Obituary for Gilles Dowek

Serge Abiteboul Pablo Arrighi Nachum Dershowitz
Gérard Huet Jean-Pierre Jouannaud Claude Kirchner

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The theoretical computer science community is heartbroken by the untimely loss of Gilles Dowek, who passed away on 21 July 21 2025, in Paris, at the age of 58. His husband, sister, brother, family, many friends and colleagues were with him during his final days.

Gilles Dowek was born on 20 December 1966 in Paris. A brilliant student, he entered École Polytechnique, nicknamed X, in 1985. In 1991, he defended a doctoral thesis, under the supervision of Gérard Huet, at the University of Paris Diderot [1]. He started his career as an Inria researcher in 1993. Invited to apply as a professor by Jean-Pierre Jouannaud, director of LIX, the Laboratory for Informatics at X, and by Gilles Kahn, member of the recruiting committee, he was appointed Professor there in 2002, the youngest professor of the École at that time. He taught from 2002 to 2010, and was a main asset in making computer science popular among students. *La Jaune et la Rouge*, a newsletter by and for the alumni, pointed out that the École would have been wise to attract him more permanently. In 2010, he returned to Inria, becoming at the same time a professor at the École normale supérieure Paris-Saclay and a member of the Laboratory for Formal Methods (LMF), until his death. Indeed, Gilles Dowek loved teaching, and students loved him as a professor, be they sophomore or graduate.

Pedagogy

An example of his incredible ability to make seem obvious what is not is a striking introductory lecture to programming [2]. If you read French, read it! His interest in pedagogy led him and Nachum Dershowitz to describe the advantages of a two-dimensional Turing machine for ease and clarity of programming [3]. A universal machine could be fully described by an easily understandable 2D program taking up half a page. He programmed an interpreter in OCaml for such a device, and drafted a children's book based on it, laying down the principles of computation.

Awards

His passion for programming began early: At the age of fifteen, he modeled the Mastermind game in order to optimize queries, which earned him the Philips Scientific Prize for Young People in 1982, and the European Philips Contest for Young Researchers and Inventors in 1983. These were the first of his many awards. He won the Prix d'Alembert for high school students from the French Mathematical Society in 2000. In the field of computer science and applied mathematics, he received the Inria–Académie des Sciences Grand Prize in 2023. In the field of philosophy and the humanities, he received the Grand Prix de Philosophie from the Académie Française in 2007 for his book *Les Métamorphoses du calcul. Une étonnante histoire de mathématiques* (The Metamorphoses of Calculation: An Astonishing History of Mathematics). In this book, he shows how mathematics and logic were transformed in the 20th century with the integration of the concept of computation. In 2024, he received the Médaille Histoire des Sciences et Épistémologie from the Académie des Sciences. These are all signs that he was one of the foremost scientists in his field, but also much more than that, as we shall see.

Science popularization

Gilles shared with his friend, the famous philosopher Michel Serres, a taste for vivid illustrations and accurate storytelling. He excelled at making the abstract clear and striking people's minds with relevant, often unexpected examples. Not surprisingly, he was thus a great communicator of science. He was the author, among other chronicles, of the column "Homo sapiens informaticus" in the magazine *Pour la science* from 2014 to 2021. He also contributed many articles to the "Blog binaire" of *Le Monde* newspaper. He coauthored the play, *Le temps des algorithmes* (The Age of Algorithms), with Serge Abiteboul, which won the La science se livre Award in 2018. To engage the general public to envision the future with AI, Gilles Dowek also co-authored "Qui a hacké Garoutzia?" (Who Hacked Garoutzia?) with Serge Abiteboul and Laurence Devillers, which premiered at the Avignon Off Festival in July 2023, directed by Lisa Bretzner.

Education

Gilles Dowek has had a decisive influence on the development of computer science education in France. He contributed to the Academy of Sciences' influential report "L'enseignement de l'informatique en France, Il est urgent de ne plus attendre" (Computer science education in France: We can't wait any longer), in 2013. He helped develop the official French CS curriculum. He contributed to the effective implementation in France of open and widely available online courses (MOOCs), which continue today in *Fun* (France Université Numérique) and Inria's Learning Lab. He wrote with coauthors textbooks such as *Informatique et sciences du numérique: Spécialité ISN en terminale S*, a popular computer science textbook for high school. Beyond science, from April 2023 on, he was a member of the Higher Council for Education Programs.

Ethics and human rights

Since the early 2000s, Gilles became involved in promoting thinking about the societal impact of digital science and technology. He participated in CERNA (Commission for Reflection on Ethics in Digital Science and Technology Research) and was a particularly active and valued member of CNPEN (National Steering Committee on Digital Ethics), where his analyses and proposals were remarkably insightful. Quoting the site of that committee: "To those who had the opportunity to work alongside him, he leaves behind a valuable example of critical and responsible thinking that was both inventive and structured, guided by a constant concern for justice, inclusivity, and clarity; thinking driven by a constant desire to empower everyone, starting with the youngest members of society." More recently, he participated in the French Digital Council. All his life, Gilles was engaged in the defense of humanistic values. In particular, he chaired the Association for the Recognition of the Rights of Homosexual and Trans People to Immigration and Residence.

Research contributions

As can be expected, Gilles Dowek contributed to many different areas, spanning several, seemingly distant scientific fields and topics, all having a relationship to mathematical logic.

Typed lambda calculi. His first research works focused on algorithms for typed lambda calculi, in order, on the one hand, to be able to represent terms and propositions of higher-order logic, and, on the other hand, to express their proofs in a Gentzen-like natural deduction style, in the spirit of the Curry-Howard correspondence. His PhD thesis tackles the question of automating proofs in the Calculus of Constructions, yielding a higher-order generalization of Nicolas de Bruijn work on Automath. This early work contributed to the design of the proof system elaborated for the Calculus of Constructions carried out within Projet Formel at Inria Rocquencourt, which ultimately gave birth to

the proof assistant Coq. In particular, he proposed a uniform way of building proofs based on unification [4].

Subsequently, Gilles developed a keen interest in matching and unification algorithms in various typed lambda calculi, in order to design semi-automatic proof techniques. In particular, he showed that third-order matching is decidable, improving previous work of Gérard Huet [5], and completing his analysis of second-order matching in the different systems of Henk Barendregt's cube of typed lambda-calculi [6]. On the other hand, he showed that the third-order case was undecidable in the case of dependent types, an ingredient essential for representing predicates [7,8]. In collaboration with Thérèse Hardin, Claude Kirchner and Frank Pfenning, he also showed that unification could be analyzed in detail thanks to an explicit substitution calculus [9]. Finally, he was invited to write the "Matching and Unification" chapter for the *Handbook of Automated Reasoning* [10].

Deduction modulo. Mathematical reasoning involves deduction steps as well as computational steps, which can be seen as a way to search within a congruence class of expressions one that better fits a specific deduction step. How deduction and computation interact when operating on terms or on propositions was an important general research theme which Gilles contributed to in collaboration with Claude Kirchner and Thérèse Hardin [11], which lead to the general theory of deduction modulo [12].

Dedukti and Logipedia. While usual computer languages all allow the same functions to be expressed, namely, the computable algorithms, the same is not true for the expression of proofs. Proof expression languages are often incomparable. Gilles therefore set himself an inspiring task: to design a universal proof language capable of representing proofs from various logical systems and facilitating their mutual translation, thereby providing support for an ambitious project, a universal library of formal mathematical proofs. To this end, he showed with his students that a lambda calculus equipped with both dependent types and user-defined rewrite rules was a good candidate for a universal proof language [13], one that he named Dedukti. An implementation of Dedukti became therefore the kernel of this endeavor, and was later completed by various translation tools, from and to, other languages such as Matita, Coq, Agda, HOL, HOL-Light, and more when new languages emerged, such as Lean. A major theoretical question that popped up is whether proofs in Dedukti make sense, requiring that the user-defined rewrite rules are confluent (diverging computations can always be joined). This classical problem became an important trend in the team and culminated with a very general theorem for the case where rewrite rules are left-linear [14], the case of non-linear ones being also studied by his students and collaborators. Then, his dream came true with Logipedia [15].

Foundations and physics. In addition to all that, Gilles Dowek also developed an interest in various relationships between computer science and physics. In particular, he was keen to clarify that there is no incompatibility between the continuous and chaotic nature of physics and the discrete nature of computability [16]. He even argued that the opposite is true: some physics postulates entail the Church-Turing thesis. This was first addressed by Robin Gandy, Alan Turing's PhD student, who proved that the thesis was a consequence of postulates about classical physics, such as a bound on the density of information. With Pablo Arrighi, Gilles generalized this proof account for quantum physics [17]. Together, they also designed the first quantum programming language allowing for quantum superpositions of programs [18]. They also came up with a first formalized explanation of the arrow of time without the need to assume a low entropy initial state [19]. And with Alejandro Diaz-Caro, he developed a novel logical connective, capturing the peculiar form of non-determinism that is inherent to quantum mechanics [20], hence laying grounds for the development of proofs of quantum programs.

In short

Gilles Dowek was a computer scientist, logician, and philosopher. In all aspects of his life, Gilles was brilliant, original, funny, with an enlightening and sometimes irreverent sense of humor. He was rigorous, passionate, warm, and above all, deeply humanistic. He will be terribly missed.

References

[1] Gilles Dowek: Démonstration Automatique dans le Calcul des Constructions (Automated Theorem Proving in the Calculus of Constructions.) Paris Diderot University, France, 1991.
[2] Gilles Dowek: Le langage mathématique et les langages de programmation. https://inria.hal.science/hal-04045740.
[3] Nachum Dershowitz, Gilles Dowek: Universality in Two Dimensions. J. Log. Comput. 26(1): 143–167 (2016).
[4] Gilles Dowek: A Complete Proof Synthesis Method for the Cube of Type Systems. J. Log. Comput. 3(3): 287–315 (1993).
[5] Gilles Dowek: Third Order Matching is Decidable. Ann. Pure Appl. Log. 69(2–3): 135–155 (1994).
[6] Gilles Dowek: A Second-Order Pattern Matching Algorithm for the Cube of Typed Lambda-Calculi. MFCS 1991: 151–160 (1991).
[7] Gilles Dowek: The Undecidability of Typability in the Lambda-Pi-Calculus. TLCA 1993: 139–145 (1993).
[8] Gilles Dowek: The Undecidability of Pattern Matching in Calculi Where Primitive Recursive Functions are Representable. Theor. Comput. Sci. 107(2): 349–356 (1993).
[9] Gilles Dowek, Thérèse Hardin, Claude Kirchner, Frank Pfenning: Unification via Explicit Substitutions: The Case of Higher-Order Patterns. JICSLP 1996:

259–273 (1996).
[10] Gilles Dowek: Higher-Order Unification and Matching. Handbook of Automated Reasoning: 1009–1062 (2001).
[11] Gilles Dowek, Thérèse Hardin, Claude Kirchner: Theorem Proving Modulo. J. Autom. Reason. 31(1): 33–72 (2003).
[12] Gilles Dowek: Deduction Modulo Theory, in Proc. RTA-TLCA, Lecture Notes in Computer Science 8560, Springer, (2014).
[13] Denis Cousineau, Gilles Dowek: Embedding Pure Type Systems in the Lambda-Pi-Calculus Modulo. TLCA 2007: 102–117 (2007).
[14] Gilles Dowek, Gaspard Férey, Jean-Pierre Jouannaud, Jiaxiang Liu: Confluence of Left-Linear Higher-Order Rewrite Theories by Checking their Nested Critical Pairs. Math. Struct. Comput. Sci. 32(7): 898–933 (2022).
[15] Gilles Dowek, François Thiré: Logipedia: A Multi-system Encyclopedia of Formal Proofs. CoRR abs/2305.00064 (2023).
[16] G. Dowek: La forme physique de la thèse de Church et la sensibilité aux conditions initiales. (The Physical Church Thesis and the Sensitivity to Initial Conditions.) In Samuel Tronçon et Jean–Baptiste Joinet, Ouvrir la logique au monde, Hermann, 2009.
[17] Pablo Arrighi, Gilles Dowek: The Physical Church-Turing Thesis and the Principles of Quantum Theory. CoRR abs/1102.1612, Int. J. Found. of Computer Science, 23(5), 1131–1145, (2012).
[18] Pablo Arrighi, Gilles Dowek: A Linear-Algebraic Lambda Calculus: Higher-Order and Confluence, Proceedings of RTA'08, Hagenberg, July 2008. LNCS 5117, 17, (2008).
[19] Pablo Arrighi, Gilles Dowek, Amélia Durbec: A Time Arrow Without Past Hypothesis: A Toy Model Explanation. New J. Phys. 26 113019, (2024).
[20] Alejandro Díaz-Caro, Gilles Dowek: A New Connective in Natural Deduction, and its Application to Quantum Computing, Theoretical Computer Science, vol. 957, 113840, (2023).