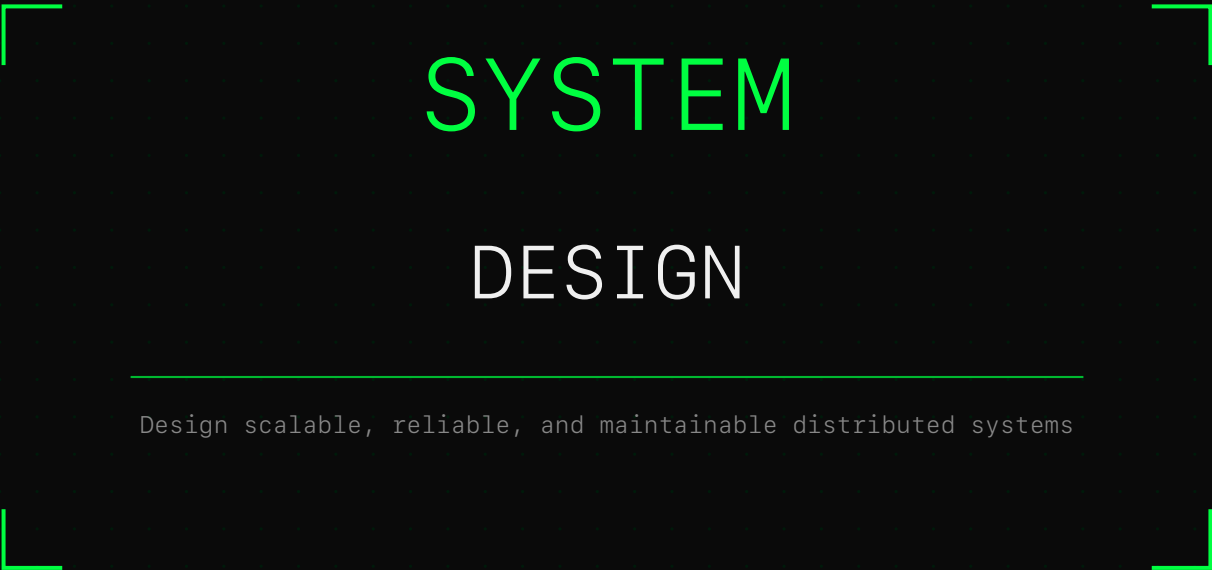




SYSTEM DESIGN

Design scalable, reliable, and maintainable distributed systems

6 stages · progressive skill path

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01

4–6 weeks

CORE FUNDAMENTALS

Scalability (Vertical vs Horizontal)

CAP Theorem

ACID vs BASE

Latency vs Throughput

Availability & Reliability (SLOs)

Back-of-envelope Estimation

Client-Server Architecture

Estimation skills separate senior engineers from everyone else

02

3–4 weeks

DATA STORAGE

SQL vs NoSQL Trade-offs

Database Sharding Strategies

Replication (leader-follower, multi-leader)

Partitioning (range, hash, list)

B-Trees vs LSM-Trees (storage internals)

Time-series Databases

Object vs Block vs File Storage

Every storage decision trades consistency, availability, and cost

03

2–3 weeks

CACHING

Cache-aside Pattern

Write-through / Write-behind / Write-around

CDN Caching & Edge Computing

Redis Architecture & Data Structures

Cache Invalidation Strategies

Cache Stampede Prevention

Consistent Hashing for Cache

Cache invalidation is one of the two hard problems in CS – respect it

04

3–4 weeks

COMMUNICATION PATTERNS

REST vs GraphQL vs gRPC

Message Queues (Kafka, RabbitMQ, SQS)

Event Sourcing & CQRS

WebSockets & Server-Sent Events

Pub/Sub Architecture

Saga Pattern (distributed transactions)

API Gateway & BFF Pattern

Async communication is the key to decoupled scalable systems

05

4–6 weeks

DISTRIBUTED SYSTEMS

Consistent Hashing (ring topology)

Load Balancing Algorithms (round robin, least conn, IP hash)

Service Discovery (Consul, etcd)

Circuit Breaker & Bulkhead Patterns

Rate Limiting (token bucket, leaky bucket)

Distributed Locks

Leader Election (Raft, Paxos concepts)

Distributed systems fail in ways single machines never do – design for failure



06

Ongoing

REAL-WORLD DESIGNS

URL Shortener (TinyURL)

Twitter / X Feed & Timeline

YouTube (video upload + streaming)

Uber (real-time location matching)

WhatsApp (messaging at scale)

Google Search (indexing + ranking)

Netflix (CDN + recommendation)

Dropbox (file sync)

Practice 2 designs per week – the same patterns repeat in every interview

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