Course: Optimization in Logistics

Lecturer	Prof. Dr. Maren Martens	
Preconditions for participation	**Formal:** None	
	Contentwise: Enjoy mathematical games	
Examination requirements	Presentation (60%) and participation in class (40%)	
Pre-examination requirements	Regular attendance in class	
Importance of examination	Affecting final grade	
Necessity to pass	Yes	
Learning outcomes / Competences	Students can identify and classify optimization problems in networks arising in logistics and production (or likewise in other sectors such as energy or telecommunication). They are proficient in modelling techniques and they can solve optimization problems algorithmically. <u>Knowledge/Understanding:</u> Students understand the scientific basics of algorithmics and complexity. For a variety of network optimization problems they know various algorithms and can classify them w.r.t. their efficiency. <u>Abilities/Transfer:</u> Students can execute basic network algorithms independently and they can use them to solve real-world optimization problems as they appear, e.g., in logistics. They are able to find modelling approaches and solution methods also for new problems from real-world applications, they independently understand algorithms, which were previously unknown to them, and deploy them correctly. They can classify problems w.r.t. their solvability and they are able to develop algorithmic approaches by themselves.	

Content	• Structural design of networks, e.g., optimal connectivity between warehouses and factories or between retailers and warehouses
	  ➢ Minimum Spanning Tree Problem
	• Shortest paths in networks, in particular in street networks
	  ➢ Shortest Path Problem
	• Transport, e.g., routing of maximum amount of goods or cost minimal routing in networks
	  ➢ Maximum Flow Problem
	  ➢ Minimum Cost Flow Problem
	• Sorting, e.g., by size
	  ➢ Various algorithms and runtime analyses
	• Assignment problems, e.g., for optimal storage locations in warehouses
	  ➢ Matchings	

	➢ Transshipment Problem ➢ Hungarian method • Tour planning, e.g., delivery to clients, paths for assembling ➢ Travelling Salesman Problem ➢ Classes P and NP ➢ Approximation algorithms • Optimal packing, e.g., of cartons or trucks ➢ Bin Packing • Staff and machine scheduling ➢ Interval Scheduling ➢ Identical Parallel Machine Scheduling ➢ Job Shop Scheduling ➢ Flow Shop Scheduling ➢ Open Shop Scheduling
Media	Projector with laptop, flipchart, blackboard
Readings	• Jungnickel, Dieter: Graphs, Networks and Algorithms. Second Edition. Springer, Berlin Heidelberg, 2005. • Ahuja, Ravindra K./Magnanti, Thomas L./Orlin, James B.: Network Flows. Theory, Algorithms, and Applications. Prentice Hall, Upper Saddle River, New Jersey 07458, 1993. • Cormen, Thomas H./Leiserson, Charles E./Rivest, Ronald L./Stein, Clifford: Introduction to Algorithms. Third Edition. The MIT Press, Cambridge, Massachusetts 02142, 2009.