Hartmut Ehrig (1944–2016)

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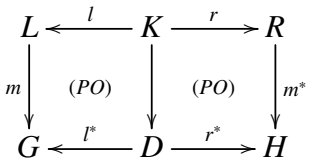
Hartmut Ehrig passed away on March 17, 2016 at the age of 71. His colleagues and friends are mourning the loss of a most creative scientist and leader who made pioneering contributions to areas of theoretical computer science such as Categorical Automata Theory, Graph Transformations, and Algebraic Specifications, inspired generations of researchers and helped to build lasting communities.

Harmut was born in Angermünde (Germany) in 1944 and spent his academic career at the Technische Universität Berlin, where he studied Mathematics, Physics and Theoretical Informatics 1963 – 1969, worked as research assistant at the Mathematics Department 1970 – 1972, and received his PhD in 1971. In 1972 he was appointed Assistant Professor at the Informatics Department and received

his Habilitation two years later. In that same year he was appointed Associate Professor of Theoretical Informatics. Hartmut became full professor at the TU Berlin in 1985 and held this position until he retired in 2010.

Early in his scientific career Hartmut developed a Unifying Theory of Automata, a categorical approach preceding computational models popular today based on monoidal categories and coalgebras. The categorical approach to semantics was a consistent theme throughout his work. In 1973 he applied it to the problem of formalising the notion of graph transformation, extending the definition of rewriting from formal (string) grammars to graphs. This led to the famous double-pushout (DPO) approach, which gave us one of the most recognisable diagrams in the application of category theory to computer science.



This innovation, published in the 1973 paper Graph-Grammars: An Algebraic Approach with Michael Pfender and Hans-Jürgen Schneider, was instrumental in creating an entire discipline, variously referred to as graph grammars, graph rewriting or graph transformation, with a series of workshops and conferences that he helped to initiate, including the International Workshops on Graph Grammars and their Application to Computer Science with Volker Claus and Grzegorz Rozenberg starting in 1978 and the International Conferences on Graph Transformation (ICGT) since 2002. He was the first chair of the ICGT steering committee from 2000 to 2008.

Hartmut not only created and led the graph transformation community but made significant contributions to funding its operation through two European projects on Computing by Graph Transformation I and II. His monographs on Fundamentals of Algebraic Graph Transformation and most recently on Graph and Model Transformation as well as the Handbooks of Graph Grammars and Computing by Graph Transformation he helped create and edit remain part the core literature of the discipline.

Another area where Hartmut applied his style of categorical semantics are Algebraic Specifications. He developed the first compositional semantics for parameterised algebraic specifications based on amalgamation, a construction using a pushout in the category of generalised algebras (over arbitrary signatures). His monographs Fundamentals of Algebraic Specification 1 and 2, and Algebraic Specification Techniques and Tools for Software Development: The Act Approach became standard references and were widely adopted for teaching.

Hartmut started the series of international conferences on Theory and Practice of Software Development (TAPSOFT) in 1985 and helped its transformation into

ETAPS from 1998 onwards, today one of the most successful Computer Science conferences in Europe. Hartmut served as vice president of the European Association of Theoretical Computer Science (EATCS) from 1997 to 2002 and was vice president of the European Association of Software Science and Technology (EASST) since 2000.

Hartmut was amazingly productive. In addition to the editing and co-editing of more than 20 proceedings and handbooks, he authored and co-authored eight books and more than 400 papers in journals, proceedings, handbooks and other collective volumes, cooperating with more than 160 coauthors.

Hartmut supervised well over 50 PhD students, many now in senior positions themselves. When I came to Berlin in 1991 for my 3rd year of studies I was attracted by his genuine passion for science, which showed of course in Hartmut's own teaching but had also infected his entire group. After following a course on algebraic specifications and another one on graph grammars I was hooked and spent most of the rest of my studies there until a position in a research project was available and I became a PhD student under Hartmut's supervision. The following years were among the most intellectually inspiring and formative of my life. I not only learned from Hartmut the tools of the trade but also his approach to supervision. Hartmut thoroughly enjoyed working with students, hardly ever stopped discussing science, including over lunch and in the pub, and so gave us the impression that our work was, at least for now, the most important in the world. I have especially fond memories of Summer evenings in the Schleusenkrug (a pub by the canal locks in the Tiergarten), the group often including visitors, drawing diagrams on napkins over beer and Currywurst.

Hartmut's collegiality, integrity and genuine interest created a legacy, not only of his scientific work but also of his personal example and approach to research. It will remain with us, who were lucky enough to know and work with him.

Hartmut Ehrig

Ugo Montanari and Andrea Corradini
University of Pisa, Italy

As friends, collaborators and coauthors of Hartmut Ehrig we were heavily shocked by his departure.

One of the areas of interest for our scientific work is graph transformation. Hartmut has been the main originator and architect of this area. The idea was to extend to general structures, collectively called graphs, the constructions and the results already known for string, term and multiset rewriting. The deep knowledge and intuition Hartmut had in category theory guided him in developing, in 1973,

together with Michael Pfender and Hans-Jürgen Schneider, the Double Push Out (DPO) construction. It works conveniently in several categories besides Graph and from the very beginning Hartmut started, with collaborators, the quest for the most general category where the interesting properties of DPO do hold, a quest eventually fulfilled recently by adhesive categories. To define a good notion of graph grammar was an open problem at the time. Ugo Montanari also contributed to it at some extent, together with John Pfaltz and Azriel Rosenfeld. When the DPO paper appeared, Azriel, a mathematician and a pioneer in picture processing and recognition, told Ugo he was definitely impressed by the clever and general construction of DPO, which was disclosing a new area of research.

Another milestone Hartmut contributed to the theory of graph transformation together with Hans-Jörg Kreowski was on concurrent rewriting. In 1978, when concurrency theory was in its infancy even for Petri nets, the notion of shift equivalence was a breakthrough. The extension of Petri Net theory (on multiset, or marking, rewriting) to graph transformation was developed later, mainly by Paolo Baldan, again with important contributions by Hartmut.

Another important result worth mentioning is on borrowed contexts, in collaboration with Barbara König. For a long time the DPO construction has been missing a notion of observation associated to a transformation. Observations are essential for defining abstract compositional semantics of processes. Following an approach by James Leifer and Robin Milner, Hartmut and Barbara introduced a categorical construction able to associate to a graph transformation an observation defined in terms of the minimal missing part necessary to apply a DPO.

Direct scientific work was by no means the only contribution Hartmut offered to our community. He was the main actor in coordinating the conference and workshop activity on graph transformation and in promoting EU working groups and projects in the area: COMPUGRAPH I (1989-1992), COMPUGRAPH II (1992-1996), GETGRATS (1997-2000) and APPLIGRAPH (1997-2000). Support for shared activities did allow for several visiting periods between partners. In particular, the connection between Berlin and Pisa was especially active and productive: in the period 1990-2000 three researchers from Pisa visited Berlin and three vice versa, for periods of about a year each on the average.

Among Hartmut's merits for the general computer science community, we want to mention explicitly the effort spent by Hartmut to organize the first TAPSOFT conference in Berlin, 1985. He recognised the need to connect theory with practice in the area of software development. Together with Maurice Nivat, the founder of EATCS and ICALP, Hartmut designed an articulated, flexible conference structure which turned out quite successful. The second TAPSOFT conference was in Pisa, 1987. Later, TAPSOFT evolved into ETAPS, presently one of the largest European conference addressing this mix of theory and practice.

We want to conclude these few words by remembering our frequent visits to

Berlin while collaborating with Hartmut and his group, for shorter and longer stays. Hartmut has always made us feel at home and, a proud host, was eager for us to enjoy the city, with all its contradictions.

Now most former students of Hartmut have left Berlin and have continued his work contributing to the development of several research centers in Germany and abroad. We will never forget the exceptional personal and scientific heritage of Hartmut Ehrig.

My 'giant' friend Hartmut

Hans-Jörg Kreowski
University of Bremen, Germany

Hartmut's death is very sad news for me as for many of his colleagues and friends. The graph transformation community and the algebraic specification community lost one of their pioneers, a leading, most inspiring and creative researcher, and guiding spirit to many of us.

As a student back in 1971, I attended Hartmut's seminar on categorical automata theory. Soon afterwards he introduced me to the fascinating world of graph transformation and supervised my PhD thesis. This was the beginning of a long, intense and fruitful period of cooperation and friendship in which we sat together for hundreds of hours discussing and working on categorical automata theory, graph transformation and algebraic specification. I owe a lot to him.

Hartmut spent all his academic career at the Technische Universität Berlin only interrupted by longer research stays at Amherst, Yorktown Heights, Los Angeles, Leiden, Barcelona, Rome and Pisa. Besides teaching and research, he was also deeply involved in university affairs serving repeatedly as department chair and leading the Institute for Software Engineering and Theoretical Computer Science for 32 years. I remember well the long hours in the 1970s sitting together with Hartmut and discussing the pressing issues of departmental politics (and there were many thrilling and conflict-laden topics to discuss at that time).

Hartmut was a most productive editor and co-editor, author and co-author. It was far from easy to keep pace with him. Not only the sheer amount of printed outcome is striking, but also the fact that he was the driving force behind most of his publications. If he looked into a matter, then he did not stop before he understood it in depth. In this process, he often came up with innovative formulations, views and approaches. He was a profound thinker who worked hard to disseminate his ideas. He was a great communicator attending a good many conferences, visiting numerous research groups all over the world and inviting a great number of famous and promising scientists to Berlin.

Hartmut was also a dedicated teacher who prepared many courses in Theoretical Computer Science and Mathematics for Computer Scientists including teaching materials as evidenced by his text book *Mathematisch-strukturelle Grundlagen der Informatik* and a wealth of unpublished lecture notes. At his university, he belonged to the minority of professors who experimented regularly with new principles of teaching. He invested much time and effort in the supervision of his students. In particular his over 50 PhD students always found him ready to advise and collaborate.

Hartmut largely personifies the area of graph transformation. But appreciating his achievements and the services rendered to graph transformation, one should not forget that he played a similar role in algebraic specification and contributed significantly also to the areas of automata theory, Petri net theory and formal and visual modeling. Beeing one of the most influential scientists in Computer Science for some decades, he was a nice, friendly, generous, reliable, and faithful colleague and friend. I have always admired his can-do attitude.

There is a very old metaphor going back to the twelfth century that we can see further making progress in science because we can stand on the shoulders of giants. Hartmut was, is and will be such a giant for our scientific community. What better way to honour him and his work than to follow his footsteps and aspire to achieve his level of service and dedication. I mourn for my 'giant' friend.

Hartmut in Barcelona

Fernando Orejas
UPC, Barcelona, Spain

In July 1988 Hartmut visited Barcelona for three weeks, because he was interested in working with us on our approach to behavioral algebraic specifications, developed by Pilar Nivela in her thesis. I had met Hartmut six years before at ICALP 82 in Aarhus, but I knew his work from some years before. My view of algebraic specification was very close to his. Actually, I had done some work on the composition of implementations, based on his notion of algebraic implementation. This visit was part of his summer vacation. While we were working in Barcelona, his family was somewhere in the Costa Brava (at some point, he joined his family for a few days and then returned to Barcelona).

I remember that, for me, this visit was a kind of nightmare, but a very nice nightmare that we both enjoyed very much. From the scientific viewpoint we did some interesting work, but we conjectured a main result that we found was false by the end of his stay. In addition, during his visit, work was very stressing for me. At the time, I had some other work commitments that I had to fulfill in

parallel, while he was on vacation with no other duties. As a consequence, our day scheduling was roughly as follows. I was waking up early (around 7 AM) and working in my other duties until 10. At that time he was showing up in my office, and we were working until 1 PM, when we were going for lunch. After lunch, he was going to the residence where he was staying to sleep a siesta. Meanwhile, I was working on my other duties, until he would show up again. Then, we were working until 7 or 8 PM, when we were going for dinner to some nice restaurant and, afterwards, to some nice bar for a drink, which meant going to sleep typically later than 2 AM. I remember that one night (fortunately it was Friday, so we were not working the following day), we were a group of people having an excellent time in a beautiful open air bar, and it was around 5 AM. Since I was quite tired I decided to suggest to leave and to go to sleep. But instead of saying it explicitly, which is a bit rude, I did it in a polite way. What I said was something like *Our glasses are empty so, either we leave, or we ask for new drinks*. His answer was *Oh! I'm enjoying this place*. So, we asked for new drinks and we left the bar around 6.

We also had some problems in the social activities of his visit. I especially remember his first day in Barcelona. We had made a reservation on a very nice seafood restaurant, but too late we discovered that he did not like seafood (or that's what he claimed) and that in this restaurant there were no meat dishes. At the end, he said that he would have some salad as first, dish and paella as main dish, although he also claimed that he did not like paella, because years before he had a terrible paella in some restaurant (probably a tourist trap). As for the rest of us, we decided to have some very nice tapas to share, first dish and then a couple of different rice dishes as mains. When all these tapas arrived to the table, he looked at them and to his boring salad and offered to us to share his salad, if he was allowed to share our tapas. At the end, he had enjoyed the seafood and the paella. Some time later he told me that he still did not like seafood, unless I would assure him that it was good. Actually, years later, in another visit, he even had a black paella, because I told him that he would like it, which he did.

Despite these initial "problems", since we both enjoyed working together, we started a long and fruitful collaboration and a very good friendship. Every two years, more or less, he was coming to Barcelona and in the complementary years I was visiting Berlin. According to DBLP, we coauthored 58 papers. Actually, he is my main coauthor and I am his main coauthor, with respect to the number of papers coauthored. Initially, we started working in algebraic specification, but later he introduced me to graph and model transformation and I introduced him to logic programming and some logical techniques for automated deduction. Anyhow, I think that I learned much more from him than he learned from me.

In the last three or four years, regrettably, our collaboration ended when Hartmut was unable to come to Barcelona because of problems with his mobility and

new duties at my university made it difficult to make time for a stay in Berlin. Nevertheless, I was planning a visit when I learned the sad news that I had lost a very good friend.

Remembering Hartmut

Grzegorz Rozenberg
Leiden University, The Netherlands
University of Colorado at Boulder, USA

We were close (also family) friends for over 40 years. We did joint research, cooperated on editing books (proceedings, handbook, ...), and on establishing a forum for researchers on graph transformation (first a workshop which then evolved into a conference). I also worked closely with Hartmut on producing some of his books.

We visited each other quite often (especially in the 1970s through the 1990s). I still remember staying in his apartment in the 1970s from where I had a bird's eye view of the Berlin wall.

Hartmut was a passionate scientist and a 100% reliable partner. Whatever project we were working on he would be a real motor behind it - it was simply not possible to stay behind when working with Hartmut. Also, whatever part of a common project he took over, I knew in advance that it would be implemented ahead of the agreed deadline.

I formed important "friendship links" through Hartmut. Once he invited me to Berlin with an explicit request to work with his very talented Ph.D. student Hans-Jörg Kreowski. This stay became the beginning of my long scientific collaboration and personal (family) friendship with Hans-Jörg.

Hartmut enjoyed very much my magic shows, especially the illusions involving unexpected/amazing coincidences. The last unexpected coincidence took place on March 17, 2016 when I wrote an email to Hartmut about his last book. This was the day that he passed away (nobody except for his close family knew about his illness).

I lost a dear friend. Scientific communities thrive because they include individuals such as Hartmut. We are all indebted to him and he will be warmly remembered by many.