Problema 1

- step-size-exacto [[3],[5],[7]]

Función Cuadrática

Ingrese Q

[[2, -1, 0], [-1, 2, -1], [0, -1, 2]]

Ingrese c

[[1], [0], [1]]

Ingrese x

[[3], [5], [7]]

Ingrese el iteraciones

100

Ingrese el step size

exacto

Ingrese el error

0.000000001

[Resolver]

k	x_k	pk	error
0.00	[[3] [5] [7]]	[[2.] [0.] [10.]]	10.20
1.00	[[2.] [5.] [2.]]	[[0.] [6.] [0.]]	6.00
2.00	[[2.] [2.] [2.]]	[[3.] [0.] [3.]]	4.24
3.00	[[0.5] [2.] [0.5]]	[[0.] [3.] [0.]]	3.00
4.00	[[0.5] [0.5] [0.5]]	[[1.5] [0.] [1.5]]	2.12
5.00	[[-0.25] [0.5] [-0.25]]	[[0.] [1.5] [0.]]	1.50
6.00	[[-0.25] [-0.25] [-0.25]]	[[0.75] [0.] [0.75]]	1.06
7.00	[[-0.625] [-0.25] [-0.625]]	[[0.] [0.75] [0.]]	0.75
8.00	[[-0.625] [-0.625] [-0.625]]	[[0.375] [0.] [0.375]]	0.53
9.00	[[-0.8125] [-0.625] [-0.8125]]	[[0.] [0.375] [0.]]	0.38
10.00	[[-0.8125] [-0.8125] [-0.8125]]	[[0.1875] [0.] [0.1875]]	0.27
11.00	[[-0.90625] [-0.8125] [-0.90625]]	[[0.] [0.1875] [0.]]	0.19
12.00	[[-0.90625] [-0.90625] [-0.90625]]	[[0.09375] [0.] [0.09375]]	0.13
13.00	[[-0.953125] [-0.90625] [-0.953125]]	[[0.] [0.09375] [0.]]	0.09
14.00	[[-0.953125] [-0.953125] [-0.953125]]	[[0.046875] [0.] [0.046875]]	0.07
15.00	[[-0.9765625] [-0.953125] [-0.9765625]]	[[0.] [0.046875] [0.]]	0.05
16.00	[[-0.9765625] [-0.9765625] [-0.9765625]]	[[0.0234375] [0.] [0.0234375]]	0.03
53.00	[[-0.99999996] [-0.99999991] [-0.99999996]]	[[0.00000000e+00] [8.94069672e-08] [0.00000000e+00]]	0.00
54.00	[[-0.99999996] [-0.99999996] [-0.99999996]]	[[4.47034836e-08] [0.00000000e+00] [4.47034836e-08]]	0.00
55.00	[[-0.99999998] [-0.99999996] [-0.99999998]]	[[0.00000000e+00] [4.47034836e-08] [0.00000000e+00]]	0.00
56.00	[[-0.99999998] [-0.99999998] [-0.99999998]]	[[2.23517418e-08] [0.00000000e+00] [2.23517418e-08]]	0.00
57.00	[[-0.99999999] [-0.99999998] [-0.99999999]]	[[0.00000000e+00] [2.23517418e-08] [0.00000000e+00]]	0.00
58.00	[[-0.99999999] [-0.99999999] [-0.99999999]]	[[1.11758709e-08] [0.00000000e+00] [1.11758709e-08]]	0.00
59.00	[[-0.99999999] [-0.99999999] [-0.99999999]]	[[0.00000000e+00] [1.11758709e-08] [0.00000000e+00]]	0.00
60.00	[[-0.99999999] [-0.99999999] [-0.99999999]]	[[5.58793545e-09] [0.00000000e+00] [5.58793545e-09]]	0.00
61.00	[[-1.] [-0.99999999] [-1.]]	[[0.00000000e+00] [5.58793545e-09] [0.00000000e+00]]	0.00
62.00	[[-1.] [-1.] [-1.]]	[[2.79396772e-09] [0.00000000e+00] [2.79396772e-09]]	0.00
63.00	[[-1.] [-1.] [-1.]]	[[0.00000000e+00] [2.79396772e-09] [0.00000000e+00]]	0.00
64.00	[[-1.] [-1.] [-1.]]	[[1.39698386e-09] [0.00000000e+00] [1.39698386e-09]]	0.00
65.00	[[-1.] [-1.] [-1.]]	[[0.00000000e+00] [1.39698386e-09] [0.00000000e+00]]	0.00
66.00	[[-1.] [-1.] [-1.]]	[[6.98491931e-10] [0.00000000e+00] [6.98491931e-10]]	0.00

- step-size-exacto [[-1],[2],[-3]]

Función Cuadrática

Ingrese Q

[[2, -1, 0], [-1, 2, -1], [0, -1, 2]]

Ingrese c

[[1], [0], [1]]

Ingrese x

[[-1], [2], [-3]]

Ingrese el iteraciones

1000

Ingrese el step size

exacto

Ingrese el error

0.000000001

Resolver

k	x_k	pk	error
0.00	[[-1] [2] [-3]]	[[-3.] [8.] [-7.]]	11.05
1.00	[[-0.09405941] [-0.41584158] [-0.88613861]]	[[1.22772277] [0.14851485] [-0.35643564]]	1.29
2.00	[[-0.7599396] [-0.49639161] [-0.69281856]]	[[-0.0234876] [0.45997494] [0.1107545]]	0.47
3.00	[[-0.74563737] [-0.77648275] [-0.76025995]]	[[0.28520801] [-0.04706818] [0.25596284]]	0.39
4.00	[[-0.86743105] [-0.75638301] [-0.86956494]]	[[0.02152091] [0.22422997] [0.01725314]]	0.23
5.00	[[-0.88040082] [-0.89151719] [-0.87996269]]	[[0.13071555] [-0.02267087] [0.1315918]]	0.19
6.00	[[-0.93624732] [-0.88183136] [-0.93618356]]	[[0.00933671] [0.10876817] [0.00946423]]	0.11
7.00	[[-0.94187394] [-0.94737875] [-0.94188703]]	[[0.06363087] [-0.01099653] [0.06360469]]	0.09
8.00	[[-0.96905945] [-0.94268062] [-0.96906135]]	[[0.00456173] [0.05275955] [0.00455792]]	0.05

| 58.00 | [[-1.] [-1.] [-1.]] | [[6.36691810e-11] [7.36686045e-10] [6.36691810e-11]] | 0.00 |

- step-size-constante 0.001 [[3],[5],[7]]

Función Cuadrática

Ingrese Q

[[2, -1, 0], [-1, 2, -1], [0, -1, 2]]

Ingrese c

[[1], [0], [1]]

Ingrese x

[[3], [5], [7]]

Ingrese el iteraciones

1000

Ingrese el step size

0.001

Ingrese el error

0.000000001

Resolver

k	x_k	pk	error
0.00	[[3] [5] [7]]	[[2.] [0.] [10.]]	10.20
1.00	[[2.998] [5.] [6.99]]	[[1.996] [0.012] [9.98]]	10.18
2.00	[[2.996004] [4.999988] [6.98002]]	[[1.99202] [0.023952] [9.960052]]	10.16
3.00	[[2.99401198] [4.99996405] [6.97005995]]	[[1.98805991] [0.03585617] [9.94015585]]	10.14
4.00	[[2.99202392] [4.99992819] [6.96011979]]	[[1.98411965] [0.04771267] [9.92031139]]	10.12
5.00	[[2.9900398] [4.99988048] [6.95019948]]	[[1.98019912] [0.05952168] [9.90051848]]	10.10
6.00	[[2.9880596] [4.99982096] [6.94029896]]	[[1.97629825] [0.07128335] [9.88077697]]	10.08
7.00	[[2.9860833] [4.99974967] [6.93041819]]	[[1.97241693] [0.08299786] [9.8610867]]	10.06
8.00	[[2.98411089] [4.99966668] [6.9205571]]	[[1.9685551] [0.09466537] [9.84144752]]	10.04

| 999.00 | [[1.61022632] [2.99262958] [2.1515671]] | [[1.22782307] [2.22346574] [2.31050461]] | 3.43 |

- step-size-constante 0.001 [[-1],[2],[-3]]

999.00	[[-0.60365901] [-0.4859957] [-0.8743294]]	[[0.27867768] [0.50599701] [-0.26266309]]	0.63

- step-size-constante 0.01 [[3],[5],[7]]

999.00	[[-0.9855318] [-0.97953886] [-0.98553179]]	[[0.00847527] [0.01198586] [0.00847529]]	0.02

- step-size-constante 0.01 [[-1],[2],[-3]]

999.00	[[-0.99841608] [-0.99776] [-0.99841608]]	[[0.00092784] [0.00131216] [0.00092783]]	0.00

- step-size-constante 0.1 [[3],[5],[7]]

373.00	[[-1.] [-1.] [-1.]]	[[4.99540298e-10] [7.06456449e-10] [4.99540298e-10]]	0.00

- step-size-constante 0.1 [[-1],[2],[-3]]

337.00	[[-1.] [-1.] [-1.]]	[[4.80465889e-10] [6.79481360e-10] [4.80465889e-10]]	0.00

- step-size-constante 0.5 [[3],[5],[7]]

Función Cuadrática

Ingrese Q
[[2, -1, 0], [-1, 2, -1], [0, -1, 2]]

Ingrese c
[[1], [0], [1]]

Ingrese x
[[3], [5], [7]]

Ingrese el iteraciones
1000

Ingrese el step size
0.5

Ingrese el error
0.000000001

Resolver			
k	x_k	pk	error
0.00	[[3] [5] [7]]	[[2.] [0.] [10.]]	10.20
1.00	[[2.] [5.] [2.]]	[[0.] [6.] [0.]]	6.00
2.00	[[2.] [2.] [2.]]	[[3.] [0.] [3.]]	4.24
3.00	[[0.5] [2.] [0.5]]	[[0.] [3.] [0.]]	3.00
4.00	[[0.5] [0.5] [0.5]]	[[1.5] [0.] [1.5]]	2.12
5.00	[[-0.25] [0.5] [-0.25]]	[[0.] [1.5] [0.]]	1.50
6.00	[[-0.25] [-0.25] [-0.25]]	[[0.75] [0.] [0.75]]	1.06
7.00	[[-0.625] [-0.25] [-0.625]]	[[0.] [0.75] [0.]]	0.75
8.00	[[-0.625] [-0.625] [-0.625]]	[[0.375] [0.] [0.375]]	0.53
9.00	[[-0.8125] [-0.625] [-0.8125]]	[[0.] [0.375] [0.]]	0.38
10.00	[[-0.8125] [-0.8125] [-0.8125]]	[[0.1875] [0.] [0.1875]]	0.27
11.00	[[-0.90625] [-0.8125] [-0.90625]]	[[0.] [0.1875] [0.]]	0.19
12.00	[[-0.90625] [-0.90625] [-0.90625]]	[[0.09375] [0.] [0.09375]]	0.13

65.00	[[-1.] [-1.] [-1.]]	[[0.00000000e+00] [1.39698386e-09] [0.00000000e+00]]	0.00
66.00	[[-1.] [-1.] [-1.]]	[[6.98491931e-10] [0.00000000e+00] [6.98491931e-10]]	0.00

- step-size-constante 0.1 [[-1],[2],[-3]]

67.00	[[-1.] [-1.] [-1.]]	[[4.65661287e-10] [-5.82076609e-10] [4.65661287e-10]]	0.00

- step-size-constante 1 [[3],[5],[7]]

No converge

805.00	[[-inf] [nan] [-inf]]	[[nan] [nan] [nan]]

- step-size-constante 1 [[-1],[2],[-3]]

No converge

805.00	[[-inf] [nan] [-inf]]	[[nan] [nan] [nan]]

- step-size-variable

Función Cuadrática

Ingrese Q

[[2, -1, 0], [-1, 2, -1], [0, -1, 2]]

Ingrese c

[[1], [0], [1]]

Ingrese x

[[3], [5], [7]]

Ingrese el iteraciones

5000

Ingrese el step size

variable

Ingrese el error

0.000000001

Resolver

k	x_k	pk	error
0.00	[[3] [5] [7]]	[[2.] [0.] [10.]]	10.20
1.00	[[1.] [5.] [-3.]]	[[-2.] [12.] [-10.]]	15.75
2.00	[[2.] [-1.] [2.]]	[[6.] [-6.] [6.]]	10.39
3.00	[[0.] [1.] [0.]]	[[0.] [2.] [0.]]	2.00
4.00	[[0.] [0.5] [0.]]	[[0.5] [1.] [0.5]]	1.22
5.00	[[-0.1] [0.3] [-0.1]]	[[0.5] [0.8] [0.5]]	1.07
6.00	[[-0.18333333] [0.16666667] [-0.18333333]]	[[0.46666667] [0.7] [0.46666667]]	0.96
7.00	[[-0.25] [0.06666667] [-0.25]]	[[0.43333333] [0.63333333] [0.43333333]]	0.88
8.00	[[-0.30416667] [-0.0125] [-0.30416667]]	[[0.40416667] [0.58333333] [0.40416667]]	0.82
9.00	[[-0.34907407] [-0.07731481] [-0.34907407]]	[[0.37916667] [0.54351852] [0.37916667]]	0.76
10.00	[[-0.38699074] [-0.13166667] [-0.38699074]]	[[0.35768519] [0.51064815] [0.35768519]]	0.72
11.00	[[-0.41950758] [-0.17808923] [-0.41950758]]	[[0.33907407] [0.4828367] [0.33907407]]	0.68
12.00	[[-0.44776375] [-0.21832562] [-0.44776375]]	[[0.32279812] [0.45887626] [0.32279812]]	0.65

4986.00	[[-0.9836776] [-0.97691665] [-0.9836776]]	[[0.00956144] [0.01352192] [0.00956144]]	0.02
4987.00	[[-0.98367952] [-0.97691936] [-0.98367952]]	[[0.00956032] [0.01352033] [0.00956032]]	0.02
4988.00	[[-0.98368144] [-0.97692207] [-0.98368144]]	[[0.00955919] [0.01351874] [0.00955919]]	0.02
4989.00	[[-0.98368335] [-0.97692478] [-0.98368335]]	[[0.00955807] [0.01351715] [0.00955807]]	0.02
4990.00	[[-0.98368527] [-0.97692749] [-0.98368527]]	[[0.00955695] [0.01351557] [0.00955695]]	0.02
4991.00	[[-0.98368718] [-0.97693019] [-0.98368718]]	[[0.00955583] [0.01351398] [0.00955583]]	0.02
4992.00	[[-0.9836891] [-0.9769329] [-0.9836891]]	[[0.00955471] [0.01351239] [0.00955471]]	0.02
4993.00	[[-0.98369101] [-0.97693561] [-0.98369101]]	[[0.00955358] [0.01351081] [0.00955358]]	0.02
4994.00	[[-0.98369292] [-0.97693831] [-0.98369292]]	[[0.00955246] [0.01350922] [0.00955246]]	0.02
4995.00	[[-0.98369484] [-0.97694102] [-0.98369484]]	[[0.00955134] [0.01350764] [0.00955134]]	0.02
4996.00	[[-0.98369675] [-0.97694372] [-0.98369675]]	[[0.00955022] [0.01350606] [0.00955022]]	0.02
4997.00	[[-0.98369866] [-0.97694642] [-0.98369866]]	[[0.0095491] [0.01350447] [0.0095491]]	0.02
4998.00	[[-0.98370057] [-0.97694913] [-0.98370057]]	[[0.00954798] [0.01350289] [0.00954798]]	0.02
4999.00	[[-0.98370248] [-0.97695183] [-0.98370248]]	[[0.00954687] [0.01350131] [0.00954687]]	0.02

Preguntas

¿Qué observa?

Con $x_0 = [\,3,\,5,\,7]^T$ converge más lento que con $x_0 = [\,-1, 2,\,-3]^T$ dado que los valores vecinos están más cercanos a $min\, f(x)\; =\; [-1, -1, -1]$, con una mejor tasa de convergencia exacta.

¿Con cuál elección de α_k ¿Se obtiene el mejor comportamiento?

El α_k con mejor comportamiento es el **exacto**, es seguido de **0.5**, convergiendo antes de las 100 iteraciones

Problema 2

Función de Rosenbrock

Ingrese el valor inicial

[0,0]

Ingrese el iteraciones

1000

Ingrese la tasa de aprendizaje

0.001

Ingrese el error

0.00000001

[Resolver]

k	x_k	pk	error
0.0000000000	[0 0]	[-2. 0.]	2.0000000000
1.0000000000	[0.002 0.]	[-1.9959968e+00 -8.0000000e-04]	1.9959969603
2.0000000000	[3.9959968e-03 8.0000000e-07]	[-1.99198376 -0.0030336]	1.9919860718
3.0000000000	[5.98798056e-03 3.83359809e-06]	[-1.98794734 -0.00640446]	1.9879576557
4.0000000000	[7.97592790e-03 1.02380607e-05]	[-1.98387785 -0.01067547]	1.9839065734
5.0000000000	[9.95980575e-03 2.09135337e-05]	[-1.97976851 -0.01565684]	1.9798304198

| 999.0000000000 | [0.67365484 0.45224669] | [-0.23121018 -0.31283093] | 0.3890004331 |

Preguntas

¿Cómo se comporta el algoritmo?

Con los valores iniciales no termina de converger

¿Afecta la elección del punto inicial x0 el comportamiento del algoritmo?

Si afecta con valores del punto inicial x_0

¿Qué característica particular tiene esta función?

Es una función que con el x_0 incorrecto o un tasa de aprendizaje incorrecta el algoritmo se pude i al infinito muy rapidamente.

38.0000000000	[3.37470635e+19 8.28859006e+12]	[1.53733302e+61 -2.27772859e+41]	1537333022754550589812495188579215693288814779548514846874 0096.0000000000
39.0000000000	[-1.53733302e+59 2.27772859e+39]	[-1.45332873e+180 -4.72678565e+120]	Inf
40.0000000000	[1.45332873e+178 4.72678565e+118]	[inf -inf]	Inf
41.0000000000	[-inf inf]	[-inf inf]	Inf

Finalmente, efectúa más experimentos pero ahora cambiando únicamente el step-size αk, ¿qué sucede con el algoritmo para las distintas elecciones de αk?

Al cambiar la tasa de aprendizaje a valores mayores el algoritmo se va al infinito y hace que no converja