CS193X: Web Programming Fundamentals

Spring 2017

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CS193X schedule

Today

- Middleware and Routes
- Single-page web app
- More MongoDB examples
- Authentication
- Victoria has office hours after class

Monday

- Our last lecture!
- A sprint through some important things I didn't cover
- What's next: An opinionated guide
- **Maybe snacks?!?**

Final project

Final Project Proposal due **today 6/2**

- No late cutoff! Must turn in on time.

Final Project is due Mon, June 12

- No late cutoff! Must turn in on time.
- More details posted
    - You will need to create a Video Walkthrough, which will **not** be graded (aside from completion)
    - Required for every project, Diary app or original
- Additional hints posted too!

Web topic requests

Post to our Piazza post:

- https://piazza.com/class/j0y7gmnuoh167p?cid=184

Modules and Routes

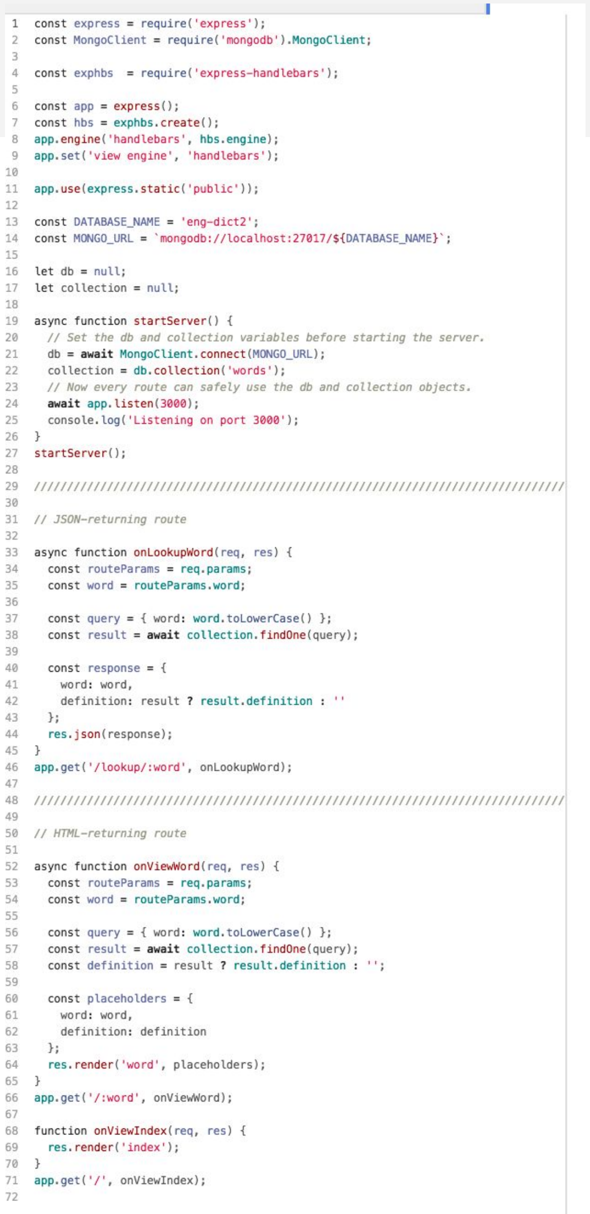
Routes

So far, our server routes have all been defined in one file.

Right now, server.js:

- Starts the server
- Sets the template engine
- Serves the public/ directory
- Defines the JSON-returning routes
- Defines the HTML-returning routes

As our server grows, it'd be nice to split up server.js into separate files.

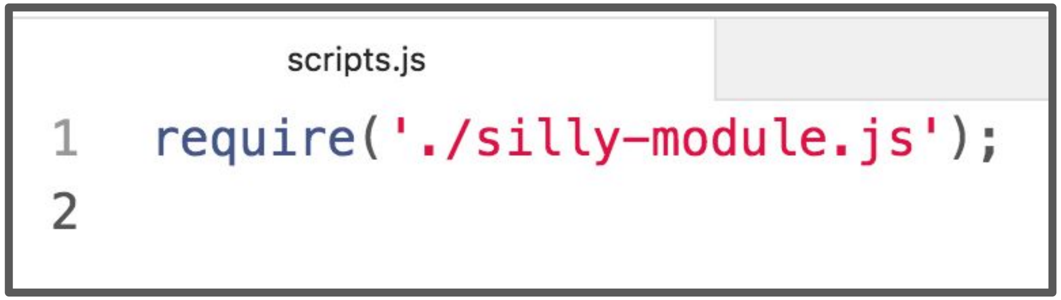


```
const express = require('express');
const MongoClient = require('mongodb').MongoClient;

const exphbs  = require('express-handlebars');

const app = express();
const hbs = exphbs.create();
app.engine('handlebars', hbs.engine);
app.set('view engine', 'handlebars');

app.use(express.static('public'));

const DATABASE_NAME = 'eng-dict2';
const MONGO_URL = `mongodb://localhost:27017/${DATABASE_NAME}`;

let db = null;
let collection = null;

async function startServer() {
  // Set the db and collection variables before starting the server.
  db = await MongoClient.connect(MONGO_URL);
  collection = db.collection('words');
  // Now every route can safely use the db and collection objects.
  await app.listen(3000);
  console.log('Listening on port 3000');
}
startServer();

////////////////////////////////////////////////////////////////////////////////

// JSON-returning route

async function onLookupWord(req, res) {
  const routeParams = req.params;
  const word = routeParams.word;

  const query = { word: word.toLowerCase() };
  const result = await collection.findOne(query);

  const response = {
    word: word,
    definition: result ? result.definition : ''
  };
  res.json(response);
}
app.get('/lookup/:word', onLookupWord);

////////////////////////////////////////////////////////////////////////////////

// HTML-returning route

async function onViewWord(req, res) {
  const routeParams = req.params;
  const word = routeParams.word;

  const query = { word: word.toLowerCase() };
  const result = await collection.findOne(query);
  const definition = result ? result.definition : '';

  const placeholders = {
    word: word,
    definition: definition
  };
  res.render('word', placeholders);
}
app.get('/:word', onViewWord);

function onViewIndex(req, res) {
  res.render('index');
}
app.get('/', onViewIndex);
```

Recall: Modules

NodeJS modules

You can include it in another JavaScript file by using the require statement:



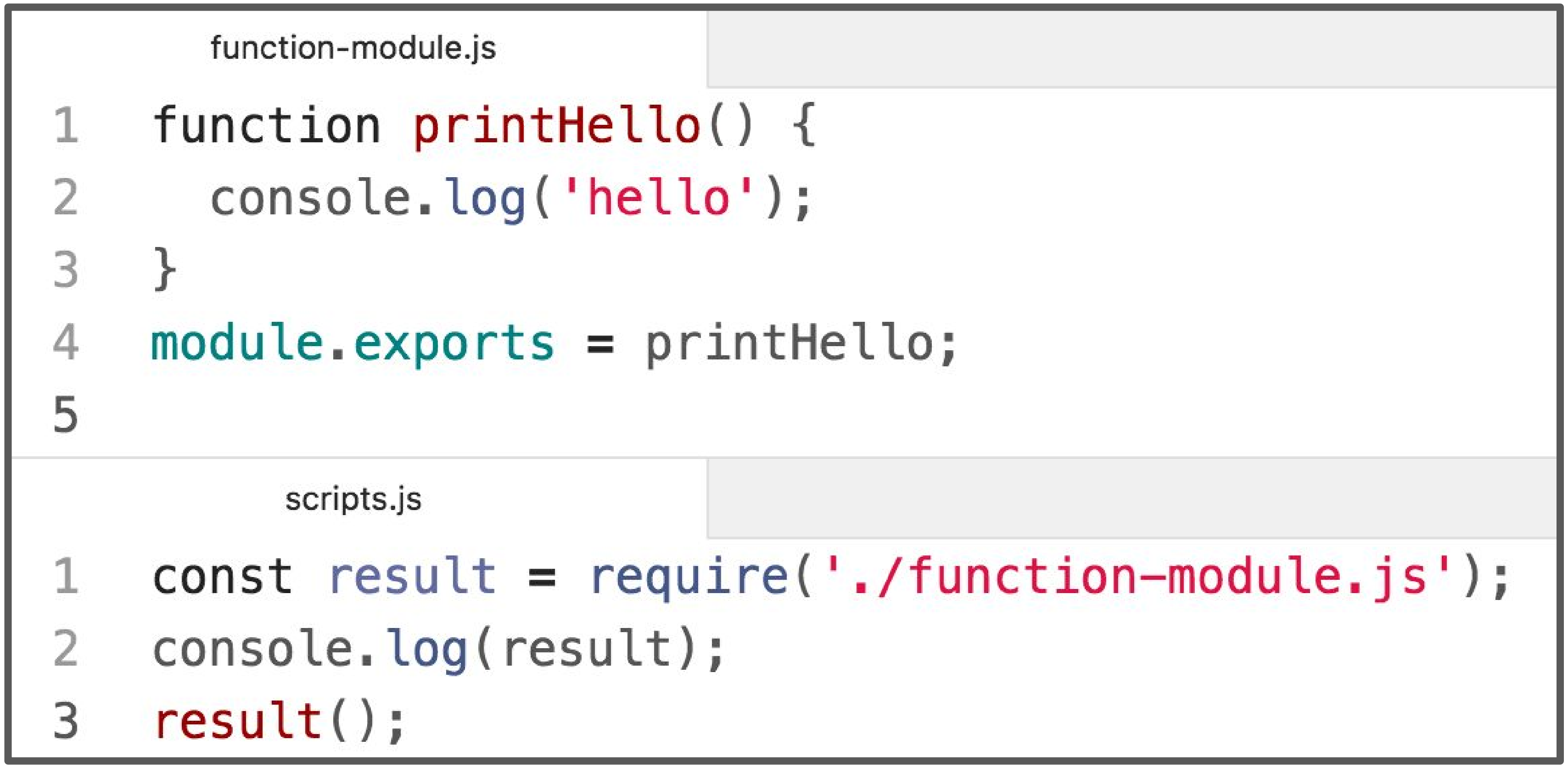
scripts.js

```javascript
require('./silly-module.js');

```

- Note that you **MUST** specify "./", "../", "/", etc.
- Otherwise NodeJS will look for it in the node_modules/ directory. See require() resolution rules

`module.exports`

- `module` is a special object automatically defined in each NodeJS file, representing the current module.
- When you call `require('./fileName.js')`, the `require()` function will return the value of **`module.exports`** as defined in fileName.js
  - `module.exports` is initialized to an empty object.


function-module.js

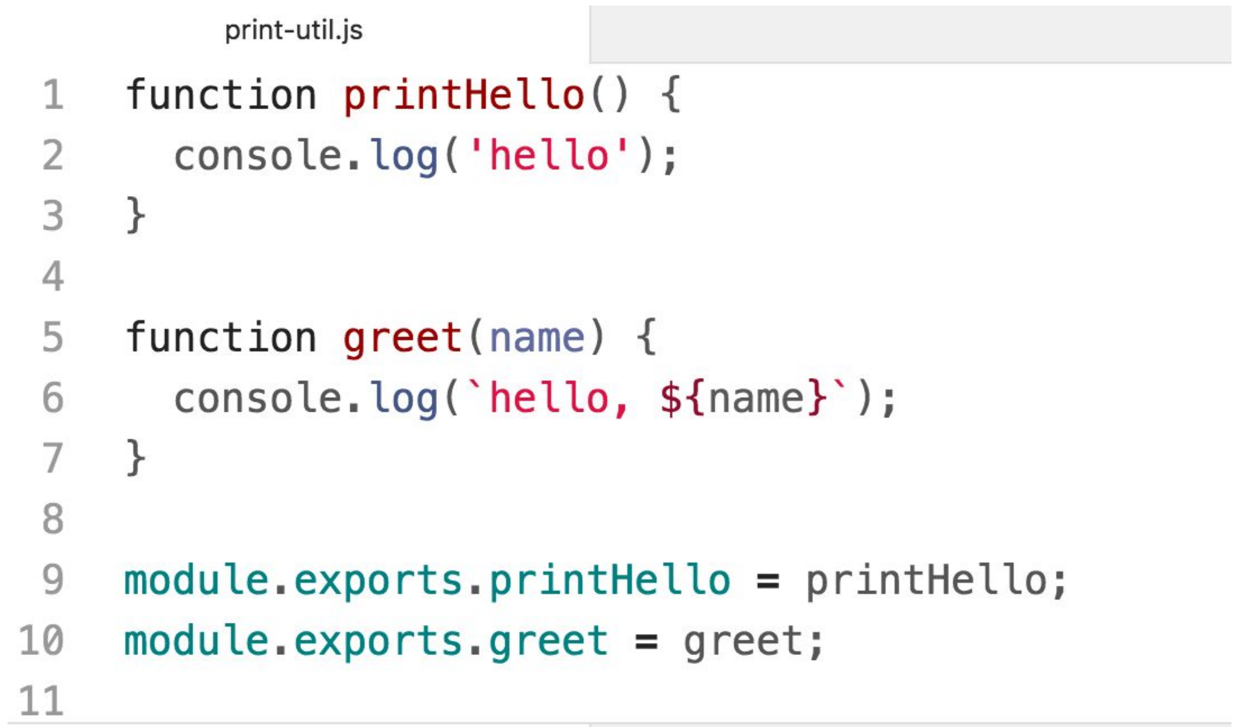
```javascript
function printHello() {
  console.log('hello');
}
module.exports = printHello;

```

scripts.js

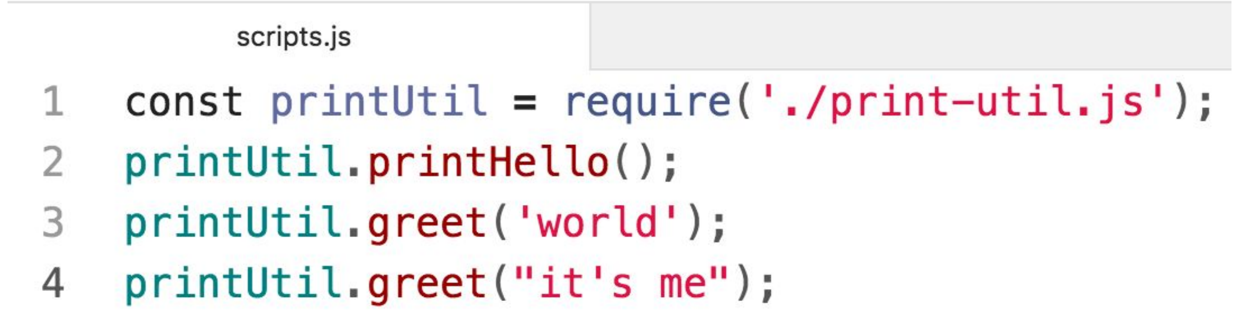
```javascript
const result = require('./function-module.js');
console.log(result);
result();
```

```
$ node scripts.js
[Function: printHello]
hello
```

- We can export a function by setting it to `module.exports`


print-util.js

```javascript
function printHello() {
  console.log('hello');
}

function greet(name) {
  console.log(`hello, ${name}`);
}

module.exports.printHello = printHello;
module.exports.greet = greet;

```


scripts.js

```javascript
const printUtil = require('./print-util.js');
printUtil.printHello();
printUtil.greet('world');
printUtil.greet("it's me");
```

```
$ node scripts.js
hello
hello, world
hello, it's me
```

- We can export multiple functions by setting fields of the `module.exports` object

Back to Routes

Routes

So far, our server routes have all been defined in one file.

Right now, server.js:

- Starts the server
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- Serves the public/ directory
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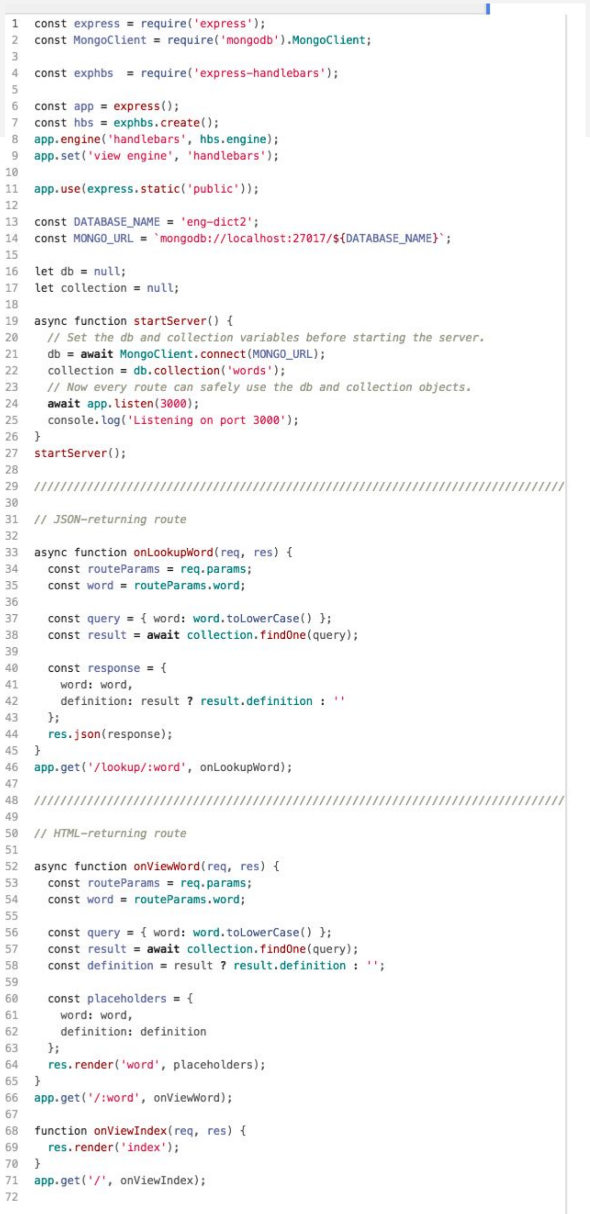
- Defines the HTML-returning routes

As our server grows, it'd be nice to split up server.js into separate files.



```javascript
const express = require('express');
const MongoClient = require('mongodb').MongoClient;

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const app = express();
const hbs = exphbs.create();
app.engine('handlebars', hbs.engine);
app.set('view engine', 'handlebars');

app.use(express.static('public'));

const DATABASE_NAME = 'eng-dict2';
const MONGO_URL = `mongodb://localhost:27017/${DATABASE_NAME}`;

let db = null;
let collection = null;

async function startServer() {
  // Set the db and collection variables before starting the server.
  db = await MongoClient.connect(MONGO_URL);
  collection = db.collection('words');
  // Now every route can safely use the db and collection objects.
  await app.listen(3000);
  console.log('Listening on port 3000');
}
startServer();

////////////////////////////////////////////////////////////////////////////////

// JSON-returning route

async function onLookupWord(req, res) {
  const routeParams = req.params;
  const word = routeParams.word;

  const query = { word: word.toLowerCase() };
  const result = await collection.findOne(query);

  const response = {
    word: word,
    definition: result ? result.definition : ''
  };
  res.json(response);
}
app.get('/lookup/:word', onLookupWord);

////////////////////////////////////////////////////////////////////////////////

// HTML-returning route

async function onViewWord(req, res) {
  const routeParams = req.params;
  const word = routeParams.word;

  const query = { word: word.toLowerCase() };
  const result = await collection.findOne(query);
  const definition = result ? result.definition : '';

  const placeholders = {
    word: word,
    definition: definition
  };
  res.render('word', placeholders);
}
app.get('/:word', onViewWord);

function onViewIndex(req, res) {
  res.render('index');
}
app.get('/', onViewIndex);
```

Goal: HTML vs JSON routes

Let's try to split server.js into 3 files.

Right now, server.js does the following:

- **Starts the server**
- **Sets the template engine**
- **Serves the public/ directory**
- **Defines the JSON-returning routes**
- **Defines the HTML-returning routes**

⟶ We'll continue to use **server.js** for the logic in blue

⟶ We'll try to move JSON routes to **api.js**

⟶ We'll try to move the HTML routes to **view.js**

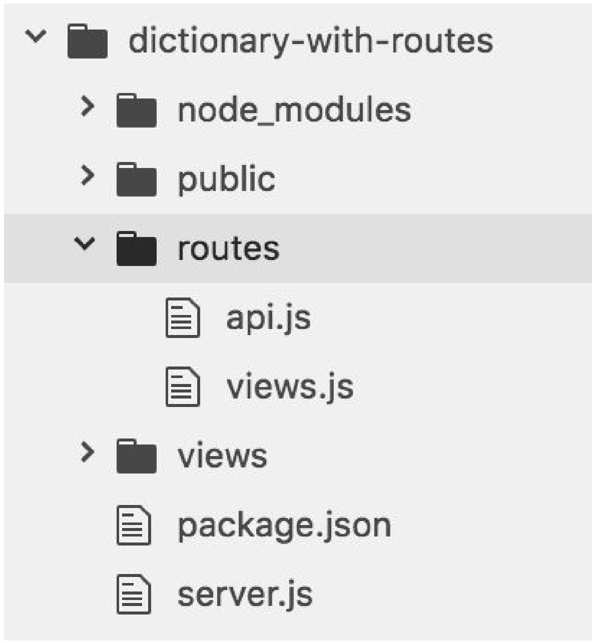
Goal: HTML vs JSON routes

⟶ We'll continue to use **server.js** for the logic in blue

⟶ We'll try to move JSON routes to **api.js**

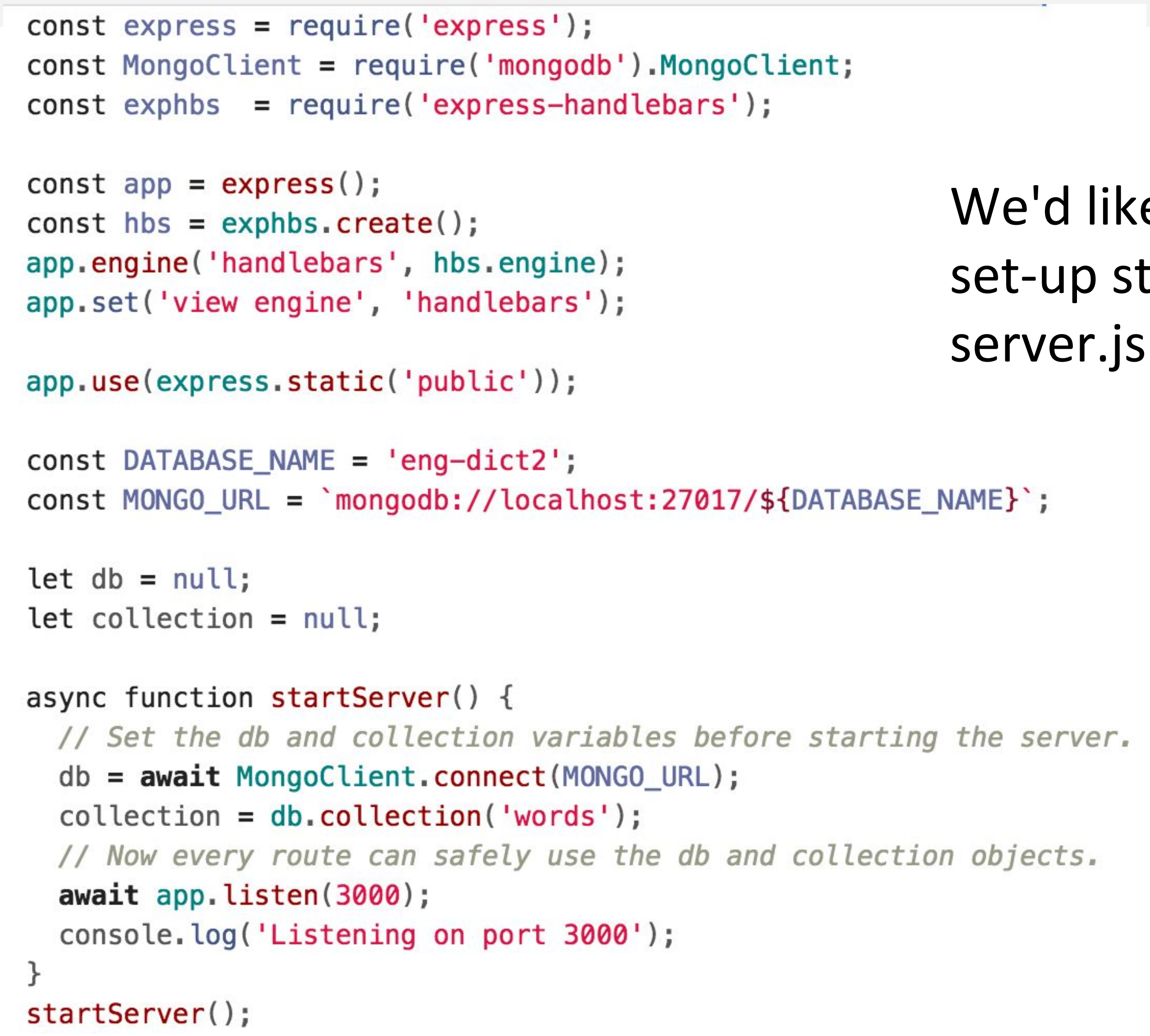
⟶ We'll try to move the HTML routes to **view.js**

Desired directory structure:



```
dictionary-with-routes
    node_modules
    public
    routes
        api.js
        views.js
    views
    package.json
    server.js
```

Desired: server.js



```
const express = require('express');
const MongoClient = require('mongodb').MongoClient;
const exphbs  = require('express-handlebars');

const app = express();
const hbs = exphbs.create();
app.engine('handlebars', hbs.engine);
app.set('view engine', 'handlebars');

app.use(express.static('public'));

const DATABASE_NAME = 'eng-dict2';
const MONGO_URL = `mongodb://localhost:27017/${DATABASE_NAME}`;

let db = null;
let collection = null;

async function startServer() {
  // Set the db and collection variables before starting the server.
  db = await MongoClient.connect(MONGO_URL);
  collection = db.collection('words');
  // Now every route can safely use the db and collection objects.
  await app.listen(3000);
  console.log('Listening on port 3000');
}
startServer();
```

We'd like to keep all set-up stuff in server.js...

Desired api.js (DOESN'T WORK)

And we'd like to be able to define the /lookup/:word route in a different file, something like the following:

```
async function onLookupWord(req, res) {
  const routeParams = req.params;
  const word = routeParams.word;

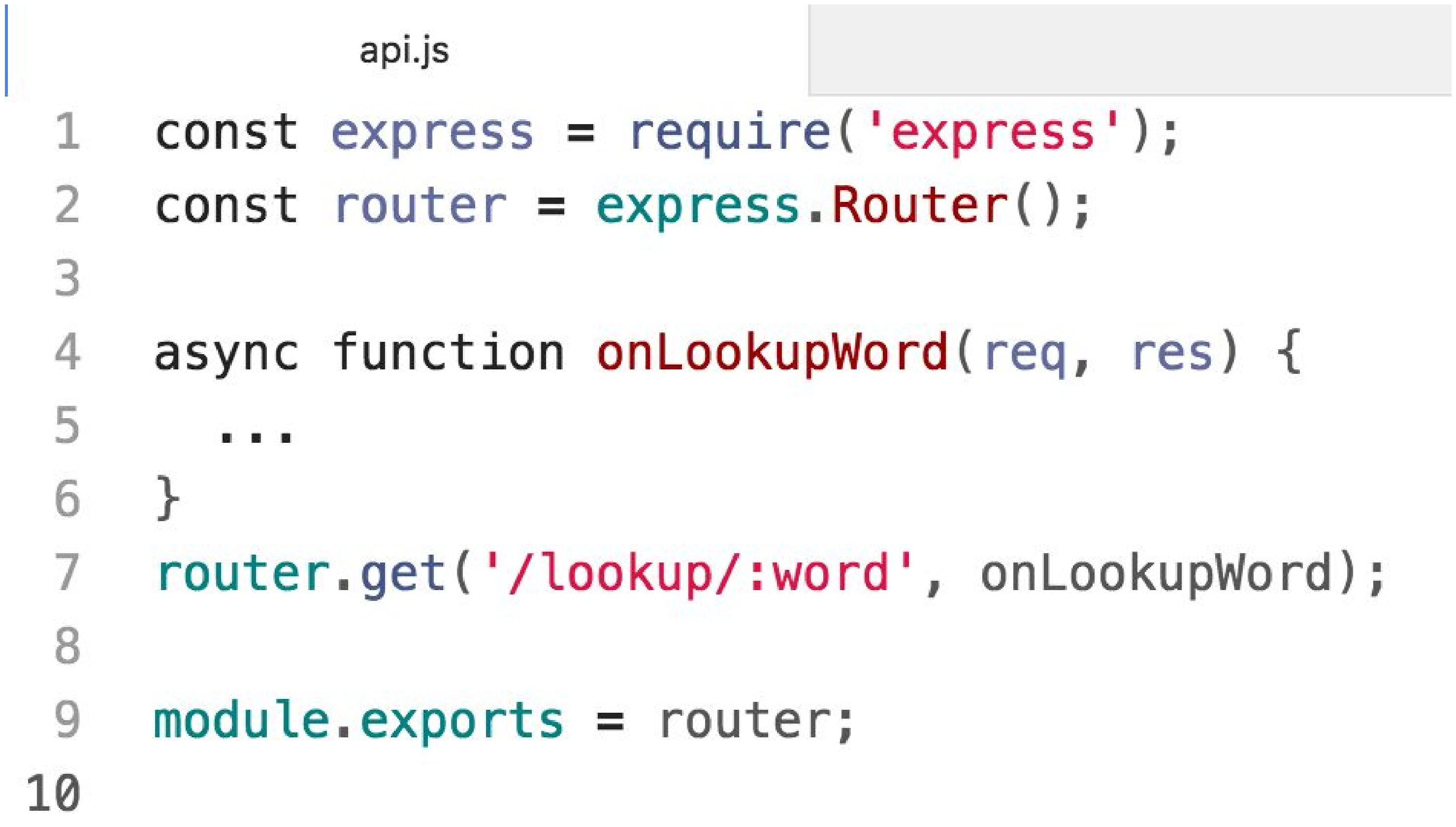
  const query = { word: word.toLowerCase() };
  const result = await collection.findOne(query);

  const response = {
    word: word,
    definition: result ? result.definition : ''
  };
  res.json(response);
}
app.get('/lookup/:word', onLookupWord);
```

Q: How do we define routes in a different file?

Router

Express lets you create `Router` objects, on which you can define modular routes:


api.js

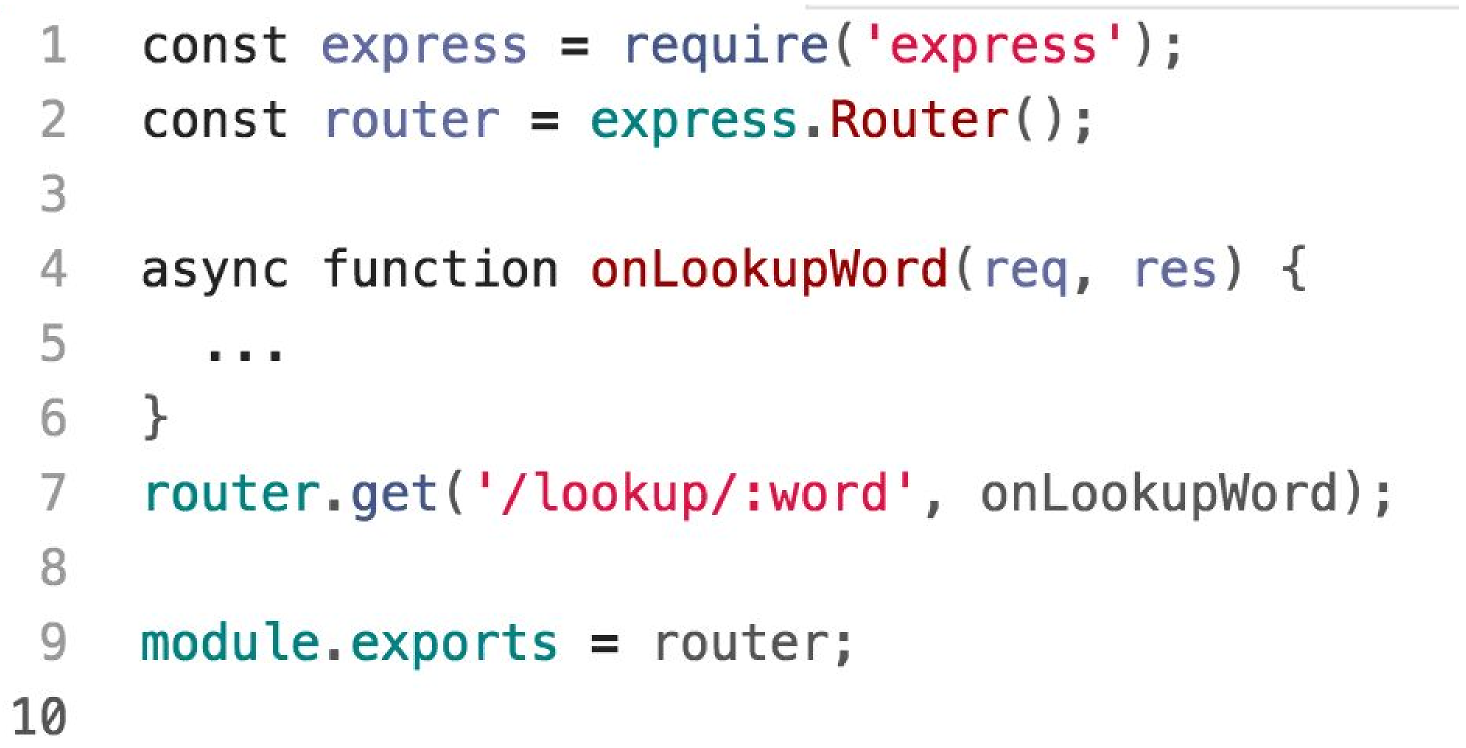
```
const express = require('express');
const router = express.Router();

async function onLookupWord(req, res) {
  ...
}
router.get('/lookup/:word', onLookupWord);

module.exports = router;

```

Router



```
const express = require('express');
const router = express.Router();

async function onLookupWord(req, res) {
  ...
}
router.get('/lookup/:word', onLookupWord);

module.exports = router;

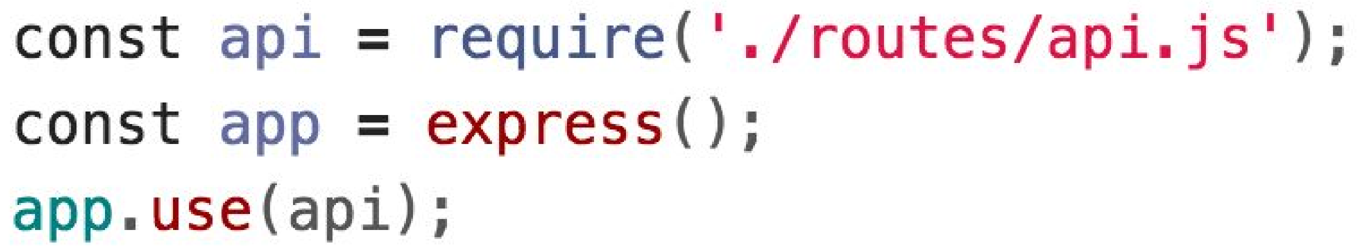
```

- Create a new Router by calling `express.Router()`
- Set routes the same way you'd set them on App
- Export the router via `module.exports`

Using the Router

Now we include the router by:

- Importing our router module via `require()`
- Calling `app.use(`***`router`***`)` on the imported router



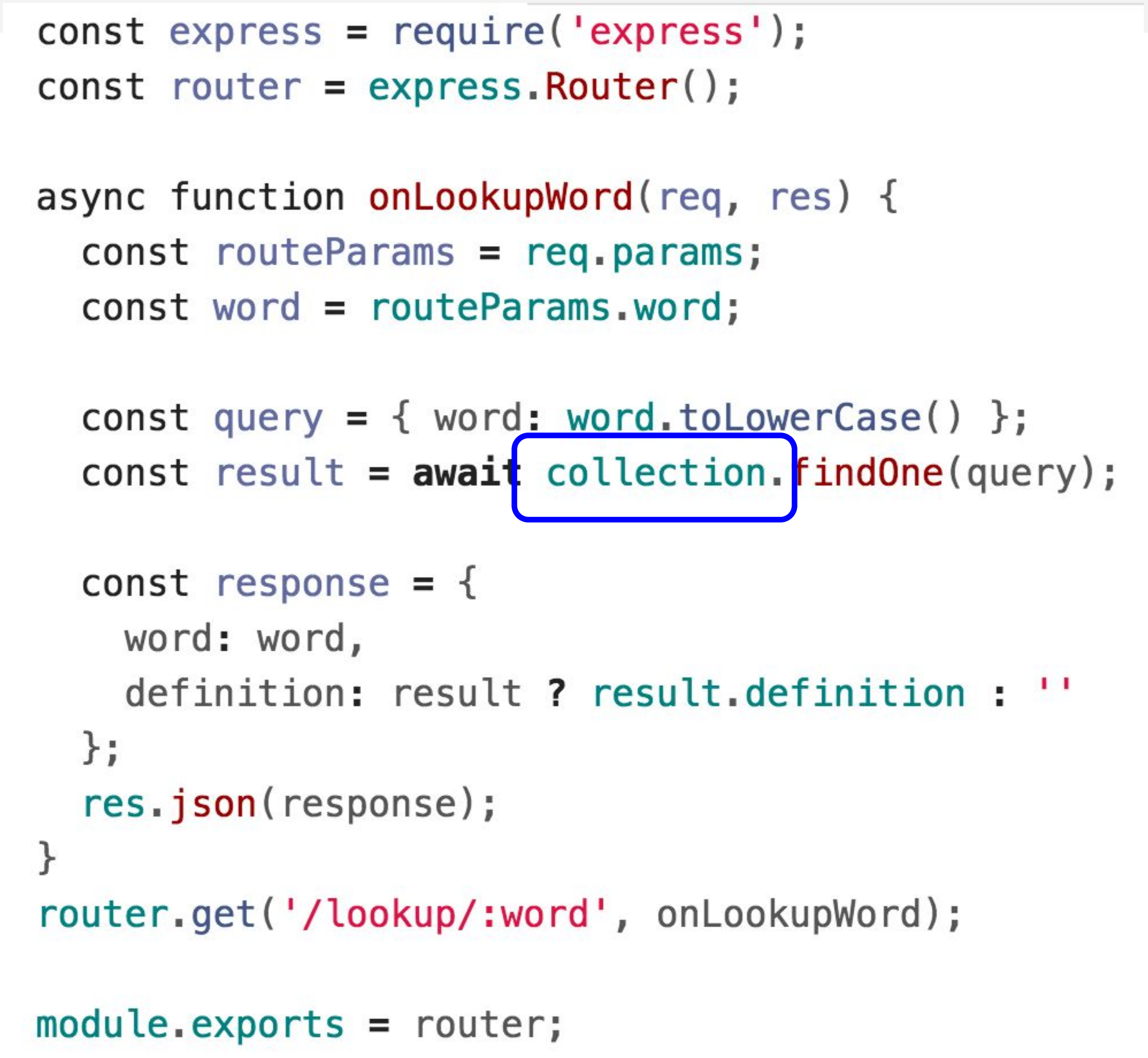
```
const api = require('./routes/api.js');
const app = express();
app.use(api);
```

Now the app will also use the routes defined in routes/api.js!

However, **we have a bug** in our code...

MongoDB variables

We need to access the MongoDB collection in our route...



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  const query = { word: word.toLowerCase() };
  const result = await collection.findOne(query);

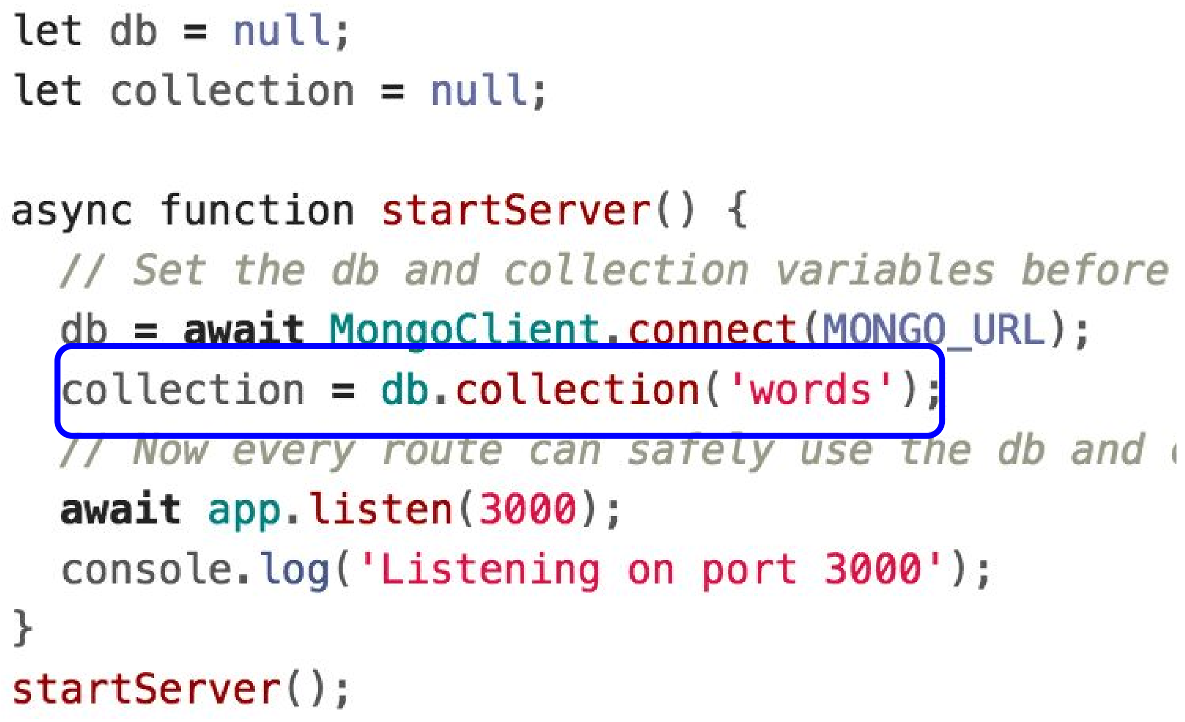
  const response = {
    word: word,
    definition: result ? result.definition : ''
  };
  res.json(response);
}
router.get('/lookup/:word', onLookupWord);

module.exports = router;
```

MongoDB variables

...Which used to be defined as a global variable in server.js.

Q: What's the right way to access the database data?



```
let db = null;
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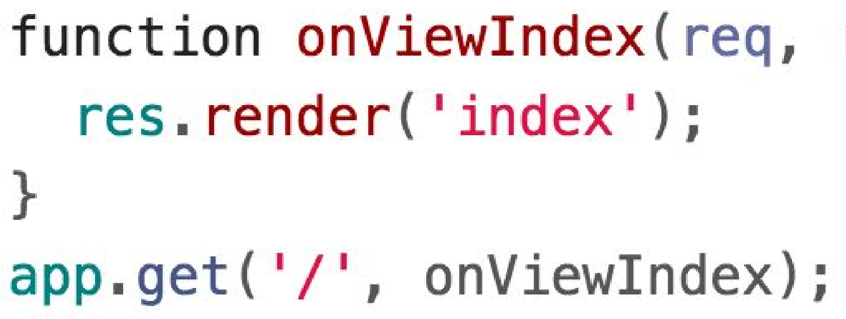
async function startServer() {
  // Set the db and collection variables before
  db = await MongoClient.connect(MONGO_URL);
  collection = db.collection('words');
  // Now every route can safely use the db and
  await app.listen(3000);
  console.log('Listening on port 3000');
}
startServer();
```

Middleware

In Express, you define [middleware functions]() that get called certain requests, depending on how they are defined.

The app.METHOD routes we have been writing are actually middleware functions:



```
function onViewIndex(req, res) {
  res.render('index');
}
app.get('/', onViewIndex);
```

onViewIndex is a middleware function that gets called every time there is a GET request for the "/" path.

Middleware: `app.use()`

We can also define middleware functions using `app.use()`:

```
// Middleware function that prints a message for every request.
function printMessage(req, res, next) {
  console.log('request to server!');
  next();
}
app.use(printMessage);
```

Middleware functions receive 3 parameters:

- `req` and `res`, same as in other routes
- **`next`**: Function parameter. Calling this function invokes the next middleware function in the app.
  - If we resolve the request via `res.send`, `res.json`, etc, we don't have to call `next()`

Middleware: app.use()

We can write middleware that defines new fields on each request:

```
const db = await MongoClient.connect(MONGO_URL);
const collection = db.collection('words');

// Adds the "words" collection to every MongoDB request.
function setCollection(req, res, next) {
  req.collection = collection;
  next();
}
app.use(setCollection);
```

Middleware: app.use()

Now if we load this middleware on each request:

```
async function startServer() {
  const db = await MongoClient.connect(MONGO_URL);
  const collection = db.collection('words');

  // Adds the "words" collection to every MongoDB request.
  function setCollection(req, res, next) {
    req.collection = collection;
    next();
  }
  app.use(setCollection);
  app.use(api);

  await app.listen(3000);
  console.log('Listening on port 3000');
}
```

Middleware: app.use()

Now if we load this middleware on each request:

```
async function startServer() {
  const db = await MongoClient.connect(MONGO_URL);
  const collection = db.collection('words');

  // Adds the "words" collection to every MongoDB request.
  function setCollection(req, res, next) {
    req.collection = collection;
    next();
  }
  app.use(setCollection);
  app.use(api);

  await app.listen(3000);
  console.log('Listening on port 3000');
}
```

Note that we need to use the api router **AFTER** the middleware

Middleware: app.use()

Then we can access the collection via `req.collection`:

```
async function onLookupWord(req, res) {
  const routeParams = req.params;
  const word = routeParams.word;

  const query = { word: word.toLowerCase() };
  const result = await req.collection.findOne(query);

  const response = {
    word: word,
    definition: result ? result.definition : ''
  };
  res.json(response);
}
router.get('/lookup/:word', onLookupWord);
```

Middleware: app.use()

Then we can access the collection via `req.collection`:

```
async function onLookupWord(req, res) {
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  const query = { word: word.toLowerCase() };
  const result = await req.collection.findOne(query);

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    word: word,
    definition: result ? result.definition : ''
  };
  res.json(response);
}
router.get('/lookup/:word', onLookupWord);
```

Views router

We can similarly move the HTML-serving logic to views.js and `require()` the module in server.js:

```
const api = require('./routes/api.js');
const views = require('./routes/views.js');
```

```
app.use(setCollection);
app.use(api);
app.use(views);
```

Views router

```
const express = require('express');
const router = express.Router();

async function onViewWord(req, res) {
  ...
  res.render('word', placeholders);
}
router.get('/:word', onViewWord);

function onViewIndex(req, res) {
  res.render('index');
}
router.get('/', onViewIndex);

module.exports = router;
```

Routes and middleware

Simple middleware example code is here:

- simple-middleware
- Run instructions

Dictionary with routes example code here:

- dictionary-with-routes
- Run instructions

Express documentation:

- Router
- Writing / Using Middleware

Recall: Web app architectures

Structuring a web app

There are roughly 4 strategies for architecting a web application:

1. **Server-side rendering:**
   Server sends a new HTML page for each unique path
2. **Single-page application:**
   Server sends the exact same web page for every unique path (and the page runs JS to change what it look like)
3. Combination of 1 and 2 ("**Isomorphic**" / "**Universal**")
4. **Progressive Loading**

Structuring a web app

There are roughly 4 strategies for architecting a web application:

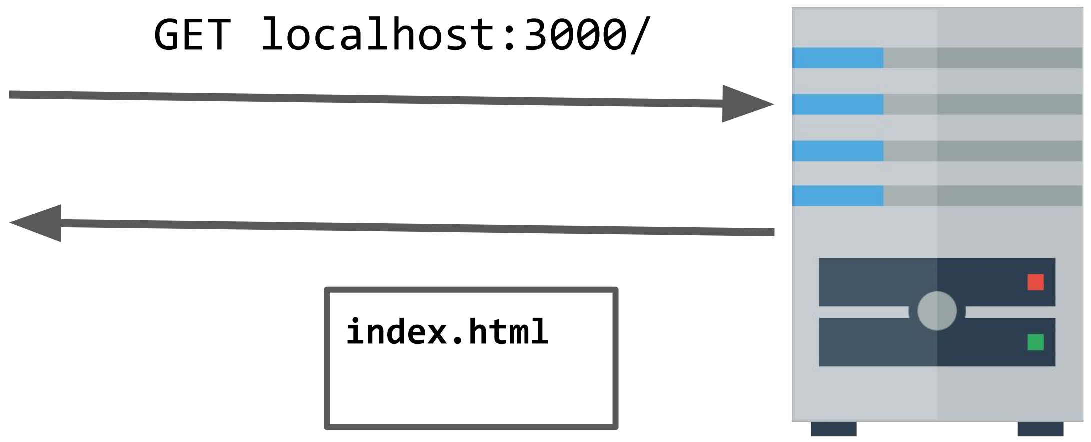
1. **Server-side rendering:**
   Server sends a new HTML page for each unique path
2. **Single-page application:**
   Server sends the exact same web page for every unique path (and the page runs JS to change what it look like)

   → Let's talk about this one now

Single-page web app

Single page web app

- The server always sends the **same one HTML file** for all requests to the web server.
- The server is configured so that requests to /**<word>** would still return e.g. index.html.
- The client JavaScript parses the URL to get the route parameters and initialize the app.



Single page web app

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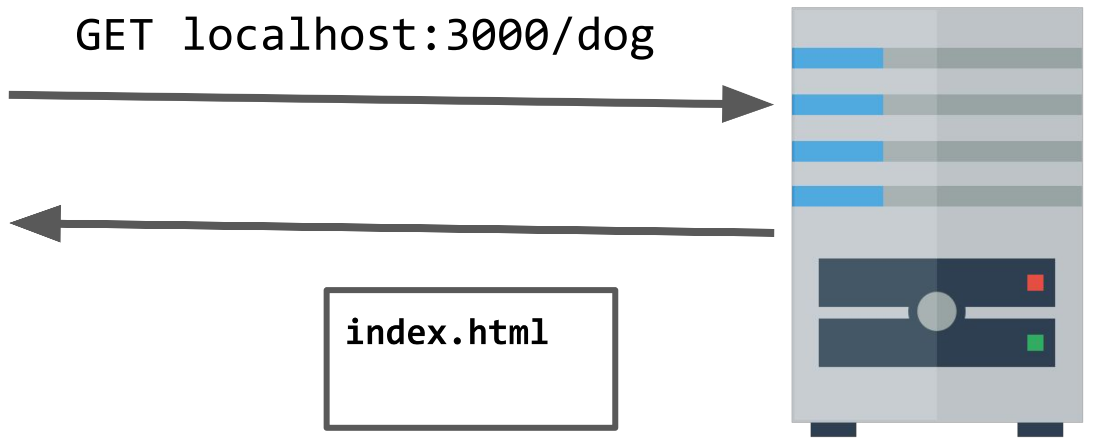
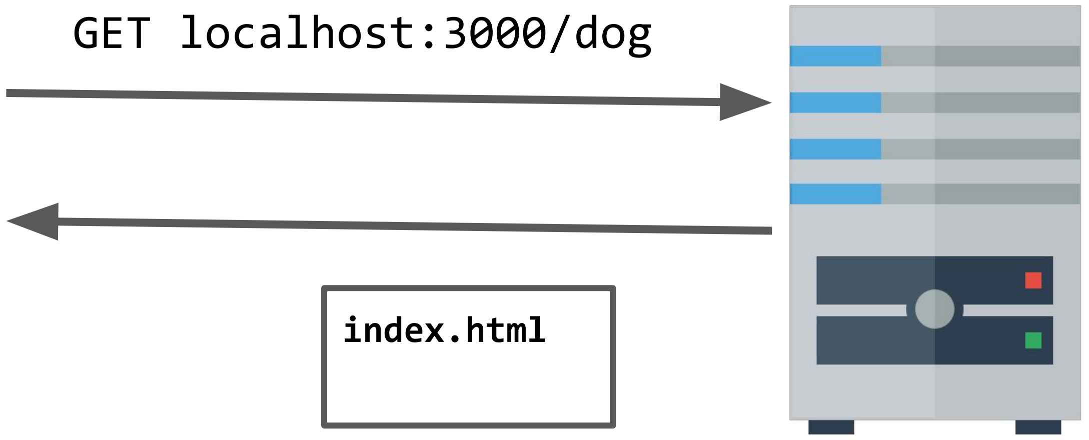


Single page web app

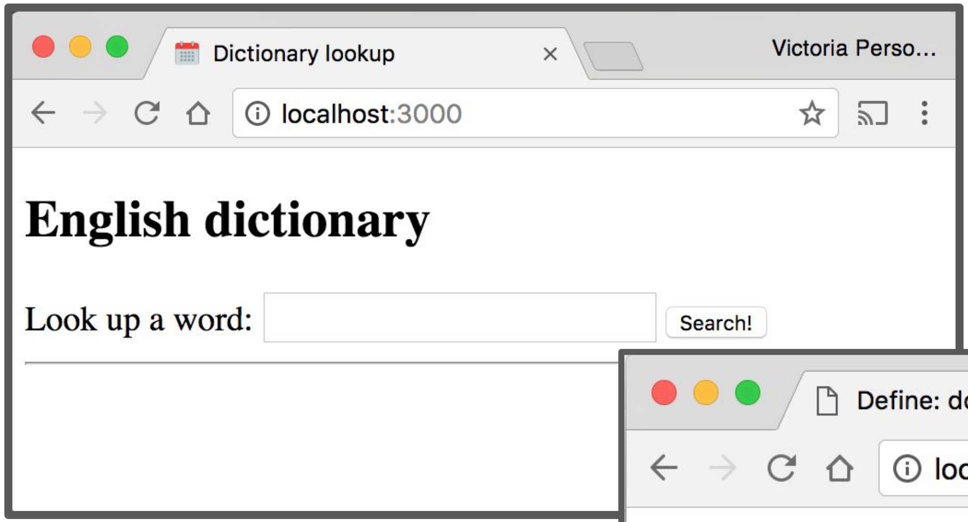
Another way to think of it:

- You embed **all your views** into index.html
- You use JavaScript to switch between the views
- You configure JSON routes for your server to handle sending and retrieving data



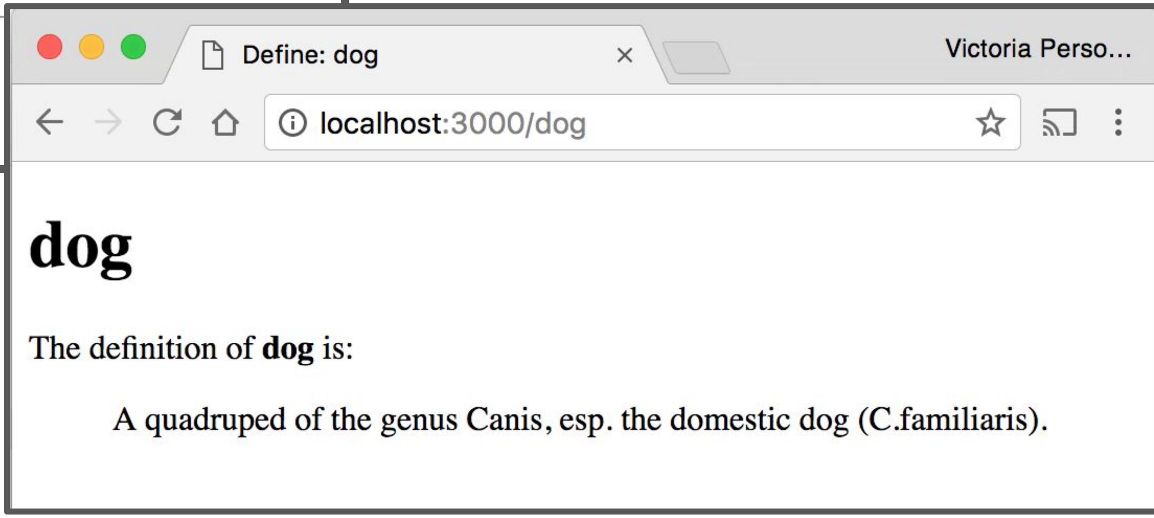
Dictionary example

Let's write our dictionary example as a single-page web app.



English dictionary

Look up a word:



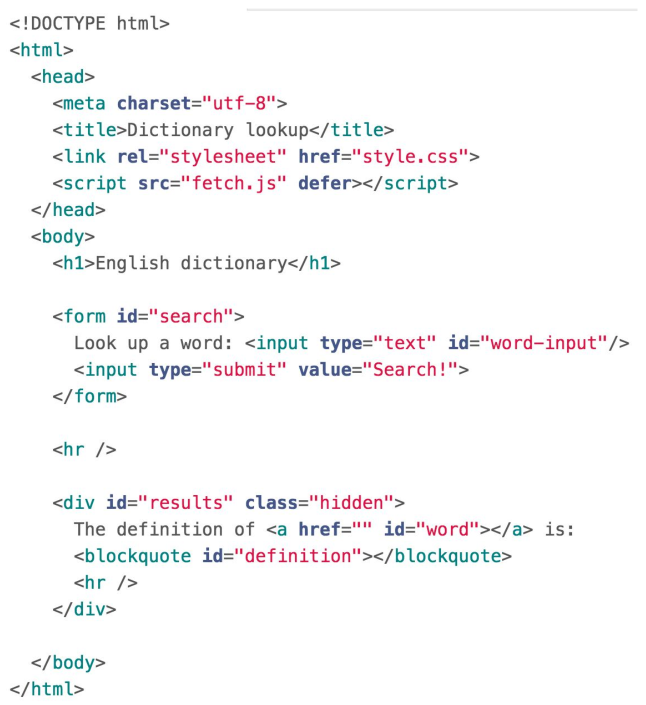
dog

The definition of **dog** is:

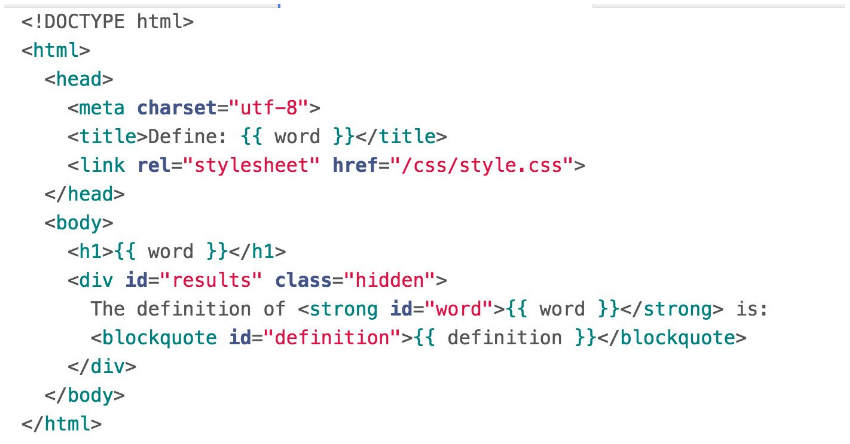
A quadruped of the genus Canis, esp. the domestic dog (C.familiaris).

Recall: Handlebars

For our multi-page dictionary app, we had two handlebars files: index.handlebars and word.handlebars



```html
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <title>Dictionary lookup</title>
    <link rel="stylesheet" href="style.css">
    <script src="fetch.js" defer></script>
  </head>
  <body>
    <h1>English dictionary</h1>

    <form id="search">
      Look up a word: <input type="text" id="word-input"/>
      <input type="submit" value="Search!">
    </form>

    <hr />

    <div id="results" class="hidden">
      The definition of <a href="" id="word"></a> is:
      <blockquote id="definition"></blockquote>
      <hr />
    </div>

  </body>
</html>
```



```html
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <title>Define: {{ word }}</title>
    <link rel="stylesheet" href="/css/style.css">
  </head>
  <body>
    <h1>{{ word }}</h1>
    <div id="results" class="hidden">
      The definition of <strong id="word">{{ word }}</strong> is:
      <blockquote id="definition">{{ definition }}</blockquote>
    </div>
  </body>
</html>
```

word.handlebars

index.handlebars

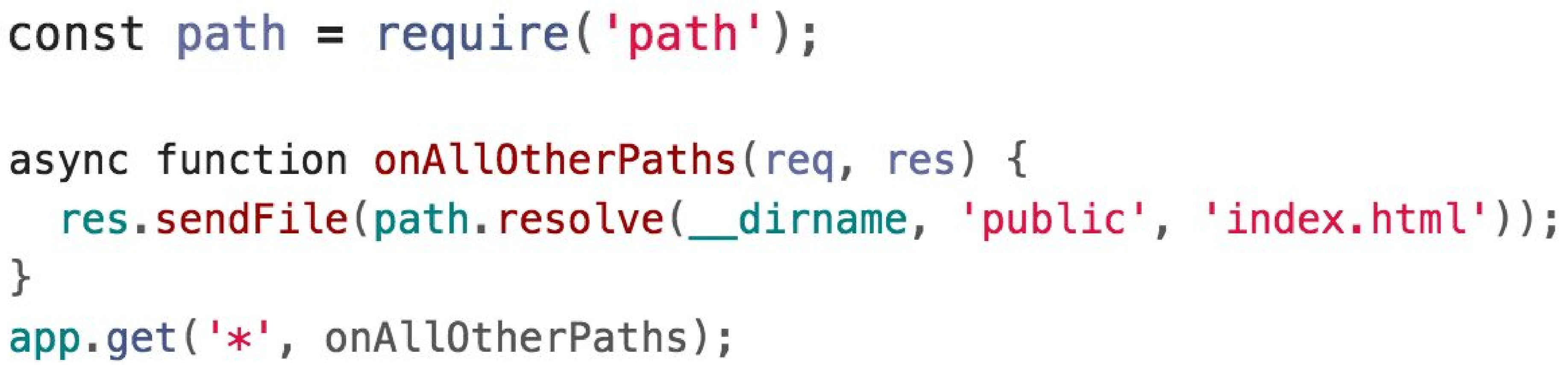
SPA

In a single-page web app, the HTML for both the Search page and the Word page are in index.html:

```html
<!-- View for the search page -->
<section id="main-view" class="hidden">
  <h1>English dictionary</h1>

  <form id="search">
    Look up a word: <input type="text" id="word-input"/>
    <input type="submit" value="Search!">
  </form>

  <hr />

  <div id="results" class="hidden">
    The definition of <a href="" id="word"></a> is:
    <blockquote id="definition"></blockquote>
    <hr />
  </div>
</section>

<!-- View for a single word -->
<section id="word-view" class="hidden">
  <h1></h1>
  The definition of <strong id="wv-word"></strong> is:
  <blockquote id="wv-def"></blockquote>
</section>
```

Server-side routing

For all requests that are not JSON requests, we return "index.html"



```
const path = require('path');

async function onAllOtherPaths(req, res) {
  res.sendFile(path.resolve(__dirname, 'public', 'index.html'));
}
app.get('*', onAllOtherPaths);
```

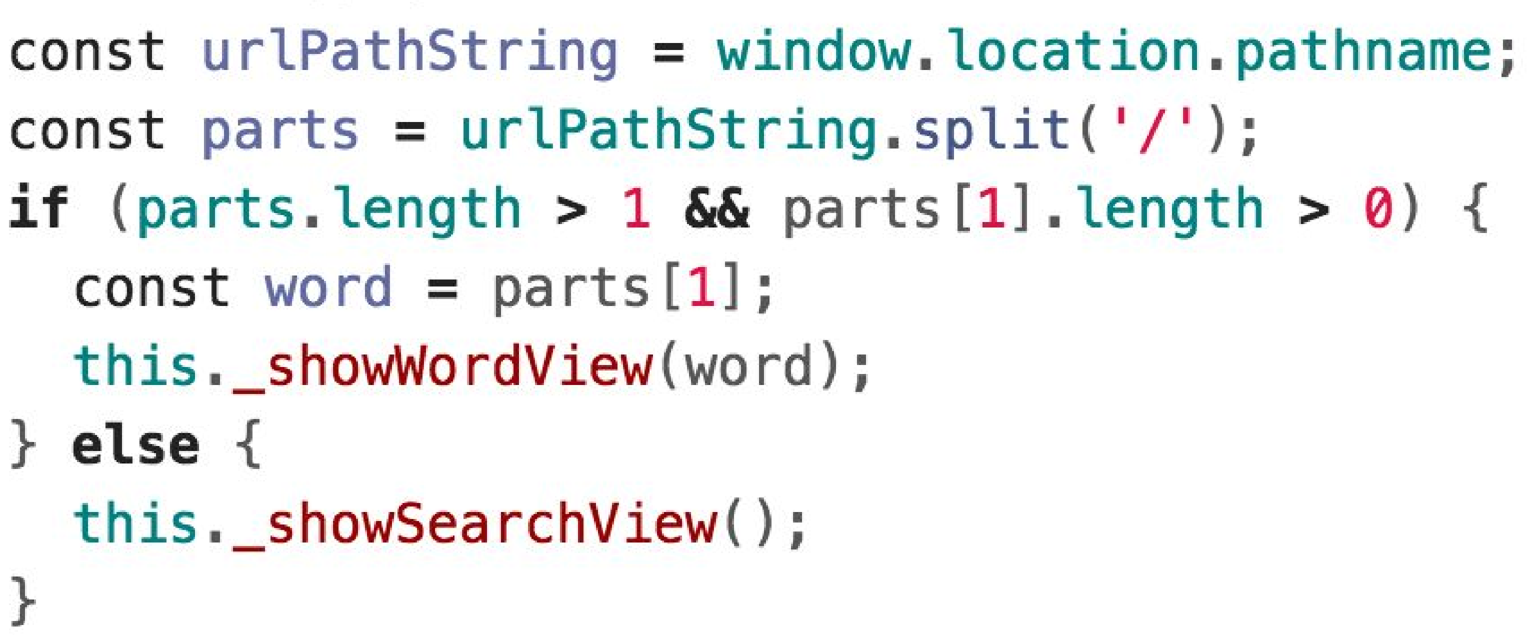
Client-side parameters

All views are hidden at first by the client.

```
<!-- View for the search page -->
<section id="main-view" class="hidden">
  ...
</section>

<!-- View for a single word -->
<section id="word-view" class="hidden">
  ...
</section>
```

Client-side parameters

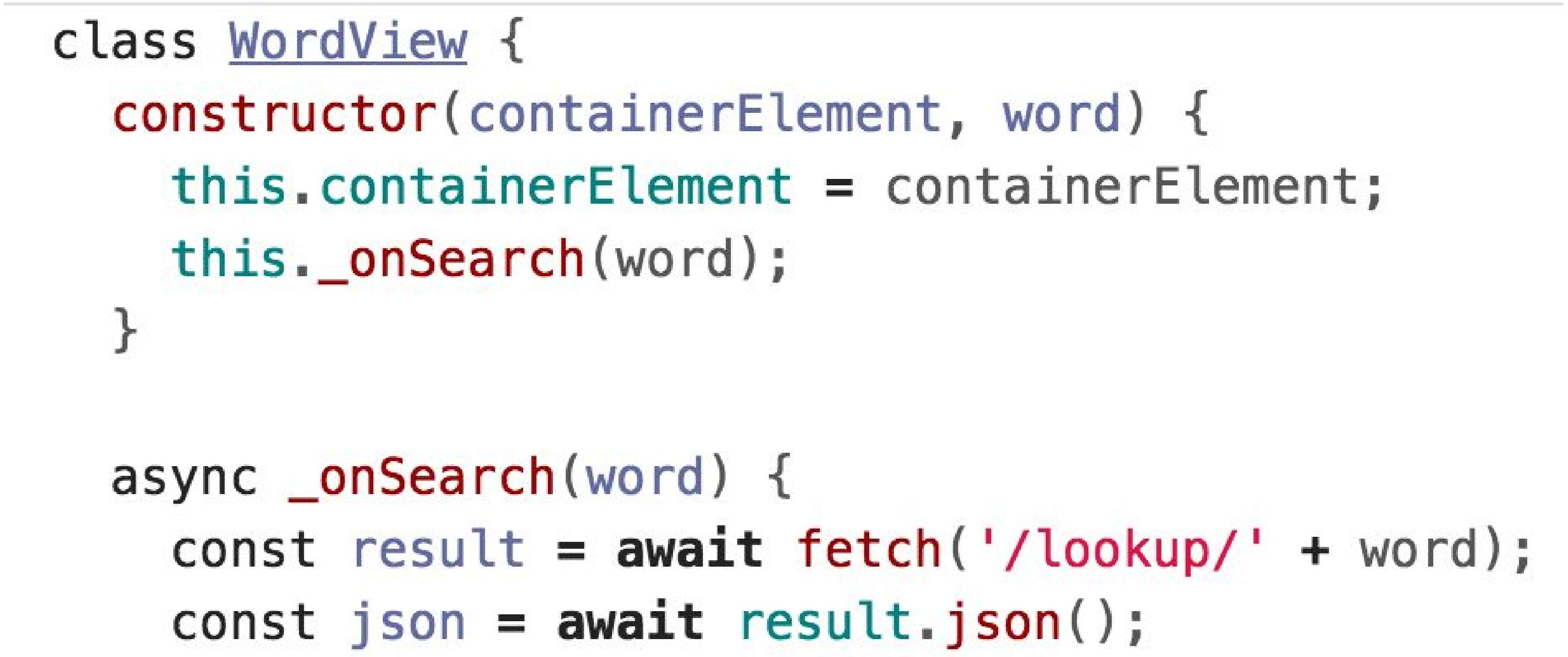
When the page loads, the client looks at the URL to decide what page it should display.



```
const urlPathString = window.location.pathname;
const parts = urlPathString.split('/');
if (parts.length > 1 && parts[1].length > 0) {
  const word = parts[1];
  this._showWordView(word);
} else {
  this._showSearchView();
}
```

Client-side parameters

To display the word view, the client makes a `fetch()` requests for the definition.



```
class WordView {
  constructor(containerElement, word) {
    this.containerElement = containerElement;
    this._onSearch(word);
  }

  async _onSearch(word) {
    const result = await fetch('/lookup/' + word);
    const json = await result.json();
```

Completed example

Completed example code:

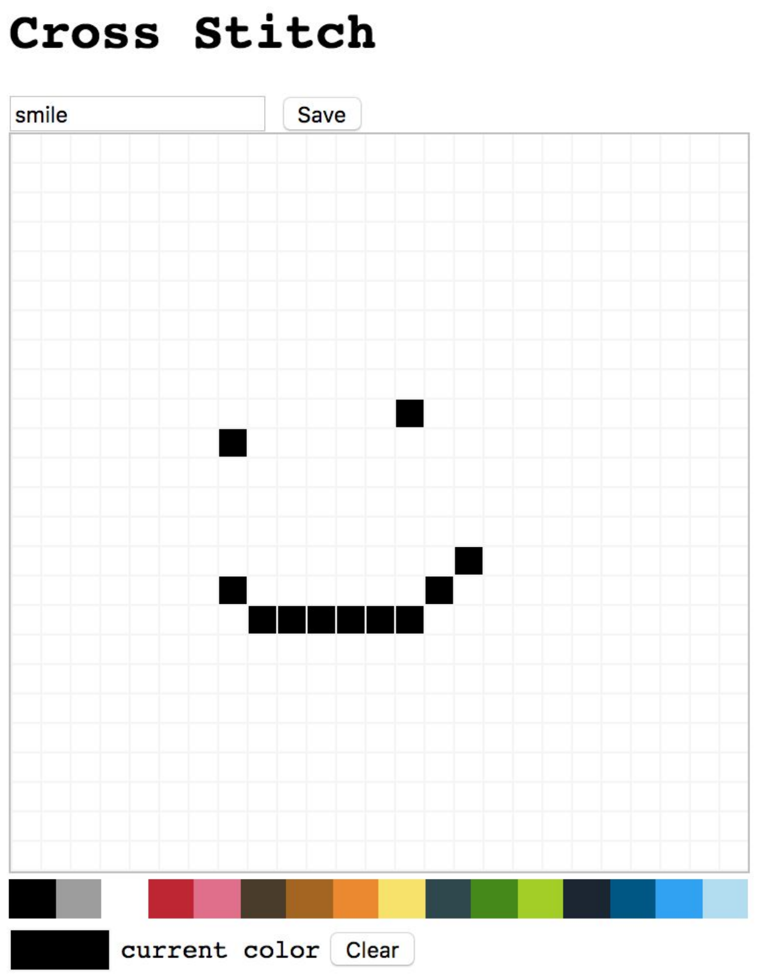
- dictionary-spa
- See run instructions

More MongoDB examples

Example: Cross-stitch

Let's say that we want to write a Cross-stitch App, that lets us create and save a cross-stitch drawing (called a "hoop").

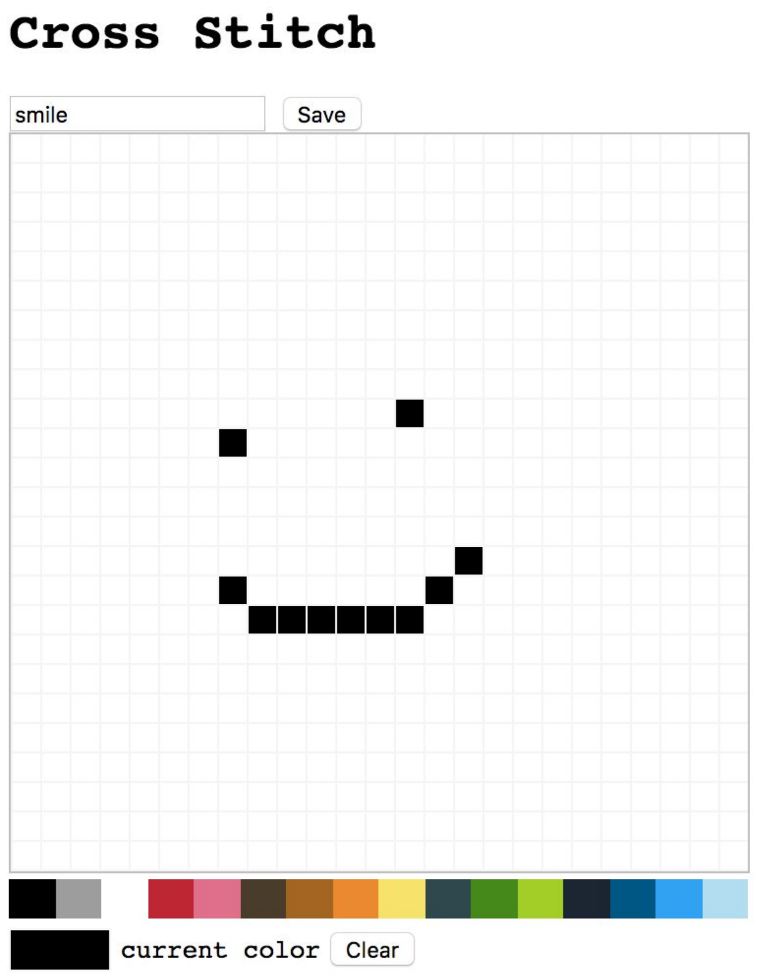
⟶ Simplest version: 1 global drawing



Implementation

There are 625 (25x25) small divs that make up each square of the drawing.

Q: How do we save the drawing to a database?



Data representation

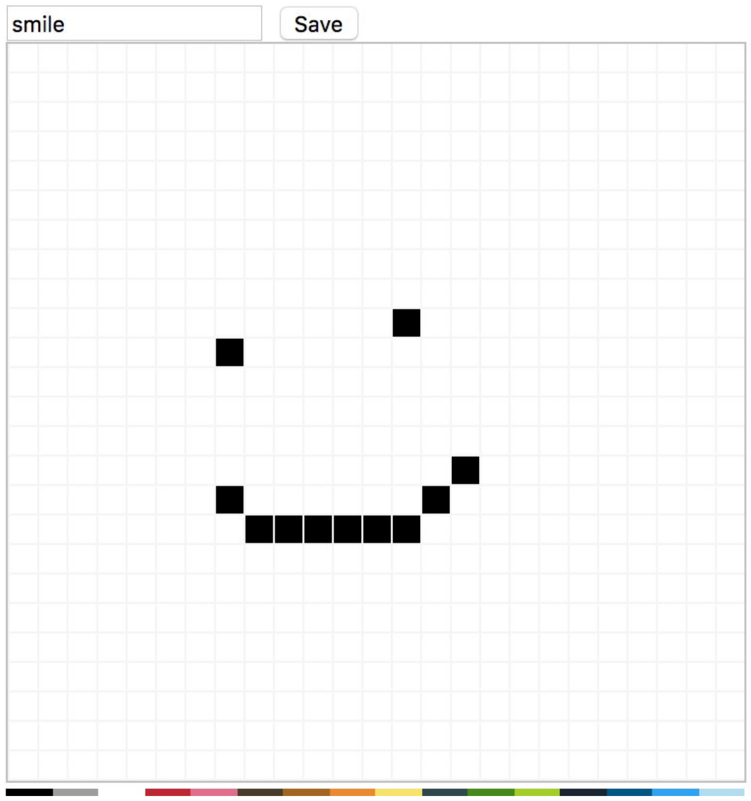
You need to figure out a way to represent your data, in a way that lets us load the drawing later.

For each colored square, need to know:

- Color
- Position

For the hoop, need to know:

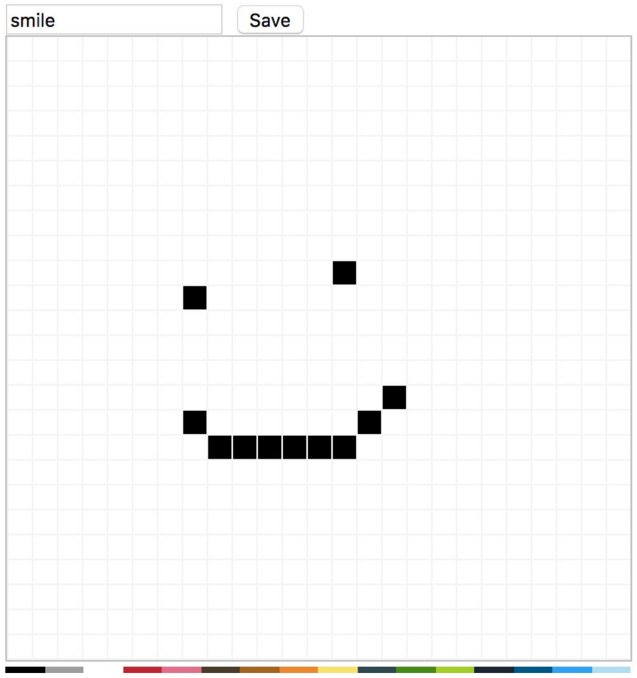
- Name of the hoop



Data representation options

One option: Give every pixel a number, 0-625, and assign each number a color

```
hoopData = {
  title: "smile",
  pixelData: [
      'white',
      'white',
      ...
    ]
}
```

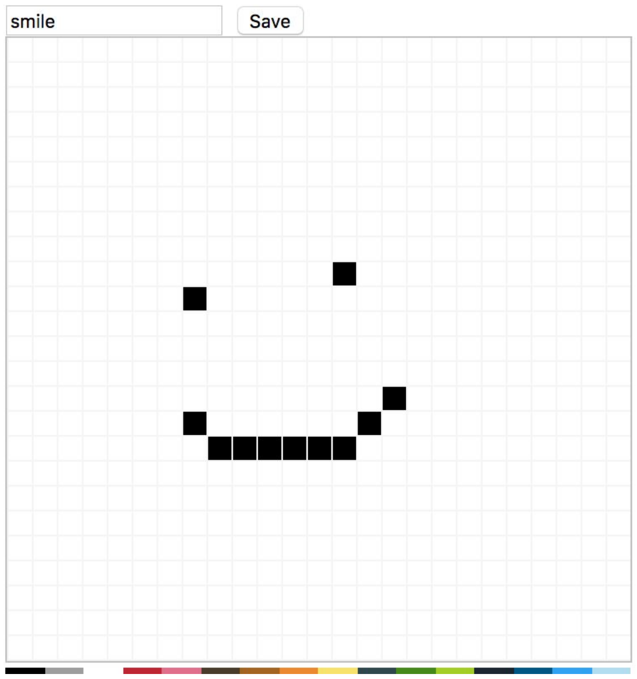


Data representation options

One option: Give every pixel a number, 0-625, and assign each number a color

Drawbacks:

- Would be hard to support grids of different sizes
- You don't need to store Information for every pixel, only the changed pixels

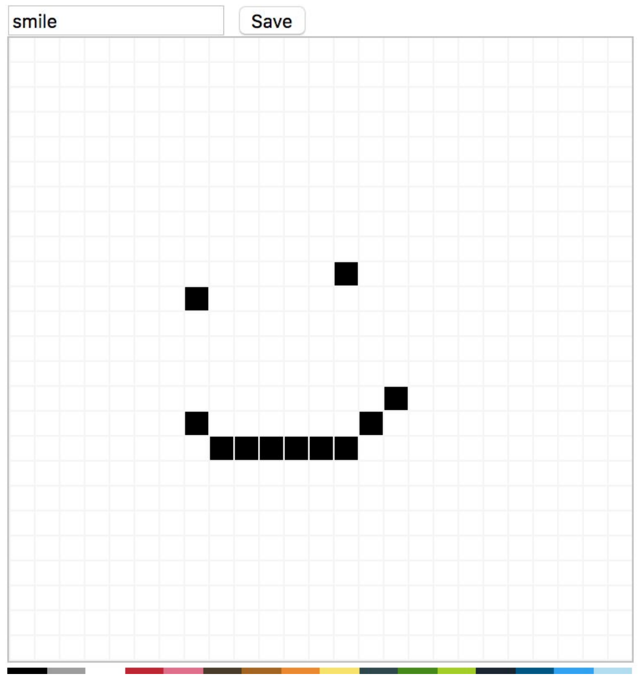


Data representation options

One option: Give every pixel a number, 0-624, and assign each number a color

Drawbacks:

- Would be hard to support grids of different sizes
- You don't need to store Information for every pixel, only the changed pixels



Data representation options

Another option: Give every non-empty pixel a row number, column number, and a color

```
hoopData = {
  title: "smile",
  pixelData: [
     { row: 12, col: 8, color: 'black' },
     { row: 11, col: 15, color: 'black' },
      ...
   ]
}
```

Saving data

Since there is only one hoop, saving and retrieving the data is pretty easy:

- On the **client side**, make a fetch POST request:

(The first time we save, we won't have an id value.)

```
const data = {
  id: this.id,
  name: title,
  data: this.hoop.getData()
};

const fetchOptions = {
  method: 'POST',
  headers: {
    'Accept': 'application/json',
    'Content-Type': 'application/json'
  },
  body: JSON.stringify(data)
};
await fetch('/save', fetchOptions);
```

Saving data

Since there is only one hoop, saving and retrieving the data is pretty easy:

- On the **server side**, upsert the entry to the database:

```
async function onSaveHoop(req, res) {
  const id = req.body.id;
  const name = req.body.name;
  const data = req.body.data;
  let query = {};
  if (id) {
    query = { _id: ObjectID(id) };
  }
  const newEntry = { name: name, data: data };
  const params = { upsert: true };
  const response = await hoops.update(query, newEntry, params);

  res.json({ success: true });
}
app.post('/save', jsonParser, onSaveHoop);
```

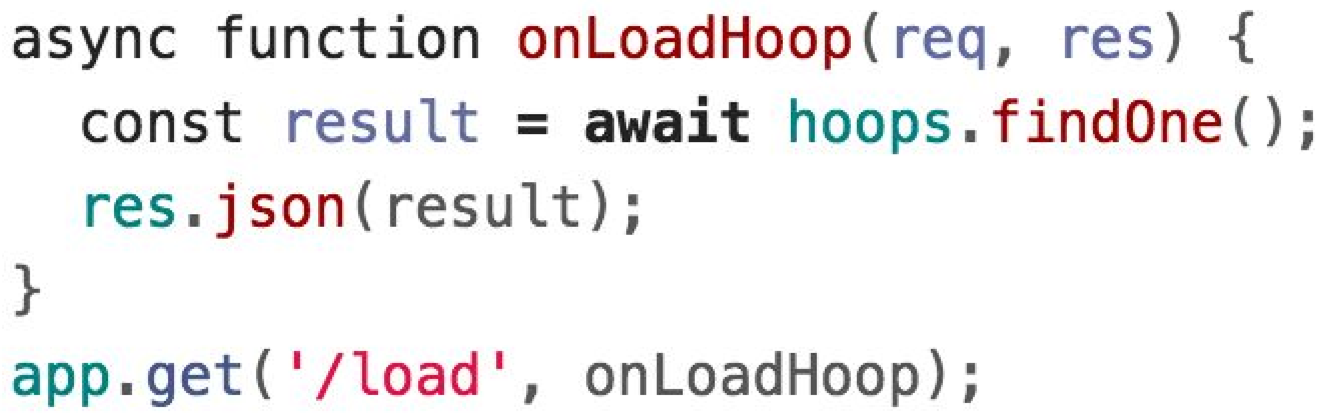
Loading data

On the **client side**, make a fetch GET request when the page first loads:

```
async _loadFromDb() {
  const response = await fetch('/load');
  const result =  await response.json();
  if (result) {
    const nameInput = document.querySelector('#hoop-name');
    nameInput.value = result.name;
    this.hoop.loadData(result.data);
    this.id = result.id;
  }
```

Loading data

On the **server side**, retrieving the data is *really* easy, since there is only one hoop:



```
async function onLoadHoop(req, res) {
  const result = await hoops.findOne();
  res.json(result);
}
app.get('/load', onLoadHoop);
```

Completed example

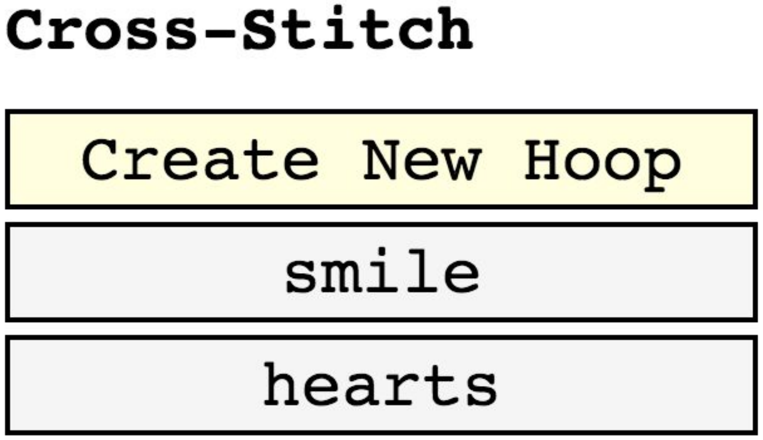
One global cross-stitch hoop:

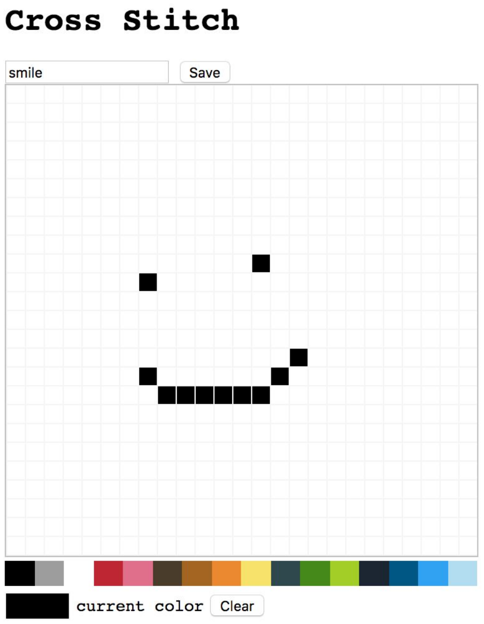
- cross-stitch-one-hoop
- See run instructions

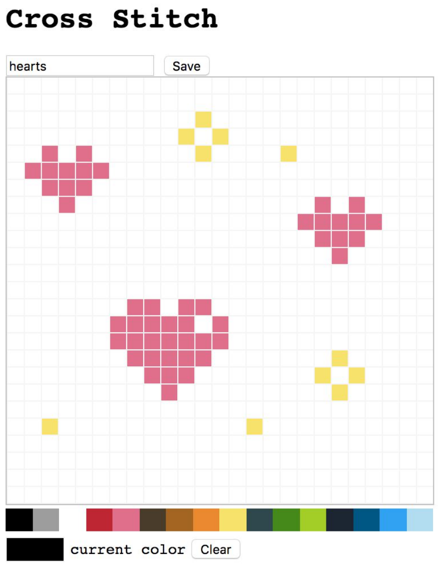
Example: Cross-stitch

Let's extend the cross-stitch App to create and save multiple cross-stitch drawings.

- Each drawing is loaded at localhost:3000/id/<id>

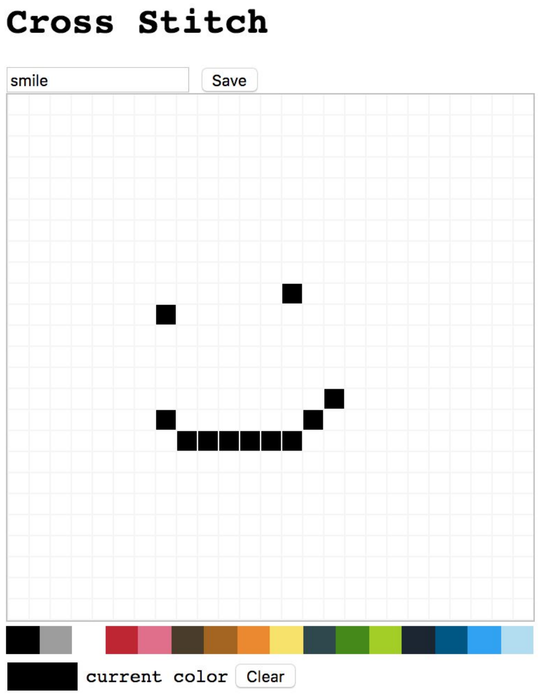


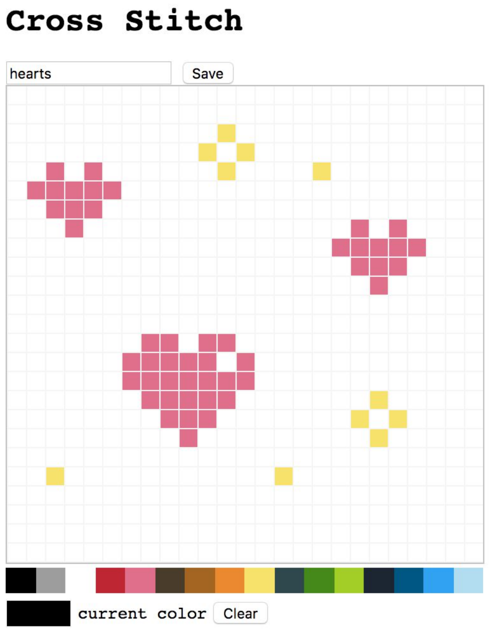




Data representation

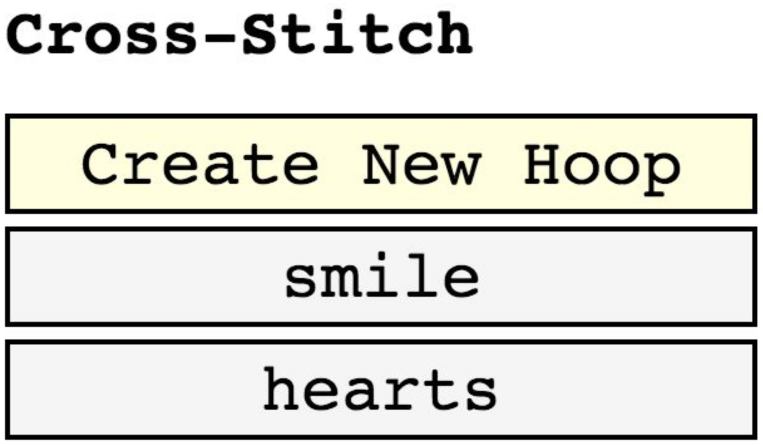
We can use the same data representation for each drawing; we're just going to have more than one:

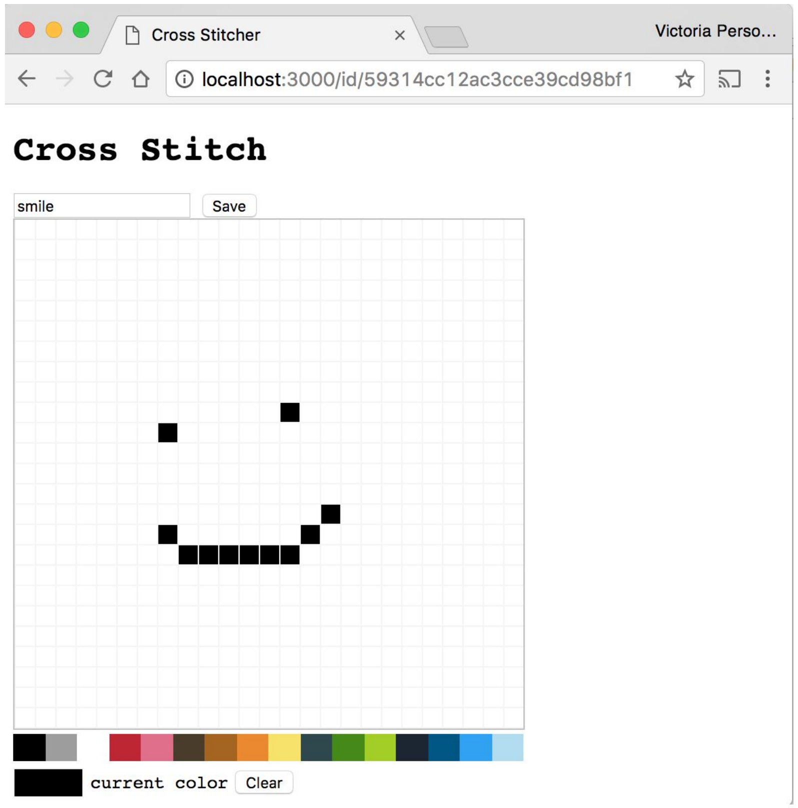




Two screens

A trickier decision is figuring out how to design the two screens, including a unique URL for each image:

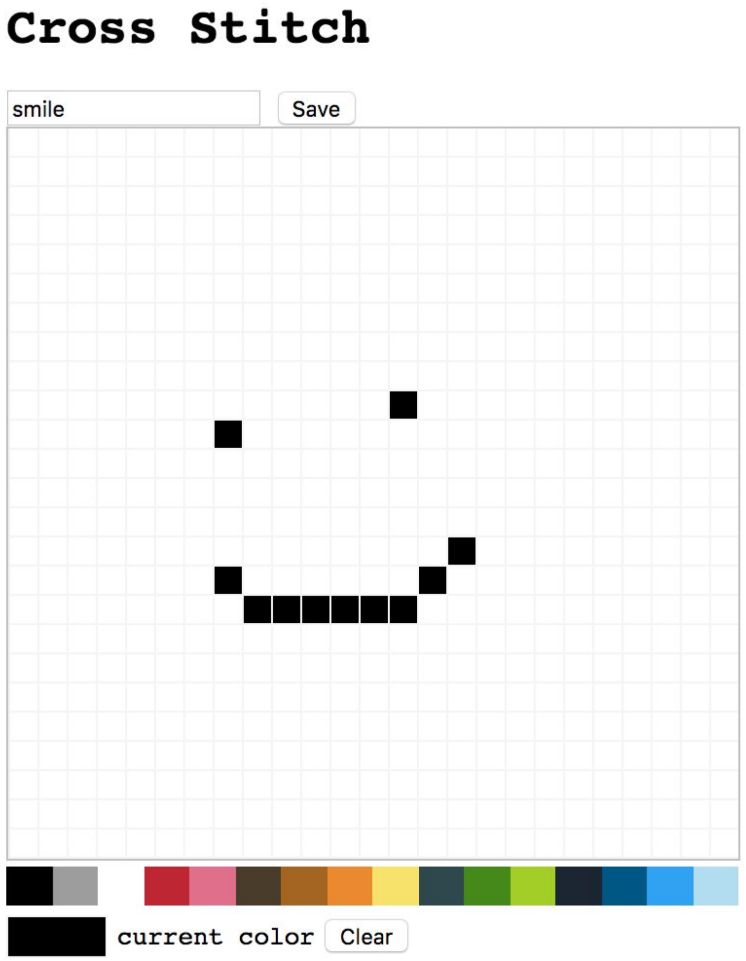




Loading data

Let's say that you have a URL at id/59314cc12ac3cce39cd98bf1.

Q: How do we load the URL for this id?



Loading data

One solution: Look at the URL on the client and get the ID

```
const urlPathString = window.location.pathname;
const parts = urlPathString.split('/');
if (parts.length > 2) {
  const id = parts[2];
  new EditView(id);
}
```

(Some other solutions:

- Build the page completely in Handlebars template (icky)
- Inject a global JavaScript variable into the Handlebars template (icky and tricky))

Loading data

The server-side lookups are easy:

```
async function onLoadHoop(req, res) {
  const id = req.params.id;
  const query = { _id: ObjectID(id) };
  const result = await req.hoops.findOne(query);
  res.json(result);
}
router.get('/load/:id', onLoadHoop);

async function onLoadAllHoops(req, res) {
  const result = await req.hoops.find().toArray();
  res.json({ response: result });
}
router.get('/load', onLoadAllHoops);
```

Aside: HashIds

In the cross-stitch app and the e-cards app, we used the raw MongoDB ids in the URL.

That's not great:

- Can be pretty guessable, since they don't change much between objects
- Very long
- Exposes database internals (the id) to the user

⟶ Try using the HashIds library

Completed example

Multiple cross-stitch hoops

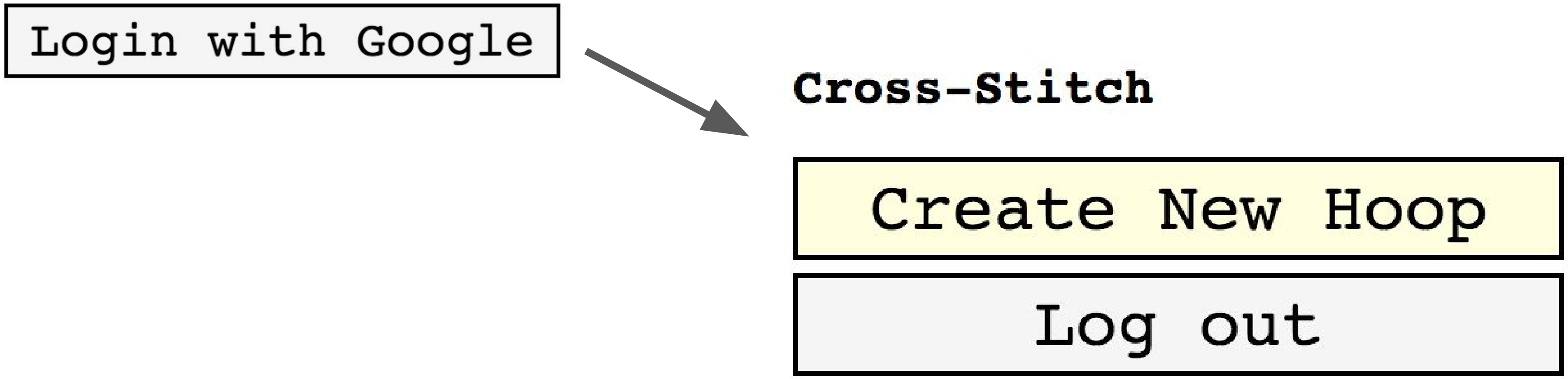
- cross-stitch-one-user
- See run instructions

Authentication

Adding user login

What if you want to add user login to your web page?

- For example, what if we extended the Cross-stitch app so that you had to log in before you could create a new cross-stitch drawing?



Authentication is hard

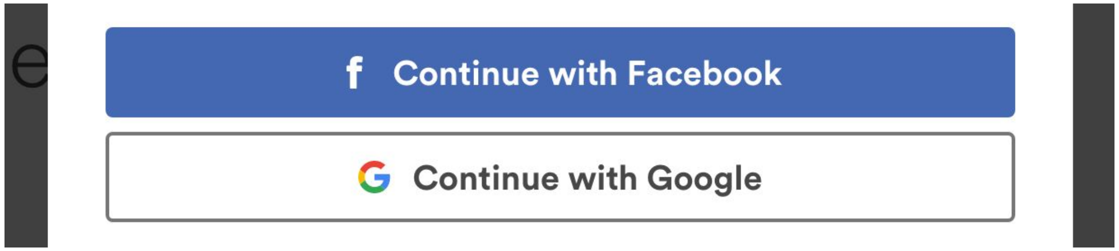
Trying to write your own login system is difficult:

- How are you going to save passwords securely?
- How do you help with forgotten passwords?
- How do you make sure users set a good password?
- Etc.

Luckily, **you don't have to build your own login**.

OAuth2

- OAuth2 is a standard for user authentication
- For users:
  - It allows a user to log into a website like AirBnB via some other service, like Gmail or Facebook
- For developers:
  - It lets you authenticate a user without having to implement log in
- Examples: "Log in with Facebook"



OAuth2 APIs

Companies like Google, Facebook, Twitter, and GitHub have OAuth2 APIs:

- Google Sign-in API
- Facebook Login API
- Twitter Login API
- GitHub Apps/Integrations

- OAuth2 is standardized, but the libraries that these companies provide are all different.
- You must read the documentation to understand how to connect via their API.

Using OAuth2

All OAuth2 libraries are going to be different, but they work like the following:

1. Get an API key
2. Whitelist the domains that can call your API key
3. Insert a `<script>` tag containing <company>'s API
4. In the **frontend** code:
   a. Use <company>'s API to create a login button
   b. When the user clicks the login button, you will get information like:
      i. Name, email, etc
      ii. Some sort of **Identity Token**

Aside: API keys

Generally you're not supposed to store API keys in your GitHub repo, even though we did in HW5 and in some lecture examples.

→ How are you supposed to store API keys?

API keys: Store in Env Vars

Generally you're not supposed to store API keys in your GitHub repo, even though we did in HW5 and in some lecture examples.

⟶ How are you supposed to store API keys?
⟶ Best practice: Use Environment Variables

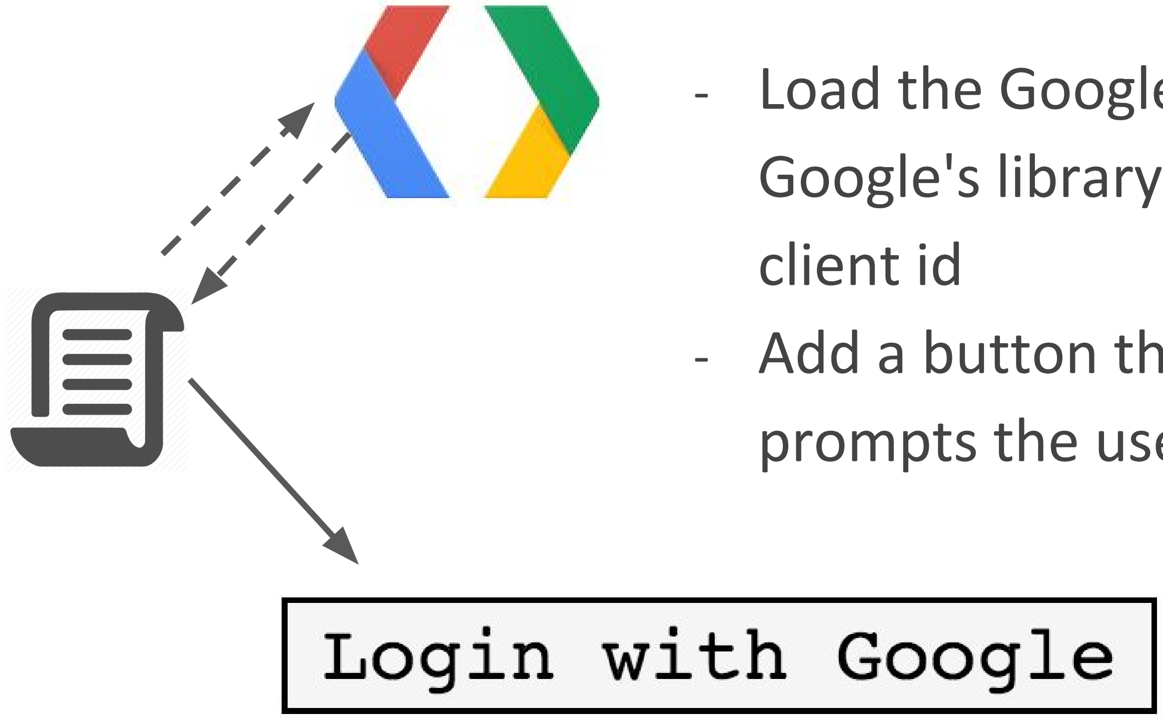
- Set the environment variable on your host, such as Heroku
- Can access the environment variable's value in NodeJS via `process.env.VAR_NAME`

Using OAuth2

You need to authenticate the identity of the client on the backend as well:

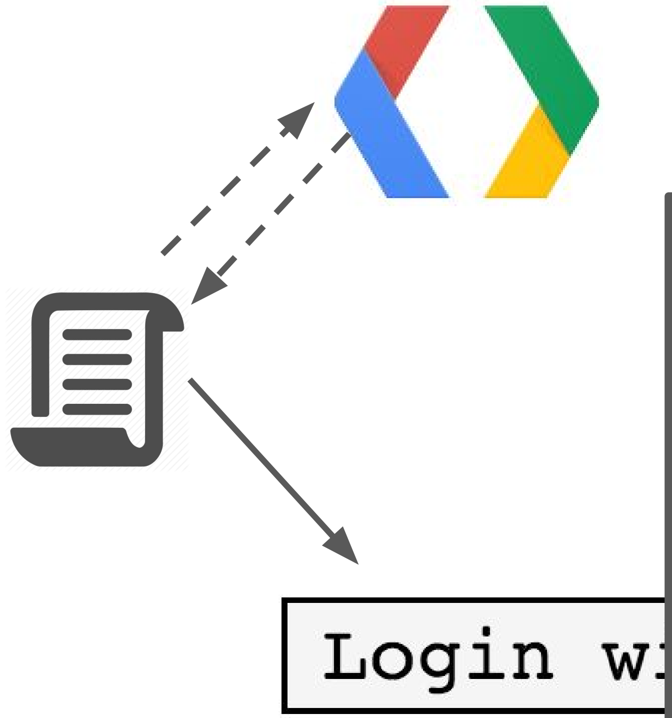
- In the **backend** code:
    - Use <company>'s libraries to verify the token from the client is a valid token

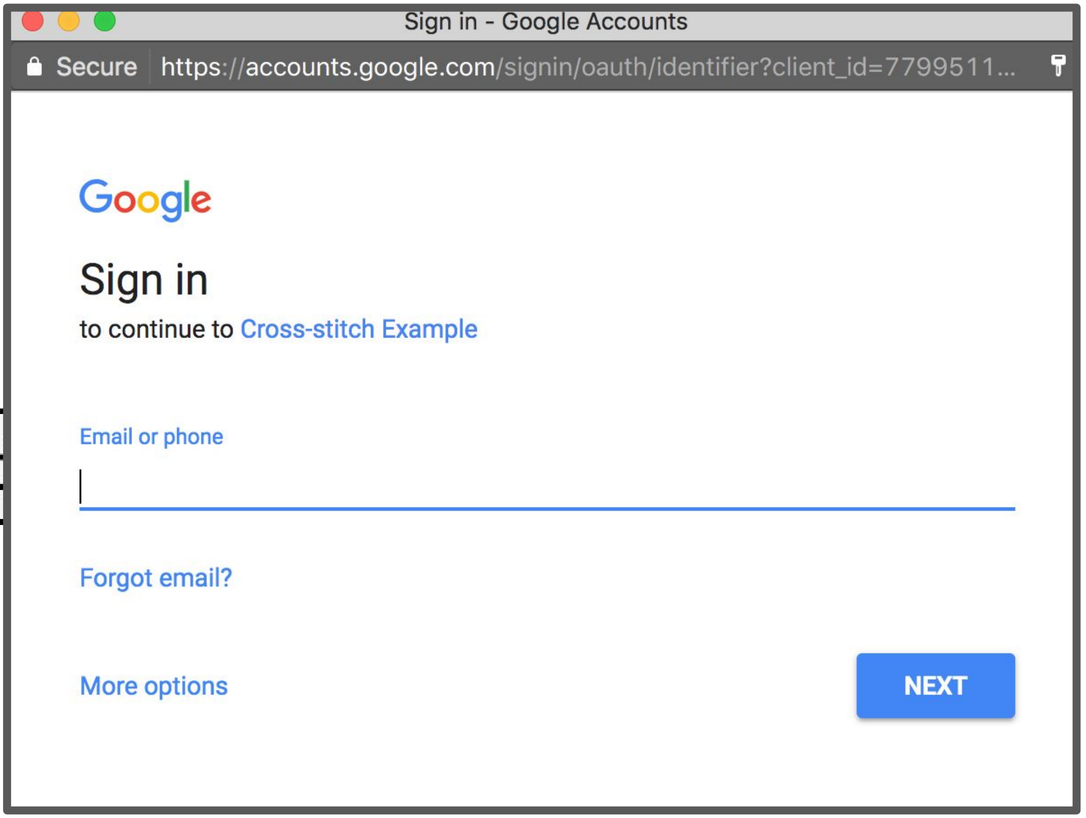
Using OAuth2: Frontend



- Load the Google API by calling Google's library functions with the client id
- Add a button that, when clicked, prompts the user to log into Google

Using OAuth2: Frontend




Sign in - Google Accounts

Secure https://accounts.google.com/signin/oauth/identifier?client_id=7799511...

Google

Sign in

to continue to Cross-stitch Example

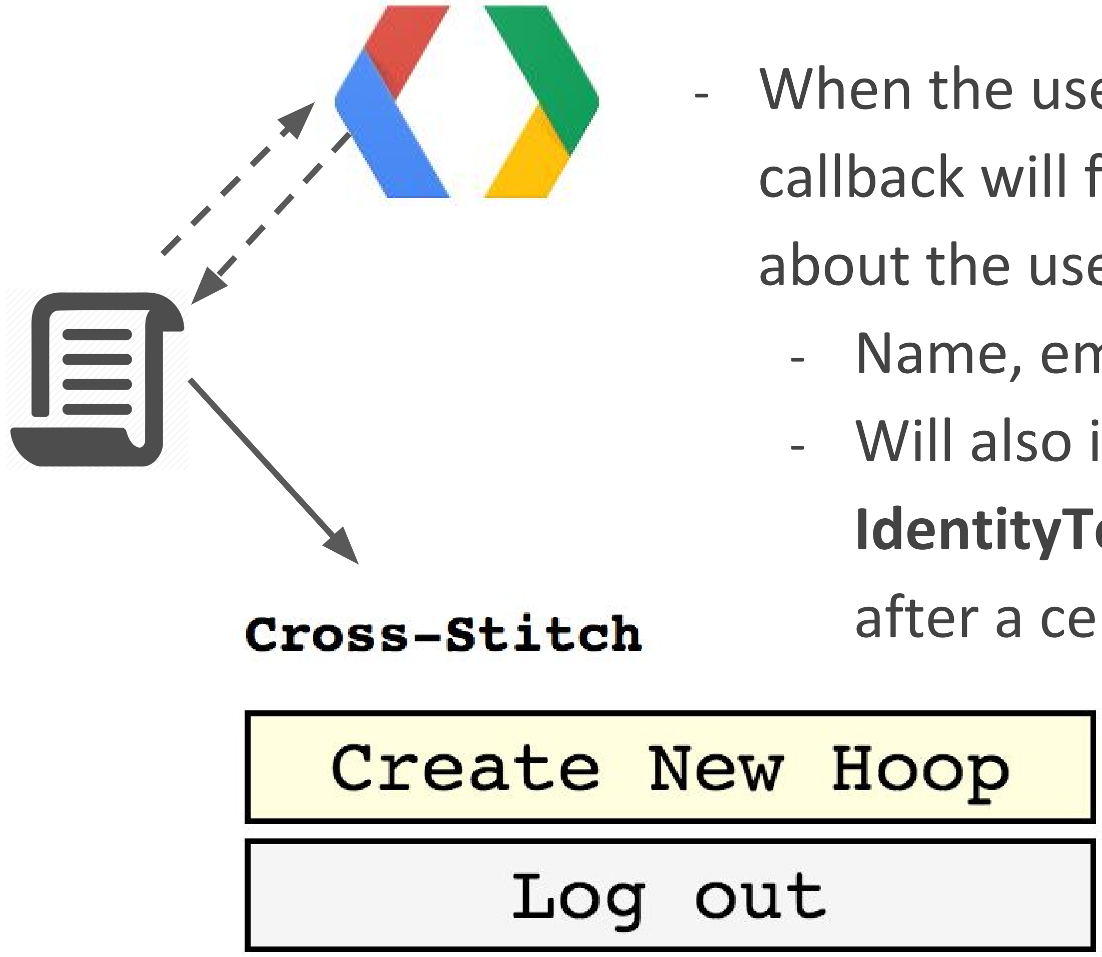
Email or phone

Forgot email?

More options

NEXT

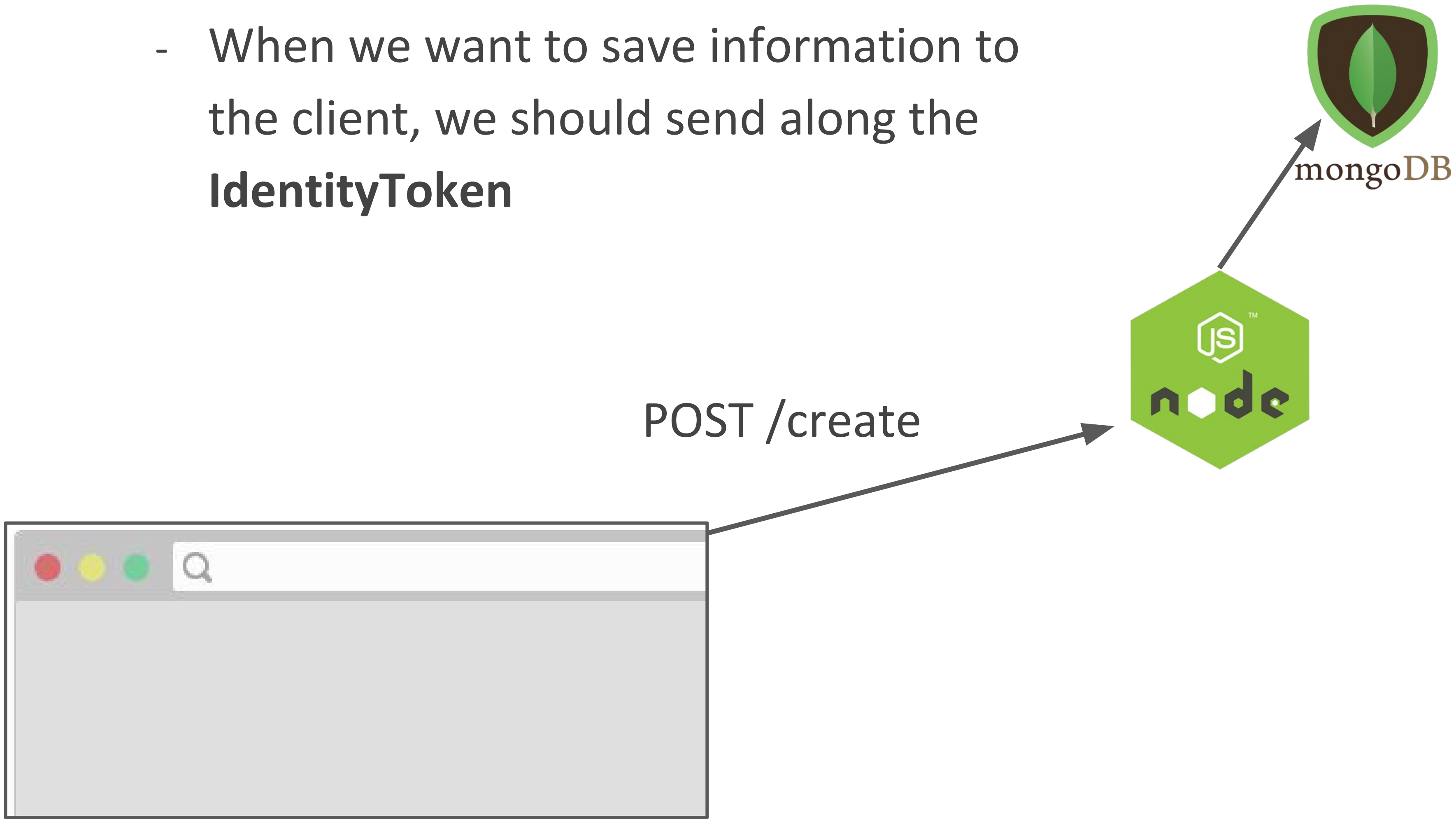
Using OAuth2: Frontend



- When the user logs in, the login callback will fire with information about the user
  - Name, email, etc
  - Will also include an **IdentityToken**, which will expire after a certain amount of time

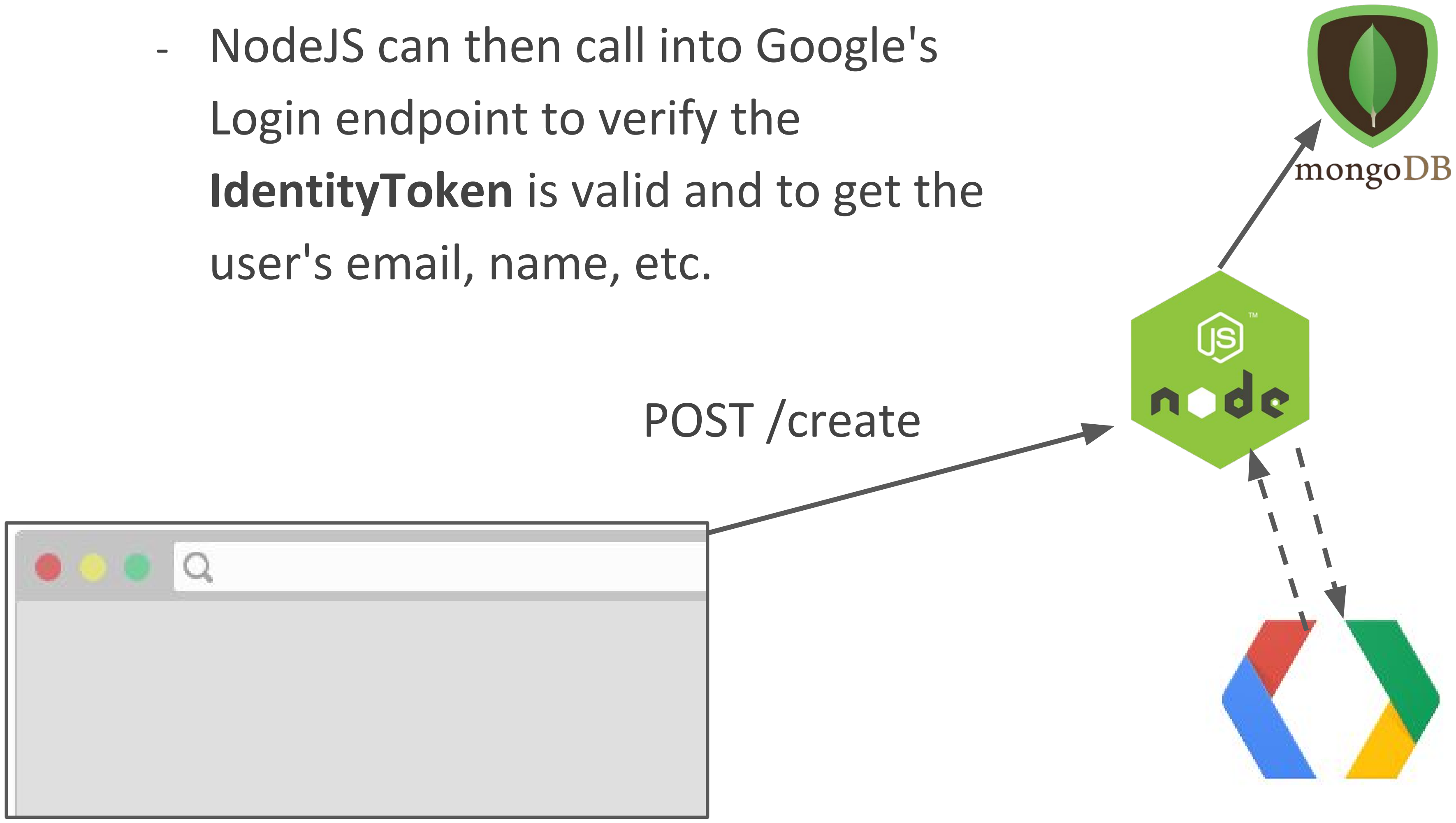
Using OAuth2: Backend

- When we want to save information to the client, we should send along the **IdentityToken**



Using OAuth2: Backend

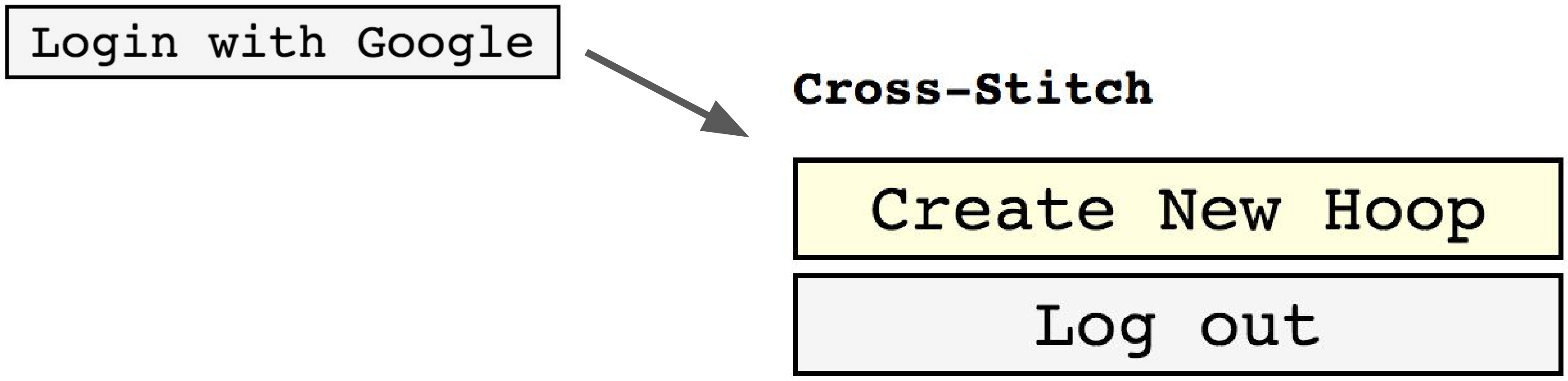
- NodeJS can then call into Google's Login endpoint to verify the **IdentityToken** is valid and to get the user's email, name, etc.

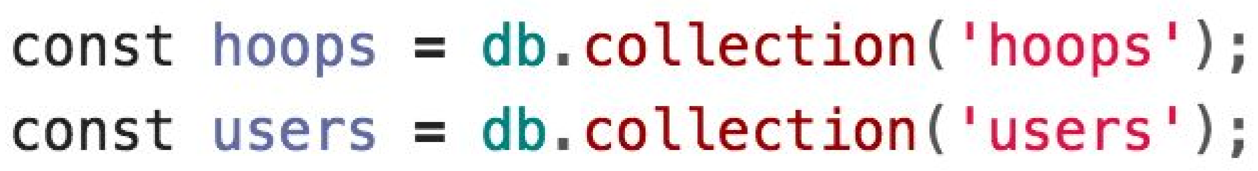


Adding user login

Adding user login to Cross-stitch:

- Now we have **two collections:** Users and Hoops

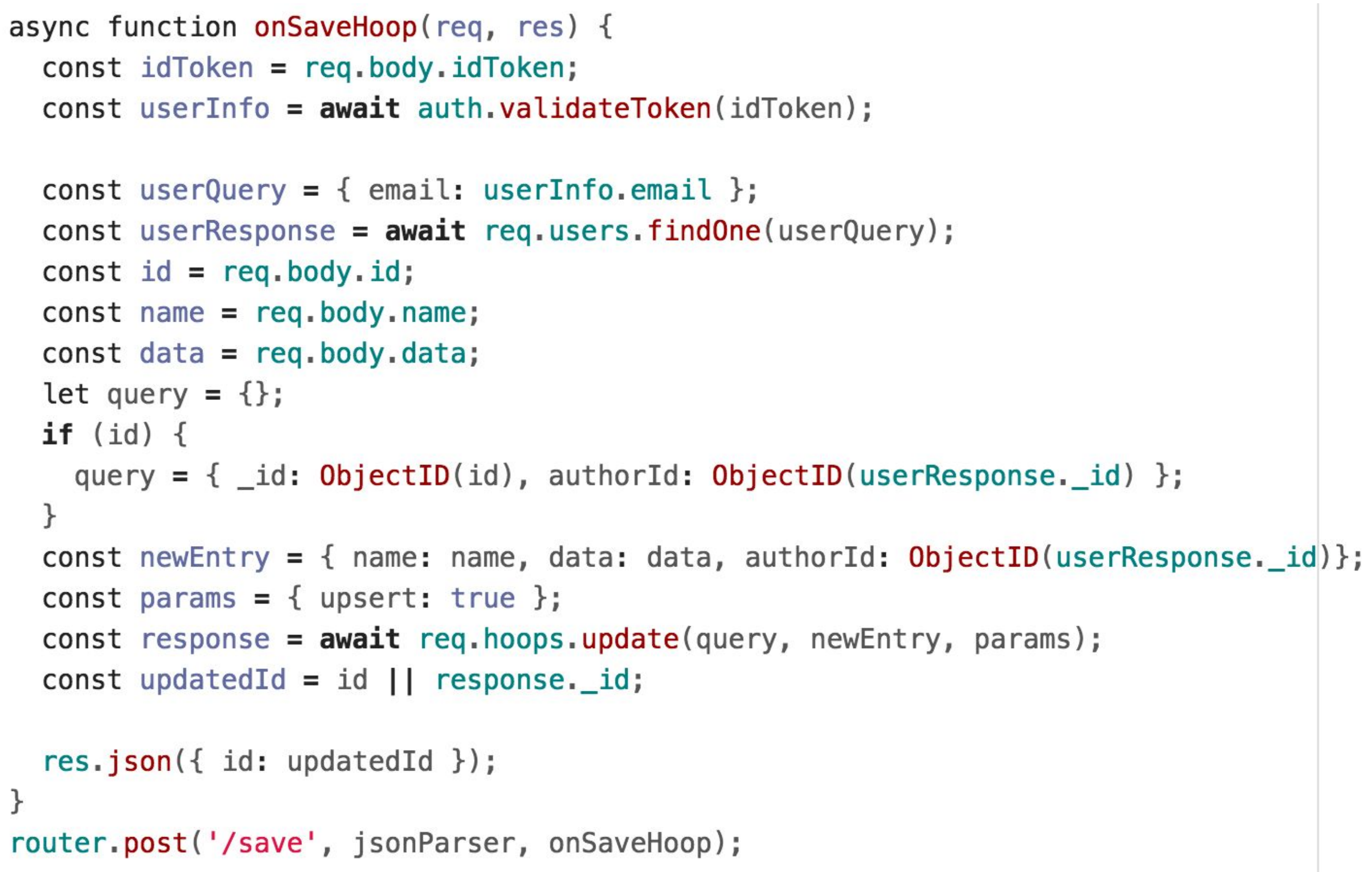




```
const hoops = db.collection('hoops');
const users = db.collection('users');
```

Saving hoops

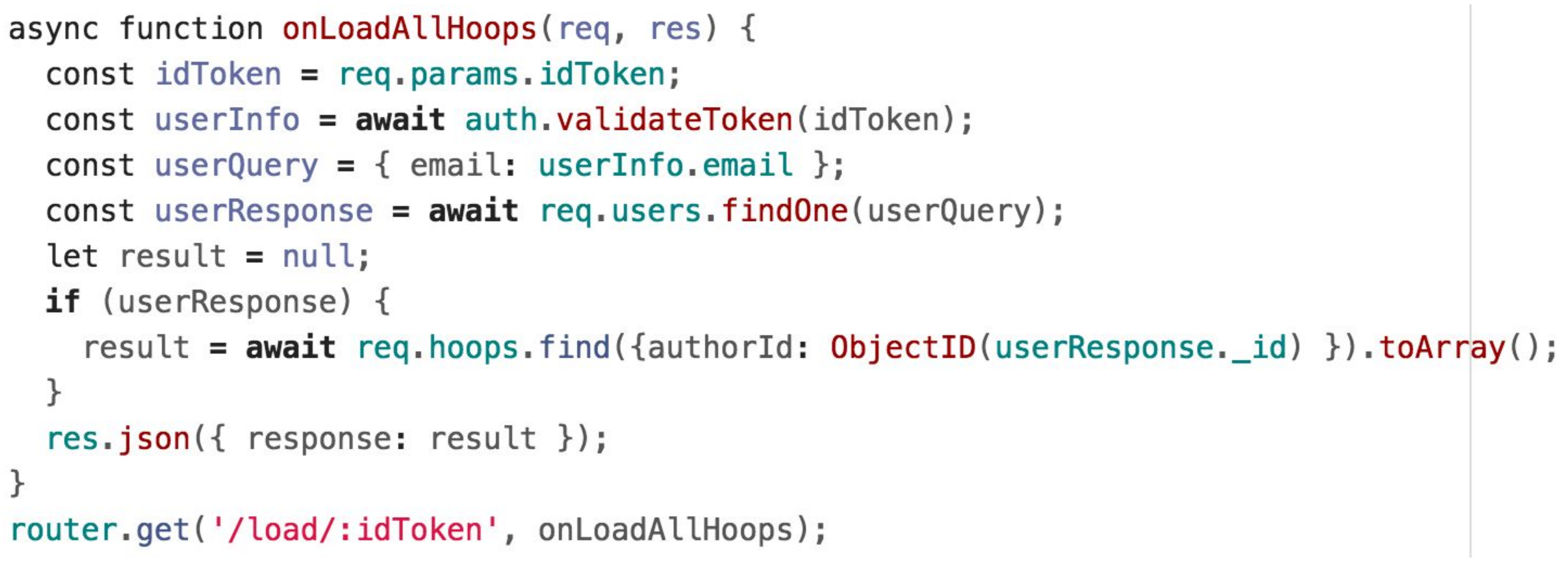
Every Hoop now has an author associated with it:



```
async function onSaveHoop(req, res) {
  const idToken = req.body.idToken;
  const userInfo = await auth.validateToken(idToken);

  const userQuery = { email: userInfo.email };
  const userResponse = await req.users.findOne(userQuery);
  const id = req.body.id;
  const name = req.body.name;
  const data = req.body.data;
  let query = {};
  if (id) {
    query = { _id: ObjectID(id), authorId: ObjectID(userResponse._id) };
  }
  const newEntry = { name: name, data: data, authorId: ObjectID(userResponse._id)};
  const params = { upsert: true };
  const response = await req.hoops.update(query, newEntry, params);
  const updatedId = id || response._id;

  res.json({ id: updatedId });
}
router.post('/save', jsonParser, onSaveHoop);
```

Loading hoops

You also need to load hoops by author:



```
async function onLoadAllHoops(req, res) {
  const idToken = req.params.idToken;
  const userInfo = await auth.validateToken(idToken);
  const userQuery = { email: userInfo.email };
  const userResponse = await req.users.findOne(userQuery);
  let result = null;
  if (userResponse) {
    result = await req.hoops.find({authorId: ObjectID(userResponse._id) }).toArray();
  }
  res.json({ response: result });
}
router.get('/load/:idToken', onLoadAllHoops);
```

This is also called an "application-level join"

Completed example

User login for cross-stitch:

- cross-stitch-user-login
- See run instructions

MongoDB database design

For more on MongoDB database design, MongoDB wrote a short, helpful blog series:

- 6 Rules of Thumb for MongoDB Schema Design:
    - Part 1: Basic modeling techniques
    - Part 2: Referencing
    - Part 3: Design recommendations

For *a lot* more on database design, take a database class!