Project 2 Rubric

Due Date March 25

Although Neural Networks may be used without Feature Selection, it can still be useful to consider. An improvement over Forward Selection and Backward Elimination is Stepwise Regression. Start with no variables in the model and add one variable that improves the selection criterion the most.

Add the second-best variable for step two. After the second step determine whether it is better to add or remove a variable.

Continue in this fashion until no improvement in the selection criterion is found. For Forward Selection and Backward Elimination, it may be instructive to continue all the way to the end (all variables for forward/no variables for backward). Stepwise regression may lead to coincidental relationships being included in the model, particularly if a penalty-free QoF measure such as R^2 is used. Typically, this approach is used when there a penalty for having extra variables/parameters, e.g., R^2 adjusted R^2, R^2 cross-validation R^2_{cv} or Akaike Information Criterion (AIC). See the section on Maximum Likelihood Estimation for a definition of AIC. Alternatives to Stepwise Regression include Lasso Regression (L_1 regularization) and to a lesser extent Ridge Regression (L_2 regularization). Perform Forward Selection, Backward Elimination, and Stepwise Regression with all four criteria: R^2, R^2 *bar*, R^2_{cv}, and AIC. Plot the curve for each criterion, determine the best number of variables and what these variables are. Compare the four criteria. As part of a larger project compare this form of feature selection with that provided by Ridge Regression and Lasso Regression.

Use the following types of models: `TranRegression`, `Perceptron`, `NeuralNet3L`, and `NeuralNetXL` (4 layers). In addition to the `AutoMPG` dataset, use the `Concrete` dataset and three more datasets from UCI Machine Learning Repository. The UCI datasets should have more instances (m) and variables (n)than the first two datasets. The testing is to be done in ScalaTion and Keras.

- Feature Selection:
  - Forward Selection
  - Backward Elimination
  - Stepwise Regression
  - L_1 Regularization
  - L_2 Regularization

- Types of Models
    - Transform Regression
    - Perceptron
    - 3 Layer Neural Network
    - 4 Layer Neural Network

- Languages
    - ScalaTion
    - Python/Keras (https://keras.io/)

Point Allocation	Forward	Backward	Stepwise	L_1 Regularization	L_2 Regularization
Transform Regression **(scalation only)**	5	5	5	+1 (bonus)	+1 (bonus)
Perceptron	5	5	5	3 (only keras)	3 (only keras)
3 Layer NN	5	5	5	3 (only keras)	3 (only keras)
4 Layer NN	5	5	5	3 (only keras)	3 (only keras)

Readme → 3 points

Good Documentation → 3 points

Balanced Group Effort → 3 points

Report → 13 points

Report should refer to the plots, how feature selection refers to the quality of fit, identify the optimal number of parameters, discuss the differences between R – squared, Adjusted R- squared, cross validated R – squared and Akaike Information Criterion (AIC).