**Deep Learning System Design**

**Table of Content**

1. Introduction to Deep Learning System Design
2. Data Acquisition and Preprocessing
3. Training Data
4. Feature Engineering
5. Model Architecture and Development
6. Model Training and Evaluation
7. Model Deployment and Inference
8. Data Distribution Shifts and Monitoring
9. Continual Learning and Production Testing
10. Infrastructure and Tooling for DL Operations (DLOps)

**Introduction to Deep Learning System Design**

* Defining Business and DL Objectives
* Requirements for Deep Learning Systems
* The Iterative Design Process
* Types of Deep Learning Tasks
* Classification vs. Regression
* Objective Functions
* Bridging the Gap Between Concept and Data

**Data Acquisition and Preprocessing**

* Sources of Data
* Third-Party Data Collection
* Data Serialization Formats Comparison
* Handling JSON, No-SQL, and Structured Data
* Transactional vs. Analytical Data Processing
* Extract, Transform, and Load (ETL) Processes
* REST and RESTful APIs

**Training Data**

* Sampling Techniques
* Labeling Strategies
* Addressing Class Imbalance
* Challenges with Imbalanced Data
* Modifying Loss Functions
* Data Augmentation Methods

**Feature Engineering**

* Handling Missing Values
* Scaling Features
* Data Discretization
* Encoding Categorical Features
* Feature Crossings
* Discrete and Continuous Positional Embeddings
* Preventing Data Leakage
* Engineering Effective Features

**Model Architecture and Development**

* Guidelines for Model Selection
* The Power of Ensembles (Boosting and Stacking)
* Experiment Tracking and Versioning
* Debugging Deep Learning Models
* Handling Model Failures
* Debugging Techniques
* Data and Model Parallelism
* AutoML (Soft and Hard)
* Four Phases of Model Development
* Offline Model Evaluation
* Evaluation Methods

**Model Training and Evaluation**

* Common Deployment Myths
* Batch vs. Online Prediction
* Unification of Batch and Streaming Pipelines
* Model Compression Techniques
* Utilizing Cloud and Edge for ML

**Data Distribution Shifts and Monitoring**

* Failures in Software Systems
* Failures Specific to ML
* Dealing with Edge Cases
* Detecting Data Distribution Shifts
* Monitoring and Observability

**Continual Learning and Production Testing**

* Concepts of Continual Learning
* Stateless vs. Stateful Retraining
* Challenges in Continual Learning
* Four Stages of Continual Learning
* Determining Model Update Frequency
* Testing Models in a Production Environment

**Infrastructure and Tooling for DLOps**

* Storage and Computational Resources
* Development Environments
* Cron, Schedulers, and Orchestrators
* Debugging and Maintenance Support
* Feature Stores for Efficient Data Management