# Lecture Data Science for Electron Microscopy Winter 2024

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#### 5 Abstract

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This is the website for the Data Science for Electron Microscopy Lecture

# 7 Plain Language Summary

- This is the website for the Data Science for Electron Microscopy Lecture
  - Pelz Lab website
  - Studon Link

# 1 Lecture 1: Intro (25.10.2024)

- Introduction
  - d2l Chapter 2: Preliminaries

#### <sup>14</sup> 2 Lecture 2: Regression and Sensor Fusion (8.11.2024)

- d2l Chapter 3: Regression
- Sensor Fusion Slides

# 3 Lecture 3: CNNs (15.11.2024)

- d2l Chapter 7: CNNs
- d2l Chapter 8: CNNs

#### 4 Lecture 4: Classification, Segmentation, AutoEncoders (22.11.2024)

- d2l Chapter 4: Classification
- d2l Chapter 14.9: Segmentation
- Segmentation
  - Dimensionality Reduction
- PCA
- Autoencoder
- Variational Autoencoder

### 5 Miniproject (29.11. - 13.12.2024)

1. Segmentation

- We will use the dataset from Rangel DaCosta et al. (2024) to implement a segmentation model.
  - 2. VAE & Dimensionality Reduction
- We will use the dataset from Shi et al. (2022) to implement a dimensionality reduction model and cluster 4DSTEM data.
  - 3. Denoising
- We will use the dataset from Sadri et al. (2024) to implement a denoising model for 4DSTEM data.
  - 4. Image-to-Image Translation
- We will use a simulated dataset from the IMN chair to implement an Image to image translation model.  $^{39}$

## 6 Lecture 5: Mixed Bag (10.1.2025)

- Project presentation
- Generative Adversarial Networks
- Gaussian Processes 1

- 7 Lecture 6: GPs (17.1.2025)
- 8 Lecture 7: Bayesian Optimization, Active Learning, Deep Kernel
   Learning (24.1.2025)
  - 9 Lecture 8: Inverse Imaging Problems 1: Tomography, Deconvolution (31.1.2025)
    - 10 Lecture 9: Inverse Imaging Problems 2: Phase Contrast Imaging, Superresolution Imaging (7.2.2025)

## 52 References

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- Sadri, A., Petersen, T. C., Terzoudis-Lumsden, E. W., Esser, B. D., Etheridge, J., & Findlay, S. D. (2024). Unsupervised deep denoising for four-dimensional scanning transmission electron microscopy. *Npj Computational Materials*, 10(1), 243.
- Shi, C., Cao, M. C., Rehn, S. M., Bae, S.-H., Kim, J., Jones, M. R., et al. (2022).

  Uncovering material deformations via machine learning combined with fourdimensional scanning transmission electron microscopy. *Npj Computational Materials*, 8(1), 114.