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Essentials of Data Analytics - (CSE3506)

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Lab-10

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L21-22 **Slot**

Tasks for Week-10: Momentum Based Gradient Descent
Understand the momentum based gradient descent of following operations/functions on ‘mtcars’ dataset based on given instructions.

AIM

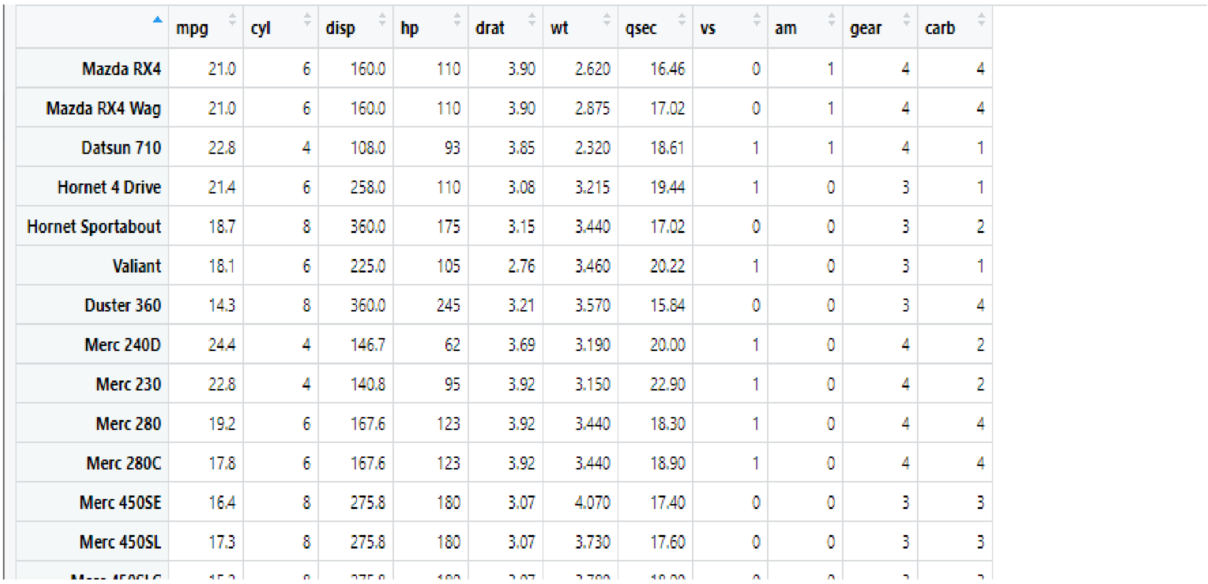
To Understand the momentum based gradient descent following operations/functions on ‘mtcars’ dataset based on given instructions.

Algorithm

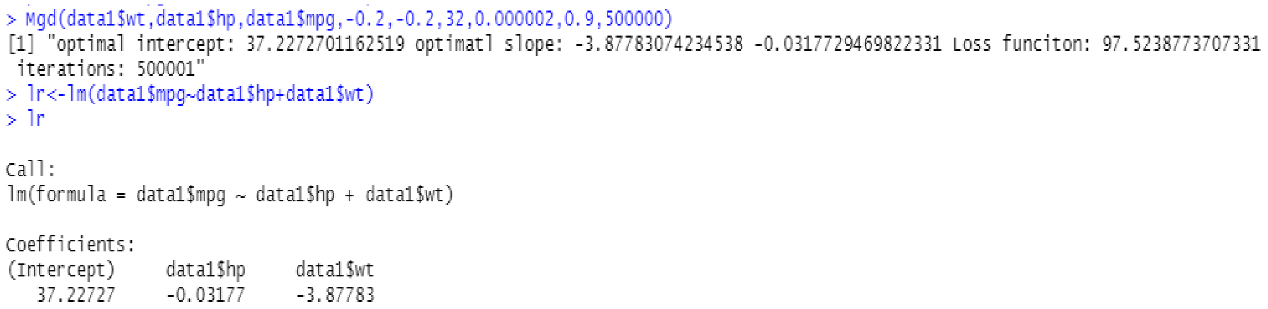
1. Start
2. Set working directory, attach library class and read data.
3. Define the gradient descent function gd”.
    a. Initialize values of loss function, iteration as 0.
    b. While iterations are less than max iteration.
        i. Calculate y_predicted as m1*x1+m2*x2+c.
        ii. Calculate the new loss value as 0.5*sum of (difference of y and y_pred)^2.
        iii. Calculate the gradient values.
        iv. Update the values of slope and c using the gradient.
        v. Check if the difference in loss function is less than tolerance value, if true then break, else continue.
        vi. Update loss function value to new loss value.
        vii. Increase iteration values.
    c. Return the optimal m1, m2, c, loss, iteration values.
4. Attach dataset mtcars.
5. Call the “Mgd” function with various parameters.
6. Make a linear model using the lm function.
7. Compare the results from Momentum based Gradient Descent (“Mgd” function) and the linear model.

Result

Dataset: mtcars



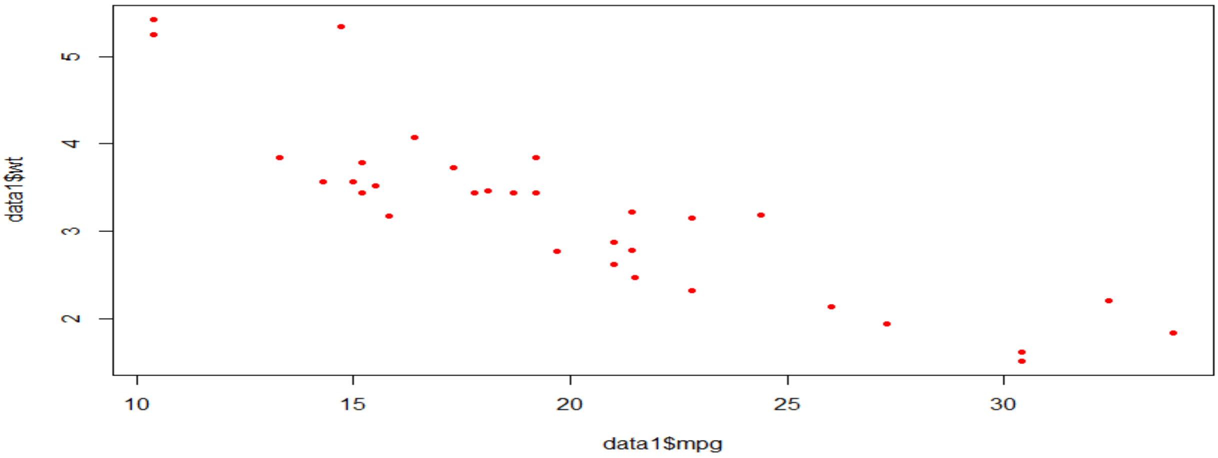
	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0	3	1
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0	4	2
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0	4	2
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0	4	4
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0	4	4
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0	3	3
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0	3	3



```
> Mgd(data1$wt,data1$hp,data1$mpg,-0.2,-0.2,32,0.000002,0.9,500000)
[1] "optimal intercept: 37.2272701162519 optimatl slope: -3.87783074234538 -0.0317729469822331 Loss funciton: 97.5238773707331
 iterations: 500001"
> lr<-lm(data1$mpg~data1$hp+data1$wt)
> lr

Call:
lm(formula = data1$mpg ~ data1$hp + data1$wt)

Coefficients:
(Intercept)     data1$hp     data1$wt  
   37.22727     -0.03177     -3.87783  
```



Inference

Using the momentum based gradient descent

- Slope: -3.877
- Intercept: 37.227
- Loss function: 97.523

Using Linear Regression model

- Slope: -3.877
- Intercept: 37.227

Program

```
rm(list=ls())
Mgd<-function(x1,x2,y,m1,m2,c,alpha,gamma,iter){
  iterations=0
  Lf<-0
  u_m1<-0
  u_m2<-0
  u_c<-0
  while(iterations<=iter){
    y_pred<-m1*x1+m2*x2+c
    Lf_new<-0.5*sum((y_pred-y)^2)
    nu_m1<-gamma*u_m1+alpha*sum((y_pred-y)*x1)
    nu_m2<-gamma*u_m2+alpha*sum((y_pred-y)*x2)
    nu_c<-gamma*u_c+alpha*sum(y_pred-y)
    m1<-m1-nu_m1
    m2<-m2-nu_m2
    c<-c-nu_c
    u_m1<-nu_m1
    u_m2<-nu_m2
    u_c<-nu_c
    Lf<-Lf_new
    iterations=iterations+1
  }
  return(paste("optimal intercept:",c,"optimatl slope:",m1,m2,"Loss funciton:",Lf,"iterations:",iterations))
}
data1<-mtcars
plot(data1$mpg,data1$wt,col="red",pch=20)
Mgd(data1$wt,data1$hp,data1$mpg,-0.2,-0.2,32,0.000002,0.9,500000)
lr<-lm(data1$mpg~data1$hp+data1$wt)
lr
```