concepts # web-api

REST API Design Principles

TCSS 460 — Client/Server Programming

You have seen what HTTP looks like and what a web API is. This reading tackles the question every API developer faces next: *how do you design a good one?* REST provides a set of architectural constraints that, when followed, produce APIs that are predictable, consistent, and easy for other developers to use. Understanding these principles now will shape every API you build in this course and beyond.

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1 What REST Actually Means

REST stands for **Representational State Transfer**. It was introduced by Roy Fielding in his 2000 doctoral dissertation at the University of California, Irvine (Fielding, 2000). Fielding was not inventing a new technology — he was describing the architectural principles that already made the World Wide Web successful, and formalizing them as a set of constraints for building networked applications.

1.1 REST Is Not a Specification

This is the single most important thing to understand about REST: **it is not a protocol, not a standard, and not a specification.** There is no RFC that defines REST the way RFC 9110 defines HTTP. REST is a set of *architectural constraints* — design rules that, when followed together, produce systems with desirable properties like scalability, simplicity, and modifiability.

This distinction matters because you will encounter endless debates online about whether an API is "truly RESTful." Most production APIs follow REST *principles* loosely rather than adhering to every constraint Fielding described. The industry term for this pragmatic middle ground is **"RESTful" or "REST-like" APIs**.

1.2 The Key Constraints

Fielding defined six constraints. You do not need to memorize these for an exam, but understanding them helps you see *why* REST APIs are designed the way they are:

Constraint	What It Means	Why It Matters
Client-Server	The client and server are separate components with distinct responsibilities	Either side can evolve independently
Stateless	Each request contains all the information the server needs to process it	No server-side session memory required; easier to scale
Cacheable	Responses must declare whether they can be cached	Reduces redundant requests, improves performance
Uniform Interface	All resources are accessed through a consistent, standardized interface	Clients can interact with any REST API using the same patterns
Layered System	The client does not need to know whether it is talking directly to the server or through intermediaries (proxies, load balancers)	Enables infrastructure flexibility
Code on Demand (optional)	The server can send executable code to the client	Rarely used in modern APIs; originally envisioned for browser applets

The constraint that most shapes day-to-day API design is **Uniform Interface**. It is the reason REST APIs follow predictable patterns for URLs, HTTP methods, and response formats — and it is the focus of the rest of this reading.

1.3 An Analogy: Food Delivery Apps

Think about how food delivery apps work. Whether you use DoorDash, Uber Eats, or Grubhub, the pattern is the same: you browse restaurants, add items to a cart, place an order, and track delivery. You do not need to learn a new system every time you switch apps because they all follow the same conventions. That uniformity is what REST provides for web APIs. Once you learn the patterns, you can predict how most REST APIs will behave — even ones you have never seen before.

2 Resources and URIs

In REST, everything is a **resource**. A resource is any piece of information that can be named: a user, a book, a movie, a comment, an order, a session. The central design decision in a REST API is identifying your resources and giving them clear, consistent addresses.

2.1 Nouns, Not Verbs

The most common mistake in API design is putting *actions* in URLs. REST URLs identify *things* (nouns), not *actions* (verbs). The HTTP method tells you the action; the URL tells you the target.

Bad (Verbs in URL)	Good (Nouns in URL)	Why
`GET /getUsers`	`GET /users`	The HTTP method already says "get"
`POST /createUser`	`POST /users`	POST means "create" — no need to repeat it
`POST /deleteUser/42`	`DELETE /users/42`	Use DELETE method, not a POST with "delete" in the path
`GET /fetchMovieById/7`	`GET /movies/7`	The path identifies the resource; the method says to fetch it
`PUT /updateUserEmail`	`PATCH /users/42`	PATCH the resource; the body specifies what changed

This pattern works because HTTP already provides a fixed set of verbs (methods). When you put verbs in your URLs, you are inventing your own vocabulary on top of HTTP's, and every consumer of your API must learn your custom language. When you use nouns, consumers already know the verbs.

2.2 Plural Resource Names

Use **plural nouns** for collection resources. This is a convention, not a rule, but it is so widely followed that breaking it creates confusion:

Consistent (Plural)	Inconsistent	Problem
`GET /users`	`GET /user`	Does `/user` return one user or all users?
`GET /users/42`	`GET /user/42`	Mixing singular and plural is confusing
`GET /movies`	`GET /movie-list`	Adding suffixes like `-list` is unnecessary

The pattern is simple: `/users` is the collection, `/users/42` is one item in that collection. Plural throughout.

2.3 Resource Hierarchies

Resources often have relationships. A user has posts. A movie has reviews. Express these relationships through nested paths:

```
GET /users/42/posts          ← All posts by user 42
GET /users/42/posts/7        ← Post 7 by user 42
GET /movies/99/reviews       ← All reviews for movie 99
GET /movies/99/reviews/3     ← Review 3 for movie 99
```

Keep nesting shallow — one or two levels deep. Deeply nested URLs become hard to read and hard to implement:

```
# Too deep — avoid this
GET /users/42/posts/7/comments/3/likes/1

# Better — flatten when nesting gets deep
GET /comments/3/likes
```

A good rule of thumb: if a resource can be identified on its own (like a comment with a unique ID), it probably deserves its own top-level endpoint.

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3 HTTP Methods as Actions

HTTP defines a set of methods (sometimes called "verbs") that map naturally to the operations you perform on resources. This mapping is at the heart of REST API design.

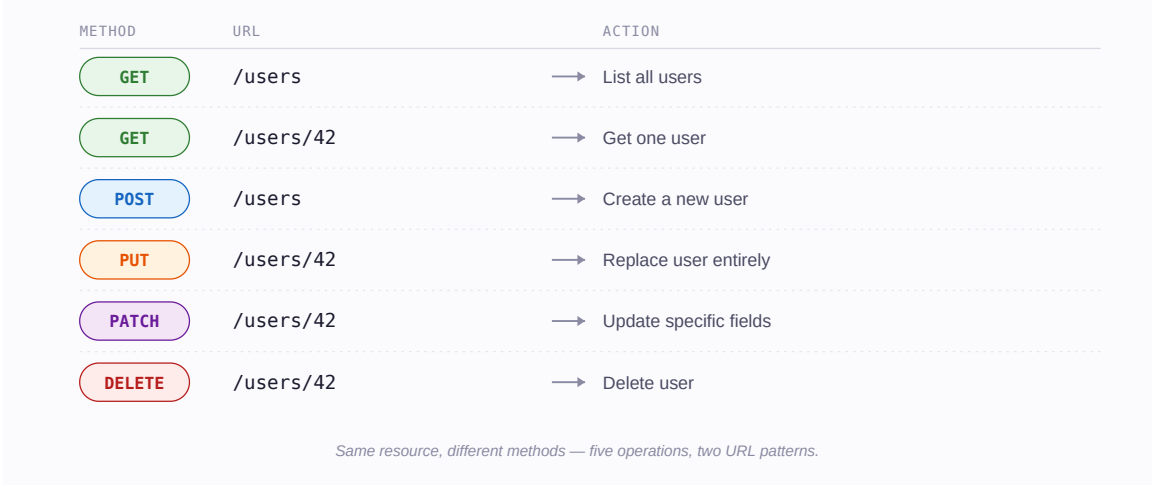
3.1 The Five Core Methods

Method	Purpose	Acts On	Has Request Body?	Typical Response
GET	Read / retrieve	Collection or single resource	No	200 with data
POST	Create a new resource	Collection	Yes	201 with created resource
PUT	Replace a resource entirely	Single resource	Yes	200 with updated resource
PATCH	Update part of a resource	Single resource	Yes	200 with updated resource
DELETE	Remove a resource	Single resource	No (usually)	204 with no body

3.2 Mapping Methods to a Resource

Here is what a complete set of endpoints looks like for a `users` resource:

```
GET    /users          ← List all users
GET    /users/42       ← Get user 42
POST   /users          ← Create a new user
PUT    /users/42       ← Replace user 42 entirely
PATCH  /users/42       ← Update specific fields of user 42
DELETE /users/42       ← Delete user 42
```



Same resource, different methods — five operations, two URL patterns.

Notice the pattern: the *URL stays the same* and the *method changes*. This is the Uniform Interface constraint in practice — five different operations, two URL patterns.

3.3 PUT vs. PATCH

The difference between PUT and PATCH causes frequent confusion. Think of it this way:

PUT replaces the entire resource. If you send a PUT request, you must include *every field*, even the ones that did not change. Any field you omit will be set to its default or removed.

PATCH updates only the fields you include. Everything else stays as it was.

Here is an example. Suppose user 42 currently looks like this:

```
{
  "id": 42,
  "name": "Alice",
  "email": "alice@example.com",
  "role": "member"
}
```

A **PUT** request to change the email must include all fields:

```
PUT /users/42

{
  "name": "Alice",
  "email": "alice@newdomain.com",
  "role": "member"
}
```

Notice that `id` is not in the request body. The URL already identifies the resource (`/users/42`), so including the ID in the body would be redundant. The same applies to POST

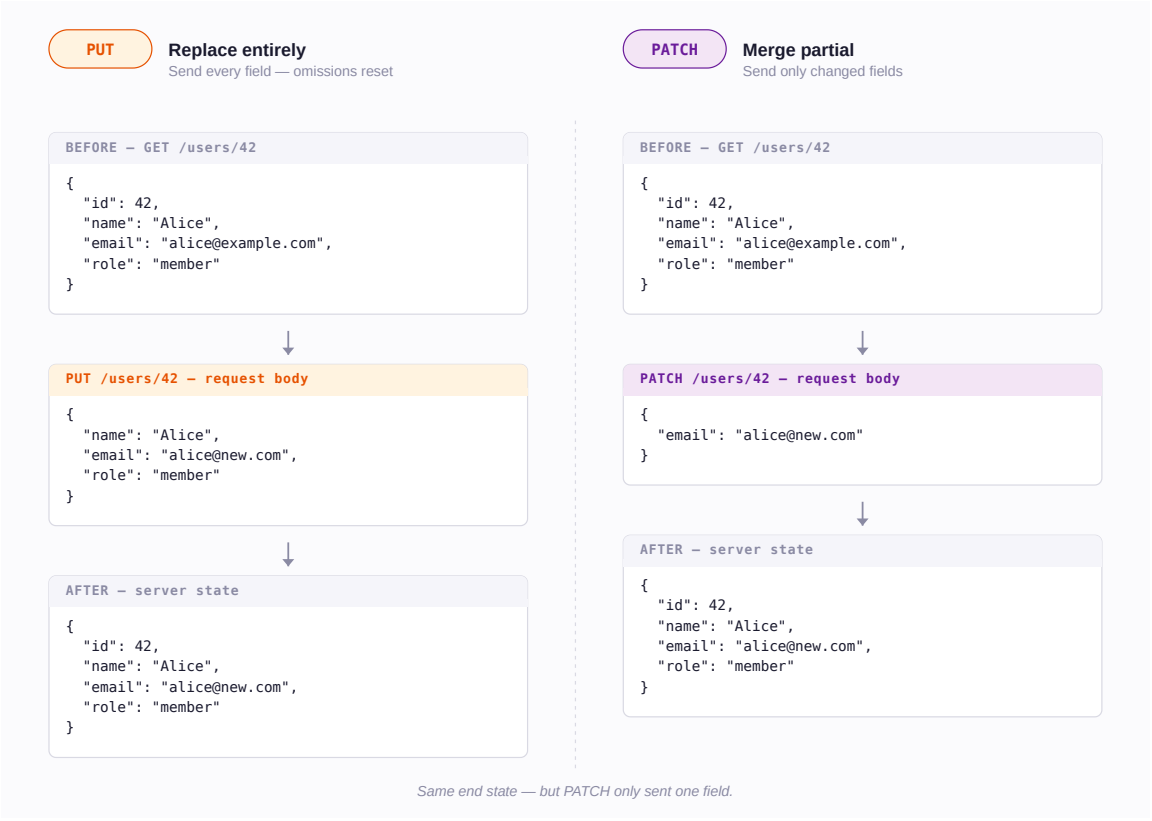
— the client does not set the ID. The server assigns it and returns it in the response. The client never controls resource IDs.

A **PATCH** request only needs the changed field:

```
PATCH /users/42

{
  "email": "alice@newdomain.com"
}
```

In practice, most APIs use PATCH for updates because it is simpler for the client and less error-prone. PUT is used when you want to guarantee that the server has *exactly* the state you sent — no leftover fields from a previous version.



3.4 Safe and Idempotent Methods

Two properties of HTTP methods matter for API design:

- A method is **safe** if it does not modify the resource. GET is safe — calling it should never change data.
- A method is **idempotent** if calling it multiple times produces the same result as calling it once. PUT and DELETE are idempotent — deleting user 42 twice has the same end result

as deleting them once.

Method	Safe?	Idempotent?
GET	Yes	Yes
POST	No	No
PUT	No	Yes
PATCH	No	No (in general)
DELETE	No	Yes

The first DELETE call might return `204 No Content` (success). The second might return `404 Not Found` (already gone). The HTTP responses are different, but the server state is the same — user 42 is gone either way. That is what idempotent means: the same *outcome on the server*, not the same response.

Why does this matter? Because network failures happen. If a client sends a DELETE request and the connection drops before the response arrives, the client does not know if the delete succeeded. Because DELETE is idempotent, the client can safely retry — if the resource is already gone, the server returns 404, but no harm is done. POST is *not* idempotent, which is why you sometimes see duplicate orders when a user clicks "Submit" twice.

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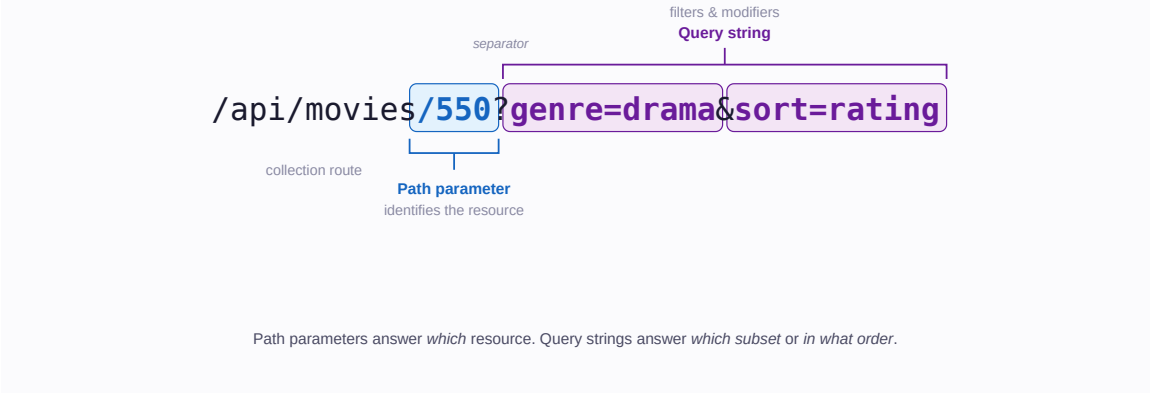
4 Path Parameters vs. Query Strings

URLs in a REST API carry two kinds of variable information: **path parameters** and **query strings**. Using the right one in the right place makes your API intuitive.



Path parameters answer *which* resource. Query strings answer *which subset* or *in what order*.

4.1 Path Parameters Identify Resources

A path parameter is part of the URL path itself. It identifies *which* resource you want:

```
GET /users/42           ← User with ID 42
GET /movies/tt0111161   ← Movie with ID tt0111161
GET /courses/TCSS460    ← Course with code TCSS460
```

Path parameters answer the question: **"Which specific resource?"**

> **Express Terminology**
>
> Express (the framework used in this course) calls these "route parameters" and accesses them via `request.params`. Same concept, different terminology.

4.2 Query Strings Filter and Modify

A query string comes after the `?` in a URL. It does not change *which* resource you are targeting — it changes *how* you want the data:

```
GET /users?role=admin            ← Filter: only admin users
GET /movies?genre=drama&year=2024 ← Filter: drama movies from 2024
GET /users?sort=name&order=asc    ← Sort: alphabetical ascending
GET /movies?page=2&limit=20       ← Paginate: page 2, 20 per page
```

Query strings answer the question: **"Which subset, or in what order?"**

4.3 When to Use Which

The rule is straightforward:

Use Case	Mechanism	Example
Identify a specific resource	Path parameter	`/users/42`
Identify a nested resource	Path parameter	`/users/42/posts/7`
Filter a collection	Query string	`/users?role=admin`
Sort results	Query string	`/users?sort=created_at`
Paginate results	Query string	`/users?page=3&limit=25`
Search within a collection	Query string	`/movies?q=inception`

A helpful test: if removing the parameter would change *which resource* you are talking about, it is a path parameter. If removing it would just change the *view* of the same collection, it is a query string.

Another way to think about it: a path parameter returns a single resource or a 404. A query string filters a collection and can return zero, five, or five hundred results — it returns 200 with an empty array, never a 404 for no matches.

4.4 A Complete Example

Consider an API for a movie database. Here is how path parameters and query strings work together:

```
GET /movies                                ← All movies
GET /movies?genre=sci-fi                   ← Sci-fi movies only
GET /movies?genre=sci-fi&sort=rating       ← Sci-fi movies, sorted by rating
GET /movies/tt0111161                      ← One specific movie
GET /movies/tt0111161/reviews              ← Reviews for that movie
GET /movies/tt0111161/reviews?rating=5     ← Only 5-star reviews for that movie
```

Each URL reads naturally, and a developer seeing this API for the first time can guess what most endpoints do without reading documentation.

4.5 Search and Filtering Patterns

One of the first design decisions you will face in your projects is how to handle search and filtering. Students tend toward one of two extremes — both problematic.

4.5.1 The Anti-Pattern: Many Search Endpoints

Some developers create a separate endpoint for every filter:

```
GET /movies/search-by-genre?genre=drama
GET /movies/search-by-year?year=2024
GET /movies/search-by-rating?min=8
GET /movies/search-by-director?name=nolan
```

This seems organized, but it creates a combinatorial problem. What if a consumer wants drama movies from 2024 with a rating above 8? There is no endpoint for that combination. You would need to create a new endpoint for every possible filter combination — and the number of combinations grows exponentially.

4.5.2 The Idiomatic Approach: One Endpoint, Composable Filters

The standard REST pattern is a single collection endpoint with optional query string filters that can be freely combined:

```
GET /movies                                        ← All movies
GET /movies?genre=drama                            ← Filter by genre
GET /movies?year=2024                              ← Filter by year
GET /movies?genre=drama&year=2024&rating_min=8     ← Combine any filters
GET /movies?genre=drama&sort=rating&order=desc     ← Filter + sort
GET /movies?genre=drama&page=2&limit=20            ← Filter + paginate
```

This is how major APIs work — Stripe, GitHub, and TMDB all use this pattern. One endpoint, many optional query parameters, all composable. The consumer picks the filters they need and ignores the rest.

The benefits are significant:

Concern	Many Endpoints	One Endpoint + Query Strings
Composability	Each combination needs its own endpoint	Filters combine freely
Documentation	N endpoints to document	One endpoint with a parameter table
Maintenance	Adding a new filter means a new endpoint	Adding a new filter means a new query parameter

Concern	Many Endpoints	One Endpoint + Query Strings
Predictability	Consumer must discover each endpoint	Consumer already knows the pattern

4.5.3 When a Dedicated Search Endpoint Makes Sense

There is one exception to the "one endpoint" rule: **full-text search**. If your API supports searching across multiple fields with a single query string — the way a search engine works — a dedicated search endpoint can be appropriate:

```
GET /movies/search?q=dark knight
```

Full-text search is semantically different from structured filtering. A query like `q=dark knight` might match titles, descriptions, actor names, and director names, possibly with relevance scoring. That behavior is different enough from filtering by specific fields that a separate endpoint is justified.

The key distinction: structured filtering (`?genre=drama&year=2024`) narrows a collection by known fields. Full-text search (`?q=dark knight`) asks "find me anything that matches this phrase." Different intent, different endpoint.

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5 Request and Response Bodies

Not every HTTP request carries a body — GET and DELETE typically do not. But when you create or update resources, the request body is how you send data to the server, and the response body is how the server sends data back.

5.1 When Bodies Are Used

Method	Request Body	Response Body
GET	None	The requested resource(s)
POST	The new resource data	The created resource (with server-assigned fields like `id`)

Method	Request Body	Response Body
PUT	The complete replacement resource	The updated resource
PATCH	Only the fields to change	The updated resource
DELETE	None (usually)	None (usually) or confirmation message

5.2 JSON as the Standard Format

Modern REST APIs almost universally use **JSON** (JavaScript Object Notation) for request and response bodies. If you have read the "What is a Web API?" reading, you have already seen JSON syntax. Here is a quick reminder:

```
{
  "id": 42,
  "name": "Alice Chen",
  "email": "alice@example.com",
  "role": "member",
  "created_at": "2026-01-15T09:30:00Z"
}
```

When sending JSON in a request, you must include the `Content-Type` header so the server knows how to parse the body:

```
POST /users HTTP/1.1
Host: api.example.com
Content-Type: application/json

{
  "name": "Bob Martinez",
  "email": "bob@example.com"
}
```

5.3 Consistent Response Structure

Well-designed APIs use a consistent structure for all responses. There is no universal standard for this, but a common pattern separates the actual data from metadata:

Single resource response:

```
{
  "id": 42,
```

```
  "name": "Alice Chen",
  "email": "alice@example.com",
  "role": "member"
}
```

Collection response with pagination metadata:

```
{
  "data": [
    { "id": 42, "name": "Alice Chen" },
    { "id": 43, "name": "Bob Martinez" }
  ],
  "pagination": {
    "page": 1,
    "limit": 20,
    "total": 157
  }
}
```

Error response:

```
{
  "error": {
    "message": "User not found",
    "detail": "No user exists with ID 999"
  }
}
```

The status code belongs in the HTTP response, not the body. Some APIs (like Google's) duplicate it in the body as a convenience, but it is redundant — the client already has the status code from the HTTP response itself.

The key principle is **consistency**. Once a consumer learns your response format from one endpoint, they should be able to predict the format of every other endpoint.

5.4 Request Bodies Are Not URLs

A common beginner mistake is trying to send data through the URL for operations that should use a request body:

```
# Bad — data crammed into the URL
POST /users?name=Alice&email=alice@example.com

# Good — data in the request body
POST /users
Content-Type: application/json

{
  "name": "Alice",
```

```
  "email": "alice@example.com"
}
```

Query strings are for filtering and sorting *existing* resources. Request bodies are for sending *new* data to the server.

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6 Status Codes as Communication

HTTP status codes are not decoration — they are the primary mechanism for communicating the outcome of a request. A well-designed API uses status codes precisely, so clients can handle responses programmatically without parsing the body.

Status codes are organized into four families by the first digit, each with a distinct meaning:

6.1 Choosing the Right Code

You encountered status codes in the HTTP reading. Here is how they map to common REST API operations:

Situation	Status Code	When to Use
Successful retrieval	`200 OK`	GET returned data
Resource created	`201 Created`	POST successfully created a resource
Successful, no content	`204 No Content`	DELETE succeeded; nothing to return
Bad request data	`400 Bad Request`	Client sent invalid JSON, missing fields, wrong types
Not authenticated	`401 Unauthorized`	No credentials provided, or credentials invalid
Not authorized	`403 Forbidden`	Authenticated, but lacking permission
Resource not found	`404 Not Found`	The requested resource does not exist
Method not allowed	`405 Method Not Allowed`	Tried DELETE on a resource that does not support it
Conflict	`409 Conflict`	Creating a user with an email that already exists
Server error	`500 Internal Server Error`	Something broke on the server side

6.2 The Lazy 200 Anti-Pattern

One of the most common API design mistakes is returning `200 OK` for everything and putting the real status in the body:

```
# Bad — 200 for an error?
HTTP/1.1 200 OK

{
  "success": false,
  "error": "User not found"
}
```

```
# Good — status code communicates the outcome
HTTP/1.1 404 Not Found

{
  "error": {
    "code": 404,
    "message": "User not found"
  }
}
```

Why does this matter? Because HTTP clients, proxies, caches, and monitoring tools all use status codes to understand what happened. A cache that sees `200 OK` will store the response. A monitoring dashboard that sees `404` will flag it. When you return `200` for errors, you break the entire ecosystem of tools built around HTTP.

6.3 Error Response Bodies

A status code tells the client *what category* of problem occurred. The response body tells the client *specifically* what went wrong. Good error responses include:

1. **A human-readable message** — What happened, in plain language
2. **A machine-readable code or type** — So the client can handle it programmatically
3. **Details** — Specific information to help fix the problem

Compare these two error responses for a POST request with a missing email field:

Unhelpful:

```
{
  "error": "Bad request"
}
```

Helpful:

```
{
  "error": {
    "code": 400,
    "message": "Validation failed",
    "details": [
      {
        "field": "email",
        "message": "Email is required"
      },
      {
        "field": "email",
        "message": "Must be a valid email address"
      }
    ]
```

```
  }
}
```

The second response tells the client exactly which fields failed and why. A frontend developer building a form against this API can map each error to the correct input field without guessing.

> ⚠️ **Never Expose Implementation Details**
>
> Helpful error messages are for *expected* errors like validation failures. For unexpected server errors, never send stack traces, file paths, SQL queries, or internal variable names to clients. Compare these two 500-level responses:
>
> **Dangerous — leaks internals to the client:**
>
> ```
> {
>   "error": {
>     "message": "Server error",
>     "stack": "TypeError: Cannot read properties of undefined
> (reading 'email')\n    at /app/src/routes/users.ts:47:22\n    at
> Layer.handle [as handle_request]
> (/app/node_modules/express/lib/router/layer.js:95:5)"
>   }
> }
> ```
>
> **Safe — generic message to the client:**
>
> ```
> {
>   "error": {
>     "message": "An unexpected error occurred. Please try again
> later."
>   }
> }
> ```
>
> Information like the stack trace belongs in server-side *logs* where your team can see it, not in HTTP responses where attackers can see it. Log the full error with `error.stack` on the server, but send only a generic message to the client.

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7 API Documentation

You can build the most elegant API in the world, but if no one can figure out how to use it, it might as well not exist. Documentation is not an afterthought — it is a core part of API

design.

7.1 Why Documentation Matters

Think about the Java APIs you have used. When you need to use `ArrayList`, you look up the Javadoc to see what methods are available, what parameters they take, and what they return. Web APIs need the same thing, but the stakes are higher:

- **No compiler to catch mistakes.** If you call a Java method with the wrong argument type, the compiler stops you. If you send the wrong JSON field to an API, you get a runtime error — or worse, silent incorrect behavior.
- **Network boundary means no source code.** You cannot read the server's source code to figure out how an endpoint works. Documentation is your only window.
- **Multiple consumers.** Your API might be used by a frontend team, a mobile team, third-party developers, and automated systems. Each needs to learn your API independently.

7.2 What Good Documentation Includes

At minimum, API documentation should describe each endpoint with:

Element	Description	Example
Method + URL	The HTTP method and path	`GET /users/{id}`
Description	What this endpoint does	"Retrieve a single user by ID"
Path parameters	Variable parts of the URL	`id` (integer) — The user's unique identifier
Query parameters	Optional filters/modifiers	`fields` (string) — Comma-separated list of fields to include
Request body	Required fields and types for POST/PUT/PATCH	`{ "name": string, "email": string }`
Response body	What the response looks like	`{ "id": 42, "name": "Alice" }`
Status codes	Possible responses	200 OK, 404 Not Found, 400 Bad Request

Element	Description	Example
Example	A concrete request/response pair	Full HTTP request and response shown

Do not just document the happy path. API consumers spend most of their debugging time on errors — invalid input, missing resources, authentication failures. Document error responses with the same detail as success responses. If your `GET /users/{id}` can return `200`, `404`, and `401`, all three should appear in the documentation with example response bodies.

7.3 OpenAPI and Interactive Documentation

Writing documentation by hand is tedious and tends to fall out of sync with the actual API. **OpenAPI** is a specification for describing REST APIs in a machine-readable format (YAML or JSON). An OpenAPI document describes every endpoint, parameter, request body, and response in a structured way.

The power of OpenAPI is that tools can *read* the specification and automatically generate:

- **Interactive documentation** — A web page where developers can browse endpoints and try them directly in the browser
- **Client libraries** — Code in various languages that knows how to call your API
- **Server stubs** — Skeleton code for implementing the API
- **Tests** — Automated tests that verify the API matches the specification

In this course, you will use **Scalar** as your interactive documentation viewer. Scalar reads your OpenAPI spec and renders it as a clean, interactive page mounted at `/api-docs` on your project's server. When you visit that URL, you will see auto-generated documentation for every endpoint — complete with parameter descriptions, example request bodies, and the ability to send live requests without writing any client code.

7.4 Documentation-First vs. Code-First

There are two approaches to API documentation:

- **Documentation-first:** Write the OpenAPI spec before writing any code. Design the API on paper, get agreement from stakeholders, then implement it. This is ideal for large teams and public APIs.
- **Code-first:** Write the code, then annotate it with comments or decorators that generate the OpenAPI spec automatically. This is faster for small teams and internal APIs.

Both are valid. In this course, you will use a code-first approach — adding `@openapi` annotations to your code that generate the OpenAPI spec automatically. Scalar then reads that spec and renders the interactive documentation. The important thing is that documentation *exists* and is *accurate*, regardless of how it was created.

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8 Common Design Mistakes

Now that you know the principles, here are the mistakes you will see most often — in your own code and in APIs you consume. Learning to recognize these patterns will save you significant debugging time.

8.1 Verbs in URLs

This was covered earlier, but it bears repeating because it is the most common mistake:

Mistake	Correct Alternative
`GET /getAllMovies`	`GET /movies`
`POST /createReview`	`POST /reviews`
`PUT /updateUser/42`	`PUT /users/42`
`DELETE /removeComment/7`	`DELETE /comments/7`
`GET /searchMovies?q=alien`	`GET /movies?q=alien`

The only widely accepted exception is for operations that do not map cleanly to CRUD. For example, `POST /users/42/deactivate` is common because "deactivation" is an action, not a resource. Even then, many API designers prefer `PATCH /users/42` with `{ "status": "inactive" }` in the body.

8.2 Inconsistent Naming Conventions

Pick one naming convention and stick with it throughout your entire API. For **URL paths**, the industry standard is **kebab-case**. URLs are case-insensitive by convention, hyphens are the

natural word separator in URLs, and this is what the vast majority of production APIs use — GitHub, Stripe, Google, Twitch, and TMDB all use kebab-case paths.

Convention	Example	Common In	Recommended?
kebab-case	`/movie-reviews`	Most REST APIs, URLs in general	**Yes — industry standard**
snake_case	`/movie_reviews`	Some Python-based APIs	Less common
camelCase	`/movieReviews`	Some JavaScript-based APIs	Less common

For **JSON keys** in request and response bodies, **camelCase** is the dominant convention. JavaScript and TypeScript use camelCase natively, and since JSON originated from JavaScript, most modern APIs follow suit. In this course, your URL paths will use kebab-case and your JSON keys will use camelCase.

Do not mix conventions:

```
# Bad — inconsistent casing
GET /users              ← lowercase plural
GET /Movie-Reviews      ← mixed case with kebab
GET /user_profiles      ← snake_case singular
```

```
# Good — consistent throughout
GET /users
GET /movie-reviews
GET /user-profiles
```

8.3 Wrong Status Codes

Using the wrong status code sends false signals to clients and tools:

Mistake	Problem	Correct Code
`200` for a created resource	Client does not know to refresh its list	`201 Created`
`200` for a deletion	Client may expect a body that is not there	`204 No Content`

Mistake	Problem	Correct Code
`200` for a validation error	Client thinks the request succeeded	`400 Bad Request`
`500` for a missing resource	Triggers server error alerts	`404 Not Found`
`403` when not authenticated	Client cannot tell if it needs to log in or lacks permission	`401 Unauthorized`

8.4 Missing or Useless Error Messages

Returning a status code without an explanation forces the client developer to guess:

```
# Bad — no body at all
HTTP/1.1 400 Bad Request
```

```
# Bad — useless message
HTTP/1.1 400 Bad Request

{ "error": "Invalid input" }
```

```
# Good — specific, actionable
HTTP/1.1 400 Bad Request

{
  "error": {
    "code": 400,
    "message": "Validation failed",
    "details": [
      { "field": "email", "message": "Must be a valid email address" },
      { "field": "name", "message": "Must be between 1 and 100 characters" }
    ]
  }
}
```

The goal is that a developer receiving an error can fix the problem *without* having to contact you or read your source code.

8.5 Forgetting About Pagination

An endpoint that returns *all* resources without pagination is a time bomb:

```
GET /users    ← Returns all 50,000 users in one response
```

This works fine during development when you have 10 test users. In production, it will be slow, consume excessive memory, and potentially crash clients that cannot handle a massive JSON array. Always design collection endpoints with pagination from the start:

```
GET /users?page=1&limit=25
```

8.6 Exposing Internal Implementation

Your API's URL structure should reflect the *resources* your consumers care about, not your internal database tables or code organization:

Leaks Implementation	Clean Design
`GET /tbl_users`	`GET /users`
`GET /api/v1/handlers/user-handler`	`GET /api/v1/users`
`GET /users/findByEmailAndRole`	`GET /users?email=alice@example.com&role=admin`

If you rename a database table, your API consumers should not notice.

---

9 Summary

Concept	Key Point
REST	Architectural constraints, not a specification — Fielding's 2000 dissertation
Resources and URIs	Everything is a resource; use nouns (`/users`), not verbs (`/getUsers`)
Plural names	`/users` for the collection, `/users/42` for one item

Concept	Key Point
HTTP methods	GET = read, POST = create, PUT = replace, PATCH = update, DELETE = remove
PUT vs. PATCH	PUT replaces the whole resource; PATCH updates only specified fields
Safe / Idempotent	GET is safe; PUT and DELETE are idempotent; POST is neither
Path parameters	Identify a specific resource: `/users/42`
Query strings	Filter, sort, or paginate a collection: `/users?role=admin`
Request bodies	POST, PUT, PATCH send JSON bodies; GET and DELETE typically do not
Consistent responses	Same structure for all endpoints — data, errors, pagination
Status codes	Use precise codes (201, 204, 400, 404) — do not return 200 for everything
Error messages	Include a human-readable message, a code, and specific details
API documentation	OpenAPI spec + Scalar viewer provides interactive, auto-generated docs
Common mistakes	Verbs in URLs, inconsistent naming, wrong status codes, missing errors, no pagination

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10 References

This reading draws from the following sources:

Foundational Work:

- Fielding, R. T. (2000). *Architectural Styles and the Design of Network-based Software Architectures* (Doctoral dissertation, University of California, Irvine).

https://ics.uci.edu/~fielding/pubs/dissertation/top.htm

Standards & Specifications:

- RFC 9110 — HTTP Semantics — Defines HTTP methods, status codes, and their semantics
- RFC 5789 — PATCH Method for HTTP — Defines the PATCH method
- OpenAPI Specification — The standard for describing REST APIs

Technical Documentation:

- MDN Web Docs — HTTP Request Methods — Comprehensive reference for HTTP methods
- MDN Web Docs — HTTP Response Status Codes — Complete status code reference
- Scalar Documentation — Interactive API documentation viewer used in this course
- OpenAPI Tools — Community-maintained directory of tools built on the OpenAPI specification

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11 Further Reading

External Resources

- RESTful Web API Design with Node.js (Microsoft Learn) — Practical REST design best practices from Microsoft's architecture guides
- HTTP API Design Guide (Heroku) — Opinionated guide to designing HTTP+JSON APIs, extracted from real-world experience
- JSON API Specification — A specification for building consistent JSON APIs, including conventions for pagination, filtering, and error handling
- REST API Tutorial — Beginner-friendly reference covering REST constraints, methods, and naming conventions
- Zalando RESTful API Guidelines — A comprehensive, opinionated set of guidelines used in production by a large engineering organization

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This reading is part of TCSS 460 — Client/Server Programming, School of Engineering and Technology, University of Washington Tacoma.