INTERVIEWER: Today is September 13, 2011. I'm Chris Boebel. As part of the MIT150 Infinite History project, we're talking with professor Tom Leighton. Professor Leighton is a professor of applied mathematics at MIT. He has served as the head of the algorithms group in MIT's computer science and artificial intelligence lab since its inception in 1996. He holds a BS in engineering from Princeton University and a PhD in mathematics from MIT.

In 1998, Professor Leighton co-founded founded Akamai Technologies, the world's leading internet content delivery network. He currently serves as Akamai's chief scientist and is a member of its board of directors. Professor Leighton is a preeminent authority on algorithms for network applications and is published on cryptography, parallel architectures, and distributed computing, among other topics.

Professor Leighton is a fellow of the American Academy of Arts and Sciences, fellow of the Society for Industrial and Applied Mathematics, and a member of the National Academy of Engineering and National Academy of Sciences. Thanks very much for coming in to talk to us today.

LEIGHTON: Thank you. It's my pleasure.

INTERVIEWER: So let's start at the beginning, as it were. Tell me a little bit about where you grew up, how you grew up, your life as a as a kid.

LEIGHTON: I grew up in Arlington, Virginia, right near Washington, DC. My dad was in the Navy, worked in the nuclear power program, and then continued that work, working for Admiral Rickover as a civilian when he got out of the Navy.

My mom spent most of her time raising us kids and then became a librarian when they needed to get some extra cash to be able to afford college for myself and my brother. It was a nice environment for growing up. Parents cared a lot about us and a lot about our education. Made sure we had all the best opportunities they could afford for us.

Went to good schools. My high school, Washington-Lee High School, was a very good public school. That's before the days when they had Thomas Jefferson in the Alexandria area, which is now a magnet school for all the science and math talented kids.

And then went to Princeton for college. Majored in electrical engineering, computer science, and then found my way to MIT for graduate school in applied mathematics.

INTERVIEWER: So tell me a little bit about growing up as a kid. Were there moments that stand out in your memory as realizations that you had a particular aptitude for math or science?

LEIGHTON: I always just loved mathematics and really liked science. As far back as I can remember, there was no question that's what I wanted to do. I suppose when I was little enough, I wanted to be a train conductor. But once I got past that stage, I just wanted to do math, and science related to it. I didn't really know what that meant in terms of careers until much later. But it was very natural for me to evolve along the graduate student research track, become a postdoc, become a professor, because I just liked doing that stuff.

I had a lot of help as a kid, starting with my parents, of course, but also through organizations like science fairs, the then Westinghouse Science Talent Search, now the Intel Science Talent Search, the International Science and Engineering Fair, teachers that went out of their way to help, and actually people in industry that went out of their way to give me special access to large-scale computing back then. Of course, the computers back then fit in my wallet today. But it was a special to have access when I was a kid to the old UNIVAC machines or whatever.

And I was able to use the computing cycles to do research on number theory, which I enjoyed a lot as a kid. And that helped encourage me in the direction of mathematics and applied mathematics and computer science in later life.

INTERVIEWER: So when you were a senior, you were a finalist in the Westinghouse Talent Search, which I recall from my days in high school-- I think I went to high school before it was the Intel Talent Search-- was a pretty big deal. Tell me about that experience and how it shaped you.

LEIGHTON: It was a fantastic experience. You get to meet 40 other kids, or 39 other kids, with similar interests. It's where I met Eric Lander, who's probably somebody else you've interviewed here. In fact, that year Eric won first place, and I won second place. And of course, I've known Eric to this day.

I met other folks there, in fact, including one of my college roommates my first year at Princeton. And I know several of those folks today. We're still friends.

So it's a wonderful experience to get together with other kids who have similar interests in science and math and who really care about it. And so today, in fact, I'm now a trustee for SSP, which is the new version of Science Service, which used to run the Westinghouse Science Talent Search. And today, Science for the Society & the Public runs the Intel Science Search. So it's a chance to give back a little bit in thanks for the impact that they had on my life.

INTERVIEWER: I also wanted to follow up on something you mentioned, this sort of early exposure to computers and early programming experiences. Tell me a bit more about that. Where did that happen? What kinds of problems were you dealing with? I have a vague memory of this myself. Were these stacks of punch cards you were working with?

LEIGHTON: I am old enough to remember the paper tape, believe it or not, in my junior high school. And we were pretty fortunate to have any computer in junior high back then. And then it evolved into punch cards.

My science project then was looking at some very famous conjectures. The first is Goldbach's conjecture. And about 300 years ago, Goldbach conjectured that every even number is expressible as the sum of two prime numbers. A prime number being a number like 3 or 11 that has no factors other than itself or 1. So for example, 12 = 5 + 7.

And he conjectured that it was true for all even numbers, you could write them this way. And so I was trying to prove that. Now, I didn't realize then I had no chance of proving that, because a lot of serious mathematicians have been working on this for centuries. But I did computer studies that gave evidence to a theory of if you viewed numbers probabilistically, that the bigger the number gets, the more representations it has as the sum of two primes.

And if you argue that primes are somehow random, then you could make an argument that says, yeah, it should be true for all of them. That's not a proof, but it gives-- today I'm not even sure I would say it gives evidence that it's true, but back then I thought it did, as a high school student.

But doing the analysis involved programming with large computers back then to get this evidence that would back up the theory. The other problem was, again, a long, open question of number theory, which is that there's an infinite number of pairs of primes, p and p + 2, where p + 2 and p are both prime. They're called twin primes. And I was trying to give evidence for the fact that in fact there were an infinite number and that, in fact, for any arithmetic sequence of primes, either the pattern occurred once, or it would occur an infinite number of times, which was a new conjecture.

I'm not sure anybody really picked up on that conjecture, but it's something I worked on in high school. And it got me introduced to computers and what they could do. And I learned how to program. And that's where people in government and industry reached out to me and gave me access.

I remember a fellow named Carl Hammer who was the senior chief scientist at UNIVAC in Washington way back when. And because he was the chief scientist of a big computer company, he had special access to state-of-the-art equipment, and he lent me that access, which was wonderful. Here I am, 16 or 17, and I had access to the state-of-the-art computing back then.

INTERVIEWER: So what about the importance of those kinds of mentors or that kind of encouragement in encouraging your early career and, I guess, by extension other people's careers too? We'll talk later about your own work as a professor and a teacher.

LEIGHTON: I think mentors are incredibly important. They become role models. You want to become like them. You see career paths. And they help you. They encourage what you're doing, which, I think, is good for kids to be thinking about math and science problems and spending a lot of time working on them. I think that's really great. It helps launch them on a track as a researcher or as a scientist and mathematician.

And they tackle real problems more seriously later in life. And it can make a difference that way. So I think mentorship is very, very important.

INTERVIEWER: Were there other important mentors to you that we haven't talked about, maybe in your high school years or at Princeton before MIT?

LEIGHTON: Yeah, I think there's a series of people. I remember there was a teacher of graph theory at Princeton. And he just was a great teacher, and he had a love for the field. And it becomes infectious. And you just love working extra hard to show him what you can do and to be able to have a dialogue with him. So it's very motivational.

Here at MIT, there were some excellent professors-- good teachers, good advisers. And you want to become like them when you grow up. And that makes a big difference. It helps you evolve into the next level by seeing people that you have a lot of respect for and that are really good at what they do.

INTERVIEWER: So at Princeton, you majored in engineering. Tell me a bit about that, how that became your focus rather than mathematics or other directions you might have gone.

LEIGHTON: Well, a couple of things. First, I was afraid of real analysis. And if you were a math student, you had to take real analysis. Math at Princeton was a little scary. Pretty tough. And it was very pure. And my interests were more on the discrete side of mathematics, which MIT is great at, the world's best at.

They had their token discrete mathematician, who's the guy who I liked as my mentor at Princeton at that time. And I found that the kinds of things I liked best actually were done in the computer science or EECS department back then. And in fact, that's where I started learning about theoretical computer science-- algorithms, complexity theory. And you can almost think of it as a branch of discrete mathematics. It's in computer science, but the tools are all mathematics, and the kinds of problems are all discrete mathematics problems, combinatorial kinds of things.

And so I really gravitated there, and they had a very flexible policy. You could do pretty much whatever you wanted. And so I just ended up going there for my degree and ended up getting lots of graduate courses and just taking everything they had, because it was so much fun. It was really great stuff.

INTERVIEWER: And then you made the decision to come to MIT for graduate school. Tell me about that.

LEIGHTON: MIT is the best place in the world for discrete mathematics and the best place in the world for theoretical computer science, so it was a perfect fit. And when I chose between the two, I decided when I came to MIT to do the applied math track. So I didn't do math as an undergrad but did do as a graduate student.

Also, I had some encouragement from my father when I was an undergrad to go the engineering route. And somewhat joking, I think he felt that if you're doing mathematics, you'll never get a job. Engineering, well, that's okay. He himself, of course, was an engineer. I'm exaggerating a little bit.

But then, by the time I got to graduate school, at that point I'm doing research anyway, and it doesn't really matter anymore to me. I'm not thinking about getting a job. I'm thinking, okay, I'm going to be a professor. Well, that's a job, but it's not the same kind of job. And so let's do the applied math thing, because that's where folks like Danny Kleitman, Gary Miller, Len Adleman, Richard Stanley-- those guys were all in the math department.

And that was just a fantastic fit, because I could do everything. I could do the math I liked. I could do the computer science I liked in that department. It was very flexible. And I had a great time doing that.

INTERVIEWER: So what year roughly did you come to MIT, and what was the environment like at the time just generally on campus but also within your department?

LEIGHTON: I came in '78. I did notice when I came, there was tension in the department between within the applied math between the discrete side and the continuous side-- the guys that do partial differential equations and so forth. And this was relevant because we had to pass our oral exams. And the prior year, all the students on the discrete were failed. And being on the discrete side, that was of some concern. And I do remember that was a big issue, and there was a tension between the two sides of the department. Now, I think they since got beyond that.

I think things on campus, I don't really have any recollection one way or the other. It was a fun experience. It was good. I really liked it. I could do research. Great faculty. Good colleagues. That was long past all the stuff with kicking ROTC off campus and all those kinds of things. So the campus, I think, was very peaceful when I came.

The question was, are you going to win your intramural softball game this weekend? That was the extent of it, as I remember anyway. Maybe I was just oblivious.

INTERVIEWER: Is there a way of explaining for someone like me discrete versus continuous?

LEIGHTON: Continuous is calculus. You do an integral for discrete mathematics. You compute the area under a curve-- sorry, in continuous mathematics. In discrete mathematics, it's summing a series of numbers. What's the sum of 1 + 2 + 4 + 8 + 16? That kind of thing.

You have differential equations on the continuous side. On the discrete side, you have a recurrence, that the running time for the algorithm on an input of size n is twice the running time it takes for an input of half the size plus n more steps.

And the techniques really down deep, there's similarities, but the actual day to day is different from continuous mathematics and discrete mathematics. Counting things is discrete. How many ways are there to put five red balls and six green balls and pick from them-- that kind of thing is discrete. Continuous is complex analysis, real analysis, calculus, and stuff like that.

Proof methods are different. You use induction when you're doing discrete mathematics. You use different approaches when you're doing pure or continuous mathematics.

INTERVIEWER: And what is it about discrete mathematics that you found attractive and appealing, that kind of clicked with you?

LEIGHTON: I found I could get my arms around it better. The definition of discrete mathematics is it's dealing with numbers, things that are countable. Doesn't mean they can't be infinite, but they're very constrained in how they're infinite, like 1, 2, 3, 4, 5, 6 to infinity. That's very concrete, get your arms around.

Continuous mathematics, there's an uncountable number of points in the unit sphere. I found it conceptually more challenging to get my mind around it. I liked it. It was good, but I liked the discrete side much better.

Also, when you get into the applications, things like computer science and theoretical computer science, it's the discrete mathematics that matters. And so you can have a chance to have impact with your applications from discrete mathematics. Structures like graphs, points and lines, or points and edges that connect them, nodes, arcs to represent communication problems or network flow problems-- that's all in discrete mathematics.

INTERVIEWER: And what kind of problems really attracted you as a grad student? What kinds of things were you working on and really drove your interest?

LEIGHTON: I think they primarily revolved around graphs-- using networks to model things and proving facts about them. Some were just pure graph theory. And most came up in the context of a computer science problem of some kind.

Ultimately I wrote my thesis on problems-- the field then was called very-large-scale integration, or VLSI. And in practice, that referred to the design of tiny microprocessors on chips and how to lay out the transistors in the wires to fit as much as you can on the device. In my mathematical version of that world, it was all about taking a graph and embedding it in a grid in a way that was efficient somehow. And that's pure mathematics at that point. So that was sort of the focus, the sweet spot when I was a graduate student.

INTERVIEWER: And who were you working with, both in terms of faculty and even other grad students at that time? Who leaves an impression in your mind as being a particularly important influence?

LEIGHTON: Gary Miller was my adviser, and he was a great adviser. He was very giving, very unselfish. He would get me good problems to work on. He'd encourage me. He'd listen to me. He'd give me good ideas. He wouldn't even try to put his name on the paper. He wouldn't try to take credit in any way. He was just a really good guy. And that's a great role model. If you have nice parents, better chance you're going to be a nice parent yourself. So that was great.

Danny Kleitman, fantastic influence. Again, super guy. Really nice. Very smart. Great to talk to. Great problems. Very encouraging, supportive. Always putting the student first. So they were probably the two largest influences on me as a graduate student, and they were both in applied math.

Len Adleman comes to mind. I worked a little bit with Len. He left MIT pretty early on. He was a great teacher. And so that's the kind of thing you try to emulate on the teaching side of things.

He made material clear. He made it be interesting, made you want to think, wow, this is important. I want to work on this stuff.

And of course, you got guys like Ron Rivest. Very famous, doing huge things. Sort of a funny story. Today there's a thing called the RSA algorithm. It is used for the encryption on everything you do online. So very important thing.

Early on, it was very revolutionary. Nobody thought that, oh, that can't be a good idea to base an encryption protocol on the difficulty of factoring numbers. Before it even became public, when I was a undergrad, I was at the then National Bureau of Standards, now called NIST. And because of the Westinghouse Science Talent Search, I got a summer job there. And I was working with a mathematician there.

And the RSA paper was sent. The government got their hands on it, and they wanted to evaluate it. And so it went to the mathematicians at the National Bureau of Standards. And so my summer project was to evaluate the RSA algorithm. It's a little scary the government is relying on some undergrad in a summer job to do the evaluation, but it was really cool.

And then later, I come to MIT years later, and, wow, there's Ron Rivest. Pretty cool.

INTERVIEWER: Did you share your evaluation?

LEIGHTON: My evaluation was that I sure as heck didn't know how to break it, that it wasn't clear that anybody would know how to break it. But also there was no proof that it was unbreakable and that if we relied on it, people would try to figure out how to factor better and that this could cause a problem.

And in the end, people have learned how to factor better. And so instead of using hundred-digit keys they were doing back, now you got to use thousand-digit keys, because people have got better factoring algorithms. And still nobody knows how to break it, but there's still no proof that they won't figure out how.

INTERVIEWER: So it's just a matter of staying ahead?

LEIGHTON: Today? Yeah, that's right. But a lot of people have been thinking about it now, so factoring seems pretty tricky.

INTERVIEWER: So tell me a little bit about making the transition then to being on the faculty at MIT.

LEIGHTON: That means you've got to teach and you've got to get research grants. Now, I had, I would say, a very cushioned experience joining the faculty, because I got a postdoc first. And it was a two-year postdoc. And after the first year, I joined the faculty, but I had the postdoc, so it meant that I didn't have to teach, but I was on the faculty. So that gave me a breather to help adjust.

And then when I did start teaching, the field, the community at large, started getting pretty excited about the field I was working in-- large-scale networks and doing large-scale parallel computation and distributed computing. The area I had gravitated to became hot out there. And so I got to create a graduate course on that material.

So it was based on the field that I cared most about, and it took me a ton of time. I spent a week for every hour and a half of lecture. But it was very worthwhile for me, because it was my field of interest. And you never really learn something until you have to teach it, at least I find. So it gave me a chance to really learn even at a deeper level what was happening in my field.

And so a lot of good research came out of the fact that I was teaching this class. Students that were interested in doing research in this new field took the class, ended up doing research with me because I'm the teacher of that class and designing it. And so it became highly productive, as opposed to my teaching a class that's unrelated to my research interests that takes a lot of time to do a good job but doesn't provide any side benefit in my research program.

So it worked out very well for me. It helped boost and accelerate my research. And it worked out, I think, good for the students at the time and probably for, I think, the department, because now they get a new field being taught. And students are actively interested in it, and research is happening at MIT. So it was a very good experience moving into teaching and the faculty position at MIT.

INTERVIEWER: So you mentioned that your research topic became hot, which clearly is related to the rise of computer networks and the importance of computer networks and ultimately the internet. I was wondering if you could talk about that, especially the internet, and at what point the research you were doing sort of became of paramount importance to that.

LEIGHTON: Yeah, that's interesting. I'm a theoretician. I certainly was a full time theoretician before. And so the quality of my work was judged based on the depth of the mathematics and the perceived importance of the problem that's being solved, not based on its perceived applicability at all. I'm in a math department. I'm in a field of theoretical computer scientists. The conferences I go to are other people like me, and we're all mathematicians underneath the covers.

Now, the field itself talks about large-scale networks and doing things like routing communication problems on those networks, avoiding congestion. And so it's not a stretch to say, hey, this might be relevant to practice. And so the first brush with practice I think came with the advent of companies like Thinking Machines, which is sort of an MIT spin-out nearby here, that were actually building large-scale parallel computers and starting to use the ideas that were in these theory papers that we'd developed.

So a close colleague of mine, Charles Leiserson, actually spent a lot of time at Thinking Machines. I consulted there and taught courses there in the summer with him. But that started getting a brush with practice.

Unfortunately, Thinking Machines went broke, and the practical side of that field sort of faded away. There never really was a impact in practice, I would say, to the work in the '80s and early '90s.

Then the next brush came actually through encouragement from DARPA. DARPA was was, and probably in some sense still is, a big funder of research in computer science at the leading universities and at MIT. In fact, back in the early to mid '90s, it was probably 2/3 of the LCS research budget was DARPA.

And theoreticians always had a hard time getting research money, because we're doing math, and DARPA's interested in things-- they're out there. They like research, but they want things that are going to really be applied-- the guys building systems and stuff like that.

There was always encouragement in the lab for computer science for guys like me to at least look a little more practical so that you could get funded. So I'm doing work on very large-scale networks. People are waking up that the internet's an important thing. And gee, some of the stuff we're doing seems like it might be relevant.

And so I did take a step a little bit to the right and start thinking about, with the encouragement and support of guys like Tim Berners-Lee, who's the father of the web, to start thinking about problems directly in the context of the internet. Using the mathematics from the large-scale network work, how would you now tackle the problem of routing around congestion in the internet? How would you solve the problem of getting a hot piece of content or piece of news to millions or billions of people in a short amount of time?

And this is the kind of problem that was right up our alley in terms of expertise-- my group and the stuff we were doing. And well, boy, if we worked on that and made some progress, we might actually get funded. So we did. And we did get funded.

Now, we weren't really thinking that we're going to change the world at this point. That started happening two years after the research began. The research, we're still publishing in theoretical conferences. It's still being judged based on the mathematical depth of the work. But there's this thing at MIT called the 50K contest. And my lead graduate student on this stuff, Danny Lewin, had a next-door neighbor who was a Sloan student who knew about the 50K. And they were talking, and Danny's going broke, because he's got all these student loans, and he's a theoretician. And we didn't get paid that much, especially when you're a graduate student. Kids in private school. So Preetish talked to him about taking the work in his thesis and turning it into a business plan for the 50K competition.

And so then Danny talked me into engaging with them on it. And we thought it would be a good learning experience. And so we entered the 50K process, starting with the three of us and ultimately growing to 35 people.

And through that experience, we really got exposed to the real world. It's hard to imagine now, but I didn't know what a VC was. I didn't know it stood for venture capitalist, and even if I did, I wouldn't know what venture capitalists did. It seems shocking today. We learned.

But as part of the 50K process, we met VCs. We met industry pundits. We ended up talking to potential customers for our pretend business plan. And so we got exposed more to the real world, and we began to understand that wow, our technology really could work in practice and make a difference. And that was a first, a fundamental change. Because people who do mathematics and do theoretical computer science, that's a very rare outcome.

Now, over the history of the field, there's been huge advances in practice from work on theoretical computer science. It really is a vital field to the economy and to the industry. But a lot of the work takes a long time before it's relevant, if ever. And this was sort of an eye-opening experience for us to see that, wow, we might be able to do something in the real world.

INTERVIEWER: So I know that at one point, with the work that ultimately became Akamai or on which Akamai founded, at one point you had attempted to approach various ISPs, internet service providers, and interest them in the work and had kind of gotten the brush-off. Was this before or after the 50K experience?

LEIGHTON: This is during and at the end of the 50K experience. The original idea of our plan was to take our technology and, well, in the business plan, sell it to ISPs with the idea that they could get better performance for their subscribers and lower their cost.

Now, we actually went to go talk to some ISPs. We went to Coolidge Corner to talk to HarvardNet. We talked to several of the local ones, called up UUNET down in Reston. And we quickly learned that they had no interest in what we were talking about. They said, look I can get caching software for free. I got much bigger problems to worry about. I'm going broke. And distributed computing, everybody knows that doesn't work in the real world. That's an ivory tower concept. Please go back to your ivory tower and let me get back to saving the company. They're all up in flames. They're in the process of going broke.

That was not encouraging, so we modified our business plan over time. At the end of the 50K, we decided not to form a company. We were actually approached by some VCs that said, hey, look, you didn't win the contest, but we liked what you're doing. It's MIT. It's sexy. It's the internet. Let's go. Let's make a company, and in six months, we'll flip it. We're all going to go home rich. And again, showing you how naive we were, we said no. We didn't want to do that.

I liked being a professor. Danny wanted to become a professor at MIT. And he was smart enough to do that. The business plan had been fleshed out. And we didn't know anything about really starting a company. The 50K thing had been as a learning experience and for fun and a challenge.

We did keep thinking about it. We did have to decide about are we going to patent things or open source it? I remember having discussions with Tim and Michael Dertouzos, head of the lab, about that. As part of that, we talked about hey, can't we just get the companies to use the technology? Because we wanted it to be used. And even if we made it free, they didn't think it would work. They think they had other things for free that if they needed to go there, they could go there. And there just was no takers.

And so at the end of the day, we decided that this is our chance to make a difference with technology. It doesn't come along very often in what we do. And we'd modified our business plan, changed it around, so we felt it could work, changed it to selling to people with websites-- the big websites of the world. Talked to some of them, and they started expressing interest, which was better than we'd had before with the ISPs. And so we said, the only way we're going to do this is to do it ourselves, so let's give it a try.

So we spun out of MIT at the end of the summer of '98, a year after the 50K started and got offices over in One Kendall and then called up those VCs and said, hey, we could use some money. Turned out to be harder than we thought to actually get the money on terms we wanted, so we had a period of about three to four months where we were funding it ourselves with friends and with some angels, professional angels. We had friends of friends we knew to bridge us to the first round with the VCs.

INTERVIEWER: So stepping back for just one minute, what was the big idea behind what ultimately became Akamai? And why do you think there was so much resistance among those initial people, the ISPs that you approached? You mentioned sort of this ivory tower attitude that they had. But just expand on that a bit.

LEIGHTON: It's not one idea per se, but it's an approach. And the approach is mathematical and with depth in technology. And that's not the way any of those guys would approach it or even understand it.

I still remember-- it seems funny in retrospect. Today I'm a professional salesman. I go out, and I give talks to customers or at keynotes at major conferences and explain the future of the internet and stuff like this. Back then, we would go talk to people. I'd get out my deep technical slides on here's the proof that consistent hashing, our brilliant new algorithm, does all these great things. And I'd start giving them a proof, mathematical proof, to the VCs. They didn't have a clue what I was talking about. out But somehow they had some belief that we were going to do something good.

So it was based on deep technology. Not the deepest math ever done for sure, but in terms of this field, bringing some depth in mathematics to the field, that was different. It used distributed computing. It used algorithms. The algorithms were expressed as a function of n. n? What's n?

So it's just very different than the way they would think. They'd build something for size four and then build a new one for size eight. And here we're just thinking at a whole different level.

Ultimately it is that capability which made us be so successful, I think, in addition to getting really strong people who worked really hard. But having that technology, I think, made a real difference and still drives the company today. It allows us to give a lot better services than the dozens of competitors that have sprung up over the years. So I would say it's not so much one idea but a philosophy.

One person I remember-- actually a well-known person in the field-- said to us years later, the only reason we were successful is because we were too naive to know that what we were trying to do was impossible. Because we were naive, and we did things out of the box. And we weren't constrained by the thinking in the industry at the time. Because we weren't even practical people.

Here we are now building systems without a clue how you're supposed to do it. That means we made a lot of mistakes, but we also did things differently, because we were mathematicians building a large-scale system. And so we came at it from a very different angle, and that helped in some ways. Today, of course, we've evolved to the point where we have the world's best systems developers working with the mathematicians to develop our systems. You need both to really do it right.

So it was sort of a philosophy, almost a naivete that we did things differently. We had a very open mind about how to approach the problems. It used things like distributed computing, which really weren't used and practiced so much back then. And we didn't know even at what level to explain things to the ISPs. Me going in and giving some proof to the guy at the ISP, I laugh at that now. No wonder they wouldn't be interested. It was what we were doing.

INTERVIEWER: I also wanted to just ask a bit more about the 50K experience. I guess first of all, for people who might not know what the 50K is, maybe just provide a little bit of context. But also you mentioned you didn't win, and yet it was also a valuable experience. Just tell me a bit more about that.

LEIGHTON: Yeah, the 50K contest, it's now called the 100K because the prize money has been increased. It's run by students in the Sloan School. And you submit a business plan. Actually there's several rounds. The first round is more of an elevator pitch. It's a one-page thing.

But ultimately, as you go towards the later rounds, you flesh out a business plan and submit that. And they pick the ones they think are going to be the most successful, most likely to make money. And they use the money to fund the company.

Now, in our case, we had no intention at that time of forming a company. It's a pretend exercise. And we were a bunch of folks-- Danny Lewin in particular-- that when you enter a contest, you like to win. So we got books out of the library, how to write a business plan. We didn't let our lack of experience hold us back. And we competed hard.

And when we got to the final round, we saw the other finalists, and we just saw how much better they were than we were. They were very professional in their presentations, just a whole different level or two levels beyond where we were. And that was a great wake-up call, because we realized, wow, we don't know how to do it the way they do it, but we know we got to get to that level if we're ever going to be serious about it. So a slap in the face like that was good for us.

At the time, we decided not to form a company. But when we changed our minds later in the summer and did start the company, knowing what we were missing was very important. And knowing what we weren't good at yet was important. Because then we would either get better at it or go get people who were really good at it.

Now, in the case of the ultimate leadership of the company, both Danny and I decided that we weren't going to be the CEO. I told Danny, I'm the professor. He's the student. I told him I'd work for him if he wanted to be the CEO. I had tremendous respect for his capabilities. Tremendous leadership. Tremendous smarts. Driven guy.

But he didn't want to be CEO either, because he was smart enough to recognize that he wanted to go get somebody really, really good. And we did. We got two people who are really, really good. We got Paul Sagan, who started Road Runner, and then George Conrades, who was number two at IBM, had gone to BBN. Bunch of academics there. Converted them into a real company. Sold it to Genuity very successfully. And now is an entrepreneur in residence at a local VC.

So because of that experience, I think helped us understand where we needed other stuff, other people, or to improve ourselves. And we went out and got the best.

INTERVIEWER: So about a year after the 50k, you decided, okay, we're going to dive in and form a company. How did you manage to attract those kinds of people to something that was such an early startup, something that was the sort of getting bootstrapped? That would clearly seem to be a very early indicator of success. I'm just curious about how you did bootstrap it.

LEIGHTON: It was MIT. It was the internet. It was sexy. It was the bubble. We had a lot of things in our favor. We met some VCs through the 50K. We knew some people to start calling. We did research on who else to call. So the timing, the environment was great for that.

Now, we also had really smart people, not in the business necessarily, but at algorithms and computer science. And I think the VCs sensed that. I think they also sensed we were pretty clueless about business. But that's their job is to help people talented at something get the help on the business side they may need.

And I think they sensed that we were motivated and committed. We wanted to have the technology be used in practice. Once we made the decision to do it, we wanted to make it be successful. We wanted it to work. And I think that helped a lot.

Now, Battery Ventures, Todd Dagres was the lead for us there. He became convinced that it was a good investment for him to be engaged in. We had a second VC as his partner in the first round. And the very last minute, as the funds are supposed to be transferred-- we'd had the handshake, the signed term sheet, the deal all worked out, all ready for the final signature and the $4 million to get wired. That was happening at the Monday morning. On Sunday night, I get a call from the managing partner of the firm letting me know he's pulling out, because he just didn't think it was going to work.

And that was devastating for us, because we'd already said no to all the other consortia that we'd negotiated with. And we were scared to death that that could put Battery in the driver's seat to really screw us, because we really needed the money at that point.

And to their credit, Todd said, we'll go through with our share of the deal, same terms, and we'll help you find somebody to fill it out. Very important. You hear all these bad stories about VCs. That was great.

So they did help us, and we went and got Polaris to fill out the round, because George Conrades was there. And we made this list of people we'd like for CEO. He was the top of the list, of your fantasy list. And he was there. And we said, okay, look we'll take Polaris if you put George on our board. And then we got him on our board. And then we seduced him into being the CEO.

INTERVIEWER: This is probably a good time for me to ask sort of the larger question about this mind-bending transition from being a professor to being an entrepreneur, to sort of be dealing with all of these things-- VC funding, and first round, second round, finding a CEO. What did that feel like?

LEIGHTON: Totally different than you do in your normal life as a professor. There are some things that help you be a good professor, that help you be good doing this stuff. First, being in mathematics, you're able to analyze the terms of a deal. You're able to see things very quickly what's better for you and how to change it in a way that's good for you. And you're able to do those analysis.

In business, you're able to see and analyze the spreadsheet or the business case really quickly and spot holes in it very quickly and understand where the meat of the problem is. So the mathematics background I found to be very valuable. And what you do coming from as a professor of mathematics, you're on a par where in some cases, you're in a better position than the guy at the other side of the table who's been doing that for a long time. He's certainly got skills that I don't have, but I've got some background that enables me to be successful there. So I find that very useful in business.

In fact, a lot of the executives today at Akamai were mathematicians, including George Conrades was a mathematics undergrad. So I think that's a that's a good skill set to have.

Also, being a professor, you're a teacher. You speak at conferences. You're selling your research. You're trying to convince people what you spent a year doing is important and that they should care, or you're trying to teach people things in a classroom, and you're trying to motivate them to pay attention to what you're saying, because you're trying to help them learn. Those are useful skills in business on the sales side-- convincing a customer to buy this crazy new product you've made. It's different than convincing some colleagues that this theorem you proved is important, but not totally unrelated. And so there are some skill sets that carry over.

But the day to day is very different. The stresses are very different. You don't spend your time proving theorems. You spend your time figuring out how you're going to make ends meet in the company, who you're going to hire, how you're going to sell things, what products to design. So it really is a lot of difference there.

I love being a professor and doing basic research and working with students. Probably first love. Always will be. I think the challenges and the rewards are different on the real-world side. And there is a gratification from having the technical work be used by billions of people. And that's gratifying in a way being a mathematician, like wow, that's fun to be able to do that.

But it's a different kind of thing, and the challenges are different. You work harder in some senses. Staying up all night proving a theorem, nights on end, you don't feel tired or anything. Staying up all night, slogging through meetings or dealing with the bubble bursting and stuff-- oh, my god. That's brutal. So it's not fun. It's necessary in that world, but it's a different kind of thing.

INTERVIEWER: So how did you guys come up with the name Akamai?

LEIGHTON: Akamai is a Hawaiian word. And a friend of Danny-- he's in PR-- when we asked him, what should we name the company-- he's in PR, and we thought he'd give us a good name-- he said, pick a Hawaiian word, because I think Hawaiian words will be in as a name for companies.

So we got a Hawaiian-English dictionary, got 50 words on the board. Akamai means clever, intelligent, and in slang means cool in Hawaiian. They say very Akamai if they want to give you a compliment. And so we thought, that would be great name. We're going to pick Akamai.

We didn't know then the name actually had been taken, had been reserved. Akamai.net existed. It was an ISP in Hawaii. The guy who did the search for us wasn't very good and said, yeah, you can have it. So we just took it, and off we went. And later, we ended up buying akamai.net. The ISP in Hawaii actually was failing at that point, so it didn't cost us too much, but we had to go acquire the name later.

INTERVIEWER: I think I was absolutely convinced the first time I saw an Akamai sign or logo that it must be a west coast company coming to Cambridge.

LEIGHTON: Yeah. And a lot of people think it's Japanese also. It's actually very close to a pornographic word. I remember one day when somebody from the White House, actually from their operations-- we were doing stuff with them-- had gone to Akamai spelled wrong .net or something, and it was an adult site, which was a disaster for us. I forget if we ever bought the site or not to get rid of it, because it was so close. And type in wrong, whoa! Not good for the brand.

INTERVIEWER: So you found the company. You've got your first round of funding. And I know that sort of almost immediately, there must've been some very difficult times. You mentioned the bubble bursting. I know there were other terrible events that occurred very early in the company's history. Tell me a little bit about that time and how you got through it.

LEIGHTON: It was all go, go, go through '99 into 2000. And stock price is crazy, and the company's worth I think $36 billion, losing a fortune. We're hiring like mad. Almost no revenue. We had actually a problem with all the MIT undergrads. We gave them all stock in the company-- a lot of stock. And they were all zillionaires on paper. We had literally 19-year-olds worth zillions of dollars. And that created issues, because they didn't all know how to handle it.

Soon resolved, because then the bubble burst, and then we had a different problem. And the bubble starts bursting in 2000 and is really in free fall in 2001. And that's very hard, because the stock had been at 350 bucks, worth $35 billion. And it's, over a two-year period, cratering down to half a buck to the point where the market cap of the company and the equity value is far less than the debt. We had about $250 million in debt then. And cash is starting to run out, because we're not profitable. We're losing money hand over fist. So very painful.

We had to fire 2/3 of the company, had to riff them. And these were all our friends, friends of friends. That was very painful through a series of reductions. Most of our customers went broke in the bubble bursting. So we had to replace them with stable enterprises and the few stable web firms that existed then and government customers.

We had to upgrade our products at the same time to go to the next level to satisfy what real enterprises needed. So a lot of work had to be done there. And then of course, worst of all, Danny got killed on September 11. And he was driving force of the company, the guy who could do anything, and a great leader. And that was devastating when that happened.

So yeah, very dark days at the end of 2001. We got down to probably a couple quarters to live in terms of our cash. We'd taken on real estate, including most of Tech Square, at huge prices. And of course, instead of growing from 1,500 to 3,000 employees, we went from 1,500 to 500. So we had all this real estate under our long-term lease we didn't need.

So we fought through it. Everybody thought we were dead, literally. Everybody thought we were dead, that we were D-listed. And used that to get out of all the bad obligations we had, because we said, look, we'll give you a million bucks today, or you can fight it out in bankruptcy court in a month. And back then, people took the million bucks to write it off.

Everybody who was left worked just as hard as they did when we started the company, around the clock. People believed, from the leadership on down, that we were going to make it. We were going to be successful. We had a road out of the difficulties to be profitable. And we persevered and got through it.

Obviously losing Danny was horrendous, but his spirit is still with us today. And we had a really nice remembrance on Sunday. And well over 100 people came-- a lot of the folks from the early days and new employees. And this last year, we produced a film on Danny talking about his life from a little kid through his legacy that lives on today at Akamai. And it was very nice. We had the first airing of that on Sunday.

INTERVIEWER: So we were talking about the really dark times at the end of 2001 at Akamai. Tell me a bit about how you managed to recover, how you managed to get through that and sort of grow the company again, turn it into a flourishing concern.

LEIGHTON: We refused to die. We were very tenacious. We had great people. And that's really the key. Smart, hardworking, do whatever it takes to succeed. We had the right technology. The technology really does work, really did work. I guess we must have had some luck, because we were down to a couple of quarters of cash. But we managed to get the corner turned. Made a lot of hard decisions and painful decisions, especially when you fire 1,000 people.

To get the corner turned and then to grow-- because once you're profitable, now you can invest more back in the business and then grow from there. We've been on a very good track record since 2004, which really is when the corner was turned.

INTERVIEWER: I was going to ask when you think the corner was turned.

LEIGHTON: I'd say 2004. You start generating cash.

INTERVIEWER: So that's a fairly long period, several years, where you really were just kind of hanging on.

LEIGHTON: Oh, yeah, it was hard for a long time. Starting a company is not an easy thing. The bubble, that made certain things be really easy, and it was unnatural and good. Actually doing it took a lot of effort, and then surviving through all the tough times-- very hard.

INTERVIEWER: So tell me a bit about Akamai today. Where's the company at in terms of its reach, in terms of its size, its operations?

LEIGHTON: We just had a really very nice milestone. We earned a billion dollars in revenue last year, which is something that people thought would never be possible. I remember when-- Paul Sagan, who's our CEO, got up in front of the entire company when we were doing $200 million back in about 2005 or something and said, our goal is a billion dollars. And people thought, oh, just not possible. But they also didn't think it was possible for us to survive the bubble crashing, and we did. A lot of hard work. And now our challenge is to go from a billion dollars to $5 billion. And there are a bunch of new products and areas we want to do that with.

Today, in terms of the impact, we carry all the top media sites, all the top commerce sites. I think it's top 60 globally all use us. Top 30 global media sites use us. Nine of the top 10 global banks use us. All the major portals and web engine use us one way or another. They don't use us for everything. Some do, but they don't all use us for everything.

We service a trillion requests a day, which is really an enormous number. Everybody who uses the internet probably uses us, because of one of the sites we carry. There's 130,000 sites we carry, so pretty good chance you're going to visit one of those sites and use us. And we make the experience be a lot faster and more reliable than it would be without us, particularly for large events or the original motivation, which is you've got some hot content that a lot of people want at once. We make that possible now.

So the company's in a very good position. We earn, or generate, several hundred million dollars of cash a year. We actually have a lot of cash in the bank now. Over a billion dollars and rapidly rising. So we're in a very good position.

We've got great financial stability. We've got very good growth. We've got all the who's who of customers. And now we're looking to take the next step.

And part of that is, how do you maintain the intensity, the drive, the focus, the tenacity when you've got a billion dollars in the bank and you made a billion dollars last year and you got all the good name brands using you and you got 2,500 employees? How do you maintain the intensity and the focus? Because if you don't, somebody else is going to take that from you. That's just the way business works.

We had great ideas 10, 15 years ago. You got to keep generating those or somebody else's great ideas are going to take over. And that's our challenge today is how do you take the culture that you've always had and keep driving it as we get bigger, as we get global, and as we get comfier?

INTERVIEWER: Okay, so how do you do that? What's next for Akamai? You mentioned new products. To the extent that you can discuss that-- I don't know if any of it's--

LEIGHTON: We changed the organization of the company in the last year to instead of sort of one monolithic decision-making structure to sort of split it up into multiple product line decision-making structures in the hopes that they now can be more autonomous and build themselves into billion-dollar companies each. And by getting the decision-making more distributed, it becomes more entrepreneurial. You can get more done. You don't have a choke point at the top.

And we actually talk about the culture. In fact, we've done a lot of that just around September 11, because Danny personified the culture you're looking for, where you work like heck. You can move any mountain if you work as a team and you work smart and you keep at it. And the entrepreneurial attitude that, hey, you can do something totally different. It's okay to try things that are really different. And it's not the name brand of the person who said the idea that matters. It's the quality of the idea that matters, no matter who said it.

So it's something we talk about and try to encourage, but it's something you do worry about as you get bigger. Then you look at the really big companies today, and you see how slow some of them move. And you go, oh, my goodness. So we sometimes beat ourselves up for being slow and taking too long to do something, because it takes us longer now than it did when we were startup.

But then you look at the really big guys, and we say, well, we're faster than them. But we really want the advantages of both. You want to be as fast and nimble as a startup but have the market presence and the power of the big guys.

INTERVIEWER: So more than 10 years later, you're still very deeply involved in Akamai. To what extent is there kind of an original-- I don't know if DNA is the right term. Some people use that in describing companies. But to what extent is that kind of our original core vision that you say Danny personified-- to what extent is that still the driver in terms of people? Is it the same people?

LEIGHTON: We have a surprising number of the people there were at Akamai back in the very early days still there. We do 10th anniversary dinner parties, and lots of people are there. That's very good, I think. Of course there's a lot of new employees too, because we cut down to 500 during the dark days.

But I think the culture is still there. I'd like to see it be even stronger. I think we all would.

It's interesting. I see it sometimes in the remote offices. I go to Bangalore a lot, because we have a big office there. And the level of enthusiasm there and the spirit of hard work, it just reminds me of the early days here in Cambridge.

Or even in Hong Kong. We got five people there. And they're new. And they're led by somebody who just reminded me of just the first five employees at Akamai in the very early days. And they're now doing that in Hong Kong. And that makes you feel really good that you see it even in remote locations.

That said, you can never have enough, I think, of that spirit. So it is still there. And it's an MIT spirit. It's just like MIT. You can solve any problem if you work hard enough and you work as a team and you work smart. And that's MIT. That's the mentality here. And of course, the first 20 employees were all MIT folks. So it still has that kind of feel there, at least to me.

INTERVIEWER: So I got to visit the Akamai offices last spring when we met for the other interview. And I'm sure I'm not alone in saying that one of the most striking things, or the most striking thing, of course, was the big board that visualizes the Akamai network. And I'm wondering if you could describe that network in a little bit greater detail just in terms of-- I don't know if it's the number of servers, distribution, penetration. I mean, it's really quite remarkable to see it visualized like that.

LEIGHTON: We have 100,000 servers, or computers, in thousands of locations around the world. They're inside 1,000 different networks in about 750 cities in 70 countries. Basically, our strategy is to get our servers close to all the end users of the internet in the world so that no matter where an end user is and how they connect to the internet, they can get a fast connection to Akamai, and we can give them the content from our customers' sites quickly and reliably.

And we have a nice display tool we made several years ago that displays that, that shows a little point of light in all the cities where we have servers in a spinning globe. And then you can zoom in on the city and see all the locations in the city where we are and then zoom in on a location and see every single server and what it's doing. And if you took enough time, you could see all 100,000 servers and see what they're doing.

And that's pretty cool. And customers love to see that, because it makes it real for them. They can sort of see where their content is around the world. And that's very helpful to be able to visualize that.

INTERVIEWER: So you just mentioned how Akamai's kind of core values, or core ideas, relate very closely to MIT's core sort of values. And you have chosen to remain a professor at MIT despite the fact that you have a lot of other things going on in your life. I was wondering if you could talk about that and balancing academic work and helping run a company like Akamai and why you would choose to set things up that way.

LEIGHTON: Yeah, trying to do two jobs full time is a hard thing. Probably don't do it all that well. But I love the teaching, advising students, doing the research. Love MIT. It's a great environment. And so I don't want to not do that.

And I find the work I do at Akamai to be very compelling and useful. And it makes a difference. And I find there's synergy between the two.

I teach the core class in discrete math for computer scientists. So more or less, all the sophomores have to take this class. It's a class I designed before Akamai with Charles Leiserson. And now when I teach it, I can bring in so many more real-world examples that the students will recognize a bunch of them. And we explain how page rank works for a Google search, for example, to motivate stuff with random processes and markup chains and graph theory.

And bringing in the real world I think helps the students get the point that, hey, this math stuff matters, and I should pay attention and learn it. And I fervently believe that, as you could imagine, that it makes a huge difference.

And now they even, I think, believe me more when I get up there in front of them early in the term and tell them, this is important, and here's why. And I have some credibility because I went out there and started a company, and it's a company they probably have heard of and that they're using.

And so I think it helps my teaching. It informs my research. And of course, working here, I think, at MIT also helps with Akamai. There's a lot of MIT people who come to Akamai for either internships or for long-term employment. And having the bridge between the two I think is a very healthy thing.

It has to be done the right way, the connection between industry and academics, but I think done in the right way is really a great outcome as possible. And some universities have pulled that off very well. And I think this is an example where MIT and Akamai are doing very well at that.

INTERVIEWER: MIT certainly has a reputation for encouraging entrepreneurship among faculty, students, the community at large. Can you talk about that at all and to what extent that's had an influence on Akamai's founding and development?

LEIGHTON: Yeah, I think MIT is a very encouraging environment for entrepreneurship. And they have programs that facilitate that. The 50K is an example. The Deshpande Center is another one.

Without the 50K, Akamai would not exist, plain and simple. I had no clue about business and no desire to go into business. I just liked doing my research. And it's because of the 50K that we sort of got exposed, learned more, met potential customers, learned how to do the business plan, and got sort of propelled into that direction.

So when it came time to decide what to do, there were was now an option besides not doing it, because nobody else would take the technology and do anything with it. But there was an option that we felt that we could do it and be successful, and that's because of all the support infrastructure around the 50K process and because MIT is supportive of doing that. And MIT has been great for me personally in supporting that and finding ways to make it work, which has been fantastic.

INTERVIEWER: I want to shift gears a little bit and ask you a little bit about the future of the internet and the web. You mentioned that you spend some of your time prognosticating for Akamai customers about that. And you also have done a fair amount of policy work and consulting with the government on things like cyber security. So what do you see as the future of the web? It's hard to imagine how it could become even more ubiquitous and all-pervasive.

LEIGHTON: Sort of the way I look at it is, we probably don't have a clue, really. You think back 10 years ago. Would we have foreseen social networks, user-generated content, all the things that have happened? Back 10 years ago, we were predicting massive video over IP. We were a little ahead of our time in the predictions. I'm still predicting that. And this time maybe it'll be sooner.

But there's just so many things we haven't thought of yet. I think the internet really is in its infancy, even though it already seems so pervasive, just in terms of the functionality and the uses we'll find for it.

What you can see is that mobile devices are exploding, both in sheer numbers of them-- 5 billion now connected-- and in the types of them-- just all different types of devices, operating systems, video protocols. It's a whole wild frontier right now with stuff.

Video and entertainment-- all that's moving online. Today we're at about one percent to two percent maybe of video watching is done over internet protocol. But I think that'll be 25 percent before you know it. I don't know what the catalyst will be. I think a lot of people think now that it's going to be a good fraction of watching. That has big impact, especially as it comes high quality. Huge traffic increases. It's the kind of stuff that our approach, the distributed competing approach, is the only way that can happen, which was our original motivation for going in that direction.

You look at commerce and transactions done online-- growing rapidly. Already in Japan now I think it's close to 40 percent of transactions are done over IP. Way behind that here in the US, but the US will move that way. In parts of Asia, your phone is your credit card. And there's forces trying to prevent that here, but it probably eventually happens.

IP addresses has exploded. Now we got to go to IPv6. Probably take us 10 years to accomplish that transition.

Security is a huge issue. The bad guys are way ahead and getting farther ahead. That's a big problem, especially if you ever get close to hostilities with a nation state that uses cyber warfare. Just look in the last few months. You have a website owned by Rupert Murdoch putting out a story that he's dead. His own damn company, somebody hacked the site and managed to get past all the security and put that story online on his site.

Sony loses all their credit cards. And not to mention all the WikiLeaks stuff. Big-name sites being taken down. And not to mention the government and all the times that you worry they've gotten penetrated and real secrets taken. You have the Google scenario with the Chinese. Took everybody's email and Google's code. That's not good.

So security-wise, things are a mess. And that's a real problem that we have to get more serious about. It's something we're putting a lot of investment in at Akamai to stop a lot of that. But it goes broader than Akamai. It goes to the core. And we need more government research funding behind it and leadership there to address that.

INTERVIEWER: So it's obviously well known that the internet was founded on an open network, that a lot of this is because of its origins and the fact that there was always this idea that things should be open and that access should be easy. Can you talk about sort of that tension between the value of having an open network and how that has actually helped the internet grow and these issues that you're talking about that are so profoundly difficult?

LEIGHTON: There is perceived tension there. Being open is hugely important. That's what lets it grow, lets people invent whole new things on it. That's great.

But we do need security. And I don't think there has to be an either/or. And that's where research is needed to how do you get security protocols in place that don't violate personal freedoms and the openness of the internet, and how do you make it work? And I think there's no reason that can't be done. In fact, theoretical computer science has a big role to play there.

INTERVIEWER: This might be a good time to ask you to talk a bit about your current research interests. We've talked a lot about your role at Akamai and growing the company. What are your current research interests? And again, how do you see that research, that not necessarily pure mathematical research, but applied mathematical research being valuable in solving some of these problems or moving networks forward?

LEIGHTON: So sort of my interests sort of are split between academic research and Akamai, or industrial, research. On the Akamai industrial side, there's a lot of focus on optimizing cost, optimizing performance. And there are good mathematical problems there that I spend time thinking about. Not as much as I'd like. But there are nice challenges there.

And then on the academic side, work with a graduate student on problems that are more along the lines of what they're interested in. And that tends to be pure theory. Every once in a while, I'll one of the problems that we have on the commercial side, and you can make a nice graph theory problem out of it. And then it becomes of interest on the theoretical side. And so that does happen from time to time. But on the academic side, it tends to be more problems related to graph theory or game theory but from the academic interest perspective, not necessarily motivated by the internet or by Akamai.

INTERVIEWER: So do you feel that MIT has changed in significant ways in your time here, starting in 1978 as a grad student through the present?

LEIGHTON: I'd say MIT has always been the premier institution for technical education and technical research. And that has not wavered. They've always just been outstanding.

The only thing I think of, there was a period-- maybe it was in the mid '80s-- where it seemed like MIT did have a bit of an inferiority complex with Harvard. And the mantra was, why is it that the MIT grad is always working for the Harvard grad later in life? And somehow we got to fix that. Because the Harvard grad's the CEO. The MIT grad is the technical guy.

And so I think they actually did have a few years where they made an effort to admit the football captain or the class president with less regard for whether they knew calculus or their math SAT score. I'm just loosely phrasing that.

And there was a problem that we saw in the math department that we had a whole wave of kids coming in that weren't even close to understanding calculus and so special education had to be put in to warm them up so they could get into the normal MIT track. And then that stopped after a few years, it seemed like, and we got back to the normal pool of kids, who actually, in addition to being good technically, are good potential candidates for CEOs and other positions in business.

And I think in the field as a whole in the outside world, it's changed, in part because of all the stuff with the internet and high tech. And you see people come straight from technical backgrounds. And they just go start companies or lead companies. And they're not necessarily the normal mold anymore of the non-technical person doing it. But otherwise I'd say MIT has been very steady from my perspective and very high quality.

INTERVIEWER: So as someone who is an entrepreneur and a professor of mathematics, a mentor to current grad students, a consultant to government and industry, what is that balance between people with very deep technical backgrounds making policy decisions and people like politicians, a typical politician making policy decisions? How do you balance that? Maybe this is too vague a question, but what's the proper role of people with very deep technical understandings of these problems?

LEIGHTON: I'm a fan of having a good understanding of what you oversee. And there's a lot of philosophies about that. One end they say you don't have to have a clue what you're managing. It's more just you deal with the people, and you don't have to understand how it works or anything like that. I'm probably more on the other end of the spectrum that says the more you understand about what your people are doing and what you're managing, the better decisions you're going to make.

Now, in the case of a policy maker or somebody in government, probably they're not going to be deep technically, but it's probably important they have people they trust on their staffs that do get it and do understand it. And they'll be better off if they do. If the staff doesn't get it and you don't get it, there's a higher risk that you'll do something that may not be the best outcome, I think. So I'm probably biased towards the more you know or the more you can get access to through somebody you trust that is working for you that gets it, the better outcome you'll have.

INTERVIEWER: So having served on presidential commissions and consulted on cyber security and other topics, has that been a rewarding experience, or is it at times frustrating in terms of that get it, don't get it divide?

LEIGHTON: I wouldn't say it's rewarding. Because being in industry, you put work in. You do something. You make something happen. In government, it doesn't work the same way. It's different processes. In my case, I chaired a subcommittee. We wrote a report. And we were thanked and then fired.

And in fact, in that case, the folks in the government did very much not like the report we wrote. And I think they really didn't want it to be true what we were saying. In the case of cyber security, they didn't want it to be the case that we're vulnerable. And they didn't want to be the case that there's not a quick silver bullet to fix it, that it's going to take a long time to fix. It's going to take investment. And here's what we think needs to be done, and that if you don't do it, we're vulnerable. So it was not a message that is a good message.

And in government, there's politics, and you worry about the message a lot. We wrote the report and did our thing. I don't know if it really mattered, made a difference. I think there's 30 other reports now that say the same thing. That can be frustrating, I think, to do that.

That said, I still try to help, and I still try to make the case. And in some cases, it's not all government. There's a lot of very good people in government. And there's a lot of people who do get it and are trying. And so I do spend time trying to help them be successful in having a good outcome.

INTERVIEWER: It sounds like also those are the kinds of reports that come back to haunt politicians if and when something does happen.

LEIGHTON: I think they get buried.

INTERVIEWER: So in terms of both technical education and also this whole question of balancing a technical education with other kinds of things, other kinds of skills, MIT-- you mentioned this period in the '80s when they were trying to bring in a different pool of students. Since then, there have been many other initiatives to not so much bring in a different pool of students necessarily but open up the perspectives of students who are here for science and engineering or mathematics education into policy and sort of other considerations.

Do you think MIT's is doing a good job at that? Could it do a better job? Or more broadly, are there other things MIT should be doing in the world that it's not doing?

LEIGHTON: I'm not an expert on a lot of the new areas that MIT has opened up. Some of them I know about. Over the last 30 years, there's been computational biology and the Whitehead Institute and the Broad Institute. And there's a lot of activity in new areas where I think science and technology can have an enormous impact on society. And MIT has been a leader there, and that is fantastic. So there's been a lot of growth that way at MIT. And that's fantastic stuff.

I think MIT has also grown in supporting women and minorities. It's never enough, but I think they've made very good strides there in several departments. And that's a good thing. So you get a broader community engaged in the Institute, which is a very good thing. And you try to push back discrimination or old ideas that aren't helpful. And that's good. So MIT is growing and making progress and investing in new things. And that's good.