COL774 Assignment-1 Report

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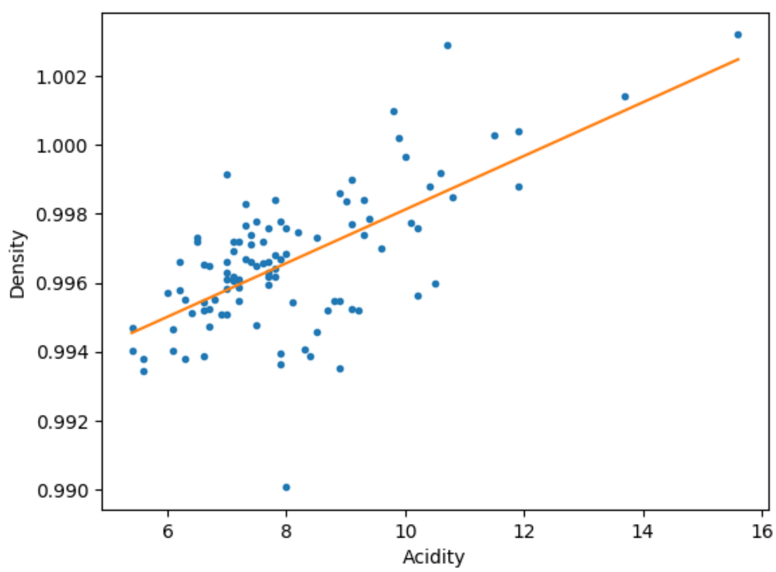
Linear Regression

Procedure

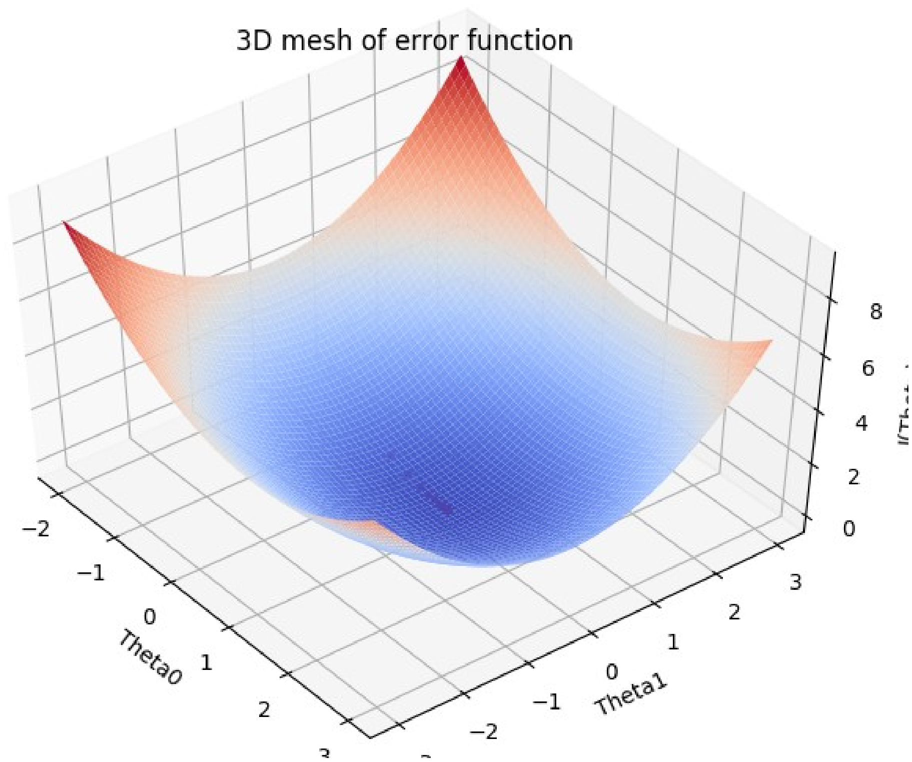
1. Normalize parameters for all examples.
2. Apply gradient descent which convergences when avg error goes below 0.00001 or number of iterations exceed 100.
3. Plot line y = theta0*x0 + theta1*x1 along with datapoints.
4. Plot a surface of z = (1/2*m)*sumation(y(i)-h(x(i))). Plot successive the theta obtained at each iteration.
5. Plot contours of error function. Plot successive the theta obtained at each iteration.

At $\eta = 0.3$

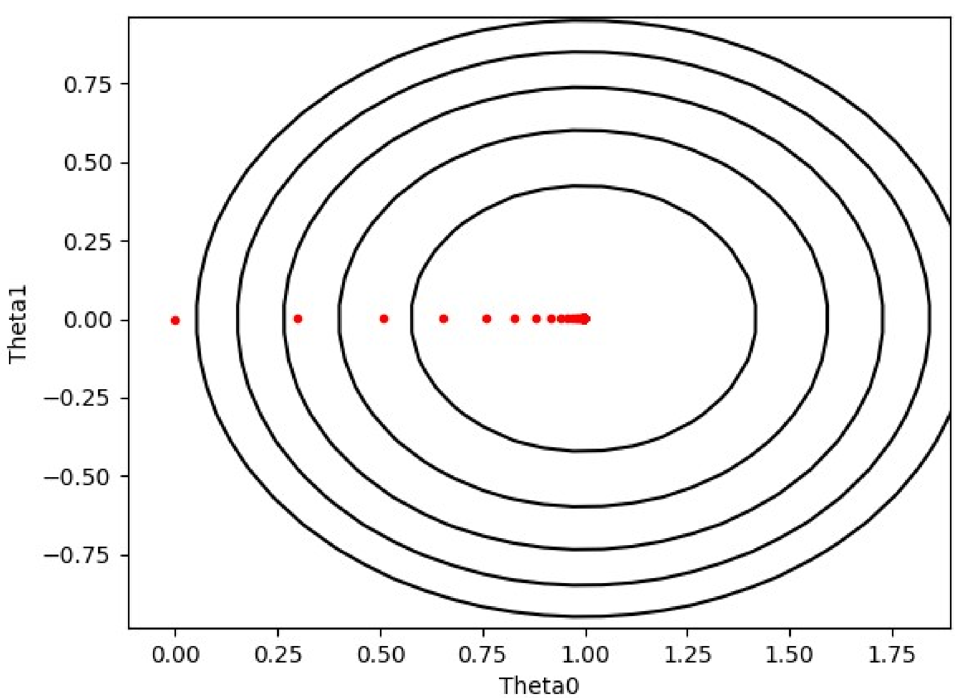
Plot of Hypothesis function and data points



Plot of error function in time gap of 0.2 second



Plot of contours



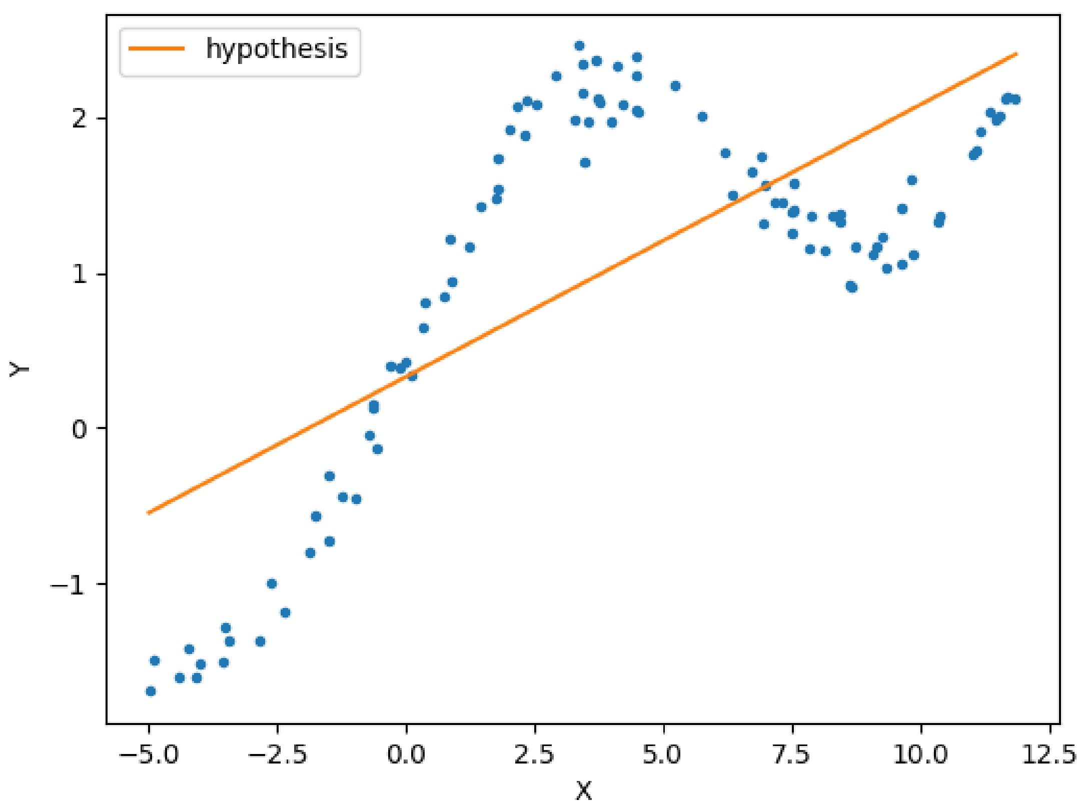
Gradient descent diverges over η > 2.0

Locally Weighted Linear Regression

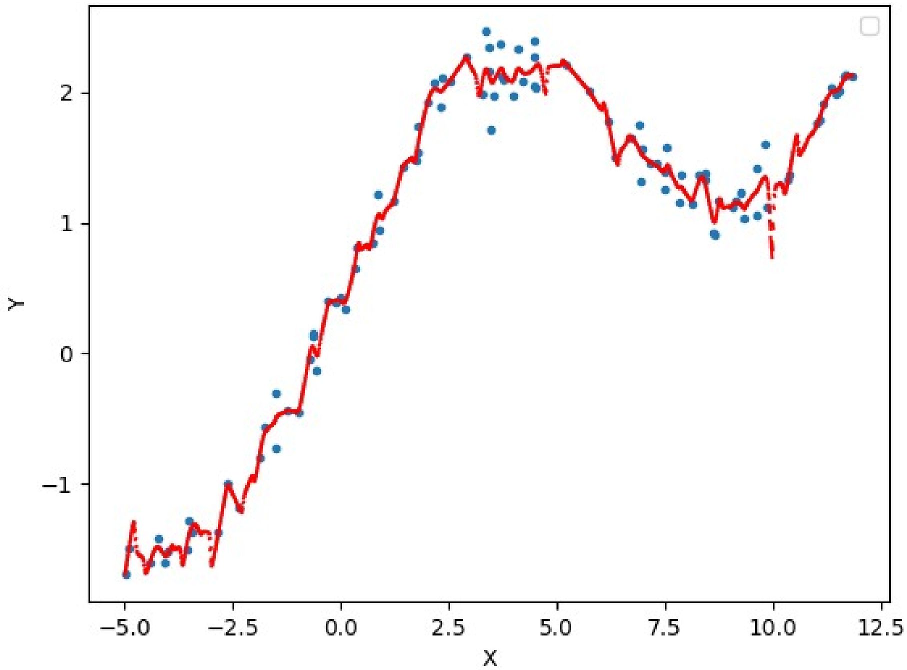
Procedure

1. Repeat linear regression procedure for this problem
2. Calculate Weight matrix W of size (no. of examples)x(no. of examples). It diagonal elements are calculated as W[k][k] = exp(-(x[k]-x[i])^2/(2*tau^2)), i at which prediction is to be made.
3. Solve the normal equation, theta = (((X^t)*W*X)^-1)*(X^t)*W*Y
4. Divide range of value of x into 1000 part. Plot line for each of these part by calculating theta for all of them

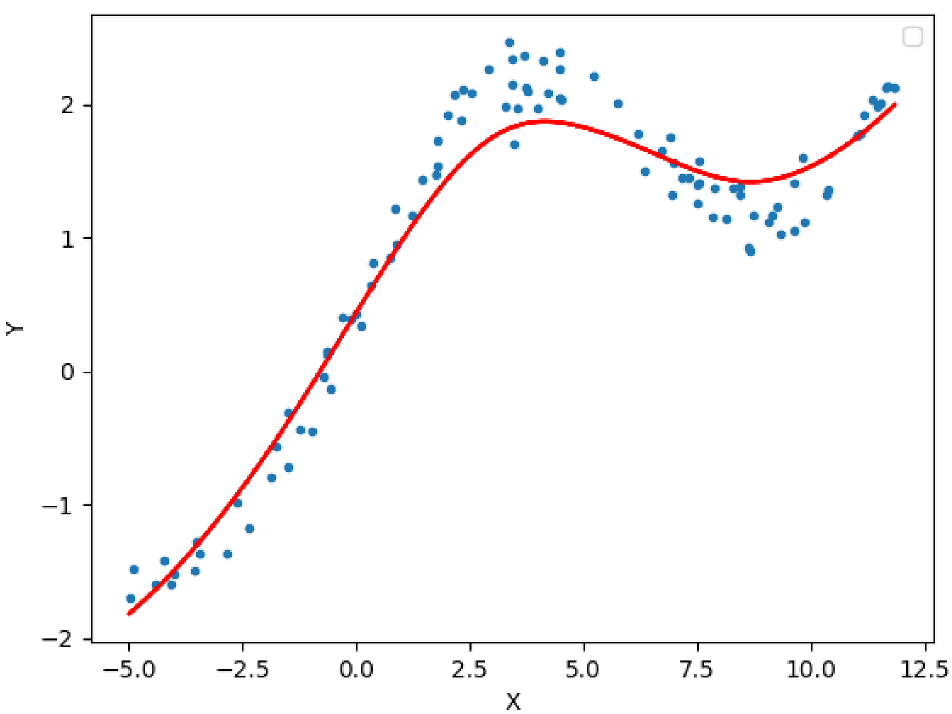
Linear regression at η = 0.3



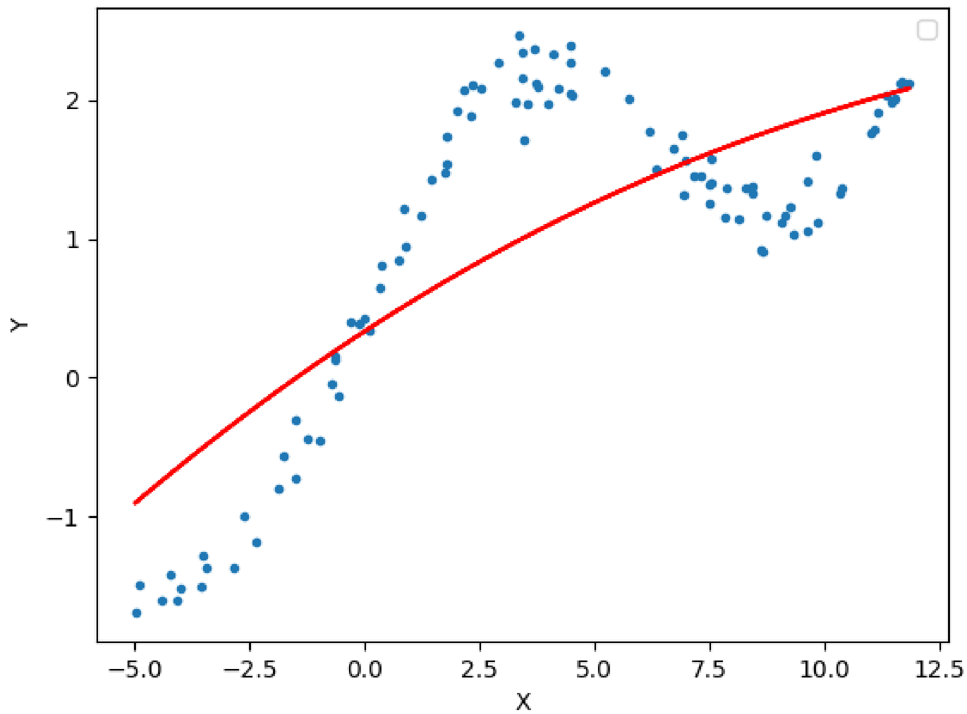
Linear regression at tau = 0.1 (Over Fitting)



Linear regression at tau = 2 (Acceptable fit)



Linear regression at tau = 10 (Under Fitting)

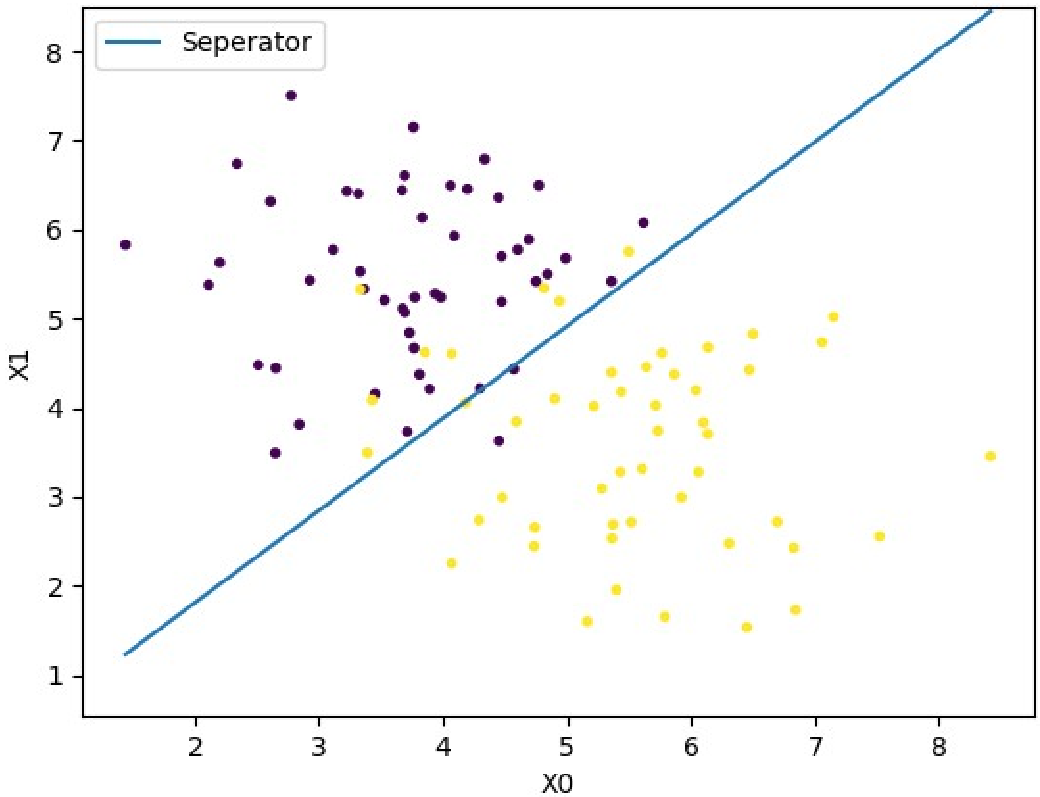


Logistic Regression

Procedure

1. Normalize parameters for all examples.
2. Calculate derivative of log likelihood
3. Calculate Hessian
4. Apply Newtons' method to calculate zero of derivative of log likelihood. Checking convergence by change in theta becomes too small or last change is less than current change or iteration exceed some threshold.

Plot of descision boundary

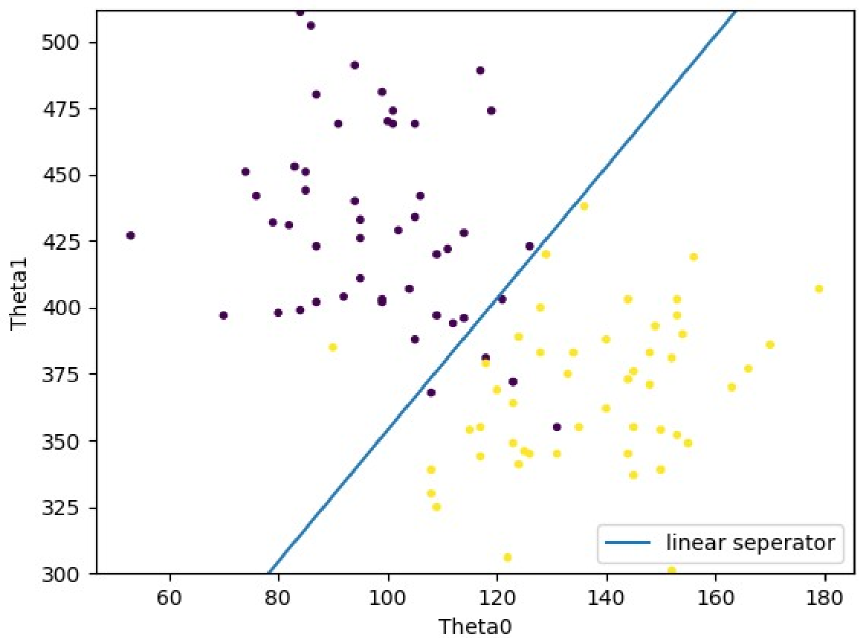


Gaussian Discrmimant Analysis

Procedure

1. Calculate mean of x - mu, probability of y = 1 according to Bernauli distribution - phi, covariance matrix of x - sigma.
2. Calculate equation of descision boundary by equating P(y=1; x, mu0, mu1, sigma0, sigma1, phi)
3. To get linear seperator put sigma1=sigma2=sigma
4. To get quadractic seperator solve using sigma1 != sigma2

Linear Descision Boundary



Quadratic Descision Boundary