

Building a large scale JavaScript application in TypeScript

Benjamin Pasero

Microsoft Monaco Team

What do we do?

Modern, web standards based developer tools,
platform, and cloud services

TypeScript Playground

The screenshot shows the TypeScript Playground interface. At the top, there's a navigation bar with the TypeScript logo and links for 'learn', 'play', 'get it', 'run it', and 'join in'. Below the navigation, there are tabs for 'TypeScript' and 'JavaScript'. The 'TypeScript' tab is active, showing a code editor with the following code:

```
1 class Greeter<T> {
2   greeting: T;
3   constructor(message: T) {
4     this.greeting = message;
5   }
6   greet() {
7     return this.greeting;
8   }
9 }
10
11 var greeter = new Greeter<string>("Hello, world");
12
13 var button = document.createElement('button');
14 button.textContent = "Say Hello";
15 button.onclick = function () {
16   alert(greeter.greet());
17 }
18
19 document.body.appendChild(button);
20
```

The 'JavaScript' tab is also visible, showing the equivalent JavaScript code:

```
1 var Greeter = (function () {
2   function Greeter(message) {
3     this.greeting = message;
4   }
5   Greeter.prototype.greet = function () {
6     return this.greeting;
7   };
8   return Greeter;
9 })();
10
11 var greeter = new Greeter("Hello, world");
12
13 var button = document.createElement('button');
14 button.textContent = "Say Hello";
15 button.onclick = function () {
16   alert(greeter.greet());
17 };
18
19 document.body.appendChild(button);
20
```

At the bottom of the playground, there is a URL: <http://www.typescriptlang.org/Playground/>. The footer contains the Microsoft logo and the text: "The code you enter in the TypeScript playground runs entirely in your browser and is not sent to Microsoft."

IE F12

The image shows a screenshot of the Internet Explorer browser with the F12 Developer Tools open. The browser window displays the Bing homepage, which includes the search bar, navigation links (WEB, IMAGES, VIDEOS, MAPS, NEWS, SEARCH HISTORY, MORE, MSN, OUTLOOK.COM), and a background image of a bird. The Developer Tools window is divided into several panes:

- Debugger:** Shows the source code for `notifications.js`. The code includes a function `i(n)` that checks the type of `n` and returns a stringified version. The current line of execution is highlighted at line 11.
- Watches:** A pane for monitoring variable values, currently empty with an "Add watch" button.
- Callstack:** A pane for viewing the call stack, currently showing "Breakpoints".
- Console:** A pane for viewing JavaScript messages, showing a message: "JavaScript Console is attached and accepting commands."

SkyDrive

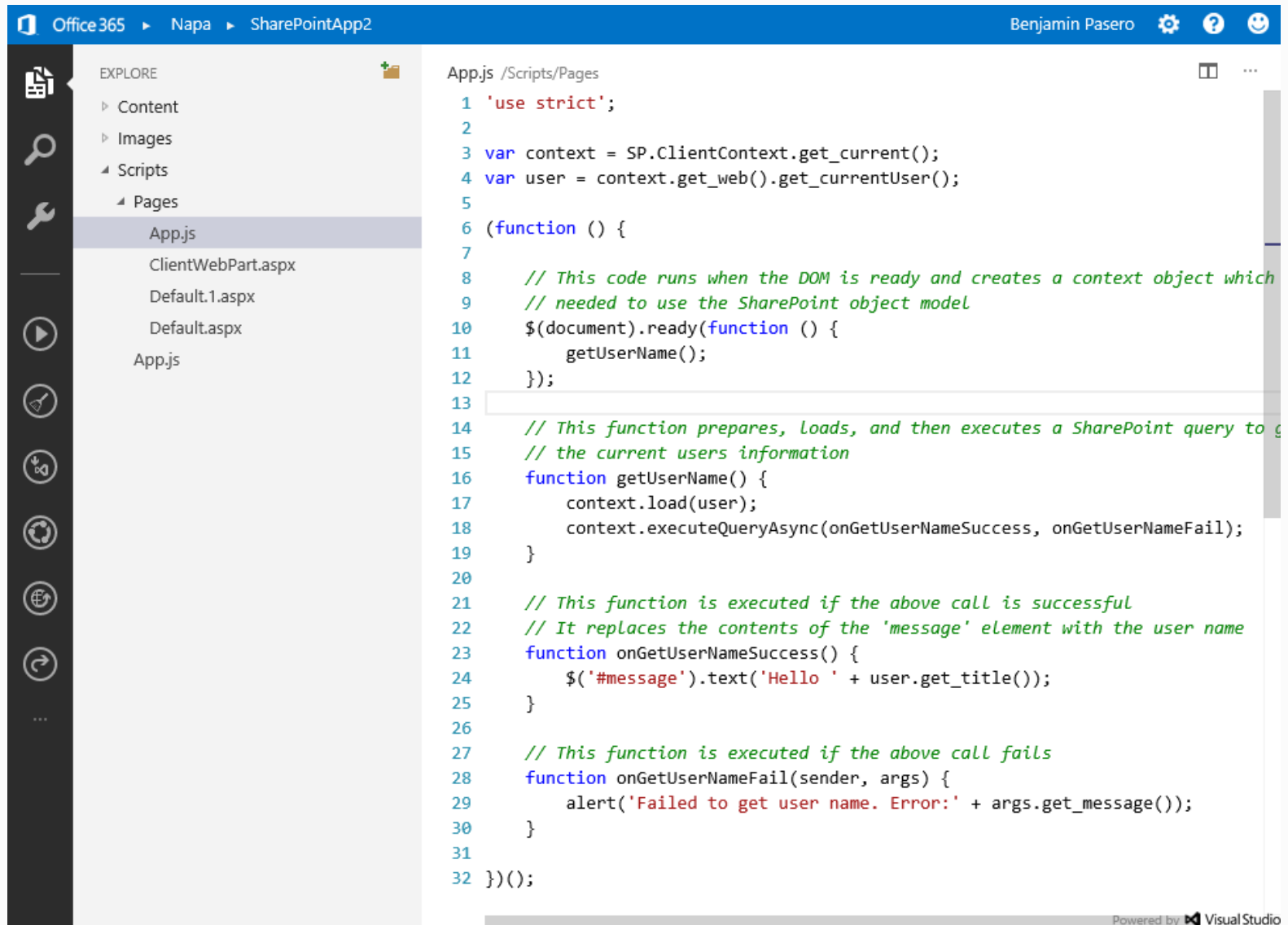
SkyDrive | Umbenennen Herunterladen Teilen Verwalten

Benjamin Pasero

my SkyDrive von Benjamin > Documents > my.html Speichern

```
1 <!DOCTYPE html>
2 <html>
3
4 <head>
5   <title>Mankala</title>
6   <meta http-equiv="X-UA-Compatible" content="IE=Edge"/>
7   <script type="text/javascript" src="Game.js"></script>
8   <script type="text/javascript" src="Driver.js"></script>
9   <script type="text/javascript" src="Features.js"></script>
10  <script type="text/javascript" src="Position.js"></script>
11  <script type="text/javascript" src="lib/Geometry.js"></script>
12  <script type="text/javascript" src="lib/Base.js"></script>
13 </head>
14
15 <body id="bod" onload="Mankala.testBrowser()">
16   <svg height="10px">
17     <defs>
18       <radialGradient id="grad1" cx="50%" cy="50%" r="50%" fx="50%" fy="50%">
19         <stop offset="0%" style="stop-color:aqua;
20           stop-opacity:0.35" />
21         <stop offset="100%" style="stop-color:rgb(0,0,255);stop-opacity:1" />
22       </radialGradient>
23       <radialGradient id="grad2" cx="50%" cy="50%" r="50%" fx="50%" fy="50%">
24         <stop offset="0%" style="stop-color:gold;
25           stop-opacity:0.35" />
26         <stop offset="100%" style="stop-color:rgb(0,255,0);stop-opacity:1" />
27       </radialGradient>
28     </defs>
29   </svg>
30 </body>
31 </html>
32
```

Napa Office 365

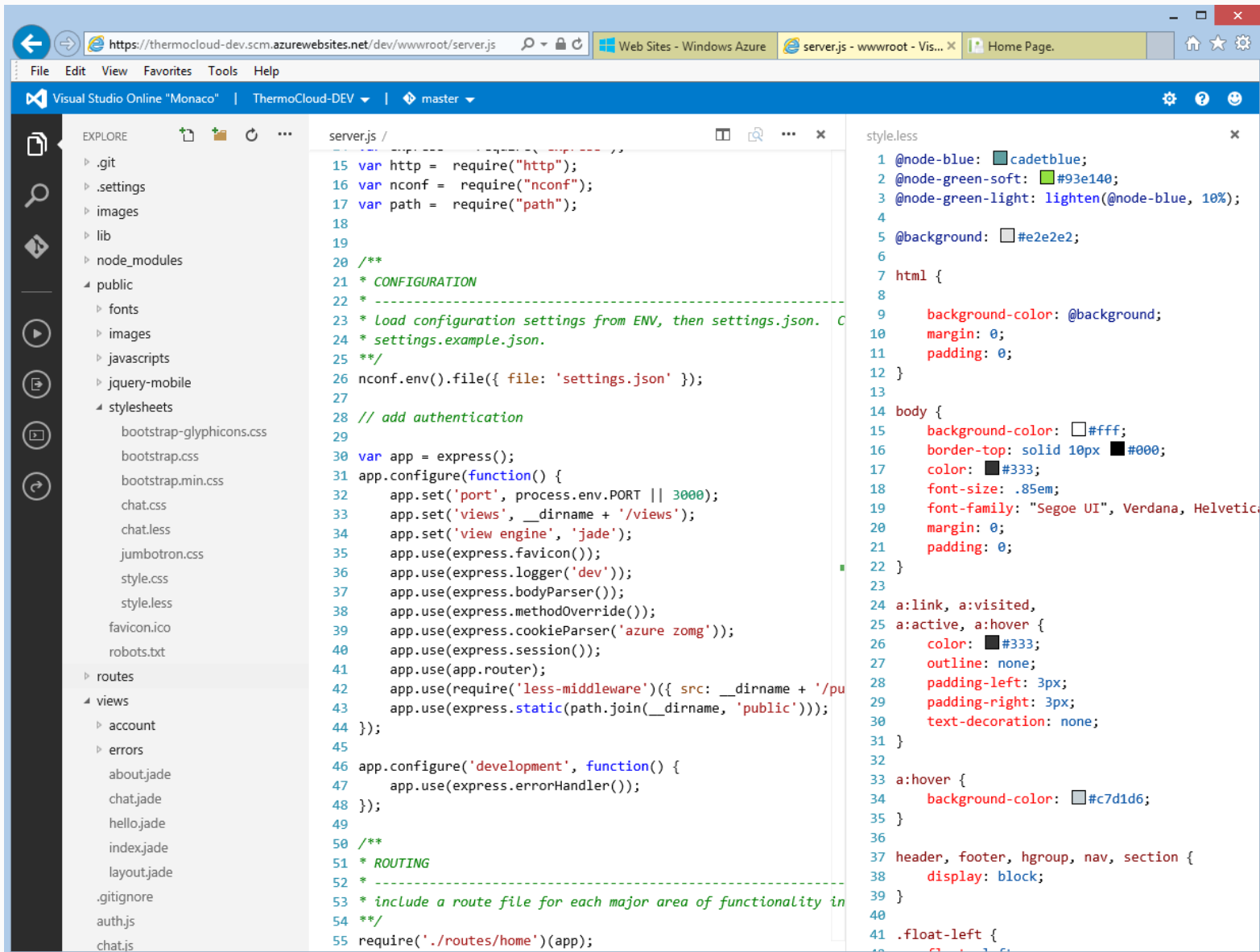


The screenshot shows the Office 365 Napa interface for a SharePoint application. The top navigation bar includes 'Office 365', 'Napa', and 'SharePointApp2', along with the user name 'Benjamin Pasero' and icons for settings, help, and a smiley face. On the left, an 'EXPLORE' sidebar lists the file structure: Content, Images, Scripts, and Pages. Under 'Pages', 'App.js' is selected. The main area is a code editor displaying the following JavaScript code:

```
App.js /Scripts/Pages
1 'use strict';
2
3 var context = SP.ClientContext.get_current();
4 var user = context.get_web().get_currentUser();
5
6 (function () {
7
8     // This code runs when the DOM is ready and creates a context object which
9     // needed to use the SharePoint object model
10    $(document).ready(function () {
11        getUserUserName();
12    });
13
14    // This function prepares, loads, and then executes a SharePoint query to get
15    // the current users information
16    function getUserUserName() {
17        context.load(user);
18        context.executeQueryAsync(onGetUserNameSuccess, onGetUserNameFail);
19    }
20
21    // This function is executed if the above call is successful
22    // It replaces the contents of the 'message' element with the user name
23    function onGetUserNameSuccess() {
24        $('#message').text('Hello ' + user.get_title());
25    }
26
27    // This function is executed if the above call fails
28    function onGetUserNameFail(sender, args) {
29        alert('Failed to get user name. Error:' + args.get_message());
30    }
31
32 })();
```

At the bottom right, it says 'Powered by Visual Studio'.

Azure Web Sites



The image shows a screenshot of the Visual Studio Online Monaco editor interface. The browser address bar at the top displays the URL `https://thermocloud-dev.scm.azurewebsites.net/dev/wwwroot/server.js`. The editor has a dark theme and shows two files: `server.js` and `style.less`.

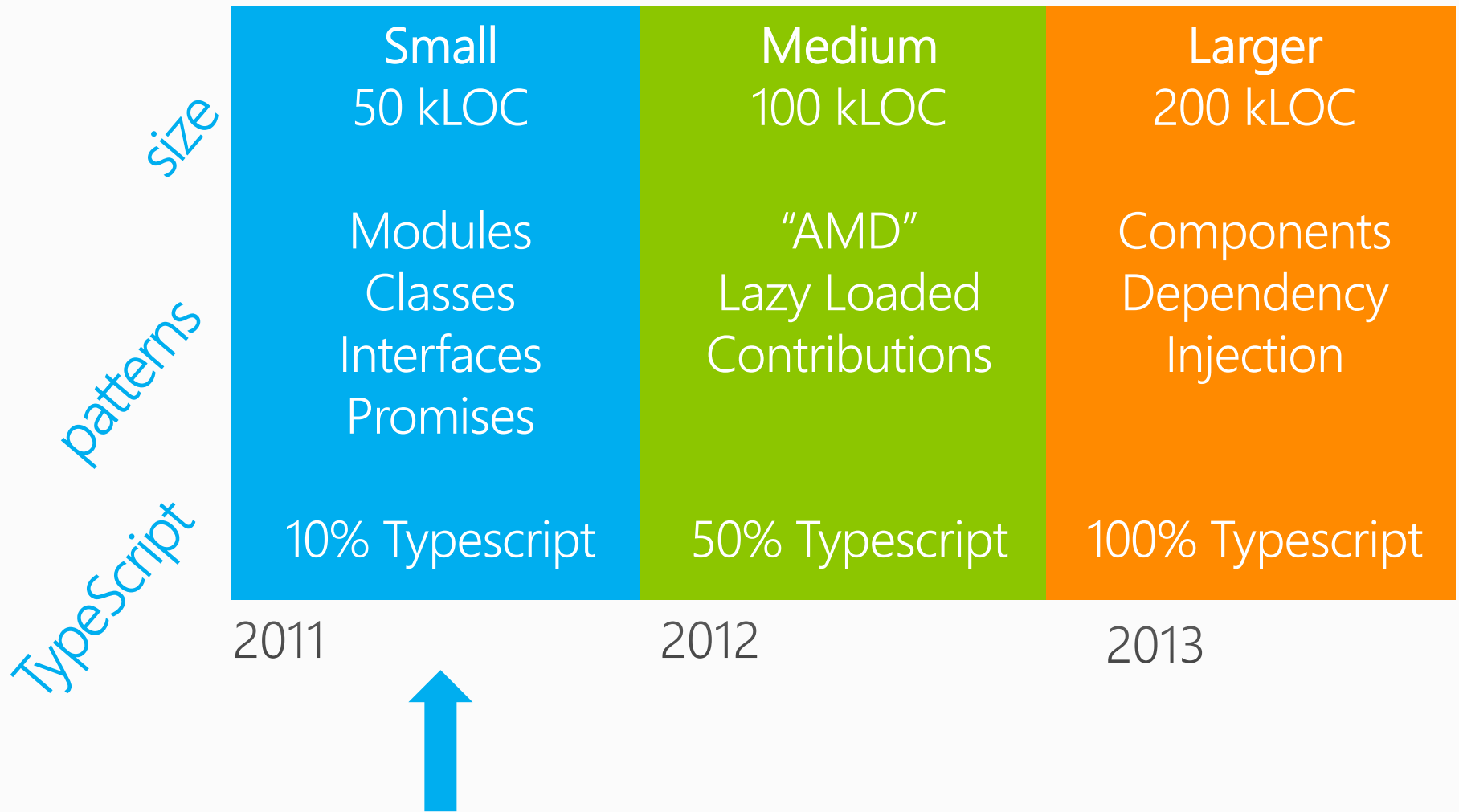
The `server.js` file contains the following code:

```
15 var http = require("http");
16 var nconf = require("nconf");
17 var path = require("path");
18
19
20 /**
21  * CONFIGURATION
22  * -----
23  * Load configuration settings from ENV, then settings.json.
24  * settings.example.json.
25  */
26 nconf.env().file({ file: 'settings.json' });
27
28 // add authentication
29
30 var app = express();
31 app.configure(function() {
32   app.set('port', process.env.PORT || 3000);
33   app.set('views', __dirname + '/views');
34   app.set('view engine', 'jade');
35   app.use(express.favicon());
36   app.use(express.logger('dev'));
37   app.use(express.bodyParser());
38   app.use(express.methodOverride());
39   app.use(express.cookieParser('azure zomg'));
40   app.use(express.session());
41   app.use(app.router);
42   app.use(require('less-middleware')({ src: __dirname + '/pu
43   app.use(express.static(path.join(__dirname, 'public')));
44 });
45
46 app.configure('development', function() {
47   app.use(express.errorHandler());
48 });
49
50 /**
51  * ROUTING
52  * -----
53  * include a route file for each major area of functionality in
54  */
55 require('./routes/home')(app);
```

The `style.less` file contains the following code:

```
1 @node-blue: #cadetblue;
2 @node-green-soft: #93e140;
3 @node-green-light: lighten(@node-blue, 10%);
4
5 @background: #e2e2e2;
6
7 html {
8
9   background-color: @background;
10  margin: 0;
11  padding: 0;
12 }
13
14 body {
15   background-color: #fff;
16   border-top: solid 10px #000;
17   color: #333;
18   font-size: .85em;
19   font-family: "Segoe UI", Verdana, Helvetica;
20   margin: 0;
21   padding: 0;
22 }
23
24 a:link, a:visited,
25 a:active, a:hover {
26   color: #333;
27   outline: none;
28   padding-left: 3px;
29   padding-right: 3px;
30   text-decoration: none;
31 }
32
33 a:hover {
34   background-color: #c7d1d6;
35 }
36
37 header, footer, hgroup, nav, section {
38   display: block;
39 }
40
41 .float-left {
```

Our Journey (Part 1)

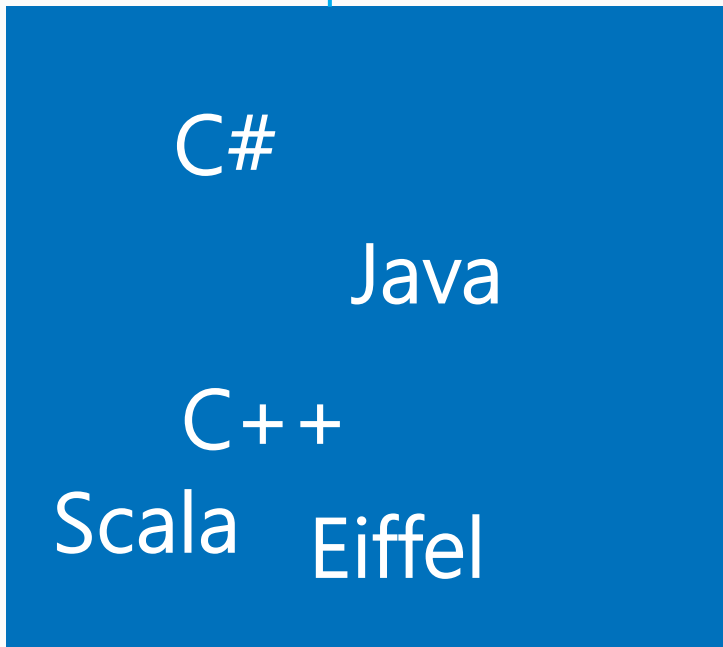


We enjoy programming
in JS*

*But we had some concerns


Application Scale JavaScript?

static "pessimistic"



C#
Java
C++
Scala Eiffel

dynamic "optimistic"



Smalltalk
Python
Ruby
JavaScript

forgiving!

Pains

Need to come up with “compensating” patterns for classes and modules/namespaces

Need patterns for managing callbacks

“JavaScript code ‘rots’ over time” --Ben

“Writing JavaScript code in a large project is like **carving code in stone**”

--Alex

TypeScript to rescue

TypeScript is a super set of JavaScript

Easy to convert existing code to TypeScript

Compiler / Library works cross browser

TypeScript compiles to plain JavaScript

TypeScript is open source

<http://typescript.codeplex.com/>

TypeScript Demo

Types, Interfaces, Classes, Generics, Modules

Writing better JavaScript

Formalization of common JavaScript patterns

Classes, modules

Type inference and structural typing

In practice very few type annotations are necessary

Works with existing JavaScript libraries

Declaration files can be written and maintained separately

TypeScript Type Definitions



branch: master ▾

DefinitelyTyped / +

Merge pull request #1611 from DotNetNerd/master ...



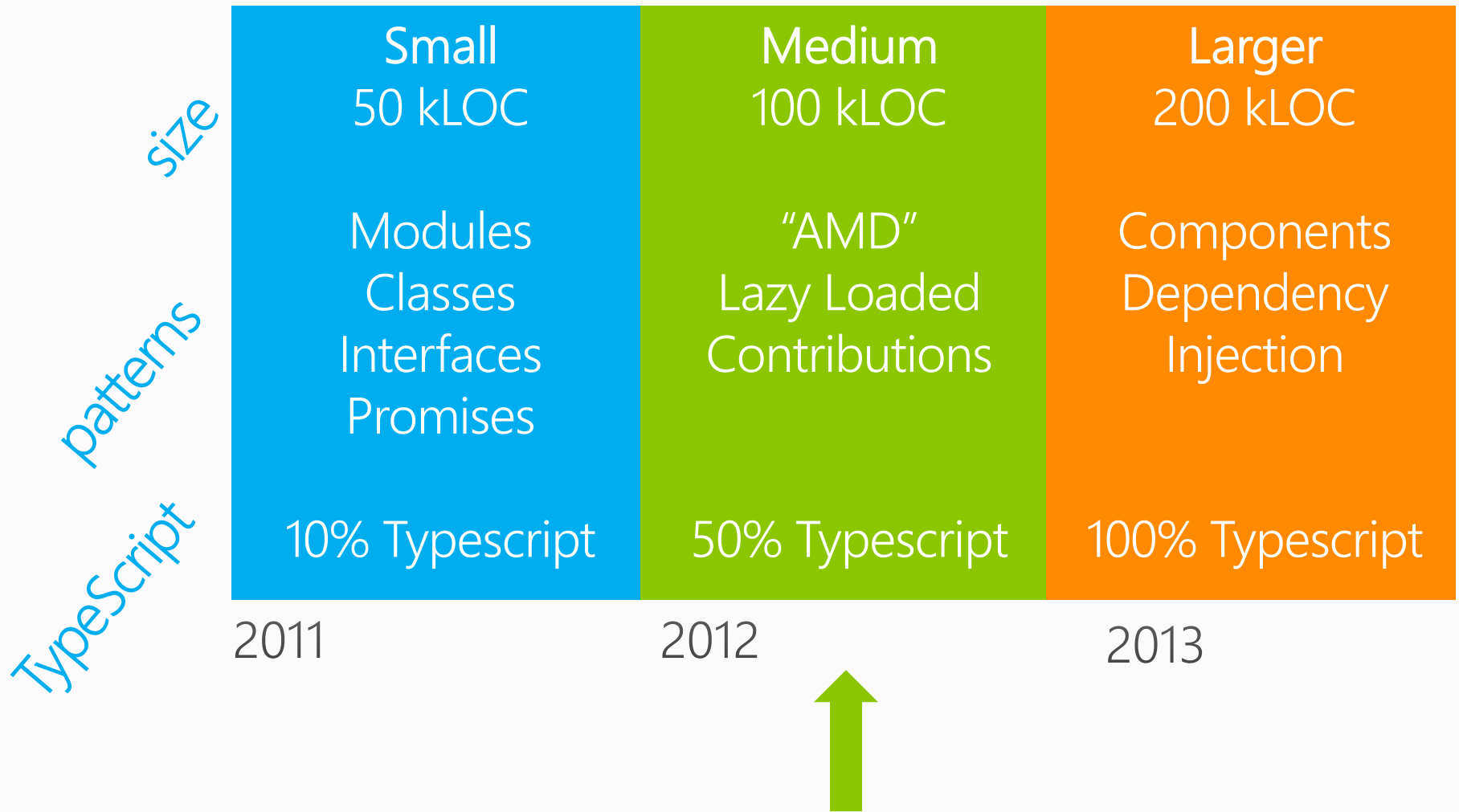
johnnyreilly authored an hour ago

latest commit feff6b9c3e

| | | |
|------------------------------|--|--------------|
| _infrastructure | Switch test runner's tsc version 0.9.1.1 to 0.9.5 | 2 months ago |
| accounting | accounting.js type definitions | 15 days ago |
| ace | Converting ungeneric "Array" to "any[]" | 2 months ago |
| add2home | Added add2home (Add To home Screen) for iPhone and iPad users. | 2 months ago |
| amcharts | added/fixed headers a-d | 14 hours ago |
| amplifyjs | Fixed tsc failed on Node.js v0.8.25 | 4 months ago |
| angular-translate | Update angular-translate.d.ts | 5 hours ago |
| angular-ui-bootstrap | angular-ui-bootstrap: update to v0.10.0 | 11 days ago |
| angular-ui | angular-ui: fixed router tests | a month ago |
| angularjs | Angular IModule::provider can accept a provider object as second argu... | 7 days ago |
| appframework | bug fix | 4 months ago |
| arbiter | Fixed tsc failed on Node.js v0.8.25 | 4 months ago |
| async | | 2 months ago |
| azure-mobile-services-client | added/fixed headers a-d | 14 hours ago |

<https://github.com/borisyankov/DefinitelyTyped>

Our Journey (Part 2)



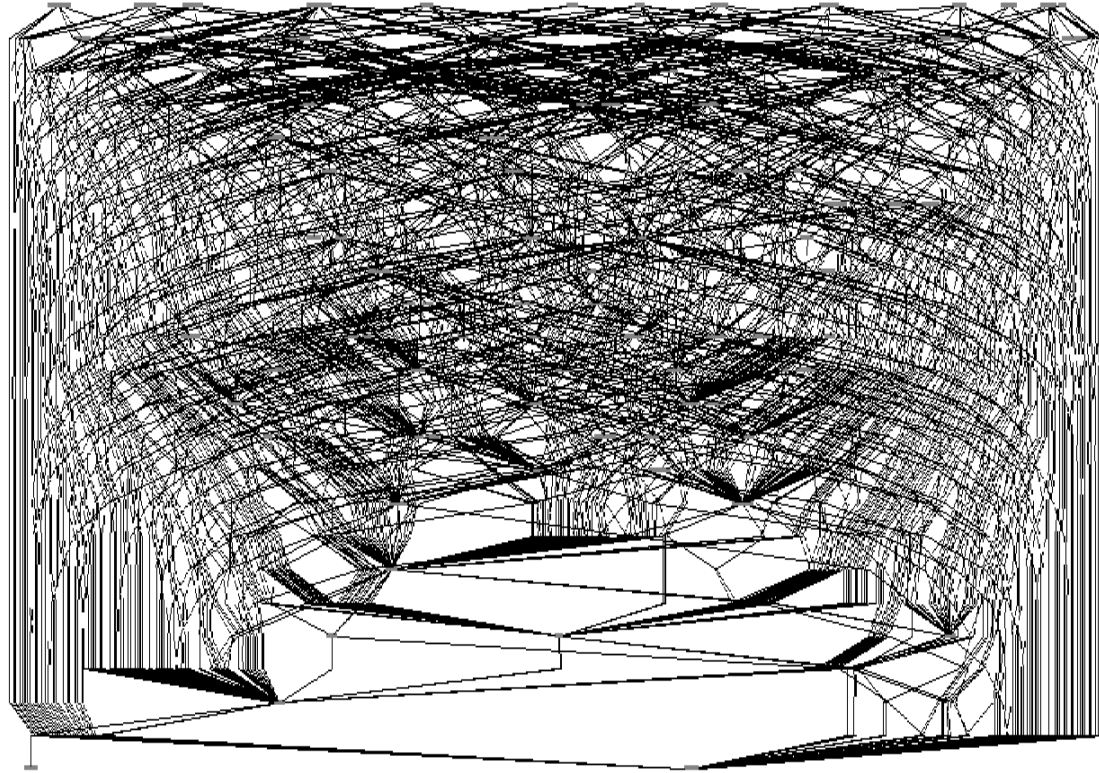
Growing Pains

Managing scripts and their order

Manually edited lists of scripts








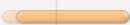







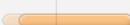



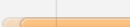



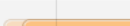

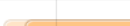

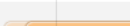

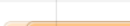

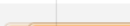

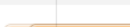



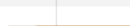
```
/ide/manifest.json
27
28   "src": {
29     "/monaco/ide/public/js/workbench.js": [
30       "public/js/constants.js",
31       "public/js/platform.js",
32       "public/js/events.js",
33       "public/js/core/context.js",
34       "public/js/core/storage.js",
35       "public/js/core/history.js",
36       "public/js/model/workspaceModel.js",
37       "public/js/ui/sitelet.js",
38       "public/js/ui/commands.js",
39       "public/js/ui/memento.js",
40       "public/js/ui/layout.js",
41       "public/js/ui/actions/action.js",
42       "public/js/ui/menu.js",
43       "public/js/ui/viewlets/viewlet.js",
44       "public/js/ui/parts/part.js",
45       "public/js/ui/parts/sidebarPart.js",
46       "public/js/ui/parts/editor/baseEditor.js",
47       "public/js/ui/parts/editor/editorModel.js",
48       "public/js/ui/parts/editor/editorInput.js",
49       "public/js/ui/parts/editor/editorOptions.js",
50       "public/js/ui/parts/editor/textEditor.js",
51       "public/js/ui/parts/editor/stringEditorModel.js",
52       "public/js/ui/parts/editor/stringEditorInput.js",
```

Growing Pains: Dependencies...



"our dependency graph was such a mess that each area had a dependency on just about every other area." – Nick (from another project)

Growing Pains: Eager loading

| Name Path | Method | Status Text | Type | Initiator | Size Content | Time Latency | Timeline | 480ms | 720ms |
|--|--------|------------------|---------------|--------------------------|------------------|---------------|---|-------|-------|
|  version.js /public | GET | 200 OK | applicatio... | FPSMeter.js:14 Parser | (from ca...) | 35ms 35ms |  | | |
|  base.js /public/lib/monaco/editor/js/base | GET | 200 OK | applicatio... | FPSMeter.js:14 Parser | (from ca...) | 39ms 31ms |  | | |
|  strada.js /public/lib/monaco/editor/js/addins/stra | GET | 200 OK | applicatio... | FPSMeter.js:14 Parser | (from ca...) | 37ms 31ms |  | | |
|  javascript.js /public/lib/monaco/editor/js/addins/jav | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 319B 22.25KB | 355ms 45ms |  | | |
|  vsxml.js /public/lib/monaco/editor/js/addins/vsx | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 318B 8.51KB | 311ms 40ms |  | | |
|  editor.js /public/lib/monaco/editor/js/editor | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 320B 401.98KB | 188ms 40ms |  | | |
|  jsbeautify.js /public/lib/monaco/editor/js/addins/jav | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 319B 44.16KB | 360ms 46ms |  | | |
|  javascript-vs.js /public/lib/monaco/editor/js/addins/jav | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 318B 3.29KB | 362ms 51ms |  | | |
|  css.js /public/lib/monaco/editor/js/addins/css | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 319B 14.44KB | 522ms 60ms |  | | |
|  strada.js /public/lib/monaco/editor/js/addins/stra | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 318B 9.72KB | 519ms 56ms |  | | |
|  php.js /public/lib/monaco/editor/js/addins/php | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 319B 22.89KB | 531ms 65ms |  | | |
|  html.js /public/lib/monaco/editor/js/addins/htm | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 319B 22.14KB | 525ms 62ms |  | | |
|  markdown.js /public/lib/monaco/editor/js/addins/mar | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 318B 5.70KB | 535ms 67ms |  | | |
|  csharp.js /public/lib/monaco/editor/js/addins/csh | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 319B 31.37KB | 537ms 69ms |  | | |
|  razor.js /public/lib/monaco/editor/js/addins/raza | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 318B 3.56KB | 543ms 71ms |  | | |
|  xml.js /public/lib/monaco/editor/js/addins/xml | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 319B 23.29KB | 545ms 74ms |  | | |
|  jshtm.js /public/lib/monaco/editor/js/addins/jsht | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 319B 12.69KB | 551ms 78ms |  | | |
|  workbench.js /public/js | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 320B 325.16KB | 554ms 80ms |  | | |
|  monaco.js /public/js | GET | 304 Not Modified | applicatio... | FPSMeter.js:14 Parser | 320B 285.92KB | 637ms 85ms |  | | |

19 / 52 requests | 1.49KB / 18.84KB transferred | 1.68s (onload: 1.49s, DOMContentLoaded: 800ms)

Solution: AMD

A module/file must declare what other modules it requires in order to function

```
define('id', ['moduleA'], function(moduleA) {  
    // code goes here  
});
```

TypeScript: External Modules

TypeScript supports code generation for **CommonJS** and the **AMD** module systems

```
import WinJS = require('vs/base/lib/winjs');  
import ZoneWidget = require('vs/editor/zoneWidget');
```

```
tsc --module amd app.ts
```

```
tsc --module commonjs HttpServer.ts
```

Before/After

AMD in JavaScript

```
define(['../winjs.base', '../zoneWidget'],  
    function(WinJS, ZoneWidget) { ... }  
);
```

TypeScript (AMD or CommonJS)

```
import WinJS = require('vs/base/lib/winjs');  
import ZoneWidget = require('vs/editor/zoneWidget');
```

AMD Applied

Support à la carte consumption

Express CSS dependencies as well

CSS AMD loader plugin

TypeScript pragma

```
///<amd-dependency path="vs/css!./actionbar" />
```

After the AMD Migration Impressions

"It feels like **fresh** showered. Self contained modules no more cycles no more globals with explicit dependencies" -Alex

"Happy - **no** more **globals**, **no** more **cyclic** dependencies, faster startup" -Dirk

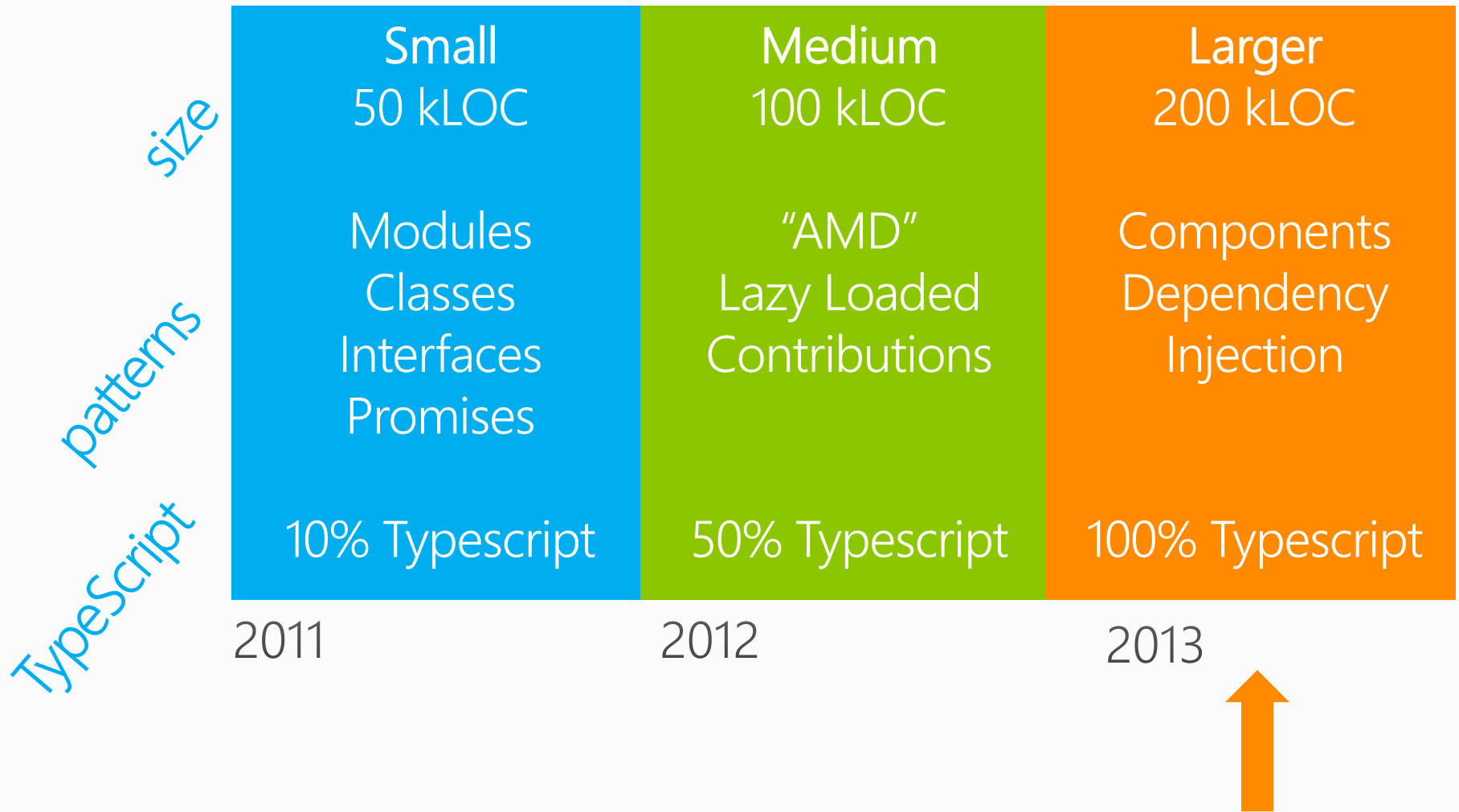
Lazy Loading Contributions



```
csharp.contribution.ts  
modeRegistry.registerMode(  
    ['text/x-csharp'],  
    new Platform.Descriptor(  
        'vs/languages/csharp',  
        'CSMode'));
```

```
csharp.ts  
export class CSMode extends  
modesExtensions.AbstractMode {  
    constructor() {  
        super('vs.languages.csharp');  
    }  
    // lots of code ....  
}
```

Our Journey (Part 3)



Componentization

Reuse TypeScript code as 'binary' JS components with a declarations file

Example using TypeScript language services as a component

Compiler and IDE services > 30kLOC of TypeScript

```
tsc -declarations -out typescriptservices.js typescript.ts
```

API

Type the API surface

No inferred 'any' type in the API => "any hunting"

```
44 | constructor(mode, buildType) {  
    |  
    | type implicitly set to 'any'
```

JSDoc the API

```
/**  
 * An direction aware selection.  
 */  
export interface IEditorSelection extends ISelection, IEditorRange {  
    /**  
     * Test if equals other selection.  
     */  
    equalsSelection(other:ISelection):bool;  
    /**  
     * Clone this selection.  
     */  
    clone():IEditorSelection;  
    /**  
     * Get directions (LTR or RTL).  
     */  
    getDirection(): SelectionDirection;
```

100% TypeScript

Migration is also code clean-up, but real work

Velocity around 300 LOCs per hour

“As I did conversions, I began **typing various object literals** I was passing around as interfaces. Soon enough, **I realized how inconsistent I was, the same data was flowing around in at least 3 different formats.** This is because of the easiness through which you can create literals in JavaScript ... Need some placeholder for data?... Just create a new literal object.” --Alex

“In JavaScript, you are really at the mercy of your ability to **spell.** ”

```
delete this.markers[range.statMarkerId]; //start
```

--Joao

TS Retrospective

We were on the **bleeding edge**...

...but we expected it and had plenty of band aid

We would **do it again**, the benefits outweigh the pains

Code readability, refactoring agility, tooling, fun

<http://www.typescriptlang.org/>

Monaco Links

Learn

Get started with the [Monaco Channel9 Series](#)

Read [Jgalloway's blog post](#) on Monaco

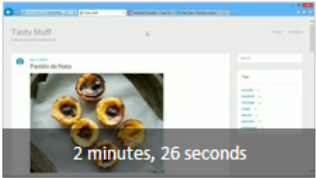
Try


Enable "Edit in Visual Studio Online" for your Azure Websites
Clone in code from Git repositories on Visual Studio Online
Develop, build, test and push to production

Feedback

Send a Smile!


#VSOMonaco



First Steps
Visual Studio Online "Monaco"
Nov 13, 2013 at 5:30 AM  9
★★★★★ (1)
Joao Moreno does a quick intro
development web site

2 minutes, 26 seconds

EDIT IN VISUAL STUDIO ONLINE

OFF ON  [PREVIEW](#)

Send us your feedback

How was your experience?



Thanks!