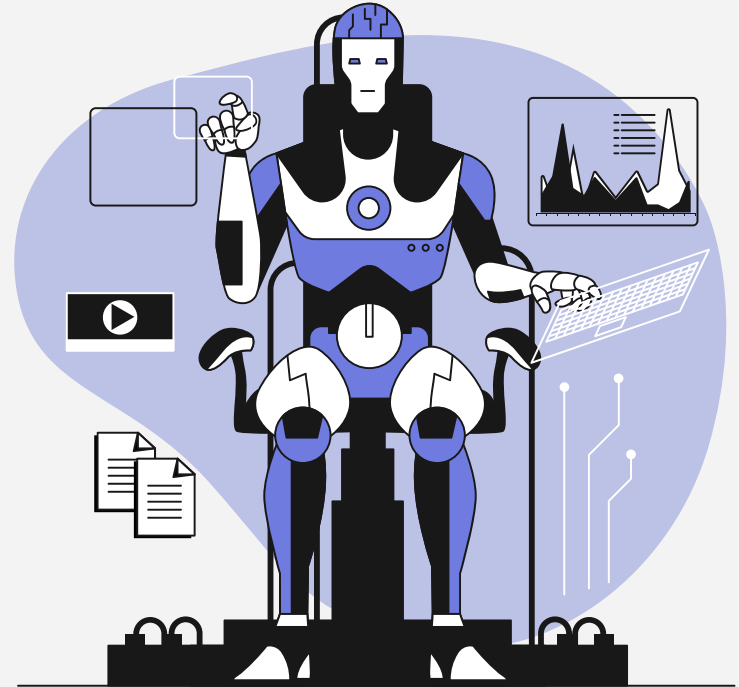


# Artificial Intelligence in Biotechnology

By Vignesh Lal and Delia Moreno



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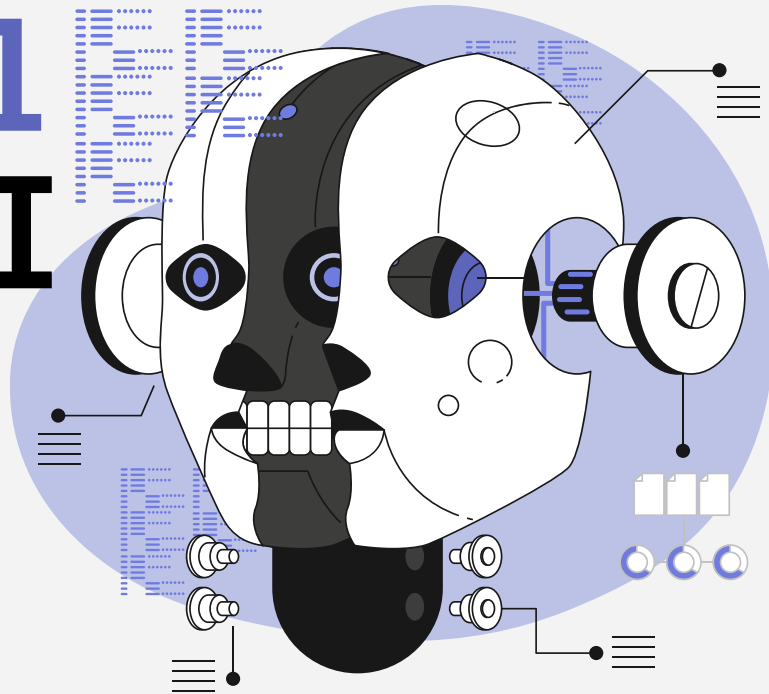
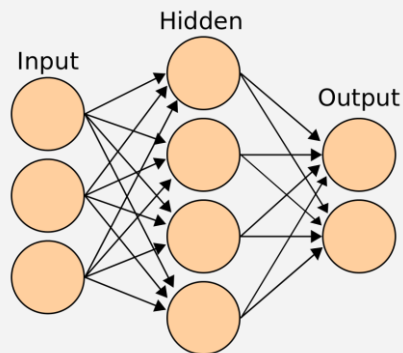
**References**

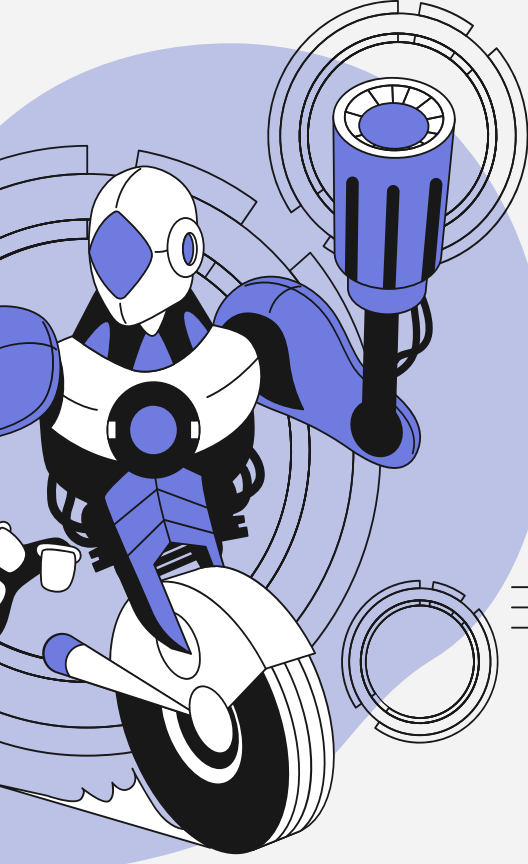


## What it is and its basics

# 01 AI

- Artificial Intelligence
  - Machine learning
- Generative Adversarial Networks
  - Deep learning
- Artificial neural networks
  - Convolutional Neural Network
  - Recurrent Neural Networks





# 02

How AI can be used to help biotechnology



## Possible Uses

- Advance biotechnology by recognizing hidden patterns that are missed
- Aids in problem solving using various data
- Possibility of reducing trial and error time which allocates human energy to other areas
- Can take up multiple parameters for thinking with strict outlines



Fields and how they use them currently

03



# Current

## Drug Discovery and Development

Expedite the confirmation of the drug target, and optimize the Design of the drug structure

## Personalized Medicine

Individualized treatment strategies and identifying possible negative reactions

## Bio-molecular Engineering and Design

Evaluate complicated bioprocess data in real-time and provide feedback for automated control systems

Docking Simulations

## Bioprocessing and Manufacturing

Determine the ideal values for variables like pH, temperature, and nutrient concentrations

Packaging

Boosting efficiency



Fields and how they use them currently

03



# Current

## Genomics

understanding of gene expression patterns, gene function prediction, and the identification of genetic variants associated with disease.

## Proteomics and Protein Structure

### Prediction

functional annotation, and protein-protein interaction detection.

## Transcriptomic and Gene Expression

### Analysis

examination of extensive RNA-seq data, forecasting RNA structures, and comprehending the regulatory mechanisms governing gene expression

## Metabolomics and Metabolic Pathway

### Optimization

detection of metabolites and the enhancement of metabolic pathways

## CRISPR Technology and Genome Editing

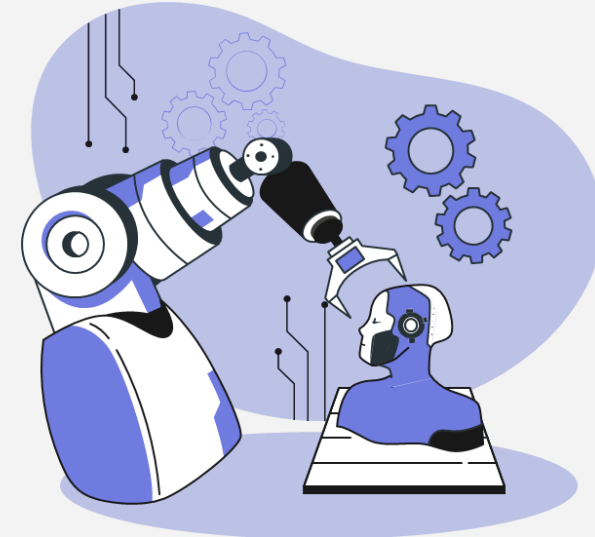
analyze vast genetic datasets to predict highly effective guide RNA sequences with greater accuracy



# What software is used for each field 04 Software

**Table 1.** AI-powered tools and techniques that enhanced biotechnological methods

SN	Machine Learning	Function	Application in Biotechnology	Reference
1.	XGBoost	Efficient Prediction	Drug Discovery and Development	[16]
2.	Random Forest	Pattern Recognition	Drug Discovery and Development	[17]
3.	Artificial Neural Network	Precise Diagnoses	Personalized Medicine	[23]
4.	SignatraX	Drug Target Identification	Transcriptomic	[49]
5.	CRISPR-P	Design High-fidelity guide RNAs	CRISPR Technology	[55]
Deep Learning				
6.	Generative Deep Neural Networks [GDNN]	Molecule Design	Drug Design	[19]
7.	Alpha Fold	Protein Structure Prediction	Drug Discovery and Development	[20]
8.	Deep Chem	Molecular Property Prediction	Drug Design	[21]
9.	Soft Sensors	Estimate Bioprocess Parameters	Bioprocessing	[58]
10.	Deep Variant	Genomic Variation Analysis	Genomics	[43]
11.	Convolutional Neural Networks [CNN]	Protein Structure Prediction	Proteomics	[45]
12.	DeepCpfR	Predicting off-target effects of guide RNA sequences	CRISPR Technology	[56]
13.	Docking Simulations	Computer-aided Drug Discovery	Bio-molecular Engineering	[32]
14.	Lifecycle Analysis	Assess the Environmental Impacts	Bioplastics	[59]

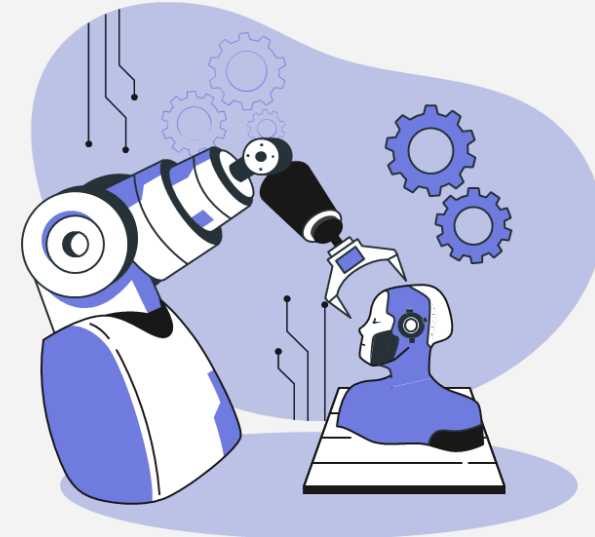


# What software is used for each field 04

## Software

**Table 2:** How AI has transformed numerous sectors within the field of biotechnology

Medical Biotechnology	Example	AI-based medical imaging for disease diagnosis
	AI Tools	Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), Natural Language Processing (NLP)
	Future Prospects	Personalized medicine, drug discovery acceleration, precision diagnostics
Animal Biotechnology	Example	AI-driven breeding programs for livestock improvement
	AI Tools	Machine Learning models for genotype-phenotype prediction, Genetic Algorithms for optimization [60]
	Future Prospects	Disease-resistant animal breeds, enhanced productivity, conservation efforts
Plant Biotechnology	Example	AI-guided crop breeding and optimization for climate resilience
	AI Tools	Deep Learning for crop disease detection, Reinforcement Learning for optimizing crop growth conditions [61]
	Future Prospects	Climate-smart crops, increased crop yields, sustainable agriculture
Industrial Biotechnology	Example	AI-driven process optimization in bio manufacturing
	AI Tools	Reinforcement Learning for process optimization, Genetic Algorithms for strain engineering [62]
	Future Prospects	Enhanced bio production efficiency, greener manufacturing processes, novel bioproduct
Food Biotechnology	Example	AI-based food safety monitoring and quality control
	AI Tools	Machine Learning for food fraud detection, Deep Learning for food image analysis [63]
	Future Prospects	Improved food safety, personalized nutrition, sustainable food production
Health Biotechnology	Example	AI-driven predictive analytics for disease prevention and management
	AI Tools	Machine Learning for patient risk stratification, Natural Language Processing for electronic health record analysis
	Future Prospects	Precision health interventions, remote patient monitoring, early disease detection
Agriculture Biotechnology	Example	AI-enabled precision agriculture for optimized resource utilization
	AI Tools	IoT sensors and drones for data collection [64], Machine Learning for decision support systems
	Future Prospects	Sustainable farming practices, reduced environmental impact, increased food security
Environmental Biotechnology	Example	AI-driven pollution monitoring and remediation strategies
	AI Tools	Machine Learning for environmental data analysis, Reinforcement Learning for autonomous monitoring systems
	Future Prospects	Cleaner ecosystems, sustainable waste management, biodiversity conservation
Marine Biotechnology	Example	AI-guided marine resource exploration and conservation efforts
	AI Tools	Machine Learning for marine species identification, Deep Learning for oceanographic data analysis [65]
	Future Prospects	Sustainable fisheries management, marine biodiversity preservation, ocean health monitoring
Nano Biotechnology	Example	AI-driven drug delivery systems using nanoparticles
	AI Tools	Quantum Machine Learning for nanomaterial design, Deep Learning for nanoscale imaging [66]
	Future Prospects	Targeted drug delivery, nanosensors for disease detection, advanced biomaterials





# 05

The possible future of AI and biotechnology

# Future



Reproducibility

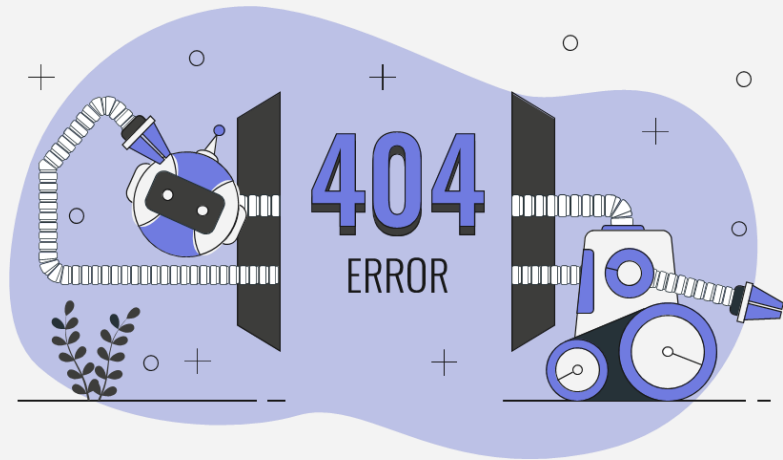
Biases

Ethical considerations

Discrimination

In Vitro Diagnostic Regulation (IVDR)

Human-in-the-loop model (HITL)



06 Thank you!

# References

- Ali, M. (n.d.). *A New Era of Discovery: How Artificial Intelligence has Revolutionized the Biotechnology*. A New Era of Discovery: How Artificial Intelligence has Revolutionized the Biotechnology| Nepal Journal of Biotechnology. <https://nepjb.com/index.php/NJB/article/view/312/205>
- Borisa , P. (n.d.). *Impact of Artificial Intelligence on Pharma Industry* . Impressions Manipal. <https://impressions.manipal.edu/cgi/viewcontent.cgi?article=1080&context=mjps>
- Dr. Rajendra Prasad Centre for Ophthalmic Sciences, R. (n.d.). *In vivo identification of angle dysgenesis and its relation ...* : *Indian Journal of Ophthalmology*. LWW. [https://journals.lww.com/ijo/fulltext/2024/72030/in\\_vivo\\_identification\\_of\\_angle\\_dysgenesis\\_and\\_its.9.aspx](https://journals.lww.com/ijo/fulltext/2024/72030/in_vivo_identification_of_angle_dysgenesis_and_its.9.aspx)
- Holzinger, A. (2023, February 6). *AI for Life: Trends in Artificial Intelligence for Biotechnology*. New Biotechnology. <https://www.sciencedirect.com/science/article/pii/S1871678423000031>

