PONTIFICIA UNIVERSIDAD JAVERIANA

ANALISIS NUMÉRICO

TALLER 1

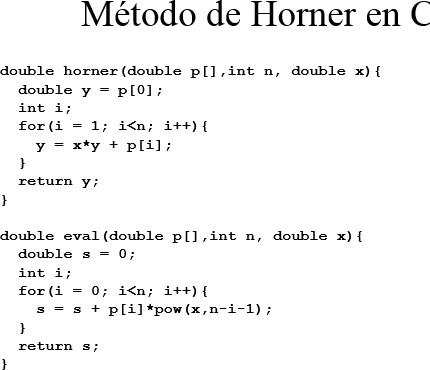
JOHAN DANIEL ORTEGÓN PARRA

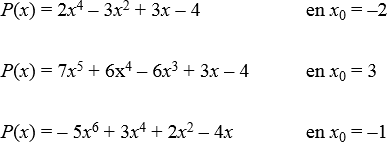
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BOGOTÁ D.C

2019

1. Evaluar el valor de un polinomio es una tarea que involucra para la maquina realizar un número de operaciones la cual debe ser mínimas. Para cada uno de los siguientes polinomios, hallar P(x) en el valor indicado y el número de operaciones mínimo para hacerlo (sugerencia utilizar el algoritmo Horner)





## Código Fuente (python 3)

from sympy import \*  
  
x = symbols('x')  
P1 = input("Por favor ingrese el polinomio a evaluar (use como variable x): ")  
Polinomio = Poly(P1)  
reemplazo\_variable = int(input("Por favor ingrese el valor por el que reemplazará la variable: "))  
coeficientes = Polinomio.all\_coeffs()  
resultado = coeficientes[0]  
iter = 0  
cant\_operaciones = 0  
while iter < len(coeficientes)-1:  
 resultado = reemplazo\_variable\*resultado + coeficientes[iter+1]  
 cant\_operaciones = cant\_operaciones+2  
 iter = iter+1  
  
print("El resultado es: ", resultado, "la cantidad de operaciones fueron: ", cant\_operaciones)

## Evaluación de los polinomios

en

Resultado: 10

Número de operaciones: 8

en

Resultado: 2030

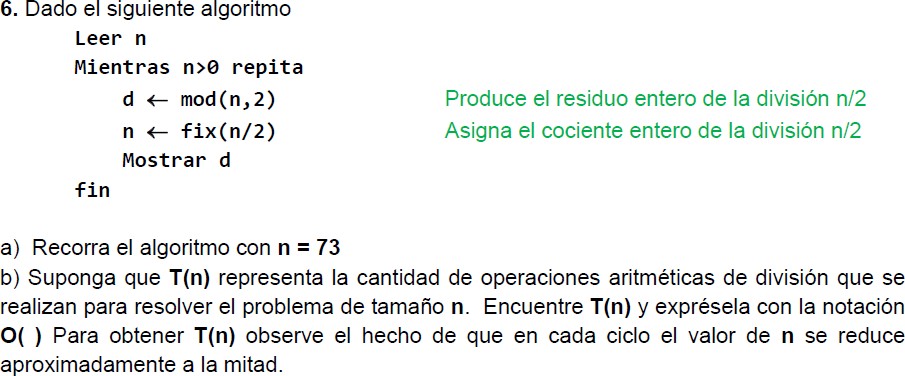
Número de operaciones: 10

en

Resultado: 4

Número de operaciones: 12

1. La eficiencia de un algoritmo esta denotada por **T(n)**



## Código fuente punto 2 (python 3)

n = int(input("Ingrese el numero n: "))  
while n > 0:  
 d = n%2  
 n = (n-d)/2  
 print('valor de d: ', d)

## Calculo de T(n)

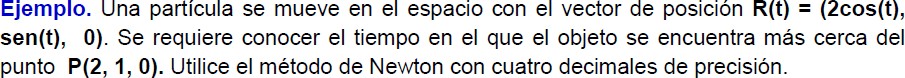
Dado que T(n) depende del numero de divisiones y al mismo tiempo el número de divisiones dependen directamente del número “n”

## Calculo de complejidad en términos o( )

Al observar el ciclo (while) del algoritmo podemos notar que la variable de la cual depende su finalización está avanzando de la forma lo cual expresa un decrecimiento y traduciendo al condicional del ciclo (while) quedaría

Despejando x: Por lo cual la complejidad es de

1. Utilice el método de Newton para resolver el problema, muestre gráficamente cómo se comporta la convergencia a la solución



## Imagen que contiene captura de pantalla Descripción generada automáticamenteGráficas, tablas y análisis

Grafica 1. Expresa el proceso de convergencia de la función usando el método de Newton, donde le eje X de la grafica expresa el numero de la iteración y el Y el valor del error.

Imagen que contiene captura de pantalla

Descripción generada automáticamente

|  |  |
| --- | --- |
| DATOS GRAFICA 1 | |
| ITERACIÓN | ERROR |
| 1 | 0,747 |
| 2 | 0,2747 |
| 3 | 0,1315 |
| 4 | 0,0651 |
| 5 | 0,0325 |
| 6 | 0,0162 |
| 7 | 0,0081 |
| 8 | 0,0041 |
| 9 | 0,002 |
| 10 | 0,001 |
| 11 | 0,0005 |
| 12 | 0,0003 |
| 13 | 0,0001 |
| 14 | 0,0001 |

Grafica 2. Expresa el proceso de convergencia de la función usando el método de Newton, donde le eje X de la gráfica expresa el numero de la iteración y el Y el valor del error.

|  |  |
| --- | --- |
| DATOS GRAFICA 2 | |
| ITERACIÓN | ERROR |
| 0 | 0,2934 |
| 1 | 0,1396 |
| 2 | 0,069 |
| 3 | 0,0344 |
| 4 | 0,0172 |
| 5 | 0,0086 |
| 6 | 0,0043 |
| 7 | 0,0021 |
| 8 | 0,0011 |
| 9 | 0,0005 |
| 10 | 0,0003 |
| 11 | 0,0001 |
| 12 | 0,0001 |

Viendo el comportamiento de las gráficas y las tablas de datos de donde se obtienen podemos ver que la disminución del error con el paso de las iteraciones describe un comportamiento que puede ser atribuido a la convergencia cuadrática.

## Código fuente (python 3)

import matplotlib.pyplot as plt  
#MODULO PARA ACCIONES GRAFICAS  
from pylab import \*  
#MODULO PARA EL MANEJO DE OPERACIONES MATEMATICAS Y MODULOS  
from sympy import \*  
from array import array  
t = symbols('t')  
PosX = 2\*cos(t) - 2  
PosY = sin(t) - 1  
derivadaX = PosX.diff(t)  
derivadaY = PosY.diff(t)  
#Declaracion del X y Y inicial  
X0 = 5  
Y0 = 0  
#Declarciond e la tolerancia  
Tol = 0.0001  
cont\_iteraciones = 0.0  
err = 1.0  
#Arreglos comportamiento de Newton  
ArrayX = []  
ArraYNumIteraciones = []  
  
ArrayY = []  
ArraYNumIteracionesY = []  
#Ciclo del algoritmo (Iteraciones)  
while (err > Tol) & (cont\_iteraciones < 50.0):  
  
 modificar = PosX.evalf(subs={t: X0})/derivadaX.evalf(subs={t: X0})  
 X1 = X0 - modificar  
 err = abs(X1 - X0)  
 print("{:^10}{:.3f}{:^10}{:.4f}{:^10}{:.4f}{:^10}{:.4f}".format('#iteracion: ', cont\_iteraciones,'\t X1: ' ,X1, 'error: ', err, 'Modificar: ', modificar))  
 ArrayX.append(err)  
 ArraYNumIteraciones.append(cont\_iteraciones)  
 X0=X1  
 cont\_iteraciones = cont\_iteraciones+1  
#REINICIAR VARIABLES  
err = 1  
cont\_iteraciones = 0  
while (err > Tol) & (cont\_iteraciones < 20.0):  
  
 modificar = PosY.evalf(subs={t: Y0})/derivadaY.evalf(subs={t: Y0})  
 Y1 = Y0 - modificar  
 err = abs(Y1 - Y0)  
 print("{:^10}{:.3f}{:^10}{:.4f}{:^10}{:.4f}{:^10}{:.4f}".format('#i: ', cont\_iteraciones, 'Y1: ', Y1, 'E: ', err, ' Modificar: ', modificar))  
 ArrayY.append(err)  
 ArraYNumIteracionesY.append(cont\_iteraciones)  
 Y0=Y1  
 cont\_iteraciones = cont\_iteraciones+1  
  
  
plt.plot(ArraYNumIteracionesY,ArrayY)  
plt.ylabel("Error")  
plt.xlabel("Número de iteraciones")  
plt.show()

1. Resolver por dos métodos diferentes, grafique las soluciones y comparar sus soluciones

Encuentre una intersección de las siguientes ecuaciones en coordenadas polares

Para el desarrollo de este punto se empleó el método de newton y el método secante, obteniendo valores similares en los resultados de cada método evaluado sobre una misma función.

from sympy import \*  
  
t = symbols('t')  
Fn1 = 2+cos(3\*t) - 2  
derivadaFn1 = Fn1.diff(t)  
  
# Declaracion del X0 inicial  
X0 = 1  
  
# Declarcion de la tolerancia  
Tol = 0.0001  
cont\_iteraciones = 0.0  
err = 1.0  
  
# Ciclo del algoritmo Newton (Iteraciones)  
print('Metodo de Newton')  
while (err > Tol) & (cont\_iteraciones < 50.0):  
 modificar = Fn1.evalf(subs={t: X0}) / derivadaFn1.evalf(subs={t: X0})  
 X1 = X0 - modificar  
 err = abs(X1 - X0)  
 print(  
 "{:^10}{:.3f}{:^10}{:.5f}{:^10}{:.4f}".format('#iteracion: ', cont\_iteraciones, '\t X1: ', X1, 'error: ', err))  
 X0 = X1  
 cont\_iteraciones = cont\_iteraciones + 1  
  
# Inicializacion de variables  
cont\_iteraciones = 0.0  
err = 1.000  
X0 = 1  
X1 = 2  
# Ciclo del algoritmo Secante (Iteraciones)  
print('\nMetodo Secante')  
while err > Tol:  
 X2 = X1 - (((X1 - X0) \* Fn1.evalf(subs={t: X1})) / (Fn1.evalf(subs={t: X1}) - Fn1.evalf(subs={t: X0})))  
 err = abs(Fn1.evalf(subs={t: X2}))  
 print(  
 "{:^10}{:.3f}{:^10}{:.5f}{:^10}{:.4f}".format('#iteracion: ', cont\_iteraciones, '\t X2: ', X2, 'error: ', err))  
 # print('#iteracion: ', cont\_iteraciones,'\t X2: ' ,X2, 'error: ', err)  
 X0 = X1  
 X1 = X2  
 cont\_iteraciones = cont\_iteraciones + 1

from sympy import \*  
  
t = symbols('t')  
Fn1 = 2 - exp(t)  
derivadaFn1 = Fn1.diff(t)  
  
# Declaracion del X0 inicial  
X0 = 1  
  
# Declarcion de la tolerancia  
Tol = 0.0001  
cont\_iteraciones = 0.0  
err = 1.0  
  
# Ciclo del algoritmo Newton (Iteraciones)  
print('Metodo de Newton')  
while (err > Tol) & (cont\_iteraciones < 50.0):  
 modificar = Fn1.evalf(subs={t: X0}) / derivadaFn1.evalf(subs={t: X0})  
 X1 = X0 - modificar  
 err = abs(X1 - X0)  
 print(  
 "{:^10}{:.3f}{:^10}{:.5f}{:^10}{:.4f}".format('#iteracion: ', cont\_iteraciones, '\t X1: ', X1, 'error: ', err))  
 X0 = X1  
 cont\_iteraciones = cont\_iteraciones + 1  
  
# Inicializacion de variables  
cont\_iteraciones = 0.0  
err = 1.000  
X0 = 1  
X1 = 2  
# Ciclo del algoritmo Secante (Iteraciones)  
print('\nMetodo Secante')  
while err > Tol:  
 X2 = X1 - (((X1 - X0) \* Fn1.evalf(subs={t: X1})) / (Fn1.evalf(subs={t: X1}) - Fn1.evalf(subs={t: X0})))  
 err = abs(Fn1.evalf(subs={t: X2}))  
 print(  
 "{:^10}{:.3f}{:^10}{:.5f}{:^10}{:.4f}".format('#iteracion: ', cont\_iteraciones, '\t X2: ', X2, 'error: ', err))  
 # print('#iteracion: ', cont\_iteraciones,'\t X2: ' ,X2, 'error: ', err)  
 X0 = X1  
 X1 = X2  
 cont\_iteraciones = cont\_iteraciones + 1

1. Resolver los ejercicios 13,14 y 15
2. El siguiente algoritmo permite calcular la raíz n-enésima de un número real a través de operaciones aritméticas básicas, siendo este proceso no muy preciso en el instante de calcular una raíz n no exacta.

## Código Fuente

# Ingreso de datos  
num = float(input('Ingrese el valor de numero a saca raíz: '))  
rz = int(input('Ingrese la raiz a sacar: '))  
# Inicialización de variables  
a = 0 # resultado  
cantidad = 0 # raíz más cercana  
  
#Búsqueda de la raiz más cercana o exacta   
while cantidad <= num:  
 if ( cantidad == num ):  
 break  
 a = a + 1  
 cantidad = a  
 for i in range(rz - 1): # Calculo de raices cercanas  
 cantidad = cantidad \* a  
if cantidad > num:  
 a = a - 1  
  
d = (1) / 10 # Declaración de un menor rango de busqueda  
#Búsqueda más precisa del valor de la raiz  
while (d > 0.01):   
 if cantidad == num:  
 break  
 cantidad = a  
 for i in range(rz - 1):  
 cantidad = cant \* a  
 if cantidad < num:  
 if cant + d < num:  
 a = a + d  
 continue  
 else:  
 break  
 d = d / 10  
 a = a + d  
  
print('La raiz ', rz, ' de ', num, ' es: ', a)

1. El siguiente es un procedimiento intuitivo para calcular una raíz real positiva de la ecuación f(x) = 0 en un intervalo [a, b] con precisión E

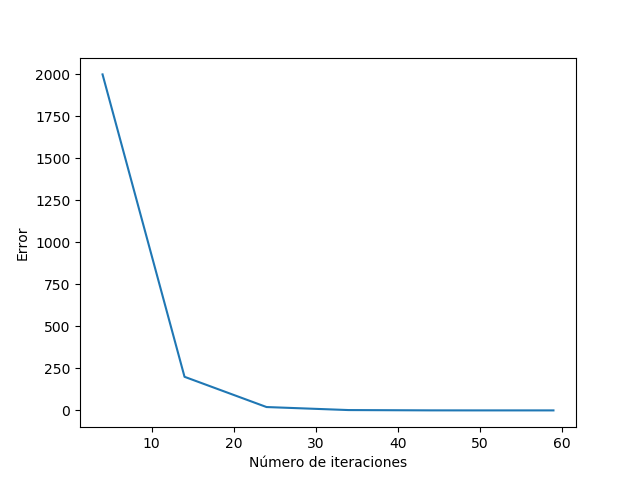
## Código Fuente

#MODULO PARA LE MANEJO DE POLINOMIOS  
from sympy import \*  
#ENTRADA DE POLINOMIO POR CONSOLA  
x = symbols('x')  
P1 = input("Por favor ingrese el polinomio a evaluar (use como variable x): ")  
poli = Poly(P1)  
#ESPECIFICACION DE LIMITES Y ERROR  
a = float(input('Por favor introducir valor de límite innferior(a): '))  
b = float(input('Por favor introducir valor de límite superior(b): '))  
E = float(input('Por favpr ingrese la precision (E): '))  
  
x1 = a  
d = (b-a)/10  
x0 = x1  
x1 = x1 + d  
  
while abs(d) >= E:  
 if poli(x0)\*poli(x1) <= 0:  
 x1 = x1 - d  
 d = d/10  
 x1 = x1 + d  
 else:  
 #print('valor de d = ', d,'X0', x0, "X1", x1, 'polinomio: ', poli(x0)\*poli(x1))  
 x0 = x1  
 x1 = x1 + d  
 if x1 > b:  
 print('La función ha superado el límite superior establecido en el rango, intente con uno nuevo')  
 break  
  
print('La raiz es :', x1)

1. Condiciones para que la raíz exista, sea única y pueda ser calculada

Para que la raíz exista la función debe estar sometida a un cambio de signo dentro del intervalo establecido, para determinar que la raíz es única la función debe ser derivable, debe existir y su solución no puede estar contenida en el intervalo dado. Final mente para que la raíz pueda ser calculada la función debe ser continua en el intervalo seleccionado.

1. Orden de convergencia y factor de convergencia del método



Grafica 3. Expresa el proceso de convergencia de la función usando el método intuitivo expresado en el punto 14, donde el eje X expresa el numero de la iteración y el eje Y el error

|  |  |
| --- | --- |
| DATOS GRAFICA 2 | |
| ITERACIÓN | ERROR |
| 0 | 2000 |
| 14 | 200.000 |
| 24 | 200.000 |
| 34 | 200.000 |
| 44 | 0,20000 |
| 49 | 0,02000 |
| 59 | 0,00200 |
| 69 | 0,00020 |
| 79 | 0,00002 |

Gracias a la apreciación de la grafica y los datos de donde procede podemos concluir que la convergencia del método es de carácter lineal y su factor de convergencia, debido a la manera en la que se comporta la disminución del error con el paso de las iteraciones, es de

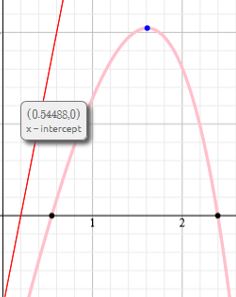
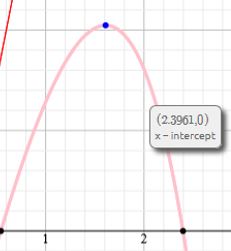
15) Se propone resolver la ecuación Con el método de punto fijo

a) Obtener la ecuación f(x) = 0 resolviendo la integral

b) Mediante un gráfico aproximado localice las raíces reales

![Imagen que contiene pared, interior

Descripción generada automáticamente](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RD4RXhpZgAATU0AKgAAAAgABAE7AAIAAAAPAAAISodpAAQAAAABAAAIWpydAAEAAAAeAAAQ0uocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAGRhbmllbCBvcnRlZ29uAAAABZADAAIAAAAUAAAQqJAEAAIAAAAUAAAQvJKRAAIAAAADODUAAJKSAAIAAAADODUAAOocAAcAAAgMAAAInAAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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+8U8/WrPm/7DflVfUf8AUJ/11X+dW6AI2k+Q/I3T0pEkxGPlbp6VI/3D9KSP/Vr9KAE83/Yb8qZHJjd8rfePapqZF/F/vGgA83/Yb8qYJP35O1vujtU1MH/Hwf8AdH9aADzf9hvypjyZaP5W+96exqamSffj/wB7+hoAPN/2G/Kq2oPusJl2kZU8mrlVdS/5Bs/+6aAE09lWxQMQDzwT7mrPmJ/eX86r6eoNihIyef5mrOxfQUARo673+YdfWn+Yn95fzpiKu9+B1qTYvoKAIy6+cvzD7p70/wAxP7y/nTSq+cvA+6afsX0FAEcrrhfmH3h396f5if3l/OmyquF4H3h/On7F9BQA13TYfmXp60I6eWvzL0Heh0XYeB0oRV8teB0FAC+Yn95fzqrYsFjl3ED96Tyat7F9BVWwAMcuRn96f6UAWfMT+8v50wOvnH5h09ak2L6CmBV848DpQA7zE/vL+dMd13p8w6+tSbF9BTHVfMTgdaAHeYn95fzpkzqYWww6etSbF9BTJlXyW4HSgB3mJ/eX86DImPvL+dLsX0FIUXHQUANidRGPmHfvTvMT+8v502JV8scDvT9i+goAqWzAXdySQAWGOetWvMT+8v51WtgDd3QI6MMVa2L6CgCMuvnD5h09af5if3l/OmlV85eB0p+xfQUARyupC4YfeHen+Yn95fzpsqrheB94U7ao6gUAcRczx3vj3VJlPNlaQ2o54JYu7fpsrr7ALFYxKWUHGTzXF6JvuWv7uRBuvNRldWA6omIh/wCizXdRooiQYH3RWNLVX7nr5j7nLS7JL7kk/wAbjvMT+8v50yN1w3zD7x71JsX0FMjVcNwPvGtjyB3mJ/eX865OyZf+Fs6kdwx/ZsfOf9oV1uxfQVyVko/4W1qQxx/Zsf8A6EKAOs8xP7y/nTHdd6fMOvrUmxfQUx1XenA60AO8xP7y/nTZXUxnDD86fsX0FMlVRGeBQA4SJj7y/nR5if3l/OgIuOgpdi+goAjhdREMsPzp/mJ/eX86bCqmIcCn7F9BQBGjr5j/ADDqO9P8xP7y/nTUVfMfgdRT9i+goAqSMDqcJyMBGyc1a8xP7y/nVaQD+04RjjY1Wti+goAjldSo+YdfWn+Yn95fzpsqrtHA60/YvoKAGu6eW3zL0Pes/ViracuCCQwPWtB1Xy24HQ1T1JB/ZTnHOB/MUnsa0XapH1JrKRfsMOWGdo71JG6/N8w+8e9Q6btfT4uBwMVPGq/NwPvGhbE1NJsd5if3l/OmB184/MPu+tSbF9BTAq+eeB92mQO8xP7y/nVW6YG4tSCDiTnnpxVvYvoKq3YAuLXA6yc/lQBZ8xP7y/nTZXUxnDD86fsX0FMlVfLPAoAcJEwPmX86PMT+8v50BFwOBS7F9BQBHE6iMZYfnT/MT+8v502JV8scCn7F9BQBGjr5knzDqO/tT/MT+8v501FXzJOB1H8qfsX0FAEZdfOX5h0Pen+Yn95fzppVfOXgdDT9i+goAqX7BoU2kH94vQ+9WvMT+8v51W1AAQpgY/eL/OrWxfQUANd02H5l6etIjr5a/MvT1pXRdh4HSiNV8teB0oAXzE/vL+dMjdRu+YfePepNi+gqONV+bgfeNAD/ADE/vL+dMDr55O4fdHf61JsX0FRhV888D7o/rQA/zE/vL+dMkdd0fzD73r7GpNi+gqORV3x8D739DQA/zE/vL+dVtRZW0+YKQSVOADVrYvoKq6ioGnzEDB2mgBdO/wCPCP8AH+Zq1WZYWKvZofOnHXgSkd6sf2en/Pe4/wC/rf40AWE/1kn1p9UU09S7/vp+v/PVqf8A2en/AD3uP+/rf40AWD/r1/3TT6onT084Dzp+h/5atT/7PT/nvcf9/W/xoAsS/dX/AHh/On1Rk09QF/fT/eH/AC1b1p/9np/z3uP+/rf40AWn+4fpSR/6tfoKqtp67T+/uOn/AD1b/GkTT1Ma/v5+g/5at/jQBdqpp/8Aq5f+urf0o/s9P+e9x/39b/Gq1lYq0cv76YYkI4kIoA1KYP8AXt9Kr/2en/Pe4/7+t/jTBp6+cR50/T/nq1AF6mP/AKxPrVf+z0/573H/AH9b/GmPp670/fT9f+erUAXqZN/qW+lV/wCz0/573H/f1v8AGmS6eoiY+dP0/wCerUAXqD0NVP7PT/nvcf8Af1v8aDp6Y/19x/39b/GgCxF/qx+P86fVGLT1MY/fT/8Af1qf/Z6f897j/v63+NABa/8AH5df7w/rVusu3sVa6uR50wwR0lPNWf7PT/nvcf8Af1v8aALB/wBev0p9UTp6+cB50/T/AJ6tT/7PT/nvcf8Af1v8aALEv3V/3hVTWrtLHQ725kO1Y4WOfwok09QB++n+8P8Alq1c946t/K8NGCJ5pHu50gCmQnOTn+lRUfLBs6cJTVXEQg+rRH4StDDpmnRFt3l2wkJPq3zn9WNdjH/q1+grB0qyjkSXaXRIxtTaxHHp/KtNNPUxr+/n6D/lq3+NEFyxSNMdUdSu5P8Aq+pdpkXRv941X/s9P+e9x/39b/GqF/ok99ZPFZaxfabLvz58DK7AemHDD9Ks4jG8X+PI9B1W30ezlsor+4AYzX8hWGEZ/ixySewH1p+mFm+Kl+XKljpcZJTofmHSsTXPAesNdaitiU1VdYsBZXN1ezBHhIG3eVUYcYJJUY5Aq9oukpZ/Ee6sxPOwh0qJd/mHJwQKAO9pj/fT61X/ALPT/nvcf9/W/wAaY+nqHT99P1/56tQBepkv+qNV/wCz0/573H/f1v8AGmS6eojP76f/AL+tQBeHQUVUGnrj/X3H/f1v8aP7PT/nvcf9/W/xoAsQ/wCqFPqjFp6mMfvp/wDv61P/ALPT/nvcf9/W/wAaALCf6x/qKfVFdPXzH/fT9v8Alq1P/s9P+e9x/wB/W/xoAJf+QpD/ALjVbrLksVGoxL50/KHnzTmrP9np/wA97j/v63+NAFiX7o+tPqjJp6hR++n6/wDPVqf/AGen/Pe4/wC/rf40AWX/ANW30NVr5d2lyD/ZzTX09Qjfv7jp/wA9W/xqOWwUWbt5sxwhODIcdKC4O0kx+jnOnL9TVuL+L/eNZWl2qz2mTLKpDHhJCBVqPT1O799P94/8tWpLYutpUkXqYP8AXn/dFV/7PT/nvcf9/W/xpg09fOI86f7v/PVqZiXqqXf/AB82v/XT+lH9np/z3uP+/rf41WurFVuLYedOcvjmU8cUAalMl/1Zqv8A2en/AD3uP+/rf402TT1EZ/fT/wDf1qALo6CiqY09MD9/cf8Af1v8aX+z0/573H/f1v8AGgCxD/qhT6oxaepjH76f/v63+NP/ALPT/nvcf9/W/wAaALCf62T6j+VPqiunr5j/AL6fqP8Alq3pT/7PT/nvcf8Af1v8aALDf65Pof6U+qJ09fOUedP0P/LVqf8A2en/AD3uP+/rf40AGo/6hP8Arqv86t1l31iqQoRNMf3ijmQnvVn+z0/573H/AH9b/GgC0/3D9KSP/Vr9Kqtp67D+/uOn/PVv8aRNPUxj9/P0/wCerf40AXaZF/F/vGq/9np/z3uP+/rf40yPT1O799P94/8ALVqAL1MH/Hwf90f1qv8A2en/AD3uP+/rf40wWC+cR50/3R/y1agC9TJPvx/739DVf+z0/wCe9x/39b/GmPp6hk/fT8t/z1b0NAF6qupf8g2f/dNJ/Z6f897j/v63+NVtQsVSwmbzpzhTwZSaALWnf8eEf4/zNWqp2+6CBY8jjPbPepPOb1H5UASp/rJPrT6rLIwZjkcn0pfOb1H5UASn/Xr/ALpp9VvMbeGyOBjpS+c3qPyoAll+6v8AvD+dPqs0jMByOCD0pfOb1H5UATv9w/Skj/1a/QVCZWIIyPyoWVgoGRwPSgCxVTT/APVy/wDXVv6U/wA5vUflUVvuhVxkfM5bpmgC7TB/r2+lRec3qPypBI28tkdPSgCzTH/1ifWovOb1H5UjSMWU5HB9KALNMm/1LfSovOb1H5UjyMyEZHPtQBZoPQ1X85vUflR5reo/KgCWL/Vj8f50+qySMqgZH5UvnN6j8qAGWv8Ax+XX+8P61bqlFujmlfI/eEHpUvnN6j8qAJT/AK9fpT6rGRt4bI6elL5zeo/KgCWX7q/7wrk/F8hm8Q6JaRy7TG0l06+u0AL/ADNdM0jMByODnpWFf6JNe+JjqZePatosEYJIIbexY9OmCv5VnUTasjvwEowrc8uif4q36mtpUfl6Xn+/lv6f0q9H/q1+gqrFuitliBHC46VIsrBQMjgelWtjkqS5ptlimRdG/wB41F5zeo/KkWRlzyOTnpTMyzXJWX/JW9S/7Bsf/oQrpfOb1H5ViW+lXUXja71lpIvImtFgVRncCCDyMYx+NAHR0x/vp9ai85vUflSNIxYHI49qALNMl/1RqLzm9R+VI8jMpGR+VAFkdBRVfzW9R+VHnN6j8qAJYf8AVCn1WSRlUDI/Kl85vUflQBKn+sf6in1WEjBmORz7UvnN6j8qAGS/8hSH/cardUm3NdJLkfKpHSpfOb1H5UASy/dH1p9VmkZgOR19KXzm9R+VAEz/AOrb6GmSDNm49UP8qY0rFSMjkelJ5jbNpI6Y6UDWjKmhn9xKPRq0Yv4v941n2EMlosgZl+ZsjHNWlkZc8jk56UlsbV2nUbRZpg/15/3RUXnN6j8qTzG8wtkdMdKZgWaqXf8Ax82v/XT+lP8AOb1H5VFLukkibI/dtnpQBdpkv+rNRec3qPypGkZlIyPyoAsjoKKriVvUflR5zeo/KgCWH/VCn1WSRlUDI/Kl85vUflQBKn+tk+o/lT6rCRgzHI59qXzm9R+VAErf65Pof6U+qxkYuGyOAe1L5zeo/KgBmo/6hP8Arqv86t1SuN00arkcMG6Y6GpfOb1H5UATv9w/Skj/ANWv0qEysVIyPypFlYKBkce1AFmmRfxf7xqLzm9R+VIsjLnkcnPSgCzTB/x8H/dH9ai85vUflSeY3mFsjpjpQBZpkn34/wDe/oai85vUflSNIxKnI4OelAFmqupf8g2f/dNO85vUflUdzunt3jyPmGOmKAP/2Q==)

Grafica 4. La grafica representa el comportamiento de la función 5 resaltando los cortes con los ejes

Graficas 5 y 6. Representan las raíces reales de la función

Dada la información del gráfico podemos afirmar que las raíces se encuentran en 0.54488 y 2.396

1. Proponer la ecuación equivalente , determine el intervalo de convergencia para calcular una de las dos raíces

Intervalo para el cálculo de la primera raíz

1. Elegir valor inicial y realizar 5 iteraciones con cada iteración verifique que se cumple la condición de convergencia de punto fijo y estime el error de truncamiento del ultimo resultado

Valor inicial: 1

PROCESO DE ITERACIÓN

|  |  |  |
| --- | --- | --- |
| DATOS DE PUNTO FIJO | | |
| ITERACIÓN | APROXIMACIÓN | ERROR |
| 0 | 0,4983649 | 0.1973753 |
| 1 | 0,5292055 | 0.05827717 |
| 2 | 0,5395166 | 0.0191117 |
| 3 | 0,5430355 | 0.006480044 |
| 4 | 0,5442447 | 0.002221853 |

Validación de la condición de convergencia:

Estimación del error de truncamiento:

Valor final: 0,54424

Raíz estimada por la grafica: 0.54488