Behind the Tech with Kevin Scott
EP 03 – Andrew Ng: Influential leader in artificial intelligence

1

00:00:01,101 --> 00:00:03,570

>> With the rise of

technology often

2

00:00:03,570 --> 00:00:05,130

comes greater concentration of

3

00:00:05,130 --> 00:00:07,490

power in smaller numbers

of people's hands,

4

00:00:07,490 --> 00:00:10,045

and I think that this creates

5

00:00:10,045 --> 00:00:12,770

greater risk of

ever-growing wealth

6

00:00:12,770 --> 00:00:14,390

inequality as well.

7

00:00:14,390 --> 00:00:16,650

To be really candid,

I think that with

8

00:00:16,650 --> 00:00:19,110

the rise of the last

few ways of technology,

9

00:00:19,110 --> 00:00:20,640

we actually did a great job

10

00:00:20,640 --> 00:00:22,100

creating wealth in the East

and the West Coast,

11

00:00:22,100 --> 00:00:23,825

but we actually did

leave large parts

12

00:00:23,825 --> 00:00:25,455

of the country behind,

13

00:00:25,455 --> 00:00:26,880

and I would love

for this next one

14

00:00:26,880 --> 00:00:30,070

to bring everyone along with us.

15

00:00:35,650 --> 00:00:37,690

>> Hi everyone. Welcome

to Behind the Tech.

16

00:00:37,690 --> 00:00:38,945

I'm your host, Kevin Scott,

17

00:00:38,945 --> 00:00:41,165

Chief Technology

Officer for Microsoft.

18

00:00:41,165 --> 00:00:43,310

In this podcast, we're going

to get behind the tech.

19

00:00:43,310 --> 00:00:44,510

We'll talk with some of

20

00:00:44,510 --> 00:00:46,130

the people who made

our modern tech world

21

00:00:46,130 --> 00:00:47,480

possible and understand what

22

00:00:47,480 --> 00:00:49,555

motivated them to

create what they did.

23

00:00:49,555 --> 00:00:51,020

So, join me to

24

00:00:51,020 --> 00:00:52,580

maybe learn a little bit

about the history of

25

00:00:52,580 --> 00:00:55,730

computing and get a few

behind the scenes insights

26

00:00:55,730 --> 00:00:56,960

into what's happening today.

27

00:00:56,960 --> 00:00:57,866

Stick around.

28

00:01:01,608 --> 00:01:04,000

Today I'm joined by my

colleague Christina Warren.

29

00:01:04,000 --> 00:01:06,280

Christina is a Senior

Cloud Developer Advocate

30

00:01:06,280 --> 00:01:08,105

at Microsoft. Welcome

back Christina.

31

00:01:08,105 --> 00:01:09,270

>> Happy to be here Kevin,

32

00:01:09,270 --> 00:01:10,855

and super excited about

33

00:01:10,855 --> 00:01:11,950

who you're going to

be talking to today.

34

00:01:11,950 --> 00:01:14,595

>> Yeah. Today's guest

is Andrew Ng.

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00:01:14,595 --> 00:01:17,620

>> Andrew is, I don't think

this is too much to say,

36

00:01:17,620 --> 00:01:19,900

he's one of the preeminent minds

37

00:01:19,900 --> 00:01:22,105

in artificial intelligence

and machine learning.

38

00:01:22,105 --> 00:01:23,260

I've been following

his work since

39

00:01:23,260 --> 00:01:24,610

the Google Brain Project,

40

00:01:24,610 --> 00:01:26,740

and he co-founded Coursera,

41

00:01:26,740 --> 00:01:29,560

and he's done so many

important things and

42

00:01:29,560 --> 00:01:31,330

so much important research

on AI and that's

43

00:01:31,330 --> 00:01:33,550

a topic that I'm really

obsessed with right now.

44

00:01:33,550 --> 00:01:35,615

So, I can't wait to hear

what you guys talk about.

45

00:01:35,615 --> 00:01:38,260

>> Yeah. In addition

to his track record as

46

00:01:38,260 --> 00:01:41,445

an entrepreneur, so

Landing.AI, Coursera,

47

00:01:41,445 --> 00:01:43,975

being one of the co-leads of

48

00:01:43,975 --> 00:01:47,500

the Google Brain Project

in its very earliest days,

49

00:01:47,500 --> 00:01:50,290

he also has this

incredible track record

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00:01:50,290 --> 00:01:52,450

as academic researcher.

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00:01:52,450 --> 00:01:56,845

He has a hundred plus

really fantastically good papers

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00:01:56,845 --> 00:02:01,215

on a whole variety of topics

in artificial intelligence,

53

00:02:01,215 --> 00:02:03,440

which I'm guessing are on

54

00:02:03,440 --> 00:02:06,665

the many a PHD

student's reading list

55

00:02:06,665 --> 00:02:07,720

for the folks who

are trying to get

56

00:02:07,720 --> 00:02:09,405

degrees in this area now.

57

00:02:09,405 --> 00:02:10,870

>> I can't wait. I'm really

58

00:02:10,870 --> 00:02:12,195

looking forward to

the conversation.

59

00:02:12,195 --> 00:02:13,440

>> Great. Christina, we'll

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00:02:13,440 --> 00:02:15,084

check back with you

after the interview.

61

00:02:17,685 --> 00:02:19,605

Coming up next, Andrew Ng.

62

00:02:19,605 --> 00:02:22,060

Andrew is founder and

CEO of Landing.AI.

63

00:02:22,060 --> 00:02:24,535

Founding lead of the

Google Brain Project

64

00:02:24,535 --> 00:02:26,125

and co-founder of Coursera.

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00:02:26,125 --> 00:02:28,450

Andrew is one of

the most influential leaders

66

00:02:28,450 --> 00:02:29,770

in AI and deep learning.

67

00:02:29,770 --> 00:02:31,910

He's also a Stanford University

68

00:02:31,910 --> 00:02:33,695

Computer Science

adjunct professor.

69

00:02:33,695 --> 00:02:35,375

Andrew, thanks for being here.

70

00:02:35,375 --> 00:02:36,725

>> Thanks a lot for

having me Kevin.

71

00:02:36,725 --> 00:02:39,270

>> So, let's go all the

way back to the beginning.

72

00:02:39,270 --> 00:02:41,460

So, you grew up in Asia?

73

00:02:41,460 --> 00:02:44,230

And I'm just sort of curious

when was it that you

74

00:02:44,230 --> 00:02:45,580

realized you were really

75

00:02:45,580 --> 00:02:48,050

interested in math

and computer science?

76

00:02:48,050 --> 00:02:49,530

>> I was born in London,

77

00:02:49,530 --> 00:02:52,140

but grew up mostly in

Hong Kong and Singapore.

78

00:02:52,140 --> 00:02:55,490

I think I started coding

when I was six-years-old.

79

00:02:55,490 --> 00:02:58,910

And my father had

a few very old computers.

80

00:02:58,910 --> 00:03:01,310

The one I used the most

was some old Atari,

81

00:03:01,310 --> 00:03:03,280

where I remember there

were these books

82

00:03:03,280 --> 00:03:05,260

where you would read

the code in a book and

83

00:03:05,260 --> 00:03:07,330

just type in a computer

and then you had

84

00:03:07,330 --> 00:03:08,390

these computer games

you could play

85

00:03:08,390 --> 00:03:09,560

that you just

implemented yourself.

86

00:03:09,560 --> 00:03:10,615

So, I thought that was wonderful.

87

00:03:10,615 --> 00:03:15,005

>> Yeah, and so that was

probably the Atari 400 or 800?

88

00:03:15,005 --> 00:03:16,920

>> Yeah. Atari 800 sounds right.

89

00:03:16,920 --> 00:03:18,270

It was definitely some Atari.

90

00:03:18,270 --> 00:03:20,350

>> That's awesome. And what sorts of

91

00:03:20,350 --> 00:03:21,755

games were you most interested in?

92

00:03:21,755 --> 00:03:23,500

>> You know, the one

that fascinated me

93

00:03:23,500 --> 00:03:25,360

the most was a

number guessing game.

94

00:03:25,360 --> 00:03:26,770

Where you, the human, would think

95

00:03:26,770 --> 00:03:28,270

of a number from 1 to 100,

96

00:03:28,270 --> 00:03:29,790

then the computer

would basically do

97

00:03:29,790 --> 00:03:32,730

binary search but chooses:

Is it higher or lower than 50?

98

00:03:32,730 --> 00:03:34,520

Is it higher or lower

than 75 and so on,

99

00:03:34,520 --> 00:03:36,230

until it guesses

the right number.

100

00:03:36,230 --> 00:03:37,540

>> Well, in a weird way,

101

00:03:37,540 --> 00:03:41,155

that's like early statistical

Machine Learning, right?

102

00:03:41,155 --> 00:03:43,860

>> Yeah, and then, so at six-years-old

103

00:03:43,860 --> 00:03:46,460

it was just fascinating that

the computer could guess.

104

00:03:46,460 --> 00:03:48,135

>> Yeah. So, from

105

00:03:48,135 --> 00:03:50,320

six years- did you go to

106

00:03:50,320 --> 00:03:52,630

a science and technology

high school?

107

00:03:52,630 --> 00:03:54,670

Did you take

computer science classes

108

00:03:54,670 --> 00:03:56,970

when you were a kid or...?

109

00:03:56,970 --> 00:03:59,845

>> I went to good schools:

St. Paul's in

110

00:03:59,845 --> 00:04:03,040

Hong Kong and then ACPS in

the Raffles in Singapore.

111

00:04:03,040 --> 00:04:04,840

I was lucky to go

to good schools.

112

00:04:04,840 --> 00:04:06,040

I was fortunate to

have grown up in

113

00:04:06,040 --> 00:04:08,170

countries with

great educational systems.

114

00:04:08,170 --> 00:04:10,900

Great teachers, they made us

work really hard but also

115

00:04:10,900 --> 00:04:14,205

gave us lots of

opportunities to explore.

116

00:04:14,205 --> 00:04:16,305

And I feel like, computer

science is not magic.

117

00:04:16,305 --> 00:04:17,965

You and I do this, we know this.

118

00:04:17,965 --> 00:04:19,625

While I'm very excited about

119

00:04:19,625 --> 00:04:22,080

the work I get to do in

computer science and AI,

120

00:04:22,080 --> 00:04:24,700

I actually feel like anyone

could do what I'd do if they

121

00:04:24,700 --> 00:04:27,880

put in a bit of time to learn

to do these things as well.

122

00:04:27,880 --> 00:04:29,315

Having good teachers helps a lot.

123

00:04:29,315 --> 00:04:32,330

>> We chatted in our last

episode with Alice Steinglass,

124

00:04:32,330 --> 00:04:34,615

who's the president of Code.org,

125

00:04:34,615 --> 00:04:36,865

and they are spending

126

00:04:36,865 --> 00:04:39,220

the sum total of their

energy trying to

127

00:04:39,220 --> 00:04:41,800

get K-12 students interested in

128

00:04:41,800 --> 00:04:44,845

computer science and

pursuing careers in STEM.

129

00:04:44,845 --> 00:04:46,140

You're also an educator.

130

00:04:46,140 --> 00:04:48,700

You are a tenured professor

at Stanford and

131

00:04:48,700 --> 00:04:51,820

spent a good chunk of

your life in academia.

132

00:04:51,820 --> 00:04:55,420

What things would you

encourage students to think

133

00:04:55,420 --> 00:04:59,795

about if they are considering

a career in computing?

134

00:04:59,795 --> 00:05:02,130

>> I'm a huge admirer

of Code.org.

135

00:05:02,130 --> 00:05:03,835

I think what they're

doing is great.

136

00:05:03,835 --> 00:05:06,490

Once upon a time, society used to

137

00:05:06,490 --> 00:05:08,985

wonder if everyone

needed to be literate.

138

00:05:08,985 --> 00:05:10,740

Maybe all we needed was for

139

00:05:10,740 --> 00:05:13,180

a few monks to read the Bible

to us and we didn't

140

00:05:13,180 --> 00:05:15,190

need to learn to read and

write ourselves because

141

00:05:15,190 --> 00:05:17,260

we'd just go and listen to

the priest or the monks.

142

00:05:17,260 --> 00:05:19,570

But we found that when a

lot of us learned to read and

143

00:05:19,570 --> 00:05:22,440

write that really improved

human-to-human communication.

144

00:05:22,440 --> 00:05:24,040

I think that in the future,

145

00:05:24,040 --> 00:05:26,610

every person needs to be computer

146

00:05:26,610 --> 00:05:28,230

literate at the level

of being able to

147

00:05:28,230 --> 00:05:30,220

write these simple programs.

148

00:05:30,220 --> 00:05:31,940

Because computers are becoming so

149

00:05:31,940 --> 00:05:33,975

important in our world and coding

150

00:05:33,975 --> 00:05:35,830

is the deepest way for

151

00:05:35,830 --> 00:05:38,075

people and machines

to communicate.

152

00:05:38,075 --> 00:05:39,310

There's such a scarcity of

153

00:05:39,310 --> 00:05:40,645

computer programmers today that

154

00:05:40,645 --> 00:05:42,550

most computer programmers

end up writing

155

00:05:42,550 --> 00:05:45,250

software for thousands

of millions of people.

156

00:05:45,250 --> 00:05:48,145

But in the future if

everyone knows how to code,

157

00:05:48,145 --> 00:05:50,140

I would love for

the proprietors of

158

00:05:50,140 --> 00:05:52,470

a small mom and

pop store at a corner to

159

00:05:52,470 --> 00:05:54,485

go program an LCD display

160

00:05:54,485 --> 00:05:56,870

to better advertise

their weekly sales.

161

00:05:56,870 --> 00:05:59,420

So, I think just as literacy,

162

00:05:59,420 --> 00:06:01,340

we found it having

everyone being able to

163

00:06:01,340 --> 00:06:03,395

read and right, improved

human-to-human communication.

164

00:06:03,395 --> 00:06:04,945

I actually think

everyone in the future

165

00:06:04,945 --> 00:06:06,590

should learn to

code because that's

166

00:06:06,590 --> 00:06:08,050

how we get people and

167

00:06:08,050 --> 00:06:10,150

the computers to communicate

at the deepest levels.

168

00:06:10,150 --> 00:06:12,490

>> I think that's

a really great segue

169

00:06:12,490 --> 00:06:14,710

into the main topic

170

00:06:14,710 --> 00:06:16,520

that I wanted to chat

about today, AI,

171

00:06:16,520 --> 00:06:19,240

because I think

even you have used

172

00:06:19,240 --> 00:06:23,690

this anecdote that AI is

going to be like electricity.

173

00:06:23,690 --> 00:06:25,355

>> I think I came up with that.

174

00:06:25,355 --> 00:06:28,360

>> Yeah. I know this is

your brilliant quote

175

00:06:28,360 --> 00:06:30,400

and it's spot on.

176

00:06:30,400 --> 00:06:34,240

The push to literacy

in many ways is

177

00:06:34,240 --> 00:06:35,950

a byproduct of

178

00:06:35,950 --> 00:06:39,800

the second and third

industrial revolution.

179

00:06:39,800 --> 00:06:43,010

We had this transformed society

180

00:06:43,010 --> 00:06:45,220

where you actually

had to be literate in

181

00:06:45,220 --> 00:06:50,615

order to function in this

quickly industrializing world.

182

00:06:50,615 --> 00:06:54,930

So, I wonder

how many analogues you

183

00:06:54,930 --> 00:06:57,160

see between the last

industrial revolution

184

00:06:57,160 --> 00:06:59,350

and what's happening

with AI right now.

185

00:06:59,350 --> 00:07:00,880

>> Yeah.

186

00:07:00,880 --> 00:07:02,360

The last industrial revolution

187

00:07:02,360 --> 00:07:04,130

changed so much human labor.

188

00:07:04,130 --> 00:07:05,730

I think one of

the biggest differences

189

00:07:05,730 --> 00:07:07,080

between the last one and this one

190

00:07:07,080 --> 00:07:10,045

is that this one

will happen faster,

191

00:07:10,045 --> 00:07:12,445

because the world is so

much more connected today.

192

00:07:12,445 --> 00:07:15,115

So, wherever you are in

the world, listening to this,

193

00:07:15,115 --> 00:07:17,530

there's a good chance that

there's a AI algorithm

194

00:07:17,530 --> 00:07:20,155

that's not yet even been

invented as of today,

195

00:07:20,155 --> 00:07:21,720

but that will probably

196

00:07:21,720 --> 00:07:23,465

affect your life

five years from now.

197

00:07:23,465 --> 00:07:25,330

A research university in

198

00:07:25,330 --> 00:07:27,350

Singapore could come up

with something next week,

199

00:07:27,350 --> 00:07:28,880

and then it will make its way to

200

00:07:28,880 --> 00:07:31,350

the United States in a month.

201

00:07:31,350 --> 00:07:32,900

And another year after that,

202

00:07:32,900 --> 00:07:34,510

it'll in be in products

that affect our lives.

203

00:07:34,510 --> 00:07:36,810

So, the world is

connected in a way that

204

00:07:36,810 --> 00:07:39,620

just wasn't true at

the last industrial revolution.

205

00:07:39,620 --> 00:07:42,750

And I think the pace and speed

will bring challenges

206

00:07:42,750 --> 00:07:45,640

to individuals and

companies and corporations.

207

00:07:45,640 --> 00:07:47,990

But our ability to drive

208

00:07:47,990 --> 00:07:50,395

tremendous value for

AI, for the new ideas,

209

00:07:50,395 --> 00:07:52,990

the tremendous driver

for global GDP growth

210

00:07:52,990 --> 00:07:54,210

I think is also maybe

211

00:07:54,210 --> 00:07:55,875

even faster and

greater than before.

212

00:07:55,875 --> 00:08:00,170

>> Yeah. So, let's dig in

to that a little bit more.

213

00:08:00,170 --> 00:08:01,420

So, you've been doing

214

00:08:01,420 --> 00:08:04,920

AI Machine Learning for

a really long time now.

215

00:08:04,920 --> 00:08:07,095

When did you decide that that's

216

00:08:07,095 --> 00:08:08,390

the thing you were

going to specialize

217

00:08:08,390 --> 00:08:09,940

on as a computer scientist?

218

00:08:09,940 --> 00:08:12,075

>> So, when I was in high

school in Singapore,

219

00:08:12,075 --> 00:08:13,730

my father who is

220

00:08:13,730 --> 00:08:16,630

a doctor was trying to

implement AI systems.

221

00:08:16,630 --> 00:08:18,660

Back then, he was actually

using XP systems,

222

00:08:18,660 --> 00:08:20,435

which turned out not to be

that good a technology.

223

00:08:20,435 --> 00:08:22,280

He was implementing AI systems of

224

00:08:22,280 --> 00:08:25,190

his day to try to diagnose,

I think lymphoma.

225

00:08:25,190 --> 00:08:27,280

>> This is in the late 80's.

226

00:08:27,280 --> 00:08:29,960

>> I think I was 15

years old at that time.

227

00:08:29,960 --> 00:08:31,260

So, yeah, late 80's.

228

00:08:31,260 --> 00:08:33,170

So, I was very

fortunate to learn from

229

00:08:33,170 --> 00:08:34,920

my father about XP Systems

230

00:08:34,920 --> 00:08:36,130

and also about neural networks,

231

00:08:36,130 --> 00:08:38,635

because they had

day in the sun back then.

232

00:08:38,635 --> 00:08:41,130

That later became

an internship at

233

00:08:41,130 --> 00:08:42,810

the National University

of Singapore

234

00:08:42,810 --> 00:08:44,795

where I wrote my first

research paper actually,

235

00:08:44,795 --> 00:08:46,390

and I found a copy of it recently.

236

00:08:46,390 --> 00:08:47,500

When I read it back now,

237

00:08:47,500 --> 00:08:49,740

I think it was a very

embarrassing research paper.

238

00:08:49,740 --> 00:08:51,640

But we didn't know

any better back then.

239

00:08:51,640 --> 00:08:53,710

And I've actually been doing AI,

240

00:08:53,710 --> 00:08:56,295

computer science and AI

pretty much since then.

241

00:08:56,295 --> 00:08:58,115

>> Well, I look at your CV and

242

00:08:58,115 --> 00:08:59,810

the papers that you've

243

00:08:59,810 --> 00:09:02,570

written over the course

of your career.

244

00:09:02,570 --> 00:09:04,520

It's like you really

had your hands

245

00:09:04,520 --> 00:09:05,875

in a little bit of everything.

246

00:09:05,875 --> 00:09:07,515

There was this inverse

247

00:09:07,515 --> 00:09:09,050

reinforcement learning

work that you

248

00:09:09,050 --> 00:09:12,560

did and published

the first paper in 2000.

249

00:09:12,560 --> 00:09:14,480

Then, you were doing some work

250

00:09:14,480 --> 00:09:17,255

on what looks like

information retrieval,

251

00:09:17,255 --> 00:09:20,310

document representations,

and what not.

252

00:09:20,310 --> 00:09:22,165

By 2007, you were doing

253

00:09:22,165 --> 00:09:24,920

this interesting stuff

on self-taught learning.

254

00:09:24,920 --> 00:09:28,330

So, transfer learning

from unlabeled data.

255

00:09:28,330 --> 00:09:32,650

Then, you wrote the

paper in 2009 on

256

00:09:32,650 --> 00:09:34,890

this large scale

unsupervised learning

257

00:09:34,890 --> 00:09:36,915

using graphical processing.

258

00:09:36,915 --> 00:09:40,230

So, just in this 10-year period

in your own research,

259

00:09:40,230 --> 00:09:42,925

you covered so many things.

260

00:09:42,925 --> 00:09:45,610

In 2009, we hadn't even really

261

00:09:45,610 --> 00:09:48,240

hit the curve yet

on deep learning,

262

00:09:48,240 --> 00:09:51,820

the ImageNet result from

Hinton hadn't happened yet.

263

00:09:51,820 --> 00:09:54,405

How do you, as one

of the principles,

264

00:09:54,405 --> 00:09:56,924

you help create the feel,

265

00:09:56,924 --> 00:09:59,660

what does the rate of

progress feel like to you?

266

00:09:59,660 --> 00:10:01,960

Because I think this is one

of the things that people

267

00:10:01,960 --> 00:10:05,925

get perhaps a little bit over

excited about sometimes.

268

00:10:05,925 --> 00:10:07,820

>> One of the things I've

learned in my career

269

00:10:07,820 --> 00:10:08,830

is that you

270

00:10:08,830 --> 00:10:11,545

have to do things before

they're obvious to everyone,

271

00:10:11,545 --> 00:10:12,530

if you want to make a difference

272

00:10:12,530 --> 00:10:13,530

and get the best results.

273

00:10:13,530 --> 00:10:17,645

So, I think I was fortunate

back in maybe 2007 or so,

274

00:10:17,645 --> 00:10:18,880

to see the early signs

275

00:10:18,880 --> 00:10:20,240

that deep learning

was going to take off.

276

00:10:20,240 --> 00:10:21,880

So, with that conviction,

277

00:10:21,880 --> 00:10:23,180

decided to go on and do it,

278

00:10:23,180 --> 00:10:25,025

and that turned out to work well.

279

00:10:25,025 --> 00:10:27,035

Even when I went to Google to

280

00:10:27,035 --> 00:10:29,030

start the Google Brain
project, at that time,

281

00:10:29,030 --> 00:10:31,035

neural networks was a bad word to

282

00:10:31,035 --> 00:10:33,245

many people and there was a

lot of initial skepticism.

283

00:10:33,245 --> 00:10:34,750

But, fortunately,

284

00:10:34,750 --> 00:10:38,365

Larry Page was supportive and

then started Google Brain.

285

00:10:38,365 --> 00:10:40,900

And I think when we started Coursera,

286

00:10:40,900 --> 00:10:43,280

online education was not

an obvious thing to do.

287

00:10:43,280 --> 00:10:44,620

There were other

previous efforts,

288

00:10:44,620 --> 00:10:46,305

massive efforts that failed.

289

00:10:46,305 --> 00:10:48,390

But because we saw signs

that we could make it

290

00:10:48,390 --> 00:10:50,695

work with the

conviction to go in.

291

00:10:50,695 --> 00:10:53,780

When I took on the role

at Baidu at that time,

292

00:10:53,780 --> 00:10:55,620

a lot people in the US

were asking me, "Hey,

293

00:10:55,620 --> 00:10:58,030

Andrew, why on earth would

you want to do AI in China.

294

00:10:58,030 --> 00:10:59,400

What AI is there in China?"

295

00:10:59,400 --> 00:11:01,070

I think, again, I was fortunate

296

00:11:01,070 --> 00:11:03,545

that I was part of something big.

297

00:11:03,545 --> 00:11:05,190

Even today, I think landing.ai

298

00:11:05,190 --> 00:11:06,800

where I'm spending a lot of my time,

299

00:11:06,800 --> 00:11:09,180

people initially ask me, "AI for

300

00:11:09,180 --> 00:11:10,310

manufacturing? Or AI for

301

00:11:10,310 --> 00:11:12,600

agriculture? Or try to

transfer calls using AI?

302

00:11:12,600 --> 00:11:13,980

that's a weird thing to do."

303

00:11:13,980 --> 00:11:16,655

I do find people actually

catch on faster.

304

00:11:16,655 --> 00:11:19,055

So, I find that as I get older,

305

00:11:19,055 --> 00:11:21,910

the speed at which people

go from being really

306

00:11:21,910 --> 00:11:23,070

skeptical about what I do

307

00:11:23,070 --> 00:11:25,115

versus to saying, "Oh,

maybe that's a good idea."

308

00:11:25,115 --> 00:11:26,540

That window is

becoming much shorter.

309

00:11:26,540 --> 00:11:28,260

>> Is that because

the community is maturing or

310

00:11:28,260 --> 00:11:31,665

because you've got such an

incredible track record that...

311

00:11:31,665 --> 00:11:33,860

>> I don't know. I think

everyone's getting

312

00:11:33,860 --> 00:11:36,245

smarter all around

the world. So, yeah.

313

00:11:36,245 --> 00:11:39,300

>> As you look at how

machine learning has

314

00:11:39,300 --> 00:11:42,790

changed over

the past just 20 years,

315

00:11:42,790 --> 00:11:46,000

what's the most remarkable thing

from your perspective?

316

00:11:46,000 --> 00:11:48,395

>> I think a lot

of recent progress

317

00:11:48,395 --> 00:11:50,810

was driven by

computational scale,

318

00:11:50,810 --> 00:11:53,985

scale of data, and then also

by algorithmic innovation.

319

00:11:53,985 --> 00:11:56,800

But, I think it's really

interesting when something

320

00:11:56,800 --> 00:11:59,580

grows exponentially,

people, the insiders,

321

00:11:59,580 --> 00:12:01,085

every year you say, "Oh yeah,

322

00:12:01,085 --> 00:12:02,700

it works 50 percent better

323

00:12:02,700 --> 00:12:04,495

than the year before."

And every year it's like,

324

00:12:04,495 --> 00:12:06,855

"Hey, another 50 percent

year-on-year progress."

325

00:12:06,855 --> 00:12:08,860

So, to a lot of

machine learning insiders,

326

00:12:08,860 --> 00:12:09,910

it doesn't feel that magical.

327

00:12:09,910 --> 00:12:11,150

It's, "Yeah, you just get up and

328

00:12:11,150 --> 00:12:12,680

you work on it, and

it works better."

329

00:12:12,680 --> 00:12:15,245

To people that didn't grow

up in machine learning,

330

00:12:15,245 --> 00:12:16,400

exponential growth often feels

331

00:12:16,400 --> 00:12:17,780

like it came out of nowhere.

332

00:12:17,780 --> 00:12:19,070

So, I've seen this in

333

00:12:19,070 --> 00:12:21,655

multiple industries with

the rise of the movement,

334

00:12:21,655 --> 00:12:23,940

with the rise of machine

learning and deep learning.

335

00:12:23,940 --> 00:12:26,650

I feel like a lot of the

insiders feel like, "Yeah,

336

00:12:26,650 --> 00:12:29,170

we're at 50 percent or

some percent better than last

337

00:12:29,170 --> 00:12:30,680

year," but it's really

338

00:12:30,680 --> 00:12:32,735

the people that weren't

insiders that feel like,

339

00:12:32,735 --> 00:12:33,910

"Wow, this came out of nowhere.

340

00:12:33,910 --> 00:12:35,105

Where did this come from?"

341

00:12:35,105 --> 00:12:36,620

So, that's been

interesting to observe.

342

00:12:36,620 --> 00:12:38,885

But one thing you and I

have chatted about before,

343

00:12:38,885 --> 00:12:41,270

there's a lot of hype about AI.

344

00:12:41,270 --> 00:12:45,820

And I think that what happened

with the earlier AI winters is

345

00:12:45,820 --> 00:12:48,270

that there was a lot

of hype about AI that

346

00:12:48,270 --> 00:12:51,190

turned out not to be

that useful or valuable.

347

00:12:51,190 --> 00:12:53,350

But one thing that's

really different today is

348

00:12:53,350 --> 00:12:56,065

that large companies

like Microsoft,

349

00:12:56,065 --> 00:12:58,790

Baidu, Google,

Facebook, and so on,

350

00:12:58,790 --> 00:13:02,465

are driving tremendous amounts

of revenue as well as

351

00:13:02,465 --> 00:13:05,805

user value through

modern machine learning tools.

352

00:13:05,805 --> 00:13:07,935

And that very strong

economic support,

353

00:13:07,935 --> 00:13:10,435

I think machine learning is

making a difference to GDP.

354

00:13:10,435 --> 00:13:12,100

That strong economic support

355

00:13:12,100 --> 00:13:14,030

means we're not in for

another AI winter.

356

00:13:14,030 --> 00:13:15,900

Having said that, there

is a lot of hype about

357

00:13:15,900 --> 00:13:18,070

AGI, Artificial

General Intelligence.

358

00:13:18,070 --> 00:13:20,634

This really over hyped

fear of evil killer robots,

359

00:13:20,634 --> 00:13:22,665

AI can do everything

a human can do.

360

00:13:22,665 --> 00:13:24,620

I would actually welcome a reset

361

00:13:24,620 --> 00:13:27,060

of expectations around that.

362

00:13:27,060 --> 00:13:28,920

Hopefully we can reset

363

00:13:28,920 --> 00:13:31,970

expectations around AGI

to be more realistic,

364

00:13:31,970 --> 00:13:34,430

without throwing out

baby with the bath water.

365

00:13:34,430 --> 00:13:35,760

If you look at today's world,

366

00:13:35,760 --> 00:13:37,050

there are a lot

more people working on

367

00:13:37,050 --> 00:13:38,170

valuable deep learning projects

368

00:13:38,170 --> 00:13:39,300

today than six months ago,

369

00:13:39,300 --> 00:13:40,600

and six months ago, there

were a lot more people

370

00:13:40,600 --> 00:13:42,175

doing this than six

months before that.

371

00:13:42,175 --> 00:13:43,610

So, if you look at it

in terms of the number

372

00:13:43,610 --> 00:13:44,740

of people, number of projects,

373

00:13:44,740 --> 00:13:45,790

amount of value being created,

374

00:13:45,790 --> 00:13:47,410

it's all going up.

375

00:13:47,410 --> 00:13:48,890

It's just that

some of the hype and

376

00:13:48,890 --> 00:13:51,200

unrealistic expectations

about, "Hey,

377

00:13:51,200 --> 00:13:52,590

maybe we'll have

evil killer robots

378

00:13:52,590 --> 00:13:53,970

in two years or 10 years,

379

00:13:53,970 --> 00:13:55,050

and we should defend against it."

380

00:13:55,050 --> 00:13:57,280

I think that expectation

should be reset.

381

00:13:57,280 --> 00:14:00,225

>> Yeah. I think you're spot on

382

00:14:00,225 --> 00:14:03,710

about the inside versus

outside perspective.

383

00:14:03,710 --> 00:14:06,280

The first machine learning

stuff that I did was

384

00:14:06,280 --> 00:14:09,885

15 years-ish ago when

385

00:14:09,885 --> 00:14:11,800

I was building classifiers for

386

00:14:11,800 --> 00:14:14,375

content for Google's Ad systems.

387

00:14:14,375 --> 00:14:16,960

Eventually, my teams

worked on some of

388

00:14:16,960 --> 00:14:19,925

the CTR predictions stuff

for the ads auction.

389

00:14:19,925 --> 00:14:24,910

It was always amazing to me

how simple an algorithm you

390

00:14:24,910 --> 00:14:27,100

could get by with if you had

391

00:14:27,100 --> 00:14:29,750

lots of compute and lots of data.

392

00:14:29,750 --> 00:14:32,910

You had these trends that

were driving things.

393

00:14:32,910 --> 00:14:35,170

So, Moore's Law and

things that we were

394

00:14:35,170 --> 00:14:37,715

doing in cloud

computing was making

395

00:14:37,715 --> 00:14:40,360

exponentially

more compute available

396

00:14:40,360 --> 00:14:42,205

for solving machine

learning problems

397

00:14:42,205 --> 00:14:43,525

like the stuff that you did,

398

00:14:43,525 --> 00:14:46,840

leveraging the

embarrassingly parallelism

399

00:14:46,840 --> 00:14:50,270

in some of these problems

and solving them on GPUs,

400

00:14:50,270 --> 00:14:52,135

which are really great at

401

00:14:52,135 --> 00:14:55,115

doing the idiosyncratic

type of compute.

402

00:14:55,115 --> 00:14:57,760

So, that computer is

one exponential trend,

403

00:14:57,760 --> 00:14:59,260

and then the amount

of available data for

404

00:14:59,260 --> 00:15:00,910

training is this other thing,

405

00:15:00,910 --> 00:15:03,695

where it's just coming in

at this crushing rate.

406

00:15:03,695 --> 00:15:05,170

You were at the Microsoft

407

00:15:05,170 --> 00:15:06,940

CEO Summit this year and you gave

408

00:15:06,940 --> 00:15:10,370

this beautiful explanation

where you said,

409

00:15:10,370 --> 00:15:12,670

"Supervised Machine Learning is

410

00:15:12,670 --> 00:15:15,490

basically learning from data,

411

00:15:15,490 --> 00:15:18,400

a black box that takes one set

412

00:15:18,400 --> 00:15:21,420

of inputs and produces

another set of outputs.

413

00:15:21,420 --> 00:15:24,190

And the inputs might be

an image and the outputs

414

00:15:24,190 --> 00:15:27,320

might be text labels for

the objects in the image.

415

00:15:27,320 --> 00:15:30,250

It might be a waveform

coming in that has

416

00:15:30,250 --> 00:15:34,665

human speech in it and

the output might be the speech."

417

00:15:34,665 --> 00:15:37,520

But really, that's

sort of at the core of

418

00:15:37,520 --> 00:15:40,165

this gigantic explosion of

419

00:15:40,165 --> 00:15:41,970

work and energy that

we've got right now,

420

00:15:41,970 --> 00:15:44,755

and AGI is a little bit

different from that.

421

00:15:44,755 --> 00:15:47,540

>>Yes, in fact to

give credit where it's due.

422

00:15:47,540 --> 00:15:49,085

You know actually many years ago,

423

00:15:49,085 --> 00:15:50,485

I did an internship at

424

00:15:50,485 --> 00:15:53,470

Microsoft Research back

when I was still in school.

425

00:15:53,470 --> 00:15:54,960

Even back then, I think it was

426

00:15:54,960 --> 00:15:56,355

Eric Brill and Michele Vanko

427

00:15:56,355 --> 00:15:59,285

at Microsoft way back had

already published a paper

428

00:15:59,285 --> 00:16:01,900

using simple

algorithms, that basically

429

00:16:01,900 --> 00:16:04,310

it wasn't who has

the best algorithm that wins,

430

00:16:04,310 --> 00:16:05,800

it was who has the most data for

431

00:16:05,800 --> 00:16:08,385

the application they

were looking at at NLP.

432

00:16:08,385 --> 00:16:11,580

And so I think that

the continuation of that trend,

433

00:16:11,580 --> 00:16:13,190

that people like Eric

and Michelle had

434

00:16:13,190 --> 00:16:15,195

spotted a long time ago,

435

00:16:15,195 --> 00:16:16,740

that's driving a

lot of the progress

436

00:16:16,740 --> 00:16:18,620

in modern machine learning still.

437

00:16:18,620 --> 00:16:22,550

>> Yeah. Sometimes, with AI Research

438

00:16:22,550 --> 00:16:25,450

you get these really

unexpected results.

439

00:16:25,450 --> 00:16:27,490

One of those I remember it was

440

00:16:27,490 --> 00:16:31,300

the famous Google CAT result

from the Google Brain Team.

441

00:16:31,319 --> 00:16:33,989

>> Yes, actually, those

are interesting projects,

442

00:16:33,989 --> 00:16:35,934

while still a full

time at Stanford,

443

00:16:35,934 --> 00:16:38,339

my students at the time

Adam Coates and others,

444

00:16:38,339 --> 00:16:40,514

started to spot trends that,

445

00:16:40,514 --> 00:16:41,744

basically the bigger you build in

446

00:16:41,744 --> 00:16:43,054

your neural networks,

the better they work.

447

00:16:43,054 --> 00:16:44,914

So that was a rough conclusion.

448

00:16:44,914 --> 00:16:48,294

So I started to look around

Silicon Valley to see

449

00:16:48,294 --> 00:16:49,804

where can I get a lot of

450

00:16:49,804 --> 00:16:52,089

computers to train

really really big neural networks.

451

00:16:52,089 --> 00:16:53,419

And I think in hindsight,

452

00:16:53,419 --> 00:16:55,494

back then a lot of us leaders of

453

00:16:55,494 --> 00:16:56,584

deep learning had

454

00:16:56,584 --> 00:16:58,674

a much stronger emphasis

on unsupervised learning,

455

00:16:58,674 --> 00:17:00,444

so learning without

label data, such

456

00:17:00,444 --> 00:17:02,869

as getting computers to

look a lot of pictures,

457

00:17:02,869 --> 00:17:05,044

or watch a lot YouTube

videos without telling

458

00:17:05,044 --> 00:17:07,454

it what every frame or

what every object is.

459

00:17:07,454 --> 00:17:11,239

So I had friends at Google

so I wound up pitching to Google

460

00:17:11,239 --> 00:17:12,974

to start a project which

461

00:17:12,974 --> 00:17:14,994

we later called the

Google Brain Project,

462

00:17:14,994 --> 00:17:17,734

to really scale up neural networks.

463

00:17:17,734 --> 00:17:20,094

We started off using

Google's Cloud,

464

00:17:20,094 --> 00:17:22,049

the CPU's and in hindsight,

465

00:17:22,049 --> 00:17:23,954

I wish we had tried to build up

466

00:17:23,954 --> 00:17:26,044

GPU capabilities
like Google sooner,

467

00:17:26,044 --> 00:17:27,164

but for complicated reasons,

468

00:17:27,164 --> 00:17:29,034

that took a long time to
do which is why I wound

469

00:17:29,034 --> 00:17:32,384

up doing that at Stanford

rather than at Google first.

470

00:17:32,384 --> 00:17:34,764

And I was really fortunate to have

471

00:17:34,764 --> 00:17:36,164

recruited a great team to work

472

00:17:36,164 --> 00:17:37,884

with me on the

Google Brain Project.

473

00:17:37,884 --> 00:17:39,564

I think one of

the best things I did was

474

00:17:39,564 --> 00:17:41,294

convince Jeff Dean

to come and work.

475

00:17:41,294 --> 00:17:43,529

And in fact, I remember the early days,

476

00:17:43,529 --> 00:17:45,614

we were actually

nervous about whether

477

00:17:45,614 --> 00:17:47,964

Jeff Dean would remain

interested in the project.

478

00:17:47,964 --> 00:17:48,804

So a bunch of us actually

479

00:17:48,804 --> 00:17:50,469

had conversations to strategize,

480

00:17:50,469 --> 00:17:52,574

"Boy, can we make sure to

keep Jeff Dean engaged

481

00:17:52,574 --> 00:17:54,814

so that he doesn't lose interest

and go do something else?"

482

00:17:54,814 --> 00:17:56,639

So thankfully he stayed.

483

00:17:56,639 --> 00:17:58,739

The Google CAT thing

was led by my,

484

00:17:58,739 --> 00:18:00,264

at the time PhD student Quoc Le

485

00:18:00,264 --> 00:18:02,234

put together with Jiquan Ngiam,

486

00:18:02,234 --> 00:18:03,554

were the first two sort of

487

00:18:03,554 --> 00:18:04,989

machine learning interns that

488

00:18:04,989 --> 00:18:06,599

I brought into the

Google Brain Team.

489

00:18:06,599 --> 00:18:08,219

And I still remember when

490

00:18:08,219 --> 00:18:11,054

Quoc had trained us on

unsupervised learning algorithms,

491

00:18:11,054 --> 00:18:13,984

it was almost a joke, you

know I was like, "Hey!

492

00:18:13,984 --> 00:18:15,759

there are a lot of cats on YouTube,

493

00:18:15,759 --> 00:18:17,454

let's see this learning

cat detector."

494

00:18:17,454 --> 00:18:18,814

And I still remember when Quoc

495

00:18:18,814 --> 00:18:20,114

told me to walk over and say,

496

00:18:20,114 --> 00:18:22,359

"Hey Andrew, look at

this." And I said, "Oh wow!

497

00:18:22,359 --> 00:18:24,164

You had unsupervised

learning algorithm

498

00:18:24,164 --> 00:18:25,874

watch YouTube videos and learn

499

00:18:25,874 --> 00:18:27,924

the concept of 'cat.'

That's amazing."

500

00:18:27,924 --> 00:18:30,799

So that winds up being

an influential piece of work,

501

00:18:30,799 --> 00:18:32,344

because it was

unsupervised learning,

502

00:18:32,344 --> 00:18:34,014

learning from tons of data for

503

00:18:34,014 --> 00:18:36,044

an algorithm to discover

concepts by itself.

504

00:18:36,044 --> 00:18:37,589

I think a lot of us actually

505

00:18:37,589 --> 00:18:40,969

overestimated the early impact

of unsupervised learning.

506

00:18:40,969 --> 00:18:43,449

But again, when I was leading

Google Brain Team,

507

00:18:43,449 --> 00:18:45,064

one of our first partners was

508

00:18:45,064 --> 00:18:46,474

the speech team working

509

00:18:46,474 --> 00:18:47,909

with Vincent Vanhoucke,

a great guy,

510

00:18:47,909 --> 00:18:50,754

and I was really working

with Vincent and his team,

511

00:18:50,754 --> 00:18:51,764

and seeing some of

the other things

512

00:18:51,764 --> 00:18:54,334

happening at Google and

outside that caused a lot

513

00:18:54,334 --> 00:18:56,324

of us to realize that there was

514

00:18:56,324 --> 00:18:57,944

much greater short term impact to

515

00:18:57,944 --> 00:18:59,904

be had with supervised learning.

516

00:18:59,904 --> 00:19:01,559

And then for better or worse,

517

00:19:01,559 --> 00:19:04,179

when lot of deep learning

communities saw this,

518

00:19:04,179 --> 00:19:05,774

so many of us shifted so much

519

00:19:05,774 --> 00:19:07,494

of our efforts to

supervised learning,

520

00:19:07,494 --> 00:19:10,344

that maybe we're under resourcing

521

00:19:10,344 --> 00:19:11,714

the basic research we still

522

00:19:11,714 --> 00:19:13,274

need unsupervised

learning these days

523

00:19:13,274 --> 00:19:15,194

which maybe, you know,

524

00:19:15,194 --> 00:19:16,104

I think unsupervised learning is

525

00:19:16,104 --> 00:19:17,314

super important that there's

526

00:19:17,314 --> 00:19:19,839

so much value to be made

with supervised learning.

527

00:19:19,839 --> 00:19:23,414

So much of the attention is

there right now. And I think,

528

00:19:23,414 --> 00:19:24,704

really what happened with

529

00:19:24,704 --> 00:19:25,824

the Google Brain Project

530

00:19:25,824 --> 00:19:27,764

was- were the first couple

of successes,

531

00:19:27,764 --> 00:19:29,644

one being the Speech Project

532

00:19:29,644 --> 00:19:31,164

that we worked with

the speech team on.

533

00:19:31,164 --> 00:19:33,214

What happened was other teams saw

534

00:19:33,214 --> 00:19:34,349

the great results that

535

00:19:34,349 --> 00:19:36,779

the speech team was getting

with deep learning with our help.

536

00:19:36,779 --> 00:19:38,444

And so, more and more

537

00:19:38,444 --> 00:19:40,764

of the speech team's

peers ranging from

538

00:19:40,764 --> 00:19:42,794

Google Maps to other teams

539

00:19:42,794 --> 00:19:44,034

started to become friends and

540

00:19:44,034 --> 00:19:45,614

allies of the Google Brain Team.

541

00:19:45,614 --> 00:19:47,834

We started doing

more and more projects.

542

00:19:47,834 --> 00:19:50,099

And then the other

story is after,

543

00:19:50,099 --> 00:19:52,369

you know, the team

had tons of momentum,

544

00:19:52,369 --> 00:19:53,804

thank god, we managed to

545

00:19:53,804 --> 00:19:56,014

convince Jeff Dean to

stick with the project,

546

00:19:56,014 --> 00:19:57,709

because one of the

things that gave

547

00:19:57,709 --> 00:19:59,564

me a lot of comfort when I wanted

548

00:19:59,564 --> 00:20:01,254

to step away from a day-to-day

549

00:20:01,254 --> 00:20:03,354

role to spend

more time in Coursera was,

550

00:20:03,354 --> 00:20:04,944

I was able to hand over

551

00:20:04,944 --> 00:20:06,574

leadership of the

team to Jeff Dean.

552

00:20:06,574 --> 00:20:08,234

And that gave me a

lot of comfort that I

553

00:20:08,234 --> 00:20:10,094

was leaving the team

in great hands.

554

00:20:10,094 --> 00:20:11,564

>> I sort of wonder, if there's

555

00:20:11,564 --> 00:20:13,584

a sort of a message or a takeaway

556

00:20:13,584 --> 00:20:16,454

for AI researchers in

557

00:20:16,454 --> 00:20:19,184

both academia and industry

about the Jeff Dean example.

558

00:20:19,184 --> 00:20:20,589

So for those who don't know,

559

00:20:20,589 --> 00:20:24,134

Jeff Dean might be

the best engineer in the world.

560

00:20:24,134 --> 00:20:25,144

>> It might be true. Yes.

561

00:20:25,144 --> 00:20:27,064

>> But I've certainly

never worked

562

00:20:27,064 --> 00:20:29,889

with anyone quite as good as him.

563

00:20:29,889 --> 00:20:31,444

I mean, I remember

there was this-

564

00:20:31,444 --> 00:20:33,794

>> He's in a league of his

own. Jeff Dean is definitely-

565

00:20:33,794 --> 00:20:36,734

>> I remember back in long,

566

00:20:36,734 --> 00:20:37,874

long ago at Google.

567

00:20:37,874 --> 00:20:41,489

This must have been 2004 or 2005,

568

00:20:41,489 --> 00:20:43,269

right after we'd gone public,

569

00:20:43,269 --> 00:20:45,754

Alan Eustace who

was running all of

570

00:20:45,754 --> 00:20:48,729

the engineering team

at the time would,

571

00:20:48,729 --> 00:20:52,304

once a year, send a note out

to everyone in engineering at

572

00:20:52,304 --> 00:20:55,629

performance review time to

get your Google resume

573

00:20:55,629 --> 00:20:57,214

polished up so that you

574

00:20:57,214 --> 00:20:59,884

could nominate yourself

for a promotion.

575

00:20:59,884 --> 00:21:01,424

First thing that you

were suppose to do

576

00:21:01,424 --> 00:21:02,894

was get your Google resume,

577

00:21:02,894 --> 00:21:04,664

which is sort of

this internal version of

578

00:21:04,664 --> 00:21:07,339

a resume that showed all of

your Google specific work.

579

00:21:07,339 --> 00:21:10,864

And the example resume that

he would send out was Jeff's,

580

00:21:10,864 --> 00:21:13,014

and even in 2004,

581

00:21:13,014 --> 00:21:14,424

like he'd been there long enough

582

00:21:14,424 --> 00:21:16,569

where he'd just done everything.

583

00:21:16,569 --> 00:21:19,429

And, you know I was

an engineer at the time.

584

00:21:19,429 --> 00:21:20,579

I would look at this and I'm like,

585

00:21:20,579 --> 00:21:23,924

"Oh my god, my resume

looks nothing like this."

586

00:21:23,924 --> 00:21:27,279

And so I remember sending

a note Alan Eustace saying,

587

00:21:27,279 --> 00:21:30,184

"You have got to find

someone else's resume.

588

00:21:30,184 --> 00:21:33,559

You're depressing

a thousand engineers

589

00:21:33,559 --> 00:21:35,334

everytime you send this out."

590

00:21:35,334 --> 00:21:36,734

Because Jeff is so great.

591

00:21:36,734 --> 00:21:38,534

>> We're just huge fans

really of Jeff.

592

00:21:38,534 --> 00:21:41,044

So me, you know, fans of

Jeff among them and just,

593

00:21:41,044 --> 00:21:42,794

not just a great scientist but

594

00:21:42,794 --> 00:21:44,859

also just an incredibly nice guy.

595

00:21:44,859 --> 00:21:47,229

>> Yeah. But this whole

notion of coupling

596

00:21:47,229 --> 00:21:49,114

world-class engineering and

597

00:21:49,114 --> 00:21:52,579

world class-systems engineering

with AI problem solving,

598

00:21:52,579 --> 00:21:55,254

I think that is

something that we don't

599

00:21:55,254 --> 00:21:58,739

really fully understand enough.

600

00:21:58,739 --> 00:22:01,889

You can be the smartest AI guy

601

00:22:01,889 --> 00:22:03,904

in the world and you know

just have this sort of

602

00:22:03,904 --> 00:22:06,514

incredible theoretical

breakthrough, but

603

00:22:06,514 --> 00:22:09,809

if you can't get

that idea implemented,

604

00:22:09,809 --> 00:22:12,124

not that it has no impact

it just sort of

605

00:22:12,124 --> 00:22:15,664

diminishes the potential

impact that the idea can have.

606

00:22:15,664 --> 00:22:17,624

That partnership I

think you have with

607

00:22:17,624 --> 00:22:20,244

Jeff is something really special.

608

00:22:20,244 --> 00:22:22,104

>> I think I was really fortunate that

609

00:22:22,104 --> 00:22:23,919

even when I started

the Google Brain Team

610

00:22:23,919 --> 00:22:25,524

I feel I brought a lot of

611

00:22:25,524 --> 00:22:27,299

machine learning

expertise and Jeff,

612

00:22:27,299 --> 00:22:28,684

and other Google engineers

613

00:22:28,684 --> 00:22:31,044

early team members

like Rajat Monga,

614

00:22:31,044 --> 00:22:33,544

Greg Corrado, just thought

a 20 percent project for

615

00:22:33,544 --> 00:22:36,214

him. But there are other

Google engineers--

616

00:22:36,214 --> 00:22:38,314

really first and foremost

Jeff--they brought a lot of

617

00:22:38,314 --> 00:22:40,579

systems abilities to the team.

618

00:22:40,579 --> 00:22:42,344

And the other convenient

thing was that,

619

00:22:42,344 --> 00:22:45,849

we were able to get

a thousand computers to run this.

620

00:22:45,849 --> 00:22:49,339

And having Larry Page's

backing and Jeff's ability to

621

00:22:49,339 --> 00:22:50,954

marshal those types

of computational

622

00:22:50,954 --> 00:22:54,114

resources turns out

to be really helpful.

623

00:22:54,114 --> 00:22:56,749

>> Well, let's switch gears

just a little bit.

624

00:22:56,749 --> 00:22:58,834

I think it was really

apt that you

625

00:22:58,834 --> 00:23:01,146

pointed out that AI and

626

00:23:01,146 --> 00:23:03,454

machine learning in

particular are starting to

627

00:23:03,454 --> 00:23:06,929

have GDP scale impact

on the world.

628

00:23:06,929 --> 00:23:08,944

Certainly, if you

look at the products

629

00:23:08,944 --> 00:23:11,154

that we're all using everyday,

630

00:23:11,154 --> 00:23:15,014

there's many levels of

machine learning involved

631

00:23:15,014 --> 00:23:19,354

in everything from search to

social networks to- I mean,

632

00:23:19,354 --> 00:23:20,969

basically everything

you use has got

633

00:23:20,969 --> 00:23:23,864

just a little kiss of

machine learning in it.

634

00:23:23,864 --> 00:23:26,354

So, with that impact and

635

00:23:26,354 --> 00:23:29,289

given how pervasive

these technologies are,

636

00:23:29,289 --> 00:23:31,344

there's a huge amount of

637

00:23:31,344 --> 00:23:35,294

responsibility that

comes along with it.

638

00:23:35,294 --> 00:23:37,074

I know that you've

been thinking a lot

639

00:23:37,074 --> 00:23:40,349

about ethical development of AI

640

00:23:40,349 --> 00:23:42,409

and what our responsibilities are

641

00:23:42,409 --> 00:23:44,204

as scientists and engineers

642

00:23:44,204 --> 00:23:45,499

as we build these technologies.

643

00:23:45,499 --> 00:23:47,894

I'd loved to chat about

that for a few minutes.

644

00:23:47,905 --> 00:23:49,890

Yeah. There's potential to promulgate

645

00:23:49,890 --> 00:23:52,270

things like

discrimination and bias.

646

00:23:52,270 --> 00:23:55,510

I think that with the rise

of technology often

647

00:23:55,510 --> 00:23:57,090

comes greater concentration of

648

00:23:57,090 --> 00:23:59,590

power in smaller numbers

of people's hands.

649

00:23:59,590 --> 00:24:02,960

And I think that this

creates greater risk

650

00:24:02,960 --> 00:24:06,350

of ever-growing wealth

inequality as well.

651

00:24:06,350 --> 00:24:09,155

So, we're recording this

here in California,

652

00:24:09,155 --> 00:24:10,650

and to be really candid,

653

00:24:10,650 --> 00:24:12,345

I think that with the rise

654

00:24:12,345 --> 00:24:14,210

of the last few waves

to technology,

655

00:24:14,210 --> 00:24:15,750

we actually did a great job

656

00:24:15,750 --> 00:24:17,310

creating wealth in the East

and the West Coast,

657

00:24:17,310 --> 00:24:18,810

but we actually did

leave large parts

658

00:24:18,810 --> 00:24:19,965

of the country behind,

659

00:24:19,965 --> 00:24:21,465

and I would love

for this next one

660

00:24:21,465 --> 00:24:23,685

to bring everyone along with us.

661

00:24:23,685 --> 00:24:26,610

>> Yeah. One of the things

that I've spent a bunch

662

00:24:26,610 --> 00:24:28,110

of time thinking about

663

00:24:28,110 --> 00:24:30,275

is, from Microsoft's perspective,

664

00:24:30,275 --> 00:24:34,345

when we think about how we

build our AI technology,

665

00:24:34,345 --> 00:24:36,580

we're thinking about

platforms that we

666

00:24:36,580 --> 00:24:38,820

can put in the hands

of developers.

667

00:24:38,820 --> 00:24:41,365

It's just sort of

our wiring as a company.

668

00:24:41,365 --> 00:24:42,740

So, the example you gave

669

00:24:42,740 --> 00:24:44,755

earlier and the talk where

you want someone in a mom

670

00:24:44,755 --> 00:24:47,000

and pop shop to be

able to program

671

00:24:47,000 --> 00:24:48,440

their own LCD sign

672

00:24:48,440 --> 00:24:51,165

to do whatever and everybody

becomes a programmer,

673

00:24:51,165 --> 00:24:54,940

we actually think that AI

can play a big role in

674

00:24:54,940 --> 00:24:56,620

delivering this future.

And we want

675

00:24:56,620 --> 00:24:59,105

everybody to be an AI developer.

676

00:24:59,105 --> 00:25:01,845

I've been spending much of

my time lately talking with

677

00:25:01,845 --> 00:25:05,205

folks in agriculture

and in healthcare,

678

00:25:05,205 --> 00:25:08,340

which again you're thinking about

679

00:25:08,340 --> 00:25:10,300

the problems that society has

680

00:25:10,300 --> 00:25:12,190

to solve. In the United States.

681

00:25:12,190 --> 00:25:13,390

the cost of healthcare is growing

682

00:25:13,390 --> 00:25:15,420

faster than GDP which is

683

00:25:15,420 --> 00:25:20,000

not sustainable over

long periods of time.

684

00:25:20,000 --> 00:25:22,930

Basically, the only

way that I see

685

00:25:22,930 --> 00:25:25,400

that you break that curve

is with technology.

686

00:25:25,400 --> 00:25:28,045

Now, it might not be AI.

I think it is.

687

00:25:28,045 --> 00:25:30,590

But something is going

to have to sort of

688

00:25:30,590 --> 00:25:33,330

intercede that pulls cost out

689

00:25:33,330 --> 00:25:35,305

of the system while still giving

690

00:25:35,305 --> 00:25:39,095

people very high quality

healthcare outcomes.

691

00:25:39,095 --> 00:25:42,410

And I just see a lot of

companies almost every week,

692

00:25:42,410 --> 00:25:46,220

there's some new result

where AI can read and

693

00:25:46,220 --> 00:25:50,510

EKG chart with cardiologists'

level of accuracy,

694

00:25:50,510 --> 00:25:54,430

which isn't about taking all

of the cardiology jobs away.

695

00:25:54,430 --> 00:25:57,150

It's about making

this diagnostic capability

696

00:25:57,150 --> 00:26:00,620

available to everyone

because the cost is free

697

00:26:00,620 --> 00:26:02,660

and then letting

the cardiologist do

698

00:26:02,660 --> 00:26:07,545

what's difficult and unique

that humans should be doing.

699

00:26:07,545 --> 00:26:09,490

I don't know if you

see that pattern

700

00:26:09,490 --> 00:26:11,917

in other domains as well.

701

00:26:11,948 --> 00:26:14,263

>> I think

there'll be a lot of

702

00:26:14,263 --> 00:26:15,883

partnerships with

the AI teams and

703

00:26:15,883 --> 00:26:17,933

doctors that will

be very valuable.

704

00:26:17,933 --> 00:26:20,373

You know, one thing that excites

me these days with

705

00:26:20,373 --> 00:26:22,533

the theme of things like

healthcare, agriculture,

706

00:26:22,533 --> 00:26:24,458

and manufacturing is helping

707

00:26:24,458 --> 00:26:28,073

great companies become

great AI companies.

708

00:26:27,319 --> 00:26:29,964

I was fortunate really, to have

led the Google Brain team

709

00:26:29,964 --> 00:26:32,559

which became I would say

probably the leading force

710

00:26:32,559 --> 00:26:34,284

in turning Google from

711

00:26:34,284 --> 00:26:35,959

what was already a great company

712

00:26:35,959 --> 00:26:37,764

into today great AI company.

713

00:26:37,764 --> 00:26:39,734

Then, at Baidu, I was responsible

714

00:26:39,734 --> 00:26:41,989

for the company's AI technology

and strategy and team,

715

00:26:41,989 --> 00:26:44,389

and I think that helped

transform Baidu from

716

00:26:44,389 --> 00:26:47,414

what was already a great company

into a great AI company.

717

00:26:47,414 --> 00:26:48,684

I think it really Satya

718

00:26:48,684 --> 00:26:50,464

did a great job also transforming

719

00:26:50,464 --> 00:26:53,004

Microsoft from a great company

to a great AI company.

720

00:26:53,004 --> 00:26:55,309

But for AI to reach

its full potential,

721

00:26:55,309 --> 00:26:58,084

we can't just transform

tech companies,

722

00:26:58,084 --> 00:27:00,164

we need to pull other industries

723

00:27:00,164 --> 00:27:02,994

along for it to create

this GDP growth,

724

00:27:02,994 --> 00:27:04,964

for it to help people

in healthcare deliver

725

00:27:04,964 --> 00:27:07,904

a safer and more accessible

food to people.

726

00:27:07,904 --> 00:27:10,289

So, one thing I'm excited about,

727

00:27:10,289 --> 00:27:12,724

building on my

experience, helping with

728

00:27:12,724 --> 00:27:14,624

really Google and

Baidu's transformation

729

00:27:14,624 --> 00:27:17,784

is to look at other

industries as well to see

730

00:27:17,784 --> 00:27:20,614

if either by providing

AI solutions or

731

00:27:20,614 --> 00:27:23,794

by engaging deeply in

AI transmission programs,

732

00:27:23,794 --> 00:27:25,829

whether my team at Landing.AI,

733

00:27:25,829 --> 00:27:27,549

whether Landing.AI can help

734

00:27:27,549 --> 00:27:30,399

other industries also

become great at AI.

735

00:27:30,399 --> 00:27:31,894

>> Well talk

a little bit more about

736

00:27:31,894 --> 00:27:34,044

what Landing.AI's mission is.

737

00:27:34,044 --> 00:27:36,984

>> We want to empower

businesses with AI.

738

00:27:36,984 --> 00:27:39,819

There is so much need for

739

00:27:39,819 --> 00:27:42,829

AI to enter other industries

than technology,

740

00:27:42,829 --> 00:27:44,339

everything ranging

from manufacturing to

741

00:27:44,339 --> 00:27:46,534

agriculture to healthcare,

and so many more.

742

00:27:46,534 --> 00:27:48,304

For example, in manufacturing,

743

00:27:48,304 --> 00:27:49,964

there are today in factories

744

00:27:49,964 --> 00:27:52,339

sometimes hundreds of

thousands of people using

745

00:27:52,339 --> 00:27:54,239

their eyes to inspect

parts as they come off as

746

00:27:54,239 --> 00:27:55,164

the assembly line to check for

747

00:27:55,164 --> 00:27:56,514

scratches and things and so on.

748

00:27:56,514 --> 00:27:58,654

We find that we can,

for the most part,

749

00:27:58,654 --> 00:28:00,609

automate that with deep learning

750

00:28:00,609 --> 00:28:02,174

and often do it at a level

751

00:28:02,174 --> 00:28:04,399

of reliability and consistency

752

00:28:04,399 --> 00:28:06,494

that's greater than the people are.

753

00:28:06,494 --> 00:28:08,474

People squinting at something

754

00:28:08,474 --> 00:28:10,704

20 centimeters away

your whole day,

755

00:28:10,704 --> 00:28:12,804

that's actually not great

for your eyesight it turns out,

756

00:28:12,804 --> 00:28:14,824

and I would love for computers

757

00:28:14,824 --> 00:28:17,499

rather than often these

young employees to do it.

758

00:28:17,499 --> 00:28:19,899

So, Landing.AI is working with

759

00:28:19,899 --> 00:28:21,504

a few different industries to

760

00:28:21,504 --> 00:28:23,669

provide solutions like that.

761

00:28:23,669 --> 00:28:25,714

We also engage companies

762

00:28:25,714 --> 00:28:28,629

with broader

transformation programs.

763

00:28:28,629 --> 00:28:31,054

So, for both Google and Baidu,

764

00:28:31,054 --> 00:28:32,679

it was not one thing,

765

00:28:32,679 --> 00:28:34,569

it's not that implement

766

00:28:34,569 --> 00:28:37,174

neural networks for ads and

so it's a great AI company.

767

00:28:37,174 --> 00:28:38,174

For a company become

768

00:28:38,174 --> 00:28:40,709

a great AI company is

much more than that.

769

00:28:40,709 --> 00:28:43,664

And then having sort of helped

two great companies do that,

770

00:28:43,664 --> 00:28:46,074

we are trying to help

other companies as well,

771

00:28:46,074 --> 00:28:48,554

especially ones

outside tech become

772

00:28:48,554 --> 00:28:51,779

leading AI entities in

their industry vertical.

773

00:28:51,779 --> 00:28:53,174

So, I find that work very meaningful

774

00:28:53,174 --> 00:28:54,489

and very exciting.

775

00:28:54,489 --> 00:28:56,994

Several days ago, I tweeted

out that on Monday,

776

00:28:56,994 --> 00:28:58,639

I literally wake up at 5:00 AM

777

00:28:58,639 --> 00:28:59,974

so excited about one of

778

00:28:59,974 --> 00:29:02,034

the Landing.AI projects,

I couldn't go back to sleep.

779

00:29:02,034 --> 00:29:04,009

I started getting and

scribbling on my notebook.

780

00:29:04,009 --> 00:29:06,044

So, I find these are

really, really meaningful.

781

00:29:06,044 --> 00:29:07,719

>> That's awesome.

One thing I want

782

00:29:07,719 --> 00:29:09,434

to sort of press on a little bit

783

00:29:09,434 --> 00:29:11,549

is this manufacturing quality

784

00:29:11,549 --> 00:29:13,409

control example

that you just gave.

785

00:29:13,409 --> 00:29:15,119

I think the thing

that a lot of folks

786

00:29:15,119 --> 00:29:16,704

don't understand is it's

787

00:29:16,704 --> 00:29:20,359

not necessarily about

the jobs going away,

788

00:29:20,359 --> 00:29:23,474

it's about these companies

being able to do more.

789

00:29:23,474 --> 00:29:26,944

So, I worked in a small

manufacturing company while

790

00:29:26,944 --> 00:29:30,364

I was in college and we had

exactly the same thing.

791

00:29:30,364 --> 00:29:34,734

So, we operated a infrared

reflow soldering machine

792

00:29:34,734 --> 00:29:36,324

there which sort of melts,

793

00:29:36,324 --> 00:29:38,639

surface mount components

onto circuit boards.

794

00:29:38,639 --> 00:29:40,234

So, you have to visually inspect

795

00:29:40,234 --> 00:29:41,904

the board before it

goes on to make sure

796

00:29:41,904 --> 00:29:43,604

the components are

seated and the solder

797

00:29:43,604 --> 00:29:45,394

has been screened and

all the right parts.

798

00:29:45,394 --> 00:29:47,074

When it comes out,

799

00:29:47,074 --> 00:29:48,884

you have to visually

inspect it to make sure

800

00:29:48,884 --> 00:29:51,289

that none of the parts

of tombstond.

801

00:29:51,289 --> 00:29:53,319

There are a variety

of like little things

802

00:29:53,319 --> 00:29:54,854

that can happen in the process.

803

00:29:54,854 --> 00:29:56,589

So, we have people doing that.

804

00:29:56,589 --> 00:29:59,064

If there was some way

for them not to do it,

805

00:29:59,064 --> 00:30:00,489

they would go do something else

806

00:30:00,489 --> 00:30:01,754

that was more valuable or we

807

00:30:01,754 --> 00:30:04,454

could run more boards

so actually, in a way,

808

00:30:04,454 --> 00:30:06,824

you could create

more jobs because

809

00:30:06,824 --> 00:30:10,954

the more work that this company

could do economically,

810

00:30:10,954 --> 00:30:13,994

the more jobs in general

that it can create.

811

00:30:13,994 --> 00:30:17,419

And I'm sort of seeing AI in

812

00:30:17,419 --> 00:30:19,514

several different places like

813

00:30:19,514 --> 00:30:23,254

in manufacturing automation

as helping to bring

814

00:30:23,254 --> 00:30:25,604

back jobs from overseas

815

00:30:25,604 --> 00:30:27,914

that were lost because

it was just sort of

816

00:30:27,914 --> 00:30:29,964

cheaper to do them with

817

00:30:29,964 --> 00:30:33,009

low cost labor in

some other part of the world.

818

00:30:33,009 --> 00:30:35,164

They're coming back

now because like

819

00:30:35,164 --> 00:30:37,714

automation has gotten

so good that you

820

00:30:37,714 --> 00:30:40,144

can start doing them with

821

00:30:40,144 --> 00:30:43,744

fewer more expert

people but here,

822

00:30:43,744 --> 00:30:44,864

in the United States,

823

00:30:44,864 --> 00:30:46,824

locally in these

communities where

824

00:30:46,824 --> 00:30:49,279

whatever it is that they're

manufacturing is needed.

825

00:30:49,279 --> 00:30:51,649

It's like these really

interesting phenomena.

826

00:30:51,649 --> 00:30:52,634

>> There was one part

of your career

827

00:30:52,634 --> 00:30:53,874

I did not know about it.

828

00:30:53,874 --> 00:30:55,609

I followed a lot of your work at

829

00:30:55,609 --> 00:30:57,414

Google and Microsoft,

and even today,

830

00:30:57,414 --> 00:31:00,974

people still speak glowingly

of their privacy practices

831

00:31:00,974 --> 00:31:02,899

you put in place

when you're at Google.

832

00:31:02,899 --> 00:31:04,304

I did not know you were into

833

00:31:04,304 --> 00:31:06,944

this soldering business way back.

834

00:31:06,944 --> 00:31:08,744

>> Yeah, I had put

myself through college

835

00:31:08,744 --> 00:31:11,014

some way or another. It was

interesting though.

836

00:31:11,014 --> 00:31:12,574

I remember one of my first jobs,

837

00:31:12,574 --> 00:31:17,394

I had to put brass rivets

into 5,000 circuit boards.

838

00:31:17,394 --> 00:31:18,949

Circuit boards were controllers

839

00:31:18,949 --> 00:31:21,119

for commercial washing

machines and there were

840

00:31:21,119 --> 00:31:24,124

six little brass tabs

that you would put

841

00:31:24,124 --> 00:31:25,759

electrical connectors onto and

842

00:31:25,759 --> 00:31:27,194

each one of them

had to be riveted.

843

00:31:27,194 --> 00:31:29,464

So, it was 30,000 rivets

that had to be done

844

00:31:29,464 --> 00:31:31,839

and we had a manual

rivet press and

845

00:31:31,839 --> 00:31:34,339

my job at this company in

846

00:31:34,339 --> 00:31:36,454

its first three months

of existence right

847

00:31:36,454 --> 00:31:38,914

after I graduated high

school was to press,

848

00:31:38,914 --> 00:31:41,859

rivet press 30,000

times, and that's awful.

849

00:31:41,859 --> 00:31:44,089

Automation is not a bad thing.

850

00:31:44,089 --> 00:31:45,694

>> In a lot countries we

851

00:31:45,694 --> 00:31:47,324

work with we're seeing,

852

00:31:47,324 --> 00:31:49,079

for example Japan, the country is

853

00:31:49,079 --> 00:31:50,809

actually very different

than the United States,

854

00:31:50,809 --> 00:31:52,629

because it has an aging population.

855

00:31:52,629 --> 00:31:52,784

>> Yeah.

856

00:31:52,784 --> 00:31:54,454

>>And there just aren't enough

people to do the work.

857

00:31:54,454 --> 00:31:54,664

>> Correct.

858

00:31:54,664 --> 00:31:56,609

>> So, they welcome automation

859

00:31:56,609 --> 00:31:58,989

because the options are

either automate or well,

860

00:31:58,989 --> 00:32:01,114

just shut down the whole plant

because it is impossible to

861

00:32:01,114 --> 00:32:03,689

hire with the aging population.

862

00:32:03,689 --> 00:32:05,674

>> Yeah. In Japan, it

actually is going to become

863

00:32:05,674 --> 00:32:07,174

a crucial social issue

864

00:32:07,174 --> 00:32:09,299

sometime in the next

100 years or so

865

00:32:09,299 --> 00:32:12,024

because their

fertility rates are such

866

00:32:12,024 --> 00:32:15,189

that they're in

major population decline.

867

00:32:15,189 --> 00:32:18,089

So, you should hope for

really good AI there,

868

00:32:18,089 --> 00:32:19,354

because we're going to need

869

00:32:19,354 --> 00:32:21,564

incredibly sophisticated

things to take

870

00:32:21,564 --> 00:32:24,239

care of the aging

population there,

871

00:32:24,239 --> 00:32:26,964

especially in healthcare

and elder care and whatnot.

872

00:32:26,987 --> 00:32:30,327

You know, I think

when we automated elevators.

873

00:32:30,327 --> 00:32:31,747

Right? Once elevators had

874

00:32:31,747 --> 00:32:33,352

to have a person operating them,

875

00:32:33,352 --> 00:32:35,827

a lot of elevator

operators did lose

876

00:32:35,827 --> 00:32:38,977

their jobs because we switched

to automatic elevators.

877

00:32:38,977 --> 00:32:41,517

I think one challenge

that AI offers is

878

00:32:41,517 --> 00:32:44,067

that there will be as

connected as it is today,

879

00:32:44,067 --> 00:32:45,557

I think this change will

happen very quickly,

880

00:32:45,557 --> 00:32:47,507

or the potential for jobs to

881

00:32:47,507 --> 00:32:50,142

disappear is faster

this time around.

882

00:32:50,142 --> 00:32:53,346

So, I think when we

work with customers,

883

00:32:53,346 --> 00:32:55,297

we actually have a stance

884

00:32:55,297 --> 00:32:58,167

on wanting to make sure that

everyone is treated well,

885

00:32:58,167 --> 00:33:00,167

and to the extent, we're

able to step in and try

886

00:33:00,167 --> 00:33:02,297

to encourage or even assist

887

00:33:02,297 --> 00:33:04,167

directly with retraining

to help them find

888

00:33:04,167 --> 00:33:06,702

better options, we're

truly going to do that.

889

00:33:06,702 --> 00:33:09,282

That actually hasn't been needed so far for

890

00:33:09,282 --> 00:33:12,202

us because we're actually

not displacing any jobs.

891

00:33:12,202 --> 00:33:14,402

But if it ever happens,

that is our stance.

892

00:33:14,402 --> 00:33:15,967

But I think this

actually speaks to

893

00:33:15,967 --> 00:33:19,057

the important role of

government with the rise of AI.

894

00:33:19,057 --> 00:33:21,057

So, I think the world is not

895

00:33:21,057 --> 00:33:22,972

about to run out of

jobs anytime soon,

896

00:33:22,972 --> 00:33:24,707

but as LinkedIn has said through

897

00:33:24,707 --> 00:33:26,457

the LinkedIn data and

many organizations,

898

00:33:26,457 --> 00:33:29,042

and Coursera has seen and

Coursera's data as well,

899

00:33:29,042 --> 00:33:31,912

our population in

the United States and globally

900

00:33:31,912 --> 00:33:35,082

is not well-matched to the

jobs that are being created.

901

00:33:35,082 --> 00:33:37,017

And we can't find

enough people for-

902

00:33:37,017 --> 00:33:38,217

we can't find enough nurses,

903

00:33:38,217 --> 00:33:40,457

we can't find enough wind

turbine technicians,

904

00:33:40,457 --> 00:33:41,397

a lot of cities,

905

00:33:41,397 --> 00:33:42,802

the highest paid person might be

906

00:33:42,802 --> 00:33:45,472

the auto mechanic and we can't

find enough of those.

907

00:33:45,472 --> 00:33:47,667

So, I think a lot of

the challenge and

908

00:33:47,667 --> 00:33:49,657

also the responsibility

for nations or

909

00:33:49,657 --> 00:33:51,917

for governments of a society is

910

00:33:51,917 --> 00:33:54,407

to provide a safety net

so that everyone has

911

00:33:54,407 --> 00:33:57,737

a shot at learning new skills

they need in order to

912

00:33:57,737 --> 00:34:00,057

enter these other trades

913

00:34:00,057 --> 00:34:01,277

that we just can't find enough

914

00:34:01,277 --> 00:34:02,547

people to work in right now.

915

00:34:02,547 --> 00:34:04,212

>> I could not agree more.

916

00:34:04,212 --> 00:34:05,857

I think this is one of

917

00:34:05,857 --> 00:34:08,892

the most important balances that

918

00:34:08,892 --> 00:34:12,077

we're going to have to

strike as a society,

919

00:34:12,077 --> 00:34:13,477

and it's not

just the United States,

920

00:34:13,477 --> 00:34:15,322

it's a worldwide thing.

921

00:34:15,322 --> 00:34:17,927

We don't want to under invest

922

00:34:17,927 --> 00:34:20,447

in AI in this technology

because we're

923

00:34:20,447 --> 00:34:24,177

frightened about

the negative consequences

924

00:34:24,177 --> 00:34:27,422

it's going to have on jobs

that might be disrupted.

925

00:34:27,422 --> 00:34:29,037

On the other hand, we don't want

926

00:34:29,037 --> 00:34:31,507

to be inhumane, incompassionate,

927

00:34:31,507 --> 00:34:34,637

unethical about how we provide

928

00:34:34,637 --> 00:34:36,537

support for folks who are going

929

00:34:36,537 --> 00:34:38,817

to be disrupted potentially.

930

00:34:38,817 --> 00:34:39,387

>> Yeah.

931

00:34:39,387 --> 00:34:41,132

>> I think Coursera plays

932

00:34:41,132 --> 00:34:43,282

an incredibly important role in

933

00:34:43,282 --> 00:34:46,067

managing this sea

change in that we have

934

00:34:46,067 --> 00:34:48,232

to make reskilling and

935

00:34:48,232 --> 00:34:52,677

education much cheaper and

much more accessible to folks.

936

00:34:52,677 --> 00:34:54,517

Because one of the things

that we're doing is,

937

00:34:54,517 --> 00:34:56,007

we're entering this new world

938

00:34:56,007 --> 00:34:59,437

where the work of the mind

is going to be far,

939

00:34:59,437 --> 00:35:01,457

far, far more

valuable even than it

940

00:35:01,457 --> 00:35:03,802

already is than the

work of the body.

941

00:35:03,802 --> 00:35:05,562

So, that's the muscle that has

942

00:35:05,562 --> 00:35:07,277

to get worked out

and we've just got

943

00:35:07,277 --> 00:35:08,692

to get people into

944

00:35:08,692 --> 00:35:11,072

that habit and make it

cheap and accessible.

945

00:35:11,072 --> 00:35:12,977

>> Yeah. It is actually

really interesting.

946

00:35:12,977 --> 00:35:16,202

When you look at

the careers of athletes,

947

00:35:16,202 --> 00:35:18,607

you can't just train them in

948

00:35:18,607 --> 00:35:21,447

great shape at age 21 and

then stop working out.

949

00:35:21,447 --> 00:35:23,107

The human body

doesn't work like

950

00:35:23,107 --> 00:35:24,732

that. Human mind is the same.

951

00:35:24,732 --> 00:35:26,547

You can't just train, work on

your brain until you're

952

00:35:26,547 --> 00:35:28,422

21 and then stop working

out your brain.

953

00:35:28,422 --> 00:35:30,232

Your brain you go

flabby if you do that.

954

00:35:30,232 --> 00:35:30,412

>> Yes.

955

00:35:30,412 --> 00:35:32,767

>> So, I think one of the ways

I want the world to be

956

00:35:32,767 --> 00:35:34,272

different is I want us to

957

00:35:34,272 --> 00:35:35,997

build a lifelong

learning society.

958

00:35:35,997 --> 00:35:38,517

We need this because the pace

of change is faster.

959

00:35:38,517 --> 00:35:40,487

There's going to be technology

invented next year and

960

00:35:40,487 --> 00:35:42,587

that will affect your job

five years after that.

961

00:35:42,587 --> 00:35:45,872

So, all of us had better

keep on learning new things.

962

00:35:45,872 --> 00:35:48,262

I think this is

a cultural sea change

963

00:35:48,262 --> 00:35:50,077

that needs to happen

across society,

964

00:35:50,077 --> 00:35:52,372

because for us to all contribute

965

00:35:52,372 --> 00:35:53,637

meaningfully to the world

966

00:35:53,637 --> 00:35:55,227

and make other people's

lives better,

967

00:35:55,227 --> 00:35:57,037

the skills you need

five years from now may

968

00:35:57,037 --> 00:35:59,187

be very different than

the skills you have today.

969

00:35:59,187 --> 00:36:00,927

If you are no longer

in college, well,

970

00:36:00,927 --> 00:36:04,002

we still need you to go and

acquire those skills.

971

00:36:04,002 --> 00:36:06,947

So, I think we just

need to acknowledge

972

00:36:06,947 --> 00:36:09,932

also that learning and

studying is hard work.

973

00:36:09,932 --> 00:36:12,542

I want people if they

have the capacity.

974

00:36:12,542 --> 00:36:14,667

Sometimes your life

circumstances prevent you from

975

00:36:14,667 --> 00:36:16,857

working in certain ways, and

everyone deserves

976

00:36:16,857 --> 00:36:19,092

a lot of support throughout

all phases of life.

977

00:36:19,092 --> 00:36:22,127

But if someone has

the capacity to spend

978

00:36:22,127 --> 00:36:23,507

more time studying rather than

979

00:36:23,507 --> 00:36:25,802

spend that equal amount

of time watching TV,

980

00:36:25,802 --> 00:36:27,217

I would rather they spend

981

00:36:27,217 --> 00:36:28,917

that time studying

so that they can

982

00:36:28,917 --> 00:36:30,567

better contribute

to their own lives

983

00:36:30,567 --> 00:36:32,337

and to the broader society.

984

00:36:32,337 --> 00:36:35,157

>> Yeah, and speaking again

about the role of government,

985

00:36:35,157 --> 00:36:37,157

one of the things that

I think the government

986

00:36:37,157 --> 00:36:39,582

could do to help

with this transition

987

00:36:39,582 --> 00:36:43,562

is AI has this enormous potential

988

00:36:43,562 --> 00:36:45,992

to lower the costs

of subsistence.

989

00:36:45,992 --> 00:36:49,167

So, through precision agriculture

990

00:36:49,167 --> 00:36:52,327

and artificial intelligence

and healthcare,

991

00:36:52,327 --> 00:36:55,247

there are probably things

that we can do to affect

992

00:36:55,247 --> 00:36:58,592

housing costs with

AI and automation.

993

00:36:58,592 --> 00:37:01,957

So, looking at

Maslow's Hierarchy of Needs,

994

00:37:01,957 --> 00:37:03,717

the bottom two levels

995

00:37:03,717 --> 00:37:06,607

where you've got food,

clothing, shelter,

996

00:37:06,607 --> 00:37:09,292

and your personal safety

and security,

997

00:37:09,292 --> 00:37:10,877

I think the more that we can be

998

00:37:10,877 --> 00:37:12,887

investing in

those sorts of things,

999

00:37:12,887 --> 00:37:15,197

like technologies that address

1000

00:37:15,197 --> 00:37:16,912

those needs and address

1001

00:37:16,912 --> 00:37:19,222

them across the board

for everyone,

1002

00:37:19,222 --> 00:37:22,677

it does nothing but lift

all boats basically.

1003

00:37:22,677 --> 00:37:24,762

I wish I had a magic

wand that I could

1004

00:37:24,762 --> 00:37:27,232

wave over more young

entrepreneurs and

1005

00:37:27,232 --> 00:37:29,402

encourage them to create

startups that are

1006

00:37:29,402 --> 00:37:32,017

taking this really interesting,

1007

00:37:32,017 --> 00:37:34,997

increasingly valuable AI toolbox

1008

00:37:34,997 --> 00:37:38,097

that they have and apply

it to these problems.

1009

00:37:38,097 --> 00:37:39,242

They really could change

1010

00:37:39,242 --> 00:37:41,172

the world in this incredible way.

1011

00:37:41,172 --> 00:37:42,597

>> You make such a good point.

1012

00:37:42,597 --> 00:37:45,767

>> So, the last tech thing

that I wanted to ask you is,

1013

00:37:45,767 --> 00:37:49,107

there is sort of just an

incredible rate of innovation

1014

00:37:49,107 --> 00:37:52,612

right now on AI in general,

1015

00:37:52,612 --> 00:37:56,727

and some of the stuff is

what I call "stunt AI"

1016

00:37:56,727 --> 00:37:59,597

not in the sense that it's

not valuable but it's-

1017

00:37:59,597 --> 00:38:01,992

>> Know go ahead. Name of

names. I want to hear.

1018

00:38:01,992 --> 00:38:04,187

>> No, so I'll name

our own name.

1019

00:38:04,187 --> 00:38:06,137

So, we, at Microsoft did

1020

00:38:06,137 --> 00:38:08,687

this really interesting

AI stunt where

1021

00:38:08,687 --> 00:38:12,717

we had this hierarchical

reinforcement learning system

1022

00:38:12,717 --> 00:38:14,417

that beat Ms. Pac-Man.

1023

00:38:14,417 --> 00:38:18,947

So, that's the flavor of

what I would call "stunt AI."

1024

00:38:18,947 --> 00:38:21,607

I think they're useful

1025

00:38:21,607 --> 00:38:23,937

in a way because a

lot of what we do is

1026

00:38:23,937 --> 00:38:28,852

very difficult for

layfolks to understand.

1027

00:38:28,852 --> 00:38:30,877

So, the value of

the stunt is holy crap,

1028

00:38:30,877 --> 00:38:33,587

you can actually have

a piece of AI do this?

1029

00:38:33,587 --> 00:38:36,807

I'm a big classical

piano fan and one of

1030

00:38:36,807 --> 00:38:38,397

the things I've

always lamented about

1031

00:38:38,397 --> 00:38:40,592

being a computer scientist is,

1032

00:38:40,592 --> 00:38:44,287

there's no performance of

computer science in general,

1033

00:38:44,287 --> 00:38:46,907

where a normal person

can listen to

1034

00:38:46,907 --> 00:38:48,197

it or if you're talking about

1035

00:38:48,197 --> 00:38:49,727

an athlete like Steph Curry,

1036

00:38:49,727 --> 00:38:51,732

who has done

an incredible amount of

1037

00:38:51,732 --> 00:38:53,642

technical preparation

and becoming as

1038

00:38:53,642 --> 00:38:55,817

good as he is at basketball,

1039

00:38:55,817 --> 00:38:57,922

there's a performance at

the end where you can

1040

00:38:57,922 --> 00:39:00,592

appreciate his skill and ability.

1041

00:39:00,592 --> 00:39:02,822

And these "stunt AI" things

 in a way are

1042

00:39:02,822 --> 00:39:05,532

a way for folks to

appreciate what's happening.

1043

00:39:05,532 --> 00:39:08,467

Those are the exciting AI things

for the layfolks.

1044

00:39:08,467 --> 00:39:10,197

What are the exciting

things as

1045

00:39:10,197 --> 00:39:12,772

a specialists that you

see on the horizon?

1046

00:39:12,772 --> 00:39:15,872

Like new things and

reinforcement learning, coming,

1047

00:39:15,872 --> 00:39:18,757

people are doing some

interesting stuff with transfer

1048

00:39:18,757 --> 00:39:21,687

learning now where

I'm starting to

1049

00:39:21,687 --> 00:39:23,097

see some promise that

1050

00:39:23,097 --> 00:39:25,507

not every machine

learning problem is

1051

00:39:25,507 --> 00:39:28,462

something where you're

solving it in isolation.

1052

00:39:28,462 --> 00:39:29,832

What's interesting to you?

1053

00:39:29,832 --> 00:39:32,207

>> So, in the short term,

1054

00:39:32,207 --> 00:39:35,937

one thing I'm excited about is

turning machine learning from

1055

00:39:35,937 --> 00:39:37,877

a bit of a black art

into more of

1056

00:39:37,877 --> 00:39:40,102

a systematic

engineering discipline.

1057

00:39:40,102 --> 00:39:42,387

I think, today, too much

of machine learning

1058

00:39:42,387 --> 00:39:45,047

among a few wise people

who happen to say,

1059

00:39:45,047 --> 00:39:48,457

"Oh, change the activation

function in layer five."

1060

00:39:48,457 --> 00:39:49,652

And if for some reason it works,

1061

00:39:49,652 --> 00:39:51,437

then that can turn

into a systematic

1062

00:39:51,437 --> 00:39:53,257

engineering process that would

1063

00:39:53,257 --> 00:39:54,457

demystify a lot of it and help

1064

00:39:54,457 --> 00:39:57,452

a lot more people

access these tools.

1065

00:39:57,452 --> 00:39:58,667

>> Do you think that

that's going to

1066

00:39:58,667 --> 00:40:00,097

come from there becoming

1067

00:40:00,097 --> 00:40:01,697

a real engineering practice

1068

00:40:01,697 --> 00:40:03,467

of deep neural network architect

1069

00:40:03,467 --> 00:40:04,817

or is that going

to get solved with

1070

00:40:04,817 --> 00:40:06,267

this learning to learn stuff or

1071

00:40:06,267 --> 00:40:09,977

auto ML stuff that folks are

working on, or maybe both?

1072

00:40:09,977 --> 00:40:12,387

>> I think auto ML is

a very nice piece of work,

1073

00:40:12,387 --> 00:40:13,727

and ia a small piece

of the puzzle,

1074

00:40:13,727 --> 00:40:15,337

maybe surrounding, optimizing

1075

00:40:15,337 --> 00:40:16,802

[inaudible] preferences,

things like that.

1076

00:40:16,802 --> 00:40:18,817

But I think there are

even bigger questions like,

1077

00:40:18,817 --> 00:40:20,602

when should you

collect more data,

1078

00:40:20,602 --> 00:40:22,017

or is this data set good enough,

1079

00:40:22,017 --> 00:40:24,697

or should you

synthesize more data,

1080

00:40:24,697 --> 00:40:26,357

or should you switch

1081

00:40:26,357 --> 00:40:28,367

algorithms from this type

of algorith to that type of algorithm,

1082

00:40:28,367 --> 00:40:30,227

and do you have

two neural networks

1083

00:40:30,227 --> 00:40:32,147

or one neural network

offering a pipeline?

1084

00:40:32,147 --> 00:40:34,722

I think those bigger

architectural questions go

1085

00:40:34,722 --> 00:40:38,027

beyond what the current automatic

algorithm is able to do.

1086

00:40:38,027 --> 00:40:38,872

I've been working on this book,

1087

00:40:38,872 --> 00:40:39,912

"Machine Learning Yearning"

1088

00:40:39,912 --> 00:40:41,957

mlyearning.org, that I've been

1089

00:40:41,957 --> 00:40:44,557

emailing out to people on

the mailing list for free

1090

00:40:44,557 --> 00:40:47,617

that's trying to conceptualize

my own ideas, I guess,

1091

00:40:47,617 --> 00:40:50,007

to turn machine learning into

1092

00:40:50,007 --> 00:40:51,612

more of the

engineering discipline

1093

00:40:51,612 --> 00:40:52,952

to make it more systematic.

1094

00:40:52,952 --> 00:40:54,592

But I think there's

a lot more that

1095

00:40:54,592 --> 00:40:57,007

the community needs

to do beyond what I,

1096

00:40:57,007 --> 00:40:59,367

as one individual,

could do as well.

1097

00:40:59,367 --> 00:41:00,877

But that will be really

exciting when we can

1098

00:41:00,877 --> 00:41:02,147

take the powerful tools of

1099

00:41:02,147 --> 00:41:03,567

supervised learning and help a

lot more people are

1100

00:41:03,567 --> 00:41:05,257

able to use them systematically.

1101

00:41:05,257 --> 00:41:07,192

With the rise of

software engineering

1102

00:41:07,192 --> 00:41:08,922

came the rise of ideas like,

1103

00:41:08,922 --> 00:41:11,217

"Oh, maybe we should have a PM."

1104

00:41:11,217 --> 00:41:12,927

I think those are

Microsoft invention, right?

1105

00:41:12,927 --> 00:41:15,457

The PM, product manager,

and then program manager,

1106

00:41:15,457 --> 00:41:18,092

project manager types

of roles way back.

1107

00:41:18,092 --> 00:41:20,062

Then eventually came ideas like

1108

00:41:20,062 --> 00:41:23,842

the waterfall planning models

or the scrum agile models.

1109

00:41:23,842 --> 00:41:26,012

I think we need new software

engineering practices.

1110

00:41:26,012 --> 00:41:26,847

How do you get people to work

1111

00:41:26,847 --> 00:41:28,322

together in a machine

learning world?

1112

00:41:28,322 --> 00:41:31,437

So all sorting it

out to Landing.AI ask

1113

00:41:31,437 --> 00:41:34,582

our product managers

do things differently,

1114

00:41:34,582 --> 00:41:35,627

then I think I see

1115

00:41:35,627 --> 00:41:37,547

any other company tell

their product managers to do.

1116

00:41:37,547 --> 00:41:39,842

So we're still figure out

these workflows and practices.

1117

00:41:39,842 --> 00:41:42,207

Beyond that, I think on

a more pure technology side

1118

00:41:42,207 --> 00:41:43,657

[inaudible] again as I do

1119

00:41:43,657 --> 00:41:45,777

transform entertainment and art.

1120

00:41:45,777 --> 00:41:47,842

It'll be interesting to see how

it goes beyond that.

1121

00:41:47,842 --> 00:41:49,947

I think the value

of reinforcement

1122

00:41:49,947 --> 00:41:52,692

learning in games

is very overhyped,

1123

00:41:52,692 --> 00:41:54,307

but I'm seeing

some real attraction in

1124

00:41:54,307 --> 00:41:56,342

using reinforced learning

to control robots.

1125

00:41:56,342 --> 00:41:58,467

So early signs from my friends

1126

00:41:58,467 --> 00:41:59,667

working on projects that are not

1127

00:41:59,667 --> 00:42:00,817

yet public for the most part,

1128

00:42:00,817 --> 00:42:03,862

but there are signs of

meaningful progress

1129

00:42:03,862 --> 00:42:07,367

in the reinforced learning

applied to robotics.

1130

00:42:07,367 --> 00:42:10,477

Then, I think transfer learning

is vastly underrated.

1131

00:42:10,477 --> 00:42:12,102

The ability to learn from-

1132

00:42:12,102 --> 00:42:13,887

so there was a paper

out of Facebook where

1133

00:42:13,887 --> 00:42:15,467

they trained on an unprecedented

1134

00:42:15,467 --> 00:42:18,057

3.5 billion images which

is very, very big

1135

00:42:18,057 --> 00:42:19,467

3.5 images is

very large,

1136

00:42:19,467 --> 00:42:20,847

even by today's standards,

1137

00:42:20,847 --> 00:42:22,537

and found that it turns out

1138

00:42:22,537 --> 00:42:24,902

training from 3.5

billion, in their case,

1139

00:42:24,902 --> 00:42:26,907

Instagram images, is

actually better than

1140

00:42:26,907 --> 00:42:29,562

training on only

one billion images.

1141

00:42:29,562 --> 00:42:30,767

So this is a good sign for

1142

00:42:30,767 --> 00:42:32,187

the microprocessor

companies, I think,

1143

00:42:32,187 --> 00:42:33,677

because it means that, "Hey,

1144

00:42:33,677 --> 00:42:35,427

keep building

these faster processes.

1145

00:42:35,427 --> 00:42:37,917

We'll find a way to suck up

their processing power."

1146

00:42:37,917 --> 00:42:40,747

But with the ability

to train on really,

1147

00:42:40,747 --> 00:42:42,557

really massive data sets to do

1148

00:42:42,557 --> 00:42:44,357

transfer learning or pre-training

1149

00:42:44,357 --> 00:42:46,082

or some set of

ideas around there,

1150

00:42:46,082 --> 00:42:47,812

I think that is very

1151

00:42:47,812 --> 00:42:51,267

underrated today still.

And then super long term-

1152

00:42:51,267 --> 00:42:54,547

We used the term unsupervised

learning to describe a really,

1153

00:42:54,547 --> 00:42:55,637

really complicated set of

1154

00:42:55,637 --> 00:42:57,407

ideas that we don't

even fully understand.

1155

00:42:57,407 --> 00:42:59,327

But I think that also will be

1156

00:42:59,327 --> 00:43:01,537

very important in

the longer term.

1157

00:43:01,537 --> 00:43:04,442

>> So tell us something that

people wouldn't know about you.

1158

00:43:04,442 --> 00:43:06,282

>> Sometimes, I just

look at those bookstore

1159

00:43:06,282 --> 00:43:08,822

and deliberately buy a magazine

1160

00:43:08,822 --> 00:43:11,337

in some totally

strange area that I

1161

00:43:11,337 --> 00:43:14,142

would otherwise never

have bought a magazine in.

1162

00:43:14,142 --> 00:43:16,207

So whatever, five dollars,

1163

00:43:16,207 --> 00:43:18,387

you end up with a magazine

in some area that you

1164

00:43:18,387 --> 00:43:20,762

just previously knew

absolutely nothing about.

1165

00:43:20,762 --> 00:43:22,287

>> I think that's awesome.

1166

00:43:22,287 --> 00:43:24,027

>> One thing that

not many people know about me,

1167

00:43:24,027 --> 00:43:25,587

is I actually really

love stationery.

1168

00:43:25,587 --> 00:43:27,667

So my wife knows, when we travel

to foreign countries,

1169

00:43:27,667 --> 00:43:29,407

sometimes I'll spend way too

1170

00:43:29,407 --> 00:43:32,247

long looking at pens

and pencils and paper.

1171

00:43:32,247 --> 00:43:34,037

I think part of me

feels like, "Boy,

1172

00:43:34,037 --> 00:43:36,452

if only I had the perfect pen

and the perfect paper,

1173

00:43:36,452 --> 00:43:38,037

I could come up

with better ideas."

1174

00:43:38,037 --> 00:43:39,302

It has not worked out so far,

1175

00:43:39,302 --> 00:43:41,877

but that dream lives on and on.

1176

00:43:41,877 --> 00:43:42,927

>> That's awesome. All right.

1177

00:43:42,927 --> 00:43:44,577

Well, thank you so much,

1178

00:43:44,577 --> 00:43:46,422

Andrew, for coming in today.

1179

00:43:46,422 --> 00:43:48,637

>> Thanks a lot for

having me here, Kevin.

1180

00:43:51,283 --> 00:43:53,187

>> That was a really

terrific conversation.

1181

00:43:53,187 --> 00:43:54,532

>> Yes, it was a ton of fun.

1182

00:43:54,532 --> 00:43:56,817

It was like all of

my best conversations,

1183

00:43:56,817 --> 00:43:58,557

I felt like it wasn't

1184

00:43:58,557 --> 00:44:00,547

long at all and was

glancing now at my phone and

1185

00:44:00,547 --> 00:44:03,287

I'm like, "Oh, my god. We've

just spent 48 minutes."

1186

00:44:03,287 --> 00:44:06,222

>> One of the questions

that you asked Andrew was,

1187

00:44:06,222 --> 00:44:08,812

what technology is he

1188

00:44:08,812 --> 00:44:10,517

most impressed by and excited by

1189

00:44:10,517 --> 00:44:12,057

this coming down

the pike with AI?

1190

00:44:12,057 --> 00:44:14,907

I wanted to turn

that back on you

1191

00:44:14,907 --> 00:44:16,352

because you've been working with

1192

00:44:16,352 --> 00:44:18,437

AI for a really long

time at Google,

1193

00:44:18,437 --> 00:44:20,287

and at LinkedIn, and

now at Microsoft.

1194

00:44:20,287 --> 00:44:23,882

So what have you seen

that really excites you?

1195

00:44:23,882 --> 00:44:26,872

>> Several things.

I'm excited that

1196

00:44:26,872 --> 00:44:30,972

this trend that started a

whole bunch of years ago,

1197

00:44:30,972 --> 00:44:34,342

more data plus

more compute equals

1198

00:44:34,342 --> 00:44:38,292

more practical AI and

machine learning solutions.

1199

00:44:38,292 --> 00:44:40,017

It's been surprising to me that

1200

00:44:40,017 --> 00:44:42,817

that trend continues

to have legs.

1201

00:44:42,817 --> 00:44:44,277

So, when I look forward into

1202

00:44:44,277 --> 00:44:46,677

the future and I see

more data coming online,

1203

00:44:46,677 --> 00:44:49,882

particularly with IoT and

the intelligent edge as

1204

00:44:49,882 --> 00:44:54,957

we get more things

connected to the Cloud that

1205

00:44:54,957 --> 00:44:59,096

are sensing either

through cameras or

1206

00:44:59,096 --> 00:45:01,212

far field microphone arrays or

1207

00:45:01,212 --> 00:45:04,412

temperature sensors or

whatever it is that they are,

1208

00:45:04,412 --> 00:45:07,497

we will increasingly be

digitizing the world.

1209

00:45:07,497 --> 00:45:09,532

Honestly, my prediction is that

1210

00:45:09,532 --> 00:45:11,947

the volumes of data that

we're gathering now will

1211

00:45:11,947 --> 00:45:14,987

seem trivial by comparison

to the volumes that

1212

00:45:14,987 --> 00:45:18,377

will be produced sometime

in the next 5-10 years.

1213

00:45:18,377 --> 00:45:20,747

I think you take that with all of

1214

00:45:20,747 --> 00:45:24,607

the super exciting stuff that's

happening with AI silicon

1215

00:45:24,607 --> 00:45:25,777

right now and just the

1216

00:45:25,777 --> 00:45:27,417

number of startups

that are working

1217

00:45:27,417 --> 00:45:29,427

on brand new architectures

1218

00:45:29,427 --> 00:45:31,616

for a training machine

learning models,

1219

00:45:31,616 --> 00:45:33,927

it really is an exciting time,

1220

00:45:33,927 --> 00:45:36,107

and I think that combo

of more compute,

1221

00:45:36,107 --> 00:45:38,147

more data is going to continue

1222

00:45:38,147 --> 00:45:40,817

to surprise and delight us with

1223

00:45:40,817 --> 00:45:43,597

interesting new results

and also deliver

1224

00:45:43,597 --> 00:45:45,357

this real world GDP

1225

00:45:45,357 --> 00:45:47,562

impacting value that

folks are seeing.

1226

00:45:47,562 --> 00:45:49,097

So that's super cool.

1227

00:45:49,097 --> 00:45:52,427

But I tell you, the things

that really move me,

1228

00:45:52,427 --> 00:45:57,607

that I have been seeing

lately are the applications

1229

00:45:57,607 --> 00:46:00,647

into which people are

putting this technology in

1230

00:46:00,647 --> 00:46:04,467

precision agriculture

and healthcare.

1231

00:46:04,467 --> 00:46:10,397

Just recently, we went out

to one of our farm partners.

1232

00:46:10,397 --> 00:46:12,227

The Microsoft Research

has been working

1233

00:46:12,227 --> 00:46:15,637

with the things that

they're doing with

1234

00:46:15,637 --> 00:46:20,667

AI machine learning

and edge computing in

1235

00:46:20,667 --> 00:46:23,392

this small organic farm in

1236

00:46:23,392 --> 00:46:26,647

rural Washington state is

absolutely incredible.

1237

00:46:26,647 --> 00:46:30,217

They're doing all of

this stuff with a mind towards

1238

00:46:30,217 --> 00:46:32,957

"How do you take

a small independent farmer

1239

00:46:32,957 --> 00:46:37,862

and help them optimize

yields, reduce the amount of

1240

00:46:37,862 --> 00:46:40,547

chemicals that they have

to use on their crop,

1241

00:46:40,547 --> 00:46:43,587

how much water they have to

use so you're minimizing

1242

00:46:43,587 --> 00:46:45,707

environmental impacts and raising

1243

00:46:45,707 --> 00:46:48,832

more food and doing it

in this local way?"

1244

00:46:48,832 --> 00:46:50,417

In the developing world,

1245

00:46:50,417 --> 00:46:53,902

that means that more people

are going to get fed.

1246

00:46:53,902 --> 00:46:56,097

In the developed world,

1247

00:46:56,097 --> 00:47:00,147

it means that we all get to

be a little more healthy

1248

00:47:00,147 --> 00:47:01,917

because the quality of

1249

00:47:01,917 --> 00:47:04,592

the food that we're eating

is going to increase.

1250

00:47:04,592 --> 00:47:06,997

There's just this trend, I think,

1251

00:47:06,997 --> 00:47:08,887

right now where people are just

1252

00:47:08,887 --> 00:47:10,967

starting to apply

this technology to

1253

00:47:10,967 --> 00:47:16,047

these things that are parts

of human subsistence.

1254

00:47:16,047 --> 00:47:18,782

Here's the food,

clothing, shelter,

1255

00:47:18,782 --> 00:47:21,567

the things that all of

us need in order to

1256

00:47:21,567 --> 00:47:25,957

live a good quality life.

1257

00:47:25,957 --> 00:47:28,657

I think as I see these things and

1258

00:47:28,657 --> 00:47:31,317

I see the potential that AI has

1259

00:47:31,317 --> 00:47:36,677

to help everyone have access

to a high quality of life,

1260

00:47:36,677 --> 00:47:38,062

the more excited I get.

1261

00:47:38,062 --> 00:47:39,857

I think in some cases, it may be

1262

00:47:39,857 --> 00:47:43,027

the only way that you're able

to deliver these things at

1263

00:47:43,027 --> 00:47:44,842

scale to all of society

1264

00:47:44,842 --> 00:47:48,557

because some of them are just

really expensive right now.

1265

00:47:48,557 --> 00:47:52,637

No matter how you redistribute

the world's wealth,

1266

00:47:52,637 --> 00:47:55,527

you're not going to be able

to tend to the needs of

1267

00:47:55,527 --> 00:47:57,127

a growing population without

1268

00:47:57,127 --> 00:47:59,307

some sort of technological

intervention.

1269

00:47:59,307 --> 00:48:00,547

>> See, I thought you were

1270

00:48:00,547 --> 00:48:01,997

going to say something like, "Oh,

1271

00:48:01,997 --> 00:48:03,717

we're going to be able

to live in the world of

1272

00:48:03,717 --> 00:48:05,847

Tron Legacy or the

Matrix or whatever."

1273

00:48:05,847 --> 00:48:07,147

Instead, you get all

serious on me and

1274

00:48:07,147 --> 00:48:08,747

talk about all the

great things that in

1275

00:48:08,747 --> 00:48:10,147

the world changing awesome things

1276

00:48:10,147 --> 00:48:11,107

that are going to happen.

1277

00:48:11,107 --> 00:48:12,727

I'm going to live

in my fantasy but I

1278

00:48:12,727 --> 00:48:15,657

like that there are

very cool things happening.

1279

00:48:15,657 --> 00:48:16,157

>> I did

1280

00:48:16,157 --> 00:48:19,457

>> over my vacation read

"Ready Player One" and

1281

00:48:19,457 --> 00:48:23,757

despite its mild

dystopian overtones.

1282

00:48:23,757 --> 00:48:24,357

>> It's a great book.

I like the book.

1283

00:48:24,357 --> 00:48:25,377

>> That's a damn good book.

1284

00:48:25,377 --> 00:48:27,752

I was like, "I want

some of this."

1285

00:48:27,752 --> 00:48:29,217

>> I'm with you. I'm with you.

1286

00:48:29,217 --> 00:48:30,147

I was a little disappointed in

1287

00:48:30,147 --> 00:48:31,692

the movie but I loved the book.

1288

00:48:31,692 --> 00:48:34,002

Yeah. We can talk about

this offline but

1289

00:48:34,002 --> 00:48:36,642

we'll end this now.

1290

00:48:36,642 --> 00:48:37,192

>> Yeah.

1291

00:48:37,192 --> 00:48:38,677

>> Well, awesome Christina.

1292

00:48:38,677 --> 00:48:39,977

I look forward to chatting with

1293

00:48:39,977 --> 00:48:41,322

you again on the next episode.

1294

00:48:41,322 --> 00:48:43,042

>> Me too. I can't wait.

1295

00:48:43,042 --> 00:48:45,067

>> Next time on Behind the Tech,

1296

00:48:45,067 --> 00:48:46,447

we're going to talk

with Judy Estrin

1297

00:48:46,447 --> 00:48:48,302

who is a former CTO Cisco,

1298

00:48:48,302 --> 00:48:51,272

serial entrepreneur,

and as a Ph.D. student,

1299

00:48:51,272 --> 00:48:53,922

a member of the lab that

created the Internet protocols.

1300

00:48:53,922 --> 00:48:55,787

Hope you will join us. Be sure to

1301

00:48:55,787 --> 00:48:57,487

tell your friends

about our new podcast,

1302

00:48:57,487 --> 00:49:01,257

Behind the Tech, and to

subscribe. See you next time.