Master-MIRI
Topics on Optimization and Machine Learning (TOML)

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- **Topics on Optimization and Machine Learning (TOML)**
  - Lecturers:
    - Jose M. Barcelo-Ordinas (topics 1 and 2), office in C6-214, email: joseb@ac.upc.edu
    - Jorge Garcia-Vidal (topic 3), office in C6-212, email: jorge@ac.upc.edu
  - Web page of the research group (**Statistical Analysis of Networks and Systems, SANS**) where you can find general info related to the activities of the research group,
    - http://sans.ac.upc.edu
  - CNDS-MIRI specialization Web-page

https://www.fib.upc.edu/en/studies/masters/master-innovation-and-research-informatics/curriculum/specializations/computer-networks-and-distributed-systems

  - TOML-MIRI web –page

https://www.fib.upc.edu/en/studies/masters/master-innovation-and-research-informatics/curriculum/syllabus/TOML-MIRI

- **Topics on Optimization and Machine Learning (TOML)**
  - Master in Innovation & Research in Informatics (MIRI),
  - **S1**, **S2** and **S3**, **S2 or S3, S1-S4**
    - 5 mandatory common courses to all specializations (**CPDS**, **SMDE**, **TMIRI**, **AMMM**, **SIRI**)
  - Specialization on Computer Networks & Distributed Systems (CNDS)
    - 3 **methodological courses** (**SANS**, **TOML**, **SNM**),
    - 2 **courses on Computer Networks** (**CNANM**, **FINE**),
    - 2 **courses on Distributed Systems** (**DS**, **CCBDA**),
    - 1 **course on applications** (**IAS**)
    - 2 **elective courses (X, Y)** from any master/specialization

- **Topics on Optimization and Machine Learning (TOML)**
  - Previous knowledge for TOML:
    - **SMDE**: some concepts related to probability, point estimation, analysis of data (Anova&Manova, PCA), design of experiments, queueing theory and simulation,
    - **SANS**: probability (discrete/continuous), regression&classification, maximum likelihood, Bayesian inference, graphical models (belief networks, MRF, graph inference),

    Basically, SANS covers chapter 2 (probability), 3-4 (linear models for regression & classification) and 8 (probabilistic graphical models) of Christopher M. Bishop's book "patter recognitions & machine learning".
  - In parallel to TOML:
    - **AMMM:** linear programming and some basics on non-linear programming modelling programming, meta-heuristics,

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1. **Topics on Non-Linear optimization (focused on convex optimization):**
   - Convex sets, convex functions, non-linear optimization problems, duality, descent methods, applications to computer networks, project on optimizing duty-cycle MAC protocols for sensor networks,
   - We cover chapters 2-5 of Stephen Boyd book “convex optimization”
2. **Topics on Machine learning:**
   - Multiple linear regression and its relation to optimization (regularization), kernel methods (e.g. Gaussian processes), ensemble methods (bootstrapping, boosting, decision trees and random forest), support vector machines/regression, project on calibrating a sensor using MLR/RF/SVR,
   - We cover chapters 6,7,14 of Bishop’s book
3. **Topics on Deep Learning (Prof Jorge Garcia-Vidal):**
   - Neural networks, back-propagation and deep networks.
   - We cover chapter 5 (and some other content) of Bishop’s book

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  - **Evaluation:**
    - **Exams on each of the three topics (50%)**
      - Exam 1: around week 6-7 (April)
      - Exam 2: when the course finishes (June)
    - **Programming exercises on optimization (10%)**
      - Delivered before Exam 1
    - **Projects (at least 2 projects) (40%)**
      - Project 1: delivered before week 10
      - Project 2: delivered before 3rd week of june