

Project 2

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<https://github.com/sim-hal/FYS3150-Project-2>

INTRODUCTION

In this article we will mainly look at ways of scaling equations, some eigenvalue problems and unit testing.

Problem 1)

We want to show that the second-order differential equation

$$\gamma \frac{d^2 u(x)}{dx^2} = -Fu(x) \quad (1)$$

can be written as

$$\frac{d^2 u(\hat{x})}{d\hat{x}^2} = -\lambda u(\hat{x}) \quad (2)$$

where $\hat{x} \equiv x/L \iff x$ is a dimensionless variable and $\lambda = \frac{FL^2}{\gamma}$. This also means that $x = \hat{x}L$. This means that

$$\frac{d}{dx} = \frac{d\hat{x}}{x} \frac{d}{d\hat{x}} = \frac{1}{L} \frac{d\hat{x}}{x} \frac{d}{d\hat{x}} = \frac{1}{L} \frac{d}{d\hat{x}}$$

We insert this into (1) and get

$$\gamma \frac{d^2 u(x)}{dx^2} = \gamma \frac{1}{L^2} \frac{d^2 u(\hat{x})}{d\hat{x}^2} = -Fu(x)$$

$$\frac{d^2 u(\hat{x})}{d\hat{x}^2} = -FL^2 \frac{1}{\gamma} u(x) = -\lambda u(x)$$