Machine Learning Development Life Cycle

Machine Learning Development Life Cycle (MLDLC) is the step-by-step workflow used to build, train, evaluate, deploy, and maintain machine learning models.

Here is the **Machine Learning Development Life Cycle (MLDLC)** explained in **simple Roman Urdu + English**, plus a **clean table** for exam notes.

🧠 Machine Learning Development Life Cycle (MLDLC)

Also called the Data Science Life Cycle

MLDLC = Step-by-step process to build, train, test, and deploy an ML model.

🟩 Roman Urdu Explanation (Simple)

Machine learning life cycle mein aik complete process hota hai jisme:

1. **Problem ko samajhna**
2. **Data collect karna**
3. **Data clean karna**
4. **Features banana**
5. **Algorithm select karna**
6. **Model train karna**
7. **Model evaluate karna**
8. **Model deploy karna**
9. **Monitoring & updating**

Ye tamam steps mil kar MLDLC kehlate hain.

🟦 English Explanation (Step-by-Step)

1) Problem Definition

Define what you want to solve.
Example: Predict sales? Detect fraud? Classify emails?

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2) Data Collection

Gather data from:
Databases, CSV files, APIs, sensors, logs, web scraping, etc.

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3) Data Cleaning / Pre-processing

Remove missing values, outliers, duplicates.
Convert raw data into clean usable form.

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4) Exploratory Data Analysis (EDA)

Understand the data:

- Patterns
- Correlations
- Visualizations
- Summary statistics

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5) Feature Engineering

Create new features for better accuracy.
(Scaling, encoding, transformations)

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6) Model Selection

Choose the appropriate algorithm:

- Linear Regression

- Decision Tree
- SVM
- Neural Networks etc.

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7) Model Training

Train the model on training data so it can learn patterns.

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8) Model Evaluation

Use test data and metrics like:

- Accuracy
- Precision
- Recall
- MSE
- F1-score

to check performance.

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9) Hyperparameter Tuning

Improve model by adjusting parameters:
learning rate, depth, K value, epochs...

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10) Deployment

Deploy model into a real-world system:
app, website, API, cloud, sensors.

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11) Monitoring & Maintenance

Continuously track performance, update model with new data.

📊 Machine Learning Development Life Cycle (Table Form)

Step No.	Phase	Description
1	Problem Definition	Understand the business problem
2	Data Collection	Gather data from multiple sources
3	Data Cleaning	Remove errors, missing values, duplicates
4	EDA	Explore and understand patterns & trends
5	Feature Engineering	Create/improve features for ML
6	Model Selection	Choose the right ML algorithm
7	Model Training	Train the algorithm on data
8	Model Evaluation	Test model using metrics
9	Hyperparameter Tuning	Optimize model performance
10	Deployment	Deploy model into production
11	Monitoring	Track, update, and maintain model
