

# Report

## FYS-STK3155 - Project 1

Neco Darian  
*University of Oslo*

(Dated: September 26, 2025)

This is the first session on this project, and not much have been done yet. Stay tuned

### I. INTRODUCTION

- During this project we analyze the Runge function using various polynomial regression methods, beginning with Ordinary Least Squares (OLS) and extending to Ridge and LASSO regression. These models are then evaluated with Mean Squared Error (MSE) and  $R^2$ , and next we compare analytical solutions with gradient-based optimization methods such as (gradient descent, momentum, Ada-Grad, RMSProp, ADAM, and stochastic gradient descent). To study model complexity, we implement bootstrap resampling for bias-variance analysis and k-fold cross-validation for error estimation. The Results are presented through figures and tables with proper discussion.

### II. METHODS

#### A. Method 1/X

- Describe the methods and algorithms, including the motivation for using them and their applicability to the problem
- Derive central equations when appropriate, the text is the most important part, not the equations.

#### B. Implementation

- Explain how you implemented the methods and also say something about the structure of your algorithm and present very central parts of your code, not more than 10 lines
- You should plug in some calculations to demonstrate your code, such as selected runs used to validate and verify your results. A reader needs to understand that your code reproduces selected benchmarks and reproduces previous results, either numerical and/or well-known closed form expressions.

#### C. Use of AI tools

- Describe how AI tools like ChatGPT were used in the production of the code and report.

### III. RESULTS AND DISCUSSION

- Present your results
- Give a critical discussion of your work and place it in the correct context.
- Relate your work to other calculations/studies
- An eventual reader should be able to reproduce your calculations if she/he wants to do so. All input variables should be properly explained.
- Make sure that figures1 and tables contain enough information in their captions, axis labels etc. so that an eventual reader can gain a good impression of your work by studying figures and tables only.

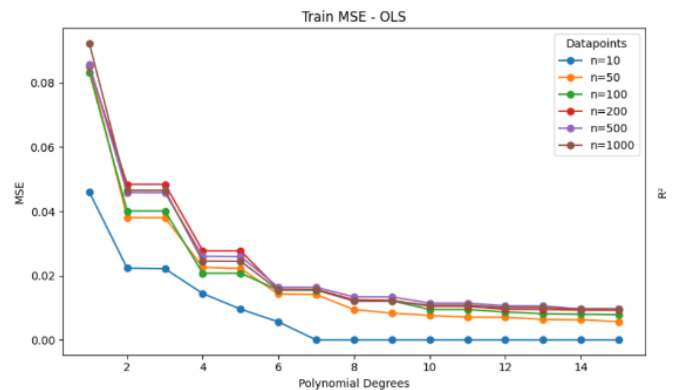


Figure 1: Figure 1: Test figure

### IV. CONCLUSION

- State your main findings and interpretations
- Try to discuss the pros and cons of the methods and possible improvements
- State limitations of the study
- Try as far as possible to present perspectives for future work

---