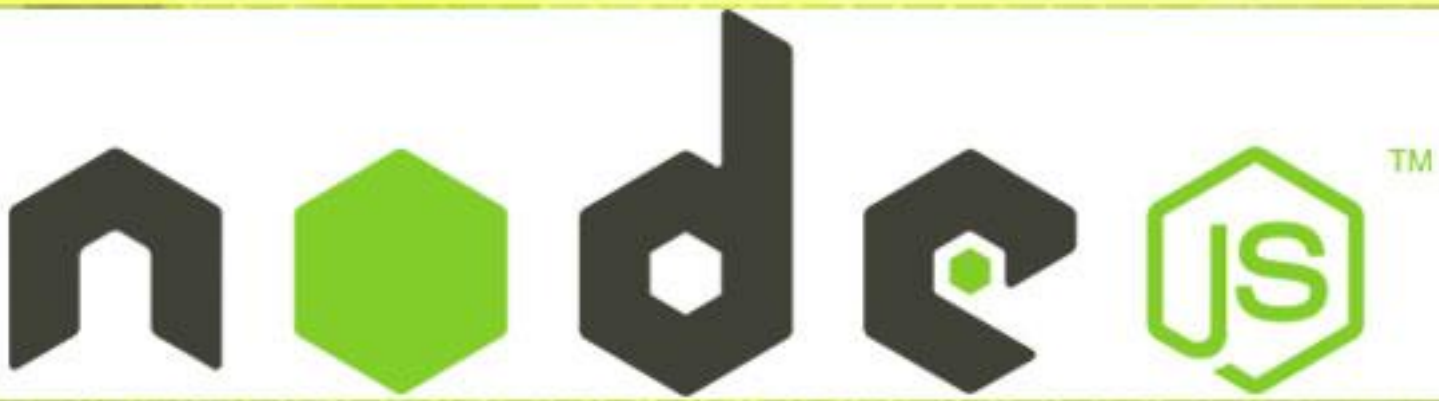

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About the Tutorial

Node.js is a very powerful JavaScript-based framework/platform built on Google Chrome's JavaScript V8 Engine. It is used to develop I/O intensive web applications like video streaming sites, single-page applications, and other web applications. Node.js is open source, completely free, and used by thousands of developers around the world.

Audience

This tutorial is designed for software programmers who want to learn the basics of Node.js and its architectural concepts. This tutorial will give you enough understanding on all the necessary components of Node.js with suitable examples.

Prerequisites

Before proceeding with this tutorial, you should have a basic understanding of JavaScript. As we are going to develop web-based applications using Node.js, it will be good if you have some understanding of other web technologies such as HTML, CSS, AJAX, etc.

Execute Node.js Online

For most of the examples given in this tutorial, you will find a **Try it** option, so just make use of this option to execute your Node.js programs on the spot and enjoy your learning.

Try the following example using the Try it option available at the top right corner of the below sample code box (on our website):

```
/* Hello World! program in Node.js */

console.log("Hello World!");
```

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Table of Contents

tutorialspoint
SIMPLYEASYLEARNING

tutorialspoint
SIMPLYEASYLEARNING

tutorialspoint
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1. INTRODUCTION

What is Node.js?

Node.js is a server-side platform built on Google Chrome's JavaScript Engine (V8 Engine). Node.js was developed by Ryan Dahl in 2009 and its latest version is v0.10.36. The definition of Node.js as supplied by its official documentation is as follows:

> Node.js is a platform built on Chrome's JavaScript runtime for easily building fast and scalable network applications. Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient, perfect for data-intensive real-time applications that run across distributed devices.

Node.js is an open source, cross-platform runtime environment for developing server-side and networking applications. Node.js applications are written in JavaScript, and can be run within the Node.js runtime on OS X, Microsoft Windows, and Linux.

Node.js also provides a rich library of various JavaScript modules which simplifies the development of web applications using Node.js to a great extent.

```
Node.js = Runtime Environment + JavaScript Library
```

Features of Node.js

Following are some of the important features that make Node.js the first choice of software architects.

- **Asynchronous and Event Driven** – All APIs of Node.js library are asynchronous, that is, non-blocking. It essentially means a Node.js based server never waits for an API to return data. The server moves to the next API after calling it and a notification mechanism of Events of Node.js helps the server to get a response from the previous API call.

- **Very Fast** – Being built on Google Chrome's V8 JavaScript Engine, Node.js library is very fast in code execution.

- **Single Threaded but Highly Scalable** – Node.js uses a single threaded model with event looping. Event mechanism helps the server to respond in a non-blocking way and makes the server highly scalable as opposed to traditional servers which create limited threads to handle requests. Node.js uses a single threaded program and the same program can provide service to a much larger number of requests than traditional servers like Apache HTTP Server.

- **No Buffering** – Node.js applications never buffer any data. These applications simply output the data in chunks.

- **License** – Node.js is released under the **MIT license**.

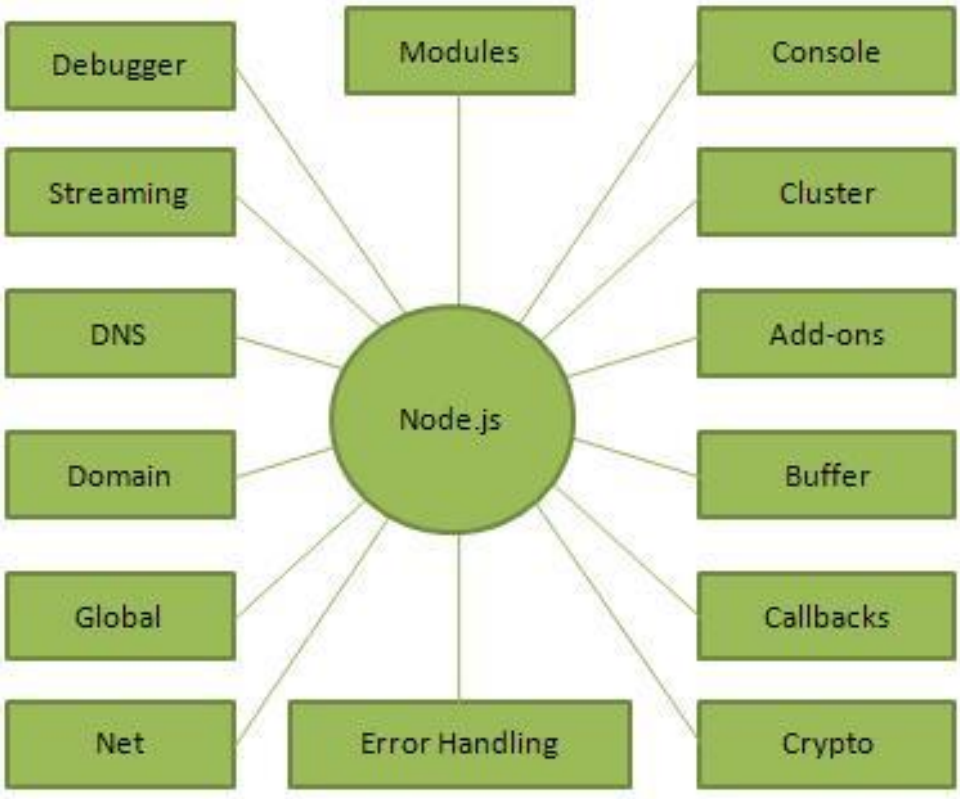
Who Uses Node.js?

Following is the link on github wiki containing an exhaustive list of projects, application and companies which are using Node.js. This list includes eBay, General Electric, GoDaddy, Microsoft, PayPal, Uber, Wikipins, Yahoo!, and Yammer to name a few.

- **Projects, Applications, and Companies Using Node**

Concepts

The following diagram depicts some important parts of Node.js which we will discuss in detail in the subsequent chapters.



Where to Use Node.js?

Following are the areas where Node.js is proving itself as a perfect technology partner.

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- I/O bound Applications
- Data Streaming Applications
- Data Intensive Real-time Applications (DIRT)
- JSON APIs based Applications
- Single Page Applications

Where Not to Use Node.js?

It is not advisable to use Node.js for CPU intensive applications.

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2. ENVIRONMENT SETUP

Try it Option Online

You really do not need to set up your own environment to start learning Node.js. Reason is very simple, we already have set up Node.js environment online, so that you can execute all the available examples online and learn through practice. Feel free to modify any example and check the results with different options.

Try the following example using the **Try it** option available at the top right corner of the below sample code box (on our website):

```
/* Hello World! program in Node.js */

console.log("Hello World!");
```

For most of the examples given in this tutorial, you will find a Try it option, so just make use of it and enjoy your learning.

Local Environment Setup

If you want to set up your environment for Node.js, you need to have the following two software on your computer, (a) a Text Editor and (b) the Node.js binary installables.

Text Editor

You need to have a text editor to type your program. Examples of text editors include Windows Notepad, OS Edit command, Brief, Epsilon, EMACS, and vim or vi.

The name and version of text editors can vary from one operating system to another. For example, Notepad will be used on Windows, and vim or vi can be used on Windows as well as Linux or UNIX.

The files you create with your editor are called source files and they contain the program source code. The source files for Node.js programs are typically named with the extension ".js".

Before you start programming, make sure you have one text editor in place and you have enough experience in how to write a computer program, save it in a file, and finally execute it.

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The Node.js Runtime

The source code that you would write in a source file is simply javascript. The Node.js interpreter interprets and executes your javascript code.

Node.js distribution comes as a binary installable for SunOS, Linux, Mac OS X, and Windows operating systems with the 32-bit (386) and 64-bit (amd64) x86 processor architectures.

The following section explains how to install Node.js binary distribution on various OS.

Download Node.js Archive

Download the latest version of Node.js installable archive file from Node.js Downloads. At the time of writing this tutorial, following are the versions available on different OS.

OS	Archive name
Windows	node-v6.3.1-x64.msi
Linux	node-v6.3.1-linux-x86.tar.gz
Mac	node-v6.3.1-darwin-x86.tar.gz
SunOS	node-v6.3.1-sunos-x86.tar.gz

Installation on UNIX/Linux/Mac OS X and SunOS

Based on your OS architecture, download and extract the archive node-v0.12.0-osname.tar.gz into /tmp, and then move the extracted files into /usr/local/nodejs directory. For example:

```
$ cd /tmp
$ wget http://nodejs.org/dist/v6.3.1/node-v6.3.1-linux-x64.tar.gz
$ tar xvfz node-v6.3.1-linux-x64.tar.gz
$ mkdir -p /usr/local/nodejs
$ mv node-v6.3.1-linux-x64/* /usr/local/nodejs
```

Add /usr/local/nodejs/bin to the PATH environment variable.

OS	Output
Linux	export PATH=$PATH:/usr/local/nodejs/bin

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Mac	export PATH=$PATH:/usr/local/nodejs/bin
FreeBSD	export PATH=$PATH:/usr/local/nodejs/bin

Installation on Windows

Use the MSI file and follow the prompts to install Node.js. By default, the installer uses the Node.js distribution in C:\Program Files\nodejs. The installer should set the C:\Program Files\nodejs\bin directory in Window's PATH environment variable. Restart any open command prompts for the change to take effect.

Verify Installation: Executing a File

Create a **js** file named main.js on your machine (Windows or Linux) having the following code.

```
/* Hello, World! program in node.js */
console.log("Hello, World!")
```

Now execute main.js using Node.js interpreter to see the result:

```
$ node main.js
```

If everything is fine with your installation, it should produce the following result:

```
Hello, World!
```


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3. FIRST APPLICATION

Before creating an actual "Hello, World!" application using Node.js, let us see the components of a Node.js application. A Node.js application consists of the following three important components:

1. **Import required modules**: We use the **require** directive to load Node.js modules.

2. **Create server**: A server which will listen to client's requests similar to Apache HTTP Server.

3. **Read request and return response**: The server created in an earlier step will read the HTTP request made by the client which can be a browser or a console and return the response.

Creating Node.js Application

Step 1 - Import Required Module

We use the **require** directive to load the http module and store the returned HTTP instance into an http variable as follows:

```
var http = require("http");
```

Step 2 - Create Server

We use the created http instance and call **http.createServer()** method to create a server instance and then we bind it at port 8081 using the listen method associated with the server instance. Pass it a function with parameters request and response. Write the sample implementation to always return "Hello World".

```
http.createServer(function (request, response) {

   // Send the HTTP header
   // HTTP Status: 200 : OK
   // Content Type: text/plain
   response.writeHead(200, {'Content-Type': 'text/plain'});

   // Send the response body as "Hello World"
```


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```
   response.end('Hello World\n');
}).listen(8081);

// Console will print the message
console.log('Server running at http://127.0.0.1:8081/');
```

The above code is enough to create an HTTP server which listens, i.e., waits for a request over 8081 port on the local machine.

Step 3 - Testing Request & Response

Let's put step 1 and 2 together in a file called main.js and start our HTTP server as shown below:

```
var http = require("http");
http.createServer(function (request, response) {

   // Send the HTTP header
   // HTTP Status: 200 : OK
   // Content Type: text/plain
   response.writeHead(200, {'Content-Type': 'text/plain'});

   // Send the response body as "Hello World"
   response.end('Hello World\n');
}).listen(8081);

// Console will print the message
console.log('Server running at http://127.0.0.1:8081/');
```

Now execute the main.js to start the server as follows:

```
$ node main.js
```

Verify the Output. Server has started.

```
Server running at http://127.0.0.1:8081/
```


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Make a Request to the Node.js Server

Open http://127.0.0.1:8081/ in any browser and observe the following result.

Congratulations, you have your first HTTP server up and running which is responding to all the HTTP requests at port 8081.

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4. REPL TERMINAL

REPL stands for Read Eval Print Loop and it represents a computer environment like a Windows console or Unix/Linux shell where a command is entered and the system responds with an output in an interactive mode. Node.js or Node comes bundled with a REPL environment. It performs the following tasks:

- **Read** - Reads user's input, parses the input into JavaScript data-structure, and stores in memory.
- **Eval** - Takes and evaluates the data structure.
- **Print** - Prints the result.
- **Loop** - Loops the above command until the user presses **ctrl-c** twice.

The REPL feature of Node is very useful in experimenting with Node.js codes and to debug JavaScript codes.

Online REPL Terminal

To simplify your learning, we have set up an easy-to-use Node.js REPL environment online, where you can practice Node.js syntax: Launch Node.js REPL Terminal

Starting REPL

REPL can be started by simply running **node** on shell/console without any arguments as follows.

```
$ node
```

You will see the REPL Command prompt > where you can type any Node.js command:

```
$ node
>
```

Simple Expression

Let's try a simple mathematics at the Node.js REPL command prompt:

```
$ node
> 1 + 3
```


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```
4
> 1 + ( 2 * 3 ) - 4
3
>
```

Use Variables

You can make use variables to store values and print later like any conventional script. If **var** keyword is not used, then the value is stored in the variable and printed. Whereas if **var** keyword is used, then the value is stored but not printed. You can print variables using **console.log()**.

```
$ node
> x = 10
10
> var y = 10
undefined
> x + y
20
> console.log("Hello World")
Hello Workd
undefined
```

Multiline Expression

Node REPL supports multiline expression similar to JavaScript. Let's check the following do-while loop in action:

```
$ node
> var x = 0
undefined
> do {
... x++;
... console.log("x: " + x);
... } while ( x < 5 );
x: 1
x: 2
```


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```
x: 3
x: 4
x: 5
undefined
>
```

... comes automatically when you press Enter after the opening bracket. Node automatically checks the continuity of expressions.

Underscore Variable

You can use underscore (_) to get the last result:

```
$ node
> var x = 10
undefined
> var y = 20
undefined
> x + y
30
> var sum = _
undefined
> console.log(sum)
30
undefined
>
```

REPL Commands

- ctrl + c - terminate the current command.
- ctrl + c twice - terminate the Node REPL.
- ctrl + d - terminate the Node REPL.
- Up/Down Keys - see command history and modify previous commands.
- tab Keys - list of current commands.
- .help - list of all commands.
- .break - exit from multiline expression.

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- .clear - exit from multiline expression.
- .save filename - save the current Node REPL session to a file.
- .load filename - load file content in current Node REPL session.

Stopping REPL

As mentioned above, you will need to use **ctrl-c** twice to come out of Node.js REPL.

```
$ node
>
(^C again to quit)
>
```


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5. NPM

Node Package Manager (NPM) provides two main functionalities:

- Online repositories for node.js packages/modules which are searchable on search.nodejs.org
- Command line utility to install Node.js packages, do version management and dependency management of Node.js packages.

NPM comes bundled with Node.js installables after v0.6.3 version. To verify the same, open console and type the following command and see the result:

```
$ npm --version
2.7.1
```

If you are running an old version of NPM, then it is quite easy to update it to the latest version. Just use the following command from root:

```
$ sudo npm install npm -g
/usr/bin/npm -> /usr/lib/node_modules/npm/bin/npm-cli.js
npm@2.7.1 /usr/lib/node_modules/npm
```

Installing Modules using NPM

There is a simple syntax to install any Node.js module:

```
$ npm install <Module Name>
```

For example, following is the command to install a famous Node.js web framework module called express:

```
$ npm install express
```

Now you can use this module in your js file as following:

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


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Global vs Local Installation

By default, NPM installs any dependency in the local mode. Here local mode refers to the package installation in node_modules directory lying in the folder where Node application is present. Locally deployed packages are accessible via require() method. For example, when we installed express module, it created node_modules directory in the current directory where it installed the express module.

```
$ ls -l

total 0

drwxr-xr-x 3 root root 20 Mar 17 02:23 node_modules
```

Alternatively, you can use **npm ls** command to list down all the locally installed modules.

Globally installed packages/dependencies are stored in system directory. Such dependencies can be used in CLI (Command Line Interface) function of any node.js but cannot be imported using require() in Node application directly. Now let's try installing the express module using global installation.

```
$ npm install express -g
```

This will produce a similar result but the module will be installed globally. Here, the first line shows the module version and the location where it is getting installed.

```
express@4.12.2 /usr/lib/node_modules/express
├── merge-descriptors@1.0.0
├── utils-merge@1.0.0
├── cookie-signature@1.0.6
├── methods@1.1.1
├── fresh@0.2.4
├── cookie@0.1.2
├── escape-html@1.0.1
├── range-parser@1.0.2
├── content-type@1.0.1
├── finalhandler@0.3.3
├── vary@1.0.0
├── parseurl@1.3.0
├── content-disposition@0.5.0
├── path-to-regexp@0.1.3
├── depd@1.0.0
```


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```
├── qs@2.3.3
├── on-finished@2.2.0 (ee-first@1.1.0)
├── etag@1.5.1 (crc@3.2.1)
├── debug@2.1.3 (ms@0.7.0)
├── proxy-addr@1.0.7 (forwarded@0.1.0, ipaddr.js@0.1.9)
├── send@0.12.1 (destroy@1.0.3, ms@0.7.0, mime@1.3.4)
├── serve-static@1.9.2 (send@0.12.2)
├── accepts@1.2.5 (negotiator@0.5.1, mime-types@2.0.10)
└── type-is@1.6.1 (media-typer@0.3.0, mime-types@2.0.10)
```

You can use the following command to check all the modules installed globally:

```
$ npm ls -g
```

Using package.json

package.json is present in the root directory of any Node application/module and is used to define the properties of a package. Let's open package.json of express package present in node_modules/express/

```
{
  "name": "express",
  "description": "Fast, unopinionated, minimalist web framework",
  "version": "4.11.2",
  "author": {
    "name": "TJ Holowaychuk",
    "email": "tj@vision-media.ca"
  },
  "contributors": [
    {
      "name": "Aaron Heckmann",
      "email": "aaron.heckmann+github@gmail.com"
    },
    {
      "name": "Ciaran Jessup",
      "email": "ciaranj@gmail.com"
```


```
    },
    {
      "name": "Douglas Christopher Wilson",
      "email": "doug@somethingdoug.com"
    },
    {
      "name": "Guillermo Rauch",
      "email": "rauchg@gmail.com"
    },
    {
      "name": "Jonathan Ong",
      "email": "me@jongleberry.com"
    },
    {
      "name": "Roman Shtylman",
      "email": "shtylman+expressjs@gmail.com"
    },
    {
      "name": "Young Jae Sim",
      "email": "hanul@hanul.me"
    }
  ],
  "license": "MIT",
  "repository": {
    "type": "git",
    "url": "https://github.com/strongloop/express"
  },
  "homepage": "http://expressjs.com/",
  "keywords": [
    "express",
    "framework",
    "sinatra",
    "web",
```


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```
    "rest",
    "restful",
    "router",
    "app",
    "api"
  ],
  "dependencies": {
    "accepts": "~1.2.3",
    "content-disposition": "0.5.0",
    "cookie-signature": "1.0.5",
    "debug": "~2.1.1",
    "depd": "~1.0.0",
    "escape-html": "1.0.1",
    "etag": "~1.5.1",
    "finalhandler": "0.3.3",
    "fresh": "0.2.4",
    "media-typer": "0.3.0",
    "methods": "~1.1.1",
    "on-finished": "~2.2.0",
    "parseurl": "~1.3.0",
    "path-to-regexp": "0.1.3",
    "proxy-addr": "~1.0.6",
    "qs": "2.3.3",
    "range-parser": "~1.0.2",
    "send": "0.11.1",
    "serve-static": "~1.8.1",
    "type-is": "~1.5.6",
    "vary": "~1.0.0",
    "cookie": "0.1.2",
    "merge-descriptors": "0.0.2",
    "utils-merge": "1.0.0"
  },
  "devDependencies": {
```


```
    "after": "0.8.1",
    "ejs": "2.1.4",
    "istanbul": "0.3.5",
    "marked": "0.3.3",
    "mocha": "~2.1.0",
    "should": "~4.6.2",
    "supertest": "~0.15.0",
    "hjs": "~0.0.6",
    "body-parser": "~1.11.0",
    "connect-redis": "~2.2.0",
    "cookie-parser": "~1.3.3",
    "express-session": "~1.10.2",
    "jade": "~1.9.1",
    "method-override": "~2.3.1",
    "morgan": "~1.5.1",
    "multiparty": "~4.1.1",
    "vhost": "~3.0.0"
  },
  "engines": {
    "node": ">= 0.10.0"
  },
  "files": [
    "LICENSE",
    "History.md",
    "Readme.md",
    "index.js",
    "lib/"
  ],
  "scripts": {
     "test": "mocha --require test/support/env --reporter spec --bail –
     check-leaks test/ test/acceptance/",

     "test-cov": "istanbul cover node_modules/mocha/bin/_mocha -- --
```


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```
    require test/support/env --reporter dot --check-leaks test/
    test/acceptance/",

    "test-tap": "mocha --require test/support/env --reporter tap –
    check-leaks test/ test/acceptance/",

    "test-travis": "istanbul cover node_modules/mocha/bin/_mocha –
    report lcovonly -- --require test/support/env --reporter spec –
    check-leaks test/ test/acceptance/"
},
"gitHead": "63ab25579bda70b4927a179b580a9c580b6c7ada",
"bugs": {
  "url": "https://github.com/strongloop/express/issues"
},
"_id": "express@4.11.2",
"_shasum": "8df3d5a9ac848585f00a0777601823faecd3b148",
"_from": "express@*",
"_npmVersion": "1.4.28",
"_npmUser": {
  "name": "dougwilson",
  "email": "doug@somethingdoug.com"
},
"maintainers": [
  {
    "name": "tjholowaychuk",
    "email": "tj@vision-media.ca"
  },
  {
    "name": "jongleberry",
    "email": "jonathanrichardong@gmail.com"
  },
  {
    "name": "shtylman",
```

```
      "email": "shtylman@gmail.com"
    },
    {
      "name": "dougwilson",
      "email": "doug@somethingdoug.com"
    },
    {
      "name": "aredridel",
      "email": "aredridel@nbtsc.org"
    },
    {
      "name": "strongloop",
      "email": "callback@strongloop.com"
    },
    {
      "name": "rfeng",
      "email": "enjoyjava@gmail.com"
    }
  ],
  "dist": {
    "shasum": "8df3d5a9ac848585f00a0777601823faecd3b148",
    "tarball": "http://registry.npmjs.org/express/-/express-4.11.2.tgz"
  },
  "directories": {},
  "_resolved": "https://registry.npmjs.org/express/-/express-4.11.2.tgz",
  "readme": "ERROR: No README data found!"
}
```


Attributes of Package.json

- **name** - name of the package
- **version** - version of the package
- **description** - description of the package

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- **homepage** - homepage of the package
- **author** - author of the package
- **contributors** - name of the contributors to the package
- **dependencies** - list of dependencies. NPM automatically installs all the dependencies mentioned here in the node_module folder of the package.
- **repository** - repository type and URL of the package
- **main** - entry point of the package
- **keywords** - keywords

Uninstalling a Module

Use the following command to uninstall a Node.js module.

```
$ npm uninstall express
```

Once NPM uninstalls the package, you can verify it by looking at the content of /node_modules/ directory or type the following command:

```
$ npm ls
```

Updating a Module

Update package.json and change the version of the dependency to be updated and run the following command.

```
$ npm update express
```

Search a Module

Search a package name using NPM.

```
$ npm search express
```

Create a Module

Creating a module requires package.json to be generated. Let's generate package.json using NPM, which will generate the basic skeleton of the package.json.

```
$ npm init
This utility will walk you through creating a package.json file.
It only covers the most common items, and tries to guess sane defaults.

See 'npm help json' for definitive documentation on these fields
and exactly what they do.

Use 'npm install <pkg> --save' afterwards to install a package and
save it as a dependency in the package.json file.

Press ^C at any time to quit.
name: (webmaster)
```

You will need to provide all the required information about your module. You can take help from the above-mentioned package.json file to understand the meanings of various information demanded. Once package.json is generated, use the following command to register yourself with NPM repository site using a valid email address.

```
$ npm adduser
Username: mcmohd
Password:
Email: (this IS public) mcmohd@gmail.com
```

It is time now to publish your module:

```
$ npm publish
```

If everything is fine with your module, then it will be published in the repository and will be accessible to install using NPM like any other Node.js module.

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6. CALLBACK CONCEPT

What is Callback?

Callback is an asynchronous equivalent for a function. A callback function is called at the completion of a given task. Node makes heavy use of callbacks. All the APIs of Node are written in such a way that they support callbacks.

For example, a function to read a file may start reading a file and return the control to the execution environment immediately so that the next instruction can be executed. Once file I/O is complete, it will call the callback function while passing the callback function, the content of the file as a parameter. So there is no blocking or wait for File I/O. This makes Node.js highly scalable, as it can process a high number of requests without waiting for any function to return results.

Blocking Code Example

Create a text file named **input.txt** with the following content:

```
Tutorials Point is giving self learning content
to teach the world in simple and easy way!!!!!
```

Create a js file named **main.js** with the following code:

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

var data = fs.readFileSync('input.txt');

console.log(data.toString());
console.log("Program Ended");
```

Now run the main.js to see the result:

```
$ node main.js
```

Verify the Output.

```
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```


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```
to teach the world in simple and easy way!!!!!
Program Ended
```

Non-Blocking Code Example

Create a text file named input.txt with the following content.

```
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```

Update main.js to have the following code:

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

fs.readFile('input.txt', function (err, data) {
    if (err) return console.error(err);
    console.log(data.toString());
});

console.log("Program Ended");
```

Now run the main.js to see the result:

```
$ node main.js
```

Verify the Output.

```
Program Ended
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```

These two examples explain the concept of blocking and non-blocking calls.

- The first example shows that the program blocks until it reads the file and then only it proceeds to end the program.

- The second example shows that the program does not wait for file reading and proceeds to print "Program Ended" and at the same time, the program without blocking continues reading the file.

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Thus, a blocking program executes very much in sequence. From the programming point of view, it is easier to implement the logic but non-blocking programs do not execute in sequence. In case a program needs to use any data to be processed, it should be kept within the same block to make it sequential execution.

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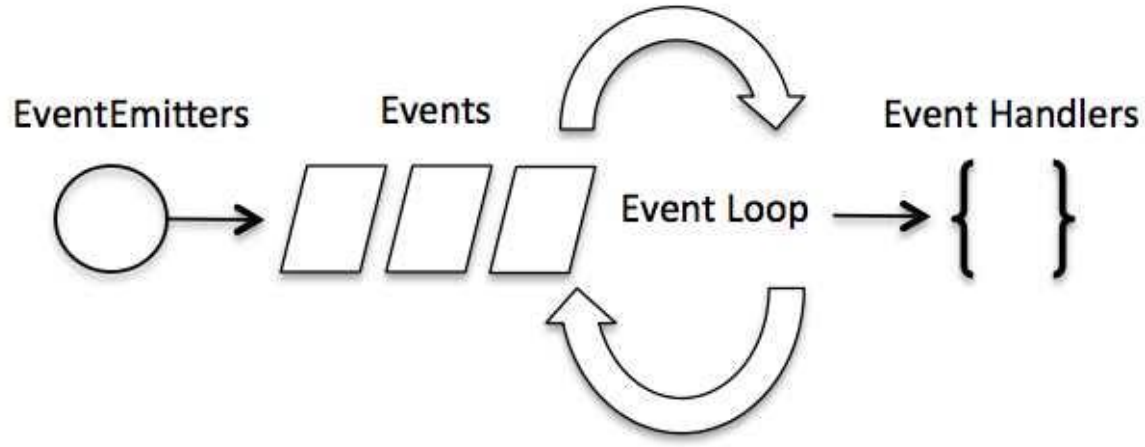
7. EVENT LOOP

Node.js is a single-threaded application, but it can support concurrency via the concept of **event** and **callbacks**. Every API of Node.js is asynchronous and being single-threaded, they use **async function calls** to maintain concurrency. Node uses observer pattern. Node thread keeps an event loop and whenever a task gets completed, it fires the corresponding event which signals the event-listener function to execute.

Event-Driven Programming

Node.js uses events heavily and it is also one of the reasons why Node.js is pretty fast compared to other similar technologies. As soon as Node starts its server, it simply initiates its variables, declares functions, and then simply waits for the event to occur.

In an event-driven application, there is generally a main loop that listens for events, and then triggers a callback function when one of those events is detected.



Although events look quite similar to callbacks, the difference lies in the fact that callback functions are called when an asynchronous function returns its result, whereas event handling works on the observer pattern. The functions that listen to events act as **Observers**. Whenever an event gets fired, its listener function starts executing. Node.js has multiple in-built events available through events module and EventEmitter class which are used to bind events and event-listeners as follows:

```
// Import events module
var events = require('events');
// Create an eventEmitter object
```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```
var eventEmitter = new events.EventEmitter();
```

Following is the syntax to bind an event handler with an event:

```
// Bind event and even handler as follows
eventEmitter.on('eventName', eventHandler);
```

We can fire an event programmatically as follows:

```
// Fire an event
eventEmitter.emit('eventName');
```

Example

Create a js file named main.js with the following code:

```
// Import events module
var events = require('events');

// Create an eventEmitter object
var eventEmitter = new events.EventEmitter();

// Create an event handler as follows
var connectHandler = function connected() {
   console.log('connection successful.');

   // Fire the data_received event
   eventEmitter.emit('data_received');
}

// Bind the connection event with the handler
eventEmitter.on('connection', connectHandler);
```


```
// Bind the data_received event with the anonymous function
eventEmitter.on('data_received', function(){
   console.log('data received successfully.');
});

// Fire the connection event
eventEmitter.emit('connection');

console.log("Program Ended.");
```

Now let's try to run the above program and check its output:

```
$ mnode main.js
```

It should produce the following result:

```
connection successful.
data received successfully.
Program Ended.
```

How Node Applications Work?

In Node Application, any async function accepts a callback as the last parameter and a callback function accepts an error as the first parameter. Let's revisit the previous example again. Create a text file named input.txt with the following content.

```
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```

Create a js file named main.js having the following code:

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

fs.readFile('input.txt', function (err, data) {
   if (err){
      console.log(err.stack);
      return;
```


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```
   }
   console.log(data.toString());
});
console.log("Program Ended");
```

Here fs.readFile() is a async function whose purpose is to read a file. If an error occurs during the read operation, then the **err object** will contain the corresponding error, else data will contain the contents of the file. **readFile** passes err and data to the callback function after the read operation is complete, which finally prints the content.

```
Program Ended
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```


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8. EVENT EMITTER

Many objects in a Node emit events, for example, a net.Server emits an event each time a peer connects to it, an fs.readStream emits an event when the file is opened. All objects which emit events are the instances of events.EventEmitter.

EventEmitter Class

As we have seen in the previous section, EventEmitter class lies in the events module. It is accessible via the following code:

```
// Import events module
var events = require('events');
// Create an eventEmitter object
var eventEmitter = new events.EventEmitter();
```

When an EventEmitter instance faces any error, it emits an 'error' event. When a new listener is added, 'newListener' event is fired and when a listener is removed, 'removeListener' event is fired.

EventEmitter provides multiple properties like **on** and **emit**. **on** property is used to bind a function with the event and **emit** is used to fire an event.

Methods

S.No.	Method & Description
1	**addListener(event, listener)** Adds a listener at the end of the listeners array for the specified event. No checks are made to see if the listener has already been added. Multiple calls passing the same combination of event and listener will result in the listener being added multiple times. Returns emitter, so calls can be chained.
2	**on(event, listener)** Adds a listener at the end of the listeners array for the specified event. No checks are made to see if the listener has already been added. Multiple calls passing the same combination of event and listener will result in the listener being added multiple times. Returns emitter, so calls can be chained.
3	**once(event, listener)**

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	Adds a one-time listener to the event. This listener is invoked only the next time the event is fired, after which it is removed. Returns emitter, so calls can be chained.
4	**removeListener(event, listener)** Removes a listener from the listener array for the specified event. **Caution**: It changes the array indices in the listener array behind the listener. removeListener will remove, at most, one instance of a listener from the listener array. If any single listener has been added multiple times to the listener array for the specified event, then removeListener must be called multiple times to remove each instance. Returns emitter, so calls can be chained.
5	**removeAllListeners([event])** Removes all listeners, or those of the specified event. It's not a good idea to remove listeners that were added elsewhere in the code, especially when it's on an emitter that you didn't create (e.g. sockets or file streams). Returns emitter, so calls can be chained.
6	**setMaxListeners(n)** By default, EventEmitters will print a warning if more than 10 listeners are added for a particular event. This is a useful default which helps finding memory leaks. Obviously not all Emitters should be limited to 10. This function allows that to be increased. Set to zero for unlimited.
7	**listeners(event)** Returns an array of listeners for the specified event.
8	**emit(event, [arg1], [arg2], [...])** Execute each of the listeners in order with the supplied arguments. Returns true if the event had listeners, false otherwise.

Class Methods

S.No.	Method & Description
1	**listenerCount(emitter, event)** Returns the number of listeners for a given event.

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Events

S. No.	Events & Description
1	**newListener** • **event** – String; the event name • **listener** – Function; the event handler function This event is emitted any time a listener is added. When this event is triggered, the listener may not yet have been added to the array of listeners for the event.
2	**removeListener** • **event** - String The event name • **listener** - Function The event handler function This event is emitted any time someone removes a listener. When this event is triggered, the listener may not yet have been removed from the array of listeners for the event.

Example

Create a js file named main.js with the following Node.js code:

```
var events = require('events');
var eventEmitter = new events.EventEmitter();

// listener #1
var listner1 = function listner1() {
   console.log('listner1 executed.');
}
```


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```
// listener #2
var listner2 = function listner2() {
  console.log('listner2 executed.');
}
// Bind the connection event with the listner1 function
eventEmitter.addListener('connection', listner1);
// Bind the connection event with the listner2 function
eventEmitter.on('connection', listner2);

var eventListeners =
require('events').EventEmitter.listenerCount(eventEmitter,'connection');
console.log(eventListeners + " Listner(s) listening to connection event");

// Fire the connection event
eventEmitter.emit('connection');

// Remove the binding of listner1 function
eventEmitter.removeListener('connection', listner1);
console.log("Listner1 will not listen now.");

// Fire the connection event
eventEmitter.emit('connection');

eventListeners =
require('events').EventEmitter.listenerCount(eventEmitter,'connection');
console.log(eventListeners + " Listner(s) listening to connection event");

console.log("Program Ended.");
```

Now run the main.js to see the result:

```
$ node main.js
```

Verify the Output.

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```
2 Listner(s) listening to connection event
listner1 executed.
listner2 executed.
Listner1 will not listen now.
listner2 executed.
1 Listner(s) listening to connection event
Program Ended.
```


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