MACHINE LEARNING

ASSIGNMENT-1

KAJA LAKSHMI SAI PRIYA

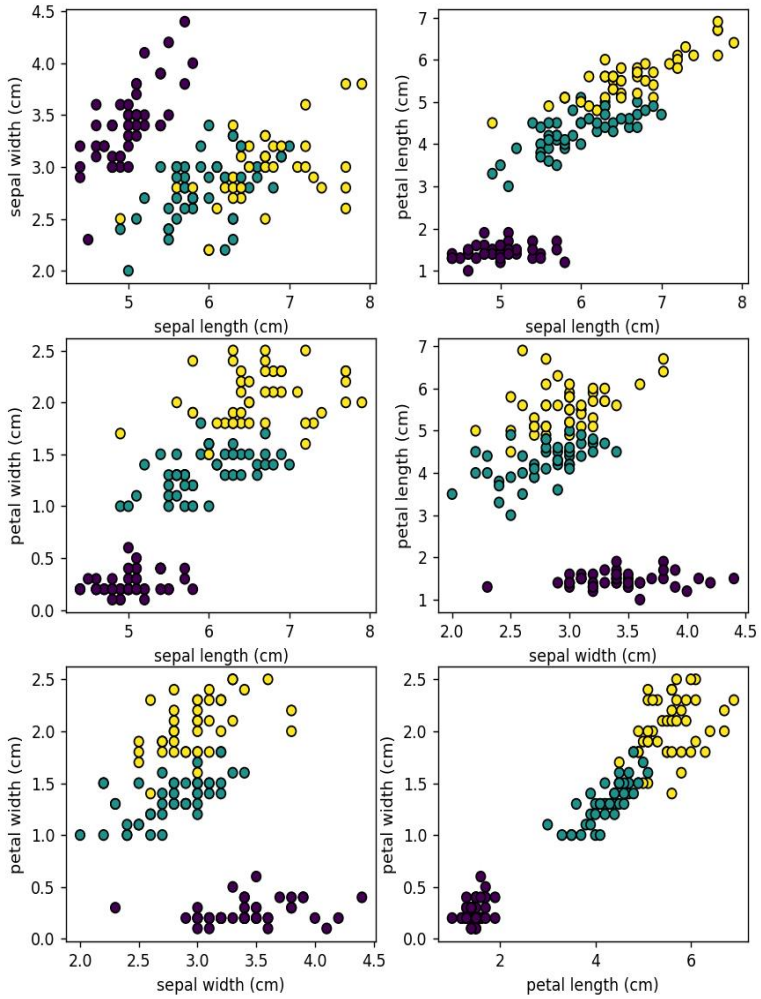
STUDENT ID: 1001843857

CSE 6363-006

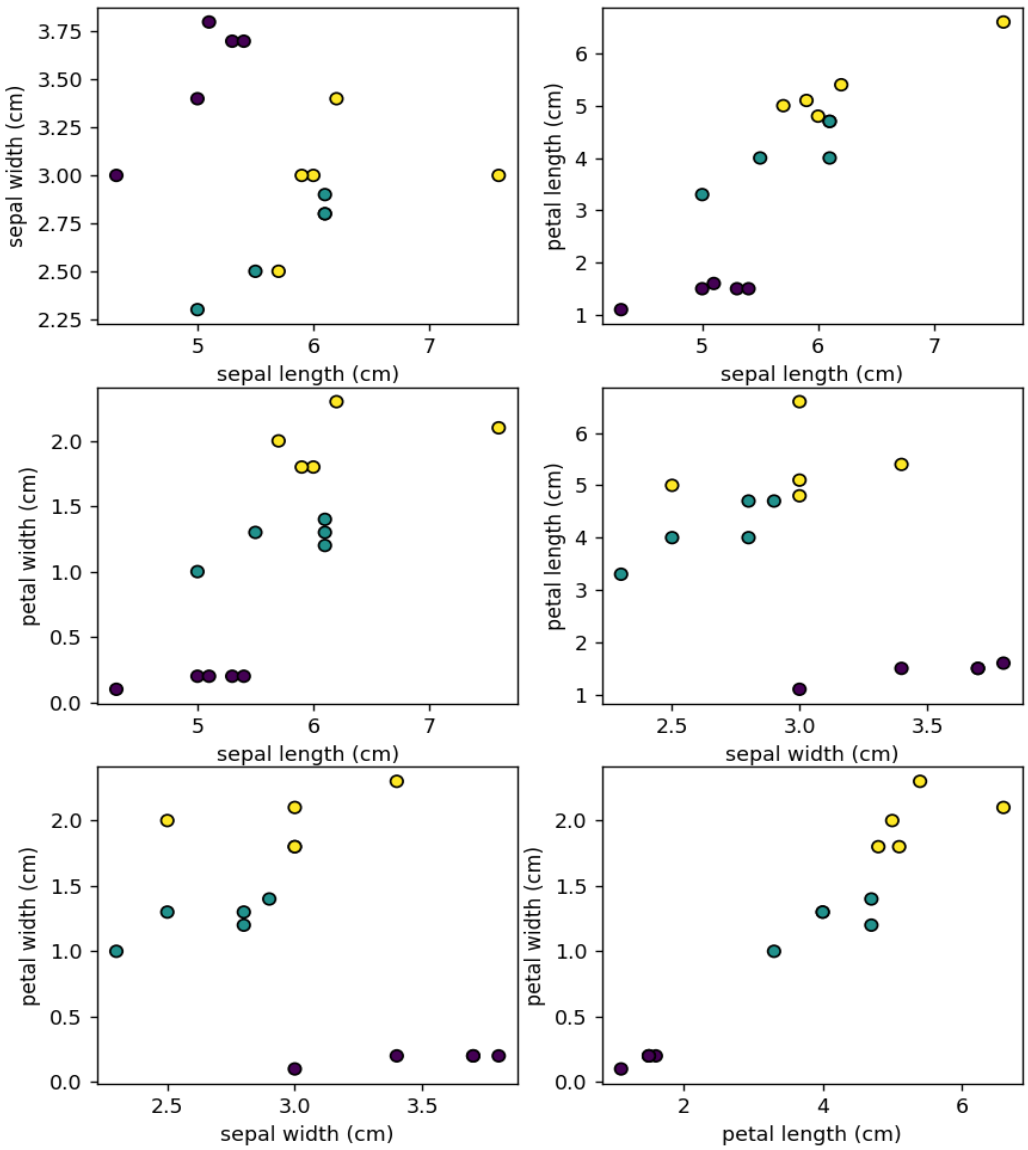
1.Preparing the Data

After splitting the dataset into test set and train set, plots are visualized as follows:

Six plots for Train set:



Six plots for test set:



2. Linear Regression

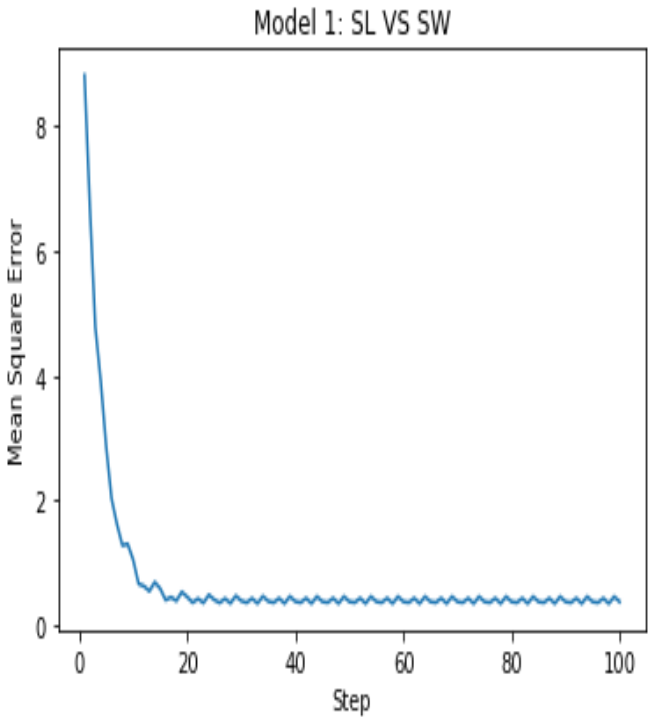
In Linear regression, we can fit 12 models with parameters (w_0,w_1).

2.1 Training

Model 1: Using Sepal Length as input feature to predict Sepal Width

Learning rate=0.01

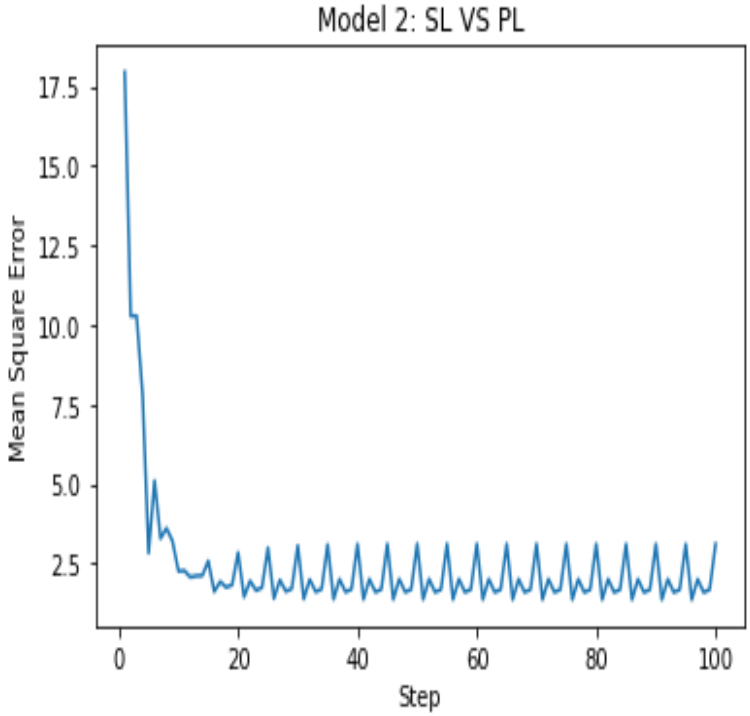
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 1 is represented as below:



Model 2: Using Sepal Length as input feature to predict Petal Length

Learning rate=0.01

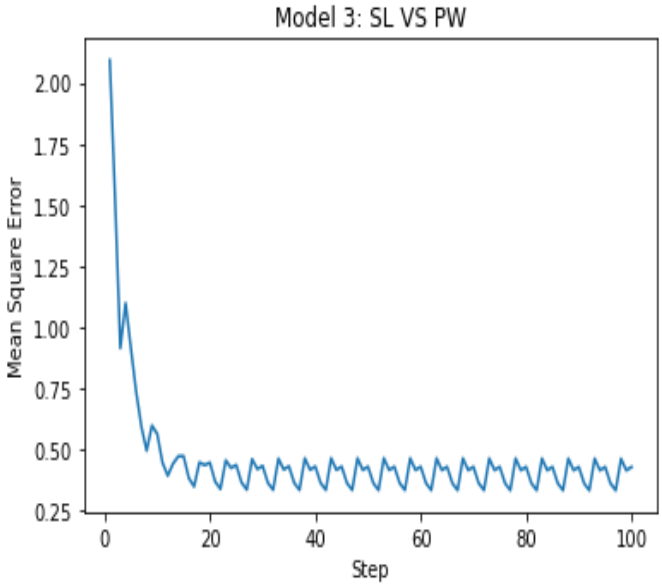
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 2 is represented as below:



Model 3: Using Sepal Length as input feature to predict Petal Width

Learning rate=0.01

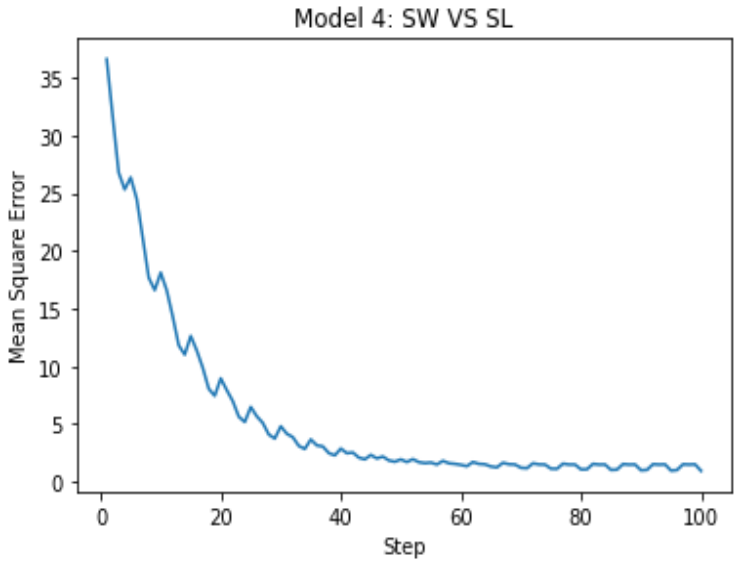
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 3 is represented as below:



Model 4: Using Sepal Width as input feature to predict Sepal Length

Learning rate=0.01

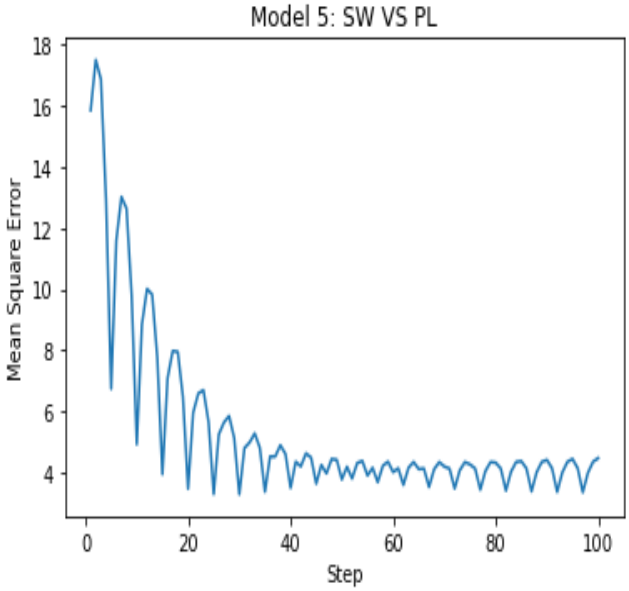
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 4 is represented as below:



Model 5: Using Sepal Width as input feature to predict Petal Length

Learning rate=0.01

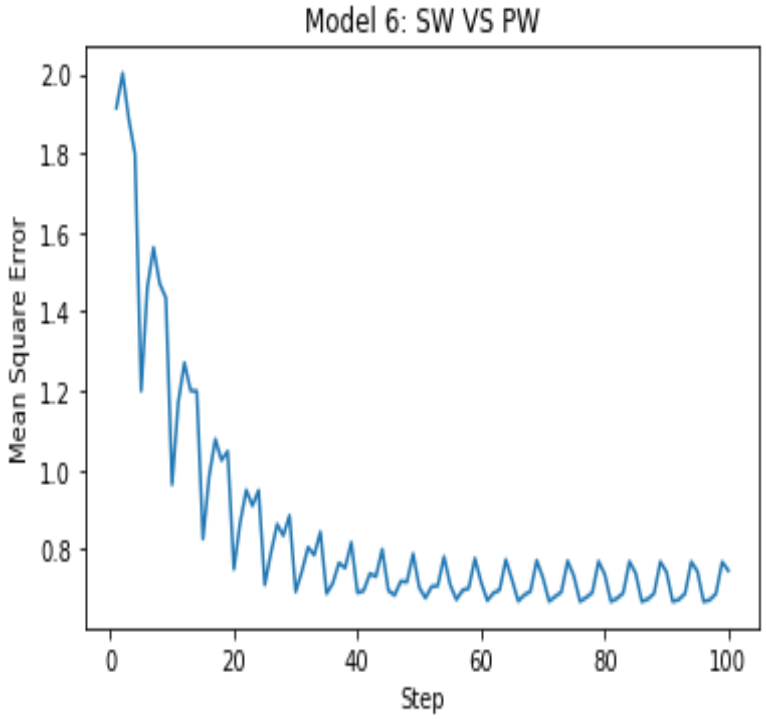
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 5 is represented as below:



Model 6: Using Sepal Width as input feature to predict Petal Width

Learning rate=0.01

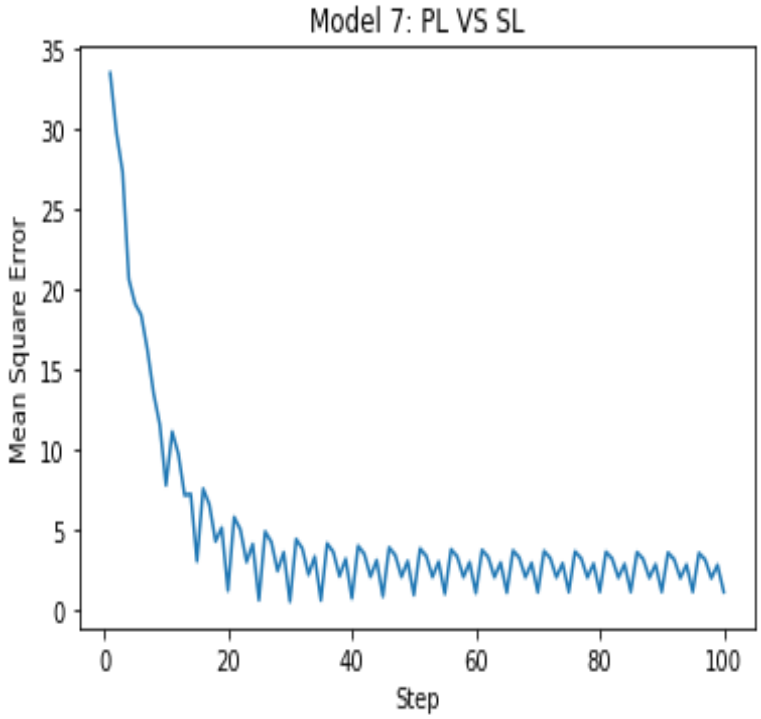
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 6 is represented as below:



Model 7: Using Petal Length as input feature to predict Sepal Length

Learning rate=0.01

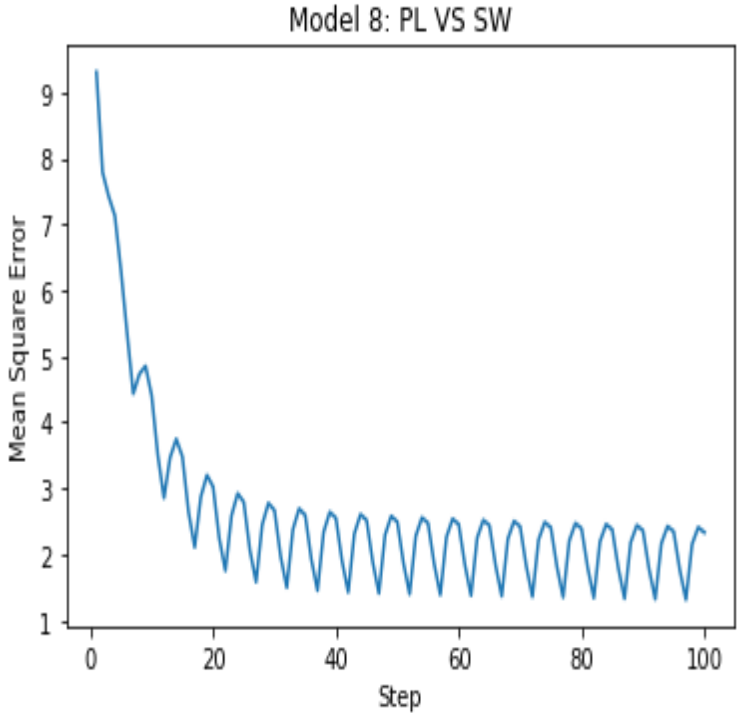
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 7 is represented as below:



Model 8: Using Petal Length as input feature to predict Sepal Width

Learning rate=0.01

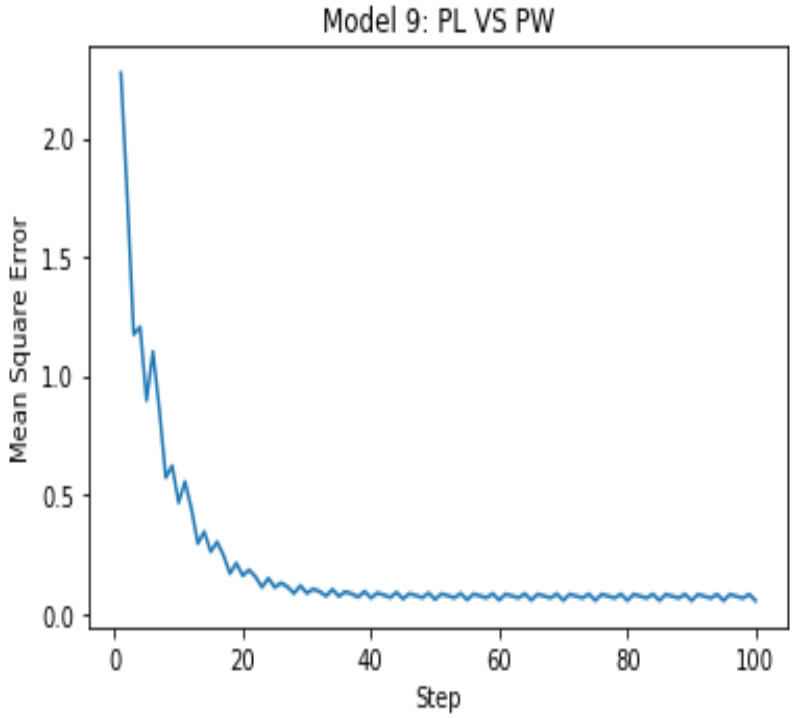
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 8 is represented as below:



Model 9: Using Petal Length as input feature to predict Petal Width

Learning rate=0.01

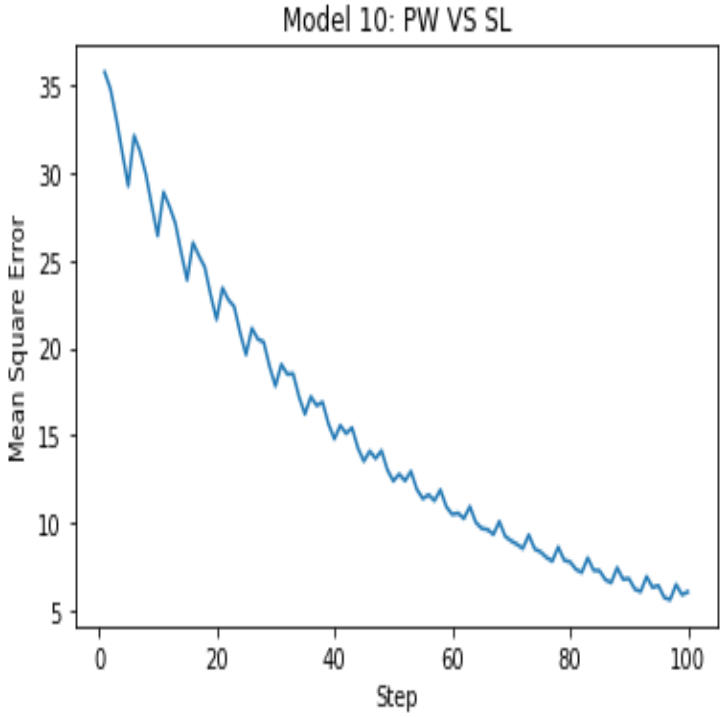
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 9 is represented as below:



Model 10: Using Petal Width as input feature to predict Sepal Length

Learning rate=0.01

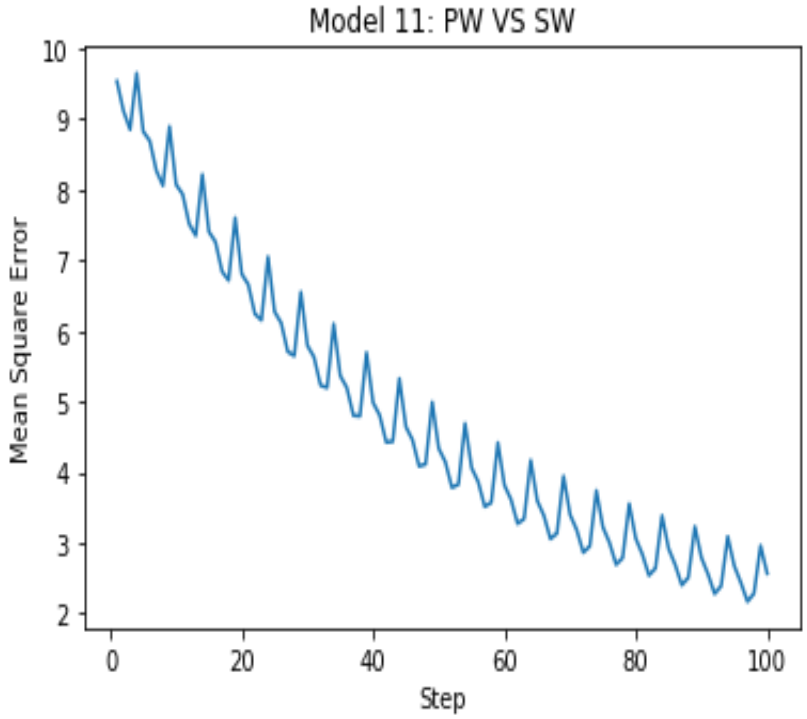
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 10 is represented as below:



Model 11: Using Petal Width as input feature to predict Sepal Width

Learning rate=0.01

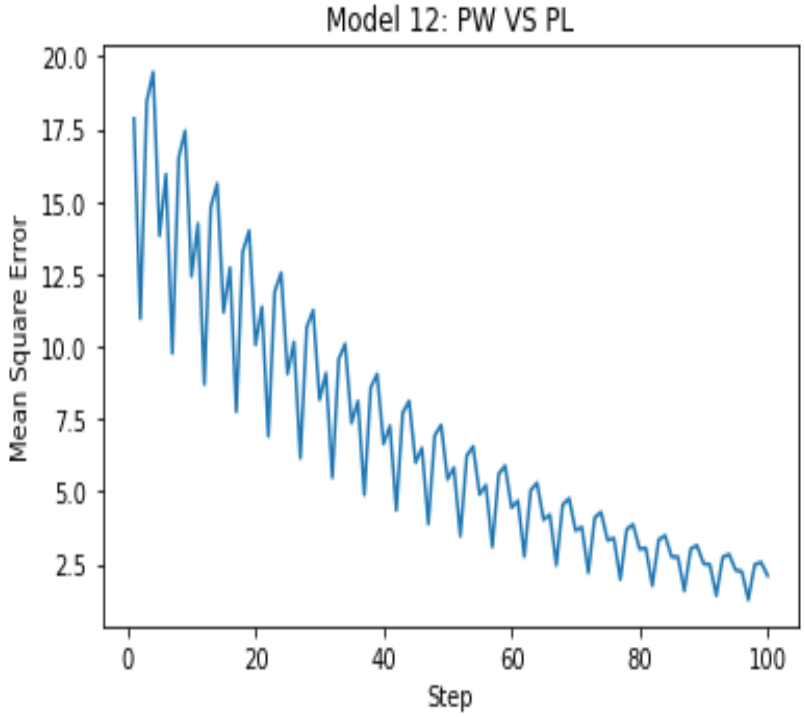
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 11 is represented as below:



Model 12: Using Petal Width as input feature to predict Petal Length

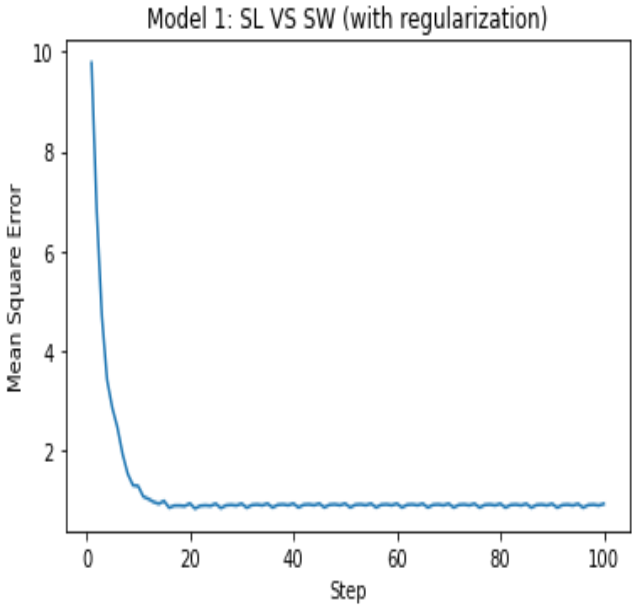
Learning rate=0.01

Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 12 is represented as below:

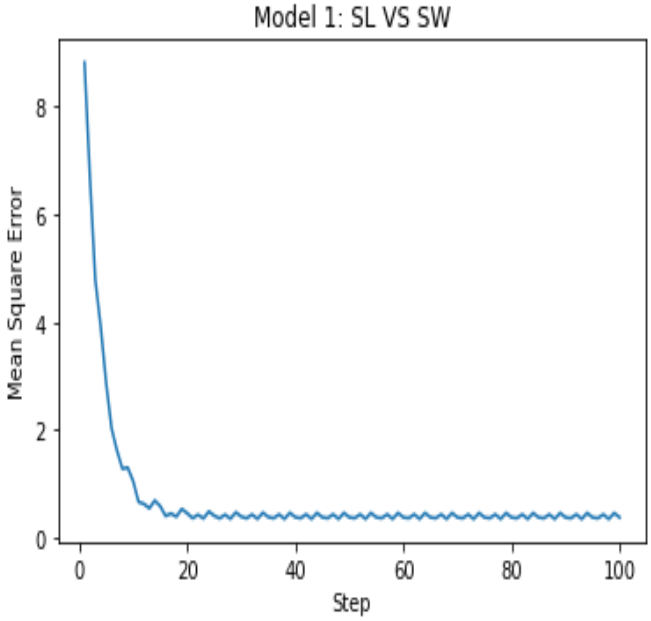


Model 1 with Regularization:

After applying the L2 regularization, the loss plot for the model sepal length as input feature to predict the sepal width is represented as follows:



Without regularization is as follows:



Comparison of weights:

Model 1 without regularization	Model 1 with regularization
8.814375000000002	9.77625
6.676265741394337	6.810143641339481
4.776850783262217	4.696858816292335
3.9156861669559215	3.42495989301142
2.874437212239542	2.866493268607032
2.0335174090357335	2.4701938767436857
1.6244403265272407	1.9363053948542037
1.2861792654373558	1.539036507939896
1.3049751408125172	1.3122820863281583
1.053143700638436	1.2967462523943867
0.6686703071340696	1.0864903412511415
0.6312598565304576	1.0369345397771157
0.5516577502023166	0.9773324401353031
0.6942789797206597	0.9403474716853136
0.5916798771596609	0.9968763106799776
0.40964026390554886	0.8623314237385784
0.45403712228005466	0.9030863533133592
0.39694287619692326	0.9045215050279127
0.5375007406694456	0.8941413693119525
0.45861464287104453	0.9468057181327004
0.3679404216029756	0.8449105437991964
0.4311792880279034	0.8995602338749792
0.36424383288204243	0.9094133308534188
0.4914559754797379	0.8986487231618013
0.41406044249500745	0.9418432534669172
0.36496056126231685	0.8544588794532604
0.4328842403038148 4	0.9097339408566824
0.35724177255206646	0.9193739149203837
0.47570238362313444	0.905829391094671
0.39703613597431225	0.9430713468587534
0.3669193560778919	0.8622311290322342
0.4361330014755493	0.9165901891777849
0.3556606485534901	0.9252923037800025
0.4695307442640293	0.9099490707948185
0.38988889472021765	0.9441160868612578
0.3684469672824559	0.8662472207889165
0.4380461791096907	0.9199303479730497
0.3552272827284060 4	0.9280355869568327
0.4668470135213749	0.911775554365704
0.38669275572492773	0.944448213204836
0.3692097460753659 4	0.8679323642671916
0.43891746307687923	0.921246400833884
0.3550388686979122	0.9290508158934547
0.4655722303679018	0.9123674885360713
0.38518668476173457	0.9443236416540992
0.3695024988342216	0.8684243667312141
0.4392208451439338	0.9215506355147711
0.3549036455515389	0.9292187185344372
0.4649035380421289	0.912356484064746

0.3844299500997707	0.9439632354319536
0.36955464151662665	0.8683446994838988
0.4392449799286135	0.9213746069812169
0.35478041538358324	0.9289875824434084
0.4645044202949975	0.9120620418312804
0.38401142798600113	0.9434895980025865
0.3694912167211475	0.8679985137781265
0.4391372006186872	0.9209755939561071
0.35466011519170104	0.9285718209531865
0.46422721714304954	0.9116366083159496
0.3837468769730119	0.9429632680512312
0.36937374804110207	0.867529650324173
0.4389682035858428	0.9204741520624637
0.3545406560023775	0.92807140541184
0.46400561604342705	0.9111511905293608
0.38355272269067464	0.9424128453998704
0.36923133279967235	0.8670047471202609
0.43877106094548884	0.9199259882380686
0.35442151453798776	0.9275324327394946
0.46380950245717967	0.9106385159045322
0.3833908377694516	0.9418515913387733
0.3690775023256845	0.8664544400280829
0.4385610730202271	0.9193566842537193
0.3543025422132811	0.9269760527246637
0.46362512865190686	0.9101135975790758
0.38324378204422144	0.9412856043722082
0.3689185022191645	0.8658927647560024
0.4383452830096497	0.9187779547488788
0.3541836900751515	0.9264119472021164
0.4634462033135931	0.9095833077733131
0.38310356829973463	0.9407176785619437
0.3687572054661391	0.8653261415239021
0.43812692573014944	0.9181951572563318
0.35406493967905306	0.9258445436332111
0.46326984412805483	0.9090507890744971
0.3829665364948186	0.9401490917782772
0.3685949315759139	0.8647575048680555
0.43790748529824985	0.917610740448324
0.35394628337944106	0.9252758656361816
0.4630947298801864	0.9085174778212046
0.38283100901218703	0.9395804279201769
0.3684322861139549	0.8641881955574378
0.43768764225622236	0.9170258231017865
0.35382771781222583	0.9247068378359605
0.4629202547717042	0.9079840302751192
0.38269621679089794	0.9390119536067003
0.3682695468702196	0.8636188259861668
0.4374677085594384	0.9164409162176139
0.3537092414358687	0.9241378825742913
0.4627461409766579	0.9074507461613677
0.38256180723849237	0.9384437904724607

2.2 Testing

Loss and testing accuracy is also calculated for all the models on the test dataset.

They are tabulated as follows:

Model	Mean Squared Error	Accuracy
Model 1	0.16762843449823692	0.024407714379117817
Model 2	0.9071617013168941	0.7719680674826264
Model 3	0.16619161249339995	0.6925919696562397
Model 4	0.4421696974733512	0.034470284049844424
Model 5	2.881182110302453	0.05285200336325779
Model 6	0.5467293749482659	0.02755644772047583
Model 7	0.11190870511301795	0.6465544827283962
Model 8	0.2932512085059545	0.25241874106231865
Model 9	0.03330811407320176	0.9435923102026916
Model 10	0.3359626643890698	0.6463385445516014
Model 11	0.1626385141571043	0.18932951516729146
Model 12	0.226810863769945	0.9303463484450665

Conclusions based on results from test dataset:

For the test dataset, according to the table, model 9 is more accurate as it has 94.3% accuracy and the mean squared error is very low compared to other models. By this, we can also determine that in model 9, petal length is a good predictor for petal width.

3. Logistic Regression

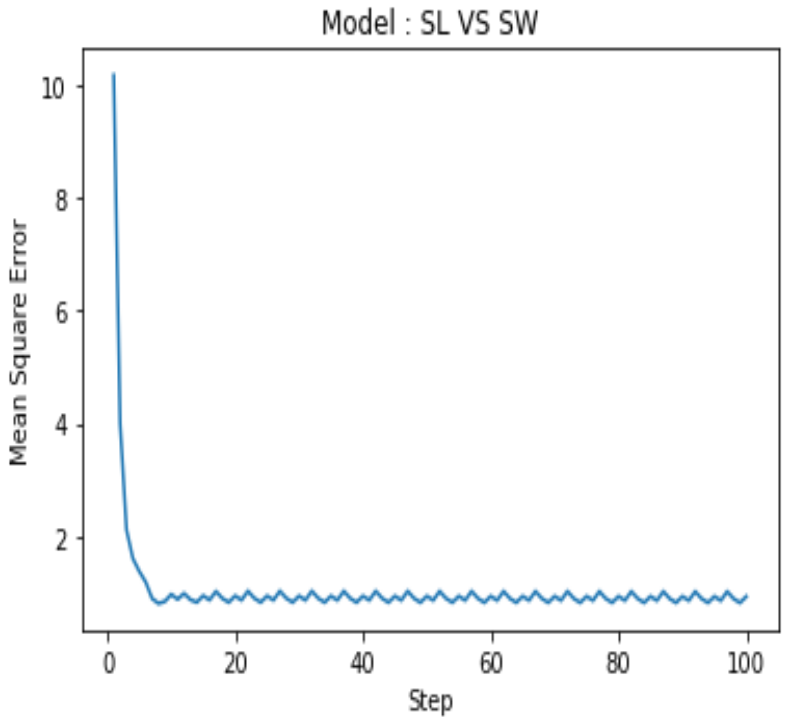
In Logistic regression, we can fit 6 models with parameters (w_0,w_1,w_2).

3.1 Training

Model 1: Using Sepal Length as input feature to predict Sepal Width

Learning rate=0.01

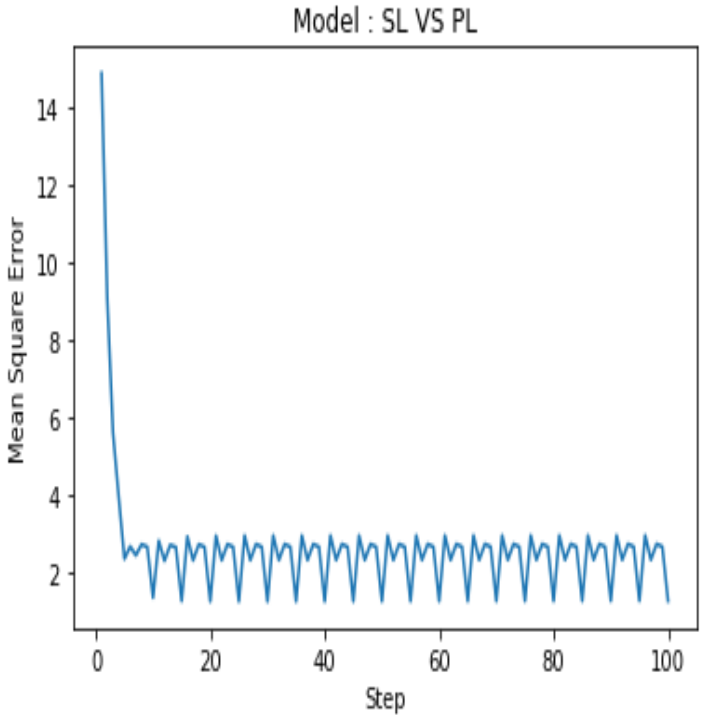
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 1 is represented as below:



Model 2: Using Sepal Length as input feature to predict Petal Length

Learning rate=0.01

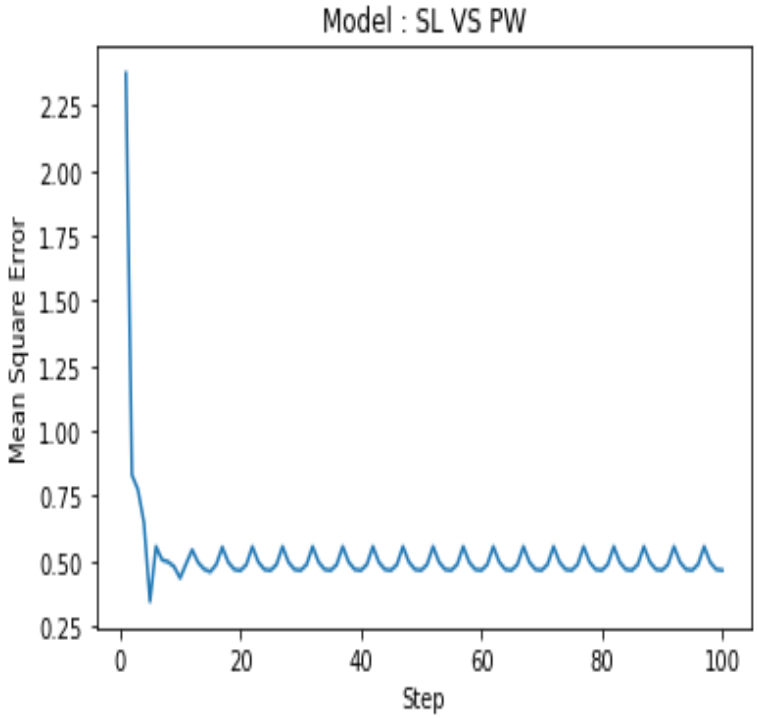
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 2 is represented as below:



Model 3: Using Sepal Length as input feature to predict Petal Width

Learning rate=0.01

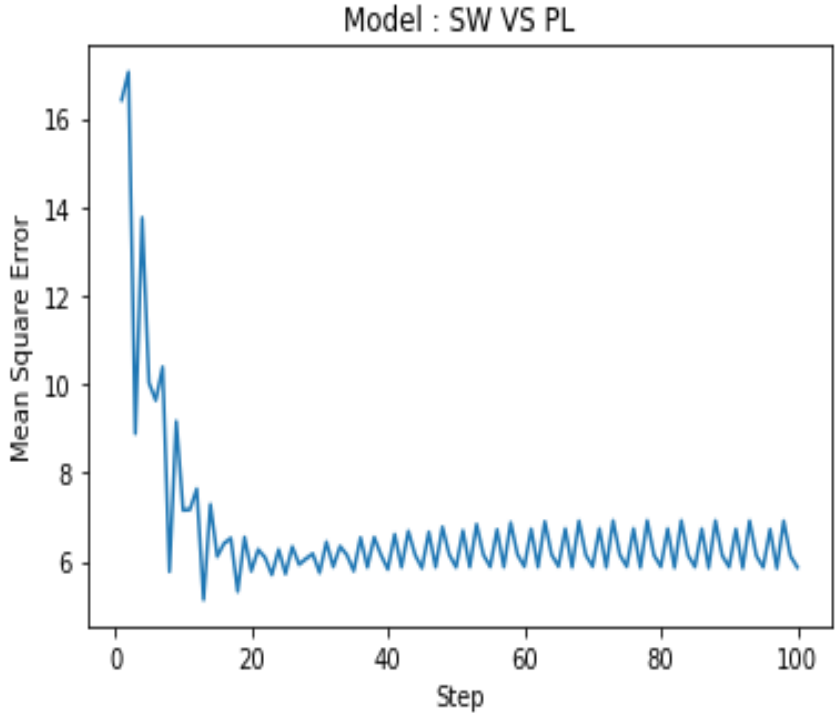
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 3 is represented as below:



Model 4: Using Sepal Width as input feature to predict Petal Length

Learning rate=0.01

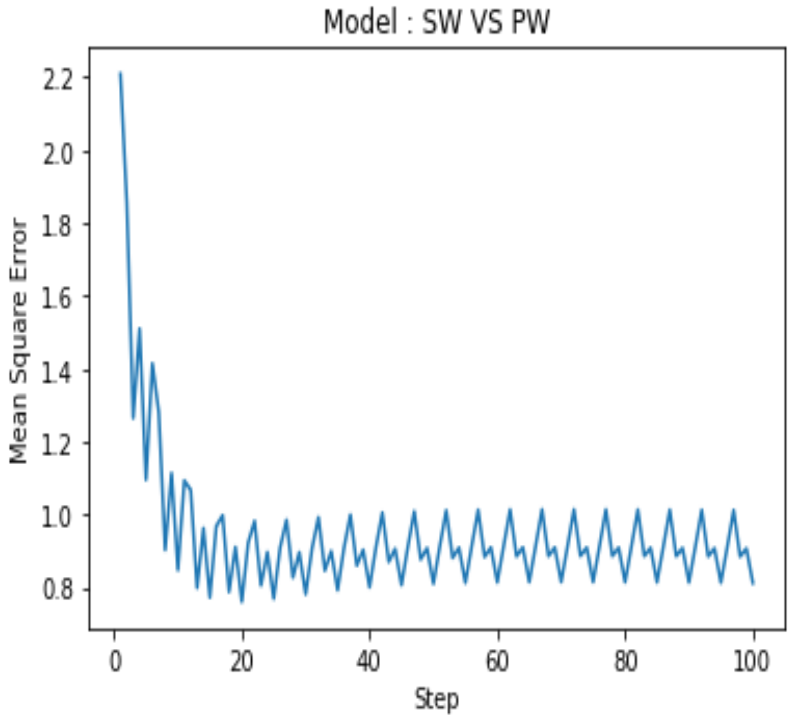
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 4 is represented as below:



Model 5: Using Sepal Width as input feature to predict Petal Width

Learning rate=0.01

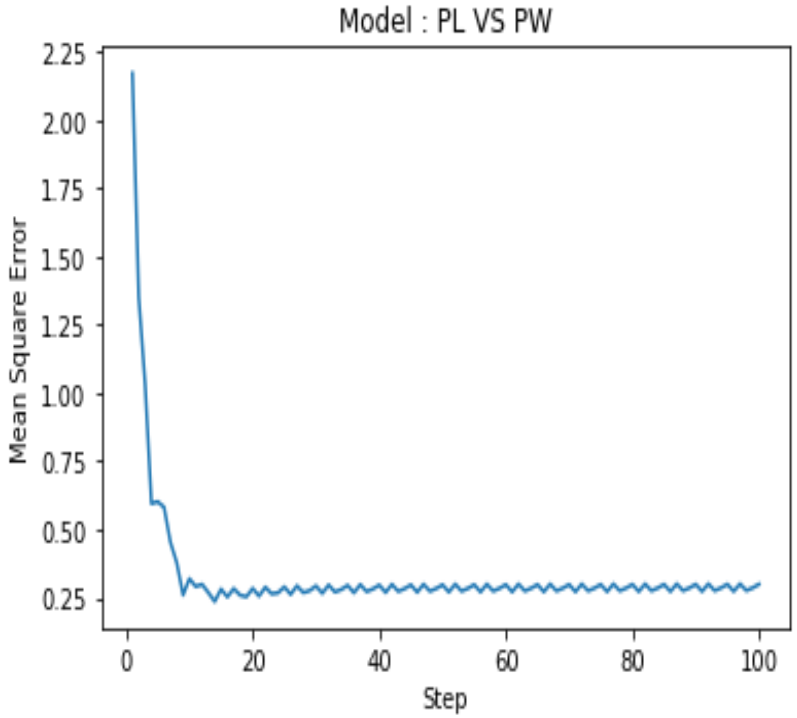
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 5 is represented as below:



Model 6: Using Petal Length as input feature to predict Petal Width

Learning rate=0.01

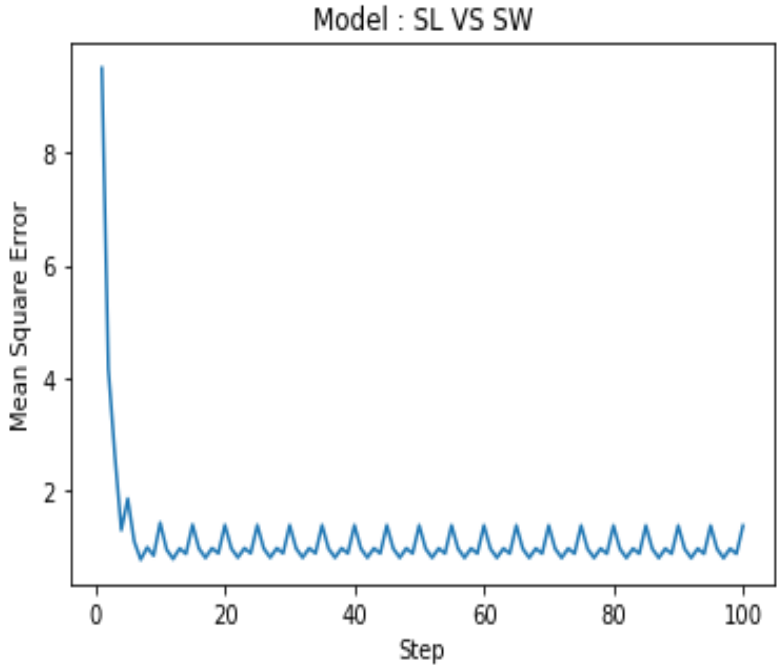
Loss plot represents how it is calculated over each step and it shows how the loss decreases over the time for the batch. Loss plot for Model 6 is represented as below:



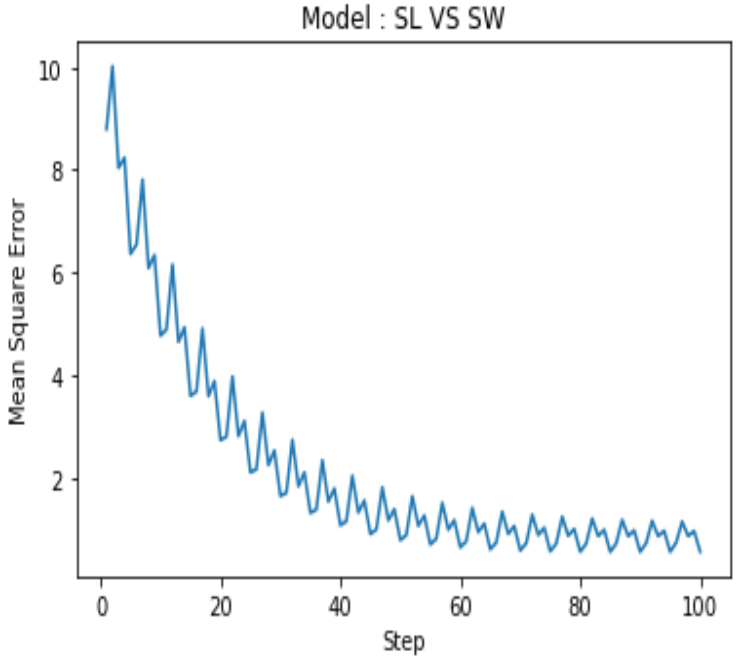
Let us consider the feature combination of Model 1: Sepal length vs Sepal Width.

Loss plots below represents how it varies over the various learning rates.

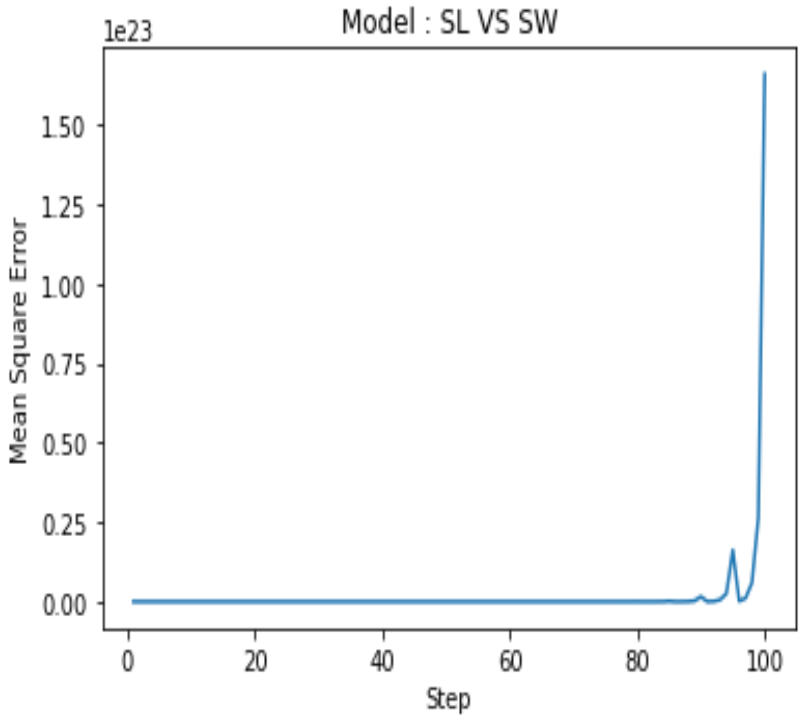
Learning Rate=0.01



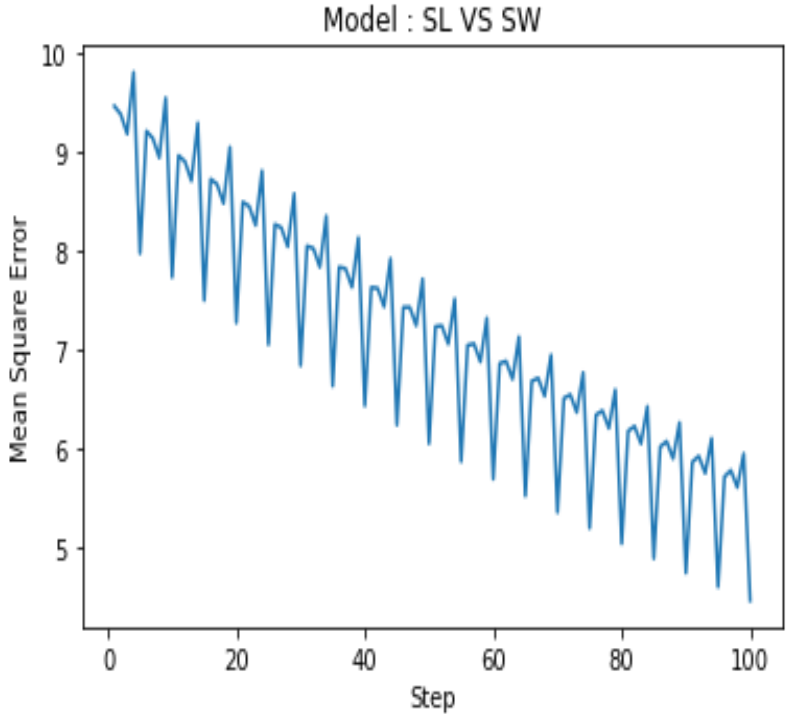
Learning Rate=0.001



Learning Rate=0.01



Learning Rate=0.0001



Result Obtained: Model 1 with Learning rate 0.001 has converged the quickest when compared with other learning rates.

3.2 Testing

Model	Error
Model 1(SL vs SW)	4.129333333333332
Model 2(SL vs PL)	11.806000000000001
Model 3(SL vs PW)	0.5400000000000001
Model 4(SW vs PL)	11.594666666666667
Model 5(SW vs PW)	0.6573333333333334
Model 6(PL vs PW)	0.7033333333333333

Conclusions based on the test dataset

Model 3(Sepal Length as input feature to petal width) is more accurate as it has the lowest error. By this, we can say that sepal length is good predictor for petal width.
Through Accuracy score, we can say that sepal length is a good predictor to petal length. This model is more accurate.