Study program:Artificial intelligence

Name of the subject: Distributed Optimization with Applications

Teacher(s):Dušan Jakovetić

Status of the subject: obligatory

Number of ECTS credits:6

Conditions: none

Subject goal

- Understanding of a wide range of modern optimization methods for large scale, parallel, and distributed optimization
- Ability to select appropriate algorithms for the problem at hand
- Ability to implement the taught algorithms in MATLAB

Outcome of the subject

- Ability and experience in applying the taught algorithms on real-world problems
- Ability to apply the taught algorithms on research problems from a wide variety of application areas
- Ability to synthesize and analyze efficient distributed algorithms for a given application

Subject content

Theory

Modern first-order methods for large-scale optimization: proximal gradient; accelerated Nesterov gradient; accelerated gradient for non-smooth optimization (FISTA); Randomized methods: randomized coordinate gradient; stochastic/online gradient; online gradient method under privacy constraints; Parallel and distributed methods: primal decomposition; dual decomposition; augmented Lagrangian; ADMM; distributed gradient; distributed dual averaging; distributed approximate Newton.

Practical learning

Application examples in telecom, electric grid (smart grid), machine learning, sensor networks, etc.; Implementation of the taught methods in MATLAB; Application of selected methods on real-world examples through the course project.

Literature

Main:

1. Nedic, Ozdaglar, Distributed Subgradient Methods For Multi-agent Optimization, Ieee Transactions On Automatic Control, Volume: 54, Issue:1 [1], Jan. 2009
2. S. Boyd, N. Parikh, E. Chu, B. Peleato, and J. Eckstein, Distributed optimization and statistical learning via the alternating direction method of multipliers , Foundations and Trends in Machine Learning, 2011
3. Soummya Kar And Jose M. F. Moura, "Distributed Consensus Algorithms In Sensor Networks: Link Failures And Channel Noise" Ieee Transactions On Signal Processing, 57:1, Pp. 355-369, January 2009
4. Wei Shi ; Qing Ling ; Kun Yuan ; Gang Wu ; Wotao Yin, On The Linear Convergence Of The Admm In Decentralized Consensus Optimization, Ieee Transactions On Signal Processing (Volume: 62, Issue: 7 2014)

Textbooks (additional):

1. S. Boyd and L. Vandenberghe: Convex Optimization, Cambridge University Press, 2004
2. D. Bertsekas, Nonlinear Programming, Athena Scientific, 2004
3. D. Bertsekas and J. Tsitsiklis: Parallel and Distributed Computation: Numerical Methods, Prentice-Hall, 1989

Number of active teaching classes	**Theoretical teaching:3**	**Practical teaching:2**

Method of carrying out the teaching

Lectures; revisions of the material; active students' participation in problem solving; knowledge tests – colloquia; application of the taught material on real-world examples within the course project.

Evaluation of knowledge (maximum number of points 100)

Pre-exam obligations	points	**Final exam**	points
Colloquia	30	Written exam	40
Course project	30		