Machine Learning Online Class

```
Exercise 1: Linear regression with multiple variables

Instructions
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This file contains code that helps you get started on the
linear regression 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 part of the exercise, you will need to change some
parts of the code below for various experiments (e.g., changing
learning rates).
```

Initialization

================ Part 1: Feature Normalization ================

Clear and Close Figures

```
clear ; close all; clc

fprintf('Loading data ...\n');
```

```
Loading data ...
```

Load Data

```
data = load('ex1data2.txt');
X = data(:, 1:2);
y = data(:, 3);
m = length(y);

% Print out some data points
fprintf('First 10 examples from the dataset: \n');
```

```
First 10 examples from the dataset:
```

```
fprintf(' x = [%.0f %.0f], y = %.0f \n', [X(1:10,:) y(1:10,:)]');
```

```
 x = [2104 3], y = 399900
 x = [1600 3], y = 329900
 x = [2400 3], y = 369000
 x = [1416 2], y = 232000
 x = [3000 4], y = 539900
 x = [1985 4], y = 299900
 x = [1534 3], y = 314900
 x = [1427 3], y = 198999
 x = [1380 3], y = 212000
 x = [1494 3], y = 242500
```

```

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

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

```
pause;

% Scale features and set them to zero mean
fprintf('Normalizing Features ...\n');
```

```
Normalizing Features ...
```

```

[X mu sigma] = featureNormalize(X);

% Add intercept term to X
X = [ones(m, 1) X];
```

================ Part 2: Gradient Descent ================

```
% ====================== YOUR CODE HERE ======================
% Instructions: We have provided you with the following starter
%               code that runs gradient descent with a particular
%               learning rate (alpha).
%
%               Your task is to first make sure that your functions -
%               computeCost and gradientDescent already work with
%               this starter code and support multiple variables.
%
%               After that, try running gradient descent with
%               different values of alpha and see which one gives
%               you the best result.
%
%               Finally, you should complete the code at the end
%               to predict the price of a 1650 sq-ft, 3 br house.
%
% Hint: By using the 'hold on' command, you can plot multiple
%       graphs on the same figure.
%
% Hint: At prediction, make sure you do the same feature normalization.
%

fprintf('Running gradient descent ...\n');
```

```
Running gradient descent ...
```

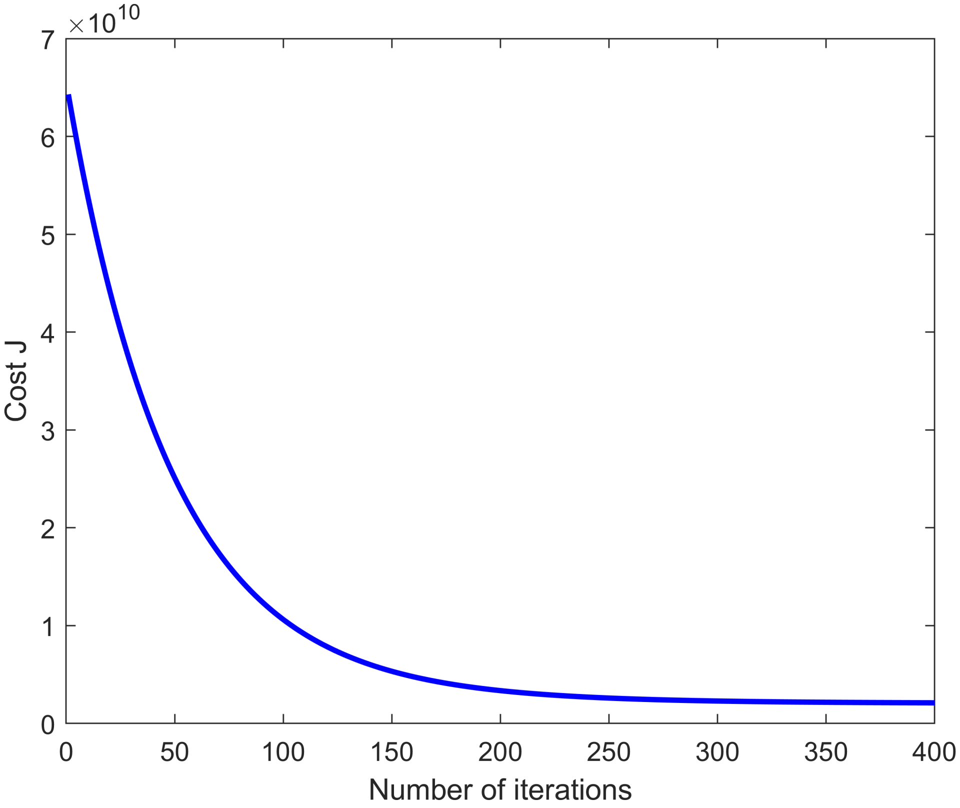
```

% Choose some alpha value
alpha = 0.01;
```

```
num_iters = 400;

% Init Theta and Run Gradient Descent
theta = zeros(3, 1);
[theta, J_history] = gradientDescentMulti(X, y, theta, alpha, num_iters);

% Plot the convergence graph
figure;
plot(1:numel(J_history), J_history, '-b', 'LineWidth', 2);
xlabel('Number of iterations');
ylabel('Cost J');
```



```


% Display gradient descent's result
fprintf('Theta computed from gradient descent: \n');
```

```
Theta computed from gradient descent:
```

```
fprintf(' %f \n', theta);
```

```
 334302.063993 
 100087.116006 
 3673.548451 
```

```
fprintf('\n');

% Estimate the price of a 1650 sq-ft, 3 br house
% ====================== YOUR CODE HERE ======================
% Recall that the first column of X is all-ones. Thus, it does
% not need to be normalized.
```

```
price =[1,(([1650,3] - mu) ./ sigma)] *theta; % You should change this


% ============================================================

fprintf(['Predicted price of a 1650 sq-ft, 3 br house ' ...
         '(using gradient descent):\n $%f\n'], price);
```

```
Predicted price of a 1650 sq-ft, 3 br house (using gradient descent):
 $289314.620338
```

```

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

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

```
pause;
```

================= Part 3: Normal Equations =================

```
fprintf('Solving with normal equations...\n');
```

```
Solving with normal equations...
```

```

% ====================== YOUR CODE HERE ======================
% Instructions: The following code computes the closed form
%               solution for linear regression using the normal
%               equations. You should complete the code in
%               normalEqn.m
%
%               After doing so, you should complete this code
%               to predict the price of a 1650 sq-ft, 3 br house.
%
```

Load Data

```
data = csvread('ex1data2.txt');
X = data(:, 1:2);
y = data(:, 3);
m = length(y);

% Add intercept term to X
X = [ones(m, 1) X];

% Calculate the parameters from the normal equation
theta = normalEqn(X, y);

% Display normal equation's result
fprintf('Theta computed from the normal equations: \n');
```

```
Theta computed from the normal equations:
```

```
fprintf(' %f \n', theta);
```

```
 89597.909544
 139.210674
 -8738.019113
```

```
fprintf('\n');


% Estimate the price of a 1650 sq-ft, 3 br house
% ====================== YOUR CODE HERE ======================
price = [1,1650,3] * theta; % You should change this


% ============================================================

fprintf(['Predicted price of a 1650 sq-ft, 3 br house ' ...
         '(using normal equations):\n $%f\n'], price);
```

```
Predicted price of a 1650 sq-ft, 3 br house (using normal equations):
 $293081.464335
```