



**UNIVERSIDAD AUTÓNOMA DE
NUEVO LEÓN**



FACULTAD DE INGENIERÍA MECÁNICA Y ELÉCTRICA
Metodos numericos

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1) $x = 3.75$

i	X	f(x)
1	3	3.03
2	3.5	3.48
3	4	4.08
4	4.5	4.87



a) Newton hacia atras

$x = 3.75$ $x_1 = 3$ $y_1 = 3.03$

$\begin{cases} x_2 = 3.5 & y_2 = 3.48 \\ x_3 = 4 & y_3 = 4.08 \\ x_4 = 4.5 & y_4 = 4.87 \end{cases}$

$h_1 = |x_2 - x_1| = |3.5 - 3| = .5$

$h_2 = |x_3 - x_2| = |4 - 3.5| = .5$ Uniformes

$h_3 = |x_4 - x_3| = |4.5 - 4| = .5$

i	x_i	y_i	$\nabla f(x_i)$	$\nabla^2 f(x_i)$
1	$x_1 = 3$	$y_1 = 3.03$		
2	$x_2 = 3.5$	$y_2 = 3.48$	$\nabla_1 = y_2 - y_1$ $= 3.48 - 3.03$ $= 0.45$	
3	$x_3 = 4$	$y_3 = 4.08$	$\nabla_2 = y_3 - y_2$ $= 4.08 - 3.48$ $= 0.6$	$\nabla^2_1 = \nabla_2 - \nabla_1$ $= 0.6 - 0.45$ $= 0.15$
4	$x_4 = 4.5$	$y_4 = 4.87$	$\nabla_3 = y_4 - y_3$ $= 4.87 - 4.08$ $= 0.79$	$\nabla^2_2 = \nabla_3 - \nabla_2$ $= 0.79 - 0.6$ $= 0.19$



$$S = \frac{x - x_i}{h} = \frac{3.75 - 4.5}{-0.5} \quad \boxed{S = 1.5}$$

$$\begin{bmatrix} S \\ 0 \end{bmatrix} = 1 \quad \begin{bmatrix} S \\ 1 \end{bmatrix} = -1.5 \quad \begin{bmatrix} S \\ 2 \end{bmatrix} = 0.375$$

$$g(x) = y_0 \left[\frac{S}{2} \right] + y_1 \left[\frac{S(S+1)}{2} \right] + y_2 \left[\frac{S(S+1)}{2} \right] + y_3 \left[\frac{S(S+1)}{2} \right]$$

$$= 4.87(1) + (0.6)(-1.5) + (0.15)(0.375) + (0.79)(0.375)(0.49)$$

$$\boxed{g(x) = 4.39375}$$

b) Newton hacia adelante

$$x = 3.75 \quad \begin{cases} x_1 3 & y_1 3.03 \\ x_2 3.5 & y_2 3.48 \\ x_3 4 & y_3 4.08 \\ x_4 4.5 & y_4 4.87 \end{cases}$$

$$h = |x_{i+1} - x_i|$$

$$h_1 = |3.5 - 3| = 0.5$$

$$h_2 = |4 - 3.5| = 0.5$$

$$h_3 = |4.5 - 4| = 0.5$$

Uniforme



i	X_i	y_i	$\Delta^1 f(x_i)$	$\Delta^2 f(x_i)$
1	$x_1 = 3$	$y_1 = 3.03$	$\Delta^1_1 = y_2 - y_1$ $= 3.48 - 3.03$ $= 0.45$	$\Delta^2_1 = \Delta^1_2 - \Delta^1_1$ $= 0.8 - 0.45$ $= 0.35$
2	$x_2 = 3.5$	$y_2 = 3.48$	$\Delta^1_2 = y_3 - y_2$ $= 4.08 - 3.48$ $= 0.6$	$\Delta^2_2 = \Delta^1_3 - \Delta^1_2$ $= 0.79 - 0.6$ $= 0.19$
3	$x_3 = 4$	$y_3 = 4.08$	$\Delta^1_3 = y_4 - y_3$ $= 4.87 - 4.08$ $= 0.79$	
4	$x_4 = 4.5$	$y_4 = 4.87$		

$$S = \frac{x - x_i}{h} \quad S = \frac{3.75 - 3}{0.5} \quad \boxed{S = 1.5}$$

$$\left[\begin{matrix} S \\ 0 \end{matrix} \right] = 1 \quad \left[\begin{matrix} S \\ 1 \end{matrix} \right] = 1.5 \quad \left[\begin{matrix} S \\ 2 \end{matrix} \right] = 0.375$$

$$q(x) = y_1 \left[\begin{matrix} S \\ 0 \end{matrix} \right] + \Delta^1_1 \left[\begin{matrix} S \\ 1 \end{matrix} \right] + \Delta^2_1 \left[\begin{matrix} S \\ 2 \end{matrix} \right] + \Delta^3_1 \left[\begin{matrix} S \\ 3 \end{matrix} \right] + \Delta^4_1 \left[\begin{matrix} S \\ 4 \end{matrix} \right]$$

$$= (3.03)(1) + (0.45)(1.5) + (0.35)(0.375) + (0.45)(0.375)(0.375) + (0.375)(0.375)$$

$$\boxed{q(x) = 4.39375}$$



C) Newton con diferencias divididas

C) Lagrange

X	y	
x ₁ 3	3.03	y ₁
x ₂ 3.5	3.48	y ₂
x ₃ 4	4.08	y ₃
x ₄ 4.5	4.87	y ₄

-0.1875

$$g(x) = \frac{y_1(x-x_2)(x-x_3)(x-x_4)}{(x_1-x_2)(x_1-x_3)(x_1-x_4)} + \frac{y_2(x-x_1)(x-x_3)(x-x_4)}{(x_2-x_1)(x_2-x_3)(x_2-x_4)} + \frac{y_3(x-x_1)(x-x_2)(x-x_4)}{(x_3-x_1)(x_3-x_2)(x_3-x_4)} + \frac{y_4(x-x_1)(x-x_2)(x-x_3)}{(x_4-x_1)(x_4-x_2)(x_4-x_3)}$$

$$g(x) = (-0.1875) + (1.9575) + (2.295) + (0.309375)$$

$$g(x) = 4.39375$$



d) interpolacion lineal

$L_n 3.75$

a)

$$L_n 2 = 0.69314718$$

$$L_n 4 = 1.386294361$$

$$a = 2$$

$$b = 4$$

$$f(a) = L_n 2$$

$$f(b) = L_n 4$$

$$x = 3.75$$

$$L_n 3.75 = 1.32175584$$

$$f(x) = L_n 3.75$$

$$g(x) = f(b) - f(a) \frac{(x-a)(f(a))}{b-a}$$

$$g(x) = (3.75-2) \left[\frac{1.386294361 - 0.69314718}{4-2} \right]$$

$$g(x) = 1.2996509639$$

$$E = |f(x) - g(x)|$$

$$E = |1.32175584 - 1.2996509639|$$

$$E = 0.0221048766$$

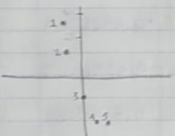


2) $f(x) = 2x^2 - 6x - 3$

a) Metodo grafico

x	y
-2	17
-1	5
0	-3
1	-7
2	-7

$2(-2)^2 - 6(-2) - 3 = 17$
 $2(-1)^2 - 6(-1) - 3 = 5$
 $2(0)^2 - 6(0) - 3 = -3$
 $2(1)^2 - 6(1) - 3 = -7$
 $2(2)^2 - 6(2) - 3 = -7$



b) punto fijo o sustituciones sucesivas

$2x^2 - 6x - 3 = 0$

a) $x = \frac{6x^2 - 3}{2}$ b) $2x^2 = 6x + 3$ c) $x = \frac{3}{2x-6}$
 $2x = \sqrt{6x+3}$
 $x = \frac{\sqrt{6x+3}}{2}$

1) despegar

$2x^2 - 6x - 3 = 0$

$x = \frac{3}{2} (3 + \sqrt{15})$



2) tabla

$$f = x^2 - 3$$

i	$2x^2 - 3/6$	X_i	$E = X_{i+1} - X_i $
0	-	0	-
1	$2(0)^2 - 3/6$	-0.5	-0.5
2	$2(-0.5)^2 - 3/6$	-0.416666	0.083333
3	$2(-0.41666)^2 - 3/6$	-0.44212969	0.02546369
4	$2(-0.442129)^2 - 3/6$	-0.43912691	0.00278909
5	$2(-0.439126)^2 - 3/6$	-0.436971208	0.0021305542
6	$2(-0.436971)^2 - 3/6$	-0.43635255	0.0006191413
7	$2(-0.436352)^2 - 3/6$	-0.436532897	0.0001802397
8	$2(-0.436532)^2 - 3/6$	-0.43647495 ₁₉	0.000052428
9	$2(-0.436474)^2 - 3/6$	-0.436495113	0.0000152611
10	$2(-0.436495)^2 - 3/6$	-0.436490672	$\epsilon =$ 0.000004489

$X_{10} = -0.436490672$



C) Metodo Newton Raphson $2x^2 - 6x - 3$

$$f'(x) = 4x - 6$$

i	x_{i+1}	$\epsilon = x_{i+1} - x_i $
0	$x_0 = 1$	
1	$x_1 = x_0 - \frac{2x_0^2 - 6x_0 - 3}{4x_0 - 6}$ $x_1 = 2.5$	$ x_1 - x_0 = 2.5 - 1 = 1.5$
2	$x_2 = x_1 - \frac{2x_1^2 - 6x_1 - 3}{4x_1 - 6}$ $x_2 = 3.875$	$ x_2 - x_1 = 3.875 - 2.5 = 1.375$
3	$x_3 = x_2 - \frac{2x_2^2 - 6x_2 - 3}{4x_2 - 6}$ $x_3 = 0.3980210526$	$ x_3 - x_2 = 3.875 - 0.3980210526 = 3.4769789474$
4	$x_4 = x_3 - \frac{2x_3^2 - 6x_3 - 3}{4x_3 - 6}$ $x_4 = -4.255899519$	$ x_4 - x_3 = 0.3980210526 - (-4.255899519) = 4.6539205716$

5
... Falso pos. v.



d) Metodo falsa posicion

$$2x^2 - 6x - 3$$

$$x \quad f(x)$$

$$-2 \quad 17$$

$$-1 \quad 5$$

$$a=0 \quad -3 \quad f(a)$$

$$b=1 \quad -7 \quad f(b)$$

$$b=2 \quad -7 \quad f(b)$$

$$x = a - \frac{f(a)(b-a)}{f(b)-f(a)}$$

$$f(a) = 2a^2 - 6a - 3$$

i	b	f(b)	a	x	f(a)	$\epsilon = x_{i+1} - x_i $
0	1	-7	0	-	-3	-
1	1	-7	0	0.6	-3	.6
2	1	-7	0.6	1.5	-5.88	.9
3	1	-7	1.5	6	-7.5	4.5
4	1	-7	6	-1.875	33	-7.875
5	1	-7	-1.875	5.3890	15.28125	7.2699
6	1	-7	5.3890	9.0898	22.76264	-1.30399
7	1	-7	-1.0859	0.9739	5.8743782	-3.1359
8	1	-7	0.97291	-915.9921	6.773250	0.00044954



e) Metodo secante

$$2x^2 - 6x - 3$$

$$f(x) = 2(0)^2 - 6(0) - 3 \quad f(x) = -3$$

$$x_0 = 0 \quad f(x) = 2(1)^2 - 6(1) - 3 \quad f(x) = -7$$

$$x_1 = 1 \quad f(x) = 2(-0.75)^2 - 6(-0.75) - 3 \quad f(x) = 2.625$$

$$x_2 = -0.75 \quad f(x) = 2(-1)^2 - 6(-1) - 3 \quad f(x) = 5$$

$$x_3 = -1 \quad f(x) = 0.28125$$

$$x_4 = 0.4365649 \quad f(x) = -0.03949$$

i	x_i	$E = x_{i+1} - x_i $
0	$x_0 = 0$	$x_1 - x_0 = 1$
1	$x_1 = 1$	$ x_2 - x_1 = 1.75$
2	$x_2 = 1 - \frac{(-1)(-6)}{-1 - (-3)} = 0.75$	$ x_3 - x_2 = 0.25$
3	$x_3 = 0.75 - \frac{(2.625)(-0.75)}{(2.625 - (-3))} = -1$	$ x_4 - x_3 = 0.526315789$
4	$x_4 = -1 - \frac{(5)(-1)}{5 - 2.625} = 0.476$	$ x_5 - x_4 = 0.0325077$
5	$x_5 = 0.476 - \frac{(0.0325077)(0.476)}{(0.0325077 - 5)} = -0.4411764$	$ x_6 - x_5 = 0.0069028$
6	$x_6 = -0.4411764 - \frac{(0.0069028)(-0.4411764)}{(0.0069028 - 0.0325077)} = -0.4365649$	$ x_7 - x_6 = 0.00044954$
7	$x_7 = 0.4365649 - \frac{(0.00044954)(0.4365649)}{(0.00044954 - 0.0069028)} = -0.4365649$	



$$\begin{aligned} 3) \quad & x - 2y + z = 3 \\ & 2x - y - z = 4 \\ & -x - y + 2z = -5 \end{aligned}$$

Ninguna solución factible
por los métodos

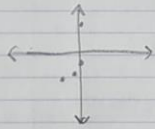
solución obtenida



5) $f(x) = e^{4x} - 4$

a) Metodo grafico

x	y	$e^{4x} - 4$
-2	-3.99966	$e^{4(-2)} - 4 = -3.99966$
-1	-3.9816843	$e^{4(-1)} - 4 = -3.9816843$
0	-3	$e^{4(0)} - 4 = -3$
1	50.598150	$e^{4(1)} - 4 = 50.598150$
2	2976.95798	$e^{4(2)} - 4 = 2976.95798$



b) Metodo biseccion

x	y	$x = \frac{a+b}{2}$
-2	-3.99966	
-1	-3.9816843	
0	-3	
1	50.598150	
2	2976.95798	



a	b	x	Comportamiento
0	1	0.5	-
0	0.5	0.25	+
0.25	0.5	0.315	-
0.25	0.315	0.3125	-
0.25	0.315	0.28375	+
0.3	0.315	0.3087	+

$$E = |0.3087 - 0.28375|$$

$$E = 0.002495$$

C) punto fijo o sustitución sucesiva

$$x = e^{4x} - 4$$

$$= Lne^{4x} = 4 \ln$$

$$4x = \ln 4 \quad x = \frac{\ln 4}{4}$$

$$\text{despeje } x = \frac{\ln 4}{4}$$



i	e^{-x_i}	x_i	$E = x_i - x $
0	-	0	-
1	$e^{(10)} - 4$	-3	-3
2	$e^{(11)} - 4$	50.599150	49.5981500
3	$e^{(100.59)} - 4$	9.3531410^{21}	$9.35314171 \times 10^{21}$
4	$e^{(350.39)} - 4$	52.32×10^{20}	-2.353246×10^{25}
5	$e^{(51.30)} - 4$	9832×10^{26}	$.34657390$
6	$e^{(48.82)} - 4$	892×10^{206}	$.00016567$
...

$$X_9 = 0.000236$$



d) Newton Raphson

$$f(x) = e^{4x} - 4$$

$$f'(x) = 4e^{4x}$$

i	X_{i+1}	$E = X_{i+1} - X_i $
0	$X_0 = 1$	
1	$X_1 = X_0 - \frac{e^{4X_0} - 4}{4e^{4X_0}}$ $X_1 = -0.23168436$	$ X_1 - X_0 $ 1 1.23168436 1 2.23168436
2	$X_2 = X_1 - \frac{e^{4X_1} - 4}{4e^{4X_1}}$ $X_2 = -138.678578402$	$ X_2 - X_1 $ 1 -138.446894042 1 $-138 - (-0.23168436)$
3	$X_3 = X_2 - \frac{e^{4X_2} - 4}{4e^{4X_2}}$ $X_3 = -8.1164291 \times 10^{240}$	$ X_3 - X_2 $ 1 $-8.1164291 \times 10^{240} - (-138.678578402)$
4	$X_4 = X_3 - \frac{e^{4X_3} - 4}{4e^{4X_3}}$ $X_4 = -8.027345 \times 10^{240}$	$ X_4 - X_3 $ 1 $-8.027345 \times 10^{240} - (-8.1164291 \times 10^{240})$ 1 0.00013478102



e) falsa posición

$$x \quad y$$

$$-2 \quad +3.99966$$

$$-1 \quad -3.99966$$

$$0 \quad -3$$

$$a = 1 \quad 50.598150 \rightarrow f(a)$$

$$b = 2 \quad 2916.95996 \rightarrow f(b) \quad f(a) = e^{2a} - 4$$

$$X = a - \frac{f(a)(b-a)}{f(b)-f(a)}$$

i	b	f(b)	a	x	f(a)	E = x _{i+1} - x _i
0	2	2916.95	1	-	50.598150	-
1	2	2916.95	1	0.0179	50.598150	-
2	2	2916.95	0.0179	0.0179	2.928393	0.0019396

$$E = 0.0019396$$



4) $X=3.3$

x	$f(x)$
1	2.4
2	3.0
3	3.6
4	4.2
5	4.8

a) Lagrange

$$\begin{aligned} g(x) &= 2.35 \frac{(3.3-3)(3.3-3.6)(3.3-4.2)(3.3-4.8)}{(2.4-3)(2.4-3.6)(2.4-4.2)(2.4-4.8)} \\ &+ 2.76 \frac{(3.3-2.4)(3.3-3.6)(3.3-4.2)(3.3-4.8)}{(3.0-2.4)(3.0-3.6)(3.0-4.2)(3.0-4.8)} \\ &+ 3.09 \frac{(3.3-2.4)(3.3-3)(3.3-4.2)(3.3-4.8)}{(3.6-2.4)(3.6-3)(3.6-4.2)(3.6-4.8)} \\ &+ 3.33 \frac{(3.3-2.4)(3.3-3)(3.3-3.6)(3.3-4.8)}{(4.2-2.4)(4.2-3)(4.2-3.6)(4.2-4.8)} \\ &+ 3.75 \frac{(3.3-2.4)(3.3-3)(3.3-3.6)(3.3-4.2)}{(4.8-2.4)(4.8-3)(4.8-3.6)(4.8-4.2)} \end{aligned}$$

$$g(x) = 2.9421895$$



b) Newton hacia adelante

$$h_1 = |x_2 - x_1| = 0.6$$

$$h_2 = |x_3 - x_2| = 0.6$$

Uniforme

$$x_i \quad y_i \quad \Delta^1 f(x_i) = y_i - y_{i-1} \quad \Delta^2 f(x_i) = \Delta^1 f(x_i) - \Delta^1 f(x_{i-1})$$

$$x_2 = 2.4 \quad y_2 = 2.55 \quad \Delta^1 = 2.16 - 2.8 = -0.64 \quad \Delta^2 = -0.64 - 0.61 = -1.25$$

$$x_3 = 3.0 \quad y_3 = 2.16 \quad \Delta^1 = 2.16 - 2.8 = -0.64 \quad \Delta^2 = -0.64 - 0.61 = -1.25$$

$$x_4 = 3.6 \quad y_4 = 3.09 \quad \Delta^1 = 3.09 - 2.16 = 0.93 \quad \Delta^2 = 0.93 - 0.64 = 0.29$$

$$x_5 = 4.2 \quad y_5 = 4.355 \quad \Delta^1 = 4.355 - 3.09 = 1.265 \quad \Delta^2 = 1.265 - 0.93 = 0.335$$

$$x_6 = 4.8 \quad y_6 = 5.375 \quad \Delta^1 = 5.375 - 4.355 = 1.02 \quad \Delta^2 = 1.02 - 1.265 = -0.245$$

$$\Delta^3 = 0.335 - 0.245 = 0.09$$

$$\Delta^4 = 0.09 - 0.09 = 0$$

$$g(x) = y_3 + \Delta^1 \left[\frac{x - x_3}{h_1} \right] + \Delta^2 \left[\frac{(x - x_3)(x - x_2)}{h_1 h_2} \right] + \Delta^3 \left[\frac{(x - x_3)(x - x_2)(x - x_1)}{h_1 h_2 h_3} \right]$$

$$g(x) = 2.16 + 0.03 + 0.000625 = 2.160625$$

$$g(x) = 2.160625$$

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$$g(x) = 2.160625$$



$$\begin{aligned} 6) \quad & 3a - b + 4c = 2 \\ & -5a + 3b - 7c = 0 \\ & 7a - 4b + 9c = 12 \end{aligned}$$

a) Gauss seidel

$$a = \frac{2 + b - 4c}{3} = 0.66666$$

$$b = \frac{5(0.66666) + 7(0)}{3} = 1.1111$$

$$c = \frac{12 - 7(0.66666) + 4(1.1111)}{4} = 1.1111$$

$$a_2 = \frac{2 + (1.1111) - 4(1.1111)}{3} = -1.66666$$

$$b_2 = \frac{5(-1.66666) + 7(3.037037)}{3} = 3.037037$$

$$c_1 = \frac{12 - 7(-1.66666) + 4(3.037037)}{4} = 3.17037$$

$$a_3 = \frac{2 + (6.37037) - 4(8.035802468)}{3} = -1.0437037$$

$$b_3 = \frac{5(-1.0437037) + 7(8.035802468)}{3} = 13.5514903$$

$$c_2 = \frac{12 - 7(10.437037) + 4(13.5514903)}{4} = 1.919369$$



b) Montante

$$\begin{array}{r|l} 3 & -1 \ 4 \ 2 \\ 5 & 3 \ -7 \ 0 \\ 7 & -4 \ 9 \ 12 \end{array}$$

↓

$$\begin{array}{r|l} 3 & -1 \ 4 \ 2 \\ 0 & 14 \ -41 \ -10 \\ 0 & -5 \ -16 \ 22 \end{array}$$

↓

$$\begin{array}{r|l} 14 & 0 \ 5 \ 6 \\ 0 & 14 \ -41 \ -10 \\ 0 & 0 \ -149 \ 86 \end{array} \rightarrow \begin{array}{r|l} -145 & 0 \ 0 \ -92 \\ 0 & -143 \ 0 \ 354 \\ 0 & 0 \ -143 \ 86 \end{array}$$

$$a = \frac{-92}{-143} = 0.643356643$$

$$b = \frac{354}{-143} = -2.475524476$$

$$c = \frac{86}{-143} = -0.601398601$$

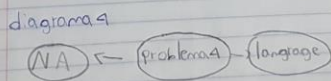
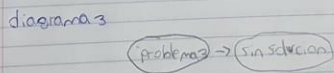
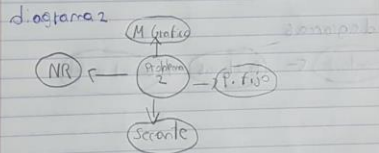
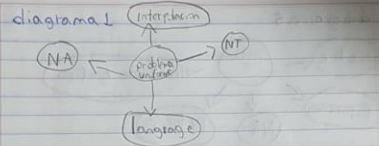




diagrama 5

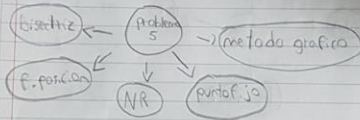


diagrama 6

