**REPORT**

**Part-2: Iris Flower Dataset:**

The following images have been generated from training the iris flower dataset with respect to different combinations with hyperparameters as

1. learning\_rate = 0.005
2. batch\_size=32,
3. regularization=0,
4. max\_epochs=100,
5. patience=3

**Chart, scatter chart

Description automatically generated**

**Chart

Description automatically generated**

**Chart, scatter chart

Description automatically generated**

**Chart, scatter chart

Description automatically generated**

**The output generated at terminal is given below:**

(base) raviailani@Ravis-MacBook-Air ml-assignment1 % /usr/local/bin/python3 /Users/raviailani/Documents/ml-assignment1/Iris\_Model.py

Combination-1 : Predicting the petal width given petal length and sepal width

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Running epoch: 11 / 100

Running epoch: 12 / 100

Running epoch: 13 / 100

Running epoch: 14 / 100

Running epoch: 15 / 100

Running epoch: 16 / 100

Running epoch: 17 / 100

Running epoch: 18 / 100

Running epoch: 19 / 100

Running epoch: 20 / 100

Running epoch: 21 / 100

Running epoch: 22 / 100

Running epoch: 23 / 100

Running epoch: 24 / 100

Running epoch: 25 / 100

Running epoch: 26 / 100

Running epoch: 27 / 100

Running epoch: 28 / 100

Running epoch: 29 / 100

Running epoch: 30 / 100

Running epoch: 31 / 100

Running epoch: 32 / 100

Running epoch: 33 / 100

Running epoch: 34 / 100

Running epoch: 35 / 100

Running epoch: 36 / 100

Running epoch: 37 / 100

Running epoch: 38 / 100

Running epoch: 39 / 100

Running epoch: 40 / 100

Running epoch: 41 / 100

Running epoch: 42 / 100

Running epoch: 43 / 100

Running epoch: 44 / 100

Running epoch: 45 / 100

Running epoch: 46 / 100

Running epoch: 47 / 100

Running epoch: 48 / 100

Running epoch: 49 / 100

Running epoch: 50 / 100

Running epoch: 51 / 100

Running epoch: 52 / 100

Running epoch: 53 / 100

Running epoch: 54 / 100

Running epoch: 55 / 100

Running epoch: 56 / 100

Running epoch: 57 / 100

Running epoch: 58 / 100

Running epoch: 59 / 100

Running epoch: 60 / 100

Running epoch: 61 / 100

Running epoch: 62 / 100

Running epoch: 63 / 100

Running epoch: 64 / 100

Running epoch: 65 / 100

Running epoch: 66 / 100

Running epoch: 67 / 100

Running epoch: 68 / 100

Running epoch: 69 / 100

Running epoch: 70 / 100

Running epoch: 71 / 100

Running epoch: 72 / 100

Running epoch: 73 / 100

Running epoch: 74 / 100

Running epoch: 75 / 100

Running epoch: 76 / 100

Running epoch: 77 / 100

Running epoch: 78 / 100

Running epoch: 79 / 100

Running epoch: 80 / 100

Running epoch: 81 / 100

Running epoch: 82 / 100

Running epoch: 83 / 100

Running epoch: 84 / 100

Running epoch: 85 / 100

Running epoch: 86 / 100

Running epoch: 87 / 100

Running epoch: 88 / 100

Running epoch: 89 / 100

Running epoch: 90 / 100

Running epoch: 91 / 100

Running epoch: 92 / 100

Running epoch: 93 / 100

Running epoch: 94 / 100

Running epoch: 95 / 100

Running epoch: 96 / 100

Running epoch: 97 / 100

Running epoch: 98 / 100

Running epoch: 99 / 100

Running epoch: 100 / 100

Weights and Bias: [0.07478836 0.24165554 0.03045577]

Score: Final validation Loss: 0.3735619742446773

Target: 2.5 - Predicted: 1.6546939360028603

Target: 2.0 - Predicted: 1.511429658416494

Target: 2.4 - Predicted: 1.6155707101160628

Target: 1.8 - Predicted: 1.4872641044861592

Target: 1.8 - Predicted: 1.414767442695156

Target: 2.3 - Predicted: 1.6955462078852979

Target: 1.9 - Predicted: 1.4648275965514648

Target: 1.9 - Predicted: 1.4257043706646675

Target: 2.3 - Predicted: 1.511429658416494

Target: 2.3 - Predicted: 1.5896761101900887

Target: 2.3 - Predicted: 1.7289196437895034

Target: 2.3 - Predicted: 1.4947429404643908

Target: 2.4 - Predicted: 1.6380072180507572

Target: 1.8 - Predicted: 1.5914051561857285

Target: 2.1 - Predicted: 1.5672396022553943

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Combination-2 : Predicting the petal width given petal length:

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Running epoch: 11 / 100

Running epoch: 12 / 100

Running epoch: 13 / 100

Running epoch: 14 / 100

Running epoch: 15 / 100

Running epoch: 16 / 100

Running epoch: 17 / 100

Running epoch: 18 / 100

Running epoch: 19 / 100

Running epoch: 20 / 100

Running epoch: 21 / 100

Running epoch: 22 / 100

Running epoch: 23 / 100

Running epoch: 24 / 100

Running epoch: 25 / 100

Running epoch: 26 / 100

Running epoch: 27 / 100

Weights and Bias: [0.31252668 0.035202 ]

Score: Final validation Loss: 0.2162850733576405

Target: 2.5 - Predicted: 1.8166040933401921

Target: 2.0 - Predicted: 1.6603407518481137

Target: 2.4 - Predicted: 1.7853514250417764

Target: 1.8 - Predicted: 1.6290880835496977

Target: 1.8 - Predicted: 1.5353300786544506

Target: 2.3 - Predicted: 1.8791094299370237

Target: 1.9 - Predicted: 1.6290880835496977

Target: 1.9 - Predicted: 1.5978354152512821

Target: 2.3 - Predicted: 1.6603407518481137

Target: 2.3 - Predicted: 1.722846088444945

Target: 2.3 - Predicted: 1.941614766533855

Target: 2.3 - Predicted: 1.6290880835496977

Target: 2.4 - Predicted: 1.7853514250417764

Target: 1.8 - Predicted: 1.7540987567433608

Target: 2.1 - Predicted: 1.722846088444945

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Combination-3 : Predicting the petal width given petal length, sepal length and sepal width:

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Running epoch: 11 / 100

Running epoch: 12 / 100

Running epoch: 13 / 100

Running epoch: 14 / 100

Running epoch: 15 / 100

Running epoch: 16 / 100

Running epoch: 17 / 100

Running epoch: 18 / 100

Running epoch: 19 / 100

Running epoch: 20 / 100

Running epoch: 21 / 100

Running epoch: 22 / 100

Running epoch: 23 / 100

Running epoch: 24 / 100

Running epoch: 25 / 100

Running epoch: 26 / 100

Running epoch: 27 / 100

Running epoch: 28 / 100

Running epoch: 29 / 100

Running epoch: 30 / 100

Running epoch: 31 / 100

Running epoch: 32 / 100

Running epoch: 33 / 100

Weights and Bias: [ 0.05663171 -0.0660929 0.28284874 -0.00946392]

Score: Final validation Loss: 0.2503277000848165

Target: 2.5 - Predicted: 1.7640998097870741

Target: 2.0 - Predicted: 1.6311769667751421

Target: 2.4 - Predicted: 1.7490335153559453

Target: 1.8 - Predicted: 1.5689130651607812

Target: 1.8 - Predicted: 1.4897216146027226

Target: 2.3 - Predicted: 1.8329420187131835

Target: 1.9 - Predicted: 1.5830777631540378

Target: 1.9 - Predicted: 1.596327325113705

Target: 2.3 - Predicted: 1.6425033093314603

Target: 2.3 - Predicted: 1.644320041802922

Target: 2.3 - Predicted: 1.9536988876217047

Target: 2.3 - Predicted: 1.618935488185234

Target: 2.4 - Predicted: 1.706552960971893

Target: 1.8 - Predicted: 1.703759127576062

Target: 2.1 - Predicted: 1.7037901100214519

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Combination-4: Predicting the sepal width given sepal length

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Weights and Bias: [0.39893595 0.07165142]

Score: Final validation Loss: 0.22007893437274745

Target: 3.3 - Predicted: 2.7445222641734492

Target: 3.0 - Predicted: 2.664735074707591

Target: 3.1 - Predicted: 2.7445222641734492

Target: 3.0 - Predicted: 2.4253735063100157

Target: 3.0 - Predicted: 2.465267101042945

Target: 3.2 - Predicted: 2.7844158589063785

Target: 2.7 - Predicted: 2.3854799115770864

Target: 2.5 - Predicted: 2.5849478852417325

Target: 3.0 - Predicted: 2.7445222641734492

Target: 3.4 - Predicted: 2.545054290508803

Target: 3.0 - Predicted: 3.143458211502742

Target: 3.1 - Predicted: 2.824309453639308

Target: 3.4 - Predicted: 2.5849478852417325

Target: 3.1 - Predicted: 2.6248414799746618

Target: 3.1 - Predicted: 2.824309453639308

Plots saved

Goodbye!

**After adding regularization, the changed parameters are:**

1. learning\_rate = 0.005
2. batch\_size=32,
3. regularization=0.60,
4. max\_epochs=100,
5. patience=3

**Chart, scatter chart

Description automatically generated**

**Chart

Description automatically generated**

**Chart, scatter chart

Description automatically generated**

**Chart, scatter chart

Description automatically generated**

**The terminal output for the program has been recorded as:**

(base) raviailani@Ravis-MacBook-Air ml-assignment1 % /usr/local/bin/python3 /Users/raviailani/Documents/ml-assignment1/Iris\_Model.py

Combination-1 : Predicting the petal width given petal length and sepal width

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Running epoch: 11 / 100

Running epoch: 12 / 100

Running epoch: 13 / 100

Running epoch: 14 / 100

Running epoch: 15 / 100

Running epoch: 16 / 100

Running epoch: 17 / 100

Running epoch: 18 / 100

Running epoch: 19 / 100

Running epoch: 20 / 100

Running epoch: 21 / 100

Running epoch: 22 / 100

Running epoch: 23 / 100

Running epoch: 24 / 100

Running epoch: 25 / 100

Running epoch: 26 / 100

Running epoch: 27 / 100

Running epoch: 28 / 100

Running epoch: 29 / 100

Running epoch: 30 / 100

Running epoch: 31 / 100

Running epoch: 32 / 100

Running epoch: 33 / 100

Running epoch: 34 / 100

Running epoch: 35 / 100

Running epoch: 36 / 100

Running epoch: 37 / 100

Running epoch: 38 / 100

Running epoch: 39 / 100

Running epoch: 40 / 100

Running epoch: 41 / 100

Running epoch: 42 / 100

Running epoch: 43 / 100

Running epoch: 44 / 100

Running epoch: 45 / 100

Running epoch: 46 / 100

Running epoch: 47 / 100

Running epoch: 48 / 100

Running epoch: 49 / 100

Running epoch: 50 / 100

Running epoch: 51 / 100

Running epoch: 52 / 100

Running epoch: 53 / 100

Running epoch: 54 / 100

Running epoch: 55 / 100

Running epoch: 56 / 100

Running epoch: 57 / 100

Running epoch: 58 / 100

Running epoch: 59 / 100

Running epoch: 60 / 100

Running epoch: 61 / 100

Running epoch: 62 / 100

Running epoch: 63 / 100

Running epoch: 64 / 100

Running epoch: 65 / 100

Running epoch: 66 / 100

Running epoch: 67 / 100

Running epoch: 68 / 100

Running epoch: 69 / 100

Running epoch: 70 / 100

Running epoch: 71 / 100

Running epoch: 72 / 100

Running epoch: 73 / 100

Running epoch: 74 / 100

Running epoch: 75 / 100

Running epoch: 76 / 100

Running epoch: 77 / 100

Running epoch: 78 / 100

Running epoch: 79 / 100

Running epoch: 80 / 100

Running epoch: 81 / 100

Running epoch: 82 / 100

Running epoch: 83 / 100

Running epoch: 84 / 100

Running epoch: 85 / 100

Running epoch: 86 / 100

Running epoch: 87 / 100

Running epoch: 88 / 100

Running epoch: 89 / 100

Running epoch: 90 / 100

Running epoch: 91 / 100

Running epoch: 92 / 100

Running epoch: 93 / 100

Running epoch: 94 / 100

Running epoch: 95 / 100

Running epoch: 96 / 100

Running epoch: 97 / 100

Running epoch: 98 / 100

Running epoch: 99 / 100

Running epoch: 100 / 100

Weights and Bias: [0.07506664 0.23410912 0.03024506]

Score: Final validation Loss: 0.42187262349218574

Target: 1.8 - Predicted: 1.4494015191953518

Target: 2.3 - Predicted: 1.549660913435591

Target: 2.4 - Predicted: 1.5739627455226435

Target: 2.5 - Predicted: 1.6123869864348535

Target: 2.1 - Predicted: 1.5271409206910052

Target: 1.8 - Predicted: 1.3791687819478942

Target: 2.3 - Predicted: 1.4728124316111713

Target: 1.9 - Predicted: 1.426881526450766

Target: 1.9 - Predicted: 1.3884572855385562

Target: 2.3 - Predicted: 1.4569081834435471

Target: 2.0 - Predicted: 1.4728124316111713

Target: 2.3 - Predicted: 1.6835106433535445

Target: 1.8 - Predicted: 1.5505518331068242

Target: 2.3 - Predicted: 1.6517021470182967

Target: 2.4 - Predicted: 1.5964827382672293

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Combination-2 : Predicting the petal width given petal length:

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Running epoch: 11 / 100

Running epoch: 12 / 100

Running epoch: 13 / 100

Running epoch: 14 / 100

Running epoch: 15 / 100

Running epoch: 16 / 100

Running epoch: 17 / 100

Running epoch: 18 / 100

Running epoch: 19 / 100

Running epoch: 20 / 100

Running epoch: 21 / 100

Running epoch: 22 / 100

Running epoch: 23 / 100

Running epoch: 24 / 100

Running epoch: 25 / 100

Running epoch: 26 / 100

Weights and Bias: [0.2993247 0.03830393]

Score: Final validation Loss: 0.27885153137498564

Target: 1.8 - Predicted: 1.5648599117013149

Target: 2.3 - Predicted: 1.6546573223660688

Target: 2.4 - Predicted: 1.7145222628092378

Target: 2.5 - Predicted: 1.7444547330308227

Target: 2.1 - Predicted: 1.6546573223660688

Target: 1.8 - Predicted: 1.4750625010365612

Target: 2.3 - Predicted: 1.5947923819228995

Target: 1.9 - Predicted: 1.5648599117013149

Target: 1.9 - Predicted: 1.5349274414797303

Target: 2.3 - Predicted: 1.5648599117013149

Target: 2.0 - Predicted: 1.5947923819228995

Target: 2.3 - Predicted: 1.8641846139171607

Target: 1.8 - Predicted: 1.6845897925876534

Target: 2.3 - Predicted: 1.804319673473992

Target: 2.4 - Predicted: 1.7145222628092378

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Combination-3 : Predicting the petal width given petal length, sepal length and sepal width:

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Running epoch: 11 / 100

Running epoch: 12 / 100

Running epoch: 13 / 100

Running epoch: 14 / 100

Running epoch: 15 / 100

Running epoch: 16 / 100

Running epoch: 17 / 100

Running epoch: 18 / 100

Running epoch: 19 / 100

Running epoch: 20 / 100

Running epoch: 21 / 100

Running epoch: 22 / 100

Running epoch: 23 / 100

Running epoch: 24 / 100

Running epoch: 25 / 100

Running epoch: 26 / 100

Running epoch: 27 / 100

Running epoch: 28 / 100

Running epoch: 29 / 100

Running epoch: 30 / 100

Running epoch: 31 / 100

Running epoch: 32 / 100

Running epoch: 33 / 100

Running epoch: 34 / 100

Running epoch: 35 / 100

Running epoch: 36 / 100

Weights and Bias: [ 0.06003676 -0.05492336 0.26151574 -0.00693185]

Score: Final validation Loss: 0.3049011326540209

Target: 1.8 - Predicted: 1.5162452258722405

Target: 2.3 - Predicted: 1.5907416328283557

Target: 2.4 - Predicted: 1.6895401675178403

Target: 2.5 - Predicted: 1.704707070018578

Target: 2.1 - Predicted: 1.6492443721913213

Target: 1.8 - Predicted: 1.4437941807367718

Target: 2.3 - Predicted: 1.5904262081911054

Target: 1.9 - Predicted: 1.526718556652446

Target: 1.9 - Predicted: 1.5415700345159338

Target: 2.3 - Predicted: 1.5707896509830073

Target: 2.0 - Predicted: 1.5784188560454153

Target: 2.3 - Predicted: 1.885827132544497

Target: 1.8 - Predicted: 1.6453775655632008

Target: 2.3 - Predicted: 1.7685062291813158

Target: 2.4 - Predicted: 1.6490484563734098

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Combination-4: Predicting the sepal width given sepal length

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Weights and Bias: [0.45330917 0.08237896]

Score: Final validation Loss: 0.07840654194650526

Target: 3.0 - Predicted: 2.7569030772469114

Target: 3.4 - Predicted: 2.89289582887432

Target: 3.1 - Predicted: 3.1195504149200017

Target: 3.3 - Predicted: 3.1195504149200017

Target: 3.1 - Predicted: 3.2102122493382743

Target: 3.0 - Predicted: 2.8022339944560475

Target: 3.0 - Predicted: 3.1195504149200017

Target: 2.7 - Predicted: 2.711572160037775

Target: 2.5 - Predicted: 2.938226746083456

Target: 3.1 - Predicted: 3.2102122493382743

Target: 3.0 - Predicted: 3.028888580501729

Target: 3.0 - Predicted: 3.572859587011365

Target: 3.1 - Predicted: 2.983557663292593

Target: 3.2 - Predicted: 3.164881332129138

Target: 3.4 - Predicted: 2.938226746083456

Plots saved

Goodbye!

(base) raviailani@Ravis-MacBook-Air ml-assignment1 % /usr/local/bin/python3 /Users/raviailani/Documents/ml-assignment1/Iris\_Model.py

Combination-1 : Predicting the petal width given petal length and sepal width

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Running epoch: 11 / 100

Running epoch: 12 / 100

Running epoch: 13 / 100

Running epoch: 14 / 100

Running epoch: 15 / 100

Running epoch: 16 / 100

Running epoch: 17 / 100

Running epoch: 18 / 100

Running epoch: 19 / 100

Running epoch: 20 / 100

Running epoch: 21 / 100

Running epoch: 22 / 100

Running epoch: 23 / 100

Running epoch: 24 / 100

Running epoch: 25 / 100

Running epoch: 26 / 100

Running epoch: 27 / 100

Running epoch: 28 / 100

Running epoch: 29 / 100

Running epoch: 30 / 100

Running epoch: 31 / 100

Running epoch: 32 / 100

Running epoch: 33 / 100

Running epoch: 34 / 100

Running epoch: 35 / 100

Running epoch: 36 / 100

Running epoch: 37 / 100

Running epoch: 38 / 100

Running epoch: 39 / 100

Running epoch: 40 / 100

Running epoch: 41 / 100

Running epoch: 42 / 100

Running epoch: 43 / 100

Running epoch: 44 / 100

Running epoch: 45 / 100

Running epoch: 46 / 100

Running epoch: 47 / 100

Running epoch: 48 / 100

Running epoch: 49 / 100

Running epoch: 50 / 100

Running epoch: 51 / 100

Running epoch: 52 / 100

Running epoch: 53 / 100

Running epoch: 54 / 100

Running epoch: 55 / 100

Running epoch: 56 / 100

Running epoch: 57 / 100

Running epoch: 58 / 100

Running epoch: 59 / 100

Running epoch: 60 / 100

Running epoch: 61 / 100

Running epoch: 62 / 100

Running epoch: 63 / 100

Running epoch: 64 / 100

Running epoch: 65 / 100

Running epoch: 66 / 100

Running epoch: 67 / 100

Running epoch: 68 / 100

Running epoch: 69 / 100

Running epoch: 70 / 100

Running epoch: 71 / 100

Running epoch: 72 / 100

Running epoch: 73 / 100

Running epoch: 74 / 100

Running epoch: 75 / 100

Running epoch: 76 / 100

Running epoch: 77 / 100

Running epoch: 78 / 100

Running epoch: 79 / 100

Running epoch: 80 / 100

Running epoch: 81 / 100

Running epoch: 82 / 100

Running epoch: 83 / 100

Running epoch: 84 / 100

Running epoch: 85 / 100

Running epoch: 86 / 100

Running epoch: 87 / 100

Running epoch: 88 / 100

Running epoch: 89 / 100

Running epoch: 90 / 100

Running epoch: 91 / 100

Running epoch: 92 / 100

Running epoch: 93 / 100

Running epoch: 94 / 100

Running epoch: 95 / 100

Running epoch: 96 / 100

Running epoch: 97 / 100

Running epoch: 98 / 100

Running epoch: 99 / 100

Running epoch: 100 / 100

Weights and Bias: [0.0751033 0.23411572 0.03024369]

Score: Final validation Loss: 0.4216892627624432

Target: 1.9 - Predicted: 1.3885805530061037

Target: 1.9 - Predicted: 1.4270127849135492

Target: 2.1 - Predicted: 1.5272888210367874

Target: 2.5 - Predicted: 1.6125441975609276

Target: 2.3 - Predicted: 1.6836594973956702

Target: 2.3 - Predicted: 1.5498198104354344

Target: 1.8 - Predicted: 1.3793090573871538

Target: 2.0 - Predicted: 1.4729553466205436

Target: 1.8 - Predicted: 1.5507003933451349

Target: 2.4 - Predicted: 1.574111965653482

Target: 2.3 - Predicted: 1.457054104111745

Target: 2.3 - Predicted: 1.4729553466205436

Target: 2.3 - Predicted: 1.6518570123780736

Target: 2.4 - Predicted: 1.596642955052129

Target: 1.8 - Predicted: 1.4495437743121962

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Combination-2 : Predicting the petal width given petal length:

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Running epoch: 11 / 100

Running epoch: 12 / 100

Running epoch: 13 / 100

Running epoch: 14 / 100

Running epoch: 15 / 100

Running epoch: 16 / 100

Running epoch: 17 / 100

Running epoch: 18 / 100

Running epoch: 19 / 100

Running epoch: 20 / 100

Running epoch: 21 / 100

Running epoch: 22 / 100

Running epoch: 23 / 100

Running epoch: 24 / 100

Running epoch: 25 / 100

Running epoch: 26 / 100

Weights and Bias: [0.2997148 0.03843666]

Score: Final validation Loss: 0.27665035107856106

Target: 1.9 - Predicted: 1.5370106595317474

Target: 1.9 - Predicted: 1.5669821395558399

Target: 2.1 - Predicted: 1.6568965796281179

Target: 2.5 - Predicted: 1.7468110197003954

Target: 2.3 - Predicted: 1.8666969397967654

Target: 2.3 - Predicted: 1.6568965796281179

Target: 1.8 - Predicted: 1.4770676994835623

Target: 2.0 - Predicted: 1.5969536195799328

Target: 1.8 - Predicted: 1.6868680596522103

Target: 2.4 - Predicted: 1.7168395396763028

Target: 2.3 - Predicted: 1.5669821395558399

Target: 2.3 - Predicted: 1.5969536195799328

Target: 2.3 - Predicted: 1.8067539797485805

Target: 2.4 - Predicted: 1.7168395396763028

Target: 1.8 - Predicted: 1.5669821395558399

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Combination-3 : Predicting the petal width given petal length, sepal length and sepal width:

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Weights and Bias: [0.0966611 0.01698135 0.14235166 0.01032339]

Score: Final validation Loss: 0.5021083416816673

Target: 1.9 - Predicted: 1.3734999908519794

Target: 1.9 - Predicted: 1.342800877880076

Target: 2.1 - Predicted: 1.4986261240014074

Target: 2.5 - Predicted: 1.5253956729083689

Target: 2.3 - Predicted: 1.6739030311755225

Target: 2.3 - Predicted: 1.4360577600880284

Target: 1.8 - Predicted: 1.324522003466196

Target: 2.0 - Predicted: 1.4297932174226078

Target: 1.8 - Predicted: 1.4645307412322712

Target: 2.4 - Predicted: 1.507764236873681

Target: 2.3 - Predicted: 1.455920625289042

Target: 2.3 - Predicted: 1.4491254370252442

Target: 2.3 - Predicted: 1.5618339802859809

Target: 2.4 - Predicted: 1.4741942023642567

Target: 1.8 - Predicted: 1.3575613923772432

##############################################################################

**Combination-4: Predicting the sepal width given sepal length**

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Weights and Bias: [0.45330883 0.08243663]

Score: Final validation Loss: 0.07840404685033864

Target: 2.5 - Predicted: 2.9382822833735784

Target: 2.7 - Predicted: 2.7116278667507383

Target: 3.1 - Predicted: 3.2102675833209866

Target: 3.3 - Predicted: 3.1196058166718506

Target: 3.0 - Predicted: 3.5729146499175304

Target: 3.4 - Predicted: 2.8929514000490104

Target: 3.0 - Predicted: 2.8022896333998744

Target: 3.0 - Predicted: 3.0289440500227145

Target: 3.1 - Predicted: 2.9836131666981465

Target: 3.1 - Predicted: 3.1196058166718506

Target: 3.1 - Predicted: 3.2102675833209866

Target: 3.0 - Predicted: 3.1196058166718506

Target: 3.2 - Predicted: 3.164936699996418

Target: 3.4 - Predicted: 2.9382822833735784

Target: 3.0 - Predicted: 2.7569587500753063

Plots saved

Goodbye!

**Thus, with regularization added, the most predictive model came out to be**

* Combination-4: **Predicting the sepal width given sepal length**
* With **Final validation Loss: 0.07840404685033864**

**Part-3: Traffic Data Dataset**

**Explanation of code:**

This code is implementing a linear regression model to predict the traffic flow at 36 spatial locations 15 minutes into the future. The code first loads the data in a .mat file using the scipy.io.loadmat function. The training and testing input data are loaded as sparse matrices, which are then converted to dense matrices and stored as numpy arrays.

Next, the code prepares the training and testing data for modeling by creating pandas dataframes with the training and testing inputs and targets. The location names are added as a column in both the training and testing dataframes, and the final training and testing inputs and targets are obtained by removing the location names and target columns.

Finally, a linear regression model is fit using the training inputs and targets, and the model's predictions are made on the testing inputs. The performance of the model is evaluated using the root mean squared error (RMSE) of the model's predictions on the testing targets. The code also plots the batch validation loss, which is a measure of the model's performance on the validation set after each iteration of training, as a scatter plot.

**Chart, histogram

Description automatically generated**

**Setting-1: The best setting came out**

* **with learning rate as 0.005**
* **Score method RMSE = 0.04650748762711367**

**The terminal output for the following program is being presented below:**

(base) raviailani@Ravis-MacBook-Air ml-assignment1 % /usr/local/bin/python3 /Users/raviailani/Documents/ml-assignment1/TrafficData.py

---------------- Prepairing training set -----------------

---------------- Prepairing testing set -----------------

---------------- Initiating model -----------------

Running epoch: 1 / 100

Running epoch: 2 / 100

Running epoch: 3 / 100

Running epoch: 4 / 100

Running epoch: 5 / 100

Running epoch: 6 / 100

Running epoch: 7 / 100

Running epoch: 8 / 100

Running epoch: 9 / 100

Running epoch: 10 / 100

Running epoch: 11 / 100

Running epoch: 12 / 100

Running epoch: 13 / 100

Running epoch: 14 / 100

Running epoch: 15 / 100

Running epoch: 16 / 100

Running epoch: 17 / 100

Running epoch: 18 / 100

Running epoch: 19 / 100

Running epoch: 20 / 100

Running epoch: 21 / 100

Running epoch: 22 / 100

Running epoch: 23 / 100

Running epoch: 24 / 100

Running epoch: 25 / 100

Running epoch: 26 / 100

Running epoch: 27 / 100

Running epoch: 28 / 100

Running epoch: 29 / 100

Running epoch: 30 / 100

Running epoch: 31 / 100

Running epoch: 32 / 100

Running epoch: 33 / 100

Running epoch: 34 / 100

Running epoch: 35 / 100

Running epoch: 36 / 100

Running epoch: 37 / 100

Running epoch: 38 / 100

Running epoch: 39 / 100

Running epoch: 40 / 100

Running epoch: 41 / 100

Running epoch: 42 / 100

Running epoch: 43 / 100

Running epoch: 44 / 100

Running epoch: 45 / 100

Running epoch: 46 / 100

Running epoch: 47 / 100

Running epoch: 48 / 100

Running epoch: 49 / 100

Running epoch: 50 / 100

Running epoch: 51 / 100

Running epoch: 52 / 100

Running epoch: 53 / 100

Running epoch: 54 / 100

Running epoch: 55 / 100

Running epoch: 56 / 100

Running epoch: 57 / 100

Running epoch: 58 / 100

Running epoch: 59 / 100

Running epoch: 60 / 100

Running epoch: 61 / 100

Running epoch: 62 / 100

Running epoch: 63 / 100

Running epoch: 64 / 100

Running epoch: 65 / 100

Running epoch: 66 / 100

Running epoch: 67 / 100

Running epoch: 68 / 100

Running epoch: 69 / 100

Running epoch: 70 / 100

Running epoch: 71 / 100

Running epoch: 72 / 100

Running epoch: 73 / 100

Running epoch: 74 / 100

Running epoch: 75 / 100

Running epoch: 76 / 100

Running epoch: 77 / 100

Running epoch: 78 / 100

Running epoch: 79 / 100

Running epoch: 80 / 100

Running epoch: 81 / 100

Running epoch: 82 / 100

Running epoch: 83 / 100

Running epoch: 84 / 100

Running epoch: 85 / 100

Running epoch: 86 / 100

Running epoch: 87 / 100

Running epoch: 88 / 100

Running epoch: 89 / 100

Running epoch: 90 / 100

Running epoch: 91 / 100

Running epoch: 92 / 100

Running epoch: 93 / 100

Running epoch: 94 / 100

Running epoch: 95 / 100

Running epoch: 96 / 100

Running epoch: 97 / 100

Running epoch: 98 / 100

Running epoch: 99 / 100

Running epoch: 100 / 100

Weights and Bias: [ 4.25898376e-03 -1.64734749e-02 -1.99546671e-02 -2.00252921e-02

-4.86481322e-02 -4.74083482e-02 2.86266863e-02 1.53660684e-01

3.02623319e-01 5.74369248e-01 -2.13893855e-03 6.50591203e-05

8.66175778e-04 1.91154107e-03 2.78158639e-03 -1.47286894e-02

2.33023377e-02 8.32504772e-02 2.38513241e-02 1.84177106e-02

7.24991677e-03 -4.02141110e-03 5.46768644e-04 1.17835662e-02

1.21258517e-02 1.86569159e-02 3.46937043e-02 7.17219928e-03

1.18915028e-02 8.70190216e-03 -5.40034686e-03 -1.89002210e-02

-3.30742468e-02 -1.60202745e-02 -2.35246271e-02 -4.49744621e-02

-4.47080991e-02 -3.14241798e-02 -2.13821957e-02 5.58719841e-03

-2.85482686e-04 5.35831798e-03 -6.90082238e-04 -8.97329245e-04

3.99155146e-03 3.91201596e-04 -3.68877837e-03 2.79144912e-03

3.48542381e-03]

Score: Final validation Loss: 0.0021629464053861307

**Score method RMSE= 0.04650748762711367**

**Setting-2:**

Learning\_rate= 0.0001

Regularization = 0

Output = Score method RMSE= 0.07477962889294897

**Setting-3:**

Learning\_rate= 0.0001

Regularization = 0.05

Output = Score method RMSE= 0.0840226919704098

**Setting-4:**

Learning\_rate= 0.01

Regularization = 0.5

Output = Score method RMSE= 0.13324944422208923