NOTES

INTRODUCTION

1. Seabrook, "Can a Machine Learn to Write?"

2. Mori, "The Uncanny Valley."

3. On the ability of algorithms of carrying out sophisticated conversations in a "natural" way, see Welch, "Google Just Gave a Stunning Demo."

4. Alan Turing proposed the Turing test in "Computing Machinery and Intelligence" to evaluate the ability of a machine to exhibit intelligent behavior. The machine passes the test if an observer cannot distinguish its contributions in a natural language conversation from those of its human partner.

5. See, e.g., Kurzweil, *The Singularity Is Near*; Bostrom, *Superintelligence*.

6. From Searle, "Minds, Brains and Programs" (1980), to Negarestani, *Intelligence and Spirit* (2018).

7. Eco, *Opera aperta*.

8. That they are controlled obviously does not mean that they are correct, neutral, or should be accepted without reservation or criticism. As the dynamics of feedback show, the presence of control does not exclude risks, manipulations, or negative results. On the other hand, human control, as is well known, is certainly not a guarantee of success, nor even of rationality.

9. Quoted in Seabrook, "Can a Machine Learn to Write for *The New Yorker*?"

CHAPTER 1

1. This chapter is a heavily revised version of "Artificial Communication? The Production of Contingency by Algorithms," *Zeitschrift für Soziologie* 46, no. 4 (2017): 249–265.

2. Ferrara et al., "The Rise of Social Bots"; Imperva, *The Imperva Global Bot Traffic Report 2019*.

3. According to Twitter itself, which provides users a tool, Twitteraudit, to calculate how many of their followers are "real" (meaning human beings).

4. In the first three-quarters of 2020, Facebook "disabled" 4.5 billion fake accounts. See Facebook's transparency report: https://transparency.facebook.com/community-standards-enforcement#fake-accounts.

5. Kloc, "Wikipedia Is Edited by Bots."

6. Kollanyi, Howard, and Woolley, "Bots and Automation over Twitter."

7. Gillespie, "Algorithms, Clickworkers, and the Befuddled Fury."

8. See Miklós, "Computer Respond to This Email."

9. Pierce, "Spotify's Latest Algorithmic Playlist."

10. See https://www.narrativescience.com.

11. See https://automatedinsights.com.

12. Podolny, "If an Algorithm Wrote This?"; Peiser, "The Rise of the Robot Reporter."

13. Youyou, Kosinski, and Stillwell, "Computer-Based Personality Judgments Are More Accurate."

14. Here the founding event is generally considered to be the Dartmouth Conference of 1956: see Moor, "The Dartmouth College Artificial Intelligence Conference."

15. For more on al-Khwarīzmī, see Chabert, *A History of Algorithms*.

16. Davis, *Computability and Unsolvability*, xv.

17. Esposito, "Algorithmische Kontingenz." Whereas in classical AI, an algorithm is the sequence of actions that must be performed to calculate a result, in machine learning, the term indicates the sequence of actions performed to make the machine learn the distinctions one wants to obtain. In the first case executing an algorithm means doing a calculation; in the second case it means "tuning" the system. I thank Stefano Borgo for this clarification.

18. "Do we want more effective machine learning models without clear theoretical explanations, or simpler, transparent models that are less effective in solving specific tasks?" asks Peng in "LeCun vs Rahimi?" It has even been claimed that in the field of machine learning a certain "inexplicability" can be a positive factor, because imprecision and errors make the working of algorithms more flexible, and are neutralized by the increase in data; see Mayer-Schönberger and Cukier, *Big Data*, 33.

19. Burrell, "How the Machine 'Thinks.'"

20. Borgo, "Ontological Challenges to Cohabitation with Self-Taught Robots."

21. For Hans Blumenberg's metaphor, see Blumenberg, "Nachahmung der Natur."

22. The idea of a progressive autonomy from human performance is not new: all media introduce a form of communication that in some respect becomes autonomous from a direct coordination with human processes: see Luhmann, *Die Gesellschaft der Gesellschaft*, 216–217. In written communication it is not necessary that

the partners are present, whereas press and mass media do not even require that they know anything about each other or that they have ever met. The readers produce their own communication, with a rhythm, a timing, and an order that can be quite different from those of the issuer. The information that the receiver gets is increasingly independent from what the issuer had in mind. With algorithms, however, apparently it is not even necessary that the issuer ever had any information in mind.

23. Goodfellow, Bengio, and Courville, *Deep Learning*, 15; and Wolchover, "AI Recognizes Cats the Same Way."

24. "In trying to build a thinking machine, scientists have so far succeeded only in reiterating the mystery of how our brain thinks." Seabrook, "Can a Machine Learn to ?"

25. Searle, "Mind, Brains and Programs."

26. Solon, "Weavrs: The Autonomous, Tweeting Blog-Bots."

27. Boellstorff, "Making Big Data, in Theory."

28. Hammond, *Practical Artificial Intelligence for Dummies*, 7.

29. Silver and Hassabis, "AlphaGo: Mastering the Ancient Game of Go." The programmers of Libratus, the poker AI that defeated the best human players in January 2017, say that "it develops a strategy completely independently from human play, and it can be very different from the way humans play the game"; see Metz, "Inside Libratus, the Poker AI That Out-Bluffed."

30. Grossman, "How Computers Know What We Want"; and Ktichin, "Big Data, New Epistemologies and Paradigm Shifts," 4.

31. Youyou, Kosinski, and Stillwell, "Computer-based personality judgments are more accurate," 1036.

32. Rogers, *Digital Methods*, 155; and Vis, "A Critical Reflection on Big Data."

33. The very distinction between social facts and personal opinions seems to be fading; see Latour, "Beware, Your Imagination Leaves Digital Traces."

34. Seaver, "Algorithmic Recommendations and Synaptic Functions."

35. Hayles, *How We Became Posthuman*; Braidotti, *The Posthuman*.

36. Shannon and Weaver's transmission model of communication is still the (revised and supplemented) basis of most sociological and semiotic approaches. Shannon and Weaver, *The Mathematical Theory of Communication*; Fiske, *Introduction to Communication Studies*; Eco, *Trattato di semiotica generale*, 65–69.

37. Data that exist as simply differences become informative when contextualized and interpreted. On the distinction between data and information, see Bateson, *Steps to an Ecology of Mind*, 582.

38. "We should take seriously the possibility that humans and robots act according to views of reality that are . . . largely incommunicable." Borgo, "Ontological Challenges to Cohabitation with Self-Taught Robots," 2.

39. In the sense of semiotics' "aberrant decoding": see Eco and Fabbri, "Progetto di ricerca sull'utilizzazione dell'informazione ambientale."

40. Luhmann, *Soziale Systeme*; *Die Gesellschaft der Gesellschaft*.

41. Luhmann, "Was ist Kommunikation?," 113.

42. Von Foerster, "Notes on an Epistemology for Living Things," 6.

43. Or writes, or indicates, or broadcasts—the concept is not bound to oral communication. See Luhmann, *Soziale Systeme*, 193–201.

44. Communication is technically defined as the unity of three selections: information, utterance (*Mitteilung*) and understanding; see Luhmann, *Soziale Systeme*, 196. To be precise, it should be specified that the understanding included in the definition of communication has a social and not a psychic reference: it does not coincide with what the receiver understands and thinks, but refers to the potential of meaning (*Sinn*) available to any possible participant in the communication; cf. Luhmann, "Wie ist Bewußtsein an Kommunikation beteiligt?" and Luhmann, *Die Gesellschaft der Gesellschaft*, 73.

45. On Luhmann's theory of society, see his *Die Gesellschaft der Gesellschaft*.

46. That communication is not made of thoughts, however, does not mean that communication can proceed without the participation of thinking people. If no one listens and no one participates, communication doesn't occur. Communication requires participants who think; nevertheless, is not made of their thoughts. One doesn't need to enter the mind of a partner to understand his or her communication, and a third party will always understand it in a different (but also legitimate) way. One just needs to make sense of what has been said.

47. Or possibly an animal when people claim to communicate with their dogs.

48. A test on WeChat (a popular messaging app in China) with the chatbot xiaoice (May 29, 2015) showed that people generally don't care that they are chatting with a machine; see Wang, "Your Next New Best Friend Might Be a Robot." In a few weeks, xiaoice had become the sixth-most-active celebrity on Weibo and had tens of billions of conversations with people, mostly about private matters. The experiment has been considered the largest Turing test in history.

49. In philosophy, and specifically in modal logic, "contingent" indicates something that is neither necessary nor impossible, that may exist but may also not exist or be otherwise. See, e.g., Hughes and Cresswell, *An Introduction to Modal Logic*.

50. Von Foerster, "Cibernetica ed epistemologia: storia e prospettive," 129.

51. See https://anki.com/en-us/cozmo for the company's website.

52. Pierce, "Meet the Smartest, Cutest AI-Powered Robot."

53. Esposito, "Risiko und Computer: Das Problem der Kontrolle," 93–108; on Weinberger's discussion of "Give up control" as a strategic principle of digital culture, see Weinberger, *Everything Is Miscellaneous*, 105.

54. See Turkle, *Alone Together*. It is not only children who do this, and it does not only happen in interactions with anthropomorphic devices, nor indeed zoomorphic

devices like robotic seals and dogs. Various experiments show that people, without realizing it, deal with computers as if they were real people; see Nass and Yan, *The Man Who Lied to His Laptop*.

55. Turkle, *Alone Together*, 26. This is also true in the case of refined robots like Cozmo. Pierce, in "Meet the Smartest, Cutest AI-Powered Robot," writes that "it's up to the humans playing with them to provide creativity." Dill, in "What Is Game AI?" 3–4, notes that in video game design, the basic issue is "creating the illusion of intelligence . . . rather than creating true intelligence."

56. Russell and Norvig, *Artificial Intelligence. A Modern Approach*, 763–764; Etzioni, "Deep Learning Isn't a Dangerous Magic Genie."

57. Hardy, "Artificial Intelligence Software Is Booming."

58. O'Reilly, "What Is Web 2.0: Design Patterns and Business Models"; Berners-Lee, Hendler, and Lassila, "The Semantic Web: A New Form of Web Content ."

59. More details on this follow in chapter 4.

60. Langville and Meyer, *Google's PageRank and Beyond*, 4–5.

61. Metz, "If Xerox Parc Invented the PC, Google Invented the Internet."

62. Page et al., *The PageRank Citation Ranking*. Interestingly, along with Larry Page, Sergey Brin, and Rajeev Motwani, the fourth author is Terry Winograd, who a decade earlier wrote with Fernando Flores one of the reference texts for a communication-oriented approach to artificial intelligence; see Winograd and Flores, *Understanding Computer and Cognition*.

63. Page et al., *PageRank Citation Ranking*, 3.

64. See Weinberger, *Taxonomies to Tags*, 8–9. Yahoo's Editor in Chief Srinija Srinivasan said to Weinberger: "Our job is to know the web, know what searchers want, and marry the two."

65. Grimmelmann, "The Google Dilemma," 941.

66. Gillespie, "The Relevance of Algorithms."

67. Granka, "The Politics of Search: A Decade Retrospective," 367.

68. See https://www.google.com/insidesearch/howsearchworks/ (accessed November 8, 2018).

69. Hamburger, "Building the Star Trek Computer."

70. According to cofounder Stewart Butterfield, search on tags at Flickr "is like page rank for pictures"—cited in Weinberger, *Taxonomies to Tags*, 23.

71. Rogers, *Digital Methods*, 83–94.

72. Vaidhyanathan, *The Googlization of Everything*, 51.

73. Luhmann, *Einführung in die Systemtheorie*, 143. The real innovation in communication with algorithms is that selection is no longer oriented to meaning. "The unity of utterance (*Mitteilung*) and understanding is abandoned"—even if both are still required in any communication: Luhmann, *Die Gesellschaft der Gesellschaft*, 309.

74. And obviously many communications involve manufactured entities: ANT's sociotechnical devices; see, e.g., Callon, "The Role of Hybrid Communities and Socio-Technical Arrangements." But they do not participate as communication partners.

75. All social objects are constructed, hence not natural; but this does not mean that in using them, one communicates. One does not communicate with the maker of a corkscrew by understanding how it works, or communicate with the corkscrew itself, see Eco, "Ci sono delle cose che non si possono dire," 22–25. One can communicate through objects, as in the case of works of art or design, and of course in the case of books—but then one communicates with the author. The object is artificial, not the communication.

76. Supervision or reinforcement are needed to direct the learning process toward useful results or to select the meaningful ones. The approach of machine learning is quite general: algorithms can be applied to solve a wide range of problems, from playing Go to controlling the parameters of a cooling system to improve fuel efficiency; see Taylor, "The Concept of 'Cat Face.'"

77. Quoted in Pierce, "Smartest, Cutest AI-Powered Robot."

78. Reinforcement can come from programmers, but algorithms that operate online recently began to regularly receive reinforcement directly from the web, taking as a reference the participation of users. In interactions with users a learning algorithm can gather a lot of reinforcement from the behavior of people—on how people are likely to react, and whether or not they accept an algorithm's proposals or continue searching. Once again one of the clearest examples can be found in Google, through the auto-correct function of its online spell check. The frequent question "did you mean . . . ?" that the algorithm addresses to users serves first of all to produce reinforcement.

79. Silver and Hassabis, "AlphaGo: Mastering the Ancient Game of Go ."

80. Schölkopf, "Learning to See and Act."; Mnih et al., "Human-Level Control."

81. Metz, "How Google's AI Viewed the Move." In this process of "self-supervised" learning, the algorithm becomes incomparably better than the players from which it learned, who would not be able to understand its moves; see Etzioni, Banko and Cafarella, "Machine Reading." The most recent version does not even need to have starting data from human players: AlphaGo Zero is trained solely by self-play reinforcement learning; see Silver et al., "Mastering the Game of Go."

82. Burrell, "How the Machine 'Thinks'"; Weinberger, "Machines Now Have Knowledge"; Gilpin et al., "Explaining Explanations: An Overview of Interpretability of Machine Learning."

83. Metz, "What the AI Behind AlphaGo."

84. Ke Jie, a Chinese grandmaster who met AphaGo in a match in May 2017, explicitly declared that the algorithm changed the way top masters play the game, making moves that are reminiscent of AlphaGo's own style. See Mozur, "Google's AlphaGo Defeats Chinese Go Master."

85. Metz, "In Two Moves, AlphaGo and Lee Sedol Redefined the Future"; Taylor, "The Concept of 'Cat Face.'"

86. AlphaGo actually also won the three-match series against Ke Jie in May 2017.

87. Etzioni, "Deep Learning Isn't a Dangerous Magic Genie."

88. "Because the methods we have used are general purpose, our hope is that one day they could be extended to help us address some of society's toughest and most pressing problems": Silver and Hassabis, "AlphaGo: Mastering the Ancient Game." The techniques developed in AlphaGo are presently used to deal with scientific issues, as for example the "protein folding problem," possibly leading to the development of new drugs or innovative ways to apply existing medications. John Jumper, a lead scientist on the DeepMind team developing these technologies, said: "We don't want to be a leader board company. We want to have real biological relevance." Quoted in Metz, "London A.I. Lab Claims Breakthrough That Could Accelerate Drug Discovery."

89. Pasquale, *The Black Box Society*.

90. Wachter, Mittelstadt, and Floridi, "Transparent, Explainable, and Accountable AI"; Doshi-Velez et al., "Accountability of AI Under the Law"; Miller, "Explanation in Artificial Intelligence"; Rohlfing et al., "Explanation as a Social Practice."

91. Weinberger, "Our Machines Now Have Knowledge."

92. On the distinction between transparency and post-hoc interpretability, see Lipton, "The Mythos of Model Interpretability."

93. See, e.g., Cimiano, Rudolph, and Hartfiel, "Computing Intentional Answers to Questions,"; Karim and Zhou, "X-TREPAN: An Extended Trepan for Comprehensibility and Classification Accuracy ." Suchman, in *Plans and Situated Actions* (1987), already explored the possibility of a collaboration between human beings and machines in producting intelligibility, relying on the exploitation of their differences in understanding.

94. Luhmann, *Gesellschaft der Gesellschaft*, 304.

95. Lévy, *L'Intelligence collective*.

CHAPTER 2

1. A previous version of this chapter appeared in *Zeitschrift fur Literaturwissenschaft und Linguistik* 47, no. 3 (2017): 351–359.

2. Eco, *Vertigine della lista*, 290.

3. Poole, "Top Nine Things You Need to Know."

4. Oring, "Jokes on the Internet."

5. Poole, "Top Nine Things You Need to Know."

6. Espeland and Sauders, "Rankings and Reactivity"; Musselin, *La Grande Course des Universités*; Langohr and Langohr, *The Rating Agencies and Their Credit Ratings*; Levich, Majnoni, and Reinhard, *Ratings, Rating Agencies*; Scott and Orlikowski,

"Reconfiguring Relations of Accountability"; Mennicken, "'Too Big to Fail and Too Big to Succeed'"; Mennicken, "Numbers and Lists: Ratings and Rankings in Healthcare"; Cooley and Snyder, *Ranking the World: Grading States as a Tool of Global Governance*; Esposito and Stark, "What's Observed in a Rating? Rankings as Orientation in the Face of Uncertainty."

7. Karpik, "La Guide rouge Michelin"; and Karpik, *L'économie des singularités*, 113.

8. Stuart, "Reputational Rankings: Background and Development."

9. Borges, "The Analytical Language of John Wilkins."

10. Von Contzen, "Die Affordanzen der Liste," 322; Weinberger, *Everything Is Miscellaneous*, 66.

11. Hunger and Archi, "Vicino Oriente"; Goody, *The Domestication of the Savage Mind*.

12. Luria, *Cognitive Development*, 12–19.

13. Ong, *Orality and Literacy*, 42–43, 48–56.

14. Goody, *Domestication of the Savage Mind*, 104.

15. Annus, "On the Beginnings and Continuities of Omen Sciences."

16. Weinberger, *Everything Is Miscellaneous*.

17. The often completely heterogeneous elements collected in a flat list are in a relationship of equivalence: see Schaffrick and Werber, "Die Liste, paradigmatisch," 307.

18. Bowker and Star describe list making as "one of the fundamental activities of advanced human society": Bowker and Star, *Sorting Things Out*, 137.

19. According to Mainberger, lists have the effect that what is near appears far away and what is far away near. Mainberger, "Exotisch—endotisch oder Georges Perec lernt von Sei Shonagon," 334.

20. "A list is our most basic way of ordering ideas. . . . If it got any simpler, it wouldn't be organized at all": Weinberger, *Everything Is Miscellaneous*, 65.

21. Doležalová, "Ad Hoc Lists of Bernard Itier (1163–1225)," 80.

22. Cf. Havelock, *Origins of Western Literacy*, chapter 3. With a certain approximation, one can say that in syllabic writing the same sign stands for the sounds "ka," "ke," "ki," "ko," and "ku."

23. For example, in my youth I was hosted as an au pair by a German family. I spoke very little German, which is a phonologically transparent language that is read as it is written. I could then read fairy-tale books out loud to the child I was looking after. Even if I did not understand anything about the content, apparently my reading was (sufficiently) satisfactory for my little listener.

24. De Mauro, *Linguistica elementare*, 187.

25. Havelock, *Preface to Plato*, ix-xi; Havelock, *The Greek Concept of Justice*, 4–14.

26. Eco, *Vertigine della lista*, 133.

27. Plato, *Meno*, part II, and *Hippias Major*, in *Complete Works*.

28. Aristotle, *Posterior Analytics*, book II, 13.

29. Visi, "A Science of List?" 14.

30. Homer, *Iliad*, book II, lines 494–759.

31. Von Contzen, "Die Affordanzen der Liste," 318. Lists also appear in modern literary texts, but have a different interpretation than those used in everyday life. Instead of being seen as supporting the ordering of information, they are perceived as foreign, disturbing factors, which the author can use for artistic or communicative purposes; see Mainberger, "Exotisch—endotisch."

32. Vandermeersch, "Dalla tartaruga all'achillea (Cina)" ; Bottéro, "Sintomi, segni, scritture nell'antica Mesopotamia."

33. Described in Porphyry, *Isagoge*.

34. See Eco, *Dall'albero al labirinto*; Weinberger, *Everything Is Miscellaneous*. This is also confirmed by Bowker and Star's description of an ideal classification system and its properties. Bowker and Star, *Sorting Things Out*, 10–11.

35. See Mainberger, "Exotisch—endotisch." As Mainberger shows, for this reason lists are a fundamental tool in ethnographic and ethnological studies, and in general in the investigation of foreign cultures—up to Montaigne and Frazer. The empty form of the list allows us to manage the unknown.

36. Davis, *Computability and Unsolvability*.

37. For more on this, see chapter 1.

38. Michura et al., "Slot Machines, Graphs, and Radar Screens," 168. The MONK (Metadata Offer New Knowledge) project for text analysis, for example, "uses lists in several different ways: layered lists, user-determined random or sequential lists, lists as graphs, user-defined lists, lists as history states, dashed lists, and search results as collapsible lists." Michura et al., 171.

39. Weinberger, *Everything Is Miscellaneous*, 8.

40. Weinberger, *Everything Is Miscellaneous*, 29.

41. Weinberger, *Taxonomies to Tags*, 30.

42. Taylor, "The Concept of 'Cat Face.'"

43. Observers typically try to make sense of algorithmic procedures when errors occur, as in the much-discussed case of software that distinguishes huskies from wolves by the presence or absence of snow in the background: cf. Ribeiro, Singh, and Guestrin, "'Why Should I Trust You?'"

44. Lepore, "The Cobweb"

45. Poole, "Top Nine Things You Need to Know."

46. On a single, typical day (March 7, 2019), besides bestseller lists, one could find on the *New York Times* online: "6 Black Chefs (and 1 Inventor) Who Changed the History of Food," "Three Stunning New Memoirs of Love and Loss," "5 Film Series to Catch in NYC This Weekend," "5 Places to Eat in the Dolomites," "The Top 25

Songs That Matter Right Now," "The 50 Best Movies on Netflix Right Now," and "5 Space Documentaries to Stream."

47. Jeremy W. Peters, Matt Flegenheimer, Elizabeth Dias, Susan Chira, Kate Zernike and Alexander Burns, "Midterm Election Results: 4 Key Takeaways," *New York Times*, Nov. 7, 2018, https://www.nytimes.com/2018/11/07/us/politics/election-news.html; Nicholas Confessore and Matthew Rosenberg, "Damage Control at Facebook: 6 Takeaways from the Times's Investigation," *New York Times*, Nov. 14, 2018, https://www.nytimes.com/2018/11/14/technology/facebook-crisis-mark-zuckerberg-sheryl-sandberg.html; Megan Specia, "Five Takeaways from Our New China Project," *New York Times*, Nov. 21, 2018, https://www.nytimes.com/2018/11/21/world/asia/china-rules-takeaways.html.

48. Lepore, "The Cobweb."

49. According to the "googlization" procedures described in chapter 1.

50. Von Soden, "Leistung und Grenze sumerischer und babylonischer Wissenschaft."

CHAPTER 3

1. Jänicke et al., "On Close and Distant Reading in Digital Humanities."

2. Moretti and Sobchuk, "Hidden in Plain Sight," 86.

3. Katsma, "Loudness in the Novel,"; Moretti, "Style, Inc. Reflections on Seven Thousand Titles, (British Novels, 1740–1850)."

4. Morin and Acerbi, for example, use a visualization to "show a decrease in emotionality in English-speaking literature starting plausibly in the nineteenth century." Morin and Acerbi, "Birth of the Cool," 1664.

5. "Big data requires visualization to even start understanding its possible structures." Schöch, "Big? Smart? Clean? Messy? Data in the Humanities," 19.

6. Gitelman and Jackson, introduction to *"Raw Data" Is an Oxymoron*, 12.

7. Moretti, *Maps, Graphs, Trees*.

8. Manovich, "How to Compare One Million Images?"

9. Card, Mackinlay, and Shneiderman, *Readings in Information Visualization, Using Vision to Think*, xiii. Jänicke emphasizes the overall increasing value of visualizations as a means of research for digital humanists since 2013—testified to by the fact that not only have surveys and state-of-the-art papers on text visualization techniques been produced, but even a Survey of Surveys (SoS) reviewing and classifying them. See Jänicke, "Valuable Research for Visualization"; Alharbi and Laramee, "SoS TextVis: A Survey of Surveys."

10. Münster and Terras, "The Visual Side of Digital Humanities."

11. "The concrete use of the new tools—the practice—preceded and overshadowed their theoretical justification." Moretti and Sobchuk, "Hidden in Plain Sight," 87.

12. A similar question—"Why might it be helpful to geovisualize literary texts?"—underlies the contributions collected in Cooper, Donaldson, and Murrieta-Flores, *Literary Mapping in the Digital Age*. In my analysis, however, visualization has a more abstract meaning than in the debate about the "Spatial Turn" in the digital humanities; cf. Presner and Shepard, "Mapping the Geospatial Turn."

13. Burrell, "How the Machine 'Thinks.'"

14. Luhmann, *Soziale Systeme*, 560–561.

15. Ware, *Information Visualization: Perception for Design*, 1–2.

16. In her reflections on operative imagery, Krämer points out the difference between oral language bound to temporal succession and two-dimensional visualization taking advantage of simultaneity. Krämer, "Operative Bildlichkeit."

17. We still do it in our widespread use of PowerPoint. See Stark and Paravel, "PowerPoint in Public."

18. Card, Mackinlay, and Shneiderman, *Readings in Information Visualization*, 1.

19. Jessop, "Digital Visualization as a Scholarly Activity," 282.

20. Keim and Ankerst, "Visual Data Mining Techniques," 816.

21. "We are experimenting with visualization as a tool to develop new arguments (and new questions) about historical processes and understandings of major historical events." Stanford Spatial History Project (Stanford University), https://web.stanford.edu/group/spatialhistory/cgi-bin/site/gallery.php.

22. Goody, *The Domestication of the Savage Mind*; Friendly, "A Brief History of Data Visualization." Cf. also the discussion on the use of lists and tables as heuristic tools in chapter 3.

23. Latour, "Visualisation and Cognition."

24. Card, Mackinlay, and Shneiderman, *Readings in Information Visualization*, 10; and Spence, *Information Visualization*, 12.

25. Manovich, "What Is Visualization?" 131.

26. In the sense of linguistics, in infovis the images have an arbitrary relationship with their signifier; see Saussure, *Cours de linguistique générale*, chapter 1. The word "dog," for example, does not resemble a real dog with legs and a tail. On the meaning of arbitrariness in visualization, see Ware, *Information Visualization*. "It's infovis [information visualization] when the spatial representation is chosen, and it's scivis [scientific visualization] when the spatial representation is given": Munzner, "Process and Pitfalls in Writing Information Visualization Research Papers," 149. For a technical comparison between scivis and infovis, see Telea, *Data Visualization*, 438–445.

27. Tufte, *The Visual Display of Quantitative Information*, 9.

28. Card, Mackinlay, and Shneiderman, *Readings in Information Visualization*, 6; Tufte, *Visual Explanations*, 9. Using Agostinho's expression, it is a "post-optical" use of images: they support not seeing but thinking. Agostinho, "The Optical Unconscious of Big Data."

29. Tufte, *Envisioning Information*, 9.

30. Ferreira de Oliveira and Levkowitz, "From Visual Data Exploration to Visual Data Mining."

31. Davis, "At Last, a Graph That Explains Scifi TV."

32. On December 2, 2019, the *New York Times* used a dynamic visualization to show in an immediately effective way the level of pollution of different cities around the world. These kinds of tools are increasingly frequent in the digital versions of mass media. See Popovich, Popovich et al., "See How the World's Most Polluted Air Compares with Your City's."

33. Telea, *Data Visualization. Principles and Practice*, 10.

34. Manovich, "What Is Visualization?"

35. Carusi, "Making the Visual Visible."

36. Telea, *Data Visualization*, 6.

37. Schwandt, "Digitale Objektivität in der Geschichtswissenschaft?" The process resembles the search procedure analyzed by Stark, where one does not know what one is looking for yet is able to recognize it when found. See Stark, *The Sense of Dissonance*.

38. A case of visualization triggering the formulation of new hypothesis is presented in Kanatova et al., "Broken Time, Continued Evolution." Kanatova and colleagues present a case of visualization triggering the formulation of a new hypothesis. In a study of the tendency towards using more anachronisms in movies over the last 40 years, the visualization of the data showed an unexpected "branching." The authors explain it in retrospect, hypothesizing a change in the function of anachronisms, which can be used to connect different time lines in the plot.

39. Clement, "The Story of One" ; Cecire, "Ways of Not Reading Gertrude Stein."

40. Algee-Hewitt et al., "Canon/Archive"; Algee-Hewitt, Heuser, and Moretti, "On Paragraphs," 1.

41. Miller, "Explanation in Artificial Intelligence"; Ribeiro, Singh, and Guestrin, "'Why Should I Trust You?'"

42. Knowledge graphs, for example, were popularized recently to provide both a human-interpretable representation and a formalized machine-readable basis for information retrieval tasks; see Haslhofer, Isaac, and Simon, "Knowledge Graphs in the Libraries and Digital Humanities Domain."

43. Sinclair and Rockwell, "Text Analysis and Visualization," 288.

44. Weinberger, *Everything Is Miscellaneous*, 189.

45. Ware, *Information Visualization: Perception for Design*, 4.

46. Wristley and Jänicke, *Visualizing Uncertainty*.

47. Elting et al. discuss an example of how the choice of visualization impacts the decision process. They discuss four presentations of the same data about the effectiveness of conventional and investigational treatments on a group of patients: a

simple table, pie charts, stacked bar charts, and a sequence of rectangles representing the patients. The decision about treatment varies significantly depending on the presentation of the data. Elting et al, "Influence of Data Display Formats on Decisions."

48. Tufte, *The Visual Display of Quantitative Information*.

49. Behrisch et al., "Quality Metrics for Information Visualization."

50. Bubblelines visualize the frequency and distribution of terms in a corpus providing a line for each document, populated by a series of bubbles of varying sizes representing the relative occurrence of words.

51. Behrisch et al., "Quality Metrics for Information Visualization."

52. Visualization can also be misleading and suggest intuitive connections that turn out to be fallacious; see Schwandt, "Digitale Objektivität in der Geschichtswissenschaft?"

53. See https://voyant-tools.org.

54. Galloway, "Are Some Things Unrepresentable?" 88. Obviously visualization is never neutral; see Amoore, "Algorithmic War." Because visualizations leave interpretation open, however, we often tend to consider them more objective and almost observer-independent; see Drucker, "Humanities Approaches to Graphical Display," and Drucker, "Graphical Approaches to the Digital Humanities." As Sinclair and Rockfell argue, it is always possible, and sometimes useful, to "get interested in the interpretation of these tools of interpretation, but this is another type of text analysis." Sinclair and Rockfell, "Making Meaning Count," 288.

55. Galloway, "Are Some Things Unrepresentable?" 89.

56. Card, Mackinlay, and Shneiderman, *Readings in Information Visualization,* 6–7.

57. Schwandt, "Digitale Methoden für die Historische Semantik," 16.

58. Jänicke, "Valuable Research for Visualization and Digital Humanities."

59. This changes with time and the conditions of communication. Until modernity, we didn't even have a verb to indicate our familiar practice of reading; see Chantraine, "Les verbes grecs signifiant 'lire'"; and Cevolini, "Der Leser im Gelesenen." The Latin verb *lego*, *-ere* meant "gather, put together," and referred to the activity of accumulating materials in collections such as a florilegium (anthology), without any reference to the unity of text or to the perspective of the author.

60. Liu, "From Reading to Social Computing"; Bode, *Reading by Numbers*.

61. Moretti, "Conjectures on World Literature," 57.

62. Hayles, "How We Read," 65. Cf. the discussion about not-reading as a kind of reading, in Kirschenbaum, "The Remaking of Reading."

63. The canon can get so narrow that the object of close reading is a single text, as in Derrida's reading of Joyce's *Ulysses* (Derrida, *Ulysse gramophone, Deux mots pour Joyce*).

64. Moretti, "Conjectures on World Literature," 57.

65. Moretti, "Style, Inc.: Reflections on Seven Thousand Titles."

66. Manovich, "How to Compare One Million Images?"

67. Jänicke et al., "On Close and Distant Reading in Digital Humanities."

68. Liu, "From Reading to Social Computing." The same goes for printed text. Before the printing press, reading texts was a very different activity from our familiar practice. In cultures that were still predominantly oral, written materials used to be memorized, and this required a different, extremely intensive form of reading; see Luhmann, *Gesellschaft der Gesellschaft*, 293f. Actually, authentic close reading could be identified with the medieval practice of repeatedly reading the same materials, with no distance from the content or from the formulations.

69. Moretti, "Patterns and Interpretation," 2.

70. Kirschenbaum, "The .txtual Condition."

71. Hayles, *How We Think*, 149.

72. Sneha, "Reading from a Distance—Data as Text."

73. Whitmore, "Text: A Massively Addressable Object."

74. As predicted by Luhmann; see *Einführung in die Systemtheorie*, 143.

75. Hayles, *My mother was a computer: digital subjects and literary texts*, 101.

76. Whitmore, "Text: A Massively Addressable Object."

77. Texts so understood are treated as things. The practices of distant reading could be seen as the heirs of the instruments introduced in early modern age after the spread of the printing press when, for the first time, text and interpretation were separated and the text was manipulated and elaborated as an object to be used in the most effective way. Indexes, summaries, front matter, page numbers, chapters, and paragraphs were introduced, and then the apparatus of filing and content organization. See Ong, *Orality and Literacy*; Cevolini, *De arte excerpendi*; Blair, "Annotating and Indexing Natural Philosophy"; and Cevolini, *Forgetting Machines*.

78. Whitmore, "Text: A Massively Addressable Object," 327.

79. Moretti, "Patterns and Interpretation," 2.

80. Hayles, *My Mother Was a Computer*.

81. Hayles, "How We Think. Transforming Power and Digital Technologies," 47.

82. Hayles, "How We Read: Close, Hyper, Machine," 73; and Moretti, *La letteratura vista da lontano*, 10.

83. Following Roland Barthes's exhortation: "Amputate literature from the individual" (quoted in Moretti, *La letteratura vista da lontano*, 12).

84. Bode, *Reading by Numbers*, 11; referring to Lacan, *Seminar XI: The Four Fundamental Concepts*, 71–73.

85. Hayles, *How We Think*, 201. Kath, Schaal, and Dumm, in "New Visual Hermeneutics," call for the development of a "second order hermeneutics" to deal with the interpretation of visualizations in the digital humanities.

86. Schwandt, "Digitale Objektivität in der Geschichtswissenschaft?"

87. Kirschenbaum, "The Remaking of Reading"; Moretti, "Style, Inc."

88. Hayles, "How We Read," 72.

89. Moretti, "Conjectures on World Literature," 57.

90. Moretti, "Patterns and Interpretation," 1.

91. Moretti, *Maps, Graphs, Trees*.

92. Manovich, "How to Compare One Million Images?"

93. Moretti, "Conjectures on World Literature," 57.

94. Hayles, "How We Read: Close, Hyper, Machine," 74.

95. Martin Mueller's idea of "scalable reading" goes in a similar direction: "a broad 'scale' of surrogates that can be put into operation as a continuum." Weitin, "Thinking Slowly," 10; see also Mueller's website about scalable reading, https://scalable reading.northwestern.edu/.

96. Liu, "The Meaning in the Digital Humanities," 414.

97. Hayles, "How We Read," 73.

98. Liu, "From Reading to Social Computing."

99. Distant reading has precedents that it dramatically extends and increases through the computational capacity of machines. It does not extend reading practices, but rather the complex "not-reading" practices that already existed for use in an extremely refined way of dealing with printed texts. They require training and can be even more informative than reading itself. Pierre Bayard describes sharply and wittily the forms and merits of not-reading books, namely the countless information that can be found about texts without reading them—looking at the cover and the publisher, referring to what people say about them, knowing the authors and their reputation through secondary sources. Only in refraining from reading books, he provocatively claims, does one gets "the necessary *distance* to speak about them accurately." Bayard, *How to Talk about Books You Haven't Read*, 113 (my italics).

100. Hayes, "How We Read," 73.

101. Moretti, "Patterns and Interpretation."

102. Clement, "The Story of One"; Cecire, "Ways of Not Reading Gertrude Stein."

103. According to Shannon and Weaver's standard model and its subsequent elaborations in various forms of semantic noise linked to disparity of codes: Shannon and Weaver, *The Mathematical Theory of Communication*. See also Eco and Fabbri, *Prima proposta per un modello di ricerca interdisciplinare sul rapporto televisione/pubblico*; for a recent survey, see Floridi, *Information: A Very Short Introduction*.

104. Moretti, "Patterns and Interpretation," 10.

105. McLuhan, *Understanding Media*.

106. On the ubiquity of patterns, see Hand, "Why Data Mining Is More Than Statistics."

107. Ramsay, *Reading Machines*, 78.

108. Tyler Vigen, at http://www.tylervigen.com/spurious-correlations, presents many examples of "spurious correlations" that algorithms identify in data: for example, that the age of Miss America correlates with murders by steam, hot vapours, and hot objects, or that the divorce rate in Maine correlates with per capita consumption of margarine.

109. Weinberger, *Everything Is Miscellaneous*, 168.

110. Jessop, "Digital Visualization as a Scholarly Activity," 284.

111. "We feel strongly that text analysis tools can represent a significant contributor to digital research, whether they were used to help confirm hunches or to lead the researcher into completely unanticipated realms." Sinclair and Rockwell, "Voyant Tools."

112. See, e.g., Poemage, a tool that supports the reading of a poem by visualizing its sonic topology: http://www.sci.utah.edu/~nmccurdy/Poemage/, accessed September 20, 2019. Sinclair and Rockwell describe their "agile interpretive style" as a combination of human and algorithmic activities: texts are explored with analytic tools and visualizations, which lead to reading the text differently. Sinclair and Rockwell, "Text Analysis and Visualization: Making Meaning Count," 277–278.

113. Etzioni, Banko, and Cafarella, "Machine Reading."

CHAPTER 4

1. See, e.g., Lury and Day, "Algorithmic Personalization as a Mode of Individuation"; Ruppert, "Population Objects: Interpassive Subjects"; Cheney-Lippold, "A New Algorithmic Identity"; Prey, "Nothing Personal: Algorithmic Individuation."

2. Brubaker, "Digital Hyperconnectivity and the Self."

3. The expression was introduced by DiNucci in 1999, and then popularized by O'Reilly and the "Web 2.0 Conference" in 2004. DiNucci, "Fragmented Future"; for the conference, see https://web.archive.org/web/20050312204307/http://www.web2con.com/web2con/.

4. Carr, *The Big Switch*, and Benkler, *The Wealth of Networks*.

5. Neff and Stark, "Permanently Beta."

6. Wasik, *And Then There's This*, 9.

7. Abruzzese and Pireddu, "Facebook come Fakebook," 77; see also Kelly, "On Chris Anderson's the End of Theory."

8. Benkler, *Wealth of Networks*, 167–170; see also Beer, "Power through the Algorithm?"

9. Anderson, *The Long Tail*, 191.

10. Gillmor, *We the Media*.

11. Pine, Peppers, and Rogers, "Do You Want to Keep Your Customers Forever?," 103.

12. Esposito, "Interaktion, Interaktivität und die Personalisierung der Massenmedien."

13. Douglas, *The End of Books*.

14. Gerlitz and Helmond, "The Like Economy."

15. See, e.g., Cevolini and Bronner, eds., *What Is New in Fake News*.

16. Benway and Lane, "Banner Blindness"; and O'Donnell and Cramer, "People's Perceptions of Personalized Ads."

17. As in the episode "Bandersnatch" of *Black Mirror*, released in December 2018.

18. See McCombs and Shaw, "The Agenda-Setting Function of Mass Media." According to Luhmann, the function of broadcast media for society is to create a shared "second reality." Luhmann, *The Reality of the Mass Media*.

19. Quito, "The Next Design Trend."

20. See Duhigg, "How Companies Learn Our Secrets."

21. See, e.g., Kotras, "Mass Personalization."

22. See Hawalah and Fasli, "Utilizing Contextual Ontological User Profiles"; Xiao, Qibei, and Feipeng, "Mobile Personalized Recommendation Model Based on Privacy Concerns"; and Pichl, Zangerle, and Specht, "Towards a Context-Aware Music Recommendation Approach."

23. See, e.g., Al-Rfou et al., "Conversational Contextual Cues"; Miele, Quintarelli, and Tanca, "A Methodology for Preference-Based Personalization of Contextual Data"; and Pagano et al., "The Contextual Turn."

24. Ciaccia, Martinenghi, and Torlone, "Foundations of Context-Aware Preference Propagation."

25. Hawalah and Fasli, "Contextual Ontological User Profiles," 4778.

26. "People have more in common with other people in the same situation, or with the same goals, than they do with past versions of themselves." Pagano et al., "The Contextual Turn," 1.

27. See Xiao, Qibei, and Feipeng, "Mobile Personalized Recommendation Model Based on Privacy Concerns"; Al-Rfou et al., "Conversational Contextual Cues."

28. This new frame of reference is welcomed as a "shift in paradigm" by Hawalah and Fasli, "Contextual Ontological User Profiles," 4781.

29. As Lury and Day observe, on the web "personalization is not only personal: it is never about only one person, just me or just you, but always involves generalization." Lury and Day, "Algorithmic Personalization as a Mode of Individuation," 18.

30. Herrman, "How TikTok Is Rewriting the World."

31. In 2018, views on premium video grew by 27 percent in the US and 15 percent in Europe, continuing a multiyear trend.

32. Smith, "Why the Success of The New York Times May Be Bad News for Journalism."

33. See Lepore, "The Cobweb"; and Rusbridger, *Breaking News*.

34. See, e.g., Flipfeed, https://www.media.mit.edu/projects/flipfeed/overview/, accessed April 20, 2019.

35. Brubaker, "Digital Hyperconnectivity and the Self," 785.

36. Goffman, *The Presentation of Self in Everyday Life*.

37. Jurgenson, *The Social Photo*, 55.

38. Jurgenson, *The Social Photo*, 8.

39. I investigate the social use of digital photos further in chapter 6.

40. Frosh, "The Gestural Image," 1611.

41. Formilan and Stark, "Testing the Creative Identity."

42. Moeller, "On Second-Order Observation and Genuine Pretending."

43. See https://ra.co/dj/abayomi.

44. Formilan and Stark, "Testing the Creative Identity."

45. Al-Rfou et al., "Conversational Contextual Cues"; and Xiao, Qibei, and Feipeng, "Mobile Personalized Recommendation Model."

46. Mullin, "Why Content Personalization Is Not Web Personalization"; Cheney-Lippold, "A New Algorithmic Identity"; As Herrman puts it: "It is possible, today, to receive highly personalized and effectively infinite content recommendations in YouTube without ever following a single account, because Google already watches what you do, and makes guesses about who you are." Herrman, "How TikTok Is Rewriting the World."

47. Cheney-Lippold, "A New Algorithmic Identity"; Ruppert, "Population Objects: Interpassive Subjects"; and Brubaker, "Digital Hyperconnectivity and the Self."

48. Prey, "Nothing Personal."

49. Cheney-Lippold, "A New Algorithmic Identity," 165.

50. Ruppert, "Population Objects: Interpassive Subjects," 220.

51. Prey, "Nothing Personal," 1087.

52. Critical media studies have long warned of the risks to privacy and freedom of self-determination, the flipside of digital individualization. See, e.g., Carr, *The Big Switch*; Morozov, *The Net Delusion*; or recently, Zuboff, *The Age of Surveillance Capitalism*.

53. Pariser, *The Filter Bubble*, 14–18.

54. McGoey, "Strategic Unknowns."

55. The growing polarization of political communication and other "echo chamber" phenomena seem to confirm this approach. See Sunstein, *Republic.com*; Sunstein, *#Republic: Divided Democracy in the Age of Social Media*; Peruzzi et al., "From Confirmation Bias to Echo-Chambers."

56. See Joyce, "Five Examples of Creepy Marketing"; Sweeney, "75% of Consumers Find Many Forms of Marketing Personalization Creepy."

57. Scott, "Use of Ad-Blocking Software Rises by 30% Worldwide."

58. Wu, *The Attention Merchants*, 335–339.

59. Nichols, "Customization vs Personalization"; Davis, "What Is the Difference between Personalization and Customization?"

60. Hearn and Schoenhoff, "From Celebrity to Influencer"; Brubaker, "Digital Hyperconnectivity and the Self," 786.

61. Wasik, *And Then There's This*, 112.

62. Wasik, *And Then There's This*. Such planned actions had no meaning: for example, all participants had to go into the lobby of the Grand Hyatt in New York and look out of the balcony at 7:07 p.m., staring down in silence for 5 minutes, then applaud for 15 seconds, and finally disperse and disappear.

63. Bresnick, *Intensified Play*; Assante, "Tutti pazzi per TikTok, il social che dà 15 secondi di celebrità."

64. Herrman, "How TikTok Is Rewriting the World."

65. Wasik, *And Then There's This*, 136.

66. Modern fiction is perceived as realistic because we "forget" that it is someone's invention, just as the central perspective of modern painting (Leon Battista Alberti's "window on the world") is perceived as realistic because we "forget" that the painting refers to the specific point of view of the painter (the vanishing point of the perspective)—while it would appear distorted by any other angle (see Baltrušaitis, *Anamorphoses ou Thaumaturgus opticus*).

67. Luhmann, *The Reality of the Mass Media*, 55–62.

68. Bissell, *Extra Lives*; Bissell, "The Grammar of Fun."

69. The virtual space of the game, in fact, requires you to go beyond the experiential space of fiction based on the tradition of linear perspective, which excludes the observer from the observed space; see Taylor, "When Seams Fall Apart." Videogames that offer players the possibility to intervene in the story "can both reproduce and challenge everyday rules of social interaction, while also generating interesting and creative innovations." Wright, Boria, and Breidenbach, "Creative Player Actions in FPS Online Video Games."

70. A second-person POV is also possible, but less common—it is the condition in which the user is directly addressed with "you," as often happens in children books. Jeffrey Eugenides's novel *The Virgin Suicides* is written from the unusual perspective of "we," in the first-person plural.

71. Waggoner, *My Avatar, My Self.*, 41; and Sabbagh, "The Important Differences Between First-Person."

72. If the avatar looks at himself in the mirror, the experience is unsettling for the player and risks jeopardizing the entire game experience. This is the case of the *X-Files* game described in Taylor, "When Seams Fall Apart": if the character Craig Wilmore looks at himself in the mirror, the player who identifies with him doesn't see "myself seeing myself" (cf. Lacan, *Ècrits*, 80), but sees Willmore.

73. Waggoner, *My Avatar, My Self*, 42.

74. Pariser, *The Filter Bubble*, 47–76.

CHAPTER 5

1. This chapter is a slightly revised version of an article published under the same title in *Big Data & Society* 4, no. 1 (2017).

2. See http://curia.europa.eu/juris/document/document.jsf?docid=152065.

3. Solove, "Speech, Privacy, and Reputation on the Internet," 18.

4. "Zu allem Handeln gehört Vergessen . . . ; es ist möglich fast ohne Erinnerung zu leben, ja glücklich zu leben, wie das Tier zeigt; es ist aber ganz und gar unmöglich, ohne Vergessen überhaupt zu leben."—"All action requires forgetting . . . ; it is possible to live almost without remembering, it is even possible to live happily, as animals show. But it is absolutely impossible to live without forgetting." Nietzsche, *Unzeitgemässe Betrachtungen: Zweites Stück*, 116 (my translation).

5. Toobin, "The Solace of Oblivion"; Nabi, "~~Resistance~~ Censorship Is Futile."

6. Nissenbaum, "Privacy as Contextual integrity"; Solove, "'I've Got Nothing to Hide'"; Solove, "Speech, Privacy, and Reputation on the Internet."

7. On the distinction between responsibility and accountability, see Simon, "Epistemic Responsibility in Entangled Socio-Technical Systems." According to Simon, responsibility would require intentionality, which cannot be attributed to technical artifacts. Algorithms may be accountable, but should not be made responsible—which of course leaves the issue of responsibility open.

8. Google not only has the task of suppressing the links, but also of deciding whether to accept the requests of "being forgotten," balancing those with the public right to information. This raises an important question of legitimacy; see Ambrose, "Forgetting Made (Too) Easy." What right allows a private entity to make decisions of public importance, without having being elected or appointed with a transparent procedure, and even without specification of the criteria to be followed in the decision (if and how long data can be considered of public interest, who are the private individuals to protect, when should the right to privacy of the individual prevail over public access)? Citizens still have the possibility of appealing to the judicial authority (§82), but this is a secondary step.

9. The extensive debate on cultural memory is focused on the definition of social memory referring to this question, starting with Halbwachs's classic text, *Les cadres sociaux de la mémoire*. See also Assmann and Hölscher, *Kultur und Gedächtnis*; Assmann, *Das kulturelle Gedächtnis*; and Esposito, *Soziales Vergessen.*

10. Google tried to get directives and guidelines in a series of meetings and discussions organized in 2014 in a tour of European capitals. As likely should have been expected, the results involved media attention more than content—but this does not make the move less meaningful from the point of view of the company and of the management of its decision-making responsibility.

11. The legislation on the right to be forgotten includes a "media exception" for the processing of personal data "carried out solely for journalistic purposes" (§9) (Rosen, "The Right to Be Forgotten"). But also archives and catalogs are protected: there is a further exception for processing data for historical, statistical, and scientific research

purposes (§7) (van Hoboken, "The Proposed Right to be Forgotten," 20). Intermediaries, on the other hand, are not held responsible if they do not know the information to which they provide access (van Hoboken, 26)—as stated in the Euopean Union directive on electronic commerce that establishes a "safe harbor" for internet service providers that operate as a "mere conduit."

12. Toobin, "The Solace of Oblivion."

13. Hildebrandt, *Smart Technologies and the End(s) of Law*.

14. Bateson, *Steps to an Ecology of Mind*, 459.

15. Agrawal, "Rakesh Agrawal Speaks Out"; and Hammond, *Practical Artificial Intelligence for Dummies*.

16. Hildebrandt, *Smart Technologies and the End(s) of Law*, 46.

17. This is one of the points emphasized by Mayer-Schönberger in his book with the evocative title *Delete*: *The Virtue of Forgetting in the Digital Age*.

18. It even remembers the future, working as an "anticipation machine" that also answers questions not yet asked. On the predictive power of algorithms, see chapter 7.

19. Blanchette and Johnson, "Data Retention and the Panoptic Society."

20. As many observers remark, however, the web also forgets a lot, but again in different ways than our familiar memory. Web content is ephemeral on many dimensions, most of them new; see Ambrose, "You Are What Google Says You Are"; Chun, *Programmed Visions: Software and Memory*; Barone, Zeitlyn, and Mayer-Schönberger, "Learning from Failure"; and Lepore, "The Cobweb." Besides the classic problems of physical rot (from natural causes such as fire or flood), there are technical problems like hardware, software or network failures, viruses, accidental file deletion, changes of media and protocols. Moreover, there are all the difficulties of reference rot and link rot, resulting from content that becomes impossible to access, with clicking on a link producing the infamous "404: Page Not Found" error message; or pages may still exist but have a different URL; see Davis, "Moving Targets." The average life span of web pages is less than 100 days, and in many cases, is more accurately measured in hours rather than days (http://blogs.loc.gov/digitalpreservation/2011/11/the-average-lifespan-of-a-webpage/). Reacting to these problems, specialized tools for web preservation have been developed, such as permalinks (https://perma.cc); another is the Wayback Machine (https://archive.org/web /) and another is Google's cache.

21. The two aspects of forgetting are obviously different, as highlighted by Rouvroy, who distinguishes the interest to forget from the interest (or even the right) to be forgotten; see Rouvroy, "Réinventer l'art d'oublier et de se faire oublier dans la société de l'information?" The first aspect concerns the possibility of projecting an open future; the second, the desire not to be bound by the past (or by certain portions of it) in one's social identity. In the debate on the European ruling, however, the two issues overlap so that in this context I do not consider the differences. Nobody, however, wants to forget or be forgotten altogether, and in this sense the expression "right to be forgotten" is somehow misleading.

22. Ricoeur, *Memory, History, Forgetting*, 412.

23. Cicero, de Oratore 2.74.299; Weinrich, *Gibt es eine Kunst des Vergessens?*

24. Esposito, *Soziales Vergessen*.

25. Anderson, "Rethinking Interference Theory"; Hulbert and Anderson, "The Role of Inhibition in Learning."

26. One must be able to distinguish the present moment from an eternal presence of the past. Forgetting then is also needed to be able to remember in a proper sense, building an internal horizon of references and recursions to face the present. The act of remembering produces and requires a parallel forgetting. See Hulbert and Anderson, "The Role of Inhibition in Learning," 8.

27. Lepore, "The Cobweb."

28. Luria, *The Mind of a Mnemonist*. The phenomenon is narratively reproduced in Borges's famous short story, "Funes el memorioso."

29. Parker, Cahill, and McGaugh, "A Case of Unusual Autobiographical Remembering"; Erdelyi, *The Recovery of Unconscious Memories*.

30. As described in chapter 2, there is an intrinsic affinity between the working of algorithms and the form of the list.

31. And if relevant users link to it—while users are relevant if they themselves are linked to by others. See Page et al., *The PageRank Citation Ranking*.

32. And somehow the algorithm learns because machine-learning techniques use selections also to orient the subsequent behavior.

33. The situation is actually more complex, since storage and accessibility are, in fact, two separate issues requiring different tools and different decisions. Digital memory remembers a lot but also forgets a lot, in new and articulated ways. Information can be lost because it is not stored, because its support is damaged, or because it cannot be accessed with the available tools.

34. See Yates, *The Art of Memory*.

35. Lachmann, "Die Unlöschbarkeit der Zeichen: Das semiotische Unglück des Memoristen," 11; Weinrich, *Lethe. Kunst und Kritik des Vergessens*, 7–8; and Eco, *Dall'albero al labirinto: studi storici sul segno e l'interpretazione*, 79–80.

36. See Eco, "An Ars Oblivionalis? Forget It!"

37. Woodruff, "Necessary, Unpleasant, and Disempowering."

38. An "index of the de-indexed"; see Binns, "How to Be Open about Being Closed."

39. Weinrich, *Gibt es eine Kunst des Vergessens?*

40. Brunton and Nissenbaum, *Obfuscation: A User's Guide for Privacy and Protest*.

41. With a similar attitude, FaceCloak generates fictitious information to oppose the excess of individual transparency on Facebook by creating, parallel to sensitive data, a series of completely irrelevant invented information. There are also procedures that, whenever you do a query on Google, generate a series of parallel ghost queries that make it difficult for companies to identify your pattern of preferences.

42. The most complex aspect of reputation management is repair; see Woodruff, "Necessary, Unpleasant, and Disempowering." Ausloos observes that the right to be forgotten only provides *ex post* solutions to privacy issues. Ausloos, "The 'Right to be Forgotten'—Worth Remembering?"

43. Ronson, *So You've Been Publicly Shamed*, 214–217.

44. http://reputationdefender.com.

45. Bolzoni, *La stanza della memoria*.

46. Foer, *Moonwalking with Einstein*.

47. Woodruff, "Necessary, Unpleasant, and Disempowering," 157; Ronson, *So You've Been Publicly Shamed*, 266–268.

48. Reding, *The EU Data Protection Reform 2012*.

49. "Most of the Digital Universe Are Unstructured Data": Gantz and Reinsel, *The Digital Universe Decade*.

50. Mayer-Schönberger and Cukier, *Big Data*, 6; see also Koops, "Forgetting Footprints, Shunning Shadows."

51. Adkins and Lury, *Measure and Value*, 6.

52. Amoore and Piotuck, "Life Beyond big Data," 355. The same problems arise in the debate about digital privacy, which in its most refined forms also concerns the problem of preserving the self-determination of individuals as a possibility of reinvention; see Solove's *The Future of Reputation*, "'I've Got Nothing to Hide,'" and "Speech, Privacy, and Reputation on the Internet." Here the advocates of privacy like Nissenbaum claim the protection of "Privacy as Contextual Integrity": one should not allow the use of data in contexts that are inappropriate to the original one. The difficulty, however, is that in many cases the workings of algorithms completely disregard context.

53. Custers, "Click Here to consent forever."

CHAPTER 6

1. Peter Szendy, Emmanuel Alloa, and Marta Ponsa, *The Supermarket of Images*, Exhibition organized by the Jeu de Paume, 2020, accessed April 5, 2020, http://www.jeudepaume.org/index.php?page=article&idArt=3349.

2. See, e.g., Williams, "24 Hours in Photos"; or Kelly, "Erik Kessels, Photographer, Prints Out 24 Hours Worth of Flickr Photos."

3. Szendy, Alloa, and Ponsa, *Supermarket of Images*.

4. Sontag, *On Photography*, 1.

5. See, e.g., Hand, *Ubiquitous Photography*; Kember, "Ubiquitous Photography."

6. Beck, *Risk Society*.

7. Van Dijck, "Digital Photography"; van House, "Personal Photography, Digital Technologies and the Uses of the Visual"; Sarvas and Frohlich, *From Snapshots to Social Media*; and Hand, *Ubiquitous Photography*.

8. Sontag, *On Photography*, 5.

9. Panofsky, "Die Perspektive als 'symbolische Form.'"

10. Sontag, *On Photography*, 15.

11. Yates, *The Art of Memory*.

12. Mayer-Schönberger, *The Virtue of Forgetting in the Digital Age*.

13. Weinberger, *Taxonomies to Tags*.

14. This enormously expands the possibility, already existing with analog pictures, of using photography to "refuse" or "ignore" experience. Sontag, *On Photography*, 6, 8.

15. Sontag, *On Photography*, 120.

16. Luhmann, *Soziologie des Risikos*; Beck, *Risk Society: Towards a New Modernity*.

17. Jurgenson, *The Social Photo*. *On Photography*, 48.

18. O'Doherty, *Inside the White Cube*, 55.

19. Already in the 1980s O'Doherty observed: "We can no longer experience anything if we don't first alienate it. . . . The vernacular example is the snapshot. You can only see what a good time you had from the summer snapshots. . . . These Kodachrome icons are used to convince friends you did have a good time: if they believe it, you believe it." O'Doherty, *Inside the White Cube*, 52.

20. Jurgenson, *The Social Photo*, 8.

21. Moeller, "On Second-Order Observation and Genuine Pretending"; Formilan and Stark, "Testing the Creative Identity."

22. Wasik, *And Then There's This*, 212.

23. O'Doherty, *Inside the White Cube*.

24. See https://holtsmithsonfoundation.org/spiral-jetty.

25. Obrist, *Ways of Curating*, 139–145. See, e.g., Douglas Gordon's experiments with time in the 1999 exhibition *Retrace Your Steps, Remember Tomorrow* and his 1993 installation *From the Moment You Read These Words, Until You Meet Someone with Blue Eyes*.

26. See *Il Tempo del Postino* or the forty volumes of his "Infinite Conversations"; Obrist, *Ways of Curating*, 55–59. A lengthy interview in the *New Yorker* informs us that "the Internet is always on Obrist's mind"—he is an "avid user of Instagram" with a keen interest in Snapchat. Max, "The Art of Conversation."

27. https://www.tate.org.uk/whats-on/tate-modern/exhibition/christian-marclay-clock.

28. The Tate, "Five Ways Christian Marclay's *The Clock* Does More Than Just Tell the Time," https://www.tate.org.uk/art/lists/five-ways-christian-marclays-clock-does-more-just-tell-time (accessed July 8, 2021).

29. Luhmann, *Die Wissenschaft der Gesellschaft*, 73–75.

30. Jurgenson, *The Social Photo*, 78, 85.

CHAPTER 7

1. Strictly speaking, the only purpose of machine-learning procedures is to extract patterns from data. These patterns can be used to test systems and improve on them by learning from mistakes. The approach of predictive analytics, however, claims to go further and to use these techniques to "defy the law of nature" that you cannot see the future because it isn't here yet. Learning algorithms would make it possible to build a system "that peers right through the previously impenetrable barrier between today and tomorrow." Siegel, "Predictive Analytics," 30.

2. O'Neil, *Weapons of Math Destruction*; Amoore, "Data Derivatives"; Anderson, "Preemption, Precaution, Preparedness"; De Goede and Randalls, "Precaution, Preemption."

3. Hacking, *The Emergence of Probability*; Porter, *The Rise of Statistical Thinking 1820–1900*.

4. Daston, *Classical Probability in the Enlightenment*, 49–111.

5. This does not mean, of course, that the programming of algorithms is reviving the superstitious and anti-scientific aspects that are often associated with divination. Algorithms offer a different form of prediction connected with the technical features of their work. But precisely because research on machine learning is perfectly integrated into contemporary scientific activity, the similarities with divination can be enlightening to investigate current developments.

6. Fahad Manjoo, "Where No Search Engine Has Gone Before."

7. Kitchin, "Big Data, New Epistemologies and Paradigm Shifts," 4.

8. "At its core, big data is about prediction," claim Mayer-Schönberger and Cukier in *Big Data*, 11. With almost the same words, Domingos argues that "at its core, machine learning is about prediction." Domingos, *The Master Algorithm*, xv. The research area of predictive analytics, which is rapidly spreading across all fields, from marketing to healthcare to government and financial services, is explicitly devoted to this: mining data to discover the structures of the future; cf. Siegel, *Predictive Analytics*.

9. Hofman, Sharma, and Watts, "Prediction and Explanation in Social systems."

10. Shmueli, "To Explain or to Predict?" The classic reference is Hempel's explanation/prediction symmetry thesis in "Aspects of Scientific Explanation," claiming that explanation and prediction have the same logical structure and differ only in the time of occurrence. A prediction is basically an explanation referring to a time later than that at which the argument is offered; see Hempel, "The Theoretician's Dilemma," 37–38.

11. "With enough data, the numbers speak for themselves," claims Anderson in "The End of Theory," In the digital world there is no need to know "why" it comes to a given result, only "what" it is; see Mayer-Schönberger and Cukier, *Big Data*, 7. If relationships can be identified without causality, explanation is not needed: "correlation supersedes causation" (Anderson, "End of Theory").

12. Daston, *Classical Probability in the Enlightenment*, chapter 5.

13. Called *observational* or *found* data. McFarland and McFarland, "Big Data."

14. Shalev-Schwartz and Ben-David, *Understanding Machine Learning: From Theory to Algorithms*, 25.

15. Wachter, Mittelstadt, and Floridi, "Transparent, Explainable, and Accountable AI."

16. Breiman, "Statistical Modeling: The Two Cultures," 208.

17. This obviously does not mean that understanding becomes irrelevant but separates the problem of transparency from the problem of interpretability; see Lipton, "The Mythos of Model Interpretability." When the way algorithms work is not comprehensible to the human mind, problems can arise in the use of algorithms. Even when the model is right, it is not always right to use it, and a decision is required; see Doshi-Velez et al., "Accountability of AI Under the Law." One can then request post-hoc interpretability: an explanation of the decisions of the algorithms that does not necessarily require describing the mechanisms involved. Often, however, it will imply producing a model to generate explanations separate from the model to generate predictions. Chapter 1 deals more thoroughly with the consequences of this condition.

18. See, e.g., the debate around Ali Rahimi's claim in his presentation at the Conference on Neural Information Processing Systems (NIPS) 2017: "Machine Learning Has Become Alchemy," https://www.youtube.com/watch?v=ORHFOnaEzPc.

19. Vernant, "Parole e segni muti"; Maul, *Die Wahrsagekunst im alten Orient*; Rochberg, *The Heavenly Writing*.

20. Brisson, "Del buon uso della sregolatezza (Grecia)."

21. Rochberg, "The History of Science and Ancient Mesopotamia," 55; Rochberg, "Reasoning, Representing, and Modeling in Babylonian Astronomy."

22. Koch, "Three Strikes and You're Out!"

23. Nissinen, "Prophecy and Omen Divination."

24. Vandermeersch, "Dalla tartaruga all'achillea (Cina)."

25. Vernant, "Parole e segni muti," 14.

26. Annus, "On the Beginnings and Continuities of Omen Sciences"; Koch-Westenholz, *Mesopotamian Astrology*, 18.

27. Maul, "Divination Culture and the Handling of the Future," 363.

28. Rochberg, "Reasoning, Representing, and Modeling in Babylonian Astronomy," 9.

29. Rochberg, *The Heavenly Writing*, 203.

30. Anzulewicz, "Aeternitas—aevum—tempus"; Luhmann, *Soziologie des Risikos*, 42.

31. See the debate on contingent futures in Aristotle, *De Interpretatione 9*: Assertions on the outcome of a future naval battle are true or false already today, but we are not yet able to choose between the two values.

32. Maul, "Divination Culture and the Handling of the Future," 363.

33. Nevertheless, divination did not necessarily correspond to a fatalistic or deterministic attitude. In Mesopotamia divinatory omens expressed a sort of warning of was what to come, providing the necessary knowledge to intervene and revise it, bending the future to one's own advantage; see Maul, "How the Babylonians Protected Themselves against Calamities." Even if the divinatory worldview did not allow for chance or hazard and everything followed a divine order, the revealed future was not irrevocable.

34. Luhmann, "Temporalisierung von Komplexität: Zur Semantik neuzeitlicher Zeitbegriffe"; Koselleck, *Vergangene Zukunft*.

35. Esposito, *Die Fiktion der wahrscheinlichen Realität*.

36. See Alessandro Vespignani, *L'algoritmo e l'oracolo: Come la scienza predice il futuro e ci aiuta a cambiarlo* [The algorithm and the oracle: How science predicts the future and helps us change it].

37. Domingos expects that the different approaches used in algorithmic programming will eventually be unified to compose an "ultimate Master Algorithm" that "can derive all knowledge in the world—past, present and future—from data." Like divinity in ancient divinatory culture, there would be one entity to whom all knowledge is accessible, for whom the difference between time horizons is irrelevant: "If you believe in an *omnipotent God*, then you can model the universe as a vast naïve Bayes distribution where everything that happens is independent given God's will. The catch is that *we can't read God's mind*" (emphasis added). Domingos, *The Master Algorithm* xviii, 152.

38. Goodfellow, Bengio, and Courville, *Deep Learning*, 98.

39. Breiman, "Statistical Modeling: The Two Cultures."

40. Amoore and Piotukh, "Life Beyond Big Data."

41. Sober, *Ockham's Razors: A User's Manual*, 134.

42. Breiman, "Statistical Modeling," 205.

43. "The Two Cultures: Statistics vs. Machine Learning?" http://stats.stackexchange.com/questions/6/the-two-cultures-statistics-vs-machine-learning (accessed February 15, 2017).

44. Assmann, *Das kulturelle Gedächtnis*, 17; Koch, "Three Strikes and You're Out!"

45. Maul, "Divination Culture and the Handling of the Future," 369.

46. Siegel, *Predictive Analytics*, 12.

47. Desrósieres, "Mapping the Social World"; Lee and Martin, "Surfeit and Surface."

48. Siegel, *Predictive Analytics*, 23.

49. Rieder, "Scrutinizing an Algorithmic Technique," 12.

50. See the discussion of algorithmic individualization in chapter 4.

51. Cardon, *À quoi rêvent les algorithmes?* 27.

52. Golder and Macy, "Digital Footprints."

53. Clark, *Surfing Uncertainty: Prediction, Action*, 163.

54. Bornstein, "Is Artificial Intelligence Permanently Inscrutable?"

55. Lee and Martin, "Surfeit and Surface"; MacKenzie, "The Production of Prediction," 440.

56. A growing number of colleges and universities in the US, for instance, use predictive analytics to spot students who are unknowingly in danger of dropping out: cf. Treaster, "Will You Graduate?"

57. See, e.g., Gitelman,*"Raw Data" Is an Oxymoron*; boyd and Crawford, "Critical Questions for Big Data"; Gillespie, "The Relevance of Algorithms"; Mittelstadt et al., "The Ethics of Algorithms."

58. The concept of reality is far away from ideas of truth as correspondence (Aristotle, *Metaphysics*, 1011b26), and rather close to a Popperian approach, assuming that the reference to reality can conclusively refute wrong hypotheses rather than confirm correct ones; see Popper, *Conjectures and Refutations*. It is an implicitly constructivist concept of reality: reality is the result of the intervention of the systems that intend to know it. See Watzlawick, *Die erfundene Wirklichkeit*; von Foerster, *Observing Systems*.

59. Cardon, *À quoi rêvent les algorithmes*, 22; Kotras, "Mass Personalization and the reshaping of consumer knowledge."

60. Sharma, "How Predictive AI Will Change Shopping."

61. MacKenzie, "The Production of Prediction," 436.

62. Sinha, Foscht, and Fung, "How Analytics and AI Are Driving the Subscription E-commerce Phenomenon."

63. Jouvenal, "Police Are Using Software to Predict Crime."

64. Clark, *Surfing Uncertainty*, 123.

65. Rieder, "Scrutinizing an Algorithmic Technique," 11, 12. Regarding the research about performative effects of models, focused on the field of economics, see MacKenzie, *An Engine, Not a Camera*; MacKenzie, Muniesa and Siu, *Do Economists Make Markets?*: *On the Performativity of Economics*; and Esposito, "The Structures of Uncertainty."

66. Clark, *Surfing Uncertainty*, 286.

67. Harcourt, *Against Prediction*. Apparently gun violence in Chicago has surged since 2015, even if the city has been using an algorithmically produced Strategic Subject List that tries to predict who is most likely to be involved in a shooting; see Asher and Arthur, "Inside the Algorithm That Tries to Predict Gun Violence in Chicago." On the evaluation of predictive policing experiments, see Hunt, Sauders, and Hollywood, *Evaluation of the Shreveport Predictive Policing Experiment*.

68. Unlike seismic events that are the reference of predictive policing software such as PredPol (http://www.predpol.com/); see Shapiro, "Reform Predictive Policing"; O'Neil, *Weapons of Math Destruction*, 87; Lum and Issac, "To Predict and Serve?"

69. O'Neil, *Weapons of Math Destruction*, 9.

70. According to apotropaic rituals intended to turn away harm or evil influences: see Annus, "On the Beginnings and Continuities of Omen Sciences," 2; Maul, "How the Babylonians Protected Themselves against Calamities," 124–126.

71. Kotras, "Mass Personalization." Cf. the highly debated case of Google Flu Trends, which, after initial success, proved ineffective in predicting the spread of influenza: see Vespignani *L'algoritmo e l'oracolo*., 61–62, 110–112. The failure has also been attributed to internal changes to Google's recommendation systems, which reacted to the increase in searches about flu and began suggesting flu-related queries to people who did not have flu: Lazer et al., "The Parable of Google Flu."

72. Lipton, "The Mythos of Model Interpretability."

73. See Harcourt, *Against Prediction*.

74. The forecast is based on the very doubtful assumption that the future reproduces the past. See Cardon, *À quoi rêvent les algorithmes*, 58; Amoore and Piotukh, "Life Beyond Big Data," 359; Rona-Tas, "Predicting the Future."

75. Goodfellow, Benjo, and Courville, *Deep Learning*, 481.

76. According to Sober one of the basic limitations of Bayesian conditionalization, inherited by machine learning procedures, is the inability to consider new objects. The system only learns (better and better) what it previously identified as its object. Models do not consider what they do not count. Sober, *Ockham's Razors: A User's Manual*, 78; O'Neil, *Weapons of Math Destruction*, 59.

77. Kerr and Earle, "Prediction, Preemption, Presumption," 67–68; Amoore, "Algorithmic War," 53–55.

78. Kotras describes the resulting "paradoxes of ultra-personalization." Kotras, "Mass Personalization."

79. Huff, *How to Lie with Statistics*.

80. Backtesting procedures used to verify algorithms are a form of predicting the past; see Siegel, *Predictive Analytics*, 88.

81. And to practical limitations: algorithms lack, for example, the creativity to make noncircular predictions—not just predicting what posts on Facebook people will like, but writing new posts that people will like; see Mullainathan, "Why Computers Won't Be Replacing You."

82. Rona-Tas, "Predicting the Future."

83. Goodfellow, Benjo, and Courville, *Deep Learning*, 110; MacKenzie, "The Production of Prediction," 439. Generalization in machine learning has a different meaning than in statistics, where generalization involves extending to the population the findings about a sample; see Hacking, *The Emergence of Probability*, chapter 19. But algorithms work with the entire population and do not need to generalize in this sense.

84. The reference to singularities is a further difference from the mainstream approach of statistics. While frequentist probability refers to repeatable events and

calculates their rate of occurrence, Bayesian probability and machine learning deal with unrepeatable events; see Goodfellow, Benjo, and Courville, *Deep Learning*, 55.

85. Domingos, "A Few Useful Things to Know about Machine Learning."

86. Eco, "An Ars Oblivionalis? Forget It!"

87. Goodfellow, Benjo, and Courville, *Deep Learning*, 155–156.

88. Barber, *Bayesian Reasoning and Machine Learning*, chapter 15.

89. Barber, *Bayesian Reasoning and Machine Learning*, chapter 13.3. The preference for simpler systems is presented as a variant of Occam's razor, which advised scholastic philosophers not to get lost in irrelevant complications, but to prefer the simplest explanation: Domingos, "The Role of Occam's Razor in Knowledge Discovery."

90. Goodfellow, Benjo, and Courville, *Deep Learning*, 130.

91. Kotras, "Mass Personalization," 7.

92. Harcourt, *Against Prediction*, 237–239.

93. Nietzsche, *Unzeitgemässe Betrachtungen*, 116. See also "Remembering to Forget" in chapter 5 above.

94. Bias reduction is paid for with futility: Mitchell, *Machine Learning*, 43. In learning algorithms, high bias translates into a tendency to consistently learn the same things, but low bias leads to learning random things irrespective of the real signal—i.e., to learn very little or to learn irrelevant things.

95. In machine learning, the issue is discussed in terms of the relationship between *exploitation* and *exploration* (initially proposed in March, "Exploration and Exploitation in Organization Learning"), where exploitation refers to the use of experience to deal with an already known world, whereas exploration refers to the pursuit of unknown facts and surprises (which can be illuminating but also risky—or futile).

96. Esposito, *Soziales Vergessen*.

97. Koselleck, *Vergangene Zukunft*, 38–66.

CONCLUSION

1. Overbye, "Can a Computer Devise a Theory of Everything?"

2. Anderson, "The End of Theory."

3. Overbye, "Can a Computer Devise a Theory of Everything?"

4. Tegmark, *Life 3.0: Being Human in the Age of Artificial Intelligence*.

5. Metz, "London A.I. Lab Claims Breakthrough."

6. Jess Thaler, director of the Institute for Artificial Intelligence and Fundamental Interactions (https://iaifi.org/), as quoted in Overbye, "Can a Computer Devise a Theory of Everything?"

7. Turing, "Computing Machinery and Intelligence."

8. "Captcha" stands for "Completely Automated Public Turing Test to Tell Computers and Humans Apart": http://www.captcha.net/.

9. "Bias is the original sin of AI," as Howard puts it in *Sex, Race, and Robots*.

10. Buolamwini and Gebru, "Intersectional Accuracy Disparities in Commercial Gender Classification."

11. Angwin et al., "Machine Bias"; Lum and Isaac, "To Predict and Serve?"

12. Reese, "Why Microsoft's 'Tay' Bot Went Wrong."

13. O'Neil, *Weapons of Math Destruction*.

14. Crawford, "Artificial Intelligence's White Guy Problem."

15. Berreby, "Can We Make Our Robots Less Biased Than We Are?"

16. On the difference between algorithmic bias and data bias, see Mehrabi et al., "A Survey on Bias and Fairness in Machine Learning."

17. The Microsoft staff who programmed Tay apparently were horrified upon reading the racist and sexually charged messages released by the chatbot, which was quickly suspended (Mason 2016). The machine's actions evidently did not reflect their values and preferences.

18. See the Algorithmic Justice League's website: https://www.ajl.org/.

19. See Walton, Macagno, and Sartor, *Statutory Interpretation*.

20. Ashley, *Artificial Intelligence and Legal Analytics*.

21. Canale and Tuzet, *La giustificazione della decisione*, IX; Or with Luhmann, *Das Recht der Gesellschaft*, 362: "The argument does not reflect what the reader has in mind."

22. Lettieri, "Law, Rights, and the Fallacy of Computation."

23. Walton, Macagno, and Sartor, *Statutory Interpretation*, 4.

24. Solan, "Pernicious Ambiguity in Contracts and Statutes," 862.

25. Garfinkel, *Studies in Ethnomethodology*, 111.

26. Vanderstichele, "Interpretable AI, Explainable AI and the Sui Generis Method"; Durt, "Why Explainability Is Not Interpretability."

27. Luhmann, *Recht und Automation in der öffentlichen Verwaltung*, 49.

28. Luhmann, *Recht und Automation in der öffentlichen Verwaltung*, 106.

29. Walton, Macagno, and Sartor, *Statutory Interpretation. Pragmatics and Argumentation*, 9.

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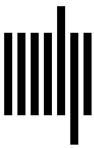

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