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BEFORE THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

UNITED STATES OF AMERICA, et al., .
Plaintiffs, . Case Number 20-cv-3010
vs. .
GOOGLE LLC, . Washington, D.C.
Defendant. . October 18, 2023
9:32 a.m.

TRANSCRIPT OF BENCH TRIAL, DAY 24
(MORNING SESSION)
BEFORE THE HONORABLE AMIT P. MEHTA
UNITED STATES DISTRICT JUDGE

APPEARANCES:

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12 Proceedings recorded by stenotype shorthand.
13 Transcript produced by computer-aided transcription.
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P R O C E E D I N G S

(Call to order of the court.)

COURTROOM DEPUTY: Good morning, Your Honor. This is Civil Action 20-3010, United States of America, et al., versus Google, LLC.

Kenneth Dintzer for the DOJ, William Cavanaugh on behalf of Plaintiff States, John Schmidlein on behalf of Google.

THE COURT: All right, everyone. Good morning. Nice to be with you all again.

All right. Before we get started, I wanted to just check in and see where the parties were in terms of the submission that *The New York Times* made last evening and your thinking and preparedness to discuss the proposed changes.

MR. SCHMIDTLEIN: Your Honor, for Google, we would like an opportunity to make a written submission in response to that. And I think we will be in a position to file something later today on that, if that would be okay with the Court. But we would like the opportunity to respond in writing to it.

THE COURT: Sure. Of course.

MR. DAHLQUIST: Thank you, Your Honor.

We've reviewed -- we do not feel a need to file a written submission, but we are prepared to address it at your convenience today and go through step by step, if that's your preference.

THE COURT: Okay.

1 MR. DAHLQUIST: I will say at the outset that we --
2 our belief is that the order, Your Honor's order as it exists,
3 could stay as it is today and that there's no need for
4 modification.

5 That being said, if Your Honor is interested in some of the
6 proposed modifications, we're happy to tell you our views on
7 each one.

8 THE COURT: Okay. And just in terms of timing,
9 Mr. Schmidtlein, when you say you expect to file something
10 today, are we talking about during the business day? Later this
11 evening?

12 MR. SCHMIDTLEIN: I think it's going to be later this
13 evening, because I've got people here in court that need to --

14 THE COURT: Fine. Just in terms of notifying counsel
15 for *The New York Times* about when he may need to appear to
16 discuss it.

17 Let me just -- in the interest of sharing my thoughts on
18 where things stand, I just want to point out a couple of key
19 cases from the D.C. Circuit that I think everybody ought to be
20 aware of, if you're not already, and how it affects some of the
21 requests that have been made by *The New York Times*.

22 I think most pertinently, everybody ought to take a look at
23 *In re: Reporters Committee for Freedom of the Press*, 773 F.2d
24 1325 from 1985. It's a decision that Judge -- then-Judge Scalia
25 wrote. And the factual posture of it is interesting, because it

1 was a case in which the trial court essentially sealed all the
2 trial exhibits and declined to make them available to members of
3 the press until the trial court ruled on post-trial motions and
4 entered judgment. And in fact, the trial court in that case
5 actually entered judgments notwithstanding the verdicts of the
6 jury in favor of the plaintiffs in that case.

7 The circuit considered what was the request of the
8 reporters to get essentially contemporaneous or nearly immediate
9 access to the exhibits during trial and prior to the entry of
10 judgment. And what the circuit held is that there is no First
11 Amendment right to access of civil records until the entry of
12 judgment. That was the holding of the D.C. Circuit.

13 And what's notable about the case is a couple of things.
14 One is that you'll see toward the tail end of it, the Court
15 talks both about the First Amendment right and clearly says
16 there's no First Amendment right, there's no -- under the First
17 Amendment test, which is sort of a history and tradition test,
18 the Court says there's no history and tradition of getting
19 immediate access.

20 The Court then sort of looks a little bit at the common law
21 issue. It's a little unclear on which it's being raised. But
22 the bottom line is that the Court says that with respect to the
23 access under the common law, that what the trial judge did in
24 that case was not problematic. And what the Court essentially
25 does is -- I'll hold my comments to myself -- recognizes the

1 challenges that a trial court faces in these sort of
2 circumstances.

3 And in fact, the facts of that case were that the
4 confidentiality issues were limited to, I think, 600 documents
5 that were being considered during the discovery phase. And the
6 question arose as to whether -- because the dissent had taken
7 the position that the documents needed to be made available
8 unless there was a document-by-document justification for the
9 confidentiality designations.

10 And the circuit said that's not required. And even if it
11 was required, it would not be required for the Court to rule on
12 those designations. And the Court, as appellate courts don't
13 always do, took a very practical approach to this and recognized
14 that there are other demands on parties, lawyers, and judges
15 throughout a trial. And those include, most importantly,
16 running the trial and moving forward with the evidence and
17 making sure that's done in an efficient way.

18 And almost -- maybe it's prescient, maybe it wasn't, but --
19 or maybe it's just because Judge Scalia had an affinity for
20 antitrust law. This was not an antitrust case. And I will just
21 note toward the very end of the opinion, in the last paragraph,
22 he writes, "It would have been excessive to expect in addition
23 at that stage of the proceedings the crafting of a
24 document-by-document specification of basis for the claim that
25 would sustain a post-trial legal attack." And then he writes,

1 "And the difficulties encountered in the present case are as
2 nothing compared with those that a major antitrust trial would
3 present."

4 So, "In sum, the dissent's made-for-the-occasion
5 categorical rule of instantaneous document-by-document
6 justification is utterly infeasible, and any feasible rule,
7 which would have to accord the district judge a reasonable
8 degree of discretion, could not conceivably have been violated
9 here where the document-by-document justification was required
10 within 30 days after the conclusion of trial."

11 So everybody ought to be aware of that as we move forward
12 in considering the proposed amendments that *The New York Times*
13 has recommended to the order that I issued mid-trial.

14 One thing I can say about what *The Times* has requested, and
15 I don't need their counsel to be here, I am now convinced that
16 with respect to their one request, I am correct that I do need
17 to give notice about the closing of the courtroom.

18 In fairness -- well, not in fairness. This isn't something
19 that happens often, and I will confess that it was not something
20 that -- I appreciate *The Times* bringing that to my attention.

21 And after I looked at the cases they submitted, I think it
22 is fair to make the request of the parties that for future
23 witnesses going forward, that I get notice by the end of the day
24 to the day the witness is expected to testify, prior day,
25 whether there's expected to be any closed session. And if there

1 is, I will post that on the docket, and if any interested
2 party -- or, I should say, if there's to be an objection to the
3 closing of the session, we can take that up at 9:30 the
4 following morning. And so we will follow that procedure from
5 here forward.

6 That's part of the reason we e-mailed everybody last night
7 about today's witness, and the parties have advised that the
8 expectation is that there will be no sealed portion. Certainly,
9 Google has said that it is not intending to examine in its
10 direct examination the witness in a closed courtroom. And I
11 believe plaintiffs are certainly expecting not to have the
12 courtroom closed, but of course, it may depend upon the direct
13 examination.

14 Mr. Dintzer?

15 MR. DINTZER: Could I rise to address the Court's
16 point? Thank you, Your Honor.

17 So just to set the stage, we're moving into a subject that
18 we haven't really dealt with. So we don't have as much
19 experience in exactly what the defendants will say is
20 confidential and how the Court will rule. We're going to be
21 looking at, as I understand it, how Google's search mechanism
22 works, among other things.

23 With Mr. Nayak being moved up, which of course we were
24 happy to accommodate and there's no issue with that, but it
25 meant that we were somewhat behind the ball where we usually are

1 in running documents through the confidentiality process. And
2 so we sent them last night the documents for them to take a look
3 at.

4 What I would propose, Your Honor, so that we save the
5 Court's time and so that we do our best to avoid a closed
6 courtroom that might otherwise be necessary, is that after the
7 defendants are finished with their examination of Mr. Nayak, we
8 take a break and we talk to them and see if there are issues,
9 see if there are issues we need to raise to the Court, and we
10 get -- we work through those before we begin our cross so that
11 we can hope to get as much as or all of in the public sphere as
12 possible.

13 THE COURT: Okay. I guess the question is whether at
14 this point Google, based upon what you all have sent over,
15 believe that there will be a -- will be requesting a closed
16 session based upon the anticipated cross.

17 MR. SCHMIDTLEIN: Your Honor, Mr. Smurzynski is going
18 to handle this witness, but they sent us documents at 10:00 p.m.
19 last night. So we have not run those documents through -- they
20 are in violation of the order, the 48-hour order. I'm not sure
21 what Mr. Dintzer is saying when he suggests they just got notice
22 of Mr. Nayak. They've had notice for two weeks that we're
23 bringing this witness on this date.

24 And so we have not had the opportunity to run this through
25 the various people who would -- they would need to be reviewed

1 for the sort of confidentiality analysis.

2 So that's where we are.

3 MR. DINTZER: Your Honor, first of all, we're in
4 violation of no order, of course, because the Court never
5 ordered us to do that. It was the process whereby we would have
6 things cleared of confidentiality, which we have been doing, and
7 quite honestly, once the documents were selected and analyzed
8 and we decided to use them as a part of the exam, then we sent
9 them to them.

10 There was no -- which is why I'm asking for this time in
11 between, so that we can go to them, talk about the lines that
12 we're -- and also, it will help us to see, based on what they
13 ask him, what -- there's some terms that -- anyway.

14 THE COURT: I guess the bottom line is, let's just see
15 where we are. My understanding from Mr. Schmidtlein was that
16 the expectation was that the direct will go through lunch.

17 Is that right?

18 MR. SCHMIDTLEIN: I think close.

19 THE COURT: So we'll likely be at a place where we
20 will have a more extended break than the usual 15 minutes that
21 you all can meet and confer about that, and hopefully, there
22 will be enough time to do so. If not, we will just have to
23 figure out how to proceed.

24 MR. DINTZER: We appreciate that, Your Honor.

25 THE COURT: Okay. All right. Great.

1 I was going to save a lot of this for later, but I feel
2 compelled to say one more thing about not this issue but what I
3 was talking about before. And I think it's underscored in light
4 of the case that I just identified. And that is, I want it to
5 be understood what I have asked the parties to do in this case
6 and what I think is unusual.

7 And that was, we, at the very outset -- when I say
8 "outset," I mean back in December of 2020 when the protective
9 order was filed in this case -- understood that confidentiality
10 would be an issue throughout the proceedings and would be an
11 issue at trial. The protective order that was put in place
12 understood that and actually planned for it, and it required the
13 parties to make a proposal about how to deal with confidential
14 records and propose something to me in advance of trial.

15 That happened. In fact, we had extended discussions about
16 it at our monthly status conferences. I gave my thoughts to the
17 parties about how to handle this matter. And it was then
18 entered into an order. And I can identify the number, but it
19 was entered into an order that specified the exact process for
20 the treatment of confidential information.

21 I'm not being critical of anybody, but there was no
22 objection raised by anyone to that process, and that process was
23 on the public docket, and it was in place for approximately four
24 weeks before we began. And so it should have come as -- it
25 should not have been a surprise the way we have proceeded,

1 because it was actually spelled out, largely spelled out, in
2 that order.

3 And what that order said was the following: One is that
4 the parties would work in good faith toward ensuring as much of
5 these proceedings to be open to the public. That's one.

6 Two, I asked the parties to do something that I thought
7 would facilitate that and, I think, has largely facilitated it.
8 And that was to not just prepare their exhibit lists but to, in
9 advance of a witness coming to the stand, identify portions --
10 not only the exhibits they intended to use with the witness, but
11 the portions of the exhibits that they actually intended to use
12 to examine the witness. And the reason for that was so that the
13 side that had the confidentiality interests, whether it be
14 Google or a third party, could say in advance whether they had
15 confidentiality concerns about that portion of the record being
16 presented in open court.

17 The parties did that, and that, I will tell you, is an
18 extra layer that I asked them to do, and they did do, that has
19 required a fair amount of work. It not only requires lawyers to
20 identify the exhibits, but it requires them to think about what
21 they want to present and then do it in a way that's timely to
22 allow the other side notice and give them notice about what they
23 might think is a confidential issue.

24 And we've operated in that way, and it's largely been
25 successful. And what it's allowed us to do is to put on the

1 public screen many more exhibits and show them to the public
2 than we have not. So that was the idea, and that's what the
3 embodiment of the process is in that order.

4 As I said yesterday, to the extent we've had closed
5 sessions, I will be the first to admit -- I will admit two
6 things. One is, I was not -- I did not appreciate that I should
7 have been giving some degree of notice to the public about going
8 into a closed session. That is now being corrected.

9 And two, that the closed sessions we had during the first
10 two weeks, again in hindsight because hindsight is helpful, I
11 think, has helped us as we've gone forward, and it allowed me to
12 get a better sense of what the parties thought needed to be
13 confidential and what I thought was acceptable to be
14 confidential.

15 And I think the delta between those two things has been
16 reflected in two things: One, the fact that we've only had, I
17 think, at most 30 minutes of a closed session yesterday within
18 the last three-plus weeks; and two, the transcripts of the
19 sealed proceedings that we have now disclosed and our disclosing
20 on a rolling basis, which was something that had not actually
21 been contemplated by the pretrial order that we entered but is
22 something that I've done and, I think, acknowledges that there
23 was this delta. So anybody that has requested access to those
24 transcripts can see that the vast majority of those transcripts
25 are now available to the public to review.

1 And so we have done a fair amount to ensure transparency in
2 an open courtroom and in an open process, and I've asked the
3 parties to do it, and they really have, I think, in fairness to
4 them worked very hard toward that. Has it been perfect? No.
5 It's a complicated trial. Could I have done better? Yes. It's
6 a complicated trial. But we're all working towards the same
7 goal.

8 I just wanted to say that at the outset. And we will get
9 to the specifics that have been requested by *The New York Times*
10 later today or after we have an opportunity to hear from Google
11 in a written filing, and then we can consider those. But I did
12 think it was important to share those thoughts with everyone
13 before we got started today.

14 Mr. Dintzer?

15 MR. DINTZER: I rise to say, Your Honor, and I try
16 never to speak on behalf of the other side, but I think I can
17 speak on behalf of the other side in saying that the process
18 from our end has worked. I mean, it is imperfect, and there are
19 documents I'm going to need to talk to them about to make sure
20 we're all on the same page before I use them in the court.

21 But given the complexity, from our point of view, it has
22 worked and allowed us to do effectively what we can in the
23 public sphere as much as possible.

24 MR. SCHMIDTLEIN: The order I think you're referring
25 to is 647, and it was entered on August the 15th after an

1 extensive amount of work, really a lot of collaborative work
2 between the parties to try to come to a solution.

3 Google absolutely supports the notion of keeping as much of
4 this trial in the public as possible. It has required, I can
5 speak on behalf of my client, an extraordinary amount of work.
6 But we understand that that was important work that needed to be
7 done to facilitate this process that Your Honor has put in
8 place. And from our perspective, we've been very grateful for
9 all of the guidance you've given us, and we think it's worked
10 very, very well to date.

11 And as I said, in 30 years, nothing ever goes perfectly in
12 trials. We always have a few little bumps. But this one
13 actually has worked, I think, extraordinarily well, given the
14 sensitivity of information, given the complexity of all the
15 third-party information that also has to be taken into account.

16 So I echo and agree with Mr. Dintzer's comments, and we're
17 very grateful for all of your careful consideration of this.

18 THE COURT: Look, you know, it is entirely appropriate
19 for people to have different views about what we've tried to
20 accomplish and whether it's been successful or not. I
21 appreciate that. I did think it important to frame it in a way
22 that I thought provided a more fulsome explanation, let me just
23 put it that way, of the process that we've put in place and how
24 we've gotten to that process.

25 No one should be under the impression that we didn't think

1 about this and that we didn't give it a lot of thought and that
2 there hasn't been a lot of thought and effort in how to do it.

3 Again, has it been imperfect? Sure. But we've done, I
4 think, overall a pretty good job, and we're continuing to strive
5 to do better.

6 All right. With that, why don't we turn to -- we'll turn
7 to Google, and we'll hear from your witness.

8 MR. SMURZYNSKI: Thank you, Your Honor. Ken
9 Smurzynski for Google, and we call Dr. Pandu Nayak.

10 THE COURT: Just so the record is clear, we're
11 obviously taking Dr. Nayak -- come on up, Dr. Nayak -- out of
12 turn to facilitate his schedule. And so none of this should be
13 considered as evidence that's being presented in the plaintiffs'
14 case. This is Google's case.

15 P. PANDURANG NAYAK, WITNESS FOR THE DEFENDANT, SWORN

16 THE COURT: Dr. Nayak, welcome. Thank you for being
17 with us.

18 MR. SMURZYNSKI: Your Honor, before we start rolling,
19 let me hand out some binders. Your Honor, if I may approach the
20 witness.

21 DIRECT EXAMINATION

22 BY MR. SMURZYNSKI:

23 Q. Good morning, Dr. Nayak. Would you please state and spell
24 your name for the record.

25 A. It's P. Pandurang Nayak is the name. It's P and then

1 P-a-n-d-u-r-a-n-g, and Nayak is N-a-y-a-k.

2 Q. What is your business address?

3 A. It's 1600 Amphitheatre Parkway, Mountain View, California
4 94043.

5 THE COURT: Dr. Nayak, if I can ask you to keep your
6 voice up. That's a mic there, and it will help amplify your
7 voice.

8 THE WITNESS: Is that better?

9 THE COURT: Yes. Thank you.

10 BY MR. SMURZYNSKI:

11 Q. Would you please tell the Court where you grew up.

12 A. I grew up in India, primarily in Mumbai.

13 Q. Where did you go to college?

14 A. I went to college at the Indian Institute of Technology in
15 Bombay.

16 Q. Did you receive any awards while there?

17 A. I did. I received the President of India Gold Medal.

18 Q. And what does that represent?

19 A. That's an award given to the graduating student with the
20 highest GPA.

21 Q. After that, what did you do in terms of education?

22 A. I came to Stanford University to get a Ph.D. in computer
23 science.

24 Q. What was your dissertation on?

25 A. So my dissertation was on artificial intelligence, and I

1 was interested in the question of how you model systems in a way
2 that it's sort of detailed enough to support the task you want
3 to solve but not so detailed that you get lost in the details.

4 Q. After graduating from Stanford -- first, what year was
5 that?

6 A. I graduated in 1992.

7 Q. After you graduated from Stanford with your Ph.D., what did
8 you do next?

9 A. I started work at NASA at their Ames Research Center.

10 Q. Is there any particular area that the Ames Research Center
11 was focused on?

12 A. So I particularly joined the lab that did artificial
13 intelligence research.

14 Q. Are there any particular projects that stand out in your
15 mind from your time working at NASA?

16 A. Yeah. I had perhaps the most exciting project I have ever
17 done that I did at NASA. We built an intelligent spacecraft, a
18 software system called the Remote Agent that provided high-level
19 autonomous control to a spacecraft, and we actually flew it on a
20 real spacecraft for about a week as an experiment. So that was
21 super exciting.

22 Q. What did you do next after NASA?

23 A. I joined a start-up that was founded by some friends.

24 Q. And what was the nature of the work you did at that
25 start-up?

1 A. So the start-up -- so the technology that we had developed
2 was around text understanding, so things like classification,
3 clustering, this kind of thing. And it started out as a
4 consumer product. So the company was named Purple Yogi at the
5 time, and it was meant to be a personalized news service.

6 But of course, being a start-up, we had to change things.
7 We changed the name to something less exciting, let's say.
8 Stratify was the new name. And we made it into an enterprise
9 portal. And we had to change once more until we finally got to
10 a successful product, which was a legal discovery system.

11 Q. There's a lot of call for that, I assume.

12 Have you ever taught at the university level?

13 A. Yes, I have.

14 Q. And where?

15 A. I taught at Stanford in the Computer Science Department.

16 Q. What are the classes that you taught in the Computer
17 Science Department at Stanford?

18 A. So I taught two classes. One was a class called Reasoning
19 Methods in Artificial Intelligence, and this was a class that I
20 developed based on the research area that I was working on. And
21 I taught that for several years.

22 And then subsequently, I co-taught a class with Professor
23 Chris Manning and with Prabhakar Raghavan on Information
24 Retrieval, which is the science and engineering of search. And
25 I taught that for many years.

1 Q. You mentioned Prabhakar Raghavan. Who is Prabhakar
2 Raghavan?

3 A. Prabhakar Raghavan is the SVP of Knowledge and Information
4 at Google. He's currently my boss, but at the time we thought
5 he was not my boss. He was merely a colleague.

6 Q. And this -- these classes you taught, were they at the
7 graduate school level, undergraduate level, or something else?

8 A. The classes themselves were graduate classes, but advanced
9 undergraduates, of course, took the class also.

10 Q. How did you come to join Google?

11 A. So, I had a lot of friends who were already at Google, and
12 one of them approached me and suggested that I consider joining
13 Google. I spent a fair amount of time talking to them, and
14 after, you know, a fair amount of time, I decided this was the
15 right thing to do. And so I joined Google.

16 Q. Let's just date that. What year did you join Google?

17 A. I joined Google in 2004, in November 2004.

18 Q. What drew you to work at Google?

19 A. So there were a number of reasons that Google seemed right
20 and has seemed right over the last, whatever, 18, 19 years that
21 I've been there.

22 The first and, I think, one of the most important reasons
23 was the people. I already knew a lot of the people there, and I
24 had high respect for their capabilities, their creativity, and
25 things. And there were people that were really fun to work

1 with. And that's actually held through these last 19 years, and
2 that's a really crucial part of what makes Google a wonderful
3 place to be.

4 The second, just as important, is Google's mission to
5 organize the world's information and make it accessible and
6 useful, and this is a mission that I think really inspires me,
7 and it gives me purpose in my work life at least, and that's
8 really, really important.

9 And the third thing is, at the end of the day, Google is a
10 technology company, and they really value, say, the skills that
11 I have been trained to and I possess. And I think it's a really
12 great place for people like me to work, and I think I'm
13 incredibly lucky to work in a company that values my skills and
14 gives me the opportunity to have this kind of positive impact on
15 the world through its mission.

16 Q. When you started at Google, what was your initial role?

17 A. So when I started at Google, the first project I took on
18 was -- I joined in search, and the first project I took on had
19 sort of this character. Search involves people coming to Google
20 with search queries. And then we try to serve those queries.
21 But it happens sometimes that the query that the user issues has
22 a problem in it. There's something wrong with the query.

23 The most obvious kind of problem, of course, is like a
24 spell correction. And Google had already developed lots of
25 techniques to help users with spell correction.

1 But there's another kind of problem that happens, which is
2 that the user has a misconception about what it is that they're
3 looking for.

4 So the motivating example I remember from the time was this
5 query "NBC survivor." That was the query. Survivor, of course,
6 is a very popular TV show. The only catch is it was actually on
7 CBS, not on NBC. And the user had this misconception that it
8 was on NBC, and that was what the query was.

9 So we had developed a technique to, in situations like
10 this, to observe maybe the user really meant CBS Survivor and
11 not NBC Survivor. We would issue a second query to get the
12 results for this alternate query and insert those results into
13 the result set with an appropriate user interface around it so
14 that if they indeed meant CBS Survivor, that they would get
15 those results. And not surprisingly, users really loved that,
16 because they really did mean the thing we thought they meant.

17 Q. Could you sketch for the Court your roles at Google from
18 that 2004 time through today.

19 A. So after working as an individual computer -- individual
20 contributor or software engineer, I started taking on sort of
21 more management leadership roles. I started with managing the
22 spelling team. So I ran that for a little while. That expanded
23 into running teams that were looking more broadly at query
24 understanding, and that slowly grew until I started being
25 responsible for the whole ranking team. And that's what I've

1 been doing. We call ourselves the search quality team. And so
2 I've been leading the search quality team now for many years.

3 Q. What is your title at Google today?

4 A. So my title today is VP of search. I'm one of the four VPs
5 of search.

6 Q. What areas do you manage at Google today?

7 A. So my primary focus is in this area that's called search
8 quality, and that involves all kinds of sort of quality-related
9 things, primarily starting with the ranking of web results, but
10 also ranking of the home page, things like spelling correction,
11 things like featured snippets. There's a whole lot of things,
12 all of which are really sort of quality-oriented things. Those
13 are sort of a part of the team that I lead.

14 Q. We're going to turn to a demonstrative now. It's DXD17.
15 Let me start with page 002. It should be on the screen in front
16 of you, Dr. Nayak.

17 What does the outer circle in this demonstrative represent?

18 A. So the outer circle in this represents essentially the web
19 and the trillions of documents that are on the web. It's the
20 corpus that Google seeks to search.

21 Q. And what are the implications for search that there are
22 trillions of pages on the web?

23 A. Well, to start with, it's a lot of pages, and it's a lot of
24 pages that need to be searched and indexed. And so it's a real
25 challenge to figure out how you start by building an index of

1 that web.

2 Q. And the next circle in the demonstrative in yellow is
3 information index. How does Google go about creating an index?

4 A. Yeah, so the index is a core piece of the search, of the
5 search system, and an index is just like an index at the back of
6 a book. There's a word and all the pages that it occurs on. So
7 you need a clear index of the web.

8 Like I said, trillions of pages is a lot of pages. So it's
9 a little difficult to get an index of the whole web. It's not
10 even clear you want an index of the whole web, because the web
11 has a lot of spam in it. So you want an index of sort of the
12 useful parts of the web that would help users.

13 And so we go out using a process of crawling the web and
14 other mechanisms for acquiring the content, and we create an
15 index of hundreds of billions of documents that we hope is
16 comprehensive in terms of the kinds of queries and questions
17 that users come to us with.

18 Q. What is the implication for search of a document being
19 either in the index or not in the index?

20 A. It has a very significant implication, which is if it's not
21 in the index, we can't serve it to users. It's as simple as
22 that. So making sure that when users come to us with queries,
23 we want to make sure that we've indexed enough of the web so we
24 can serve those queries. And so that's why the index is such a
25 crucial piece of the puzzle.

1 Q. Does creating an index for purposes of search require any
2 judgment or decisions on the part of Google?

3 A. Yeah, there's actually a lot that goes on to make sure you
4 have a good index. Like I said, one big piece of it is that
5 there's tremendous amounts of spam out on the web. It's frankly
6 quite shocking. And so being able to make sure that -- if you
7 fill your index with spam, then you're not really going to help
8 your users. And so making sure that you get sort of the right
9 subset of the web, that's one piece of it.

10 There are other things that we need to do, things like the
11 freshness. So it's not as if you go to the web, crawl it once,
12 and you're done. The web changes all the time. Pages change
13 all the time. Some of them change very quickly. The home page
14 of CNN changes, you know, every 15 minutes as they add new
15 pages. Other pages might change more slowly. A Wikipedia page
16 might change slowly as people make edits to it. And some pages,
17 like say the blog post I wrote back in 2004, may never change.

18 But pages change at different rates. And if you want to
19 search the web effectively, you need to keep your index
20 up-to-date. So you need to estimate which pages are changing
21 quickly, which pages are changing slowly, and so forth.

22 Q. Is there a cost associated with creating an index of this
23 size?

24 A. Oh, there's a very significant cost associated with it,
25 because you need machines to create the index. You need the

1 network bandwidth to go out and fetch the documents. You need
2 the storage to create the index. So there is a fairly big
3 investment that goes into creating this index, yes.

4 Q. Now, Dr. Nayak, has there ever come a time when the size of
5 Google's index as measured by the number of documents in it ever
6 decreased?

7 A. Yes, there have been times when the size of the index has
8 decreased in terms of the number of documents.

9 Q. And why is that?

10 A. So we start out with some set of resources in terms of
11 storage, let's say, and that hosts some number of documents.
12 But over time at various times, the average size of documents
13 has gone up for whatever reason. Webmasters have been creating
14 larger and larger documents in various ways. And so for the
15 same size of storage, you can index fewer documents, because
16 each document has now become larger.

17 In addition to that, our understanding of documents has
18 also improved over time. So when we get these documents, not
19 only do we create an index, we create a bunch of metadata
20 associated with the document which reflects our understanding of
21 the document. And that has also grown over time. And so that
22 also takes space in the index. And as a result, that results in
23 the number of documents that you can index in a fixed size of
24 storage to go down.

25 Q. Have those changes you've just described in the index

1 compromised the quality of Google's search?

2 A. No. At an aggregate level, it does not compromise the
3 quality of search.

4 Q. Does Google from time to time compare its index to that of
5 Microsoft?

6 A. Yes, we do that every so often, yes.

7 Q. Dr. Nayak, you have a binder in front of you that has a
8 white cover. And I would like to direct your attention to
9 UPX268A, which is an evidence. And the A just simply reflects
10 that it's a native version.

11 And, Your Honor, there are pieces of this that are
12 confidential. So we will be following along.

13 First, what is this document in front of you?

14 A. It looks like a document that talks about various
15 competitive facts.

16 Q. Okay. And if I could ask you to please turn to the
17 document that ends in .033.

18 A. Yes.

19 Q. What is being shown -- and I ask you to be careful not to
20 identify any particular numbers. But what is being shown on
21 this page?

22 A. So this is an attempt to measure the relative coverage of
23 the Google index against the Bing index.

24 Q. And what is shown by the blue line on that page in front of
25 you, .033?

1 A. So the strategy that was adopted to do this measurement was
2 as follows: We started with a large sample of queries that were
3 representative of the query stream. And for those queries, we
4 looked at what results Bing returned for those queries. And
5 then we looked to see what fraction of those results were in our
6 index. All right? So that's the blue line.

7 And you can see over time most of the results that were in
8 the Bing results were in the Google index. You can ignore that
9 little sharp line that goes down. That's just a data error at
10 that point, and that can be ignored. But you can see that the
11 blue line suggests that most of the results that were in the
12 Bing results were in the Google index.

13 The red line is the opposite of that. So we looked at all
14 the results that were showing up for Google, and we asked
15 ourselves which of these results were in the Bing index. And as
16 you can see, there's sort of a meaningful gap in the index
17 coverage there.

18 Q. Does that gap in coverage have any implications for the
19 differences in quality between Google and Bing?

20 A. I think in general, it goes back to the point that if it's
21 not in the index, you can't serve it. And so if you have useful
22 results that are not in the index, as is the case here, then
23 that has a direct impact on quality.

24 Q. Let's turn to the next page, 034, which is also redacted.
25 What are we seeing here?

1 A. Here, we have two charts that are created in the same way
2 as that -- the top-level chart that we talked about in the past.
3 The top chart here is on a subset of queries that are identified
4 as long-tail queries. So these are queries that occur quite
5 infrequently in the query stream. And you can see that the gap
6 between the Google line and the Bing line is actually larger
7 here. The bottom line is on popular queries. These are more
8 common queries that occur more frequently, and you can see that
9 the gap is smaller here.

10 So this suggests that the index coverage is poorer, or the
11 index coverage gap is larger in long-tail queries.

12 Q. Dr. Nayak, what are the implications for the differences in
13 search quality between Bing and Google on popular and long-tail
14 queries with respect to this chart?

15 A. So what the charts would suggest is that the quality gap
16 between Google and Bing is larger on long-tail queries than on
17 popular queries.

18 Q. What, if anything, does that have to do with the index?

19 A. The thing with long-tail queries is that this is where you
20 really need to have a more comprehensive index, because the user
21 is asking for something very specific. It's not a very common
22 document. And if you don't have that document in the index, you
23 can't serve that long-tail intent that the user came to you
24 with.

25 So it's the index -- comprehensiveness of the index is

1 crucial to being able to serve long-tail queries like this.

2 Q. I would like to turn now to the topics of mobile and
3 desktop.

4 THE COURT: Sorry. If I could just follow up with a
5 question.

6 Dr. Nayak, to what -- let me back up.

7 Can you just share with me what -- in your estimation, what
8 are the most important variables in creating a quality index?

9 THE WITNESS: I think the first thing you need to
10 create a quality index is to know which parts of the web to
11 crawl. All right? So you have to make sure that you don't fill
12 your index with spam or low-quality content like that. You need
13 to know where the high-quality pages are that people will find
14 useful. So that's a big part of it.

15 You need to invest enough in the infrastructure for
16 crawling, and that's another important part.

17 There's another sort of a subtler point here, which is when
18 you crawl the web, you actually use resources of the website,
19 because you're actually, you know, issuing requests to the
20 website to serve this thing. So a really important part of your
21 crawling system is to make sure you don't overwhelm those
22 websites. You need to be very respectful of websites when you
23 do this. So there's a lot of subtle, careful algorithms that
24 are built to allow you to do this in a way that allows you to
25 keep things fresh, while not overwhelming these websites in this

1 way.

2 And so then I touched upon the freshness issue. You need
3 to know how to recrawl them to make sure that you do at all
4 times have a reasonably fresh copy of the web that you are
5 looking at.

6 THE COURT: And does user interaction data play any
7 role in determining, for example -- well, in terms of index
8 quality? Let me just ask generally.

9 THE WITNESS: I mean, I think certainly pages that
10 users have found useful in the past you want to make sure
11 continue to be in the index. So certainly, there is a role for
12 user interactions in that way.

13 But there is clearly more to it than that, because there's
14 a ton of pages on the web that have no user interactions, but
15 you still want to make sure they're in the index, particularly
16 for long-tail queries, which by their definition are unlikely to
17 have many or any user interactions.

18 So yes, you will certainly use user interactions to make
19 sure some set of the web that has interactions is in your index,
20 but that's by no means the whole story.

21 THE COURT: Thank you.

22 BY MR. SMURZYNSKI:

23 Q. Dr. Nayak, focusing for a moment on mobile and desktop,
24 what, in your view, is the primary difference between how Google
25 serves results on mobile versus desktop?

1 A. I think the most salient difference between mobile and
2 desktop is in the user experience. Right? And there's a very
3 good reason and obvious reason for that. The mobile device has
4 very limited real estate. There's just sort of one column of
5 information. Whereas, the desktop device, of course, has a lot
6 of real estate to provide your search experience. There's
7 multiple columns. There's more information vertically that you
8 can see. It's just a very different experience.

9 So to me, that is sort of the primary difference between
10 mobile and desktop, is just the form factor.

11 Another sort of difference, which hopefully is becoming
12 less true today but is still, I think, there, is that mobile
13 devices tend to be on mobile networks, which are just not as
14 fast or reliable as WiFi. That is, desktop devices tend to be
15 on WiFi. And this difference is also something that you need to
16 take into account when you build your mobile experiences.

17 Q. What does the term "search feature" mean within Google?

18 A. Search feature for us, so the core of search, of course, is
19 the web results. But then we add to the web results various
20 features. They might be like the "did you mean" feature of
21 spell correction that we talked about. Or it might be a
22 knowledge panel about a particular entity of some sort,
23 President of the United States or something like that, or it
24 might be a certain experience for sports, let's say, to
25 highlight what's happened to your sports team or a sports league

1 that you're interested in, or weather experience.

2 So these are all features that we add to make search be
3 more helpful to users.

4 Q. And how do search features relate to differences between
5 mobile and desktop, if they do?

6 A. So again, the first implication is that of real estate. So
7 to give you sort of a concrete example, when we first put out
8 knowledge panels, it was done on the desktop, and the knowledge
9 panel was in the right-hand column, and the main web results
10 were down the center column.

11 But of course, when we brought it to mobile, there was no
12 right-hand column to put the knowledge panel in. And so the
13 knowledge panel had to be bordered onto the center panel, and
14 then there was a question of how you rank the knowledge panel
15 against all of the other results. So a number of technical
16 challenges had to be solved in that regard.

17 So this is something that is something you have to look at
18 carefully, as you add these features in, where on the page do
19 you add them, because there's only one vertical column of
20 information to be shown on a mobile experience.

21 Q. As it relates to the area that you have focused most on at
22 Google, ranking, what differences, if any, do you see between
23 mobile and desktop?

24 A. So I think there's two things to highlight here, one of
25 which I think does affect ranking and one that affects it less.

1 MR. DINTZER: Your Honor, I hate to interrupt, but if
2 the witness is testifying -- the question was sort of broader
3 than Google. If the witness is testifying about Google, we
4 don't have any problem with him, of course, testifying about
5 Google. If he's testifying broader than that, then we would
6 need a foundation laid, and we might have some questions about
7 that.

8 So if we could ask counsel to focus his questions about
9 what Google is doing now, that would clean this up.

10 THE COURT: Okay. I understand him to be drawing on
11 his experience at Google in talking about what Google was doing.

12 MR. DINTZER: As long as that's understood.

13 THE COURT: Am I wrong about that?

14 MR. SMURZYNSKI: Your Honor, he's obviously talking
15 about his experience at Google. He's been in the industry for
16 19 years.

17 THE COURT: Right.

18 MR. SMURZYNSKI: I think the objection, if it is, that
19 these observations can't have any import beyond Google is -- we
20 can all argue about that later, but he's obviously testifying
21 based on his experience and 19 years at Google and the like.

22 MR. DINTZER: Your Honor, this is not a minor
23 distinction. If Google is offering him to testify about things
24 that are beyond the four walls of Google, then we would ask the
25 Court to hear an objection of ours.

1 THE COURT: Well, I guess I'm not clear on the
2 distinction in the sense that it's not clear to me that, for
3 example, when he's -- a lot of what he's been talking about is
4 at a very high level. It's not clear to me that that's
5 different from one company to the next.

6 So if, Counsel, you have a sense that something is specific
7 to Google, if you could embed that in the question so that
8 that's clear. And it may not always be.

9 MR. SMURZYNSKI: I understand, Your Honor. I think --
10 I'm obviously asking him for his actual experience as somebody
11 at Google. And we can argue later about what the implications
12 of that are for anything else, but what I'm eliciting is based
13 on his experience at Google.

14 MR. DINTZER: And Your Honor, I appreciate what
15 counsel has said. I just want to be very clear about our
16 potential objection, because they're fuzzing the line a little
17 bit.

18 If the witness is talking from personal experience about
19 what he's doing at Google, we're good. If he is extrapolating
20 from what he has done at Google, talking about what other search
21 engines might be doing inside their four walls, thinking, doing,
22 then that enters the realm of expert testimony, for which he is
23 not tendered, not qualified, and we have not had a chance --
24 obviously, it opens a bunch of doors that we haven't wanted to
25 raise, and as long as he talks about Google, then we don't need

1 to raise.

2 But this is not something that we can kick down the road
3 and argue about down the road. If Google is tendering him to
4 talk about something other than what happens in the walls of
5 Google or what's on Google's page, obviously, if he sees
6 something on Bing's page, we didn't object when they run tests
7 against Bing. We don't have a problem with that, because that's
8 happening within Google. But if he's making broader sweeping
9 statements about the industry, about what people do, then that's
10 entering expert testimony that he hasn't been qualified for, and
11 we have concerns.

12 THE COURT: Okay. Look, from what I've heard, I've
13 understood him to be limiting his testimony to his experience at
14 Google and speaking to that.

15 Dr. Nayak, if you are going beyond that, you will let us
16 know.

17 But my understanding is so far he's stayed within the walls
18 you've suggested.

19 MR. DINTZER: We appreciate that, Your Honor. Thank
20 you.

21 THE COURT: Why don't we revert to that last question,
22 which I think had to do with ranking between mobile and desktop.

23 BY MR. SMURZYNSKI:

24 Q. So I think the question was, and you may have started to
25 answer, I don't know if you had completed, as it relates to your

1 area within Google, ranking, what differences, if any, do you
2 see between mobile and desktop?

3 A. So we observed two types of differences between mobile and
4 desktop. But before I get to the differences, we also observed
5 that there was a lot of similarity also.

6 So on the first point, on the differences, one difference
7 is that the distribution of queries on mobile and desktop, we
8 found differences. There tended to be more location-specific
9 queries on mobile. Those same queries did occur on desktop. So
10 it wasn't like they didn't occur at all on desktop. They just
11 occurred less frequently. So the distribution was sort of
12 skewed towards a little bit more local queries.

13 Similarly, on desktop, you found more queries which were
14 more research-oriented, because, you know, maybe people like to
15 do research with -- more realistic like this. That doesn't mean
16 those queries didn't occur on mobile. It's just that the
17 distribution was such.

18 So that was, I think, one difference. But what was
19 interesting was, a very large fraction of the queries were
20 really the same on both sides. So it wasn't like the difference
21 was completely different.

22 The second interesting difference was even for queries that
23 occurred on both mobile and desktop, we noticed that in some
24 cases, again, by no means all, by no means even a large
25 fraction, but in some cases, the intents on mobile were slightly

1 different.

2 A good example of that is, let's say you issued the
3 query "Bank of America" for your bank. Then on desktop, chances
4 are you want to go to the online home page of Bank of America to
5 do online banking. Whereas, on mobile, chances are you were
6 looking for the locations of the ATMs for the bank, Bank of
7 America.

8 So the intent was slightly different. It doesn't mean that
9 the intents -- that on mobile you couldn't be going to the home
10 page, because you might be wanting to do online banking there
11 also, and it doesn't mean that on desktop you didn't want the
12 locations; you would want that. But it felt like there was a
13 bias on the mobile side to have this more location-focused
14 intents. And so there was somewhat of a difference in that.
15 Again, not for all queries, but there were queries where there
16 was this distinction.

17 Q. How does Google Search handle a situation like that where
18 there are potential multiple intents for a query, whether it's
19 on desktop or mobile?

20 A. So one of the signals that does go into Google Search is,
21 you know, is it a desktop query or is it a mobile query. In
22 most cases, that signal doesn't make a difference, but in some
23 cases, you might recognize the difference in intent. And for
24 like that Bank of America query, the result might be that on
25 mobile you might promote the local block that shows the map

1 where the ATMs are and make the home page of Bank of America be
2 the second result.

3 Whereas, on desktop, those two would be switched. The home
4 page would be the first, because maybe that's the primary
5 intent, and the map with the locations near you would be the
6 second result.

7 Q. Are the interactions -- the user interactions on desktop
8 have any relevance to how Google presents results on mobile?

9 A. So I think I gave you some examples where queries are
10 different. But in a large fraction of queries, they're really
11 the same. The intents are the same. And so the user
12 interactions on desktop are really no different from the user
13 interactions on mobile.

14 In that subset of cases where there's a difference, you
15 will see the difference in user interactions.

16 Q. I'm going to move on from mobile to another topic,
17 Dr. Nayak.

18 THE COURT: Let me just ask you, can you estimate just
19 roughly what you would consider to be in that subset, that is,
20 the number -- the percentage of queries where the intent may be
21 slightly different depending upon the device you're using?

22 THE WITNESS: So I don't know what it is today,
23 honestly. I remember a study that was done some time ago, and
24 it seemed like there were about of the order of 6 percent of
25 queries which were sort of more mobile-focused and 6 percent

1 that were more desktop-focused, and the rest, whatever, 86,
2 88 percent, whatever, were roughly the same.

3 So that's the kind of qualitative feel I have that says a
4 lot of queries are really, really the same, and then there are
5 some that are more sort of mobile-focused and some that are more
6 desktop-focused.

7 THE COURT: Thank you.

8 BY MR. SMURZYNSKI:

9 Q. Dr. Nayak, you have in your binder a document that's
10 identified as DX227. And this again is a document that there's
11 some partial redactions on.

12 But to start, what is this document?

13 A. So this is a presentation that we gave at the search
14 quality all-hands meeting in December of 2020.

15 Q. Okay. And if you could turn to the page that ends in .011.

16 A. Yeah.

17 Q. And without identifying any of the particulars, what is set
18 forth in this page?

19 A. So this -- remember, this is December 2020. So this is a
20 slide that was talking about the work that we had planned to do
21 in 2021, in the new year. So this was a strategy document, or a
22 summary of the strategy anyway, of the primary pieces of work
23 that we were planning to do in 2021.

24 MR. SMURZYNSKI: I would just note this document is in
25 evidence. Thank you.

1 BY MR. SMURZYNSKI:

2 Q. If you will turn to the second -- or the next page, at
3 .012.

4 Again, what is being set forth, without getting into the
5 exact detail, with respect to these points?

6 A. Yeah. So on the previous slide, where we had talked about
7 the different -- the strategy for 2021, we had broken up the
8 work into different buckets of work. One of the most important
9 buckets of work was that first bucket, which is highlighted on
10 this slide here, which is to maintain industry-leading search
11 quality. This is an important objective, important goal for us
12 every year, is to do this investment.

13 And what this slide is describing is the specific metrics
14 we were using and the specific key results, so the specific
15 goals we were trying to achieve to allow us to continue to
16 maintain industry-leading search quality.

17 And there were two metrics that we were measuring ourselves
18 with. One is our sort of top-level information satisfaction
19 metric. That's IS. It's a measure of overall quality of
20 results. And the other is the PQ, the page quality metric.
21 It's a measure of the reliability of search results.

22 And ever since the beginning of Google, when they
23 introduced page rank as a measure of reliability, our goal has
24 always been to surface results that are relevant and, whenever
25 possible, from reliable sources. So those are sort of the two

1 key elements of great search results, and information
2 satisfaction and page quality are the two metrics we use to
3 track that.

4 And so we set ourselves goals every year for improving IS
5 and PQ, and that's what this was capturing.

6 Q. It's hard to read, but within the IS portion under "key
7 goals," there's a reference to "NBU goal."

8 What does NBU mean?

9 A. NBU stands for next billion users, and it represents
10 various emerging markets where we operate, things like India,
11 Indonesia, Brazil, Nigeria. We seek to serve users all over the
12 world. So it's important for us to have search quality
13 improvements everywhere. And so one of the key things we had
14 called out there was to set ourselves a goal of improving search
15 in these NBU markets.

16 Q. Now, this document we just reviewed was for 2021. Are
17 there similar documents and goals for other years at Google?

18 A. Yeah. This is a part of our annual planning. Every year,
19 we set ourselves goals that -- OKRs, you may have heard of
20 those, objectives and key results. And we set up objectives
21 along these lines.

22 In search quality, we always have an objective like this
23 one here to improve search quality according to the metrics that
24 we measure here. And we do this every year, yes.

25 Q. Dr. Nayak, does Google only seek to make improvements in

1 its quality when it senses some competition?

2 A. No, not at all. This is something we do all the time.

3 This is -- this goes to the core of serving the mission that we
4 have, is to constantly improve search quality.

5 Q. Does Google conduct any measurements of its quality in the
6 ordinary course of its search engine?

7 A. Yes, we do.

8 Q. And why does it do that?

9 A. Well, there's a saying which is sometimes attributed to
10 Lord Kelvin, maybe misattributed. It says you can't improve
11 what you don't measure. And even if the attribution isn't
12 accurate, it makes an important point. If we are seeking to
13 improve search quality, then we better have a way of measuring
14 whether it actually is making improvements or not.

15 Q. What metrics does Google use to measure its search quality?

16 A. So we use a number of different things of course, but there
17 is one measure that is sort of, I think, the most important, and
18 that is the information satisfaction measure that we touched
19 upon briefly.

20 Q. Are there any subcomponents of that IS score that you've
21 mentioned?

22 A. So the IS score is meant to capture what makes great search
23 results. And really, there are, as I mentioned, really two
24 elements to that: Are other search results relevant, and are
25 they from reliable sources or not?

1 And so those are sort of the two major pieces of the IS
2 metric. And we get raters to help us make these judgments that
3 then get put together into this metric.

4 Q. On what scale is that aggregate metric portrayed on?

5 A. The aggregate metric is on a 0 to 100 scale.

6 Q. And can you please give the Court some sense of what one IS
7 point or some portion of an IS point means in terms of quality.

8 A. So not surprisingly, it's a little tricky to give a very
9 clear definition of what one IS point would mean. So we came up
10 with the following way of thinking about it: Wikipedia is a
11 really important source on the web, lots of great information.
12 People like it a lot. If we took Wikipedia out of our index,
13 completely out of our index, then that would lead to an IS loss
14 of roughly about a half point.

15 So that gives you a sense for what a point of IS is. A
16 half point is a pretty significant difference if it represents
17 the whole Wikipedia wealth of information there.

18 So that's how we've been thinking about it.

19 Q. And how does Google go about scoring -- or generating the
20 data to create these IS scores?

21 A. So we have a whole system of evaluation to produce these IS
22 scores. The core of it is we have a whole lot of raters. These
23 are people that are hired from all over the world. We have
24 about 16,000 or more of them around the world. And we
25 essentially ask them to take a look at a sample of queries and

1 the results for them and to provide judgments, ratings for how
2 well the results match the queries.

3 Now, to do this, to help them do this, we have actually
4 developed a very detailed search quality rater guideline
5 document. It's a 160-page document. It's a public document.
6 You can actually search for it on the web. And if you don't
7 find it, you can complain to me. But it is a public document
8 that anyone can look at.

9 And raters are expected to read this document, understand
10 it, internalize it, and take a test on it. And having done
11 that, they are then expected to interpret what this document is
12 saying in terms of the specific queries and results that we
13 show.

14 And the document itself, as I mentioned, what search wants
15 to be is to produce relevant results from reliable sources
16 whenever possible. And so this document goes into a lot of
17 detail on what does it mean to be relevant, what does it mean to
18 be reliable. Right? And so that gives raters guidance on
19 making those judgments.

20 So they give those judgments on these queries, query result
21 pairs. We aggregate those judgments up to the query level and
22 then aggregate it up to the query set level. And so we get an
23 overall metric for how we're doing for that particular sample of
24 queries that represents our query stream.

25 Q. You may have already mentioned this, and I apologize if you

1 did. Approximately how long in terms of pages is this rater
2 guideline?

3 A. It's 160 pages.

4 Q. And you mentioned it's public. Why does Google publish its
5 rater guidelines?

6 A. I think a big part of it is transparency. In a sense, the
7 search rater guidelines is our product spec. It's what search
8 wants to be. It's what we try to accomplish. And we want to be
9 transparent about what it is that search is trying to do here,
10 and the search rater guidelines is a key part of that
11 transparency. It also gives webmasters a lot of guidance on
12 what we think is pages that will serve our users and what are
13 the characteristics of those.

14 So those are sort of the reasons why we've made this
15 document public.

16 Q. Allen, if you could bring up the demonstrative in slide 3.

17 Dr. Nayak, what is shown on the demonstrative in front of
18 you, slide 003?

19 A. So this -- these charts show the different kinds of
20 experiments that we do as a part of search quality. And you can
21 see we do -- we certainly do live experiments, which are shown
22 in red there. But a big part of the experimentation we do is
23 around the human rater testing evals that we do.

24 Q. And why does Google choose to use all these human rater
25 tests when it already has available live traffic?

1 A. I think the reason for that is live traffic is certainly
2 helpful. That's why we do live experiments like this. Right?
3 But they can also be extremely misleading, particularly in
4 issues of sort of page quality-type things.

5 So I think everyone is probably familiar with click bait,
6 for example. These are -- tend to be low-quality results, but
7 that when you look at the headline for it, you know, you really
8 do want to click on it to find out what's going on.

9 And so users will do that, and if we just follow what the
10 live experiment says, we're likely to promote click bait. And
11 so while live experiments are useful, they're not a great sort
12 of top-line metric for what we do.

13 Instead, we want to have the human raters, human rater
14 program with the search quality rater guidelines so that we can
15 have a very clear sense for this is what we think great search
16 is.

17 Q. And you mentioned page quality. What is the relationship
18 between page quality on the one hand and clicks?

19 A. I mean, the -- when looked sort of at an aggregate level,
20 what we have noticed is that page quality is a little
21 anticorrelated with clicks.

22 Q. When you say "anticorrelated," what do you mean by that?

23 A. It means that in cases where we improve page quality on the
24 margins, not sort of at the -- at the big level, I think page
25 quality is a good thing in the long term. But on the margins,

1 whenever we improve page quality, what we've noticed is that our
2 live experiments come out not so great. So they move in sort of
3 opposite directions.

4 And I think part of it is things that I mentioned around
5 things like click bait and variations thereof. If we demote the
6 click bait, users may still seek it out, and that looks like a
7 loss on the live experiment when really it's actually a good
8 thing to do that.

9 Q. All right. We can take that demonstrative down, and let's
10 turn to a document in your binder, UPX1082.

11 Your Honor, this was on the government's exhibit list. I
12 believe we at one point posed an objection, but we're obviously
13 withdrawing that objection at this point.

14 THE COURT: Okay.

15 BY MR. SMURZYNSKI:

16 Q. Dr. Nayak, what is UPX1082?

17 A. This is -- I believe this is a deck that describes some
18 experiments that we did to connect improvements in search
19 quality to growth in search usage.

20 Q. And why did Google perform a study such as this?

21 A. So for the longest time, we have believed that improving
22 metrics like IS -- in the past, we have had other variations of
23 IS. They were called different things. But it was the same
24 basic idea.

25 We have long believed almost as an article of faith that

1 improving metrics like that leads to a more helpful search for
2 users. And some years ago, actually a little before when this
3 deck was done, we decided well, let's make sure it's not just an
4 article of faith, it really is the case that we are building a
5 more helpful Google.

6 And the way we wanted to say that we're being more helpful
7 is to see if users would use search more. We used growth
8 essentially or usage of search as a proxy for helpfulness, the
9 idea being that if users find it helpful, they're going to use
10 it more. They're going to use it more frequently. They're
11 going to use it for more tasks that they're looking for, but in
12 general just using it more.

13 And so we were trying to sort of connect these two things.
14 And so we wanted to see whether making improvements in IS was
15 actually correlated with greater usage of search, so that it
16 wasn't just an article of faith but we could say we've got data
17 that shows this. And that's what this deck was describing.

18 Q. All right. And this deck describes a degradation of one IS
19 point. We've redacted the actual effect from that, but what
20 conclusions did you draw from the change in user behavior with a
21 one IS point degradation?

22 A. I mean, the conclusion I draw is I find the study to be
23 remarkable in a sense, that we make these changes in search
24 quality which nobody really notices obviously, you know. You're
25 changing the web results around. No one knows you launched

1 anything. No one knows you made an improvement. And yet, users
2 subliminally notice that search got better. And they feel like
3 they need to use search more. I think it's just a remarkable
4 thing that this shows.

5 And to me, that was the big takeaway, that it matters what
6 we do in improving search quality. People notice it, even if
7 subliminally.

8 Q. If you could turn to the fifth page of that document,
9 under "caveats." And in the bottom paragraph there, there's a
10 statement about the relationship between IS and growth and
11 conclusions one can draw for different or not draw for different
12 IS points.

13 What is being conveyed there?

14 A. So the document itself or the studies that they did seemed
15 to imply that there was a linear relationship between IS and
16 growth. Okay? So that was -- these were sort of good data
17 scientists who did it, and they wanted to make sure that we
18 understood the limitations of the study.

19 And what they were pointing out is they did these
20 experiments in a certain range of IS changes where there was
21 this linear relationship that they observed, and they wanted to
22 point out that if you made much larger IS changes, the
23 relationship might not stay linear. It might become nonlinear.
24 There might be inflection points where if you make search much
25 worse, for example, you might actually lose a lot more traffic

1 than one might imagine with this.

2 So this was just a caveat, that it might not be linear
3 outside because we had not investigated that.

4 MR. SMURZYNSKI: Your Honor, I'm about to change
5 topics. If this is a convenient time for our morning break, it
6 would be useful in the course of this exam.

7 THE COURT: Sure. All right. It's a little bit
8 before 11:00. We will resume at 11:15.

9 Dr. Nayak, I will ask you not to discuss your testimony
10 during the break. Thank you, sir.

11 THE WITNESS: Thank you.

12 (Recess taken from 10:56 a.m. to 11:15 a.m.)

13 (Call to order of the court.)

14 THE COURT: Please be seated. Thank you, everyone.
15 Counsel, whenever you're ready.

16 MR. SMURZYNSKI: Thank you, Your Honor.

17 If we could put up the demonstrative again.

18 BY MR. SMURZYNSKI:

19 Q. Dr. Nayak, is the quality of Google's search engine
20 determined by the volume of user interaction data it has?

21 A. There's actually a lot that goes into the quality of search
22 results at Google. User interaction is one piece of it, but by
23 no means the only piece. There's many, many other important
24 pieces in there.

25 Q. Using this demonstrative, could you start to explain that?

1 I realize it's a lengthy and complicated topic.

2 A. So as we discussed earlier, we have hundreds of billions of
3 documents in the index. And certainly, being in the index is a
4 crucial part of search quality, because if it's not in the index
5 you can't serve it. But even once it's in the index, there's a
6 lot of work that needs to happen.

7 And given a query, the first step you have to do is to
8 retrieve documents that match the query. A typical query might
9 have millions of documents on the web that match it, but there's
10 no way that in the fraction of a second that we need to do all
11 this in we can look at a million or millions of documents and
12 retrieve them.

13 So instead, what we do is we have a retrieval process that
14 gets us of the order of tens of thousands of documents from the
15 index that you can actually look at. And here, too, you have to
16 do a good job of deciding which tens of thousands of documents
17 to get, because if you don't get the relevant or the important
18 documents in there, again, you've lost it. It's like it's not
19 in the index. So the retrieval step is a crucial one there.

20 And then given the retrieval step, given that you've
21 retrieved tens of thousands of documents, you then need to go in
22 and start deciding which ones you're going to really spend a lot
23 of time scoring so that you get down to like several hundred
24 documents. You do some lightweight scoring at the beginning to
25 get down to several hundred documents that you're actually going

1 to do a detailed ranking with your best scoring functions. And
2 then you bring it all the way down to, say, the ten documents
3 that you're actually showing.

4 So there's a culling process starting even with crawling
5 from the trillions of documents to the hundreds of billions,
6 from the hundreds of billions to the tens of thousands for
7 retrieval, and then to the hundreds and then down to the ten
8 documents.

9 There's a culling process that goes on, and in each step,
10 you have to be careful to make sure that the relevant documents
11 are returned.

12 Q. And does all that have to happen before you can even have a
13 click?

14 A. Yeah. I mean, I think it's important to realize that the
15 only documents that get clicks are the ones that we surface to
16 the user. So you have to work hard to make sure you surface
17 good documents to the user before they can even consider
18 clicking on them.

19 Q. At a high level, how has Google gone about developing its
20 systems to surface documents in the first instance?

21 A. I mean, we use a variety of signals. We have several
22 hundred signals that we use that work together to give us the
23 experience that is search today.

24 The signals vary on a number of different dimensions. It
25 starts with the most basic and in some ways the most important

1 signal, which is just the words on the page. The words on the
2 page are actually kind of crucial, and that's where the index
3 comes in. Where the words occur, is it in the title or is it in
4 some metadata or is it in the body, these kind of signals are
5 very important.

6 Another very important signal is the links between pages.
7 That proves to be another extremely valuable signal. When
8 Google first started, they introduced this notion of page rank,
9 which is really a business of processing these links between
10 pages, and it continues to be an important signal today.

11 There's a variety of other signals that we --

12 THE COURT: I'm sorry. That topic has come up a
13 couple of times. Can you explain what you mean by links between
14 pages? Do you mean hyperlinks between websites? Is that what
15 you're referring to?

16 THE WITNESS: Yeah, it's exactly the hyperlinks
17 between pages on the web. And the important thing here is, each
18 hyperlink has some text associated with it, the linked text
19 associated with it. The linked text is actually about what the
20 target page is about, not what the source page is about.

21 So the linked text is a very valuable clue in deciding what
22 the target page is relevant to. So that's what makes it such a
23 powerful signal.

24 THE COURT: And I'm sorry. I interrupted you. There
25 was more to your answer.

1 THE WITNESS: Then there are other signals that we
2 use. We talked a little about freshness as a signal. Freshness
3 is important even as a notion of relevance. For example, if you
4 wanted to find out something about your favorite sports team,
5 you want the pages that were published maybe this morning or
6 yesterday, not the ones that were published a year ago, even
7 though they might be relevant in that sense, but they're not
8 really relevant because they're not the information you're
9 seeking.

10 Similarly, if you're looking for a new laptop, maybe you
11 don't want the page that was published today, but you want
12 laptop reviews from 2023, because those are the laptops you will
13 be looking at, not the laptop reviews in 2022.

14 On the other hand, if you're planning your Thanksgiving
15 meal and you want a turkey recipe, then maybe the recipe from
16 ten years ago is actually better than the recipes from today.

17 So the notion of freshness and deciding whether to use it
18 or not is a crucial element here.

19 Similarly, another important signal is location. We
20 touched upon it a little with mobile. But location is an
21 important one. You can search for pizza. You want the pizza
22 restaurants near you, because you actually want to eat the
23 pizza -- not maybe the Gino's East or Renaldi's Pizza in
24 Chicago, which everyone tells me is the worst crust greatest
25 pizza. Right? So that's not as relevant to you. And the thing

1 that gives you that signal is location.

2 And then we have a whole lot of signals that we broadly
3 think of as language understanding. And language understanding
4 is sort of a crucial element here, because you need to
5 understand the language of queries, the language of documents,
6 and the match between them.

7 Q. You made reference in your answer to freshness. How do the
8 existence of a collection of clicks in the logs interact with
9 this concept of freshness?

10 A. The challenge with freshness and clicks is that clicks
11 accrete over time, which means older pages, potentially stale
12 pages, tend to have more clicks than fresh pages which may start
13 out with no clicks at all, but even if they start acquiring
14 clicks still will have fewer clicks than sort of the pages that
15 have been around for a while.

16 And so if you want to have a good fresh set of results, you
17 really have to take into account the fact that clicks tend to
18 create staleness, and you need to compensate for that in some
19 way.

20 Q. And when you were talking about those links between pages,
21 is there another term that's used at Google to describe that
22 sort of text in the links?

23 A. We call it link text is the text on the link. Anchors is
24 another phrase that we use. Anchors is also links, yes.

25 Q. And all of these things you've described, some of which use

1 click data and some of them which don't, does Google just mine
2 the clicks and create a table and serve results, or is there
3 other stuff that's gone on over the last 20 years at Google
4 while you've been involved with search ranking?

5 A. No, I think -- I mean, certainly, we use clicks and clicks
6 are important. There's no question about that. But you have to
7 do a lot more. And one whole area that I didn't mention and
8 even the previous answer was this notion of page quality, which
9 is largely nothing to do with clicks and, in fact, as we noted,
10 can be anticorrelated with clicks.

11 Page quality signals are tremendously important, because we
12 want to have the sort of authoritative, reliable information
13 being surfaced in Google.

14 And so there's just a lot of work that goes on in all these
15 different areas. Language understanding today is, perhaps, the
16 most exciting area of work going on.

17 Q. We'll get to that in some more detail in a little bit.

18 We talked earlier about long-tail queries. What's the
19 role, if any, of user interaction data in responding to
20 long-tail queries?

21 A. So long-tail queries, by their very nature, occur
22 infrequently. That's almost by definition is what happens. And
23 as a result, they have few, if any, clicks for them. And even
24 the clicks that they do have, again by the nature of being
25 clicks, can be noisy. And when there's few of them, the noise

1 becomes meaningful. When there's a lot of them, then you can
2 say that the noise can be modulated.

3 And so for ranking of long-tail queries, language
4 understanding becomes sort of the crucial element in ranking
5 long-tail queries.

6 Q. Google has a large collection of sessions logs. Does each
7 click, each piece of data have the same value to Google?

8 A. So there's a broader notion of the law of diminishing
9 returns, which very much applies for us in our use of logs. And
10 the idea is very simple: When you start out and start getting
11 some data, there's a lot of value to it. Right? And so there's
12 significant increase in quality as you get more data.

13 But after a while, the value you get from every additional
14 piece of data starts falling, starts diminishing, and it starts
15 sort of flattening out. So you get this sort of law of
16 diminishing returns.

17 Now, of course, it continues to increase a little bit. So
18 more is better than less at that level. But even here, the
19 story is more nuanced. Because as you get more data, it's more
20 expensive to process. So the cost of processing the data goes
21 up if we're talking about large amounts of data. So the cost of
22 processing it goes up. The time to process it goes up. It has
23 implications on the number of experiments you can run, because
24 each time you have to make a change you have to wait a while for
25 the model to be built and so forth.

1 And so there is this trade-off that we have in terms of
2 amount of data that you use, the diminishing returns of the
3 data, and the cost of processing the data. And so usually,
4 there's a sweet spot along the way where the value has started
5 diminishing, the costs have gone up, and that's where you would
6 stop.

7 Q. Dr. Nayak, in your binder, there is a document DX108. And
8 the DOJ or maybe both plaintiffs have a relevance objection to
9 this, but I don't know if they're standing on it.

10 MR. DINTZER: No objection, Your Honor.

11 MR. SMURZYNSKI: Your Honor, we ask that DX108 be
12 admitted.

13 THE COURT: It is admitted.

14 (Exhibit DX108 received into evidence.)

15 BY MR. SMURZYNSKI:

16 Q. Dr. Nayak, this is a confidential document. So it will be
17 in the binder but not on the screen.

18 What is DX108?

19 A. This is discussing a launch report that I guess was in 2017
20 where we were looking at decreasing the amount of data used for
21 one of our systems by about a third.

22 Q. Okay. And we can identify the name of the system. What
23 was the system?

24 A. This was for the Navboost system, which used session logs,
25 click inquiry data on session logs, and it was looking at

1 decreasing the use of that data.

2 Q. And what did Google find when it made the determination to
3 reduce the Navboost data in the respect that's shown in DX108?

4 A. I mean, what we found was that there was no meaningful
5 change in search quality with this decrease, which was really
6 great, because we could then process the data more quickly
7 because there was a third less data to process.

8 THE COURT: Did Google implement that change?

9 THE WITNESS: Oh, yes. This was approved, and we
10 moved ahead with this, yes.

11 BY MR. SMURZYNSKI:

12 Q. As head of search quality, do you have any involvement with
13 Google's machine learning systems?

14 A. Yes, I do.

15 Q. Earlier this morning, you mentioned that you received your
16 Ph.D. in artificial intelligence in 1992. At a high level, what
17 is artificial intelligence?

18 A. Artificial intelligence is the science and engineering of
19 getting machines, typically computer programs, to exhibit
20 intelligent behavior. It's a bit of a circular definition, but
21 that's as close I think as you're going to get.

22 Q. And without tracing the entire history of it, has
23 artificial intelligence work changed since 1992?

24 MR. DINTZER: Objection, Your Honor. Again, if he's
25 talking about Google and how it's changed Google, we have no

1 problem. This question is about as broad as you can ask for,
2 and that floats into expert territory, which again we would have
3 some problems with. So if he wants to ask about artificial
4 intelligence work at Google, then we have no problem at all.

5 THE COURT: Well, I think this is a predicate to
6 getting there.

7 MR. SMURZYNSKI: I'm not going to focus on exactly how
8 AI worked in 1992, Your Honor.

9 THE COURT: I understand this to be just a general
10 background question that he's more than qualified to answer, and
11 we will move from there.

12 MR. DINTZER: Thank you, Your Honor.

13 THE COURT: So the objection is overruled.

14 BY MR. SMURZYNSKI:

15 Q. Do you recall the question?

16 A. Yeah, can you just repeat it?

17 Q. Certainly. At a high level, how has AI changed from the
18 time you received your Ph.D. in 1992 to today?

19 A. So when I did my Ph.D. and my own work, for that matter, a
20 lot of the work was focused on directly developing algorithms to
21 exhibit the kind of intelligent behaviors that we were
22 interested in: Planning, diagnostic reasoning, this kind of
23 thing. And a lot of the work had that character to it.

24 There was work in machine learning even at the time, and
25 machine learning is a very different way of approaching the same

1 problem, which is, instead of trying to directly develop
2 algorithms to exhibit the behavior of interest, you start with a
3 corpus of data that describes the phenomenon that you're
4 interested in modeling. And then you use machine-learning
5 algorithms to induce patterns from that data so that your
6 program can then exhibit the behavior of interest. So there
7 were machine learning systems there.

8 What has happened over the years is in the 21st century,
9 particularly with the rise of deep learning as a very powerful
10 machine-learning approach, AI has essentially moved to the
11 business of machine learning. So there is very little work as
12 far as I know anywhere. Certainly, all the excitement is around
13 machine learning with deep learning to exhibit the kinds of
14 intelligent behaviors that we're talking about here.

15 Q. Turning now to your time at Google, in the first decade or
16 so of your time at Google Search, so that's 2004 to 2014, how
17 did Google Search use machine learning?

18 A. So in those early years at Google, we did not use machine
19 learning very much. There was a deeply philosophical position
20 that we held that effectively said that it's very important that
21 we understand in detail how our systems work. Right? And so we
22 would develop ranking functions by hand, which we understood the
23 properties of. And the reason for wanting this
24 understandability was that when things went wrong, which they
25 reliably did, you wanted to go back and understand what about

1 your system led to that failure. And by understanding the
2 system, we felt that you could actually do a really good job of
3 fixing it and improving your system.

4 And this philosophical position held us in very good stead
5 for many years. We ventured into forms of machine learning
6 where we would learn some of the parameters of the functions
7 along the way, but still, the systems were still understandable
8 in this way.

9 This changed in 2015 when we moved to using machine
10 learning a lot more, but this was sort of the position we had
11 for the first many years.

12 Q. And Allen, if you could put up in the demonstrative the
13 timeline.

14 Dr. Nayak, at a high level, what was your involvement in
15 creating this timeline?

16 A. I worked with you and various others to produce this
17 timeline.

18 Q. And what is the relationship or the significance of some
19 items being on top of the line and some items being below the
20 line?

21 A. So the items on the top of the line is work, either systems
22 or papers, done by members of the Google research team. So
23 these are all various research advances that our research teams
24 did.

25 The items below the line are applications of this research

1 that our team in search and search quality did to use these
2 advances in search.

3 Q. Let's start with the 2011 entry for Google Brain.

4 What is Google Brain?

5 A. So Google Brain is, I think, the first large-scale machine
6 learning system that was built. It was done in collaboration
7 between Professor Andrew Ng, who was an expert from Stanford on
8 machine learning, on deep learning, and he was spending some
9 time at Google, and he collaborated with Jeff Dean, one of our
10 foremost engineers and an expert on distributed systems.

11 And so the idea in Google Brain was to see if you could
12 train massive neural networks on a distributed platform with
13 lots of computers, because with these very large networks of
14 neural net, they won't fit on one machine. So you need a
15 distributed setup with many different computers talking to each
16 other.

17 And the result was Google Brain, and it started doing some
18 pretty amazing things. The scale and the size of these things
19 and the way to train them was all quite remarkable and has
20 really set off the explosion of interest that we're seeing in
21 machine learning, large-scale machine learning today.

22 Q. And you mentioned distributed computing. How does that
23 relate in any way to the work that Google Search had done up to
24 that date?

25 A. So distributed computing is absolutely central to

1 everything Google did from the beginning, for the simple reason
2 that the only way you get scale, that is, you can operate with
3 large amounts of queries coming in, large indices that you have
4 to create, et cetera, none of these things can be done on a
5 single machine. You need to have a collection of machines
6 working together and all the challenges that that poses in terms
7 of the reliability of those machines and so forth.

8 So distributed computing is one of the core technologies
9 that people like Jeff Dean and others developed over the years
10 to make Google what it is.

11 Q. All right. I see the next entry on the timeline is 2013,
12 Word2vec.

13 If you could advance the slide deck, Allen, to 06.

14 What was Word2vec?

15 A. So when you start -- neural nets essentially operate on
16 numbers, and it's computing some sort of a big function with
17 numbers. So if you want to model text in a neural net, you have
18 to find a way to convert text or words into numbers.

19 And so the very clever idea that was brought up here was
20 this notion of embedding vectors. And the idea is as follows:
21 You take every word and you map it into a high-dimensional
22 space. A high-dimensional space, 128 dimensions, 256
23 dimensions, something of that sort, so some high-dimensional
24 space. So every word is a point or a vector in that space.

25 And you want this embedding, this mapping, to have the

1 property that if two words sort of mean the same thing or are
2 close in meaning, then they map to points that are close to each
3 other in this space. Right?

4 Now, we've tried to show that in this demonstrative here.
5 It's in three-dimension, because nobody has yet figured out how
6 to visualize a 128-dimension space. But it illustrates the
7 idea.

8 As you can see, the word "porpoise" and "dolphin," they're
9 sort of related, very closely related items. So they both get
10 mapped to or they get embedded to points or vectors that are
11 very close to each other. SeaWorld is quite correlated with
12 dolphins, Shamu and so forth. Right? So the embedding or the
13 mapping of SeaWorld is also close, though not nearly as close as
14 porpoise, as close to dolphin. But something like Paris is
15 actually quite far away.

16 And so this is the kind of property you want from
17 embeddings, is this notion of semantic similarity being
18 proximity in this Cartesian space. Word2vec was a way of
19 automatically creating these mappings by processing data and
20 looking for word occurrences in a big corpus of data, like a
21 Wikipedia corpus, or nowadays, it's done with even larger
22 corpora like the web corpora.

23 And you look at this co-occurrence of words. And Word2vec
24 was one of the first really powerful ways of creating these
25 embeddings that have this property and lots of other interesting

1 properties here.

2 And so in that sense, it was sort of a central element in
3 being able to apply neural networks for text.

4 THE COURT: Can you just explain what you mean by
5 vectors? I think of a vector as a line, but that's not what you
6 mean.

7 THE WITNESS: Actually, the way that -- a vector is
8 simply the line from the origin to this point. So when I have
9 these two points, the porpoise and the dolphin point, they're
10 actually two vectors, one from here to here and one from here to
11 here. So the two are interchangeable.

12 THE COURT: So the point is representative of the
13 proximity or closeness of the words?

14 THE WITNESS: Yes, exactly. When those two points are
15 close to each other, the implication -- what you want is that
16 should mean that the two words sort of mean the same thing or
17 are close in meaning or are related in some way.

18 BY MR. SMURZYNSKI:

19 Q. Allen, if you could advance the slide -- sorry. Go ahead.

20 A. These are not mappings you can do by hand. So you have to
21 induce them from corpora of data, and that is what Word2vec did,
22 as sort of a concrete example.

23 Q. Below the line on the timeline in 2015, we have RankBrain.
24 What is RankBrain?

25 A. So RankBrain is the first application of Google Brain, this

1 sort of massively -- this massively parallel neural net that
2 they had built, but applying it specifically to the problem of
3 search. So it essentially looked at a query in a document,
4 representations of those in terms of text, created the network
5 and, you know, generated a score that said how relevant is the
6 document to the query.

7 Q. And I don't know if in 128 dimensions or more there's a
8 notion of closeness, but is that the idea that's going on, that
9 you have a query and you have a document and you're trying to
10 find those that are close in 128-dimensional space?

11 A. So that's an important point, but that actually is done by
12 one of the later systems.

13 Q. I've jumped ahead. I'm sorry.

14 THE COURT: You're ahead of your time.

15 THE WITNESS: But the -- what this is doing is it's
16 inducing from data this notion of relevance between queries and
17 documents. And the way this proximity comes in is in the
18 generalization step.

19 So if you have two queries, and suppose for the first query
20 you know this document is relevant, and the second query defers
21 from the first query in only, let's say, one word, which is a
22 synonym word. Then you would expect that the embeddings for
23 those two queries would be sort of close to each other, because
24 they're synonyms in this sense, which means if the first query
25 is determined to be relevant to the -- the document is relevant

1 to the first query, then an embedding that is sort of close by
2 will also be relevant, the document will be relevant to that
3 query.

4 So in a sense, you've generalized from one query document
5 pair to a different query document pair in this way because of
6 this notion of proximity. And that's one of the ways that these
7 neural nets generalize. They do it in other ways also, but
8 that's where the real power of these neural nets comes in.

9 Q. Did the launch of RankBrain have an impact on search
10 quality at Google?

11 A. Yeah. RankBrain was the single biggest launch for any
12 single launch. It was the biggest search launch that we've had
13 in improving search quality since I can remember, at any rate.
14 Maybe before that there were bigger ones, but certainly, it was
15 a very significant improvement.

16 Q. All right. And above the line in 2017, there's a reference
17 to the paper "Attention is All You Need."

18 Who published "Attention is All You Need"?

19 A. This was a paper again published by researchers in Google
20 Research.

21 Q. And what was the point being explained in "Attention is All
22 You Need"?

23 A. So this is a really, really interesting series of ideas.
24 The first thing to note is that language and the meanings of
25 words is incredibly context-dependent. All right? There's this

1 famous linguist from the 1950s, John Rupert Firth, and he had
2 this beautiful line, which was, "You shall know a word by the
3 company it keeps." And the observation being that words derive
4 their meaning from the context in which they're used. Right?
5 So that is sort of one key point.

6 Now, in Google Brain and in RankBrain, we took queries or
7 any sort of sequences of words and broke them up into pieces and
8 created a bag of words, individual words as such.

9 And what that meant was a query or a sentence like "dog
10 bites man" would look very similar to a sentence like "man bites
11 dog," because they have the same set of words in them. So when
12 you think of them as bags of words, those two look the same.
13 But of course, one of them generates a news article and the
14 other doesn't. Right? So they mean very different things. And
15 what makes the difference in meaning is the actual sequence.

16 So "Attention is All You Need" was an attempt at
17 understanding words in sequence, not as bags of words as was
18 done in Google Brain or in RankBrain, but as in this sequence
19 manner.

20 And what the paper did was it introduced a component called
21 a transformer, which is a collection of neural net elements put
22 together into a unit like that. And the transformer looked at
23 all the context of words around a given word to try and
24 understand its meaning.

25 But it did one other very important thing, which is it said

1 not all the words in the context are important. There's only
2 some words that are important. You need to pay attention to
3 only some words.

4 And so this transformer element both gave you the context
5 but also gave you a mechanism to focus on only certain parts of
6 the context that were relevant that you paid attention to. And
7 they showed that using this notion of a transformer, you could
8 get a lot of good stuff for understanding words in sequence.

9 Q. And in this context of machine learning, what is a
10 transformer? What's its nature?

11 A. So the transformer, as I said, it's a network of neural
12 elements. It's a software component. And you can build larger
13 networks out of it. In fact, all of the excitement around large
14 language models that we have today are built out of
15 transformers. So you might have heard of ChatGPT. The T stands
16 for transformers. So they're all based off of this article
17 here.

18 Q. Okay. And then the next article in the timeline, 2018,
19 refers to BERT.

20 What is that article about?

21 A. So BERT was really quite a landmark publication, again by
22 people at Google, that essentially took the transformers from
23 the 2017 paper, and it created an architecture that -- and they
24 introduced a particular way of training this model that proved
25 to be incredibly helpful in solving just about every language

1 understanding problem that the research community was looking
2 at.

3 Q. And if you will advance the slide deck, Allen.

4 What's depicted here, Dr. Nayak?

5 A. So this is what BERT looks like. It's made up of a set of
6 layers, up to 24 layers. So it's a very deep network. Each
7 layer consists of a set of transformers. There's -- and what
8 each transformer is doing is it's taking one of those initial
9 word encodings, encodings or embeddings that we talked about.
10 It looks at the context in which that word occurs, and it
11 creates an output encoding and sort of sends it through. So
12 there's one sort of transformer stack for each word.

13 And I think it's easiest to describe this in the context of
14 an example. Consider the sentence "the animal didn't cross the
15 road because it was tired," and consider the encoding or the
16 embedding of the word "it" and the word "animal." In a
17 context-independent fashion, which is what the Word2vec and what
18 we had before, you would expect that they would get embedded
19 quite far apart. But of course, we know that in this
20 context "it" refers to the animal.

21 So what BERT was doing is, as it was looking at the context
22 in which it is used, it is creating these contextual word
23 encodings at the bottom. And in the contextual word encodings,
24 the word "it" in this context will map close to the
25 word "animal," because in fact they refer to the same thing.

1 And in terms of attention, notice that it probably paid
2 attention to the words "was tired," because that's the thing
3 that clues it in to the fact that it refers to animal. If the
4 sentence had been "the animal didn't cross the road because it
5 was too wide," then "it" would refer to the road, and it was
6 paying attention to the "too wide" is what told it that it's the
7 road.

8 And so that's what the word is doing, is it's developing
9 this contextual understanding of words in the sequence. And it
10 turns out that this contextual understanding becomes incredibly
11 powerful to help you solve all sorts of natural language
12 problems, question answering, and a part of speech tagging and
13 all kinds of further such things.

14 Q. How is BERT trained, Dr. Nayak?

15 A. BERT is trained -- in the BERT paper, they trained it on a
16 large corpus of text. I think it may have been Wikipedia text,
17 but it might have been something more than that. But it was
18 trained on text.

19 Q. In your binder, if you would turn to Exhibit DX134, which
20 is in evidence. We'll start with the cover slide, "zero to BERT
21 in 60 minutes, 2019 Rankapalooza."

22 What is Rankapalooza at Google?

23 A. It's an event that we have for our whole search quality
24 team. We try to bring them together. We build community. We
25 have educational events. We take it as a place for people to

1 work together. We find it to be incredibly helpful in enabling
2 our team to do good things.

3 Q. If you will turn to page that ends of .030, and it's a
4 slide that has the title "happy things."

5 That first bullet reads, "BERT emerged from a collaboration
6 between web answers and research, extending a line of internal
7 and external research."

8 Can you just explain what's being conveyed there?

9 A. Yeah, so we described what BERT was, this pretty remarkable
10 landmark publication. It didn't just come out of nowhere. The
11 researchers, Jacob Devlin and others who worked on it worked
12 very closely with our web answers team. This is a part of our
13 search quality team. The web answers team is focused on
14 extracting the right passage from a document that is most
15 relevant to your query.

16 So it's the featured snippets you sometimes see at the top
17 of the search results. So it's like a question answering-type
18 task.

19 So the research team was working closely with us to see how
20 they could help us improve their answers. And as a part of that
21 collaboration, BERT emerged as sort of the general research idea
22 that helped us improve, among other things, web answers.

23 Q. And the next bullet point on page 030 reads, "Not a lucky
24 coincidence."

25 What's being conveyed there?

1 A. I think what's being conveyed there is that innovations
2 like BERT again don't just happen. It's because -- they happen
3 because Google has set up an environment that enables
4 innovations like this.

5 So what are some of the elements of that environment? One
6 is Google understood early on that machine learning was going to
7 be extremely useful. And so they made a lot of investments in
8 machine learning hardware. They developed TPUs, Tensor
9 Processing Units, for example. They invested in enabling
10 researchers and product teams like ours to use these TPUs in
11 various ways. And so that was a key element that allowed us to
12 develop BERT at all.

13 The other thing is relationships. That is, these problems
14 that our researchers were working on, they were not working on
15 it sort of in an abstract ivory tower fashion. They were
16 working closely with us on the product teams to say how can we
17 advance the research to enable more effective products, and
18 that's what's led to these very impactful things here.

19 Q. Allen, if you could go back to the timeline, please.

20 How has BERT been applied by Search into the search
21 product?

22 A. So BERT is applied in a number of ways, but I think one of
23 the most interesting ways was for our core ranking work. We
24 launched a system called DeepRank, which is -- essentially uses
25 the technology of BERT to significantly improve language

1 understanding that we need for ranking.

2 And DeepRank essentially was the largest single change we
3 made, improvement we made to search since RankBrain. So big
4 advance again.

5 Q. All right. Allen, if you could advance the demonstrative.

6 Briefly, Dr. Nayak, what is shown on slide 010?

7 A. So this is an example from the DeepRank launch report, one
8 of the queries in the valuation that we had there, and it
9 illustrates some of the more subtle nuances that DeepRank seemed
10 to understand about language that we didn't capture before.

11 So here, the query is "can you get medicine for someone
12 pharmacy." Before DeepRank, we surfaced a pretty good result
13 about filling prescriptions, but it seems to miss the nuance
14 that it's not just about filling prescriptions. You want to
15 know if someone else can pick up your prescription at the
16 pharmacy. So it missed that nuance.

17 After DeepRank, we seem to have captured that particular
18 nuance, and we surfaced another good result that stemmed from
19 HHS which is specifically about whether a patient can have a
20 friend or family member pick up the prescription for them.

21 So what we saw in that evaluation is that language
22 understanding that BERT provided DeepRank really manifested
23 itself in us being able to understand more of the nuance in
24 queries like this, these longer, more complex queries.

25 Q. The other search product that you identified on the

1 timeline derived from BERT was Deep Embed BERT --

2 A. RankEmbed.

3 Q. Excuse me. RankEmbed BERT. What was RankEmbed BERT?

4 A. RankEmbed BERT is essentially the idea you were talking
5 about earlier. Remember we had this notion of embeddings for
6 words.

7 This thing takes it one step further. It says why don't we
8 embed queries into that space, and why don't we embed documents
9 into that space, and let's do it in a way that if a document is
10 close to a query, then the document is relevant to that query,
11 so let's create the same mapping in a manner similar to what we
12 had done before.

13 So we've got this mapping here, and now if you hide -- if
14 you embedded all these queries in documents in this way, if
15 you're given a new query, you embedded into the space and you
16 look in the neighborhood around it for documents that are close
17 by and you retrieve those documents. So you can augment your
18 retrieval that we needed to do, and it turns out that this thing
19 retrieves some really great documents, particularly for
20 long-tail queries.

21 Q. You mentioned long-tail queries. Overall, what has been
22 the impact of RankEmbed BERT on search?

23 A. RankEmbed BERT was again one of those very strong impact
24 things, and it particularly helped with long-tail queries where
25 language understanding is that much more important.

1 Q. All right. Continuing on, in 2021, there's a reference to
2 MUM.

3 What was MUM, Dr. Nayak?

4 A. MUM was a -- one of the first generation of the so-called
5 large language models that we developed particularly for search,
6 and it proved to be incredibly valuable for many, many different
7 aspects of search.

8 Q. And I see above the line there's another article with
9 regard to the T5.

10 What was that?

11 A. So T5 was again a paper published by researchers at Google.
12 They introduced a particular neural network architecture that we
13 found to be very useful that we used in MUM.

14 Q. All right. Allen, if you could advance the slide.

15 Dr. Nayak, under the heading "multitask unified model," or
16 MUM, there are a number of bullet points here. The first refers
17 to "1,000 times more powerful than BERT."

18 A. Yeah.

19 Q. What does that mean?

20 A. So this is a fairly simple idea. The network on the right
21 is the T5 network, and it's got a number of parameters, a very
22 large number of parameters. The "thousand times more powerful
23 than BERT" simply says there were a thousand times more
24 parameters than the BERT model had. So it was a much larger
25 model, and as a result, it was able to exhibit much more

1 powerful, more capable behaviors.

2 Q. And then going down those bullets, in the third bullet,
3 there's the statement "understand and generate human language."
4 Let's start with the first half of that first. Actually, let's
5 do both parts.

6 How do you know that MUM understands and can generate human
7 language?

8 A. So in the public domain, there are various metrics that
9 have been developed. The most recent one that people use are
10 these SuperGLUE metrics, which is a measure of how well these
11 big, large language models are doing for tasks like
12 understanding and generating human language.

13 MUM scored above 90 on the SuperGLUE scale. Just to give a
14 sense, they believe that human performance on that particular
15 collection of problems gives you a SuperGLUE score of about 90.
16 So at least on the problems described there, MUM was sort of at
17 human performance.

18 Q. What is MUM trained on, Dr. Nayak?

19 A. MUM is trained on a high-quality subset of the web corpus.
20 So it's part -- it's trained on that.

21 Q. Let's go to the next slide, please.

22 Here, we have a query on the right side. Could you explain
23 what's going on there?

24 A. So the context of this slide is that we used MUM to improve
25 many, many different aspects of search. So you can see we

1 powered some 90 launches in the past year using MUM.

2 One of the launches that's sort of highlighted here is in
3 the web answer space, and this is where we actually try to
4 identify the particular passage in the document that answers the
5 question that you're looking for.

6 So in this case, the question is "can worms have seizures."
7 And before the MUM-powered version of the system, we sort of
8 didn't quite get this right. We surfaced a passage about
9 whether worms can cause seizures in humans. Right? But of
10 course, we know that that's not what the query is asking for.
11 They're asking if worms can actually have seizures.

12 And after MUM, I think we understood that, and we were able
13 to surface a passage that indeed they do get some epileptic
14 seizures in these tiny round worms that sort of look like
15 seizures, which is quite fascinating.

16 Q. And on the left, there are a number of observations about
17 MUM in search. The first refers to "improvements in IS."

18 A. Yeah.

19 Q. Did MUM -- go ahead.

20 A. We used MUM on some of our systems that improved IS and
21 RankEmbed in particular, and it led to very significant
22 improvements for all the reasons that we've described. It was
23 just a more powerful way of understanding language.

24 Q. And the next piece of this slide reads "most wins in
25 understanding long-tail complex queries."

1 First of all, what does "wins" mean there?

2 A. Wins is where using the system that was powered by MUM,
3 using that led to improvements in search in some way compared to
4 the old system. We call those wins.

5 Q. And why is it that MUM in particular had this effect, this
6 most wins with respect to long-tail complex queries?

7 A. I think it gets back to the point we've made, which is on
8 long-tail and complex queries, language understanding plays a
9 crucial role. And as machine learning has advanced, as the
10 technology has advanced to understand language better, we're
11 able to handle long-tail and complex questions that much better.

12 Q. All right. Then on the bottom, it indicates "powered 90
13 launches in past year."

14 What's being conveyed by that?

15 A. I think the main point conveyed there is that MUM wasn't
16 some one singular launch. Rather, it was used in a variety of
17 different ways. Different projects used it in different ways,
18 but it is used in a variety of different ways to improve many,
19 many different aspects of search, so not just the ranking of
20 results, but many of the features and so forth.

21 In particular, it powered like 90 different launches in
22 this way.

23 Q. Allen, let's advance this slide, if we could.

24 What is this, Dr. Nayak?

25 A. So this is just a small sample of those 90.

1 MR. DINTZER: Your Honor, I have to object. If this
2 was powered launches in the last year, that means this powered
3 launch is without any depositions or documents related to this.

4 COURT REPORTER: Counsel, if you could turn on the
5 mic.

6 MR. DINTZER: That means this is addressing material
7 that was not turned over to us in discovery, we don't have the
8 information on, and to the extent that the witness is relying on
9 this to talk about the importance of MUM and how powerful it is
10 and great, we don't have that, and we don't have the ability to
11 challenge him about the accuracy or the completeness of his
12 testimony, given that.

13 And so he's welcome to testify about all the stuff, we
14 haven't challenged any of the stuff that he's done so far, but
15 this is expressly stuff that has been created outside of the
16 discovery window that we had the ability to contest and ask.

17 I can go further, that they're using him as an undisclosed
18 expert on this area, but we believe that that's enough to keep
19 this out.

20 THE COURT: Let's at least start with the question of
21 when these were -- when these launches were released. That
22 might be a helpful way to suss this out.

23 MR. SMURZYNSKI: Your Honor, if I could just make an
24 observation. We heard from Dr. Ramaswamy about events that
25 occurred in 2023.

1 THE COURT: I know.

2 MR. SMURZYNSKI: We've heard from others about events
3 that have occurred since the close of discovery. I'm not going
4 into great depth on this. But I will elicit the information you
5 are interested in, Your Honor.

6 BY MR. SMURZYNSKI:

7 Q. First, Dr. Nayak, when was MUM launched by Google?

8 A. We can look at the timeline to make sure, but I think it's
9 2021.

10 Q. Okay.

11 A. We announced this at Google I/O.

12 Q. Looking at that slide 014, in the upper left-hand corner,
13 there is a reference to a launch with regard to helping users in
14 crisis.

15 When was MUM first used with respect to queries of that
16 nature?

17 A. I think this was early last year, early in 20- -- yeah, for
18 MUM, this was early last year, I think.

19 Q. Okay. And what is being done in that launch?

20 A. What we did here, so we had -- we sometimes get queries
21 from users who are in crisis of one sort or the other.
22 Sometimes, they're suicidal, and they come to ask us questions
23 about their state.

24 And in those cases, when we detect that a query refers to
25 someone who is in a crisis, who is suicidal, we believe it is

1 useful to surface a one box, an experience that points them
2 towards help lines to help them in those crisis situations.

3 So we had launched this earlier. And a key part of doing
4 that is to make sure that the query really refers to a user in
5 crisis. So you don't want to trigger this experience if the
6 query doesn't refer to someone in a crisis.

7 So if a user comes to us with a query Suicide Girls, for
8 example, that's actually a music band, and surfacing this would
9 not be helpful in that case.

10 So you need a classifier that says oh, look, this feels
11 like a crisis query, please trigger this.

12 We had launched something with an earlier classifier, but
13 with MUM, we were able to do a much better job of detecting
14 whether a query was or was not a user in crisis like this. We
15 were able to double the coverage in seven languages and launch
16 this experience in 16 different languages all told. So a very
17 focused, small-use case, you might say, but in some ways, an
18 incredibly important use case for something like MUM.

19 Q. Let's go back to the timeline. Dr. Nayak, there are
20 references here to LaMDA, PaLM, and PaLM2.

21 At a high level, what are these?

22 A. So LaMDA itself was also put out in 2021 in Google I/O.
23 And it was one of these large language models that was
24 particularly focused on conversation. It was very good at
25 conversation.

1 And PaLM and PaLM2 have built on that. They've become
2 larger. They have more capabilities than LaMDA. And these are
3 all systems that our research teams have built.

4 Q. And then below the line, Dr. Nayak, there's a reference to
5 "2023 SGE." Just at a very high level, what is SGE?

6 A. SGE stands for search generative experience, and it's an
7 experience that we've built that takes all this excitement
8 around generative AI and brings it to search.

9 Q. And are there others within the search organization who
10 have focused more on SGE than you?

11 A. Yeah, one of the other VPs in search, Liz Reid, she's the
12 one primarily responsible for SGE.

13 Q. Okay. Now, you've touched on this briefly as we've gone
14 through the timeline, but I would like to talk about overall the
15 data that's being used in these models, these applications. And
16 let's focus first on the top, above the line, the research
17 applications.

18 Is there any search user click and query data that is used
19 to train those models?

20 A. No. They usually work off of open web corpus or other
21 corpora that have been developed outside. They do not use
22 search data.

23 Q. Okay. And I would like now to talk about the applications
24 below the line, those in search. If we could advance the
25 demonstrative to 016.

1 And some of these numbers, Your Honor, are redacted, but
2 they should be on the deck, and you should have them in front of
3 you.

4 Could you walk through sort of the evolution of the use of
5 click and query data with respect to these applications that use
6 these large language models and ML that we've been talking about
7 this morning?

8 A. Yes. All of these, at least the first three classes of
9 models, they use both search logs data, which is click and query
10 data, but they also use IS scores, the human-rated scores that
11 we had generated. So two sources of data are used there.

12 RankBrain uses a few months' worth of search logs. DeepRank
13 uses a little bit more than half of what RankBrain does. And
14 RankEmbed uses a small fraction of the data that DeepRank uses,
15 a small percentage of what DeepRank uses.

16 Q. And then let's continue on with regard to MUM.

17 How is click and query data used, if at all, in MUM?

18 A. MUM itself, as we have discussed before, is pretrained on a
19 corpus of web data. It's a subset of the web corpus. The
20 specific applications was 90-plus applications that we
21 mentioned. They bring some amount of training data for their
22 specific tasks. Some of them may be click data. Some of them
23 may not be click data, like the one in the example we talked
24 about. They had a small training set of queries that
25 represented users in crisis, and there was no click and query

1 data for that. But there were applications that also used it,
2 but it was the applications that used it, not MUM.

3 Q. What has been the trend over time in terms of the amount of
4 click and query data and its significance in these models?

5 A. I think the trend is clear, is that you need less and less
6 click and query data, that what these models are doing is
7 they're very powerful at generalizing, and they're generating
8 very good language understanding. And as a result, you need
9 less and less query data to get that additional benefit from
10 them.

11 THE COURT: Can I ask what is undoubtedly an
12 oversimplification in a simple question: Can you explain to me
13 how these models interact when it comes to a search? Is it that
14 one model fully replaces the other? Do they do it on top of one
15 another? How would one conceptualize the relationship among
16 these models and affecting search quality?

17 THE WITNESS: That's a great question. This really
18 goes back to that philosophical point that we had made earlier
19 about how we build search ranking, which is we want to
20 understand it.

21 Now, when you get to these deep learning systems, they're
22 much harder to understand. But we want to use them, because
23 they're very powerful. So what we have done is we don't turn
24 over the ranking as a whole to these large models. Rather, we
25 still have an infrastructure that we understand, a series of

1 ranking functions with signals coming in. And the outputs of
2 these models are additional signals into that ranking function.

3 And so they're used as additional signals, maybe very
4 powerful signals, maybe very informative signals, but
5 nonetheless additional signals that get balanced both against
6 each other as well as against other signals, like our page
7 quality signals and so forth.

8 So there is no sense in which we have turned over our
9 ranking to these systems. We still exercise a modicum of
10 control over what is happening and an understandability there.

11 Q. I'm going to switch topics now. Are you familiar with
12 Microsoft's Bing?

13 A. Yes.

14 Q. What is Bing?

15 A. Bing is a search engine.

16 Q. Does Google Search ever conduct comparisons of itself to
17 Bing?

18 A. Yes, we do.

19 Q. And how does Google go about doing that?

20 A. It's very much like how we evaluated the quality of Google
21 Search itself. We start with a sample of queries, and we see
22 what results Google and Bing generate for those, and we get our
23 raters to rate them. And so we get an IS score for Google and
24 an IS score for Bing, and that's how we do the comparison.

25 Q. Why does Google compare itself to Bing in particular in the

1 search organization?

2 A. The -- we actually do more than just comparison to Bing.
3 We have regular comparisons to Bing, because they're relatively
4 easy to do, because the way Bing operates is very similar to the
5 way Google operates. But we do comparisons with other places
6 that users look for information. We just don't do it as
7 frequently, because it's not as easy to do it. But we get
8 insights, more qualitative insights in those cases on how people
9 are looking for information.

10 So, for example, recently, we've been doing comparisons
11 with TikTok, where young people particularly are increasingly
12 turning to TikTok for their information needs, and we want to
13 understand what is it that they're doing there, what are they
14 finding useful, what should we do with Google to address that.

15 MR. DINTZER: Objection, Your Honor. To the extent he's
16 going to go any further about what they've recently done with
17 TikTok, it hasn't been turned over to us and given a chance to
18 examine. I think at this level, it's fine, but anything more
19 than that, we would have a significant objection.

20 THE COURT: Let's see where the questioning goes.

21 BY MR. SMURZYNSKI:

22 Q. The question simply is, why is it harder to compare
23 something like Google Search to whether it's TikTok or Facebook
24 before it or Amazon, a system such as that as compared to Bing?

25 A. I think the fact that Bing looks so much like Google and we

1 have all the infrastructure set up for evaluating Google makes
2 it easier to make those comparisons.

3 The others, they look different in various ways. And so
4 you have to do more qualitative analysis, and it's not something
5 that you can automate in quite the same way.

6 Q. And over those 19 years in which Google's been doing those
7 comparisons to Microsoft's search product and other search
8 engines of the same ilk, what has Google seen in terms of the
9 quality differences?

10 A. I think we've seen a fairly meaningful difference in
11 quality. I would guess in the range of three to four points of
12 IS at various points is the gap we've seen.

13 Q. Dr. Nayak, it's been suggested by plaintiffs that perhaps
14 Google Search took the approach of being good enough.

15 Was it ever the case in your years at Google that its
16 approach to search quality was to be good enough?

17 A. No, not at all.

18 Q. And what is Google's culture?

19 A. We very much have a culture of trying to improve search for
20 our users. We are consumed by this. We spend all our time
21 doing this. We set ourselves goals to continually improve
22 search.

23 And frankly, there's a lot of work to be done for all sorts
24 of reasons. The most interesting of them is every time we
25 improve search, users ask us harder questions. There's always

1 this sort of boundary of questions that we don't do a good job
2 on. And so there's always lots of work to be done, and we
3 continually expand the boundaries as we go. So there's no sense
4 in which search has ever been good enough.

5 MR. SMURZYNSKI: Your Honor, I have no more questions
6 for the witness.

7 I'd like to move into evidence the demonstrative in the
8 same fashion that we have been doing that for others, DXD17.

9 THE COURT: Okay.

10 MR. DINTZER: As long as it's coming in as a
11 demonstrative, we don't have any objection, Your Honor.

12 MR. SMURZYNSKI: In the same fashion that we've been
13 doing this with the others.

14 THE COURT: So it will be accepted for that purpose.

15 (Exhibit DXD17 received into evidence.)

16 THE COURT: Okay. So this is an opportunity -- so
17 you're finished with your direct examination?

18 MR. SMURZYNSKI: Yes, Your Honor.

19 THE COURT: Terrific. It's a little after 12:25. We
20 will resume at 1:30. We will obviously take our lunch break.

21 Dr. Nayak, the same instruction as before, please do not
22 discuss your testimony during the break. Thank you.

23 THE WITNESS: Thank you.

24 (Recess taken at 12:26 p.m.)
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CERTIFICATE OF OFFICIAL COURT REPORTER

I, Sara A. Wick, certify that the foregoing is a correct transcript from the record of proceedings in the above-entitled matter.

/s/ Sara A. Wick

October 18, 2023

SIGNATURE OF COURT REPORTER

DATE

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