Contents

Machine Learning Online Class - Exercise 1: Linear Regression

```
%  Instructions
%  ------------
%
%  This file contains code that helps you get started on the
%  linear exercise. You will need to complete the following functions
%  in this exericse:
%
%     warmUpExercise.m
%     plotData.m
%     gradientDescent.m
%     computeCost.m
%     gradientDescentMulti.m
%     computeCostMulti.m
%     featureNormalize.m
%     normalEqn.m
%
%  For this exercise, you will not need to change any code in this file,
%  or any other files other than those mentioned above.
%
% x refers to the population size in 10,000s
% y refers to the profit in $10,000s
%
```

Initialization

```
clear ; close all; clc
```

==================== Part 1: Basic Function ====================

Complete warmUpExercise.m

```
fprintf('Running warmUpExercise ... \n');
fprintf('5x5 Identity Matrix: \n');
warmUpExercise()

fprintf('Program paused. Press enter to continue.\n');
pause;
```

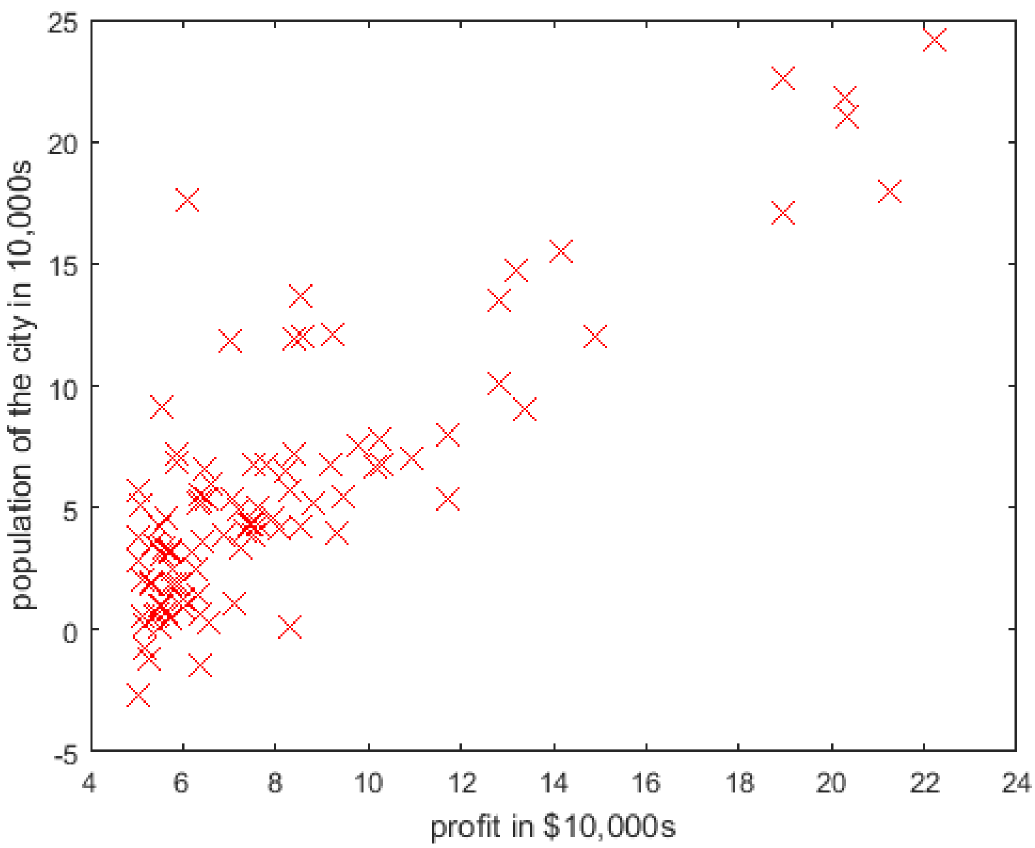
```
Running warmUpExercise ...
5x5 Identity Matrix:
```

```
ans =

     1     0     0     0     0
     0     1     0     0     0
     0     0     1     0     0
     0     0     0     1     0
     0     0     0     0     1

Program paused. Press enter to continue.
```

======================= Part 2: Plotting =======================

```
fprintf('Plotting Data ...\n')
data = load('ex1data1.txt');
X = data(:, 1); y = data(:, 2);
m = length(y); % number of training examples

% Plot Data
% Note: You have to complete the code in plotData.m
plotData(X,y);

fprintf('Program paused. Press enter to continue.\n');
pause;
```

```
Plotting Data ...
Program paused. Press enter to continue.
```

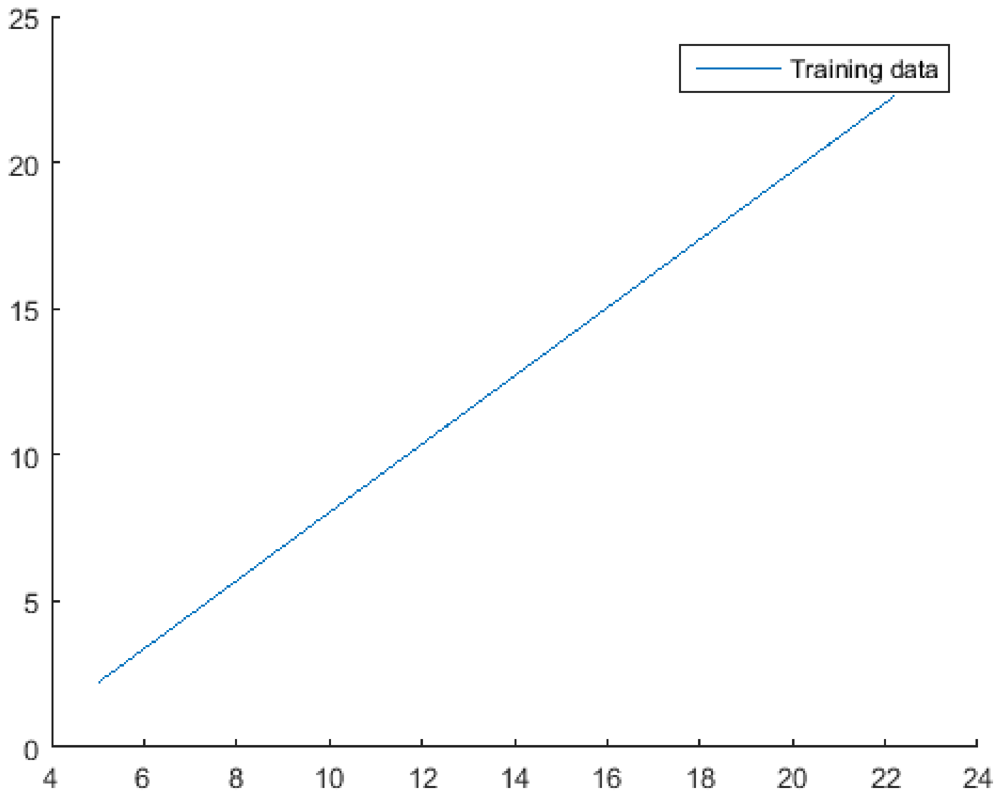


=================== Part 3: Gradient descent ===================

```
fprintf('Running Gradient Descent ...\n')

X = [ones(m, 1), data(:,1)]; % Add a column of ones to x
theta = zeros(2, 1); % initialize fitting parameters

% Some gradient descent settings
iterations = 1500;
alpha = 0.01;

% compute and display initial cost
computeCost(X, y, theta)

% run gradient descent
theta = gradientDescent(X, y, theta, alpha, iterations);

% print theta to screen
fprintf('Theta found by gradient descent: ');
fprintf('%f %f \n', theta(1), theta(2));

% Plot the linear fit
hold on; % keep previous plot visible
plot(X(:,2), X*theta, '-')
legend('Training data', 'Linear regression')
hold off % don't overlay any more plots on this figure

% Predict values for population sizes of 35,000 and 70,000
predict1 = [1, 3.5] *theta;
fprintf('For population = 35,000, we predict a profit of %f\n',...
    predict1*10000);
predict2 = [1, 7] * theta;
fprintf('For population = 70,000, we predict a profit of %f\n',...
```

```
    predict2*10000);

fprintf('Program paused. Press enter to continue.\n');
pause;
```

```
Running Gradient Descent ...

ans =

   32.0727

    4.4834

Theta found by gradient descent: -3.630291 1.166362
Warning: Ignoring extra legend entries.
For population = 35,000, we predict a profit of 4519.767868
For population = 70,000, we predict a profit of 45342.450129
Program paused. Press enter to continue.
```

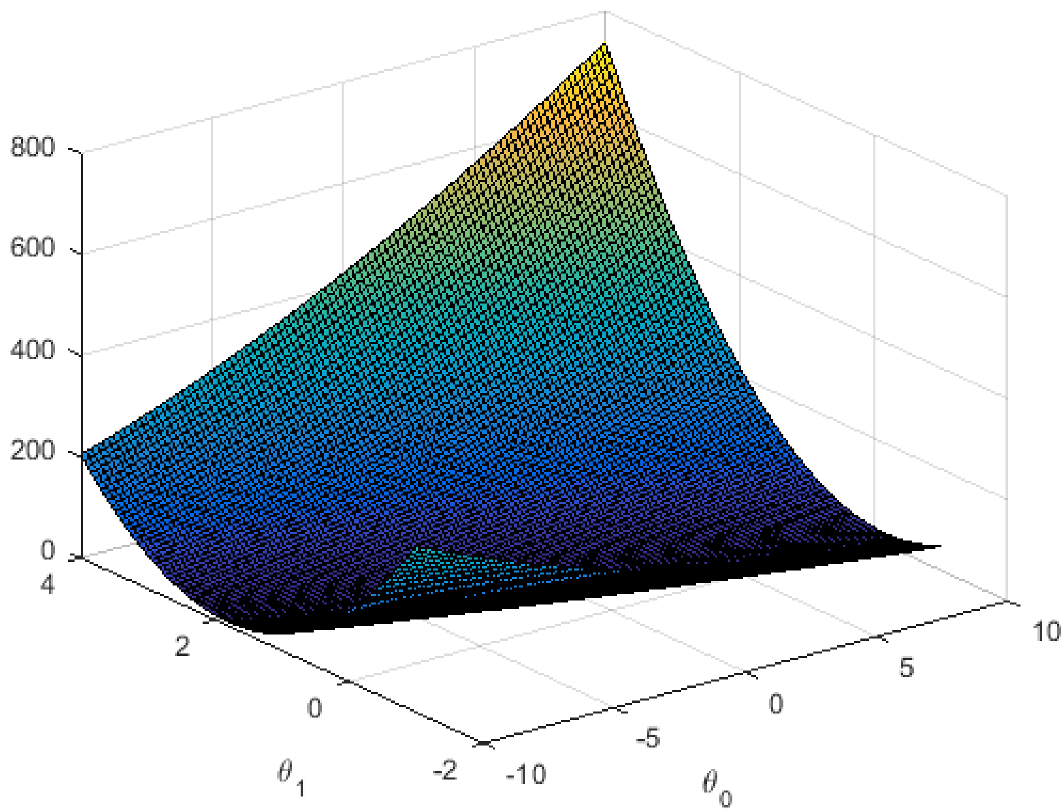


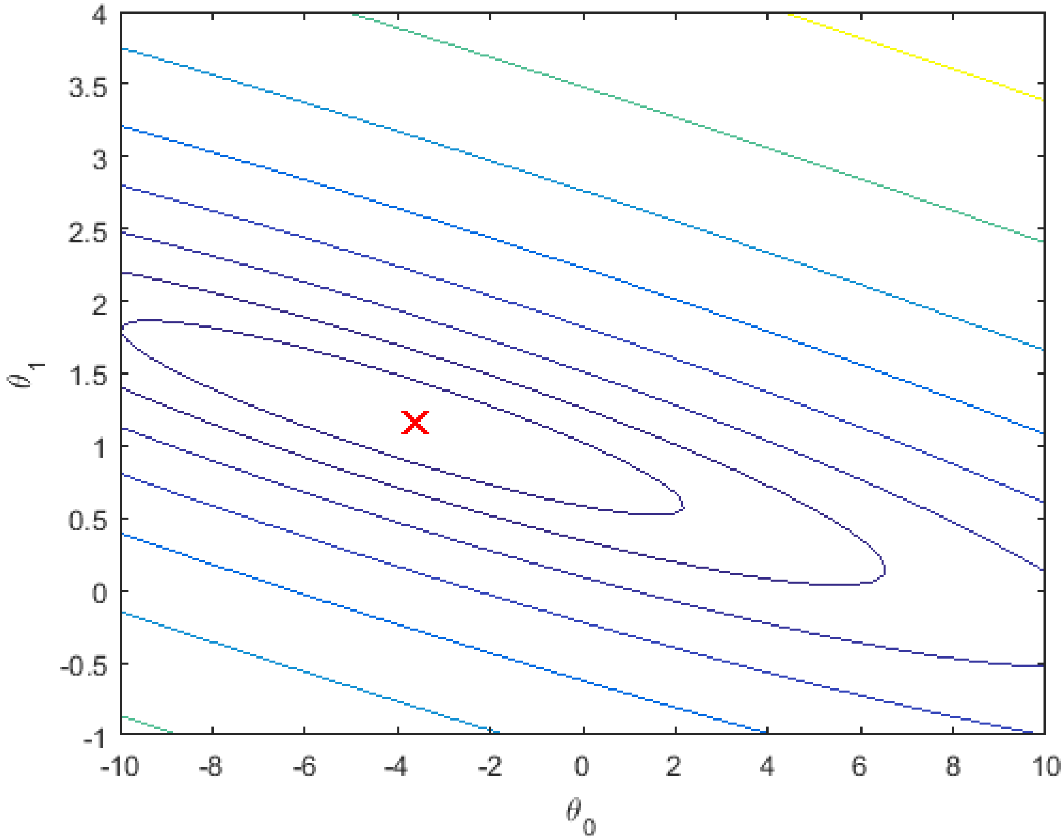
============= Part 4: Visualizing J(theta_0, theta_1) =============

```
fprintf('Visualizing J(theta_0, theta_1) ...\n')

% Grid over which we will calculate J
theta0_vals = linspace(-10, 10, 100);
theta1_vals = linspace(-1, 4, 100);

% initialize J_vals to a matrix of 0's
J_vals = zeros(length(theta0_vals), length(theta1_vals));

% Fill out J_vals
```

```
for i = 1:length(theta0_vals)
    for j = 1:length(theta1_vals)
          t = [theta0_vals(i); theta1_vals(j)];
          J_vals(i,j) = computeCost(X, y, t);
    end
end


% Because of the way meshgrids work in the surf command, we need to
% transpose J_vals before calling surf, or else the axes will be flipped
J_vals = J_vals';
% Surface plot
figure;
surf(theta0_vals, theta1_vals, J_vals)
xlabel('\theta_0'); ylabel('\theta_1');

% Contour plot
figure;
% Plot J_vals as 15 contours spaced logarithmically between 0.01 and 100
contour(theta0_vals, theta1_vals, J_vals, logspace(-2, 3, 20))
xlabel('\theta_0'); ylabel('\theta_1');
hold on;
plot(theta(1), theta(2), 'rx', 'MarkerSize', 10, 'LineWidth', 2);
```

```
Visualizing J(theta_0, theta_1) ...
```





4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-10
-8
-6
-4
-2
0
2
4
6
8
10
θ_0
θ_1