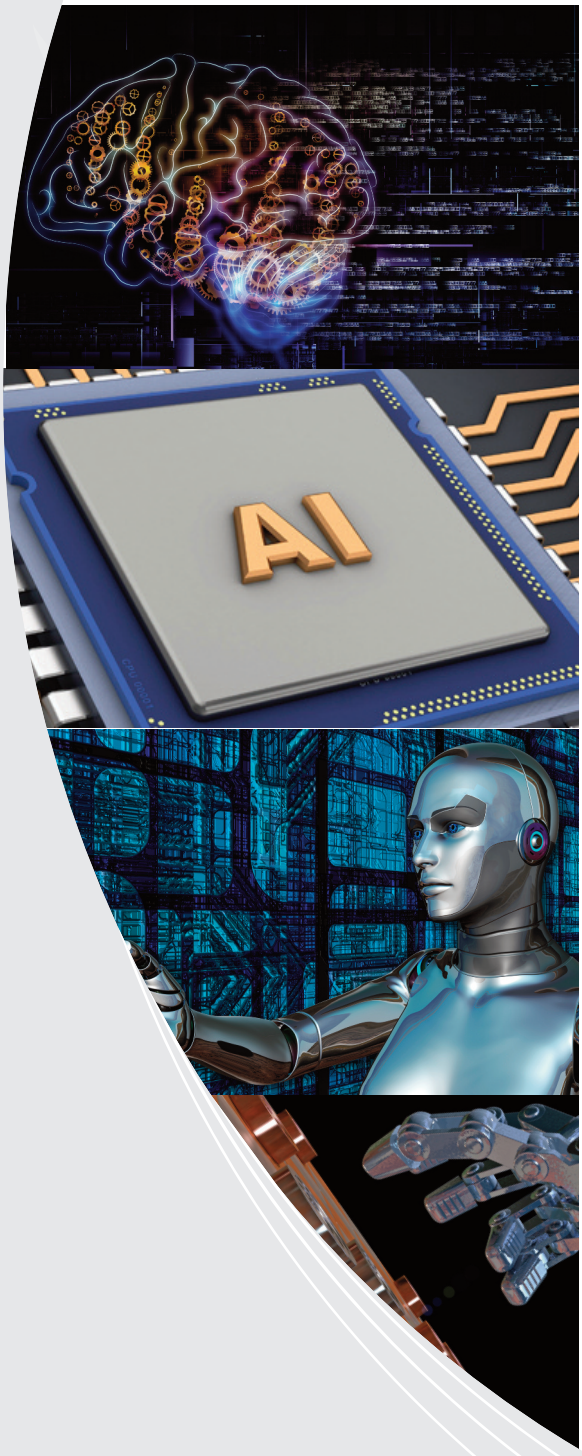
INSTITUT DE FRANCE
Académie des sciences

Symposium



Machine Learning for Artificial Intelligence

February 20th, 10 am to 4 pm
Venue: Institut de France, Grande salle des séances

23, quai de Conti, 75006 Paris

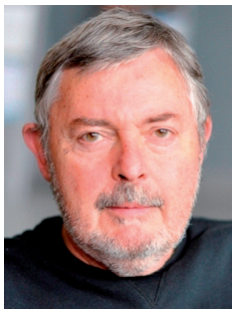
Artificial Intelligence (AI) is the name given to the set of algorithms and techniques aiming at reproducing the sensorial and cognitive abilities of living beings in electronic machines.

The sciences involved in the progress of AI are numerous: neuroscience, mathematics, information theory, computer science, electronics, linguistics, etc. The applications are just as various: image, scene and speech recognition, sense extraction in text, automatic summarization, robotics, games, etc.

This symposium, jointly organized by the Académie des sciences *and the Korean Academy of Science and Technology (KAST), will highlight the variety of applications and the diversity of algorithmic approaches serving the progress of machine learning.*

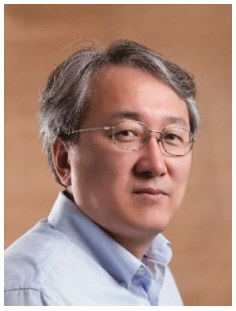
The topics addressed will be visual recognition, brain imaging, brain-machine interface, natural language processing and bioinformatics through presentations given by renowned experts from our two countries.

Chairmen



Claude Berrou

Claude Berrou is a Fellow of Académie des sciences and a professor emeritus at IMT Atlantique. His research is devoted to information theory at large with applications to telecommunication and artificial intelligence. He is the inventor of turbo codes, the first quasi-optimal error correcting codes widely used today in 3G and 4G mobile systems (IEEE Richard W. Hamming Medal 2003, Marconi Prize 2005)



Seong-Whan Lee

Seong-Whan Lee is the Hyundai-Kia Motor Chair Professor at Korea University, where he is the head of the Department of Brain and Cognitive Engineering.
He received the B.S. degree in computer science and statistics from Seoul National University, Seoul, Korea, in 1984, and the M.S. and Ph.D. degrees in computer science from Korea Advanced Institute of Science and Technology in 1986 and 1989, respectively. From February 1989 to February 1995, he was an Assistant Professor in the Department of Computer Science at Chungbuk National University, Cheongju, Korea. In March 1995, he joined the faculty of the Department of Computer Science and Engineering at Korea University, Seoul, Korea, and now he is the tenured full professor. In 2001, he stayed at the Department of Brain and Cognitive Sciences, MIT as a visiting professor.
A Fellow of the IEEE, IAPR, and Korean Academy of Science and Technology, he has served several professional societies as chairman or governing board member. He was the founding Co-Editor-in-Chief of the International Journal of Document Analysis and Recognition and has been an Associate Editor of several international journals: Pattern Recognition, ACM Trans. on Applied Perception, IEEE Trans. on Affective Computing, Image and Vision Computing, International Journal of Pattern Recognition and Artificial Intelligence, and International Journal of Image and Graphics. His research interests include pattern recognition, artificial intelligence, and brain engineering. He has more than 300 publications in international journals and conference proceedings, and authored 10 books..

Organized by

Académie des sciences &
Korean Academy of Science and Technology (KAST)

Sukhan Lee (Sungkyunkwan University, Vice-President for Academic Affairs KAST)
Dong Soo Lee (Seoul National University, Fellow KAST)
Olivier Faugeras (INRIA Sophia Antipolis, Académie des sciences)
Sébastien Konieczny (CRIL, CNRS)
Stéphane Mallat (ENS Paris, Académie des sciences)

Program

10:00	**Visual Understanding of 3D Objects and Scenes for Robotic tasks.** **Sukhan Lee,** Vice-President for Academic Affairs, KAST / Distinguished Chair Professor, Sungkyunkwan University
10:40	**Automatic Understanding of the Visual World** **Cordelia Schmid,** INRIA Grenoble Rhone-Alpes
11:20	**Deep Learning-Enhanced Brain Imaging for Personal Connectomics** **Dong Soo Lee,** Fellow, KAST / Professor, Seoul National University
14:00	**Teaching Machines to Understand Natural Language** **Antoine Bordes,** Facebook AI Research Paris
14:40	**A Mind-Reading Technology: Brain-Computer Interface** **Seong-Whan Lee,** Fellow, KAST / Professor, Korea University
15:20	**How Computers Break (Serious) Puzzles with Logic and (a Different Breed of) Learning** **Thomas Schiex,** INRA MIAT Toulouse

Abstracts and biographies

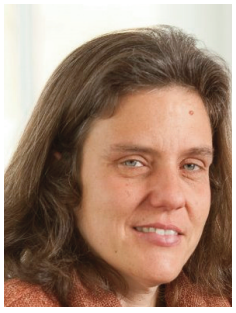
Sukhan Lee

Vice-President for Academic Affairs, KAST / Distinguished Chair Professor, Sungkyunkwan University

Prof. Sukhan Lee is currently Distinguished Chair Professor at Sungkyunkwan University and a Vice President of Korea National Academy of Science and Technology (KAST). Previously, he served as Dean of the University Graduate Studies as well as an Executive VP and Chief Research Officer at Samsung Advanced Institute of Technology. He also worked for JPL/NASA as a Senior MTF and for University of Southern California as a Professor of EE and CS. Prof. Lee is a fellow of IEEE and of KAST. He has research interest in robotics, computer vision and artificial intelligence.

Visual Understanding of 3D Objects and Scenes for Robotic tasks

Robotic tasks rely on understanding the 3D workspace at hand by recognizing and localizing 3D objects embedded in the scene. This talk addresses visual representation of the workspace in terms of the layout of 3D objects as well as of the structure of local geometric features associated with 3D objects. To this end, 2D and 3D proposal networks are formulated to describe the layout of 3D objects in the workspace, whereas a Cluster-Segmentation Network (CS-Net) is designed to extract a hierarchy of local geometric features of 3D objects. The highlight of this talk is twofold: 1) how the CS-Net designed is to meet the challenges of current deep learning networks, namely reducing data dependency while enhancing generalization in training and 2) how a hierarchy of local geometric features extracted is to link data-driven deep learning to symbol-driven ontology for semantic exploration. Experimental results are shown with the visually guided errand service of a home service robot, "HomeMate," as a testbed.



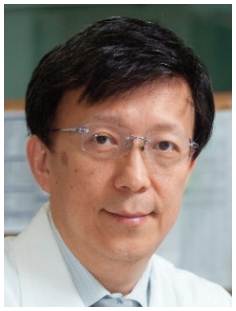
Cordelia Schmid

INRIA Grenoble Rhone-Alpes

Cordelia Schmid holds a M.S. degree in Computer Science from the University of Karlsruhe and a Doctorate, also in Computer Science, from the Institut National Polytechnique de Grenoble (INPG). Her doctoral thesis received the best thesis award from INPG in 1996. Dr. Schmid was a post-doctoral research assistant in the Robotics Research Group of Oxford University in 1996-1997. Since 1997 she has held a permanent research position at INRIA Grenoble Rhone-Alpes, where she is a research director and directs an INRIA team. Dr. Schmid has been an Associate Editor for IEEE PAMI (2001-2005) and for IJCV (2004-2012), editor-in-chief for IJCV (2013---), a program chair of IEEE CVPR 2005 and ECCV 2012 as well as a general chair of IEEE CVPR 2015 and ECCV 2020. In 2006, 2014 and 2016, she was awarded the Longuet-Higgins prize for fundamental contributions in computer vision that have withstood the test of time. She is a fellow of IEEE. She was awarded an ERC advanced grant in 2013, the Humbolt research award in 2015 and the Inria & French Academy of Science Grand Prix in 2016. She was elected to the German National Academy of Sciences, Leopoldina, in 2017.

Automatic Understanding of the Visual World

One of the central problems of artificial intelligence is machine perception, i.e., the ability to understand the visual world based on the input from sensors such as cameras. Computer vision is the area which analyzes visual input. In this talk, I will present recent progress in visual understanding. It is for the most part due to design of robust visual representations and learned models capturing the variability of the visual world based on state-of-the-art machine learning techinques, including convolutional neural networks. Progress has resulted in technology for a variety of applications. I will present in particular results for human action recognition.



Dong Soo Lee

Fellow, KAST / Professor, Seoul National University

Prof. Dong Soo Lee is a nuclear medicine physician and majored in brain mapping and connectivity studies using mostly PET (positron emission tomography). He belongs also to department of molecular medicine and biopharmaceutical sciences. His recent interest moved to re-interpretation of PET/MRI connectomics data in the framework of persistent homology at individual patient level named as 'personal connectomics'. In collaboration with Dr. Choi, he tries to apply deep learning to multi- and high-dimensional biomedical data with many missing points in addition to brain imaging data. Better classification and prediction is his group's goal.

Deep Learning-Enhanced Brain Imaging for Personal Connectomics

Although deep learning needs to address several clinical unmet needs, there are several issues to facilitate application to brain imaging. Firstly, as ground-truth is ambiguous in medical data and 'disease status' is defined as deviation from the normal population spectrum, what we need is to develop good biomarker predicting patients' outcome. Second, as brain is highly connected structure, appropriate network architectures are needed, instead of convolutional layers used popularly for image classification. Third, uncertainty measurements shall facilitate clinical application, which can be obtained by Bayesian approximation and presuming distribution of the output. Unsupervised learning using, for example, generative models will help limited data availability, in medicine. Beyond deep learning models mimicking the clinicians' decision-making, latent biomarkers in multimodal and high-dimensional data might be eventually discovered by deep learning.

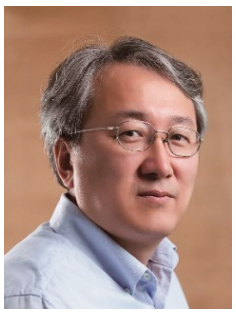
Antoine Bordes

Facebook AI Research Paris

Antoine Bordes leads the lab of Facebook Artificial Intelligence Research in Paris. Prior to joining Facebook in 2014, he was a CNRS researcher in Compiègne in France and a postdoctoral fellow in Yoshua Bengio's lab of University of Montreal. He received his PhD in machine learning from Pierre & Marie Curie University in Paris in 2010 with two awards for best PhD from the French Association for Artificial Intelligence and from the French Armament Agency. Antoine's current interests are centered around natural language understanding using neural networks, with a focus on question answering and dialogue systems. He published more than 50 papers cumulating more than 6 000 citations.

Teaching Machines to Understand Natural Language

Despite the recent successes of Deep Learning for multiple tasks ranging from image segmentation to speech recognition, understanding language remains a largely unsolved problem for machines. This is still highly challenging for multiple reasons such as the intrinsic complexity of language, the need for machine common-sense or the difficulty of actually evaluating natural language understanding. Yet, current research is making progress and this talk will exhibit some of them in the areas of open-domain question answering (answering questions on any topic) and machine reading (answering questions related to a short piece of text). We will show how the combined use of innovative neural networks architectures with new training and test benchmarks can yield promising results.



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A Mind-Reading Technology: Brain-Computer Interface

Brain-computer interface (BCI) is a mind-reading technology that interprets and delivers user's intention to the external world without relying on the normal output pathways of peripheral nerves and muscles. Today, BCI technology with artificial intelligence (AI) is highly regarded as a future technology that will lead the 4th industrial revolution. It could be a powerful and versatile tool to advance the intelligence and the quality of our lives. In particular, electroencephalography (EEG) which is a non-invasive brain signal acquisition method has been widely used in BCI researches due to its portability, low set-up cost, ease of use, and so on. In this talk, I will briefly introduce a fundamental concept and the principle of BCI based on EEG. And I will discuss recent advances from Korea University that have helped to broaden the spectrum of applicability for BCI including exoskeleton robot control, wheelchair control, neuro-driving, BCI-racing game and explainable deep learning for BCI. I will also discuss a BCI-based conscious level detection study that could reduce diagnostic error in anesthesia surgery.

Thomas SCHIEX
INRA MIAT Toulouse

Thomas Schiex shares his time between extending AI core technology and developing computational biology tools. On the AI side, he is trying to push the limits of guaranteed NP-hard problem solving. Thanks to the close contact with biologists that Institut National de la Recherche Agronomique (INRA) makes possible, he also developed computational tools that have produced genetic maps for a variety of plant and animal genomes, or identified millions of genes in the genomic DNA of prokaryotic and eukaryotic organisms (cocoa remaining his favorite). All this could not have been done without many amazing collaborators, both intra and inter-disciplines. He is now trying to give AI technology the ability to help human design new proteins, the molecules of life. Dr. Schiex is an Associate Editor of the Journal of Artificial Intelligence Research, of the Artificial Intelligence Journal and of the BMC bioinformatics journal.

How Computers Break (Serious) Puzzles with Logic and (a Different Breed of) Learning

It's with logic that we prove and with intuition that we find", said Henri Poincaré in La valeur de la science [Flammarion, 1905]. Although Deep Learning seems now able of granting AIs with some intuition, even the simplest AI is endowed with the capacity of performing billions of logical operations per second. It is therefore unsurprising to see that brute force has granted AIs with superhuman capacities in simple logic and calculus. However, when it comes to solving complex problems such as theorem proving, or software and hardware verification, an AI that solely relies on brute force will fail dramatically. Simply because brute force requires to consider a number of cases which, on these so-called NP-hard problems, can easily exceed a googol (10100) far more than the number of atoms in the known universe.

In the last twenty years however, AIs have made spectacular progress in provenly solving real instances of these difficult problems. This progress results from simple ingredients, with a combined power that we do not fully understand. I invite you to discover some ingredients of this new "brute reason" through the presentation of various recent results, including ours, from mathematics to molecular design, from bits to atoms.

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