CHAPTER 12

LEARNING TO RACE *WITH* MACHINES: RECOMMENDATIONS FOR INDIVIDUALS

"But they are useless. They can only give you answers."

—Pablo Picasso, on computers[1]

We've talked about our research findings and conclusions with many different groups, from executive teams to radio show audiences. Almost every time we do, one of the first questions is something like, "I have children in school. How should I be helping them prepare for the future you're describing?" Sometimes the kids are in college, sometimes they're in kindergarten, but the question is the same. And it's not just parents who are concerned about career opportunities in the second machine age. Students themselves, leaders of the organizations that might hire them, educators, policy makers and elected officials, and many others also wonder which human skills and abilities, if any, will still be valued as technology continues to improve.

Recent history shows that this is a difficult question to answer. Frank Levy and Richard Murnane's excellent book *The New Division of Labor* was by far the best research and thinking on this topic when it came out in 2004, arguing that pattern recognition and complex communication were the two broad areas where humans would continue to hold the high ground over digital labor. As we've seen, however, this has not always proved to be the case. So as technology races ahead, will it leave a generation behind in all areas, or at least most of them?

The answer is no. Even in those areas where digital machines have far outstripped humans, people still have vital roles to play. This sounds like a contradiction in terms; the game of chess shows why it's not.

Even Though It's Checkmate, It's Not Game Over

After the reigning world champion Garry Kasparov lost to the IBM computer Deep Blue in 1997, head-to-head contests between people and chess computers lost much of their allure; it was clear that future competitions would be increasingly one-sided. Dutch grandmaster Jan Hein Donner summed up the current attitude of human chess masters. When asked how he would prepare for a match against a computer, he replied, "I would bring a hammer."[2]

It might seem, then, that humans no longer have anything to contribute to the game of chess. But the invention of 'freestyle' chess tournaments shows how far this is from the truth. In these events, teams can include any combination of human and digital players. As Kasparov himself explains when discussing the results of a 2005 freestyle contest,

> 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.
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> 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.[3]

The key insight from freestyle chess is that people and computers don't approach the same task the same way. If they did, humans would have had nothing to add after Deep Blue beat Kasparov; the machine, having learned how to mimic human chess-playing ability, would just keep riding Moore's Law and racing ahead. But instead we see that people still have a great deal to offer the game of chess at its highest levels once they're allowed to race with machines, instead of purely against them.

So what are these still-valuable, uniquely human abilities? Kasparov writes about human "strategic guidance" vs. computers' "tactical acuity" in chess, but the distinction between these two is often not clear, particularly in advance. Similarly, as we noted earlier, technology has made deeper inroads into routine tasks than nonroutine work.

This distinction is a valid and important one—adding up a column of numbers is totally routine and by now totally automated—but here again the boundary between the two task categories is not always obvious. Very few people, for example, would have considered playing chess a 'routine' task half a century ago. In fact, it was considered one of the highest expressions of human ability. As the former world champion Anatoly Karpov wrote about the idols of his youth, "I simply lived in one world, and the grandmasters existed in a completely different one. People like that were not really even people, but like gods or mythical heroes."[4] But the human heroes fell to routine, number-crunching computers in this domain. And yet, once they were allowed to work with machines instead of only against them, they reasserted their value. How?

Eureka—Something Computers Can't Do!

Kasparov offers an important clue when describing a match he played against the Bulgarian grandmaster Veselin Topalov, during which they were each allowed to freely consult a computer. Kasparov knew, he wrote, that "since we both had equal access to the same database, the advantage still came down to creating a new idea at some point."[5] As we look across examples of things we haven't seen computers do yet, this idea of the "new idea" keeps recurring.

We've never seen a truly creative machine, or an entrepreneurial one, or an innovative one. We've seen software that could create lines of English text that rhymed, but none that could write a true poem ("the spontaneous overflow of powerful feelings, recollected in tranquility," as Wordsworth described it). Programs that can write clean prose are amazing achievements, but we've not yet seen one that can figure out what to write about next. We've also never seen software that could create good software; so far, attempts at this have been abject failures.

These activities have one thing in common: *ideation*, or coming up with new ideas or concepts. To be more precise, we should probably say *good* new ideas or concepts, since computers can easily be programmed to generate new combinations of preexisting elements like words. This however, is not recombinant innovation in any meaningful sense. It's closer to the digital equivalent of a hypothetical room full of monkeys banging away randomly on typewriters for a million years and still not reproducing a single play of Shakespeare's.

Ideation in its many forms is an area today where humans have a comparative advantage over machines. Scientists come up with new hypotheses. Journalists sniff out a good story. Chefs add a new dish to the menu. Engineers on a factory floor figure out why a machine is no longer working properly. Steve Jobs and his colleagues at Apple figure out what kind of tablet computer we actually want. Many of these activities are supported and accelerated by computers, but none are driven by them.

Picasso's quote at the head of this chapter is just about half right. Computers are not useless, but they're still machines for generating answers, not posing interesting new questions. That ability still seems to be uniquely human, and still highly valuable. We predict that people who are good at idea creation will continue to have a comparative advantage over digital labor for some time to come, and will find themselves in demand. In other words, we believe that employers now and for some time to come will, when looking for talent, follow the advice attributed to the Enlightenment sage Voltaire: "Judge a man by his questions, not his answers."[6]

Ideation, creativity, and innovation are often described as 'thinking outside the box,' and this characterization indicates another large and reasonably sustainable advantage of human over digital labor. Computers and robots remain lousy at doing anything outside the frame of their programming. Watson, for example, is an amazing *Jeopardy!* player, but would be defeated by a child at *Wheel of Fortune*, *The Price is Right*, or any other TV game show unless it was substantially reprogrammed by its human creators. Watson is not going to get there on its own.

Instead of conquering other game shows, however, the IBM team behind Watson is turning its attention to other fields such as medicine. Here again, it will be limited by its frame. Make no mistake: we believe that Watson will ultimately make an excellent doctor. Right now human diagnosticians reign supreme, but just as Watson soon got good enough to beat Ken Jennings, Brad Rutter, and all other human *Jeopardy!* players, we predict that Dr. Watson will soon be able to beat Dr. Welby, Dr. House, and real human doctors at their own game.

While computer reasoning from predefined rules and inferences from existing examples can address a large share of cases, human diagnosticians will still be valuable even after Dr. Watson finishes its medical training because of the idiosyncrasies and special cases that inevitably arise. Just as it is much harder to create a 100-percent self-driving car than one that merely drives in normal conditions on a highway, creating a machine-based system for covering all possible medical cases is radically more difficult than building one for the most common situations. As with chess, a partnership between Dr. Watson and a human doctor will be far more creative and robust than either of them working alone. As futurist Kevin Kelly put it "You'll be paid in the future based on how well you work with robots."[7]

Sensing Our Advantage

So computers are extraordinarily good at pattern recognition within their frames, and terrible outside them. This is good news for human workers because thanks to our multiple senses, our frames are inherently broader than those of digital technologies. Computer vision, hearing, and even touch are getting exponentially better all the time, but there are still tasks where our eyes, ears, and skin, to say nothing of our noses and tongues, surpass their digital equivalents. At present and for some time to come, the sensory package and its tight connection to the pattern-recognition engine of the brain gives us a broader frame.