Monique Baron, Monique Grandbastien

Introduction (EN)

Volume 3, nº 1-2 (2022), p. 19-35.

<http://roia.centre-mersenne.org/item?id=ROIA_2022__3_1-2_19_0>

Revue Ouverte d'Intelligence Artificielle
Volume 3, n° 1-2, 2022, 19-35

Introduction (EN)

Jacques Pitrat passed away on October 14, 2019, at the age of 85. A pioneer in Artificial Intelligence (AI) research in France, he devoted his entire scientific career, since the beginning of his thesis work in 1960, to developing the original and ambitious vision he had of Artificial Intelligence, namely to build general systems whose capabilities would exceed those of human intelligence. This vision guided his scientific contributions, with the enthusiasm he displayed leaving its mark on the many generations of students and researchers that he taught. Even recently, in November 2018, he presented his concept of strong AI, while introducing himself as a "full-time researcher in AI", at a Computer Science colloquium[(1)] at Sorbonne University.

A tribute day[(2)] was organized by the French Association for AI (AFIA) on March 6, 2020, on the Jussieu campus of Sorbonne University, in association with LIP6 and SCAI[(3)]. Over the course of this day, former students and colleagues spoke about different facets of his professional career and his research work, as well as his exceptional human qualities. The ROIA journal decided to extend and expand this tribute in the form of a special issue, for which we gladly agreed to be the guest editors[(4)], and for which a call for papers was published in December 2020.

As the authors of tributes [3] [5] [6] published at the time of his death point out, Jacques Pitrat was an internationally recognized researcher who became a passionate believer in the possibilities of AI, and one who explored several areas of this subject during his career. Examples include automated theorem proving, game programming, automated natural language processing, solving constraint satisfaction problems, and knowledge representation and use. From the early 1980s, he developed his vision of metaknowledge, reflexive systems and the bootstrap principle. Jacques Pitrat was also very interested in all research concerning AI and psychology, and more broadly the

(1) Computer Science colloquium at Sorbonne University on 11/14/2018, "l'IA forte" [Strong AI] by Jacques Pitrat: `https://www.lip6.fr/colloquium/?guest=Pitrat`.

(2) Slides and videos available on line: `https://afia.asso.fr/journee-hommage-j-pitrat/`.

(3) Sorbonne Center for Artificial Intelligence.

(4) We were both part of Jacques Pitrat's team, at different times. Monique Grandbastien took the first Artificial Intelligence course that he gave at the master level in 1967-68, then prepared her PhD under his supervision. Monique Baron took his master's courses in 1977-78, then prepared her PhD under the supervision of J.-L. Laurière in the Artificial Intelligence team "Pitrat-Laurière"; she continued her career as an academic in the team "Expert Systems" led by J.-L. Laurière until 1988, then in the "Metaconnaissances" team led by Jacques Pitrat at LAFORIA, before the reorganization of research themes at LIP6 in 1997. We presented a history of these teams during the tribute day on March 6, 2020.

Cognitive Sciences, as evidenced by several of his articles, books and conferences. One could say, to use a well-known expression, that when it came to intelligence there was nothing human or artificial that was foreign to him.

We will now go on to discuss some general aspects of his work and ideas, as well as his role as educator and team director, before presenting the contents of this special tribute issue.

The international context of Jacques Pitrat's work, an overview

Jacques Pitrat's early work in Artificial Intelligence brings us back to the origins of the discipline with the appearance of the term "artificial intelligence" during the founding seminar at Dartmouth College (New Hampshire) in 1956. Several documents report that he was the first to translate this term into French. From a scientific point of view, the work presented on this occasion – in particular the Logic Theorist of A. Newell, H. Simon and C. Shaw which was capable of demonstrating theorems of propositional logic – paved the way for the domain of automated theorem proving, domain that Jacques Pitrat was the first to continue pursuing in France, with his thesis entitled "Production of theorem demonstration programs using heuristic methods".

Therein, he already introduced the idea of "meta" with metatheorems and metatheories and the equivalent at the metameta level. As early as 1961, Jacques Pitrat published his work and was recognized as one of the leading researchers in the field. This is demonstrated, for example, by his participation in the editorial committee of the historic journal Artificial Intelligence, created in 1970, as well as his invitation to join a panel [2] on game programs by H. Berliner with the "greats" in this field (namely, R. Greenblatt, A. Samuel and D. Slate) at the 1977 IJCAI conference, as well as his subsequent involvement in the ICCA[(5)] journal, which later became the ICGA, specializing in the field of games. He also maintained an ongoing exchange with H. Simon, which he recounts in the special issue [12] of the *Revue d'Intelligence Artificielle* that he published in 2002 in his memory.

The Artificial Intelligence seminar organized in the Ile de France region from 1989 to 1996 by researchers from EDF, IBM and Renault, and thereafter the EDF-LAFORIA seminar, also provided many opportunities for discussions among foreign scientists, as reflected in the article by J.-L. Dormoy. Jacques Pitrat disseminated his concepts of artificial intelligence as widely as possible abroad, through his books, in particular the one on natural language processing translated into English in 1988, and through his final book, "Artificial Beings: the Conscience of a Conscious Machine", written in English and published in 2009. He also published in English his reflections on Artificial Intelligence and on the results of his experimental work on the CAIA system in his blog [15] from 2013 to 2019.

Several articles in this issue, notably those by H. Prade & J.-P. Haton and T. Cazenave, complete this brief overview. J. Quinqueton, in his testimony, reminds

[(5)] ICGA journal: International Computer Games Association Journal, which, in 2000, succeeded the ICCA journal (founded in 1977) as the International Computer Chess Association Journal.

us that Jacques Pitrat was elected AAAI Fellow in 1994 "for his roles as a pioneer of AI in France, outstanding teacher and student leader; and for his many valuable contributions involving metaknowledge".

Jacques Pitrat, the teacher, thesis supervisor and team leader

Jacques Pitrat knew that the development of Artificial Intelligence required the training of researchers in this new discipline and he devoted part of his time to giving master's courses. The clarity of these courses and the strength of conviction that emanated from them are underlined by several authors in this issue. He supervised many young researchers, both French and foreign, who have often mentioned his extreme scientific rigor accompanied by an attitude that is ever-positive and attentive toward everyone. There are 70 theses prepared under his supervision (list in appendix 1). His scientific influence and his enthusiasm for the progress of artificial intelligence then spread widely since many of his doctoral students went on to become lecturers and professors. They taught artificial intelligence, enriched by his courses and his vision of artificial intelligence, in many French and foreign universities (Spain, Mexico, Egypt, Canada, South America, etc.) where they in turn were able to train doctoral students.

After his recruitment into the CNRS' Blaise Pascal Institute, Jacques Pitrat created a research team in artificial intelligence. From 1970 to 1975, this team brought together researchers from the University of Paris 6, such as J.-L. Laurière and B. Flavigny, as well as teaching assistants from relatively nearby universities (Orsay, Caen, Le Mans, Rouen, Strasbourg and Nancy) who came to prepare their PhD theses in AI at Paris 6. The meetings of this team were then shared with that formed at the end of the 1970s by J.-L. Laurière (until he broke off into the private sector in 1988). During these monthly meetings, Jacques Pitrat shared interesting articles that he had read, in particular in the journals Artificial Intelligence and Cognitive Science, but also in the proceedings of the major congresses in the field. The rest of their time was devoted to presentations and discussions on the work in progress by the doctoral students or other members of the team. With respect to these discussion forums featuring Jacques Pitrat and Jean-Louis Laurière, the scientific complicity, mutual respect and admiration displayed by these two men for one another also marked many of their colleagues.

An annual colloquium, of a few days in length, was included in the team's framework from 1974 onwards. It was held at the beginning or end of summer, at a university outside of Paris, in association with a local team (until 1990), and then in various other places, including the reception center on the Island of Berder (from 1994 to 2001) together with the DER EDF, the role of which is evoked by J.-L. Dormoy in this issue. These colloquia aimed to deepen the scientific questions addressed in the theses defended and in the other work of the team, and made it possible to explore new subjects (such as that of emotions, in 1997). Most of them were the subject of proceedings (list attached in Appendix 2). Several authors in this issue, who took part in these colloquia, talk about the frank and open work environment that made it possible to have in-depth discussions about the problems encountered in their research work, or simply to share

ideas. Some noted “the interest aroused by Jacques Pitrat’s presentation” and “the renewed enthusiasm with which everyone left”.

Beyond the various areas of AI, some founding concepts

Since his thesis work, Jacques Pitrat sought to build general systems, which were the only ones, in his opinion, within which one can recognize a little intelligence. To progress in this direction, he explored various fields of Artificial Intelligence, as we mentioned at the beginning of this introduction. These fields are, for the most part, taken up in specific contributions of this issue, their diversity and the path which led Jacques Pitrat to address them can also be analyzed through the proceedings published on the occasion of the team’s colloquia. But three cross-cutting themes, featured in several articles in this tribute issue, concern his major scientific contributions.

The first is **metaknowledge**. Whereas the notion of meta is already present in his thesis work concerning theorem proving in the early 1960s, with [meta]metatheorems and [meta]metatheories, as mentioned above, the theme of metaknowledge emerged in the work of Jacques Pitrat in the early 80s, beginning with problems posed by the use of large quantities of declarative knowledge, such as those appearing in the rule bases of “expert systems” [11, p. 16-40] . One of his objectives was then to clarify knowledge on how to implement these rules so that they would not remain stuck within the program of an inference engine, and therefore to clarify metaknowledge also in declarative form, as explained by Jacques Pitrat at the 1982 AI colloquium [9]. He implemented this principle in 1983 within the MACISTE system, which he presented at the 1985 AI colloquium [10]. In addition, other metaknowledge makes it possible to consider the statement of a problem (to find its symmetries, for example) and to explain the resolution of a problem.

Several authors refer to Jacques Pitrat’s lectures and book [11] on this theme, with some also showing how they expanded upon this notion during their subsequent research. Some of them even emphasize the topicality of this theme, particularly the use of metaknowledge in the context of “Explainable Artificial Intelligence”.

The second theme, based on the first, is **reflexivity**, i.e. the possibility for a system to observe its functioning with the aim of controlling and improving it. As an epigraph to his book [11, p. 7], Jacques Pitrat writes: “How can we conceive of a superior intelligence that does not reflect upon the statement of the problems it deals with and that does not have a mechanism analogous to human consciousness for knowing what it did and why it did it, for understanding the reasons for its successes and failures, for observing its progress towards its goal and for modifying its plans according to its observations?”. He illustrates and reiterates these aspects throughout this book, particularly in Part I, chapter 4 (Reflexivity) and in Part II (Multi-level Operation).

The third theme is **bootstrap**, a progressive design process, where the realization at stage N is used for the next stage, which needs to bring the final goal closer. Jacques Pitrat often used simple examples to illustrate the idea of bootstrapping, such as the evolution of the hammer, each successive hammering tool having gradually contributed

to the realization of better hammers [11, p. 187-188]. He experimented with a process for bootstrapping the use of knowledge in the MACISTE system in the early 1980s [11, p. 191-198]. This idea of bootstrap, combined with those of metaknowledge and reflexivity, allowed him to consider using AI itself to achieve the goal of strong AI, by bootstrapping AI [8], and led him to design CAIA (an Artificial Researcher in AI)[(6)], to which he devoted the last 30 years of his life. He considered it only as a step on the very long path towards AI singularity, that is to say the realization of general systems with better performances than humans [14].

Another common feature of the various works by J. Pitrat (MACISTE, MALICE and CAIA) is the modeling of problems in the form of **constraint solving**, inspired by J.-L. Laurière's thesis, using the ALICE language and program (1976). Several authors of this volume have taken up examples of this type, borrowed or not from the problems addressed by Jacques Pitrat.

Finally, one last essential idea for Jacques Pitrat is that Artificial Intelligence is an **experimental science** in the sense that any new idea (hypothesis) must be the subject of a program that allows one to carry out experiments that either validate or invalidate the hypothesis, the computer being the preferred tool of this process. This approach has been widely used by the great pioneers of AI, and is reflected in the work discussed in this volume.

Some "meta" research questions

J.-L. Dormoy entitled the last section of his text "*Jacques Pitrat, l'homme des grandes questions*" referring to the current tendency to fund research that is much more oriented towards short-term objectives than to the study of "*grandes questions*" **requiring long-term work**. Jacques Pitrat himself – in his blog of May 12, 2017 and in article [14] of the AFIA newsletter n° 100 – indicates that the design and realization of a system like CAIA requires a researcher to devote at least half of his time to it for many years, which is not compatible with the demands of current careers in public research; G. Sabah makes similar remarks. It is significant that several texts, written without consultation, raise this question of **the place of fundamental research** by evoking the work of Jacques Pitrat.

Jacques Pitrat also addressed the issue of evaluating such research: how does one publish results about self-improving software over several years, and how does one evaluate such work? He was generally skeptical about certain peer review processes, such as accepting an article at a conference, where the conjunctive judgment model does not, in his view, favor the originality of the research, exploring new paths and taking risks in relation to the existing, as he explains in the book "Métaconnaissance, futur de l'IA" [11, p. 233-234], advocating instead for a disjunctive judgment model.

It should also be noted that he adhered to the principle of never co-authoring papers with his doctoral students, allowing them to publish their work alone. In

[(6)] J. Pitrat presented CAIA in detail, at the stage of its development in early 2008, in the paper "A Step toward an Artificial Artificial Intelligence Scientist" available online from [8].

his own articles and books, he always quoted scrupulously the work (of students or colleagues) to which he borrowed ideas or examples.

Remembering the beginnings of Artificial Intelligence in France

This volume is a collection of testimonies and scientific articles on AI themes developed or inspired by Jacques Pitrat, but also, over the years, a set of slices in the life of AI research in France since the late 1960s. This is certainly one of its most original features compared to other published scientific tributes; it seemed important to us to publish these narratives, combining personal testimonies and scientific texts in varying proportions, because scientific contributions are seldom presented in relation to the contexts and human experiences that enabled and accompanied their existence. In this, we see a form of the "meta" level dear to Jacques Pitrat. Even though he did not define "metaresearch" in his metaknowledge glossary, in it he indicates that a metabook "speaks of the book itself ... of the history of its realization, its vocabulary, its errors". This is illustrated in the two metabook metaparts that frame the chapters of his 1990 book [11].

The memories evoked sometimes go back more than 50 years; this publication could thus constitute a useful source for historians of science interested in the development of Artificial Intelligence in France. Some of their articles already concern the beginnings of computing, and we thus refer the interested reader to them because these works significantly complete and shed light on the context of the 1960s in France [7] [4]. They mention Jacques Pitrat's thesis and his recruitment into the CNRS at the Blaise Pascal Institute.

Organization of the contributions to this volume

We chose to group the texts into three parts, as follows:

1) A presentation of the career of Jacques Pitrat at the CNRS and at Paris 6, from an institutional angle, supplemented by individual testimonies;

2) A general overview of the scientific work of Jacques Pitrat, situated in the international historical context of Artificial Intelligence, followed by texts that present works inspired by his ideas, or describing his influence on all or part of a researcher's career;

3) Texts which are particularly relevant to the CAIA system.

Part 1: Career and testimonials

This first part brings together four contributions by colleagues or former students, who evoke their memories of Jacques Pitrat within the academic context they shared with him or, in the last article, on the occasion of a research-industry collaboration.

Bernadette Bouchon-Meunier took Jacques Pitrat's master's courses between 1969 and 1971 before joining the GR22, a CNRS laboratory, as a research associate in 1972,

in the team of Claude François Picard. She traces his entire institutional career through the evolution of the University of Paris 6's Laboratory (GR22, LAFORIA, then LIP6) where they collaborated in various capacities until the end of Jacques Pitrat's emeritus for more than forty years. She also evokes other actors of the laboratory, including Jean-Louis Laurière, whom she describes as the "scientific right-hand man" of J. Pitrat, and she highlights the significant events marking artificial intelligence in France.

More specific testimonies also contribute to this recollection of the beginnings of artificial intelligence in French laboratories.

Michel Chein, who was a professor at Paris 6 University from 1972 to 1980, evokes the difficulties surrounding the emergence of computer science in universities during the 1970s, and the even more complicated emergence of Artificial Intelligence alongside computer science. He recounts his meeting and his relations with Jacques Pitrat at GR22 (and later), describing in particular those traits of character that impressed him the most, and he underlines the influence that the ideas discussed with Jean-Louis Laurière and Jacques Pitrat had on his subsequent orientation towards Artificial Intelligence, at the Centre de Recherches en Informatique de Montpellier.

Joël Quinqueton discovered artificial intelligence in the classes of Jacques Pitrat and Jean-Louis Laurière during his master's degree in 1974-75. Although he did his thesis work in Pattern Recognition and was subsequently appointed to Montpellier, he continued to be interested in this research field, which he would later join as part of his work in machine learning. It evokes the ALICE and RABBIT systems designed by Jean-Louis Laurière, which inspired Jacques Pitrat to create MALICE, the resolution module of CAIA. He shares CAIA's solution to the so-called Saint-Exupéry problem, which was published in one of Jacques Pitrat's blogs [15] in 2019.

Jean-Luc Dormoy prepared his thesis at EDF in the mid-1980s, under the supervision of Jean-Louis Laurière, with the objective of introducing tools derived from Artificial Intelligence into the operation of nuclear power plants, which was to lead him on to developments in qualitative physics. He recalls his first meeting with Jacques Pitrat during a monthly team meeting, but above all, he relates his experience of an original type of cooperation between research and industry in the 1980s-90s, while working for the Research Department of EDF. This leads him to question which resources should be allocated to long-term research on "big issues" such as those that Jacques Pitrat addressed throughout his scientific life.

Part 2: Overview of Jacques Pitrat's research and presentation of works inspired by his ideas

This second part brings together six contributions. The first provides an overview of the Jacques Pitrat's scientific career; the next four, from former doctoral students of his, relate each to a field of research linked to his works: AI and Natural Language, expert system with rules and metarules, AI and Games, metaknowledge for Technology Enhanced Learning; the sixth contribution shows the influence that Jacques Pitrat's

teachings and work have had on the author's research approach in the field of constraint programming.

The article by Henri Prade and Jean-Paul Haton presents an overview of Jacques Pitrat's research, from the early 1960s until his death, placing it within the international historical context of AI development. The authors highlight the coherence and diversity of this research, as well as the topicality of the approach, while showing its specificity, and evoking in passing a certain number of theses that he supervised in different fields. Having neither been students of his, nor members of the same laboratory as he was, they represent the point of view of colleagues who knew and appreciated him in the university community of Artificial Intelligence.

François Rousselot attended Jacques Pitrat's master's courses in the early 1970s. He describes how he turned to the field of AI and Natural Language by doing his PhD thesis and then his main thesis on this topic, under his supervision, while he was initially an assistant at the University of Strasbourg. He retraces the major stages of his subsequent research work, through successive appointments and collaborations in various multidisciplinary projects, which led to his interest in issues of representation and acquisition of knowledge from texts. This article shows us how the approaches, methods and techniques of Artificial Intelligence have penetrated certain domains very slowly. The last project he presents, in the field of patents and industrial creativity, shows how new developments may well still be possible.

Suzanne Pinson describes her first steps in AI at the end of an unusual journey that led her to prepare a thesis with Jacques Pitrat, while she already held a PhD in Pattern Recognition and had returned from a post-doc in the United States. She presents the principles and architecture of her CREDEX system, a multi-expert system to help assess the risks involved in granting a loan to a company. She shows how this approach – based on modeling a lot of knowledge and the cognitive process of the expert in a decision-making situation, implemented and executed through the power of SNARK's language and inference engine from J-.L. Laurière – still remains viable, particularly with respect to achieving the objective of AI systems with explanatory capabilities.

Tristan Cazenave defended his thesis on the game of Go with Jacques Pitrat in 1996, and has since become a renowned specialist in game programs, internationally recognized notably as editor of ICGA journal. He recounts the founding works of Jacques Pitrat in General Game Playing in the 60s and his subsequent work on the theme of AI and Games, situating them in relation to the major trends in this field. He also shows how general multi-game approaches and bootstrap design, which he himself applied to Monte Carlo research, are at the heart of the success of current game programs that self-improve by observing their own functioning.

Nathalie Guin notes the strong impression made on her by Jacques Pitrat's master's course, taken in 1994-95, and how the book "Métaconnaissance, futur de l'intelligence artificielle" became the reference for her thesis and for her subsequent work in TEL (Technology Enhanced Learning). The overall objective of this work is to design systems that facilitate the elicitation of knowledge to support learners in their learning.

She followed the path laid down by Jacques Pitrat, that is to say the construction of general systems at a metalevel, which are then specialized for particular groups of problems. She believes that the elicitation of metaknowledge could assist in making current artificial intelligence systems more explicable, which is essential for teaching and learning environments such as TEL systems.

Nicolas Beldiceanu said he was "most fortunate to have been able to attend Jacques Pitrat's classes, as well as the monthly meetings of his team", although he did not prepare his thesis with him. He retained seven key ideas from these encounters, and shows how he was able to make use of these for his work in constraint programming, and more generally for his approach as a researcher. He particularly insists on the timeliness of Jacques Pitrat's ideas at a time when the limitations of "black box" systems, or those requiring too much dedicated knowledge, are coming out. Some ideas, deemed unrealistic at first, may well prove to be suitable now.

Part 3: Reflections on CAIA, an Artificial Researcher in Artificial Intelligence

This last part includes three contributions that provide different insights into the ideas implemented by Jacques Pitrat towards the realization of the CAIA system, as well as a few pointers as to the technical aspects of the CAIA software.

Marc Porcheron defended his thesis in 1990 under the supervision of Jacques Pitrat, and then joined the studies and research division at EDF. In his article, he presents two key concepts that Jacques Pitrat developed and implemented for the CAIA system: metaknowledge and bootstrapping. How does one initiate a process of self-improvement of (meta)knowledge in an artificial system? He illustrates the process of bootstrapping with respect to a problem that is well-known among computer scientists, namely that of writing the compiler of a new language in that very language itself. He explains how he designed a meta-expertise for compiling a rule language, using a process similar to that implemented by Jacques Pitrat for the MACISTE system. Evoking the AI bootstrapping used with CAIA and the issue of singularity, he thinks, like other authors, that the hybridization of symbolic AI methods with connective/neuronal AI approaches could prove fruitful when it comes to improving Artificial Intelligence systems.

Jean-Yves Lucas prepared his thesis at EDF and defended it in 1989 under the supervision of Jean-Louis Laurière, on the SIREN system that combined a constraint propagation approach inspired by the ALICE system with program generation. He also joined EDF's research and studies department. He evokes a personal memory linked to the reviewing of an article by Jacques Pitrat, concerning CAIA's consideration of the symmetries of a problem posed in terms of formal constraints, in order to reduce the research space. After a general presentation of CAIA, he goes into detail concerning a magic cube problem, the language used and the processing carried out by this system in order to take symmetries into account. He ends with an anecdote related to a meeting in Paris of Jacques Pitrat and Douglas Hofstadter, which illustrates the atmosphere in the Pitrat-Laurière research team.

Gérard Sabah began his career as a researcher in pattern recognition at the CNRS within the GR22 in 1972. He then became interested in automatic language processing and continued his career as a research director at LIMSI in Orsay. He proposed the CARAMEL model, the acronym of which was redefined during the Caramel2 project (Consciousness, Automatisms, Reflexivity and Learning for a Model of Mind and Language). He shares his thoughts on the notion of consciousness that he himself worked on and that he had the opportunity to discuss in a working group of the Académie des Technologies [1], of which Jacques Pitrat was also a member. His very comprehensive presentation includes a comparison between the approach of the notion of consciousness in Jacques Pitrat's texts and his own reflections on this subject. In particular, he develops his own perception of the notion of consciousness in CAIA.

Concerning CAIA, those readers interested in a software engineering point of view and further technical information may consult the presentation given by Basile Starynkevitch at the tribute day on March 6, 2020 [16]. B. Starynkevitch, currently a software engineer at the CEA, participated in the meetings of the Metaknowledge team before and after his thesis defense in 1990, under the supervision of Jean-Marc Fouet, for which the subject was on the explicitation of metaknowledge. He then met regularly with Jacques Pitrat, who, in February 2016, entrusted him with the (entirely self-generated) code of CAIA, i.e. approximately 500,000 lines. Jacques Pitrat wrote about this subject in [13], explaining that the only parts of code used and not generated by CAIA were the GCC compiler and the Linux system! The bootstrapping of such a system over many years poses challenges that software engineering must take into account in order to promote these AI developments as an experimental science. Based on more up-to-date foundations, B. Starynkevitch initiated the REFPERSYS project [17], an acronym for Reflexive Persistent System, in which he proposes to design, with other volunteer collaborators, a successor to CAIA that could be applied to other areas than constraint resolution, for example, health.

Colleagues who passed away prematurely

It would be remiss of us to end this introduction without pausing to remember three great disciples of Jacques Pitrat, whose premature deaths affected him greatly: Martial Vivet (1945-1999) and Jean-Marc Fouet (1949-2000), to whom he dedicated the proceedings of the AI symposium of September 2000, as well as Jean-Louis Laurière (1945-2005) whose ALICE system was a constant source of inspiration, and for whom he organized a day of tribute at the University of Paris 6, on March 22, 2006.

Conclusion

We hope that this introduction will inspire our readers to explore the articles in this special tribute issue dedicated to Jacques Pitrat, and thus enable them to learn more about, or even to discover, his scientific work along with its relevant contexts and developments in Artificial Intelligence, according to the different points of view of the various authors.

We leave the last word to Jacques Pitrat. In October 2015, he wrote in his blog that he had been doing research in Artificial Intelligence for 55 years and that he had been developing CAIA for 30 years. He pointed out that there was still a lot of work to be done in order to complete and conclude the bootstrapping implemented in CAIA, and remarked: "I don't have another 55 years in which to complete it, but I hope that other researchers will continue this extremely difficult task".

Acknowledgements

In addition to the members of the ROIA editorial committee, we wish to thank the reviewers having made a constructive contribution with respect to improving the articles in this volume:

- Nicolas Beldiceanu
- Christian Bessières
- Jean-Gabriel Ganascia
- Jean-Paul Haton
- Eric Jacopin
- Jean-Marc Labat
- Jean-Yves Lucas
- Jean-Marie Pierrel
- Christian Queinnec
- Gérard Sabah.

Monique Baron, LIP6, Sorbonne Université
Monique Grandbastien, LORIA, Université de Lorraine

Bibliography

[1] Académie des Technologies, *Vers une technologie de la conscience*, Collection Académie des Technologies, EDP Sciences, 2013.

[2] H. Berliner et al., "Panel on computer game playing", in *IJCAI'77: Proceedings of the 5th international joint conference on Artificial Intelligence*, vol. 2, 1977, p. 975-982.

[3] T. Cazenave, "Disparition de Jacques Pitrat", 2019, site Web INS2I-CNRS, `https://www.ins2i.cnrs.fr/fr/cnrsinfo/disparition-de-jacques-pitrat`.

[4] A. Collinot & P. E. Mounier-Kuhn, "Forteresse ou carrefour : l'Institut Blaise-Pascal et la naissance de l'informatique universitaire parisienne", *La Revue pour l'histoire du CNRS* (automne-hiver 2010), nº 27–28.

[5] Y. Demazeau, "Hommage à Jacques Pitrat", *Bulletin de l'AFIA* **107** (2020), p. 4, `https://afia.asso.fr/wp-content/uploads/2020/02/107_jan20.pdf`.

[6] J.-G. Ganascia, "Hommage à Jacques Pitrat", *1024 – Bulletin de la Société Informatique de France* **15** (2020), p. 113-116, `https://www.societe-informatique-de-france.fr/wp-content/uploads/2020/04/1024-numero-15_Article22.pdf`.

[7] P. E. Mounier-Kuhn, "Logic, Formal Linguistics and Computing in France: From Non-reception to Progressive Convergence", in *3rd International Conference on History and Philosophy of Computing, (HaPoC), Oct 2015, Pisa, Italy*, 2015, p. 24-41.

[8] J. Pitrat, Blog, `http://jacques.pitrat.pagesperso-orange.fr/`.

[9] ———, "Les connaissances déclaratives", in *Actes du Colloque Intelligence Artificielle, Le Mans, 20-24 septembre 1982, Publication n° 30, GR22-C. F. Picard*, 1982, p. 3-16.

[10] ———, "MACISTE ou comment utiliser un ordinateur sans écrire de programme", in *Actes du Colloque Intelligence Artificielle, Toulouse, 16-20 septembre 1985, Publication n° 58, GR22-C. F. Picard*, 1985, p. 223-240.
[11] ———, *Métaconnaissance, futur de l'intelligence artificielle*, Hermès, Paris, 1990, 420 p.
[12] ———, "Numéro spécial d'hommage à Herbert Simon", *RIA* **16** (2002), n° 1-2.
[13] ———, *Artificial Beings: The Conscience of a conscious Machine*, ISTE/Wiley, 2009.
[14] ———, "N'oublions pas l'IA forte !", *Bulletin de l'AFIA* **100** (2018), p. 23-28, https://afia.asso.fr/wp-content/uploads/2018/11/100_avr18.pdf.
[15] ———, "My view on Artificial Intelligence", 2019, Blog, http://bootstrappingartificialintelligence.fr/WordPress3/.
[16] B. Starynkevitch, "From CAIA to RefPerSys – reflexive, introspective, meta-based AI systems", présentation à la journée d'hommage à Jacques Pitrat, 6 mars 2020, http://refpersys.org/Starynkevitch-CAIA-RefPerSys-2020mar06.pdf.
[17] B. Starynkevitch, A. Chakravarti & N. Neema, "REFPERSYS high-level goals and design ideas", October 2019 - May 2021, http://www.starynkevitch.net/basile/refpersys-design.pdf.

Appendix 1. List of the 70 Theses defended under the supervision of Jacques Pitrat at the University of Paris 6

List compiled by Dominique Pastre and Monique Baron, with the kind assistance of Mrs Pitrat

In the list below, "thèse d'État" is indicated only when it is relevant; in all other cases, the "thèse de 3e cycle" is concerned, until 1984 included, and then, from 1985 onwards, the current doctorate (or PhD) is concerned.[7]

1970 Jean-Loïc Delhaye, DATAL, un programme de démonstration automatique de théorèmes.

1971 Jean-Louis Laurière, Sur la coloration de certains hypergraphes. Application aux problèmes d'emploi du temps.

1972 Jean-Pierre Laurent, Un programme qui calcule des limites en levant les indéterminations par des procédés heuristiques.

1972 Chi Công Pham, Analyse automatique de spectres de résonance magnétique nucléaire par des procédés heuristiques.

1972 Bruno Flavigny, Sur la détection a priori des erreurs dans les programmes.

1973 Anne Adam-Nicolle, GADGET : Un programme de génération automatique de programmes sur les graphes et les ensembles.

1973 Odile Carrière, Réalisation d'un programme heuristique qui résout des tests psychologiques de mesure de facteur G.

1973 Martial Vivet, Un programme qui vérifie des identités en utilisant le raisonnement par récurrence.

[7] The French system of postgraduate studies was modified in 1984: until that date, there were two doctorates, known as the "doctorat de 3e cycle" and the "doctorat d'État", which gave way, respectively, to the doctorate currently in effect, or the PhD, and to the "habilitation à diriger des recherches", which roughly translates to the "accreditation to supervise research".

1973 Martine Rousseau, Résolution automatique d'exercices d'électricité posés en français.

1974 Roger Dallard, Présentation d'un programme de démonstration de théorèmes d'arithmétique.

1974 Christian Lemaitre, Problèmes de planification et apprentissage dans le cas d'un programme de simulation de robot.

1974 Monique Grandbastien, Un programme qui résout formellement des équations trigonométriques par des procédés heuristiques.

1975 Michel Buthion, Un programme qui résout formellement des problèmes de constructions géométriques.

1975 Alfred Durand, Un programme de démonstration d'exercices d'algèbre.

1975 François Rousselot, Simulation d'un robot qui comprend et exécute des ordres donnés en français.

1975 Maria-Felisa Verdejo, Étude du langage naturel. Simulation d'un robot capable de mener un dialogue en espagnol.

1975 Arnaud Hertz, Programme de démonstration de théorèmes formulables en logique des prédicats du premier ordre avec égalité.

1976 Jean-Louis Laurière, Un langage et un programme pour énoncer et résoudre des problèmes combinatoires. (Thèse d'état)

1976 Paul Gloess, GENER, un générateur de programmes.

1976 Dominique Pastre, Démonstration automatique de théorèmes en théorie des ensembles.

1978 Anne Adam-Nicolle, Utilisation des transformations sémantiques pour la correction automatique de programmes. (Thèse d'état)

1978 Jean-Pierre Laurent, Un système qui met en évidence des erreurs sémantiques dans les programmes. (Thèse d'état)

1978 Dominique Bourgoin, Un programme heuristique pour résoudre des équations d'arithmétique.

1978 Janick Carnet, Une méthode heuristique de maillage dans le plan pour la mise en œuvre des éléments finis.

1978 Francisco Garijo, GPFAR-2 Un système d'écriture automatique de programmes pour le calcul optimisé des fonctions récursives.

1979 Marie-Odile Cordier, Commande d'un robot en langage naturel dans un domaine nécessitant des connaissances pragmatiques : les recettes de cuisine.

1979 Behnam Chichetchi, Compréhension du langage naturel : traductions paraphrasées d'exercices sur le courant alternatif posés en persan.

1979 Jean-Marc Fouet, Conception par ordinateurs de mécanismes à une boucle.

1979 Bernard Mérialdo, Représentation des ensembles en démonstration automatique.

1979 Bénédicte Hudault, Un exemple de compréhension du langage naturel : sommaires automatiques d'une jurisprudence rendue en matière de responsabilité de la circulation.

1980 Marc Gillet, Un exemple d'utilisation de connaissances en démonstration automatique.

1980 Mervat Gheith, Réalisation d'un programme comprenant des exercices de mécanique posés en arabe.

1980 Chadia Moghrabi, Un programme de génération conceptuelle de l'arabe : application aux recettes de cuisine.

1981 Miguel Tomasena, Réalisation d'un système de compréhension de textes décrivant en français des règles de réussites.

1983 Gustavo Arango, Une approche pour amorcer le processus de compréhension et d'utilisation du sens des mots en langage naturel.

1983 Najib Chelly, Un système expert pour négocier en langage naturel l'orientation des bacheliers.

1984 Dominique Pastre, MUSCADET : un système de démonstration automatique de théorèmes utilisant connaissances et méta-connaissances en mathématiques. (Thèse d'état)

1984 Radu Popescu, CHELEM, un système expert pour trouver la ligne du jeu du déclarant au bridge.

1984 François Rousselot, Réalisation d'un programme comprenant des textes en utilisant un formalisme unique pour représenter toutes les connaissances nécessaires. (Thèse d'état)

1984 Martial Vivet, Expertise mathématique et informatique : CAMELIA un logiciel pour raisonner et calculer. (Thèse d'état)

1984 Xavier Debanne, SESP, un Système Expert pour la Sélection du Personnel.

1985 Ana Maria Martinez Enriquez, L'archivage automatique des connaissances à partir de textes en français.

1985 Eric Fimbel, Les réseaux miroirs, un mécanisme d'inférence général ; application à un système d'assimilation de textes.

1985 Nathalie Simonin, Utilisation d'une expertise pour engendrer des textes structurés en français.

1986 Liana Popesco, Analyse et génération de textes à partir d'un seul ensemble de connaissances pour chaque langue naturelle et de métarègles de structuration.

1987 Jean-Marc Fouet, Utilisation de connaissances pour améliorer l'utilisation de connaissances : la machine GOSSEYN. (Thèse d'état)

1987 Suzanne Pinson, Méta-modèle et heuristiques de jugement : le système CREDEX, application à l'évaluation du risque crédit entreprise.

1987 Bertrand Roger, Un système de dialogue intelligent avec un interlocuteur à la découverte du monde simulé par un logiciel quelconque.

1988 Yannick Parchemal, SEPIAR, un système à base de connaissances qui apprend à utiliser efficacement une expertise.

1989 Hélène Giroire-Brousse, Un système à base de connaissances pour la génération d'exercices dans des domaines liés au monde réel.

1990 Claudia Jimenez Dominguez, Sur l'explication dans les systèmes à base de règles : le système PROSE.

1990 Gérard Tisseau, Modélisation à partir d'un énoncé informel : le système MODELIS. Application à des exercices de thermodynamique.

1990 Joël Courtois, Siam : un système de diagnostic qui s'adapte aisément à de nouveaux domaines et qui enseigne sa méthode.

1990 Marc Porcheron, Utilisation de méta-connaissances pour la compilation des règles de production.

1990 Philippe Mazas, Acquisition de connaissances de conception : le système SYSIFE.

1991 Mélanie Hilario, L'apprentissage d'heuristiques de contrôle pour la planification : une approche abductive.

1993 Marc Bardinet, Sahel : un système qui résout un problème combinatoire en adaptant dynamiquement ses connaissances. Application à la recherche de topologies du réseau électrique 400 kv français vérifiant certains types de contraintes.

1993 Sylvie Kornman, SADE : un système réflexif de surveillance à base de connaissances.

1994 Michel Pintado, Apprentissage et démonstration automatique de théorèmes.

1995 Bruno Bouzy, Modélisation cognitive du joueur de go.

1995 Michel Masson, DIACODEX : un langage et un système pour effectuer un diagnostic à l'aide de connaissances déclaratives expertes.

1995 Jean-Marc Nigro, La réalisation et la conception d'un générateur automatique de commentaires : le système GénéCom. Application au jeu du Tarot.

1995 Patrick Ricaud, Gobelin une approche pragmatique de l'abstraction appliquée à la modélisation de la stratégie élémentaire du jeu de go.

1996 Tristan Cazenave, Système d'apprentissage par auto-observation. Application au jeu de go.

1997 Nathalie Guin, Reformuler et classer un problème pour le résoudre. L'architecture SYRCLAD et son application à quatre domaines.

1998 Georges Pecego, SYGEP, un système de génération d'énoncés de problèmes dans des domaines variés.

1999 Vincent Le Cerf, Suivi symbolique de véhicules dans un carrefour urbain à partir de plusieurs caméras.

2000 Régis Moneret, Strategos : un système multi-jeux utilisant la théorie combinatoire des jeux, capable d'apprendre automatiquement les dépendances entre sous-jeux locaux.

2002 Henri Lesourd, Le système hammourabi.

2002 Tristan Pannérec, Un système général avec un contrôle de la résolution à base de métaconnaissances pour des problèmes d'affectation optimale.

Appendix 2. Artificial Intelligence colloquia of the "Pitrat team"

These colloquia, which took place almost every year from 1974 to 2001, brought together researchers and doctoral students from the Pitrat team and, from 1979, included those from the Laurière team, as well as those from other teams with which they were co-organized. The colloquia were open to former members or doctoral students.

1974: Caen, 1-5 juillet, Séminaire de Caen sur la démonstration de théorèmes.

1975: Le Mans, 23-27 juin, Applications de l'IA en informatique et en linguistique, Notes rédigées par Martial Vivet, Publication de l'Université du Mans

1977: Strasbourg, 19-23 sept., Applications de l'IA à l'informatique (Publi. GR 22 n° 5)

1979: Rouen, 17-21 sept., Programmes d'IA utilisant une grande quantité de connaissances (Publi. GR22 n° 11)

1980: Caen, 22-26/09, Quelques méthodes en IA (Publi. GR22 n° 20)

1981: Toulouse, 6-10/07, Colloque Intelligence Artificielle de Toulouse (Publi. GR22 n° 24)

1982: Le Mans, 20-24/09, Utilisation des connaissances déclaratives (Publi. GR22 n° 30)

1983: Chambéry, 19-23/09, Connaissances et métaconnaissances (Publi. GR22 n° 38)

1984: Aix-en Provence, 17-21/06, Colloque Intelligence Artificielle (Publi. GR22 n° 49)

1985: Toulouse, 16-20/09, Colloque Intelligence Artificielle (Publi. GR22 n° 58)

1986: Strasbourg, 15-19/09, Colloque Intelligence Artificielle (Cahiers du LAFORIA, n° 60)

1987: Caen, 14-18/09, Colloque Intelligence Artificielle (Cahiers du LAFORIA, n° 63)

1988: Arenys de Mar (Espagne), 19-23/09, Colloque franco-espagnol d'intelligence artificielle « De la Métaconnaissance » (Cahiers du LAFORIA, n° 70)

1989: Le Mans, 11-15/09, Colloque Intelligence Artificielle sur la Métaconnaissance (Cahiers du LAFORIA, n° 77)

1990: Lyon, 11-14/09, Colloque Intelligence Artificielle sur la Métaconnaissance (Cahiers du LAFORIA, n° 81)

1991: Bierville (Ile de France), 16-18/09, Colloque Intelligence Artificielle

1992: Beuvray (Morvan), 15-18/09, Colloque Intelligence Artificielle

1993: Cap-Hornu (Baie de somme), 13-15/09, Colloque Intelligence Artificielle

1994: Ile de Berder (Morbihan) mi-sept/09, Colloque Intelligence Artificielle

1995: Ile de Berder, 16-18/09, Colloque Intelligence Artificielle

1996: Ile de Berder, 16-18/09, Colloque Intelligence Artificielle

1997: Ile de Berder, 16-18/09, Colloque Intelligence Artificielle (rapport LIP6 n° lip6.1998.007)

1998: Ile de Berder, 14-16/09, Colloque Intelligence Artificielle (rapport LIP6 n° lip6.1999.005)

1999: Ile de Berder, 22-24/09, Apprentissage et acquisition de connaissances, Colloque Intelligence Artificielle Berder (rapport LIP6 n° lip6.2000.002)

2000: Ile de Berder, 13-15/09, Colloque Intelligence Artificielle de Berder (rapport LIP6 n° lip6.2001.014)

2001: Ile de Berder, 19-21/09, Colloque Métaconnaissance de Berder (rapport LIP6 n° lip6.2002.006)