Tooling and Testing

SWE 432, Fall 2018

Web Application Development

Review: Bind and This

```
var profHacker = {
  firstName: "Alyssa",
  lastName: "P Hacker",
  teaches: "SWE 432",
  office: "ENGR 6409",
  fullName: function(){
     return this.firstName + " " + this.lastName;
  }
};
```

```
var func = profHacker.fullName;
console.log(func())//undefined undefined
```

This occurs because when the function is called, ‘this’ refers to the ‘this’ that calls it (who knows what that is… the file itself?)

Review: Binding This

```
var func = profHacker.fullName.bind(profHacker);
console.log(func()); //Alyssa P Hacker


var ben = {
  firstName: "Ben",
  lastName: "Bitdiddle"
};
var func = profHacker.fullName.bind(ben);
console.log(func()); //Ben Bitdiddle
```

The bind() function lets you pre-set the arguments for a function (starting with what ‘this’ is)

Review: JSON: JavaScript Object Notation

Open standard format for transmitting *data* objects.

- No functions, only key / value pairs
- Values may be other objects or arrays

```
var profHacker = {
    firstName: "Alyssa",
    lastName: “P Hacker",
    teaches: "SWE 432",
    office: “ENGR 6409”,
    fullName: function(){
        return this.firstName + " " + this.lastName;
    }
};
```

Our Object

```
var profHacker = {
    firstName: "Alyssa",
    lastName: “P Hacker",
    teaches: "SWE 432",
    office: "ENGR 6409",
    fullName: {
        firstName: “Alyssa”,
        lastName: “P Hacker”}
};
```

JSON Object

Today

- Web Development Tools
- What's behavior driven development and why do we want it?
- Some tools for testing web apps - focus on Jest

Options for executing JavaScript

- Browser
    - Pastebin—useful for debugging & experimentation
- Outside of the browser (focus for now)
    - node.js—runtime for JavaScript

Demo: Pastebin

```
var course = { name: 'SWE 432' };

console.log('Hello '+ course.name +'!');
```

https://jsbin.com/?js,console

Node.js

- Node.js is a *runtime* that lets you run JS outside of a browser
- We're going to write backends with Node.js
- Download and install it: https://nodejs.org/en/
  - We recommend LTS (LTS -> Long Term Support, designed to be super stable)

Demo: Node.js

```
var course = { name: 'SWE 432' };
console.log('Hello '+ course.name +'!');
```

Node Package Manager

Working with libraries

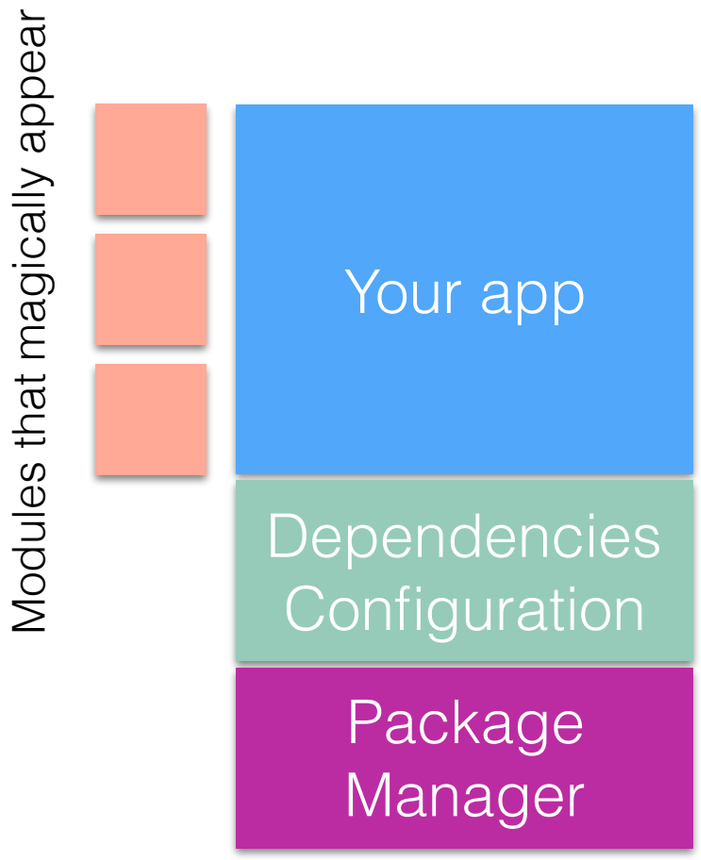
"The old way"

```
<script src="https://fb.me/react-15.0.0.js"></script>
<script src="https://fb.me/react-dom-15.0.0.js"></script>
<script src="https://cdnjs.cloudflare.com/ajax/libs/babel-core/5.8.34/browser.min.js"></script>
```

- What's wrong with this?
  - No standard format to say:
    - What's the name of the module?
    - What's the version of the module?
    - Where do I find it?
- Ideally: Just say "Give me React 15 and everything I need to make it work!"

A better way for modules

- Describe what your modules are
- Create a central repository of those modules
- Make a utility that can automatically find and include those modules



NPM: Not an acronym, but the Node Package Manager

- Bring order to our modules and dependencies
- Declarative approach:
  - "My app is called helloworld"
  - "It is version 1"
    - You can run it by saying "node index.js"
    - "I need express, the most recent version is fine"
- Config is stored in json - specifically package.json

Generated by npm commands:

```
{
  "name": "helloworld",
  "version": "1.0.0",
  "description": "",
  "main": "index.js",
  "scripts": {
    "test": "echo \"Error: no test
specified\" && exit 1"
  },
  "author": "",
  "license": "ISC",
  "dependencies": {
    "express": "^4.14.0"
  }
}
```

Installing packages with NPM

- `npm install <package> --save` will download a package and add it to your package.json
- `npm install` will go through all of the packages in package.json and make sure they are installed/up to date
- Packages get installed to the `node_modules` directory in your project

Using NPM

- Your “project” is a directory which contains a special file, package.json
- Everything that is going to be in your project goes in this directory
- Step 1: Create NPM project
  ```
  npm init
  ```
- Step 2: Declare dependencies
  ```
  npm install <packagename>
  ```
- Step 3: Use modules in your app
  ```
  var myPkg = require(“packagename”)
  ```
- Do NOT include node_modules in your git repo! Instead, just do
  ```
  npm install
  ```
  - This will download and install the modules on your machine given the existing config!

https://docs.npmjs.com/index

NPM Scripts

- Scripts that run at specific times.
- For starters, we'll just worry about *test* scripts

https://docs.npmjs.com/misc/scripts

```
{
    "name": "starter-node-react",
    "version": "1.1.0",
    "description": "a starter project structure for react-app",
    "main": "src/server/index.js",
    "scripts": {
        "start": "babel-node src/server/index.js",
        "build": "webpack --config config/webpack.config.js",
        "dev": "webpack-dev-server --config config/webpack.config.js --
devtool eval --progress --colors --hot --content-base dist/"
    },
    "repository": {
        "type": "git",
        "url": "git+https://github.com/wwsun/starter-node-react.git"
    },
    "author": "Weiwei SUN",
    "license": "MIT",
    "bugs": {
        "url": "https://github.com/wwsun/starter-node-react/issues"
    },
    "homepage": "https://github.com/wwsun/starter-node-react#readme",
    "dependencies": {
        "babel-cli": "^6.4.5",
        "babel-preset-es2015-node5": "^1.1.2",
        "co-views": "^2.1.0",
        "history": "^2.0.0-rc2",
        "koa": "^1.0.0",
        "koa-logger": "^1.3.0",
        "koa-route": "^2.4.2",
        "koa-static": "^2.0.0",
        "react": "^0.14.0",
        "react-dom": "^0.14.0",
        "react-router": "^2.0.0-rc5",
        "swig": "^1.4.2"
    },
    "devDependencies": {
        "babel-core": "^6.1.2",
        "babel-loader": "^6.0.1",
        "babel-preset-es2015": "^6.3.13",
        "babel-preset-react": "^6.1.2",
        "webpack": "^1.12.2",
        "webpack-dev-server": "^1.14.1"
    },
    "babel": {
        "presets": [
            "es2015-node5"
```

Demo: NPM

Unit Testing

- Unit testing is testing some program unit in isolation from the rest of the system (which may not exist yet)

- Usually the programmer is responsible for testing a unit during its implementation (even though this violates the rule about a programmer not testing own software)

- Easier to debug when a test finds a bug (compared to full-system testing)

Integration Testing

- Motivation: Units that worked in isolate may not work in combination
- Performed after all units to be integrated have passed all unit tests
- Reuse unit test cases that cross unit boundaries (that previously required stub(s) and/or driver standing in for another unit)

Unit vs Integration Tests

Writing good tests

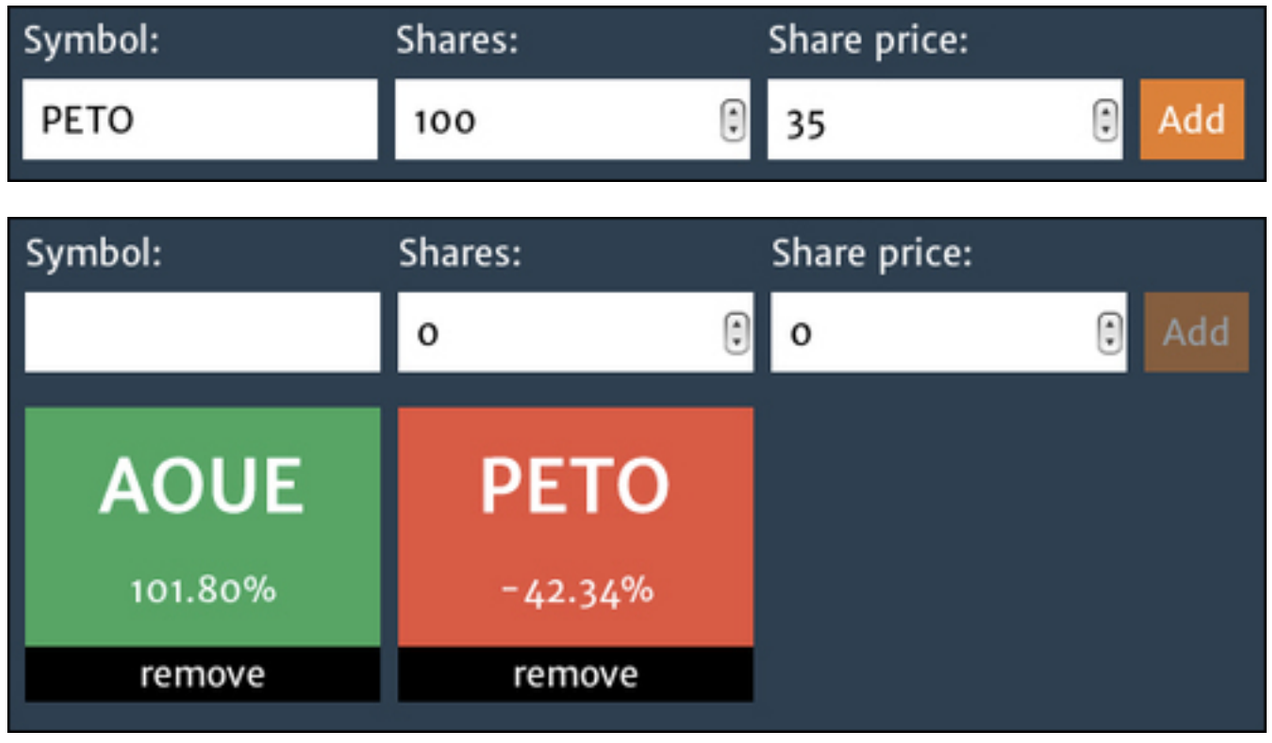
- How do we know when we have tested “enough”?
  - Did we test all of the features we created?
  - Did we test all possible values for those features?

Behavior Driven Development

- Establish *specifications* that say what an app should do
- We write our spec *before* writing the code!
- Only write code if it's to make a spec work
- Provide a mapping between those specifications, and some observable application functionality
- This way, we can have a clear map from specifications to tests

Investment Tracker

- Users make investments by entering a ticker symbol, number of shares, and the price that the user paid per share
- Once the investment is inputted, the user can see the current status of their investments
- How do we test this?



Investment Tracker

- What's an investment for our app?
  - Given an investment, it:
    - Should be of a stock
    - Should have the invested shares quantity
    - Should have the share paid price
    - Should have a current price
    - When its current price is higher than the paid price:
      - It should have a positive return of investment
      - It should be a good investment

jestjs.io

Jest 23.3

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Jest

Delightful JavaScript Testing

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Developer Ready

Complete and ready to set-up JavaScript testing solution. Works out of the box for any React project.

Instant Feedback

Fast interactive watch mode runs only test files related to changed files and is optimized to give signal quickly.

Snapshot Testing

Capture snapshots of React trees or other serializable values to simplify testing and to analyze how state changes over time.

Jest lets you specify behavior in *specs*

- Specs are written in JS
- Key functions:
  - `describe, test`, `expect`
- `Describe` a high level scenario by providing a name for the scenario and function(s) that contains some **`test`**s by saying what you **`expect`** it to be
- Example:

```
describe("Alyssa P Hacker tests", () => {
    test("Calling fullName directly should always work", () => {
        expect(profHacker.fullName()).toEqual("Alyssa P Hacker");
    });
}
```

Writing Specs

- Can specify some code to run before or after checking a spec

```
var profHacker;
beforeEach(() => {
    profHacker = {
        firstName: "Alyssa",
        lastName: "P Hacker",
        teaches: "SWE 432",
        office: "ENGR 6409",
        fullName: function () {
            return this.firstName + " " + this.lastName;
        }
    };
});
```

Making it work

- Add jest to your project (npm install --save-dev jest)

- Configure NPM to use jest for test in package.json

```
"scripts": {
  "test": "jest"
},
```

- For file x.js, create x.test.js

- Run npm test

Multiple Specs

- Can have as many tests as you would like

```
test("Calling fullName directly should always work", () => {
     expect(profHacker.fullName()).toEqual("Alyssa P Hacker");
 });

 test("Calling fullName without binding but with a function ref is
undefined", () => {
     var func = profHacker.fullName;
     expect(func()).toEqual("undefined undefined");
 });
 test("Calling fullName WITH binding with a function ref works", () => {
     var func = profHacker.fullName;
     func = func.bind(profHacker);
     expect(func()).toEqual("Alyssa P Hacker");
});
test("Changing name changes full name", ()=>{
     profHacker.firstName = "Dr. Alyssa";
     expect(profHacker.fullName()).toEqual("Dr. Alyssa P Hacker");
})
```

Nesting Specs

- “When its current price is higher than the paid price:
  - It should have a positive return of investment
  - It should be a good investment”
- How do we describe that?

```
describe("when its current price is higher than the paid price", function() {
    beforeEach(function() {
      stock.sharePrice = 40;
    });
    test("should have a positive return of investment", function() {
      expect(investment.roi()).toBeGreaterThan(0);
    });
    test("should be a good investment", function() {
      expect(investment.isGood()).toBeTruthy();
    });
  });
});
```

Matchers

- How does Jest determine that something is what we expect?

```
expect(investment.roi()).toBeGreaterThan(0);
expect(investment).isGood().toBeTruthy();
expect(investment.shares).toEqual(100);
expect(investment.stock).toBe(stock);
```

- These are “matchers” for Jest - that compare a given value to some criteria
- Basic matchers are built in:
  - toBe, toEqual, toBeTruthy, toBeNaN, toBeNull, toBeUndefined, >, <, >=, <=, !=, regular expressions
- Can also define your own matcher

Truthiness

```
describe("toBeTruthy", function() {
  test("should pass the true boolean value", function() {
    expect(true).toBeTruthy();
  });

  test("should pass any number different than 0", function() {
    expect(1).toBeTruthy();
  });
  test("should pass any non empty string", function() {
    expect("a").toBeTruthy();
  });

  test(“should pass any object (including an array)", function() {
    expect([]).toBeTruthy();
    expect({}).toBeTruthy();
  });
});
```

Demo: Jest

Introducing Promises

- Promises are a wrapper around async callbacks
- Promises represents *how* to get a value
- Then you tell the promise what to do *when* it gets it
- Promises organize many steps that need to happen in order
- At any point a promise is either:
  - Is unresolved
  - Succeeds
  - Fails

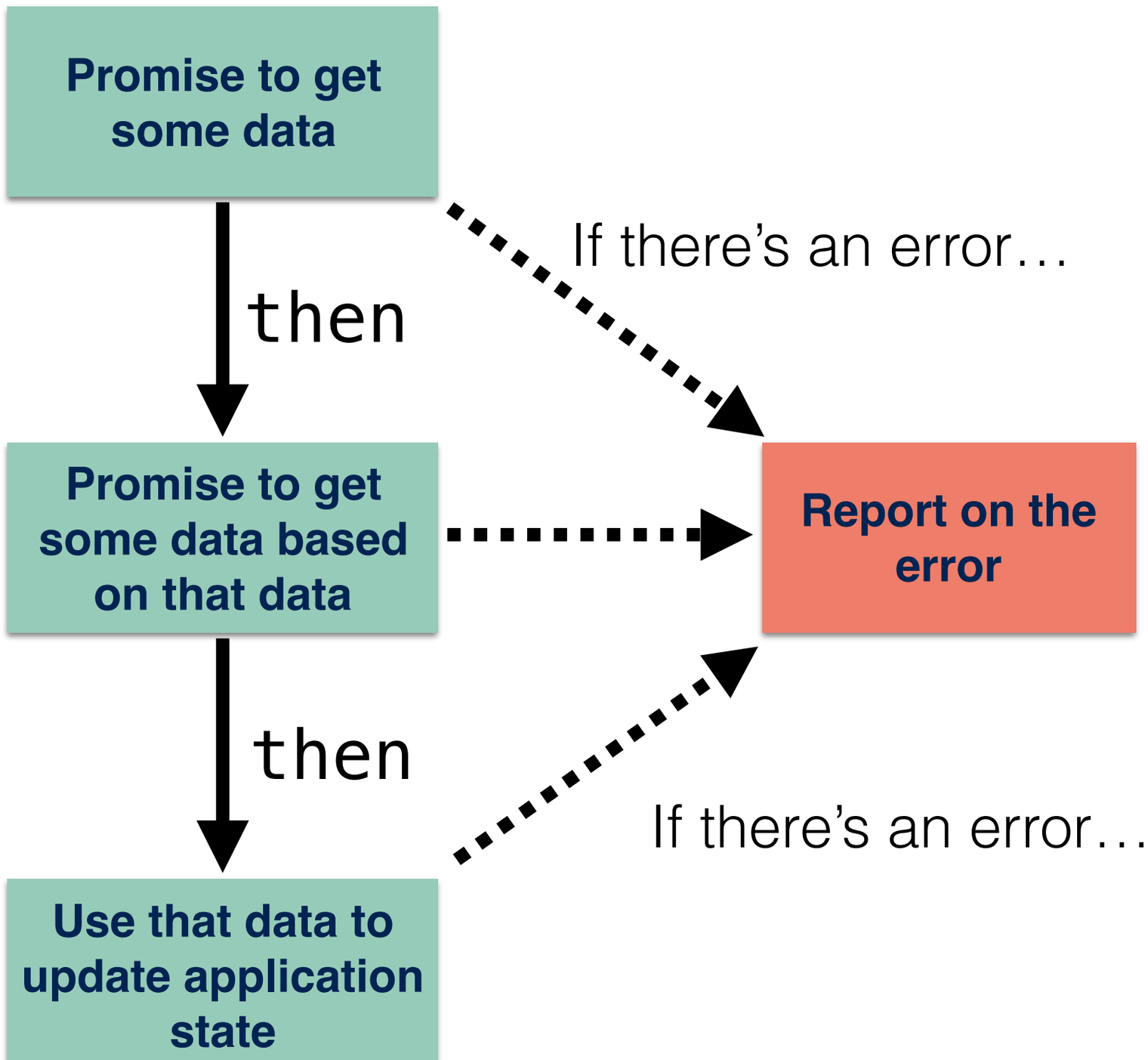
Using a Promise

- Declare what you want to do when your promise is completed (**`then`**), or if there's an error (**`catch`**)

```
fetch('https://github.com/')
    .then(function(res) {
        return res.text();
    });
```

```
fetch('http://domain.invalid/')
    .catch(function(err) {
        console.log(err);
    });
```

Promise one thing then another



Chaining Promises

```
myPromise.then(function(resultOfPromise){
    //Do something, maybe asynchronously
    return theResultOfThisStep;
})
.then(function(resultOfStep1){
    //Do something, maybe asynchronously
    return theResultOfStep2;
})
.then(function(resultOfStep2){
    //Do something, maybe asynchronously
    return theResultOfStep3;
})
.then(function(resultOfStep3){
    //Do something, maybe asynchronously
    return theResultOfStep4;
})
.catch(function(error){

});
```

Promising many things

- Can also specify that *many* things should be done, and then something else

- Example: load a whole bunch of images at once:

```
Promise
  .all([loadImage("GMURGB.jpg"), loadImage(“JonBell.jpg")])
.then(function (imgArray) {
        imgArray.forEach(img => {document.body.appendChild(img)})
    })
.catch(function (e) {
  console.log("Oops");
  console.log(e);
});
```

Writing a Promise

- Most often, Promises will be generated by an API function (e.g., fetch) and returned to you.

- But you can also create your own Promise.

```
var p = new Promise(function(resolve, reject) {
    if (/* condition */) {
        resolve(/* value */);  // fulfilled successfully
    }
    else {
        reject(/* reason */);  // error, rejected
    }
});
```

Example: Writing a Promise

- loadImage returns a promise to load a given image

```
function loadImage(url){
    return new Promise(function(resolve, reject) {
        var img  = new Image();
        img.src=url;
        img.onload = function(){
            resolve(img);
        }
        img.onerror = function(e){
            reject(e);
        }
    });
}
```

Once the image is loaded, we'll resolve the promise

If the image has an error, the promise is rejected