The Top Seven Ways Scientists and Engineers Should Prepare for the AI-Driven Era

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In late 2022, ChatGPT took the world by storm, reaching one million users in just five days — faster than platforms like Netflix, Airbnb, Twitter, Facebook, Spotify, and Instagram — including eighty percent of Fortune 500 companies and forty-three percent of college students. Over a period of one year, it doubled its number of active users, reaching over 200 million weekly users by the end of 2024. This marked the beginning of a new era for generative AI (GenAI), sparking a wave of innovation across industries. Many Fortune 500 companies are now building their own large language models (LLMs), and scores of GenAI applications have emerged.

Yet, while GenAI dominates headlines, it's important to recognize that the bulk of nearly half a trillion dollars invested in AI startups over the past decade has gone into non-GenAI applications. Machine learning, analytics, predictive AI, deep learning, computer vision, natural language processing, and data management have been the primary focus. According to McKinsey, artificial intelligence (AI) could create anywhere from 20 million to 50 million new jobs globally by 2030, transforming industries like healthcare, technology, manufacturing, and finance.

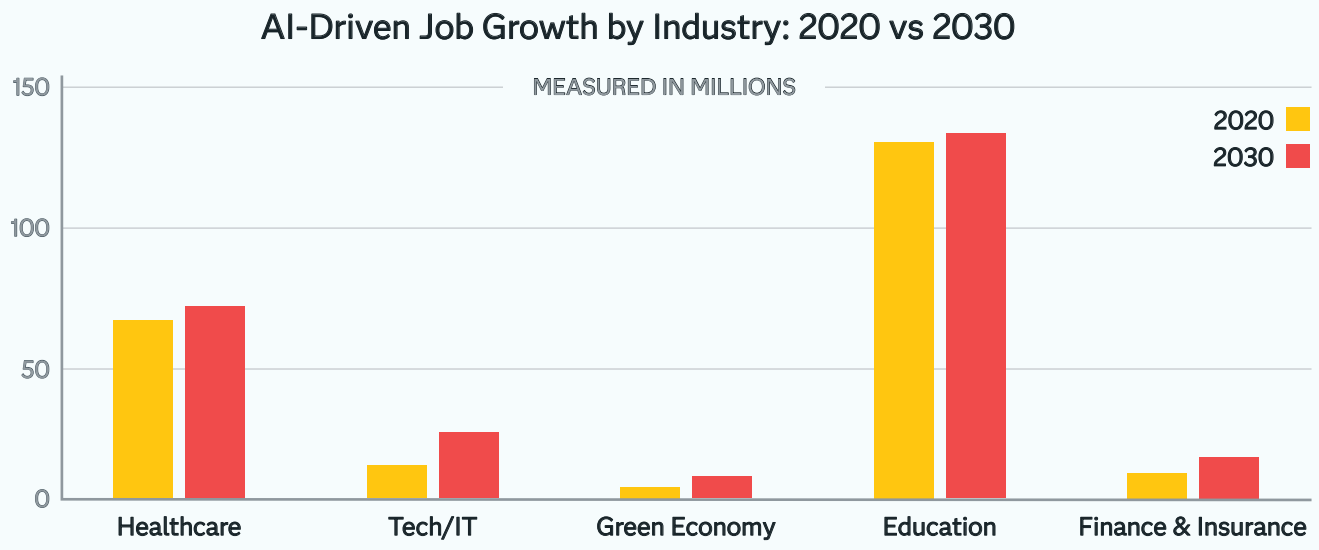

CHART SOURCES: World Economic Forum, Bureau of Labor Statistics, BMJ Global Health, McKinsey

AI's potential to solve global challenges such as cancer, climate change, and poverty is immense. But how will these advancements affect the roles of researchers, scientists, and engineers?

> *We are in the midst of one of the largest surges of analytical productivity in human history, impacting nearly every branch of science and engineering. The biggest benefits for scientists and engineers lie not in generative AI but in classic AI—leveraging traditional predictive modeling using image, unstructured text, or numerical and tabular data."*
>
> — Russ Wolfinger, *Director of Scientific Discovery and Genomics and Distinguished Research Fellow at JMP*

AI's Growing Impact on Scientific Research & Engineering

AI is reshaping the way scientific research and engineering are conducted, from revolutionizing data analysis to advancing experimentation and problem-solving. Its potential to significantly accelerate discovery and innovation is already being realized across a wide range of industries (as shown in the table below). By automating complex data analysis processes, AI is freeing up scientists and engineers to focus on higher-level creative and strategic tasks, enhancing both efficiency and innovation.

Common Uses of AI Across Science and Engineering Disciplines

Chemical

AI enhances chemical process optimization by predicting reaction outcomes and improving production efficiency through advanced data analysis techniques.

Industrial Manufacturing

AI-driven systems are now performing visual inspections and detecting product defects, roles that previously required human inspectors.

Energy

By analyzing vast amounts of geological and commercial data, AI enables energy companies to swiftly and precisely locate potential subsurface carbon storage sites, cutting down the time from months to mere hours.

Pharmaceutical

AI accelerates drug discovery by analyzing molecular interactions and predicting potential candidates for clinical trials faster than traditional methods.

Material Science

Google's Graph Networks for Materials Exploration (GNoME) has accelerated the discovery of new materials. Out of 2.2 million predictors, over 380,000 materials show potential for experimental synthesis, including superconductors and advanced batteries.

Semiconductor

AI enables wafer manufacturers to assess quality by analyzing millions of images generated during the production process, detecting defects at early stages.

Why Humans Will Always Be Essential

The rise of AI has sparked concerns that its capabilities could lead to job loss, with machines replacing human expertise. While AI has the potential to dramatically speed up development cycles, it's crucial to acknowledge the risks of over-reliance. The rapid pace of AI can lead to shortcuts, compromise safety margins, and undermine essential engineering principles.

While AI enables rapid innovation, it is essential to recognize that speed must not come at the expense of rigor. The importance of human oversight cannot be overstated. Even as AI takes on more roles in research and development, experts in science and engineering must remain deeply involved to ensure that AI's outputs align with the stringent standards of these fields. By doing so, AI can drive progress while upholding the necessary checks and balances that safeguard quality and safety.

> *AI is only as good as the data and information it is trained on. Expert scientists and engineers are the ones who generate this content and should always remain one or more steps ahead."*
>
> — Russ Wolfinger, *Director of Scientific Discovery and Genomics and Distinguished Research Fellow at JMP*

The presence of AI in scientific research and engineering is undeniable, but its integration must strike a careful balance between embracing innovation and upholding established principles. As AI continues to evolve, its role should be seen as enhancing—not replacing—the expertise and creativity of scientists and engineers. This balance will drive unprecedented breakthroughs while maintaining the rigor and precision that these fields demand. As we consider these challenges, we must also address concerns about job displacement.

Ultimately, AI is not poised to replace researchers, scientists, or engineers, but to augment their work. While AI will automate certain manual or repetitive tasks, it will also increase the demand for roles that require deep expertise and critical thinking, ensuring that human contributions remain indispensable.

The Top Seven Ways to Prepare for Changes with AI

According to research from Foote Partners, AI has quickly become one of the most in-demand skill sets in the job market, with AI-related skills now commanding pay premiums of 7% to 21% over base salary. In response, nearly a third (29%) of organizations have created dedicated AI roles, while 24% have restructured teams to better meet AI-driven needs.

This growing demand shows that scientists and engineers who embrace AI will thrive in the years ahead. However, this doesn't mean they need to become AI specialists building complex models or cutting-edge algorithms. Instead, the key is to master AI-powered tools that enhance their existing skill sets in predictive analytics and statistical analysis.

As AI systems become more proficient at analyzing data, generating hypotheses, and even designing experiments, the role of human scientists and engineers is shifting. **To fully harness AI's potential and stay competitive in an evolving landscape, professionals must adapt and position themselves to capitalize on AI's capabilities. Below are the seven key steps to prepare for these changes:**

1. Shift Focus to Higher-Level Problem Framing, Interpretation, and Creative Thinking

While AI excels at number crunching and identifying patterns within vast datasets, it cannot replace human ingenuity and creativity. AI's conclusions are derived from the data and frameworks provided by humans, so it is still up to people to define the problems for AI to solve. By embracing AI as a tool for faster and more efficient work, scientists and engineers can focus on high-level problem-solving and innovation that AI cannot achieve on its own. "AI is and always will be a tool that must be properly guided by human hands," says Wolfinger.

2. Develop Skills to Collaborate With and Guide AI Systems

Success in the AI-driven era depends on the ability to collaborate with AI systems. This involves designing insightful prompts for AI, understanding its capabilities, and correctly interpreting its outputs. AI is only as useful as the person guiding it, and those who master how to effectively direct AI will drive research and development forward.

3. Maintain Critical Thinking to Evaluate and Validate AI Insights

AI systems, though powerful, are not infallible; they can produce errors or misleading results. As such, human oversight remains critical in assessing and validating AI-generated insights. Now, more than ever, scientists and engineers need to apply critical thinking to scrutinize AI outputs and reject any faulty conclusions that arise. For instance, someone once convinced an AI chatbot at a car dealership to sell them an SUV for just one dollar, while another instance involved an airline's AI chatbot promising a non-existent bereavement discount to a customer, which led to legal action. These real-world examples underscore the importance of maintaining human oversight to prevent costly errors.

4. Address Bias and Ethical Concerns

As AI systems become more integrated into research and development, addressing bias and maintaining ethical standards will be paramount. Scientists and engineers must ensure that AI is trained on diverse, unbiased datasets and undergoes regular checks to prevent unintended consequences. Ethical guidelines must be established to govern the use of AI, ensuring it is not used for harmful or unethical purposes. Human intervention will remain crucial in monitoring and correcting AI bias and misuse.

5. Enhance Interdisciplinary Collaboration

AI offers an opportunity to break down traditional silos in science and engineering. "Most day-to-day research consists of bringing two or more technologies or concepts together that have never been in contact before. AI can certainly help with this by suggesting a vast number of potentially complex interactions of known entities," said Wolfinger. Interdisciplinary collaboration—often hindered by internal divisions, proprietary concerns, or lack of shared knowledge—can be enhanced through AI. As AI is neutral to corporate or regional boundaries, it can foster greater cooperation between domain experts and AI specialists. To embrace this, scientists and engineers will need to develop basic AI literacy, transitioning into hybrid roles that combine their domain expertise with AI knowledge.

6. Stay Relevant and Understand the Pitfalls

Staying up-to-date with AI developments is crucial as the technology evolves rapidly. “One of the most difficult things is just keeping up with what is available and what pitfalls should be avoided,” said Wolfinger. “Sometimes technologically superior methods get overlooked due to hype over the latest trendy technique. We work extremely hard at JMP and SAS to screen through a large range of options and deliver only validated and trustworthy methods to our customers.” Understanding these pitfalls and knowing which AI tools to trust will enable scientists and engineers to make informed decisions.

7. Focus on Classic and Proven Methods

While generative AI garners much attention, classic AI methods, such as image and text classification, remain essential and reliable. “I would encourage folks to focus on more classic methods like image and text classification, as they are now very well vetted and reliable and can be trained readily on common hardware,” said Wolfinger. “They also provide great insights into how the more modern generative methods work and where and why they fail. There are tons of potential applications of classic methods yet to be explored and leveraged for success.” By focusing on proven AI techniques, scientists and engineers can explore untapped opportunities for innovation.

> *Nearly all AI consists of interpolations between what it has been trained on, so it tends to not extrapolate into any areas that are fundamentally groundbreaking. There will always be room for uniquely human creativity.”*
>
> — Russ Wolfinger, *Director of Scientific Discovery and Genomics and Distinguished Research Fellow at JMP*

Balancing AI and Human Expertise

As AI continues to evolve, what does this mean for the future role of human expertise in science and engineering? Rather than displacing human capabilities, AI is well-positioned to complement them, enabling professionals to solve increasingly complex challenges. As AI systems become more adept at analyzing data, generating hypotheses, and even designing experiments, the role of scientists and engineers will naturally evolve. Their focus will shift to one of oversight, guidance, and critical evaluation of AI-generated outputs.

Human expertise will remain indispensable for providing the context, intuition, and ethical safeguards that AI inherently lacks. To fully harness AI's potential, scientists and engineers must find the right balance between leveraging AI's capabilities and maintaining their core skills, creativity, and critical thinking. By doing so, they will continue to drive innovation while ensuring that AI serves as a valuable tool in advancing science and engineering.

About JMP

JMP empowers scientists and engineers across multiple industries to make world-changing discoveries through powerful, AI-driven statistical analysis. With four specialized products, JMP enables professionals to advance green technologies, accelerate cancer treatments, protect ecosystems, and develop cutting-edge space exploration tools. The software's predictive modeling and AI capabilities streamline research and development by automating model fitting, selection, and validation. JMP's user-friendly interface allows researchers to harness advanced machine learning methods and statistical modeling techniques without coding or extensive training.

For more information, visit jmp.com

About Russ Wolfinger

Russ Wolfinger, PhD, is the Director of Scientific Discovery and Genomics at JMP Statistical Software LLC, a SAS company specializing in interactive desktop software for dynamic data visualization and analysis.

Russ is co-author of more than 150 publications, four books; he is the most cited author at SAS. He is a fellow of both the American Association for the Advancement of Science and the American Statistical Association, an adjunct faculty member at NCSU and the University of North Carolina at Chapel Hill, and a Kaggle Competition Grandmaster.

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