microservices

1. Basics of .NET Core

- **Objective:** Build foundational knowledge of .NET Core.
- **Topics:**
  - Overview of .NET Core vs. .NET Framework.
  - Understanding the structure of a .NET Core project.
  - Dependency Injection in .NET Core.
  - Building and running a basic ASP.NET Core Web API.
  - Middleware and request pipeline in .NET Core.

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2. RESTful API Development

- **Objective:** Learn to build scalable APIs.
- **Topics:**
  - What is REST, and how to design RESTful APIs?
  - Creating Controllers and Action Methods.
  - Model Binding and Validation.
  - Versioning APIs in ASP.NET Core.
  - Exception Handling and Error Responses.
  - Using Swagger for API Documentation.

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3. Entity Framework Core (EF Core)

- **Objective:** Master database interactions for microservices.
- **Topics:**
  - Setting up EF Core in a .NET Core project.

- Code-First and Database-First Approaches.
- Migrations for Database Schema Updates.
- Querying data with LINQ.
- Working with Relationships (1-to-1, 1-to-many, many-to-many).
- Using Repository and Unit of Work Patterns.

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4. Microservices Architecture

- **Objective:** Understand the fundamentals of microservices.
- **Topics:**
  - Monolithic vs. Microservices Architecture.
  - Benefits and challenges of microservices.
  - Microservices design principles (e.g., Single Responsibility, Domain-Driven Design).
  - API Gateway and Service Mesh.

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5. Building Microservices

- **Objective:** Build, deploy, and communicate between microservices.
- **Topics:**
  - Creating multiple independent services using ASP.NET Core.
  - Communicating between microservices (REST, gRPC).
  - Designing a service interface with contracts (DTOs).
  - Handling service-to-service communication failures.

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6. Database Per Microservice

- **Objective:** Decouple databases for independent scalability.
- **Topics:**

- Database design for microservices (Separate DBs per service).
- Transaction management across microservices.
- Eventual consistency and Saga Pattern.
- Read models and CQRS (Command Query Responsibility Segregation).

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7. Service Communication

- **Objective:** Implement reliable inter-service communication.
- **Topics:**
  - Synchronous communication (HTTP REST/gRPC).
  - Asynchronous communication (Message Brokers like RabbitMQ, Azure Service Bus, Kafka).
  - Patterns for messaging (Publish-Subscribe, Event Sourcing).

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8. Service Discovery and Load Balancing

- **Objective:** Dynamically discover and route requests.
- **Topics:**
  - Introduction to service discovery (e.g., Eureka, Consul).
  - Using API Gateway for routing (e.g., Ocelot).
  - Load balancing strategies for microservices.

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9. Security in Microservices

- **Objective:** Secure communication and access control.
- **Topics:**
  - Implementing authentication and authorization (JWT, OAuth2, OpenID Connect).
  - Securing inter-service communication (mTLS, API Gateway security).

- Data encryption for sensitive information.
- Protecting APIs against common vulnerabilities (e.g., injection, CSRF, CORS).

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10. Testing Microservices

- **Objective:** Build reliable microservices with proper testing.
- **Topics:**
  - Unit Testing (xUnit, NUnit).
  - Integration Testing with TestServer.
  - Mocking dependencies (Moq, FakeItEasy).
  - End-to-end testing for microservices.
  - Contract testing using Pact.

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11. Observability

- **Objective:** Monitor and troubleshoot microservices.
- **Topics:**
  - Structured logging with Serilog/ELK Stack.
  - Distributed tracing (e.g., OpenTelemetry, Jaeger).
  - Metrics collection (Prometheus, Grafana).
  - Health checks in ASP.NET Core.

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12. Containerization and Orchestration

- **Objective:** Deploy microservices effectively using containers.
- **Topics:**
  - Introduction to Docker (Creating Docker images for microservices).
  - Managing containers with Docker Compose.

- Kubernetes Basics (Pods, Services, Deployments).
- Deploying microservices on Kubernetes.

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13. DevOps for Microservices

- **Objective:** Automate build and deployment pipelines.
- **Topics:**
  - CI/CD Pipelines using Azure DevOps/GitHub Actions/Jenkins.
  - Deploying microservices to cloud platforms (Azure, AWS, GCP).
  - Blue-Green and Canary Deployments.

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14. Advanced Topics

- **Objective:** Prepare for advanced tasks and challenges.
- **Topics:**
  - Event-driven architecture in microservices.
  - Using Dapr for building portable and reliable services.
  - Resilience and Fault Tolerance (Circuit Breaker, Retry, Timeout policies using Polly).
  - Handling data consistency with Outbox Pattern.

Project Ideas for Practice

1. **E-Commerce System:**
   - Create services for Product, Order, and Payment.
   - Use RabbitMQ for asynchronous events like order confirmation.
2. **Blogging Platform:**
   - Separate services for Users, Blogs, and Comments.
   - Secure APIs using JWT authentication.

3. **Ride-Sharing App:**
    - Build services for Drivers, Riders, and Trips.
    - Implement CQRS and Event Sourcing for the Ride service.

Mastery Roadmap

1. Deepen Your Understanding of Microservices Architecture

- **Books & Articles:**
    - Read *Microservices Patterns* by Chris Richardson for a deeper understanding of design patterns and principles.
    - Study *Building Microservices* by Sam Newman to explore concepts such as service granularity, design decisions, and scaling microservices.
    - Follow blogs and articles from top engineers and companies implementing microservices.
- **Key Concepts to Master:**
    - **Design Principles**: Learn about service decomposition, bounded contexts, and domain-driven design (DDD).
    - **CQRS & Event Sourcing**: Master these architectural patterns, which are crucial for scaling complex microservices.
    - **Transaction Management**: Dive deep into **Eventual Consistency** and **Saga Patterns** for handling distributed transactions.
    - **Idempotency**: Master the concept of ensuring services can safely handle repeated requests, especially in asynchronous communication.

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2. Master Advanced .NET Core and ASP.NET Core

- **Deep Dive into ASP.NET Core:**
    - Study **Middleware** and how to implement custom middleware for cross-cutting concerns (logging, authentication, authorization).
    - Learn **Dependency Injection** in-depth and explore the service lifecycle (Transient, Scoped, Singleton).

- Master **Entity Framework Core**, especially advanced topics like migrations, custom conventions, and performance optimization.
- Understand advanced features of ASP.NET Core, such as **gRPC**, **SignalR**, and **WebSockets** for real-time communication.

- **Topics to Explore:**
  - **Asynchronous Programming**: Master async programming, especially when dealing with database and network calls.
  - **Scalable APIs**: Explore how to optimize your APIs for high availability, scalability, and low latency.
  - **Caching**: Use **distributed caching** (e.g., Redis) for improving microservice performance.
  - **API Gateway & Service Mesh**: Implement patterns like **API Gateway (e.g., Ocelot)** and **Service Mesh (e.g., Istio)**.

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3. Advanced Microservices Practices

- **Deepen Understanding of Service-to-Service Communication:**
  - **Synchronous**: HTTP REST, **gRPC**, WebSockets.
  - **Asynchronous**: Message queues (RabbitMQ, Kafka), **Event-Driven Architecture**.
  - Understand how to handle **message deduplication**, **event replay**, and **event versioning**.
- **Handling Faults and Resilience:**
  - Master **Polly** for **retry**, **circuit breaker**, and **timeout** policies.
  - Implement **Resilience** patterns, including **bulkheads**, **timeout management**, and **fallback strategies**.
- **Securing Microservices:**
  - Learn advanced authentication/authorization strategies using **OAuth2** and **JWT**.
  - Secure communication between microservices using **mTLS**.

- Use **API Gateways** for central management of API security.

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4. Scalability and Performance

- **Scaling Microservices**:
  - Study **horizontal scaling** vs **vertical scaling**.
  - Understand **statelessness** and its importance in scaling microservices.
- **Database Scaling**:
  - Master **sharding** and **replication** for scaling databases in a microservices architecture.
  - Learn about **Polyglot Persistence** and when to use different databases (e.g., SQL for transactions, NoSQL for flexible schema).
- **Performance Optimization**:
  - Learn how to optimize API performance with techniques like **Caching** (e.g., Redis, Memcached), **CDN**, **compression**.
  - Analyze **latency**, **throughput**, and **resource utilization** using tools like **Profiler**, **Distributed Tracing** (e.g., OpenTelemetry, Jaeger), and **Prometheus/Grafana**.

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5. Implementing Advanced Microservices Patterns

- **Event-Driven Microservices**:
  - Master the **Event Sourcing** and **CQRS** patterns.
  - Learn how to implement **Saga** and **Choreography** patterns for distributed transactions.
  - Implement **Eventual Consistency** and handle compensating transactions.
- **Database per Service**:
  - Master **Database Per Microservice** pattern for isolation and data ownership.
  - Learn how to handle data **synchronization** between microservices and manage cross-service queries.

6. Hands-On Practice and Projects

- **Personal Projects**:
  - **E-Commerce Microservices**: Build services for product catalog, inventory, order processing, payment, and shipment. Integrate asynchronous communication (using RabbitMQ/Kafka).
  - **Customer Management System**: Implement a **CQRS**based customer management system with separate read and write models.
  - **Real-Time Chat Application**: Implement a microservices architecture with WebSocket or SignalR for real-time chat.
- **Open-Source Contributions**:
  - Contribute to microservices-related open-source projects. Look for **beginner-friendly** issues in **GitHub repositories** that use microservices.
  - Engage with **public microservices projects** on GitHub to study real-world solutions.
- **Pair Programming & Mentorship**:
  - Collaborate with other developers via pair programming.
  - Seek a mentor who has experience in microservices to guide your learning path.

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7. Containerization and Orchestration

- **Master Docker**:
  - Learn to containerize your microservices using **Docker**.
  - Master **multi-container Docker applications** using **Docker Compose**.
  - Dive into **Docker networking** and how to connect multiple microservices in containers.
- **Kubernetes**:
  - Learn to deploy and manage microservices in **Kubernetes**.

- Understand the concepts of Pods, Deployments, ReplicaSets, and Services.
- Use **Helm** for managing Kubernetes charts and deployments.

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8. DevOps for Microservices

- **CI/CD**:
  - Master CI/CD pipelines using tools like **Azure DevOps**, **GitLab CI**, or **Jenkins**.
  - Learn how to automate builds, tests, and deployments for microservices.
- **Automated Testing**:
  - Implement **unit**, **integration**, and **end-to-end** testing.
  - Master **contract testing** (Pact) to ensure service contracts are adhered to.

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9. Stay Updated with Latest Trends

- **Keep Learning**:
  - Follow **microservices blogs**, **newsletters**, and **conferences** (e.g., **KubeCon**, **QCon**).
  - Regularly review the latest updates in **.NET Core** and **microservices-related tools**.
- **Contribute to the Community**:
  - Share your knowledge by writing **technical blog posts**.
  - Speak at **meetups** and **conferences** to solidify your learning and network with experts.