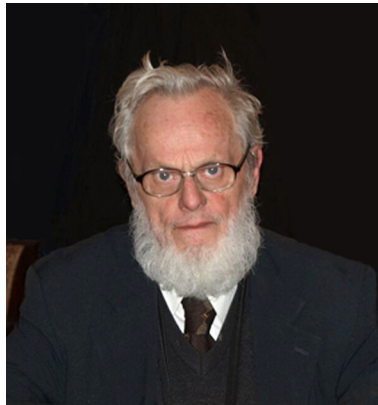# Petr Hájek, Obituary

Zuzana Haniková [a,*], Lluís Godo [b]

[a] *Institute of Computer Science, Czech Academy of Sciences, 182 07 Prague 8, Czech Republic*
[b] *Artificial Intelligence Research Institute, IIIA-CSIC, Bellaterra 08193, Spain*

Available online 2 June 2017

Picture courtesy of Petr Cintula.

Petr Hájek, a renowned Czech logician, passed away on 26 December 2016. He was retired from the Czech Academy of Sciences, where he had been appointed an emeritus, having worked there for more than half a century. His achievements in mathematical logic leave a permanent imprint in set theory, arithmetic, and fuzzy logic, but he also worked in applications of logic. He authored several monographs that capture his scientific interests, some of them remaining sources of knowledge and inspiration to generations of researchers.

Petr Hájek was born in Prague on 6 February 1940. He studied mathematics at the Faculty of Mathematics and Physics of Charles University in Prague from 1957, finishing in 1962 with a master thesis in algebra. He subsequently obtained a postgraduate position at the Institute of Mathematics of the Czechoslovak Academy of Sciences. Apart from his mathematical education, Petr received a profound musical training, eventually graduating from the Academy of Performing Arts in Prague, where he studied the organ with Jiří Reinberger, a Czech organ virtuoso, teacher and composer. For several decades, Petr would serve as organist at the protestant Clement's Church in Prague.

Petr commenced his mathematical studies with the Czech logician Ladislav Svante Rieger, who at that time worked at the Institute of Mathematics. Rieger ran a seminar in mathematical logic; one of the attendees was Petr Vopěnka.

---

* Corresponding author.
 E-mail address: zuzana@cs.cas.cz (Z. Haniková).

Rieger passed away as early as 1963; Vopěnka then started his own seminar in axiomatic set theory at the Faculty of Mathematics and Physics, with Petr Hájek attending. Hájek referred to Vopěnka as his advisor; they would later become coauthors, although they worked from different institutions, as Hájek was not allowed to teach because of his religion.

Vopěnka's set theory seminar brought together a focused group of young researchers, such as Bohuslav Balcar, Tomáš Jech, Karel Hrbáček, Karel Příkrý, Antonín Sochor or Petr Štěpánek. Their research concerned models of set theory and forcing. Hájek's doctoral dissertation, defended in 1965, was titled *Models of set theory with individuals* (see [9]).

The Theory of Semisets, written by Petr Vopěnka and Petr Hájek, was published in 1972 (see [34]). In a somewhat non-classical setting that admits semisets (i.e., proper subclasses of sets) in addition to the usual sets and classes, it presents the methods developed by Vopěnka's school. For Vopěnka, the book meant a goodbye to classical set theory; he later founded another seminar that studied an alternative set theory proposed by himself. Petr Hájek also shifted his interests; after some deliberation, he settled on studying arithmetic (see [28]).

Pavel Pudlák started working with Petr Hájek in mid seventies; another person in the group was Petr's wife Marie, whose thesis concerned arithmetic (see [19]). In the late seventies, Vítězslav Švejdar, joined in, defending his thesis in 1982 (see [30,31]). A working group in arithmetic, including also Jan Krajíček, formed itself in the Institute of Mathematics, starting a seminar that is still run within the institute. In 1988 Petr submitted a *doctor scientiarum* (DrSc) dissertation *Metamathematics of First-Order Arithmetic* (see [10]), a direct predecessor of Petr's part of the book on arithmetic with the same title, written jointly with Pavel Pudlák a couple of years later (see [18]).

From mid 1960's, Petr Hájek was involved in the development of the GUHA method of exploratory data analysis, and in theoretical research pertaining to it, which would fall under the umbrella terms of observational calculi and also reasoning under uncertainty. The method was developed and implemented as early as 1965. This work, which ran parallel to Petr's more abstract interests in set theory and arithmetic, later contributed to his interest in fuzzy logic.

GUHA was a pioneering attempt that was as marvellous as it was precocious. Statisticians such as Tomáš Havránek came aboard, and the theory surrounding GUHA was captured in the book *Mechanizing Hypothesis Formation: Mathematical Foundations of a General Theory* (see [16]). Petr gained two doctoral students in the GUHA method: Jiří Ivánek ([23]) and Jan Rauch ([29]). The development of the method occasioned the formation of an application-oriented seminar, which in time broadened its scope and later moved with Petr to the Institute of Computer Science, changing contents according to the shift of Petr's interests. The seminar still continues to be run, giving a lot of attention to fuzzy and substructural logic.

During the eighties Petr Hájek and his colleagues worked on expert systems, seeking to complement the existing GUHA procedures. Again Petr gained students in the area: Julio Valdés (see [33]), and Milan Daniel (see [6]). Theoretical issues on processing uncertainty gave rise to a book, *Uncertain Information Processing in Expert Systems*, written by Petr Hájek, Tomáš Havránek, and Ivan Jiroušek (see [17]). Other important coworkers were Ivan Kramosil and Dagmar Harmancová.

In 1991, Tomáš Havránek, then director of the Institute of Computer Science and Petr Hájek's coauthor and friend, passed away prematurely. It was proposed that Petr Hájek enter as candidate for the position of director; he was elected and assumed office in March 1992, holding it until early 2000. (This would have been impossible during the totalitarian era, because he was not in the good books of the authorities.) He never mitigated his research effort during the period as director; in fact, it was during his years as director that he started research in fuzzy logic, and wrote and published his famous monograph [13].

The early works in fuzzy set theory and fuzzy logic by Lotfi Zadeh ([35]) and Joseph Goguen ([8]) did not pass unnoticed by Petr Hájek, although he was working in different areas at that time. He was thesis opponent to two subsequent students of Aleš Pultr in fuzzy logic: Jan Pavelka defended in 1976 (see [27] for the material), Vilém Novák defended in 1988 (see [26]). Moreover, Vilém Novák published a book in Czech about fuzzy logic ([25]).

Another impetus came in 1991 when Gaisi Takeuti visited Prague, bringing with him his and Satoko Titani's paper [32]. Petr Hájek thought highly of this paper; later he continued the research in the logic (see [13]) and worked on his version of the set theory (see [15]).

Moreover, fuzzy logic constituted by that time, *sui generis*, reasoning under uncertainty, an area that Petr Hájek knew well from his application-oriented research. It was also in 1991 when, taking advantage of his first visit to Francesc Esteva and Lluís Godo in Barcelona, Petr attended the first ECSQAU conference (later called ECSQARU) in Marseille, where he could meet the main European researchers in uncertainty and fuzzy logic. And in fact, one of