RICHA VIRMANI: The following interview is conducted as a part of the retroTECH Online Software Preservation Oral History Project. Today Is November 7, 2018. The interview Is taking place in Dr. Fortnow's office, room 3406 of the Klaus Advanced Computing building. The interviewer is Richa Virmani, and the interviewee is Dr. Lance Fortnow. I wanted to thank you again for participating in this project. Dr. Lance Fortnow coded a version of Frogger called Ribbit when he was younger, and it did really well in sales until he received a cease-and-desist. Okay so I'm going to start with background contextual questions just to understand a little bit more about you. Where were you born, and where did you grow up?

LANCE FORTNOW: So I was born up in New York City. Spent a year there, a couple years in the Bronx and then most of my childhood in New Jersey.

VIRMANI: That's cool. Please tell me about your education and/or career experiences?

FORTNOW: So then I went to high school in New Jersey. I went to Cornell undergrad. From there, I spent a year at Berkeley for my PhD program, and then followed my adviser to MIT where I got my PhD. And let's see, I first worked at University of Chicago for about ten years, and then I moved to NEC Research- which is in New Jersey- for four years, then back to University Chicago, and then to Northwestern, and then when I was at Northwestern they hired me down here to become a department chair.

VIRMANI: That's really cool. What are your interests and/or hobbies?

FORTNOW: A lot of interests- I guess right now, my biggest interest is music. I mean I'm trying to teach myself how to play the piano. I love the Opera, so I see as much of it as I can whether it be in Atlanta or when I travel or even streaming. The Opera, and then after that I like technology. I like fiddling with stuff.

VIRMANI: Do you think any of your hobbies have stemmed from computer science or that computer science has stemmed from any of your hobbies?

FORTNOW: Well I do find music pretty mathematical. I think there's a connection there. I did a MOOCs about a year or two years ago on music theory, so it's kind of cool to see how really mathematical that is and a lot of my other hobbies are really already you know like hacking things and other stuff yeah.

VIRMANI: Umm please describe a significant person or event that influenced who you are today?

FORTNOW: So I don't think there's any single person or event that really.. a lot of people on the way. Probably, the number one person I would say is someone named [name]. He's one of the founders of my research area, computational complexity, and I was lucky to have him as my introductory theory teacher at Cornell. It's a graduate question and he's the one who really charted me going into this- my research area then my career um.

VIRMANI: And before Northwestern, when you were offered a job here at Georgia Tech was there any other like event influencing you to come to Georgia Tech?

FORTNOW: Well, so it was interesting. So when I was at Northwestern, we were trying to figure out what to do about computer science, you know? Right- when I was there, it was a mixed EECS department, and we're trying to- I mean we didn't even have a CS division, so I felt like I was taking a leadership role there, but I was kind of limited because I didn't have any official role, and during this time, I got a call from Dick Lipton who was a professor here who was retired, and Dick asked me if I was interested in being a department chair down here and I said something like, "I'm curious," and it went from there. So it's just a great yeah... There's computer science and the appeal of department chair yeah.

VIRMANI: So what specific programs, units, or research initiatives at Georgia Tech are you participating in or have you participated in?

FORTNOW: Oh! Well most of my role is in the School of Computer Science as department chair. There's a lot of exciting things that were going on in the last- you know I guess I'm in my seventh year now. So our department's you know part of new institutes such as the information- it's the information side- it's good for information security and privacy so that's

cybersecurity, information for- institute for data engineering and sciences, ideas. That's where we have something happening and who it goes to, uhh ideas about data science- IRI. It's for any researchers these are the big big things at Georgia Tech. Umm we've got [...], some of our faculty is running Crunch which is a research center developed in trying to find new ways to do computer architecture. Things are definitely changing, and just in general I mean it's finding computing has grown so much even in a few years I've been here, trying to figure out how to handle how to deal with the role that we play and massively growing enrollments and things. It's challenging, but it's good challenges to have.

VIRMANI: That's good, yeah, How your interactions with these programs affected your work or personal life?

FORTNOW: To kill my research mostly that's the biggest effect it's had. That's okay- on the hand it has been great because I get to work with a lot of great faculty, a lot of great computer scientists. I see a much broader view I mean my my own research is very theoretical, but this gave me a much more broader view of computing, so I can only see some of the great things that are happening- systems and security, networks, architecture. Just across the board, you really get a much broader view of what's going on in computing and much greater respect, and you even see how things are changing you know? We're definitely moving to much more data in the world.

VIRMANI: Yeah. What's an example of something you've seen change since you came to Tech versus now?

FORTNOW: To say things have stayed the same would be a harder thing to say. Um well there's definitely a much bigger interest in data meaning that the role of having a lot of information and being able to sort of you know- typically you know when we coded we- we figured out exactly what we were doing, and then you would take your logical thinking and convert it into computer code, but that's changing these days you know not completely, but a lot of what we're doing now is instead collecting lots of data, figuring out and using that to sort of create program based on that that oh yeah so it's now become very data-driven and that's that's changed up sort of just completely rethinking how we're making computers make decisions yeah, and of course also changes the way we have to design computers to make these things work, but it's also created a lot of huge numbers of challenges not just in the technology but in terms of social and politics and fairness and there's this in so many places. All of a sudden we're becoming- we used to be just people who would make fast machines now we're becoming people who are affecting society. It's an exciting but it's a challenging role to play, you know?

VIRMANI: Yeah that makes sense. Now I wanted to move on more to like Ribbit, but describe the technology context in which you created and used the software, like when did you start creating the software?

FORTNOW: Okay so now I got to go back, so I got- so going back a long- going back 40 years, going back to the late 70s. In 1978- 40 ago- I got my first computer. it was something called a TRS-80. Yes, 4K of ram. Yeah you know 4,000 bits of ram, bytes of ram. Saved your your- saved your program on a cassette tape. And so, but the, but I was actually one of their first you know kids to have a computer at home, and so I just loved I mean I kind of fell in love with the computer at the time. Yeah, I had a friend of mine, Chris [...]. He was a year ahead of me in high school, and he also really got into computing, and then we kind of just- we kind of bonded- very very different people, but- but nevertheless we kind of bonded over computing and I think we complement each other well. So we started kind of just doing little coding projects together. Umm this is also a very popular time for computer arcades, so you would go to a mall, and it would be a big room full of video machines, and you would just kind of hang out and play you know before we really had good games at home, cause you know at home you know you only had pong. It's very simple, and over here you had the much more advanced video games. Not as advanced as today, but in the 70s they were pretty impressive.

VIRMANI: I saw on your blog post like arcade and all.

FORTNOW: Right yeah. So so there are a lot of games there, and then you know people are starting to move these games from the from the arcade down to your home machine, so I mean actually I think we started- first wrote some version of Missile Command, I believe just to see if we could do it. And then- and then there was Frogger. There didn't seem to be a PC version of Frogger. So so hopefully you must be familiar with Frogger. You were supposed to get this frog across the street, across the river without drowning or getting hit, and you know you know lots of- lots of people were creating versions of this, and we even were- we even talked to someone who worked at a computer magazine and they

said, "'Well as long as you change the look and feel a little bit and change the name you shouldn't run into any legal issues.'" So we've done an apple 2- this is pre Mac, so this would have been- let's see the program came out summer '82, so we probably worked in the summer of '81 on this. So this would have been right before I went to college. I started college- I graduated high school in summer of '81, started Cornell in '81. So probably probably like right before I went off to college, Chris and I spent a good chunk of that summer just coding and working on this and creating this- this version of Frogger. Using and writing in an assembly language because even speed mattered I mean these processes were considerably slower than what we have today, so you really need as much- as fast as you could so you had to write things in basic assembly- assembly languages were basically just directly machine code you get as much as fast as you could. Or even weird things like the way the Apple screen worked, you had to actually divide- you had to divide your corner by seven to figure out which byte to push in it. Divided by seven is not easy on a computer and then we finally figure out the right way to do it which was to build a huge table- a lookup table for dividing by seven, but you know we created the table slowly but then you could use it quickly so yeah lots of awesome tricks along these lines. But I think in the end we came up with- you know- a pretty good version of the game.

VIRMANI: So like the inspiration or purpose behind creating this game is purely self fulfilling?

FORTNOW: Well I mean, a couple of things: one is that yes we enjoy writing computer program, we wanted something that we could do. We actually did think, "maybe we can make money off of it." I wasn't planning then when I was off. Maybe Chris was more focused on *maybe you can make a career out of this.* I was- I was you know going off to college, and I wasn't even planning initially in college to do computers or computing. I just wanted to be an engineer when I started college, so I was figuring okay there's just a little one fun little fun thing I'll do, it'll make a few bucks, and I'll move on.

VIRMANI: Okay, umm what was being developed in the industry at the time in terms of hardware and software?

FORTNOW: Well hardware- so this was the time when the micro-processors were coming out. I think it was before there were the I- well before IBM got into the game. Yes so we- so we had the Apple 2, there was the Commodore pet, there was the TRS-80. So there were just basically these kinds of small platforms that were out there. There weren't any like- there wasn't really any official interface like a Windows or a Mac. There wasn't a mouse, was all keyboard, and and the- and you either had high level programming that was just really slow like basic, or you had to do things directly in machine language for assembly code. So you know it's interesting at least it wasn't you know few years before that you would've had to build your own computer. We didn't have to do that, but you know it was a old technology um.

VIRMANI: So can you describe kind of what your role was versus your partner's role went coding?

FORTNOW: Uh I was kind of- I was really good at kind of figuring out the- the tricks, the technical aspects. He was a good hacker. Chris was a good hacker, and he was a good coder too. So- but I think- I think he was good at the visual stuff, you know making the stuff you know helping design- the design, what you want the game to look like and what the solution should be, and then figuring out- and then together we would figure out you know how to do sorts of things. And I was good- but I really enjoyed the problem-solving aspect of coding, finding the bugs.

VIRMANI: And when you were creating the software, you said like both of you were like probably a little bit thinking about making money off of it. What was the competitive environment like in terms of it, or was it just Frogger as a main competitor?

FORTNOW: Well Frogger wasn't even a competitor. I mean yeah the other competitors were coming out with lots of other video games, so there were a lot of games based on real video games, lots some games coming out just in general. There was I think the early Ataris were out by then, so but those games are pretty basic. So we were competing against that. I mean not everyone owns a computer. We're not going to sell games to someone that doesn't have a computer. So I think there were just a lot of other kinds of games out. And not all the video games you know are games of different nature. People are still- it was just very early. You're talking about very early in the- and this is just about the time people started buying computers. So it's just people were trying to figure out, "okay what kinds of things would people want to play?" I mean there's also people developing things like word processing and spreadsheets. Those things were just starting to pick up as well, but not even sure the spreadsheet was out yet, but there were definitely things you could, you

know, build or office type stuff that you could run on computers. But- but the gaming thing is- clearly there was gonna be money in gaming people. People- people- there would be adventure games and people. We would play other people's games. We could see how things were going, so but we were just trying to enter that space.

VIRMANI: And so would you think it was people your age you're the prime customer?

FORTNOW: Uhh people our age or slightly older? Yeah, people in high school, let's say College

VIRMANI: Like you said, people who had computers.

FORTNOW: People who had computers, people that were interested in playing games.

VIRMANI: So when was the software introduced to users like what was the timeline of creation and then putting it out?

FORTNOW: Yes. I think it went out about- so it definitely was spring of '82 I don't know exactly, but that's when we we signed a contract. There's a local computer store in the town next to us, so I grew up in- I grew up in Short Hills which is part of Millburn, New Jersey. There's a town over called Summit. That's and we decided to create our own kind of software lines. It was piccadilly software in the company. And so but we had we had good friends there, so we could do that

VIRMANI: And this is the end of your first year of college?

FORTNOW: Yeah, I've done most of it. I mean Chris this is actually Chris's- since I was away at college, Chris did most of the converting it to the data software and working with the company and doing the business though. I was always less directly a part of that. I mean, he kept me informed. We'd chat on the phone, or I guess I visited over winter break, things like that. But- but yeah that part was mostly Chris.

VIRMANI: Yeah and how is this software received by users upon its introduction?

FORTNOW: So you know the ones who've seen it- I mean it's kind of weird because I didn't see it myself I didn't uhh- I didn't uhh- I wasn't actually didn't know really who was buying our software. I mean it sold I think in the end a couple of thousand copies, not that many to get pirated. And that kind of version got yeah it's been around a bit more. I think people liked it- the ones who said they saw it. So but you know also there was like- should I tell the story of the what happened to the software?

VIRMANI: Yeah, sure. We'd love to hear it.

FORTNOW: Yeah so what really happened- so turns out that unbeknownst to us that the people who made Frogger sold- Sega I believe- sold the PC rights- I mean the computer rights to a company called Sierra Online. So Sierra Online created their own version of Frogger which since they the rights, it could be called Frogger, and they sent us a cease and desist order [...]. And then we talked that over briefly, but they really had to rights, and our program really did look a lot like Frogger, and we admitted it, so we basically just cease and desisted. So I think we sold about 1200 copies in the end, but in the end, we did just stop selling the software. There was- a couple months later, there was a review- maybe a year or so later- a review in a PC Magazine, computer magazine, on Frogger which had- which had the line- it which it was actually not with that well-received as, you know, my version of Frogger. It was something, you know, something to the effect of, "even worse than a version that was named after the sound a frog makes." I felt, you know, at least we did a better job than they did even if I- I mean I thought I version was pretty good. In the summer of '82, I worked at a computer camp in Montecito, California, just a little bit north of Santa Barbara, and then towards the later part of that summer, I noticed that a lot of people had the pirated version of our game. A lot of these kids would show up with the software on their computers, and they had a pirated version of our game. And it was- and it kind of shocked me. First thing I would say is "it's a pirated version," but then I went over- well it's not like you could sell them the regular version because of the cease and desist order, so yeah at first they got angry and somebody said, "well there's no honor among thieves," but uhh- but in a reality the pirated version definitely spread. So let me explain how pirated- back then there would be people

who would actually just love to take, you know, most of the software use was kind of protected, so you could play the game, but you couldn't- you couldn't just use the regular tools on the computer to copy to another disk, and give it away. So but it doesn't- you know if you knew- of you really knew what you were doing. you could do it, and so this was- these people were kind of called pirates, computer pirates and you would create this software and then distribute the software usually for free, and so you know then- then they would have a version which you could easily copy. Yeah then those things would spread like wildfire. I mean you know the only thing about the pirated version is they took my name off of it. I was like happy, like, "okay pirate my copy, but at least give me credit for."

VIRMANI: Its okay, we're giving you credit right now.

FORTNOW: So yeah and then- so that was- that was- so that- and then you know what? Sometimes I occasionally run into people who- who remember playing the game whether it be the pirated or the real version, and they'd be like, "Yeah, I really liked that game." Like I remember even sophomore year of college, I'd run into people that would have an Apple 2, and they'd say, "do you know about this game?" and I'd be like "yeah, yeah, I like that game." So that was kind of cool.

VIRMANI: So in terms of games today, how has this software inspired other software or other games?

FORTNOW: I don't- I mean I think we were one of many at the time. I mean I love creating- you know, just showing what the kinds of games- so I was suddenly saying, "we did it on our own," but recently, one of many who showed that there was a market for computer gaming, and of course that market has grown and changed dramatically. I mean this is not, you know, you look at my game, it's not compared to the kinds of games that you'd see, you know, on a XBox or a PC today, and of course we don't have the networking you know a little bit player yeah you know with all the graphics it's just incredible these changes that have happened in computer gaming since then. You don't have to write it in assembly code anymore, you don't have to write tables for division anymore. I mean yeah okay you can- you can really do- it's a lot more power and, not only that, you know, basically the writing it's- but there's another big change is that back then, two high school boys and uh you know in a bedroom somewhere could put together a game that could sell 1200 copies. Today, it's almost like making a movie. Right? The amount of- the amount of effort and money and people that go into creating a computer game. So umm, it'd be very hard to compete just to compete for a small number, you'd really need a team. Yeah so that's changed.

VIRMANI: Yeah so the software still exists only in its pirated version, right?

FORTNOW: Well I mean that's not true, I mean there's uh- I have the original disc. I already gave them to somebody in retroTECH.

VIRMANI: Yeah, I think we received a lot of stuff at the end of the summer.

FORTNOW: Okay so- so I think so yeah actually what happen a couple of years- about a year or so ago, so someone reached out to me and said, "I found this copy of Ribbit. It's like an original version from my garage. You want a copy?" And I said, "sure."

VIRMANI: That's cool. Umm, so what hardware or other software does the original version require to run?

FORTNOW: Oh well so, there's a couple things. One is, you could still run it if you had a working Apple 2 in retroTECH. I actually tried that at retroTECH, it was pretty cool. So- so you can run an original Apple 2, but there actually are simulators, so you can run it on a simulator on a- on one of those machines- on a Mac. So people have written these simulators, still they slow things down. So you can still play it, you can play- I think on the simulator, the only version that's there is the pirated version. At least you can see the game, and umm I played the real version on Apple 2 and it still works. So you can play it on lots of platforms. I mean obviously it's not going to be as- as immersive as the kinds of games now, but- but there are still groups of people out there, and there are websites devoted to old Apple 2 games. So- so, and you know, some of the people have- some people that run these websites have talked to me. It's a0 it's kinda neat that there's still interest out there, but, you know, it's like people interested in antique cars.

VIRMANI: So we're kind of nearing the conclusion questions, but how did the creation of the software affect your personal growth?

FORTNOW: That's a good question. Umm, I mean it's this and other things that, you know, other pieces of software that I've worked on that have really, you know, helped me become a programmer, and made me think about computing, and think computationally which definitely helped me. I ended up transitioning to computer science later in college, computer science and mathematics, so I definitely made me someone who eventually would do a career in computer science. It provided programming experience.

VIRMANI: Yeah, have you created or worked closely with any other software programs?

FORTNOW: So I mean a couple. Chris and I also developed something we called Excalibur which was a game that played the computer, and we actually even entered some contests. Won around 8th in the country [...]. And when I was at Cornell, I worked on an email system because this was the early days, you know, and they had something that was kind of thrown together, and they wanted something that ran quicker in assembly language, so I got hired by computer services, and I spent about three years on that which was a lot of fun, but once I left, they scrapped it for more. Our commercial systems came online, but I needed to learn- that was useful because I got to learn how the internet works, and this is we're talking early eighties, so we're talking understanding the internet well before it became popular. In fact we had some ideas that you know I think we're a little bit ahead of our time, but, you know, how to communicate yeah- yeah we didn't pursue in that direction, but we could have in retrospect.

VIRMANI: So are there any other further experiences you would like to share. It's a very general question.

FORTNOW: General experiences. I mean I've been lucky. I guess the neat thing is just, you know, when you have something- some hobby that really whether it be programming or- or playing music or gymnastics or whatever, you know ,whatever you're into, you know you have some hobby that really obsesses you, first you have to really enjoy and want to spend a lot of time on it, but you can get really good at it. You if- you if it kind of obsesses you. I think it's what Malcolm Gladwell once said the 10,000 hour rule: you spend 10,000 hours sort of practicing and doing something and that's what- that's where the experts are, you know? Whether- whether it's playing a violin or hacking on a computer I guess. No yeah so, I'd say that that's what I would definitely believe in, and just I think the important thing is just making sure that you're enjoying these things. We know people it's not fun to spend a lot of time doing something you don't enjoy. I think just making sure you're having fun, because you've progressed through life trying to figure out what excites you.

VIRMANI: That was really inspiring, but thank you for sharing your story with us and for participating in our project.

FORTNOW: Thanks for asking them. Try out the software.