Homework 1

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Problem 2

```
%%%% a) With eps = 1, gamma = 1 a minimum is not found. Instead, NaN's
 are returned

X=[1 0.2;0.1 1];
C=[0.1;0.5];

eps=1; % stopping criterion for gradient algorithm
gamma=1;   % step for gradient algorithm
M=1000000;
[a_opt1] = gradient_test1(X,C,eps,gamma,M);

%%%% b) eps = 0.1, gamma = 0.1 a minimum is found, but not the
 minimum. This is due
% to eps being too small

eps=0.1; % stopping criterion for gradient algorithm
gamma=0.1;   % step for gradient algorithm
[a_opt2] = gradient_test1(X,C,eps,gamma,M);

%%%% c) eps = 0.001, gamma = 0.1 results in a solution that is closer
 to the actual
% minimum

eps=0.001; % stopping criterion for gradient algorithm
gamma=0.1;   % step for gradient algorithm
[a_opt3] = gradient_test1(X,C,eps,gamma,M);

%%%% e) eps = 0.01, gamma = 0.01 results in a solution that is further
 from the
% minimum than was found in the previous step. This shows that perhaps
 gamma
% isn't the parameter that should be changed (in this case).

eps=0.001; % stopping criterion for gradient algorithm
gamma=0.01;   % step for gradient algorithm
[a_opt4] = gradient_test1(X,C,eps,gamma,M);
```

Note

With each subsequent reduction of the size of eps, the number of steps required to be within that bound increases.

```
%%%% e) eps = 0.001, gamma = 0.1 results in a solution that is very
 close to the
% actual minimum.

eps=0.0001; % stopping criterion for gradient algorithm
gamma=0.1;   % step for gradient algorithm
[a_opt5] = gradient_test1(X,C,eps,gamma,M);
```

Problem 3

A solution that is reasonably close to the minimum can be obtained by having epsilon = 1e-9. This choice of eps was determined by iteratively decreasing eps until a minimum that was within 1-09 of the acutal minimum was reached.

```
eps=1e-9; % stopping criterion for gradient algorithm
gamma=0.1;   % step for gradient algorithm
[a_opt6] = gradient_test1(X,C,eps,gamma,M);
```

Problem 4

Adjusting the stopping criterion to be `f(ai + 1)- f(ai)` < eps resulted in worse performance than in the previous problems. As shown below, gamma had to to be adjusted and the number of steps required to reach a minimum increased approximately 3 orders of magnitude.

```
eps=1e-9; % stopping criterion for gradient algorithm
gamma=1e-5;   % step for gradient algorithm
[a_opt7] = gradient_test1(X,C,eps,gamma,M);
```

Problem 5

Using the steepest descent algorithm results in a much quicker convergence and with greater accuracy than using a static step-size.

```
eps=1e-9; % stopping criterion for gradient algorithm
[a_opt8] = gradient_test2(X,C,eps,M);


a_opt =

   NaN
   NaN


steps =

     1000001
```

```
a_opt =

    0.0300
    0.1040


steps =

     3


a_opt =

    0.0049
    0.4951


steps =

    27


a_opt =

    0.0345
    0.4456


steps =

   119


a_opt =

    0.0005
    0.4995


steps =

    42


a_opt =

    0.0000
    0.5000


steps =

   116
```

```
a_opt =

    0.0000
    0.5000


steps =

      587616


a_opt =

    0.0000
    0.5000


steps =

    17
```

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