The AI Revolution on Campus

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The past several decades have seen tremendous change in technology. In 1984, Apple and IBM were fierce competitors, showcased by one famous Super Bowl ad.[1] The two companies were fighting a battle over the personal computer, a market that would see around two million devices sold that year.[2] And the biggest robotics story was a small-budget film called *The Terminator,* about a robot coming back in time to wipe out humanity and starring a relatively unknown Austrian actor. It would become one of the biggest box office hits of the year.

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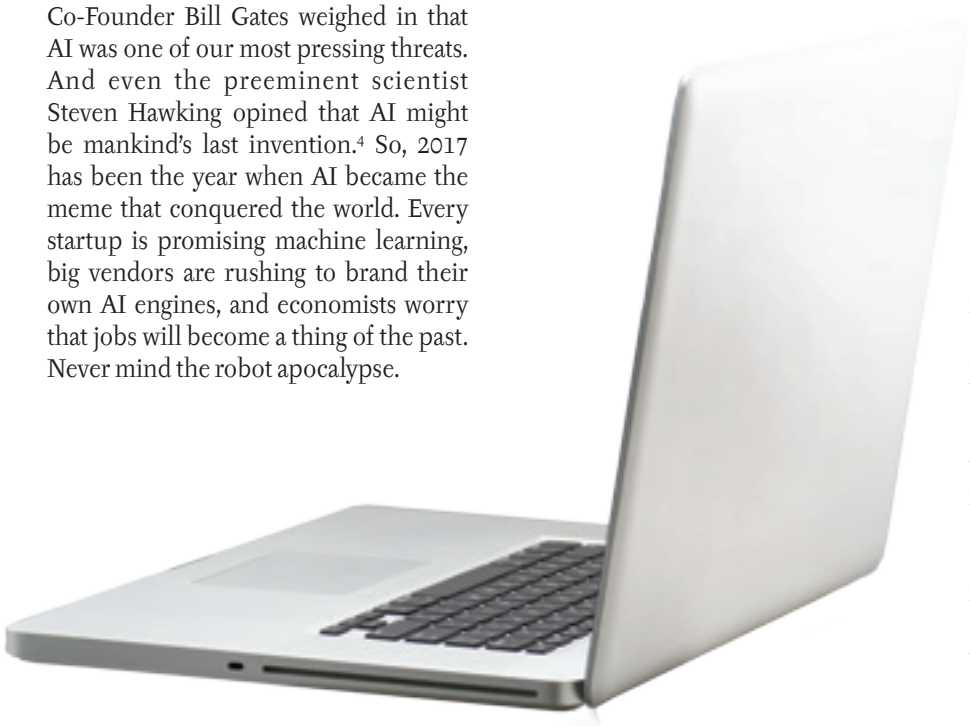
Fast forward thirty-three years. Apple and IBM are now partners, collaborating on mobile applications and services for enterprise clients, and the technology industry is estimated to ship more than two billion devices in 2017.[3] In 2015, Arnold Schwarzenegger revitalized his post-gubernatorial career with a big-budget film called *Terminator Genisys*, about a robot coming back in time to wipe out humanity. The more things change, the more some things stay the same.

This year, the media hype has been all about robots and artificial intelligence (AI). Tesla CEO Elon Musk warned that AI could wipe out humanity. Microsoft Co-Founder Bill Gates weighed in that AI was one of our most pressing threats. And even the preeminent scientist Steven Hawking opined that AI might be mankind's last invention.[4] So, 2017 has been the year when AI became the meme that conquered the world. Every startup is promising machine learning, big vendors are rushing to brand their own AI engines, and economists worry that jobs will become a thing of the past. Never mind the robot apocalypse.



The reality of AI is both less dramatic and more impactful than the hype. We are entering a new era of computing that will bring tremendous change. The past thirty-plus years have seen the personalization of computing hardware, with single, big machines supplanted by supercomputers in everyone's pockets and on-demand cloud services. This technical advance has brought individuals access to services anytime, anywhere and has spurred major transformations on college and university campuses. In the new AI era, machine learning and big data, which together enable *cognitive computing*, will bring personalization through software to every corner of our economy. Higher education will play a critical role in how this new era of the economy evolves, and it's important that academy leaders understand the potential and the risks in order to develop a strategy for navigating the coming disruptions.

Computing 3.0

AI has been around for some time. IBM's Deep Blue computer captured media attention when it beat the reigning chess champion, Garry Kasparov, in a 1997 six-game match. At that time, the Deep Blue system won through sheer computational speed, essentially exploring 200 million chess positions per second to anticipate more moves ahead than Garry.[5] That power overcame the human competitor.

In 2011, IBM again staged a public competition, this time with two reigning champions of the *Jeopardy* television game show. The IBM computer, Watson, won the contest, showcasing the ability both to process natural language, with a dependency on context, and to rapidly search a massive database of facts to identify and rank answers. This new version of AI was built on large amounts of data, which is a key component of cognitive computing. Natural language interfaces and other tools use AI techniques to improve computer interactions. But it is big data that is the main enabler of the cognitive era.

The volume of data is growing dramatically around the world, with at least 90 percent of it having been created in just the past few years. There are billions of mobile devices and internet users, all generating massive amounts of interaction data. The Internet of Things and intelligent sensors will grow this number dramatically. Projections are that global data will increase by an order of magnitude by the end of this decade—to 44 zettabytes, or 44 trillion gigabytes. And the types of data that computers can process have evolved to include audio, text,

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and other "unstructured" materials. This new unstructured material is estimated to represent 80 percent of all data.[6]

All this big data has been called "the next natural resource."[7] Machine learning is the key technology to refine this new resource into productivity. Tools like IBM Watson use large data sets not only to create insights but also to improve those insights through training. The systems continuously improve their accuracy based on new input data.

The new AI platforms use vast amounts of data, both structured and unstructured, to uncover hidden patterns for insight, but they can also create recommendations on next best actions. Using these data sets to find optimal pathways is how AI can impact a variety of business processes. To appreciate the influence of AI on the economy, we need to understand how business processes can be transformed through manipulating massive data sets, as well as how AI technology can make it easier for humans to access and act on these insights.

The use of AI and big data promises to personalize every service for every individual. AI is not a more clever human, and other than in new *Terminator* movie sequels, it is not going to lead to sentient robots that are a threat to humanity, as Musk, Gates, and Hawking fear. It will clearly impact most industries and many jobs, but threats of a jobless economy are also overwrought. Although the automated teller machine (ATM) was feared as a job killer for bank tellers in the mid-1980s, this has not been the case. As Charles Fishman pointed out in *Fast Company*: "At the dawn of the self-service banking age in 1985, for example, the United States had 60,000 automated teller machines and 485,000 bank tellers. In 2002, the United States had 352,000 ATMs—and 527,000 bank tellers. ATMs notwithstanding, banks do a lot more than they used to and have a lot more branches than they used to."[8] While some jobs may become obsolete, it is the impact of personalization that will reshape industries and jobs.

The college or university will need to become a *cognitive campus*. The age of hyper-personalization will continue to pressure institutions to meet rising demands.

IBM's first commercial offering with Watson was an oncology advisor for physicians. This "cognitive advisor" used machine learning and big data sets—including patient genomic data, patient cohort data, and even research publications—to make recommendations for individual treatment plans. This level of personalization holds promise for improving patients' outcomes but can also immediately save time for the physician. Watson doesn't replace the physician, but it offers recommendations for action, along with direct links to supporting data.

Cognitive assistants use big data and AI to provide personalized recommendations to professionals or consumers. Other applications include financial advisors that develop investment recommendations. Charles Schwab uses machine learning and large data sets to provide "intelligent portfolio" allocations. H&R Block partnered with IBM to use Watson to streamline and review the tax-preparation process. AI tools are also being integrated directly into business processes, such as security and supply chain management.

The Cognitive Campus

What is the significance for higher education? These developments mean that the college or university will need to become a *cognitive campus*. Consumer expectations will continue to evolve based on new personalized services. Just as higher education institutions had to embrace personal and mobile computing to serve students and educators, they will need to develop deeper personalized services in the AI era. Students and other constituents will request more personalization as their other service providers get to "know them." The age of hyper-personalization will continue to pressure institutions to meet rising demands in learning and support services.

Second, AI will create opportunities for cost reduction and administrative efficiency, just as in any other industry. Today, AI and big data can improve IT security on campus by identifying threats earlier and creating more rapid interventions. Institutions will deploy AI tools across the student life-cycle, improving retention and optimizing outcomes, which frequently have a bottom-line effect on costs.

But the most important issue for higher education is to prepare the next

generation to prosper in an AI-driven economy. A persistent debate is whether higher education should focus on preparing students for citizenship or for the workforce. The answer is both. With increasing competition and new alternatives, institutions must align to workforce needs and ensure that their students gain employment. The accelerating rate of change in industry will require institutions to be far more adaptable in the future. That pace of change will make the idea of "lifelong learning" truly an imperative for the individual. In addition, the broad impact of AI on society reinforces the need for higher education to address questions of equity, ethics, and citizenship. Students should be asking themselves: "How should my personal data be used without my knowledge? Should it be? What do AI algorithms do for me? What are their limits?" As AI systems work their way across the economy, we will need a workforce *and* a citizenry that is deeply familiar with the technology, its capability, and the social issues it creates. We should view this familiarity as a requirement not only for those steeped in the technology but for everyone.

To prepare for this future, colleges and universities must not only teach about cognitive computing but also teach with it. Those higher education institutions that lead the adoption of cognitive computing will familiarize themselves with the issues and approaches while insulating themselves from increased competition and new entrants. These technologies can be disruptive, and they require a level of enterprise-wide investment not typically seen in classroom-centered initiatives. To succeed, academic leaders must partner with frontline educators to drive an institutional effort.

Understanding where cognitive computing is currently affecting institutions can help chart this course. Early projects point toward three major areas of transforming the student experience. First, AI can have an impact in the classroom, improving the experience for both educators and students. Second, cognitive computing can extend outside the classroom and across the campus to improve student engagement and persistence. Finally, big data, particularly unstructured materials, can support career coaching to help learners adapt to changing workforce needs throughout their lives.

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One of the most publicized tools for classroom AI has been "Jill Watson," a teaching assistant developed by Ashok Goel and his team at Georgia Tech University. Jill was created to help manage the volume of questions in his AI course. Many students were surprised when Goel revealed that "Jill" was not an actual person but was a chatbot built on IBM Watson. Given that the average faculty member deals with 10,000 queries in a large course deployment, the advantage for faculty is clear. And students benefit from a more responsive course experience.[9]

Other AI tools, such as Declara, are using machine learning to create personalized learning pathways. AI tools can rapidly identify and organize content, then couple it with individual learner insights to create custom pathways or interventions. This can support instructors' tools or direct student engagement. McGraw-Hill Education's Assessment and Learning in Knowledge Spaces (ALEKS) uses AI to measure the success of students and present specific content that a student is most ready to learn. ALEKS has been used by millions of students across several subjects.

In October 2016, Pearson announced a partnership with IBM to develop an intelligent tutor using Watson.[10] The tutor will expand Pearson's REVEL learning platform, using Watson to build an adaptive learning experience. The tutor acts as a personal assistant to students during study and quizzes. When students need help, they can ask the tutor questions and get answers or hints. The tutor will also prompt students to review key learning objectives. Based on students' answers, the tutor assesses the skill mastery level and conducts more conversations to bridge any gaps.

Cognitive computing is also being used across the campus. In April 2016, Campus Management released Retention360, which includes an AI persona. "RENEE" (named for Retain, Engage, Notify, and Enablement Engine) automatically launches interventions based on student profiles, best practices, and other inputs. Another company, the technology startup AdmitHub, uses AI chatbots as "campus coaches" for students. A partnership with AdmitHub at Georgia State University demonstrated significant improvement in incoming student metrics.[11]

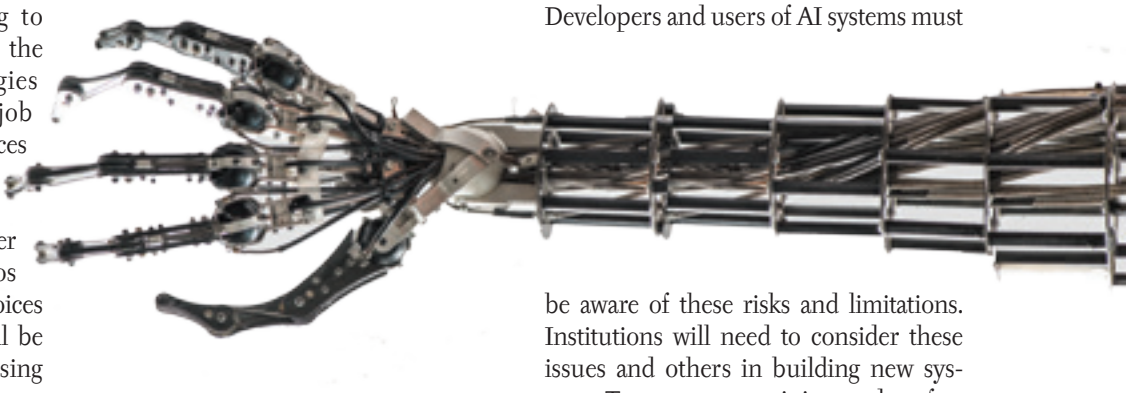
One of the most exciting areas in cognitive computing is career tools that help students create personal aspirations and bring clarity to the pathways to achieve those goals. Many states and institutions are building tools and pathway programs to help students navigate to careers. Georgia has been a leader in this area through its College and Career Clusters/Pathways program. This program provides tools and published paths to support institutions in offering guidance to students. In the future, these pathways can become data sets to enable AI-based coaching tools. Students will have tools that provide customized insights and recommendations to help them explore and pursue their career goals.

Various services are emerging to address this important segment of the market. Burning Glass Technologies provides a real-time database of job market data, along with analytic services to support decision making. Road-trip Nation has developed a broad library of video interviews on the career paths of different individuals, videos that can help personalize career choices for students and job-seekers. AI will be able to personalize the career-advising experience for students, leveraging services such as these and others to provide ongoing interactions on students' chosen paths.

MARi is one such tool already in the market. It is a personal learning platform that creates pathways to careers and jobs, based on individuals' skills and credentials. It functions like a "Career GPS," helping users navigate from their current skill set through a series of educational experiences and on to their stated job goal.

IBM is piloting a Watson career advisor internally to support employees on possible next steps and suggested experiences to prepare. The MyCA tool, or My Career Advisor, makes use of job skills information, work experience, and personality insights to help employees manage their careers. Early feedback is that employees in a place as big as IBM generally feel overwhelmed by options but that the MyCA tool helps sort those options and provide reasonable next steps. The tool should be able to answer the question of where individuals can go next to build their skills, so that they can stay relevant to their employer. Most students would agree that career options can be overwhelming, so this technology should be valuable not just to employees but also to learners at all stages of career preparation.

None of these technologies will replace human educators. Humans excel at nurturing common sense, imagination, and compassion, whereas computers excel at finding knowledge, computation, and pattern recognition. Just as in most commercial industry applications of AI, educational applications will find their strongest use as "Augmented Intelligence"— that is, personalizing the educational experience and augmenting the role of the frontline professional. I travel all over the world, meeting people at all stages of their careers. One common theme I hear is the story of a key person who inspired a love of learning, nurtured personal confidence, and helped chart a path to success. No computing system is anywhere near to replacing that critical role. AI will help students learn key concepts, will encourage them along their path, and will personalize instructor and institutional support. Both the institution and the instructor retain a critical role in students' education.



Yet institutions and instructors must be attuned to the challenges and risks of AI. The technology is only as good as the data sources. One of the primary challenges is curating the data sets that will train an AI system. Many higher education institutions don't have a "single view" of the student—a view that would inform many of these services. Building relationships for outside data sets will be important. In addition, the security of that data, the privacy and ownership policies, and acceptable uses of the data must all be part of the campus strategy.

Recognizing these limits of AI technology can avoid missteps. Limited data sets can lead to "selection bias"—for example, perhaps recommending only a handful of known careers. Or "filter bias" might inappropriately limit content recommendations to an instructor or student. Students might view new AI services as intrusive rather than valuable. Developers and users of AI systems must be aware of these risks and limitations. Institutions will need to consider these issues and others in building new systems. Transparency, training, and professional development will be required to foster a data-aware culture.

A Five-Step Roadmap

Becoming a cognitive campus requires an institutional strategy. Leaders should be engaged and visible in setting the direction and in executing plans. AI will have a profound impact on the role of the institution with all constituents, will demand sustained investment, and will have great benefits as well as risks in deployment. There are five steps that higher education institutions must get right:

1. Create strong organizational alignment
2. Build a portfolio of personalized services, starting with early "wins"
3. Develop a robust data strategy
4. Continually align to workforce needs
5. Create a more agile environment of support services

The changes that AI has brought to the economy will challenge colleges and universities to adapt to the rapidly evolving needs of both students and employers. Coupled with the shifts caused by cognitive tools on campus, this could mean a radical transformation of the higher education institution. It will be key to create alignment on vision and goals—from frontline educators to senior leadership. The transformation can't be viewed as only a technology initiative; it must also be seen as a people initiative. Faculty and leadership development, change management, and other tactics must be employed to move forward.

The goal of AI and big data is to drive more personalization to improve user experiences and learning outcomes. Higher education institutions should start soon to build a new generation of personalized services, look for early success, and work toward a long-term portfolio. Deakin University was the first university to partner with IBM Watson and created a service to provide answers to students' common questions about campus life.[12] The solution helps students navigate across the institution, lowers costs, and sets the stage for future services. Mobile applications that leverage basic analytics can also serve as starting points for the journey.

The foundation for these services must be institutional data. Without control of key data, there is no enterprise in the future. I've heard it said that higher education doesn't have data silos; it has data dungeons. Cloud-based services have exacerbated that challenge by moving student data to remote services provided by third-party vendors, sometimes even outside institutional control. Leveraging the power of AI requires deep data insights about students, as well as a variety of other curated resources. Institutions must create a long-term plan to manage their data as an enterprise resource.

However, platform and policy are not enough. Educators and staff need support to understand the proper uses of data, along with possible pitfalls. Students deserve to have greater insight into and control over how their data is used. Education can play an important role in defining a new "data citizenship" that prepares students for the AI economy, in which their personal data is an important commodity. Colleges and universities therefore need a comprehensive policy that not only spans institutional data practice, platforms, and personnel awareness but also fosters greater awareness and engagement from students.

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The accelerating pace of change in the economy and workforce will increase the pressure to stay connected with market needs. Higher education institutions of all types must begin to build ecosystems to support these connections. Collaborative groups, such as the BHEF (Business–Higher Education Forum), have pioneered these ecosystems. Institutions can play a leadership role in convening and collaborating with key players in their region.

Creating new capabilities on campus can help too. Data-driven technology can assist students in connecting with careers, internships, and workforce-readiness preparation. Many technology companies offer online training and credentialing, which can be used by any institution to create a supplemental program. These approaches can be adapted and scaled across a variety of employers and industries in the future.

New models of teaching—like blended approaches with technology, flexible learning spaces, and challenge-based curricula—help build the "soft" skills that employers seek. Communication, problem-solving, team-based collaboration, and creativity are some of the attributes that employers consistently request. These are also the skills that will foster individual flexibility in a cognitive economy. Colleges and universities should continue to pursue these strategies to help align with workforce needs.

Finally, the future pace of change and institutional demands require an agile foundation. Flexibility and adaptability are core concepts for the future higher education institution. AI and other new

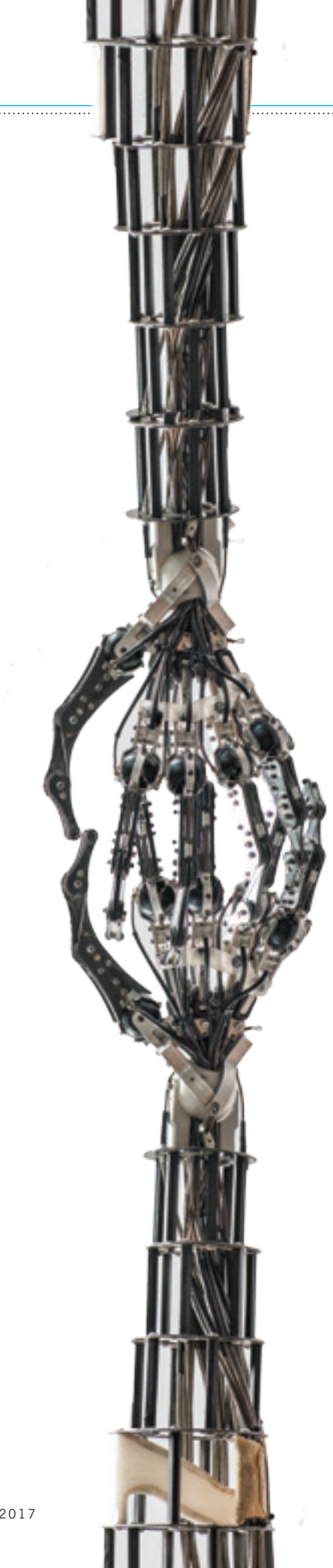
technologies, such as cloud computing, will allow a shift from fixed-cost, capital-intensive projects to variable-cost models for administrative services. To subsidize fixed costs, many institutions are exploring innovative models that are facilitated through modern technology (e.g., subletting real estate). Prospering in an era of rapid and unpredictable change will require campus leadership to define the core mission clearly and fund it consistently, while creating cost and operational efficiencies in noncore activities.

The Future

The cognitive era will unleash a new wave of innovation to reengineer business processes, lower costs, and build new personalized services. Industries and jobs will be transformed in an accelerating pace of change. Education will be critical for individuals and society to prosper in this new era. Higher education leaders should begin preparing their institutions for the challenges and opportunities that lie ahead.

Higher education institutions can become the "learning home" for individuals throughout their lives. Cognitive computing will reach prospective students sooner in their learning journey, guide them through the right learning programs, and provide ongoing support to retain the relevance of their skills. Institutions will become vital to the long-term success of their learners. These institutions can be the steward of individual skill profiles and can leverage cognitive tools to become a pervasive advisor in a rapidly changing economy. They can work with employers to continually bring insights and connections to students and better integrate with workforce needs. Successful institutions will not view this as a temporary episode for traditional students but, rather, as a lifelong relationship with learners—one in which the institution will become a trusted partner to help them navigate the economic changes brought by technology.

The future is bright for those colleges and universities that embrace cognitive computing and prepare for these changes. The past few decades have seen the pervasive growth of personal computing, transforming business processes and the student experience on campus. The coming decades will see a new wave of personalization enabled by big data and artificial intelligence. Higher education has the potential and the imperative to lead that transformation. ■



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