SUMMER INTERNSHIP

DEPARTMENT: MECHANICAL AND INDUSTRIAL ENGINEERING

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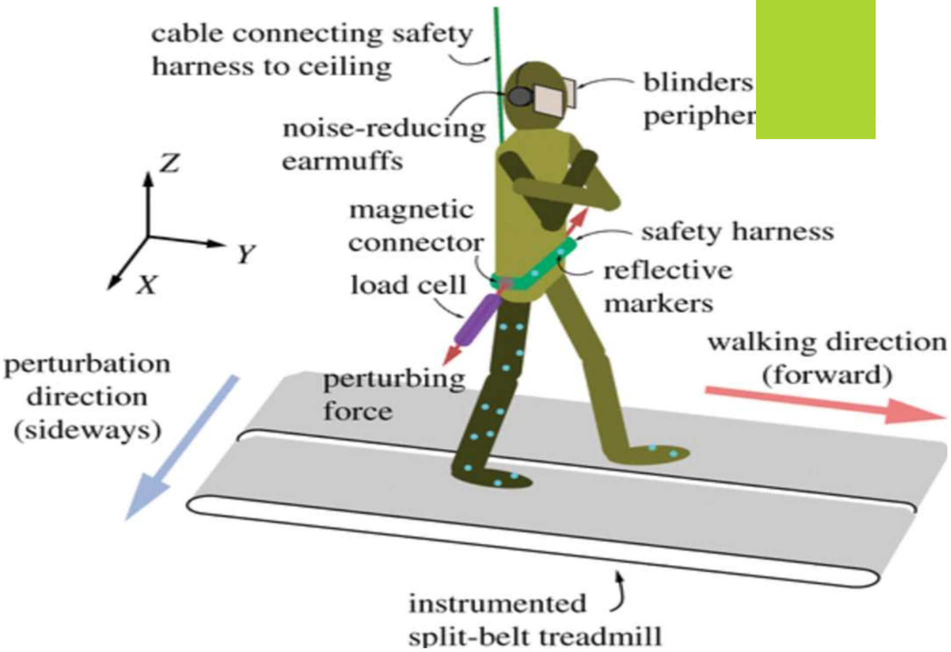
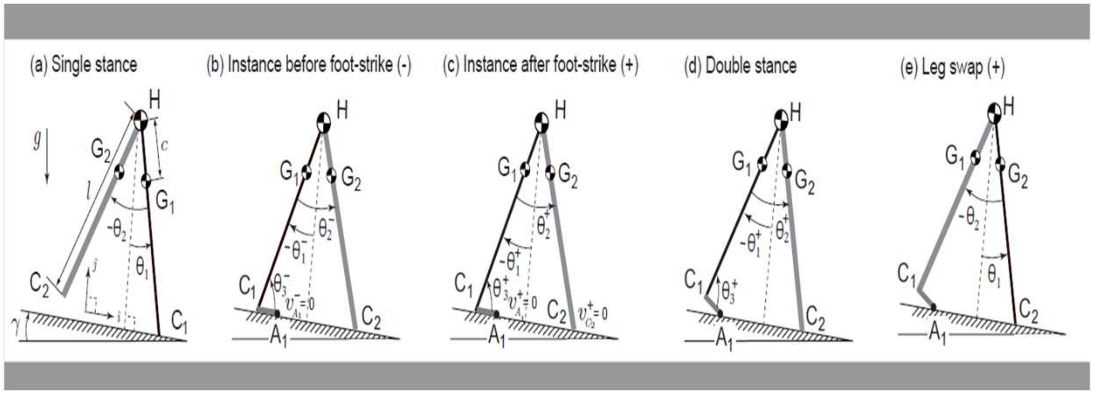
INTERN: NGUYEN HOA PHAM

Project description

- Title: Data mining human walking data
- Conducted research on experimental data collected by Ohio State University
- Fitted model of person to data to obtain joint torques
- Objectives: Identify how human balance based on relationship between joint torques and joint angles.


cable connecting safety harness to ceiling
blinders
peripher
noise-reducing earmuffs
Z
Y
X
magnetic connector
safety harness
load cell
reflective markers
walking direction (forward)
perturbation direction (sideways)
perturbing force
instrumented split-belt treadmill



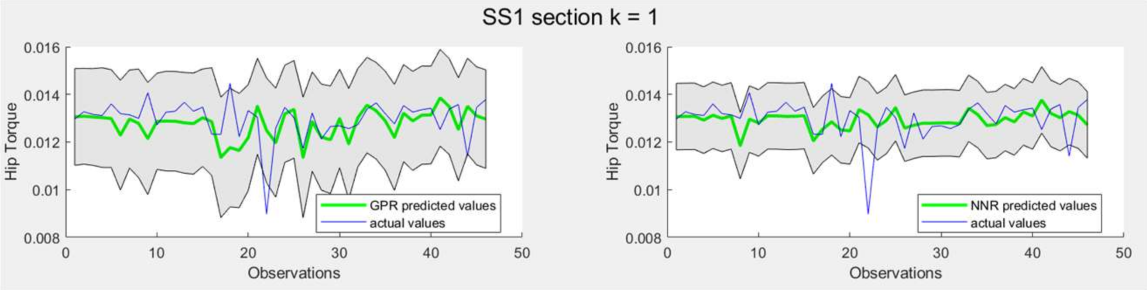
Responsibilities

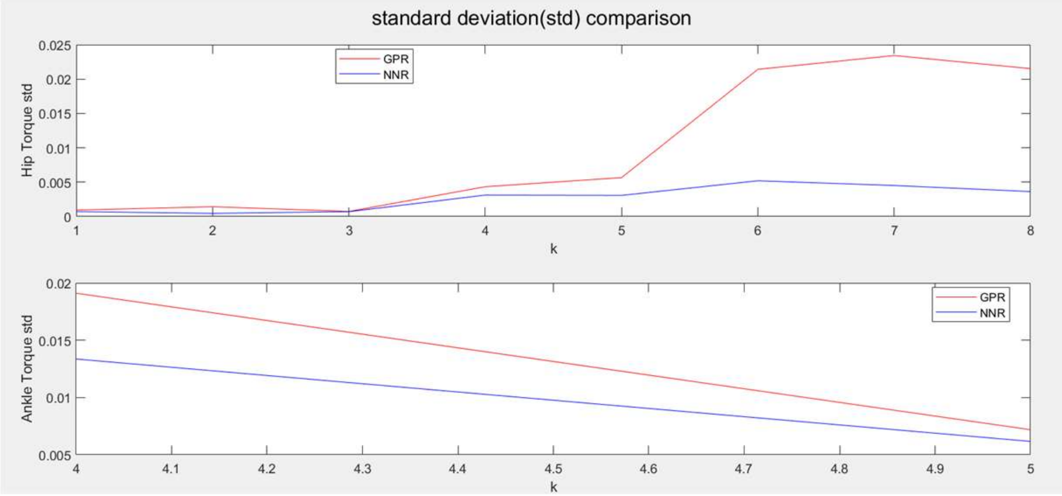
- Using data mining and regression techniques to figure out how human balance.

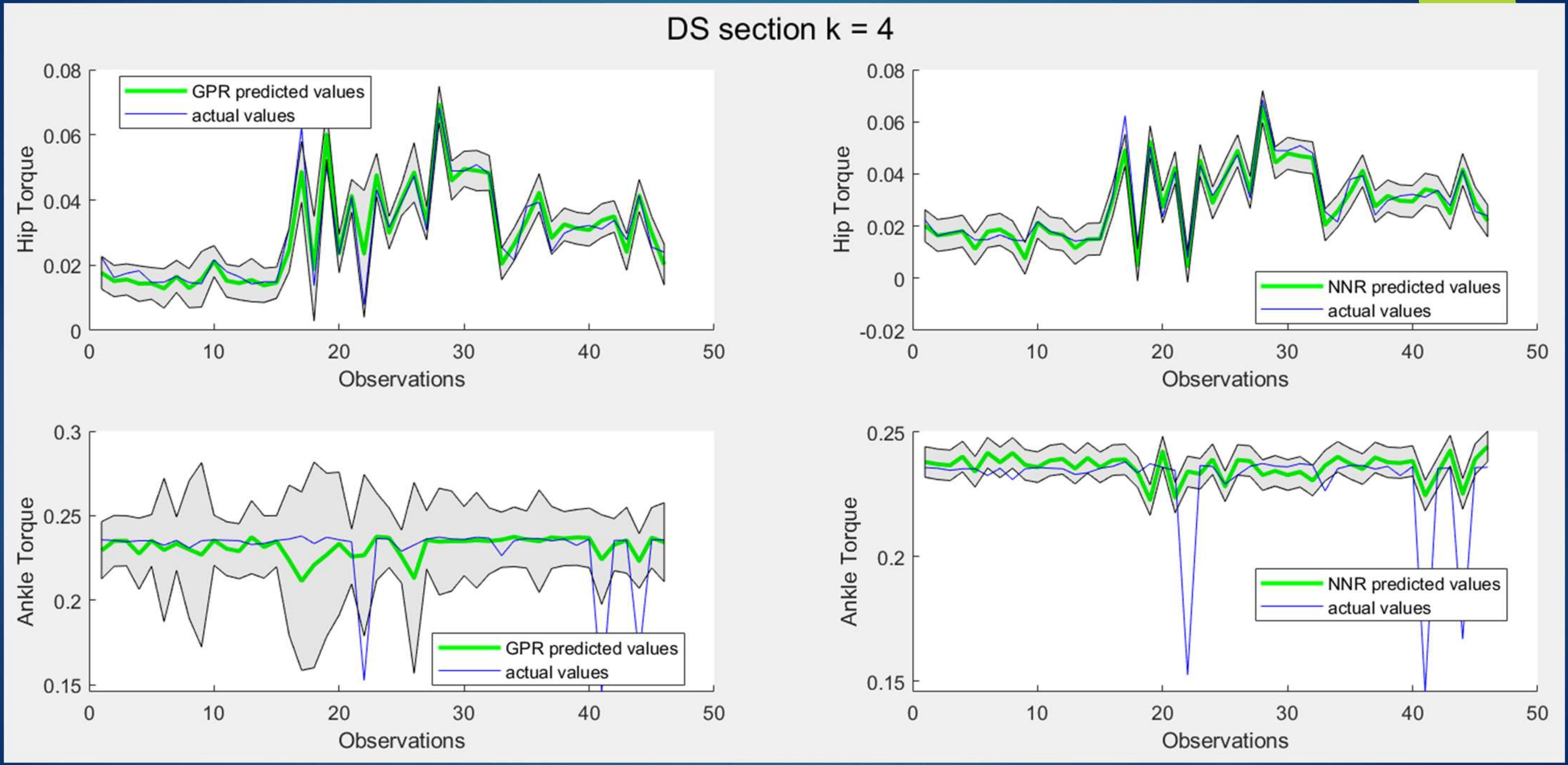
1. Learn regression tools in MatLab
2. Fit models to data
3. Visualize the fitting results using figures and plots
4. Optimize the model using feature selection methods.

Tools - regression

- Used functions in matlab to generate the regression models.
- Gaussian Process regression: fitrgp function
- Neural network regression: fitrnet function, fitnet function
- Objective: Fit a controller to predict the torques used in physical model.

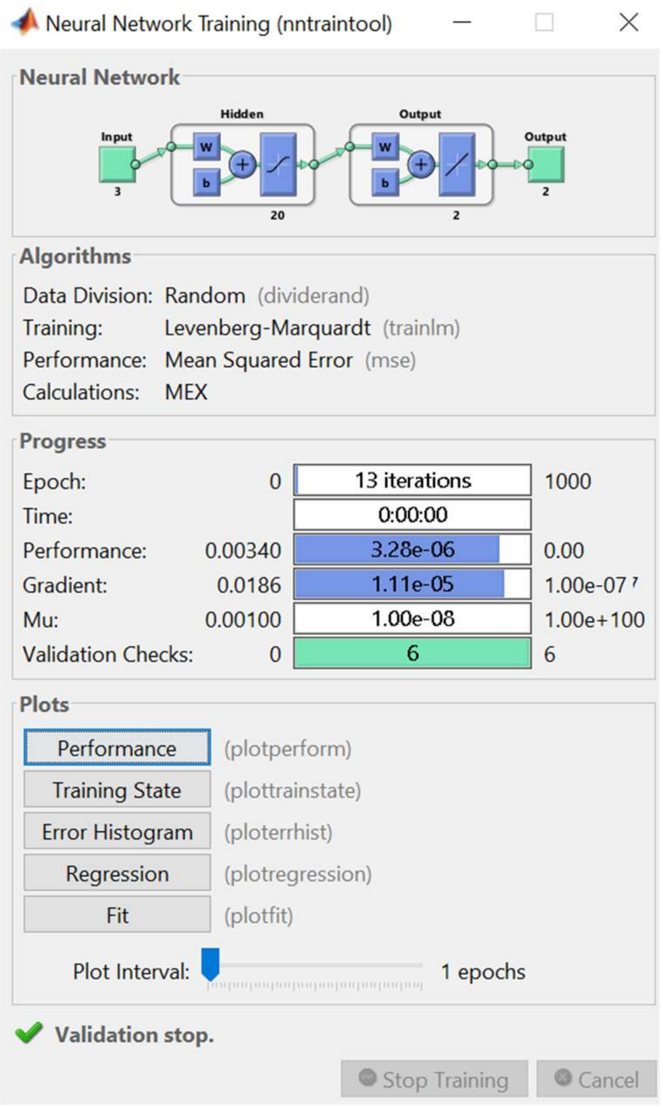





DS section k = 4

Neural network layer size experiment

- Objective: determine the hidden layer sizes that give the lowest mean squared error on predictions of fitnet function



Algorithms

Data Division: Random (dividerand)
Training: Levenberg-Marquardt (trainlm)
Performance: Mean Squared Error (mse)
Calculations: MEX

Progress

Epoch:	0	13 iterations	1000
Time:		0:00:00	
Performance:	0.00340	3.28e-06	0.00
Gradient:	0.0186	1.11e-05	1.00e-07
Mu:	0.00100	1.00e-08	1.00e+100
Validation Checks:	0	6	6

Plots

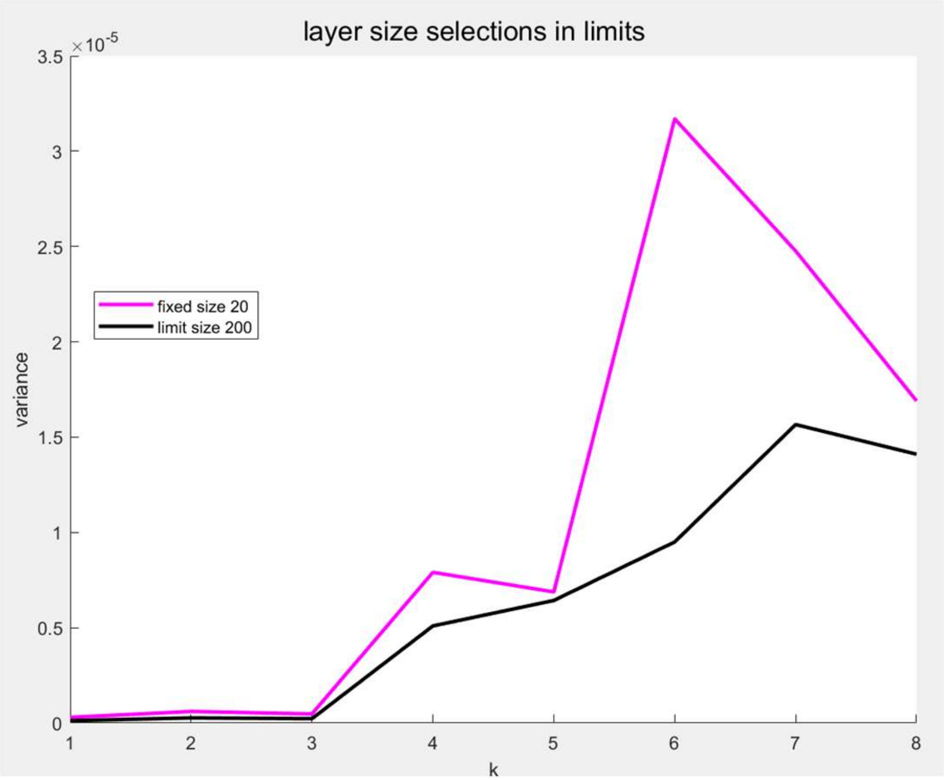
Performance (plotperform)
Training State (plottrainstate)
Error Histogram (ploterrhist)
Regression (plotregression)
Fit (plotfit)

Plot Interval: 1 epochs

✓ **Validation stop.**

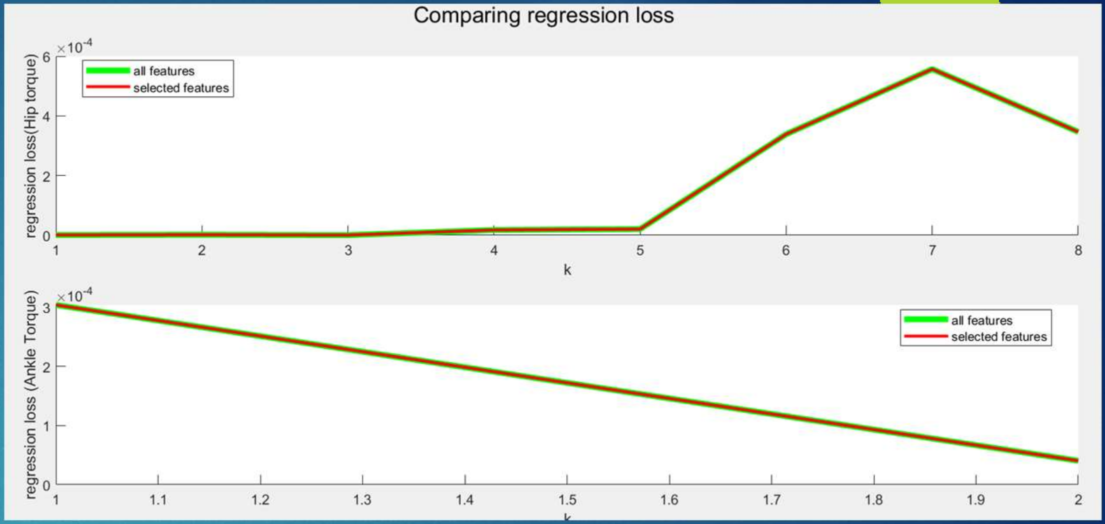
Neural network layer size experiment

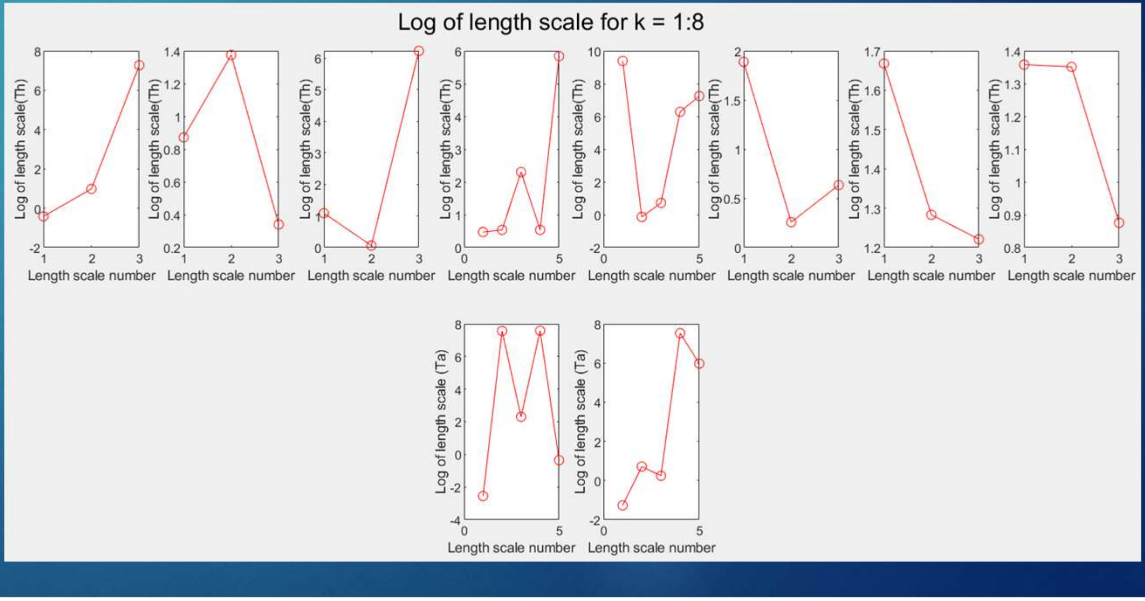
- Result:
- Layer sizes = 149, 180, 127, 178, 162, 114, 60, 32 for each section k respectively
- The variance of the prediction decreased but not significant
- The time for training the model increases as the layer sizes increase, but not affect the time to get the predictions from the model

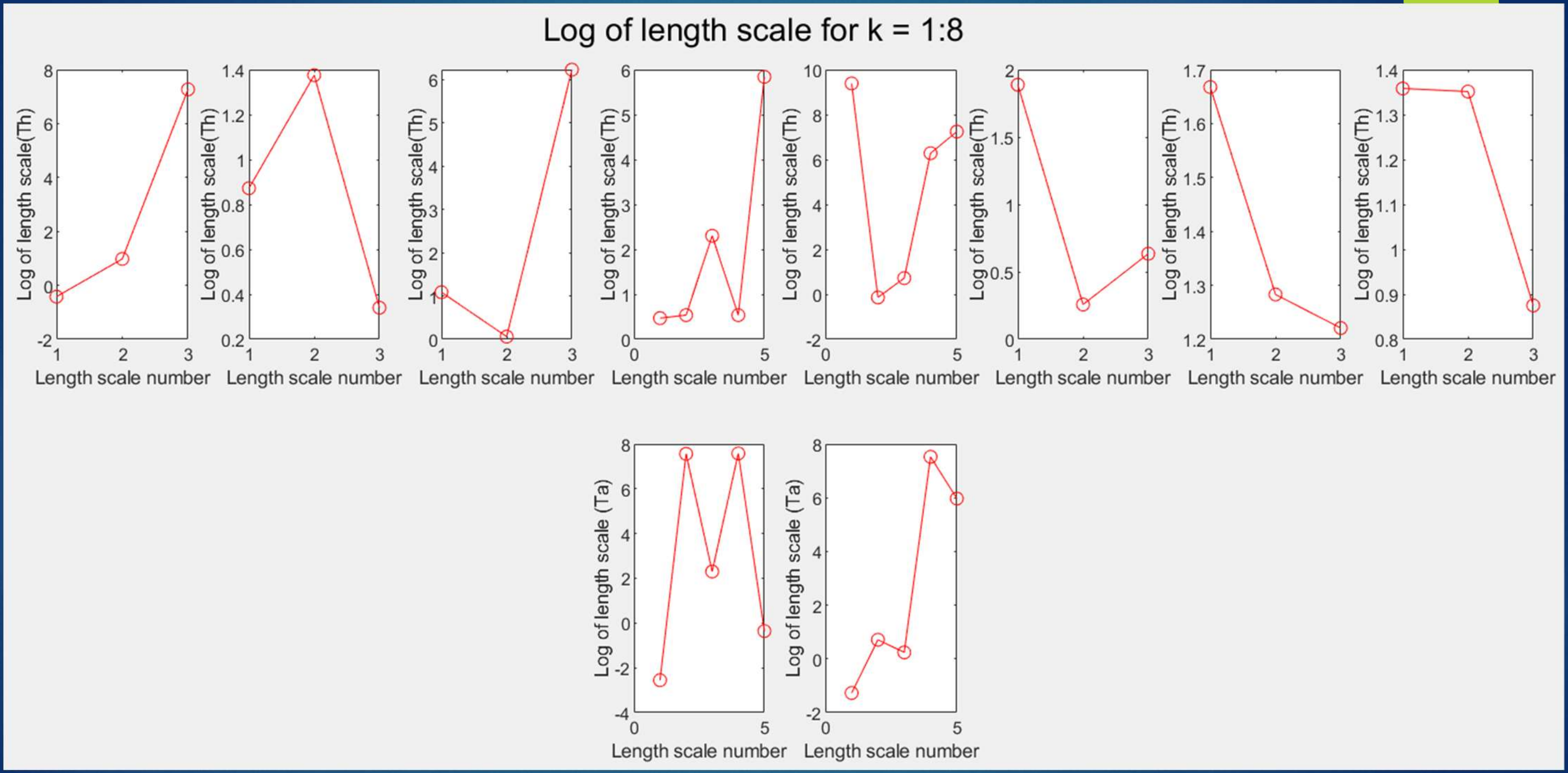


Tools – feature selection

- Objective: Identify the importance of the features in predicting the output
- Tools used: used separate length scale for predictors.







Log of length scale for k = 1:8

Thank you for listening