COURSE DESCRIPTION – ACADEMIC YEAR 2016/2017

Course title	**Intelligent Agents**
Course code	72054
Scientific sector	INF/01
Degree	Master in Computer Science (LM-18)
Semester	1
Year	2
Credits	8
Modular	No

Total lecturing hours	48
Total lab hours	24
Total exercise hours	--
Attendance	Not compulsory, but recommended.
Prerequisites	None
Course page	https://ole.unibz.it/

Specific educational objectives	The course belongs to the type "caratterizzanti – discipline informatiche" in the curriculum "Data and Knowledge Engineering". This course provides an overview and a deep knowledge into the topic Intelligent Agents. The course covers learning in single agent and multi-agent scenarios and focuses on collective learning as in Swarm Intelligence. • Objective 1: Learn the concept of collective learning • Objective 2: Learn the influence of the environment and its dynamics on multi-agent systems • Objective 3: Learn the concept of optimization using population based methods • Objective 4: Problem Solving using multi-agent systems • Objective 5: Learn the topics related to Ant based systems, division of labor • Objective 7: Application of Swarm intelligence in robotics and technical systems • Objective 8: Learn about model-based agents • Objective 8: Learn about the use of robots in industry • Objective 10: Learn modelling techniques based on logic and ontology

Lecturers	Sanaz Mostaghim Stefano Borgo
Contact	Piazza Domenicani 3, Room 1.04, sanaz.mostaghim@ovgu.de, stefano.borgo@unibz.it
Scientific sector of lecturer	INF/01
Teaching language	English
Office hours	During the lecture time span, arrange beforehand by email.
Lecturing Assistant (if any)	Stefano Borgo
Contact LA	Piazza Domenicani 3, Room 1.04, stefano.borgo@unibz.it
Office hours LA	During the lecture time span, by previous appointment via e-mail
List of topics	• Part 1: Fundamentals of swarm intelligence o Swarm stability and stability analysis

	o Swarm aggregation o Swarm in known environments o Swarm in unknown environments: Particle Swarm Optimization o Dynamic Optimization o Multi-Objective Particle Swarm Optimization • Part 2: Swarm and multi-agent systems o Division of labor and task allocation o Swarm clustering and sorting o Ant systems and optimization • Part 3: Applications o Swarm localization and display o Swarm robotics • Part 4: Robotics in Industry o Classification of (complex) robots in AI o Use of robots in the industrial domains o Modeling tasks and environment for production robots o Standards for industrial robots
Teaching format	Frontal lectures and exercises

Learning outcomes	Knowledge and understanding • Know the main techniques for learning in single agent and multi-agent systems. • Understand the methods of swarm intelligence (collective learning) and its applications. • Logical and ontological modeling for declarative knowledge Applying knowledge and understanding • Be able to design and create collective learning mechanisms for multi-agent systems. • Be able to design and execute experimental analyses for solving optimization problems • Be able to build a suitable model of the environment for simple industrial robots Making judgments • Be able to plan and re-plan a technical project activity aimed at building an information system and to bring it to completion by meeting the defined deadlines and objectives. • Be able to identify reasonable work goals and estimate the resources required to achieve the objectives. Communication skills • Be able to structure and prepare scientific and technical documentation describing project activities. Ability to learn • Be able to autonomously extend the knowledge acquired during the study course by reading and understanding scientific and technical documentation.

Assessment	Written and project work: • written exam with verification questions • written project report done in groups
Assessment language	English
Evaluation criteria and criteria for awarding marks	Clarity of answers, mastery of language (also with respect to teaching language), ability to summarize, evaluate, and establish relationships between topics.

Required readings	• Veysel Gazi and Kevin M. Passino, Swarm Stability and Optimization, Springer, 2011 • Eric Bonabeau, Marco Dorigo and Guy Theraulaz, Swarm Intelligence: From Natural to Artificial Systems, Oxford University Press, 1999 • Andries Engelbrecht, Fundamentals of Computational Swarm Intelligence, Wiley 2006 • James Kennedy and Russel Eberhart, Swarm Intelligence, Morgan Kaufmann, 2001 • Marco Dorigo and Thomas Stützle, Ant Colony Optimization, The MIT Press, 2004
Supplementary readings	• Zbigniew Michalewicz and David Fogel, How to solve it: Modern Heuristics, Springer, 2001 • C. Solnon: Ant Colony Optimization and Constraint Programming. Wiley 2010 • Gerhard Weiss, Multiagent Systems: A modern approach to distributed artificial systems, The MIT Press, 2000 • Christian Müller-Schloer, Hartmut Schmeck and Theo Ungerer, Organic Computing — A Paradigm Shift for Complex Systems, Springer, 2011 • Artificial Intelligence A Modern Approach. Stuart Russell & Peter Norvig. 3rd Edition Prentice Hall, 2009 • Baader F., Calvanese D., McGuinness D.L., Nardi D., and Patel-Schneider P.F. (eds.). The Description Logic Handbook: Theory, Implementation, and Applications. Cambridge University Press, Cambridge, UK, 2003 • Further readings provided in class depending on the students' interest
Software used	There will be the possibility to choose which software to use (e.g., Matlab, Protege, Jason), depending on the task and project.