

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

286

1	I take the input bits to the repeater in Figure 3,	05:21:06
2	divide them into subblocks, and repeat each subblock	05:21:11
3	a different number of times, then I have an	05:21:14
4	irregular repetition, correct?	05:21:18
5	MR. GLASS: Same objections. Asked and	05:21:19
6	answered.	05:21:21
7	THE WITNESS: What you're asking me is if	05:21:21
8	I take a repeater accumulated code and make it	05:21:24
9	irregular, is it irregular? Yes.	05:21:29
10	BY MR. DOWD:	05:21:32
11	Q. Okay. And so taking a set of input bits,	05:21:32
12	dividing that into subblocks and repeating each	05:21:40
13	subblock a different number of times, that to you is	05:21:42
14	the definition of an irregular code?	05:21:45
15	MR. GLASS: Calls for a legal conclusion.	05:21:47
16	Outside the scope.	05:21:48
17	THE WITNESS: I have no opinion on that.	05:21:48
18	BY MR. DOWD:	05:22:04
19	Q. Now, is it your position that Dr. Frey and	05:22:04
20	Dr. Divsalar were in different groups that didn't	05:22:07
21	talk to each other?	05:22:09
22	A. This would be best posed to them. I have	05:22:10
23	absolutely no idea.	05:22:12
24	Q. Okay. So to the best of your knowledge,	05:22:13
25	Dr. Frey and Dr. Divsalar may well have talked to	05:22:16

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

287

1	each other?	05:22:18
2	A. I could speculate, but I prefer not to.	05:22:19
3	Q. Well, we don't have to speculate.	05:22:23
4	MR. DOWD: Let's mark as Exhibit 22, a	05:22:30
5	copy of a document Caltech24021, it's an e-mail from	05:22:33
6	Dr. Frey to Dr. Divsalar.	05:22:39
7	(Urbanke Exhibit 22 was marked for	05:22:41
8	identification and attached to the	05:22:41
9	transcript.)	05:22:53
10	BY MR. DOWD:	05:22:53
11	Q. Do you have Exhibit 22?	05:22:53
12	A. Yes.	05:22:54
13	Q. This is an e-mail that Dr. Frey sent to	05:22:54
14	Dr. Divsalar in December of '99, right?	05:22:57
15	A. The date reads: 12/8/1999.	05:23:05
16	Q. And he says -- he references the irregular	05:23:09
17	turbo codes work that he's been doing, right?	05:23:14
18	A. He -- in -- in there it's written	05:23:18
19	"irregular turbo codes" is two of the words that	05:23:22
20	appear in the e-mail; that is correct.	05:23:24
21	Q. And he asks:	05:23:28
22	"Dr. Divsalar, have you had a chance	05:23:34
23	to look through the Allerton paper?"	05:23:36
24	Right?	05:23:39
25	A. That is a sentence that appears; that's	05:23:41

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

288

1	correct.	05:23:44
2	Q. Exhibit 21 is the irregular turbo codes	05:23:44
3	paper from the 1999 Allerton conference, correct?	05:23:48
4	A. Whether he refers to the turbo code paper,	05:23:52
5	I have no idea. It doesn't say specifically.	05:23:55
6	It says -- he mentions: Have you looked	05:23:57
7	through the Allerton paper? Which paper he refers	05:24:00
8	to, I have no idea.	05:24:03
9	Q. My question was, Exhibit 21 is the	05:24:04
10	irregular turbo codes paper Dr. Frey presented at	05:24:08
11	Allerton in 1999, correct?	05:24:11
12	A. Reference 21 is a code -- a paper	05:24:14
13	entitled: "Irregular Turbo Codes," which was	05:24:23
14	published or which was presented presumably at the	05:24:27
15	Allerton conference in 1999.	05:24:32
16	Q. Okay. And if we return to Exhibit 22, he	05:24:34
17	says:	05:24:38
18	"Regardless, it would be interesting	05:24:38
19	to extend the work that you and Bob have	05:24:40
20	done to the case of irregular turbo	05:24:42
21	codes."	05:24:42
22	Have I read that correctly?	05:24:46
23	A. Yes.	05:24:47
24	Q. If we go to Exhibit 6, that's the Divsalar	05:24:48
25	paper we've been talking about so far today, right?	05:24:54

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

289

1	A.	Yes.	05:24:57
2	Q.	And two of the authors on that paper are	05:24:58
3		Dr. Divsalar and Bob McEliece, right?	05:25:01
4	A.	That is correct.	05:25:05
5	Q.	And so at this time Divsalar and McEliece	05:25:09
6		were working together on RA codes, correct?	05:25:13
7	A.	Their main motivation was to extend what	05:25:16
8		was --	05:25:18
9		THE REPORTER: I'm sorry. Start over.	05:25:18
10		THE WITNESS: Their main motivation was to	05:25:20
11		extend what was called the interleaver gain	05:25:22
12		conjecture, I believe, to turbo codes. And they	05:25:27
13		succeeded in the RA paper to do that for the very	05:25:30
14		specific case of RA codes.	05:25:36
15		BY MR. DOWD:	05:25:39
16	Q.	Okay. So --	05:25:40
17	A.	That is what their main work was at that	05:25:40
18		time.	05:25:44
19	Q.	So my question was, at that time	05:25:44
20		Dr. Divsalar and Dr. McEliece, what they were	05:25:47
21		working on together was RA codes, right?	05:25:52
22	A.	They were working on the weight	05:25:53
23		distribution problem.	05:25:56
24	Q.	They were working on a problem that	05:25:56
25		resulted in the RA codes that we have in Exhibit 6,	05:25:58

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

290

1	right?	05:26:02
2	MR. GLASS: Objection. Asked and	05:26:02
3	answered.	05:26:04
4	THE WITNESS: As it's written even in the	05:26:04
5	paper, I believe, their motivation for looking at it	05:26:07
6	and their main work for doing it was to solve the	05:26:10
7	interleaver gain component conjecture.	05:26:14
8	BY MR. DOWD:	05:26:17
9	Q. Okay.	05:26:18
10	A. By doing this they looked at a specific	05:26:18
11	case or in order to accomplish it of RA -- of RA	05:26:20
12	codes. And, hence, I would consider that what the	05:26:23
13	main concern at that point was -- was to prove or to	05:26:27
14	establish the validity of this interleaver gain	05:26:33
15	conjecture to various forms of turbo codes.	05:26:39
16	Q. Now, we said earlier that RA codes are a	05:26:44
17	form of turbo; do you recall that testimony?	05:26:47
18	A. That is correct.	05:26:50
19	Q. The Frey irregular turbo codes paper from	05:26:52
20	1999, Exhibit 21, is about making turbo codes	05:26:55
21	irregular, right?	05:27:00
22	A. That is correct.	05:27:00
23	Q. And if I make the repetition of the RA	05:27:03
24	code in Figure 3 irregular, I have an IRA code by	05:27:23
25	definition, right?	05:27:30

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

291

1	MR. GLASS: Objection. Vague.	05:27:31
2	THE WITNESS: So, you know, without giving	05:27:32
3	a legal opinion here, one way of making --	05:27:34
4	accomplishing I -- IRA codes is of -- by definition	05:27:38
5	introducing irregular repeats.	05:27:42
6	BY MR. DOWD:	05:27:45
7	Q. Okay. Now, I take it that if we return to	05:27:46
8	Exhibit 2 you'd never seen -- oh, withdrawn, sorry.	05:27:53
9	I'm sticking with the e-mail exhibit 22.	05:27:57
10	A. Right.	05:28:01
11	Q. So I take it that before you were retained	05:28:01
12	for this case, you had never seen the e-mail that	05:28:04
13	we've marked as Exhibit 22?	05:28:07
14	A. I'm pretty sure no.	05:28:08
15	Q. Okay. So let's see if we can agree on	05:28:10
16	some kind of basic points.	05:28:19
17	We can agree that making an LDPC code	05:28:22
18	irregular improved performance over a regular LDPC	05:28:27
19	code, right?	05:28:32
20	A. We can agree that --	05:28:33
21	MR. GLASS: Objection. Incomplete	05:28:33
22	hypothetical.	05:28:34
23	Go ahead.	05:28:34
24	THE WITNESS: We can agree that in	05:28:35
25	particular situations as there were Luby '97 and	05:28:37

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

292

1 Luby '98 and Richardson '99, each of them with very 05:28:42
2 specific restrictions, some form of irregularity 05:28:47
3 improved the performance. The restrictions in the 05:28:49
4 Luby '97 paper were for the binary racial channel 05:28:54
5 for particularly cascaded codes. The restrictions 05:28:58
6 in this Luby '98 paper were that there were a 05:29:02
7 particular way of doing the decoding, which is 05:29:04
8 neither equal to message passing nor equal to the 05:29:07
9 flipping algorithm. 05:29:10
10 And in the case of LDPC codes in the -- in 05:29:11
11 the Richardson '99 paper this was strictly concerned 05:29:16
12 with Gallager type but irregular codes. 05:29:21
13 BY MR. DOWD: 05:29:29
14 Q. So if we go back to Exhibit 17, Luby '98, 05:30:16
15 at page 925, the statement there is: 05:30:23
16 "It is shown that using irregular 05:30:36
17 graphs yields codes with much better 05:30:39
18 performance than regular graphs." 05:30:41
19 Have I read that quote correctly? 05:30:43
20 A. In the context of the quotes, they're 05:30:45
21 consistent. 05:30:49
22 Q. And in Luby '98, they don't say: 05:30:49
23 "It's shown that using irregular 05:30:58
24 graphs yields codes with much better 05:30:59
25 performance than regular graphs only as 05:31:01

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

293

1	compared to a flipping algorithm when	05:31:05
2	you're decoding," do they?	05:31:07
3	MR. GLASS: Objection. Vague. Asked and	05:31:10
4	answered.	05:31:11
5	THE WITNESS: That's the only possible	05:31:11
6	conclusion you can draw because that's the only	05:31:13
7	thing they show in the paper.	05:31:16
8	BY MR. DOWD:	05:31:17
9	Q. Well, and maybe that's the only conclusion	05:31:18
10	you can draw, but --	05:31:19
11	A. It's the only conclusion someone, you	05:31:20
12	know, versed in the art could draw.	05:31:22
13	Q. Okay. Sir, in the statement where they	05:31:24
14	explain why it's better performance, there's no	05:31:27
15	mention here on this page of flipping, is there?	05:31:30
16	MR. GLASS: Objection. Asked and answered	05:31:35
17	several times now.	05:31:36
18	Go ahead.	05:31:37
19	THE WITNESS: As I mentioned, it's not	05:31:37
20	customary that every single time when you talk about	05:31:40
21	something that you would repeat all possible	05:31:44
22	restrictions that you're considering.	05:31:46
23	Typically in the abstract you would say,	05:31:47
24	we're considering, you know, a certain type of code.	05:31:50
25	We're considering certain type of decoder. You	05:31:53

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

294

1	would not repeat that at every single sentence.	05:31:56
2	BY MR. DOWD:	05:32:00
3	Q. Right. In the abstract, can you point out	05:32:00
4	where it says that this is about a flipping decoder	05:32:03
5	in the abstract?	05:32:06
6	A. Here it's in the abstract, but it's very	05:32:06
7	clearly explained in the paper that that decoding	05:32:06
8	does not send a message passing decoder, but --	05:32:06
9	THE REPORTER: Wait. You're going to have	05:32:06
10	to start that answer over.	05:32:13
11	THE WITNESS: In the paper it is clearly	05:32:13
12	explained that that is not a standard message	05:32:15
13	pattern. We couldn't -- but the Gallager algorithm,	05:32:20
14	as we had discussed beforehand, and it is followed	05:32:23
15	by a flipping algorithm.	05:32:25
16	BY MR. DOWD:	05:32:25
17	Q. Oh, so now it's not important enough to	05:32:27
18	make it into the abstract, but it's still --	05:32:29
19	MR. GLASS: Objection. Argumentative and	05:32:32
20	vague.	05:32:34
21	(Overlapping speakers.)	05:32:34
22	THE REPORTER: Wait. Wait. There was not	05:32:34
23	even a complete question there, and I don't know	05:32:34
24	what your response was, so why don't you guys try	05:32:34
25	again.	05:32:39

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

295

1	BY MR. DOWD:	05:32:39
2	Q. Sir, I am correct that the abstract of	05:32:42
3	Luby nineteen ninety -- 1998 does not say anything	05:32:46
4	about flipping decoders, right?	05:32:51
5	MR. GLASS: Objection. Asked and	05:32:58
6	answered.	05:33:02
7	THE WITNESS: It talks about the Gallager	05:33:02
8	algorithm.	05:33:06
9	BY MR. DOWD:	05:33:06
10	Q. Okay.	05:33:06
11	A. Sorry, sorry, let me read this again.	05:33:07
12	It talks about for which our decoding	05:33:12
13	algorithm. It doesn't specify exactly what that is	05:33:15
14	in the abstract because the abstract doesn't specify	05:33:17
15	every single technical detail but it doesn't talk	05:33:20
16	about a message passing algorithm, but it talks	05:33:20
17	about our --	05:33:22
18	THE REPORTER: Wait. Wait. Slow down.	05:33:25
19	"...but it doesn't talk" --	05:33:25
20	Start there.	05:33:26
21	THE WITNESS: It doesn't talk about the	05:33:26
22	message passing algorithm, but it talks about our	05:33:29
23	decoding algorithm.	05:33:33
24	BY MR. DOWD:	05:33:42
25	Q. And if we go to Luby '97, let's turn to	05:33:42

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

296

1	Page 94.	05:33:47
2	A. That would be exhibit?	05:33:49
3	MR. GLASS: 9.	05:33:55
4	MR. DOWD: 9.	05:33:58
5	THE WITNESS: 9. Page, sorry?	05:34:01
6	BY MR. DOWD:	05:34:03
7	Q. Last page, 944. Actually, second to the	05:34:03
8	end.	05:34:09
9	A. Yes.	05:34:10
10	Q. The acknowledgement section they describe,	05:34:10
11	quote:	05:34:14
12	"Strong evidence that irregular degree	05:34:14
13	sequences are better than regular degree	05:34:17
14	sequences."	05:34:19
15	Do you see that?	05:34:24
16	A. You're talking about the last paragraph	05:34:24
17	before the acknowledgement?	05:34:33
18	Q. I'm talking about in the acknowledgement	05:34:34
19	they say: There has been, quote, "Strong evidence	05:34:37
20	that irregular degree sequences are better than	05:34:42
21	regular degree sequences", closed quote.	05:34:45
22	Correct?	05:34:47
23	A. That's some acknowledgement. I don't --	05:34:51
24	there's not technical description what "strong"	05:34:53
25	means. It doesn't mean what the decoder is. It	05:34:56

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

297

1	doesn't mean what type of irregularity. It doesn't	05:34:59
2	say about, you know, what exactly the channel they	05:35:02
3	are talking about, so it would be impossible to make	05:35:04
4	a qualified statement about that.	05:35:07
5	Q. Y3, it doesn't mention any of those	05:35:09
6	things, right?	05:35:12
7	A. It doesn't mention what they are talking	05:35:17
8	about.	05:35:19
9	Q. All it says is: There's strong evidence	05:35:19
10	that, quote, "irregular degree sequences are better	05:35:21
11	than regular degree sequences."	05:35:24
12	A. If they have found strong evidence that	05:35:26
13	proves such a thing, in general, they would have	05:35:29
14	published it at some point.	05:35:32
15	Q. Now, we can agree that making turbo codes	05:35:37
16	irregular improve their performance over regular	05:35:41
17	turbo codes, right?	05:35:44
18	MR. GLASS: Objection. Vague. Incomplete	05:35:46
19	hypothetical.	05:35:47
20	THE WITNESS: Some particular way of	05:35:47
21	improving might help; some other ways might hurt.	05:35:49
22	BY MR. DOWD:	05:35:53
23	Q. Well, if you'd turn in Exhibit 21, the	05:35:54
24	Frey '99 paper, to Page 1826, do you see there are	05:36:05
25	results on that page?	05:36:16

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

298

1	A.	18 -- sorry, 18 --	05:36:17
2	Q.	26.	05:36:20
3	A.	Thank you.	05:36:21
4	Q.	Do you see there are results shown on that	05:36:22
5		page, under the heading 5?	05:36:26
6	A.	Figure 4 we're talking about?	05:36:30
7	Q.	I'm saying -- Y3, under the heading 5	05:36:32
8		is -- that's the heading that says: "Results."	05:36:36
9	A.	Oh, I see in that section.	05:36:37
10	Q.	And the second paragraph says: "The	05:36:39
11		irregular turbo code clearly performs better than	05:36:42
12		the regular turbo code for bit error rates," and	05:36:45
13		then it lists them?	05:36:48
14	A.	Yes. So some specific irregular turbo	05:36:49
15		code performs in their experiment better.	05:36:52
16	Q.	Okay. So we can agree that, at least in	05:36:55
17		Luby '99, the regular turbo code outperformed the	05:37:02
18		regular turbo code, right?	05:37:05
19	A.	Luby doesn't talk about turbo codes, I	05:37:07
20		think.	05:37:09
21	Q.	I'm sorry. Let me restate that.	05:37:09
22		We can agree that in Frey '99, the	05:37:11
23		irregular turbo code performed 0.15-dB better than	05:37:15
24		the regular turbo code, right?	05:37:21
25	A.	The particular --	05:37:23

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

299

1	MR. GLASS: Objection. Vague.	05:37:23
2	THE WITNESS: The particular irregular	05:37:23
3	turbo code that they're -- that they're referring to	05:37:26
4	has a better performance, yes.	05:37:28
5	BY MR. DOWD:	05:37:30
6	Q. Now, if a person of ordinary skill had	05:37:32
7	read Divsalar and Luby or Divsalar and Richardson or	05:37:36
8	Divsalar and Frey and wanted to make Divsalar's	05:37:40
9	repeat irregular, they could have done so, right?	05:37:44
10	MR. GLASS: Objection. Incomplete	05:37:46
11	hypothetical. Compound.	05:37:47
12	THE WITNESS: In my analysis or my	05:37:49
13	expertise, I was asked in particular to refer to	05:37:53
14	Luby '97, Luby '98 and Richardson '99, and that's	05:37:58
15	what I have done.	05:38:01
16	BY MR. DOWD:	05:38:02
17	Q. Okay. So if a person of skill read	05:38:02
18	Divsalar and Luby '97 and wanted to make Divsalar's	05:38:05
19	repeater irregular they would have known how to do	05:38:11
20	so, right?	05:38:13
21	A. No.	05:38:14
22	Q. Okay. What about Richardson and Divsalar?	05:38:14
23	MR. GLASS: Objection. Vague. Incomplete	05:38:20
24	hypothetical.	05:38:21
25	THE WITNESS: As I have opinioned in my	05:38:21

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

300

1 expert report, there were many reasons why the 05:38:26
2 invention of turbo codes was something novel and 05:38:31
3 something surprising. 05:38:36
4 Number one, RA codes -- sorry, irregular 05:38:38
5 RA codes were semi novel and surprising. 05:38:41
6 Number one, at that point in time, RA -- 05:38:45
7 RA codes were routinely represented in an entirely 05:38:49
8 different way. So there were no notions of variable 05:38:55
9 nodes or check nodes or anything like that. 05:39:00
10 BY MR. DOWD: 05:39:03
11 Q. I understand. I -- I'm really not asking 05:39:04
12 that question. My question was a very specific 05:39:05
13 question. 05:39:09
14 If a person of skill in '99 read Divsalar, 05:39:09
15 read the Richardson '99 paper and decided that 05:39:15
16 they'd like to make Divsalar's repeater irregular, 05:39:20
17 they would have the technical ability to do that, 05:39:25
18 right? 05:39:25
19 A. I don't know what -- 05:39:28
20 MR. GLASS: Objection. Objection. Vague. 05:39:28
21 Incomplete hypothetical. 05:39:30
22 Go ahead. 05:39:31
23 THE WITNESS: I don't know what any of 05:39:32
24 these things mean. What does it mean to say to make 05:39:33
25 a repeater irregular: What notions would that have 05:39:36

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

301

1	carried over the Luby paper which talks about	05:39:40
2	specific class of codes which are LDPC codes?	05:39:44
3	So unless you tell me exactly what	05:39:47
4	representation you have in mind and what notions	05:39:49
5	would have carried over, I don't see how to combine	05:39:50
6	those.	05:39:54
7	BY MR. DOWD:	05:39:58
8	Q. Okay. Now, in your report you talk about	05:39:59
9	the prosecution that led to the patents; do you	05:40:19
10	recall that?	05:40:22
11	A. I did a very cursory summary to the best	05:40:22
12	of my knowledge. I'm not an expert. I'm not sure	05:40:25
13	if I got this all right, but I tried to, a little	05:40:29
14	bit, for my benefit, to summarize.	05:40:33
15	Q. Okay. And if we turn, for example, to	05:40:36
16	Paragraph 87, there's a discussion about how the	05:40:43
17	patents claim priority to a provisional application	05:40:46
18	filed on May 18, 2000.	05:40:50
19	Do you see that?	05:40:52
20	A. Right.	05:40:53
21	MR. DOWD: Let's mark as Exhibit 23 a copy	05:40:54
22	of the provisional application.	05:40:56
23	(Urbanke Exhibit 23 was marked for	05:40:59
24	identification and attached to the	05:40:59
25	transcript.)	05:41:11

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

302

1	BY MR. DOWD:	05:41:17
2	Q. Do you have Exhibit 23?	05:41:17
3	A. Yes.	05:41:18
4	Q. Do you recognize it?	05:41:19
5	A. You know, some of the figures look	05:41:29
6	familiar, but I must say I have browsed through this	05:41:32
7	very, very quickly, and so, you know, with so many	05:41:35
8	documents to review, I cannot say with certainty	05:41:40
9	what all these documents are.	05:41:43
10	Q. So you can't tell me whether you've read	05:41:45
11	Exhibit 23 before?	05:41:49
12	A. Oh, I've flipped through the history,	05:41:49
13	that's for sure, but, you know, how exactly these	05:41:52
14	pages looked like and what exactly it contained, I	05:41:55
15	don't recall.	05:42:00
16	Q. All right. My question is a simpler one.	05:42:00
17	Is Exhibit 23 the May 18, 2000 provisional	05:42:03
18	application that you are referencing in Paragraph 87	05:42:07
19	of your report?	05:42:10
20	A. I would not know for sure. Clearly, for	05:42:16
21	writing this particular part, I had legal counsel,	05:42:19
22	and to the best of my knowledge, I tried to	05:42:24
23	summarize. But it's possible that I might have	05:42:27
24	gotten some of the facts not exactly correct. I'm	05:42:31
25	not a lawyer.	05:42:33

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

303

1	Q.	Okay. So this part 6 of your report, the	05:42:35
2		summary of the patents-in-suits, who wrote that, you	05:42:37
3		or the Caltech's lawyers?	05:42:42
4	A.	I went over the file history very quickly	05:42:45
5		and had legal assistance trying to sort out and, you	05:42:48
6		know, explain to me what, you know, some very	05:42:53
7		standard notions were. And so with help of legal	05:42:56
8		counsel, this was written.	05:43:01
9	Q.	So let me see if I understand.	05:43:03
10		You -- you had explained to you what	05:43:07
11		happened in the file histories of the four	05:43:10
12		patents-in-suits; is that correct?	05:43:14
13		MR. GLASS: Objection. Mischaracterizes	05:43:16
14		the testimony.	05:43:16
15		THE WITNESS: No. I simply had a lot of	05:43:18
16		questions. I ask many of the questions. I got some	05:43:19
17		explanations. Whether or not indeed I fully	05:43:22
18		understood these, is not clear to me. I'm not a	05:43:25
19		lawyer.	05:43:28
20		BY MR. DOWD:	05:43:28
21	Q.	Okay.	05:43:28
22	A.	That's not my main expertise.	05:43:29
23	Q.	And in terms of paragraphs 85 through 119	05:43:31
24		of this, where this section appears, who actually	05:43:39
25		typed this up; did you type this up?	05:43:42

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

304

1	A.	Many of these things might not have been	05:43:44
2		that I typed up, but were in discussions.	05:43:47
3	Q.	Okay.	05:43:50
4	A.	I don't recall exactly which parts exactly	05:43:51
5		I typed up, but I clearly had legal counsel.	05:43:53
6	Q.	Okay. So let's return to Exhibit 23, the	05:43:58
7		provisional application. And I'd like you to take a	05:44:02
8		moment and just look through the -- the slide deck	05:44:05
9		that is attached, which begins on Caltech Page 6584	05:44:10
10		and runs through 6616, and just let me know when	05:44:14
11		you're done.	05:44:18
12	A.	What was the last page, 661 -- I don't	05:46:10
13		remember.	05:46:13
14	Q.	It's the last page of the document, so	05:46:13
15		just to the last slide there on Page 6616.	05:46:15
16	A.	So there's several slide decks; is that	05:49:13
17		correct?	05:49:18
18	Q.	There should be two. Just let me know	05:49:18
19		when you've gotten to the end.	05:49:20
20	A.	I've reached the end.	05:51:39
21	Q.	Okay. Can you tell me whether the	05:51:40
22		provisional application discusses indexing memory	05:51:43
23		locations?	05:51:46
24	A.	This is about 60 pages.	05:51:48
25		MR. GLASS: Objection. Objection.	05:51:51

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

305

1	Outside the scope.	05:51:52
2	THE WITNESS: I don't know exactly even	05:51:53
3	what the definition of -- of the term that they have	05:51:55
4	used would be. It would be impossible for me now to	05:51:58
5	tell.	05:52:02
6	BY MR. DOWD:	05:52:02
7	Q. Okay. So in your review sitting here now,	05:52:02
8	did you see in anything that discussed memory	05:52:05
9	locations?	05:52:07
10	MR. GLASS: Same objection. Outside the	05:52:08
11	scope.	05:52:09
12	THE WITNESS: These are slides. Many of	05:52:09
13	the things, you know, might not be in there, might	05:52:11
14	be in there. I don't know exactly what the	05:52:14
15	particular term means in the realm that you are	05:52:16
16	talking about.	05:52:18
17	BY MR. DOWD:	05:52:19
18	Q. Okay.	05:52:19
19	A. I have no idea.	05:52:20
20	Q. I'm just asking, you just read through the	05:52:20
21	slides; we took several minutes to do it. Can you	05:52:23
22	point me to any place that discusses an indexed	05:52:28
23	memory location?	05:52:31
24	MR. GLASS: Same objection. Outside the	05:52:32
25	scope --	05:52:32

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

306

1	BY MR. DOWD:	05:52:32
2	Q. "Yes" or "no"?	05:52:34
3	MR. GLASS: -- of the expert report.	05:52:34
4	THE WITNESS: I don't even know what the	05:52:35
5	term "index memory location" means for you.	05:52:37
6	BY MR. DOWD:	05:52:37
7	Q. Have you heard the term "index memory	05:52:40
8	location"?	05:52:44
9	A. That means many things to different	05:52:44
10	people.	05:52:44
11	Q. Does it have meaning to you?	05:52:45
12	A. Potentially, but it's not something that I	05:52:45
13	have thought about.	05:52:48
14	Q. What does "index memory location" mean to	05:52:48
15	you?	05:52:51
16	A. I don't know in this particular thing. I	05:52:51
17	have not been asked to opinion on that. It's not my	05:52:53
18	realm of expertise.	05:52:56
19	Q. And am I correct that in reviewing the	05:52:56
20	slides just now you didn't see anything about index	05:52:58
21	memory locations?	05:53:03
22	MR. GLASS: Objection. Outside the scope	05:53:05
23	of --	05:53:06
24	(Overlapping speakers.)	05:53:06
25	THE REPORTER: Wait.	05:53:06

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

307

1	MR. GLASS: -- the expert report. Go	05:53:07
2	ahead.	05:53:07
3	THE WITNESS: I didn't look for	05:53:07
4	any particular instance of that. I wasn't even	05:53:12
5	aware of that term --	05:53:12
6	THE REPORTER: Repeat your answer and slow	05:53:12
7	down.	05:53:13
8	THE WITNESS: I was not in particular	05:53:13
9	aware of the term until you told me. I think that	05:53:15
10	would be a particular term to be looking out for.	05:53:19
11	BY MR. DOWD:	05:53:21
12	Q. Okay. Take a minute and just tell me, is	05:53:21
13	there any discussion in here of an index memory	05:53:25
14	location?	05:53:28
15	MR. GLASS: Same objection. Outside the	05:53:28
16	scope.	05:53:29
17	THE WITNESS: Can you give me a definition	05:53:29
18	of what that means.	05:53:30
19	BY MR. DOWD:	05:53:32
20	Q. You -- your understanding, as the person	05:53:32
21	of skill in this art, is better than mine; so using	05:53:35
22	whatever understanding of that term you have.	05:53:38
23	A. I don't have any particular --	05:53:40
24	MR. GLASS: And objection. Calls --	05:53:40
25	THE WITNESS: -- understanding.	05:53:41

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

308

1	MR. GLASS: And objection. Calls for a	05:53:41
2	legal conclusion.	05:53:43
3	BY MR. DOWD:	05:53:43
4	Q. You don't know what a memory location is?	05:53:44
5	A. I have some understanding what a memory	05:53:46
6	location might be. Whether or not that has any	05:53:48
7	legal bearing or any opinion on what a memory	05:53:51
8	location means in that case, I have no idea.	05:53:54
9	Q. What is your understanding of what a	05:53:56
10	memory location is?	05:53:58
11	A. It might simply be a place in memory,	05:53:59
12	perhaps physical, perhaps abstract.	05:54:03
13	Q. Do you know what an index is?	05:54:06
14	A. I know what an index could be.	05:54:09
15	Q. Do you know -- what is your understanding	05:54:12
16	of an index with respect to memory?	05:54:13
17	A. I don't know. An index could be	05:54:21
18	important, so perhaps we're talking about important.	05:54:22
19	I have no idea.	05:54:25
20	Q. Okay. So with that understanding of what	05:54:26
21	a memory is and what an index is, do you see any	05:54:27
22	discussion of a memory location or an index in the	05:54:31
23	provisional application?	05:54:40
24	MR. GLASS: Objection. Outside the scope	05:54:40
25	of the expert report.	05:54:41

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

309

1	THE WITNESS: This is about 50 pages. If	05:54:42
2	that's a question, I would take, you know, quite a	05:54:44
3	long of time to look at that in detail. Now within	05:54:47
4	a few minutes, it would be impossible to answer that	05:54:50
5	question.	05:54:53
6	BY MR. DOWD:	05:54:53
7	Q. Well, take a few minutes and just if you	05:54:53
8	could see --	05:54:56
9	(Overlapping speakers.)	
10	THE REPORTER: Wait. Wait. Wait. You	
11	cannot interrupt him, please.	
12	THE WITNESS: Sorry.	
13	THE REPORTER: Can I get a clean question,	
14	please.	
15	MR. DOWD: Sure.	
16	Q. I'd like you to take a few minutes, go	05:55:04
17	back through the slides and tell me if you can	05:55:06
18	identify anything in there that is discussing memory	05:55:09
19	locations or indexing.	05:55:12
20	MR. GLASS: Same objection. Outside the	05:55:13
21	scope of the expert report.	05:55:15
22	THE WITNESS: You're asking right now to	05:55:16
23	do work that typically an expert would take many	05:55:19
24	hours or perhaps days to do within a few seconds or	05:55:21
25	a few minutes on the fly. That's not --	05:55:25

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

310

1	BY MR. DOWD:	05:55:27
2	Q. Well --	05:55:27
3	A. -- a reasonable request.	05:55:26
4	Q. -- whether it's reasonable or not, please	05:55:28
5	do so.	05:55:30
6	MR. GLASS: Same objection. Outside --	05:55:30
7	outside the scope of the expert report.	05:55:32
8	THE WITNESS: I would not even know	05:55:33
9	exactly how I would look for whatever you want me --	05:55:34
10	I don't know exactly the definition you have in	05:55:37
11	mind. I would have no idea how to get started with	05:55:39
12	this task.	05:55:42
13	MR. GLASS: Objection. Calls for a legal	05:55:42
14	analysis.	05:55:44
15	BY MR. DOWD:	05:55:44
16	Q. So if all I ask you is, can you identify	05:55:44
17	for me a set of memory locations or a corresponding	05:55:48
18	index in a provisional patent application, you would	05:55:53
19	have no ability to understand what you're supposed	05:55:57
20	to look for?	05:55:59
21	MR. GLASS: Mischaracterizes the	05:56:00
22	testimony. Outside the scope.	05:56:01
23	BY MR. DOWD:	05:56:01
24	Q. Is that correct?	05:56:04
25	MR. GLASS: Calls for a legal analysis.	05:56:04

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

311

1	Go ahead.	05:56:06
2	THE WITNESS: I would need to know exactly	05:56:06
3	what you have been looking for. I would then take a	05:56:08
4	considerable amount of time to ponder that question.	05:56:11
5	I would have to look at these documents in detail,	05:56:14
6	and after a considerable amount of time, which might	05:56:17
7	be hours, which might be days, I might be able to	05:56:19
8	perform an opinion. But it's not something that	05:56:22
9	can -- that can be done within a certain amount of	05:56:24
10	minutes.	05:56:27
11	BY MR. DOWD:	05:56:28
12	Q. So I take it, sitting here right now, you	05:56:28
13	can't tell me one way or the other whether a memory	05:56:31
14	location or a corresponding index is anywhere	05:56:36
15	disclosed in this Exhibit 23?	05:56:40
16	MR. GLASS: Same objections. And	05:56:42
17	mischaracterizes the testimony.	05:56:43
18	THE WITNESS: Without a detailed analysis,	05:56:45
19	this would be impossible to do.	05:56:50
20	MR. DOWD: Let's mark as Exhibit 24 a copy	05:57:20
21	of a document that bears Bates number HUGHES513989	05:57:22
22	through 514001.	05:57:27
23	(Urbanke Exhibit 24 was marked for	05:57:37
24	identification and attached to the	05:57:37
25	transcript.)	05:57:38

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

312

1	BY MR. DOWD:	05:57:38
2	Q. Do you have Exhibit 24?	05:57:47
3	A. Yes.	05:57:48
4	Q. And if you would, also take out Exhibit 4,	05:57:50
5	the materials considered page.	05:58:01
6	Do you see on your materials considered	05:58:22
7	there is a reference to Exhibit 24?	05:58:24
8	A. It refers to the fourth item, I believe.	05:58:26
9	Q. Right. But in the body of your report,	05:58:55
10	you did not provide a substantive opinion about	05:58:57
11	Exhibit 24, correct?	05:59:01
12	A. No.	05:59:02
13	Q. You agree with me?	05:59:02
14	A. Yes, that's correct.	05:59:04
15	Q. Okay.	05:59:07
16	MR. DOWD: Let's mark as Exhibit 25 a copy	05:59:15
17	of United States Patent Number 6,081,909, Luby et	05:59:18
18	al.	05:59:37
19	(Urbanke Exhibit 25 was marked for	05:59:37
20	identification and attached to the	05:59:37
21	transcript.)	05:59:38
22	BY MR. DOWD:	05:59:38
23	Q. Do you have Exhibit 25?	05:59:38
24	A. Yes.	05:59:39
25	Q. Have you seen Exhibit 25 before?	05:59:39

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

313

1	A.	I don't believe so. I'm not 100 percent	05:59:44
2		sure.	05:59:47
3	Q.	Okay. Am I correct that you have provided	05:59:48
4		no opinion about Exhibit 25, the Luby '909 patent --	05:59:51
5	A.	I don't --	05:59:51
6	Q.	-- in your expert report?	05:59:58
7	A.	I don't believe I have.	05:59:59
8	Q.	Okay.	06:00:01
9		MR. DOWD: Why don't we take a short	06:00:04
10		break. I'm out of exhibit stickers.	06:00:06
11		THE VIDEOGRAPHER: Going off the record.	06:00:09
12		The time is 6:00 p.m.	06:00:10
13		(Recess taken at 6:00 p.m.)	06:00:13
14		THE VIDEOGRAPHER: We are back on the	06:11:08
15		record at 6:11 p.m.	06:11:09
16		MR. DOWD: Sir, during the break I marked	06:11:11
17		as Exhibit 26 a copy of U.S. Patent 4623999.	06:11:13
18		(Urbanke Exhibit 26 was marked for	06:11:21
19		identification and attached to the	06:11:21
20		transcript.)	06:11:21
21	BY MR. DOWD:		06:11:21
22	Q.	Do you have that?	06:11:21
23	A.	Yes, I do.	06:11:22
24	Q.	And if we look at Exhibit 4, your list of	06:11:22
25		materials considered, the '999 patent is listed on	06:11:25

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

314

1	the second page, right?	06:11:33
2	A. Yes.	06:11:34
3	Q. But in your -- the body of your expert	06:11:34
4	report, you've provided no opinion about the '999	06:11:38
5	patent, correct?	06:11:43
6	A. That is correct.	06:11:43
7	MR. DOWD: Let's mark as Exhibit 27 a copy	06:11:53
8	of the MacKay et al., paper, "Comparison of	06:11:55
9	Constructions of Irregular Gallager Codes" from	06:12:00
10	1999. It bears production HUGHES1760 through 1765.	06:12:05
11	(Urbanke Exhibit 27 was marked for	06:12:18
12	identification and attached to the	06:12:18
13	transcript.)	06:12:19
14	BY MR. DOWD:	06:12:19
15	Q. Do you have Exhibit 27?	06:12:24
16	A. That is correct.	06:12:25
17	Q. If you look at Exhibit 4, your list of	06:12:26
18	materials considered, the MacKay paper we've marked	06:12:29
19	as Exhibit 27 is listed on the first page of your	06:12:33
20	materials considered, right?	06:12:38
21	A. That is correct.	06:12:39
22	Q. But in the body of your report, you do not	06:12:40
23	provide any substantive opinion about the MacKay	06:12:44
24	paper that we've marked as Exhibit 27?	06:12:48
25	A. That is correct.	06:12:50

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

315

1	Q.	Okay.	06:12:51
2		MR. DOWD: Let's mark as Exhibit 28 a copy	06:12:59
3		of the paper by Ping, et al., titled:	06:13:03
4		"Low-Density Parity Check Codes With	06:13:07
5		Semi-Random Parity Check Matrix."	06:13:13
6		(Urbanke Exhibit 28 was marked for	06:13:16
7		identification and attached to the	06:13:16
8		transcript.)	06:13:16
9		BY MR. DOWD:	06:13:16
10	Q.	Do you have a copy of Exhibit 28?	06:13:23
11	A.	Yes.	06:13:25
12	Q.	Exhibit 28 is the Ping paper that's listed	06:13:26
13		on the first page of Exhibit 4, your list of	06:13:31
14		materials considered, right?	06:13:34
15	A.	That is correct.	06:13:35
16	Q.	But in the body of your expert report, you	06:13:36
17		do not provide an opinion about the Ping paper,	06:13:39
18		Exhibit 28, correct?	06:13:44
19	A.	That is correct.	06:13:45
20	Q.	Okay. I apologize if I already asked	06:13:46
21		this, but if we go back to Exhibit 16, the RA.c	06:14:19
22		code.	06:14:25
23	A.	I have it in front of me.	06:14:49
24	Q.	Am I correct that you provide no opinion	06:14:51
25		about the RA.c code that we've marked as Exhibit 16	06:14:53

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

316

1	in the body of your report?	06:14:57
2	A. That is correct.	06:14:58
3	Q. Okay. Again, I apologize if we already	06:15:00
4	covered this, but you've not offered an opinion	06:15:39
5	comparing any specific prior art reference to any	06:15:42
6	specific claim limitation in your report, correct?	06:15:45
7	A. Any specific -- could you just repeat one	06:15:50
8	more time so just that I can parse the sentence	06:15:52
9	exactly?	06:15:56
10	Q. Yes. You have not offered an opinion	06:15:57
11	comparing any specific prior art reference to any	06:16:00
12	specific claim in any of the patents that are at	06:16:04
13	issue?	06:16:07
14	A. That is correct.	06:16:08
15	Q. And, therefore, you've also not provided	06:16:09
16	an opinion comparing any combination of prior art	06:16:11
17	references to any specific claim at issue in the	06:16:14
18	case?	06:16:17
19	A. That is correct.	06:16:17
20	Q. Okay. With respect to the IRA codes	06:16:23
21	discussed in your paper -- or discussed in your	06:16:33
22	report, we looked before at Paragraph 82 where you	06:16:36
23	cite the Jin et al., IRA codes paper; do you recall	06:16:53
24	that?	06:17:01
25	A. Paragraph 82?	06:17:01

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

317

1	Q.	Uh-huh.	06:17:01
2	A.	Yes.	06:17:10
3	Q.	And that's also discussed in Paragraph 84,	06:17:12
4		right? That's that same --	06:17:23
5	A.	You mean the particular reference or the	06:17:24
6		notion of IRA codes?	06:17:26
7	Q.	The particular reference there as to the	06:17:28
8		IRA codes paper by Jin et al., what we've marked as	06:17:30
9		Exhibit 5.	06:17:55
10	A.	This is Exhibit 5, you say?	06:17:57
11	Q.	Uh-huh.	06:18:03
12	A.	Yes, it refers to the work by this group	06:18:07
13		of people relating to irregular repeat-accumulate	06:18:11
14		codes.	06:18:16
15	Q.	But you testified earlier that the IRA	06:18:16
16		codes that you're discussing in your report are not	06:18:20
17		the specific IRA codes of that paper, Exhibit 5,	06:18:22
18		right?	06:18:28
19	A.	Can you please repeat? I -- I -- I	06:18:28
20		discussed that the IRA codes discussed in my report	06:18:30
21		are...?	06:18:35
22	Q.	Are not the specific IRA code of the Jin	06:18:36
23		et al., paper that we marked as Exhibit 5, right?	06:18:40
24	A.	I believe I discussed that I didn't give	06:18:43
25		an explicit reference in the sense of, you know,	06:18:45

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

318

1	referring to one of the specific references, but	06:18:50
2	only stated, I guess, I believe here the term	06:18:53
3	Dr. McEliece in lieu of that specific reference.	06:18:57
4	Q. Can you point me to anywhere in your	06:19:01
5	report where you identify what the exact structure	06:19:04
6	is of the IRA codes that you are comparing Luby '97,	06:19:07
7	Luby '98, or Richardson '99 to?	06:19:14
8	A. Are we talking now in reference to the RA	06:19:16
9	codes or the result of the -- result of the	06:20:16
10	invention which led to IRA codes?	06:20:18
11	Q. What I'm asking you to do is point me in	06:20:21
12	your report to the paragraph where you identify the	06:20:25
13	exact structure of the IRA code to which you are	06:20:29
14	comparing Luby '97, Luby '98, and Richardson '99.	06:20:33
15	A. I believe a better characterization of	06:20:41
16	comparing these codes is my characterization of	06:20:52
17	claiming that, from the RA description of the codes,	06:20:57
18	it would have not been obvious to a person of	06:21:02
19	ordinary skills at how to arrive at an irregular	06:21:08
20	version.	06:21:11
21	Q. Well, I'm actually asking a different	06:21:11
22	question.	06:21:14
23	So, for example, if you'd turn to	06:21:23
24	Page 28 --	06:21:47
25	A. Yes.	06:21:48

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

319

1	Q.	-- do you see there's a heading there that	06:21:48
2	says:		06:21:51
3		"Comparison of IRA Codes and Codes	06:21:51
4		Discussed in Dr. Frye's report"?	06:21:54
5		That's your heading number eight?	06:21:56
6	A.	Right. That's correct.	06:22:00
7	Q.	And so what I'd like to see is, can you	06:22:01
8	point me in your report to where it is you defined		06:22:05
9	the exact structure of the IRA code that you are		06:22:07
10	comparing against Luby '97, Luby '98, or Luby		06:22:11
11	ninety -- or Richardson '99?		06:22:17
12	A.	Right. One such place would be Figure 1	06:22:17
13	on page -- or figure I on Page 30.		06:22:20
14		THE REPORTER: 30?	06:22:28
15		THE WITNESS: 30.	06:22:28
16	BY MR. DOWD:		06:22:30
17	Q.	If we look at Figure 3 on the right-hand	06:23:22
18	side on Page 3?		06:23:27
19	A.	Figure 3, yes.	06:23:28
20	Q.	Uh-huh. Now, it's possible to implement	06:23:30
21	the code of Figure 3 in more than one way, right?		06:23:35
22	A.	You mean mapping it into hardware, into	06:23:42
23	software, a mathematical description; what exactly		06:23:46
24	are you referring to?		06:23:50
25	Q.	I mean that any of the above. You can	06:23:52

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

320

1	implement it in hardware in more than one way; you	06:23:58
2	can implement the relationships of variable nodes to	06:24:02
3	check nodes in more than one way, correct?	06:24:06
4	A. There are several ways of representing	06:24:08
5	such code, yes.	06:24:10
6	Q. Right. Now, Figure 3 does not require any	06:24:12
7	specific performance against the Shannon limit,	06:24:24
8	correct?	06:24:27
9	MR. GLASS: Objection. Vague. Incomplete	06:24:27
10	hypothetical.	06:24:29
11	THE WITNESS: Figure 3 is simply a	06:24:29
12	representation of the code itself. It doesn't	06:24:34
13	contain further descriptions.	06:24:37
14	BY MR. DOWD:	06:24:41
15	Q. So you could implement Figure 3 in a way	06:24:44
16	that was closer to the Shannon limit and you could	06:24:46
17	implement Figure 3 in a way that is further away,	06:24:48
18	correct?	06:24:52
19	MR. GLASS: Objection. Vague. Incomplete	06:24:52
20	hypothetical.	06:24:54
21	THE WITNESS: Figure 3's an abstraction,	06:24:54
22	so it doesn't say exactly what that code is. So in	06:24:58
23	my opinion, that's not a question of implementation;	06:25:03
24	it's a question of what exact code do we mean by	06:25:05
25	this figure.	06:25:08

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

321

1	BY MR. DOWD:	06:25:11
2	Q. So let me ask you that question.	06:25:11
3	Can you tell me what the exact code	06:25:13
4	structure is of Figure 3?	06:25:15
5	A. I take it to be a code structure as	06:25:16
6	described by the set of authors in which this degree	06:25:20
7	distribution is chosen to be a good code.	06:25:25
8	Q. So a -- withdrawn.	06:25:31
9	Does Figure 3 require any particular code	06:25:36
10	complexity?	06:25:45
11	MR. GLASS: Objection. Vague. Lacks --	06:25:47
12	vague.	06:25:52
13	THE WITNESS: Require in the sense of that	06:25:52
14	a natural implementation would require that or that	06:25:59
15	it can only be done if it requires that?	06:26:02
16	BY MR. DOWD:	06:26:05
17	Q. The latter.	06:26:05
18	A. One might be able to take any code and	06:26:11
19	make it very complicated and have the complexity	06:26:14
20	that's potentially much worse than what they're, you	06:26:18
21	know, an intended or reasonable implementation might	06:26:22
22	have.	06:26:25
23	Q. And that would still be an IRA code,	06:26:25
24	right?	06:26:29
25	A. I -- you know, whether or not that would	06:26:29

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

322

1	be considered an IRA code or not is a matter of	06:26:33
2	definition.	06:26:35
3	Q. Well, you could implement Figure 3 in a	06:26:36
4	very, very complex way; am I correct?	06:26:39
5	MR. GLASS: Objection. Vague.	06:26:42
6	THE WITNESS: You know, if you define to	06:26:44
7	me what "complex" means.	06:26:46
8	BY MR. DOWD:	06:26:48
9	Q. Well, in your report you describe more	06:26:51
10	complex codes and less complex codes, right?	06:26:55
11	A. So in my report, I state that RA codes are	06:26:59
12	linear time encodable, linear time decodable and are	06:27:03
13	efficient codes. So that means that these codes are	06:27:09
14	actually efficient in the implementation.	06:27:14
15	Q. Now, let's turn to Subpart B where you	06:27:52
16	discuss Luby '98, and specifically on Page 31,	06:27:57
17	Section 2 where you say:	06:28:02
18	"Luby '98 cannot be combined with RA	06:28:04
19	codes or turbo codes to arrive at IRA	06:28:06
20	codes."	06:28:10
21	Do you see that there?	06:28:10
22	A. Yes.	06:28:11
23	Q. And is there an identification of the	06:28:11
24	specific IRA codes that you're using for this	06:28:14
25	discussion?	06:28:17

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

323

1	A.	I don't believe that I have repeated the	06:28:18
2		plot that you can see in Figure I.	06:28:29
3		THE REPORTER: Figure?	06:28:34
4		THE WITNESS: Figure I.	06:28:34
5		BY MR. DOWD:	06:28:36
6	Q.	Okay. But did you have in mind the same	06:28:36
7		IRA codes?	06:28:41
8	A.	Yes.	06:28:41
9	Q.	And is the same true for your discussion	06:28:41
10		of Richardson '99?	06:28:44
11	A.	Yes.	06:28:46
12	Q.	Now, let's turn back to Page 15 in	06:28:48
13		Paragraph 68. Actually, we should start on	06:29:43
14		Paragraph 67. You say:	06:29:51
15		"Researchers in the coding community	06:29:53
16		have tried many types of changes,	06:29:54
17		including different types of irregularity	06:29:57
18		throughout the years."	06:29:59
19		Right?	06:30:00
20	A.	Yes.	06:30:01
21	Q.	And so it's correct that in the 1998/1999	06:30:03
22		period that researchers tried many different types	06:30:13
23		of changes to codes, right?	06:30:16
24	A.	Yes.	06:30:19
25	Q.	And one of the things that a researcher	06:30:19

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

324

1	could try is irregular -- irregularity, right?	06:30:22
2	A. All of these forms that are listed in 68	06:30:26
3	are some form of irregularity, yes.	06:30:30
4	Q. And so what you've identified here are	06:30:36
5	different ways that researchers working on coding	06:30:40
6	may have tried to improve the codes, right?	06:30:46
7	MR. GLASS: Objection. Vague. Incomplete	06:30:52
8	hypothetical.	06:30:53
9	THE WITNESS: I describe various ways in	06:30:53
10	which, in some settings, I'm not claiming that for	06:30:58
11	each particular setting everything has been tried,	06:31:02
12	but I claim that some of these settings or in some	06:31:04
13	settings some of these methods that I mention in 68	06:31:08
14	have been tried.	06:31:15
15	BY MR. DOWD:	06:31:15
16	Q. And the goal at this time was to improve	06:31:15
17	the performance of the codes to get it closer to the	06:31:17
18	Shannon limit, right?	06:31:23
19	MR. GLASS: Objection. Vague.	06:31:24
20	THE WITNESS: That was one primary goal.	06:31:24
21	There might have been other goals to achieve;	06:31:26
22	perhaps, for example, getting lower error floor or	06:31:29
23	other objectives that people had in mind.	06:31:33
24	BY MR. DOWD:	06:31:38
25	Q. And so what researchers in the field were	06:31:40

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

325

1	doing at this time was trying different ways to	06:31:43
2	change the code so that they could get closer to the	06:31:48
3	Shannon limit, among other things, right?	06:31:53
4	MR. GLASS: Objection. Vague.	06:31:56
5	THE WITNESS: Among other things. Sorry.	06:31:57
6	(Overlapping speakers.)	06:31:59
7	BY MR. DOWD:	06:32:00
8	Q. And one of the ways that they were trying	06:32:02
9	to change the code to get closer to the Shannon	06:32:08
10	limit was to change the degrees of the variable	06:32:14
11	nodes --	06:32:18
12	MR. GLASS: Same objection.	06:32:18
13	BY MR. DOWD:	06:32:18
14	Q. -- right?	06:32:18
15	MR. GLASS: Same objection.	06:32:20
16	THE WITNESS: In the setting of cascaded	06:32:20
17	LDPC codes and for the DC and in the setting of as	06:32:23
18	this was done in Luby '97 and in the setting of LDPC	06:32:29
19	codes irregular but using a particular type of	06:32:34
20	decoder, which is not a message passing decoder, and	06:32:38
21	in the setting of standard LDPC codes, that was	06:32:44
22	done, yes.	06:32:47
23	BY MR. DOWD:	06:33:06
24	Q. Now, is there a difference between an	06:33:07
25	irregular LDPC code and an irregular RA code?	06:33:12

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

326

1	MR. GLASS: Objection. Vague.	06:33:16
2	THE WITNESS: If you could specify to me	06:33:20
3	what do you mean with "a difference," then I can try	06:33:22
4	to answer this question.	06:33:25
5	BY MR. DOWD:	06:33:26
6	Q. Sure. So we've been talking about	06:33:26
7	irregular LDPC codes today, right?	06:33:28
8	A. Right.	06:33:32
9	Q. We've been talking about irregular RA	06:33:32
10	codes today, right?	06:33:36
11	A. Yes.	06:33:36
12	Q. What is the difference between an	06:33:37
13	irregular LDPC code and an RA code?	06:33:40
14	MR. GLASS: Same objection.	06:33:45
15	THE WITNESS: So if I take the standard	06:33:46
16	LDPC code as it was considered prior to the claimed	06:33:48
17	patent date, then they all relate to either the	06:33:53
18	standard bipartite graph version as of Gallager in	06:33:57
19	which there was no additional structure other than	06:34:03
20	the irregularity or they pertain to the particular	06:34:05
21	structure of the cascade construction as in Luby,	06:34:10
22	and all of them pertain to particular decoding	06:34:16
23	algorithms. And IRA code has particular extra	06:34:20
24	structure that makes it suitable, not only to have	06:34:26
25	surprisingly very good performance, but also makes	06:34:31

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

327

1	them inherently linear time encodable and decodable.	06:34:34
2	Q. Does an irregular LDPC code repeat	06:34:39
3	information bits a different number of times?	06:34:43
4	MR. GLASS: Objection. Vague.	06:34:46
5	THE WITNESS: In irregular LDPC codes, you	06:34:47
6	have code word bits and these code word bits have or	06:34:52
7	can have different degrees, depending on which class	06:34:55
8	they fall into.	06:34:59
9	BY MR. DOWD:	06:35:01
10	Q. And so my question is, for an irregular	06:35:01
11	LDPC code, does that code repeat bits a different	06:35:07
12	number of times?	06:35:11
13	MR. GLASS: Same objection.	06:35:12
14	THE WITNESS: I don't know what "repeat"	06:35:13
15	in this context would mean.	06:35:15
16	BY MR. DOWD:	06:35:16
17	Q. It means duplicate.	06:35:16
18	MR. GLASS: Same objection.	06:35:18
19	BY MR. DOWD:	06:35:19
20	Q. So with that understanding of repeat, does	06:35:19
21	an irregular LDPC code repeat bits -- input	06:35:22
22	information bits different numbers of times?	06:35:29
23	A. All I see is that the variable nodes that	06:35:29
24	are -- have different degrees, that's what I'm	06:35:31
25	seeing. How this might be described in other	06:35:35

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

328

1	language I don't know.	06:35:38
2	Q. And so if all you know is that you've got	06:35:40
3	variable nodes with different degrees, that's not	06:35:43
4	enough to know whether you're repeating the	06:35:45
5	information bits a different number of times?	06:35:49
6	A. That's a definition of what repeat means;	06:35:51
7	it's not a definition what -- what an LDPC code	06:35:53
8	means. So that's simply whatever you have as a	06:35:57
9	definition, according to that definition, you might	06:36:00
10	judge.	06:36:03
11	I don't have any preconceived notion of	06:36:03
12	what that definition means, so I cannot answer that	06:36:05
13	question.	06:36:07
14	Q. Well, my -- what I'm asking you to assume	06:36:08
15	is that repeat means duplicate; can you make that	06:36:11
16	assumption?	06:36:14
17	A. What does "duplicate" mean?	06:36:14
18	Q. Whatever it means. Do you have any	06:36:16
19	understanding of --	06:36:16
20	(Overlapping speakers.)	06:36:17
21	THE REPORTER: Wait. Hold on. I cannot	06:36:22
22	take two people at a time.	06:36:22
23	THE WITNESS: I'm sorry. I'm sorry.	06:36:22
24	THE REPORTER: Just stop for a minute.	06:36:22
25	Clean question, please.	06:36:23

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

329

1	BY MR. DOWD:	06:36:23
2	Q. Can you tell me one way or the other	06:36:24
3	whether you understand what it means to duplicate a	06:36:27
4	bit?	06:36:29
5	A. Unless you give me a definition, I cannot	06:36:30
6	tell you if that agrees with this definition.	06:36:33
7	Q. So you can't tell me one way or the other	06:36:37
8	whether -- withdrawn.	06:36:42
9	If I tell you that repeating a bit	06:36:52
10	requires making additional copies of that bit, do	06:36:54
11	you understand what I mean?	06:36:57
12	A. "Requires" is a necessary condition. That	06:36:59
13	doesn't mean a sufficient condition, so it doesn't	06:37:02
14	specify what that actually means.	06:37:04
15	Q. So you can't answer my question?	06:37:07
16	A. You haven't given me a definition. I	06:37:09
17	cannot answer to an unspecified question.	06:37:12
18	Q. My -- my assumption that I'm asking you to	06:37:15
19	make is that repeat requires the creation of a new	06:37:20
20	copy of the input bits, okay? Can you make that	06:37:25
21	assumption?	06:37:32
22	A. You're simply replacing one definition	06:37:32
23	with another definition. At the end it's a chain of	06:37:35
24	definitions. Unless you give me one specific	06:37:38
25	definition and a mathematical term, it's not	06:37:40

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

330

1 well-defined. 06:37:43

2 Q. Well, I guess what I'm struggling with is, 06:37:43

3 I've given you what I -- I've given you what the 06:37:47

4 Court has defined "repeat" to mean and you're 06:37:48

5 telling me that you can't answer my question. So... 06:37:50

6 A. I have not looked at the exact definition 06:37:54

7 as they're defined in the -- in the patents. I 06:37:56

8 don't know exactly what they mean. I have seen 06:37:59

9 certain -- you know, that certain terms were 06:38:03

10 defined, but that is English. 06:38:04

11 I'm a scientist; I'm dealing with 06:38:06

12 equations; I'm dealing with mathematical objects. 06:38:08

13 Mathematical objects are defined from basic 06:38:12

14 parameters that everyone agrees, and based on these 06:38:15

15 parameters, there's a definition. And there's a 06:38:18

16 logical way to get from one definition to another 06:38:20

17 one, either you can or you cannot. 06:38:22

18 Right now we're talking about English. 06:38:24

19 That's a very different realm. I -- it's quite 06:38:26

20 possible that in the realm of law, these things are 06:38:30

21 defined in this way. I'm not familiar with that. 06:38:32

22 But as a scientist I feel uncomfortable to start 06:38:35

23 with a definition that I don't fully understand or 06:38:38

24 that's not fully specified. 06:38:41

25 Q. So if all I said to you was, I need to 06:38:43

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

331

1	know whether or not having different variable nodes	06:38:47
2	with different numbers of edges, different degrees,	06:38:57
3	means that I repeat bits or I don't repeat bits, you	06:39:04
4	couldn't tell me based on that amount of information	06:39:09
5	what the answer is?	06:39:11
6	MR. GLASS: Incomplete hypothetical.	06:39:12
7	THE WITNESS: No.	06:39:13
8	MR. DOWD: Okay. I think I have nothing	06:39:47
9	further. Thank you.	06:39:49
10	THE WITNESS: Thank you.	06:39:50
11	MR. GLASS: Let's just go off the record.	06:39:51
12	Before we close out, let's go off the record for a	06:39:52
13	minute.	06:39:56
14	THE VIDEOGRAPHER: Going off the record.	06:39:57
15	The time is 6:39 p.m.	06:39:58
16	(Recess taken at 6:39 p.m.)	06:40:00
17	THE VIDEOGRAPHER: We are back on the	06:46:17
18	record at 6:46 p.m..	06:46:19
19	MR. GLASS: Great. Thank you. No further	06:46:22
20	questions, and we can close the deposition out.	06:46:24
21	MR. DOWD: Thank you.	06:46:26
22	THE VIDEOGRAPHER: Thank you. This marks	06:46:27
23	the end of the deposition of Dr. Rüdiger Urbanke.	06:46:28
24	We are going off the record at 6:46 p.m.	06:46:31
25	(Off the record at 6:46 p.m.)	

VIDEOTAPED DEPOSITION OF RUDIGER L. URBANKE
CONDUCTED ON WEDNESDAY, FEBRUARY 25, 2015

332

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CERTIFICATE OF SHORTHAND REPORTER
(SAN FRANCISCO, CALIFORNIA)

I, JAMES BEASLEY, RPR, CA CSR No. 12807,
the officer before whom the foregoing deposition was
taken, do hereby certify that the foregoing
transcript is a true and correct record of the
testimony given;

that said testimony was taken by me
stenographically and thereafter reduced to
typewriting under my direction; that reading and
signing was not requested;

and that I am neither counsel for, related
to, nor employed by any of the parties to this case
and have no interest, financial or otherwise, in its
outcome.

IN WITNESS WHEREOF, I have hereunto set my
hand this 26th day of February, 2015.



REGISTERED PROFESSIONAL

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<p style="text-align: center;">A</p> <p>Aamod 71:12,16 148:10</p> <p>ability 300:17 310:19</p> <p>able 116:19,22 125:3 145:23 146:2,12 146:15 182:7,16 183:4,12 184:10 311:7 321:18</p> <p>absolute 130:6</p> <p>absolutely 69:18 106:5 155:16 165:22 189:6 238:25 250:13 286:23</p> <p>abstract 152:24 166:5 168:14 190:19 271:9,15,16 293:23 294:3,5 294:6,18 295:2 295:14,14 308:12</p> <p>abstraction 320:21</p> <p>academia 23:5</p> <p>accent 21:3</p> <p>accomplish 15:21 190:24 290:11</p> <p>accomplishing 291:4</p> <p>accomplishments 18:5</p> <p>accumulate 42:18 57:24 58:5 127:20 155:8 175:23 176:8 267:12 283:17</p> <p>accumulated 89:14 92:25 286:8</p>	<p>accumulates 80:13 99:12</p> <p>accumulation 78:12 83:5 86:11 86:14 87:1 101:18 107:4 283:10,13,15</p> <p>accumulator 79:24 80:12 82:3 82:7,9,24 83:17 84:19 85:11,14 85:15 86:4,16 88:1,17,20 89:16,20,21 93:1,12,12,16 93:25 94:1,18 95:2,10 99:12 99:15,24 100:10 100:17,23 102:11 108:4 115:4 122:19,23 122:24 173:5,15 278:16,19,21,22 278:24 279:5 280:3,4,12,22 280:23 281:14 282:20,23</p> <p>accumulators 174:15,19 177:11</p> <p>accurate 270:21</p> <p>accurately 54:4</p> <p>achieve 324:21</p> <p>achieved 255:15 256:7,17 270:10</p> <p>achieves 270:14</p> <p>acknowledgem... 296:10,17,18,23</p> <p>acronym 42:4</p> <p>acronyms 275:24</p> <p>act</p>	<p>127:19</p> <p>actively 264:6</p> <p>actors 70:24</p> <p>actual 74:14 109:18 110:10,16 125:5 127:1 132:10 162:17,20 180:5 186:9 190:3 219:21 222:25 238:25 261:6</p> <p>ad 105:24 116:13</p> <p>adapted 153:5,11</p> <p>add 92:1 99:14 102:4 123:22 284:6</p> <p>added 12:21 32:6 111:17 124:16</p> <p>adding 91:7 114:9 124:24 141:23 284:5</p> <p>addition 15:8 97:7,14,17 102:17,18,24 103:3,4,7,12,14 103:16,18,24 105:10 106:7,10 106:16,22 107:17 124:19 125:16 229:10 229:12</p> <p>additional 109:24 123:23 124:20 125:16 140:5,6 204:9 326:19 329:10</p> <p>address 246:7</p> <p>addresses 247:9</p> <p>adds</p>	<p>122:24,24,25</p> <p>administer 9:6</p> <p>advance 28:12,15 156:24 263:14</p> <p>advantage 254:16,20 255:6 257:21</p> <p>advantages 254:13</p> <p>advisor 151:7,12</p> <p>affect 74:8</p> <p>affirmed 9:10</p> <p>afraid 26:13</p> <p>ago 19:11,12,20 35:14 62:16 128:11 257:20 269:7</p> <p>agree 28:1 61:10 62:6 63:25 77:1 97:17 114:10 130:13 131:18 131:21 134:15 140:4 141:24 202:10 226:22 238:22 252:5 255:5 283:21 291:15,17,20,24 297:15 298:16 298:22 312:13</p> <p>agreed 62:16</p> <p>agreement 37:2 253:11</p> <p>agrees 329:6 330:14</p> <p>Ah 24:17</p> <p>ahead 8:22 16:20 40:15 41:9 57:15 61:8</p>	<p>78:24 81:10 90:19 91:16 94:21 132:8 158:13 170:24 179:5 246:21 256:23,25 258:18 284:11 285:9 291:23 293:18 300:22 307:2 311:1</p> <p>aim 143:16,18</p> <p>al 8:10 32:5 50:10 50:16,25 51:4 54:21 68:5 164:11 312:18 314:8 315:3 316:23 317:8,23</p> <p>albeit 238:14</p> <p>alerted 207:16</p> <p>algorithm 68:11 170:8,10 198:9 217:15 218:2 219:25 220:5,11,17,18 220:19,20,22,22 220:24 221:1,10 221:12,12,13,15 221:16 234:24 234:25 239:2,4 239:15 240:9,10 240:15,19,20,24 292:9 293:1 294:13,15 295:8 295:13,16,22,23</p> <p>algorithms 198:13 199:23 200:11,19 326:23</p> <p>Allerton 22:16,19,20 25:1 25:2,8 56:2 165:4 268:18,22 287:23 288:3,7</p>
--	---	--	--	---

288:11,15 allow 72:18 88:6 90:11 132:15 137:16 138:24 139:17 221:9 223:12 241:13 allowed 94:16 alphabet 176:16 alphabets 174:25 Alto 1:17 2:7 8:2,18 Ambleside 21:20,23,24 22:8 22:15 25:9 169:1,2,17 194:18,21,23 251:5,15 Ambleson 168:23 amend 164:22 Amin 249:8 amount 311:4,6,9 331:4 analysis 6:7 45:21 47:11 47:23 48:7 51:4 51:7,13 54:13 56:11,12,14,20 58:14,17 79:14 83:12 84:4,10 84:23 85:1,19 87:22 93:21 94:14 96:17 119:10 130:12 156:16 215:10 215:20,24 222:8 222:25 299:12 310:14,25 311:18 analytical 198:3	analyze 52:13 84:7 analyzed 38:23 53:10 267:22 and/or 9:10 56:12 Angeles 3:22 10:13 answer 10:24 19:18 27:4 27:11 40:15 46:16 48:12 65:16 69:10 72:22 79:3 88:8 94:11 96:15 100:9 102:1 105:14 106:15 107:13 138:19 151:21 156:1 176:23 177:6 179:2 184:16,25 211:9 213:19 216:4 226:3 232:15 238:1,6 258:9,11 278:24 281:6,20 282:7 282:8 294:10 307:6 309:4 326:4 328:12 329:15,17 330:5 331:5 answered 256:24 258:17 286:6 290:3 293:4,16 295:6 answering 129:10 282:8 answers 10:16 answer's 183:15 anyone's 116:24 apologize 52:11 90:14 157:15 164:4	169:1 315:20 316:3 apparent 277:14 appear 98:9 239:21 287:20 appearing 82:10 98:13,24 114:23 appears 74:24 79:18 98:15,18,22 99:1,5,10 100:5 109:19 117:23 215:9 244:22 249:20 276:6 287:25 303:24 apples 65:12 applicable 216:11,15 application 7:7 51:23 60:6,9 60:11 63:8 64:4 126:24 143:7 238:24,25 301:17,22 302:18 304:7,22 308:23 310:18 applications 14:22 17:21 61:23 67:22 199:20 200:3,7 200:16 applied 162:2 172:19 190:23 276:2 applies 51:25 214:15 apply 15:23 227:3,20,24 227:25 228:1,3 228:7 229:3 245:7 285:1 applying 271:4,6	appreciate 10:6 41:7 90:17 approach 45:1 127:25 128:4 215:23 216:9,13 219:1 approved 58:3 approximate 254:23 April 6:17 70:2 194:3,9 207:11,17 245:8 245:12,13,22 246:16 249:11 249:20 250:7,8 250:12 251:3 262:13 April-ish 194:4 area 13:14 14:15,17,22 29:18,25 30:11 30:12 70:10,11 70:16 areas 14:18 39:22,23 73:19 arguably 153:19 argument 161:19 Argumentative 294:19 arithmetic 102:25 arrive 229:15 318:19 322:19 arrives 100:11 art 39:9 51:8,20 71:25 160:22 250:22 264:18 293:12 307:21 316:5,11,16	Article 4:23 5:3,8,23 6:3 6:7,18,22 7:8,17 7:21 ART@scarpia.... 6:12,16 aside 137:13 139:20 189:9 207:20 212:14,21 213:1 228:24 239:17 278:1 asked 31:9,25 32:2 36:4 39:16 47:23 79:12,15 94:19 94:22 97:21 105:20 116:11 116:15 129:10 135:1 155:19 173:24 221:20 243:16 256:24 258:16 286:5 290:2 293:3,16 295:5 299:13 306:17 315:20 asking 14:23 43:13 84:9 84:10 85:23,24 92:6,7 105:9 160:18 175:4 182:13 189:8 213:1 218:5 228:22,23 230:1 230:4 232:16,23 286:7 300:11 305:20 309:22 318:11,21 328:14 329:18 asks 287:21 aspect 14:21 15:6,23,25 16:2 47:6 67:21 73:7 74:3,5 264:19 aspects
---	---	--	---	---

<p>12:20 15:9,10 18:5 assert 41:13 130:3 asserted 39:15 40:6 47:14 48:5 126:1 assertion 171:16 assessment 14:20 assistance 303:5 associated 25:3 associating 206:21 assume 36:4 55:24 100:16 120:1 138:6,6 139:23 141:10,18 177:5 177:8 188:13,17 188:20 189:12 189:17 192:16 211:15 273:6 328:14 assumption 229:8 328:16 329:18,21 assumptions 190:9,12 231:20 attached 4:6 12:2 30:19 42:22 49:21 50:18 54:23 111:12 114:3 117:16 123:12 124:10 131:2 136:2 148:2 165:6 185:23 215:3 244:2,5 249:14 265:20 284:22 287:8 301:24 304:9 311:24 312:20 313:19 314:12</p>	<p>315:7 attempt 52:24 53:8 54:12 attempted 39:12 attend 21:12 23:4 24:2,8 269:2 attended 21:24 23:10 24:5 268:23 269:5 attending 25:10 attorney 31:8 attorney-client 27:3 author 189:5 authors 52:24 56:25 68:4 289:2 321:6 authorship 165:14 available 73:16 245:21 246:1,9,10,13 246:14 250:17 252:6 Avenue 3:5,20 awarded 148:18 awardee 17:6 aware 34:17 45:19,22 66:19 71:8,12 71:12,14,15,21 72:1,3,5,12 73:5 73:11,23 74:13 103:13 150:20 151:3,9,11 152:8,15 153:24 185:9,15,17 193:5 194:19,22 207:14,18,21</p>	<p>211:10 241:16 241:20 242:5,14 243:13 262:14 262:16,18,21 269:10 307:5,9 a.m 1:19 8:4 <hr/> <p style="text-align: center;">B</p> <hr/> <p>B 4:5,20 5:1 6:1 7:1 49:18 203:24 206:22 208:3 322:15 back 34:2 48:20 65:18 65:25 66:18 74:21 82:19 93:6 98:7 105:7 106:25 108:2 112:21 122:7,15 127:12 139:20 142:12 146:18 150:9 151:14 152:23 162:5 163:23 166:21 169:16 172:5 173:8 179:18,22 181:9 182:5 189:10 190:14 194:17 195:2 202:9 206:11 213:21,22 226:23 230:16 230:19 243:9,21 251:4 254:4 258:23 262:12 266:7 268:3,16 269:10 278:15 283:24 292:14 309:17 313:14 315:21 323:12 331:17 background 12:17 34:6 67:14 67:19 68:18 190:24 191:4,5 191:11 192:10</p> </p>	<p>192:12,18,24 backgrounds 142:17 191:3 192:4,6 bad 60:22 130:4,14 238:23 239:2 balance 223:12,14 224:7 base 143:2 144:10 based 37:7 71:6 72:4,10 73:3,9,15 74:2 215:21 219:6,12 238:13 330:14 331:4 basic 44:20 54:13 100:6 259:2,9 291:16 330:13 basically 68:12 179:22 basis 74:14 75:15 92:12 batch 247:6 Bates 54:21 166:24 185:20 196:5,10 268:2 271:21 311:21 bathroom 204:22 BC 156:18 217:14,16 325:17 bearing 308:7 bears 54:21 185:20 244:8,9 311:21 314:10 Beasley 1:25 2:13 9:5 332:4</p>	<p>began 141:9 beginning 22:22 174:24 begins 8:7 48:24 50:9 93:11 105:5 154:9 166:6 181:7 196:15 197:23 202:17 215:14 221:24 255:21 258:24 258:25 266:5 304:9 BEHALF 3:2,17 behave 263:17 behaved 52:25 beholder 272:8 belief 71:7 72:11 73:3,9 74:2 143:3 144:11 220:12 220:24 221:1 254:23 255:2 believe 13:3,11 18:10 19:12,19,20 22:4,9 24:25 25:1,3 29:18 31:3 35:9 38:2,4 38:6,8,11 43:16 49:18 54:17 55:17 56:16,18 71:16 74:15 92:13 137:5 157:9 160:25 161:5,25 167:23 168:25 171:11 186:7,9 191:11 191:12 192:23 193:6 194:13,25 203:1,11,11 207:5,9,13</p>
---	--	---	--	--

216:10 225:19 235:16,21 247:22 260:25 262:8 263:18 268:14 289:12 290:5 312:8 313:1,7 317:24 318:2,15 323:1 believed 155:13 Bell 18:17,17,18,18,24 71:13,16 190:25 192:12 193:16 245:18 250:12 belongs 210:3 benchmark 264:1 beneficial 228:23 benefit 126:25 228:19 301:14 Berrou 243:10 best 10:4,6 13:4 60:10 69:20 116:2 153:19 154:2 155:1,20 167:14 167:16 223:6,9 241:21 245:23 245:24 246:15 247:5 248:14 286:22,24 301:11 302:22 beta 203:16 206:20 208:4 better 22:5 53:7 58:11 63:21 129:16 171:22 214:17 217:8,21 218:9 224:10 228:24 234:19 235:2	238:12,19 239:14 240:17 253:19 258:5 263:15,16 264:17,20 265:1 273:19 292:17 292:24 293:14 296:13,20 297:10 298:11 298:15,23 299:4 307:21 318:15 Beyond 151:17 big 263:24 272:6 bigger 101:14 161:1 binary 101:12,22,23 102:3,7 167:16 292:4 bipartite 206:22 207:22 212:11 214:7 219:6,12 222:5 222:9 259:12,13 259:15,17,21,22 261:24 262:1 326:18 bit 12:14 22:25 35:16 66:22 78:18,19 79:6,8 81:4,12 84:25 98:8,21 99:10 99:10,11,13,18 100:1,2,4,5,11 100:12,19 101:7 101:11 102:4,9 102:11,15 113:13 136:15 137:16 158:15 187:7 188:7 195:23 207:23 208:20 209:5,6 210:3,6,11,16 211:7 272:22	276:5 298:12 301:14 329:4,9 329:10 bits 59:23,24 75:16,17 76:8,22 77:2,6 78:15,17,20,21 79:5 80:3,8,12 80:25 81:8,18 81:20,23 82:2,5 82:9 88:4,10,12 89:10,13,17,22 90:5 91:7,8,8 92:1 108:12,15 108:17,20,22,22 108:23 109:4,7 109:9,10,21,22 109:24,24,25 110:9,11,11,12 110:14,16,17,17 110:22,23,23 111:3,6,18 112:15,15,17,19 112:20,22,23,23 114:20,21,23 115:2,4,5,7 118:13,14 120:8 120:15 121:5,6 122:19,25,25 123:3 127:3 129:3 138:1,2 140:1,8,10,10 140:12 176:13 176:13,20,21,22 176:25 177:1,5 177:19,19,25 178:6,11,19,20 179:9,10 182:10 182:12,22,23 183:11,13,19 187:11 188:18 195:17,20,21 196:2 203:7,10 203:12,13,15,18 203:21 206:20 206:21,21 208:5 208:5 209:14,15	210:4,6 211:19 211:22 213:12 233:6,7 236:20 260:5,7,11 270:7,16,19 273:1,4,11,12 274:3,9,11,13 274:14,15,23,24 274:25 275:2,3 275:3,9,12,15 275:19 276:4,10 276:14,14,17,20 276:23 277:1,4 277:10,16 279:4 279:4,5,10,10 279:19 280:4,25 281:1,10,11,16 281:18,18,24 283:17 284:2,3 284:14,16,25 285:15,22 286:1 286:11 327:3,6 327:6,11,21,22 328:5 329:20 331:3,3 black 133:20,21 140:9 block 75:12,22 76:2,8 76:12,17,19 78:4,7,10,12,16 78:20 79:9 80:24 82:3,11 82:17,21 86:20 86:20,21 87:2,6 87:10,11,15 88:2,17,22,25 89:2 95:3,3,4,14 95:14,15 173:2 173:5,15 188:17 189:15,18,19,19 189:20 197:4 201:15,20 272:1 275:10 284:3,16 285:14 blocks 78:1 88:11 89:5	172:22 176:15 275:12,16 blue 5:18,21 boastful 272:16,17 Bob 29:19 192:24 288:19 289:3 body 312:9 314:3,22 315:16 316:1 book 16:23,23 bottom 43:18 50:13 114:10 118:12 133:11,13,20,22 133:23 138:1,9 140:10,12 167:15 169:17 196:6 221:5 226:15 230:11 230:24 234:3 241:5 258:25 259:4 261:3 274:4 boundaries 27:17 bounds 223:1 box 77:11 92:24 115:7 123:24 175:16,21 176:7 176:8,8 177:10 177:11 178:8,9 178:10 226:15 278:4,10 281:3 281:10,14,25 282:3,15,18,18 282:25 283:7,11 283:16 boxes 77:9 175:21,24 branch 110:13 111:3,18
---	---	---	---	--

114:19 174:18 174:19,24 branched 142:21 branches 142:24 174:2,2,9 174:23 175:15 272:25 273:1,2 brand 272:14 break 10:22,25 11:1 65:21 66:3 105:9 113:12 122:10,18 125:7 125:13 144:3 160:9 176:5 180:25 181:11 204:22 205:4 206:7 232:10 233:22 243:17 243:17,24 267:16 313:10 313:16 breaking 58:13 170:12,16 171:5 breaks 10:21 breakthrough 156:9,13 157:3 Brendan 7:3 67:15 186:8 briefly 77:25 bring 30:8 53:19 145:9 Britain 30:1 British 272:8,9 BROADBAND 1:12 brought 156:14 browsed 302:6	bug 37:20 B2 4:18 C C 3:1 4:1 5:1 6:1 7:1 8:6 CA 1:25 332:4,25 calculated 92:15 California 1:2,4,17 2:7,14 3:12,14,22 8:2,9 8:12,19 332:2 call 127:5,9,15 196:4 207:1 209:19 219:7 259:14 called 17:6,20 20:16 21:8,20 56:11 59:10 67:11 82:16 89:13 91:6 103:11 104:11,16 108:12 153:4 156:7,8 190:25 195:4,16 209:1 215:9 217:16 220:18,19,20 221:12 239:1 247:5 267:20 282:3,15,18,19 289:11 calling 27:3 75:13 76:11 77:17 calls 13:20 27:2 45:9 46:25 47:20 48:11 94:2 95:20 126:4,4 130:16 132:7 246:19 252:7 284:10 285:4,7	286:15 307:24 308:1 310:13,25 Caltech 8:25 19:4 36:11 36:14 37:22,22 169:3 193:1 244:8,9,24 304:9 Caltech's 303:3 Caltech24021 287:5 Cambridge 66:15 capable 213:2 capacity 59:10 62:19 63:23 263:8 carefully 166:15 carried 58:16,18,21,22 301:1,5 carries 259:1 261:4 carry 56:19 58:15 cascade 204:17 205:11 326:21 cascaded 208:18 292:5 325:16 case 1:7 8:12 12:18,24 13:4 20:10 30:13 31:2 32:16 33:11 35:7 36:5,11,23 37:12,20 38:14 40:6 47:14 48:5 48:17 50:3 65:11 71:6 72:4 72:10 74:7 84:23 92:11 94:15 103:1	107:13 109:8 136:9 150:3 157:10 168:24 169:8 188:24 191:6,11 203:14 211:11 213:22 220:23 224:18 247:22 250:23 288:20 289:14 290:11 291:12 292:10 308:8 316:18 332:14 cases 65:16 casual 190:4 catch 44:12 87:8 179:1 cause 34:23 caution 31:11 cell 15:13,14 Central 1:2 8:11 certain 23:7 74:18 77:11 100:6 107:7 137:23 208:24 208:25 211:25 214:14,14,15 228:18 250:4 275:5 293:24,25 311:9 330:9,9 certainly 18:16 41:17 69:14 71:11 84:1 97:1 103:13 108:19 121:2 162:19 241:22 263:19 264:5 certainty 20:23 21:13 41:13 302:8 CERTIFICATE	332:1 Certified 2:14 9:11 certify 332:6 cetera 258:1 chain 329:23 challenge 196:16 chance 21:16 24:5 246:3 287:22 change 81:23 102:6 127:3 130:25 131:8 132:13 140:14 177:8,10 178:18 185:3 231:17 265:23 265:24 272:6 325:2,9,10 changed 102:14 changes 132:23 277:1 323:16,23 changing 177:18 284:7 channel 64:17,24,24 65:2 65:4,4 156:17 216:16 217:14 218:1,21 220:6 292:4 297:2 channels 216:12 Chapter 154:8 155:7 156:5 characteristic 33:24 characteristics 54:3 58:13,19,23 59:20 60:2,14 61:25 62:6
--	---	--	--	---

216:25 257:9 characterization 219:16 318:15,16 characterize 109:25 211:1 characterized 14:9 charge 37:8 chart 262:13 check 6:20 7:22,23 24:6 43:6 50:22 55:17,22 118:8 118:13,18,24 120:11,13,14 135:16 138:11 154:17 157:9 159:20,22 161:3 166:8 167:1,18 195:17,21 196:2 203:18,21 206:20 207:23 208:5,12 212:1 212:7 215:21 223:9 224:5,9 226:15 230:10 230:23 231:21 237:1,7,11,17 237:22 249:12 249:22 250:1 251:19 254:7,10 260:1,13,13 261:10 270:6,9 300:9 315:4,5 320:3 checked 129:20 checks 140:11 214:2 236:22 Chinese 143:20 choice 173:20 choose	60:21 173:17 174:8,10 175:1 203:24 208:12 263:4 chose 61:13 158:1 256:16 264:21 chosen 119:11 199:21 200:9,17 255:15 256:7,18 321:7 circle 96:6,7 97:6,9,13 circles 138:8,9,11 230:23 circular 133:21 circumstance 178:17 citation 170:9 242:16 cite 207:13 316:23 cited 69:22 155:8 157:6 251:17 268:5 cites 154:15 167:6,24 168:1 269:24 270:1 claim 39:9 40:6 44:2,18 45:3,6,13,17,18 45:23 46:3,4,9 46:11,12,22,23 47:9,17 48:5,5,8 48:17 124:4 135:2 138:22,23 163:14 180:2 219:23 240:4 301:17 316:6,12 316:17 324:12 claimed 128:15 175:16 179:7 218:3,23 219:19 326:16	claiming 147:21 173:25 190:11 318:17 324:10 claims 38:23 39:15,19 43:19,22,25 44:8,21,23 46:5 46:7 47:13,15 84:6 107:22 123:5 126:1,6 132:4,11 162:18 162:20 163:15 202:2,5 275:4 276:19 clarify 155:21 class 153:3,6,19 216:16 272:14 301:2 327:7 classic 190:15 classical 192:3,9 classically 192:18 clean 72:24 212:19 278:23 309:13 328:25 clear 41:2 79:13 199:14 214:4 256:11 274:15 277:18 278:7 280:8 303:18 clearly 130:5 200:14 265:5 294:7,11 298:11 302:20 304:5 clockcycle 99:25 100:2,4 close 59:10,11 128:2 156:9 219:1	241:1 331:12,20 closed 296:21 closely 254:23 closeness 65:10 closer 63:13 64:15,25 65:6 130:11 320:16 324:17 325:2,9 closest 17:17 19:8 257:17 code 6:5 15:7,18 29:23 40:9,22 53:18 53:18 54:10,11 54:12 56:21 57:24 58:6,9,10 59:3,3,6,11,13 59:19,21 60:3 60:10,15,20,24 62:19,20 64:2,5 64:25 65:6 77:14,15 79:22 80:12 86:20 88:9 95:14,24 108:6,9,11,13 108:24 109:1,6 109:16,17,17,19 109:20,20 110:3 110:8 111:24 112:4,12,13,14 112:24 113:10 113:16,21 114:9 114:11,12,17,21 115:5,11,11,15 116:17,18,23 117:5,11 118:6 118:12 121:2,5 121:9,17,22 122:1 123:18 124:3,6,21,24 124:25 125:5,17 125:18,24,25	126:12,13,17,21 126:21,22 127:17,20,23,24 127:24 128:2,3 128:10,12 129:8 129:19,21,23 130:4,5,6,8 131:17,19,22 132:3,14,14,24 133:1,6,7,9 134:7 135:10,13 135:14 136:8,10 136:10 137:15 137:19,20,20,22 138:15,16,23,24 139:7,24 140:13 140:15,19 141:5 141:11,16,16,19 146:25 149:9,21 149:25 151:16 152:6 159:11 163:6 172:2,22 173:18 174:13 175:5 176:10 177:15 180:2,8 180:9,20 181:19 181:25 182:6 184:9,10,13,22 185:10 186:5,9 186:22 187:17 187:21,22 188:14,14,24,25 189:2,13 190:7 190:15 195:24 196:1,4 197:4 199:3,4,6,6,9 201:1 202:7 203:14 204:14 205:8,15,16,18 205:19,20 206:1 206:2,4,5,19 208:8 211:6,19 212:6 213:16 217:12,17,24,24 218:1,12,18,20 219:13,22 220:4 224:18,22 225:2
---	--	--	---	--

225:8,13,13,18	326:13,13,16,23	150:4,12,17,21	257:2,10,13,15	67:3 69:3 70:11
225:25 226:9,12	327:2,6,6,11,11	152:9,16 153:4	257:17,21,21	110:5 119:2,7,8
228:24 229:8,18	327:21 328:7	153:5,7,11,11	258:4,4,5,8	142:15 145:21
229:19,20,24,24	coders	153:18,20,25	259:16,18	146:1 164:24
229:25 230:1,2	93:13 95:3	154:9,13,21	262:14,16,19	190:19,22 192:3
232:1 233:6	266:24,24	155:8,15 156:1	263:5,6,9,12,16	192:9 270:9,14
235:1,2,24	278:17,25	157:7,12,21,22	263:17,22,23,25	271:25 323:15
236:3,7,10,15	codes	159:20,22	264:4,14,22,24	324:5
239:22,24	4:24 5:5,9,24 6:4	160:23 161:18	264:24,25	coincidence
240:25 241:1,7	6:8,20 7:9,19,22	162:2,3,13	266:10,13,20,21	127:5,14
241:8 255:25	13:13 14:21	163:5 164:20	266:23 267:1,20	Coke
256:3 258:6,10	15:4,8,23 16:5	165:3,12,17,21	267:25 269:13	204:24
258:13,14,19,20	30:7 40:23	165:25 166:8,8	269:16,17,21	colleague
260:6,8,17,17	41:12,25 42:3	166:9,9 167:1,4	270:6,6,15,25	16:22
260:20 261:24	43:25 46:6 49:8	167:8,10,11,16	270:25 271:3,5	colleagues
262:2,4,10	49:13 50:8,11	167:17 168:10	271:7,7,10,11	245:10 246:17
263:17,22 264:2	50:16,25 51:4	169:12,13,19,22	271:18 272:14	column
264:7,13,23	51:10,14,14,16	169:23,23 170:7	272:15 273:21	45:2 93:7,10,11
265:3,5,5	51:18,21,21,24	170:16 171:3,6	282:4 287:17,19	96:23 107:2,2
266:14,19 267:5	51:25 52:1,3,5,9	171:12,12,16,22	288:2,10,13,21	167:19 196:13
270:7,14,16,18	52:15,17,18,19	172:13,18 173:9	289:6,12,14,21	197:20,23 198:2
271:5,24 272:21	52:20,21,22,25	173:10,11,12	289:25 290:12	199:19 215:14
272:24 273:3,11	53:4,6,7,11,15	174:9 175:2	290:15,16,19,20	218:24 220:9
273:15,16,18,25	53:16 54:4,5,6	185:13,17 190:3	291:4 292:5,10	221:6,7,23
274:11,14,24	54:20 55:9 56:8	190:5 193:4,5	292:12,17,24	combination
275:3,4 276:4,6	56:9 58:4,11,13	193:11 196:20	297:15,17	39:13 58:8
277:5,11,12,17	58:14,15,18,19	197:6 201:2,9	298:19 300:2,4	100:22,25
277:19,21 278:1	58:23,24 61:1,5	205:23 206:16	300:5,7 301:2,2	202:14 220:18
278:3,4,10	61:9 62:3,5,10	208:18 215:11	314:9 315:4	221:11 316:16
279:11 280:17	62:21 63:2,5,6,7	215:21,24 216:9	316:20,23 317:6	combinations
280:18,24 281:2	63:7,13,14,16	217:7,20 218:9	317:8,14,16,17	162:17
281:14 282:16	63:19,22 64:1,4	218:14 219:5,7	317:20 318:6,9	combine
282:19,21,25	64:12 66:23	219:11 222:20	318:10,16,17	73:15 100:21
283:11,16	67:4,11,11	225:4 229:16	319:3,3 322:10	179:10 301:5
285:22 286:8,14	68:10,21,25	234:18,20	322:10,11,13,13	combined
288:4,12 290:24	70:16,18 71:1,7	235:10,12	322:19,19,20,24	74:10,19 162:1
290:24 291:17	88:13 109:14	238:12,13,22,23	323:7,23 324:6	322:18
291:19 293:24	110:1,19 121:1	239:11,15,21,23	324:17 325:17	combining
298:11,12,15,17	121:23 129:16	240:7,7,8,14,16	325:19,21 326:7	101:1,3 102:10
298:18,23,24	129:16 130:14	240:18 241:2,6	326:10 327:5	122:19
299:3 315:22,25	130:14 134:3,13	243:11,13	code's	come
317:22 318:13	134:19 135:10	249:12,22 250:1	165:24	34:2 53:9 55:19
319:9,21 320:5	136:18 137:1,2	251:19 253:18	coding	57:8,9 65:18
320:12,22,24	137:21 139:1	254:7,10,13,14	5:3 15:1,22 16:4	75:16 82:5 93:4
321:3,5,7,9,18	142:6,6,14	254:18,25	16:7,8 17:5	97:23 119:2,7,9
321:23 322:1	145:4 147:14,15	255:16,23 256:2	54:19 55:8	122:7 125:8,13
325:2,9,25,25	148:9 149:5	256:7,12,18,19	56:22 58:7 67:1	139:16 162:5,5

184:23 264:13 282:2 comes 99:13 102:9 108:8 comfortably 145:11 coming 9:20 28:12 68:20 76:6 81:19 101:5 263:9 command 247:9 comment 39:16 159:15 186:21 commercially 202:6 common 15:14 57:11,16 69:5 142:21 143:13 264:12 264:16 commonly 134:11 communicate 15:14 communication 14:10,12 15:11 communications 1:8 8:10 11:12,15 11:19 22:23 24:12 31:12 191:1 communities 68:14 74:12 community 67:3 323:15 compare 64:3,7,21 65:15 118:11 130:7 163:15 263:4 265:4 279:8 compared 51:8 258:7 265:3 293:1 compares	39:8 comparing 65:11 162:16 168:9 316:5,11 316:16 318:6,14 318:16 319:10 comparison 7:17 30:6 51:20 162:23 264:1,8 314:8 319:3 compatible 225:15 compensation 37:4,7 competing 223:3,5,13 competitors 263:21 complete 10:16 12:12,15 72:19 294:23 completely 67:20 74:11 147:1 complex 60:8 322:4,7,10 322:10 complexity 48:9,10,18 53:24 59:14,16 201:10 201:17 254:17 254:22 255:4,6 255:9 257:22 321:10,19 complicated 53:6 119:14 321:19 complied 29:5 230:18 component 84:13 119:13 175:2 204:7 290:7 components 80:15 84:5,11,24 85:20 119:10,14 174:10	Compound 299:11 comprised 92:16,21 196:2 computer 11:12,13,16,19 13:18,25 14:3,6 67:15,19 68:15 68:16 70:10,15 142:16 145:22 186:5,9 190:16 191:13,17,19 238:24 computes 92:19,25 computing 200:6 concatenated 52:20 205:18,22 205:25 206:3 266:21,23 concept 68:12 103:4 164:12,17,18 212:11 271:5 273:22 284:24 concepts 67:13 69:6,7 concern 290:13 concerned 292:11 conclusion 13:20 45:10 47:1 47:21 48:11 75:14 76:11 77:18 94:3 95:20 97:23 126:4 130:16 132:7 179:13,14 238:22 239:10 239:19 240:21 241:11,13 246:20 252:8 284:10 285:5,7 286:15 293:6,9 293:11 308:2	conclusions 258:1 concrete 41:20 condition 329:12,13 conditions 10:19 conduct 253:5 conducted 18:11 conference 10:10 17:19,22 20:12,16,20,22 21:7,12,20,25 22:16,17,18,19 22:20,21,23 23:1,19 24:14 24:19 25:1,3,6,7 25:8,9 41:15,21 41:23 55:20,21 56:3 57:2,4 165:4 169:5 194:21 268:18 269:8 288:3,15 conferences 16:24 17:16,19 20:19 22:3 24:5 25:11,16,20,24 26:7 66:11 68:15,17 241:19 268:22 confidentiality 253:10 confirm 39:25 confused 53:2 66:21 confusion 34:23 230:17 conjecture 56:17,18 57:21 289:12 290:7,15 connect 237:7,8,24 connected	67:8 68:7 139:10 193:14 221:17 281:1 connecting 237:11 connection 278:13 connections 18:23 29:19 192:25 278:11 consider 17:12 87:10 159:4,20 196:3 219:5 290:12 considerable 311:4,6 considered 4:21 49:19 50:2 53:13 58:12 95:2 108:9 158:9,21 159:19 169:12 173:8 191:21 192:2 221:4 234:5 265:6 312:5,6 313:25 314:18 314:20 315:14 322:1 326:16 considering 293:22,24,25 consisted 49:8 consistent 292:21 constant 179:9 constraints 260:14 construct 201:9 constructed 58:10 273:18 construction 7:18 108:8 132:20 219:23 326:21 Constructions
--	---	--	--	--

30:6 314:9 construed 211:11 consumption 59:19 contact 17:17 20:12 31:16 contacted 31:7,8 32:17 36:22 contacts 17:14 contain 320:13 contained 302:14 containing 187:21 contains 76:18 102:22 content 67:23 68:8 context 22:3 213:16 256:1,11,15 257:4,5 292:20 327:15 continuation 28:23 43:7 continue 27:22 181:12 199:18 continues 49:9 88:24 182:3 222:6 contribute 214:1 236:21,25 237:18,22 contributes 237:4 contributing 114:21 115:5 contribution 215:15,19 control 22:24	convenient 204:25 convolitional 86:17 93:13 95:11 277:5,11 277:12,17 278:3 278:4,9,16,18 278:24 279:1,11 279:20 280:5,6 280:12,16,17,17 280:24 281:2,11 281:13 282:3,16 282:19,21,24,25 283:11,16 convolutionally 279:5 copies 57:12 80:7 329:10 copy 11:24 30:15 42:20 43:11,13 43:14 49:18 50:15,24 54:19 56:24 57:5 110:24 117:13 123:10 130:24 147:25 165:3 185:20 211:18 211:20,21 215:1 249:11 252:1 265:18 268:9 287:5 301:21 311:20 312:16 313:17 314:7 315:2,10 329:20 copy-and-paste 123:3 CORPORATI... 1:10 correct 11:21,23 14:19 15:3,17 32:14 36:11 39:10,11 47:10 50:3 52:20 60:13 62:11,14,15	74:2,6,20 75:9 78:6,9,13,18 79:19 80:4 81:21,25 83:11 86:3,25 87:25 89:8 91:2 98:8 99:9 100:18,20 100:24 102:11 102:15,16 103:10 108:5 109:5,22 113:17 115:9,20 116:20 120:21,24 121:7 121:19 123:18 124:18,21 125:18 126:14 127:25 129:4,5 129:14,17 132:5 135:3,8 146:23 153:10 154:18 156:25 157:13 159:9 160:5,6 160:24 161:13 162:11 163:1,16 164:9,15 167:9 173:1 176:8 177:14,16 183:6 183:10 186:24 188:4,19 193:11 195:12,15,18,22 199:1,7 200:24 201:7 202:11 205:21 208:7 209:8 213:25 214:22 217:13 218:12 221:2 222:18 223:24 224:1 230:25 236:2,6,9,13 241:1 242:24 243:12 245:8 250:20 256:18 257:19 258:5,14 258:21 259:20 260:3,15,18,22 261:22 263:1,3 265:16 266:25	268:1,11 269:25 270:3 271:20 274:7 275:14,18 277:3 278:17 279:6,7 280:12 281:15 282:16 282:21,22 283:1 284:17 285:3 286:4 287:20 288:1,3,11 289:4,6 290:18 290:22 295:2 296:22 302:24 303:12 304:17 306:19 310:24 312:11,14 313:3 314:5,6,16,21 314:25 315:15 315:18,19,24 316:2,6,14,19 319:6 320:3,8 320:18 322:4 323:21 332:7 correcting 68:20,25 219:5,11 correction 13:12,15 145:4 correctly 14:13 136:11 239:25 256:8 288:22 292:19 corresponding 108:10 129:23,24 208:4 310:17 311:14 corresponds 137:18 203:2 211:6 counsel 8:20 10:1 28:13 28:15 31:13 35:2,21 40:20 243:16 302:21 303:8 304:5 332:13 counterintuitive 253:18	couple 19:3 59:2 course 12:20 31:22 204:8 242:9 court 1:1 8:11 9:4 10:3 10:12 330:4 cover 130:13 268:17 covered 126:1 162:15 316:4 co-author 32:5,12 249:23 co-authors 67:18 245:9 create 113:9,20 114:11 115:14 116:19 116:23 117:10 178:10,19 211:18,22 272:13 created 101:8 102:10 111:10 creating 112:4 178:6 creation 329:19 criteria 60:8 61:3,4 63:23 CSR 1:25 2:15 332:4 332:25 current 99:15 101:4 102:4,10 Curriculum 4:8 cursor 301:11 customary 257:3 293:20 cut 128:23
---	---	--	---	---

CUTLER 2:5 3:19	218:20,21,21	293:2 294:7	141:1,2,20	296:13,20,21
CV 11:25 12:11,11,17 12:25	debating 27:20	295:12,23 326:22	182:9,20 183:1 184:12,14	297:10,11 321:6
C(B) 206:19	December 287:14	deem 29:11	187:15 205:24 210:14 211:8	degrees 135:19 139:17 140:1 199:10 208:9,15,24 209:17 212:12 223:17 234:7 236:14,20 260:21 325:10 327:7,24 328:3 331:2
D	decide 108:16 112:21 208:13	deemed 29:10	232:18 262:8 286:14 290:25 291:4 305:3 307:17 310:10 322:2 328:6,7,9 328:9,12 329:5 329:6,16,22,23 329:25 330:6,15 330:16,23	demonstrate 264:12
D 5:1 6:1 7:1 8:6 78:11 82:11,17 86:19 275:16 276:21	decided 300:15	defendants 1:13 3:17 9:3	definitions 105:22 329:24	demonstrated 151:3
Darius 7:4	deck 304:8	define 45:6,23 106:10 119:7 224:22,23 247:7 261:8 322:6	degree 15:5 80:15 129:12,13 131:12,12 132:17,17 133:12,14,15,16 133:19 135:16 135:17 140:17 176:17 191:13 191:21 194:22 208:21,25 209:1 209:3,5,7,8,10 209:19 210:24 210:25 211:4 214:8,9,23 223:7,10,18,20 223:24 224:2,10 224:14,15,17,19 224:20,22,23 225:5,6 226:25 227:1,17,18 228:4,8,9 229:2 229:2 231:3,4 231:17 232:2,2 233:7 234:8,12 235:15,16,22 236:1,5,8,12,18 236:23 241:20 260:24 261:1,9 261:9,17,20,21 262:2,3 296:12	demonstrates 49:1,7
darius@shano... 6:13	decks 304:16	defined 94:9 105:22 106:15 107:13 107:16,24 112:13,19 118:18 190:3 319:8 330:4,7 330:10,13,21	density 6:8 7:21 159:21 254:10	demonstrating 264:19
data 75:12 109:18 120:6,7	decodable 61:22 62:1 119:9 322:12 327:1	defines 118:24 168:20	department 11:11,14,15,18	denotes 97:6,14
date 8:14 26:13 31:17 34:25 35:8 55:18 71:17 186:14 194:2,6 242:18,23 243:3 245:12,16 250:4 250:8 268:14 287:15 326:17	decode 59:22 224:3	defining 206:19	depend 60:18 108:23 210:2	depending 23:6 60:4,5,9 61:12 127:6,17 257:25 273:15 327:7
dated 6:14 7:4 154:5	decoded 59:25 169:19 170:7 196:21	definitely 241:18 243:5 265:2 269:12	definition 60:19,24 65:10,13 88:13 89:12 91:20 106:13,18 106:20,22,23 107:21 108:14 108:16 109:4,8 109:10 112:14 112:24 118:23 121:2,21 122:5 125:3 127:7,18 128:9,14,22 129:7 130:4 132:21 133:3,8 134:2,3,4,10,12 134:21 135:2,3 135:4,5,7,8,9,10 140:18,19,24	denotes 110:4 129:22 130:4 140:18 228:19 236:25 257:24 281:16
dates 194:3	decoder 170:11 217:17 218:22 221:18 228:15,16,19 239:8,12,14 293:25 294:4,8 296:25 325:20 325:20	definition 60:19,24 65:10,13 88:13 89:12 91:20 106:13,18 106:20,22,23 107:21 108:14 108:16 109:4,8 109:10 112:14 112:24 118:23 121:2,21 122:5 125:3 127:7,18 128:9,14,22 129:7 130:4 132:21 133:3,8 134:2,3,4,10,12 134:21 135:2,3 135:4,5,7,8,9,10 140:18,19,24	deponent 8:25	depos 8:17 9:6
Dave 165:15	decoders 254:22 295:4	defining 206:19	deposited 9:22	deposition
David 67:7 186:17,20 191:20	decoding 5:24 29:23 47:18 48:6 59:16,18 68:10 148:10 197:8,17 198:9 198:13,18 199:23 200:11 200:19 201:17 217:15 218:2 219:25 220:5,10 220:11,17,21,25 221:10 224:3 234:24 240:9,10 240:15,19 254:17 292:7	definition 60:19,24 65:10,13 88:13 89:12 91:20 106:13,18 106:20,22,23 107:21 108:14 108:16 109:4,8 109:10 112:14 112:24 118:23 121:2,21 122:5 125:3 127:7,18 128:9,14,22 129:7 130:4 132:21 133:3,8 134:2,3,4,10,12 134:21 135:2,3 135:4,5,7,8,9,10 140:18,19,24		
day 332:19	deals 30:10 217:14			

<p>1:16 2:1 4:7 5:2 6:2 7:2 8:8,17 26:23,25 27:9 28:6,13,19,21 105:1,6 181:4,8 266:1,6 331:20 331:23 332:5 describe 131:19 153:18 224:6,12 254:13 272:19 296:10 322:9 324:9 described 84:12 89:5 121:10,18 126:14 142:7 163:5,6 185:17 239:13 240:19 241:3 280:9,25 321:6 327:25 describes 93:16 209:2,9 278:5 describing 142:13 180:19 202:24 207:22 207:25 254:6 259:12,13,23 278:7 description 77:22,23 83:24 95:8 102:12 182:18 183:25 187:5 203:3 277:6,19,20 279:13 280:19 281:2,8,17,22 296:24 318:17 319:23 descriptions 320:13 design 6:18 64:12 180:3 215:20,23 249:11,21,25 251:18 263:15 designed</p>	<p>254:24 Designs 6:9 desirable 265:6 detail 44:1 83:10 96:12 97:22 148:17 151:20 152:1 155:18 168:12 171:10 295:15 309:3 311:5 detailed 155:19 311:18 details 20:6 28:9 94:6 determine 39:13 46:5 132:11 187:22 188:11 264:1 determined 234:20 determines 210:10 determining 43:24 development 56:9,22 diagram 76:24 77:8 229:9 dictionary 145:18 Diego 17:20 difference 65:14 96:8,22 122:22 125:1,8 125:14 127:18 137:8 244:23 325:24 326:3,12 differences 61:12 96:18 157:23 different 25:19 29:25 44:23 45:1 63:10,11 64:12</p>	<p>64:12 65:15,16 66:25 67:1,21 68:14,21 69:1,7 71:3,4 72:7 74:11 81:7 93:5 112:25 132:17 138:23 139:25 140:1,17 142:7 142:13,21,22,23 143:9 144:2 146:5,8 147:1 160:18 168:9 173:17 174:15 175:1,1,5 178:20 180:5 182:12,24 183:11,11,13,13 183:18,19 184:24,25 188:21 189:23 192:20 197:7 208:9,14,21,24 209:7,15 210:1 210:16,22 212:6 212:12 213:6,24 214:2,8,9,21,22 218:5 223:17,17 224:8 230:4 234:13 235:24 235:25 236:3,5 236:8,11,14,18 236:20,21,24 237:4,18 239:14 240:18 241:15 241:19,19 250:3 257:9 260:20 270:17 273:4,12 273:16 274:10 276:3,7 284:3 284:16,21 285:1 285:16,23 286:3 286:13,20 300:8 306:9 318:21 323:17,22 324:5 325:1 327:3,7 327:11,22,24 328:3,5 330:19</p>	<p>331:1,2,2 differs 194:7 212:3 251:1 difficult 143:21,25 183:20 183:24 184:2 226:2 272:20 273:13 digression 56:23 dimension 101:13 dimensional 59:7 direct 71:23 110:13 111:2,7,17 114:19 direction 173:9 332:11 directions 67:1 142:22 directly 47:3 57:3 64:20 disagree 63:18 92:12 153:14 disagreeing 265:13 disallow 179:23 Disc 181:4 disclose 40:5 158:1 202:10 disclosed 84:11,14 85:20 265:14 311:15 discloses 39:14 85:24 202:12 disclosure 84:5 85:3,4 163:12,13 discuss</p>	<p>19:6 245:3 256:3 257:2 322:16 discussed 10:1 51:8 66:3 75:7 261:23 294:14 305:8 316:21,21 317:3 317:20,20,24 319:4 discusses 167:10 304:22 305:22 discussing 107:17 120:16 150:12 309:18 317:16 discussion 12:4 52:8,14 117:18 156:1 166:25 167:3 222:12,20,23 226:24 253:15 258:24 265:10 269:15 301:16 307:13 308:22 322:25 323:9 discussions 304:2 DISH 1:10,11 DISHNET 1:11 distinct 25:15 254:13,20 distinction 110:8 distributed 57:5 246:17 247:12 253:9 distribution 56:12 67:23 68:8 248:9 252:17,18 289:23 321:7 District 1:1,2 8:11,12 divide 132:16 188:17</p>
---	--	--	--	--

285:14 286:2 divided 118:7 189:19 192:15 dividing 286:12 Divsalar 7:4 33:10 40:2 54:20 55:10,13 71:1 74:17,21 74:25 76:16 83:25 84:4,12 84:20,24 85:5 85:24 86:4,5 87:14 88:1,16 92:10 95:8 96:5 96:22 97:16 98:7 107:1 113:15 120:22 120:25 121:8,16 137:10 144:15 149:10 150:11 150:17,20 151:4 151:15 158:10 158:21,21 159:8 159:11 160:2,4 160:22 161:6,13 162:10 163:5,12 163:20 167:6,9 168:5 172:5,25 173:23 177:3 181:12 183:5,17 184:9 185:2 188:14 189:10 191:25 192:14 194:12 206:2 225:8,13 241:15 241:20,23 242:4 246:6,8 247:14 247:15 248:6,19 252:13 266:10 267:14 278:15 279:3 282:20,24 283:24,25 285:2 286:20,25 287:6 287:14,22 288:24 289:3,5	289:20 299:7,7 299:8,18,22 300:14 Divsalar's 33:18 85:3 284:1 299:8,18 300:16 divulge 31:12 DJCM 186:19 doc 29:20 document 4:8,11,17,20 7:6 7:11,14 29:1,13 148:20 185:20 249:24 250:11 250:22 256:9,10 287:5 304:14 311:21 documents 29:8,10 97:18 302:8,9 311:5 doing 53:4 89:1 91:18 92:5 101:17 168:12 175:3 176:1 178:16,24 179:7 185:18 213:2 264:18,19 272:17 287:17 290:6,10 292:7 325:1 DORR 2:5 3:19 dot 187:2,2,2 double-sided 4:10,16,19,22,25 5:5,10,25 6:6,10 6:21,24 7:10,13 7:16,20 doubt 94:5 Dowd 3:18 4:3 8:22 9:2 9:2,17 11:24	12:5 13:23 14:11 16:6 17:10 19:22 21:17 25:17 26:1 27:7,12,15 27:19,22 28:2,4 30:15,21 31:14 34:1 40:11,13 40:18,25 41:4,6 41:8,10 42:14 42:19,24 43:10 44:17 45:11 46:8 47:7 48:1 48:15 49:5,17 49:23 50:15,20 54:16,19 55:1 57:17 59:1 60:23 61:24 62:7,12 63:1,9 64:9,22 65:5,17 65:20 66:2 69:9 71:22 72:15 73:1 75:18 76:15 77:13,24 79:7,17 80:6,18 81:5,14 82:1,18 83:13 85:10,22 86:12 87:13,19 88:15 89:15,23 90:3,23 91:24 92:20 93:3,23 94:13,24 95:23 96:4,20 97:4,9 97:11,12 98:1,6 98:14,20 99:7 100:14 101:16 102:8 104:1,6 104:19,23 105:8 106:1 107:9,15 108:1 109:3 110:24 111:9,14 112:5 113:11,22 113:24 114:5,18 115:17 116:1,14 117:1,13,19 118:20 119:16 119:18,22	120:19 122:2,9 122:17 123:9,14 124:7,12 125:6 125:12,23 126:8 127:21 129:1 130:9,19,23 131:4 132:2,12 132:22 135:18 135:21 136:4 137:6 139:19 141:8 144:3,8 147:24 148:4 149:17 151:1,8 151:13,22 152:14,22 154:6 155:3 158:17 159:2 165:2,8 165:23 166:4,17 168:22 170:1,5 170:19 171:2,24 174:11 175:22 177:2 178:25 180:4,15,17 181:2,10 185:19 186:1 187:24 191:15 192:8 198:11 200:20 205:1,4,6 206:6 206:13 210:8 211:3 212:20 214:25 215:5 216:7 217:2 220:7 221:19,22 227:11 228:2,21 229:17 230:3 232:8,19 233:13 233:17,20 235:7 238:5 239:16 240:22 243:16 243:23 244:7 247:1 249:10,16 252:16 255:11 257:7 258:22 262:11 264:11 265:17,22 266:8 267:6 276:8 280:10,20	281:12 282:1 283:9,23 284:12 284:23 285:10 285:24 286:10 286:18 287:4,10 289:15 290:8 291:6 292:13 293:8 294:2,16 295:1,9,24 296:4,6 297:22 299:5,16 300:10 301:7,21 302:1 303:20 305:6,17 306:1,6 307:11 307:19 308:3 309:6,15 310:1 310:15,23 311:11,20 312:1 312:16,22 313:9 313:16,21 314:7 314:14 315:2,9 319:16 320:14 321:1,16 322:8 323:5 324:15,24 325:7,13,23 326:5 327:9,16 327:19 329:1 331:8,21 download 245:21 246:10,11 downloaded 57:2 Dr 4:12 8:25 16:18 16:21 17:12 18:2 19:1 20:9 26:4,5 28:5 29:14,16,17 33:10,10,18,18 39:17,18 48:25 49:6 66:4,6,19 67:7 69:13 92:10 105:2,6,9 134:9,23 140:20 140:25 147:25 148:12,14,18 149:4 150:20,23
---	--	---	---	--

150:24 151:2 152:8,15 153:10 153:24 154:19 155:13,25 156:6 156:8 157:3 158:1 164:15 165:3,13 181:4 181:8 191:6,12 192:19,22 193:3 193:3,6,16 243:23 244:25 246:6,8 247:14 247:15,19 248:2 248:6,6,19,24 249:2,6 265:13 266:2,6,9 268:9 269:24 280:11 286:19,20,25,25 287:6,6,13,14 287:22 288:10 289:3,20,20 318:3 319:4 331:23	duplication 178:6 E E 3:1,1 4:1,5 5:1,1 6:1,1 7:1,1 8:6,6 9:15 67:3 147:13 earlier 14:1 24:11 31:20 51:9 60:25 196:1 200:22 261:23 290:16 317:15 easiest 225:22 easily 144:23 easy 62:1,14 184:20 224:3 edge 123:23 124:20,25 125:16 210:24 237:6 edges 209:18,18 210:1,4 210:5,6,7,9,16 211:25 212:1,2 212:7 213:5,7 213:24,25 214:21,22 224:23 227:6,22 228:11 229:5 231:6 234:13 235:17,18,19,20 235:23 237:1,3 237:11,15,16,20 275:10,13,17 278:9 281:3,25 282:2,14,17 331:2 educational 34:6 EE 69:2 147:7 190:24 191:3	192:3,6,10,18 effect 125:4 201:18 efficient 322:13,14 efficiently 15:16 effort 145:12,17,19 147:23 197:7 eight 4:24 6:23 319:5 either 30:16 55:21 56:1 56:3 58:3 90:5 105:22 179:1 192:23 197:8 208:12 326:17 330:17 elaborate 137:17 Electric 192:7 element 92:19 204:13 elements 45:15 54:13 58:8 91:4 102:23 eliminate 53:19,23 Emanuel 3:4,11 8:24 9:1 empirical 170:11 171:4 employed 332:14 employee 18:20 employer 18:15 employment 148:25 empty 54:1,1 enclose 202:12 encodable	61:14,21 62:1,11 119:3,8 271:12 271:19 322:12 327:1 encode 197:1 279:5 encoded 75:12 82:23 109:18 120:8 196:21 260:5,8 encoder 75:11 76:21 77:1 77:23 78:5 86:18 93:24 95:12 108:7 109:5,6 110:10 111:23 183:4 189:13,25 190:1 278:19 279:2,21 280:5,7,12,16 281:11 282:24 encoding 47:18 48:6 59:14 59:16 75:7 76:21,24 77:2 77:16 78:14 116:16 197:8,17 197:24 198:5,9 198:13,17,22 199:2,12,12,22 200:11,18 201:6 201:10,23 282:25 energy 59:19 engaged 31:1 engagement 36:24 engineering 192:7 English 144:17,19 146:15 146:21 330:10 330:18 ensemble 150:4	entertainment 17:23,24 entirely 73:6,9 143:9 184:24,25 237:9 285:23 300:7 entitled 4:8,11,17,20,23 5:3,8,23 6:3,7 6:18,22 7:6,8,11 7:14,17,21 30:5 55:7 155:7 185:21 249:21 288:13 EPFL 11:8 66:12 equal 292:8,8 equals 103:1,8,8,9,9 106:7,8,8,9 272:1 equations 270:9 277:12 330:12 erasure 215:24 erratic 201:17 error 13:12,15 29:23 34:10,15,16 59:20 68:20,24 82:10 145:4 219:5,11 298:12 324:22 errors 34:17 especially 167:6 ESQUIRE 3:3,10,18 essence 64:6 essentially 20:19,21 53:19 59:22 64:2,5
---	---	---	---	--

65:12 66:23	42:5 44:15	138:24 146:24	49:17,18,20,24	231:25 233:5,24
67:10 127:19	55:17,23 56:9	147:6,12,13	49:25 50:16,17	244:1,4,9,12,18
128:5 143:14	61:12 63:25	149:4 150:3	50:21,24 51:15	244:24 245:6,7
144:25 145:10	81:12 86:10	164:24 174:18	51:22 52:3	246:5 249:10,13
216:14 232:12	87:11 89:21	176:12 177:20	54:16,22 55:2	249:17,24 250:8
244:20 263:8	94:9,10 96:2	177:24 178:4	74:22 85:6 93:7	250:11,14 251:4
275:16	106:14,19,24	179:10 191:4,5	110:24 111:10	251:11,12,13,16
establish	122:4,5,21	236:15 240:19	111:11,15,24	251:22 252:1,5
290:14	127:6,19 133:24	241:24 252:25	112:8 113:17,24	254:4 265:17,19
established	137:12 139:13	253:1 260:23	114:2,6,8,10	267:15,17
252:12 275:21	143:11 144:24	261:12,15,15,16	115:9 116:19	269:10 287:4,7
estimate	145:8 148:25	261:18,19 264:8	117:3,6,13,15	287:11 288:2,9
32:22	156:3 166:2	301:15 318:23	117:20 118:11	288:16,24
et	168:19 182:15	324:22	121:11,19	289:25 290:20
8:10 32:5 50:10	183:8,21 184:5	examples	123:10,11,15,17	291:8,9,13
50:16,25 51:4	184:16 185:7	144:23 261:6,7	124:8,9,13,16	292:14 296:2
54:20 68:5	192:17 200:6	exception	124:16,20	297:23 301:21
164:11 258:1	205:13 207:25	102:25	125:17,24	301:23 302:2,11
312:17 314:8	211:2,20 213:16	exchange	126:13,16	302:17 304:6
315:3 316:23	218:3 227:25	26:18,20	127:23 128:12	311:15,20,23
317:8,23	229:13 232:7,12	exchanged	128:17,19 129:2	312:2,4,7,11,16
event	241:3,10 242:1	21:14	129:11,18	312:19,23,25
41:22	243:6 245:11,25	exchanges	130:23,25 131:1	313:4,10,17,18
events	248:4,12 250:2	17:15	131:5,17 132:3	313:24 314:7,11
19:8 193:13	267:13 269:13	excitement	132:14,14,25	314:15,17,19,24
evidence	270:21 272:22	41:24	133:5 134:6,14	315:2,6,10,12
218:14,16 240:3	274:12,23	exclude	135:22 136:1,5	315:13,18,21,25
296:12,19 297:9	277:14 284:21	18:22	136:7,9,11	317:9,10,17,23
297:12	295:13 297:2	exclusive	137:4,11,14	exhibits
evolution	301:3 302:13,14	90:6 91:1 92:3,8	138:8,14 139:20	139:21 225:19
159:21	302:24 304:4,4	97:7,14,17	139:20 140:4,14	243:25 245:2
exact	305:2,14 310:9	excuse	140:15 141:15	250:1,7
31:17 32:19,22	310:10 311:2	54:2 164:3	147:24 148:1,5	exist
71:17 80:16	316:9 319:23	execution	148:11 165:2,5	278:2
96:18 105:21	320:22 330:8	247:6	165:9,16 166:19	existed
107:21,22	EXAMINATION	exhibit	169:16 172:7,8	207:6
108:14 176:6	4:2	4:7,8,11,17,20,20	172:9 181:14	exists
182:18 194:2,6	examine	4:23 5:2,3,6,7,8	185:20,22 186:2	277:24 278:2
210:13 211:8	43:25 83:10	5:11,14,17,20	186:6,11 194:23	exit
255:18 268:14	examined	5:23 6:2,3,5,7	194:24,25 195:3	282:15
268:24 318:5,13	80:16	6:11,15,18,22	196:7,8 214:25	expense
319:9 320:24	example	7:2,3,6,8,11,14	215:2,6 225:11	238:14
321:3 330:6	15:11 17:5 40:2	7:17,21 11:24	225:24 226:5,8	experience
exactly	41:16 46:22	12:1,6,23 13:3	226:13,18,21	14:24,24,25
13:21 19:12 22:2	61:11 100:16	30:15,16,18,22	227:4,20 228:10	116:16 145:3
35:3,13 36:12	101:14 126:22	31:23 42:19,21	229:3,12 230:7	207:11
36:17,18 41:13	129:18 137:25	42:25 43:14	230:13 231:1,19	experiment

298:15	explored	57:23 73:15	farther	117:5,12 121:9
expert	178:4	74:16 171:22	63:15 64:16 65:1	121:17 137:10
4:11 13:4 16:10	exponent	185:9 189:5	65:7	137:10 138:3
28:7,8 30:25	56:17,18 57:21	201:8 273:10	fashion	149:10,11,15,20
36:23 37:6	exponential	282:7,11	116:13	149:22,22 152:3
77:18 79:16,19	255:4	factor	fast	152:5,7 172:1,6
80:14 91:18,19	express	75:17 123:4	21:2 199:23	172:22,24
91:23 104:4,8	144:20,24	facts	200:19	174:14 176:7
104:18 113:19	expressed	28:25 31:22 36:3	FD	178:18 181:12
114:14 115:13	31:23 69:7 72:10	36:19 143:12	274:6 275:15	181:17,22,24
115:22 116:12	73:2,17 143:2	189:25 302:24	276:20 284:15	183:4,18 184:9
130:16 132:7	expresses	faculty	February	185:2 188:15
134:8,22,25	143:11	23:8	1:18 8:3,14 19:13	189:10,13
140:20,22	extend	fair	32:18 35:1,8	204:20 205:7,9
151:18,24 152:1	288:19 289:7,11	10:7,8 12:19 13:5	36:3 38:19,19	207:4,5 225:16
154:23 300:1	extending	14:20 20:8,8	332:19	233:4 258:3
301:12 306:3	38:19	23:18 41:4	feel	273:6,8,25,25
307:1 308:25	extensive	54:11 113:12	30:16 85:20	274:2,17,19,21
309:21,23 310:7	188:10	189:8 232:20	93:21 96:12,17	275:8 278:8
313:6 314:3	extensively	253:6 256:4	330:22	279:3,8,9,16,17
315:16	26:15	264:15	field	279:18,20,20
expertise	extent	fairly	11:19,20 13:17	280:2,22,23
14:16 39:17	13:19 27:22 46:6	60:7 139:15	14:6 15:4 17:4,8	282:14 283:1,5
212:23 299:13	107:22 188:6	184:21 188:10	17:9 20:22	283:12,16,25
303:22 306:18	extra	194:7 220:23	21:12 24:20	284:13 285:2,14
experts	326:23	fall	57:12 91:4,5	285:21,21 286:1
33:14	extremely	327:8	101:14 102:19	290:24 298:6
explain	16:25 17:3	false	102:22 112:7	319:12,13,17,19
33:19 84:25	124:24 128:2	285:6,12	115:20 145:3	319:21 320:6,11
106:16 131:7	200:5 238:23	familiar	148:23 183:17	320:15,17,21,25
136:14,15	eye	21:20 22:17,18	184:8 252:19	321:4,9 322:3
151:15 238:21	272:7	69:12 109:12,14	253:5 255:5	323:2,3,4
293:14 303:6	e-mail	123:6 195:4	324:25	figures
explained	6:11,15 7:3 17:15	302:6 330:21	fields	138:7 302:5
294:7,12 303:10	26:18,20 57:12	family	241:16,19	file
explains	244:14,21,23	197:6	figure	247:8 303:4,11
84:24	246:7,24 247:6	fantastic	74:23 75:6,19,25	filed
explanation	247:9,11 248:20	16:23	76:5,21 77:1,16	43:9 169:3
42:2 111:2	248:25 253:4,11	far	79:18 82:8 83:2	301:18
197:16 261:5	253:12 287:5,13	20:13 23:15	83:6,16,24 84:5	files
explanations	287:20 291:9,12	63:16 100:4	84:11,20 85:3	244:25
303:17	e-mailed	146:8 147:16,23	85:15 86:4,6,14	filled
explicit	245:9	150:23 152:12	108:2 109:7	138:11 226:15
184:4 317:25	e-mails	167:17 212:8	110:25 111:24	230:23
explicitly	250:6 252:10	228:14 239:24	112:18 113:15	filled-in
163:9,19,22		240:25 241:7	114:12,15,16	230:10
184:19	F	246:22 288:25	115:11 116:18	final
	fact			

78:10 171:9 194:7 207:15 280:2 Finally 236:10 241:14 financial 332:15 find 69:5 234:18 264:17 finding 68:24 fine 60:19 131:22 finish 128:24 205:1 233:21 finished 69:10 283:14 finishing 238:7 firm 10:10 37:22 first 9:10 23:13,17 28:17,20 31:1 38:12 40:8 41:11,20 55:13 55:24 56:16,19 57:8 58:16 65:20 70:5 71:12,14,15 72:6,8 75:10 78:4 92:18 99:17,25 100:3 100:5,19 124:23 125:15 126:21 132:16 133:5 135:22 143:20 147:20 154:11 155:8 156:17 160:10 164:16 178:8,9,10 202:19 204:13 205:19 209:11 209:14 214:1 222:20 232:17	238:11 239:6,7 243:10 254:8,16 269:15,18,23 271:14 282:6 314:19 315:13 firsthand 189:6 fits 108:16 five 25:4 210:7 260:24 261:9,10 261:17,20 262:3 fix 179:12 fixed 272:25 flavor 266:19 flavors 271:2 flipped 302:12 flipping 220:20 221:12,13 239:1,4,5,15 240:20,24 292:9 293:1,15 294:4 294:15 295:4 floor 3:6,13 59:21 324:22 fly 309:25 focus 15:6 22:23 45:2 46:22 74:22 77:25 85:11,12 134:18 189:9 203:4 222:4 236:15 focused 206:3 focusing 204:10 235:22 folded 251:8	folks 23:4 25:10 follow 17:1 27:12 184:6 followed 121:5 267:9,10,12 294:14 following 163:13,14 184:3 follows 9:13 215:22 273:1 Footnote 160:11 foregoing 332:5,6 form 16:7,8 36:24 37:2 37:4 94:16 101:12 107:4 109:19 116:12 190:5 290:17 292:2 324:3 formed 40:1,4 48:4 115:23 186:11 187:25 190:2 forming 50:2 89:2 171:9 forms 276:3 290:15 324:2 formula 83:6,7,20 85:16 86:5,10,11,14 86:23,24 87:12 89:6,8 93:14 95:6,6,17,17,24 95:25 96:3,22 96:23 97:18 98:12 107:1,1,1 formulae 107:4,6 formulas 98:3 forth 216:24	forward 156:16 found 16:24 48:23 167:16 297:12 foundation 16:19 25:13 33:21 40:10,21 four 37:12 43:8 66:25 129:13 131:10 131:12 210:5,6 235:12,24 236:10 237:15 237:22 238:18 303:11 fourth 83:15 312:8 FOX 68:16 fraction 127:3 208:24 209:2,4,6,9,12 209:14,16 210:4 213:6,7,23,24 214:1,3,8,9,14 214:15,20,21 223:20 274:8,18 274:21 275:19 276:14,17,20 fractions 214:11 274:22 frame 24:1 35:5 66:18 66:21 158:22 166:22 207:18 253:17 Francisco 3:14 35:11 332:2 free 30:16 freedom 139:17 frequency 34:8,14 Frey 7:3 39:17,18 40:3	67:7,15 134:9 134:23 140:20 140:25 144:16 163:3 242:6 249:2 265:10,13 265:18 267:21 267:24 268:9 269:24 270:23 270:23 271:18 279:9 280:24 281:14 282:14 282:25 283:11 283:16 284:13 284:24 286:19 286:25 287:6,13 288:10 290:19 297:24 298:22 299:8 Frey's 186:8 friend 17:12 friends 249:8 front 29:1,9 85:6 143:24 181:13 226:6 243:7 251:8 268:16 315:23 Frye's 163:21 319:4 fulfill 277:11 full 11:4,8,11 29:6 196:14 197:22 fully 303:17 330:23,24 function 64:20 86:18 95:12 197:9 funny 40:20,22 further 59:20 60:2 113:25 122:6
---	---	--	---	--

255:21 320:13 320:17 331:9,19 F1 274:6 284:15 F2 274:6,18,21,25 275:9 276:14 284:15 F3 274:6 275:12 276:17 284:15	general 14:25 30:11 32:1 32:3 35:21 44:8 44:8 46:5 51:23 52:1 79:20 91:19 163:18 215:22 216:9,10 216:11,12,12,14 216:15,16,16,18 219:1,2 220:24 255:2 277:9,12 297:13 generalization 221:14 generally 25:10 44:19 generate 195:17 generated 201:3 generator 195:5,16 201:1 202:24 204:2,5 German 143:21 getting 28:9 54:9 121:25 136:19 142:1 324:22 GF(2) 91:4,5,21 102:19 102:21,22 103:3 105:11 giant 139:15 gifted 145:16,16 give 13:5 32:3,4 58:6 65:9,12 70:5 88:6,8 102:5 105:23 108:14 138:19 139:18 144:23 147:12 160:15 182:18 197:17 210:13 211:8 218:14	226:3 260:23 261:16,19 282:11 307:17 317:24 329:5,24 given 17:7 106:13 171:11 173:21 179:25 182:19 208:1 226:10 234:20 329:16 330:3,3 332:8 gives 60:7 86:24 201:19 giving 40:23 226:19 291:2 Glass 3:3 8:23,23 13:19 14:7 16:19 25:12,21 27:1 27:10,16,21,25 31:11 33:20 40:10,15 43:5 45:9,25 46:25 47:20 48:11 57:14 60:16 61:6 62:4,9,23 63:4,24 64:18 65:8 75:13 76:10 77:4,17 78:25 79:10 80:5,9 81:1,9,24 83:8 85:17 86:7 87:3,17 88:3 89:11,18,25 90:7,9,15,19 91:13,15 92:17 92:23 93:18 94:2,20 95:19 96:1,9,24 97:19 98:4,11,17 99:3 101:9 104:3,9 104:14 105:17 107:5,11,19 112:1,9 113:18 114:13 115:12	115:21 116:3,9 116:21 117:7 118:15 119:20 120:17 121:20 122:11 124:1,22 125:19 126:3 130:15 131:24 132:6,19 144:6 150:22 151:5,10 151:17 152:11 152:18 154:1,22 158:12,23 165:18 166:1,13 168:17 169:24 170:3,23 171:19 178:23 179:4 210:19 216:19 219:14 221:21 227:7,23 228:13 229:6 232:4 233:9,15,19 235:4 238:20 246:19 252:7 255:8 256:24 258:16 262:5 264:3 280:13 283:2,18 284:9 284:18 285:4,7 285:19 286:5,15 290:2 291:1,21 293:3,16 294:19 295:5 296:3 297:18 299:1,10 299:23 300:20 303:13 304:25 305:10,24 306:3 306:22 307:1,15 307:24 308:1,24 309:20 310:6,13 310:21,25 311:16 320:9,19 321:11 322:5 324:7,19 325:4 325:12,15 326:1 326:14 327:4,13 327:18 331:6,11 331:19	go 8:22 9:24 16:20 20:22 23:3,17 25:16 40:15 41:9 48:21 57:15 61:8 74:21 78:24 81:10 82:19 90:19 91:16 94:20 98:7 104:21,23 106:25 108:2 112:21 132:8 136:23 139:20 140:14 142:12 146:18 151:14 152:2,23 158:13 163:23 170:24 172:5 173:4,7,8 179:5 194:17 195:2 197:20 202:9,16 205:7 206:14 210:16 212:1,2 221:5,7 221:23 222:11 231:19 233:16 233:21,22 235:8 238:7 239:18 243:9 246:21 251:4 253:1,14 254:4 256:23,25 258:18,23 262:12,24 265:7 265:24 268:16 269:7,14 271:21 278:9 281:1,3 281:25 282:3,15 284:11 285:9 288:24 291:23 292:14 293:18 295:25 300:22 307:1 309:16 311:1 315:21 331:11,12 goal 68:20,23,24 142:21 324:16
--	---	--	---	---

324:20	123:10,17 132:1	group	231:15,16 232:1	103:11 108:17
goals	134:13 135:23	67:17 68:4 70:9	232:3,6 261:19	269:12 306:7
324:21	137:11 140:13	70:11,15,20	261:21 262:2,3	heart
goes	149:12,16 152:6	71:3,7,20	hand	30:3
82:11,16 153:17	199:21 200:9,17	142:15,15 143:5	29:4,6 67:17	held
171:13,25	204:8 205:15	144:11,13 145:6	230:15,19	2:2
going	206:22,25 207:2	145:23 176:14	332:19	help
20:24,25 23:19	207:3,22 208:3	190:14 191:1,16	handed	156:1,3 297:21
27:1,12,19	210:15 212:12	191:17,18,19,22	138:7 243:24	303:7
31:11 37:20	213:5,22 214:7	191:24 192:3,10	hands	hereunto
42:11 44:13	214:19 222:5,9	192:11,12,15,20	179:16,22 250:18	332:18
57:4,9 65:22	225:1,12,18,24	192:25 193:9	handwriting	hierarchical
82:9,13 90:15	226:8 229:3	208:14 210:3	5:12,15	119:13 164:20
96:14 98:9	231:25 233:5	245:10 248:14	happen	201:11 202:13
101:5,6 105:15	235:2,3 257:8	248:18,23	57:18 281:23	203:3 208:18
122:12 125:8	258:3,12 259:17	284:14 317:12	happened	hierarchically
130:25 136:22	259:21,21	groups	19:8 21:16 33:19	199:8
136:23 141:23	261:24 262:1	66:25 67:6 68:7	42:1 57:7,19	high
144:4 147:10	326:18	68:13 69:4	169:5 303:11	69:23 223:7,24
174:13 176:6	graphs	132:16 142:13	happening	224:2,14,19
177:8,9,10,11	6:9 123:7 152:10	142:21 143:4	187:10	226:25 227:17
200:13 204:15	152:16 203:24	145:9,11 158:19	happens	228:4,8 229:1
206:8 210:6,7	205:11 207:6	191:20 193:2	75:11 76:20	231:3 232:2
210:10 211:25	215:12,22	235:24 247:7	81:22 83:5	higher
227:3 230:19	216:12 217:7,8	263:24 274:3	100:20 276:10	101:13 176:15
237:3,7 243:18	217:20,22 218:8	286:20	hardware	232:2 233:7
270:22,23 274:9	218:10 219:7,12	guess	60:4,4 61:23 62:2	highest
282:17 294:9	222:12,21	23:18 32:20	62:13 258:1	17:7
313:11 331:14	223:12 234:5,21	34:24 55:16	319:22 320:1	hindsight
331:24	238:13,18,19	103:20 116:24	heading	141:22 156:20
good	259:12,13,14,16	160:3 163:7	118:1 149:11,15	207:1 233:10
6:19 9:18,19 17:3	259:22 292:17	225:10 258:25	149:24 152:7	hinges
20:2 21:15 58:9	292:18,24,25	318:2 330:2	181:21 202:17	184:16
58:10 59:3,3,6	Graph-based	guessing	274:2 298:5,7,8	hired
63:6,7 68:24	5:23 148:9	248:11,13	319:1,5	190:25 191:6
129:22 130:8,14	grave	guys	health	193:6,8,16,20
146:7,13 169:13	34:19	42:10 179:2	20:1,2	histories
171:12,17 224:4	gray	212:18 294:24	hear	303:11
249:8,12,22,25	115:7	H	14:12 90:12	history
251:18 264:2,13	Great	H	149:14 180:14	18:19 38:14
264:22,24 321:7	29:7 30:1 331:19	4:5 5:1 6:1 7:1	180:14	149:1 153:12
326:25	greater	HALE	heard	302:12 303:4
gotten	227:22 228:11	2:5 3:19	13:24 21:21,22	hoc
302:24 304:19	229:5 231:6,10	half	22:2 33:12,15	105:24 116:13
Grand	231:15 238:14	131:12 138:18	38:13,15 40:8	hold
3:20	ground	140:16,17 231:2	40:21 41:12,14	20:24 34:11,11
graph	9:24 58:12	231:2,3,5,6,12	41:18,18 69:24	61:16,16 65:3

72:14 87:7 103:21,21 104:21 116:7 119:4 127:8 139:4 179:19,19 187:18 200:4 212:18 256:20 328:21 Honestly 249:5 honor 17:7 honored 16:22 hope 40:11,13 hour 37:11 hourly 37:7 hours 19:3 32:19,21 35:18 309:24 311:7 Hughes 1:8,9 8:10 268:3 271:22 273:24 HUGHES1760 314:10 HUGHES1858 185:21 HUGHES1916 54:21 HUGHES513989 311:21 hurt 297:21 hypothetical 212:25 227:8 232:5 233:9 235:5 262:6 283:3,19 285:8 291:22 297:19 299:11,24 300:21 320:10 320:20 324:8 331:6	I	145:13 201:12 immediately 86:5 199:22 200:10,18 impaired 20:2 implement 15:21 16:3 62:14 113:15 115:10 116:17 117:3,4 121:9,17 212:5 319:20 320:1,2 320:15,17 322:3 implementation 212:10,25 213:15 257:24 320:23 321:14,21 322:14 implemented 213:11,17 263:11 263:20 implicit 253:3 implicitly 163:8,20 implies 199:22 200:10,18 imply 60:19 134:4 276:5 implying 99:6 important 10:3 12:16 29:11 29:11 56:8,21 59:9,13 60:3 88:7 157:5 294:17 308:18 308:18 impose 277:10 280:4 impossible 147:21 250:18 297:3 305:4 309:4 311:19 improper 27:15,23 28:1	improve 67:4 172:13 184:21 222:13 222:21 297:16 324:6,16 improved 6:8 215:11 291:18 292:3 improvement 270:24 improves 223:22 improving 297:21 inception 194:6 include 52:2 78:15 108:11 109:7 included 248:18,23 includes 109:21,23 including 323:17 incoming 78:17,18,21 79:5 79:6 81:4 100:12,21 102:14 Incomplete 227:7 232:4 233:9 235:4 262:5 283:2,18 285:8 291:21 297:18 299:10 299:23 300:21 320:9,19 324:7 331:6 inconsistent 171:16 Incorporated 8:10 incorrect 260:9 incorrectly 87:20	independently 67:25 68:6 index 306:5,7,14,20 307:13 308:13 308:14,16,17,21 308:22 310:18 311:14 indexed 305:22 indexing 304:22 309:19 indicate 256:6 indicated 254:21 indicates 155:13 indicating 111:5 251:7 255:14 indication 281:24 indicative 272:19 indirect 47:5 individual 84:11 infinite 87:11 information 15:20 17:5,8,21 20:17 21:9,19 24:22 25:8 27:3 41:16 49:15 56:2 73:4,10 75:22 76:2,8,13 76:22 77:2,9,21 79:8,22 81:19 82:21 98:8,21 99:10 108:23 109:21 110:14 110:16 111:3,18 112:22 114:20 114:21,23 115:2 116:15 118:13
--	----------	---	---	--

120:8 121:5	188:17 197:10	68:8 191:23	interruption	37:12
122:24 123:23	197:13,15	248:16 263:9	72:25	involving
128:20 129:3,11	205:15,19 206:1	273:23	interview	20:20 67:18
131:10,11,14	276:11,23 277:5	interesting	20:5	in-depth
132:15 138:1,9	277:17 279:11	238:23 288:18	interviewed	83:12 85:19
140:8,16 189:15	285:13 286:1,11	interleave	17:18 19:3	87:21 96:16
190:18,18,20	327:21 329:20	279:4,10	interviewing	IRA
195:20,23 203:9	inputted	interleaved	17:25	40:9,22,23 41:12
208:20 209:5,6	276:10	81:20	introduce	42:3 43:25 46:6
209:13,15	inputting	interleaver	153:3 164:16,18	49:7,12 50:16
210:10 211:5,7	176:20,20	56:14,17,18 57:20	208:19	50:25 51:4,10
212:7 213:6,7	input/output	57:25 58:3 78:8	introduced	51:14,16,20,21
213:12,23,25	56:11	81:18,22 82:3,6	52:25 149:5	51:24,25 52:1,2
214:20,21 224:5	inside	82:23 267:10,11	150:5 159:18	52:5 56:8 60:15
224:10 226:14	133:22 189:18	289:11 290:7,14	164:11 215:23	61:1,5,9 62:19
227:5,21 228:10	insist	internally	introduces	62:20,21 63:19
229:4 230:9,22	163:8	177:1	178:1	126:13,16
231:5,11,12,15	instance	international	introducing	128:10 129:15
231:21 232:1	20:14 21:15	20:17 21:8,8,18	219:1 291:5	129:16,19
233:2,6,7	26:11 307:4	24:22 25:7	introduction	130:14,14
235:25 236:4,8	Institute	41:15 49:15	269:14,19	131:17,19,22
236:11 237:6,11	1:4 8:9	50:7 56:1	intuition	132:3,14,24
237:15,16 260:5	instruct	interpret	222:24 223:1	133:1 136:10
260:11 268:13	27:4,11	123:20 125:3	224:6	137:18,20
274:3,13 284:2	instruction	137:25 138:25	invented	141:16 153:5,10
327:3,22 328:5	27:13,15,25 184:3	139:2,3,7 141:3	52:22 264:4	155:25 174:13
331:4	184:4 185:2	141:4,7,19,22	inventing	177:15 188:24
informed	instructions	143:25 206:5	49:1,7	190:1,3,5,7
20:1	27:23	219:18 266:22	invention	224:22 225:4
infrequent	intended	278:12	66:23 142:9	229:16,18,20,24
17:14	54:4,5 232:9,10	interpretation	300:2 318:10	229:24 230:1,1
inherently	321:21	83:4 112:19	inventor	261:24 275:22
184:20 327:1	intending	114:16 119:25	20:10 26:3	276:1 290:24
initialization	131:7	120:5,12 136:13	inventors	291:4 316:20,23
100:16	intention	137:19,24	26:2 43:9	317:6,8,15,17
initials	246:12	138:18,21,22	investigated	317:20,22 318:6
186:17	interacted	139:16 140:6,13	15:18 47:5	318:10,13 319:3
inner	19:9	190:6 226:10,17	investigation	319:9 321:23
266:24	interaction	226:22 230:12	46:3	322:1,19,24
input	142:23	interpretations	invitation	323:7 326:23
76:22 77:3 81:18	intercoder	139:18 273:17	23:2,3	irregular
82:3 86:20 87:1	94:17	interpreted	invited	4:23 6:9,22 7:8
87:4,15 88:1,2	interest	140:8,9,11 201:2	23:7 66:17	7:18 30:7 42:7
88:17,17,19,22	146:3,12 238:25	204:7,14 220:23	involved	42:13 49:12
95:3,14 108:10	332:15	233:11	15:22 16:13	50:10 123:22
111:7 176:25	interested	interrupt	involves	124:3,6,20
177:5 178:11	29:23 67:20,23	79:1 309:11	16:4 17:25 21:10	125:4,18,21,22

125:25 126:12 126:17 127:4,6 127:16 128:10 128:12,18 129:7 133:9 134:2,3,7 134:16,18,20 136:8 137:14 138:15 139:24 140:15,19 141:11,12 153:4 153:18,25 154:9 154:13,21 155:7 155:14 157:7,11 157:21,22 167:17 169:22 172:18 173:3,6 173:8,15,25 175:6,8,11,12 175:14,24 176:4 176:9,11,18 177:15,18,22 178:18 180:8,8 180:19 182:7,9 182:20,22 183:5 184:10,13 185:4 185:11 193:3,5 193:11 198:22 199:3,4,6,10,12 202:10,13 204:4 204:6,11 208:8 208:11 211:5,19 212:5 213:5,22 214:7,19 215:11 215:21 216:9 217:7,20 218:8 219:6,7,12 222:12,19,21 223:12 224:15 224:17,21 229:14 235:2,21 238:18 239:11 239:21,23 240:6 240:8,14,16 241:6 254:6,9 254:13 255:16 255:23 256:2,7 256:12,18,19	257:1,17,21 258:4,4,13,19 260:19 262:4,9 262:14 263:5 267:20,25 269:12,15,16,21 270:5,13,14,25 271:3,5,8,11,18 271:25 273:3,11 273:25 284:1 285:3,16 286:4 286:9,9,14 287:16,19 288:2 288:10,13,20 290:19,21,24 291:5,18 292:12 292:16,23 296:12,20 297:10,16 298:11,14,23 299:2,9,19 300:4,16,25 314:9 317:13 318:19 324:1 325:19,25,25 326:7,9,13 327:2,5,10,21 irregularity 128:6,7,9 133:8 134:5,10,12 135:2 140:20 141:1,24 164:12 164:17,19,23 165:1 172:19 178:2 208:19 239:13 261:6,13 261:16,19 271:6 276:2 284:6,6 292:2 297:1 323:17 324:1,3 326:20 irregularity's 276:2 irrespective 104:7 106:21 201:25 213:18 issue	37:23 48:17 59:7 204:17 205:2 316:13,17 issues 20:6 107:23 228:24 ITA 17:20 24:25 25:8 item 127:6,9,15,16 312:8 iterative 5:24 148:9 263:12 J James 1:25 2:13 3:3,18 8:23 9:5 332:4 January 19:14,21 31:3,4 31:15 34:25 38:17,18,18 Jim 9:2 Jin 26:4,5 50:10,16 50:24 51:4 316:23 317:8,22 Job 1:23 joined 71:13,16,18 Joseph 3:25 8:16 journal 24:16 207:12 JPL 192:1 193:1 246:6 judge 27:24 60:10 146:2,12 328:10 judgements 96:13 judgment 93:22 96:18 July	41:17 268:13 jumps 139:8 June 21:10 41:17 June/July 41:21 J.C 186:18 K K 187:3,12 188:1 Kang 3:10 9:1 keep 12:22 119:5 176:6 177:24 197:12 278:14 key 24:1 Khandekar 20:9 147:25 148:10,12,18 149:4 150:20,23 151:2 152:8,15 153:10,24 154:19 155:13 156:8 157:3 158:1 163:23 164:15 196:6 243:9 Khandekar's 148:14 155:25 kind 24:1 113:25 138:21 143:18 145:9 146:5 174:25 190:19 190:22 201:13 223:19,20 253:10 263:23 291:16 kinds 53:24 143:15 knew 74:16,19 120:25 121:4 194:9,12	194:14 255:6 know 10:22 12:13,22 13:6,22 14:15 16:22 17:1,13 17:14,16,23,25 18:6,17,18 19:7 20:5,6,9,13 22:5 24:6 26:4,19 27:17 28:24,25 29:11,20,25 30:10 32:22 33:3,13 34:20 36:17,19 37:21 38:15 41:14,19 41:24 42:1 46:9 46:15 47:6,12 47:24 48:22 53:2,7,25,25 55:23 56:12 58:9 60:1,21 61:23 63:20 65:13 66:6,10 67:12 69:17,25 70:7 71:17 76:16 77:7 79:11,13,21 80:16,23 83:21 87:23 88:19 91:9 92:7 93:9 93:19,25 94:5,9 97:20 98:2,5 106:19 107:12 107:20,23 110:4 116:4 118:17,21 119:23 123:3 126:24 127:4 129:20,21 130:7 130:17 131:25 134:12 138:19 138:20 139:9 140:25 141:20 142:2 143:10,13 143:24 145:15 146:5,19,25 147:1 148:25 149:1 150:24
---	---	---	---	--

151:19 152:20	308:17 309:2	125:21 176:17	211:5,19 254:13	284:10 285:5,7
153:12 154:3,3	310:8,10 311:2	263:18	257:13,17,21	286:15 291:3
154:3,4,24	317:25 321:21	largely	258:4,13 259:16	302:21 303:5,7
155:5,16,19	321:25 322:6	228:19	260:8,19 262:14	304:5 308:2,7
156:4,5 157:13	327:14 328:1,2	larger	263:5,23 269:16	310:13,25
160:2 162:25	328:4 330:8,9	227:5	270:14,15,25,25	length
163:1 164:22	331:1	late	271:3 275:21,25	75:22 76:2,17
165:20 166:2,23	knowing	193:7	291:17,18	82:21 128:3,3
168:11 171:8,21	192:17	lately	292:10 301:2	129:23 130:7
172:3,4 174:16	knowledge	22:24	325:17,18,21,25	189:16 197:4,15
174:22 179:23	33:13 189:6	launch	326:7,13,16	201:15,20
184:21 185:5,16	245:24 286:24	265:23	327:2,5,11,21	263:18 272:1
187:13 188:9,10	301:12 302:22	law	328:7	lengths
189:1,5 193:20	known	10:10,12 37:22	lead	153:21
194:2,5,5	69:15 73:19,20	330:20	17:2	letter
202:21 204:1,4	110:1 112:7	lawsuit	leafed	36:25
207:10 210:18	121:3 144:12	169:3	148:16	let's
210:22 211:4,13	153:6,20 171:23	lawyer	learn	11:24 26:2,22
212:1 213:14,20	259:16,20	35:22 46:14,21	147:22 252:19	28:1,17 30:15
214:5,18 216:13	299:19	302:25 303:19	learned	46:22 48:20
216:22,22,23		lawyers	147:22 193:8,21	49:17 50:15
219:17,17	L	303:3	learning	52:7 54:16
223:19 224:8	L	layer	145:13	74:21 76:25
232:6,7 241:21	1:16 2:1 4:2 9:9	14:10,12,18,18,24	lecture	77:25 79:25
241:24 242:1,3	11:6	67:21	70:5	80:20 85:11
242:25 243:8	labeled	layers	led	86:13 89:4
245:25 246:1,2	5:11,14,17,20	201:11	301:9 318:10	92:14 98:7
246:14 247:20	78:7,10 115:1,7	LBC	left	99:23 100:15
248:7,8,10,16	152:5	164:25	59:25 75:4,10	104:23 108:2
249:7 250:3,4	Labs	LDGM	76:6 77:9	110:24 113:12
250:14,14,15	18:17,17,18,18,24	195:7 201:6,8	196:13 207:23	113:12,24
251:5 252:2,3,9	71:13,16 190:25	202:11 204:10	208:4,10 218:24	117:13 125:13
252:25 253:1	192:12 193:16	204:11,12,13,14	220:9 234:3,6	127:22 129:9
257:25 263:22	245:18 250:12	LDGM/LDPC	235:19,20,23,23	130:23 134:18
265:2,8 268:14	lacks	202:13 208:18	238:10 257:13	135:22 143:20
268:25 269:5,6	16:19 25:12	LDPC	257:17 259:24	144:3,3 147:2
269:6,13 272:11	33:20 40:10,20	67:11 70:16,18	260:10,16	147:14,24
273:13 274:23	321:11	110:19 119:14	legal	152:23 154:7
278:6 280:8	language	134:13 135:9	13:20 35:21	156:4,22 158:19
291:2 293:12,24	69:1,3,5 95:22	137:21 138:24	45:10 46:25	160:9 165:2
294:23 297:2	142:7 143:9	142:6 153:18,25	47:20 48:11	169:16 172:5
300:19,23 302:5	144:1,2,17,19	154:13 157:11	75:14 76:11	173:22 175:9
302:7,13,20	145:14 146:22	157:21,22	77:18 94:3,8,10	176:5 177:3
303:6,6 304:10	328:1	164:20 165:25	95:20 126:4	178:5 183:16
304:18 305:2,13	languages	169:22 178:4	130:16 132:7	184:22 188:13
305:14 306:4,16	69:8 143:16	193:3,5,11	211:12 246:19	189:17 190:4
308:4,13,14,15	large	201:5,9,13	252:7 256:9	195:2 196:5
	64:6 124:5			

197:11 201:25 203:4 206:14 208:12 211:14 212:14,21 213:21,21 214:25 220:8 225:7 226:5 230:14 239:17 244:12 249:10 251:4 254:4 258:23 261:14 261:14 262:12 265:17 267:15 268:16 273:24 275:8 276:9,9 279:8 283:24 287:4 291:15 295:25 301:21 304:6 311:20 312:16 314:7 315:2 322:15 323:12 331:11 331:12	257:3 316:6 limitations 39:14 40:5 44:7 44:21 45:13,23 162:18,20 limited 217:14 limits 190:20,24 line 34:7,12 71:16 93:8,11,14 95:1 97:5 107:3,3 111:7 124:16 156:4,4 187:1 254:8 255:18,20 257:4 269:18 271:15 linear 47:19 48:6 61:14 61:21,22 62:1,1 62:10 119:2,3,8 119:8 196:21 197:1,9,17 201:10,19,20,23 202:3 234:4 238:15 271:11 271:19 322:12 322:12 327:1 lines 5:19,22 93:8 98:18 186:25 231:10 282:17 283:8 list 13:7 49:19 50:1 70:4 247:3,11 248:9,21,22 249:2,6,9 252:15 313:24 314:17 315:13 listed 14:5 70:1 243:10 254:16 269:23 313:25 314:19 315:12 324:2 lists	298:13 literature 56:15 146:19 164:24,25 litigation 16:13 little 12:14 21:3 22:25 35:16 66:22 84:25 113:13 136:14 137:16 158:15 301:13 LLC 1:9,11,12 LLP 2:5 3:4,11,19 local 170:8 located 29:25 location 22:8 305:23 306:5,8,14 307:14 308:4,6 308:8,10,22 311:14 locations 304:23 305:9 306:21 309:19 310:17 locked 153:21 logical 42:2 330:16 long 18:4,19 32:15 35:17 131:15 146:25 147:13 147:15 149:1 153:20 165:20 169:7 197:11,13 309:3 look 15:2 16:7 34:3 64:24 75:19 84:6 92:14 110:19,20	113:25 116:24 119:13 161:8,8 162:19 181:23 186:25 197:5 218:6 219:21 220:16 241:10 242:6 245:2 261:24 264:7 274:17,20 275:8 287:23 302:5 304:8 307:3 309:3 310:9,20 311:5 313:24 314:17 319:17 looked 15:19 46:4,6 47:15 48:14 51:6 56:20 94:5 106:14 132:10 151:20 158:24 165:19 169:22 187:13,14 227:15 262:1 270:24 288:6 290:10 302:14 316:22 330:6 looking 63:22 70:16 121:8,16 132:1 168:5 172:2 192:20 193:3,10 206:15 221:11 227:12 228:20 241:4 255:18 290:5 307:10 311:3 looks 251:6 Los 3:22 10:13 lose 251:13 loss 196:22 Loss-Resilient 5:9 lost	279:25 lot 136:13 138:17 190:9 257:24 303:15 low 6:8 7:21 201:10 223:9 224:14,20 226:25 227:17 228:5,9 229:2 231:4 254:22 255:9 lower 224:10 255:6 257:22 324:22 low-density 6:19 159:20,22 166:7 167:1 195:5,10 200:25 201:3 204:1,5 215:10,20 249:12,22,25 251:18 254:7 270:6 315:4 Luby 32:7,7,8 40:2,3 51:9 67:18 68:5 68:6 70:19,22 70:22 71:8,8 72:1,1,12 73:5,5 73:11,12 74:16 74:16 117:14,23 118:21 119:23 119:23 120:3,10 120:20 121:10 121:18,24 122:4 138:21 144:15 144:16 145:22 145:23 146:3 154:13,16,16,20 154:20 155:9,9 155:14,14,25,25 156:6,9,12,12 156:14,14,22,22 156:24,24 158:2 158:2,10,22,25 158:25 159:8,13
---	---	---	---	---

160:23 161:7,8 161:9,13 163:4 163:12 164:2,2 164:8,8,11,15 164:16 167:25 168:2,5 191:16 191:18 193:3,9 193:22 194:10 195:2 196:10 198:22,25 199:6 200:25 202:9,10 202:25 206:14 207:21 208:16 208:20 214:6,18 215:1,9 216:2,8 216:8 217:3,4 217:19 218:6,25 219:10,11,22 220:9 223:23 226:23 227:9,13 227:15 228:14 229:1 233:22 234:2,16,17 238:18 239:20 240:5,23 241:6 241:15,20,22 242:5,19,23 243:3,5,13 249:6 262:21,22 262:25 263:2 269:24 270:17 291:25 292:1,4 292:6,14,22 295:3,25 298:17 298:19 299:7,14 299:14,18 301:1 312:17 313:4 318:6,7,14,14 319:10,10,10 322:16,18 325:18 326:21	M	290:20 291:3,17 297:15 329:10	marks 104:25 181:3 265:25 331:22	18:2 19:1 29:19 48:25 49:6 192:24 247:19 247:21 248:6,24 252:13 289:3,5 289:20 318:3
Luby's 242:14	M 3:3 9:15	managed 56:19 225:3	master's 149:2	McEliece's 244:25
luminaries 17:4	MAC 14:18	map 62:2	match 54:6 84:7	mean 11:17 12:14 13:22 14:2 47:4 53:17 76:23 79:1 85:1,9 87:20 94:10 99:6 108:15,21 120:3,10 123:1 134:6 137:24 140:7 158:18 164:22 165:1 182:16 189:3 197:1 198:17,19 199:2,3,15 211:17,21,22 216:11,15 224:20 227:4 228:1 231:4,9 232:11 237:3,5 240:16 241:8 253:6,8 259:5 261:6 274:13,14 274:15 275:3 278:13 281:25 283:8 296:25 297:1 300:24,24 306:14 317:5 319:22,25 320:24 326:3 327:15 328:17 329:11,13 330:4 330:8
lunch 122:9,14	MacKay 29:14,16,17 30:12 66:4,6 67:7 68:18 70:19,20 150:25 165:13 165:15 169:17 170:15 186:18 186:20 191:20 192:19,22 193:3 194:18 242:10 242:12 248:2 252:1 270:23 272:8 314:8,18 314:23	mapped 60:4 61:23 237:1	material 13:3 19:4 241:12	math 81:7 191:5,5,11 191:19
	Madison 3:5	mapping 319:22	materials 4:21 49:19 50:1 312:5,6 313:25 314:18,20 315:14	
	main 14:15 15:5,10 16:8 60:2 70:23 118:25 119:1,6 119:15 215:15 215:19 263:21 289:7,10,17 290:6,13 303:22	mappings 190:10	mathematically 91:21 92:25 279:13	
	major 156:9,13 157:2	March 193:23	mathematical 90:2,4 103:4 107:7 127:5,14 212:11 280:18 319:23 329:25 330:12,13	
	making 28:24 93:21 96:12,17 124:3 124:6 125:21,22 174:14 175:4,5 175:7 176:3 177:15 178:15 185:11 211:21 218:17 253:18 267:25 270:7,13 271:7 272:5	mark 11:24 30:15 31:9 42:19 49:17 50:15 54:16 110:24 113:24 117:13 124:8 130:23 135:22 147:24 165:2 185:19 214:25 249:10 265:17 287:4 301:21 311:20 312:16 314:7 315:2	mathematics 67:20 90:6,21 142:16 191:1,13 191:14	
		marked 12:1 30:18 42:21 49:20 50:17 51:15 54:22 85:6 111:11 114:2 117:15 123:10,11 124:9 130:24 131:1 136:1 137:11 148:1 165:5 185:22 215:2 243:24 244:1,4 249:13 265:19 267:16 287:7 291:13 301:23 311:23 312:19 313:16,18 314:11,18,24 315:6,25 317:8 317:23	matrix 7:24 195:5,10,16 195:20,23 201:1 202:23,24 203:2 203:16,25 204:2 204:5 315:5	
			matter 8:9 61:13,18 125:15 322:1	meaning 211:20 306:11
			maximum 255:3	meaningful 279:13
			MB 202:23 203:16,25	meaningless 283:5
			McEliece 16:18,21 17:12	meanings

210:22	memory	message-passing	mischaracterizes	125:9,14 128:11
means	304:22 305:8,23	170:8 221:15,18	45:25 105:17	202:20 257:20
35:3 36:13,18	306:5,7,14,21	228:16 234:25	210:19 216:19	304:8
65:10 78:19	307:13 308:4,5	met	280:13 303:13	monitor
80:7 85:4,5 94:7	308:7,10,11,16	16:24 20:11,15,18	310:21 311:17	8:15
94:8 120:1	308:21,22	20:23 26:6,12	misdirect	month
125:1 133:8	309:18 310:17	26:14,21 28:15	259:5	31:19
158:16 168:19	311:13	66:8,11 193:21	miserably	morning
171:5,7 182:20	mention	method	60:14	9:18,19 266:9
182:22 188:1	59:6 74:6 134:1	75:7	missed	motion
195:10,13	161:4,14,18,24	methods	34:21	119:21 221:21
199:11 205:14	217:11 293:15	324:13	missing	motivation
209:11,13,17,25	297:5,7 324:13	middle	12:17	155:17 175:7
210:15,17,18	mentioned	149:23 154:12	misspeaking	289:7,10 290:5
211:9,15,18,23	19:10 21:18	163:25 164:6	275:6	motivations
212:4 216:13	24:10 25:9	232:10 238:10	misspoke	228:18
224:15,17	33:12,15 36:22	257:15	52:11 164:4	Mourgos
227:21 228:9	56:23 57:20	Mill	274:20	3:25 8:16
231:14,18	59:2 62:8 70:3	2:6 8:18	Misstates	move
236:20,23 237:2	73:7 74:4,6,11	million	171:19	25:6 119:16
261:13,16,19	106:24 109:11	263:19	mistake	122:10 144:4,6
274:13 278:12	111:1 112:11	mind	164:5	221:20
283:5 284:21	132:9,25 186:7	51:14,21,23 52:9	mistaken	moving
296:25 305:15	253:4 293:19	56:5 78:2 85:13	192:2	279:19
306:5,9 307:18	mentions	134:24 141:15	Mitzenmacher	multiple
308:8 322:7,13	168:7,16,18 242:1	143:17 166:3	70:22	174:15 175:24
327:17 328:6,8	288:6	177:6,12 178:7	mix	237:10
328:12,15,18	merge	178:13 182:25	191:2,3	multiple-access
329:3,14 331:3	69:5	211:16 213:4	mixed	15:11
meant	message	225:9,14,17,24	11:15 192:11,13	multiplied
15:12 52:11	118:7,12,18,22,24	226:2,20 231:23	mixture	203:16
63:11 68:19	119:24 120:1,4	233:15 274:23	239:4,9	multiply
119:24 134:23	203:7,15 206:20	276:12 301:4	mod	195:19,22
146:16,22 164:4	207:22 208:5,9	310:11 323:6	90:5 97:7,14	must've
169:1 171:11,18	217:16 223:6,17	324:23	102:17 103:11	20:18,23 26:6,14
171:22 197:3	223:23 224:11	mine	103:13,15,18,23	26:14 41:18
198:21 214:13	224:13,14,19,19	307:21	105:10 106:6,10	55:21 247:16
276:1	224:24 226:24	minimum	106:13,16,18,22	mystery
medical	226:25 227:16	48:9,18	106:23 107:17	39:21
20:6	227:17 228:4,8	minute	model	
medications	228:9 229:1,2	60:13 204:23	156:17	N
10:18	231:3 234:12,13	233:16 307:12	modifications	N
meet	239:6,7,8 292:8	328:24 331:13	172:14	3:1 4:1,1 5:1,1
17:15 28:13,15,20	294:8,12 295:16	minutes	modify	6:1,1 7:1,1 8:6
35:1,3	295:22 325:20	18:4 305:21	172:12	9:15,15 75:12
meeting	messages	309:4,7,16,25	moment	75:22 76:2,5,17
35:4,10,17	224:2	311:10	62:16 83:14	76:22 77:2
				78:15,20 79:9

80:8 82:21 86:21,22 87:2 87:15 88:2,18 88:25 95:4,5,13 95:15,16 114:21 114:23 115:2 177:5 187:2,2,2 187:11,12,12 188:1,1,1,18 189:16 197:5,6 197:9 203:7,9 203:15,16,16 208:4,4 272:1	204:17,23 265:23 281:5 311:2 330:25 needed 59:15 197:8 needs 60:8 negative 228:19 neither 101:1 239:5 247:10 292:8 332:13 NETWORK 1:9,10,11 never 17:1,1 40:21 53:11 130:6 187:14 291:8,12 nevertheless 58:8 new 3:7,7 31:18 101:6 101:7 102:5,9,9 102:11,14 122:10 153:3 156:21 265:24 272:14 329:19 nineteen 295:3 ninety 295:3 319:11 nitpick 136:15 NK 188:18 189:20 node 209:19 210:10,11 210:24 211:5,23 211:24 212:3,3 212:3,7,8 231:21 237:7,7 237:11,12,15,16 nodes 123:23 128:20 129:12 131:10 131:11,15	132:15 133:11 133:12,13,20,22 133:23 135:11 135:15,16 137:24 138:1,2 138:9,10,12,25 139:12 140:6,7 140:9,16 141:4 199:9 207:22,23 208:4,4,9,13,14 208:21,25 209:2 209:5,6,10 212:1,12 213:6 213:8,23 214:1 214:20,21 223:6 223:9,17,19,20 223:23 224:4,5 224:9,11,13,14 224:19,20,24 226:11,14,15,16 226:24,25 227:5 227:16,17,21 228:4,8,9,10 229:1,2,4,11,13 230:9,10,10,10 230:11,11,23,23 230:24 231:3,5 231:11,11,12,15 231:21,22 232:2 233:2,3 234:6,7 234:12,14 235:15,17,18,19 235:20,21,23,24 235:25 236:4,8 236:11 237:1,17 237:23 259:23 260:1,4,10,13 260:16,20,24 261:17,20 262:2 262:3 284:20 300:9,9 320:2,3 325:11 327:23 328:3 331:1 nonnegotiable 59:24 nonresponsive 119:17 144:5	nonsystematic 112:24 119:1 nonuniform 167:18 non-binary 174:25 Nos 4:14 notation 259:2,9 note 259:14 Notice 2:13 noticeable 125:1 noticed 39:7 notion 110:21 208:19 225:5,6 229:15 240:17 317:6 328:11 notions 300:8,25 301:4 303:7 novel 300:2,5 number 8:12 32:23,23 43:18 59:14,17 99:9,14 123:4 124:5 125:21 128:2,5,20 129:3,11 131:14 132:15 150:16 172:14,18 173:10 174:17 175:2 176:16 177:9,10 178:2 178:3,19,20 179:8,9 182:11 182:12,23,24 183:11,13,19 184:22 185:21 187:6 188:7,20 189:23 209:15	209:18 210:1,9 210:15 211:6 212:2,6 213:5,7 213:24,25 214:2 214:20,22 224:23 227:6,22 228:11 229:5 231:6,10,15 234:13 236:22 237:2,4,17 272:22,25 273:4 273:12 274:10 276:7 284:3,7 284:17 285:1 286:3,13 300:4 300:6 311:21 312:17 319:5 327:3,12 328:5 numbers 53:7 54:21 122:25 183:18 190:13 270:8 275:5 285:16 327:22 331:2 N1 188:18 189:19 N2 188:18 189:19 O O 4:1 5:1 6:1 7:1 8:6 9:15 oath 9:7 object 27:1 144:6 objection 13:19 14:7 16:19 25:12 27:10 33:20 43:5 45:9 45:25 46:25 47:20 57:14 60:16 61:6 75:13 76:10 83:8 85:17 87:3 88:6 89:25 90:7 90:11 91:13
---	--	--	--	--

92:23 93:18	327:13,18	offices	85:12,25 87:14	178:6,15 179:20
95:19 96:9	objections	2:2	88:16,24 89:4	180:24 182:2,21
101:9 104:9,13	25:21 28:3 62:4,9	oh	89:16 90:22,24	183:16,23 184:2
104:14 105:17	63:4 64:18 65:8	24:15 70:7	91:25 92:10,14	184:7 185:1,9
107:5,19 112:1	77:4,17 78:25	149:19 196:8	92:15,21 93:4	186:10 187:25
112:9 113:18	79:10 80:5,9	200:2,5 222:16	93:16 94:25	188:13,18,22,23
115:12,21 116:3	81:1,24 86:7	271:16 278:19	98:2,7 99:17	189:11,13,16,20
116:8,9,21	87:17 88:3	279:14 291:8	100:15,17,20	189:21,23,24
117:7 118:15	89:18 94:2,20	294:17 298:9	101:7,17,22	190:7 192:9
119:20 121:20	96:1,24 98:4,17	302:12	102:9,20 103:5	193:23 194:4,17
124:1 125:19	99:3 107:11	okay	103:11,15	196:7 198:12,22
126:3 130:15	285:19 286:5	9:24 10:9,15 11:2	106:25 107:16	199:11,18 200:6
131:24 132:6,19	311:16	11:4,17 12:23	109:12 110:1,7	201:4,21 202:9
150:22 151:5,10	objective	13:7 14:4,17	110:18 111:9	202:23 203:4
151:17 152:11	122:5 146:6	15:2,8 16:17	112:6 113:23	204:10,15 205:3
152:18 154:1,22	objectives	20:25 21:1,4,18	114:19 115:9,18	206:6 207:20
158:12,23	324:23	22:6,14 23:20	117:2,24 119:5	209:4 210:9
165:18 166:1,13	objects	24:1,18 25:18	120:14,20 122:3	211:14,15 212:5
168:17 169:24	143:18 330:12,13	26:2 28:8,12,17	122:7 123:6,21	212:14,22
170:3,22 171:19	observer	28:19 29:1,13	124:7 125:7,24	213:11,21
179:2 210:19	190:4	30:2,12 31:21	126:9 127:22	218:16 221:19
216:19 219:14	obtain	32:15,24 33:2,4	128:16,19 129:6	223:2 225:7,8
221:21 227:7,23	271:25	33:9 34:17,24	129:15 130:10	225:23 226:5,16
228:13 229:6	obtained	35:15,23 36:1	130:22 132:3,13	226:23 230:6,14
232:4 235:4	245:18	36:10,24 37:9	132:23 133:23	230:19 231:1,19
238:20 246:19	obvious	37:19 38:12,17	133:25 134:18	232:25 233:14
252:7 255:8	73:15 136:13	38:21,23 39:12	134:20 135:21	235:8,22 236:14
256:22 258:16	146:8 147:17,23	39:20 40:8,17	136:12 137:13	238:6,21 239:17
262:5 264:3	318:18	41:3,20 43:11	138:4,12 139:21	240:2,5 242:5
275:18,19	obviously	43:17 44:2,11	140:1 141:9,12	243:16 244:12
280:13 283:2	194:14 252:13	44:14,16,25	141:25,25 144:3	244:18 245:1,14
284:9,18 285:4	271:1	45:12,19,21	144:15,21	245:17 247:23
290:2 291:1,21	occasional	46:9,20 47:8	146:21 149:19	248:18,23 249:2
293:3,16 294:19	26:17	48:2,16,20	150:14 151:14	250:6,20 252:17
295:5 297:18	occasions	50:24 51:3,19	153:14 154:7	253:14,25
299:1,10,23	57:19 66:12	52:2,7 54:8,15	155:24 156:6	258:23 261:11
300:20,20	occur	56:4,23 57:18	157:6,24 158:8	261:14 262:12
303:13 304:25	211:7	60:12 61:25	159:3,6 160:7	264:12,25 265:7
304:25 305:10	October	62:16 63:2	160:13,19 161:2	266:20 267:14
305:24 306:22	22:22	66:18 70:21	161:6,17 162:5	269:10 270:22
307:15,24 308:1	offered	72:24 73:8 74:1	162:14,22,24	271:9 272:11,21
308:24 309:20	160:20 250:20	74:14,21 75:4	163:17 164:5	274:12,25 276:9
310:6,13 320:9	316:4,10	76:16,25 77:14	166:5,18 168:13	276:11 277:15
320:19 321:11	office	77:25 78:1,14	171:3,25 173:22	278:8,14 282:12
322:5 324:7,19	55:22 158:3	78:19 79:2 81:6	173:23 174:12	282:20 283:24
325:4,12,15	officer	81:15,22 83:23	175:6,23 176:5	284:8 286:11,24
326:1,14 327:4	332:5	84:3,17 85:11	177:3,5,11	288:16 289:16

290:9 291:7,15 293:13 295:10 298:16 299:17 299:22 301:8,15 303:1,21 304:3 304:6,21 305:7 305:18 307:12 308:20 312:15 313:3,8 315:1 315:20 316:3,20 323:6 329:20 331:8 once 35:9 66:14 225:3 ones 51:22 60:2 64:6 97:2 156:17 159:4 231:20,21 231:22 253:5 263:10 one-half 131:11 on-spot 96:18 on-the-spot 93:22 96:12 open 138:8,9 278:14 operate 59:11 operates 85:3,15 86:4,14 99:24 122:19,23 122:23 operating 84:24 operation 59:16 76:21 77:2 77:16 78:14 90:2,5 91:2,10 92:3,8,11 99:17 151:15 283:6,11 operations 59:15,17 77:11 176:16 197:12 198:20 opinion	32:3 33:7 39:8 40:1,4 47:8 48:2 48:4,16 71:6,10 71:24 72:4 73:14,17 74:9 79:12 89:3 94:16,23 97:21 105:24 115:24 116:12 155:4,19 158:1,6 159:5,9 159:17 160:21 161:11 162:8,16 163:2,11,18 171:9 186:11 187:25 188:8 190:2 202:2,5 211:12 242:22 243:2 250:21,25 254:1 282:11 286:17 291:3 306:17 308:7 311:8 312:10 313:4 314:4,23 315:17,24 316:4 316:10,16 320:23 opinioned 299:25 opinions 31:23 32:4,6 35:24 37:5,10 50:2 72:9 73:2 74:1,7 84:23 143:2 144:10 162:6 opposed 14:18 36:16,16 47:19 255:3 opposite 53:8 145:6 optimal 170:11 196:22 optimized 60:8,9 61:2,3 options 180:11,18 oranges	65:12 order 19:4 21:10 28:25 32:20 35:19 81:23 139:16,23 147:20 182:17 246:24 252:11 277:1 290:11 ordinary 71:25 72:11 73:4 73:10,22 74:9 102:24 112:6 158:9,20 159:7 160:21 161:12 162:1,9 182:5 183:3 185:4 299:6 318:19 organized 23:6,8 66:16 original 16:25 17:2 74:24 109:21,23 111:3 111:18 112:17 114:20 136:20 139:8,10 originally 29:17 32:17 other's 241:17 outcome 332:16 outer 181:19,25 266:24 outgoing 210:5 236:24 237:6 outperform 264:25 outperformed 264:14 298:17 outperforming 258:13,20 265:5 output 80:2,25 82:2 86:21 88:25 89:2 95:4,15 101:6 108:3,6	108:13 109:5,6 109:9 110:13 111:8,19 112:17 112:18 115:4 205:15,19,25 283:17 outset 106:2 outside 61:6 62:23,23 63:24 76:10 77:18 78:25 80:9 81:1,9 83:8 85:17 86:7 87:3 89:11,18 90:9 90:16 91:15 92:17 93:18 95:19 96:9 97:19 98:11 104:3 107:5 112:1,9 113:18 114:13 115:12 115:22 116:9 117:7 118:15 120:17 121:20 124:1,22 126:3 130:15 132:6 150:22 154:1,22 165:18 166:13 168:17 170:3,19 170:23 284:18 286:16 305:1,10 305:24 306:22 307:15 308:24 309:20 310:6,7 310:22 overall 77:22 201:18,19 201:20 204:8 221:16 239:8 overbroad 27:17 overlap 25:14 63:20 overlapped 212:18 Overlapping	78:23 85:7 180:12 212:16 294:21 306:24 309:9 325:6 328:20 P P 3:1,1 8:6 78:7 81:18,23 pack 17:2 page 2:6 4:2,7 5:2,6,7 5:13,16,19,22 6:2,14,17 7:2,5 8:18 13:7 14:5 36:7,7 43:17,18 57:2 74:24,24 75:7 80:22 93:10 95:9 117:24 121:10 121:18 148:13 149:3,3,18,20 149:23 150:8 151:14 152:2,24 154:7 159:15 163:24 166:24 166:25 167:13 169:16 181:24 196:5,10 199:19 199:25 202:15 202:16 204:19 205:7 206:15 215:13 220:8 221:8 222:11,14 222:16,19 233:2 233:21,23 234:16 235:9 238:8 242:9 251:16 254:6 255:12,19,20 257:8 258:12 259:1,1,4,6 261:3,4,8,15 262:12,24 268:3 268:17 271:14 271:21,22
---	---	---	---	--

273:24 278:15 292:15 293:15 296:1,5,7 297:24,25 298:5 304:9,12,14,15 312:5 314:1,19 315:13 318:24 319:13,13,18 322:16 323:12 pages 1:24 4:10,16,19 4:21,25 5:5,9,25 6:4,5,10,20,23 7:7,9,13,16,19 7:24 187:16,21 196:5 258:23 261:18 302:14 304:24 309:1 paid 37:9,11 Palo 1:17 2:7 8:2,18 paper 18:9 29:14 30:4,5 30:8,10 32:4,11 48:25 49:6,11 49:12,14 50:5 50:16,25 51:5,6 51:15 54:19 55:7,11,14 56:4 56:22 57:3,10 69:22 70:2 74:17,22,25 76:17 79:11,15 83:6,10,12 84:1 84:8,12,15 85:4 85:5,8,9 105:23 112:18 117:23 118:25 119:1,7 119:15 144:16 146:9 150:12,17 150:21 151:4,6 151:12,15 157:6 157:8,11,14,19 158:22 159:1,11 159:19 160:3,4 160:4,5,23,23	161:9,15,24 162:4,13 163:20 163:22 164:19 165:4,13,20 166:7,11 168:2 168:2,8,12,14 169:17 171:15 193:15,23,25 194:1,15,15,18 194:22,23 196:20 197:3 198:19,25 207:8 207:11,14,17,19 210:14,23 212:9 212:13,14,21,24 213:1,14 215:10 215:19 216:24 217:13,25 218:4 218:19,20,25 219:16,20,21,24 220:16 222:8,24 224:12 239:3 241:23 242:17 244:16,17 245:3 245:10,17,21 246:9,16 247:18 248:17 249:11 249:21 251:5,14 251:15 252:20 252:24 254:5,9 254:22 255:13 256:3 262:8,25 265:11,14,18 266:10 267:15 267:19,21 268:6 268:9,12 269:3 269:24 270:1,2 270:18,18,23 271:23 284:22 287:23 288:3,4 288:7,7,10,12 288:25 289:2,13 290:5,19 292:4 292:6,11 293:7 294:7,11 297:24 300:15 301:1 314:8,18,24	315:3,12,17 316:21,23 317:8 317:17,23 papers 29:24 32:7 57:13 67:8 68:5 71:9 73:17,23 74:13 74:19 126:6 143:8 145:5 146:17 157:4 161:21 163:18 164:2,8 168:5 242:10 paper's 204:5 paragraph 33:23 34:3 48:21 48:23,24 50:6 51:1 52:7,10,15 75:20 76:1 79:19 83:15 142:2,12,19 150:1 153:1,2 154:12 160:11 163:2 164:1,7 166:6 167:11,15 169:10,18 172:10 196:14 196:15,17 197:22 198:8,10 199:19 202:19 204:16 215:14 218:25 221:24 238:11 239:18 253:14,21,23 254:12 255:21 259:8 265:8 296:16 298:10 301:16 302:18 316:22,25 317:3 318:12 323:13 323:14 paragraphs 33:16,17 96:19 161:19 163:2,21 303:23 parameter	197:9 parameters 59:5,12 61:10 188:12 226:19 235:9 330:14,15 pardon 24:17,24 parentheses 167:9 168:3 parity 6:19 7:22,23 108:12,15,17,20 108:22 109:4,7 109:10,22,25 110:9,17,23 112:15,20,23 115:3,5,7 118:14 120:13 120:15 121:6 138:2,10 140:9 140:11,11,12 159:20,22 166:7 167:1,17 195:20 196:2 203:21 214:2 215:21 226:16 230:11 230:24 231:22 236:22 249:12 249:22,25 251:18 254:7,10 260:13 270:6,8 274:15 315:4,5 parse 316:8 part 17:22,24 39:21 70:20 71:20 73:9 74:2 87:8 108:24,25 109:19 149:14 187:19 191:8,21 201:1,2,5,16,19 204:13 205:25 239:6,7 267:3 302:21 303:1 participants 20:21 21:11	participate 270:8 particular 15:20 26:13,20,20 33:13,23 38:15 44:22 45:19 47:16 51:17 52:4,21 53:16 56:11,13 58:7 60:11 64:2,17 68:4,5 77:7,11 79:15,21 80:17 83:12 84:6,8,15 100:11 109:10 115:24 119:9 124:4 125:2,20 135:6,15,17 137:22 138:25 139:2 141:1 156:4,17,18 158:25 160:1 161:15,23 164:18,20 174:1 174:5,5,19 178:1 198:24 202:13 212:2,23 218:13 219:13 219:16,24 220:4 220:5,6,21 225:4 226:10 233:12 234:24 239:12 240:9,15 242:25 246:3 250:24 251:2 258:15,19,20 259:17 260:25 263:17 265:3 266:14 273:15 273:22 291:25 292:7 297:20 298:25 299:2,13 302:21 305:15 306:16 307:4,8 307:10,23 317:5 317:7 321:9 324:11 325:19 326:20,22,23
--	--	---	--	---

<p>particularly 58:12 67:25 79:12 121:24 199:8 218:19 292:5</p> <p>particulars 189:9</p> <p>parties 332:14</p> <p>partition 284:2</p> <p>partitioned 284:15</p> <p>partitioning 284:25</p> <p>parts 33:3 253:2 304:4</p> <p>passage 241:4</p> <p>passing 161:4 217:16 239:6,7,8 292:8 294:8 295:16,22 325:20</p> <p>patent 4:13,18 7:7,12,15 38:1,3,24 39:19 42:20 43:12,15 45:7 46:2 84:14 85:20,23 93:6 93:20 94:17 96:6,23 107:2 132:4,10 158:3 310:18 312:17 313:4,17,25 314:5 326:17</p> <p>patents 13:8,10,17 14:5,8 26:3 37:13,16 38:9,13,16 43:8 43:8 105:23 106:14,19,21 107:22 126:2,5 130:13,18 168:24 190:3 202:1,3,6 211:13 250:23</p>	<p>301:9,17 316:12 330:7</p> <p>patents-in-suit 162:18</p> <p>patents-in-suits 303:2,12</p> <p>pattern 294:13</p> <p>pause 60:12 90:11 137:7</p> <p>peeling 217:17</p> <p>pending 10:24</p> <p>people 15:13 17:8 18:1,2 18:7 20:20 23:2 23:7 25:15,15 25:19,23 53:3,4 56:19 57:4,11 66:13 67:2 69:2 71:11 73:19 74:19 90:12 120:25 143:15 145:10,15,16 147:7,13,22 166:3 168:4 185:10,18 191:2 191:4,10,22 193:13 244:15 245:24 246:23 247:2,4,12 248:1,4,5,8,15 249:4 252:11,15 252:18,18 253:9 255:5 263:8,11 263:20,24 264:6 272:16,17 306:10 317:13 324:23 328:22</p> <p>percent 23:14 269:8 274:15 313:1</p> <p>percentage 47:10</p> <p>perform</p>	<p>59:15,17 60:13 61:2,3 63:13,14 64:15 77:16 84:4,10,23 90:4 91:10 94:22 198:20 238:12 238:19 240:7 282:24 283:10 283:15 311:8</p> <p>performance 47:9 54:6 58:3 59:4 62:17 125:1,5,8,14 127:24 129:15 129:21 131:23 172:1,2 217:8 217:21 218:9 222:13,21 223:23 234:19 239:2 253:19 254:24 255:14 255:24 256:6,17 257:9 258:5 262:13 263:5 270:24 291:18 292:3,18,25 293:14 297:16 299:4 320:7 324:17 326:25</p> <p>performed 51:13,20 94:15 158:5 283:7 298:23</p> <p>performing 45:21 51:3,7 63:21,22 94:14 101:8 129:19 199:12 264:2,13 264:22</p> <p>performs 62:19,21 76:21 77:1,11 89:16 92:11 185:3 235:2 298:11,15</p> <p>period 24:7 159:23 323:22</p>	<p>periodically 10:21</p> <p>permanently 193:20</p> <p>permutation 5:12,15,18,21 123:24 175:14 226:14 231:11</p> <p>permutations 174:20</p> <p>permute 176:8</p> <p>permuted 81:20</p> <p>permuter 84:19 276:24 278:9 279:4,10 282:3,15,18 283:17</p> <p>permuters 177:9</p> <p>permutes 79:23 80:12</p> <p>person 35:4 71:7,24 72:11 73:3,10 74:9,13,15 112:6 115:19 116:18,22 143:20 145:6 146:1 147:18 158:9,20 159:6 160:21 161:11 161:25 162:9 182:5 183:3,9 183:11,12 184:7 184:17,19,21 185:4,7 299:6 299:17 300:14 307:20 318:18</p> <p>personal 26:8</p> <p>personally 66:8</p> <p>pertain 326:20,22</p> <p>phone</p>	<p>15:14</p> <p>phones 15:13</p> <p>phrased 27:1,11,16</p> <p>PHY 14:24</p> <p>physical 14:10,12,17 67:21 308:12</p> <p>physicist 29:17 146:24 147:15</p> <p>physicists 147:8 190:16 191:17</p> <p>physics 29:18 67:15 68:18 70:10,15 142:16 191:20 191:21,23 192:24</p> <p>Ph.D 15:2,3,6,7 116:15 145:2 148:11,19 148:20 150:24 190:17</p> <p>PICKERING 2:5 3:19</p> <p>picture 121:24 136:19 137:2 138:20 139:18 141:19 141:23,23 149:7 207:25 208:23 225:10 273:21 277:13,16,23 281:9,23 283:22</p> <p>pictures 19:5 136:14 146:6 190:10,13</p> <p>piece 122:8 204:11</p> <p>pieces 80:21</p> <p>Ping 315:3,12,17</p>
--	--	---	---	--

place 8:18 17:19 21:9 22:21 35:12 141:6 191:24 305:22 308:11 319:12	92:2,22 95:13 96:5,7 97:1,6,8 97:13,16 102:25 103:8,8,9,9 106:7,7,8,8 109:24 161:7	16:1,4 19:17 21:6 33:4 202:16	5:8 126:23 190:23 201:24 263:10	previous 44:15 254:21 284:9
places 99:5 253:16	point 18:19,22 19:6	portions 250:5 251:2	practice 53:13 60:3 239:22	previously 130:24 153:6 226:7
plagiarize 253:7	20:2,3,18 21:13 26:15,18 29:22 33:22 41:25	posed 32:1 154:2 155:20 213:17 213:18 286:22	preconceived 328:11	primary 324:20
plaintiff 1:6 3:2 8:25	53:1,5 58:14 63:20 66:4 67:7 67:12 68:7,11 69:23 70:3 71:19 73:18	position 145:2,20,25 158:8 158:18 171:15 241:5,14 279:17 286:19	predict 263:16	prime 235:13,13 236:7 236:10 239:23 239:23 241:6,7
Planet 8:17 9:5	76:14 77:8,20 77:21 99:13,20 101:15 102:13 111:6 137:3,17 139:10 146:2 154:25 155:22 156:19 159:23 161:19 173:8 184:23 191:7 193:18 194:17 207:14 222:24 241:10 256:5 262:18 263:7,20 263:21 269:13 271:2 279:19 280:21 290:13 294:3 297:14 300:6 305:22 318:4,11 319:8	positive 69:18 228:18	prefer 86:19 87:22,24 95:13 105:23 287:2	principal 58:17
platform 60:5		possible 34:23 53:20 54:2 58:16 59:22 69:18 83:4 108:15 120:5,12 132:1 137:20 166:23 224:7 225:17 237:9 249:7,8 265:4 266:17,18 268:25 293:5,21 302:23 319:20 330:20	preparation 26:22 28:18,18 29:12	principle 110:3
played 192:22		possibly 218:23 219:19	prepare 26:24 27:8 28:5 28:20,22 85:18	principles 125:15
please 8:20 9:6 11:4 12:13 16:1 27:5 44:13 48:22 72:8,17,25 75:23 79:4 82:14 88:8 90:12 97:10 100:9 102:1 111:10 116:8 121:12 127:11 128:24 140:23 147:11 149:14 158:15 175:17 180:16 181:1 183:10 212:19 259:14 267:3 275:24 280:1 281:7 309:11,14 310:4 317:19 328:25		post 29:20	prepared 12:23 151:21	prior 39:9 41:19 51:8 51:20 83:23 123:2 142:8 250:22 264:18 316:5,11,16 326:16
plot 323:2	pointing 82:20 205:10 253:23	postdoc 192:23	preprint 69:21 157:19 194:3,6 245:3 246:9	priori 110:21 112:14 237:2
plugging 145:17	points 19:7 232:10 291:16	posted 250:11	present 3:25 163:14 196:20 254:9 255:13 260:6	priority 301:17
plus 78:11 82:11,16 86:19 90:20,22 91:1,9,20,20	ponder 311:4	potentially 27:2 53:10,12 146:10 262:9 306:12 321:20	presentation 17:3 112:17 269:2	privileged 27:3
	poorly 61:4 62:21 129:18	powerful 173:12	presented 100:19 238:13 268:17 288:10 288:14	probability 59:24 214:14
	portion	practicable 202:7	presumably 148:22 163:22 288:14	probably 14:9 22:5 23:17 41:17 60:17,18 60:20 63:19 67:15 192:2 244:14 245:13
		practical	presume 269:19	problem 146:10 289:23,24
			pretty 63:7 194:20 291:14	problems 20:4
				proceeding 201:24
				proceedings

268:18	254:23 255:3	published	13:4	283:14 284:10
process	proper	18:9 49:14 52:23	qualify	285:25,25 288:9
97:24	253:5	55:16 145:6	126:16 128:17	289:19 294:23
processes	properly	152:13,21	250:22	300:12,12,13
39:21	255:15 256:7,17	159:24 207:8,15	quantified	302:16 309:2,5
produce	proportional	242:23 243:4	257:23	309:13 311:4
80:25 121:4	197:14	251:1 252:25	question	318:22 320:23
170:16 180:19	prosecution	288:14 297:14	10:23,25 15:15	320:24 321:2
203:18 228:24	301:9	pure	27:2,6,17,18	326:4 327:10
258:4	protection	248:11	32:1 40:16,19	328:13,25
produced	196:23	purpose	41:6,8,11 44:9	329:15,17 330:5
32:18 108:6	provably	35:20 36:4 43:24	44:15 47:16	questions
180:7 244:25	6:19 249:12,22,25	54:13 60:20	51:19 61:1	72:7 129:10
260:17	251:18	104:17 135:6	63:11 65:16	139:23 141:10
product	prove	purposes	69:12 71:23	141:11 184:23
52:12 101:1	146:7 290:13	12:18 84:3 136:9	72:6,8,21,25	190:18 226:4
production	proves	139:22 183:2	84:16,18,22	245:5 303:16,16
244:8,9 314:10	297:13	Pursuant	87:23,25 91:25	331:20
Prof	provide	2:13	94:12 97:22	quickly
4:9	10:16 31:21	put	106:15 107:13	43:23 223:24
professional	157:25 171:25	82:6 155:17	119:19 126:18	224:3 302:7
2:14 12:21	224:4,10 312:10	156:3 163:10	126:19 129:2	303:4
332:24	314:23 315:17	176:14,21	144:9 145:20	Quinn
professor	315:24	216:24 247:8	146:11,14 151:2	3:4,11 8:23 9:1
11:8,11 150:25	provided	277:7 280:16,17	152:15 155:2,21	quite
professors	36:3 159:8	280:21,23	155:22,24 156:2	23:23 53:2 69:4
11:18 14:3	250:15 268:9	puts	158:6 160:15,18	138:22 143:21
profile	313:3 314:4	79:23	160:20 161:10	182:15 199:14
209:1,9 210:24,25	316:15	putting	161:21,22 162:7	201:17 264:6
211:5 214:8,9	provides	88:10 183:7	162:7 163:7	269:7 309:2
214:10,12,13,23	95:6,17	pyramid	165:24 173:14	330:19
223:18 228:4,5	providing	201:12,14	176:2 180:5,14	quote
234:12 235:15	196:22	p.m	180:15 183:2,8	88:17 153:19
235:16,23	provisional	331:16,25	183:9,14 184:15	156:9,10 219:1
profiles	7:6 301:17,22		184:16,24 185:1	240:25 241:1
208:21 261:1,7	302:17 304:7,22	Q	185:7 193:10	292:19 296:11
program	308:23 310:18	qN	211:9,14 212:19	296:19,21
184:6 186:7	publically	80:2,25 81:7,17	212:23 213:17	297:10
187:14,16,20	252:6	82:2,8,10,16,23	213:18 214:17	quotes
188:11 189:1,7	publication	89:9 108:4	218:5,6 220:25	292:20
189:9	55:18 85:25 86:1	115:3,5	224:8 230:5	
programming	86:2 144:12	quadratic	232:17,22,25	R
234:4	145:21 242:18	202:3	237:14 243:2	Rüdiger
progress	publications	qualifications	245:6 258:9,12	4:9,12 8:8 11:6
241:25 242:2	143:5	13:6	273:10 274:12	105:2,6 181:8
propagation	publish	qualified	278:23 281:13	266:2,6 331:23
220:12,24 221:2	68:15	297:4	282:6,7,8,11	RÜDIGER
		qualifies		1:16 2:1 4:2 9:9

<p>R 3:1 8:6 42:3,8,15 RA 52:15,17 53:7,15 53:18 54:10,11 57:24 60:20,24 62:2,5,10 63:2,5 63:7,13,14,16 64:1,2,4,5,12,25 65:6 71:1,7 88:13 109:5,6 111:23 114:12 115:10,15 116:17 132:13 133:6,7 136:10 136:18 137:1,2 137:19 139:7 140:13,19 141:4 141:16,19 150:4 150:12,17,21 151:16 152:6,9 152:16 153:11 159:11 160:23 161:18 162:2,3 162:12 169:12 169:22 171:16 172:2,12,17,22 183:4 185:13,17 189:13 206:2 224:18 225:1,8 225:13,13,18,25 226:8,12 229:3 229:8,19,23 233:5 235:1,2 262:2,4,9,18 266:10,13,20 267:1,5 275:21 275:25 289:6,13 289:14,21,25 290:11,11,16,23 300:4,5,6,7 318:8,17 322:11 322:18 325:25 326:9,13 race 263:8 racial</p>	<p>292:4 radar 69:23 raise 27:23 ramifications 80:16 random 5:11,14,17,20 123:24 219:6,12 226:14 231:11 rate 64:2,20 78:4 82:13 278:18 279:1 rates 64:12 65:15 298:12 rate-1 78:11 80:24 82:9 82:11,16,24 86:17 93:13 95:11 RA.c 185:21 315:21,25 reached 304:20 reaching 31:23 react 135:1 reaction 134:25 read 16:23 38:9 43:22 55:19 71:11 83:14,20,21,22 83:24 84:1 85:9 86:1 93:8,20 118:21 119:23 127:12 146:14 146:17,21 152:12 155:18 166:15,18 168:11 170:25 200:13,13 202:20,21,22</p>	<p>214:6 216:10,17 216:21 228:14 239:25 252:19 253:1 256:8,10 256:15 271:1 272:9,18 277:6 288:22 292:19 295:11 299:7,17 300:14,15 302:10 305:20 reading 39:7 75:10 87:20 89:1 145:21 159:7 160:22 161:12 162:10 252:23 257:12 261:2 332:11 reads 118:5 270:12 287:15 real 126:24 realization 226:3 realized 67:12 68:11 really 53:3 64:3,7,20 87:23 114:9 171:9 239:6 245:24 248:3 249:3 279:14 300:11 realm 134:13 137:21 228:17 305:15 306:18 330:19 330:20 realtime 79:14 reask 41:6,8 reason 10:15 46:4 56:4,9 74:12 153:14 175:16,18,20 176:22,24,25</p>	<p>179:12 201:9 223:22 264:21 reasonable 58:9 179:23 310:3,4 321:21 reasons 128:1 222:12,21 300:1 recall 20:14 21:14 24:8 26:11,19 31:17 41:21,22 51:10 56:25 57:1,7,21 66:4 70:13 105:12,16,19 106:2 111:4 122:20 141:12 166:20 226:9 227:1 246:22 257:22 259:2,8 265:11 266:11 266:14 290:17 301:10 302:15 304:4 316:23 receive 33:4 37:7 189:15 received 55:21,24 56:24 57:3 receives 75:11 receiving 37:4 recess 65:24 105:4 122:14 181:6 206:10 243:20 266:4 313:13 331:16 recite 46:11 47:17 48:9 recited 43:19 45:6,17 recognize 12:8 30:22 55:4 117:22 148:7 165:11 186:4</p>	<p>215:6 244:13,19 249:19 267:19 302:4 recollection 245:15,25 246:4 246:15 247:5,17 247:25 249:4 250:13 251:25 252:4,11,14 268:8,24 recollects 242:8 record 11:5 12:4 41:2 65:22 66:1 104:22,24 105:2 105:7 117:18 122:12,16 170:12,16 171:4 181:5,9 200:13 206:8,12 233:16 243:18,22 266:2 266:7 313:11,15 331:11,12,14,18 331:24,25 332:7 recursive 86:17 93:13 95:11 99:17 red 5:18,21 111:21 114:20 124:17 125:17 rediscovered 67:10,13 68:9,12 70:17 reduced 332:10 reduces 178:1 refer 32:11 37:15 46:5 55:10 121:23 160:1 162:3,12 163:20 195:7 204:15 225:21 244:16 270:18 273:19 299:13</p>
---	---	---	--	---

<p>reference 39:9,13 40:2 42:20 46:23 47:4 117:14 150:11,16 157:9 163:8 164:1,7 168:6 196:11 200:21 216:2 218:19 241:22 241:23 242:6,7 243:10,10 251:17 262:25 263:2 268:5 269:23 288:12 312:7 316:5,11 317:5,7,25 318:3,8</p> <p>referenced 250:1</p> <p>references 39:14 40:5 51:8 51:10 69:22 70:1,4 72:1,5 73:5 154:15 155:9 158:10 167:24 168:1 242:10,12 243:15 271:1 287:16 316:17 318:1</p> <p>referencing 302:18</p> <p>referred 49:12 56:13 62:18 197:5</p> <p>referring 24:15 45:12,13 50:25 57:23 120:7 160:4,5 161:20 163:19 163:21 164:19 178:9 217:4 222:17 225:10 225:23 226:23 242:19 269:18 271:14 273:6,8 273:14 275:20</p>	<p>276:4 299:3 318:1 319:24</p> <p>refers 44:22 157:14,15 163:4,22 200:22 214:10 241:2 255:2 269:21 270:16 274:11 274:16,24 275:2 288:4,7 312:8 317:12</p> <p>refinement 113:25</p> <p>reflect 54:4</p> <p>reflected 45:22</p> <p>refresh 251:25 268:8</p> <p>regarded 264:22</p> <p>regarding 4:13 212:24</p> <p>Regardless 288:18</p> <p>register 77:6</p> <p>Registered 2:14 332:24</p> <p>regular 123:18 127:20 128:10 134:15 135:10,13,14 137:14 138:15 140:4 177:24 217:8,21 218:10 234:20 235:3 238:13,19 239:15,22,24 240:7,18,25 241:1,7,8 257:13 270:25 271:10 272:21 272:24 291:18 292:18,25 296:13,21 297:11,16</p>	<p>298:12,17,18,24</p> <p>relate 14:6 35:23 43:24 85:19 126:6 147:17,20 190:13 326:17</p> <p>related 13:12 15:4 18:6 50:8 59:3,18 86:22 95:5,16 117:11 155:25 190:17 274:14 332:13</p> <p>relates 30:13 59:21 157:20,22 159:16 264:18</p> <p>relating 14:9 32:4 55:25 84:14 317:13</p> <p>relationship 16:17 18:25 26:8 89:5 107:7,10 139:14</p> <p>relationships 320:2</p> <p>relatively 12:22 17:14 62:14 63:16 195:13</p> <p>relevant 146:9 154:20 155:14 156:19</p> <p>reliably 59:11</p> <p>relied 31:22</p> <p>remark 87:5 124:23 201:22</p> <p>remarkable 255:14,24 256:6 256:17</p> <p>remember 30:2 41:24 207:16 227:13 227:18 245:11</p>	<p>248:4,5 304:13</p> <p>rendered 242:22 250:24</p> <p>reordered 277:4,16</p> <p>repeat 16:1 19:17 27:5 42:9,16 44:13 57:24 68:2 72:8 78:17 79:21 80:11 81:4 96:15 121:12 123:22 126:20 134:3 147:11 149:14 155:8 173:2 175:12 176:7,11,23 180:8 183:11,12 183:18 184:18 185:11,11 210:13,18,21,23 211:9,10,15,19 224:15 231:14 232:15 257:3 275:24 277:10 279:4,10 281:6 281:20 284:1,3 284:16,25 285:3 285:15,17 286:2 293:21 294:1 299:9 307:6 316:7 317:19 327:2,11,14,20 327:21 328:6,15 329:19 330:4 331:3,3</p> <p>repeated 75:17 78:20,21 79:6 80:25 81:8 81:17 82:2,22 89:10 128:20 129:3 131:10 179:8 182:10,12 182:22,24 189:23 209:14 210:11 272:22 273:4,11 274:9</p>	<p>274:25 275:4 276:15,18,21,23 277:4,16 284:7 323:1</p> <p>repeater 78:15 80:2 81:11 81:16 84:18 122:23,25 176:10 177:18 177:21,22 185:3 189:16,18 278:19,20 285:2 285:14 286:1,8 299:19 300:16 300:25</p> <p>repeaters 276:11</p> <p>repeating 78:15 178:12,14 213:12 286:12 328:4 329:9</p> <p>repeats 79:22 80:12 81:13 122:25 211:6 276:6 291:5</p> <p>repeat-accumul... 4:24 50:11 52:9 52:18,19,21 77:14,15 123:18 124:21 125:18 125:25 126:12 127:17 128:12 134:7,19 136:8 137:14 138:15 138:16 139:24 140:15 141:11 149:5,9,21,25 150:4 153:4,7 154:9,21 155:15 157:7 163:5,6 166:9 167:4,8 170:16 176:10 180:9,20 185:10 186:22 188:14 189:2,4 232:1 317:13</p>
---	---	--	--	---

repeat/accumul... 79:22	151:18,24 152:1 154:23 157:25	119:4 125:10 127:8,13 128:23	146:4 152:9,16 244:24 300:7	324:5,25
repetition 78:5,17 80:24 81:3 123:5 134:4,5,15,19 139:25 141:12 177:15 178:5 179:15 181:19 181:25 182:6 183:5,6 184:9 184:10,13 185:4 187:6 224:21 267:5,8,9,11 275:10,12,16 286:4 290:23	158:25 159:16 160:25 161:11 161:24 162:8,16 163:3,4,11,21 169:10 172:10 186:8 190:8 197:18 204:16 241:25 242:2,24 243:3 250:21 251:9 253:15,16 253:24 254:2 265:7 267:22 300:1 301:8 302:19 303:1 306:3 307:1 308:25 309:21 310:7 312:9 313:6 314:4,22 315:16 316:1,6 316:22 317:16 317:20 318:5,12 319:4,8 322:9 322:11	129:25 135:12 136:22 139:4 140:21 147:4,9 149:13 170:21 174:4 175:17 176:23 179:1,17 179:19 180:13 180:16,25 187:18 191:8 192:5 198:6 200:12 209:21 209:24 212:17 216:4,6 220:1 229:21 232:14 238:1 240:12 256:20,22 267:2 275:23 279:22 279:25 281:5,19 289:9 294:9,22 295:18 306:25 307:6 309:10,13 319:14 323:3 328:21,24 332:1 332:25	representing 8:17,24 9:5 51:24 52:4 90:22 91:22 136:18 320:4 represents 37:22 76:24 86:11 91:1 226:8 reproduced 74:23 108:3 request 204:21 310:3 requested 332:12 require 46:10,12 136:13 137:25 138:19 139:9,11,13 175:24 190:9,12 202:3,6 253:10 320:6 321:9,13 321:14 required 45:17 59:17 145:19 requirement 46:11,12 48:18 requirements 223:3,5,13,15 requires 47:9 48:6 137:23 138:17 139:8 178:6 226:17 321:15 329:10 329:12,19 research 18:11 52:13 71:4 142:24 176:2 researcher 143:3 144:11,12 323:25 researchers 142:13,15,20 143:5 323:15,22	resembles 119:13 resorting 248:13 respect 47:6,16 62:17 84:8 155:24 159:6 161:23 175:9 186:10 190:2 211:13 308:16 316:20 respectively 208:5 respond 134:9 response 39:17,18 282:12 294:24 rest 131:10 restart 209:23 restate 267:2 298:21 restricted 180:1 restriction 252:22 restrictions 141:3 253:3 280:7 292:2,3,5 293:22 result 81:7 100:22,25 253:19 255:24 285:3 318:9,9 resulted 289:25 resulting 203:25 results 6:4 165:3,12 170:11,17 171:4 185:15 255:13 256:6 297:25 298:4,8
report 4:12 28:7,9,16,24 29:2 30:16,25 32:2,17,24 33:1 33:1,16,18 34:18,25 35:8 35:24 36:2 37:6 37:10 38:20 39:8,16 45:22 48:20 49:18 50:2 52:8 72:10 73:3 74:1,24 77:19 79:16,19 80:14 84:4 91:18,19,23 104:5,8,18 105:16 108:3 113:19 114:14 115:13,22 116:12 126:14 130:16 131:20 132:7 134:9,22 135:1 142:1 143:3 144:10	Reported 1:25 reporter 2:14,15 9:5,6,11 10:3 15:24 19:16 20:24 21:2,5 34:11 40:24 41:1,5,7,9 42:10 44:10,12 49:2 54:18 58:20 61:16 65:2 68:1,22 71:14 72:14,16 72:21,24 78:24 79:2 82:12 87:7 88:5 90:10,17 96:14 97:8,10 100:8 101:25 103:21 104:12 104:21 108:25 109:2 110:6 113:4 116:6	reports 33:10 represent 8:21 120:6 195:24 225:3 229:8 244:22 260:4,7,11,13 representation 12:19 51:16,17 110:15,20,21 112:16 136:20 136:20,25 137:2 139:9 149:8 206:25 207:2 224:25 225:1,4 259:18 301:4 320:12 representations 137:21 142:8 represented 49:14 139:11		

retained 35:7 36:2,10,13 36:18,20,21 37:19,21,25 38:10 169:7 291:11	right 10:18 13:9 16:2 21:22 24:10 37:25 39:22,24 42:3,4 45:2,6,16 46:13,24 47:13 47:19 48:8 49:10 52:3,6,15 57:20 62:3,8,22 63:3,15,23 64:13,14 65:18 68:3 69:25 70:12,14,16 71:2 75:4,5,8,10 75:12 76:6,9,17 76:22 77:3,10 77:16 78:5,8,12 78:16,20 79:9 79:25 80:3,8 81:17,18,23 82:4,9,25 83:3,7 83:15 85:16 86:3,13,24 87:2 87:16 88:25 89:10,17,24 90:6 91:11 92:8 92:16,22 93:17 95:18,25 97:16 97:18 98:16,23 99:2,18,23 100:1,3,4 103:16 104:23 107:4,10 108:4 108:7,12 110:2 111:25 112:8 115:3 117:6 118:14 120:16 120:20,23 121:1 121:6 123:25 124:17 125:16 126:2 128:8,13 129:13,16,19 131:17,20,23 132:18,24 138:10 140:4,17 141:17 142:17 142:25 144:18	147:3 148:12,21 148:24 149:10 149:21 150:1,6 150:13,18,21 151:4,9,16 152:6,10,17,23 153:11,15,22,25 154:13,16,21 156:10,13 157:3 157:8,12,21 158:3 160:11,12 160:17 161:7,23 165:13,17,25 167:1,4,7,10,20 167:22 168:2,6 168:10,15,24 169:4,8,14 170:2,13,17 171:8 172:1,2,4 172:20,23 173:3 173:19 175:12 175:25 177:15 177:22 178:21 178:25 180:8 181:17 182:8 183:20 184:3,11 186:14,21,23 187:8,12 188:2 188:8,25 190:1 190:8 192:10,21 193:4,24 194:10 194:12,19 195:11,14,17,21 196:2 197:18,20 197:22 198:1,23 199:13,18 200:2 201:1 202:3,7 202:25 203:1,7 203:10,15,17,19 203:20,21 204:2 204:6,12 205:12 205:16,20,23 206:4,25 207:4 207:6,7,23,24 208:4,6,10,16 208:22 209:7 210:12 213:13	214:5,9,24 216:2,9 217:4,9 217:12,24,24 218:18 219:1,8 219:13 221:23 222:6,9,13,22 223:3,7,10,13 223:17,25 224:5 224:11,16,21 226:13 227:6,22 228:12 229:5 230:8 231:7,12 231:16 232:3 233:8 234:7,14 234:22 235:3,15 235:18,19,21,22 236:1,22 237:7 238:16,17,19 241:14 242:6,11 242:15 243:11 243:14 245:20 248:10 250:9,10 251:4,11,23 252:23 254:2,7 254:14,18 255:1 255:7,17 257:10 257:12,13,13,18 258:9 259:12,16 259:24 260:2,5 260:8,19,21,24 262:14,16,19,22 262:25 263:2 264:23 265:1,15 266:21 267:8,16 267:22,25 268:6 268:16 269:17 269:24 270:2,11 270:15,25 271:5 271:19 272:3,6 272:14,23 273:5 273:12 274:1,4 274:6,10,13,18 275:1,10,13,17 276:15,18,21,24 277:2,5,17,22 278:3,10,25 282:4 283:17	284:4 287:14,17 287:24 288:25 289:3,21 290:1 290:21,25 291:10,19 294:3 295:4 297:6,17 298:18,24 299:9 299:20 300:18 301:13,20 302:16 309:22 311:12 312:9 314:1,20 315:14 317:4,18,23 319:6,12,21 320:6 321:24 322:10 323:19 323:23 324:1,6 324:18 325:3,14 326:7,8,10 330:18 rights 45:24 right-hand 98:13,25 215:14 221:7 319:17 rigorous 222:25 Road 2:6 8:18 Robert 3:10 9:1 role 192:22 roles 139:12 226:11 229:11 room 10:10 143:15 root 201:15 rough 32:22 round 70:24 135:9 routinely 300:7 row
---	---	---	--	---

23:22	153:13,18	330:11,22	298:10 314:1	234:9 240:3
RPR	163:11 164:10	scope	seconds	241:11,12
1:25 332:4	165:12 167:13	61:7 62:23,24	309:24	242:18 245:19
rules	169:18 170:6,20	63:24 76:11	section	246:5,7 247:7
9:25 275:20	171:3,4 177:4	77:18 79:1	17:23,24 157:7	248:8 250:6
run	181:18,24	80:10 81:2,9	161:1 202:18	251:9,20 252:9
21:13 187:14	186:15 187:1,5	83:8 85:17 86:8	206:16 222:17	253:12,20 259:3
running	189:2 196:19	87:3 89:11,19	222:19,20	262:24 268:7,20
99:15 238:15	198:12 203:23	90:9,16 91:15	296:10 298:9	271:13 274:18
runs	205:8 214:23	92:17 93:18	303:24 322:17	274:22 275:9
304:10	215:18 216:8	95:20 96:10	see	281:3 282:17,19
	217:3 219:4	97:19 98:11	13:8 16:10 25:18	291:15 296:15
S	220:9 222:3	104:3 107:5	29:14,15 34:7	297:24 298:4,9
S	232:12,18 234:3	112:2,10 113:18	34:12 43:19	301:5,19 303:9
3:1 4:1,5 5:1 6:1	234:16,23,23	114:13 115:12	44:25 47:17	305:8 306:20
7:1 8:6	238:11 239:20	115:22 116:10	49:9 55:20,20	308:21 309:8
sake	240:1,8,14,25	117:8 118:16,25	57:8 75:20 76:3	312:6 319:1,7
100:15 211:14	241:6 245:17	119:1,6,15	76:5,25 82:10	322:21 323:2
San	247:15,21	120:17 121:20	83:1,18,19	327:23
3:14 17:20 35:11	248:21,25 254:8	124:1,22 126:3	85:14 86:15	seeing
332:2	268:17 271:9,17	130:15 132:4,6	88:21,23 89:7,8	82:15 136:12
SATELLITE	271:22 274:2,8	150:22 151:17	95:1,7 97:5,15	144:1 327:25
1:12	276:16 281:10	154:1,22 165:18	98:12,24 111:17	seen
saw	287:16 288:6,17	166:13 168:17	114:22,23 115:6	38:1,3 43:2
55:13,24 149:9	294:4 297:9	170:3,23 284:19	115:7 118:3,9	110:14 144:1
225:8	298:8,10 319:2	286:16 305:1,11	124:15,17	186:6,9 194:3
saying	scale	305:25 306:22	133:19 136:11	291:8,12 312:25
64:23 126:15	130:6	307:16 308:24	142:10 149:5,7	330:8
137:9 145:24	SCCC	309:21 310:7,22	150:7,11,15,16	segment
170:15 176:19	150:3	scrambled	152:2 153:8,23	18:3
181:23 203:9	scheme	82:22	154:4,8,14	select
205:11 216:25	15:22 16:4 80:17	screen	155:10,11 156:6	30:8
227:12 228:25	119:8,12,13	69:24	156:8 157:18	selected
233:12 240:6	schemes	second	163:25 164:6,13	29:8
256:14 259:11	119:2 159:21	23:18 34:4,7,12	164:14 166:5,10	semi
269:16 270:4	scholars	48:21 50:7	166:25 167:2,8	300:5
272:13,14	256:10,10	98:21 99:24	167:11,21 168:3	Semi-Random
283:10,20	science	118:5 143:19	169:20,21 170:4	7:23 315:5
285:13 298:7	11:12,13,16,19	154:12 159:13	170:14 181:17	send
says	13:18,25 14:3,6	196:14,19 200:4	182:3 186:14,16	294:8
75:21 76:1,17	67:16,19 68:15	202:1 204:22	186:18,19 187:9	sense
82:20 83:16	68:17 70:10,15	205:19 206:18	196:24 198:10	32:13 37:17
86:2,15 87:14	142:16 145:22	209:16 212:15	198:15 199:24	55:11 105:19
88:16,21 92:13	190:16 191:13	212:21 213:2	200:5 206:17	157:2 161:15
93:24 95:1,9	191:17,19	214:2 218:25	210:22 215:16	185:16 195:8
97:5 148:8,13	215:11 238:24	254:12,20	215:25 220:13	199:16 212:6
149:11,15,24	scientist	271:21 296:7	222:1 233:1	216:15 317:25
150:2 152:7				

<p>321:13 sensitive 19:25 sent 6:17 244:15 246:6,18,24 247:4,9,13,16 247:18,21,25 248:2,6,12,25 249:1 250:7 252:1,10,12 253:11 287:13 sentence 56:13 75:20,25 76:18 82:19 83:1,15 88:21 118:5 121:13 143:11 144:23 144:24 153:17 153:23 154:14 167:21 170:4,14 181:24 196:19 200:2 206:18 216:18 217:3 219:2 261:3 287:25 294:1 316:8 sentences 143:13 separate 179:3 separated 57:25 September 22:22 186:15 sequel 221:25 222:4 sequence 76:13 77:5,12 88:4,10,11,11 88:12 89:21 107:8,8 129:12 129:13 132:17 132:18 133:12 133:14 145:8 193:12 280:3 sequences</p>	<p>296:13,14,20,21 297:10,11 serial 52:19 205:18,22 205:24 206:3,5 266:21,22 serially 266:21 series 139:23 serious 145:19 147:22 sessions 23:6 set 52:23,23 54:1 66:22 112:13 127:18 139:19 141:9 189:9 190:12 212:14 212:21 213:1 214:11,12,15,16 216:12,12 228:24 239:17 246:23 247:25 248:15 249:4 252:10,14 278:5 286:11 310:17 321:6 332:18 sets 190:20 setting 137:13 178:4 188:6 207:20 278:1 324:11 325:16,17,18,21 settings 324:10,12,13 seven 7:16 Shannon 17:6 46:24 47:3 47:10 59:4,11 61:11 62:18 63:14,15,17 64:15,16,19 65:14 127:25</p>	<p>128:4 257:10,18 320:7,16 324:18 325:3,9 shapes 276:3 share 144:25 250:4 shares 216:25 shifted 22:25 77:6,9,10 shocked 252:3 Shokrollahi 33:10,18 70:23 191:6,12 193:6 193:16 short 12:22 49:13 128:3 130:5 313:9 shortest 130:7 Shorthand 2:15 9:11 332:1 show 18:7 91:8 92:1 107:4,6 111:9 113:8 114:17 123:9 124:7 135:7 185:19 225:20 232:9,10 263:15 264:14 271:23 277:25 293:7 showed 56:10 133:5 194:22 showing 58:17 114:9 135:6 257:8 264:16 shown 75:6 77:15 80:2 82:8 83:2,6 84:20 109:6 111:21 112:8</p>	<p>113:17 114:20 117:5,12 121:11 121:19 125:17 126:15 207:4,5 217:6 270:7 277:15,16 279:9 284:13 292:16 292:23 298:4 shows 54:2,3 111:24 114:10 115:10 132:25 141:15 141:18 149:4 225:16 231:25 232:7 233:5 235:9,12 257:8 258:13 277:22 277:23 278:8 284:20 side 91:9 98:13,25 201:6 234:6,8 238:10 319:18 sign 36:24 37:2 91:1 92:2 96:5,7 253:10 signal 75:8,12 265:22 signature 36:8 signed 36:2 significant 157:23 251:2 270:9,14 significantly 234:19 signing 332:12 signs 97:1 similar 68:20,23 69:6 143:16 198:20 199:20 200:3,7 200:16</p>	<p>similarities 95:21,22 simple 15:11 53:9 101:17 197:12 200:5 221:17 simpler 253:18 302:16 simplest 53:20 54:2 266:18 simplification 220:11 221:1,4,14 simplified 56:10 239:7 simplify 53:8 54:12 simply 17:1 18:7 19:5 28:24 43:23 73:6 91:4 92:18 99:13,19 101:10 108:13 127:4 132:1 134:3 136:12 140:16 145:17,18 177:24 184:5 196:4 210:15 211:23 212:10 214:13 229:25 232:21,23 237:2 240:3 247:8 253:1 261:5,12 267:5 272:8 277:10 279:18 280:3 281:3,10 283:7 303:15 308:11 320:11 328:8 329:22 simulator 186:22 189:3,4 single 32:25 81:12 124:25 143:12 147:2 175:16,21 179:13 222:9 257:3,4,4 276:5</p>
--	--	---	--	--

293:20 294:1 295:15 sir 40:24 52:10 72:15 79:18 119:19 293:13 295:2 313:16 sits 201:13 sitting 96:21 98:3 186:12 305:7 311:12 situations 291:25 six 7:19 25:4 50:13 233:1,3 236:3 236:17 size 82:23 102:5 201:14,18 skill 71:25 72:11 73:4 73:10 112:6 115:19 158:9,20 159:7 160:21 161:12 162:1,9 182:5 183:3 185:5 299:6,17 300:14 307:21 skills 17:3 73:22 74:9 318:19 skimmed 43:23 skip 216:14 slide 304:8,15,16 slides 305:12,21 306:20 309:17 slightly 15:19 41:19 63:10 250:3 270:17	slimmed 266:16 slow 20:25 21:6 34:13 41:3 42:10,11 49:2 61:16 72:16 96:15 100:8 113:4,4 119:5 125:10 127:10 129:25 139:4 140:23 147:10 175:17 179:19 220:1,1 232:15 240:12 240:12 275:23 275:23 281:7,19 281:20 295:18 307:6 slower 136:23 280:1 slowly 200:14 small 124:24 126:22 128:3 149:11,16 159:15 204:21 244:15 social 18:25 society 17:8 software 60:5 258:1 319:23 solve 290:6 somebody 121:8,16 183:17 something's 45:17 somewhat 160:18 191:2 254:17 266:18 soon 100:11 sorry 15:24 21:1 24:21	32:9,9 35:6 40:12 43:7,13 44:7,10,14 49:2 56:17 63:12 72:6,20,23 83:7 91:17 101:25 103:9 104:12 107:3 110:7 119:6 121:12 128:25 135:12 149:13,19,19 154:8 156:7 160:3,7,8 164:5 184:18 192:5,16 198:1,3 199:25 200:4 206:15 209:21 222:16 228:5 253:21 256:21,25 259:5 267:2 274:20 278:20 279:22 280:22 289:9 291:8 295:11,11 296:5 298:1,21 300:4 309:12 325:5 328:23,23 sort 140:11 303:5 sorts 23:4 source 6:5 187:6,11,21 188:7 South 3:20 Spanish 143:19 sparse 195:11 199:21 200:9,17,21 203:24,25 speak 10:4,5 speaker 66:13 speakers 66:17 78:23 85:7	180:12 212:16 294:21 306:24 309:9 325:6 328:20 speaking 10:5 28:3 90:12 270:20 speaks 143:19,20,21 special 23:5 61:10 192:22 specific 12:14 20:14 21:15 26:11 28:11,22 39:9 40:4,5 104:17 104:17 110:22 118:23 162:13 190:12 216:23 216:23 217:12 217:14,15,17,23 218:1,1,2,12,18 218:20,21,22 219:22 220:17 225:23 226:3,4 229:11,14 232:17 245:15 247:17,24,25 249:4 252:4 257:24 258:6,10 273:20,21 289:14 290:10 292:2 298:14 300:12 301:2 316:5,6,7,11,12 316:17 317:17 317:22 318:1,3 320:7 322:24 329:24 specifically 12:25 15:19 24:9 39:19 161:20 241:2 253:23 288:5 322:16 specified 190:5 193:12	330:24 specifies 214:12 223:18 specify 158:15 228:1 295:13,14 326:2 329:14 speculate 287:2,3 spend 32:15 64:10 Spielman 67:25 68:5 70:23 sponsored 24:23 spot 85:21 87:22 94:11 square 201:15 squarely 191:18 stack 29:7,13 stage 66:22 179:11 203:5 204:12,13 stages 203:2 stand 42:6,8,12,15,17 186:19 standard 12:25 110:20 134:12 135:9 136:18,25 137:2 141:2,20,21 146:6 162:2 173:7 192:3 205:24 234:25 240:17 253:5 267:1,4 280:6 294:12 303:7 325:21 326:15 326:18 standpoint 62:13
---	--	---	---	--

start 21:5 34:13 42:11 61:19 82:14 83:23 87:8 97:10 100:5,9 113:5 125:10 127:10 130:2 136:23 139:4 145:25 174:7 175:19 183:16 186:10 198:7 199:5 228:6 229:7 244:12 279:23 289:9 294:10 295:20 323:13 330:22	292:15 293:13 297:4 states 1:1 4:18 7:12,15 8:11 16:14 157:3 199:19 312:17 state-of-the-art 32:3 156:15,15,21 156:25 229:10 statistic 29:18 stays 99:20 stenographically 332:10 step 83:5 121:14 127:22,22 129:9 134:20 156:23 280:2 steps 139:15 279:3,9 stick 173:22 177:3 206:14 261:14 stickers 313:10 sticking 291:9 sticks 56:5 STOCK 68:16 stop 281:6,20,20 328:24 stored 211:24 strange 171:10 stream 75:16 81:19 82:5 87:11 Street 3:12 strict	141:3 185:16 strictly 270:20 292:11 strike 119:16 144:4,7 216:17 221:20 strips 266:17 strive 255:10 strong 192:25 296:12,19 296:24 297:9,12 stronger 175:1,5,8,10,10 strongly 161:25 structure 176:7 201:12 204:9 208:17 217:18 220:5 318:5,13 319:9 321:4,5 326:19 326:21,24 structured 199:9 structures 138:23 struggling 330:2 student 16:23 29:20 150:24 151:11 192:23 studied 96:11 99:5 105:21 116:5 130:18 149:1 171:9 study 18:11 97:22 107:21 122:6 126:5 188:10 studying 145:7 style 271:3	sub 86:20,21,22,22 87:2,2,15,15 88:2,2,18,18,25 88:25 95:3,4,4,5 95:14,15,15,16 187:2,2,3,11,12 187:12 188:1,1 188:1 subblock 285:1,15 286:2,13 subblocks 189:19,22 284:2 284:15,25 285:15 286:2,12 subgroup 188:21 subgroups 188:18 subject 20:1 265:24 submitted 148:12 207:12 251:19 268:12 suboptimal 221:3 suboptimum 220:23 Subpart 322:15 subset 92:16,21 98:15 182:10,11 236:21 244:15 260:23 subsets 89:17 92:15 98:9 98:22 99:2,9 140:1 187:11 236:4,7,11,17 substantial 194:8 substantive 312:10 314:23 subtle 107:23 subtleties	107:20 succeeded 289:13 suffering 10:19 suffices 234:18 sufficient 329:13 suggest 40:21 253:6,13 suitable 135:5 326:24 Suite 3:21 Sullivan 3:4,11 8:24 sum 90:2 91:4 92:19 99:15 101:3,4 summarize 301:14 302:23 summary 239:20 301:11 303:2 summation 90:1 91:11 summer 18:21 summing 89:24 90:5 101:8 sums 89:17,21 superior 239:22,24 240:7 240:24,25 241:7 supporting 241:12 supports 240:3 supposed 28:2 310:19 sure 8:23 13:21 20:18 21:22 23:14 24:4,6 26:14 27:8,21 28:24
--	---	--	---	---

34:2,5 36:12,17 44:23 66:15 78:3 84:21 101:19 102:2,20 121:14 122:11 129:22 136:17 138:10,17 140:2 162:15 173:16 181:2 194:20,21 205:5 213:3,10 228:3 233:19 242:21 243:8 246:12 250:5 268:25 269:6,9 291:14 301:12 302:13,20 309:15 313:2 326:6 surprising 300:3,5 surprisingly 326:25 swear 69:25 Switzerland 11:9 swore 106:3 sworn 9:10 symbol 82:10,15 98:13,24 118:22,24 symbols 97:2,3 118:7,8,8 118:12,14,18,19 119:24 120:2,4 120:6,11,13,14 120:18 176:13 176:15,15 177:19,25 178:16 179:11 symmetrical 198:14,18,21 Symposium 20:17 21:8,19 24:22 25:7	41:16 49:15 50:8 56:1 symptotic 147:3,7 symptotically 147:15 system 99:19,20,21 systematic 109:14,16,17,20 110:1,8,16,23 111:6,24 112:4 112:15,25 113:9 113:16,21 114:11,17 115:11,15 116:18,23 117:5 117:11 118:6,25 121:1,2,9,17,22 121:23 122:1 systems 1:9 11:12 77:7,8 77:20 111:6 system's 137:3 139:10 279:18 T T 4:1,1,5 5:1,1 6:1 6:1 7:1,1 9:15 table 5:6,7,11,14,17,20 103:7,15,18,23 105:10,11 106:6 106:11,12,24 235:9 260:25 take 10:21,25 11:1 35:12 36:10 40:25 41:2 53:18,18 54:12 65:20 81:3 82:5 83:14 90:13 93:6 102:3 110:3 121:21 122:9 126:20 127:22 129:9	156:22 158:19 163:11 166:15 176:12,13 180:25 183:4,17 184:8 185:2 188:10 197:4,7 197:11,14 206:6 226:5 228:25 229:23 230:7 233:22 236:15 237:14 243:17 276:2 277:9 280:3,6 282:6 285:13,22 286:1 286:8 291:7,11 304:7 307:12 309:2,7,16,23 311:3,12 312:4 313:9 321:5,18 326:15 328:22 taken 10:3,11 65:24 105:4 110:11 122:14 145:10 181:6 206:10 243:20 266:4 313:13 331:16 332:6,9 takes 17:19 21:9 22:21 79:22 80:12 81:12 92:18 276:5 talk 18:4 28:17 55:25 89:4 99:23 143:17 145:11 147:8 178:5 204:16 212:15 213:14 225:21 241:21 273:22 286:21 293:20 295:15,19,21 298:19 301:8 talked 19:7 26:15 70:9 70:10 112:18	122:18 137:4 239:3 286:25 talking 30:11 34:8,14 49:11 50:6 52:12 65:11 69:6 70:25 84:13 90:8 93:10 133:20,21 134:17 146:25 147:7,13,14,16 149:22 159:10 159:24 160:10 165:16,25 172:7 178:8 181:11,14 181:21 185:12 185:16 196:7 198:24 200:22 206:24 207:3 217:23 219:15 219:22,24,25 220:3 223:4 227:10 228:15 228:17 230:17 234:11 240:11 253:22 255:19 256:1 257:5 266:10 267:24 278:20,21 288:25 296:16 296:18 297:3,7 298:6 305:16 308:18 318:8 326:6,9 330:18 talks 146:24 154:11 161:1 212:9,11 212:13 218:25 295:7,12,16,22 301:1 tallied 32:23 Tanner 123:6,10,17 134:13 135:23 137:10 149:11 149:16 152:5,9	152:16 206:25 207:2,6 225:1 225:12,18,24 226:8 231:25 233:5 259:14,21 Tanner's 207:8 tape 181:7 265:23,24 task 83:9 310:12 taught 88:1 tautology 106:12 183:15 229:25 teaching 53:13 227:3,15,20 227:25 228:1,3 228:7,25 teammates 49:1,7 technical 18:7 75:15 295:15 296:24 300:17 technically 34:20 94:7 technique 159:17,21 234:5 Technology 1:5 8:9 tell 9:11 22:1 36:13 36:20 83:14 88:18 91:25 105:16 106:3 126:9 130:20 132:1 133:4 145:7 147:19 155:12 168:13 182:14,17 183:10 184:1,12 184:17,19,20 213:19 226:11 229:10,13,19,23 231:1 232:12,18
---	---	---	--	--

247:13 283:6 301:3 302:10 304:21 305:5 307:12 309:17 311:13 321:3 329:2,6,7,9 331:4 telling 179:15,21 182:14 183:21 184:5 330:5 tells 138:5 281:9 term 13:25 14:1 40:9 40:22 41:12 108:17 166:3 305:3,15 306:5 306:7 307:5,9 307:10,22 318:2 329:25 Terminology 118:2 terms 61:11 105:22 106:10 138:18 147:19 156:16 162:12,13 168:19 208:1 229:8 303:23 330:9 testified 9:12 92:10 128:11 133:5 226:7 266:13 280:11 317:15 testimony 40:23 46:1 105:18 160:10 171:20 210:20 216:20 280:14 285:17 290:17 303:14 310:22 311:17 332:8,9 text 86:15 247:8 thank	9:4 41:5 90:17 109:2 123:16 180:16 209:24 216:6 230:20 279:25 298:3 331:9,10,19,21 331:22 Thanks 9:20 29:7 Theis 148:10 theme 173:10 263:15 theorem 56:22 Theorems 5:4 54:20 55:8 theoretic 15:20 theoretical 67:19 68:14,16 156:15 191:19 theoretically 157:4 theorist 145:21 theorists 190:15 theorist's 142:15 theory 17:5,21 20:17 21:9,19 24:23 25:8 41:16 49:16 56:2 70:11 73:4,11 116:15 146:1 190:18,18,20 268:13 thermodynamic 147:16 thesis 15:3 147:25 148:11,14 151:3 151:20,25 152:12,21 154:4 155:18 156:5	163:24 208:2 259:19 they'd 184:10 300:16 thing 10:22 28:23 40:22 46:4 75:11 76:20 94:6,6 114:8 120:1 144:22,25 152:20 155:20 179:13,14,24,25 216:23 217:25 218:2,23 219:18 250:25 257:2 266:17 269:5 293:7 297:13 306:16 things 19:5 33:8 56:10 104:10,15 105:15,20 107:24 146:4,7 147:17 154:11 174:23 179:23 184:21 225:6 284:7 297:6 300:24 304:1 305:13 306:9 323:25 325:3,5 330:20 think 12:19 13:5 16:8 21:15 22:1,12 25:9 27:16 34:19,19 56:13 57:16 62:16 63:6 64:6,11 66:12 67:7 86:19 91:3 94:7 95:13 141:25 152:19 154:2 155:1,20 161:25 162:14 170:18 171:5,17 174:12 184:15 191:12 191:14 195:2	204:17 210:14 212:9 230:21 238:6 245:23 248:7 272:7 273:13,17,19 275:20 298:20 307:9 331:8 thinker 16:25 thinking 52:1 87:6,10 155:22,23 third 26:3 43:7,8 75:20 75:23,25 153:1 166:6 268:5 270:1 thought 24:15 53:11 72:7 74:10 154:19,25 155:1,5 156:19 172:12,17 213:15 248:16 306:13 thoughtful 97:23 thousand 20:20,21 21:11 197:13 thousands 197:14 three 4:10 35:18 43:9 62:8 66:25 99:5 129:12 131:11 131:12 133:16 145:3 148:24 162:17 166:12 168:7,14 172:22 187:11 188:18 189:19 233:6,7 236:7 241:24 261:21 262:4 275:13 276:18 three-years 116:16 tie	179:15,22 time 8:15 16:9 18:16 18:21 19:2,16 23:13 24:1 26:14,20 27:19 28:1,22 29:22 32:16,17 34:8 34:14 35:5 36:1 38:12 40:8 41:12,20 42:1 47:19 48:6 53:2 53:5 55:13,15 55:16 56:16,19 57:11 61:14,21 61:22 62:1,1,10 64:10 65:23 66:1,18,21 67:5 67:14 73:18 76:14 90:13 99:13,21 119:2 119:3,8,9 121:15 122:13 122:16 129:9 135:4 136:19,24 137:1,3,9 141:21 148:19 154:25 155:6 156:19,23 158:22 159:23 159:23 161:20 165:20 166:18 166:21 171:23 196:21 197:2,17 198:7 201:10,23 204:24 206:9,12 207:18 238:15 241:10 243:19 243:22 253:17 263:7,20 269:13 271:11,19 272:22 281:21 289:5,18,19 293:20 300:6 309:3 311:4,6 313:12 316:8 322:12,12
---	--	--	--	---

324:16 325:1 327:1 328:22 331:15 timed 193:12 times 28:16 35:1 59:2 78:15,18,20,22 79:6,23 81:4,13 82:22 123:4 128:21 129:4 179:9 182:11,12 182:23,24 183:12,13,19 189:23 203:16 209:15 210:11 231:16 272:23 273:4,12 274:10 275:1,5 276:7 276:18,21 284:4 284:7,17 285:1 285:16 286:3,13 293:17 327:3,12 327:22 328:5 title 30:3,3 165:21 186:21 215:10 251:22 titled 154:5 315:3 today 8:16 9:1,5 10:16 14:1 26:25 27:9 28:6,13 29:12 30:9 35:13 83:24 96:21 98:3 106:2 153:20 186:12 247:7 256:14 288:25 326:7,10 Today's 8:14 told 71:19,20 105:11 185:7 204:6 246:8 283:4 307:9	Tong 31:16,21 tool 53:14 toolbox 115:19 tools 198:3 top 123:24 124:17 125:16 133:12 133:15 138:1,8 140:7 163:25 164:6 186:15 201:14 220:8 226:14 227:5 228:11 229:4 230:9,22 233:3 259:1,6 261:4 268:20 271:22 278:3 279:20 topic 23:7 topics 22:23,24 50:8 191:23 total 23:24 201:15 221:10 tower 15:15 toy 53:13 126:22 traditional 67:2 69:3 142:14 145:21 trained 192:18 training 192:17 transaction 24:21 transactions 24:11 268:13 transcript 4:6 10:11 12:3 30:20 42:23	49:22 50:19 54:24 111:13 114:4 117:17 123:13 124:11 131:3 136:3 148:3 165:7 185:24 215:4 244:3,6 249:15 265:21 287:9 301:25 311:25 312:21 313:20 314:13 315:8 332:7 transfer 86:18 95:12 transform 34:8,15 transformed 77:22 110:12 translation 143:22 transmission 67:22 transmitted 118:6 transmitting 195:25 treat 176:14,22 177:1 177:25,25 treats 177:18 tried 53:5,8 93:20 248:7,8 263:11 301:13 302:22 323:16,22 324:6 324:11,14 trivial 53:22 58:6 145:12,17 147:13 181:20 182:1 278:18 279:1 triviality 187:17,22 trouble	21:3 true 17:6 46:19 47:13 62:2 63:2 79:20 92:9 104:8,11 104:16 105:15 105:21 106:6 117:9 128:14 134:8 138:6 156:12 161:6 167:22,23 168:4 169:6,9 218:15 218:17 220:15 235:1,6 240:6 280:5 323:9 332:7 truncated 86:17 93:12 95:11 trust 46:18 153:13 truth 9:11,12,12 103:7 103:15,17,23 105:10,11 106:3 106:3,4,6,11,12 106:24 truthful 10:16 try 52:24 84:7 103:5 223:14 285:25 294:24 324:1 326:3 trying 15:14 16:3 52:13 53:6,23 60:21 67:4 136:15 145:8 264:17 303:5 325:1,8 Tung 31:9 turbo 15:4,7,8,18,23 16:5 50:8 52:22 52:24 53:16,18 54:3,5,6,12 56:9	56:21 58:14,15 58:19,23 66:23 67:4 110:5,7 142:6 164:24 166:9 167:10,11 169:23 173:9,10 174:9 243:11,13 254:14,18 257:15,21 258:5 258:6,7,10,14 258:20 262:16 263:5,22,25 264:4,7,14,21 264:24,25 265:3 265:5,5 266:14 266:19 267:20 267:25 269:12 271:5,7,7,10,11 271:18,24 272:15,21,24 273:3,11,25 287:17,19 288:2 288:4,10,13,20 289:12 290:15 290:17,19,20 297:15,17 298:11,12,14,17 298:18,19,23,24 299:3 300:2 322:19 Turbocodes 6:23 Turbo-Like 5:4 7:9 54:20 55:8 turn 26:22 36:7 43:17 48:20 52:7 93:6 93:7 117:24 142:1 149:3 150:8 154:7 156:20 163:24 166:24 167:13 169:16 196:5 202:15 204:19 215:13 220:8 224:9 242:9
---	--	---	--	---

<p>244:18 251:16 255:12 267:15 268:2 273:24 278:14 283:24 295:25 297:23 301:15 318:23 322:15 323:12</p> <p>turned 70:18</p> <p>tweaking 271:24 272:5,15</p> <p>tweaks 60:18</p> <p>twice 276:15</p> <p>two 4:21 7:24 17:18 19:10,12,20 35:14,18 58:4 66:12 67:6 90:12 91:7,8,8 92:1 96:19 98:3 101:3 102:23 105:20 106:25 107:3,6 116:16 125:14 128:5 132:16 133:15 133:19 139:14 145:3 147:17 148:24 154:15 155:8 158:10 167:24 168:1,5 190:10 208:9 210:4 223:2 237:16,17,20,24 263:21,23 274:25 275:10 287:19 289:2 304:18 328:22</p> <p>type 32:25 33:8 58:17 198:20 206:3 217:12 218:21 218:22 219:13 239:12,14 240:9 240:10,15,18 255:25 259:18</p>	<p>263:12 278:16 278:24 292:12 293:24,25 297:1 303:25 325:19</p> <p>typed 33:2,3 303:25 304:2,5</p> <p>types 71:4 168:9,14 257:9 323:16,17 323:22</p> <p>typewriting 332:11</p> <p>typically 17:1 21:10 22:21 23:8 67:3,3 196:3 214:13 255:9 264:16 293:23 309:23</p> <p style="text-align: center;">U</p> <p>U 5:1 6:1 7:1 23:16</p> <p>Uh-huh 25:6 26:16 29:21 59:8 99:1 141:14 188:16 200:8 217:5 224:13 258:3 259:10 271:4 282:9 317:1,11 319:20</p> <p>UIUC 23:8</p> <p>UK 22:11 66:16</p> <p>unable 145:4</p> <p>unaltered 109:19</p> <p>unaware 143:4,6</p> <p>uncomfortable 85:21 93:21 96:12,17 330:22</p> <p>uncommon 264:7,9</p> <p>understand</p>	<p>10:9 33:9 36:12 37:12 39:22 40:14 44:2,15 44:20,24 45:5 45:16 52:24 53:3 54:7 64:23 68:2 69:5 80:20 80:21 85:2 86:1 92:2 102:20 108:20 120:3,10 131:13,16 137:8 139:12,13 145:5 145:23 146:15 146:18,19,22 159:7 160:22 161:12 162:9 166:11 174:12 182:15 238:6 256:14 263:12 277:25 300:11 303:9 310:19 329:3,11 330:23</p> <p>understanding 14:4 21:3 22:7 44:4,6,18 51:25 54:10 69:20 88:13 113:14 116:2 121:22 136:7 140:3 147:10 182:21 248:14 307:20 307:22,25 308:5 308:9,15,20 327:20 328:19</p> <p>understatement 272:9</p> <p>understood 11:3 252:24 257:5 303:18</p> <p>undertaking 145:12</p> <p>Unfortunately 204:23 247:3,10 248:3,10 249:3 252:13</p> <p>uniformly 63:5,16</p>	<p>United 1:1 4:17 7:11,14 8:11 16:14 312:17</p> <p>university 23:9,15 34:20,21 34:22 66:15 70:6</p> <p>UNIX 247:9</p> <p>unspecified 329:17</p> <p>updated 99:21 100:12 102:13</p> <p>upside 230:21</p> <p>upstream 176:19</p> <p>Urbana-Cham... 23:9</p> <p>Urbanke 1:16 2:1 4:2,7,9 4:12 5:2 6:2 7:2 8:8,25 9:9 11:6 12:1 28:5 30:18 42:21 49:20 50:17 54:22 105:2,6,9 111:11 114:2 117:15 123:11 124:9 131:1 136:1 148:1 165:5 181:4,8 185:22 215:2 243:23 244:1,4 249:13 265:19 266:2,6,9 280:11 287:7 301:23 311:23 312:19 313:18 314:11 315:6 331:23</p> <p>Urbanke/Richa... 251:17</p> <p>URL 245:18</p>	<p>Urquhart 3:4,11 8:24</p> <p>usable 127:1</p> <p>use 30:16 51:4 68:25 88:14 126:23 137:10 159:17 166:3 198:20 200:25</p> <p>uses 134:10 151:15</p> <p>U.S 4:13 13:10 313:17</p> <p style="text-align: center;">V</p> <p>v 1:7</p> <p>vague 25:12 33:20 43:5 44:4 45:9 57:14 60:16 61:6 63:24 81:9 101:9 112:1,9 115:21 118:15 131:24 132:19 158:12,23 166:1 178:23 179:4 184:21 219:14 227:7 235:4 255:8 262:5 264:3 283:2,18 285:4 291:1 293:3 294:20 297:18 299:1,23 300:20 320:9,19 321:11,12 322:5 324:7,19 325:4 326:1 327:4</p> <p>vaguely 190:5</p> <p>valid 135:7 140:12 277:19,19,20,21 280:18</p> <p>validity 4:13 290:14</p>
---	--	--	---	---

value 101:24 102:14 211:24 223:24	verbally 177:6	141:21,22 273:16,20 279:19	229:21,21,21 232:14,14 238:1 240:12 256:20 256:20 275:23 279:22,22 281:5 281:5,19 294:9 294:22,22 295:18,18 306:25 309:10 309:10,10 328:21	111:5 113:1,2,6 113:7,8,9,16,16 113:21 114:11 115:10 121:10 121:18,25 123:22 124:4 126:9 130:20 136:18 138:25 139:3,6,11 143:7 146:4 147:1 151:23 155:12 163:10 165:25 171:1 172:24 173:7,12 174:1,6,16,21 175:12,13 176:9 178:1,17,24 179:6 180:2 190:23 192:15 192:20 195:19 201:24 203:6,9 211:2,20 214:6 214:19 216:10 216:17,21 221:13,17 223:16 224:3 233:12 241:21 247:4 250:17 252:23 263:14 264:12,16 269:16 271:7 273:15,20 278:5 278:6 279:13 280:9 282:10 284:1,6 291:3 292:7 297:20 300:8 311:13 319:21 320:1,3 320:15,17 322:4 329:2,7 330:16 330:21
valued 17:4	verbatim 168:23 169:6	viewed 83:17 86:16 95:10 190:22	walk 75:3 79:25 80:20 86:13 276:9	
values 197:7	versed 293:12	viewing 273:15	Wang 163:6	
variable 135:11 208:12,21 209:18 210:2,24 212:2,3,3 259:23 260:4,10 260:16,20,24 261:17,20 262:2 262:3 300:8 320:2 325:10 327:23 328:3 331:1	version 30:17,17 49:13,13 52:22 53:16,20 54:2 68:9,10 69:21 123:2 125:3,20 157:16 157:20,20 164:20 194:7 207:15 221:3 239:8 242:20,25 243:5,7 249:21 250:3,16 251:1 251:2 262:9 266:14,16,18 267:1,4 318:20 326:18	viewpoint 110:10	want 39:25 64:3,10 163:19 183:8,18 185:2 225:20,21 230:14,15 245:6 256:15 280:17 280:18 310:9	
variables 187:15 188:9 210:1	versions 164:23,25 263:22 263:23	virtual 20:23 21:13	wanted 12:22 58:15 111:23 115:14 121:9,17 123:21 125:7 135:7 174:20,21 175:11 182:6 219:18 264:8 283:25 299:8,18	
variations 173:10	versus 8:10 118:25 133:15 190:15	visible 98:19	Wash 23:16	
varied 197:6	video 8:7,15,17 10:11 105:1,5 266:1,5	visited 18:20 19:3,13 23:2 66:11 193:19	Washington 23:15	
varies 99:10	videographer 3:25 8:7,16 9:4 65:22,25 104:25 105:5 122:12,15 181:3,7 206:8 206:11 243:18 243:21 265:25 266:5 313:11,14 331:14,17,22	Vitae 4:9	wasn't 45:19 307:4	
variety 18:2	videotaped 1:16 2:1 8:8 41:2	voice 8:20	waste 27:19 28:1	
various 25:23 26:18 33:3 51:16,24 56:14 57:6 64:4 65:15 68:7 73:19 77:9 85:20 119:10 138:25 139:12 145:11 174:10 191:20 209:9 223:19 226:11 290:15 324:9	Vienna 34:20,21,22	wait 19:16,16 34:11 42:10 49:2 58:20 68:1,1,22 72:14,14 78:24 82:12 87:7,7 88:5,5 90:10,10 96:14 100:8,8,8 104:12 113:4 116:6,6,6 119:4 127:8 128:23,23 128:24 129:25 135:12 136:22 136:22 140:21 140:21 147:4,9 147:9 149:13 170:21,21,21 174:4 179:17 180:13 191:8 198:6,6,6 200:12,12 212:17,17 220:1	way 45:1 46:16 47:5 52:1,4 53:8 54:6 63:10 64:1 84:7 92:2,5,7 93:5,13 94:10,11 103:6 107:16 110:12	
vary 209:20 225:5 258:2	view 77:8,20,21 111:6 137:3 139:10		ways 15:17,20,20 51:24 57:6 90:22 91:18,22 92:7 112:4,12 113:14 115:15 117:2,4	
varying 234:7 270:8				
vector 60:8 203:7				

117:10 124:2,6 125:22 141:7 172:19 173:4 174:10,17 175:2 176:1,3 178:2,3 179:8 194:8 226:1 284:5 297:21 320:4 324:5,9 325:1,8	150:12 206:2 226:13 234:5 236:17 266:20 288:25 291:13 314:18,24 315:25 317:8 326:6,9	36:23 40:12,14 40:17 42:13 43:6 44:11,14 46:2 47:2,22 48:12 57:16 58:22 60:17 61:9,20 62:5,10 62:25 63:5,25 64:19 65:9 68:3 68:24 71:15 72:20,23 75:15 76:12 77:5,20 79:5,11 80:11 81:3,11,25 82:15 83:9 85:8 85:18 86:9 87:4 87:9,18 88:4,9 89:12,20 90:1,8 90:14,20 91:14 91:17 92:18,24 93:19 94:4,22 95:21 96:2,11 96:16,25 97:20 98:5,12,18 99:4 100:10 101:10 102:2 103:23 104:4,10,15 105:19 107:6,12 107:20 109:1 110:7 112:3,11 113:7,20 114:15 115:14,23 116:4 116:11,22 117:9 118:17 119:6 120:18 121:21 124:2,23 125:20 126:5 127:11,16 128:25 130:3,17 131:25 132:9,20 135:14 136:25 139:6 140:24 147:6,12 149:15 150:23 151:6,11 151:19 152:12 152:19 154:2,24 158:14,24 165:19 166:2,14	168:18 170:4,20 170:25 171:21 174:8 175:20 176:24 178:24 179:6,18,21 187:20 191:10 192:6 198:8 200:15 204:21 205:3,5 209:23 209:25 210:21 216:5,21 219:15 220:4 227:9,24 228:14 229:7,23 230:18 232:6,16 233:10 235:6 238:3,21 240:14 246:22 252:9 255:9 256:21 257:1 258:19 262:7 264:4 267:4 275:25 279:23 280:2,15 281:8,22 283:4 283:20 284:20 285:6,20 286:7 286:17 289:10 290:4 291:2,24 293:5,19 294:11 295:7,21 296:5 297:20 299:2,12 299:25 300:23 303:15 305:2,12 306:4 307:3,8 307:17,25 309:1 309:12,22 310:8 311:2,18 319:15 320:11,21 321:13 322:6 323:4 324:9,20 325:5,16 326:2 326:15 327:5,14 328:23 331:7,10 332:18	76:18 94:7 108:6,9,11,13 108:24 109:1,6 109:19,20 112:12 114:9,11 114:21 115:5 118:12 121:5 143:12 147:2 195:24 196:1,4 203:14 210:23 211:10 216:18 260:6,17 270:7 270:16,18 274:11,14,24 275:3,4 276:4,6 285:22 327:6,6
web 57:2	whatever's 101:5			
website 245:19,22 246:10 246:11 250:12	whatsoever 58:7			
Wednesday 1:18 8:3	When's 55:13 166:18			
weeks 35:14	WHEREOF 332:18			
weight 56:12 167:18 289:22	white 133:22			
welcome 9:21 16:16	widely 71:10			
well-defined 90:21 103:3 330:1	wider 13:14 14:22			
well-known 18:1	WILMER 2:5 3:19			
went 23:15,22 53:7 303:4	WilmerHale 9:2 10:10			
we'll 10:21,25 11:1 27:23 122:7,7 157:24 162:5,5	withdraw 232:22,25			
we're 10:9 26:4 30:11 57:9 90:8 136:22 178:8,15 178:16 185:16 228:17,20 240:10 242:18 293:24,25 298:6 308:18 330:18	withdrawn 13:16,24 17:11 46:10 48:3 90:25 99:8 109:13 117:3 144:9 156:7 167:25 171:14 202:15 209:12 221:6 233:4 261:17,25 272:12 280:22 291:8 321:8 329:8			
we've 70:25 84:18,19,19 107:17 120:15	witness 13:21 14:8 16:2 16:11,21 19:19 21:1,4,7 25:14 25:22 27:4,5,11 27:14 29:5 31:12 33:22			
				words 21:14 45:5,14 95:22 112:14 145:1 146:14,16 148:19 256:15 270:13 287:19
				word-for-word 33:17
				work 11:7,13,22 14:21 15:2 18:7 33:7 66:20 69:13 71:16,21,21 84:5,12 158:21 190:17 193:8 194:19 205:23 215:22 222:25 241:17 242:14 242:16 253:7 263:13 270:5 281:15 287:17 288:19 289:17 290:6 309:23 317:12
				worked 18:14,17 30:12 244:15 263:13 263:24 264:6
				working 17:8 32:15 57:12 67:1 71:3
				wonder 274:23
				word 32:25 34:21 47:2

115:19 142:14 148:23 191:22 192:1 241:15,18 289:6,21,22,24 324:5 works 75:4 80:1 85:12 88:9 180:3 193:22 195:19 203:6 205:25 282:10 workshop 66:16 workshops 17:17 145:8 world 110:4,5,8,19 127:1 192:15,21 275:21,21,22,25 276:1,1 worse 63:19,21 321:20 wouldn't 87:24 154:3 183:19,23 241:16,16 wrap 233:17 write 226:21 230:14,16 256:16 writing 28:8,23 148:20 302:21 written 33:5 38:20 39:18 80:14 84:14 86:9,10 94:4 95:24 100:22 104:18 143:8,8 144:17 146:2,9 146:20 151:6 226:18 229:12 230:22 232:11 245:12 246:2 256:10 270:17 280:15 285:18	285:20,21 287:18 290:4 303:8 wrong 39:23 183:10 wrote 28:7 29:23,24 32:24 33:1 256:16 265:14 303:2 <hr/> X x 1:3,14 4:5 5:1 6:1 7:1 9:15 86:20 86:21 87:2,2,4 87:15,15 88:2,2 88:17,18 95:3,4 95:14,15 97:2 107:8 XN 88:22 89:9 XOR 89:16,24 91:10 92:11 107:12 X1 87:5 88:22 89:9 89:13 92:16,21 98:8,13 99:10 99:18 X2 92:22 98:22,24 99:11 <hr/> Y Y 86:21,22 88:25,25 95:4,5,15,16 107:8 yeah 19:24 22:10,12,15 32:9,10 34:16 35:16 41:1,4 69:19 118:17 121:14 year 17:20 21:9 23:17 23:18,20 38:21	69:14 120:22 269:8 yearly 20:16 22:20 23:1 years 17:18 19:11,12,20 23:22,23,24 24:3 25:5 145:3 145:10 148:24 269:7 323:18 Year's 31:18 yield 81:7 217:20 yields 217:7 218:8 292:17,24 YN 89:2 92:15 98:10 98:16,22 99:2 York 3:7,7 Y1 89:2 92:14,16,18 98:9,15 Y2 92:21 98:22 99:2 Y3 98:22 233:4 244:20,22 277:8 297:5 298:7 <hr/> \$ \$500 37:11 <hr/> 0 0 92:1 100:17,21 101:1,21 103:1 103:8,8,9,9,9,9 106:7,7,8,9 0s 195:14 200:23 0.15-dB 272:1 298:23 032 37:16 38:3 39:1	05 6:17 09/28 186:16 <hr/> 1 1 1:24 4:8 11:24 12:1,6,23 13:3 78:4 92:1 100:19 101:1,20 187:2,11 188:1 207:4 235:9 254:6 271:2,2 273:6 274:17,19 278:18 279:1 319:12 1A 207:5 1s 195:14 200:23 1.4 149:20,23,24 1.6 152:3 1:18 p.m 122:16 10 5:5,11 23:24 107:2,3 123:10 123:11,15,17 124:16 128:17 128:19 129:2 130:25 132:14 132:25 133:5 134:6,14 138:8 139:21 140:4,15 141:19,23 145:10 156:5 226:5,8,13,18 226:21 227:4,20 228:10 229:3,12 230:7,13 231:1 235:13 236:7 239:23 241:6 242:10 100 23:14 197:11,12	269:8 274:15 313:1 10010 3:7 11 5:9,14 6:10 7:9 124:8,9,13,16 124:20 125:17 125:24 126:13 126:16 127:23 128:12 129:11 129:18 11:03 a.m 65:23,24 11:11 a.m 66:1 11:55 a.m 105:3,4 111 5:6 114 5:7 115 5:25 117 5:8 119 303:23 12 4:8,19 5:17 6:4 130:23 131:1,5 131:17 132:3,14 139:21 140:14 141:15,23 160:1 160:11 231:19 231:25 233:4,5 242:10 12/08/1999 7:5 12/8/1999 287:15 12:08 p.m 105:7 12:27 p.m 122:13,14 123 5:11
---	--	--	---	---

124 5:14 12807 1:25 2:15 332:4 332:25 13 5:20 135:22 136:1,5,7,9,11 137:11,14 138:8 138:14 139:20 149:22 131 5:17 131072 272:2 135 160:11 136 5:20 139 204:16 14 5:23 147:24 148:1,5,11 235:12,13,24 236:10 239:21 239:23 241:7 141 163:2 148 5:23 15 6:3 149:5 150:5 150:11,16 165:2 165:5,9,16 166:19 169:16 194:25 195:1 238:14,22 240:19 241:2 251:4,11,12,16 323:12 152 117:24 121:10,18 142:2 153 169:10 154	172:10 155 172:16 16 6:5,5 185:20,22 186:2,6,11 187:16,21 269:7 315:21,25 165 6:3 17 6:7 214:25 215:2 215:6 233:24 292:14 17th 32:18 35:1,8 36:3 1765 314:10 177 265:8 18 6:11 243:25 244:1,8,12 245:2,6 246:5 250:1,7 298:1,1 301:18 302:17 1822 271:22 1824 273:24 1826 297:24 1827 268:3 1847 166:25 185 6:5 1850 167:13 1873 185:21 19 6:15 45:3,6 46:22 46:23 47:9,17 48:5,8 243:25 244:4,9,18,24	245:2,7 250:1,7 1925 54:21 1990 23:16 1992 23:14,18 1997 24:2 120:20 158:22 163:12 207:7 1998 69:13 110:2 112:7 115:20 120:23 150:12 162:10 185:10 185:12 186:15 295:3 1998/1999 323:21 1999 6:17 71:25 74:15 112:7 116:17 145:7 157:19 158:11,22 162:10 165:4 166:21 167:22 168:4,6 169:13 183:3 193:24 194:4,9 245:8,9 245:22 246:16 246:16 249:11 249:21 250:7,8 250:21 251:18 252:6 255:6 256:16 268:19 269:11 288:3,11 288:15 290:20 314:10 1999/2000 253:17 <hr/> 2 4:11 30:15,18,22 31:23 90:5 97:7 97:14 102:17 103:12,13,16,18	103:23 105:5,10 106:7,10,13,16 106:18,22,23 107:17 166:24 169:16 172:1 181:4 187:2,12 188:1 204:20 205:7,9 206:16 258:24 259:1,4 259:6 261:3,15 261:18 273:25 273:25 274:2,21 275:8 279:8,9 279:17 280:23 282:14 283:1,12 283:16 284:13 285:21,21 291:8 322:17 2A 172:1 2B 172:1 2:13-cv-07245-... 1:8 8:13 2:29 p.m 181:5,6 2:41 p.m 181:9 20 6:18 246:23 247:2 249:10,13 249:17,24 250:8 250:11 251:13 251:22 252:1,5 252:12,17 254:4 2000 24:2 41:17,21 57:11 66:19 69:13,14 145:8 169:5 190:14 301:18 302:17 2001 157:14,15,20 160:4 194:7 207:15 2002 152:13,21 154:5	155:1 2004 70:7 2005 70:7 2013 19:23,24 2015 1:18 8:3,14 31:5 123:19 141:22 207:1 332:19 2015-vision 233:11 2018 169:6 206 94:17 21 6:22 265:17,19 267:15,17 269:10 288:2,9 288:12 290:20 297:23 2100 3:21 212 3:8 213 3:23 215 6:7 22 7:3 235:13 236:3 236:15 239:21 287:4,7,11 288:16 291:9,13 22nd 3:6,13 23 7:6 107:3 301:21 301:23 302:2,11 302:17 304:6 311:15 23593 244:8 24 7:8 93:8,14 97:5
---	---	---	---	---

261:8 311:20,23 312:2,7,11 244 6:11,15 249 6:18 25 1:18 7:11 8:3 312:16,19,23,25 313:4 25th 8:14 35:14 26 7:14 298:2 313:17,18 26th 332:19 265 6:22 27 7:17 159:15 314:7,11,15,19 314:24 28 7:21 142:12 186:15 315:2,6 315:10,12,18 318:24 287 7:3 29 142:19 3 3 4:17 13:7 14:5 42:19,21,25 43:14,19 74:23 75:6 76:21 77:1 77:16 83:2,24 84:5,11,20 85:3 85:15 86:4 93:7 93:7,10,11 96:23 107:2 108:2 109:7 110:25 111:24 112:18 113:15 114:12 115:11	116:18 117:5 121:9,17 137:10 149:10 154:8 155:7 156:5 172:6,22,24 174:14 176:7 178:18 181:7,12 181:22 183:4,18 184:9 185:2 188:15 189:10 189:13 206:15 222:19 225:10 225:16 259:1 261:4,15,18 263:2 266:1 271:2 279:3,16 279:18 280:2,22 283:25 285:2,14 286:1 290:24 319:17,18,19,21 320:6,11,15,17 321:4,9 322:3 3's 320:21 3.1 222:17 3:14 p.m 206:9,10 3:20 p.m 206:12 30 4:11 18:3 319:13 319:14,15 301 7:6 31 322:16 311 7:8 312 7:11 313 7:14 314 7:17 315 7:21	3293 152:24 3301 163:24 164:3,4 3311 149:3,18,20 151:14 3312 149:19 3315 152:2 332 1:24 3331 164:3 3345 154:8 3354 154:7 34 262:24 3400 150:8 35 7:7 350 3:20 36 6:20 36:7 37th 268:18 39 4:15 4 4:20 49:17,20,24 49:25 255:12,19 255:20 266:5 298:6 312:4 313:24 314:17 315:13 4,623,999 7:15 4/05/1999 6:14 4:08 p.m 243:19,20	4:16 p.m 243:22 4:47 p.m 266:3,4 4:56 p.m 266:7 415 3:15 42 4:17 7:12 443-5309 3:23 4623999 313:17 49 4:20 5 4:23 34:3 50:16 50:17,21,24 51:15,22 52:3 74:24,24 75:7 93:8,11 95:9 242:6,7 257:8 258:3,12 262:12 262:25 278:15 298:5,7 317:9 317:10,17,23 5th 245:8,12,13 250:7 5.1 83:7,21 85:16 86:5,14 89:6,8 98:12 107:1 50 3:12 4:23 32:21 309:1 51 3:5 52:11,15 514001 311:22 54 5:3 79:19 57 52:7,10 578 163:2	579 163:3 58 52:10,15 6 6 5:3 54:16,22 55:2 70:2 74:22 85:6 137:4 172:8,9 181:14 225:11 249:11 288:24 289:25 303:1 6th 249:20 250:8,12 251:3 6,081,909 7:12 312:17 6:00 p.m 313:12,13 6:11 p.m 313:15 6:39 p.m 331:15 6:39 331:16 6:46 p.m 331:18,24 6:46 331:25 60 304:24 60s 67:13 208:2 6351 43:19 650 2:8 6584 304:9 661 304:12 6616 304:10,15 67 323:14 68 323:13 324:2,13
--	--	---	--	--

<p style="text-align: center;">7</p> <p>7 5:6 95:1 110:24 111:10,11,15,24 112:8 113:17 137:5 154:20 215:23 216:2 7,116,710 4:14 7,421,032 4:14 7,916,781 4:15,18 710 37:15 38:1,24 75 253:14,22,23 77059 1:23 781 37:16 38:5 39:3 42:20 43:11,14 93:6 94:17 96:6 96:23 107:2 79 32:7</p> <hr/> <p style="text-align: center;">8</p> <p>8 5:7 113:24 114:2 114:6,8,10 115:9 116:19 117:6 118:11 121:11,19 137:5 202:17,18 8,284,833 4:15 80s 207:9 82 48:21 50:6 51:1 316:22,25 833 37:16 38:7 39:5 84 317:3 849-7000</p>	<p>3:8 85 303:23 858-6000 2:8 87 301:16 302:18 875-6600 3:15</p> <hr/> <p style="text-align: center;">9</p> <p>9 4:3 5:8 117:13,15 117:20 195:3 196:8 296:3,4,5 9:57 a.m 8:15 9:57 1:19 8:4 90071 3:22 909 313:4 925 215:13 292:15 926 220:8 221:8 928 222:16 929 222:11,14,16,16 222:19 93 52:25 66:24 264:5 930 202:15 931 233:23 234:1,16 932 235:9 933 238:8,9 243:9 93390 244:9 934 242:10 937</p>	<p>196:10 199:19 938 206:15 939 204:19 205:7,9 94 296:1 94111 3:14 943 202:16,18 94304 2:7 944 296:7 95 66:24 950 2:6 8:18 97 32:8,9 40:2 51:9 71:8 72:1 73:5 73:11 74:16 117:14,23 121:10,18 144:15 154:16 154:20 155:9,14 155:25 156:9,12 156:14,22,24 158:2,25 159:8 159:14 160:23 161:8 163:4 164:2,8,16,19 195:2 196:10 198:25 199:6 200:25 202:9,10 206:14 207:21 208:16,20 214:6 214:18 216:2,8 217:4,13,25 218:25 219:11 219:22,23 262:21,25 291:25 292:4 295:25 299:14 299:18 318:6,14 319:10 325:18</p>	<p>98 32:7,10 40:3 51:9 55:16,19 57:11 66:18 71:8 72:1 72:12,12 73:5 73:12 74:16 144:16 154:16 154:20 155:9,14 155:25 156:9,12 156:14,22,24 158:2,25 159:11 160:5,22 161:7 161:9,13,13 162:3 164:2,8 164:16 167:6,9 168:2 182:6 186:16 193:7 215:1,10 216:8 217:3,19 218:6 219:10 220:9,16 223:23 226:23 227:13,15 228:14 229:1 234:2,17 238:18 239:3,20 240:5 240:23 241:6,23 242:5,14,17,19 242:20,23,24 243:1,3,5,6 262:22 263:2 269:24 270:18 292:1,6,14,22 299:14 318:7,14 319:10 322:16 322:18</p> <p>99 32:12 40:3,3 51:9 57:10,11 69:16 69:21 70:2,2 71:9,17 74:16 144:16,16 157:8 158:2 159:16,18 159:19 161:9 167:25 168:2,23 169:17 182:6 190:14 193:7,15 194:1,3,15,18</p>	<p>207:11,17 244:17 245:3 246:9 247:18 251:5,14,15 254:5 262:13 265:10,14,18 267:21,24 268:6 268:11,13,15 270:2,23 279:9 280:24 281:14 282:14 283:11 284:24 287:14 292:1,11 297:24 298:17,22 299:14 300:14 300:15 318:7,14 319:11 323:10</p> <p>99's 271:18</p> <p>999 313:25 314:4</p>
--	---	---	---	---