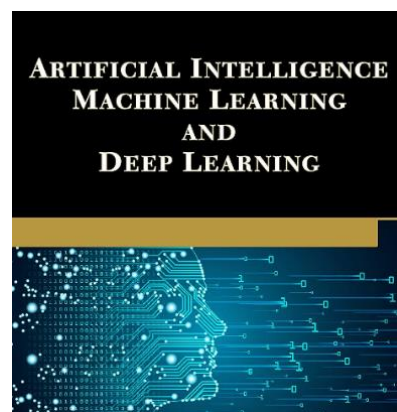# Machine Learning and Deep Learning Advancements and Opportunities for Minority Business Enterprises
U.S. Department of Commerce, MBDA

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Directed Detail Assignment

Report for: Joann J. Hill, Chief, OBD, MBDA

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Introduction:

Machine learning and deep learning technologies have become the center of attention in the recent years, re-imagining what was thought to be previously impossible and shaping the future vision of society. Said innovations have opened numerous opportunities for businesses to leverage these newfound intelligent systems, gaining a competitive edge in an otherwise stagnating and human-dominated tech market. While these advancements hold immense potential, we must ensure that the benefits are accessible and manageable to all, including minority business enterprises (MBEs).

MBEs play a critical role in promoting diversity, innovation, and cultural growth. However, MBEs have historically faced challenges and barriers in accessing emerging technologies, capital, and resources critical for business success due to wealth disparity or discrimination. It is of absolute priority that MBEs participate in this technological breakthrough of machine learning and deep learning. Through these gifts of tools given to us, we can promote inclusivity, bridge the digital divide between cultures and nations, and unlock the untapped potential within underrepresented communities.

This report aims to explore the advancements made in machine learning and deep learning, identify specific opportunities for MBEs to leverage these technologies, and facilitate both integration and success. We aim to bridge the gap and ensure that the benefits of machine learning and deep learning are accessible to everyone. By fostering an inclusive environment and facilitating the participation of minority-owned businesses, we can create a prosperous future where innovation knows no boundaries.

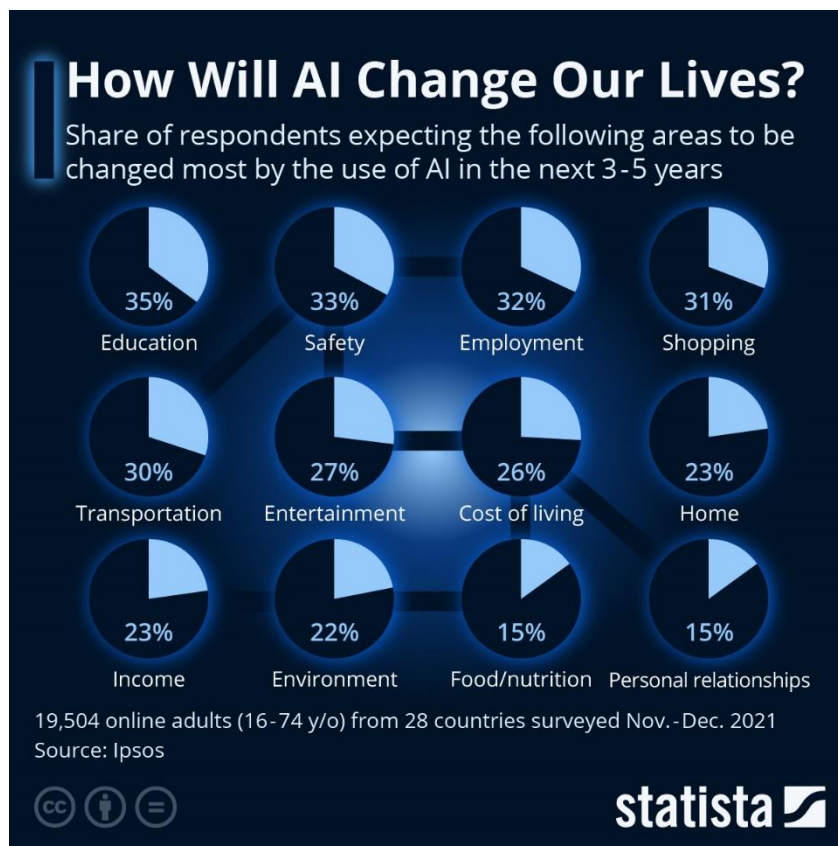<u>**US and Global Machine Learning/Deep Learning Trends:**</u>

Generative Models: Generative models, such as ChatGPT and other AI assistants have gained popularity for their ability to generate synthetic data and create realistic samples. These models have applications in areas like image synthesis, data augmentation, and anomaly detection.

Market leader companies, such as Google, Meta, and Microsoft all have their own respective models of Generative Ai: Google Bard, Meta's LLaMa, and Microsoft's Copilot.[1]

Transfer Learning: Transfer learning involves leveraging pre-trained models and applying them to new tasks or domains with limited labeled data. This approach has gained popularity due to its ability to accelerate model training and improve performance.[2]

Autonomous Vehicles/Self Driving Technology: Self Driving Technology has been a prominent trend, especially among cars. As of 2021, Tesla completely popularized this concept with the optional "self-driving package" available on all their car models. Many car brands followed suit, such as Rivian, Lucid, BMW, and more. Self-Driving combines various technologies such as computer vision, sensor function, motion planning, and deep learning to the transfer learning technology to create an efficient, brand-new entry into the self-driving car market.

These trends are only the surface of a rapidly expanding industry. According to Source I below, the poll from 19,504 adults showed that Artificial Intelligence may be more involved in our lives than we ever thought. Artificial intelligence and virtual reality may eventually be indistinguishable from reality, creating an augmented reality of sorts.

(Source III: https://www.statista.com/chart/29229/areas-of-life-most-expected-to-change-by-the-use-of-ai/)

Current AI Market:

- The United States, China, and India all dominate the AI Market. In 2021, the US accounted for 54% of the total global AI market revenue, while China had 18% market share.[4]
- Less than 29% of global AI Scientific Pages supplied by other countries outside of these three countries.[5]
- The Biden Administration signed an executive order directing federal agencies to root out bias in their design and current AI architecture to protect the public from algorithmic and technological discrimination.[6]
- New Investments to power responsible American AI Research and Development: The National Science Foundation is announcing $140 million in funding to launch seven new National AI Research Institutes.[7]
- The US leads in total AI investment, with over $93 billion invested since 2015, including $20.6 billion in 2021 alone. Leading tech firms like Google, Microsoft, Meta, and Amazon account for the bulk of this investment.[8]

Where New AI Research Comes From

How many papers are published in each country annually?

Global output of AI scientific papers
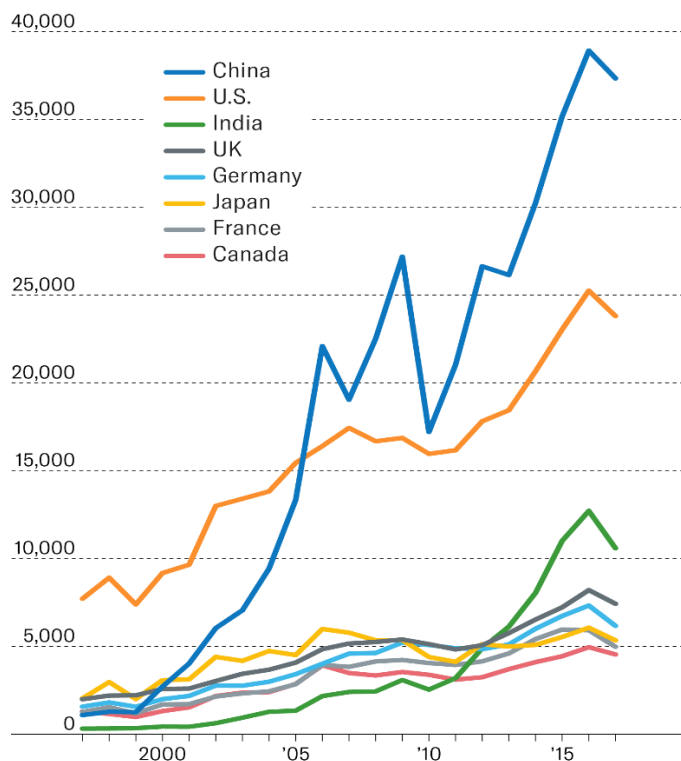
Source: *China AI Development Report 2018*, China Institute for Science and Technology Policy at Tsinghua University

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Steps and Opportunities in the Machine Learning/Deep Learning Trend:

The U.S. is home to many of the world's largest publicly traded tech companies that are pioneers in AI research and development, such as Apple, Microsoft, Nvidia, Meta, and Google.[9]

AI Technology is still in its early stages, as the concept of AI to the general public was popularized by ChatGPT, which debuted in November 30, 2022.

Partnerships between federal agencies and US tech companies provide minority entrepreneurs with access to AI resources, data, and cloud credits to accelerate adoption.[10]

Leading US tech companies have created startup accelerators focused on increasing diversity, which provide access to mentors, training, and investor networks for minority-owned businesses.[11]

The innovations driven domestically strengthen the US's position as a hub for AI research and commercialization, which brings new opportunities and demands that MBEs can fulfill.

Federal AI ML/DL Programs:

The National Artificial Intelligence Initiative: To ensure continued U.S leadership in A.I. research and development, to lead the world in the development and use of trustworthy AI in the public and private sectors and prepare the present and future U.S workforce for the integration of AI Systems across all sectors of the economy and society.[12]

The National AI Research Resource Task Force – A joint task force between the White House, National Science Foundation, and Department of Energy to facilitate and provide access to computing resources for AI research and development to students, engineers, and scientists.[13]

The National Security Commission on AI: This commission provides guidance to the President and Congress to advance AI in support of national security. A key focus is establishing partnerships with industry and allies to deliver cutting-edge capabilities while upholding American values.[14]

What MBEs Need:

For MBEs to effectively leverage AI/ML technologies and participate in this rapidly evolving field, certain needs must be addressed:

- Access to funding and investments to acquire AI solutions, data resources, infrastructure, and talent. Government grants and/or corporate partnerships could provide necessary capital.
- Development of digital skills and AI/ML literacy through educational initiatives and training programs tailored to MBEs. Partnerships with academia and Big Tech could facilitate this process.
- Availability of high-quality, unbiased training data that reflects diverse populations. MBEs face barriers in data collection. Providing high quality in this scenario would be a catalyst for further diversity.
- Access to AI/ML tools, frameworks, and pre-trained models to expedite development. Open-source libraries and cloud-based services with free tiers can lower barriers. Examples include the free versions of ChatGPT and Google Bard.
- Visibility and networking platforms to connect MBEs with partners, collaborators, mentors, and customers in the AI ecosystem. Conferences, meetups and showcases focused on MBEs could expedite vital relationships and networks.
- Policy and regulatory support to promote algorithmic fairness, transparency, and accountability.

Targeted action to ensure MBEs can obtain the necessary resources, knowledge, data, tools, connections, and policy support is essential. With ensuring that AI programs are carefully designed from the ground up, the potential to uplift and empower MBEs through technology can be fully realized.

Risks and Considerations:

Generative AI Risks:

- Ethical concerns regarding deepfakes that spread misinformation. For example, a convincing fake video of a politician could misrepresent their views and manipulate voters.
- Legal implications and copyright issues. Services like Getty Images have threatened lawsuits against AI image generators like Stable Diffusion for replicating copyrighted visual assets.

Transfer Learning Risks:

- Challenges customizing models require expertise. For example, a model trained on analyzing social media text may not understand industry-specific jargon.
- Inadvertently transferring biases can lead to discrimination. Facial recognition models trained on biased datasets often struggle with fairness toward women and minorities.

Self-Driving Technology Risks:

- Reliability concerns, as accidents like Tesla fatalities illustrate. Ensuring safety is complex, as systems struggle perceiving some objects.
- Job displacement may occur disproportionately in lower-income areas. For example, autonomous trucking could impact trucker jobs concentrated along certain routes.
- The potential displacement of human workers in industries heavily reliant on driving, which may disproportionately affect certain communities and exacerbate economic disparities.

General Considerations:

- Access to resources and expertise in AI technologies, as MBEs may face barriers such as limited funding, lack of technical skills, or limited access to quality training data.
- Addressing the digital divide, as the benefits of AI adoption may not reach all communities equally, further widening existing socioeconomic disparities.
- Ensuring inclusivity and diversity in the AI industry by promoting the participation of underrepresented groups and avoiding biases in AI development.
- The need for effective and comprehensive regulations to mitigate risks, promote transparency, and establish accountability frameworks for AI systems.

Conclusion:

In conclusion, the recent trends in AI, deep learning, and machine learning present significant opportunities and advancements for Minority Business Enterprises (MBEs) to benefit from. By ensuring the accessibility and scalability of these opportunities for MBEs, we can promote inclusivity, bridge the digital divide between nations, and unlock the untapped potential of technology.

There are various AI trends in the field, such as generative models, transfer learning, and autonomous vehicles/self-driving technology we talked about above. Generative models, ChatGPT and Google Bard specialize in image synthesis, data generation/modification, and anomaly detection. Transfer learning has gained popularity for its ability to leverage pre-trained

models/systems and improve performance in new tasks or domains with limited labeled data. Meanwhile, self-driving technology, powered by computer vision, sensor function, motion planning, and deep learning, is revolutionizing the automotive industry.

The current AI market is primarily consisted of the United States, China, and India, but given the technological advancement and generative AI nature other countries are not far behind. To emphasize the United States' lead in this market, the Biden Administration has directed federal agencies to root out bias in AI systems, and investments are being made in responsible AI research and development. The National Science Foundation's funding of new National AI Research Institutes and creation of the National Artificial Intelligence Initiative demonstrate the commitment of the United States to lead in AI research, development, and workforce preparation.

To drive MBE participation, targeted programs providing access to resources, partnerships, training, and policy influence are recommended. Proactive monitoring for biases through careful AI Construction is also key. With concerted efforts to foster an inclusive environment, MBE integration in AI will empower underrepresented communities, promote diversity and innovation, and build a future where all can benefit from AI.

Overall, by fostering an inclusive environment and providing MBEs with knowledge, resources, and opportunities, we can create a more equal and prosperous future. Through the integration of MBEs in the ever-expanding field of machine learning and deep learning, we bridge the gap, promote diversity, innovation, and cultural growth, and ensure that the benefits of these technologies are accessible to all. We empower underrepresented communities, unlock their potential, and build a society where innovation knows no boundaries.

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Glossary:

AI - Artificial intelligence; simulation of human intelligence in machines that are programmed to think like humans and mimic their actions.

Algorithmic bias - Systematic and repeatable errors in a computer system that create unfair outcomes, especially for certain disadvantaged groups.

Anomaly detection - The identification of rare events or observations that raise suspicions by differing significantly from most data.

Augmented reality - An enhanced version of reality created using technology to overlay digital information on the physical world.

Autonomous vehicles - Self-driving vehicles that can sense their environment and navigating without human input.

Chatbots - Computer programs designed to simulate conversation with human users, especially over the internet.

Computer vision - The field of artificial intelligence focused on enabling computers and systems to derive meaningful information from digital images, videos and other visual inputs.

Data augmentation - Strategies used to increase the amount/diversity of data available for machine learning models to train and adapt on.

Deep learning (DL) - A type of advanced machine learning where the machine searches existing online networks and information available on the internet, allowing for more comprehensive analysis and research.

Digital divide - The technological difference between groups/cultures/countries that have access to modern information technology and those that don't have access.

Generative adversarial networks (GANs) - A class of machine learning frameworks involving two neural networks contesting with each other to generate new, synthetic data.

Inclusivity - The practice of ensuring equal access to opportunities and resources for people who might otherwise be excluded from.

Machine learning (ML) - The study and construction of algorithms that can learn from and make predictions on data, without being explicitly programmed.

Marginalized communities - Groups and populations that are treated as insignificant or discriminated by the mainstream community.

Minority business enterprises (MBEs) - Businesses that are at least 51% owned and operated by individuals who are part of a minority group.

Natural language processing (NLP) - A field of artificial intelligence focused on interactions between computers and human languages.

Predictive analytics - Techniques used to make predictions about future outcomes based on historical data and trends using machine learning or statistical modeling.

Recommendation systems - Systems that seek to predict items or content that a user may be interested in based on various data gathered from customers.

Robotics process automation (RPA) - Technologies that automate traditional tasks performed by humans.

Self-driving technology - Technology allowing vehicles to operate and navigate without active physical control by a human operator.

Sentiment analysis - A language processing technique focused on identifying, extracting, and analyzing subjective information and emotions expressed in text or writing.

Transfer learning - A machine learning approach applying knowledge gained during training on one problem to a different, related problem.