

In PURSUIT *of* ELEGANCE

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Why the Best Ideas Have Something Missing

MATTHEW E. MAY

DOUBLEDAY
New York London Toronto
Sydney Auckland



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PROLOGUE

The Missing Piece

ON SUNDAY, JUNE 10, 2007, nearly twelve million television viewers in the United States tuned their sets to HBO to watch the final episode of the hit series *The Sopranos*. The show, which told the story of a modern-day mob boss who runs a colorful crew of only slightly organized criminals in northern New Jersey, had garnered more than twenty major awards over an eight-year period spanning six seasons, including both the Golden Globe for Best Television Series and the Emmy for Outstanding Drama Series. Flush with acclaim previously enjoyed only by network shows, *The Sopranos* touched off a renaissance of innovative television, positioning HBO at the forefront of the entertainment industry.

The last episode held the promise of being particularly special, as creator David Chase would act as both writer and director—something of a rare event since the early days of the show in 1999. Television hadn't seen such ballyhoo and buildup since the *Friends* finale in 2004. Media critics

heralded the end of an era, loyal followers expressed their sadness on their blogs and Web pages, and even the highly respected editorialist Peggy Noonan devoted her entire weekend Declarations column in the *Wall Street Journal* to the show that (violence and criminal behavior notwithstanding) had so poignantly captured the challenges everyone faces in work and life. In her words, “*The Sopranos* wasn’t only a great show or even a classic. It was a masterpiece, and its end Sunday night is an epochal event.”

As the hour played out that Sunday evening, everyone waited with anticipation to find out the fate of Tony Soprano. Debates had been raging for the twenty-two months since Chase had announced the final airdate: *Would he or wouldn't he be “whacked”?* But instead of receiving a concrete answer to the big question, viewers sat shocked as, during the final seconds of the show, their television screens suddenly went black. Credits rolled within a few more seconds, and *The Sopranos* series came to an end.

What is so fascinating about the abrupt ending is not the decision itself, although it was unprecedented and broke new ground artistically. Rather, what is most intriguing about the black screen is the thinking behind how it came to be and the aftermath.

The most immediate reaction—*What just happened to my television signal?*—had nothing to do with the story line, but instead rested on the assumption of electronic failure. Now, such a response may have been predictable in this age of satellite and cable TV, but what is so curious is that everyone had the *same* reaction: something had gone wrong. Only when the credits rolled and viewers realized that what they had just experienced was actually the ending did they stop and think. And it’s what occurred over the course of the next few days that’s worth noting.

The following Monday morning media coverage was overwhelming, with every major news source weighing in, from the *New York Times* to CNN. Critics, of course, cried foul and accused David Chase of avoidance, gimmickry, and ulterior motives. (Whatever fate Tony Soprano met would inevitably disappoint some portion of the audience, and ambiguity left open the option for a feature film.) Comedy shows like *The Daily Show* immediately mocked the event and imitated the act on their own programs. On the viewer side of the street, though, the initial bitter disappointment at being left hanging was quickly replaced by an unparalleled level of postshow scrutiny coupled with a fresh appreciation for “the genius of David Chase,” spurred by his semi-cryptic public comment that “Anybody who wants to watch it, it’s all there.”

Realizing that every scene was carefully crafted by Chase, viewers, aided by their TiVo recorders, reexamined the show frame by frame, noting both blatant and subtle visual clues, soundtrack hints, veiled dialogue, past-show references—even nuances like camera angles, color palettes, and lighting effects. Theory upon theory popped up in both online and traditional media. The debate took on a life of its own. Viewers crafted their own endings, filling in the missing scene with the intricate trail of code Chase had provided. To most, Tony Soprano’s fate became quite obvious, albeit only through a full retrospective. From the initial uncertainty, at least three different but distinct endings emerged, each with its own camp of believers arguing vehemently for their version.

The point here is that no straightforward conclusion would have engaged viewers with the same intensity and debate. Even if they didn’t like it, most critics labeled the final airing of *The Sopranos* as the creative highpoint of the 2007 season, with many hailing it the most innovative and memo-

rable hour in recent television history. By all accounts, the episode is quite indelible.

But what was the magic behind such dramatic and enduring impact?

The answer to that question may lie in an unexpected place: the words of Chinese philosopher Lao Tzu:

*Thirty spokes share the wheel's hub,
It is the centre hole that makes it useful.
Shape clay into a vessel,
It is the space within that makes it useful.
Cut doors and windows for a room,
It is the holes which make it useful.
Therefore profit comes from what is there,
Usefulness from what is not there.*

David Chase's groundbreaking choice to abandon a conventional story resolution certainly granted him the creative freedom to solve several difficult character and plot problems at once with a single stroke. Not only could he tie together seemingly disparate story lines and random scenes, but he deftly sidestepped disappointing a significant share of the audience while achieving even greater viewer involvement. The deeper thought and meticulous attention to detail required to embed subtle clues in every scene pushed him to elevate his art. The utter simplicity of the *nothingness* of that black screen exacted stunning power—it riveted and seduced the viewer. By leaving the conclusion open-ended, and thus open to interpretation, Chase engaged his audience in an entirely original and altogether different way, one that told his viewers that he respected *their* intelligence and creativity.

Was the last episode of *The Sopranos* perfect? No. "Perfec-

tion” implies something finished, something flawless. The show was anything but! It was, however, something perhaps even more powerful. It was *elegant*.

a.

Gaze at the image below for a moment. The three sets of right-angled lines depict something so ubiquitous that you’d be hard-pressed to make it through the day without it. Can you identify it?



If you can’t, it’s because a key piece of information is missing. Once that information is shared, however, you will never again be able to see the image in quite the same way again. *You are looking at the uppercase version of the most widely used letter in the English language.* The letter, though, exists in the white space. Do you see it now? It is the letter *E*. Look again. My guess is that from now on, you’ll have difficulty *not* seeing it.

What you’ve just experienced is the power of “the missing piece.” It’s not a parlor trick. It’s an example of the transformative idea that lies at the heart of elegance, and at the center of this book: what *isn’t* there can often trump what *is*.

Just as no traditional conclusion to *The Sopranos* series

could have caused such a stir, no “complete” *E*, no matter how elaborately or ornately rendered, could have engaged you as fully and had the same kind of indelible impact on you. Once you were given a clue, your brain created the image for you, changing your mind-set, without your having much say in the matter. Like *The Sopranos* finale, the incomplete *E* took on a new form, a life of its own—one with real staying power.

What is important to take away from this quick demonstration is that the full power of elegance is achieved when the maximum impact is exacted with the minimum input. Adding anything to the figure would have actually detracted from the desired effect: the surprise you likely experienced when the *E* became visible. The *E* is obvious only in retrospect, but it is the unusually simple yet thoughtful construction of what *is* there that gives the missing piece its surprising power. Elegance is not, in other words, a matter of simple erasure.

The power of the missing piece—Lao Tzu’s *what is not there*—is exactly what David Chase tapped into, consciously or not, with his final episode of *The Sopranos*. Chase did what the best innovators and most prolific individuals are doing in many different domains: creatively engaging people’s imaginations by leaving out the right things.

Although this is not necessarily a new idea (Lao Tzu’s wisdom is easily over 2,500 years old), it remains rare and radical nonetheless. If I asked you to tell me what the easiest thing to do in any situation might be, you might naturally and instinctively reply, with a nonchalant shrug of the shoulders, “Nothing.” But doing nothing isn’t easy. In fact, it’s just the opposite of what comes most naturally and instinctively.

Suppose, for example, you’re on an African photo safari and are just about to click the perfect shot of a mother hip-

popotamus and her calf when she decides to charge. If you're like most people, you'd run so fast the cheetahs would be jealous—and yet, *National Geographic* adventure journalist Boyd Matson told me that even if you can run the hundred-yard dash in nine seconds flat, that's exactly what you *shouldn't* do. And he should know—charging mama hippos are part of a day's work for Boyd. As Boyd suggests, you should stand perfectly still—in other words, *do nothing*. But that's hardly easy when an angry two-ton beast is barreling toward you.

Moreover, if I told you to do nothing for the next five minutes, my bet is you couldn't—you would undoubtedly do *something* during that time. What we normally think of as the easiest thing in the world to do—*nothing*—is in reality often the hardest.

b.

The value of what *isn't* there dawned on bestselling business author and self-employed professor Jim Collins when, in the throes of his early post-Stanford Business School career at Hewlett-Packard, his favorite former professor reproached him for a lack of discipline. An expert in creativity and innovation, she told him his hard-wired energy level was riding herd over his mental clarity, enabling a busy yet unfocused life. Her words rang true: at the time, Jim was aggressively chasing his carefully set stretch goals for the year, confident in his ability to accomplish them. Still, his life was crowded with the commotion of a fast-tracking career. Her comment made him pull up short and reexamine what he was doing. To help, she did what great teachers do, con-

structuring a lesson in the form of an assignment she called “20-10”: *Imagine that you’ve just inherited \$20 million free and clear, but you only have 10 years to live. What would you do differently—and specifically, what would you stop doing?*

The exercise did precisely what it was intended to do—make Jim stop and think about what mattered most to him. It was a turning point, for three reasons. First, he realized he’d been racing down the wrong track spending enormous energy on the wrong things. In fact, he woke up to the fact that he hated his job. He promptly quit and headed back to Stanford to launch a new career of research, teaching, and writing.

Second, the assignment became a constant reminder of just how important and precious his time is. He now starts each year by choosing what *not* to do, and each of his to-do lists always includes “stop-doing” items. Collins preaches his practice, impressing upon his audiences that they absolutely must have a “stop-doing” list to accompany their to-do lists. As a practical matter, he advises developing a strong discipline around first giving careful thought to prioritizing goals and objectives, then eliminating the bottom 20 percent of the list . . . forever.

Third, the strategy helped him identify what factors led the companies he was studying to become “great” while others remained merely “good.” The great companies routinely eliminated activities and pursuits that did not significantly contribute to the following criteria: profit, passion, and perfection. Profit meant engaging in only the activities that would result in value for both the company and the customer. Passion meant having a sense of noble purpose beyond just making money. And perfection meant focusing on flawlessly executing each task in such a way as to make the competition

irrelevant. All three criteria had to be met in order for any activity to remain in these great companies' repertoires.

Jim Collins made the "stop-doing" argument in an eloquent essay, which appeared in *USA Today*:

A great piece of art is composed not just of what is in the final piece, but equally what is not. It is the discipline to discard what does not fit—to cut out what might have already cost days or even years of effort—that distinguishes the truly exceptional artist and marks the ideal piece of work, be it a symphony, a novel, a painting, a company, or most important of all, a life.

c.

Collins's statement came as a thunderbolt of insight for me. At the time, I was a hired gun at Toyota, struggling with a unique but challenging assignment: to identify and then teach the hidden process behind Toyota's uncanny ability to successfully implement several hundreds of thousands of inventive ideas each year. It occurred to me as I read the essay that each of those ideas had behind it the "stop-doing" philosophy.

I suddenly realized that I had been looking at the problem in the wrong way. As is natural and intuitive, I had been looking at what to *do*, rather than what to *not do*. But as soon as I shifted my perspective, the vaunted Toyota Production System became for me a study of what *wasn't* there, and of how and what to *stop doing*. The Lexus line of cars, which had by

then become America's leading luxury nameplate, was suddenly a shining example of eliminating anything that lacked passion and perfection. The singular thought that what *isn't* there can often be as or more powerful than what *is* presented me with a completely different view of the world. In fact, it presented an altogether unique reality—and a life-changing one, at that.

My fresh perspective led to my authoring a book entitled *The Elegant Solution*, which used Toyota as the door through which one could walk to discover a fundamentally different view of innovation. But Toyota's world dominance resulted in what I saw as the real story being upstaged by the example. The elusive nature of elegance, and the power of elegant solutions of all kinds, remained to be explored and revealed, untethered from any single illustration.

So what I did next was apply the “stop-doing” strategy to my own life, leaving my management consulting practice behind in order to focus on writing, teaching, and conducting independent research on the hows and whys of elegance. For two years I dug deeper into the concept, trying to understand it better, looking for more stories of people and groups achieving far more with much less. It turns out that if you know where to look and what to look for, the letter E-type strategy at the heart of elegance can be found in a wide universe of fields: from the arts to athletics, from industry to architecture, from science to society.

I'll introduce you to some of the individuals, teams, and companies that have become adept at exploiting this uniquely powerful principle to better sculpt their ideas, performances, and lives. The point of my quest is to answer a single question: *What can we discover and learn that might allow us to bring more elegance into our own endeavors?* I should warn you in advance that

the search will be exemplary rather than exhaustive—for as Henry David Thoreau once observed, if you're familiar with a principle you don't have to be familiar with all of its applications. My goal is not to reduce the concept of elegance to a stepwise prescription. There is no magic elixir, there are no secret ingredients—because there is no single recipe for elegance.

Why is elegance so surprisingly powerful? The reasons aren't readily apparent, but if we can somehow decode them, we can hope to understand the thinking required to give the phenomenon genuine utility. In other words, I'm after the bigger picture, the bigger idea.

This perspective is an admittedly Eastern view, a cultural artifact resulting from my earlier immersion in an Asian company and culture. But there is some science behind this, as well. When psychologists at the University of Illinois showed a picture of an elephant in a jungle to a study group consisting of people of all ages from the United States and Asia, the image triggered different brain activity as shown by functional magnetic resonance imaging (fMRI). Basically, for all the Americans, the part of the brain that recognizes objects was lit up. Not so for the Asians. In other words, Asians saw a jungle that happened to have an elephant in it. But the Americans saw an elephant without taking much notice of the jungle. In my pursuit of elegance, I will be focusing on the jungle that happens to have elephants in it, as opposed to examining elephants of any particular kind.

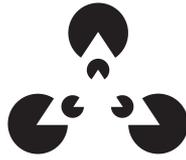
To paint that bigger picture vividly we need to examine elegance from a number of different angles. (Artists tell me this helps to “render the truth.”) We need some understanding of the virtues and dimensions of elegance in order to

decipher its code. We need to understand why its impact is so forcefully seductive. We need to grasp the subtractive process behind its power. We need a sustainable way to apply the insight we gain. Finally, we need an understanding of why elegant ideas are so hard to come by, what the obstacles are to crafting an elegant this or that. These few objectives will help us unwrap the central idea, and will form the basic structure of this book.

d.

But why, you might still be wondering, is this so important? Because a world in which *not doing* can be more powerful than *doing* is a different world than the one we are used to, with important implications. Because the most pressing challenges facing society are in urgent need of sustainable solutions—*elegant* ones. Because without a new way of viewing the world we will most assuredly succumb to employing the same kind of thinking that created so many of our problems in the first place. Because precious resources such as land, labor, and capital are at all-time premiums, and in some cases are rapidly shrinking or being depleted. Because by nature we tend to add when we should subtract, and act when we should stop and think. Because we need some way to consistently replace value-destroying complexity with value-creating simplicity. Because we need to know how to make room for more of what matters by eliminating what doesn't.

We all reach for elegance at some level, and yet it so often exceeds our grasp. Just why that's so is what I want to explore.



CHAPTER ONE

Elements of Elegance

IN THE AUTUMN of 2000, two enterprising Harvard University undergraduates, Anthony Delvecchio and Jason Karamchandari, launched a Web site they called ShuttleGirl. The concept could not have been more simple: help their classmates make sense out of the comprehensively confusing campus shuttle schedule. On the site, the two gents quipped:

It is needless to say that taking the shuttle can be a routine part of a Harvard student's life. ShuttleGirl wants to make this aspect of your life a bit easier. Think about it. We've all seen the shuttle schedule. We've all seen twenty-year-olds reduced to tears when they board a Quad-bound shuttle at 10:00 PM only to hopelessly return to the Science Center at 10:25 PM, a final pre-Quad stop. Indeed, the shuttle schedule is complex in its organization. Some would even say that a working knowledge of game theory is necessary to

understand the current shuttle schedule. ShuttleGirl has seen all this pain and she will stand silently no more.

To Delvecchio and Karamchandari, and to the entire shuttle-going student population, for that matter, the campus shuttle schedule was an incomprehensible, incomplete, inconvenient, inaccessible, inaccurate, infuriating mess. Their thought was to deliver just enough information, just in time, in just the right way so that the shuttle rider's experience would be effortless.

In addition to providing route information, ShuttleGirl evolved to provide a number of services, including real-time updates that could be received on cellular handheld devices. Not unlike Google founders Larry Page and Sergey Brin, Delvecchio and Karamchandari coupled their combined ingenuity with computer savvy, developed several new technologies, tied them to a powerful algorithm, and hid it behind a spare, user-friendly interface.

They chose for their logo a tantalizing enigma: the silhouette of an undisclosed celebrity pop star, which would later be replaced by a partial photograph of a mystery coed that in turn created a campuswide obsession over ShuttleGirl's true identity.

Their platform was so enormously appealing that the Massachusetts Bay Transit Authority (MBTA), Boston's mass transportation agency, adopted it for its entire commuter rail schedule. Soon, six other cities and a number of other colleges would purchase the system, and the duo formed a company called Second Kiss Wireless to market the ShuttleGirl platform more widely.

In a June 2001 interview with the campus newspaper the

Harvard Crimson, Delvecchio said of ShuttleGirl's various capabilities: "One algorithm does it all. We think ShuttleGirl is an incredibly elegant solution."

At Davidson College in Charlotte, North Carolina, a course on short prose fiction taught by award-winning writer Randy Nelson begins with a peculiar assignment: using only a box of 250 toothpicks, three feet of string, and a 2.5-ounce tube of glue, each student must build a bridge at least two toothpicks high and strong enough to hold a brick. The goal, Nelson says, is for each student to come up with "an elegant solution—one that is simple, beautiful, strong and stunningly original," and one that uses "every inch of string, every drop of glue and clicks into place with the 250th toothpick." Nelson's lesson is directly applicable to good fiction, he says, which in his view must also be beautiful, original, sturdy, not require any more words than necessary, and click into place with the last word.

For six months in 1983, a lengthy political struggle involving the White House, Congress, and civil rights groups seemed likely to destroy the United States Commission on Civil Rights. The conflict was sparked by then president Ronald Reagan's precipitous nomination of three new commissioners. The act turned pending legislation intended to extend the life of the commission into a political minefield, as civil rights groups and Congress saw the independent, bipartisan nature of the commission threatened by executive interference. Both the House of Representatives and the Senate introduced resolutions calling for the commission to be reconstituted as an arm of Congress, rather than as a part of the executive branch. But Senate leadership was unsettled by the idea of a new commission in the legislative branch and balked at calling for a floor vote. Meanwhile, the House

voted to deny the commission funding if it retained executive branch status. As the expiration date of the commission rapidly approached, negotiations intensified and ran around the clock. At the last possible minute, the Senate proposed a compromise: a new hybrid agency that would have a six-year term and eight commissioners—half Democrat and half Republican, four appointed by the president, two by the House, two by the Senate—who were to run staggered terms, with removal only for cause. In a single stroke, the offer effectively preserved the interests of all involved. Declared the *New York Times*: “It’s an elegant solution.”

The choice to use the phrase “elegant solution” implies that there is something distinctive about how each of these multifarious problems was resolved. What Delvecchio, Nelson, and the *New York Times* seem to share is the understanding that an elegant solution is in a class all its own, that what sets it apart is the unique combination of surprising power and uncommon simplicity, and that elegance entails achieving far more with much less when faced with a complex problem. Elegance is indeed a widely sought-after quality, and yet it takes many forms.

Scientists, mathematicians, and engineers search for theories that explain highly complex phenomena in stunningly simple ways. Artists and designers use white, or “negative,” space to convey visual power. Musicians and composers use pauses in the music—silence—to create dramatic tension. Athletes and dancers search for maximum effect with minimal effort. In Japan, architects and martial artists pursue *shibumi*, a word appropriately without definition but meaning, very loosely translated, “effortless effectiveness.” Physicians draw on the Occam’s razor principle in an effort to find a single diagnosis to explain the entirety of a patient’s

symptoms, shaving the analysis down to the simplest explanation. Filmmakers, novelists, and songwriters strive to tell stories that seem simple but that foster multiple meanings yet achieve universal resonance.

But no matter how determinedly we pursue it, elegance is an elusive target. As a principle it resists reduction—it's difficult to decode. Perhaps that helps explain why it's rare. Experiencing elegance is nearly always profound: it gives us pause, often evoking an “Of course!”—usually accompanied by a mild slap to the forehead. It can change our view of things, often forever.

Webster's New World Dictionary, in an updated definition, describes elegance as “marked by concision, incisiveness and ingenuity; cleverly apt and simple, as an elegant solution to a problem.” But is there a practical way to explain better what it is and isn't, what it means, and how it works?

a.

When you enter the office of retired professor Donald Knuth in the Stanford University Computer Sciences Department, several things strike you immediately as somewhat odd: he prefers pad and pencil over a keyboard, he works standing up, and he doesn't use e-mail. It's peculiar because Donald Knuth is none other than the father of computer science, revered by those in the know for his contributions to the field.

Knuth's love affair with computers and programming began over a half century ago, in 1957, and as mainframe computers were just emerging, “There was something special about the IBM 650,” Knuth says in a memoir, “some-

thing that has provided the inspiration for much of my life's work."

By the following year Knuth had written instructional code for the IBM 650 and drafted a user manual. *CBS Evening News*, which featured one of Knuth's first programs—it was designed to compute basketball game statistics—described it as a "magic formula."

Author of *The Art of Computer Programming*, a multivolume tome that many consider to be the masterwork of the field, Knuth introduced, as one University of California professor put it, "elegance into programming," believing that computer programmers should view lines of computer code more as literature, so that people (and not simply other computers) could easily read and understand them. According to Knuth, elegant software requires programming in such a transparent way that not only can other programmers learn from it, but they can also enjoy reading it in front of the fire, "like good prose."

One of Knuth's favorite lecture topics is "solving puzzling problems." He knows he's ready to solve a problem elegantly when he can hold the answer in his head without having to write it down. Even with all of the advancement in software coding in the last fifty years, his programs remain the de facto standard for scientific publishing today.

What is Donald Knuth's definition of elegance? "Symmetrical, pleasingly memorable, spare—with the ease and immortal ring of an $E=mc^2$."

Those criteria are a bit cryptic, which perhaps isn't so surprising, given that Knuth's world revolves around a code, something that is by definition mysterious.

So what exactly does he mean?

b.

In 1782 a Swiss mathematician by the name of Leonhard Euler wrote about a numerical array called Latin squares. Latin squares were symmetrical grids with an equal number (n) of rows and columns. The only rule was that every number from 1 to n had to appear exactly once in each row and column. In other words, if there were seven rows and seven columns, the numbers 1 through 7 would appear exactly once in each row and column.

Fast-forward nearly two hundred years to 1979, when Dell puzzle magazines published a numerical brainteaser they called Number Place. Indianapolis architect Howard Garnes had, in his spare time, tinkered with Euler's Latin squares to design a nine-by-nine Latin square with a new twist. He added nine three-by-three subgrids. Each could contain exactly one occurrence of all the numbers 1 through 9, in addition to the rows and columns requirement. The goal, of course, was to fill in the matrix completely. A few clues were given in the form of numbers already in place in one of the eighty-one boxes.

Shortly thereafter, in 1984, the Japanese publisher Nikoli introduced the game in its newspaper, adding yet a further twist. No more than thirty clues or "givens" were permitted, and they had to be distributed with exact mirror symmetry. Nikoli renamed the game Sudoku. It became a nationwide obsession in Japan within a few years.

In 2004, retired Hong Kong judge and puzzle fanatic

Wayne Gould made a trip to London in a successful effort to persuade the *Times* editors to print Sudoku puzzles in their paper. The *Times* introduced Sudoku as a daily feature on November 12, 2004. The craze spread to Australia and New Zealand, where newspapers like the *Daily Telegraph* and the *Daily Mail* began publishing Sudoku the following year. In July 2005, British satellite television channel Sky One launched the world's largest Sudoku puzzle, a 275-foot construction, by carving it in the side of a hill near the city of Bristol.

By the end of 2005, the World Puzzle Federation had declared Sudoku the number-one logic puzzle in the world. Today there are online versions, Sudoku radio and television shows and games, Sudoku clubs, strategy books, videos, card games, and competitions. In 2006, Italy hosted the first World Sudoku Championship, with teams from around the world participating. Being the champion in one's own country is tough enough, but the competition in these international games is even more fierce.

Will Shortz, the famed crossword puzzle editor for the *New York Times* and the only person in the world with a degree in enigmatology (the study of codes and puzzles), describes himself as a Sudoku "addict." By the end of 2006, Sudoku was a worldwide craze, with millions playing it daily.

So what is the connection between Sudoku and Knuth? I would argue that it is the elements of elegance. In keeping with Knuth's criteria, Sudoku can help us to arrive at a concise working definition of the concept.

First, in keeping with Knuth's first dimension, Sudoku is *symmetrical*, with its squares inside of squares and mirrored distribution of clues. Second, it is *seductive*—to the point of being irresistible and craze-worthy—another way to couch

Knuth’s “pleasingly memorable.” Will Shortz confirms that his Sudoku addiction stems from the seductive appeal of the empty squares to be filled in. It is intentionally spare, in keeping with Knuth’s third dimension, through a process best described as *subtractive*. The Sudoku puzzle designer crafts a complete solution and then symmetrically subtracts filled-in squares to arrive at the starting grid, which is predominantly empty. Finally, and as a result of these first three, the game is *sustainable* in terms of both the infinite number of games that can be constructed, as well as players’ interest in the game. In other words, there is an “ease and immortal ring” to it. In fact, Sudoku could not be easier to learn: you do not even need to know how to count, its one rule can be explained in a single sentence, it takes but a minute to grasp, and it is universal in nature (unlike crossword puzzles, which are knowledge-based as well as language-specific) because the numbers are just symbols. And yet, the underlying complexity behind the logic needed to solve a Sudoku puzzle can be incredibly challenging.

Symmetry. Seduction. Subtraction. Sustainability. These are the key elements of elegance—the laws that can help us harness the power of the missing piece.

Symmetry helps us solve problems of structure, order, and aesthetics. We are natural-born symmetry seekers. Most of nature, with its infinitely repeating patterns, is symmetrical. It is present in nearly every living thing, and we generally equate symmetry with beauty and balance. In fact, a number of studies have found that most people find symmetrical faces more attractive. But symmetry isn’t limited to biology. Symmetry is where mathematics, nature, science, and art come together. We are adept at noticing a lack of symmetry, which is why we can exploit it to our advantage—when someone

experiences a degree of *asymmetry*, they naturally want to “fill in” the obviously missing piece. It’s the nature of symmetry that enables us to find solutions given only partial information. When symmetry comes into play, what appears to be missing isn’t. It’s at once absent, and yet present.

When, for example, *Sopranos* viewers were robbed of a standard story structure—a beginning, middle, and end—they were initially distraught. But when reassured by the story creator himself that the missing piece was “all there,” they went in search of an ending—the “truth”—to restore their perceived loss of symmetry. Symmetry allowed you to complete the letter *E* earlier, and the role of symmetry in Sudoku is clear.

Seduction addresses the problem of creative engagement. It captivates any attention and activates any imagination. The power of suggestion is often stronger than that of full disclosure. Leaving something to the imagination, open to interpretation, creates an irresistible aura of mystery, and we are compelled to find answers. The seduction is in what we don’t know. What we don’t know far outweighs what we do, and we are naturally curious; we are easily drawn to the unknown, precisely because it *is* unknown. What isn’t there drives us to resolve our curiosity.

The gentlemen of ShuttleGirl understood the impact of mystique. Withholding the true identity of ShuttleGirl wasn’t a cheap schoolboy trick—it was a stroke of marketing ingenuity that engaged the entire student body.

Neuroscientists conducting research into positive emotional reactions have found that solving puzzles like Sudoku, and the missing *Sopranos* ending, activates the “satisfaction” center of the brain known as the striatum. The striatum is connected to parts of the frontal lobe known to be involved

with directing logical thought and action toward goals. The accomplishment of “filling in” a Sudoku puzzle, or solving a whodunnit mystery, releases dopamine—a neurotransmitter long associated with pleasure and addictive behaviors. It delivers a mental “rush” that makes the player crave more. Will Shortz is in fact accurate in labeling his Sudoku habit as addictive.

Subtraction helps us solve the problem of economy. Doing less, *conserving*, doesn’t come naturally. Humans are natural-born adders, hard-wired to push, collect, hoard, store, and *consume*. Perhaps that’s why Costco is so successful—something about taking home thirty-six rolls of toilet tissue makes us feel especially secure.

And therein lies the conundrum. The same penchant we have to “fill in,” to *add*, is exactly why elegance, being subtractive, is so elusive. Whether we’re talking about a product, a performance, a market, or an organization, our addiction to addition results in inconsistency, overload, or waste, and sometimes all three. We all face these types of problems. It is how we handle them that enables or prevents elegance.

Do we really gain through loss? Can we actually *add* value by *subtracting*?

W. L. Gore and Associates, recognized as one of the world’s most innovative companies, completely eliminated job titles and typical corporate hierarchy in order to release the creativity of its staff employees. Toyota’s youth brand, Scion, refused to advertise and drastically reduced the number of standard features on its vehicles to allow ad-averse Generation Y buyers who wanted to make a personal statement to customize their cars with trendy accessories. Europe’s “do nothing” default on organ donations—meaning you are an organ donor unless you opt out—results in nearly

quadruple the participation seen in the United States. The British bank first direct went branchless and became the most highly recommended bank in the United Kingdom. French manufacturing company FAVI realized better employee relations when they eliminated their human resources department. Cities in Holland have eliminated traffic controls and experienced not only better traffic flow but also a significant drop in automobile accidents.

So the answer is yes. The trick is in understanding what to eliminate, and exactly how to go about it. Sustainability helps us solve that problem; it implies a process that is both repeatable and lasting. To consistently find elegant solutions, we need to alter how we approach problems, so that the principles of symmetry, seduction, and subtraction can be applied effectively, over and over again. A sustainable thinking strategy helps us to do that by giving us a process we can use and reuse to tap the power of the missing piece.

Together symmetry, seduction, subtraction, and sustainability provide a solid framework for understanding how these elements work in the pursuit of elegance. But while each plays a part, it is the *collective* execution of all four elements that determines the uncommon simplicity and surprising power we seek. Symmetry, for example, doesn't necessarily require or even imply a corresponding subtractive, spare quality. That something is subtractive or spare need not mean it's seductive. And simply because something is seductive in some way does not automatically render it sustainable; it may turn out to be a fleeting fancy. In fact, the elements of elegance can easily conflict with one another. That's one of the things that makes it so difficult to achieve. Elegance is *at once* symmetrical, seductive, subtractive, and sustainable.

It takes a blend of logic and creativity to understand how to balance the four.

c.

There is an old joke among economists that the solution for inflation is actually quite simple: lower the price of what you sell, and pay people less. The point of the joke, of course, is that the solution isn't a solution at all, because it ignores the complexities of a vexing problem. Unfortunately, the quip often plays out in real life. For example, in 2003, Mitsubishi Motors attempted to prop up their flagging sales in the United States with a promotion called Zero-Zero-Zero. Consumers could buy a car with no money down, no payments, and no interest for one full year. Unfortunately, the program lived up to its name: thousands scooped up the offer, driving their car for one year, but then letting the car get repossessed. Mitsubishi's losses approached a half billion dollars from the defaulted loans. The solution failed because it fell short of addressing the more complex issue of why no one was interested in buying a Mitsubishi vehicle in the first place.

When U.S. Supreme Court Justice Oliver Wendell Holmes Jr. said generations ago that "I wouldn't give a fig for simplicity on this side of complexity, but I would give my life for simplicity on the other side of complexity," he meant that to find elegance, you must appreciate, embrace, and then travel beyond complexity. When we use the word *elegant*, we're describing a solution that is as surprisingly powerful as it is

uncommonly simple: it goes to the heart of a wickedly complex problem with such laser-like clarity that it leaves no doubt that the solution is the right one, or at the very least a long way down the right road. Elegant solutions solve intractable problems once and for all without causing further ones. Put another way, not everything simple is elegant, but everything elegant is simple.

Elegance is “far side” simplicity that is artfully crafted, emotionally engaging, profoundly intelligent. It should not be confused with “near side” simplicity, which stops short of confronting complexity, much like the “voluntary simplicity” movement that peaked during the 1990s in the U.S. Pacific Northwest did. In principle espousing a philosophy of more elegant living, in practice it centered more on rejecting and avoiding many of the complications of the modern world—a practice resulting for the most part in simply eliminating many of the conveniences and advantages of a rapidly advancing, technologically progressive society.

Elegance is to this sort of simplicity as chess is to checkers. Both are played on the same board, yet the first demands more strategic thinking and much deeper experience to truly master the goal of immobilizing—checkmating—a single piece, the opponent’s king, in as few moves as possible. Games can go on for days, with no action for hours as the players think through their many moves and countermoves ahead. Checkers, with its mostly single-step play, is far less demanding, easier to learn, and quicker to play.

Chess masters understand the nature of complexity—that it is part of the game, and it’s why they play it. The challenge and thrill lies in the endless search for ways to manage and exploit those complexities. Complexity isn’t the enemy—without it they’d be playing checkers. Similarly, elegance re-

quires the presence of complexity. In much the same way light requires darkness and trust requires uncertainty, without complexity one need not, in fact cannot, talk about elegance.

Elegance is about chess, not checkers.

d.

There is a final oddity about Donald Knuth worth mentioning. He and his wife, Jill, have a peculiar and extensive photo collection of road signs. In fact, they have over eight hundred of them, from all over the United States and elsewhere. They are classified into one of ten major categories: arrows, intersections, lanes, road status, temporary, people, animals, vehicles, entrances, and weather. Each is listed with complete details of the sighting, accompanied by Global Positioning System coordinates. But that's not what makes the collection so strange. Rather, it's the fact that only diamond-shaped signs are included, and at that only the ones Knuth considers truly unique.

Why only those with a diamond shape? The answer is not so surprising. To Knuth, diamonds are the icon of elegance.

Think for a moment about diamonds. They are rare, valuable, and elegant. They are made from the incredibly simple elements, carbon (on which every living organism on earth is based) and oxygen (one of the predominant components of the air we breathe): carbon dioxide. They are formed in nature over eons and under just the right conditions—extreme heat and pressure—through a complex process that rearranges the carbon bonds in a highly organized and enor-

mously powerful way. They are essentially transparent, not unlike Knuth's vision of what elegantly engineered computer code should look like. They can withstand and dissipate tremendous heat and pressure. They are balanced, symmetrical, and multifaceted when cut into gems. Diamonds become more valuable not by the addition of material, but by the subtraction of it—the precise cutting of a raw diamond into a brilliant and polished gem. The end result is seductive, carrying a unique power to captivate and enthrall. Diamonds, so the saying goes, are forever.

It is no mystery, then, why Donald Knuth is attracted to road signs that embody the ideal of elegance: *symmetry, seduction, subtraction, sustainability*.

We're ready to begin our journey. First stop: Symmetryville. What we find there may surprise you.