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clear

```
clear;
close all;
fclose all;
```

prepare data

```
randn('seed', 1);
beta = zeros(10, 1);
beta(3) = 1;
beta(5) = 7;
beta(10) = 3;
n = 100;
p = 10;
X = randn(n, p);
y = X * beta + 0.1 * randn(n, 1);
lambda = 0.2;
```

solve using fminunc (to verify our result)

```
a0 = rand(10, 1);
V = @(a) norm(y - X * a, 2) ^ 2 + lambda * norm(a, 1);
aopt = fminunc(V, a0);
```

```
Warning: Gradient must be provided for trust-region algorithm; using
quasi-newton algorithm instead.

Local minimum found.

Optimization completed because the size of the gradient is less than
the default value of the optimality tolerance.
```

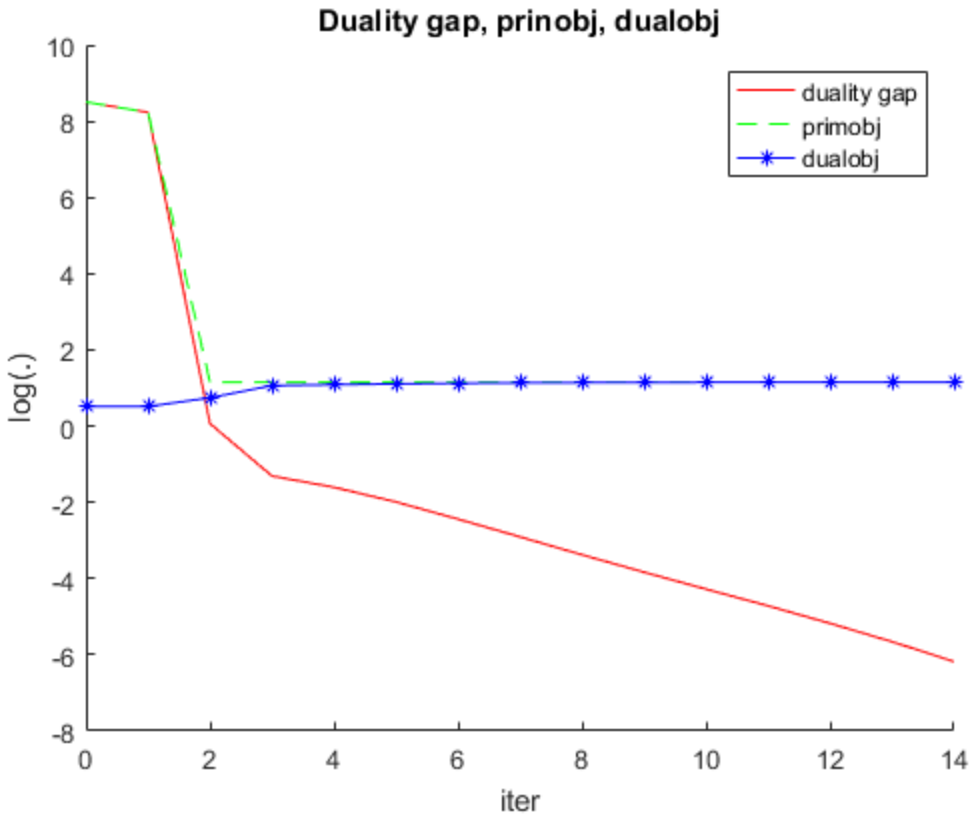
implement my own algorithm

```
[beta, status, history] = l1_norm_ls_solver(X, y, lambda);
```

```
Solving a problem of size (n=100, p=10), with lambda=2.00000e-01
-----------------------------------------------------------------------------
 iter       gap         primobj         dualobj        reltot
   0     4.92e+03     4.91972e+03     1.67317e+00     2.93935e+03
   1     3.77e+03     3.76975e+03     1.67323e+00     2.25198e+03
   2     1.07e+00     3.17128e+00     2.10371e+00     5.07467e-01
   3     2.70e-01     3.16589e+00     2.89636e+00     9.30589e-02
   4     2.01e-01     3.16587e+00     2.96512e+00     6.77048e-02
   5     1.37e-01     3.16585e+00     3.02915e+00     4.51294e-02
   6     8.71e-02     3.16584e+00     3.07871e+00     2.82996e-02
   7     5.47e-02     3.16582e+00     3.11116e+00     1.75699e-02
   8     3.42e-02     3.16579e+00     3.13163e+00     1.09087e-02
   9     2.17e-02     3.16574e+00     3.14409e+00     6.88601e-03
  10     1.39e-02     3.16565e+00     3.15179e+00     4.39943e-03
  11     8.95e-03     3.16554e+00     3.15659e+00     2.83476e-03
  12     5.65e-03     3.16538e+00     3.15973e+00     1.78873e-03
  13     3.49e-03     3.16525e+00     3.16175e+00     1.10477e-03
  14     2.07e-03     3.16514e+00     3.16306e+00     6.55760e-04
Absolute tolerance reached.
```

show figures

```
hold on;
figure(1);
title('Duality gap, prinobj, dualobj');
xlabel('iter');
ylabel('log(.)');
plot(history(:, 1), log(history(:, 2)), 'r-');
plot(history(:, 1), log(history(:, 3)), 'g--');
plot(history(:, 1), log(history(:, 4)), 'b*-');
legend('duality gap', 'primobj', 'dualobj')
hold off;
```



compare with matlab fminunc

```
error = aopt - beta;
fprintf('Difference with matlab fminunc:\nerror=');
disp(error);
```

```
Difference with matlab fminunc:
error=   1.0e-03 *

   -0.6304
   -0.5299
    0.0067
   -0.6078
    0.0981
   -0.3700
   -0.1489
   -0.5425
   -0.3541
    0.0099
```

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