Reasoning and Decision Making under Uncertainty (5171040)

Module name english	Reasoning and Decision Making under Uncertainty					
Type of module	Pflichtmodul		**Responsible for module**		Prof. Dr. Frank Deinzer	
Lecturer	Prof. Dr. Frank Deinzer					
Language of instruction, L. of examination	Englisch		**Semester**		1	
SWS	4		**Teaching and learning formats**		Seminaristischer Unterricht	
ECTS-Credits	5		**Type of examination**		Portfolio	
Bonus benefits						
Workload	**Workload (Total)**	150	**Attendance time**	60	**Self-Study time (incl. exam preparation)**	90
Duration of module	1 Semester		**Frequency**		ME/OE	
Type of grading	Differenzierte Note		**Verwendbarkeit**		Artificial Intelligence	
Conditions for participation	none					
Recommended prerequisites						
Module's learning outcomes	- Students develop further knowledge and skills on the necessary mathematical foundations for understanding and developing algorithms for AI. - Students can apply the principles of Reinforcement Learning algorithms - Students can use the principles of modelling gents, environments and rewards. - Students understand the necessity of function approximations in learning. - Students understand the concepts of statiscal sensor fusion - Students can realize sensor fusion applications - Students build on their acquired knowledge to master learning problems.					
Module content	The course is composed of 2 thematic blocks. Block A: Reinformcement Learning 1. Basic Reinforcement Learning Concepts - Actions and States - Goals, Rewards, Returns and Episodes - Policies and Value Functions 2. Basic Reinforcement Learning Methods - Finite Markov Decision Processes - Dynamic Programming - Monte Carlo Methods 3. Advanced tabular learning Methods - Temporal-Difference Learning - Bootstrapping Methods 4. Learning in Continuous State and Action Spaces - On-Policy Approximation - Value-function Approximation - Off-Policy Approximation - Approximate Eligibility Traces 5. Value Function Approximation Case Studies - Computer Vision: Action planning - Mastering Games: Backgammon, Go 6. Applications and Exercises Block B: Sensor Fusion 1. Using Bayes for Sensor Data Fusion - Modeling and Estimation of Densities - Sensor Fusion over Time 2. Hidden Markov Models and Viterbi Algorithm 3. Recursive State Estimation - Gaussian Filters - Nonparametric Filters 4. Applications					

Literature	1. Sutton, Barto. Reinforcement Learning - An Introduction. Bradford Books, 2018 2. Thorp. Beat the Dealer. Random House. 1966 3. Mitchell. Data Fusion: Concepts and Ideas. Springer. 2014 4. Thrun, Burgard, Fox: Probabilistic Robotics. MIT Press. 2005 5. Johnson, Freund, Miller. Miller & Freund's Probability and Statistics for Engineers. Pearson Further specialized literature will be announced in the course.