Eight Minutes, Not Eight Hours

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Algorithms to Live By

The Computer Science of Human Decisions

BOOK AUTHORS: **BRIAN CHRISTIAN** AND **TOM GRIFFITHS**

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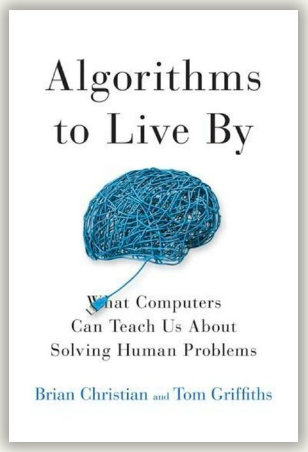

Non-fiction writing and cognitive science collide as Brian Christian and Tom Griffith illustrate how algorithms can be applied to everyday decision-making. The book *Algorithms to Live By:* The Computer Science of Human Decisions details how computers use specific algorithms. The authors then put those algorithms into contexts we can all understand. Covering a variety of topics including research, memory, creativity, social scenarios, and aging, this book enlightens us on how we process and apply the overwhelming amount of information we encounter every day.

Key Quote

"Most broadly, looking through the lens of computer science can teach us about the nature of the human mind, the meaning of rationality, and the oldest question of all: how to live" (p. 4)."

KEY POINTS

Applying Science to Human Life

Christian and Griffiths emphasize the importance of algorithms in our daily lives. They argue that humans make decisions every day that determine their effectiveness. They propose that by understanding these problems through the lens of algorithms, we can minimize mistakes and optimize our decision-making process.

- Humans face difficult decisions every day that ultimately determine how "good" they are. By looking at the fundamentals of these problems through the lens of algorithms, we can better understand the mistakes we make (p. 5).

Identifying the Ideal Number of Choices

The authors delve into the 'optimal stopping problem', presenting a simple rule called the "Look-Then-Leap" rule. They also introduce the ***37% Rule*** which provides a systematic decision-making process. Optimal stopping rules apply in a variety of situations from selling a house, parking a car, to quitting when you're ahead.

- "In any optimal stopping problem, the crucial dilemma is not which option to pick, but how many options to even consider" (p. 10). The "Look-Then-Leap" rule holds that you should set an amount of time to be spent exploring options with no intention of making a decision. After this research period is over, you should choose the next option that presents as superior to those in the research period (p. 12).
- "As the applicant pool grows, the exact place to draw the line between looking and leaping settles to 37% of the pool, yielding the ***37% Rule:*** Look at the first 37% of the applicants, choosing none, then be ready to leap for anyone better than all those you've seen so far" (p. 13). This gives us a systematic decision-making process with the best chance of success in exchange for a small amount of time spent (p. 14).
- Optimal stopping rules apply to decision-making in which options present themselves one by one. This is "...the basic structure of selling a house, parking a car, and quitting when you're ahead" (p.20).

Methods for Decision-Making

The book further explores the tension between exploration and exploitation in decision-making, a dilemma known as the "multi-armed bandit problem."

- "Simply put, exploration is ***gathering*** information, and exploitation is using the information you have to get a known good result" (p. 32).
- Tension is created between exploration and exploitation because of the restriction of time. The "multi-armed bandit problem" is one in which you are faced with multiple options and lack information about what will result from any given option (p. 33). The dilemma is whether to continue exploring your options or choose the one that has seemed best thus far (p.33).

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- Mathematician Josh Gittins discovered that, when facing a decision, each option must be considered for its individual payout. The Gittins Index algorithm "completely solves the multi-armed bandit with geometrically discounted payoffs (p. 39).
- Jeff Bezos made the decision to take a risk by starting Amazon based on what he calls the "regret minimization framework" - the idea that "regret is the result of comparing what we actually did with what would have been best in hindsight" (p.43).

Facts on Regret

Regret can be managed effectively using an optimal strategy, emphasizing the significance of learning from past decisions.

- "Assuming you're not omniscient, your total amount of regret will probably never stop increasing, even if you pick the best possible strategy—because even the best strategy isn't perfect every time" (p. 43).
- "Regret will increase at a slower rate if you pick the best strategy than if you pick others; what's more, with a good strategy regret's rate of growth will go down over time, as you learn more about the problem and are able to make better choices" (p. 43).

APPLYING RESEARCH

There are benefits to continuing exploration and research, even when circumstances are ever-changing.

- "When the world can change, continuing to explore can be the right choice" (p. 54). In a context of ever-changing circumstances, researching previously explored options can lead to the right answer.

On Dominance and Human Interaction

Christian and Griffiths suggest that a systematic method for determining hierarchy in human interaction is vital for smooth operations in large-scale societies.

- Human interaction is able to determine rank in a civilized way which "naturally orders a set without requiring pairwise comparisons. Accordingly, it makes possible dominance hierarchies that don't require direct head-to-head matchups" (pp. 81-82).
- The large-scale society of humans requires a predetermined hierarchy for operation and a systmatic method for determining that hierarchy (p. 83).

ON MEMORY

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- "Since [the 1960s], caches have appeared everywhere in computer science. The idea of keeping around pieces of information that you refer to frequently is so powerful that it is used in every aspect of computation" (p. 87).
- An algorithm used by computers called "Last Recently Used" is similar to a problem-solving strategy people use. This algorithm determines which information to evict from the cache by how recently it was used, just as a person decides which item of clothing to get rid of based on the last time he or she wore it (p. 89).
- Amazon's fulfillment center storage systems demonstrate how the idea of computer caches can be applied to physical objects. Employees are told to place items wherever they can find space unless the item is in high demand, in which case it is placed in a more easily accessible area" (p. 93).
- In 1879, a young psychologist named Hermann Ebbinghaus mapped out a graph that demonstrates how memory fades over time. This is now referred to as "the forgetting curve". This curve

demonstrates that the "pattern by which things fade from our minds is the very pattern by which things fade from use around us" (pp. 99-100).

CONCEPTS FOR RANKING PROBLEMS

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- **Earliest Due Date:** If the goal is to complete all tasks on time, then one should begin with the task due earliest and end with the task due latest (p. 108).
- **Moore's Algorithm:** If the goal is to minimize the number of tasks that will be left uncompleted, then one should begin by ordering tasks by due date (earliest to latest). However, as soon as the next task is in danger of going uncompleted, the most time-consuming task should be set aside for the end (p. 108).
- **Shortest Processing Time:** If the goal is to minimize the cumulative amount of time it will take to complete all tasks, then the tasks requiring the shortest amount of time should always be completed first.
- "Sometimes that which matters most cannot be done until that which matters least is finished, so there's no choice but to treat that unimportant thing as being every bit as important as whatever it's blocking" (p. 115).
- Switching from one task to another comes at a cost in that by switching contexts, we must reassess the information involved which can cause delays and errors (p. 120).

Making Predictions from Small Data

- "A famous presentation made by Peter Norvig, Google's director of research, carried the title 'The Unreasonable Effectiveness of Data' and enthused about 'how billions of trivial data points can lead to understanding'" (p. 129).
- ***Bayes's Rule*** says that preexisting beliefs can be combined with observed evidence by multiplying their probabilities together (p. 134). Christian and Griffiths use this rule to demonstrate that prior experience is the most important element in making predictions (p. 139).

DRAWBACKS OF OVERTHINKING

Overthinking and its effects are explored next. The authors illustrate how decision-making can be paralyzed by too many choices and too much information, which is dubbed "Analysis Paralysis". They argue that this paralysis can be combated by employing practical methods like 'satisficing'.

- "Considering more and more factors and expending more effort to model them can lead us into the error of optimizing for the wrong thing" (p. 156).
- We can easily overthink a problem by looking too deeply into the data we have gathered which

leads to ineffective solutions. To avoid this, we must balance our desire to find the right solution with the reality of the data at hand (p. 160).

- “Giving yourself more time to decide about something does not necessarily mean that you’ll make a better decision” (p. 166).

Minimalizing Data to Find Solutions

By “relaxing” a problem, or removing a number of small factors from it, we can reach a solution that is almost as complete and accurate as the entire, complex problem (p. 177).

- “If we’re willing to accept solutions that are close enough, then even some of the hairiest problems around can be tamed with the right techniques” (p. 175).

Chance and Creativity

Christian and Griffiths argue that randomness can sometimes be the best strategy, particularly when up against a ‘last-to-go’ disadvantage in competitive situations.

- Sometimes the best solution to a problem is to turn to chance rather than trying to fully reason out an answer” (p. 182).
- When it comes to manipulating complex problems, sometimes the best strategy is not manipulating at all, but leaving it up to chance. Random samples can provide insight when a problem is too complex to examine directly (p. 191).
- When William James was an assistant professor of psychology at Harvard in 1880, he wrote an article discussing the evolution of ideas in which he highlighted the necessity of randomness for creativity to occur. The most creative people tend to have the most random ideas (p. 201).

On Communication

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- “In human society, we tend to adopt a policy of giving people some finite number of chances in a row, then giving up entirely. Three strikes, you’re out”. Christian and Griffiths demonstrate through an algorithm called “exponential backoff” that when an action results in a failure, we should increase the amount of time we wait before issuing another attempt. For example, each time a friend fails to return a phone call, we should increase the amount of time we wait before we try calling again. This consumes less time but we never have to give up entirely.
- “Buffering” is the tactic used by computers to create a stream of information rather than short bursts. This can be applied to human life in that technology provides us with a constant stream of communication and information that prevents idleness almost entirely (p. 226).

Mechanisms of Society

- Game Theory: The study of the problems we impose on one another and the information introduced to the equation from others (p. 229). "Quantifying the price of anarchy has given the field a concrete and rigorous way to assess the pros and cons of decentralized systems, which has broad implications across any number of domains where people find themselves involved in game-playing" (p. 237).
- Mechanism Design: Problems can sometimes be solved more effectively by changing the rules of the situation rather than acting differently within the same set of rules (p. p. 240).
- Information Cascades: When considering "man vs. man" problems, more information can be acquired by considering what the other person knows and using that information in your own decision-making.

KEY CONCEPTS SUMMARY

At its core, **Algorithms to Live By: *The Computer Science of Human Decisions*** is about understanding how the principles of computer science

At its core, **Algorithms to Live By:** The Computer Science of Human Decisions *is about understanding how the principles of computer science can be applied to improve our everyday decision-making. The book concludes with the message that employing these algorithmic principles can not only aid in decision-making but also provide a profound understanding of human cognition and behavior.*

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