

Here's a comprehensive list of topics for learning MongoDB from scratch to an advanced level:

## **Part 1: MongoDB Fundamentals (Scratch)**

### **1. Introduction to NoSQL and MongoDB**

- What is NoSQL?
- Why NoSQL? Relational vs. NoSQL.
- Types of NoSQL databases (Key-Value, Document, Column-Family, Graph).
- What is MongoDB? Key features and advantages.
- Use cases for MongoDB.

### **2. Setting Up MongoDB**

- Installation (Community Edition).
- MongoDB Shell (mongosh).
- MongoDB Compass (GUI Tool).
- MongoDB Atlas (Cloud Service - overview).

### **3. Core Concepts**

- Database.
- Collection.
- Document (JSON/BSON).
- Fields.
- Embedded Documents.
- Arrays.
- `_id` Field.

### **4. Basic CRUD Operations (Create, Read, Update, Delete)**

- **Create:**
  - `insertOne()`
  - `insertMany()`
- **Read (Querying):**
  - `find()` (basic queries, projection).
  - Query Operators (`$eq`, `$gt`, `$gte`, `$lt`, `$lte`, `$ne`, `$in`, `$nin`).
  - Logical Operators (`$and`, `$or`, `$not`, `$nor`).
  - Element Operators (`$exists`, `$type`).
  - Array Operators (`$all`, `$size`, `$elemMatch`).
  - Regular Expressions (`$regex`).
  - Text Search (`$text`).
  - Sorting (`sort()`).
  - Limiting (`limit()`).
  - Skipping (`skip()`).
- **Update:**
  - `updateOne()`
  - `updateMany()`

- replaceOne()
- Update Operators (\$set, \$unset, \$inc, \$mul, \$push, \$pull, \$addToSet, \$pop, \$rename).
- **Delete:**
  - deleteOne()
  - deleteMany()
  - drop() (collection and database).

## Part 2: Intermediate MongoDB

### 5. Data Modeling

- Schema Design Principles (denormalization, normalization trade-offs).
- Embedding vs. Referencing.
- One-to-One Relationships.
- One-to-Many Relationships.
- Many-to-Many Relationships.
- Tree Structures (Parent References, Child References, Materialized Paths, Nested Sets).

### 6. Indexing

- What are Indexes? Why use them?
- Types of Indexes:
  - Single Field Indexes.
  - Compound Indexes.
  - Multikey Indexes (for arrays).
  - Text Indexes.
  - Geospatial Indexes (2dsphere, 2d).
  - Unique Indexes.
  - Partial Indexes.
  - TTL (Time-To-Live) Indexes.
- Creating Indexes (createIndex()).
- Managing Indexes (getIndexes(), dropIndex(), dropIndexes()).
- explain() method for query optimization.

### 7. Aggregation Framework

- What is Aggregation?
- The Aggregation Pipeline concept.
- Common Aggregation Stages:
  - \$match (filter documents).
  - \$project (reshape documents, select fields).
  - \$group (group by and aggregate data).
  - \$sort (sort results).
  - \$limit (limit results).
  - \$skip (skip results).

- \$unwind (deconstruct array fields).
- \$lookup (perform left outer join - for joins across collections).
- \$addFields (add new fields).
- \$out (write results to a new collection).
- \$merge (merge results into an existing collection).
- Aggregation Operators (\$sum, \$avg, \$min, \$max, \$count, \$first, \$last).

### **Part 3: Advanced MongoDB**

#### **8. Replication (Replica Sets)**

- What is a Replica Set?
- Why use Replica Sets? (High Availability, Data Redundancy).
- Primary and Secondary Nodes.
- Election Process.
- Read Preferences.
- Write Concerns.
- Setting up a Replica Set (local and cloud).

#### **9. Sharding**

- What is Sharding?
- Why use Sharding? (Horizontal Scaling, Large Datasets).
- Components of a Sharded Cluster (Shard, Config Server, Mongos).
- Shard Key Selection.
- Chunk Migration.
- Setting up a Sharded Cluster.
- Balancing.

#### **10. Security**

- Authentication (SCRAM-SHA-1, SCRAM-SHA-256).
- Role-Based Access Control (RBAC).
- Users and Roles.
- Authorization.
- Encryption (TLS/SSL).
- Auditing.
- Network Security (Firewalls, IP Whitelisting).

#### **11. Performance Tuning and Monitoring**

- Query Optimization (using explain()).
- Indexing Strategies.
- Schema Design for Performance.
- Hardware Considerations.
- Monitoring Tools (MongoDB Cloud Manager/Ops Manager, mongostat, mongotop).
- Caching Strategies.

#### **12. Transactions (Multi-Document ACID Transactions)**

- What are Transactions?

- When to use Transactions.
  - Syntax and Usage.
  - Limitations and Best Practices.
- 13. GridFS**
- Storing large files in MongoDB.
  - Use cases.
- 14. Change Streams**
- Real-time data changes.
  - Use cases (e.g., real-time dashboards, microservices communication).
- 15. Integration with Programming Languages (e.g., Node.js/Mongoose, Python/PyMongo)**
- Connecting to MongoDB.
  - Performing CRUD operations.
  - Using ODM/ORM libraries.
- 16. Backup and Restore**
- mongodump and mongorestore.
  - Snapshot backups.
  - Point-in-time recovery.
- 17. Advanced Aggregation Topics**
- Graph Lookup (\$graphLookup).
  - Facet (\$facet).
  - Window Operators (\$window).
- 18. MongoDB Atlas Specifics (if focusing on cloud)**
- Cluster Deployment.
  - Security Features.
  - Performance Advisor.
  - Backup and Restore.
  - Atlas Search.
  - Atlas Data Lake.
  - Atlas App Services (Functions, Triggers, GraphQL API).

This list provides a comprehensive path from foundational knowledge to advanced administration and optimization techniques in MongoDB.