



**PROOF
THERE CAN
ONLY BE
ONE GOD**

**DAVID
WOLPERT**

PART TWO

1
00:00:03,970 --> 00:00:01,750
i think philosophy is almost by

2
00:00:05,430 --> 00:00:03,980
definition the most important

3
00:00:07,510 --> 00:00:05,440
[Music]

4
00:00:10,070 --> 00:00:07,520
intellectual endeavor there is but and

5
00:00:11,990 --> 00:00:10,080
this is being a real snide i

6
00:00:14,709 --> 00:00:12,000
don't the thing is really unfortunate

7
00:00:20,070 --> 00:00:14,719
people that actually engage in it

8
00:00:24,310 --> 00:00:21,910
this is part two of the conversation

9
00:00:25,830 --> 00:00:24,320
with the great david wallpark part one

10
00:00:27,349 --> 00:00:25,840
is in the description and i recommend

11
00:00:29,589 --> 00:00:27,359
that you watch that first in order to

12
00:00:31,429 --> 00:00:29,599
gain an overview of the professor's work

13
00:00:33,830 --> 00:00:31,439

in this podcast we cover what the

14

00:00:35,990 --> 00:00:33,840

definition of an observer is and we also

15

00:00:37,990 --> 00:00:36,000

cover many audience questions including

16

00:00:40,869 --> 00:00:38,000

those from the inventive and prolific

17

00:00:43,270 --> 00:00:40,879

chris langan carl fristen and neil seth

18

00:00:45,430 --> 00:00:43,280

and kevin knuth among others we also

19

00:00:46,709 --> 00:00:45,440

cover a topic virtually never touched on

20

00:00:48,229 --> 00:00:46,719

in the public discussion of the

21

00:00:50,069 --> 00:00:48,239

foundations of mathematics and

22

00:00:51,910 --> 00:00:50,079

philosophy called algorithmic

23

00:00:53,910 --> 00:00:51,920

information theory david believes that

24

00:00:55,910 --> 00:00:53,920

the only unquestionable results in

25

00:00:57,990 --> 00:00:55,920

philosophy are those found in

26

00:01:00,549 --> 00:00:58,000

algorithmic information theory so we

27

00:01:02,549 --> 00:01:00,559

perform a cursory examination of it

28

00:01:04,630 --> 00:01:02,559

lastly david makes a distinction between

29

00:01:06,789 --> 00:01:04,640

the what consciousness and the how

30

00:01:08,870 --> 00:01:06,799

consciousness personally i'm generally a

31

00:01:11,030 --> 00:01:08,880

fan of disambiguation and think that

32

00:01:12,469 --> 00:01:11,040

many philosophical problems exist

33

00:01:14,070 --> 00:01:12,479

because of a befuddlement of our

34

00:01:15,749 --> 00:01:14,080

conflicted language which later

35

00:01:17,270 --> 00:01:15,759

generations disembroil and then they

36

00:01:19,429 --> 00:01:17,280

think back and wonder why previous

37

00:01:20,950 --> 00:01:19,439

generations were so confused in fact

38

00:01:22,469 --> 00:01:20,960

john verveiki also separates

39

00:01:23,990 --> 00:01:22,479
consciousness into adjectival

40

00:01:25,910 --> 00:01:24,000
consciousness and adverbial

41

00:01:27,350 --> 00:01:25,920
consciousness click on the timestamp in

42

00:01:29,910 --> 00:01:27,360
the description if you'd like to skip

43

00:01:31,830 --> 00:01:29,920
this intro my name is kirchey mungle i'm

44

00:01:33,830 --> 00:01:31,840
a torontonian filmmaker with a

45

00:01:35,990 --> 00:01:33,840
background in mathematical physics

46

00:01:37,990 --> 00:01:36,000
dedicated to the explication of the

47

00:01:39,990 --> 00:01:38,000
variegated terrain of theories of

48

00:01:42,149 --> 00:01:40,000
everything from a theoretical physics

49

00:01:43,910 --> 00:01:42,159
perspective but as well as analyzing

50

00:01:45,990 --> 00:01:43,920
consciousness and seeing its potential

51
00:01:47,590 --> 00:01:46,000
connection to fundamental reality

52
00:01:49,429 --> 00:01:47,600
whatever that is essentially this

53
00:01:51,510 --> 00:01:49,439
channel is dedicated to exploring the

54
00:01:53,429 --> 00:01:51,520
underived nature of reality the

55
00:01:55,030 --> 00:01:53,439
constitutional laws that govern it

56
00:01:57,429 --> 00:01:55,040
provided those laws exist at all and are

57
00:01:59,350 --> 00:01:57,439
even noble to us if you enjoy witnessing

58
00:02:02,149 --> 00:01:59,360
and engaging with others on the topics

59
00:02:04,310 --> 00:02:02,159
of psychology consciousness physics etc

60
00:02:05,990 --> 00:02:04,320
the channel's themes then do consider

61
00:02:07,910 --> 00:02:06,000
going to the discord and the subreddit

62
00:02:09,669 --> 00:02:07,920
which are linked in the description

63
00:02:11,350 --> 00:02:09,679

there's also a link to the patreon that

64

00:02:13,190 --> 00:02:11,360

is patreon.com

65

00:02:15,190 --> 00:02:13,200

kirchheim uncle if you'd like to support

66

00:02:17,030 --> 00:02:15,200

this podcast as the patrons and the

67

00:02:19,510 --> 00:02:17,040

sponsors are the only reasons that i'm

68

00:02:21,430 --> 00:02:19,520

able to have podcasts of this quality

69

00:02:23,670 --> 00:02:21,440

and this depth given that i can do this

70

00:02:25,430 --> 00:02:23,680

now full time thanks to both the patrons

71

00:02:27,750 --> 00:02:25,440

and the sponsors support speaking of

72

00:02:29,750 --> 00:02:27,760

sponsors there are two the first sponsor

73

00:02:31,190 --> 00:02:29,760

is brilliant during the winter break i

74

00:02:32,949 --> 00:02:31,200

decided to brush up on some of the

75

00:02:35,110 --> 00:02:32,959

fundamentals of physics particularly

76

00:02:37,110 --> 00:02:35,120

with regard to information theory as i'd

77

00:02:38,710 --> 00:02:37,120

like to interview chiara marletto on

78

00:02:40,390 --> 00:02:38,720

constructor theory which is heavily

79

00:02:42,070 --> 00:02:40,400

based in information theory now

80

00:02:43,430 --> 00:02:42,080

information theory is predicated on

81

00:02:45,750 --> 00:02:43,440

entropy at least there's a fundamental

82

00:02:47,509 --> 00:02:45,760

formula for entropy so i ended up taking

83

00:02:49,589 --> 00:02:47,519

the brilliant course i challenged myself

84

00:02:51,589 --> 00:02:49,599

to do one lesson per day and i took the

85

00:02:53,830 --> 00:02:51,599

course's random variable distributions

86

00:02:55,509 --> 00:02:53,840

and knowledge slash uncertainty what i

87

00:02:57,270 --> 00:02:55,519

loved is that despite knowing the

88

00:02:59,430 --> 00:02:57,280

formula for entropy which is essentially

89
00:03:01,350 --> 00:02:59,440
hammered into you as an undergraduate it

90
00:03:03,270 --> 00:03:01,360
seems like it comes down from the sky

91
00:03:04,949 --> 00:03:03,280
arbitrarily and with brilliance for the

92
00:03:06,550 --> 00:03:04,959
first time i was able to see how the

93
00:03:08,869 --> 00:03:06,560
formula for entropy which you're seeing

94
00:03:10,550 --> 00:03:08,879
right now is actually extremely natural

95
00:03:12,550 --> 00:03:10,560
and it'd be strange to define it in any

96
00:03:14,229 --> 00:03:12,560
other manner there are plenty of courses

97
00:03:15,509 --> 00:03:14,239
and you can even learn group theory

98
00:03:16,869 --> 00:03:15,519
which is what's being referenced when

99
00:03:19,750 --> 00:03:16,879
you hear that the standard model is

100
00:03:21,430 --> 00:03:19,760
predicated on u_1 cross su_2 cross su_3

101
00:03:23,509 --> 00:03:21,440
those are league groups continuous lead

102
00:03:26,149 --> 00:03:23,519
groups visit brilliant.org

103
00:03:27,830 --> 00:03:26,159
toe t-o-e to get 20 off an annual

104
00:03:29,990 --> 00:03:27,840
subscription and i recommend that you

105
00:03:31,830 --> 00:03:30,000
don't stop before four lessons i think

106
00:03:33,589 --> 00:03:31,840
you'll be greatly surprised at the ease

107
00:03:35,430 --> 00:03:33,599
at which you can now comprehend subjects

108
00:03:38,149 --> 00:03:35,440
you previously had a difficult time

109
00:03:40,309 --> 00:03:38,159
grokking the second sponsor is algo now

110
00:03:42,309 --> 00:03:40,319
algo is an end-to-end supply chain

111
00:03:44,309 --> 00:03:42,319
optimization software company with

112
00:03:46,309 --> 00:03:44,319
software that helps business users

113
00:03:48,550 --> 00:03:46,319

optimize sales and operations planning

114

00:03:50,470 --> 00:03:48,560

to avoid stockouts reduce return and

115

00:03:52,789 --> 00:03:50,480

inventory write downs while reducing

116

00:03:55,990 --> 00:03:52,799

inventory investment it's a supply chain

117

00:03:58,070 --> 00:03:56,000

ai that drives smart roi headed by amjad

118

00:04:00,470 --> 00:03:58,080

hussein who's been a huge supporter of

119

00:04:03,509 --> 00:04:00,480

this podcast since near its inception in

120

00:04:05,350 --> 00:04:03,519

fact amjad has his own podcast on ai and

121

00:04:07,270 --> 00:04:05,360

consciousness and business growth and if

122

00:04:09,190 --> 00:04:07,280

you'd like to support the toe podcast

123

00:04:10,949 --> 00:04:09,200

then visit the link in the description

124

00:04:12,949 --> 00:04:10,959

to see amjad's podcast because

125

00:04:15,350 --> 00:04:12,959

subscribing to him or at least visiting

126

00:04:17,670 --> 00:04:15,360

supports the toe podcast indirectly

127

00:04:19,990 --> 00:04:17,680

thank you and enjoy professor why don't

128

00:04:22,790 --> 00:04:20,000

you explain what laplace's demon is and

129

00:04:25,430 --> 00:04:22,800

then why there's an impossibility result

130

00:04:26,550 --> 00:04:25,440

about the existence of laplace's demon

131

00:04:29,350 --> 00:04:26,560

okay

132

00:04:32,150 --> 00:04:29,360

um not surprisingly um laplace's demon

133

00:04:34,870 --> 00:04:32,160

is named for a simone laplace

134

00:04:37,909 --> 00:04:34,880

um worked towards the end of the 18th

135

00:04:39,749 --> 00:04:37,919

century mostly the early 19th century

136

00:04:42,710 --> 00:04:39,759

he was among other things the first

137

00:04:45,110 --> 00:04:42,720

person to really use bayesian statistics

138

00:04:48,230 --> 00:04:45,120

he applied it to planetary motion

139

00:04:49,110 --> 00:04:48,240

to try to infer what the actual um true

140

00:04:54,150 --> 00:04:49,120

or

141

00:04:56,870 --> 00:04:54,160

parameters of the motion the planets is

142

00:04:59,430 --> 00:04:56,880

um a whole bunch of um uh

143

00:05:02,150 --> 00:04:59,440

mathematics um that we use that um

144

00:05:04,150 --> 00:05:02,160

undergraduates will be using in um uh

145

00:05:05,830 --> 00:05:04,160

the physics and math majors and so on

146

00:05:07,350 --> 00:05:05,840

has his name involved so he's a very

147

00:05:11,029 --> 00:05:07,360

very bright guy

148

00:05:13,110 --> 00:05:11,039

now he was um working at a time when

149

00:05:16,230 --> 00:05:13,120

people thought that everything was

150

00:05:18,070 --> 00:05:16,240

ultimately newtonian classical physics

151
00:05:19,909 --> 00:05:18,080
well before relativity well before

152
00:05:20,870 --> 00:05:19,919
quantum mechanics

153
00:05:21,670 --> 00:05:20,880
and

154
00:05:25,029 --> 00:05:21,680
he

155
00:05:28,230 --> 00:05:25,039
realized that in that paradigm

156
00:05:29,749 --> 00:05:28,240
if you give a um a brilliant scientist

157
00:05:32,469 --> 00:05:29,759
or a demon

158
00:05:34,310 --> 00:05:32,479
sufficient information about these state

159
00:05:36,710 --> 00:05:34,320
of the world at present

160
00:05:38,469 --> 00:05:36,720
they can predict exactly what the state

161
00:05:41,749 --> 00:05:38,479
of the world would be in all of its

162
00:05:44,550 --> 00:05:41,759
details arbitrarily far into the future

163
00:05:46,390 --> 00:05:44,560

um and this was true before

164

00:05:49,350 --> 00:05:46,400

not only many notions of quantum

165

00:05:51,270 --> 00:05:49,360

mechanics or relativity but also before

166

00:05:54,629 --> 00:05:51,280

people knew about chaos or any of the

167

00:05:56,950 --> 00:05:54,639

other kinds of phenomena that have been

168

00:05:59,110 --> 00:05:56,960

uncovered in the 20th century that might

169

00:06:00,629 --> 00:05:59,120

make one think that apostles demon can't

170

00:06:01,909 --> 00:06:00,639

quite hold

171

00:06:04,870 --> 00:06:01,919

um

172

00:06:06,950 --> 00:06:04,880

so that's his demon one

173

00:06:08,550 --> 00:06:06,960

the work that i've been involved with on

174

00:06:10,790 --> 00:06:08,560

inference devices

175

00:06:13,510 --> 00:06:10,800

one of the it's almost kind of a trivial

176

00:06:15,350 --> 00:06:13,520

but one of the kinds of things that it

177

00:06:18,070 --> 00:06:15,360

uncovers

178

00:06:21,430 --> 00:06:18,080

is that regardless of what actually the

179

00:06:22,790 --> 00:06:21,440

laws of physics are um regardless of

180

00:06:24,390 --> 00:06:22,800

whether it's got anything to do with

181

00:06:27,029 --> 00:06:24,400

what's currently called the standard

182

00:06:28,870 --> 00:06:27,039

model whether it's quantum physics

183

00:06:30,710 --> 00:06:28,880

um whether it's classical physics it

184

00:06:33,990 --> 00:06:30,720

could have been newtonian it could have

185

00:06:35,670 --> 00:06:34,000

been newtonian where there was no chaos

186

00:06:38,230 --> 00:06:35,680

it could have been exactly the paradigm

187

00:06:41,110 --> 00:06:38,240

that um laplace was thinking in

188

00:06:42,870 --> 00:06:41,120

but even given that kind of a

189

00:06:44,950 --> 00:06:42,880

hypothesis

190

00:06:46,870 --> 00:06:44,960

his demon could not exist there's a

191

00:06:49,589 --> 00:06:46,880

logical fallacy

192

00:06:52,309 --> 00:06:49,599

embedded in the very notion

193

00:06:55,029 --> 00:06:52,319

and that is actually intuitively it's

194

00:06:56,469 --> 00:06:55,039

quite simple you can set it up in terms

195

00:06:58,230 --> 00:06:56,479

of um

196

00:07:01,270 --> 00:06:58,240

what sometimes called a cretin's liars

197

00:07:02,950 --> 00:07:01,280

paradox some people say

198

00:07:05,350 --> 00:07:02,960

pepa amenities

199

00:07:07,589 --> 00:07:05,360

was the person who first wrote it down

200

00:07:09,110 --> 00:07:07,599

others say it actually um has earlier

201
00:07:11,270 --> 00:07:09,120
roots still

202
00:07:13,110 --> 00:07:11,280
but um basically you can set it up in

203
00:07:16,550 --> 00:07:13,120
such a way that

204
00:07:18,550 --> 00:07:16,560
they're um even in a classical universe

205
00:07:21,589 --> 00:07:18,560
where it's a finite one even let's make

206
00:07:24,469 --> 00:07:21,599
it be finite with no chaos

207
00:07:26,950 --> 00:07:24,479
you can very easily um construct

208
00:07:28,950 --> 00:07:26,960
possible questions concerning the future

209
00:07:31,430 --> 00:07:28,960
state of that universe

210
00:07:33,029 --> 00:07:31,440
that laplace could not possibly get

211
00:07:35,270 --> 00:07:33,039
correct

212
00:07:37,990 --> 00:07:35,280
by definition whatever his prediction is

213
00:07:40,070 --> 00:07:38,000

it would be exactly wrong

214

00:07:42,390 --> 00:07:40,080

precisely because applause is part of

215

00:07:44,550 --> 00:07:42,400

the universe that is the key

216

00:07:46,869 --> 00:07:44,560

um so it's not too hard to convince

217

00:07:48,469 --> 00:07:46,879

yourself of why that might be true

218

00:07:51,110 --> 00:07:48,479

and um

219

00:07:52,230 --> 00:07:51,120

we can work through the details if you

220

00:07:54,070 --> 00:07:52,240

want

221

00:07:56,950 --> 00:07:54,080

i don't know how you might actually get

222

00:07:58,710 --> 00:07:56,960

this out to your audience

223

00:08:00,869 --> 00:07:58,720

but um there's

224

00:08:02,950 --> 00:08:00,879

um some work

225

00:08:04,309 --> 00:08:02,960

i can show a slide later you can just

226

00:08:08,469 --> 00:08:04,319

send me those

227

00:08:11,430 --> 00:08:08,479

yeah maybe we can do that later um

228

00:08:13,430 --> 00:08:11,440

yeah let's get to all that later um

229

00:08:16,070 --> 00:08:13,440

so in any case the um

230

00:08:18,629 --> 00:08:16,080

so that is part of a general inference

231

00:08:21,670 --> 00:08:18,639

devices really grew out of

232

00:08:23,589 --> 00:08:21,680

the desire to quantify and build a

233

00:08:26,309 --> 00:08:23,599

formal structure

234

00:08:28,230 --> 00:08:26,319

that goes beyond this impossibility

235

00:08:30,550 --> 00:08:28,240

argument of the possible demon which by

236

00:08:32,550 --> 00:08:30,560

the way i have not actually proven it to

237

00:08:34,550 --> 00:08:32,560

you but certainly not in the generality

238

00:08:36,790 --> 00:08:34,560

that i stated it about how it's

239

00:08:38,389 --> 00:08:36,800

impossible where it doesn't depend on

240

00:08:40,870 --> 00:08:38,399

the laws of physics

241

00:08:43,190 --> 00:08:40,880

so what inference devices is about that

242

00:08:45,509 --> 00:08:43,200

whole formalism

243

00:08:48,790 --> 00:08:45,519

at root what it says when it first

244

00:08:55,190 --> 00:08:48,800

notices is that um

245

00:08:59,829 --> 00:08:57,190

attribute of reality

246

00:09:01,990 --> 00:08:59,839

that most card carrying physicists

247

00:09:03,910 --> 00:09:02,000

certainly cosmologists

248

00:09:05,670 --> 00:09:03,920

would ascribe to

249

00:09:08,870 --> 00:09:05,680

independent of the detailed physical

250

00:09:11,590 --> 00:09:08,880

theory which is that the um human beings

251
00:09:13,990 --> 00:09:11,600
themselves are physical systems

252
00:09:16,550 --> 00:09:14,000
so this is so it's really a perspective

253
00:09:17,990 --> 00:09:16,560
that turns conventional philosophy on

254
00:09:19,430 --> 00:09:18,000
its head

255
00:09:21,670 --> 00:09:19,440
in that

256
00:09:23,190 --> 00:09:21,680
rather than try to understand what

257
00:09:25,750 --> 00:09:23,200
various

258
00:09:28,310 --> 00:09:25,760
um what our scientific theories might be

259
00:09:31,509 --> 00:09:28,320
um in terms of well are we just

260
00:09:32,949 --> 00:09:31,519
discovering the external reality or like

261
00:09:35,750 --> 00:09:32,959
an instrumentalist would say we're

262
00:09:37,829 --> 00:09:35,760
discovering useful variables for making

263
00:09:39,030 --> 00:09:37,839

predictions about the external reality

264

00:09:42,389 --> 00:09:39,040

and so on

265

00:09:44,470 --> 00:09:42,399

instead to practicing physicists as i

266

00:09:46,389 --> 00:09:44,480

said especially those who deal with for

267

00:09:47,509 --> 00:09:46,399

example cosmology

268

00:09:49,829 --> 00:09:47,519

rather

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00:09:52,949 --> 00:09:49,839

physical reality is the starting point

270

00:09:55,269 --> 00:09:52,959

and then you derive human beings

271

00:09:57,110 --> 00:09:55,279

as an approximation to some of the

272

00:09:58,949 --> 00:09:57,120

equations and physics of that of the

273

00:10:00,870 --> 00:09:58,959

actual true world

274

00:10:01,990 --> 00:10:00,880

so to whatever degree

275

00:10:04,630 --> 00:10:02,000

those

276

00:10:06,949 --> 00:10:04,640

epi phenomena of human beings

277

00:10:08,310 --> 00:10:06,959

can themselves make accurate theories

278

00:10:10,470 --> 00:10:08,320

about this physical system they're

279

00:10:13,430 --> 00:10:10,480

embedded with that's a secondary

280

00:10:15,750 --> 00:10:13,440

question so rather than starting from

281

00:10:17,590 --> 00:10:15,760

the perspective of humans

282

00:10:19,190 --> 00:10:17,600

saying what um

283

00:10:21,910 --> 00:10:19,200

what is it that we're talking about when

284

00:10:24,150 --> 00:10:21,920

we talk about science how does it relate

285

00:10:26,069 --> 00:10:24,160

to the external reality

286

00:10:28,710 --> 00:10:26,079

the physicists make that be a very very

287

00:10:31,030 --> 00:10:28,720

secondary minor question saying let's

288

00:10:32,949 --> 00:10:31,040

start with the physical reality

289

00:10:34,790 --> 00:10:32,959

then human beings are just one of the

290

00:10:37,190 --> 00:10:34,800

phenomena in that physical reality that

291

00:10:39,030 --> 00:10:37,200

we can describe completely and if we

292

00:10:39,990 --> 00:10:39,040

wanted to we could drill down into even

293

00:10:41,590 --> 00:10:40,000

more

294

00:10:44,150 --> 00:10:41,600

my minute

295

00:10:45,670 --> 00:10:44,160

semi-trivial questions like well some of

296

00:10:47,590 --> 00:10:45,680

those human beings they call themselves

297

00:10:49,590 --> 00:10:47,600

philosophers of science

298

00:10:51,269 --> 00:10:49,600

and they're looking at these various

299

00:10:53,190 --> 00:10:51,279

things that other human beings called

300

00:10:54,710 --> 00:10:53,200

scientists that come up with

301
00:10:56,630 --> 00:10:54,720
and they're trying to worry about how

302
00:10:59,030 --> 00:10:56,640
they might relate to this underlying

303
00:11:00,710 --> 00:10:59,040
physical reality and yet that's all well

304
00:11:03,430 --> 00:11:00,720
and good but it's

305
00:11:04,230 --> 00:11:03,440
very very secondary to the presumption

306
00:11:05,990 --> 00:11:04,240
that

307
00:11:08,150 --> 00:11:06,000
physical reality is just the set of

308
00:11:09,350 --> 00:11:08,160
mathematical questions and we humans and

309
00:11:11,590 --> 00:11:09,360
all of our

310
00:11:13,269 --> 00:11:11,600
conundrums are just something that comes

311
00:11:17,670 --> 00:11:13,279
out from it

312
00:11:20,230 --> 00:11:17,680
so if you adopt that perspective

313
00:11:23,829 --> 00:11:20,240

then you can go very very

314

00:11:25,509 --> 00:11:23,839

broad scale on some of the issues that

315

00:11:27,030 --> 00:11:25,519

are addressed in philosophy of science

316

00:11:29,269 --> 00:11:27,040

and associate branches of philosophy

317

00:11:31,269 --> 00:11:29,279

called epistemology

318

00:11:33,110 --> 00:11:31,279

you can say

319

00:11:35,350 --> 00:11:33,120

given any agent doesn't have to be a

320

00:11:38,870 --> 00:11:35,360

human being that is

321

00:11:41,910 --> 00:11:38,880

situated in that physical reality

322

00:11:44,790 --> 00:11:41,920

so the states of its brain are simply a

323

00:11:47,910 --> 00:11:44,800

subset of they only

324

00:11:51,590 --> 00:11:47,920

how to phrase it so the physical reality

325

00:11:54,550 --> 00:11:51,600

to allow it to have any kinds of laws

326

00:11:56,870 --> 00:11:54,560

we will reduce it to a set which is the

327

00:11:59,829 --> 00:11:56,880

set of all possible

328

00:12:01,670 --> 00:11:59,839

histories of reality through all time

329

00:12:02,949 --> 00:12:01,680

what is called a world line in

330

00:12:03,750 --> 00:12:02,959

relativity

331

00:12:04,949 --> 00:12:03,760

so

332

00:12:07,269 --> 00:12:04,959

um

333

00:12:10,470 --> 00:12:07,279

there's going to be one world line

334

00:12:12,389 --> 00:12:10,480

in which you kurt are wearing a um a red

335

00:12:13,910 --> 00:12:12,399

off-reddish jacket

336

00:12:15,190 --> 00:12:13,920

there's another world line that would be

337

00:12:17,190 --> 00:12:15,200

the same laws of physics but it's

338

00:12:18,790 --> 00:12:17,200

another element in the set in which

339

00:12:20,550 --> 00:12:18,800

you're right now wearing instead of more

340

00:12:22,949 --> 00:12:20,560

brownish jacket

341

00:12:25,110 --> 00:12:22,959

these are both world lines

342

00:12:28,389 --> 00:12:25,120

that are elements of the set of all

343

00:12:30,389 --> 00:12:28,399

possible world line histories

344

00:12:33,269 --> 00:12:30,399

so if i then look at the particular

345

00:12:35,110 --> 00:12:33,279

world line in which kurt is sitting in

346

00:12:37,350 --> 00:12:35,120

that so if i look at the particular

347

00:12:39,509 --> 00:12:37,360

event that curt is right now

348

00:12:41,829 --> 00:12:39,519

sitting in that chair

349

00:12:43,829 --> 00:12:41,839

that actually selects out a subset of

350

00:12:45,190 --> 00:12:43,839

all possible world lines

351

00:12:46,310 --> 00:12:45,200

there will be some in which you are

352

00:12:47,350 --> 00:12:46,320

sitting in that chair and someone which

353

00:12:50,069 --> 00:12:47,360

you are not

354

00:12:52,310 --> 00:12:50,079

so that event is really just a subset of

355

00:12:54,310 --> 00:12:52,320

the set of all possible world lines of

356

00:12:55,990 --> 00:12:54,320

the universe

357

00:12:58,710 --> 00:12:56,000

in addition

358

00:13:00,790 --> 00:12:58,720

the um event where you pose to yourself

359

00:13:03,350 --> 00:13:00,800

a question like

360

00:13:05,910 --> 00:13:03,360

what happens when um two bodies are

361

00:13:07,509 --> 00:13:05,920

gravitationally attracted to one another

362

00:13:09,350 --> 00:13:07,519

and have the following masses of

363

00:13:11,110 --> 00:13:09,360

momentum come within a certain distance

364

00:13:13,269 --> 00:13:11,120

of one another

365

00:13:14,870 --> 00:13:13,279

the set of realities in which you pose

366

00:13:18,310 --> 00:13:14,880

that question

367

00:13:20,629 --> 00:13:18,320

is a subset of all possible world lines

368

00:13:22,470 --> 00:13:20,639

the set of realities in which you give a

369

00:13:23,590 --> 00:13:22,480

possible particular answer to that

370

00:13:26,310 --> 00:13:23,600

question

371

00:13:29,269 --> 00:13:26,320

is another subset

372

00:13:31,430 --> 00:13:29,279

and also we can presume that the set of

373

00:13:32,870 --> 00:13:31,440

physical realities in which your answer

374

00:13:35,110 --> 00:13:32,880

is correct

375

00:13:37,910 --> 00:13:35,120

and which your answer is wrong

376

00:13:40,790 --> 00:13:37,920

are yet other subsets

377

00:13:42,550 --> 00:13:40,800

so what this sets up so to speak

378

00:13:45,750 --> 00:13:42,560

um is that there's a relationship

379

00:13:47,350 --> 00:13:45,760

between these sets where one subset of

380

00:13:48,550 --> 00:13:47,360

all the realities where you pose a

381

00:13:50,150 --> 00:13:48,560

question

382

00:13:52,790 --> 00:13:50,160

another one is where you give a

383

00:13:55,189 --> 00:13:52,800

particular answer both of which are just

384

00:13:57,030 --> 00:13:55,199

physical states of your brain and then

385

00:13:58,230 --> 00:13:57,040

there's a third one which has to do with

386

00:13:59,990 --> 00:13:58,240

the actual

387

00:14:02,150 --> 00:14:00,000

physical system you are asking this

388

00:14:05,350 --> 00:14:02,160

question about

389

00:14:07,189 --> 00:14:05,360

the answer to your question may in some

390

00:14:09,430 --> 00:14:07,199

of those describe that physical system

391

00:14:11,110 --> 00:14:09,440

accurately and they may do it

392

00:14:12,870 --> 00:14:11,120

inaccurately they might be wrong in

393

00:14:15,110 --> 00:14:12,880

other words

394

00:14:17,670 --> 00:14:15,120

it turns out that just by making that

395

00:14:20,069 --> 00:14:17,680

decomposition that everything about you

396

00:14:23,189 --> 00:14:20,079

are making a prediction

397

00:14:25,030 --> 00:14:23,199

is involves questions answers and truths

398

00:14:27,269 --> 00:14:25,040

we can also say everything about your

399

00:14:28,470 --> 00:14:27,279

making an observation you are right now

400

00:14:29,670 --> 00:14:28,480

observing

401
00:14:31,350 --> 00:14:29,680
something

402
00:14:33,590 --> 00:14:31,360
which you can be then posing a question

403
00:14:35,430 --> 00:14:33,600
to yourself what am i observing

404
00:14:37,750 --> 00:14:35,440
you can then have an answer to that what

405
00:14:39,509 --> 00:14:37,760
am i um what do i think in response to

406
00:14:41,269 --> 00:14:39,519
that question

407
00:14:43,269 --> 00:14:41,279
and then it can be the actual truth and

408
00:14:45,509 --> 00:14:43,279
these again are just three subsets of

409
00:14:48,629 --> 00:14:45,519
all possible world lines

410
00:14:50,310 --> 00:14:48,639
whether your observation is correct or

411
00:14:52,230 --> 00:14:50,320
is distorted

412
00:14:54,470 --> 00:14:52,240
will be determined by the overlap

413
00:14:56,710 --> 00:14:54,480

between these world lines

414

00:14:58,790 --> 00:14:56,720
so everything you observe

415

00:15:00,470 --> 00:14:58,800
everything you predict

416

00:15:02,310 --> 00:15:00,480
everything that you remember which is

417

00:15:04,069 --> 00:15:02,320
another example of this

418

00:15:06,790 --> 00:15:04,079
everything you could control you could

419

00:15:08,069 --> 00:15:06,800
reach out your hand and try to be having

420

00:15:10,790 --> 00:15:08,079
the question

421

00:15:12,550 --> 00:15:10,800
where is this pencil going to be

422

00:15:14,470 --> 00:15:12,560
one minute from now and you are making

423

00:15:16,150 --> 00:15:14,480
it so

424

00:15:18,230 --> 00:15:16,160
anything in this most broad sense

425

00:15:20,310 --> 00:15:18,240
imaginable of what um in philosophy is

426

00:15:21,509 --> 00:15:20,320

called epistemology of you of your

427

00:15:24,310 --> 00:15:21,519

knowledge

428

00:15:26,069 --> 00:15:24,320

about this world about whether your

429

00:15:27,750 --> 00:15:26,079

knowledge could be correct or could be

430

00:15:30,629 --> 00:15:27,760

or wrong

431

00:15:32,949 --> 00:15:30,639

we can reduce all analysis of it

432

00:15:35,110 --> 00:15:32,959

to saying how is it that these three

433

00:15:38,069 --> 00:15:35,120

subsets

434

00:15:40,470 --> 00:15:38,079

relate to one another

435

00:15:43,990 --> 00:15:40,480

based upon that so notice that this

436

00:15:46,069 --> 00:15:44,000

level of formalism we're far beyond any

437

00:15:47,670 --> 00:15:46,079

specifics like is it a universe where

438

00:15:49,910 --> 00:15:47,680

quantum mechanics holds or classical

439

00:15:52,790 --> 00:15:49,920

mechanics hold the universe could be

440

00:15:54,629 --> 00:15:52,800

finite the universe could not have chaos

441

00:15:57,030 --> 00:15:54,639

on it it doesn't matter

442

00:15:58,310 --> 00:15:57,040

nor does it matter how you are

443

00:16:00,470 --> 00:15:58,320

making your

444

00:16:02,550 --> 00:16:00,480

questions and answers whether it be by

445

00:16:05,189 --> 00:16:02,560

prediction predicting whether the sun

446

00:16:06,230 --> 00:16:05,199

will come up tomorrow or um what's going

447

00:16:08,710 --> 00:16:06,240

to be happening with those two

448

00:16:11,030 --> 00:16:08,720

gravitation gravitating bodies i

449

00:16:14,949 --> 00:16:11,040

alluded to before or if it comes via

450

00:16:18,150 --> 00:16:14,959

observation or even memory

451
00:16:21,269 --> 00:16:18,160
or directly control any form of these is

452
00:16:23,829 --> 00:16:21,279
being covered by the structure of three

453
00:16:26,550 --> 00:16:23,839
overlapping subsets

454
00:16:29,110 --> 00:16:26,560
it turns out that once you do that that

455
00:16:31,829 --> 00:16:29,120
all that is needed is that

456
00:16:33,670 --> 00:16:31,839
formalism of three overlapping subsets

457
00:16:36,069 --> 00:16:33,680
that you can get a whole bunch of

458
00:16:38,629 --> 00:16:36,079
impossibility results

459
00:16:39,829 --> 00:16:38,639
and one of them to return to the point

460
00:16:41,350 --> 00:16:39,839
that you were raising before has to do

461
00:16:43,749 --> 00:16:41,360
with the apostles demon

462
00:16:46,870 --> 00:16:43,759
you can say that laplace

463
00:16:48,629 --> 00:16:46,880

is somebody asking a question

464

00:16:53,910 --> 00:16:48,639

we can say that what that question

465

00:16:57,269 --> 00:16:53,920

involves is his future answer itself

466

00:16:59,430 --> 00:16:57,279

then there can be the answer he gives

467

00:17:02,069 --> 00:16:59,440

and there can be reality and if

468

00:17:04,789 --> 00:17:02,079

basically if laplace's questions of the

469

00:17:06,390 --> 00:17:04,799

form will i not be thinking that the

470

00:17:09,029 --> 00:17:06,400

answer is yes

471

00:17:11,270 --> 00:17:09,039

one second from now

472

00:17:14,069 --> 00:17:11,280

whatever answer he gives now you can set

473

00:17:15,350 --> 00:17:14,079

up in such a way that his answer to his

474

00:17:17,270 --> 00:17:15,360

question will actually be the opposite

475

00:17:19,110 --> 00:17:17,280

of the truth

476

00:17:21,669 --> 00:17:19,120

and it doesn't matter what kind of a

477

00:17:23,909 --> 00:17:21,679

system he uses to make that future

478

00:17:25,990 --> 00:17:23,919

prediction it doesn't matter if the

479

00:17:28,870 --> 00:17:26,000

paradigm in which he was working of

480

00:17:30,230 --> 00:17:28,880

classical non-chaotic finite physics was

481

00:17:31,270 --> 00:17:30,240

correct

482

00:17:36,470 --> 00:17:31,280

his

483

00:17:38,549 --> 00:17:36,480

sense going to be wrong he has a demon

484

00:17:40,470 --> 00:17:38,559

will be wrong and there will still be

485

00:17:42,070 --> 00:17:40,480

instances of such

486

00:17:44,710 --> 00:17:42,080

erroneousness

487

00:17:46,070 --> 00:17:44,720

even if he builds a

488

00:17:47,590 --> 00:17:46,080

demon that goes off and makes the

489

00:17:50,070 --> 00:17:47,600

prediction on his behalf so if it's not

490

00:17:52,390 --> 00:17:50,080

laplace's demon it's not the plus is the

491

00:17:53,750 --> 00:17:52,400

demon he makes it even the same kind of

492

00:17:55,590 --> 00:17:53,760

thing goes through

493

00:17:58,070 --> 00:17:55,600

so that's the way that we can actually

494

00:17:59,190 --> 00:17:58,080

formalize the very simple notion of

495

00:18:02,310 --> 00:17:59,200

laplace

496

00:18:03,990 --> 00:18:02,320

this says demon is a flawed concept in

497

00:18:05,830 --> 00:18:04,000

its very

498

00:18:08,630 --> 00:18:05,840

presumption it's very structured

499

00:18:10,549 --> 00:18:08,640

independent of the rules of reality

500

00:18:12,830 --> 00:18:10,559

in such a way that actually allows us to

501
00:18:16,630 --> 00:18:12,840
then derive things like the monotheism

502
00:18:20,310 --> 00:18:16,640
theorem and the deism theorem and these

503
00:18:22,870 --> 00:18:20,320
other things about how many omnipotent

504
00:18:24,950 --> 00:18:22,880
entities might a physical reality have

505
00:18:26,710 --> 00:18:24,960
independent of the laws of physics it

506
00:18:28,549 --> 00:18:26,720
sounds like what you said is that there

507
00:18:31,110 --> 00:18:28,559
exists a question such that he will

508
00:18:32,789 --> 00:18:31,120
necessarily be incorrect so when i was

509
00:18:34,310 --> 00:18:32,799
first reading about this i thought that

510
00:18:36,310 --> 00:18:34,320
it was going to go along the lines of

511
00:18:38,789 --> 00:18:36,320
there exists configurations of physical

512
00:18:40,710 --> 00:18:38,799
space such that he won't necessarily be

513
00:18:42,310 --> 00:18:40,720

correct but you're saying no there's a

514

00:18:45,270 --> 00:18:42,320

question such that he will necessarily

515

00:18:47,350 --> 00:18:45,280

be wrong no matter what no matter what

516

00:18:50,549 --> 00:18:47,360

question answer pair

517

00:18:52,549 --> 00:18:50,559

he comes up with it will be wrong if it

518

00:18:54,870 --> 00:18:52,559

is supposed to be related to physical

519

00:18:57,590 --> 00:18:54,880

reality remember there are three things

520

00:19:00,230 --> 00:18:57,600

there's your question your answer and

521

00:19:02,549 --> 00:19:00,240

then whatever the truth of the matter is

522

00:19:05,510 --> 00:19:02,559

and so there are ways of setting up that

523

00:19:07,430 --> 00:19:05,520

though that triple i say i see so

524

00:19:09,750 --> 00:19:07,440

we can be guaranteed

525

00:19:11,510 --> 00:19:09,760

that um if that question answer in

526
00:19:15,350 --> 00:19:11,520
reality is supposed to be something that

527
00:19:17,669 --> 00:19:15,360
concerns the future state of his brain

528
00:19:18,789 --> 00:19:17,679
then um no matter what the details are

529
00:19:21,830 --> 00:19:18,799
we can always

530
00:19:22,950 --> 00:19:21,840
set up a question in such a way that the

531
00:19:24,950 --> 00:19:22,960
answer

532
00:19:27,430 --> 00:19:24,960
will not actually be the same thing as

533
00:19:29,510 --> 00:19:27,440
reality says but will be the opposite

534
00:19:32,470 --> 00:19:29,520
question when you stated it it reminded

535
00:19:34,630 --> 00:19:32,480
me of the liar's paradox or gerda

536
00:19:37,350 --> 00:19:34,640
have you found any impossibility results

537
00:19:39,669 --> 00:19:37,360
that are on more trivial questions when

538
00:19:42,150 --> 00:19:39,679

i say trivial i mean recall back in the

539

00:19:44,230 --> 00:19:42,160

early 1900s when girdle came up with

540

00:19:45,270 --> 00:19:44,240

this some mathematicians said sure in

541

00:19:47,350 --> 00:19:45,280

some

542

00:19:49,270 --> 00:19:47,360

special cases there exist statements

543

00:19:51,190 --> 00:19:49,280

that you can't prove but it's not like

544

00:19:52,630 --> 00:19:51,200

those are useful statements or

545

00:19:55,110 --> 00:19:52,640

statements that we talk about they're

546

00:19:56,390 --> 00:19:55,120

incredibly contrived statements that was

547

00:19:58,310 --> 00:19:56,400

a critique back at the time it's no

548

00:20:00,630 --> 00:19:58,320

longer critique but i'm wondering so is

549

00:20:02,789 --> 00:20:00,640

your impossibility result does it cover

550

00:20:03,590 --> 00:20:02,799

those non-trivial statements sorry those

551
00:20:05,510 --> 00:20:03,600
two

552
00:20:06,789 --> 00:20:05,520
this particular one about the process

553
00:20:08,870 --> 00:20:06,799
demon

554
00:20:11,270 --> 00:20:08,880
i would say is one of the more of the

555
00:20:12,630 --> 00:20:11,280
trivial ones here's a more interesting

556
00:20:13,230 --> 00:20:12,640
one

557
00:20:14,630 --> 00:20:13,240
um

558
00:20:16,789 --> 00:20:14,640
[Music]

559
00:20:18,310 --> 00:20:16,799
and i'm going to state it in very loaded

560
00:20:20,310 --> 00:20:18,320
language what we were discussing in the

561
00:20:21,990 --> 00:20:20,320
previous podcast about you should not

562
00:20:23,669 --> 00:20:22,000
use terms

563
00:20:25,510 --> 00:20:23,679

afterwards you and i had this um back

564

00:20:28,549 --> 00:20:25,520

and forth where it's called the uh

565

00:20:30,710 --> 00:20:28,559

persuasion um definition that i guess

566

00:20:33,510 --> 00:20:30,720

where you define something some way in a

567

00:20:35,190 --> 00:20:33,520

particular way so you know that you can

568

00:20:36,470 --> 00:20:35,200

you define out of it everything that

569

00:20:38,390 --> 00:20:36,480

makes it interesting the first place but

570

00:20:41,190 --> 00:20:38,400

be that resume this is actually not

571

00:20:45,029 --> 00:20:41,200

completely an exercise of that but

572

00:20:47,350 --> 00:20:45,039

so let's define an inference device

573

00:20:49,270 --> 00:20:47,360

as a question answer pair so you are an

574

00:20:50,789 --> 00:20:49,280

inference device a computer can be an

575

00:20:52,710 --> 00:20:50,799

inference device

576

00:20:55,190 --> 00:20:52,720

um my dog

577

00:20:57,110 --> 00:20:55,200

whose name is choco and he's the most um

578

00:20:58,710 --> 00:20:57,120

amazing dog in the universe

579

00:21:00,390 --> 00:20:58,720

i'm just to make sure that people are

580

00:21:02,470 --> 00:21:00,400

aware of that is that a true fact is

581

00:21:04,070 --> 00:21:02,480

that true you have a dog named taco yeah

582

00:21:05,510 --> 00:21:04,080

i named him choco he looks somewhat like

583

00:21:06,310 --> 00:21:05,520

the canyon

584

00:21:08,390 --> 00:21:06,320

um

585

00:21:10,549 --> 00:21:08,400

he's a good a mutt somewhere off the

586

00:21:11,909 --> 00:21:10,559

streets of l.a

587

00:21:13,590 --> 00:21:11,919

he's got a bunch of long-haired

588

00:21:15,190 --> 00:21:13,600

chihuahua in him and other things and he

589

00:21:18,470 --> 00:21:15,200

is

590

00:21:21,029 --> 00:21:18,480

sterilized

591

00:21:23,830 --> 00:21:21,039

because he is so gentle he's so good

592

00:21:26,230 --> 00:21:23,840

with people and he is so smart

593

00:21:28,549 --> 00:21:26,240

i never trained him to do anything um

594

00:21:30,070 --> 00:21:28,559

but he just can tell by my tone of voice

595

00:21:31,590 --> 00:21:30,080

he took after the gentle and smart

596

00:21:33,669 --> 00:21:31,600

nature of his owner

597

00:21:35,669 --> 00:21:33,679

oh don't i wish i could say that and

598

00:21:37,590 --> 00:21:35,679

rather everything that i treat my

599

00:21:40,070 --> 00:21:37,600

deepest wisdom about life all of it i

600

00:21:41,909 --> 00:21:40,080

learned by watching him say no don't be

601
00:21:44,230 --> 00:21:41,919
more like him but then you'll be able to

602
00:21:47,430 --> 00:21:44,240
get through this as well um but in any

603
00:21:49,909 --> 00:21:47,440
case these are all inference devices

604
00:21:51,750 --> 00:21:49,919
so you can say that well some inference

605
00:21:53,750 --> 00:21:51,760
devices let's

606
00:21:55,510 --> 00:21:53,760
um and different inference devices are

607
00:21:58,230 --> 00:21:55,520
going to be able to make correct

608
00:21:59,909 --> 00:21:58,240
inferences about different things

609
00:22:01,350 --> 00:21:59,919
um we have this problem of them trying

610
00:22:03,669 --> 00:22:01,360
to make these inferences about

611
00:22:05,750 --> 00:22:03,679
themselves um my

612
00:22:08,390 --> 00:22:05,760
flyers paradox um apply to

613
00:22:10,230 --> 00:22:08,400

themselves but that but let's we can

614

00:22:14,070 --> 00:22:10,240

assume that they can make um good

615

00:22:16,230 --> 00:22:14,080

inferences about almost everything else

616

00:22:17,909 --> 00:22:16,240

but and and notice that the notion of an

617

00:22:19,590 --> 00:22:17,919

inference device it's not just being

618

00:22:22,070 --> 00:22:19,600

able to make predictions and also how to

619

00:22:26,310 --> 00:22:22,080

even into control

620

00:22:29,510 --> 00:22:26,320

so for example um a really strong person

621

00:22:31,190 --> 00:22:29,520

who's able to move things physically

622

00:22:33,190 --> 00:22:31,200

part of what they can do and

623

00:22:35,510 --> 00:22:33,200

successfully them as an inference device

624

00:22:37,590 --> 00:22:35,520

is actually move those objects

625

00:22:39,190 --> 00:22:37,600

that way atlas

626

00:22:41,270 --> 00:22:39,200

the greek odd would have been they or

627

00:22:42,549 --> 00:22:41,280

titan was he i'll forget what was this

628

00:22:44,630 --> 00:22:42,559

yeah was the one with the world on his

629

00:22:46,070 --> 00:22:44,640

shoulders yeah yeah i just can't

630

00:22:47,350 --> 00:22:46,080

remember he don't think he was a god i

631

00:22:48,630 --> 00:22:47,360

think he may have been a titan but i

632

00:22:50,149 --> 00:22:48,640

don't remember

633

00:22:52,950 --> 00:22:50,159

um the titans were the predecessors of

634

00:22:54,230 --> 00:22:52,960

the gods in any case um he would would

635

00:22:55,590 --> 00:22:54,240

have been an inference device a very

636

00:22:59,430 --> 00:22:55,600

strong one

637

00:23:01,750 --> 00:22:59,440

so um one can then so basically

638

00:23:05,190 --> 00:23:01,760

you can conjecture

639

00:23:08,789 --> 00:23:05,200

that there the universe might have a

640

00:23:11,029 --> 00:23:08,799

god in the sense of an inference device

641

00:23:13,909 --> 00:23:11,039

that can control

642

00:23:16,230 --> 00:23:13,919

and accurately predict everything except

643

00:23:18,230 --> 00:23:16,240

for in the case of laplace's demon

644

00:23:20,230 --> 00:23:18,240

that it can go after everything else and

645

00:23:23,110 --> 00:23:20,240

do it correctly

646

00:23:25,110 --> 00:23:23,120

so as long as you're not asking god this

647

00:23:26,470 --> 00:23:25,120

puget of god or goddess whatever it

648

00:23:28,230 --> 00:23:26,480

would be deity

649

00:23:30,630 --> 00:23:28,240

deity dude we'll call it deity doo dee

650

00:23:32,789 --> 00:23:30,640

dee so long as you're not asking so long

651
00:23:34,310 --> 00:23:32,799
as dd is not asking itself questions

652
00:23:36,630 --> 00:23:34,320
along the lines of what will i not be

653
00:23:38,470 --> 00:23:36,640
asking a second from now

654
00:23:42,549 --> 00:23:38,480
so long as dee dee is asking things like

655
00:23:44,950 --> 00:23:42,559
oh well is um adam going to eat this

656
00:23:46,710 --> 00:23:44,960
apple that was just prefer proffer to

657
00:23:49,909 --> 00:23:46,720
him by eve

658
00:23:51,029 --> 00:23:49,919
so and so long as dede is doing things

659
00:23:53,269 --> 00:23:51,039
like

660
00:23:56,710 --> 00:23:53,279
reaching down his hand

661
00:23:58,470 --> 00:23:56,720
and writing on walls parting red seas

662
00:24:01,669 --> 00:23:58,480
doing things that are more interesting

663
00:24:03,190 --> 00:24:01,679

from the non-judeo-christian religions

664

00:24:04,870 --> 00:24:03,200

they in some ways had much more

665

00:24:07,269 --> 00:24:04,880

interesting deities than

666

00:24:09,190 --> 00:24:07,279

just the standard yahweh from

667

00:24:12,549 --> 00:24:09,200

judeo-christian islamic religion but in

668

00:24:17,430 --> 00:24:14,390

we can suppose that there is a universe

669

00:24:18,390 --> 00:24:17,440

that does have such a dd in it

670

00:24:20,149 --> 00:24:18,400

um

671

00:24:22,950 --> 00:24:20,159

and so with where it would be actually

672

00:24:25,269 --> 00:24:22,960

correct in everything that it says about

673

00:24:27,029 --> 00:24:25,279

everything in its own universe

674

00:24:28,870 --> 00:24:27,039

except that doesn't have this weird kind

675

00:24:31,430 --> 00:24:28,880

of structure related to itself

676
00:24:33,350 --> 00:24:31,440
that it's correct

677
00:24:36,789 --> 00:24:33,360
now let's consider the question though

678
00:24:39,669 --> 00:24:36,799
could we have two dd's

679
00:24:41,669 --> 00:24:39,679
and it turns out that we need to um in

680
00:24:43,669 --> 00:24:41,679
addition to these two deities as an

681
00:24:45,510 --> 00:24:43,679
aside david i want to make sure these

682
00:24:48,149 --> 00:24:45,520
deities are they embedded in the

683
00:24:49,909 --> 00:24:48,159
physical universe yes that's the key

684
00:24:51,830 --> 00:24:49,919
that's the key but this physical

685
00:24:53,669 --> 00:24:51,840
universe itself

686
00:24:55,830 --> 00:24:53,679
you can define that however you want and

687
00:24:57,830 --> 00:24:55,840
whatever the deity is so long as it

688
00:25:00,470 --> 00:24:57,840

itself

689

00:25:02,310 --> 00:25:00,480

it does things at various times and

690

00:25:04,789 --> 00:25:02,320

we're not even saying requiring it to be

691

00:25:07,669 --> 00:25:04,799

lawful in any sense just that we can

692

00:25:10,470 --> 00:25:07,679

write down a set of world lines

693

00:25:13,029 --> 00:25:10,480

and those word lines are by definition

694

00:25:15,190 --> 00:25:13,039

they are the record of what the deity

695

00:25:17,190 --> 00:25:15,200

its state is across

696

00:25:18,390 --> 00:25:17,200

all space and time is in one of these

697

00:25:20,630 --> 00:25:18,400

world lines

698

00:25:22,470 --> 00:25:20,640

so this might very well extend to

699

00:25:24,630 --> 00:25:22,480

supernatural

700

00:25:27,350 --> 00:25:24,640

variables that are not embedded in the

701
00:25:28,710 --> 00:25:27,360
laws of physics it doesn't even matter

702
00:25:31,190 --> 00:25:28,720
there's no presumption here that the

703
00:25:32,789 --> 00:25:31,200
deity is in any sense lawful

704
00:25:35,110 --> 00:25:32,799
bound by laws

705
00:25:37,110 --> 00:25:35,120
it's simply that it can that it states

706
00:25:39,750 --> 00:25:37,120
um we can be recorded

707
00:25:41,669 --> 00:25:39,760
and in a certain sense if not then

708
00:25:43,830 --> 00:25:41,679
i mean that almost means if by

709
00:25:45,909 --> 00:25:43,840
definition non-consequential

710
00:25:47,590 --> 00:25:45,919
you know wittgenstein's platitude about

711
00:25:48,630 --> 00:25:47,600
that which you cannot talk shut the hell

712
00:25:49,990 --> 00:25:48,640
up

713
00:25:51,830 --> 00:25:50,000

certainly would come to play there

714

00:25:52,789 --> 00:25:51,840

because we're in any case

715

00:25:55,029 --> 00:25:52,799

um

716

00:25:57,750 --> 00:25:55,039

but so now let's consider the

717

00:25:59,830 --> 00:25:57,760

um possibility that there are two

718

00:26:02,789 --> 00:25:59,840

separate deities

719

00:26:05,909 --> 00:26:02,799

and now in addition to um

720

00:26:08,310 --> 00:26:05,919

abusing the term deity i'm going to now

721

00:26:10,149 --> 00:26:08,320

abuse another term

722

00:26:11,510 --> 00:26:10,159

i mean even worse which is the one with

723

00:26:13,830 --> 00:26:11,520

the ones we were talking about yesterday

724

00:26:15,350 --> 00:26:13,840

which is free will

725

00:26:16,950 --> 00:26:15,360

and so this is what i'm going to say i'm

726
00:26:19,750 --> 00:26:16,960
going to say kurt you're an inference

727
00:26:22,470 --> 00:26:19,760
device i'm an inference device

728
00:26:25,110 --> 00:26:22,480
we both have free will if the following

729
00:26:29,269 --> 00:26:25,120
property holds

730
00:26:32,070 --> 00:26:29,279
whatever state david might be in

731
00:26:34,070 --> 00:26:32,080
it's possible for kurt to it's not

732
00:26:36,870 --> 00:26:34,080
somehow there is a

733
00:26:39,750 --> 00:26:36,880
element of the states of the set

734
00:26:41,830 --> 00:26:39,760
of all possible world lines in which

735
00:26:44,470 --> 00:26:41,840
david is in that state

736
00:26:46,470 --> 00:26:44,480
and kurt is in state a

737
00:26:49,510 --> 00:26:46,480
there's also another one in which david

738
00:26:50,950 --> 00:26:49,520

is in that state and kurt is in state b

739

00:26:53,590 --> 00:26:50,960

there's another one in which david is in

740

00:26:55,190 --> 00:26:53,600

that state and kurt is state c

741

00:26:57,350 --> 00:26:55,200

so basically

742

00:26:59,510 --> 00:26:57,360

the definition of free will is that the

743

00:27:01,750 --> 00:26:59,520

state that david is in

744

00:27:03,909 --> 00:27:01,760

does not rule out

745

00:27:06,390 --> 00:27:03,919

the possibility of kurtz being in

746

00:27:08,390 --> 00:27:06,400

various states in that sense

747

00:27:09,909 --> 00:27:08,400

it's not a matter of i'm controlling you

748

00:27:11,590 --> 00:27:09,919

it's not even having anything to do with

749

00:27:14,789 --> 00:27:11,600

physical correlation

750

00:27:17,430 --> 00:27:14,799

it's simply saying that i cannot um be

751
00:27:20,870 --> 00:27:17,440
in a state like for example where i

752
00:27:23,909 --> 00:27:20,880
have in my head the edict curt

753
00:27:25,750 --> 00:27:23,919
is not wearing a jacket

754
00:27:28,070 --> 00:27:25,760
you could that either could be true or

755
00:27:29,990 --> 00:27:28,080
it could be false in that sense you are

756
00:27:38,070 --> 00:27:30,000
free

757
00:27:39,669 --> 00:27:38,080
not sense not definition

758
00:27:41,029 --> 00:27:39,679
and i it's very very much

759
00:27:43,110 --> 00:27:41,039
tongue-in-cheek for me to call that free

760
00:27:44,149 --> 00:27:43,120
will but if we have free will in that

761
00:27:47,510 --> 00:27:44,159
sense

762
00:27:49,750 --> 00:27:47,520
at least one moment

763
00:27:51,269 --> 00:27:49,760

then it is impossible to have two

764

00:27:56,310 --> 00:27:51,279

deities

765

00:27:58,070 --> 00:27:56,320

in the sense that they can both

766

00:28:00,389 --> 00:27:58,080

have perfectly accurate inferences by

767

00:28:03,029 --> 00:28:00,399

everything other themselves if they both

768

00:28:04,710 --> 00:28:03,039

have free will at least once that's

769

00:28:06,630 --> 00:28:04,720

incredibly interesting does an

770

00:28:08,470 --> 00:28:06,640

impossibility result against more than

771

00:28:09,430 --> 00:28:08,480

one god yes

772

00:28:11,029 --> 00:28:09,440

yep that's why it's called the

773

00:28:13,029 --> 00:28:11,039

monotheism theorem

774

00:28:15,430 --> 00:28:13,039

it might be that we are in a universe in

775

00:28:17,430 --> 00:28:15,440

which you could have one god who knows

776

00:28:18,950 --> 00:28:17,440

i'm not going to go there i mean my

777

00:28:21,029 --> 00:28:18,960

personal

778

00:28:23,590 --> 00:28:21,039

um feeling uh

779

00:28:25,269 --> 00:28:23,600

conclusions on it are that in our

780

00:28:27,110 --> 00:28:25,279

particular universe no

781

00:28:30,710 --> 00:28:27,120

um but there could but there is no

782

00:28:32,149 --> 00:28:30,720

reason why i think the the concept

783

00:28:34,710 --> 00:28:32,159

itself is not inherently

784

00:28:36,549 --> 00:28:34,720

self-contradictory like apostles demon

785

00:28:37,909 --> 00:28:36,559

there could be universes i would say

786

00:28:39,269 --> 00:28:37,919

there's no sense in which we can

787

00:28:42,830 --> 00:28:39,279

actually

788

00:28:46,310 --> 00:28:42,840

rule them out in fact in which there are

789

00:28:47,190 --> 00:28:46,320

deities um but there cannot be any of

790

00:28:49,990 --> 00:28:47,200

them

791

00:28:51,590 --> 00:28:50,000

that support two deities

792

00:28:53,510 --> 00:28:51,600

so we might be in one of those ones in

793

00:28:55,430 --> 00:28:53,520

which there is a deity who knows but we

794

00:28:56,789 --> 00:28:55,440

can't be one which is more than one and

795

00:28:58,389 --> 00:28:56,799

when you say there can't be two

796

00:29:00,789 --> 00:28:58,399

omniscient to deities

797

00:29:02,149 --> 00:29:00,799

there can't be two that have free will

798

00:29:04,789 --> 00:29:02,159

ah

799

00:29:06,310 --> 00:29:04,799

so you could have one where there's zeus

800

00:29:07,269 --> 00:29:06,320

and hera

801
00:29:09,669 --> 00:29:07,279
but

802
00:29:10,789 --> 00:29:09,679
um zeus can always be in a particular

803
00:29:14,149 --> 00:29:10,799
state

804
00:29:15,909 --> 00:29:14,159
that restricts hera for being in in some

805
00:29:17,830 --> 00:29:15,919
of her particular states

806
00:29:20,389 --> 00:29:17,840
interesting in that sense she does not

807
00:29:23,669 --> 00:29:20,399
have free will of him at one particular

808
00:29:25,909 --> 00:29:23,679
time one particular state of zeus

809
00:29:27,029 --> 00:29:25,919
it's just not going to be any possible

810
00:29:33,190 --> 00:29:27,039
um

811
00:29:35,269 --> 00:29:33,200
in our universe in which hera

812
00:29:37,430 --> 00:29:35,279
is in um one of her particular states

813
00:29:39,669 --> 00:29:37,440

there's some limitation my being one

814

00:29:41,990 --> 00:29:39,679

particular state at one particular time

815

00:29:43,830 --> 00:29:42,000

it could causes a restriction on the

816

00:29:45,990 --> 00:29:43,840

possible states that you could be in at

817

00:29:47,669 --> 00:29:46,000

that time and if that's true that we

818

00:29:49,590 --> 00:29:47,679

have no free will have you heard of

819

00:29:53,110 --> 00:29:49,600

norton's dome

820

00:29:54,870 --> 00:29:53,120

i think i

821

00:29:56,549 --> 00:29:54,880

did a while ago drinking a bell but i

822

00:29:59,269 --> 00:29:56,559

can't bring it up sure it's a thought

823

00:30:01,350 --> 00:29:59,279

experiment about newtonian mechanics and

824

00:30:04,310 --> 00:30:01,360

it's to show that newtonian mechanics

825

00:30:06,950 --> 00:30:04,320

isn't deterministic even though it's

826

00:30:09,430 --> 00:30:06,960

often said it is and the reason is there

827

00:30:11,350 --> 00:30:09,440

are certain configurations you can set

828

00:30:13,430 --> 00:30:11,360

up such that there is not a unique

829

00:30:15,190 --> 00:30:13,440

answer to the differential equations you

830

00:30:17,190 --> 00:30:15,200

know ordinarily in physics just for

831

00:30:19,110 --> 00:30:17,200

people to know one of the reasons why

832

00:30:20,710 --> 00:30:19,120

mathematicians quibble with physicists

833

00:30:22,630 --> 00:30:20,720

is that this is hand wave and gloss over

834

00:30:24,070 --> 00:30:22,640

many details and so one of them is

835

00:30:25,830 --> 00:30:24,080

whenever we have an ordinary

836

00:30:28,070 --> 00:30:25,840

differential equation we tend to say

837

00:30:29,830 --> 00:30:28,080

there's uniqueness in existence however

838

00:30:32,149 --> 00:30:29,840

that's contingent on something called

839

00:30:33,750 --> 00:30:32,159

the lipschitz continuity and if you

840

00:30:35,590 --> 00:30:33,760

don't have lift shit's continuity you

841

00:30:36,950 --> 00:30:35,600

don't necessarily have a unique solution

842

00:30:39,190 --> 00:30:36,960

so you basically set up a certain

843

00:30:41,110 --> 00:30:39,200

situation with a ball on a dome and the

844

00:30:42,789 --> 00:30:41,120

equation for the dome is fairly simple

845

00:30:44,310 --> 00:30:42,799

it's almost like a parabola and then it

846

00:30:46,630 --> 00:30:44,320

turns out one solution is it stays there

847

00:30:49,269 --> 00:30:46,640

forever the zero velocity initially and

848

00:30:51,830 --> 00:30:49,279

then another solution is at some point t

849

00:30:54,149 --> 00:30:51,840

and the time t is not specified it goes

850

00:30:55,510 --> 00:30:54,159

down some route and any one of them so

851
00:30:57,509 --> 00:30:55,520
that's extremely interesting let's

852
00:30:59,110 --> 00:30:57,519
imagine we live in a newtonian world is

853
00:31:00,710 --> 00:30:59,120
that related to free will would you say

854
00:31:02,549 --> 00:31:00,720
or is that not related to free will

855
00:31:04,710 --> 00:31:02,559
that's something different i know a free

856
00:31:06,630 --> 00:31:04,720
will forget about the sense of intention

857
00:31:08,549 --> 00:31:06,640
interacting with the laws of nature to

858
00:31:10,149 --> 00:31:08,559
produce that effect yeah the norton's

859
00:31:11,509 --> 00:31:10,159
dome it's also um i think it was

860
00:31:13,830 --> 00:31:11,519
actually sabine

861
00:31:17,269 --> 00:31:13,840
um who has a um

862
00:31:19,190 --> 00:31:17,279
one of her fqxi essays that she points

863
00:31:21,269 --> 00:31:19,200

out that chaos

864

00:31:22,630 --> 00:31:21,279

is what is in some sense it can be a

865

00:31:24,310 --> 00:31:22,640

much stronger phenomenon than people

866

00:31:25,830 --> 00:31:24,320

understand and that you can set up

867

00:31:27,590 --> 00:31:25,840

physical systems

868

00:31:29,110 --> 00:31:27,600

in which the chaos is to such a degree

869

00:31:31,990 --> 00:31:29,120

that actually passes a certain point in

870

00:31:33,029 --> 00:31:32,000

time you cannot there it is not defined

871

00:31:34,870 --> 00:31:33,039

but the state of the system will be

872

00:31:37,110 --> 00:31:34,880

after that so that's i think that's the

873

00:31:38,870 --> 00:31:37,120

context in which i ran across it it's

874

00:31:40,630 --> 00:31:38,880

also they're related things the work

875

00:31:42,630 --> 00:31:40,640

that goes back to um two people called

876

00:31:45,029 --> 00:31:42,640

parel and richards

877

00:31:46,950 --> 00:31:45,039

um those were physicists who as well

878

00:31:48,230 --> 00:31:46,960

known that for example the three-body

879

00:31:50,470 --> 00:31:48,240

problem

880

00:31:52,310 --> 00:31:50,480

um where even if you do so there you do

881

00:31:54,070 --> 00:31:52,320

have the standalone continuity and so on

882

00:31:54,789 --> 00:31:54,080

you've got gravitational attraction so

883

00:31:56,710 --> 00:31:54,799

on

884

00:31:58,789 --> 00:31:56,720

um you can

885

00:32:01,029 --> 00:31:58,799

set it up to be a what's called a

886

00:32:03,430 --> 00:32:01,039

universal turing machine

887

00:32:05,190 --> 00:32:03,440

you basically what you do is you encode

888

00:32:07,590 --> 00:32:05,200

the um input

889

00:32:08,789 --> 00:32:07,600

tape to that turing machine

890

00:32:11,110 --> 00:32:08,799

into

891

00:32:13,269 --> 00:32:11,120

the actual precise initial conditions of

892

00:32:16,470 --> 00:32:13,279

these three bodies

893

00:32:19,029 --> 00:32:16,480

and then by reading the appropriate

894

00:32:20,470 --> 00:32:19,039

bits of the state of the system at some

895

00:32:22,230 --> 00:32:20,480

future time

896

00:32:24,630 --> 00:32:22,240

you can figure out what that universal

897

00:32:26,870 --> 00:32:24,640

turing machine state of its tape would

898

00:32:29,509 --> 00:32:26,880

be at that time

899

00:32:30,950 --> 00:32:29,519

what this means is that you can feed in

900

00:32:32,389 --> 00:32:30,960

a configuration that's actually the

901
00:32:34,789 --> 00:32:32,399
halting problem

902
00:32:37,509 --> 00:32:34,799
so that that physical system in fact it

903
00:32:39,590 --> 00:32:37,519
violates the church turing thesis

904
00:32:41,110 --> 00:32:39,600
that that physical system its um as

905
00:32:42,950 --> 00:32:41,120
state in the future would not be

906
00:32:44,710 --> 00:32:42,960
computable

907
00:32:45,669 --> 00:32:44,720
so it's a very closely related kind of

908
00:32:48,870 --> 00:32:45,679
result

909
00:32:50,470 --> 00:32:48,880
describing

910
00:32:53,830 --> 00:32:50,480
are stronger in that they don't

911
00:32:55,669 --> 00:32:53,840
presuppose differential equations

912
00:32:58,149 --> 00:32:55,679
they don't suppose any of that kind of

913
00:32:59,909 --> 00:32:58,159

lawful structure whatsoever

914

00:33:01,350 --> 00:32:59,919

um so that's the sense in which they

915

00:33:02,549 --> 00:33:01,360

would hold no matter what the laws of

916

00:33:04,549 --> 00:33:02,559

physics are

917

00:33:07,190 --> 00:33:04,559

and that's this that is for that reason

918

00:33:09,509 --> 00:33:07,200

as well that they encompass any possible

919

00:33:12,789 --> 00:33:09,519

supernatural

920

00:33:17,830 --> 00:33:15,430

phenomenology um

921

00:33:19,750 --> 00:33:17,840

impact on the real world not no matter

922

00:33:22,310 --> 00:33:19,760

how you might even think about it

923

00:33:24,230 --> 00:33:22,320

because it's they're just subsets of the

924

00:33:25,669 --> 00:33:24,240

set of all possible world lines and

925

00:33:27,430 --> 00:33:25,679

world lines

926

00:33:30,149 --> 00:33:27,440

in this sense

927

00:33:31,669 --> 00:33:30,159

they're just a um

928

00:33:34,070 --> 00:33:31,679

themselves

929

00:33:35,990 --> 00:33:34,080

are a set of events in a completely

930

00:33:37,269 --> 00:33:36,000

arbitrary

931

00:33:40,070 --> 00:33:37,279

sense what the word event means it

932

00:33:42,149 --> 00:33:40,080

doesn't even presuppose space time

933

00:33:43,669 --> 00:33:42,159

um really the mathematics just says here

934

00:33:45,350 --> 00:33:43,679

is a set i'm going to call the elements

935

00:33:46,470 --> 00:33:45,360

the set world lines

936

00:33:48,789 --> 00:33:46,480

because that's what they happen to

937

00:33:51,110 --> 00:33:48,799

correspond to in our kind of world but

938

00:33:53,430 --> 00:33:51,120

they're just things

939

00:33:56,470 --> 00:33:53,440

and um there and everything that's got

940

00:33:58,710 --> 00:33:56,480

that we as humans would call rules and

941

00:34:00,549 --> 00:33:58,720

laws concerning them

942

00:34:02,470 --> 00:34:00,559

has to do with things like um

943

00:34:03,669 --> 00:34:02,480

observation operators on them and

944

00:34:05,590 --> 00:34:03,679

projections and things like that but

945

00:34:07,669 --> 00:34:05,600

that's all extra structure just the

946

00:34:09,669 --> 00:34:07,679

topology of it the fact that you have

947

00:34:11,829 --> 00:34:09,679

these interlocking subsets that itself

948

00:34:14,470 --> 00:34:11,839

has many consequences

949

00:34:16,790 --> 00:34:14,480

one of which is the monotheism theorem

950

00:34:19,829 --> 00:34:16,800

you could maybe have a god

951
00:34:20,950 --> 00:34:19,839
but you can't have more than one

952
00:34:22,869 --> 00:34:20,960
um i

953
00:34:24,790 --> 00:34:22,879
i view that

954
00:34:27,349 --> 00:34:24,800
the way that i

955
00:34:29,510 --> 00:34:27,359
how to phrase this

956
00:34:32,069 --> 00:34:29,520
i play a bunch of fast and loose games

957
00:34:34,710 --> 00:34:32,079
when i describe this result

958
00:34:37,909 --> 00:34:34,720
on the one hand almost to protect myself

959
00:34:40,149 --> 00:34:37,919
in intellectual discourse

960
00:34:42,710 --> 00:34:40,159
i want to say that i'm phrasing that

961
00:34:45,270 --> 00:34:42,720
theorem very much tongue-in-cheek

962
00:34:47,030 --> 00:34:45,280
and there's an element of truth to that

963
00:34:48,470 --> 00:34:47,040

but without

964

00:34:49,750 --> 00:34:48,480

making a

965

00:34:51,430 --> 00:34:49,760

firm

966

00:34:53,589 --> 00:34:51,440

declaration

967

00:34:55,270 --> 00:34:53,599

i would say quite honestly

968

00:34:58,230 --> 00:34:55,280

that this does

969

00:35:00,390 --> 00:34:58,240

prove that by any notion of a deity in

970

00:35:03,430 --> 00:35:00,400

any of the world's religions and any

971

00:35:04,950 --> 00:35:03,440

philosopher might ever have come up with

972

00:35:07,349 --> 00:35:04,960

no you can't have more than one this

973

00:35:09,190 --> 00:35:07,359

actually does prove monotheism

974

00:35:10,950 --> 00:35:09,200

so if you push me to the wall i'm going

975

00:35:12,790 --> 00:35:10,960

to go tongue-in-cheek and say well i'll

976

00:35:14,870 --> 00:35:12,800

be using my definitions

977

00:35:16,790 --> 00:35:14,880

but there's a large part of me that's

978

00:35:18,790 --> 00:35:16,800

thinking that no in fact this does prove

979

00:35:20,790 --> 00:35:18,800

that you can't have more yet polytheism

980

00:35:22,150 --> 00:35:20,800

is ruled out sorry

981

00:35:24,870 --> 00:35:22,160

this sounds like a great time to talk

982

00:35:27,670 --> 00:35:24,880

about what an observer is

983

00:35:30,230 --> 00:35:27,680

so an observer in this sense

984

00:35:32,230 --> 00:35:30,240

is basically an inference device if

985

00:35:33,430 --> 00:35:32,240

we're talking so an observer we could be

986

00:35:35,670 --> 00:35:33,440

thinking about there's many different

987

00:35:39,670 --> 00:35:35,680

frameworks the way that i know how to

988

00:35:42,230 --> 00:35:39,680

phrase this okay this is a digression um

989

00:35:46,870 --> 00:35:42,240

or a diversion i'll i'll come back i'm

990

00:35:46,880 --> 00:35:49,430

when i

991

00:35:51,510 --> 00:35:50,230

do

992

00:35:53,589 --> 00:35:51,520

my own

993

00:35:55,270 --> 00:35:53,599

personal philosophizing if that's the

994

00:35:58,550 --> 00:35:55,280

world when i built when i

995

00:36:02,710 --> 00:35:58,560

construct configure my own

996

00:36:07,030 --> 00:36:04,870

dwelling that's got to do with

997

00:36:08,870 --> 00:36:07,040

that i call the philosophy house

998

00:36:11,030 --> 00:36:08,880

so to speak

999

00:36:13,510 --> 00:36:11,040

what what it really amounts to is the

1000

00:36:15,670 --> 00:36:13,520

following that there are different

1001

00:36:18,230 --> 00:36:15,680

i'm almost exclusively interested in

1002

00:36:22,230 --> 00:36:18,240

metaphysics i frankly couldn't care less

1003

00:36:25,109 --> 00:36:22,240

about philosophy of art for example i

1004

00:36:27,349 --> 00:36:25,119

think it's an oxymoron philosophy of

1005

00:36:29,349 --> 00:36:27,359

morality i think harsanyi's got some

1006

00:36:32,710 --> 00:36:29,359

interesting things to say

1007

00:36:34,310 --> 00:36:32,720

rawls um less so singer i think has some

1008

00:36:37,030 --> 00:36:34,320

interesting things to say

1009

00:36:39,270 --> 00:36:37,040

but not all that much more than that um

1010

00:36:41,030 --> 00:36:39,280

but so mostly it's metaphysics in other

1011

00:36:41,910 --> 00:36:41,040

words what is reality and so on and so

1012

00:36:44,069 --> 00:36:41,920

forth

1013

00:36:45,829 --> 00:36:44,079

and basically as you strip and what

1014

00:36:49,349 --> 00:36:45,839

philosophy house

1015

00:36:51,829 --> 00:36:49,359

is built upon is the understanding that

1016

00:36:54,230 --> 00:36:51,839

you can do certain investigations where

1017

00:36:56,710 --> 00:36:54,240

you make certain assumptions

1018

00:36:58,630 --> 00:36:56,720

then when you weaken those assumptions a

1019

00:37:00,069 --> 00:36:58,640

lot of it falls apart and you get to a

1020

00:37:01,910 --> 00:37:00,079

deeper level of reality where there's

1021

00:37:03,670 --> 00:37:01,920

less structure

1022

00:37:05,670 --> 00:37:03,680

weaken assumptions and you keep going

1023

00:37:08,390 --> 00:37:05,680

down and down and down until the whole

1024

00:37:09,270 --> 00:37:08,400

thing actually eats itself

1025

00:37:11,510 --> 00:37:09,280

so

1026

00:37:14,550 --> 00:37:11,520

up at one level

1027

00:37:16,950 --> 00:37:14,560

i'm more than happy to be a steadfast

1028

00:37:19,349 --> 00:37:16,960

card-carrying member of the school of

1029

00:37:20,870 --> 00:37:19,359

people call themselves scientists

1030

00:37:23,109 --> 00:37:20,880

scientific realists whatever you might

1031

00:37:25,349 --> 00:37:23,119

want to call it um

1032

00:37:27,109 --> 00:37:25,359

then at another level

1033

00:37:30,069 --> 00:37:27,119

you can start to say well what is

1034

00:37:31,829 --> 00:37:30,079

reality you can't even define it

1035

00:37:33,750 --> 00:37:31,839

and

1036

00:37:36,630 --> 00:37:33,760

you start to then start worrying about

1037

00:37:38,950 --> 00:37:36,640

things like inference devices you can

1038

00:37:39,990 --> 00:37:38,960

then say wait a second combine what you

1039

00:37:42,069 --> 00:37:40,000

just

1040

00:37:43,430 --> 00:37:42,079

said about no reality is more real than

1041

00:37:45,589 --> 00:37:43,440

any other that all of them are just

1042

00:37:47,910 --> 00:37:45,599

different these subsets

1043

00:37:49,190 --> 00:37:47,920

of possible universes that

1044

00:37:50,870 --> 00:37:49,200

you can have define these inference

1045

00:37:52,230 --> 00:37:50,880

devices structures that's all that any

1046

00:37:53,750 --> 00:37:52,240

reality is

1047

00:37:56,069 --> 00:37:53,760

that none is any

1048

00:37:57,750 --> 00:37:56,079

is a privilege over any other

1049

00:37:59,430 --> 00:37:57,760

doesn't that also can't you also then

1050

00:38:01,990 --> 00:37:59,440

apply that to your own reasoning your

1051
00:38:03,829 --> 00:38:02,000
own question answer process

1052
00:38:05,750 --> 00:38:03,839
and conclude that that itself is going

1053
00:38:07,589 --> 00:38:05,760
to be illegitimate in a sort of apost

1054
00:38:09,829 --> 00:38:07,599
demons kind of sense

1055
00:38:11,990 --> 00:38:09,839
so you've just concluded that no reality

1056
00:38:14,069 --> 00:38:12,000
is privileged above any other

1057
00:38:16,710 --> 00:38:14,079
but in doing so if you want to strip

1058
00:38:18,550 --> 00:38:16,720
down the very last remaining assumption

1059
00:38:21,109 --> 00:38:18,560
you are not allowed to assume that your

1060
00:38:22,710 --> 00:38:21,119
reasoning process itself is somehow

1061
00:38:25,750 --> 00:38:22,720
proof against

1062
00:38:28,069 --> 00:38:25,760
um that kind of conclusion

1063
00:38:30,230 --> 00:38:28,079

and so as was put in i think as one of

1064

00:38:32,790 --> 00:38:30,240

the hitchhikers guides

1065

00:38:35,349 --> 00:38:32,800

um uh little um

1066

00:38:38,150 --> 00:38:35,359

[Music]

1067

00:38:39,829 --> 00:38:38,160

episodes that everything vanishes in a

1068

00:38:41,670 --> 00:38:39,839

proof of logic

1069

00:38:42,870 --> 00:38:41,680

um and that's where you would ultimately

1070

00:38:44,790 --> 00:38:42,880

end up going

1071

00:38:47,430 --> 00:38:44,800

so the reason i mention that is when you

1072

00:38:49,030 --> 00:38:47,440

say the word observation

1073

00:38:51,430 --> 00:38:49,040

it can mean very different things

1074

00:38:52,790 --> 00:38:51,440

depending on where we are in this whole

1075

00:38:54,710 --> 00:38:52,800

edifice

1076

00:38:56,950 --> 00:38:54,720

this philosophy house where we're

1077

00:38:59,829 --> 00:38:56,960

stripping out assumptions and so on

1078

00:39:03,030 --> 00:38:59,839

in the context of inference devices

1079

00:39:04,950 --> 00:39:03,040

observation is just like prediction

1080

00:39:06,310 --> 00:39:04,960

control or memory

1081

00:39:08,630 --> 00:39:06,320

for that matter

1082

00:39:10,470 --> 00:39:08,640

it's just a way for you to be posing

1083

00:39:11,589 --> 00:39:10,480

questions you then have an observation

1084

00:39:14,790 --> 00:39:11,599

device

1085

00:39:15,750 --> 00:39:14,800

that is providing you answers and what

1086

00:39:19,910 --> 00:39:15,760

the

1087

00:39:23,349 --> 00:39:19,920

you

1088

00:39:24,790 --> 00:39:23,359

observation device is they're always

1089

00:39:26,950 --> 00:39:24,800

going to be situations where the answer

1090

00:39:29,109 --> 00:39:26,960

gives you is wrong

1091

00:39:31,109 --> 00:39:29,119

so that's what observation means in the

1092

00:39:33,589 --> 00:39:31,119

context of inference devices it means

1093

00:39:34,870 --> 00:39:33,599

other things in other contexts

1094

00:39:35,670 --> 00:39:34,880

um

1095

00:39:38,790 --> 00:39:35,680

but

1096

00:39:42,550 --> 00:39:38,800

in the structure of instruments devices

1097

00:39:44,230 --> 00:39:42,560

note that prediction and memory are

1098

00:39:45,750 --> 00:39:44,240

identical

1099

00:39:48,390 --> 00:39:45,760

so

1100

00:39:50,390 --> 00:39:48,400

the block model of the universe that we

1101

00:39:52,470 --> 00:39:50,400

think we were talking about last time

1102

00:39:53,829 --> 00:39:52,480

the second law and the psychological era

1103

00:39:54,950 --> 00:39:53,839

of time

1104

00:39:57,109 --> 00:39:54,960

memory

1105

00:39:59,190 --> 00:39:57,119

is just retrodiction it's a prediction

1106

00:40:00,950 --> 00:39:59,200

about the past rather than the future

1107

00:40:02,390 --> 00:40:00,960

that we suppose

1108

00:40:03,430 --> 00:40:02,400

for reasons having to do with the second

1109

00:40:05,270 --> 00:40:03,440

law

1110

00:40:06,950 --> 00:40:05,280

um has to be

1111

00:40:08,870 --> 00:40:06,960

much more accurate at least some of our

1112

00:40:10,630 --> 00:40:08,880

memory than our predictions why do you

1113

00:40:12,550 --> 00:40:10,640

say that it's a prediction about the

1114

00:40:14,390 --> 00:40:12,560

past rather than a statement about the

1115

00:40:16,950 --> 00:40:14,400

past ah because we have no way of

1116

00:40:19,670 --> 00:40:16,960

knowing it's true it's a statistical

1117

00:40:21,349 --> 00:40:19,680

it's identical there is no privileged

1118

00:40:23,030 --> 00:40:21,359

arrow of time

1119

00:40:25,270 --> 00:40:23,040

this is um something that physicists

1120

00:40:26,790 --> 00:40:25,280

have been wrestling with especially

1121

00:40:29,349 --> 00:40:26,800

cosmologists i think i mentioned last

1122

00:40:31,589 --> 00:40:29,359

time there's a 1973

1123

00:40:33,349 --> 00:40:31,599

book by paul davies the physics of time

1124

00:40:34,870 --> 00:40:33,359

asymmetry and sean carroll's got some

1125

00:40:37,030 --> 00:40:34,880

nice stuff in this

1126

00:40:38,990 --> 00:40:37,040

and there's i i have a paper in i think

1127

00:40:42,309 --> 00:40:39,000

it was

1128

00:40:43,990 --> 00:40:42,319

1992 in the international journal of

1129

00:40:45,829 --> 00:40:44,000

theoretical physics

1130

00:40:47,430 --> 00:40:45,839

on these kinds of things there is no

1131

00:40:48,870 --> 00:40:47,440

sense in which the past is more real in

1132

00:40:50,790 --> 00:40:48,880

the future

1133

00:40:53,589 --> 00:40:50,800

all moments are just as real as one

1134

00:40:56,870 --> 00:40:53,599

another and all that we are doing as

1135

00:40:59,190 --> 00:40:56,880

scientists or as people remembering

1136

00:41:00,870 --> 00:40:59,200

is making statistics predictions in the

1137

00:41:04,829 --> 00:41:00,880

statistic sense

1138

00:41:06,390 --> 00:41:04,839

despite that um uh prefix the word pre

1139

00:41:07,430 --> 00:41:06,400

addiction

1140

00:41:08,790 --> 00:41:07,440

from a

1141

00:41:11,430 --> 00:41:08,800

scientific point of view from the point

1142

00:41:12,710 --> 00:41:11,440

of view of the laws of physics

1143

00:41:15,349 --> 00:41:12,720

there is no difference between a

1144

00:41:17,430 --> 00:41:15,359

prediction and a retrodiction

1145

00:41:19,510 --> 00:41:17,440

they are both using

1146

00:41:21,750 --> 00:41:19,520

null data at the present to make a

1147

00:41:23,829 --> 00:41:21,760

statistical estimate

1148

00:41:26,309 --> 00:41:23,839

of the state of a variable at a time

1149

00:41:28,470 --> 00:41:26,319

other than the present

1150

00:41:29,910 --> 00:41:28,480

so retrodiction you could be wrong

1151
00:41:31,750 --> 00:41:29,920
and in fact

1152
00:41:32,950 --> 00:41:31,760
that's of course um a whole another body

1153
00:41:34,870 --> 00:41:32,960
of the

1154
00:41:36,950 --> 00:41:34,880
work and things we could discuss about

1155
00:41:37,910 --> 00:41:36,960
is how in fact the mind very often is

1156
00:41:40,230 --> 00:41:37,920
wrong

1157
00:41:42,630 --> 00:41:40,240
and there's implanted memories and just

1158
00:41:43,990 --> 00:41:42,640
generally fallibility of memory and

1159
00:41:45,750 --> 00:41:44,000
all this business about how

1160
00:41:48,390 --> 00:41:45,760
consciousness is a

1161
00:41:49,670 --> 00:41:48,400
just so story that we concoct

1162
00:41:51,270 --> 00:41:49,680
to try to give us the illusion that

1163
00:41:54,230 --> 00:41:51,280

we're actually in control that we have

1164

00:41:56,550 --> 00:41:54,240

some memory accurate memory of the past

1165

00:41:58,870 --> 00:41:56,560

and that both are actually erroneous

1166

00:42:01,589 --> 00:41:58,880

um but so anyway

1167

00:42:04,870 --> 00:42:01,599

memory is just retrodiction

1168

00:42:06,950 --> 00:42:04,880

and so it is as prone subject to all

1169

00:42:09,829 --> 00:42:06,960

these impossibility results as any of

1170

00:42:11,430 --> 00:42:09,839

the inference device

1171

00:42:13,190 --> 00:42:11,440

so what that means in particular is what

1172

00:42:14,550 --> 00:42:13,200

the plus was only thinking forward in

1173

00:42:16,710 --> 00:42:14,560

time

1174

00:42:19,030 --> 00:42:16,720

the impossibility and so he wouldn't

1175

00:42:21,109 --> 00:42:19,040

even think there was an issue for having

1176

00:42:22,950 --> 00:42:21,119

of having to construct a demon

1177

00:42:24,470 --> 00:42:22,960

that would actually predict the past you

1178

00:42:25,670 --> 00:42:24,480

just simply say you you remember the

1179

00:42:28,069 --> 00:42:25,680

past

1180

00:42:29,190 --> 00:42:28,079

and so sure your memories are 100

1181

00:42:30,630 --> 00:42:29,200

accurate

1182

00:42:31,349 --> 00:42:30,640

in point of fact

1183

00:42:32,950 --> 00:42:31,359

no

1184

00:42:34,550 --> 00:42:32,960

according to these impossibility results

1185

00:42:37,670 --> 00:42:34,560

for the same reason that laplace cannot

1186

00:42:39,829 --> 00:42:37,680

predict the future with 100 accuracy

1187

00:42:40,870 --> 00:42:39,839

it's impossible to build a 100 percent

1188

00:42:43,270 --> 00:42:40,880

accurate

1189

00:42:45,510 --> 00:42:43,280

memory device

1190

00:42:46,630 --> 00:42:45,520

memories will always be valuable will

1191

00:42:48,390 --> 00:42:46,640

always be wrong there's always going to

1192

00:42:50,950 --> 00:42:48,400

be one other memories and recording that

1193

00:42:53,829 --> 00:42:50,960

device which could be your head

1194

00:42:57,510 --> 00:42:55,430

is there a relationship between the no

1195

00:42:59,510 --> 00:42:57,520

free lunch theorem and the limits on

1196

00:43:02,790 --> 00:42:59,520

inference devices

1197

00:43:04,710 --> 00:43:02,800

very good question so i found

1198

00:43:05,990 --> 00:43:04,720

somewhat to my bemusement that a lot of

1199

00:43:07,430 --> 00:43:06,000

the

1200

00:43:13,030 --> 00:43:07,440

stuff that i

1201
00:43:15,270 --> 00:43:13,040
investigate the things that i chew on

1202
00:43:17,190 --> 00:43:15,280
have to do with impossibilities

1203
00:43:19,109 --> 00:43:17,200
no free lunch is one of them inference

1204
00:43:21,030 --> 00:43:19,119
devices is another one

1205
00:43:23,270 --> 00:43:21,040
as i think i mentioned to you

1206
00:43:26,309 --> 00:43:23,280
the notion that mathematics itself might

1207
00:43:27,990 --> 00:43:26,319
be inherently sarcastic which is you uh

1208
00:43:30,150 --> 00:43:28,000
offline we discussed about how that's

1209
00:43:32,710 --> 00:43:30,160
related to intuitionism

1210
00:43:34,550 --> 00:43:32,720
some of the ideas of nikolas um gisen

1211
00:43:36,790 --> 00:43:34,560
and intuitionism of course

1212
00:43:38,950 --> 00:43:36,800
traces back to brower

1213
00:43:40,950 --> 00:43:38,960

um a great mathematician the 20th

1214

00:43:42,150 --> 00:43:40,960

century

1215

00:43:44,069 --> 00:43:42,160

and i think that there are some

1216

00:43:45,589 --> 00:43:44,079

potentially some possibility results

1217

00:43:47,670 --> 00:43:45,599

there as well

1218

00:43:50,470 --> 00:43:47,680

but all of these i suspect have to be

1219

00:43:55,270 --> 00:43:50,480

related to one another

1220

00:43:59,750 --> 00:43:57,030

that's on my

1221

00:44:02,870 --> 00:43:59,760

i've got everybody's got to do lists

1222

00:44:04,790 --> 00:44:02,880

and that's on one of my longer term

1223

00:44:07,190 --> 00:44:04,800

greatest size font

1224

00:44:08,790 --> 00:44:07,200

so to speak to do lists

1225

00:44:11,910 --> 00:44:08,800

is figure out

1226

00:44:13,750 --> 00:44:11,920

how to integrate these impossibility

1227

00:44:15,190 --> 00:44:13,760

results there's also ones that i haven't

1228

00:44:16,069 --> 00:44:15,200

that weren't the ones that i came up

1229

00:44:18,230 --> 00:44:16,079

with

1230

00:44:19,430 --> 00:44:18,240

there are the impossibility results um

1231

00:44:21,750 --> 00:44:19,440

that are involved with that have to do

1232

00:44:22,790 --> 00:44:21,760

with touring machines and girdle and so

1233

00:44:25,670 --> 00:44:22,800

on

1234

00:44:28,309 --> 00:44:25,680

um you think they're all related

1235

00:44:29,750 --> 00:44:28,319

well for example i'm doing some work at

1236

00:44:32,069 --> 00:44:29,760

a very very

1237

00:44:33,270 --> 00:44:32,079

low burner i wish i could do it um more

1238

00:44:36,790 --> 00:44:33,280

intensely

1239

00:44:38,790 --> 00:44:36,800

um on trying to

1240

00:44:40,390 --> 00:44:38,800

take you exploit the church touring

1241

00:44:43,349 --> 00:44:40,400

thesis

1242

00:44:46,309 --> 00:44:43,359

um to be able to say that in and as

1243

00:44:48,309 --> 00:44:46,319

within the context of inference devices

1244

00:44:49,829 --> 00:44:48,319

to say that if there is a universal

1245

00:44:52,150 --> 00:44:49,839

turing machine it's going to be

1246

00:44:54,309 --> 00:44:52,160

inference device

1247

00:44:56,870 --> 00:44:54,319

and can the and the impossibility

1248

00:44:58,470 --> 00:44:56,880

results concerning inference devices

1249

00:45:00,230 --> 00:44:58,480

do they for example tell us something

1250

00:45:01,990 --> 00:45:00,240

like you can't have two

1251
00:45:03,589 --> 00:45:02,000
um uh

1252
00:45:04,870 --> 00:45:03,599
perfectly accurate universal turing

1253
00:45:06,870 --> 00:45:04,880
machines

1254
00:45:09,829 --> 00:45:06,880
do they say do they provide another way

1255
00:45:11,990 --> 00:45:09,839
to prove the halting theorem

1256
00:45:13,990 --> 00:45:12,000
and so that's on my to-do list to see if

1257
00:45:15,430 --> 00:45:14,000
they might be integrated that way

1258
00:45:17,270 --> 00:45:15,440
um another

1259
00:45:18,710 --> 00:45:17,280
interesting thing is that the inference

1260
00:45:21,750 --> 00:45:18,720
devices

1261
00:45:22,710 --> 00:45:21,760
structure that i was describing to you

1262
00:45:24,630 --> 00:45:22,720
um

1263
00:45:27,030 --> 00:45:24,640

had no probability distributions over it

1264

00:45:29,910 --> 00:45:27,040

we were just talking about subsets of um

1265

00:45:31,670 --> 00:45:29,920

the set of all possible world lines

1266

00:45:33,270 --> 00:45:31,680

well let's slap down a probability

1267

00:45:34,950 --> 00:45:33,280

distribution

1268

00:45:37,190 --> 00:45:34,960

we can now modify some of our

1269

00:45:38,150 --> 00:45:37,200

definitions of what it means to infer

1270

00:45:39,190 --> 00:45:38,160

something

1271

00:45:40,069 --> 00:45:39,200

accurately

1272

00:45:42,150 --> 00:45:40,079

to be

1273

00:45:45,750 --> 00:45:42,160

to infer with a higher than certain

1274

00:45:48,069 --> 00:45:45,760

probability of being correct

1275

00:45:50,390 --> 00:45:48,079

we can then say well over all possible

1276

00:45:51,990 --> 00:45:50,400

probability distributions

1277

00:45:53,829 --> 00:45:52,000

so right so that what that means is that

1278

00:45:55,349 --> 00:45:53,839

rather than the impossibility results of

1279

00:45:57,430 --> 00:45:55,359

an inference devices that concern for

1280

00:45:59,750 --> 00:45:57,440

example two deities

1281

00:46:02,710 --> 00:45:59,760

instead what you start talking about the

1282

00:46:03,589 --> 00:46:02,720

probability distribute of all the worst

1283

00:46:04,950 --> 00:46:03,599

case

1284

00:46:10,069 --> 00:46:04,960

probability

1285

00:46:11,670 --> 00:46:10,079

that both deities could be um uh correct

1286

00:46:13,270 --> 00:46:11,680

or was the best case probability that

1287

00:46:15,190 --> 00:46:13,280

they could be correct over all possible

1288

00:46:16,950 --> 00:46:15,200

probability distributions

1289

00:46:19,109 --> 00:46:16,960

so rather than saying it's impossible

1290

00:46:20,069 --> 00:46:19,119

for them to both always be overall

1291

00:46:20,950 --> 00:46:20,079

interesting

1292

00:46:22,630 --> 00:46:20,960

yeah

1293

00:46:24,630 --> 00:46:22,640

and guess what you actually get some

1294

00:46:26,230 --> 00:46:24,640

results out of that that look a little

1295

00:46:28,790 --> 00:46:26,240

bit like the heisenberg uncertainty

1296

00:46:30,630 --> 00:46:28,800

principle is this published work um i

1297

00:46:32,470 --> 00:46:30,640

think it's mentioned in one of my papers

1298

00:46:34,309 --> 00:46:32,480

but it's both that and the turing

1299

00:46:36,069 --> 00:46:34,319

machine stuff

1300

00:46:38,470 --> 00:46:36,079

very tentative

1301
00:46:39,510 --> 00:46:38,480
there's a lot more that needs to be done

1302
00:46:41,910 --> 00:46:39,520
and that i

1303
00:46:43,910 --> 00:46:41,920
want to get to at some point i mean

1304
00:46:44,790 --> 00:46:43,920
there's this meta optimization problem

1305
00:46:47,190 --> 00:46:44,800
for

1306
00:46:48,309 --> 00:46:47,200
people who are so very very lucky like

1307
00:46:50,950 --> 00:46:48,319
as me

1308
00:46:52,470 --> 00:46:50,960
that society provides us the resources

1309
00:46:55,030 --> 00:46:52,480
to go off and

1310
00:47:00,550 --> 00:46:55,040
well play is the way it feels like to me

1311
00:47:04,309 --> 00:47:01,990
i wouldn't use the word plus i mean i

1312
00:47:06,230 --> 00:47:04,319
mean fortunate but fortunate yes people

1313
00:47:08,390 --> 00:47:06,240

who are so fortunate

1314

00:47:09,510 --> 00:47:08,400

um there's this optimization question of

1315

00:47:12,150 --> 00:47:09,520

well there's all these things that you

1316

00:47:13,750 --> 00:47:12,160

do want to work on

1317

00:47:15,190 --> 00:47:13,760

you've only got some finite number of

1318

00:47:16,069 --> 00:47:15,200

years left you don't even know what they

1319

00:47:18,150 --> 00:47:16,079

are

1320

00:47:19,910 --> 00:47:18,160

prioritize dude or do that as the case

1321

00:47:21,829 --> 00:47:19,920

might be

1322

00:47:23,510 --> 00:47:21,839

and so i'm not sure so at some point yes

1323

00:47:25,430 --> 00:47:23,520

i do want to work on these things but

1324

00:47:27,190 --> 00:47:25,440

the question is when and how and how to

1325

00:47:28,950 --> 00:47:27,200

get the time and if you can do it with

1326

00:47:30,549 --> 00:47:28,960

collaborators which i try to do and so

1327

00:47:31,990 --> 00:47:30,559

on and

1328

00:47:34,710 --> 00:47:32,000

it's one of the challenges of being

1329

00:47:36,870 --> 00:47:34,720

somebody who's as fortunate as i am is

1330

00:47:38,710 --> 00:47:36,880

what how best to use that fortune have

1331

00:47:41,109 --> 00:47:38,720

you heard of donald hoffman

1332

00:47:42,790 --> 00:47:41,119

no i don't think so okay donald hoffman

1333

00:47:45,990 --> 00:47:42,800

has an argument that says whatever we

1334

00:47:47,109 --> 00:47:46,000

see is not reality as it is oh yes yes

1335

00:47:47,990 --> 00:47:47,119

yes

1336

00:47:49,910 --> 00:47:48,000

um

1337

00:47:51,190 --> 00:47:49,920

i don't think i i've drilled into it i

1338

00:47:52,549 --> 00:47:51,200

don't think it really amounts to that

1339

00:47:55,109 --> 00:47:52,559

much

1340

00:47:58,150 --> 00:47:55,119

um to be quite honest yes let's hear why

1341

00:48:01,750 --> 00:47:58,160

um i'd have to

1342

00:48:04,630 --> 00:48:01,760

go back and review my notes um

1343

00:48:07,910 --> 00:48:06,230

i'm sorry

1344

00:48:10,150 --> 00:48:07,920

you um

1345

00:48:12,470 --> 00:48:10,160

so i've actually got i'm putting it up

1346

00:48:14,710 --> 00:48:12,480

right now for example my annotated

1347

00:48:16,230 --> 00:48:14,720

version of his

1348

00:48:20,549 --> 00:48:16,240

work

1349

00:48:24,549 --> 00:48:23,190

yeah and this is too much

1350

00:48:34,950 --> 00:48:24,559

i

1351

00:48:37,109 --> 00:48:34,960

that's one of the other challenges um

1352

00:48:39,270 --> 00:48:37,119

being fortunate is you have to very

1353

00:48:40,790 --> 00:48:39,280

quickly come to decisions about whether

1354

00:48:42,790 --> 00:48:40,800

it makes sense for you to be spending

1355

00:48:46,230 --> 00:48:42,800

any effort drilling down on things

1356

00:48:48,309 --> 00:48:46,240

so yeah i did look into his stuff and i

1357

00:48:50,069 --> 00:48:48,319

wasn't very impressed so there's one

1358

00:48:51,829 --> 00:48:50,079

particular article of his that you think

1359

00:48:53,510 --> 00:48:51,839

i should maybe look at rather than

1360

00:48:55,349 --> 00:48:53,520

whatever i did look at if you could just

1361

00:48:56,470 --> 00:48:55,359

email that to me

1362

00:48:57,670 --> 00:48:56,480

i'll see if there's anything different

1363

00:48:59,990 --> 00:48:57,680

about that one

1364

00:49:01,670 --> 00:49:00,000

sure that's a quick aside

1365

00:49:03,670 --> 00:49:01,680

my background's not computer science as

1366

00:49:05,829 --> 00:49:03,680

you know whenever i've skimmed the

1367

00:49:07,670 --> 00:49:05,839

church turing thesis it seems more like

1368

00:49:09,829 --> 00:49:07,680

a definition of what it means to compute

1369

00:49:12,230 --> 00:49:09,839

rather than a theorem per se

1370

00:49:13,910 --> 00:49:12,240

it's very close to that it's very close

1371

00:49:16,309 --> 00:49:13,920

to that there's a question of whether

1372

00:49:17,829 --> 00:49:16,319

it's ultimately vacuous or not there's

1373

00:49:20,069 --> 00:49:17,839

something called the physical church

1374

00:49:22,309 --> 00:49:20,079

touring thesis

1375

00:49:26,230 --> 00:49:22,319

where instead we people say things like

1376
00:49:28,470 --> 00:49:26,240
you cannot build a physical computer

1377
00:49:30,549 --> 00:49:28,480
that can do that

1378
00:49:32,710 --> 00:49:30,559
that implements algorithms

1379
00:49:35,430 --> 00:49:32,720
that can come to conclusions that would

1380
00:49:36,790 --> 00:49:35,440
not be um possible to do

1381
00:49:38,549 --> 00:49:36,800
on a physical

1382
00:49:40,950 --> 00:49:38,559
turing machine

1383
00:49:42,549 --> 00:49:40,960
and it's squirrely to even define it

1384
00:49:44,470 --> 00:49:42,559
there there are different definitions

1385
00:49:47,030 --> 00:49:44,480
you can find in the literature

1386
00:49:49,750 --> 00:49:47,040
scott aronson actually has a nice

1387
00:49:52,230 --> 00:49:49,760
video at like two hours long where he

1388
00:49:53,990 --> 00:49:52,240

talks about different um

1389

00:49:55,270 --> 00:49:54,000

challenges to the physical church during

1390

00:49:57,270 --> 00:49:55,280

thesis

1391

00:49:59,190 --> 00:49:57,280

one of the reasons i recall that david

1392

00:50:01,430 --> 00:49:59,200

deutsch first started working in quantum

1393

00:50:03,190 --> 00:50:01,440

computation his original paper

1394

00:50:06,390 --> 00:50:03,200

was to try to say that well if the

1395

00:50:10,069 --> 00:50:06,400

physical church touring thesis can be

1396

00:50:12,710 --> 00:50:10,079

either fully ironclad formalized and or

1397

00:50:13,750 --> 00:50:12,720

i'm established as actually a law of

1398

00:50:15,750 --> 00:50:13,760

nature

1399

00:50:17,670 --> 00:50:15,760

that means we have to be able to express

1400

00:50:19,750 --> 00:50:17,680

computation in purely quantum mechanical

1401

00:50:21,109 --> 00:50:19,760

systems because quantum mechanics is the

1402

00:50:23,430 --> 00:50:21,119

law of nature

1403

00:50:25,750 --> 00:50:23,440

so that was a large part as i understand

1404

00:50:27,510 --> 00:50:25,760

it of his impetus for starting to work

1405

00:50:29,270 --> 00:50:27,520

on what now has become called quantum

1406

00:50:30,230 --> 00:50:29,280

computation

1407

00:50:31,990 --> 00:50:30,240

um

1408

00:50:33,910 --> 00:50:32,000

so but yes you're correct that the

1409

00:50:35,190 --> 00:50:33,920

church touring thesis as it was

1410

00:50:37,829 --> 00:50:35,200

understood

1411

00:50:40,390 --> 00:50:37,839

say in the middle of the 20th century

1412

00:50:42,309 --> 00:50:40,400

seemed very dangerously close to simply

1413

00:50:45,030 --> 00:50:42,319

being a definition rather than actually

1414

00:50:46,710 --> 00:50:45,040

a statement about the physical world

1415

00:50:47,670 --> 00:50:46,720

so before we get to the audience

1416

00:50:48,870 --> 00:50:47,680

questions

1417

00:50:50,549 --> 00:50:48,880

you mentioned

1418

00:50:52,870 --> 00:50:50,559

in one of your talks by the way during

1419

00:50:55,270 --> 00:50:52,880

the break i did quickly remind myself

1420

00:50:56,230 --> 00:50:55,280

about um professor hoffman

1421

00:51:00,150 --> 00:50:56,240

okay

1422

00:51:02,150 --> 00:51:00,160

yeah and uh so what i understand and my

1423

00:51:04,630 --> 00:51:02,160

take on

1424

00:51:07,109 --> 00:51:04,640

his work so in a nutshell

1425

00:51:10,230 --> 00:51:07,119

um he's a neuroscientist and

1426

00:51:13,109 --> 00:51:10,240

in a um extension of what we were

1427

00:51:15,670 --> 00:51:13,119

talking about earlier a vast um

1428

00:51:18,069 --> 00:51:15,680

elaboration of the notion that

1429

00:51:19,829 --> 00:51:18,079

um uh consciousness and so on and so

1430

00:51:22,710 --> 00:51:19,839

forth it's all a fable

1431

00:51:25,109 --> 00:51:22,720

um he has been doing a lot of work

1432

00:51:28,630 --> 00:51:25,119

showing that in particular

1433

00:51:30,470 --> 00:51:28,640

our understanding of the external world

1434

00:51:32,710 --> 00:51:30,480

is completely concocted

1435

00:51:35,190 --> 00:51:32,720

that it's whatever our

1436

00:51:37,430 --> 00:51:35,200

century apparatus is going to think is

1437

00:51:38,470 --> 00:51:37,440

actually most effective

1438

00:51:40,950 --> 00:51:38,480

um

1439

00:51:42,950 --> 00:51:40,960

how to phrase it our sentry apparatus is

1440

00:51:45,109 --> 00:51:42,960

going to be telling us

1441

00:51:47,430 --> 00:51:45,119

precisely whatever natural selection

1442

00:51:49,589 --> 00:51:47,440

finds out by trial and error

1443

00:51:52,069 --> 00:51:49,599

is the best thing to tell us to get us

1444

00:51:54,069 --> 00:51:52,079

to act in an efficient way

1445

00:51:55,349 --> 00:51:54,079

as far as our reproductive success is

1446

00:51:58,069 --> 00:51:55,359

concerned

1447

00:52:00,150 --> 00:51:58,079

that which is telling us to do that

1448

00:52:02,950 --> 00:52:00,160

might have nothing really to do with any

1449

00:52:05,270 --> 00:52:02,960

kind of an external physical reality

1450

00:52:07,349 --> 00:52:05,280

it's kind of an elaboration of all the

1451
00:52:09,910 --> 00:52:07,359
um aspects that what you think you are

1452
00:52:11,270 --> 00:52:09,920
seeing for example you are not it's all

1453
00:52:12,870 --> 00:52:11,280
being filled in with what's called

1454
00:52:14,150 --> 00:52:12,880
predictive coding

1455
00:52:15,829 --> 00:52:14,160
in its broadest sense in the

1456
00:52:19,349 --> 00:52:15,839
neuroscience community

1457
00:52:21,750 --> 00:52:19,359
and so my understanding of his work

1458
00:52:23,829 --> 00:52:21,760
was that he has done some interesting

1459
00:52:25,829 --> 00:52:23,839
things related to that particular

1460
00:52:29,030 --> 00:52:25,839
scientific issue

1461
00:52:31,349 --> 00:52:29,040
but then um sort of uh

1462
00:52:33,430 --> 00:52:31,359
well frankly puffs it up

1463
00:52:35,670 --> 00:52:33,440

as to saying something about there is no

1464

00:52:36,549 --> 00:52:35,680

objective reality and so on and so forth

1465

00:52:39,109 --> 00:52:36,559

it's

1466

00:52:41,109 --> 00:52:39,119

no rather our human being fallible

1467

00:52:43,829 --> 00:52:41,119

perception of reality

1468

00:52:45,670 --> 00:52:43,839

um it can be very very different

1469

00:52:47,510 --> 00:52:45,680

and natural selection in fact you would

1470

00:52:48,630 --> 00:52:47,520

say which should make it be very very

1471

00:52:50,390 --> 00:52:48,640

different

1472

00:52:52,630 --> 00:52:50,400

from what we would from what an actual

1473

00:52:54,230 --> 00:52:52,640

reality is

1474

00:52:55,750 --> 00:52:54,240

okay now before we get to some audience

1475

00:52:57,589 --> 00:52:55,760

quest and just so you know as an aside i

1476

00:52:59,030 --> 00:52:57,599

don't believe donald hoffman although

1477

00:53:00,710 --> 00:52:59,040

maybe you have a different paper i don't

1478

00:53:03,270 --> 00:53:00,720

believe he indicates that there is no

1479

00:53:05,589 --> 00:53:03,280

reality he does say what you said which

1480

00:53:06,870 --> 00:53:05,599

is that our relationship to that reality

1481

00:53:08,710 --> 00:53:06,880

because the way that he constructs

1482

00:53:10,309 --> 00:53:08,720

reality it looks strange the way that

1483

00:53:12,470 --> 00:53:10,319

it's like three it's like agents

1484

00:53:15,270 --> 00:53:12,480

interacting with one another etc that's

1485

00:53:16,790 --> 00:53:15,280

the truth

1486

00:53:19,190 --> 00:53:16,800

that was just based on a quick skim

1487

00:53:20,790 --> 00:53:19,200

reminding myself from i have to put

1488

00:53:22,710 --> 00:53:20,800

after you admit the very pedestrian

1489

00:53:24,630 --> 00:53:22,720

source which is quantum magazine that's

1490

00:53:27,190 --> 00:53:24,640

okay and one of your talks i think in

1491

00:53:29,430 --> 00:53:27,200

one of your fpxi talks you mentioned

1492

00:53:31,430 --> 00:53:29,440

that some of the most profound results

1493

00:53:33,430 --> 00:53:31,440

in philosophy come from algorithmic

1494

00:53:34,790 --> 00:53:33,440

information theory yeah and

1495

00:53:36,790 --> 00:53:34,800

coincidentally i'll be speaking to

1496

00:53:38,069 --> 00:53:36,800

gregory chayton in a few weeks

1497

00:53:40,549 --> 00:53:38,079

so okay

1498

00:53:44,390 --> 00:53:40,559

please explain to me why you think that

1499

00:53:46,790 --> 00:53:44,400

okay i can use one of um uh greg

1500

00:53:49,270 --> 00:53:46,800

chetan i mean he does insist that be

1501
00:53:50,390 --> 00:53:49,280
pronounced chaitin rather than shaytan

1502
00:53:52,549 --> 00:53:50,400
um

1503
00:53:54,150 --> 00:53:52,559
he's a very interesting fellow in many

1504
00:53:55,270 --> 00:53:54,160
ways and he's done some great work one

1505
00:53:57,430 --> 00:53:55,280
of his

1506
00:53:59,430 --> 00:53:57,440
results in fact i think does have this

1507
00:54:01,510 --> 00:53:59,440
character to it he's got an

1508
00:54:05,270 --> 00:54:01,520
impossibility theorem

1509
00:54:06,549 --> 00:54:05,280
which is um basically it says that there

1510
00:54:08,710 --> 00:54:06,559
is

1511
00:54:09,670 --> 00:54:08,720
a integer

1512
00:54:11,109 --> 00:54:09,680
um

1513
00:54:14,470 --> 00:54:11,119

I

1514

00:54:16,190 --> 00:54:14,480

such that we can never ever prove

1515

00:54:17,589 --> 00:54:16,200

that any particular

1516

00:54:19,750 --> 00:54:17,599

[Music]

1517

00:54:21,109 --> 00:54:19,760

um uh

1518

00:54:23,510 --> 00:54:21,119

computation

1519

00:54:24,470 --> 00:54:23,520

that we would want to do any particular

1520

00:54:29,190 --> 00:54:24,480

string

1521

00:54:33,750 --> 00:54:31,670

okay there is some such integer and

1522

00:54:35,750 --> 00:54:33,760

he actually has an estimate of it as i

1523

00:54:36,630 --> 00:54:35,760

believe based upon this programs of

1524

00:54:39,109 --> 00:54:36,640

being

1525

00:54:39,990 --> 00:54:39,119

4000 if you're using lisp as your turing

1526
00:54:40,789 --> 00:54:40,000
machine

1527
00:54:42,789 --> 00:54:40,799
um

1528
00:54:44,710 --> 00:54:42,799
but think about what that means

1529
00:54:46,390 --> 00:54:44,720
there's going to be this number like ml

1530
00:54:47,829 --> 00:54:46,400
which is like say 4 000 that's saying

1531
00:54:50,150 --> 00:54:47,839
that you know anything that's longer

1532
00:54:52,789 --> 00:54:50,160
than 4 000 bytes

1533
00:54:55,750 --> 00:54:52,799
um so you cannot prove that the komodo

1534
00:54:59,270 --> 00:54:55,760
complexity of any particular string

1535
00:55:00,470 --> 00:54:59,280
is going to be greater than 4000 bytes

1536
00:55:03,510 --> 00:55:00,480
we know

1537
00:55:05,430 --> 00:55:03,520
that there's a very finite number of uh

1538
00:55:06,710 --> 00:55:05,440

strings that have less than four

1539

00:55:08,950 --> 00:55:06,720

thousand bytes

1540

00:55:10,390 --> 00:55:08,960

at most depending on the grammar and

1541

00:55:11,750 --> 00:55:10,400

syntax of your

1542

00:55:13,349 --> 00:55:11,760

language and so on it would be two to

1543

00:55:14,470 --> 00:55:13,359

the four thousand which would be a big

1544

00:55:17,030 --> 00:55:14,480

number but

1545

00:55:19,190 --> 00:55:17,040

i'm not it's very very finite

1546

00:55:21,430 --> 00:55:19,200

so that means that there's an infinite

1547

00:55:22,870 --> 00:55:21,440

number of strings

1548

00:55:25,589 --> 00:55:22,880

that exist

1549

00:55:29,829 --> 00:55:25,599

whose komodo complexity

1550

00:55:33,589 --> 00:55:31,910

so we can never know what is the

1551
00:55:34,630 --> 00:55:33,599
simplest program

1552
00:55:37,270 --> 00:55:34,640
size

1553
00:55:39,349 --> 00:55:37,280
for determining the simplest program

1554
00:55:41,510 --> 00:55:39,359
for actually doing those calculations

1555
00:55:43,990 --> 00:55:41,520
it's an amazing restriction on what we

1556
00:55:46,150 --> 00:55:44,000
human beings can do

1557
00:55:49,670 --> 00:55:46,160
to give you another example this is one

1558
00:55:51,670 --> 00:55:49,680
that i know best from my a book by um

1559
00:55:54,630 --> 00:55:51,680
lee and vitani it's kind of like the

1560
00:55:57,030 --> 00:55:54,640
bible and these turing machine things

1561
00:56:00,230 --> 00:55:57,040
you can actually

1562
00:56:02,789 --> 00:56:00,240
prove the existence of a function

1563
00:56:05,349 --> 00:56:02,799

from the integers to the integers

1564

00:56:06,950 --> 00:56:05,359

which is always increasing it never it

1565

00:56:09,270 --> 00:56:06,960

never sometimes will stay the same but

1566

00:56:11,589 --> 00:56:09,280

it never goes down and eventually gets

1567

00:56:14,069 --> 00:56:11,599

to infinity

1568

00:56:17,190 --> 00:56:14,079

such that every function you can

1569

00:56:19,990 --> 00:56:17,200

possibly compute no matter how you do it

1570

00:56:21,190 --> 00:56:20,000

that is also always increasing and gets

1571

00:56:24,950 --> 00:56:21,200

to infinity

1572

00:56:26,789 --> 00:56:24,960

will be strictly greater than this

1573

00:56:28,710 --> 00:56:26,799

you wouldn't have even thought there is

1574

00:56:29,670 --> 00:56:28,720

such a limitation that could even make

1575

00:56:31,829 --> 00:56:29,680

sense

1576

00:56:33,270 --> 00:56:31,839

do whatever you want say okay here's a

1577

00:56:35,190 --> 00:56:33,280

function which

1578

00:56:37,270 --> 00:56:35,200

it has the value one

1579

00:56:39,670 --> 00:56:37,280

for the first million numbers from one

1580

00:56:42,150 --> 00:56:39,680

through a million it's got the value one

1581

00:56:44,390 --> 00:56:42,160

then it's got the value two but that's

1582

00:56:45,349 --> 00:56:44,400

for the next million to the millions

1583

00:56:46,789 --> 00:56:45,359

okay

1584

00:56:48,789 --> 00:56:46,799

you know make it be whatever you want

1585

00:56:50,950 --> 00:56:48,799

every rule that you can put down for how

1586

00:56:52,870 --> 00:56:50,960

to construct this

1587

00:56:56,390 --> 00:56:52,880

it's going to actually be getting to

1588

00:56:59,510 --> 00:56:56,400

infinity faster than this other function

1589

00:57:00,950 --> 00:56:59,520

which is a very strange thing and it's

1590

00:57:02,309 --> 00:57:00,960

reality

1591

00:57:05,109 --> 00:57:02,319

it's one of the most fundamental

1592

00:57:07,190 --> 00:57:05,119

philosophical results in the sense that

1593

00:57:09,670 --> 00:57:07,200

philosophy

1594

00:57:13,750 --> 00:57:09,680

should not be biased towards what we

1595

00:57:15,750 --> 00:57:13,760

human beings consider to be compelling i

1596

00:57:19,349 --> 00:57:15,760

find it that

1597

00:57:21,750 --> 00:57:19,359

impossibility results in general

1598

00:57:24,309 --> 00:57:21,760

and of these sorts in particular

1599

00:57:26,230 --> 00:57:24,319

they are very deep philosophy whether or

1600

00:57:28,390 --> 00:57:26,240

not we even appreciate they had meaning

1601
00:57:30,390 --> 00:57:28,400
before we came across them

1602
00:57:31,990 --> 00:57:30,400
um another one what was the name of that

1603
00:57:33,670 --> 00:57:32,000
one that second one

1604
00:57:34,630 --> 00:57:33,680
oh this is i don't even think it has a

1605
00:57:39,349 --> 00:57:34,640
name

1606
00:57:41,109 --> 00:57:39,359
point you to the chapter and yeah

1607
00:57:43,750 --> 00:57:41,119
um it's but there's another one that for

1608
00:57:46,150 --> 00:57:43,760
example um scott aronson has a nice blog

1609
00:57:47,430 --> 00:57:46,160
post on this it's called the busy beaver

1610
00:57:49,990 --> 00:57:47,440
function

1611
00:57:52,150 --> 00:57:50,000
and he's actually recently written some

1612
00:57:53,750 --> 00:57:52,160
uh papers on it as well

1613
00:57:55,270 --> 00:57:53,760

and this is kind of the flip side of

1614

00:57:56,150 --> 00:57:55,280

what i just said

1615

00:57:59,190 --> 00:57:56,160

that

1616

00:58:01,910 --> 00:57:59,200

let's try to make the fastest increasing

1617

00:58:03,670 --> 00:58:01,920

function possible

1618

00:58:05,670 --> 00:58:03,680

so you curt

1619

00:58:08,309 --> 00:58:05,680

say that well for the value one it's got

1620

00:58:10,710 --> 00:58:08,319

the value one for the value 2 it's got

1621

00:58:12,950 --> 00:58:10,720

the value 10 to the 10 to the 10.

1622

00:58:14,789 --> 00:58:12,960

for the value 3 it's got

1623

00:58:15,829 --> 00:58:14,799

white height for the value 2 but now

1624

00:58:18,630 --> 00:58:15,839

itself

1625

00:58:20,870 --> 00:58:18,640

make it be whatever you want

1626
00:58:23,109 --> 00:58:20,880
there is always going to be something

1627
00:58:25,829 --> 00:58:23,119
which is called the busy beaver function

1628
00:58:28,470 --> 00:58:25,839
which is actually increasing faster than

1629
00:58:30,470 --> 00:58:28,480
the the fastest increasing function you

1630
00:58:32,069 --> 00:58:30,480
can write down in other words there's an

1631
00:58:36,870 --> 00:58:32,079
upper limit

1632
00:58:39,109 --> 00:58:36,880
the speed of increase of any function

1633
00:58:41,750 --> 00:58:39,119
from the introduce the integers that you

1634
00:58:43,750 --> 00:58:41,760
can possibly define

1635
00:58:45,510 --> 00:58:43,760
it's it's in a certain sense it's

1636
00:58:47,910 --> 00:58:45,520
mind-boggling that there's that kind of

1637
00:58:49,670 --> 00:58:47,920
a limitation on what we can do i'm not

1638
00:58:50,870 --> 00:58:49,680

understanding it correctly so at first

1639

00:58:52,150 --> 00:58:50,880

the way that i understood what you said

1640

00:58:54,230 --> 00:58:52,160

is that you have a function that's

1641

00:58:57,190 --> 00:58:54,240

increasing and then you can make it

1642

00:58:59,349 --> 00:58:57,200

increase faster but then there's a bound

1643

00:59:01,030 --> 00:58:59,359

there's about i can write down an

1644

00:59:02,390 --> 00:59:01,040

increase i can write down the definition

1645

00:59:04,950 --> 00:59:02,400

of a function

1646

00:59:07,190 --> 00:59:04,960

and it exists i can prove it exists

1647

00:59:09,430 --> 00:59:07,200

and it is an increasing function

1648

00:59:11,349 --> 00:59:09,440

and it will be increasing faster than

1649

00:59:12,150 --> 00:59:11,359

any function that you can possibly write

1650

00:59:14,069 --> 00:59:12,160

down

1651
00:59:15,510 --> 00:59:14,079
now i have a question about that like i

1652
00:59:17,510 --> 00:59:15,520
mentioned i'm speaking to someone who's

1653
00:59:19,430 --> 00:59:17,520
an ultrafinitist an intuitionist and

1654
00:59:21,270 --> 00:59:19,440
they don't particularly like existence

1655
00:59:23,430 --> 00:59:21,280
proofs they like construction

1656
00:59:25,589 --> 00:59:23,440
yep and that's that is the foundation of

1657
00:59:27,910 --> 00:59:25,599
intuitionism i don't think that actually

1658
00:59:30,390 --> 00:59:27,920
nicholas gibson

1659
00:59:32,390 --> 00:59:30,400
that goes that far though i'm not sure

1660
00:59:33,349 --> 00:59:32,400
he might in some side eddy of one of his

1661
00:59:35,349 --> 00:59:33,359
papers

1662
00:59:37,589 --> 00:59:35,359
um but yeah that was the foundation they

1663
00:59:39,829 --> 00:59:37,599

don't like existence proofs they want a

1664

00:59:41,030 --> 00:59:39,839

um constructive proof only is this

1665

00:59:43,190 --> 00:59:41,040

constructed or you just showed the

1666

00:59:45,109 --> 00:59:43,200

existence of this one oh the busy beaver

1667

00:59:48,309 --> 00:59:45,119

function um

1668

00:59:50,870 --> 00:59:48,319

it has been constructed for the first

1669

00:59:52,390 --> 00:59:50,880

some number of values of what of the

1670

00:59:53,990 --> 00:59:52,400

integer so we know

1671

00:59:56,150 --> 00:59:54,000

for we can write down a busy beaver

1672

00:59:57,670 --> 00:59:56,160

function for one for two for three for

1673

01:00:00,789 --> 00:59:57,680

four and so on

1674

01:00:03,109 --> 01:00:00,799

up to some particular value but i think

1675

01:00:04,390 --> 01:00:03,119

that um in the busy beaver function in

1676

01:00:05,990 --> 01:00:04,400

its entirety

1677

01:00:07,430 --> 01:00:06,000

almost by definition no it can't be

1678

01:00:11,190 --> 01:00:07,440

constructed

1679

01:00:13,990 --> 01:00:11,200

kurt would construct it

1680

01:00:15,430 --> 01:00:14,000

that's the point that this thing exists

1681

01:00:16,710 --> 01:00:15,440

wait sorry i don't get that last my way

1682

01:00:18,309 --> 01:00:16,720

if it could be constructed i could

1683

01:00:21,589 --> 01:00:18,319

construct it what do you mean

1684

01:00:24,549 --> 01:00:21,599

um so the definition so if it if by

1685

01:00:27,270 --> 01:00:24,559

construct if i construct a function we

1686

01:00:29,430 --> 01:00:27,280

mean you write down a program

1687

01:00:31,030 --> 01:00:29,440

that spits out its values

1688

01:00:33,510 --> 01:00:31,040

that's what we mean to construct a

1689

01:00:36,309 --> 01:00:33,520

function then the busy beaver function

1690

01:00:38,150 --> 01:00:36,319

is something that increases faster than

1691

01:00:40,950 --> 01:00:38,160

could be the output of any such program

1692

01:00:43,510 --> 01:00:40,960

you can write down oh okay okay okay

1693

01:00:45,270 --> 01:00:43,520

mean it's very very easy to define

1694

01:00:47,990 --> 01:00:45,280

and um

1695

01:00:49,750 --> 01:00:48,000

and the uh so in

1696

01:00:51,589 --> 01:00:49,760

it is purely an existence function that

1697

01:00:54,950 --> 01:00:51,599

you can't construct it but

1698

01:00:57,190 --> 01:00:54,960

i can define it very very easily

1699

01:01:02,230 --> 01:00:57,200

um it takes only a couple of sentences

1700

01:01:05,990 --> 01:01:04,150

so there are these kinds of results

1701
01:01:08,069 --> 01:01:06,000
which

1702
01:01:09,750 --> 01:01:08,079
i find in many ways

1703
01:01:11,349 --> 01:01:09,760
flabbergasting

1704
01:01:14,309 --> 01:01:11,359
because they're

1705
01:01:18,870 --> 01:01:14,319
if one adopts the church turing thesis

1706
01:01:20,230 --> 01:01:18,880
these are limitations on human thinking

1707
01:01:21,430 --> 01:01:20,240
and there are other ones and this is an

1708
01:01:23,829 --> 01:01:21,440
addition to all the ones like the

1709
01:01:25,910 --> 01:01:23,839
halting problem you know halting theorem

1710
01:01:27,430 --> 01:01:25,920
which is um very closely related to of

1711
01:01:28,470 --> 01:01:27,440
course some girls in completeness

1712
01:01:32,710 --> 01:01:28,480
theorem

1713
01:01:36,230 --> 01:01:32,720

these other things

1714

01:01:42,549 --> 01:01:38,950

really

1715

01:01:44,789 --> 01:01:42,559

i think that the only actual results of

1716

01:01:46,309 --> 01:01:44,799

the only actual

1717

01:01:48,309 --> 01:01:46,319

philosophical advances that have been

1718

01:01:50,710 --> 01:01:48,319

made by humanity

1719

01:01:53,430 --> 01:01:50,720

are these kinds of results

1720

01:01:55,430 --> 01:01:53,440

everything else is not only questionable

1721

01:01:57,670 --> 01:01:55,440

um and is being questioned it is

1722

01:01:59,349 --> 01:01:57,680

ultimately going to be quicksand and

1723

01:02:00,950 --> 01:01:59,359

it's just going to be squishy and you're

1724

01:02:02,309 --> 01:02:00,960

not going to get anywhere

1725

01:02:04,069 --> 01:02:02,319

these are the only ones that we have

1726
01:02:05,109 --> 01:02:04,079
managed to generate so far these are it

1727
01:02:06,870 --> 01:02:05,119
folks

1728
01:02:08,150 --> 01:02:06,880
by definition they are the deepest

1729
01:02:10,069 --> 01:02:08,160
because they are

1730
01:02:12,109 --> 01:02:10,079
the full set of things that we have

1731
01:02:14,630 --> 01:02:12,119
actually established

1732
01:02:17,589 --> 01:02:14,640
incontrovertibly or as incontrovertible

1733
01:02:19,109 --> 01:02:17,599
as any um deductive logic could be for

1734
01:02:21,190 --> 01:02:19,119
mathematics

1735
01:02:22,950 --> 01:02:21,200
okay i'm going to send you a chat right

1736
01:02:24,630 --> 01:02:22,960
now let me know if you can pull it up on

1737
01:02:26,470 --> 01:02:24,640
your end or if it automatically gets

1738
01:02:28,630 --> 01:02:26,480

sent to you see there

1739

01:02:30,230 --> 01:02:28,640

well it's a big one okay yeah yeah okay

1740

01:02:32,390 --> 01:02:30,240

so the reason i'm sending it to you is

1741

01:02:34,069 --> 01:02:32,400

because i'm probably going to miss read

1742

01:02:35,670 --> 01:02:34,079

this and it's easier if you read along

1743

01:02:38,069 --> 01:02:35,680

with me oh these are questions from the

1744

01:02:39,750 --> 01:02:38,079

audience yes this is not live obviously

1745

01:02:41,349 --> 01:02:39,760

i'm just saying this is from before so

1746

01:02:42,390 --> 01:02:41,359

this question

1747

01:02:43,750 --> 01:02:42,400

we're now we're getting onto some

1748

01:02:45,510 --> 01:02:43,760

audience questions and this comes from

1749

01:02:47,829 --> 01:02:45,520

chris langan let's get to question

1750

01:02:49,910 --> 01:02:47,839

number two which says he prior to this

1751

01:02:51,910 --> 01:02:49,920

was was referencing how in your

1752

01:02:53,990 --> 01:02:51,920

definition of observer there's a

1753

01:02:55,789 --> 01:02:54,000

theological aspect because an observer

1754

01:02:57,990 --> 01:02:55,799

wants to preserve its own

1755

01:02:59,510 --> 01:02:58,000

self-organization properties

1756

01:03:00,549 --> 01:02:59,520

not required in the definition of

1757

01:03:02,309 --> 01:03:00,559

observer

1758

01:03:05,349 --> 01:03:02,319

it doesn't there's nothing in there

1759

01:03:06,870 --> 01:03:05,359

about what your goal is

1760

01:03:09,029 --> 01:03:06,880

there's nothing in there about

1761

01:03:10,630 --> 01:03:09,039

intentionality in any of the inference

1762

01:03:13,990 --> 01:03:10,640

devices work

1763

01:03:16,230 --> 01:03:14,000

it's just you could be observing by luck

1764

01:03:19,029 --> 01:03:16,240

you're predicted so it includes the case

1765

01:03:20,470 --> 01:03:19,039

where your predictions are correct by

1766

01:03:22,390 --> 01:03:20,480

pure luck

1767

01:03:23,829 --> 01:03:22,400

or maybe even worse you thought that you

1768

01:03:25,910 --> 01:03:23,839

were answering a different question from

1769

01:03:26,950 --> 01:03:25,920

the real one but you were screwed up in

1770

01:03:29,190 --> 01:03:26,960

your thinking you happened to

1771

01:03:31,029 --> 01:03:29,200

accidentally get the answers right well

1772

01:03:32,710 --> 01:03:31,039

no the impossibility results so you

1773

01:03:34,630 --> 01:03:32,720

can't even do it that way

1774

01:03:36,549 --> 01:03:34,640

you can't get there by averted vision so

1775

01:03:38,630 --> 01:03:36,559

to speak so there's nothing about um

1776

01:03:41,270 --> 01:03:38,640

what you mean

1777

01:03:43,430 --> 01:03:41,280

for the question to actually be about

1778

01:03:45,190 --> 01:03:43,440

then let's do number four your work

1779

01:03:47,589 --> 01:03:45,200

straddles the boundary between mind and

1780

01:03:49,750 --> 01:03:47,599

matter what about cartesian mind slash

1781

01:03:51,270 --> 01:03:49,760

matter dualism which says that mind and

1782

01:03:52,950 --> 01:03:51,280

matter are fundamentally different do

1783

01:03:54,549 --> 01:03:52,960

you agree or do you believe they're both

1784

01:03:58,069 --> 01:03:54,559

aspects of

1785

01:04:00,470 --> 01:03:58,079

i don't see there's anything useful to

1786

01:04:02,230 --> 01:04:00,480

be had with the cartesian mind matter

1787

01:04:03,510 --> 01:04:02,240

duelist

1788

01:04:05,349 --> 01:04:03,520

perspective remember what we were

1789

01:04:06,470 --> 01:04:05,359

talking about before about it

1790

01:04:07,910 --> 01:04:06,480

let me just complete the sentence

1791

01:04:10,390 --> 01:04:07,920

because the audience doesn't have access

1792

01:04:11,829 --> 01:04:10,400

so do you agree or do you believe that

1793

01:04:13,349 --> 01:04:11,839

they're both aspects of a single

1794

01:04:15,109 --> 01:04:13,359

underlying reality

1795

01:04:18,870 --> 01:04:15,119

okay i didn't see that second part in

1796

01:04:24,230 --> 01:04:21,029

mind and matter um

1797

01:04:26,630 --> 01:04:24,240

okay so it's got to a degree i see um

1798

01:04:29,430 --> 01:04:26,640

it involves a little part a little bit

1799

01:04:31,270 --> 01:04:29,440

where we are in that philosophy house

1800

01:04:33,510 --> 01:04:31,280

and what level we've gone to and i'm

1801

01:04:35,670 --> 01:04:33,520

sitting there with all the assumptions

1802

01:04:37,829 --> 01:04:35,680

about of these sort of what i could very

1803

01:04:39,670 --> 01:04:37,839

loosely and inaccurately describe as

1804

01:04:41,270 --> 01:04:39,680

scientific realism

1805

01:04:42,630 --> 01:04:41,280

then there is zero reason to believe

1806

01:04:43,829 --> 01:04:42,640

that there's anything in mind that does

1807

01:04:46,069 --> 01:04:43,839

not matter

1808

01:04:47,750 --> 01:04:46,079

and in fact even most even people that i

1809

01:04:49,750 --> 01:04:47,760

think are frankly wrong about many

1810

01:04:51,990 --> 01:04:49,760

things like david chalmers

1811

01:04:55,349 --> 01:04:52,000

worrying about um about consciousness

1812

01:04:56,069 --> 01:04:55,359

means and qualia and sorry penrose as

1813

01:04:58,710 --> 01:04:56,079

well

1814

01:05:02,069 --> 01:04:58,720

mind

1815

01:05:06,829 --> 01:05:02,079

um even these people um uh

1816

01:05:10,069 --> 01:05:08,549

almost

1817

01:05:12,549 --> 01:05:10,079

uniformly

1818

01:05:17,190 --> 01:05:12,559

and almost in total

1819

01:05:19,190 --> 01:05:17,200

um accept that mind is ultimately matter

1820

01:05:21,029 --> 01:05:19,200

um so that

1821

01:05:22,950 --> 01:05:21,039

this is part of why i find qualia to

1822

01:05:24,630 --> 01:05:22,960

ultimately be a vacuous concept is that

1823

01:05:25,990 --> 01:05:24,640

if you do accept that

1824

01:05:27,270 --> 01:05:26,000

i don't see whether there really any

1825

01:05:29,029 --> 01:05:27,280

wiggle room

1826

01:05:31,029 --> 01:05:29,039

to worry about well what are your

1827

01:05:32,710 --> 01:05:31,039

subjective impressions then i'll amount

1828

01:05:34,870 --> 01:05:32,720

to which is essentially what the quote

1829

01:05:36,789 --> 01:05:34,880

hard question of conscience is about

1830

01:05:38,950 --> 01:05:36,799

so when i'm sitting up there

1831

01:05:40,309 --> 01:05:38,960

in my scientific reel as some room of

1832

01:05:43,510 --> 01:05:40,319

the house

1833

01:05:45,589 --> 01:05:43,520

um a mind is just a um

1834

01:05:47,510 --> 01:05:45,599

attribute of a matter

1835

01:05:50,390 --> 01:05:47,520

for the reasons that hoffman alludes to

1836

01:05:52,150 --> 01:05:50,400

dates um elucidates um dan dennett has

1837

01:05:53,990 --> 01:05:52,160

some great work all the

1838

01:05:56,789 --> 01:05:54,000

zombie within stuff

1839

01:05:58,710 --> 01:05:56,799

um what mind um thinks it knows about

1840

01:06:00,630 --> 01:05:58,720

matter actually is in many many ways

1841

01:06:01,510 --> 01:06:00,640

completely fallacious

1842

01:06:04,470 --> 01:06:01,520

um

1843

01:06:05,910 --> 01:06:04,480

then when i drill down below that of

1844

01:06:08,470 --> 01:06:05,920

course you start running into things

1845

01:06:10,150 --> 01:06:08,480

like solipsism brain in a vat brain of

1846

01:06:12,390 --> 01:06:10,160

that is a cutesy little thing that

1847

01:06:14,150 --> 01:06:12,400

freshmen debate and has kind of been

1848

01:06:16,549 --> 01:06:14,160

ignored in the academy

1849

01:06:18,630 --> 01:06:16,559

nobody has gotten a answer to that

1850

01:06:20,470 --> 01:06:18,640

challenge because you can't have one

1851
01:06:22,069 --> 01:06:20,480
instead what do you do is you assume

1852
01:06:23,510 --> 01:06:22,079
that no let's assume that we're not a

1853
01:06:25,029 --> 01:06:23,520
brain in a vat

1854
01:06:26,630 --> 01:06:25,039
and that's the basis for most of

1855
01:06:27,510 --> 01:06:26,640
metaphysics because you can't go beyond

1856
01:06:29,109 --> 01:06:27,520
that

1857
01:06:31,589 --> 01:06:29,119
but if you were to

1858
01:06:33,029 --> 01:06:31,599
not make that assumption if you as i

1859
01:06:35,270 --> 01:06:33,039
mentioned before you go through these

1860
01:06:37,190 --> 01:06:35,280
various rooms in the house of philosophy

1861
01:06:39,029 --> 01:06:37,200
by throwing out assumptions

1862
01:06:41,589 --> 01:06:39,039
if you don't make the a priori

1863
01:06:43,670 --> 01:06:41,599

assumption that what we are perceiving

1864

01:06:45,670 --> 01:06:43,680

is somehow

1865

01:06:48,150 --> 01:06:45,680

coupled to a reality that we are more

1866

01:06:50,069 --> 01:06:48,160

than a brain in the vat or matrix if you

1867

01:06:51,750 --> 01:06:50,079

wish to view it that way or whatever

1868

01:06:53,990 --> 01:06:51,760

then you're stuck right there and the

1869

01:06:55,670 --> 01:06:54,000

question of is there a duality between

1870

01:06:57,670 --> 01:06:55,680

mind and matter

1871

01:06:59,190 --> 01:06:57,680

um if we're going to allow that i'm a

1872

01:07:01,270 --> 01:06:59,200

brain in a vat

1873

01:07:03,589 --> 01:07:01,280

then um that question takes on

1874

01:07:04,390 --> 01:07:03,599

completely different um aspects to it

1875

01:07:05,750 --> 01:07:04,400

that

1876

01:07:07,510 --> 01:07:05,760

mind

1877

01:07:08,390 --> 01:07:07,520

becomes matter in a different sense and

1878

01:07:12,710 --> 01:07:08,400

you can

1879

01:07:14,150 --> 01:07:12,720

and start saying that well in fact and i

1880

01:07:16,069 --> 01:07:14,160

think this is where ultimately the

1881

01:07:17,589 --> 01:07:16,079

quality of people the heart problem of

1882

01:07:19,270 --> 01:07:17,599

consciousness people are coming from

1883

01:07:21,990 --> 01:07:19,280

that ultimately

1884

01:07:24,309 --> 01:07:22,000

mind comes first and whether there is

1885

01:07:26,789 --> 01:07:24,319

even matter or not

1886

01:07:28,549 --> 01:07:26,799

is a tbd

1887

01:07:30,309 --> 01:07:28,559

or to put it in another way i could

1888

01:07:32,309 --> 01:07:30,319

define a universe in the sense of

1889

01:07:35,029 --> 01:07:32,319

inference devices

1890

01:07:38,150 --> 01:07:35,039

which arguably is only mind

1891

01:07:39,430 --> 01:07:38,160

um and there is no such thing as matter

1892

01:07:41,430 --> 01:07:39,440

so you know once we get down to the

1893

01:07:45,270 --> 01:07:41,440

level of inference devices where a

1894

01:07:46,870 --> 01:07:45,280

universe is just a set of world lines

1895

01:07:49,430 --> 01:07:46,880

essentially we're down at what's called

1896

01:07:51,190 --> 01:07:49,440

sometimes anti-structural realism

1897

01:07:53,829 --> 01:07:51,200

we've actually gone even further than

1898

01:07:56,710 --> 01:07:53,839

max tegmart's multiverses

1899

01:07:58,390 --> 01:07:56,720

and all that any of reality amounts to

1900

01:07:59,589 --> 01:07:58,400

is a

1901

01:08:02,870 --> 01:07:59,599

pattern

1902

01:08:06,710 --> 01:08:02,880

relating aspects of these world lines

1903

01:08:09,029 --> 01:08:06,720

laws of the universe are just patterns

1904

01:08:11,670 --> 01:08:09,039

which could at any time be violated or

1905

01:08:13,990 --> 01:08:11,680

not and once you get to that level

1906

01:08:15,430 --> 01:08:14,000

that's just patterns just mathematics

1907

01:08:17,669 --> 01:08:15,440

that reality

1908

01:08:19,030 --> 01:08:17,679

to a pawn on a chess board is the laws

1909

01:08:21,510 --> 01:08:19,040

of chess

1910

01:08:23,269 --> 01:08:21,520

because that's what it's reality is it's

1911

01:08:25,110 --> 01:08:23,279

almost definitional

1912

01:08:26,950 --> 01:08:25,120

then you have no such there is no

1913

01:08:28,709 --> 01:08:26,960

distinction between mind and matter or

1914

01:08:30,709 --> 01:08:28,719

anything else

1915

01:08:32,470 --> 01:08:30,719

it's all just patterns at that level

1916

01:08:34,470 --> 01:08:32,480

there is no distinction the distinction

1917

01:08:37,189 --> 01:08:34,480

between minor matter

1918

01:08:38,709 --> 01:08:37,199

they come to play with you put throw in

1919

01:08:40,470 --> 01:08:38,719

other assumptions

1920

01:08:44,229 --> 01:08:40,480

that put you in other

1921

01:08:47,749 --> 01:08:46,070

so the answer depends where you want to

1922

01:08:49,669 --> 01:08:47,759

situate your self-interest original

1923

01:08:52,309 --> 01:08:49,679

assumptions you adopt

1924

01:08:55,269 --> 01:08:52,319

this question now comes from i just sent

1925

01:08:58,149 --> 01:08:55,279

it this question is carl fristen carl

1926

01:08:59,990 --> 01:08:58,159

fristen of the free energy principle

1927

01:09:01,510 --> 01:09:00,000

it is a compelling notion that systems

1928

01:09:03,430 --> 01:09:01,520

extract information from their

1929

01:09:06,229 --> 01:09:03,440

environment to maintain themselves far

1930

01:09:08,950 --> 01:09:06,239

from equilibrium but is this extraction

1931

01:09:10,630 --> 01:09:08,960

cause or consequence in other words are

1932

01:09:12,789 --> 01:09:10,640

non-equilibrium steady states a

1933

01:09:15,269 --> 01:09:12,799

consequence of observing or making

1934

01:09:17,030 --> 01:09:15,279

inferences about other systems and then

1935

01:09:17,510 --> 01:09:17,040

there's some pulse amble

1936

01:09:18,829 --> 01:09:17,520

um

1937

01:09:22,070 --> 01:09:18,839

[Music]

1938

01:09:24,870 --> 01:09:22,080

so this is touching on a huge body work

1939

01:09:26,470 --> 01:09:24,880

my primary body of research these days

1940

01:09:27,430 --> 01:09:26,480

which we've actually not discussed at

1941

01:09:32,149 --> 01:09:27,440

all

1942

01:09:33,430 --> 01:09:32,159

thermodynamics non-equilibrium

1943

01:09:34,470 --> 01:09:33,440

thermodynamics

1944

01:09:36,950 --> 01:09:34,480

um

1945

01:09:38,309 --> 01:09:36,960

carl right there is i think without

1946

01:09:40,309 --> 01:09:38,319

being sure without this actually being a

1947

01:09:42,789 --> 01:09:40,319

proper conversation is he's trying to

1948

01:09:45,590 --> 01:09:42,799

lead me into

1949

01:09:47,269 --> 01:09:45,600

saying things which basically justify

1950

01:09:49,510 --> 01:09:47,279

his notions of having with markov

1951

01:09:50,950 --> 01:09:49,520

blankets and so on and so forth

1952

01:09:53,030 --> 01:09:50,960

um

1953

01:09:55,030 --> 01:09:53,040

instead to make a plug for myself is a

1954

01:09:56,950 --> 01:09:55,040

paper that i wrote with a postdoc artemy

1955

01:09:57,990 --> 01:09:56,960

kolczynski

1956

01:10:00,390 --> 01:09:58,000

um

1957

01:10:04,310 --> 01:10:00,400

with the title has to do with semantic

1958

01:10:07,669 --> 01:10:04,320

information and non-equilibrium physics

1959

01:10:09,350 --> 01:10:07,679

in which we make the case that

1960

01:10:11,830 --> 01:10:09,360

without necessarily wanting to say that

1961

01:10:14,310 --> 01:10:11,840

they are living systems whether they are

1962

01:10:16,870 --> 01:10:14,320

conscious systems in a certain sense

1963

01:10:17,990 --> 01:10:16,880

interesting systems are those that are

1964

01:10:19,750 --> 01:10:18,000

what are at what are called

1965

01:10:22,149 --> 01:10:19,760

non-equilibrium steady states which is a

1966

01:10:24,229 --> 01:10:22,159

word that carl is using there

1967

01:10:26,550 --> 01:10:24,239

and that maintain themselves as being

1968

01:10:28,709 --> 01:10:26,560

non-equilibrium steady states

1969

01:10:30,390 --> 01:10:28,719

because of the information that they are

1970

01:10:33,270 --> 01:10:30,400

actually getting from the environment

1971

01:10:35,910 --> 01:10:33,280

getting from it in a precise sense of

1972

01:10:37,270 --> 01:10:35,920

conditional information flows

1973

01:10:39,189 --> 01:10:37,280

um

1974

01:10:42,229 --> 01:10:39,199

and i think that those are very

1975

01:10:43,990 --> 01:10:42,239

interesting systems to

1976

01:10:45,830 --> 01:10:44,000

investigate and that's a whole nother

1977

01:10:47,270 --> 01:10:45,840

body of work that i would like to

1978

01:10:50,870 --> 01:10:47,280

investigate

1979

01:10:53,030 --> 01:10:50,880

but in terms of which came first

1980

01:10:55,350 --> 01:10:53,040

i'm

1981

01:10:57,510 --> 01:10:55,360

is this extraction cause or consequence

1982

01:10:59,990 --> 01:10:57,520

to me it's actually much more

1983

01:11:01,830 --> 01:11:00,000

that there are systems which do have

1984

01:11:04,070 --> 01:11:01,840

that extraction

1985

01:11:05,990 --> 01:11:04,080

and i would say it's neither cause nor

1986

01:11:08,229 --> 01:11:06,000

consequence

1987

01:11:10,830 --> 01:11:08,239

um are non-equilibrium steady states a

1988

01:11:13,189 --> 01:11:10,840

consequence of observing other

1989

01:11:15,350 --> 01:11:13,199

systems and physicists can give a very

1990

01:11:16,470 --> 01:11:15,360

simple answer no i can define non-equi

1991

01:11:18,550 --> 01:11:16,480

but enough a way to make a

1992

01:11:20,310 --> 01:11:18,560

non-equilibrium steady state is to

1993

01:11:22,310 --> 01:11:20,320

simply hook up a system to two heat

1994

01:11:24,070 --> 01:11:22,320

baths at different temperatures

1995

01:11:25,830 --> 01:11:24,080

and it will go into what is called in

1996

01:11:28,310 --> 01:11:25,840

physics a non-equilibrium steady state

1997

01:11:29,910 --> 01:11:28,320

is observing anything

1998

01:11:31,669 --> 01:11:29,920

you could say it's in a certain sense

1999

01:11:33,189 --> 01:11:31,679

quote observing the two different

2000

01:11:33,990 --> 01:11:33,199

temperatures but

2001

01:11:36,630 --> 01:11:34,000

that

2002

01:11:38,229 --> 01:11:36,640

i think does basically expands the

2003

01:11:40,229 --> 01:11:38,239

definition of the term observed so it

2004

01:11:42,229 --> 01:11:40,239

includes everything

2005

01:11:43,750 --> 01:11:42,239

it is interacting with its external

2006

01:11:46,630 --> 01:11:43,760

world and there are aspects of it that

2007

01:11:50,630 --> 01:11:46,640

are describable by information theory

2008

01:11:52,630 --> 01:11:50,640

and i think to use words like causal or

2009

01:11:55,350 --> 01:11:52,640

um

2010

01:11:57,510 --> 01:11:55,360

observation in that context

2011

01:12:01,830 --> 01:11:57,520

can be a very very fraught thing

2012

01:12:05,270 --> 01:12:01,840

it's in danger of um uh being a deepity

2013

01:12:06,870 --> 01:12:05,280

as dan dennett calls it calls it

2014

01:12:09,669 --> 01:12:06,880

okay this next question comes from

2015

01:12:11,590 --> 01:12:09,679

professor anil seth of neuroscience

2016

01:12:13,669 --> 01:12:11,600

and he has a book out on consciousness

2017

01:12:15,350 --> 01:12:13,679

which i'll link in the description he

2018

01:12:17,030 --> 01:12:15,360

says ask david whether he thinks

2019

01:12:17,750 --> 01:12:17,040

consciousness is substrate independent

2020

01:12:19,830 --> 01:12:17,760

so

2021

01:12:22,229 --> 01:12:19,840

a silicone computer can be in principle

2022

01:12:24,310 --> 01:12:22,239

conscious and if so why and then as a

2023

01:12:27,110 --> 01:12:24,320

sub note with regard to free will i'm

2024

01:12:30,149 --> 01:12:27,120

always interested if they referring to

2025

01:12:32,149 --> 01:12:30,159

you david and anyone else if you david

2026

01:12:35,030 --> 01:12:32,159

realizes that the determinism versus

2027

01:12:38,149 --> 01:12:35,040

stochastic debate is a total red herring

2028

01:12:39,590 --> 01:12:38,159

um well uh okay let me

2029

01:12:43,110 --> 01:12:39,600

respond to these

2030

01:12:45,030 --> 01:12:43,120

in order i once asked um

2031

01:12:47,350 --> 01:12:45,040

julio tinoni

2032

01:12:50,550 --> 01:12:47,360

um according to his integrated conscious

2033

01:12:53,910 --> 01:12:50,560

is integrated information measure

2034

01:12:54,709 --> 01:12:53,920

which i am not a fan of let me say that

2035

01:12:56,630 --> 01:12:54,719

um

2036

01:12:58,950 --> 01:12:56,640

but in any case scott anderson is not

2037

01:13:03,189 --> 01:12:58,960

either and so he's got a blog post on it

2038

01:13:06,950 --> 01:13:03,199

um but uh according to his measure

2039

01:13:09,030 --> 01:13:06,960

a computer a silicon computer

2040

01:13:11,669 --> 01:13:09,040

whether it implements its code in

2041

01:13:13,669 --> 01:13:11,679

parallel or in serial

2042

01:13:15,430 --> 01:13:13,679

determines whether it's conscious or not

2043

01:13:16,550 --> 01:13:15,440

i asked him that point blank and he said

2044

01:13:18,630 --> 01:13:16,560

yes that determines whether it's

2045

01:13:21,430 --> 01:13:18,640

conscious or not

2046

01:13:26,310 --> 01:13:24,630

i'm first um responding to that aspect

2047

01:13:28,630 --> 01:13:26,320

of my conversation with julio before

2048

01:13:30,149 --> 01:13:28,640

getting to a neil um by the way i do

2049

01:13:31,350 --> 01:13:30,159

think anneal does some very interesting

2050

01:13:34,310 --> 01:13:31,360

work um

2051

01:13:37,270 --> 01:13:34,320

but so my reaction to that is

2052

01:13:39,270 --> 01:13:37,280

what is gained by defining

2053

01:13:41,030 --> 01:13:39,280

you can define words or if you want to

2054

01:13:42,390 --> 01:13:41,040

define it that's one of the liberties of

2055

01:13:43,990 --> 01:13:42,400

mathematics is to find things wherever

2056

01:13:46,149 --> 01:13:44,000

you want

2057

01:13:47,750 --> 01:13:46,159

and you could define it so that julio

2058

01:13:50,229 --> 01:13:47,760

could say i am by definition correct

2059

01:13:52,630 --> 01:13:50,239

that this is consciousness my measure

2060

01:13:54,070 --> 01:13:52,640

that's okay you can you can say that and

2061

01:13:55,110 --> 01:13:54,080

um if that's your definition that's your

2062

01:13:56,390 --> 01:13:55,120

definition

2063

01:14:00,229 --> 01:13:56,400

but getting back to what we were talking

2064

01:14:02,229 --> 01:14:00,239

about last time persuasive definitions

2065

01:14:03,750 --> 01:14:02,239

this also gets back to cyril with his

2066

01:14:05,510 --> 01:14:03,760

chinese room argument which i thought

2067

01:14:06,550 --> 01:14:05,520

was completely vacuous

2068

01:14:08,390 --> 01:14:06,560

um

2069

01:14:11,430 --> 01:14:08,400

if you are to whatever if you are to

2070

01:14:16,470 --> 01:14:11,440

give a definition of consciousness

2071

01:14:16,480 --> 01:14:20,790

any aspects to it which

2072

01:14:24,870 --> 01:14:22,950

if it is going to be restricted to being

2073

01:14:26,630 --> 01:14:24,880

a characteristic of the behavior of a

2074

01:14:30,149 --> 01:14:26,640

system

2075

01:14:32,070 --> 01:14:30,159

of the what rather than the how

2076

01:14:34,790 --> 01:14:32,080

then it cannot

2077

01:14:37,189 --> 01:14:34,800

differ for a serial or parallel computer

2078

01:14:39,270 --> 01:14:37,199

and that's what cyril also missed

2079

01:14:40,790 --> 01:14:39,280

if consciousness if thinking whatever

2080

01:14:43,110 --> 01:14:40,800

you want to call it

2081

01:14:45,110 --> 01:14:43,120

is a what rather than how

2082

01:14:47,430 --> 01:14:45,120

and i think it's extremely liberty

2083

01:14:48,470 --> 01:14:47,440

liberating as a scientist to conceive of

2084

01:14:50,070 --> 01:14:48,480

it that way

2085

01:14:53,270 --> 01:14:50,080

then it doesn't matter by definition you

2086

01:14:55,110 --> 01:14:53,280

just said no the how is interesting

2087

01:14:57,590 --> 01:14:55,120

is worthy of study but it's a different

2088

01:14:59,110 --> 01:14:57,600

question entirely from the what

2089

01:15:02,070 --> 01:14:59,120

and how these are and these should be

2090

01:15:04,630 --> 01:15:02,080

disentangled it is a category error to

2091

01:15:06,070 --> 01:15:04,640

mistake the how for the what am i to

2092

01:15:07,830 --> 01:15:06,080

understand that another way of saying

2093

01:15:09,510 --> 01:15:07,840

that is that if it's a state versus a

2094

01:15:11,430 --> 01:15:09,520

process

2095

01:15:13,030 --> 01:15:11,440

oh no is that is that false what i just

2096

01:15:14,950 --> 01:15:13,040

said like that's not the correct analogy

2097

01:15:16,870 --> 01:15:14,960

that's not what i mean to say

2098

01:15:19,590 --> 01:15:16,880

you right now

2099

01:15:22,790 --> 01:15:19,600

if behind those

2100

01:15:26,470 --> 01:15:22,800

baby brown eyes if behind your face

2101

01:15:29,350 --> 01:15:26,480

were a silicon computer

2102

01:15:31,110 --> 01:15:29,360

that has no consequence to the behavior

2103

01:15:31,910 --> 01:15:31,120

of our discussion that's what touring's

2104

01:15:34,470 --> 01:15:31,920

great

2105

01:15:36,149 --> 01:15:34,480

insight with the turing test is

2106

01:15:37,830 --> 01:15:36,159

and the importance of the turing test is

2107

01:15:39,189 --> 01:15:37,840

not whether you're using a teletype and

2108

01:15:41,350 --> 01:15:39,199

things like that

2109

01:15:43,030 --> 01:15:41,360

is to say that as far as he

2110

01:15:45,350 --> 01:15:43,040

um alan turing was concerned and there's

2111

01:15:47,350 --> 01:15:45,360

a lot to be said for this that is useful

2112

01:15:49,270 --> 01:15:47,360

to carve out from whatever you discuss

2113

01:15:52,390 --> 01:15:49,280

whenever you just want to discuss about

2114

01:15:53,189 --> 01:15:52,400

consciousness it is very useful to carve

2115

01:15:54,790 --> 01:15:53,199

out

2116

01:15:56,550 --> 01:15:54,800

as its own

2117

01:15:58,550 --> 01:15:56,560

phenomenon

2118

01:16:00,550 --> 01:15:58,560

call it consciousness prime call it

2119

01:16:02,390 --> 01:16:00,560

precon whatever you want to be

2120

01:16:04,149 --> 01:16:02,400

where we're just looking at the behavior

2121

01:16:06,950 --> 01:16:04,159

of the system

2122

01:16:10,709 --> 01:16:06,960

and you can have things ones in silicon

2123

01:16:13,910 --> 01:16:10,719

one is instead a real human being

2124

01:16:16,470 --> 01:16:13,920

one is instead a simulacrum that's being

2125

01:16:18,229 --> 01:16:16,480

controlled by somebody outside the room

2126

01:16:20,070 --> 01:16:18,239

looking in wherever you want

2127

01:16:21,350 --> 01:16:20,080

that's behaving that same way but if

2128

01:16:23,189 --> 01:16:21,360

it's behaving the same way you can't

2129

01:16:25,510 --> 01:16:23,199

tell the difference

2130

01:16:28,229 --> 01:16:25,520

and so for this

2131

01:16:30,229 --> 01:16:28,239

particular aspect of consciousness

2132

01:16:32,550 --> 01:16:30,239

it does not make any difference

2133

01:16:34,709 --> 01:16:32,560

so the tanoni is actually looking at the

2134

01:16:36,790 --> 01:16:34,719

other side he's focusing it's kind of

2135

01:16:39,110 --> 01:16:36,800

he's mixing up the two i would say

2136

01:16:39,990 --> 01:16:39,120

the how and the want

2137

01:16:41,669 --> 01:16:40,000

um

2138

01:16:43,030 --> 01:16:41,679

so to me the interesting thing is the

2139

01:16:45,669 --> 01:16:43,040

what

2140

01:16:48,310 --> 01:16:45,679

you first have that then once we have

2141

01:16:49,830 --> 01:16:48,320

that what clarified which we don't have

2142

01:16:51,430 --> 01:16:49,840

we don't know how to define even at a

2143

01:16:52,790 --> 01:16:51,440

behavioral level what the conscious

2144

01:16:54,790 --> 01:16:52,800

entity would be

2145

01:16:56,229 --> 01:16:54,800

or so on and so forth we can then start

2146

01:16:57,910 --> 01:16:56,239

to look at the how

2147

01:16:59,510 --> 01:16:57,920

and that's where neurobiology comes to

2148

01:17:00,870 --> 01:16:59,520

play which is anil's

2149

01:17:03,590 --> 01:17:00,880

particular

2150

01:17:05,669 --> 01:17:03,600

comparative advantage his specialty

2151
01:17:08,470 --> 01:17:05,679
and that's a completely open issue

2152
01:17:09,350 --> 01:17:08,480
frankly as and one that he's doing work

2153
01:17:11,110 --> 01:17:09,360
on

2154
01:17:13,030 --> 01:17:11,120
um involving things like predictive

2155
01:17:15,189 --> 01:17:13,040
coding blah blah blah blah is how do

2156
01:17:16,950 --> 01:17:15,199
neurobiological systems achieve it

2157
01:17:19,910 --> 01:17:16,960
silicon computers can achieve the same

2158
01:17:21,750 --> 01:17:19,920
what they're doing in a different way

2159
01:17:23,430 --> 01:17:21,760
and so it's a different question

2160
01:17:25,189 --> 01:17:23,440
then with regard to free will i'm always

2161
01:17:27,270 --> 01:17:25,199
interested in whether dota taught

2162
01:17:29,189 --> 01:17:27,280
whether they think that whether they

2163
01:17:30,550 --> 01:17:29,199

think slash realized so that's obviously

2164

01:17:31,669 --> 01:17:30,560

a limited question

2165

01:17:33,590 --> 01:17:31,679

that the determinism versus

2166

01:17:34,709 --> 01:17:33,600

stochasticity debate is a total red

2167

01:17:39,430 --> 01:17:34,719

herring

2168

01:17:40,630 --> 01:17:39,440

that's a extremely loaded leading

2169

01:17:42,229 --> 01:17:40,640

question

2170

01:17:44,550 --> 01:17:42,239

and i'm going to assume that it does

2171

01:17:47,270 --> 01:17:44,560

have that character because of uh

2172

01:17:49,270 --> 01:17:47,280

basically word length so to speak a

2173

01:17:51,189 --> 01:17:49,280

total red herring for what

2174

01:17:53,750 --> 01:17:51,199

um and

2175

01:17:56,070 --> 01:17:53,760

it's a question that cannot be answered

2176

01:17:57,669 --> 01:17:56,080

i would say that free will is commonly

2177

01:17:59,110 --> 01:17:57,679

used in common discourse is what we're

2178

01:18:00,390 --> 01:17:59,120

talking about yesterday persuasive

2179

01:18:02,870 --> 01:18:00,400

definitions

2180

01:18:04,630 --> 01:18:02,880

not yesterday but last time yes people

2181

01:18:06,149 --> 01:18:04,640

commonly use free will they're not even

2182

01:18:08,149 --> 01:18:06,159

sure what they mean

2183

01:18:11,030 --> 01:18:08,159

that some people to some people it is

2184

01:18:13,990 --> 01:18:11,040

determinism versus stochasticity

2185

01:18:15,750 --> 01:18:14,000

um and that's what they mean that that's

2186

01:18:17,910 --> 01:18:15,760

what they mean to other people it's not

2187

01:18:19,430 --> 01:18:17,920

whether it's a total red herring has to

2188

01:18:20,950 --> 01:18:19,440

do with how you define the concept in

2189

01:18:23,030 --> 01:18:20,960

the first place

2190

01:18:24,470 --> 01:18:23,040

i don't view there as being a concept

2191

01:18:26,390 --> 01:18:24,480

worth discussion

2192

01:18:27,990 --> 01:18:26,400

i free view as being pointless come up

2193

01:18:29,750 --> 01:18:28,000

with your definition

2194

01:18:31,189 --> 01:18:29,760

your definition is going to then say

2195

01:18:33,590 --> 01:18:31,199

whatever you want your definition to

2196

01:18:35,030 --> 01:18:33,600

mean but it's your definition that's why

2197

01:18:36,470 --> 01:18:35,040

i'm saying we should call it what

2198

01:18:37,669 --> 01:18:36,480

consciousness rather than how

2199

01:18:39,110 --> 01:18:37,679

consciousness

2200

01:18:40,550 --> 01:18:39,120

just so we're clear in our definitions

2201

01:18:42,070 --> 01:18:40,560

i'm not going to say either one is

2202

01:18:43,350 --> 01:18:42,080

consciousness

2203

01:18:44,870 --> 01:18:43,360

i'm going to instead just make two

2204

01:18:46,950 --> 01:18:44,880

different definitions and say that when

2205

01:18:48,870 --> 01:18:46,960

people use the word consciousness they

2206

01:18:51,030 --> 01:18:48,880

sometimes conflate things

2207

01:18:53,110 --> 01:18:51,040

and free will is far more prone to that

2208

01:18:54,630 --> 01:18:53,120

when people use the word free will

2209

01:18:56,310 --> 01:18:54,640

there's actually many many flavors they

2210

01:18:57,590 --> 01:18:56,320

mean very many different things and they

2211

01:18:59,990 --> 01:18:57,600

are ultimately fighting about whose

2212

01:19:02,070 --> 01:19:00,000

arbitrary definition to use and that is

2213

01:19:03,590 --> 01:19:02,080

an exercise in futility set your

2214

01:19:06,830 --> 01:19:03,600

arbitrary definition and then we can

2215

01:19:09,669 --> 01:19:06,840

maybe or maybe not say something

2216

01:19:11,189 --> 01:19:09,679

um so in any case

2217

01:19:12,310 --> 01:19:11,199

it sounds like this question sets you

2218

01:19:14,229 --> 01:19:12,320

off

2219

01:19:15,510 --> 01:19:14,239

well it does because it's such a waste

2220

01:19:17,590 --> 01:19:15,520

of time

2221

01:19:19,590 --> 01:19:17,600

it's only it's people are debating

2222

01:19:20,709 --> 01:19:19,600

definitions

2223

01:19:22,870 --> 01:19:20,719

i don't

2224

01:19:25,030 --> 01:19:22,880

life's too short folks

2225

01:19:27,510 --> 01:19:25,040

define things wherever you want just be

2226

01:19:29,189 --> 01:19:27,520

clear what it is you are defining

2227

01:19:31,110 --> 01:19:29,199

and once we have the definition and we

2228

01:19:34,310 --> 01:19:31,120

don't have any

2229

01:19:35,990 --> 01:19:34,320

definitions have no import by themselves

2230

01:19:38,229 --> 01:19:36,000

it's only things we can conclude

2231

01:19:40,790 --> 01:19:38,239

starting from the definitions

2232

01:19:42,550 --> 01:19:40,800

make your definitions feel free just be

2233

01:19:43,910 --> 01:19:42,560

very clear what your definitions are and

2234

01:19:46,149 --> 01:19:43,920

then after that there might be some

2235

01:19:48,950 --> 01:19:46,159

interesting consequences to

2236

01:19:51,270 --> 01:19:48,960

um investigate but to have fights about

2237

01:19:52,870 --> 01:19:51,280

definitions is preposterous

2238

01:19:54,310 --> 01:19:52,880

and that's what a lot of these

2239

01:19:55,990 --> 01:19:54,320

fights really are about is just

2240

01:19:58,550 --> 01:19:56,000

definition pushing

2241

01:20:00,310 --> 01:19:58,560

let me steal man the definition i up to

2242

01:20:01,430 --> 01:20:00,320

just a few months ago i'm on board with

2243

01:20:03,270 --> 01:20:01,440

you 100

2244

01:20:05,110 --> 01:20:03,280

now let me steal man the definitions

2245

01:20:07,350 --> 01:20:05,120

point of view i was speaking to

2246

01:20:09,510 --> 01:20:07,360

professor jorah barnatan of mathematics

2247

01:20:11,350 --> 01:20:09,520

in toronto here and he was saying i was

2248

01:20:13,030 --> 01:20:11,360

asking him can you also in preparation

2249

01:20:14,550 --> 01:20:13,040

for our interview tell me which proofs

2250

01:20:16,229 --> 01:20:14,560

which theorems are your favorite and

2251

01:20:17,990 --> 01:20:16,239

then he responded and said he doesn't

2252

01:20:20,149 --> 01:20:18,000

like proofs and theorems and what

2253

01:20:21,910 --> 01:20:20,159

standard textbooks focus on he actually

2254

01:20:24,070 --> 01:20:21,920

thinks perhaps definitions are more

2255

01:20:25,350 --> 01:20:24,080

important or perhaps techniques

2256

01:20:27,990 --> 01:20:25,360

i thought you might be going there but

2257

01:20:29,430 --> 01:20:28,000

here's what i think he actually meant

2258

01:20:33,669 --> 01:20:29,440

he thought that coming up with

2259

01:20:36,310 --> 01:20:33,679

definitions that lead to a very rich set

2260

01:20:39,590 --> 01:20:36,320

of theorems and proofs that that is the

2261

01:20:41,669 --> 01:20:39,600

key to being i mean here is my putting

2262

01:20:43,430 --> 01:20:41,679

words in his mouth to being a successful

2263

01:20:45,830 --> 01:20:43,440

and important and do important work in

2264

01:20:49,990 --> 01:20:45,840

mathematics is to first come up with the

2265

01:20:51,750 --> 01:20:50,000

very fruitful definitions i fully agree

2266

01:20:53,350 --> 01:20:51,760

that but that is not what people who are

2267

01:20:55,430 --> 01:20:53,360

arguing about free will are arguing

2268

01:20:57,350 --> 01:20:55,440

about they're not saying for which

2269

01:20:59,030 --> 01:20:57,360

definition of free will

2270

01:21:01,189 --> 01:20:59,040

and he wasn't actually either your

2271

01:21:02,629 --> 01:21:01,199

professor he wasn't saying which

2272

01:21:03,669 --> 01:21:02,639

definition

2273

01:21:05,270 --> 01:21:03,679

of

2274

01:21:06,790 --> 01:21:05,280

um parallel

2275

01:21:08,870 --> 01:21:06,800

should i adopt

2276

01:21:11,030 --> 01:21:08,880

he was saying no what's important is if

2277

01:21:12,470 --> 01:21:11,040

i put together the words in a certain

2278

01:21:14,070 --> 01:21:12,480

way

2279

01:21:15,750 --> 01:21:14,080

and then i call them what i call them

2280

01:21:17,430 --> 01:21:15,760

doesn't matter

2281

01:21:20,390 --> 01:21:17,440

but those set of words put together in

2282

01:21:23,189 --> 01:21:20,400

this way we'll call it a alpha b beta

2283

01:21:25,590 --> 01:21:23,199

we've just defined a alpha b beta if i

2284

01:21:27,830 --> 01:21:25,600

can use a alpha b beta to prove a whole

2285

01:21:29,030 --> 01:21:27,840

bunch of fruitful things that's a good

2286

01:21:31,350 --> 01:21:29,040

definition

2287

01:21:34,310 --> 01:21:31,360

these people instead are saying what

2288

01:21:36,229 --> 01:21:34,320

should a alpha b beta mean

2289

01:21:39,430 --> 01:21:36,239

which is backwards

2290

01:21:41,910 --> 01:21:39,440

so that professor um he was saying that

2291

01:21:44,149 --> 01:21:41,920

it's not the words it's not the clothes

2292

01:21:46,070 --> 01:21:44,159

don't make the man it's not the words

2293

01:21:48,470 --> 01:21:46,080

that you're draping this with that

2294

01:21:50,470 --> 01:21:48,480

matter is whatever this is

2295

01:21:53,189 --> 01:21:50,480

and here people are saying well i've got

2296

01:21:56,149 --> 01:21:53,199

my words first and i'm gonna fight with

2297

01:21:59,110 --> 01:21:56,159

you about whether um they actually mean

2298

01:22:02,310 --> 01:21:59,120

this or they mean that

2299

01:22:04,310 --> 01:22:02,320

it's it's useless it's it's backwards

2300

01:22:06,950 --> 01:22:04,320

it's not only anti-scientific i would

2301

01:22:08,310 --> 01:22:06,960

say it's anti-intellectual almost

2302

01:22:09,590 --> 01:22:08,320

now for the sake of playing the devil's

2303

01:22:10,390 --> 01:22:09,600

advocate let me know what you think

2304

01:22:11,430 --> 01:22:10,400

about this

2305

01:22:12,470 --> 01:22:11,440

now when we're not talking about

2306

01:22:14,870 --> 01:22:12,480

mathematics something that's

2307

01:22:16,390 --> 01:22:14,880

specifically well defined when we come

2308

01:22:18,550 --> 01:22:16,400

up with a definition

2309

01:22:20,950 --> 01:22:18,560

it works somewhat akin to this we have

2310

01:22:23,590 --> 01:22:20,960

an intuitive notion of some concept and

2311

01:22:25,669 --> 01:22:23,600

it's ambiguous and then we give it a

2312

01:22:26,870 --> 01:22:25,679

name and we usually give it a name by

2313

01:22:29,270 --> 01:22:26,880

pointing to different objects that

2314

01:22:31,189 --> 01:22:29,280

satisfy what we think is that intuitive

2315

01:22:32,629 --> 01:22:31,199

definition so for example with life

2316

01:22:34,950 --> 01:22:32,639

we'll say the couch behind you is not

2317

01:22:36,709 --> 01:22:34,960

alive you're alive the beetle is alive

2318

01:22:38,709 --> 01:22:36,719

the fire is alive

2319

01:22:40,629 --> 01:22:38,719

let's say minus 3000 years ago and then

2320

01:22:42,229 --> 01:22:40,639

there's other people arguing about that

2321

01:22:44,070 --> 01:22:42,239

well the fire is not alive but i do

2322

01:22:45,910 --> 01:22:44,080

agree david is alive and i also agree

2323

01:22:49,270 --> 01:22:45,920

that the couch is not alive so we have

2324

01:22:51,270 --> 01:22:49,280

these volutinous feelings of amorphous

2325

01:22:53,350 --> 01:22:51,280

balls and we're trying to see okay well

2326

01:22:55,110 --> 01:22:53,360

what's the intersection between us which

2327

01:22:56,950 --> 01:22:55,120

one captures what we're trying to say

2328

01:22:57,990 --> 01:22:56,960

most which one captures the most

2329

01:23:00,149 --> 01:22:58,000

relevant

2330

01:23:01,590 --> 01:23:00,159

concepts so that's why there are

2331

01:23:03,270 --> 01:23:01,600

disagreements about the definition we're

2332

01:23:05,990 --> 01:23:03,280

trying to figure out we're arguing about

2333

01:23:08,470 --> 01:23:06,000

what the entries in the oed should be

2334

01:23:09,830 --> 01:23:08,480

there's an entry in the oed for life and

2335

01:23:11,030 --> 01:23:09,840

what should it be the oxford english

2336

01:23:13,430 --> 01:23:11,040

dictionary

2337

01:23:14,870 --> 01:23:13,440

and so for example on that particular

2338

01:23:15,669 --> 01:23:14,880

topic

2339

01:23:19,430 --> 01:23:15,679

um

2340

01:23:21,590 --> 01:23:19,440

people do define life as a bit

2341

01:23:22,950 --> 01:23:21,600

and i always and the question is well

2342

01:23:24,470 --> 01:23:22,960

how should i define that bit if they

2343

01:23:26,310 --> 01:23:24,480

want it to always be it's alive or it's

2344

01:23:27,750 --> 01:23:26,320

not alive what's how do we define what

2345

01:23:29,830 --> 01:23:27,760

one or the other means

2346

01:23:31,189 --> 01:23:29,840

so this is a other work of mine earlier

2347

01:23:32,870 --> 01:23:31,199

in my career i did with a fellow called

2348

01:23:35,510 --> 01:23:32,880

bill mccrady and others have picked it

2349

01:23:36,709 --> 01:23:35,520

up since um

2350

01:23:38,790 --> 01:23:36,719

so

2351

01:23:40,870 --> 01:23:38,800

my reaction to that was that this is

2352

01:23:42,790 --> 01:23:40,880

silly definition plugging come up with

2353

01:23:45,189 --> 01:23:42,800

your definition and whatever to say

2354

01:23:47,030 --> 01:23:45,199

something israel is not alive is silly

2355

01:23:49,270 --> 01:23:47,040

um at a minimum if you're talking about

2356

01:23:51,830 --> 01:23:49,280

biological organisms

2357

01:23:53,669 --> 01:23:51,840

it's not going to be just a single bit

2358

01:23:55,350 --> 01:23:53,679

it's going to be actually at least a

2359

01:23:57,030 --> 01:23:55,360

real number and well actually it's going

2360

01:23:58,390 --> 01:23:57,040

to be a vector we'll actually know it's

2361

01:23:59,910 --> 01:23:58,400

going to be some much more higher

2362

01:24:02,229 --> 01:23:59,920

dimensional thing

2363

01:24:04,229 --> 01:24:02,239

it's not going to be life is a bit

2364

01:24:07,189 --> 01:24:04,239

clever life is some

2365

01:24:08,709 --> 01:24:07,199

other mathematical structure and here's

2366

01:24:09,750 --> 01:24:08,719

one that we happen to come up with that

2367

01:24:11,590 --> 01:24:09,760

actually turned out to be somewhat

2368

01:24:13,350 --> 01:24:11,600

fruitful another topic of research i

2369

01:24:17,110 --> 01:24:13,360

wanted to work with

2370

01:24:19,830 --> 01:24:17,120

you know what a fractal is i assume okay

2371

01:24:21,189 --> 01:24:19,840

so i take the m the magnifying glass and

2372

01:24:22,870 --> 01:24:21,199

i magnify that microscope and i keep

2373

01:24:24,550 --> 01:24:22,880

seeing the same thing

2374

01:24:25,830 --> 01:24:24,560

let's take that magnifying glass that

2375

01:24:29,030 --> 01:24:25,840

microscope

2376

01:24:31,669 --> 01:24:29,040

put it on your skin

2377

01:24:33,510 --> 01:24:31,679

as we keep running up the power

2378

01:24:35,669 --> 01:24:33,520

we go down to the level where we're

2379

01:24:37,750 --> 01:24:35,679

seeing now individual cells now we start

2380

01:24:38,870 --> 01:24:37,760

going with you know within the cells and

2381

01:24:40,790 --> 01:24:38,880

so on

2382

01:24:44,550 --> 01:24:40,800

the images in that

2383

01:24:47,270 --> 01:24:44,560

microscope keep changing

2384

01:24:48,709 --> 01:24:47,280

you are not self-similar you are self

2385

01:24:51,350 --> 01:24:48,719

dissimilar

2386

01:24:55,270 --> 01:24:51,360

the patterns in you are very different

2387

01:24:56,390 --> 01:24:55,280

from one another at each different scale

2388

01:24:58,950 --> 01:24:56,400

in fact

2389

01:25:01,350 --> 01:24:58,960

that seems to be true of almost all

2390

01:25:04,470 --> 01:25:01,360

systems that are alive

2391

01:25:07,669 --> 01:25:04,480

it is not true of almost all systems

2392

01:25:13,590 --> 01:25:10,629

moreover this self-dissimilarity is a

2393

01:25:16,229 --> 01:25:13,600

way to give nuance and structure

2394

01:25:17,830 --> 01:25:16,239

to the form of the life

2395

01:25:20,070 --> 01:25:17,840

because you can actually be looking at

2396

01:25:22,149 --> 01:25:20,080

how is it that the patterns of at each

2397

01:25:24,550 --> 01:25:22,159

scale are related to one another you've

2398

01:25:25,790 --> 01:25:24,560

got an entire matrix

2399

01:25:28,550 --> 01:25:25,800

and so this we called it

2400

01:25:30,709 --> 01:25:28,560

self-dissimilarity and we were very

2401

01:25:32,790 --> 01:25:30,719

careful not to say it's living or not

2402

01:25:34,709 --> 01:25:32,800

and we simply say actually i think we

2403

01:25:36,229 --> 01:25:34,719

reverse this effect

2404

01:25:37,870 --> 01:25:36,239

any system that does have

2405

01:25:39,430 --> 01:25:37,880

self-dissimilarity high

2406

01:25:41,669 --> 01:25:39,440

self-dissimilarity

2407

01:25:42,950 --> 01:25:41,679

is almost by definition going to be very

2408

01:25:44,709 --> 01:25:42,960

interesting

2409

01:25:47,430 --> 01:25:44,719

and some people might say it's actually

2410

01:25:48,870 --> 01:25:47,440

a complex system but we again we don't

2411

01:25:51,030 --> 01:25:48,880

want to be

2412

01:25:52,189 --> 01:25:51,040

selling it with these definitions we're

2413

01:25:53,750 --> 01:25:52,199

just going to simply say it's

2414

01:25:55,590 --> 01:25:53,760

self-dissimilarity

2415

01:25:57,510 --> 01:25:55,600

we put it out there as a proposal to the

2416

01:25:59,350 --> 01:25:57,520

research community that they shouldn't

2417

01:26:01,590 --> 01:25:59,360

be spending all this effort in trying to

2418

01:26:04,149 --> 01:26:01,600

figure out what should the definition of

2419

01:26:06,310 --> 01:26:04,159

this bit living or not living be

2420

01:26:08,149 --> 01:26:06,320

that that's fruitless and it's just

2421

01:26:10,550 --> 01:26:08,159

going to be in terminable wars that

2422

01:26:12,470 --> 01:26:10,560

never are going to end up

2423

01:26:13,990 --> 01:26:12,480

being rich in the sense of definitions

2424

01:26:14,950 --> 01:26:14,000

that your mathematics professor was

2425

01:26:20,950 --> 01:26:14,960

thinking

2426

01:26:22,629 --> 01:26:20,960

self-dissimilarity of different systems

2427

01:26:24,470 --> 01:26:22,639

because why would you think that an

2428

01:26:26,550 --> 01:26:24,480

interesting living system might be

2429

01:26:27,750 --> 01:26:26,560

self-dissimilar in the first place so

2430

01:26:29,350 --> 01:26:27,760

it's not just that we can notice

2431

01:26:30,750 --> 01:26:29,360

phenomenologically

2432

01:26:32,709 --> 01:26:30,760

that living systems are all

2433

01:26:34,709 --> 01:26:32,719

self-dissimilar whereas non-living

2434

01:26:38,149 --> 01:26:34,719

systems like mountaintops and so on are

2435

01:26:39,830 --> 01:26:38,159

so similar we can actually ask why might

2436

01:26:41,910 --> 01:26:39,840

that be the case

2437

01:26:44,790 --> 01:26:41,920

and so here's a

2438

01:26:46,709 --> 01:26:44,800

interesting proposal that i have not yet

2439

01:26:49,110 --> 01:26:46,719

time to investigate

2440

01:26:50,790 --> 01:26:49,120

what if biological systems this is

2441

01:26:53,830 --> 01:26:50,800

somewhat along the lines of the things

2442

01:26:56,149 --> 01:26:53,840

that carl fussing is interested in

2443

01:26:59,350 --> 01:26:56,159

what if biological systems

2444

01:27:01,430 --> 01:26:59,360

had to as a for for um and also for that

2445

01:27:04,070 --> 01:27:01,440

mayor donald hoffman had to as an

2446

01:27:07,110 --> 01:27:04,080

evolutionary imperative

2447

01:27:10,470 --> 01:27:07,120

extract the maximal computational bang

2448

01:27:12,229 --> 01:27:10,480

out of a given physical body buck

2449

01:27:14,790 --> 01:27:12,239

how might they do that well one thing

2450

01:27:16,629 --> 01:27:14,800

you can think of doing is distribute

2451

01:27:20,390 --> 01:27:16,639

different parts of that computation to

2452

01:27:22,470 --> 01:27:20,400

different spatial locations in that body

2453

01:27:24,390 --> 01:27:22,480

and that's what systems do biological

2454

01:27:25,750 --> 01:27:24,400

systems to a large degree they have the

2455

01:27:28,070 --> 01:27:25,760

computations that are going on your

2456

01:27:30,149 --> 01:27:28,080

brain being a different part of you from

2457

01:27:32,790 --> 01:27:30,159

the computations that are going on

2458

01:27:34,870 --> 01:27:32,800

in your kidney for example you've been

2459

01:27:36,550 --> 01:27:34,880

um the computation's been distributed

2460

01:27:38,149 --> 01:27:36,560

but you might also not only want to

2461

01:27:39,590 --> 01:27:38,159

distribute the computation across

2462

01:27:42,310 --> 01:27:39,600

different positions

2463

01:27:43,910 --> 01:27:42,320

but also across scales

2464

01:27:45,030 --> 01:27:43,920

there might be different and there are

2465

01:27:47,189 --> 01:27:45,040

if you think about it different

2466

01:27:48,229 --> 01:27:47,199

computations being done by the cells in

2467

01:27:49,830 --> 01:27:48,239

you

2468

01:27:51,990 --> 01:27:49,840

compared to the computations being done

2469

01:27:54,070 --> 01:27:52,000

by the organs in you

2470

01:27:55,910 --> 01:27:54,080

moreover these computations being done

2471

01:27:58,390 --> 01:27:55,920

at the different scales are actually

2472

01:28:00,229 --> 01:27:58,400

communicating with one another

2473

01:28:02,550 --> 01:28:00,239

so you can imagine that as an

2474

01:28:04,390 --> 01:28:02,560

evolutionary imperative biological

2475

01:28:06,550 --> 01:28:04,400

systems would be driven

2476
01:28:08,310 --> 01:28:06,560
to want to distribute the computations

2477
01:28:10,390 --> 01:28:08,320
that they do

2478
01:28:12,229 --> 01:28:10,400
across their different scales as well as

2479
01:28:14,629 --> 01:28:12,239
their different spatial position part

2480
01:28:15,990 --> 01:28:14,639
positions within them which would then

2481
01:28:17,590 --> 01:28:16,000
lead us to start to think about what

2482
01:28:19,590 --> 01:28:17,600
does it even mean

2483
01:28:21,110 --> 01:28:19,600
to distribute computation across scales

2484
01:28:22,070 --> 01:28:21,120
what are the general features of such

2485
01:28:23,510 --> 01:28:22,080
systems

2486
01:28:26,310 --> 01:28:23,520
and it would lead you down a research

2487
01:28:27,669 --> 01:28:26,320
path which i've not had time to go

2488
01:28:30,629 --> 01:28:27,679

but it would lead you down a fruitful

2489

01:28:36,149 --> 01:28:30,639

greek church path to in fact

2490

01:28:37,430 --> 01:28:36,159

um uh refute and and and dispute and

2491

01:28:38,870 --> 01:28:37,440

and

2492

01:28:40,390 --> 01:28:38,880

um

2493

01:28:42,229 --> 01:28:40,400

avow no

2494

01:28:43,590 --> 01:28:42,239

to the concept that life can be reduced

2495

01:28:47,110 --> 01:28:43,600

to a bit

2496

01:28:50,070 --> 01:28:47,120

but we if we start by saying that this

2497

01:28:52,470 --> 01:28:50,080

exercise is an exercise in futility

2498

01:28:54,390 --> 01:28:52,480

that instead we want to come up with um

2499

01:28:56,870 --> 01:28:54,400

not a definition that's reducible to a

2500

01:28:59,189 --> 01:28:56,880

bit you are or you are not but rather

2501
01:29:01,030 --> 01:28:59,199
look at this much more nuanced structure

2502
01:29:02,470 --> 01:29:01,040
it might lead us in much more fruitful

2503
01:29:04,550 --> 01:29:02,480
research directions it might be a much

2504
01:29:05,990 --> 01:29:04,560
more useful definition

2505
01:29:07,830 --> 01:29:06,000
in the sense of that mathematics

2506
01:29:09,990 --> 01:29:07,840
professor you're you are describing

2507
01:29:11,750 --> 01:29:10,000
before

2508
01:29:13,110 --> 01:29:11,760
now if you can answer this one quickly

2509
01:29:15,110 --> 01:29:13,120
because this isn't a site about what you

2510
01:29:17,350 --> 01:29:15,120
said you mentioned that

2511
01:29:19,189 --> 01:29:17,360
it may not be a bit it could be a vector

2512
01:29:21,270 --> 01:29:19,199
now i see how it could not be a bit it

2513
01:29:23,990 --> 01:29:21,280

could be a real number but i don't see

2514

01:29:26,229 --> 01:29:24,000

how is it that this dissimilarity

2515

01:29:28,709 --> 01:29:26,239

measure could be a vector like r_2 r_3 et

2516

01:29:30,950 --> 01:29:28,719

cetera ah so here's what i can do

2517

01:29:32,390 --> 01:29:30,960

i take that microscope this is an

2518

01:29:34,950 --> 01:29:32,400

exercise that we've actually did on

2519

01:29:36,709 --> 01:29:34,960

various some image data sets for example

2520

01:29:39,990 --> 01:29:36,719

and we applied it to things like the

2521

01:29:44,070 --> 01:29:40,000

logistic dynamics and so on and so forth

2522

01:29:46,709 --> 01:29:44,080

um take that microscope that's um uh

2523

01:29:48,149 --> 01:29:46,719

getting distributions of of the visual

2524

01:29:50,470 --> 01:29:48,159

images of the patterns at different

2525

01:29:53,110 --> 01:29:50,480

scales

2526

01:29:55,030 --> 01:29:53,120

these are now going to be distributions

2527

01:29:58,390 --> 01:29:55,040

over the pixel pattern within the

2528

01:30:01,669 --> 01:29:58,400

microscope's field of view

2529

01:30:03,189 --> 01:30:01,679

now i can there's many measures from uh

2530

01:30:05,189 --> 01:30:03,199

machine learning probability theory

2531

01:30:07,910 --> 01:30:05,199

information theory for saying how

2532

01:30:10,870 --> 01:30:07,920

different two distributions are

2533

01:30:13,750 --> 01:30:10,880

so this way i can say for any one of the

2534

01:30:15,270 --> 01:30:13,760

following say 10 scales

2535

01:30:18,790 --> 01:30:15,280

how different

2536

01:30:21,669 --> 01:30:18,800

is the distribution over images at those

2537

01:30:23,750 --> 01:30:21,679

two scales so i'm comparing scales

2538

01:30:25,189 --> 01:30:23,760

magnification two times a modification

2539

01:30:27,430 --> 01:30:25,199

seven times

2540

01:30:30,229 --> 01:30:27,440

those scales have associated

2541

01:30:31,590 --> 01:30:30,239

distributions over images

2542

01:30:33,669 --> 01:30:31,600

i look at how different those

2543

01:30:35,990 --> 01:30:33,679

distributions over images are the scale

2544

01:30:37,990 --> 01:30:36,000

two times and seven times that gives me

2545

01:30:40,550 --> 01:30:38,000

a real number

2546

01:30:41,990 --> 01:30:40,560

i then look at it for another pair of

2547

01:30:43,750 --> 01:30:42,000

magnifications that gives me another

2548

01:30:45,590 --> 01:30:43,760

real number

2549

01:30:48,390 --> 01:30:45,600

so in this so in essence what you were

2550

01:30:51,830 --> 01:30:48,400

seeing that this pat this set of

2551
01:30:53,669 --> 01:30:51,840
of differences between distributions

2552
01:30:55,669 --> 01:30:53,679
at the different scales

2553
01:30:58,149 --> 01:30:55,679
can be wound up into one actually it's a

2554
01:30:59,430 --> 01:30:58,159
matrix because you're putting in the two

2555
01:31:01,270 --> 01:30:59,440
scales

2556
01:31:02,709 --> 01:31:01,280
that i'm comparing into these elements

2557
01:31:05,030 --> 01:31:02,719
of these matrix so for if you give me

2558
01:31:07,189 --> 01:31:05,040
two scales i'll give you a real number

2559
01:31:10,790 --> 01:31:07,199
it's actually more rich than a vector is

2560
01:31:13,110 --> 01:31:10,800
a full matrix a symmetric matrix

2561
01:31:15,189 --> 01:31:13,120
um yeah uh yes this particular case is

2562
01:31:16,390 --> 01:31:15,199
symmetric exactly so okay so now this

2563
01:31:17,830 --> 01:31:16,400

question comes from

2564

01:31:19,350 --> 01:31:17,840

kevin knuth and i know you got to go

2565

01:31:20,870 --> 01:31:19,360

don't worry i got to go to

2566

01:31:24,550 --> 01:31:20,880

kevin knuth

2567

01:31:25,910 --> 01:31:24,560

so he wants to know what is life it's a

2568

01:31:27,910 --> 01:31:25,920

question that people have entertained

2569

01:31:29,590 --> 01:31:27,920

for a long time without obvious answers

2570

01:31:31,990 --> 01:31:29,600

your thoughts on observers i sent them

2571

01:31:33,910 --> 01:31:32,000

your video on observers seem to be

2572

01:31:36,070 --> 01:31:33,920

relevant i have always thought of living

2573

01:31:37,510 --> 01:31:36,080

things as systems that use information

2574

01:31:39,830 --> 01:31:37,520

to create some kind of model of the

2575

01:31:41,350 --> 01:31:39,840

world around them in order to locate and

2576

01:31:43,110 --> 01:31:41,360

take advantage of potential energy

2577

01:31:45,030 --> 01:31:43,120

gradients which are then used to keep

2578

01:31:46,709 --> 01:31:45,040

them away from equilibrium and i can

2579

01:31:48,229 --> 01:31:46,719

give some examples and so on i would

2580

01:31:49,990 --> 01:31:48,239

agree that a hurricane is not alive a

2581

01:31:52,149 --> 01:31:50,000

hurricane's a heat engine that he's

2582

01:31:53,990 --> 01:31:52,159

referencing your talk however it's not

2583

01:31:55,830 --> 01:31:54,000

alive because it doesn't use the

2584

01:31:57,830 --> 01:31:55,840

information about its surrounding to

2585

01:31:59,110 --> 01:31:57,840

model these energy gradients the models

2586

01:32:01,350 --> 01:31:59,120

living things can employ are quite

2587

01:32:02,950 --> 01:32:01,360

diverse for humans these are our mental

2588

01:32:04,950 --> 01:32:02,960

models et cetera et cetera some bacteria

2589

01:32:06,709 --> 01:32:04,960

etc so these are my thoughts about life

2590

01:32:08,070 --> 01:32:06,719

i really need to write them down maybe

2591

01:32:09,350 --> 01:32:08,080

david would be interested in working

2592

01:32:11,750 --> 01:32:09,360

with me on this

2593

01:32:13,990 --> 01:32:11,760

okay so this these are kevin knuth's

2594

01:32:15,590 --> 01:32:14,000

thoughts i'm sure you can pull a

2595

01:32:17,510 --> 01:32:15,600

question out from that or just comment

2596

01:32:18,470 --> 01:32:17,520

on it as a whole

2597

01:32:20,390 --> 01:32:18,480

um

2598

01:32:21,830 --> 01:32:20,400

yes so

2599

01:32:23,830 --> 01:32:21,840

um what kevin

2600

01:32:25,830 --> 01:32:23,840

what he's talking about here first of

2601
01:32:27,270 --> 01:32:25,840
all um hi kevin and yes i think we could

2602
01:32:28,950 --> 01:32:27,280
have some very interesting discussions

2603
01:32:31,910 --> 01:32:28,960
about here um

2604
01:32:33,110 --> 01:32:31,920
so as i mentioned before and um okay so

2605
01:32:34,870 --> 01:32:33,120
backing it up

2606
01:32:36,470 --> 01:32:34,880
kevin is talking about presentation i

2607
01:32:38,629 --> 01:32:36,480
made that's where there was observers

2608
01:32:41,830 --> 01:32:38,639
and hurricanes and so on

2609
01:32:44,390 --> 01:32:41,840
um the observers are what i was there

2610
01:32:47,430 --> 01:32:44,400
i'm using as a term to describe

2611
01:32:50,709 --> 01:32:47,440
these non-equilibrium steady states

2612
01:32:52,550 --> 01:32:50,719
that if you were to um basically in a

2613
01:32:55,590 --> 01:32:52,560

judah pearl sense intervene of the

2614

01:32:57,270 --> 01:32:55,600

information flow from the outside world

2615

01:32:58,950 --> 01:32:57,280

into these systems

2616

01:33:00,550 --> 01:32:58,960

they would no longer be at

2617

01:33:03,030 --> 01:33:00,560

non-equilibrium they would actually

2618

01:33:05,510 --> 01:33:03,040

collapse to being at equilibrium

2619

01:33:07,270 --> 01:33:05,520

and we were calling that in this is what

2620

01:33:08,709 --> 01:33:07,280

we were calling an observer

2621

01:33:10,950 --> 01:33:08,719

this was um

2622

01:33:12,950 --> 01:33:10,960

what they were called in this talk of

2623

01:33:15,350 --> 01:33:12,960

mine that kevin saw

2624

01:33:17,590 --> 01:33:15,360

and um the and we were

2625

01:33:19,189 --> 01:33:17,600

making the definitions be

2626

01:33:21,270 --> 01:33:19,199

um we were careful

2627

01:33:23,030 --> 01:33:21,280

so that we would not i mean the words

2628

01:33:24,550 --> 01:33:23,040

observer and alive are being just

2629

01:33:26,390 --> 01:33:24,560

mangled around here

2630

01:33:27,750 --> 01:33:26,400

but um that we were trying to make it so

2631

01:33:30,070 --> 01:33:27,760

that a hurricane is not in a certain

2632

01:33:33,590 --> 01:33:30,080

sense observing its environment

2633

01:33:34,470 --> 01:33:33,600

um whereas say a paramecium going up a

2634

01:33:40,629 --> 01:33:34,480

uh

2635

01:33:42,470 --> 01:33:40,639

environment and is alive

2636

01:33:45,030 --> 01:33:42,480

so um

2637

01:33:46,149 --> 01:33:45,040

let's see so

2638

01:33:49,910 --> 01:33:46,159

well

2639

01:33:52,709 --> 01:33:49,920

i am my collaborator artemis kochinski

2640

01:33:55,669 --> 01:33:52,719

we're going after in that paper

2641

01:33:57,350 --> 01:33:55,679

where we define semantic information and

2642

01:34:00,390 --> 01:33:57,360

observation

2643

01:34:02,229 --> 01:34:00,400

and so on as a non-equilibrium study is

2644

01:34:03,430 --> 01:34:02,239

a system that's in a non-equilibrium

2645

01:34:05,430 --> 01:34:03,440

steady state

2646

01:34:07,030 --> 01:34:05,440

such that if you intervened on the

2647

01:34:08,070 --> 01:34:07,040

information it gets from the outside

2648

01:34:10,310 --> 01:34:08,080

world

2649

01:34:12,950 --> 01:34:10,320

it would collapse to equilibrium

2650

01:34:15,270 --> 01:34:12,960

equilibrium being a synonym for depth

2651
01:34:18,629 --> 01:34:15,280
we were saying that those are systems

2652
01:34:20,629 --> 01:34:18,639
that are either observers or living or

2653
01:34:22,550 --> 01:34:20,639
just generally of interest without using

2654
01:34:25,910 --> 01:34:22,560
loaded terminology

2655
01:34:28,070 --> 01:34:25,920
um that is all the what

2656
01:34:30,550 --> 01:34:28,080
kevin is talking about models that the

2657
01:34:34,229 --> 01:34:30,560
system has internally

2658
01:34:35,270 --> 01:34:34,239
that is that basically play a middle

2659
01:34:37,910 --> 01:34:35,280
step

2660
01:34:41,109 --> 01:34:37,920
in the map from the information entering

2661
01:34:44,550 --> 01:34:41,119
from the outside to the actions that the

2662
01:34:46,390 --> 01:34:44,560
um entity does back on the outside

2663
01:34:50,070 --> 01:34:46,400

that a lot that end up allowing the

2664

01:34:52,390 --> 01:34:50,080

entity to be away from equilibrium

2665

01:34:53,990 --> 01:34:52,400

the model is the way that it does that

2666

01:34:56,709 --> 01:34:54,000

it's a way of interpreting what's going

2667

01:34:58,310 --> 01:34:56,719

on in the entity in between these steps

2668

01:35:01,189 --> 01:34:58,320

of getting information from the outside

2669

01:35:02,550 --> 01:35:01,199

and then acting back on the outside

2670

01:35:04,950 --> 01:35:02,560

um

2671

01:35:07,510 --> 01:35:04,960

what we were

2672

01:35:09,830 --> 01:35:07,520

analyzing in our work

2673

01:35:11,669 --> 01:35:09,840

deleted that step we were not trying to

2674

01:35:13,350 --> 01:35:11,679

say anything about internal models we

2675

01:35:14,390 --> 01:35:13,360

were simply saying the end result is

2676

01:35:17,270 --> 01:35:14,400

that if you

2677

01:35:18,870 --> 01:35:17,280

interrupt the information flow from the

2678

01:35:21,430 --> 01:35:18,880

outside

2679

01:35:23,030 --> 01:35:21,440

we were saying nothing about the reasons

2680

01:35:24,070 --> 01:35:23,040

whether it go through models or some

2681

01:35:27,030 --> 01:35:24,080

other

2682

01:35:29,910 --> 01:35:27,040

phenomena but the ultimate effect was

2683

01:35:32,229 --> 01:35:29,920

that you collapsed back to equilibrium

2684

01:35:33,510 --> 01:35:32,239

so it was saying that if you if i sunder

2685

01:35:34,790 --> 01:35:33,520

the information you're going from the

2686

01:35:36,950 --> 01:35:34,800

outside you're getting right now

2687

01:35:39,270 --> 01:35:36,960

information from the outside about where

2688

01:35:42,070 --> 01:35:39,280

a cheeseburger is on a table

2689

01:35:44,229 --> 01:35:42,080

if i stop that information flow

2690

01:35:45,510 --> 01:35:44,239

eventually you die you fall back to

2691

01:35:47,109 --> 01:35:45,520

equilibrium

2692

01:35:48,950 --> 01:35:47,119

so that's the so what you are doing is

2693

01:35:50,870 --> 01:35:48,960

you are right now in a non-equilibrium

2694

01:35:52,709 --> 01:35:50,880

steady state because you're getting

2695

01:35:54,870 --> 01:35:52,719

information from the outside world and

2696

01:35:57,669 --> 01:35:54,880

what i and what we were analyzing there

2697

01:35:59,350 --> 01:35:57,679

is systems where if you were to chop

2698

01:36:02,070 --> 01:35:59,360

that information flow from the outside

2699

01:36:03,750 --> 01:36:02,080

world the result is that they actually

2700

01:36:05,750 --> 01:36:03,760

collapse back down into being

2701

01:36:08,709 --> 01:36:05,760

equilibrium they die

2702

01:36:10,790 --> 01:36:08,719

the means by which that happens

2703

01:36:12,950 --> 01:36:10,800

in your particular case or well if you

2704

01:36:15,350 --> 01:36:12,960

had that information about where the

2705

01:36:17,910 --> 01:36:15,360

cheeseburger is you could then reach out

2706

01:36:20,070 --> 01:36:17,920

your hand based upon an internal model

2707

01:36:22,149 --> 01:36:20,080

of the outside world grab that

2708

01:36:23,510 --> 01:36:22,159

cheeseburger bring it to your mouth

2709

01:36:25,189 --> 01:36:23,520

digest it

2710

01:36:27,189 --> 01:36:25,199

get a whole bunch of glucose which is

2711

01:36:28,790 --> 01:36:27,199

what you then use to stay out of

2712

01:36:30,550 --> 01:36:28,800

equilibrium

2713

01:36:33,030 --> 01:36:30,560

so that's everything that happened in

2714

01:36:35,430 --> 01:36:33,040

between you're getting the information

2715

01:36:37,750 --> 01:36:35,440

and you're staying out of equilibrium

2716

01:36:40,149 --> 01:36:37,760

in other processes like the paramecium

2717

01:36:41,590 --> 01:36:40,159

it's getting information about the

2718

01:36:42,790 --> 01:36:41,600

gradient of a chemical in its

2719

01:36:44,870 --> 01:36:42,800

environment

2720

01:36:46,870 --> 01:36:44,880

it is then using that information one

2721

01:36:49,430 --> 01:36:46,880

could maybe say an implicit genetic

2722

01:36:51,350 --> 01:36:49,440

model that's what kevin is saying but

2723

01:36:52,950 --> 01:36:51,360

whatever the end result is that it uses

2724

01:36:54,950 --> 01:36:52,960

that to determine

2725

01:36:57,750 --> 01:36:54,960

how it should reorient itself before it

2726

01:37:00,950 --> 01:36:57,760

uses this flagella to actually move

2727

01:37:02,390 --> 01:37:00,960

so that it can actually then ingest

2728

01:37:04,709 --> 01:37:02,400

these particular chemicals and that's

2729

01:37:06,950 --> 01:37:04,719

how it stays out of equilibrium

2730

01:37:09,189 --> 01:37:06,960

so in my work with artemy kalczyński all

2731

01:37:12,149 --> 01:37:09,199

that we did was looked at the um

2732

01:37:13,910 --> 01:37:12,159

the beginning point and the end point

2733

01:37:16,870 --> 01:37:13,920

notice that you need the information

2734

01:37:18,629 --> 01:37:16,880

coming in to stay out of equilibrium

2735

01:37:21,270 --> 01:37:18,639

those are interesting systems we said

2736

01:37:23,830 --> 01:37:21,280

from a physics point of view

2737

01:37:26,070 --> 01:37:23,840

kevin is now discussing is a special

2738

01:37:28,470 --> 01:37:26,080

case of such systems

2739

01:37:30,550 --> 01:37:28,480

which are physics systems that capture

2740

01:37:33,830 --> 01:37:30,560

at least a large part of what is

2741

01:37:35,270 --> 01:37:33,840

what one might want to say is a living

2742

01:37:37,189 --> 01:37:35,280

system they're not just interesting

2743

01:37:40,390 --> 01:37:37,199

these things they do capture a large

2744

01:37:42,229 --> 01:37:40,400

part of what it means to be alive

2745

01:37:44,629 --> 01:37:42,239

so that's a very long-winded answer to

2746

01:37:47,030 --> 01:37:44,639

question to kevin's question kevin yes

2747

01:37:49,510 --> 01:37:47,040

if you do want to in particular the

2748

01:37:51,750 --> 01:37:49,520

directed information flow of people like

2749

01:37:53,830 --> 01:37:51,760

daniel palani and nihai

2750

01:37:55,830 --> 01:37:53,840

i think could be a very very interesting

2751

01:37:57,109 --> 01:37:55,840

fruitful way to try to build more

2752

01:37:59,590 --> 01:37:57,119

structure

2753

01:38:01,669 --> 01:37:59,600

into these particular systems

2754

01:38:03,270 --> 01:38:01,679

a halfway point to building full-on

2755

01:38:06,229 --> 01:38:03,280

internal models

2756

01:38:07,669 --> 01:38:06,239

so yeah kevin drop me a line

2757

01:38:09,590 --> 01:38:07,679

now the last question you can answer

2758

01:38:13,189 --> 01:38:09,600

hopefully fairly quickly it's even

2759

01:38:14,709 --> 01:38:13,199

though it's long it's one sentence

2760

01:38:16,470 --> 01:38:14,719

it's actually just one sentence so i

2761

01:38:18,870 --> 01:38:16,480

love this one comes from professor

2762

01:38:20,550 --> 01:38:18,880

edward lee of berkeley i love david how

2763

01:38:21,830 --> 01:38:20,560

your work has complicated the faith many

2764

01:38:23,830 --> 01:38:21,840

scientists hold in an ultimately

2765

01:38:25,830 --> 01:38:23,840

deterministic world i was wondering

2766

01:38:27,669 --> 01:38:25,840

whether you've looked at john norton so

2767

01:38:29,430 --> 01:38:27,679

we talked about that

2768

01:38:31,109 --> 01:38:29,440

so we actually did talk about that in

2769

01:38:33,189 --> 01:38:31,119

particular why is this example

2770

01:38:36,950 --> 01:38:33,199

controversial why are so many people

2771

01:38:39,270 --> 01:38:36,960

offended by the idea of uncaused action

2772

01:38:42,229 --> 01:38:39,280

yeah i've also encountered um uh

2773

01:38:44,629 --> 01:38:42,239

professor lee's work and i find also

2774

01:38:47,189 --> 01:38:44,639

mutual admiration here um that i am

2775

01:38:49,109 --> 01:38:47,199

impressed with a lot of his work um this

2776

01:38:50,870 --> 01:38:49,119

is actually a subtle thing i'm very

2777

01:38:52,950 --> 01:38:50,880

careful in my

2778

01:38:55,510 --> 01:38:52,960

stuff on inference devices

2779

01:38:57,510 --> 01:38:55,520

there is no laws discussed mentioned

2780

01:38:59,790 --> 01:38:57,520

anyway there's no rules

2781

01:39:02,550 --> 01:38:59,800

there's no

2782

01:39:04,629 --> 01:39:02,560

mathematicalization of the patterns in

2783

01:39:07,669 --> 01:39:04,639

the underlying reality

2784

01:39:14,070 --> 01:39:09,750

world lines in a set

2785

01:39:16,390 --> 01:39:14,080

and in an observer is one particular um

2786

01:39:19,030 --> 01:39:16,400

subset of those world lines something

2787

01:39:21,109 --> 01:39:19,040

it's observing is another subset

2788

01:39:23,350 --> 01:39:21,119

what it means to observe

2789

01:39:25,189 --> 01:39:23,360

has to do with the relationship between

2790

01:39:27,270 --> 01:39:25,199

those two subsets

2791

01:39:29,750 --> 01:39:27,280

what it would mean to make predictions

2792

01:39:32,070 --> 01:39:29,760

would then be another subset

2793

01:39:34,950 --> 01:39:32,080

and basically by means of these subsets

2794

01:39:36,790 --> 01:39:34,960

and their overlaps that this topology

2795

01:39:38,709 --> 01:39:36,800

you would build up the structure of a

2796

01:39:41,510 --> 01:39:38,719

scientist using theories to make

2797

01:39:43,350 --> 01:39:41,520

predictions about what might occur in

2798

01:39:46,550 --> 01:39:43,360

the world and those theories are going

2799

01:39:48,390 --> 01:39:46,560

to be in the form of rules and laws

2800

01:39:51,750 --> 01:39:48,400

and so for example max tegmark's

2801

01:39:53,910 --> 01:39:51,760

multiverse work i highly plug his

2802

01:39:56,629 --> 01:39:53,920

foundations of physics paper in the

2803

01:39:59,510 --> 01:39:56,639

earlier animals of physics um papers

2804

01:40:02,470 --> 01:39:59,520

on the multiverse don't bother with pop

2805

01:40:03,830 --> 01:40:02,480

books go to go for the real meat um

2806

01:40:05,990 --> 01:40:03,840

in that work

2807

01:40:08,070 --> 01:40:06,000

he ultimately

2808

01:40:10,229 --> 01:40:08,080

reduces the notion of physical reality

2809

01:40:11,830 --> 01:40:10,239

to a set of laws to a set of

2810

01:40:13,189 --> 01:40:11,840

mathematical

2811

01:40:14,790 --> 01:40:13,199

rules

2812

01:40:17,510 --> 01:40:14,800

and the presumption that all physical

2813

01:40:18,790 --> 01:40:17,520

reality is is just a set of rules which

2814

01:40:24,550 --> 01:40:18,800

is

2815

01:40:25,910 --> 01:40:24,560

because it seems to

2816

01:40:27,910 --> 01:40:25,920

wreak havoc with the notion that

2817

01:40:29,430 --> 01:40:27,920

physical reality can be reduced to a set

2818

01:40:30,870 --> 01:40:29,440

of rules

2819

01:40:32,310 --> 01:40:30,880

that's i think ultimately from a

2820

01:40:34,229 --> 01:40:32,320

sociological point of view why people

2821

01:40:36,149 --> 01:40:34,239

are upset about that

2822

01:40:37,430 --> 01:40:36,159

i'm very careful in my work that rules

2823

01:40:40,390 --> 01:40:37,440

don't appear

2824

01:40:42,790 --> 01:40:40,400

there's just subsets there's a topology

2825

01:40:45,590 --> 01:40:42,800

there might be patterns those patterns

2826

01:40:47,189 --> 01:40:45,600

can be violated at any point in time

2827

01:40:49,030 --> 01:40:47,199

no free lunch

2828

01:40:50,390 --> 01:40:49,040

um newton's laws even if they are there

2829

01:40:52,790 --> 01:40:50,400

they might just suddenly disappear

2830

01:40:55,510 --> 01:40:52,800

tomorrow before the um

2831

01:40:57,350 --> 01:40:55,520

before uh the ball of john norton has

2832

01:40:59,030 --> 01:40:57,360

even had a chance to try to think about

2833

01:41:00,229 --> 01:40:59,040

falling off of the dome

2834

01:41:04,629 --> 01:41:00,239

um

2835

01:41:06,070 --> 01:41:04,639

but many people instead want to

2836

01:41:08,950 --> 01:41:06,080

implicitly

2837

01:41:10,149 --> 01:41:08,960

they think of a mathematical universe as

2838

01:41:11,510 --> 01:41:10,159

being

2839

01:41:13,109 --> 01:41:11,520

a set of things like differential

2840

01:41:14,790 --> 01:41:13,119

equations

2841

01:41:16,550 --> 01:41:14,800

rules laws

2842

01:41:19,270 --> 01:41:16,560

and i just think of it instead as being

2843

01:41:20,470 --> 01:41:19,280

a set and there can be a topology on

2844

01:41:22,709 --> 01:41:20,480

that set

2845

01:41:24,470 --> 01:41:22,719

and the topology might have patterns

2846

01:41:26,470 --> 01:41:24,480

which you might be able to embody as

2847

01:41:28,310 --> 01:41:26,480

such rules and laws

2848

01:41:30,870 --> 01:41:28,320

or it might not

2849

01:41:33,510 --> 01:41:30,880

it all just depends on the topology and

2850

01:41:36,790 --> 01:41:33,520

different topologies are going to

2851

01:41:38,950 --> 01:41:36,800

either be rule like or not rule-like

2852

01:41:40,550 --> 01:41:38,960

law-like or not law-like

2853

01:41:41,990 --> 01:41:40,560

and it's not even the case that one is

2854

01:41:44,229 --> 01:41:42,000

real and one is not real they're just

2855

01:41:46,149 --> 01:41:44,239

all different realities

2856

01:41:47,430 --> 01:41:46,159

it's legitimate to one as legitimate as

2857

01:41:49,669 --> 01:41:47,440

one another there's no privileged

2858

01:41:51,750 --> 01:41:49,679

reality

2859

01:41:53,189 --> 01:41:51,760

i i suspect that

2860

01:41:55,750 --> 01:41:53,199

all of these kinds of answers i'm giving

2861

01:41:57,669 --> 01:41:55,760

you these questions

2862

01:41:58,870 --> 01:41:57,679

are not necessarily fully fruitful it's

2863

01:42:02,070 --> 01:41:58,880

kind of

2864

01:42:04,470 --> 01:42:02,080

as an aside as an interviewee to give a

2865

01:42:07,030 --> 01:42:04,480

answer to a question in a stand-alone

2866

01:42:08,870 --> 01:42:07,040

manner rather than in a dialogue

2867

01:42:10,550 --> 01:42:08,880

where i can see the response of the

2868

01:42:12,229 --> 01:42:10,560

questioner and therefore refine my

2869

01:42:14,310 --> 01:42:12,239

answer

2870

01:42:16,229 --> 01:42:14,320

accordingly it's a kind of a strange

2871

01:42:18,470 --> 01:42:16,239

thing because it's almost like open loop

2872

01:42:21,030 --> 01:42:18,480

rather than closed loop control

2873

01:42:22,709 --> 01:42:21,040

um but in any case um i hope that

2874

01:42:26,149 --> 01:42:22,719

answers a little bit um a professor

2875

01:42:29,830 --> 01:42:27,990

professor thank you so much for spending

2876

01:42:31,669 --> 01:42:29,840

so much time with me and the audience

2877

01:42:34,629 --> 01:42:31,679

i'm sure thanks you too

2878

01:42:36,310 --> 01:42:34,639

okay well thanks very much sorry if i

2879

01:42:39,109 --> 01:42:36,320

was too much open loop control i think i

2880

01:42:41,270 --> 01:42:39,119

was a little bit logarettic today but

2881

01:42:43,669 --> 01:42:41,280

so uh thank you very very much

2882

01:42:46,310 --> 01:42:43,679

and if you could give me the information

2883

01:42:48,790 --> 01:42:46,320

about um the forum for this so i can

2884

01:42:51,030 --> 01:42:48,800

then forward that to the sfi people and

2885

01:42:53,750 --> 01:42:51,040

kevin contact me

2886

01:42:56,229 --> 01:42:53,760

great okay okay goodbye professor thank

2887

01:42:58,149 --> 01:42:56,239

you okay truly it was a blast like i'm

2888

01:42:59,669 --> 01:42:58,159

great to be speaking to someone who also

2889

01:43:01,750 --> 01:42:59,679

is philosophically inclined even though

2890

01:43:03,430 --> 01:43:01,760

you had your excoriations on philosophy

2891

01:43:05,750 --> 01:43:03,440

you still had your philosophy of

2892

01:43:08,470 --> 01:43:05,760

philosophy

2893

01:43:10,070 --> 01:43:08,480

yeah um in many ways yes

2894

01:43:13,830 --> 01:43:10,080

i think philosophy is almost by

2895

01:43:15,910 --> 01:43:13,840

definition the most important

2896

01:43:18,229 --> 01:43:15,920

intellectual endeavor there is but and

2897

01:43:20,310 --> 01:43:18,239

this is being a real snide

2898

01:43:23,030 --> 01:43:20,320

i don't i think it's really unfortunate

2899

01:43:24,550 --> 01:43:23,040

people that actually engage in it

2900

01:43:28,149 --> 01:43:24,560

have not been trained

2901
01:43:32,149 --> 01:43:28,159
properly and that's most of philosophers

2902
01:43:34,470 --> 01:43:32,159
um it's unfortunately exceptions um you

2903
01:43:36,310 --> 01:43:34,480
know dan dan i think

2904
01:43:38,070 --> 01:43:36,320
the training can either be explicitly or

2905
01:43:39,430 --> 01:43:38,080
implicitly and i think dan is an example

2906
01:43:41,669 --> 01:43:39,440
of somebody who's

2907
01:43:43,990 --> 01:43:41,679
quote trained well to be really speaking

2908
01:43:45,510 --> 01:43:44,000
in snotty asinine terms

2909
01:43:48,229 --> 01:43:45,520
um but yeah i think it's the most

2910
01:43:51,510 --> 01:43:48,239
important um subject there is

2911
01:43:55,590 --> 01:43:53,830
all right take care sir okay

2912
01:43:56,870 --> 01:43:55,600
and we'll talk soon bye bye okay thank

2913
01:43:58,870 --> 01:43:56,880

you

2914

01:44:00,709 --> 01:43:58,880

there were two extra questions from sam

2915

01:44:03,030 --> 01:44:00,719

thompson and chris langan that we didn't

2916

01:44:05,030 --> 01:44:03,040

have a chance to address on video due to

2917

01:44:06,709 --> 01:44:05,040

limited time but david was kind enough

2918

01:44:08,629 --> 01:44:06,719

to answer over email

2919

01:44:10,629 --> 01:44:08,639

sam thompson asks do you see any

2920

01:44:12,310 --> 01:44:10,639

socio-political implications in your

2921

01:44:14,870 --> 01:44:12,320

work on the formal limitations of

2922

01:44:17,189 --> 01:44:14,880

inference devices david walpart says

2923

01:44:19,669 --> 01:44:17,199

interesting question one could consider

2924

01:44:22,070 --> 01:44:19,679

for example the laplace's demon theorem

2925

01:44:23,590 --> 01:44:22,080

or the monotheism theorem as concerning

2926

01:44:25,350 --> 01:44:23,600

limitations of what a government is

2927

01:44:27,270 --> 01:44:25,360

capable of but those theorems are based

2928

01:44:29,270 --> 01:44:27,280

on worst case scenarios they show that

2929

01:44:31,270 --> 01:44:29,280

there is some question-answer pair that

2930

01:44:33,750 --> 01:44:31,280

an inference device gets wrong not that

2931

01:44:35,510 --> 01:44:33,760

it must get wrong a particular such pair

2932

01:44:37,430 --> 01:44:35,520

more interesting and future work would

2933

01:44:39,109 --> 01:44:37,440

be an extension of the inference theorem

2934

01:44:40,870 --> 01:44:39,119

would be an extension of the inference

2935

01:44:43,350 --> 01:44:40,880

device formalism to incorporate

2936

01:44:46,310 --> 01:44:43,360

probabilities and degrees of failure

2937

01:44:48,070 --> 01:44:46,320

then for example we could maybe get

2938

01:44:50,070 --> 01:44:48,080

impossibility results concerning the

2939

01:44:52,149 --> 01:44:50,080

maximal probability that the error of

2940

01:44:54,870 --> 01:44:52,159

the inference device would be less than

2941

01:44:56,550 --> 01:44:54,880

a bound in sociopolitical terms rather

2942

01:44:58,390 --> 01:44:56,560

than a result concerning worst-case

2943

01:45:00,470 --> 01:44:58,400

failures of a government the current

2944

01:45:02,229 --> 01:45:00,480

impossibility theorems we would have a

2945

01:45:04,070 --> 01:45:02,239

result concerning the likelihood that a

2946

01:45:05,030 --> 01:45:04,080

government failure is worse than a given

2947

01:45:07,189 --> 01:45:05,040

amount

2948

01:45:09,189 --> 01:45:07,199

now on to the question from chris langan

2949

01:45:11,189 --> 01:45:09,199

do you base your definition of

2950

01:45:13,189 --> 01:45:11,199

observer on principles of physical

2951
01:45:15,669 --> 01:45:13,199
causation including thermodynamics and

2952
01:45:18,149 --> 01:45:15,679
statistical mechanics dot david

2953
01:45:20,070 --> 01:45:18,159
interjects i've used the term observer

2954
01:45:21,830 --> 01:45:20,080
in different ways depending on whether

2955
01:45:23,990 --> 01:45:21,840
i'm talking about inference devices or

2956
01:45:26,229 --> 01:45:24,000
the semantics of information formalism

2957
01:45:27,990 --> 01:45:26,239
with artemy or noisy deductive reasoning

2958
01:45:30,229 --> 01:45:28,000
which meaning do they have in mind so

2959
01:45:32,709 --> 01:45:30,239
then chris langen finishes the question

2960
01:45:34,950 --> 01:45:32,719
do you subscribe to physicalism the idea

2961
01:45:36,950 --> 01:45:34,960
that reality is basically physical in

2962
01:45:38,550 --> 01:45:36,960
nature or do you think that a broader

2963
01:45:40,870 --> 01:45:38,560

more sophisticated understanding of

2964

01:45:42,790 --> 01:45:40,880

causality one that exceeds the classical

2965

01:45:44,390 --> 01:45:42,800

concept of physical mechanism and

2966

01:45:46,390 --> 01:45:44,400

quantum theoretic concepts like

2967

01:45:48,229 --> 01:45:46,400

entanglement non-locality and quantum

2968

01:45:51,270 --> 01:45:48,239

wave function collapse will eventually

2969

01:45:53,590 --> 01:45:51,280

be required david answers in short there

2970

01:45:55,590 --> 01:45:53,600

is right now absolutely zero data slash

2971

01:45:57,830 --> 01:45:55,600

evidence to believe that will

2972

01:46:02,149 --> 01:45:57,840

quote-unquote eventually be required so

2973

01:46:05,830 --> 01:46:04,070

the podcast is now finished if you'd

2974

01:46:08,950 --> 01:46:05,840

like to support conversations like this

2975

01:46:13,109 --> 01:46:08,960

then do consider going to patreon.com

2976

01:46:15,669 --> 01:46:13,119

c-u-r-t j-a-i-m-u-n

2977

01:46:17,510 --> 01:46:15,679

that is kurt jaimungle it's support from

2978

01:46:19,350 --> 01:46:17,520

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