What is the ML Development Life Cycle (MLDLC)?

The **Machine Learning Life Cycle** is a **cyclic process** that guides how ML models are developed — from problem framing to deployment and improvement.
It ensures that **every step**, from gathering data to testing and deploying, is done systematically for the best results.

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7 Core Steps of the ML Life Cycle

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1 Gathering Data

- Collect relevant and sufficient data from various sources (APIs, sensors, databases, CSV files, etc.).
- The **quality and quantity** of this data **directly affect model performance**.

Garbage in, garbage out — better data = better models.

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2 Data Preparation

(Data Preprocessing)

- Clean the data (remove duplicates, handle missing values).
- Standardize or normalize the format.
- Convert text, dates, or categories into machine-readable forms.

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3 Data Wrangling / EDA (Exploratory Data Analysis)

- Understand data distributions, relationships, and patterns.
- Visualize using plots, histograms, correlation matrices.
- Spot anomalies or trends that impact modeling.

Helps form **initial hypotheses** and guides feature engineering.

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4 Analyze Data / Feature Engineering

- Create new meaningful features from existing ones.

- Select only the most relevant features to **reduce complexity** and **improve model performance**.

Example: Converting "date of birth" into "age" as a feature.

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5 Model Training

- Choose an appropriate algorithm (e.g., Decision Trees, SVM, Neural Networks).
- Feed the cleaned and processed data into the model.
- Adjust hyperparameters to optimize learning.

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6 Model Testing / Evaluation

- Validate performance using **test data** not seen during training.
- Use metrics like **accuracy, precision, recall, F1-score, AUC-ROC**.
- Compare multiple models to pick the best one.

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7 Deployment

- Convert the trained model into a production-ready service (API, app, or cloud endpoint).
- Deploy it into an environment where it can be used in **real-time or batch predictions**.

Examples: ML models in web apps, mobile apps, embedded devices.

Post-Deployment Phases

Beta Testing

- Release to a limited group of users.
- Collect feedback and monitor for edge cases or unexpected behavior.

Model Optimization

- Improve the model based on:
    i. Real-world performance

ii. New data availability
iii. Feedback from users or systems

- May involve **retraining**, **feature tweaking**, or **upgrading the model architecture**.

Cycle Continues

The ML development life cycle is **not one-time** — it's **iterative**:
New data → Re-train → Re-test → Re-deploy.

Summary Table

Step	Goal
1. Gathering Data	Collect raw data for the problem
2. Data Preparation	Clean and format the data
3. Data Wrangling / EDA	Understand data patterns and distributions
4. Feature Engineering	Create and select meaningful features
5. Model Training	Teach the model to learn from data
6. Model Testing	Evaluate performance on unseen data
7. Deployment	Launch the model into production
8. Beta Testing	Monitor with limited users before full rollout
9. Optimization	Continuously improve based on real-world performance

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Final Thought

The ML life cycle ensures a **disciplined approach** to building reliable and scalable ML solutions not just writing code, but **understanding data, engineering features, evaluating properly, and deploying responsibly**.
