Laudatio
anläßlich der Verleihung der Ehrendoktorwürde an
Prof. em. Lotfi Zadeh PhD
University of California at Berkeley
am 26. Juni 2000

Prof. Dr. Christopher Habel

Dear Professor Zadeh,
Sehr geehrter Herr Vizepräsident, sehr geehrte Damen und Herren,

today we have met to honor one of the most prominent scientists in the field of the Computing Sciences, Lotfi Zadeh, "The Father of Fuzzy Logic". The Department for Informatics awards the honorary doctorate of the Sciences ("Dr. rer.nat.") to Lotfi Zadeh according to his outstanding merits in advancing Computing Science.

It is my role - as vice dean for research - to convey to you, why we - i.e. the members of the Department for Informatics, in particular, and the international scientific community of Computing Science, in general - hold Lotfi Zadeh and his scientific contributions in highest regard.
Zadeh's contributions to science cover theoretical, mathematical foundations of representation of knowledge and decision making as well as the development of reasoning systems and other knowledge-based systems. Since 1965, the year in which his seminal paper "Fuzzy sets" was published in "lnformation and Control", the idea of "Fuzzy Logic" has influenced thousands of scientists all over the world. And what - from my point of view - is also extraordinary, Zadeh's ideas have been included in scientific theories of quite different fields: In Computer Science and Electrical Engineering - his home disciplines - in the Social and Cognitive Sciences, and in the Humanities, e.g. in economics, sociology, psychology and linguistics. Furthermore, the idea of Fuzzy Logic has lead to the development of numerous systems, from electronic devices to large software systems, which are used in government and industry or are part of consumer products.

What was the background in which this influential ideas have been developed? Lotfi Zadeh was born in Baku, Soviet Azerbaijan. He grew up in a multinational - Persian-Russian - family, firstly in Baku later in Tehran. He graduated from the University of Tehran with a Bachelor of Science in electrical engineering. Afterwards, he continued his scientific training in the United States: He took a Master's degree from the Massachusetts Institute of Technology (MIT) in 1946 and a Ph.D. from Columbia University (New York) in 1949, where he taught system theory - inally as a full professor. In 1959 Lotfi Zadeh joined the Department of Electrical Engineering at the University of California, Berkeley. Since 1991 he is professor emeritus in the Graduate School of the Computer Science division of the Department of Electrical Engineering and Computer Sciences and also director of the Berkeley initiative in Soft Computing, which was founded in the same year.

Until 1965, Zadeh's work had centered on system theory and its applications. His famous first paper on Fuzzy Sets - published in this year - is the starting point for a new direction of thinking in the field of the Computing Sciences. By introducing the idea of fuzzy sets, that is, of classes with gradual membership, he developed a basis for a qualitative approach to the analysis of complex systems in which so-called "linguistic" rather than numerical variables describe the behavior and the performance of a system.

Since Rudolf Kruse, Christian Freksa and Ramon Lopez de Mantaras already illustrated some important specific aspects of fuzzy theories, I will take now a more general perspective, namely that of philosophy and history of science: The Sciences - i.e. what is called "Naturwissenschaften" in German - and also Computing Science, Engineering, the Social, the Behaviorial and the Cognitive Sciences are now - at the beginning of the 21st century - based on strict mathematical foundations. In Mathematics there is a traditional dichotomy between algebraic approaches, on the one hand, and the calculus with its extensions and probability theory, on the other hand. It is well known that bridging the gap between the opposite branches of mathematics was fundamental for some of the most difficult results of mathematics, e.g. the proof of Fermat's theorem. Whereas Fermat's theorem can be easily formulated in elementary number theory, which is part of the algebraic branch, the decisive, final steps in proving the theorem in the last decade belong to a branch of mathematics, which combines algebra with non-algebraic results and methods. The mathematical tradition of some of the disciplines mentioned above, e.g. Physics and Electrical Engineering, lies on the calculus-side of mathematics. The same holds for psychology and economics, and some others. In contrast, philosophy and linguistics are logic oriented, or - in the terms used above - they posses an algebraic foundation. Computing Science has its foundations in both traditions: For examples, the theory of automata and formal languages is based on discrete mathematics and algebra, computer vision is mathematically rooted in the calculus. Simulation has an algebraic and an analytic branch.

The idea of Fuzzy Sets and Fuzzy Logics is an approach, which bridges the gap between the two traditions: The concept of "linguistic" variables within the approach of fuzzy sets allows the combination of qualitative entities with probabilistic concepts. Thus, it is possible to model reasoning and decision processes in a "logical way". This "Fuzzy Logic" differs in some relevant aspects from traditional Aristotelian logic, since it integrates algebraic and probabilistic methods. It is - from my point of view - this innovative integration of traditionally opposite methods in mathematizing, which gives the approach its enormous power.

The 1965 paper was the starting point of a very fruitful period: Since 1965, Lotfi Zadeh and an increasing group of scientists extended his new approach for reasoning and decision making. Only a few years passed until Fuzzy Theory became widely known and eventually also widely accepted. But from the beginning, the scientific influence and the areas of application have been widespread. Since the early seventies fuzzy sets are used in psychological and linguistic approaches for understanding and explaining the human system of concepts and words. The first fuzzy-oriented systems for approximate reasoning and decision making have been developed in the seventies and early eighties. The nineties can be described as the Fuzzy Decade: Fuzzy has become a household name, since the principles of fuzzy theory are used in numerous consumer products, as cameras, video recorders, washing machines. To sum up, today the idea of fuzzy sets and fuzzy logic is widely - and especially: successfully - used in basic research as well as in industrial development projects. Consequently, the international recognition of Lotfi Zadeh's contribution to science is reflected by numerous awards, prices, and honorary doctorates.

If the nineties have been the Fuzzy Decade, what will be in the new century? (By the way, whether we are now in the new century or not, is also a question which involves fuzzy concepts.) Fuzzy logic is one starting point - together with neural networks and genetic algorithms - for the development of "soft computing", the scientific idea Lotfi Zadeh is currently pushing forward.

Lotfi Zadeh is an outstanding advocate of a comprehensive view of Computing Science, that integrates aspects of human reasoning and decision making and leads to successful applications in developing software systems as well as hardware components. The Department for Informatics shares this commitment to multidisciplinary Computing Sciences. From the foundation of the

department in the seventies until now, the Hamburg-style of Informatics can be characterized by the integration of interdisciplinary perspectives on our common scientific subject, namely the processing of information by machines and by humans. The research questions investigated at Hamburg are kindred to those considered by Lotfi Zadeh. Some solutions that we have found in the past were influenced by his work. Furthermore, our research in the future will profit from the cooperation with him.

After this - short and only partial - overview on Lotfi Zadeh's eminent contribution to Computing Science it is time to perform the act of awarding the degree of an honorary doctorate of the Sciences.

Dear Professor Zadeh,
lt is an honor and a pleasure for me to hand over to you the document of the honorary doctorate awarded by the Department for Informatics of the University of Hamburg.