AI and ML in Healthcare and Lifesciences: The Jargons (Part 1)

To the curious friends of science,

In this blog, let's explore the jargons used in Artificial Intelligence (AI) and Machine Learning (ML) — words that might have once sounded bizarre but are now broken down into simpler terms. Each term is explained in two ways — its actual meaning and a simpler or science-based analogy that connects with our world of experiments, data, and discovery.

From a fellow biotechy to new biotechies! Let's read!

1. Artificial Intelligence

- The extensive field of building machines that are able to carry out tasks that normally demand for human intelligence like reasoning, decision making.
- Think of AI as the entire hospital — with departments like diagnosis, radiology being Machine Learning, Deep Learning etc

2. Machine Learning

- Machine Learning is just one department (subset) within it (AI) that focuses on learning from experience (data).
- Like teaching a child using flashcards — you show them many pictures of fruits and tell them which is an apple and which is a banana. After seeing enough, they can tell you which fruit is which or tell whether it's a new fruit.

3. Model

- A mathematical structure that learns patterns from data and makes predictions (outcome) or decisions.
- Like a **trained** doctor's mind — The trained doctor's mind absorbs patient histories and symptoms (data) and then gives a diagnosis (prediction).
  Note : Here being a TRAINED doctor is important

4. Algorithm

- A defined set of rules or steps used by computers to solve a problem or perform a calculation.
- Our standard lab protocols which ensure every experiment (or learning process) is done systematically to reach consistent results.

5. Data

- Information collected from various sources that forms the basis for analysis and learning.
- Patient test reports, microscope images, or sequencing results — the raw material of every ML experiment.

6. Dataset

- A structured collection of related data used for analysis or model training.
- All your patient records, gene expression data, or clinical trial results bundled together — the foundation for your model.

7. Training Data

- The dataset used to teach a model the patterns or relationships between inputs and outputs.
- Like the textbook or training set a medical student study before practicing on real patients.

8. Test Data

- A separate dataset used to evaluate how well the trained model performs on new, unseen data.
- Giving the student final exam question paper which has conceptual understanding questions rather from the book (out of syllabus questions).

9. Validation Data

- A dataset used during training to fine-tune the model's parameters and prevent overfitting.
- Mock exams — which helps the student to identify the areas where they lag before the final test.

10. Features

- Individual measurable properties or characteristics used by the model to make predictions.
- Think of them as the "symptoms" — like age, BP, tumor size, or gene count — that helps doctor (model) decide the diagnosis (predictions).

11. Structuring the Data

- The process of cleaning, organizing, and formatting raw data to make it suitable for analysis.
- Cleaning our lab hood with ethanol and labeling samples correctly before starting an experiment — no analysis works without it.

12. Supervised Learning

- A learning method where the model is trained on labeled data — inputs with known outputs.
- Mentoring a junior — you show them patient scans and the correct diagnoses until they can predict new ones themselves.

13. Unsupervised Learning

- A learning method where the model finds patterns or groups in unlabeled data.
- Sorting a box of mixed objects by color or shape — even though no one told you their names, you group similar ones together.

14. Reinforcement Learning

- A type of learning where the model learns by interacting with an environment and receiving rewards or penalties.
- Teaching a puppy — you give it a treat when it sits and don't give when it doesn't, so it learns what actions get rewards.

15. Classification

- Predicting which category an observation belongs to.
- Identifying whether a tissue sample is benign or malignant.

16. Regression

- Predicting continuous numerical values instead of categories.
- Estimating tumor growth rate or predicting cholesterol level from patient data.

17. Overfitting

- When a model learns too much detail (and noise) from training data, performing poorly on new data.
- Memorizing exact case reports without understanding — great for practice cases, bad for real patients.

18. Underfitting

- When a model is too simple to capture underlying patterns in the data.
- Skimming through the notes and failing to understand the core concepts.

19. Bias

- Systematic error in data or learning that leads to unfair or inaccurate predictions.
- If your study mostly includes male patients, your model might fail on female patients — that's bias.

20. Variance

- When a model's predictions change drastically with small changes in data — it's too sensitive.
- Like a lab test giving different readings each time on the same sample — unstable and unreliable.