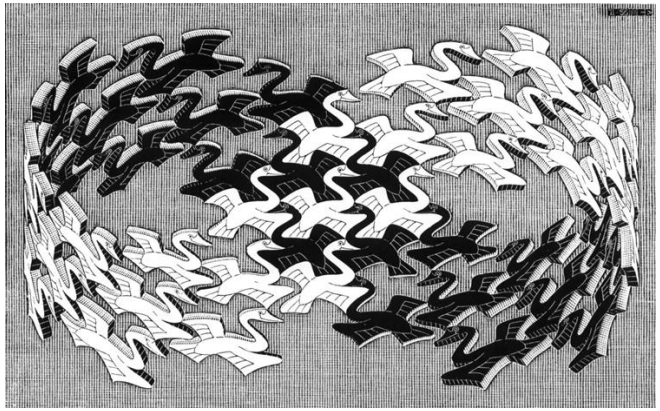
Wednesday Feb 13 (Pippard lecture theatre, Sheffield Building, level 5)

09:00	Reinforcement learning in the multi-agent setting. - **Sebastian van Strien** (Imperial)
09:30	A Dynamical Systems and Optimal Control Approach to Deep Learning. - **Qianxiao Li (**Singapore)
10:00	The Limit Points of (Optimistic) Gradient Descent in Min-Max . - **Ioannis Panageas** (SUTD)
10:30	Refreshment Break
11:00	Online Optimization in Zero-Sum Games: A Dynamical Systems Approach. - **Georgios Piliouras** (SUTD)
11:30	Predict Globally. Correct Locally: A dynamical systems view of distributed multilevel learning - **Panos Parpas** (Imperial)
12:00	Convergence of the ADAM algorithm from a Dynamical System Viewpoint. - **Pascal Bianchi** (Saclay)
12:30	Convergence of Online Training Algorithms for Recurrent System. - **Pierre-Yves Masse** (Saclay)
13:00	Lunch Break
14:00	A Gaussian process to detect underdamped modes of oscillation . - **Robert MacKay** (Warwick)
14:30	How Entropic Regression Beats the Outliers Problem in Nonlinear System Identification. - **Erik Bollt** (Clarkson)
15:00	The universality problem in dynamic machine learning. - **Juan-Pablo Ortega** (St Gallen)
15:30	Recurrence structure. - **Axel Hutt** (German Meteorological Service)
16:00	Refreshment Break
16:30	Panel Discussion
17:30	End

This meeting has been made possible with the generous support of:
EU H2020 grants CRITICS, RGDD, STALDYS,
Data Sciences Institute, Imperial College London
Department of Mathematics, Imperial College London
The Alan Turing Institute, London
London Mathematical Laboratory



Symposium on Machine Learning and Dynamical Systems, Imperial College London, Feb. 11-13, 2019

Since its inception in the 19th century through the efforts of Poincar*é* and Lyapunov, the theory of dynamical systems addresses the qualitative behaviour of dynamical systems as understood from models. From this perspective, the modeling of dynamical processes in applications requires a detailed understanding of the processes to be analyzed. This deep understanding leads to a model, which is an approximation of the observed reality and is often expressed by a system of Ordinary/Partial, Underdetermined (Control), Deterministic/Stochastic differential or difference equations. While models are very precise for many processes, for some of the most challenging applications of dynamical systems (such as climate dynamics, brain dynamics, biological systems or the financial markets), the development of such models is notably difficult.

On the other hand, the field of machine learning is concerned with algorithms designed to accomplish a certain task, whose performance improves with the input of more data. Applications for machine learning methods include computer vision, stock market analysis, speech recognition, recommender systems and sentiment analysis in social media. The machine learning approach is invaluable in settings where no explicit model is formulated, but measurement data is available. This is frequently the case in many systems of interest, and the development of data-driven technologies is becoming increasingly important in many applications.
The intersection of the fields of dynamical systems and machine learning is largely unexplored, and the goal of this symposium is to bring together researchers from these fields to fill the gap between the theories of dynamical systems and machine learning in the following directions:

- Machine Learning for Dynamical Systems: how to analyze dynamical systems on the basis of observed data rather than attempt to study them analytically.
- Dynamical Systems for Machine Learning: how to analyze algorithms of Machine Learning using tools from the theory of dynamical systems.

Organizers: Boumediene Hamzi, Yi-Ke Guo, Jeroen Lamb, Diana O'Malley (Imperial College London) and Robert MacKay (University of Warwick and The Alan Turing Institute).

Monday Feb 11 (G16 LT1, Sir Alexander Fleming Building)

08:00	Registration
09:00	Welcome, **Boumediene Hamzi and Jeroen Lamb** (Imperial)
09:15	Geometric methods in statistical learning problems for (stochastic) dynamical systems. - **Mauro Maggioni** (JHU)
10:00	Consistent manifold learning from data. - **Tim Sauer** (GMU)
10:30	Refreshment Break
11:00	Data based computation of invariant objects for dynamical systems. - **Michael Dellnitz** (Paderborn), **Andreas Bittracher** (FU Berlin), **Sebastian Peitz** (Paderborn)
12:00	Machine Learning for the control of complex systems. - **Markus Abel** (Ambrosys)
12:30	Empirical risk minimization over dynamical models. - **Kevin McGoff** (UNCC)
13:00	Lunch Break
14:00	Data-driven kernel methods for dynamical systems with application to atmosphere ocean science. - **Eniko Szekely** (Swiss Data Science Center)
14:30	Metric on nonlinear dynamical systems with Perron-Frobenius operators . **- Isao Ishikawa** (Tokyo)
15:00	Accelerating Implicit Integrators for Parametric ODE Systems by Greedy Kernel Approximation - **Bernard Haasdonk** (Stuttgart)
15:30	Kernel Methods for Dynamical Systems. - **Boumediene Hamzi** (Imperial)
16:00	Move to City & Guilds Building (Foyer and LT200).
16:15	Poster session + Refreshment Break
17:30	DSI distinguished lecture: Machine Learning for Forecasting Chaos (Including that of Large Spatially Distributed Systems). - **Ed Ott** (Maryland)
18:30	Reception and continuation of the Poster Session (until 19:30)

Posters by:

Samuel Rudy (UW), Lazaros Mitskopoulos (Crete), Anthony Caterini (Oxford), Jehan AlSwaihli (Reading), Lynn Houthuys (KU Leuven), Anastasios Tsourtis (Crete), Martin Lellep (Marburg), Jaideep Pathak (Maryland), Sanket Kamthe (Imperial), Karim Cherifi (Boumerdes, Algeria and MPI Magdeburg), Djalel Benbouzid (Volkswagen), Maximilian Karl (Volkswagen), Maximilian Soelch (Volkswagen), Miguel Xochicale (Birmingham), Giulia Denevi (IIT, Genova), Siyakha Mthunzi (Staffordshire).

Tuesday Feb 12 (Pippard lecture theatre, Sheffield Building, level 5)

09:00	Deep Data Assimilation: Integrating Deep Learning with Data Assimilation. - **Rossella Arcucci** (Imperial)
09:30	Local minima in training of neural networks. - **Grzegorz Swirszcz** (IBM)
10:00	NAIS-NET: Stable Deep Networks from Non-Autonomous Differential Equations. - **Marco Gallieri** (Nnaisence)
10:30	Refreshment Break
11:00	Deep Self-Organization: Interpretable Discrete Representation Learning on Time Series. - **Vincent Fortuin** (ETH)
11:30	Network attractors and the functional dynamics of RNN. **Peter Ashwin** (Exeter)
12:00	Effective networks: a model to predict network structure and critical transitions from datasets **.** - **Tiago Pereira** (USP)
12:30	Nonnegative polynomials, learning, and control. - **AmirAli Ahmadi** (Princeton)
13:00	Lunch Break
14:00	Analysing dynamics and networks using topological data analysis. - **Heather Harrington** (Oxford)
14:30	TDA for time-series analysis and dynamical systems. - **Hamza Ghadyali** (Duke)
15:00	Incremental Learning-to-Learn with Statistical Guarantees. - **Massimiliano Pontil** (UCL)
15:30	Bilevel Learning of the Group Lasso Structure. - **Saverio Salzo** (IIT)
16:00	Refreshment Break
16:30	Data-driven modeling of chaotic dynamics: a model reduction perspective **. - Kevin Lin** (Arizona)
17:00	Data-driven stochastic modeling for multiscale dynamical systems **. - Daan Crommelin** (CWI)
17:30	Challenges and design choices for global weather and climate models based on machine learning. - **Peter Dueben** (ECMWF)
18:00	Move to Ognisko Polish Club, 55 Exhibition Road, SW7 2PN.
18:30	Symposium Dinner (until approx 20:30)