

THEMATIC SCHOOL ON ARTIFICAL INTELLIGENCE

MUFRAMEX 2ND THEMATIC SCHOOL ON DEEP GENERATIVE MODELS

NOVEMBER 16th - 19th, 2022

CIMAT • CIMAT - DE JALISCO S/N, VALENCIANA, 36023 GUANAJUATO, GTO., MEXICO

MUFRAMEX INJEGN UNIVERTIALIE FRANCE HEZKLAHE









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| Lectures | Working sessions | Panel discussion |
|----------|------------------|------------------|
| Kevnotes | Social events | |

| | NOVEMBER, 16 th | NOVEMBER, 17 th | NOVEMBER, 18 th | NOVEMBER, 19 th | | |
|------------------------|--|---|---|--|-------------------------------|--|
| 9:00 am - | Welcoming words Victor Rivero (CIMAT) | | | | | |
| 7:30 ann - | Lecture 1: Introduction to Machine Learning 9:30 - 11:00 | Lecture 2: An introduction to deep generative models 9:30 - 11:00 | Lecture 2: An introduction to deep generative models 9:30 - 11:00 | Team work 9:30 - 11:00 | Al Ecosystems 9:30 - 11:00 | |
| 11:00 am - | Coffee break | Coffee break | Coffee break | Coffee break | | |
| 11:30 am - | Lecture 1: Introduction to Machine Learning 11:30 - 1:00 | Lecture 4: Ontologies for describing data 11:30 - 1:00 | Lecture 3: Exploring deep generative models 11:30 - 1:00 | Team work 11:30 - 1:00 | | |
| 1:00 pm - | Lunch | Lunch | Lunch | Lunch | | |
| 2:00 pm - | Poster session 2:00 - 3:30 | Lecture 3: Exploring deep generative models 2:00 - 3:30 | Poster session & tianguis of thesis proposals 2:00 - 3:30 | Team work 2:00 - 3:30 | | |
| 3:30 pm - | Coffee break | Coffee break | Coffee break | Coffee break | | |
| 4:00 pm - | Al-driven peptide design 4:00 - 5:00 | Deep variational method with attention for high- definition face generation 4:00 - 5:00 | Critical perspectives on Al development 4:00 - 5:00 | Challenge results 4:00 - 5:00 School organization 5:00 - 6:00 | | |
| 6:00 pm - | Programming tutorial 5:00 - 6:00 | Applications of deep generative modelling in pedestrian trajectory prediction 5:00 - 6:00 | Artificial intelligence in government 5:00 - 6:00 | | | |
| 0.00 pm - | Challenge presentation 6:00 - 7:00 | Programming tutorial 6:00 - 7:00 | Programming tutorial 6:00 - 7:00 | Diplomad 6:00 - | o program 7:00 | |
| 7:00 pm - | | | | | | |
| 8:00 pm - 8:30 pm - | | Taquiza in CIMATEL 7:30 - 9:00 | Team work 7:00 - 8:30 | | | |
| 9:00 pm - | | | | | | |



LECTURE 1: INTRODUCTION TO MACHINE LEARNING

Lecturer: Johan Van Horebeek, Centro de Investigación en Matemáticas - CIMAT (Mexico)

Schedule: November 16th, 9:30 am -11:00 am & 11:30 am -1:00 pm

Syllabus: This course will first introduce the vocabulary and definition necessary to understand machine learning. Notions such as classification, regression, overfitting, bias, etc. will be presented. Based on these definitions, some well chosen algorithms will be explained and applied to classical datasets using Jupyter Notebooks.

Software requirements: Basics in Python, Basics in Statistics. Please either (a) install jupyter notebook, scikit learn, matplotlib, sns, panda libraries on your machine or (b - prefered) have a google colab account set up before the class.

LECTURE 2: AN INTRODUCTION TO DEEP GENERATIVE MODELS

Lecturer: Émile Mathieu, University of Cambridge (UK)

Schedule: November 17th, 9:30 am -11:00 am & November 18th, 11:30 am -1:00 pm

Syllabus: This course will introduce several of the most influential deep generative models, with a particular focus on variational auto-encoders, normalising flows and score based diffusion models.

Software requirements: None.

LECTURE 3: EXPLORING DEEP GENERATIVE MODELS

Lecturer: Dennis Wilson, ISAE-SUPAERO (France)

Schedule: November 17th, 2:00 pm - 3:30 pm & November 18th, 11:30 am - 1:00 pm

Syllabus: This class will allow students to explore generative models through practical examples. Students will interactively create, train, and evaluate generative models on simple examples. The first class will focus on Generative Adversarial Networks and the second on diffusion models.

Software requirements: Pytorch (1.9 or above), Jupyter, numpy, matplotlib in a local environment or a Google Colab account.

LECTURE 4: ONTOLOGIES FOR DESCRIBING DATA

Lecturer: Nathalie Hernandez, IRIT (France)

Schedule: November 17th, 11:30 am -1:00 pm

Syllabus: Ontologies allow to define formal vocabularies to describe and reason about data. We will see in this course to what extent ontologies and knowledge graphs can facilitate the reuse and automatic processing of data.

Software requirements: A web browser.



AI-DRIVEN PEPTIDE DESIGN: OPPORTUNITIES AND CHALLENGES

Speaker : Fabien Plisson, Centro de Investigación y de Estudios Avanzados - CINVESTAV (Mexico)

Schedule: November 16th, 4:00 pm - 5:00 pm

Peptides are short strings of 2-50 amino acids that regulate several processes in human physiology. They have beneficial role in slowing down the aging process, reducing inflammation, and destroying microbes. Major limitations preventing peptides from translating into clinics are their low metabolic stability, poor oral bioavailability and high toxicity. Reducing hurdles to clinical trials without compromising the therapeutic promises of peptide candidates becomes an essential step in drug design. For any given peptide sequence, the number of possible mutations is astronomical. It is not practical to synthesize all sequences or even to investigate all functionally interesting variants. A central goal for computational peptide design is to create novel sequences that carry the underlying properties of natural peptides with defined structural and functional properties. Machine learning algorithms intertwine predictive and generative models to design optimal sequences rationally. In this presentation, we will discuss the current opportunities and challenges in AI-driven peptide design, and the solutions to develop robust and fair models for the discovery and design of safe peptide-based drugs.

APPLICATIONS OF DEEP GENERATIVE MODELLING IN PEDESTRIAN TRAJECTORY PREDICTION

Speaker: Jean-Bernard Hayet, CIMAT (Mexico)

Schedule: November 17th, 5:00 pm - 6:00 pm

This talk will deal with the problem of human trajectory prediction and try to explain how useful it can be to solve it in some applications. We will see that ad-hoc variants of classical generative modelling algorithms can handle some of the specific difficulties arising in this kind of problems, such as multi-modal nature of the predictive distributions and interactions between agents.

DEEP VARIATIONAL METHOD WITH ATTENTION FOR HIGH-DEFINITION FACE GENERATION

Speaker: Mariano Rivera, CIMAT (Mexico)

Schedule: November 17th, 4:00 pm - 5:00 pm

Super-Resolution (SR) methods estimate a high-resolution image with natural and realistic textures from a low-resolution image. We can classify SR methods based on Deep Neural Networks between two paradigms: single image SR (SISR) and reference image-based SR (RefSR). Some of the problems of traditional SISR are blurring effects; such methods achieve a kind of interpolation. For this reason, Generative Adversarial Networks (GANs) have surged as an option for introducing textures; however, they could cause hallucinations of textures or unnatural textures. Recently, RefSR methods transfer high-resolution textures from a given reference (Ref) image, producing visually pleasing results. In this talk we present a model based on neural network architectures for generating realistic high-resolution faces that combines a variational model with an attention model based on transformers to improve the quality of generated high-definition images that looks realistic. Experimental results demonstrated the method capabilities with a High-Quality Faces dataset.



CRITICAL PERSPECTIVES ON AI DEVELOPMENT

Speaker: Sofia Trejo, Instituto Tecnológico Autónomo de México - ITAM (Mexico)

Schedule: November 18th, 4:00 pm - 5:00 pm

What guides AI as a technological development? Is the pursuit of particular objectives? Is it benchmarks? Who decides which systems get developed and deployed? What are the negative impacts of these technologies and are they equally distributed? In this talk, we will explore these questions, paying particular attention to Mexico's context, to reflect on Al's present and possible future.

ARTIFICIAL INTELLIGENCE IN GOVERNMENT

Speaker: Ulises Moya, Gobierno de Jalisco (Mexico)

Schedule: November 18th, 5:00 pm - 6:00 pm

This talk will explore recent applications of artificial intelligence (in particular deep learning) in the Jalisco Government such as diabetic retinopathy detection, remote sensing crop classification using time series data. We will discuss some of the particular challenges to generating end-to-end solutions with current deep learning techniques and data limitations. We hope that this talk help to the summer school students to be aware of the model limitations and the real-world problems in the implementation.

PANEL DISCUSSION

AI ECOSYSTEMS IN FRANCE AND MEXICO

Speakers: Ulises Moya (Gobierno de Jalisco), Victor Larios (Universidad de Guadalajara), Nicolas Viallet (ANITI) & Ivete Sánchez Bravo (CIMAT)

Schedule: November 19th, 9:30 am - 11:00 am

This talk will explore recent applications of artificial intelligence (in particular deep learning) in the Jalisco Government such as diabetic retinopathy detection, remote sensing crop classification using time series data. We will discuss some of the particular challenges to generating end-to-end solutions with current deep learning techniques and data limitations. We hope that this talk help to the summer school students to be aware of the model limitations and the real-world problems in the implementation.

LECTURERS



JOHAN VAN HOREBEEK

RESEARCHER

CIMAT (MEXICO)

Johan Van Horebeek is a researcher at the Computer science Department of CIMAT, a federal funded research centre in Mathematics, Statistics and Computer Science in Guanajuato City (Mexico). He holds a PhD from the University of Leuven (Belgium) in statistics. His research interests are statistical pattern recognition, analysis of complex data and machine learning. He teaches at CIMAT and at the University of Guanajuato and participates regularly in consultancy projects (INEGI, Central Bank of Mexico, etc).



NATHALIE HERNANDEZ

FULL PROFESSOR

UNIVERSITÉ TOULOUSE JEAN-JAURÈS (FRANCE)

Nathalie Hernandez has been a Full Professor at Toulouse Jean Jaurès University since September 2021. Her research is in the field of Artificial Intelligence, and more specifically concerns Knowledge Engineering and the Semantic Web. Anchored in the field of AI, the research themes in which she is interested have evolved with the development of the Web and societal issues. Focused during ger thesis on the use of ontologies to facilitate the task of searching for information within a corpus of texts, today they address the issues related to the integration of connected-objects as Web resources, knowledge graphs and distributed reasoning in the Internet of Things as well as the hybridization of symbolic reasoning and machine-learning.



EMILE MATHIEU POSTDOCTORAL RESEARCH ASSOCIATE

UNIVERSITY OF CAMBRIDGE (UK)

Emile Mathieu is a postdoctoral research associate in the Cambridge Machine Learning Group. His research interests centre around deep probabilistic machine learning with a focus on encoding problem symmetries and geometrical constraints, with application to the natural sciences.



DENIS WILSON ASSOCIATE PROFESSOR

ISAE-SUPAERO (FRANCE)

Dennis Wilson is an associate professor in AI and Data Science at ISAE-SUPAERO. Their research focuses on bio-inspired artificial intelligence, namely evolutionary computation and neural networks. Dennis is engaged with climate applications through ongoing collaborations with the CNES on shoreline change forecasting and with MIT on wind farm optimization.

SPEAKERS



JEAN-BERNARD HAYET

SENIOR RESEARCH SCIENTIST DEPARTMENT OF COMPUTER SCIENCE CIMAT (MEXICO)



FABIEN PLISSON

RESEARCH ASSOCIATE PROFESSOR NATIONAL LABORATORY IN GENOMICS FOR **BIODIVERSITY LANGEBIO-CINVESTAV IPN** (MEXICO)



VICTOR LARIOS

PROFESSOR RESEARCHER CUCEA SMART CITIES INNOVATION CENTER UNIVERSIDAD DE GUADALAJARA (MEXICO)



ULISES MOYA DIRECTOR OF AI

ARTIFICIAL INTELLIGENCE DIVISION **GOVERNMENT OF JALISCO (MEXICO)**

MARIANO RIVERA

RESEARCH PROFESSOR

DEPARTMENT OF COMPUTER SCIENCE CIMAT (MEXICO)



NICOLAS VIALLET

MÉXICO - ITAM (MEXICO)

SOFIA TREJO

DATA SCIENCE

CHIEF OPERATING OFFICER ARTIFICIAL AND NATURAL INTELLIGENCE **TOULOUSE INSTITUTE - ANITI (FRANCE)**

LECTURER ON ETHICS AND LEGALITY OF

INSTITUTO TECNOLÓGICO AUTÓNOMO DE

IVETE SÁNCHEZ BRAVO TECHNOLOGY SERVICES COORDINATOR CIMAT (MEXICO)

ORGANIZING COMMITTEE

PROGRAM COMMITTEE

- Thomas Batard, CIMAT
- Jean-Bernard Hayet, CIMAT
- Hervé Luga, Université de Toulouse
- Victor Larios, Universidad de Guadalajara

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