Oral History of C. L. “David” Liu

Interviewed by:
Doug Fairbairn

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Doug Fairbairn: OK. We're here today at the Computer History Museum. It's Monday, June 2, 2014. I'm Doug Fairbairn, and I'm sitting here with Professor Chung Laung Liu, who has a very rich and interesting background covering many fields, including computer science, mathematics, VLSI design automation, and others, which he is going to share with us. He has been a professor, a teacher, a mentor, and perhaps also equally or more important, a husband, father, and grandfather, which he might also tell us about at the end.

C. L. “David” Liu: Thank you.

Fairbairn: He has been a board member and adviser to companies large and small. He's been a university president. And has been and is currently a host on a radio show.

Liu: That's correct.

Fairbairn: So we have a lot of information, a lot of stories to cover. And so given his name, you might want to share with the audience the name which we didn't mention, which you are also just known as Dave or David. So tell us how you went from Chung Luang Liu to David.

Liu: Thank you. Let me begin, really, at the very beginning. I was born in south China in the city of Guangzhou. Then I moved from Guangzhou to Macau when I was four years old.

Fairbairn: Do you remember anything about your time where you were born?

Liu: Not when I was born.

Fairbairn: From the first four years?

Liu: Yes. First four years, not that much, only the place.

Fairbairn: And what year was that that you were born?

Liu: Well, 1934 I was born. I moved to Macau in 1937. Now you remember your history well, you know why at that time. It was the outbreak of the China-Japanese War.

Fairbairn: Right.

Liu: So I move to Macau. And my family stay in Macau for 14 years. I went to school there all those 14 years. Again, it's something not very many people pay attention to. During the Second World War, Macau is only city that remained neutral in the whole Southeast Asia. So I had actually a rather quiet uneventful time, because I did not have any direct experience with the war.

Fairbairn: It's remarkable. Such an isolated city in total destruction and chaos.

Liu: It was a Portuguese colony until only 1999.

Fairbairn: So tell me a little bit about your schooling there. What kind of schools did you go to? And when did you develop your interest in science, and mathematics, and technology?

Liu: Well not until I enter college. I must say that I had a wonderful time and a very rigorous primary school and high school training. And we were encouraged to do well in mathematics and science, as well as in literature and drama, and of course athletic activities. At that time there was no pressure to enter college, because there was no college to be entered. There was no what we call entrance examinations, or what you call SAT. We all spent our time doing everything possible.

Fairbairn: Very multidisciplinary.

Liu: Yes. Exactly, exactly. And I think, of course later on I became an engineer and scientist, I think that my background in literature was built during those formative years.

Fairbairn: And what language were you educated in? Macau is a Portuguese colony.

Liu: It really is regretful that I look back and we did not have any chance to learn Portuguese. We learned English, but of course Chinese is the major language of instruction. By which I do not mean Mandarin. I mean Cantonese. So today I speak English with a Chinese accent. I speak Mandarin with a Cantonese accent.

Fairbairn: But not Portuguese.

Liu: Not Portuguese, no.

Fairbairn: So how long did you go to school in Macau? And what was the--

Liu: Indeed from first grade all the way through high school. And we had what probably is known as an American system-- six, three, and three.

Fairbairn: And now tell me a little bit about your parents. Did they encourage you in any specific area? And did you have any brothers and sisters? Little bit about your family life.

Liu: Yes. My father was with the Chinese Air Force. And so he actuality left us in Macau and he went to China, in the Chongqing area. I have two brothers. All three of us later on turned out to be engineers. My older brother is an aeronautical engineer, and my younger brother is a chemical engineer. Again when we were young, I think just like any typical Chinese-American family, our parents encouraged us to do well academically. And beyond that, they really did not have any specific direction in mind for ourselves.

Fairbairn: Were there any teachers that had a particularly strong influence, or helped steer you in a particular direction during high school or earlier?

Liu: They were all wonderful, wonderful teachers. But again, today if you ask me, I naturally remember the teachers who taught me mathematics and science. But in particular, my Chinese teacher. Today I still remember my learning of Chinese literature extremely well.

Fairbairn: Interesting.

Liu: I now write often in Chinese. As I mentioned to you earlier-- or you mentioned actually-- I host a radio show in Taiwan. I turn the transcripts into books. I've so far published seven books on the basis of the contents of the radio show, from popular science to social science to Chinese literature, and including English literature. For example, not too long ago on my radio show, I took the lyrics from the musical Cats and rewrote them in Chinese. Not to translate them, but rewrite them in Chinese.

Fairbairn: Interesting. So you really do have a very broad background. So as the time came to graduate from high school, what were your options? What were you considering?

Liu: That actually is quite interesting. I graduated from high school in 1952. And as I said, at that time there was no universities in Macau. So I went to Taiwan for my college education. At that time in Taiwan, there were four universities. Actually to be more precise, that was one university and three colleges. I entered the College of Engineering in Taiwan. Now it is known as the National Cheng Kung University.

Fairbairn: And you chose engineering at that time because you were interested in mathematics and related fields? Or what was the--

Liu: That's one of the reasons. Another reason is in the early '50s, engineering is a profession that would guarantee good employment. At that time in Taiwan, to enter electrical engineering there were two major employers. One is the Taiwan power company, the other is the Taiwan communication company.

Fairbairn: So at that point when you entered the College of Engineering, you were still thinking in terms of staying in Taiwan or in China to pursue your career?

Liu: At the beginning, yet.

Fairbairn: So tell me how that evolved. What courses you took and what types of courses you took, and how your interest evolved during your college days.

Liu: Yes. I mean of course at the beginning, the first two years, calculus, physics. But I must mention, even for calculus I had a wonderful teacher who was trained in France. So when we did calculus for a simple end equation problem, he would encourage us to come up with different methods. So instead of solving one problem with one method--

Fairbairn: So you're talking about your calculus professor?

Liu: Yes. I mean, as I said, we were encouraged to solve the same problem in different ways. Now looking back, I think that is one of the most important lessons to learn. How to solve a problem, how to look at a problem from different angles, different perspectives. Solving it in a single way is good enough, but not good enough.

Fairbairn: Interesting.

Liu: Yeah. And I went on, of course, for the second. Year I still remember we learned the fundamentals of electrical engineering. In then I remember in my junior year, a professor came back from the United States with a new textbook on electronics. So that was my first course on electronics. We learned about ~~[? TRIOS, ?] [? PENTOSE ?]~~triodes and pentodes for the whole semester. And that was almost my only experience in the electronic area at that time. We learned about batteries, storage batteries much bigger than those in an automobile or something as small as a penny.

We learned about motors and generators. What's more is Professor Richard Feynman offered a prize of $1,000 to build motor the size of 164 inches.[??] And I think the record in 2011 is about one millimeter. We learned about power transmission and distribution, not knowing that smart grid comes back 50 years

later and is with us again. So again as I said, when I look back I learned things that in a short period of five times, looking back they were all ancient, antique, and useless. 50 years later, they're all new.

Fairbairn: They're all relevant. So what did you end up specializing in then as you went through and completed your college career?

Liu: Nothing. Nothing special. Again, I had a rather, at that time, fundamental education in electrical engineering, covering basically power, transmission, distribution, storage battery, to a class in transmission lines. That was a rather advanced course already.

Never heard of a computer for my four years. I remember there was a book in the library on information theory. I tried to read that, but really did not get much out of it.

Fairbairn: So as you completed your college career then, what was your next step? How did your interests--

Liu: Well at that time, according to the rules, I spent two years in the military for military service. At that time it was 1958. And it was really just the beginning for students, for college graduates, from Taiwan to look for opportunities for further studies in the United States.

At that time that was right after the Sputnik that the Russians launched. So we were told there were plenty of scholarships available. So indeed I applied to a number of major universities, and was fortunate enough to be accepted by several of them.

Fairbairn: All in the United States?

Liu: All in the United States.

Fairbairn: So at some point you decided that the United States was the place you wanted to go.

Liu: Well I think if you go back and look at the timeline in the early, late '50s, '60s, United States is the place to go for higher education, and for many things as well.

Fairbairn: So did you have at that point an idea as to-- you decided to continue your college education, university education, as opposed to going and taking a job.

Liu: That's right, that's right, that's right.

Fairbairn: That's the thing that most interested you. And were your parents supportive of that?

Liu: Of course. Yes. But then I must say, after I entered graduate school for a short period of time, I was thinking about getting my master's degree and going into industry. But I quickly changed my mind after I had the opportunity to serve as a teaching assistant in graduate school, and decided to pursue a career in education.

Fairbairn: So it was then that you decided to focus on education. And so what was it like? You grew up in Macau and then Taiwan in the '50s, and then you arrive in the United States in Boston. Is that your first stop? In what was that like?

Liu: It was my first stop. I would say this. People ask a similar question. People also ask me questions about colleges, universities, students in Macau, in Taiwan, in United States. My answer is that they're all the same. They're all wonderful, they're all good people, and they're all nice experience. Now I was able to adjust rather quickly, without any difficulties, when I came to the United States in the fall of 1958 and I entered MIT as a graduate student.

Fairbairn: So you entered MIT. Did you have at that point a focus as to what academic area you wanted to focus on?

Liu: I was very, very fortunate. I must tell you a little bit of the details. I was fortunate enough to be given a fellowship endowed by a successful Chinese-American businessman at the National Cheng Kung University.

He then gave me $5,000 US for two years. I could choose any school that I wanted to go to. At that time, $5,000 US was plenty at MIT. Tuition was $1,500 a year. There was not quite enough to cover two years of expenses.

So when I got there, the admissions officer, the professor in charge of admission, his name of course I still remember fondly, Professor [? Carl ?] [? Wiles. ?] And he arranged for me to have a part-time job in a laboratory. Actually it was not a part-time job. It was an opportunity for me to be with a professor to start doing my master's thesis.

Liu: Sounds like a research assistant.

Fairbairn: Yes. It was a research assistant, but on the other hand, on a part-time basis. The professor I got to meet, Professor Ronald Howard, is still now a professor at Stanford University. He just completed his PhD under the well-known physicist Professor Moore, who entered the area of operations research after many years of good work in the physics area. So at that time Professor Ronald Howard suggested that I do a thesis in the area of computer-aided instruction.

Fairbairn: Instruction?

Liu: Computer-aided instruction. So I get into the computer-aided instruction area in 1958.

Fairbairn: Wow, that's very early. I didn't know anybody was thinking about that.

Liu: Now it comes back all over again under the name M-O-O-C. I still have a copy of my master's thesis with me. At that time in my master's thesis, I talk about when you have computer as an aid for instruction. It is interactive, it is individualized, it is incremental.

Fairbairn: This is all in your thesis?

Liu: All in my thesis, all in my thesis. The only thing I did not have was anywhere, anytime. And that's what we have today. But why did I get into that area? Because that was the time, the notion of time sharing computer disappeared.

There were several important papers. One was by [? Strache, ?] one was by John McCarthy, and one was by Herbert [? Teeger. ?] They all talk about the possibility of having a computer system that can be shared by several people at the same time. And of course if you have a shared computer system, you can use it to do interactive computing. And of course, education would be the first thing you think of.

Fairbairn: I didn't realize that the research in that had begun so earlier. I didn't know that it had started so soon.

Liu: I have copies of it. Maybe I'll remember to dig it out and send it.

Fairbairn: I believe you. I'm just surprised.

Liu: I must tell you this. I came from Taiwan. Never heard of a computer before. But when Professor Ronald Howard encouraged me to look into this, you know what I first look up? BF Skinner's teaching machine. So I quoted that in my thesis.

Fairbairn: Interesting. So you were interested in teaching, you became interested in, you did some research in computer-aided instruction, and that's what your master's thesis was on then.

Liu: Yes. So let me tell you two things. After I finished my master's thesis, somehow I was interested in more mathematical work more along the line of structures. So I decided to pursue my PhD study in the area of finite-state machine. So that's one thing that happened.

The other thing indeed was after my master's study, my fellowship ran out. And I was offered a choice between a research assistantship and a teaching assistantship. I made a choice of accepting a teaching assistantship. Again, I met a wonderful professor and his name was Alfred Susskind. He was teaching a course in logic design.

So he said, I'll make a deal with you. The first semester you grade papers for me. The second semester I'll let you have the course. So imagine a graduate student from Taiwan, after two years, in the third year I was handling a course completely on my own-- lectures, homework, examinations. And so that was wonderful, wonderful experience.

In the meantime, I was looking for a thesis topic. I knew switching theory, logic design, was the general area I wanted to get in to. And at that time there were several really significant figures in the field. One is Professor David Huffman. One is Professor Dean Arden. I happened to be accepted by Professor Dean Arden as his student. Professor Dean Arden actually participated in the design of the Whirlwind machine.

So I worked under his direct. And I did a PhD thesis on the structure of finite-state machines. But also in the meantime, Professor Claude Shannon actually returned to MIT from Bell Laboratory. So I had the opportunity of taking a class from him.

So I spent two additional years to complete my PhD study. And decided to accept an offer to stay at MIT on the faculty. And that was the time time-sharing operating system was developed from what was known as CTSS, Compatible Time-Sharing System, led by Professor Corbato.

And then from CTSS, Professor Robert Fano, Professor Licklider, provided the leadership to start Project MAC. As a matter of fact, it was exactly last weekend they had a big celebration of the 50th anniversary of Project MAC. And I was a young assistant professor, and I was again very fortunate to be accepted to join Project MAC.

Fairbairn: And what year was this then?

Liu: 1963. And I still remember at the time, there was a summer study. Project MAC invited, I would say, all of the big figures in the field of computers to MIT. And we spent a summer together talking about various aspects of computer science. I mean, of course, some of the names are Professor Marvin Minsky, Professor John McCarthy, Arthur Samuel, [INAUDIBLE], of course as I mentioned earlier, Robert Fano. Licklider, I must say I don't remember his first name.

Fairbairn: No, they know. So you, it sounds like you went sort of smoothly from getting your PhD and a teaching assistant to, into a professorship at MIT. Is that--

Liu: But again, when I was with Project MAC, somehow it was by choice of my own interest. I got into the area of combinatorial mathematics and algorithms. And it was at that time I wrote a textbook called Introduction to Combinatorial Mathematics. And that really was one of the earlier attempts to bring concepts from graph theory, optimization techniques, enumerative techniques, into computer science for application in solving computing problems.

Fairbairn: So what was your specific contribution in the Project MAC program?

Liu: I did a compiler. It was called a table-driven compiler. Now at that time, again, compiler was something very significant. So at that time for every language, there is a language-specific compiler. So the concept of table-drive compiler, as the name implies, for a different language, you just replace the table, you get a different compiler. So I, together with a group of students, worked out a table-drive compiler.

But again, as I said at the time, people might not pay as much attention to that. It was the beginning of computer science education. And actually at that time there was no such department as Department of Computer Science. Even at MIT, there's still only Department of Electrical Engineering and Computer Science today. It was at that time--

[OFF-CAMERA CHATTER]

Liu: It was at that time Stanford started an effort to build up its Department of Computer Science. The famous numerical analyst George Forsythe was invited to be the department head. And he recruited, among other people, John McCarthy and Donald Knuth. And so I was at Project MAC, and MIT of course was also building. MIT was also working on designing curriculum, at least courses, for students in the computer science area.

So a question was what kind of mathematics that we should teach them. The answer was, of course, discrete mathematics. What kind of discrete mathematics? Modern algebra, logic.

And besides the two, at that time again I was very fortunate to audit a class in combinatorial mathematics under a truly, truly wonderful professor, Gian-Carlo Rota. I learned combinatorial mathematics from him. And I tried to turn what I learned into more application-oriented, into more computer science-oriented descriptions. And so that really was my involvement in educational development in the computer science area.

Fairbairn: So you continue down this path, and at some point you move to the University of Illinois.

Liu: That's right.

Fairbairn: So tell me about what other things you might have done at MIT, and what drove your move to--

Liu: There actually was [INAUDIBLE], at least for me. I work in the theory area. As I said, I begin with finite-state machine theory. Then we got into algorithms. And I think at that time we were influenced by major figures such as Donald Knuth, Bob Floyd, and so on.

And at the time, we began to realize the importance of the notion of complexity theory. Then it came to the work of Steve Cook and Richard Karp on the notion of computational complexity. But after a number of years working in that area, we began, some of us began, to look for applications. And at that time integrated circuit design became a natural area of applications.

But hopefully you must go back and look at that time, when people like myself, who had a background in theory, looked into the integrated circuit areas. I remember the simple directions people follow. One important direction at that time is the limitation-- lower bound, upper bound on the time and the area an integrated circuit that performs a certain function would take. The so-called famous [? 80 ?] squared bound.

For myself, I happened to discover routing, placement, is an area that is really well-structured. If you go back and look at the EDA area, people begin to work in areas that are more mathematically structured and defined, and try to solve them in a more mathematical way. If you go all the way back, there was a famous paper talking about a lower bound on the channel width, and it is called "Density of the Channel Routing Problem." It was a famous paper by Hashimoto and Stevens.

And so at that time, people worked very hard on the channel routing problem. And because it is mathematically well-defined, you can measure how good your result is by comparing your result with the channel density. And that brings me, actually, to my first Design Automation Conference paper.

Fairbairn: Before you get there, what year was this when you started thinking about complexity issues with respect to--

Liu: Early '70s. Let me give you some data points. Steve Cook's paper was published in 1971. And Dick Karp's paper was published in 1972. So we got into that area. I'll come back to that for a different point.

So in particular, in the year 1982, I had my first paper published in the Design Automation Conference. I actually gave a keynote speech in 2012. The title of that speech was, "1982-- My First Design Automation Conference." I looked up the proceedings. And if you are curious about it, there were at least six or seven papers all written by mathematicians in the general area of channel routing.

And my paper in the 1982 Design Automation Conference was on optimality of PLA folding. The content is not important. The importance, in my opinion, were two key words. One is optimality. Not just a result that's good enough, it is the best. Two is PLA, based in the notion of programmability. So as I said, when I look back I saw that.

But then I must mention it was by, again, my good fortune that I spent a summer, I believe it's the summer of 1971, at JPL. My manager at that time, his name was Jim [? Layland, ?] and he was working on some scheduling problem. And so he invited me to join him. At that time the notion of real-time scheduling, that means when jobs come in at real time you have to make instantaneous decisions how to schedule them. It was important for space exploration application.

So we work on two algorithms. One is called rate-monotic scheduling algorithm. One is called deadline-driven driven scheduling algorithm. And we published a paper. The paper actually came out in 1973. Now at that time we really did not know, 1971, at least we did not know about the notion of computational complexity.

So when a problem, when a problem is not known to be computationally efficient, we tried to obtain approximation algorithm. When you use approximation algorithm, you do not know whether you obtain the best possible result. But if you can measure how far away you are from the optimal result, this is useful.

So our rate-monotonic scheduling algorithm is known not to be optimal. But we do have a precise measure on how far away it is from the optimal solution. And that really was a piece of work before the

notion of NP-completeness was fully understood. The paper this time, of course, is 14 years old. And the number of citations is still increasing. And it probably has about 9,000 citations.

So after that, again, it was natural for me to apply what I learned in theory, in algorithm analysis, into the design of integrated circuits. So indeed we began with routing. Then we got into placement.

Fairbairn: That wasn't until the '80s, right?

Liu: That's the '80s.

Fairbairn: The 1970s, integrated circuit design was just the domain of craftsmen who were just doing--

Liu: Let me mention a couple of things. Actually there was a, quote unquote, in the early '60s, someone did an analysis and said the computer cost of using the stretch computer, the design in 100 circuits, will cost more than the salary of a draftsman for a year. Now let me remind you, when I was a graduate student, the IBM 7004 overall cost $200 an hour. The stretch computer probably cost on the order of thousands. And you pay a draftsman about $500 a month.

And that's an interesting way to put it at that time. We pay $500 to an engineer to build a $100,000 system. Now we pay our engineers $100,000 to build $500 systems.

So getting back to the design automation area, I must say I was fortunate again in my life. I have some wonderful, extremely capable graduate students. So we work together as a team. And many of my students went on to become very successful, famous, in the design automation areas.

Fairbairn: What year did you leave MIT and go to Illinois?

Liu: 1972.

Fairbairn: So all of this work was done at Illinois then?

Liu: Yes Design automation began at Illinois.

Fairbairn: And what triggered the change? What made you want to move to--

Liu: Well because, I must say at that time, I worked in the theory area, and as for myself I did not see with my interest that I could have gone on to do something else. Although that really was-- just like everybody else in the research-- there were many, many great ideas, many, many good opportunities. For example, I actually had an interest in algebraic coding theory. And I taught a class and I did some work, and I wrote a paper, which I think was an interesting paper, called [INAUDIBLE] Code."

Now of course, if you go but and look at the history, it was in the mid '70s, the notion of public key encryption came out. And actually Martin Hellman was a professor at MIT that I got to know. Also, he only developed his idea on public key encryption, as I understood it, after he returned to Stanford. And the of course, the famous group of people-- Rivers, Edelman, and [? Shamia ?], did their famous work, [? RSA, ?] also in the mid '70s.

And again as I said, you don't get any areas when someone says that he could not go on any further, other people will see that there are many, many bright future. So for example, actually there are areas-- parallel computation, computer- aided instruction, were all opportunities.

A very good friend of mine, Professor David Koch, is a pioneer in the parallel computation area. He is still a professor at the University of Illinois at Urbana- Champaign. And if you talk about parallel computation, actually it goes all the way back to the '60s. Professor Daniel Slotnick, he was at Westinghouse. He built a parallel computer cal called Solomon. S And he again, in my opinion, one of the most capable, brightest individual.

And then Professor David Koch started his work in paraphrase, which is a parallel compiler that turned Fortran code into possible parallel execution paths. So again at that time, Illinois also was building transistor computers.

As I said, let me go all the way back, at MIT I used the TX-0. And later on it was the TX-s in the Lincoln Laboratory. At MIT-- I'm sorry-- at Illinois, we were building ILLIAC II, ILLI ILLIAC III, I ILLIAC IV. Then I also, again, was fortunate enough to be with some of the giants in the field. Jim Robertson, Jim Schneider, and Bill McCormick. So again, as I said, that all these people were very influential, were very helpful to me in my career.

Then I move on in the design automation area. It was really at that time I began to have industrial contact. Because in the past as a theoretician, I did not make much money. And no company would be much interested in supporting research activities like that. So in particular, I got to know Ajoy Bose, who was a manager at AT&T. So I got to know Ajoy way back at that time.

And also the other areas we go into is the area of programmable logic array, FPGA's, and so on. Then when you get this, all these problem can then again, placement, routing, and so on.

Fairbairn: Who first introduced you to VLSI, or integrated circuit design? Because there wasn't a lot of academic work being done back then.

Liu: No, no. Yes or no. Of course, you have to mention Mead and Conway.

Fairbairn: But that didn't come until the '80s. '79.

Liu: Well, we began to think about it. I think, as I said, at least for me and some other people, we began to think about other things to do. And that, of course, again as I said, I mentioned the paper via Stevens and Hashimoto, and that paper actually was written at Illinois in 1971, if my memory serves me right.

Because at that time, Illinois was building ILLIAC I or II. They had to face some hardware design problems. So in a way, I mean, we happened to go that way. There was some significant influences by giant leaders, and also push by good graduate students.

I must tell you a story that my professor at MIT, as I said, Dean Arden was my thesis adviser. So at one point when I was at Illinois, I invited him to come to give a seminar, and also to meet with my graduate students. So after he met with my graduate students, he told me, y you do have some good graduate students. And I said to him, yes, my graduate students are better than at least this one. Then later on my students, after their meeting with Professor Arden, told me, you had a wonderful thesis advisor. I said yes. My advisor is better than yours.

Fairbairn: So it was the type of work, and the perhaps more practical kind of work that was being done in Illinois--

Liu: In the meantime, in the meantime, yes, I really continued to pay attention to my teaching. I turned my book, Introduction to Combinatorial Mathematics, into Introduction to Discrete Mathematics. Now it's not quite introduction, it's called Elements of Discrete Mathematics.

And at that time it became one of the earliest books on discrete mathematics. But I also taught freshman-level courses. I learned to program in Fortran. I taught mathematica. I taught PR [? one. ?] I wrote a textbook on Pascal.

And then, and then, in a way, if you look at my research career, in 1995 and '96, couple of things happened. I spent half a year of sabbatical in Taiwan at Tsing Hua University. So I got to know the place better. I'm not going to say well. I was always connect to the universities in Taiwan, but that half a year

was a more intensive, extensive interaction period. Then also at that time I was invited to serve as an associate provost under Provost Larry Faulkner, under him.

Fairbairn: Provost where?

Liu: Illinois. University of Illinois, Urbana- Champaign. And of course, the provost has several associate provosts under him. And I was the academic associate provost. So that gave me opportunity to get to know indeed all the deans, all the department heads.

And also my first and only administrative experience as an educator. I had never been a department head. So in 1998 I was offered the opportunity to become the President of the National Tsing Hua University.

Fairbairn: So before we jump ahead to that, I just wanted to make sure that we covered-- going back to your VLSI design work, when were you and how were you introduced to the work of Mead and Conway?

Liu: I would say, of course, we heard about it. We heard about the work at the PARC. At that time, if I remember, you actually invited many university professors to spend summers there. And I remember, if you go back and look at the book, you mentioned the work of [? Rivers ?] for sure. [? Rivers ?] actually had a paper in the 1982 Design Automation Conference called River [? "River ?] Routing" or something like that.

And actually at that time under his leadership, MIT built a place and route system called the [? PIE ?] system. Right? And again, as I said, there were other professors. I I distantly remember someone from Brown University for sure.

Fairbairn: There were dozens of professors who came through PARC to pick up--

Liu: People at AT&T also wrote papers. And so we heard about their work, and as I said we were close friends. So we were inspired by what we have heard, what we have read. And of course, as I said, Mead and Conway's book certainly was extremely influential to make us think about--

Fairbairn: Right. So you continued your work. Do you want to say anything more about the highlights of your work at Illinois before moving on to--

Liu: No, I think indeed at the time for us it was natural. But for people in that area it was not as obvious that when all this algorithmic techniques into design automation. It was the notion of complexity. For

example, when you go all the way back, I think in the '60s, there was a paper on maze router. It did the routing, maze routing. You never worry about the complexity as long as it works. And it works. It works well. And we need to partition it.

You just partition it. You were never worried about how much time it takes. So I think for me, that was a direction naturally for us to push. Maybe on one paper I wrote with a student of mine, Professor Martin [INAUDIBLE], on placement. Again, we brought in some rather simple-minded mathematical structures and placement tree. And that enabled us to indeed employ some interesting algorithmic techniques to obtain a good solution.

Fairbairn: So during this time when you were at MIT, and then Illinois, where you making regular trips back to Taiwan?

Liu: Yes. Well not really that regular. But once every year, once every two years, to attend a conference, to give a seminar, and so on. But now you mention that, I actually was once invited to the President's monthly meeting with all the government officials to give a talk on computing.

Fairbairn: So on your trips back you developed or maintained relationships with Tsing Hua or other universities?

Liu: Other universities. I mean, Tsing Hua was one of them. But it just happened, it just happened-- I mean, life is also always interesting. I had a year of sabbatical come up and I was so busy I never made any plan to choose a place to go. And it just happened at that time there were two professors at Tsing Hua who received their PhD at the University of Illinois Urbana- Champaign. And so they say, we have made all the arrangements, just come. So I went.

Now I went there for only half a year. Then I return to the University of Illinois Urbana- Champagne. And then two years later they were searching for a president. And again, I was fortunate enough-- I must say in all honesty, I had some very strong competitors. But somehow at the end of it, I was the search committee's choice. But also the other candidate's choice. And the job fell in my lap. And I never hesitated, never hesitated.

Fairbairn: And you had had some experience in administrative work as a vice provost, but you are convinced that that was the next step for you in terms of your career?

Liu: Yes. Yes. I mean, as I said, I never hesitated. When the job was offered to me, I said yes.

Fairbairn: So somewhere along here you got married and developed a family. How did that--

Liu: Not somewhere along the line. My wife was at the National Cheng Kung University. She was one year behind me. And so she immigrated to this country with her family, and of course we actually got married in 19-- when I was a graduate student.

Fairbairn: At MIT?

Liu: At MIT. And then later on she joined me. She studied for her PhD. So she also has a PhD in electrical engineering from MIT. And she probably is among the first, maybe, ten female PhD's from electrical engineering since the mid '50s. I cannot quite tell, but she was one of the first. And then of course we got married, and we have a daughter. And she was born in Cambridge. And she is studying medicine. She did her undergraduate at Harvard, and then did her PhD and MD at UC San Francisco. And is now a professor and clinician at UCSF.

Fairbairn: So she's local here. You get to see her while you're here.

Liu: That's right.

Fairbairn: That's good. That's good. So what did your wife think about going back to Taiwan?

Liu: My wife also is a very dedicated researcher in computer science. She and I were together at the University of Illinois as professors. When I returned to Taiwan as the President of Tsing Hua University, she was going to move to join me. And a friend of hers at Microsoft said, why don't you gain some experience at Microsoft first? So she spent several years at Microsoft. And so now we have an apartment in Seattle because of that. Then she indeed jointed me in Taiwan. And she is still now a full-time researcher.

Fairbairn: In Taiwan.

Liu: In Taiwan. In Academia Sinica, is Academy of Sciences and Humanities in Taiwan. So both of us keep a busy life. And she is very focused with her research in computer science. Her recent research activities is in the area of emergency management.

For me, on the other hand, I do a number of things. I continue to contribute in the education area, but more at the policy level. I serve on the board of a number of semiconductor companies, including Powerchip, UMC, MediaTek, Macronix, and so on. I also host a weekly show for the last nine years.

Every week I pick a topic that I like and talk about it. And the transcripts of the show were turned into books. I have now seven books.

Fairbairn: Now these-- I want to go back. But while we're on the radio show, give me some examples of the topics that you--

Liu: For the last two months I talk about Bitcoin, I talk about the Black-Scholes formula.

Fairbairn: About the what?

Liu: The Black-Scholes formula.

Fairbairn: Oh yeah.

Liu: Now I did it without a blackboard, assuming the background of the audience is high school students, engineers in a science park, or anybody. But on the other, I also talk about literature, poetry, some Chinese, some English.

And as I said, I rewrote the lyrics of all the songs in the musical Cats. Now I rewrote them in the form of some kind of poetry. Not lyrics that can be sung with the original music. So anything that comes to my mind that I'm interested in and I should learn about.

I mean, clearly I did not know much about all of this. But for example, Bitcoin. I looked at it from a computer science perspective. There's some very, very interesting ideas, very clever ideas, that were put together. Among them, of course, the notion of public key encryption is a very significant concept.

But on the other hand, for example, since you asked what I talk about, President Obama's inauguration speech, the first one. I essentially translated it. But again, when I say I translated it, I have license to rewrite some of the sentences. I did that. But when I talk about President Obama's speeches, I talk about Abraham Lincoln's speeches.

Now there's something I must say I did not know. I was told by a lady-- let me ask you that. What was considered to be President Lincoln's most famous speech?

Fairbairn: I think the most famous is probably the Gettysburg Address.

Liu: At least according to many historians, the best is his second inauguration speech. So I did not know that. I look it up. So I talk about that.

Fairbairn: Gettysburg Address is nice because it's so short.

Liu: It is 297 words. I think 10 sentences. So I talk about that. And again as I said, for me, I must say, it is really a learning experience. A learning experience. Now in order to learn about all these subjects, which I knew actually just rather superficially, what do I do? I remember MOOC.

So I look it up on YouTube and on many websites where there are lectures on these subjects. So that all came back to me when I have to learn something new. And then I make comparisons. How does Khan explain Bitcoin in the Khan Academy videos?

Fairbairn: I'm having trouble understanding-- be court? What?

Liu: Bitcoin. B-I-T-C-O-I-N.

Fairbairn: Bitcoin. OK.

Liu: Now for example, on my radio show I talk about Bitcoin. Bitcoin is a word that comes from bit and coin. Bit is a word that comes from binary digit. Binary digit to become Bitcoin was Professor John Tukey.

John Tukey was a famous statistician at Princeton University, spent time at Bell Labs. So Tukey was the first one who came up with the term bit. And was first used officially in a technical paper by Claude Shannon in his most famous paper on information theory. So after I talked about that, I said there is a natural pun that I can use. The term bit was coined by Professor Tukey. So I mean, I have a lot of fun, a lot of fun doing things like that.

Fairbairn: So we skipped over, you became president. How long were you president of the university?

Liu: Four years. 1998 to 2002.

Fairbairn: And what made you decide to quit? What was the--

Liu: They decided I should quit. In Taiwan there is a rule. Presidency cannot be renewed after one reaches 65.

Fairbairn: Oh I see.

Liu: I mean you must begin your tenure before 65. And in most cases one could be renewed for another term, but before 65. But on the other hand, it's always the case, maybe you can always look at that and see it in a positive way. Because I stepped down when I was still young, I had time to do all this in the last 10 years, over the last 10 years.

Oh, I forgot to mention one thing. For the last 10 years I actually spent quite a bit of time in Hong Kong and Macau because of my connections. For five years I worked for a charitable foundation in Hong Kong. I commuted to Hong Kong one day a week. And quite often leaving Taipei in the morning and coming home at night.

And after that now for the last seven or eight years I work as an advisor for a government-sponsored fund for the development of science and technology. And I go there once a week, or no I'm sorry, once a month for two days. And I spend most of my time in Taipei, of course. That's where my wife and I have our home base. But of course I also go to, I come to California often to see my daughter. I go to Japan and China for professional reasons.

Fairbairn: So one of the things you mentioned, that your students have gone on to do many things. And I know some of them have started companies or helped launch companies and so forth. Have you-- it strikes me that Taiwan has a strong entrepreneurial culture maybe similar to the US. Is that correct? And is that something that you try to encourage?

Liu: Yes or no. Now let me first of all point out that indeed, if you look at the Taiwan high tech industries, it was started about 35 to 40 years ago when Taiwan decided to go into the [INAUDIBLE] business. And then of course, the two major companies at this point, TSMC and UMC. And that's in one direction.

The other is in the PC area. Acer and ASUS and Quanta. Now actually, Foxconn started in the connector business and becomes very, very big. So in this sense Taiwan did, does, have a lot of entrepreneurial activities. Because we had to begin from ground zero.

But on the other hand, my observation is many of the companies in Taiwan who were successful initially did not go on to turn that it into something much, much bigger. And I think that one of the reasons is we do not have successful examples as Yahoo, Google, Facebook.

These entrepreneurs not only saw the direction, they saw the distant future. And they were willing to keep going before selling to bigger company, or turning away to do something else. And that's what Taiwan doesn't have, in a sense of big successful examples.

The second thing is, I think, at this moment Taiwan doesn't have as many examples of successful venture capitalists. And the two go hand-in-hand. Successful examples of start-ups and successful examples of venture capitalists.

Fairbairn: I was going to ask you about whether money was available.

Liu: Money is available. But on the other hand is the mentality. Now let me go away from Taiwan for one minute. I use a good example that's in Hong Kong. Because I actually served as the director of a small high tech company that was listed in the Hong Kong Stock Exchange. But very quickly, the stock did not do well. So the mother company decided to privatize the company and bring it back to Taiwan. And the company is doing extremely well. Now why is that?

Because in a place like Hong Kong, to wait for two or three years for a high tech company to be successful is too long. You can make a lot of money a lot faster by going into, for example, real estate. Now, that is not exactly the same case as in Taiwan. But as I said, for the venture capitalists in Taiwan, some of them do not have the appreciation of the way high tech companies develop. And some of them indeed consider that as too long a waiting period.

Fairbairn: So, switching topics here as we wrap things up in a little bit, you've explored many different areas through your career. If you were entering college now, what area do you find most interesting or the best opportunity? What would you--

Liu: You mean for myself, or for a young person?

Fairbairn: Well, for a young person. Whether yourself entering, I mean, putting yourself in that place.

Liu: I give you really--

Fairbairn: What do you recommend to those students?

Liu: I would recommend for myself, I would study mathematics and Chinese-English literature. That would be my choice, because I think I enjoy these and I think I can do well. Even at this point, when I was in high school and in college, I thought about a career in law and diplomacy. I do not know how good I will be as a really big manager.

Fairbairn: So but from a technical point of view, where do you think the most interesting or important technical challenges are? In a wide berth. If you were a professor and you want to go after the next big thing? What's your--

Liu: My answer actually is a simple one. From my own experience as an educator, it's the fundamentals. You know your fundamentals well. I mean for me, in a way, you said you have done so many things. In a way, I think I've done the same thing.

There's all the fundamentals that carry me from one area to another area. And of course, as I said earlier, when you talk about the fundamentals, it also is your training in the whole academic spectrum. People these days talk about college education. You should educate your students to become leaders, to be innovative, to be able to communicate with people. How do you do that?

My answer is very simple. You read. I've told people over and over again to read. And of course, for me I read a whole spectrum of things because I have the luxury that I can afford that. I mean, I don't have to face an examination. I don't have to face solving a particular technical problem.

But on the other hand, I think these days, when you look at education, in my opinion, it's really a bit shortsighted. You worry about examinations. You worry about being able to get into a top technology company. I remember, I remember, there is a very famous professor at Stanford, a good friend of mine.

Well what he said to the chairman of a company, if you want to hire someone who can work for you tomorrow, it is someone you will not want to keep 10 years from now. That really is really true. The ability to learn. I mean this is indeed cliche. But on the other hand, these days look at our educational systems. We do not emphasize enough the ability to learn, to create, on a long term basis.

Fairbairn: I agree with that. So in that context, what do you think is the appropriate role of computers and technology? We talked about computer-aided education. What is the appropriate role for computers and technology in general in the classroom, whether university or lower level?

Liu: I studied electrical engineering and I could also say this at MIT. What does electric engineering cover? Anything that uses electricity is electrical engineering, right? So anything that uses a computer is computer science and engineering. That indeed is the case.

The beauty of both of these disciplines which I happen to have experience in is it has a theoretical side, it has a fundamental side, it has an application~~al~~ side. And for computer science, it even has a much stronger humanities side. So they're all the same to me. They're all the same to me. So once you understand the fundamentals, they're all the same to me.

So sometimes as an old-timer, when people tell me a lot of these new things, they indeed are new. But the fundamentals are all the same. I mean, yes, without the new technology, many of the old ideas cannot be useful, or cannot be powerful. OK, but the old ideas were there. It's just a much, much better way to implement it.

And of course, in the process of implementing these old ideas, you came up with new ideas. That is the case. So, one cannot say it is deja vu all over again, but we have seen some of this. I mean, in a way computer science has a short history. We are fortunate. So we have to go back and look at what people have done, what achievements they have attained, and what misjudgements they have made.

Fairbairn: OK. Is there anything you'd like to add before we wrap things up here? What might I have missed?

Liu: I still remember, was it Joe DiMaggio when they bid him farewell in the Yankee Stadium? And he said, I am a very fortunate man.

Fairbairn: I think that was Lou Gehrig.

Liu: Lou Gehrig, I'm sorry, Lou Gehrig. Yes. I am a very fortunate man.

Fairbairn: And we all are.

Liu: Yes.

Fairbairn: To have lived through the last 50 years.

Liu: Yes. To see all of this happening, all these exciting things and so on.

Fairbairn: I feel the same way.

Liu: So I hope you and I will have a rematch in 10 years.

Fairbairn: That would be good. Thank you very much for taking the time to come down and spend the time with us.

Liu: Thank you so much. It was a joy.

END OF INTERVIEW

