Artificial Intelligence and Its Implications for Lawyers and Law Schools.docx

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Billionaire investor Warren Buffett recently stated that capitalism inevitably cuts jobs in its quest for greater efficiency, productivity and profit. That is what he says is going on with AI/robotics. While lamenting this dynamic, Buffett did go as far as saying that government needed to develop strategies to help the “Roadkill” represented by workers pushed out of jobs that will not be recreated.1 If we accept the dismal placement figures for recent law school graduates, far too many are “Roadkill”, both because they find out on graduating that there is no place to go for work of the kind they anticipated, or any kind related to law, and because they are burdened by massive debt with little hope of being able to repay that obligation.

This brief look at the effects of technological development on law jobs and law schools is derived from research and analysis developed in a book I have been writing for the past year and a half, Artificial Intelligence, Robotics and Their Impact on Work and Democracy. Although legal education and lawyers are not any direct part of that book’s focus, the developments described there are relevant to law schools and lawyers. So, just “for fun”, the analysis offered below sets out some of the best predictions and warnings related to AI/robotics and asks readers to think about the extent to which the developments have implications for the traditional practice of law as we know it, for law schools as institutions, and for the delivery of legal education and law knowledge.

In setting the framework for this analysis I want to begin with understanding the potential of AI/robotics systems along with some predictions that are being made concerning how those technologies will rapidly alter our society and the nature of employment. A report by researchers at the London Business School concludes there will be sweeping replacement of many human workers by robotic ones within the next twenty years. A report on the London report indicates:

Lawyers, doctors and accountants may be redundant in 20 years after scientists have claimed their jobs will be taken over by robots. A study into the future of human employment has predicted a surge in machine-led work such as robotic counsellors, body part makers and virtual lawyers. This is bad news for those in the [legal] profession, who could see themselves out of a job due to highly-skilled artificial intelligence. The worrying research suggests that humans will be replaced because robots are able to produce better results. 2

The “Existential Threat” Posed By Artificial Intelligence

Although it is not my focus here, I should mention that a possible “ultimate” consequence of AI/robotics is what intellectual or business leaders such as Stephen Hawking, Elon Musk, Bill Gates, Yuval Noah Harari, Nick Bostrom and James Barrat have described as an “existential
threat” to the survival of the human race. I recommend a reading of Harari’s *Homo Deus: A Brief History of Tomorrow*, Bostrom’s *Superintelligence*, and Barrat’s *Our Final Invention* to gain an understanding of why some very bright thinkers consider Artificial Intelligence to be a real threat to the human race.\(^3\)

This claim recently led to a “battle of the billionaires” as Musk has repeatedly warned of the serious implications arising from Artificial Intelligence, and Facebook’s Mark Zuckerberg arguing that AI is a great thing and that Musk is just being irresponsibly negative.\(^4\) Musk responded that Zuckerberg doesn’t know much about AI or actually understand what he is talking about, saying: "I have exposure to the most cutting edge AI, and I think people should be really concerned by it. ... AI is a fundamental risk to the existence of human civilization."\(^5\) It is helpful to keep in mind that Musk has a significant share in the British company DeepMind that is on the cutting edge of AI technology.

While I share some of the concerns about the threat AI/robotics pose, my primary focus in the book is not one of “existential” writ large, but with the impact of the rapid shift toward the use of AI/robotic systems in the workplace, politics, governmental surveillance, grossly inadequate governmental revenues relative to expanding needs for assistance, invasions of privacy, and the empowerment of identity groups and political factions in ways that is undermining our sense of community and causing the fragmentation of our democratic culture into warring factions. The concern about the impact of AI/robotic systems on work is the main point being discussed here. Artificial Intelligence will inevitably replace numerous categories of employment even at the highest levels of our current activity.

**AI/Robotics Systems Are Not Just Another Tool**

AI/robotics systems are a “game changer” altering and contradicting the rules by which we have organized our societies. This includes our educational systems, law schools, professions and economies. Entrepreneur Richard Waters has concluded we are only at the beginning of the transformation being driven by the convergence of AI/robotics, slumping employment opportunities and rising needs for social assistance and added revenues.\(^6\) Waters warns that we make a mistake if we see computers and information systems as just another tool.\(^7\) An innovator in the Artificial Intelligence field explains why AI is having such a sweeping impact.

> "Technologically, it’s a paradigm shift from putting commands into a box to a time when computers watch you and learn." [He adds about his own work]

> "We don’t describe what we’re doing as AI — we call it, ‘automating human-intensive knowledge work’,” ... “Probabilistic techniques are used to “train” machines as they churn through the data, until they are able to see patterns and reach conclusions that were not programmed in at the outset.”\(^8\)

Whether performed by biological cells and neurons or designed into intricate silicon chips, the idea of self-learning systems that grow and evolve through their own experiences sounds much like the way we would describe the trial and error ways humans learn from experience and adapt to the stimuli of their environment. This includes creating
conceptual and interpretive structures that integrate, assess and utilize what is learned. Except now rather than humans we are talking about AI/robotics systems that possess this adaptive learning capability. We are already experiencing one of the significant downsides of the rapid emergence of AI systems, computer applications and dramatic improvements in the technology of robotics. David Rotman explains how the technology is destroying jobs.

[Erik] Brynjolfsson, a professor at the MIT Sloan School of Management, and ... Andrew McAfee have been arguing for the last year and a half that impressive advances in computer technology—from improved industrial robotics to automated translation services—are largely behind the sluggish employment growth of the last 10 to 15 years. Even more ominous for workers, the MIT academics foresee dismal prospects for many types of jobs as these powerful new technologies are increasingly adopted not only in manufacturing, clerical, and retail work but in professions such as law, financial services, education, and medicine.9

Rotman further relates that Brian Arthur: “a visiting researcher at the Xerox Palo Alto Research Center’s intelligence systems lab and a former economics professor at Stanford University, calls it the “autonomous: it involves “digital processes talking to other digital processes and creating new economy.” [He adds] It’s far more subtle than the idea of robots and automation doing human jobs processes,” enabling us to do many things with fewer people and making yet other human jobs obsolete.” 10

Our skills and organizations may be incapable of keeping up because the AI/robotic systems can do the tasks better, more efficiently, or at least less expensively and without the frustrating hassles involved with human workforces. This shortcoming will only get worse as AI/robotics systems make rapid advances. Part of the threat to human jobs is created because an AI/robotic system can not only be more efficient than human workers, but cheaper, more reliable, less likely to complain, take sick days or get pregnant, go on strike, take vacation, demand higher pay or insist that special accommodations be provided, etc. Given the checkered history of labor/management relations in many businesses it is unsurprising that quite a few employers are thrilled to do away with human employees.

Nothing Is Safe or Sacred

One of the main points of this analysis is that although we tend to think in terms of robots taking over lower-level labor-intensive work, the combination of Artificial Intelligence (AI) and robotics will increasingly replace higher-end careers.11 This is already taking place in medicine, finance, journalism and law.12 Many highly compensated Wall Street jobs are being replaced by robots and advanced investment algorithms.13 Newspapers are consolidating. The New York Times is slashing its editorial staff and recently sold its fancy headquarters building while downsizing. The print media industry is shrinking and even
disappearing as technology replaces people and cuts costs. Department of Labor statistics indicate that the newspaper industry lost 60 percent of its jobs over the past sixteen years.\textsuperscript{14}

The issue in what is occurring in terms of job elimination in many industries—both production and service—is timing. It is easy to look around and say “it really isn’t that bad” in relation to the encroachment of AI/robotics on numerous areas of employment, but the fact is that in addition to R&D’s rapid increase in AI abilities there is also the fact that the companies adopting AI/robotics “workers” need to test, calibrate, evaluate and improve the systems’ performance in the workplace. The testing, evaluation and adjustment process takes time. This includes making customers comfortable with the systems in situations where humans and robotics interact.

There should be no doubt, however, that as the AI/robotics “workers” are developed, tested and perfected, the loss of human jobs will accelerate as the sweep and penetration of the systems takes over a significant portion of the workplace. The speed with which this occurs will vary with the economic activity but it will be pervasive. This is one reason why in looking at the predictions of job loss set out below a number of the predictions set the most significant element of job loss at ten to fifteen years from now. That does not mean it is not already occurring or that companies are not committed to more extensive adaptations of AI/robotics technologies, simply that implementation and wide spread adoption are processes and not a single event.

\textbf{Bursting the “Feel Good” Bubble}

Gavin Newsom, a candidate for governor of California, warns of the AI/robotic tsunami coming our way, suggesting it is a crisis for America. In a presentation to computer science students at UC Berkeley, Newsom burst the “feel good” bubble of new graduates about to enter the workforce in the Silicon Valley area.

The … frontrunner to win California’s gubernatorial race next year, warned the students that the “plumbing of the world is radically changing”. The tech industry that would make them rich, Newsom declared, was also rendering millions of other people’s jobs obsolete and fueling enormous disparities in wealth. “Your job is to exercise your moral authority,” he said. “It is to do the kinds of things in life that can’t be downloaded.”

“This is code red, a firehose, a tsunami that’s coming our way,” he told the Guardian a few days after his commencement address at Berkeley. “We’re going to get rolled over unless we get ahead of this.” California, a crucible of technological transformation that is reshaping the world, could be on the cusp of the first major election to be dominated by a debate over what to do about robots.\textsuperscript{15}

Newsom is absolutely correct about the seriousness of the challenge. What is occurring is unfolding quickly. When he highlights the need to “get ahead of this” and urges the
graduates to “exercise your moral authority” the problem is that there is no single point of leverage from which we can manipulate or control what is taking place. His message to “do the things in life that can’t be downloaded” is inspiring oratory. The problem is that we don’t know what those things are, nor do we know if there is “room at the (employment) inn” for what we might want to do even if we somehow figure it out. AI/robotics, much of it based in California but quite a lot in the United Kingdom, European Union, Russia, China and Japan, is reshaping the world but no one has control of the pieces or other “crucibles” of change.

Have We Reached “Peak Human?”

One analyst described what is occurring in finance and banking involving the use of AI and complex algorithms as the moment of “peak human”. This means that AI systems in those disciplines have not only passed the period in which large numbers of human workers are needed, but that economic decision-makers will continue to replace flesh-and-blood personnel with algorithmic workers and advisors in the AI/robotics transformation, perhaps, to their surprise, ultimately replacing themselves. The process of gradual replacement of human workers in the financial sector is described below.

Machine learning, where the decision-making power of algorithms improves as more data are raked in, can replace people in some instances, say finance executives including [the] head of JPMorgan’s investment and corporate bank. Algorithms already tackle tasks such as vetting banking clients, pricing assets, and hedging some orders without human intervention. “As we make those processes more and more efficient, you will need less people to do what we do today”. 16

If the technological and other changes described here are valid, then we may have already reached what has been called “peak human” and can only go downhill from here. Suresh Kumar, chief information officer of Bank of New York Mellon, states that: “Bots armed with AI and the ability to understand and respond in natural language can [already] be used to answer clients’ queries and eventually execute transactions. “You start with something simple, maybe just offering information, then you start doing transactions,” Kumar says. “We obviously want to automate everything, but you have to prioritize.” 17

The labor saving and efficiency multiplying growth of information creation, storage, communication, sharing and application systems made possible through computers, as well as the connective linkages of the Internet and the rise of incredibly large and powerful companies such as Google, Apple and Amazon are causing significant loss of employment, including in the legal profession. This is because those systems are “force multipliers” and allow us to “do more with less” and do it far more comprehensively, thoroughly and quickly. Sophisticated software applications are making it possible to reduce or eliminate many of the functions of millions of jobs in numerous industries. This includes not only lower level positions such as bank tellers, store check out workers, receptionists, gas station attendants, toll booth collectors, etc., but increasingly is eliminating higher level employment niches in
accounting, medicine, law support and law practice, journalism, finance and securities, real estate and insurance.

AI/robotics will also open up alternative pathways to the distribution and use of law knowledge. This will have significant and continuing impacts on the legal profession. If we assume that if law schools exist for the primary purpose of preparing their students to practice law as a main focus, and the functions and methods of that system of law practice change dramatically in form, technique and substance so must the law schools if they hope to remain relevant.

**How Fast Is the AI/Robotics Transformation Occurring?**

*Answer: Very fast, with lightning speed, beyond anyone's rational projections. One report on the rapid progress of AI research states that over the last several years: “The newcomers to AI believe that the technology has finally caught up with the hopes, bringing a heightened level of intelligence to computers.”*  
*They promise a new way for humans to interact with machines — and for the machines to encroach on the world of humans in unexpected ways. The head of a company training computers to replace white-collar workers such as financial analysts says: “it's a paradigm shift from putting commands into a box to a time when computers watch you and learn”.*  

It seems new breakthroughs are announced every day. Artificial Intelligence systems are starting to beat human whizzes in competitive games, including the highly complex Japanese strategy game GO. Nick Bostrom’s 2014 *Superintelligence* book projected that an AI “player” might be able to beat a skilled human GO master in ten years or so. A year and a half from that initial prediction the world's consensus best GO master was left humiliated and depressed. The message is that AI breakthroughs are happening much faster than our best estimates suggest and across a range of functions thought to be reserved to human ingenuity.

Robotics and AI have already been used for surgery and for painting masterpieces. China’s Alibaba is conducting research to allow systems to recognize and understand aesthetic beauty. The company’s CEO, Jack Ma, predicts that sometime in the next 30 years Artificial Intelligence systems are even likely to become CEOs themselves. He admits that we are in for decades of very difficult times as the AI/robotics transition occurs. Ma is likely correct at least in part about the conclusions but the challenge we face is that this is not a “Schumpeterian Cycle”. We are going to experience something much more drastic and longer lasting than several decades of severe economic difficulty.

The rapid development of increasingly sophisticated AI/robotics systems means that job categories we have been thinking are “safe” havens for human workers are being challenged. This is an absolutely critical development because it means that there will be no jobs of the kind that tens of millions of people are capable of doing. Many of those people are young or are residing on the lower end of the socio-economic spectrum with limited education and few resources. This has disturbing implications for the ability of people to patch together more or less temporary jobs in what is being called the “gig”
economy. In the US we are seeing robot fast food cooks, pizza makers, drone delivery systems that are replacing drivers, rapid development of autonomous self-driving cars, buses, delivery vehicles and even semi-trucks that will replace millions of human workers whose qualifications and training don’t prepare them for doing much else.

Replacing humans in the workforce doesn’t stop there. In relation to Japanese robotics Research & Development (R&D), there is ongoing experimentation with robots as caregivers for the elderly in assisted living facilities. This may seem farfetched but if one has had to deal with a parent or grandparent in such facilities, even ones thought of as of higher quality, it is not that difficult to understand how with some further “tweaking” involving a robotic caregiver could be an upgrade to the quality of care received in many of the facilities.

Mimicking or creating the ability on the part on robotic systems to “seem” human is a key element of some R&D efforts. Extensive research is going into how to make the robotic caregivers seem empathetic, communicative and caring as well as efficient. While some may sneer and argue that the robotic caregivers’ portrayal of compassion and caring might be phony, the reality is that the same conclusion can be voiced in relation to many human caregivers. This means that while there is and will continue to be an increasing number of elderly in need of care, and people are being told that this offers a safe and secure career path for future workers, many of the jobs may be filled by “Roberta the Robot” rather than a human worker.

“Genius Squared”: Alternative and Artificial Intelligence Systems v. The Ordinariness of Our Flawed and Limited Humanity

To understand the potential of the AI/robotics “Perfect Storm” consider that according to Masayoshi Son, the CEO of Softbank, a major world actor in AI/robotics and the “Internet of Things”, Artificial Intelligence systems are likely to reach an IQ level of 10,000-level within the next thirty years, perhaps even by 2030. This compares to the human Einsteinian “genius” IQ capacity of 200. Son’s prediction that in less than fifteen years Artificial Intelligence systems could reach the equivalent of IQs as high as 10,000 is frightening, but maybe if we are lucky the AI “brains” will peak at IQ levels of only 500 or 1,000.

Few who pay attention to ongoing AI/robotics research have much doubt that such systems will be able to do many things humans cannot do at all, as well as being able to do much of what we do faster and better. The “deep learning”, “machine learning” and complex neural networks developments unfolding in the field of AI indicate strongly that self-learning, self-programming and even self-replicating systems that learn from experience will move beyond many aspects of human capability and the ability to control. This sounds like science fiction. It is not.

To gain a sense of how AI systems are moving beyond large scale industrial production and similar economic venues into ones that could transfer into the kinds of things lawyers do, one financial analyst describes the significant job elimination already taking place in complex fields of finance and information management, ones sufficiently close to some
areas of law practice to create concerns. Daniel Nadler, chief executive of Kensho, a financial services analytics company partly owned by the Goldman Sachs Group, describes what he sees as ongoing job loss in those fields.

"Anyone whose job is moving data from one spreadsheet to another ... that's what is going to get automated" ... "Goldman Sachs will be in here in 10 years, JPMorgan will be here. They're just going to be much more efficient in terms of operating leverage and headcount," [Nadler] added. Big banks have slashed tens of thousands of jobs in recent years as businesses like bond trading have become less profitable. Under tremendous pressure from investors to boost profits, but unable to grow revenue much, banks have increasingly turned to technology to reduce costs.30

Paul Vigna writes:

Technology is changing the world, but it is also destroying a lot of jobs, causing upheaval, and may even change the very nature of what is considered work.... This will have profound political implications ... but the current crop of national leaders is hopelessly behind this curve, leaving it to central bankers to try and mop up the mess. "Our economy has changed, but voters and their elected representatives don’t seem to know what's really wrong,” [He adds] Every politician promises some variation on the theme of creating a brighter future, whether their “fix” is to build a wall, balance a budget, or make college free. “But here’s the thing... “No one in 2016 is really addressing the future as we are likely to experience it.”31

We are already seeing airborne drone delivery systems, robot chefs and fast food cooks, physical therapists, robot nurses and medical floor managers, robotic surgeons, self-driving motor vehicles, security guards, insurance and travel agents, financial advisers and bankers, 3-D home construction systems that eliminate construction workers, grape and apple harvesters along with considerably more AI/robotics entrants replacing human workers in areas that only a very few years ago seemed impossible. The scale of almost certain elimination of numerous job categories is stunning. Consider, for example, the analysis contained in, “Actors, teachers, therapists – think your job is safe from robots? Think again”.32 It reads:

Thanks to advances in artificial intelligence, many jobs that weren’t considered ripe for automation suddenly are. In the battle for the 21st century workplace, computers are winning. And the odds of us puny humans making a comeback are not very good. A January 2017 report from the McKinsey Global Institute estimated that roughly half of today’s work activities could be automated by 2055, give or take 20 years. ... Robots will destroy our jobs - and we’re not ready for it. 33

AI/robotics will take our work opportunities away and there are limited options for stopping what is occurring. The above report argues:
Computers are not yet as good as humans at things like personal interaction and off-the-cuff decision-making. But that’s changing. Thanks to advances in artificial intelligence, natural language processing, and inexpensive computing power, jobs that once weren’t considered good candidates for automation suddenly are. ... The number and types of jobs that computers can do has expanded enormously in just a few years, ranging from the predictable to the absurd. 34

"If machines are capable of doing almost any work humans can do, what will humans do?"

Think about the possible effects such developments will have on lawyers and therefore should have on US law schools. One response is that what lawyers do is “special” and couldn’t possibly be done by some machine or AI program. Law teachers are likely to say categorically and with an appropriately condescending tone, “An AI program teaching people how to analyze legal doctrine or communicating law knowledge and legal analysis, inconceivable!” Even though I am certain my former colleagues who would voice such a response must be correct, humor me for a moment and see if we can all engage in a literary suspension of judgment and at least consider the possibility that such teaching capabilities in AI systems are looming on the educational horizon.

Moshe Vardi, Professor of Computer Science at Rice University, delivered a talk to the American Association for the Advancement of Science exploring the critical question: "If machines are capable of doing almost any work humans can do, what will humans do?" 35 Vardi is not alone in concluding almost half the world’s workers will be replaced by machines within the next 30 years. If that elimination of human jobs actually occurs, it will wipe out middle-class jobs across a wide spectrum and exacerbate income and wealth inequality.

Increasing wealth inequality as a consequence of the rapid expansion of AI/robotics and human job loss is something beyond a mere possibility. Vivek Wadha, a Professor at Carnegie-Mellon University, set out a vital concern in a 2016 presentation at the World Economic Forum in Davos. Wadha warned about the significant risk that the rapid technological shifts pose for income inequality.

[R]apid, ubiquitous change has ... a dark side. Jobs as we know them will disappear. ... The ugly state of politics in the United States and Britain illustrates the impact of income inequality and the widening technological divide. More and more people are being left behind and are protesting in every way they can. ... The situation will get only worse – unless we find ways to share the prosperity we are creating. 36

Some of the lost jobs will be in law. Even if law jobs were not going to be replaced by AI/robotics technologies they will still be diminished as a result of a reduced base of paying clientele caused by the redistribution of wealth and earnings to the high and low ends of the economic spectrum. If there is the growth in wealth and earnings inequality that is predicted as returns to capital expand dramatically and returns to labor shrink due to what
has been called the “hollowing out of the middle class” there will be far fewer people in the economic middle and lower class who will have the resources to hire lawyers. The really rich people will have their lawyers, of course, but the rest who will have slid rather dramatically down the socio-economic ladder will not be able to pay much. Those at the bottom will be broke and this does not bode well for the legal profession.

Massive Job Losses and Economic Collapse

I hope the most sweeping predictions about the elimination of human employment offered below are overstated. But that could be because I want them to be wrong. They are, however, the best predictions being made by some top-level experts. Unless the predictions are so grossly “over the top” that they are entirely outside reality, we are in serious trouble not only in the US, the UK, and EU but globally. If the predictions are even fifty percent accurate we have a set of problems with which we are unlikely to be able to deal.

What I am talking about is not the absolute replacement of the "human factor". There will be jobs, but not enough. There will be a dramatic drop in opportunity and social mobility. The impossibility of living Horatio Alger’s dream will be an unattainable nightmare for most people. No one knows at this point how far the job loss and blocked socio-economic pathways will go, but some analysts are warning that the penetration of AI/robotics systems into all levels of human activity—work and otherwise—will be deep and profound. Predictions of job loss to AI/robotics range across a wide spectrum but all pose serious concerns. A sampling of those predictions includes projections such as the following:

1. 50% of US jobs will disappear by 2030. [Fast Forward 2030: The Future of Work and the Workplace] or 50% of US jobs will be gone by 2025. [2 Billion Jobs to Disappear (Globally) by 2030].
2. 5,000,000 US manufacturing jobs have already been lost since 2000.
3. 12,000,000 US jobs will disappear by 2026. [Robots Set to Disrupt White-Collar Work, 2016].
4. 500 million jobs in the world’s 25 richest economies will be lost to AI/robotics.
5. 50 percent of today’s work activities will be automated by 2050—give or take 20 years. Robots will take over most of the world’s jobs by 2045.
6. 4.1 million US driver compensated jobs (taxis, semi-trucks, delivery vehicles, busses) will be lost to self-driving vehicles.
7. The continuing improvement in software applications is making it possible for non-specialists to gain knowledge in areas controlled by formerly arcane disciplines such as law so that they can have insight into matters about which they might formerly have sought assistance. The knowledge they gain may be imperfect or “spot on” but we are becoming a nation of “pseudo-experts” and “quasi-experts” to the point that traditional disciplines will be challenged by non-specialists’ vastly increased access to the “secrets” of those disciplines. Law knowledge is one area where this is occurring.
8. Imposing a $15 minimum hourly wage in the US could eliminate between three to five million jobs. [Earned Income Tax Credit Is Better Tool to Raise Income than $15 Minimum Wage, 2016].

9. Black males in US have an unemployment rate of 17.5% and Black teenagers an unemployment rate of 41%. Youth unemployment is threatening the future of millions of young Europeans. The unemployment rate in the eurozone reached 10% in 2009, “and has been stuck in double digits ever since. On average, more than one out of five young people in the labour force are unemployed, but in the worst hit crisis countries, almost half of people looking for work can’t find jobs.” (From Nobel Laureate in Economics, Joseph Stiglitz).

10. The McKinsey Global Institute has warned that if the “slow growth” conditions of the past decade continue, up to 80 percent of people in developed economies could see flat or falling incomes. MIT researchers report a large-scale “hollowing out” of the US middle class with many sliding down on the socio-economic ladder. While working hours are at an all-time high human productivity has collapsed and earnings are flat or declining for most workers even as the cost of goods and services continues to increase.

11. Half of US households over the age of 55 have no retirement savings.

12. We will increasingly experience a demographic “Age Curse”. By 2050, if current longevity trends continue, the US will have 1,000,000 people aged 100 years. Trends indicate that more than 50 percent of children born today have life expectancies of beyond 100 years. For law schools, as the population shifts to a dramatically older demographic, fewer people will seek enrollment, particularly to become members of a profession that is itself shrinking and suffering lower incomes for most practitioners.

13. While Social Security, Medicare and Medicaid are in trouble on the federal level, state and local pension plans in the US collectively have significant shortfalls in the trillions of dollars they are unlikely to be able to meet. Private sector pension plans run by corporations are also at significant risk.

14. Significant numbers of large private companies have consistently underfunded their pension plans to the point of non-viability and, as a number of those corporations declare bankruptcy due to economic conditions, they will shed those pension promises and leave their workers high-and-dry.

15. The US is bankrupt. We are not only “between a fiscal rock and a hard place”- we are “being crushed beneath the rock”. David Walker, a former US Comptroller-General has warned that an honest analysis of the US national debt, including large scale off-budget borrowing, makes that debt obligation closer to $65 trillion rather than the $18 trillion when he spoke in 2015 or the current official figure of $19.8 trillion. Given that the US is adding between $500 billion and $1.5 trillion annually to its national debt depending on what is counted, there is no way it will ever be paid off.

16. Laurence Kotlikoff, a Boston University economist, has testified to Congress that when you apply what he calls the “Infinite Horizon” fiscal gap methodology to US debt obligations, that still growing figure is $210 trillion,
or more than ten times what is officially stated. The Infinite Horizon budget gap approach takes into account all the already committed federal government financial obligations.

17. The Congressional Budget Office (CBO) has warned repeatedly over the past several years that the US faces a serious fiscal crisis that will hit within the next decade if we do not make the hard decisions required to deal with our national debt, and that failing to make needed decisions in the next few years risks our fundamental economic health.

**Fast Forward 2030: Large Scale Job, Fiscal and Social Disruption**

As if the predictions of job loss listed above were not enough to trigger some concern, an intriguing report, *Fast Forward 2030: The Future of Work and the Workplace*, concluded:

> Artificial intelligence will transform businesses and the work that people do. Process work, customer work and vast swathes of middle management will simply disappear. [One key conclusion of the Report is that] *Nearly 50 percent of occupations today will no longer exist in 2025.* New jobs will require creative intelligence, social and emotional intelligence and ability to leverage artificial intelligence. The next 15 years will see a revolution in how we work, and a corresponding revolution will necessarily take place on how we plan and think about workplaces. By 2030, a majority of real estate transactions may be made online. And most of them will be made using real time marketplaces, the report noted.38

The projections offered in reports such as *Fast Forward 2030* may be accurate, overstated or truly dire. But, as shown here, the authors of that study are far from alone in what they describe.39 Something is happening that is transforming the world of work and destroying human jobs across a wide and diverse spectrum while shrinking the middle class on which strong democracies depend. One recent prediction states a “disruptive tidal wave” in the workplace will begin by 2021. Brian Hopkins of the market research company Forrester warns: “*Solutions powered by AI/cognitive technology will displace jobs, with the biggest impact felt in transportation, logistics, customer service and consumer services.*”40

We increasingly hear about the “hollowing out of the middle class”, but we are not paying adequate attention to the impact this will have on the composition of our society or what the “hollowing” portends for our political, economic or educational systems. The impacts include rising burdens on national budgets and the question of whether anything close to a somewhat coherent community can continue to exist.41 We are already experiencing the rise of an internal “civil war” between identity groups of all kinds seeking greater shares from the public purse and special treatment and entitlements under law while muffling any criticism of their position. These challenges have begun to “hit” our supposedly democratic society with force and will only get worse as AI/robotics further penetrates the system at all levels and functions with more and more of our population “left out in the cold”.

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Although the 2013 landmark study by Carl Frey and Michael Osborne, *The Future of Employment: How Susceptible are Jobs to Computerisation?*, focused on the loss of repetitive low-skilled jobs, no area of work is sacrosanct. As lawyers and recent law graduates have already painfully discovered in their own niches of traditional employment, the “winds of change” are blowing through the economic system in ways that are eliminating work opportunities from the most “intellectual” activity down to the most basic areas of services and labor.

Some analysts predict that fifty percent of jobs currently done by humans could disappear in the next ten years. One US-based study predicts the loss of 12,000,000 American jobs in less than ten years. Another projects a six percent permanent US job loss within the next half-decade. That study also asserts:

> Developments in robotics and technology mean more and more white collar jobs are being automated and performed by machines, according to experts, who also predict that this automation could solve the productivity gap. *Estimates of the impact of robotic automation vary, but market research by Forrester forecasts that automation will replace 12 million jobs in the U.S. by 2025…* The jobs most likely to be disrupted by automation will be roles in customer service, office and administration.

The report claims that other jobs will be created to replace what is lost. Of course *some* new jobs will come into being. But far fewer jobs for humans will exist, regardless of what they are. Nonetheless, the analysis in the above-cited report does suggest: "The cognitive era will create new jobs, such as robot monitoring professionals, data scientists, automation specialists, and content curators," [the report said]. "But the transformation of existing jobs resulting from reengineering a process to use cognitive support — such as turning low-value data entry work to higher-level analyst or customer-oriented roles — will be even more dramatic."  

Frey and Osborne point out that we don’t know what type of new work will be created. We have already seen a shift away from agriculture and manufacturing jobs and, as more jobs become automated, repetitive, low-skilled work will vanish. Given that we are in a society where many people are mainly or solely qualified to work in those “repetitive, low-skilled” jobs and are unlikely to suddenly develop the ability to do higher end innovative, technical, scientific and conceptual work, the inevitability of massive job loss on the basic levels of work poses an extreme challenge.

**This Is Not a Schumpeterian Cycle: We Must Create Strategies to Protect Human Workers as an “Endangered Species”**

My “bottom line” is simple. It is that if we do not get a handle on the processes of change and make strong, fast and accurate decisions that at least slow down the transformation, Western society as we know it is going to collapse. If Oxford university economists Carl Frey and Michael Osborne’s estimation of probable US job loss by 2030 at 47 percent is even close to accurate no society is equipped to deal with such an economic nightmare. It is
impossible to know what will occur with full precision, but that level of job loss, or anything even close to it, will produce a wide range of harmful and even devastating impacts.

In their 2013 study of the massive impacts of computerization on human jobs, Frey and Osborne indicate that the AI/robotics technological shift is not like others we have experienced. Their fear is that unlike what has occurred in connection with other transformations of our economic system, there may not be a significant employment recovery on the other side of the downturn. They highlight this fact by observing:

This raises questions about: (a) the ability of human labour to win the race against technology by means of education; and (b) the potential extent of technological unemployment, as an increasing pace of technological progress will cause higher job turnover, resulting in a higher natural rate of unemployment. ... While the present study is limited to examining the destruction effect of technology, it nevertheless provides a useful indication of the job growth required to counter-balance the jobs at risk over the next decades.48

What is occurring is unique and outside what is generally referred to as Austrian economist and Harvard University professor Joseph Schumpeter's cyclical process of “Creative Destruction”. The Schumpeterian cycle was one in which, after a period of crisis and job loss due to changing technologies, there is a “rebirth” in which large numbers of new jobs are created. Our problem is that rather than going through a difficult economic and technological cycle, we are quite possibly experiencing a permanent transformation that will leave very large numbers of people chronically or permanently unemployed or underemployed. Our entire concept of work, the role of governments, and the abuses of power by whoever controls the “machines” are at risk.

“Creative destruction” in Schumpeterian terms stands for a cycle of innovation. It involves the destruction of existing social and economic structures as the new technology is adopted and widely incorporated into our productive activity, and then a rebirth and a blossoming of new jobs. Some are harmed by the transition but in a general sense the overall society is enriched as the new system takes hold. In this classic Schumpeterian model pre-existing economic forms are destroyed by new technologies, and then eventually replaced by even better (in some ways) forms of work.49 The process is neither neat nor painless for those who lose out as their world disintegrates around them. There is significant turmoil and displacement for many people as the familiar world of work shifts. Those displaced by the economic transformation suffer, but in a macro-economic sense the overall community ends up benefitting as new types of jobs are created in large numbers.

The challenge we face is that AI/robotics is not simply a temporarily disruptive set of technologies in the Schumpeterian sense. AI/robotics appears to represent something new and different that will leave us with limited options and a radically changed social, economic and political environment. What is now occurring is too profound, too different, too sweeping, too fast and too comprehensive. This is an economic, technological and social
“event” unlike anything we have previously faced. It can be compared to a gravitational “Black Hole” with such power that everything is drawn into it, and even the “light” of American legal education cannot escape its power. “Business as usual” will be suicidal for a significant number of law schools.

Another analysis of the “Non-Schumpeterian” nature of what we are experiencing concludes:

Past economic revolutions—from the steam engine to the jet engine and the internet—created in their wake a productivity revolution. To be sure, as brute force or slower technologies lost out, so did some companies and classes of people. But generally the economy got stronger and more productive. People got places sooner, information flows quickened, and new jobs were created, many of them paying middle- and working-class people a living wage. This is largely not the case today. As numerous scholars ... have pointed out, the new social-media based technologies have had little positive impact on economic productivity, now growing at far lower rates than during past industrial booms, including the 1990s internet revolution.  

In that regard, Howard Schneider observes:

The data highlight a central question: has the nation's ability to generate well-paying jobs in manufacturing and other sectors been fundamentally scarred by changes in the global economy that may predate the 2008-2009 economic crisis but were more starkly revealed in its aftermath?  

Schneider then goes on to indicate that we are facing something outside human experience.

At the Fed, Chair Janet Yellen has spoken of the steady drift in national income "away from labor and towards capital," while some policymakers worry the full depth of the changes are not yet clear. "We have to understand what structurally is going on ... Is the country really changing in a fundamental way?" Atlanta Federal Reserve Bank President Dennis Lockhart said last month, citing the possibility that "polarized labor markets" could become entrenched. That would mean a workforce based on large numbers of lower paid workers, with a few highly paid managers, professional and technology workers, and a permanent hollowing out of the middle class.

The forces and technologies pushing us in the “Non-Schumpeterian” direction of job destruction without adequate new job creation are relentless. Even if people do not fully understand what is happening, events are creating a sense of uncertainty. Gillian Tett, in “Investors stockpile cash to offset economic despair” writes: “Asset managers fear that the policy landscape is about to get even weirder and more disorienting.” Tett is correct. Uncertainty about what is happening should be the order of the day. Uncertainty is in fact a reasonable response to what is going on.
Where no one knows where things are heading, no one is in control, and the motivations and needs of the primary actors are in conflict uncertainty is an appropriate state of mind. The normally optimistic Jack Ma, the CEO of the Chinese technological giant Alibaba, recently stated that Artificial Intelligence will cause people more pain over the coming decades than bringing them happiness and a feeling of social and economic security. Ma warned: “Social conflicts in the next three decades will have an impact on all sorts of industries and walks of life.” Ma added: “A key social conflict will be the rise of artificial intelligence and longer life expectancy, which will lead to an aging workforce fighting for fewer jobs.”

Given the radical changes in employment projected to occur over slightly more than a single decade leading up to 2030, the effects on human societies will be as if the bottom fell out of the system of employment on which we depend for our livelihoods, that rely on to fund essential governmental expenditures, and that propel the energy, optimism and sense of purpose in our society. Our workforce and society are not things that can be turned around or redirected immediately, even when it becomes clear we are heading for a collision. They are like massive ocean-going oil tankers that take twenty miles or more to stop even after the captain gives the order. The “course changes” that are required to deal with AI/robotics, job destruction and political discord will take time because the system has developed such incredible weight and momentum. The longer we delay implementing strategies to protect and preserve human work, the more pain is going to be inflicted on people.

The fact is that we need to sustain, improve and facilitate human work even in the face of the developments going on with stunning rapidity in the ongoing shift to an AI/robotics economy and society. As AI/robotics systems improve through such methods as “deep learning”, “machine learning”, “self learning” from experience, and are designed with more advanced neural networks they will spread out into unanticipated work domains where they will be doing most of the work. One probable result is a “permanent economic and social depression”.

Knowing Enough to Formulate Accurate Questions and Search Hypotheses Is Key

I am going to assert here that as a general matter our educational systems are not ready for the challenge, either intellectually or from the perspective of their traditional business models. This inadequacy is not only on the part of American law schools but exists throughout the educational system. As to a significant part of the university system and much of legal education the heavy reliance on a tenured faculty system that more or less rigidly locks people and subject matter into place is something likely to disappear over the next decade.

The world of work and the structure and dynamics of our economic system are moving far too fast for tenured academics to understand or keep up, rendering them not only irrelevant but even counterproductive. It is probable that the traditional model of the university will in many instances be replaced by more flexible and adaptable designs. This will include the elimination of life tenure for most instructors. I will be surprised if there is
not a downsizing and restructuring “bloodbath” in the next decade as tenure and job security for academics are eliminated as a matter of institutional change and survival for many universities and law schools.

One of the challenges for survival in the emerging “new economy” is the acquisition of new skills and strategic approaches to work. A problem at this point is that we aren’t at all sure about what those skills or strategies are. But even if the various predictions about “hot” jobs are correct there is a strong likelihood to the point of near certainty that there will not be enough human jobs to go around, whatever the primary skills might be. This does not even take into account the fact that, contrary to what several analyses of AI/robotics job replacement of human employment sectors claim, some quite intelligent people are convinced that AI systems will develop the kinds of sophisticated “human” qualities associated with the preferred skills in the relatively near future and that AI will replace humans even in advanced conceptual and creative venues.

There is a downside to becoming dependent on systems such as Google. Steven Poole writes about how Google’s amazing information system may be having the effect of causing people to actually know less. This is because they no longer have to “download” information into their own brains but can use Google as an instantaneous data source whenever they need to know anything. 58 This has consequences. Poole asks: “Does anyone know anything any more? The ease with which one can look up facts on a phone at any time is one of the wonders of the modern age. But are we becoming too reliant on it? A new study indicates, at least, that there might be a snowball effect to such reliance. The more we depend on Google for information recall, it suggests, the more we will do so in the future." 59

Poole’s concern about the effects of a “Google fixation” is that: “the ability to draw creative connections between facts may depend on having internalized them already as knowledge, so that they are instantly available to the reasoning mind. Until we have direct brain connections to the internet, it is still far more laborious to look everything up about a topic one wants to think about. Plus, to look something up, one needs to know already what it is one wants to know.”60

The danger is that we can’t test our theories, assumptions and hypotheses or make critical distinctions related to the information acquired unless we have the ability to formulate the questions that need to be answered and use our conceptual structures to evaluate what we find. Excessive dependence on external information sources has a negative effect because we need to have our own conceptual structures in place with significant depth and scope of knowledge in order to formulate the key questions before search systems can provide adequate qualitative information that we have the ability to evaluate rather than take as gospel.

We also need to understand how “things”, informational “bits” and clusters of specialized data interact with other informational points as part of a system, not only as isolated and disconnected “factoids”. Without such overarching and integrative conceptual structures we may have mastered trivia but lack the ability to understand reality and to act upon our
world effectively. This is a key function of education and one we have largely abandoned over the past several decades.

**Critical Thinking: Analysis, Synthesis and Strategic Action**

Critical thinking is going to be increasingly vital in the new economy and society. The problem is that effective critique requires that you actually know something as opposed to simply taking others’ statements at face value. If we pursue data that interests us and we retain, integrate and synthesize the information, we are creating conceptual structures that allow us to recognize and interpret a wider range of experiential stimuli. But if we don’t create a sophisticated, complex, honest and comprehensive conceptual structure, we become overly dependent on external frameworks that may themselves be flawed, whether they are the opinions of human experts or systems such as Google or Facebook that contain their own biases, agendas and limits.

A prescient 2008 analysis by Mark Bauerlein provides a detailed and clear analysis of what has been occurring as the “Digital Age” takes hold. I highly recommend Bauerlein’s *The Dumbest Generation: How the Digital Age Stupifies Young Americans and Jeopardizes Our Future.* Unless we figure out how to overcome the educational limitations and race-based discrimination that are undermining the quality of learning for many of our young people we must count on to contribute and compete in the future, the US will find itself a fading economic and political power.

Don’t get me wrong. I love having instantaneous access to the world’s information base. I no longer have to go through the snail-like pace of traveling to libraries, going through a host of indices, seeing if the particular place had the material, and gaining a context of the best material in a field. I have always been intrigued with the possibility of understanding a wide range of disciplines and knowledge sources. Internet research systems have multiplied the speed and scope of what I can now access by a factor of fifteen or twenty times. Fuller understanding is gained by integrating the best insights and experiences of others into our own intellectual and perceptual systems through which we understand the world we inhabit.

Virtually everything is at my fingertips and I read, integrate, compare material from diverse and conflicting databases, voraciously consume data, learn and impose structure, interpret patterns, predict the implications of trends and project consequences based on my interpretations of that data. It is as if my brain has had a “portable drive” added to it that extends its capacity and ability to access and integrate knowledge. I love this aspect of the information society created by the new technology. That is what I mean when I say the technology alters us, both for good and bad. It is good because it provides this fantastic capability and access to information. It is bad because it is addictive and obsessive, and because it alters the nature of contact between people and accelerates the pace of life.

We are losing our competitive drive while others, particularly in Asia, are intensifying theirs. In the US we commonly hear that jobs involving STEM-educated workers (Science, Technology, Engineering and Mathematics disciplines) represent the safest employment
future for university study. Yet in many instances students undertaking such university majors have shown an unsettling tendency to drop out, allegedly because the subject matter is supposedly too hard or demanding.65

**The American and European “Job Deficits” and the Rise of the “Precariats”**

It is not only the US. Europe is also having serious economic problems. The average level of unemployment among younger workers in the EU is above twenty percent, and in the countries of Southern Europe it is around fifty percent for young people. Nobel economist Joseph Stiglitz describes the situation.

When the US unemployment rate hit 10% in October 2009, most Americans thought that was intolerable. It has since declined to less than 5%. Yet the unemployment rate in the eurozone reached 10% in 2009 as well, and has been stuck in double digits ever since. *On average, more than one out of five young people in the labour force are unemployed, but in the worst-hit crisis countries, almost one out of two looking for work can’t find jobs.* Dry statistics about youth unemployment carry in them the dashed dreams and aspirations of millions of young Europeans, many of whom have worked and studied hard. They tell us about families split apart, as those who can leave emigrate from their country in search of work. They presage a European future with lower growth and living standards, perhaps for decades to come. *These economic facts have, in turn, deep political ramifications. The foundations of post-cold war Europe are being shaken.*66

As the European and US situations indicate, there is absolutely no reason to believe there will be enough “decent” or fulfilling jobs available to satisfy human worker demand even if we had the insight needed to design the most brilliant educational systems. Where young people are headed on the job front is unclear but quite troubling to the point of dismay for their prospects. One report indicates: “In seven major economies in North America and Europe, the growth in income of the average young couple and families in their 20s has lagged dramatically behind national averages over the past 30 years. In two of these countries – the US and Italy – disposable incomes for millennials are scarcely higher in real terms than they were 30 years ago...”67

This economic slippage has resulted in the development of the concept of the *Precariat* and *Middle Precariat* to represent just how shaky many Millennials are finding the world of employment and opportunity, including lawyers.68 We are metaphorically “between a rock and a hard place” in terms of the future of employment.69 Universities and other elements of our education and training system are likely to be preparing students for areas of work that either have only a limited number of slots available or represent categories of employment that are moving targets that keep “slip sliding away” as the AI/robotics transformation continues to unfold and supplants human workers in a progressively wider zone of activity.70
Reports indicate that young people may be anticipating frequent job movement throughout their lives with as many as 15-20 different jobs in a sort of “Gig” economy rather than having a single career with one or two employers. Whether from choice or necessity, if it does come to dominate the workplace this pattern will have a significant impact on employee loyalty and quality of performance. It also suggests the need for diverse skills given the likely range of employment contexts and this has significant implications for educational processes that need to provide students with a wide range of skills and subject matter as those individuals seek to adapt to a rapidly changing and diverse working context.

The worlds of work and education need to be structured into systems that deal with the continually changing “moving targets” in which knowledge is required over a lifetime of changing and evolving needs, rather than focusing to deliver a massive input of information in a tightly bound and structured disciplinary curriculum process delivered over a fixed and limited period. Educators need to be dynamic and evolving actors, not masters of disciplines that are more or less fixed or seen as changing only slowly within a tightly bound field of specialization.

Even that idea of continuing and flexible adaptation may be only a dream for many because such transient patterns of work demanding frequent adaptation and new information, skills and insights may not even be available for most people. Those other than the most fortunate and talented may find the world of work to be a desperate patchwork process of “scrabbling” around in highly uncertain work environments seeking to make ends meet. In that more likely reality people will move from one short-term position at low pay, inadequate or no benefits, and limited or non-existent security to another. The frequent movement will be due to job insecurity or elimination rather than enlightened worker choice.

**Say Goodbye to Many of These Jobs**

There are job-types in which AI/robotics research and quite a few breakthroughs and applications are already taking place, with numerous others on the cusp. While economies of scale may allow some work niches to be preserved in which an activity is simply not worth the capital investments required to replace human workers, or are artisanal crafts that have a certain uniqueness or “snob appeal” sufficient to maintain a market presence, in many areas of work activity the AI/robotics R&D will allow such systems to supplant human workers in many areas of work, if we let that occur.

1. Finance and investment, accounting, banking.
2. Operations managers, retail sales [ongoing and very significant elimination of jobs and stores], clerical and filing, record keeping and retrieval, technical professionals with formulaic tasks (CPAs, Tax Preparers, Workers Compensation, etc.), measurement workers (meter readers, pool maintenance, etc.).
3. Delivery [surface and air delivery systems are developing rapidly] and paid driving [buses, delivery trucks and vans, semi-trucks, taxis, limos, school bus drivers, Uber and Lyft drivers].

4. Insurance advice and agents, real estate agents, travel advisers and agents.

5. Fast food cooks, chefs, food preparation, waiters, food services.

6. Lawyers, paralegals, law-supported ancillary jobs, lower-level judges, magistrates and law clerks, court reporters, law professors.

7. Surgery and other medical jobs, medical diagnosis, nursing, assisted living aides, home health aides, counselors and emotional therapists, physical therapists, nursing home workers.

8. Public bureaucracy (federal, state and local), private corporate bureaucracy.

9. Security services, police, military, surveillance.


11. Journalism, writing, newspapers, various media.

12. Teachers and educators, university and elementary and high school staff, librarians.

13. Lawn mowing, grape picking for wine making, apple and other large scale harvesting, cowboys and herding, manufacturing (large system), manufacturing (small system), car production, mechanical repair and maintenance, warehousing.


15. Retail services and cashiers.

**What Skills and Jobs Are Likely to Be the Most Important Or Lasting?**

An example of concerns about the most productive skills and strategies for human workers is found in Charlotte Seager's analysis in "After the robot revolution, what will be left for our children to do?" She echoes Oxford University economists Carl Frey and Michael Osborne in suggesting there are important areas of work in which humans will be able to maintain their superiority and outperform AI/robotics systems—at least for a time. These areas are presumably intended to be our “safety net” in which there is a unique reservoir of human talent and capability that will allow our children and their descendants to sustain themselves productively in a society shared with AI/robotic systems.

In presenting her arguments (or hopes) Seager indicates: “there are three types of roles that we won’t easily be able to automate, and jobs for the next generation will focus on
These areas of continuing human employment are supposedly ones that require social skills, creativity and the ability to engage in “object manipulation” autonomously without continual oversight and input from human operators. I am considerably less optimistic than Seager or the Oxford researchers.

While Seager reaches her conclusion based largely on the research and assumptions of Frey and Osborne there is considerable ongoing research and development in AI/robotics that is aimed at overcoming the kinds of “humanistic” and technical obstacles Seager, Frey and Osborne describe as being uniquely in the realm of human capability and outside that of AI/robotics systems. Within the very near future there may be few functions that are beyond the performance capabilities of AI/robotics.

If you read the full Frey/Osborne analysis, their assertion is that the three areas of work involving social skills, creativity and object manipulation and dexterity will be continuing sanctuaries for human employment beyond the relatively short-term. This is certainly accurate to some extent but is less than fully convincing as an overarching proposition. My concern is due to the core assumptions made by the authors about the limits of Artificial Intelligence systems because there has been extremely rapid and diverse technological progress in AI/robotics just in the four years since the 2013 Frey/Osborne study.

Frey and Osborne did take care to note that advances that might be made in machine learning, deep learning or self learning, coupled with autonomous operation by AI systems could mean that such systems would become able to learn in ways that allow the technologies to replace humans in one or more of the three areas involving Social, Creative, and Autonomous Object Manipulation capabilities. They thought this “could” occur in the relatively distant future. The unfortunate fact is that there are already rapidly evolving developments in AI capabilities and robotic performance just since their 2013 report point that suggest the technology will “leapfrog” the Frey/Osborne predictions.

According to Seager the “Social” category is one in which humans are expected to have a continuing advantage. She explains that jobs that involve complex social interactions won’t be easy for a machine to do. In relation to the Oxford study Seager explains: “If you think of all the social tasks – negotiating or taking care of others – it is almost unthinkable that a robot will acquire these skills at human levels of social intelligence” says Frey. So careers such as teaching, social care, nursing and counseling are all likely to stay after the robot revolution.” Yet significant work on social care, nursing and even counseling using AI/robotic systems is ongoing.

Nor is it necessarily the fact that human workers who occupy such positions actually provide the kind of idealized behaviors that are implied by Frey. There are quite a few poor teachers, uncaring social care workers, negligent nurses and ineffective counselors. There are even a few incompetent and dishonest lawyers who provide less than stellar representation to clients or steal from them. One question, therefore, is how “human” must a robotic system be in order to provide what is accepted as adequate service and assistance in such jobs? Assessing the standard that needs to be met in relation to an ideal or a level of performance that only the very best human teachers, counselors, care givers, nurses,
lawyers and the like provide represents something that misstates what AI/robotics systems need to be able to do to provide consistently good work at a decent level that on average meets or exceeds what is generally done in a particular area of work.

The “Creative” advantage of humans over AI is said to be due to the fact that while: “Computers are very good at processing problems once the problem has been specified … they’re not as good at generating new creative ideas,” [Frey observes]. So [Seager notes] artists, writers and musicians will all be safe – but this creativity is relevant to the science, technology, engineering and maths (Stem) sectors, too, meaning high-level engineers, mathematicians and those working in the sciences are also less likely to be susceptible to automation.” 76 As is suggested above and shown at various points in the analysis of the very rapid progress being made in AI/robotics design and applications, such assertions are in some areas of work little more than wishful thinking. AI is already writing novels, news stories, plays, movie scripts, painting art works and much more.

It is misleading to pin projections of future work opportunities on skills many people do not possess, while ignoring the fact only the few who truly excel in such areas will dominate a limited employment pool. Trying to figure out what skill sets will be most advantageous in the new economy is a challenge. There aren’t going to be enough jobs to go around. In the context of the “soft skills” (interpersonal, creative, artistic, aesthetic, quality of judgment, etc.) that are frequently being cited as unique to humans, it is delusional to fail to consider that AI systems appear well on the way to developing “human” abilities that will allow them to supplant biological humans in many work contexts requiring such skills.

An example of the possibility of AI/robotics systems achieving “human” capabilities is suggested in a recent report that Facebook’s researchers have been developing “bots” that can negotiate and compromise. This offers insight into how far and fast AI systems might be able to go in their evolution.77 Another report suggests that serious research is being done into creating an AI system with imagination.78 Of course the R&D on such capabilities isn’t complete but the research is well underway.

The irony—whether tragic or amusing—in the Facebook situation involving negotiation is that the AI bots apparently learned how to lie as well as negotiate. When we talk about mimicking human intelligence, that is absolutely “too human” and suggests that “AI lawyers” pose a threat to their human counterparts in terms of their ability to master the craft of law practice.79 AI systems are also said to be showing biases that were somehow programmed into them at the beginning even if the programmers did not understand that they were injecting those biases into the programming.80

“Enterprise” Skills

As to the issue of what types of skills will give an individual a competitive advantage in the emerging workplace, one analysis contained in The New Basics report reveals that some employers are beginning to place a premium on what are being labeled as “enterprise skills”.81 The researchers found an increasing demand for “enterprise skills” of the kind
considered to be the skills required to function most effectively within a business activity and for an individual to provide the greatest “value-added” to an enterprise. These enterprise skills include digital literacy (demand noted during the period increased by 212%), critical thinking (increased by 158%), creativity (increased by 65%), and presentation skills (increased by 25%).

As part of a report by the Committee on Economic Development of the leading business group, The Conference Board, Monica Herk lists seven “general” skills that most employers are looking for in addition to the technical skills and knowledge most essential for specific jobs such as data management, finance, accounting, computer coding and the like. She writes: “Having excluded attributes that are either less “trainable” or very difficult to demonstrate through any sort of standardized assessment, the remaining skills and knowledge that appear repeatedly on employer surveys seem to me to fall into seven buckets of related skills that I call the Big Seven.”

1. Teamwork

2. Communication, communication, communication

3. Quantitative and analytical skills/critical thinking

4. Creativity and problem solving in the real world

5. The ability to keep up in a rapidly changing world... In older surveys this often appeared simply as “computer skills,” but now, given the rapid change in a wide variety of technologies, I have seen it expressed as “the ability to stay current on changing technologies and their applications to the workplace.”

6. [All] While staying organized and keeping one’s head above water. Given the firehose of data, new information, new technology and just general change that many workers increasingly face in their jobs, another bucket of skills – again, based on employer surveys – has to do with being organized and having the ability to prioritize what is important and what is less so. At higher levels, I group this with strategic planning or having a “design mindset” – i.e., “the ability to represent and develop tasks and work processes for desired outcomes.”

7. Diversity and cultural awareness.

What these “skills” actually mean and how it can be determined whether an individual possesses them is challenging. Even beyond the issues of definition, recognition and substance, we need to ask the extent to which such diverse skill sets are teachable versus representative of innate qualities that one either “has” or does not. Creativity, for example, is not something possessed by all or even by many. There is also an important issue of creativity in specific dimensions of activity. Some people are artistically creative while
others are financially creative along with numerous other variants of the supposed skill such as mathematical skill or pattern recognition. It is necessary, therefore, to ask, “creativity” for what category of activity.

Digital literacy, another frequent component of skill lists, is a technical skill that many Millennials and even ten year olds possess to some degree. So while digital literacy will be a necessary qualification, it is a “dime-a-dozen” factor unless linked to something such as high creativity in a relevant area of work activity and advanced innovative ability. Critical thinking, creativity, pattern recognition and the ability to possess deep knowledge in multiple fields and to effectively cross-reference, interpret and apply that knowledge can be developed at the margins. That capability can be improved through education, but at the higher ends of such skills only a few excel while most others basically “try hard”.

In my experience a surprisingly small portion of the American population lacks the capacity or willingness to do high-level critical thinking. Our educational systems have turned out to be substandard in teaching the partly innate, but still teachable skills of critique, analysis and synthesis. Critical thinking and analysis “hurts” and when it involves assessing human behavior and needs requires us to understand ourselves and others far better than we like. It requires the questioning of virtually everything and the ability to recognize the links and interactions between the different elements with which we are dealing. In the ultra sensitive and politically correct world we have now created, that kind of questioning and critique can get you into trouble and offend many who take their conception of reality for a given and resent and even punish and ostracize anyone they feel is challenging or contradicting the tenets of their belief system, comfort zone or “safe space”.

As to presentation and communication skills—or, written and visual—a larger number of people may have those skills to a reasonable level but there will only be a need for a limited number who can communicate clearly and persuasively. That number represents only a small percentage of the overall employment market. What many young workers will face with the growing use of AI systems that multiply individuals’ productivity, is that we will increasingly see the employment equivalent of “No Vacancy” signs on the most desirable employment niches. Many people will want the jobs but only a limited number will be needed.

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8 Richard Waters, “Investor rush to artificial intelligence is real deal”, Financial Times, 1/4/15. http://www.ft.com/cms/s/2/019b3702-92a2-11e4-a1fd-00144feabdc0.html#ixzz3Nxmi03Q.


http://www.washingtongexaminer.com/a-first-more-workers-at-online-sites-than-newspapers/article/2594197.


Official US Labor Department data showed the newspaper sector lost 271,800 jobs in the period from January 1990 to March 2016, or 59.7 percent of the total over the past 26 years. The numbers, first cited in a report by the news website Engadget, confirm the massive shift to digital media that has hammered traditional newspapers. Magazines fared only slightly better, losing 36 percent of their jobs in the same period. Employment in Internet publishing and broadcasting, meanwhile, rose from about 30,000 to nearly 198,000, the Bureau of Labor Statistics data showed. The growth in digital has coincided with a drop of some 27 percent of the jobs in radio, according to the figures.


“California’s would-be governor prepares for battle against job-killing robots”, Paul Lewis, 6/5/17.


“We’ve Hit Peak Human and an Algorithm Wants Your Job. Now What? On Wall Street, the still-essential business of banking will go on—but maybe without as many suits”. Hugh Son, 6/8/16.
Are the humans of finance an endangered species? People are still the lubricant that oils the wheels of finance, toiling at innumerable tasks—executing and settling trades, writing analysis, monitoring risk. That’s about to change. Squeezed by low interest rates, shrinking trading revenue, and nimble technology-based competitors, banks are racing to remake themselves as digital companies to cut costs and better serve clients. In other words, they’re preparing for the day that machines made by men and women take over more of what used to be the sole province of humans: knowledge work. Call it self-disruption.


Machine learning, where the decision-making power of algorithms improves as more data are raked in, can replace people in some instances, say finance executives including Daniel Pinto, head of JPMorgan’s investment and corporate bank. Algorithms already tackle tasks such as vetting banking clients, pricing assets, and hedging some orders without human intervention. “As we make those processes more and more efficient, you will need less people to do what we do today,” Pinto says.


Robo advisers—automated investment services that assess risk tolerance and manage a portfolio of exchange-traded funds at a low cost—are running into the realities of the highly competitive wealth-management market, including thin profit margins. So they are expanding in areas that didn’t used to be associated with robo advisers, including managing “529” college-savings plans, administering 401(k) retirement accounts and adding account features that involve partnerships or co-branding deals. In effect, as traditional brokerage firms challenge the robos with their own lost-cost offerings, the robos are evolving. For individual investors, this evolution is blurring the line between the robo advisers and the more traditional investment firms such as Vanguard Group, Charles Schwab Corp. and Fidelity Investments, which are quickly adding automated services. Wells Fargo & Co., J.P. Morgan Chase & Co., Bank of America Corp. and Citigroup Inc. have all said they plan to offer low-
cost, automated investment services either on their own or by joining with a private-label robo adviser.


DeepMind’s latest AI, unveiled yesterday, has cleared one of the important hurdles on the way to human-level AGI – artificial general intelligence. Most AIs can perform only one trick because to learn a second, they must forget the first. The problem, known as “catastrophic forgetting”, occurs because the neural network at the heart of the AI overwrites old lessons with new ones. DeepMind solved the problem by mirroring how the human brain works. When we learn to ride a bike, we consolidate the skill. We can go off and learn the violin, the capitals of the world and the finer rules of gaga ball, and still cycle home for tea. This program’s AI mimics the process by making the important lessons of the past hard to overwrite in the future. Instead of forgetting old tricks, it draws on them to learn new ones. Because it retains past skills, the new AI can learn one task after another. ... There is no doubt that thinking machines, if they ever truly emerge, would be powerful and valuable. Researchers talk of pointing them at the world’s greatest problems: poverty, inequality, climate change and disease. They could also be a danger. Serious AI researchers, and plenty of prominent figures who know less of the art, have raised worries about the moment when computers surpass human intelligence. Looming on the horizon is the “Singularity”, a time when super-AIs improve at exponential speed, causing such technological disruption that poor, unenhanced humans are left in the dust. These superintelligent computers needn’t hate us to destroy us. As the Oxford philosopher Nick Bostrom has pointed out, a superintelligence might dispose of us simply because it is too devoted to making paper clips to look out for human welfare.

23 Bostrom, Superintelligence, supra, n. at 16.
25 http://www.scmp.com/tech/enterprises/article/1934516/alibabas-ai-out-prove-it-can-recognise-aesthetic-beauty-predicting. Alibaba’s ‘Ai’ out to prove it can recognise aesthetic beauty by predicting winner of reality TV singing contest 4/7/16 and 8/5/16. “Artificial intelligence software from China’s e-commerce king will be put to the test this Friday on Hunan TV’s ‘I’m a singer’”. http://www.telegraph.co.uk/technology/2016/05/06/google-ai-to-learn-art-of-conversation-through-erotic-novels/. “Google AI to learn art of conversation through erotic romance novels”, Cara McGooagan, 5/6/16.
27 http://www.theguardian.com/lifeandstyle/2016/mar/14/robot-carers-for-elderly-people-are-another-way-of-dying-even-more-miserably. “Robot carers for elderly people are ‘another way of dying even more miserably’: Japan has a robot with 24 fingers that can wash hair, while in Europe we’re getting a ‘social companion robot’. I’m going off for a little cry”, Michele Hanson, 3/14/16.
Scientists, signalling the approach of an era in which human intelligence can be supplemented by that of machines.

Hundreds of documents prior to trials; and on technology, many jobs that weren't considered ripe for automation suddenly are. In the battle for “Actor inequality,” 8/11/16. “When it comes to caregiving, these robots may be better companions than humans”, Dan Bobkoff and Andrew Stern, 7/11/16.

Robots might be machines, but that doesn't mean they can't care for humans. For those with autism, a new generation of robots is making a big difference. Some, experts say, are better than humans at teaching autistic people how to understand human emotions. For the elderly, the promise of robotic caretakers is almost here. Whether it's helping people do chores, or pour a glass of wine, robots could soon be a constant companion, especially in places like Japan, with aging populations and a shortage of human caretakers.

“Most of the benefits we see from automation is about higher quality and fewer errors, but in many cases it does reduce labor,” Michael Chui, a partner at the McKinsey Global Institute, said on Tuesday during a panel on “Is Any Job Truly Safe”? ... Technology has not only done away with low-wage, low-skill jobs, some of the more than 700 speakers said. They cited robots operating trucks in some Australian mines; corporate litigation software replacing employees with advanced degrees who used to sift through thousands of documents prior to trials; and on Wall Street, the automation of jobs previously done by bankers with MBAs or PhDs. "Anyone whose job is moving data from one spreadsheet to another ... that's what is going to get automated," said Daniel Nadler, chief executive of Kensho.


“Actors, teachers, therapists – think your job is safe from robots? Think again”. “Thanks to advances in artificial intelligence, many jobs that weren't considered ripe for automation suddenly are. In the battle for the 21st century workplace, computers are winning. And the odds of us puny humans making a comeback are not very good.”

By 2021, robots will have eliminated 6% of all jobs in the US, starting with customer service representatives and eventually truck and taxi drivers. [A Forrester report stated]. These robots, or intelligent agents, represent a set of AI-powered systems that can understand human behavior and make decisions on our behalf. Current technologies in this field include virtual assistants like Alexa, Cortana, Siri and Google Now as well as chatbots and automated robotic systems. For now, they are quite simple, but over the next five years they will become much better at making decisions on our behalf in more complex scenarios, which will enable mass adoption of breakthroughs like self-driving cars.

For a discussion concerning the impact of technology on the form of our democratic systems, see, https://www.theguardian.com/sustainable-business/2017/jan/11/can-democracy-survive-the-fourth-industrial-revolution-should-it. “Can democracy survive the fourth industrial revolution? Should it?: As automation and digitisation undermine employment and increase inequality, established political systems will need to adapt – fast”, Jeff Sparrow, 1/11/17. In implying that an “elitist class” should run our political systems rather than an ignorant general electorate, Sparrow writes:

[I]n his recent book Against Democracy, the libertarian economist Jason Brennan rejects the basic assumption underlying any democratic system: the legitimacy of the electorate. On the contrary, he suggests many – perhaps most – voters don’t possess the competence necessary for sensible decision making. “A large percentage of people have no clue what’s going on at all,” he says, “and for them, their votes are almost random.” In place of universal suffrage, Brennan argues for something he calls “epistocracy” – a system in which only the well-informed may vote. Brennan’s position might be extreme. But throughout 2016, versions of that argument were voiced with increasing regularity. ... In Foreign Policy, James Traub, the magazine’s contributing editor, published an article entitled It’s time for the elites to rise up against the ignorant masses; prolific blogger Andrew Sullivan explained that “elites” were “the critical ingredient to save democracy from itself”.


http://www.futuristspeaker.com/business-trends/2-billion-jobs-to-disappear-by-2030/. “2 Billion Jobs to Disappear by 2030”, 2/3/12: Date Modified: 9/4/16. [Thomas Frey says] "When I brought up the idea of 2 billion jobs disappearing (roughly 50% of all the jobs on the planet) it wasn't intended as a doom and gloom outlook. Rather, it was intended as a wakeup call, letting the world know how quickly things are about to change, and letting academia know that much of the battle ahead will be taking place at their doorstep.”

http://www.cnbc.com/2016/07/07/the-robots-set-to-disrupt-white-collar-work.html. “The robots set to disrupt white collar work”, Luke Graham, 7/7/16. Graham writes: “Developments in robotics and technology mean more and more white collar jobs are being automated and performed by machines, according to experts, who also predict that this automation could solve the productivity gap. Estimates of the impact of robotic automation vary, but market research by Forrester forecasts that automation will replace 12 million jobs in the U.S. by 2025, according to its report published last month.”
Robot developers say they are close to a breakthrough—getting a machine to pick up a toy and put it in a box. It is a simple task for a child, but for retailers it has been a big hurdle to automating one of the most labor-intensive aspects of e-commerce: grabbing items off shelves and packing them for shipping. Several companies, including Saks Fifth Avenue owner Hudson’s Bay Co. HBC -1.08% and Chinese online-retail giant JD.com Inc, JD 0.37% have recently begun testing robotic “pickers” in their distribution centers. Some robotics companies say their machines can move gadgets, toys and consumer products 50% faster than human workers. Retailers and logistics companies are counting on the new advances to help them keep pace with explosive growth in online sales and pressure to ship faster. ... Picking is the biggest labor cost in most e-commerce distribution centers, and among the least automated. Swapping in robots could cut the labor cost of fulfilling online orders by a fifth, said Marc Wulfraat, president of consulting firm MWPVL International Inc. “When you’re talking about hundreds of millions of units, those numbers can be very significant,” he said. “It’s going to be a significant edge for whoever gets there first.”


https://www.theguardian.com/technology/2017/apr/24/alibaba-jack-ma-artificial-intelligence-more-pain-than-happiness. “Alibaba founder Jack Ma: AI will cause people ‘more pain than happiness’: The billionaire said key social conflict will be the rise of artificial intelligence and longer life expectancy, which will lead to aging workforce fighting for fewer jobs”, Olivia Solon, 4/24/17.

Steve Poole, “Does it matter if Google is rewiring our minds? Ask Plato”, 8/18/16.
“Is Google making us stupid?” The answer, of course, depends among other things on what “stupid” means. If we all come to increase our “cognitive offloading” onto the internet, that may simply portend a cultural shift in the ways in which we value mental abilities. Since recall of facts is now so easy and quick via the internet, we may just become less impressed by factual knowledge, and more impressed by understanding and creativity. The problem with this, as the researchers themselves note, is that the ability to draw creative connections between facts may depend on having internalized them already as knowledge, so that they are instantly available to the reasoning mind.

59 Steven Poole, “Does it matter if Google is rewiring our minds? Ask Plato”, id.
60 Steven Poole, “Does it matter if Google is rewiring our minds? Ask Plato”, id.

Even if they come from poorer, less educated families, Asian Americans significantly outperform white students by fifth grade, authors wrote. "What accounts for Asians' greater academic effort than whites?” asked study authors Amy Hsin of Queens College in New York and Yu Xie of the University of Michigan. "Asian and Asian American youth are harder working because of cultural beliefs that emphasize the strong connection between effort and achievement,” the authors wrote. "Studies show that Asian and Asian American students tend to view cognitive abilities as qualities that can be developed through effort, whereas white Americans tend to view cognitive abilities as qualities that are inborn.” See also: http://www.greatschools.org/gk/articles/u-s-students-compare/... “Students in the United States performed near the middle of the pack. On average 16 other industrialized countries scored above the United States in science, and 23 scored above us in math. ... Experts noted that the United States' scores remained about the same in math between 2003 and 2006, the two most recent years the test — the Programme for International Student Assessment (PISA) — was given. Meanwhile, many other nations, Estonia and Poland being two, improved their scores and moved past the U.S.


Kids adore their new robot siblings. Many parents have been startled and intrigued by the way these disembodied, know-it-all voices — Amazon’s Alexa, Google Home, Microsoft’s Cortana — are impacting their kids' behavior, making them more curious but also, at times, far less polite. ... But psychologists, technologists and linguists are only beginning to ponder the possible perils of surrounding kids with artificial intelligence, particularly as they traverse important stages of social and language development.

63 See also: https://www.washingtonpost.com/local/how-millions-of-kids-are-being-shaped-by-know-it-all-voice-assistants/2017/03/01/c0a644c4-ef1c-11e6-b4ff-ac2cf509efe5_story.html?utm_term=.9114bfa62b7a. "How millions of kids are being shaped by know-it-all voice assistants”, Michael S. Rosenwald, 3/2/17.

Humans are inherently social animals, and our health suffers if we're cut off from social ties. So it's no wonder the so-called loneliness "epidemic" is being called a public health crisis. But as we sit on the cusp of massive technological advances, the near future could exacerbate this growing problem. Loneliness can happen to anyone. It is indiscriminate of age, country,
and social status. In Britain, more than one in eight people say they don’t consider anyone a close friend, and the number of Americans who say they have no close friends has roughly tripled in recent decades. A large proportion of the lonely are young; almost two-thirds of 16- to 24-year-old Brits said they feel lonely at least some of the time, while almost a third are lonely often or all the time. One pervasive source of our loneliness is technology. While it offers an easy way to keep in contact with friends — and meet new people through dating and friendship apps — technology’s omnipresence encourages shallow conversations that can distract us from meaningful, real-life, interactions.

65 http://www.news.cornell.edu/stories/2010/04/tougher-grading-one-reason-high-stem-dropout-rate. George Lowery, April 2, 2010, “Tougher grading is one reason for high STEM dropout rate”. “Some 50 percent of American college students who major in a STEM -- science, technology, engineering and mathematics -- field drop out, and the persistence rates for women and people of color are lower than those of their white male classmates, reported researchers at a Cornell conference March 25-26.”


Precariousness is not just a working-class thing. In recent interviews, dozens of academics and schoolteachers, administrators, librarians, journalists and even coders have told me they too are falling prey to an unstable new America. I’ve started to think of this just-scrapping-by group as the Middle Precariat. The word Precariat was popularized five or so year ago to describe a rapidly expanding working class with unstable, low-paid jobs. What I call the Middle Precariat, in contrast, are supposed to be properly, comfortably middle class, but it’s not quite working out this way. ... Many of the Middle Precariat work jobs that used to be solidly middle class. Yet some earn roughly what they did a decade ago. At the same time, middle-class life is now 30% more expensive than it was 20 years ago. The Middle Precariat’s jobs are also increasingly contingent – meaning they are composed of short-term contract or shift work, as well as unpaid overtime. Buffeted by Silicon Valley-like calls to maximize disruption, the Middle Precariat may have positions “reimagined”. That cruel euphemism means they are to be replaced by younger, cheaper workers, or even machines.

69 http://www.theguardian.com/commentisfree/2016/mar/08/robots-technology-industrial-strategy. “Manufacturing will increasingly take place with limited and highly specialized human labor.” “When robots do all the work, how will people live? Technology is bringing profound, unstoppable change to society. It is vital that government faces this – and comes up with a new industrial strategy”, Tom Watson, 3/8/16.

70 http://www.theguardian.com/business/2016/mar/17/one-in-3-workers-in-wrong-job-productivity-ons. “One in three UK workers are in the wrong job, ONS figures claim: Data shows one in six staff are overqualified for their role with a further one in six undereducated”, Katie Allen, 3/17/16.


For many, it seems the career ladder is dead, but what’s replacing it may be more daunting. A career web, or lattice, is a professional path where lateral moves are as important to a worker’s end goal as traditional promotions and upwards mobility. ... Many are still figuring out how to deal with the exhausting amount of opportunities that go with navigating this less traditional, flatter career path. Workers are “shifting to a web [or] labyrinth – there’s no career ladder you should climb,” says Katy Tynan, chief talent development strategist at
Coreaxis, a consulting firm that works with multinational companies. For most people it’s a good thing because, "the ladder construct forces everybody to be shooting for a single position at the top – it’s a recipe for lack of success," she adds. ... To navigate the career web, younger generations will need to prioritise building soft skills across a series of different industries, says Barclays senior marketing manager Tracy Williamson. There’s now less focus on industry experience and more focus on managing change in the workplace, communication across a variety of platforms and problem solving. Experience that’s specific to one industry can often be less important, she adds. ... But while that choice [option] seems liberating at first, constant decision-making is also exhausting – experts say constant reinvention requires more energy to make the kind of lateral changes that eschew a traditional path.


75 Seager, “After the robot revolution”, supra.

76 Seager, “After the robot revolution”, supra.

77 https://code.facebook.com/posts/1686672014972296/deal-or-no-deal-training-ai-bots-to-negotiate/. "Deal or no deal? Training AI bots to negotiate”, 6/14/17.

78 http://www.wired.co.uk/article/googles-deepmind-creates-an-ai-with-imagination. “Google’s DeepMind creates an AI with 'imagination': The AI firm is developing algorithms that simulate the human ability to construct plans”, Libby Plummer, 7/26/17. Plummer writes:

“Google’s DeepMind is developing an AI capable of 'imagination', enabling machines to see the consequences of their actions before they make them.” She adds: “Its attempt to create algorithms that simulate the distinctly human ability to construct a plan could eventually help to produce software and hardware capable of solving complex tasks more efficiently. DeepMind's previous research in this area has been incredibly successful, with its AlphaGo AI managing to beat a series of human champions at the notoriously tricky board game Go. However, AlphaGo relies on a clearly defined set of rules to provide likely outcomes, with relatively few factors to consider.”

79 https://www.theregister.co.uk/2017/06/15/facebook_to_teach_chatbots_negotiation/. “Facebook tried teaching bots art of negotiation – so the AI learned to lie: Given training data was real human chatter, this says more about us than anything else”, Kaytanna Quach, 6/15/17.

One report suggests the importance of enterprise and entrepreneurial skills in the future of employment. [https://targetjobs.co.uk/careers-advice/skills-and-competencies/344302-enterprise-and-entrepreneurial-skills-seizing-opportunities-and-seeing-them-th]. “Enterprise and entrepreneurial skills: seizing opportunities and seeing them through”, Graduates with strong enterprise skills can spot an opportunity and use their initiative and a proactive approach to make the most of it.

Graduate recruits with enterprise and entrepreneurial skills are an asset to a company because they will be able to spot gaps in the market and innovate, and because they are commercially minded. Graduate job seekers can showcase their strengths in this area by demonstrating a capacity for independent work and original thinking, as well as sound business sense and an interest in the market that their potential employer operates in. Being enterprising and entrepreneurial involves spotting an unexploited opportunity and making the most of it: essentially, identifying a gap in the market and filling it. However, it can also be about trying something new or improving a process to increase efficiency or boost results.


In highlighting “enterprise” skills I am not downplaying technical ones. See, [https://www.usatoday.com/story/tech/news/2017/05/30/heres-what-you-need-land-americas-best-jobs/101730006/]. “Here’s what you need to land America’s best jobs”, Marco della Cava and Eli Blumenthal, 7/20/17. The challenge is that the “top” jobs are limited in number and only available to the “best of the best”.

The nation’s best jobs boast salaries that average $100,000 and up, offer generous company benefits, and promise to have recruiting suitors fighting for your hand. But they are highly technical roles carrying job descriptions like DevOps engineer and analytics manager that demand an alphabet soup of computer skills as well as incessant on-the-job learning. So do you have to be a math genius with a spare PhD in physics to get one of these great gigs? What we found might surprise you. ... The market for tech talent is so hot that technology jobs now rate as the best type of employment opportunities in the nation. A 2017 survey of [the top jobs in America] by employer ranking and assessment site Glassdoor — based on earning potential, job satisfaction and number of openings — ranked data scientist, DevOps engineer, data engineer, and analytics manager as the 1, 2, 3, and 5 top jobs (the fourth was tax manager). That’s also the second year in a row data scientist took the top slot. Other jobs surveys, including [one from search site Indeed.com], have echoed these results, reflecting a cloud computing-driven surge in information capture.


[https://globaldigitalcitizen.org/the-importance-of-teaching-critical-thinking]. “The Importance of Teaching Critical Thinking”, Lee Watanabe Crockett, 7/25/15. See also, [https://www.theguardian.com/teachernet/2012/sep/12/critical-thinking-overlooked-in-secondary-education]. “Why critical thinking is overlooked by schools and shunned by students”, Ben Morse, 9/12/12. “Ben Morse argues that for as long as universities fail to recognise achievements in critical thinking with UCAS points, the subject will continue to be ignored at secondary level.”