IN4MATX 133: User Interface Software

Lecture 7: Package Management & TypeScript

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Today's goals

By the end of today, you should be able to…

- Describe the role of package managers in web development
- Use the Node Package Manager (NPM) to install packages
- Write code which follows object-oriented principles in TypeScript
- Explain the advantages and disadvantages of using TypeScript

Importing packages so far

- Through content delivery networks (CDNs)
  - Pasting a “script” tag into the head of our HTML files
  - `<script src="https://cdnjs.cloudflare.com/ajax/libs/mathjs/5.2.0/math.min.js"></script>`
- Downloading from the source
  - e.g., if you downloaded Bootstrap rather than using a CDN

Package managers

- Provide an easy way to install software on your computer
  - Both new programs and libraries
- Simplify the process of updating software to the latest version
  - A challenge: packages depend on other packages,
    and often varied versions of those packages
  - Your package manager should deal with this for you
- They’re essentially app stores, except all the content is free

OS-level package managers

apt-get (Unix)

homebrew (macOS)

chocolatey (Windows)

Language-level package managers

pip (Python)

RubyGems (ruby)

npm (JavaScript)

yarn (also JavaScript)

Why are there
so many package managers?

So many package managers

- There’s some value in keeping language or domain-specific contexts
  - Certain languages interface better with certain formats
- Most managers are driven by community efforts
  - New package manager solves some problem of a previous one
- But a lot of these are excuses; in reality, it’s often a frustrating mess

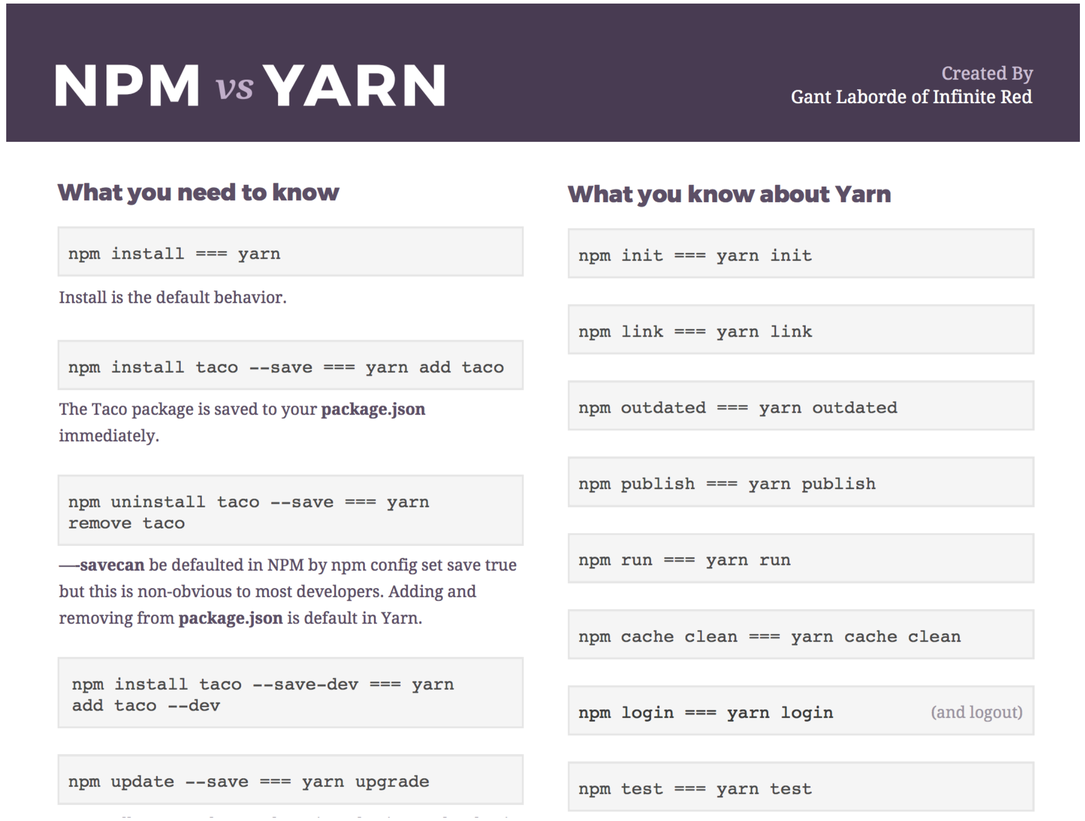
https://www.quora.com/Why-do-so-many-different-programming-languages-have-their-own-package-manager

npm and Yarn: web package managers

- npm was introduced as the package manager for Node.js (server-side JavaScript)
  - Yarn was developed later, released by Facebook as open-source
  - Uses the same registry (list of packages)
- Have a lot of useful libraries for developing webpages and web interfaces
  - “library” and “package” will often be used interchangeably
- Occasionally used to install system-wide software
- package and library are often used interchangeably, which can be misleading

Yarn as an “upgrade” to npm

- Yarn intentionally uses the same concepts as npm
  - Faster, more secure
- But npm is still more widely used
  - Facebook developed Yarn, some people don’t like their involvement
  - We’ll use npm in this class, but maybe not the next time I teach it



NPM *vs* YARN

Created By
Gant Laborde of Infinite Red

What you need to know

```
npm install === yarn
```

Install is the default behavior.

```
npm install taco --save === yarn add taco
```

The Taco package is saved to your **package.json** immediately.

```
npm uninstall taco --save === yarn
remove taco
```

—**savecan** be defaulted in NPM by npm config set save true but this is non-obvious to most developers. Adding and removing from **package.json** is default in Yarn.

```
npm install taco --save-dev === yarn
add taco --dev
```

```
npm update --save === yarn upgrade
```

What you know about Yarn

```
npm init === yarn init
```

```
npm link === yarn link
```

```
npm outdated === yarn outdated
```

```
npm publish === yarn publish
```

```
npm run === yarn run
```

```
npm cache clean === yarn cache clean
```

```
npm login === yarn login
```
(and logout)

```
npm test === yarn test
```

https://shift.infinite.red/npm-vs-yarn-cheat-sheet-8755b092e5cc

Some example web libraries

- Moment js: for managing time and timezones
  - https://momentjs.com/docs/
- Math js: for any math, unit conversion etc.
  - http://mathjs.org/docs/
- Express: for routing your website to different content (other pages or files)
  - https://expressjs.com/

npm concepts

- `package.json` file: the libraries installed in a given project
  - Kept in the root folder of your project by convention
- `package-lock.json` file
  - Used to keep track of the specific versions of other libraries that the library you've installed requires
- `node_modules` folder: all the libraries you've installed in your project

npm and git

- Maybe you've seen the `.gitignore` file
  - Specifies what files should *not* be committed to your repository
- Commit the `package.json` and `package-lock.json` files
  - Allows someone else to install the same versions of your packages
- Do not commit the `node_modules` directory
  - Would be redundant; `package.json` specifies what versions to download
  - Add the folder to the `.gitignore` file

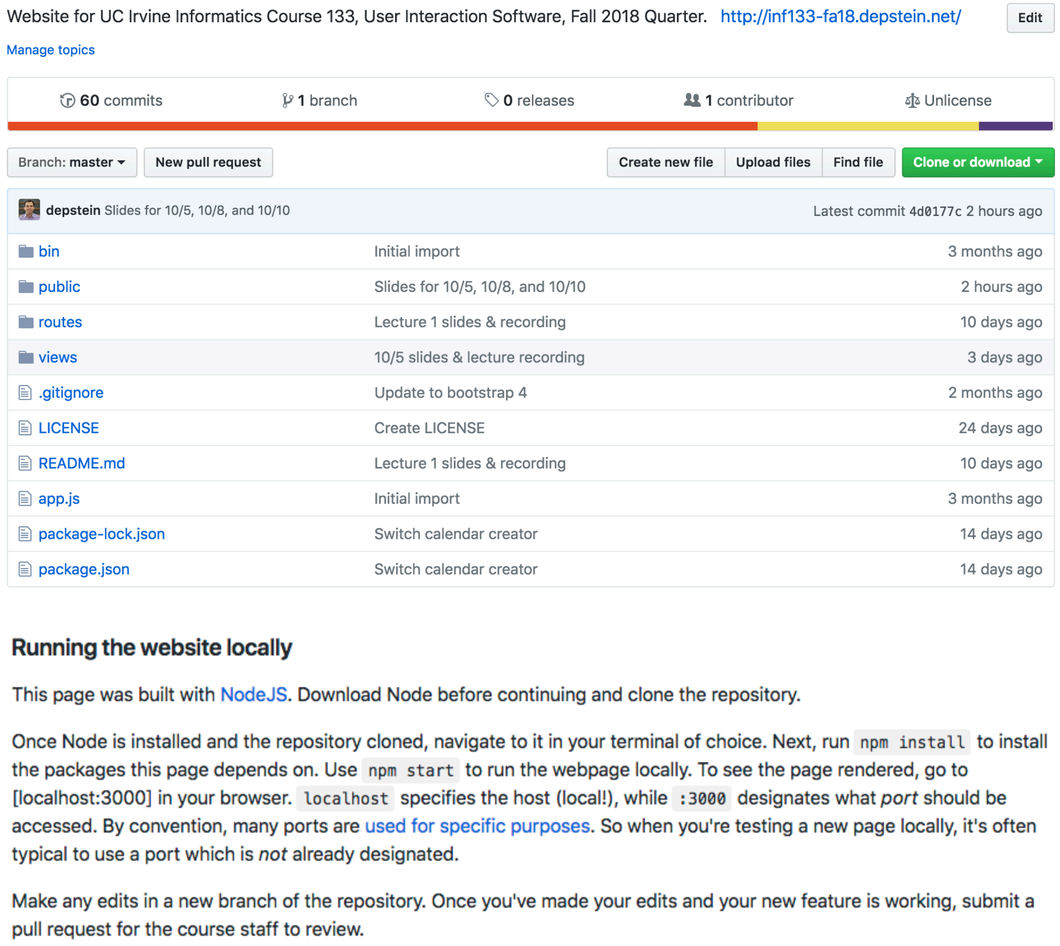
Using npm

- Runs in your operating system's command line
- Install packages: `npm install packagename`
  - Will install package into your project's `node_modules/` folder
  - Add `--save` flag to add it to your `package.json` (should usually be done)
- Get the latest version of a package: `npm update`
  - Important for patching security vulnerabilities

https://www.npmjs.com/get-npm

Using npm

- Let's say we wanted to run the course webpage
  - Assume we've installed npm, clone the repository
- Run `npm install` in the project's root directory
  - Will add all of the libraries the webpage depends on to `node_modules/`



Website for UC Irvine Informatics Course 133, User Interaction Software, Fall 2018 Quarter. http://inf133-fa18.depstein.net/ Edit

Manage topics

60 commits | 1 branch | 0 releases | 1 contributor | Unlicense

Branch: master | New pull request | Create new file | Upload files | Find file | Clone or download

depstein Slides for 10/5, 10/8, and 10/10 — Latest commit 4d0177c 2 hours ago

bin	Initial import	3 months ago
public	Slides for 10/5, 10/8, and 10/10	2 hours ago
routes	Lecture 1 slides & recording	10 days ago
views	10/5 slides & lecture recording	3 days ago
.gitignore	Update to bootstrap 4	2 months ago
LICENSE	Create LICENSE	24 days ago
README.md	Lecture 1 slides & recording	10 days ago
app.js	Initial import	3 months ago
package-lock.json	Switch calendar creator	14 days ago
package.json	Switch calendar creator	14 days ago

Running the website locally

This page was built with NodeJS. Download Node before continuing and clone the repository.

Once Node is installed and the repository cloned, navigate to it in your terminal of choice. Next, run `npm install` to install the packages this page depends on. Use `npm start` to run the webpage locally. To see the page rendered, go to [localhost:3000] in your browser. `localhost` specifies the host (local!), while `:3000` designates what *port* should be accessed. By convention, many ports are used for specific purposes. So when you're testing a new page locally, it's often typical to use a port which is *not* already designated.

Make any edits in a new branch of the repository. Once you've made your edits and your new feature is working, submit a pull request for the course staff to review.

https://github.com/uci-inf-133/inf133-fa18

Using npm

- npm can also install *global* packages, which are just software on your computer
  - `npm install -g packagename`
  - Usually programs which run via command line
- These global packages are programs rather than libraries, so they're not added to `package.json` or `node_modules/`
  - Though your project might depend on them to run
- Global packages are often redundant with OS-level package managers
- A2 only requires global packages

package.json

- Do not edit manually unless you know what you're doing!
  - `npm update --save` will edit version numbers

```
{
  "name": "ics133-fa2018",
  "version": "0.0.0",
  "private": true,
  "scripts": {
    "start": "node ./bin/www"
  },
  "dependencies": {
    "body-parser": "^1.18.3",
    "cookie-parser": "~1.4.3",
    "debug": "^2.6.9",
    "express": "^4.16.3",
    "fs-extra": "^7.0.0",
    "ical-generator": "^1.1.1",
    "moment": "^2.22.2",
    "morgan": "^1.9.1",
    "pug": "~2.0.0-beta10",
    "serve-favicon": "^2.5.0"
  }
}
```

^: Version number is "compatible with" (e.g., 1.X.X)

~: Version number is "approximately the same as" (e.g., 2.0.X)

Also explicit >, <, >=, =

Question 

1. Downloads package to `node_modules`
2. Adds package to `package.json`
3. Adds package's depencencies to `package-lock.json`
4. Package is usable as a program from the command line

Which is correct?

	`npm install packagename`	`npm install packagename --save`	`npm install -g packagename`
A	1, 2, 3, 4	2, 3	1, 4
B	1, 2, 3	1, 2, 3	4
C	1	1, 2, 3	4
D	1, 2, 3	1	2, 3, 4
E	1	2, 3, 4	1, 4

Using npm to install TypeScript

- `npm install -g typescript`
- Installs `tsc`, the TypeScript transpiler
- Could also install via HomeBrew (mac) or Chocolatey (pc)

https://www.typescriptlang.org/#download-links

So what is TypeScript?

About TypeScript

- Released by Microsoft in 2012
- Originally only supported in Visual Studio
  - Now in Eclipse, Sublime, Webstorm, Atom, etc.
- Latest version is TypeScript 3.0, released in July 2018

About TypeScript

- Introduces static types, type checking, and objects
  - These are all optional!
- A strict superset of JavaScript
  - Syntactically-correct JavaScript will also run in TypeScript
  - Means TypeScript can import popular JavaScript libraries
- “Transcompiles” or “Transpiles” to JavaScript
  - Takes TypeScript code and converts it to equivalent JavaScript code

Typing

- hello.ts

```
var courseNumber:number = 133;

console.log('Hello, IN4MATX ' + courseNumber + '!');
```

- `tsc hello.ts`

- Generates hello.js

```
var courseNumber = 133;
console.log('Hello, IN4MATX ' + courseNumber + '!');
```

Typing

- Pre-defined types
  - Number
  - Boolean
  - String
  - Void (generally a function return type)
  - Null
  - Undefined
  - Any

Typing

- Typing is optional

```
var courseNumber:any = 133;
var courseNumber = 133;

console.log('Hello, IN4MATX ' + courseNumber + '!');
```

Typing

- Functions can specify argument types and return types

```
function area(shape: string, width: number, height: number)
{
    var area = width * height;
    return "I'm a " + shape + " of area " + area + " cm^2.";
}

// "better" function
function area(shape: string, width: number,
height: number):string {
    var area:number = width * height;
    return "I'm a " + shape + " of area " + area + " cm^2.";
}
```

Typing

- Types enable error checking

```
// "better" function
function area(shape: string, width: number, height:
number):string {
    var area:number = width * height;
    return "I'm a " + shape + " of area " + area + "
cm^2.";
}

document.body.innerHTML = area(15, 15, 'square');
```

```
error: Argument of type ’15’ is not assignable to parameter of type ‘string’
```

Question

Which TypeScript files would transpile to

```
function pythagorean(a, b) {
    var cSq = a * a + b * b;
    return Math.sqrt(cSq);
}
```

?

A 1

B 2

C 3

D 1 and 2

E 1, 2, and 3

1

```
function pythagorean(a:number, b:number):number {
   var cSq = a*a + b*b;
   return Math.sqrt(cSq);
}
```

2

```
function pythagorean(a:number, b:number) {
   var cSq = a*a + b*b;
   return Math.sqrt(cSq);
}
```

3

```
function pythagorean(a, b) {
    var cSq = a * a + b * b;
    return Math.sqrt(cSq);
}
```

Type declaration files

- Because types get stripped out when compiling, a “declaration file” (`.d.ts`) can be created
  - Important when someone else will use your code as a library
  - Declaration file helps their code check types in your library
  - `tsc --declaration test.ts`
- You can install a library’s typings declaration from npm
  - `npm install --save @types/your-library-here`

Type declaration files

```ts
//test.ts
function area(shape: string, width: number, height: number):string {
    var area:number = width * height;
    return "I'm a " + shape + " of area " + area + " cm^2.";
}

document.body.innerHTML = area('square', 15, 15);
```

```ts
// transpiled test.js
function area(shape, width, height) {
    var area = width * height;
    return "I'm a " + shape + " of area " + area + " cm^2.";
}
document.body.innerHTML = area('square', 15, 15);
```

```ts
// generated test.d.ts
declare function area(shape: string, width: number, height: number): string;
```

Interfaces

- Just like in Java, describes the “inputs” and “outputs” of an object

```
interface Shape {
    name: string;
    width: number;
    height: number;
    color?: string; // ? Specifies an "optional" value
}

function area(shape : Shape):string {
    var area = shape.width * shape.height;
    return "I'm " + shape.name + " with area " + area + " cm squared";
}

console.log(area({name: "rectangle", width: 30, height: 15}));
console.log(area({name: "square", width: 30, height: 30, color: “red"}));
```

Classes

- Also just like in Java, with a constructor and methods

```
class Shape {
    area: number;
    color: string;
    name: string;

    constructor (name: string, width: number, height: number ) {
        this.name = name
        this.area = width * height;
        this.color = "pink";
    };
    shoutout() {
        return "I'm " + this.color + " " + this.name +  " with an area of " +
this.area + " cm squared.";
    }
}

var square = new Shape("square", 30, 30);
```

Classes

- Will make a function() with prototype methods when transpiled

```
//shape.js
var Shape = /** @class */ (function () {
    function Shape(name, width, height) {
        this.name = name;
        this.area = width * height;
        this.color = "pink";
    }
    ;
    Shape.prototype.shoutout = function () {
        return "I'm " + this.color + " " + this.name + " with an area of
" + this.area + " cm squared.";
    };
    return Shape;
}());
var square = new Shape("square", 30, 30);
```

Inheritance

- Like in Java, classes and interfaces can be extended

```
class Shape3D extends Shape {
    volume: number;

    constructor (name: string, width: number, height: number, length: number ) {
        super( name, width, height ); //calls base class constructor
        this.volume = length * this.area;
    };

    shoutout() { //overrides the base class
        return "I'm " + this.name +  " with a volume of " + this.volume + " cm cube.";
    }

    superShout() { //calls base class shoutout method
        return super.shoutout();
    }
}

var cube = new Shape3D("cube", 30, 30, 30);
console.log( cube.shoutout() );
console.log( cube.superShout() );
```

Generics

- Also work the same a Java

```
function identity<T>(arg: T): T {
    return arg;
}

let output = identity<string>("myString");  // type of
output will be 'string'
let output = identity("myString");  // type of output
will be 'string'
```

https://www.typescriptlang.org/docs/handbook/generics.html

tsconfig.json

- Indicates a TypeScript project
  - Indicates what files or folders to compile
  - Pick compiler options, such as whether to remove comments
  - Specify what version of ECMAScript to compile to
  - `tsc --project tsconfig.json`

https://www.typescriptlang.org/docs/handbook/tsconfig-json.html

Benefits of TypeScript

- Type checking
  - Transpiler can show warnings or errors *before* code is executed
  - Because your editor knows the types,
    it can autocomplete methods and API features
  - Easier to refactor code
- Object-oriented
  - Easier to manage/maintain large code bases
  - Simple enough to use; same principles as Java and other OO languages

Drawbacks of TypeScript

- Compiling is occasionally a pain
  - Can be slow for large projects
- Might not work with new JavaScript libraries out of the gate
  - It took a little while for TypeScript to interface nicely with Angular and React, for example
  - Now it’s the default for Angular

Other noteworthy JavaScript transpilers

- Dart
  - Developed by Google
  - Introduces typing and similar object-oriented practices
  - Transpiles to JavaScript with dart2js

- CofeeScript
  - Open-source development
  - “Python-like” variable assignment, loops, and conditionals
  - Mostly meant to make JavaScript syntax prettier/cleaner

Today's goals

By the end of today, you should be able to…

- Describe the role of package managers in web development
- Use the Node Package Manager (NPM) to install packages
- Explain the advantages and disadvantages of typing in programming languages
- Write code which follows object-oriented principles in TypeScript

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