AIM-Net Deep Learning Summer School

Provisional program

TUESDAY 2/6

12:00	**Bus from Barcelona Airport T2**
14:30	**Expected arrival**
16:00-19:00	**WELCOME AND TEAM PRESENTATION** **PYTHON INTRODUCTION** • Notebooks and conda environments • Variables, loops, conditions, functions • Numerical computing with NumPy • Handling images with scikit-image • Image feature measurements • Simple data modeling **PROJECT INTRODUCTION**

WEDNESDAY 3/6

09:30-11:30	**BIOMAGE ANALYSIS WORKFLOWS** • Image tresholding • Image filters and convolutions • Connected components • Object measurements • Machine learning pixel classifiers

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- Widgets and interactive data exploration

11:30-12:00 **Break**

12:00:13:30 **BUILDING YOUR FIRST NEURAL NETWORK**

- Classifying Data with a Single Neuron
- Classifying 1D and 2D Data
- Bias, Regularization and Activation Functions

13:30-15:00 **Break**

15:00-16:30 **CLASSIFYING DATA WITH A DENSE NEURAL NETWORK**

- Implementing a Dense Neural Network
- Training with error backpropagation
- Classifying Handwritten Digits

GROUP FORMATION AND PROJECT ASSIGNMENT

16:30-17:00 **Break**

17:00-18:30 **RECOGNIZING PATTERNS WITH DENSE NEURAL NETWORKS**

- Training Using Batches
- Tracking Training Metrics
- Splitting the Data and Validating the Neural Network

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THURSDAY 4/6

09:30-11:30 — **UNDERSTANDING CONVOLUTIONS**

- Convolving 1D and 2D Data
- Using Convolutions in a Neural Network

11:30-12:00 — **Break**

12:00-13:30 — **IMPLEMENTING CNNS IN PYTORCH**

- Defining Layers and Activations for Image Transformations
- Image Classification with a CNN
- Classifying Malaria-Infected Blood Smears

13:30-15:00 — **Break**

15:00-16:30 — **ENCODERS-DECODERS AND AUTOENCODERS**

- Understanding Encoder-Decoders
- Implementing a Denoising Encoder-Decoder
- Denoising the Image

16:30-17:00 — **Break**

17:00-18:30 — **VARIATIONAL AUTOENCODERS**

- Understanding Variational Autoencoders
- Generating Images with the Decoder

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- Clustering Images with the Encoder

FRIDAY 5/6

09:30-11:30 **U-NETS**

- Introducing U-Nets
- Understanding Semantic Segmentation
- Segmenting Images of Biological Tissues

11:30-12:00 **Break**

12:00-13:30 **U-NETS AT WORK**

- Detecting Quantum Dots in Fluorescence Images
- Counting Cells

13:30-15:00 **Break**

15:00-16:30 **SELF-SUPERVISED LEARNING**

- Understanding Self-Supervised Learning
- Contrastive Self-Supervised Learning
- Non-Contrastive Self-Supervised Learning
- Geometric Self-Supervised Learning

16:30-17:00 **Break**

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17:00-18:30	**SELF-SUPERVISED LEARNING IN ACTION** • Determining the Position of an Image • Localizing Mouse Stem Cells with LodeSTAR

SATURDAY 6/6

09:30-11:30	**GENERATIVE ADVERSARIAL NETWORKS** • Understanding GANs • Discriminating Between Real and Fake Data • Generating Realistic Fake Data
11:30-12:00	**Break**
12:00-13:30	**GANS APPLICATION** • Generating Realistic Fake Data • Virtually Staining a Biological Tissue
13:30-15:00	**Break**
15:00-16:30	**PROJECT FINALIZATION**
16:30-17:00	**Break**
17:00-18:30	**PROJECT PRESENTATIONS**

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20:00	**SOCIAL EVENT**

SUNDAY 7/6

10:00	**Bus to Barcelona Airport T2**

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