DSSC: SPECIALIZATIONS

Curriculum: Artificial Intelligence and Machine Learning

Specialization in AI for Cyber-Physical Systems

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Data Management for Big Data	INF/01	B	9	II
Reinforcement Learning	INF/01	C	6	II
Probabilistic Machine Learning	INF/01	B	6	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Deep Learning	INF/01	B	6	II
Cyber-Physical Systems	INF/01	C	6	II
Control Theory	ING-INF/04	C	6	I ?
One course between				
Global and Multi-Objective Optimization	INF/01	D	6	?
Computer Vision and Pattern Recognition	ING-INF/04	C	6	I
Software Development Methods	ING-INF/05	C	6	I
Natural Language Processing	ING-INF/05	C	6	II
Stochastic Modelling and Simulation	INF/01	D	6	II
Identification and Estimation of Systems	ING-INF/04	D	6	I ?

Curriculum: Artificial Intelligence and Machine Learning

Specialization in Foundations of AI and ML

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Data Management for Big Data	INF/01	B	9	II
Reinforcement Learning	INF/01	C	6	II
Probabilistic Machine Learning	INF/01	B	6	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Deep Learning	INF/01	B	6	I
Advanced Topics in Machine Learning	INF/01	D	6	II
18 CFU (min 6 of TAF C) between				
Computer Vision and Pattern Recognition	ING-INF/04	C	6	I
Software Development Methods	ING-INF/05	C	6	I
Natural Language Processing	ING-INF/05	C	6	II
Information Theory	INF/01	C	6	I
Cyber-Physical Systems	INF/01	C	6	II
Stochastic Modelling and Simulation	INF/01	D	6	II
Information Retrieval and Data Visualization	INF/01	D	6	I
Mathematical Optimization	MAT/09	D	6	II
Control Theory	ING-INF/04	C	6	I ?
Bayesian Statistics	SECS-S/01	D	6	II
Unsupervised Learning	FIS/07	D	6	II
Statistical Learning for Data Science	SECS-S/01	D	6	II
Advanced Probability	MAT/06	D	6	?

Global and Multi-Objective Optimization	INF/01	D	6	?
Advanced Data Management and Curation	INF/01	D	6	II

Curriculum: Data Science and Applications

Specialization in Data Management and Engineering

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Data Management for Big Data	INF/01	B	9	II
Unsupervised Learning	FIS/07	C	6	II
Probabilistic Machine Learning	INF/01	B	6	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Information Retrieval and Data Visualization	INF/01	C	6	I
Advanced Data Management and Curation	INF/01	C	6	II
Open Data Management and the Cloud	ING-INF/05	D	6	I
At least 6 CFU between				
Software Development Methods	ING-INF/05	C	6	I
Deep Learning	INF/01	D	6	II
Statistical Learning for Data Science	SECS-S/01	C	6	II

Curriculum: Data Science and Applications

Specialization in Data Science for Health and Life Sciences

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Data Management for Big Data	INF/01	B	9	II
Unsupervised Learning	FIS/07	C	6	II
Probabilistic Machine Learning	INF/01	B	6	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Computational Biology	INF/01	C	6	I
Health Data Analytics	MED/01	C	6	I
At least 12 CFU between				
Information Retrieval and Data Visualization	INF/01	C	6	I
Management of Health Data	ING-INF/06	D	6	I
Molecular Simulation	ING-IND/24	C	6	I
Software Development Methods	ING-INF/05	C	6	I
Computer Vision and Pattern Recognition	ING-INF/04	D	6	I
Natural Language Processing	ING-INF/05	D	6	II
Deep Learning	INF/01	D	6	I
Advanced Data Management and Curation	INF/01	C	6	II
Statistical Learning for Data Science	SECS-S/01	C	6	II

Curriculum: Data Science and Applications

Specialization in Data Science for Social Sciences

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Data Management for Big Data	INF/01	B	9	II
Statistical Learning for Data Science	SECS-S/01	C	6	II
Probabilistic Machine Learning	INF/01	B	6	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Information Retrieval and Data Visualization	INF/01	C	6	I
Natural Language Processing	ING-INF/05	D	6	II
Statistical Analysis of Networks	SECS-S/05	C	6	II
At least 6 CFU from				
Bayesian Statistics	SECS-S/01	C	6	II
Deep Learning	INF/01	D	6	I

Curriculum: Data Science and Applications

Specialization in Geodata Science

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Data Management for Big Data	INF/01	B	9	II
Unsupervised Learning	FIS/07	C	6	II
Probabilistic Machine Learning	INF/01	B	6	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Information Retrieval and Data Visualization	INF/01	C	6	I
Earth Sciences Analytics	GEO/10	C	6	?
At least 12 CFU between				
Geophysics Analytics	GEO/10	D	6	?
Deep Learning	INF/01	D	6	I
Advanced Data Management and Curation	INF/01	C	6	II
Global and Multi-Objective Optimization	INF/01	D	6	?
Software Development Methods	ING-INF/05	C	6	I
Statistical Learning for Data Science	SECS-S/01	C	6	II

Curriculum: Computational Science and Engineering

Specialization in Computational Fluid Dynamics

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Stochastic Modelling and Simulation	INF/01	B	6	II
Advanced Numerical Analysis	MAT/08	B	6	II
Mathematical Optimization	MAT/09	B	9	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Fluid Dynamics	ICAR/01	C	6	I
Physics and Modelling of Turbulent Flows	ICAR/01	C	6	II
At least 12 CFU between				
Parallel Programming for HPC	ING-INF/05	C	6	?
Software Development Methods	ING-INF/05	C	6	I
Probabilistic Machine Learning	INF/01	B	6	II
Deep Learning	INF/01	D	6	I
Global and Multi-Objective Optimization	INF/01	D	6	?
Geophysics Analytics	GEO/10	D	6	?

Curriculum: Computational Science and Engineering

Specialization in Computational Physics

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Stochastic Modelling and Simulation	INF/01	B	6	II
Advanced Numerical Analysis	MAT/08	B	6	II
Mathematical Optimization	MAT/09	B	9	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Computational Physics Laboratory	FIS/01	C	6	II
At least 18 CFU (of which at least 6 of TAF C) between				
Molecular Simulation	ING-IND/24	C	6	I
Fluid Dynamics	ICAR/01	C	6	I
Software Development Methods	ING-INF/05	C	6	I
Parallel Programming for HPC	ING-INF/05	C	6	?
Numerical Methods in Quantum Mechanics	FIS/03	D	6	II
Simulation of Multibody Systems	FIS/03	D	6	II
Computational Quantum Chemistry	CHIM/02	C	6	II
Statistical Mechanics	CHIM/02	D	6	I
Probabilistic Machine Learning	INF/01	B	6	II
Deep Learning	INF/01	D	6	I
Advanced Topics in Machine Learning	INF/01	D	6	?

Curriculum: Computational Science and Engineering

Specialization in Computational Cosmology

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Stochastic Modelling and Simulation	INF/01	B	6	II
Advanced Numerical Analysis	MAT/08	B	6	II
Mathematical Optimization	MAT/09	B	9	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Astrophysics	FIS/05	C	6	I
Formation of Cosmological Large-Scale Structures	FIS/05	C	6	I
Introduction to Cosmology	FIS/05	F	1	I
Radiative Processes in Astrophysics	FIS/05	D	6	II
At least 6 CFU (TAF D) between				
Computational Physics Laboratory	FIS/01	C	6	II
Simulation of Multibody Systems	FIS/03	D	6	II
Probabilistic Machine Learning	INF/01	B	6	II
Parallel Programming for HPC	ING-INF/05	C	6	?

This specialization is recommended only to students with a bachelor in Physics.

Curriculum: Computational Science and Engineering

Specialization in Computational Chemistry

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Stochastic Modelling and Simulation	INF/01	B	6	II
Advanced Numerical Analysis	MAT/08	B	6	II
Mathematical Optimization	MAT/09	B	9	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Computational Physics Laboratory	FIS/01	C	6	II
Computational Quantum Chemistry	CHIM/02	C	6	II
Molecular Simulation	ING-IND/24	C	6	I
At least 6 CFU (TAF D) between				
Numerical Methods in Quantum Mechanics	FIS/03	D	6	II
Simulation of Multibody Systems	FIS/03	D	6	II
Statistical Mechanics	CHIM/02	D	6	I
Software Development Methods	ING-INF/05	C	6	I
Parallel Programming for HPC	ING-INF/05	C	6	?

Curriculum: Computational Science and Engineering

Specialization in Quantum Computing

I Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Advanced Programming and Algorithmic Design	ING-INF/05	B	12	I+II
Foundations of High Performance Computing	ING-INF/05	B	9	I
Introduction to Machine Learning	ING-INF/05	B	6	I
Statistical Methods for Data Science	SECS-S/01	C	6	I
Numerical Analysis	MAT/08	B	6	I
Stochastic Modelling and Simulation	INF/01	B	6	II
Probabilistic Machine Learning	INF/01	B	6	II
Mathematical Optimization	MAT/09	B	9	II

II Year

Course	*SSD*	*TAF*	*CFU*	*SEM*
Introduction to Quantum Information Theory	FIS/02	C	6	II
Introduction to Quantum Mechanics and Quantum Computing	FIS/02	C	6	I
Information Theory	INF/01	C	6	I
At least 6 CFU between				
Bayesian Statistics	SECS-S/01	D	6	II
Software Development Methods	ING-INF/05	C	6	I
Deep Learning	INF/01	D	6	I
Advanced Topics in Machine Learning	INF/01	D	6	II
Unsupervised Learning	FIS/07	C	6	II
Advanced Quantum Computing	FIS/02	D	6	?