

Module Name	Neural Networks and Memristive Hardware Accelerators
Module Number	Eul-IST-E-NNMHA, Eul-NES-E-NNMHA
Responsible Lecturer	Prof. Dr. phil. nat. habil. Ronald Tetzlaff ronald.tetzlaff@tu-dresden.de
Qualification Objectives	Upon completion of the module, students are familiar with the concepts of machine learning and neural networks. They understand that these neural learning methods rely on large datasets and that computational power is a limiting factor in the development of neural models. Students are acquainted with basic neural network accelerators for synapses and neurons, particularly those based on memristors, and understand the key circuit theories for modeling memristors and their applications. Furthermore, students possess competencies in Python programming, enabling them to implement basic neural models using ML-related Python libraries such as PyTorch. They are also capable of implementing and simulating memristors using LTSpice.
Contents	The module covers fundamental concepts of machine learning and neural networks for various data types such as time series and images, as well as different neural learning methods, optimizers, and loss functions. Additionally, principles of neural network accelerators for synapses and neurons based on memristors, circuit theory, models, and applications of memristors (e.g., logic circuits, crossbar arrays, and spiking neural networks) are addressed. The module also includes essential concepts of Python programming related to the aforementioned topics.
Teaching and Learning Forms	2 hours per week of lectures, 2 hours per week of projects, 2 hours per week of practical lab courses, and self-study. The language of instruction for lectures, projects, and practical lab courses is English.
Prerequisites for Participation	In the Master's program Nanoelectronic Systems, basic knowledge in the fields of electrical engineering and computer science at the Bachelor's level is required. In the Diploma program Information Systems Engineering, the competencies to be acquired in the modules Basics of Electrical Engineering, Microelectronic Technologies and Components, Programming, and RoboLab are required.
Usability	The module is an elective module according to § 6 paragraph 2 of the study regulations and § 33 paragraph 3 of the examination regulations in the Master's program Nanoelectronic Systems. Furthermore, it is an elective module in the elective area "Competence Deepening" according to § 6 paragraph 3 of the study regulations and § 33 paragraph 3 of the examination regulations of the main study program in the field of Microelectronics, Electronic Circuits, and Systems in the Diploma program Information Systems Engineering. In the Diploma program Information Systems Engineering, the module cannot be chosen if the module Python has already been selected. The module creates the prerequisites for the modules listed under "Prerequisites for Participation."
Prerequisites for the Award of Credit Points	Credit points are awarded when the module examination is passed. The module examination consists of a written exam lasting 180 minutes and a complex assignment with a workload of 60 hours. The written exam is a pass-relevant component.
Credit Points and Grades	7 credit points can be earned through the module. The module grade is determined by the weighted average of the grades of the examination components. The written exam is weighted fourfold, and the complex assignment is weighted singly.
Frequency of the Module	The module is offered every winter semester.
Workload	The total workload is 210 hours.
Duration of the Module	The module lasts one semester.