Evolutionary Multi-Objective Optimization

Summer

(in German: Evolutionary Multi-Objective Optimization)

Module-ID: FIN-INF-120469

Abbreviation	Credit Points	Semester	Term	Duration	Language	Level
EMO	6	Summer	starting at 1.	1 Semester	english	Master

Link:	LSF
Limited accessability:	
Responsibility:	Sanaz Mostaghim
Lecturer:	Sanaz Mostaghim
Classes:	• Lecture *Evolutionary Multi-Objective Optimization* • Exercises *Evolutionary Multi-Objective Optimization*
Applicability in curriculum:	- M.Sc. INF: Informatik - M.Sc. INGINF: Informatik - M.Sc. WIF: Informatik - M.Sc. DKE: Learning Methods and Models for Data Science - M.Sc. DE: Methoden der Informatik - M.Sc. VC: Computer Science

Intended learning outcomes:

The students...

- have a full understanding of optimization and decision-making algorithms using evolutionary algorithms.
- are able to develop EMO algorithms
- can design optimization algorithms, model optimization problems and perform experiments.

Content:
In our daily life, we are inevitably involved in optimization. How to get to the university in the least time is a simple optimization problem that we encounter every morning. Just looking around ourselves, we can see many examples of optimization problems, even with conflicting objectives and higher complexities. It is natural to want everything to be as good as possible, in other words optimal. The difficulty arises when there are conflicts between different goals and objectives. Indeed, there are many real-world optimization problems with multiple conflicting objectives in science and industry, which are of great complexity. We call them Multi-objective Optimization Problems.
Over the past decade, many new ideas have been investigated and studied to solve such optimization problems as any new development in optimization which can lead to a better solution of a particular problem is of considerable value to science and industry. Among these methods, evolutionary algorithms are shown to be quite successful and have been applied to many applications. This course addresses the basic and advanced topics in the area of evolutionary multi-objective optimization and contains the following content:

- Introduction to single-objective optimization (SO) and multi-objective optimization (MO), classical methods for solving MO, definitions of Pareto-optimality and other theoretical foundations for MO
- Basics of evolutionary algorithms (algorithms, operators, selection mechanisms, coding and representations)
- Evolutionary multi-objective algorithms (NSGA-II, EMO scalarization methods such as MOEA/D)
- Constraint handling in SO and MO, robust optimization in EMO, surrogate methods for expensive function evaluations
- Evaluation mechanisms (Design of experiments, test problems, metrics, visualization)

Workload:
56 h contact time + 124 h self study

Pre-examination requirements:	Type of examination:	Teaching method / lecture hours per week (SWS):
	Written exam (120 Min) Exercises	• 2 SWS lecture • 2 SWS exercise class

Prerequisites according to examination regulations:	Recommended prerequisites:
none	

Media:	Literature:
	• Deb, Kalyanmoy. Multi-Objective Optimization Using Evolutionary Algorithms, Wiley, 2001. • Coello, Carlos A. Coello, Gary B. Lamont, and David A. Van Veldhuizen. Evolutionary algorithms for solving multi-objective problems. Vol. 5. New York: Springer, 2007. • Miettinen, Kaisa. Nonlinear multiobjective optimization. Vol.12. Springer Science & Business Media, 2012. • Ehrgott, Matthias. Multicriteria optimization. Vol. 491. Springer Science & Business Media, 2005. • Kruse, Rudolf, et al. Computational intelligence: a methodological introduction. Springer, 2016.

Comments:

Revision #1
Created 2026-10-20 17:13:33 UTC by Fakultät für Informatik
Updated 2026-10-20 17:13:33 UTC by Fakultät für Informatik