dedicated list of intermediate and advanced Angular interview questions focused specifically on RxJS and NgRx, covering theory, use cases, and real-world scenarios

🟦 Intermediate RxJS & NgRx Questions

1. What is RxJS, and why is it integral to Angular?

RxJS (Reactive Extensions for JavaScript) is a library for **reactive programming using Observables**.
Angular uses RxJS extensively — for example in:

- **HttpClient** (returns Observables)
- **Reactive Forms**
- **Event handling**
- **Async data streams**

It enables **declarative handling** of asynchronous events and simplifies complex async logic.

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2. What is the difference between Observable, Subject, and BehaviorSubject?

- **Observable**: Emits data asynchronously; unicast (each subscriber gets its own execution).
- **Subject**: Both an observer and observable; multicasts values to all subscribers.
- **BehaviorSubject**: Like a Subject, but stores and replays the **latest emitted value** immediately to new subscribers.

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3. How do cold and hot observables differ?

- **Cold observables** start producing values **when subscribed** (like HTTP requests).
- **Hot observables** emit values **regardless of subscription** (like user events or WebSocket streams).
  Hot observables are often managed using Subjects.

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4. What are common RxJS operators and their use?

Operators transform, combine, or filter streams.

- **Creation operators**: of, from, interval
- **Transformation**: map, mergeMap, switchMap

- **Filtering**: filter, debounceTime, takeUntil
- **Error handling**: catchError, retry

They are **composable**, allowing clean async logic pipelines.

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5. What are higher-order observables?

An observable that emits other observables.
Operators like switchMap, mergeMap, and concatMap flatten them into a single stream.
This is essential in Angular when handling **dependent API calls** or **chained async operations**.

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6. What is the purpose of takeUntil() and why is it useful?

takeUntil() automatically completes a subscription when another observable emits.
It's widely used in Angular's ngOnDestroy() pattern to **prevent memory leaks** from long-lived subscriptions.

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7. How can RxJS improve performance in Angular applications?

By replacing imperative logic with **reactive streams**, you can:

- Cancel stale API requests automatically
- Debounce user input efficiently
- Manage data flow in a predictable way
- Minimize re-rendering and race conditions

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8. What are schedulers in RxJS?

Schedulers control **when** and **where** execution happens (synchronously or asynchronously).
Examples include:

- asyncScheduler for timers and intervals
- queueScheduler for synchronous queuing
  Schedulers enable fine-tuning performance and task prioritization.

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9. How does error handling work in RxJS?

You can handle errors using catchError, retry, or retryWhen.
Errors in one stream can be recovered gracefully without breaking the entire app flow.

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10. What are marble diagrams and how are they useful?

Marble diagrams visually represent how observables emit, transform, and complete over time.
They help in **debugging and reasoning** about operator behavior and timing.

🟥 Advanced RxJS & NgRx Questions

1. What is NgRx, and what problem does it solve?

NgRx is a **reactive state management library** built on RxJS.
It enforces a **unidirectional data flow** and provides predictable state transitions using Actions, Reducers, and Effects.
It's most beneficial in **large-scale apps** where many components share and mutate common state.

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2. Explain the key building blocks of NgRx.

- **Actions** → Events describing *what happened*.
- **Reducers** → Pure functions defining *how state changes*.
- **Selectors** → Query logic to retrieve and derive state slices efficiently.
- **Effects** → Handle side effects (e.g., API calls, local storage) triggered by actions.

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3. How does NgRx ensure immutability of state?

NgRx enforces immutability by requiring **pure reducer functions** that return new state objects instead of mutating existing ones.
This ensures predictable change detection and debugging using time-travel tools.

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4. How do selectors improve performance in NgRx?

Selectors are **memoized** — they cache the result until the state they depend on changes.
This prevents unnecessary recomputation and helps Angular skip re-rendering components when state is unchanged.

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5. What are side effects, and how does NgRx handle them?

Side effects are tasks that interact with external systems (like HTTP calls or logging).
NgRx handles them via **Effects**, which isolate side effects from components and reducers, maintaining clean separation of concerns.

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6. Explain the concept of NgRx Entity.

NgRx Entity simplifies managing collections of records (like users, products) in the store.
It provides helper functions to handle CRUD operations efficiently and standardizes collection management patterns.

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7. How can you debug NgRx applications effectively?

- Use **NgRx Store DevTools** for time-travel debugging.
- Enable **Action Logging** in development mode.
- Combine **Selectors** with Chrome Redux DevTools for tracing state evolution.
- Use **Effects testing utilities** to test async flows.

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8. What are NgRx Facades and why use them?

A **Facade** is an abstraction layer over the NgRx store that encapsulates all state interactions (actions, selectors, etc.).
It simplifies component logic and prevents tight coupling to NgRx APIs, improving scalability and testability.

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9. How do you handle optimistic updates in NgRx?

Optimistic updates immediately update the UI before the server confirms the change.
If the API call fails, a rollback action reverts the state.
This pattern provides a **snappy user experience** while keeping data consistent.

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10. What are best practices for structuring NgRx state?

- Split state into **feature slices** using feature modules.
- Use **selectors** to access nested state.

- Keep **actions descriptive** and **reducers pure**.
- Use **facades** to isolate store logic from components.
- Avoid storing derived or temporary values in state.

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11. How do NgRx and RxJS complement each other?

NgRx builds on top of RxJS — the store, actions, and effects are all streams.
RxJS operators (map, mergeMap, etc.) are used to:

- Transform actions into side effects
- Filter specific actions
- Combine async data flows
  This combination gives Angular apps **predictable, reactive state flow**.

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12. When should you avoid NgRx?

NgRx adds overhead for simple apps.
Avoid it when:

- The app has limited shared state
- Data flow is straightforward
- Using services and BehaviorSubjects is sufficient
  NgRx shines only in **complex, multi-feature apps** with lots of interdependent state.