Activity Report 2017

Team TAU

TAckling the Underspecified

Inria teams are typically groups of researchers working on the definition of a common project, and objectives, with the goal to arrive at the creation of a project-team. Such project-teams may include other partners (universities or research institutions).

RESEARCH CENTER
Saclay - Île-de-France

THEME
Optimization, machine learning and statistical methods

Table of contents

Team TAU

Creation of the Team: 2016 December 01

Keywords:

Computer Science and Digital Science:

A3.3.3. - Big data analysis
A3.4. - Machine learning and statistics
A3.5.2. - Recommendation systems
A8.2. - Optimization
A8.6. - Information theory
A9.2. - Machine learning
A9.3. - Signal analysis

Other Research Topics and Application Domains:

B4. - Energy
B7.2.1. - Smart vehicles
B9.1.2. - Serious games
B9.4.3. - Physics
B9.4.5. - Data science
B9.5.10. - Digital humanities

1. Personnel

Research Scientists

Marc Schoenauer [Team leader, Inria, Senior Researcher, HDR]
Guillaume Charpiat [Inria, Researcher]
Cyril Furtlehner [Inria, Researcher]
Yann Ollivier [CNRS, Researcher, until May 2017, HDR]
Martine Sebag [CNRS, Senior Researcher, HDR]
Paola Tubaro [CNRS, Researcher]

Faculty Members

Cécile Germain [Univ. Paris-Sud, Professor, HDR]
Isabelle Guyon [Univ. Paris-Sud + Inria chair, Professor + Advanced Research Position]
Philippe Caillou [Univ Paris-Sud, Associate Professor]
Aurélien Decelle [Univ. Paris-Sud, Associate Professor]

Post-Doctoral Fellows

Berna Bakir Batu [Inria]
Edgar Galvan Lopez [Programme Marie-Curie, until Mar 2017]
Olivier Goudet [Inria]

PhD Students

Nacim Belkhir [Thalès, until May 2017]
Victor Berger [Inria, from Oct 2017]
Vincent Berthier [Inria, until Nov 2017]
Benjamin Donnot [RTE]
Guillaume Doquet [Univ Paris-Sud]
Victor Estrade [Univ Paris-Sud]

Giancarlo Fissore [Inria, from Oct 2017]
François Gonard [Institut de recherche technologique System X]
Diviyan Kalainathan [Univ Paris-Sud]
Zhengying Liu [Univ Paris-Sud (AMX), from Oct 2017]
Pierre-Yves Masse [Inria, until Dec. 2017]
Marc Nabhan [Renault, from Jun 2017]
Adrian Pol [Organisation européenne pour la recherche nucléaire]
Herilalaina Rakotoarison [Inria, from Nov 2017]
Théophile Sanchez [Univ Paris-Sud, from Oct 2017]
Thomas Schmitt [Inria]
Lisheng Sun [Univ Paris-Sud]
Corentin Tallec [Univ. Paris-Sud (AMX)]
Aris Tritas [Inria, Intern from Apr-Sep 2017, PhD since Oct. 2017]
Pierre Wolinski [Univ. Paris-Sud]

Technical staff

Yasmina Bouzbiba [Inria, from Apr 2017]
Etienne Brame [Inria]
Raphaël Jaiswal [Inria, from Sep 2017]
Felix Louistisserand [Inria]
Luis Marti Orosa [Inria]
Dejan Tusar [Inria, until Sep 2017]

Interns

Louis Béthune [L3 ENS Lyon, June-July 2017]
Leonard Blier [Ecole Normale Supérieure Paris, from Apr 2017 until Oct 2017]
Laurent Cetinsoy [Inria, from Jun 2017 until Sep 2017]
Raphaël Guégan [Master 1 UPSud, April-Aug. 2017]
Mhamed Hajaiej [Inria, from Apr 2017 until Jul 2017]
Rumana Lakdawala [Inria, from Apr 2017 until Aug 2017]
Clément Leroy [Inria, from Mar 2017 until Jun 2017]
Priyanka Mandikal Phanindra [Inria, until May 2017]
Erwann Martin [Inria, from Jun 2017 until Aug 2017]
Christina Oster [Inria, from Mar 2017 until May 2017]
Julian Posada [CNRS, from Jul 2017 until Dec 2017]
Hugo Richard [ENS Lyon, from Sept. 2017]
Martin Toth [Parcours recherche Centrale]
Cedric Vachaudez [Inria, from Jun 2017 until Aug 2017]

Administrative Assistant

Olga Mwana Mobulakani [Inria, until May 2017 – no assistant Jun-Dec 2017]

Visiting Scientist

Mandar Chandorkar [CWI, from Sep 2017]

External Collaborators

Bernat Gacias [Other Univ., until Mar 2017]
Flora Jay [CNRS]
Balasz Kegl [CNRS]
Nilo Schwenke [Ecole Polytechnique]

2. Overall Objectives

2.1. Presentation

The last two years have been a turning point for the team. Of course, since its creation in 2003, TAO activities had constantly but slowly evolved, as old problems were being solved, and new applications arose. But recent abrupt progresses in Machine Learning (and in particular in Deep Learning) have greatly accelerated these changes also within the team. It so happened that this change of slope also coincided with some more practical changes in TAO ecosystem: following Inria 12-years rule, the team definitely ended in December 2016. The new team TAU (for **TA**ckling the **U**nderspecified) has been proposed, and the creation process is on-going. At the same time important staff changes took place, that also justify even sharper changes in the team focus. The year 2017 is hence the first year of a new era for the (remaining) members of the team, and some research topics might still continue to change in the next months.

As said above, several permanent members left the team. The good news is that Anne Auger and Nikolaus Hansen left TAO only to create, together with Dimo Brockoff (from the Dolphin team in Lille) their own offspring team, RANDOPT, also in the Saclay Inria Center.

The departure of both Olivier Teytaud and Yann Ollivier is a not-so-good news, in the sense that this participates to the general brain drain that is observed in all French academia toward the large private AI research centers: Olivier Teytaud (since June 2016) and Yann Ollivier (since May 2017) are now with respectively Google Zurich and Facebook AI Research in Paris. Whereas Yann continues his collaboration with us, and in particular still the supervision of his current PhD students (with more to come), Olivier's activities in TAO had to be continued by other permament researchers, namely Isabelle Guyon (see below) and Marc Schoenauer (who took over the last months of the PhD students supervisions - with Olivier in the background). We nevertheless have started a new collaboration with Olivier.

Finally, to end this presentation of the evolution of the team personal on a positive note, we were lucky enough that Isabelle Guyon joined the team (as of January 2016), as full Professor at Université Paris-Sud, and on the Inria/Université Paris-Sud Chair on Data Science for E-Science. She contributed not only by bringing her own research themes to the team, but also by enthusiastically taking over most activities of the team in the Energy application domain (see Section 4.1), the main context of Olivier's work in the recent years.

Next Sections will describe in more detail the current positionning of the new TAU team.

2.2. Context and overall goal of the project

Building upon the expertise in machine learning (ML) and stochastic optimization of the late TAO project-team, the TAU team aims to tackle **the vagueness of the Big Data purposes**. Based on the claim that (sufficiently) big data can to some extent compensate for the lack of knowledge, Big Data is hoped to fulfill all Artificial Intelligence commitments. This makes Big Data under-specified in three respects:

- A first source of under-specification is related to **common sense**, and the gap between observation and interpretation. The acquired data do not report on "obvious" issues; still, obvious issues are not necessarily so for the computer. Providing the machine with common sense is a many-faceted, AI long, challenge. A current challenge is to **interpret the data** and cope with its blind zones.
- A second source of under-specification regards the **steering of a Big Data system**. Such systems commonly require constant learning in order to deal with open environments and users with diverse profiles, expertise and expectations. A Big Data system thus is a dynamic process, whose behavior will depend in a cumulative way upon its future environment. The question regards the **control of a lifelong learning system**.
- A third source of under-specification regards its social acceptability. There is little doubt that Big Data can pave the way for Big Brother, and ruin the social contract through modeling benefits and costs at the individual level. What are the **fair trade-offs between safety, freedom and efficiency** ? We do not know the answers. A first practical and scientific challenge is to assess the fairness of a solution.

The tackling of the under-specified issues in Big Data in TAU currently relies on four core research dimensions, taking inspiration and validation in four main application domains. These research dimensions involve Causal Modelling (required to support prescriptive Big Data), Deep Learning (related to constructive representations, and their compositionality), Optimization and Meta-Optimization (including sequential decision making and categorization of problems), and Big-Data Driven Design. The application domains include the long-lasting domains of Energy Management and High Energy Physics, the more recent focus of TAO/TAU in Computational Social and Economic Sciences, and, new this year, the Autonomous Vehicle, and Population Genetics.

3. Research Program

3.1. Causal modelling

Data science is viewed as an information processing cycle: i) exploiting data and prior knowledge to build models; ii) using models to support optimal decisions in view of desirable ends; and iii) acquiring more data in order to refine the models and/or the desirable ends. Inasmuch data science supports prescriptive recommendations, it requires building causal models: these hold in front of interventions on the application domain – as opposed to predictive models. Causal modelling, acknowledged a priority at the international level (DARPA 2015), opens principled and sound ways to deal with the unbounded expectations / irrational exuberance about Big Data. Furthermore, causality offers an operational framework to better handle transfer learning, semi-supervised learning and missing data.

Mainstream approaches to causality involve restrictive assumptions (no confounders; no causal cycles) with severe scalability limitations [83]. The international challenges proposed by I. Guyon in the last 3 years (See book in preparation) opened brand new research directions, based on learned causation models [78], [75]. The validation of causal graphs still is an open problem in the general case (multiple hypothesis testing issues, heterogeneous variables, temporal dimensions).

TAU is one of the first teams worldwide with expertise in this domain, collaborating with Max Planck Institute (B. Schölkopf), FORTH (I. Tsamardinos) and Facebook Research (D. Lopez Paz). Among the applications calling for causal models are Energy Management (RTE use-cases include failures of equipment and catastrophic cascades of failures; Inria post-doc work of Berna Batu, see Section 4.1) and computational social sciences (with impact on strategic societal issues, see Section 4.2).

3.2. Deep learning

Deep Learning is at the root of quite a few breakthroughs in machine learning and sequential decision making, albeit requiring gigantic resources [72]. Some reasons for these performance jumps are clear (more data, more computational power, more complex search space). Still, the nature of the dynamical system made of training a deep NN yet remains an open question, at the crossroad of information geometry and non-convex optimization. A related open question concerns the neural architecture design. Deep Learning recent developments regarding generative adversarial networks [68] and domain adaptation [67] are relevant to optimal design applications.

The challenges addressed by TAU range from theoretical ML issues (characterization of learnable problems w.r.t the ratio of the data size/neural architecture size) to functional issues (how to encode information invariance and deal with higher order logic beyond convolutional architectures) to societal issues (how to open the black-box of a deep NN and ensure the fairness of the process).

The TAU team has a unique international expertise in three aspects relevant to deep learning, respectively regarding Riemannian geometry [76], [77] (in order to efficiently navigate in the search manifold), statistical physics [66] (to apprehend the learnability region as the architecture size goes to infinity with the data size), and Genetic Programming [57] and neuro-evolution (that provide original avenues for DNN architecture learning). Related industrial contracts involve ADAMME (FUI 2016) and RTE (Energy Management).

3.3. Optimization and Meta-optimization

TAO, with a first-rank expertise worldwide in stochastic black-box optimization, has now been splitted into the new team RANDOPT, and the present team TAU. While RANDOPT further investigates single- and multi-objective continuous stochastic optimization, TAU continues to focus on the fruitful hybridization of ML and stochastic optimization, with the dual persepectives of using ML for a better informed Optimization, and using Optimization to improve ML performances.
One long-term research perspective in the former context is to apprehend the black-box optimization process (BBO) as a sequential optimal decision process, along the lines of the learning to learn framework [58]. An effective policy (in expectation) can be trained on a representative set of benchmark problems, noting that comparison-based BBO methods offer good generalization properties thanks to their invariances properties, opening the road to Riemanian geometric approaches [11]. Another research perspective concerns interactive optimization, where the initially unknown optimization objective is gradually estimated based on the feedback of the human in the loop, and tackled [62], [56]. But this requires making a trade-off between the optimization search space (rich enough to contain good solutions) and the preference search space (simple enough to support effective preference learning with a limited number of queries).
On the other hand, the meta-optimization problem, concerned with selecting a nearly optimal algorithm and its hyper-parameters depending on the problem instance at hand, has been identified a key issue in both ML [61], [59], and Optimization [71]. This issue becomes a bottleneck for the tranfer to industry, due to the acknowledged shortage of data scientists and the increasing complexity of ML/Optimization toolboxes. The *a priori* algorithm selection and calibration in ML is hindered by the lack of appropriate meta-features to describe a problem instance [10], and the state of the art thus relies on Bayesian optimization, alternatively building a surrogate model of algorithm performances on the instance at hand [82]. The search for meta-features can be revisited, exploiting latent representations derived from Collaborative Filtering [10] and Domain Adaptation approaches based on adversarial networks [68], [67].
Note that Isabelle Guyon was the main organizer of the AutoML challenge, whose purpose was to come up with automatic use of ML methods.

3.4. Big Data-Driven Design

Big data-driven modelling/assimilation/simulation/design (BD3) is concerned with the calibration and extension of first principle-based models and equations using data (aka data assimilation), and using such models for optimal design. BD3 can significantly decrease time-to-design, through fast interactions between the modelling, predicting, optimizing, controlling and designing stages, sharing their advances (in particular, coupling first principles and data [63], or repairing/extending closed-form models). Besides the predictive modelling aspects, TAU more specifically investigates the generative and adversarial modelling aspects [68], aimed at data assimilation from biased data.

A first challenge is to find an operational umbrella to handle noisy, sparse, unstructured, missing data, possibly issued from different distributions (e.g. simulated vs real-world data). Collaborative filtering, deep learning, and their hybrids can be used to forge scalable unified intermediate representations, with applications in energy and computational social sciences (involving times series, documents, and/or graphs). Related issues regard the interpretation of such latent representations and the decisions based thereupon. Another challenge is to deliver guarantees for the data-driven models and designs. As more intelligence is put in the modelling, more intelligence must be put in the validation, as reminded by Leon Bottou. Along this way, generative models will be used to support the design of "what if" scenarios, to enhance anomaly detection and monitoring via refined likelihood criteria.

Several recent, on-going, or submitted projects witness the links of TAU members with experts from application domains: in High Energy Physics (LAL, CERN), in space weather (CWI), in anomaly detection (Thalès ThereSIS), and, within the ADAMME project (FUI 2016), in automatic image labelling (Armadillo), and in yield management (VoyagesSncf.com Technologies).

3.5. Transverse Activity: Organisation of Challenges

Challenges have been an important drive for Machine Learning research for many years, and TAO members have played important roles in the organization of many such challenges: Michèle Sebag was head of the challenge programme in the Pascal European Network of Excellence (2005-2013); Isabelle Guyon, as mentioned, was the PI of many challenges ranging from causation challenges [69], to AutoML [70]. The Higgs challenge [55], most attended ever Kaggle challenge, was jointly organized by TAO (C. Germain), LAL-IN2P3 (B. Kegl) and I. Guyon (not yet at TAO), in collaboration with CERN and Imperial College. The challenge activity continue d within TAU, in relation with fundamental and applied issues.

TAU is particularly implicated with the ChaLearn Looking At People (LAP) challenge series in computer vision, in collaboration with the University of Barcelona [46]. Notably in 2017, TAU co-organized several international LaP challenges:

- ChaLearn Looking at People (LAP) - Job Candidate Screening Coopetition [21]. In conjunction with IJCNN 2017 workshop on explainability in machine learning.
- ChaLearn LAP Real Versus Fake Expressed Emotion Challenge (ICCV 2017) [30].
- ChaLearn LAP Large-scale Continuous Gesture Recognition Challenge (ICCV 2017) [30].
- ChaLearn LAP Large-scale Isolated Gesture Recognition Challenge (ICCV 2017) [30].

TAU was also implicated in organizing a follow up of the AutoML challenge for the PAKDD conference. TAU also co-organized local events (hackathons), as “rehearsals” of international competitions in preparation:

- Spatio-temporal time series challenges for the European See.4C challenge about Energy Management (Paris, 14/2/2017, and Toulon, 22/4/2017). Book with Sprimger in preparation.
- Track ML: tracking particles in high energy physics (Orsay, 21/3/2017) [16].

The Codalab challenge platform, originally designed within Microsoft Research with Isabelle Guyon as one of the PIs, has now been migrated to U. Paris-Sud. It is an open source project. Part of the development is supported by Isabelle Guyon’s Paris-Saclay chair (co-funded by Inria). Codalab’s user base has been steadily growing. At the end of 2017, we now have over 10’000 users who have entered more than 480 challenges (145 of which are public).

This year, there was a major upgrade of Codalab, featuring:

- A step-by-step Wizard to guide beginner challenge organizers through the process of organizing challenges. This Wizard facilitates the work of students learning to organize challenges.
- Use of dockers and queues, allowing challenge participants to easily use their own computer resources in the backend to support challenges with code submissions.
- A modular competition logic, which will enable supporting new types of challenges such as reinforcement learning competitions.

4. Application Domains

4.1. Energy Management

Energy management has been one of our priority application fields since 2012, under the lead of Olivier Teytaud. The first works were concerned with sequential decision making, and were based on TAO experience in games, in particular GO, starting with the Associated Team (EA) with Tainan (Taiwan) and the Inria ILAB Metis, in collaborations with SME Artelys. This collaboration continued to be very fruitful, with the ADEME BIA project POST (2014-2017), about long-term investments in power systems, and the ADEME BIA NEXT, that started in April 2017 for 4 years, about the optimization of local grids (at the city or region level). Another line of research is addressed in collaboration with RTE, the company that manages the global French electric network, through Benjamin Donnot’s CIFRE PhD.

The collaboration with Artelys had moved from sequential decision making in the Metis ILAB to reinforcement learning, and the design of the Direct Policy Search approach to handle non-anticipativity, in the POST project. Currently, the NEXT project is concerned with the optimization of local networks to meet customer demand, and hightlights the need for an accurate, robust, and fast simulator (Big Data), and some efficient modeling of the demand (Small Data). This is the topic of Victor Berger's PhD (started Oct. 2017). Another issue is directly related to the network optimization - and the optimal setting (possibly online) of graph optimization algorithms, which this is the topic of Herilalaina Rakotoarison's PhD, started Nov. 2017.

The on-going collaboration with RTE is about learning the parries in reaction to network or demand changes to enforce the "n-1" security constraint: at any time, the failure of any of the 30000 links in the network should preserve the security constraints. Logs of network operations over many years are available, but without any "parry" label. This can be achieved by simulating what would have happened without that particular operations regarding the n-1 constraint. The available network simulator is far too slow and sensitive to noise to be useful here. Modeling the network using Deep Networks is straightforward, for a given topology, though computationally costly. The challenge is to take into account the tolopology so that the n-1 constraint can be quickly checked with a single network. The first results on a small grid (118 nodes) outperform the classical DC approximation while providing a significant speedup in calculations [42]. Further works include scaling up, and incorporating all the intricacies of real data.

Several other energy-related works have been, or will be addressed [20], including the organization of a large scale challenge funded by the EU, which was endowed with 2 million euros in prizes (Isabelle Guyon co-organizer), in the context of the EU project See.4C. The participants are asked to predict the power flow on the entire French territory over several years. This challenge will be followed by a challenge in reinforcement learning (RL), in the context of Lisheng Sun's PhD thesis (started Oct. 2016), who is now working on the problem of RL and Automatic Machine Learning (reducing to the largest possible extend human intervention in reinforcement learning). Another direction being explored is the use of causal models to improve explainability of predictive models in decision support systems (Inria-funded post-doc Berna Batu). This should allow us making more intelligible suggestions of corrective actions of operators to bring network operations back to safety when incidents or stress occur.

4.2. Computational Social Sciences: Toward AI Fairness

Several TAU projects are related to computational social and economic sciences. This activity is at the core of the French DataIA *Institut de Convergence*, (head Nozha Boujemaa), gathering 19 partners in the Paris-Saclay area to explore the scientific and ethical impacts of data science and artificial intelligence on the academic, industrial and societal sectors.

Many projects in the domain are related to Causal Modelling (see Section 7.1.1). Some are internal to our team; others involve collaborations with external partners, with a transfer dimension. Others are closely related to some Software platform and are desribed in the corresponding Sections (io.datascience, Section 6.1 and Catolabe, Section 6.3).

- AmiQap (Philippe Caillou, Isabelle Guyon, Michèle Sebag, Paola Tubaro, started 2015). The multivariate analysis of state questionaire data relative to the quality of life at work, in relation with the socio-economical indicators of firms, aims at investigating the relationship between quality of life and economic performances (conditionally to the activity sector), in collaboration with the RITM (U. Paris-Sud), SES (IMTelecom) and La Fabrique de l'Industrie, on data gathered by the Ministry of Labour (DARES). AmiQap is a motivating application for the Causal Modelling studies (PhD Divyan Kalainathan; post-doc Olivier Goudet; coll. David Lopez-Paz, Facebook AI Research).
- Collaborative Hiring (Philippe Caillou, Michèle Sebag, started 2014). Thomas Schmitt's PhD, started in 2014, aims at matching job offers and resumes viewed as a collaborative filtering problem. An alternative approach based on Deep Networks has been developped by François Gonard within his IRT SystemX PhD. The study has been conducted in cooperation with the Web hiring agency Qapa and the non-for-profit organization Bernard Gregory.

- U. Paris-Saclay Nutriperso IRS (Philippe Caillou, Flora Jay, Michèle Sebag, Paola Tubaro) aims to uncover the relationships between health, diets and socio-demographic features. The ultimate goal is to provide personalized *acceptable* recommendations toward healthier eating practices. A milestone is to uncover the causal relationships between diet and health (coll. INRA, INSERM, CEA).
- RESTO (Paola Tubaro, Philippe Caillou). A study of transformations brought about by digital platforms and their effects on the restaurants sector, using a mix of methods that includes both agent-based simulations and machine learning, and fieldwork.
- Sharing Networks (Paola Tubaro, started 2016). Mapping the "collaborative economy" of internet platforms through social network data and analysis.
- OPLa - DiPLab (Paola Tubaro). Two related projects investigating the economy of micro-work platforms in France, and how they integrate with the AI industry ecosystem.

Scientific challenges are related to the FAT (Fairness, Accountability and Transparency) criteria: Metric learning, where the distance/topology to be learned must reflect prior knowledge (e.g. ontologies); Interpretation of clusters built from heterogeneous textual and quantitative data, using the learnt metric/distance; Integration of the human-in-the-loop ("dire d'experts"); Assessment of the models w.r.t. their causality (as opposed to their predictive accuracy) in order to support further interventions.

4.3. High Energy Physics (HEP)

The project started in 2015 with the organization of the Higgs boson ML challenge, in collaboration with the Laboratoire de l'Accelerateur Lineaire (LAL) (David Rousseau and Balazs Kègl) and the ATLAS and CMS projects at CERN. These collaborations have been at the forefront of the broadening interaction between Machine Learning and High Energy Physics, with co-organisation of the Weizmann Hammers and Nails 2017 workshops [44], DataScience@HEP at Fermilab and the Connecting The Dots series.

1. **SystML** (Cécile Germain, Isabelle Guyon, Michèle Sebag, Victor Estrade, Arthur Pesah): Experimental data involve two types of uncertainties: statistical uncertainty (due to natural fluctuations), and systematic uncertainty (due to "known unknowns" such as the imprecise characterization of physics parameters). The SystML project aims to deal with experimental uncertainties along three approaches: i) better calibrating simulators; ii) learning post-processors aimed to filter out the system noise; iii) anticipating the impacts of systematic noise (e.g., on statistical tests) and integrating this impact in the decision process.

   V. Estrade's PhD, focusing on the second approach, searches for new data representations insensitive to system-related uncertainty. Taking inspiration from the domain adaptation literature, two strategies have been investigated: i) an agnostic approach based on adversarial supervised learning is used to design an invariant representation (w.r.t. the physics parameters); ii) a prior knowledge-based approach.
2. **TrackML** (Cécile Germain, Isabelle Guyon):
   A Tracking Machine Learning challenge (TrackML) [79], [51] is being set up for 1T 2018. Current methods used employed for tracking particles at the LHC (Large Hadron Collider) at CERN will be soon outdated, due to the improved detector apparatus and the associated combinatorial complexity explosion. The LAL and the TAU team have taken a leading role in stimulating both the the ML and HEP communities to renew the toolkit of physicists in preparation for the advent of the next generation of particle detectors.

   TrackML refers to recognizing trajectories in the 3D images of proton collisions at the Large Hadron Collider (LHC) at CERN. Think of this as the picture of a fireworks: the time information is lost, but all particle trajectories have roughly the same origin and therefore there is a correspondence between arc length and time ordering. Given the coordinates of the impact of particles on detectors (3D points), the problem is to "connect the dots" or rather the points, i.e. return all sets of points belonging to alleged particle trajectories [16]. From the machine learning point of view, beyond simple clustering, the problem can be treated as a latent variable problem, a tracking problem, or a pattern de-noising problem. A very large dataset (100GB) has been built by the Atlas and CMS collaborations specifically for the challenge.

TrackML will be conducted in 2 phases, the first one favoring innovation over efficiency and the second one aiming at real-time reconstruction. The challenge is supported by Kaggle.

4.4. Autonomous Vehicle

This new application domain builds in fact upon former collaborations of the TAO team with the automotive industry, that created the links with some of the researchers of the R&D departments of Renault (within the Systematic CSDL project and the SystemX ROM project (François Gonard's PhD) and PSA (M. Yagoubi's PhD [84], [85]).

The current work, in collaboration with Renault, is related to the safety of the autonomous vehicle. The validation of the software system is today based on statistics of incidents (failures of some automatized component) assessed from millions of hours of 'driving', either by human drivers in real cars, or by simulations. The work for TAU is related to the set of sample scenarii that are used to compute these statistics. This will require in the first place to identify some latent representation space common to both the actual real-life experiments and the results of the simulation, something that will be achieved using Deep Auto-Encoders of the time series recording the experiments. Two works have started this Fall:

- How to assess the representativity of current set of scenarii, and identify new scenarii to be fed into the simulator to improve the coverage of the scenario space in the common latent representation space, and is the goal of the yet-to-be-signed POC with Renault (Raphaël Jaiswal is working on Renault data since September 2017);
- How to identify original scenarii that lead to failures, an optimization problem in the scenario space. Several criteria for failures will be considered (e.g., getting too close to the preceding car), and the optimization will most likely require building a surrogate model of the simulator for each chosen criterion (and here again Deep Networks are a good candidate), due to its high computing time. This is the topic of Marc Nabhan's CIFRE PhD, started in October 2017 (after a 3 months internship).

4.5. Population Genetics

Work in this application domain started recently, with two main lines of research : dimension reduction of genetic datasets and prediction tasks using genetic data (such as the prediction of past human demography).

- Flora Jay collaborated with Kevin Caye and colleagues (TIMC-IMAG, Grenoble) who developed an R package for inferring coefficients of genetic ancestry, using matrix factorization, alternating quadratic programming and projected least squares algorithms [4]. The extension of ancestry inference and visualization methods to temporal data (for paleogenetics applications) remains to be done.
- The demographic history of one or several population (of any organism) can be partially reconstructed using modern or ancient genetic data. A common approach in the population genetics field is to simulate pseudo-datasets for which the demographic parameters are known and summarize them into handcrafted features. These features are then used as a reference panel in an Approximate Bayesian Computation (likelihood-free) framework. Flora Jay has been developping such methods for the application to whole-genome data [14] [60].
- An untackled challenge in the field is to skip the summary step and directly handle raw data of genetic variations. Théophile Sanchez, who did a 6 month internship in TAU, started his PhD in October 2017 and is currently designing deep learning architectures that are suitable for multi-genome data [33]. In particular these networks should be invariant to the permutation of indiviual genomes and flexible to the input size (see Section 7.2.7).

5. Highlights of the Year

5.1. Organisation and Distinctions

- Isabelle Guyon, General Chair, **NIPS 2017** in Los Angleles (8000+ attendees). She also co-organized several workshops (two *See.4C* workshops, *Connecting the dots* at LAL, *AutoML* a ICML, BayLearn, and CiML at NIPS).
- Flora Jay co-organized **JDSE17**, the second edition of the Junior Conference on Data Science and Engineering, Paris-Saclay (September 2017).
- Yann Ollivier coordinated several events in France (workshop, public conferences, initiatives with school teachers, ...) related to **Shannon100**, the celebration of the Claude Shannon's hundredth birthday, a world-wide event. In particular he created a public exhibit that took place from December 2016 to April 2017 in the Musee des Arts et Metiers in Paris, with extremely positive feedback.
- Marc Schoenauer, expert with Cédric Villani for his national mission on the French AI strategy.
- Michèle Sebag, elected at the *Académie Française des Technologies*; ephemeral nominated member of the *Conseil National du Numérique* (Dec. 2017); member of TransAlgo; head of the DataIA Research programme.
- Paola Tubaro organized **RECSNA17**, an international conference on Recent Ethical Challenges in Social Network Analysis with support from Maison des Sciences de l'Homme Paris-Saclay and Institute for Advanced Studies, in partnership with British Sociological Association, Association Française de Sociologie and European Network on Digital Labor.

5.2. Awards and Prizes

- **AS-AC-CMA-ES Winner**, single objective track at **BBComp**, the Black Box Competition for continuous optimization at ACM-GECCO 2017 (July, Berlin). Nacim Belkhir, Johann Dréo, Pierre Savéant and Marc Schoenauer.
- **ASAP** V2 and V3 [23] ranked **first and second** at the **Open Algorithm Selection Challenge 2017** (see the official results – slide 22). François Gonard, Marc Schoenauer, and Michèle Sebag.

BEST PAPER AWARD:

[28]
Y. OLLIVIER, G. MARCEAU-CARON. *Natural Langevin Dynamics for Neural Networks*, in "GSI 2017 - 3rd conference on Geometric Science of Information", Paris, France, Springer Verlag, November 2017, vol. 10589, pp. 451-459, https://arxiv.org/abs/1712.01076 - Best Paper Award [*DOI :* 10.1007/978-3-319-68445-1_53], https://hal.archives-ouvertes.fr/hal-01655949

6. New Software and Platforms

6.1. io.datascience

Input Output Data Science
KEYWORDS: Open data - Semantic Web - FAIR (Findable, Accessible, Interoperable, and Reusable)
FUNCTIONAL DESCRIPTION: io.datascience (Input Output Data Science) is the instance of the Linked Wiki platform developed specifically in Paris-Saclay University as part of its Center for Data Science.

The goal of io.datascience: to facilitate the sharing and use of scientific data. The technological concept of io.datascience: the exploitation of semantic web advances, and in particular wiki technologies.

One of the grand challenges of data-intensive science is to facilitate knowledge discovery by assisting humans and machines in their discovery of, access to, integration and analysis of, task-appropriate scientific data and their associated algorithms and workflows. The guiding principles for this challenge have been defined: Data should become FAIR (Findable, Accessible, Interoperable, and Reusable) (Wilkinson, M., and The FAIR Guiding Principles for Scientific Data Management and Stewardship, Nature Scientific Data 2016)

io.datascience is both a data sharing platform and a framework for further development. It realizes a practical implementation of FAIR principles through a user-centric approach. • Share: Software users can declare the sources of the data they use as well as their query requests. • Discover: Using a form, users can link their data sources to each other. The repository used is that of Wikidata. The user can then retrieve his data sources and example queries through a search interface or directly through Google and Wikipedia. • Reuse: data is identified and qualified, a simple interface allows the user to provide the desired level of description for the data they refer to, as well as examples of use. • Analyze: io.datascience will soon be proposing the creation of RDF databases on the cloud on the cloud of Paris Sud University.

- Partners: Border Cloud - Paris Saclay Center for Data Science - Université Paris-Sud
- Contact: Cécile Germain-Renaud
- Publications: Data acquisition for analytical platforms: Automating scientific workflows and building an open database platform for chemical anlysis metadata - A platform for scientific data sharing - TFT, Tests For Triplestores - Une autocomplétion générique de SPARQL dans un contexte multi-services - Certifying the interoperability of RDF database systems - Transforming Wikipedia into an Ontology-based Information Retrieval Search Engine for Local Experts using a Third-Party Taxonomy - The Grid Observatory 3.0 - Towards reproducible research and open collaborations using semantic technologies
- URL: https://io.datascience-paris-saclay.fr/

6.2. Codalab

KEYWORDS: Benchmarking - Competition
FUNCTIONAL DESCRIPTION: Challenges in machine learning and data science are competitions running over several weeks or months to resolve problems using provided datasets or simulated environments. Challenges can be thought of as crowdsourcing, benchmarking, and communication tools. They have been used for decades to test and compare competing solutions in machine learning in a fair and controlled way, to eliminate “inventor-evaluator" bias, and to stimulate the scientific community while promoting reproducible science. See our slide presentation.

As of december 2017 there are 145 public competitions on Codalab and over 10000 users. Some of the areas in which Codalab is used include Computer vision and medical image analysis, natural language processing, time series prediction, causality, and automatic machine learning. Codalab was selected for the million Euro challenge See.4C that was awarded a H2020 EU grant for its organization.

TAU is going to continue expanding Codalab to accommodate new needs. One of our current focus is to support use of challenges for teaching (i.e. include a grading system as part of Codalab) and support for hooking up data simulation engines in the backend of Codalab to enable Reinforcement Learning challenges and simulate interactions of machines with an environment. For the third year, we are using Codalab for student projects. M2 AIC students create mini data science challenges in teams of 6 students. L2 math and informatics students then solve them as part of their mini projects. We are collaborating with RPI (New York, USA) to use this platform as part of a curriculum of medical students. Our PhD. students are involved in co-organizing challenges to expose the research community at large with the topic of their PhD. This helps them formalizing a task with rigor and allows them to disseminate their research.

- Partner: Microsoft
- Contact: Isabelle Guyon
- URL: http://competitions.codalab.org

6.3. Cartolabe

KEYWORD: Information visualization
FUNCTIONAL DESCRIPTION: The goal of Cartolabe is to build a visual map representing the scientific activity of an institution/university/domain from published articles and reports. Using the HAL Database and building upon the AnHALytics processing chain, Cartolabe provides the user with a map of the thematics, authors and articles and their dynamics along time. ML techniques are used for dimensionality reduction, cluster and topics identification, visualisation techniques are used for a scalable 2D representation of the results.
NEWS OF THE YEAR: Improvement of the graphical interface

- Contact: Philippe Caillou
- URL: http://cartolabe.lri.fr/

7. New Results

7.1. Causality, Explainability, and Reliability

As said, the fairness, accountability and transparency of AI/ML need be assessed, measured and enforced to address the ethical impacts of data science on industry and society. TAU has started working toward improving the confidence in ML algorithms through three research directions.

7.1.1. Causality

Links between quality of life at work and company performance Within the Amiqap project, a new approach to functional causal modeling from observational data called *Causal Generative Neural Networks* (CGNN) has been developed [45]. CGNN learns a generative model of the joint distribution of the observed variables, by minimizing the Maximum Mean Discrepancy between generated and observed data. An approximate learning criterion scales the computational cost of the approach to linear complexity in the number of observations. CGNN extensions, motivated by the redundancy of real-world variables, are under-going to achieve a causal model of the corporate- and human resource-related variables at the firm and economic sector levels.

Generating Medical Data This project, in collaboration with RPI (New York), aims to provide medical students with case studies, generated using CGNN . and fully preserving their confidentiality. We are exploring the benefits of using data generated by CGNNs in replacement for real data. Such data will preserve the structure of the original data, but the patient records will not represent real patients.

Missing Data Missing and corrupted data is a pervasive problem in data modeling. Our interest in this problem stems from 2 applications: epidemiology (in collaboration with Alain-Jacques Valleron, INSERM, and RPI New York) and computer vision (in collaboration with Aix-Marseille University and University of Barcelona). As it turns out, missing data is a causality problem [80]. In a paper under review, we outline the danger of imputing values in risk factor analysis in the presence of missing data. We are also preparing a challenge on the problem of "inpainting" to restore images with occlusions and to eliminate captions in movies.

Power Networks Berna Batu (post-doc Inria) explores causal modeling in time series to explain cascades of events. Other applications (e.g., in epidemiology) may develop from this approach.

7.1.2. Explainability

Explainable Machine Learning for Video Interviews [21]. The challenge consisted in analyzing 15s videos, (human) annotated with the Big Five persinality traits (Openness to experience, Conscientiousness, Extroversion, Agreableness, and Neurotism – sometines referred to as OCEAN features). Human annotators also voted whether a given candidate should be invited for an interview. As organizers we provided a strong baseline system, which was based on deep learning methods having won part challenges. Onty the winners outperformed quantitatively the basline method.

The winner of the prediction challenge (BU-NKU) performed a very sophisticated analysis, combining face analysis (from the entire video) and scene analysis (from the first image), both analyses contributing to the final decision. Face analysis extracted spatio-temporal featured from a pre-trained convolutional neural network (CNN) and using Gabor filters. Scene analysis features were also extracted with a pre-trained CNN. Acoustic features were extracted with the OpenSMILE tool. From the feature set, the personality traits are predicted with kernel ridge regression and from there on, the "invite for interview" is predicted using Random Forests.

For the explainability challenge, the BU-NKU team performed final predictions with a classifier based on binarized predicted OCEAN scores mapped to the binarized ground truth using a decision tree, a self-explanatory model that can be converted into an explicit recommender algorithm, using the trace of each decision from the root of the tree to the leaf. The verbal explanations are finally accompanied with the aligned image from the first face-detected frame and the bar graphs of corresponding mean normalized scores. Trained on the predicted OCEAN dimensions, this gave over 90% classification accuracy.

Note that another team (TUD), who did not enter the quantitative competition, nevertheless won forst place ex-aequo with the BU-NKU team on the explainability challenge. Interestingly, they added facial features (using OpenFace) and text features (using published "Readability" features) in an effort to capture level of education from the sophistication of language, which was not captured by personality traits. They then used PCA to reduce dimention, and the coefficients of a linear regression model, fed back into the PCA model to generate explanations.

Skin image classification Also, the on-going collaboration with Roman Hossein Khonsari, surgeon at Necker hospital, is continuing, on the topic of skin disease image classification, with the goal of explaining how the trained neural networks produce their predictions, in order to be trusted by users. For this, we analyse the features that are learned, and show which ones are found in each image example.

7.1.3. Model systematic bias and reliability

A related problem is the reliability of models and their robustness to bias. We initiated research on this topic in the context of eliminating bias of Hight Energy Physiscs simulators. Discovering new particules relies on making accurate simulations of particle traces in detectors to diagnose collision events in high energy experiments. We are working on data from the ATLAS experiment at CERN, in collaboration with David Rousseau at the Laboratoire de l'Accelerateur Lineaire (LAL). We produced two preliminary studies on this topic: Adversarial learning to eliminate systematic errors: a case study in High Energy Physics [32] and Robust deep learning: A case study [43].

This line of research will extend to the calibration of other simulators, particularly energy transport and distribution simulators and medical data simulators, which we are working on in the context of other projetcs.

Beyond the calibration of simulators, we are also interested in using such approaches to forter fairness and de-bias data. For instance, in the "personality trait" data mentionned in the previous section, our analysis shows that labelers are biased favorably towards females (vs. males) and unfavorably towards African-American (vs. Caucasian or Asian).

7.2. Deep Learning and Information Theory

7.2.1. Convergence proofs for recurrent networks

Pierre-Yves Massé, in his PhD, defended Dec.2017 under the supervision of Yann Ollivier [3], obtained the very first rigorous results of convergence for online training of recurrent neural networks, by viewing them from the viewpoint of dynamical systems.

7.2.2. Fast algorithms for recurrent networks

Corentin Tallec (in his on-going PhD) and Yann Ollivier produced a new, faster algorithm for online training of recurrent networks, UORO, which is guaranteed to converge locally, and requires only linear time [49].

7.2.3. An explanation for LSTMs

The LSTM structure is currently the most popular recurrent network architecture. However, it is quite complex and very much ad hoc. Corentin Tallec (in his on-going PhD) and Yann Ollivier derived this architecture from first principles in a very simple axiomatic setting, simply by requiring that the model is invariant to arbitrary time deformations (such as accelerations, decelerations) in the data.

7.2.4. Bayesian neural networks

The Bayesian approach to neural networks makes several suggestions. First, it suggests to artificially add a very specific amount of noise during training, as a protection against overfit. This has to be done carefully (Langevin dynamics) in relation with the Fisher information metric. Gaetan Marceau-Caron and Yann Ollivier demonstrated that this approach can be applied efficiently for neural networks [28] (Best paper award at GSI17).

Second, a Bayesian viewpoint can help select the right size for each layer in a neural network. A comparison to a theoretical model of an infinitely large network suggests ways to adapt learning rates and criteria to select or deselect neurons or even layers (Preliminary results in a preprint by Pierre Wolinski (PhD), Yann Ollivier and Guillaume Charpiat, in preparation.)

7.2.5. Kalman filtering and information geometry

Filtering and optimization have been brought much closer by the following result [48]: the natural gradient in optimization is mathematically fully identical to the Kalman filter, for all probabilistic (machine learning) models. Even though both methods had been known for decades and were an important reference in their respective fields, they had not been brought together. The result extends to the non-iid setting (recurrent neural networks).

7.2.6. Computer vision

The activity of computer vision is run jointly with the program of Looking at People (LaP) challenges [46]. We edited a book in Springer, which is a collection of tutorials and papers on gesture recognition [54], to which we contributed a survey chapter on deep-learning methods [34] a shorter version of which was published at the FG conference [17].

Several papers were published this year analyzing past LAP challenges. The "first impressions" challenge aimed at detecting personality traits from a few seconds of video. In [8], we demonstrate how deep residual networks attain state-of-the art performance on that task and lend themselves well to identifying which parts of the image is responsible for the final decision (interpretability). We also analyzed last years' challenge on apparent age estimation from in still images and proposed improvements with deep residual networks [15]. A similar methodology based on deep-residual networks was applied to apparent personality trait analysis [24], [8].

7.2.7. Flexible deep learning architectures suitable to genetic data

Genetic data is usually given in the form of matrices, one dimension standing for the different individuals studied and the other dimension standing for the DNA sites. These dimensions vary, depending on the indivual sample size and on the DNA sequence length. On the other side, standard deep learning architectures require data of fixed size. We consequently search for suitable, flexible architectures, with as an application the prediction of the demographic history of a population given its genetic data (changes in the number of individuals through time). Théophile Sanchez, now PhD student, presented his work at the Junior Conference on Data Science and Engineering at Paris-Saclay [33]. To our knowledge this is the first attempt in the population genetics field to learn automatically from the raw data.

7.2.8. *Image segmentation and classification*

Emmanuel Maggiori, PhD student in the Titane team, Inria Sophia-Antipolis, mainly supervised by Yuliya Tarabalka, and co-supervised by Guillaume Charpiat, defended his PhD thesis [73], on the topic of remote sensing image segmentation with neural networks. This year, an architecture for proposed to be able to deal with high resolution images; a benchmark was built and made public (as there is lack of those in the remote sensing community); and the output of segmentation predictions was turned into a vectorial representation by suitable automatic polygonization [9], [25], [26].

Through a collaboration with the company Armadillo within the ADAMme project, we have also worked on image classification with multiple tags. The database consists of 40 millions images, with thousands of different possible tags (each image is on averaged associated with 10 tags). We started from a ResNet pre-trained network and adapted it to our task. A demonstration of our results was performed at the annual review meeting of the project.

7.2.9. *Non-rigid image alignment*

Automatic image alignment was also studied. In remote sensing, the task consists in aligning satellite or aerial images with ground truth data such as OpenStreetMap's cadastrial maps. This task is crucial in that such ground truth data is actually never well registered but is spatially deformed, preventing any further use by machine learning tools. Based on the analysis of multiple scale classical frameworks, a deep learning architecture was proposed to perform this task. This work is currently under submission to CVPR. On a related topic, in a collaboration with the start-up company Therapixel, we have been studying the registration of 3D medical images, but without any ground truth or template.

7.2.10. *Video analysis*

Time coherency is usually poorly handled in video analysis with neural networks. We have studied, on 3 different applications, different ways to take it better into account. First, in a collaboration with the Vision Institute, we studied different ways of incorporating neural networks in reinforcement learning approaches for the tracking of microbes with a motorized microscope. Second, in a collaboration with the SATIE team, we worked on the incorporation of optical flow for crowd density estimation, and, finally, in a collaboration with the Parietal team, we study how to link brain fMRI signals to the videos people are watching.

7.3. Algorithm Selection and Configuration

Automatic algorithm selection and configuration (hyper-parameter selection) depending on the problem instance at hand is a pervasive research topic in TAO, for both fundamental and practical reasons: in order to automatically deliver a peak performance on (nearly) every new problem instance, and to understand the specifics of a problem instance and the algorithm skills w.r.t. these specifics.

7.3.1. *Algorithm recommendation*

A collaborative filtering approach called Alors (Algorithm Recommender System) has been proposed to achieve algorithm selection [10], considering after [81] that a problem instance "likes better" algorithms with good performances on this instance. Alors, tackling a cold-start recommendation problem, enables to independently assess the quality of the benchmark data (representativity of the problem instances w.r.t. the algorithm portfolio) and the quality of the meta-features used to describe the problem instances. Experiments on SAT, CSP and ML benchmarks yield state-of-art performances in the former two domains; these good results contrast with the poor results obtained on the ML domain, blamed on the comparatively poor quality of the ML meta-features.

7.3.2. *AutoML and AutoDL*

Isabelle Guyon has organized the AutoML challenge (paper in preparation), proposing a series of algorithm selection and configuration problems of increasing difficulty. Following this successful challenge, a new challenge will be organized in collaboration with Google Zurich, specifically targeting the selection of deep network architectures (AutoDL: Automatic Deep learning) in five domains: Image; Video; Audio; Text; Customer demographic descriptors.

The expected result of the challenge is to alleviate the burden on data scientists to design a good architecture ("black art"), and to enforce the reproducibility of the results. In particular, this challenge will encourage advances regarding a few key research questions:

- How to make optimization algorithms more efficient without introducing more tunable parameters?
- How to efficiently automate the tuning of many hyper-parameters?
- How to automatically design or optimize a network architecture for a particular problem?
- How to further automate the learning process by directly learning how to learn?

7.3.3. Per Instance Algorithm Configuration for Continuous Optimization

Nacim Belkhir's PhD thesis (defended on Nov. 30., 2017) was centered on PIAC (Per Instance Algorithm Configuration) in the context of continuous optimization. After a detailed study of features that had been proposed in the litterature, he studied the dependency of the PIAC results on the size of the sample on which they are computed. The rationale is that you must take into account the number of function evaluations that are used to compute the features when addressing a new target instance. He demonstrated that PIAC based on very small sample sets (down to 50 times the dimention) can nevertheless help improving the overall results of the optimization procedure [18], in particular by winning the single-objective track of the GECCO 2017 Black Box Competition.

7.3.4. Feature-based Algorithm Selection in Combinatorial Optimization

In the first part of his PhD (to be defended in Feb. 2018, see also Section 4.2), François Gonard designed ASAP, an Algorithm Selection algorithm that combines a global pre-scheduler and a per instance algorithm selector, to take advantage of the diversity of the problem instances on one hand and of the algorithms on the other hand. ASAP participated to two competitions: the 2016 ICON challenge [35], in which it obtained a *Special Mention* for its originality (and obtained excellent results on half of the problems); the 2017 OASC challenge where two versions of ASAP obtained the first overall best performances [23].

7.3.5. Deep Learning calibration

In a starting collaboration with Olivier Teytaud (who left TAO for Google Zurich in 2016), we proposed [40] an online scheme for Deep Learning hyper-parameter tuning that detects and early-stops unpromising runs using extrapolation of learning curves [64], taking advantage of the parallelism, and offering optimality guarantees within the multiple hypothesis testing framework.

7.3.6. Learning Rate Adaptation in Stochastic Gradient Descent

Based on an analogy with CMA-ES step-size adaptation (comparison with random walks), an original mechanism was proposed for adapting the learning rate of the stochastic gradient descent [52]. As increasing the learning rate can increase the number of catastrophic events (exploding gradients or loss values), a change detection test is used to detect such events and backtrack to safe regions. First experiments on small size problems (MNIST and CIFAR10) validate the approach. Interestingly, the same mechanism can be applied to the Adam optimizer and also improves on its basic version.

7.3.7. Domain Adaptation

The subject of V. Estrade's PhD is to advance domain adaptation methods in the specific context of uncertainty quantification and calibration in High Energy Physics analysis. The problem consists of learning a representation that is insensitive to perturbations induced by nuisance parameters. The need for the adversarial techniques, assuming a completely knowledge-free approach, has been questioned. Our results [32], [43] contrast the superior performance of incorporating a priori knowledge (Tangent Propagation approach) on a well separated classes problem (MNIST data) with a real case setting in HEP.

7.4. Generative Models and Data-driven Design

Learning generative models from observational data faces two critical issues: model selection (defining a loss criterion well suited to the considered distribution space) and tractable optimization.

7.4.1. A Statistical Physics Perspective

Restricted Boltzmann machines (RBM) define generative models, and advanced mean field methods of statistical physics can be leveraged to analyze the learning dynamics. Giancarlo Fissore's Master thesis (now in PhD), co-supervised by Aurélien Decelle and Cyril Furtlehner, has characterized the information content of an RBM from its spectral properties and derived a phenomenological equation of the learning process by means of the spectral dynamics of the weight matrix [5]. The learning dynamics has been analyzed in both linear and non-linear regimes, investigating the impact of the input data.

Secondly [37], the weight matrix ensemble which results from this spectral representation is used to analyze the thermodynamical properties of RBMs in terms of a phase diagram. The conditions for the RBM training, interpreted as a so-called ferromagnetic compositional phase, are given. Ferromagnetic order parameters are identified in the aforementionned phenomenological equation; a closed-form is obtained through explicit integration in simple cases, yielding a behavior of the learning spectral dynamics that matches the actual dynamics of standard RBM training (e.g. using contrastive divergence). After this model, a repulsive interaction takes place among the singular modes of the weight matrix, as some pressure of the lower modes is exerted on higher modes along training. Remarkably, this repulsive interaction is observed in algorithmic experiments for low learning rates.

7.4.2. Functional Brain Dynamics

Generative models have also been used by Aurélien Decelle and Cyril Furtlehner to model the dynamics of the Functional conectome (FCD) in the context of the BRAINTIME exploratory project, along two lines.

On the one hand, Restricted Boltzmann Machines have been used to learn the statistics of the time-varying resting state BOLD activity of 49 human subjects in the age span of 18 to 80 years. RBM models trained on a *per* individual basis show at least two statistically distinct pure states for each subject, between which resting state activity is stochastically wandering. Through mean-field TAP approximations of free energy we have evaluated the energy barrier between these two states *per* individual. Interestingly young and old individuals have different switching statistics: more regular for young subjects *vs* bursty and temporally irregular for elderly subjects. Furthermore, the switching probability is correlated with the energy difference between the two pure RBM states, opening the way to a personalized "landscape" analysis of the resting state FCD.
On the other hand, extremely sparse precision matrices describing the co-activation statistics of different brain regions during resting state based on BOLD time-series have been derived using sparse Gaussian copula models. Such extremely sparse models support direct inter-subject comparisons, in contrast with usually dense FC descriptions. A further step is to characterize the brain activity dynamics, e.g. through considering multi-temporal slice models.

7.4.3. Power systems Design and Optimization

Last work within the POST project, Vincent Berthier's PhD [2] addressed issues in global continuous optimization, and proposed to use unit commitment problems to go beyond classical benchmarks of analytical functions.

Benjamin Donnot (RTE Cifre PhD, now under Isabelle Guyon's supervision), successfully started to disseminate his work in the power system community [20]. His main results regard the design of an original alternative to the one-hot encoding for the topology of the French power grid, termed *Guided Dropout*. Taking advantate of the high redundancy of network connections, the idea is to learn a random mapping between all possible "n-1" topologies and the connections of the neurons [65], [42].

7.4.4. Multi-Objective Optimization

Dynamic Objectives: Within the E-Lucid project, coordinated by Thales Communications & Security, the on-going work about anomaly detection in network flow [74] led to an original approach to many-objective problem, where the objectives are gradually introduced, preventing the population to be abruptly driven toward satisficing only the easy objectives at the beginning of the evolution [27] (runner-up for the Best Paper Award of the Evolutionary Multi-Objective track at GECCO 2017).

Dynamic Fitness Cases: In [22], we propose to gradually introduce the fitness cases in the case of symbolic regression with Genetic Programming, so as to guide the search more smoothly. Experimental results demonstrate a better success rate in the case of both static and dynamic problems.

7.4.5. Space Weather Forecasting

In the context of the MDG-TAU joint team project, focusing on space weather forecasting, Mhamed Hajaiej's Master thesis (under Aurélien Decelle, Cyril Furtlehner and Michèle Sebag's supervision) has tackled the prediction of magnetic storms from solar magnetograms, more specifically considering the representation of solar magnetograms based on auto-encoders. Besides finding a well-suited NN architecture, the difficulty was to find a loss function well suited to the data distribution. A next step (Mandar Chandorkar's PhD at CWI under Enrico Camporeale supervision) is to estimate from the solar images the speed of the solar wind, and the time needed for solar storms to reach the first Lagrange point; this estimation is meant to build a well-defined supervised learning problem, associating a solar image at t to its effect measured at $t + \delta$ on the first Lagrange point.

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- **Thales Research & Technology** 2014-2017 (30 kEuros), related to Nacim Belkhir's CIFRE PhD
  Coordinator: Marc Schoenauer
  Participants: Johann Dréo, Pierre Savéant, Nacim Belkhir
- **ESA Tender** 2016-2017 (52 kEuros)
  Coordinator: Bart Boonacker (TNO)
  Participant: Marc Schoenauer, Dejan Tusar
- **Réseau Transport d'Electricité** 2015-2018 (72 kEuros), related to Benjamin Donnot's CIFRE PhD
  Coordinator: Olivier Teytaud (until May 2016), now Isabelle Guyon
  Participants: Benjamin Donnot, Antoine Marot, Marc Schoenauer
- **Therapixel** 2017 (6 mois, 3 kEuros), on the topic of 3D medical image non-rigid registration with neural networks
  Coordinators: Guillaume Charpiat, Olivier Clatz
  Participant: Priyanka Mandikal (master internship)
- **Myndblue**, 2017-2018 (1 an, 50kEuros) related to consulting activities with DMH (Digital for Mental Health).
  Coordinator: Aurélien Decelle
  Participants: all TAU members
- **La Fabrique de l'Industrie** 2017-2018 (1 an, 30kEuros) A COMPLETER (Michéle ?)
- **Renault (POC)** 2017-2018 (125 kEuros), *Clusterisation et optimisation de scenarii pour la validation des véhicules autonomes*
  Coordinator: Marc Schoenauer and Philippe Reynaud (Renault)
  Participants: Guillaume Charpiat, Raphaël Jaiswal (engineer), Marc Schoenauer
- **Renault (CIFRE)** 2017-2020 (45 kEuros), related to Marc Nabhan's CIFRE PhD *Sûreté de fonctionnement d'un véhicule autonome - évaluation des fausses détections au travers d'un profil de mission réduit*
  Coordinator: Hiba Hage and Yves Tourbier (Renault)
  Participants: Guillaume Charpiat, Marc Nabhan (PhD), Marc Schoenauer

- **RESTO** 2017 (14k Euros), *REseaux et Simulations : usages Technologiques et Opinions multiples sur les plateformes numériques dans les marchés de la restauration*, funded by Mission Interdisciplinarité of CNRS. Supported the internship of J. Posada.
Coordinator: Paola Tubaro
Participants: Philippe Caillou (with partners at Telecom ParisTech and Université Paris-Dauphine).
- **OPLa** 2017-2018, Organizing Platform Labor (27k euros), funded by Force Ouvrière.
Coordinator: A.A. Casilli (Telecom ParisTech)
Participants: Paola Tubaro
- **DiPLab** 2017-2018, Digital Platform Labor (24k euros), funded by MSH Paris-Saclay.
Coordinators: Paola Tubaro (avec A.A. Casilli, Telecom ParisTech)

9. Partnerships and Cooperations

9.1. National Initiatives

9.1.1. ANR

- **ACTEUR** 2014-2018 (236kEuros). Cognitive agent development for urban simulations,
Coordinator: P. Taillandier (IDEES, Univ Rouen)
Participant: Philippe Caillou
- **EPITOME** 2017-2020 (225kEuros). Efficient rePresentatIon TO structure large-scale satellite iMagEs,
Coordinator: Yuliya Tarabalka (Titane team, Inria Sophia-Antipolis)
Participant: Guillaume Charpiat

9.1.2. Others

- **ROM***Model Reduction and Multiphysics Optimization* 2014-2017 (50 Keuros)
Coordinator: IRT System X
Participants: Marc Schoenauer, Michèle Sebag, François Gonard (PhD)
- **MAJORE***A Collaborative Filtering Approach to Matching Job Openings and Job Seekers*, 2013-2017 (105 kEuros)
Thomas Schmitt's PhD (funded by ISN).
Participants: Philippe Caillou, Michèle Sebag, Thomas Schmitt (PhD)
- **AMIQAP** 2015-2017 (12 months of Postdoctoral fellow). Qualité de vie au travail.
Project funded by ISN
Partners: Mines-Telecom SES, RITM (Univ. Paris Sud) and *La Fabrique de l'Industrie*
Extended for 6 months in 2018 via a donation from *La Fabrique de l'Industrie*
Participants: Philippe Caillou, Olivier Goudet, Isabelle Guyon, Michèle Sebag, Paola Tubaro, Diviyan Kalainathan (PhD)
- **Nutriperso** 2017-2018, 37 kEuros. Personalized recommendations toward healthier eating practices.
U. Paris-Saclay IRS (*Initiative de Recherche Stratégique*)
Partners: INRA (coordinator), INSERM, Agro Paristech, Mines Telecom
Participants: Philippe Caillou, Flora Jay, Michèle Sebag, Paola Tubaro
- **POST** 2014-2017 (1,220 MEuros, including 500 kEuros for a 'private' cluster). Platform for the optimization and simulation of trans-continental grids
ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie)
Coordinator: ARTELYS
Participants (in 2017, after Olivier Teytaud left): Vincent Berthier (PhD defended in Dec.), Marc Schoenauer

- **E-LUCID** 2014-2017 (194 kEuros)
  Coordinator: Thales Communications & Security S.A.S
  Participants: Marc Schoenauer, Cyril Furtlehner, Luis Marti
- **PIA ADAMME** 2015-2018 (258 kEuros)
  Coordinator: Bull SAS
  Participants (in 2017): Marc Schoenauer, Guillaume Charpiat, Cécile Germain-Renaud, Yasmina Bouzbiba, Etienne Brame
- **CNES contract** 2015-2017 (70 kEuros)
  Coordinator: Manuel Grizonnet (CNES) & Yuliya Tarabalka (Inria Sophia-Antipolis, Titane team)
  Participant: Guillaume Charpiat
- **NEXT** 2017-2021 (675 kEuros). Simulation, calibration, and optimization of regional or urban power grids
  ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie)
  Coordinator: ARTELYS
  Participants Isabelle Guyon, Marc Schoenauer, Michèle Sebag, Victor Berger (PhD), Herilalaina Rakotoarison (PhD), Berna Bakir Batu (Post-doc)
- **BRAINTIME** 2017 (7 kEuros) Défi exploratoire interdisciplinaire de l'appel INFINITE (CNRS) concerning the functional connectome dynamics of the brain.
  Coordinator: Andrea Brovelli (CNRS), Institut de Neurosciences de la Timone (INT)
  Participants Aurélien Decelle, Cyril Furtlehner
- **CDS DeepGenetics** 2017 (6mois, 3k euros), Deep Learning for Population Genetics.
  funded by Center for Data Science
  Coordinators: Flora Jay and Guillaume Charpiat
  Participants: Théophile Sanchez (master internship)

9.2. European Initiatives

9.2.1. FP7 & H2020 Projects

See.4C 2016-2017 (2.7 kEuros). SpatiotEmporal ForEcasting: Coopetition to meet Current Cross-modal Challenges
Participants: Isabelle Guyon

9.2.2. Collaborations with Major European Organizations

MLSpaceWeather 2015-2019. Coupling physics-based simulations with Artificial Intelligence.
Coordinator: CWI
Participants: Michèle Sebag, Aurélien Decelle, Cyril Furtlehner, Mhamed Hajaiej

ESA Tender 2015-2017
Coordinator: Bart Boonacker (TNO)
Participant: Marc Schoenauer, Dejan Tusar

9.3. International Initiatives

9.3.1. Inria Associate Teams Not Involved in an Inria International Labs

9.3.1.1. MDG-TAO

Title: Data-driven simulations for Space Weather predictions

International Partner: CWI (Netherlands) – Multiscale Dynamics Group – Enrico Camporeale

Start year: 2017

We propose an innovative approach to Space Weather modeling: the synergetic use of state-of-the-art simulations with Machine Learning and Data Assimilation techniques, in order to adjust for errors due to non-modeled physical processes, and parameter uncertainties. We envision a truly multidisciplinary collaboration between experts in Computational Science and Data assimilation techniques on one side (CWI), and experts in Machine Learning and Data Mining on the other (Inria). Our research objective is to realistically tackle long-term Space Weather forecasting, which would represent a giant leap in the field. This proposal is extremely timely, since the huge amount of (freely available) space missions data has not yet been systematically exploited in the current computational methods for Space Weather. Thus, we believe that this work will result in cutting-edge results and will open further research topics in space Weather and Computational Plasma Physics.

9.3.2. Inria International Partners

9.3.2.1. Declared Inria International Partners

Isabelle Guyon partner of Google Zurich *Preparation of a competition AutoDL: Automatic Deep Learning*.

9.3.2.2. Informal International Partners

Marc Schoenauer partner of the ARC-DP (Australian Research Council Discovery Project) *Bio-inspired computing methods for dynamically changing environments*. Coordinator: University of Adelaide (Frank Neumann), 5 years from Nov. 2015, 400 k$-AUS. Visit to Adelaide: 2 weeks in Feb. 2017. Paper in preparation.

Isabelle Guyon partner of UC Berkeley *Fingerprint verification with deep siamese neural networks using ultratonic sensor data.* Co-advisor of a master student (Baiyu Chen). Partners: Alyosha Efros, Bernhard Boser.

9.4. International Research Visitors

9.4.1. Visits of International Scientists

- **Edgar Galvan Lopez** University College Dublin, April 2015 - April 2017, funded by the ELEVATE Fellowship, the Irish Research Council's Career Development Fellowship co-funded by Marie Curie Actions. Now Lecturer at Maynooth University, Ireland.

9.4.1.1. Internships

- **Tomas Lungenstrass** June 2016 - June 2017, self-funded, collaboration with Inria Chile. Worked on magnetic storm prediction under A. Decelle's, C. Furtlehner's and M. Sebag's supervision.

10. Dissemination

10.1. Promoting Scientific Activities

10.1.1. Scientific Events Organisation

10.1.1.1. General Chair, Scientific Chair

- Guillaume Charpiat, Workshop Statistics/Learning at Paris-Saclay 2017 and 2018
- Isabelle Guyon, General Chair, NIPS 2017
- Flora Jay, Junior Conference on Data Science and Engineering Paris-Saclay (JDSE 2017)
- Paola Tubaro, Recent Ethical Challenges in Social Network Analysis (RECSNA 2017)

10.1.1.2. Member of the Organizing Committees

- Cecile Germain, co-organizer of DataScience@HEP 2017; Hammers and Nails Weizmann Workshop.

- Isabelle Guyon, co-organizer BayLearn, NIPS workshops Challenges in Machine Learning, AutoML workshop at ICML, LAP challenge workshops (ICCV, ICPR).
- Marc Schoenauer, Steering Committee, Parallel Problem Solving from Nature (PPSN); Steering Committee, Learning and Intelligent OptimizatioN (LION).
- Michele Sebag, President of Steering Committee, Eur. Conf. on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML-PKDD).

10.1.1.3. Member of Conference Program Committees

All TAO members are members of the Program Committees of the main conferences in the fields of Machine Learning, Evolutionary Computation, and Information Processing.

10.1.1.4. Reviewer

All TAO member review papers for the most prestigious conferences in the fields of Machine Learning and Evolutionary Computation.

10.1.2. Journal

10.1.2.1. Member of the Editorial Boards

- Isabelle Guyon, action editor, *Journal of Machine Learning Research* (JMLR); series editor, *Springer series Challenges in Machine Learning* (CiML).
- Marc Schoenauer, member of Advisory Board, *Evolutionary Computation Journal*, MIT Press, and *Genetic Programming and Evolutionary Machines*, Springer Verlag; action editor, *Journal of Machine Learning Research*(JMLR).
- Michèle Sebag, Editorial Board, Machine Learning, Springer Verlag.
- Paola Tubaro, Associate Editorial Board, *Sociology*, Sage; member of Editorial Board, *Revue Française de Sociologie*, Presses de Sciences Po.

10.1.2.2. Reviewer - Reviewing Activities

All members of the team reviewed numerous articles for the most prestigious journals in the fields of Machine Learning and Evolutionary Computation.

10.1.3. Invited Talks

- Philippe Caillou, 7 march 2017, *Simulation analysis with charts in GAMA*, Gama Training session, TU Delft, Delft.
- Guillaume Charpiat, 9 May 2017, *Introduction to Neural Networks*, Mathematical coffees, Huawei.
- Guillaume Charpiat, 30 November 2017, *Apprentissage profond pour la segmentation d'images satellite haute résolution*, Workshop Deep Learning - Télédétection - Temps, Issy-les-Moulineaux.
- Aurélien Decelle, 24 March 2017, *Ising inverse problem : recovering the topology of the network*, International workshop on numerical methods and simulations for materials design and strongly correlated quantum matters
- Isabelle Guyon, 19 Jan 2017, *Causal graph reconstruction*, ENS Ulm, Paris.
- Flora Jay, 7 April 2017, *Reconstructing past history from whole-genomes: an ABC approach handling recombining data*, European Mathematical Genetics Meeting, Estonia.
- Cecile Germain, 9 May 2017, *Review on Anomaly/Outlier detection*, DataScience@HEP, Fermilab.
- Marc Schoenauer, 23 Feb. 2017, *Adaptation and self-adaptation in Evolutionary Computation and in scientific careers*, School of Computer Science, University of Adelaide; 7 Sep. 2017, *l'Intelligence Artificielle dans le domaine scientifique*, Open Laboratories, IMRA, Sophia Antipolis; 21 Sep. 2017, *Getting hints from random walks in Optimization and Deep Learning*, CSAIL Seminar, MIT, Boston; 31 Oct. 2017, *Adaptation in Artificial Systems: lessons from Evolution Strategies applied to Deep Learning*, XIII Brazilian Congress on Computational Intelligence, Rio de Janeiro.

- Michèle Sebag, July 2017, *AI without hot air / Le vent de l'IA*, Académie des Technologies; July 2017, *IA et Intelligence Service*, DGA Ecole Militaire; Sept. 2017, *Causal Generative Neural Networks*, Lorentz center, Leiden; Sept. 2017, *Stochastic Gradient Descent: Going as fast as possible but not faster*; Sept. 2017, *AutoML@ECMLPKDD*, Skopje; Sept. 2017, *Algorithm Recommender System*, keynote speech JST CREST Program on Big Data Applications, Tokyo.
- Paola Tubaro, 11 May 2017, *Mapping the collaborative economy: social networks, status and norms*, RITM Seminar, Université Paris Sud, Sceaux.

10.1.4. Leadership within the Scientific Community

- Isabelle Guyon, President and co-founder of ChaLearn, a non-for-profit organization dedicated to the organization of challenge.
- Marc Schoenauer, Chair of ACM-SIGEVO (Special Interest Group on Evolutionary Computation), re-elected July 2017 (2-years term).
- Marc Schoenauer, founding President of SPECIES (Society for the Promotion of Evolutionary Computation In Europe and Surroundings), that organizes the yearly series of conferences *EvoStar*.
- Michèle Sebag, elected Chair of Steering Committee, ECML-PKDD; head of the Research Programme, Institut de Convergence DataIA
- Paola Tubaro, convenor of the Social Network Analysis Group of British Sociological Association; co-founder of European Network on Digital Labor

10.1.5. Scientific Expertise

- Cécile Germain, evaluator for the H2020-ICT-2017-1 Big Data PPP call.
- Marc Schoenauer, mission Villani pour l'Intelligence Artificielle

10.1.6. Research Administration

- Cécile Germain, University officer for scientific computing; deputy head of the computer science departement, in charge of research; member of the scientific council of faculty of Science (UPsud) and of its board; member of the Board of the Lidex *Center for Data Science*; member of the scientific council of faculty of Medicine (UPsud).
- Isabelle Guyon, representative of UPSud in the DataIA *Institut de Convergence* Program Committee, University of Paris-Saclay.
- Marc Schoenauer, co-chair (with Sylvain Arlot) of the *Maths-STIC* program of the Labex of Mathematics Hadamard (LMH).
- Michele Sebag, deputy director of LRI, CNRS UMR 8623; elected member of the Research Council of Univ. Paris-Saclay; member of the STIC department council of Univ. Paris-Saclay; member of the Scientific Council of Labex AMIES, Applications des Mathématiques ds l'Industrie, l'Entreprise et la Société; member of the Scientific Council of IRT System'X; member of the CSFRS (Conseil supérieur de la formation et de la recherche stratégique).
- Paola Tubaro, representative of CNRS in the DataIA *Institut de Convergence* Program Committee, University of Paris-Saclay.

10.2. Teaching - Supervision - Juries

10.2.1. Teaching

Licence : Philippe Caillou, Computer Science for students in Accounting and Management, 192h, L1, IUT Sceaux, Univ. Paris Sud.

Licence : Aurélien Decelle, Computer Architecture, 28h, L2, Univ. Paris-Sud.

Licence : Aurélien Decelle, Machine Learning and Artificial Life, 55h, L2, Univ. Paris-Sud.

Licence : Aurélien Decelle, Object-oriented programming , 26h, L2, Univ. Paris-Sud.

Licence : Aurélien Decelle, Computer Architecture, 26h, L3, Univ. Paris-Sud.

Licence and Polytech : Cécile Germain, Computer Architecture

Licence : Isabelle Guyon, Project: Creation of mini-challenges, M2, Univ. Paris-Sud.

Master : Guillaume Charpiat and Corentin Tallec, Advanced Machine Learning, 34h, M2 Recherche, Centrale-Supélec.

Master : Aurélien Decelle, Machine Learning, 26h, M1, Univ. Paris-Sud.

Master : Aurélien Decelle, Probability and statistics, 26h, M1, Univ. Paris-Sud.

Master : Cécile Germain, Parallel Programming

Master : Isabelle Guyon, Project: Resolution of mini-challenges (created by M2 students), L2, Univ. Paris-Sud.

Master : Yann Ollivier, Deep learning, 4h, M2 Recherche, Telecom/Polytech.

Master : Michèle Sebag, Machine Learning, 12h; Deep Learning, 6h; Reinforcement Learning, 6h; M2 Recherche, U. Paris-sud.

Master : Paola Tubaro, Sociology of social networks, 24h, M2, EHESS/ENS.

Master : Flora Jay, Population Genetics, 10h, M2, Univ. Paris-Sud.

Doctorate: Paola Tubaro, Research Methods, 12h, University of Insubria, Italy.

10.2.2. Supervision

PhD: Vincent Berthier, *Studies on stochastic optimisation and applications to the real world*, Univ. Paris-Saclay, 29/9/2017, Olivier Teytaud.

PhD: Nacim BELKHIR, *On-line parameter tuning*, Univ. Paris-Saclay, 30/11/2017, Marc Schoenauer and Johann Dréo (Thalès), CIFRE Thalès.

PhD: Pierre-Yves MASSÉ, *Gradient Methods for Statistical Learning*, Univ. Paris-Saclay, 15/12/2017, Yann Ollivier

PhD: Emmanuel MAGGIORI, *Large-Scale Remote Sensing Image Classification*, 22/06/2017, Univ. Nice-Sophia-Antipolis, Yuliya Tarabalka, Pierre Alliez and Guillaume Charpiat

PhD: Yasaman SARABI, *Network Analysis of Private Water Companies, Challenges Collaboration and Competition*, 15/12/2017, Paola Tubaro (at the University of Greenwich, London, UK).

PhD in progress: Mehdi CHERTI *Learning to discover: supervised discrimination and unsupervised representation learning with applications in particle physics.* 01/10/2014, Balazs Kegl.

PhD in progress: Benjamin DONNOT, *Optimisation et méthodes d'apprentissage pour une conduite robuste et efficace du réseau électrique par anticipation sur base de parades topologiques.*, 1/09/2015, Isabelle Guyon and Marc Schoenauer

PhD in progress: Guillaume DOQUET, *ML Algorithm Selection and Domain Adaptation*, 1/09/2015, Michele Sebag

PhD in progress: Victor ESTRADE *Robust domain-adversarial learning, with applications to High Energy Physics,* 01/10/2016, Cécile Germain and Isabelle Guyon.

PhD in progress: François GONARD, *Automatic optimization algorithm selection and configuration*, 1/10/2014, Marc Schoenauer and Michèle Sebag, thèse IRT SystemX.

PhD in progress : Hoang M. LUONG, *Squaring the Circle in Modelling Corporate Governance, Market Structure and Innovation: A Tobin's Q Approach to R&D Investment when Network Effects Are Present*, 01/09/2014, (with M. Ugur and S. Gorgoni, at the University of Greenwich, London, UK).

PhD in progress: Anna PIAZZA, *Inter-Organisational Relationships and Organisational Performance: Network Analysis Applications to a Health Care System*, 01/09/2014, Paola Tubaro (with F. Pallotti and A. Lomi, at the University of Greenwich, London, UK).

PhD in progress: Adrian POL *Machine Learning Anomaly Detection, with application to CMS Data Quality Monitoring,* 01/10/2016, Cécile Germain.

PhD in progress: Thomas SCHMITT, *A Collaborative Filtering Approach to Matching Job Openings and Job Seekers*, 1/11/2014, Philippe Caillou and Michèle Sebag and Jean-Pierre Nadal (EHESS)

PhD in progress: Lisheng SUN, *Apprentissage Automatique: Vers une analyse de données automatisé*, 1/10/2016, Isabelle Guyon and Michèle Sebag

PhD in progress: Corentin TALLEC, *Reinforcement Learning and Recurrent Neural Networks: Dynamical approaches*, 1/10/2016, Yann Ollivier

PhD in progress: Pierre WOLINSKI, *Learning the Architecture of Neural Networks*, 1/9/2016, Guillaume Charpiat and Yann Ollivier

PhD in progress: Victor BERGER, *Variational Anytime Simulator*, 1/10/2017, Michèle Sebag and Marc Schoenauer

PhD in progress: Giancarlo FISSORE, *Statistical physics analysis of generative models*, 1/10/2017, Aurélien Decelle and Cyril Furtlehner

PhD in progress: Diviyan KALAINATHAN, *Causal models and quality of life at work*, 1/10/2017, Michèle Sebag and Isabelle Guyon

PhD in progress: Zhengying LIU, *Automation du design des reseaux de neurones profonds*, 1/10/2017, Isabelle Guyon

PhD in progress: Herilalaina RAKOTOARISON, *Automatic Algorithm Configuration for Power Grid Optimization*, 1/10/2017, Marc Schoenauer and Michèle Sebag

PhD in progress: Théophile SANCHEZ, *Reconstructing the past: deep learning for population genetics*, 1/10/2017, Guillaume Charpiat and Flora Jay

PhD in progress: Aris TRITAS, *Modélisation causale des relations entre alimentation et santé*, 1/10/2017, Michèle Sebag and Philippe Caillou

10.2.3. Juries

Guillaume Charpiat, jury of the 2017 Gilles Kahn PhD prize (SIF); jury of a MdC hiring committee at Univ. Paris-Sud.

Cecile Germain, jury of the Telecom PhD prize; half-way jury of Jacob Montiel (Telecom)

Isabelle Guyon, PhD jury Mathieu Bouyrie (Univ. Paris-Saclay, 11/1/2017) HDR jury Alexandre Gramfort (Univ. Paris-Saclay, 6/11/2017)

Flora Jay, half-way juries of Bérénice Alard (MNHN), Arnaud Becheler (EGCE), Cyriel Paris (INRA Toulouse)

Marc Schoenauer, PhD jury of Mathieu Carriere (Univ. Paris-Saclay, 21/11/2017), Elvis Dohmatob (Univ. Paris-Saclay, 29/9/2017) ; PhD committee and half-way jury of Arthur Mensch (Univ. Paris-Saclay, 3/7/2017), Julio Navarro Lara (Univ. Strasbourg, 25/7/2017), Jean Marçais (Univ. Rennes, 10/2017).

Michèle Sebag, Research Quality Assessment Panel for the Department of Computer Science, U. Copenhagen; Hiring Jury, Professor U. Nice Cote d'Azur; Hiring Jury, Professor U. Dortmund, Germany; Hiring Jury, MdC UPSud; Reviewer PhD Audrey Durand, U. Laval Québec; Reviewer PhD Antonio Vergari, U. Bari, Italie; Jury Member: Gisselbrecht, UPMC; Renyu Xury, UPSud.

10.3. Popularization

Philippe Caillou, talk on quality of life at work, AFRAME association for ethic management, Paris, 28/11/2017

Isabelle Guyon: press release at NIPS conference (5/12/2015); interview l'Usine Nouvelle (12/12/2017).

Michèle Sebag: interview France 2; interview l'Usine Nouvelle; 2 articles The Conversation France.

Paola Tubaro: interview Pourquoi Docteur (online health magazine, 01/01/2017); article in Journal du CNRS (02/02/2017); op-ed Libération (02/02/2017); interview Le Devoir (daily newspaper, Canada, 29/04/2017); interview Les Echos (19/09/2017); interview Le Monde (09/11/2017); 1 article OuiShare magazine (13/07/2017); 1 article The Conversation France (French version 02/11/2017, English version 11/12/2017); round table on Open data at "Science and You" conference, Montréal (05/05/2017); round table "Cuisine and Performance" at Centre Pompidou, Paris (18/11/2017).

11. Bibliography

Publications of the year

Doctoral Dissertations and Habilitation Theses

[1] N. BELKHIR. *Per Instance Algorithm Configuration for Continuous Black Box Optimization*, Paris Saclay, November 2017, https://hal.inria.fr/tel-01669527

[2] V. BERTHIER. *Studies on stochastic optimisation and applications to the real world*, Université Paris 11, September 2017, https://hal.inria.fr/tel-01668371

[3] P.-Y. MASSÉ. *Around the Use of Gradients in Machine Learning*, Université Paris-Saclay, December 2017, https://hal.archives-ouvertes.fr/tel-01665478

Articles in International Peer-Reviewed Journals

[4] K. CAYE, F. JAY, O. MICHEL, O. FRANÇOIS. *Fast Inference of Individual Admixture Coefficients Using Geographic Data*, in "Annals Of Applied Statistics", 2018, forthcoming, https://hal.archives-ouvertes.fr/hal-01676712

[5] A. DECELLE, G. FISSORE, C. FURTLEHNER. *Spectral Dynamics of Learning Restricted Boltzmann Machines*, in "EPL - Europhysics Letters", November 2017, https://hal.inria.fr/hal-01652314

[6] C. FERNANDO CRISPIM-JUNIOR, A. GÓMEZ URÍA, C. STRUMIA, M. KOPERSKI, A. KONIG, F. NEGIN, S. COSAR, A.-T. NGHIEM, G. CHARPIAT, F. BREMOND, D. P. CHAU. *Online recognition of daily activities by color-depth sensing and knowledge models*, in "Sensors", June 2017, vol. 17, n^o^ 7, pp. 1-15 [*DOI :* 10.3390/S17071528], https://hal.inria.fr/hal-01658438

[7] I. GUYON, H. J. ESCALANTE, V. ATHITSOS, P. JANGYODSUK, J. WAN. *Principal motion components for one-shot gesture recognition*, in "Pattern Analysis and Applications", February 2017, vol. 20, n^o^ 1, pp. 167 - 182 [*DOI :* 10.1007/S10044-015-0481-3], https://hal.inria.fr/hal-01677941

[8] Y. GÜÇLÜTÜRK, U. GÜÇLÜ, X. BARÓ, H. J. ESCALANTE, I. GUYON, S. ESCALERA, M. A. J. VAN GERVEN, R. VAN LIER. *Multimodal First Impression Analysis with Deep Residual Networks*, in "IEEE Transactions on Affective Computing", September 2017, vol. PP, n^o^ 99, pp. 1-14 [*DOI :* 10.1109/TAFFC.2017.2751469], https://hal.inria.fr/hal-01668375

[9] E. MAGGIORI, Y. TARABALKA, G. CHARPIAT, P. ALLIEZ. *High-Resolution Semantic Labeling with Convolutional Neural Networks*, in "IEEE Transactions on Geoscience and Remote Sensing", December 2017, https://arxiv.org/abs/1611.01962 , https://hal.inria.fr/hal-01393279

[10] M. MISIR, M. SEBAG. *Alors: An algorithm recommender system*, in "Artificial Intelligence", March 2017, vol. 244, pp. 291-314, Published on-line Dec. 2016, https://hal.inria.fr/hal-01419874

[11] Y. OLLIVIER, L. ARNOLD, A. AUGER, N. HANSEN. *Information-Geometric Optimization Algorithms: A Unifying Picture via Invariance Principles*, in "Journal of Machine Learning Research", 2017, vol. 18, n^{o} 18, pp. 1-65, https://hal.inria.fr/hal-01515898

[12] F. PALLOTTI, P. TUBARO, A. A. CASILLI, T. W. VALENTE. *"You see yourself like in a mirror": The effects of internet-mediated personal networks on body image and eating disorders*, in "Health Communication", 2017, Published online on 6 July 2017 [*DOI :* 10.1080/10410236.2017.1339371], https://hal.archives-ouvertes.fr/hal-01520138

[13] P. TUBARO. *Les tensions entre sociologie et politique à l'aune d'une tentative de législation des sites web sur les troubles alimentaires* , in "SociologieS", November 2017, pp. 1-13, https://hal.archives-ouvertes.fr/hal-01648305

Invited Conferences

[14] F. JAY, S. S. BOITARD, F. AUSTERLITZ. *Reconstructing past history from whole-genomes: an ABC approach handling recombining data*, in "European Mathematical Genetics Meeting", Tartu, Estonia, April 2017, https://hal.archives-ouvertes.fr/hal-01679379

International Conferences with Proceedings

[15] E. AGUSTSSON, R. TIMOFTE, S. ESCALERA, X. BARÓ, I. GUYON, R. ROTHE. *Apparent and real age estimation in still images with deep residual regressors on APPA-REAL database*, in "FG 2017 - 12th IEEE International Conference on Automatic Face and Gesture Recognition", Washington DC, United States, May 2017, pp. 1-12, https://hal.inria.fr/hal-01677892

[16] S. AMROUCHE, N. BRAUN, P. CALAFIURA, S. FARRELL, J. GEMMLER, C. GERMAIN, V. GLIGOROV, T. GOLLING, H. GRAY, I. GUYON, M. HUSHCHYN, V. INNOCENTE, B. KÉGL, S. NEUHAUS, D. ROUSSEAU, A. SALZBURGER, A. USTYUZHANIN, J.-R. VLIMANT, C. WESSEL, Y. YILMAZ. *Track reconstruction at LHC as a collaborative data challenge use case with RAMP*, in "Connecting The Dots / Intelligent Tracker", Orsay, France, March 2017, vol. 150, 00015 p. [*DOI :* 10.1051/EPJCONF/201715000015], https://hal.archives-ouvertes.fr/hal-01584689

[17] M. ASADI-AGHBOLAGHI, A. CLAPES, M. BELLANTONIO, H. J. ESCALANTE, V. PONCE-LÓPEZ, X. BARÓ, I. GUYON, S. KASAEI, S. ESCALERA. *A Survey on Deep Learning Based Approaches for Action and Gesture Recognition in Image Sequences*, in "FG 2017 - 12th IEEE Conference on Automatic Face and Gesture Recognition", Washington, DC, United States, IEEE, May 2017, pp. 476-483 [*DOI :* 10.1109/FG.2017.150], https://hal.inria.fr/hal-01668383

[18] N. BELKHIR, J. DREO, P. SAVÉANT, M. SCHOENAUER. *Per instance algorithm configuration of CMA-ES with limited budget*, in "GECCO 2017 - Proceedings of the Genetic and Evolutionary Computation Conference", Berlin, Germany, July 2017, pp. 681-688, https://hal.inria.fr/hal-01613753

[19] I. BRIGUI-CHTIOUI, P. CAILLOU, E. NEGRE. *Intelligent Digital Learning: Agent-Based Recommender System*, in "ICMLC 2017 - 9th International Conference on Machine Learning and Computing", Singapore, Singapore, February 2017 [*DOI :* 10.1145/3055635.3056592], https://hal.inria.fr/hal-01680527

[20] B. DONNOT, I. GUYON, M. SCHOENAUER, P. PANCIATICI, A. MAROT. *Introducing machine learning for power system operation support*, in "IREP Symposium", Espinho, Portugal, August 2017, https://arxiv.org/abs/1709.09527 , https://hal.inria.fr/hal-01581719

[21] H. J. ESCALANTE, I. GUYON, S. ESCALERA, J. JACQUES, M. MADADI, X. BARÓ, S. AYACHE, E. VIEGAS, Y. GÜÇLÜTÜRK, U. GÜÇLÜ, M. A. J. VAN GERVEN, R. VAN LIER. *Design of an Explainable Machine Learning Challenge for Video Interviews*, in "IJCNN 2017 - 30th International Joint Conference on Neural Networks", Anchorage, AK, United States, Neural Networks (IJCNN), 2017 International Joint Conference on, IEEE, May 2017, pp. 1-8 [*DOI :* 10.1109/IJCNN.2017.7966320], https://hal.inria.fr/hal-01668386

[22] E. GALVÁN-LÓPEZ, L. VA´ZQUEZ-MENDOZA, M. SCHOENAUER, L. TRUJILLO. *On the Use of Dynamic GP Fitness Cases in Static and Dynamic Optimisation Problems*, in "EA 2017- International Conference on Artificial Evolution", Paris, France, Evelyne Lutton, October 2017, pp. 1-14, https://hal.inria.fr/hal-01648365

[23] F. GONARD, M. SCHOENAUER, M. SEBAG. *ASAP.V2 and ASAP.V3: Sequential optimization of an Algorithm Selector and a Scheduler*, in "Open Algorithm Selection Challenge 2017", Brussels, Belgium, Proceedings of Machine Learning Research, September 2017, vol. 79, pp. 8-11, https://hal.inria.fr/hal-01659700

[24] Y. GÜÇLÜTÜRK, U. GÜÇLÜ, M. PEREZ, H. J. ESCALANTE BALDERAS, X. BARÓ, I. GUYON, C. ANDUJAR, J. J. JUNIOR, M. MADADI, S. ESCALERA, M. A. J. VAN GERVEN, R. VAN LIER. *Visualizing Apparent Personality Analysis with Deep Residual Networks*, in "International Conference on Computer Vision - ICCV 2017", Venice, Italy, October 2017, https://hal.inria.fr/hal-01677962

[25] E. MAGGIORI, Y. TARABALKA, G. CHARPIAT, P. ALLIEZ. *Can Semantic Labeling Methods Generalize to Any City? The Inria Aerial Image Labeling Benchmark*, in "IEEE International Symposium on Geoscience and Remote Sensing (IGARSS)", Fort Worth, United States, July 2017, https://hal.inria.fr/hal-01468452

[26] E. MAGGIORI, Y. TARABALKA, G. CHARPIAT, P. ALLIEZ. *Polygonization of Remote Sensing Classification Maps by Mesh Approximation*, in "ICIP 2017 - IEEE International Conference on Image Processing", Beijing, China, September 2017, 5 p. , https://hal.inria.fr/hal-01530460

[27] L. MARTÍ, A. FANSI-TCHANGO, L. NAVARRO, M. SCHOENAUER. *Progressively Adding Objectives: A Case Study in Anomaly Detection*, in "Genetic and Evolutionary Computation Conference (GECCO 2017)", Berlin, Germany, July 2017 [*DOI :* 10.1145/3071178.3071333], https://hal.inria.fr/hal-01525611

[28] *Best Paper*
Y. OLLIVIER, G. MARCEAU-CARON. *Natural Langevin Dynamics for Neural Networks*, in "GSI 2017 - 3rd conference on Geometric Science of Information", Paris, France, Springer Verlag, November 2017, vol. 10589, pp. 451-459, https://arxiv.org/abs/1712.01076 - Best Paper Award [*DOI :* 10.1007/978-3-319-68445-1_53], https://hal.archives-ouvertes.fr/hal-01655949.

[29] T. SCHMITT, F. GONARD, P. CAILLOU, M. SEBAG. *Language Modelling for Collaborative Filtering: Application to Job Applicant Matching*, in "ICTAI 2017 - 29th IEEE International Conference on Tools with Artificial Intelligence", Boston, United States, November 2017, pp. 1-8, https://hal.inria.fr/hal-01659543

[30] J. WAN, S. ESCALERA, G. ANBARJAFARI, H. J. ESCALANTE, X. BARÓ, I. GUYON, M. MADADI, J. ALLIK, C. LIN, Y. XIE. *Results and Analysis of ChaLearn LAP Multi-modal Isolated and Continuous Gesture*

Recognition, and Real versus Fake Expressed Emotions Challenges, in "International Conference on Computer Vision - ICCV 2017", Venice, Italy, October 2017, https://hal.inria.fr/hal-01677974

[31] N. YOSHIKAWA, N. BELKHIR, S. SUZUKI. *Recurrent Neural Network-based Fault Detector for Aileron Failures of Aircraft*, in "ASCC 2017 - The 2017 Asian Control Conference", Gold Coast, Australia, December 2017, https://hal.inria.fr/hal-01669540

Conferences without Proceedings

[32] V. ESTRADE, C. GERMAIN, I. GUYON, D. ROUSSEAU. *Adversarial learning to eliminate systematic errors: a case study in High Energy Physics*, in "NIPS 2017 - workshop Deep Learning for Physical Sciences", Long Beach, United States, December 2017, pp. 1-5, https://hal.inria.fr/hal-01665925

[33] T. SANCHEZ, G. CHARPIAT, F. JAY. *SPI-DNA: End-to-end Deep Learning Approach for Demographic History Inference*, in "Paris-Saclay Junior Conference on Data Science and Engineering", Orsay, France, September 2017, https://hal.archives-ouvertes.fr/hal-01679385

Scientific Books (or Scientific Book chapters)

[34] M. ASADI-AGHBOLAGHI, A. CLAPES, M. BELLANTONIO, H. J. ESCALANTE, V. PONCE-LÓPEZ, X. BARÓ, I. GUYON, S. KASAEI, S. ESCALERA. *Deep learning for action and gesture recognition in image sequences: a survey* , in "Gesture Recognition", Springer Verlag, July 2017, pp. 539-578, A reduced version of this paper appeared appeared in the Proceedings of 12th IEEE International Conference on Automatic Face and Gesture Recognition (FG 2017), 2017, https://hal.inria.fr/hal-01678006

[35] F. GONARD, M. SCHOENAUER, M. SEBAG. *Algorithm Selector and Prescheduler in the ICON challenge*, in "Bioinspired heuristic optimization", E.-G. TALBI, A. NAKIB (editors), Computational Intelligence, Springer Verlag, 2017, forthcoming, https://hal.inria.fr/hal-01663174

[36] D. KALAINATHAN, O. GOUDET, P. CAILLOU, P. TUBARO, T. WEIL, E. BOURDU. *Portraits de travailleurs : Comprendre la qualité de vie au travail*, Presses des Mines - La Fabrique de l'Industrie, 2017, https://hal.inria.fr/hal-01665423

Research Reports

[37] A. DECELLE, G. FISSORE, C. FURTLEHNER. *Thermodynamics of Restricted Boltzmann Machines and Related Learning Dynamics*, Inria Saclay Ile de France ; LRI, Université Paris-Sud, January 2018, n^{o} RR-9139, pp. 1-36, https://hal.inria.fr/hal-01675310

Scientific Popularization

[38] A. A. CASILLI, P. TUBARO. *Réprimer les sites «pro-anorexie» : une fausse bonne idée* , in "Libération", February 2017, pp. 1-2, https://hal.archives-ouvertes.fr/hal-01577074

[39] P. TUBARO. *Social Networks: face-to-face and online ties at OuiShare Fest*, July 2017, Texte court publié dans OuiShare Magazine, https://hal.archives-ouvertes.fr/hal-01666817

Other Publications

[40] O. BOUSQUET, S. GELLY, K. KURACH, M. SCHOENAUER, M. SEBAG, O. TEYTAUD, D. VINCENT. *Toward Optimal Run Racing: Application to Deep Learning Calibration*, June 2017, https://arxiv.org/abs/1706.03199 - working paper or preprint, https://hal.inria.fr/hal-01634381

[41] A. A. CASILLI, P. TUBARO. *Rethinking ethics in social-network research*, December 2017, Texte de vulgarisation publié dans The Conversation, une version française existe également, https://hal.archives-ouvertes.fr/hal-01666784

[42] B. DONNOT, I. GUYON, M. SCHOENAUER, A. MAROT, P. PANCIATICI. *Fast Power system security analysis with Guided Dropout, supplemental material*, November 2017, working paper or preprint, https://hal.archives-ouvertes.fr/hal-01649938

[43] V. ESTRADE, C. GERMAIN, I. GUYON, D. ROUSSEAU. *Robust deep learning: A case study*, September 2017, pp. 1-5, JDSE 2017 - 2nd Junior Conference on Data Science and Engineering, https://hal.inria.fr/hal-01665938

[44] C. GERMAIN. *Summary of the Weizmann workshop: Hammers & Nails - Machine Learning & HEP*, July 2017, pp. 1-48, 2017 - Hammers & Nails - Machine Learning & HEP, https://hal.inria.fr/hal-01665940

[45] O. GOUDET, D. KALAINATHAN, P. CAILLOU, D. LOPEZ-PAZ, I. GUYON, M. SEBAG, A. TRITAS, P. TUBARO. *Learning Functional Causal Models with Generative Neural Networks*, November 2017, https://arxiv.org/abs/1709.05321 - working paper or preprint, https://hal.archives-ouvertes.fr/hal-01649153

[46] I. GUYON, S. ESCALERA, X. BARÓ, H. J. ESCALANTE. *ChaLearn Looking at People: A Review of Events and Resources*, January 2018, https://arxiv.org/abs/1701.02664 - Paper to appear in proceedings of IJCNN 2017 - IEEE - Associated website: http://chalearnlap.cvc.uab.es, https://hal.inria.fr/hal-01677944

[47] A. MAROT, S. TAZI, B. DONNOT, P. PANCIATICI. *Large-scale power grid hierarchical segmentation based on power-flow affinities*, November 2017, https://arxiv.org/abs/1711.09715 - working paper or preprint, https://hal.archives-ouvertes.fr/hal-01633508

[48] Y. OLLIVIER. *Online Natural Gradient as a Kalman Filter*, December 2017, https://arxiv.org/abs/1703.00209 - working paper or preprint, https://hal.inria.fr/hal-01660622

[49] Y. OLLIVIER, C. TALLEC. *Unbiased Online Recurrent Optimization*, December 2017, https://arxiv.org/abs/1702.05043 - working paper or preprint, https://hal.archives-ouvertes.fr/hal-01666483

[50] Y. OLLIVIER, C. TALLEC. *Unbiasing Truncated Backpropagation Through Time*, December 2017, https://arxiv.org/abs/1705.08209 - working paper or preprint, https://hal.inria.fr/hal-01660627

[51] D. ROUSSEAU, S. AMROUCHE, P. CALAFIURA, S. FARRELL, C. GERMAIN, V. GLIGOROV, T. GOLLING, H. GRAY, I. GUYON, M. HUSHCHYN, V. INNOCENTE, M. KIEHN, A. SALZBURGER, A. USTYUZHANIN, J.-R. V. VLIMANT, Y. YILMAZ. *WCCI 2018 TrackML Particle Tracking Challenge*, July 2018, The document describes the challenge data, task and organization, https://hal.inria.fr/hal-01680537

[52] A. SCHOENAUER-SEBAG, M. SCHOENAUER, M. SEBAG. *Stochastic Gradient Descent: Going As Fast As Possible But Not Faster*, September 2017, https://arxiv.org/abs/1709.01427 - working paper or preprint, https://hal.inria.fr/hal-01634375

[53] N. B. SHAH, B. TABIBIAN, K. MUANDET, I. GUYON, U. VON LUXBURG. *Design and Analysis of the NIPS 2016 Review Process*, December 2017, https://arxiv.org/abs/1708.09794 - working paper or preprint, https://hal.inria.fr/hal-01668377

References in notes

[54] S. ESCALERA, I. GUYON, V. ATHITSOS (editors). *Gesture Recognition*, Springer, 2017, https://doi.org/10.1007/978-3-319-57021-1

[55] C. ADAM-BOURDARIOS, G. COWAN, C. GERMAIN, I. GUYON, B. KÉGL, D. ROUSSEAU. *How Machine Learning won the Higgs Boson Challenge*, in "Proc. European Symposium on ANN, CI and ML", 2016

[56] R. AKROUR, M. SCHOENAUER, M. SEBAG. *Programming by Feedback*, in "International Conference on Machine Learning", JMLR Proceedings, JMLR.org, 2014, n° 32, pp. 1503-1511

[57] M. AMIL, N. BREDÈCHE, C. GAGNÉ, S. GELLY, M. SCHOENAUER, O. TEYTAUD. *A Statistical Learning Perspective of Genetic Programming*, in "EuroGP", Proceedings of EuroGP 09, Springer Verlag, 2009

[58] M. ANDRYCHOWICZ, M. DENIL, S. GÓMEZ, M. W. HOFFMAN, D. PFAU, T. SCHAUL, N. DE FREITAS. *Learning to learn by gradient descent by gradient descent*, in "Advances in Neural Information Processing Systems 29", D. D. LEE, M. SUGIYAMA, U. V. LUXBURG, I. GUYON, R. GARNETT (editors), Curran Associates, Inc., 2016, pp. 3981–3989

[59] J. BERGSTRA, R. BARDENET, Y. BENGIO, B. KÉGL. *Algorithms for Hyper-Parameter Optimization*, in "25th Annual Conference on Neural Information Processing Systems (NIPS 2011)", J. SHAWE-TAYLOR, R. ZEMEL, P. BARTLETT, F. PEREIRA, K. WEINBERGER (editors), Advances in Neural Information Processing Systems, Neural Information Processing Systems Foundation, 2011, vol. 24

[60] S. BOITARD, W. RODRÍGUEZ, F. JAY, S. MONA, F. AUSTERLITZ. *Inferring population size history from large samples of genome-wide molecular data-an approximate Bayesian computation approach*, in "PLoS genetics", 2016, vol. 12, n° 3, e1005877 p.

[61] P. BRAZDIL, C. GIRAUD CARRIER, C. SOARES, R. VILALTA. *Metalearning: Applications to Data Mining*, Springer Verlag, 2009

[62] E. BROCHU, V. M. CORA, N. DE FREITAS. *A tutorial on Bayesian optimization of expensive cost functions, with application to active user modeling and hierarchical reinforcement learning*, in "arXiv preprint arXiv:1012.2599", 2010

[63] S. BRUNTON, J. PROCTOR, N. KUTZ. *Sparse Identification of Nonlinear Dynamics (SINDy)*, in "Bulletin of the American Physical Society", 2016, vol. 61

[64] T. DOMHAN, J. T. SPRINGENBERG, F. HUTTER. *Speeding Up Automatic Hyperparameter Optimization of Deep Neural Networks by Extrapolation of Learning Curves*, in "Proceedings of the 24th International Conference on Artificial Intelligence", IJCAI'15, AAAI Press, 2015, pp. 3460–3468, http://dl.acm.org/citation.cfm?id=2832581.2832731

[65] B. DONNOT, I. GUYON, M. SCHOENAUER, A. MAROT, P. PANCIATICI. *Fast Power system security analysis with Guided Dropout*, 2018, submitted

[66] C. FURTLEHNER, A. DECELLE. *Cycle-based Cluster Variational Method for Direct and Inverse Inference*, in "Journal of Statistical Physics", 2016, vol. 164, n^{o} 3, pp. 531–574

[67] Y. GANIN, E. USTINOVA, H. AJAKAN, P. GERMAIN, H. LAROCHELLE, F. LAVIOLETTE, M. MARCHAND, V. LEMPITSKY. *Domain-Adversarial Training of Neural Networks*, in "Journal of Machine Learning Research", 2016, vol. 17, n^{o} 59, pp. 1-35

[68] I. GOODFELLOW, J. POUGET-ABADIE, M. MIRZA, B. XU, D. WARDE-FARLEY, S. OZAIR, A. COURVILLE, Y. BENGIO. *Generative Adversarial Nets*, in "NIPS 27", Z. GHAHRAMANI, M. WELLING, C. CORTES, N. D. LAWRENCE, K. Q. WEINBERGER (editors), Curran Associates, Inc., 2014, pp. 2672–2680

[69] I. GUYON, C. F. ALIFERIS, G. F. COOPER, A. ELISSEEFF, J.-P. PELLET, P. SPIRTES, A. R. STATNIKOV. *Design and Analysis of the Causation and Prediction Challenge*, in "WCCI Causation and Prediction Challenge", JMLR W-CP, 2008, pp. 1–33

[70] I. GUYON, K. BENNETT, G. CAWLEY, H. J. ESCALANTE, S. ESCALERA, T. K. HO, N. MACIA, B. RAY, M. SAEED, A. STATNIKOV. *Design of the 2015 ChaLearn AutoML challenge*, in "Proc. IJCNN", IEEE, 2015, pp. 1–8

[71] H. H. HOOS. *Programming by Optimization*, in "Commun. ACM", 2012, vol. 55, n^{o} 2, pp. 70–80

[72] Y. LECUN, Y. BENGIO, G. HINTON. *Deep learning*, in "Nature", 2015, vol. 521, n^{o} 7553, pp. 436–444

[73] E. MAGGIORI. *Learning approaches for large-scale remote sensing image classification*, Université Côte d'Azur, June 2017, https://hal.inria.fr/tel-01589661

[74] L. MARTI, A. FANSI-TCHANGO, L. NAVARRO, M. SCHOENAUER. *Anomaly Detection with the Voronoi Diagram Evolutionary Algorithm*, in "Parallel Problem Solving from Nature – PPSN XIV", Edinburgh, United Kingdom, J. HANDL, E. HART, P. LEWIS, M. LÓPEZ-IBÁÑEZ, G. OCHOA, B. PAECHTER (editors), LNCS, Springer Verlag, September 2016, vol. 9921, pp. 697-706 [*DOI :* 10.1007/978-3-319-45823-6_65], https://hal.inria.fr/hal-01387621

[75] J. M. MOOIJ, J. PETERS, D. JANZING, J. ZSCHEISCHLER, B. SCHÖLKOPF. *Distinguishing Cause from Effect Using Observational Data: Methods and Benchmarks*, in "Journal of Machine Learning Research", 2016, vol. 17, n^{o} 32, pp. 1-102

[76] Y. OLLIVIER. *Riemannian metrics for neural networks I: Feedforward networks*, in "Information and Inference", 2015, vol. 4, n^{o} 2, pp. 108–153

[77] Y. OLLIVIER. *Riemannian metrics for neural networks II: Recurrent networks and learning symbolic data sequences*, in "Information and Inference", 2015, vol. 4, n^{o} 2, pp. 154–193

[78] J. PEARL. *Causality: Models, Reasoning, and Inference (2nd edition)*, Cambridge University Press, 2009

[79] D. ROUSSEAU, P. CALAFIURA, C. GERMAIN, V. INNOCENTE, R. CENCI, M. KAGAN, I. GUYON, D. CLARK, S. FARREL, R. CARNEY, A. SALZBURGER, D. COSTANZO, M. ELSING, T. GOLLING, T. TONG, J.-R. V. VLIMANT. *TrackML: a LHC Tracking Machine Learning Challenge*, in "International Conference

on Computing in High Energy and Nuclear Physics", San Francisco, United States, October 2016, https://hal.inria.fr/hal-01422939

[80] I. SHPITSER, K. MOHAN, J. PEARL. *Missing Data as a Causal and Probabilistic Problem*, in "Proceedings of the Thirty-First Conference on Uncertainty in Artificial Intelligence, UAI 2015, July 12-16, 2015, Amsterdam, The Netherlands", M. MEILA, T. HESKES (editors), AUAI Press, 2015, pp. 802–811, http://auai.org/uai2015/proceedings/papers/204.pdf

[81] D. H. STERN, H. SAMULOWITZ, R. HERBRICH, T. GRAEPEL, L. PULINA, A. TACCHELLA. *Collaborative Expert Portfolio Management*, in "Proceedings of the Twenty-Fourth AAAI Conference on Artificial Intelligence, AAAI 2010", M. FOX, D. POOLE (editors), AAAI Press, 2010

[82] C. THORNTON, F. HUTTER, H. H. HOOS, K. LEYTON-BROWN. *Auto-WEKA: Combined Selection and Hyperparameter Optimization of Classification Algorithms*, in "Proc. of KDD-2013", 2013, pp. 847-855

[83] S. TRIANTAFILLOU, I. TSAMARDINOS. *Constraint-based Causal Discovery from Multiple Interventions over Overlapping Variable Sets*, in "Journal of Machine Learning Research", 2015, vol. 16, pp. 2147-2205

[84] M. YAGOUBI, M. SCHOENAUER. *Asynchronous Master/Slave MOEAs and Heterogeneous Evaluation Costs*, in "Genetic and Evolutionary Computation Conference (GECCO 2012)", United States, T. SOULE, J. H. MOORE (editors), ACM Press, July 2012, pp. 1007-1014, https://hal.archives-ouvertes.fr/hal-00689965

[85] M. YAGOUBI. *Multi-objective parallel evolutionary algorithms : Application to Diesel Combustion*, Université Paris Sud - Paris XI, July 2012, https://tel.archives-ouvertes.fr/tel-00734108