Industry-University Partnerships to Create AI Universities:

A Model to Spur U.S. Innovation and Competitiveness in AI

By Hodan Omaar | July 19, 2022

INTRODUCTION

Universities aid in national artificial intelligence (AI) innovation and competitiveness in several ways. Most obviously, they are where much AI research and technological innovation gets done. Countless major AI discoveries have been the direct result of university research; in fact, the field of AI research itself was founded at a workshop held on the campus of Dartmouth College in 1956.[1] Universities and colleges also educate and train the entire range of workers that will one day enter the AI labor market, including those who go into occupations directly related to developing AI systems, such as engineers, scientists, and product developers, and those who go into occupations that use AI systems. Finally, universities foster technological change indirectly via their links with industry and government.[2] A 2022 report finds that collaborations in AI publications between universities and industry, universities and government, and universities and nonprofit actors have more than doubled over the past two decades.[3]

The problem is university-based AI knowledge and talent production in many countries is concentrated to small groups of elite universities, and a chief cause of the divergence between the "haves" and "have nots" is access to AI infrastructure. Limited access to AI infrastructure, which includes hardware, software, data, and expertise, not only hampers the ability of academic AI researchers to solve important and pressing challenges, but also restrains the types of educational opportunities universities can offer students. Hyper-concentration of AI resources to well-funded universities therefore represents a serious productivity, competitiveness, and equity problem.

The U.S. government has rightly recognized it has an important role to play in increasing access to AI resources for academia and through government-university collaborations. The National Science Foundation (NSF) is currently leading an effort to create a national network of AI research centers by facilitating partnerships between government agencies and academic institutions.

There is also another type of collaboration that could create hubs of AI research and education that support national AI goals: industry-university partnerships. A recent and comprehensive example of such a partnership is between the University of Florida (UF), a public land-grant research university in Gainesville, Florida, and NVIDIA, a U.S. company that develops graphics chips. Anchored by gifts from UF alumnus and founder of NVIDIA, Chris Malachowsky, and hardware, software, training, and services from NVIDIA, UF has launched an initiative to become an "AI University," which has significantly increased its ability to conduct impactful AI research, educate the Floridian workforce, and help ensure all individuals have equal opportunity to succeed in becoming the next generation of AI researchers by sharing its AI resources with groups that are traditionally underrepresented in science and engineering.

The UF-NVIDIA partnership to create an AI university is the first of its kind in the United States—a nation uniquely positioned for such partnerships, as, compared with many other countries, it has a highly developed and successful industry-university collaboration system. Among the many reasons why is its culture. A long tradition of pragmatism has dominated U.S. universities, leading them to view collaboration with industry as something that is useful and can advance knowledge.[4] In addition, the U.S. system, with a diverse assortment of universities and ownership has created a competitive environment wherein universities innovate and compete to work with industry. Finally, in many states, public colleges and universities are encouraged and supported by state and local governments in their efforts to work more closely with industry.[5]

Drawing on interviews with key stakeholders from industry, academia, and government, this report presents the UF-NVIDIA partnership as a case study to provide an understanding of how this partnership was constructed and implemented; highlight the impact of the initial outcomes from this partnership in supporting national goals for AI research, AI education, and equitable access AI to resources; and draw five lessons for effective industry-university partnerships to foster AI:

1. Focus industry-university partnerships on increasing AI computing capacity at universities.

2. Articulate realistic goals for partnerships based on a clear understanding of institutional capacity.

3. Encourage institutional buy-in within a partnering university by spreading the benefits of the partnership across disciplines.

4. Encourage government to stimulate demand for the AI research and skills industry-university partnerships create.

5. Develop an appropriate and ongoing assessment program.

HOW DID THE PARTNERSHIP BETWEEN THE UNIVERSITY OF FLORIDA AND NVIDIA COME TOGETHER?

There are several types of relationships possible in industry-university partnerships. For example, a single company may partner with a single university, multiple companies in the same sector may partner with a single university, or multiple companies may partner with multiple universities. Moreover, these partnerships may or may not involve partners from state or local government. Each partner brings different knowledge and resources to the table, and finding the right partners is crucial for success. The NVIDIA-UF partnership is an example of a single company partnering with a single university and state.

In its first iteration, the NVIDIA-UF partnership was initiated by industry, as many successful industry-university partnerships often are.[6] Malachowsky initiated this first partnership underpinning UF's AI initiative in October 2019 when he met with the university's central team for advancement—a small team that devises major strategies and recommends actions to advance the mission of the university. This team includes the likes of the provost and senior vice president for academic affairs, the chief technology officer, the vice president for research, and vice president for advancement.
The discussions began with Malachowsky offering to gift the school $25 million toward a powerful AI supercomputer. The university's steering committee then approached NVIDIA, the Silicon Valley-based technology company Malachowsky founded, which agreed to match the gift with $25 million in hardware, software, training, and services.

Anchored by these gifts, the university's steering committee began looking for partners within its own walls. UF is home to 16 academic colleges, covering a diverse range of subjects. The committee surmised that finding partners across academic divisions could better enable students from different disciplines to benefit from AI resources for research and education and enhance the partnership by leveraging university funding, which is decentralized across colleges. The university's central committee asked the deans of each college to be a partner—which they all did—and as a whole, the university pledged an initial $20 million toward establishing UF as an AI-centric university (a goal discussed in more detail ahead).

Next, the committee turned to government. UF's state and federal government relations teams reached out to stakeholders, and Florida's state government agreed to partner. Among other measures, the state of Florida provided $110 million in funding for UF to build a new data center in preparation for an AI supercomputer and committed to providing $15 million a year to hire 100 new AI faculty to support the broader AI initiative.

Finally, the steering committee turned to private gifts and donations. The university has over 450,000 alumni worldwide and many collaborative partnerships with industry. Raising funds from its external private network was another crucial funding mechanism to ensure consistent and stable investments in the initiative. For example, the new data center would cost $150 million, which meant the university needed to raise an additional $40

million in private donations on top of the state's funding. In total, UF's AI initiative was a more than one billion dollar initiative.

WHAT WERE THE GOALS OF THE PARTNERSHIP?

Successful partnerships tend to be characterized by clear objectives. The steering committee for advancement at UF worked with its partners to identify and articulate the broad goal of becoming an "AI university," which encompassed three main objectives.

First was the objective to advance, at scale, AI research at UF and its application in areas of local and national import. While UFhas consistently ranked among the top 25 research universities in the United States, the quantity and impact of its AI research has lagged behind many other major U.S. research universities. In part, this is because AI research has a high-cost barrier to entry, requiring significant funding to support resource-intensive computing facilities and large, curated datasets. As a public university, UF has less of the resources and funding available to top private research institutions. Consider that the top three contributors at leading AI research conferences are well-resourced private universities—namely the Massachusetts Institute of Technology (MIT), Stanford University, and Carnegie Mellon University, all of which have more funding for AI and computer science research, according to a 2019 report from the Center for Measuring University Performance.[7] This dynamic is unlikely to change without intervention because, as a 2019 Information Technology and Innovation Foundation (ITIF) report notes that "twenty years of underfunding by state governments have led to a decline in many public research universities' capabilities relative to private research universities."[8] Increasing UF's ability to conduct AI research will help attract funding for research itself, which is not only supporting the research mission of the university but is also in the interest of the private sector because academia is primarily responsible for conducting basic, curiosity-driven research the private sector draws on for innovation.

The goal of the UF-NVIDIA partnership was to set the university apart as an AI university by not only offering AI majors and courses, but being the first U.S. university to embed AI into every subject.

A second objective was to strengthen AI education and workforce development. Currently, very few universities offer specific AI majors or courses at the undergraduate level. Carnegie Mellon University's School of Computer Science began offering an undergraduate AI degree to a maximum of 35 students each year in 2018—and it was the first U.S. university to do so.[9] Most colleges and universities offer computer science bachelor's degrees with AI concentrations or specializations. However, many of these courses are increasingly oversubscribed, as the interest in studying AI and AI-related courses at U.S. universities surges due, in part, to the market for these skills soaring. [10] The goal of the UF-NVIDIA partnership was to set the university apart as an AI university by not only offering AI majors and courses, but being the first U.S. university to embed AI into every subject.

A third aim of the partnership was to support all individuals having equal opportunity to succeed in becoming the next generation of AI researchers by extending access to UF's AI resources beyond the campus to researchers and students across the state and country.

WHAT WAS INVOLVED IN INSTALLING AN AI SUPERCOMPUTER AT UF?

The heart of the initiative, which was announced in October 2019, was the acquisition and installation of an NVIDIA AI supercomputer at UF.

To this end, UF first had to find the physical space to install the system. Fortunately, it had already built a 5,000 square foot data center in 2013 to house the university's first supercomputer, a general-purpose supercomputing system it called HiPerGator 1.0. This supercomputer has since been retired and replaced with an upgraded general-purpose supercomputer called HiPerGator 2.0. But even with an updated system, the data center had thousands of empty, usable square footage, meaning plenty of space to install an AI supercomputer. According to research computing director Erik Deumens, "Investing in the data center back in 2013 put the university in a unique position to be able to even accept the gift of an AI supercomputer from Chris Malachowsky and NVIDIA."[11]

"Investing in the data center back in 2013 put the university in a unique position to be able to even accept the gift of an AI supercomputer from Chris Malachowsky and NVIDIA."

Erik Deumens, UF research computing director.

However, UF's data center needed several updates before it could receive NVIDIA's supercomputer specialized for AI. One of the most important tasks was to double the power supply from 1.6 megawatts to 3.2 megawatts. The AI supercomputer itself draws 1.1 megawatts at full capacity, which, for comparison, is about enough electricity to power 100 to 200 homes in Florida.[12] This meant the university had to negotiate a contract with the regional electricity company that supplies the university's large electrical grid. In addition, the university had to double its cooling capacity by adding 12,000 gallons of chilled water storage and upgrade its piping systems to accommodate this increased volume of chilled water. In total, the university spent $15 million upgrading its electrical and cooling capacity. Fortunately, UF's computing and utilities staff were already seasoned by nearly 10 years of experience with HiPerGators 1.0 and 2.0, meaning they had the knowledge necessary to plan and successfully execute preparations for an AI supercomputing system. The main challenge of preparing for the system was planning. A variety of projects had to be completed concurrently, each of which had several different companies involved. Indeed, according to Deumens, there were more than 50 companies engaged across the range of projects needed to build the infrastructure for the HiPerGator AI.

With the preparations underway, the system was ordered in August 2020 and began to be connected and optimized for performance in November. Because the supercomputer had specific architecture, NVIDIA solution architects and product engineers needed to work with UF on installation, operation, and optimization. For example, there were thousands of fiber optic cables that amounted to more than 10 miles of cables that needed to be connected in specific ways between the nodes of the computing system.

HiPerGator AI consists of 140 NVIDIA servers, called "nodes," each of which contains 8 graphics processing units (GPUs) and has an additional 17,920 central processing units (CPUs). CPUs and GPUs have a lot in common but have different architectures and are built for different purposes. CPUs focus their processing cores on getting individual tasks done quickly, making them

well suited to processing tasks wherein latency or per-core performance is important. GPUs are made up of more-specialized cores that work together to deliver massive performance in processing tasks that can be easily divided up and processed across many cores. This makes GPUs better suited to tasks wherein bandwidth rather than speed is important. To see this, imagine a CPU is a sports car and a GPU is a semitruck, and their task is to move a house full of boxes from one place to another. The sports car will move the boxes more quickly, but it will have to keep making the journey back and forth, whereas the semitruck will carry a much greater load but will travel more slowly. A supercomputing system is like a 100-lane highway, wherein many vehicles are working in parallel and the ratio of sports cars to semitrucks depends on the size and nature of the boxes being moved.[13] The combination of CPUs and GPUs in HiPerGator AI makes it especially suited to power AI applications and research.

The system went into production for AI system validation and early user access in January 2021. That same year, it was ranked the second most powerful supercomputer among universities nationwide and third in higher education worldwide.[14]

WHAT WERE THE INITIAL OUTCOMES OF THE PARTNERSHIP?

HiPerGator AI has been in production since January 2021 and UF has made considerable headway in using its new resources to become an AI university that conducts impactful research, develops strong AI education and workforce training, and spreads access to AI to underrepresented groups.

IMPACT ON AI RESEARCH

Diversifying AI Research Across the University

The UF-NVIDIA partnership has fueled AI research across the breadth of domains UF's colleges focus on. To catalyze a wide range of AI research and leverage the new system, UF created a $1 million AI Research Catalyst Fund, awarding 20 research projects with $50,000 each. UF's vice president for research David Norton noted that the purpose of the AI Research Catalyst Fund was "to encourage multidisciplinary teams of faculty and students to rapidly pursue imaginative applications of AI across the institution."[15] And it did. There were a total of 133 proposals submitted from across the university, which were then evaluated by a team of faculty reviewers for the top 20 that had the greatest potential to elevate UF's AI research profile. The chosen projects were diverse, including a research project between the Department of Materials Science & Engineering and Department of Psychiatry to use AI to detect biomarkers for Alzheimer's disease; a project between College of Design, Construction and Planning and Department of Statistics to use machine learning to track past and present land use patterns in Florida to better simulate future impacts of anticipated changes in land developments; and a project in the College of Education's School of Teaching and Learning to use AI to enable teachers to identify academically at-risk students, even if those learning remotely.

Importantly, many of the research projects UF chose for funding are leverage the university's existing research strengths to accelerate its impact in ways that achieve goals of state, national, and global import. For instance, UF already has a strong research portfolio in agricultural science, with its Institute of Food and Agricultural Sciences ranked first in the country for agriculture research and development (R&D) by NSF in 2019. Therefore, its choice to fund a project to use AI to more quickly and cheaply identify parasitic nematodes—which are microscopic worms that have been estimated to cause $173 billion in agricultural damage across the world each year and are particularly common in Florida—serves to further advance its unique agricultural research capabilities.[16] Similarly, the AI for Alzheimer's project the university has funded will strengthen the work of 1Florida Alzheimer's Disease Research Center (ADRC), a UF-organized consortium of leading research institutions including the Mount Sinai Medical Center in Miami Beach, the University of Miami, Florida Atlantic University, and Florida International University aimed at making Alzheimer's and related dementias treatable and preventable. Such work is of particular importance for the state given Florida is estimated to have the nation's second-highest prevalence of Alzheimer's disease, which is the sixth leading cause of death for Floridians ages 65 and over.[17]

Creating Moonshot Research Project GatorTron

In addition to broadening the types of research UF conducts across domains, the AI initiative has also taken a "moonshot" approach to AI research by making targeted advances on pressing global challenges. The first example of this at the university is the development of an AI system called GatorTron in 2021, the largest clinical language model of its scale in the world.

GatorTron is a natural language processing model that enables computers to read and interpret medical language in clinical notes that are stored in electronic health records (EHRs). An estimated 80 percent of data contained in EHRs is unstructured because the clinical data physicians record is in the form of narrative text notes.[18] This data contains relevant, richly detailed, and nuanced information about the illness trajectory and care processes of patients, making the challenge of automatically extracting accurate information from these notes quickly and with clarity important to accelerating clinical research and medical decision-making.

To pre-train and develop GatorTron, UF and NVIDIA used HiPerGator AI and the vast clinical data from the medical network associated with the university, UF Health, which included a decade of anonymized data from 2011 to 2021 related to information on more than 2 million patients and 50 million patient interactions across an array of medical specialties, including oncology, internal medicine, and critical care.[19] In total, the model was trained on more than 82 billion words and 8.9 billion parameters in seven days, beating ClinicalBERT, the largest model prior to GatorTron, which was trained on 0.5 billion words and 110 million parameters.[20]

The key value of such a model is the myriad of downstream medical applications it can power. One example UF will be exploring is the

development of applications that more efficiently identify relevant patients for lifesaving clinical trials. Each clinical trial has rules about who can and cannot participate based on factors such as age, gender, health profile, etc. To find and recruit eligible participants, researchers must manually review medical records, a laborious process that has proven to be one of the chief bottlenecks in the drug development process. While some of the data in medical records is structured and can be pulled out of standard data fields, much of it has to be pulled from unstructured data, making GatorTron highly valuable in the development of natural language processing applications that can rapidly analyze thousands—if not tens of thousands—of EHRs for eligible participants in clinical trials.

One challenge with any AI model built on sensitive health care data is protecting the privacy of patients. With GatorTron, the UF Institutional Review Board and UF Health Information Technology ensured sufficient security controls were in place to protect patients' privacy during the development. But now, UF Health and NVIDIA are partnering on a second model called "SynGatorTron," which is a neural network that generates synthetic clinical data researchers can use to train other AI models in health care. Like GatorTron, SynGatorTron has been pretrained on a wealth of data, but rather than extracting information, the model creates synthetic patient profiles that mimic the health records it has learned from.[21] SynGatorTron can, for example, create health records of digital cancer patients and researchers can create tools and models using this synthetic data without risks or privacy concerns. In fact, NVIDIA has launched a new version of GatorTron called GatorTron-S, which was trained on 22 billion words from synthetic clinical records created using SynGatorTron.[22]

IMPACT ON AI EDUCATION AND WORKFORCE DEVELOPMENT

Increasing Tertiary AI Education Options

UF has instituted AI Across the Curriculum, incorporating it into all undergraduate majors and graduate programs, as an innovative way to increase the number of AI courses in higher education and spread knowledge and resources among all colleges. One of the chief reasons universities do not increase their AI course offerings despite increased demand is institutional resistance. Reallocating resources to support more AI courses means taking resources from elsewhere, such as social science and humanities courses, and as Stanford economist Paul Romer noted, a "university that has fixed investment in faculty who teach in areas outside of the sciences and that faces internal political pressures to maintain the relative sizes of different departments may respond to this pressure by making it more difficult for students to complete a degree in science."[23]

UF is the first university in the country to introduce AI curricula across disciplines, offering a number of elective AI courses students can explore through an electronic portal. For instance, undergraduate students can now take Biomedical Data Science, a course that teaches machine learning data analysis and data visualization techniques for biomedical applications; or AI in Agricultural and Life Sciences, which provides hands-on experience

building and using AI to solve agriculture-related problems; or even AI in the Built Environment, which provides an introduction to the application of AI in architecture, construction management, sustainability, and urban planning. Similarly, there are a host of graduate-level courses ranging from those that are course specific such as AI in Media and Society, which explores AI as it applies to the media professions including journalists reporting on AI, to AI courses that are not course specific such as Neural Networks for Computing and Math for Intelligent Systems. Perhaps the most novel academic offering UF is providing is its nine-credit AI certificate for undergraduate students, which requires them to take a fundamentals of AI course, an ethics course, and one course-specific elective. In addition, UF announced in March 2022 that it is creating a centralized office to act as a focal point for academic activity related to AI to better coordinate its AI-across-the-curriculum effort, including:

> the coordination and development of programs and certificates; the identification of opportunities for faculty and students to engage with AI; the co-organization of seminars and conferences; the development of an AI Scholars program; and partnerships with UF's Career Connections Center, the Florida College System and private industry that will promote an AI-ready workforce and help businesses integrate AI into their current processes.[24]

Increasing AI-Focused Faculty

Another reason U.S. universities are frequently unable to meet increased demand for AI courses and majors is too few universities are able to sufficiently compensate qualified professors or otherwise convince them to choose working in academia over accepting lucrative private sector jobs.[25] Without increasing the number of faculty, universities cannot offer more classes to students. As part of the public-private partnership, UF has been able to commit to hiring an additional 100 AI-focused faculty members that reflect a diversity of backgrounds and experiences. For example, in 2021, UF welcomed four artists and creative technologists to join its College of the Arts and lead scholarly and creative research in AI and the arts. These faculty are bringing AI into the School of Music, School of Theatre and Dance, and School of Art and Art History, as well as imbuing AI education at UF's Digital Worlds Institute.[26]

Many of UF's faculty have also been upskilled through NVIDIA's Deep Learning Institute (DLI) Ambassador Program, a free training program the company offers university faculty on GPU-accelerated computing. University staff and faculty who undergo the program, such as those working with UF research computing director Erik Deumens, become certified instructors in accelerated computing, deep learning, and robotics and have access to kits and materials they can use to teach students and researchers. As of July 2022, DLI Ambassadors at UF have trained approximately 815 students. DLI also offers free online training, certification, and cloud access to GPUs to students, which they can use to demonstrate subject matter competency and support their career growth.[27]

Developing Credentials for Workforce Development

To support workforce development, UF launched an AI microcredential in September 2021. The university already had a program called "Micro-Gator" that provided a range of microcredentials, which are short, focused credentials that provide those who enroll with digital certificates demonstrating in-demand skills, know-how, and experience.[28] Several universities offer these sorts of skills credentials, with a 2018 report noting that 20 percent of colleges and universities offered for-credit and non-credit microcredentials, and forecasting it to grow to approximately 35 percent of college and universities within a decade.

The popularity of AI skills credentialing in particular has soared over the past few years amidst purported skills gaps in the AI labor market. AI skills credentials are considered one solution to closing workforce skills gaps because they enable companies to have a better way to assess the AI skills of prospective and current workers, while also providing workers with a better way to identify and gain the AI skills they need to be successful. Offered through the Office of Professional and Workforce Development, UF's AI microcredential is designed for working professionals. To earn certification, participants must complete two required courses that teach key concepts and foundations of AI and also a self-selected focus-area course, which are offered by the colleges of agriculture and life sciences, business, engineering, liberal arts, and sciences. As of July 2022, 1,030 individuals have registered for courses through the program.

Unfortunately, however, there is currently little market demand from employers for these certifications in lieu of a four-year degree—and the less market demand there is, the fewer students and workers choose to get AI certifications, which in turn further dampens the market for these credentials. This is where the state government can step in to overcome such chicken-and-egg dynamics by encouraging the private sector to accept alternative certifications for AI, namely a suitable set as a substitute for a college degree when filling state government jobs.

IMPACT OF INCREASING ACCESS TO UNDERREPRESENTED GROUPS

UF is part of the state university system in Florida, which consists of 12 public universities that include Florida Agricultural and Mechanical University (Florida A&M), one of the largest historically black colleges and universities (HBCUs) in the country. UF is sharing its AI resources with all the universities in the Florida State System, thereby enabling increased access to AI resources for groups that are traditionally underrepresented in science and engineering because, while HBCUs such as Florida A&M make up 3 percent of U.S. institutions of higher education, they enroll 16 percent of all African-American students, while Hispanic Serving Institutions (HSIs) enroll 40 percent of all Hispanic Americans.[29] UF has also partnered to share resources with Miami-Dade College (MDC), which has the largest undergraduate enrollment of any college or university in the country, 75 percent of which is Hispanic and 15 percent of which is Black.[30] NSF awarded MDC a grant of almost $1 million to fund the development and integration of

AI courses in August 2021, which paved the way for collaboration with UF. Together, UF and MDC are developing AI courses that meet the needs of their diverse student body and integrate AI curricula into existing courses. As UF's instructional assistant professor in the Department of Engineering Education noted, "Through this partnership, we can impact a mix of students that we don't always have the ability to impact here at UF. Miami Dade College also has non-traditional students; working professionals and students in the military. AI for all, which is the whole point."[31]

Additionally, UF launched an AI initiative with the Southeastern Conference (SEC), an association of 14 public universities in 10 states, in November 2021. Through the SEC AI Consortium, which UF is leading, member universities are providing access to HiPerGator AI and, together, are sharing educational resources such as curricular materials and certificate and degree program structures; seeking joint partnerships with industry; and sharing best practices on how to ensure students graduate with requisite AI skills that benefit the region and nation. Importantly, several SEC member universities are flagship institutions located in states that are conducting high levels of AI research but have low levels of access to AI research resources. For instance, the University of Georgia and Auburn University (in Alabama) are SEC members located in states identified in a 2020 report by the Center for Data Innovation as ones policymakers should prioritize for AI resources given investments in them will have the highest return in AI research.[32] While also an SEC member, the University of Arkansas, on the other hand, has no significant funding in computer science, which is impeding it from attracting skilled staff with the expertise to train the next generation of AI researchers. Partnering with UF through the SEC AI Consortium could help address this.

Finally, UF is working and supporting the nonprofit organization Inclusive Engineering Consortium to increase the quantity and quality of African American, Hispanic, and Native American AI graduates.

5 LESSONS FOR EFFECTIVE INDUSTRY-UNIVERSITY AI PARTNERSHIPS

There are five lessons for effective industry-university partnerships to foster AI:

1. Focus industry-university partnerships on increasing AI computing capacity at universities

Access to sufficient computing capabilities is one the most—if not the most—important limiting factors academic researchers and faculty face to AI innovation. At the campus level, few universities sufficiently invest in AI computing infrastructure because institutional decision-makers must make funding decisions in the face of competing priorities and scarce resources. Even though purchasing an AI computing system is often treated as a capital expense, most computing systems only have a relatively short useful lifetime, which means maintaining those that can support modern research is a recurring cost every three to five years.[33] When one considers the costs for staffing, power, and building infrastructure, the costs of operating a campus

AI computing facility can quickly grow to that of operating an entire academic department, leaving most resource-strapped universities to balk at the idea of investing in AI compute. Industry-university partnerships that seek to transform a university into one that conducts significant research or properly trains the workforce should focus on overcoming this barrier if they want to create impact.

2. Articulate realistic goals for partnerships based on a clear understanding of institutional capacity

Universities across the country have different sets of existing knowledge, skills, and systems, which means their ability to achieve impact on AI innovation through increased research and education also differs. For instance, before its partnership with NVIDIA, UF was already one of 146 institutions in the country classified as conducting very high levels of research. There was demonstrable evidence that demand for AI computing was high and investing in one of the most powerful AI computing systems in the world would further the university's existing research efforts. The university also already had both a decade of experience maintaining supercomputing systems and the physical space to house such a system. Other universities, especially those that are not research heavy, may not have the same demand for the extensive functionalities of a leadership-class system such as UF did, or may not have any experience acquiring or managing high-performance computing systems. But that does not mean they cannot bolster their AI capabilities through smaller, mid-range or cloud-based systems to advance their own goals and competitive standing. Universities should carefully evaluate their own institutional capabilities and set goals that play to their unique strengths and missions, if they want to be successful.

3. Encourage institutional buy-in within a partnering university by spreading the benefits of the partnership across disciplines

Even though there is increasing demand for AI education and skills development within higher education, few universities currently accommodate increased AI offerings because of institutional resistance. Allocating resources to support more AI education and research, which are typically centered in the computer science departments at universities, means reallocating them from other departments such as social science and humanities (fields where there may be declining student enrolment). Faculty in the latter areas therefore do not view university investments in more AI resources as in their best interests. By diffusing the benefits and opportunities of increased AI resources across disciplines through its AI-across-the-curriculum approach, UF has not only overcome institutional resistance, it has been able to channel the funding and knowledge of its diverse colleges to the goals of the broader initiative. Universities that seek to advance their AI capacity and take a holistic approach to AI education should do the same.

4. Encourage government to stimulate demand for the AI research and skills industry-university partnerships create

Unlike other stakeholders in public-private partnerships for AI, governments can play a unique, dual role. On one hand, government can support the inputs to a partnership through funding. For instance, the state of Florida supports the NVIDIA-UF partnership by providing funding for the university to hire 100 AI faculty. On the other hand, government can also stimulate demand for the outputs of the partnership. For example, the NVIDIA-UF initiative has created a digital AI credential to enable workers to better signal their AI skills to employers. The state of Florida could better support the impact this credential has by accepting it as a substitute for a college degree when filling its own job openings. Furthermore, the U.S. Department of Labor (DOL) should promote AI credentials by creating a working group that administers a grant for AI-specific public-private partnerships. DOL already promotes such credentials through its Apprenticeship: Closing the Skills Gap grant program, which launched in 2020 to expand apprenticeships in several industries, one of which was AI. The program awards grants ranging from $500,000 to $6 million to public-private partnerships, requiring recipients to provide apprenticeships that include a work-based learning component and, importantly, an educational component that results in the issuance of an industry-recognized credential.[34] Several of the 28 public-private partnership grantees are led by both institutions and state systems of higher education. For instance, North Carolina State University is using grant funding to train 5,000 professionals from across the country through paid apprenticeships with industry partners and two AI credential pathways: one basic and one advanced.[35] DOL should expand on these grants and prioritize partnerships that create AI-credential programs, especially those that are led by Minority-Serving Institutions (MSIs), community and technical colleges, HBCUs, and other underrepresented community groups and organizations.

5. Develop an appropriate and ongoing assessment program

While the costs of investing in an AI initiative such as that of NVIDIA-UF are easily quantifiable, the benefits are more difficult to quantitively translate. Many would agree that the impacts on research, education, and equity of access have been positive, but there exist few consistent, quantitative measures of the effect of AI supercomputing on research output or AI Across the Curriculum on skills development. Without such measures, it is difficult for partners to evaluate the extent of an initiative's impact against its articulated goals and to decide how best to move forward strategically. UF is only in its second year of the initiative and is working on developing its own metrics for success. Any similar partnership should develop its own metrics as well.

ENDNOTES

[1] "Artificial Intelligence (AI) Coined at Dartmouth," accessed June 1, 2022, https://250.dartmouth.edu/highlights/artificial-intelligence-ai-coined-dartmouth.

[2] Mark Zachary Taylor, *The Politics of Innovation: Why Some Countries Are Better Than Others at Science and Technology* (New York: Oxford University Press, 2011), 83.

[3] Daniel Zhang et al., "The AI Index 2022 Annual Report" (AI Index Steering Committee, Stanford Institute for Human-Centered AI, Stanford University, March 2022), https://aiindex.stanford.edu/wp-content/uploads/2022/03/2022-AI-Index-Report_Master.pdf.

[4] Robert D. Atkinson, "Understanding the U.S. National Innovation Ecosystem, 2020," (ITIF, 2020), https://itif.org/publications/2020/11/02/understanding-us-national-innovation-system-2020.

[5] "Federal Policy," accessed June 29, 2022, https://ssti.org/federal-policy.

[6] National Research Council, *Government-Industry Partnerships for the Development of New Technologies* (Washington, D.C.: The National Academies Press, 2003), https://doi.org/10.17226/10584.

[7] John V. Lombardi, Craig W. Abbey, and Diane D. Craig, "The Top American Research Universities," The Center for Measuring University Performance (CMUP) 2019 Annual Report, (CMUP, 2019), 20, https://mup.umass.edu/sites/default/files/mup-2019-top-american-research-universities-annual-report.pdf.

[8] Robert D. Atkinson and Caleb Foote, "U.S. Funding for University Research Continues to Slide" (ITIF, 2019), https://itif.org/publications/2019/10/21/us-funding-university-research-continues-slide.

[9] Bryon Spice, "Carnegie Mellon Launches Undergraduate Degree in Artificial Intelligence," *Carnegie Mellon University News*, May 10, 2018, https://www.cmu.edu/news/stories/archives/2018/may/ai-undergraduate-degee.html.

[10] Cade Metz, "A.I. Researchers Are Making More Than $1 Million, Even at a Nonprofit," *The New York Times*, April 19, 2018, https://www.nytimes.com/2018/04/19/technology/artificial-intelligence-salaries-openai.html.

[11] Erik Deumens (research computing director, University of Florida), in discussion with the author, July 2021.

[12] Ariana Aspuru, "UF Board of Trustees approves $20 million investment in artificial intelligence," *The Independent Florida Alligator*, July 21, 2020, https://www.alligator.org/article/2020/07/uf-board-of-trustees-approves-20-million-investment-in-artificial-intelligence.

[13] Hodan Omaar, "How the United States Can Increase Access to Supercomputing" (Center for Data Innovation, December 2020), https://www2.datainnovation.org/2020-how-the-united-states-can-increase-access-to-supercomputing.pdf.

[14] "HiPerGator AI Achieves Highest Top500 Ranking Yet," UF Information Technology, last updated June 28, 2021, https://news.it.ufl.edu/research/hipergator-ai-achieves-highest-top500-ranking-yet.

[15] Joe Kays, "Artificial Intelligence Research Catalyst Fund awards 20 grants totaling $1 million," *University of Florida News blog,* December 4, 2020, https://news.ufl.edu/2020/12/artificial-intelligence-research-catalyst-fund-.

[16] Elisa Gamalero and Bernard R. Glick, "The Use of Plant Growth-Promoting Bacteria to Prevent Nematode Damage to Plants," *Biology (Basel)* (2020): 381, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7695023.

[17] The Florida Department of Elder Affairs, "Alzheimer's Disease State Plan 2020," https://elderaffairs.org/wp-content/uploads/alzheimers-disease-state-plan-2020.pdf.

[18] Joshua R. Vest et al., "Using structured and unstructured data to identify patients' need for services that address the social determinants of health," *International Journal of Medical Informatics*, (2017) 107:101–6, DOI: 10.1016/j.ijmedinf.2017.09.008.

[19] University of Florida, "University of Florida Health, NVIDIA Develop AI Model for Clinical trials, Medical Decision-Making," *HPCWire*, April 15, 2021 https://www.hpcwire.com/off-the-wire/university-of-florida-health-nvidia-develop-ai-model-for-clinical-trials-medical-decision-making.

[20] Xi Yang et al., "GatorTron: A Large Clinical Language Model to Unlock Patient Information from Unstructured Electronic Health Records," pre-print available on medRxiv, March 18, 2022, https://doi.org/10.1101/2022.02.27.22271257.

[21] Anthony Costa, "Unlimited Data, Unlimited Possibilities: UF Health and NVIDIA Build World's Largest Clinical Language Generator," *NVIDIA blog*, March 22, 2022, https://blogs.nvidia.com/blog/2022/03/22/uf-health-syngatortron-ai-synthetic-clinical-data.

[22] "GatorTron-S," NVIDIA, accessed May 28, 2022, https://catalog.ngc.nvidia.com/orgs/nvidia/teams/clara/models/gatortron_s.

[23] Paul M. Romer, "Should the Government Subsidize Supply or Demand in the Market for Scientists and Engineers?" *National Bureau of Economic Research* (2000), DOI: 10.3386/w7723.

[24] "UF announces Artificial Intelligence Academic Initiative Center," *University of Florida News blog,* March 14, 2022, https://news.ufl.edu/2022/03/uf-announces-ai-academic-initiative-center.

[25] Natasha Singer, "The Hard Part of Computer Science? Getting Into Class," *The New York Times*, January 24, 2019, https://www.nytimes.com/2019/01/24/technology/computer-science-courses-college.html.

[26] Brandon McKinley, "UF College of the Arts welcomes 'AI and the Arts' faculty cohort to lead research, curriculum, creative practice and interdisciplinary exploration," *University of Florida Research blog,* July 8, 2021, https://explore.research.ufl.edu/uf-college-of-the-arts-welcomes-ai-and-the-arts-faculty-cohort-to-lead-research-curriculum-creative-practice-and-interdisciplinary-exploration.html.

[27] "Bringing GPU-accelerated Computing and AI to the Classroom," NVIDIA, accessed June 1, 2022, https://www.nvidia.com/en-us/on-demand/session/gtcspring22-s42540.

[28] "Micro-Gator–Advancing the Workforce for the 21st Century," UF, accessed May 2, 2022, https://hub.aa.ufl.edu/micro-credential.

[29] "Minority Serving Institutions Program," U.S. Department of the Interior website, accessed March 5, 2022, https://www.doi.gov/pmb/eeo/doi-minority-serving-institutions-program.

[30] "About Miami Dade College," Miami Dade College website, accessed May 2, 2022, https://www.mdc.edu/about/facts.aspx.

[31] Cynthia Roldán Hernández, "Why this UF professor says everyone needs to understand AI," *University of Florida News blog,* October 6, 2021,

https://news.ufl.edu/2021/10/uf-professor-says-everyone-needs-to-understand-ai.

[32] Hodan Omaar, "How the United States Can Increase Access to Supercomputing."

[33] Amy W. Apon et al., "Assessing the effect of high performance computing capabilities on academic research output," *Empirical Economics* vol. 48 (2015): 283–312, https://doi.org/10.1007/s00181-014-0833-7.

[34] U.S. Department of Labor, "U.S. Department of Labor Announces Nearly $100 Million in Apprenticeship Grants to Close the Skills Gap," U.S. Department of the Interior website, news release, January 20, 2021, https://www.dol.gov/newsroom/releases/eta/eta20200218.

[35] "Artificial Intelligence (AI) Academy at NC State University," National Apprenticeship, accessed June 2, 2022, https://nationalapprenticeship.org/new-page.

ACKNOWLEDGEMENTS

This report was made possible in part by the generous support of NVIDIA. The Center maintains complete editorial independence for all its work. All opinions, findings, and recommendations are those of the Center and do not necessarily reflect the views of its supporters. Any errors and omissions are the author's alone.

ABOUT THE AUTHOR

Hodan Omaar is a senior policy analyst at the Center for Data Innovation. Previously, she worked as a senior consultant on technology and risk management in London and as an economist at a blockchain start-up in Berlin. She has an MA in Economics and Mathematics from the University of Edinburgh.

ABOUT THE CENTER FOR DATA INNOVATION

The Center for Data Innovation is the leading global think tank studying the intersection of data, technology, and public policy. With staff in Washington, D.C., and Brussels, the Center formulates and promotes pragmatic public policies designed to maximize the benefits of data-driven innovation in the public and private sectors. It educates policymakers and the public about the opportunities and challenges associated with data, as well as technology trends such as open data, artificial intelligence, and the Internet of Things. The Center is part of the nonprofit, nonpartisan Information Technology and Innovation Foundation (ITIF).

contact: info@datainnovation.org

datainnovation.org