Otto von Guericke University Magdeburg
Institute for Analysis and Numerics
Max Planck Institute for Dynamics of Complex Technical Systems
Computational Methods in Systems and Control Theory

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Model Reduction of Dynamical Systems
Exercise 1

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Problem 1. *Image compression using SVD (in Python)*

(a) Download the Jupyter notebook `exercise1.ipynb` from the course website[1].

(b) Download and save any picture in JPEG format to the same folder where you saved the notebook.

(c) Complete the exercises in the notebook.

(d) Add your files to a local Git repository and push it to your private repository on GitLab[2] or Bitbucket[3].

Problem 2. *Laplace transform*

(a) Find Laplace transform of the following functions:

(i) $f(t) = 2t^2 - 3t + 5$,
(ii) $f(t) = t^2 e^{-2t}$,
(iii) $f(t) = \sin(2t)\cos(2t)$,
(iv) $f(t) = \sin(2t) + e^{-3t}\cos(2t)$.

(b) Invert each of the following Laplace transforms:

(i) $F(s) = \frac{4}{s^5}$,
(ii) $F(s) = \frac{32}{s(s^2+16)}$.

(c) Using Laplace transform, solve the following ordinary differential equations:

(i) $\ddot{x}(t) + x(t) = t$, $x(0) = 0$, $\dot{x}(0) = 2$,
(ii) $\ddot{x}(t) + 2\dot{x}(t) + 5x(t) = 8e^{-3t}$, $x(0) = \dot{x}(0) = 0$.

[1] http://www.mpi-magdeburg.mpg.de/csc/teaching/17ss/mor
[2] https://about.gitlab.org
[3] https://bitbucket.org