Some tools for building web-based groupware

Michel Beaudouin-Lafon
mbl@lri.fr

Javascript

- More powerful than you think
- Functional: functions are first-class objects
  - **function** map(a, f) {
    var sum = 0;
    for (var i = 0; i < a.length; i++)
    sum += f(a[i]);
    return sum;
    }
  - map([1, 2, 3], **function**(x) { **return** x*x }); // 14

Javascript

- Functional: functions are first-class objects
  - **function** currify(f, x) {
    return function(y) {
    return f(x, y);
    };
    }
  - **function** add(a, b) { **return** a+b; }
  - **var** add4 = currify(add, 4);
  - add4(2); // 6

Javascript

- Object-oriented: based on the notion of **prototype** instead of the notion of class
  - **var** p = {
    x: 10,
    y: 25,
    moveBy: **function**(dx, dy) {
    this.x += dx; this.y += dy
    }
    }
  - p.moveBy(5, 10); // p = { x: 15, y: 35, moveBy: …}

Javascript

- Each object inherits from its **prototype**
  - **var** protoPoint = {
    x: 0, y: 0,
    moveBy: **function**(dx, dy) {
    this.x += dx; this.y += dy;
    }
    }
  - **var** p = {}; p.prototype = protoPoint;
    // note : the above does NOT work – see next slide
    // (a constructor is the only way to define a prototype)
  - p.x; // 0 (from the prototype)
    p.x = 10; // x is now a property of p
    p.moveBy(5, 10); // p = {x: 15, y: 10}

Javascript

- We can re-create a class-based system
  - **function** Point() { // this is a constructor function
    this.x = 0; this.y = 0
    // also assigns this.prototype
    }
  - **var** p = **new** Point(); // calls Point with a new object
  - // this is equivalent to a "method" of "class" Point
    Point.prototype.moveBy = **function**(dx, dy) {
    this.x += dx; this.y += dy;
    }
  - p.moveBy(5, 10); // p = {x:5, y:10};

Modern Javascript

- Classes
  - A more convenient notation for creating classes
  - class Point {
    constructor() { this.x = 0; this.y = 0; }
    moveBy(dx, dy) { this.x += dx; this.y += dy; }
    }
  - var p = new Point(); p.moveBy(10, 20)
- Other useful features, including
  - Iterators and generators
  - Arrow functions, Promises

Typescript

- Javascript with types
  - function fib(n: number): number { … }
- Powerful type system
  - Generic types:
    function swap<T>(a: T, b:T): T { var x = a; a = b; b = x}
- Other powerful features
- Translates to plain Javascript
- Works with plain Javascript libraries
  - Through definition files (see definitelytyped.org)

Node.js

- Use Javascript to program web app servers
- Module system
  - Modules are installed with npm, the Node Package Manager: npm install <package>
  - Packages can be local or global (npm –g)
  - A package is imported with require:
    var fs = require('fs'); // access to file system
    fs.fileExists(…)
  - Node has built-in modules to access the OS: file system, processes, HTTP protocol, …

Node.js

- Node implements a reactive programming model based on events and event handlers
- Asynchronous event handling
  - **var** Emitter = require('events').EventEmitter;
    var chatRoom = new Emitter(), participants = [];
  - chatRoom.on('hello', **function**(name) {
    console.log(name, 'says Hi!');
    });
  - chatRoom.on('hello', **function**(name) {
    participants.push(name);
    });
  - chatRoom.emit('hello', 'Alice');

Node.js

- Using continuations (or callbacks) to program in an asynchronous world
  - Many node modules use callbacks, which are called when the task is actually performed:
  - **var** fs = require('fs');
    var fd = fs.open('myFile', 'w');
    if (fd) fs.write(fd, 'Hello'); // wrong: file not opened!
  - fs.open('myFile', 'w', **function** (err, fd) {
    if (! err) fs.write(fd, 'Hello', **function**(err, fd) { …});
    });
    // green function called when **open** is finished
    // blue function called when **write** is finished

Promises

- Facilitate asynchronous programming
- An asynchronous call returns a Promise object instead of taking a callback
- The then function of the promise is used to specify what to do when the call succeeds:
  - var fs = require('fs'), util = require('util');
    var readdir = util.promisify(fs.readdir);
    readdir(path).then(function(files) {
    console.log(files.join('\n'))
    });

Promises

- Instead of being nested like callbacks, Promises are chained
- open(path, 'w').**then**(function (fd) {
  write(fd, 'Hello');
  return fd;
  }).**then**(function(fd) {
  close(fd);
  })

Node.js – Express HTTP server

- Basis of many web applications
  - **% npm install express**
  - **var** express = require('express'),
    app = express();
    app.get('/', **function**(request, response) {
    response.send('Hello World');
    });
    app.listen(8080);
  - // serve static files
    app.use(express.static(__dirname + '/public'));

Node.js – socket.io

- Communication between web page and server
- Server :
  - **% npm install socket.io**
  - **var** io = require('socket.io').listen(http);
    io.on('connection', **function** (client) {
    client.on('msg', **function** (data) {
    // send to all other clients
    client.broadcast.emit('msg', data);
    });
    });

Node.js – socket.io

- Client (web page)
  - <script src="/socket.io/socket.io.js"></script>
    <script>
    var client = io ();
    client.on('connect', **function** () {
    client.emit('msg', 'Hello');
    });
    client.on('msg', **function**(data) {
    $('#chat').append(data);
    });
    </script>

ShareDB

- Shared text strings and JSON objects synchronized through operational transformation
- Server
  - **var** ShareDB = require('sharedb').client;
    var share = new ShareDB(options);
    …
    // when a client connects to the server:
    share.listen(client);

ShareDB

- Client that synchronizes text in a textarea
  - **var** ShareDB = require('shared/lib/client');
    var sock = new WebSocket('<server address>');
    var connection = new ShareDB.Connnection(sock);
    …
    var doc = connection.get('mydoc', 'textarea');
    doc.subscribe(function(err) {
        if (err) throw err;
        var binding = new StringBinding(element, doc);
        binding.setup()
    }

Node-webkit

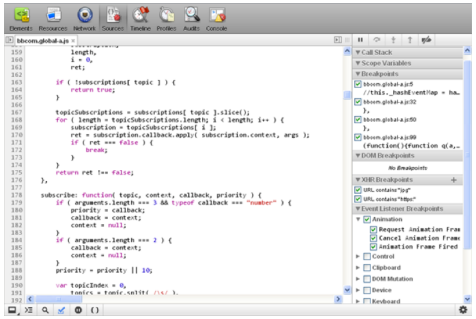
- Combines a node.js server and a web browser
- Access to desktop: files, menus, …
- Desktop-based web applications
- Avoids web protocol issues (same-origin, …)
- Global namespace shared between node server and every web window

Node-webkit

- A web page that lists the files in the current directory
  - <script>
    var fs = require('fs'); // node module in HTML file!
    fs.readdir('.', **function**(err, files) {
      files.map(**function**(filename) {
        $('#list').append('
'+filename+'
');
      });
    });
    </script>
  - <ul id='list'>

Debugging

- In the browser: developer tools



Debugging

- Node.js
  - Built-in debugger:

    % node debug myscript.js
    (you need to add calls to debugger in the script)
  - Remote debugging with web inspector
    - Install the node-inspector package (once)

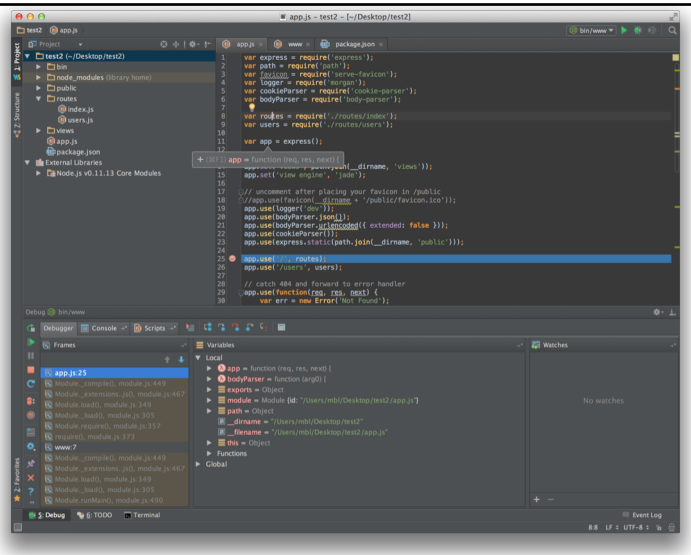
      % npm install –g node-inspector
    - Run the script in debug mode

      % node --debug-brk myscript.js

      % node-inspector &
    - Browse to http://localhost:8080/debug?port=5858 and use web inspector in that window

WebStorm

- Integrated Development Environment (IDE)
- Project manager
- Editor
  - Multiple cursors
  - Refactoring
  - Linting
- Debugger
- Supports Typescript

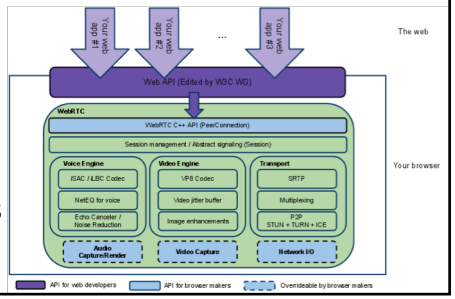


The (near) future: WebRTC

https://webrtc.org

- Set of APIs for real-time communication
- Supports audio, video, data
- Web APIs as well as native APIs

- But:
- Complex
- Still unstable
- Only supported in some browsers



Project ideas

- Shared drawing tool (doodling)
- Shared browsing
- Shared annotation of any web page
- Multi-room chat
- …