Laboratorio 7

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0.0.2 Curso: Análisis Numeérico

1 Pregunta 1

```
In [1]: import __metodos_Iterativos as mi
        import numpy as np
```

```
toolNick se ha importado correctamente.
__metodos_Iterativos se ha importado correctamente.
```

```
In [2]: # Definimos los valores

        A = np.array([[5,2],[1,-4]])
        b = np.array([1,0])
        x_0 = np.array([1,2])
```

1.0.1 Metodo Jacobi

```
In [3]: #Realizamos 4 iteraciones
        x = mi.Jacobi(A,b,x_0, n_iter=4,v='True')
```

```
D:
 [[ 5  0]
 [ 0 -4]]
E:
 [[ 0  0]
 [-1  0]]
F:
 [[ 0 -2]
 [ 0  0]]
========== Invirtiendo matriz D: =============
J:
[[ 2.22044605e-16 -4.00000000e-01]
 [ 2.50000000e-01  0.00000000e+00]]
c:
[0.2 0. ]
```

```
========== Iterando la solucion =============

Iteration 0:x = [1 2]
Iteration 1:x = [-0.6   0.25]
Iteration 2:x = [ 0.1  -0.15]
Iteration 3:x = [0.26  0.025]
```

1.0.2 Metodo Gauss Seidel

```
In [4]: x = mi.Gauss_Seidel(A,b,x_0,n_iter=4,v='True')
```

```
D:
 [[ 5  0]
 [ 0 -4]]
E:
 [[ 0  0]
 [-1  0]]
F:
 [[ 0 -2]
 [ 0  0]]
========== Invirtiendo matriz (D-E): =============
G:
[[ 0.  -0.4]
 [ 0.  -0.1]]
c:
[0.2  0.05]
Iteration 0:x = [1 2]
Iteration 1:x = [-0.6  -0.15]
Iteration 2:x = [0.26  0.065]
Iteration 3:x = [0.174  0.0435]
```

2 Pregunta 2

Matrices son diagonal dominante

```
In [5]: import toolNick as tn
        import numpy as np
```

```
In [6]: A = np.array([[4,1],[3,8]])
        bo = tn.matrix_Diagonal_Dominante(A)
        bo
```

```
Out[6]: True
```

```
In [13]: A = np.array([[4,4],[3,8]])
         bo = tn.matrix_Diagonal_Dominante(A)
         bo
```

```
Out[13]: True

In [11]: A = np.array([[4,1,1],[2,8,-3],[3,2,9]])
         bo = tn.matrix_Diagonal_Dominante(A)
         bo

Out[11]: True

In [12]: A = np.array([[4,1,1],[2,8,-7],[3,-10,20]])
         bo = tn.matrix_Diagonal_Dominante(A)
         bo

Out[12]: False
```

2.1 Método de Continuación u Homotopía

Para el siguiente método importamos la libreria homotopia.

```
In [7]: import numpy as np
        from homotopia import *

Se a importado correctamente la libreria homotopia
```

3 Pregunta 5

Sea el sistema no lineal de ecuaciones siguiente:

$f_1(x_1; x_2; x_3) = {x_1}^2 + x_2 37 = 0$

$f_2(x_1; x_2; x_3) = x_1 {x_2}^2 5 = 0$

$f_3(x_1; x_2; x_3) = x_3 + x_1 + x_2 3 = 0$

Mediante el método de Continuación u Homotopía calcúlese la aproximación de la solución, comenzando en el punto inicial

$P_0 = ({x_1}^{(0)}; {x_2}^{(0)}; {x_3}^{(0)})^T = (0; 0; 0)^T$ y realizando $n = 2$ iteraciones.

```
In [8]: F = lambda X : np.array([
                              X[0]**2 * X[1] - 37 ,
                              X[0] - X[1]**2 - 5 ,
                              X[2] + X[0] + X[1] - 3])

        J = lambda X : np.array([
                              [ 2*X[0],     1    , 0],
                              [ 1     , -2*X[1] , 0],
                              [ 1     ,    1    , 1]])

        X_0 = np.array([0.0, 0.0, 0.0])

        x = solve_Homotopia(F, J, X_0, v=True, iv=True)
```

```
=======================================
Hallando X_1:
=======================================
Hallando k_1:
w_1 = [0. 0. 0.]

J(w_1) :
[[ 0.  1.  0.]
 [ 1. -0.  0.]
 [ 1.  1.  1.]]

Inversa(J(w_1)):
[[ 0.  1.  0.]
 [ 1.  0.  0.]
 [-1. -1.  1.]]

k_1 = [  1.66666667  12.33333333 -13.        ]
----------------------------------------
Hallando k_2:
w_2 = [ 0.83333333  6.16666667 -6.5       ]

J(w_2) :
[[  1.66666667   1.           0.        ]
 [  1.         -12.33333333   0.        ]
 [  1.           1.           1.        ]]

Inversa(J(w_2)):
[[ 0.57216495  0.04639175  0.        ]
 [ 0.04639175 -0.07731959 -0.        ]
 [-0.6185567   0.03092784  1.        ]]

k_2 = [ 7.13402062  0.44329897 -6.57731959]
----------------------------------------
Hallando k_3:
w_3 = [ 3.56701031  0.22164948 -3.28865979]

J(w_3) :
[[ 7.13402062  1.          0.        ]
 [ 1.         -0.44329897  0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_3)):
[[ 0.10649815  0.24024001  0.        ]
 [ 0.24024001 -1.71387719  0.        ]
 [-0.34673816  1.47363718  1.        ]]

k_3 = [ 1.71387719  0.10649815 -0.82037534]
----------------------------------------
```

```
Hallando k_4:
w_4 = [ 1.71387719  0.10649815 -0.82037534]

J(w_4) :
[[ 3.42775437  1.          0.        ]
 [ 1.         -0.2129963   0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_4)):
[[ 0.1231122   0.57800161  0.        ]
 [ 0.57800161 -1.98124754  0.        ]
 [-0.70111381  1.40324593  1.        ]]

k_4 = [ 2.48171985  3.82660727 -5.30832712]
----------------------------------------
X_1: [ 3.64069702  2.87658914 -5.51728616]

========================================
Hallando X_2:
========================================
Hallando k_1:
w_1 = [ 3.64069702  2.87658914 -5.51728616]

J(w_1) :
[[ 7.28139404  1.          0.        ]
 [ 1.         -5.75317828  0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_1)):
[[ 0.13413437  0.02331483  0.        ]
 [ 0.02331483 -0.16976445 -0.        ]
 [-0.15744919  0.14644963  1.        ]]

k_1 = [ 0.04885271 -1.1078849   2.39236552]
----------------------------------------
Hallando k_2:
w_2 = [ 3.66512338  2.32264669 -4.3211034 ]

J(w_2) :
[[ 7.33024675  1.          0.        ]
 [ 1.         -4.64529338  0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_2)):
[[ 0.132529    0.02852974  0.        ]
 [ 0.02852974 -0.20913001 -0.        ]
 [-0.16105874  0.18060028  1.        ]]
```

```
k_2 = [ 0.08355407 -1.36464103  2.61442029]
-----------------------------------------
Hallando k_3:
w_3 = [ 3.68247406  2.19426862 -4.21007601]

J(w_3) :
[[ 7.36494812  1.          0.        ]
 [ 1.         -4.38853725  0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_3)):
[[ 0.13170347  0.03001079  0.        ]
 [ 0.03001079 -0.22102791 -0.        ]
 [-0.16171426  0.19101712  1.        ]]

k_3 = [ 0.09368739 -1.4421718   2.68181774]
-----------------------------------------
Hallando k_4:
w_4 = [ 3.73438441  1.43441734 -2.83546842]

J(w_4) :
[[ 7.46876882  1.          0.        ]
 [ 1.         -2.86883468  0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_4)):
[[ 0.12792071  0.04458978  0.        ]
 [ 0.04458978 -0.33303077 -0.        ]
 [-0.17251049  0.28844099  1.        ]]

k_4 = [ 0.19016933 -2.17249978  3.31566379]
-----------------------------------------
X_2: [ 3.73961451  1.39425408 -2.80053526]

=======================================
Hallando X_3:
=======================================
Hallando k_1:
w_1 = [ 3.73961451  1.39425408 -2.80053526]

J(w_1) :
[[ 7.47922903  1.          0.        ]
 [ 1.         -2.78850817  0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_1)):
[[ 0.12758611  0.04575425  0.        ]
 [ 0.04575425 -0.34220655 -0.        ]
```

```
 [-0.17334037  0.29645229  1.        ]]

k_1 = [ 2.37959215 -0.29576309 -1.4171624 ]
-----------------------------------------
Hallando k_2:
w_2 = [ 4.92941059  1.24637254 -3.50911646]

J(w_2) :
[[ 9.85882118  1.          0.        ]
 [ 1.         -2.49274508  0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_2)):
[[ 0.09746603  0.03909988  0.        ]
 [ 0.03909988 -0.3854787  -0.        ]
 [-0.1365659   0.34637882  1.        ]]

k_2 = [ 1.83111509 -0.55088459 -0.61356383]
-----------------------------------------
Hallando k_3:
w_3 = [ 4.65517206  1.11881179 -3.10731718]

J(w_3) :
[[ 9.31034412  1.          0.        ]
 [ 1.         -2.23762358  0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_3)):
[[ 0.10248793  0.04580213  0.        ]
 [ 0.04580213 -0.4264336  -0.        ]
 [-0.14829006  0.38063147  1.        ]]

k_3 = [ 1.94048338 -0.56481643 -0.70900029]
-----------------------------------------
Hallando k_4:
w_4 = [ 5.6800979   0.82943766 -3.50953555]

J(w_4) :
[[11.36019579  1.          0.        ]
 [ 1.         -1.65887531  0.        ]
 [ 1.          1.          1.        ]]

Inversa(J(w_4)):
[[ 0.08359098  0.05039015  0.        ]
 [ 0.05039015 -0.57244197 -0.        ]
 [-0.13398113  0.52205182  1.        ]]

k_4 = [ 1.62445516 -0.95237705 -0.00541144]
```

```
-----------------------------------------
X_3: [ 5.66415522  0.81433039 -3.47848561]
```

4 Pregunta 6

Sea el sistema de ecuaciones no lineales siguiente.

$f_1(x_1; x_2) = sin(4x_1x_2)2x_2x_1 = 0$

$f_2(x_1; x_2) = (41)(e^{2x_1}e)/4 + 4ex_2{}^2 2ex_1 = 0$

Mediante el método de Continuación u Homotopía calcúlese la aproximación de la solución, comenzando en el punto inicial

$P_0 = (x_1{}^{(0)}; x_2{}^{(0)}; x_3{}^{(0)})^T = (0; 0; 0)^T$ y realizando $n = 2$ iteraciones.

```
In [9]: F = lambda X : np.array([
                              np.sin(4*np.pi*X[0]*X[1])-2*X[1]-X[0],
                              ((4*np.pi - 1)*(np.e**(2*X[0])-np.e))/(4*np.pi) - 4*np.e*X[1]**2 -

        J = lambda X : np.array([
                              [ np.cos(4*np.pi*X[0]*X[1])*(4*np.pi*X[1])-1, np.cos(4*np.pi*X[0]*X
                              [ (4*np.pi - 1)*(2*np.e**(2*X[0]))/(4*np.pi) - 2*np.e, 8*np.e*X[1]

        X_0 = np.array([0.0, 0.0])

        x = solve_Homotopia(F, J, X_0, v=True, iv=True)
```

```
=======================================
Hallando X_1:
=======================================
Hallando k_1:
w_1 = [0. 0.]

J(w_1) :
[[-1.        -2.       ]
 [-3.5957186  0.       ]]

Inversa(J(w_1)):
[[-0.         -0.27810853]
 [-0.5         0.13905426]]

k_1 = [-0.21992062  0.10996031]
-----------------------------------------
Hallando k_2:
w_2 = [-0.10996031  0.05498015]

J(w_2) :
[[-0.31109188 -3.37781623]
```

```
 [-3.95913362  1.19561243]]

Inversa(J(w_2)):
[[-0.08698418 -0.24574567]
 [-0.28803815  0.02263281]]

k_2 = [-0.19432895  0.01789741]
----------------------------------------
Hallando k_3:
w_3 = [-0.09716448  0.0089487 ]

J(w_3) :
[[-0.88755397 -3.22093193]
 [-3.92083576  0.19460081]]

Inversa(J(w_3)):
[[-0.01520145 -0.25160653]
 [-0.30628027  0.06933223]]

k_3 = [-0.19896357  0.05482603]
----------------------------------------
Hallando k_4:
w_4 = [-0.19896357  0.05482603]

J(w_4) :
[[-0.31749871 -4.47679608]
 [-4.20004783  1.19226076]]

Inversa(J(w_4)):
[[-0.06215746 -0.23339379]
 [-0.21896577  0.01655251]]

k_4 = [-0.18456143  0.01308927]
----------------------------------------
X_1: [-0.19851118  0.04474941]

======================================
Hallando X_2:
======================================
Hallando k_1:
w_1 = [-0.19851118  0.04474941]

J(w_1) :
[[-0.44116243 -4.4790384 ]
 [-4.19892856  0.97313205]]

Inversa(J(w_1)):
[[-0.05058787 -0.23284095]
```

```
 [-0.21827956  0.02293365]]

k_1 = [-0.19237869  0.01841556]
-----------------------------------------
Hallando k_2:
w_2 = [-0.29470053  0.05395719]

J(w_2) :
[[-0.33544557 -5.62962826]
 [-4.41552165  1.17336678]]

Inversa(J(w_2)):
[[-0.04646749 -0.22294369]
 [-0.17486282  0.01328426]]

k_2 = [-0.18419664  0.01055162]
-----------------------------------------
Hallando k_3:
w_3 = [-0.2906095   0.05002522]

J(w_3) :
[[-0.38182567 -5.59113533]
 [-4.40713316  1.08786115]]

Inversa(J(w_3)):
[[-0.04341676 -0.22314333]
 [-0.17588957  0.01523874]]

k_3 = [-0.1843542   0.01216299]
-----------------------------------------
Hallando k_4:
w_4 = [-0.38286538  0.0569124 ]

J(w_4) :
[[-0.31146158 -6.63198766]
 [-4.58058174  1.2376315 ]]

Inversa(J(w_4)):
[[-0.04023008 -0.21557739]
 [-0.14889501  0.01012428]]

k_4 = [-0.17809937  0.00800437]
-----------------------------------------
X_2: [-0.3831078   0.05672427]
```