## **Book Reviews**

with drugs and energy drinks. "Basically he works all the time." When not at the office he is still at the call of the bank, constantly chained to mobile computing technologies. He seems unable to maintain healthy human relationships. There is no mention of his family until the end of the book. He loses two girlfriends. He has only one friend.

Not far into the novel both Jessica and Ethan lose their jobs. Jessica makes the mistake of confessing feelings of guilt to her biological father, who happens to be in prison. That she had to confess via letter to a biological father she does not even know is symptomatic of her isolation. Since her guilt involves a drone strike with civilian casualties, the confession is a security breach resulting in her discharge. Ethan, in a moment of physical and emotional fatigue also brought about from guilt and failed relationships, makes a decimal point error that causes his bank to lose a few hundred thousand dollars. This is presumably a fraction of the money his algorithms have actually earned the bank, but since Ethan also made the mistake of being unshackled from his technologies for twenty-four hours, it provides an excuse for his boss to fire him.

Then the real drama begins. Having been conditioned to isolation, both struggle to adjust to life away from that work, and in particular to build real human relationships not mediated, restricted, or distracted by technology. The struggles are not easy, and are compounded by the secretive—and immoral—nature of their former jobs. Jessica, with her knowledge of sensitive military secrets, becomes a wanted fugitive. Ethan winds up in a legal battle with his former employer.

Interestingly, the paths of the two protagonists never cross. The only connection is the fact that Ethan's algorithms enabled his bank to profit off the drone strikes carried out by Jessica. Not until the very end of the novel does Childress reveal the thin thread that unites their personal lives, and leaves the reader with the possibility that they might meet in person. But Childress provides a fascinating cast of other characters ranging from an FBI agent who once interrogated (or tortured) Al Qaeda suspects in Afghanistan (thus weaving in another aspect of social concern), to a weed-smoking tattoo artist, to a bisexual painter who goes from a struggling to a wildly successful artist, to a Russian billionaire, to a suicidal father of an ex-girlfriend.

The book raised a number of interesting questions about my own views of technologies and how I use them, and I found myself pondering some of these after closing the pages. The pacing of the novel is excellent, switching back and forth between numerous scenes in the two separate storylines, and now and then jumping to the point of view of one of the minor characters. My primary critique is that many of the characters are one dimensional: caricatures or types rather than fleshed-out persons. Even the protagonists do not really grow or change until the very end, and the change is seen then in only one short scene. Nonetheless, Childress succeeded at the most important level in that I found myself caring what happened to both Ethan and Jessica, even if at points I did not like the former very much. That, and the well-crafted suspense, kept me reading and made it a book I would recommend.

Reviewed by Matthew Dickerson, Professor of Computer Science, Middlebury College, Middlebury, VT 05753.

THE MASTER ALGORITHM: How the Quest for the Ultimate Learning Machine Will Remake Our World by Pedro Domingos. New York: Basic Books, 2015. 311 pages, index. Hardcover; \$29.99. ISBN: 9780465065707.

Pedro Domingos is a professor of computer science at the University of Washington and a leading researcher in the area of machine learning. The central thesis of this book is, as he states it, that "all knowledge—past, present, and future—can be derived from data by a single, universal learning algorithm" (p. 26). He calls that algorithm, yet to be discovered, the "Master Algorithm"—hence the title of the book.

The book begins by discussing the ubiquity of machine learning in the present day. Email spam filters, recommendation systems used by companies such as Amazon and Netflix, selection of stocks by mutual funds, the layout of goods in a supermarket, credit card fraud detection, and loan application approval—among many others—make heavy use of machine learning. According to Domingos, even the result of the 2012 presidential election was heavily influenced by machine learning: "the candidate with the best voter model wins, like Obama versus Romney" (p. xiv).

The author classifies workers in the field into five rival schools, which he often refers to as tribes. The Master Algorithm would unify these five approaches into a single algorithm that draws on the strengths of all five. Domingos claims that

if such an algorithm is possible, inventing it would be one of the greatest scientific achievements of all time. In fact, the Master Algorithm is the last thing we'll ever have to invent because, once we let it loose, it will go on to invent everything else that can be invented. (p. 25) Domingos devotes one chapter to each of the five tribes of machine-learning workers. The Symbolist approach (chap. 3) uses induction to derive symbolic rules such as decision trees. Connectionist models (chap. 4) emulate the learning that takes place in the human brain through neural networks. The Evolutionist approach (chap. 5) uses learning strategies modeled after the way species have learned (i.e., become more fit for their environment) through the evolutionary process; hence the names "genetic algorithms" and "genetic programming" for variants of this approach. The Bayesian approach (chap. 6) involves algorithms that learn to assess the probability of statements of the form effect  $\rightarrow$  cause by learning the probability of statements of the form cause  $\rightarrow$  effect by means of data mining, followed by an application of Bayes's theorem and/or developing a Markov chain. The Analogizer approach (chap. 7) learns from a study of cases that are analogous to the question under consideration.

In the next two chapters, the author explores what the Master Algorithm, an algorithm that draws on all five approaches, might look like. He describes a system known as Alchemy that he has been working on since 2003, which he regards as a step along the road toward the Master Algorithm and which is available for download. Domingos points out that Alchemy still has significant shortcomings, for instance, "it does not yet scale to truly big data" and "someone without a PhD in machine learning will find it hard to use" (p. 255). He notes that Alchemy has been successfully applied to many applications, and describes one example in detail:

One of Alchemy's largest applications to date was to learn a semantic network ... from the web. A semantic network is a set of concepts (like planets and stars) and relationships among these concepts (planets orbit stars). Alchemy learned over a million such patterns from facts extracted from the web (e.g., Earth orbits the sun). It discovered concepts like planet all by itself. (p. 255)

In the final chapter, the author moves into a broader view of the future of artificial intelligence (AI), with the Master Algorithm playing a key role. He envisions the day when a digital model of each person, based on the totality of their data and under the individual person's control, might facilitate moreaccurate matching in everything from advertising, to personalized medicine, to finding a job, to computer dating. From there he moves on to speculate about the further impact of such technological growth on society. One thing this reviewer found fascinating was his discussion of the singularity theory espoused by Ray Kurzweil and others. While agreeing with Kurzweil that the point at which machine intelligence surpasses human intelligence is coming, he argues that it will come about as a result of invention of the Master Algorithm, rather than as a result of reverse-engineering the brain as Kurzweil postulates. He criticizes (rightly in this reviewer's opinion) Kurzweil's tendency to see various phenomena as exhibiting exponential growth into the distant future rather than as S-curves trending toward an asymptote.

It is at this point, in this reviewer's opinion, that the author falls into the same trap that seems to especially bedevil people working in AI: claiming that future developments in AI will lead humanity to utopia, and even ascribing God-like powers to it. As he puts it, "any sufficiently advanced AI is indistinguishable from God" (p. 285). If the basic problem of humanity is lack of knowledge, then arguably AI may be the solution; but if it is estrangement from our Creator as a result of sin, then it is not the tree of knowledge that humanity needs, but rather the tree of the Cross.

That having been said, the book is still a fascinating glimpse into the increasingly important field of machine learning, written by an expert in the field who is also a good communicator.

Reviewed by Russell C. Bjork, Professor of Computer Science, Gordon College, Wenham, MA 01984.



God and Nature Magazine a source for those who are searching GODANDNATURE.ASA3.ORG e//oy/ ' poetry ' fiction ' opinion ' humor ' & more