EAFIT UNIVERSITY

DEPARTMENT OF SYSTEMS AND
COMPUTING

Jaba Methods Calculator

Subject: Workshop 2

Responsible teacher:
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Deadline: 26/09/2022

Objective

Principal and first methods that we are going to introduce in the Jaba calculator, such as: Incremental search, Bisection, false position, fixed point, Newton, secant, multiple roots, Gauss simple, Gauss partial, Gauss total.

Tested methods

Functions to use:

$f(x) = ln(sin(x)^2 + 1) - \frac{1}{2}$
$f'(x) = 2(sin(x)^2 + 1)^{-1} \times sin(x) \times cos(x)$
$f_1(x) = ln(sin(x)^2 + 1) - \frac{1}{2} - x$
$g(x) = ln(sin(x)^2 + 1) - \frac{1}{2}$
$h(x) = e^x - x - 1$
$h(x) = e^x - 1$
$h(x) = e^x$

Images

$Bisection.Inputvalues : f, a = 0, b = 1, ToleranceyN.$

```
└─ /bin/python3 /home/belt/Eafit/semestre2022-2/numerical-analisis/numerical-analysis/methods/bisection.py
ite 1 a = 0 b = 1 c = 0.5
ite 2 a = 0.5 b = 1 c = 0.75
ite 3 a = 0.75 b = 1 c = 0.875
ite 4 a = 0.875 b = 1 c = 0.9375
ite 5 a = 0.875 b = 0.9375 c = 0.90625
ite 6 a = 0.90625 b = 0.9375 c = 0.921875
ite 7 a = 0.921875 b = 0.9375 c = 0.9296875
ite 8 a = 0.9296875 b = 0.9375 c = 0.93359375
ite 9 a = 0.93359375 b = 0.9375 c = 0.935546875
ite 10 a = 0.935546875 b = 0.9375 c = 0.9365234375
ite 11 a = 0.935546875 b = 0.9365234375 c = 0.93603515625
ite 12 a = 0.93603515625 b = 0.9365234375 c = 0.936279296875
ite 13 a = 0.936279296875 b = 0.9365234375 c = 0.9364013671875
ite 14 a = 0.9364013671875 b = 0.9365234375 c = 0.93646240234375
ite 15 a = 0.9364013671875 b = 0.93646240234375 c = 0.936431884765625
ite 16 a = 0.9364013671875 b = 0.936431884765625 c = 0.9364166259765625
ite 17 a = 0.9364013671875 b = 0.9364166259765625 c = 0.9364089965820312
ite 18 a = 0.9364013671875 b = 0.9364089965820312 c = 0.9364051818847656
ite 19 a = 0.9364013671875 b = 0.9364051818847656 c = 0.9364032745361328
ite 20 a = 0.9364032745361328 b = 0.9364051818847656 c = 0.9364042282104492
ite 21 a = 0.9364042282104492 b = 0.9364051818847656 c = 0.9364047050476074
ite 22 a = 0.9364042282104492 b = 0.9364047050476074 c = 0.9364044666290283
ite 23 a = 0.9364044666290283 b = 0.9364047050476074 c = 0.9364045858383179
ite 24 a = 0.9364044666290283 b = 0.9364045858383179 c = 0.9364045262336731
Solution found in x = 0.9364045262336731 ,iteration:  24
```

$IncrementalSearch.Inputvalues : f, X_0 = -3, delta_x = 0.5yN.$

```
└─ /bin/python3 /home/belt/Eafit/semestre2022-2/numerical-analisis/numerical-analysis/methods/incremental-search.py
iteration 1 [ -3 , -2.5 ] f(x) = 0.093108493917752 2
iteration 2 [ -2.5 , -2.0 ] f(x) = -0.01988598756585438
the interval with possible root is [ -2.5 , -2.0 ]
```

$FalsePosition.Inputvalues : f, a = 0, b = 1, ToleranceyN.$

```
/bin/python3 /home/belt/Eafit/semestre2022-2/numerical-analisis/numerical-analysis/methods/false-position.py
iteration 1 interval: [ 0 , 1 ] mid point c = 0.9339403807182157
iteration 2 interval: [ 0.9339403807182157 , 1 ] mid point c = 0.9365060516656253
iteration 3 interval: [ 0.9339403807182157 , 0.9365060516656253 ] mid point c = 0.9364047307426412
iteration 4 interval: [ 0.9339403807182157 , 0.9364047307426412 ] mid point c = 0.9364045811008692
Solution found in x = 0.936404580879889 , iteration:  4
```

$$Newton.Inputvalues : f, f', X_0 = 0.5, ToleranceyN.$$

```
/bin/python3 /home/belt/Eafit/semestre2022-2/numerical-analisis/numerical-analysis/methods/newton.py
iteration:  0 p =  0.5
iteration:  1 p =  0.9283919899125719 error =  0.4283919899125719
iteration:  2 p =  0.9363667412673313 error =  0.007974751354759446
iteration:  3 p =  0.9364045800189902 error =  3.783875165885853e-05
iteration:  4 p =  0.9364045808795621 error =  8.605719470367035e-10
solution found in x =  0.9364045808795621 iterations:  4
```

$$FixedPoint.Inputvalues : f_1, g, X_0 = -0.5, ToleranceyN.$$

```
/bin/python3 /home/belt/Eafit/semestre2022-2/numerical-analisis/numerical-analysis/methods/fixed-point.py
iteration 1 point 1 function -0.2931087267313766 error 0.7058516325180302
iteration 2 point 2 function -0.4198215436062573 4 error 0.3018254275052694
iteration 3 point 3 function -0.3463045191776651 error 0.21229010988122773
iteration 4 point 4 function -0.3909584565423095 error 0.11421657881394863
iteration 5 point 5 function -0.3644050348941392 error 0.0728678780628926
iteration 6 point 6 function -0.3804263031679563 error 0.04211398670491969
iteration 7 point 7 function -0.37083679528020885 error 0.02585910570309367
iteration 8 point 8 function -0.3766056453635812 error 0.01531801276585489
iteration 9 point 9 function -0.373145417607189 error 0.009273134797101538
iteration 10 point 10 function -0.3752246411870562 error 0.005541276749014581
iteration 11 point 11 function -0.37397658604830963 error 0.003337254751518905
iteration 12 point 12 function -0.3747262157084321 error 0.002004729551821904
iteration 13 point 13 function -0.37427613331045395 error 0.0012025410062811435
iteration 14 point 14 function -0.3745464284580923 error 0.0007216599254491759
iteration 15 point 15 function -0.3743841264348447 error 0.0004335173737015251
iteration 16 point 16 function -0.3744815908319551 error 0.000260264855460219
iteration 17 point 17 function -0.37442306518389706 error 0.000156308874906739 2
iteration 18 point 18 function -0.37445820986270584 error 9.385474235338472e-05
iteration 19 point 19 function -0.3744371058494556 error 5.6361970863841786e-05
iteration 20 point 20 function -0.37444977872741303 error 3.3843999055066256e-05
iteration 21 point 21 function -0.37444216876320036 error 2.0323470077661768e-05
iteration 22 point 22 function -0.3744467385052047 error 1.2203983996760467e-05
iteration 23 point 23 function -0.37444399440652526 error 7.328462254553512e-06
iteration 24 point 24 function -0.37444564222126353 error 4.400678102421738e-06
iteration 25 point 25 function -0.37444465271927385 error 2.6425854461879188e-06
iteration 26 point 26 function -0.3744452469090602 error 1.5868535954951491e-06
iteration 27 point 27 function -0.37444489010190096 error 9.52896323851302e-07
iteration 28 point 28 function -0.37444510436235334 error 5.722079148160649e-07
iteration 29 point 29 function -0.3744449757003151 error 3.4360732976868657e-07
iteration 30 point 30 function -0.37444505296105535 error 2.0633398582508698e-07
iteration 31 point 31 function -0.3744450065664714 error 1.2390226372041536e-07
iteration 32 point 32 function -0.37444503442612515 error 7.440251889927153e-08
solution found in iteration: 32 with x= -0.37444503442612515
```

$$Secant.Inputvalues : f, X_0 = 0.5, X_0 = 1, ToleranceyN.$$

```
/bin/python3 /home/belt/Eafit/semestre2022-2/numerical-analisis/numerical-analysis/methods/secant.py
iteration: 0 p =  0.5
iteration: 1 p =  1 error =  0.5
iteration: 2 p =  0.946166222306525 error =  0.05383377769347497
iteration: 3 p =  0.9359965807911726 error =  0.010169641515352379
iteration: 4 p =  0.9364070023767038 error =  0.0004104215855311732 5
iteration: 5 p =  0.9364045814731196 error =  2.420903584265943e-06
iteration: 6 p =  0.9364045808795615 error =  5.935580915661376e-10
solution found in x =  0.9364045808795615 iterations:  6
```

$$MultipleRoots.Inputvalues : h, h', h'', X_0 = 1, ToleranceyN.$$

```
└─ /bin/python3 /home/belt/Eafit/semestre2022-2/numerical-analisis/numerical-analysis/methods/root.py
Iteration: 1   X = -0.23421061355351425 F(x) = 0.025405775475345838 Error = 1.2342106135535142
Iteration: 2   X = -0.00845827991076109 F(x) = 3.567060801401567e-05 Error = 0.22575233364275316
Iteration: 3   X = -1.1890183808588653e-05 F(x) = 7.068789997788372e-11 Error = 0.008446389726952502
Iteration: 4   X = -4.218590698935789e-11 F(x) = 0.0 Error = 1.1890141622681664e-05
Iteration: 5   X = -4.218590698935789e-11 F(x) = 0.0 Error = 0.0
Solution found in X = -4.218590698935789e-11      iterations: 5     error = 0.0
```

$Gaussiansimpleelimination.Inputvalues:$

$A = ([[2, -1, 0, 3], [1, 0.5, 3, 8], [0, 13, -2, 11], [14, 5, -2, 3]])$

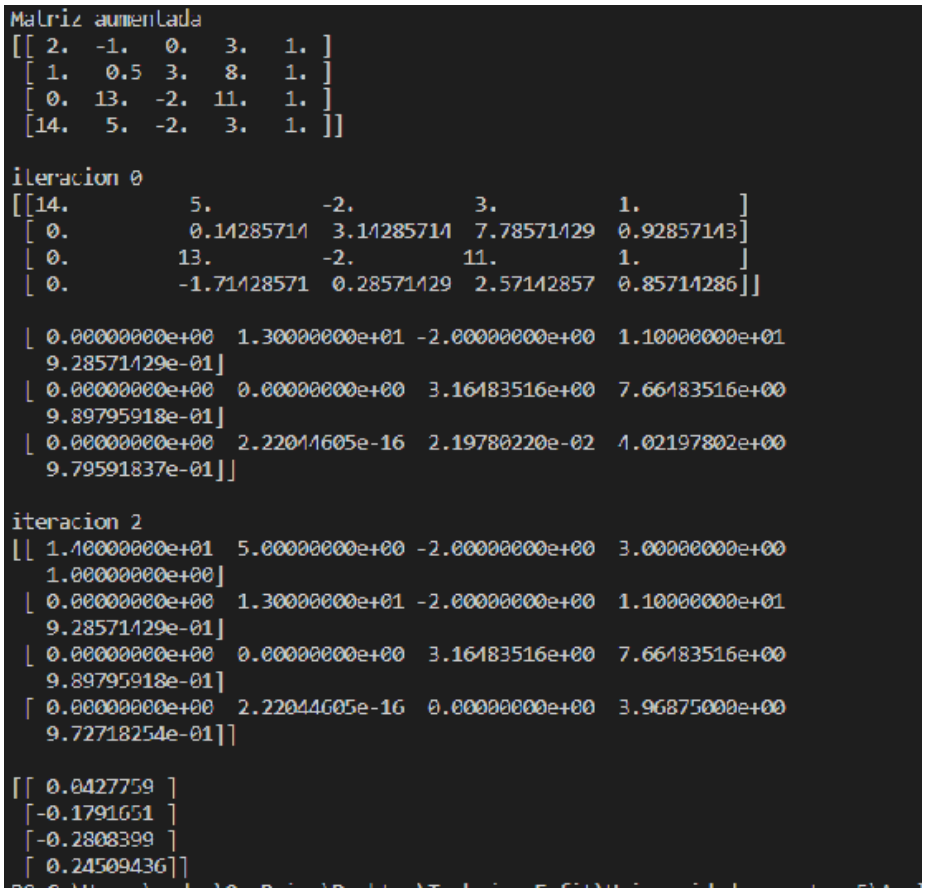
$b = ([1], [1], [1], [1]])$

```
[[ 2.  -1.   0.   3.   1. ]
 [ 1.   0.5  3.   8.   1. ]
 [ 0.  13.  -2.  11.   1. ]
 [14.   5.  -2.   3.   1. ]]

[[  2.   -1.    0.    3.    1. ]
 [  0.    1.    3.    6.5   0.5]
 [  0.   13.   -2.   11.    1. ]
 [  0.   12.   -2.  -18.   -6. ]]

[[  2.   -1.    0.    3.    1. ]
 [  0.    1.    3.    6.5   0.5]
 [  0.    0.  -41.  -73.5  -5.5]
 [  0.    0.  -38.  -96.  -12. ]]

[[  2.          -1.           0.           3.           1.        ]
 [  0.           1.           3.           6.5          0.5       ]
 [  0.           0.         -41.         -73.5         -5.5       ]
 [  0.           0.           0.         -27.87804878  -6.90243902]]

[[ 0.03849519]
 [-0.18022747]
 [-0.30971129]
 [ 0.24759405]]
```

$Gaussianpartialelimination.Inputvalues:$

$A = ([[2, -1, 0, 3], [1, 0.5, 3, 8], [0, 13, -2, 11], [14, 5, -2, 3]])$

$b = ([1], [1], [1], [1]])$



$Gaussiantotalelimination.Inputvalues$:

$A = ([[2, -1, 0, 3], [1, 0.5, 3, 8], [0, 13, -2, 11], [14, 5, -2, 3]]),\ \ b = ([1], [1], [1], [1]])$

```
Etapa  0
Matriz aumentada
 [[14.          5.         -2.          3.          1.        ]
 [ 0.          0.14285714  3.14285714  7.78571429  0.92857143]
 [ 0.         13.         -2.         11.          1.        ]
 [ 0.         -1.71428571  0.28571429  2.57142857  0.85714286]]
Etapa  1
Matriz aumentada
 [[ 1.40000000e+01  5.00000000e+00 -2.00000000e+00  3.00000000e+00
   1.00000000e+00]
 [ 0.00000000e+00  1.30000000e+01 -2.00000000e+00  1.10000000e+01
   1.00000000e+00]
 [ 0.00000000e+00  0.00000000e+00  3.16483516e+00  7.66483516e+00
   9.17582418e-01]
 [ 0.00000000e+00  2.22044605e-16  2.19780220e-02  4.02197802e+00
   9.89010989e-01]]
Etapa  2
Matriz aumentada
 [[ 1.40000000e+01  5.00000000e+00  3.00000000e+00 -2.00000000e+00
 [ 0.00000000e+00  1.30000000e+01  1.10000000e+01 -2.00000000e+00
   1.00000000e+00]
 [ 0.00000000e+00  0.00000000e+00  7.66483516e+00  3.16483516e+00
   9.17582418e-01]
 [ 0.00000000e+00  2.22044605e-16  0.00000000e+00 -1.63870968e+00
   5.07526882e-01]]
```

Student's signs