

Strengthening the U.S. AI Workforce

A POLICY AND
RESEARCH AGENDA

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CENTER *for* SECURITY *and* EMERGING TECHNOLOGY

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Executive Summary

Artificial intelligence is increasingly important to national security and economic growth, and human capital is a key determinant of nations' strength in AI. To help strengthen the U.S. AI workforce, this report lays out what is currently known about domestic and global AI talent, identifies priorities for U.S. policymakers, and describes policy-relevant knowledge gaps that researchers should fill.

Our research highlights the existence of global AI talent shortages; the United States' reliance on foreign talent to sustain its AI workforce; and recent increases in international competition for students, workers, and entrepreneurs (**Section 1, "Background on the U.S. AI Workforce"**). We recommend that policymakers adopt immigration reforms to ensure continued U.S. competitiveness in attracting and retaining foreign AI talent in the short term. Our long-term recommendation is to launch education and R&D programs to lay the foundation for domestic AI workforce growth (**Section 2, "The Policy Agenda"**). Researchers can support these efforts to strengthen the U.S. AI workforce by, among other things, measuring the global stock and flow of AI talent, identifying the key immigration problems encountered by foreign AI talent in the United States, and assessing the potential effectiveness of different domestic education programs (**Section 3, "The Research Agenda"**).

KEY FINDINGS

- There is a significant talent shortage in AI, both domestically and globally. One consequence of U.S. talent shortages is that U.S. companies are moving AI R&D abroad.
- The United States heavily relies on foreign-born talent. For example, more than 50 percent of computer scientists with graduate degrees employed in the country today were born abroad, as were nearly 70 percent of enrolled computer science graduate students.
- The vast majority of foreign-born talent wants to stay in the United States. Among U.S.-trained PhD graduates in AI-related fields, around 80 percent have remained in the country.
- The United States' established strength in top talent recruitment and retention is at risk due to adverse trends in U.S. immigration policy and efforts by other countries to open up new immigration pathways and launch talent-attraction programs.

KEY POLICY PRIORITIES

- Adopting immigration policies that eliminate existing barriers to recruiting and retaining foreign-born AI talent and halting the implementation of ongoing immigration reforms that reduce U.S. competitiveness.
- Formulating targeted policies that counter the harmful transfer of AI technologies and know-how. In so doing, ensuring against overly-broad restrictions that could make the United States inhospitable to foreign researchers and workers, which would worsen talent shortages.
- Launching education and R&D initiatives that simultaneously address domestic workforce shortages and fund neglected but important research areas.
- Developing strategies for government AI workforce development based on agency-led investigations of AI talent demand and potential supply.

1 Background on the U.S. AI workforce

Policymakers interested in strengthening the U.S. AI workforce should target their efforts where they are most needed and where they can be most effective. To help policymakers prioritize, this section summarizes publicly available information and recent international policy developments relevant to the AI workforce.

ISSUE 1: THE U.S. AI WORKFORCE, LIKE THE GLOBAL AI WORKFORCE, FACES SIGNIFICANT TALENT SHORTAGES, WITH LIKELY NEGATIVE ECONOMIC AND SECURITY CONSEQUENCES.

There is a talent shortage in AI in the United States.

Several labor market indicators reveal a tight market for AI talent in the United States. First, job site statistics show that demand for workers far exceeds supply. On *Monster.com*, listings for many AI skills increased more than five-fold between 2015 and 2017, and demand for “deep learning” skills increased by a factor of more than 30.¹ *Indeed* saw the number of AI job postings more than double between 2015 and 2018, while the number of job searches grew only slowly.² On *Glassdoor*, the number of AI-related job postings has doubled in 11 months, and its chief economist predicts that demand will outstrip supply for at least another five years.³

A second indicator of a tight labor market is high private-sector salaries. For example, in a user survey by data science platform *Kaggle*, the median salary for U.S. respondents was \$110,000.⁴ Top AI talent in corporate labs makes several times that amount, even in entry-level jobs.⁵ The

subjective assessments of employers align with these indicators. “Skill gaps” rank among the top two barriers to technology adoption among firms surveyed by the World Economic Forum in 2018, most of which report a desire to invest in artificial intelligence.⁶

The exact extent of the talent shortage is difficult to measure, and different organizations have published wildly different estimates.

Although there is broad consensus in the field that talent shortages are substantial,⁷ there is no commonly accepted way to define an “AI expert” or to measure supply and demand for AI talent. As a result, different observers give hugely varying estimates of the size of the global AI workforce and the extent of global talent shortages:

- The Research Institute at Tencent, a major Chinese technology company, asserts there are roughly 300,000 AI researchers and practitioners worldwide, with market demand for millions of roles.⁸
- Element AI, a leading Canadian AI company, estimated in 2018 that there are roughly 22,000 PhD-educated researchers globally who are able to work on AI research, with only about 25 percent of those “well-versed enough in the technology to work with teams to take it from research to application.”⁹
- AI firm Diffbot estimates that there are over 700,000 people skilled in machine learning worldwide.¹⁰

These wildly differing numbers result from both definitional and measurement difficulties. Measurement challenges have also prevented researchers from reliably assessing or comparing specific countries’ AI workforces. For example, no credible estimates of the size of China’s AI workforce have yet been produced.

What is the “AI workforce,” and who counts as an “AI expert”?

When people talk about the “AI workforce” it is often not clear what they are referring to. There are many different *kinds* of expertise, ranging from a top researcher with a PhD and years of experience who could lead an R&D team to an entry-level engineer who is not a machine learning specialist but who has enough skills to execute coding tasks. There are also many different *domains* of expertise; AI systems consist of hardware and data as well as algorithms, and successful AI teams require expertise in computing infrastructure and data management as well as machine learning.¹¹

There is, therefore, no single “correct” number to determine the size of the AI workforce. Which skills and backgrounds matter most—or matter at all—depends on what kinds of AI activity one is interested in, and how broadly or narrowly one defines AI.¹² For example, Tencent and Diffbot’s AI workforce estimates seem to include people with only basic machine learning (or even just software) skills.¹³ In contrast, Element AI’s study attempts to capture only top-level talent, consisting of people who could make significant contributions to cutting-edge progress in machine learning.¹⁴ All studies claim to be tracking the “AI workforce,” but they are interested in very different groups of people.

Beyond these definitional problems, there are measurement challenges, especially when it comes to cross-country comparisons. Data from LinkedIn (on which Element AI’s estimates are based) underestimate talent numbers in countries with low LinkedIn penetration (e.g. China), and Diffbot notes that its knowledge graph has poor coverage in China due to the closed-off nature of that country’s internet.¹⁵ Similarly, data based on other metrics, such as conference publications, undercount industry R&D employees (who have fewer incentives to publish) and applied data science talent.

In this paper, we occasionally use statistics about graduate students in computer science and computer engineering when discussing the AI workforce. We focus on this group because surveys of the AI workforce indicate that most important roles in AI teams are still primarily filled by people with graduate degrees in computer science and engineering¹⁶ and because more reliable data exists on this segment of the AI workforce than on others. In future work, as described at the end of this report, we plan to collect and analyze data on other parts of the AI workforce as well.

Talent shortages in AI are likely to have negative economic and security consequences.

Projections about AI's economic effects highlight its potential to drive growth, but economists worry that a shortage of trained workers could "slow the rate of diffusion of the new technology and any productivity gains that accompany it."¹⁷ In AI, they note, talent shortages are more important than other common business problems such as funding constraints.¹⁸ Moreover, the lack of skilled workers, together with the high costs and uncertainty involved in applying for U.S. visas for foreign employees, is particularly burdensome for cash- and time-constrained startups. Experts worry that this could depress economic competition and innovation.¹⁹

On the security side, the United States needs ample talent in the public and private sectors to anticipate and defend against AI applications that could pose societal risks. Shortages of AI talent have already delayed this work.²⁰

ISSUE 2: THE U.S. AI WORKFORCE IS HIGHLY RELIANT ON FOREIGN-BORN TALENT, AND ADVERSE TRENDS IN IMMIGRATION POLICY ARE PUTTING THIS WORKFORCE AT RISK.

The U.S. AI workforce consists mostly of people born abroad.

The majority of workers in AI-related jobs and students in AI-related graduate programs are not originally from the United States.

- Among computer scientists with graduate degrees employed in the United States, 51 percent of those with master's and 59 percent of those with PhDs were born abroad. For engineers, these numbers are 35 percent for master's and 55 percent for PhDs.²¹
- Around 65 percent of computer and mathematics professionals in Silicon Valley were born abroad (70 percent for ages 25 to 44).²²
- More than 50 percent of teaching and research staff in computer science and engineering positions at American universities were born abroad. (Around half of them have become naturalized U.S. citizens.)²³
- In computer science, information science, and computer engineering, the proportion of PhD students who were non-resident aliens was 62 percent in 2017. At the master's level, the proportion was around 70 percent.²⁴

India and China are the most common countries of origin for international employees and students. For example, nearly half of all Silicon Valley professionals are from these two countries (26 percent from India and 14 percent from China),²⁵ as are the majority of international students in AI-relevant fields.

Foreign students in AI-relevant programs overwhelmingly seek to stay in the United States.

The United States has been able to retain much of the foreign talent that trains at its universities. For example, around 75 percent of students who were temporary visa holders during their computer science and engineering PhDs stay in the United States for at least ten years after completing their doctorate.²⁶ Recently, an increasing number of international STEM students—172,000 in 2016, up from 73,000 in 2014—make use of the opportunity to do Optional Practical Training to stay and work in the United States after graduating from American universities.²⁷

Students from India and China, the most common countries of origin, have some of the highest stay rates. Around 85 percent report that they want to work in the United States after graduating, and these rates have held steady over the past decade (data is available until 2017).²⁸ Actual five- and 10-year stay rates for students from these countries are also around 85 percent. Students from allied countries tend to stay at much lower rates, around 60 to 70 percent.²⁹

It would significantly damage U.S. scientific and economic progress if foreign-born students and workers in AI-related fields were to stop coming to the country.

Immigrants in the tech sector generate new jobs for American workers by contributing to innovation and growth. Chinese or Indian engineers led about 25 percent of all high-technology businesses in Silicon Valley in the early 2000s.³⁰ In 2011, 87 percent of top university patents awarded for semiconductor device manufacturing and 84 percent of those for information technology had at least one foreign-born inventor.³¹

Moreover, foreign-born AI talent is not crowding American students or workers out of the labor market. Private sector executives have noted in interviews that “the demand for tech and science talent is so great that when they find both a qualified U.S. applicant and another who is a foreign national, they would offer jobs to both individuals.”³²

Immigration obstacles have already begun to hurt AI activity in the United States. For example, Ian Goodfellow, previously one of Google’s top machine learning scientists (currently at Apple), said, “visa restrictions have been one of the largest bottlenecks to our collective research productivity over the last few years.”³³ These problems have recently led leading companies—including Facebook, Microsoft, Google, Amazon, and Intel—to set up AI centers in other countries in pursuit of local talent.³⁴ Because innovation attracts talent and vice versa,³⁵ these trends could set in motion a self-reinforcing process that firmly establishes AI talent hubs abroad.

Changes in U.S. immigration policy are making the United States a less attractive place for foreign AI talent.

Other countries have seen a recent uptick in applications from international tech workers who previously would have wanted to work in the United States. In 2017, 62 percent of high-growth Canadian companies said they had seen a notable recent increase in U.S.-based applicants in the preceding year, attributed largely to the U.S. immigration environment at the time. For example, AI chatbot startup Zoom.ai saw its U.S.-based applications rise from virtually zero to a third of total engineering applicants.³⁶ This trend has continued in 2019.³⁷

The U.S. immigration system has been particularly unfriendly toward prospective foreign-born entrepreneurs, especially since the 2017 rollback of the International Entrepreneur Rule, which until then was the only program available to immigrants who wanted to start new businesses. Surveys show that foreign-born STEM PhDs are more excited than domestic students to start companies or join startups, but also that, due to legal constraints, they disproportionately end up working at established firms instead.³⁸ In 2017, about a quarter of tech workers surveyed by the job platform *Hired* said the U.S. immigration environment made them less likely to start a company.³⁹

Business leaders and practitioners are taking notice of these trends. Industry executives surveyed by the World Economic Forum in 2018 listed “Shifts in legislation on talent migration” as one of the main trends that could negatively affect business growth,⁴⁰ and researchers in AI labs have expressed strong concerns that changes in immigration policy will lead to both a decrease in talent coming into the United States and an increase in talent leaving the country.⁴¹

Other countries, including U.S. allies and China, strategically respond to changes in U.S. immigration policy, and they have significantly increased efforts to recruit U.S.-based AI talent.

Many countries have recently launched and expanded visa schemes aimed at attracting high-skill tech talent, including AI talent. Canada has implemented a Global Skills Strategy for temporary foreign workers and an Express Entry program for permanent residency applications; both systems process applications significantly faster than their U.S. counterparts.⁴² Many of these efforts—one 2018 study found nearly 20 country programs—target entrepreneurs in particular.⁴³ For example, the U.K. has a “Tech Nation Visa Scheme,” and France has implemented a similar program.⁴⁴

China has been particularly willing to invest in AI talent programs,⁴⁵ including several programs aimed at foreign recruitment. Chinese technology companies such as Baidu have established labs in the United States and other Western countries;

A billboard in San Francisco advertising Canada's start-up visa to U.S.-based international tech workers on H-1B visas.



(PETER DASILVA/THE NEW YORK TIMES/REDUX)

both have done so because, as Baidu executives put it, the “the top echelon of AI talent” is concentrated in the West and because such labs are a “main recruitment channel” for funneling talent to China.⁴⁶ China has also reformed immigration rules at both the national and local level to attract foreign tech talent and entrepreneurs.⁴⁷

Countries competing with the United States for AI talent closely monitor and strategically respond to changes in U.S. high-skill immigration policy.⁴⁸ For example, the deputy editor for *China Daily USA* stated that “[the United States’] expanding employment-based visas and the H-1B visa program ‘would pose a huge challenge for China, which has been making great efforts to attract and retain talent.’”⁴⁹ Canadian tech executives, in response to the White House considering H-1B reform in early 2017, drafted a letter to the Canadian government asking it “to institute an immediate and targeted visa providing those currently displaced by the US Executive Order with temporary residency in Canada.”⁵⁰

ISSUE 3: U.S. LEADERSHIP IN AI EDUCATION AND RESEARCH IS STILL HELPING IT ATTRACT TOP FOREIGN TALENT, BUT THIS LEADERSHIP POSITION IS BECOMING LESS SECURE.

The United States benefits greatly from its role as a leader in AI education and R&D.

The United States has long been a leader in AI, having originated and funded much of the field's progress in the twentieth century.⁵¹ This leadership position has helped its universities attract much of the world's top talent, who, had they not wanted to study in the country, may not have come at all—many foreign-born, highly skilled workers first come to the United States to study and only later make the decision to stay and work.⁵²

American universities' attractiveness to the world's top AI talent has large downstream economic benefits. AI companies tend to cluster around university centers for talent access;⁵³ six of the 10 U.S. metro areas with the most AI job offerings are also home to top AI universities. Notable pairings include Silicon Valley with Stanford, Boston with MIT, and Austin with the University of Texas, Austin.⁵⁴ Such talent ecosystems are significant sources of innovation and job growth.

Faculty and teacher shortages are a significant concern in AI education and could pose a bottleneck for talent growth, forcing talented foreign students to go elsewhere.

Student enrollment in AI-relevant fields such as computer science has rapidly risen in recent years. The number of bachelor's degrees granted in computer science and computer engineering at U.S. institutions nearly tripled from 2009 to 2017.⁵⁵ In many AI-focused introductory courses, enrollment in 2017 was three to five times higher than in 2012.⁵⁶ Due to a lack of teaching staff, however, few colleges have been able to meet student demand.⁵⁷

There has been an even larger spike in demand for graduate education, with a similar supply shortage. For example, Berkeley's Electrical Engineering and Computer Science doctoral program saw an increase from 341 applications in 2008 to more than 2,500 in 2017, with the intake class growing only from 10 to 38.⁵⁸ The total number of computer science PhD students in the United States remained almost flat between 2007 and 2017.⁵⁹

Many in the field worry that the number of capable instructors is failing to keep pace with demand due to private sector "poaching" of academics.⁶⁰ From 2006 to 2014, the proportion of deep learning publications with a corporate-affiliated author increased from about 0 to 40 percent, reflecting increasing movement of researchers from academia to the private sector.⁶¹ The most commonly-cited reason for this movement is high private sector salaries,⁶² but a lack of access to large-scale, interesting datasets and sufficient resources for computationally intensive experiments also plays an important role.⁶³

U.S. companies are not properly incentivized to provide in-house AI training.

Companies realize they would benefit from having their employees acquire AI skills, and one might expect them to compensate for the lack of requisite university offerings by providing employees with on-the-job training and other educational resources. However, the highly competitive labor market for AI talent means many companies are unlikely to invest significant resources in training, since there is a large risk that their employee gets poached soon after having acquired new skills.⁶⁴

Other countries, most notably China, are trying hard to challenge U.S. leadership in AI education and R&D.

About 20 countries have adopted national AI strategies in the last two years. Several strategies—including those of France, the U.K., South Korea, and the European Union—entail funding commitments exceeding \$1 billion for AI talent and R&D programs.⁶⁵ China’s “AI Innovation Action Plan for Colleges and Universities” calls for the establishment of 50 new AI institutions by 2020.⁶⁶ (Data that tracks the implementation of these AI strategies is not currently available.)

China is emerging as the main academic competitor to the United States, although it still lags behind. In 2014, the top 15 AI universities internationally (ranked based on top conference papers authored by university-affiliated researchers) included nine U.S. universities, two each for Israel and Canada, and one each for the U.K. and China. In 2018, there were eight U.S. universities, four for China, and one each for the U.K., Switzerland, and Singapore.⁶⁷

Talent indicators paint a mixed picture of how effective other countries have been in challenging the attractiveness of the United States. For example, international enrollment in U.S. graduate engineering programs has fallen rapidly (10 percent drops in both the 2016-2017 and 2017-2018 academic cycles), but the trend in computer science is the opposite (2 percent and 6 percent increases, respectively).⁶⁸ In 2016, the proportions of colleges that had students decline admission offers because they stayed at home or went to a third country were 14 and 19 percent, respectively. By 2018, these had risen to 39 and 59 percent.⁶⁹

2 The Policy Agenda

While more research is needed to provide targeted policy recommendations, there is sufficient data to identify the issues that should top the agenda of policymakers who aim to strengthen the U.S. AI workforce. This section lays out what these priorities are.

PRIORITY 1: TARGET IMMIGRATION AND COUNTER-TRANSFER REFORMS TO MAXIMIZE THE BENEFITS AND MINIMIZE THE RISKS ASSOCIATED WITH FOREIGN AI TALENT.

Determine which aspects of the U.S. immigration system cause the most problems for AI talent and employers and use this knowledge as the basis for targeted reforms.

Without more data on the background and immigration status of current and prospective AI workers, it will remain unclear which reforms to the existing immigration system would most benefit the AI workforce. Together with external experts, agencies with relevant data should explore in more detail which degrees and fields are the most important feeders into the AI workforce and which immigration problems foreign-born AI talent most commonly encounter.⁷⁰

Policymakers could also consider creating new immigration pathways for AI experts.⁷¹ There is precedent for the creation of such targeted pathways. For example, certain groups, such as fashion models or citizens of Australia and Singapore, currently have access to special visa categories. However, the main downside of talent prioritization by policy rather than

by employers is that policy often struggles to keep up with rapid changes in emerging technical fields.

Even if positive reform proves infeasible in the short term, the AI workforce would benefit from simply maintaining and efficiently administering the current immigration system. Several recently implemented or proposed changes are likely to negatively affect the AI workforce. Scaling down or eliminating the post-education Optional Practical Training program for student visa holders would be especially harmful, as AI students and employers use this program extensively.⁷²

Raise awareness of knowledge and technology transfer risks within academia and the private sector and investigate options for targeted counter-measures.

AI is a powerful general-purpose technology with both economic and security value. Other countries, most notably China, are actively trying to transfer and absorb AI knowledge and technology from the United States for their industries and militaries.⁷³ The relevant U.S. government agencies should explore ways to make AI researchers and companies more aware that their work is strategically relevant and therefore targeted by foreign governments and intelligence services. Currently, such awareness is often lacking.⁷⁴

At the same time, policymakers should keep in mind that indiscriminate counter-transfer measures, such as visa restrictions targeted at entire national groups, would be counterproductive.⁷⁵ Such restrictions would make the United States a less attractive place for AI talent, leading companies in search of workers to transfer more of their work abroad—thereby in fact *increasing* the potential for knowledge and technology transfer. These kinds of policies should be used only as measures of last resort.

Instead, counter-transfer efforts should focus on more targeted programs such as investment screening, enhanced information security, and the prosecution of industrial espionage.⁷⁶ These programs should involve extensive partnerships with private sector actors, who possess much of the most sensitive AI technology and knowledge. They should also emphasize efforts aimed at prevention in addition to response⁷⁷ and be implemented with due attention to the risks of discriminatory impacts or perceptions.⁷⁸

PRIORITY 2: SUPPORT UNIVERSITIES, SCHOOLS, AND BUSINESSES IN SCALING UP AI TRAINING INITIATIVES.

Ensure U.S. universities remain able to compete for top talent against both private sector and international academic competitors.

Universities are an important part of the American AI ecosystem. To maintain the U.S. lead in academic AI research, policymakers should ensure that universities and schools have access to the requisite computational and data resources to conduct cutting-edge AI research and training, allocating additional resources where necessary. This could involve, for example, public-private partnerships,⁷⁹ financial support for initiatives that facilitate external (e.g. cloud-based) compute usage,⁸⁰ or government data-sharing programs with universities.⁸¹

It remains to be seen whether other countries' AI initiatives, such as China's program to create fifty research and training centers by 2020, will be able to meaningfully challenge American predominance. The relevant agencies should put in place mechanisms to track the performance of these international initiatives so that R&D and training resources can be deployed if America's edge in particular AI research and application areas appears to be eroding.

Incentivize AI education and training initiatives outside of university settings.

Schools and businesses can play an important role in strengthening the U.S. AI workforce. To expand the domestic talent pipeline, Congress should make available funding that helps K-12 schools offer computer science classes at earlier stages and encourage them to treat computer science as being on par with traditional sciences like chemistry and biology. These efforts should be paired with new programs for training new high-quality computer science teachers⁸² and investment in under-represented groups, whose current lack of access to computer science education means their talents remain underutilized.⁸³

In the private sector, policymakers should explore ways to encourage AI adoption and incentivize on-the-job AI training. For example, making AI human capital expenditures tax-deductible, as physical capital expenditures are, could lead to more business-led training initiatives, thereby strengthening the AI workforce as a whole.⁸⁴

PRIORITY 3: IMPROVE DIRECT GOVERNMENT ACCESS TO AI TALENT.

Investigate where the need for AI skills in government is greatest and the ways in which talent can be recruited, trained, and retained in government service.

There is widespread recognition that the U.S. government could benefit from having employees with AI skills, but effective AI workforce planning and recruitment will require more groundwork. On the demand side, federal departments and agencies should inventory what AI applications they are interested in implementing and

what kinds of skill and resource gaps, if any, prevent implementation. The Office of Personnel Management should also be asked to track how many AI experts are employed in government and how many AI job openings exist.

On the supply side, policymakers should also explore new mechanisms and authorities for bringing AI talent into government. For example, Congress could expand existing proposals for public-private sector exchanges in cyber security, like the “Cyber Security Exchange Act,” to cover AI and other technical domains.⁸⁵ To ensure such efforts are well-targeted, agencies should conduct focus groups and surveys with AI students and practitioners to collect data on what types of projects and employment arrangements would be most attractive to AI talent.⁸⁶

3 The Research Agenda

Policymakers will need more rigorous evidence and research to effectively pursue AI workforce policy priorities. This section outlines several research topics and questions that are valuable to tackle from a policymaking perspective. CSET is working on many of these questions, and we welcome feedback and proposals for collaboration.

PRIORITY 1: MAP WHERE AI TALENT AND R&D ARE LOCATED TO HELP ASSESS DIFFERENT ACTORS' CAPABILITIES AND MONITOR TRENDS.

- What are the relevant skill and job categories on AI research and application teams? How many students and workers exist with which kinds of skills and qualifications? Where are they from, where are they located, who do they work for, and why? Are there any important changes over time in the stock and flow of AI talent across different companies, sectors, and countries?
- Where is AI R&D concentrated, both within the United States and globally? Do these geographical patterns differ across AI application areas or techniques? How important is access to talent for companies when deciding where to set up AI labs? If more talent were available in the United States, would that slow down or reverse the trend of U.S. companies increasingly setting up AI R&D labs abroad?

PRIORITY 2: DETERMINE WHAT IMMIGRATION POLICY REFORMS WOULD MOST BENEFIT THE U.S. AI WORKFORCE.

- What visa categories are most widely used by foreign-born AI talent? How accessible are visas in these categories? Are there potential immigrants with AI skills who are not well-served by existing visa categories? What other obstacles in the U.S. immigration system exist for AI talent? What policy changes would most effectively address these obstacles? Is it possible to estimate quantitatively the positive and negative effects from different potential policy scenarios?
- What are other countries doing to attract and retain foreign-born AI talent? Are their programs working? And what lessons can the United States learn from these efforts?

PRIORITY 3: ANALYZE THE POLICY MEASURES AND FUNDING INCREASES NEEDED FOR UNIVERSITIES AND BUSINESSES TO DO MORE R&D AND TRAINING.

- How many academics have moved into non-university labs, either full-time or part-time? How large is the shortfall of AI instructors in universities and schools? How many additional students could be trained if funding for faculty hiring or student scholarships were to increase? What are universities across the world doing to attract and retain talented students and faculty? Can the United States learn from those efforts?
- From the perspective of R&D quality and focus areas, what is the right balance between industry- and academia-based research? What types of AI R&D are likely to be underfunded without government programs, how much funding is needed in these areas, and where should that funding go, exactly? What can the government do to help create additional self-sustaining tech R&D ecosystems in the United States that attract talent and drive innovation?

PRIORITY 4: ASSESS WHETHER U.S.-BASED AI KNOWLEDGE AND TECHNOLOGY IS BEING TRANSFERRED AND EVALUATE POTENTIAL COUNTERMEASURES.

- What are the main venues and vectors through which other countries are attempting to absorb or transfer AI-relevant knowledge and technology from the United States? How successful have they been, and what factors have contributed to their success (or lack thereof)?

- How can the government, universities, and companies work together most efficiently to prevent harmful transfer? What countermeasures are already in place? What would be the net effects of different types of additional countermeasures, taking into account both deterrent effects and potential loss of talent due to restrictions and perceived discrimination?

PRIORITY 5: INVESTIGATE WHETHER AND HOW THE GOVERNMENT COULD TRAIN, RECRUIT, AND RETAIN AI TALENT, LOOKING AT BOTH TALENT DEMAND AND SUPPLY.

- What are the main mechanisms the government has to train, recruit, and retain AI talent? If these are inadequate, what new mechanisms need to be created? How much and what kind of AI talent does the government need to have in-house? What lessons can be learned from existing and past programs that aimed to grow the technical talent base in the federal workforce?⁸⁷
- Are AI researchers and practitioners receptive to working for the government? For what reasons, in what kinds of arrangements, and on what kinds of applications? Have they ever considered the option or been contacted? What kinds of resources would be helpful to them in thinking about potential government jobs or careers?

4 Conclusion

In the coming decades, the United States' competitiveness in AI will depend in large part on its ability to continue attracting and retaining the world's top talent in the field. All the components of AI systems—algorithms, computing hardware, and data—are ultimately useless without highly skilled people who can work with them. Talent in AI is scarce, however, and competition will continue to be intense.

As outlined in this report, the United States has started the competition for AI talent from a place of advantage. Its universities and companies have long attracted many of the most ambitious and innovative people in the field. And even though many of these students, workers, and entrepreneurs are not American citizens, most want to stay and settle in the United States.

Recent developments have jeopardized this leadership position. Domestically, changes in immigration policies are negatively affecting universities and companies, which have consequently started shifting some of their AI activities abroad. Other countries are investing heavily in AI R&D and training while also opening up new immigration pathways for foreign talent—often explicitly targeting U.S.-based students, workers, and entrepreneurs.

Policymakers should orient their AI workforce efforts toward achieving two overarching goals. First, they should lay the foundation for long-term growth of the domestic talent pool, focusing not only on universities, but also on schools and businesses. Second, they should ensure that foreign talent remains both eager and able to come to this country. U.S. govern-

ment support was essential in launching the field of AI and sustaining it for much of the twentieth century. Today, as in the past, policy will be crucial for maintaining U.S. leadership in the development and application of AI technologies.

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