MASYNCTECH
SCHOOL

FULLSTACK WEB DEV

mongoose

BACKEND DEVELOPMENT

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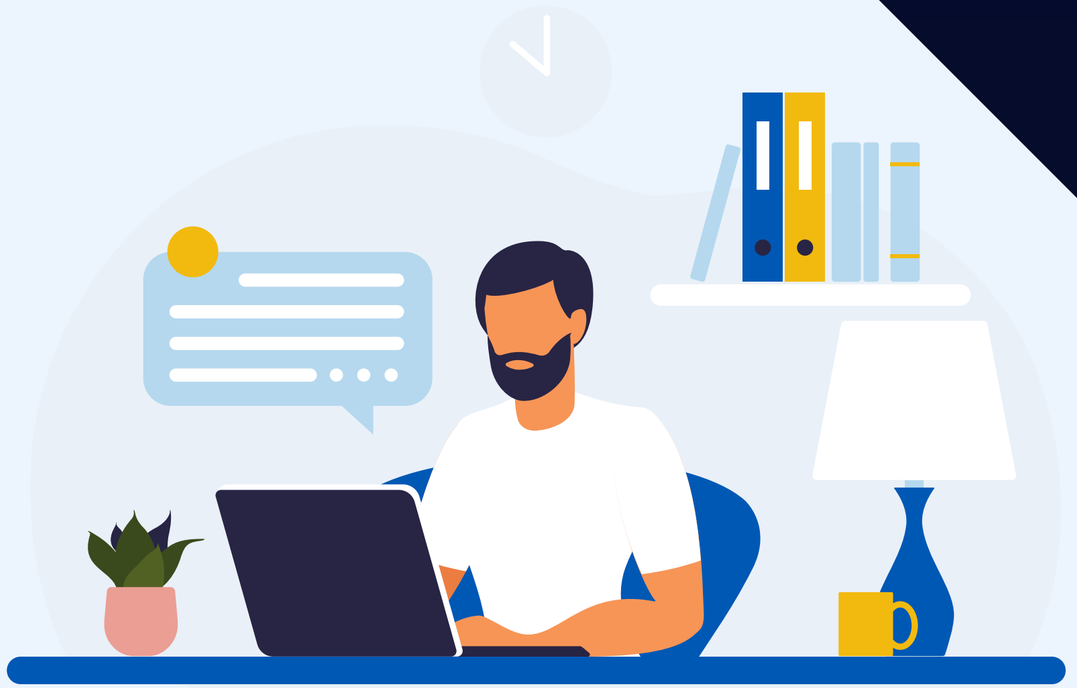
WHAT'S MONGOOSE



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CORE CONCEPTS

MONGOOSE OVERVIEW

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High-Level Explanation

- Mongoose: ODM library for MongoDB in Node.js
- Offers schema-based models, validation, queries, hooks, etc.
- Simplifies MongoDB interaction in Node.js apps.

Analogue

- Analogy: Mongoose as a toy box organizer
- Keeps MongoDB data neat and organized
- Ensures data matches your desired structure

Best Practices

- Steps for Mongoose usage:
  - Define schema for collections
  - Employ validators for data integrity
  - Utilize middleware for pre/post-save operations

Deep Dive

- Mongoose abstracts MongoDB for ease
- Handles validation, casting, queries, and hooks
- Defines document structure with Schemas
- Features: population, virtual properties, middleware, plugins
- Maintains MongoDB's flexibility with added structure

When to use?

- Mongoose benefits for:
  - Complex projects with structured DB needs
  - Ensuring data adheres to rules/schemas
  - Quick prototyping for speed and convenience

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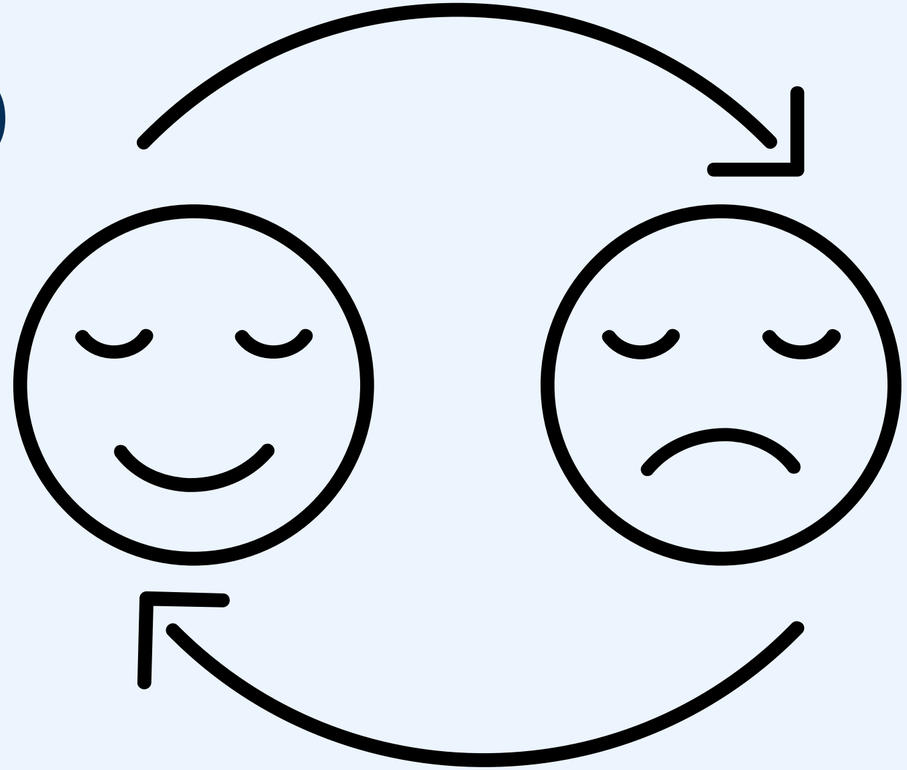
MONGODB VS MONGOOSE



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CORE CONCEPTS

MONGOOSE VS MONGODB

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High-Level Explanation

- Mongoose vs. MongoDB native driver:
  - Mongoose: Higher-level, schema-based, validation
  - MongoDB native driver: Lower-level, direct access

Analogue

- Mongoose: Organized kitchen with helpers for correct data storage.
- MongoDB Native Driver: Basic kitchen without organizers; user responsibility for data handling.

Best Practices

- **Mongoose:**
  - Leverage schemas and built-in validation.

- **MongoDB Native Driver**:
  - Manage data integrity manually, exercise caution in DB operations.

Deep Dive

- Mongoose:
- ODM layer with schemas, rich features.
- Strongly-typed schemas, hooks, virtuals.
- Eases development but adds some abstraction.

- **MongoDB Native Driver:**
  - Direct connection, more control, less abstraction.
  - Developer handles data integrity.
  - Faster for basic CRUD due to less overhead.

When to use?

- **Mongoose:**
  - Complex apps, data validation, ease of use.
  - Speedy development.

- **MongoDB Native Driver:**
  - Simple CRUD, intricate MongoDB operations.

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MONGOOSE OFFICIAL DOCS

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CORE CONCEPTS

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MONGOOSE

INSTALLATION

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SCHEMA OVERVIEW

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CORE CONCEPTS

SCHEMA OVERVIEW

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High-Level Explanation

- MongoDB schema: Blueprint for collection documents
- Mongoose schema: Defines fields, types, validators, structure

Analogue

- Analogy: MongoDB is like open LEGO pieces.
- Mongoose is the rulebook for building a stable LEGO castle.
- Ensures walls, towers, drawbridge follow the right design.

Best Practices

- Define document shape with Mongoose schema.
- Apply suitable field validation.
- Minimize use of `any` data type.
- Implement pre- and post-save hooks as needed.

Deep Dive

- **Mongoose schemas:**
  - Define field types, default values, validation
  - Create virtual properties for app logic
  - Maintain data integrity in schema-less MongoDB
  - Manage complex relationships, validation, hooks, methods

When to use?

Use Mongoose schemas when:

- Structured data with specific types needed.
- Data validation before database save crucial.
- Pre- or post-save hooks required.
- Handling complex relationships between documents.

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SCHEMA TYPES

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CORE CONCEPTS

SCHEMA TYPES

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High-Level Explanation

- Mongoose schema types:
  - `String`, `Number`, `Date`, `Boolean`, `Array`, `ObjectID`
  - Used to define structure of MongoDB documents.

Analogue

- Analogy: Schema types as LEGO blocks
- `**String**`: Long, flat piece for names, descriptions
- `**Number**`: Small, square block for age, price
- `**Array**`: Tray for multiple blocks of same/different shapes

Best Practices

- Opt for the most restrictive type for data integrity.
- Minimize use of `Mixed` unless compelling need.
- Think about performance implications.
- Use `ObjectID` for document references in relational data.

Deep Dive

- Mongoose schema types:
  - `**String**`: Textual data, symbols, numbers.
  - `**Number**`: Integers and floats.
  - `**Date**`: Date and optional time.
  - `**Boolean**`: True or false.
  - `**Array**`: Multiple values, often of the same type.
  - `**ObjectID**`: Unique identifier, typically auto-generated.
  - `**Mixed**`: Flexible, holds any data type (use sparingly).
  - Embedded Documents: Nested, complex structures within schemas.

When to use?

Use specific schema types when you:
- Have precise data expectations.
- Need validation or transformation.
- Want data integrity assurance.
- Seek query performance optimization.

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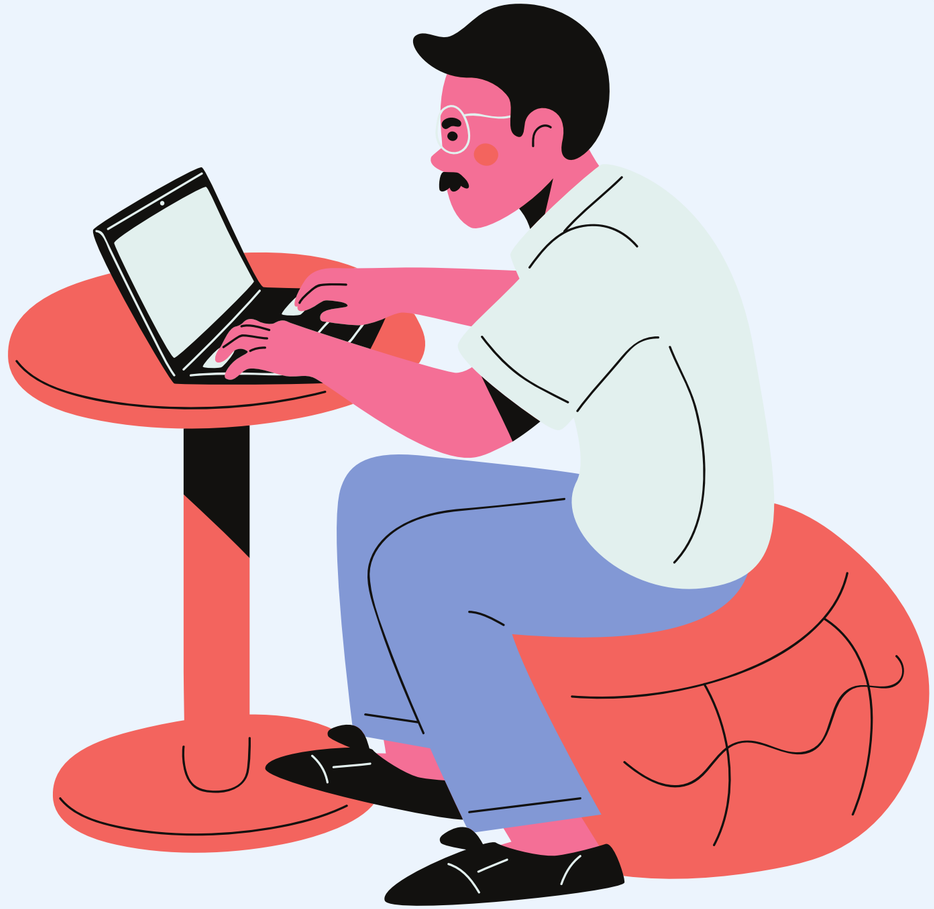
DEMO TIME



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MODELS

OVERVIEW

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CORE CONCEPTS

MODELS OVERVIEW

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High-Level Explanation

- Mongoose model: Interface for MongoDB interactions.
- Created by combining schema with CRUD methods.
- Defines fields, types, and how to work with data.

Analogue

- Analogy: Model as a blueprint for houses
- Blueprint (Schema): Defines walls, doors, windows (fields)
- Build houses (documents) based on blueprint
- Find houses with specific features (querying)

Best Practices

- **Single Responsibility:** One model, one concept.
- **Naming**: Singular, capitalized model names.
- M**ethod Attachment**: Attach custom logic via instance or static methods.

Deep Dive

- Models construct MongoDB documents.
- Compiled from a schema.
- Map to MongoDB collections.
- Define document structure.
- Perform CRUD and aggregations.
- Components: Schema, Collection, Document, Query Interface.

When to use?

Use models when you:
- Perform read/write operations in MongoDB.
- Need to enforce structure on collection documents.
- Want to encapsulate data-related business logic (preferably simple logic).

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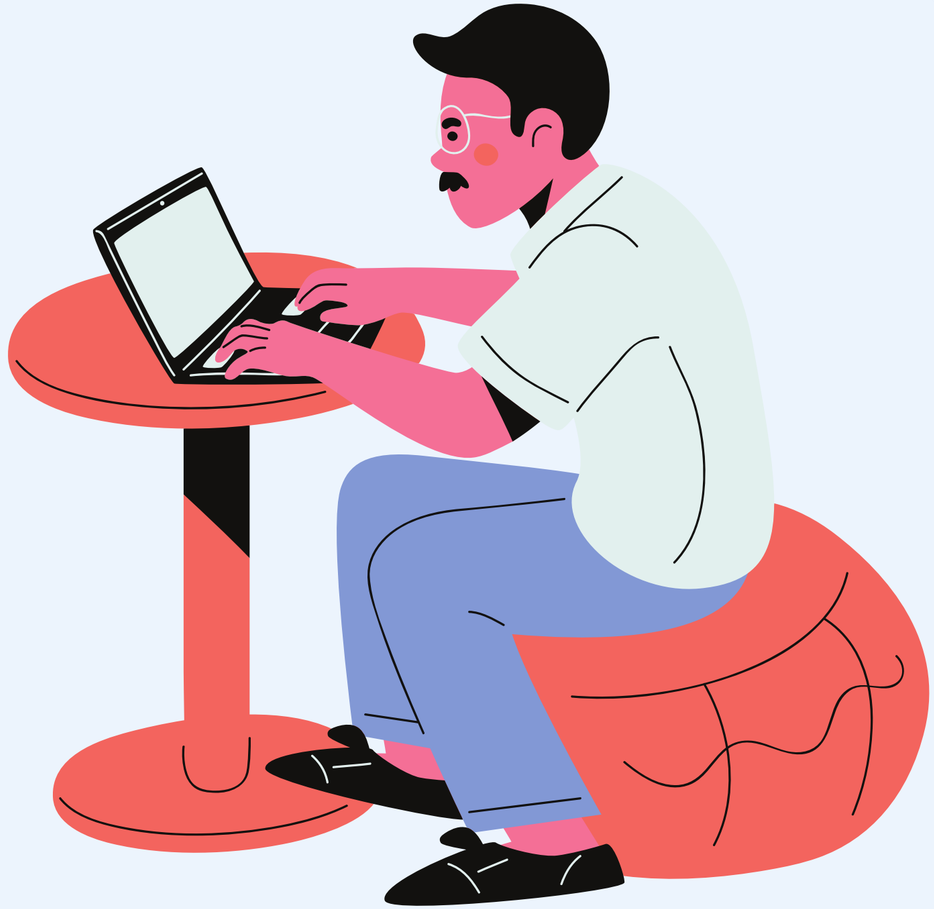

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MONGOOSE CRUD OPERATIONS

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CREATE OPERATIONS (.save())

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CRUD OPERATIONS

CREATE OPERATIONS USING `.SAVE()

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High-Level Explanation

- `.save()` in Mongoose: Create operation, saves new document to DB.

Analogue

- Analogy: `.save()` in Mongoose like 'Save Game' in video games.
- Stores the new 'game state' (document) in MongoDB.

Best Practices

- Always handle promises (`.then/.catch` or `async/await`).
- Validate input before `.save()` to prevent incorrect data.
- Prepare for possible failures like duplicate keys.

Deep Dive

- Instantiate a Mongoose object using a model for an instance.
- Invoke `.save()` on the instance.
- Mongoose handles validation, transformation, MongoDB `insert`.
- Promise resolves on success, rejects on failure.
- Catch errors with `.catch()`.

When to use?

Use `.save()` when:

- Inserting a new document into the collection.
- Updating an existing document after making changes.

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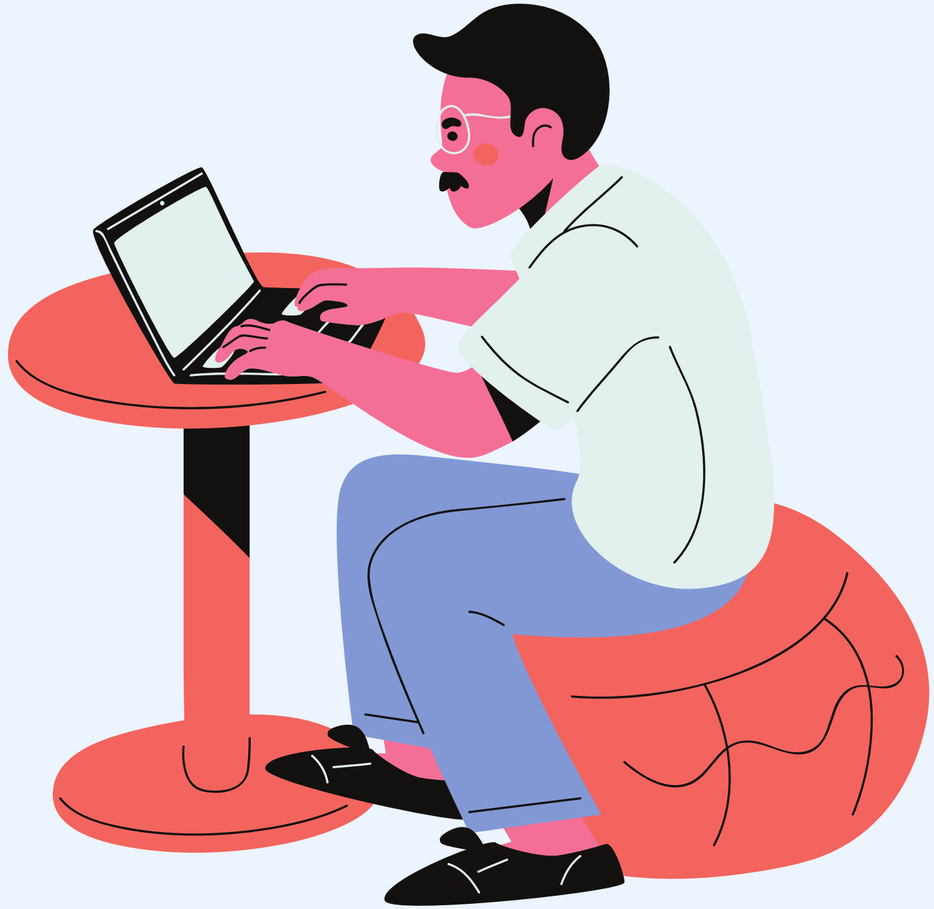
DEMO TIME



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CREATE OPERATIONS (.create())

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CRUD OPERATIONS

CREATE OPERATIONS USING THE `.CREATE()`

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High-Level Explanation

- `**.create()**` in Mongoose: Shortcut for saving one or more documents to MongoDB.
- Combines model instantiation and `.save()` in one step.

Deep Dive

- Traditionally: Instantiate, modify, and `.save()` for a new document.
- `.create()` simplifies, creating and saving in one step.
- Makes code more concise and maintainable.

Analogue

- Analogy: Traditional vs. `.create()` method in video game.
- Traditional: Gather materials, go to site, build.
- `.create()`: Cheat code, instant house construction.

When to use?

Use `.create()` when:

- Swift document insertion without prior manipulation.
- Inserting multiple documents with confidence.
- Aiming for concise and clean code.

Best Practices

- Handle errors with the returned promise (`.then` or `await`).
- Validate data before using `.create()`; schema validations run.
- Caution with multiple document insertions; one failure blocks all.

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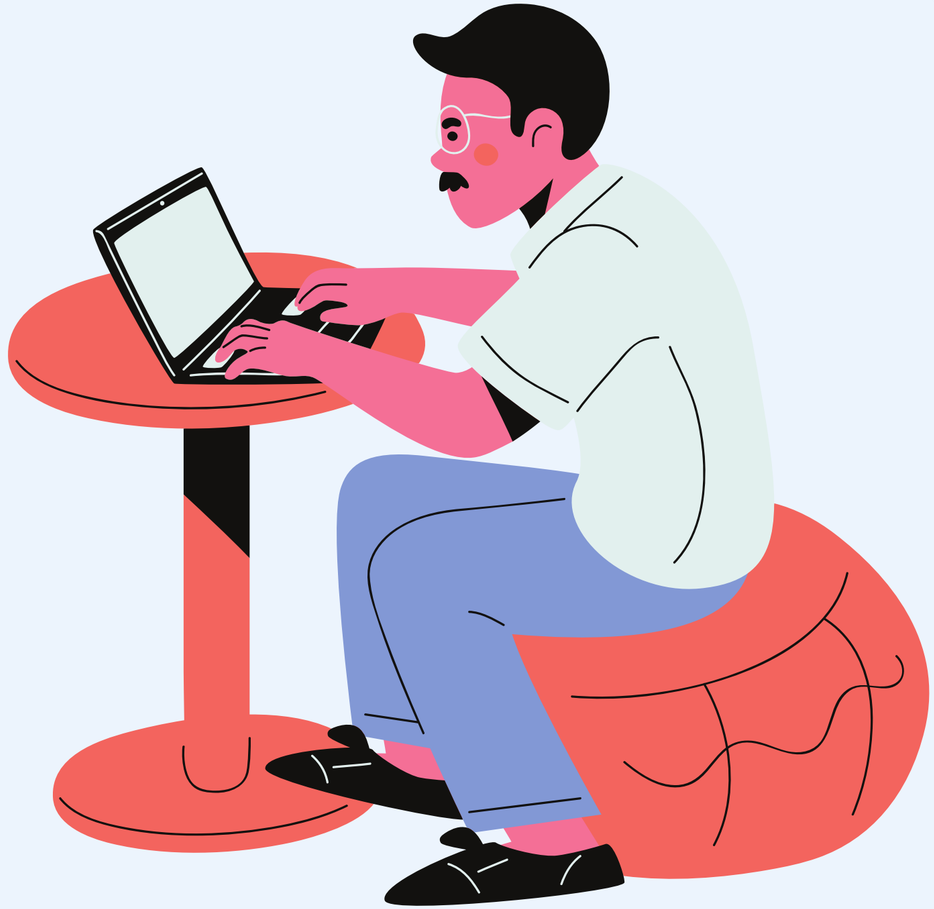
DEMO TIME



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CREATE OPERATIONS (.insertMany())

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CRUD OPERATIONS

BATCH OPERATIONS USING USING `.INSERTMANY()

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High-Level Explanation

- `.insertMany()` in MongoDB: Insert multiple docs in one operation.
- Useful for batch processing, efficient data insertion.

Deep Dive

- `.insertMany()`: Insert multiple items in collection at once.
- Ideal for seeding databases or efficient bulk inserts.

Analogue

- Analogy: `.insertMany()` like dumping Lego bricks into a big box.
- Saves time and effort by inserting multiple docs at once.

When to use?

Use `.insertMany()` when:

- Seeding a database with initial data.
- Inserting an array of objects into a collection.

Best Practices

- Validate documents against schema.
- Watch document size limit (16MB).

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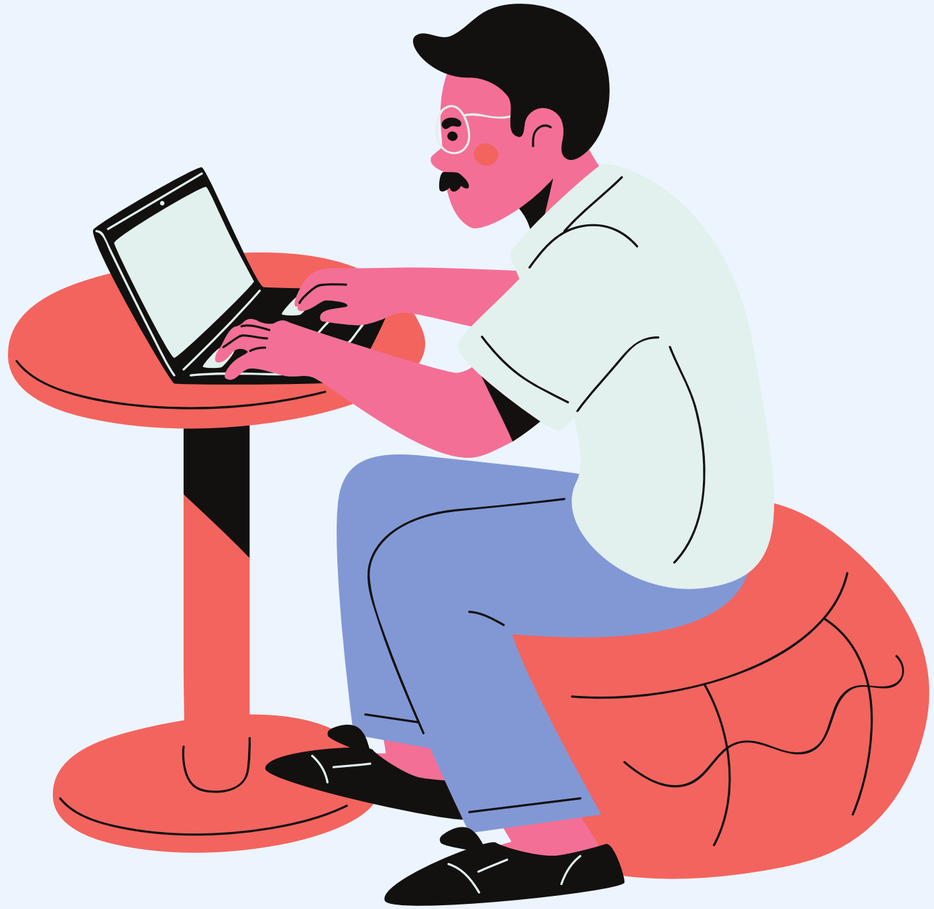
DEMO TIME



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CREATE OPERATIONS (.insertMany())

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CRUD OPERATIONS

BATCH OPERATIONS USING USING `.INSERTMANY()

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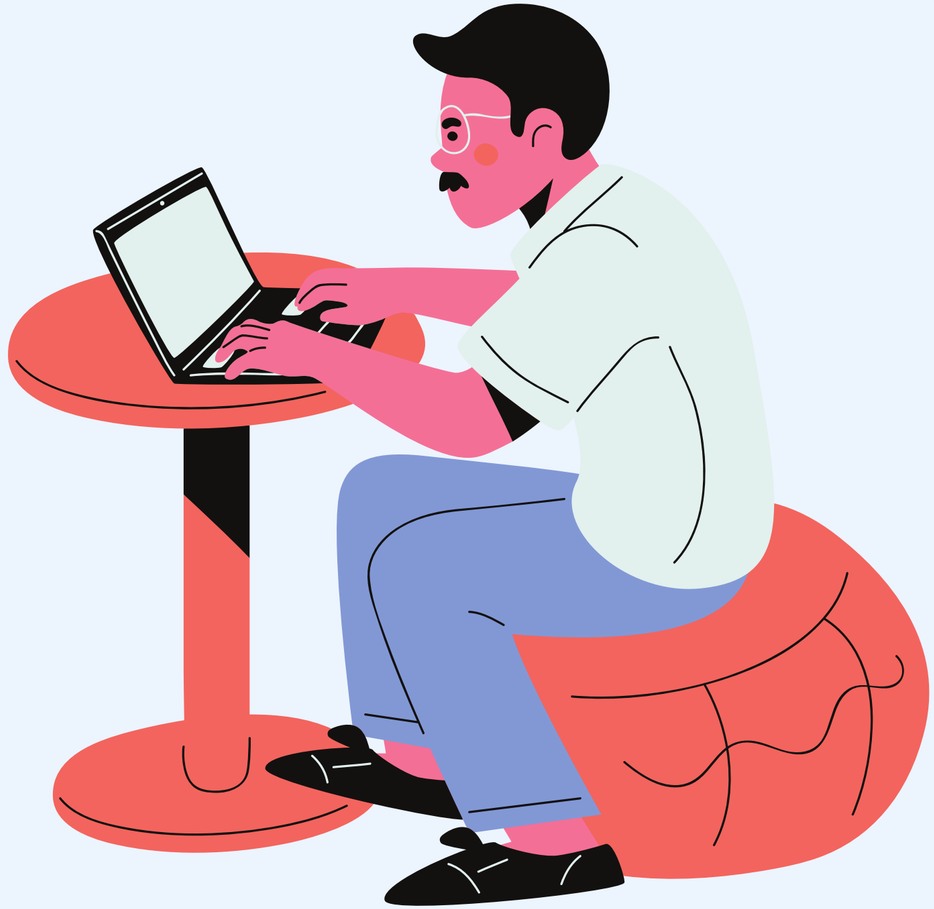

MASYNCTECH
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READ

OPERATIONS

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CRUD OPERATIONS

READ OPERATIONS .FIND() AND .FINDONE()

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High-Level Explanation

- `.**find**()`: Fetch multiple documents based on query.
- `.**findOne**()`: Retrieve single document based on criteria.

Analogue

- Analogy: `.find()` like scrolling through matches.
- `.findOne()` like picking the top match based on preferences.

Best Practices

- Projections: Limit fields returned, reduce data transfer.
- Options: `sort`, `limit`, `skip` for query fine-tuning.
- Handle errors using try-catch or `.catch()`.

Deep Dive

- `.**find**()`: Returns array of matching docs or empty array.
- `.**findOne**()`: Returns first matching doc or `null`.
- Both accept projections, sorting, limiting, and skipping.

When to use?

- `.find()`: For multiple docs, like all products in a category.
- `.findOne()`: For a single doc, like user details by username.

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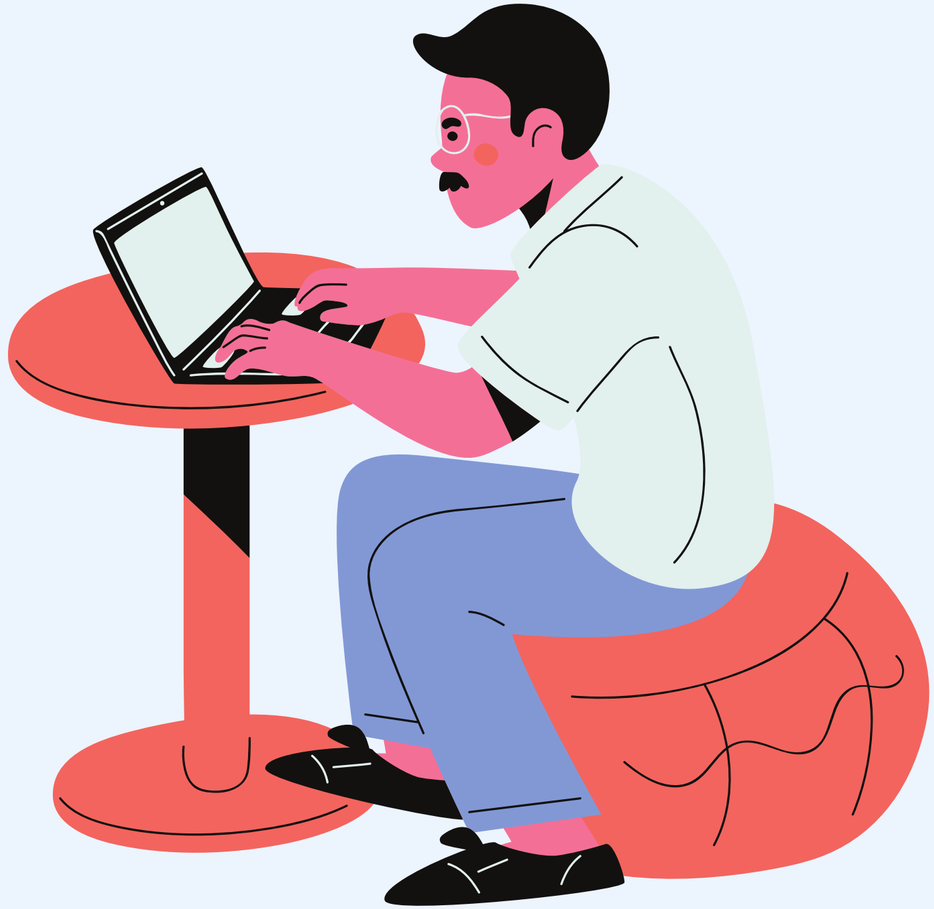
DEMO TIME



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READ QUERIES OPERATIONS

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QUERY OPERATIONS

READ OPERATIONS `.WHERE()`, `.SORT()`, `.LIMIT()`

MASYNCTECH SCHOOL

High-Level Explanation

- `**.where()**`, `**.sort()**`, **and** `**.limit()**` refine query results.
- Typically chained to `.find()` or `.findOne()` queries.

Deep Dive

- `**.where()**`: Filter docs with conditions, logical operators.
- `**.sort()**`: Sort docs based on fields.
- `**.limit()**`: Limit the number of returned docs.

Analogue

- `**.where()**`: "Red" filter
- `**.sort()**`: "Sort by Price: Low to High"
- `**.limit()**`: "Show only the first 5 options"

When to use?

- `**.where**()`: Complex filtering with multiple conditions.
- `**.sort**()`: Organizing data for readability or analysis.
- `**.limit**()`: Pagination or performance optimization by limiting records.

Best Practices

- `**.where**()`: Validate input to prevent injection attacks.
- `**.sort**()`: Let the database handle sorting for efficiency.
- `**.limit**()`: Be cautious with the limit to avoid missing data or overwhelming the system.

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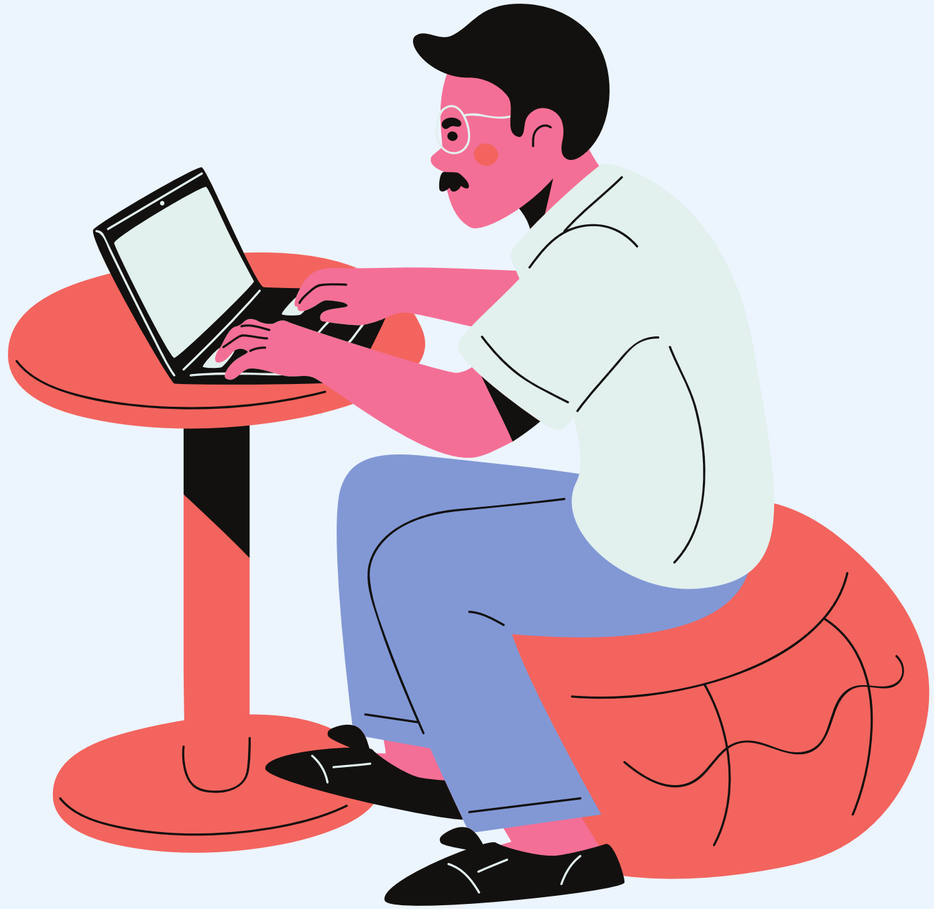
DEMO TIME



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READ QUERIES OPERATIONS

Filtering Results

mongoose

QUERY OPERATIONS

READ OPERATIONS USING QUERY CONDITIONS

MASYNCTECH SCHOOL

High-Level Explanation

- MongoDB query conditions filter returned documents.
- Operators like `$eq`, `$gt`, `$lt`, `$in`, `$nin` used for criteria.
- Essential for precise search results.

Analogue

- Analogous to music playlist filters
- `$eq`: Genre equals a certain type
- `$gt`: Released after 2010
- `$nin`: Not in disliked genres list
- Filters tailor playlist to specific taste

Best Practices

- Optimize by indexing frequently queried fields.
- Ensure data validation to prevent misuse.
- Enhance readability with helper methods (e.g., `.gte()`, `.lt()`).

Deep Dive

- Query conditions: Key-value pairs
- Key: Field of interest
- Value: Condition (often another key-value pair)
- Examples:
  - `$**eq**`: Equal
  - `$**gt**`: Greater than
  - `$**lt**`: Less than
  - `$**in**`: Matches any in array
  - `$**nin**`: Matches none in array

When to use?

- Query conditions ideal for large datasets
- Valuable in:
  - Data analytics
  - Reporting tools
  - Rapid info retrieval in real-time apps

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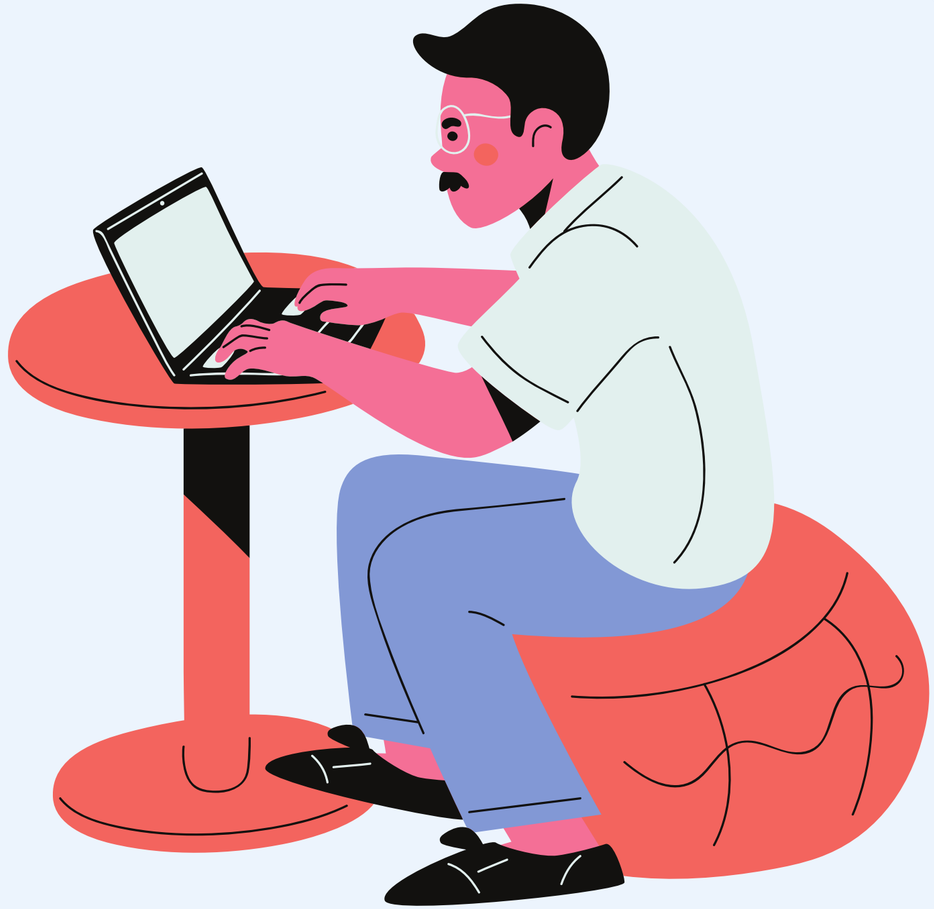
DEMO TIME



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QUERY

PROJECTION

Selecting fields

mongoose

QUERY OPERATIONS

PROJECTIONS: SELECTING SPECIFIC FIELDS

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High-Level Explanation

- MongoDB projections: Select specific document fields
- Include/exclude fields, boost query performance
- Minimize data transfer over network

Analogue

- Analogous to phone contact list
- Display only necessary info (name, photo)
- Like MongoDB projections, faster access

Best Practices

- Avoid mixing inclusion/exclusion, except for `_id`
- Use projections carefully for efficiency
- Be mindful of array field results

Deep Dive

- MongoDB projection in `.find()` and `.findOne()`
- Object specifies inclusion (`1` or `true`) or exclusion (`0` or `false`)
- Exception: `_id` field included by default, can be explicitly excluded.

When to use?

- Reasons to use MongoDB projections:
  - Minimize network data
  - Crucial for data-sensitive mobile apps
  - Tailor fields for specific use cases

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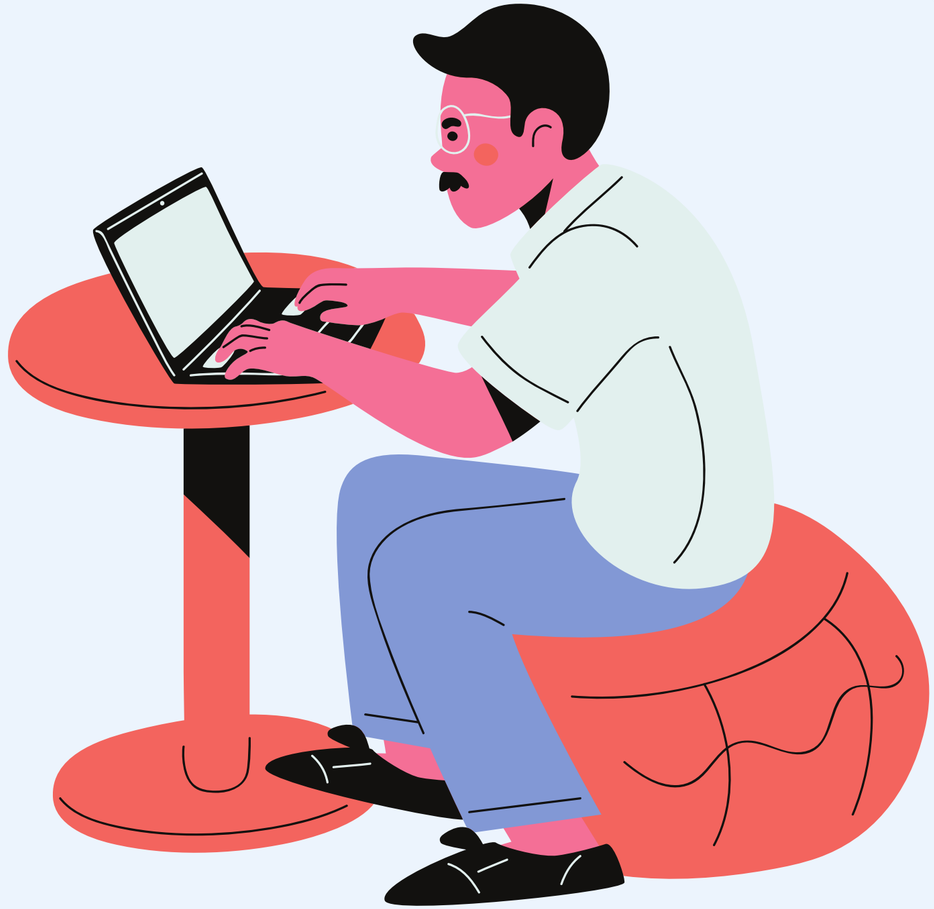
DEMO TIME



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UPDATE OPERATIONS

Using `.update()` and `.updateOne()`...

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QUERY OPERATIONS

UPDATE OPERATIONS

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High-Level Explanation

- `**updateOne**`: Update a single document.
- `**updateMany**`: Update multiple documents.
- `**findByIdAndUpdate**`: Find by ID and update a document.
- `**findOneAndUpdate**`: Find one document and update it.

Analogue

- Analogy: Twitter feed as MongoDB collection, tweets as documents
- `**findOneAndUpdate**`: Modify single tweet with conditions
- `**updateMany**`: Change tweets with specific hashtag
- `**findByIdAndUpdate**`: Update tweet with known ID

Best Practices

- Validate updates to avoid unintended changes.
- Use `{ new: true }` option for updated document return.
- Note: Not all update methods trigger Mongoose middleware.

Deep Dive

- Use appropriate Mongoose update method for operation scale.
- Define update conditions and changes.
- Framework interacts with MongoDB for updates.
- Account for update options, default values, and middleware.

When to use?

- `**updateOne**`: Single doc, specific criteria.
- `**updateMany**`: Bulk updates, multiple matching criteria.
- `**findByIdAndUpdate**`: Unique ID known.
- `**findOneAndUpdate**`: Update first matching filter.

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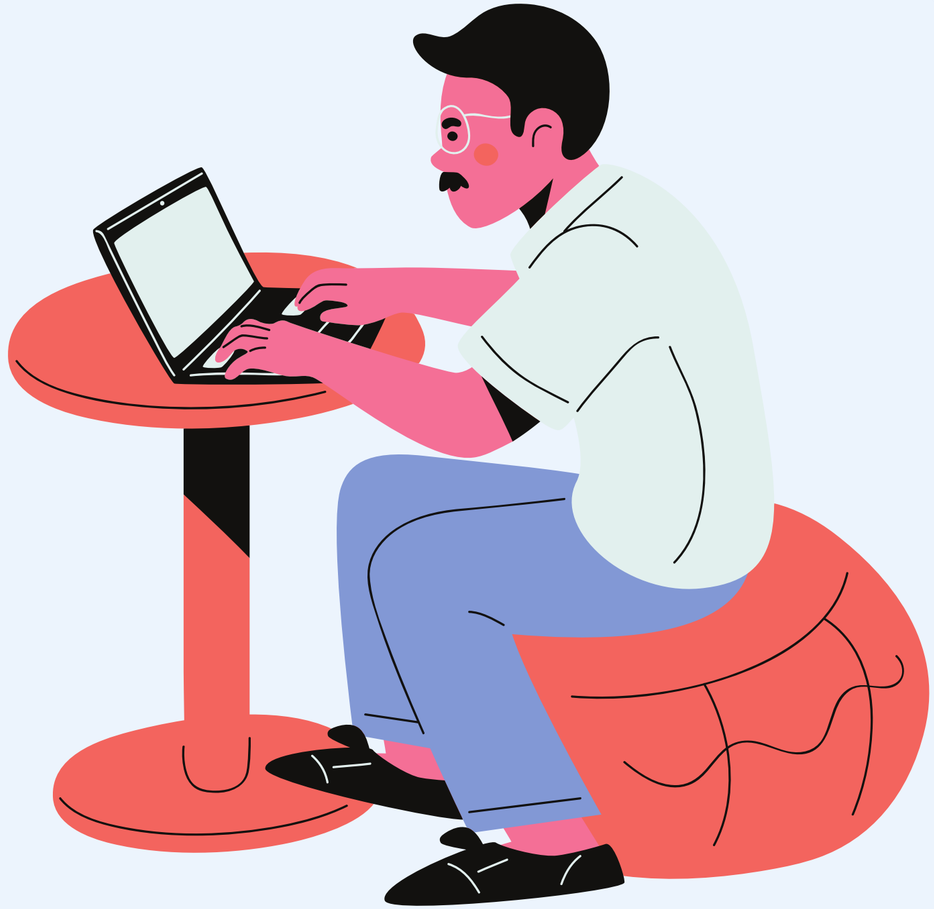
DEMO TIME



MASYNCTECH
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UPDATE

OPERATORS

mongoose

QUERY OPERATIONS

UPDATE OPERATORS

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SCHOOL

High-Level Explanation

- Mongoose update operators modify field values in documents.
- Useful for changing values without replacing the entire doc.

Deep Dive

Field Update Operators:

- `$set`: Set field value in document.
- `$unset`: Remove field from document.

Array Update Operators:

- `$addToSet`: Add item if not exists in array.
- `$push`: Add item to array.
- `$pop`: Remove item from array.
- `$pull`: Remove all instances of value from array.
- `$pullAll`: Remove all matching values from array.

Arithmetic Operators:

- `$inc`: Increment field's value.
- `$mul`: Multiply field's value.
- `$min`: Update field to minimum of current and given values.
- `$max`: Update field to maximum of current and given values.

Date Operators:

- `$currentDate`: Set field to current date.

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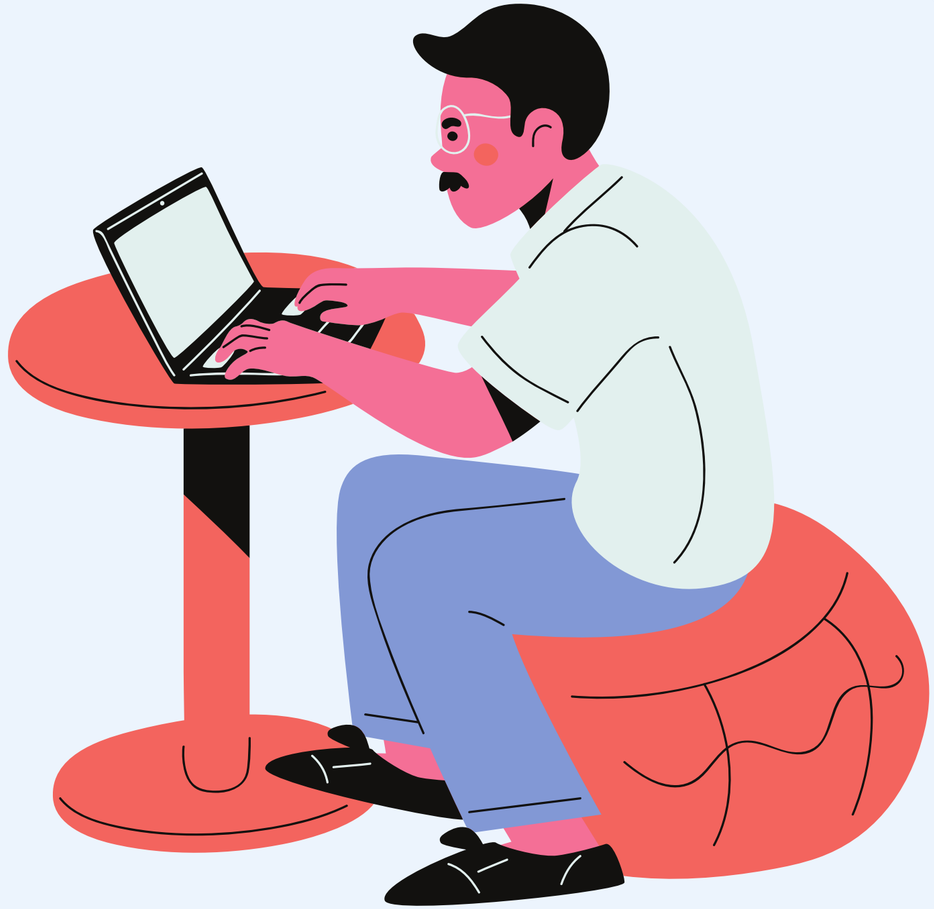
DEMO TIME



MASYNCTECH
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DELETE

OPERATIONS

Using `.remove()`, `.deleteOne()`, and `.deleteMany()`

mongoose

QUERY OPERATIONS

DELETE OPERATIONS

MASYNCTECH SCHOOL

High-Level Explanation

- `**deleteOne**`: Delete a single document based on criteria.
- `**deleteMany**`: Remove multiple documents matching criteria.
- `**findByIdAndDelete**`: Find by ID and delete a document.
- `**findOneAndDelete**`: Find one document and delete it.

Analogue

- Analogy: Collection as deck of cards
- `**deleteOne**`: Remove first 'Heart'
- `**deleteMany**`: Remove all 'Hearts'
- `**findByIdAndDelete**`: Remove card by ID
- `**findOneAndDelete**`: Remove and show first 'Heart'

Best Practices

- Test deletions on dev database first.
- Use callbacks/promises for error handling or post-deletion actions.
- Be cautious with `deleteMany` in production.

Deep Dive

- `**deleteOne**`: Removes first matching document by filter.
- `**deleteMany**`: Deletes all matching documents by filter.
- `**findByIdAndDelete**`: Deletes document by unique `_id`.
- `**findOneAndDelete**`: Deletes and returns first matching doc by query.

When to use?

- `**deleteOne**`: Remove first matching doc.
- `**deleteMany**`: Batch deletion with common attribute.
- `**findByIdAndDelete**`: Delete by known `_id`.
- `**findOneAndDelete**`: Show data of deleted doc.

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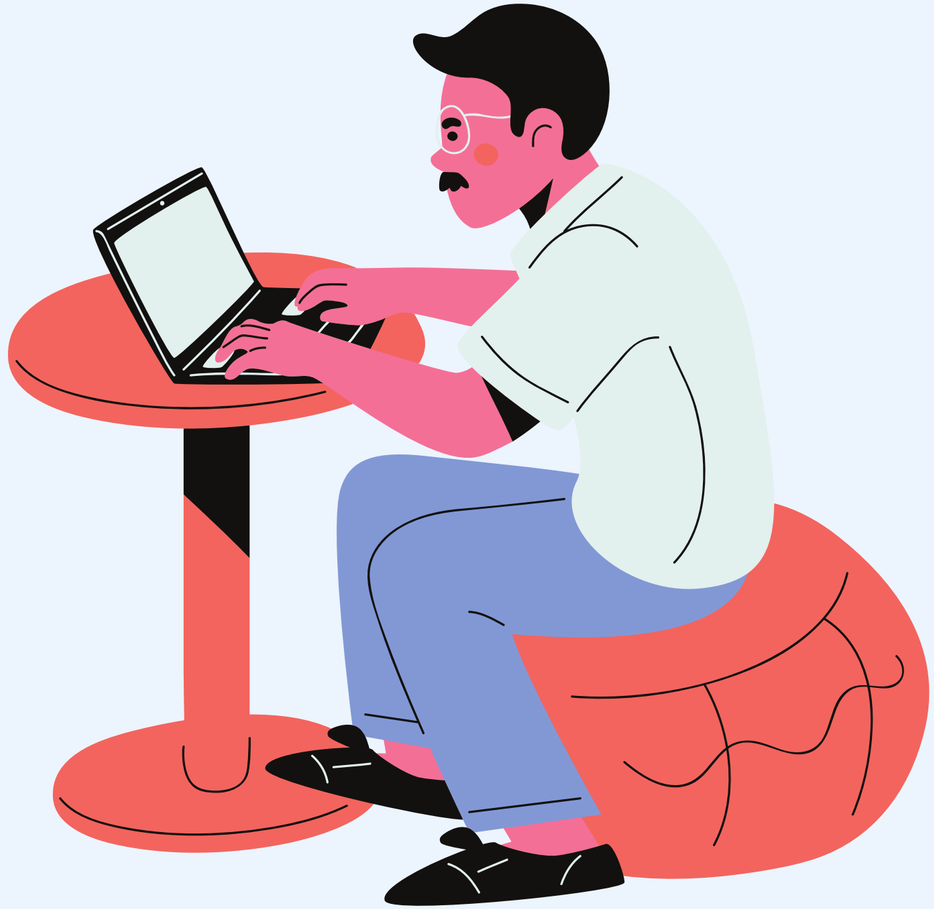
DEMO TIME



MASYNCTECH
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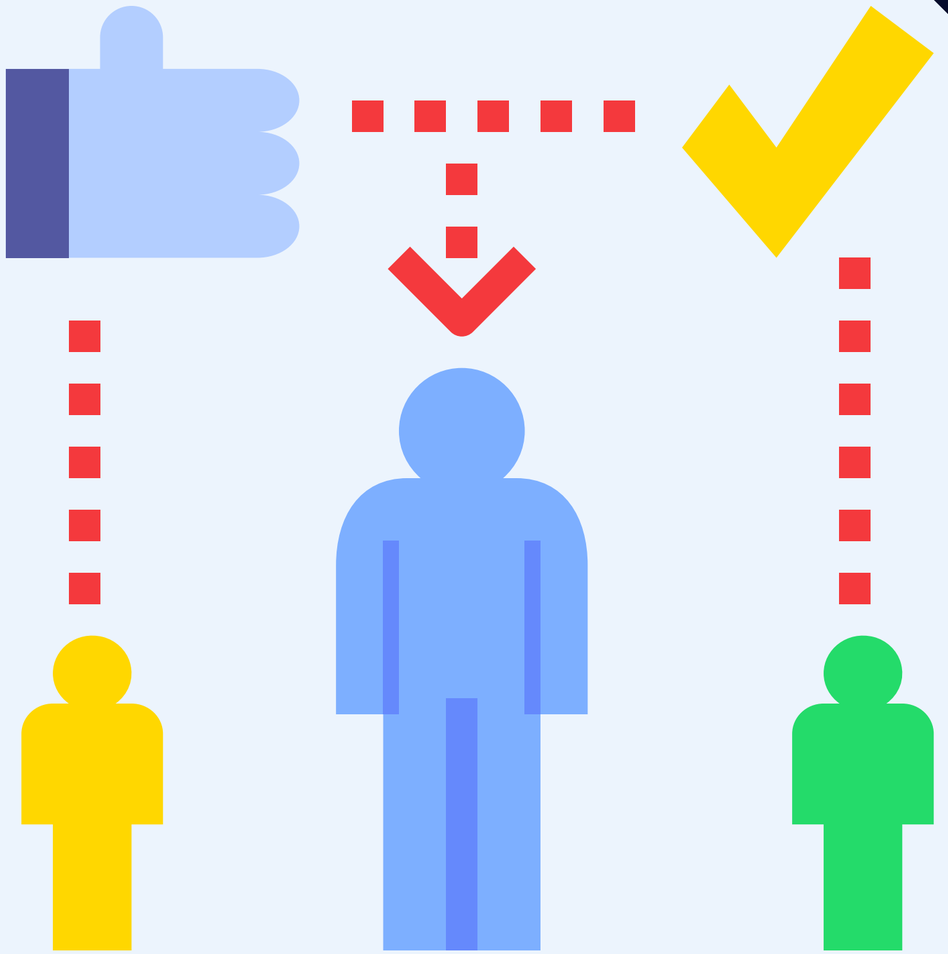
VALIDATIONS



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MONGOOSE VALIDATION

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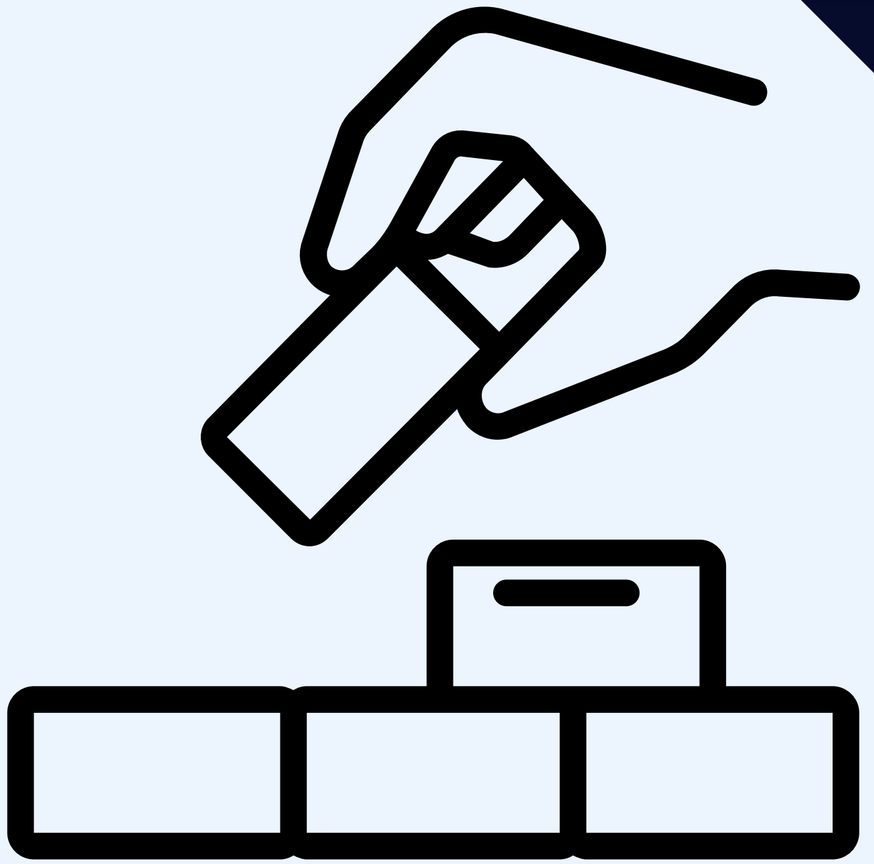
SCHOOL

BUILT-IN VALIDATORS



mongoose

MONGOOSE VALIDATION

BUILT-IN MONGOOSE VALIDATORS

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High-Level Explanation

- Mongoose validators: Enforce data validation on MongoDB docs.
- Predefined checks like `required`, `min`, `max`, `enum`, `unique`, etc.
- Streamline data validation process.

Analogue

- Analogy: Mongoose validators like spell checker.
- Built-in features prevent mistakes.
- E.g., field for email only, Mongoose enforces it.

Best Practices

- Pair with server-side checks for robust validation.
- Don't rely solely on `unique` for critical uniqueness.
- Provide meaningful error messages for client-side feedback.

Deep Dive

Required: Field must exist with a value.
Type: Enforce datatype (String, Number, Date, etc.).
Minlength/Maxlength: Set string length limits.
Validate: Custom async validation.
Min/Max: Enforce numerical range.
Enum: Value must match options in an array.
Unique: Ensure uniqueness within a collection (schema option).
Match: Validate against a regex pattern.

When to use?

- Use Mongoose built-in validators for:
  - Quick, efficient validation.
  - Standard requirements without custom logic.

Summary

- Mongoose built-in validators: Quick, reliable, standard rules.
- Cover field requirements, types, value constraints.
- Maintain data integrity without extensive custom code.

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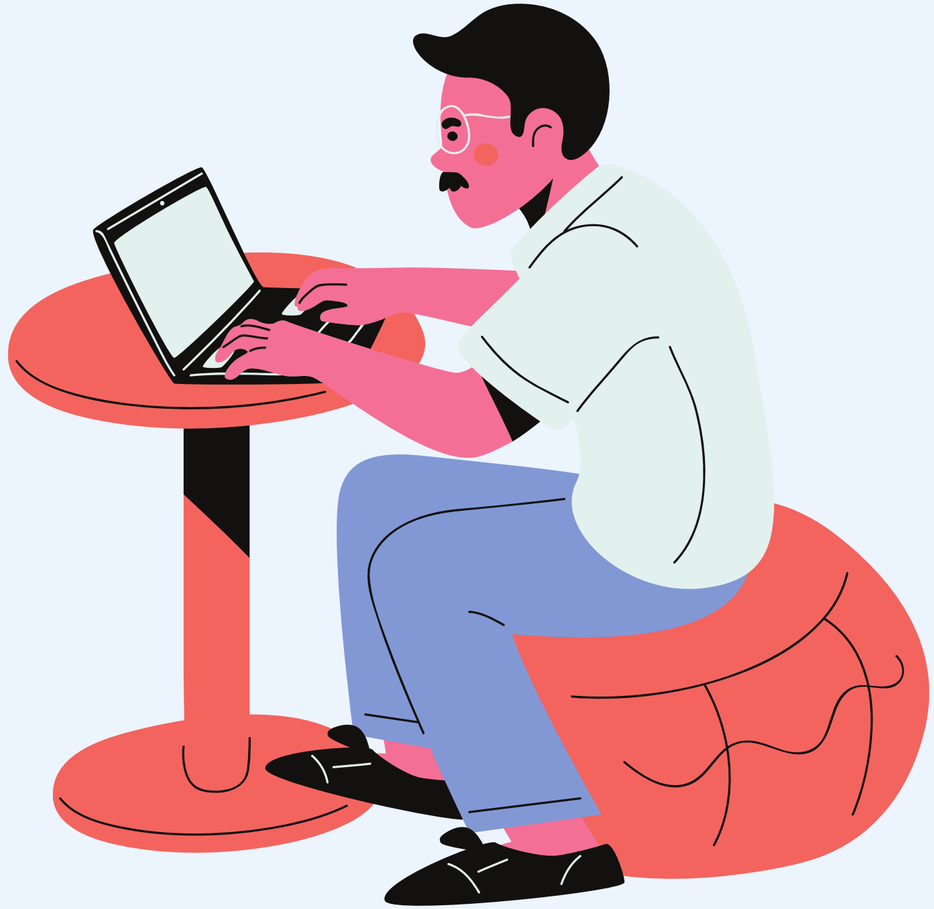
DEMO TIME



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CUSTOM VALIDATION LOGIC

mongoose

MONGOOSE VALIDATION

CUSTOM VALIDATION LOGIC

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High-Level Explanation

- Custom validation logic in Mongoose: Define own rules.
- Use `validate` property in schema definition.
- Implement custom function returning `true` or `false` for validation.

Analogue

- Analogy: Hosting a party, acting as a custom validator
- Players pick specific balls based on custom rules
- Ensuring everyone follows the unique criteria

Best Practices

- Handle both synchronous and asynchronous errors.
- Provide clear and meaningful error messages.
- Rigorously test your custom validation logic.
- Keep validation functions as lightweight as possible.

Deep Dive

- Mongoose's `validate` attribute: Custom validation function
- Returns `true` for valid, `false` for invalid
- Supports `Promise` for async validation
- Use for custom criteria beyond built-in validators

When to use?

- Built-in validators are inadequate.
- Complex logic spans multiple fields.
- Asynchronous operations, like API calls, are required for validation.

Summary

- Mongoose custom validation: Flexible, beyond built-in validators
- Enforce unique, complex rules, or involve external APIs
- Custom validation for all your specific needs

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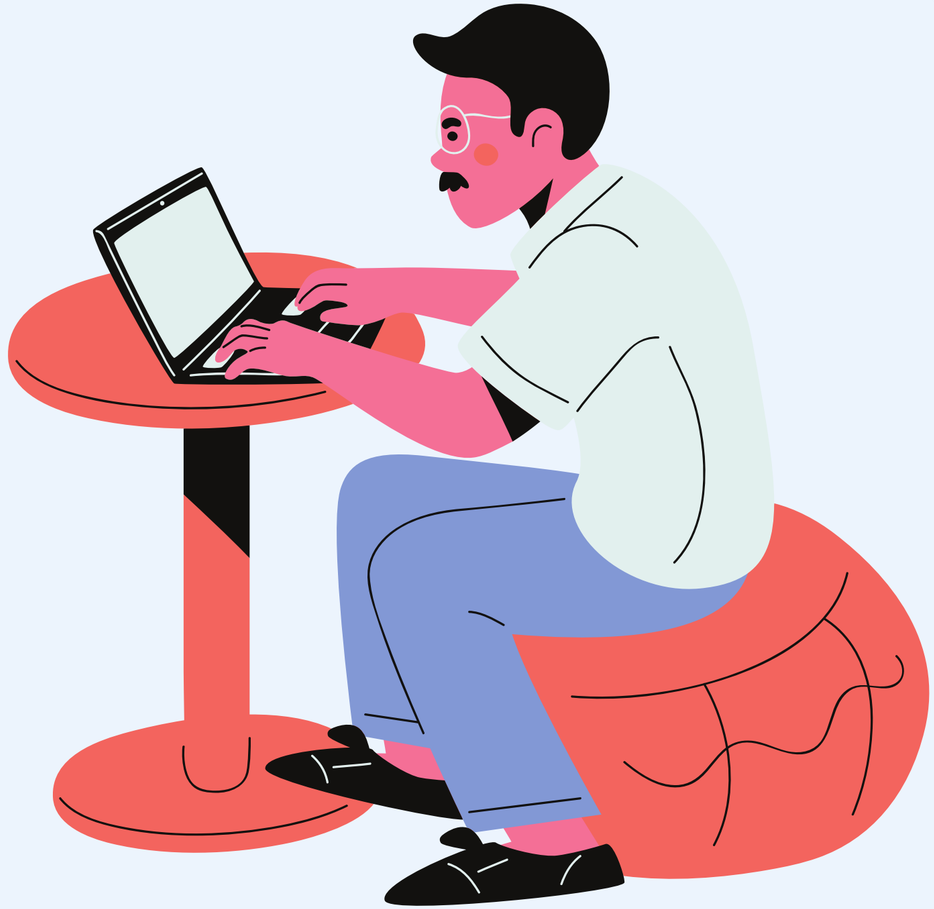
DEMO TIME



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ASYNC CUSTOM VALIDATORS

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MONGOOSE VALIDATION

ASYNCHRONOUS CUSTOM VALIDATORS

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High-Level Explanation

- Asynchronous custom validators in Mongoose: Perform async operations
- Use `validate` with Promise for asynchronous logic
- Ideal for database queries, API calls, async validation

Analogue

- Analogy: Asynchronous validation as party entry
- Bouncer checks list online (async)
- Confirmation depends on list loading

Best Practices

- Handle Promise rejections to prevent unhandled errors.
- Keep operations lightweight to maintain application speed.
- Implement timeouts to prevent indefinite hangs in async operations.

Deep Dive

- Asynchronous custom validator returns a Promise.
- Resolve with `true` for success, `false` for failure.
- Use `async/await` for async operations.
- Validation failure results in rejection and error thrown.

When to use?

- External database checks for unique values are required.
- Validation relies on external API responses.
- I/O operations are necessary for your validation logic.

Summary

- Asynchronous custom validators: Useful for external/time-consuming logic
- Implemented with Promise in `validator` or `async/await`

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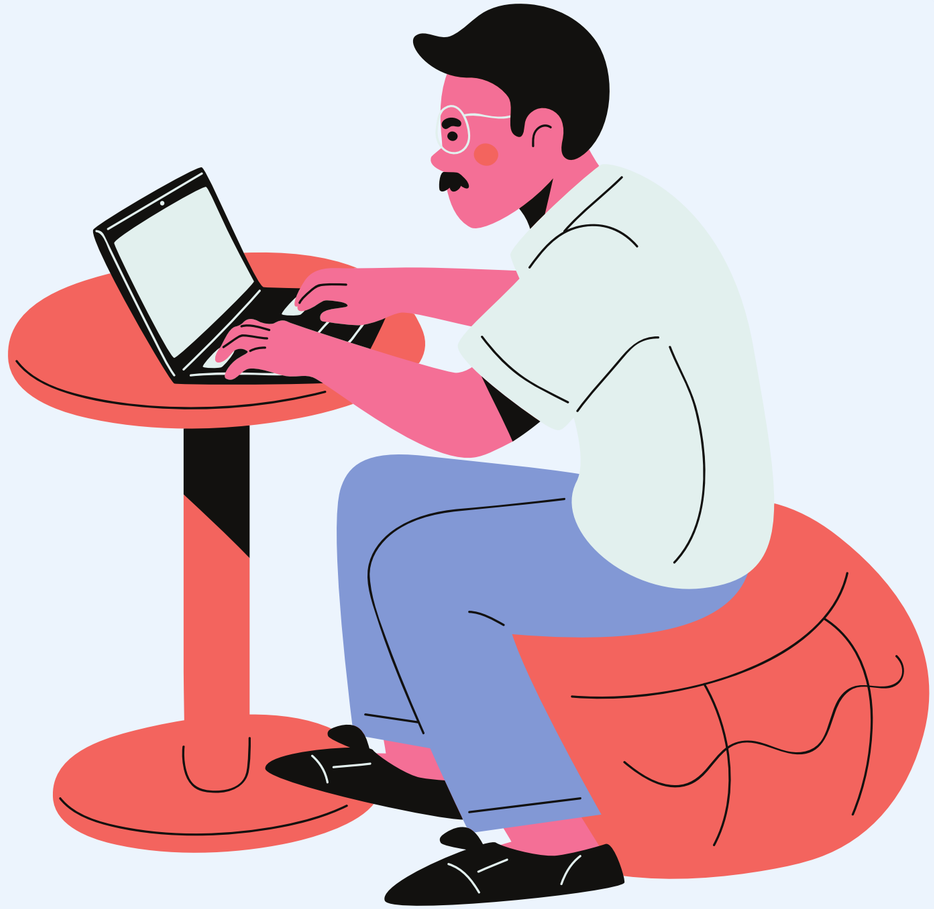
DEMO TIME



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DATA SANITIZATION TECHNIQUES

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MONGOOSE VALIDATION

DATA SANITIZATION TECHNIQUES

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High-Level Explanation

- Data sanitization: Clean, validate data before processing/saving
- Enforces quality standards, prevents malicious code

Deep Dive

- Data sanitization layers: Client to server-side
- Techniques: Remove special chars, type conversion, allow-lists
- Prevents attacks like SQL injection, XSS, injection
- Mongoose, ExpressJS: Middleware, custom validators, libraries

Analogue

- Analogy: Database as a refrigerator
- Data sanitization as checking and cleaning items
- Ensure only safe, quality data is stored

When to use?

- When handling external or user-generated data.
- For sensitive data with strict formatting (e.g., emails, URLs).
- To protect against malicious activities in database transactions.

Best Practices

- Never trust user input; sanitize before processing.
- Utilize trusted libraries for common sanitization.
- Validate data types, length, format, and range.
- Use parameterized SQL queries to thwart SQL injection.
- Apply the "Principle of Least Privilege" to limit accepted data.

Summary

- Data sanitization: Clean, validate data for quality, security.
- Essential for application security, data integrity.

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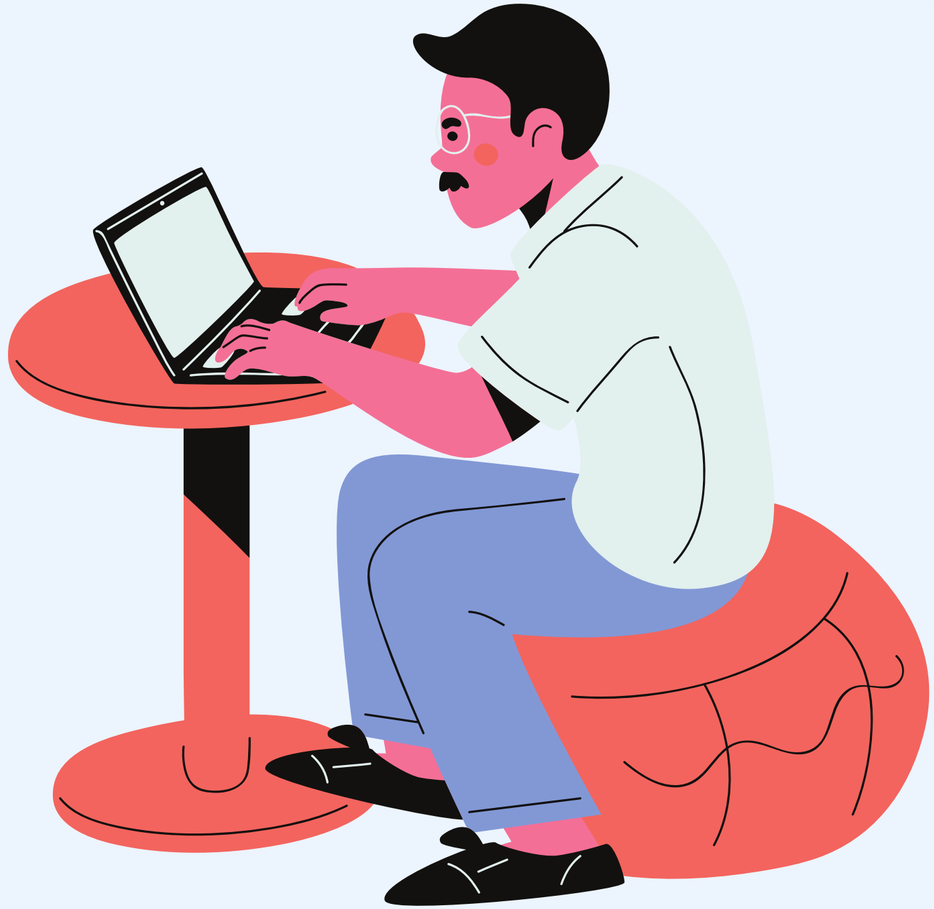
DEMO TIME



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VALIDATOR LIBRAY

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MONGOOSE VALIDATION

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THE `SET` & `GET` SCHEMATYPE OPTIONS

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MONGOOSE VALIDATION

THE `SET` AND `GET` SCHEMATYPE OPTIONS

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High-Level Explanation

- `set` option: Transforms data before saving to the database.
- `get` option: Transforms data after retrieval but before use.

Deep Dive

- Setters (`set`): Functions called when setting property values.
- Standardize data formatting (e.g., lowercase, trim).
- Getters (`get`): Functions after retrieving data but before use.
- Modify values (e.g., append domain to username).

Analogue

- Analogy: Digital locker with `set` and `get`
- `set`: Locker organizes items when you put them in.
- `get`: Locker gift-wraps items when you take them out.

When to use?

- Setters: Sanitize, format data before saving to DB.
- Getters: Format, combine fields for app use without altering DB.

Best Practices

- Setters: Avoid complex validation; focus on transformation.
- Note: Setters run each time property is set, not just on save.

- Getters: Avoid sensitive logic exposed to clients.
- Use sparingly to prevent unexpected behavior, debugging issues.

Summary

- `set` and `get` in Mongoose schemas: Data transformation tools
- Setters prepare, sanitize before storage
- Getters polish, adjust data during retrieval

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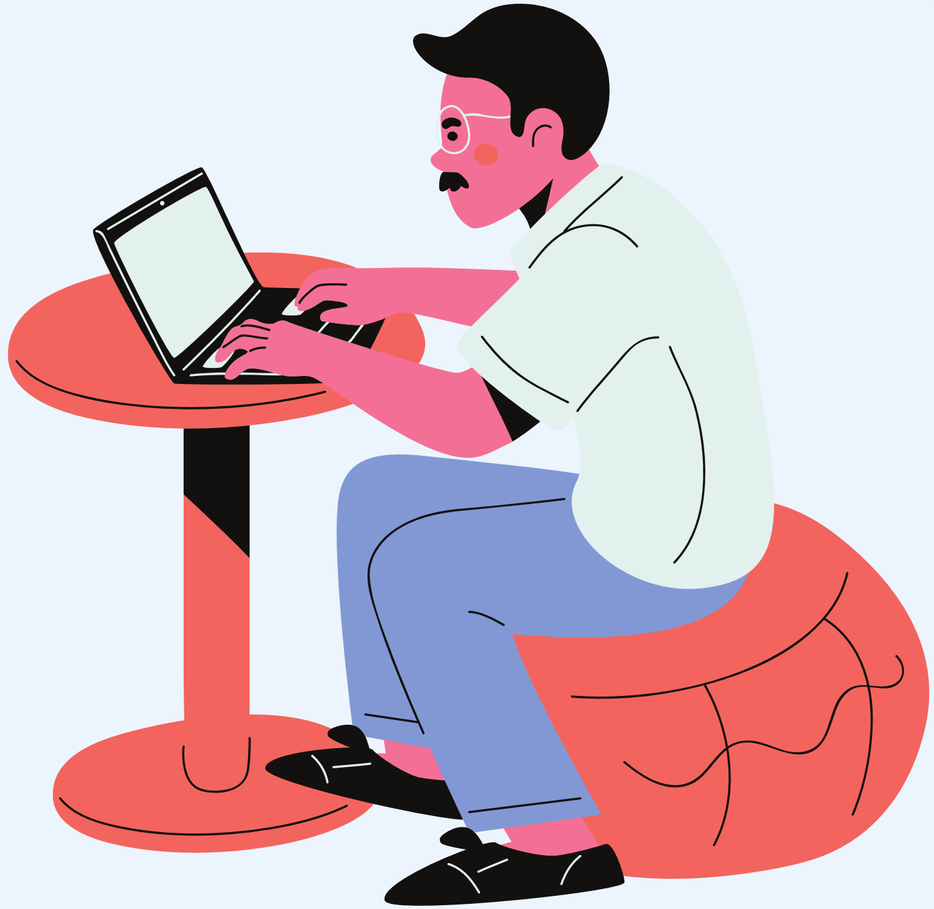
DEMO TIME



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DATA MODELLING

Overview

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DATA MODELLING OVERVIEW

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High-Level Explanation

- Data modeling: Defines data shape, relationships, integrity.
- Mongoose schemas: Specify MongoDB document structure.

Deep Dive

- Data modeling: High-level design, relationships, integrity, DB-agnostic.
- Mongoose schemas: Specific for MongoDB, define types, validation, structure.

Analogue

- Analogy: Data modeling as house furniture arrangement.
- Schema as furniture instruction manual.
- Defines parts and assembly for specific furniture.

When to use?

- Data modeling: Initial app design, high-level data plan.
- Schemas: Implement high-level design in MongoDB with Mongoose.

Best Practices

- Data modeling: Grasp business requirements thoroughly.
- Schemas: Define types, set up validation for data integrity.

Summary

- Data modeling: Design data structure and relations.
- Schemas in Mongoose: Implement design for MongoDB documents.

MASYNCTECH
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EMBEDDED DOCUMENTS

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DATA MODELLING

UNDERSTANDING EMBEDDED DOCUMENTS

MASYNCTECH SCHOOL

High-Level Explanation

- Embedded documents: Sub-docs within a parent doc.
- Suitable for nested structures, e.g., address in user profile.

Analogue

- Analogy: Embedded docs as backpack pockets.
- Backpack = Main item (parent doc).
- Pockets = Embedded docs holding specific items.
- Pockets are part of backpack, not separate.

Best Practices

- Monitor document size limit.
- Avoid embedded docs for frequently independent queries.
- Acknowledge complexity in updates to embedded docs within parent.

Deep Dive

- Define embedded documents in Mongoose with separate schema.
- Include them in parent schema as array or nested object.
- Embedded docs have fields, validation, methods.
- No separate database collection; only in parent doc.
- Efficient reads but potential document size limits.

When to use?

- Use embedded docs when:
  - Clear hierarchical data.
  - Frequent retrieval of parent and embedded data.
  - Embedded data within MongoDB's size limit (16MB).

Summary

- Embedded docs in Mongoose: Sub-docs in parent doc.
- Ideal for nested, hierarchical data.
- Limitations include MongoDB's doc size limit.

UNDERSTANDING EMBEDDED DOCUMENTS

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parent document schema

```
const UserSchema = new Schema({
  name: String,
  email: String,
  address: AddressSchema // Embedding AddressSchema
});
```

Embedded document schema

```
const AddressSchema = new Schema({
  street: String,
  city: String,
  state: String,
  zip: Number
});
```

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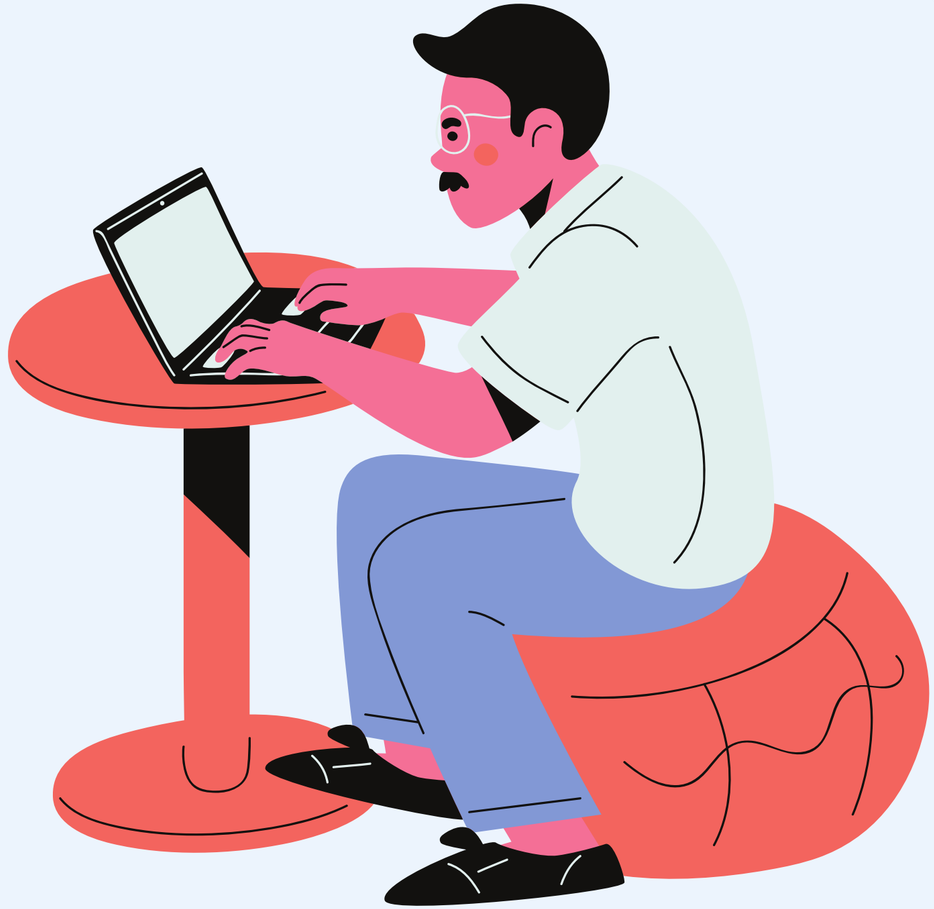
DEMO TIME



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ARRAYS OF
SUB-DOCUMENTS

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DATA MODELLING

WORKING WITH ARRAYS OF SUBDOCUMENTS

MASYNCTECH SCHOOL

High-Level Explanation

- Arrays of subdocuments in Mongoose manage embedded docs.
- Useful for one-to-many relationships within one parent doc.
- Manipulate arrays for efficient data management (add, update, delete subdocs).

Analogue

- Analogy: Embedded docs as backpack pockets.
- Backpack = Main item (parent doc).
- Pockets = Embedded docs holding specific items.
- Pockets are part of backpack, not separate.

Best Practices

- Watch for MongoDB's 16MB doc size limit.
- Large subdoc arrays: Consider pagination or separate collections.
- Use Mongoose validation for subdocs to ensure data integrity.

Deep Dive

- Create arrays of subdocs with `[]` notation in schema.
- Add subdocs using `push` or by assigning a new array.
- Update by finding parent and using array methods or Mongoose subdoc API.
- Delete by retrieving parent and using `splice` or Mongoose methods.
- Query subdoc fields, but performance may differ from standalone docs.

When to use?

- Use arrays of subdocs for:
  - Strongly related nested data.
  - Collections within doc size limits.
  - Operations often need entire sub-array, reducing complex queries.

Summary

- Arrays of subdocs in Mongoose: Manage one-to-many within one doc.
- Great for smaller, closely related data sets.
- Challenges: Complex querying, 16MB doc size limit.
- Awareness of constraints informs design decisions.

WORKING WITH ARRAYS OF SUBDOCUMENTS

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Sub document schema

```
const SubdocumentSchema = new mongoose.Schema({
  field1: String,
  field2: Number
});
```

Parent schema

```
const ParentSchema = new mongoose.Schema({
  subdocuments: [SubdocumentSchema]
});
```

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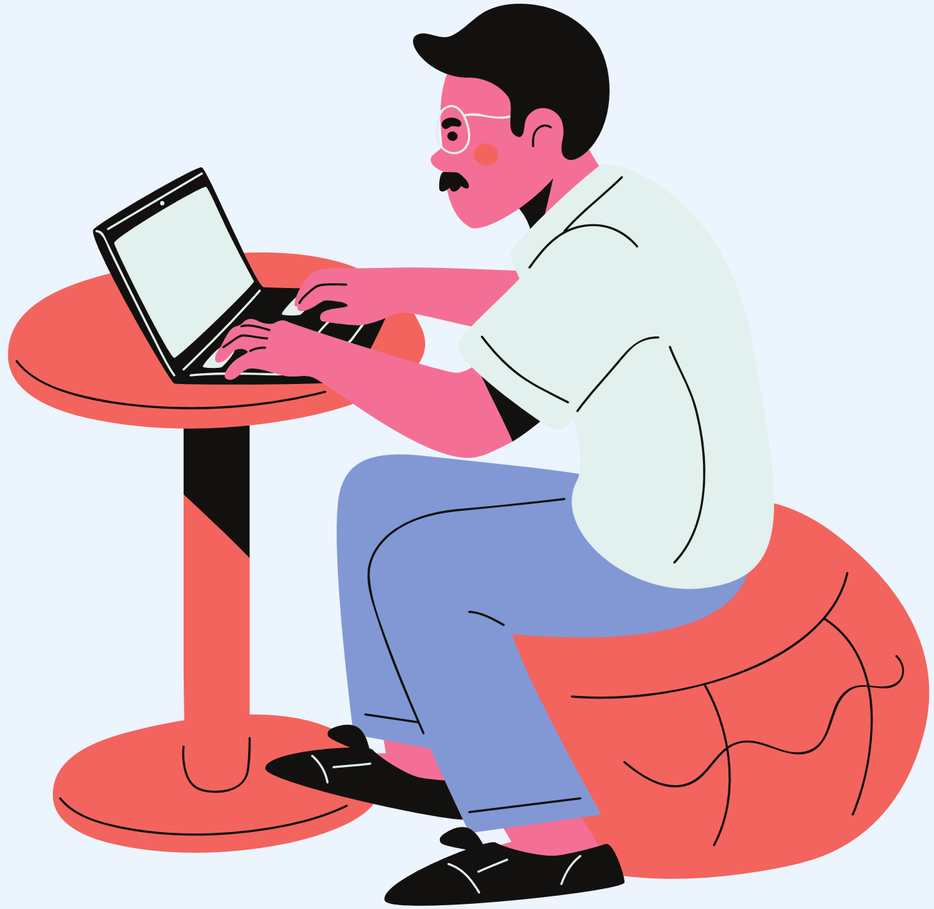
DEMO TIME



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LIMITATIONS OF EMBEDDED DOCUMENTS

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DATA MODELLING

LIMITATIONS OF EMBEDDED DOCUMENTS

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High-Level Explanation

- Embedded docs in Mongoose: Store nested data in MongoDB doc.
- Manage relationships without joins.
- Limitations: Doc size constraints, query complexity, limited ops support.
- Consider pros and cons for design decisions.

Deep Dive

- MongoDB's 16MB BSON document size limit applies to embedded docs.
- Query complexity increases with nested fields.
- Some operations (e.g., "distinct") less straightforward.
- Redundancy and data integrity challenges.
- ACID transactions less performant on deeply nested embedded docs.

Analogue

- Analogy: Computer's game folders.
- Main folder = "My Games."
- Sub-folders = Embedded docs.
- 16MB limit = Computer's "no more space."
- Complexity = Treasure hunt for specific info in embedded docs.

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DATA

REFERENCING

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DATA MODELLING

UNDERSTANDING DATA REFERENCING

MASYNCTECH SCHOOL

High-Level Explanation

- Data referencing in Mongoose: Linking docs from different collections.
- Used for many-to-many, one-to-many relationships.
- Avoids size limits, supports complex queries.

Analogue

- Analogy: Toy box (collection) and friends (another collection).
- Referencing: Friend's name on toy list, not on toy (no embedding).
- Query: List helps find who has which toy.

Best Practices

- `.populate()`: Easy data retrieval but can be slow for large datasets.
- For frequent multi-collection references, optimize data architecture (indexing).
- Beware "callback hell" with nested queries for multiple references.

Deep Dive

- Data referencing in Mongoose: Two types - manual and population.
- **Manual referencing**: Store related `_id`, manual queries.
- **Population**: `.populate()` auto-replaces `_id`, simpler retrieval.
- **Normalization**: Data separate in collection, not duplicated.
- Contrast: Denormalized data has subdocs embedded in parent.

When to use?

- Use data referencing when:
  - Referenced data is large (exceeds 16MB limit).
  - Data is shared among multiple docs.
  - Complex queries on referenced data needed.

Summary

- Data referencing in Mongoose: Relate separate docs.
- Manual referencing = query control.
- `.populate()`: Simplifies data retrieval.
- Strategic use enhances database efficiency.

UNDERSTANDING DATA REFERENCING

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Authors document schema

```
const AuthorSchema = new mongoose.Schema({
  name: String,
  birthYear: Number
});
```

Books document schema

```
const BookSchema = new mongoose.Schema({
  title: String,
  author: {
    type: mongoose.Schema.Types.ObjectId,
    ref: 'Author'
  }
});
```

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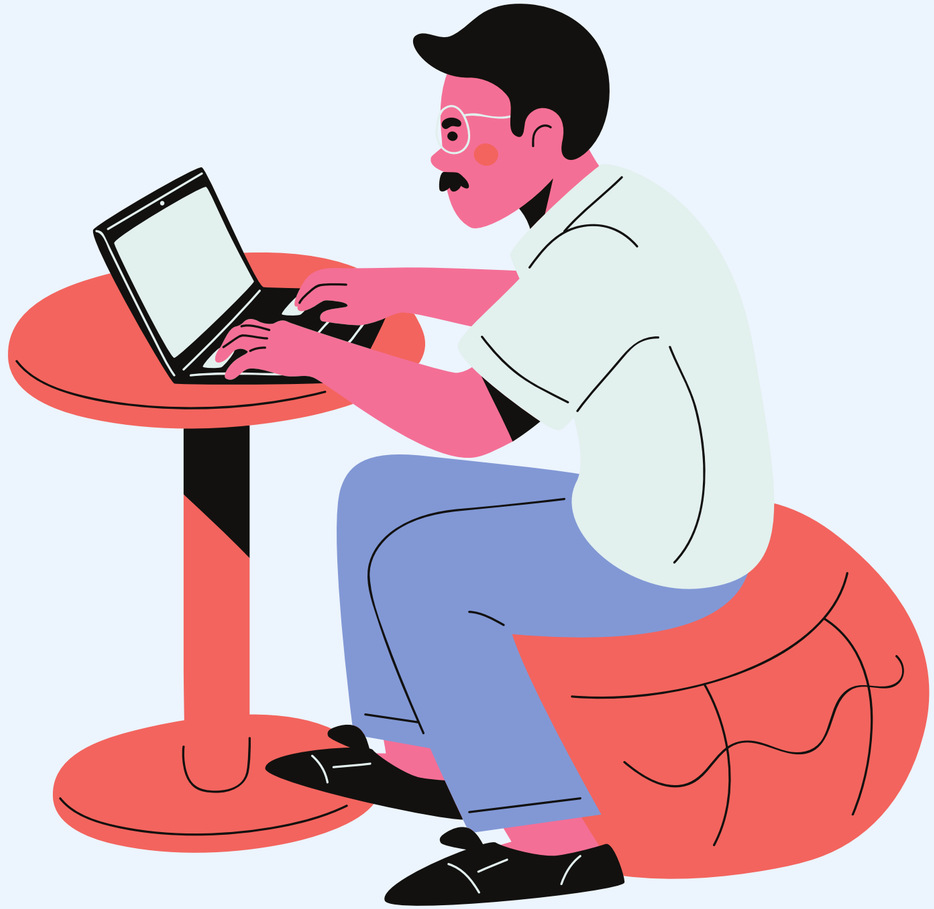
DEMO TIME



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THE `REF` & POPULATE PROPERTIES

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DATA MODELLING

THE `REF` PROPERTY AND POPULATION

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High-Level Explanation

- `ref` specifies the referenced model in a schema.
- `populate` replaces Object IDs with data from referenced model.
- Similar to SQL JOIN, simplifying data retrieval.

Deep Dive

- `ref` property: Used to specify the referenced model in a schema.
- `populate` method: Replaces Object IDs with data from the referenced model.
- Query-level population: Allows for dynamic data retrieval as needed.

Analogue

- The `ref` property specifies the referenced model for a field.
- `populate()` fetches data from the referenced model, akin to opening a treasure chest to reveal its contents in a game.

When to use?

- Use `ref` in schema to specify referenced model.
- `populate` dynamically replaces Object IDs with data.
- Useful for normalized data, complex updates, and on-demand loading.

Best Practices

- Use population sparingly for large datasets.
- Selective field population can limit populated fields.

Summary

- `ref` property specifies the referenced model for an Object ID field.
- `populate` uses this reference to replace IDs with actual docs.
- Essential for managing complex data relationships in Mongoose.

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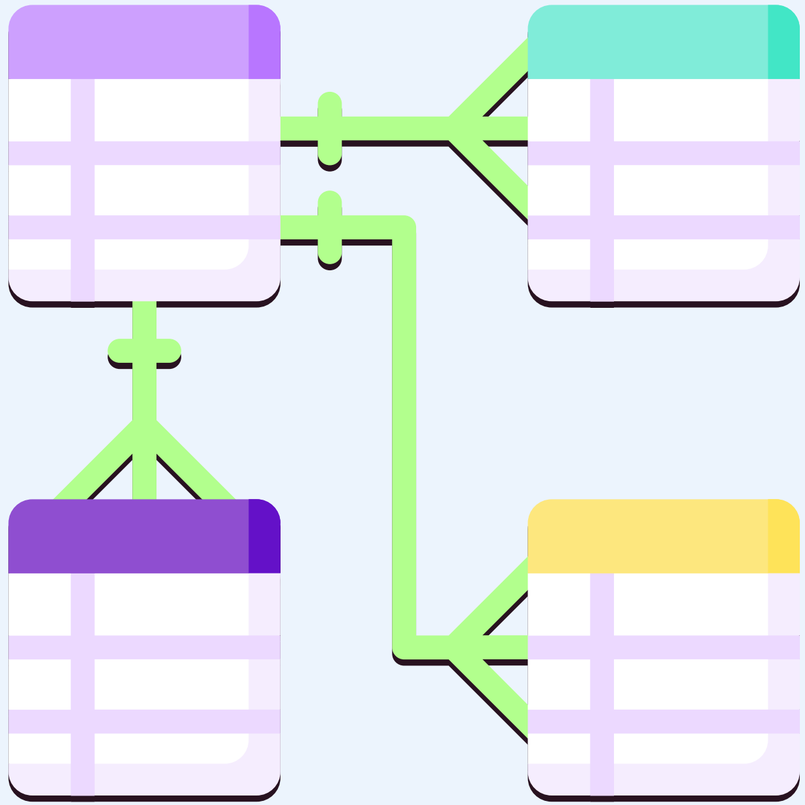
DATA RELATIONSHIP



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MONGOOSE DATA RELATIONSHIP

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ONE-ONE RELATIONSHIPS

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MONGOOSE DATA RELATIONSHIP

ONE-TO-ONE RELATIONSHIPS

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High-Level Explanation

- One-to-one relationship: Single doc in one collection matches one in another.
- Implement via Embedded Docs or References in Mongoose.

Analogue

- Embedded: "About Me" content directly on profile page.
- Reference-based: "About Me" content on a separate page, linked from the profile.

Best Practices

- Embed data for read-heavy and stable data.
- Use references for write-heavy or dynamic data.
- Base decision on application's data access patterns.

Deep Dive

- Embedded: Store related doc as sub-doc within parent.
- Reference-based: Use ObjectId reference in another collection.
- Choice depends on app requirements: access patterns, change rate, data size.

When to use?

- Frequent access to associated data together.
- True one-to-one connection between documents.
- Data size won't exceed MongoDB's document size limit.

Summary

- One-to-one relationships in MongoDB via embedding or referencing.
- Decision hinges on app needs, like data access and change frequency.

MASYNCTECH SCHOOL

Embedded Approach

```
Users Collection
└── User Document
    ├── _id: ObjectId("...")
    ├── name: "John Doe"
    ├── email: "john.doe@example.com"
    └── address: Embedded Document
        ├── street: "123 Main St"
        ├── city: "Springfield"
        └── zipCode: "62704"
```

Reference-Based Approach

```
Users Collection                                  Addresses Collection
└── User Document                                  └── Address Document
    ├── _id: ObjectId("...")                           ├── _id: ObjectId("...")
    ├── name: "John Doe"                               ├── street: "123 Main St"
    ├── email: "john.doe@example.com"                  ├── city: "Springfield"
    └── address: ObjectId("...")  --------> └── zipCode: "62704"
```

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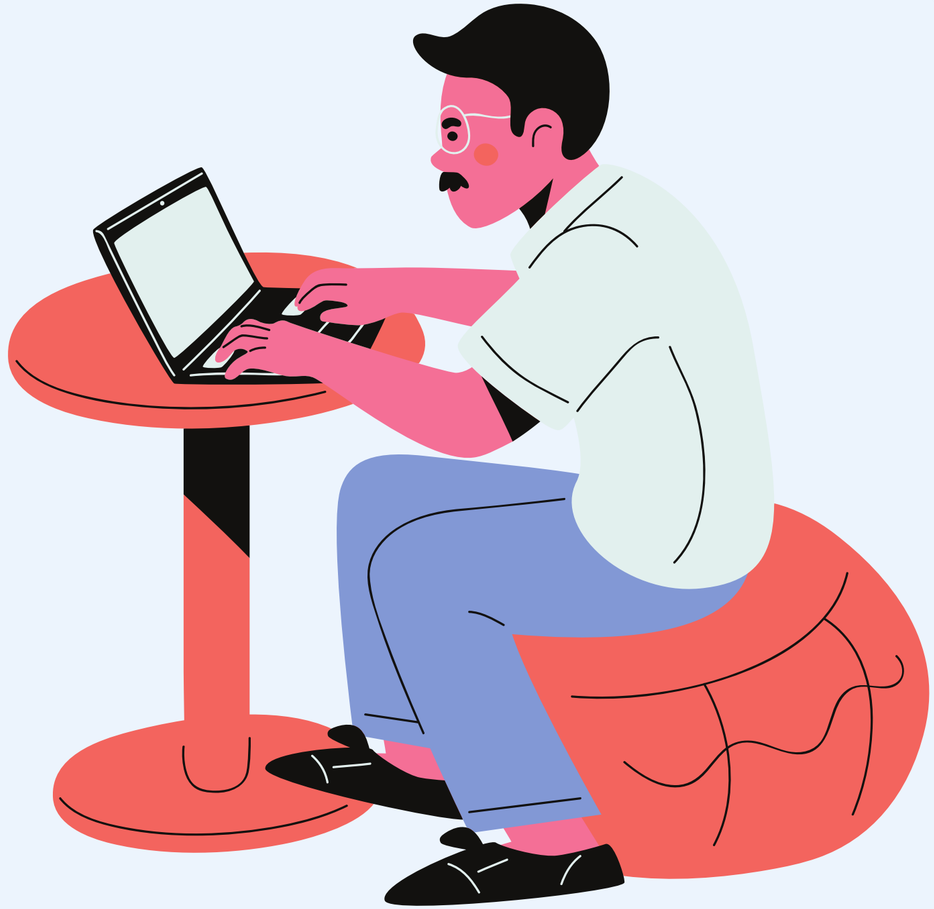
DEMO TIME



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ONE-MANY
MANY-ONE
RELATIONSHIPS

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MONGOOSE DATA RELATIONSHIP

ONE-TO-MANY AND MANY-TO-ONE RELATIONSHIPS

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High-Level Explanation

- One-to-many: One document in Collection A associated with multiple in Collection B.
- Many-to-one: Multiple in Collection A refer to one in Collection B.
- Perspective shift differentiates the two.

Analogue

- Classroom analogy: One-to-many – one teacher, many students.
- Student's perspective: Many students, one teacher – many-to-one.

Best Practices

- Use arrays for one-to-many but watch document size limit.
- Avoid deep nested arrays for simpler queries/updates.
- In many-to-one, maintain referential integrity by verifying existence of referred-to document.

Deep Dive

- **One-to-many:** Use arrays with ObjectIds in source collection.
  - E.g., Blog post with an array of comment references.
- **Many-to-one**: Multiple records refer to one in target collection.
  - E.g., Many comments belong to a single blog post, specified by a field.

When to use?

- **One-to-many:** Good for logical grouping, infrequent access.
  - Data consistency less critical (no MongoDB transactions).
- **Many-to-one**: Useful when frequent access to a single document.
  - Logical to link multiple records to one central record.

Summary

- One-to-many and many-to-one are two perspectives of the same relationship.
- One-to-many: Array of references in 'one' to 'many.'
- Many-to-one: 'Many' pointing back to the 'one.'

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One-to-Many Relationship

```
BlogPosts Collection                          Comments Collection
└── BlogPost Document                         └── Comment Document 1
    ├── _id: ObjectId("...")                      ├── _id: ObjectId("...")
    ├── title: "My First Blog"                    ├── text: "Great post!"
    └── comments: Array of ObjectIds  --->        └── blogPostId: ObjectId("...")
                                                  └── Comment Document 2
                                                      ├── _id: ObjectId("...")
                                                      ├── text: "Thanks for sharing!"
                                                      └── blogPostId: ObjectId("...")
```

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SCHOOL

Many-to-One Relationship

```
Comments Collection                          BlogPosts Collection
└── Comment Document 1                        └── BlogPost Document
    ├── _id: ObjectId("...")                      ├── _id: ObjectId("...")
    ├── text: "Great post!"                       ├── title: "My First Blog"
    └── blogPostId: ObjectId("...")  <---          └── comments: Array of ObjectIds
└── Comment Document 2
    ├── _id: ObjectId("...")
    ├── text: "Thanks for sharing!"
    └── blogPostId: ObjectId("...")
```

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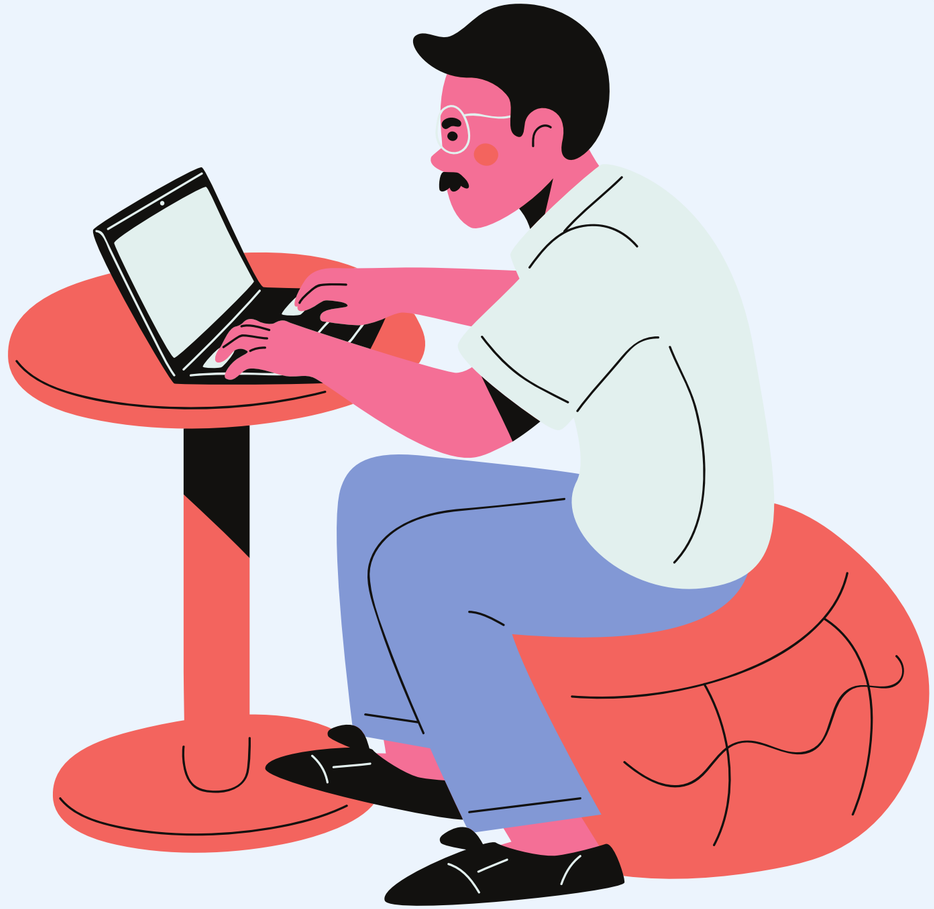
SCHOOL

DEMO TIME



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MANY TO MANY RELATIONSHIPS

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MONGOOSE DATA RELATIONSHIP

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Many-to-Many Relationship

```
Students Collection                          Courses Collection
└── Student Document 1                       └── Course Document 1
    ├── _id: ObjectId("...")                     ├── _id: ObjectId("...")
    ├── name: "Alice"                            ├── name: "Math 101"
    └── enrolledCourses: Array of ObjectIds ---> enrolledStudents: Array of Obje
         └── ObjectId("...")                          └── ObjectId("...")
                                                      └── ObjectId("...")

└── Student Document 2                       └── Course Document 2
    ├── _id: ObjectId("...")                     ├── _id: ObjectId("...")
    ├── name: "Bob"                              ├── name: "History 101"
    └── enrolledCourses: Array of ObjectIds ---> enrolledStudents: Array of Obje
         └── ObjectId("...")                          └── ObjectId("...")
         └── ObjectId("...")                          └── ObjectId("...")
```

MANY-TO-MANY RELATIONSHIPS

MASYNCTECH
SCHOOL

High-Level Explanation

- Many-to-many relationship: Multiple docs in one collection associate with multiple docs in another.
- Complex compared to one-to-many and many-to-one relations.

Analogue

- Social media platforms like Instagram: Classic many-to-many relationship.
- You follow multiple people, and multiple people follow you.
- Mutual, bidirectional relationship.

Best Practices

- Watch array size due to MongoDB's 16MB limit.
- Complex relationships? Consider a join collection.
- Maintain data consistency and integrity during updates/deletes.

Deep Dive

- Many-to-many relationship in Mongoose: Arrays of ObjectIds in both collections.
- Example: Students with course ObjectIds, Courses with student ObjectIds.
- Allows multiple students in multiple courses.

When to use?

- Use many-to-many relationships when:
  - Complex associations between document sets.
  - Non-hierarchical, non-singular relationships.
  - Frequent need for querying these relationships.

Summary

- Many-to-many relationships: Multiple docs related to multiple docs.
- Implement with arrays of references or separate join collection.

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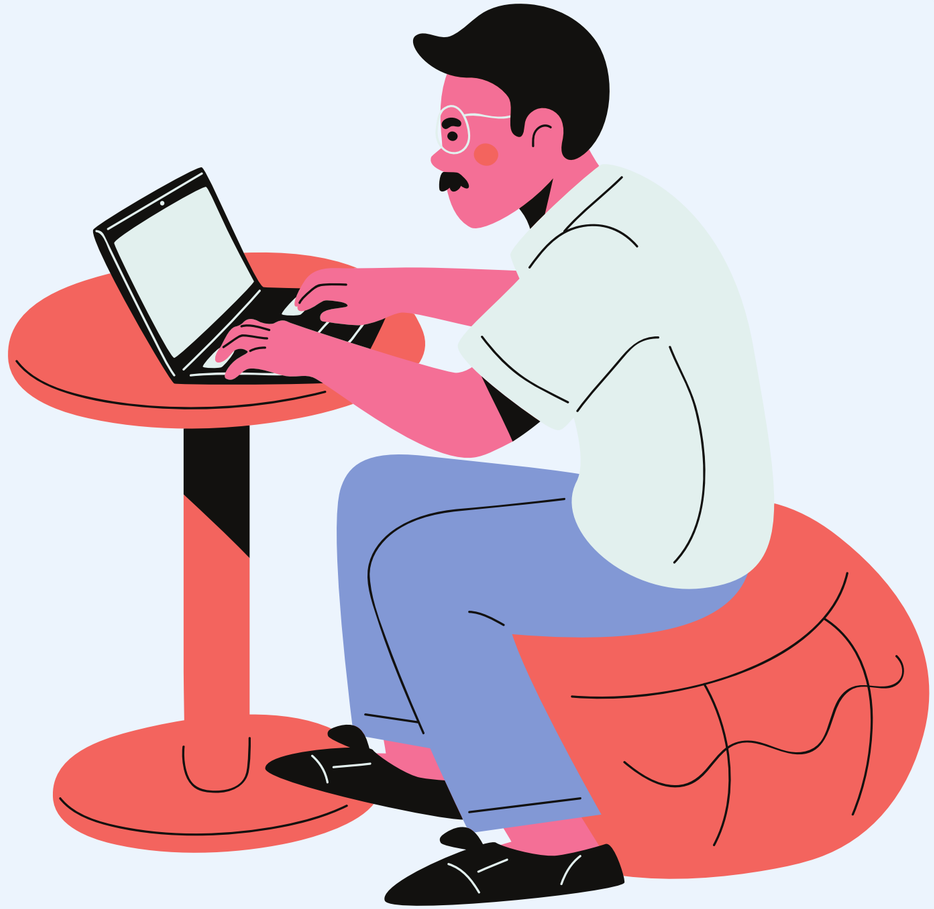

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DATA
AGGREGATION

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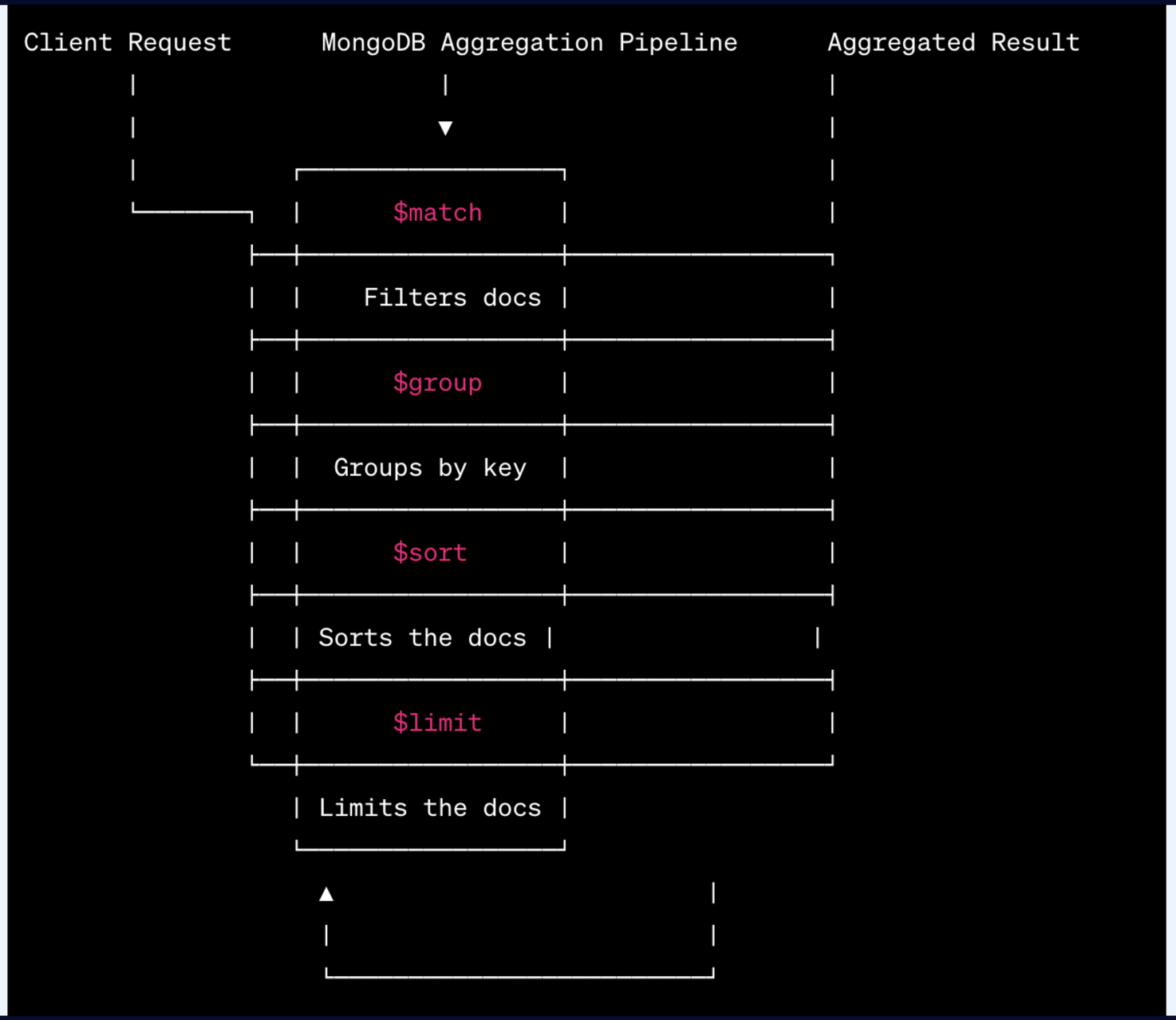
MONGOOSE DATA RELATIONSHIP

DATA AGGREGATION



DATA AGGREGATION

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High-Level Explanation

- Data aggregation in MongoDB: Transform data via operations.
- Compute derived data, stats, manipulations.
- Original dataset remains unchanged.

Analogue

- Analogy: Creating a playlist from music collection.
- Aggregation stages:
  1. `$match`: Pick rock songs.
  2. `$group`: Categorize by artist.
  3. `$sort`: Sort by song length.
  4. `$limit`: Select top 10 songs.

Best Practices

- Optimize with indexes for `$match` and `$sort`.
- Control document count per stage for memory.
- Monitor performance for resource-intensive aggregations.

Deep Dive

- MongoDB aggregation pipeline: Complex data transformation.
- Ordered stages process documents to aggregated results.
- Common stages: `$match`, `$group`, `$sort`, `$limit`, etc.
- Mongoose: Use `.aggregate()` method on a model.

When to use?

- Use MongoDB aggregation when you:
  - Summarize data for analytics.
  - Transform documents into different forms.
  - Compute derived data or statistics.

Summary

- Data aggregation in MongoDB/Mongoose: Powerful for data manipulation.
- Aggregation pipeline: Sequence of ops for filtering, grouping, sorting, and aggregating.
- Generates aggregated results from documents.

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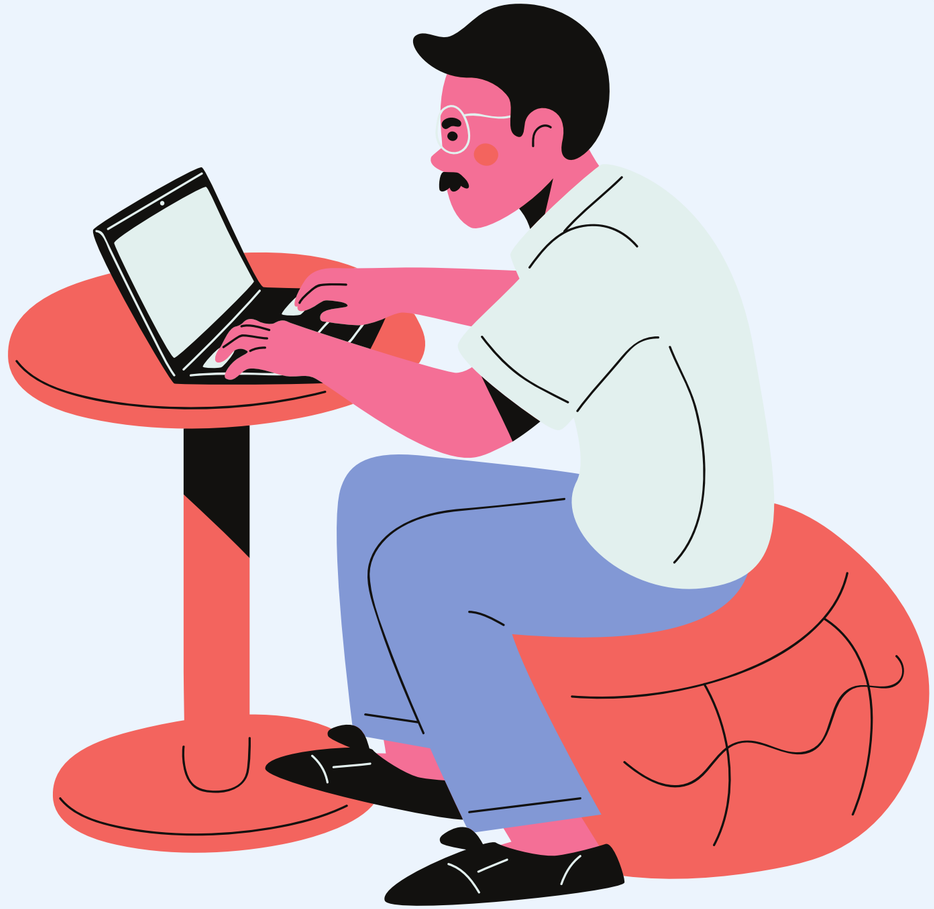

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MONGOOSE MIDDLEWARES OVERVIEW

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MONGOOSE MIDDLEWARES

MONGOOSE MIDDLEWARES OVERVIEW

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High-Level Explanation

- Mongoose middlewares: Functions in Mongoose document lifecycle.
- Hook into stages like validation, saving, finding.
- Enable custom logic, data modification.

Analogue

- Analogy: Mongoose middlewares as video game checkpoints.
- Check, modify data before proceeding to next stage.
- Ensure conditions are met before advancing.

Best Practices

- Keep them small and focused, performing a single task.
- Handle errors in asynchronous operations.
- Be cautious when modifying queries or data to avoid unintended consequences.

Deep Dive

Mongoose middlewares are categorized into different types:

- **Document Middlewares**: Operate on individual documents (e.g., `save`, `validate`, `remove`).
- **Query Middlewares**: Operate on queries (e.g., `find`, `update`).
- **Aggregate Middlewares**: Work with aggregation pipelines.
- **Model Middlewares**: Apply to model's static functions.

They can be synchronous or asynchronous, registered using `pre` and `post` hooks.

When to use?

- Document middlewares: Single document actions (validation, modification).
- Query middlewares: Query modification, logging.
- Aggregate middlewares: Complex data transformation.
- Model middlewares: Collection-wide actions (e.g., data seeding).

Summary

- Mongoose middlewares: Insert custom logic at data operation stages.
- Apply at document, query, and other levels.
- Essential for effective data management in Mongoose apps.

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DOCUMENT MIDDLEWARES

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MONGOOSE MIDDLEWARES

DOCUMENT MIDDLEWARES

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High-Level Explanation

- Mongoose Document middlewares (hooks): Custom logic pre/post events.
- Hooks: `init`, `validate`, `save`, `remove`.
- Trigger at various stages in document lifecycle.

Analogue

- Analogy: Mongoose Document middlewares as theater crew.
- `init`: Preparing the stage before the show.
- `validate`: Ensuring everything is in place.
- `save`: Managing the action during the performance.
- `remove`: Cleaning up after the show.

Best Practices

- Asynchronous: Employ `next()` for async continuation.
- Error Handling: Manage errors with try-catch or pass to `next()`.
- Immutable Fields: Don't alter immutable fields in `pre('save')` hooks.

Deep Dive

Mongoose Document middlewares provide control and customization of operations:

- `init`: Triggers on document load.
- `validate`: Pre-validation.
- `save`: Pre/post save (before/after).
- `remove`: Pre/post remove (before/after deletion from collection).

When to use?

- `init`: Set initial values or conditions.
- `validate`: Enforce complex validation rules.
- `save`: Automate tasks, manipulate data pre/post save.
- `remove`: Perform clean-up, delete associated records.

Summary

- Mongoose Document middlewares: Custom logic at lifecycle stages
- Init, validate, save, remove hooks
- Enhance app robustness and maintainability

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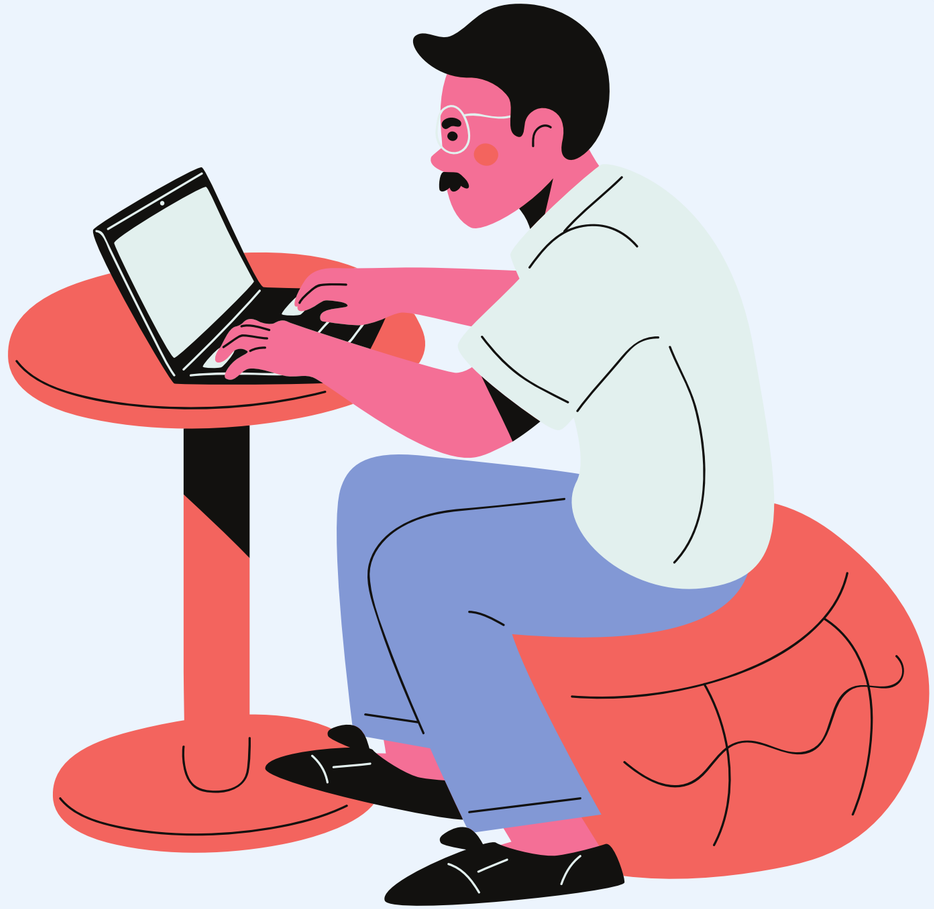
DEMO TIME



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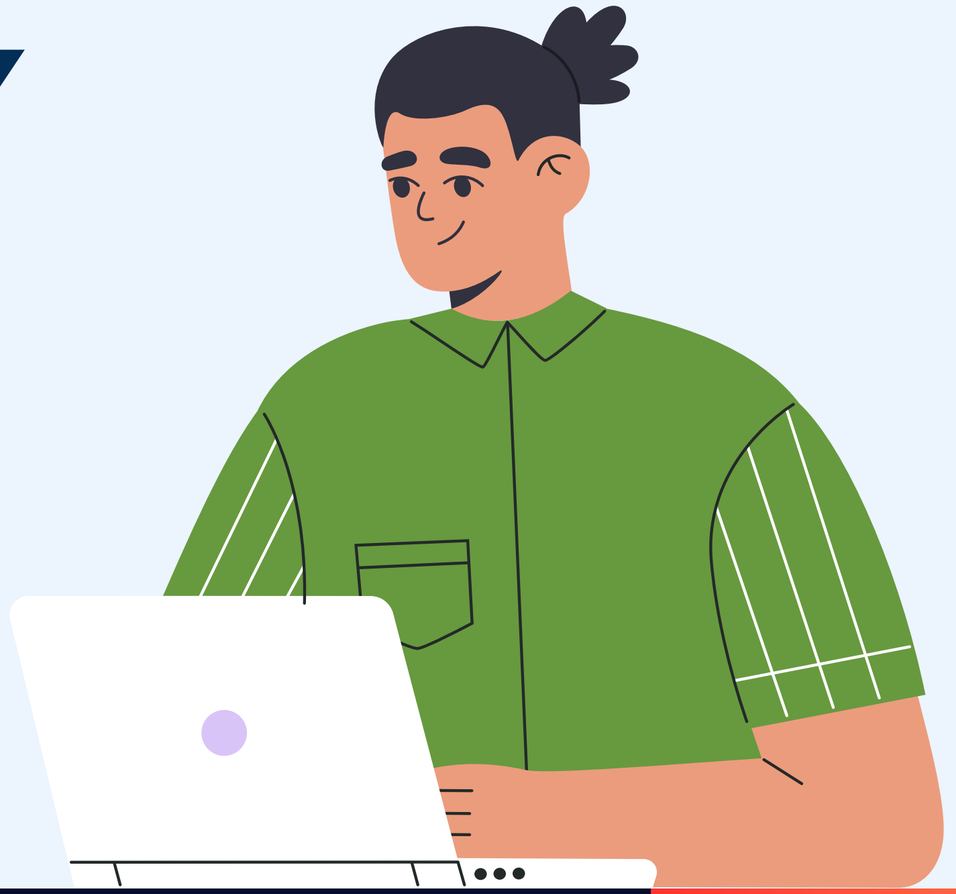
QUERY

MIDDLEWARES



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MONGOOSE MIDDLEWARES

QUERY MIDDLEWARES

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High-Level Explanation

- Mongoose Document middlewares (hooks): Custom logic pre/post events.
- Hooks: `init`, `validate`, `save`, `remove`.
- Trigger at various stages in document lifecycle.

Deep Dive

- Query middleware uses: Data normalization, validation, caching
- Operate on query objects, not documents
- Two types: "pre" (before) and "post" (after)
- Modify query with `pre('find')`, process results with `post('find')`

Analogue

- Analogy: Google Search and Mongoose query middlewares
- Pre-middleware: Filter out specific terms (like Google)
- Post-middleware: Count results for analytics (like Google)
- Mongoose middlewares for database operations

When to use?

Common use cases for Mongoose query middlewares:

1. Data Validation: Ensure queries meet specific criteria.
2. Authorization: Check permissions before executing a query.
3. Caching: Implement caching for query performance.
4. Logging: Track database activities for auditing purposes.

Best Practices

1. Utilize `async/await` for async operations in middlewares.
2. Keep middlewares lightweight; avoid heavy computations for performance.
3. Carefully chain multiple middlewares to maintain code readability.
4. Always call `next()` in pre-middlewares to continue execution.

Summary

- Mongoose query middlewares: Hooks into query lifecycle
- Pre/post-processing for validation, logging, caching
- Powerful for augmenting database operation behavior

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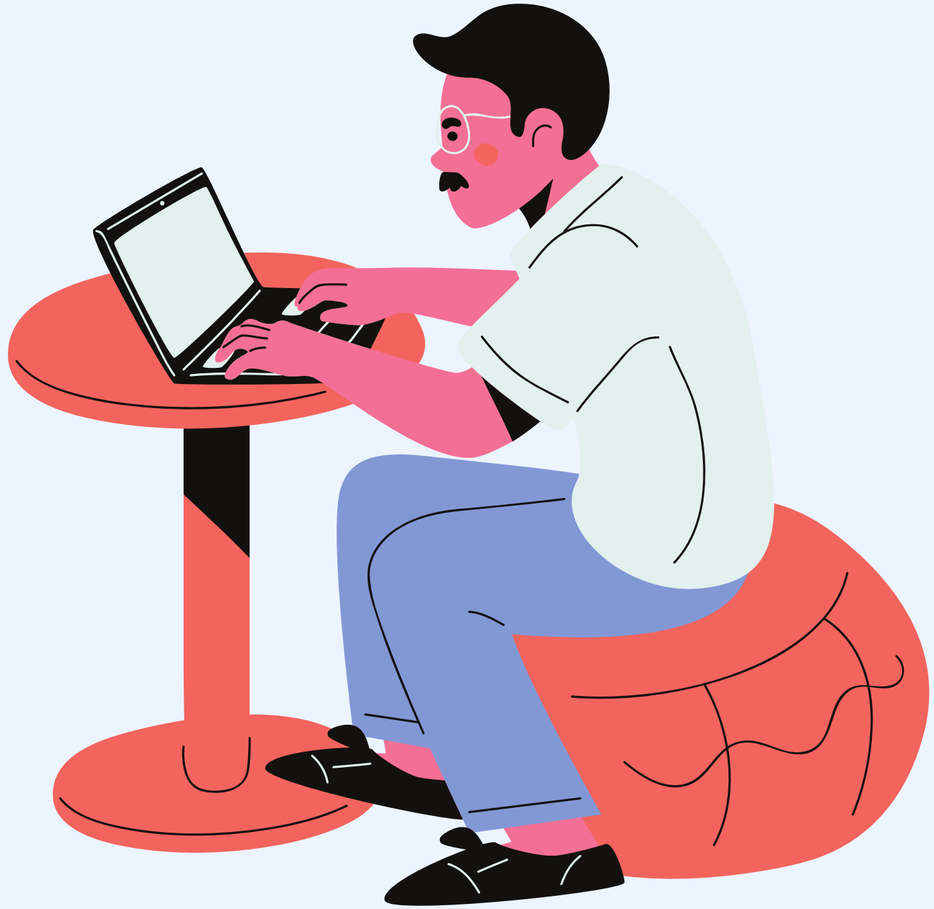
DEMO TIME



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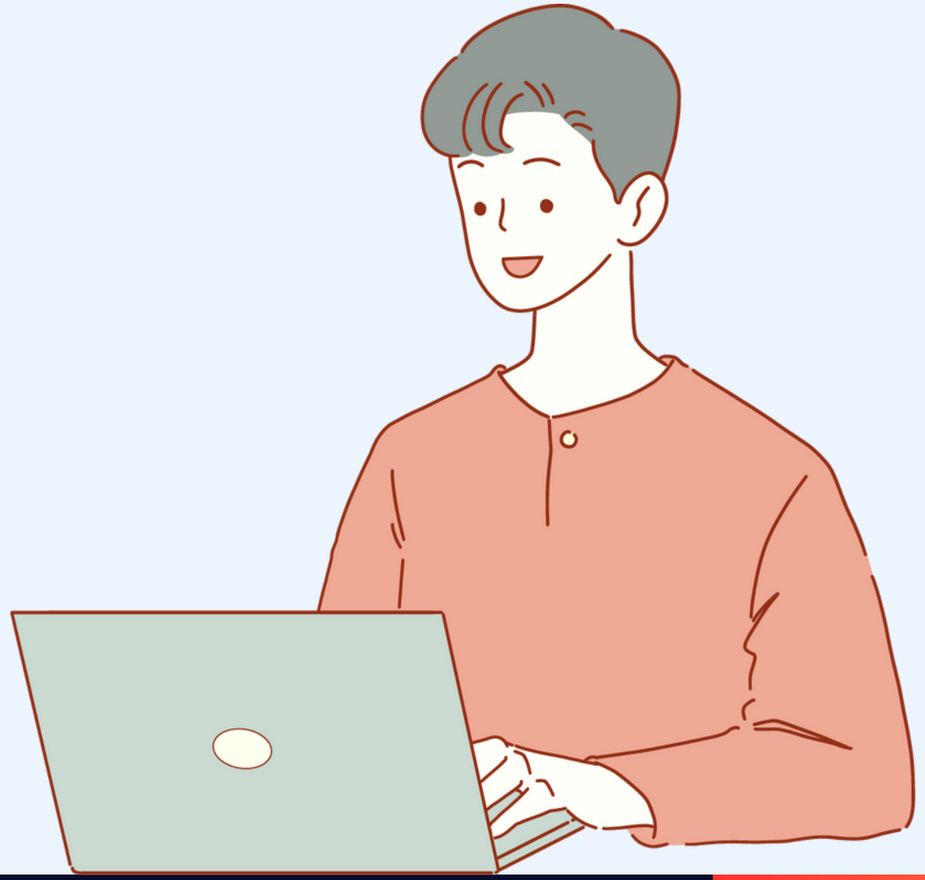
AGGREGATE

MIDDLEWARES



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MONGOOSE MIDDLEWARES

AGGREGATE MIDDLEWARES

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High-Level Explanation

- Mongoose's Aggregate Middlewares: Pre and post hooks
- Intervene in aggregation pipeline execution
- Modify pipeline or process aggregated data

Analogue

- Analogy: Aggregation pipeline as a party playlist
- `pre('aggregate')`: Adjust before the party, add excitement.
- `post('aggregate')`: Review after the party, note dance hits.

Best Practices

- Pre-aggregate: Avoid unintentional pipeline changes.
- Post-aggregate: Watch for increased computational complexity.
- Use both judiciously to maintain code readability.

Deep Dive

- Mongoose schema allows defining middlewares for various operations.
- `pre('aggregate')`: Executed before aggregation, modifies pipeline.
- `post('aggregate')`: Executed after aggregation, post-processing.

When to use?

- Pre-aggregate: Enforce security policies or conditions.
  - e.g., User can only aggregate their data.

- Post-aggregate: Log for auditing, transform aggregated data.
  - e.g., Activity logging or additional data processing.

Summary

- Mongoose Aggregate Middlewares: Hooks for pre/post aggregation.
- Useful for dynamic pipeline modification, rule enforcement, data processing.
- Use with care for code readability and performance.

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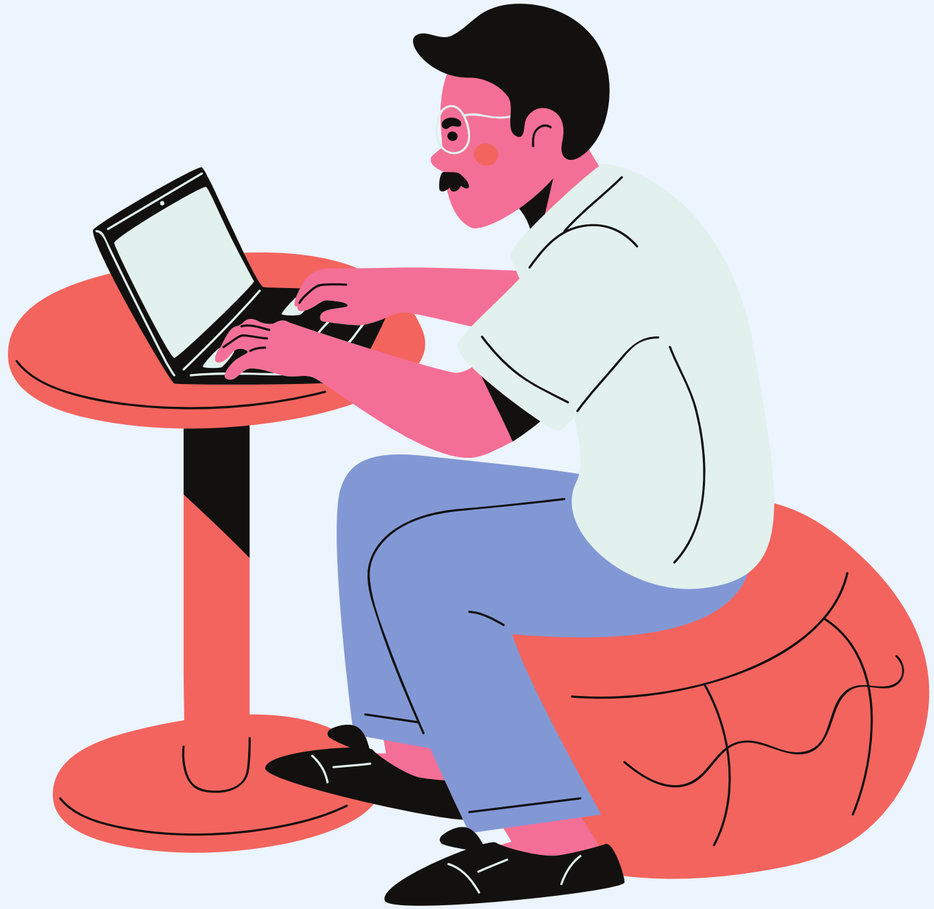
DEMO TIME



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MODEL
MIDDLEWARES

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MONGOOSE MIDDLEWARES

MODEL MIDDLEWARES

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High-Level Explanation

- Mongoose model middlewares: Pre and post-hooks for model methods.
- **Pre-hooks**: Triggered before method execution, e.g., `pre('save')`.
- **Post-hooks**: Run after method execution, handle operation results, e.g., `post('save')`.

Analogue

- Analogy: Blog post on a website and Mongoose model middlewares
- `pre-save` hook: Spell-check or tag addition before "Publish."
- `post-save` hook: Share on social media after publication.

Best Practices

- **Ordering**: Sequence of hook definitions matters.
- **Asynchronous Operations**: Handle async operations carefully.
- **Error Handling**: Ensure error handling, especially in pre-hooks for data validation.

Deep Dive

- Mongoose schema allows defining middlewares for various operations.
- `pre('aggregate')`: Executed before aggregation, modifies pipeline.
- `post('aggregate')`: Executed after aggregation, post-processing.

When to use?

- Pre-hooks: Validation, data transformation, business logic.
- Post-hooks: Notifications, logging, post-operation actions.

Summary

- Mongoose Model Middlewares: Gatekeepers and observers.
- Useful for validation, transformation, logging, notifications.
- Implement with care for a clean, efficient codebase.

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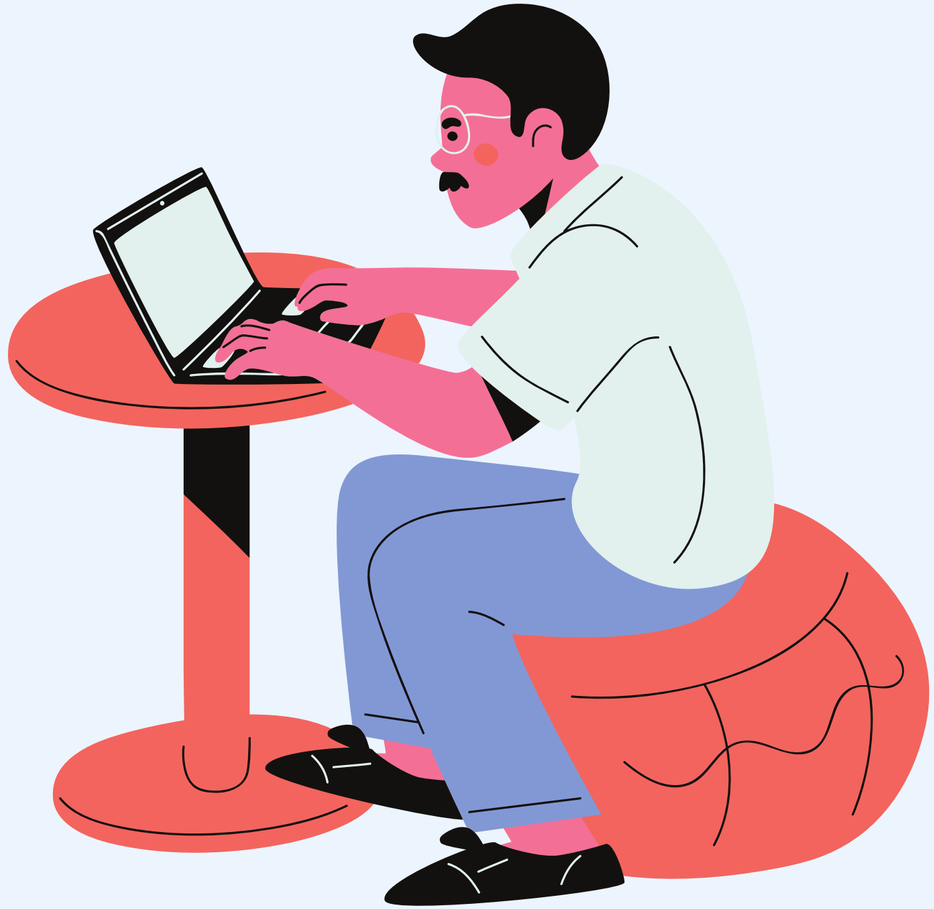

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MIDDLEWARES
STAGES

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MONGOOSE MIDDLEWARES

MIDDLEWARE STAGES

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High-Level Explanation

- `**init**`: Data manipulation after fetch but before use.
- `**validate**`: Last chance data validation before save.
- `**save**`: Pre/post save logic, widely used.
- `**remove**`: Pre-document removal logic, e.g., cascading deletes, notifications.

Analogue

- Analogy for Mongoose middleware stages:
  - `init`: Starting a new game level, stage is set.
  - `validate`: Checking inventory before proceeding.
  - `save`: Reaching a checkpoint, progress is saved.
  - `remove`: Exiting with an option to save friend's scores.

Best Practices

- Asynchrony: Call `next()` after async operations complete.
- Error Handling: Pass errors to `next()` for proper handling.

Deep Dive

- Mongoose schema allows defining middlewares for various operations.
- `pre('aggregate')`: Executed before aggregation, modifies pipeline.
- `post('aggregate')`: Executed after aggregation, post-processing.

When to use?

- `init`: Initial state setup, document transformations.
- `validate`: Custom validation rules.
- `save`: Timestamps, encryption, business logic.
- `remove`: Cleanup tasks, associated record deletion.

Summary

- Mongoose middleware stages offer precise document lifecycle control.
- Improve data integrity and application logic.
- Follow best practices: error handling, async operation management.

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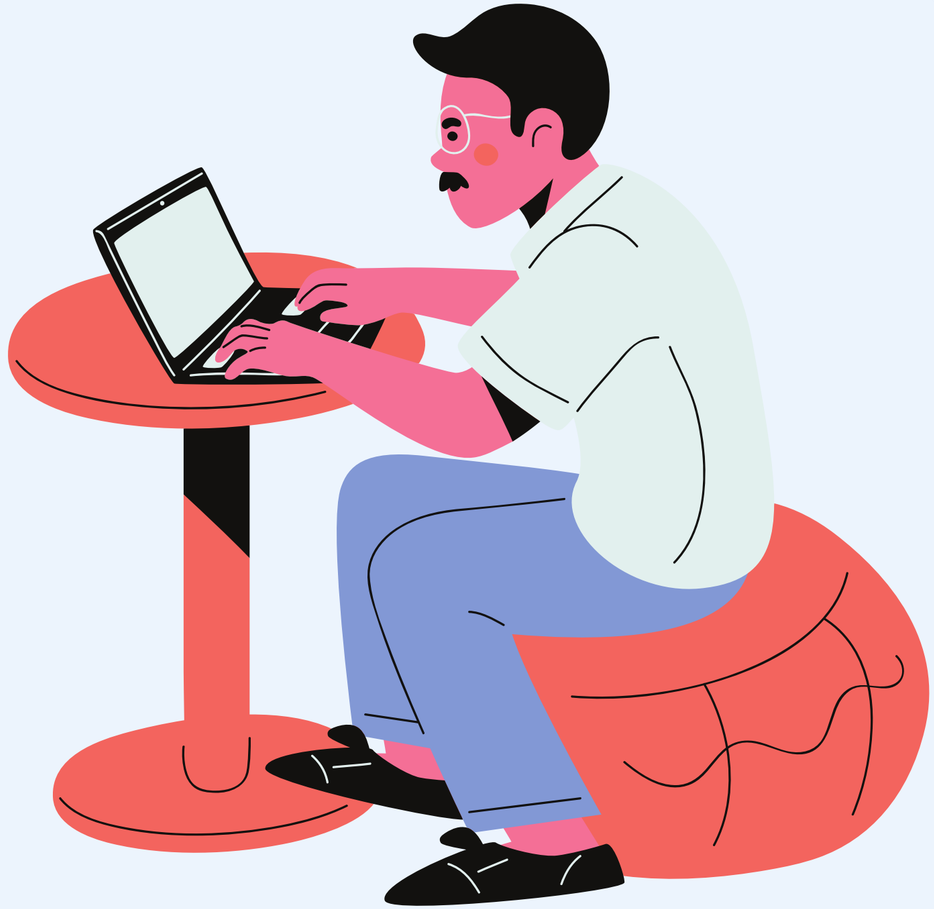
DEMO TIME



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POPULATING REFERENCES AUTOMATICALLY

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MONGOOSE MIDDLEWARES

POPULATING REFERENCES AUTOMATICALLY

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High-Level Explanation

- Mongoose Query Middleware: Populate references automatically.
- Fill referenced documents in schema before returning data to app.

Deep Dive

- Mongoose Schema: Define fields as ObjectIds referencing other collections.
- Normally, use `.populate()` method to fill references.
- Query Middleware automates this, populating references on query.

Analogue

- Analogy: Auto-complete for search bar.
- Normally, separate button for full details.
- With Query Middleware, related data auto-populated.

When to use?

- Frequent queries needing populated references.
- When client apps expect fully formed objects, server-side population.

Summary

- Auto-populating references: Automatically fill in data.
- Resolves references between collections.
- Simplifies client-side code.
- Query Middleware automates and streamlines this process.

Best Practices

- Watch out for performance impact with extensive auto-population.
- Avoid overuse, especially for occasional reference needs.

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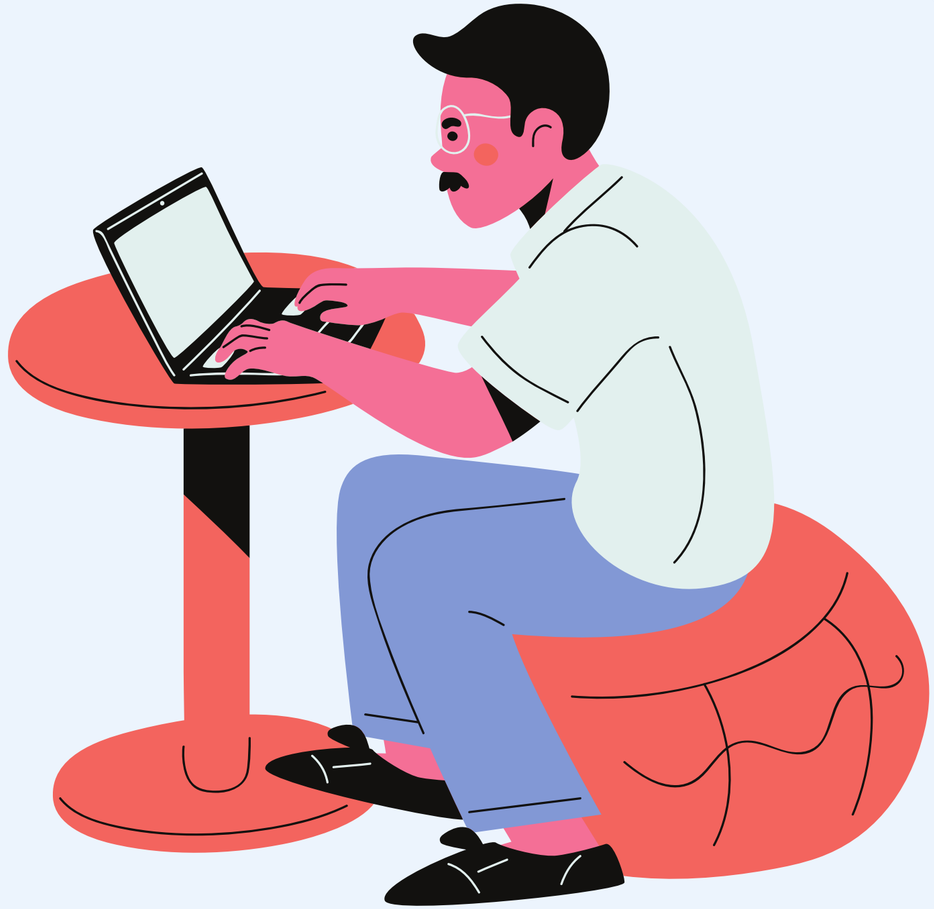
DEMO TIME



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THANK YOU