By Gary Kasparov

In 1985, in Hamburg, I played against thirty-two different chess computers at the same time in what is known as a simultaneous exhibition. I walked from one machine to the next, making my moves over a period of more than five hours. The four leading chess computer manufacturers had sent their top models, including eight named after me from the electronics firm Saitek.

It illustrates the state of computer chess at the time that it didn't come as much of a surprise when I achieved a perfect 32–0 score, winning every game, although there was an uncomfortable moment. At one point I realized that I was drifting into trouble in a game against one of the "Kasparov" brand models. If this machine scored a win or even a draw, people would be quick to say that I had thrown the game to get PR for the company, so I had to intensify my efforts. Eventually I found a way to trick the machine with a sacrifice it should have refused. From the human perspective, or at least from my perspective, those were the good old days of man vs. machine chess.

Eleven years later I narrowly defeated the supercomputer Deep Blue in a match. Then, in 1997, IBM redoubled its efforts—and doubled Deep Blue's processing power—and I lost the rematch in an event that made headlines around the world. The result was met with astonishment and grief by those who took it as a symbol of mankind's submission before the almighty computer. ("The Brain's Last Stand" read the Newsweek headline.) Others shrugged their shoulders, surprised that humans could still compete at all against the enormous calculating power that, by 1997, sat on just about every desk in the first world.

It was the specialists—the chess players and the programmers and the artificial intelligence enthusiasts—who had a more nuanced appreciation of the result. Grandmasters had already begun to see the implications of the existence of machines that could play—if only, at this point, in a select few types of board configurations—with godlike perfection. The computer chess people were delighted with the conquest of one of the earliest and holiest grails of computer science, in many cases matching the mainstream media's hyperbole. The 2003 book Deep Blue by Monty Newborn was blurbed as follows: "a rare, pivotal watershed beyond all other triumphs: Orville Wright's first flight, NASA's landing on the moon…."

The AI crowd, too, was pleased with the result and the attention, but dismayed by the fact that Deep Blue was hardly what their predecessors had imagined decades earlier when they dreamed of creating a machine to defeat the world chess champion. Instead of a computer that thought and played chess like a human, with human creativity and intuition, they got one that played like a machine, systematically evaluating 200 million possible moves on the chess board per second and winning with brute number-crunching force. As Igor Aleksander, a British AI and neural networks pioneer, explained in his 2000 book, How to Build a Mind:

By the mid-1990s the number of people with some experience of using computers was many orders of magnitude greater than in the 1960s. In the Kasparov defeat they recognized that here was a great triumph for programmers, but not one that may compete with the human intelligence that helps us to lead our lives.

It was an impressive achievement, of course, and a human achievement by the members of the IBM team, but Deep Blue was only intelligent the way your programmable alarm clock is intelligent. Not that losing to a $10 million alarm clock made me feel any better.

My hopes for a return match with Deep Blue were dashed, unfortunately. IBM had the publicity it wanted and quickly shut down the project. Other chess computing projects around the world also lost their sponsorship. Though I would have liked my chances in a rematch in 1998 if I were better prepared, it was clear then that computer superiority over humans in chess had always been just a matter of time. Today, for $50 you can buy a home PC program that will crush most grandmasters. In 2003, I played serious matches against two of these programs running on commercially available multiprocessor servers—and, of course, I was playing just one game at a time—and in both cases the score ended in a tie with a win apiece and several draws.

Inevitable or not, no one understood all the ramifications of having a super-grandmaster on your laptop, especially what this would mean for professional chess. There were many doomsday scenarios about people losing interest in chess with the rise of the machines, especially after my loss to Deep Blue. Some replied to this with variations on the theme of how we still hold footraces despite cars and bicycles going much faster, a spurious analogy since cars do not help humans run faster while chess computers undoubtedly have an effect on the quality of human chess.

Another group postulated that the game would be solved, i.e., a mathematically conclusive way for a computer to win from the start would be found. (Or perhaps it would prove that a game of chess played in the best possible way always ends in a draw.) Perhaps a real version of HAL 9000 would simply announce move 1.e4, with checkmate in, say, 38,484 moves. These gloomy predictions have not come true, nor will they ever come to pass. Chess is far too complex to be definitively solved with any technology we can conceive of today. However, our looked-down-upon cousin, checkers, or draughts, suffered this fate quite recently thanks to the work of Jonathan Schaeffer at the University of Alberta and his unbeatable program Chinook.

The number of legal chess positions is 1040, the number of different possible games, 10120. Authors have attempted various ways to convey this immensity, usually based on one of the few fields to regularly employ such exponents, astronomy. In his book Chess Metaphors, Diego Rasskin-Gutman points out that a player looking eight moves ahead is already presented with as many possible games as there are stars in the galaxy. Another staple, a variation of which is also used by Rasskin-Gutman, is to say there are more possible chess games than the number of atoms in the universe. All of these comparisons impress upon the casual observer why brute-force computer calculation can't solve this ancient board game. They are also handy, and I am not above doing this myself, for impressing people with how complicated chess is, if only in a largely irrelevant mathematical way.

This astronomical scale is not at all irrelevant to chess programmers. They've known from the beginning that solving the game—creating a provably unbeatable program—was not possible with the computer power available, and that effective shortcuts would have to be found. In fact, the first chess program put into practice was designed by legendary British mathematician Alan Turing in 1952, and he didn't even have a computer! He processed the algorithm on pieces of paper and this "paper machine" played a competent game.

Rasskin-Gutman covers this well-traveled territory in a book that achieves its goal of being an overview of overviews, if little else. The history of the study of brain function is covered in the first chapter, tempting the reader to skip ahead. You might recall axons and dendrites from high school biology class. We also learn about cholinergic and aminergic systems and many other things that are not found by my computer's artificially intelligent English spell-checking system—or referenced again by the author. Then it's on to similarly concise, if inconclusive, surveys of artificial intelligence, chess computers, and how humans play chess.

There have been many unintended consequences, both positive and negative, of the rapid proliferation of powerful chess software. Kids love computers and take to them naturally, so it's no surprise that the same is true of the combination of chess and computers. With the introduction of super-powerful software it became possible for a youngster to have a top- level opponent at home instead of needing a professional trainer from an early age. Countries with little by way of chess tradition and few available coaches can now produce prodigies. I am in fact coaching one of them this year, nineteen-year-old Magnus Carlsen, from Norway, where relatively little chess is played.

The heavy use of computer analysis has pushed the game itself in new directions. The machine doesn't care about style or patterns or hundreds of years of established theory. It counts up the values of the chess pieces, analyzes a few billion moves, and counts them up again. (A computer translates each piece and each positional factor into a value in order to reduce the game to numbers it can crunch.) It is entirely free of prejudice and doctrine and this has contributed to the development of players who are almost as free of dogma as the machines with which they train. Increasingly, a move isn't good or bad because it looks that way or because it hasn't been done that way before. It's simply good if it works and bad if it doesn't. Although we still require a strong measure of intuition and logic to play well, humans today are starting to play more like computers.

The availability of millions of games at one's fingertips in a database is also making the game's best players younger and younger. Absorbing the thousands of essential patterns and opening moves used to take many years, a process indicative of Malcolm Gladwell's "10,000 hours to become an expert" theory as expounded in his recent book Outliers. (Gladwell's earlier book, Blink, rehashed, if more creatively, much of the cognitive psychology material that is re-rehashed in Chess Metaphors.) Today's teens, and increasingly pre-teens, can accelerate this process by plugging into a digitized archive of chess information and making full use of the superiority of the young mind to retain it all. In the pre-computer era, teenage grandmasters were rarities and almost always destined to play for the world championship. Bobby Fischer's 1958 record of attaining the grandmaster title at fifteen was broken only in 1991. It has been broken twenty times since then, with the current record holder, Ukrainian Sergey Karjakin, having claimed the highest title at the nearly absurd age of twelve in 2002. Now twenty, Karjakin is among the world's best, but like most of his modern wunderkind peers he's no Fischer, who stood out head and shoulders above his peers—and soon enough above the rest of the chess world as well.

Excelling at chess has long been considered a symbol of more general intelligence. That is an incorrect assumption in my view, as pleasant as it might be. But for the purposes of argument and investigation, chess is, in Russkin-Gutman's words, "an unparalleled laboratory, since both the learning process and the degree of ability obtained can be objectified and quantified, providing an excellent comparative framework on which to use rigorous analytical techniques."

Here I agree wholeheartedly, if for different reasons. I am much more interested in using the chess laboratory to illuminate the workings of the human mind, not the artificial mind. As I put it in my 2007 book, How Life Imitates Chess, "Chess is a unique cognitive nexus, a place where art and science come together in the human mind and are then refined and improved by experience." Coincidentally the section in which that phrase appears is titled "More than a metaphor." It makes the case for using the decision-making process of chess as a model for understanding and improving our decision-making everywhere else.

This is not to say that I am not interested in the quest for intelligent machines. My many exhibitions with chess computers stemmed from a desire to participate in this grand experiment. It was my luck (perhaps my bad luck) to be the world chess champion during the critical years in which computers challenged, then surpassed, human chess players. Before 1994 and after 2004 these duels held little interest. The computers quickly went from too weak to too strong. But for a span of ten years these contests were fascinating clashes between the computational power of the machines (and, lest we forget, the human wisdom of their programmers) and the intuition and knowledge of the grandmaster.

In what Rasskin-Gutman explains as Moravec's Paradox, in chess, as in so many things, what computers are good at is where humans are weak, and vice versa. This gave me an idea for an experiment. What if instead of human versus machine we played as partners? My brainchild saw the light of day in a match in 1998 in León, Spain, and we called it "Advanced Chess." Each player had a PC at hand running the chess software of his choice during the game. The idea was to create the highest level of chess ever played, a synthesis of the best of man and machine.

Although I had prepared for the unusual format, my match against the Bulgarian Veselin Topalov, until recently the world's number one ranked player, was full of strange sensations. Having a computer program available during play was as disturbing as it was exciting. And being able to access a database of a few million games meant that we didn't have to strain our memories nearly as much in the opening, whose possibilities have been thoroughly catalogued over the years. But since we both had equal access to the same database, the advantage still came down to creating a new idea at some point.

Having a computer partner also meant never having to worry about making a tactical blunder. The computer could project the consequences of each move we considered, pointing out possible outcomes and countermoves we might otherwise have missed. With that taken care of for us, we could concentrate on strategic planning instead of spending so much time on calculations. Human creativity was even more paramount under these conditions. Despite access to the "best of both worlds," my games with Topalov were far from perfect. We were playing on the clock and had little time to consult with our silicon assistants. Still, the results were notable. A month earlier I had defeated the Bulgarian in a match of "regular" rapid chess 4–0. Our advanced chess match ended in a 3–3 draw. My advantage in calculating tactics had been nullified by the machine.

This experiment goes unmentioned by Russkin-Gutman, a major omission since it relates so closely to his subject. Even more notable was how the advanced chess experiment continued. In 2005, the online chess-playing site Playchess.com hosted what it called a "freestyle" chess tournament in which anyone could compete in teams with other players or computers. Normally, "anti-cheating" algorithms are employed by online sites to prevent, or at least discourage, players from cheating with computer assistance. (I wonder if these detection algorithms, which employ diagnostic analysis of moves and calculate probabilities, are any less "intelligent" than the playing programs they detect.)

Lured by the substantial prize money, several groups of strong grandmasters working with several computers at the same time entered the competition. At first, the results seemed predictable. The teams of human plus machine dominated even the strongest computers. The chess machine Hydra, which is a chess-specific supercomputer like Deep Blue, was no match for a strong human player using a relatively weak laptop. Human strategic guidance combined with the tactical acuity of a computer was overwhelming.

The surprise came at the conclusion of the event. The winner was revealed to be not a grandmaster with a state-of-the-art PC but a pair of amateur American chess players using three computers at the same time. Their skill at manipulating and “coaching” their computers to look very deeply into positions effectively counteracted the superior chess understanding of their grandmaster opponents and the greater computational power of other participants. Weak human + machine + better process was superior to a strong computer alone and, more remarkably, superior to a strong human + machine + inferior process.

The “freestyle” result, though startling, fits with my belief that talent is a misused term and a misunderstood concept. The moment I became the youngest world chess champion in history at the age of twenty-two in 1985, I began receiving endless questions about the secret of my success and the nature of my talent. Instead of asking about Sicilian Defenses, journalists wanted to know about my diet, my personal life, how many moves ahead I saw, and how many games I held in my memory.

I soon realized that my answers were disappointing. I didn’t eat anything special. I worked hard because my mother had taught me to. My memory was good, but hardly photographic. As for how many moves ahead a grandmaster sees, Russkin-Gutman makes much of the answer attributed to the great Cuban world champion José Raúl Capablanca, among others: “Just one, the best one.” This answer is as good or bad as any other, a pithy way of disposing with an attempt by an outsider to ask something insightful and failing to do so. It’s the equivalent of asking Lance Armstrong how many times he shifts gears during the Tour de France.

The only real answer, “It depends on the position and how much time I have,” is unsatisfying. In what may have been my best tournament game at the 1999 Hoogovens tournament in the Netherlands, I visualized the winning position a full fifteen moves ahead—an unusual feat. I sacrificed a great deal of material for an attack, burning my bridges; if my calculations were faulty I would be dead lost. Although my intuition was correct and my opponent, Topalov again, failed to find the best defense under pressure, subsequent analysis showed that despite my Herculean effort I had missed a shorter route to victory. Capablanca’s sarcasm aside, correctly evaluating a small handful of moves is far more important in human chess, and human decision-making in general, than the systematically deeper and deeper search for better moves—the number of moves “seen ahead”—that computers rely on.

There is little doubt that different people are blessed with different amounts of cognitive gifts such as long-term memory and the visuospatial skills chess players are said to employ. One of the reasons chess is an “unparalleled laboratory” and a “unique nexus” is that it demands high performance from so many of the brain’s functions. Where so many of these investigations fail on a practical level is by not recognizing the importance of the process of learning and playing chess. The ability to work hard for days on end without losing focus is a talent. The ability to keep absorbing new information after many hours of study is a talent. Programming yourself by analyzing your decision-making outcomes and processes can improve results much the way that a smarter chess algorithm will play better than another running on the same computer. We might not be able to change our hardware, but we can definitely upgrade our software.

With the supremacy of the chess machines now apparent and the contest of “Man vs. Machine” a thing of the past, perhaps it is time to return to the goals that made computer chess so attractive to many of the finest minds of the twentieth century. Playing better chess was a problem they wanted to solve, yes, and it has been solved. But there were other goals as well: to develop a program that played chess by thinking like a human, perhaps even by learning the game as a human does. Surely this would be a far more fruitful avenue of investigation than creating, as we are doing, ever-faster algorithms to run on ever-faster hardware.

This is our last chess metaphor, then—a metaphor for how we have discarded innovation and creativity in exchange for a steady supply of marketable products. The dreams of creating an artificial intelligence that would engage in an ancient game symbolic of human thought have been abandoned. Instead, every year we have new chess programs, and new versions of old ones, that are all based on the same basic programming concepts for picking a move by searching through millions of possibilities that were developed in the 1960s and 1970s.

Like so much else in our technology-rich and innovation-poor modern world, chess computing has fallen prey to incrementalism and the demands of the market. Brute-force programs play the best chess, so why bother with anything else? Why waste time and money experimenting with new and innovative ideas when we already know what works? Such thinking should horrify anyone worthy of the name of scientist, but it seems, tragically, to be the norm. Our best minds have gone into financial engineering instead of real engineering, with catastrophic results for both sectors.

Perhaps chess is the wrong game for the times. Poker is now everywhere, as amateurs dream of winning millions and being on television for playing a card game whose complexities can be detailed on a single piece of paper. But while chess is a 100 percent information game—both players are aware of all the data all the time—and therefore directly susceptible to computing power, poker has hidden cards and variable stakes, creating critical roles for chance, bluffing, and risk management.

These might seem to be aspects of poker based entirely on human psychology and therefore invulnerable to computer incursion. A machine can trivially calculate the odds of every hand, but what to make of an opponent with poor odds making a large bet? And yet the computers are advancing here as well. Jonathan Schaeffer, the inventor of the checkers-solving program, has moved on to poker and his digital players are performing better and better against strong humans—with obvious implications for online gambling sites.

Perhaps the current trend of many chess professionals taking up the more lucrative pastime of poker is not a wholly negative one. It may not be too late for humans to relearn how to take risks in order to innovate and thereby maintain the advanced lifestyles we enjoy. And if it takes a poker-playing supercomputer to remind us that we can’t enjoy the rewards without taking the risks, so be it.

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