```
>> nonlinearmin_test(1, 0)

-------------------------------------------------------------------------------
---------
Minimizing quadratic, min at origin
Executing minimization of function @(x)x'*H*x
Starting at point [1, 2],
Using DFP method.

outer it.   iteration     x        step size      f(x)      norm(grad)  ls iters
lambda
    init                +1.00e+00               2.30e+01
                        +2.00e+00

    1           1       +3.80e-01   2.16e+00    4.55e-01    2.09e+01        3
1.03e-01
                        -6.83e-02

                2       +7.12e-10   3.86e-01    2.97e-17    2.38e+00        3
1.63e-01
                        +2.37e-09

    2           1       +7.12e-10   0.00e+00    2.97e-17    2.41e-08        1
0.00e+00
                        +2.37e-09


x =

   1.0e-08 *

     0.0712
     0.2372


no_its =

     4


normg =

   2.4101e-08

Executing minimization of function @(x)x'*H*x
Starting at point [1, 2],
Using BFGS method.

outer it.   iteration     x        step size      f(x)      norm(grad)  ls iters
lambda
    init                +1.00e+00               2.30e+01
                        +2.00e+00

    1           1       +3.80e-01   2.16e+00    4.55e-01    2.09e+01        3
1.03e-01
                        -6.83e-02

                2       +7.12e-10   3.86e-01    2.96e-17    2.38e+00        3
1.61e-01
```

+2.37e-09

    2   1   +7.12e-10   0.00e+00   2.96e-17   2.41e-08   1
0.00e+00
                           +2.37e-09

x =

   1.0e-08 *

     0.0712
     0.2372

no_its =

     4

normg =

   2.4100e-08

Minimizing quadratic, min at origin
Executing minimization of function @(x)x'*H*x
Starting at point [-5, -3],
Using DFP method.

outer it.   iteration   x   step size   f(x)   norm(grad) ls iters
lambda
   init   -5.00e+00   1.20e+02
                      -3.00e+00

    1   1   -1.25e+00   5.30e+00   7.50e+00   4.24e+01   3
1.25e-01
                      +7.50e-01

               2   +1.96e-08   1.46e+00   3.06e-15   1.06e+01   3
1.42e-01
                      +1.96e-08

    2   1   +1.96e-08   0.00e+00   3.06e-15   2.28e-07   1
0.00e+00
                      +1.96e-08

x =

   1.0e-07 *

     0.1957
     0.1957

no_its =

```
       4


normg =

   2.2820e-07

Executing minimization of function @(x)x'*H*x
Starting at point [-5, -3],
Using BFGS method.

outer it.   iteration     x       step size     f(x)      norm(grad)  ls iters
lambda
    init               -5.00e+00              1.20e+02
                       -3.00e+00

    1            1     -1.25e+00   5.30e+00    7.50e+00    4.24e+01       3
1.25e-01
                       +7.50e-01

                 2     +1.96e-08   1.46e+00    3.08e-15    1.06e+01       3
1.33e-01
                       +1.96e-08

    2            1     +1.96e-08   0.00e+00    3.08e-15    2.29e-07       1
0.00e+00
                       +1.96e-08


x =

   1.0e-07 *

    0.1961
    0.1961


no_its =

     4


normg =

   2.2874e-07

------------------------------------------------------------------------------------
---------
Minimizing quadratic, min at origin
Executing minimization of function @(x)x'*H*x
Starting at point [7, 7, 7, 7, 7],
Using DFP method.

outer it.   iteration     x       step size     f(x)      norm(grad)  ls iters
lambda
    init               +7.00e+00              1.22e+03
                       +7.00e+00

    1            1     +6.06e+00   1.21e+01    1.36e+02    1.80e+02       3
```

```
6.73e-02
                      +4.17e+00
                      +2.29e+00
                      +4.00e-01
                      -1.49e+00

              2       +4.77e+00   4.60e+00    3.51e+01    4.52e+01        3
1.05e-01
                      +1.44e+00
                      -4.09e-01
                      -7.64e-01
                      +3.70e-01

              3       +3.25e+00   2.61e+00    1.29e+01    1.85e+01        3
1.53e-01
                      -2.87e-01
                      -4.70e-01
                      +3.72e-01
                      -8.84e-02

              4       +1.47e+00   2.05e+00    4.20e+00    9.84e+00        3
2.41e-01
                      -6.55e-01
                      +3.54e-01
                      -1.20e-01
                      +1.82e-02

              5       -3.43e-08   1.66e+00    1.88e-13    6.30e+00        3
3.27e-01
                      -8.64e-08
                      -1.08e-07
                      -9.85e-08
                      -6.44e-08

      2       1       -3.43e-08   0.00e+00    1.88e-13    2.17e-06        1
0.00e+00
                      -8.64e-08
                      -1.08e-07
                      -9.85e-08
                      -6.44e-08


x =

   1.0e-06 *

   -0.0343
   -0.0864
   -0.1084
   -0.0985
   -0.0644


no_its =

    10


normg =
```

2.1664e-06

Executing minimization of function @(x)x'*H*x
Starting at point [7, 7, 7, 7, 7],
Using BFGS method.

outer it. lambda	iteration	x	step size	f(x)	norm(grad)	ls iters
init		+7.00e+00		1.22e+03		
		+7.00e+00				
1 6.73e-02	1	+6.06e+00	1.21e+01	1.36e+02	1.80e+02	3
		+4.17e+00				
		+2.29e+00				
		+4.00e-01				
		-1.49e+00				
9.88e-02	2	+4.77e+00	4.60e+00	3.51e+01	4.52e+01	3
		+1.44e+00				
		-4.09e-01				
		-7.64e-01				
		+3.70e-01				
1.30e-01	3	+3.25e+00	2.61e+00	1.29e+01	1.85e+01	3
		-2.87e-01				
		-4.70e-01				
		+3.72e-01				
		-8.84e-02				
1.80e-01	4	+1.47e+00	2.05e+00	4.20e+00	9.84e+00	3
		-6.55e-01				
		+3.54e-01				
		-1.20e-01				
		+1.82e-02				
2.12e-01	5	-5.77e-08	1.66e+00	1.64e-13	6.30e+00	3
		-8.98e-08				
		-7.88e-08				
		-7.36e-08				
		-8.63e-08				
2 0.00e+00	1	-5.77e-08	0.00e+00	1.64e-13	2.10e-06	1
		-8.98e-08				
		-7.88e-08				
		-7.36e-08				
		-8.63e-08				

x =

   1.0e-07 *

```
    -0.5768
    -0.8985
    -0.7882
    -0.7361
    -0.8634


no_its =

    10


normg =

    2.0982e-06


------------------------------------------------------------------------------------
---------
Minimizing negative definite quadratic form, has no minimum
Executing minimization of function @(x)x'*H*x
Starting at point [5, 9],
Using DFP method.

outer it.   iteration     x        step size      f(x)       norm(grad)  ls iters
lambda
    init               +5.00e+00              -1.06e+02
                       +9.00e+00

[#Warning: The function does not seem to be convex: cannot
be minimized.]#

Executing minimization of function @(x)x'*H*x
Starting at point [5, 9],
Using BFGS method.

outer it.   iteration     x        step size      f(x)       norm(grad)  ls iters
lambda
    init               +5.00e+00              -1.06e+02
                       +9.00e+00

[#Warning: The function does not seem to be convex: cannot
be minimized.]#

------------------------------------------------------------------------------------
---------
Minimizing indefinite quadratic form, has no minimum
Executing minimization of function @(x)x'*H*x
Starting at point [5, 9],
Using DFP method.

outer it.   iteration     x        step size      f(x)       norm(grad)  ls iters
lambda
    init               +5.00e+00               3.30e+02
                       +9.00e+00

     1          1       +8.57e+00   1.13e+01   -2.06e+02    9.49e+01        3
1.19e-01
                       -1.71e+00
```

[#Warning: The function does not seem to be convex: cannot
be minimized.]#

Executing minimization of function @(x)x'*H*x
Starting at point [5, 9],
Using BFGS method.

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters
lambda						
init		+5.00e+00		3.30e+02		
		+9.00e+00				
1	1	+8.57e+00	1.13e+01	-2.06e+02	9.49e+01	3
1.19e-01						
		-1.71e+00				

[#Warning: The function does not seem to be convex: cannot

Minimizing rosenbrock function, min at (1, 1)
Executing minimization of function rosenbrock
Starting at point [200, 200],
Using DFP method.

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters
lambda						
init		+2.00e+02		1.58e+11		
		+2.00e+02				
1	1	-1.20e-03	2.00e+02	4.02e+06	3.18e+09	23
6.28e-08						
		+2.00e+02				
	2	-5.04e-01	2.00e+02	2.26e+00	4.01e+04	5
4.99e-03						
		+2.54e-01				
2	1	-4.89e-01	1.54e-02	2.24e+00	3.00e+00	3
5.12e-03						
		+2.54e-01				
	2	-2.81e-01	2.92e-01	1.73e+00	3.05e+00	3
1.37e-01						
		+4.88e-02				
3	1	-2.56e-01	3.52e-02	1.58e+00	8.46e+00	3
4.16e-03						
		+7.38e-02				
	2	-1.53e-01	1.18e-01	1.34e+00	2.34e+00	7
5.21e-02						
		+1.65e-02				
4	1	-1.26e-01	3.09e-02	1.29e+00	3.07e+00	3
1.01e-02						
		+3.06e-02				
	2	-2.73e-02	1.02e-01	1.06e+00	3.31e+00	7

```
4.54e-02
                +2.80e-03

   5      1    +7.66e-03   3.57e-02   9.87e-01   2.07e+00      6
1.72e-02
                -4.26e-03

          2    +8.96e-02   8.20e-02   8.39e-01   2.15e+00      7
3.71e-02
                -2.18e-03

   6      1    +1.19e-01   5.07e-02   8.38e-01   2.51e+00      2
2.02e-02
                +3.91e-02

          2    +2.43e-01   1.26e-01   5.77e-01   5.80e+00      6
6.89e-02
                +6.42e-02

   7      1    +2.55e-01   1.38e-02   5.60e-01   2.31e+00      3
6.01e-03
                +5.78e-02

          2    +3.56e-01   1.14e-01   4.45e-01   1.62e+00      4
8.56e-02
                +1.09e-01

   8      1    +3.52e-01   1.34e-02   4.21e-01   3.70e+00      4
3.61e-03
                +1.22e-01

          2    +4.91e-01   1.71e-01   2.97e-01   1.10e+00      4
1.62e-01
                +2.22e-01

   9      1    +4.84e-01   1.25e-02   2.67e-01   4.79e+00      3
2.61e-03
                +2.32e-01

          2    +6.13e-01   1.82e-01   1.76e-01   7.50e-01      5
2.45e-01
                +3.60e-01

  10      1    +6.07e-01   9.24e-03   1.55e-01   4.57e+00      3
2.02e-03
                +3.66e-01

          2    +7.23e-01   1.84e-01   9.39e-02   5.03e-01      6
3.69e-01
                +5.09e-01

  11      1    +7.17e-01   6.75e-03   8.00e-02   4.15e+00      3
1.63e-03
                +5.14e-01

          2    +8.18e-01   1.78e-01   4.26e-02   3.24e-01      6
5.50e-01
                +6.60e-01
```

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters
12	1	+8.14e-01	4.71e-03	3.45e-02	3.46e+00	3
1.36e-03		+6.62e-01				
	2	+8.98e-01	1.61e-01	1.49e-02	1.94e-01	5
8.27e-01		+8.00e-01				
13	1	+8.95e-01	3.06e-03	1.10e-02	2.58e+00	3
1.18e-03		+8.01e-01				
	2	+9.58e-01	1.30e-01	3.17e-03	1.02e-01	4
1.27e+00		+9.14e-01				
14	1	+9.57e-01	1.67e-03	1.87e-03	1.56e+00	3
1.07e-03		+9.15e-01				
	2	+9.57e-01	0.00e+00	1.87e-03	4.00e-02	1
0.00e+00		+9.15e-01				
15	1	+9.57e-01	0.00e+00	1.87e-03	4.00e-02	1
0.00e+00		+9.15e-01				

x =

    0.9568
    0.9153

no_its =

    30

normg =

    0.0400

Minimizing rosenbrock function, min at (1, 1)
Executing minimization of function rosenbrock
Starting at point [399, -711],
Using DFP method.

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters
lambda						
init		+3.99e+02		2.56e+12		
		-7.11e+02				
1	1	-5.79e-04	3.99e+02	5.05e+07	2.55e+10	24
1.56e-08		-7.10e+02				

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters	lambda
	2	+8.87e-01	7.11e+02	1.28e-02	1.42e+05	5	5.01e-03
		+7.86e-01					
2	1	+8.87e-01	6.98e-05	1.28e-02	2.27e-01	2	3.08e-04
		+7.86e-01					
	2	+9.51e-01	1.30e-01	4.40e-03	1.84e-01	4	1.17e+00
		+8.99e-01					
3	1	+9.49e-01	1.96e-03	2.62e-03	1.81e+00	3	1.08e-03
		+9.00e-01					
	2	+9.90e-01	8.82e-02	3.51e-04	4.77e-02	3	1.85e+00
		+9.78e-01					
4	1	+9.90e-01	0.00e+00	3.51e-04	6.80e-01	1	0.00e+00
		+9.78e-01					

```
x =

    0.9899
    0.9782


no_its =

     8


normg =

    0.6804
```


Minimizing rosenbrock function, min at (1, 1)
Executing minimization of function rosenbrock
Starting at point [399, -711],
Using BFGS method.

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters	lambda
init		+3.99e+02		2.56e+12			
		-7.11e+02					
1	1	-5.79e-04	3.99e+02	5.05e+07	2.55e+10	24	1.56e-08
		-7.10e+02					
	2	+8.87e-01	7.11e+02	1.28e-02	1.42e+05	5	5.01e-03

| | | +7.86e-01 | | | | |
| | | | | | | |

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters
lambda						
2	1	+8.87e-01	6.98e-05	1.28e-02	2.27e-01	2
3.08e-04						
		+7.86e-01				
	2	+9.51e-01	1.31e-01	4.28e-03	1.84e-01	4
8.98e-01						
		+9.00e-01				
3	1	+9.50e-01	1.94e-03	2.55e-03	1.79e+00	3
1.08e-03						
		+9.01e-01				
	2	+9.90e-01	8.73e-02	3.35e-04	4.70e-02	3
1.86e+00						
		+9.79e-01				
4	1	+9.90e-01	0.00e+00	3.35e-04	6.67e-01	1
0.00e+00						
		+9.79e-01				

x =

    0.9901
    0.9788

no_its =

     8

normg =

    0.6666

Minimizing rosenbrock function, min at (1, 1)
Executing minimization of function rosenbrock
Starting at point [3990, -7111],
Using DFP method.

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters
lambda						
init		+3.99e+03		2.54e+16		
		-7.11e+03				
1	1	-4.58e-05	3.99e+03	5.06e+09	2.54e+13	30
1.57e-10						
		-7.11e+03				
	2	+7.83e-01	7.11e+03	4.71e-02	1.42e+06	4
5.00e-03						
		+6.13e-01				
2	1	+7.84e-01	8.82e-04	4.70e-02	4.34e-01	2

2.03e-03

                    +6.13e-01

                    2   +8.69e-01   1.59e-01   2.37e-02   2.76e-01   5
6.83e-01

                    +7.47e-01

    3   1   +8.66e-01   3.78e-03   1.80e-02   3.03e+00   3
1.24e-03

                    +7.49e-01

                    2   +9.84e-01   2.37e-01   1.76e-02   1.34e-01   2
1.77e+00

                    +9.55e-01

    4   1   +9.78e-01   5.93e-03   4.63e-04   5.78e+00   3
1.03e-03

                    +9.57e-01

                    2   +9.78e-01   0.00e+00   4.63e-04   1.96e-02   1
0.00e+00

                    +9.57e-01

    5   1   +9.78e-01   0.00e+00   4.63e-04   1.96e-02   1
0.00e+00

                    +9.57e-01

x =

    0.9785
    0.9574

no_its =

    10

normg =

    0.0196

Minimizing rosenbrock function, min at (1, 1)
Executing minimization of function rosenbrock
Starting at point [3990, -7111],
Using BFGS method.

outer it.   iteration   x   step size   f(x)   norm(grad) ls iters
lambda
    init   +3.99e+03   2.54e+16
                        -7.11e+03

    1   1   -4.58e-05   3.99e+03   5.06e+09   2.54e+13   30
1.57e-10
                        -7.11e+03

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters	lambda
	2	+7.83e-01	7.11e+03	4.71e-02	1.42e+06	4	5.00e-03
		+6.13e-01					
2	1	+7.84e-01	8.82e-04	4.70e-02	4.34e-01	2	2.03e-03
		+6.13e-01					
	2	+8.69e-01	1.59e-01	2.37e-02	2.76e-01	5	4.87e-01
		+7.47e-01					
3	1	+8.66e-01	3.78e-03	1.80e-02	3.03e+00	3	1.24e-03
		+7.49e-01					
	2	+9.84e-01	2.37e-01	1.76e-02	1.34e-01	2	1.76e+00
		+9.55e-01					
4	1	+9.78e-01	5.93e-03	4.64e-04	5.78e+00	3	1.03e-03
		+9.57e-01					
	2	+9.78e-01	0.00e+00	4.64e-04	1.96e-02	1	0.00e+00
		+9.57e-01					
5	1	+9.78e-01	0.00e+00	4.64e-04	1.96e-02	1	0.00e+00
		+9.57e-01					

x =

    0.9785
    0.9573

no_its =

    10

normg =

    0.0196

Minimizing rosenbrock function, min at (1, 1)
Executing minimization of function rosenbrock
Starting at point [200, 200],
Using DFP method.

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters	lambda
init		+2.00e+02		1.58e+11			
		+2.00e+02					

1 6.28e-08	1	-1.20e-03 +2.00e+02	2.00e+02	4.02e+06	3.18e+09	23
4.99e-03	2	-5.04e-01 +2.54e-01	2.00e+02	2.26e+00	4.01e+04	5
2 5.12e-03	1	-4.89e-01 +2.54e-01	1.54e-02	2.24e+00	3.00e+00	3
1.37e-01	2	-2.81e-01 +4.88e-02	2.92e-01	1.73e+00	3.05e+00	3
3 4.16e-03	1	-2.56e-01 +7.38e-02	3.52e-02	1.58e+00	8.46e+00	3
5.21e-02	2	-1.53e-01 +1.65e-02	1.18e-01	1.34e+00	2.34e+00	7
4 1.01e-02	1	-1.26e-01 +3.06e-02	3.09e-02	1.29e+00	3.07e+00	3
4.54e-02	2	-2.73e-02 +2.80e-03	1.02e-01	1.06e+00	3.31e+00	7
5 1.72e-02	1	+7.66e-03 -4.26e-03	3.57e-02	9.87e-01	2.07e+00	6
3.71e-02	2	+8.96e-02 -2.18e-03	8.20e-02	8.39e-01	2.15e+00	7
6 2.02e-02	1	+1.19e-01 +3.91e-02	5.07e-02	8.38e-01	2.51e+00	2
6.89e-02	2	+2.43e-01 +6.42e-02	1.26e-01	5.77e-01	5.80e+00	6
7 6.01e-03	1	+2.55e-01 +5.78e-02	1.38e-02	5.60e-01	2.31e+00	3
8.56e-02	2	+3.56e-01 +1.09e-01	1.14e-01	4.45e-01	1.62e+00	4
8 3.61e-03	1	+3.52e-01	1.34e-02	4.21e-01	3.70e+00	4

		+1.22e-01				
	2	+4.91e-01	1.71e-01	2.97e-01	1.10e+00	4
1.62e-01		+2.22e-01				
9	1	+4.84e-01	1.25e-02	2.67e-01	4.79e+00	3
2.61e-03		+2.32e-01				
	2	+6.13e-01	1.82e-01	1.76e-01	7.50e-01	5
2.45e-01		+3.60e-01				
10	1	+6.07e-01	9.24e-03	1.55e-01	4.57e+00	3
2.02e-03		+3.66e-01				
	2	+7.23e-01	1.84e-01	9.39e-02	5.03e-01	6
3.69e-01		+5.09e-01				
11	1	+7.17e-01	6.75e-03	8.00e-02	4.15e+00	3
1.63e-03		+5.14e-01				
	2	+8.18e-01	1.78e-01	4.26e-02	3.24e-01	6
5.50e-01		+6.60e-01				
12	1	+8.14e-01	4.71e-03	3.45e-02	3.46e+00	3
1.36e-03		+6.62e-01				
	2	+8.98e-01	1.61e-01	1.49e-02	1.94e-01	5
8.27e-01		+8.00e-01				
13	1	+8.95e-01	3.06e-03	1.10e-02	2.58e+00	3
1.18e-03		+8.01e-01				
	2	+9.58e-01	1.30e-01	3.17e-03	1.02e-01	4
1.27e+00		+9.14e-01				
14	1	+9.57e-01	1.67e-03	1.87e-03	1.56e+00	3
1.07e-03		+9.15e-01				
	2	+9.57e-01	0.00e+00	1.87e-03	4.00e-02	1
0.00e+00		+9.15e-01				
15	1	+9.57e-01	0.00e+00	1.87e-03	4.00e-02	1
0.00e+00		+9.15e-01				

```
x =

    0.9568
    0.9153


no_its =

    30


normg =

    0.0400
```


```
Minimizing rosenbrock function, min at (1, 1)
Executing minimization of function rosenbrock
Starting at point [200, 200],
Using BFGS method.
```

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters	lambda
init		+2.00e+02		1.58e+11			
		+2.00e+02					
1	1	-1.20e-03	2.00e+02	4.02e+06	3.18e+09	23	6.28e-08
		+2.00e+02					
	2	-5.04e-01	2.00e+02	2.26e+00	4.01e+04	5	4.99e-03
		+2.54e-01					
2	1	-4.89e-01	1.54e-02	2.24e+00	3.00e+00	3	5.12e-03
		+2.54e-01					
	2	-4.13e-01	1.06e-01	2.00e+00	3.05e+00	9	2.44e-02
		+1.79e-01					
3	1	-3.50e-01	1.02e-01	1.88e+00	2.23e+00	4	4.59e-02
		+9.89e-02					
	2	-2.17e-01	1.64e-01	1.67e+00	7.62e+00	5	6.05e-03
		+3.67e-03					
4	1	-1.89e-01	4.76e-02	1.42e+00	1.06e+01	3	4.48e-03
		+4.24e-02					
	2	-1.08e-01	8.87e-02	1.23e+00	2.30e+00	7	3.77e-02
		+7.26e-03					

5	1	-5.65e-02	5.42e-02	1.17e+00	2.55e+00		5
2.12e-02		+2.56e-02					
	2	-5.65e-02	0.00e+00	1.17e+00	4.76e+00		1
0.00e+00		+2.56e-02					
6	1	-5.63e-02	5.57e-04	1.16e+00	4.76e+00		3
1.17e-04		+2.50e-02					
	2	+1.70e-02	7.40e-02	9.88e-01	4.66e+00		9
2.72e-02		+1.51e-02					
7	1	+3.14e-02	2.51e-02	9.42e-01	3.62e+00		3
6.94e-03		-5.48e-03					
	2	+8.13e-02	5.00e-02	8.53e-01	2.26e+00		7
1.87e-02		-3.01e-03					
8	1	+9.80e-02	2.69e-02	8.21e-01	2.45e+00		3
1.10e-02		+1.81e-02					
	2	+1.13e-01	1.51e-02	7.93e-01	2.72e+00		6
3.72e-03		+2.06e-02					
9	1	+1.30e-01	2.10e-02	7.65e-01	2.64e+00		3
7.96e-03		+8.12e-03					
	2	+1.75e-01	4.66e-02	6.93e-01	2.17e+00		7
1.66e-02		+1.96e-02					
10	1	+1.82e-01	1.86e-02	6.71e-01	2.38e+00		4
7.83e-03		+3.69e-02					
	2	+2.33e-01	5.36e-02	5.89e-01	2.06e+00		7
1.97e-02		+5.45e-02					
11	1	+2.57e-01	2.44e-02	5.69e-01	1.58e+00		3
1.54e-02		+5.30e-02					
	2	+2.82e-01	2.83e-02	5.33e-01	2.60e+00		6
5.71e-03		+6.63e-02					
12	1	+2.82e-01	1.29e-02	5.16e-01	2.63e+00		3
4.90e-03		+7.92e-02					

	2	+3.83e-01	1.17e-01	3.91e-01	1.42e+00	5	7.23e-02	+1.37e-01
13	1	+3.82e-01	8.47e-03	3.82e-01	2.12e+00	3	4.01e-03	+1.45e-01
	2	+5.16e-01	1.69e-01	2.68e-01	1.11e+00	4	1.36e-01	+2.48e-01
14	1	+5.09e-01	1.14e-02	2.41e-01	4.63e+00	3	2.47e-03	+2.57e-01
	2	+6.36e-01	1.83e-01	1.57e-01	6.94e-01	6	2.61e-01	+3.89e-01
15	1	+6.30e-01	8.75e-03	1.37e-01	4.54e+00	3	1.93e-03	+3.95e-01
	2	+7.43e-01	1.84e-01	8.12e-02	4.62e-01	6	3.96e-01	+5.40e-01
16	1	+7.38e-01	6.30e-03	6.86e-02	4.02e+00	3	1.57e-03	+5.44e-01
	2	+8.36e-01	1.75e-01	3.53e-02	2.94e-01	6	5.94e-01	+6.89e-01
17	1	+8.32e-01	4.34e-03	2.82e-02	3.29e+00	3	1.32e-03	+6.92e-01
	2	+9.12e-01	1.55e-01	1.15e-02	1.73e-01	5	8.96e-01	+8.25e-01
18	1	+9.09e-01	2.74e-03	8.23e-03	2.37e+00	3	1.16e-03	+8.27e-01
	2	+9.67e-01	1.20e-01	2.09e-03	8.74e-02	4	1.38e+00	+9.32e-01
19	1	+9.66e-01	1.40e-03	1.17e-03	1.33e+00	2	1.05e-03	+9.33e-01
	2	+9.66e-01	0.00e+00	1.17e-03	3.14e-02	1	0.00e+00	

```
                           +9.33e-01

    20            1     +9.66e-01   0.00e+00    1.17e-03    3.14e-02         1
0.00e+00
                           +9.33e-01


x =

    0.9659
    0.9327


no_its =

    40


normg =

    0.0314


x02 =

   113
   999


--------------------------------------------------------------------------------
---------
Minimizing Booth, min at (1, 3)
Executing minimization of function @(x)(x(1)+2*x(2)-7)^2+(2*x(1)+x(2)-5)^2
Starting at point [9, 10],
Using DFP method.

outer it.   iteration     x      step size      f(x)      norm(grad)  ls iters
lambda
    init              +9.00e+00              1.01e+03
                      +1.00e+01

     1         1     +1.44e+00   1.06e+01    3.95e-01    1.91e+02         3
5.56e-02
                      +2.56e+00

               2     +1.00e+00   6.29e-01    8.12e-16    1.26e+00         3
5.00e-01
                      +3.00e+00

     2         1     +1.00e+00   0.00e+00    8.12e-16    1.71e-07         1
0.00e+00
                      +3.00e+00


x =

    1.0000
    3.0000
```

```
no_its =

     4


normg =

   1.7099e-07


--------------------------------------------------------------------------------
---------
Minimizing Booth, min at (1, 3)
Executing minimization of function @(x)(x(1)+2*x(2)-7)^2+(2*x(1)+x(2)-5)^2
Starting at point [9, 10],
Using BFGS method.

outer it.   iteration     x       step size     f(x)       norm(grad)  ls iters
lambda
   init                 +9.00e+00               1.01e+03
                        +1.00e+01

    1          1        +1.44e+00   1.06e+01    3.95e-01    1.91e+02       3
5.56e-02
                        +2.56e+00

               2        +1.00e+00   6.29e-01    8.12e-16    1.26e+00       3
5.00e-01
                        +3.00e+00

    2          1        +1.00e+00   0.00e+00    8.12e-16    1.71e-07       1
0.00e+00
                        +3.00e+00


x =

    1.0000
    3.0000


no_its =

     4


normg =

   1.7099e-07


--------------------------------------------------------------------------------
---------
Minimizing Booth, min at (1, 3)
Executing minimization of function @(x)(x(1)+2*x(2)-7)^2+(2*x(1)+x(2)-5)^2
Starting at point [113, 999],
Using DFP method.

outer it.   iteration     x       step size     f(x)       norm(grad)  ls iters
lambda
   init                 +1.13e+02               5.92e+06
```

```
                              +9.99e+02

    1           1       -3.95e+02   7.92e+02   3.08e+05   1.42e+04       3
5.59e-02
                              +3.92e+02

                2       +9.97e-01   5.55e+02   1.80e-04   1.11e+03       3
5.00e-01
                              +3.00e+00

    2           1       +9.97e-01   0.00e+00   1.80e-04   8.04e-02       1
0.00e+00
                              +3.00e+00


x =

    0.9971
    2.9966


no_its =

     4


normg =

    0.0804


--------------------------------------------------------------------------------
---------
Minimizing Booth, min at (1, 3)
Executing minimization of function @(x)(x(1)+2*x(2)-7)^2+(2*x(1)+x(2)-5)^2
Starting at point [113, 999],
Using BFGS method.

outer it.  iteration    x       step size     f(x)      norm(grad)  ls iters
lambda
    init             +1.13e+02               5.92e+06
                     +9.99e+02

    1           1       -3.95e+02   7.92e+02   3.08e+05   1.42e+04       3
5.59e-02
                              +3.92e+02

                2       +9.97e-01   5.55e+02   1.80e-04   1.11e+03       3
4.97e-01
                              +3.00e+00

    2           1       +9.97e-01   0.00e+00   1.80e-04   8.04e-02       1
0.00e+00
                              +3.00e+00


x =

    0.9971
    2.9966
```

```
no_its =

     4


normg =

     0.0804

--------------------------------------------------------------------------------
---------
Minimizing Styblinski-Tang function, min at (-2.904)
Executing minimization of function @(x)1/2*(x(1)^4-16*x(1)^2+5*x(1)+x(2)^4-
16*x(2)^2+5*x(2))
Starting at point [-3, -3],
Using DFP method.

outer it.   iteration     x       step size     f(x)      norm(grad)  ls iters
lambda
   init                 -3.00e+00              -7.80e+01
                        -3.00e+00

    1          1        -2.90e+00   1.36e-01    -7.83e+01    4.95e+00       4
2.76e-02
                        -2.90e+00

               2        -2.90e+00   0.00e+00    -7.83e+01    0.00e+00       1
0.00e+00
                        -2.90e+00

    2          1        -2.90e+00   0.00e+00    -7.83e+01    0.00e+00       1
0.00e+00
                        -2.90e+00


x =

   -2.9035
   -2.9035


no_its =

     4


normg =

     0

--------------------------------------------------------------------------------
---------
Minimizing Styblinski-Tang function, min at (-2.904)
Executing minimization of function @(x)1/2*(x(1)^4-16*x(1)^2+5*x(1)+x(2)^4-
16*x(2)^2+5*x(2))
Starting at point [-3, -3],
Using BFGS method.
```

```
outer it.   iteration     x        step size      f(x)       norm(grad)  ls iters
lambda
   init               -3.00e+00                -7.80e+01
                      -3.00e+00

    1           1     -2.90e+00   1.36e-01     -7.83e+01    4.95e+00        4
2.76e-02
                      -2.90e+00

                2     -2.90e+00   0.00e+00     -7.83e+01    0.00e+00        1
0.00e+00
                      -2.90e+00

    2           1     -2.90e+00   0.00e+00     -7.83e+01    0.00e+00        1
0.00e+00
                      -2.90e+00


x =

   -2.9035
   -2.9035


no_its =

     4


normg =

     0

--------------------------------------------------------------------------------
---------
Minimizing Styblinski-Tang function, min at (-2.904)
Executing minimization of function @(x)1/2*(x(1)^4-16*x(1)^2+5*x(1)+x(2)^4-
16*x(2)^2+5*x(2))
Starting at point [-1.5, -1.5],
Using DFP method.

outer it.   iteration     x        step size      f(x)       norm(grad)  ls iters
lambda
   init               -1.50e+00                -3.84e+01
                      -1.50e+00

    1           1     -2.16e+00   9.37e-01     -6.38e+01    2.79e+01        9
3.36e-02
                      -2.16e+00

                2     -2.90e+00   1.05e+00     -7.83e+01    2.39e+01        6
1.91e-01
                      -2.90e+00

    2           1     -2.90e+00   0.00e+00     -7.83e+01    5.12e-06        1
0.00e+00
                      -2.90e+00
```

```
x =

   -2.9035
   -2.9035


no_its =

     4


normg =

   5.1238e-06
```


```
Minimizing Styblinski-Tang function, min at (-2.904)
Executing minimization of function @(x)1/2*(x(1)^4-16*x(1)^2+5*x(1)+x(2)^4-
16*x(2)^2+5*x(2))
Starting at point [-1.5, -1.5],
Using BFGS method.
```

outer it.	iteration	x	step size	f(x)	norm(grad)	ls iters
lambda						
init		-1.50e+00		-3.84e+01		
		-1.50e+00				
1	1	-2.16e+00	9.37e-01	-6.38e+01	2.79e+01	9
3.36e-02						
		-2.16e+00				
	2	-2.90e+00	1.05e+00	-7.83e+01	2.39e+01	6
1.91e-01						
		-2.90e+00				
2	1	-2.90e+00	0.00e+00	-7.83e+01	4.14e-06	2
0.00e+00						
		-2.90e+00				

```
x =

   -2.9035
   -2.9035


no_its =

     4


normg =

   4.1431e-06
```


```
Minimizing Styblinski-Tang function, min at (-2.904)
Executing minimization of function @(x)1/2*(x(1)^4-16*x(1)^2+5*x(1)+x(2)^4-
16*x(2)^2+5*x(2))
Starting at point [-1, -1],
Using DFP method.

outer it.    iteration      x        step size      f(x)       norm(grad)  ls iters
lambda
   init                   -1.00e+00              -2.00e+01
                          -1.00e+00

    1           1         -1.00e+00   0.00e+00    -2.00e+01    2.33e+01       1
0.00e+00
                          -1.00e+00


x =

    -1
    -1


no_its =

     2


normg =

    23.3345


-----------------------------------------------------------------------------------
---------
Minimizing Styblinski-Tang function, min at (-2.904)
Executing minimization of function @(x)1/2*(x(1)^4-16*x(1)^2+5*x(1)+x(2)^4-
16*x(2)^2+5*x(2))
Starting at point [-1, -1],
Using BFGS method.

outer it.    iteration      x        step size      f(x)       norm(grad)  ls iters
lambda
   init                   -1.00e+00              -2.00e+01
                          -1.00e+00

    1           1         -1.00e+00   0.00e+00    -2.00e+01    2.33e+01       1
0.00e+00
                          -1.00e+00


x =

    -1
    -1


no_its =

     2
```

```
normg =

   23.3345
```