

Machine Learning System Design

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Introduction to Machine Learning Systems Design

- Business and ML Objectives
- Requirements for ML Systems
- Iterative Process
- Types of ML Tasks
- Classification versus regression
- Objective Functions
- Mind Versus Data

Data Engineering Fundamentals

- Type of different source
- Third-party data collector
- Comparison of data-serialization formats
- JSON
- No-SQL
- Structured data vs Unstructured data
- Transactional and Analytical Processing
- ETL: Extract, Transform, and Load
- REST and RESTful

Training Data

- Sampling
- Labeling
- Class imbalance
- Challenge with imbalanced data
- Handling Class Imbalance
- How to modify Loss Function
- Data Augmentation

Feature Engineering

- Handling Missing Values
- Scaling
- Discretization
- Encoding Categorical Features
- Feature Crossing
- Discrete and Continuous Positional Embeddings
- Data Leakage
- Common Causes for Data Leakage
- Engineering Good Features

Model Development and Offline Evaluation

- Six tips for model selection
- Ensembles
- Boosting
- Stacking
- Experiment tracking
- Versioning
- Debugging ML
- ML model to fail
- Some debugging techniques
- Data parallelism
- Model parallelism
- **AutoML**
 - I. Soft AutoML: Hyperparameter tuning
 - II. Hard AutoML: Architecture search and learned optimizer
- FOUR PHASES OF ML MODEL DEVELOPMENT
- Model Offline Evaluation

- Evaluation Methods

Model Deployment and Prediction Service

- Machine Learning Deployment Myths
- Batch Prediction Versus Online Prediction
- Unifying Batch Pipeline and Streaming Pipeline
- Model Compression
- ML on the Cloud and on the Edge

Data Distribution Shifts and Monitoring

- Software System Failures
- ML-Specific Failures
- Edge cases
- Data Distribution Shifts
- Detecting Data Distribution Shifts
- Monitoring and Observability

Continual Learning and Test in Production

- continual learning
- Stateless Retraining Versus Stateful Training
- Continual Learning Challenges
- Four Stages of Continual Learning
- How Often to Update Your Models
- Test in Production

Infrastructure and Tooling for MLOps

- Storage and Compute
- Development Environment
- Cron, Schedulers, and Orchestrators
- To help with debugging and maintenance
- Feature Store
