An Introduction to node.js

By **Mavity, Brian**

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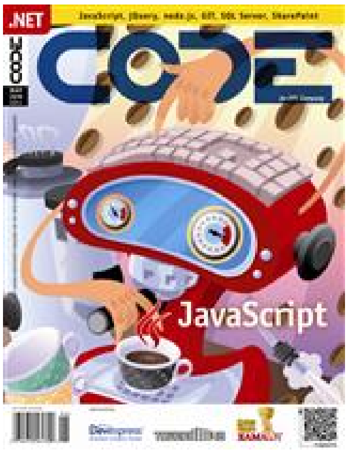

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node.js Design Patterns

JavaScript has a lot of momentum these days. It seems you can’t get very far in a software development discussion without hearing about node.js. If you are wondering what all the fuss is about, and why you should care, you’re in the right place.

The tag line for node is “Evented I/O for V8 JavaScript” with a goal of “[providing] an easy way to build scalable network programs.” If the tag line seems a bit cryptic, all you really need to know is that V8 is the extremely fast JavaScript engine maintained by Google that is used in their Chrome web browser, and “evented I/O” means that I/O in node is completely nonblocking. Like a web browser, node has a built-in event loop that runs continually in the background. When writing code, you subscribe to events using callback functions and node sleeps until something happens that it needs to process. If that sounds familiar, it should. It's the same way you'd handle, let's say, a click event using jQuery.

In this article, I'm going to explore node and progress through the basic concepts needed to develop with it. By the end of the article not only will you have a functioning chat server, you'll understand enough to take the sample code and enhance it on your own. I hope you'll be pleasantly surprised at how easy it is.

Installation

With node.js, the world is pretty clearly divided. Its development is done completely in Linux or Mac OSX, and a massive majority of its community works in the same environments. There has been very little attention given to Windows until recently, and some versions of node were impossible to run. Luckily, while doing the work for this section of the article, I found a relatively simple solution to running node on Windows that is unobtrusive and just works. There are some slight differences that you will have to contend with when running node on Windows, but I will address them when they are needed. The following subsections give installation instructions.

Windows

In Windows, use the following steps to install node:

1. Go to http://www.rafaljonca.org/d/nodejs-windows and download the NodeJS 0.4.1 package.
2. The built-in Windows extractor won't work, since the package is in 7-zip format. Download an extractor that will work if you need to. For a free one, go to http://7-zip.org/.
3. You can extract it anywhere, I just put it on my Desktop.
4. Open up a PowerShell prompt with administrator privileges and navigate to the bin folder in the distribution you just extracted.
5. Execute *./shell.cmd*.

Please note that every time you open a new PowerShell prompt to use node, you will need to execute the *shell.cmd* file as outlined in step 5.

OSX

In OSX, use the following steps to install node:

1. Go to http://sites.google.com/site/nodejsmacosx/ and download the NodeJS-0.4.1.pkg file.
2. Install the package.
3. Open your shell of choice.

Type the following command and make sure you get matching output:

```
> node -v
v0.4.1
```

There are some alternate ways to install node.js both on Windows and OSX. You can see them on the node.js wiki https://github.com/joyent/node/wiki/Installation.

First Example

Let's take a look at a simple node.js program. Open your favorite IDE or text editor and create a file called *flyingMonkeys.js*, and then type in the code from the following code snippet and save the file:

```
// Simple console logging.
// It works the same way it would in a web browser
console.log('Look! Flying monkeys!');
```

To run programs in node, you'll go back to your trusty command-line tool and type the following command: (note: if you have installed node using the Windows instructions I provided above, make sure that you have executed *./shell.cmd*):

```
> node flyingMonkeys.js
Look! Flying monkeys!
```

Hooray! OK, now that the ubiquitous "Hello, world!" app is out of the way, let's look at a comparison of the behavior between node and the browser.

Web Browser vs. node.js

In a web browser environment, there is a global object named *window*, which is available to JavaScript on the page as well as JavaScript in external files. I'm going to take a look at an example illustrating variable scope. To start off, let's create a file named *external.js* and type the following code into it:

```
// declaring variable without the var keyword
// makes it global in JavaScript
externalWithoutVar = 'without var';

// declaring a variable with the var keyword
// outside of a function declaration adds it
// to the window object in the browser.
var externalWithVar = 'with var';
```

All you're doing here is declaring two variables. One declaration will use the *var* keyword and the other will not. If this seems pretty useless, bear with me, it will all make sense shortly.

Next, let's create an HTML file named *globals.html*. The HTML can be anything you'd like as long as there is a script tag containing the following JavaScript. There's a working example shown in **Listing 1** that you can use if you don't want to make up your own:

```
var onThisPage = 'this page';

// 'without var'
console.log(window.externalWithoutVar);

// 'with var'
console.log(window.externalWithVar);

// 'this page'
console.log(window.onThisPage);

// 'this page'
console.log(onThisPage);
```

Now open *globals.html* in your web browser and you should see the following console output:

```
without var
with var
this page
this page
```

When files are loaded by the browser, variables declared outside of a function scope are added to the window object. If you’re not careful with how you declare your variables you end up with a large amount of them attached to the window object. This is what is known as “polluting the global namespace” and should be avoided.

In node.js, instead of *window*, the global object is aptly named *global*. This object, like *window* in the browser, is available in all your JavaScript files. To illustrate the differences between the two environments, you’re going to make the node equivalent of *globals.html*. Create a file named *globals.js* in the same directory as the *external*.js file and type the following code:

```
require('./external');

var inThisFile = 'this file';

// 'without var'
console.log(global.externalWithoutVar);

// undefined
console.log(global.externalWithVar);

// undefined
console.log(global.inThisFile);

// 'this file'
console.log(inThisFile);
```

Before you run this code, take a quick look. As you can see with all the console logging, you’ve merely substituted *global* for *window*. You can also see the *require* function, which imports the file *external.js*. I’m going to sidestep further discussion of the *require* function for now, but I’ll get back to it, I promise. For now, run the example. You should see:

```
> node globals.js
without var
undefined
undefined
this file
```

OK, so there is a difference. The variables that were declared with the *var* keyword are undefined on *global*. Why did this happen? It’s because in node, every file is loaded as a module. I’ll explain the module concept further in a bit, but for this example, what you need to know is that any variable declared with the *var* keyword cannot be directly accessed outside of that module.

Declaring a variable without the *var* keyword in JavaScript automatically makes it global, so you get the behavior you'd expect from *externalWithoutVar*. You can also see that the *externalWithVar* and *inThisFile* variables are not defined in the global scope, and that *inThisFile* can be referenced locally.

> Declaring a variable without the var keyword in JavaScript automatically makes it global.

Even for this very simple example, there's something that I find very cool. You're using the exact same *external.js* file for both examples. That type of thing is not going to happen in most circumstances (yet). The exciting part is that, eventually, it will.

Built-in Modules and Asynchronous Programming

OK, enough with the introductory material, it's time to look at something useful. In this section, you're going to take some big strides. You're going to learn how to reference built-in modules, how to load a file, and how to respond to an HTTP request. You'll be introduced to the two main ways node.js handles asynchronous operations by using a direct callback and an instance of *events.EventEmitter*. By the end of this section, you'll know 80% of the coding concepts you'll need in order to be a successful node JavaScript programmer.

Up until this point, I have not covered any of the asynchronous aspects of programming with node.js. The built-in node modules mainly use one of two mechanisms for dealing with asynchronous programming. The first method is using a direct callback. This is used when you want to directly request the result of an operation. The second common method is using an object that is an instance of the built-in *events.EventEmitter* object. You use an instance of *EventEmitter* when something will potentially happen multiple times and you want to be notified whenever it does.

Modules

As I said earlier, every file in node.js is loaded as a module. In addition to the variable scoping discussed previously, being a module also means that every file has access to a specific set of properties and functions. Modules in node implement the CommonJS module specification, which defines the presence of a *require* function and a couple of other objects I'll discuss later.

You first saw the *require* function in the globals example. There, you were importing one of your own files. In this section, you're going to use the *require* function to import a couple of different built-in node modules. To do this, you're going to call the *require* function with a module name, which will then load that module and return it. Here are two lines of code you could use to load the built-in HTTP and file system modules:

```
var http = require('http');
var fs = require('fs');
```

There's something interesting about the *require* function. It's one of the few built-in node I/O functions that only has a synchronous version. This is acceptable because node only loads a module from disk the first time it is requested. After that, the module is cached, and all remaining access to it is from memory. This means that you'll pay a bit of overhead up front, but during run time you won't have to worry about being delayed by any blocking.

The File System Module and Direct Callbacks

You just saw how to import node's built-in file system module, and now you're going to use it to read a file and log the file's contents to the console. You'll do this using a direct callback, and in the process learn about node's error handling convention.

First, create a text file and put a line of text in it. I used a file called *flyingMonkeys.txt* containing the text "Look! Flying monkeys!" In the same directory, create a JavaScript file with the following code, I named mine *fsDirectCallback.js*:

```
var fs = require('fs');

var logFileContents = function(fileName) {
  fs.readFile(fileName, function(err, file) {
    if(err) {
      console.log('There was an error.');
    } else {
      console.log(file.toString());
    }
  });
};
// 'Look! Flying monkeys!'
logFileContents(__dirname + '/flyingMonkeys.txt');
// 'There was an error.'
logFileContents('does not exist');
```

Let's examine the code you've created. After you load the file system module, you define a function named *logFileContents* that has a file name as its only argument. Inside *logFileContents*, you call the *fs.readFile* function with the file name that was passed into *logFileContents* as the first argument, and then provide an anonymous direct callback function as the second argument.

Even though the callback function may look a bit strange, it follows the established convention in node. Callback functions always have an error object as their first argument and the result of the call as the second argument. If the operation completes successfully, the error object will be null. Because of this, inside the callback function, you need to check to see if the error object exists. In the case of an error, you're going to log a message to the console. In the case of a successful read of the file, you're going to log the contents of the file to the console.

> Callback functions always have an error object as their first argument and the result of the call as the second argument.

Notice that in the case of a successful file read, you called the *toString* function on the file object. When you call the *fs.readFile* function the way you did, the file object is an instance of *Buffer*. This is because the *fs.readFile* function takes an alternate file encoding argument, which you did not provide. The *Buffer* object is used by node to handle binary data, and to convert from a *Buffer* to a string, you need to call the *toString* function of the *Buffer* object.

> The value of the __dirname property is the path to the directory that contains the module.

To finish off the code sample, you call the *logFileContents* method with two different file names. The first file is the one you created earlier. The value of the __dirname property is the path to the directory that contains the module. You use it in this instance to make sure that you have the correct full path to the *flyingMonkeys.txt* file. This function call will result in the contents of *flyingMonkeys.txt* being logged to the console. The second file will not exist. Therefore, the error object will not be null and you'll end up logging the error message to the console. Let's run the sample and make sure you get the results you expect:

```
> node fsDirectCallback.js
There was an error.
Look! Flying monkeys!
```

Everything looks good… err what? Didn't the code start opening the *flyingMonkeys.txt* file before it started opening the file that didn't exist? Remember, these operations are executed asynchronously; the order in which they will finish isn't guaranteed. It turns out that in this case, while the file is loading in the background, the error occurs and you end up reporting the error first. This is something that you'll have to keep in mind when programming in node. Now that you've seen how direct callbacks work, let's take a look at an *EventEmitter*.

> Remember, these operations are executed asynchronously; the order in which they will finish isn't guaranteed.

The HTTP Module and EventEmitter

At this point, I'm feeling a bit like I've sold you a bill of goods. You've been doing a bunch of JavaScript and have yet to do anything "webby." Let's make up for that now by creating a web server to serve up your new favorite phrase. Node.js is designed for building web frameworks, so there is already a built-in web server. To create a web server, you're going to use the *createServer* function of the HTTP module. For now, that's enough talk. Let's look at the code. I created a file named *httpEventEmitter.js* with the following code:

```
var http = require('http'),
    server = http.createServer();

server.on('request', function(req, res) {
  // Handler functions receive http.ServerRequest
  // and http.ServerResponse objects as arguments
  res.writeHead(200, {
    'Content-Type': 'text/plain'
  });
  res.write('Look! Flying monkeys!');
  res.end();
});

// Start the http server on port 8000
server.listen(8000);
```

You can see the importing of the HTTP module and creation of the web server at the beginning of the code. The interesting part is what comes next. Since the web server is an instance of *events.EventEmitter*, it will accept listeners to its events through the *on* function. One of the events the web server will emit is the *request* event.

> Since the web server is an instance of events.EventEmitter, it will accept listeners to its events through the on function.

To be notified of every request, call the *server.on* function with the event name, *request*, and a callback function that has a request object and a response object as its arguments. Be aware that unlike direct callback functions, there is not a convention for callbacks subscribing to *EventEmitter* events. You will have to check the documentation for each event. For the request event, when the callback is invoked, the arguments will be instances of *http.ServerRequest* and *http.ServerResponse* respectively.

The code inside the callback was a little scary to me at first. I was only vaguely familiar with HTTP response codes and headers. The sum total of my experience with them was the *404-File Not Found* pages and *500-Server Error* pages. This was when it really hit home to me that node was an environment to build web frameworks and I was going to have to look around if I wanted to be more productive.

I figured a little additional knowledge wasn't going to kill me, so I sucked it up and dove in. I'll share that knowledge with you by quickly going over what's happening in the callback. When an HTTP server responds to a request, it provides an HTTP response code. 200 is the code for *OK*, and is used when there's a successful request. The server also must add an HTTP header, which indicates the type of content it is returning. In this case that's plain text, indicated by the value *text/plain*.

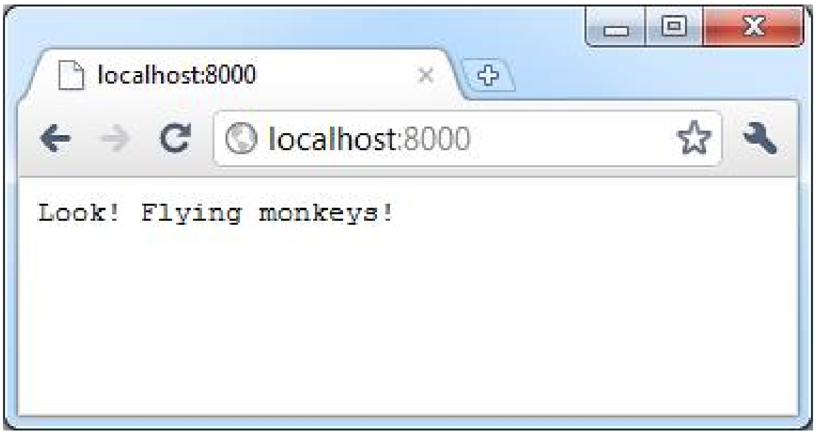
The server is going to respond to every HTTP request with the same phrase. This is the part I was most familiar with from my previous work. You write to the response object until all your content has been returned. Finally, you end the response to let the browser know that the server won't be sending any more data. The code ends up being a bit verbose, but it's not so bad, right?

Now that you know what's going to happen on every request, all that's left is to start up the server. The *listen* function starts the server and you pass it the port number you want it to listen on. Let's run it and see what happens:

```
> node httpOnly.js
```

Hey look, something new. The programs you've run previously have exited immediately after writing results to the console. Here you have a program that is just sitting there, seemingly doing nothing. What exactly is happening here? Once the *http.Server* object starts listening on a port, it goes to sleep until there's an incoming HTTP request. When the request comes in, the server handles the request and goes back to sleep until the next request comes in.

How about you wake up your lazy server process and make it do some work? Open your favorite web browser and navigate to http://localhost:8000/. You should see something similar to **Figure 1**.



```
Look! Flying monkeys!
```

Figure 1: This is the output when running httpOnly.js.

The Node Package Manager, npm

If node.js was only about dealing with raw HTTP request and response objects, it would be little more than a novelty. But node has an extremely robust third-party module ecosystem that is growing at an unbelievable pace. When you installed node earlier, you also installed something called *npm*. The Node Package Manager is the *de facto* way of including external modules in your code, and it's time to learn a bit more about it.

The philosophy behind node is to keep the core libraries small and focused to encourage extension by outside packages.

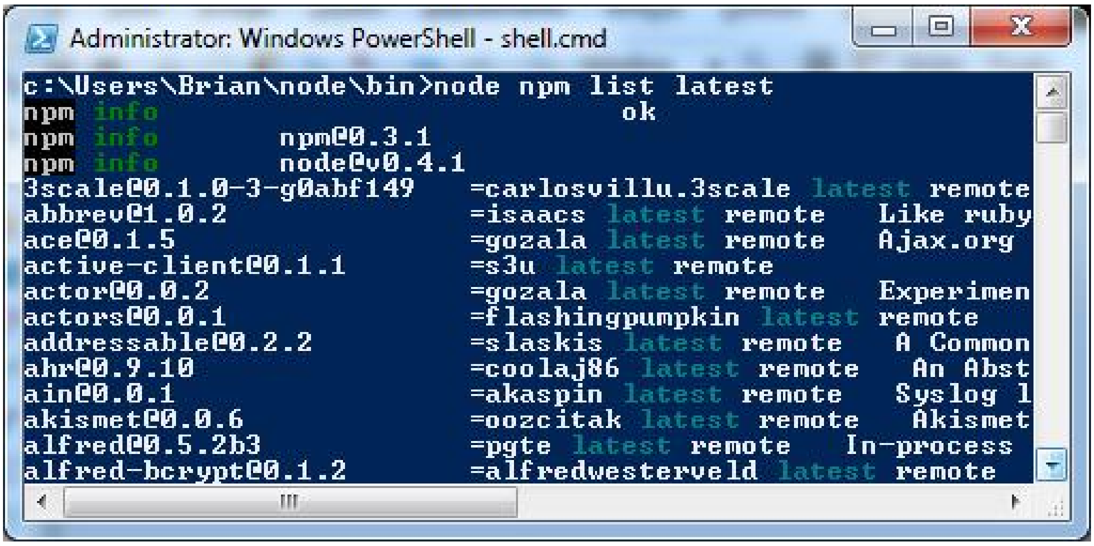
The philosophy behind node is to keep the core libraries small and focused to encourage extension by outside packages. *Npm* is a command-line utility for installing those packages on your system. Before getting a couple of packages, you should peruse the menu and see what's out there. If you want to see the latest version of all registered node packages, you can run the command:

```
> npm list latest
```

If you are on Windows, and have installed node the way I described in the installation section, you're going to have to do things a bit differently. You're going to have to navigate your command line to your node install's *bin* directory and instead of the above command, you'll have to run npm directly through node, like this:

```
> node npm list latest
```

This should result in the output similar to **Figure 2**. Going forward, I am going to show *npm* commands without the node prefix because that's the usual way of using it. Please substitute the additional node syntax if you need to.



```
c:\Users\Brian\node\bin>node npm list latest
npm info                                 ok
npm info          npm@0.3.1
npm info          node@v0.4.1
3scale@0.1.0-3-g0abf149    =carlosvillu.3scale latest remote
abbrev@1.0.2               =isaacs latest remote   Like ruby
ace@0.1.5                  =gozala latest remote   Ajax.org
active-client@0.1.1        =s3u latest remote
actor@0.0.2                =gozala latest remote   Experimen
actors@0.0.1               =flashingpumpkin latest remote
addressable@0.2.2          =slaskis latest remote   A Common
ahr@0.9.10                 =coolaj86 latest remote   An Abst
ain@0.0.1                  =akaspin latest remote   Syslog l
akismet@0.0.6              =oozcitak latest remote   Akismet
alfred@0.5.2b3             =pgte latest remote   In-process
alfred-bcrypt@0.1.2        =alfredwesterveld latest remote
```

Figure 2: This is a list of the latest packages available through npm.

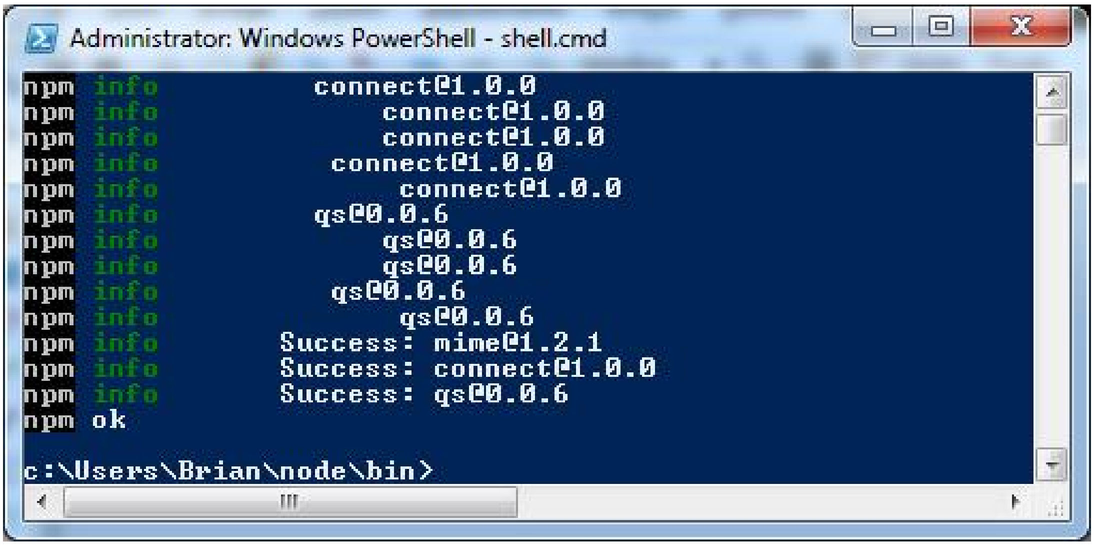
It's time to take *npm* out for a spin and get a couple of packages you'll need in the next section. *Connect* is a server middleware library that provides a friendlier way to deal with HTTP requests. It's similar to Rack in Ruby and OWIN in .NET. You'll use it to simplify the way you serve web pages. *Socket.io* is a brilliant library that abstracts the different possible transports for long running communication between the web browser and the server. You are going to lean heavily on *socket.io*.

> With npm, you can specify the version of the package that you want to install, or you can leave the version out and it will just install the latest.

Let's get these installed. With *npm*, you can specify the version of the package that you want to install, or you can leave the version out and it will just install the latest. Because node moves so fast, new versions of these two packages will almost certainly have been released by the time this article is published, so you should install the versions I used to create this article to avoid potential incompatibilities. First, *connect* version 1.0.0:

```
> npm install connect@v1.0.0
```

If successful, the output should look a bit like **Figure 3**. To make sure *connect* has installed properly, you can run the *list* command with the *installed* tag:

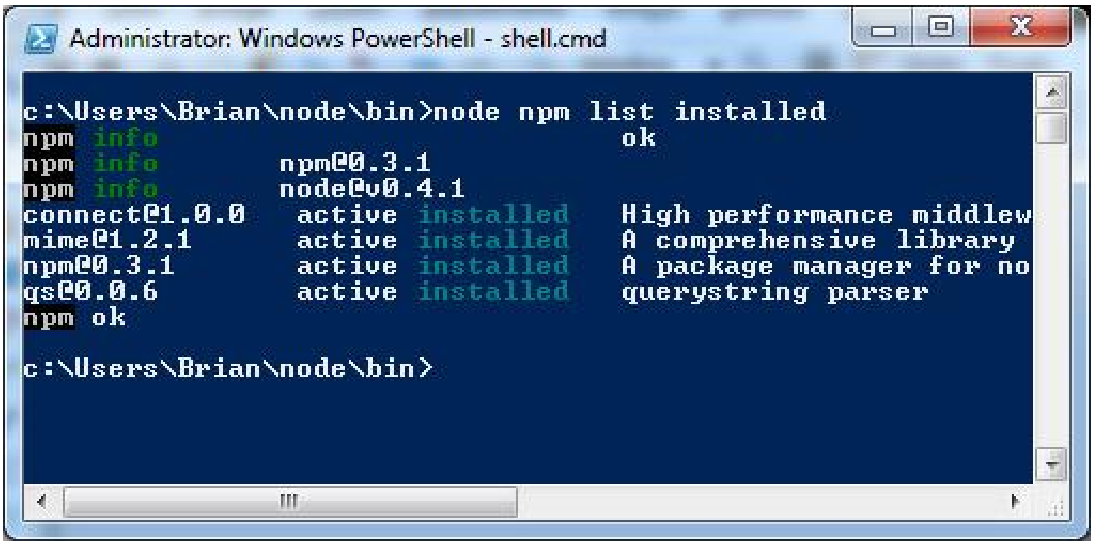


```
npm info             connect@1.0.0
npm info                 connect@1.0.0
npm info                 connect@1.0.0
npm info              connect@1.0.0
npm info                  connect@1.0.0
npm info             qs@0.0.6
npm info                 qs@0.0.6
npm info                 qs@0.0.6
npm info              qs@0.0.6
npm info                  qs@0.0.6
npm info           Success: mime@1.2.1
npm info           Success: connect@1.0.0
npm info           Success: qs@0.0.6
npm ok

c:\Users\Brian\node\bin>
```

Figure 3: This is a successful install of the connect module.

```
> npm list installed
```

You should see something similar to **Figure 4**. Assuming you've only been following along with this article, you're going to see 4 modules installed. *Npm* is installed by default, and you just installed *connect*, but what's with the other two? Modules can have dependencies on other modules. When you request a module using *npm* it will install all that module's dependencies before it installs that module. This ensures the module you want will work correctly. Let's finish up and get *socket.io* installed:



```
c:\Users\Brian\node\bin>node npm list installed
npm info                                 ok
npm info          npm@0.3.1
npm info          node@v0.4.1
connect@1.0.0    active installed    High performance middlew
mime@1.2.1       active installed    A comprehensive library
npm@0.3.1        active installed    A package manager for no
qs@0.0.6         active installed    querystring parser
npm ok

c:\Users\Brian\node\bin>
```

Figure 4: This is a list of installed npm packages.

```
> npm install socket.io@v0.6.15
```

Npm is really handy and powerful. I recommend looking through the list of latest modules and trying out anything that catches your eye. Check back often, new modules are being added every day. If you get stuck, you can see some of the other commands with:

```
> npm help
```

Next you'll finally get to the moment that has been the cause of all this buildup. I've almost forgotten what it was.

Didn't I Promise You a Chat Server?

Indeed, that was the ultimate goal of this article. Here's where you're going to make that a reality. In the last section, you installed two third-party modules with *npm*. Now let's use them in some code.

Serving Static Files With Connect

Creating an HTTP server with the connect module is slightly different than using the built-in HTTP module. After importing the *connect* module, use the *connect.createServer* function to create the server instance. You're going to call the *createServer* function with the middleware modules that you want your server to use. It will accept multiple middleware modules as parameters, and when an HTTP request is received, *connect* will call them in the order they are passed in. Here's an example:

```
var connect = require('connect');

// Creating a connect server with
// two middleware modules. The logger
// module will always be called first.
var server = connect.createServer(
  connect.logger(),
  connect.static(__dirname)
);

server.listen(8000);
```

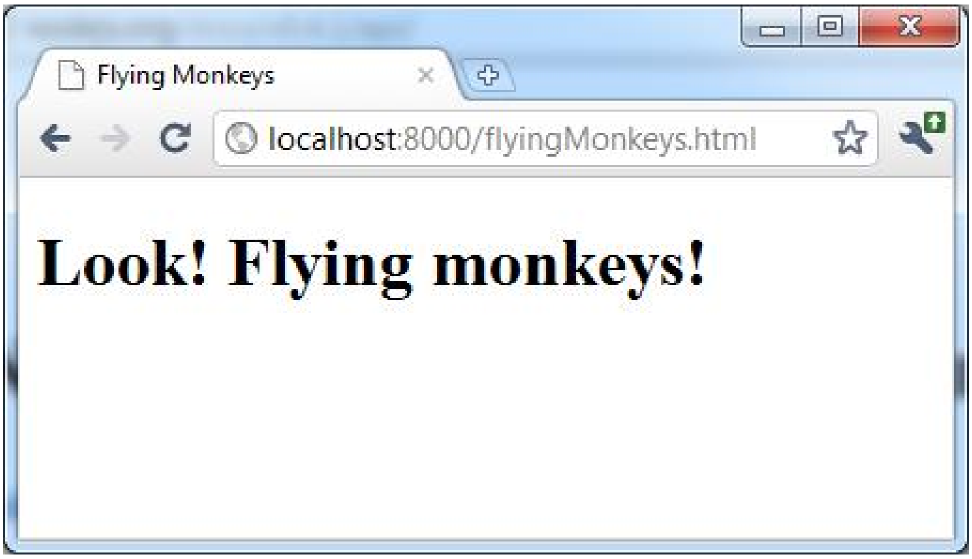
The *connect.Server* is an instance of *http.Server* so it has the same functions. You're passing the *connect.static* middleware module the directory that contains the *connectServer.js* file, so *connect* will look for files in that directory. I created a file called *connectServer.js* with the above code, and then added an HTML file called *flyingMonkeys.html* in the same directory using the following HTML:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="utf-8">
  <title>Flying Monkeys</title>
</head>
<body>
  <h1>Look! Flying monkeys!</h1>
</body>
</html>
```

Let's make sure that your *connect* static file server works by executing the following command:

```
> node connectServer.js
```

Now navigate your web browser to http://localhost:8000/flyingMonkeys.html. If you used the HTML from above, you should see something that looks like **Figure 5**. Now that you have your static file server working, let's add in some code to handle chat connections.



Look! Flying monkeys!

Figure 5: This is the output when running connectServer.js.

Web Sockets With socket.io.Listener

The *socket.io* module uses *WebSockets* to keep long connections between a web browser and a web server alive. A great thing about *socket.io* is that if the web browser does not support *WebSockets*, *socket.io* will keep trying different protocols until it finds one that the browser supports. To create a *socket.io.Listener*, you need to pass an instance of *http.Server* to the *socket.io.listen* function. Then, since the *socket.io.Listener* object is an instance of *EventEmitter*, you're going to have to subscribe to events to make anything happen. Unfortunately, you have to serve some type of HTML to connect to *socket.io*, so you're going to look at a code snippet that will not run, but will illustrate what you do when you want to be notified that a client has connected to your socket server:

```
var http = require('http'),
    io = require('socket.io');

var server = http.createServer();
var socketListener = io.listen(server);

socketListener.on('connection', function(client) {
  socketListener.broadcast('someone connected');
});

server.listen(8000);
```

In this sample, you're listening for the *connection* event of the *socket.io.Listener*. This event is emitted every time a new client connects to the socket server. When this happens, you'll call the *broadcast* function of *socketListener*, which will send the same message to all currently connected clients. Even though it's not being used, I included the *client* parameter in the callback function because it will be passed a *socket.io.Client* object, which is itself an instance of *EventEmitter*.

There are two parts to the *socket.io* module. I've discussed the server module, but there's also a script that can be used in the browser. You can include it in your web pages with the following line of HTML:

```
<script src="socket.io/socket.io.js"></script>
```

When *socket.io* listens to an instance of *http.Server* it will intercept any request to *socket.io/socket.io.js*and return its client script file. To use a socket on the client, you need to create an instance of *io.Socket* and pass it the host you want to connect to. You should not include the port number. You can then connect to the server using the socket's *connect* function. Similarly to the server, you can listen for a message using the *on* function and you can send a message using the socket's *send* function. You can see how this would work in the following code snippet:

```
var socket = new io.Socket('localhost');


socket.on('message', function(message) {
  console.log(message);
});


socket.connect();
socket.send('hi!');
```

Fitting the Pieces Together

Now that you know how the two major pieces work, I'll go over the functionality that you'll want your chat client to handle. I'll keep it simple and allow chatting between connected users and a polite notification when a user has been disconnected. This implies two different types of message. There's a simple *chat* message, and what is more accurately described as a *system* message. It's important to differentiate because these messages are going to be displayed differently.

Earlier, you saw that whenever a new client is connected, *socketListener* emits the *connection* event. Your callback then gets passed the newly created *socket.io.Client* object. To create the behavior you're looking for, you want to listen for that client sending a message and the client disconnecting. You're also going to need a way to keep track of each client. Luckily, all *socket.io.Client* objects have a *sessionId* property that uniquely identifies them as long as they remain connected.

When a user sends a message, you're going to notify all other users that this message was sent. The *socket.io.Client* object has a *broadcast* function that will perform this for you. To display a chat message to other users, you're going to need to know the message text, the type of the message, and who sent it. There is a code snippet below that shows an implementation:

```
client.on('message', function(message) {
  client.broadcast({
    messageType: 'chat',
    nick: client.sessionId,
    text: message
  });
});
```

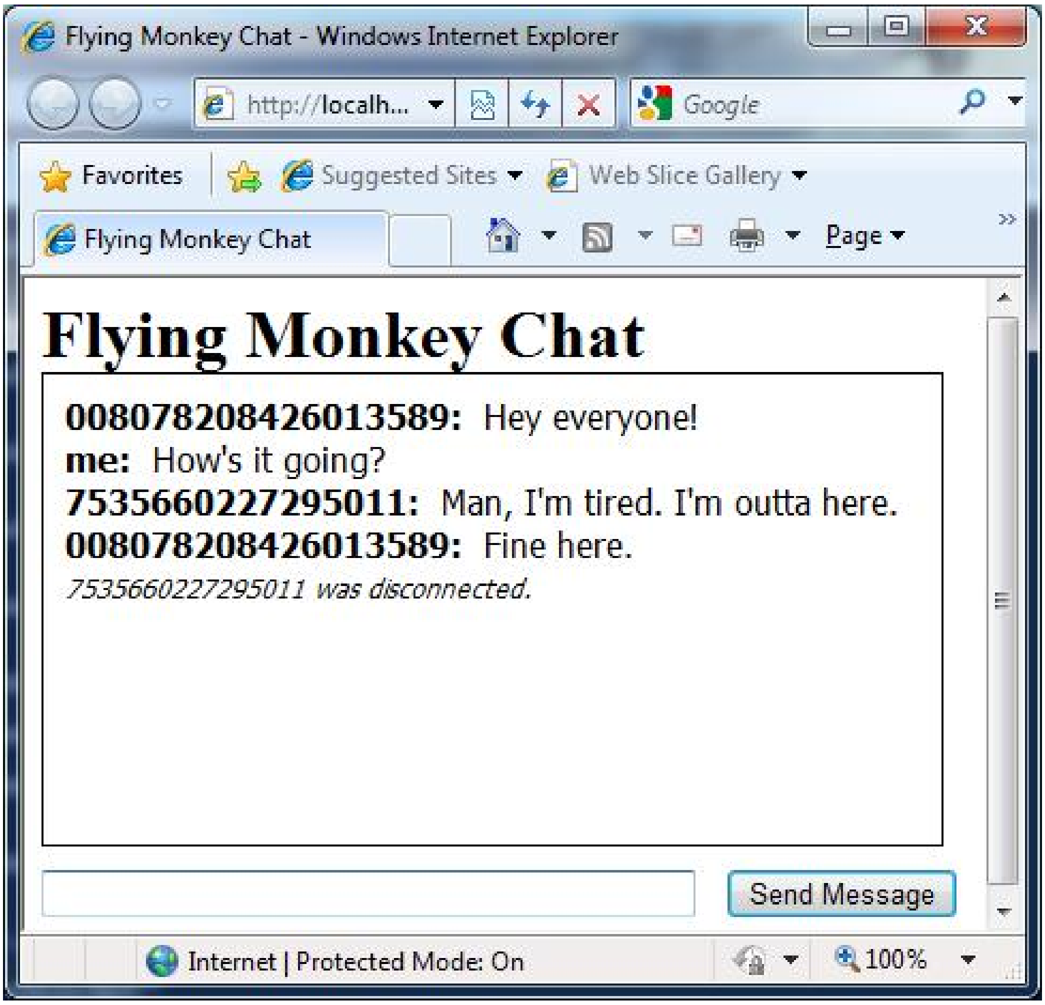
Now that you're able to send chat messages back and forth, let's make sure that you're not sending them to an empty room. When one user disconnects, all the remaining users need to be notified that this has happened. To send a message to all users, use the *socketListener* object's *broadcast* function. This time, you only need the type of message and the message text. Again, here's a code snippet with an implementation:

```
client.on('disconnect', function() {
  socketListener.broadcast({
    messageType: 'system',
    text: client.sessionId + ' was disconnected.'
  });
});
```

Now that I've gone over the specifics, let's create the full server. You can copy the code from **Listing 2**, which I've named *server.js*. As you can see from the code, you're also going to need a directory named *public* in the same directory as the *server.js* file to hold an HTML page and an external JavaScript file needed to run the chat program in the browser. Create files based on **Listing 3** and **Listing 4**. I named mine *chat.html* and *chatClient.js* respectively. (Unfortunately, a discussion of the client code is outside the scope of the article. Feel free to send email to me with any questions.) It's the moment of truth, fire up the chat server using the following command:

```
> node server.js
xxxxxxx - socket.io ready - accepting connections
```

Now, navigate your web browser of choice to http://localhost:8000/chat.html. Do it again; you're simulating chat, after all. Feel free to experiment by exchanging messages between the two windows. If you want to test the disconnect message, refresh one of the browser windows. It should look something like **Figure 6** and **Figure 7**.

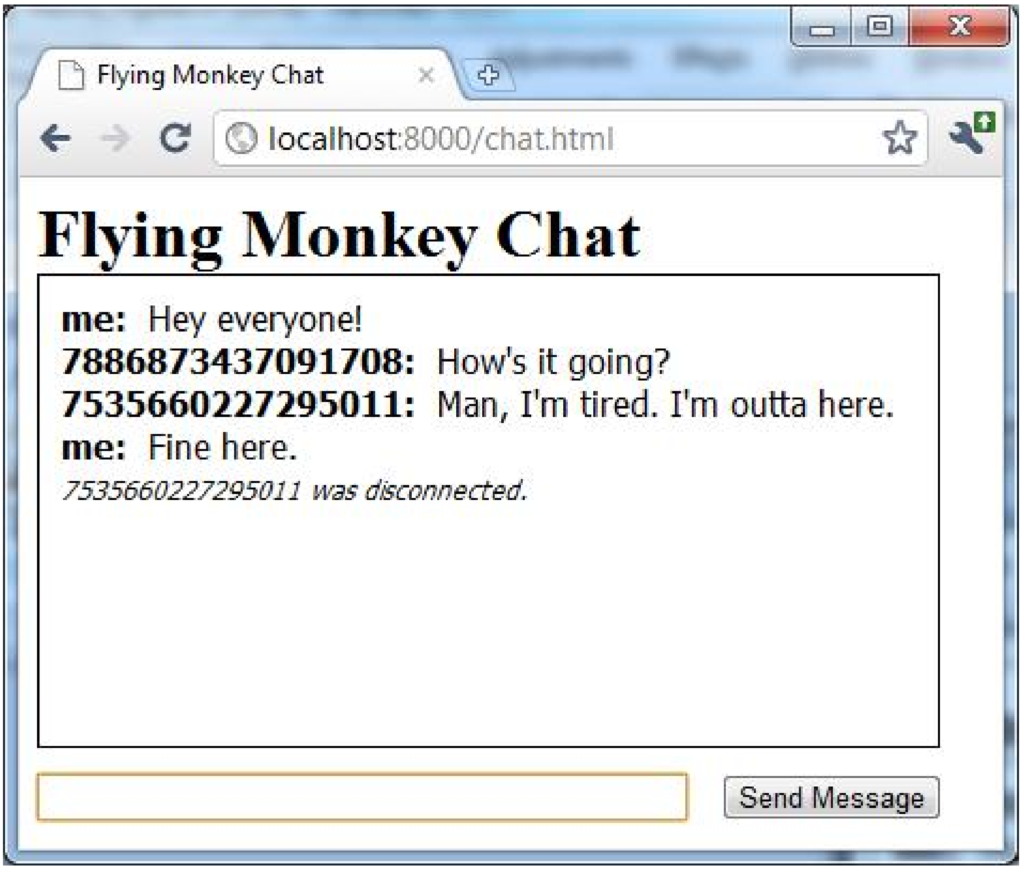


Flying Monkey Chat

008078208426013589: Hey everyone!
me: How's it going?
7535660227295011: Man, I'm tired. I'm outta here.
008078208426013589: Fine here.
7535660227295011 was disconnected.

Send Message

Figure 6: This is one user's chat perspective.



Flying Monkey Chat

me: Hey everyone!
7886873437091708: How's it going?
7535660227295011: Man, I'm tired. I'm outta here.
me: Fine here.
7535660227295011 was disconnected.

Send Message

Figure 7: This is the other user's chat perspective.

I don't know about you, but as cool as this is, I think a couple of improvements are in order. After all, who wants to chat with a big number? I'd also like to know when someone joins the chat. Let's see how to fix this up.

Nicknames and Connections

Improving the chat server functionality shouldn't be difficult, but a lot of logic is starting to accumulate inside of the *server.js* file. It would be better if the logic for the chat room was extracted into its own file to keep things clean and maintainable. There's a bit of a problem, though. You haven't learned how to create a module yet. Let's rectify that.

Your Very Own Module

So far, you've been consuming modules that have been created by other people, but you haven't yet created your own. All your *require* statements have been in the form of:

```
var connect = require('connect');
```

In reality, the *require* function accepts the path to a file. In the case of npm and the built-in modules, you only have to supply the name because node has default paths that it searches in when only a name is provided. To include your own file, you must supply its path relative to the file that contains the *require* function call. A sample should clear this up. Let's say you had a file named *finalServer.js* and a module file in the same directory named *chatRoom.js*. To import the *chatRoom* module into your *finalServer* module, you'd use:

```
var room = require('./chatRoom');
```

When importing your own modules, you must have a "./" or "../" prefix, and you do not include the file extension. Also of note, the *require* function works differently than the file system module in that it does not use the current working directory as the starting point for its searching. One more note before you finish up with modules. There is a way to include your own modules by name, which involves a directory named *node_modules*, but it's beyond the scope of the article.

Now that you know how to import your module, let's learn how you make functions and properties available outside of it. Remember earlier, I showed that variables defined in a node module are only available inside of that module. You could make them global, but that might result in your coworkers smacking you around. To stay safe, let's find a better way. Every module in node has a *module* property that has information about the module when it gets loaded. For your purposes, you're going to focus on the *exports* property of the *module* object. Any property you add to this *exports* property is then available to consumers of your module. The following code is what it will look like:

```
var sayHi = function() {
  console.log('hi');
};

// sayHi is now available to
// consumers of this module.
module.exports.sayHi = sayHi;
```

You've learned how to import your own module and make its functionality available to consumers. The only thing left is to get back to your chat room example and modify your chat server to use it.

Chat Room and Final Server Implementations

Your chat room module is going to need to handle four different cases. You were already handling two of them previously, but you're going to delegate that functionality to the *chatRoom* module. If you want to get better context for some of the following code samples, you can see the full implementation in **Listing 5**. Now let's start with chat messages.

The *chatRoom* module should process messages from users in the room. The code to handle chatting is very similar to the code you used before, but this time, you have the additional functionality of changing nicknames. A user should be able to do this by typing the following command into a chat window:

```
/nick Joe
```

I'll have you take an extremely naïve approach and assume that if a message does not start with "/nick" then it's a chat. If it does, then you should modify the nickname and return a system message. Here's what it looks like:

```
var processMessage = function(sessionId, message) {
  if(message.indexOf('/nick') === 0) {
    return changeNick(sessionId, message);
  }
  return {
    messageType: 'chat',
    nick: clients[sessionId],
    text: message
  };
};
```

In addition to the raw message, pass the *sessionId* to the *processMessage* function to identify the user that is submitting the message. Also, it isn't shown here, but the *chatRoom* module in **Listing 5** has a *clients* object, which holds key/value pairs where the key is a user's *sessionId* and the value is the user's nickname.

Next, I'll have you tackle the case where a user disconnects from your chat room. In this case, you're going to want to delete the user from your *clients* object and return the same system message as earlier:

```
var removeUser = function(sessionId) {
  var nick = clients[sessionId];
  delete clients[sessionId];
  return {
    messageType: 'system',
    text: nick + ' was disconnected.'
  };
};
```

And finally, to be notified when a new user joins your chat room, you're going to need to add the user to your *clients* object. Then, so you don't have to see that hideous *sessionId*, you're going to give each user a default nickname and return a system message indicating that a new user has connected:

```
var addUser = function(sessionId) {
  var userName = 'User ' + userCount;
  clients[sessionId] = userName;
  userCount++;
  return {
    messageType: 'system',
    text: userName + ' has connected.'
  };
};
```

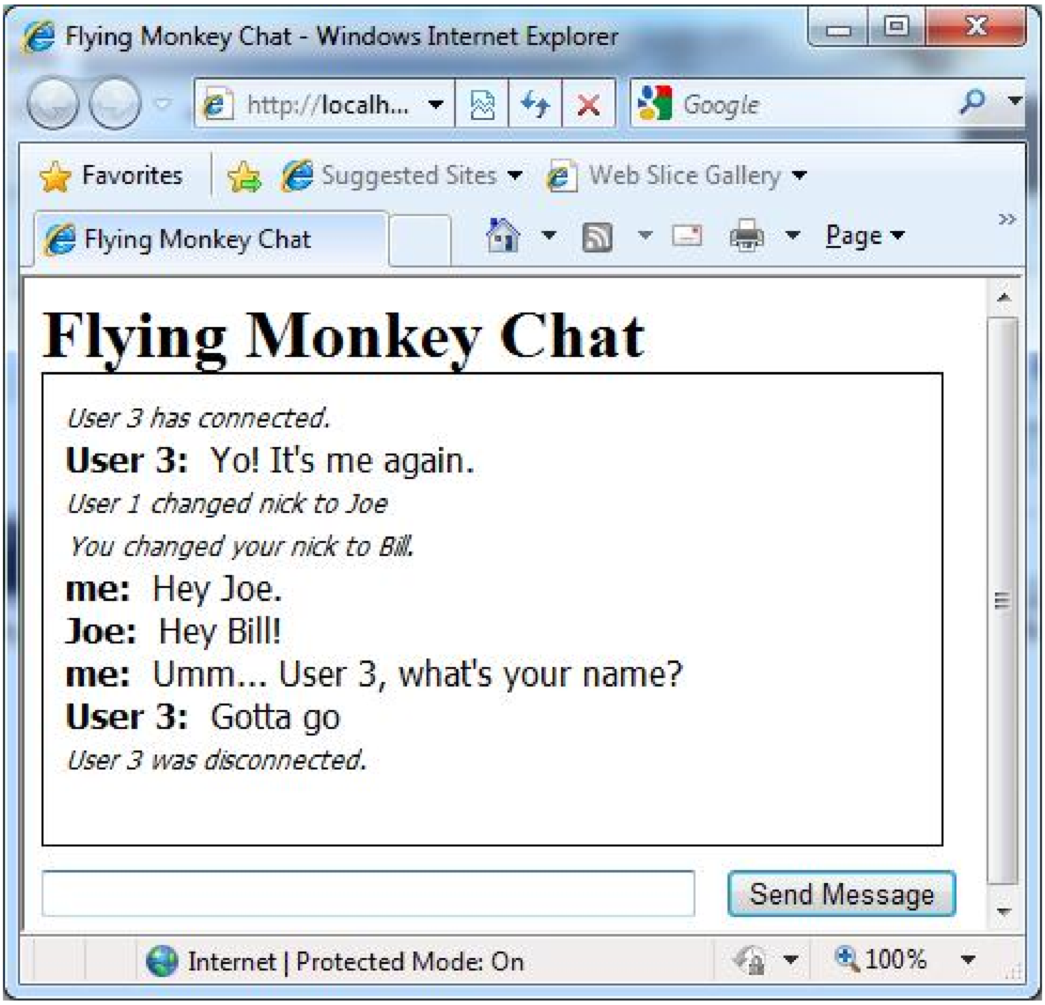
You're also going to need to modify the section of *finalServer.js* using the code from **Listing 6**. The relevant section is where you use your new *chatRoom* module. Other than adding the functionality for a user joining the chat room, all you've really done here is replace the anonymous functions that were in **Listing 2** with calls to your new module:

```
socketServer.on('connection', function(client) {
  var sessionId = client.sessionId,
      addedUserMessage = room.addUser(sessionId);

  client.on('message', function(message) {
    var pMsg = room.processMessage(sessionId, message);
    client.broadcast(pMsg);
  });
  client.on('disconnect', function() {
    var ruMsg = room.removeUser(sessionId);
    socketServer.broadcast(ruMsg);
  });

  client.broadcast(addedUserMessage);
});
```

As I said earlier, the final code for your chat server is in **Listing 5**, which I've called *chatRoom.js,* and **Listing 6,** which I've called *finalServer.js*. If you create them in the same directory that you created the *server.js* file from the first version of the chat server, you can reuse the *chat.html* and *chatClient.js* files from **Listing 3** and **Listing 4**. Otherwise, you'll have to create a directory named *public* and add those files to it. You can run *finalServer.js* using the following command:

```
> node finalServer.js
xxxxxxx - socket.io ready - accepting connections
```

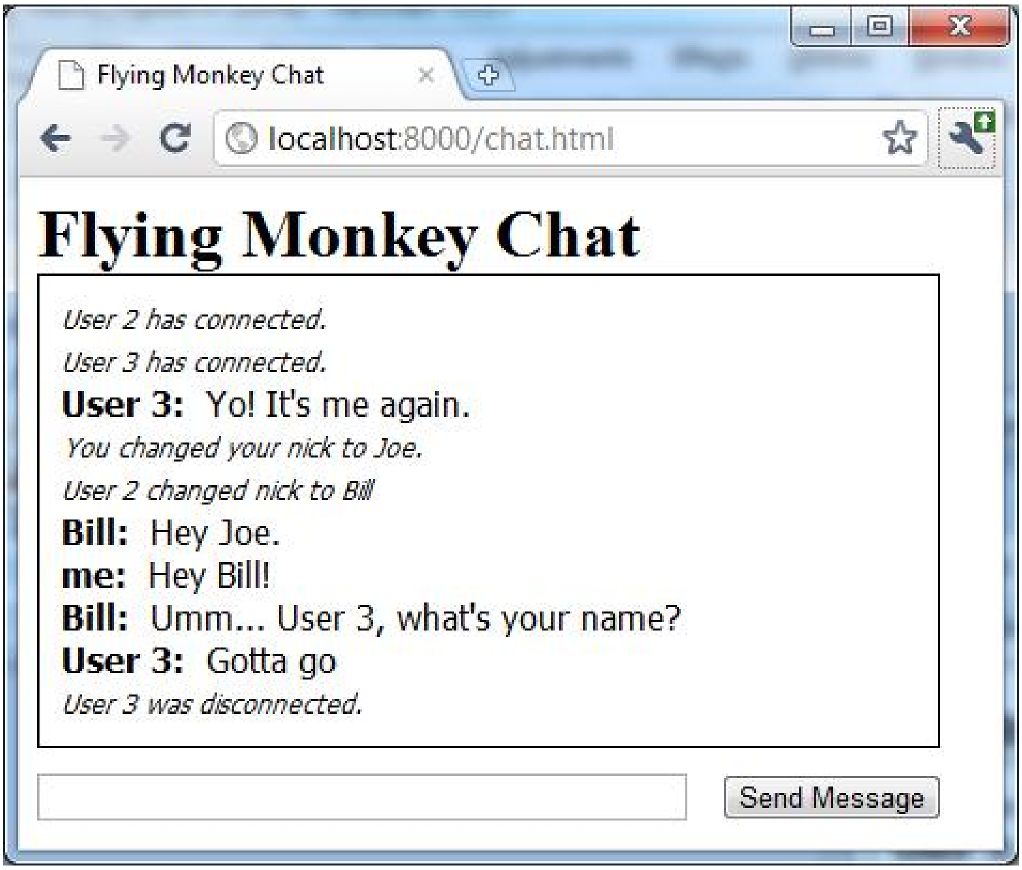
Once again, feel free to play around. Open a couple of browser windows, and look for the message when a user connects. Change your nickname, chat, and have some fun. It will look like **Figure 8** and **Figure 9**.



Flying Monkey Chat

User 3 has connected.
User 3: Yo! It's me again.
User 1 changed nick to Joe
You changed your nick to Bill.
me: Hey Joe.
Joe: Hey Bill!
me: Umm... User 3, what's your name?
User 3: Gotta go
User 3 was disconnected.

Figure 8: This is one user's perspective when using the final chat server.



Flying Monkey Chat

User 2 has connected.
User 3 has connected.
User 3: Yo! It's me again.
You changed your nick to Joe.
User 2 changed nick to Bill
Bill: Hey Joe.
me: Hey Bill!
Bill: Umm... User 3, what's your name?
User 3: Gotta go
User 3 was disconnected.

Figure 9: This is another user's perspective when using the final chat server.

Wrapping Up and Final Thoughts

This has been quite a ride, and if you've stuck around this long, I hope you've been able to learn something. I would like to give some caution about using the code samples from this article as anything other than a learning tool. With any web technology, there are a lot of security implications to consider.

As of the writing of this article, node.js is still changing very rapidly. It incremented versions twice before I finished. Innovative modules pop up all the time. The great thing about doing something different is that people are freed to rethink the way they've traditionally solved problems. Node.js is being used in production on many web sites and it holds up well. It's definitely something to keep an eye on.

Command Line Samples

Working with node.js requires use of the command line. In Windows, you'll likely be using Command Prompt or PowerShell. In OSX, you'll probably use terminal or zsh. I will be using a specific format with the command line samples in this article. Lines that begin with a ">" character need to be typed in. Lines without an opening character are output.

For the following, you would type "echo hi" and press enter, which would give you the output "hi".

```
> echo hi
```

```
hi
```

The Console Object

Those of you that have used a browser other than Internet Explorer for JavaScript development will recognize the console object. In case you haven't, in web browsers, the console has a log function that outputs text to the browser's output window.

In node.js, console.log writes the arguments provided to it to stdout. When run from the command line, this has the effect of printing text out to the command line. When logging an object, node will print out the object's property names and values in a friendly manner. It's a quick and dirty way to do some debugging.

The Current Working Directory

When starting a program using node.js, the process is assigned a current working directory that corresponds to the directory you execute the node command from. You can access the current working directory through the global *process* object using the *cwd* function. Be careful, because the current working directory is not necessarily the directory that contains the file you are running.

In some of the code samples, the global variable *__dirname* has been used when you are reading a file. The reason for this is that node loads files in relationship to the current working directory, so the full path is necessary to ensure that the file can be found no matter where the program is run from. I was bitten by this problem very often in my early days using node.

Listing 1: An HTML page which includes the JavaScript demonstrating the global scope in a web browser.

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="utf-8">
  <title>Globals</title>
</head>
<body>
<h1>Demonstrates Globals</h1>
<script src="external.js"></script>
<script>
  // IE fix: define console.log to alert
  window.console = window.console || {
    log: window.alert
  };

  var onThisPage = 'this page';

  // 'without var'
  console.log(window.externalWithoutVar);
  // 'with var'
  console.log(window.externalWithVar);
  // 'this page'
  console.log(window.onThisPage);
  // 'this page'
  console.log(onThisPage);
</script>
</body>
</html>
```

connection handlers:

```
var connect = require('connect'),
    io = require('socket.io');

var server = connect.createServer(
  connect.static(__dirname + '/public')
);
```

```
var socketListener = io.listen(server);

socketListener.on('connection', function(client) {
  client.on('message', function(message) {
    client.broadcast({
      messageType: 'chat',
      nick: client.sessionId,
      text: message
    });
  });

  client.on('disconnect', function() {
    socketListener.broadcast({
      messageType: 'system',
      text: client.sessionId + ' was disconnected.'
    });
  });
});

server.listen(8000);
```

Listing 3: An HTML page used to let users connect to your chat server.

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="utf-8">
  <title>Flying Monkey Chat</title>
  <style>
    div, h1, p {
      margin:0;
      padding:0;
    }
    #chatMessages {
      border:solid 1px #000;
      height:200px;
      overflow:auto;
      padding:10px;
      width:400px;
    }
      #chatMessages .message {
        font-family:Tahoma, Geneva, sans-serif;
        line-height:20px;
      }
          #chatMessages .message.chat {
            font-size:16px;
          }
          #chatMessages .message.system {
            font-size:12px;
            font-style:italic;
          }
        #chatMessages .message .nick {
          font-weight:bold;
          padding-right:10px;
        }
    form {
      margin-top:10px;
    }
    #messageText {
      margin-right:10px;
      width:300px;
    }
  </style>
</head>
<body>
  <h1>Flying Monkey Chat</h1>
  <div id="chatMessages"></div>
  <form>
    <input id="messageText" type="text">
    <input type="submit" value="Send Message">
  </form>
  <script
    src="http://code.jquery.com/jquery-1.5.1.min.js"
  ></script>
  <script src="socket.io/socket.io.js"></script>
  <script src="chatClient.js"></script>
</body>
</html>
```

Listing 4: An external client JavaScript file that can be used to run your chat client.

```
(function() {
  var socket = new io.Socket('localhost'),
      $chatMessages = $('#chatMessages'),
      $form = $('form'),
      $messageText = $('#messageText');

  var messageFactory = (function() {
    var that = {},
        $chatMessage = $('<p></p>').
          addClass('chat message'),
        $nick = $('<span></span>').
          addClass('nick'),
        $systemMessage = $('<p></p>').
          addClass('system message');

    var chat = function(message) {
      var $filledNick = $nick.clone().
            text(message.nick + ':');
      return $chatMessage.clone().
        append($filledNick).
        append(message.text);
    };

    var system = function(message) {
      return $systemMessage.clone().text(message.text);
    };

    that.chat = chat;
    that.system = system;

    return that;
  })();
  socket.on('message', function(message) {
    var handler = messageFactory[message.messageType];
    $chatMessages.append(handler(message));
  });

  $form.submit(function() {
    var message = $messageText.val(),
        nick;
    $messageText.val('');
    if(message.indexOf('/nick') === 0) {
      nick = message.replace('/nick ', '');
      $chatMessages.append(messageFactory.system({
        text: 'You changed your nick to ' + nick + '.'
      }));
    } else {
      $chatMessages.append(messageFactory.chat({
        nick: 'me',
        text: message
      }));
    }
    socket.send(message);
    return false;
  });

  socket.connect();
})();
```

Listing 5: The chatRoom module.

```
var clients = {},
    userCount = 1;

var addUser = function(sessionId) {
  var userName = 'User ' + userCount;
  clients[sessionId] = userName;
  userCount++;
  return {
    messageType: 'system',
    text: userName + ' has connected.'
  };
};

var changeNick = function(sessionId, nickMessage) {
  var originalNick = clients[sessionId],
      newNick = nickMessage.replace('/nick ', '');
  clients[sessionId] = newNick;
  return {
    messageType: 'system',
    text: originalNick + ' changed nick to ' + newNick
  };
};

var processMessage = function(sessionId, message) {
  if(message.indexOf('/nick') === 0) {
    return changeNick(sessionId, message);
  }
  return {
    messageType: 'chat',
    nick: clients[sessionId],
    text: message
  };
};

var removeUser = function(sessionId) {
  var nick = clients[sessionId];
  delete clients[sessionId];
  return {
    messageType: 'system',
    text: nick + ' was disconnected.'
  };
};


module.exports.addUser = addUser;
module.exports.processMessage = processMessage;
module.exports.removeUser = removeUser;
```

Listing 6: The final chat server implementation, referencing your chatRoom module.

```
var connect = require('connect'),
    io = require('socket.io'),
    room = require('./chatRoom');

var server = connect.createServer(
  connect.static(__dirname + '/public')
);

var socketServer = io.listen(server);

socketServer.on('connection', function(client) {
  var sessionId = client.sessionId,
      addedUserMessage = room.addUser(sessionId);

  client.on('message', function(message) {
    var procdMsg = room.processMessage(sessionId, message);
    client.broadcast(procdMsg);
  });

  client.on('disconnect', function() {
    var removedUserMessage = room.removeUser(sessionId);
    socketServer.broadcast(removedUserMessage);
  });

  client.broadcast(addedUserMessage);
});

server.listen(8000);
```

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Got something to say? Leave a comment!