For the jupyter notebook we use this octave kernel: https://github.com/Calysto/octave_kernel

```
pip install octave_kernel
cd <root of the project>
jupyter notebook
```

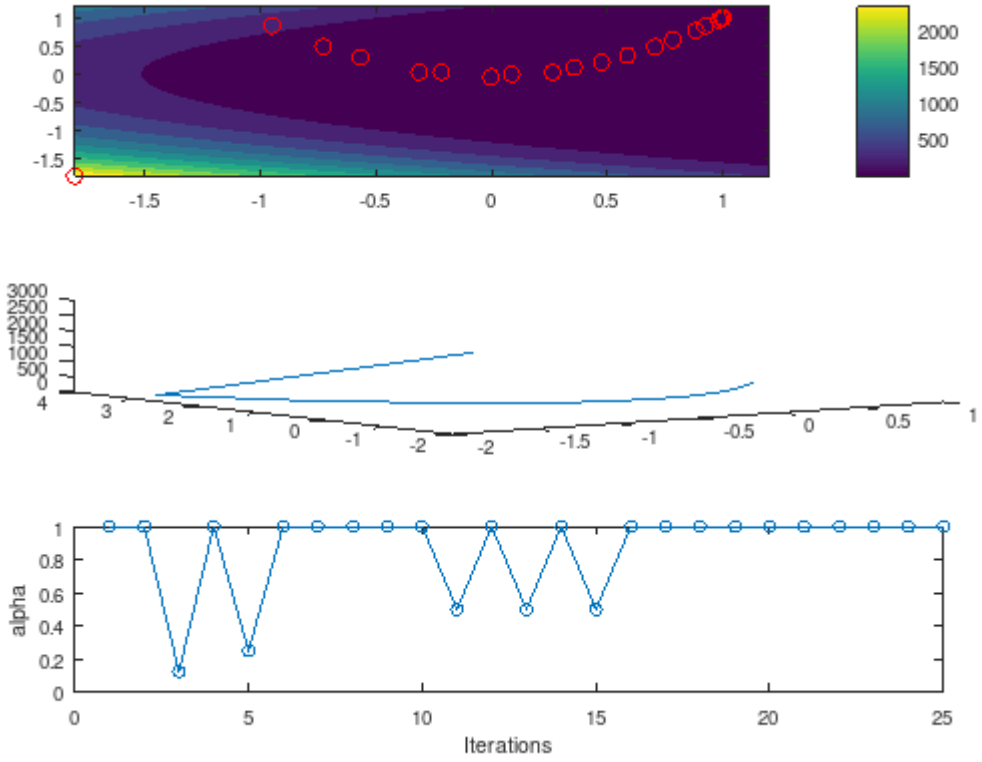
In [6]:
```
format longE

# setup the path to include the 'utils' directory
directory = pwd
addpath(genpath(directory))
```

```
directory = /home/thodkatz/repos/personal/math-optimization
```

In [7]:
```
# define rosenbrock function

function f = rosen_sym()
    syms x y
    f = 100*(y-x^2)^2 + (1-x)^2;
end
```

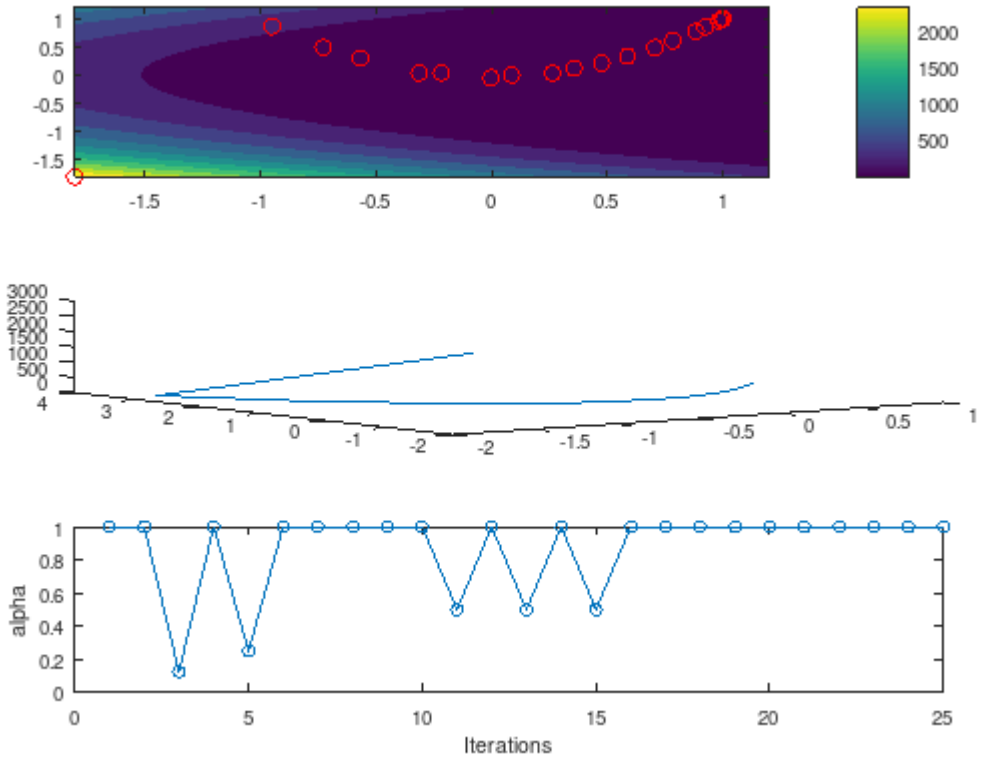
In [4]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
[xmin, fmin] = newton(rosen_sym, [-1.8,-1.8]', 'backtracking_wolfe_weak', search_x, s
```

```
Symbolic pkg v3.1.1: Python communication link active, SymPy v1.11.1.
STARTED Line search using newton
ENDED Line search using newton
xmin =

   9.999999999816411e-01
   9.999999999576280e-01

fmin = 3.534107889272943e-21
```



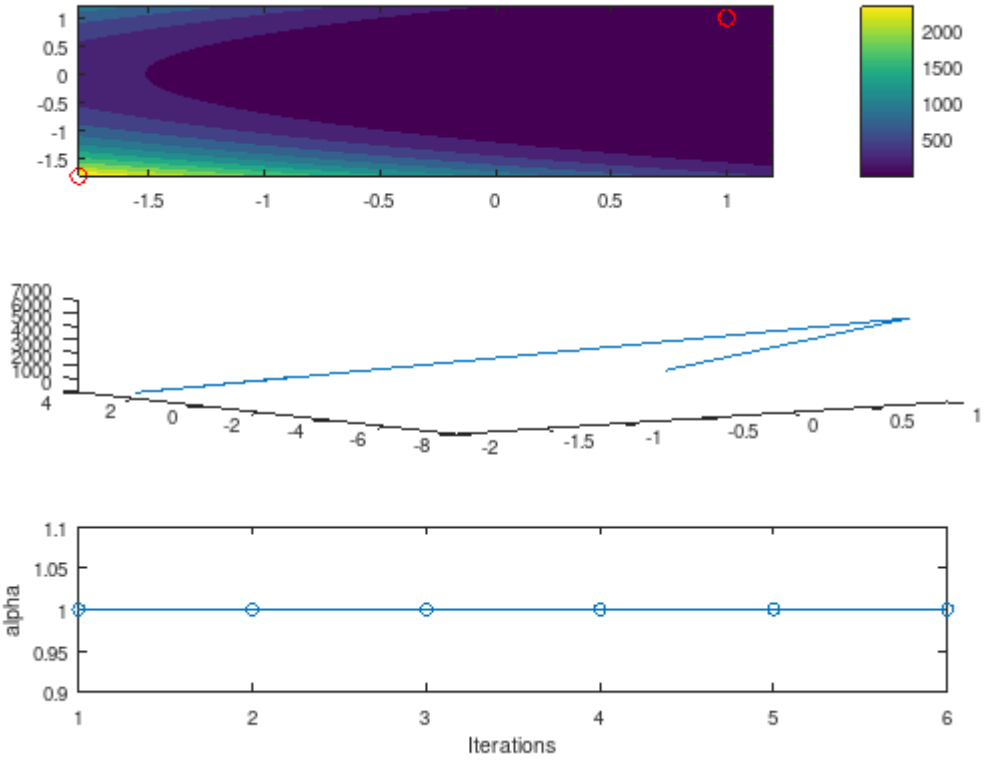
In [54]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
[xmin, fmin] = newton(rosen_sym, [-1.8,-1.8]', 'backtracking_armijo', search_x, searc
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   9.999999999816411e-01
   9.999999999576280e-01

fmin = 3.534107889272943e-21
```



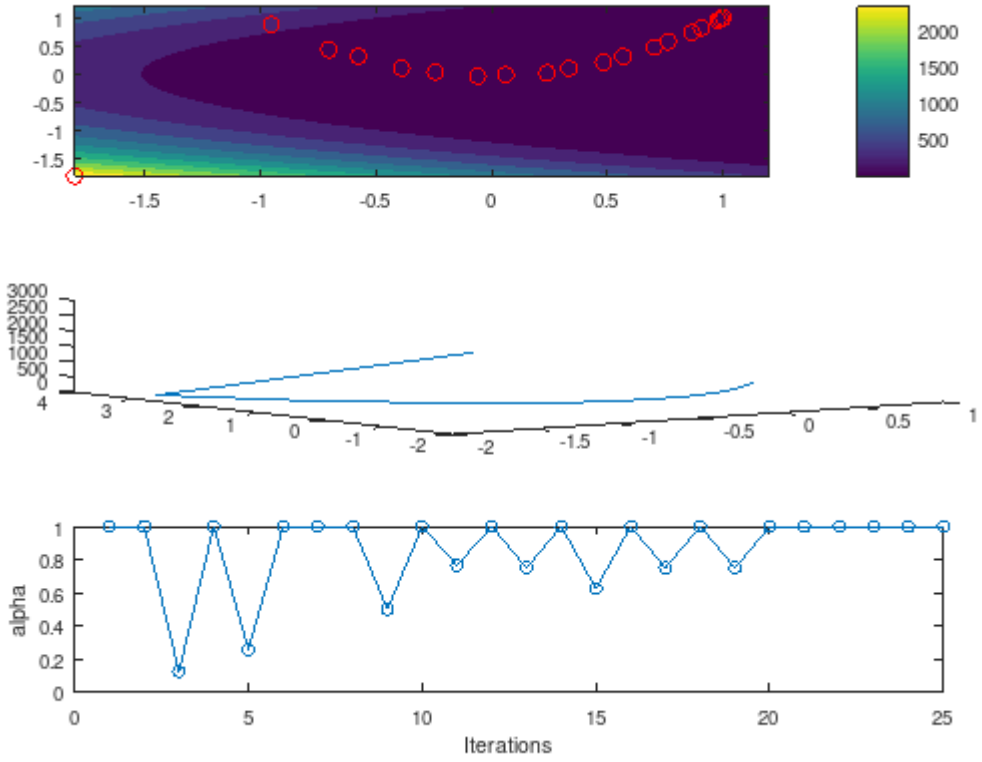
In [55]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
[xmin, fmin] = newton(rosen_sym, [-1.8,-1.8]', 'none', search_x, search_y);
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   9.999999999999759e-01
   9.999999999999519e-01

fmin = 5.816493213323984e-28
```



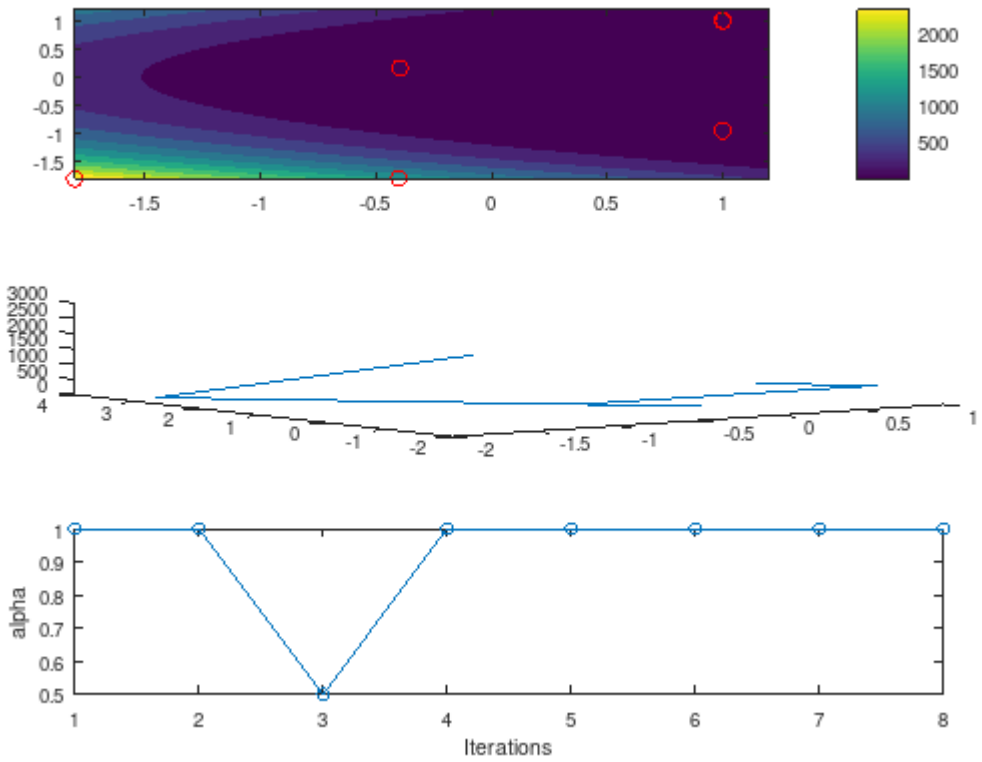
In [56]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = newton(rosen_sym, [-1.8,-1.8]', 'wolfe_strong', search_x, search_y, c,
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   9.999999998532665e-01
   9.999999996432530e-01

fmin = 4.219657651944829e-19
```



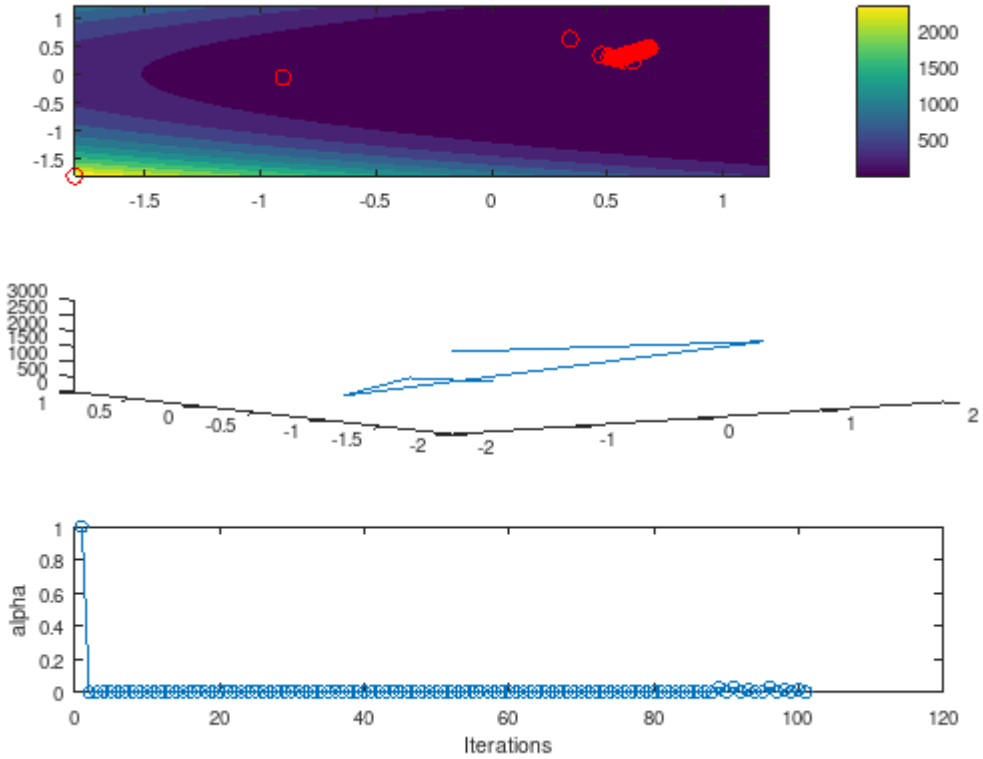
In [9]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
[xmin, fmin] = newton(rosen_sym, [-1.8,-1.8]', 'nonmonotone_backtracking_armijo', sea
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   9.999999999998471e-01
   9.999999999996944e-01

fmin = 2.337282696009845e-26
```



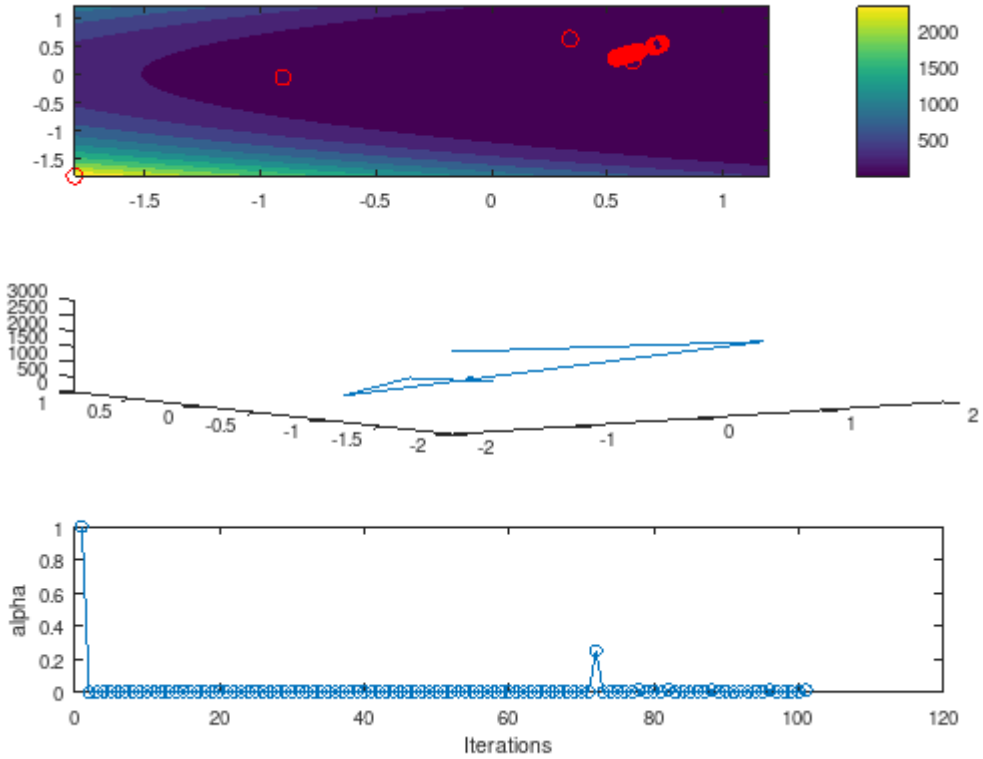
In [5]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
[xmin, fmin] = steepest_descent(rosen_sym, [-1.8,-1.8]', 'backtracking_wolfe_weak', s
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

   6.830308556342202e-01
   4.645442633745788e-01

fmin = 1.008642102262281e-01
```



In [61]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
[xmin, fmin] = steepest_descent(rosen_sym, [-1.8,-1.8]', 'backtracking_armijo', searc
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

   7.314832480328027e-01
   5.367666412124249e-01

fmin = 7.238987188855434e-02
```

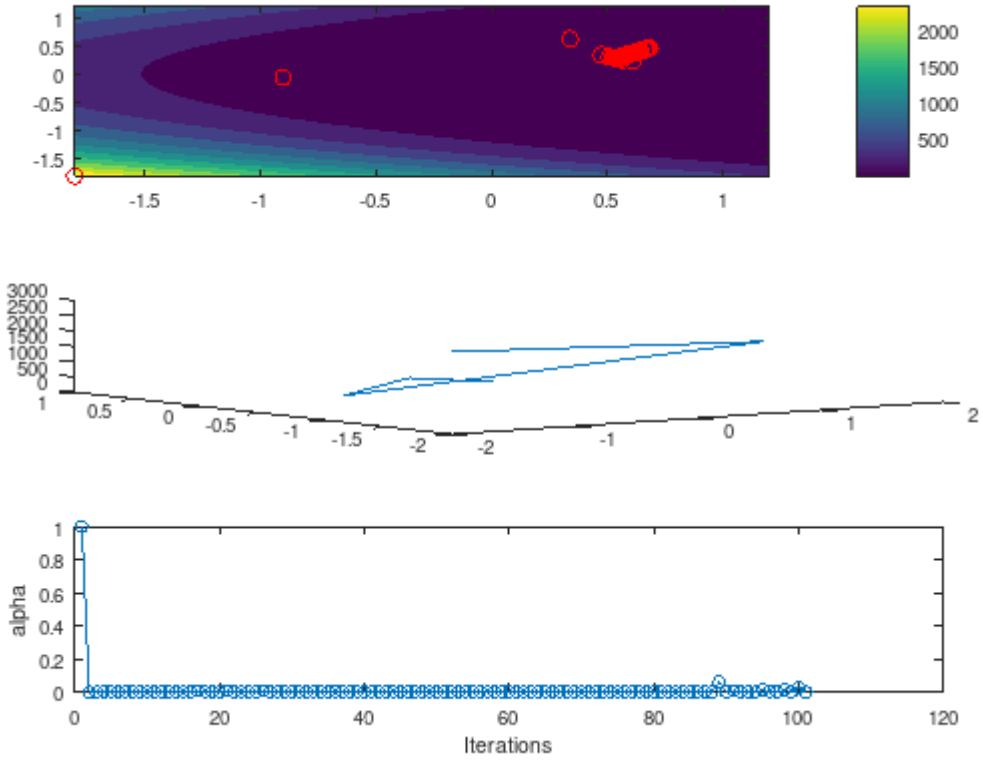


In [62]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
[xmin, fmin] = steepest_descent(rosen_sym, [-1.8,-1.8]', 'none', search_x, search_y);
```

```
STARTED Line search using steepest descent
error: Failed to converge. Inf value reached
error: called from
    steepest_descent at line 45 column 13
```

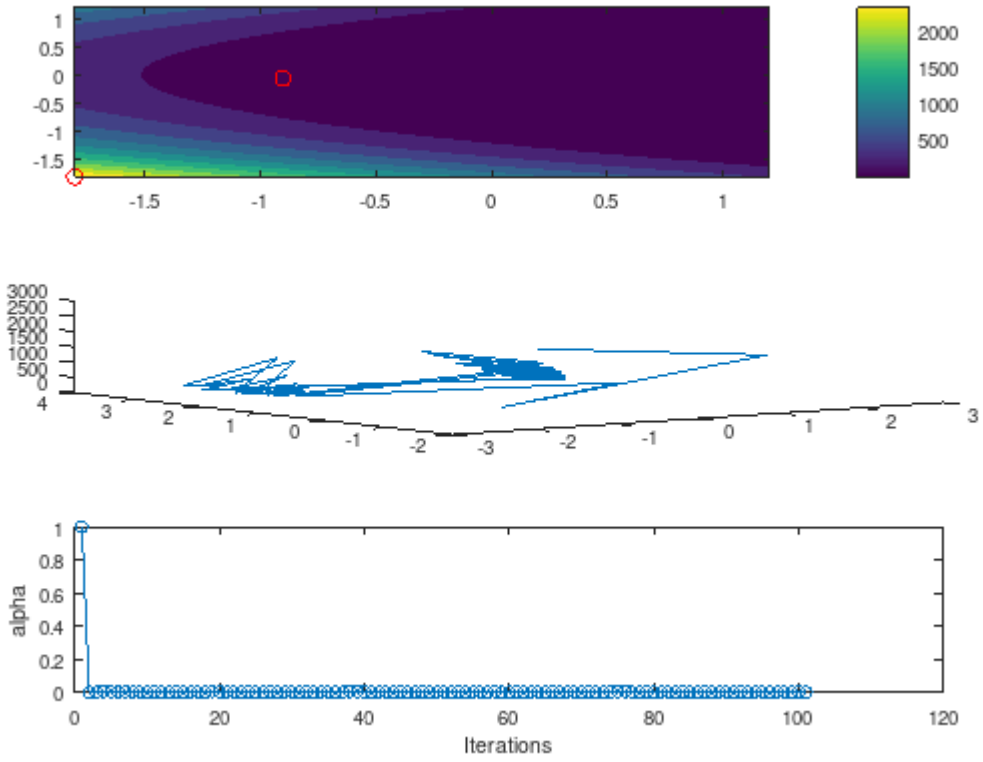
In [11]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = steepest_descent(rosen_sym, [-1.8,-1.8]', 'wolfe_strong', search_x, se
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

   6.826021505276558e-01
   4.636937784980141e-01

fmin = 1.012485080504487e-01
```



In [12]:
```
search_x = -1.8:0.1:1.2;
search_y = -1.8:0.1:1.2;
[xmin, fmin] = steepest_descent(rosen_sym, [-1.8,-1.8]', 'nonmonotone_backtracking_ar
```

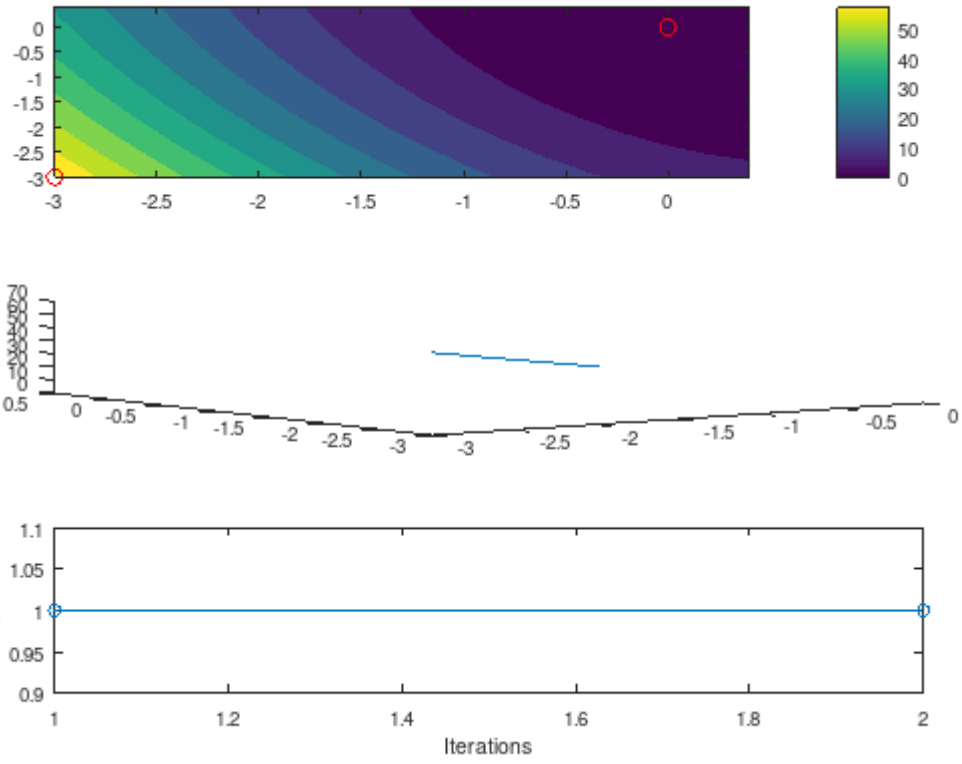
```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

   1.360838364638030e+00
   2.372879081758366e+00

fmin = 2.727409874831804e+01
```



In [23]:
```
% f(x,y) = x^2 + 4y^2 + 2xy -- fmin = 0 at x = 0, y = 0 -- Search domain: -3 ≤ x, y ≤

function f = f1_sym()
    syms x y
    f = x^2 + 4*y^2 + 2*x*y;
end
```

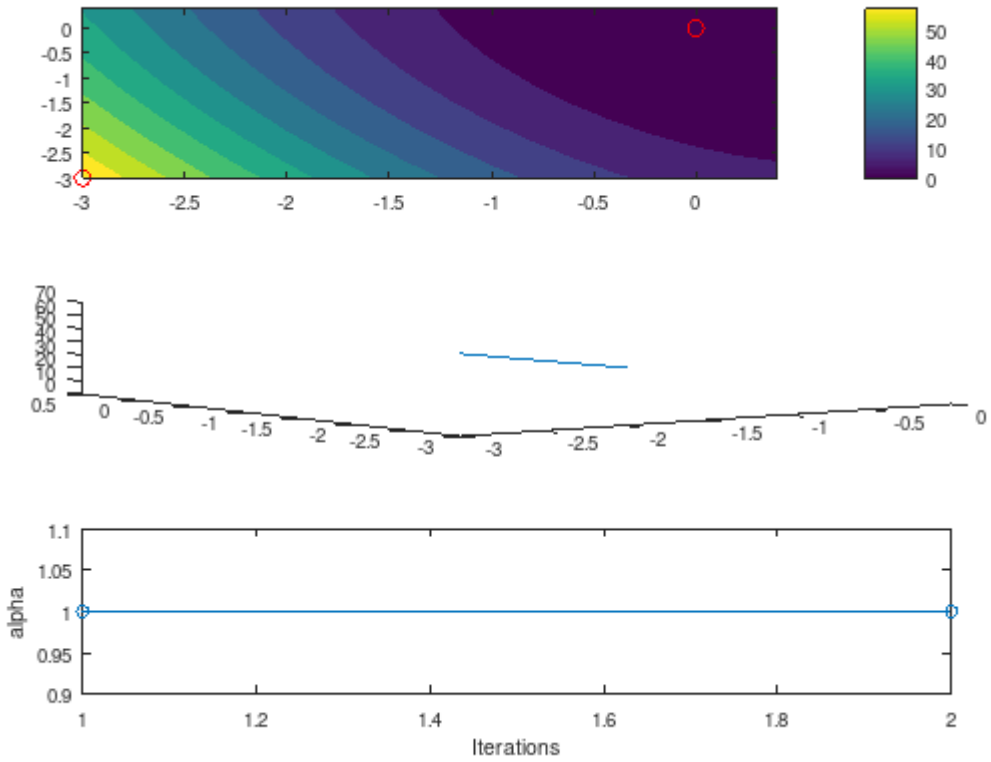
In [65]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
[xmin, fmin] = newton(f1_sym, [-3,-3]', 'backtracking_wolfe_weak', search_x, search_y
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
```



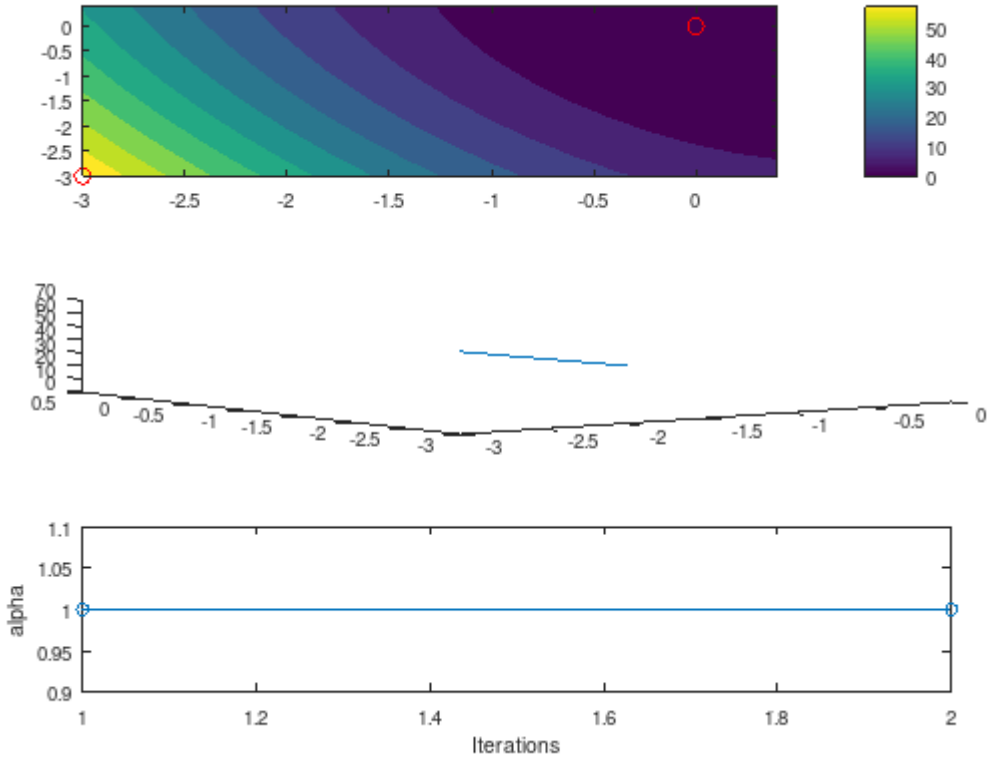
In [66]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
[xmin, fmin] = newton(f1_sym, [-3,-3]', 'backtracking_armijo', search_x, search_y)
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
```



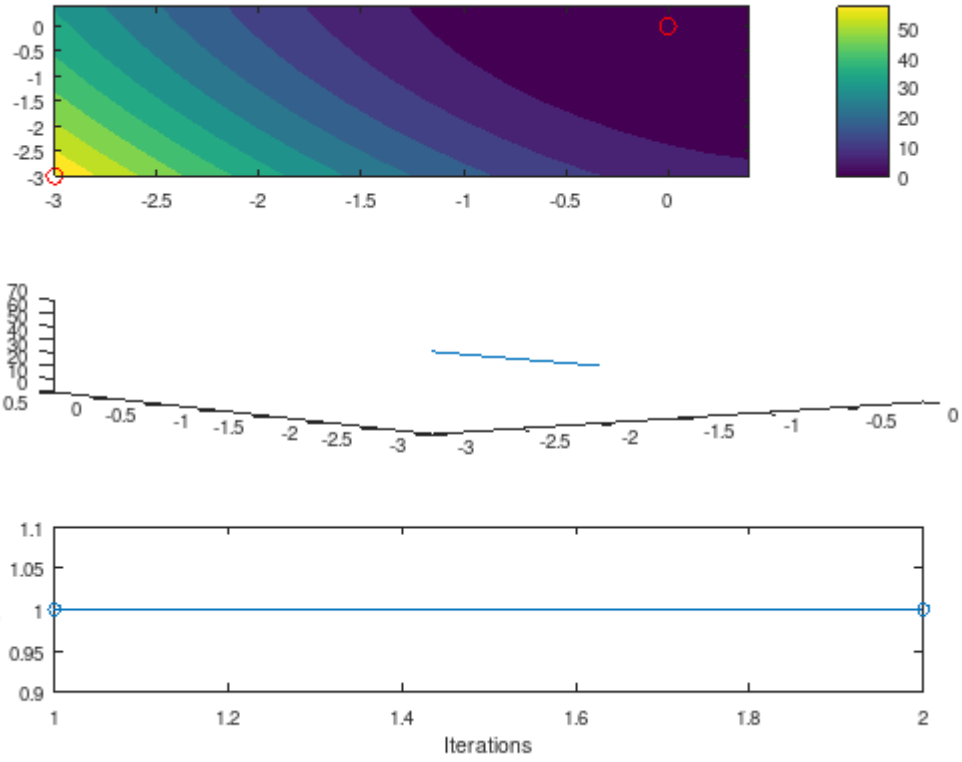
In [67]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
[xmin, fmin] = newton(f1_sym, [-3,-3]', 'none', search_x, search_y)
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
```



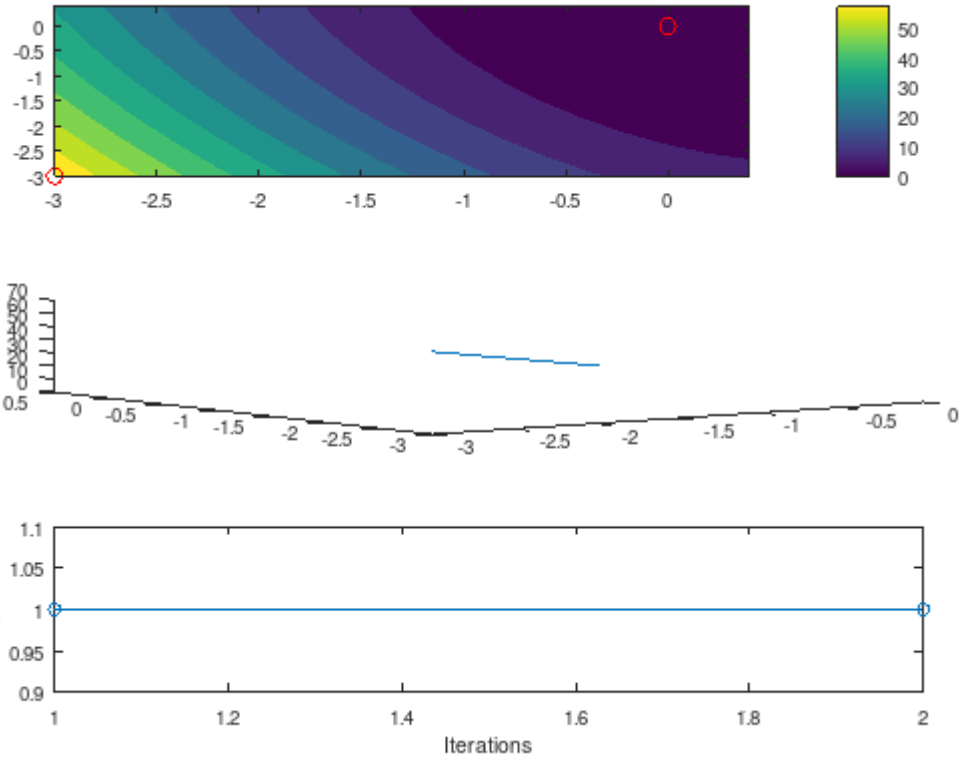
In [68]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = newton(f1_sym, [-3,-3]', 'wolfe_strong', search_x, search_y, c, rho)
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
```



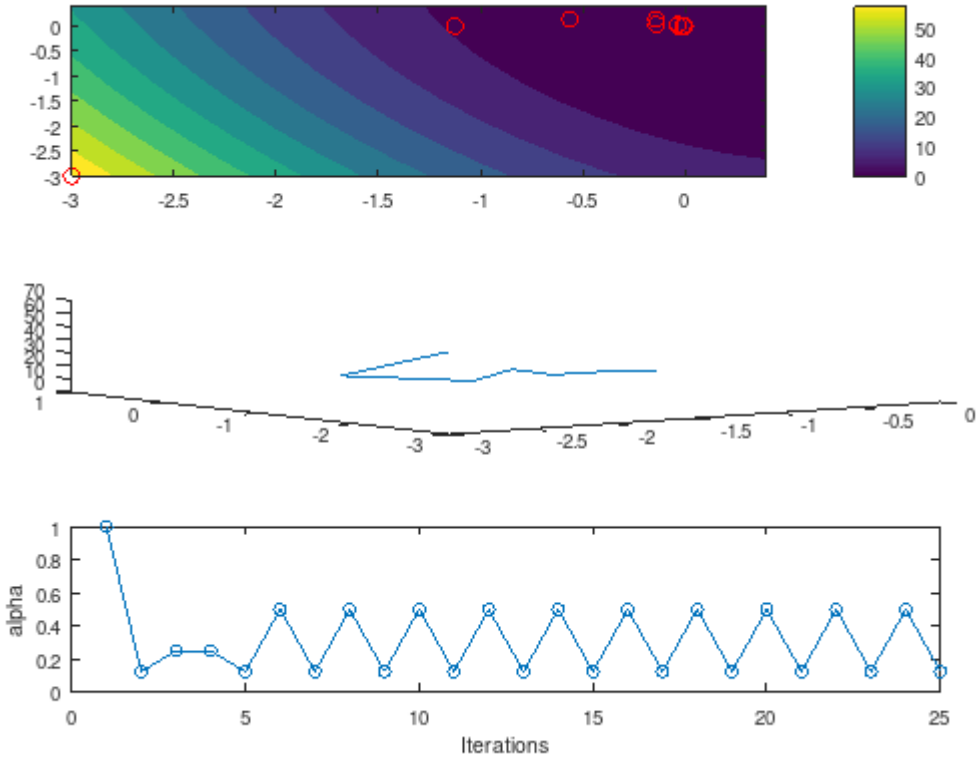
In [24]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
[xmin, fmin] = newton(f1_sym, [-3,-3]', 'nonmonotone_backtracking_armijo', search_x,
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
xmin =

  -1.332267629550188e-15
   8.881784197001252e-16

fmin = 2.563797941968288e-30
```



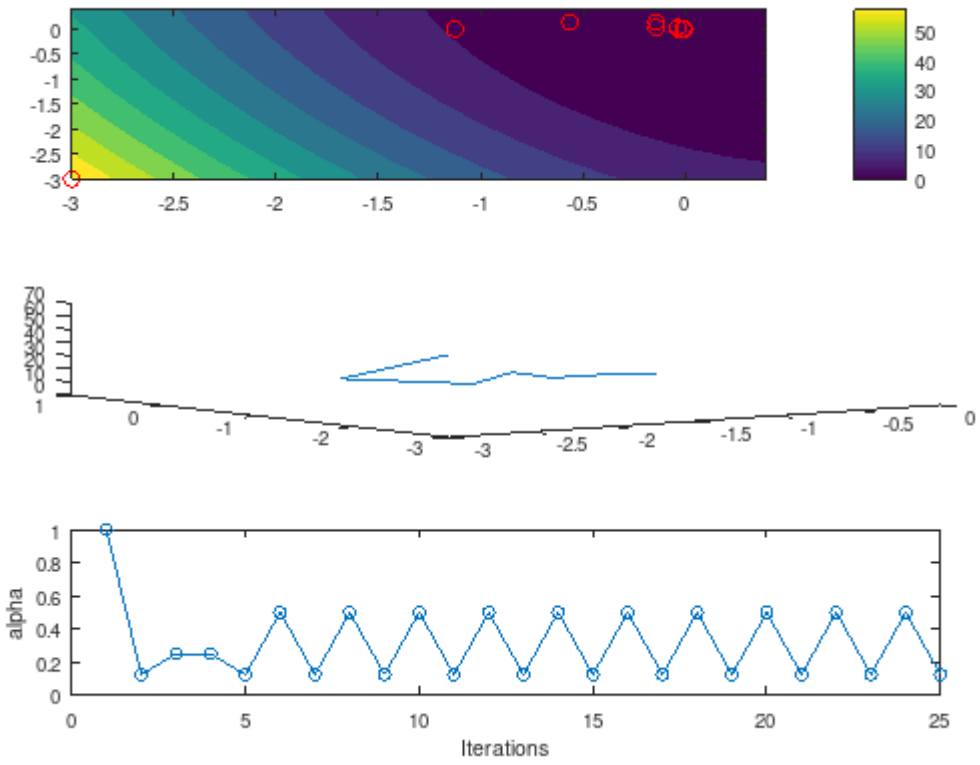
In [5]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
[xmin, fmin] = steepest_descent(f1_sym, [-3,-3]', 'backtracking_wolfe_weak', search_x
```

```
Symbolic pkg v3.1.1: Python communication link active, SymPy v1.11.1.
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

  -5.364418029785156e-07
   1.341104507446289e-07

fmin = 2.158273559871304e-13
xmin =

  -5.364418029785156e-07
   1.341104507446289e-07

fmin = 2.158273559871304e-13
```



In [70]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
[xmin, fmin] = steepest_descent(f1_sym, [-3,-3]', 'backtracking_armijo', search_x, se
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

  -5.364418029785156e-07
   1.341104507446289e-07

fmin = 2.158273559871304e-13
xmin =

  -5.364418029785156e-07
   1.341104507446289e-07

fmin = 2.158273559871304e-13
```



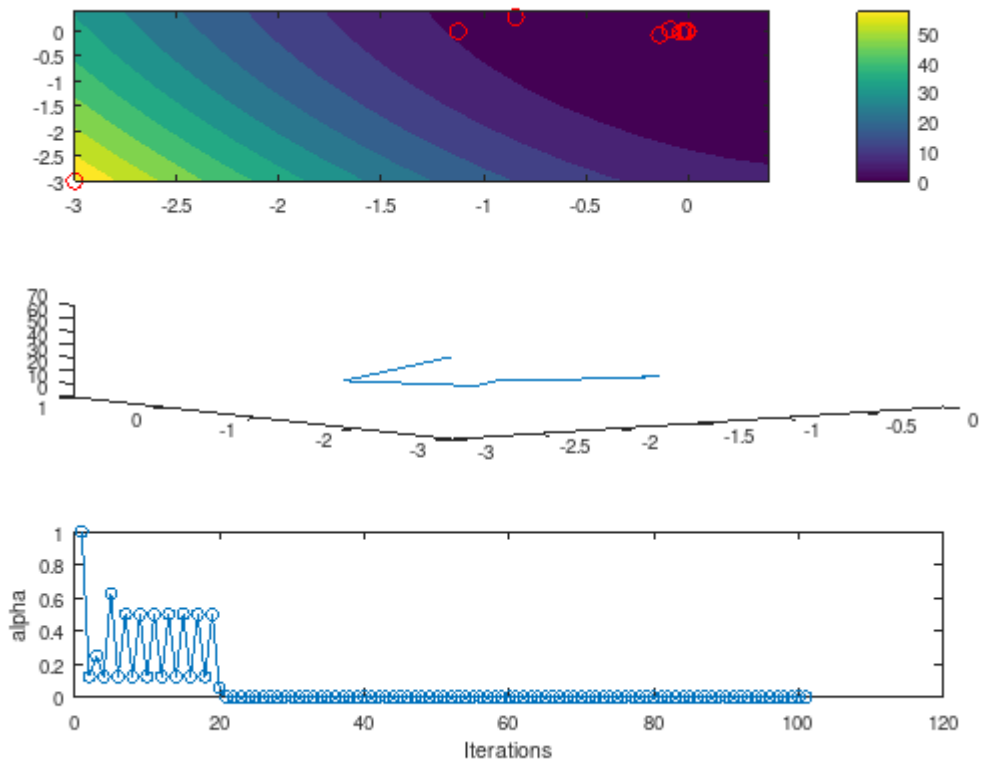
In [71]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
[xmin, fmin] = steepest_descent(f1_sym, [-3,-3]', 'none', search_x, search_y);
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

  -1.406335921346234e+88
  -4.644812019489721e+88

fmin = 1.013392274910718e+178
error: set: "cameraviewangle" must be finite
error: called from
    plot3 at line 371 column 10
    plot_line_search1 at line 41 column 9
    steepest_descent at line 65 column 5
```

```
Inline plot failed, consider trying another graphics toolkit

error: set: "cameraviewangle" must be finite
error: called from
    _make_figures>safe_print at line 125 column 7
    _make_figures at line 49 column 13
```

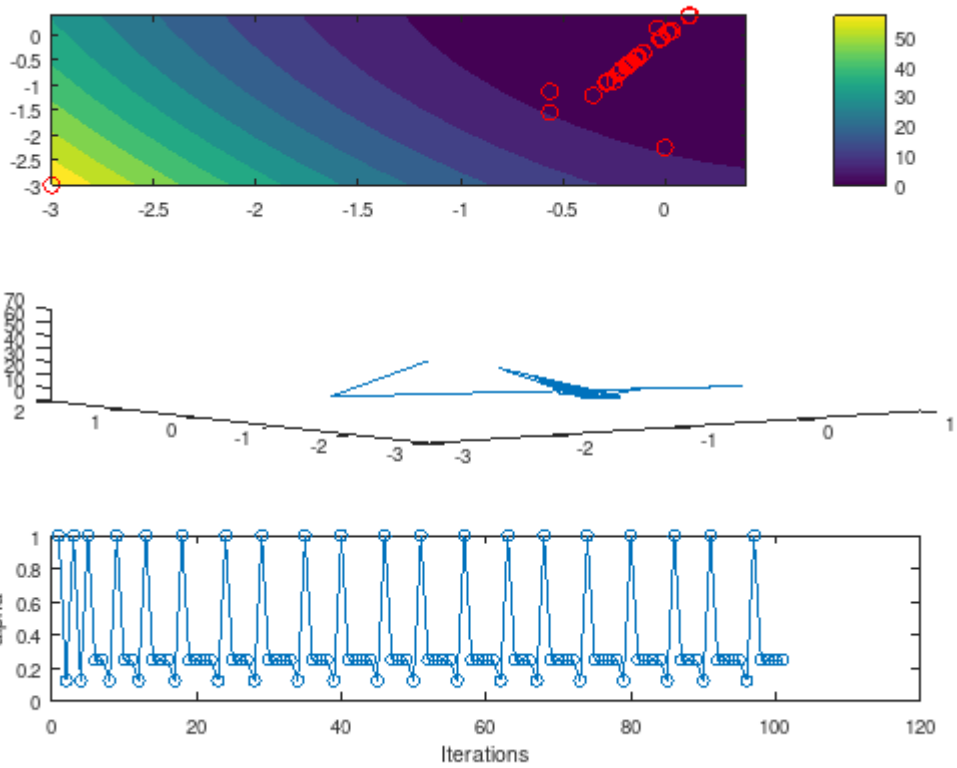
In [6]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = steepest_descent(f1_sym, [-3,-3]', 'wolfe_strong', search_x, search_y,
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

  -6.383952198571882e-06
  -5.914933985905300e-07

fmin = 4.970643460070100e-11
```



In [25]:
```
search_x = -3:0.2:0.4;
search_y = -3:0.2:0.4;
[xmin, fmin] = steepest_descent(f1_sym, [-3,-3]', 'nonmonotone_backtracking_armijo',
```

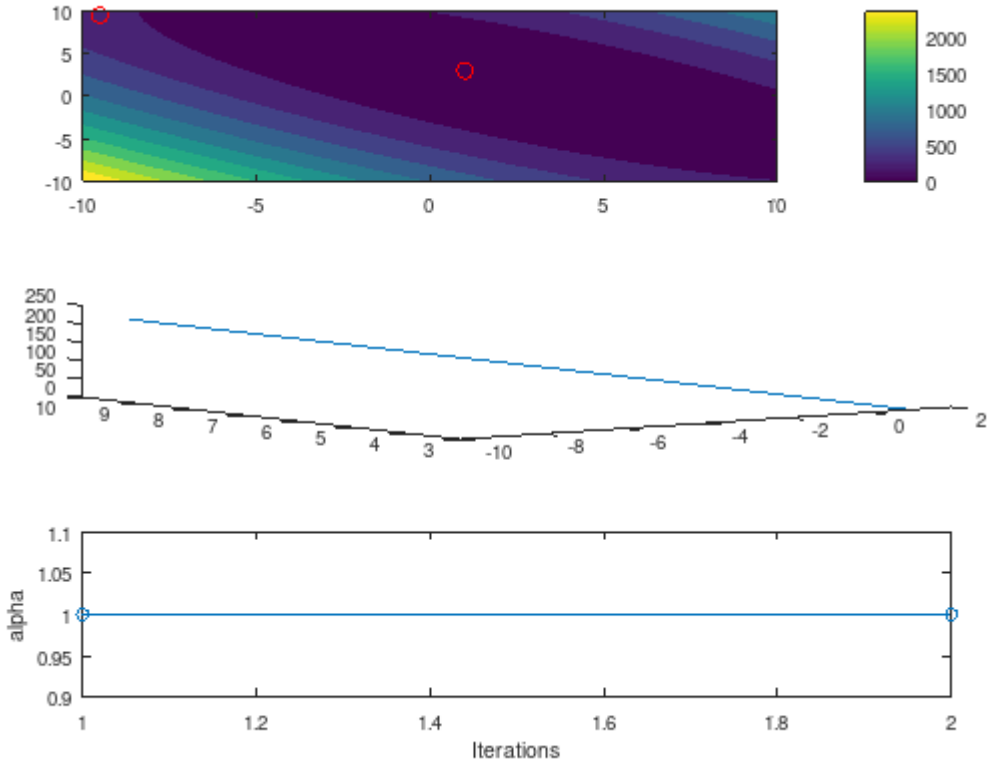
```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

  -1.881054424659777e-01
  -6.212700727014284e-01

fmin = 1.813018234255819e+00
```



In [26]:
```
% f(x,y) = (x + 2y - 7)^2 + (2x + y - 5)^2 -- fmin = 0 at x = 1, y = 3 -- Search doma

function f = f2_sym()
    syms x y
    f = (x+2*y-7)^2 + (2*x + y - 5)^2;
end
```

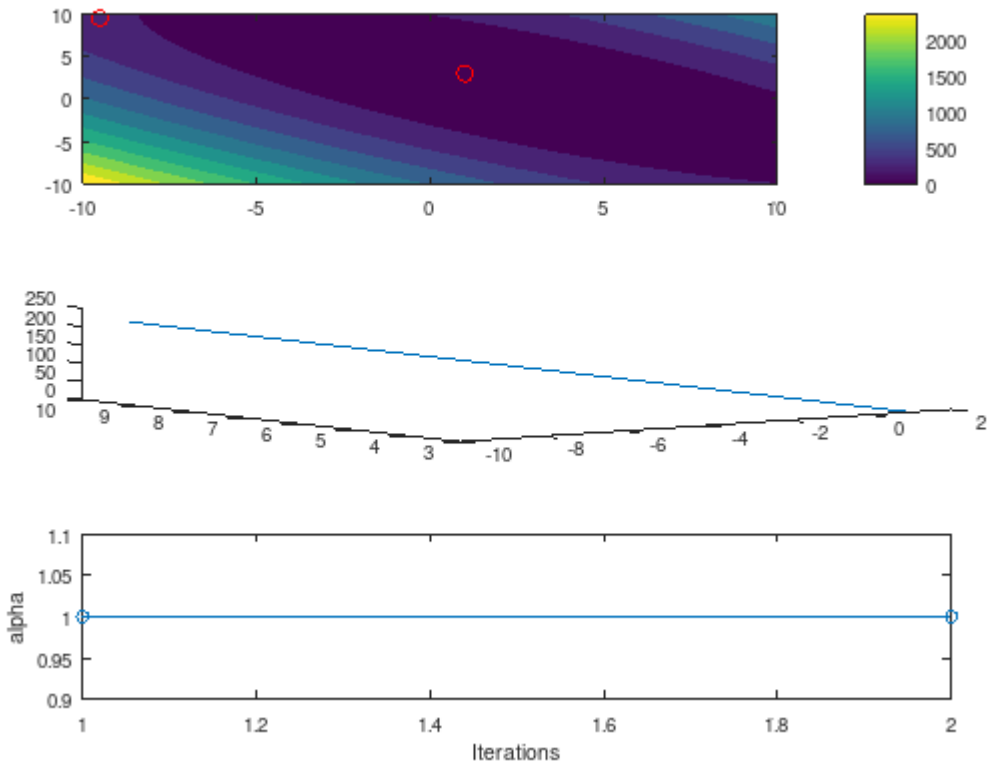
In [8]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
[xmin, fmin] = newton(f2_sym, [-9.5,9.5]', 'backtracking_wolfe_weak', search_x, searc
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   1.000000000000000e+00
   3.000000000000000e+00

fmin =                    0
```



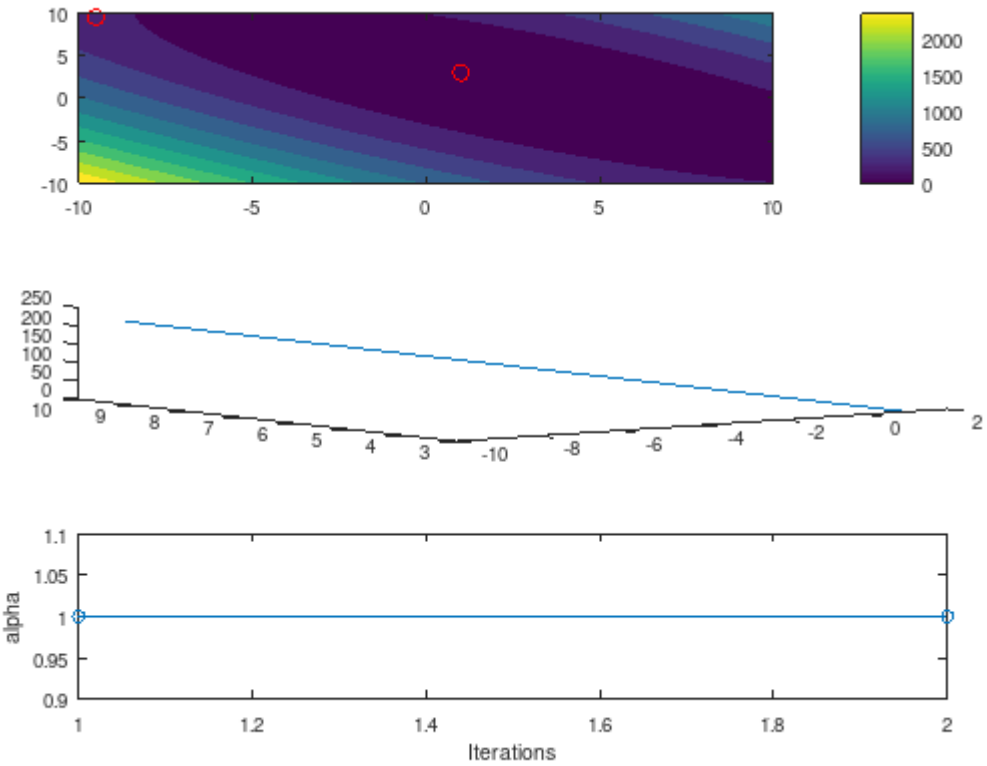
In [9]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
[xmin, fmin] = newton(f2_sym, [-9.5,9.5]', 'backtracking_armijo', search_x, search_y)
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   1.000000000000000e+00
   3.000000000000000e+00

fmin =                    0
```



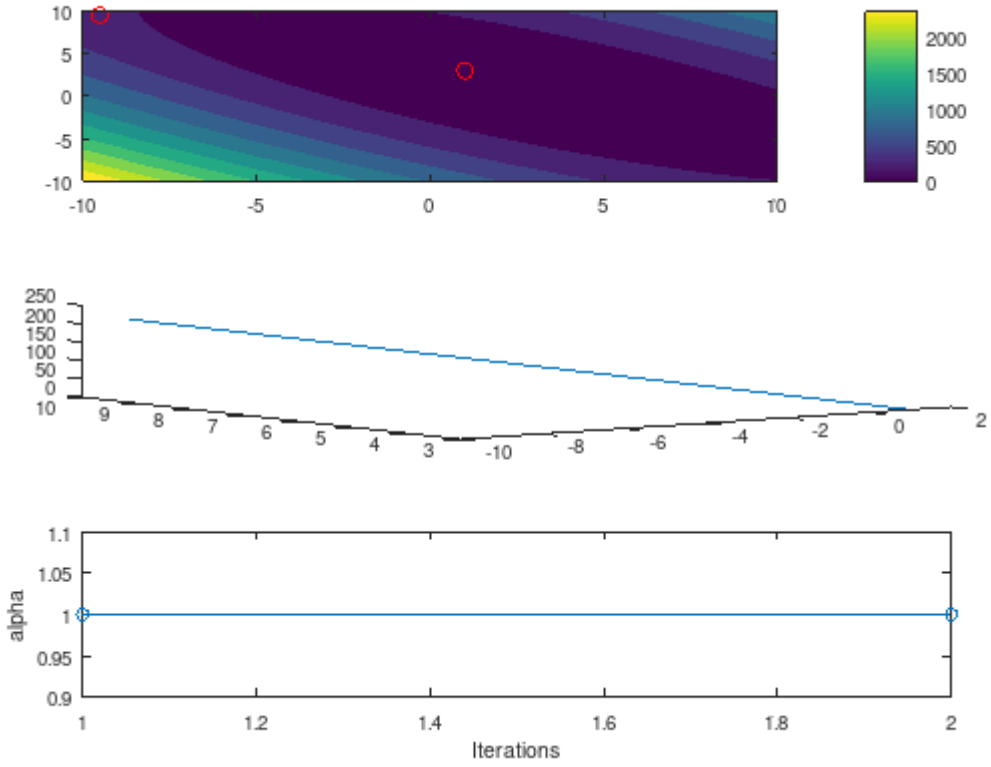
In [10]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
[xmin, fmin] = newton(f2_sym, [-9.5,9.5]', 'none', search_x, search_y);
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   1.000000000000000e+00
   3.000000000000000e+00

fmin =                    0
```



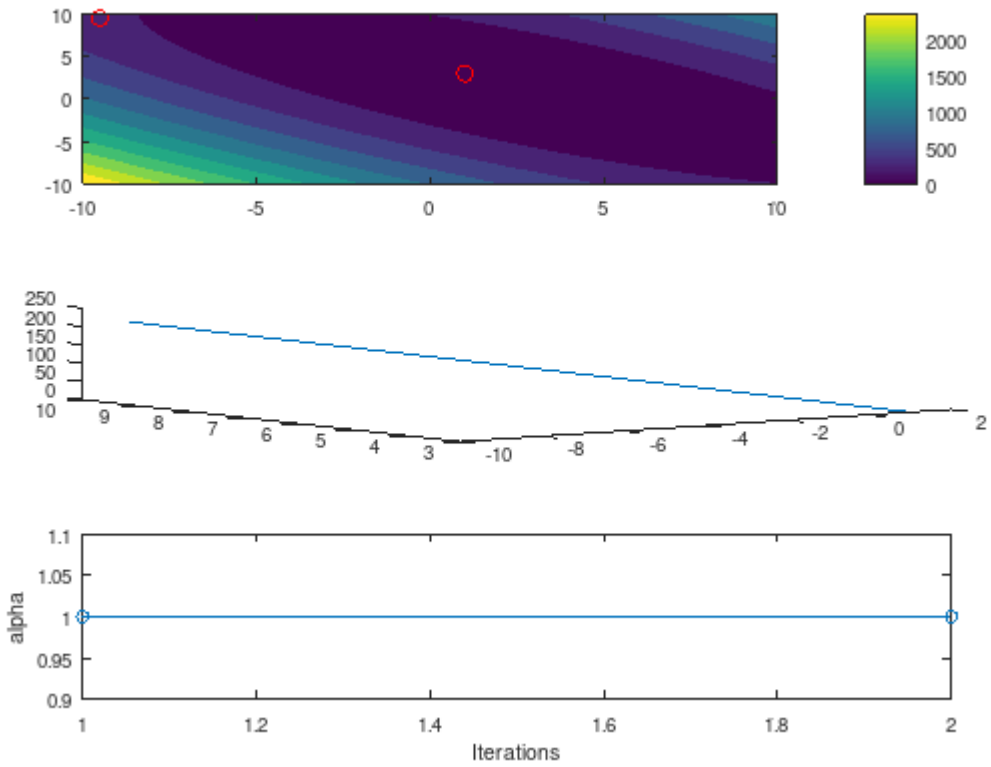
In [11]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = newton(f2_sym, [-9.5,9.5]', 'wolfe_strong', search_x, search_y, c, rho
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   1.000000000000000e+00
   3.000000000000000e+00

fmin =                    0
```



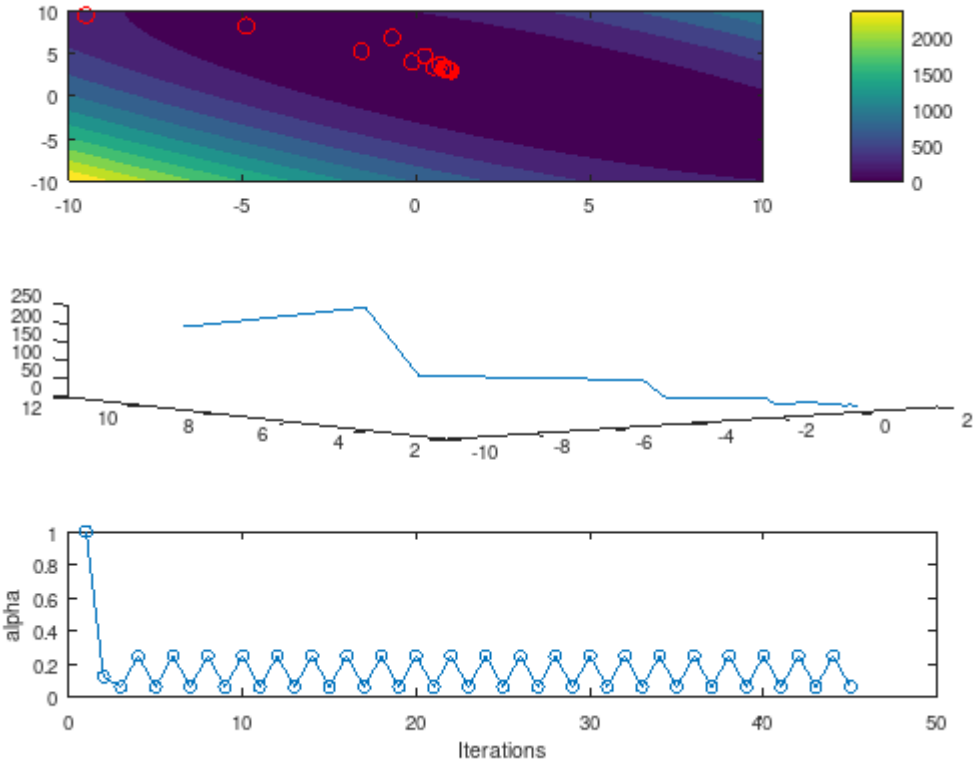
In [27]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
[xmin, fmin] = newton(f2_sym, [-9.5,9.5]', 'nonmonotone_backtracking_armijo', search_
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   1.000000000000000e+00
   3.000000000000000e+00

fmin =                    0
```



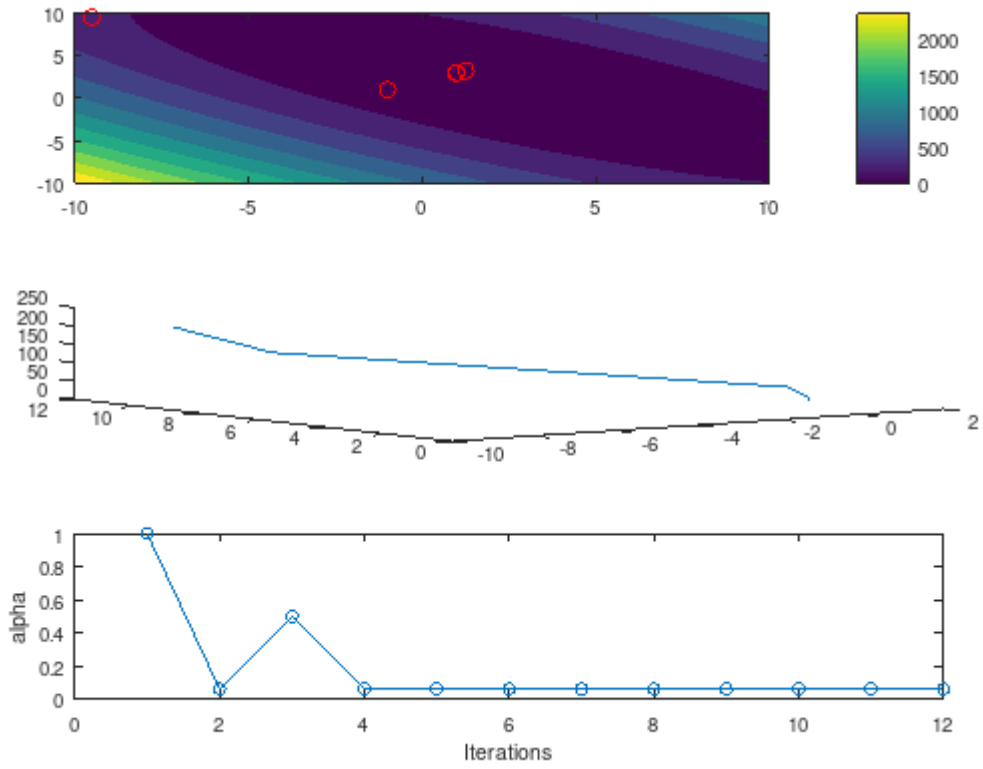
In [12]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
[xmin, fmin] = steepest_descent(f2_sym, [-9.5,9.5]', 'backtracking_wolfe_weak', searc
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

   9.999998299014621e-01
   3.000000152050948e+00

fmin = 5.335586537193396e-14
```



In [13]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
[xmin, fmin] = steepest_descent(f2_sym, [-9.5,9.5]', 'backtracking_armijo', search_x,
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

   1.000000014901161e+00
   3.000000014901161e+00

fmin = 3.996802888650564e-15
```



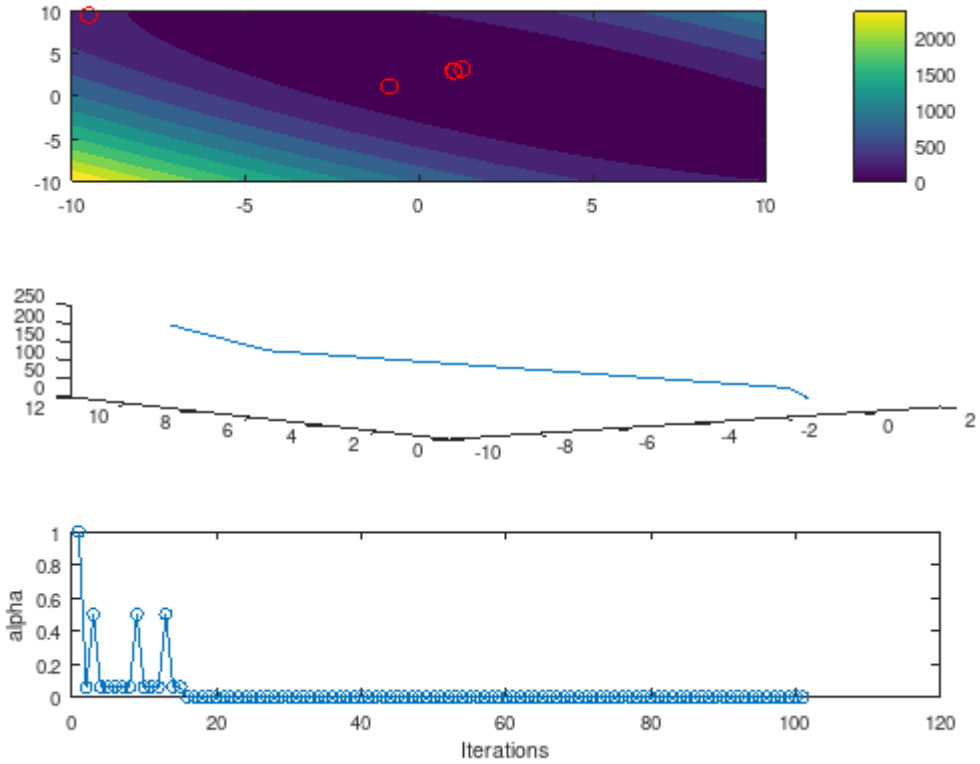
In [14]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
[xmin, fmin] = steepest_descent(f2_sym, [-9.5,9.5]', 'none', search_x, search_y);
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

  -2.217798745561569e+123
  -2.217798745561569e+123

fmin = 8.853536296466041e+247
error: set: "cameraviewangle" must be finite
error: called from
    plot3 at line 371 column 10
    plot_line_search1 at line 41 column 9
    steepest_descent at line 65 column 5
```

```
Inline plot failed, consider trying another graphics toolkit

error: set: "cameraviewangle" must be finite
error: called from
    _make_figures>safe_print at line 125 column 7
    _make_figures at line 49 column 13
```

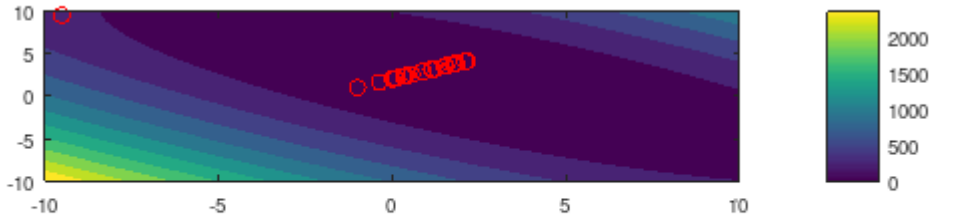
In [15]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = steepest_descent(f2_sym, [-9.5,9.5]', 'wolfe_strong', search_x, search
```

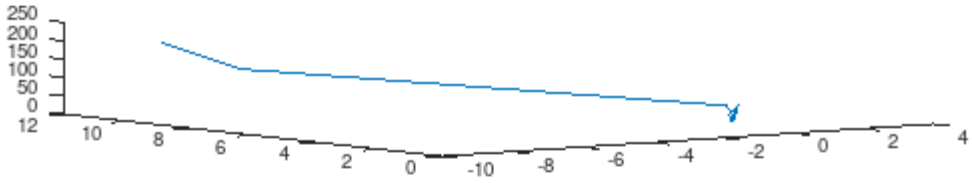
```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

   9.999999381765151e-01
   2.999999934833218e+00

fmin = 7.257496400782470e-14
```

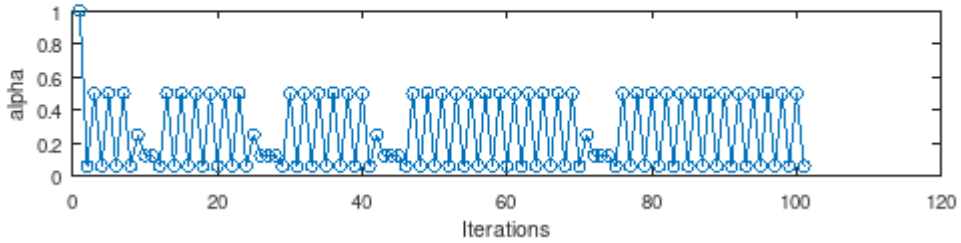


In [28]:
```
search_x = -10:0.5:10;
search_y = -10:0.5:10;
[xmin, fmin] = steepest_descent(f2_sym, [-9.5,9.5]', 'nonmonotone_backtracking_armijo
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

   8.933741807150000e-01
   2.893374180715000e+00

fmin = 2.046431760875547e-01
```



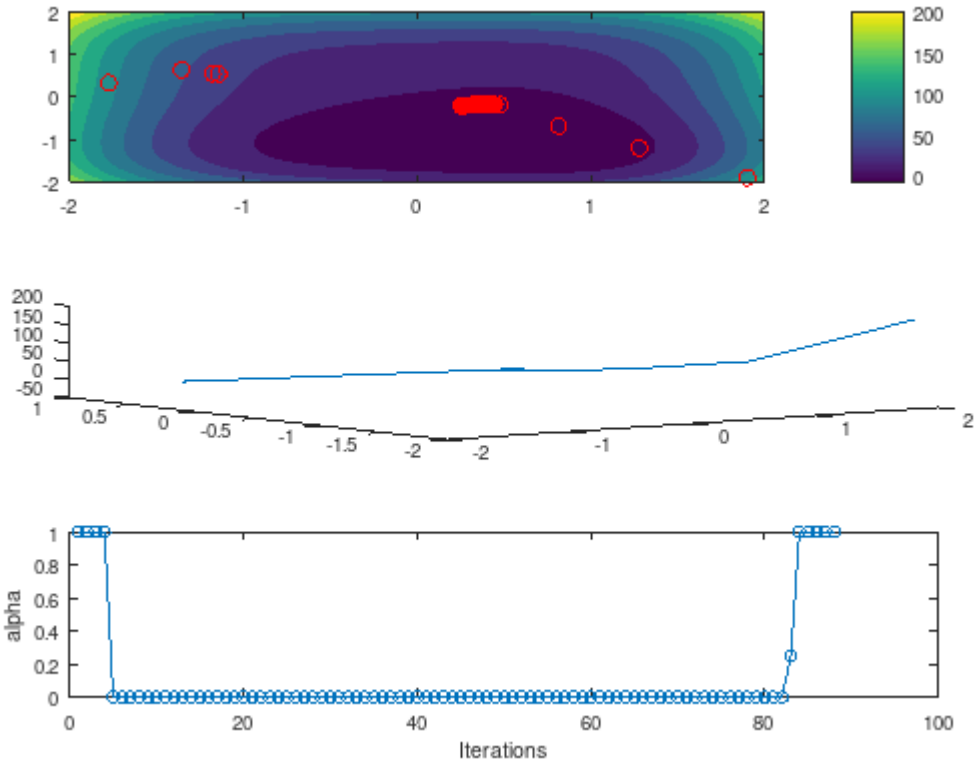




In [29]:
```
% f(x,y) = 5x^4 + 6y^4 - 6x^2 + 2xy + 5y^2 +15x - 7y + 13 -- fmin = -6.4931 at x = -1

function f = f3_sym()
    syms x y
    f = 5*x^4 + 6*y^4 - 6*x^2 + 2*x*y + 5*y^2 + 15*x - 7*y + 13;
end
```

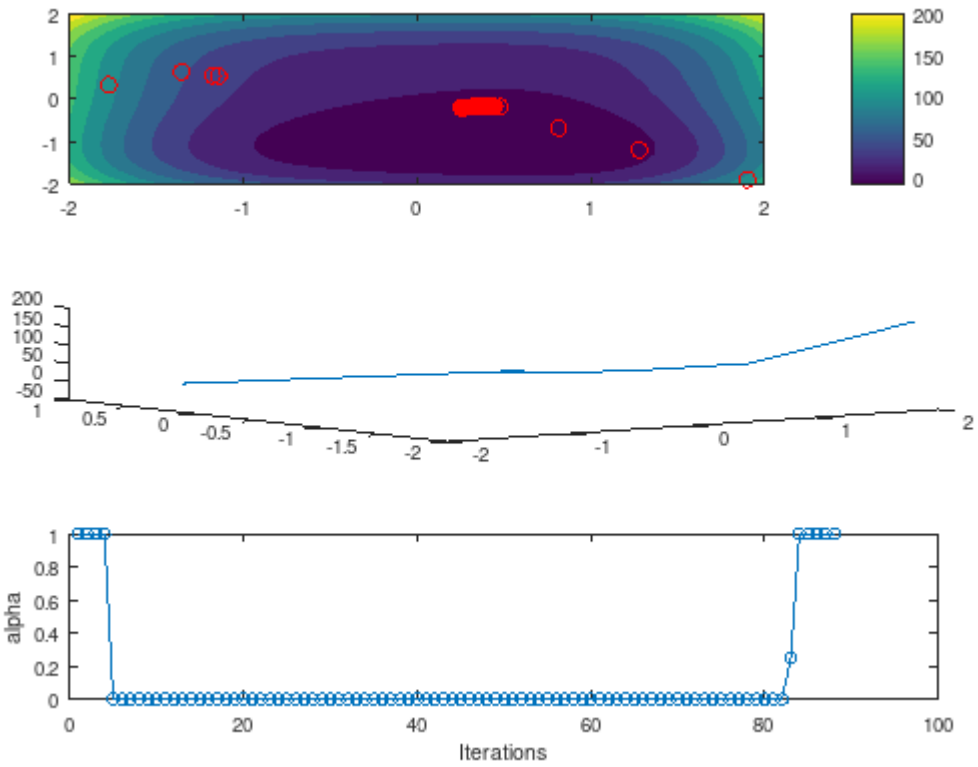
In [18]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
[xmin, fmin] = newton(f3_sym, [1.9,-1.9]', 'backtracking_wolfe_weak', search_x, searc
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -1.142054928372278e+00
   5.433724812053312e-01

fmin = -6.496118935491067e+00
```



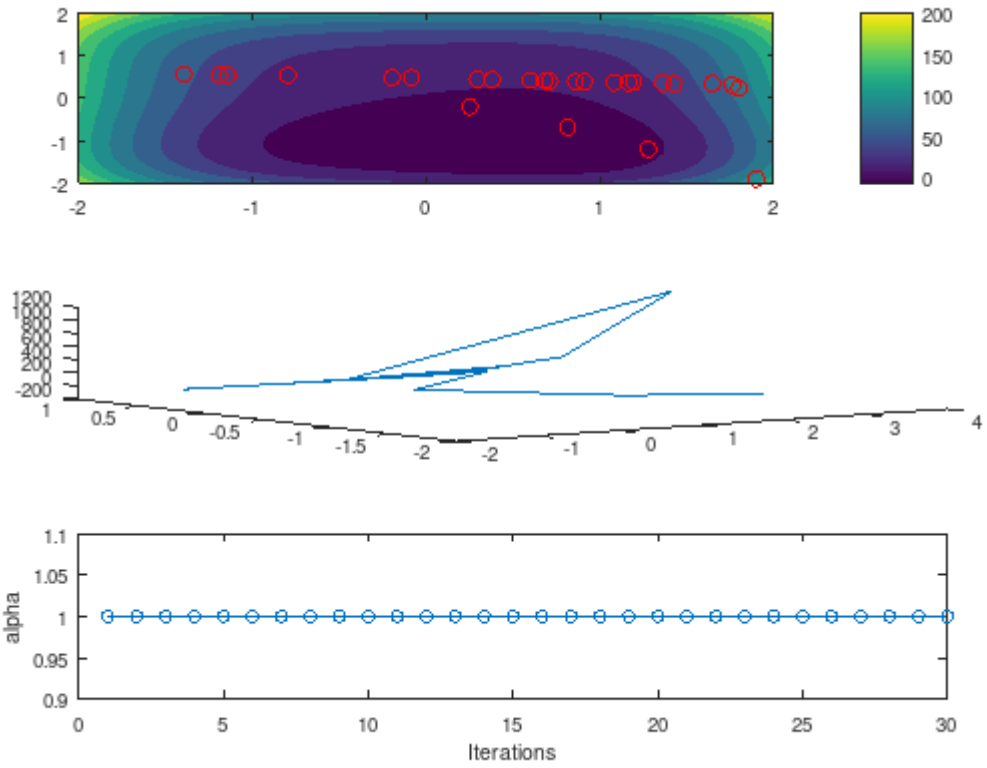
In [19]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
[xmin, fmin] = newton(f3_sym, [1.9,-1.9]', 'backtracking_armijo', search_x, search_y)
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -1.142054928372278e+00
   5.433724812053312e-01

fmin = -6.496118935491067e+00
```



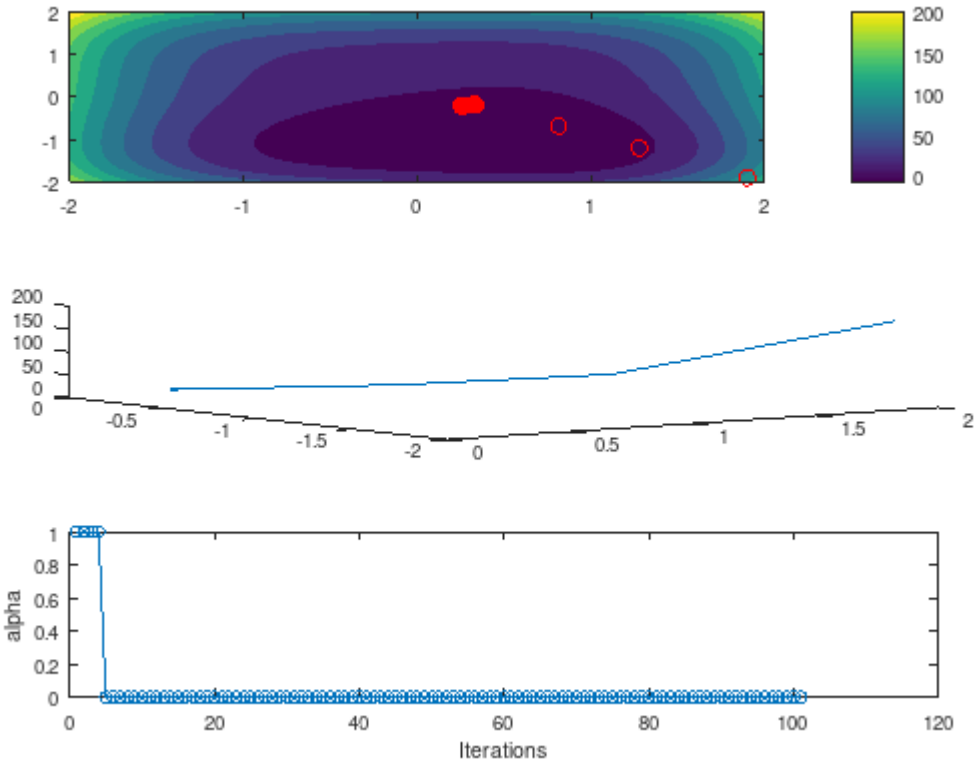
In [20]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
[xmin, fmin] = newton(f3_sym, [1.9,-1.9]', 'none', search_x, search_y);
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -1.142054928396837e+00
   5.433724812070151e-01

fmin = -6.496118935491067e+00
```



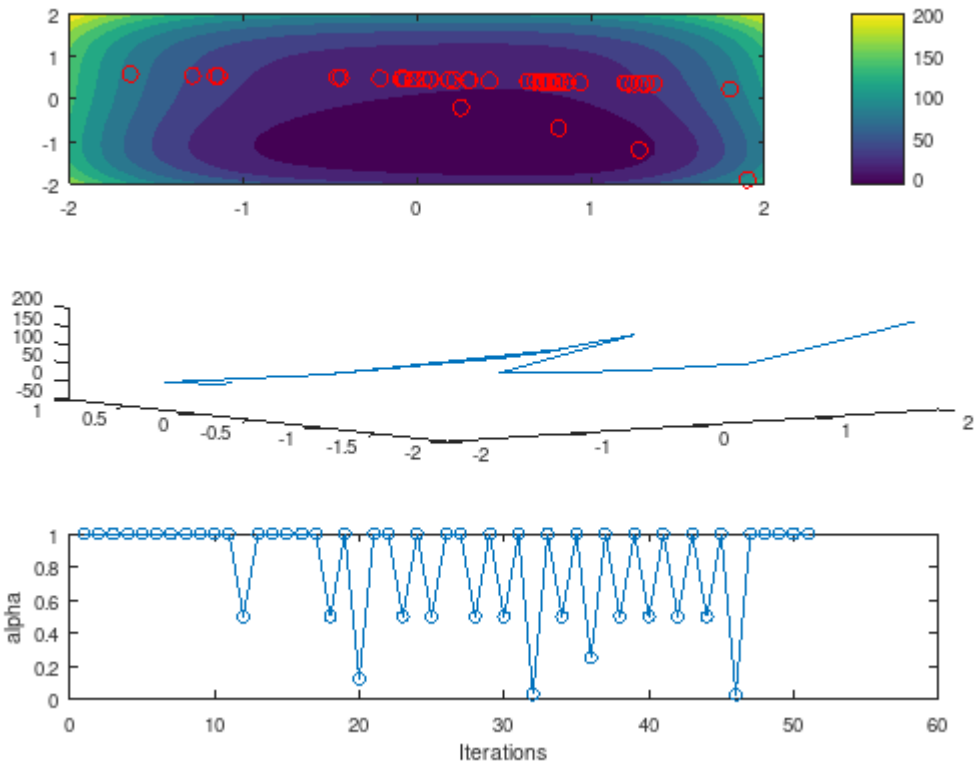
In [21]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = newton(f3_sym, [1.9,-1.9]', 'wolfe_strong', search_x, search_y, c, rho
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   3.370260384521531e-01
  -1.856908054665151e-01

fmin = 1.879259020424283e+01
```



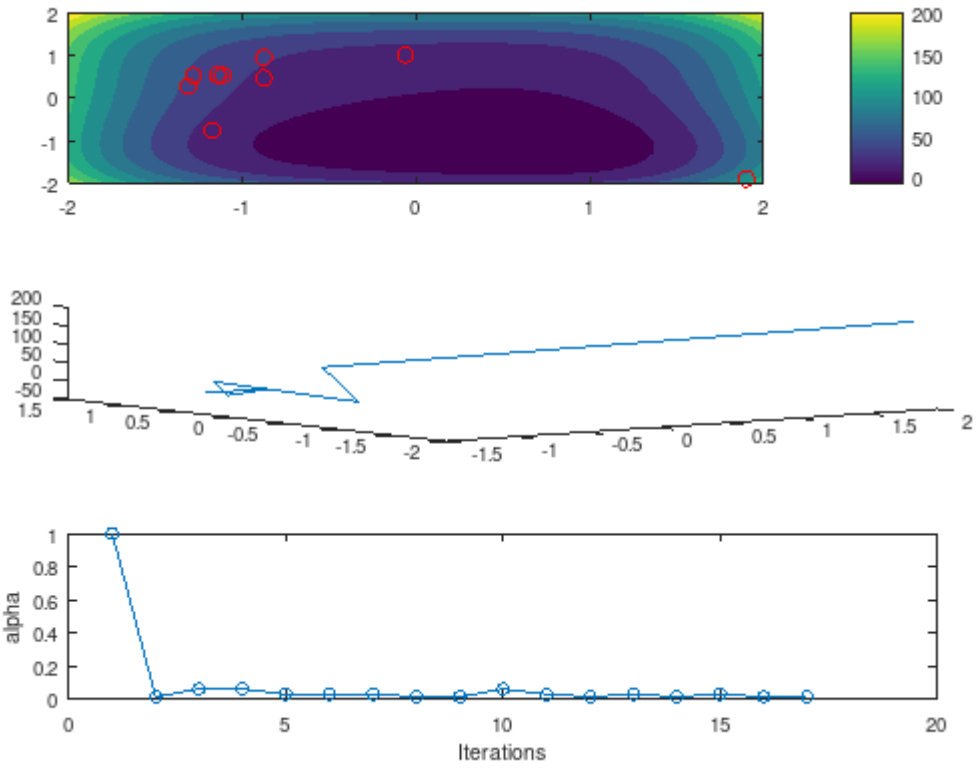
In [30]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
[xmin, fmin] = newton(f3_sym, [1.9,-1.9]', 'nonmonotone_backtracking_armijo', search_
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -1.142054928369260e+00
   5.433724812050884e-01

fmin = -6.496118935491067e+00
```



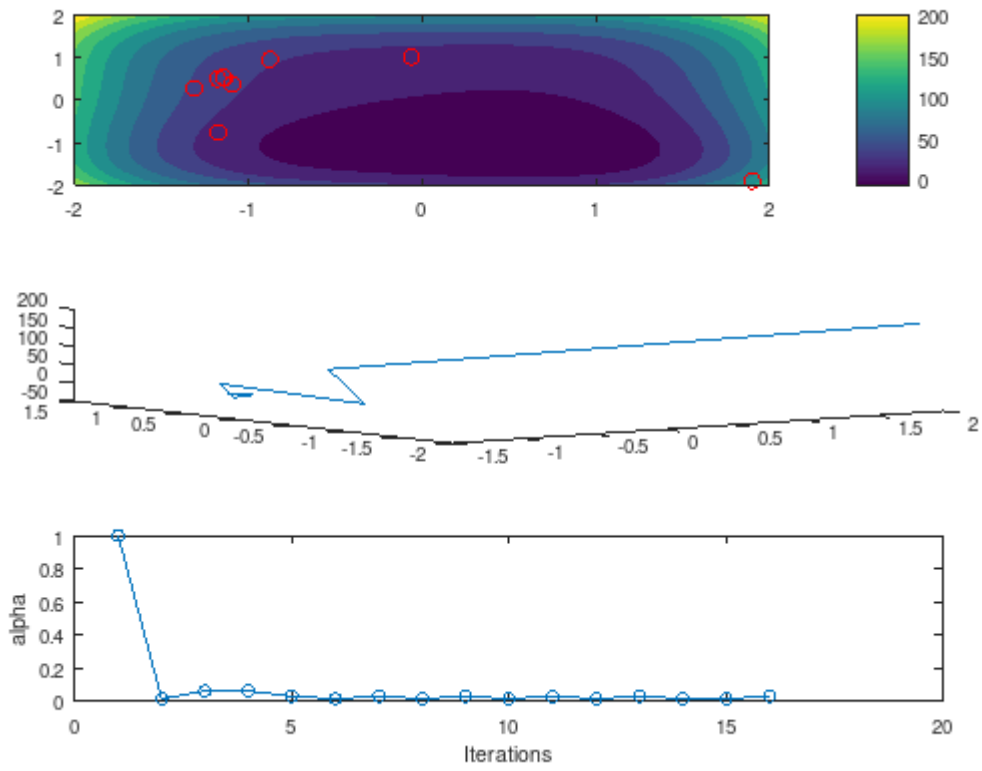
In [22]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
[xmin, fmin] = steepest_descent(f3_sym, [1.9,-1.9]', 'backtracking_wolfe_weak', searc
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

  -1.142054930103962e+00
   5.433724860137114e-01

fmin = -6.496118935491067e+00
```



In [23]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
[xmin, fmin] = steepest_descent(f3_sym, [1.9,-1.9]', 'backtracking_armijo', search_x,
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

  -1.142054921038707e+00
   5.433724802876779e-01

fmin = -6.496118935491065e+00
```

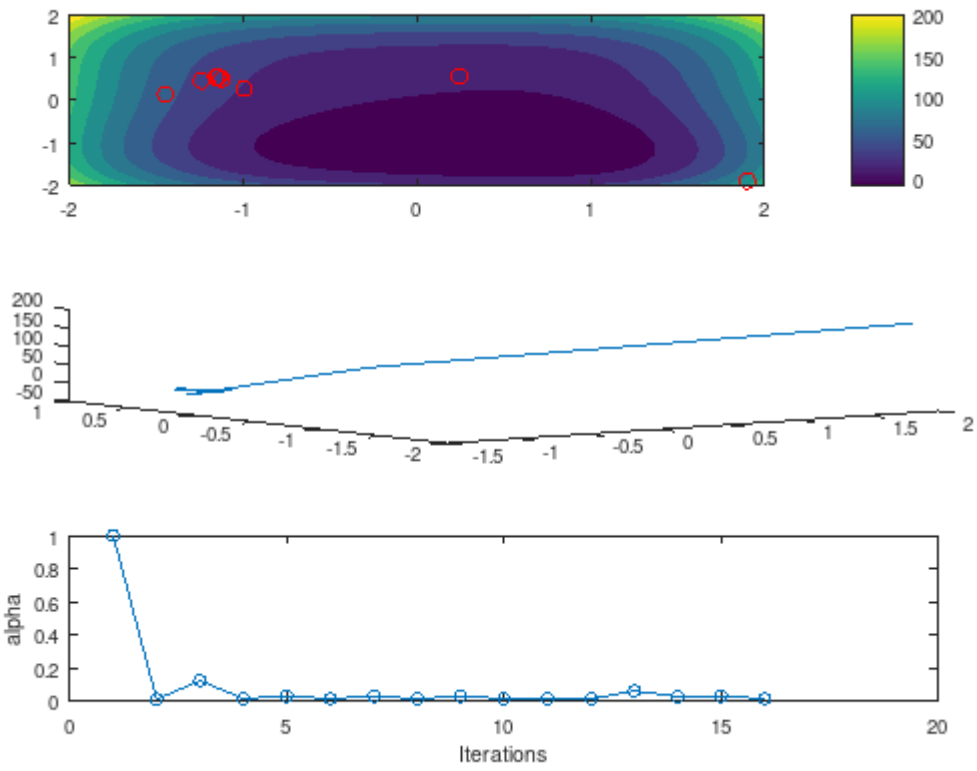


In [25]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
[xmin, fmin] = steepest_descent(f3_sym, [1.9,-1.9]', 'none', search_x, search_y);
```

```
STARTED Line search using steepest descent
error: Failed to converge. Inf value reached
error: called from
    steepest_descent at line 45 column 13
```

In [26]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = steepest_descent(f3_sym, [1.9,-1.9]', 'wolfe_strong', search_x, search
```

```
STARTED Line search using steepest descent
ENDED Line search using steepest descent
xmin =

  -1.142054917024262e+00
   5.433724830420348e-01

fmin = -6.496118935491062e+00
```



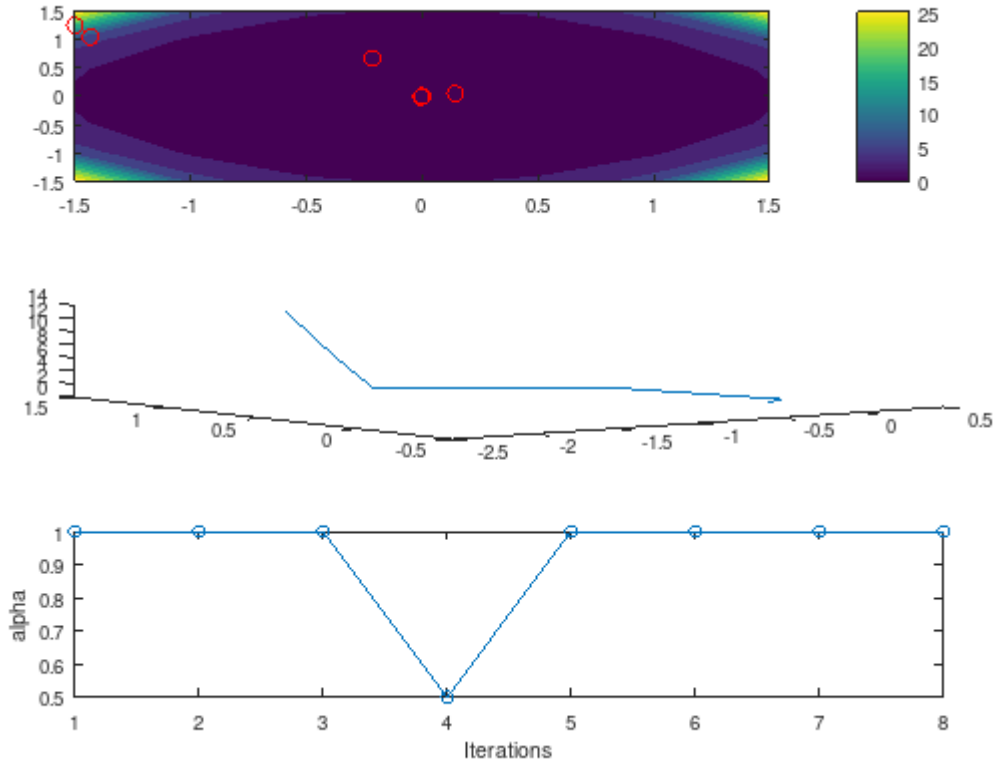
In [ ]:
```
search_x = -2:0.1:2;
search_y = -2:0.1:2;
[xmin, fmin] = steepest_descent(f3_sym, [1.9,-1.9]', 'nonmonotone_backtracking_armijo
```

```
STARTED Line search using steepest descent
```

In [ ]:
```
% f(x,y) = (x^2)^(y^2 + 1) + (y^2)^(x^2+1) -- fmin = 0 at x = 0, y = 0 Search domain:

function f = f4_sym()
    syms x y
    f = (x^2)^(y^2 + 1) + (y^2)^(x^2 + 1);
end
```

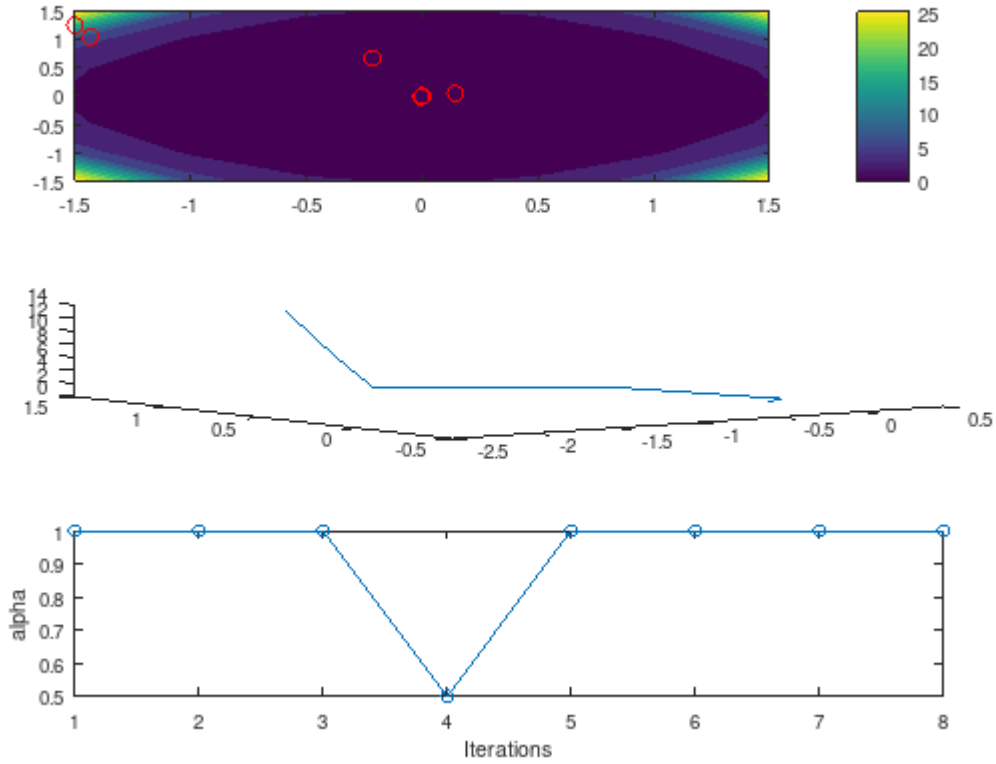
In [8]:
```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
[xmin, fmin] = newton(f4_sym, [-1.5,1.25]', 'backtracking_wolfe_weak', search_x, sear
```

```
Symbolic pkg v3.1.1: Python communication link active, SymPy v1.11.1.
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -4.898290906457485e-13
  -1.411519028897868e-12

fmin = 2.232318506983620e-24
```



In [9]:
```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
[xmin, fmin] = newton(f4_sym, [-1.5,1.25]', 'backtracking_armijo', search_x, search_y
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -4.898290906457485e-13
  -1.411519028897868e-12

fmin = 2.232318506983620e-24
```



In [10]:
```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
[xmin, fmin] = newton(f4_sym, [-1.5,1.25]', 'none', search_x, search_y);
```

```
STARTED Line search using newton
warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
    newton at line 60 column 12

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    linsolve at line 113 column 7
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    linsolve at line 113 column 7
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                                                    7
```

```
    newton at line 60 column 12

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    linsolve at line 113 column 7
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    linsolve at line 113 column 7
    newton at line 60 column 12

warning: matrix singular to machine precision
warning: called from
```



```
 7
```

```
    newton at line 60 column 12

warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
    newton at line 60 column 12

warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
    newton at line 60 column 12

warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
    newton at line 60 column 12

warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
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warning: matrix singular to machine precision
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    linsolve at line 113 column 7
    newton at line 60 column 12

warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
    newton at line 60 column 12

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warning: matrix singular to machine precision
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warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
    newton at line 60 column 12

warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
    newton at line 60 column 12

warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
```
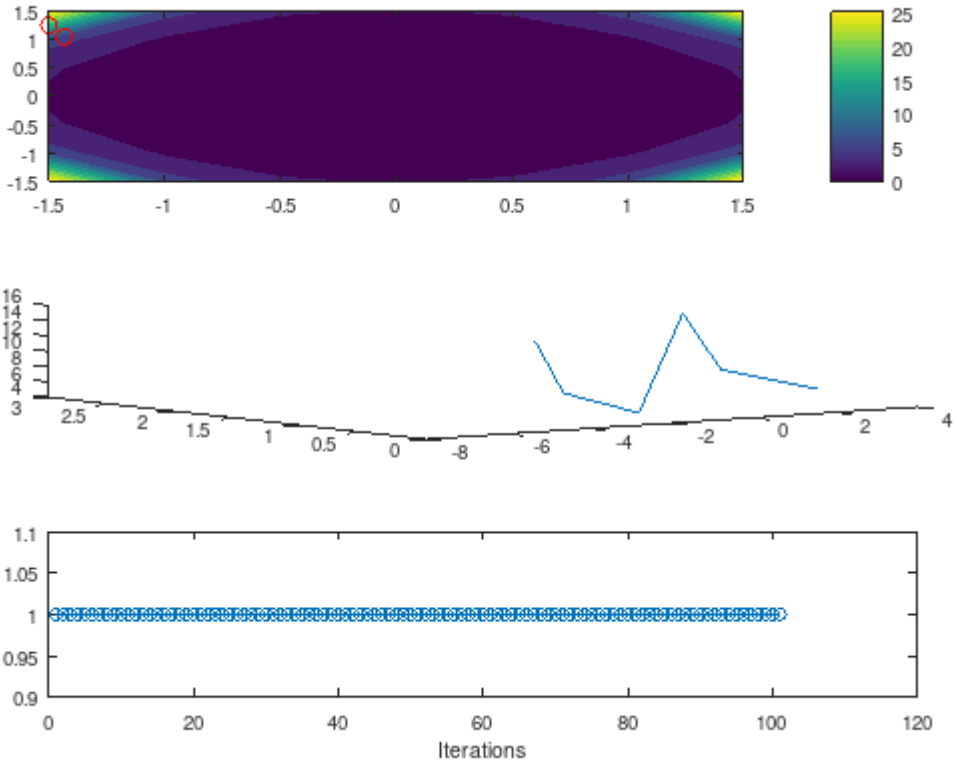

```
warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
    newton at line 60 column 12

warning: matrix singular to machine precision
warning: called from
    linsolve at line 113 column 7
    newton at line 60 column 12

ENDED Line search using newton
xmin =

                    NaN
                    NaN

fmin = NaN
```



In [ ]:
```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = newton(f4_sym, [-1.5,1.25]', 'wolfe_strong', search_x, search_y, c, rh
```

In [ ]:
```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
[xmin, fmin] = newton(f4_sym, [-1.5,1.25]', 'nonmonotone_backtracking_armijo', search
```

In [12]:
```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
[xmin, fmin] = steepest_descent(f4_sym, [-1.5,1.25]', 'backtracking_wolfe_weak', sear
```

```
STARTED Line search using steepest descent
Traceback (most recent call last):
  File "<stdin>", line 31, in octoutput
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 372, in __call__
    return self.__wrapped__(*args, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2871, in pretty
    return pp.doprint(expr)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 66, in doprint
    return self._print(expr).render(**self._settings)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 1933, in _print_Add
    pforms.append(self._print(term))
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2011, in _print_Mul
    a = [self._print(ai) for ai in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2011, in <listcomp>
    a = [self._print(ai) for ai in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2107, in _print_Rational
    result = self.__print_numer_denom(expr.p, expr.q)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2093, in __print_numer_denom
    return prettyForm(str(p))
ValueError: Exceeds the limit (4300) for integer string conversion; use sys.set_int_m
ax_str_digits() to increase the limit

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "<stdin>", line 2, in <module>
  File "<stdin>", line 12, in octoutput_drv
  File "<stdin>", line 34, in octoutput
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/core/_print_helpers.
py", line 29, in __str__
    return sstr(self, order=None)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 372, in __call__
    return self.__wrapped__(*args, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 1000, in sstr
    s = p.doprint(expr)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 292, in doprint
    return self._str(self._print(expr))
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 56, in _print_Add
    t = self._print(term)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
```

```
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 366, in _print_Mul
    a_str = [self.parenthesize(x, prec, strict=False) for x in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 366, in <listcomp>
    a_str = [self.parenthesize(x, prec, strict=False) for x in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 37, in parenthesize
    return self._print(item)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 681, in _print_Integer
    return str(expr.p)
ValueError: Exceeds the limit (4300) for integer string conversion; use sys.set_int_m
ax_str_digits() to increase the limit
error: Python exception: ValueError: Exceeds the limit (4300) for integer string conv
ersion; use sys.set_int_max_str_digits() to increase the limit
    occurred while copying variables from Python.
    Try "sympref reset" and repeat your command?
    (consider filing an issue at https://github.com/cbm755/octsympy/issues)
error: called from
    pycall_sympy__ at line 192 column 5
    subs at line 269 column 5
    sym2fun at line 3 column 9
    steepest_descent>@<anonymous> at line 37 column 14
    backtracking_wolfe_weak>armijo_condition at line 26 column 7
    backtracking_wolfe_weak at line 8 column 58
    step_size at line 12 column 14
    steepest_descent at line 55 column 14
```

In [13]:

```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
[xmin, fmin] = steepest_descent(f4_sym, [-1.5,1.25]', 'backtracking_armijo', search_x
```

```
STARTED Line search using steepest descent
Traceback (most recent call last):
  File "<stdin>", line 31, in octoutput
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 372, in __call__
    return self.__wrapped__(*args, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2871, in pretty
    return pp.doprint(expr)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 66, in doprint
    return self._print(expr).render(**self._settings)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 1933, in _print_Add
    pforms.append(self._print(term))
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2011, in _print_Mul
    a = [self._print(ai) for ai in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2011, in <listcomp>
    a = [self._print(ai) for ai in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2107, in _print_Rational
    result = self.__print_numer_denom(expr.p, expr.q)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2093, in __print_numer_denom
    return prettyForm(str(p))
ValueError: Exceeds the limit (4300) for integer string conversion; use sys.set_int_m
ax_str_digits() to increase the limit

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "<stdin>", line 2, in <module>
  File "<stdin>", line 12, in octoutput_drv
  File "<stdin>", line 34, in octoutput
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/core/_print_helpers.
py", line 29, in __str__
    return sstr(self, order=None)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 372, in __call__
    return self.__wrapped__(*args, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 1000, in sstr
    s = p.doprint(expr)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 292, in doprint
    return self._str(self._print(expr))
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 56, in _print_Add
    t = self._print(term)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
```

```
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 366, in _print_Mul
    a_str = [self.parenthesize(x, prec, strict=False) for x in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 366, in <listcomp>
    a_str = [self.parenthesize(x, prec, strict=False) for x in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 37, in parenthesize
    return self._print(item)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 681, in _print_Integer
    return str(expr.p)
ValueError: Exceeds the limit (4300) for integer string conversion; use sys.set_int_m
ax_str_digits() to increase the limit
error: Python exception: ValueError: Exceeds the limit (4300) for integer string conv
ersion; use sys.set_int_max_str_digits() to increase the limit
    occurred while copying variables from Python.
    Try "sympref reset" and repeat your command?
    (consider filing an issue at https://github.com/cbm755/octsympy/issues)
error: called from
    pycall_sympy__ at line 192 column 5
    subs at line 269 column 5
    sym2fun at line 3 column 9
    steepest_descent>@<anonymous> at line 37 column 14
    backtracking_armijo>armijo_condition at line 19 column 7
    backtracking_armijo at line 6 column 11
    step_size at line 7 column 14
    steepest_descent at line 55 column 14
```

In [14]:

```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
[xmin, fmin] = steepest_descent(f4_sym, [-1.5,1.25]', 'none', search_x, search_y);
```

```
STARTED Line search using steepest descent
Traceback (most recent call last):
  File "<stdin>", line 31, in octoutput
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 372, in __call__
    return self.__wrapped__(*args, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2871, in pretty
    return pp.doprint(expr)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 66, in doprint
    return self._print(expr).render(**self._settings)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 764, in _print_MatrixBase
    D = self._print_matrix_contents(e)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 702, in _print_matrix_contents
    Ms[i, j] = self._print(M[i, j])
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 1933, in _print_Add
    pforms.append(self._print(term))
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2011, in _print_Mul
    a = [self._print(ai) for ai in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2011, in <listcomp>
    a = [self._print(ai) for ai in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2107, in _print_Rational
    result = self.__print_numer_denom(expr.p, expr.q)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2093, in __print_numer_denom
    return prettyForm(str(p))
ValueError: Exceeds the limit (4300) for integer string conversion; use sys.set_int_m
ax_str_digits() to increase the limit

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "<stdin>", line 2, in <module>
  File "<stdin>", line 12, in octoutput_drv
  File "<stdin>", line 34, in octoutput
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/matrices/matrices.p
y", line 852, in __str__
    return "Matrix(%s)" % str(self.tolist())
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/core/_print_helpers.
py", line 29, in __str__
    return sstr(self, order=None)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 372, in __call__
    return self.__wrapped__(*args, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
```

```
ne 1000, in sstr
    s = p.doprint(expr)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 292, in doprint
    return self._str(self._print(expr))
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 56, in _print_Add
    t = self._print(term)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 366, in _print_Mul
    a_str = [self.parenthesize(x, prec, strict=False) for x in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 366, in <listcomp>
    a_str = [self.parenthesize(x, prec, strict=False) for x in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 37, in parenthesize
    return self._print(item)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 681, in _print_Integer
    return str(expr.p)
ValueError: Exceeds the limit (4300) for integer string conversion; use sys.set_int_m
ax_str_digits() to increase the limit
error: Python exception: ValueError: Exceeds the limit (4300) for integer string conv
ersion; use sys.set_int_max_str_digits() to increase the limit
    occurred while copying variables from Python.
    Try "sympref reset" and repeat your command?
    (consider filing an issue at https://github.com/cbm755/octsympy/issues)
error: called from
    pycall_sympy__ at line 192 column 5
    subs at line 269 column 5
    multidim_grad at line 31 column 9
    steepest_descent>@<anonymous> at line 38 column 19
    steepest_descent at line 48 column 12
```

In [15]:

```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = steepest_descent(f4_sym, [-1.5,1.25]', 'wolfe_strong', search_x, searc
```

```
STARTED Line search using steepest descent
Traceback (most recent call last):
  File "<stdin>", line 31, in octoutput
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 372, in __call__
    return self.__wrapped__(*args, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2871, in pretty
    return pp.doprint(expr)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 66, in doprint
    return self._print(expr).render(**self._settings)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 1933, in _print_Add
    pforms.append(self._print(term))
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2011, in _print_Mul
    a = [self._print(ai) for ai in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2011, in <listcomp>
    a = [self._print(ai) for ai in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2107, in _print_Rational
    result = self.__print_numer_denom(expr.p, expr.q)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/pretty/pret
ty.py", line 2093, in __print_numer_denom
    return prettyForm(str(p))
ValueError: Exceeds the limit (4300) for integer string conversion; use sys.set_int_m
ax_str_digits() to increase the limit

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "<stdin>", line 2, in <module>
  File "<stdin>", line 12, in octoutput_drv
  File "<stdin>", line 34, in octoutput
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/core/_print_helpers.
py", line 29, in __str__
    return sstr(self, order=None)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 372, in __call__
    return self.__wrapped__(*args, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 1000, in sstr
    s = p.doprint(expr)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 292, in doprint
    return self._str(self._print(expr))
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
```

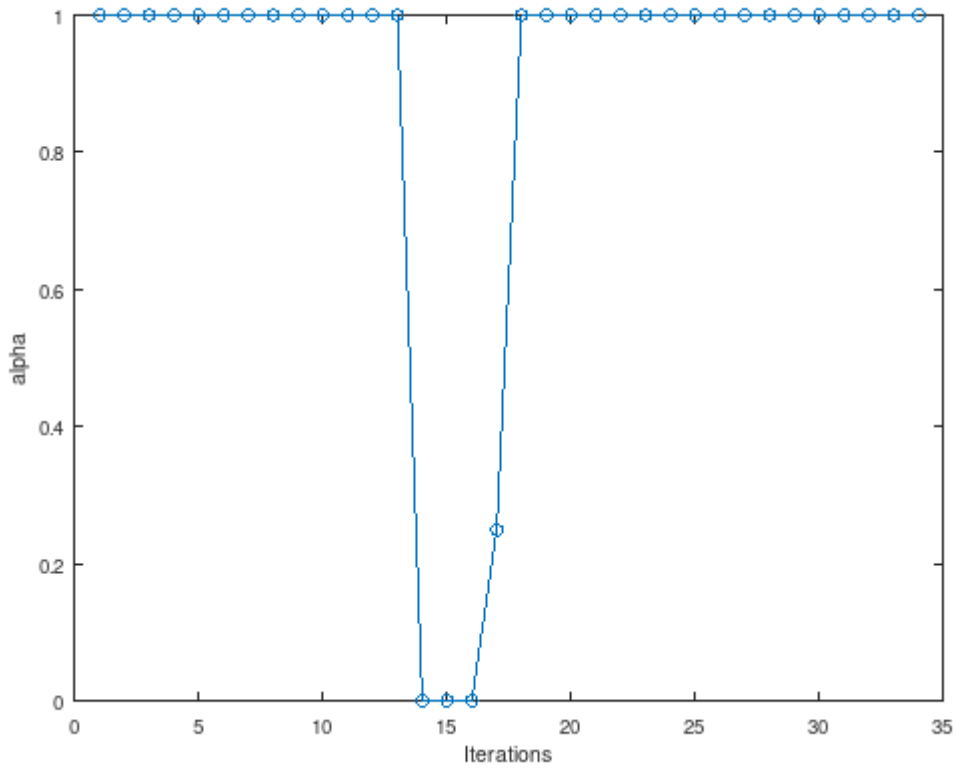
```
    t = self._print(term)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 366, in _print_Mul
    a_str = [self.parenthesize(x, prec, strict=False) for x in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 366, in <listcomp>
    a_str = [self.parenthesize(x, prec, strict=False) for x in a]
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 37, in parenthesize
    return self._print(item)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/printer.p
y", line 331, in _print
    return printmethod(expr, **kwargs)
  File "/home/thodkatz/.local/lib/python3.10/site-packages/sympy/printing/str.py", li
ne 681, in _print_Integer
    return str(expr.p)
ValueError: Exceeds the limit (4300) for integer string conversion; use sys.set_int_m
ax_str_digits() to increase the limit
error: Python exception: ValueError: Exceeds the limit (4300) for integer string conv
ersion; use sys.set_int_max_str_digits() to increase the limit
    occurred while copying variables from Python.
    Try "sympref reset" and repeat your command?
    (consider filing an issue at https://github.com/cbm755/octsympy/issues)
error: called from
    pycall_sympy__ at line 192 column 5
    subs at line 269 column 5
    sym2fun at line 3 column 9
    steepest_descent>@<anonymous> at line 37 column 14
    wolfe_strong at line 16 column 13
    step_size at line 21 column 14
    steepest_descent at line 55 column 14
```

In [ ]:
```
search_x = -1.5:0.5:1.5;
search_y = -1.5:0.5:1.5;
[xmin, fmin] = steepest_descent(f4_sym, [-1.5,1.25]', 'nonmonotone_backtracking_armij
```

In [ ]:
```
% f(x,y,z)=(x^2+y^3-z^4)^2+(2*x*y*z)^2+(2*x*y-3*y*z+x*z)^2 -init x=y=z=10-obj =0.0000

function f = f5_sym()
    syms x y z
    f = (x^2 + y^3 - z^4)^2 + (2*x*y*z)^2 + (2*x*y-3*y*z+x*z)^2;
end
```

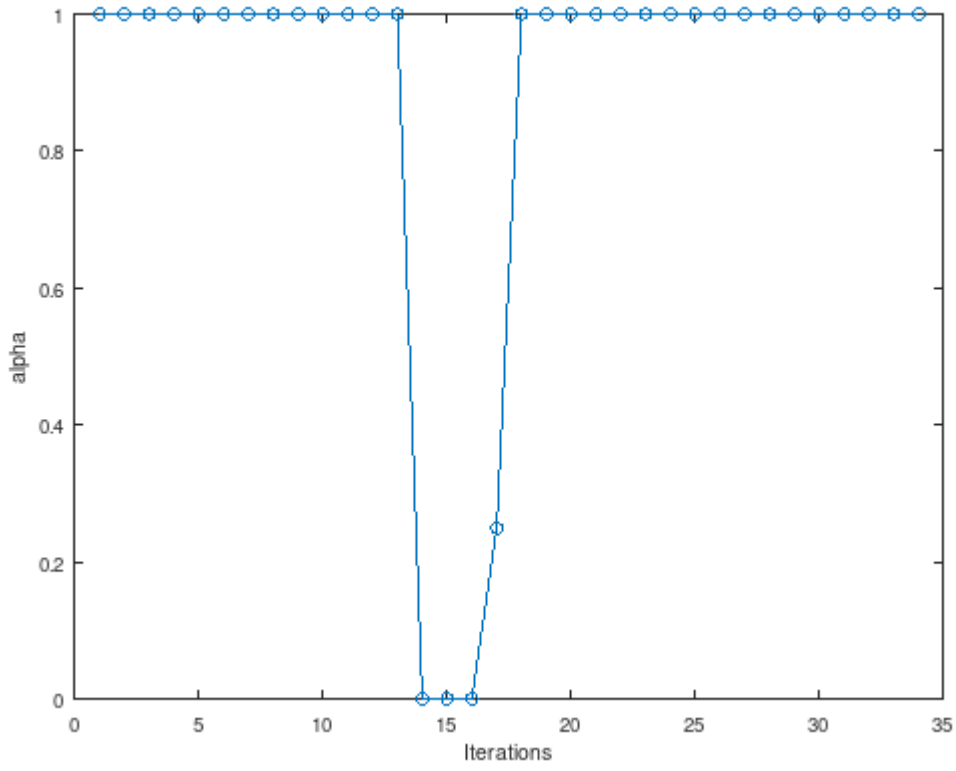
In [4]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = newton(f5_sym, [10,10,10]', 'backtracking_wolfe_weak', search_x, searc
```

```
Symbolic pkg v3.1.1: Python communication link active, SymPy v1.11.1.
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -2.126482159228893e-05
  -7.097574255828430e-06
   9.006911588552714e-02

fmin = 4.331130112795951e-09
```



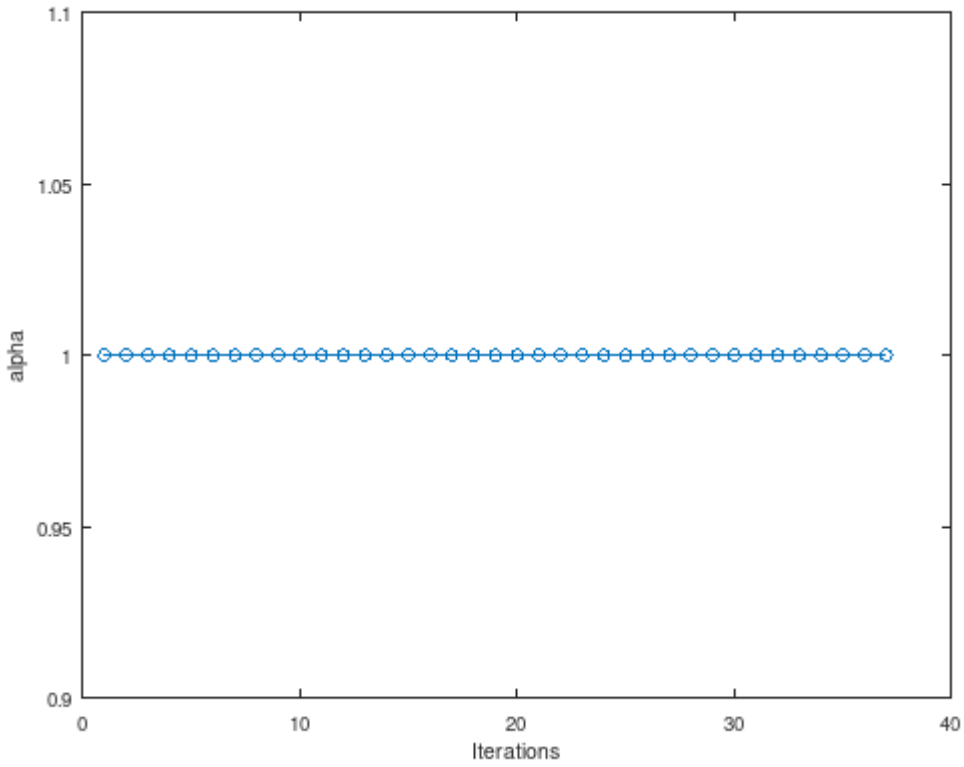
In [5]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = newton(f5_sym, [10,10,10]', 'backtracking_armijo', search_x, search_y)
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

  -2.126482159228893e-05
  -7.097574255828430e-06
   9.006911588552714e-02

fmin = 4.331130112795951e-09
```



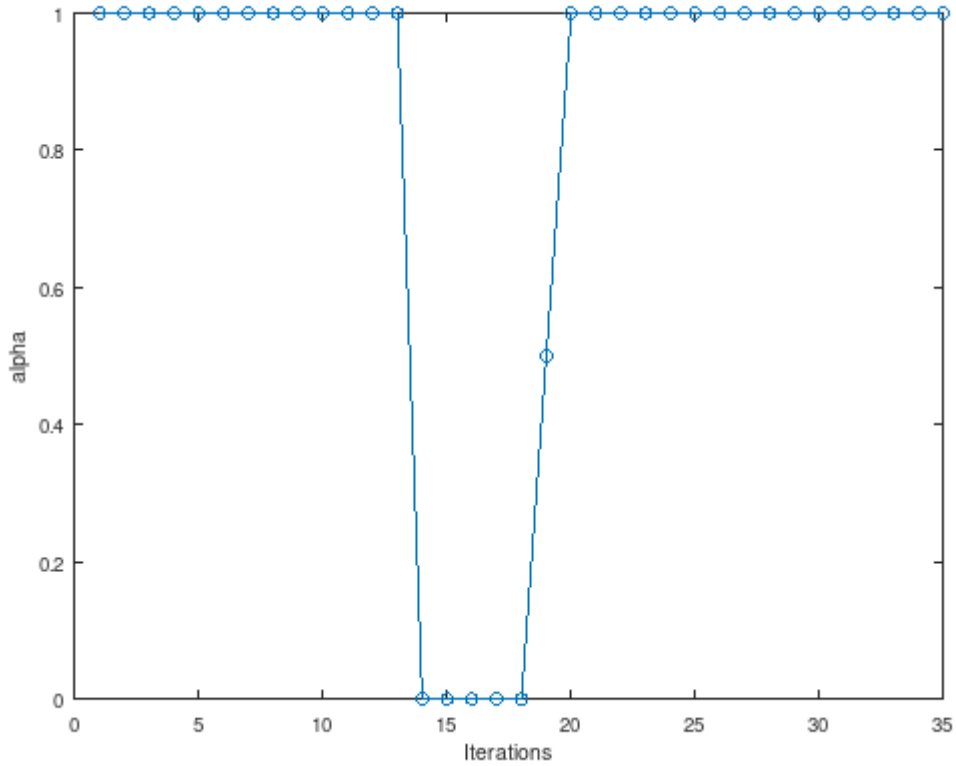
In [6]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = newton(f5_sym, [10,10,10]', 'none', search_x, search_y);
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   2.525601052449970e-04
   3.792558884054644e-02
   1.684963639464687e-04

fmin = 2.982697279570769e-09
```



In [7]:
```
search_x = -1:1:1;
search_y = -1:1:1;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = newton(f5_sym, [10,10,10]', 'wolfe_strong', search_x, search_y, c, rho
```

```
STARTED Line search using newton
ENDED Line search using newton
xmin =

   2.167392528313391e-03
  -2.296477871401249e-03
   3.761317198771993e-03

fmin = 6.032867139200067e-10
```



In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = newton(f5_sym, [10,10,10]', 'nonmonotone_backtracking_armijo', search_
```

In [8]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = steepest_descent(f5_sym, [10,10,10]', 'backtracking_wolfe_weak', searc
```

```
STARTED Line search using steepest descent
error: Failed to converge. Inf value reached
error: called from
    steepest_descent at line 45 column 13
```

In [9]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = steepest_descent(f5_sym, [10,10,10]', 'backtracking_armijo', search_x,
```

```
STARTED Line search using steepest descent
error: Failed to converge. Inf value reached
error: called from
    steepest_descent at line 45 column 13
```

In [10]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = steepest_descent(f5_sym, [10,10,10]', 'none', search_x, search_y);
```

```
STARTED Line search using steepest descent
error: Failed to converge. Inf value reached
error: called from
    steepest_descent at line 45 column 13
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = steepest_descent(f5_sym, [10,10,10]', 'nonmonotone_backtracking_armijo
```

In [11]:
```
search_x = -1:1:1;
search_y = -1:1:1;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = steepest_descent(f5_sym, [10,10,10]', 'wolfe_strong', search_x, search
```

```
STARTED Line search using steepest descent
error: Failed to converge. Inf value reached
error: called from
    steepest_descent at line 45 column 13
```

In [ ]:
```
% f(x,y,z,k)=(x-1)^2+ (x-y)^2 + (y-z)^2 + (z-k)^2 -init x=y=z=k=0.1 -obj =1.13719e-10

function f = f6_sym()
    syms x y z k
    f = (x-1)^2 + (x-sqrt(y))^2 + (y-sqrt(z))^2 + (z-sqrt(k))^2;
end
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = newton(f6_sym, [0.1,0.1,0.1,0.1]', 'backtracking_wolfe_weak', search_x
```

```
STARTED Line search using newton
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = newton(f6_sym, [0.1,0.1,0.1,0.1]', 'backtracking_armijo', search_x, se
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = newton(f6_sym, [0.1,0.1,0.1,0.1]', 'none', search_x, search_y);
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
c = [1e-4 0.9];
rho = 2;
[xmin, fmin] = newton(f6_sym, [0.1,0.1,0.1,0.1]', 'wolfe_strong', search_x, search_y,
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = newton(f6_sym, [0.1,0.1,0.1,0.1]', 'nonmonotone_backtracking_armijo',
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = steepest_descent(f6_sym, [0.1,0.1,0.1,0.1]', 'backtracking_wolfe_weak'
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = steepest_descent(f6_sym, [0.1,0.1,0.1,0.1]', 'backtracking_armijo', se
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = steepest_descent(f6_sym, [0.1,0.1,0.1,0.1]', 'none', search_x, search_
```

In [ ]:
```
search_x = -1:1:1;
search_y = -1:1:1;
c = [1e-4 0.9];
```

```
rho = 2;
[xmin, fmin] = steepest_descent(f6_sym, [0.1,0.1,0.1,0.1]', 'wolfe_strong', search_x,
```

In [ ]:

```
search_x = -1:1:1;
search_y = -1:1:1;
[xmin, fmin] = steepest_descent(f6_sym, [0.1,0.1,0.1,0.1]', 'nonmonotone_backtracking
```