

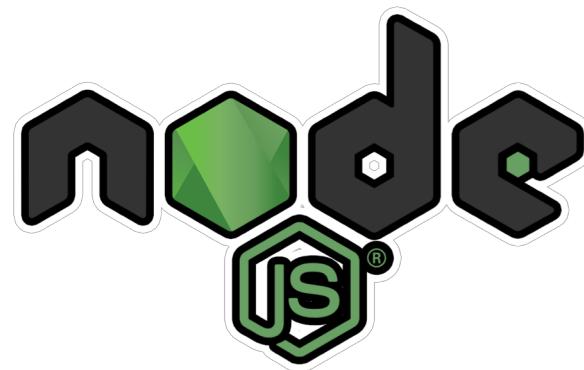


# Getting Started

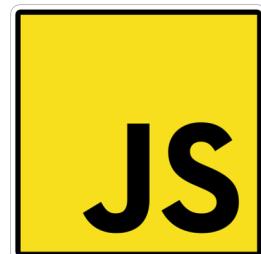
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What's Inside this Course?

## What is Node.js?

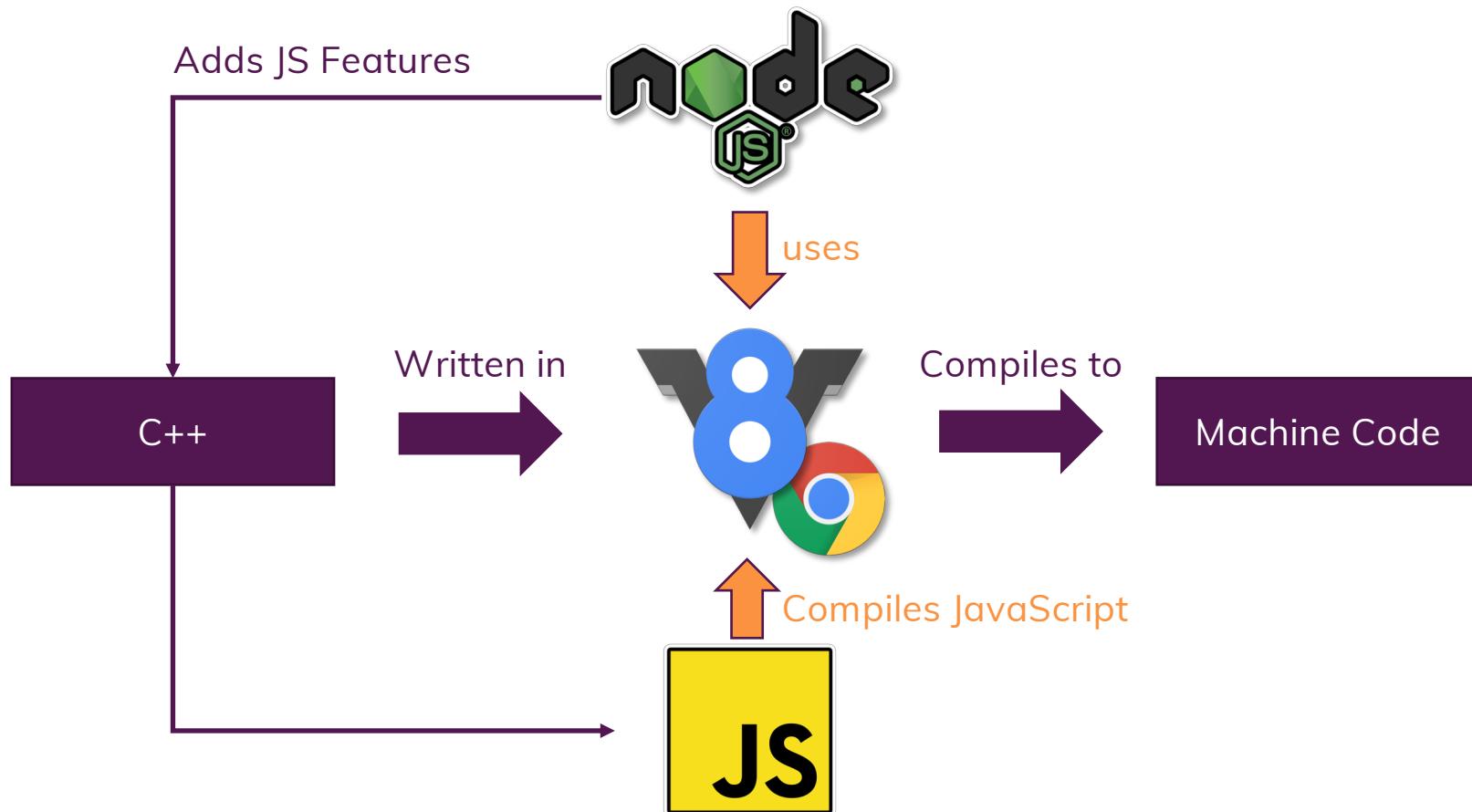


A JavaScript Runtime

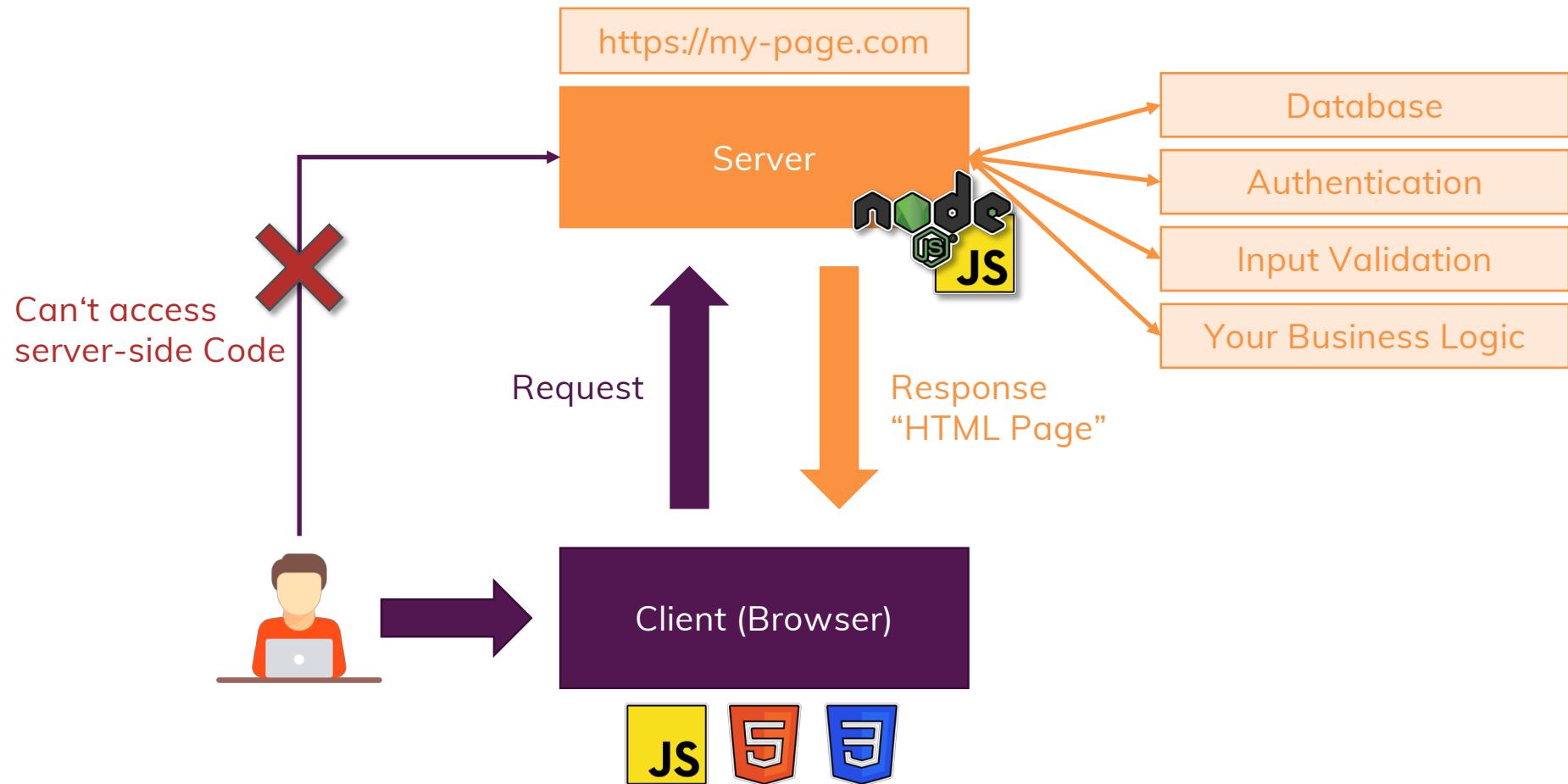


“JavaScript on the Server”

## What Does That Mean?



# JavaScript on the Server



## Side note: You're not limited to the Server!

Node.js is a JavaScript Runtime



You can use it for more than just  
Server-side Code



Utility Scripts, Build Tools, ...

# Node.js' Role (in Web Development)

Run Server

Create Server & Listen to Incoming Requests

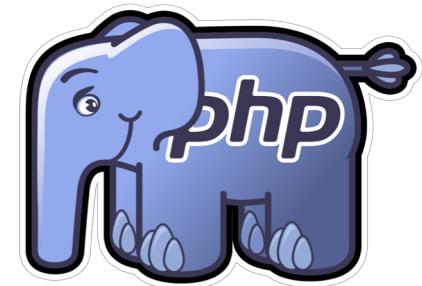
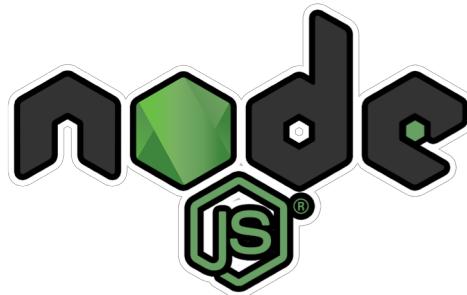
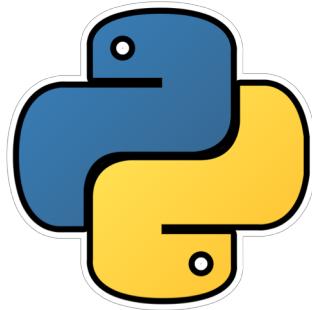
Business Logic

Handle Requests, Validate Input, Connect to Database

Responses

Return Responses (Rendered HTML, JSON, ...)

## Alternatives

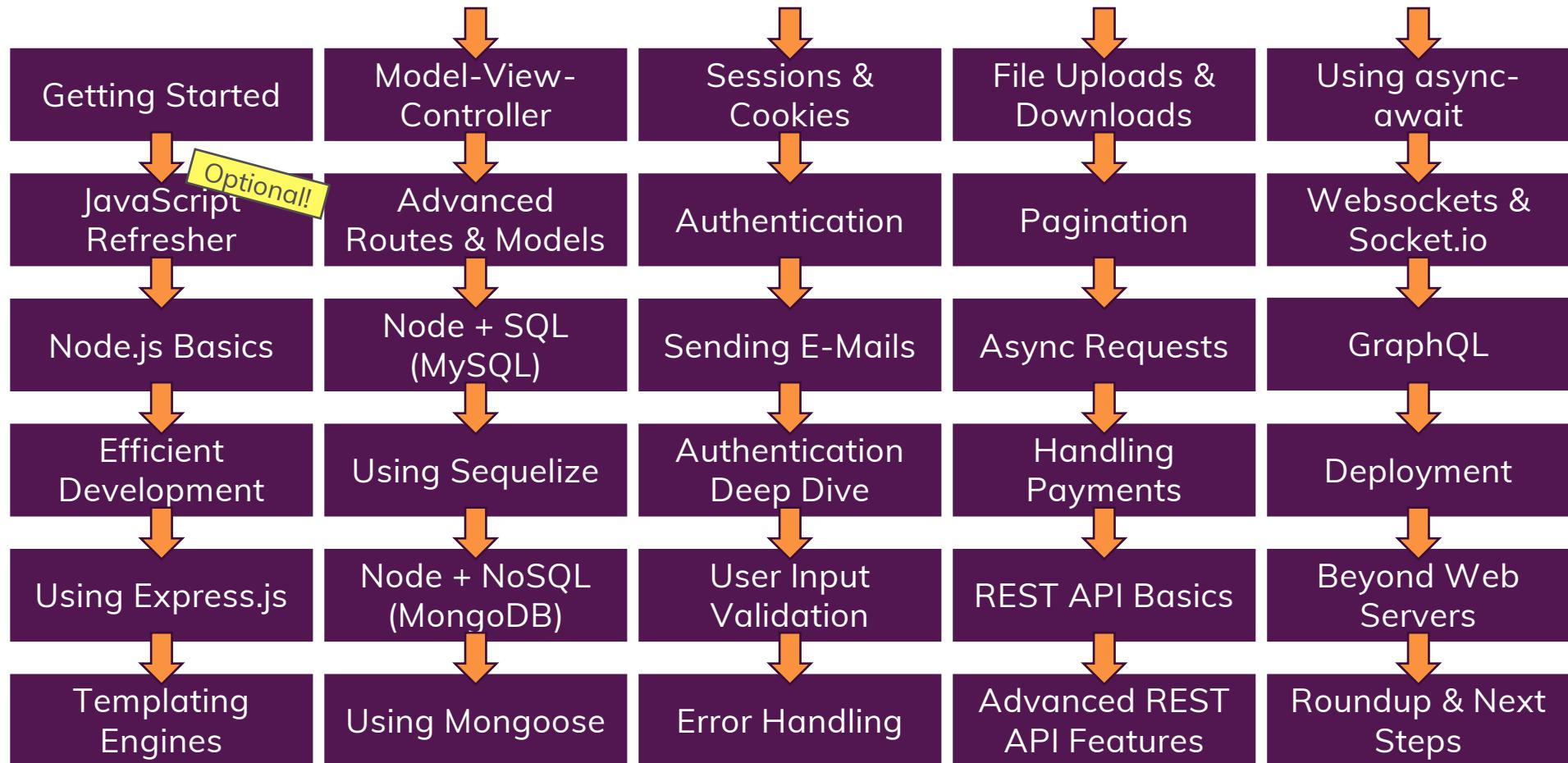


And More (Ruby, ASP.NET, ...)

Ultimately, you can build the same web apps with all of them

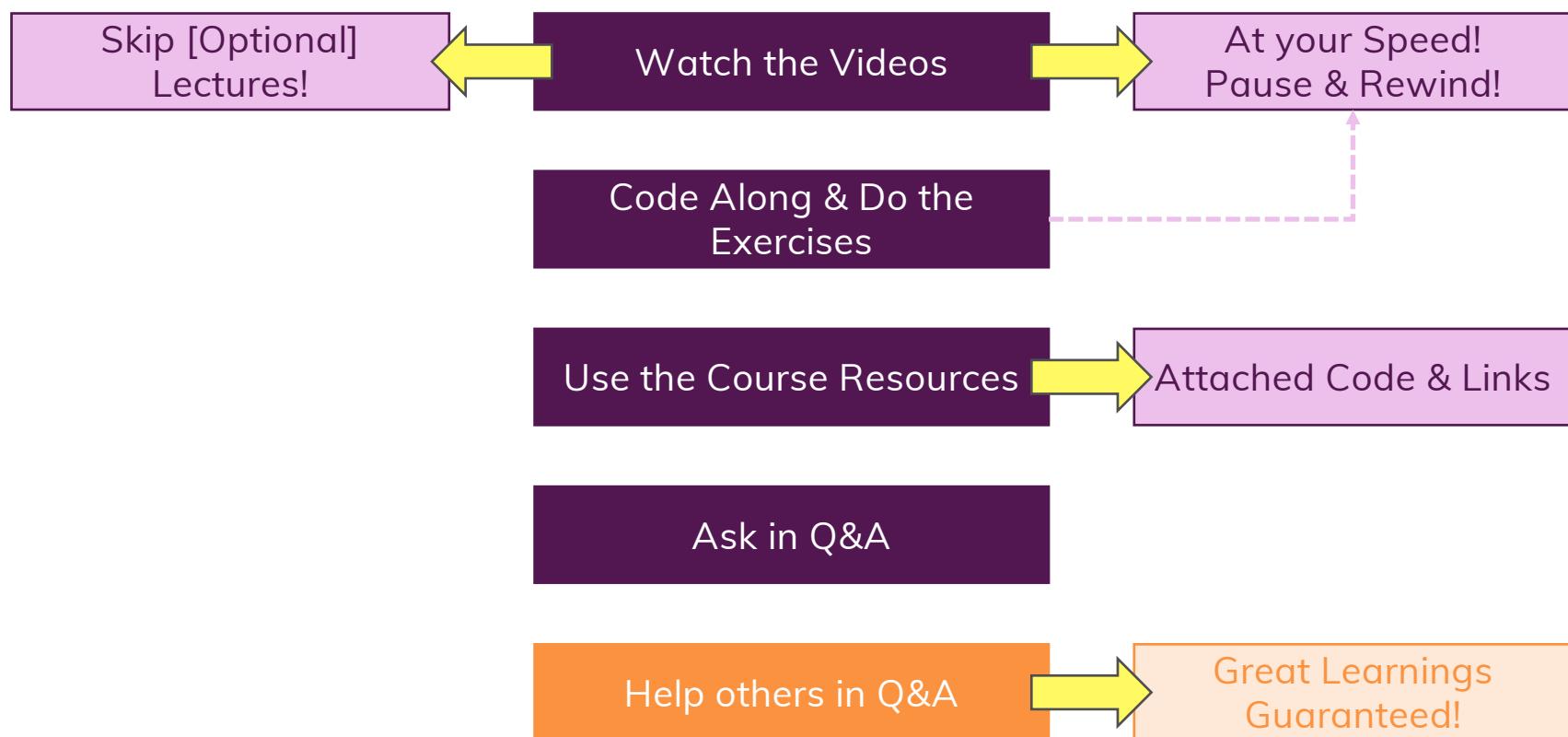
Choose your preferred syntax, community, ecosystem

# Course Outline

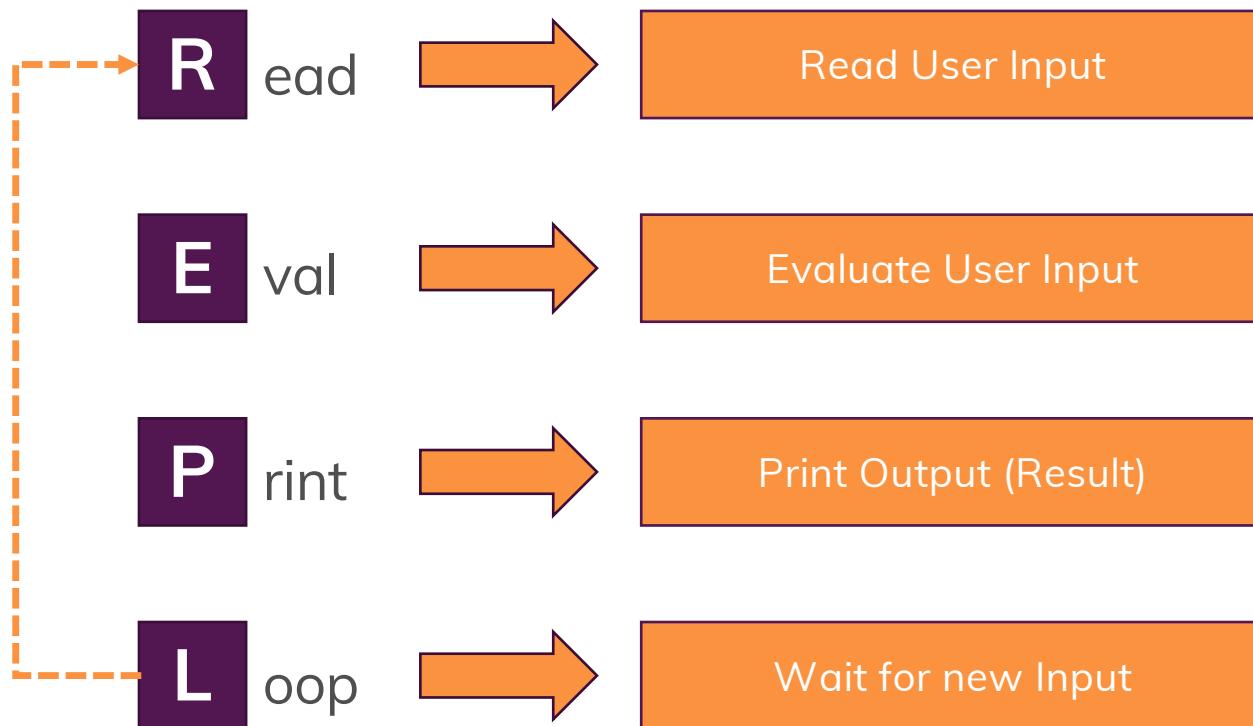




# How To Get The Most Out Of The Course



## The REPL





# Running Node.js Code

Execute Files

Use the REPL

Used for real apps

Great playground!

Predictable sequence of steps

Execute code as you write it



# JavaScript Basics

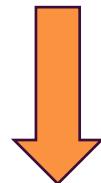
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A Quick Refresher



## Skip This Module!

Already know JavaScript?



Skip this Module!

# JavaScript Summary

Weakly Typed Language

No explicit type assignment

Data types can be switched dynamically

Object-Oriented Language

Data can be organized in logical objects

Primitive and reference types

Versatile Language

Runs in browser & directly on a PC/ server

Can perform a broad variety of tasks

# let & const

var

let

const

variable values

constant values

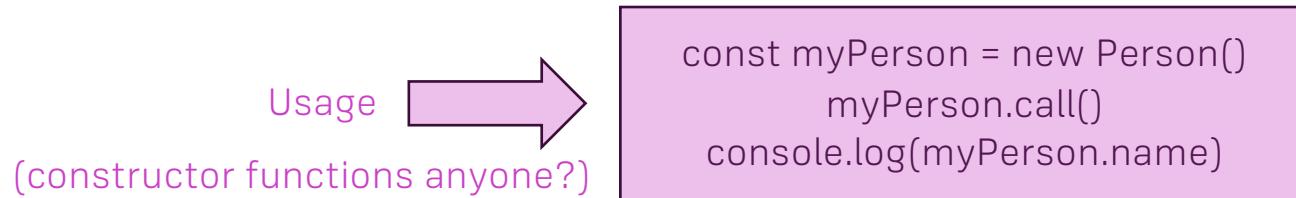
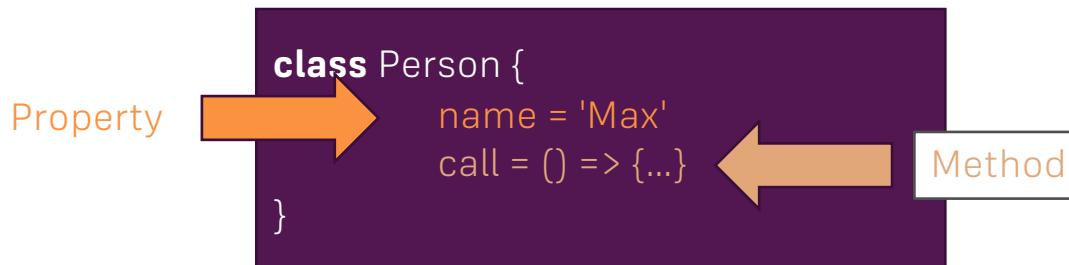
## Arrow Functions

```
function myFnc() {  
  ...  
}
```

```
const myFnc = () => {  
  ...  
}
```

No more issues with the **this** keyword!

# Classes



# Classes, Properties & Methods

Properties are like “variables attached to classes/ objects”

ES6

```
constructor () {  
    this.myProperty = ' value'  
}
```

ES7

```
myProperty = ' value'
```

Methods are like “functions attached to classes/ objects”

ES6

```
myMethod () { ... }
```

ES7

```
myMethod = () => { ... }
```

# Spread & Rest Operators

...

Spread

Used to split up array elements OR object properties

```
const newArray = [...oldArray, 1, 2]  
const newObject = { ...oldObject, newProp: 5 }
```

Rest

Used to merge a list of function arguments into an array

```
function sortArgs(...args) {  
    return args.sort()  
}
```

# Destructuring

Easily extract array elements or object properties and store them in variables

## Array Destructuring

```
[a, b] = ['Hello', 'Max']
console.log(a) // Hello
console.log(b) // Max
```

## Object Destructuring

```
{name} = {name: 'Max', age: 28}
console.log(name) // Max
console.log(age) // undefined
```



# Node.js Basics

---

The Essential Knowledge You Need



## What's In This Module?

How Does The Web Work (Refresher)?

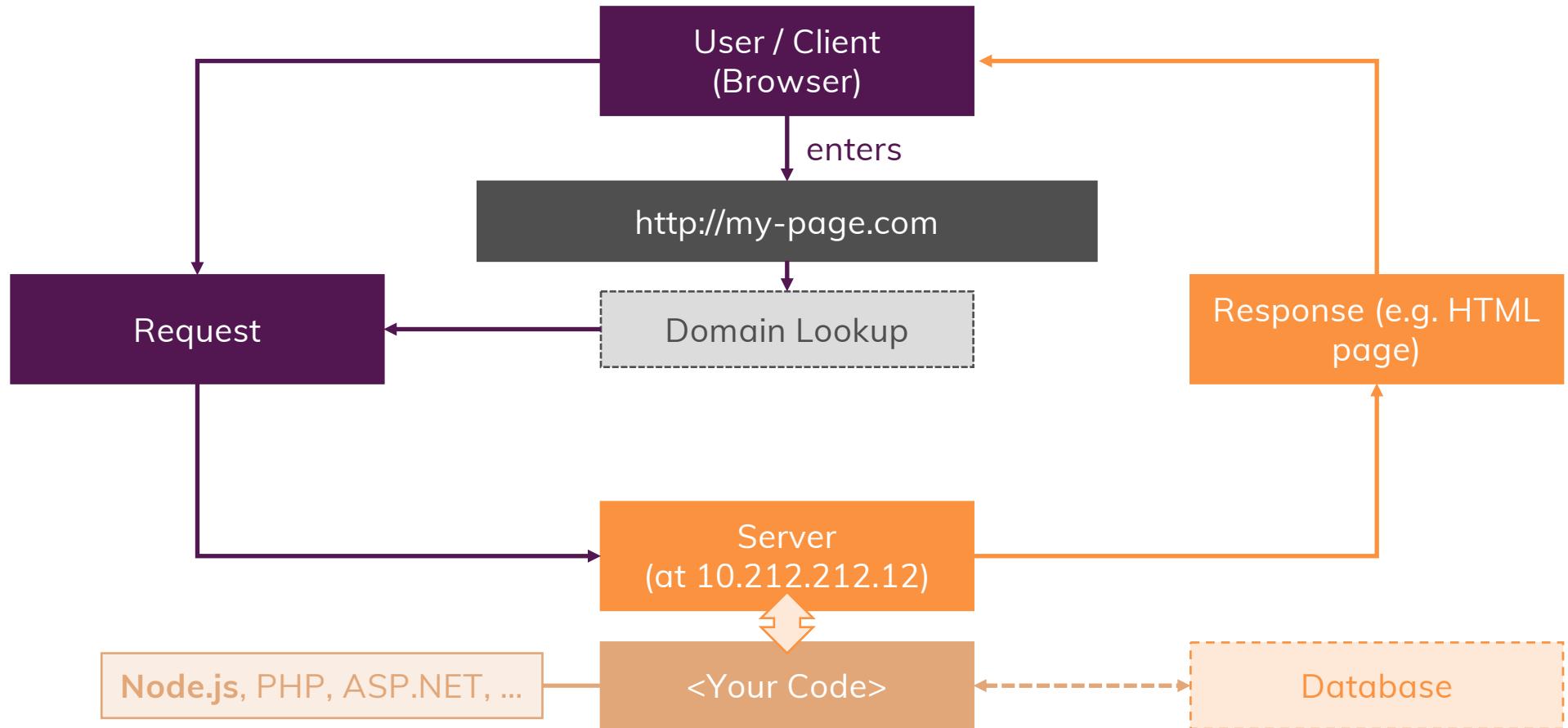
Creating a Node.js Server

Using Node Core Modules

Working with Requests & Responses  
(Basics)

Asynchronous Code & The Event Loop

# How the Web Works



## HTTP, HTTPS

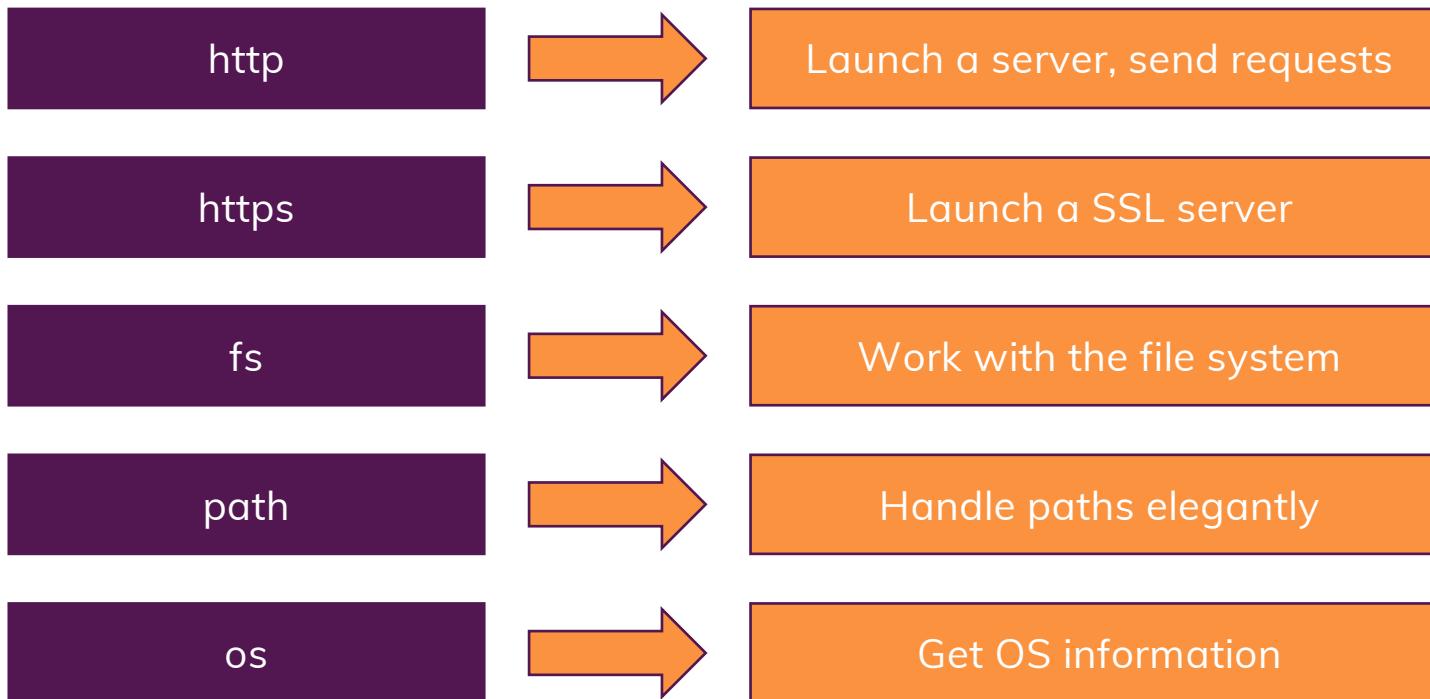
### Hyper Text Transfer Protocol

A Protocol for Transferring Data which is understood by Browser and Server

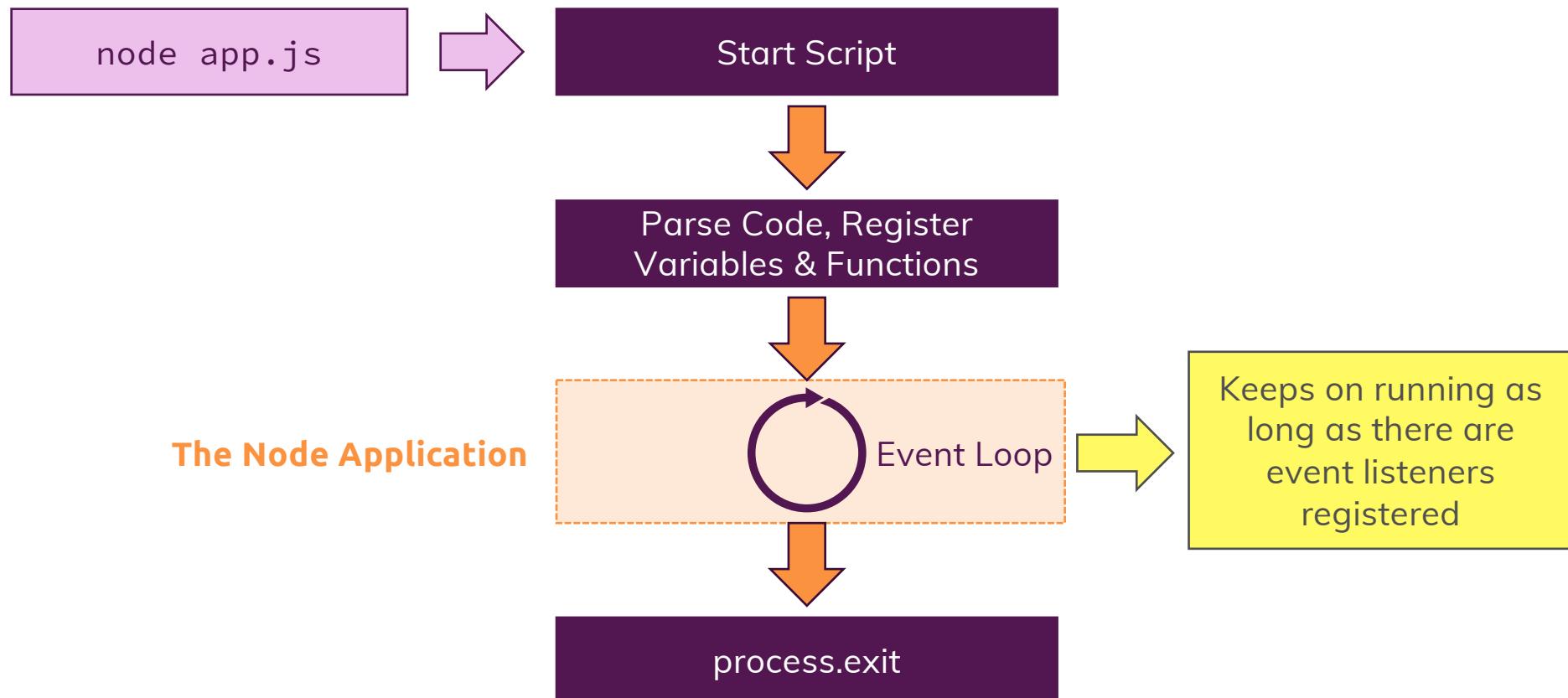
### Hyper Text Transfer Protocol Secure

HTTP + Data Encryption (during Transmission)

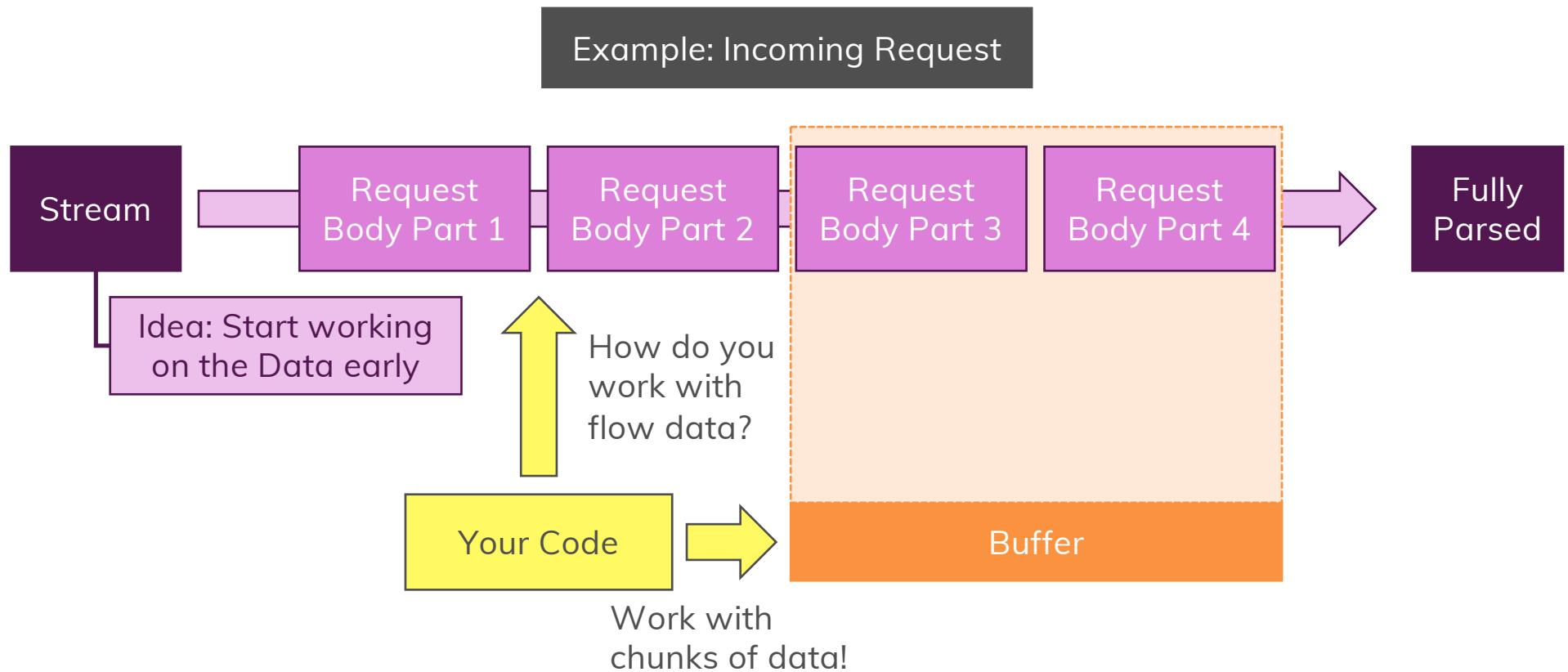
## Core Modules



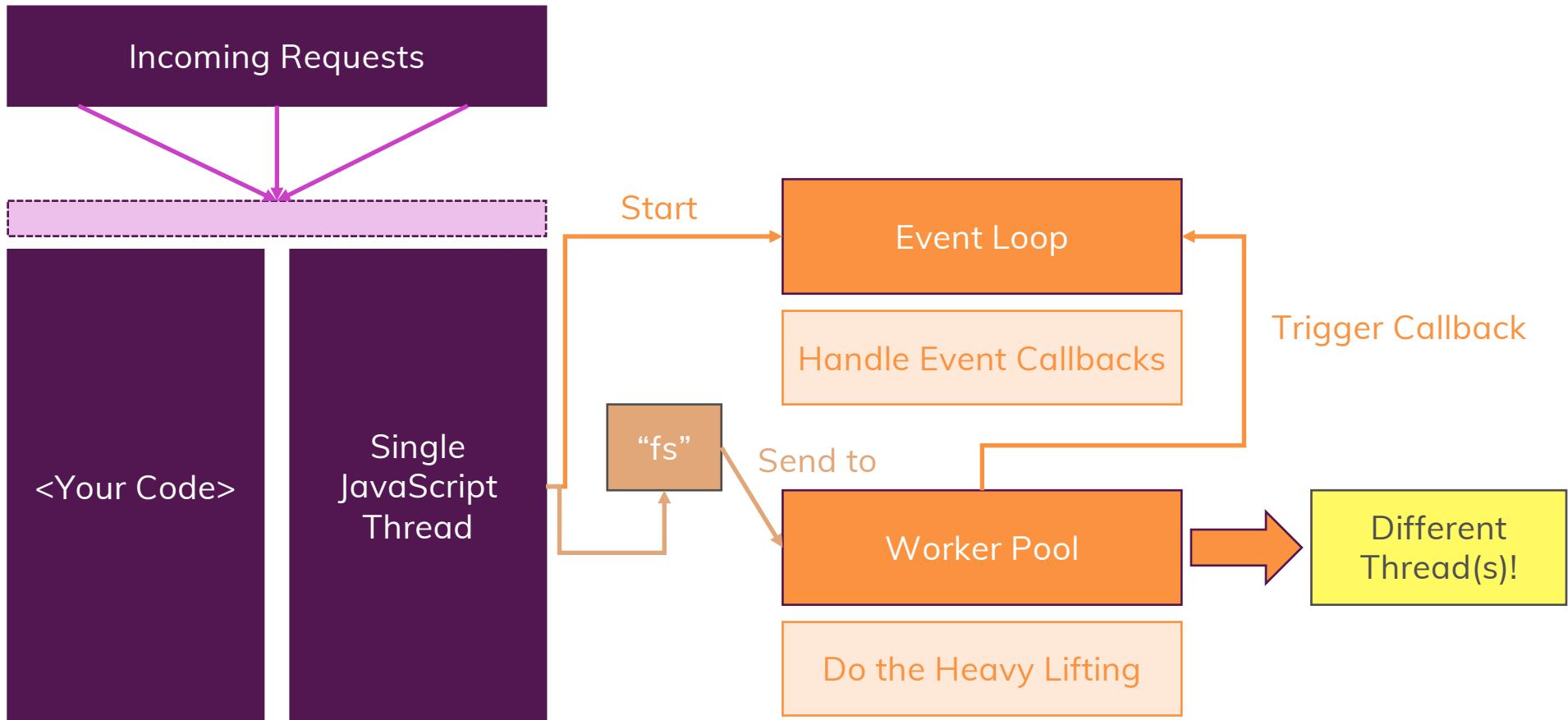
# Node.js Program Lifecycle



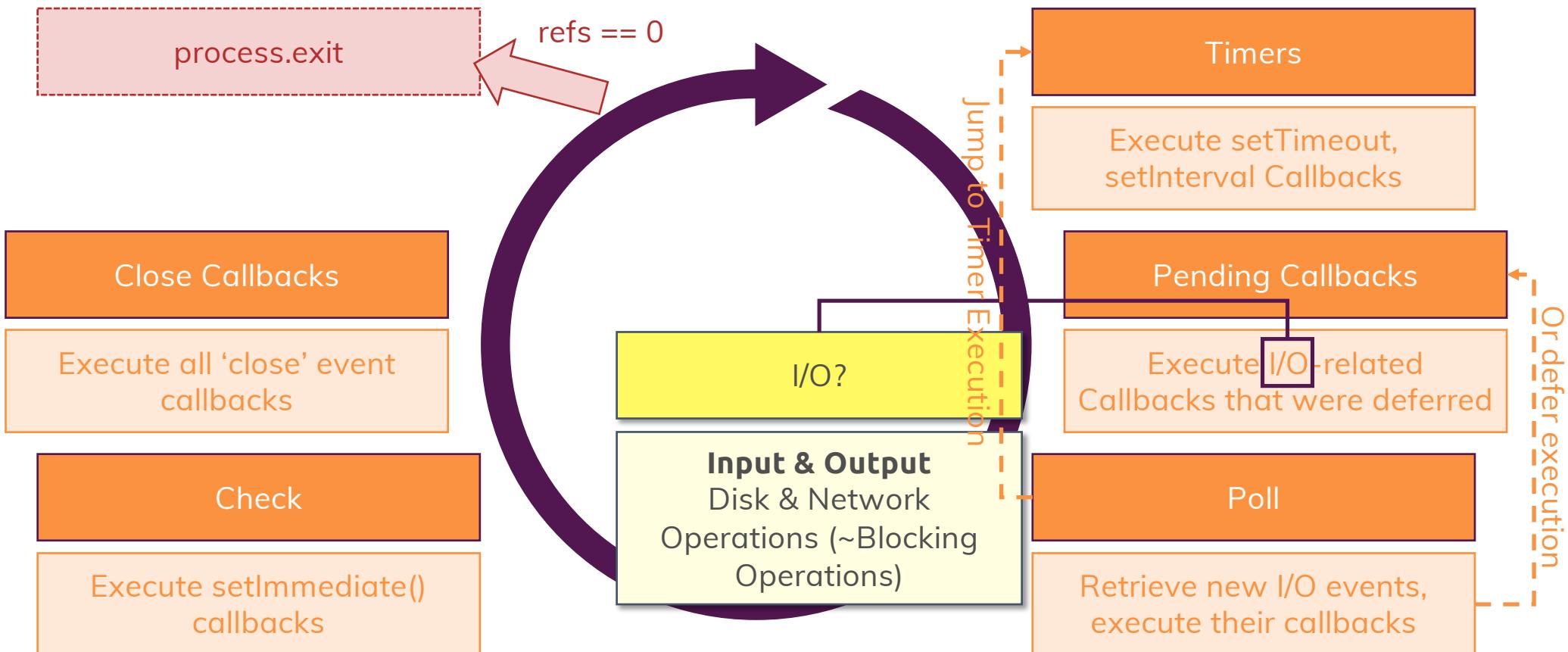
# Streams & Buffers



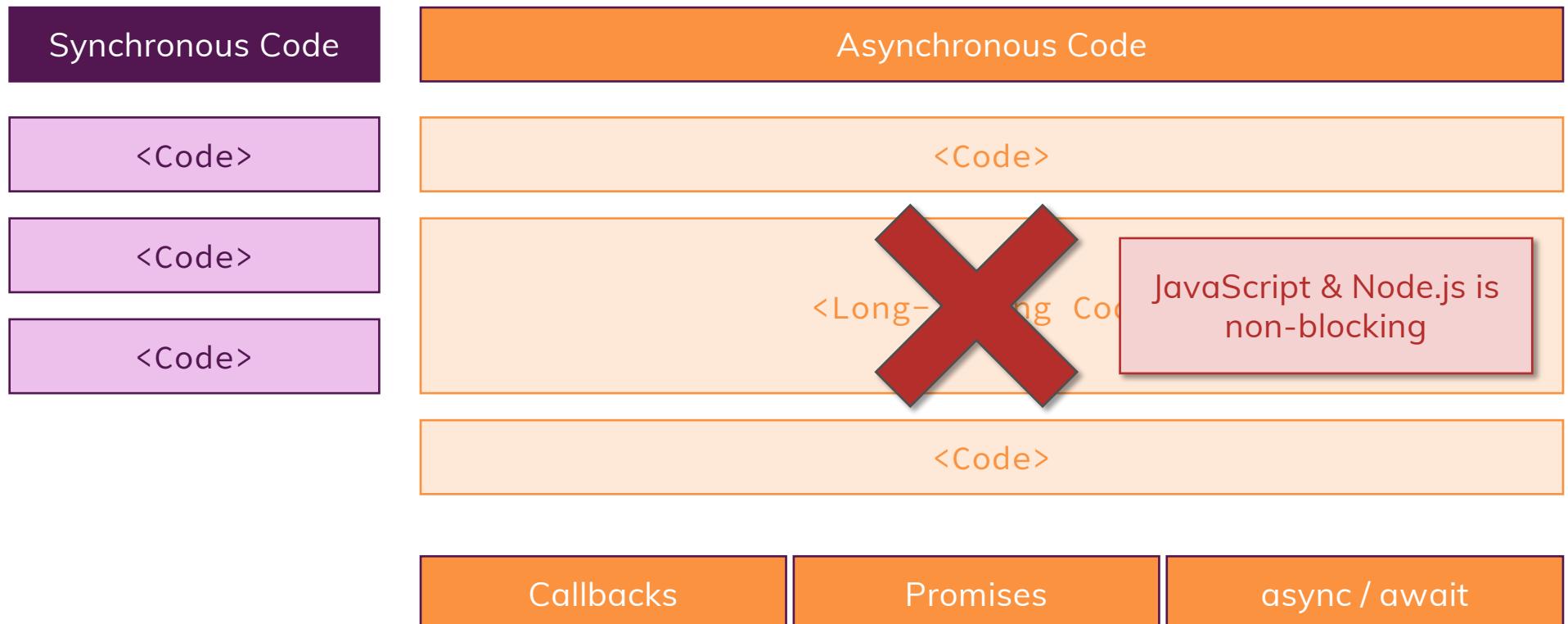
# Single Thread, Event Loop & Blocking Code



# The Event Loop



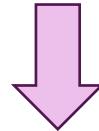
# Asynchronous Code



## Node's Module System

```
module.exports = ...
```

```
exports is an alias for module.exports
```



```
exports.something = ...
```

But `exports = { ... }` won't work! Because  
you then re-assign the alias!

# Module Summary

## How the Web Works

Client => Request => Server => Response => Client

## Program Lifecycle & Event Loop

- Node.js runs non-blocking JS code and uses an event-driven code ("Event Loop") for running your logic
- A Node program exits as soon as there is no more work to do
- Note: The `createServer()` event never finishes by default

## Asynchronous Code

- JS code is non-blocking
- Use callbacks and events => Order changes!

## Node.js & Core Modules

- Node.js ships with multiple core modules (`http`, `fs`, `path`, ...)
- Core modules can be imported into any file to be used there
- Import via `require('module')`

## The Node Module System

- Import via `require('./path-to-file')` for custom files or `require('module')` for core & third-party modules
- Export via `module.exports` or just `exports` (for multiple exports)

## Requests & Responses

- Parse request data in chunks (Streams & Buffers)
- Avoid "double responses"

# Assignment

1

Spin up a Node.js-driven Server (on port 3000)

2

Handle two Routes: “/” and “/users”

- Return some greeting text on “/”
- Return a list of dummy users (e.g. <ul><li>User 1</li></ul>)

3

Add a form with a “username” <input> to the “/” page and submit a POST request to “/create-user” upon a button click

4

Add the “/create-user” route and parse the incoming data (i.e. the username) and simply log it to the console



# Debugging & Easier Development

---

Fixing Errors, Developing Efficiently

## Types of Errors

Syntax Errors

Runtime Errors

Logical Errors

# Module Summary

## npm

- npm stands for “Node Package Manager” and it allows you to manage your Node project and its dependencies
- You can initialize a project with `npm init`
- npm scripts can be defined in the `package.json` to give you “shortcuts” to common tasks/ commands

## 3rd Party Packages

- Node projects typically don’t just use core modules and custom code but also third-party packages
- You install them via npm
- You can differentiate between production dependencies (`--save`), development dependencies (`--save-dev`) and global dependencies (`-g`)

## Types of Errors

- Syntax, runtime and logical errors can break your app
- Syntax and runtime errors throw (helpful) error messages (with line numbers!)
- Logical errors can be fixed with testing and the help of the debugger

## Debugging

- Use the VS Code Node debugger to step into your code and go through it step by step
- Analyze variable values at runtime
- Look into (and manipulate) variables at runtime
- Set breakpoints cleverly (i.e. respect the `async`/ event-driven nature)



# Express.js

---

Don't re-invent the Wheel!



## What's In This Module?

What is Express.js?

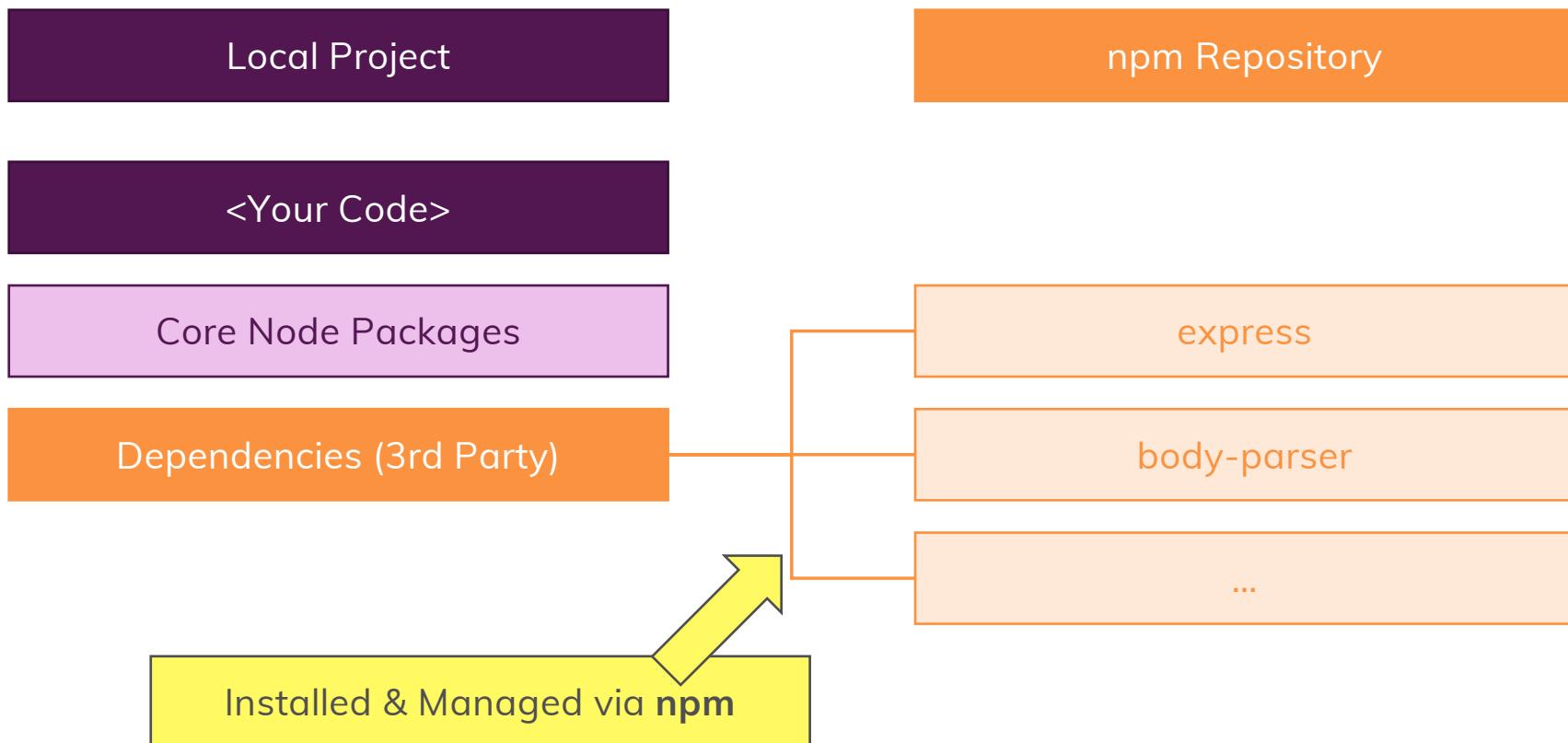
Using Middleware

Working with Requests & Responses  
(Elegantly!)

Routing

Returning HTML Pages (Files)

# npm & Packages



## What and Why?

Server Logic is Complex!

You want to focus on your Business Logic, not  
on the nitty-gritty Details!

**Framework:** Helper functions,  
tools & rules that help you build  
your application!

Use a Framework for the Heavy Lifting!

express

# What Does Express.js Help You With?

Parsing Requests &  
Sending Responses

Routing

Managing Data

Extract Data

Execute different Code for  
different Requests

Manage Data across  
Requests (Sessions)

Render HTML Pages

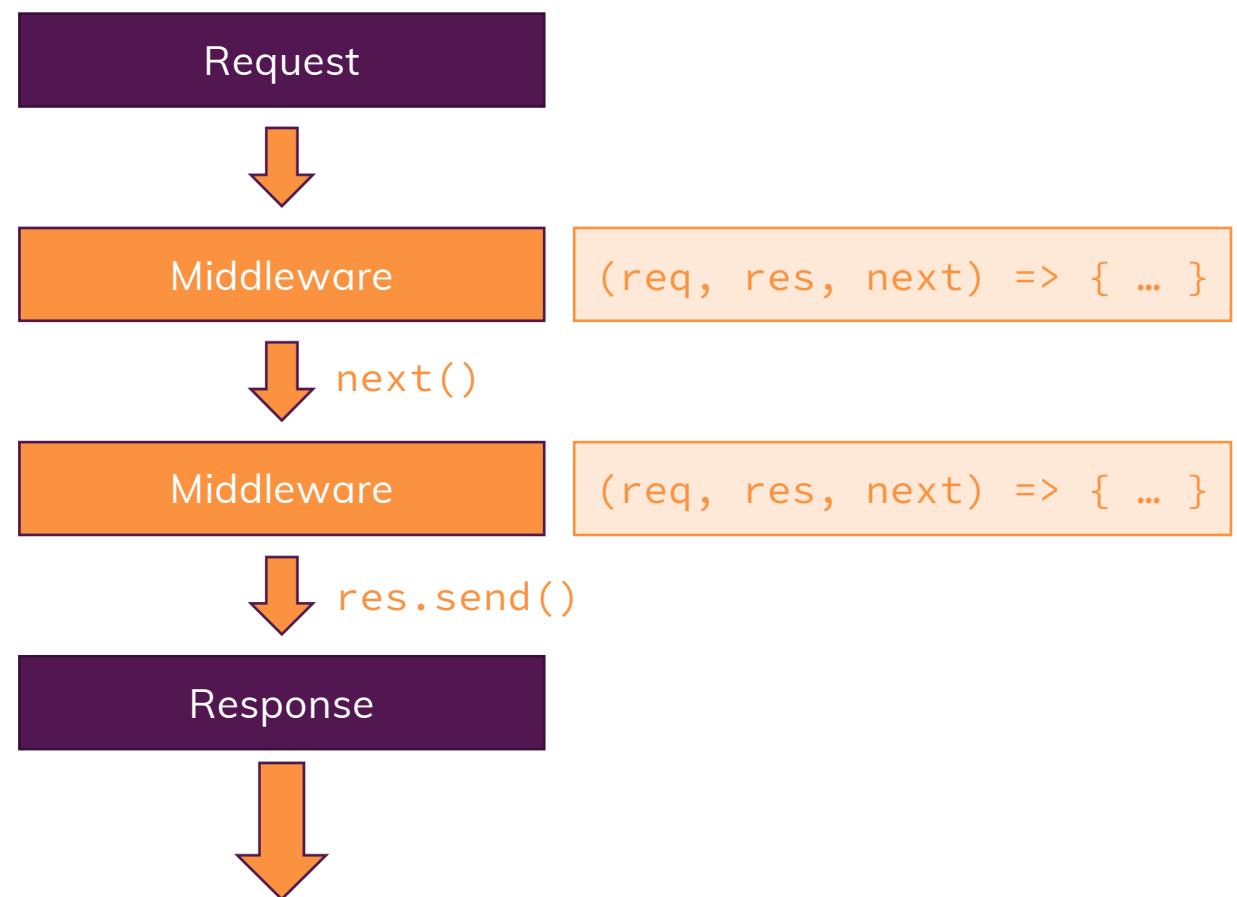
Filter / Validate incoming  
Requests

Work with Files

Return Data / HTML  
Responses

Work with Databases

# It's all about Middleware



# Assignment

1

Create a npm project and install Express.js (Nodemon if you want)

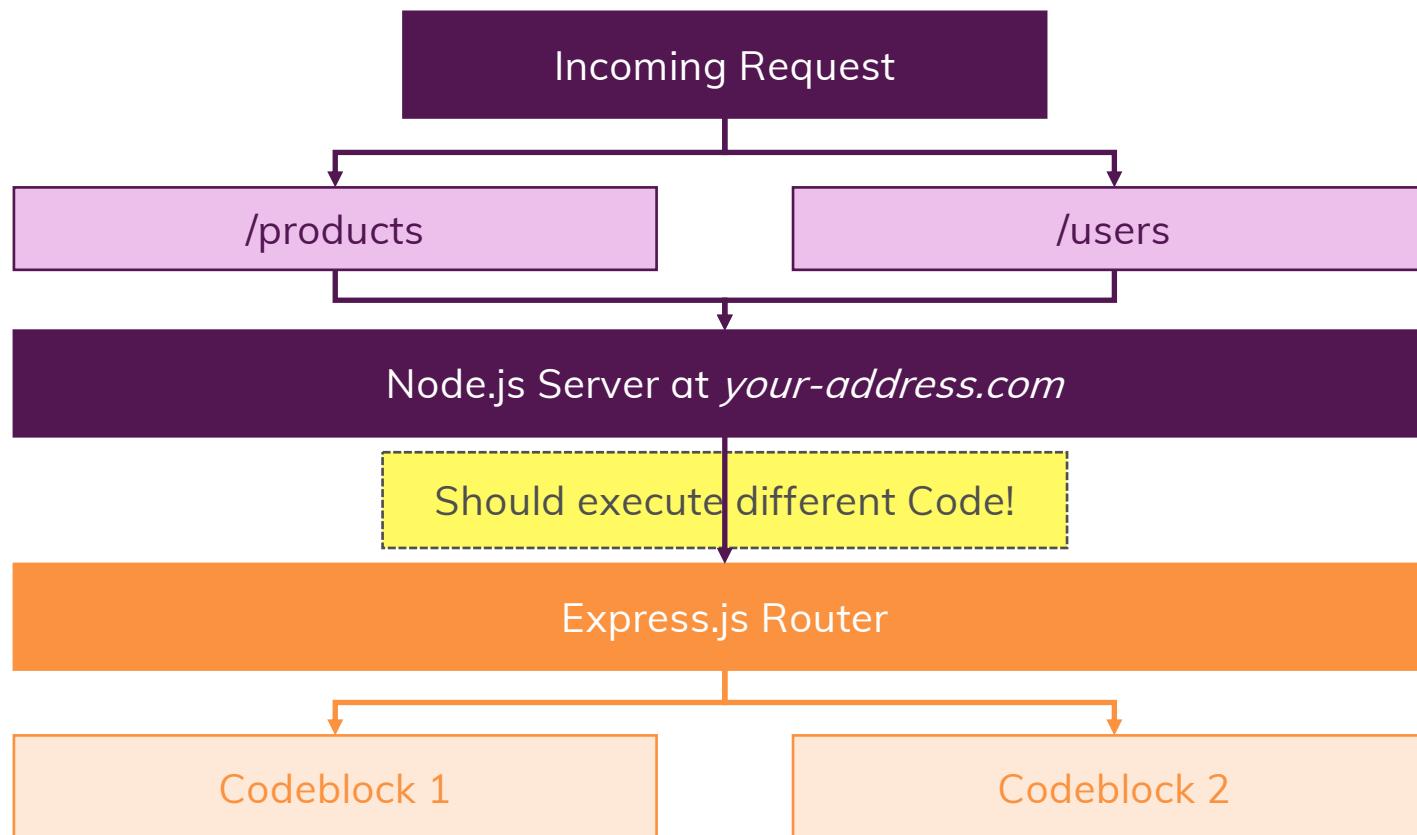
2

Create an Express.js app which funnels the requests through 2 middleware functions that log something to the console and return one response.

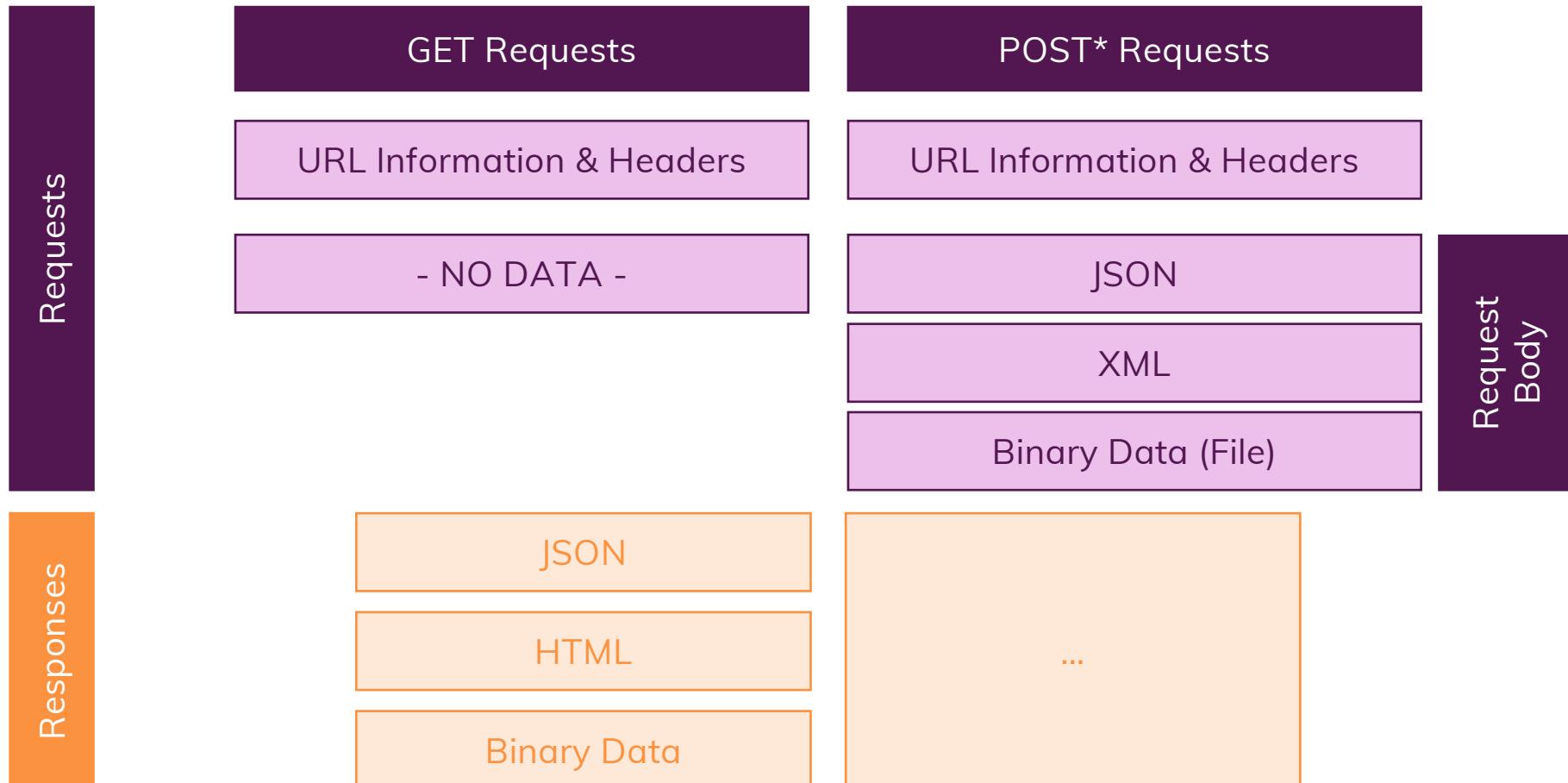
3

Handle requests to “/” and ”/users” such that each request only has one handler/ middleware that does something with it (e.g. send dummy response).

# Routing



# Request & Response Data



## Alternatives to Express.js

Vanilla Node.js

Adonis.js

Koa

Sails.js

...

# Assignment

1

Create a npm project and install Express.js (Nodemon if you want)

2

Create an Express.js app which serves two HTML files (of your choice/with your content) for "/" and "/users".

3

Add some static (.js or .css) files to your project that should be required by at least one of your HTML files.

## Module Summary

### What is Express.js?

- Express.js is Node.js framework – a package that adds a bunch of utility functions and tools and a clear set of rules on how the app should be built (middleware!)
- It's highly extensible and other packages can be plugged into it (middleware!)

### Routing

- You can filter requests by path and method
- If you filter by method, paths are matched exactly, otherwise, the first segment of a URL is matched
- You can use the express.Router to split your routes across files elegantly

### Middleware, next() and res()

- Express.js relies heavily on middleware functions – you can easily add them by calling use()
- Middleware functions handle a request and should call next() to forward the request to the next function in line or send a response

### Serve Files

- You're not limited to serving dummy text as a response
- You can sendFile()s to your users – e.g. HTML files
- If a request is directly made for a file (e.g. a .css file is requested), you can enable static serving for such files via express.static()



# Dynamic Content & Templates

---

Rendering more than Static HTML



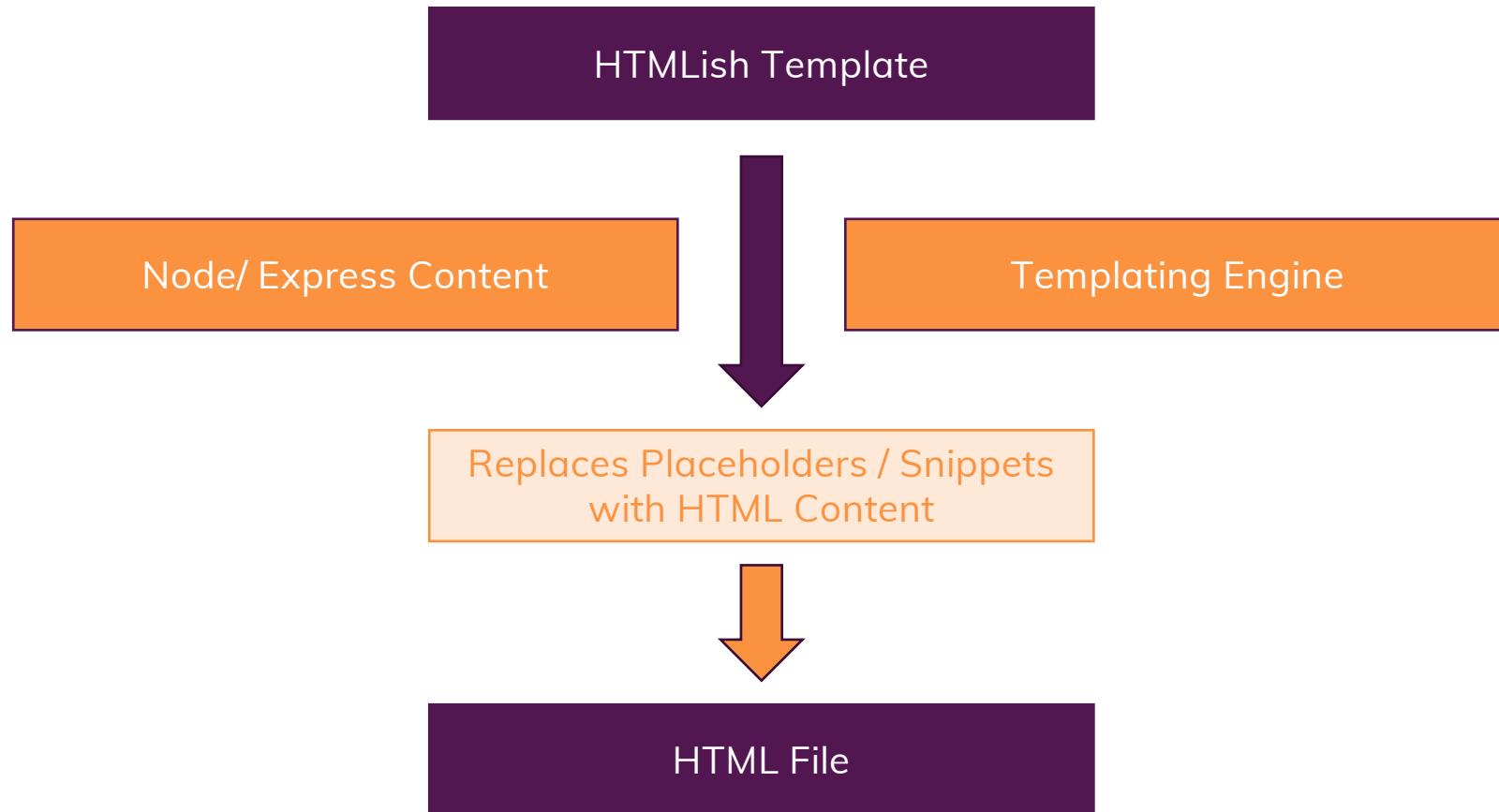
## What's In This Module?

Managing Data (without a Database)

Render Dynamic Content in our Views

Understanding Templating Engines

# Templating Engines



# Available Templating Engines

EJS

Pug (Jade)

Handlebars

```
<p><%= name %></p>
```

```
p #{{name}}
```

```
<p>{{ name }}</p>
```

Use normal HTML and plain JavaScript in your templates

Use minimal HTML and custom template language

Use normal HTML and custom template language

# Assignment

1

Create a npm project and install Express.js (Nodemon if you want)

2

Add two routes:

- "/" => Holds a <form> that allows users to input their name
- "/users" => Outputs an <ul> with the user names (or some error text)



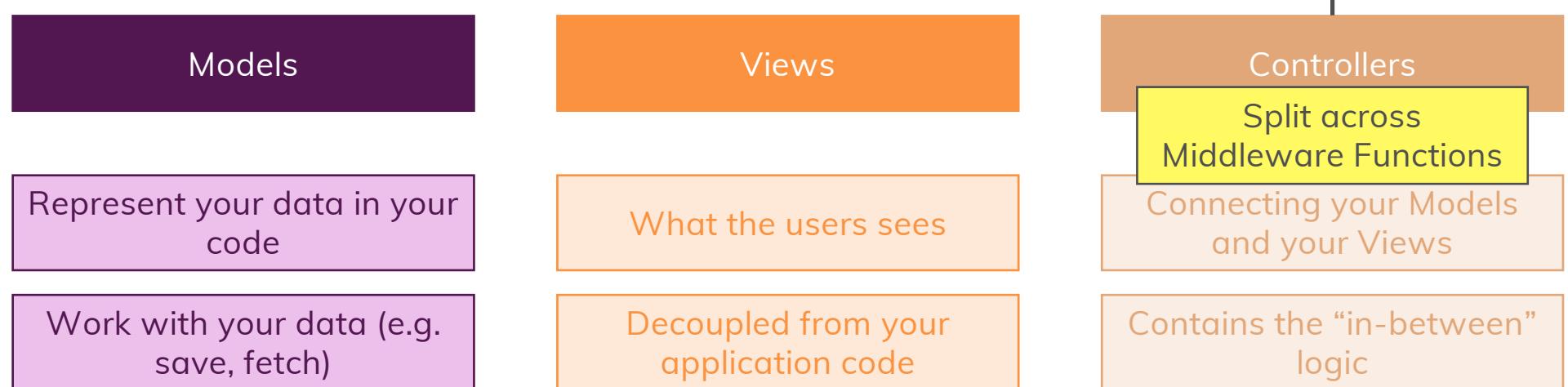
# Model View Controller (MVC)

---

Structuring your Code

# What's MVC?

## Separation of Concerns



## Module Summary

### Model

- Responsible for representing your data
- Responsible for managing your data (saving, fetching, ...)
- Doesn't matter if you manage data in memory, files, databases
- Contains data-related logic

### Controller

- Connects Model and View
- Should only make sure that the two can communicate (in both directions)

### View

- What the user sees
- Shouldn't contain too much logic (Handlebars!)



# Dynamic Routes & Advanced Models

---

Passing and Using Dynamic Data



## What's In This Module?

Passing Route Params

Using Query Params

Enhance our Models

## Module Summary

### Dynamic Routing

- You can pass dynamic path segments by adding a ":" to the Express router path
- The name you add after ":" is the name by which you can extract the data on `req.params`
- Optional (query) parameters can also be passed (`?param=value&b=2`) and extracted (`req.query.myParam`)

### More on Models

- A Cart model was added – it holds static methods only
- You can interact between models (e.g. delete cart item if a product is deleted)
- Working with files for data storage is suboptimal for bigger amounts of data



# Using Promises & Improving Async Code

---

Escaping Callback Hell



## What's In This Module?

What is Callback Hell?

Promises to the Rescue!

Writing Good Async Code

# Callback Hell

```
fs.readFile('path', (err, fileContent) => {
  fs.writeFile('path', 'new content', (err) => {
    ...
  })
});
```



Deeply nested callbacks can be hard to read, understand & maintain!

## Module Summary

### Dynamic Routing

- You can pass dynamic path segments by adding a ":" to the Express router path
- The name you add after ":" is the name by which you can extract the data on `req.params`
- Optional (query) parameters can also be passed (`?param=value&b=2`) and extracted (`req.query.myParam`)

### More on Models

- A Cart model was added – it holds static methods only
- You can interact between models (e.g. delete cart item if a product is deleted)
- Working with files for data storage is suboptimal for bigger amounts of data

# Storing Data in Databases

---

Storing Application Data Correctly

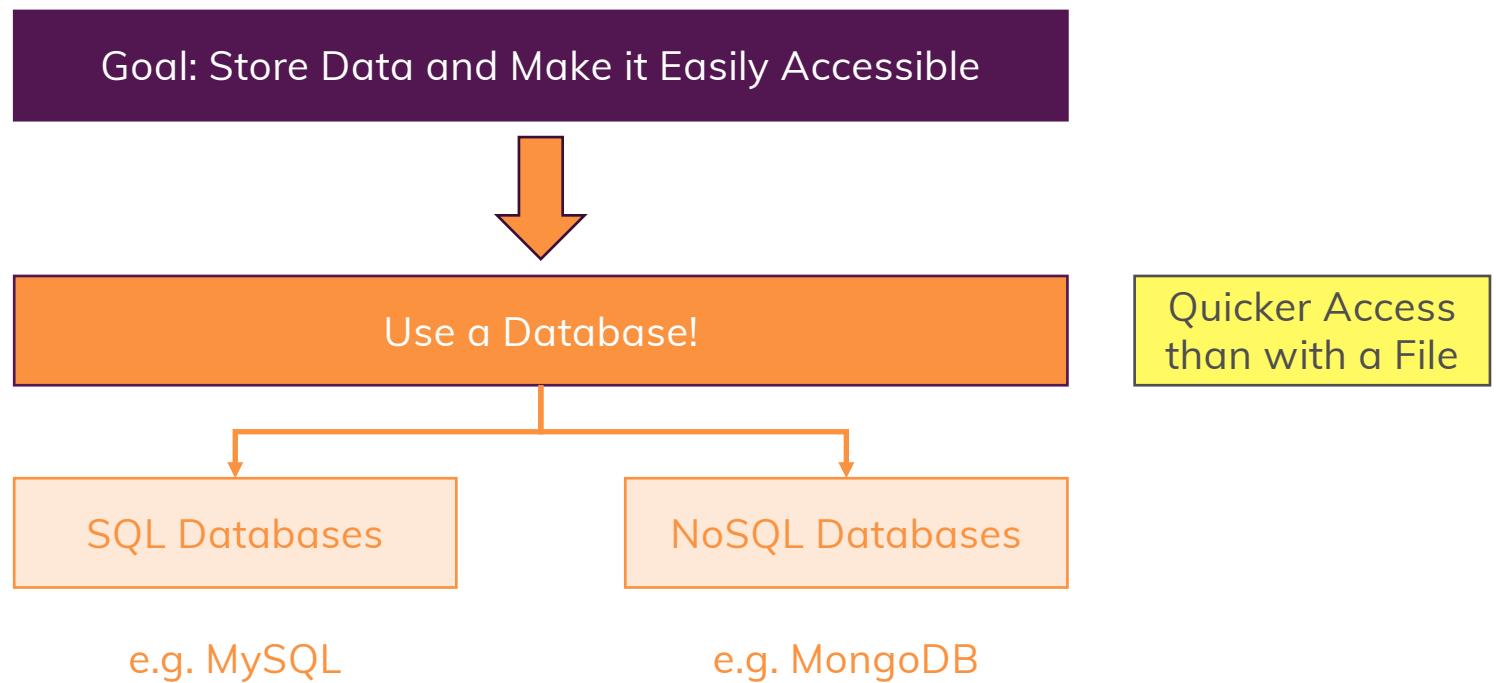


## What's In This Module?

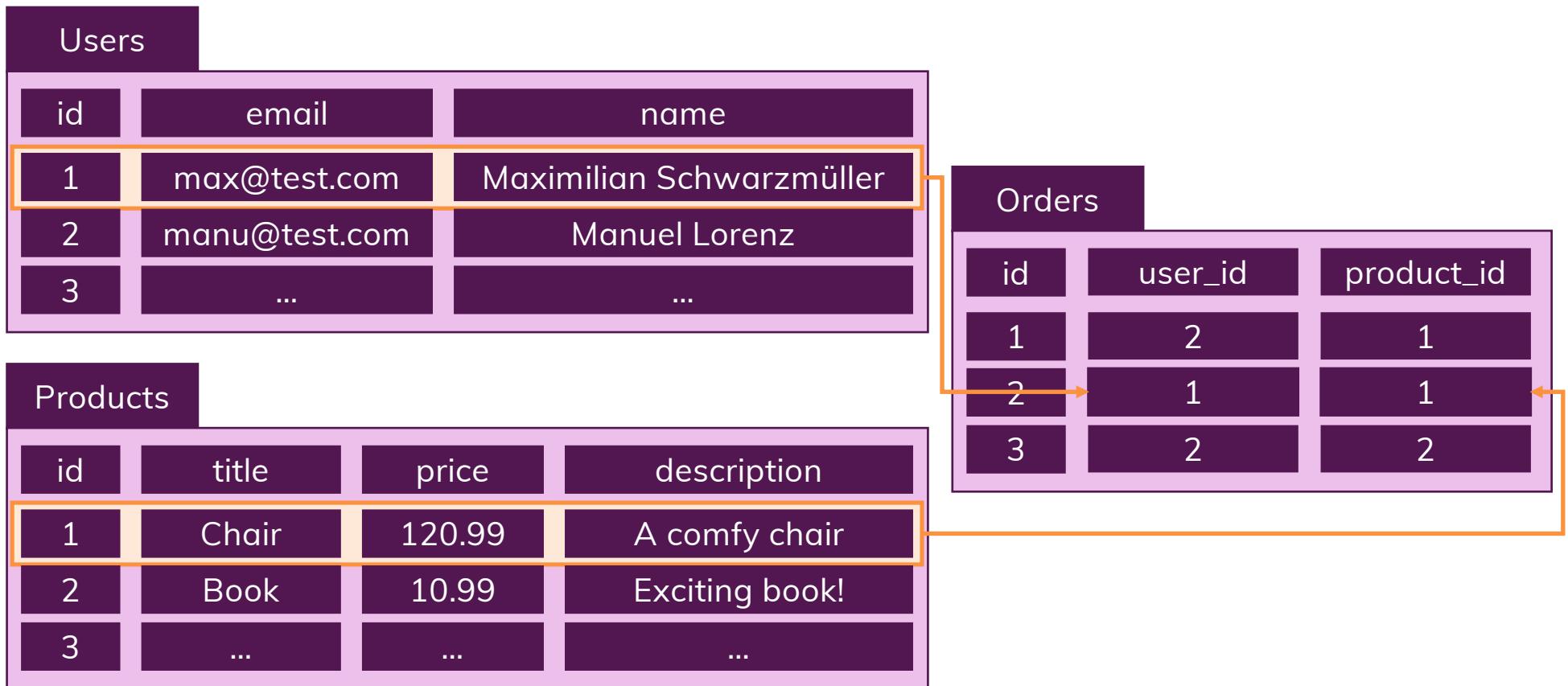
Different Kinds of Databases (SQL vs NoSQL)

Using SQL in a Node.js App

# SQL vs NoSQL



# What's SQL?



## Core SQL Database Characteristics

Data Schema → All Data (in a Table) has to fit!

`id`   `name`   `age`

Data Relations → Tables are connected

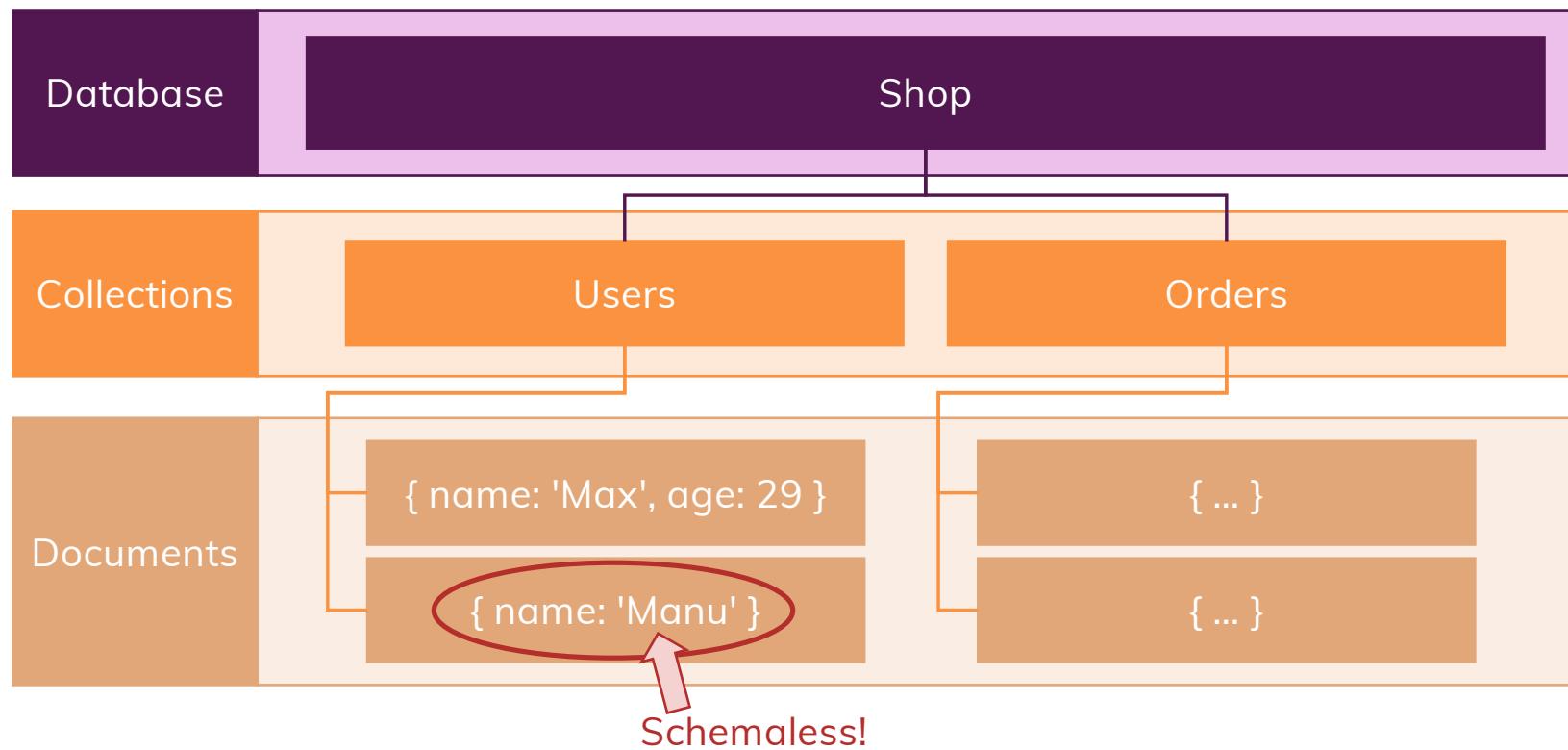
One-to-One  
One-to-Many  
Many-to-Many

## SQL Queries

```
SELECT * FROM users WHERE age > 28
```



# NoSQL



# What's NoSQL?

Orders

Duplicate Data

```
{ id: 'ddjfa31', user: { id: 1, email: 'max@test.com' }, product: { id: 2, price: 10.99 } }
```

```
{ id: 'ldao1', user: { id: 2, email: 'manu@test.com' }, product: { id: 1, price: 120.99 } }
```

```
{ id: 'nbax12', product: { id: 2, price: 10.99 } }
```

```
{ ... }
```

Users

```
{ id: 1, name: 'Max', email: 'max@test.com' }
```

```
{ id: 2, name: 'Manu', email: 'manu@test.com' }
```

```
{ ... }
```

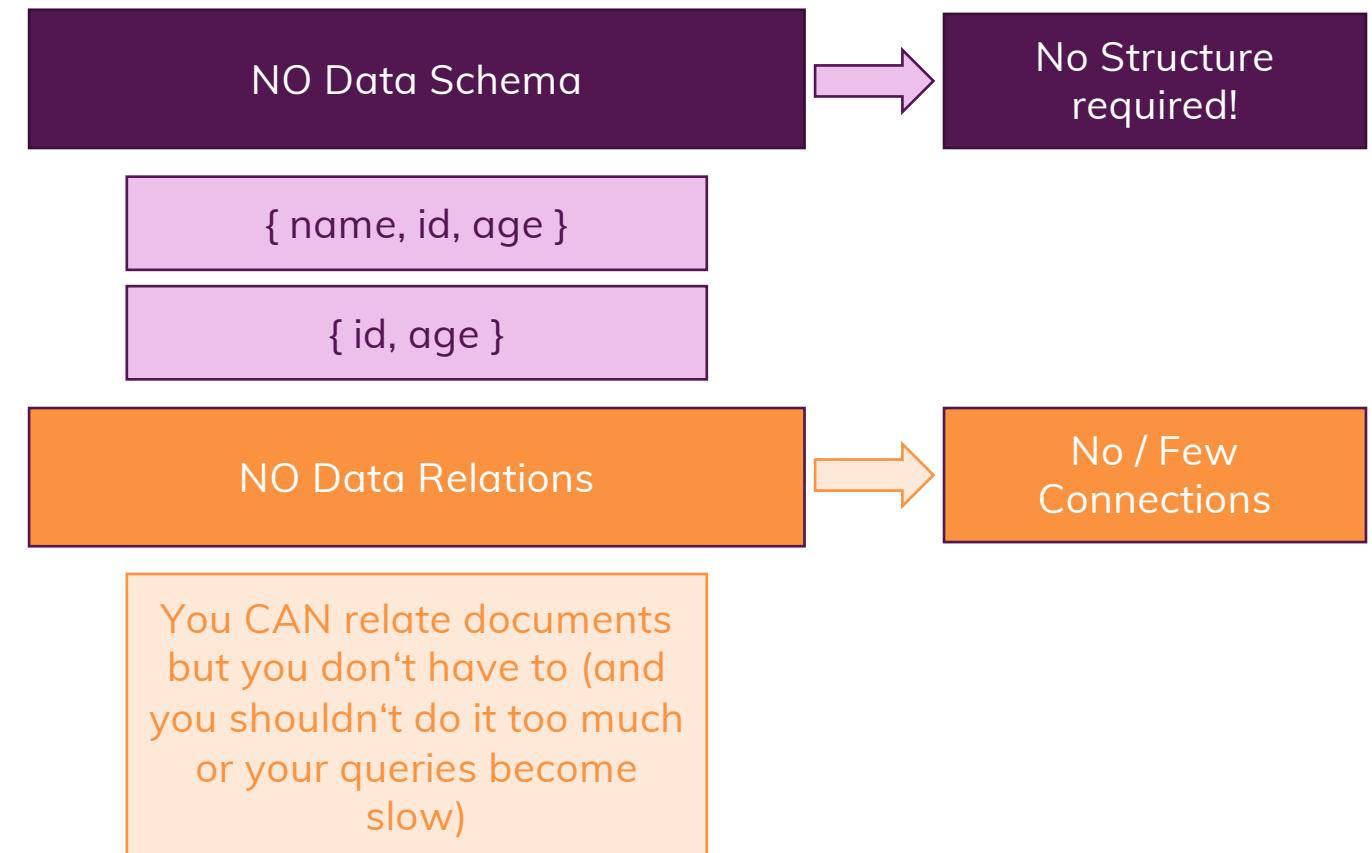
Products

```
{ id: 1, title: 'Chair', price: 120.99 }
```

```
{ id: 2, name: 'Book', price: 10.99 }
```

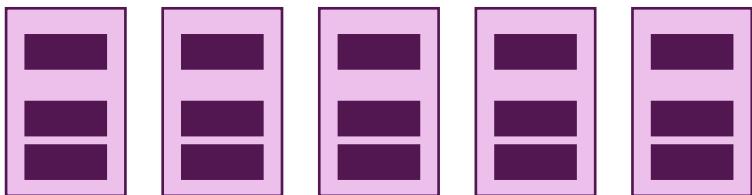
```
{ ... }
```

## NoSQL Characteristics



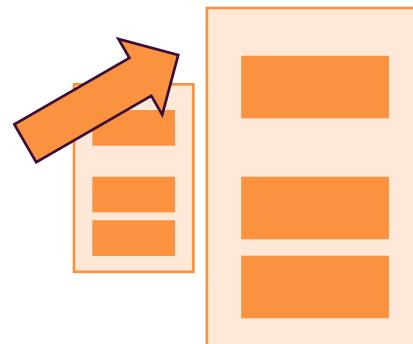
# Horizontal vs Vertical Scaling

Horizontal Scaling



Add More Servers (and merge Data into one Database)

Vertical Scaling



Improve Server Capacity / Hardware

## SQL vs NoSQL

### SQL

Data uses Schemas

Relations!

Data is distributed across multiple tables

Horizontal scaling is difficult / impossible; Vertical scaling is possible

Limitations for lots of (thousands) read & write queries per second

### NoSQL

Schema-less

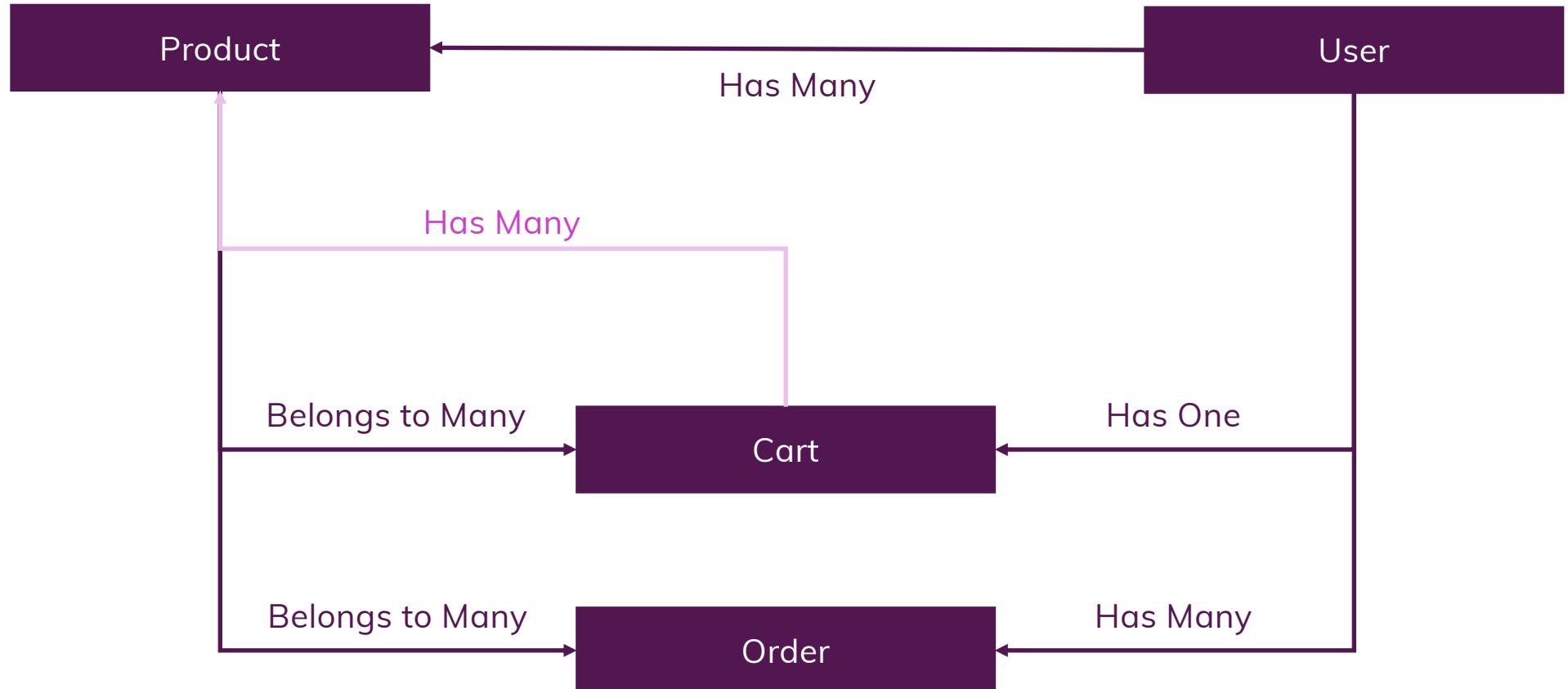
No (or very few) Relations

Data is typically merged / nested in a few collections

Both horizontal and vertical scaling is possible

Great performance for mass read & write requests

## Associations



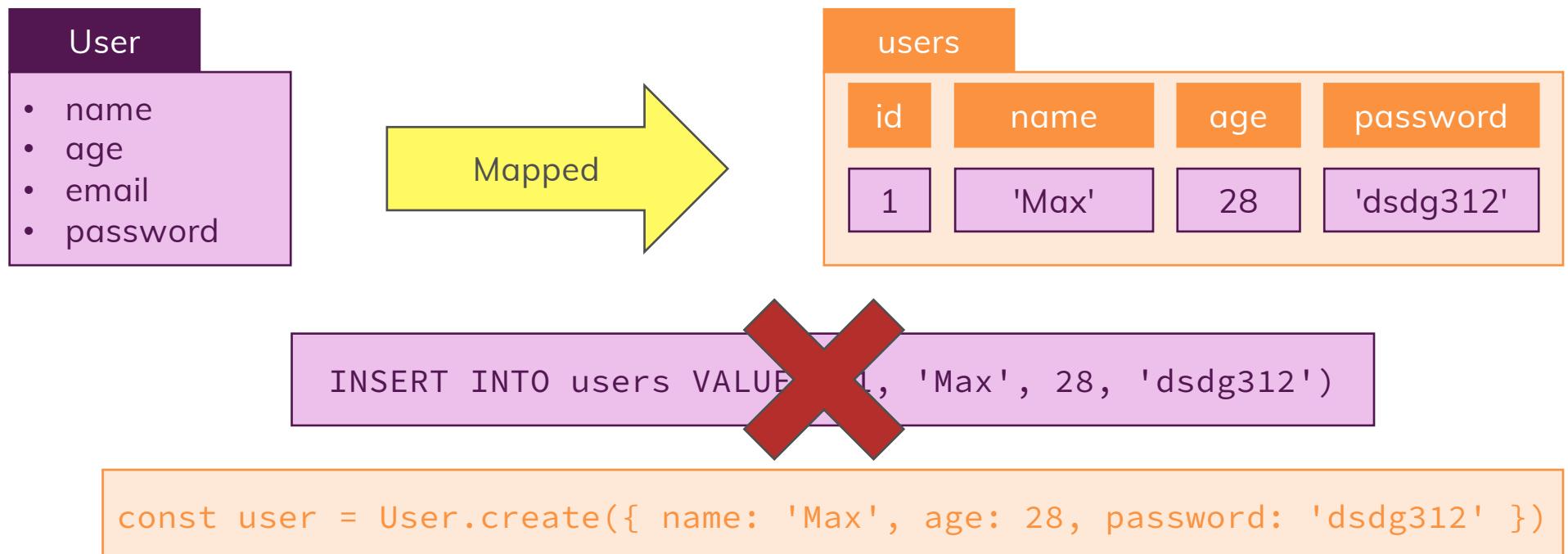
# Sequelize

---

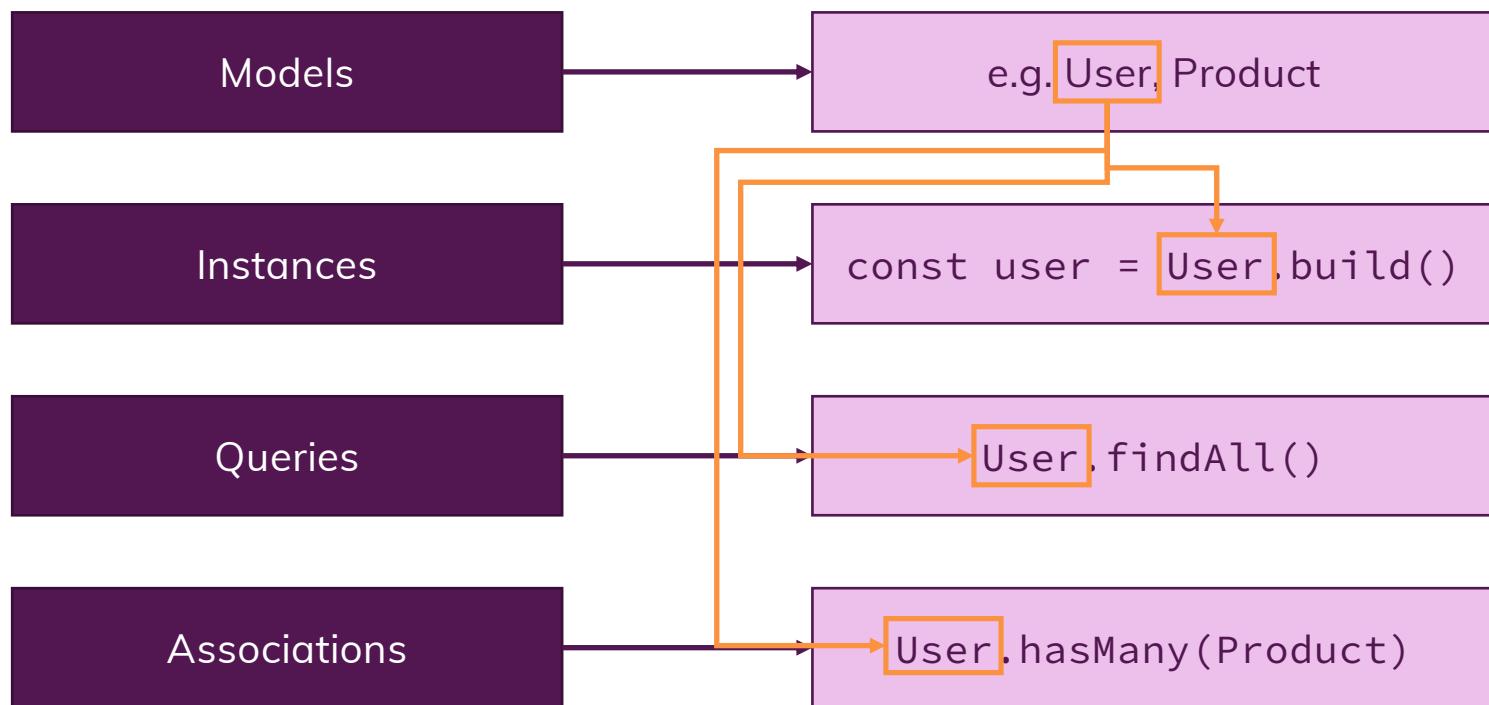
Focus on Node.js, not on SQL

# What is Sequelize?

An Object-Relational Mapping Library



# Core Concepts



## Module Summary

### SQL

- SQL uses strict data schemas and relations
- You can connect your Node.js app via packages like mysql2
- Writing SQL queries is not directly related to Node.js and something you have to learn in addition to Node.js

### Sequelize

- Instead of writing SQL queries manually, you can use packages (ORMs) like Sequelize to focus on the Node.js code and work with native JS objects
- Sequelize allows you define models and interact with the database through them
- You can also easily set up relations (“Associations”) and interact with your related models through them

# NoSQL Databases / MongoDB

---

Storing Data in a Different Kind of Database

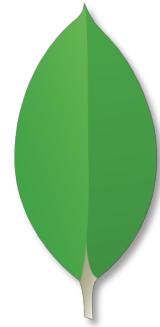


## What's In This Module?

What is MongoDB?

Using the MongoDB Driver in Node.js Apps

What?

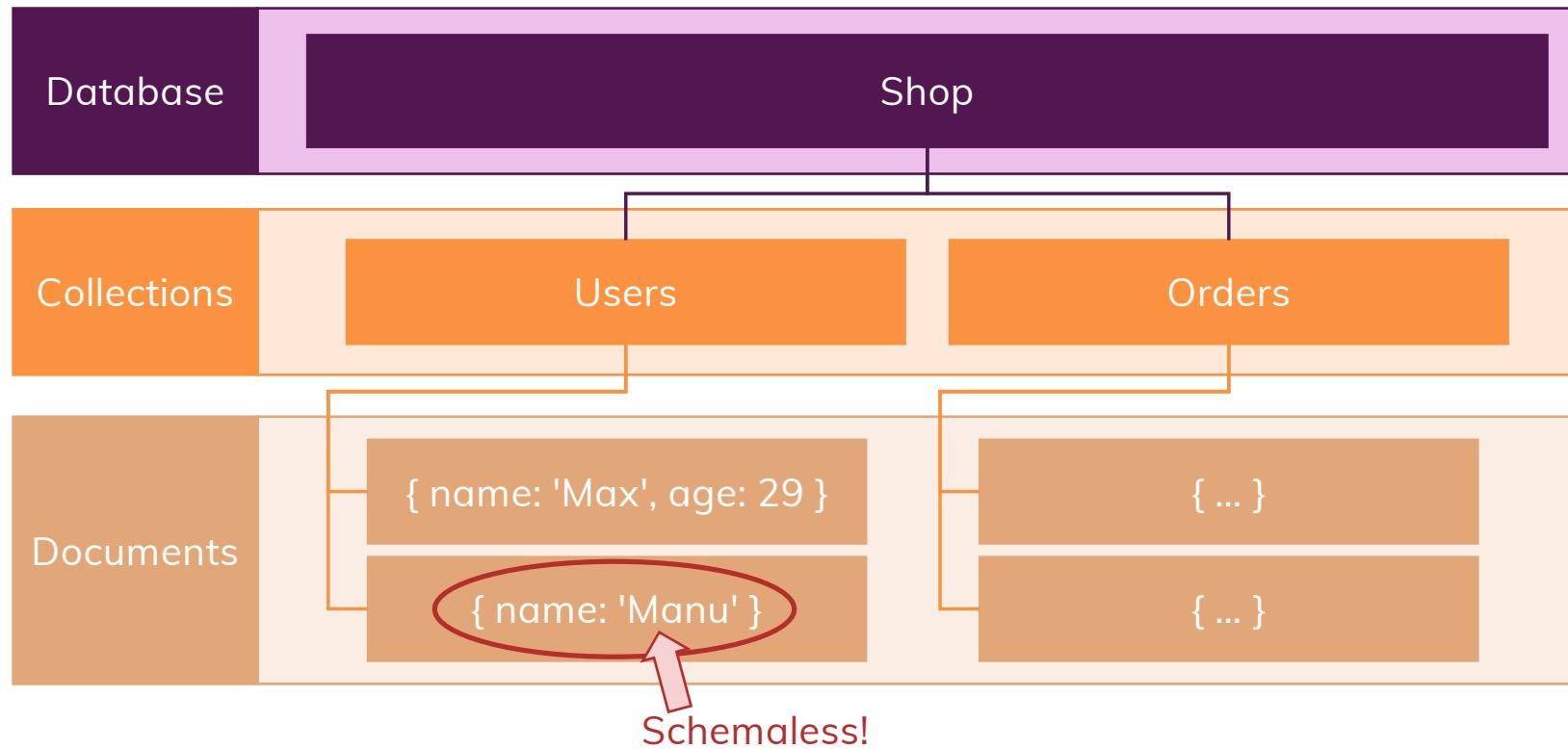


mongoDB®

Humongous

Because it can store lots and lots of data

## How it works



## JSON (BSON) Data Format

```
{  
    "name": "Max",  
    "age": 29,  
    "address":  
        {  
            "city": "Munich"  
        },  
    "hobbies": [  
        { "name": "Cooking" },  
        { "name": "Sports" }  
    ]  
}
```

# What's NoSQL?

Orders

Duplicate Data

```
{ id: 'ddjfa31', user: { id: 1, email: 'max@test.com' }, product: { id: 2, price: 10.99 } }
```

```
{ id: 'ldao1', user: { id: 2, email: 'manu@test.com' }, product: { id: 1, price: 120.99 } }
```

```
{ id: 'nbax12', product: { id: 2, price: 10.99 } }
```

```
{ ... }
```

Users

```
{ id: 1, name: 'Max', email: 'max@test.com' }
```

```
{ id: 2, name: 'Manu', email: 'manu@test.com' }
```

```
{ ... }
```

Products

```
{ id: 1, title: 'Chair', price: 120.99 }
```

```
{ id: 2, name: 'Book', price: 10.99 }
```

```
{ ... }
```

# Relations - Options

## Nested / Embedded Documents

```
Customers  
{  
  userName: 'max',  
  age: 29,  
  address: {  
    street: 'Second Street',  
    city: 'New York'  
  }  
}
```

## References

```
{  
  user:  
    favBooks: [{...}, {...}]  
}
```

Lots of data duplication!

```
Customers  
{  
  userName: 'max',  
  favBooks: ['id1', 'id2']  
}
```

```
Books  
{  
  _id: 'id1',  
  name: 'Lord of the Rings 1'  
}
```

## NoSQL Characteristics

NO Data Schema

No Structure  
required!

{ name, id, age }

{ id, age }

Fewer Data Relations

You CAN relate documents  
but you don't have to (and  
you shouldn't do it too much  
or your queries become  
slow)

## SQL vs NoSQL

### SQL

Data uses Schemas

Relations!

Data is distributed across multiple tables

Horizontal scaling is difficult / impossible; Vertical scaling is possible

Limitations for lots of (thousands) read & write queries per second

### NoSQL

Schema-less

No (or very few) Relations

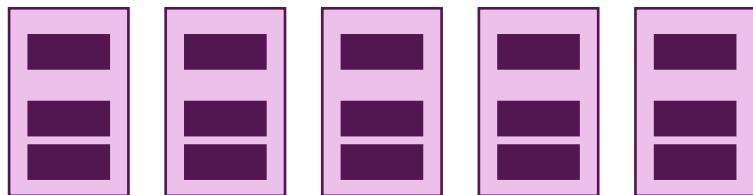
Data is typically merged / nested in a few collections

Both horizontal and vertical scaling is possible

Great performance for mass (simple) read & write requests

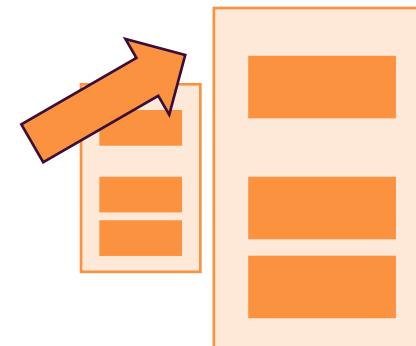
# Horizontal vs Vertical Scaling

Horizontal Scaling



Add More Servers (and merge Data into one Database)

Vertical Scaling



Improve Server Capacity / Hardware

## Module Summary

### NoSQL / MongoDB

- Alternative to SQL databases
- No strict schemas, fewer relations
- You can of course use schemas and reference-based relations but you got more flexibility
- Often, relations are also created by embedding other documents/ data

### Working with MongoDB

- Use the official MongoDB Driver
- Commands like `insertOne()`, `find()`, `updateOne()` and `deleteOne()` make CRUD-operations very simple
- Check the official docs to learn about all available operations + configurations/operators
- All operations are promise-based, hence you can easily chain them for more complex flows



# Mongoose

---

A MongoDB ORM



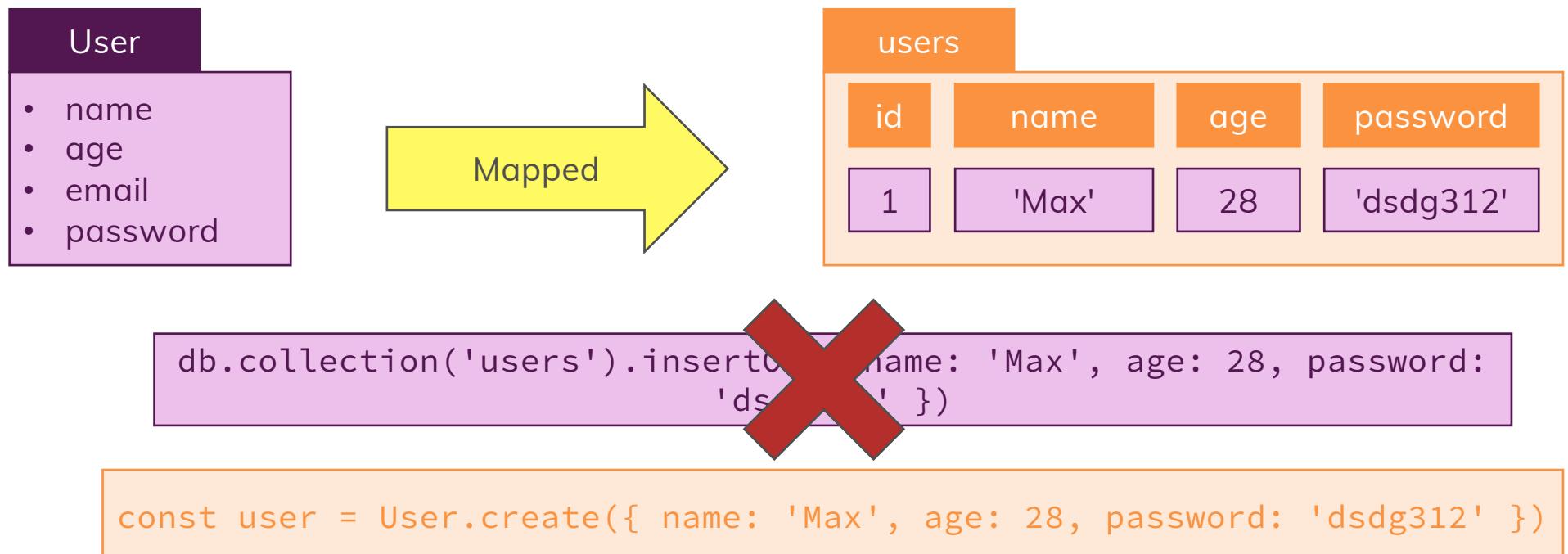
## What's In This Module?

What is Mongoose?

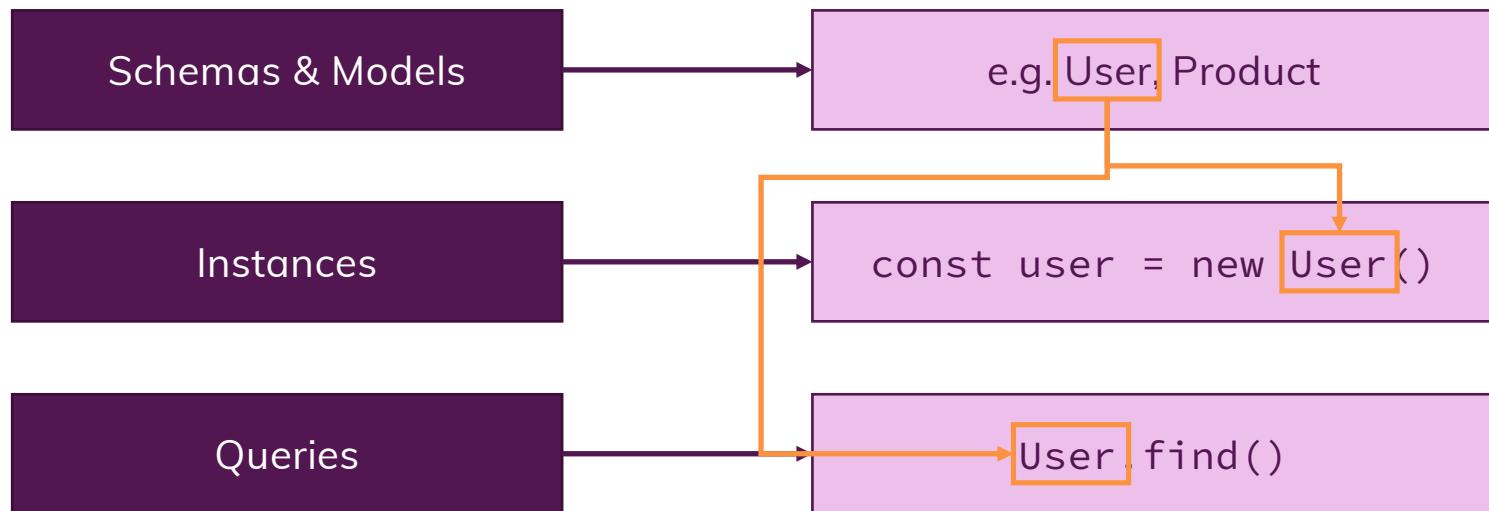
Using Mongoose in Node.js Apps

# What is Mongoose?

A Object-Document Mapping Library



# Core Concepts



## Module Summary

### Mongoose

- SQL uses strict data schemas and relations
- You can connect your Node.js app via packages like mysql2
- Writing SQL queries is not directly related to Node.js and something you have to learn in addition to Node.js

### Sequelize

- Instead of writing SQL queries manually, you can use packages (ORMs) like Sequelize to focus on the Node.js code and work with native JS objects
- Sequelize allows you define models and interact with the database through them
- You can also easily set up relations (“Associations”) and interact with your related models through them



# Sessions & Cookies

---

Persisting Data across Requests



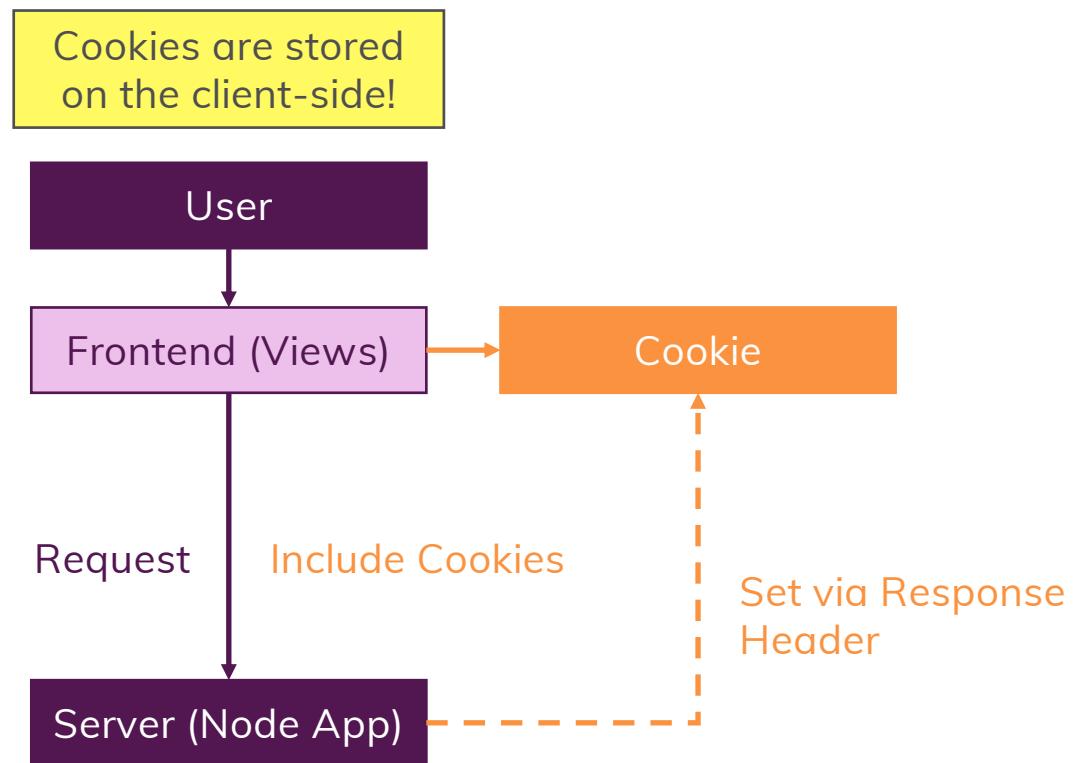
## What's In This Module?

What are Cookies?

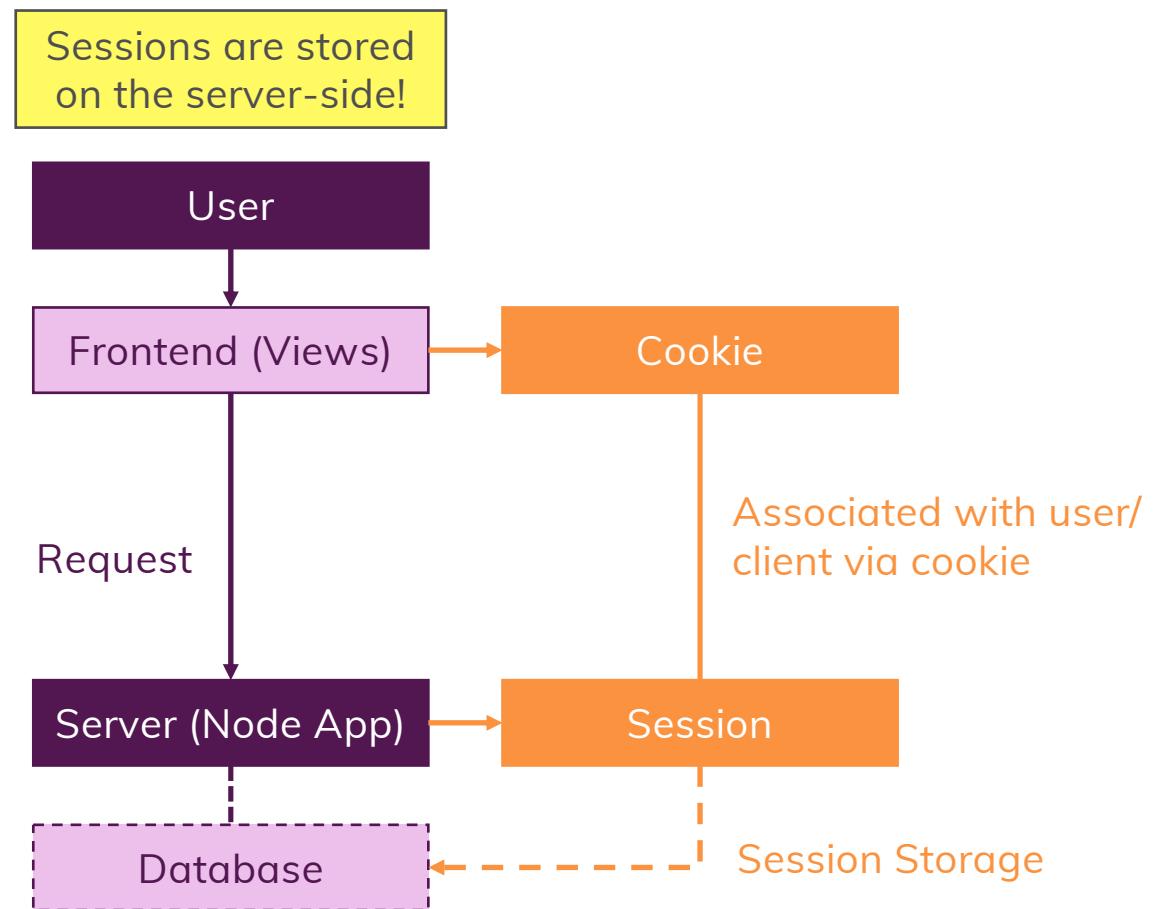
What are Sessions?

Using Session & Cookies?

# What's a Cookie?



# What's a Session?



## When to use What

Cookies

Stored on client

(Ad) Tracking

Authentication Session  
Management

Session

Stored on server

Authentication Status Management  
(across Requests)

General Cross-Request Data  
Management

## Module Summary

### Cookies

- Great for storing data on the client (browser)
- Do NOT store sensitive data here! It can be viewed + manipulated
- Cookies can be configured to expire when the browser is closed (=> “Session Cookie”) or when a certain age/ expiry date is reached (“Permanent Cookie”)
- Works well together with Sessions...

### Sessions

- Stored on the server, NOT on the client
- Great for storing sensitive data that should survive across requests
- You can store ANYTHING in sessions
- Often used for storing user data/ authentication status
- Identified via Cookie (don’t mistake this with the term “Session Cookie”)
- You can use different storages for saving your sessions on the server



# User Authentication

---

Restricting Access



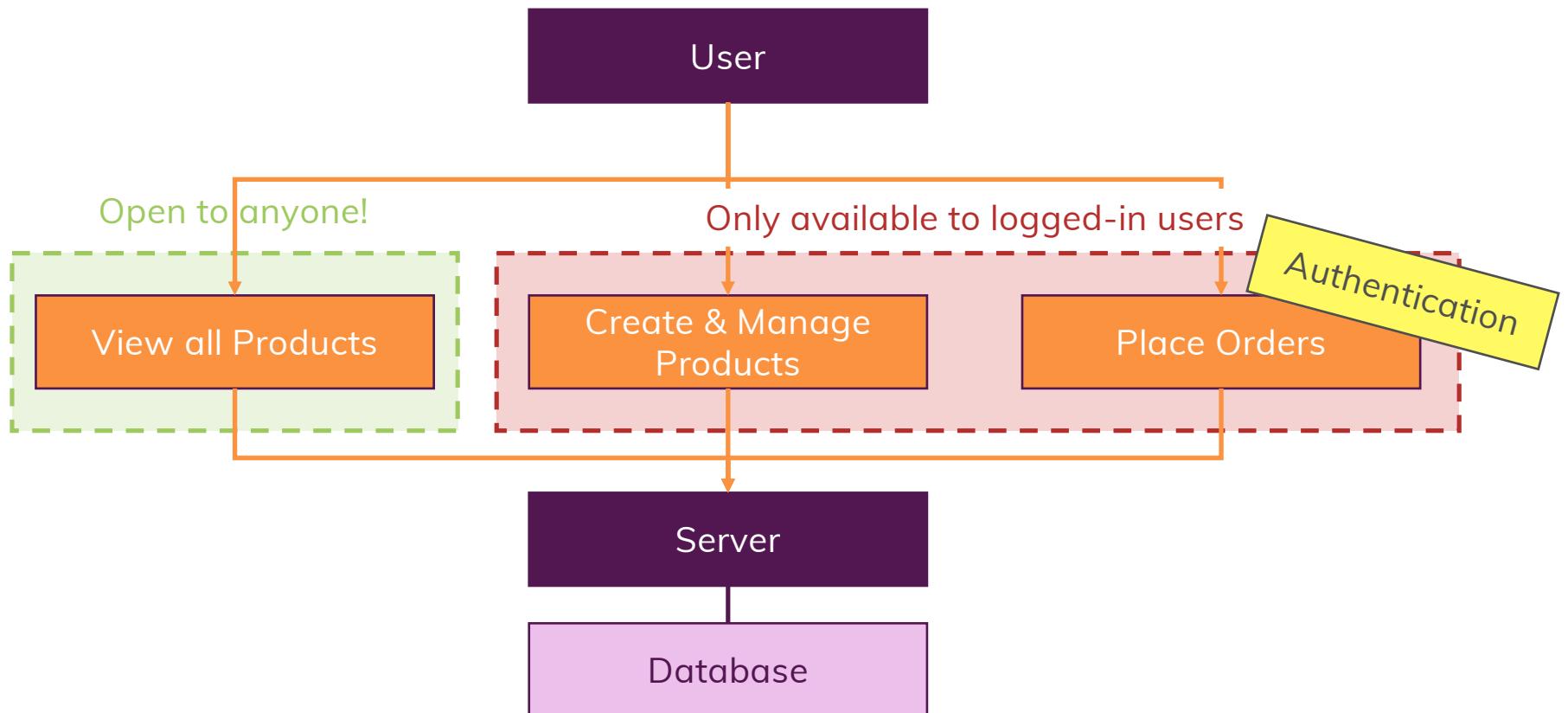
## What's In This Module?

What exactly is “Authentication”?

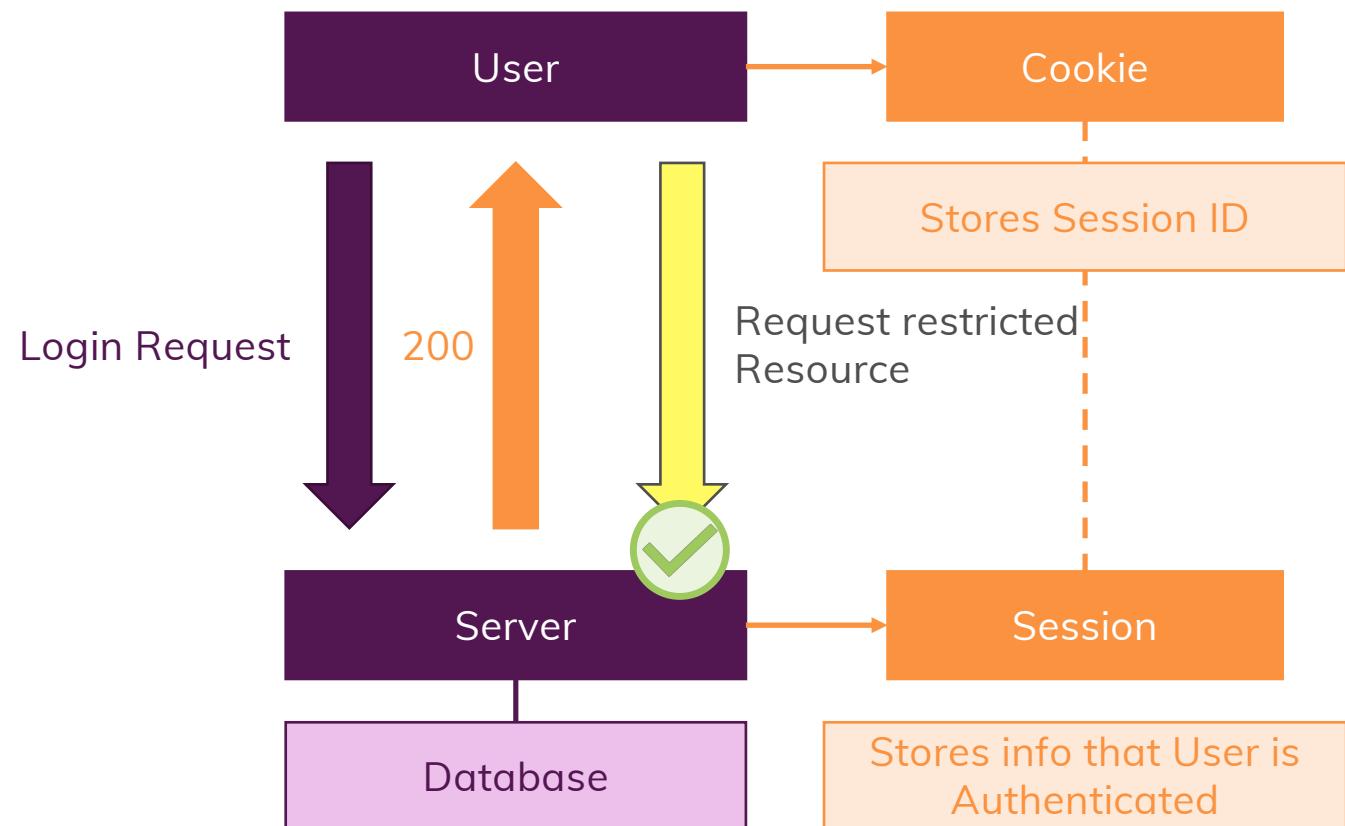
Storing & Using Credentials

Protecting Routes

# What is “Authentication”?

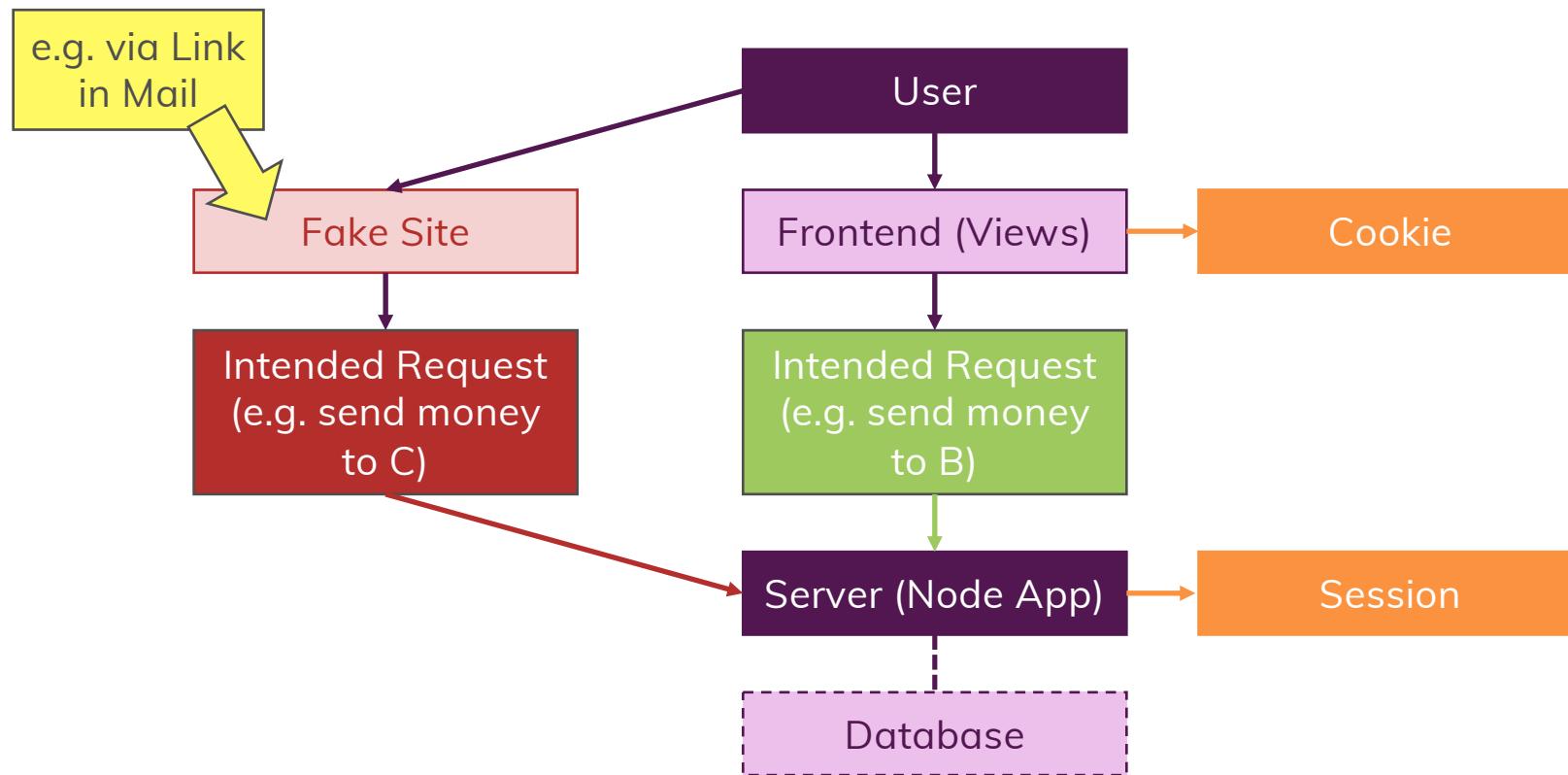


## How is Authentication Implemented?



# CSRF Attacks

## Cross-Site Request Forgery



## Module Summary

### Authentication

- Authentication means that not every visitor of the page can view and interact with everything
- Authentication has to happen on the server-side and builds up on sessions
- You can protect routes by checking the (session-controlled) login status right before you access a controller action

### Security & UX

- Passwords should be stored in a hashed form
- CSRF attacks are a real issue and you should therefore include CSRF protection in ANY application you build!
- For a better user experience, you can flash data/ messages into the session which you then can display in your views



# Sending Mails

---

Communicating with the Outside World

# How Does Sending Mails Work?





# Advanced Authentication & Authorization

---

Beyond Signup & Login



## What's In This Module?

Resetting Passwords

Authorization

## Module Summary

### Password Resetting

- Password resetting has to be implemented in a way that prevents users from resetting random user accounts
- Reset tokens have to be random, unguessable and unique

### Authorization

- Authorization is an important part of pretty much every app
- Not every authenticated user should be able to do everything
- Instead, you want to lock down access by restricting the permissions of your users



# Forms, User Input & Validation

---

Getting that Precious User Input

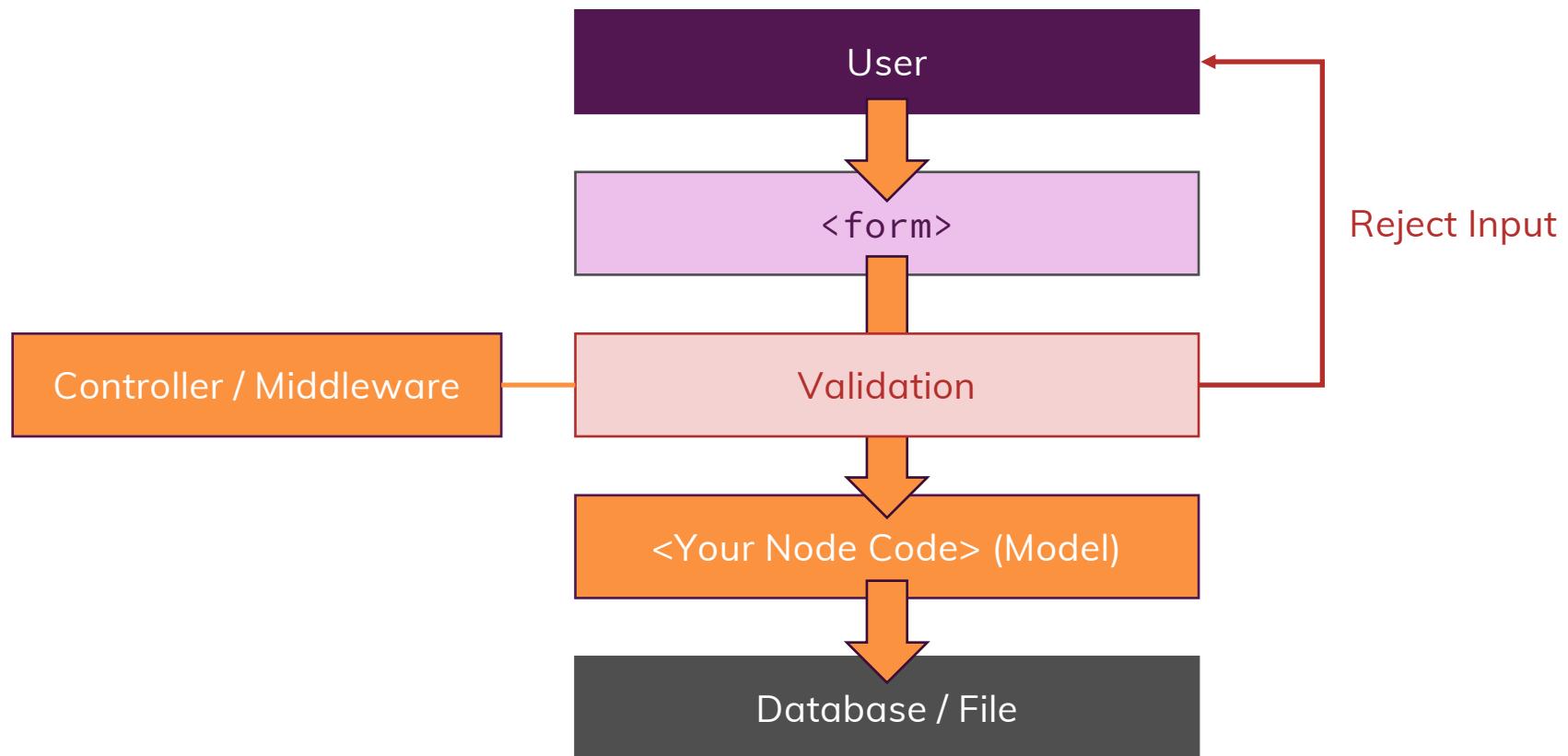


## What's In This Module?

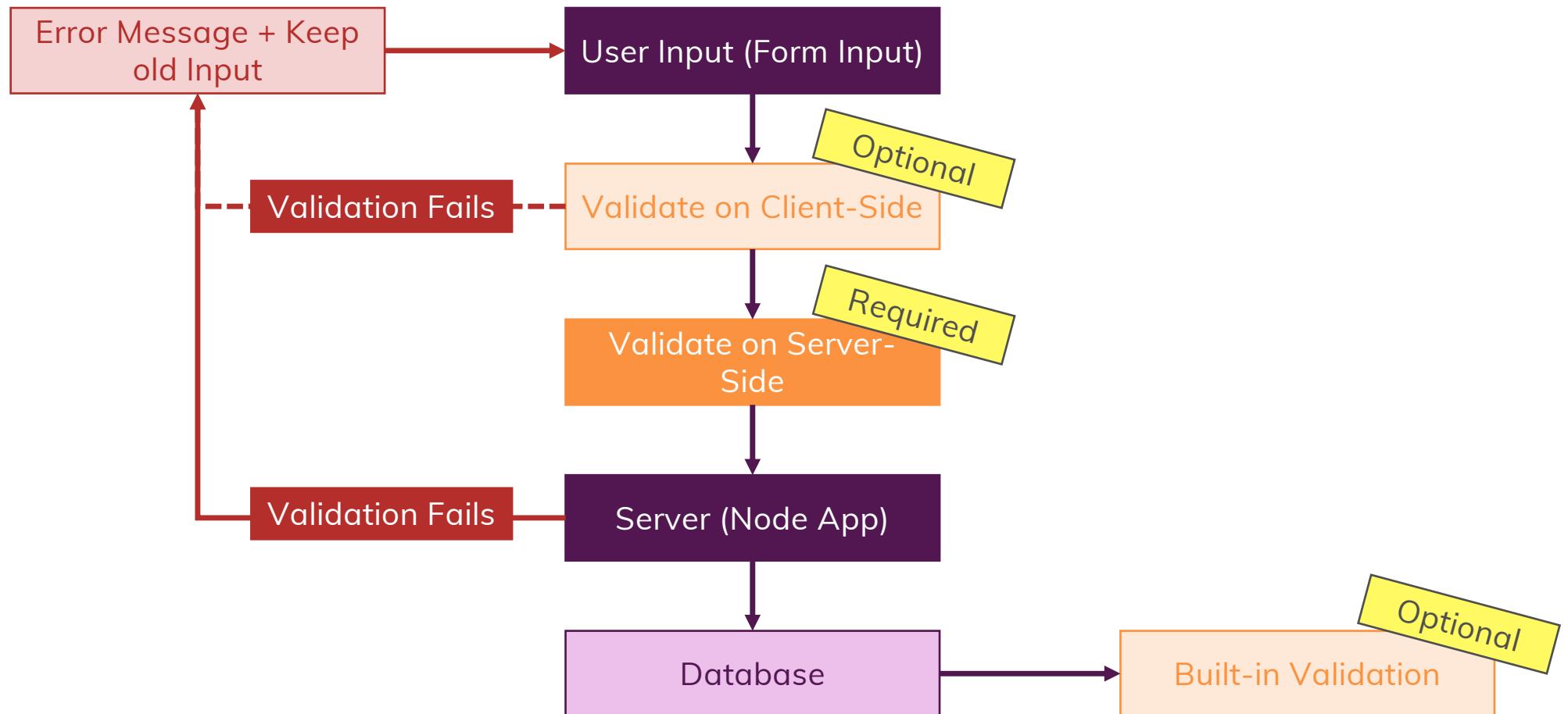
Why Validate?

How to Validate

## Why Validate?



## How to Validate





# Error Handling

---

Fail Gracefully



## What's In This Module?

Different Types of Errors

Handling Errors

## How Bad Are Errors?

Errors are not necessarily the end of your app!



You just need to handle them correctly!

# Different Types of Errors

Technical/ Network Errors

“Expected” Errors

Bugs/ Logical Errors

e.g. MongoDB server is down

e.g. File can't be read,  
database operation fails

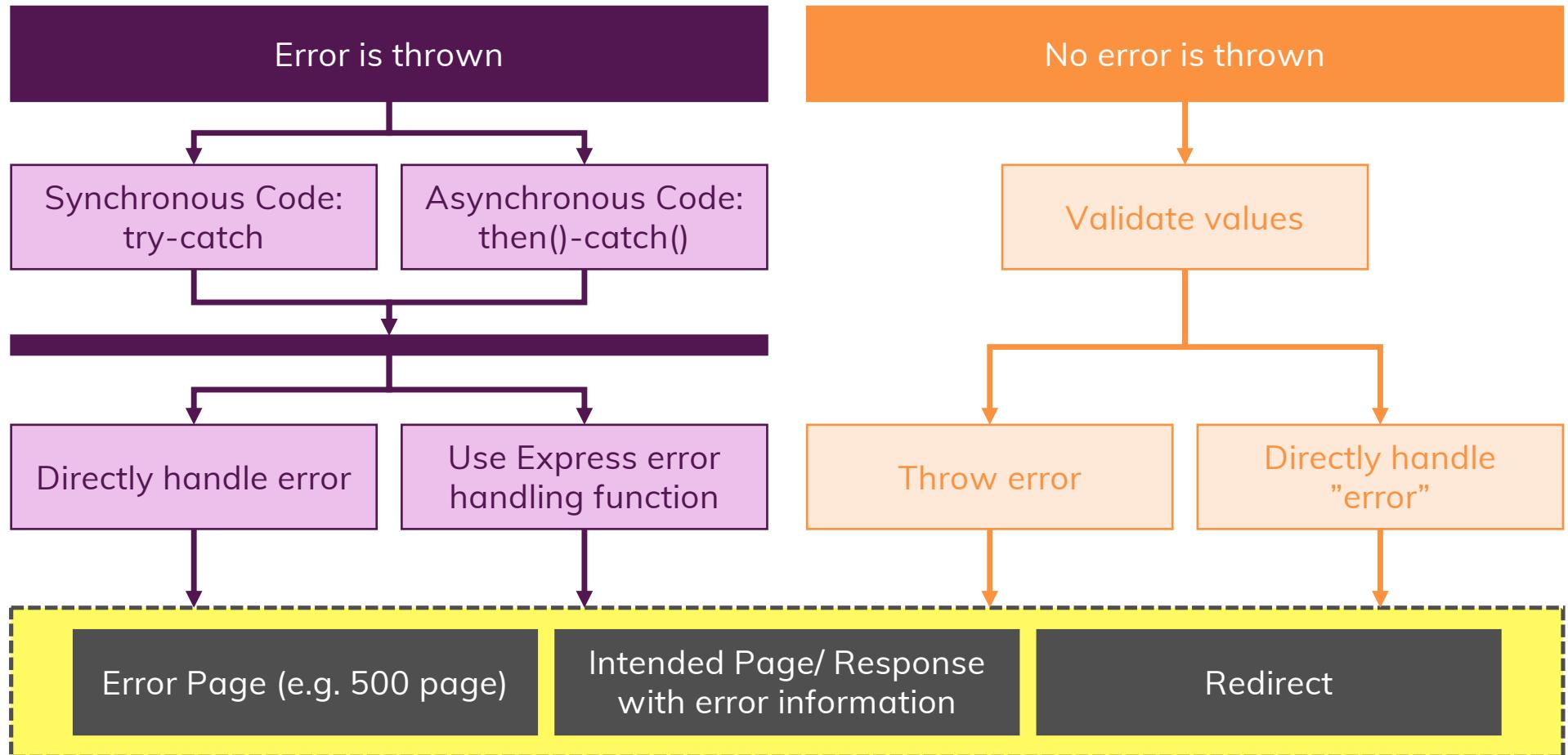
e.g. User object used when it  
doesn't exist

Show error page to user

Inform user, possibly retry

Fix during development!

# Working with Errors





# Errors & Http Response Codes

2xx (Success)

200

Operation succeeded

201

Success, resource created

3xx (Redirect)

301

Moved permanently

4xx (Client-side error)

401

Not authenticated

403

Not authorized

404

Not found

422

Invalid input

5xx (Server-side error)

500

Server-side error

## Module Summary

### Types of Errors & Handling Errors

- You can differentiate between different types of errors – technical errors (which are thrown) and "expected errors" (e.g. invalid user input)
- Error handling can be done with custom if-checks, try-catch, then()-catch() etc
- You can use the Express error handling middleware to handle all unhandled errors

### Errors & Status Code

- When returning responses, it can make sense to also set an appropriate Http status code – this lets the browser know what went wrong
- You got success (2xx), redirect (3xx), client-side errors (4xx) and server-side errors (5xx) codes to choose from
- Setting status codes does NOT mean that the response is incomplete or the app crashed!



# File Uploads & Downloads

---

Handling Files Correctly



## What's In This Module?

Uploading Files

Downloading Files

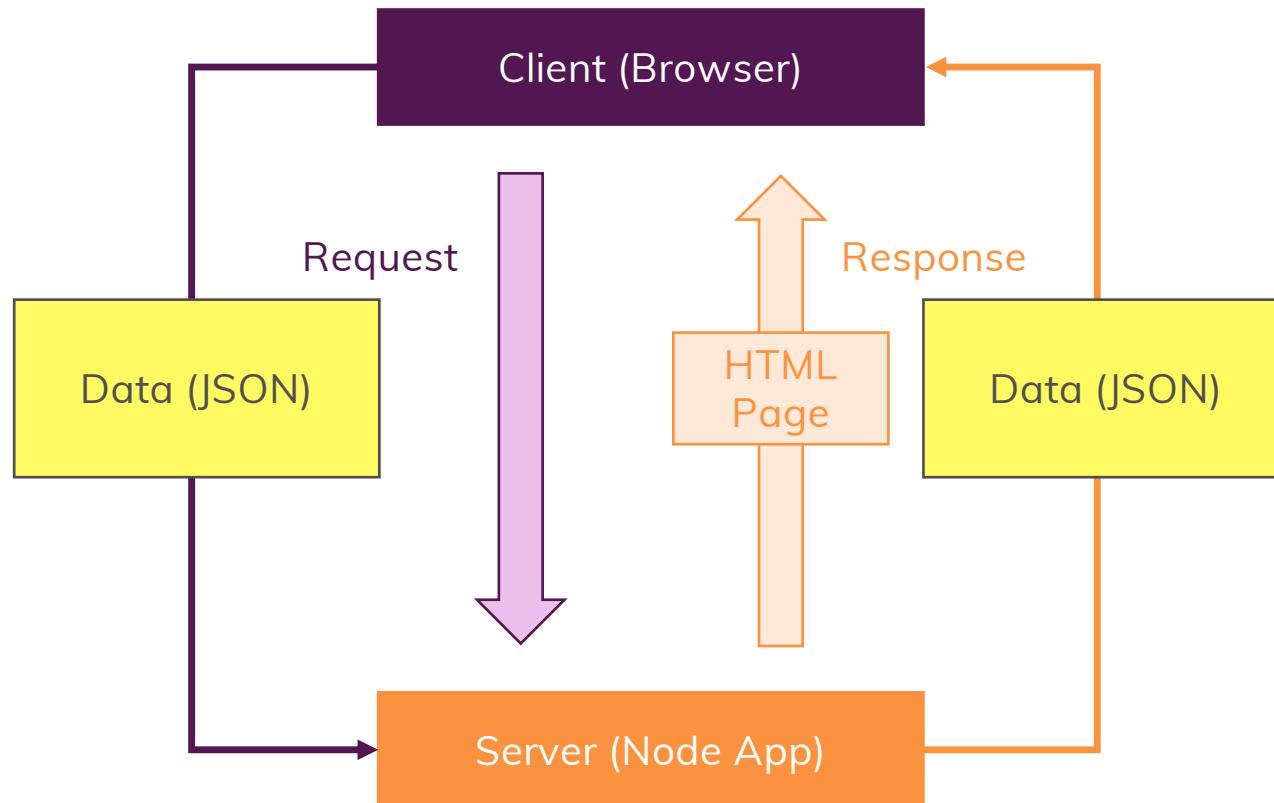


# Asynchronous JavaScript Requests

---

Behind-The-Scenes Work

# What are Asynchronous Requests?



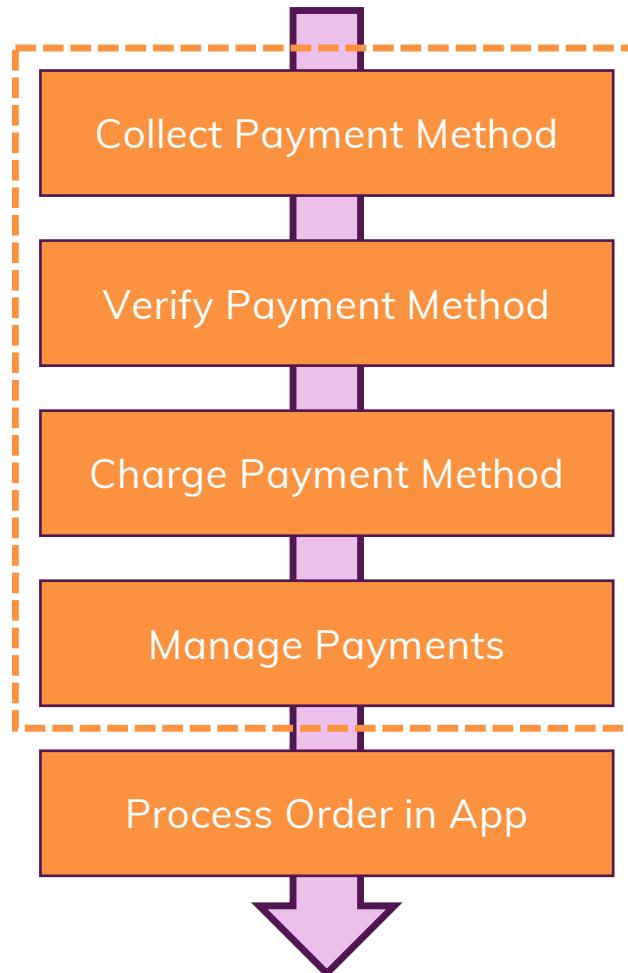


# Adding Payments

---

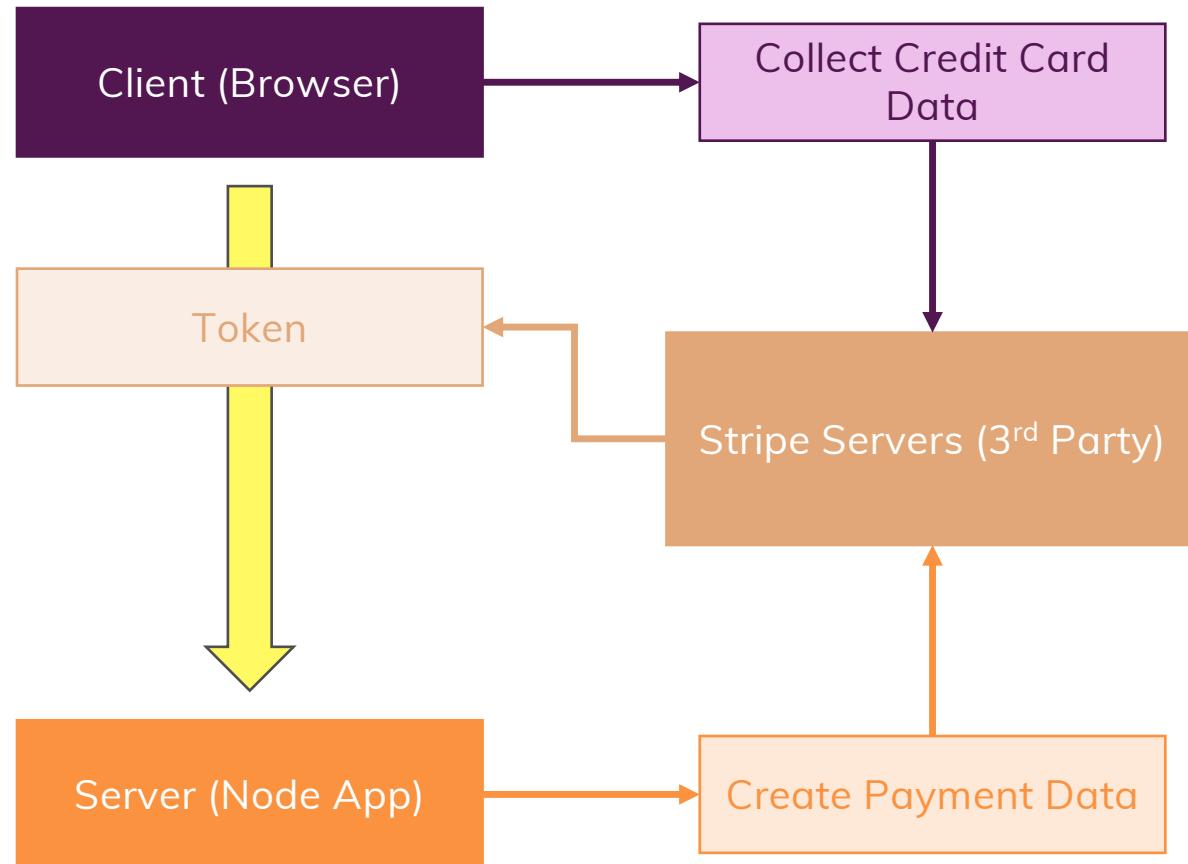
Creating a Real Shop

# Payment Process



Complex Tasks,  
typically  
outsourced

## How Stripe Works





# REST APIs

---

Decoupling Frontend and Backend



## What's In This Module?

What are “REST APIs”?

Why use/ build REST APIs?

Core REST Concepts & Principles

First REST API!

## What & Why?

Not every Frontend (UI) requires HTML Pages!

**Mobile Apps**

(e.g. Twitter)

**Single Page Web Apps**

(e.g. Udemy Course Player)

**Service APIs**

(e.g. Google Maps API)

Frontend (UI) is decoupled from the Backend (Server)

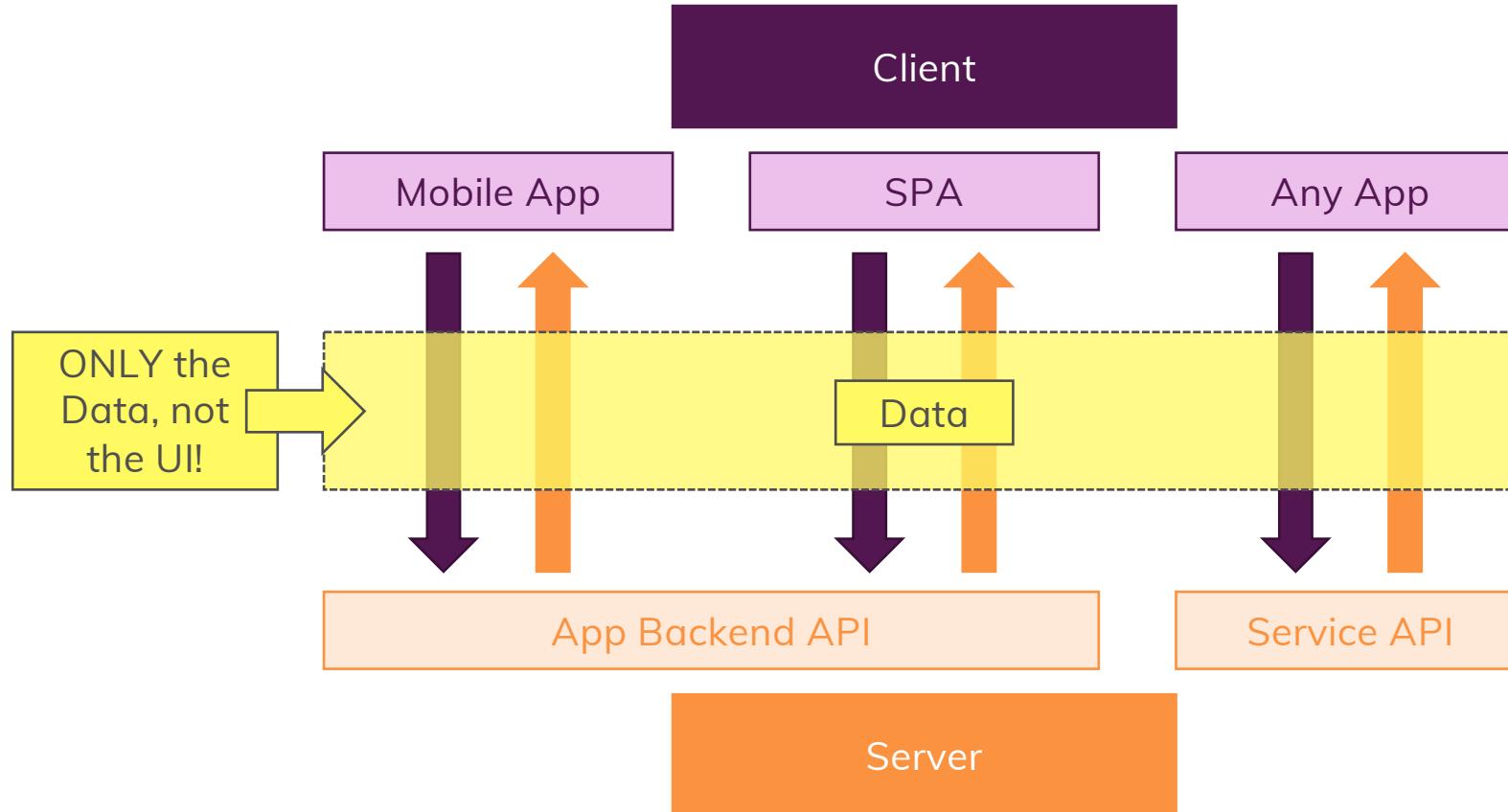
## A Different Kind of Response is Needed

Representational State Transfer

Transfer Data instead of User Interfaces

Important: Only the response (and the request data) changes, NOT the general server-side logic!

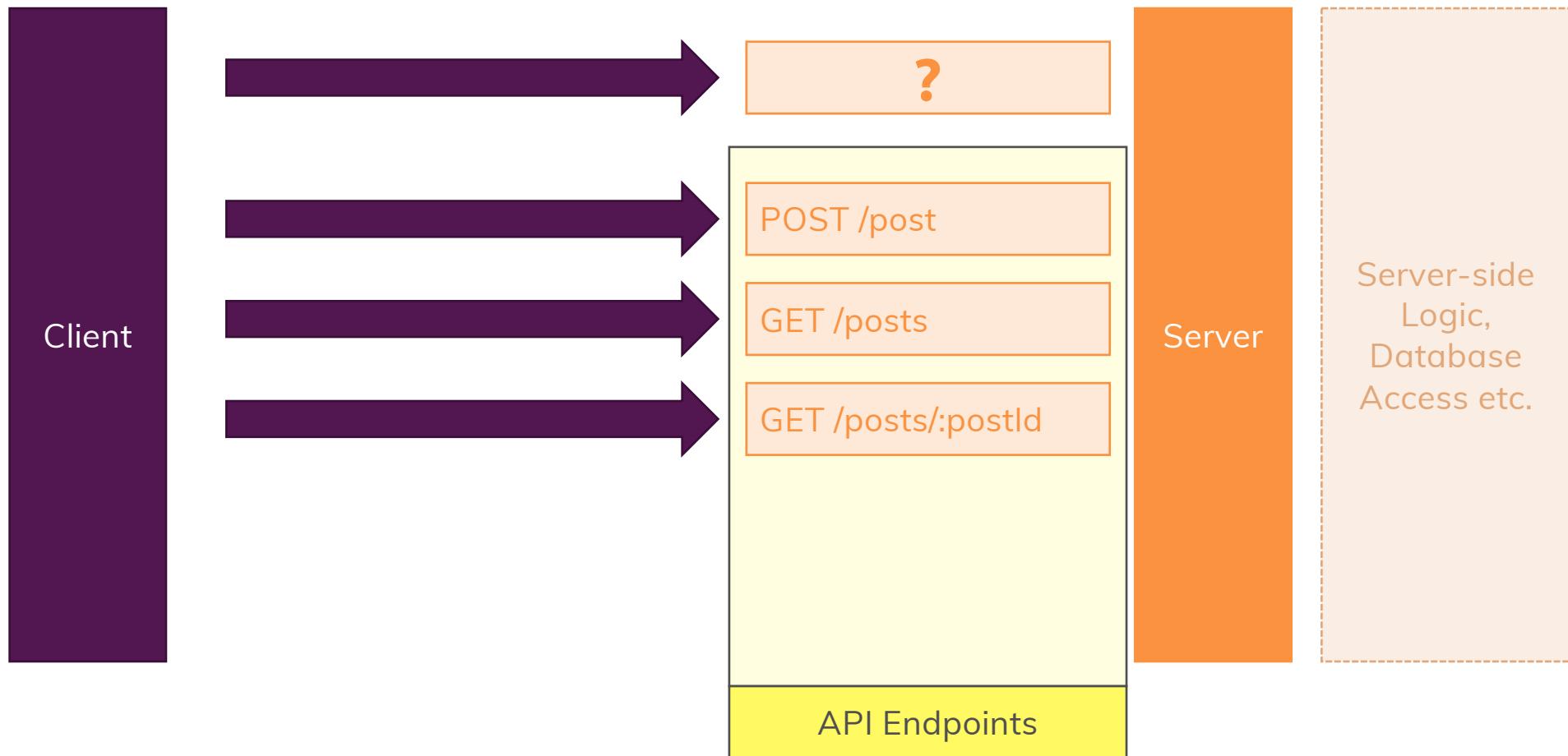
## REST API Big Picture



# Data Formats

HTML	Plain Text	XML	JSON
<p>Node.js</p>	Node.js	<name>Node.js</name>	{"title": "Node.js"}
Data + Structure	Data	Data	Data
Contains User Interface	No UI Assumptions	No UI Assumptions	No UI Assumptions
Unnecessarily difficult to parse if you just need the data	Unnecessarily difficult to parse, no clear data structure	Machine-readable but relatively verbose; XML-parser needed	Machine-readable and concise; Can easily be converted to JavaScript

# Routing



# Http Methods (Http Verbs)

More than just GET & POST

GET

POST

PUT

Get a Resource from the Server

Post a Resource to the Server (i.e. create or append Resource)

Put a Resource onto the Server (i.e. create or overwrite a Resource)

PATCH

DELETE

OPTIONS

Update parts of an existing Resource on the Server

Delete a Resource on the Server

Determine whether follow-up Request is allowed (sent automatically)

# REST Principles

## Uniform Interface

Clearly defined API endpoints with clearly defined request + response data structure

## Stateless Interactions

Server and client don't store any connection history, every request is handled separately

## Cacheable

Servers may set caching headers to allow the client to cache responses

## Client-Server

Server and client are separated, client is not concerned with persistent data storage

## Layered System

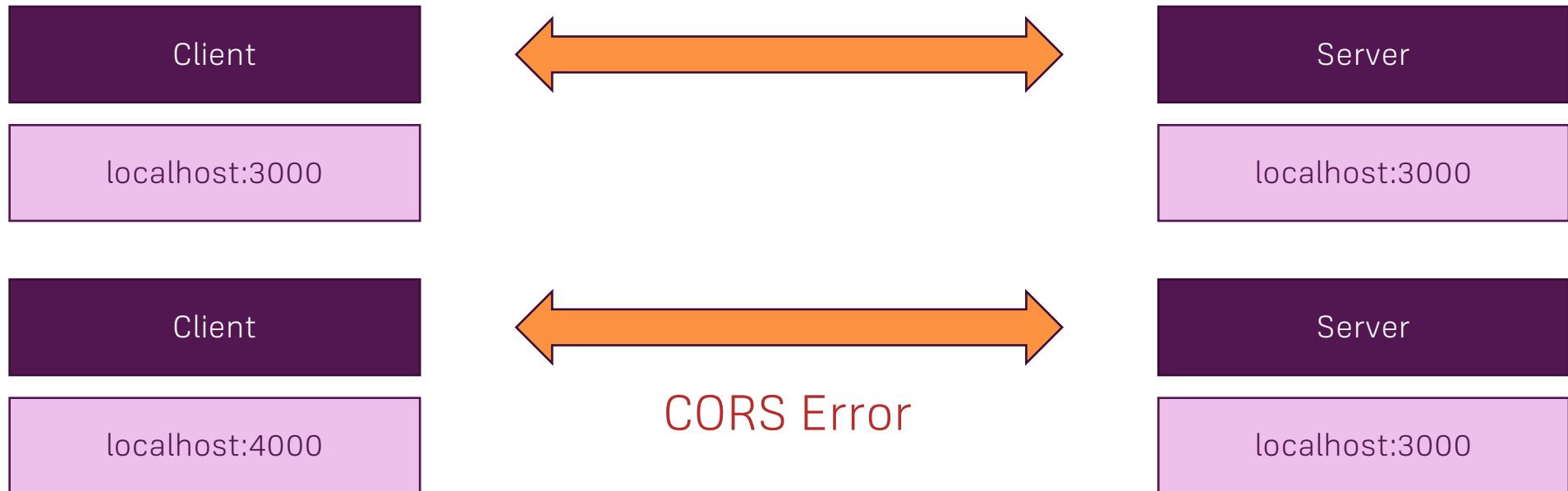
Server may forward requests to other APIs

## Code on Demand

Executable code may be transferred from server to client

# CORS?

## Cross-Origin Resource Sharing



## Module Summary

### REST Concepts & Ideas

- REST APIs are all about data, no UI logic is exchanged
- REST APIs are normal Node servers which expose different endpoints (Http method + path) for clients to send requests to
- JSON is the common data format that is used both for requests and responses
- REST APIs are decoupled from the clients that use them

### Requests & Responses

- Attach data in JSON format and let the other end know by setting the “Content-Type” header
- CORS errors occur when using an API that does not set CORS headers



# Advanced REST API Topics

---

Complete Project, Authentication & More



## What's In This Module?

Planning a REST API

CRUD Operations & Endpoints

Validation

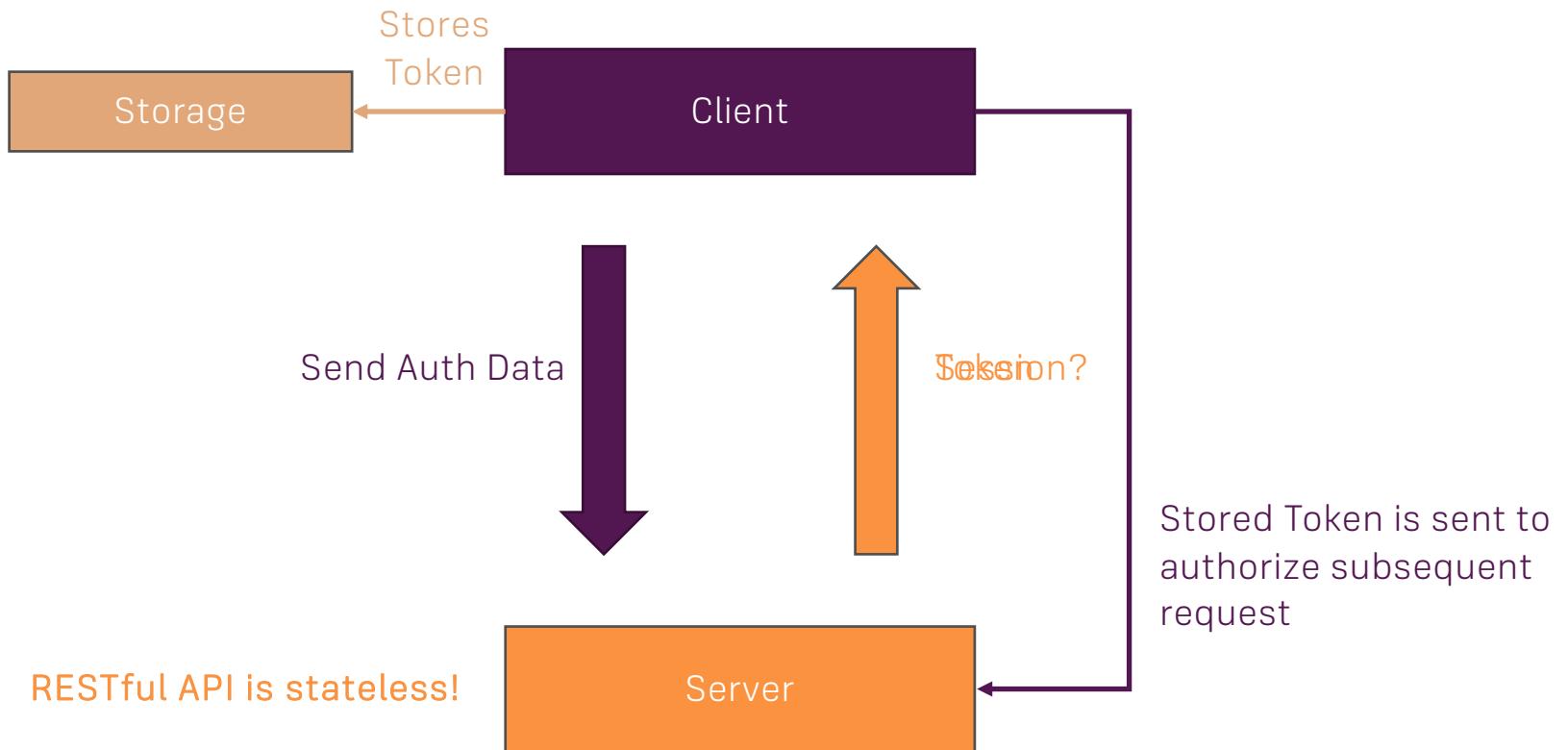
Image Upload

Authentication

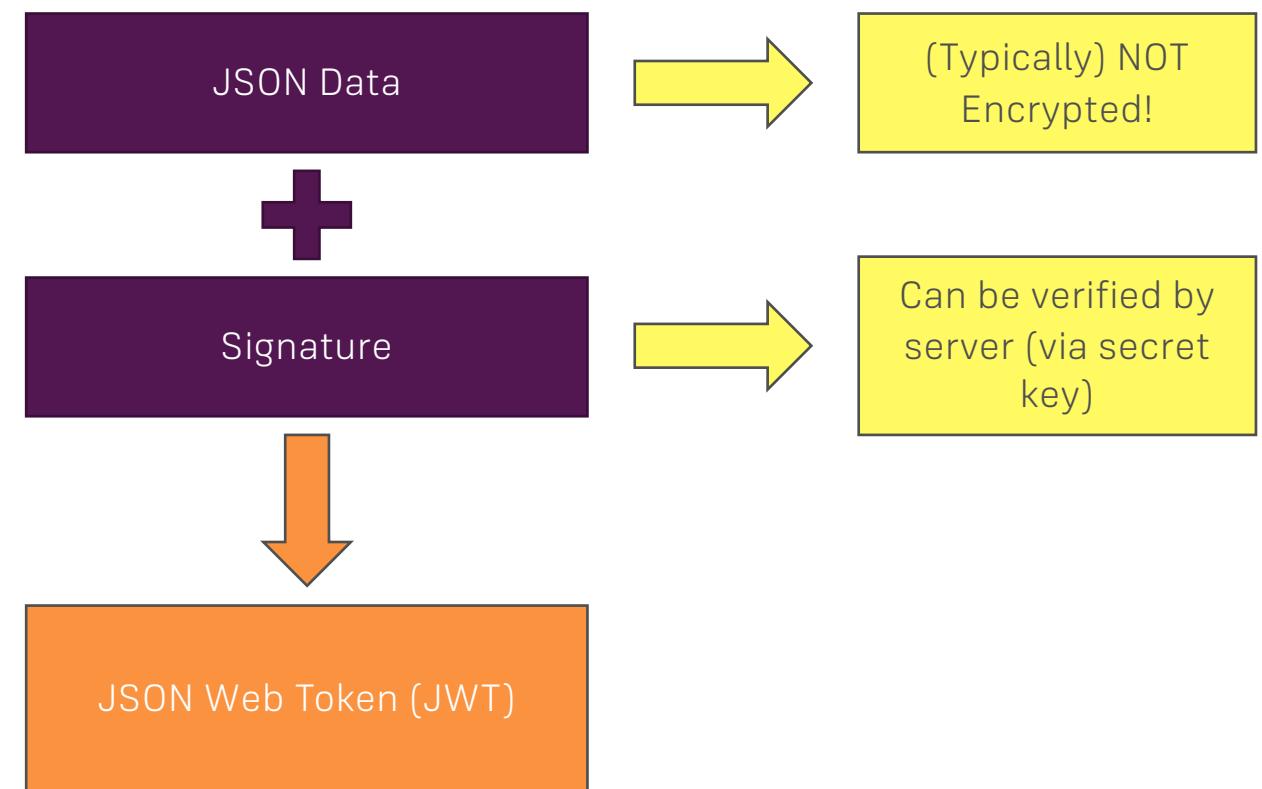
## REST & The Rest of the Course

Node + Express App Setup	→	No changes
Routing / Endpoints	→	No real changes, more Http methods
Handling Requests & Responses	→	Parse + Send JSON Data, no Views
Request Validation	→	No changes
Database Communication	→	No changes
Files, Uploads, Downloads	→	No changes (only on client-side)
Sessions & Cookies	→	No Session & Cookie Usage
Authentication	→	Different Authentication Approach

# How Authentication Works



## What's that Token?



## Module Summary

### From “Classic” to REST API

- Most of the server-side code does not change, only request + response data is affected
- More Http methods are available
- The REST API server does not care about the client, requests are handled in isolation => No sessions

### Authentication

- Due to no sessions being used, authentication works differently
- Each request needs to be able to send some data that proves that the request is authenticated
- JSON Web Tokens (“JWT”) are a common way of storing authentication information on the client and proving authentication status
- JWTs are signed by the server and can only be validated by the server



# async/await

---

Working with Async Code more Elegantly



What?

## Asynchronous Requests in a Synchronous Way\*

\*Only by the way it looks, NOT by the way it behaves



# Real-Time Web Services with WebSockets

---

Pushing Data from Server to Client

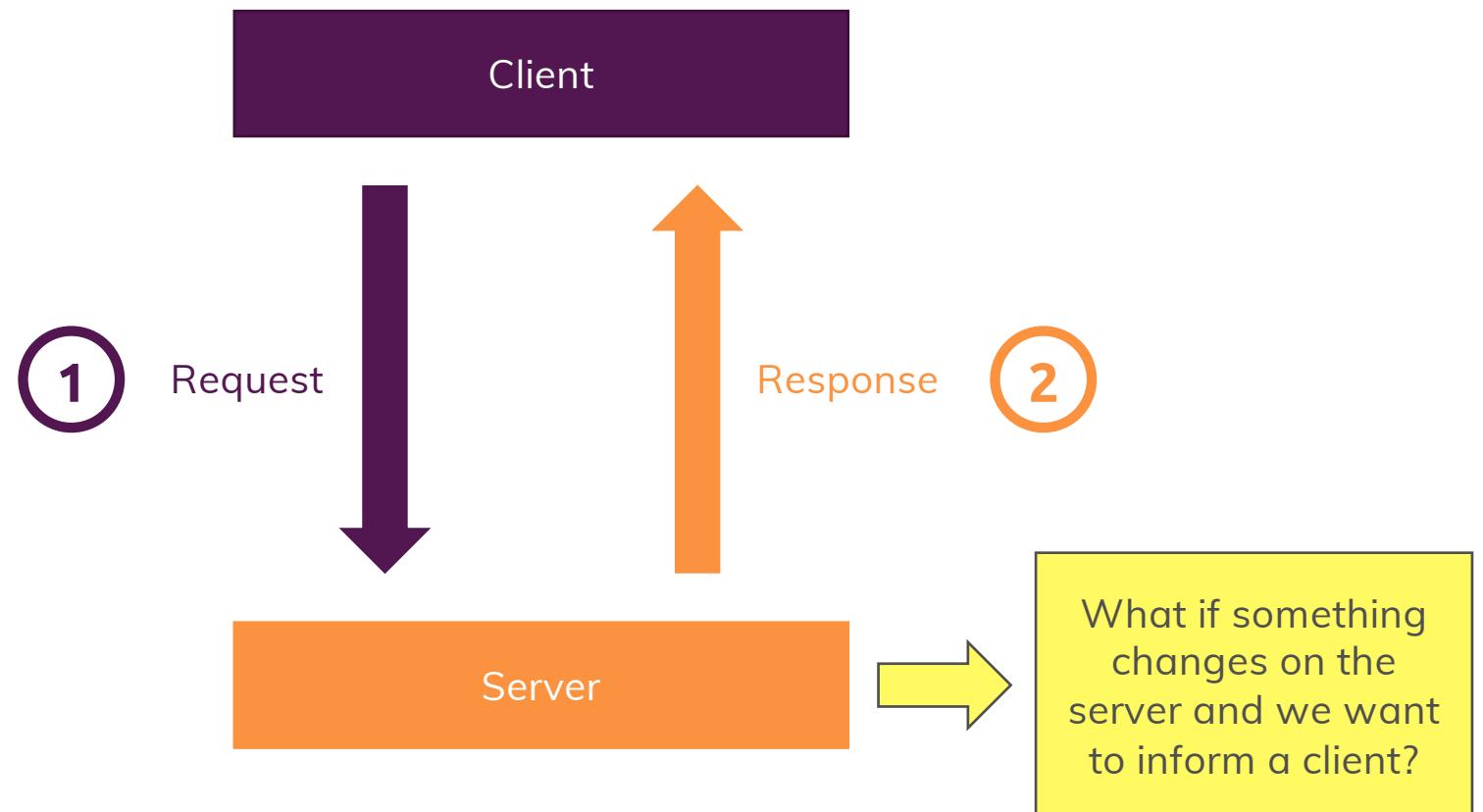


## What's In This Module?

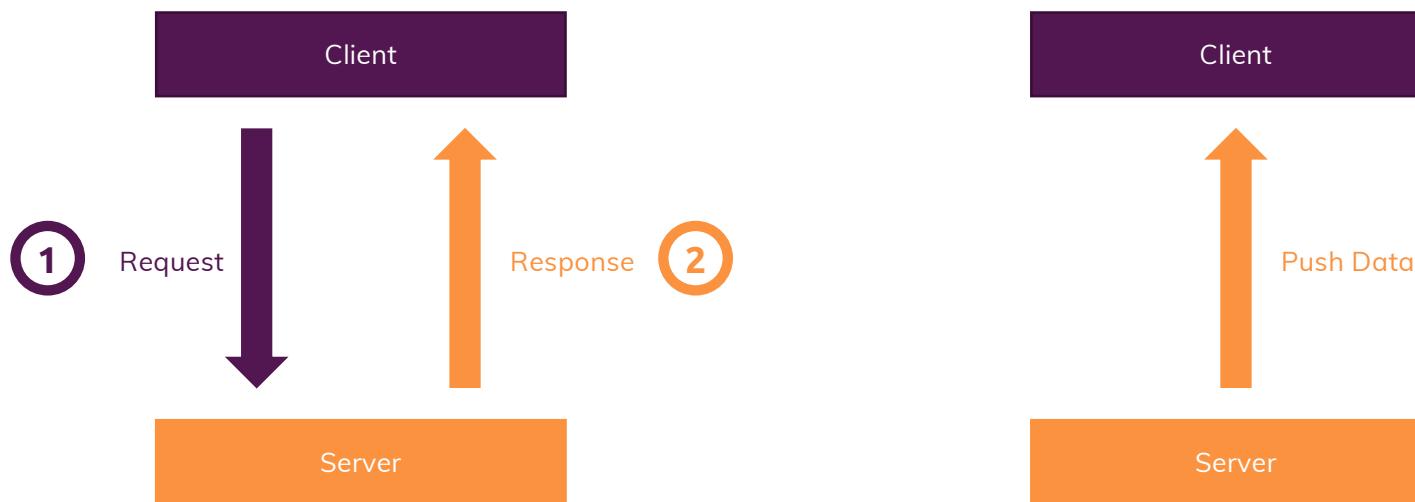
Why Realtime?

How to Add Realtime Communication to a  
Node App

## How It Currently Works



## WebSockets instead of Http



You can use both together in one and the same Node app!



# GraphQL

---

REST on Steroids



## What's In This Module?

What is GraphQL?

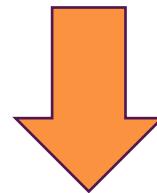
GraphQL vs REST

How to use GraphQL

# What is GraphQL?

REST API

Stateless, client-independent API for exchanging data



GraphQL API

Stateless, client-independent API for exchanging data with higher query flexibility

# REST API Limitations

GET /post

Fetch Post

```
{  
  id: '1',  
  title: 'First Post',  
  content: ' ... ',  
  creator: { ... }  
}
```

What if we only need the title and id?

Solution 1

Create a new REST API Endpoint (e.g. GET /post-slim)

Problem: Lots and lots of Endpoints & lots of Updating

Solution 2

Use Query Parameters (e.g. GET /post?data=slim)

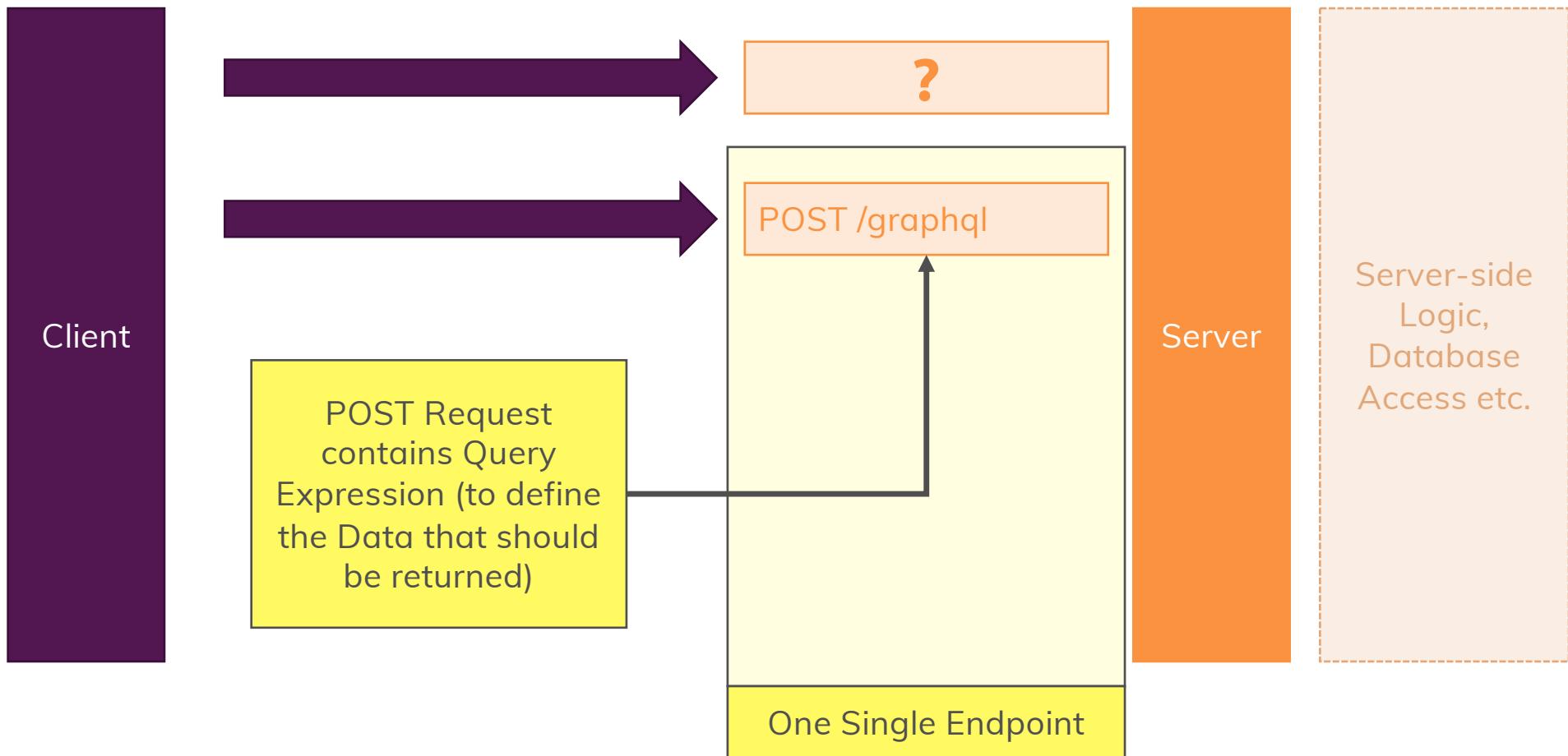
Problem: API becomes hard to understand

Solution 3

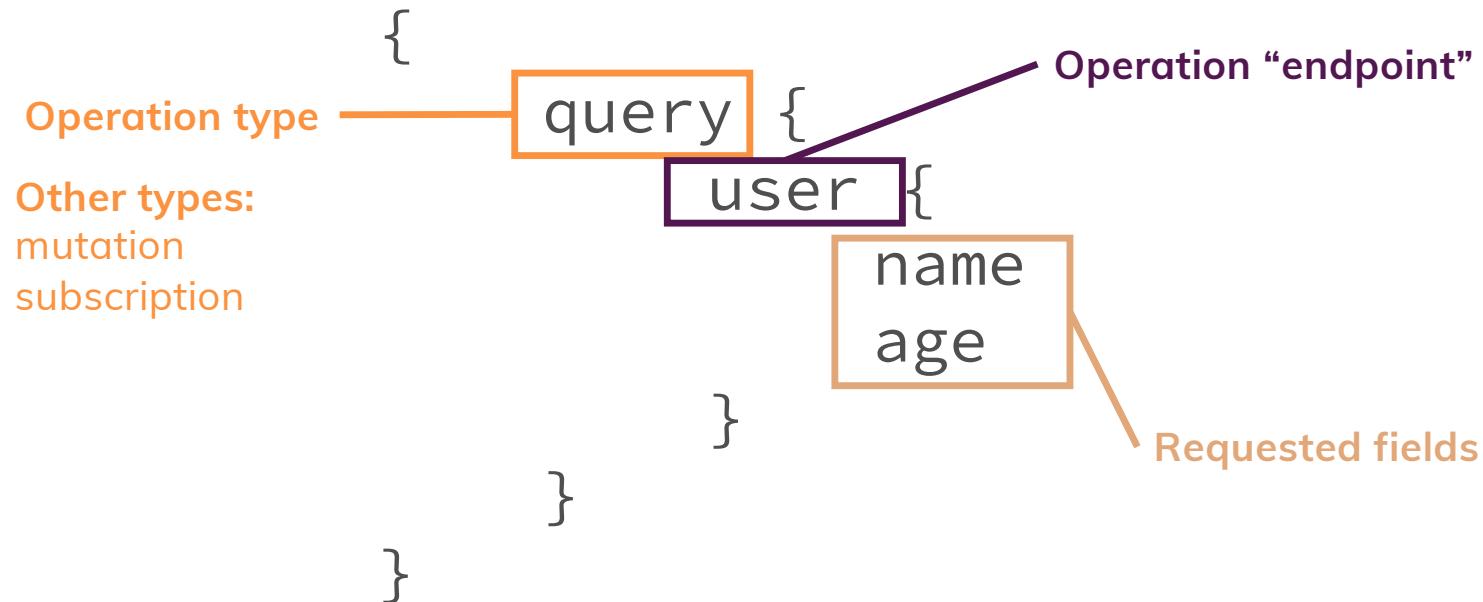
Use GraphQL!

Problem: None

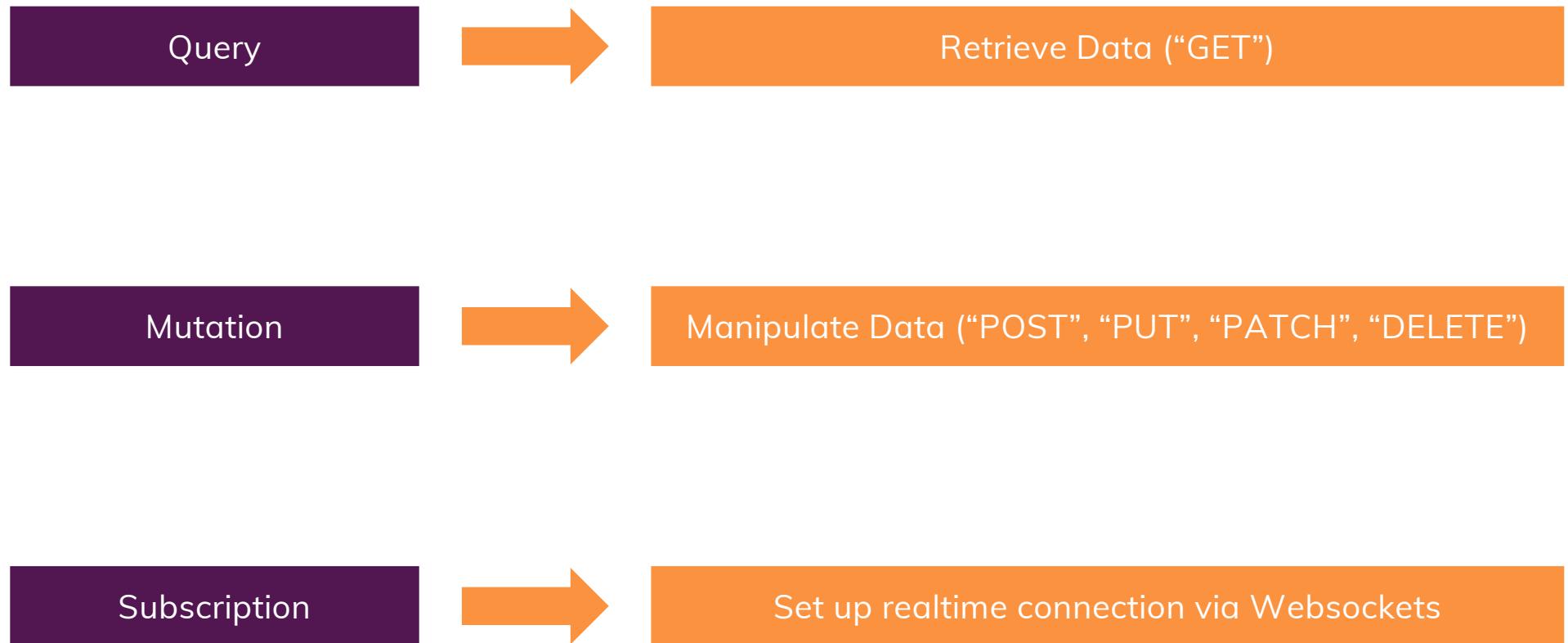
## How does GraphQL Work?



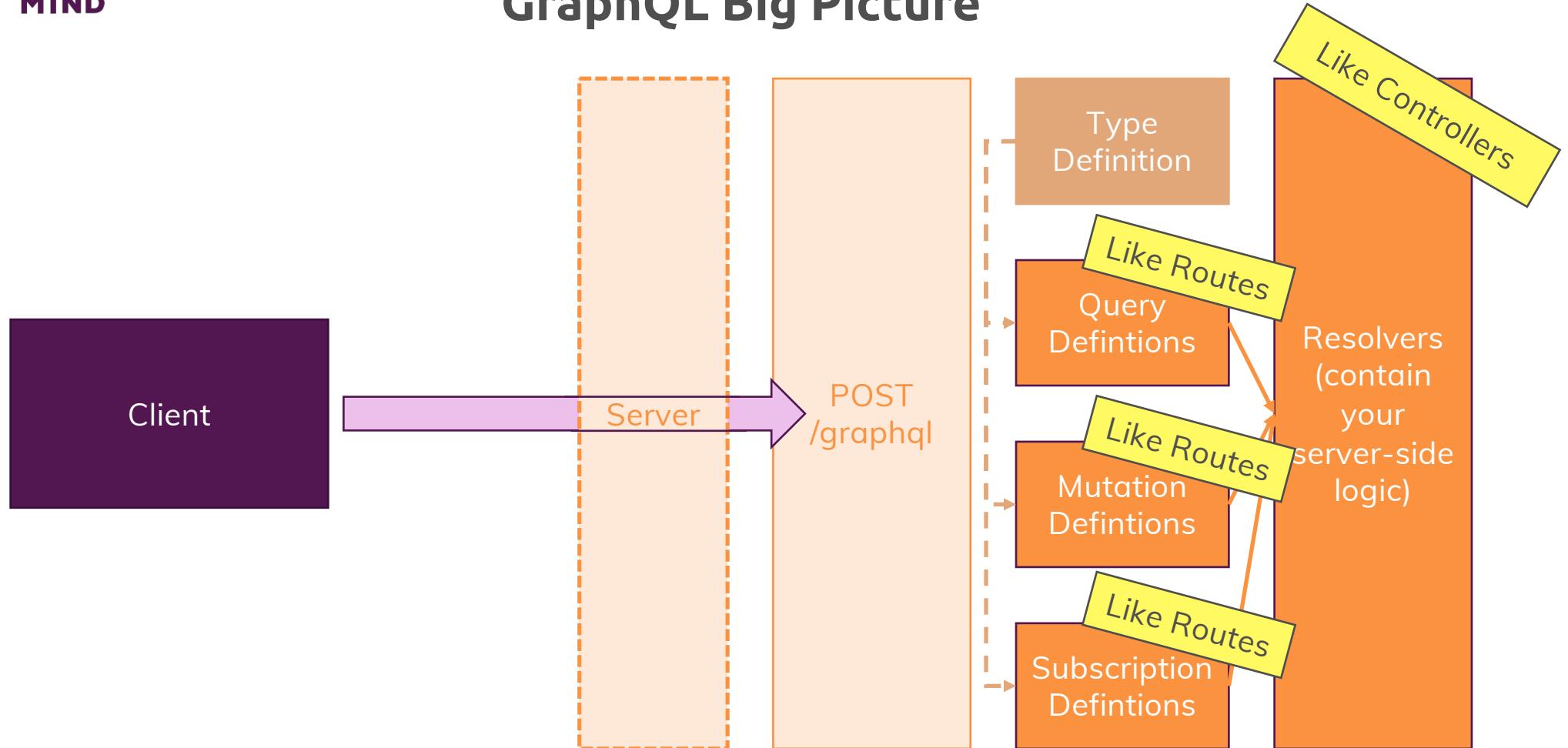
## A GraphQL Query



## Operation Types



# GraphQL Big Picture



## How does GraphQL Work?

It's a normal Node (+ Express) Server!

ONE Single Endpoint (typically /graphql)

Uses POST because Request Body defines Data Structure of retrieved Data

POST for Getting Data? Yep!

Server-side Resolver analyses Request Body, Fetches and Prepares and Returns Data

## Module Summary

### GraphQL Core Concepts

- Stateless, client-independent API
- Higher flexibility than REST APIs offer due to custom query language that is exposed to the client
- Queries (GET), Mutation (POST, PUT, PATCH, DELETE) and Subscriptions can be used to exchange and manage data
- ALL GraphQL requests are directed to ONE endpoint (POST /graphql)
- The server parses the incoming query expression (typically done by third-party packages) and calls the appropriate resolvers
- GraphQL is NOT limited to React.js applications!

### GraphQL vs REST

- REST APIs are great for static data requirements (e.g. file upload, scenarios where you need the same data all the time)
- GraphQL gives you higher flexibility by exposing a full query language to the client
- Both REST and GraphQL APIs can be implemented with ANY framework and actually even with ANY server-side language



# Deploying Node.js Applications

---

From Development to Production



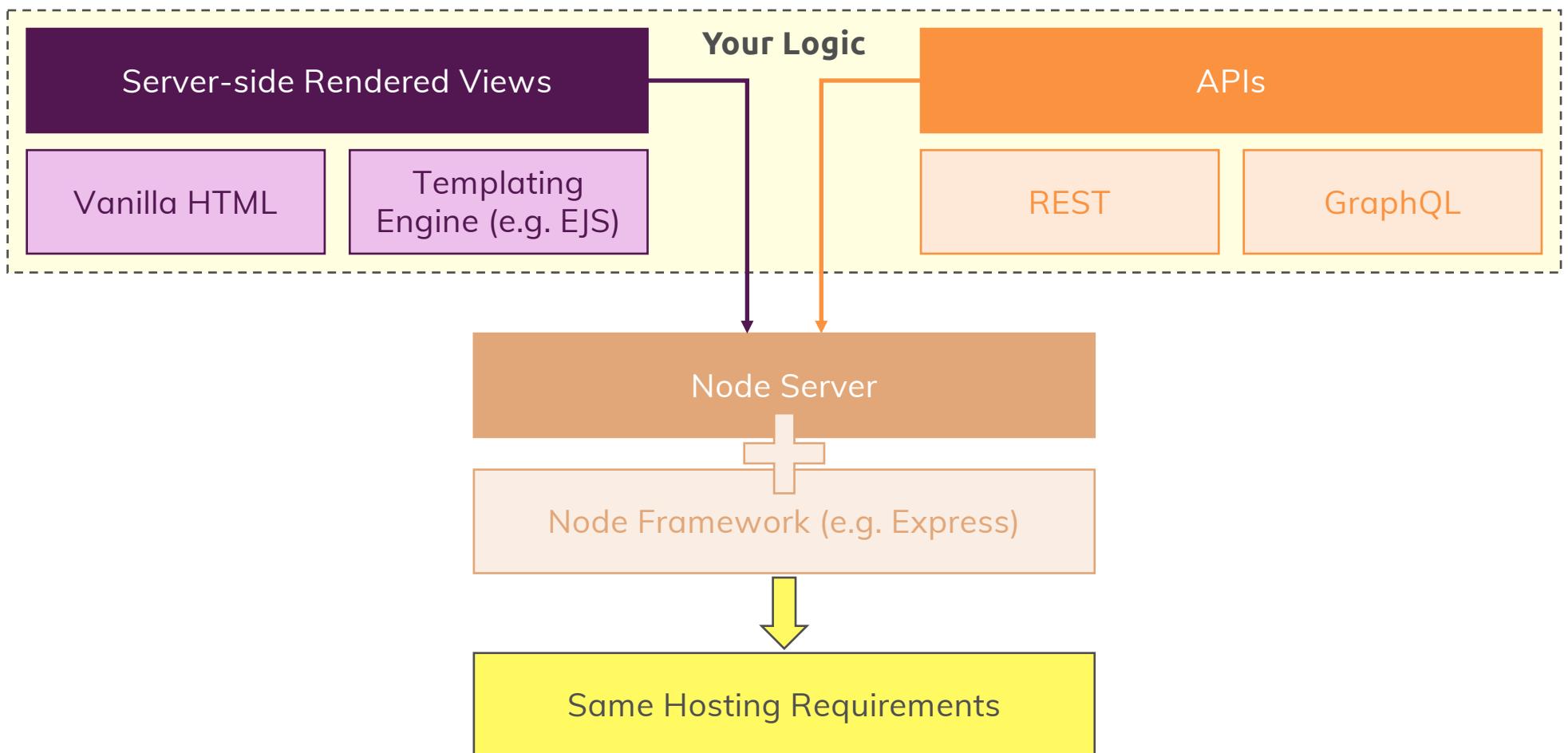
## What's In This Module?

Preparing for Deployment

Deployment Steps & Config

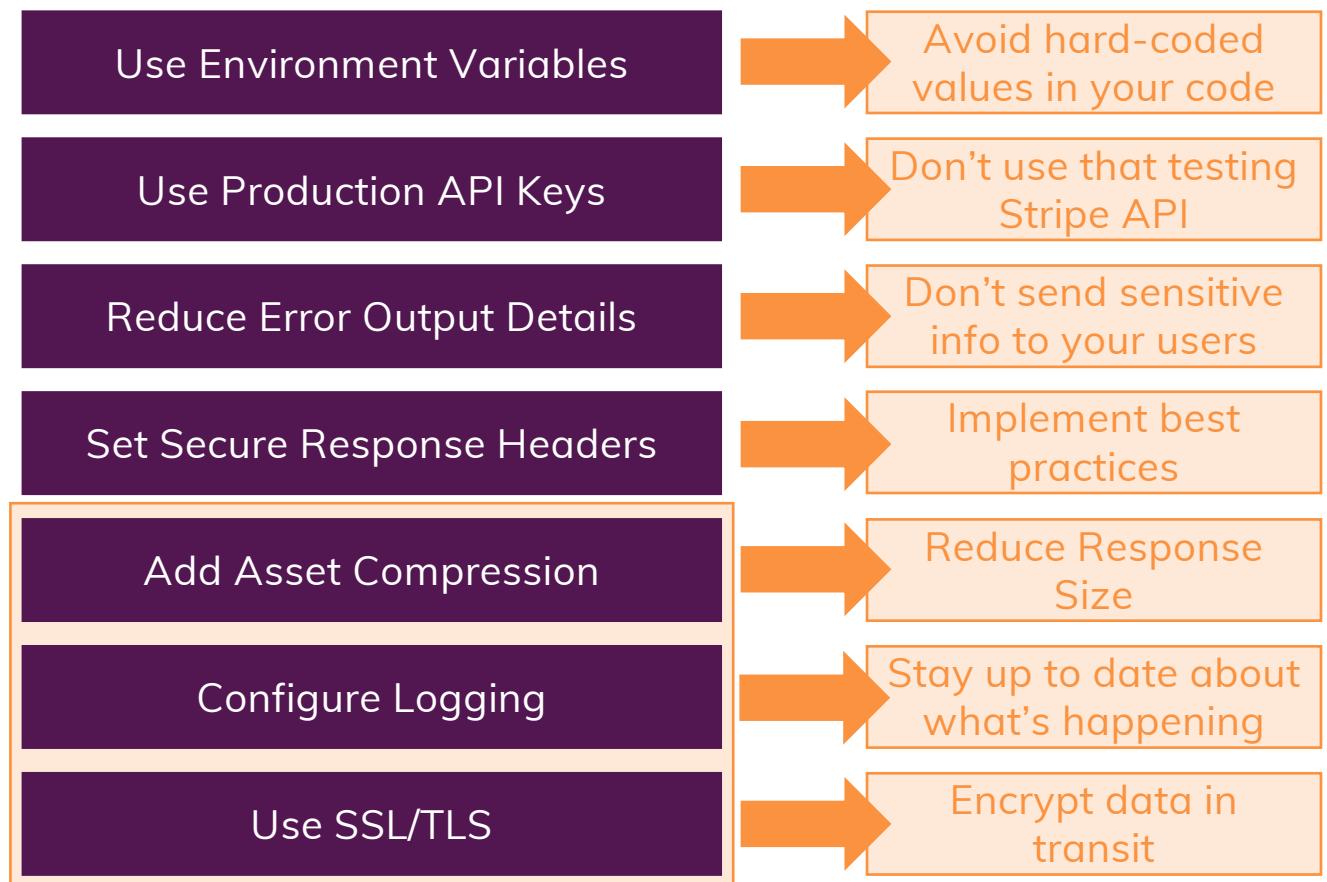
Security

# Which Kind of Application?

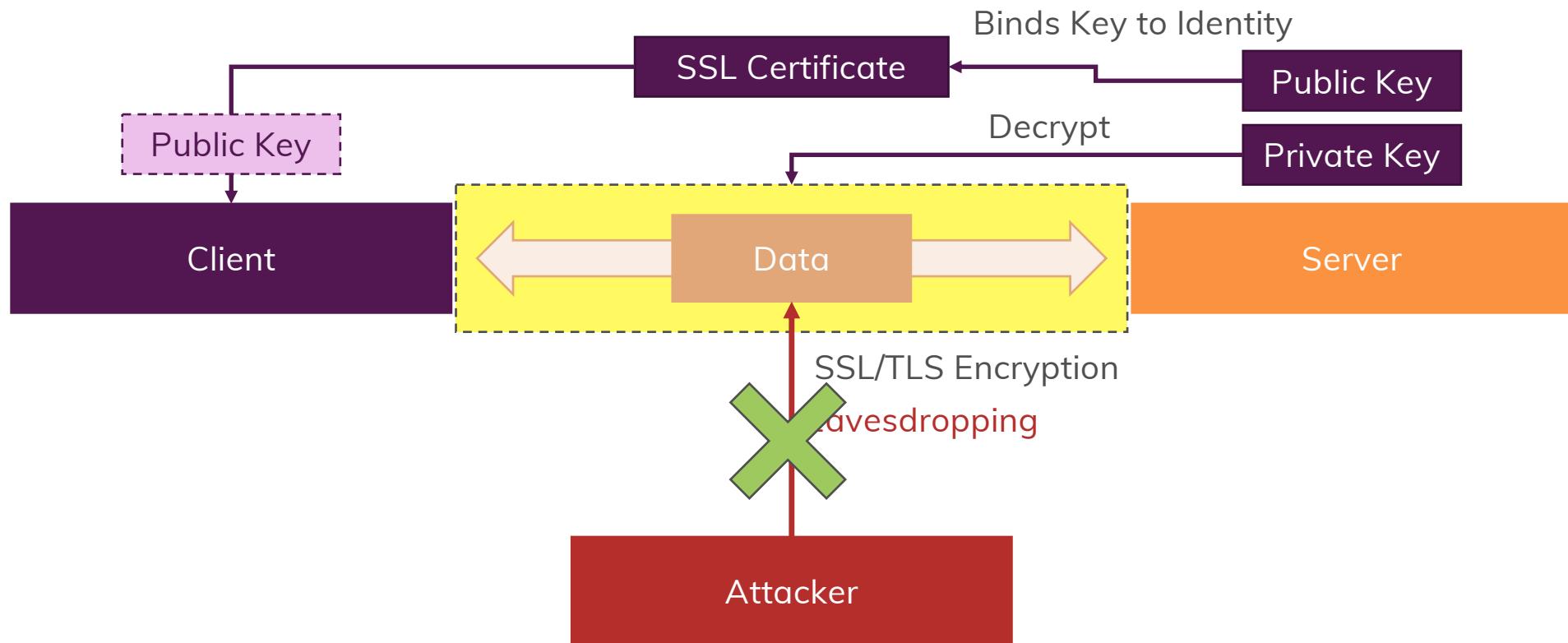


# Preparing the Code for Production

Often handled by the  
Hosting Provider



## Using SSL/TLS



# Configuring the Server (in a Secure Way)

Secure & Scalable Server Configuration is Hard!

Install & Update required  
Software

Lock Server Down

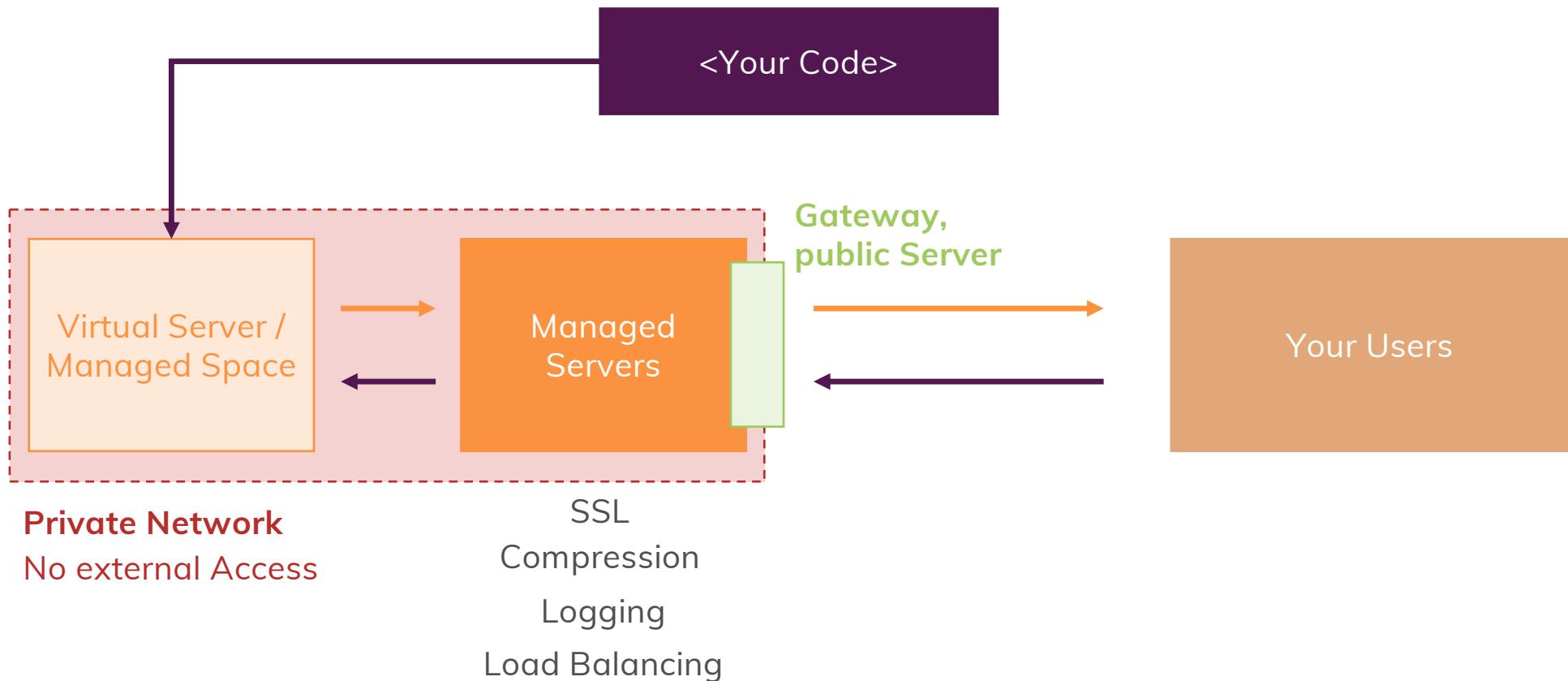
Protect & Manage Server  
Network

Way More!



Use Manage Service unless you know what you're doing!

# Using a Hosting Provider



# Version Control (Git)

Save & Manage Your Source Code

Commits

Branches

Remote Repositories

“Snapshots” of your code

Different “versions” of your code

Store code + commits + branches in the cloud

Easily switch between commits

e.g. master (production), development, new-feature

Protect against loss of local data

Create commit after bugfixes, new features, ...

Separate development of new features and bugfixing

Deploy code automatically

# Heroku Deployment Process

- 1 Prepare project (including compression)
- 2 Prepare git master branch for deployment
- 3 Use Heroku CLI to connect Heroku with app
- 4 Push code to Heroku
- 5 Enable SSL + Logging (Paid)

# Storing Files

Static Code Files

HTML

JavaScript

CSS

Stored with Other Source Code

No Persistent Storage Required (re-added  
with every Restart/ Re-Deployment)

User-Uploaded Files

Images

Videos

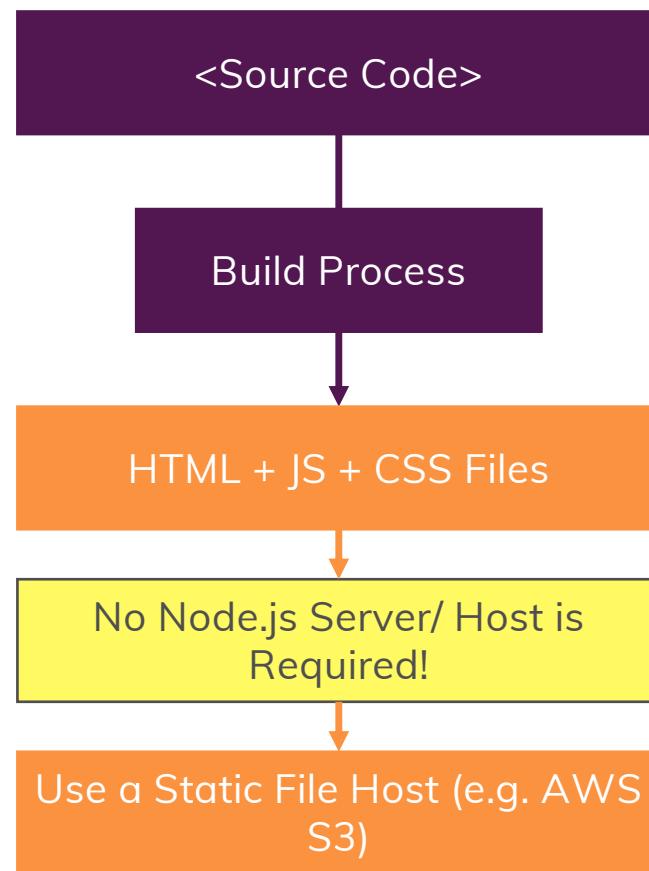
...

Not included in Source Code Package

Persistent Storage Required, NOT re-added  
with Restarts/ Re-Deployments

e.g. AWS S3 with s3-proxy

## Bonus: Deploying Frontend Web Apps (SPAs)



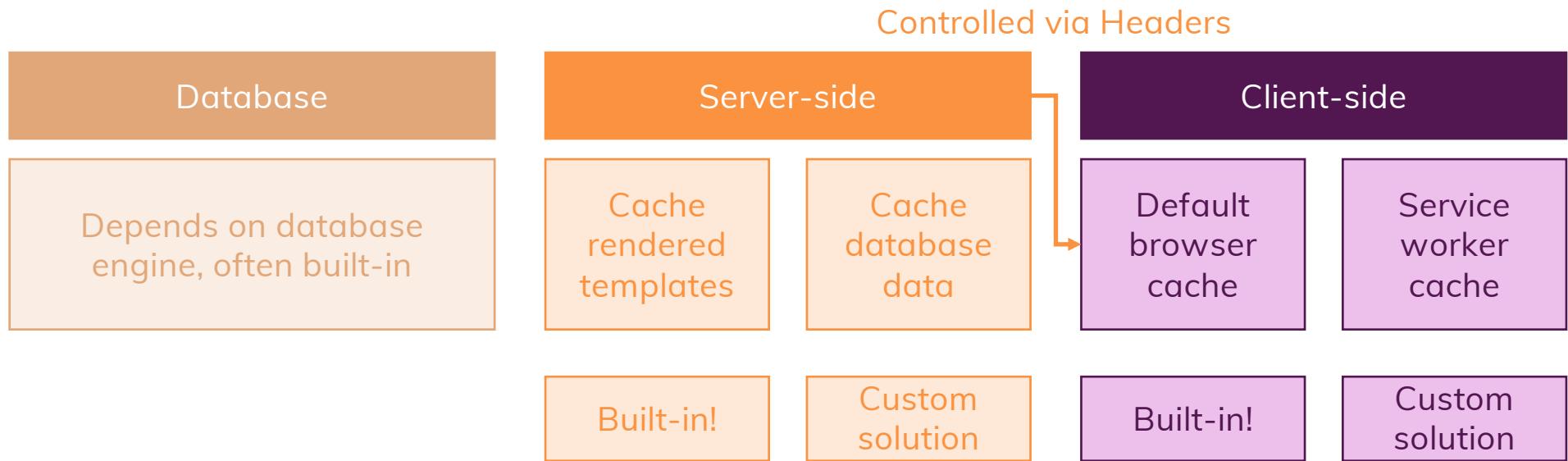


# Caching

---

Serving Files & Data as Fast as Possible

# Different Types of Caching





# npm & Node as a Build Tool

---

Beyond Node Web Servers



## Two for the Price of One

Node.js

npm

Execute Code

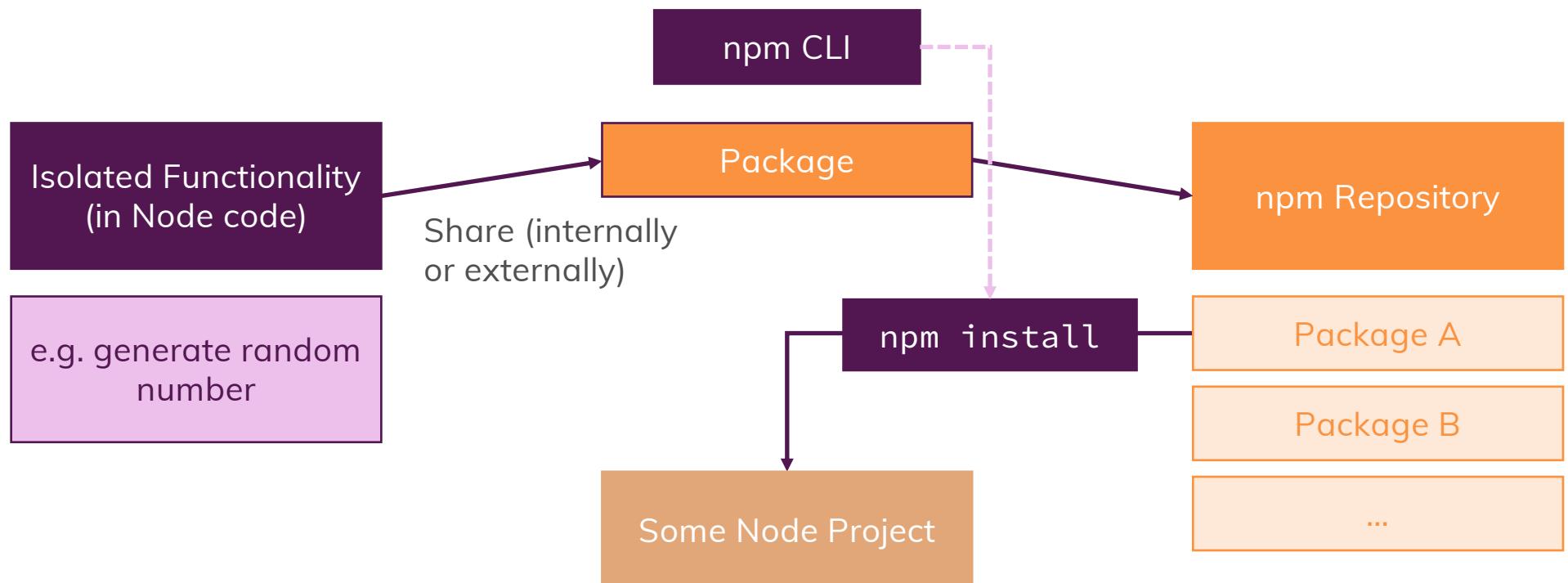
Manage Packages

Interact with Files

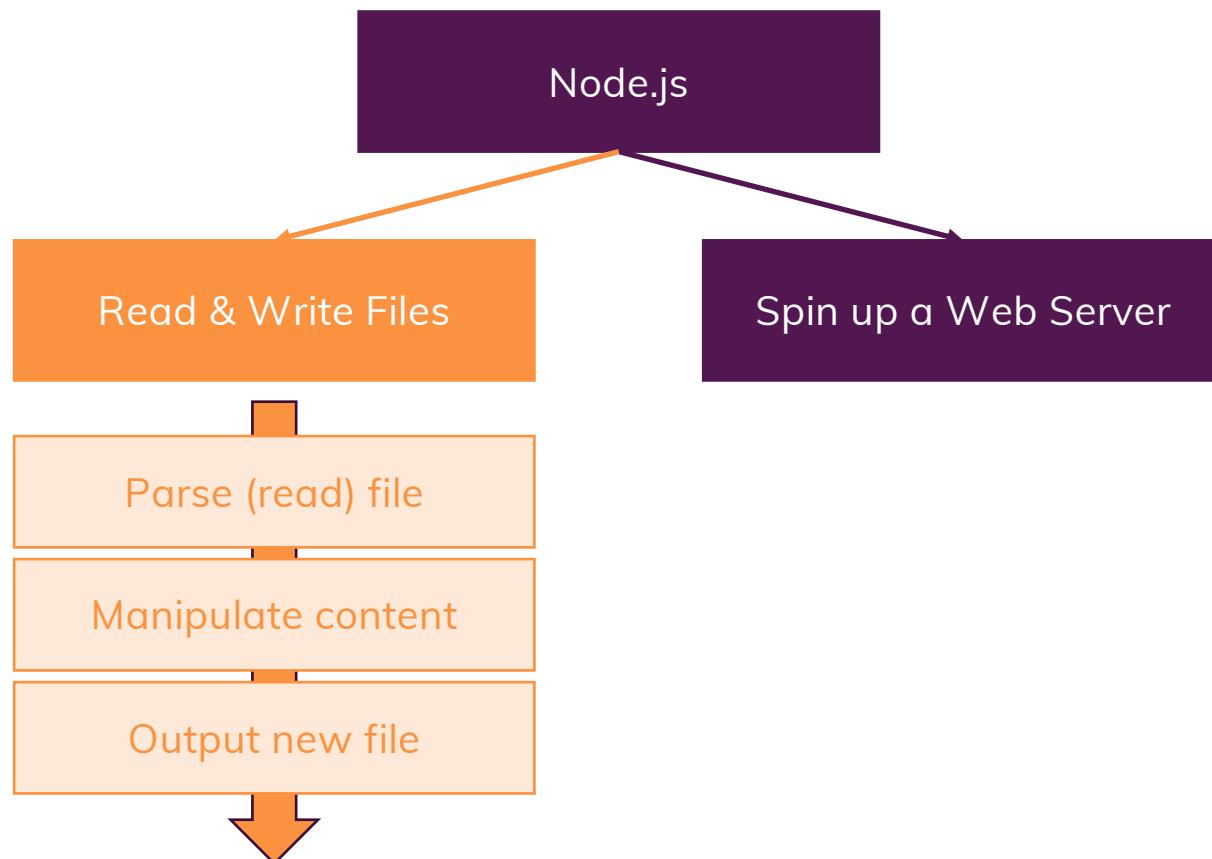
Run Scripts

## Understanding npm

### Node Package Manager



## Remember: Node can execute any .js File!



# What is a “Build Tool”? And Why?

Primarily important in frontend development!

Unoptimized but manageable Code

Next-gen Features

Optimized Code

```
const copy = (arr) =>
{
  return [...arr];
}
```

```
const copy = (arr) =>
{
  return [...arr];
}
```

```
var a = function(b)
{return b.slice()}
```



## Global npm Packages

Now global packages make sense!



# Roundup & Next Steps

---

How to Continue?



## Next Steps

Practice!

Explore APIs & Serverless Apps

Dive into Frontend Development