Tarea 1

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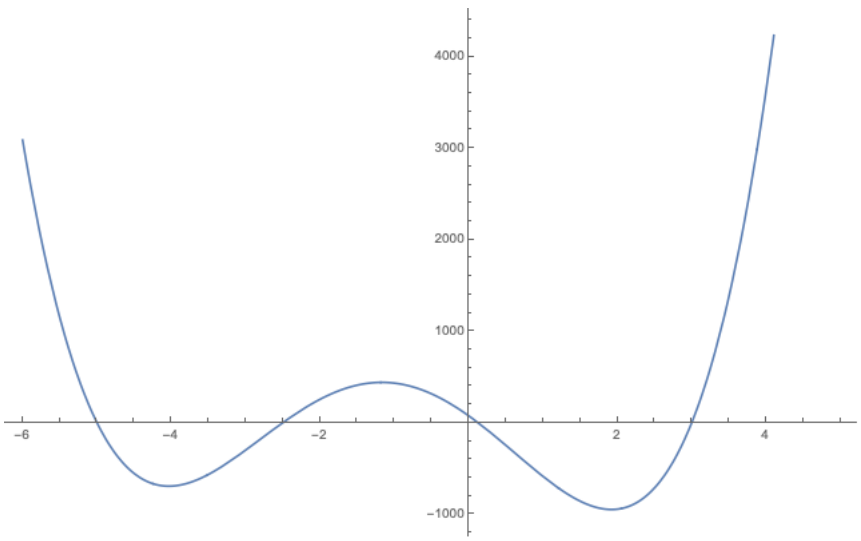
1 Encontrar los ceros del polinomio

Empezamos por graficar el polinomio:



Para el primer punto usamos $p_0 = -8 + 0i$, $p_1 = -7 + 0i$ y $p_2 = -6 + 0i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	-5.56988770741102+0j	1366.1300931573928+0j
1	-5.253213136295214+0j	495.11617890693424+0j
2	-5.098845924131111+0j	173.8892671646845+0j
3	-5.024791372074857+0j	41.38752244099669+0j
4	-5.003476678249181+0j	5.716037928335936+0j
5	-5.000158597502512+0j	0.26012961100877874+0j
6	-5.000001181494323+0j	0.0019376523382561572+0j
7	-5.000000000421358+0j	6.910286174388602e-07+0j
8	-5+0j	0j

Para el segundo punto usamos $p_0 = -5.5 + 0i$, $p_1 = -4 + 0i$ y $p_2 = -3 + 0i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	-2.73014360107805+0j	-136.74477205133985+0j
1	-2.5499814337627+0j	-29.08776618373531+0j
2	-2.507713928583022+0j	-4.460345829948892+0j
3	-2.5003258053984068+0j	-0.18816259248796996+0j
4	-2.500002511682252+0j	-0.0014504970934012817+0j
5	-2.5000000008553442+0j	-4.939613518217811e-07+0j
6	-2.500000000000002+0j	-1.3642420526593924e-12+0j

Para el tercer punto usamos $p_0 = -1 + 0i$, $p_1 = -0.5 + 0i$ y $p_2 = -0 + 0i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	0.10636615495378643+0j	11.48189096004183+0j
1	0.12432985679642755+0j	0.4146504754316993+0j
2	0.12499576897414577+0j	0.0026183413773708253+0j
3	0.12499999900157793+0j	6.178672578016631e-07+0j
4	0.1249999999999985+0j	9.237055564881302e-13+0j

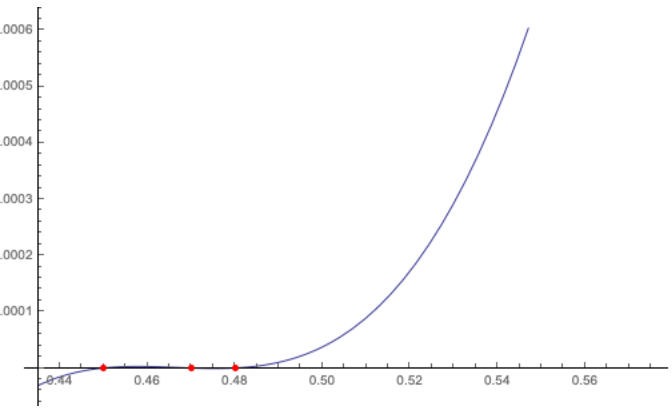
Para el cuarto punto usamos $p_0 = 1 + 0i$, $p_1 = 1.5 + 0i$ y $p_2 = 2 + 0i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	0.10636615495378643+0j	11.48189096004183+0j
1	0.12432985679642755+0j	0.4146504754316993+0j
2	0.12499576897414577+0j	0.0026183413773708253+0j
3	0.12499999900157793+0j	6.178672578016631e-07+0j
4	0.1249999999999985+0j	9.237055564881302e-13+0j

2 2o ejercicio

Encontrar las raíces del polinomio $x^5 - 3.4x^4 + 5.4521x^3 - 4.2077x^2 + 1.50924x - 0.20304$

Empezamos por graficar el polinomio para localizar las raíces:



Para el primer punto usamos $p_0 = 0.1 + 0i$, $p_1 = 0.2 + 0i$ y $p_2 = 0.3 + 0i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	0.4458286112629127+0j	-4.5035571730744905e-06+0j
1	0.447862249714668+0j	-1.984579714342516e-06+0j
2	0.44911066631197444+0j	-7.480005712046101e-07+0j
3	0.44973410889903526+0j	0.44973410889903526+0j
4	0.4499539551055597+0j	-3.612369059435849e-08+0j
5	0.44999683279627883+0j	-2.4758296524041157e-09+0j
6	0.44999995472396714+0j	-3.5383473928618514e-11+0j
7	0.4499999999522736+0j	-3.735900477863652e-14+0j
8	0.450000000000077+0j	0j

Para el segundo punto usamos $p_0 = 0.44449 + 0i$, $p_1 = 0.45 + 0i$ y $p_2 = 0.46 + 0i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	0.46361984035922454-0.006480490395900713j	2.315981070533102e-06+2.077710561383672e-06j
1	0.4644536016521566-0.0013817275971592683j	1.6195876901825557e-06+3.940042875242439e-07j
2	0.4681675684182604-0.0016224161844768433j	4.894803319333008e-07+4.777100273906446e-07j
3	0.46941074191987503-0.0005016559512962782j	1.5250603035976695e-07+1.357088822529851e-07j
4	0.46996400037246505-0.0001786353845617478j	8.828068498445418e-09+4.5936642648156806e-08j
5	0.4700099838395804-1.818521082275532e-05j	-2.5606796683064204e-09+4.653959900532918e-09j
6	0.47000065692413423+3.1214107531578656e-07j	-1.682864958496566e-10-7.995896020945756e-11j
7	0.46999999705608536+1.2287968008216802e-09j	7.541745006278688e-13-3.147932586412226e-13j
8	0.470000000000476+1.5254619116459673e-13j	-2.220446049250313e-16-3.907928325070722e-17j

Para el tercer punto usamos $p_0 = 0.46 + 0i$, $p_1 = 0.47002 + 0i$ y $p_2 = 0.48321 + 0i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	0.47660443303598554+0j	-7.600668973095637e-07+0j
1	0.47989521248348477+0j	-3.938347747922677e-08+0j
2	0.47999870157997+0j	-4.947687815004542e-10+0j
3	0.4800000011944164+0j	4.551914400963142e-13+0j
4	0.48000000000005055+0j	-1.1102230246251565e-16+0j

Para el cuarto punto usamos $p_0 = 0.96 - 0.96i$, $p_1 = 0.97 - 0.97i$ y $p_2 = 0.98 - 0.98i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	0.999999989509428-0.9999999819177748j	-5.54634412841537e-08-2.507695140430144e-08j
1	1.0000000153197894-0.9999999870935946j	-3.288684002900055e-08+4.8170878397257866e-08j
2	1.0000000147687256-1.000000005888029j	2.139572685688762e-08+4.105273565535583e-08j
3	1.0000000006269771-1.0000000024209634j	7.197350604393193e-09+1.104973446075519e-09j
4	1.0000000016368629-0.9999999988980542j	-2.7112517786420653e-09+5.065483144051086e-09j

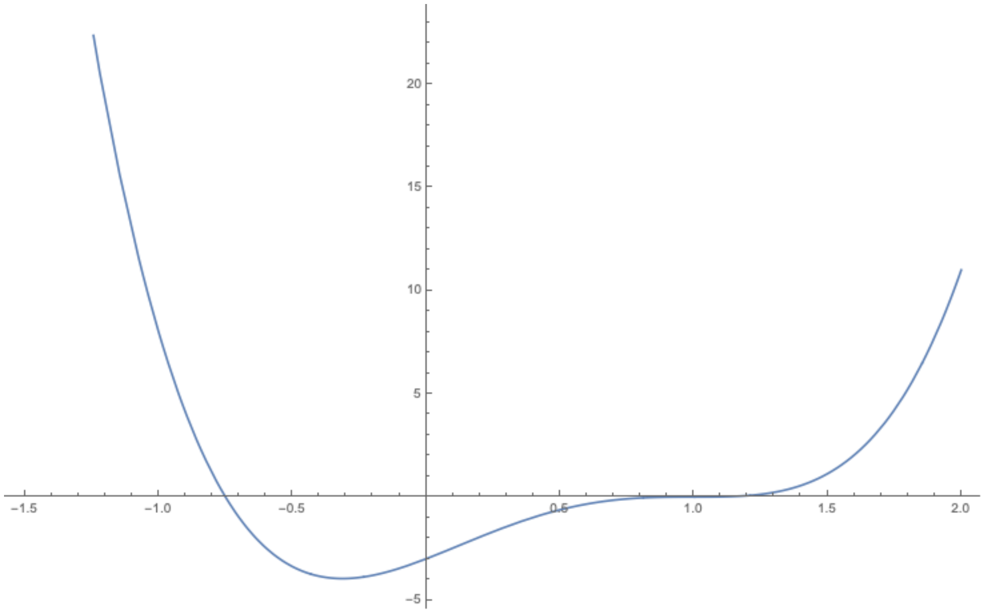
Para el cuarto punto usamos $p_0 = 0.96 + 0.96i$, $p_1 = 0.97 + 0.97i$ y $p_2 = 0.98 + 0.98i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	0.999999989509428+0.9999999819177748j	-5.54634412841537e-08+2.507695140430144e-08j
1	1.0000000153197894+0.9999999870935946j	-3.288684002900055e-08-4.8170878397257866e-08j
2	1.0000000147687256+1.000000005888029j	2.139572685688762e-08-4.105273565535583e-08j
3	1.0000000006269771+1.0000000024209634j	7.197350604393193e-09-1.104973446075519e-09j
4	1.0000000016368629+0.9999999988980542j	-2.7112517786420653e-09-5.065483144051086e-09j

3 3er ejercicio

Encontrar las raíces del polinomio $4x^4 - 9x^3 + 3x^2 + 5x - 3$

Empezamos por graficar el polinomio para localizar las raíces:



Para el primer punto usamos $p_0 = -1.2 + 0i$, $p_1 = -1 + 0i$ y $p_2 = -0.7 + 0i$ y obtenemos lo siguiente:

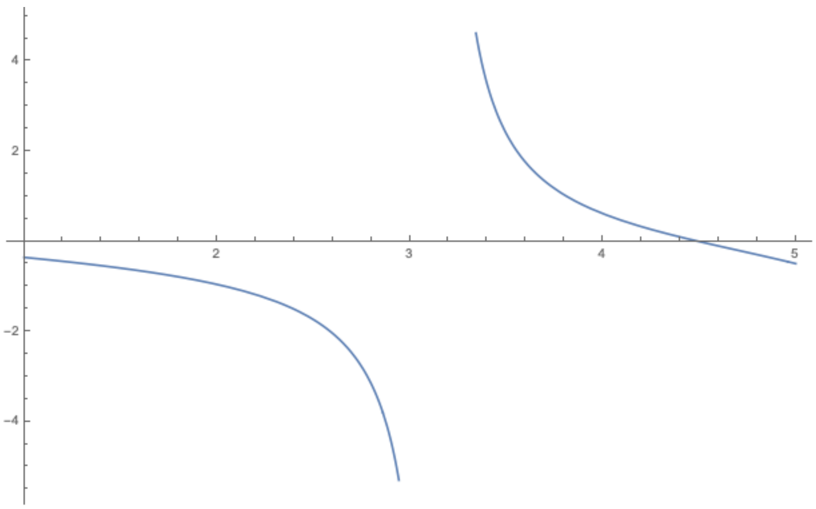
n	p_n	$f(p_n)$
0	-0.7496075804729001+0.00014754164740447048j	-0.008407635090922128-0.0031586699106211555j
1	-0.7499936143696264+3.4158211366882337e-06j	-0.00013689088140012018-7.322506243110868e-05j
2	-0.7499999895530871-3.1236003243294187e-09j	-2.239556913252727e-07+6.696217955436136e-08j
3	-0.7499999999998296-2.325816020044391e-13j	-3.652633751016765e-12+4.98596809296725e-12j
4	-0.75-8.415717376759247e-21j	1.8041194126427636e-19j

Para el segundo punto usamos $p_0 = 0.7 + 0i$, $p_1 = 0.8 + 0i$ y $p_2 = 0.9 + 0i$ y obtenemos lo siguiente:

n	p_n	$f(p_n)$
0	0.9999917539097252+0j	-3.9968028886505635e-15+0j
1	0.9999930288112501+0j	-2.6645352591003757e-15+0j
2	0.9999949014295727+0j	-2.239556913252727e-07+6.696217955436136e-08j
3	0.9999969129400132+0j	0j

4 4o ejercicio

Encuentre la raíz en el intervelo $(1, 4)$ de la ecuación $0 = tan(x) - x$... Graficamos la ecuación:



Obtuve la siguiente salida:

```
Pn =   (0.5856668850499257+0.031871354027825226j)    f(Pn) =   (0.07763120524727807-0.031871354027825226j)
Pn =   (0.6343486922117533+0.05378678195972636j)    f(Pn) =   (0.1014477578866434-0.05378678195972636j)
Pn =   (0.6276486207762642-0.009124017011029953j)    f(Pn) =   (0.09787087369165592+0.009124017011029953j)
Pn =   (0.6523773934308053+0.022896182845312682j)    f(Pn) =   (0.11158511944094351-0.022896182845312682j)
Pn =   (0.7392571942165473-0.0019431783213480422j)    f(Pn) =   (0.1724711549249066+0.0019431783213480422j)
Pn =   (0.728342277154346+0.07414994000222072j)    f(Pn) =   (0.16359431607275876-0.07414994000222072j)
Pn =   (0.7692535441512413+0.0067990543357318856j)    f(Pn) =   (0.19896751515899969-0.0067990543357318856j)
Pn =   (0.6982955991695758-0.08686104624233627j)    f(Pn) =   (0.14108336770641416+0.08686104624233627j)
Pn =   (0.7040447495173705-0.15927091493876575j)    f(Pn) =   (0.14518160128719682+0.15927091493876575j)
Pn =   (0.8568906441282128-0.13920648395672797j)    f(Pn) =   (0.2973869407745421+0.13920648395672797j)
Pn =   (0.7837290325115153-0.20029118506799531j)    f(Pn) =   (0.21293826533774451+0.20029118506799531j)
Pn =   (0.9463615656683555-0.31177891961538373j)    f(Pn) =   (0.4413221140578394+0.31177891961538373j)
Pn =   (0.9204248187034686-0.17492333471272897j)    f(Pn) =   (0.39399701399237286+0.17492333471272897j)
Pn =   (1.0190375952860966-0.3692598067508163j)    f(Pn) =   (0.6055847572496904+0.3692598067508163j)
Pn =   (0.8198856105659826-0.47939281662889377j)    f(Pn) =   (0.25158236845945825+0.47939281662889377j)
Pn =   (0.9726372587692411-0.48835717343153523j)    f(Pn) =   (0.49484845890915485+0.48835717343153523j)
Pn =   (0.9383554070567094-0.18858782646290817j)    f(Pn) =   (0.42616181143452325+0.18858782646290817j)
Pn =   (1.0535255244939514-0.173690183062307j)    f(Pn) =   (0.7041180238107483+0.173690183062307j)
Pn =   (0.8578708461768232-0.2711177104153648j)    f(Pn) =   (0.2986955098900279+0.2711177104153648j)
Pn =   (0.8456423514339728-0.40235195852776384j)    f(Pn) =   (0.2827353844582099+0.40235195852776384j)
Pn =   (0.922067459106631-0.1457782789601025 4j)    f(Pn) =   (0.3968447108529903 3+0.1457782789601025 4j)
Pn =   (0.8351570381321629-0.31066837001008357j)    f(Pn) =   (0.26966296033194603+0.31066837001008357j)
Pn =   (1.0592879803291024-0.20205246111204403j)    f(Pn) =   (0.7221614184292313+0.20205246111204403j)
Pn =   (0.8972983952885902-0.24981928364005196j)    f(Pn) =   (0.35589177809200057+0.24981928364005196j)
Pn =   (0.6958069149796313-0.3049188284582381j)    f(Pn) =   (0.13933878206090755+0.3049188284582381j)
Pn =   (0.7350755814621511-0.4999731133305765j)    f(Pn) =   (0.16902423452945514+0.4999731133305765j)
Pn =   (0.6884670901673817-0.24615533779524024j)    f(Pn) =   (0.13429517255119594+0.24615533779524024j)
Pn =   (0.8552936998602332-0.14422512781246055j)    f(Pn) =   (0.2952660912229277+0.14422512781246055j)
Pn =   (0.8443289781249054-0.3627349053641833j)    f(Pn) =   (0.2810675662218324+0.3627349053641833j)
Pn =   (0.788567447572954-0.17495441227100644j)    f(Pn) =   (0.21779129472926306+0.17495441227100644j)
Pn =   (0.6084338780952785-0.22544832142362564j)    f(Pn) =   (0.0881563781543937+0.22544832142362564j)
Pn =   (0.5471450678415788-0.34684217997903066j)    f(Pn) =   (0.06203890297882919+0.34684217997903066j)
Pn =   (0.6378166436603091-0.17426119446219498j)    f(Pn) =   (0.10333899092126109+0.17426119446219498j)
Pn =   (0.6990289222270409-0.03284460239057979j)    f(Pn) =   (0.14160080574913014+0.03284460239057979j)
Pn =   (0.7945949748818805-0.08103590172178454j)    f(Pn) =   (0.22396990924373672+0.08103590172178454j)
Pn =   (0.6664713037758889+0.04939459442841568j)    f(Pn) =   (0.1200553180074787-0.04939459442841568j)
Pn =   (0.7245242958837602+0.0799710843020907j)    f(Pn) =   (0.16058015066475473-0.0799710843020907j)
Pn =   (0.7379416797653479-0.07121251645139247j)    f(Pn) =   (0.1713805199298709+0.07121251645139247j)
Pn =   (0.7537975188229522-0.013823833211006477j)    f(Pn) =   (0.18491743778076541+0.013823833211006477j)
Pn =   (0.8479282464009141-0.11636457784306314j)    f(Pn) =   (0.2856593159979648+0.11636457784306314j)
Pn =   (0.7441380568983732-0.15144882081869415j)    f(Pn) =   (0.1765683891243629+0.15144882081869415j)
Pn =   (0.8623969353806733-0.14968039330999575j)    f(Pn) =   (0.30480556370031753+0.14968039330999575j)
Pn =   (0.836685252208653-0.012780402190765539j)    f(Pn) =   (0.271534082135483+0.012780402190765539j)
Pn =   (0.923905258311696-0.024067548749248487j)    f(Pn) =   (0.40005385538734184+0.024067548749248487j)
Pn =   (0.7749476618532053-0.042347729605817994j)    f(Pn) =   (0.20436675670890458+0.042347729605817994j)
Pn =   (0.8546142617238456-0.10089027712004132j)    f(Pn) =   (0.2943678923348515+0.10089027712004132j)
Pn =   (1.0234971067666137-0.12854252185663498j)    f(Pn) =   (0.6174737355326698+0.12854252185663498j)
Pn =   (0.920020731246169-0.233053341115043j)    f(Pn) =   (0.3932994552411784+0.233053341115043j)
Pn =   (1.0339655848613776-0.3572787011160914j)    f(Pn) =   (0.6463402513269396+0.3572787011160914j)
Pn =   (1.062689927213113-0.1726553030988708j)    f(Pn) =   (0.7330443346896127+0.1726553030988708j)
Pn =   (0.9449731135104408-0.36017559729877857j)    f(Pn) =   (0.43865622797122616+0.36017559729877857j)
Pn =   (0.8606149842700973-0.4699955210660351j)    f(Pn) =   (0.3023866347572902+0.4699955210660351j)
No se encontró la raiz
```

como podemos ve el metodo no converge. Usando la otra forma de la ecuación obtuve lo siguiente:

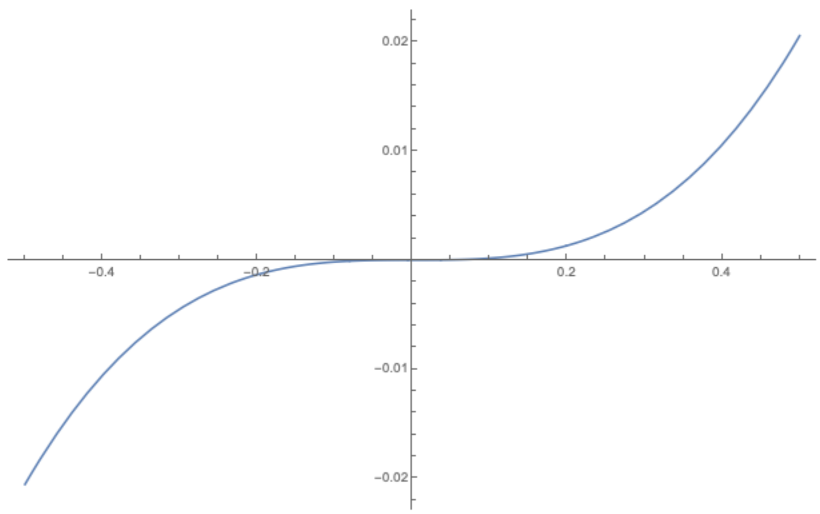
n	p_n	$f(p_n)$
0	4.49331814720452	9.13125603730081e-5
1	4.49340765899325	1.79891653645514e-6
2	4.49340945620222	1.70684263944842e-9
3	4.49340945790903	3.2834845953289e-14

Y como podemos observar me dio una raiz fuera del intervalo aunque en la gradica vemos que efectivamente la raiz está fuera del intervalo dado.

5 5o ejercicio

Encontrar las raíces complejas cercanas al origen de la ecuación $x - \sin(x)$

Empezamos por graficar el polinomio para localizar las raíces:



Esta función sólo tiene una raiz real en $(0, 0)$

Usando los puntos $p_0 = -0.1 + 0i$, $p_1 = 0.001 + 0i$ y $p_2 = 0.00001 + 0i$ obtuve

n	p_n	$f(p_n)$
0	0.001000903020366235	1.6711857635590133e-10

6 Codigo del programa

```
def MullerM(f,p0,p1,p2,tol,maxIter):
from numpy.lib.scimath import sqrt
p0 = p0
p1 = p1
p2 = p2
f0 = f(p0)
f1 = f(p1)
```

```
    f2 = f(p2)
    f3 = 0
    i = 0
    while i<=maxIter:
        c = f2
        b = ((p0-p2)**2 *(f1-f2)-(p1-p2)**2 *(f0-f2))/((p0-p2)*(p1-p2)*(p0-p1))
        a = ((p1-p1)*(f0-f2) - (p0-p2)*(f1-f2))/((p0-p2)*(p1-p2)*(p0-p1))
        p3 = p2 - 2*c/(b+(b/abs(b))*sqrt(b**2 -4*a*c))
        f3 = f(p3)
        print ("Pn = ", p3, "   f(Pn) = ", f3)
        if abs(p3-p2)<tol:
            return p3
        p0 = p1
        p1 = p2
        p2 = p3
        f0 = f(p0)
        f1 = f(p1)
        f2 = f(p2)
        i = i+1
    print ("No se encontro la raiz")

def f(x):
    fx = 16*x**4 + 70*x**3 -169*x**2 -580*x + 75
    return fx

MullerM(f,complex(1.5,0),complex(2,0),complex(2.5,0),0.00000001,100)
```