AIBT105 - Optimization topics for AI

From the Advanced Master AIBT

(Artificial Intelligence & Business Transformation)

Key elements

Period: **Mid-December**

Estimated duration: **28 hours**

For whom:
recent graduates, jobseekers and experienced employees

Location:
ISAE-SUPAERO, Toulouse

Language: **English**

Highlights

- Foundations of AI algorithms
- Generic approaches and improvements
- Practical course

Artificial Intelligence almost always implies an underlying optimization process. Getting to know the optimization methods behind modern AI is therefore a crucial asset.

How to find the most intelligent imaging plan for a satellite constellation, or the best dispatching of aircraft around an airport? How to minimize the number of calls to a CSM solver when looking for the perfect aircraft wing design? Why is convergence in Deep Learning such a critical issue?

Learning objectives

After completing this course, participants will be able to:

- Model a decision making problem as an optimization problem;
- Know the main categories of optimization algorithms for AI;
- Choose an appropriate optimization algorithm for a specific problem.

Prerequisites

- General knowledge on computer science, mathematics, and algorithmics.
- The Python programming language will be used throughout the course, but only a prior basic experience in programming is required.

Information and registration

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Course Content

- Introduction;
  Artificial Intelligence, Machine Learning and Optimization: what? why? how?
- Gradient Descent Optimization: walking downhill;
  Interactive introduction: linear regression, linear separation;
  Overview of gradient based optimization methods;
  Hands-on: Program your own gradient descent;
  Concluding remarks: Why is convergence in Deep Learning such a critical issue?
- Discrete optimization: solving combinatorial problems;
  Overview of discrete satisfaction and optimization methods;
  Interactive session: Branch and Bound applied to MILP and CSP;
  Hands-on: Modelling exercises;
  Challenge: the Orbit Transition Problem;
  Concluding remarks: Scaling issues, opening on metaheuristics;
- Metaheuristics: the compromise between speed and quality;
  Overview: Single-state methods and Population methods;
  Hands-on: Program your own simulated annealing;
  Interactive session: Discovering genetic algorithms;
  Challenge: Aircraft conflict resolution with Genetic Algorithms;
  Concluding remarks: other stochastic methods, CMA-ES, cross-entropy.

Teaching methods

Teaching methods	Yes
Lectures / tutorial	X
Collaborative learning	
Flipped classroom	
Blended learning (online and face to face)	
Learning by doing	X
Project-based	X
Simulation	
Case study	

Assessment

- Project (100 %)