Human-Computer Interaction Design

COGS120/CSE170 - "Intro. HCI"

Instructor: Philip Guo

Lab 4 - Server-side backend web development (2016-10-20)

by Michael Bernstein, Scott Klemmer, and Philip Guo

Lab roadmap

Portfolio website

Browser

Server-side

Frontend development

- HTML for page structure: Lab 1
- CSS for styling: Lab 2
- JavaScript for interaction: Lab 3
- AJAX for updates w/out reload: Lab 6

Backend development

- Express server-side web framework for Node.js: **Lab 4**
- Data storage (future)

Generate pages on-demand based on user input

Routes
Controllers
Templates
JSON

The story so far… loading static content

This only works if all data is ***static***:
they never change based on user input.

What about…

https://www.facebook.com/zuck

Home 20+ Khalil

Mark Zuckerberg

Follow Message

Timeline About Photos Friends More

Follow Mark to get his public posts in your news feed.

Follow

18,821,144 Followers

Recent
2013
2012
2011
2010
2009
2008
2007
2006
2005
2004
2002
2000
1998
Born

About

Founder and CEO at Facebook
February 4, 2004 to present

Studied Computer Science at Harvard University
Past: Phillips Exeter Academy and Ardsley High School

Lives in Palo Alto, California

From Dobbs Ferry, New York

Followed by 18,821,144 people

Khalil shared a link.
about a minute ago

What about…


Google
human-computer interaction
Web
Books
Images
News
Videos
More
Search tools
About 43,600,000 results (0.17 seconds)
Ad related to human-computer interaction
Computer Interaction - mhcid.washington.edu
mhcid.washington.edu/
Earn a MS in Human-Computer Interaction. Get a Degree in 1 Year
About the Program
Admissions
FAQs
Curriculum
Scholarly articles for human-computer interaction
Human computer interaction - Dix - Cited by 4292
Human-computer interaction - Baecker - Cited by 61
… and design tool in human-computer interaction - MacKenzie - Cited by 850
Human–computer interaction - Wikipedia, the free encyclopedia
en.wikipedia.org/wiki/Human–computer_interaction
Human–computer interaction (HCI) involves the study, planning, and design of the interaction between people (users) and computers. It is often regarded as the ...
Goals - Differences with related fields - Design - Display designs
Stanford HCI Group
hci.stanford.edu/

concepts

Dynamically generating HTML with code

GET http://introhci.org/name/Michael

```
function {
  ...
}
```

Welcome, Michael!

Web browser (e.g., Chrome on your laptop)

Web server (e.g., Heroku) runs code to *generate* HTML

This architecture supports **dynamic** responses. Instead of loading an HTML file, you are running code that *generates* an HTML file on-demand.

Web servers turn **requests** into **responses**

Conceptually (this is pseudocode, not real code!) …

```
if (request == “homepage”) {
  homepage HTML = “<h1>Welcome!</h1><p>Thanks for..."
  load user’s photo from database and add it to HTML
  return homepage HTML
}
else if (request == “project page”) {
  get project name
  get project description
  project HTML = “<h1>” + project name + “</h1>...”
  return project HTML
}
```

Node.js (remember from Lab 2?) is a web server implemented in JavaScript

Conceptually (this is pseudocode, not real code!) …

```
if (request == “homepage”) {
  homepage HTML = “<h1>Welcome!</h1><p>Thanks for..."
  load user’s photo from database and add it to HTML
  return homepage HTML
}
else if (request == “project page”) {
  get project name
  get project description
  project HTML = “<h1>” + project name + “</h1>...”
  return project HTML
}
```

Dissection: hello world Node.js application

```
# clone from: https://github.com/pgbovine/lab4
# change into the introHCI/lab4/hello directory
cd introHCI
cd lab4/hello
```

```
# start Node.js web server
node app.js
```

```
pgbovine@Philips-Air ~/Desktop/introHCI/lab4/hello
$ node app.js
connect deprecated methodOverride: use method-override npm module instead app.js:24:17
express-session deprecated req.secret; provide secret option node_modules/express/node_
s/connect/lib/middleware/session.js:33:10
Express server listening on port 3000
```

Dissection: the major arteries

```
introHCI/lab4/hello
├─app.js
├─┬routes
│ ├──hello.js
├─┬views
│ ├──index.handlebars
├─┬public
│ ├──css
│ ├──js
│ ├──images
```

Main project file

What do we do when the browser requests /name?

HTML lives here

Where did the HTML come from?

Inside a file called views/index.handlebars:

```
<div class="container">
    <div class="jumbotron">
        <h1>Hello, {{name}}!</h1>
    </div>
</div>
```

Template variable
Replaced with a variable that is passed to the template

Where did the template get the {{name}} variable?

Inside the file routes/hello.js:

```
exports.view = function(req, res){
  var nameToShow = req.params.userName;
  console.log("name is " + nameToShow);
  res.render('index', {
    'name': nameToShow,
  });
};
```

URL parameters
Get the name
from the URL

Render template
Insert variables into
the HTML template

What called the `hello.view()` function?

Inside the application's main file, app.js:

```
var app = express();
var hello = require('./routes/hello');
app.get('/hello/:userName', hello.view);
```

Function to call
Call `view()` in the `hello` module

URL parameters (:variable)
Place the URL parameter into the `userName` variable

All together now

`{{name}}` in HTML template

is populated with…

`userName` request parameter in `hello.view()`

which is called by…

A function registered to listen to
the URL `http://localhost:3000/hello/:userName`

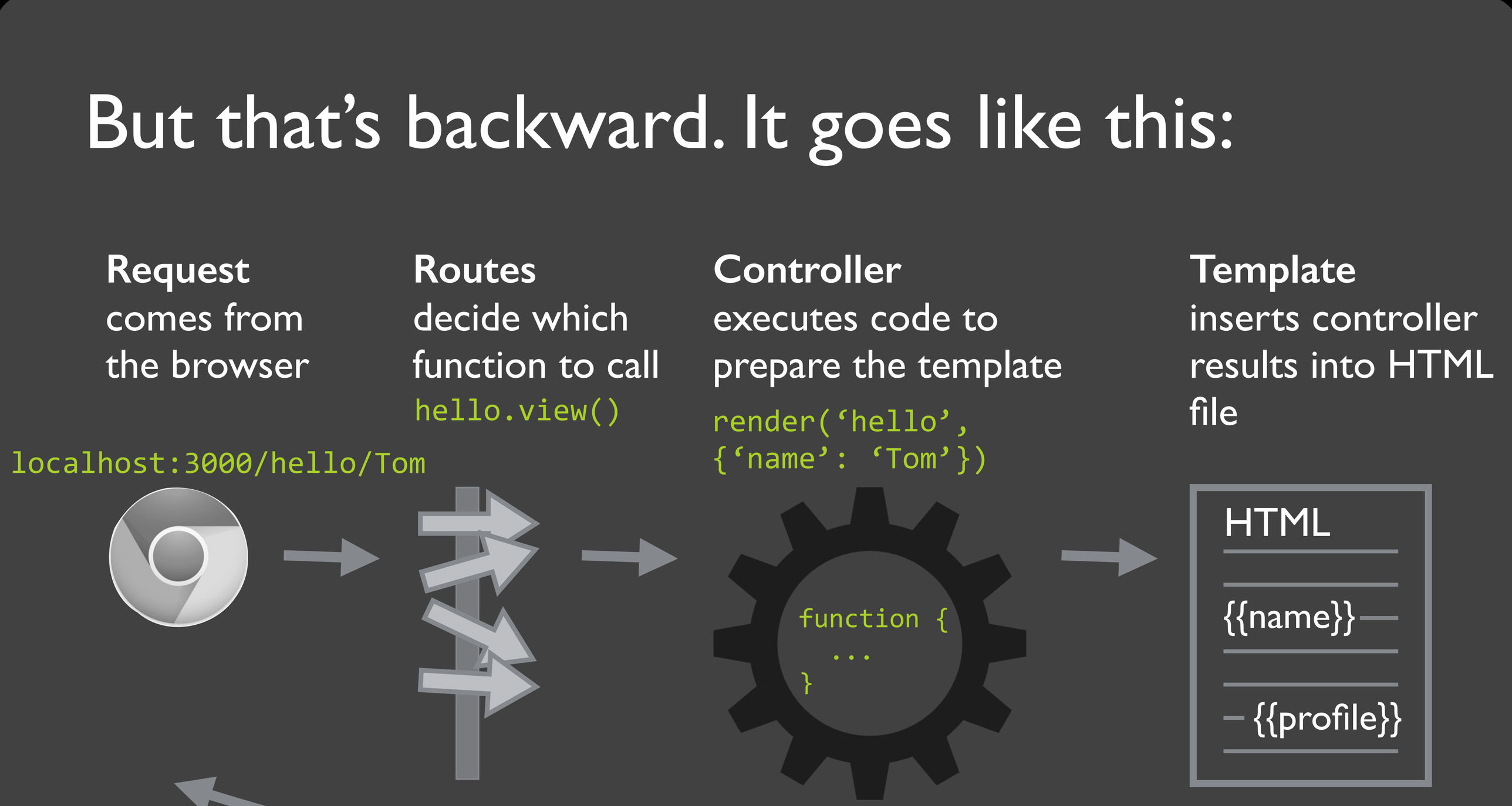
But that's backward. It goes like this:

Request
comes from the browser

Routes
decide which function to call
`hello.view()`

Controller
executes code to prepare the template
`render('hello', {'name': 'Tom'})`

Template
inserts controller results into HTML file



Our server-side web development stack: Google these terms

Node.js
Web server

JavaScript web server

Express
Web framework

Friendlier web development with node.js

Handlebars
Template engine

Syntax for inserting variables into HTML

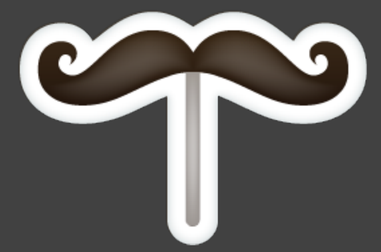
Our web server: Node.js

- Google made JavaScript engines fast. Really fast.
  Fast enough to run servers that handle lots of traffic.
- Upsides of Node.js
  - It's very popular and has an active community
  - You already know Javascript
  - Also, you already know Javascript
- Downsides
  - More complicated than Ruby on Rails to manage database calls
- For documentation: nodejs.org

Our web framework: Express

- Express is a web application framework for Node.js
- It adds:
  - Easy routing
  - Template support
  - Plumbing to support common needs that node.js doesn't provide
- For the purposes of this class, most of what we call "Node.js" will actually be Express helper functions
- For documentation: expressjs.com

Our template engine: Handlebars



- Syntax is embedded in the HTML you know and love
- For documentation: handlebarsjs.com and https://github.com/ericf/express3-handlebars

Our server-side web development stack: Google these terms

Node.js
Web server

JavaScript web server

Express
Web framework

Full-stack framework for development with node.js

Handlebars
Template engine

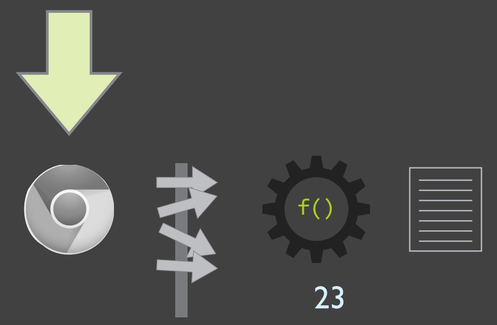
Syntax for inserting variables into HTML

Note that this is only one of many, many, many, many, many, many possible web development stacks. Other ones you may have heard of: Meteor, Ruby on Rails, Django, React, Angular, … [tons of new ones are invented every year]

Requests describe what the user wants

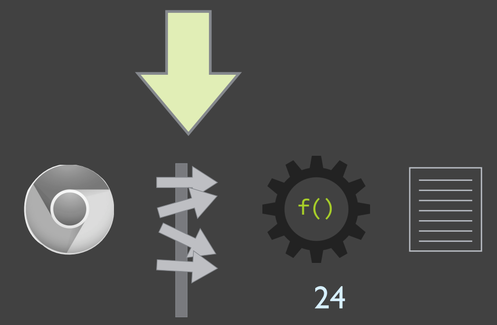
- URLs are user interfaces — design them.

`http://introhci.org/u/13249/p/view` vs.
`http://introhci.org/project/needfinding`



Routes determine which controller functions to call on each kind of request

- `http://introhci.org/createproject?user=msb`:
  call `createProject()` in project.js
- `http://introhci.org/deleteproject?project=introhci`
  call `deleteProject()` in project.js
- `http://introhci.org/reset`
  call `destroyAllHumans()` in utils.js



Example routes

- `app.all('/users', user.list);`
- `app.all('/user/:id/:op?', user.load);`
- `app.get('/user/:id', user.view);`
- `app.get('/user/:id/view', user.view);`
- `app.get('/user/:id/edit', user.edit);`
- `app.post('/user/:id/edit', user.update);`

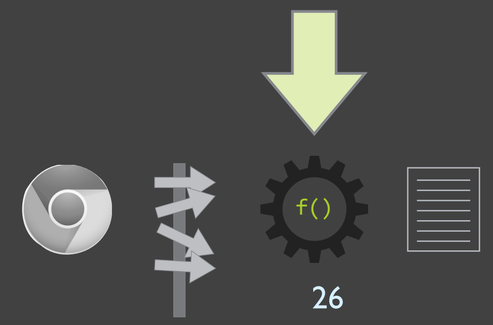
Controller
Call `update()` in the `user` module

URL parameters (:variable)
Place the URL parameter into the `id` variable

Verb
`GET` (the most common one) requests HTML or data
`POST` and `PUT` send data

Controllers process the request and prepare data

- In other words: **this is where you write code**
- Things that controllers might want to do…
- if/else logic
- Query the database
- Save to the database
- Error check the user's input
- Prepare the result the user asked for



The controller's usual goal in life: prepare data for an HTML template

Inside the file routes/hello.js:

```
exports.view = function(req, res){
  var nameToShow = req.params.userName;
  console.log("name is " + nameToShow);
  res.render('index', {
    'name': nameToShow,
  });
};
```

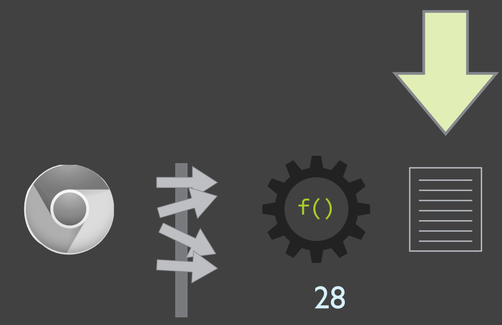
Controller logic
Prepare anything you need to hand off to the template

Render template
Load raw HTML and inserts its variables

Templates contain the HTML to send back to the browser

Almost identical to the index.html from previous labs

```
<html>
<head>
    <meta charset="utf-8" />
</head>
<body>
    <h1>Presenting: {{userName}}</h1>
</body>
</html>
```



Variables: the power of templates

```
<html>
<head>
    <meta charset="utf-8" />
</head>
<body>
    <h1>Presenting: {{userName}}</h1>
</body>
</html>
```

Insert the variable
This must be passed in by the controller

Basic control flow is available in templates

```
<body>
{{#if role==“moderator”}}
<a href=“./mod“>Switch to moderator view</a>
{{/if}}
<p>My favorite people in the world are…</p>
{{#each username}}
    <h1>{{this}}</h1>
{{/each}}
</body>
```

Conditional logic

Loops

concepts

Data in Javascript

What's with all the brackets { } ?

```
res.render('hello', {
   'name': userName
});
```

…from when we sent the data structure to the template

Javascript data structures are flexible

Define the contents as needed:

```
{
   'userName': 'msb',
   'firstName': 'Michael',
   'lastName': 'Bernstein',
   'milesFromCampus': 2,
   'classes': ['CS147', 'CS247', 'CS376']
}
```

Brackets `{ }` define the beginning and end of an object

Properties and values `'property': value` follow as a list.

Nest objects within each other

```
{
  'userName': 'msb',
  'firstName': 'Michael',
  'lastName': 'Bernstein',
  'classes': ['CS147', 'CS247', 'CS376'],
  'milesFromCampus': 2,
  'officeHours': {
    'start': '15:45',
    'end': '17:30',
    'room': 'Gates 308'
  }
}
```

This data format is called JSON

JavaScript Object Notation

(Note that technically JSON strings need to be enclosed in "double-quotes", but JavaScript also accepts 'single quotes' when the data appears within JavaScript code. Some people find single quotes easier to type and read.)

Common JSON mistakes

Can you find the four mistakes?

```
[                                   {
  userName = "msb"                    "userName": "msb",
  firstName = "Michael"               "firstName": "Michael"
]                                   }
```

1. Using `Property = value` instead of `property: value`
2. Forgetting quotes around the property name
3. Forgetting the commas between properties
4. Brackets `[ ]` instead of braces `{ }`

practice

Template editing

Fork and clone lab 4

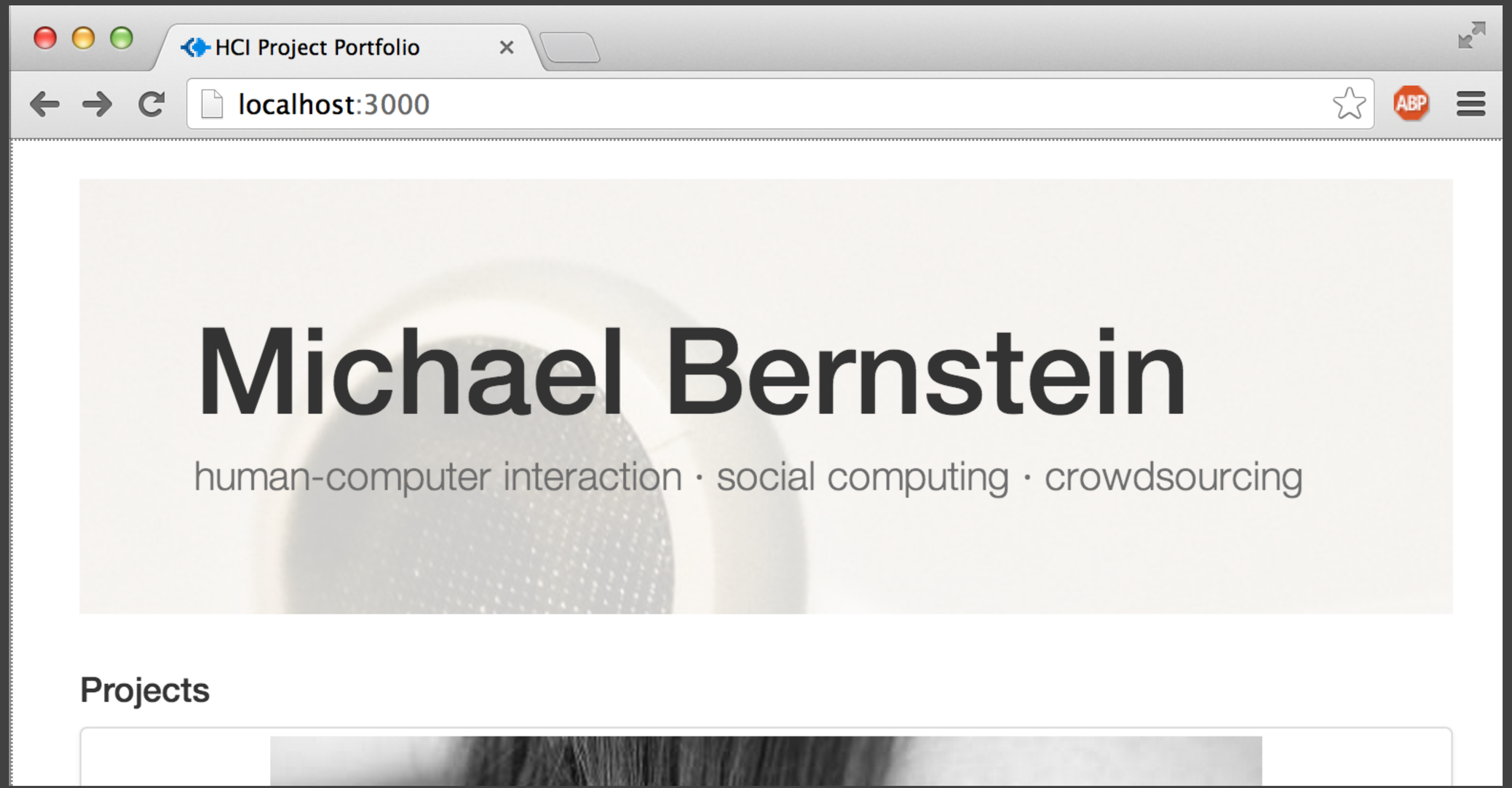
- git config --global core.autocrlf input
- Fork (like last time): https://github.com/pgbovine/lab4
- Then, `git clone` your forked repository into your introHCI directory

Start Node.js

- `cd introHCI/lab4` to enter the lab 4 directory
  (*not* the hello directory from my earlier demo)
- To start Node.js, run: `node app.js`

```
pgbovine@Philips-Air ~/Desktop/introHCI/lab4
$ node app.js
Express server listening on port 3000
```

Test that it's working on localhost



Open views/index.handlebars in Sublime text (or your text editor of choice)

- This is an exact copy of the previous labs' HTML
- Let's make this code more elegant and reusable

Add template variables

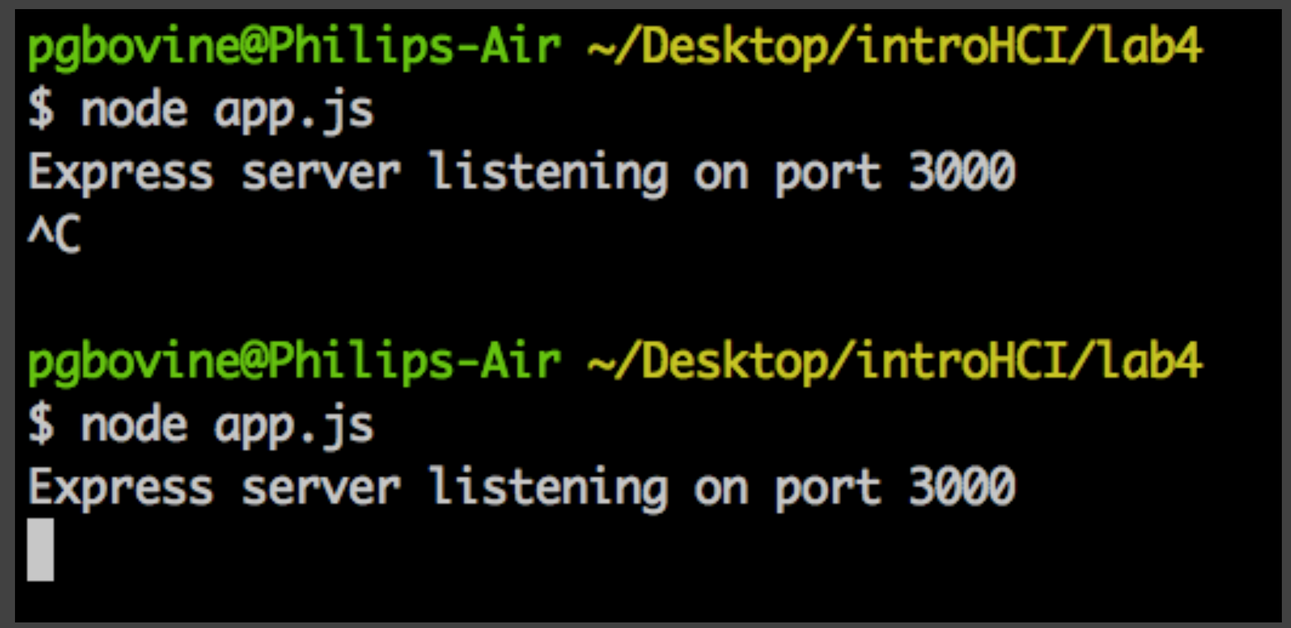
- Remove all but one copy of the `project` div
- Insert handlebars expressions for `name`, `image`, and `id`
  - To avoid pain, leave the `images/` prefix to the img src

```
<div class="project" id="{{id}}">
   <a href="project" class="thumbnail">
      <img src="images/{{image}}" class="img">
      <p>{{name}}</p>
   </a>
</div>
```

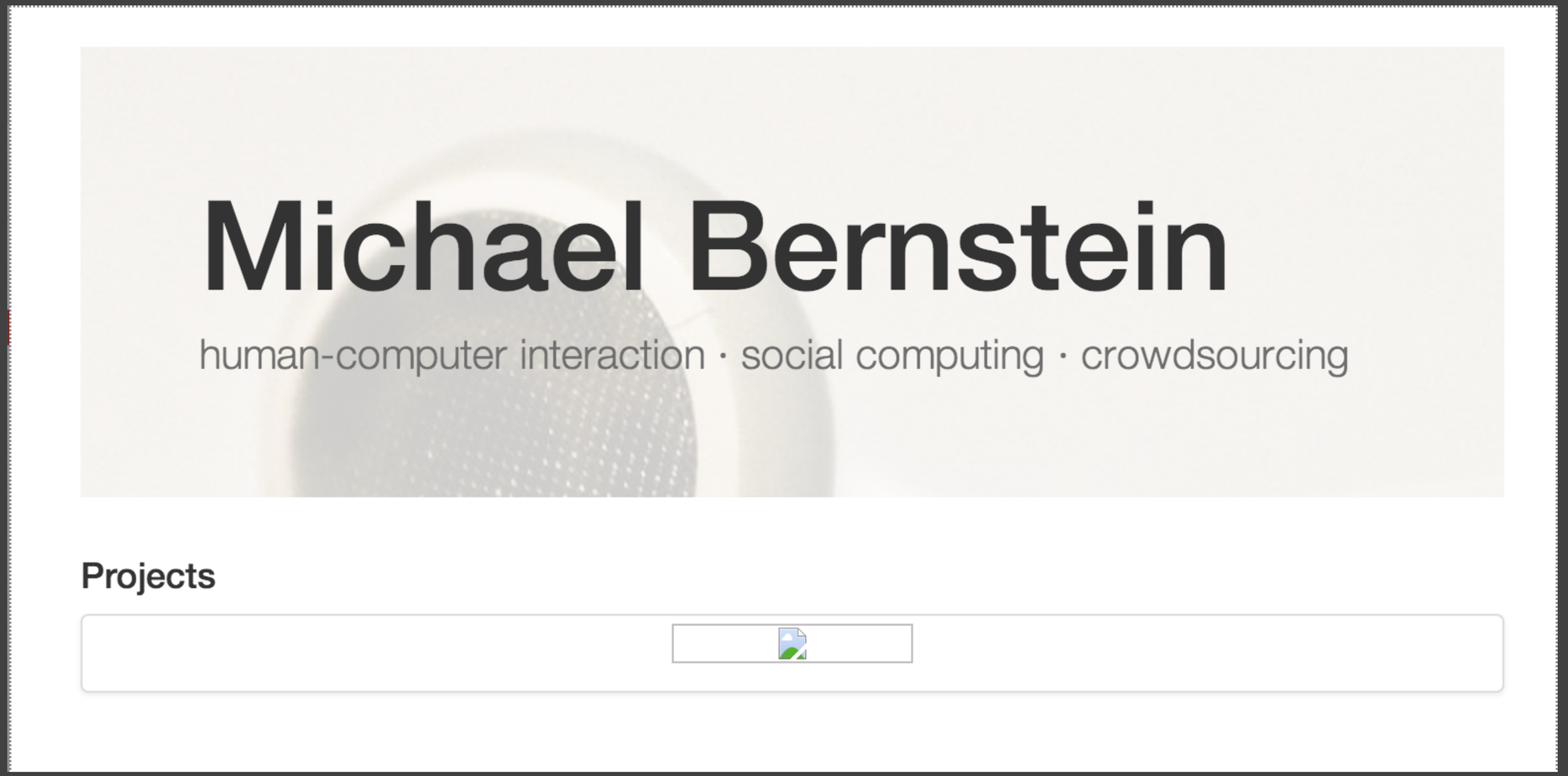
Restart Node.js to load the changes

- Node.js loaded everything in to its own memory when it started up, so when you make changes, it doesn't know.
- Now that you've made a change:
  - `<Control>-c` at command line to stop Node.js (Control key + c)
  - Restart it: `node app.js`
  - (more advanced tools exist for auto-reloading, Google for them)

- Type: `<Control>-c`



Not good: now we have no content

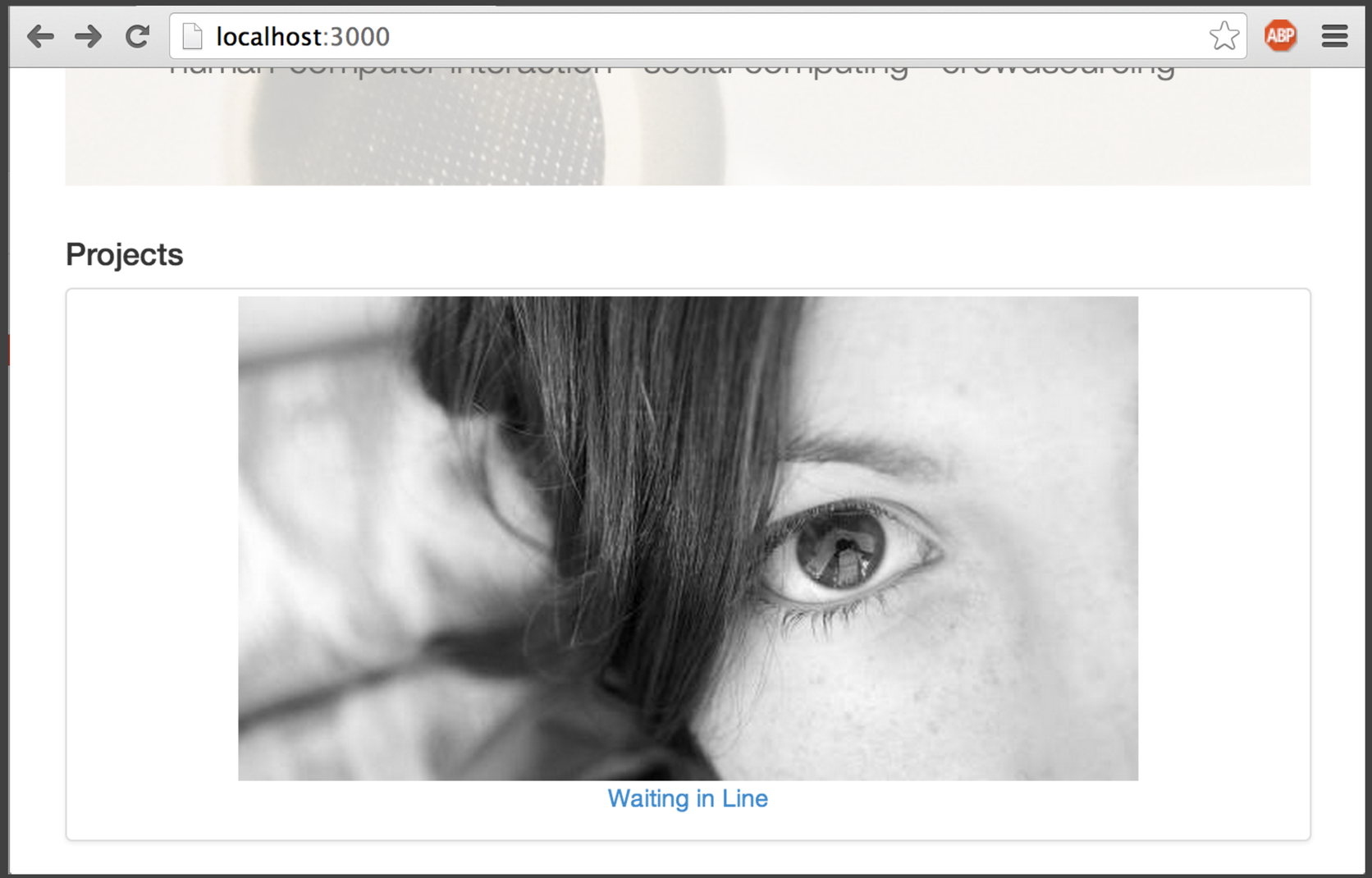


- We haven't yet passed the data to the handlebars template

Add project JSON to routes/index.js

```
exports.view = function(req, res){
  res.render('index', {
    'name': 'Waiting in Line',
    'image': 'lorempixel.people.1.jpeg',
    'id': 'project1'
  });
};
```

To see your changes, restart node.js in terminal and reload localhost:3000 in your web browser



In the controller, create a project list

In routes/index.js, define `projects` to be a list using […]

```
exports.view = function(req, res){
  res.render('index', {
    'projects': [
      { 'name': 'Waiting in Line',
        'image': 'lorempixel.people.1.jpeg',
        'id': 'project1'
      },
      { 'name': 'Needfinding',
        'image': 'lorempixel.city.1.jpeg',
        'id': 'project2'
      },
      { 'name': 'Prototyping',
        'image': 'lorempixel.technics.1.jpeg',
        'id': 'project3'
      },
    ]
  });
}
```

brackets […] denote a list of elements

Practice: change the template to iterate over the list of projects

- Loop using `{{#each projects}}` and `{{/each}}`
- For each loop iteration, the fields `name`, `image`, and `id` are still accessible via `{{name}}`, `{{image}}`, `{{id}}`.

- Simple example:

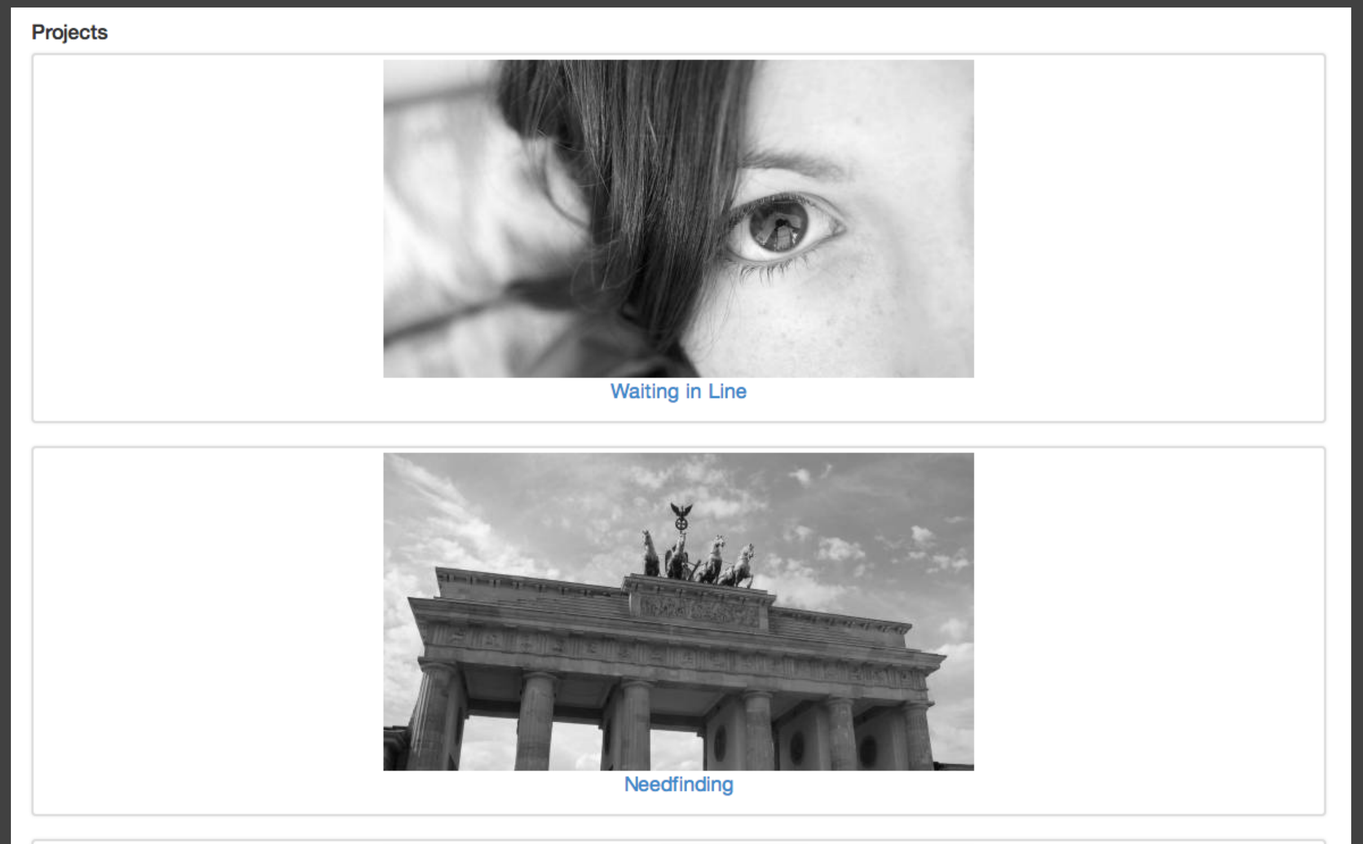
```
{{#each projects}}
  <p>Project name: {{name}}</p>
{{/each}}
```

Solution: enclose your project template in an #each block

Everything else is the same:

```
{{#each projects}}
    <div class="project" id="{{id}}">
        <a href="project" class="thumbnail">
            <img src="images/{{image}}" ... />
            <p>{{name}}</p>
        </a>
    </div>
{{/each}}
```

Restart Node.js, reload browser, and test again (manual reloads can get tedious; look up ways to auto-reload … require more setup, though)



Reflection: what did we accomplish?

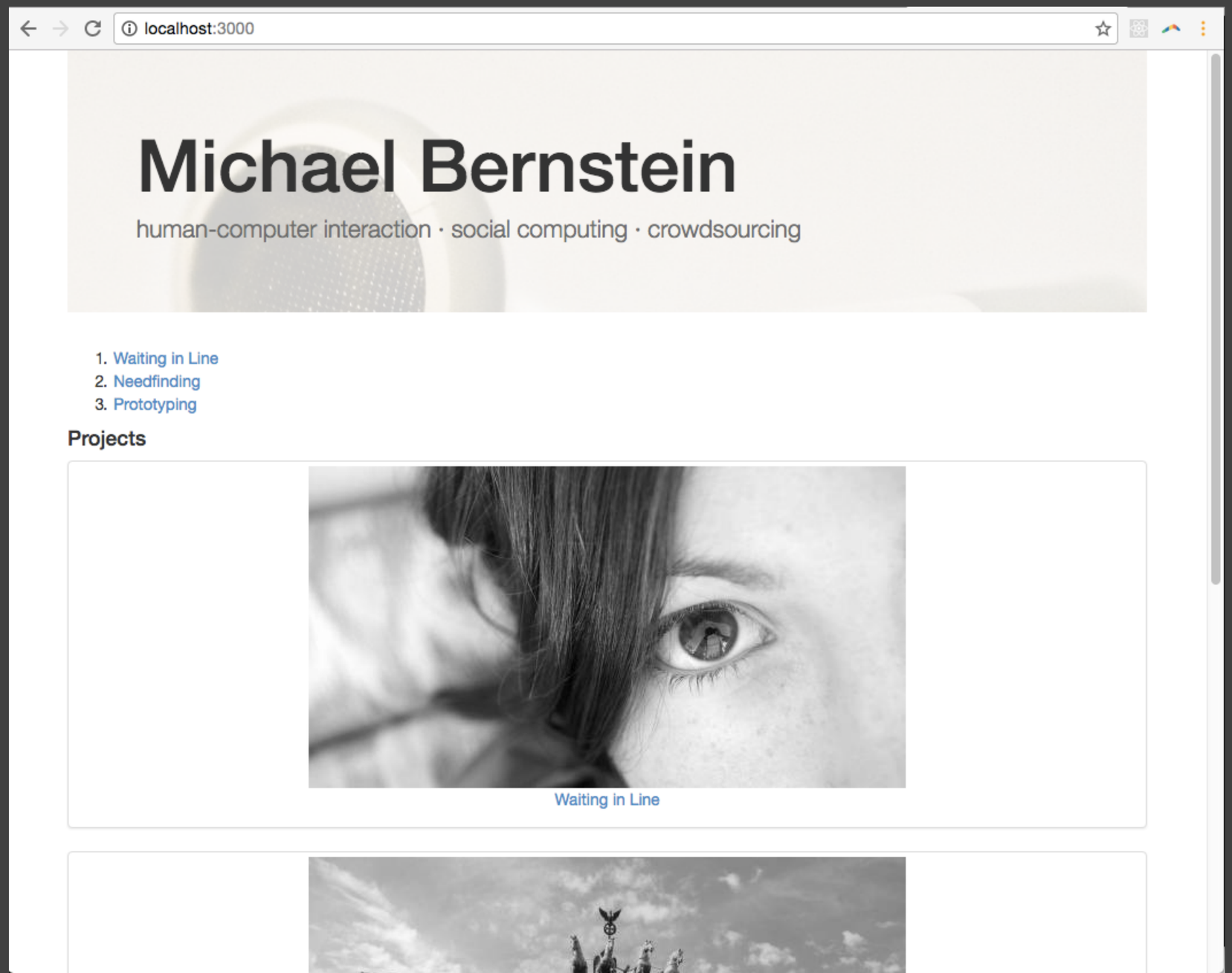
- Changing the project JSON in routes/index.js will now change the project HTML!
- We can change the UI for all the projects listed in the HTML by changing one `{{#each}}` block

Add a table of contents

- A second view using the same data — add it below the jumbotron:

```
<ol>
{{#each projects}}
   <li><a href="#{{id}}">{{name}}</a></li>
{{/each}}
</ol>
```

Two components rendering from the same dataset



practice

Route editing

Goal: add project pages to our portfolio

Add the route to app.js

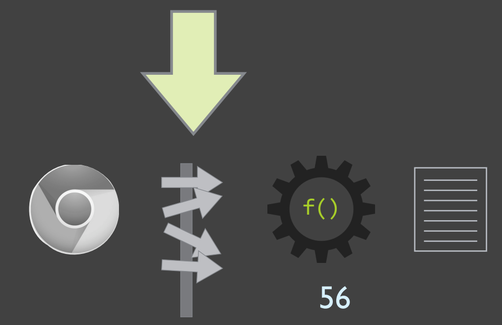
- We want http://localhost:3000/project to load a project page
- Open lab4/app.js in Sublime Text
- Below our existing controller import

```
var index = require('./routes/index');
```

add a new one for projects:

```
var project = require('./routes/project');
```

Load all controllers in routes/project.js



Route the URL to the controller

- Still in app.js, near the bottom below our existing route

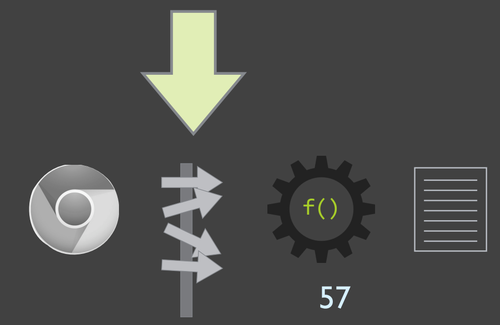
```
app.get('/', index.view);
```

at the bottom of the file, add a new one for projects:

```
app.get('/project', project.viewProject);
```

Register the URL localhost:3000/project

Call the `project.viewProject()` function when that URL is requested

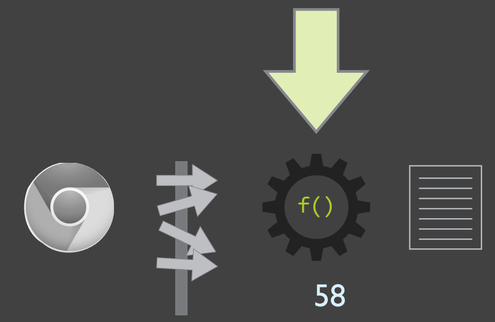


Add a new controller for project pages

- Create a new file in Sublime Text and save it as `routes/project.js`
- Tell it to export the new endpoint we asked for in app.js:

```
exports.viewProject = function(req, res) {
  // controller code goes here
};
```

Make a controller called ‘viewProject’ available to the application

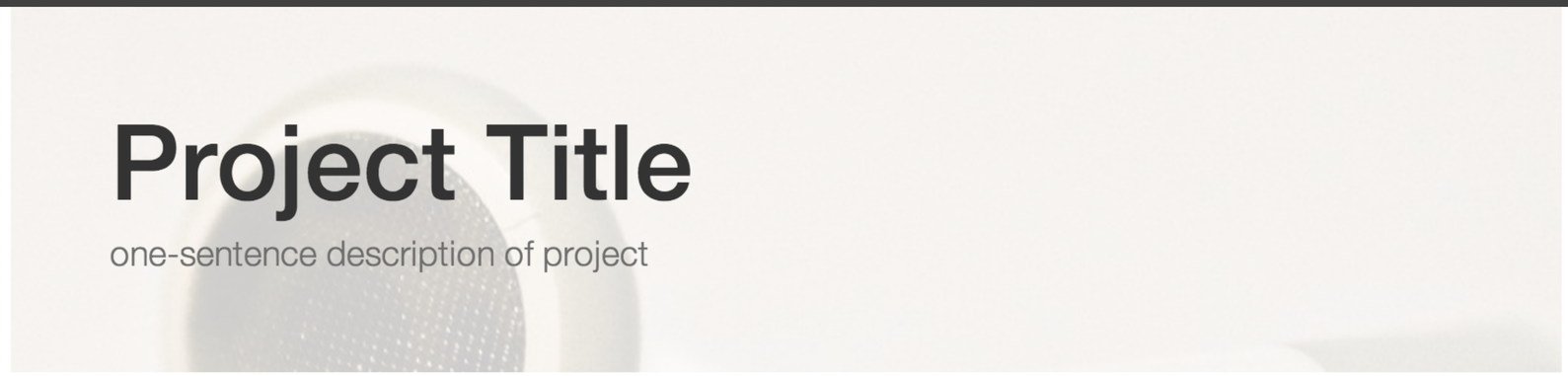


Tell it to render our (conveniently prepackaged) project page template

```
exports.viewProject = function(req, res) {
  res.render('project');
}
```

Load a file called
‘views/project.handlebars’ and display it

Restart node.js and go to http://localhost:3000/project



Project Title

one-sentence description of project

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Phasellus enim diam, adipiscing sodales sem ut, tristique suscipit odio. Nam mollis ipsum et venenatis euismod. Aliquam erat volutpat. Praesent placerat condimentum tristique. Morbi egestas dapibus viverra. Mauris sit amet dignissim risus, non elementum eros. Donec urna dui, placerat et feugiat non, vulputate in ipsum. Quisque dignissim pulvinar nisi. Quisque feugiat commodo dolor nec suscipit. Donec pretium scelerisque aliquet. Vivamus vitae turpis metus. Sed lobortis vitae orci sed gravida. Donec euismod ipsum sagittis pellentesque pellentesque. Aenean at lorem nec leo consequat tincidunt. Maecenas sit amet felis vel ante dictum suscipit quis nec magna. Sed augue velit, imperdiet quis mi a, porta aliquet urna.

Phasellus at neque eget sapien elementum sollicitudin. In odio mauris, pulvinar quis turpis sed, faucibus tristique leo. Phasellus a volutpat tortor. Nunc blandit imperdiet iaculis. Nam purus orci, placerat in venenatis ut, ultrices id dolor. Duis ornare erat lectus, at posuere justo mollis eu. Duis dictum feugiat imperdiet. Praesent vitae orci in eros semper lacinia a ut arcu. Cras vitae sapien et erat faucibus imperdiet nec a turpis. Integer at egestas ipsum, sed suscipit eros.

User	Salient need
Schoolteacher	Wants to know what music students are listening to so he can integrate it into his lessons.
Student 5th grade	Desire to be seen as a tastemaker for her friends. Hears about new music from older sister in middle school.

practice

URL parameters

Goal: show the project title in the URL

Add an argument to the URL

- Go back to app.js to find the route near the bottom
- Change the old route

```
app.get('/project', project.viewProject);
```

by adding a :name variable

```
app.get('/project/:name', project.viewProject);
```

Whatever is in this position in the URL becomes a variable named ‘name’

routes/project.js receives the name variable

- Let's try using console.log():

```
exports.viewProject = function(req, res) {
  var name = req.params.name;
  console.log('The project name is: ' + name);
  res.render('project');
}
```

- Reload node.js and check the console when loading http://localhost:3000/project/foo

```
The project name is: foo
GET /project/foo 304 8ms
GET /css/bootstrap.min.css 304 8ms
GET /css/bootstrap-theme.min.css 304 8ms
```

Pass the name to the template

```
exports.viewProject = function(req, res) {
  var name = req.params.name;
  console.log('The project name is: ' + name);
  res.render('project', {
    'projectName': name
  });
}
```

Add the name to the template

Open views/project.handlebars and change the title to use the variable `{{projectName}}`

```
<div class="jumbotron">
  <h1>{{projectName}}</h1>
  <p>one-sentence description of project</p>
</div>
```

Homepage: embed titles in the <a> links

Now restart Node.js, reload the home page, and click on the individual project links. Each project page should have a customized title now.

Back in index.handlebars:

```
{{#each projects}}
    <div class="project" id="{{id}}">
        <a href=“project/{{name}}” class="thumbnail">
            <img src="images/{{image}}" ... />
            <p>{{name}}</p>
        </a>
    </div>
{{/each}}
```

localhost:3000

Projects

Waiting in Line

localhost:3000/project.html

Note: No spaces allowed in URLs, so Handlebars will escape them using "%20"