INTERVIEW

Interview with Prof. Dr. Claudio Moraga at TU Dortmund, November 3, 2016

Rudolf Seising

RUDOLF SEISING: Bereit? We should change to English.
CLAUDIO MORAGA: Schieβlos!

R.S.: You turned 80 some days ago and we know each other for about 10 % of this time. Congratulations to your birthday, Claudio!

C.M.: Thank you!

R.S.: 80 years ago, you were born in Chile. Please, can you tell us about your first years in this country and about your education?

C.M.: From the first years, I don't remember much, you know. My father was teacher at a High School and since I was the son of a teacher I had a scholarship to study in this private school. This was a kind of a privilege because the state education was not very good. The private school was good but expensive, so I could study in a High School all my school age.

R.S.: When did you start these studies?

C.M.: 1944 I entered the third class and 1953 I obtained my High School diploma.

R.S.: I think that you started studies in Electrical Engineering. Is that right?

C.M.: No, I started studying Architecture.

R.S.: Architecture?!

C.M.: It was rather a funny situation because I very much liked mathematics. But to study mathematics at that time in Chile, in the city where I lived, the only possibility was to study mathematics to become a teacher for mathematics in school. And the last thing that I wanted to do at that time was to be a teacher. Particularly for the small children.

I just wanted to study pure mathematics but this was not possible. There was no programme on pure Mathematics; there was just the program for education in mathematics. Then I had to start looking for other things and I was good for drawing. So, finally I started studying architecture.

R.S.: I think the city was Valparaiso. Is that right?

C.M.: That is the city, Valparaiso.

R.S.: Why did you have this love to mathematics? Did you have some idols in science in that time?

C.M.: No, I just had some facilities for mathematics. I liked it and enjoyed solving problems, I liked geometry, Euclidean geometry, I didn't know anything about Riemannian geometry. I wanted to continue studying mathematics just for fun! I would say. Well, if Pythagoras just did it why couldn't I do the same?

R.S.: Yes, why not? - Then, in August 1961 you earned the Bachelor's degree and in September 1962 you got your Master's degree, but you got these degrees in Electrical Engineering. When did you change and why?

C.M.: I changed after, let's say, according to the German system I had the “Vordiplom” in Architecture and in those times, there was a particular change at this School of Architecture where I was studying. There came people that said: ‘Architecture is the “forgotten art”!’ And they put a very striking example, they said: Ask your friends to tell you about ten famous writers, they will tell you. Ask them to tell ten good musicians, they will give you. Tell them to name ten painters, they will have some difficulties. Ask them to tell you three architects and they will never be able to do that. That was in a strike. And they changed the whole system. The design courses became the most important courses. In a way, they were meant to discover whether you would be an “artist” or not. I passed all mathematics without exams. If I had a good mark I didn't have to go to the finals. But then, in this design part where you were supposed to be a potential artist, I realized that I could see “no light at the end of the tunnel”. Finally I said “No, that is not for me”. And then I changed to Electronics.

R.S.: And why Electronics?

C.M.: There was a new School of Electronics at the same University and it was something new then in Chile. Moreover they were looking for students. I knew some other class-
mates of mine who would change, too. I decided to see what would happen.

Claudio Moraga at his “Graduation Day” at MIT, Cambridge, USA, 1962.

R.S.: In your Bachelor’s and your Master’s degree what kind of research did you do?
C.M.: For the master’s degree I had to build an equipment to control a flashing system. The professor was interested in measuring reactions of - let’s say of the brain - according to different kind of sequences of flashing and I had to build the equipment to produce the driving pulses for the flashing system.

R.S.: Already in this time you were interested in Neural networks!

C.M.: Neural networks as such, I think, did not exist, actually. Rosenblatt had already made the Perceptron about that time, but Minsky said no. And it did take over 25 years until the “rebirth” of the subject with the works of David Rumelhart and James McClelland.

R.S.: Did you know these works already in that time?
C.M.: No, I had no idea of that.

R.S.: So, how did you come to this kind of subject?
C.M.: I was lucky that my advisor said: Well, you know, why don’t you try ternary systems? I was good in digital systems. Why don’t you consider that as a subject? Then I started reading and I was thinking, “Well, I will do it!”

Claudio Moraga in front of his “library” (= shelf with books) of the small department for Electronics of the Catholic University of Valparaiso, Chile, where he had become director (about 1968).

R.S.: Then, you did your Ph. D. studies in Chile, what was the subject of your Ph. D. thesis?
C.M.: Non-binary digital systems.
R.S.: Multivalued logic already!

---

1. Jan Łukasiewicz (1878-1956) was a Polish philosopher, logician and mathematician. He is a pioneer investigator of multi-valued logics. He introduced his three-valued propositional calculus in the year 1917 as the first explicitly axiomatized non-classical logical calculus.
2. Stephen Cole Kleene (1909-1946) was an US-American logician. He is the founder of the so-called recursion theory.
R.S.: So you read Kleene or what kind of multivalued logic literature you knew in that time?
C.M.: I guess, I started with my own ideas how to do that and I came to the triple-valued maximum and minimum and multiple values. And then I found contact with some people in the states and that were researching decisions in multivalued logic conferences. I was lucky to attend the first one and then I knew what the others were doing and then I looked for the others literature. Then I knew the different algebras that were available and why they were used to this or the other problem so, that did help quite a lot.
R.S.: Do you remember when was this first conference and where?
C.M.: It was in 71 in Buffalo.
R.S.: You had got already funding for travelling?
C.M.: Yes, from the university. It allowed me to travel to that conference.
R.S.: I guess that in this year 71 you have not been familiar with Fuzzy Logic in that time?
C.M.: No, not at all.
R.S.: There was nobody giving talks on Fuzzy Logic in this conference?
C.M.: No, I think that at that time in Chile there was no one working on Fuzzy Logic. That started much later.
R.S.: After your Ph.D. you had a kind of scientific and administrative career in Chile?
C.M.: Well, first of all I became a professor at the university where I made my Ph. D. Later, I was a Dean of Electrical Engineering and finally I was Vice-rector.
R.S.: That was a fast career in that time, isn’t it?
C.M.: Yes, it was fast career but it was easy: there were no other candidates!
R.S.: In 1973 you left Chile. Can you tell us something about these circumstances?

---

C.M.: Well, I was lucky that the Alexander-von-Humboldt-Stiftung from Germany provided me with a research stay in Germany at the right time because the military dictatorship started in Chile in those years.
R.S.: It was because of the military dictatorship after Allende? That was the reason why you left Chile?
C.M.: Yes, also.
R.S.: First, you wanted to go to England?
C.M.: Well actually all the contacts that I had were people in the United States because of the conference that I had been attending. I could speak English but I didn’t know a single word of German. Usually you get a scholarship, a fellowship etc. for one, maybe two years. That’s it! At that time my older son was already going to school and for the situation in Chile the state education was not good enough. Private education was better. There was the German school which was supported by the German government. And it had low fees so we could afford that. For this reason, my son was attending education in this German school. We told them that my wife and I didn’t speak a single word of German and they said that this was not a problem. About one half of the children attending the school had parents that did not speak German. So my son started there learning the language. It seems that he was learning fast because there were courses for children who could speak German and courses for children who were learning. And my son was moved for the mathemathic courses to the German group. So he learned the “1+1” in German, not in Spanish.

Then going to the States or Canada for one year, may be two, it would not be long enough for him to learn English but it would be long enough to have a mixture of English and German so he would lose more than winning.

Then it became clear that we, my wife and I, had to learn German and try to come to Germany. And I was right: we looked for and found the Alexander-von-Humboldt-Foundation and they found us. This is how and why we came to Germany and not to some English-speaking country.
R.S.: Professor Reusch was involved in this changing?
C.M.: Yes, because if you have an invitation from the Foundation, you need some host who is willing to accept you, and he was willing to take the risk of having me as a guest.
R.S.: Was there somebody else? I think that you all three met in a conference in Israel? Who was this third person involved?
C.M.: We met at a conference in Israel. The third person involved was Zvi Kohavi, one of the professors at the Technion. He was one of the organizers of this conference where I happened to attend and Professor Reusch was also attending this conference and we met there some time but there were over 300 people. I knew, when I received the possibility from the Humboldt-Foundation to come to Germany, I had to look for a host and I had no contact to Germans,
I thought it was interesting. And we had good contact with Professor Zadeh. You know him, it is very easy to get acquainted with him. We had nice talks even though we were working on different areas.

I met him again on several other conferences and I was lucky to be chair of a conference where he was an invited speaker at the 30th anniversary of his original paper. I think that in the meantime I changed to the University of Bremen. I was one and a half year there, and when I returned to Dortmund I started here [at the Technical University of Dortmund] a seminar on Fuzzy Sets. I think that short after that Professor Reusch started with the Fuzzy Days. For one point I remember that he was talking with the other professors, saying, “See, this is an interesting thing, Fuzzy Logic”. He had been reading papers of Lotfi and I heard him saying that it would be a good thing for the department to start working on that. “If no one else will, I will do it at my Chair, but motivating the people to do work that.” And short after that he started with the Fuzzy Days-conferences.

R.S.: So, you started with studied Fuzzy Sets already in your time in Bremen?
C.M.: In Bremen, I think also I gave some seminars on Fuzzy Sets.
R.S.: Was this the first time of seminars on Fuzzy Sets in Germany?
C.M.: No, there were people already working with Fuzzy Sets or this kind of logics. Professor Thiele had been working with that quite longer.
R.S.: Let’s go back to the times when you started in Dortmund the first time. I think it was in September 1976 when you became lecturer in Dortmund, right?
C.M.: No, I arrived in Dortmund in 74. And I was two years guest from the Foundation. But in 76 then I was guest of the University. So, I got my first assistant contract from the university.
R.S.: This was not a permanent position, right?
C.M.: No, that was not a permanent position. But since the department was starting and the university was starting there were a lot of positions that were approved by the ministry but were not already occupied. So, they could borrow from these different positions for one year. And it was not difficult to give me this position.
R.S.: How long did you stay in this position in Dortmund before you moved to Bremen?
C.M.: Oh, quite long because finally they discovered that there was one legal possibility for giving me a permanent position. That was considered in the law of universities. If there is one particular task that requires continuity more than one year then it is possible to assign a permanent position. They asked me whether I was willing to create from scratches a laboratory for digital systems for the students in Computer Science. And since I had done that in Chile a couple of times, I said “Ok, I will do it.” I had the unusually experience of becoming a lot of money that I had to spend up to the end of the calendar year. I couldn’t keep the money for the following years when I could find equipment cheaper but I had to...
Jyh-Shing Roger Jang received his Ph.D. from the EECS Department at the University of California, Berkeley. He studied fuzzy logic and artificial neural networks with Prof. Lotfi Zadeh. He was a professor in the CS Dept. of National Tsing Hua Univ., Taiwan, from 1995 to 2012. Since August 2012, he has been a professor in the CSIE Dept. of National Taiwan Univ., Taiwan.
that they would offer a kind of sabatic. Professor Trillas, at that time at the Technical University of Madrid, knew about this program and he asked whether he could invite somebody from Germany to spend a sabatic while visiting for one year and immediately they said “Yes”. This is how I was invited to Madrid and in one year I was “fuzzyfied” by Professor Trillas and his group.

R.S.: After that you became Professor ad honorem in Dortmund and you still collaborated with many people in many countries.

C.M.: Well, mainly with the series of TEMPUS projects in Serbia and Macedonia and on the other side I kept contact with my former students and now colleagues in Chile because after the end of the dictatorship in Chile programs of academic exchange between Germany and Chile that had been stopped during the dictatorship were reactivated and the Ministry of Education and Research in Germany invited to submit proposals for joint research with people in Chile. I called up my former students, now colleagues, and we presented one project on Intelligent systems, that was immediately accepted. Both the Ministry for Education and research of Germany and the National Commission for Research in Chile took part contributing to the financial support to the project. And that’s how I started again working with colleagues in Chile.

R.S.: I remember at least two other persons, one from Algeria and one from Georgia.

C.M.: Yes, the one from Algeria, she, - it’s a lady, - she wanted do to something on Evolutionary systems applied to the design of digital systems.

R.S.: That is Fatima Hadjam.

C.M.: That is Fatima Hadjam, that was in 2007. But somehow she wanted to do her Ph. D. in this area, but the profes-
sor with whom she was working moved to another country and then she was alone. Well, through Internet I guess, she found some names and tried to contact these people working in similar areas and at this is how I received one letter of her that she was interested in work in this particular area. If I could send her papers or whatever. I told her, you know, the German Academic Exchange service had some short time visiting possibilities, why don’t you apply for a short visiting period? Come here to Germany. Then I can provide you with whatever you may need for your Ph. D. and then you can go back to work at your university. It was lucky that she applied not for a short visiting but for a full scholarship from the DAAD. At that time the rector of her university in Algeria also supported this and allowed her to be one year here in Dortmund and contributed also with that scholarship. She could stay three semesters in Dortmund and then we advanced quite a lot. She was a hard worker and after that when she could return to Algeria, we continued via Internet connected; she could finish her Ph. D. actually already in Spain at the European Centre for Soft Computing. She came a month every year and was working there intensively with me until she finished her Ph. D. and we have continued to do work on that, now applied to reversible circuits.

Claudio Moraga, Fatima Z. Hadjam, and Igor Aizenberg at the conference dinner of IEEE WCCI-2010 in Barcelona, Spain, in July 2010.

R.S.: Was it similar with the other lady from Georgia, I forgot her name. She passed away.

C.M.: Yes, she passed away last year, it was Tatiana Kieselova. She had been here at the chair, I don’t know how she came but Professor Reusch accepted her as a guest, later she had some position as assistant for several years and she was very friendly and a hard worker. Also she tried to work with different people. She was working in Fuzzy things. After her residence here finished she returned to Georgia, to her home university to continue in that area but she got sick and unfortunately she passed away.

R.S.: I remember that. In the year 2006 the Foundation for the Advancement of Soft Computing launched the European Centre for Soft Computing in Mieres in Asturias (Spain). You became as Emeritus Researcher the Head of the Research Unit “Fundamentals of Soft Computing”. This was one of four research units. Do you remember the first time you heard about the plans to establish this centre?

C.M.: Well, let’s say I knew this project of Enric Trillas much longer ago. He tried at different other places and it didn’t work. It was a very lucky circumstance that lead to an agreement and finally it was decided to start the Centre in Asturias. Then he phoned me and he said: “Well, now it will be true, the centre will start here. We need you!”

R.S.: I remember that there was a letter by Lotfi Zadeh to the chancellor of Germany, Angela Merkel, to establish such a centre in Germany.

C.M.: Yes, also, I remember and I don’t know whether it was true...

R.S.: Yes, it is, I saw this letter...

C.M.: No, that he talked to her, yes; but people say that he had told Frau Merkel: Charge one additional Euro in the taxes to every people and you have enough money to support a centre of this kind for the next ten years. At that time there were 80 Million people in West-Germany. So, 80 Million Euros. That could have been a lot of money to have no problems for 10 years. 8 million per year is more than the centre could spend. But she was not convinced of that...

R.S.: Maybe she never read this letter. Now, the European Centre for Soft Computing was launched in Mieres, in Asturias and I think that Enric Trillas was one of the driving persons...

C.M.: He was the man with the idea behind that and moved the creation of the centre. I was only the founding researcher, I was the first one in moving to Mieres.

R.S.: When did you decide to do this job?

C.M.: When he called me and said “We need you!” I said “Ok”. In the next month, March 2006, I was the first one there.

R.S.: After 10 years, in December 2015, the ECS terminated. The center existed only 10 years. What is your opinion about the 10 years of the European Centre for Soft Computing in Mieres? Was it a success or not?

C.M.: On the one side it was unique project. A modern project for Spain and probably for Europe. A research centre where both fundamental and applied things were considered. Any centre that works on basic research cannot be self-supported. So, it has to be supported from external sources. If we compare it with the situation in Germany:
many we have the Max-Planck-Society\textsuperscript{15} with support from the Government. They are devoted to basic research. In parallel we have the Fraunhofer-Research-system\textsuperscript{16} that work together with industry. They support themselves through projects with and for the industry, while the Max-Planck Institutes do not have priority in industrial projects. If they can, certainly they will do, but their main concern is fundamental science. They would be glad to have support from industry, but basically they have support from the Government to do basic research. That was not understood in the situation in Spain. Those who started with the support, at one point they said: “No, we don’t give any longer support, you should support yourselves.” I remember that I was asking: “Tell me who buys theorems, I will try to sell them some of my theorems.” But no one. No one buys the theorems!

Claudio Moraga after the Ph. D. defense of his student Juan Zamora.

R.S.: You moved back to Germany and now you are here in Dortmund again. - or still! What are you doing now in science? What kind of research are you doing now?

C.M.: First of all I am a permanent stubborn guest at the university and particularly at the chair on Logic for Computer Science. I don’t work on logic but I do a couple of different things, I continue working on properties of discrete functions. There are some new families of functions that interest me to do research on, so-called Bent functions which in the binary case they are important for cryptography, in the multiple-valued case they are not, since cryptography is basically binary. But in the multiple-valued case there are very challenging problems. Actually, a lot of mathematicians are working on that, because generating, characterizing, and counting Bent functions are very tough problems, in the non-binary world. So, I do a few things in that case. And now, with the latest new project of the European Community Reversible Computing I do something on reversible circuits. Reversible circuits have the property that if you give some inputs and calculate the outputs If you introduce the outputs you could recover the original inputs. This can be done on different levels, not only on the hardware level but at other levels on computing too. In the case of programs, for instance, you will start (back) with “end” until reaching “begin”. This means that you are able to return in your program which is important, for instance, for testing and finding the errors in programs. You do step-by-step-returning and you can find out where something is out of order. The European Community has a project on that for three or four years long, trying to create a network of researchers interested and active in the subject. The network will allow people to exchange information and experiences. A conference on Reversible Computation is organized every year where the best results are presented.

All participants of the celebration of Claudio Moraga’s 80th birthday in Dortmund, November 4, 2016.

R.S.: Thank you very much for this interview!
C.M.: You’re welcome!

New book

The book is an authoritative collection of contributions by leading experts on the topics of fuzzy logic, multi-valued logic and neural network. Originally written as an homage to Claudio Moraga, seen by his colleagues as an example of concentration, discipline and passion for science, the book also represents a timely reference guide for advance students and researchers in the field of soft computing, and multiple-valued logic.

\textsuperscript{15}The Max Planck Society for the Advancement of Science (Max-Planck-Gesellschaft) is funded by the federal and state governments of Germany as a non-governmental and non-profit association of German research institutes. It was founded in 1911 as the Kaiser Wilhelm Society and renamed in 1948 in honor of its former president, theoretical physicist Max Planck.

\textsuperscript{16}The Fraunhofer Society (Fraunhofer-Gesellschaft) for the Advancement of Applied Research, is a German research organization with 67 institutes spread throughout Germany, each focusing on different fields of applied science.