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Nassim Nicholas Taleb's *The Black Swan* and *Foiled by Randomness: The Hidden Role of Chance in Life and the Markets* are favorite books of paranoid engineers of all varieties. Taleb's *Antifragile: Things that Gain from Disorder* is also rightly admired, but is just slightly too recent to fall within the *Passages* requirement that a book be at least ten years old before you can reasonably call it a classic.

Taleb, more than any other author considered in this column before, is personally controversial, to say the least. An infamous review of his latest (popular, rather than technical) book in the Guardian

(<https://amp.theguardian.com/books/2018/feb/25/skin-in-the-game-by-nassim-nicholas-taleb-digested-read>) said that "This book is 25% probability theory, 25% classical anecdotes, 25% stating the bleeding obvious, and 25% complete bullshit" (which, admittedly, is both a hostile dismissal, and something more, as we will see at the end of this column). And that is a book review, focusing less on the cantankerous author than the book itself. Taleb fights a lot, on Twitter (probably in real life, too); Taleb tackles famous people, like the great classicist Mary Beard, on their own academic turf. Taleb shifts from Bitcoin enthusiast to Bitcoin skeptic (and crypto-enthusiast mocker) in short order. He thinks a lot of important, famous, supposedly clever people are fools, and he doesn't suffer fools gladly. In between lifting weights and doing math and predicting failures, he probably views going into intellectual battle with all guns blazing as a kind of light entertainment. This adds to the fun of his books, which have a certain combative spice, but it's not really important. If Taleb were a retiring soul who respected his peers and never used bad language, he'd still be worth reading, though it's hard to imagine how he'd write the books he writes.

The essence of Taleb's books is a modern, mathematically informed, market-experience-based version of classical philosophical skepticism. Taleb is, in Wikipedia, first described as an "essayist" and he is, in a sense, Montaigne in a happily furious mood. Beyond the idiosyncrasies of personality, the reason Taleb gets into so many fights is that his central message, in a world of experts who (Taleb argues) overstate, sometimes radically overstate, their certainty, is that we know much less than we think we know. Taleb is not a pure skeptic, like David Hume at his most acidic, arguing that we know nothing beyond a stream of sensory impressions. He inherits, however, the moderate skepticism that questions the grounds on which experts believe their models, their systems, and their advice match reality. His most famous claim, in *The Black Swan*, is specifically that economists and financial experts often assume that market behavior follows a predictable normal distribution, with limits to losses (and gains) that make risk-taking a rationalizable behavior. Among other things, formulas and trading strategies assume that various random variables are independent and uncorrelated, and ignore (his central statistical concept) "fat-tails." Fat tails are a feature of probability distributions that decay towards one or both extremes more slowly than a normal distribution. This means that extreme events may be more extreme, and determine real expectation, much more than with a

normal distribution. An oversimplification of Taleb's basic argument is that fewer things are normally distributed than people find it convenient to assume. And, historically, financial markets tend to make strong arguments for his argument, e.g. in the 2007-2008 crash.

The timing of his book *The Black Swan*, which came out almost as if by design just as financial outlier events dominated the news, made Taleb famous. That the book, rather than being a dry summary of a case for humility in risk-taking, was a baroque mix of aesthetics, math, vitriol, and fictional biographies, made swallowing Taleb's bitter pill a pleasure. Taleb's style, vigorous and anecdote-driven, full of allusion and wide-ranging erudition, fits well with his central message on risk-taking under uncertainty. Because "rational, expert" analysis is often based on simplified, academic, mathematical models, the contrary approach is based on tradition, history, heuristic, and a kind of aesthetics of risk, in addition to certain technical mathematical points. That is, because the mathematical tools Taleb emphasizes in his understanding of risk-analysis expand the degree of uncertainty present in formal models, Taleb can point to "your grandmother" as an equally valuable source of wisdom and risk estimation. Survival is a good argument, is one way to put it. Hume, recall, was a conservative, almost a reactionary, in politics and in his proposals as to how society and life should be ordered; precisely because we know so little, we should be careful to not risk too much or make grand plans based on our limited knowledge.

What does this have to do with software engineering? Plenty. Software engineering is a field where optimistic risk estimates based on assumptions from poorly-justified models have caused a world of harm. Software systems themselves, in addition to their schedules and budgets, are often designed under a set of assumptions driven as much by hope and convenience as truly justified belief. When inputs fall outside of "possible" bounds software systems tend to collapse in "disbelief" like over-leveraged financial systems.

For testing people, like myself, there is a particular message here, not unrelated to Knuth's famous warning to "Beware of bugs in the above code; I have only proved it correct, not tried it." Aggressive subjection of systems to unexpected, "outside the normal distribution," inputs is essential if we are to lower the risk inherent in software systems. Assumptions and expert assurances are too often based on weak or faulty arguments, and Montaigne and even Sextus Empiricus are safer guides to how to plan for the real world of users, hackers, and operating environments than are idealistic optimists such as Condorcet.

In a way, Taleb's works are poor subjects for a book review. The Guardian's "25% probability theory, 25% classical anecdotes, 25% stating the bleeding obvious, and 25% complete bullshit" is as good a summary as any, once you understand that ignoring the bleeding obvious, the fat tails we all know exist from experience, the "Gods of the copybook headings" as Kipling calls them, is a perpetual risk in engineering design, and that 25% is a smaller BS ratio than that offered by most nonfiction books offering actionable advice on how to proceed in complex decision-making under uncertainty that you'll ever read.