You know, on WALL-E it's towards the end and we're racing to beat the clock to get it done in time. And all of a sudden, the director says, "I'm so sorry, but I've realized that if I make this
critical change in the story,

that it's going to make it

a better film.

And I know it means

you guys are going to

have to throw some of this

out and start over.

And we're already down
to the wire,

but I think it's going to
make a better movie."
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

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(music)

00:00:33,000 --> 00:00:33,999
>>Hi, everyone.

00:00:34,000 --> 00:00:34,999
Welcome to
Behind the Tech.

00:00:35,000 --> 00:00:35,999
I'm your host, Kevin Scott

00:00:36,000 --> 00:00:38,999
Chief Technology Officer
for Microsoft.

00:00:39,000 --> 00:00:40,999
In this podcast, we're going
to get behind the tech.
We'll talk with some
of the people who
have made our modern
tech world possible,
and understand what
motivated them
to create what they did.
So, join me to maybe learn
a little bit about
the history of computing,
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

00:00:51,000 --> 00:00:52,999
and get a few behind-the-scenes insights

00:00:53,000 --> 00:00:53,999
into what’s happening today.

00:00:54,000 --> 00:00:54,999
Stick around.

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(music)

00:01:01,000 --> 00:01:02,999
Today, I'm here with my colleague, Christina Warren.

00:01:03,000 --> 00:01:04,999
Christina is a senior cloud developer advocate
Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
at Microsoft.

I’m so excited about your conversation today.

Yeah, today we’re going to chat with Danielle Feinberg.

I’ve been really excited to get her on the show.
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

>>Yeah, I think this will be really interesting

to a lot of engineers because not only does she work

at one of the coolest tech companies on the planet --

Pixar.

But they're also one of the most creative companies

on the planet.
Behind the Tech with Kevin Scott  
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist  
So, she gets to mix these two worlds.

where she's literally programming movies.

>>Yeah, and she's so incredibly inspirational

in addition to being a brilliant technologist

and a brilliant storyteller,

she also is doing this really incredible work
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

00:01:42,000 --> 00:01:44,999
to inspire the next generation
of computer scientists

00:01:45,000 --> 00:01:46,999
to come into the field.

She has a really great
platform for doing that

in that her work is literally
so visual and captivating.

>>And she's working on
some of the most iconic
films and projects.
Things that all of us kind of look at.

>>Yeah, absolutely.

She goes and puts in all of this crazy work on these film projects.

And then the thing that comes out is, by and large, adored by many, many, many millions of people.
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

00:02:14,000 --> 00:02:15,999
>>Well, I can't wait to hear what you two talk about.

00:02:16,000 --> 00:02:17,999
>>Yeah, so, we will chat later.

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(music)

00:02:20,000 --> 00:02:22,999
Coming up next, Danielle Feinberg.

00:02:23,000 --> 00:02:24,999
Danielle is Director of Photography for Lighting

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at Pixar Studios.
Her love of combining computers and art began when she was eight years old. This eventually led her to a BA in computer science from Harvard.

Today, besides making films for Pixar, she mentors teenage girls, encouraging them
to pursue code, math, and science.

Welcome, Danielle.

>>Thank you.

>>I'm so, so, so excited.

(laughter)

In some ways, I think you have the best job in the world.
Because you get to code,
and it's non-trivial,

very mathematical coding.

And at the same time,
you get to indulge

your creative side.

So, let's talk for a second
about lighting.

Do you think you could do
a little two- or three-minute
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
00:03:04,000 --> 00:03:06,999

explanation of what the lighting problem is?

86
00:03:07,000 --> 00:03:07,999
>>Sure.

87
00:03:08,000 --> 00:03:10,999
Because the software is mimicking real life in many ways,

88
00:03:11,000 --> 00:03:11,999

89
00:03:12,000 --> 00:03:15,999
if we don't put any lights in, it actually comes out black.

90
00:03:16,000 --> 00:03:16,999
Because it looks around the room.
Where are the lights?

And what color am I going
to make these pixels?

If we don't put lights in,
it comes out black.

>>And in some ways,
it's really similar to cinema.

If you go onto a movie set,
you've got these lights.

>>Absolutely.
>>And they know where the shadows are going to fall.

>>Yes. And it's mimicking all that, but ultimately,

we want control.

And so we want to kind of harness the power of what are the physics of real-world stuff?

But then let me tweak that because I'm making a movie;
I'm making art.

Our biggest job in lighting is actually to help tell the story.

We have a humongous impact on the mood.

Now, if you can imagine your favorite film, lit as if it all took place at the DMV.

With that horrible overhead, boring, fluorescent light.
(Kevin laughs)

That's a really different movie than if you put Coco all in DMV lighting,
the feel of that movie is completely different.

>>Yes.

And Coco is a really good example for a great many
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EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

00:04:03,000 --> 00:04:04,999
reasons that would just be impossible to do

00:04:05,000 --> 00:04:05,999
with classic lighting.

00:04:06,000 --> 00:04:06,999
>>Yeah.

00:04:07,000 --> 00:04:07,999
>>The number of light sources.

00:04:08,000 --> 00:04:09,999
Like when you go into the --

00:04:10,000 --> 00:04:10,999
>>Yeah. The Land of the Dead.
>>Oh, my god.

It's unbelievable.

I still don't know how you did it.

>>Well, that first show has 8.5 million lights in it.

And it took so much time to figure out how to do it.

We had to develop new technology.

That's like eight million more than we ever had.
>>Yeah, you can't hand place eight million.

>>You can't hand place all of them, right?

And so we get the sets department to build all the street lamps named a certain way.

And then we write the code to find all the street lamps.
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EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
And then it points a point
at every street lamp

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that, then, is a light.

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But then you do this
super-special light

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So, the computer considers it
one expansive light,
And so I can change the color of all of them at once.

I change how much the throw is all at once.

But let's say you end up in one little spot

where you need a couple of those street lamps.

You don't want it controlled by the whole thing.
We have a way to upgrade them into their own lights.

And on and on and on.

And so there's this massive complexity to it.

But put all that aside.

We're trying to make this magical world.

We want you to walk into The Land of the Dead
and feel this enormous awe

because we want you to feel what Miguel feels.

I know if I were trying to do your job,

I am such a technical nerd

that I would be completely overwhelmed by all of the
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EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

00:05:16,000 --> 00:05:17,999
sort of sterile technical bits.

00:05:18,000 --> 00:05:18,999
(Danielle chuckles)

00:05:19,000 --> 00:05:19,999
And there must be this
tension

00:05:20,000 --> 00:05:21,999
that people fight against.

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Here's all of this
technical complexity,

00:05:23,000 --> 00:05:26,999
and there has to be a human
story somewhere in there.
Behind the Tech with Kevin Scott
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00:05:27,000 --> 00:05:27,999

>>Yeah.

163
00:05:28,000 --> 00:05:27,999
>>That must be interesting.

164
00:05:28,000 --> 00:05:28,999
>>Yeah.

165
00:05:29,000 --> 00:05:31,999
And I think everyone at Pixar is so nerded-out about

166
00:05:32,000 --> 00:05:34,999
making great movies, that anything you need to do

167
00:05:35,000 --> 00:05:37,999
to get to that point, and that you get the opportunity

168
00:05:38,000 --> 00:05:38,999
Behind the Tech with Kevin Scott
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to contribute to that,

169
00:05:39,000 --> 00:05:40,999
everybody gets totally into it, you know.

170
00:05:41,000 --> 00:05:43,999
And so, sometimes you have to wade through a lot of

171
00:05:44,000 --> 00:05:46,999
sort of technical stuff to get to the thing that's

172
00:05:47,000 --> 00:05:47,999
your contribution to the movie.

173
00:05:48,000 --> 00:05:50,999
But I think, in secret,
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

most people love

that part, too. (laughter)

>>So, I want to go

all the way back


and try to understand how

this started.

When did you start to

either develop your

creative tendencies or

your coding tendencies
when you were little?

>>Yeah. My parents are both super artistic.

My sister’s super artistic.

We just grew up in this family where the after-school stuff or the classes or whatever were always art classes that my parents put us in.
And so that was sort of a part of life.

>>And what sort of stuff did you do?

Did you draw? Was it painting?

It was all kinds of stuff.

I remember taking, when I was really little, a pottery class.
And then I remember when I was maybe

seven or eight years old going --

I grew up in Boulder, Colorado.

Going to the University of Colorado, and we made those paper mache masks, where you take a balloon and blow it up and do paper mache on it.
And so I just sort of grew up with art all around.

And then I went to this really cool, creative, unusual kind of private elementary school called Bixby School in Boulder.

And one day, one of the dads said,
“Hey, I want to teach a programming class after school for the kids.”

And I was eight or nine.

This is like mid to early '80s, I guess.

And so it was like we had three of the first Apple computers.

>>Oh, that's awesome.
>>And it was, like, well,

I don't know what programming is,

but I love these computer things.

And so it turned out to be in the language Logo.

And so it just happened that my very first programming experience was writing
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code that made this little

00:07:15,000 -- 00:07:16,999
icon of a turtle drive around
on the screen

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and everywhere it went,
it left a line.

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And so, my first coding experience made pictures.

00:07:22,000 -- 00:07:22,999
And coming from this art background, but also

00:07:23,000 -- 00:07:25,999
really deeply already
loving math and science,
it was like this magical combo of the two

that I had no idea at the time what it meant.

I just was like, "This is really cool."

"I like programming."

(laugh)

>>Yeah. I remember I had similar experiences.

The thing that enticed me to want to understand
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227
00:07:40,000 --> 00:07:42,999
programming more, part of
it was just -- it's the mystery.

228
00:07:43,000 --> 00:07:42,999
Right?
>>Yeah.

229
00:07:43,000 --> 00:07:43,999
And the more mysterious
the thing,

230
00:07:44,000 --> 00:07:45,999
the more I wanted to
understand how it worked.

231
00:07:46,000 --> 00:07:48,999
But the real hook for me
were video games.

232
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When I grew up,

the console video games

had just started coming out.

And I'm, like, "Oh, my god."

And there were video games on the Apple IIe.

And I'm like,
"I've got to figure out

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EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

When I grew up,

the console video games

had just started coming out.

And I'm, like, "Oh, my god."

And there were video games on the Apple IIe.

And I'm like,
"I've got to figure out
Or the games were --

The kids would probably cringe at now,

but it was all text, but you were writing things and investigating a world.

And you had to figure out where the key was

and the thing that the --
You know, and there were no pictures.

It was all text.

But it was this whole world,

and it all existed inside the computer.

>>And you were in charge of it.
I just felt so empowered. It was this amazing thing.

So, where did you go from there?

You're eight years old, you're learning Logo.

>>Yeah.

>>What's next?

>>The school then brought in --
happened to be a woman from the University of Colorado who was studying programming. And she taught us the language BASIC. I always think it's so awesome that my second computer science teacher was a woman.
And my third one was a woman.

And my fourth one was a woman.

>>Wow.

>>Which had to have some impact in there somewhere.

But she came in and taught us BASIC.

And then, of course, I could
at home on my Apple computer.

And so it became just this hobby to program in my spare time.

>>And so, what were some of the first programs that you wrote, that were like actually real programs?
>>Like, I made a horse-
racing program. (laugh)

And it had little animations
of these horses

>>That's awesome.

>>You might have been
able to bet on the horses

and whether they
won or not. (laughter)
So, you literally were just destined to do what you do.

I think I was, yeah.

And it's like of course, not anything you realize at the time.

You're just messing around and having fun.

Yeah.
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And did you share any of the programs that you wrote with your friends?

Was there community there?

Or were you just doing it mostly for yourself?

>>You know, it was all for myself.

I mean, maybe, like I did a programming class
And there were three of us in the class I think.

And so I probably shared it with the other two people in the class, but it wasn't a big thing then, I don't think.

And, eventually, I read somewhere...
that you learned Pascal?

>>Uh-huh. (affirmative)

>>So, was this Turbo Pascal or was it MPW Pascal?

>>MPW Pascal.

>>Gotcha.

>>And in high school, I was dying to learn something
with more depth to it
than BASIC.

Because, you know, that was
a limited language

"I want to be a
real programmer."

"I've got to learn --"

And it turned out, like, okay,
Pascal seemed to be
the most accessible thing.

>>Yeah. (laugh)

>>And then I sign up for the Pascal class.

And the first class, I look around and I'm like,

"This is sort of a weird collection of people for a programming class."
And the teacher comes in
and she takes roll

and she shows us how to
turn the computers on.

And she says,
"I'm going to get coffee."

And she never came back.
(laugh)

And it turned out, it was like
the classroom for derelicts.

Where everybody sat there
And the teacher went left
and never came back.

And so my friend and I were
so bored after the first week
that we broke into
the cabinets
to get the textbooks
to teach ourselves.
And so in the room full of derelicts,

the little honors students were actually the people that were breaking and entering on school property.

(laugh)

>>That's outstanding.

Outstanding.

And were you able
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to teach yourself?

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>>We did a little bit.

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But I really learned freshman year in college.

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When Pascal was the language that they taught us

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first semester of freshman year.

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>>And so you, basically, just had this positive
You show up at Harvard, and you know that you
wanted to major in computer science?

because in my head, that was equivalent
to inventing things.
Behind the Tech with Kevin Scott
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But it satisfied the math
and science

00:10:56,000 --> 00:10:56,999
and the creation thing.

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But I kind of looked
at the classes and I went,

00:10:59,000 --> 00:11:01,999
"These don't look that great
anymore."

00:11:02,000 --> 00:11:02,999
"But I can take these
computer science classes,

00:11:03,000 --> 00:11:04,999
because they count towards
engineering, and that'll
buy me some time, while I figure out

And then I think it was really two weeks into the first semester, I was like,

"Wait, why am I not studying computer science?"

"This is idiotic."
So, it took me two weeks
to figure it out,

but then it was
pretty obvious.

>>And how mathematically
prepared were you?

Because you chose a
specialty inside of
computer science, where
math is really important.

>>Yeah.
>>It's not just the lie that we tell that's, like,

"Oh, it's important for everything."

>>Right. Right. Totally.

>>It's really important for computer graphics.

>>Yeah. You know, I loved math.

And I would say --
I was always in honors math.

And I was on the math team in junior high.

But I went to public junior high and high school.

And at my high school, at least then,

you couldn't take calculus unless you were honors and a year ahead.
And so I was honors, but not a year ahead.

And so I never got to take calculus.

And so I got to Harvard, and like everybody had taken calculus.

And so you do the testing, you know,

when you first get there,
to see what you test into.

And I test into calculus.

Seemingly, obviously, right?

But I realized pretty quickly that everyone else in there had already taken calculus.
They just hadn't tested out of it.

And so I was at a massive deficit going into it because I was trying to learn stuff that people had already spent a year learning.

>>And that's one of the hard things.

Like, I found when I was teaching computer sciences.
I taught CS201 at the University of Virginia --

or I TA'd a section of it.

And I had this huge diversity in my class.

I had some kids who had no business being there because everything was just trivially easy for them.

We should have just tested them out
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

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and sent them on to
something more challenging.

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And then we had kids who

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had no programming
experience whatsoever

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and no talent for it.

00:12:47,000 --> 00:12:47,999
And it was just sort of awful.

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It's just hard teaching
a class like that.
And it’s really hard being a student.

How did you figure out that it was sort of okay that you were where you were, and that the people who were doing better than you just because they got a chance to take the materials in high school?
You know, I don't know that I did ever figure that out really until long afterwards.

It was that thing of like you sit in there, and it's full-on imposter syndrome, because you're already sitting at Harvard.

And I already felt like,
"Wow, somebody made a giant mistake and let me in here."

"And they're going to figure it out at some point."

And so, while experiencing all that,

I also just beared down and was like,
You know, I'm pretty dogged about that kind of thing.

When it's like, this is what I want to do.

I'm not giving up.

And I may torture myself with all these feelings of not deserving to be there or whatever it is.

But I'm not stopping.
And so I put in a huge amount of effort.

Every week, I'm going to the office hours to get almost an extra hour or two hours of class.

And talking to the teachers.

And, unfortunately, those entry-level math classes are taught by
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graduate students, who

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that's not their gig.

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They're not there to teach,
and so they don't actually

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really care that much.

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So, it was those first two
semesters that were

00:13:56,000 --> 00:13:58,999
the hardest, because it was
hard to get to someone

00:13:59,000 --> 00:13:59,999
who cared about teaching
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
you as much.

Yes.

And then the third semester,

I got the woman who was

the head of the math department.

And that lady was awesome.

And I would go to
and she would totally dig into it with me.

>>And what class was that you were taking?

>>That was linear algebra, which --

>>Oh! Murder!

>>Yeah.

>>And also probably
For computer graphics, it's like critical.

So, it was pretty awesome.

>> Oh, that's great.

So, when did you decide that computer graphics was the thing?

>> Well, you know, it's that same thing of, like,
I'm looking at these engineering classes.

I don't know, looking at the computer classes and I go, (gasps)

"Look at that computer graphics class."

"That sounds awesome."

"I want to take that."
"How soon can I take that?"

"Oh, well, it's got this prerequisite here."

And then, "Oh, I can't take it till junior year."

And so I'm such a nerd.

Sophomore year,
I emailed the professor,
is there anything I could do
to get ahead?

Is there anything I could just
play with now?"

And I got the most confused
e-mail back from him.

You know, I don't think most
Harvard students are like

emailing professors for
future classes

and asking how they can
He was, like, "I guess you could go buy the textbook."

But it must have made an impression.

We're still friends to this day.

And he clearly knew my enthusiasm going into the class.
And so I go in,

00:15:09,000 --> 00:15:10,999
and it was really a class
about programming --

00:15:11,000 --> 00:15:12,999
all the underpinnings of the
programming

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to get to the 3D world.

00:15:14,000 --> 00:15:17,999
But there was a day where
he turned off the lights

00:15:18,000 --> 00:15:18,999
and he started playing
these films.
And it was the Pixar short films from the late '80s and early '90s.

And this is, I think, '94.

And I still completely clearly etched in my mind, just watched those with my mouth hanging open.

Was like, "That is what I have to do with my life."
Because it was all this math, science, and code.

I'd been learning, but it created a world and stories in this way, that to me, was just the most perfect combination of everything that I loved.

>>Yeah. That's so amazing.
Those films made an impact on me as well.

And for a while, I thought I was going to be a computer graphics person, but --

>>Really?

>>Yeah.

I just decided I wasn’t creative enough to do it.
I had no role-modeling
for it.

And I was super happy
with my specialization.

I was a compiler guy.

>>Nice!

>>I've always had this great
degree of empathy

for software developers
and wanting to do things
for them that help them
practice their craft.

And it's underlied
my entire career.

But I've always sort of
wondered about the
computer graphic stuff
because it's a little bit more
performative than maybe any
other kind of

software engineering.
>>Yeah.

>>Because, I can't show, my "Ooh! Look, I did static

single assignment form."

And show it to my mom and like, "Yay!" (laugh)

No, none of that.

Whereas you worked on Coco.
And I literally wept three times.

in the course of this movie

because it was so compelling.

So, that must be amazing.

>>It's incredible. Yeah.

It's really incredible.
So, you see these films in this class,

and then how soon were you able to connect programming to you being able...

That must have been a really interesting journey.

Thinking back to then, it was like,
okay, I saw these Pixar short films.

But what's Pixar?

Nobody knows what Pixar is.

It's nothing right now.

It's some animation studio you've never heard of.

And even if I wanted to watch those films again,
I couldn’t, because it’s not like we had iTunes or YouTube or something.

You had to go to a Spike and Mike’s Animation festival in a theater or someone had to have an actual copy of them -- a VHS tape, perhaps. (laugh)
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
And so the next year,
my senior year,

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Toy Story came out.

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00:17:20,000 --> 00:17:22,999
And it was like suddenly
that's that same company

552
00:17:23,000 --> 00:17:23,999
that made those short films.

553
00:17:24,000 --> 00:17:25,999
And they've made this
feature film.

554
00:17:26,000 --> 00:17:28,999
It was the first feature-length,
computer-animated film

555
00:17:29,000 --> 00:17:30,999
And I was, like, "Those are the guys."

But how do I work there?

Like, what do I have to do to qualify to work there?

Because who knows?

Because it's this brand-new thing that's coming up.

So I thought,
"Well, I'd better get some art on my resume."

So, I took a couple classes through the art department.

And my senior year, I took a year-long animation class.

That was more traditional animation.

But for my senior film,
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
computer animation

568
00:17:56,000 --> 00:17:56,999
for my senior film.

569
00:17:57,000 --> 00:17:57,999
>>Oh, that’s awesome.

570
00:17:58,000 --> 00:17:58,999
Do you still have that
laying around?

571
00:17:59,000 --> 00:17:59,999
>>I do. The lighting is
atrocious.

572
00:18:00,000 --> 00:18:00,999
I didn’t know what
lighting was at all.

573
00:18:01,000 --> 00:18:01,999
It’s really funny,
The whole thing's embarrassing.

But it sure was fun.

And so I started to get a little bit of a sense,

but there were no role models.

There was no information anywhere.
And so it was kind of scrapping to try and figure out what to do to get qualified.

It turned out, I probably didn't even have to think that hard about it.

Because having gotten a computer science degree and specialized in computer graphics,
no one had any experience.

So, when I ended up applying to Pixar,

they were like, "You're great, come work on this next film,

A Bug's Life, because we need people that know computer science.

And if you know computer graphics, fantastic."
>>I remember going to see
A Bug’s Life

when I was taking a graduate computer graphics seminar.

>>Oh, really?

>>And so we -- yeah, this was a great part of this class,

these full-length, animated movies.

So, there was Bug’s Life.
And there was Antz from DreamWorks, I guess.

>>Yeah. Yeah.

>>And the pipeline was just starting to go.

And so part of our duty as scholars,

we would go see these movies.

>>Shoot, that's so hard.
>>Yes, so difficult.

And it just struck me that the progress was so fast.

How was experiencing that as a Pixar employee?

Because it must have been like just exponential curve after exponential --

>>Oh, it was insane.
So, coming in after Toy Story,

I'm coming in early '97.

Toy Story came out in November of '95.

And Bug's Life comes out towards the end of '98.

So, I worked on A Bug's Life for over a year and a half.

And sort of seeing a little bit of how Toy Story was made
Behind the Tech with Kevin Scott
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00:19:22,000 --> 00:19:24,999
and the giant leaps they had made

00:19:25,000 --> 00:19:27,999
just in the software we were using to make A Bug’s Life.

00:19:28,000 --> 00:19:29,999
And the problems that were faced were, like,

00:19:30,000 --> 00:19:32,999
on Toy Story, you’re making plastic toys

00:19:33,000 --> 00:19:35,999
that have very defined ways in which they move.

00:19:36,000 --> 00:19:38,999
The best thing the computer can do is make plastic.
For whatever dumb reason,

that's the easiest thing
to simulate.

So, now you're making
these bugs,

down on the forest floor,

with all this organic
plants and nature.

And it was like such a
massive leap harder
that on A Bug's Life,

the last department that happens is lighting.

The last creative step.

And they got half of my department,

the rendering department,

to come help on lighting so we could make the deadline
because everybody's missing their deadlines

because it's so, so, so, so hard.

And we're trying to hit the deadline.

And that was actually how I got my first taste of lighting was on A Bug's Life because that movie was so much harder than
And Toy Story was so hard because they're making it all up as they go, too.

You know, I get asked, "What was the hardest film you've ever worked on?"

I'm, like, "They all are." When you're working
every single one feels like it's the hardest one you've ever done.

We aren't biting off quite as gigantic leaps of change and breaking barriers in terms of, like, What? Hair? We can't do hair.
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
Now we can do hair.

651
00:20:32,000 --> 00:20:32,999
What? Curly hair?
We can't do curly hair.

652
00:20:33,000 --> 00:20:36,999
Okay, now it's not quite as huge of barriers,

653
00:20:37,000 --> 00:20:37,999
but each one still feels like it's the hardest thing

654
00:20:38,000 --> 00:20:39,999
you've ever worked on.

655
00:20:40,000 --> 00:20:42,999
>>Yeah. And I remember seeing A Bug’s Life.

656
00:20:43,000 --> 00:20:44,999
One of the incredible things was just how many more polygons were in that movie than Toy Story.

>>Yeah. Yeah.

>>Do you remember, count-wise,

>>I don't know.
A while ago, someone said,

"Oh, if we tried to render
the original Toy Story now

or something insane,
you know?

And especially if you look
at those couple early films,
if you went from Toy Story to Finding Nemo,

the sort of visual jumps that each one was taking was pretty phenomenal.

>>Yeah, staggering.

And part of that is the software.

And part of that is -- Sharon Calahan, who I
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
learned lighting from,

who’s probably one of the
best computer lighters

in the entire world.

And she’s saying,

"Hey, can you do this to the
software now?"

"Can you add this to the
software now?"

"Can you add this?"
And so part of it is people with experience and technology and the two of those things coming together, so your art tool set is getting better and better.

I can sort of understand how you went from eight years old through your
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EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
senior year at Harvard,

and you just sort of learned
all of the mechanical bits

about how you write
computer programs

and even the mathematical
bits about how you do

like 3D modeling and the
cool lighting stuff.

How did you learn
how to tell stories?
That's really from being at Pixar and just being around some of the best storytellers in the world. And understanding that a massive part of it is iteration, and people understanding what makes great stories.
And also the amount of feedback people get at Pixar, there are directors that have made these blockbusters, but they still are talking to the creative brain trust. They're showing them their movie, taking their comments.
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

00:22:20,000 --> 00:22:21,999

You know, art is such a hard thing.

00:22:22,000 --> 00:22:23,999

Where, when you get into it, you can't always see what's happening.

00:22:24,000 --> 00:22:24,999

You get really kind of myopic about it.

00:22:25,000 --> 00:22:27,999

And to have these people that you trust be able to give you this feedback on it.
so that you can pull back
out again and you can

solve those problems and
understand

so that the movie plays for
all kinds of people,

maybe not just you.

And you watch all of that
happen over and over again

and like, you know,
on WALL-E,
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

716
00:22:43,000 -- 00:22:43,999
it's towards the end.

717
00:22:44,000 -- 00:22:44,999
And we're racing
to beat the clock,

718
00:22:45,000 -- 00:22:45,999
to get it done in time.

719
00:22:46,000 -- 00:22:48,999
And all of a sudden,
the director says,

720
00:22:49,000 -- 00:22:51,999
"I'm so sorry, but I've
realized that if I make

721
00:22:52,000 -- 00:22:53,999
this critical change
in the story,
that it's going to make it
a better film."

"And I know it means
you guys are going to
have to throw some of this
out and start over,
and we're already down
to the wire,
but I think it's going to
make a better movie."
And everyone sort of goes, "Okay." You know?

And there's no complaining after that.

I mean, our spouses and stuff might complain a little bit because we're gone on Saturdays.

But people are so dedicated to it that that you just go after it in that way.
Yeah. And is that something that Pixar had from the beginning?

I know I’ve read the famous story about the restart on Toy Story 2.

Where John Lasseter wasn't as involved, and then came in and realized that there was
no way to bridge the gaprom where the movie was

to like where it needed to be.

And then just basically
a big restart.

Was that one of those pivotal
moments in the company?

Or did you guys always
have that?
It's so easy to look back
and be, like,

"Oh, we've always
done this."

But the truth is, it felt like

there's these guys
who are really brilliant.

Some of the very core
Pixar folks,

and some of them went to
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EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
CalArts together and stuff.

But they were like buddies

and they trusted each other artistically.

And so they’re banding together at this tiny little company that no one knows who it is

it has no money.

You know, you’re making
You don't know what you're doing because no one else has done it before.

You're making everything up.

And so you're just figuring it out as you go with some people that you trust.
And it works.

And so then you go,

"Whoa, okay, what part of that worked?"

And you go make the next one and it works.

And so then you go,

"Whoa, okay,

what part of that worked?"
And you go make the next one.

And as you go, you find the things that work.

And that becomes your process.

But it's not like anyone from the beginning was like "Well, this is the process."

"And this is how we should do it."
"And it's always going to work."

And with the Toy Story 2 one,

I think, in a way, that sealed our dedication to creating the very best stories that we could,

no matter what.

Because what was happening is that movie was originally...
supposed to go direct
to video

which was a thing Disney
was doing a lot.

And we all felt sort of like,
well, that in itself

made it seem like it was
this second-rate story

that we don't have to put as
much effort into or something.

And that, already, even
at that point,

felt really weird.

We already knew that wasn't what the root of that company.

And so I think everybody was actually quite relieved when it was we're not doing this direct-to-video thing.

This is going to be a
and we're going to drop
everything to make it
the best thing possible.
Actually, I think we made
that movie in nine months
is my recollection.
That's one of my happiest
golden moments
of memories from then,
because the whole company was sitting there.

all day, all night making that movie together.

And bonding that way.

>>Yeah, so, in a way, the mistake there

was doing an unnatural thing.

>>Yeah, yeah, exactly.
>>Yeah, no, that's interesting.

And I've always appreciated the consistent quality of the art and the storytelling.

I've got an eight-year-old and a ten-year-old.

And when they were much younger,
Disney was pushing out the computer-animated films like Tinkerbell.

So, I've seen all of these dozens of times each.

And they were so good.

And you could just see the John Lasseter touch on all of them.

It's like even though they
816
00:25:54,000 --> 00:25:54,999
ty they were just great.

817
00:25:55,000 --> 00:25:56,999
My kids would watch them
ever and ever again.

818
00:25:57,000 --> 00:25:58,999
Like, they were so good,
that my wife and I

819
00:25:59,000 --> 00:26:00,999
would watch them over
and over again with them.

820
00:26:01,000 --> 00:26:01,999
>>That's awesome.

821
00:26:02,000 --> 00:26:03,999
>>And we would
Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

eagerly await the next one coming out.

That’s amazing discipline for your product so that you’re putting that into this thing that, you probably could have gotten by with less if you wanted.

>>Yeah. Well, you have to
trust on some level

00:26:15,000 --> 00:26:17,999
that that's going to pay off
in the end.

00:26:18,000 --> 00:26:19,999
Because I think that's a
huge leap of faith

00:26:20,000 --> 00:26:20,999
most of the time
in the world, right?

00:26:21,000 --> 00:26:22,999
No, if you actually
spend this money

to make this better,
you will not only recoup that money,

but get more of it.

It takes a very specific kind of faith in things to follow through on that.

>>So, how do you get people to be vulnerable enough to put themselves out there creatively

enough to put themselves out there creatively
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
in this process where you need lots of feedback

00:26:42,000 --> 00:26:45,999
and lots of criticism in order to get to the best thing?

00:26:46,000 --> 00:26:47,999
>>I think it’s really hard.

00:26:48,000 --> 00:26:50,999
I mean, I think you know coming in

00:26:51,000 --> 00:26:52,999
that that's what's going to happen.

00:26:53,000 --> 00:26:55,999
I don't know that it's easy for anyone.
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

00:26:56,000 --> 00:26:57,999

I mean, that's particularly difficult.

846

00:26:58,000 --> 00:26:59,999

We've had people where it didn't work out for them to be directors at Pixar.

847

00:27:00,000 --> 00:27:00,999

Being a director there, it is no joke.

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00:27:01,000 --> 00:27:01,999

People are like,

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00:27:02,000 --> 00:27:03,999

"Oh, you want to direct a film, right?"
And I'm like, "Oh, geez, I don't know." (laugh)

We're a director-driven studio.

You're in charge of the story,

but you're in charge of everything else.

Nothing goes into those movies without someone presenting it to you and saying,
"Do you like this? Is this what you imagined?"

And so you have to be a story expert.

And you also have to have an opinion on everything or understand how to trust your lieutenants and stuff.

It's pretty challenging.

>>And it must impact everybody, though,
because you want everybody
whether they're
a lighting engineer
or a storyboard artist
or a director to take
creative risk.

>>Yeah, definitely.

>>And sort of the same
thing that you want

in any high-performing
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
company, actually.

00:27:43,000 --> 00:27:44,999
You want employees to
come in and

give their best idea to sort of

00:27:45,000 --> 00:27:49,999
push the boundaries
on things.

00:27:50,000 --> 00:27:51,999
And when you do that,
sometimes you fail.

00:27:52,000 --> 00:27:52,999
>>Yeah.

00:27:53,000 --> 00:27:54,999
One thing is that because
an art background, where people are particularly used to -- like, if you go to art school,
you get an art critique every time.

In my brain, it's almost like hitting in baseball.

If you're amazing, you only succeed
one out of three times

anyways.

>>Right.

>>And so I think some

part of it is people come

in with that understanding

that this is art,

and you can't always

control what's going on

and so you need help

from people.
And you definitely have to be vulnerable,

but you also understand the stakes involved.

And also, that is another part of the culture at Pixar is people want to take risks.

So, a movie like WALL-E with a robot who doesn't talk or Ratatouille, with rats that cook,
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

892
00:28:31,000 --> 00:28:34,999
you know, those are not
normal or low-risk ideas

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00:28:35,000 --> 00:28:35,999
for movies, generally.

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00:28:36,000 --> 00:28:37,999
But people are at Pixar
because that's the kind of

895
00:28:38,000 --> 00:28:39,999
stuff they want to make.

896
00:28:40,000 --> 00:28:41,999
They don't want to make
boring, schlocky films.

897
00:28:42,000 --> 00:28:43,999
They're into, like, the
excitement of it
and doing cutting-edge things.

>>Yeah. How do you onboard new people into your team?

Like, what are the big challenges?

>>A lot of the challenge is really the technology because we have this sort of
Behind the Tech with Kevin Scott
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Frankenstein pipeline

904
00:28:56,000 --> 00:28:59,999
where we’ve built this
beast of a pipeline

905
00:29:00,000 --> 00:29:00,999
that is a beast so that
you can plug in

906
00:29:01,000 --> 00:29:01,999
different pieces
of software.

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00:29:02,000 --> 00:29:03,999
And so part of it is our own
proprietary software,

908
00:29:04,000 --> 00:29:04,999
and part of it --

909
00:29:05,000 --> 00:29:05,999
>>And it evolves pretty quickly, right?

Probably from film to film, they're like --

>>Oh, yeah, day to day sometimes.

Which is awesome, because then when you need something, you can get something.

You know, you're not trying to talk to
some other company
and convince them

they need to do this
thing for you.

But we can also plug in
third-party software as well.

And so part of
the onboarding

is really people getting up to
speed on that process.

At least in lighting,
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EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist

we've made that a lot easier,

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00:29:25,000 --> 00:29:26,999
where our tools have gotten
sort of streamlined

922
00:29:27,000 --> 00:29:28,999
and easier, and a little clearer.

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00:29:29,000 --> 00:29:30,999
Plus, now, we're using
a software package

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00:29:31,000 --> 00:29:32,999
that's used in other --

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00:29:33,000 --> 00:29:33,999
it's a public package
called Katana.

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00:29:34,000 --> 00:29:35,999
And so more people come in
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
with at least a little bit of

927
00:29:36,000 --> 00:29:36,999
experience with it.

928
00:29:37,000 --> 00:29:38,999
Where, before, it was our
own software.

929
00:29:39,000 --> 00:29:39,999
It was our own lights.

930
00:29:40,000 --> 00:29:40,999
It was everything was ours.

931
00:29:41,000 --> 00:29:42,999
And so you had to come in
and try and untangle

932
00:29:43,000 --> 00:29:44,999
the mess of what was
going on there.
>>Yeah. And sort of culture-wise,

Because everywhere I've worked,

there's been this sort of "Frankenpipeline"

(laughter)

of stuff, right?
Like, I don't know why I always choose to work for companies who have a lot of, you know, "not invented here."

But the culture stuff is interesting as well.

The hardest thing is that because the computer
and visual effects industry has been changing a lot

over the last, I don't know, ten years,

where things are getting shipped to, say,

India and different parts of Asia.

And some of the visual effects houses went under.
And the whole industry,

everybody was pretty freaked out about how long it was going to stick around.

And then a lot of people, instead of being at a company for years and years,
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they end up doing freelance

957
00:30:30,000 --> 00:30:30,999
and then kind of moving
place to place.

958
00:30:31,000 --> 00:30:32,999
And so people come
to Pixar,

959
00:30:33,000 --> 00:30:34,999
and we can't always do this,
but generally,

960
00:30:35,000 --> 00:30:36,999
when you work at Pixar,
you work at Pixar.

961
00:30:37,000 --> 00:30:37,999
We don't do contract hires.

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00:30:38,000 --> 00:30:39,999
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
We don’t hire per project because we feel like

00:30:40,000 --> 00:30:42,999
the culture takes a hit then.

00:30:43,000 --> 00:30:43,999
And, you know, you build up all this expertise,

00:30:44,000 --> 00:30:45,999
we want you to stay and all these things.

00:30:46,000 --> 00:30:47,999
And so, people come in and they're so used to

00:30:48,000 --> 00:30:50,999
having to sell themselves quickly
so that they can keep getting jobs at this place

because they're freelance.

That's actually the hardest thing is to get people to calm down about that

because it's so opposite of what our culture is,

that you're like,
"Okay, you don't have to sell
yourself anymore."

"Like, just come. Just be
a part of things."

"Try not to get too
competitive about it."

When the competitive part
gets introduced

amongst people
within a department

is when things
get really funky.
Because making these movies is hard

and it's like a very team thing.

You're very dependent on your teammates and stuff.

>>Yeah. Well, and it sounds too like again,

your process is about competing against mediocrity
not against each other.

> Exactly. Yes. Totally.

(laughter)

>> So, speaking of this big change in the industry,

what are the big changes that you've seen in either computer-animated films or at Pixar over your tenure there?
Well, I think at Pixar, a lot of it's about the technology and continuing to push it and see what you can do. And it's really about the story. People can think up any story they want. And so, then, how does
to tell that story?

And so there's been a lot of that.

In general, in the sort of bigger scope of things, with VR coming out, how does that impact us?

And I don't think anyone really gets how to
We tell these stories, and we're super --

I don't know, really picky and precise about how we're framing a shot.

We spend a lot of time thinking about where we place the camera and how we light it
And if the audience suddenly could look wherever they wanted, I don't know if we know how to tell stories anymore.

And so someone will crack the code.

I mean, there's already been a bunch of VR stuff.
But someone will get that.

I don't know that it's going to be us.

But, obviously, there's stuff changing all around.

You look at video games, they're doing some of that sort of storytelling in that way.

The visuals of storytelling are getting much closer
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1021
00:32:28,000 --> 00:32:29,999
to the visuals of computer animation.

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00:32:30,000 --> 00:32:31,999
There's all these things that are starting to cross over.

1023
00:32:32,000 --> 00:32:33,999
And live-action movies are using way more

1024
00:32:34,000 --> 00:32:35,999
computer graphics.

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00:32:36,000 --> 00:32:36,999
>>But that’s an interesting thing.

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00:32:37,000 --> 00:32:38,999
I mean, I remember being a
I never enjoyed the choose-your-own-adventure books as much as I enjoyed something where the author had a perspective. Carefully orchestrated and set up so that the things were revealed at this pace, and when they wanted
Yeah.

>>Yeah, it's a thing, storytelling.

>>Yeah. Yeah.

>>Some people are good at it.

And also, I'm guessing, practice makes perfect.

So, after you've done it
you're going to inherently
be better than

someone who's just trying
to extemporaneously

create an example for
themselves.

>>Right. Right. Totally.

>>Yeah. I think that's one
of the big challenges
The technology is actually really at an incredible point right now.

There are a bunch of really compelling industrial applications, but the consumer applications right now are --
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we've got some thoughts about what it could look like.

1051
00:33:24,000 --> 00:33:24,999
But that's the hard problem I think.

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00:33:25,000 --> 00:33:25,999
>>Yeah.

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00:33:26,000 --> 00:33:27,999
The thing that's most exciting about VR, to me,

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00:33:28,000 --> 00:33:29,999
is what you could do in education.

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00:33:30,000 --> 00:33:31,999
And, like, how excited you could get kids immediately
and engaged and feed them all the things they need to be learning,

but in a way where they were totally engaged.

That, to me, is the thing.

I can't wait to see more of that stuff coming out.

>>So, Danielle, I know one of the things
that you are really passionate about is mentoring and helping the younger generation.

So, tell us a little bit more about that.

>>15 years ago, I spoke at this girls'
math and science camp.

And I talked to them about how we made the films at Pixar and all the math, science, and code behind it.

And it was amazing to see their eyes light up when I told them about it.

It was kind of like when I was sitting in that college class.
And so it’s turned into
my passion thing.

I spend almost all of my free
time running around
giving talks, talking about the
STEM behind our movies

and trying to get kids
excited about that stuff.

>>Yeah. And I think
that's how

I first became aware of you.
I was watching one of these documentary films.

And I'm, like, "Oh, who is this enthusiastic person?"

And then we met at Grace Hopper, where you sat for a portrait session for Behind the Tech.
Yeah, I've been an enormous fan ever since.

You are quite a role model to many young computer scientists.

And do you have particular things that you're actively pushing on in education, other than VR,
Because, you know, in a sense, you almost got an ideal path through our educational system.

>>Yeah. Yeah.

>>And, like, my god, what if we could give that to every child who had interest and potential?
>>That would be amazing.

>>Yeah.

>>Well, I do have an agenda.

I want them to see how exciting computer science is.

And how exciting math and science are.

So that, you know, when I
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EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
was in my classes in college,

I was one of a couple girls
studying in these huge

lecture halls.

And sort of knowing how
lonely that is,

and how much of a
detriment that is

to just learning something
that you're
You have to get over this hump of every time you walk in the room, there aren't people that look like you, so everything around you is telling you you don't belong there.
And when you have any kind of struggles, you start going, "Maybe I don't belong here."

You know?

And so finding a way to get girls and underrepresented minorities and stuff excited about math, science, code,
so that when they
hit those, they go,

"I don't care, this is too cool.
I'm going to keep on going."

That's really my agenda, is
so that we get

more and more diversity
in the classroom

so that just because you
want to study

computer science, you don't
have to go through
this whole other extra thing

just to learn the thing you want to learn.

>>Well, I also think the thing that you were talking about earlier around this sort of notion of imposter syndrome, and holy crap, some of this stuff is really hard.
Hearing somebody like you saying that,

"This was hard for me,"
can give people inspiration to push through.

It's like this weird thing with math and computer science.

There are all these apocryphal stories about these great geniuses,
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people who have gone on

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00:36:34,000 --> 00:36:35,999
to accomplish these
incredibly difficult

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intellectual feats.

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00:36:39,000 --> 00:36:40,999
And, you know, many of
them, when they write

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their biographies, will sort of
describe these moments

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where, oh my god, like,
I almost gave up here

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00:36:46,000 --> 00:36:46,999
Behind the Tech with Kevin Scott
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because it was too hard or

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00:36:47,000 --> 00:36:48,999
nobody gave me
permission to struggle.

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00:36:49,000 --> 00:36:49,999
>>Yeah.

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00:36:50,000 --> 00:36:52,999
>>I thought that the struggle
was a sign that I was --

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>>Not good at it.

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00:36:54,000 --> 00:36:55,999
>>Not good at it, and I
didn't belong because

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00:36:56,000 --> 00:36:57,999
all these other folks looked
I really love to hear accomplished folks sort of say that, "Man, this really was hard."

Because you're just not doing anybody any good pretending that it was trivial.

>>No, in fact, you're getting them out of it
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because they go, "Well, this isn't easy for me,

so, I clearly don't belong here, right?"

The woman who is my mentor at Pixar, Sharon,

one day, long, long ago,

she emailed me a quote.

And it was something along the lines of

"Confidence is a gift for the creatively
less talented" or something
like that. (laugh)

And I was, like, "Oh, this is amazing."

"This is like validating all the days where I feel like
I don't know what I'm doing.

(laughter)

>>So, what are you most excited about
on the horizon?

Either technologically or inside of computer science?

>>Yeah.

If I'm going to answer that completely honestly,

it really is the VR stuff for education.

Just because, did you see the Mars bus thing?
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Where the students get on
the bus

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and all of a sudden, they're
transported to Mars.

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>>So cool.

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>>And they're sitting next
to each other

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and pointing out things

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and yelling and screaming.

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And I was like, "Oh, that is --"

And they're just driving around.

It was like D.C. or something.

And it's just -- it's a bus.

It's outfitted, and they're suddenly transported to Mars.
And I was, like, when you can do that kind of stuff, man, that's life-transforming.

>>Yeah, that's awesome.

So, any advice that you would give to folks who are trying to enter the field either to become programmers
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or maybe they want to do
something like you did

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00:38:24,000 --> 00:38:24,999
that's more creative?

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00:38:25,000 --> 00:38:25,999
>>Yeah. You know,
it's funny.

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I talk to students now,
and they come up

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and they said, "Well, I
thought I had to choose

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00:38:31,000 --> 00:38:33,999
between art and STEM.

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Behind the Tech with Kevin Scott  
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And now I see that maybe
I don't have to do that."

And so that is always
really exciting to me

because my happiest place
is the combination

of those two things.

And now it isn't just making
animated films

is the only place you
can do that.
There's just billions of ways you can combine those things.

And that's one of the exciting things, I think, about computer science period is that you asking kids now to specialize more and more.

And you have to decide what you want to do.

I was talking to these girls, and this 13-year-old girl says,
"I'm gonna be a lawyer."

And I was, like, "Why are you deciding that at 13?"

That's insane.

And the thing that I'm always saying from my love of computer science is

this actually opens up the entire world to you.
This is the base for any job in the world now.

There is an element of computer science.

And so instead of shutting things down,

you're actually opening things up in this really marvelous way.

So, I don't even remember what the original question was.
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But -- (laughs)

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>>But that’s a good answer.

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00:39:24,000 --> 00:39:26,999
And I will put an exclamation point behind that.

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So, like, parents and kids who may be listening to this

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00:39:31,000 --> 00:39:35,999
should really understand that we are rapidly becoming

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a world where every business needs technology.
It's not just that the technology industry is the place where technology is being created.

So, we did a thing with LinkedIn data a few months back where we showed that the rate of hiring of software engineers is growing.
more quickly outside of the technology industry.

You have all sorts of things like major automotive companies hiring more software engineers than mechanical engineers.

And so the opportunity that's
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go to be there

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for these kids in the future
is absolutely incredible.

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>>Yeah. Yeah.

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00:40:13,000 --> 00:40:14,999
>>I don’t know about you,
but the thing that is

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remarkable to me when
I sit down at the keyboard

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and try to write anything
these days

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Behind the Tech with Kevin Scott
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is how rapidly our tools are becoming more powerful.

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So, like, what you can accomplish with a given amount of effort is becoming more and more every day.

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>>Absolutely.

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00:40:32,000 -- 00:40:32,999
>>It's just this thing that you can do.

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Whether you have a creative bent or you're very analytic
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00:40:38,000 --> 00:40:38,999

or whatever.

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00:40:39,000 --> 00:40:40,999
If you master these skills,

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00:40:41,000 --> 00:40:42,999
you don't necessarily have to
be a computer scientist.

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But it's going to be this tool
that you can use to --

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>>You can use all over
the place.

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00:40:46,000 --> 00:40:46,999
Like, when people are saying,
"Well, you have to know
how to write. You have
to know how to do math."

And this is on par with
how important those things are

if not more.

>>Yes. And, again,
exclamation point.

You know, given the work
that I do,

it almost seems nonsensical
to have to emphasize that.
But you still sort of have to.

It hasn't sunk in yet.

>>Talking about advice for kids that want to get out there and do this stuff is that

as schools struggle to keep up with developing their computer science curriculum,
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00:41:13,000 --> 00:41:15,999
finding teachers who
know computer science

00:41:16,000 --> 00:41:16,999
who aren't like, "See you,
I'm going to go industry."

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You know, different things
like that.

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Sort of remembering that
if you're one of those kids,

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that there's now all kinds of
stuff online

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Behind the Tech with Kevin Scott
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where you can teach
yourself.

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And, also, you might
have a teacher,

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but it doesn’t make every
teacher a good teacher.

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And so you might go
take a class,

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and it doesn’t make
any sense to you.

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00:41:34,000 --> 00:41:34,999
And that isn’t necessarily
because you aren’t
any good at it, it might be there's a teacher struggling
to figure out how to teach it to you.
You know?
And so if the class doesn't go well,
go find an online thing and work at it a little bit.
Because we've all had the bad math teacher

or the bad English teacher

or whatever

And it turned out, it was just like

you needed a different person.

>>Yeah. And if you can

invest in a foundation early
of sort of practicing learning.

Of course, you want to learn something that's valuable,

but just sort of the practice of quickly getting information in your head,

and figuring out how to retain it

is, like, such a valuable tool -- especially when you have
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1298
00:42:08,000 --> 00:42:09,999
all of these online assets.

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00:42:10,000 --> 00:42:11,999
I'm just pathologically
curious. (laugh)

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00:42:12,000 --> 00:42:13,999
And so I'm just going around
teaching myself

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00:42:14,000 --> 00:42:14,999
all sorts of crap
on Coursera

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or open courseware
or YouTube.

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00:42:17,000 --> 00:42:17,999
>>Awesome, yeah.
It's like the Matrix, you can just download this crap into your head.

>>So much stuff, yeah.

>>I mean, it's just sort of shocking what you can teach yourself.

>>Yeah, totally.
>>Yeah, you want to go

become a blacksmith?

>>You can do it, yeah.

>>Reproduction swords.

(laughter)

>>Yeah, totally, you can

find anything out there.

>>Anything.
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00:42:31,000 --> 00:42:33,999

Which is really amazingly
different from

00:42:34,000 --> 00:42:34,999
when you and I were kids.

00:42:35,000 --> 00:42:38,999
>>Right. You had to break
into the cabinet

to get the textbook in the
class you were sitting in.

00:42:39,000 --> 00:42:39,999
>>Yeah. Yeah.

00:42:40,000 --> 00:42:40,999
The information is free now.
>>Yeah. Yeah.

Thank you so much for coming.

This was amazing.

And I really appreciate the opportunity to chat to you about all the amazing stuff that's happened in your career.

>>Thank you, Kevin.
This is such a joy.

I always love our conversations because it feels like we're two peas in a pod.

So, it's super fun.

(laughter)

Awesome. Thank you so much.
Behind the Tech with Kevin Scott
EP 05 - Danielle Feinberg: Pixar’s Academy-Award winning computer scientist
00:42:58,000 --> 00:43:08,999
(music)

00:43:09,000 --> 00:43:10,999
Well, thanks for joining us for Behind the Tech.

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So, Danielle Feinberg, oh my god,

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what an amazing computer scientist.

00:43:16,000 --> 00:43:18,999
And what a truly interesting career she's had.

00:43:19,000 --> 00:43:18,999
>>Yeah.
I really loved her advice
to the next generation

of telling girls or boys
or anybody else out there

that they don't have to
choose between

art and computer science.

>>That the answer can just
be "Yes."

>>Yes.
You know, you can do both.

But to something that you said earlier is that everything that we do is going to be shaped by technology.

>>And it will be yet another really interesting tool in everyone's arsenal.
And great that we have folks like Danielle

helping to inspire that next generation.

I cannot stress enough the importance of role models in helping kids be able to just imagine themselves whether they actually are going to choose that particular career path or not.
But just giving them the material

where they can sort of imagine the possibility

of them doing something is so valuable.

Especially for younger kids.

>>You were talking about how your kind of initial interest in computers came from gaming.
And you thought that you were going to be studying graphics.

You said you weren't creative enough to want to do that.

But you're still artistic.

You still do photography and things like that.
Have you found that what you do as an engineer shapes the art that you do and vice versa?

>>I think, not accidentally, lots of computer programmers tend to get involved in photography. And on the one hand, a very technical thing.

You have to sort of understand
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how your camera works

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00:44:38,000 -- 00:44:40,999
and apertures and
exposure times

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and ISOs and all of this stuff.

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But it's also a fairly
artistic thing

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00:44:45,000 -- 00:44:46,999
in that you have to be
thinking about

1381
00:44:47,000 -- 00:44:49,999
what it is that you're trying
to convey to someone

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00:44:50,000 -- 00:44:52,999
a photograph that you take.

And I just sort of love things that blend those two sides of your brain -- the creative, human side and the technical, nerdy side.

Not that nerds aren't humans.

>>Because there is kind of
that a lot of people have
where you don't need

the right brain, you don't
need creativity

when it comes to code.

I, personally, completely
disagree.

But I'd love to know
your perspective
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and where you feel like creativity, programming,

and engineering intersect.

>>Yeah, I think there's a huge amount of overlap.

The good thing about programming is

I think it offers a safe haven for lots of different types of folks to be able to make really great contributions.
I've always thought of code as a craft -- borderline art.

There's, certainly, deeply technical parts about coding.

And in many cases in coding, solving a problem is more clear cut than putting out a piece of art.

It either gets the bits to the user in less than a second or not.
It either solves a particular algorithmic problem inside of the constraints of a problem or it doesn't.

But in writing the code itself, there's a lot that can be fairly artistic.

So, for folks who have never looked at code before,
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it can be almost literary.

00:46:14,000 --> 00:46:15,999
The difference between
elegantly written code

00:46:16,000 --> 00:46:17,999
and sort of poorly
written code

00:46:18,000 --> 00:46:21,999
is almost the difference between
Finnegans Wake

00:46:22,000 --> 00:46:23,999
and the scribblings
of a five-year-old

00:46:24,000 --> 00:46:28,999
trying to learn language
for the first time at all.
There's just an incredible difference in like how programmers choose to express the solution to a particular problem. That's a great thing that can be, in some cases, the interesting part of the job is the care to craft and detail that you take with the thing.
For me, I attribute a lot of that --

not that I will claim to write the world's most elegant code -- but my grandfather and my father were both in construction. And, you know, my grandfather was a great craftsman.
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He cared about every little detail of the things

that he was building.

And even though, on the surface,

coding is very different from building a house,

actually, when you look at it, many, many, many more similarities

than there are differences.
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>>Definitely, because things need to be done

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a certain way to work together,

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but you can also have a lot of freedom to build that house

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00:47:22,000 --> 00:47:22,999
however you want.

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00:47:23,000 --> 00:47:23,999
>>Yes.

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00:47:24,000 --> 00:47:24,999
>>And you were talking about
that are in code before

that something's going to
work or it's not.

I think that kind of opens up
artistic possibilities, too.

When you're forced into
sometimes even

certain constraints that can
force people to become

more creative and
more artistic --
>>Yeah.

>>in what they decide to build.

>>And, also, sometimes
when you're coding,

you're building a system,

you can put little
flourishes in there that are

incredibly satisfying.
And you may be the only person who knows that they’re there.

You know, the same way that a stonesmith might carve an extra little thing into something.

And she may be the only person in the world who knows that that thing is there,
Behind the Tech with Kevin Scott
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00:48:03,000 --> 00:48:04,999
but incredibly satisfying.

00:48:05,000 --> 00:48:05,999
>>I love it.

00:48:06,000 --> 00:48:07,999
>>So, once again,
it's been great chatting.

00:48:08,000 --> 00:48:08,999
See you next time.

00:48:09,000 --> 00:48:09,999
>>See ya!

00:48:10,000 --> 00:48:10,999
(music)

00:48:11,000 --> 00:48:11,999
>>Be sure to join us
next time
Behind the Tech with Kevin Scott
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1466
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on Behind the Tech.

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We'll be chatting with
Reid Hoffman --

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investor, author,
and entrepreneur.

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Reid was co-founder
and executive chairman

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of LinkedIn.

1471
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And is now partner at the
venture firm Greylock,
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host of the podcast
Masters of Scale,

and author of the upcoming book, Blitzscaling.

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and to subscribe.

See you next time.
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(music.)