INTERVIEWER: It's Friday, August 28th, 2015. I'm Chris Boebel

and I'm here at MIT with Anant Agarwal. Anant is a pioneer in computer architecture and a professor of electrical engineering at MIT. He's also the founding CEO of edX. The online learning destination established in 2012 is a joint partnership by MIT and Harvard. Anant taught the very first edX course from MIT on circuits and electronics which drew 155,000 students from 162 countries.

He has also served as the director of CSAIL, the Computer Science and Artificial Intelligence Laboratory at MIT. Anant is also an entrepreneur. He has co-founded and led the development of a number of successful companies, including Tilera, Virtual Machine Works, and Oxygen.

Anant has received multiple recognitions for his teaching and research. He is a member of the National Academy of Engineering, a fellow of the American Academy of Arts and Sciences, and a fellow of the Association of Computer Machinery. He holds a Ph.D from Stanford University and a bachelor's degree from the Indian Institute of Technology at Madras.

So welcome, Anant. Thanks for coming today. Thanks for sitting down with us.

AGARWAL: Oh, thank you for having me.

INTERVIEWER: So in reading your biography, your life story, it's fascinating that there are these two threads that sort of come together, this sort of thread of education and an interest in education. And then, of course, electrical engineering and computer science. And I'm wondering about the origin story for that. Going way back to your earliest memories growing up in India, were they present from the beginning or is it something that you found your way to?

AGARWAL: Well, I found my way into electrical engineering and computer science quite late in life. I grew up in a small town in India on the Arabian sea coast, of the Western coast of India called Mangalore. It was a small port city. Yet, it's Mangalore. I like to joke that it's Bangalore with an M. Bangalore is a much bigger town.

I went to school there, to a public school. To a Jesuit school. And a there, I had the usual public school kind of education in India. And certainly, through high school, I really had not been exposed to electrical engineering or computer sciences. There were certainly no computers back then. This was in the early and mid '70s. There, funnily enough, my ambition was to become a fighter pilot in the Indian Air Force. And it turned out that at the end of your 10th grade, you have to take an exam called the NDA. It was a National Defense Academy exam. And I was all set to go do the exam and try to become a fighter pilot. And there I never heard of IIT. Mangalore was a small town and really, when I was in 10th grade, to my knowledge there had been nobody from Mangalore who'd gone to any of the IITs.

There I was inspired by my math teacher, JL Saldanha. So he was very inspirational and he exposed me to IIT, and he said, hey, look you should try to get into an IIT. I had not heard of IIT before, and then when I learned about it, it was-- it seemed completely unattainable. IIT accepted one in 100 students that applied. And just in comparison, MIT admits about one in 10 students that apply. So this was just extraordinarily out of my reach. And so I thought this was beyond the pale in terms of what was possible.

But he really inspired me to aim high. He would tutor me and help me. And he wouldn't take a penny for it. So he worked with me, asked me to come to his house, and taught me math. Or really help me bone up in math.

The standards of the school-- the school was good, but the public education standards and so on were pretty bad. And the IIT entrance exam was a completely different-- at a different level altogether. So I'm did quite a bit of studying, by the end of 10th standard, I had gotten-- I was getting more and more excited about the IIT.

What happened that year, was the NDA, the Defense Academy exam was changed from being after 10th grade to after 12th grade. And so I was pretty disappointed that I couldn't take the exam to be a fighter pilot. But fortunately for me, or unfortunately for me, I don't know, in the last two years, 11th and 12th standard, my interests shifted to electronics. And then I applied to IIT and I managed to get into IIT Madras. And so really that's how my interests changed, pretty much towards the end of my high school.

INTERVIEWER: Tell me a bit about your family, your parents. I mean, growing up in a small town like that, were they supportive of this dream that seemed unattainable, supportive of education in general?

AGARWAL: My parents were totally supportive. My father was a professor of pathology at the local medical college. It's called the Kasturba Medical College, KMC. My mother-- she had a masters in English, but she was a homemaker and she also started a business in our own home that enabled her to augment my father's income.

So we were a middle class family. There were very heavily into education and really inspired us to really get well-educated. I still remember the days when my father would come home, he would dictate 100 words, and I would have to spell them every single day. So they were certainly very involved in our learning and doing better.

So they were completely supportive. But it pretty much left us to do what we wanted to do. They didn't push us. They really had not heard of IIT themselves, and so it was really up to me to aspire to what I wanted to do and become.

And what was interesting, is even after I got into an IIT, which is Indian Institute of Technology, I remember one day my father was-- as you know, parents like to brag about their kids. My father was bragging to a local-- another friend that oh, our son is going to be going to IIT. And they were quite surprised. They said, whoa, you mean he could not get into the local engineering college. Is that why he's going far away?

And so, in Mangalore, you aspired to go to the local engineering college. And so, they thought I was going there, because I did not quite make the cut to go to the local college. So it was pretty interesting how the whole local feel, certainly in the early to mid '70s was just a completely different culture from where things are likely to be today.

INTERVIEWER: And it's interesting that you say your parents, obviously, were very focused on education, very focused on doing well, but not necessarily pushing you in any direction, not necessarily laying out for you the path that you ended up taking.

AGARWAL: Yeah, our parents did not lay down the path at all, whatsoever. They didn't have a strong feeling one way or the other. They didn't push us. They pretty much gave us space.

And it could be that the times were different. Where we had our space. We enjoyed a lot. Really, our school did not give us any homework. I did not do any homework at home. I would come back and spend my time playing and having fun.

And once I got into a building things, I would do a lot of building fun gizmos and gadgets and so on. But really, there was no organized activity as such outside of school. And our parents did not push us or did not suggest any paths that we go down. They were simply supportive of whatever we want to do. It doesn't help that I was doing quite well in school, and so they didn't feel the need to ask me to work harder or-- they just pretty much let us be.

INTERVIEWER: You mentioned that it was really in high school that you became interested in electronics and building gizmos and gadgets. Are there any strong memories that you have of what sparked that interest or how that came about? Because that seems like a major shift in your life you know. Talk a bit about how that happened?

AGARWAL: You went through middle school and high school and I would be puttering around and building various things. And now that I look back, I like to build things. But it never occurred to me there was a career there. I had wanted to be a fighter pilot all the way growing up, for whatever reason.

And so, I do remember that in sixth grade, an uncle visited me and he gave me a kit. And the kit contained a power supply, contained some copper wire. It contained some magnets. And you could play around with it. And so I remember I tried to build a motor for an electrical motor for one year, and I could never quite do it.

And I finally figured out how to get the things right. There was no web to look up things. And I would go to one of the teachers in my middle school and ask them, how do you do? And of course, nobody had any idea. We learned science in school, of course, but-- so I would putter around and be building various things.

I also remember creating an explosion once. I took a whole bunch of matchstick heads and I made a hole in the mango tree in our backyard, and I filled it up with the powder from the heads of matchsticks. I took a big nail, and I anchored the nail in the hole. And then I took a hammer and whacked it in and there was an explosion. And so I would do stupid things like that, not quite knowing what I was doing.

So I did have fun building things like this, but really I wasn't thinking of it as something that was a precursor to a career or any such thing.

INTERVIEWER: So you applied to the Indian Institute of Technology, IIT, and you've got in. And obviously it you know, it has a phenomenal global reputation. Talk about that experience, making that transition, and what it was like getting an undergraduate education there.

AGAWARL: So the transition to IIT was actually very scary for me. Because when I went to school, I did very well in school and everything was very easy. In fact, frankly, way too easy. I really did not find a need to study or do any homework. The standards were just not great. The teachers were good but the standards were just not-- I would say-- up to a world-class standards in math or physics and in other subjects.

I somehow managed to sneak into an IIT, IIT Madras. And there, I still remember, physics was taught-- physics was calculus-based. And they expected you to know calculus as it applied to physics, and I had no clue what was going on. And so in the first mid-term, I remember there were about 200 students in the freshman-- 200 or 300 students in the freshman class taking physics. And in the first mid-term, two students failed. And I was one of them.

And so that was very scary time for me. I go there from a small town background not having learned calculus-based physics and so on. So today, when students come into MIT, they've all taken advanced placement calculus and BC Calc in high school and they have learned advance physics based on AP physics. I went in there-- had not applied. I knew a little bit of calculus, but I hadn't applied it to physics. And so I was one of two that failed. And it was a very harrowing experience when I wondered, what the hell am I doing. What the heck am I doing in this place?

But I worked up-- worked real hard to catch up. And eventually, things got better as I managed to catch up and learn that, oh, the way you solve the problem is by applying calculus. And here I was, trying to discover calculus in the midterm exam by trying to subtract the velocities at different times, and tried to use the deltas in the velocities to compute what they were asking for. I had no idea how to do it. When a simple derivative would have given me what I needed.

So fortunately, I caught up. Being with all the other students was phenomenal. Just the whole group of students, they've all become close friends for life. It was frankly, the best five years of my life may have been my five years at IIT. Where all the students were not just bright, but also interested in all kinds of things.

One of my friends was the national chess champion. And another friend who was a national swimmer. There was another student who could solve the Times crossword puzzles in five minutes or less. Everybody was amazing at a variety of things, public speakers, drama, games, sports, really good at a number of things. So it wasn't just about work and study.

And we learned a lot from each other and people helped each other. It was just a remarkable, a very remarkable experience as we grew up and learned with a group a phenomenal students. At IIT, if you looked at the teaching and so on, research-- I just tended not to be, and still don't tend to be a very heavy research oriented place that focuses more on undergraduate education and some on graduate education.

And as you might imagine, the quality of the teaching was-- there were great teachers and there were some not-so-good teachers. But really the group of students that went through it together were a absolutely amazing in how we learned from each other and provided support. And they've all become dear friends for life.

And what is interesting is that even today, in Silicon Valley, there have been book after book written that talk about how this diaspora from IITs were one significant aspect of the whole startup culture. There are studies that showed that a significant fraction of startups in California had at least one IIT founder in them.

INTERVIEWER: So during your time at IIT, what were the subjects they drew your interest? How did those interests develop over your undergraduate career? And talk about how that led you to the work that you started out doing once you came to the US.

AGARWAL: Sure. In India, interestingly enough, you're admitted into college, whether it's a regional college or an IIT based on merit. Pure and simple. It's just based on your-- at regional college it's based on your grades, politics, physics, chemistry, and math into engineering.

And IIT, it's an entrance exam. And they just rank you from one. In my year, I think a couple hundred thousand students took the exam and the top 2000 made it into an IIT. And they rank you from 1 to 2000. And you can just pick your subject based on your rank.

And so for me, about that time, I had wanted to do electronics. There was really no computer science at that time. Electronics was the most popular field and also the most sought after. And so they went by your grade in the entrance exam and I didn't quite make the cut for electronics at IIT Madras. But I made a second cut which would give me mechanical engineering.

But I really wanted to do electrical engineering, and it turned out that at the end of the first year and if you were among the top what, two or three students in your entire class, they would let you-- it was sort of like a wild card. You had this wild card opportunity and they let you switch to any branch that you liked, and so I was lucky enough to win the wild card slot, and as part of that, I switched from mechanical to electronics. And I started in electronics following that.

And even there, in electronics-- the teachers in electronics, the Professor Rao and Professor Reddy were exceptional. Two of the best teachers of circuits and electronics I have ever seen in my life. The pair had even invented a new op app. It was called the Rao and Reddy op app. Great teachers. So I learned a lot from them and I got more excited about electronics.

I did a little bit of computer science on the side in my freshman year at IIT. There was this computer center with this big IBM mainframe. And I did learn to program with punch cards. We used punch cards and I did some programs. I remember my first program was computing the value e using a series calculation.

We were doing small programs with punch cards. We really did not get into computers, but certainly I was doing my IIT study in electronics.

INTERVIEWER: So that was your first introduction to computers at IIT? You had not worked with computers before that? Or what was your awareness of computing and electrical engineering up to that point?

AGARWAL: My awareness of computing was certainly zero. To me, my first notion of a computer was in my first year at IIT and where I used punch cards to program e on the mainframe. Where you turned in your deck and you got the results back the next day. That was my first, absolutely first introduction to a computer. I had not heard of computers before. I may have known what a computer was, but really, it wasn't something that was even on my radar screen, so to speak.

Electrical engineering-- I had built small little gizmos like motors and had built small, started to create the various gadgets. Invent funky stuff and so on. Using electrical stuff and so I knew some electrical stuff.

But I really had no experience with the electronics. I had never used or never heard of a transistor, as such. I just knew about electrical stuff, so anything I did was with magnets and wire. I would build things like speakers and so on and so forth. But really no, absolutely no, connection to electronics at that time.

INTERVIEWER: So I suspect that soon we'll be talking about teaching styles, methodologies of effectiveness of teaching. Tell me a little bit about the teaching style that was prevalent at IIT at the time you were there. You mentioned having a couple of amazing professors. What was the predominant style of teaching and what was your thinking at the time about whether or not it was effective?

AGARWAL: So teaching style-- whether it was in my relatively modest high school in Mangalore or the teaching style at IIT or for that matter the teaching style at MIT-- was identical. There's really no difference in teaching style. So as an example, in IIT, we had a smaller group of students. So in electronics, the entire class of electronics was 30 students. So our classes had 30 students in them and that's it for the entire year. For that year, there were 30 students.

And so we had desks in the class and we sat down. Each of us had a little desk with a place to put our books. The teacher would lecture on a blackboard and we did not get homeworks as such, because there was no concept of the teaching assistants. The professors would lecture and we would take notes. And that's it.

Each semester-- it was a semester system-- we had three exams and one final exam. And so, the three quizzes, if you will, were offered at three times in the year. And before each quiz, they would give you a what they call a tutorial sheet. And the tutorial sheet had a set of problems. There were no solutions given. They were not graded. And you would just practice. And then you would go and take the exam.

So that was a teaching style very much like MIT with the exception that at MIT we give our students weekly homeworks. And we have a lot more resources to hire teaching assistants where the teaching assistants and graders grade the homeworks, which is very expensive and give it back to students. And IITs-- we did not have that.

So we did not have at least, when I was there in the late '70s, there was no homework. There was no concept of homework. So we would just prepare for exams and go in and take the exams and get graded. And there were labs, weekly labs in certain subjects. But otherwise, the teaching style was virtually identical. The professor would stand in front of the class and they would lecture to the students and write on a blackboard. That was the predominant major teaching part.

There's no one on one tutorials. There was not-- didn't have the small group tutorials. No grading of homeworks. Nothing. Just the teaching was a professor lectured to the students.

That was the majority of teaching, which frankly, is the way I learned in high school since I went to first year of my high school, first year of my schooling in 1964 or 1965 and that's the system I had there. We all sat in front of the teacher in neat little rows, and t the teacher would lecture at us and wrote things on the board. Same thing at IIT and the same thing at MIT for most of my 27-year career today in the mid 2015 at MIT.

INTERVIEWER: So a while ago, you mentioned the diaspora from my IIT. And I was wondering if you could talk about your own decision to come to the United States to attend Stanford for graduate school. How did that come about? What was your thinking at the time? I'm not sure if you were familiar with the US or if you had traveled in the US up to that point, but tell us the story.

AGARWAL: So in those days, IIT was a five-year program. I remember there was a debate about whether IITs were going to go to a four-year program. And a lot of the people felt that if would be a disaster if it went from five years to four years. So it was a fire-year program.

So by the end-- the middle to the end of the fourth year-- we have to make a decision about what do we do after IIT. And from IIT, there's a significant fraction of the students would go abroad for higher studies, for a master's and a PhD. And so I decided that I wanted to pursue a career in research. I had not decided that I wanted to teach, but I wanted to pursue a career in research, for which you needed to get a PhD. So I applied to a number of schools around the world and I was lucky enough to get into Stanford.

It is interesting that the one school that has turned me down at every step has been Berkeley. I love Berkeley, but I applied to Berkeley. They turned me down then. I applied to Berkeley for a faculty position. They turned me down again. And so I've had a string of turn-downs from Berkeley in my career, interestingly enough, but I got into Stanford. And there, I started in electrical engineering at Stanford, not in computation.

INTERVIEWER: So had you had much experience with the US? Was this a big life changing decision, obviously, to come here? And once you were here, tell me a bit about the experience of studying at Stanford in California-- in what was not yet Silicon Valley, but that was the moment when it was all emerging, right?

AGARWAL: Right, so I flew to Stanford from India in 1982. And a lot of firsts for me. I had never been out of the country before, so it was the first time out of the country. And in fact, it was my second time I was flying, even. In my fourth year, I had managed to publish a paper at the International Conference on the acoustic speech and signal processing on a speech recognition system for Hindi digits. And I did at that point, aboard my first plane ride flying from India to Paris.

But this was my second time flying on a plane and went to Stanford. And first time living out of the country. Fortunately, I knew-- I mean, I spoke English and at IIT, we used US textbooks and so on. And certainly the level of the IIT education, the rigor and so on, was certainly compatible to the rigor of engineering education in the US. It's just that we did not have homeworks, which was quite interesting. So it's not clear how much we learned, but it was rigorous, nonetheless.

And so when I came to Stanford, I began taking graduate level courses. The transition was pretty straightforward. I worked with Professor Thomas Kailath, who was a research assistant for him in the field of information and decision systems. I switched fields over time, but that's where I started.

INTERVIEWER: It must have been exciting to come down in that area at that time. I mean, that was again the computer PC revolution had begun, but it was still really kind of just beginning in the early 1980s and Stanford was right in the middle of it What was the environment like? And what was the interest that drew you and how did that interest evolve while you were at Stanford?

AGARWAL: Those were really exciting times. I took a class on VLSI, so in fact, chip design and chips. But really, what built Silicon Valley? It's not Software Valley. It's Silicon Valley. And so the chips and silicon was what really propelled it.

And to some of the pioneers in Silicon at Stanford at that time, some of the first design tools we're built at Stanford at that time. MIT had also been building a few things. Chris Terman at MIT had built a simulator. And there were other people at MIT as well, but certainly Stanford was one of the leaders in the field and I was able to work with some of the people building the first CAD tools for chip design, the people doing pioneering work in devices and so on at Stanford.

So it was really exciting being exposed to real leaders in the field. And at Stanford, as I took a VLSI class, I got really excited. I think for the first time in my life, I got really, really excited about a field. And so then I asked around, hey, I'd like to work, do my thesis and build a career in chip design.

And it turned out that two of the professors, Newkirk and Matthews, who I liked a lot and whose class I took, they were going to be leaving Stanford, unfortunately. And so I asked around to say, OK who else could I work with on to the systems level part of chip design, not the device physics part, but the system level design of chips.

And turned out that I was seeking a professor. One professor told me, there's this new professor in this building. He couldn't quite recall his name, and then he said, oh yeah, it's John Hennessy. And he's just joined Stanford. He's doing something with computers and so on and something with a chip. Why don't you go talk to him ?

I walked into John Hennessy's office. And he'd been at Stanford-- he didn't have tenure at that point-- for maybe four years. And I asked him up if I could be-- join his group and being on RA for his group. So he interviewed me and then he gave me an RA and he asked me to build-- So his group had been building the MIPS chip. The MIPS chip became a revolutionary concept.

And he asked me to build the MIPS computer. And so this was my first hardware project, and as part of the group, I built the MIPS computer, which actually were the first MIPS computer. This computer still hangs outside my wall.

And those were incredible days. And we didn't realize that they were doing and using systems that were the first of their kind in the world. So, for example, in the hardware lab at Stanford, I used a multibus card cage. And it was a card cage into which I prototyped, I built a multibus card in which I prototyped the MIPS computer. And what is really interesting was, someone later told me that out of the same card cage, that one of the early founders of Sun had prototyped one of the very early Sun systems before he went out to become one of the early founders of Sun.

And so it was curious we happened to be using the same system. And what I ended up building was actually the first MIPS computer. RISC and MIPS became household names after that, but certainly in those days it was certainly not a household name and a lot of the things we were building were things that would become very well known later.

INTERVIEWER: What was it that first excited you about chip design? I mean, of all of the research issues you could have taken on, of all the directions your research career could have gone, was there something that really spoke to you about that particular subject and that particular challenge?

AGARWAL: I think what excited me was before that, I was an analog guy. I would do differential equations. I would build up circuits for 405 transistors, and do math on paper and do math with matrices and very analog mathematics. And I could do small things. The hard-to-make things work. I built a filter, it took forever to make the filter work and noise-- it was really painstaking.

When I was exposed to digital design and VLSI systems, it completely blew my mind that you could build these little chips with-- in those days, thousands of transistors, even tens of thousands of transistors-- and you could build very complicated systems. And it's very easy. It's unbelievable how easy it was to do it, whereby following and adhering to some principles, you could build very complicated systems with using tools and digital technology where the chips would have a power and performance that was completely, absolutely unimaginable in the analog space. It completely blew my mind, because I came from the analog space.

And so that's when I said, I want to be building these things. I want to be building these chips and I certainly felt that they were going to change the world. And so, that's why I got into it where things that mere humans could put together could have such incredible potency and impact.

INTERVIEWER: So we've been talking about the origins of your research career. What about an interest in teaching? How did that develop? When did it develop? You said, you came to graduate school really thinking you were training to be a researcher, but clearly your interest expanded at some point.

AGARWAL: My life itself-- I sort of took things as they came at me, and things up just changed over time. At Stanford, I was a research assistant all the five years I was there. I didn't teach ever. I never taught that class ever. I did enjoy public speaking and I did enjoy explaining things to people. And even at IIT when I would explain something to somebody else, I thought I was pretty good at explaining things and mentoring people and helping them understand things.

And so, I certainly liked that aspect, but I hadn't thought of class as such. So when I finished my PhD, at that point, I had to make a decision as to whether to go into a teaching career or a research career. And by which point I felt that I wanted to go into a professorial carrier.

Because as a professor, I felt I could do a number of things. I could start startup companies. I could do research. I could teach. I would have resources to do things. And so I felt that if I went into a teaching career, I could be able to do all of the above.

And that's when I applied for a professorship at a number of universities and as I mentioned earlier, Berkeley turned me down. They turned me down as a graduate student as well. So then I applied to a number of schools and I was fortunate enough to get an offer from MIT.

And I really hadn't known much of what MIT was doing in building computers. Certainly from where I was at Stanford, a lot of the work and the energy seem to be coming out of Berkeley and Stanford. And so when I came here, I was up very pleasantly surprised and excited by the cool work that was happening here the work that Steve Ward was doing and the way he thought about things. And Arvind was doing some of his work.

And so what I discovered was at MIT, the thinking was very different and very far out. And I thought this was the place to be. But all of these times I was still very research-focused. I mean, teaching was-- I still wasn't thinking about jobs and so on, as teaching jobs. So really, I was coming here for research and working with students and working with colleagues and others on building cool things and inventing new stuff.

Teaching was something you did, certainly for me at that time. I still remember, when I had to teach my first class, and it's still this way in all our universities. I was told, OK, you're teaching this class. You go teach it. And we don't give people any training, anything, and of course, you do what everyone's been doing forever. And so, I went to my class and I stood there, and for the first time, I felt like a deer in front of headlights.

And it was pretty scary. Here I am in front of MIT students, MIT undergraduate students, you know, creme de la creme, bright kids, and so on. And here I am. It was pretty scary as you teach in front of the students. But you build up confidence over time. But certainly I felt like a deer in front of headlights. I had never taught before. I had never formerly been trained in teaching.

And certainly I would be petrified if somebody had recorded my first years of teaching to my later years of teaching. And I'm sure I learned on the job, but it's not clear. And I certainly saw my ratings go up over time, so I knew I must have been learning the job.

But even there, teaching was never considered the main thing that you did. It was mainly the research. And education and teaching itself as a primary focus of what I did certainly came to me a lot later.

INTERVIEWER: Yeah, I would like to get back to your research in a moment, but I'm curious about just following up on the teaching. I mean, you've won every teaching award under the sun at this point. So how does that develop? Going from someone just saying, go teach. no training and being stuck in that moment, to really developing quite, presumably, a love for it and also certainly, a lot of talent for it. Were there key moments in that journey?

AGARWAL: So there, I think it wasn't studied or it wasn't something that I thought too deeply about. But I found I enjoyed teaching. I didn't enjoy certain parts of teaching like preparing for the lecture or integrating. There were certainly some aspects that were painful, but I really enjoyed the act of teaching where you stood in front of a class and you give a lecture.

And the part that really enjoyed the most was where they would ask you questions and so on. And you answered questions. I find I really, really enjoyed that.

And I think the key was the realization that-- I began to say that teaching is theater. Teaching is theater and to really view it as-- to really give a lot of importance to it, to really be passionate about it, to care deeply about your audience and your students, and you'll do fine. And not to overthink it, but be more organized and really view it like theater.

So as an example, in the very first year that I taught, I would simply go in cold and I would write on the whiteboard. But in my later years, when I was lecturing a big class, I would actually orchestrate how many white boards of material I would write. I wouldn't even plan in my own mind which part of the whiteboard I would write different things.

And so I would plan things, so we used to have sliding blackboards in the 10-250 class or one of the other classes. And I would keep even the layout of the blackboards in mind and I would design my writing on the whiteboards, so that it would be easier for students to comprehend.

The goal was to take out any overhead that was unnecessary. Any unnecessary complexity introduced by the geometry of the boards, and so I would draw pictures on one side and make sure that it would be easy to refer to another board and I would stop and I would make sure that the board was well laid out.

So I would really practice in my own mind as I went through, not the material as such, but how things would lay out. So really, this is almost like choreographing a play, where the way-- you wouldn't even think in my own mind, where would I stand when I said certain things? How would I--

I would have demonstrations. Frankly, I spent the most amount of effort on the demos in 6.002. I think we had some spectacular demos. There's one demo-- it's on YouTube. It's very popular on YouTube involving a chain saw dance that my TA and I did. And the MIT video team they recorded it, and we would dance to Men In Black with chainsaws.

And the main thing was to make teaching fun. And my philosophy is that if you're passionate about it, if you view it as theater, and if you could excite and engage the students, then you simply get out of the way. They'll learn and be fine. But you have to excite the students and get them to want to learn the material. Once you get there, then you can just leave it alone.

INTERVIEWER: That's a wonderful encapsulation of a really powerful teaching philosophy. You spend you spent a lot of time, obviously now thinking about effective teaching, effective learning, how does learning happen, what are the barriers to learning-- at that point, where you thinking in a more organized way about pedagogy beyond the teaching as theater, or was that an interest that came later.

AGARWAL: So I was definitely thinking about teaching pedagogy and certainly in the context of the circuits course, where I found the circuit and electronics material very exciting. And I was in computer science at that time. And one day, in the late '90s, Paul Penfield, who was a department head, came to me and he said, hey Anant. I want you to rethink how we teach circuits.

And so, frankly, when he walked into my office, I said to myself, uh-oh. When the department head walks into a professor's office, looking very grim, you say, hmm, what did I do now? When he comes in and he says, Anant, I need to ask you something. I said, uh-oh. And then he said, I want to take over the circuits course and rethink it.

And the first question that went to my mind is that, are you in the right place. This is computer science. I teach architecture. I taught programming classes and systems classes. But the only circuits that I had done was as an undergraduate, 20 years earlier. I took a couple of circuits classes and that's it. So why me?

And so I'm not sure what Paul had in his mind, but he said, look, Anant, I really want you to do this. And for some reason, I've always been a little bit crazy in my life and when something fun and crazy shows up, scarily enough, I rarely turn something like that down. And so, I tried. I said, hmm, interesting.

And he indicated how the enrollments were dropping, the ratings were not very good, the students didn't like the material. And as I said, let me take a look. It was really surprising that, why were students not liking the material? Why was there not engagement?

So I jumped into it. And my colleague, Jeff Lang and I, we worked on it together. So we looked at the material, and then it became very clear to me that we were still teaching circuits in a very '60s style.

The world had completely moved to MOSFET transistors, but we were teaching circuits using bipolar transistors which were rarely used. There were all kinds of fantastic, innovative applications of circuits that we were using in everyday life, and the course wasn't at any point, never making the connection to those fantastic things that students could do from those. So the content was great and correct and rigorous, but it was missing a lot of the scaffolding, and connections, and excitement, and applications, and in some cases, pedagogy as well. The way certain things were taught, I felt were made unnecessarily complicated.

My style of teaching is I like to excite the students first. Show them an application first, excite them, try to mesmerize them, show them a problem, get them to want to solve the problem, and show them a challenge. And then say, OK, how the heck do you do this? And then once they're excited, once they're sitting at the edge of the seats wanting to know, gee, this looks like magic, how did it happen? Then you go down to how it works.

And at that point, once you've got their attention, it doesn't matter whether you're throwing differential equations at them or deep theory at them, you've got them hooked. But if you start with the complicated theory, and you build up to the app, the students are asleep. They're gone. But the time you come to the exciting app, you have two people left in your class, so we did several things.

So one is we brought in a digital while we taught analog circuits. We showed that the digital world was a key application of analog. We drew the connection to some key application areas.

Second, we built some spectacular demonstrations for every class. Every single class in circuits now had a spectacular demonstration. So we would start every class with a demo, usually saying, huh, how do you think this happens? How do you think this works? And then we go into the foundations and theory.

The concepts were the same, but we really taught differently. So we got them excited. We got them hooked. So those are two or three of the big things. And then we made the course a lot more contemporary. We began talking about many more contemporary technologies and showing the connection to the modern world. So I would say, that these were the things that made the course exciting and certainly the students felt that. I mean, they certainly felt interested. And before we knew it, my colleague and I had wrote a textbook in circuits and electronics.

And so that journey-- we started that in, oh, around '98. And it's 2015, and I still teach the electronic circuits class online. But it started almost as a challenge and almost what seemed like mistaken identity. Certainly when it started for me.

INTERVIEWER: So I, of course, want to spend some time speaking about the development of that online class, but I also don't want to forget that at the same time, you were pursuing a very rich research career at MIT. I was wondering if you could talk a little bit about your directions in research, the kinds of problems that you're really excited about engaging with, and the spin outs, the companies that ended up resulting from some of that work.

AGARWAL: MIT has been a great place. It's been a fantastic playground where you could do all kinds of stuff. And so for me, it was just an absolute perfect choice of career, where I could combine my love for teaching, for research, for starting companies, for entrepreneurialism. It just gave me a perfect cauldron where I could explore all of these things. I don't think there's any other place like MIT, maybe a couple other universities where you can get the same kind of feel-- maybe Stanford, maybe Berkeley-- where you get this perfect cauldron of people that think big, people are crazy, and do crazy stuff, and teach, and start companies. It was just an absolutely fantastic environment that I had.

In the research area, for my work with John Hennessy at Stanford, when I was building computers and computer chips, I continued that work at MIT. And built many new kinds of computers at MIT. We built a computer-- the first chip we built was a chip called Sparkle. Sparkle was the world's first multi-threaded microprocessor. Previously, microprocessors ran one thread, but this was the first chip that could run multiple threads into weave. It was the world's first multi-threaded processor.

And we introduced for the first time the concept of block multi-threading or switch on event multi-threading. There was no name for that concept. We named it. And today, virtually every microprocessor has that concept of threading and switching threads efficiently built into it.

We built a machine called Alewife, which was a parallel computer. And we built technologies for maintaining the coherence of data. Will invented new schemes to build up ways to scale to many large numbers of threads, large numbers, of course. And this was the first scalable cache coherence machine that we built, where the coherent scheme was arbitrarily scalable that had not been done before.

We built a scheme called limitless directories. Previously, this concept called directories that let you scale to a given extent. But limitless directories let you scale virtually forever. So we built the first computer that could scale arbitrarily in terms of maintaining the coherence of data in a parallel computer. So that was Alewife.

Then we built a chip called Raw. Raw was a chip we built in 2002, where we were able to put all these parallel computing units inside a single chip. Alewife was a machine with many boards. Each board was a computer.

Here, we would put many computers on a single chip. We build 16 cores on a single chip. And no one had built a chip with this many parallel engines inside a single chip where you could run big programs in each of these cores.

Some of the big innovations in that chip was-- one of them was the concept of a tiled architecture, where you design one tile, and then you stamp it out, so that you can scale almost like buying computing by the yard. You want 100 by 100? Sure. Build a 100 by 100. So it was a technique that let you build chips. And today, the tile architect technique is in customary use in the industry, 15, 20 years later.

We also did some very interesting work in how do you maintain coherence of data in a chip. How do you build efficient interconnects? So there were a lot of interesting work came out in many PhD theses. I've been just very honored to work with some amazing graduate students. I've had about close to 20 of my PhD students went on to become professors in other universities.

So as I said, Berkeley has always been a sore spot with me. But one of my first students became a professor at Berkeley. So I could take some vicarious pleasure in having one of my students be a professor at Berkeley, if not them accepting me. Students have been professors at a number of other universities: there's Georgia Tech; University of Chicago; a number of other universities all over the world.

So that has been very delightful to see that many of them go to become professors in their own right. It's always a proud moment for a faculty member when they see their own student kind of taking the same path that they took themselves. You must be doing something right.

So along the way, we also did a number of startup companies. So I've always been an entrepreneur. I remember one of my first one entrepreneurial activities was as a middle schooler. I went and bought forty chickens from the local chicken store, the veterinary store, and I actually built a chicken farm and had a number of chickens with eggs and so on. And I discovered that half of the chickens turned out to be males, and so I was only getting 20 eggs. But I struck a deal with a local restaurant, and I would sell them my eggs in bulk, so I've always been a businessman.

So even at MIT, I continued doing startup companies. And my first company out of MIT, was in '93, called Virtual Machine Works. We had a very interesting technology that came out of a project.

It's a technology we built to test the chip. So the research ideas were in the chip, but my students and I built the technology that enabled us to test chips really effectively using a technique called virtual wires. So that was a research technique in itself, and be filed a patent, and we formed a company called Virtual Machine Works, a venture capital funded company.

In the very early days of Kendall Square in '94. And so that company did quite well. It was acquired by ICOS, and then Mentor Graphics acquired ICOS And proudly twenty years later, a significant part of the team is still at Mentor Graphics, and at its peak, the machine that we built up sold more than $100 million of revenue in one year in the late '90s. It still continues to do well and MIT has been getting close to for the 21 years of the patent life, close to a million or whatever dollars of license revenue from the patents that came out of it. So that's one company.

I did other companies along the way. I did one company called Tilera. It was a chip company. We took the ideas of the Raw project and commercialized them as Tilera. So era of tiles, Tilera. And so that company is also doing well. Today, Tilera chips are in many embedded systems. So you can find them in video conferencing systems coming out of some of the leading companies.

You can find those chips in many computer systems that people build supercomputers out of. But a large focus is in networking gear and security equipment like firewalls and network monitors and so on. So the chip has found a home in embedded systems. And most recently, a company called Easy Chip acquired Tilera. And so the team is doing good work with the Tilera chips at Easy Chip today.

So all through, I've done a number of companies. I've done a total of five startup companies in my career. A couple of them are not so successful. I did a company called Insert Software where we rewrote binary software to embed monitoring into the system, a company called Insert Software. And there, the company did not do so well, but at the end, the company was acquired, not for a lot of money. Again, great technology, but it wasn't a commercial success. All of these companies have been VC-backed. INTERVIEWER: So is there a an innovation in chip design or a research initiative that you're particularly proud of, that you feel like is something that has made the biggest difference in the computer industry? I mean, there are a bewildering list of innovations-- so maybe you can't choose, I'm not sure-- but if you had to choose, would there be one?

AGARWAL: We've built a lot of ideas and a lot of inventions and it's like choosing between your children. But if I were to point to one thing, I think some of the work that my students and I did resulted in the concept of scalable approaches to maintaining data consistency in parallel computers. So approaches to creating a consistency of data through a variety of directory schemes. I would point to that as probably one of the biggest and practical innovations that we contributed.

If you were to ask me what's the contribution that I myself am most proud of, I would say, to me, the part that I was most proud of was I developed a mathematical model for interconnection networks. It enables people to model a network analytically with a few mathematical equations and predict the performance of networks. So I worked on that myself. I'm very, very proud of that.

It's very mathematical and so on. It's appeared in some textbooks and so on. But people find it much more convenient to simulate networks. But that's said from an intellectual contribution and something that made me feel very proud, proud of myself, was the model of interconnection networks. So that was just incredibly was a real high in terms of coming up with that model and showing that, hey, we could actually predict the performance of something that people had only simulated before.

The other big project that has been a big success, both in some of the inventions that came out, but also in terms of the extraordinary collaboration that we fostered, was the Oxygen Project. Oxygen Project was a collaborative effort of almost I would say, 15 faculty, in both the computer science lab-- what used to be called LCS-- and AI lab. And we had a collaborative project where we built various environments, thinking with the future of computing. And Oxygen, the name that we gave the project, had to do with wanting computation to be wherever: in your hand, in the walls of the building, so that you could live your life knowing that this computation was close by, and you could enable that computation to serve humankind.

So we came up with the concept of an Edge 21, which was-- and I remember this was in '98-- we developed the concept of an Edge 21, which was a handheld device in many respects, it presaged the smartphone today. It showed that you could build a phone, a camera, a GPS device, a radio, audio music player, all of that in one device. And we actually prototyped one of them. It was big and bulky, and although you did not need a truck to carry it around, you needed two hands to carry it around.

And so we did a variety of experiments and we have some cool videos with those experiments where you could talk to it. And remember, this was in the late '90s. You could talk to it. It would do your bidding.

And if you began some work on the handheld and you put it down, the work would transfer into the computation in the walls. And then we started it-- this was before cloud computing-- and so, the cloud today has become the equivalent of computing in the walls. And so the same computation would go from the handheld, would go into the ether, into the computation in the walls, into the cloud, so to speak, and continue to support you. And so when you were in aspace where there was power around, then you could start interacting with the computers in the wall. But if you had to go out into the public where there was no computers nearby, you could pull out your handheld and continue the operation.

So pretty novel techniques came out of that. One of my colleagues, Hari Balakrishnan, invented Cricket which is a way of doing a detailed location within buildings where GPS would not work. And some of the key contributions were how you could create new applications that became automatically aware of where you are. Now today, smartphones do it routinely. Based on your location, you get some services.

But when we were thinking of those concepts, it was the late '90s. In fact, our first papers were from '97. The earliest reports we wrote were in '97. This was almost 15 years before these things have become commonplace. So we were playing around with a lot of these concepts that became popular.

But to me, one of the big success of the project was just the fact that a lot of faculty and students came together and did a big project together, which hadn't happened in computer science and AI lab since the days of Project Mac. And many people likened the feeling and the environment to Project Mac days, which really started off computer science at MIT. And so, that was very exciting.

Later on, AI and CS merged and formed CSAIL. And most people would credit the Oxygen Project with bringing the two labs together in collaborative efforts, saying that we really need to be one lab. And that's when we formed CSAIL, the Computer Science and AI Lab.

INTERVIEWER: So, of course, eventually, you became Director of CSAIL. It's terrific that you bring it up. I was wondering if you could talk a bit about the formation of CSAIL, continue the story, what it is for people who may not know, and how it's evolved since its formation and your directorship before edX.

AGARWAL: So again, we take a lot of things for granted, but I still remember the day in the early part of 2000 where at that time I was the associate director of a LCS, the Lab for Computer Science. And Mike Dertouzos was the director and then he was traveling. And so I still remember there was a ceremony, where we had the first breaking of the ground for the Stata Center, where CSAIL was housed. And I remember Rod and I with shovels doing the first breaking of the ground, oh my goodness, almost 15 years ago now.

And the Oxygen Project brought a number of the researchers together. And we felt a lot of synergy between the artificial intelligence and computer science, and the different hardware that we were building. And we decided that the two labs should come together, and I remember a lot of discussion about how do we-- what do we name the lab?

And the final name that came up was CSAIL, the Computer Science and AI Lab. I was Associate Director under Mike Dertouzos. Victor Zue was also Associate Director at that time. CSAIL was founded and we moved into the Stata Center, so at that time, Rod Brooks became the first director of CSAIL, and then Victor Zue became the next director of CSAIL.

And so I was very happy as a professor, and I really had very little interest in becoming a director. I remember many colleagues approached me to discuss if I would be interested in serving as the director of CSAIL when Victor Zue was stepping down. So this was in 2010. So I realized it would be a complete change in my life. I'd been very happy as a professor, teaching and starting companies with a large research group. I had close to 20, 25 people in my research group. And I just could not see how that reconcile with being a director of CSAIL, which is a 1000 person lab. It's the biggest lab at MIT. So that was a really hard decision for me, where I knew that my life would change completely, becoming the director of a large lab.

And so I guess they could not find anybody else to do it, so they arm-twisted me into doing it. So I said, it's important that all of us pitch in which some service to MIT and to our colleagues, and so I said, all right, I'll jump in and be a director. But that's certainly changed a lot of my life.

Many things, not happily. I had to cut down on research quite a bit. You can't have a very strong research career and a teaching career and startup company career and be a lab Director, so I cut back quite a bit. I really cut back my efforts at Tilera, a startup company where I continued to consult. I had just began to serve on the board at that point. I had a very large research group, I really cut back the research group substantially.

And then jumped into serving as lab director. This was in-- I served as lab director in-- 2011. INTERVIEWER: So speaking of life-changing events, let's talk a bit about the decision to put Circuits and Electronics online, how that came about and where it led. I mean, and whether you had any inkling that that was where it was going to lead?

AGARWAL: So, the thing was, as director of the Computer Science and AI Lab and jumping into a completely new thing, had not managed a large-- beyond my research group, I had not done administration. It was the first time I was doing it. And there's some good-- some spectacular parts and some spectacularly painful aspects. And I was doing that and I threw myself into it wholeheartedly.

And then, that's when the education bug really hit me. So until then, teaching was something we did, we were passionate about it. But really, teaching was not the prime focus of our lives. Research was the prime focus of our lives, and then I became lab director. The lab and the lab family became the focus of my life. Teaching was never really the major focus.

But it turned out that as I was doing circuits course, I had been innovating in various pedagogies, so starting around 2000, I built a WebSim It was one of my own pet projects. So a WebSim was a online computer laboratory. And so in the early part of the decade, around 2000, 2001, I built WebSim where it was an online circuits laboratory, where you could build circuits and test them, and play around with them, completely virtually. It was a virtual lab.

And, in my mind, I knew that we had to go digital with education and go online and I've been thinking about it. But to me, I felt the online lab was the hard part. And it could never be done. So I said, I'm going to prototype it and see if we could make it work. And if I could make what I thought as the hard part, the online lab work, then maybe there's something to thinking of education differently.

So I built WebSim, and if you google WebSim MIT or WebSim Agarwal, you can still go to my lab. It's still there and it can still do those experiments. And so, in retrospect, in my mind, that was the first MOOC lab, to my knowledge. On an average day, 200 to 300 students from all over the world will somehow find WebSim, and come and do lab experiments. And so, I was maintaining the site. I was running it. It was running out of a computer under my desk. And students all over the world we're doing these circuits experiments.

And I did a lot of fun stuff with it. I brought in audio, so they could inject audio into the simulations and listen to how things sounded, and see graphs and videos-- everything done through simulations. So that was very exciting.

However, I had never thought of taking it to the next step, and also put my course of OCW, OpenCourseWare, where all the course materials were available for free to the students. And the circuits course, even though it's circuits, and it's a hard course, it has consistently been among the top five or ten visited courses on OpenCourseWare at MIT, which has thousands of courses.

So as we're doing that, we just-- that's when I stopped. I put the circuits labs online for free. So anybody in the world could come and do a circuits lab for free and have some fun. And the whole thing was web-based, but that's where I stopped.

And then in 2011, in the summer of 2011, an event happened. Sebastian Thrun from Stanford, he put his AI, entire AI course at Stanford online. So what we had done, was put my circuits lab online for free for anybody in the world to take. And we had hundreds of students taking it every day, but what he did was put his entire course online.

And before that, Sal Khan who was my student at MIT, he'd put his videos online and he was teaching math videos. What Sebastian Thrun did in 2011 was in the summer, put his AI course online. And he had 160,000 students that take the AI course. And that's when it hit me. It was an epiphany. Wow. We got to do this.

So that's what I said, MIT should be doing this. We should be putting entire courses online and that should be the next step for the kind of things I've been doing with the circuits lab, with the OCW, and so that's when I pitched to Rafael Reif, who was the provost at that time, Israel Ruiz who was the treasurer and Greg Morgan, who was the general counsel. I discussed with them, hey, look, maybe we should do something here. And a small group of us began to brainstorm about what could happen.

And through those discussions was born MITx. And so we launched MITx December 19, 2011. And the concept there was hey, we're going to put MIT courses online. We're going to create a virtual MIT.

And the whole thing was happening at incredible speed, and we didn't even have time to think of a name. And so we said, all right, they're going to code name it MITx. It's code name. We'll come up with a good name later. And if you look at the first press releases that we issued said, code named MITx.

But over time, people said, well, MITx, that's a really cool name. How much did you pay-- which agency did you pay to get that name? And we said, huh, that's a pretty cool name. So we took out the code named and we just stuck with MITx.

Then we announced it. A bunch of us at MIT had announced MITx. So a bunch of us were the founders of MITx, so to speak. And the funny part was it's like we jumped off a cliff knowing that there was incredible stuff down there, and then we're looking around, saying, now who has a parachute?

And so it's like so we're looking around. I'm looking to my colleagues saying, hey, look, we need to create the first course. We said the first course would start in February, on February 1st. And everybody around said it can't be done. You can't create an online course this quickly.

So we said, whoa, the ground is coming at us at incredible speed. We got to build a parachute before we land. And so that's when I thought, let me jump in and do the circuits course. I had an online circuits lab. I had my videos from OpenCourseWare, so I said maybe I could do the circuits course.

And so that's why the circuits course became the first course that we put together for edX And around September time frame, we hired Piotr Mitros who was the first recruit into what was MITx, which later became edX. So Piotr and team began building in the basement of CSAIL. So edX was really built in the basement of CSAIL.

And we were building the platform there. We hired a few people, building the platform. And circuits course came online. And we offered the circuits course.

And around that time, we began to think about-- so initially, the thought was MITx is MIT online. Around that time, Rafael Reif from MIT and Alan Garber from Harvard began to have discussions. And that's when Harvard and MIT decided to team up and invest in a common platform that clearly, we could not call it MITx. And so we came up with a new name, edX. And here, a PR agency was involved in the naming and color schemes and so on.

And there again, we told them the announcement's happening on Tuesday, and we told them this on Friday. And we said we need the whole thing done in like, a day. And for everything that we did, the answer was, it can't be done. And then, of course, it can be done and everything was done.

And Nate Nickerson was involved in that. And I remember when we first launched the MITx site. We announced it at 11 o'clock at night, and Nate Nickerson was one of those on the site testing the site. So we got everybody involved. Nate Nickerson was the VP of Communications of MIT in 2012, in early 2012 when we launched the course, the circuits course on MITx.

And so, in the first hour, we had 10,000 students sign up for the course, and so we knew that this was very exciting. MIT and Harvard had been talking, and they decided to team up. And they asked us to put together a business plan, so Israel Ruiz and I hammered out a two or three page business plan for two years, and we put up a proposal for s $60 million. And MIT and Harvard committed to funding it at 30 million apiece. And that's how edX was formed in. And edX was launched on May 2, of 2012. And Harvard and MIT both came together.

INTERVIEWER: So please go ahead. Yes.

AGARWA;L; Maybe I can a describe the one little event that-- I remember one meeting that I went to as director of CSAIL. We had a number the deans and heads of departments and MIT leadership at the meeting where the discussion was around the future of MIT. And a number of the deans and leaders-- there was a lot of discussion about oh, we need to open up a new campus in Abu Dhabi We need to open up a new campus in Bangalore. Or we opened a new center in Russia.

A lot of discussion about opening up new centers. And I remember making a comment there and that probably drew the ire of a lot of my colleagues around the table, where I said, opening up one new physical campus at a time. I said, this is so '80s. Why don't get into the new century? Why don't we create a global, worldwide, virtual campus. Why should be keep hitting singles? Why don't we steal third base?

Why don't we go virtual? Why don't we take MIT virtual? And create a virtual MIT where anybody in the world can take virtual courses, not just a hundred students in Abu Dhabi And it made the remark. And there was no, really no comment, no reaction, and I said, OK, no interest.

I later discovered that Philip Khoury was at the meeting, and I think he must have gone and whispered something to Rafael Reif, the provost at that time. And I got a call from Rafael. He said, hey, Anant, I want to talk to you.

So I go to Rafael's office and Rafael starts by saying, you know, Anant, you really spoke out of turn yesterday, And he said, you caused a bit of a stir yesterday. In my mind, I'm thinking, great, maybe I'm fired as being director of CSAIL.

I can go back to being a nice little professor. And great, I can get my old job back. This is it. I lasted exactly four months in that job.

I had to go and say something silly. So as I was prepared for the boom to drop on me, Rafael in his inimical Rafael style, he puts his arm around me and he says, hey Anant, I want you to go make this happen. So I said, uh-oh, now I'm in bigger trouble than I thought.

And so that's when we began thinking about creating an online effort like MITx. We had already begun thinking about it. I mean, Sebastian's course inspiring me to do it. And then with support from Rafael, we formed a small group of people to brainstorm about it. Rafael, Israel, Greg, and myself on a regular basis. And we brainstormed about what it would take to do something like this. What would it look like? And so that was really a core group of people that brainstormed about it.

And then Harvard came on board and we formed edX. What's interesting is that, I was the director of CSAIL. And so my thinking was I would help launch edX as a founder and then we began looking for someone to run edX, someone to serve as the president and CEO of edX. So I began working with the HR people at MIT to recruit a president and CEO for edX. So we had a search going.

And we interviewed a large number of candidates over the December, January, February time frame. At one point, they even talked to Sal Khan about coming and running, leading MITx as the president and CEO. And he seriously considered it. And at one point, I thought that he was going to do it. But that was not to be.

We interviewed a number of people. And around February or thereabouts I think one or two of my colleagues at CSAIL-- I remember Steve Ward coming to me and I was lamenting interviewing candidates. We need to find someone soon, because it was getting very difficult for me, running MITx and running CSAIL. It was just incredibly hard. Both were more than full-time jobs, and so when Steve Ward put the bug in my mind.

He said, you know Anant, have you thought about you running it? You running edX. I said, oh, impossible for me to do-- I can't do two jobs. I mean, each is a full time job, CSAIL and edX.

And then he said, no. He said, education, this is important. Why don't you go do that. He said, CSAIL has been around for a while.

CSAIL will continue. We'll find another great director, but edX needs someone to run it.

So initially, when he said that, I would not entertain the thought because I had been director of CSAIL for one year. And to me, I don't quit. When you do something, you do it well and you do it for a substantial amount of time. You make a commitment.

And so he encouraged me to think about it. And a number of other colleagues came to me and said the same thing, which is that I should really do MITx which would become edX. And this would be a good thing for CSAIL. This would be a good thing for MIT.

Given that edX was incubated in CSAIL. And the it would be a good thing for everybody if you could help reinvent education. And so I had a lot of encouragement. So that gave me confidence that I would not be leaving something half-done. That CSAIL would be in great hands and that I could go and do this.

So that's when I talked to MIT Leadership about my doing edX. I think everyone was supportive. And interestingly enough, the same search committee for CSAIL that had found me somewhere I guess. The same committee re-convened to look for the next leader. Unfortunately in the space of a year. So I felt really badly stepping down as director of CSAIL. It was like choosing between your children.

It was extremely, extremely hard, of course, because this was another major change in my life. The CSAIL directorship change was from being a professor to a director. Now it was from research to something completely different. So I served as the president and CEO of edX. And now, in that transition in March of 2012 where the transition happened, and I transitioned in June of 2012, I stepped down as director of CSAIL.

The day of the transition was even bigger. There, I completely stopped my research work. I completely stopped campus teaching. I still teach online now, but and then, I'm running a nonprofit company and we came out and took space in Kendall Square, and this is a nonprofit company. So that was a much, much bigger transition. But there's a lot of encouragement all around, and so that's when I made the transition.

INTERVIEWER: So edX, I mean, obviously it's a massive undertaking, organizationally, technically, financially, also conceptually. And I'm interested in the idea-- I mean, distance education has obviously been around for a long time. Online education has been around for a while. I mean, MIT was a pioneer with OCW 15 or more years ago, but this is different. And I was wondering if you could talk about conceptually, what the differences are. What is the big idea that has driven not just edX, but the other startups that you mentioned, the other sort of pioneering online courses?

AGARWAL: I think the big innovation here is really marrying technology and education and taking it to a whole new level. So what is very different from what edX is doing with massive open online courses or MOOCs and online education in general is not your grandfather's online education. Frankly, in the '80s and '90s, the early work on online education, particularly from some of the for profits had begun to get somewhat of a negative reputation. And people equated online education with poor quality education.

So our goal was to apply technology to education with world-class quality. And with edX, we had a three part mission, increasing access to education, improving the quality of education, and doing research with all the data that we gathered. So quality was a big part of what we started out to do.

And so the big difference with what we did was we married education with several new technologies that really came about in the latter part of the 2000s, that part the decades. So there was cloud computing. There was video distribution at scale. And there was social networking.

So this was a combination of video distribution, social networking, and cloud computing married to education. So that is what is different. So in the previous online education, there was really no concept of education being provided from the cloud. You could not access it as easily through a web browser, for example. You could not do automatic grading at scale. The scale simply wasn't there. Now with cloud computing, with computation becoming very cheap, and cloud computing we could do massive scale education.

The circuits course, for example, we had planned for 2000 students to sign up for the course. We had 155,000. Why did it work? Because of the cloud. With a few keystrokes, we were able to increase the number of servers in the cloud in Amazon, serving this from one or two or three machines, to hundreds of machines. That's the beauty of the cloud. It's computing by the yard. Almost goes back to the Oxygen philosophy in the late '90s when we felt that you just get computation like the air you breathe. And so the cloud was a big part of it.

Second was video distribution at scale. We could distribute quality, high def video to a large number of students all over the world. And video distribution at scale was enabled by what I called CDNs, Content Distribution Networks. And all of that happened around 2005, 2006 and there abouts.

The third part was social networking where people are very comfortable having discussions on social forums and so on. And so in many respects what edX was doing with online education was marrying high quality education, a la Berkeley, MIT, Harvard, Stanford and so on, along with YouTube-like video distribution. Facebook-like social networking, Amazon-like cloud computing. So think of it as top university marries YouTube, Facebook, Amazon. That was the key.

And that's why this was so different. And the product, these MOOCs, online courses were nothing like you would ever dream about. So we would have high quality videos, short videos inter-weaved with exercises that were automatically graded by the computer. A student would get instant feedback. There was no hand grading. Instant feedback for the students.

There would be a discussion forum where they could ask questions. And a student from Pakistan asks a question. Maybe the answer is provided by a student from the US. So it's instant answering of questions from hundreds of thousands of learners all having discussions on the discussion forum aspect of social networking.

And so, a lot of these things brought a game-like element to education. So this really made education as fun and interesting: the instant feedback, the video, and the high performance computing, the instantaneous responses really brought an element of gaming. So education could become as much fun as a video game. And so that's what these technology brought to bear, and that's what made this so different from either the online education of the '80s and '90s or even the distribution of course materials by OpenCourseWare.

So this was a very different, because OpenCourseWare was course materials. This was courses, which brought instant feedback. We also had a certificate from the University that the students got. Discussion forums, all this was very different.

INTERVIEWER: Very, very early on, the decision was made to make edX a consortium of schools and to build that consortium. I was wondering if you could talk about that decision. Why a consortium? And then also, the reality of going out and doing that. And recruiting dozens of universities worldwide to participate in this shared organization.

AGARWAL: When I first talked about a virtual MIT at the meeting the leadership meeting of deans and so on, there, I was just shooting off my mouth and I was really thinking of a virtual MIT. Just put MIT online. And suddenly, once we launched MITx when I was trying to recruit a president and CEO for edX. When I talked to Sal Khan for example, or others, I was really pitching it as a virtual MIT. At that time it had been MIT, a virtual MIT.

When we announced it, we announced it as a nonprofit. We felt that education is a human right. And this was going to be very revolutionary, disruptive technology, and so we felt it's important that decisions that came out of it were made in a non-profit manner. We also felt that it had to be open source. The platform had to be given away. Open source. Anybody could take it. This was so important. We certainly knew that this would have impact.

When other universities realized that , MIT and Harvard had also been talking about this during that time and so they decided to come together and form edX, so it was MIT and Harvard. So around that time, a number of other universities saw that we had made the announcement, nonprofit, open source. And the mission was three-part, increasing access to education, improving the quality of education both on campus and online, and facilitating research in learning. When many universities saw that, they said, well, this is terrific.

What's not to like about nonprofit and many universities approached us saying, we'd love to do this together with you. Can be form up? Can we work with you on this?

And frankly, in early 2012, when we were approached by other universities, we didn't have a model and we did not know what to do. I still have some emails, forwarded to me by Rafael Reif or Drew Faust or Alan Garber, where-- let me say, emails forwarded to me by Rafael Reif, Susan Hockfield, Drew Faust, or Alan Garber where we really did not have a good sense of what to do, because we didn't have a model.

And so in many respects, we were late to respond to universities. And well, it was Susan Hockfield responding as she and Drew and Rafael and Alan were creating edX. The response was, well, we're trying to think about it and we don't quite know, but as we think about what might be a model, we'll come back to you.

And I think if there's one mistake that we made was, we didn't move fast enough into thinking about a consortium model. And part of it was, I myself was in the throes of running an online course. It was really hard work and there's just not enough time to think about the bigger picture of a consortium.

By the time June rolled around-- May and June rolled around-- we said, we should think about creating a consortium. And we came up with a consortium model. And what was interesting was, Berkeley was the first to team up with us. And what was interesting was that Berkeley was actually a partner at Coursera.

Coursera had moved very fast at that time. Coursera was launched as Coursera a couple of days before edX was launched as edX in early May. And so they had teamed up with Coursera, because Coursera was trying to pull together a consortium model in the early days, where in the early days, edX looked like, let's just put MIT and Harvard courses online.

And so, Berkeley at that point, was thinking about building its own platform and building a nonprofit open source platform itself and doing the same thing that we were doing. And that's what we began talking and we said this doesn't make any sense to have two non-profits doing the same thing, so we combined forces.

And Berkeley merged some of its key contributions into the edX platforms. So for example, Berkeley had a great discussion forum. So even today, edX;s discussion forum is a code contributed by Berkley as part of their vision for a platform. So Berkeley joined us. And then the UT-- University of Texas system-- joined us. And that's when we first came up with the consortium model.

And I remember the murky agreement was a whole bunch of questions came up and we had to come up with a nonprofit consortium model. And Berkeley also has a board observer seat on the edX board from those early days. And so that's how the consortium model grew out of it.

INTERVIEWER: So you finally got Berkeley. You mentioned graduate school, early junior faculty, and now Berkeley was the first.

AGARWAL: Berkeley was the first member to join the consortium after MIT and Harvard. My students have managed to get appointments at Berkeley, but maybe it's on my bucket list to get some appointment at Berkeley.

[LAUGHTER]

But they kept turning me down, so--

[LAUGHTER]

INTERVIEWER; But they came to you in the end.

AGARWAL: Yeah, I mean, we teamed up with Berkeley in the end.

INTERVIEWER: So there was obviously a huge flurry of media attention. I mean, I think you have really become a public figure in many ways. Just a lot of popular culture media attention on MOOCs, the promise of MOOCs, the threat of MOOCs. I was wondering if you could talk a little bit about that and whether you anticipated that and how you handled it.

AGARWAL: So suddenly-- we did not expect things to go the way they went. We launched our first course. We had 10,000 people sign up in the first hour.

I still remember a discussion with Susan Hockfield as we are launching MOOC, launching edX. And she was very worried. And rightfully so. Here are some crazies from CSAIL insisting they can change the world and MIT's reputation.

And so she was really worried as we launched the course. What if you only get 200 people to sign up for the course? It would be embarrassing. And so I was talking with Susan one day, and she asked me, Anant, why this circuits course? And she said, why not an exciting computer science course? Why a circuits course?

And I said, yes, Susan. Why a circuits course? It's got differential equations. It's hard. I have to do it. I might convince some colleagues to join me. But a lot of effort. And so I was crazy.

But I told her I could not get any of my colleagues to do. And so we announced it, so we got to do it. So she was really worried. And so she said, what if you get only 200 people. I said, it could be.

I said, we expect about two thousand , so we had designed the system for 2000. We've got 10,000 students in the first hour to sign up for the course. And 10,000 students was more than the number of students in the entire MIT campus.

And then as one 6.002x, the circuits course, started we had 155,000 students signed up for the course, which was more than the total number of MIT in its 150 year history. So I think Susan must have breathed a huge sigh of relief, when we had enough enrollments coming into the course.

So certainly as edX evolved, there were just a lot of challenges in the kind of thinking. A lot of things surprised us. Certainly, the hype. We did not expect the hype that we got.

I got an invitation to be on the Colbert Report. It was a harrowing experience in 2012, but the beauty of it was that have we got-- the Colbert Report was 2000-- We just take out the date. So we got invited to be on the Colbert Report and we got a huge bump in enrollments. We credit about 200,000 enrollments because of the Colbert show.

So a lot of hype about MOOCs and online education. Certainly something we had not expected. And a lot of people asked me, do you believe the hype is justified? And my answer has always been the following: I said, look, we as a society value sports. So if a really, really tall guy can take this round object and dunk it through a hoop and they become multimillionaires and we as a society revel in that. I said, for the first time we are hyping and getting excited about education. And if teachers become heroes, I said, the more force to that. Let there be more hype for education. What's wrong with that?

So I always felt that the hype was a good thing. It was for education. What better to hype than education? What better to promote and make a superstar than a teacher. And so I was completely on board with just getting a lot of media attention.

There was just a lot of hype, a lot of-- CNN with Fareed Zakaria were talking about it. As I said, Colbert Report. Charlie Rose. everybody was talking about education and MOOCs and it certainly brought up education and how we could revolutionize education using technology.

Why should technology just be used to revolutionize social networking or dating? Not that dating is not important. All that is important. Or video distribution. Why not revolutionize education with technology? And so, I think the hype has been certainly very good.

Today, it's 2015. Since we started thinking about it, certainly for me, it's four years. And the hype has died down. But the beauty is, the hype has died down, but here is where the real troopers hunker down and continue the good work. And that's what we are doing.

What is surprisingly, is even though the hype has died down, our enrollments continue to grow at an unprecedented pace. So today, we hit-- two weeks ago, we hit the five million student mark on edX. So we have more than 5 million learners from every single country in the world.

Today we have about 60,000 new learners registering on edX a week, which is more than twice as many learners registering on edX a year ago. So our growth rate has doubled this past year. So even though the hype has died down, there's incredible quality. We went from one course in the spring of 2012, my circuits course which I taught with my colleagues Gerry Sussman, Chris Terman, Piotr Mitros, Jacob White, all of whom just did heroic effort to put the course together. From one course in 2012 to about 20 courses in 2013 to about 80 courses in 2014, to over 600 courses in 2015. So we've been growing exponentially in the number of courses. And so as we have more content, quality is also substantially improved. The effort to produce a course has gone down substantially. We've created tools, an authoring tool called edX Studio, that makes it easy to alter courses. It's like GarageBand for courses.

So we've made substantial progress. And so even though the hype has died down, the improvements in education and quality and authoring has just been going up exponentially. I'm really, really proud of our team and of our university partners that have really been creating these spectacular courses.

INTERVIEWER: So today in 2015, how would you understand or described the mission of edX looking forward, and has your understanding of that mission changed at all since the beginning? Has your thinking about online education and its mission or a purpose shifted?

AGARWAL: So we have been absolutely steadfast in our mission. Our mission has not changed and we continue to do exactly what we said we would. We are a nonprofit. Our platform is open source. And we are three part mission: increasing access to students all of the world, our courses are free-- we make revenues through upsells or crosssells like verified certificates and so on-- we're improving the quality of education online and on campus, and amazing research results are coming out as we produce the big data of learning. And so we've been steadfast in our mission.

And I was having a conversation with Alan Garber, the provost at Harvard when we had our third year anniversary of edX a few months ago. And he asked me question. What are you proudest of at edX? And I turned around and asked him. I asked him, what are you proudest of at edX? And his response to me was what made him the most proud, was the fact that edX had remained true to its mission all these years.

We had all sorts of forces pulling us in all sorts of directions, but we remained true to our mission and we've accomplished all that we said we would do and more. In the early days of edX, I said, we want to reach a billion learners in 10 years. If we keep doubling at the rate we are, we are on track to do that.

We made our platform open source, and so now not just edX, but many countries have adopted the open edX platform. So, for example, France launched the France Universite Numerique. Which is an online platform for all of France. China, the Ministry of Education, and Tsinghua University launched XuetangX, which is a Chinese national platform. Saudi Arabia launched Doroob. Jordan launched Edraak. And so there are countries launching national platforms based on the open edX platform.

There are many companies that have launched that use the open edX platform. McKinsey Academy uses-- it's an online business training system launched by McKinsey. A number of other universities have adopted at edX.

Stanford, from where the two for profit MOOC providers, Udacity and Coursera came out. Stanford is now the biggest contributor to the open edX platform. So, in fact, Stanford's own open edX. Stanford's own MOOC site named lagurita.stanford.edu is based on open edX. So it's really exciting that even Stanford has adopted open edX today. And so Berkeley, Stanford, MIT, Harvard, the UT system, Georgetown, IIT Bombay,

Australia National Universities, University of Tokyo, Tsinghua in China, Peking University in China-- so we have some of the best universities and organizations in the world. Organizations like Catalyst from New York, Amnesty International, International Monetary Fund, Smithsonian, corporations like Microsoft, Tenaris Corporation, a number of partners at edX that create these great courses on edX that we've been able to launch.

So we've certainly been true to our mission and have been accomplishing all the goals that we set out to accomplish. And so even though there are five million learners on edX, there are millions of learners on all the open edX sites. And I'm confident that in 10 years, when you look at the learners on open edX sites and edX, we will get to a billion learners since we started in 10 years.

I should add one more thing. edX has remained true to its mission: nonprofit, open source. However some of the for-profits have been pivoting. Udacity pivoted from offering MOOCs. They focus much more on vocational training. Coursera has also begun to focus a lot more on vocational programs or skills-based courses.

In our case, we've continued to be focused with our mission. And if anything, from a broad university education, we have now expanded to both high school courses and also skills-based courses. So we've actually expand what to do, some university to high school to skills-based. We launched a program where we offer all of high schools AP courses online, Advanced Placement courses. Imagine any kid anywhere in the US could now take a high school AP course for free. We launched Global Freshman Academy with Arizona State University where anybody anywhere in the world can take a course. And if they pass the course, by paying a small fee, they can get credit for that course at Arizona State University and put that on a transcript. So we really expanded and continued to be completely true to our mission.

INTERVIEWER: From where you sit now, leading edX in 2015, what are the big challenges that you see, either right now in the present moment or on the horizon?

AGARWAL: Certainly we've seen many challenges over time. In the early days, the challenge was simply, could we even build a platform that'll support a thousand learners. Next was the challenge, can we support more than 10 courses? Today we added 600. We have 90 partners.

Then the challenge was would be able to support more than a few thousand learners. Today, we added five million learners. Would we be able to support a lot of authors? We have more than 1,000 people authoring courses on our authoring platform.

So we managed challenge after challenge. On the pedagogy side, we will work on many challenges. Initially, we felt, how do you do online labs and some of the early work that I did with WebSim had certainly convinced me 15 years ago that we could do labs online. So I knew we could do that with virtual labs.

But we were not sure we could grade open responses, like essays. We built technologies to using machine learning to build an AI assessment technology for essays. We also built peer grading, where people grade each other, to grade open responses. We built techniques to grade a question that involved equations and formulae and so on. Ike Chuang built a grader that enabled us to grade formulaic responses, among a number of other things. So we overcame those challenges.

Next was the big challenge of how do you get the small group feel that you commonly have in humanities courses on the edX platform. Well, six months ago, in the early part of 2015, we launched Cohorts, which is a way of grouping students within edX.

Then people said, how do you do teams? How do you get collaboration? We recently launched Teams on edX, which is a way to have two to five people work collaboratively, invite each other, work collaboratively on the platform. We kept overcoming these challenges.

Going ahead, I continue to see there will be the many challenges down the road. I think one challenge we will face from a policy standpoint, is how do we get financial aid for the students who are taking edX courses. So we have students on edX taking courses and earning credit for those courses at the universities. But today, we have no way for them to use financial aid to pay for the credit. So even though we are providing education virtually for free, credit cost some money. And so how do they use financial aid. So we need to overcome that.

We need get a full cadre of courses. We have 600 courses on our platform. We have 600 courses on our platform. We need to get to 10,000 courses, which might be the full complement of courses you might find at some of the top universities in the world.

Getting there is a challenge, because creating courses is not cheap. It may cost anywhere from $10,000 to $100,000 to create a course. And universities and edX need resources to create these courses.

Where is the money going to come from? And so sustainability is a big challenge for us, which is how does edX sustain itself? How does our partners sustain themselves?

Any university can feel comfortable to invest half a million dollars or a million dollars and create four courses or eight courses, but how do we get to 10,000 courses, where we have a full complement of courses. And so that is not cheap, if you have 10,000 courses. Even if each course is $100,000, you are talking about-- what is it-- 10,000 times 100,000 is a billion dollars. It's a billion dollars to create 10,000 courses. So where do you get that money?

And let me just make sure, take a pause and make sure that calculation is correct.

[LAUGHTER]

INTERVIEWER: I will defer to you. AGARWAL: So 10,000 times 100,000-- so that is 1,000 times 1,000-- is a million. And so 10 times 100-- it's a billion, yup. It's a billion dollars-- so a hundred million divided by-- yup, that's right. OK. So that calculations is correct.

So to get to that level of vision, if you want to educate a billion students, we need a full complement of courses. So how do we become sustainable? And by we, I mean our partner universities and edX. How do we collectively become sustainable?

Our universities need revenues and money to keep producing courses, supporting courses. edX needs revenues to provide training to universities. We host the platform. We provide student support. We develop new technologies and platform technologies, authoring technologies.

So one of the biggest challenges facing us is sustainability. How do you be sustainable as a nonprofit? How do you get to a mode where the revenues that come in to the platform will sustain both the university partners and edX. So that's the biggest challenges facing us going ahead.

And it's a billion dollars. So philanthropy by itself is not going to do if. We need some revenue model. And so we are developing revenue models going ahead.

So improving student outcomes is the second biggest challenge. How do we, in an online setting, provide the right support to students? In a classroom setting, if a student is not doing too well, there are TAs, they might go for office hours, the professor. There are a lot of supports around. The students work with each other and help each other to get through when the going becomes hard.

Online, even with verified certificates, for those students who've signed up for a verified certificate on edX by paying a small fee, the pass rates are about 60%. How do we increase that number to campus pass rates at MIT, where the campus pass rates at MIT might be upwards of 97, 98%. How do we get there?

And so that's a big challenge. And we have a number of ideas. One approach might be to have online tutoring systems. Can we crowd-source tutoring, where people who have taken the course before can help the people who are taking the course now? Can we create adaptive learning systems that enable students, that can guide students, intelligently? There are many, many approaches, but that's a challenge as well.

INTERVIEWER: So we're doing these oral histories as part of the observation of the 100th anniversary of the opening of MIT's campus here in Cambridge. And I think is fascinating to ask you to reflect on the purpose of a campus. And in another 100 years, what might the purpose of the campus be? I mean, there's been, of course, a lot of fear of the sort of disruptiveness of MOOCs and these dire predictions that it's going to mean the end of universities as we know them. What is your feeling about the long, long view on online education, digital education, and its place within the sort of matrix of what we already have, residential education, places like MIT, Stanford, Berkeley?

AGARWAL: I do believe that residential education in 20 years won't look anything like today's residential education, first of all. I believe that it will transform itself into a blended model. Already at MIT, 9 out of 10 undergraduates use the edX platform in one course on another during their undergraduate days at MIT, where professors are blending online with in-person even on campus. In some classes, the students may watch a video offline and then come to class and have discussions with a professor. In other classes, professors use the ability of the computer to provide instant feedback to students as a way of engaging students better.

Either way, the campus education will transform itself. I mentioned earlier that my own experience with education was identical in my small school, in Mangalore in India or in my IIT campus or Stanford or MIT in the space of almost 50 years. I really haven't noticed any difference. However, I believe that the next 20 years will be a time of rapid change. I believe that the campus education will become blended as professors innovate and try to bring the best of online and in person. So I believe, the campus of tomorrow will be very different.

I also believe that the campus of tomorrow will be augmented by purely online experiences as well. I believe that in the not-too-distant future, maybe even in five years, the learners in any part of the world will be able to get a quality education and a degree completely online through education as you might find on edX. So many people that could not afford to go to campus or don't have access to a campus or for a variety of reasons, just want to stay home to take care of an aged mother or father. It happens a lot in India, where people don't travel because they want to stay home to take care of aging parents. They, I can easily see them getting a full education online, getting a quality education online.

However, I do believe that there will also be campuses where many students will be lucky enough to be able to afford a campus experience to be able to come to campus. I think campus education in the US in particular, has been increasing in cost at a much faster pace than inflation. So I expect that fewer and fewer people in the US would will be able to afford to go to a campus. But those that can afford to go to a campus will have a better experience on campus. For those that can't afford to go to a campus, I do believe that the online education experience will be a very viable alternative.

And so I believe that five to 10 years from now, students will routinely be making a choice. Do I do my education completely online from high quality content and courses with a place like edX? Or do I go to a campus and learn?

And as with all things in life, I suspect the answer will be in the middle in something I call continuous education, where a student of tomorrow might complete one year of education completely online, taking three courses on edX. There may come to campus like MIT for two years to get the campus experience, to work in-person with faculty and other students and learn all the kinds of things that you could only learn by working with each other in close proximity. And then after two years on campus, you go to industry and then you become a continuous learner, so that fourth year gets spread out over life, as you become a continuous learner. Perhaps you get a subscription back to your university where you take online classes from university for the next 100 to 120 years that future students are going to live, where with technologies changing every 10 years, what I learned twenty years ago no longer applies today.

So being continuous learners for the rest of your life will become the norm. And going to campus for four years when you're 18 to learn a set of skills will be completely antediluvian in the future when things are changing every 10 or 20 years, you have to keep up to speed with what's happening in the world. And so online education and learning online for the rest of your life we become simply a vital necessity as opposed to a luxury as it is today.

INTERVIEWER: So your journey, your educational journey, your life journey has been really quite extraordinary with some twists and turns that might perhaps not have been as expected. Looking ahead for you personally, I mean are there are other ambitions that you have? I mean, you know, you've had this fertile research career, this teaching career and now leading this really transformative organization? What's next? Do you have a plan or are you just sort of winging it?

AGARWAL: Isn't educating a billion people a good enough goal? You want me to do better than that?

INTERVIEWER: Well, I guess what I'm asking is this-- for you now-- the purpose that you want to stay with? I mean, having had done all these other amazing things, is this really your calling?

AGARWAL: I don't know if I've ever called it a calling. I sort of landed in this by-- I'm sort of an an accidental tourist, so to speak. But certainly, as far as I can tell, this is my life. I mean, this is-- edX and trying to reinvent education, and try to reach a billion people. It can't be done in the year. I see this as-- certainly at this instant, I see this as the rest of my life and career. This is what I will be doing. And so, it's very exciting. It's an extraordinarily ambition. I can't imagine anything else popping up in terms of impact and what I could do in happiness, I could top this.

But that said, the story of my life has been winging it. I've been winging it all through. And I've been hit by two by fours all along the way and been completely knocked off my path. I thought that directing CSAIL was going to be my life and I was really excited, and it lasted all of one year. And I'm still wondering how I made that decision to do edX, because I was really having fun and really enjoyed being the director of CSAIL.

But as far as I can tell at this time, this is it. This is what I'm going to be doing. But that said, I've always been winging it and who knows what life has in store for me and for the rest of us.

INTERVIEWER: Well, I want to thank you. I mean, educating a billion people is certainly enough of a life goal. I'm not searching for more. It just struck me that you've had so many facets in your career that it's quite extraordinary. But thank you so much for coming today. It's been fascinating and I don't know if you have anything else to add but this is-- we've really covered a lot of ground here.

AGARWAL: No, thank you. I really appreciate your doing this. Oftentimes, records like this can-- You sort of forget things and it's great to make a record of who were the early people that were dreaming about edX, and what were our fears, and what are our worries. Who helped us? It's really great to be able to sort of record all that, so that we remember all the people that had to-- that really contributed dramatically to something like this coming together.