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Homework Introduction

```
% Geneva Porter, 2019.10.24
% Homework 3, Math 693A
% Professor Uduak George, SDSU

% This assignment minimizes the function:
%
%               f(x) = 10(x2-x1^2)^2 + (1-x1)^2
%
% I use a trust region method, utilizing the Cauchy point algorithm to
% minimize the quadratic model. The trust region radius will vary from zero
% to 2. Results will show the countour lines of the objective function
% juxtaposed against the contour lines of the quadratic model. First, the
% initial point x = (0, -1) will be used, then we will repeat the algorithm
% for x = (0, 0.5).
%
```

Establishing Parameters

```
clear
clc

alpha       = 1.0;
c1          = 1e-4;
tolerance   = 1e-8;

param = [alpha, c1, tolerance];

p1          = [ 0 ; -1];
p2          = [ 0 ; .5];
```

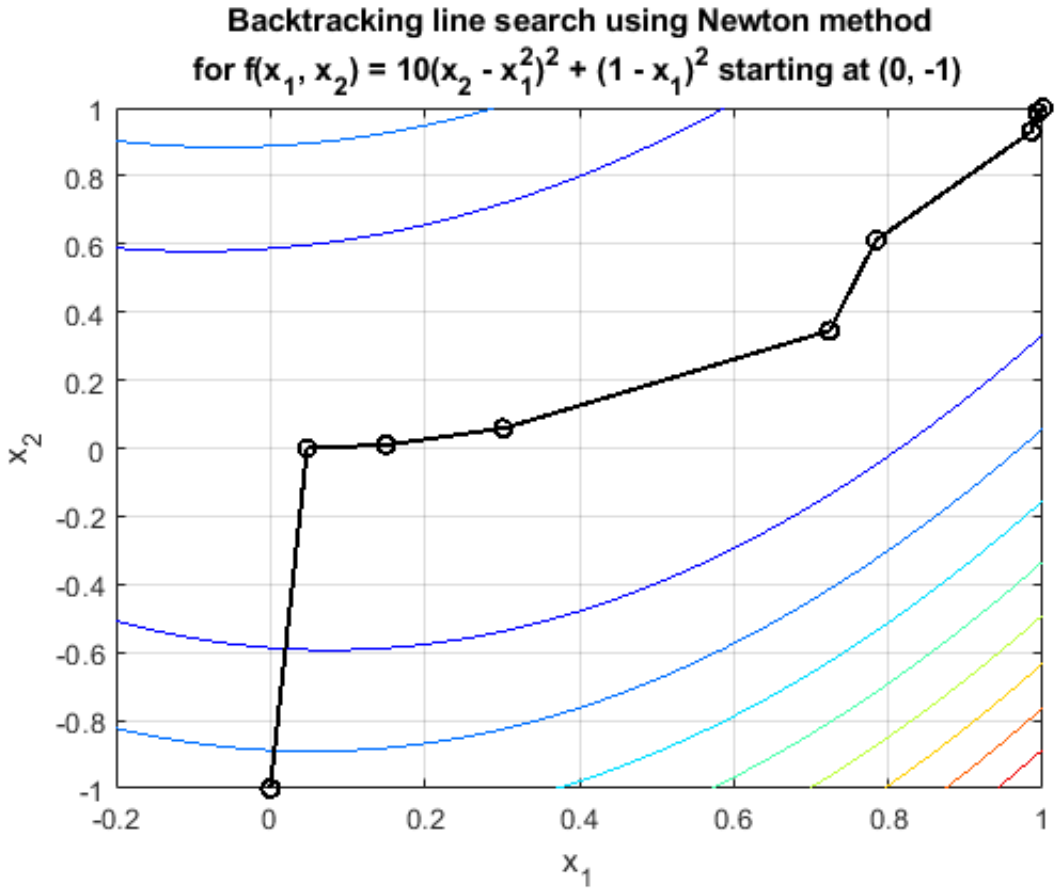
Setting Up Functions

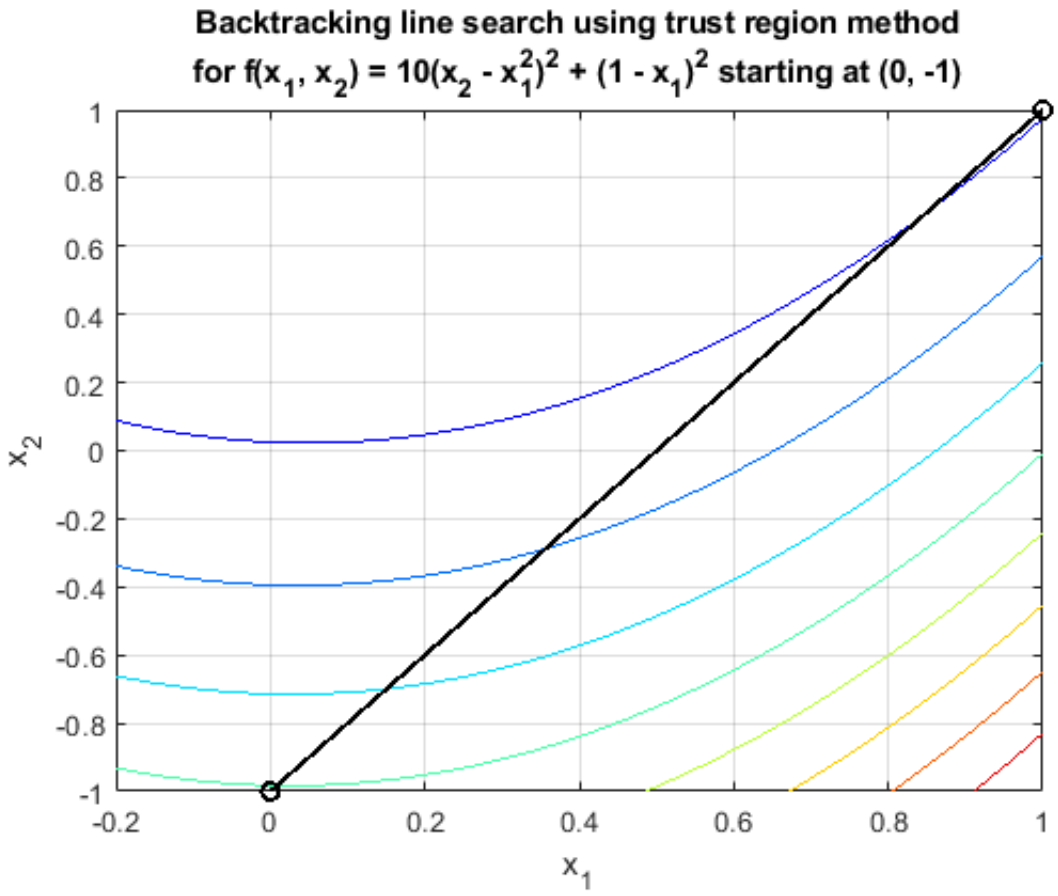
```
x           = sym('x', [2,1]);
p           = sym('p', [2,1]);
f(x)        = 10*(x(2) - x(1).^2).^2 + (1 - x(1)).^2;
f_grad(x)   = gradient(f);
f_hess(x)   = hessian(f);
m1(x)        = f + p1'*f_grad + 0.5 * p1' * f_hess * p1;
m2(x)        = f + p2'*f_grad + 0.5 * p2' * f_hess * p2;
```

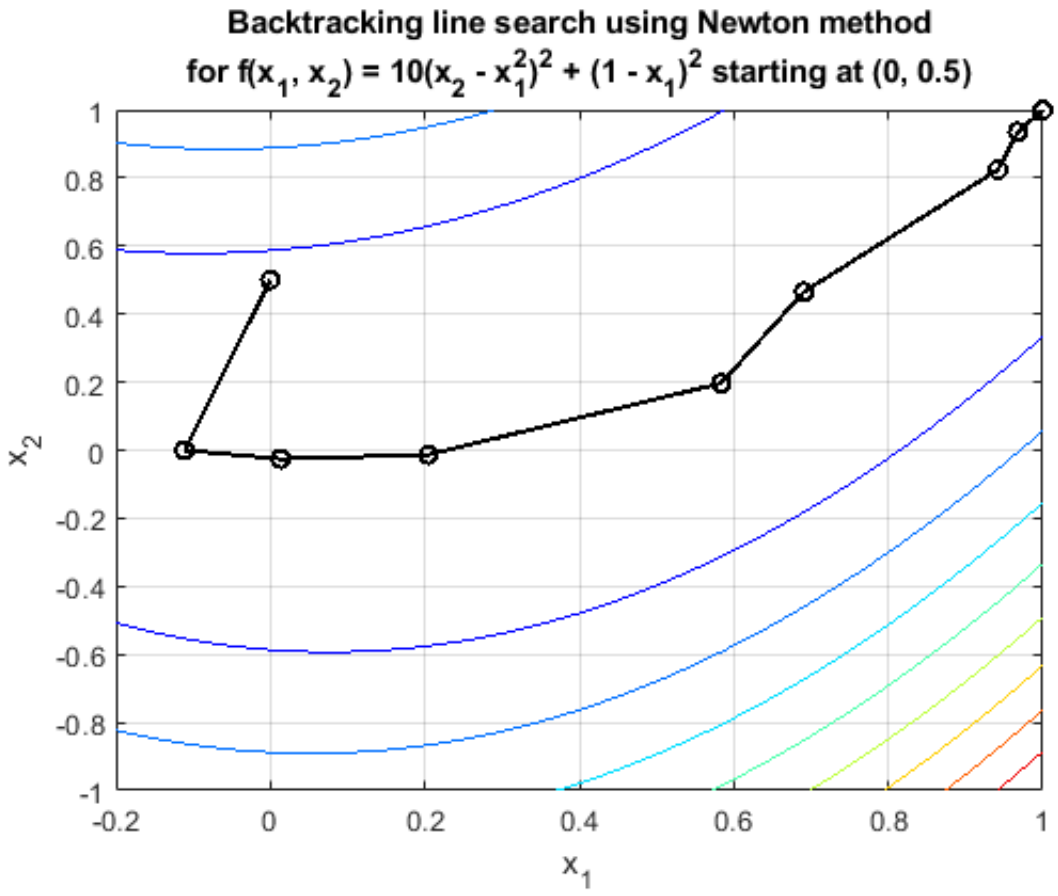
```
NE = "Newton";
SD = "steepest descent";
TR = "trust region";
```

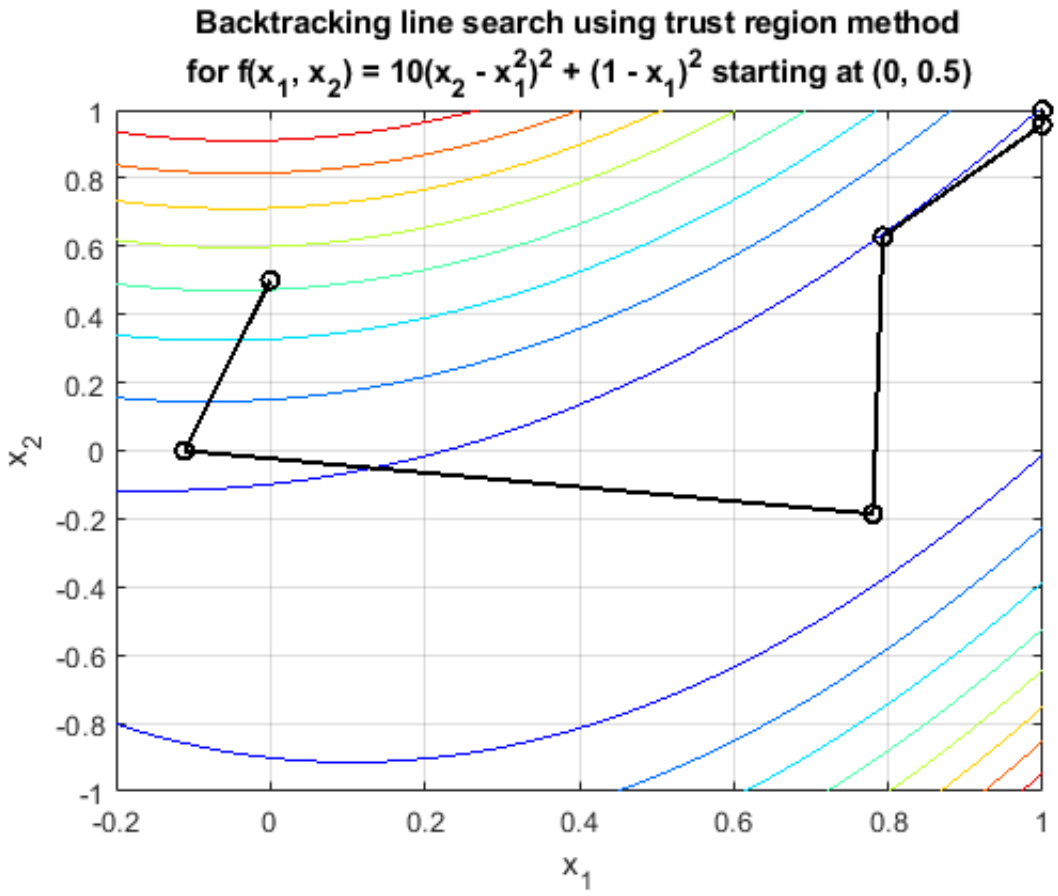
Iterating Methods and Printing Results:

```
figure(1)
clf
hold on

SD_point1 = line_search3(NE, f, p1, param);
plot_trust(SD_point1, NE, f);

figure(2)
clf
hold on

TR_point1 = line_search3(TR, f, p1, param);
plot_trust(TR_point1, TR, m1);

figure(3)
clf
hold on

SD_point2 = line_search3(NE, f, p2, param);
plot_trust(SD_point2, NE, f);

figure(4)
clf
hold on

TR_point2 = line_search3(TR, f, p2, param);
plot_trust(TR_point2, TR, m2);
```


Backtracking line search using Newton method
for f(x1, x2) = 10(x2 - x1^2)^2 + (1 - x1)^2 starting at (0, -1)
x2
x1
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.2
0
0.2
0.4
0.6
0.8
1


Backtracking line search using trust region method
for f(x1, x2) = 10(x2 - x1^2)^2 + (1 - x1)^2 starting at (0, -1)
x2
x1
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.2
0
0.2
0.4
0.6
0.8
1


Backtracking line search using Newton method
for f(x1, x2) = 10(x2 - x1^2)^2 + (1 - x1)^2 starting at (0, 0.5)
x2
x1
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.2
0
0.2
0.4
0.6
0.8
1


Backtracking line search using trust region method
for f(x1, x2) = 10(x2 - x1^2)^2 + (1 - x1)^2 starting at (0, 0.5)
x2
x1
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.2
0
0.2
0.4
0.6
0.8
1

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