Title of course	**Computational Intelligence**
Responsible instructor	*Prof. Dr. Martin Golz*
Learning objectives	*The students will get the opportunity to* *- Analyse typical problems of sub-symbolic data and knowledge processing,* - Conceive the process chain of adaptive data analytics, *- Comprehend and apply methods of the process chain,* - Comprehend and apply methods of validation, - Know basic assumptions and models of empirical inference, *- Know some of the mathematical background issues.*
Course contents	*1. Introduction 1.1. Five types of statistical inference* *1.2. Typical applications* *1.3. Process chain* *2. Statistical learning theory 2.1. Empirical risk minimisation* *2.2. PAC learning* *2.3. General learning model* *2.4. Learning with uniform convergence* *2.5. Bias complexity trade-off* *2.6. Vapnik Chervonenkis dimension* *3. Multivariate, linear regression analysis* *3.1. Introduction* *3.2. Model* *3.3. Principle of maximal a-posteriori probability* *4. Linear discriminant analysis (LDA)* *4.1. Introduction* *4.2. Multi-class LDA* *4.3. Least squares LDA* *4.4. Fisher LDA* *5. Kernel function discriminant analysis* *5.1. Introduction* *5.2. Theorem of Cover* *5.3. Dual representation* *5.4. Generation of kernel functions* *5.5. Radial basis function networks* *5.6. Recursive least squares minimisation* *5.7. Gaussian processes* *5.8. Applications* *6. Adaptive Filter* *6.1. Linear adaptive filtering* *6.1.1. Least squares algorithm (LS)* *6.1.2. Recursive LS algorithm (RLS)* *6.1.3. Extended RLS algorithm (Ex-RLS)* *6.2. Non-linear adaptive filtering 6.2.1. Reproducing kernel Hilbert space (RKHS)* *6.2.2. Kernel function LS filtering* *6.3. Applications* *7. Deep learning* *7.1. Characterisation* *7.2. Representation learning*

	7.3. Deep auto-encoder *7.4. Restricted Boltzmann machines* *7.5. Applications*
Teaching methods	*- Frontal lectures with* • Digital presentation slides, • Demonstration programs *- Exercises held in the computer pool* • Programming with MATLAB • Clarification of open issues
Prerequisites	*No formal suppositions* *Basic knowledge in linear algebra, analysis, statistics*
Suggested reading	*The following books are recommended:* *- Nielsen (2015) Neural networks and deep learning. Determination press* *- Mohri, Rostamizadeh (2012) Foundations of machine learning. MIT press* *- Bishop (2006) Pattern recognition & machine learning. Springer* *- Duda, Hart, Stork (2001) Pattern classification. Wiley*
Applicability	*This module is an obligatory subject.* *An appropriation to similar majors is possible under stipulation of their examination regulations*
Workload	*180 hours, including 60 hours in presence and 120 hours self-instruction*
ECTS credit points and weighting factor	*5 CP (Emphasis of the Grade for the final Grade 5/120)*
Basis of student evaluation	*Oral examination (30 minutes)*
Time	*1st Semester*
Frequency	*Once a year*
Duration	One semester
Course type	*Obligatory subject*
Remarks	Teaching language is English.