山东大学 计算机科学与技术 学院

机器学习与模式识别 课程实验报告

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实验题目：Logistic Regression and Newton’s Method		
实验学时：2	实验日期：2025/3/18	

实验环境：

软件环境：

系统：Windows 11 家庭中文版 23H2 22631.4317

计算软件：MATLAB 版本: 9.8.0.1323502 (R2020a)

Java 版本: Java 1.8.0_202-b08 with Oracle Corporation Java HotSpot(TM) 64-Bit Server VM mixed mode

硬件环境：

CPU：13th Gen Intel(R) Core(TM) i9-13980HX 2.20 GHz

内存：32.0 GB (31.6 GB 可用)

磁盘驱动器：NVMe WD_BLACKSN850X2000GB

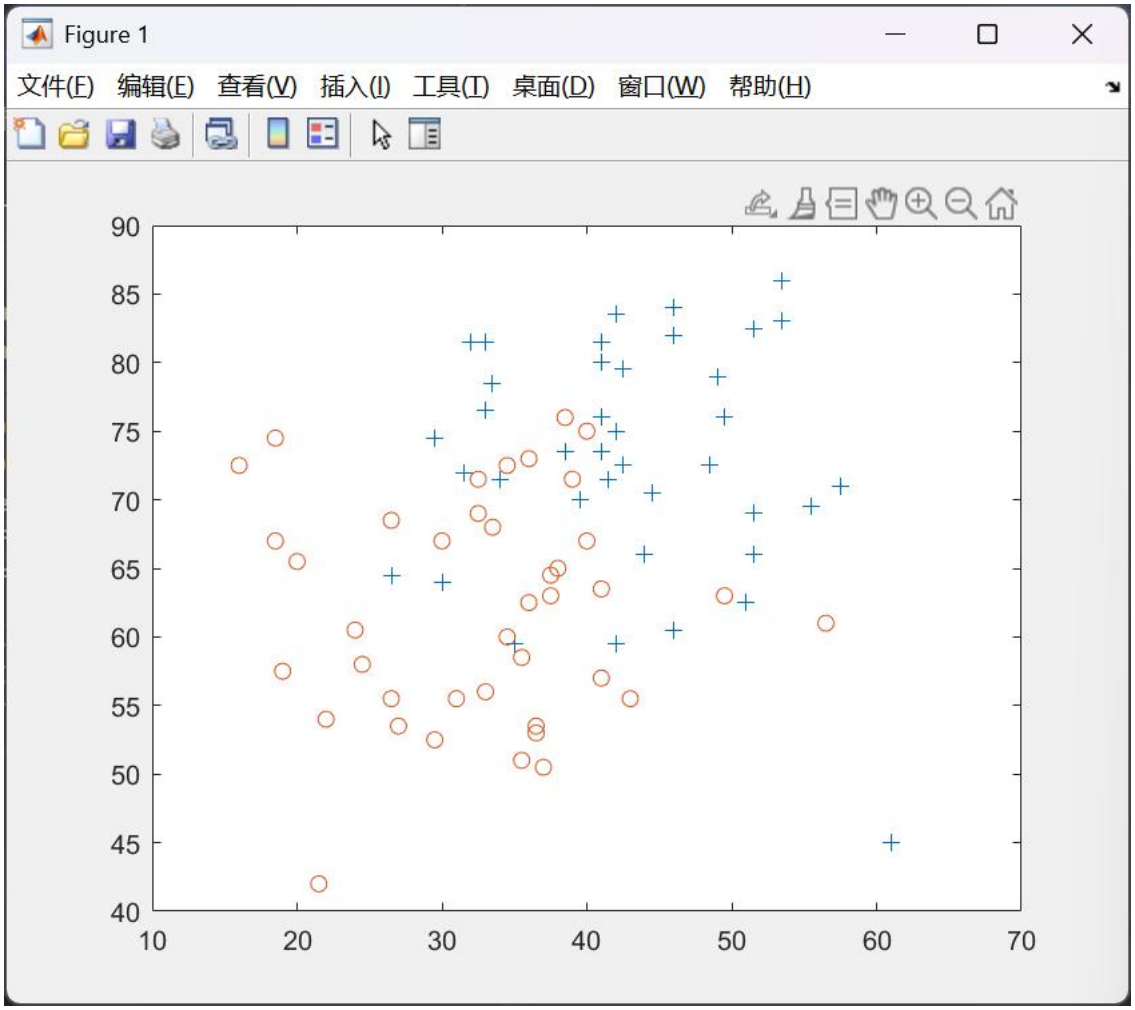
显示适配器：NVIDIA GeForce RTX 4080 Laptop GPU

1. 实验内容

In this exercise, you will use Newton’s Method to implement logistic regression on a classification problem.

2. 实验步骤

(1) 获取实验需要的数据



(2) 构造模型

$$h_\theta(x) = g(\theta^T x) = \frac{1}{1 + e^{-\theta^T x}} = P(y = 1 \mid x; \theta)$$

(3) 构造代价函数

$$J(\theta) = \frac{1}{m} \sum_{i=1}^{m} [-y^{(i)} \log(h_\theta(x^{(i)})) - (1 - y^{(i)}) \log(1 - h_\theta(x^{(i)}))]$$

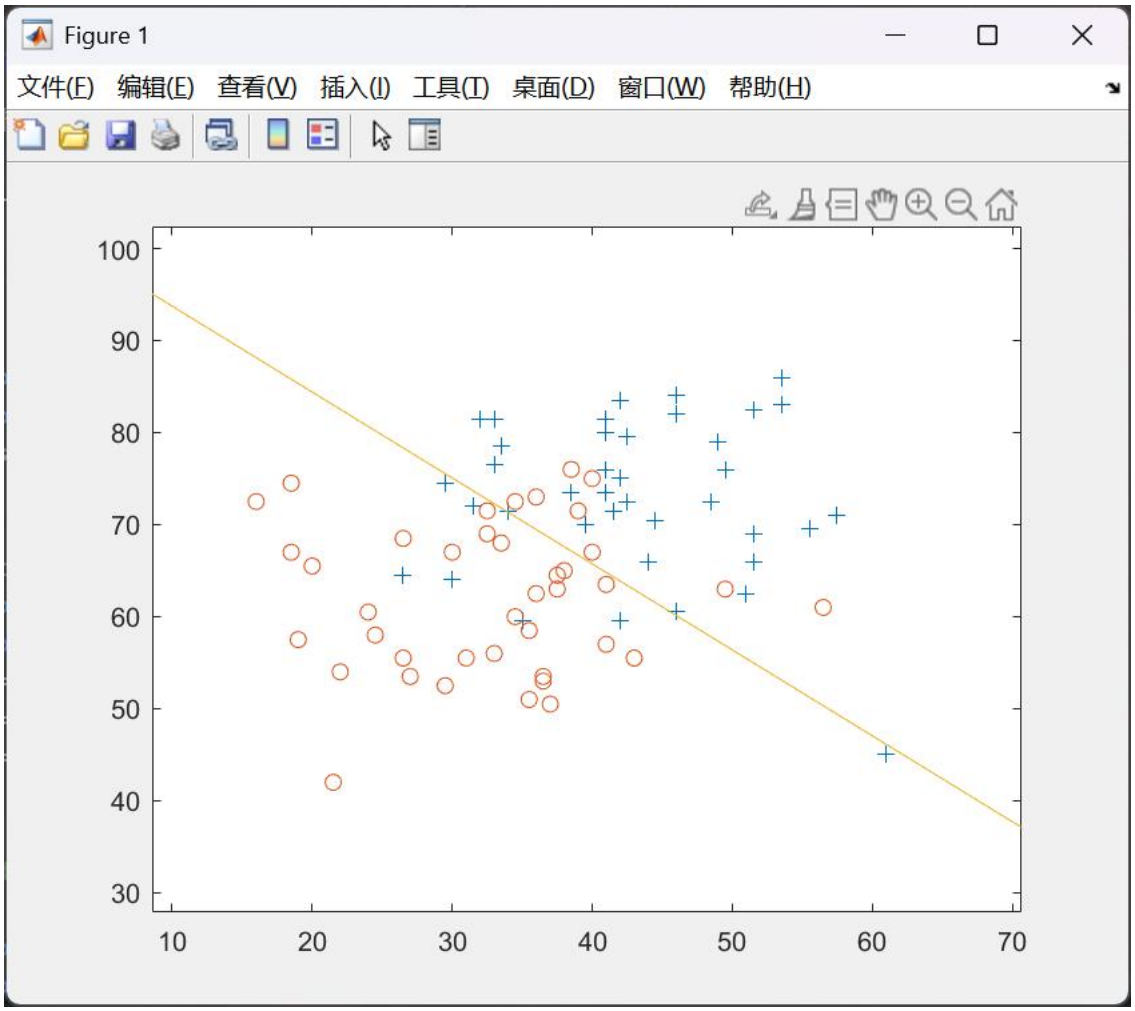
(4) 构造牛顿法逻辑回归的计算方法

$$\theta^{(t+1)} = \theta^{(t)} - H^{-1} \nabla_\theta J$$

(5) 用 matlab 完成计算
(6) 完成结果可视化
(7) 计算要求的测试题目

3. 测试结果

完成计算后的分类如下图：



数据为：

```
迭代次数
     5

  -16.3787
    0.1483
    0.1589
```

经过 5 次迭代后收敛， θ 的值为[-16. 3787, 0. 1483, 0. 1589]^T

```
通过率为
    0.3320
```

计算出的录取率为 0. 3320，未被录取率为 0. 6680

4. 附录：实现源代码

```
%% 清空工作区
clc; clear; close all;
%% 加载数据

x = load('ex4Data/ex4x.dat')
y = load('ex4Data/ex4y.dat')
```

```
% disp(x)
% disp(y)
x = [ones(size(x,1),1) x];
pos = find(y==1);
neg = find(y==0);
figure;
plot(x(pos,2),x(pos,3),'+');hold on;
plot(x(neg,2),x(neg,3),'o');
%% 全局变量
global theta;% 参数
%% 计算
theta = zeros(size(x,2),1);
gradientDescent(x,y,15);
disp(theta)
x_l = linspace(0,100,100);
y_l = (-theta(1)-theta(2)*x_l)/theta(3);
plot(x_l,y_l);hold on;
test = [1 20 80];
disp("通过率为")
disp(hx(test))
%% 函数
%% hx
function result = hx(x)
    global theta;
    result = sigmoid(x * theta);
end
%% cost
function J = cost(x,y)
    global theta;
    m = length(y);
    h = hx(x);
    J = (1/m) * (-y' * log(h) - (1 - y)' * log(1 - h));
end
%% gradient decent
function [theta,J_history] = gradientDescent(x,y,num_iters)
    global theta;
    J_history = cost(x,y);
    for i = 1:num_iters
        H = HMatrix(x,y);
        disp(H)
        grad = deltaJ(x,y);
        H = inv(H);
        theta = theta - H*grad;
        J_history = [J_history cost(x,y)]
        if abs(J_history(end) - J_history(end-1)) < 1e-6
            disp("迭代次数");
```

```
            disp(i);
            break;
        end
    end
end
% HesMatrix
% 海森矩阵
function H = HMatrix(x, y)
    global theta;
    m = length(y);
    h = sigmoid(x * theta);
    H = zeros(size(theta));
    for i = 1:m
        h_i = h(i);
        x_i = x(i, :);
        H = H + h_i * (1 - h_i) * (x_i' * x_i);
    end
    H = H / m;
end
% ΔJ
function result = deltaJ(x,y)
    global theta;
    m = length(y);
    h = hx(x);
    result = (1/m) * (x' * (h - y));
end
% sigmoid
function result = sigmoid(z)
    result = 1 ./ (1 + exp(-z));
end
```