Computer
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Oral History of Ike Nassi

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Markoff: This is an oral history with Ike Nassi and it is 1:00 p.m. on Friday the 26th of August, 2016. I'm John Markoff.

Hsu: I am Hansen Hsu.

Nassi: And I'm Ike Nassi.

Markoff: Here we all are. So let's start at the very beginning. Start in Brooklyn in 1949 and tell us about growing up in Brooklyn and also tell us a bit about your parents.

Nassi: Okay. My parents were high school graduates. My father went off to war, World War II. When he came back, he opened up a restaurant, then he opened up a second restaurant, kosher delicatessens in Brooklyn. He-- in the restaurant, he hired all these kids. He really wanted to be a teacher and it's interesting that years later, he went back to college and became a teacher. But be that as it may, he hired all my cousins, all my friends, and that was really a lot of fun. I was pretty good in science. I loved science. One of his friends encouraged me to go to Brooklyn Technical High School, which I did. At the time, Brooklyn Tech only admitted boys. We had 6,000 boys and it was wonderful. We were very good in the teams. I personally was a city champ in riflery in high school. I--

Markoff: And let me just jump back. Were your parents born in the United States?

Nassi: Yes, they were.

Markoff: They were. Okay. And your grandparents came from?

Nassi: Turkey. All four of my grandparents came from Turkey.

Markoff: So Ashkenazi or--

Nassi: Sephardic.

Nassi: We got kicked out of Spain during the Inquisition. Some of the family went off to Holland and then wound up in Turkey. My ancestors-- my father's name was Joseph, Joseph Nassi, but people know my really far back ancestor, Joseph Nassi, was the Duke of Naxos and one of the people that purported to convince Queen Isabella to fund Christopher Columbus.

Markoff: That's good lineage.

Nassi: Yeah. So--

Markoff: And your mom, what was her name?

Nassi: My mother was Carol, Carol Comerchero. My grandfather, my paternal grandfather, was a waiter. My maternal grandfather was a bootlegger and he had a little coffee shop on the Lower East Side.

Markoff: Do a compare and contrast between Brooklyn Tech and Bronx Science.

Nassi: Ah, we were much better. <laughter> So I have a lot of friends who went to Bronx Science. I'm still friends with them. Larry Tesler went to Bronx Science, Len Kleinrock went to Bronx Science, and it's a source of interesting competition to this day. I just-- it's just great. Len and I interact at TTI-Vanguard. We just talk about that a lot. I think it's more geographic than anything. I lived in Brooklyn. I went to Brooklyn Tech. I'm not sure where Len lived growing up, but he went to Bronx Science. I'm not sure where Larry lived and he went to Bronx Science. But it was an academic competition, but we rarely saw each other. One of the people that went to Brooklyn Tech-- in fact, I just went back for my 50th anniversary and one of the people who went to Brooklyn Tech I knew about. He's a very good friend of mine, and yours, Alan Kay. So Alan went to Brooklyn Tech, but--

Markoff: Ahead of you. He graduated a couple of years ahead of you? Is that correct?

Nassi: He graduated-- well, actually, he didn't graduate. That's another story. He got into an argument with the principal <laughter> and wasn't allowed to complete his education at Brooklyn Tech. But that's a whole other story. You'll have to talk to Alan about that. <laughter> Another graduate was Harry Chapin, the folk singer. Another was Arno Penzias, the Nobel Prize winner. Another guy was a guy I worked with at Apple. I had no idea he went to Brooklyn Tech, but he turned out to be our VP of Education at Apple, Bernie Gifford. So there's a lot of people there and I just went back. We-- my wife and I walked into the 50th anniversary and the students were lined up and just gave us a round of applause. I thought it was just incredible.

Markoff: That's wonderful. So you graduated in '66 then?

Nassi: I did. Just to finish up the Brooklyn piece, I thought that what was really interesting about that was I grew up in a time when everybody was competing with everybody and it was a good thing. Okay? We

competed in sports. We competed academically. Everything was a competition and we just thrived on it. And I don't know to what extent that's still true today. I have a feeling it's not and I think that's a shame.

Markoff: So did you encounter computers while you were at Brooklyn Technical?

Nassi: The only computer we had at the time was a numerically controlled milling machine, and I wasn't allowed to touch it.

Markoff: So you were a math jock?

Nassi: I was a math-- I liked math in high school and I did my undergraduate degree in mathematics at Stony Brook.

Markoff: Did you have a sense of Sputnik? Was your cohort influenced by Sputnik?

Nassi: Yes. As a matter of fact, we had these things-- you know what baseball cards are. We had space cards. <laughter> And I had a full collection of space cards, complete collection. It was just incredible.

Markoff: You are a child of Sputnik, then. Absolutely. That's great. And did you read science fiction?

Nassi: I did. Oh my God. Isaac Asimov, *Foundation* trilogy, fantastic. Clifford Simak, *City*. In fact, I just bought another copy of that because I want to reread it. I'm rereading a lot of books I read as a kid.

Markoff: Did you think that being steeped in science fiction was influential in your worldview or your choices?

Nassi: I think it was the other way around. I was attracted to science fiction because of--

Markoff: There's so much here. <laughter>

Nassi: I'm sorry.

Markoff: No, no. It's really quite remarkable. So '66, were politics an issue before you got to college? Were you insulated from--

Nassi: Yes. It changed a lot when I got to college. Two things changed me. Number one, in no particular order, I found out there were these things called girls. <laughter> Having been to an all-boys school, this was interesting. And the second thing was politics, exactly. I mean, this was the Vietnam War and I remember marching on Washington and having long hair and running around in all kinds of interesting clothing. And I started an alternative newspaper at Stony Brook with one of my friends. Sat in in the president's office when we took over the library where the president was located. And I remember when I got my Ph.D., he remembered that. <laughter>

Markoff: Was SDS active on your campus?

Nassi: Absolutely.

Markoff: Were you involved?

Nassi: I was involved only in the sense that I went on the SDS trip to Washington when we did the march on Washington. I was tear-gassed, the whole thing. I guess the other thing I might add was I was a resident assistant and an orientation leader at Stony Brook and in 1968, the Suffolk County Police came in and conducted a drug raid on campus. C.N. Yang, the Nobel Prize winner, stepped in and tried to calm things down. The protesters knocked over the gatehouse, overturned a police vehicle, set it on fire. And they wound up on my hall and I remember a knock on the door late at night and it was one of my freshmen-- I was a resident assistant in a freshman hall. And they said, "Ike, there's something going on here. You should come out." Now, I knew that if I opened the door, there would be a water bomb hitting me. I mean, I absolutely knew that. But then, they came back about 15 minutes later. Says, "No. Ike, you really should come out. There's a whole bunch of police that went into this guy's suite." So I went out and I used my passkey to open up the door and all of a sudden, this gun is pointed at my head, ouch, and asked me to identify this person. I didn't know where he was and I didn't identify him, but as I was leaving, I saw he was sitting in the lounge area. <laughs> But anyway, I accompanied him to police headquarters the next morning and I called up his folks. It was a very interesting time.

Markoff: Let me go back just a little bit. Were you raised in an Orthodox or Reformed family? What kind of religious--

Nassi: We were-- we belonged-- it's a little complicated. We belonged to two synagogues. One was a Sephardic synagogue and one was an Ashkenazi synagogue. And it turns out that my parents' best friends were the rabbi and his wife of the Ashkenazi synagogue, but my grandparents helped start the Sephardic synagogue. So we did just double duty. And I was just in Manhattan recently and I was able to reconnect with the rabbi's-- the Ashkenazi rabbi's kids. He had three boys. I used to babysit for the boys and I had lost touch with them and it was just phenomenal to reconnect with them. I just loved it.

Markoff: Are you acquainted with book-- Chaim Potok, or any of that series?

Nassi: Absolutely. Sure.

Markoff: So did you have that kind of a--

Nassi: I was not Hassidic at all. I was not that deeply religious. My sister is, I might add, my youngest sister. And it's like a different religion, as far as I'm concerned.

Markoff: And also in high school, just because I don't want to miss anything, did you have hobbies, interests, besides--

Nassi: Well, I just said, I was on the rifle team. I had played a lot of baseball as a kid. I was a catcher. And then, I started having problems with my retinas and so they said no more baseball. I was a catcher and I used to get pretty close to the plate and a couple of times, I got hit in the head with the bat. <laughs> I said that's it. So I joined the rifle team and I started shooting and I-- that was-- for a person who's interested in engineering and mathematics, the precision of precision target shooting was very interesting. Beyond that, I worked with my father, who hired all my friends so I'd have people to play with at work, and worked pretty hard.

Markoff: And why did you pick Stony Brook?

Nassi: Oh, that's a good question. You know, I had a scholarship, a Regent's Scholarship. My parents were middle class. It was a good value for the money. It was the Berkeley of the East, as they say. And I liked it. I just liked it. I started in biology and then decided I really didn't like biology and I switched to mathematics after my freshman year.

Markoff: And what was campus life like in terms of did you live on campus, off campus? Were there fraternities?

Nassi: No, there were no fraternities, almost by law, actually. But the campus, when I got there, it was mud. I mean, in 1966, it was all mud. It was just being built. You know, it had just started. I think the first class at Stony Brook was in either '64 or '65 and I came in the fall of '66. So it was being constructed as we got there. I remember we used to do movies on the weekend in the physics auditorium and I-- we used to line up and there was-- I remember lining up in front of C.N. Yang's office and other famous physicists. We had a very good physics department there and I liked physics, but not as much as I liked math, and I liked the math because there were the fewest number of required courses. <laughter> But

interestingly enough, I learned to read. I mean, I knew how to read, but reading mathematics, for me, was a different skill. Okay? The ability to read a sentence and not go on to the next sentence till you understood the sentence you were reading was really important. And-- yeah.

Markoff: And was—numerical methods—since—at that point, there was not a CS major. Is that correct?

Nassi: There wasn't even a CS major when I started graduate school. No. I was really in the math department. You know, I took courses in various flavors of algebras and advanced calculus and-- I don't think I took any numerical analysis as an undergraduate, although I did as a graduate student, and then I taught it. We were talking about Ben Shneiderman before and we were graduate students together and Ben was also teaching at the time. And he needed to spend a year totally on campus so he gave up his teaching position at one of the local community colleges and he asked me to teach it and they gave me the numerical analysis course to teach, actually. It was fun.

Markoff: So you discovered computing somewhere along the way, though.

Nassi: Yeah, as a sophomore. I-- we had-- I took a Fortran course and I liked it and then, I took an assembly language course the following year. And then, I think it was that summer, I was working in-- I was spending the summer on campus. I worked in a local delicatessen at-- in Setauket and in walks this guy who I knew, because I had taken a graduate operating systems class with him, Art Bernstein. And he said, "I'm doing this informal seminar over the summer. Maybe you'd like to take it?" And I did and that's when I really started getting hooked. I student taught my senior year, in math, and I remember driving to my student teaching gig and thinking to myself, oh, wow. What am I going to do when I graduate? And then, the light bulb goes off. I should go to graduate school. It's what I really like. I like computers. And that decided it for me.

Markoff: In college, mentors? Any faculty that rose to the level of being--

Nassi: Not really. There was one professor in math education I really liked because he could explain things. I liked the way he would explain things so that you can teach them to other people. Bill Lister was his name, but other than that, no. Not really.

Markoff: Was the first machine an IBM 360 or what class of machine--

Nassi: Well, it was a 7094, actually. And then, by the time I started programming in assembly language, it was 360-BAL, Basic Assembly Language.

Markoff: So there was a computer center already, even though it was mud?

Nassi: Oh, yeah. That-- my wife still talks about that. I met my wife at Stony Brook. Actually, you met my wife also. And a date on Saturday night was spent in the computer center with her punching my punch cards. <laughter> And she still talks about it. In fact, I had my grandkids here just a couple of weekends ago and they were punching-- well, they wanted to punch on the punch cards, but they weren't able to.

Markoff: Your early sort of interaction with computers was about math assignments and doing math problems, no?

Nassi: No. It was programming. And there were only a couple of courses in an undergraduate that you could take. It wasn't until I got to graduate school that I really got entrenched, and that's a whole other--

Markoff: So Fortran was your first language, then?

Nassi: Fortran was my first language, assembly language was my second language, and then I got to graduate school and started designing languages.

Markoff: We'll get to that. But did you have anything of a romance with-- when you discovered the ability to program, did it feel like you--

Nassi: Oh, it was instant, total focus. The ability to just focus on the job at hand and knowing when you could get it right and nobody could evaluate it, either it worked or it didn't work, that's what really attracted me.

Markoff: You mentioned a date in the computer center on a Saturday night.

Nassi: Yes.

Markoff: That sounds like you've crossed over into the hacker culture.

Nassi: Yeah.

Markoff: If you're in the computer center on a Saturday night, probably you're--

Nassi: Yeah.

Markoff: Was the term around at that point?

Nassi: No.

Markoff: It was still in the MIT world and-- but you were of that culture.

Nassi: Yeah.

Markoff: Were there others?

Nassi: Yeah. Sure. Yeah. Of course. This was the Berkeley of the East, after all. <laughter>

Markoff: Although I was thinking about it. Santa Cruz was being built about the same time. So in a sense, it was a little bit like a Santa Cruz.

Nassi: Very much so. And that's why I'm a professor at Santa Cruz because it reminds me of Stony Brook. <laughter>

Markoff: Is there a "why" to the math? I mean, was it because you were good at it? Because it was the most interesting thing? Why math as opposed to-- well, you said you were interested in physics, but you chose math.

Nassi: Yeah. So I joke around and say it had the fewest number of required courses. But that's not the real reason. The real reason was I just really liked it. When I was in high school, I had a teacher in high school, a math teacher in geometry, named Saul Madens, and he made us, in plane geometry, do these very sharp Ts with assertions and reasons to prove theorems. We had to do it very-- in a very orderly way and I really liked the precision of that order. So when I got to college and-- I started really digging it, so to speak.

Markoff: And in terms of campus life, besides politics and school, was there anything else? Did you continue to shoot? Is that--

Nassi: No. I did bring my rifle on campus, but I used it once, maybe. There was no opportunity. I guess the interesting thing was taking the rifle on the New York City subway system in high school. But that's a whole other story. <laughter> You can't do that anymore.

Markoff: Unless you're in Texas. Did you have to work while you were at school?

Nassi: Not much. You know, my room and board was paid for because I was a resident assistant, and I had the Regent's Scholarship, so my tuition was paid for. And all I really did was-- now that I think about it, I'm sorry. I was on crew. I used to row. So I did that for a while. But I delivered-- we started a coffeehouse in my-- I think it was my junior year and I delivered the pastries. I went to the doughnut place and picked up the doughnuts and brought them to the coffeehouse.

Markoff: The alternative paper, was it college or was it--

Nassi: In college. Yeah.

Markoff: What was it called? Do you remember?

Nassi: *Introspect.*

Markoff: Was it because the campus paper was conservative? Why did you create a separate paper?

Nassi: The '60s, you know? It was an alternative, leftist newspaper. It lasted one year and that was it. We did have wonderful concerts, Rolling Stones. I mean, just-- Eric Andersen. I mean, these wonderful concerts and things on campus and I discovered folk music at that time and I-- it was all part of the genre, I suspect.

Markoff: Was your wife a math student too?

Nassi: No. Sociology.

Markoff: Oh, sociologist. Interesting.Yeah.

Nassi: We've been married 46 years, I have to say. For the record, 46 years to the same person.

Markoff: You stayed at Stony Brook after graduating.

Nassi: Yes, I did.

Markoff: Why did you decide to stay?

Nassi: Well, I got into a number of schools for graduate school, but she got a job teaching on Long Island and so, we decided to just stay on Long Island. Her parents lived in Queens. My parents had abandoned me and moved to California, but-- so I-- we just stayed. It was a good department, good set of people.

Markoff: What was the commute from Long Island to Stony Brook?

Nassi: Stony Brook is on Long Island. No commute.

Markoff: Never went. Didn't realize that. Had some notion it was-- that's embarrassing. And what was-- so how did your-- you picked computer science because it seemed like-- explain that decision.

Nassi: Well, as I said, I was driving to my student teaching assignment. I taught math in a junior high school and I'm thinking about what I want to do next year. The Draft was hanging over my head, but I had a relatively high number in the Draft lottery and so that wasn't an over-- I wasn't overly concerned about that. But I just really remember rushing back from a student teaching assignment so I could attend the computer science class I was taking. And I just-- like I said, the light bulb went off and I said this is what I want to do. And I did and I applied and I got in and it was great.

Markoff: The fellowship, is that where--

Nassi: I got a partial fellowship my first year and-- my first semester, actually, and then they converted it to a full research assistantship. I can talk about my graduate school experience.

Markoff: Yeah. It was sort like a focus is what-- I mean, did you develop a language interest early on?

Nassi: So one of my professors, first year, was a fellow named Herb Gelernter. His son was David Gelernter.

Markoff: The son. Well--

Nassi: Yes, of course. David was a few years behind me in graduate school, but Herb, I just was fascinated with Herb teaching us about the theoretical foundations of computer science. With my math background and logic and predicate logic and-- it was a very challenging class and it-- again, a lot of competition. Ben Shneiderman was in the class and a bunch of other people. And Herb had a way of handing out the midterms in order of grade. So you knew if you're one of the first people, you didn't get a good grade. And I knew I did well. I-- and it was a-- one of these gut courses. You know, it was, like, the most competitive course in graduate school. And I thought, I got all these answers right. I know I got them right. I must have come out at the top. And I didn't. I was the second in the class. <laughter> And the first one in the class was a guy named Reggie Nakajima. Reggie, after that, got his Ph.D. at Berkeley. He left after the first year and went to become a professor at Kyoto University and did Kyoto Common Lisp, if you remember that. But-- and then, he invited me to Kyoto a few years later to visit. But I really loved that class. I learned about Gödel. I learned about all these uncertainty things, recursive function theory, Kleene, Church, Post, and I just really was fascinated by that. And in the end, even though I loved to program. I basically did my dissertation in theory.

Hsu: Was there a computer science department at this time?

Nassi: No. There was no computer science-- I entered in applied mathematics and they created the computer science department during my first year and they put me in that program.

Markoff: Was Gelernter part of that, the creation of the--

Nassi: Yes. He was one of the first faculty members. He, Art Bernstein, Dick Kieburtz were all there at the beginning.

Markoff: And you did something jointly with Shneiderman while you were a student?

Nassi: Yes.

Markoff: While you were both students.

Nassi: Our very first semester, we were-- we had gotten sandwiches and we're sitting in the computing lab and we had just read-- I had just read, I don't remember if Ben read it, Jack Johnston's paper on the contour model regarding execution of ALGOL 60, and that was a dynamic model. And I said, "You know, there's a static representation for this." So we started talking about it and we realized we can statically represent a program. After all, control structures and structured programming was the "in thing" then. And so, we came up with this graphical flow chart language for expressing programs in a very structured way. And we sent it in for publication. This was at the-- I think it was the end of the-- my first semester as a

graduate student, and Ben took the lead on that. He sent it in and we got this scathing rejection back. Absolute scathing rejection and the reviewer said we should collect up all these things and we should burn them and-- I mean, for a graduate student, it was just awful. But we persevered and we sent it into another publication and it got accepted. <laughter> And Ben was just invited a couple of years ago to give a keynote at Stony Brook and he talked about this experience, the lesson being that don't worry about the rejections. Just keep pushing forward. And it was great.

Markoff: And did that model or that approach, did it have-- did it go anywhere?

Nassi: Yeah. Actually, it's interesting that you ask that because when I went to do my Ph.D. quals, I had already done some Ph.D. work and you had to pass this bar in order to allow you to proceed with your Ph.D. And I proved this key theorem and then one week before my quals, somebody else proved the same theorem. So the standard joke around the department was, "You don't want to get 'Iked'." <laughter> And obviously, I passed because there's no way I could have plagiarized it. So they passed me anyway, but they made me go and do a lot more work, which turned out to be a very good thing, actually. So, I mean, you don't want to hear about my Ph.D. thesis, but it was all theorems and proofs and it was under 100 pages and I remember walking into my advisor's office after the holiday break in my fourth year as a graduate student. And I walked in for our weekly meeting and I said, "Ralph, I'm done." He said, "What do you mean, you're done?" I said, "I proved this theorem." And I went to the board and I wrote out the theorem. He said, "Prove it." And for the next two hours, I proved it. At the end, he said, "Yeah. You're done." <laughter>

Markoff: Who was your faculty advisor?

Nassi: The late Ralph Akkoyunlu , who went on to become a computer scientist at-- he was a-- went to Columbia, got his Ph.D. there, but he became a professor at Brooklyn College and he passed away a couple of years ago.

Markoff: So how broad was your language experience while you were a graduate student? And, I mean, there are religious issues related to language. Did you have particular passions?

Nassi: Yeah. It's an interesting-- it's actually an interesting story. I'm glad you-- I-- I mean, this is really great, that I'm remembering all this stuff. When I was a first-year graduate student, Art Bernstein, who was my operating systems professor, said, "We're going to take a trip." I said, "Where are we going?" He says, "A place called Bell Labs." And I said, "Okay. Why are we going to do that?" He says, "Well, because you've been working with this language called BCPL--" I brought up BCPL on a PDP-15 at Stony Brook. It was the first compiler work I ever did, again, as a first-year graduate student. "And they have another systems implementation language and I want you to hear what they have to say and they're also working on an operating system." So we got in the car. He drove us to Bell Labs in Murray Hill, New

Jersey, and introduced me to this guy named Ken Thompson <laughter> and Dennis Ritchie. And Ken is Canadian, as you may know, and so-- you remember the Unix prompt "eh". It comes from being a Canadian. And so, the first language that he and Dennis did was a language which they called "A" the letter A. And they said-- Ken told me it wasn't very good. Now, Ken was wearing shorts and hippie beads and sandals and it was a really interesting place. And so--

Markoff: This would have been '68 or '69?

Nassi: This was '68, I think. Maybe-- yes. Probably '68. And so then, he says, "Well, okay. So we didn't get A right so we did another language we called B." And that was better, but it had this fundamental flaw; don't ask me what the flaw was because I don't remember it now. And he said, "We finally settled on this other language called C and I think this one's going to stick." And that in fact is what happened.

Markoff: You just mentioned parenthetically that your first compiler work was-- what's the-- did-- there was no instruction manual for building compilers at that point.

Nassi: No. But there was-- I didn't actually build a compiler. I ported a compiler. Martin Richards in the UK had developed this language called CPL. I think Strachey was involved in that as well. And then, they did a systems implementation version that--called BCPL, CPL meaning Cambridge Plus London, for some reason. And so, I brought up-- I bootstrapped a BCPL compiler on the PDP-15.

Markoff: At that point, were you working at display terminal? This was '68. What was the work environment at that--

Nassi: Paper tape, man! Paper tape! <laughter>

Nassi: And the PDP-15, we'd crash every so often. You have to kick it right in a certain place and--

Markoff: So paper tape and printouts.

Nassi: Yeah.

Markoff: So your interface was the printout from the last--

Nassi: Yeah. And switches on the PDP--

Markoff: To--

Nassi: Yeah. To enter the boot loader. Yeah. Did all that. We had a VT-15 graphics terminal, but we weren't allowed to use that. <laughter>

Markoff: That's remarkable. So '68, how much--

Nassi: And then, in my third year, we got a PDP-10 also, I have to say, hooked into Brookhaven and got us on there.

Markoff: So did ARPANET touch at all when you were in graduate--

Nassi: No. But soon thereafter.

Markoff: But I'm just thinking about the environment at that point and what was going on in languages and sort of outside your community. You know, object-oriented language had not really-- they were just starting to filter into the world. Did they have any--

Nassi: No. There was ALGOL.

Markoff: Pascal hadn't been written.

Nassi: Pascal was not written at that time.

Markoff: There was ALGOL.

Nassi: ALGOL. And ALGOL was a brilliant tour de force. It was ALGOL 68 that was just coming on. Van Wijngaarden had just done ALGOL 68, but none of us really understood it, <laughter> frankly.

Markoff: And in terms of the computer industry, what was the relationship of being in school in a department and the surrounding industry? Was there--

Nassi: Not much.

Markoff: Even though Gelernter had been at IBM, there wasn't a--

Nassi: You know, he did this-- so I should mention that. He did this thing called the geometry theorem-proving machine, and he also went to Brooklyn Tech. And he had accumulated somehow years of New York State Regent's exams in mathematics, which he started feeding into his geometry theorem-proving machine when he was at IBM. And there was one-- this is a very-- this is actually interesting. He told the story of how his geometry theorem-proving machine discovered a theorem that had been long forgotten. It's called the pons asinorum. And I went back and bought Euclid's *Elements* a few years ago and I looked it up and it was really in there. So here's the proof. Okay? How do you prove that the base angles in an isosceles triangle are equal? Now, when you're in high school, you're taught to drop a perpendicular and prove similarity of these things. That's not what his program did. What his program did was assuming the two-- by the hypothesis of the theorem, the two lines were of equal length, and let's say the root vertex was A. So he had A, B, C and he proved-- his program proved congruency of two triangles, A, B, C and A, C, B. Now, as humans, they're the same triangle, but to a computer, they were not. And so, this computer came up with a very unique proof that had been forgotten for thousands of years.

Markoff: That's very cool. Did you travel? For example, did you go to Joint Fall Computer Conferences as a graduate student?

Nassi: I went to a conference that I had a paper published in. It was-- I don't remember the name of it. Sorry.

Markoff: You don't remember the conference. Do you remember where in the country it was?

Nassi: It was either in Boston or in New Jersey. I don't remember.

Markoff: So that wasn't-- that model of--

Nassi: It was the Princeton Conference. It was a-- it was called the Princeton Conference on something or other. Sorry I can't remember.

Markoff: One of the questions here that's interesting is were there any key experiences as a graduate student that really stand out in your mind?

Nassi: I-- well, I remember after knowing I was going to get my Ph.D. applying to various places. And my professors wanted me to take a job teaching at a university and so I applied to a bunch of schools and I actually got offers from all of them. Michigan under-- with Bernie Galler and Cornell and the University of Texas at Dallas had just formed and they offered me a job and the University of Iowa. I knew that wasn't going to be for me because you got off the plane and it said, "Number one in corn and pork," and when I told my wife that and the fact that they-- the Hillel rabbi had just left, that just wasn't going to fly.

<laughter> But then, I was talking to my wife one day and she said, "You know, you've been in school continuously since you were in kindergarten. Maybe you should try going to industry." <laughter> And so, I did and-- even though I had all these academic offers, I wound up going to industry, which was--

Markoff: Before we leave this, there's a mention of a paper called "Structured Flow Charts." Did you write that?

Nassi: That's the paper with Ben Shneiderman.

Markoff: As a?

Nassi: As a first-year graduate student.

Markoff: Was that--

Nassi: That's the paper that got blasted and--

Markoff: And then, you--

Nassi: Yeah. And I wrote another paper that was published at this other conference I mentioned. It was just a summary of my Ph.D. thesis.

Hsu: So that was different from the Control Structure Semantics for Programming Languages--

Nassi: That was my Ph.D. thesis.

Hsu: So you were really big on structured programming?

Nassi: Yes, I was. And I read-- I was known in the department for having read all the relevant papers. And at one point, I remember talking to some of my older professors and, "Why did you let me out? I mean, it was only four years. I could have done a lot more." He says, "Well, you already went out and got a job. What were we going to do?" <laughter> So--

Hsu: So big supporter of "Go To Considered Harmful?"

Nassi: Absolutely. <laughter> That was-- I-- my parents lived in California and I read the Bohm and Jacopini paper and a Dijkstra paper on a plane from New York to go visit my parents in California. And, again, a light bulb went off after I read the Bohm and Jacopini paper on that and that was the paper that really proved that Dijkstra's assertion about "Go To Considered Harmful" had a theoretical basis that made sense to me. Because what Bohm and Jacopini proved, that you could write a very large class of programs using the control structures for structured programming.

Nassi: And then, I extended that. So Tony Hoare had built a logic, which became known as Hoare's Axiomatics, and he showed a logic for proving properties of programs in this structured form. What I did for my Ph.D.-- one of the things I did in my Ph.D. thesis was I extended Hoare's Axiomatics to cover a larger set of control structures, and even that wasn't good enough for my committee. They said, "Well, it's all very nice that you did that, but how do we know these control structures are relevant for anything?" And so, what I wound up doing is proving that you could, through a mechanical set of transformation rules, prove that-- prove all the axioms in the rules of inference could be theorems in operational or denotational semantics, which is what Strachey did in the UK. So it was-- what was really evident about that and the reason why my central thesis was difficult was because I was proving theorems about three-valued logics using two-valued logic mathematics, and keeping all that stuff straight was very difficult. <laughter>

Hsu: Did you overlap with John Hennessey?

Nassi: Well, yeah. I didn't know it until years later, but he cornered me one day. We were at a conference or something, I think it was in San Antonio, and he said, "You know, you were my teaching assistant for the compiler class," <laughter> and I had no idea at that point. Another person who was a student of mine that I didn't find out about until years later was Marjorie Blumenthal, who was at the National Science Foundation.

Markoff: So how did you enter the job market? Did the recruiters come through at that point? What was the-- how did you look around to see?

Nassi: Ah, that's a good question. I had completely forgotten about that. Well, of course, I was getting the *Communications of the ACM* and there was a company that put in a full-page ad in the back of the *Communications of the ACM*. So I sent in a resume and they hired me. That was a company that was founded by Doug Ross from MIT and I flew up, I interviewed, they offered me a job. They moved me from New York to Boston.

Markoff: What did SofTech do?

Nassi: Well, SofTech did a bunch of things, but they had these large government contracts and I wound up writing a number of compilers for various airplanes, really. The F-16, the B-1, another computer that--

Markoff: You did a compiler for the B-1. That's so great.

Nassi: I did, yeah.

Markoff: Do you know that I was part of the campaign to stop the B-1?

Nassi: No. <laughter> Well, it's interesting for me, having spent this time with SDS in Stony Brook in the '60s. Here I am writing compilers for these military things. But let me tell you a good story about that, and this was a seminal kind of turning point. I was writing these very highly optimizing compilers and what was interesting is there's a direct correlation between how fast you can do these radar detection loops and the probability of a plane getting shot down. So these were defensive computers at the time. I've done offensive ones, but this is a defensive computer and you had to really do it well. And one of the cofounders of the company and I had a little competition. His name was Jorge Rodriguez and he and I were just competing terribly on this stuff and I won the competition. But one day, the program manager came into my office at SofTech and he said, "This optimization is amazing. How did you do it?" And I looked. His name was Mike Willoughby and I said, "Mike, just put it there. I'll look at it later. I'm busy with something else." But of course, as soon as he left my office, I picked it up and I looked at it. And I don't know how I did it either. <laughter> But then, I analyzed it and I realized I didn't actually do it. What I did was I had built several other optimizations that had combined in an unexpected way to do an optimization that I hadn't anticipated.

Markoff: Don't things usually combine in bad ways?

Nassi: Yes.

Markoff: But actually had a synergy that was--

Nassi: Yes. This was combined in a good way. And this is a very important thing because it was the first time I had written software that did stuff I didn't intend for it to do, and it was a very positive thing for it to do. And that comes up later in my career.

Markoff: So let me jump back to college before we go on. Did you actually write any of your own languages in college?

Nassi: I did. I started working in the language laboratory and there was a language called--

Markoff: I meant graduate school. But yeah.

Nassi: --Coursewriter, and I wound up writing a compiler for Coursewriter. So yes. That was on an IBM 1800.

Markoff: I don't know that machine.

Nassi: It was like 1130. You probably don't know that machine either.

Markoff: <laughs> I know of that machine.

Nassi: So yeah. I did do a compiler.

<crew talk>

Markoff: So what was-- just separate from work, what was it like moving from Long Island to Boston? Was that a plus? Did you enjoy it?

Nassi: Oh, it was a challenge. It was an adventure. I mean, we had had a little garden apartment in-- on Long Island and we liked it there and we had a lot of friends. And a guy who was ahead of me by a year in graduate school, Rick Shantz, had moved there the year before. And when I interviewed, I stayed with him and he helped us get settled and I really liked it. Boston is a hard town to crack. We lived there for 20 years and we made a lot of very close friends over the time, but it was a hard-- it was hard to sort of get acclimated to Boston. I mean, a lot of history, people-- it's hard to crack in, but after a couple of years, it was just great.

Markoff: Where did you settle?

Nassi: Framingham.

Markoff: And your wife, was she working as a sociologist at this point or what was she doing professionally?

Nassi: No. She had-- she taught while I was in graduate school and then, when we moved to Massachusetts, she stopped teaching. And, given that she had a master's degree and had a head on her shoulders, she was one of the few people that could learn to operate the different kinds of cash registers at Jordan Marsh. So she did that and then we found out she was pregnant and she became a full-time mom.

Markoff: Was SofTech out in the--

Nassi: Waltham.

Nassi: Right on the-- right on Route 128 actually.

Markoff: So you were sort of out of Boston. You were in the MIL-SPEC world. Were you building these things on top of MIL-SPEC computers that were made by companies like Honeywell? What-- who made aerospace computers at that point?

Nassi: Well, General Dynamics. AIL on Long Island, Aircraft Instrumentation Laboratories I think it was called. IBM; I wrote a compiler for the IBM machine-- for one of the IBM machines you probably never heard of. So-- but the compilers that I wrote actually ran on 360s. So I remember making some suggestions about how to redesign some of the target computers and I think it was General Dynamics that actually added the instructions I asked for because that would make a huge difference. So that was kind of interesting.

Nassi: After two years-- these were all cost-- fixed cost contracts. So the faster you got it done, the more money the company made, and it was-- I had a new baby and I was just getting burned out over this stuff. And I was doing a very good job, but I just decided I needed a change. So I called up a friend who had gone to Digital Equipment Corporation and I sent a resume and I wound up at Digital a couple of years later.

Markoff: '76, that was pre-VAX, right?

Nassi: <laughs> So I got my PhD in '74. Worked at SofTech from '74 to '76. When I got hired into Digital, they didn't tell me what I was going to work on. So I thought it was going to be one of these fancy small PDP-10s or something. It wasn't. It was the VAX. <laughs>

Markoff: So, you started in the VAX development effort?

Nassi: I started-- I had a corner little piece of that effort, yes.

Nassi: It wasn't a major effort, but my office was down the hall from Dave Cutler and I-- it was great to see him a few-- a couple of months ago here at the museum.

Markoff: Was Gordon involved in hiring you?

Nassi: No. I got hired by Ron Brender and the consultant that we were using at the time was Bill Wulf from Carnegie Mellon. And the first thing I started there was using the BLISS compilers and helping enhance-- I actually was involved in the BLISS-32, the BLISS compiler for the VAX. And then, I took on some management responsibilities and I was responsible for VAX DEBUG, the debugger for the VAX, and then the runtime library and then a bunch of the tools and just started working my way up.

Markoff: In the mid-'70s like that, had the work environments changed enough? Were you working at displays? What was the compiler environment that you had to--

Nassi: So we did all the-- the software for the VAX was initially done on a PDP-10 and we started with the-- I don't remember the name of it, but it was a terminal that you put paper in, impact printer, and then I remember getting my first CRT. It was the LA-36, I think it was called. And then, I got a CRT and then another CRT and-- interesting sideline on that, I was working a lot and I remember I had both a CRT and an LA-36 at home in the basement. And I had a toddler who wanted to sit on my lap doing stuff and we had a little program called Maze on the CRT. And so, while I was puzzling over some-- whatever I was doing, he was playing this Maze game on there. And then, when he had to take a test to get into kindergarten, the first thing they did was put a maze in front of him. He picked up a pencil and [whooshing sound] <laughter> went right through it and they put him in the gifted children program. <laughter> So-- but it was fun. DEC was a wonderful, wonderful place. I wrote the--

Markoff: So you had a home display for working at home?

Nassi: Yeah.

Markoff: Circa '70--

Nassi: Must have been '77, maybe?

Markoff: Were you doing any telecommuting or was it just convenient so you could work around the clock?

Nassi: Work around the clock. <laughter>

Nassi: I was in the office every day and on weekends and nights and the whole bit.

Markoff: And was the network accessible to you then? Had you become a part of the ARPANET community by that time?

Nassi: Not at that time, soon thereafter. I'll explain that in a minute. But it was strictly dial-up.

Nassi: Modems, right? Acoustic couplers and the whole bit.

Markoff: But by that time, had you gone beyond 300, 1,200-baud modems at that point? Was that the state of the art?

Nassi: I don't remember the dates, but I do remember getting a 1,200-baud modem and being ecstatic about it. <laughter> But let me say one other thing. You know, part of my work on avionics stuff caused the army to contact me when they were starting a high order language working group. And I was invited to become a consultant to the army on evaluating candidate language designs for their standard high order language. And so, Nico Habermann, myself, Greg Andrews at the University of Arizona, Tom Cheetham from Harvard, were all part of this committee to help the army formulate a position on that. And worked on that for a while.

Markoff: This is long before Ada.

Nassi: This was Ada.

Markoff: This is the roots of Ada. So roughly what years did the--

Nassi: It was probably '77, '78.

Markoff: So the IA-432 was rumbling around in the world at that point too?

Nassi: Yes, it was.

Markoff: But not--

Nassi: Well, we did a study about that at DEC and Justin Ratner was involved in that and he also became a good friend of mine and we decided-- and Hank Levy, who-- I don't know if--

Markoff: I know the name.

Nassi: Hank is University of Washington. Yale, also, now. But we concluded that it was far too complicated. Other stories about that, but-- and capabilities and all that stuff. But we-- there were four candidate languages, the red language, the blue language, the green language, and the yellow language. Yellow being the SRI language; green being Honeywell Bold; blue being SofTech, I think; and red was Carnegie Mellon & Intermetrics.

Markoff: Which became--

Nassi: No, green. So Nico Habermann-- so I-- Nico and I worked together and we came up with this compiler optimization, and they wound up calling it the Habermann-Nassi transformation. And we proved—I remember we were there for the final big meeting. It was in a church in Reston, Virginia. DARPA took over this church and all the candidate languages presented stuff and then I was asked to present this Habermann-Nassi transformation, which I did, which showed through clever compilation techniques that the rendezvous in Ada was equivalent to a message passing architecture. And, again, I can go into more detail than you want to hear about that, but it allowed the choice of-- the dynamic choice in the runtime of the best way to compile it. So you didn't do it in the compilation level, you did it in the runtime level, and it was efficient in all cases

Nassi: So green became the language of choice. I was asked to join the language design team, which I did, was [inaudible].

Markoff: But you were a DEC employee while this--

Nassi: I was a DEC employee, unpaid consultant to the army. In parallel, I started a DEC Ada project, which-- nothing said I couldn't do that. Right? So Ron Brender and I started the Ada project. He had been on sabbatical at Carnegie Mellon. When he came to DEC, we started that project. We hired a couple of developers and that was a very interesting effort because a few years later, we were generating about $40 million in revenue, drawing also $200 million in VAX sales. So it was almost a quarter of a billion dollars, and the whole project started with the two of us in corporate research. By the time they kicked us out, because we had hired-- I think we had 25 people. So our one project was the size of the corporate research group and they wound up kicking us out for real estate reasons. <laughter>

Markoff: Describe DEC at that point, in the mid-'70s when you were there, when you entered. Just what do you remember about DEC?

Nassi: A lot of-- good structure. "Making do", "doing the right thing" (for the customer), were all very positive things that were very, very important. Very engineering driven, consensus-driven culture. Give you another side story. One day, Gordon Bell calls me up and he says, "Ike, I got a group coming in from Stanford. They have a design for a workstation." And I was very interested in workstations at that point and I said, "Well, okay. What do you want me to do?" He said, "Well, I want you to take them around and introduce them to all the key players at DEC. And they want us to manufacture this workstation and I want you to introduce them to all these people and then we'll make a decision whether we're going to manufacture it for them or not." And I said, "Okay. Can-- do you have anything I can read about?" He says, "Yeah. I'll send you over the specs." And I open the specs and it's based on this new microprocessor called the 68000. And it's a three-board set, has a processor memory board, a bitmap display board, and Ethernet board. Three boards and I'm looking at this thing. I said, "This is fantastic." So very enthusiastically, I went around and I introduced them to a whole variety of people at DEC in both manufacturing and engineering. We had a meeting a few weeks later. Supposed to be a one-hour meeting. After two hours, no consensus. I start off the meeting saying, "We have to make a decision here. No decision's a decision." So I had to call up Gordon and say, "Look, I did the best I could. No decision." The project was called the Stanford University Network. The company became Sun Microsystems.

Markoff: Did Forrest and Andy come through? Who came through?

Nassi: You know, I asked Gordon if he remembered and I don't remember and I never went back and asked Forrest-- Andy was probably there.

Nassi: A couple of other Stanford people. I don't remember Bill Joy being there, but--

Markoff: Joy wasn't there yet?

Nassi: No.

Markoff: It was just Andy and--

Nassi: No, but I'll tell you the follow-up story. I was so frustrated with Digital, I took a call from a recruiter and I-- two months later, I was out of there and I went to a company briefly in New York that was actually owned by Caesar's World, the gaming company. Don't ask me why. <laughter> But they had a manufacturing line because they were building word processing terminals. The company was called Ontel and I had this wonderful manufacturing facility. So I called up the guys who had started Sun. So I called

this guy, Vinod Khosla, and I said, "You know, Vinod, you guys wanted us to manufacture this stuff at DEC. Well, I have a manufacturing facility. If you want, we can manufacture it for you." And he said, "Yeah. You know, you're just a little too late." I said, "Why?" He says, "Well, we just hired this guy, Scott McNealy, to run manufacturing." <laughter>

Markoff: On both ends, that's a fascinating story because, I mean, Sun might not have ever existed. Well, no. They would have existed, but DEC would-- anyway. That's-- <laughter> It's a complicated-- well, before we-- so CISC didn't exist as a concept when you were there.

Nassi: Sorry, what?

Markoff: CISC. Remember the CISC-RISC--

Nassi: Oh, yeah.

Markoff: --wars? This was pre-CISC-RISC, but you were in VAX land.

Nassi: I was-- actually, it was definitely what we, today, would call CISC.

Markoff: How did you look at architect-- I mean, you were a software guy. What was your view of the VAX architecture?

Nassi: My view was the Motorola 68000 was a two-address VAX. VAX was a three-address machine; 68000 was a two-address machine. Other than that, they were very similar. The fact that it had 24-bit address space on the 68000 was, for me, hugely exhilarating because you didn't have to be tied to 16-bit addressing and it was just-- it was great. The ambitions, the kinds of programs you could write if they gave us more address bits were many, many orders of magnitude more ambitious and better.

Markoff: I don't know a lot about BLISS. Was BLISS a big part of what you--

Nassi: Well, it's very similar to C, actually, except that it had some funky notations that never caught on. There's a concept in programming language that's called L values and R values, where L values are addresses and R values are contents, and it's a thing that never caught on. But BLISS stood for Bill's Language for Implementing System Software, Bill being Carnegie Mellon's Bill Wulf. And so, we wound up writing most of the VAX software and a lot of the PDP-11 software in BLISS.

Markoff: Any memories of Dave Cutler that stand out?

Nassi: Ooh. <laughter> Everybody has memories of Dave Cutler. We had a simulator, a VAX simulator, before we had hardware, and you had to sign up for time on the simulator if you wanted to try your VAX programs on the simulator. And there was one guy who overstepped his welcome and the guy who was waiting for him to finish was Dave Cutler and, as the story goes, I didn't see it first-hand, but as the story goes, Dave is waiting, is waiting, is waiting, and he gets past his waiting point. He walks in, picks up the guy by the belt and the shirt, and just throws him across the room, <laughter> and gets on the simulator.

Markoff: Any stories about Gordon?

Nassi: So Gordon's office was not too far away from mine, but he was the VP of engineering and I was a grunt. So not a lot of stories. He had a guy to head up software who worked for him and mostly the guy was there to apply let's call it project management and budgeting oversight. I remember Gordon called a lot of the engineering team together--

Nassi: It's a lesson I learned from Gordon about measuring things and when not to measure things if you're not going to make use of the data that you get out of the measurements. And I remember this one very large meeting in which he just was very emphatic over-- about people collecting data that wasn't going to be used, because it was expensive and so forth. Other than that, I remember the VAX design meetings and-- but most of what Gordon-- Gordon's contributions were offline. He'd be very careful about what he said in front of people. I can come back to that a few years later, at Encore, but-- Gordon was a god and every time I was around him, it was-- I was in awe. And still am, by the way.

Markoff: <laughs> With Ken, the CEO?

Nassi: <laughs> Ken was, you know, Boston, stoic. He used to have these meetings from time to time, he wanted to hear what the engineers had to say, and I got invited to a few of those. One day, on the third floor of building 3, and he was on the first floor of building 12 -- Gordon's on the second floor of building 12, anyway, I'm walking down the stairs and Ken is walking up the stairs, and at the landing, there's a leak in the ceiling. He's looking at the leak, I'm looking at the leak. He goes like this, shrugs. I got like this, I shrug, and then we continue on. <laughs> So making do is a big thing. You know, the Mill, if you've never been there, is an old gabardine mill. It was a big deal when we sandblasted it and we could actually see the brick. <laughs> It's just a-- what can I say? I loved working at DEC. I wrote the VAX software engineering manual, by the way. People thought it was a brilliant piece of work. All I did was go around and collect the conventions and processes everybody else was using. I think I wrote one chapter of that book myself.

Markoff: Now, you said there was a story about finding the network. Did that happen as a result of your Ada work? Did you get--

Nassi: Actually, it was. So DECnet was being built. We had to do a lot of this collaboration on the Ada design. Jean Ichbiah was in Versailles, I was in Boston, other people were in other places, and the only way to collaborate, because Jean was a real stickler for these language design notes. He wanted everything written down and debated and all this stuff. So we had to keep current on it and there were no central file servers. So I remember I had to get access to this Honeywell system in France all the time and there was no real way to get it. So we ordered a Vadic 1,200-baud Unibus modem. Plugged it into the back of our brand new VAX, the first time I touched hardware ever. Plugged it in. I wrote a program called AutoDial and what that program did was anything you typed on your keyboard was sent out over this 1,200-baud serial line and we got an account at the MIT TAC. Okay? And anything that came on the TAC, we would display on the screen. So this is what today you would call a terminal emulator. This is the first terminal emulator, I think ever, maybe. And every night, I would download the entire-- all the design notes that had changed in the last day, automatically, and it was a great experience. A couple of years later, I got called into Gordon Bell's secretary's office after we were already at Encore-- I know we haven't gotten to Encore yet. Mary-Jane Forbes said, "There's something wrong with our VAX. Could you take a look at it?" Because when Gordon left DEC, they gave him a VAX 11/730 as a going away gift. <laughter> So I got on the VAX, Mary-Jane-- Gordon's VAX and I'm looking through all the programs in there and I see AutoDial in there. <laughter> And I-- what is this doing here? Well, it turned out they started shipping it with every VAX. <laughter> Had no idea. Just funny.

Markoff: What's your historical assessment of Ada? I mean, if you step way back and look at the impact of Ada, how do you see it?

Nassi: Well, good and bad. We missed the whole object oriented thing, [object] oriented programming thing. [I] said I'm friends with Alan [Kay] and we've talked about that for a long time. But to this day, Ada integrated a lot of very difficult concepts in a very structured and complete way. So for example, I worked on some of the data abstraction parts of the language, I worked on the multitasking part of the language. I made sure to integrate exception handling in that and, to this day, I don't know of any other language that's doing that.

Markoff: Were you doing this as an unpaid volunteer at this point or by that time, had you got DARPA money? Or how-- what was your contribution?

Nassi: Well, I was working at DEC. DEC was paying me, but I was also part of the design team. So my travel, everything was paid by DEC. I think we got money from some of product line-- the government product line at DEC to fund some of the travel and stuff. But that was a very exciting thing. Jean and I became very good friends, stubborn as all hell. So was I. He's a Sephardic Jew, I'm a Sephardic Jew.

<laughter> And we got to be really good friends and boy did we fight. It was very sad when he passed away.

Markoff: Tell us just a little bit about Ontel. It was a word processing company?

Nassi: Yes, it was.

Markoff: Owned by a gambling casino.

Nassi: Yes. <laughter>

Nassi: Caesar's World had bought Diablo. Okay?

Markoff: That's interesting in itself. <laughs>

Nassi: And they swore up and down, as I was at the end of the interview process-- no, we're not going to sell the company, we're not going to sell the company. And I was there a week and they announced they were selling the company. I moved the family all down to New York and then, a year later, I had to move them all back. The company was purchased by Visual Technology in Tewksbury, Massachusetts. So that was exciting. But I bought a nice house in Centerport overlooking the water, that was very nice, and had to sell it.

Markoff: I seem to remember Ontel as a word processing player for a very brief period. Right?

Nassi: Yes. Well, one of the [CHM] Fellows a couple of years ago was Evelyn Berezin and she was involved in helping fund that actually.

Markoff: So when you were at DEC in that period up till '82, did you make any strong relationships with the community at MIT? Were you-- did you have a MIT AI account or were you around CSAIL or LCS or--

Nassi: Well -- okay. So the answer's yes--

Markoff: MIT-AI.

Nassi: No, it wasn't SAIL. It was LCS. But--

Nassi: So once we finished the Ada work, once the government gets their claws into you, sometimes they don't like to let go. And so, I get a call one day, could I join this oversight committee for DARPA called--

Markoff: Oh, ISAT?

Nassi: ISAT, yes. It was ISAT. So I joined ISAT and met this guy who became a very good friend of mine, Michael Dertouzos, and we had a grand old time. And so, yeah. I became a research affiliate, actually when I was at Apple, MIT, and Michael and I got to be and stayed very good friends.

Markoff: Visual Technology, tell us just a--

Nassi: Terminal company, wanted to get into the computer business. I learned how to build hardware there. We built a CP/M machine. When I was at Ontel, I built a CP/M machine, CP/M-86. It was a 16-bit micro on the 8086 processor-- sorry, so the 286 processor. And I-- Intel couldn't believe we did this. So they wanted to do a video story. The product manager was a guy named Casey Powell and we had the photographers all lined up and then a couple of days before that happened, Casey resigned from Intel to start up Sequent and he hired one of my colleagues from DEC, actually. And so, there were two companies building symmetric multiprocessors by then, Sequent and Encore, and we competed with them.

Markoff: So this was sort of a minicomputer at that point. It was a Xenix or Unix minicomputer?

Nassi: We did a Xenix machine, we did a CP/M-86 machine, we did a CP/M-80 machine. We built-- we did a portable. We built-- I probably built four computers in that two years.

Markoff: Did you start going to COMDEXes at that point? Was that--

Nassi: Probably yeah. I hated it. Oh, God, I hated it. <laughter> I hated it. But yes.

Markoff: But that was the market. That was how you marketed this?

Nassi: Yeah.

Markoff: It was the small business market that you were looking at?

Nassi: Yeah. And we bundled-- just like Adam Osborne did, we started bundling a lot of software. You know, words, numbers, pictures, and we bundled all that in.

Markoff: So did you leave to join Encore? And tell us the Encore story, how did you--

Nassi: So Gordon had left and Gordon started Encore with Ken Fisher, who was the president of Prime, and Henry Burkhardt, who used to work at DEC and worked on the design with Ed DeCastro of the PDP-8, but then co-founded Data General. And so, that's why they called it Encore. It was another one. Right? And so, Gordon, Henry, and Ken were the founders of Encore and within a couple of months of founding it, Gordon contacted me and invited me to come and join him. And I said, "Gordon, I don't know anything about parallel processing." He said, "Yeah, but you know software. Parallel processing is all about the software." So I wound up joining Gordon at Encore. I met this guy who I thought was a janitor. Turned out it was Henry Burkhardt. <laughter> He had this big booming voice, his shirts were never tucked into his pants, and I had a blast. He was brilliant, absolutely brilliant. I'm not-- I don't think he ever graduated Princeton, but we got along great.

Markoff: And the family had moved back to Framingham?

Nassi: Yeah. When [I] went to work at Visual after they acquired and we went back to Framingham.

Markoff: Where was Encore?

Nassi: Encore was-- well, it started in Wellesley, another story. So here we are in an office building in Wellesley and there's a small company across the street called Software Arts <laughter> and a friend of mine worked at Software Arts and he smuggled me in to see this new computer that he wasn't supposed to do, but it's what became the Macintosh. And David Reed who also worked at Software Arts, who now works for me at-- and worked for me at SAP and here and was a friend of mine for many years. So yeah. So we started-- that was in Wellesley and then, we moved to Marlborough. But then, the Macintosh came out in 1984 and I was the first kid on the block to have one. I mean, I just had to have this because I'd lusted after an Alto and-- I tried to get a job at PARC, they had a hiring freeze.

Markoff: <laughs> Where did you see your first Alto?

Nassi: Probably Carnegie Mellon.

Nassi: There was the Three Rivers PERQ there.

Nassi: So-- because I was at Carnegie Mellon a lot because of my work with Nico and because of my Ada work and-- I spent a lot of time at Carnegie Mellon.

Nassi: But anyway, I-- what was really interesting was I was building these supercomputers during the week and nights and weekends, I'm hacking Macintoshes. <laughter> So I built--

Markoff: That's as early as '84, you were woven into the Mac culture?

Nassi: Already, yeah.

Markoff: At Software Arts, who was there still? Was Brickland and Frankston still there?

Nassi: Oh, yeah, yeah. My friend Steve Lipka was there, David was there.

Markoff: They were close. But you spent five years in the supercomputer world?

Nassi: Well, if you call Encore a supercomputer, yeah.

Markoff: They were called mini supers, weren't they?

Nassi: Yeah. Super mini maybe. Gordon came up with the term.

Nassi: Multi-- no. Gordon's-- Gordon's term was multi. He called it a multi. <laughter> That was his idea of having-- classifying a machine. So yeah. So I started there. I worked on a workstation first and then, we had terminal concentrators and we had the multiprocessor. And then, we came up with this idea, since we had these multiprocessors-- I don't remember who it was. Might have been Gordon who came up with the idea of making a hierarchical version of these things. So you could tie a bunch of multiprocessors together with a bus that went between them, which we called the Ultrabus, hence the Ultramax, submitted a proposal to DARPA, and they gave us $23.5 million to build this thing. Well-- but Gordon-- Henry had a fight with Ken and they wound up splitting and Henry wanted me to start Kendall Square Research with him. But I had this DARPA contract and I just didn't feel comfortable doing that.

Markoff: So you stayed at Encore.

Nassi: I stayed at Encore.

Markoff: Henry went off to KSR.

Nassi: Henry went off to KSR. They got into trouble.

Nassi: One of their employees was-- well-- they hired several of my employees from Encore to go work at KSR, one of whom was this guy called Fred Weber, who I hired right out of graduate school. Fred went on to become the CTO of AMD. Okay? Built the Opteron, which killed Itanium, and he's the guy I hired right out of college and now he's on my board at TidalScale.

Markoff: Excellent. Small world. But you stayed in there. How did Encore do in the market?

Nassi: They wound up selling midling. They wound up-- after I left, selling out to Sun, actually, they had acquired another company in Fort Lauderdale and I wound up commuting between Marlborough and Framingham and Fort Lauderdale, and it was awful. I did that for a few months and--

Markoff: Didn't Gordon end up with another super mini company out on the West Coast?

Nassi: Yes.

Markoff: What was that called?

Nassi: Give me a minute.

Nassi: There's a street (Dana)-- it was named after the street that they were on. But I'll--

Markoff: You weren't involved?

Nassi: I wasn't involved in that, no.

Markoff: But when you were hacking Macintoshes in the evening, what kinds of things were you--

Nassi: It was very simple. I went to a meeting of the Boston Computer Society and-- what's the guy's name? Tracy Licklider.

Nassi: Yeah. Lick's son, Tracy. And so, he was running these meetings and I went every month. And then, somebody at the end of the meeting, they-- just like the Homebrew Club, does anybody know anything about X or Y or Z? And the Mac Plus had come out and had a SCSI port. And I said, "You know, that SCSI port, I could build a hard drive for this thing." So I went to Adaptec and I bought some controllers and I wrote a device driver, and because I was at Encore, I could get these ST-506 disk drives. I put two of them in a package and found somebody who had some sheet metal I could wrap around it and I had a hard disk sub-system that I built for the Macintosh. So this guy made this announcement. I said, yeah. I know how to do that. And so, we actually went into a little side business building disks--

Markoff: What's your company called? Did you have a little company? A little disk--

Nassi: We just started selling them. It was like-- think of Woz but on the East Coast. So we sold a few of them. It was enough to fund my hobby. That's about it. But it was a lot fun. I learned a lot. I had a grand old time. Because we were doing software, I had hired my four-year-old son, I think, to back up all my software on floppy disks. <laughter> Paid him $1 an hour; it was big money then. Today, he is a controller for $2.2 billion in a private equity firm. <laughter>

Markoff: He's gone on from his early roots. That's great. Are there any other Encore stories?

<1:14:51>

Nassi: Oh, yeah, there are. Loads of them. So you remember I told you about the optimization. So we were building a workstation and I didn't like how it was coming out and things were choppy and the-- visually, it wasn't very appealing. So I gave it to one of my younger programmers, who I had hired out of Digital. Name of Dan McCue. He went on to be a VP at Xerox. And I said, "Dan, see what you can do here." And PARC had pioneered this thing called BitBlt and Dan wrote an implementation of BitBlt in software and after a week, I looked at this and it was stunning. It was fast, it was great. I said, "Dan, how did you do this?" He said, "Well, I looked-- just looked at the parameters to BitBlt . I tried to figure out how the rectangles, whether they overlapped or not, and actually had several different algorithms and I chose dynamically which would be the best one." I said, "Well, isn't there an overhead to doing that?" He says, "Look at the result." So there again was-- sometimes, you have to think out of the box and what at first you might reject turned out to be exactly the right answer. So that was one thing at Encore that was good. Another thing was I remembered going-- there were several of us. There was myself, there was Danny Hillis, Randy Rettberg at BBN, and Chuck Seitz at Caltech and DARPA had us on these road shows. So we'd go around the country talking to the national labs. Some of our money came from the Star Wars program, so I wound up going around with this colonel and--

Nassi: But wherever I went, maybe Randy was there a week before and maybe Danny was there the week after. It was just a fun time.

Markoff: Encore didn't compete head on with Thinking Machines?

Nassi: No. And it's only in the sense that we were both DARPA-funded and--

Markoff: Were you head of software for Encore?

Nassi: I was VP [of] Research. I did this Ultramax thing, hardware and software.

Markoff: Did you build a parallelizing compiler?

Nassi: No. We didn't-- I-- no. I was dead set against it, actually.

Markoff: Because?

Nassi: I never thought they would work. I think-- just like Ada, I mean, give the programmer the tools to do concurrency, it's going to get a much better result. The technology to build a parallelizing compiler was not there. If there's no construct for parallelism in the language, forget about it. I still believe that.

Hsu: I guess the only question that I have was you sort of moved from working on minicomputers to then sort of building microcomputers. Like, what was sort of the feeling at the time of this whole PC industry coming up?

Nassi: It was Gordon, I think. I remember when I was interviewing, Gordon and he was explaining to me how you could build a parallel processing machine. It was a little mysterious to me in the interview process and then, all of a sudden, the clouds parted and I realized that you could have multiple processors in a shared memory and each of them would have a unique view of that shared memory and it would look very conventional. And for me, that was a breakthrough in my thinking. So that's how I got into that, again, mostly from the language side, but then the operating system side and then because of my previous contacts with DARPA and-- it just all sort of came together.

Markoff: During that period, did you have contact with-- do you remember Multiflow?

Nassi: Multiflow, yeah.

Markoff: Josh Fisher's company, it was VLIW?

Nassi: Not a lot.

Nassi: Yeah. Yale, right?

Markoff: Yeah.

Nassi: No, not a lot. I heard of it, but we didn't cross paths.

Markoff: Did Larry Tesler bring you to Apple? How did you--

Nassi: He sure did. So when I was at DEC, I had a MIT co-op student named Harvey Alcabes and Harvey wrote part of the-- error correcting part of the parser for Ada for us as part of his master's thesis at MIT. Did a very good job. When I started getting involved in the Macintosh, all of a sudden, one day, I had sent away for this book called *Inside Macintosh* and who writes the cover letter but Harvey Alcabes? So I write Harvey back a note saying, "Are you the Harvey Alcabes who was my student when--" "Yeah, that was me. You know, I'm really glad you did this. Let me introduce you-- actually, are you going to OOPSLA?" And I said, "Yeah. As a matter of fact, I am." He said, "I want you to meet Larry Tesler there." I met Larry. And so, Harvey was brokering this thing with me and Larry and Larry offered me a job and I turned him down. And then, a couple-- a year or two later, he offered me another job and I turned him down. And then, the third time, I was really getting tired of commuting between Framingham and Fort Lauderdale and Larry calls me up and said, "Look, we're buying this company in Cambridge. We're going to build a research lab there for ATG. Do you want to run it?" And I thought, oh, maybe three nanoseconds. <laughter> I said yes. Now, my son was getting Bar Mitzvahed the following weekend. <laughs> So I waited until after that and then discussed it with the family and--

Markoff: Before we jump ahead to Apple, was Tom Gruber ever your student? He worked for DEC as a contract student when he was going to-- a graduate student at Western Mass. I wonder if you overlapped.

Nassi: The name sounds familiar, but I--

Markoff: He's at Apple now. He's one of the architects of Siri.

Nassi: No. I don't think so.

Markoff: He spent a couple of summers while he was at-- not Western Mass. Yeah, he was in Western Mass. What was the school? But he was--

Nassi: UMass Amherst maybe?

Markoff: Yeah, it was.

Nassi: Name sounds familiar, but I don't know.

Markoff: So you created Apple's East Coast lab?

Nassi: I did.

Markoff: Was it focused on-- how broad was it? Were you focused on Dylan from the start or was it broader?

Nassi: No. Initially, the focus was Dylan, the Dynamic Language, and then, of course, Bob Dylan sued us, but that's another story. <laughter>

Markoff: But you won.

Nassi: Yeah. Well, we had to give him a couple of Macintoshes and a-- <laughter> Some small amount of money.

Markoff: Can you believe--

Nassi: That--

Markoff: I wonder what Steve would have thought about that. <laughter>

Nassi: He probably would have crucified me. I don't know. Lawyers handled it. But anyway, we-- so, the idea was-- and you know some of the participants. So, the Newton development team, including our friend Jerome, really wanted a dynamic language. And we had dynamic language technology. We'd done a Common Lisp that ran on a one megabyte Macintosh. And then Larry went off to the Consumer Electronics Show. And he realized that what we had designed was just not going to fly because, at the

time, Newton had a seven-inch screen, two RISC processors in there. And it was going to be way too expensive. So, he came back. And we talked about it. And he asked me to do a study about different microprocessors. So, the chip that we were planning to use from AT&T was evaluated against this company called Acorn, which of course became the Acorn RISC Machine. And we wound up doing an investment in ARM, which saved Apple's bacon years later. But that's another story. But anyway, the study that I did, that my team did, at any given clock speed, we could have a two to one code density factor, which meant we needed a lot less memory. So, we wound up redoing Newton to use the ARM chip as opposed to the AT&T Hobbit.

Markoff: The Hobbit, it was the Hobbit?

Nassi: Yeah. So, we did that.

Markoff: Which was also a RISC architecture, but yeah.

Nassi: Yes it was. It was, but it wasn't anywhere near as tight as the ARM. So, I remember-- I can't remember the guy's name right now, but I used to call him in the UK all the time. And commuting in his convertible, and it was hard to hear him. Anyway, so we re-vectored Dylan to the Macintosh. We released the Common Lisp product on Mac-- rereleased the Common Lisp product on the Macintosh. And given that I was the senior R&D person on the East Coast, Sculley would come out and visit. And I wound up giving these talks all over the place about Apple Research. And when Larry went over to do Newton, Dave Nagel who was my-- so, there were three of us at ATG. There was Shane Robison, Dave Nagel, and myself. We were the three leaders working for Larry. And we're still all good friends today. But--

Markoff: That was Apple of a particular era. You must have fit in-- because you'd been in a research kind of startup, it must have been a fairly easy transition to come-- And you were also independent. You were away from Cupertino.

Nassi: I was. I was. And in fact, Jerome, who ran the software project at Newton, at first wouldn't believe I was an Apple employee. I had to convince him, show him my badge all the time. He's a very funny guy. But he now works for us at TidalScale so.

Markoff: And so, let's see. So, did Dylan have an intellectual impact on languages? Are there ideas that came out of Dylan that--

Nassi: People say it does. But frankly, I don't see it. We tried to do a C-like syntax around Dylan. It was very object-oriented, very dynamic. Alan Kay loved it. It had a lot of things going for it. But it wasn't substantially better than the Common Lisp Object System.

Markoff: Was Alan still there when you showed up?

Nassi: Yeah.

Markoff: Okay, so-- did you have some contact?

Nassi: Oh yeah.

Markoff: And you showed up right around the time that Knowledge Navigator was--

Nassi: I wound up giving all the talks on the East Coast on Knowledge Navigator. So, I'd get trotted out. So, Sculley's PR person, Gabi Schindler, used to fly out. And she would take me to all these places. And I'd give the talk. And it was fun. It was a lot of fun.

Markoff: It was brilliant. You know that Knowledge Navigator directly influenced Adam Cheyer and Tom Gruber to design Siri?

Nassi: No, I didn't know that.

Markoff: That was absolutely the reason. And when trying to figure out where it came from, I went to Alan first. He sent me to Negroponte. And then there's one step farther to a cyberneticist whose name I've forgotten. But it's a really interesting kind of--

Nassi: Well, Alan was probably the guy that thought up the thing in the first place. And the way I would present-- the way I would give that talk, there was the Knowledge Navigator video and then the talk that went with it. And I would talk about the fact that-- show the video. And then I would show all the different constituent pieces of technology in the video and explain how virtually everything was being researched at Apple. And the only exception was the folding screen. We could never figure out how to do the folding screen. One day, I don't know if you know him, but I'm at a conference with Satjiv Chahill.

Markoff: Oh, I know Satjiv.

Nassi: So, I'm at a conference with Satjiv. We had both left Apple years earlier. And he's listening to all this stuff. And I see these tears coming down his cheeks. I said, "Satjiv, what's wrong?" He said, "Ike, remember, we did all this stuff before? And we just never get recognized for it."

Markoff: Were you speaking on college campuses mostly? What kinds of-- was that part of your charter, recruitment, or sort of--?

Nassi: No, no, it wasn't recruitment. But I spoke at the Harvard Business School. I don't remember all the places I spoke. It was a lot.

Markoff: How big did the ATG East Coast lab get under your--?

Nassi: Twenty, twenty-five, thirty people. Something like that. And then so, we got involved-- we, at Apple, got involved in several different merger talks at that time. And when one of the projects completed, John [Sculley] had a party at his house in Woodside. And he asked me to come to his study. And I came to his study. And Michael Spindler came to the study. And they literally cornered me in John's study and said, "Dave wants you to move to California. He needs help running software at Apple. Well, we want you to move to California." And I mean literally, they cornered me, didn't want to me to leave until I agreed to do it. I didn't agree. I said, "I have to talk to my wife." But that's what we did.

Markoff: Okay. How old were your kids-- kid/kids at that point?

Nassi: Kids, yeah. I had two at the time. No, I had three at the time. We had three at the time, yeah.

Hsu: This was what year?

Nassi: Well, I moved to California in '93.

Markoff: '93.

Nassi: So, and we had other discussions with other companies.

Markoff: Let's see. So, Sun, who else? Sun is the one that publicly--

Nassi: Sun, IBM.

Markoff: IBM, yeah.

Nassi: And AT&T.

Markoff: Yeah.

Nassi: So, we had discussions with all of them.

Markoff: Yeah, and you came out as VP Development for Software?

Nassi: VP of Development Tools.

Markoff: Oh, Tools okay.

Nassi: Yeah, so I had MPW, if you remember MPW, all the languages and all that stuff. And then, within the first year, I was asked to take over the OS group. So, I hired Peter Christie, who you may know.

Markoff: I do.

Nassi: And I turned over the development tools thing to Peter. And I went on to do that.

Markoff: What generation of the Mac OS was that? Was that 6, 6/7?

Nassi: 7.0 maybe, so--

Markoff: Oops, sorry.

Nassi: I turned the Cambridge lab over to another guy. I turned development products over to Peter. And then I took over the OS group. And then when--

Hsu: Was the PowerPC already in the works at that point?

Nassi: Yeah. So, it was a very complex time, but when Dave took over all of Engineering at Apple, I took over all of Software at Apple. And that kind of gets into the whole Mach thing, which I'll get to in a few minutes. But yeah, we had this idea to open up the Macintosh. And I remember sitting in a conference room. And I couldn't believe what I was hearing. So, I didn't believe it at first that they wanted to build a hardware reference platform to make a portable Macintosh. It seemed to me the most crazy thing I'd ever heard of because there was absolutely no need to build a Common Hardware Reference Platform around the PowerPC. So, I think it was '95. It was the first working day of '95. We had an off-site in Saratoga. It

was David, myself, Howard Lee, Bill Caswell, the guy who helped start TiVo, Brodie, Brodie Keast. So, we're in this little conference, this off-site. And by then, I had made the decision that this OS kernel that the kernel team, Mac OS team, wanted to build, they called it NuKernel, it was just not going to fly. I mean I took--

Hsu: That was the one from Copland?

Nassi: Yeah, that was the kernel for Copland.

Markoff: Jean-Louis was gone by this time. Is that right?

Nassi: Jean-Louis was-- yes, that definitely, Jean-Louis was gone. I'll come back to Jean-Louis in a minute. When I came out to interview at Apple, they introduced me to this guy, Jean-Louis Gassée. So, I walked in. And I shook hands and introduced myself. And then Jean-Louis spoke for the next hour non-stop. He didn't ask me any questions. But somehow, I passed, and they hired me. Anyway, so yeah, so we're at this meeting in '95, I think it was. And I proposed to pull in this OS kernel that I had worked on at Encore with Rick Rashid and Avie Tevanian and others, Mach microkernel. We made the first symmetric-- true symmetric multiprocessor version of that. I sent a team down to work at Carnegie Mellon to get this work done. And Howard, the hardware guy, all of a sudden he's getting very pale. And I said, "Howard, are you okay? What's wrong?" He says, "You can't possibly tell anybody you're proposing this." I said, "Why?" He said, "Because if you do this, IBM will stop making PowerPCs. And it will absolutely tank us." But I felt pretty strongly about it. And Dave let me start a project to do MacMach. And I did. And in the '90--

Markoff: Why would that have pissed off IBM?

Nassi: Because it was portable. We could move to Intel almost immediately.

Markoff: Oh, I see. I see, yes.

Nassi: And that's what happened. That's exactly what happened. So, I started a small project with a couple people from the OSF, Open Software Foundation, at Cambridge, a couple guys in France, a couple of my guys in Cambridge from the ATG lab in Cambridge, and a couple people in Cupertino, but very, very quiet and couldn't talk about it. And then it was '96, I think, at the developer conference I started handing out MkLinux CDs with all the source code on it and all that stuff. At the same time, Gil-- yeah of course, Gil [Amelio] was already CEO by that point. Dave had left. Sculley had left. [Michael] Spindler had left. Gil was hired. Ellen [Hancock] was on board. And Gil just wanted me to do Be.

Hsu: Really?

Nassi: The Be operating system.

Markoff: Yeah, they were going to acquire Be, so you were going to be the manager of Be.

Nassi: Dave had asked me to do an evaluation when he was CEO of PalmSource. And I did that. And they actually bought the rights to that, as well. But given Mach versus Be, I thought that was just insane. I already had Mach up and running. Why do this, Gil, why? And he and I just didn't see eye to eye on that question. And that was in the summer. And shortly thereafter, I talked to the HR person. I said, "Look, I want out of here." "No, you can't go. You can't go." But by November, October/November--

Markoff: Did Gil have an imperial style?

Nassi: Ellen certainly did.

Markoff: Yeah because she was IBM culture.

Nassi: He did too.

Markoff: I heard there were stories of the silverware in the executive dining room and all this stuff that Steve sort of cleared out when he came back.

Nassi: I probably shouldn't talk about that stuff.

Markoff: Yeah.

Nassi: There are lots of stories. But anyway, so Gil and I didn't see eye to eye. And I was-- Heidi was there at the time. Heidi Roizen and I were colleagues. And I just had to get out. And I did. And that's when I went to Berkeley actually.

Hsu: So, you weren't involved in the negotiations with NeXT at all?

Nassi: That all happened just as I had one foot out the door. Steve had called up either Gil or Ellen, I'm not sure. And I was already leaving. But I had-- Mach was already up and running. Now, we didn't hook it

up to the rest of the Mac OS. I don't want to diminish anything that that team did when they came in. It was brilliant. But the microkernel was all there. And you know years later, I was having dinner with Rick [Rashid], who I've been friends with forever, we were both-- we both had the time on the board of the Anita Borg Institute for Women in Technology. We were having dinner in Palo Alto. I said, "Rick, how did it feel? You're head of Research at Microsoft. And yet, you're work is in my Macintosh?" He looks at me. He says, "You know, that's not what amazes me." I said, "What amazes you?" He pulls out his iPhone. He says, "My software is in every iPhone that's there in addition to the Macintosh." And of course the iPad came out later, but that was just a lot of fun, a lot of fun. But it is-- the Mach microkernel is literally at the root of every iPhone, iPad, and Macintosh today. And just for the record, I brought that into Apple.

Markoff: That's very cool.

Hsu: So, that was in MkLinux?

Nassi: So, another funny story about that, I had a friend who's an astrophysicist at UC Santa Cruz by the name of George Blumenthal. Today, he's the chancellor of UC Santa Cruz. And one day, he calls me up. And he says, "There's a lecture. Maybe you want to hear the lecture. It's an IT lecture. And I'm thinking of going to it because the guy who's giving it is a very famous physicist, astrophysicist." I say, "Who's that?" He says, "Arno Penzias." So, I said, "Sure." So, George picks me up. We go down to Santa Cruz. And he's going on and on and on about this thing called Linux. And he really likes it. And it's got a Fortran compiler. And he can run it on his Sun workstation. Well, we get to the lecture, and we listen to Arno talking about IT for some reason. I don't know why. And then George says, "Do you want to get some coffee?" I said, "Yeah." And so, George says, "Let me just introduce myself to Arno Penzias." And see, George is very, very tall. And I'm very short. So, we go down to the front of the lecture hall. And George peels off to go say hello to Arno. Arno sees me, says, "Ike, what are you doing here?" I said-- George looks at me. He says, "You know Arno Penzias?" I said, "Yeah, as a matter of fact, we were on the Council on Competitiveness together in Washington." It was just a funny story.

Markoff: That's great.

Nassi: But when we had to make a decision about what personality to use for Mach on a Macintosh. I called up George. I said, "Remember all that stuff you told me about Linux?" He says, "Yeah." I says, "I think that's what we-- do you think that's what we should do?" He said, "Absolutely." So, I put George in the press release. So, we give out MkLinux. And then there was another version of it, a couple of versions of it. And then Steve came back and brought Mach into the company.

Hsu: That was NeXTSTEP.

Nassi: That was NeXTSTEP.

Hsu: I had-- I wanted to go back to when you were head of Developer Tools and MPW. So, that was around the time that the transition to the Power Mac was going on. And was it worrying that third party developers were using CodeWarrior rather than MPW?

Nassi: Wow, you've got a good memory. So, Greg Galanos and I also became friends. I liked CodeWarrior, but no it wasn't a particular problem.

Markoff: In the early days of the Mac, did you ever run across MacNosy?

Nassi: Of course, Steve Jasik could talk my ear off all the time. Absolutely.

Markoff: He's still doing it to this day.

Nassi: He's still doing it to this day, right.

Hsu: Was MacApp part of your--

Nassi: Yes.

Hsu: Part of your group.

Nassi: Yes.

Hsu: Like was there any reason why MacApp was never fully successful compared to PowerPlant?

Nassi: We-- MacApp had a long positive history. At the time, we were very interested in doing common development environments for Windows and Macintosh. And Symantec had a framework called Bedrock. And Apple had entered into a development agreement with Gene Wang and the CEO, Gordon Eubanks. And the first day after moving to California, the first day-- literally, the first day 8 AM, Gordon and Gene were in my office because I had read through the contract. And it was a terrible, terrible contract. And I just wanted us to get out of it. And they started lobbying me very heavily not to do that. But that's what we did. And we paid them some money. And we got out of the contract.

Hsu: So, the Bedrock killed MacApp because it was competing?

Nassi: No, actually we got out of the Bedrock contract. And by that point, well I don't remember what happened at that point. But eventually NeXTSTEP came in.

Hsu: Right, okay. Yeah.

Markoff: Were you—did Taligent precede you?

Nassi: I was on the board of Taligent.

Hsu: Oh yeah, you were on the board, right.

Markoff: So, had you gotten to California?

Nassi: Yeah, I was already in California. I was on the board of Taligent.

Markoff: It was Taligent, and what was the other one, Taligent and--? It sounded like a skin--

Hsu: Kalieda, Kaleida?

Markoff: Kaleida, yeah.

Nassi: I wasn't on the board of Kaleida. But I was on Taligent.

Markoff: Taligent, yeah.

Nassi: But that was supposed to be a successor. And there was some codenames. And I don't remember the codenames.

Hsu: So, why did Taligent-- like comparing Taligent to, say, NeXTSTEP, they're both sort of quote, "object-oriented operating systems."

Nassi: Well, it was more of a development environment than anything else. But actually, all that stuff-- at the time, the technology wasn't as well understood as it is today. And a lot of those environments became very bloated. And they just never worked. They just were not viable. I'll leave it at that.

Markoff: So, toward the end, the web was a fact of life starting '92/'93/'94. So, gosh not HyperCard, but Cyber--

Hsu: HyperCard, CyberDog?

Markoff: CyberDog.

Nassi: So, CyberDog was done under my watch.

Hsu: OpenDoc.

Nassi: OpenDoc was done under-- I was on the board of the OpenDoc Foundation also. But I've got to just tell you a funny story. This a very funny story. So, on the way-- I moved in the summer of '93 to California. And we dropped my oldest son off at Brandeis. He was just starting college. We literally dropped him off at orientation and continued on to Logan Airport, got on a plane, moved to California. I wasn't very popular with my wife at that point. But be that as it may, after a few months, Jason came out to visit. And he liked it in California. It was the first time he wore shorts on his birthday. And I brought him to my office at Apple. And I said, "I want to show you this thing. It's called a browser. And it's really interesting." And I gave him a tour of the Louvre using the Mosaic browser. And he's looking. And he's starting to shake his head. I said, "Jason, what's wrong?" He says, "It's never going to work." I said, "What do you mean it's never going to work?" He says, "At Brandeis, we have all these other programs, things like Gopher and FTP," and this and that. He says, "That's the future of computing." Now wait a minute. Now, Jason, after six months, got a job in the computer center. And he did this, was his job in college. After he graduates Brandeis, he comes out because Brandeis offered him a job. They want him to work there full time. They're going to offer him what he thought was a lot of money. It really wasn't. And so, his mother and I convinced him he really wants to come to California. He comes to California. And after a week, he still doesn't have a job. And after two weeks, he doesn't have a job. And he's going crazy because he doesn't want to live with us. After four weeks, he gets a job at a small company called Netscape.

<laughter>

Nassi: The rest is history.

Markoff: What did he do for them when he-- do you remember when he was first--?

Nassi: He started working on LDP-- sorry, LDAP. And then he became a manager. He worked on the Sun/Netscape joint-- Sun/AOL joint venture, whose name I can't remember at the moment. And then they got a divorce. Sun and Netscape-- AOL got a divorce. And he went back to AOL. And they wanted him to move to Virginia. And he didn't want to move to Virginia. So, he left. And then he helped-- he was employee number sixteen at SugarCRM. He did that a number of years, left that and went to help start Twilio doing the same thing. He worked for me part time at TidalScale-- no full time at TidalScale, but for a year, almost two years. And then he left in April. And he's now the head of customer engineering at SalesForce.

Markoff: Oh. So, you know he works with? Benji Jasik. Do you know Steve's son is a real--?

Nassi: No, I didn't that.

Markoff: Benji went to Princeton, got a CS degree. And he's one of Mark's troubleshooters. But he's—

Nassi: I'll ask him about that—

Markoff: Ask him what he thinks-- Benji's great. He's not like his dad at all in terms of being-- So, in your Apple experience, by the time you got to Cupertino, the diaspora of General Magic had happened. But when you were at ATG, did you cross-- there were all these great projects. There was Magic Crystal, or Pocket Crystal. There was Swatch.

Nassi: Marc Porat was one of my colleagues there. Yes, absolutely.

Markoff: Did you get involved from a software point of view in any of those?

Nassi: Not really. Mark would try to hook as many people in as possible. But I was busy.

Markoff: And did you-- when you came to California, was Paul Mercer still around when you came out? Did you have to manage Paul?

Nassi: No, I didn't have to manage Paul. I did have to manage some of the other interesting people.

Markoff: Yeah.

Nassi: And we talked about Shai, Shai Agassi.

Markoff: Oh, that's right. He passed through Apple, too, didn't he?

Nassi: He did. He did. He had a company. And they consulted for ATG. And when I-- and the reason why he tells everybody jokingly that I fired him was because I wouldn't accept-- I wouldn't transfer his project from ATG into Development. And that caused them to stop the development project. And so, he went on to do other things.

Markoff: Okay.

Nassi: And he was the one who hired me as chief scientist at SAP.

Markoff: Okay so, but before that, your step out of Apple was to this small startup called--

Nassi: No, no, when I left Apple, Sue Graham at Berkeley contacted me and asked me to come to Berkeley as a visiting scholar. And I did that for a number of months. And I worked with Larry Rowe and Steve Mann and Sue Gerhardt-- Sue--

Markoff: Yeah, I know who you mean.

Nassi: Anyway--

Markoff: What fun. But a long commute--

Nassi: Of too long a commute. That's why I stopped. Randy Katz had started to try to get me better integrated. He asked me to join the book club that he was running. I just couldn't do it. It was just too far. So, then this recruiter called me up and said there was a really interesting company that he wanted me to take a look at called InfoGear. And then Dan Eilers, who I'd worked with at Apple, wanted me to do what sounded like the same thing. And it turned out they were the same thing. CIDCO, that Dan was now the CEO of, was building the product that InfoGear had designed. And I chose to go with InfoGear.

Markoff: That was a handset, essentially.

Nassi: That was the iPhone. It was the first iPhone.

Markoff: Oh, it was portable?

Nassi: It wasn't portable in the sense that the iPhone is portable today. It was--

Markoff: It was like a smart telephone.

Nassi: It was a smart telephone. It had a seven-inch screen, a pullout keyboard. It had a browser, email, a whole backend Solaris-based infrastructure that did all the heavy lifting and the rendering for the browser.

Markoff: So, they just put yesterday, two days ago, a Cisco handset on my desktop. Is that the set?

Nassi: It's probably some of our technology.

Markoff: It's passed down through the--

Nassi: Yeah, so Cisco bought InfoGear. They had already owned-- so, Intel was an investor. NEA was an investor. Allegis was an investor. And Cisco was an investor, Charlie Giancarlo. And we were preparing to go public, the bubble-- you remember the bubble at the time. And I get a phone call from our CEO at the time at InfoGear. He says, "Well, Cisco wants to buy the rest of the company." They already owned eight percent. They want to buy the other ninety-two percent. And I said, "Take it." And we did.

Markoff: Were you-- did you become CEO of InfoGear?

Nassi: No, no, I didn't. I was the CTO and head of Products. So, I learned to do manufacturing and a bunch of other things. The guy who ran Performa manufacturing at Apple, I hired into InfoGear, Malachy Moynihan. And we built a series of products.

Markoff: How would you-- what was the metavision of Infogear?

Nassi: Internet appliances. Internet appliances, easy to use Internet appliances, touchscreens. And that was, of course-- so, we sold the company to Cisco. And then in parallel with that, we were designing, on a handshake really, a wireless web pad. Wi-Fi, 802.11 was just being ratified. So, we built a wireless web pad. And Cisco didn't bring either of them to market. And they asked me to do the multimedia version. And I said, "This is ridiculous." And so, I was-- I had a two-year contract there. And I asked Charlie to get me out of the contract. And they did. And I asked for something like nine months' severance or something. And they said, "No, no, no, no." They wound up giving me eighteen months' severance. But I left. And I joined Allegis Capital as an EIR and did a bunch of consulting. And then I realized I didn't want to be a VC. I want to build products. I want to be part of a team. So, I started another company.

Markoff: What was going to be the startup out of Allegis?

Nassi: Oh, it was Firetide. That was the wireless mesh network.

<1:49:48>

Markoff: Okay. So, let me step back. What was your time like at Cisco? You didn't stick your two years out?

Nassi: No, a year, I was there a year. It was good. I just watched the stock tank horribly. I mean when we sold the company, our valuation on that stock was sixty-two dollars a share, something. It went up to eighty. Then it went down to eight. And I was locked up. I couldn't sell very much of it. And but the company was a great company. I liked it. But I just never felt integrated into it.

Markoff: So, you're at Allegis. How did you stumble into wireless technologies and mesh network--? What led you in that direction?

Nassi: Oh, that's interesting. Well, it happened when I was at Berkeley. When I was at Berkeley, I just started thinking about what happens if you put a radio in every router. How did I come up with that idea? I don't remember. But I said okay, if I have a radio in every router, what would the routing protocols look like. And one thing led to another. I found that SRI already had been doing research in this area. And I felt that I could start a company. And if I could license the technology from SRI, I'd get a head start on everybody else. So, we went and had a very-- and I'd already had a collection of people around me at that point. And we all went to visit SRI. It was the first time we met as a team. And that was on September 11th 2001.

Hsu: Wow.

Markoff: You were there when--?

Nassi: I was at-- yes. I was at SRI when the twin towers came down.

Markoff: Wow.

Nassi: Well, actually, they had just come down a couple hours earlier.

Markoff: So, everything was paralyzed for-- nothing happened for weeks.

Nassi: That's when I-- that's-- you'll be interested in this. That's when I-- the next day is when I started subscribing, again, to the New York Times. And I've been a subscriber ever since.

Markoff: Thank you. So, you built this team around this new architecture in wireless?

Nassi: Yeah. It was very hard to raise money. The bubble had just burst. A friend of mine, Barry Weinman, had suggested that I try raising money, not in Silicon Valley, but in Hawaii. And he was a big fan of Hawaii. And they had tax credits, all kinds of advantages, retired VCs lived there. So, I travelled out to Honolulu. I stayed in one of his-- he had two apartments. I stayed in one of the apartments. And I started talking about wireless Waikiki. And one thing led to another. And we raised one point seven million dollars. And we started a company in Honolulu. And I started commuting from Los Gatos, where I lived, to Honolulu. And--

Markoff: Did you draw the parallels between ALOHAnet, did that come--?

Nassi: Absolutely. Absolutely. The Sprint network is great in Honolulu. I gave talks at the University of Hawaii at Manoa campus. I started meeting a lot of people there. But in the end, you couldn't hire good engineers in Honolulu. And we wound up shutting it down a year later and moving it to Los Gatos.

Markoff: And the time from founding to the time you sold it, how long was the--?

Nassi: Well, I left in 2005. But the company was only sold last year or the year before.

Markoff: And were you still in touch with Hennessy because he was involved in a Wi-Fi company, too?

Nassi: Yeah. Atheros.

Markoff: Yeah.

Nassi: So, yes. So, that's a story I haven't told yet. So, let me go back. Remember I told you about Henry Burkhardt at Encore?

Markoff: Yeah.

Nassi: So, we were looking at—we had to get a new microprocessor. And one of the things we wanted to do was come to the West Coast and look at MIPS and look at various other microprocessors. And so, we came out. And so, we brought a bunch of people with us. And we were going to meet John Hennessy at MIPS. John Hennessy, everybody's all excited about that. So, we get into the meeting. And we're talking with Steve Blank. And we're there. And Hennessy's late. And Hennessy walks in. He looks at me. He says, "Ike, what are you doing here?" And my colleagues, including Henry, look at me. They're, "You know John Hennessy?" "Yeah." It was just a lot fun. We wound up getting the Motorola 88000, by the way. So, we didn't actually get MIPS in the end.

Markoff: Yeah, this was just as the component for the Encore machine?

Nassi: Yeah.

Markoff: Interesting.

Nassi: Yeah. But you were asking me about wireless. Yeah so, Teresa Meng was one of the people there and John. And then when I was looking for a CEO at Firetide, I started talking to Rich Redelfs, who is now on the board here at the museum. But he wanted to be a VC. So, I didn't get him to be CEO. I had to hire somebody else.

Markoff: And your decision to leave Firetide, what motivated you to--?

Nassi: Well, we had gotten to the point where we had money in the bank, six to seven million dollars in the bank. And I had built the manufacturing team. I built the whole executive team, the engineering team. And frankly, they didn't need me anymore. So, I had a conversation with Dubose Montgomery at Menlo Ventures. And Dubose was encouraging me to leave, basically. And I looked at it from the standpoint of an investor rather than an employee. I didn't really need to stay there. And I didn't. So, they asked me to do one last thing. They asked me, because I had been-- we haven't gone through this, but as a hobby, I started studying Mandarin. And they asked me to open up China. So, I got on a plane. And I went to China. And I started talking to the press and all this stuff. And it was a lot fun. And then I had a down day. So, I had to find something to do. And I went to the Great Wall at Ba Da Ling, which I've been to a number of times. But it was very crowded that day. And I was walking down the steps. There was a crowd. And I wound up falling down the steps at the Great Wall. And well, I spoke Mandarin. It wasn't the greatest Mandarin. But it was good enough. But I knew I broke my foot. It was just broken. And so, I had to cut it all short. I had to start haggling for a cane, a souvenir cane in Mandarin. And when I got home, it was a little dangerous because when you fly with any kind of a-- immobilized in any way, you get these blood clots. So, but I got home. And I'm on crutches. And I think it was about Passover time. And I went to a Seder. And a friend said, "I told a friend, 'Why are you on crutches?' And he told me." So, he listens.

And he's, "Oh, it was the Great Fall of China." So, I said, "Yeah." And that kind of stuck. That was Dennis Wolf. Dennis is now the CFO at DataStax, was at MySQL and other things. He's a good friend.

Markoff: Before we go on, I just realized that you were deeply enmeshed in Route 128 culture. Then you were deeply enmeshed in Silicon Valley culture. Could you step back and just sort of when people ask you to compare and contrast--

Nassi: That's a very interesting question. It's a very deep question actually. We could spend a lot of time on that, I think. But if I had to summarize it, on the East Coast, you argue and argue and argue. And it's a common way of doing things. And you can argue very vehemently on technical matters. When I got to the West Coast, I remember doing the same thing. And on the West Coast, that's the wrong thing to do. People take it personally. So, when you argue against somebody's idea, they think you're arguing against them. On the East Coast, you're arguing against an idea. It's a completely different mindset. So, I had to learn to adapt pretty quickly.

Markoff: You know, that's interesting. As a reporter, that precisely describes the way I think about Bill Gates and Steve Jobs because I dealt with them over-- you could argue with Bill forever. And it was not personal. Steve, everything was personal. But anyway, that's--

Nassi: That was exactly right. I remember I had dinner with Bill once-- anyway.

Markoff: How did SAP find you?

Nassi: Well, there I am on crutches. And somehow, the SAP folks found out that I'd left Firetide. Aliza Peleg, if you know Aliza, she worked for me at Apple. And she had-- was now the managing director at Palo Alto Labs working for Shai. Shai was the president of SAP products. And she found out. And she said, "Shai wants you to come in." And I'd just bought a new car with a clutch. I couldn't drive. I had to get my wife to drive me and walk in. And that's how they found me. And Shai said, "I could have met you in Los Gatos," because I lived in Los Gatos. "That's okay. Don't worry about it." So, he offered me a job building an appliance, an appliance for NetWeaver. I said, "I've been in that business. I don't want to do that again." So, I turned him down. And then he said-- well, he talked to one of his colleagues, another board member at SAP, Peter Zenke, who had responsibilities, among other things, for research. And Peter offered me the research job. And I thought that could be interesting. And I joined as senior vice president of SAP research at-- that's how I got there. But the more interesting thing happened in that around 2007/2008, we started acquiring pieces of technology. Hasso Plattner had this idea about in memory databases to compete with his arch enemy Larry Ellison over at Oracle. And I certainly don't agree with everything Hasso said. But in this particular case, I agreed with him, very much so. And so, we start acquiring these pieces of technology. And then Victor Zue asked me to come to MIT on sabbatical. And I asked Vishal Sikka, who was the CTO, "Do you have a problem with that?" "No." So, I went off to

MIT for a while. And when I came back, I'm sitting in the boardroom at SAP. And we're doing a review of what ultimately became SAP HANA. And I remembered something I learned from Dave Cutler back at DEC. What Dave used to say was, "There's nothing that worked-- nothing that helps virtual memory like real memory." And so, I paraphrased Dave at this meeting. I said, "Hey guys, if we're really serious about building in memory databases, you do realize you need a lot of memory, right?" And I look around the room and blank stares. So, I talked to Vishal. And one thing leads to an-- so, he asked me to study that. And I did. And I remember, it was my anniversary weekend. It was July of 2010. It was Saturday. I called him up at home and we talked about it. He said, "What should we do?" And I said, "If you want, I'll build you a machine." "You can do that?" "Yeah, I can do that," because I've done it already, right? So, I built the first of these machines. It was a ten terabyte machine. It had a lot of memory and a lot of processors and very fast interconnect. And that October, we announced internally the first results. And the queries were twelve times faster than what was being done on a Teradata machine. So, we announce that. And everybody's-- the top two hundred executives at SAP. And everybody's, "Wow, this is great. This is fantastic." And then he said, "Oh, by the way, we're running it on a machine that Ike built. And it was only one fifth of the price. And so, it was twelve divided by one fifth. It was 60x price-performance advantage. And all of sudden, people started moving away from me because we're a software company. What are we doing building hardware? So, I was supposed to get that machine back. I never got it back, turned it over to the HANA team, what became the HANA team. And over the next fifteen months, I wound up building fifteen of these machines. And we put five of them in the customer sites and ten of them were used for internal development.

Markoff: You call them a memory-oriented supercomputer? What would you call it?

Nassi: What?

Markoff: I'm just thinking about it. What-- how to describe this?

Nassi: And you just-- I just remembered the name of the company Gordon did. It was Dana.

Markoff: Dana, that's right. Dana.

Nassi: <laughs>

Markoff: Yeah, yeah, yeah, yeah.

Nassi: But anyway, I'm sorry, what was your question?

Markoff: Oh, was this-- would you call it a memory-oriented supercomputer? What would--

Nassi: So we did two versions of it. One was a very tightly coupled distributed system. Ten nodes, 10 copies of the OS, 1 terabyte per node, 4 sockets for each node. So it was a lot of power. And 40 gigabit Infiniband. But the thing that I felt really compelling was, could we build a coherent shared memory one like the Encore Ultramax that I had done years earlier-- decades earlier. And so we built 5 of those, okay. And SAP, you know, this was a time when Oracle had just acquired Sun. HP was acquiring software companies. Leo was the CEO. And so the only big company out there that wasn't only hardware or only software was SAP. So I was trying to get SAP to become both. And another odd story, Scott McNealy and I are both big hockey fans. Our seats were near each other at the Shark Tank. Hasso would wave and Vishal would wave. And we saw-- they saw McNealy there. And so I wound up walking into a room, the board room at SAP, and I'm sitting there with McNealy. And we start talking and one thing leads to another and he said, "What's to convince? You're already a hardware and software company." I said, "Well, no, not really." And so they kept on in fits and starts making the decision and then unmaking it about, you know, do we want to be an appliance thing. Now this is all in addition to my day job, which is running research centers around the world, right. But after four abortive attempts at trying to do this, I said, "You know, I don't need to do this anymore." So I came home on a Friday and I said, "That's it. I'm done." 'Cause they just can't-- I was supposed to present to the SAP board the following Monday in Vancouver and on Friday afternoon, they cancelled my agenda item at the meeting. I said, "That's it. I'm done."

Markoff: Yeah.

Nassi: And so I said, "I'm going to retire in a few months and just let's leave it at that." And I did. And that's when Santa Cruz found out. I told Santa Cruz that I was leaving, 'cause I had sponsored work there in the Ceph file system. And they said, "Well, why don't you come here and be a professor?" "Well, I can do that." And that's how I got to Santa Cruz.

Markoff: Just a little bit about the, you know, running the Silicon Valley arm of a German corporation.

<laughter>

Nassi: No. This is worth-- there are many books about-- that you could write about this.

Markoff: There was texture.

Nassi: Ah. <laughs> A lot of competition. I had groups in Germany, Ireland, Bulgaria, Montreal, Israel, Shanghai. I had these groups all over. I mean, you know, IBM[1] Global Services four years running, you know. And there was always this real tension between the Germans and the Americans about who was controlling it. Vishal was the CTO doing the flagship product, HANA, much of which was done in Germany. Product management was in Israel. It was very, very difficult.

Markoff: Was Vishal the person who funded Allan?

Nassi: Yes. I introduced them, so. I had Allan come in once to address the SAP board about new technology. <laughs>

Markoff: Interesting.

Nassi: The board's eyes glazed over. But I introduced him to Vishal and yes, that's how that happened.

Markoff: Yeah, yeah. What did you teach at Santa Cruz when you went as a professor?

Nassi: I don't actually teach classes. I have some graduate students and I'm part of the Database Group, the Systems Group and the Storage Group at Santa Cruz, and I still am.

Hsu: So you're a faculty advisor for graduate students doing research?

Nassi: And I fill in and teach classes when somebody's going off to a conference or something and they ask me to fill in. I'll do that. I have an office on campus.

Markoff: Yeah.

Nassi: I really like it there.

Markoff: Just going back to, you know, the fact that you had this global purview into research, how level or unlevel is the playing field of the world-- you know, at your level, at that kind of state of the art research, you know, compare and contrast the different labs in terms of the quality of the research or-- Like, I've been wondering about how close China is, for example, to the U.S. in certain technologies, like AI or software. Did you see differences?

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[1] Correction: United Airlines Global Services

Nassi: Oh. Well, you know, the state of industrial research in the U.S. is sinusoidal in nature. You know, there's never going to be another PARC as far as I can tell. I mean, think it-- Well, you know this as well as anybody, you know, graphical user interfaces, WYSIWYG editing, Ethernet, laser printers. Just the set of things coming out of there. The book "Fumbling the Future," which I'm sure you've read. Bell Labs is no more. And, you know, SAP Research I think is no more as well. I mean, I just don't think they have a research group. I don't know that for a fact, but. They're actually one of my investors, you know, in my current company. And I was just there two days ago, but I didn't ask that question. <laughs> You know, I think what I try to do, what I've always tried to do is applied research, not pure research in any sense. And, you know, even Microsoft, Rick [Rashid] had a 20 year run as head of Microsoft Research, and they shut down the research center here right across the street. I think it's just really hard to do that these days.

Markoff: Yeah. Were the roots of TidalScale at all in that experience you had in building those interesting machines at SAP?

Nassi: Absolutely. Absolutely. I mean, you know, so in preparation for that meeting I told you about where we ran the first queries 12 times faster than Teradata, it took the team of very talented-- 30 talented developers a month to do that first benchmark, 'cause they had to partition the data, shard the data. You know, I joke around, you know. SAP is used at Apple a lot, okay. And if you really peel the iTunes Music Store back, there's an SAP system in there, right. And when John Lennon comes back from the dead, they're going to have to re-shard all that data.

<laughter>

Nassi: So <laughs> yeah. So the roots go back to Encore, 'cause if you think about what is today on a board, you have multiple cores on a processor. You have multiple processors on a board. That is a hierarchically structured multiprocessor. That's what we built in the eighties at Encore. And in some sense, I'm just resurrecting that same idea, but I'm building a whole bunch of them and tying them together. And I'm doing it in a way today that I think is much better than what I did at SAP. Much different as well.

Markoff: So just tell us the story of TidalScale. The idea and then you know.

Nassi: Yeah, so I built these, 15 of these what I call Enterprise supercomputers over a 15-month period and--

Hsu: At SAP.

Nassi: At SAP, and I was very frustrated with the effort. Not the idea, but the effort of how much work it was going to be and was to do all this scale out kind of computing. I mean, you know, Hadoop was already out there. But you know what? Not easy to use. You had to shard the data. You had to re-shard the data. You had to partition queries across a distributed system. You had application people writing distributed systems programs. And it was very frustrating. So I went to Santa Cruz and I'm in the Systems Group and it was February, I think, of 2012. And I'm saying, "You know, the stuff-- my intuition back at Encore was spot on. And the same thing happened at SAP. I really should start another company." So I just went and I found the domain name and registered it and incorporated the company. And had no big thoughts about that. We had a post-doc, a woman, a theorist really, who was a post-doc in our Systems Group, and her post-doc appointment was coming to an end and she had two little kids at home. Her husband worked at Google. And I caught her one day writing some code. I said, "What are you doing?" She says, "I'm writing Euclid's algorithm. I have to learn to program." The woman has a Ph.D. from the University of Toronto. I said, "What are you doing?" I bought her a book on Macintosh programming and I started teaching her how to program. And so she wrote the first program. I said, "I'm going to do this right with you." And I wrote the same program and we did it and we finished about the same time. I said, "Now go to exercise number two." And this was the Cocoa book, I think it was.

Hsu: Oh. Which Cocoa book?

Nassi: I don't remember. <laughs>

Hsu: Aaron Hillegass's Cocoa book?

Nassi: I don't remember.

Markoff: <laughs>

Nassi: So she started on the second one and she finished it. I hadn't even started it at that point. And so I said, "You know, you really need to learn Python and I want you to write a distributed discrete event simulation."

Markoff: <laughs>

Nassi: So I loaned her a bunch of laptops and she started writing this code. And one thing led to another and within a few months, I had four people working basically out of my house. Gordon wanted to invest. And I said, "Gordon, when I invest, you can invest. I'm not ready to take investments yet. I'm just playing around with these ideas." In the meantime, I had written the first patent. Well, I had written a comprehensive patent disclosure which became two patents. I filed them. And in November, I have four

people now working full-time on this. I wasn't paying them anything, so I put some money in the company and I called Gordon so he could put some money in the company. And Gardner Hendrie put some money in the company and Dan Siwiorek who had worked on the stuff years or decades earlier at Carnegie Mellon put some money in the company and all of a sudden we had, you know, some money. So we could now-- I told everybody we were going to start payroll. And one of the guys was Chuck Piercey who ran product management for me at Apple. So it was Kleoni, Chuck, I had introduced-- I had been introduced to Michael Berman who became our VP of Engineering and myself. And I'm basically working full-time on this stuff. So we started payroll in January. And a friend of mine from SAP, from SAP Ventures at the time, was now working at Citrix, so she introduced me to some of the M&A people at Citrix. And one thing led to another and we became part of the Citrix startup accelerator. They gave us office space which was greatly needed. And we started working at Citrix. And they invited us to a hockey game. So, okay. And as I said earlier, I'm a very big hockey fan and I had very good seats, and much better seats than Citrix. So I didn't want to accept those seats. But Chuck convinced me I really should. So I gave my seats to my son and his fiancée, now wife, and we went to the Citrix box. And as usual, I got there early 'cause I like to watch the warmups and in walks this guy who introduces himself. His name is Lars Leckie and he's from Hummer Winblad, managing director at Hummer Winblad. So he asks what we're doing and we tell him. And the next day, Chuck says to me, "You know, he checked us out on LinkedIn." I said, "Really? That's interesting." So then I get an email from Lars and he invites me to come and meet with him and one of his partners. And we go up there and at this point I have a deck put together. And Mitch Kerzman. And Mitch I knew from Boston days. Mitch was the CEO of Sybase, subsequently acquired by SAP, but that's a different story. And I'm on slide two and I'm showing him the value proposition and he stops me and he says, "Ike. This sounds like complete snake oil." And I was like, "Well, Mitch, let me go through the presentation and hopefully I'll convince you that it's not." So we go through the whole presentation and at the end I said, "Does it still sound like snake oil?" And he says, "No, you might have something there." So we get in the car and just drive-- they're in San Francisco-- and we're driving back and mid-way down the Peninsula, I get a phone call from Lars saying can you come and meet, you know, Ann and Hummer, [Ann] Winblad. Can you come and do the full partnership thing? I said, "Okay." So we go up there and do the full partnership thing. And 20 minutes after we leave, they tell us they want to invest in the company and they do. And so then Fred's on my-- Fred Weber's now on my advisory board and he's consulting for Samsung. And they had been talking about making a quarter of a million-dollar investment. I asked them, "Well, how about a half?" The next thing I turn around, it's a million-dollar investment. So now we're got $3.2 million in investments and we can start building the team. And we did. And we were able to get a prototype up and running pretty quickly. So, did that. And then in 2014, we started looking around for a true Series A. This was a seed investment, really. We did a Series A. And we were oversubscribed, so I had to turn down some VCs. But very often people would say the same thing. "This is not possible. A lot of people have tried it. It can't be done, blah, blah, blah." Well, you know, we did it. So, wound up choosing Bain Capital and Enrique Salem from Symantec joined our board. So now we had Fred, myself, Lars and Enrique on our board. And since that time, we've been just marching forward building what everybody told us couldn't be done.

Markoff: And describe the unobtainable. <laughs> Unobtanium.<laughs>

Nassi: So you're familiar with what VMWare and Zen and KVM do. They build virtual machines and they allow people to multiplex virtual machines on a single computer.

Markoff: Right.

Nassi: On a single server. Our idea, my idea was that we can flip that model upside down. Instead of taking multiple virtual machines and running them on a computer, take a single virtual machine and running it on multiple computers in a way that makes it look like it's one single computer. So we built this what we call a HyperKernel. The HyperKernel runs on each of these nodes. When you power up the system, it's like a BIOS. It sits underneath the operating system, and it inventories all the resources. How many processors. How much memory. How many networks and so forth. How many disks. And they start talking to each other and they build a table that is an aggregated table. It's the sum of all the resources, the physical resources in the system. And then one of them starts booting an operating system. And the operating system doesn't know any better, so it just starts running. It thinks it's got, you know, 5 terabytes of memory. Right. We lie. We lie through our teeth. But hardware is hardware. I mean, at some point, it's, that's not going to fly. So as soon as it doesn't fly, we get a trap, a machine fault. Okay. And we fix it up and then we return control back to the instruction that caused the fault in what we call the guest. Now how do we do that? That's where it gets interesting. The way we do that is we-- I designed these weighted non-linear polynomials that allow you to very quickly look at the costs of the different strategies to resolve that fault. So either we move the memory to where the processor was that requested it, or we take a snapshot of the state of the processor and move it to where the memory is. Okay. Now all this is running on a dedicated 10 gig Ethernet, commodity Ethernet, commodity servers, unchanged operating system, unchanged database, unchanged application. It's 100 percent unchanged, bit for bit unchanged. We look like hardware. So you boot this thing, it looks like hardware. And it's done that since October of 2014. We have no incompatibilities whatsoever, and we're running it 24 by 7, meaning we're testing compatibility all the time. Now why do we do that? Let me just--

Markoff: Okay. Water?

Nassi: Why do we do that? We do that because we want something that's simple. It can't be any simpler than not having a customer do anything, okay. We want it to scale, we don't want to use expensive supercomputers. We want to use the cheap kind of Facebook two socket servers that are the sweet spot. We don't want you to have to buy 20 of them at a time. You can buy 2 at a time and grow as your needs grow. We don't want programmers getting involved in this thing, and this actually is very much related to your book, because it's all-- it's all machine intelligence below the OS level. So we figure out what the right thing to do is based on past history. It's a generalization of work that Peter Denning did in 1968 on working sets. Only we extended instead of just memory on a uniprocessor, we have multiprocessors and it's not just memory, it's processors, networks, storage, the whole kit and caboodle. And finally, it's all software. So as the hardware gets better, we get better. We don't have to make any changes.

Markoff: Two questions in different directions. But one for-- How does the current market trend towards containerization--

Nassi: Ha!

Markoff: Affect--

Nassi: Beautiful.

Markoff: Affect--

Nassi: It's actually beautiful. Today, you can build a container on an OS and you could limit it to the size of the machine you're running on. In our case, you can build big containers. You can have multiple containers in one machine, and we do. In fact, we do all our QA using containers.

Markoff: So the containerization trend is one that you can ride or it can ride you.

Nassi: Absolutely.

Markoff: It can ride you.

Nassi: We're doing it today.

Markoff: Yeah, okay.

Nassi: We do scale out. We do scale up. Gordon says-- he's one of the original investors, right-- he says, "This is the way all computers are going to be built in the future." This was in fact, was our vision back in at Encore, that DARPA contract in the eighties. And it's true.

<2:22:34>

Markoff: Have you started-- So I noticed you slightly came out of stealth. You had a party.

Nassi: Yeah.

Markoff: Where are you in terms of launching the company? Are you commercialized yet and--

Nassi: Oh, yeah. Oh, yeah. We do-- 1.1 release is supposed to be out today. It might be a couple days from now. We have some very, very good benchmark results. We just did an install in Japan last week. I can't mention the company names, but you've heard--

Markoff: The kinds of application-- or the kinds of--

Nassi: It's very simple. It's very simple. It's database, data management, analytics--

Markoff: Okay.

Nassi: All of our customers have said the same thing. We've never been able to run a job this size before. Some of the results of some of the simulations we've been doing have already appeared in the press. They can't be attributed to us. They can't even be attributed to the customers who bought the stuff from us. But you've heard of the results. They've been in the "Journal" and other places. So we've done some work in computational genomics but not gone too far with that, 'cause frankly, we're a small company and we have to focus on some things. But the computational genomics problem, I think, is very, very interesting, because you know, what happens is if you-- what an oncologist is going to do is pull some cancerous DNA and non-cancerous DNA from the same patient. And then they're going to put these billions of base pairs in memory and they look for diffs. They try to find what are the differences in these billions of base pairs. And then they consult the database, which happens to be in San Diego, which tries to find what treatments work for people who have that profile of differences, and that's what they tell the oncologists.

Markoff: Wow.

Nassi: So it's really very, very interesting.

Markoff: Yeah.

Nassi: But again, you know, we can't be everywhere, every time. The whole company is 20 people. It's 19 until Jerome comes back <laughs> actually.

Markoff: <laughs>

Nassi: So I hired a CEO April 18th.

Markoff: Where did you get them from? What kind of a person did you--

Nassi: He worked with-- he was the Chief Strategy Officer and EVP at Fusion IO. He worked with Shane.

Markoff: Yeah.

Nassi: Okay. So Shane was in to see us a couple weeks ago, actually. So Gary Smerdon's our CEO, and that has allowed me to get back to doing technical work. I've been running the company and raising the money and doing all this stuff for several years. So now I'm back writing patents, doing design, talking to the engineers, and it's a very exciting, very, very exciting time right now.

Markoff: What's it like to build a hardware company in a time when the Silicon Valley has become all but--

Nassi: It's not a hardware company. We're a software company.

Markoff: I guess you are a software company, yeah.

Nassi: We buy white box boxes. We run Dells. I mean, Dell servers.

Markoff: <laughs> I see. So the customers, do you deliver them a white box solution? Or do you just give them the software and they--

Nassi: We deliver it in a couple of different ways. We can install it at their site with-- on their hardware. The example we did with IBM Cloud Services SoftLayer was we had IBM put together a rack of 20 servers. We booted a 15 terabyte machine with 400 cores at IBM. And if a customer comes to us and wants to do that, they can. The last few months, I've been spending some time in New York, and it turns out the financial services industry is far more interested than I ever expected, and I really don't know a lot about that. So just this week, I hired somebody who knows a lot more about financial services than I do. But we're talking to major banks now, okay, and the trading companies. And honestly, I don't know what they do.

Markoff: So it's risk analysis, probably.

Nassi: It's risk analysis. There's some fraud detection.

Markoff: Yeah.

Nassi: There's portfolio computation. There's years, histories of trading data. They want to put it all in memory. Because you can have very fast NVMe flash storage, for example, which is wonderful. But you know, DRAM is 1000 to 10,000 times faster than the fastest flash. There's no comparison. I can show you charts, if this were a customer, I mean, I would show you charts that would just knock your socks off. Here's the other thing that people-- that I realized at SAP. You know, you hear about, you know, what the chip guys, the processor guys are talking about, and they're talking about more at higher density cores per chip. You know, we have enough cores per chip. What we don't have is enough memory addressing memory, okay. And so one of the things I realized at SAP was if you take the ratio of memory to cores, okay, the core density goes up like this. Memory density is also going up, but it's going up like this. Therefore, if you do the math, the ratio is going down, okay. That's not what people need. They want flexibility and they want more memory. They want to put all this transactional data in memory and every one of our customers is telling us the same thing.

Markoff: How would you guys do a LINPAC? Would this be-- is this not--

Nassi: Not a--

Markoff: I know LINPACs is--

Nassi: Could care less about LINPACs. <laughs>

Markoff: Yeah, LINPAC's passé.

Nassi: Yeah. I did that at Encore. <laughs> It's just--

Markoff: Yeah, yeah.

Nassi: You know, just it's not a problem for us. What the problem is-- So here's another example. I mean, the SQL guys, and this is I'm wearing a little bit of my academic hat now, the SQL guys really sweat the details on query optimization. If they can get, you know, 20 percent, they're doing good. The first time we ran a MySQL test on our thing, we got a 60X performance speed on it.

Hsu: <laughs>

Nassi: The job went from 7 hours to 7 minutes.

Hsu: Just 'cause you're keeping everything in memory.

Nassi: Just 'cause you're keeping it, 'cause you're not doing a memory cliff, you're not paging to disk anymore, everything's in memory. You can, in MySQL, you can create a large InnoDB cache and convert MySQL to an in-memory database, okay. And I gave a talk on this at the High Performance Transaction Systems Conference a year ago. It's a very powerful, powerful idea.

Markoff: So you built a small team. What was it like to build a team during this crazy period? And, you know, this is one of these--

Nassi: This is a dream team. You know, we have, so first of all, with only two exceptions, everybody on the team has worked with at least one other person on the team before. Okay. So we all know each other, sometimes, indirectly, but. And the whole company is 20 people. It's not-- it's not huge.

Markoff: Yeah.

Nassi: So very experienced. A lot of very experienced kernel hackers from VMWare, Oracle. We have some security people. We have a person from f5. All very, very experienced people. We have-- Unfortunately, you know, one of our investors, Gardner, Gardner Hendries says, "You know, Ike, the probability of success is inversely proportional to the number of Ph.D.s."

<laughter>

Nassi: "Except for you. Except for you." So we have, I think, five Ph.D.s on staff. But you know, what's that mean? It doesn't mean anything to me. You want people who really know what they're doing, and who respect each other and who work as a team. We're, just about everybody is local, except, well, David is in Boston and we have one guy in Seattle. But everybody else, every other engineer is local.

Markoff: Yeah. And what city are you in? Where is your office currently?

Nassi: We're on the Campbell-Los Gatos border. It's 1.4 miles from my house.

Markoff: Yeah.

Nassi: And since I just, you know, two years ago I bought a Tesla, it's such a waste.

<laughter>

Nassi: But anyway. We're right by the Los Gatos Creek Trail, so it's a wonderful location.

Markoff: Oh, that's pretty neat. So let's look back over your entire career now. And in these points that you made at the very end, you sort of spelled out the idea that there were a set of principles that have evolved.

Nassi: Yeah.

Markoff: And could you sort of, you know, sort of pick and pull out some of those.

Nassi: It's still evolving, you know, it's still evolving. But I got interested early on with networking communications. I like the idea of controlling processing units remotely over a network. We went back and talked about the autodial example. We talked about mesh network. And what's a mesh network? It's a set of processors communicating over a wireless network. You know, just example after example of this. And what we're doing here is you know, we're taking a bunch of, you take these two socket boards, they're, the sockets are communicating with the memory and themselves over Intel QPI or AMD HyperTransport. But then you start putting them together, and they're starting cooperatively to talk to each other. So it's the same basic idea of processors cooperating with other processors to achieve a goal. And I might add one other thing about that. The architecture that we put together for this is such that everybody on the one hand looks out for himself-- every node in this system, every server looks out for itself but cooperates with every other one. And as a result, these things don't crash hardly at all, just like the mesh network. The mesh network never crashes. It just does a fail over, and, you know, things get picked up and they just continue running. What we'll see is there may be spikes in performance. The lapse time may be longer than you want. I'm very enamored, and you mentioned this in your book, actually, Andy McAfee and Erik Brynjolfsson are pretty good friends of mine. Andy talks about the distinction between algorithms and experts and how if you look at the Bureau of Labor Statistics' statistics, you find that there aren't a lot of experts. Okay. It turns out that just looking at income, something like 6 percent of the income in the U.S. is driven by one-tenth of 1 percent of the people. Okay. You look at Peter Jennings. Peter Jennings, no--

Markoff: Denning or?

Nassi: The expert on Watson.

Markoff: Oh.

Nassi: Ken Jennings. Ken Jennings.

Markoff: Oh, the Jeopardy player.

Nassi: Jeopardy, right.

Markoff: Yeah, yeah. Uh-huh.

Nassi: So, you know, there are studies of studies, okay, and I have some of them, actually, which show-- or you look at FiveThirtyEight.com, you know. There are experts and there are algorithms. And it turns out very often the algorithms beat the experts. Now if you look at what we're doing under the covers at TidalScale, we're building the machine. We don't tune the machine, we're training the machine to tune itself. It's fundamentally, it's a very different way of looking at what we're doing. Now you have to integrate that with the whole simplicity argument. I mentioned to you that, you know, I didn't design AppleTalk, but, you know, I loved AppleTalk. And Michael Dertouzos and I, Michael from MIT, used to make fun of people trying to configure these TCP/IP networks during our DARPA ISAT meetings. And, you know, we'd just plug in our computers to each other and it would just work, okay. Simplicity is really, really, really important. And you can't be any simpler for a customer than telling the customer he doesn't have to do anything.

Markoff: <laughs>

Nassi: 'Cause we handle it all. So I guess those are the two things I wanted to say.

Markoff: But there's also this notion of this you're building a computational fabric in a sense.

Nassi: Yes.

Markoff: I mean, architecturally, that seems to be the arc of--

Nassi: Yes.

Markoff: That's spreading out throughout the--

Nassi: Yeah, now we don't do thousands of servers. We can't do thousands of servers. We do dozens of servers, and each of them looks like some big supercomputer. But you know what? If you have a Hadoop node, let's say you have a 1000 Hadoop node network, would you like to manage 1000 Hadoop node network? Or would you like to, if you're going to have a Hadoop network, maybe 100 Hadoop nodes with 10 servers each?

Markoff: Right.

Nassi: It makes a lot more sense. Or, let's say you've made an investment in 256 gigabyte servers and you have somebody who wants to do-- needs a terabyte server. In our case, you just put 4 of them together--

Markoff: <laughs>

Nassi: And you've got a terabyte server. You don't spend any money, except for our license fees.

Markoff: Yeah. <laughs>

Nassi: So it's just people have tried to do this before. It's a ridiculously difficult problem. We put together a team that solved this problem.

Markoff: And there's this optimization going on underneath.

Nassi: Yes. And learning. Learning. It's all machine learning.

Markoff: Is it machine-- Yeah. Is it Bayesian stuff? What kind of techniques do you use?

Nassi: It's, I'm not that smart, John.

<laughter>

Nassi: It's really pretty simple. So what we're doing is dynamically building working sets, modifying them on an as needed basis, and being careful not to destroy them. So if you run a command or you run a set

of queries on Linux or Windows or whatever, what's going to happen is, you know, the memory that it touches is going to be spread out over a number of these nodes. And our software is going to cause all the memory and all the processors that need to be together, to be together. And when they're together, there's no overhead. The thing is running at machine speed. Now how do I know this? I know this very simply by looking at the bandwidth utilization on the network. At first, people were saying, "Oh, you're going to swamp the network. You're going to swamp the network." SGI built, you know, massive optical networks to solve this problem. On a 10 gig Ethernet, our measured bandwidth utilization on customer workloads is 5 percent. What does that mean? It means we're doing a damn good job of keeping everything where it needs to be.

Markoff: Right.

Nassi: And only when we have to--

Markoff: Move.

Nassi: Move things around. Yeah. And you can't predict this. This is happening in microseconds.

Markoff: And it's interesting. When you look at it this way, what happens if you sort of turn it over and you look at-- do different applications-- can you see the characteristics of the applications by the utilization of the--

Nassi: Well, we can see the differences, but do we have to do anything? No.

Markoff: Yeah.

Nassi: We don't care-- we don't care which operating system is running, 'cause we don't change it.

Markoff: Yeah.

Nassi: We don't care which application is running. We don't change it. The OS doesn't know that it's running on a software virtual machine, it thinks it's running on hardware. There-- the Linux test procedures are something like 1568 tests. We run that every day.

Markoff: Yeah.

Nassi: We run that every day.

Markoff: Could you take a crack at the data center world? Are there, I mean, you could go in the data centers, but could you--

Nassi: We are.

Markoff: You are?

Nassi: Yeah.

Markoff: So it's a possible substrate.

Nassi: Yeah. I can't say who we're talking to, but we're talking to the ones you would expect we would be talking to.

Markoff: So that's computational fabric.

Nassi: We did an announcement with IBM Cloud Services, so.

Markoff: Yeah.

Nassi: They were the first ones.

Markoff: Yeah. Does that mean that Watson is running on top of you? Is it possible?

Nassi: Watson's not running on top of us as far as I know.

Markoff: Yeah.

Nassi: But could it? It probably could.

Markoff: Yeah, yeah.

Nassi: But, you know, I mentioned I was over at SAP the other day. <laughs>

Markoff: Yeah, yeah. That's very--

Nassi: But, you know, MySQL works great. R, Python, any applications written in Python work great.

Markoff: Yeah.

Nassi: We did a major piece of work with TIBCO for their TIBCO Enterprise Runtime for R. They put us in their keynote in June at the-- it was May or June in Las Vegas.

Markoff: So your last note is taking these principles and pushing them forward. So you're not ready to retire?

Nassi: Argh.

Markoff: <laughs>

Nassi: I will retire. One day, I will retire.

<laughter>

Nassi: I don't know when. My wife retired two years ago. She was the head of the Chamber of Commerce in Los Gatos for 12 years. And she's retired. She's been to Cuba, Paris. She's been all over the place. We have grandkids. All the grandkids live in Colorado now. So I will retire, but I'm still having a lot of fun. I just in the last couple of weeks wrote two patents. You know, I'm just-- I'm, you know, this is not anything derogatory about SAP, but the year I left SAP, I was on fire. It was my most creative year ever. It had nothing to do with SAP, just clearing out the cobwebs.

Markoff: Yeah.

Nassi: It's been a fantastic run. I'm having a blast right now. And now that I have a CEO, I'm even having more of a blast.

Nassi: And I had to beg-- I had to beg my board to let me hire a CEO. <laughs>

Markoff: Yeah. But it's so interesting. You've created this kind of a company just at the time where the Valley seems to be able to think of nothing but AI, you know.

Nassi: Well--

Markoff: You're going in a different direction--

Nassi: Not really. This is AI. I mean, this, under the covers, it's really AI.

Markoff: Yeah.

Nassi: Again, the system-- Look, I'm not talking about Skynet here. I'm not talking about Schwarzenegger. I'm talking about a system, it goes back to the McAfee thing I mentioned earlier. There aren't enough experts to do these things. The computers can run themselves better than any human can do it. We just have to teach them how to do it. That's what we're doing.

Markoff: Yeah.

Nassi: You know, I was interested in, you know, parts in your book about von Neumann, for example. I mean, I'm reading this thing and I'm saying, "John's going to love what I'm doing here," because that's exactly what we're doing.

Markoff: I mean, so you've got some principles here. So you've sort of done all this magic underneath. And but this is what computer scientists always tells me. If you have a problem, just add one more layer of abstraction.

Nassi: No. You never heard that from me.

Markoff: No.

Nassi: You never heard that from me. What I like to do is bust through those levels of abstraction and cheat where it makes sense to cheat. That's what I do.

Markoff: Yeah. <laughs>

Nassi: So I told you about the compiler optimization story at the beginning of my career. I built two optimizations. They were both individually very good, but when they combined together in a way that I couldn't predict, it was a whole lot better.

Markoff: Yeah.

Nassi: This theme keeps reappearing over and over and over again, this idea that the mesh of mesh network recovers on its own. The last project I did at Firetide was in response to the sales guys complaining that they didn't know when a mesh node went down. I had to write a special layer of software just so that I can tell them where there was a mesh node that wasn't working properly.

Markoff: <laughs>

Nassi: It's been fascinating stuff.

Hsu: Where did the name TidalScale come from?

Nassi: Oh, so at SAP, the projects I was-- the project name I used was Big Iron. Okay. But Big Iron was taken when I went to get to the naming. So you find a domain name that makes sense. And Tidal, so what we're doing, the technology here is you want the resources to flow through the network like the ebb and flow of the tides in a way that scales, so TidalScale.

Markoff: Tell us a little bit about your interest in the Computer History Museum. When did you get-- Well, you were, that's right, you go all the way back.

Nassi: I was in Boston.

<laughter>

Nassi: I was there in the beginning.

Hsu: Wow.

Markoff: Yeah, you were.

Nassi: I was at the very beginning. I mean, if you walk out there, you'll see the founder issue. I'm on there.

<laughter>

Markoff: Yeah, that's right. You helped create the, yeah.

Nassi: No, I mean, we-- We were in Boston. I worked on several exhibits in Boston. I was on the Board of Overseers. When we moved out here, Gordon moved out here, I moved out here and we started meeting at Dave House's house. Len Shustek got involved. That's how it all started.

Markoff: Yeah, so you were part and parcel of the fabric of it, yeah.

Nassi: I was one of the first-- Basically, a co-founder of the museum.

Markoff: Yeah.

Nassi: And today, I'm on the-- I ran the Fellows selection committee for many years. I'm on the nominating committee. Because of my corporate involvement, I can't do everything anymore. So I couldn't do Fellows selection, so Len has run the Fellows selection process for the last two years. But he says he's only keeping my seat warm.

<laughter>

Nassi: I love this museum.

Markoff: Yeah.

Nassi: Just one other story. I had my grandkids here a few weeks ago and my granddaughter loves the robots and my grandson loves the games. So when they, a couple of years ago the first time I brought them here, I told my granddaughter, "Stay here. I'm going to take Zachary over to the games. Don't move.

Stay right here." So I take Zachary over to the games. I come back. I can't find Talia. Where is she? I can't find her. And then I look, and she crawled behind the Plexiglas to play with the robots.

Hsu: Oh.

Nassi: So I had to tell-- So we now have a piece of Plexiglas there to prevent kids from climbing under the--

Markoff: <laughs> Crawling into the exhibit--

Nassi: The Talia Wall.

<laughter>

Nassi: But the picture I took, the wonderful picture I took just a couple weeks ago, Zach and Talia are sitting there with an 026 keypunch machine, okay. And she's smiling, you know. And this was the same machine I took their father to when we were back in Boston. He was fascinated by the 026 keypunch. He would punch a card, punch another card, punch another card. And then he, I remember he turned and looked at me and he says, "Daddy, what did you use this for?" And I said, "Well, Mark, this is how we used to communicate with computers. We used to punch holes in cardboard and that's how we used to communicate." And then he punched another card and he said, "Yeah, right."

<laughter>

Nassi: He didn't believe me. And I have a picture of his kids <laughs> in front of the same machine. And you know, if we don't do-- if we don't do something like the Computer History Museum, who's going to do it?

Markoff: No, I agree.

Nassi: It's a labor of love.

Markoff: Yeah. Well, and it puts the-- You know, this is a-- this is a, you know, there's no "there" there. There would be no "there" in Silicon Valley if it wasn't for the Computer History Museum.

Nassi: Exactly. Exactly. Exactly.

Markoff: What is the Valley? It's a place, you know, and now it has a place.

Nassi: And I've been in Boston and Silicon Valley, so of course I'm here.

Markoff: Yeah.

Nassi: I walk around with four different business cards.

<laughter>

Nassi: You know? One from the university, one from the museum, a personal one and one for my company. When people ask for my card, they get four cards.

<laughter>

END OF THE INTERVIEW