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AI in Healthcare and Life Science

In a previous communication [1], we highlighted the inaugural 2023 IEEE Conference on AI (IEEE CAI 2023) - https://cai.ieee.org/2023/ - our first conference with an industry focus. IEEE CAI 2023 is structured along six verticals, covering *Industrial AI, AI in Healthcare/Life Science, Transportation/Aerospace, Energy, Earth System Decision Support, and Social Implications of AI/Privacy* (Fig. 1). Here we focus on the second vertical, *AI in Healthcare and Life Science*.

Healthcare is itself a very large field, covering everything from the development of novel therapeutics to medical imaging to wearable sensors to detecting incipient medical issues to in-home monitoring. Life science is its own additional large field focusing on the understanding of genomics, proteomics, systems biology, and the mapping of genotypes to phenotypes in light of environmental and developmental dynamics. The scientific lessons learned in life sciences are transformed into improved healthcare outcomes on a daily basis [2]. How does AI/CI play a role?

Even just within the process of drug development, there are many areas where AI plays an active role. A new biological target of interest can be identified using AI to help screen the literature or other datasets. This target, typically a protein, may play an important role in a biochemical pathway. The understanding of that role in the entire system of protein interactions in a cell can be enhanced through AI by studying protein-protein interactions and inferring novel connections. A pharmaceutical company may be interested in developing small molecule compounds that bind to and block the active site of this target protein. A search begins in silico for small molecule candidates that bind to the target. Many of these tools make use of aspects of computational intelligence to search large spaces of small molecule chemistries to identify putative novel drug candidates. The top molecules from this process are then considered candidates for lead optimization to refine them for their suitability as a drug as the compound must not only have the proper inhibitory function but have the proper solubility and transport to get to the locations where its activity have the intended effect over time. AI can be used to help medicinal chemists make educated changes to small molecules to improve their efficacy. Each drug candidate (now termed as a medical entity (NME)) then enters a process of phased clinical trials of increasing cost and stringency. AI can assist in predicting the success or failure of these candidates in this pipeline or assist in the repurposing of NMEs should they fail at some point during the process. Given the clinical trials are costly, AI can also be used to optimize the trials themselves or help understand other barriers to approval. Should the NME pass all clinical phases and be approved, it can then be cleared for market delivery to improve human health. Given the average cost of this entire process from start to finish is roughly US$1 billion per NME that succeeds, any advantages that AI can provide in accelerating the process or improving the odds of success are valued highly.

However, the applications of AI do not stop there. Each drug that has been brought to market now has to be produced efficiently at scales and then distributed nationally or globally. AI can assist with supply chain optimization or prediction of market demand. Further, medical personnel needs to be educated on when to use the new drug, and patients made need to be monitored to ensure that they are adhering properly to their drug regimen. In these scenarios, AI can also provide assistance; however, one must be mindful to remain sensitive to ethics and a requirement for patient approval prior to 24/7 monitoring. Patients under medical care are reviewed regularly, and in some cases AI can be used to alert physicians to deviations that might have adverse effects.

These and other similar challenges will be addressed at the IEEE CAI 2023 conference in the AI in Healthcare vertical. How do we identify companion diagnostics that look at the genetic

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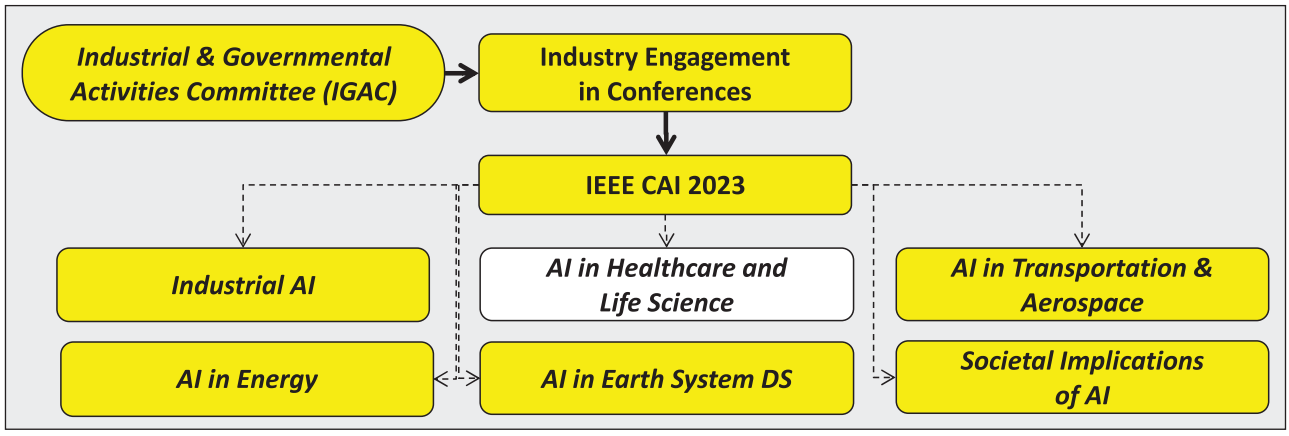

FIGURE 1. The six verticals of the IEEE Conference on Artificial Intelligence 2023 (IEEE CAI 2023).

signatures of a person to know if our new drug will be right for them or not? Can we model the clinical trial process to generate in silico trials at reduced expense? Can we reduce the burden on physicians for electronic medical records by having an AI assistant pre-populate information in forms? What happens if the AI assistant populates the form in an incorrect manner? How do we keep healthcare data private or protect it from being manipulated without physician consent? Can we leverage advances in explainable AI to help increase the adoption of AI decision aids in clinical settings?

We invite interested readers to follow IEEE CAI 2023 developments via https://cai.ieee.org/2023/ and attend the conference to benefit directly from the interactions between industrial thought leaders, practitioners, and researchers.

References

[1] P. P. Bonissone, "IEEE CAI 2023, An industry-centered conference on AI," *IEEE Comput. Intell. Mag.*, vol. 17, no. 4, pp. 6–7, Nov. 2022.

[2] G. B. Fogel, "Computational intelligence approaches for pattern discovery in biological systems," *Brief. Bioinf.*, vol. 9, no. 4, pp. 307–316, 2008.