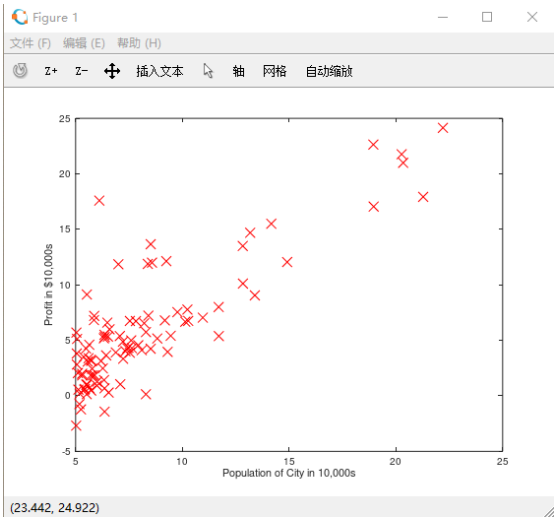
ex1

必做部分

第一部分：打印数据点



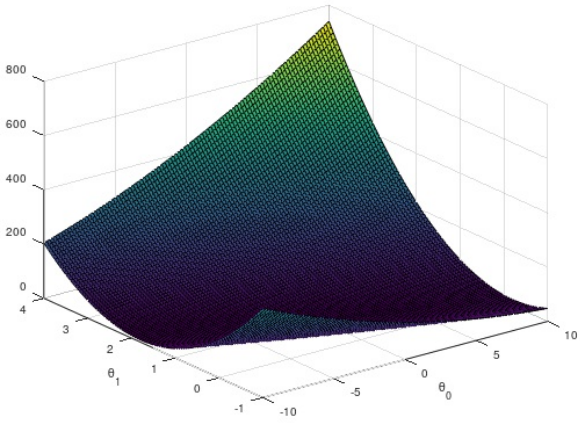
第二部分：计算损失函数值

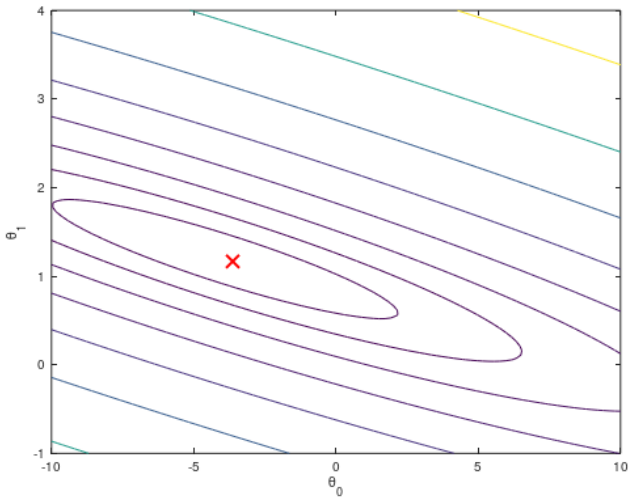
```
ans =  32.073
```

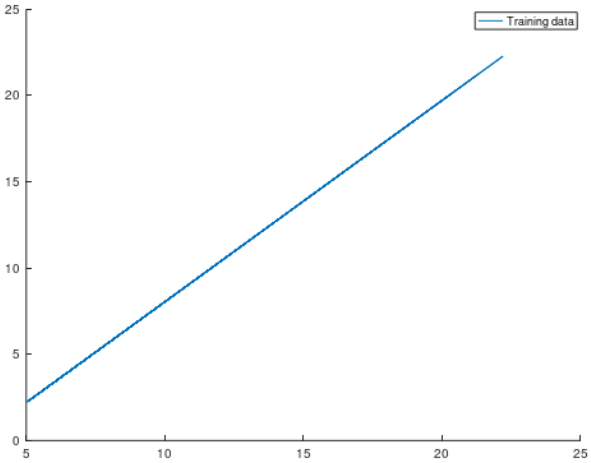
第三部分：梯度下降法求最终θ及此时的损失函数

```
Theta found by gradient descent: -3.630291 1.166362
warning: legend: ignoring extra labels
warning: called from
    legend at line 468 column 13
    ex1 at line 75 column 1
For population = 35,000, we predict a profit of 4519.767868
For population = 70,000, we predict a profit of 45342.450129
```

第四部分：输出损失函数的Surface图、等高线图以及拟合直线







此时提交作业：

```
                                Part Name |     Score | Feedback
                                --------- |     ----- | --------
                            Warm-up Exercise |  10 /  10 | Nice work!
                  Computing Cost (for One Variable) |  40 /  40 | Nice work!
                Gradient Descent (for One Variable) |  50 /  50 | Nice work!
                             Feature Normalization |   0 /   0 |
                   Computing Cost (for Multiple Variables) |   0 /   0 |
                 Gradient Descent (for Multiple Variables) |   0 /   0 |
                             Normal Equations |   0 /   0 |
                                --------------------------------
                                                | 100 / 100 |
```

选做部分

第五部分：特征标准化（对较大数据进行缩放，加快梯度下降速度）

初始样本数据：

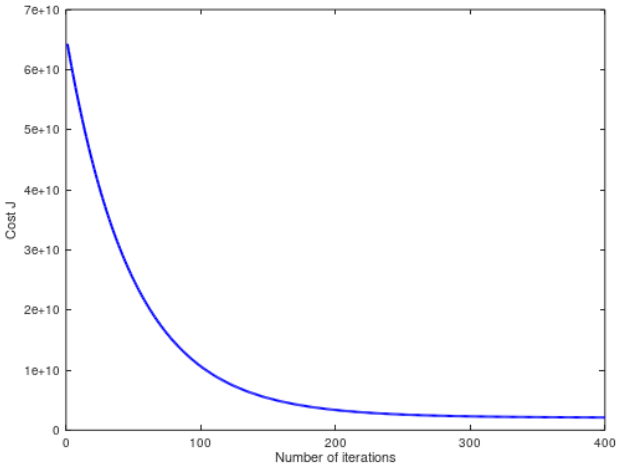
```
First 10 examples from the dataset:
 x = [2104 3], y = 399900
 x = [1600 3], y = 329900
 x = [2400 3], y = 369000
 x = [1416 2], y = 232000
 x = [3000 4], y = 539900
 x = [1985 4], y = 299900
 x = [1534 3], y = 314900
 x = [1427 3], y = 198999
 x = [1380 3], y = 212000
 x = [1494 3], y = 242500
```

初始化之后的样本数据（需要在ex1_multi文件中插入输出代码）：

```
Normalizing Features ...
 x = [0 -0], y = 399900
 x = [-1 -0], y = 329900
 x = [1 -0], y = 369000
 x = [-1 -2], y = 232000
 x = [1 1], y = 539900
 x = [-0 1], y = 299900
 x = [-1 -0], y = 314900
 x = [-1 -0], y = 198999
 x = [-1 -0], y = 212000
 x = [-1 -0], y = 242500
```

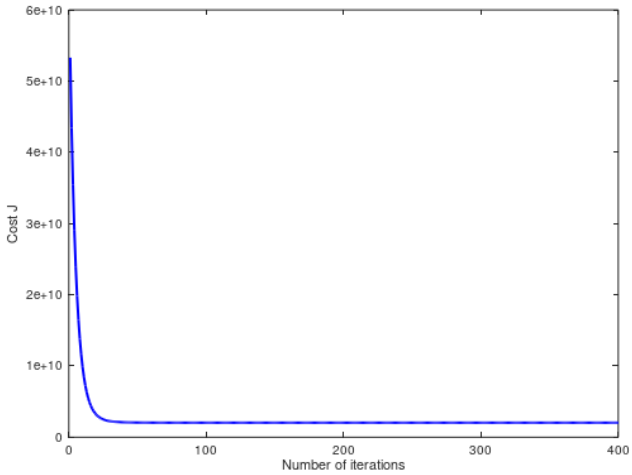
第六部分：多元变量梯度下降

```
Running gradient descent ...
Theta computed from gradient descent:
 334302.063993
 100087.116006
 3673.548451
```

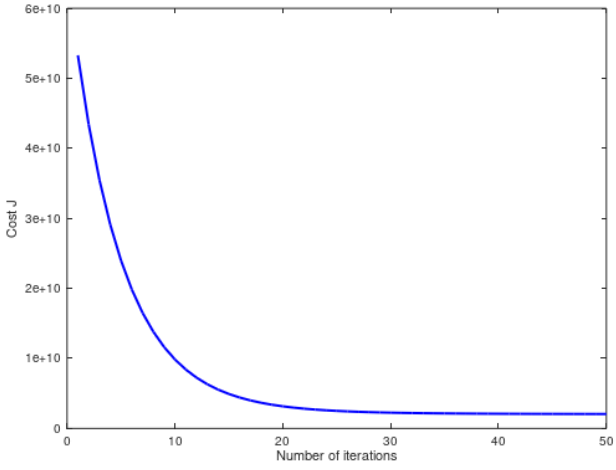


第七部分：

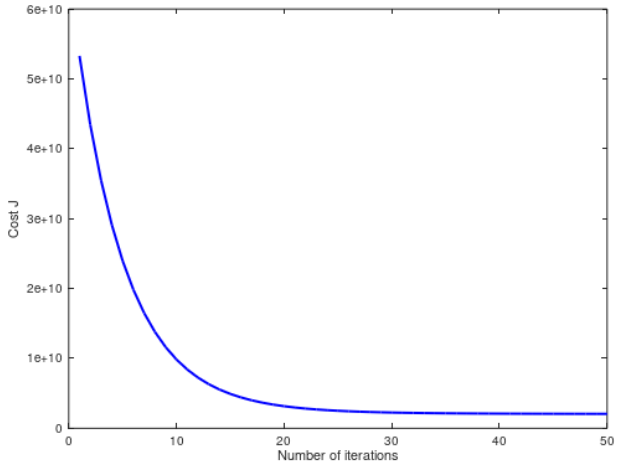
将学习速率从0.01更换为0.1



将迭代次数从400更换成50次



获取合适的学习速率（0.01->0.03->0.1->0.3，这里选择0.1,最优在0.13附近）：



第八部分：预测1650公顷，3间卧室的房价

错误答案：

```
Predicted price of a 1650 sq-ft, 3 br house (using gradient descent):
 $172148542.368130
```

正确答案（对预测样本进行标准化处理）：

```
Predicted price of a 1650 sq-ft, 3 br house (using gradient descent):
 $292748.085232
```

第九部分：正规方程法获得最有θ值及其对应的预测房价（不用对预测样本进行标准化处理，但是仍然需要加入插入项）

```
Solving with normal equations...
Theta computed from the normal equations:
 89597.909542
 139.210674
 -8738.019112

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

此时提交：

```
                                   Part Name |     Score | Feedback
                                   --------- |     ----- | --------
                             Warm-up Exercise |  10 /  10 | Nice work!
                   Computing Cost (for One Variable) |  40 /  40 | Nice work!
                  Gradient Descent (for One Variable) |  50 /  50 | Nice work!
                               Feature Normalization |   0 /   0 | Nice work!
                 Computing Cost (for Multiple Variables) |   0 /   0 | Nice work!
              Gradient Descent (for Multiple Variables) |   0 /   0 | Nice work!
                             Normal Equations |   0 /   0 | Nice work!
                                   ----------------------------------
                                                | 100 / 100 |
```