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Artificial Intelligence and the Role it will play in Chemical Research in the 21st Century

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The use of Artificial intelligence (AI) has been at the top of technological, medicinal, and scientific lists for the last few decades. Though advancements have come slowly, they are increasing consistently. So much so that it would be difficult to ignore the ongoing development and presentation of AI powered resources. From home monitoring systems and voice-activated devices to robots in hospital operating room, AI has made a significant impact on the way people experience life.

The technology, in short, is designed to make life better and easier. Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information derived from this data and deciding the best action(s) to take to achieve the given goal [1]. This system is used to make obtainable breakthroughs in medicine, education, and research to uncover secrets long hidden from human knowledge. AI allows users to think more quickly, make faster decisions, and provide more practical and advanced solutions.

Though it has been around for decades, its capabilities have exploded in recent years due to exponential advances in computing power and the availability of big data [2]. The field draws upon theoretical constructs from a wide variety of disciplines, including mathematics, psychology, linguistics, neurophysiology, computer science, and electronic engineering [3]. The ability to combine information and data across a variety of fields has allowed researchers to advance their findings and introduce more complex products, more often. Being aware of this, the world's leading pharmaceutical companies have already begun to use artificial intelligence to improve their research regarding new drugs [4]. AI is now being employed by many health care systems in the diagnosis and treatment of cancer, and it will continue to transform the practice of medicine in very promising ways [2]. Treating, curing, and eradicating diseases that have dev-

astated humankind are hopeful byproducts of research employing AI.

Right now, there is unyielding innovation in technology and because of that growth chemistry researchers can benefit from the use of artificial intelligence to enhance the scope and reach of their studies. When people talk about artificial intelligence in the education field, they're often referring to machine learning, in which a machine is trained to perform some teaching tasks, typically more quickly and on a larger scale than the human brain can do [5]. However, artificial intelligence has the potential to do much more, because true AI technologies are in a state of continuous learning, developing better strategies and tactics as they analyze more data [5]. In the field of chemistry specifically, this could mean newer models for breaking down and teaching complex concepts, advanced research methodologies, and more rapid data interpretation.

The versatility of Artificial Intelligence in process systems is not restricted to modelling and control only, but also as estimators to estimate the unmeasured parameters as an alternative to the conventional observers and hardware sensors [6]. These estimators, also known as software sensors, have been successfully applied in many chemical process systems such as reactors, distillation columns, and heat exchanger due to their robustness, simple formulation, adaptation capabilities and minimum modelling requirements for the design [6].

In science-fiction literature and film, human beings simultaneously feel fear and allure in the presence of intelligent machines [7]. Likewise, marvel at the amazing things done in labs and classrooms today due to the power of computers and robotics. Placing data into a computer, allowing it to analyze the data quicker and with less of a human error component allows for research speeds that were unheard of even 20 years ago. Ray Kurzweil, a noted inventor, entrepreneur, and futurist believes the 21st century should witness technological progress equivalent to 200,000 years [8].

It is imperative that college students gain exposure to such cutting-edge technologies and ingrain the conceptual, inquiry, critical thinking, creativity, and integrative learning skills needed to add value in a world where machines will work alongside human professionals [9]. This exposure opens avenues to inventiveness and revolutionary breakthroughs in the world of scientific research and beyond. "There is no more important opportunity or challenge facing our nation than to responsibly harness the power of artificial intelligence so that we remain competitive globally and achieve breakthroughs that will improve our entire society," said Stephen Schwarzman billionaire cofounder of private equity company Blackstone [10].

We can envision a future that is within our grasp involving and evolving around cutting edge technology that can think on its own. Though the use of AI in chemistry research has been limited, especially in comparison to other fields, the technology promises to make as significant an impact in the field as it has in others. Artificial intelligence has the potential to make researching and resolving complex issues much easier for scientific research. The 21st century will be a historic century full of breakthroughs that will solve puzzles that have long plagued researchers.

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