000000e+00]]
[01-25 20:43:46][INFO] i= 9 x: [[3.0000000e+00 9.4931875e+03]]
[01-25 20:43:46][INFO] i= 10 x: [[-4.74579375e+04  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 11 x: [[3.00000000e+00 7.11924062e+04]]
[01-25 20:43:46][INFO] i= 12 x: [[-3.55954031e+05  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 13 x: [[3.00000000e+00 5.33936547e+05]]
[01-25 20:43:46][INFO] i= 14 x: [[-2.66967473e+06  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 15 x: [[3.0000000e+00 4.0045176e+06]]
[01-25 20:43:46][INFO] i= 16 x: [[-2.002258e+07  1.000000e+00]]
[01-25 20:43:46][INFO] i= 17 x: [[3.00000000e+00 3.00338755e+07]]
[01-25 20:43:46][INFO] i= 18 x: [[-1.5016937e+08  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 19 x: [[3.0000000e+00 2.2525406e+08]]
[01-25 20:43:46][INFO] i= 20 x: [[-1.12627029e+09  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 21 x: [[3.00000000e+00 1.68940544e+09]]
[01-25 20:43:46][INFO] i= 22 x: [[-8.4470272e+09  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 23 x: [[3.00000000e+00 1.26705408e+10]]
[01-25 20:43:46][INFO] i= 24 x: [[-6.3352704e+10  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 25 x: [[3.00000000e+00 9.50290561e+10]]
[01-25 20:43:46][INFO] i= 26 x: [[-4.7514528e+11  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 27 x: [[3.00000000e+00 7.12717921e+11]]
[01-25 20:43:46][INFO] i= 28 x: [[-3.5635896e+12  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 29 x: [[3.0000000e+00 5.3453844e+12]]
[01-25 20:43:46][INFO] i= 30 x: [[-2.6726922e+13  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 31 x: [[3.0000000e+00 4.0090383e+13]]
[01-25 20:43:46][INFO] i= 32 x: [[-2.00451915e+14  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 33 x: [[3.00000000e+00 3.00677873e+14]]
[01-25 20:43:46][INFO] i= 34 x: [[-1.50338936e+15  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 35 x: [[3.00000000e+00 2.25508405e+15]]
[01-25 20:43:46][INFO] i= 36 x: [[-1.12754202e+16  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 37 x: [[3.00000000e+00 1.69131303e+16]]
[01-25 20:43:46][INFO] i= 38 x: [[-8.45656517e+16  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 39 x: [[3.00000000e+00 1.26848478e+17]]
[01-25 20:43:46][INFO] i= 40 x: [[-6.34242388e+17  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 41 x: [[3.00000000e+00 9.51363582e+17]]
[01-25 20:43:46][INFO] i= 42 x: [[-4.75681791e+18  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 43 x: [[3.00000000e+00 7.13522686e+18]]
[01-25 20:43:46][INFO] i= 44 x: [[-3.56761343e+19  1.00000000e+00]]
```

```
[01-25 20:43:46][INFO] i= 45 x: [[3.00000000e+00 5.35142015e+19]]
[01-25 20:43:46][INFO] i= 46 x: [[-2.67571007e+20  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 47 x: [[3.00000000e+00 4.01356511e+20]]
[01-25 20:43:46][INFO] i= 48 x: [[-2.00678256e+21  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 49 x: [[3.00000000e+00 3.01017383e+21]]
[01-25 20:43:46][INFO] i= 50 x: [[-1.50508692e+22  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 51 x: [[3.00000000e+00 2.25763037e+22]]
[01-25 20:43:46][INFO] i= 52 x: [[-1.12881519e+23  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 53 x: [[3.00000000e+00 1.69322278e+23]]
[01-25 20:43:46][INFO] i= 54 x: [[-8.4661139e+23  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 55 x: [[3.00000000e+00 1.26991709e+24]]
[01-25 20:43:46][INFO] i= 56 x: [[-6.34958543e+24  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 57 x: [[3.00000000e+00 9.52437814e+24]]
[01-25 20:43:46][INFO] i= 58 x: [[-4.76218907e+25  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 59 x: [[3.00000000e+00 7.14328361e+25]]
[01-25 20:43:46][INFO] i= 60 x: [[-3.5716418e+26  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 61 x: [[3.00000000e+00 5.35746271e+26]]
[01-25 20:43:46][INFO] i= 62 x: [[-2.67873135e+27  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 63 x: [[3.00000000e+00 4.01809703e+27]]
[01-25 20:43:46][INFO] i= 64 x: [[-2.00904851e+28  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 65 x: [[3.00000000e+00 3.01357277e+28]]
[01-25 20:43:46][INFO] i= 66 x: [[-1.50678639e+29  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 67 x: [[3.00000000e+00 2.26017958e+29]]
[01-25 20:43:46][INFO] i= 68 x: [[-1.13008979e+30  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 69 x: [[3.00000000e+00 1.69513468e+30]]
[01-25 20:43:46][INFO] i= 70 x: [[-8.47567342e+30  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 71 x: [[3.00000000e+00 1.27135101e+31]]
[01-25 20:43:46][INFO] i= 72 x: [[-6.35675507e+31  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 73 x: [[3.0000000e+00 9.5351326e+31]]
[01-25 20:43:46][INFO] i= 74 x: [[-4.7675663e+32  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 75 x: [[3.00000000e+00 7.15134945e+32]]
[01-25 20:43:46][INFO] i= 76 x: [[-3.57567472e+33  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 77 x: [[3.00000000e+00 5.36351209e+33]]
[01-25 20:43:46][INFO] i= 78 x: [[-2.68175604e+34  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 79 x: [[3.00000000e+00 4.02263406e+34]]
[01-25 20:43:46][INFO] i= 80 x: [[-2.01131703e+35  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 81 x: [[3.00000000e+00 3.01697555e+35]]
[01-25 20:43:46][INFO] i= 82 x: [[-1.50848777e+36  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 83 x: [[3.00000000e+00 2.26273166e+36]]
[01-25 20:43:46][INFO] i= 84 x: [[-1.13136583e+37  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 85 x: [[3.00000000e+00 1.69704875e+37]]
[01-25 20:43:46][INFO] i= 86 x: [[-8.48524373e+37  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 87 x: [[3.00000000e+00 1.27278656e+38]]
[01-25 20:43:46][INFO] i= 88 x: [[-6.3639328e+38  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 89 x: [[3.0000000e+00 9.5458992e+38]]
[01-25 20:43:46][INFO] i= 90 x: [[-4.7729496e+39  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 91 x: [[3.0000000e+00 7.1594244e+39]]
[01-25 20:43:46][INFO] i= 92 x: [[-3.5797122e+40  1.0000000e+00]]
[01-25 20:43:46][INFO] i= 93 x: [[3.0000000e+00 5.3695683e+40]]
```

```
[01-25 20:43:46][INFO] i= 94 x: [[-2.68478415e+41  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 95 x: [[3.00000000e+00 4.02717622e+41]]
[01-25 20:43:46][INFO] i= 96 x: [[-2.01358811e+42  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 97 x: [[3.00000000e+00 3.02038217e+42]]
[01-25 20:43:46][INFO] i= 98 x: [[-1.51019108e+43  1.00000000e+00]]
[01-25 20:43:46][INFO] i= 99 x: [[3.00000000e+00 2.26528663e+43]]
```

METODO DE GAUSS-SEIDEL con X0=(1,1)

```
A = [[2,10],[3,2]]
b = np.array([16,11],dtype=float)
x0=np.zeros(len(b))
max_iter = 100
tol = 10e-10

x, tray_seidel = gauss_seidel(A=A, b=b, x0=(1,1), tol=tol,
max_iter=max_iter)
```

```
[01-25 20:46:05][INFO] i= 0 x: [[1. 1.]]
[01-25 20:46:05][INFO] i= 1 x: [[3. 1.]]
```

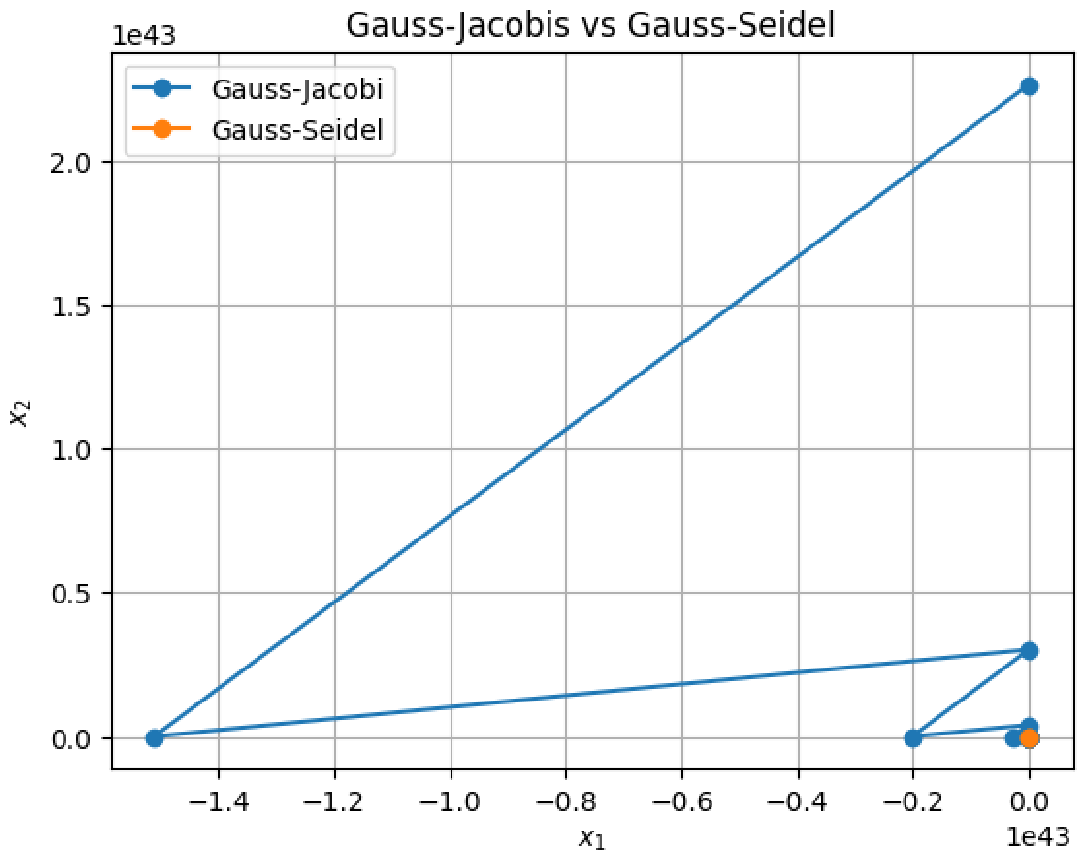
GRAFICAR sin CONVERGENCIA

```
import numpy as np
import matplotlib.pyplot as plt

tray_jacobi = np.squeeze(np.array(tray_jacobi))
tray_seidel = np.squeeze(np.array(tray_seidel))
x1_values_j = tray_jacobi[:, 0]
x2_valuesj_j = tray_jacobi[:, 1]
x3_values_j = tray_seidel[:, 0]
x4_valuesj_j = tray_seidel[:, 1]

# Graficar la relación entre x1 y x2
plt.plot(x1_values_j, x2_valuesj_j, marker='o', label="Gauss-Jacobi",
linestyle='-')
plt.plot(x3_values_j, x4_valuesj_j, marker='o', label="Gauss-Seidel",
linestyle='-')


# Personalizar la gráfica
plt.title("Gauss-Jacobis vs Gauss-Seidel")
plt.xlabel("$x_1$")
plt.ylabel("$x_2$")
plt.grid()
plt.legend()
plt.show()
```



Gauss-Jacobis vs Gauss-Seidel
1e43
Gauss-Jacobi
Gauss-Seidel
2.0
1.5
1.0
0.5
0.0
x_2
−1.4
−1.2
−1.0
−0.8
−0.6
−0.4
−0.2
0.0
x_1
1e43

REPOSITORIO:

https://github.com/ImYasid/METODOS_NUMERICOS.git

REFERENCIAS BIBLIOGRÁFICAS:

[1] Richard L. Burden, 2017. Análisis Numérico. Lugar de publicación: 10ma edición. Editorial Cengage Learning.

DECLARACIÓN DEL USO DE INTELENGIA ARTIFICIAL

Se utilizo IA para la optimización de código adicional al mejoramiento de la gramática del texto para un mejor entendimiento.