Deep Learning and Computational Modelling for the Next Generation of CRISPR Technologies

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CRISPR-based genome editing is revolutionizing applications in medicine, agriculture, and sustainable technologies. In this talk, I will present recent developments at the intersection of deep learning and molecular modelling that are advancing our understanding and design of CRISPR systems. Deep learning-driven structure prediction, in combination with physics-based simulations, is shedding light on the dynamic behaviour of large CRISPR assemblies such as Cascade and guiding the engineering of more compact Cas13 variants. Attention-based neural networks are revealing regulatory mechanisms in CRISPR-associated transposons and improving the design of RNA-targeting editors like Cas13a. Furthermore, generative AI models – including diffusion models and large language models – are emerging as tools for designing novel CRISPR components, anti-CRISPR proteins, and predicting guide RNA activity. These approaches exemplify a shift toward data-driven design in genome engineering and position AI as a key enabler in the development of next-generation programmable editing technologies.

References

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Figures

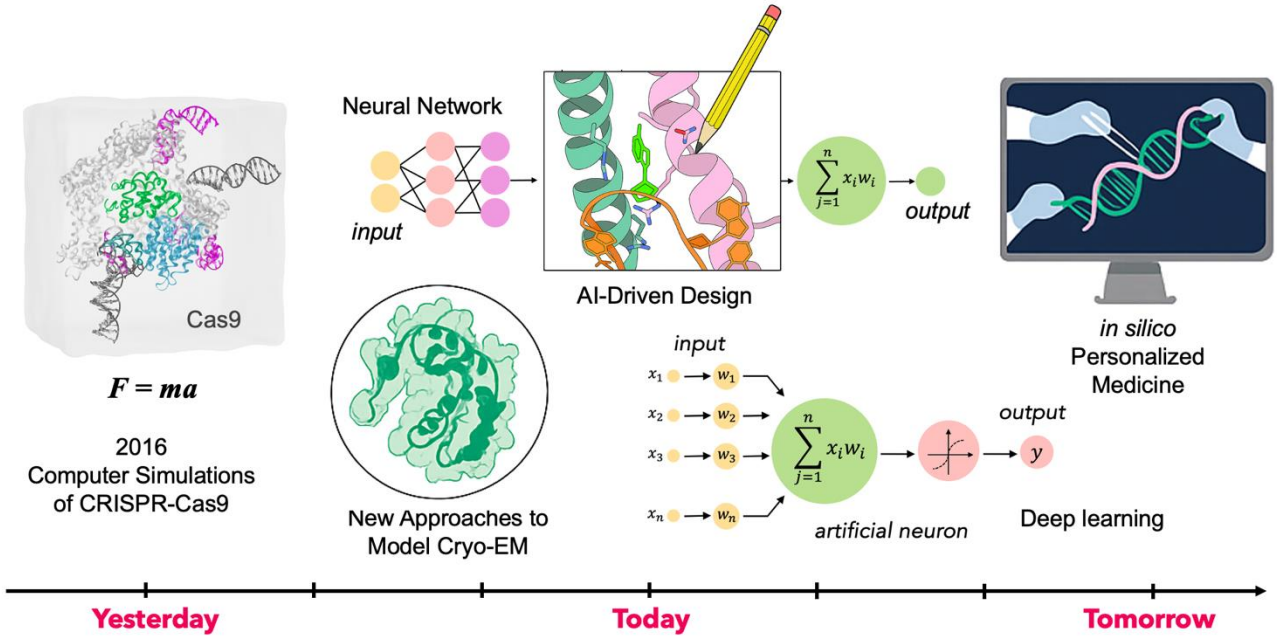

Figure 1: Past, present and future of computational gene editing