



## RESEARCH PAPER

# Computers and AI: Driving forces in modern bioinformatics

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**Abstract :** The field of bioinformatics has undergone a remarkable transformation driven by advancements in computer technology and artificial intelligence. This review examines how computational approaches, particularly machine learning, have become central to modern biological research. The exponential growth of biological data from high-throughput technologies has necessitated sophisticated computational tools to extract meaningful information from increasingly complex datasets. I systematically analyze the historical progression of computational methods in bioinformatics, from early sequence analysis algorithms to contemporary deep learning applications. The evolution of computational power has enabled the development of specialized biological databases and increasingly sophisticated analytical tools. Sequence alignment algorithms like Needleman-Wunsch and Smith-Waterman established the foundation for comparative genomics, while heuristic approaches such as BLAST facilitated rapid sequence comparisons at scale. Machine learning has revolutionized genomics and proteomics, with landmark achievements like AlphaFold demonstrating unprecedented accuracy in protein structure prediction. In systems biology and drug discovery, Artificial Intelligence (AI) has accelerated modeling of complex biological systems and prediction of drug-target interactions. Despite these advances, challenges remain in model interpretability, data integration, and accessibility of computational resources. Future directions include the development of explainable AI techniques, integration of multimodal data through federated learning, exploration of quantum computing for solving complex biological problems, and democratization of computational tools. This review synthesizes key developments across the computational biology landscape, providing both historical context and forward-looking perspectives crucial for researchers navigating this rapidly evolving interdisciplinary field.

**Key Words :** Computers, AI, Driving forces, Modern bioinformatics

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