

INF-MSc-238: Deep Reinforcement Learning					BOSS-Nr. 62620	
Englischer Modultitel: Deep Reinforcement Learning						
Studiengänge: Masterstudiengang Informatik, Masterstudiengang Angewandte Informatik, Masterstudiengang Wirtschaftsinformatik						
Turnus: jedes Sommersemester		Dauer: 1 Semester	Studienabschnitt: 1.–3. Semester		Credits: 8	Aufwand: 240 (90/150)
1	Modulstruktur					
	Nr.	Element / Lehrveranstaltung		Typ	Credits	SWS
	1	Deep Reinforcement Learning		Vorlesung	5	4
	2	Übung zu Deep Reinforcement Learning		Übung	3	2
2	Lehrveranstaltungssprache: englisch					
3	<p>Lehrinhalte This Master-level course provides an in-depth introduction to reinforcement learning (RL) and its modern extension through deep neural networks, deep reinforcement learning (DRL). Students will learn the theoretical foundations of RL, explore classical algorithms, and then advance to state-of-the-art techniques that enable agents to learn complex behaviors from high-dimensional sensory data. The course combines mathematical rigor with practical implementation experience using popular frameworks such as PyTorch and Gymnasium. By the end of the course, students will be able to design, implement, and evaluate DRL systems for real-world applications such as robotics, game playing, and autonomous decision-making. In particular, we will cover the following topics Foundations of reinforcement learning</p> <ul style="list-style-type: none"> • Markov Decision Processes (MDPs) • Policies, value functions and Bellman equations • Exploration vs. exploitation trade-off <p>Classical RL algorithms</p> <ul style="list-style-type: none"> • Dynamic programming approaches • Value iteration and policy iteration • Q-learning and SARSA • Monte Carlo methods and temporal-difference learning <p>Deep reinforcement learning algorithms</p> <ul style="list-style-type: none"> • Value function methods (deep Q-Learning, ...) • Policy gradient methods • Advanced actor-critic algorithms • Off-policy vs. on-policy learning approaches <p>Model-based RL Exploration strategies and sample efficiency Advanced topics</p> <ul style="list-style-type: none"> • Offline RL • Transfer learning in DRL • Multi-agent RL and hierarchical RL 					

4	<p>Kompetenzen After completing the course, the participants will have the following competencies Theoretical Understanding</p> <ul style="list-style-type: none"> • Explain the mathematical foundations of reinforcement learning, including Markov Decision Processes (MDPs), value functions, and Bellman equations. • Derive and analyze classical RL algorithms such as Q-learning, SARSA, and policy gradient methods. • Understand convergence properties and stability issues in RL and DRL algorithms. <p>Practical Implementation Skills</p> <ul style="list-style-type: none"> • Design and implement RL agents using modern deep learning frameworks such as PyTorch. • Apply neural network architectures for function approximation in high-dimensional state spaces. • Tune hyperparameters, manage training stability, and evaluate performance metrics for DRL systems. <p>Algorithmic Proficiency</p> <ul style="list-style-type: none"> • Implement advanced DRL algorithms from scratch or by extending existing codebases. • Compare different approaches (value-based vs. policy-based; on-policy vs. off-policy) based on their theoretical assumptions and empirical behavior. <p>Analytical and Critical Thinking</p> <ul style="list-style-type: none"> • Critically assess research papers in the field of deep reinforcement learning. • Identify limitations of current methods and propose directions for improvement or extension. • Evaluate trade-offs between exploration strategies, sample efficiency, and computational cost. <p>Application and Problem-Solving</p> <ul style="list-style-type: none"> • Formulate real-world problems (e.g., robotics control or resource optimization) as RL tasks with appropriate reward structures. • Integrate DRL solutions into simulation environments or physical systems safely and effectively. 		
5	<p>Prüfungen</p> <ul style="list-style-type: none"> • Modulprüfung: Mündliche Prüfung oder Klausur BOSS-Nr. 62692 • Studienleistung: gemäß Ankündigung des Veranstalters/Prüfers zu Beginn der Lehrveranstaltung können ggf. folgende Voraussetzungen für eine erfolgreiche Erbringung der Studienleistung vorliegen: Erreichen der Mindestpunktzahl der Übungsaufgaben oder erfolgreiches Bestehen von mehreren Testaten während des Semesters BOSS-NR. 62642 <p>Die Studienleistung ist Voraussetzung für die Teilnahme an der Modulprüfung.</p>		
6	<p>Prüfungsformen und -leistungen [x] Modulprüfungen [] Teilleistung</p>		
7	<p>Teilnahmevoraussetzungen</p> <ul style="list-style-type: none"> • Vorausgesetzte Kenntnisse: Grundlegende Kenntnisse der Mathematik (lineare Algebra, Analysis und Statistik) • Wünschenswerte Kenntnisse: Programmierkenntnisse (vorzugsweise Python/PyTorch) 		
8	<p>Modultyp und Verwendbarkeit des Moduls</p> <ul style="list-style-type: none"> • Basismodul in den Masterstudiengängen Informatik und Angewandte Informatik • Forschungsbereich: Intelligente Systeme 		
9	<p>Modulbeauftragte/r Prof. Dr. Sebastian Peitz</p>	<p>Zuständige Fakultät: Informatik</p>	<p>Beschluss Fakultätsrat: 25.02.2026</p>