

COMPLETE



Introduction to NodeJS



CERTIFICATE

NOTES

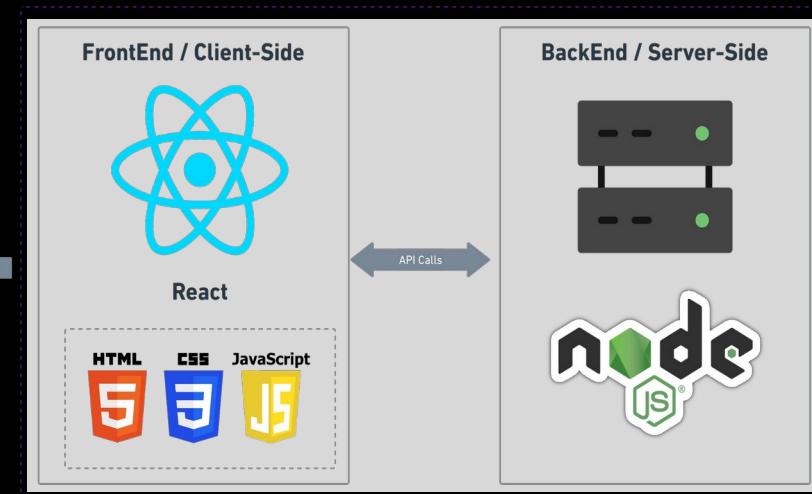
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NodeJS

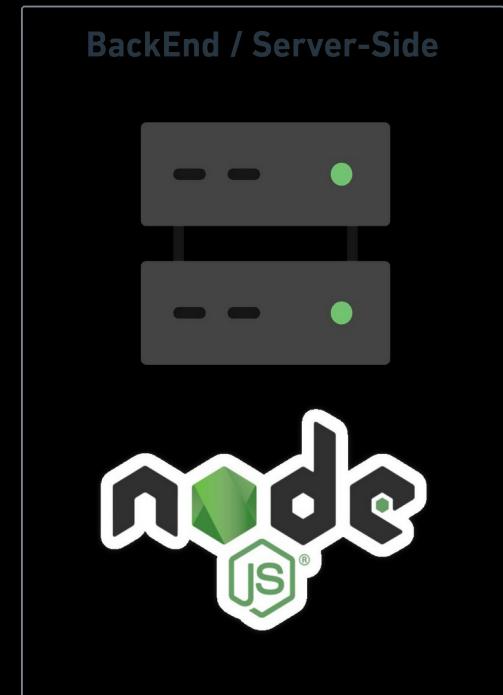
Complete Course





Introduction to NodeJS

1. *Pre-requisites*
2. *What is NodeJS*
3. *NodeJs Features*
4. *JavaScript on Client*
5. *JavaScript on Server*
6. *Client Code vs Server Code*
7. *Other uses of NodeJs*
8. *Server architecture with NodeJs*



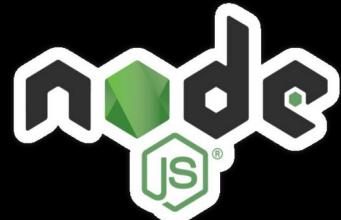


Pre-Requisites

Should have basic knowledge of -

1. *HTML*
2. *CSS*
3. *JavaScript*
4. *Basics of REACT (Not Mandatory)*

BackEnd / Server-Side





2. What is NodeJS

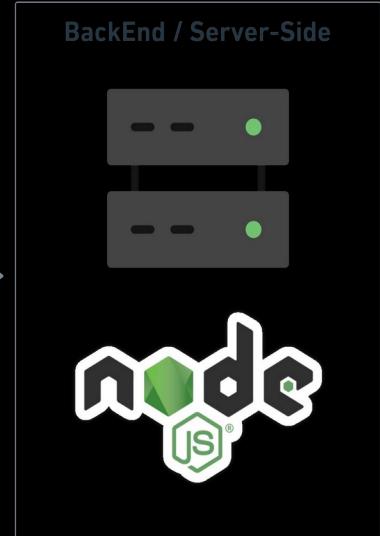
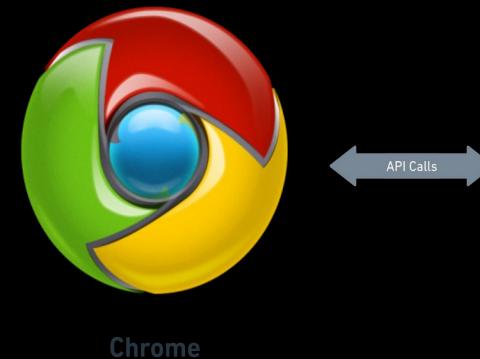


1. **JavaScript Runtime:** Node.js is an **open-source, cross-platform** runtime environment for executing **JavaScript code outside of a browser**.
2. **NodeJs** is a **JavaScript in a different environment** meaning **Running JS on the server or any computer**.
3. **Built on Chrome's V8 Engine:** It runs on the **V8 engine** which **compiles JavaScript directly to native machine code**, enhancing performance.
4. **V8** is written in **C++** for speed.
5. **V8 + Backend Features = NodeJs**



2. What is NodeJS

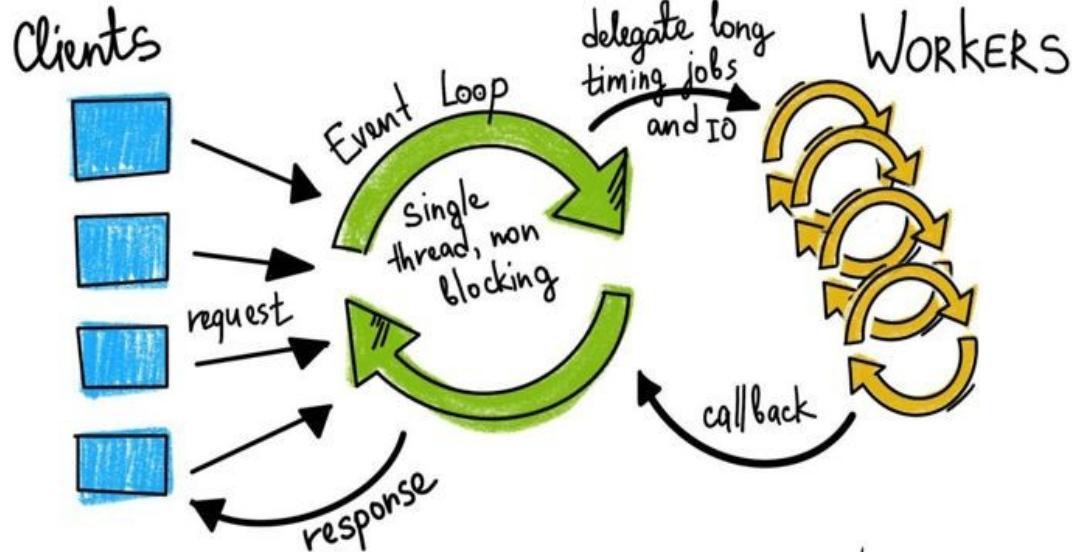
1. **Design:** Features an **event-driven, non-blocking I/O** model for efficiency.
2. **Full-Stack JavaScript:** Allows using JavaScript on both **server** and **client** sides.
3. **Scalability:** Ideal for **scalable network** applications due to its architecture.
4. **Versatility:** Suitable for web, real-time chat, and **REST API servers**.





3. Node.js Features

(Added)



@luminousmen.com operations

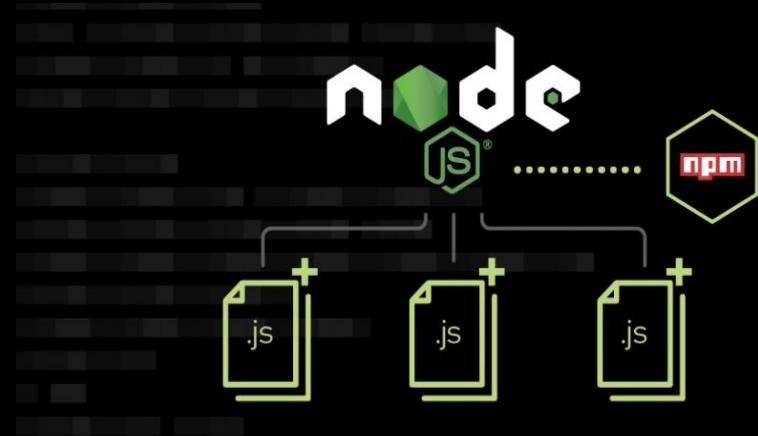
by default, making it suitable for I/O-heavy operations.

2. **Networking Support:** Supports TCP/UDP sockets, which are crucial for building lower-level network applications that browsers can't handle.



3. Node.js Features

(Added)

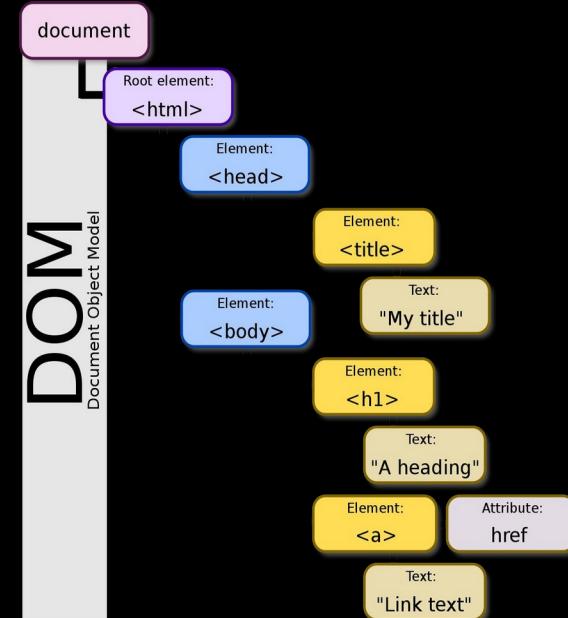
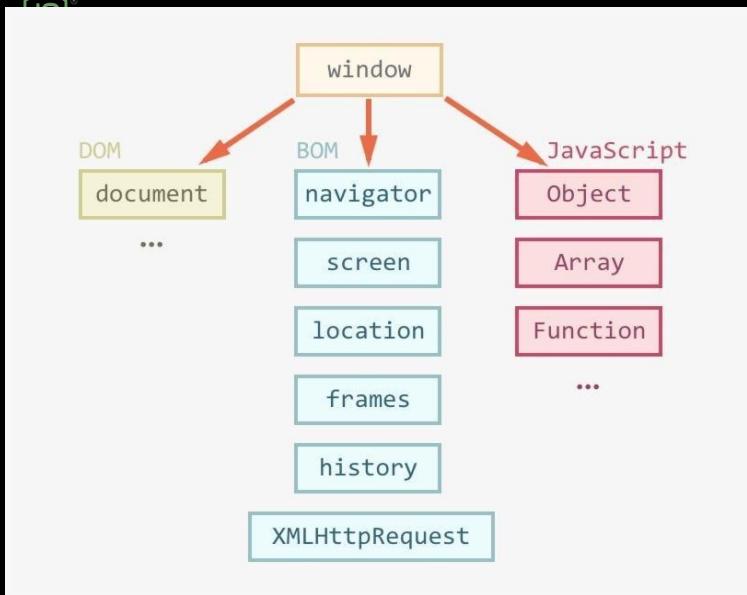


1. **File System Access:** Provides APIs to **read and write files** directly, which is **not possible in browser environments** for security reasons.
2. **Server-Side Capabilities:** Node.js enables JavaScript to run on the server, handling **HTTP requests**, **file operations**, and other server-side functionalities.
3. **Modules:** Organize code into **reusable modules** using `require()`.



3. Node.js Features

(Removed)

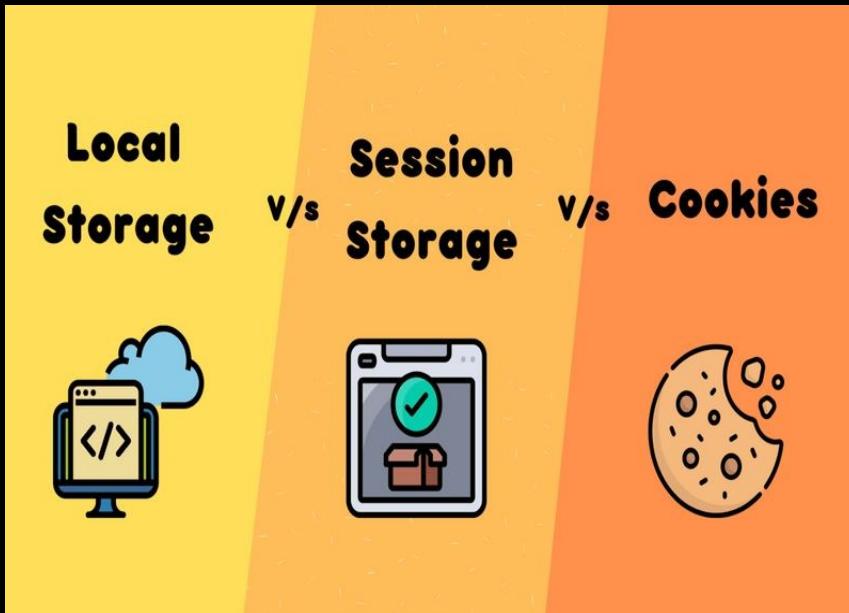


1. **Window Object:** The global **window object**, which is part of web browsers, is absent in **Node.js**.
2. **DOM Manipulation:** **Node.js** does not have a built-in Document Object Model (DOM), as it is **not intended to interact with a webpage's content**.
3. **BOM (Browser Object Model):** No direct interaction with things like



3. Node.js Features

(Removed)



A screenshot of the Chrome DevTools Application tab. The tab bar includes Application, Elements, Console, and Sources. The Application tab is selected. The main area shows:

- Application**: Manifest, Service workers, Storage
- Storage**: Local storage, Session storage, IndexedDB, Cookies, Private state tokens, Interest groups, Shared storage, Cache storage

On the right side, there are sections for App Manifest (unknown), Errors and warnings (Richer PWA Ins, Richer PWA Ins, Most operating), Installability (Page has no ma), and Identity.

Web-Specific APIs: APIs like `localStorage`, `sessionStorage`, and `fetch` are not available in Node.js.



4. *JavaScript on Client*

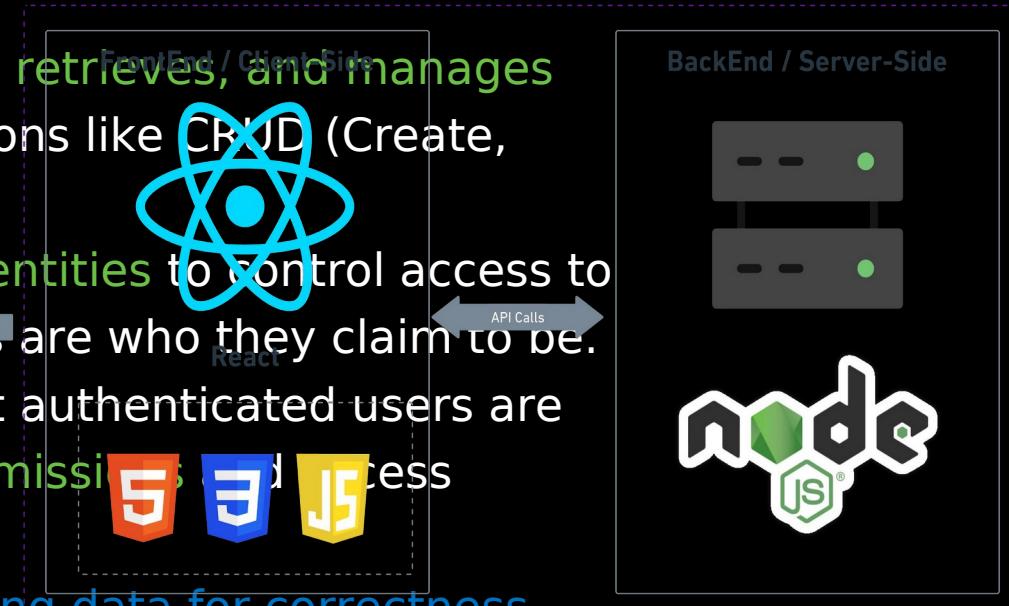


1. **Displays Web Page:** Turns HTML code into what you see on screen.
2. **User Clicks:** Helps you interact with the web page.
3. **Updates Content:** Allows changes to the page using JavaScript.
4. **Loads Files:** Gets HTML, images, etc., from the server.



5. JavaScript on Server

1. **Database Management:** Stores, retrieves, and manages data efficiently through operations like CRUD (Create, Read, Update, Delete).
2. **Authentication:** Verifies user identities to control access to the system, ensuring that users are who they claim to be.
3. **Authorization:** Determines what authenticated users are allowed to do by managing permissions and access controls.
4. **Input Validation:** Checks incoming data for correctness, completeness, and security to prevent malicious data entry and errors.
5. **Session Management:** Tracks user activity across various requests to maintain state and manage user-specific





5. JavaScript on Server

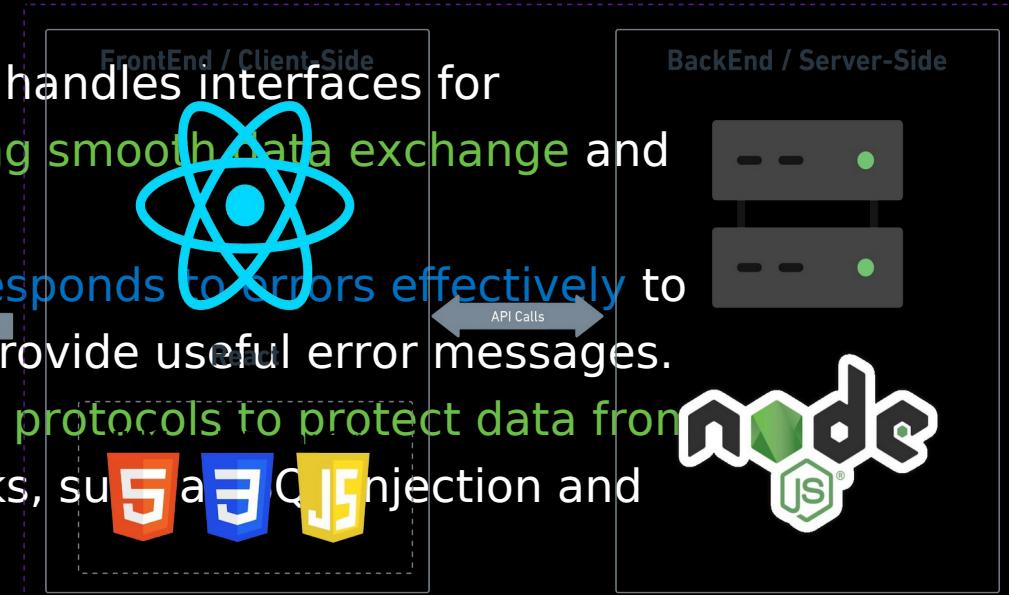
6. **API Management:** Provides and handles interfaces for applications to interact, ensuring smooth data exchange and integration.

7. **Error Handling:** Manages and responds to errors effectively to maintain system stability and provide useful error messages.

8. **Security Measures:** Implements protocols to protect data from unauthorized access and attacks, such as SQL injection and cross-site scripting (XSS).

9. **Data Encryption:** Secures sensitive information by encrypting data stored in databases and during transmission.

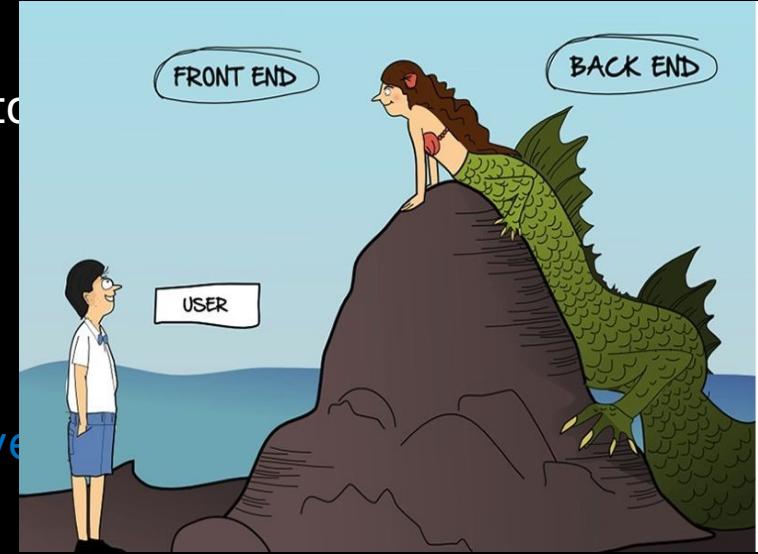
10. **Logging and Monitoring:** Keeps records of system activity to diagnose issues and monitor system health and security.





6. Client Code vs Server Code

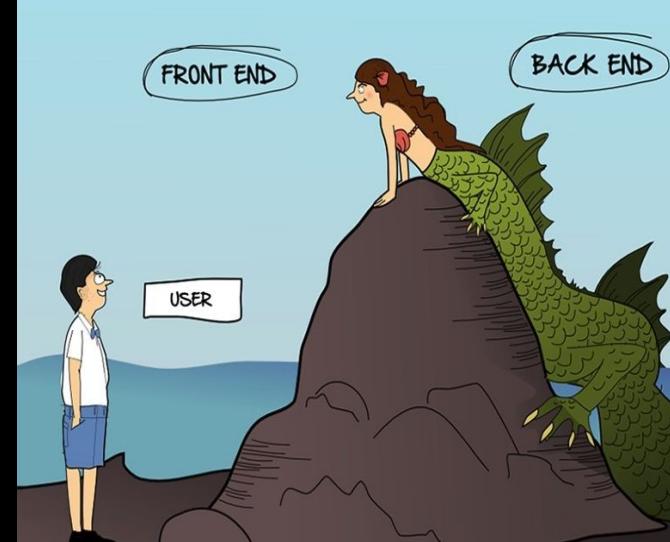
1. User/client can't access server code directly.
2. Client must raise requests for particular APIs to access certain features or data.
3. **Environment Access:** Server-side JavaScript accesses server features like file systems and databases.
4. **Security:** Server-side code can handle sensitive operations securely, while client-side code is exposed and must manage security risks.
5. **Performance:** Heavy computations are better performed on the server to avoid slowing down the client.





6. Client Code vs Server Code

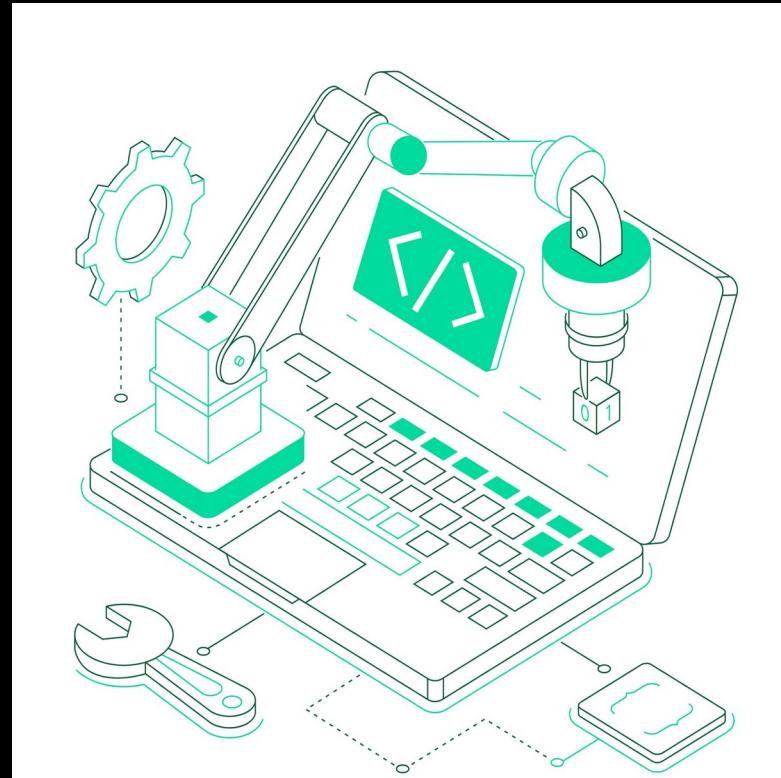
6. Resource Utilization: Servers generally offer more powerful processing capabilities than client devices.
7. Data Handling: Server-side can directly manage large data sets and database interactions, unlike client-side JavaScript.
8. Asynchronous Operations: Server-side JavaScript is optimized for non-blocking I/O to efficiently manage multiple requests.
9. Session Management: Servers handle sessions and user states more comprehensively.
10. Scalability: Server-side code is designed to scale and handle requests from multiple clients.





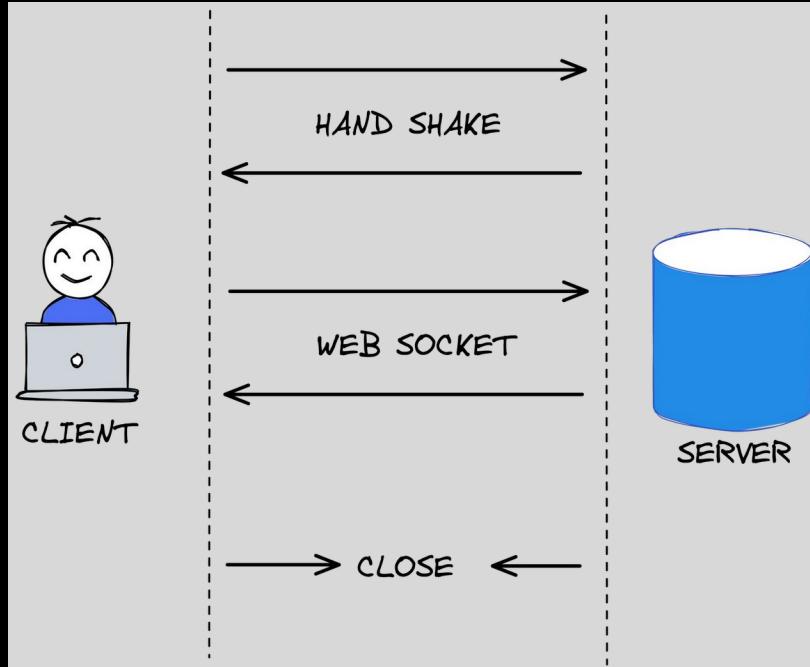
7. Other uses of Node.js

1. **Local Utility Scripts:** Automates tasks and processes files locally, like using shell scripts but with JavaScript.
2. **Internet of Things (IoT):** Develops server-side applications for IoT devices, managing communications and data processing.
3. **Scripting for Automation:** Automates repetitive tasks in software development processes, such as testing and deployment.





7. Other uses of Node.js



Real-Time Applications: Efficiently manages real-time data applications, such as chat apps and live updates, using WebSockets.



7. Other uses of Node.js

Apps users love, built with Electron

Thousands of organizations spanning all industries use Electron to build cross-platform software.

The grid contains the following applications:

- 1Password
- Asana
- Discord
- Dropbox
- Figma
- Agora Flat
- Github Desktop
- itch
- Loom
- MongoDB Compass
- Notion
- Obsidian
- Polypane
- Postman
- Signal
- Skype
- Slack
- Splice
- Microsoft Teams
- Tidal
- Trello
- Twitch
- VS Code
- WordPress Desktop

Desktop Applications: Creates **cross-platform desktop applications** using frameworks like **Electron**.



7. Other uses of Node.js

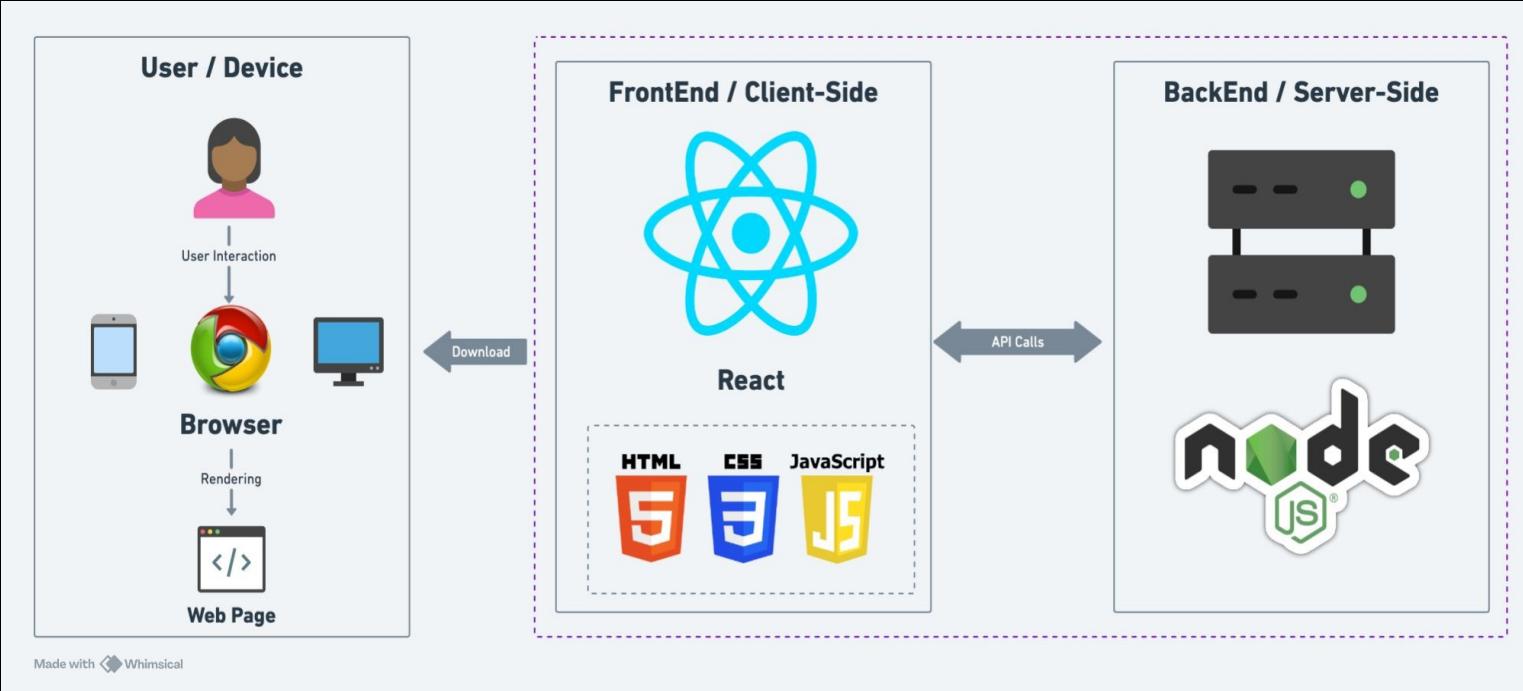
Build Tools: Powers build processes for front-end technologies using tools like:

- Webpack
- Grunt
- Gulp
- Browserify
- Brunch
- Yeoman





8. Server architecture with NodeJs



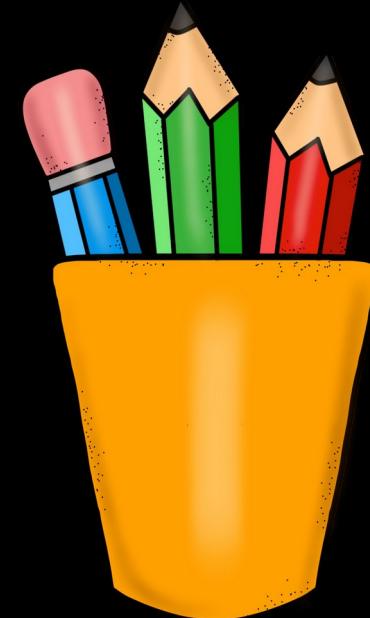
Nodejs server will:

1. Create server and **listen to incoming requests**
2. Business logic: validation, connect to db, actual processing of data



Revision

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2. Installation of NodeJS

1. What is IDE
2. Need of IDE
3. MAC Setup
 - Install latest Node & VsCode
4. Windows Setup
 - Install latest Node & VsCode
5. Linux Setup
 - Install latest Node & VsCode
6. VsCode (Extensions and Settings)
7. Executing first .js file
8. What is REPL
9. Executing Code via REPL





2.1 *What is IDE*

1. IDE stands for **Integrated Development Environment**.
2. Software suite that consolidates basic tools required for **software development**.
3. Central hub for **coding**, finding problems, and testing.
4. Designed to improve developer efficiency.





2.2 Need of IDE

1. Streamlines development.
2. Increases productivity.
3. Simplifies complex tasks.
4. Offers a unified workspace.
5. IDE Features
 1. Code Autocomplete
 2. Syntax Highlighting
 3. Version Control
 4. Error Checking

A screenshot of an Android Studio code editor window titled "MainActivity.kt". The code is written in Kotlin and defines a Composable function named "MessageCard". The code uses Jetpack Compose's Row, Image, Spacer, and Column components with various modifiers like padding, width, height, and background color.

```
@Composable
fun MessageCard(msg: Message) {
    Row(modifier = Modifier.padding(all = 8.dp)) {
        Image(
            painter = painterResource(R.drawable.android_studio_logo),
            contentDescription = "Profile Picture",
            modifier = Modifier
                .size(45.dp)
        )
        Spacer(modifier = Modifier.width(8.dp))
        Column (Modifier
            .background(color = Color.White)) {
            Text(text = msg.author, color = Color.Black)
            Spacer(modifier = Modifier.height(1.dp))
            Text(text = msg.body, color = Color.Black)
        }
    }
}
```

2.3 MAC Setup





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Node.js includes npm (10.7.0). Read the changelog for this version. Read the blog post for this version. Learn how to verify signed SHASUMS. Check out all available Node.js download options.

2.3 MAC Setup

(Install latest Node)

Search Download NodeJS



2.3 MAC Setup

(Install VsCode)



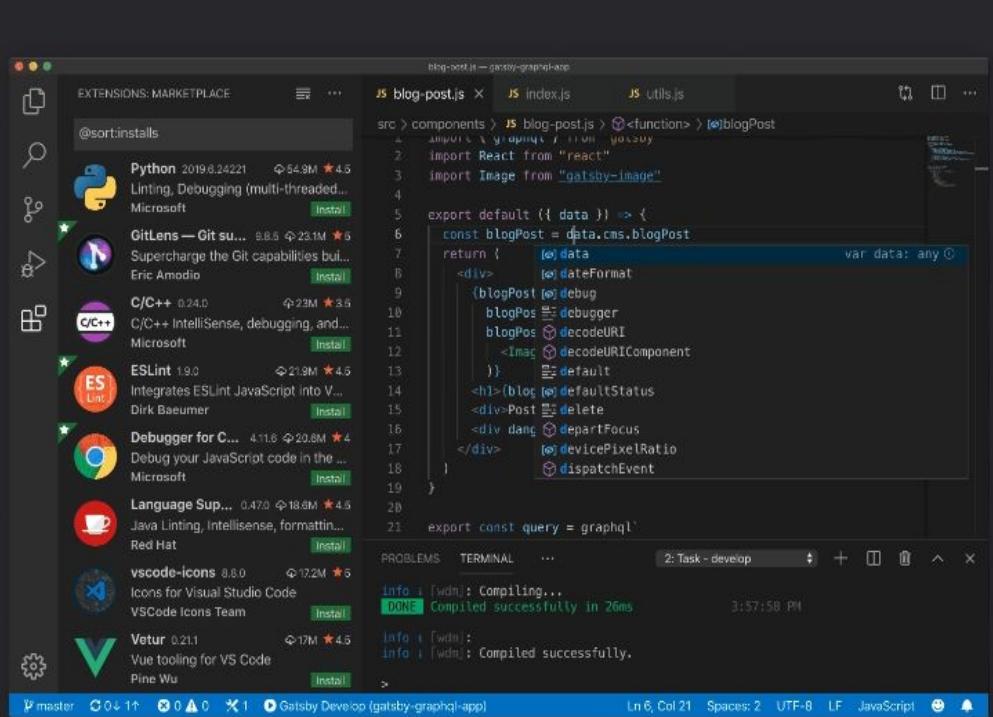
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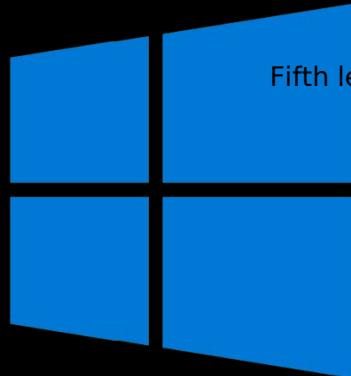


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2.4 *Windows Setup*



Windows



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2.4 Windows Setup

(Install latest Node)

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2.4 Windows Setup



(Install VsCode)

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Redefined.

Free. Built on open source. Runs everywhere.

Download for Windows
Stable Build

Web, Insiders edition, or other platforms

By using VS Code, you agree to its
[license and privacy statement](#).

The screenshot shows the Visual Studio Code interface. The code editor displays a service worker registration script. The terminal below shows the command '1:node' and the output 'You can now view create-react-app in the browser.' The status bar at the bottom indicates the file is '1 master' and provides code navigation information.

```
src > JS serviceWorker.js > register > window.addEventListener('load') callback
checkValidServiceWorker(swUrl, config);
// Add some additional logging to localhost, p...
// service worker/PWA documentation.
navigator.serviceWorker.ready.then(() => {
  ...
})
```

TERMINAL

```
1:node
```

You can now view create-react-app in the browser.

Local: http://localhost:3000/
On Your Network: http://10.211.55.3:3000/

Note that the development build is not optimized.

EXTENSIONS: MARKETPLACE

- Python 2019.6.24221 54.9M 4.5 Microsoft Install
- GitLens — Git super... 9.8.5 23.1M 5 Eric Amodio Install
- C/C++ 0.24.0 23M 3.5 Microsoft Install
- ESLint 1.9.0 21.9M 4.5 Dirk Baeumer Install
- Debugger for Ch... 4.11.6 20.6M 4 Microsoft Install
- Language Supp... 0.47.0 18.7M 4.5 Red Hat Install
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- C# 1.21.0 15.6M 4 Microsoft Install



2.5 *Linux Setup*



Linux



2.5 Linux Setup (Install latest Node)

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Prebuilt Installer Prebuilt Binaries **Package Manager** Source Code

Install Node.js v22.1.0 (Current) on Linux using NVM

```
1 # installs NVM (Node Version Manager)
2 curl -o https://raw.githubusercontent.com/nvm-sh/nvm/v0.39.7/install.sh | bash
3
4 # download and install Node.js
5 nvm install 22
6
7 # verifies the right Node.js version is in the environment
8 node -v # should print 'v22.1.0'
9
10 # verifies the right NPM version is in the environment
11 npm -v # should print '10.7.0'
```

Bash

Copy to clipboard

Please ensure you have the right package manager installed before running a script.



2.5 Linux Setup

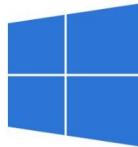
(Install VsCode)

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Download Visual Studio Code

Free and built on open source. Integrated Git, debugging and extensions.



↓ Windows

Windows 10, 11



↓ .deb

Debian, Ubuntu

↓ .rpm

Red Hat, Fedora, SUSE



↓ Mac

macOS 10.15+

User Installer x64 Arm64

System Installer x64 Arm64

.zip x64 Arm64

CLI x64 Arm64

.deb x64 Arm32 Arm64

.rpm x64 Arm32 Arm64

.tar.gz x64 Arm32 Arm64

Snap Snap Store

.zip Intel chip Apple silicon Universal

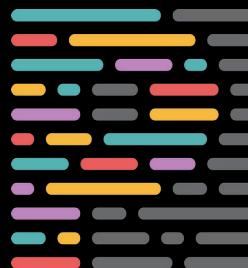
CLI Intel chip Apple silicon



2.6 VsCode

(*Extensions and Settings*)

1. Prettier (Format on Save)
2. Line Wrap
3. Tab Size from 4 to 2





2.7 Executing first js file

```
1  const fs = require('fs');
2
3  // Define two variables
4  let a = 10;
5  let b = 5;
6
7  // Basic arithmetic operations
8  let sum = a + b;
9  let product = a * b;
10
11 // Prepare data to write
12 let data = `Sum: ${sum}\nProduct: ${product}`;
13 console.log(data);
14
15 // Write data to a local file
16 fs.writeFile('output.txt', data, (err) => {
17   if (err) throw err;
18   console.log('Data written to file');
19 });
```

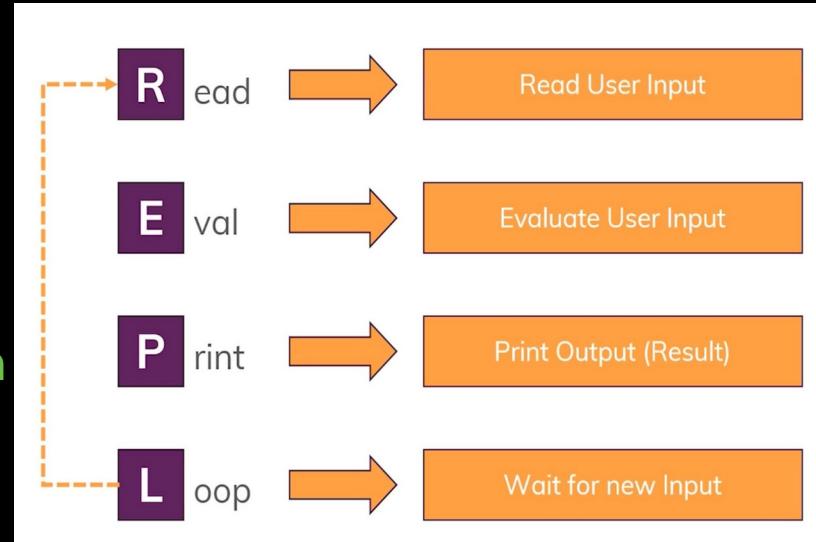
```
prashantjain@Mac-mini Desktop % node test.js
Sum: 15
Product: 50
Data written to file
```

1. Streamlines Node Command: Use `node filename.js` to execute a JavaScript file in the Node.js environment.
2. Require Syntax: Use `require('module')` to include built-in or external modules, or other JavaScript files in your code.
3. Modular Code: `require` helps organize code into reusable modules, separating concerns and improving maintainability.
4. Caching: Modules loaded with `require` are cached, meaning the file is executed only once even if included multiple times.



2.8 What is REPL

1. **Streamlines Interactive Shell:** Executes JavaScript code **interactively**.
2. **Quick Testing:** Ideal for **testing** and **debugging code snippets** on the fly.
3. **Built-in Help:** Offers help commands via **.help**.
4. **Session Management:** Supports saving (**.save**) and loading (**.load**) code sessions.
5. **Node.js API Access:** Provides **direct access** to Node.js **APIs** for experimentation.
6. **Customizable:** Allows **customization** of **prompt** and behaviour settings.





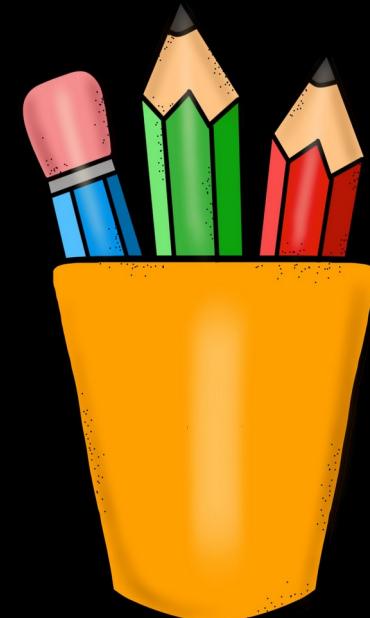
2.9 Executing Code via REPL

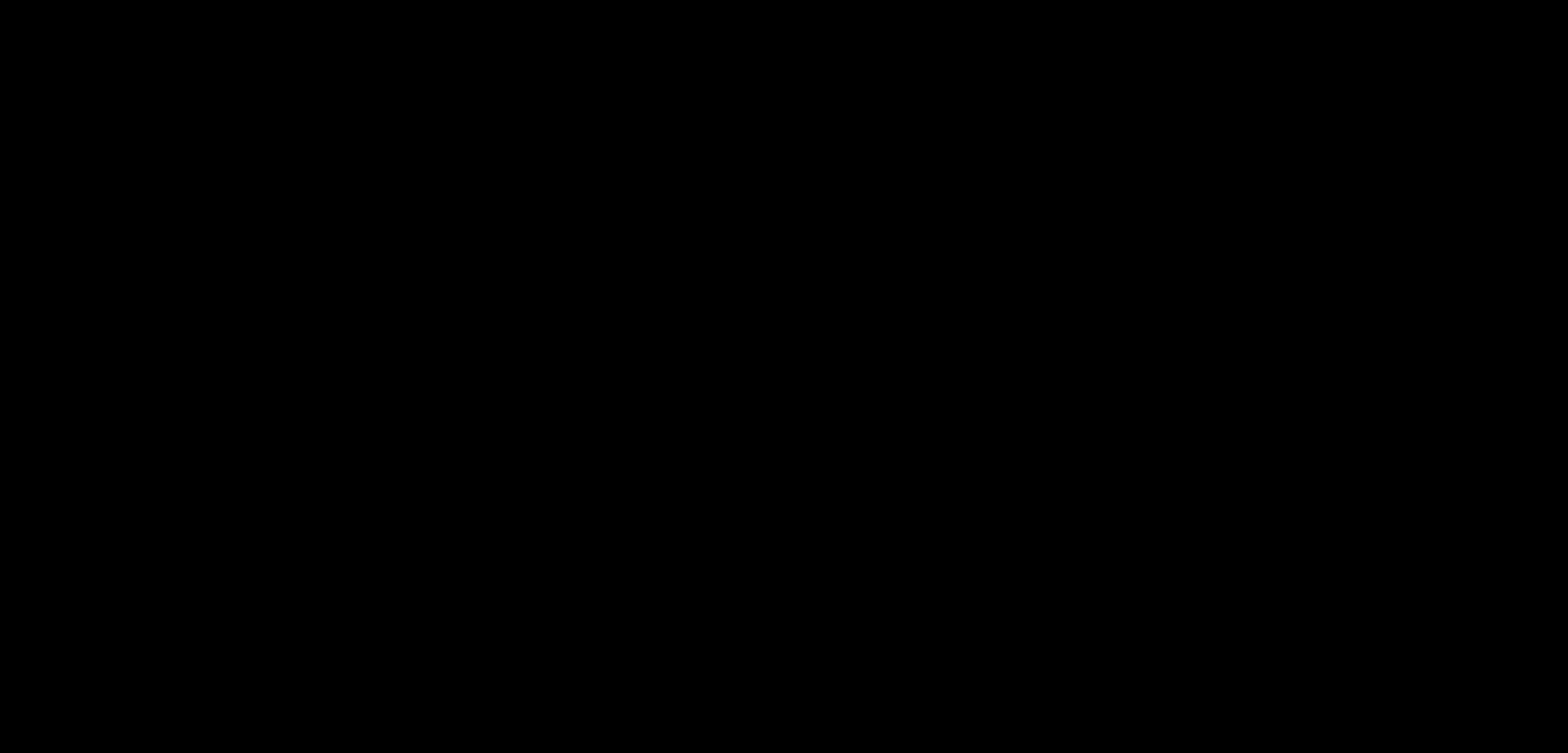
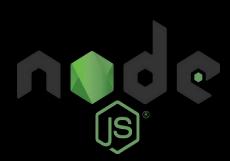
```
prashantjain@Mac-mini Desktop % node
Welcome to Node.js v20.9.0.
Type ".help" for more information.
> 5 + 6
11
> console.log('KG Coding is the best');
KG Coding is the best
undefined
> fs.writeFile('output.txt', 'Writing to file', (err) => {
...     if (err) throw err;
...     console.log('Data written to file');
... });
undefined
> Data written to file
```



Revision

1. *What is IDE*
2. *Need of IDE*
3. *MAC Setup*
 - *Install latest Node & VsCode*
4. *Windows Setup*
 - *Install latest Node & VsCode*
5. *Linux Setup*
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6. *VsCode (Extensions and Settings)*
7. *Executing first .js file*
8. *What is REPL*
9. *Executing Code via REPL*







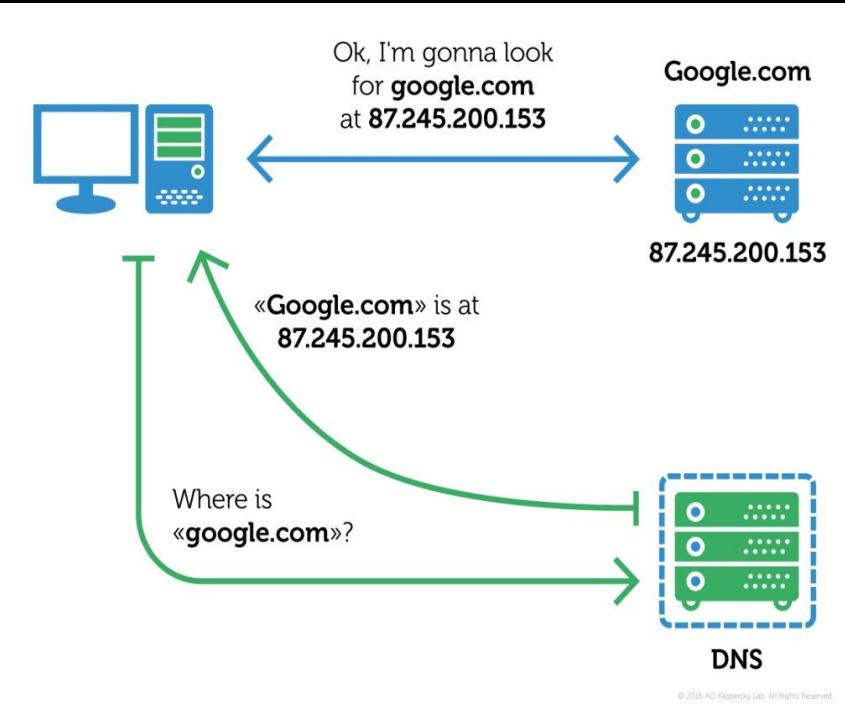
3. First Node Server

1. How DNS Works?
2. How Web Works?
3. What are Protocols?
4. Node Core Modules
5. Require Keyword
6. Creating first Node Server





3.1 How DNS Works?

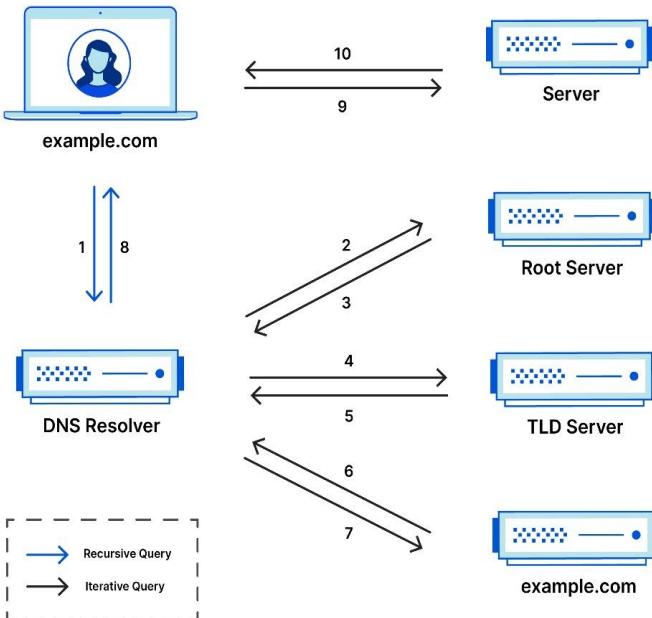


1. **Domain Name Entry:** User types a domain (e.g., `www.example.com`) into the browser.
2. **DNS Query:** The browser sends a DNS query to resolve the domain into an IP address.
3. **DNS Server:** Provides the correct IP address for the domain.
4. **Browser Connects:** The browser uses the IP to connect to the web server and loads the website.



3.1 How DNS Actually Works?

Complete DNS Lookup and Webpage Query

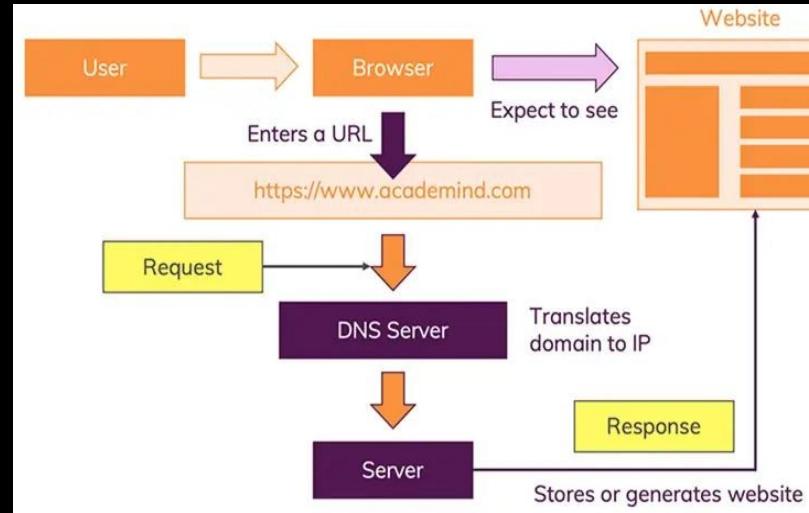


1. Root DNS: Acts as the starting point for DNS resolution. It directs queries to the correct TLD server (e.g., .com, .org).
2. TLD (Top-Level Domain) DNS: Handles queries for specific top-level domains (e.g., .com, .net) and directs them to the authoritative DNS server (e.g., Verisign for .com, PIR for .org).
3. Authoritative DNS: Contains the actual IP address of the domain and answers DNS queries with this information. (e.g. Cloudflare, Google DNS).

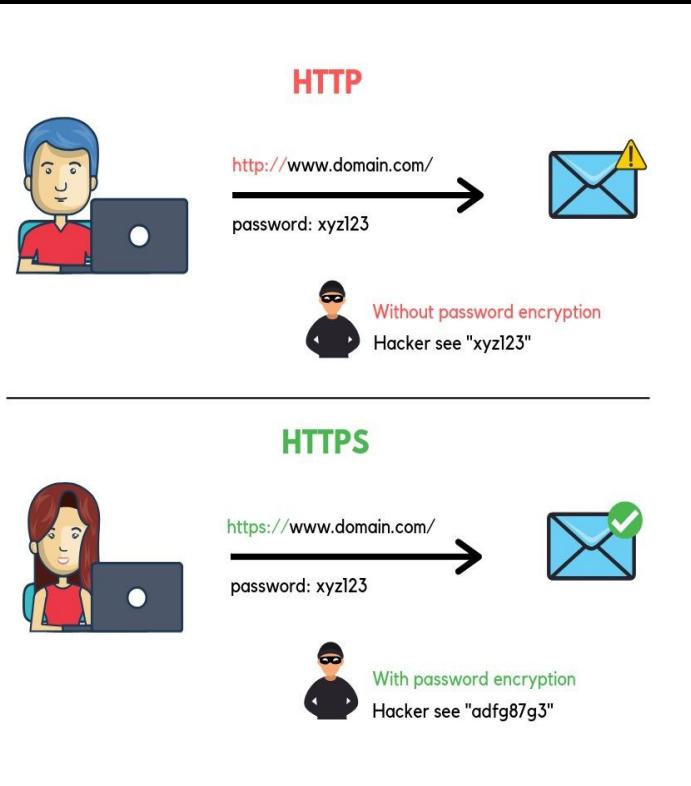


3.2 How Web Works?

1. Client Request Initiation: The client (browser) initiates a network call by entering a URL.
2. DNS Resolution: The browser contacts a DNS server to get the IP address of the domain.
3. TCP Connection: The browser establishes a TCP connection with the server's IP address.
4. HTTP Request: The browser sends an HTTP request to the server.
5. Server Processing: The server processes the request and prepares a response.
6. HTTP Response: The server sends an HTTP response back to the client.
7. Network Transmission: The response travels back to the client over the network.
8. Client Receives Response: The browser receives and interprets the response.
9. Rendering: The browser renders the content of the response and displays it to the user.



3.3 What are Protocols?



Http (HyperText Transfer Protocol):

- Facilitates communication between a web browser and a server transfer web pages.
- Sends data in plain text (no encryption).
- Used for basic website browsing without security.

HTTPS (HyperText Transfer Protocol Secure):

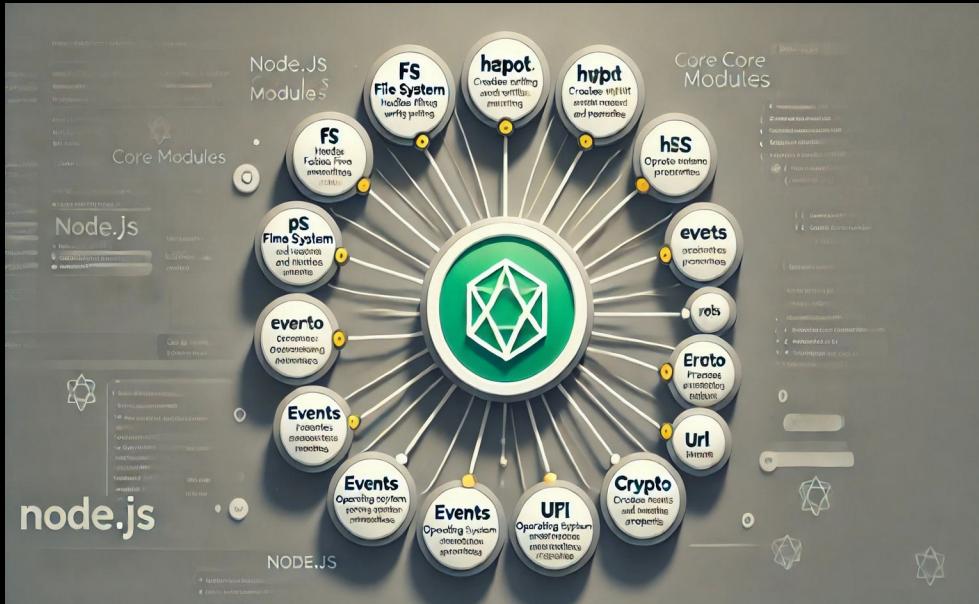
- Secure version of HTTP, encrypts data for secure communication.
- Uses SSL/TLS to encrypt data.
- Used in online banking, e-commerce.

TCP (Transmission Control Protocol):

- Ensures reliable, ordered, and error-checked data delivery over internet.
- Establishes a connection before data is transferred.



3.4 Node Core Modules



1. **Built-in:** Core modules are included with Node.js installation.
2. **No Installation Needed:** Directly available for use without npm install.
3. **Performance:** Highly optimized for performance.



3.4 *Node Core Modules*

1. **fs (File System)**: Handles file operations like reading and writing files.
2. **http**: Creates HTTP servers and makes HTTP requests.
3. **https**: Launch a SSL Server.
4. **path**: Provides utilities for handling and transforming file
5. **path.os**: Provides operating system-related utility methods and properties.
6. **events**: Handles events and event-driven programming.
7. **crypto**: Provides cryptographic functionalities like hashing and encryption.
8. **url**: Parses and formats URL strings.



3.5 *Require Keyword*

1. **Purpose:** Imports modules in Node.js.
2. **Caching:** Modules are **cached** after the first **require** call.
3. **.js** is added automatically and is not needed to at the end of module name.
4. **Path Resolution:** Node.js searches for modules in **core**, **node_modules**, and **file paths**.

Syntax:

```
const moduleName = require('module')
```

```
// Load the built-in http module
const http = require('http');
```

```
// Load the third party express module
const express = require('express');
```

```
// Load the custom myModule module
const myModule = require('./myModule');
```



3.6 Creating first Node Server

```
1 // Simple Node.js server
2 const http = require('http');
3
4 function requestListener(req, res) {
5   |   console.log(req);
6 }
7
8 http.createServer(requestListener);
```



3.6 Creating first Node Server

```
1 // Simple Node.js server
2 const http = require('http');
3
4 http.createServer(function (req, res) {
5   console.log(req);
6 });
```



3.6 Creating first Node Server

```
1 // Simple Node.js server
2 const http = require('http');
3
4 http.createServer((req, res) => {
5   console.log(req);
6 });
```

Run the code with:

`node app.js`



3.6 Creating first Node Server

```
1 // Simple Node.js server
2 const http = require('http');
3
4 const server = http.createServer((req, res) => {
5   console.log(req);
6 });
7
8 server.listen(3000);
```

```
insecureHTTPParser: undefined,
requestTimeout: 300000,
headersTimeout: 60000,
keepAliveTimeout: 5000,
connectionsCheckingInterval: 30000,
requireHostHeader: true,
joinDuplicateHeaders: undefined,
rejectNonStandardBodyWrites: false,
_events: [Object: null prototype],
_eventsCount: 3,
_maxListeners: undefined,
_connections: 2,
_handle: [TCP],
_usingWorkers: false,
_workers: [],
_unref: false,
_listeningId: 2,
allowHalfOpen: true,
pauseOnConnect: false,
noDelay: true,
keepAlive: false,
keepAliveInitialDelay: 0,
highWaterMark: 65536,
httpAllowHalfOpen: false,
timeout: 0,
maxHeadersCount: null,
```



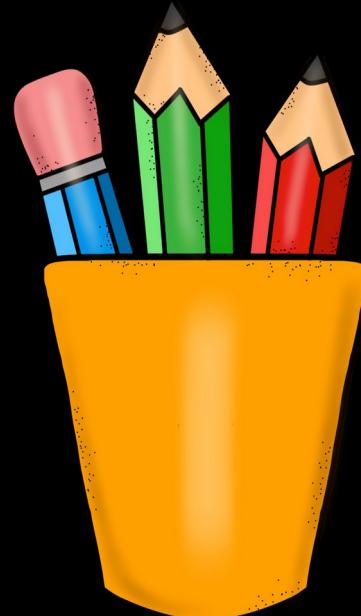
3.6 Creating first Node Server

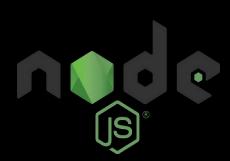
```
1 // Simple NodeJS server
2 const http = require('http');
3
4 const server = http.createServer((req, res) => {
5   console.log(req);
6 });
7
8 const PORT = 3000;
9 server.listen(PORT, () => {
10   console.log(`Server running at http://localhost:${PORT}/`);
11});
```



Revision

1. *How DNS Works?*
2. *How Web Works?*
3. *What are Protocols?*
4. *Node Core Modules*
5. *Require Keyword*
6. *Creating first Node Server*







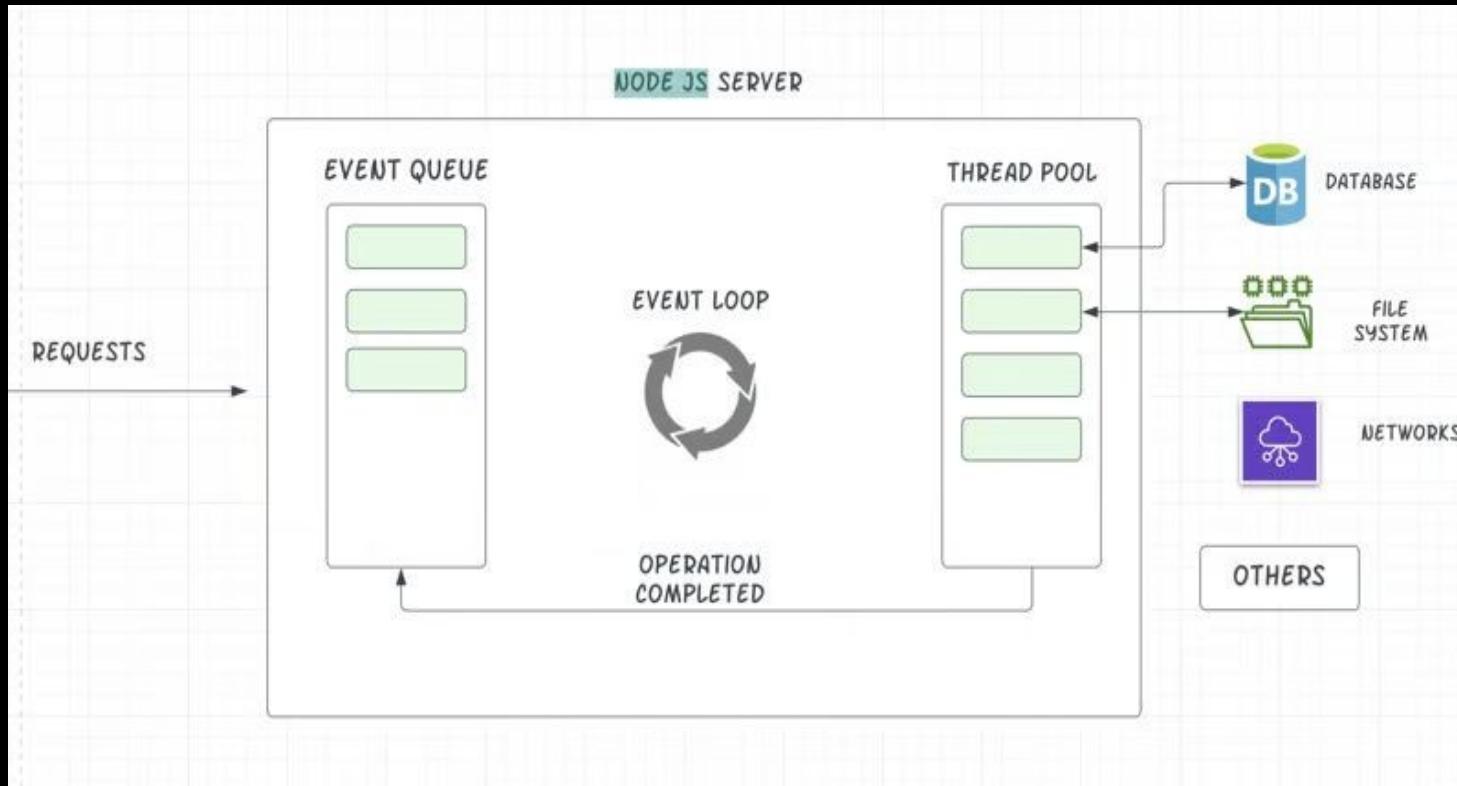
4. Request & Response

1. *Node Lifecycle & Event Loop*
2. *How to exit Event Loop*
3. *Understand Request Object*
4. *Sending Response*
5. *Routing Requests*
6. *Taking User Input*
7. *Redirecting Requests*





4.1 Node Lifecycle & Event Loop





4.2 How to exit Event Loop

```
1 // Simple Node.js server
2 const http = require('http');
3
4 const server = http.createServer((req, res) => {
5   console.log(req);
6   process.exit(); // Stops event loop
7 });
8
9 const PORT = 3000;
10 server.listen(PORT, () => {
11   console.log(`Server running at http://localhost:${PORT}/` );
12 });
```



4.3 Understand Request Object

```
[Symbol(kHeaders)]: {
  host: 'localhost:3000',
  connection: 'keep-alive',
  'cache-control': 'max-age=0',
  'sec-ch-ua': '"Chromium";v="128", "Not;A=Brand";v="24", "Google Chrome";v="128"',
  'sec-ch-ua-mobile': '?0',
  'sec-ch-ua-platform': '"macOS"',
  'upgrade-insecure-requests': '1',
  'user-agent': 'Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/128.0.6482.129 Safari/537.36',
  accept: 'text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/apng,*/*;q=0.7',
  'sec-fetch-site': 'none',
  'sec-fetch-mode': 'navigate',
  'sec-fetch-user': '?1',
  'sec-fetch-dest': 'document',
  'accept-encoding': 'gzip, deflate, br, zstd',
  'accept-language': 'en-US,en-IN;q=0.9,en;q=0.8,hi-IN;q=0.7,hi;q=0.6',
  cookie: 'token=eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJpZCI6ImM3M2Y0MzNjLTFLYzYtNDUqvUSRMLqbP1uy5bTjnJEQHXc1c'
},
[Symbol(kHeadersCount)]: 32,
[Symbol(kTrailers)]: null,
[Symbol(kTrailersCount)]: 0
}
```



4.3 Understand Request Object

```
// Simple NodeJS server
const http = require('http');

const server = http.createServer((req, res) => {
  console.log(req.url, req.method, req.headers);
});

const PORT = 3000;
server.listen(PORT, () => {
  console.log(`Server running at http://localhost:${PORT}/`);
});
```

Use the browser to access:

<http://localhost:3000/>



4.4 Sending Response

```
1 // Simple NodeJS server
2 const http = require('http');
3
4 const server = http.createServer((req, res) => {
5   //res.setHeader('Content-Type', 'json');
6   res.setHeader('Content-Type', 'text/html');
7   res.write('<html>');
8   res.write('<head><title>Complete Coding</title></head>');
9   res.write('<body><h1>Like / Share / Subscribe</h1></body>');
10  res.write('</html>');
11  res.end();
12 });
13
14 const PORT = 3000;
15 server.listen(PORT, () => {
16   console.log(`Server running at http://localhost:${PORT}/`);
```



4.4 Sending Response

localhost:3000

Video Ideas Bookmarks Rare YouTube Watermark KG Coding YouTube Complete Coding Complete Coding

Like / Share / Subscribe

Network

Preserve log Disable cache No throttling Invert Hide data URLs Hide extension URLs

All Fetch/XHR Doc CSS JS Font Img Media Manifest WS Wasm Other Blocked requests 3rd-party requests

10 ms 20 ms 30 ms 40 ms 50 ms 60 ms 70 ms 80 ms 90 ms

Name	Headers	Preview	Response	Initiator	Timing	Cookies
localhost			<html><head><title>Complete Coding</title></head><body><h1>Like / Share / Subscribe</h1></body></html>			
favicon.ico						



4.5 Routing Requests

```
const server = http.createServer((req, res) => {
  res.setHeader('Content-Type', 'text/html');
  res.write('<html>');
  res.write('<head><title>Complete Coding</title></head>');
  if (req.url === '/') {
    res.write('<h1>Welcome to Home page</h1>');
    res.end();
  } else if (req.url.toLowerCase() === '/products') {
    res.write('<h1>Products</h1>');
    res.end();
  }
  res.write('<body><h1>Like / Share / Subscribe</h1></body>');
  res.write('</html>');
  res.end();
});
```



4.5 Routing Requests

```
✉ prashantjain@Prashants-Mac-mini node % node app.js
```

```
Server running at http://localhost:3000/
```

```
node:_http_outgoing:699
```

```
    throw new ERR_HTTP_HEADERS_SENT('set');
    ^
```

```
Error [ERR_HTTP_HEADERS_SENT]: Cannot set headers after they are sent to the client
```

```
at ServerResponse.setHeader (node:_http_outgoing:699:11)
```

```
at Server.<anonymous> (/Users/prashantjain/workspace/Test Project/node/app.js:14:7)
```

```
at Server.emit (node:events:520:28)
```

```
at parserOnIncoming (node:_http_server:1146:12)
```

```
at HTTPParser.parserOnHeadersComplete (node:_http_common:118:17) {
```

```
  code: 'ERR_HTTP_HEADERS_SENT'
```

```
}
```

```
Node.js v22.5.1
```



4.5 Routing Requests

```
const server = http.createServer((req, res) => {
  res.setHeader('Content-Type', 'text/html');
  res.write('<html>');
  res.write('<head><title>Complete Coding</title></head>');
  if (req.url === '/') {
    res.write('<h1>Welcome to Home page</h1>');
    return res.end();
  } else if (req.url.toLowerCase() === '/products') {
    res.write('<h1>Products</h1>');
    return res.end();
  }
  res.write('<body><h1>Like / Share / Subscribe</h1></body>');
  res.write('</html>');
  return res.end();
})
```



4.6 Taking User Input

```
if (req.url === '/') {
  res.write('<h1>Welcome to Home page</h1>');
  res.write('<form action="/submit-details" method="POST">');
  res.write('<input type="text" id="name" name="name" placeholder="Enter your
  name"><br><br>');
  res.write('<label for="gender">Gender:</label>');
  res.write('<input type="radio" id="male" name="gender" value="male">');
  res.write('<label for="male">Male</label>');
  res.write('<input type="radio" id="female" name="gender" value="female">');
  res.write('<label for="female">Female</label><br><br>');
  res.write('<button type="submit">Submit</button>');
  res.write('</form>');
  return res.end();
}
```



4.7 Redirecting Requests

```
} else if (req.method == 'POST' &&
| | | | req.url.toLowerCase() === '/submit-details') {
fs.writeFileSync('user-details.txt', 'Prashant Jain');
res.statusCode = 302;
res.setHeader('Location', '/');
return res.end();
}
```

```
node > ≡ user-details.txt
```

1 Prashant Jain



Practise Set

Create a page that shows a navigation bar of Myntra with the following links:

- A. Home
- B. Men
- C. Women
- D. Kids
- E. Cart

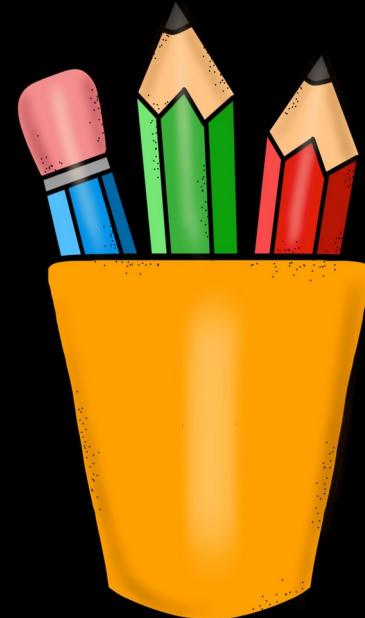
Clicking on each link **page** should **navigate** to that **page** and a **welcome to** section **text** is shown there.

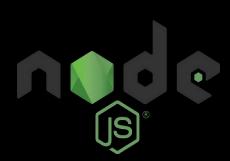




Revision

1. *Node Lifecycle & Event Loop*
2. *How to exit Event Loop*
3. *Understand Request Object*
4. *Sending Response*
5. *Routing Requests*
6. *Taking User Input*
7. *Redirecting Requests*







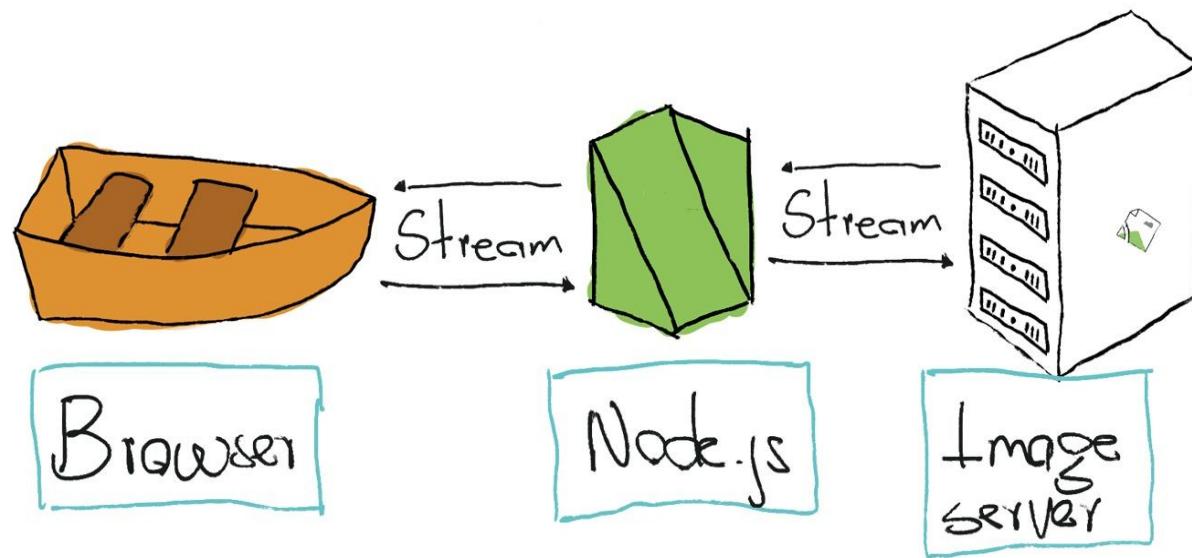
5. Parsing Request

1. Streams
2. Chunks
3. Buffers
4. Reading Chunk
5. Buffering Chunks
6. Parsing Request
7. Using Modules



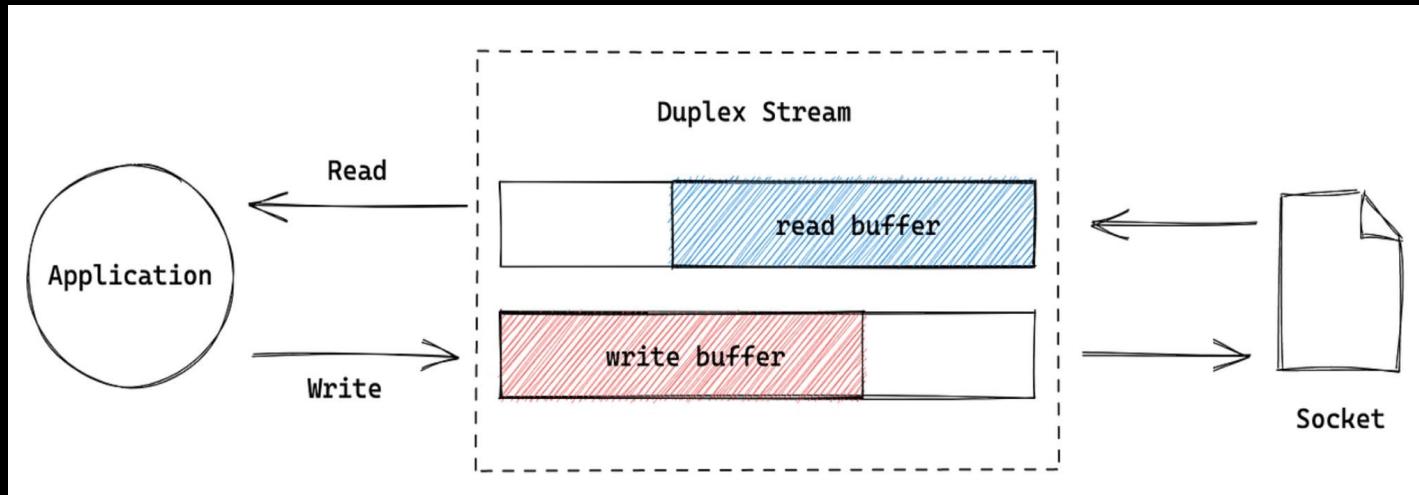


5.1 Streams



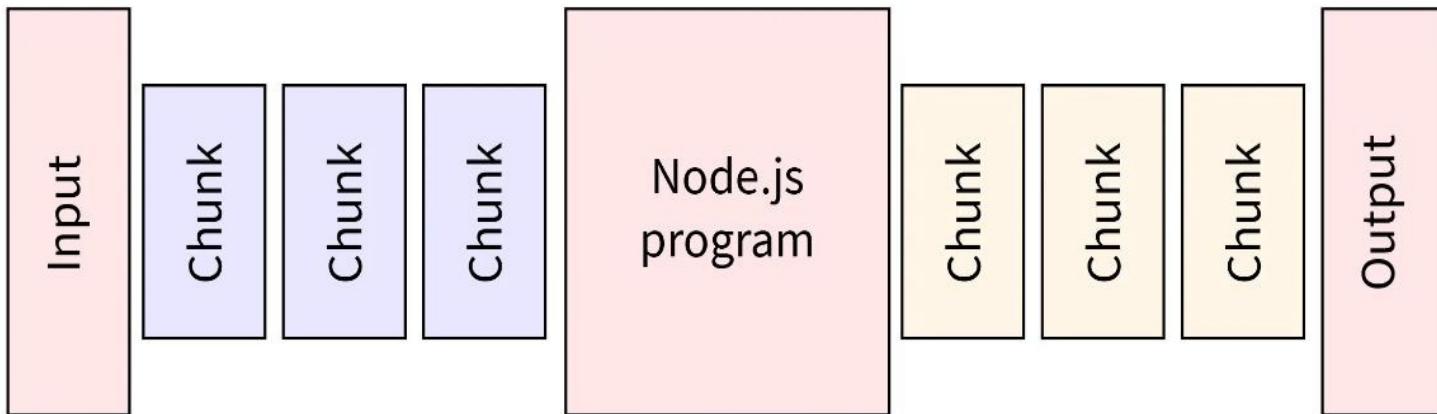


5.1 Streams



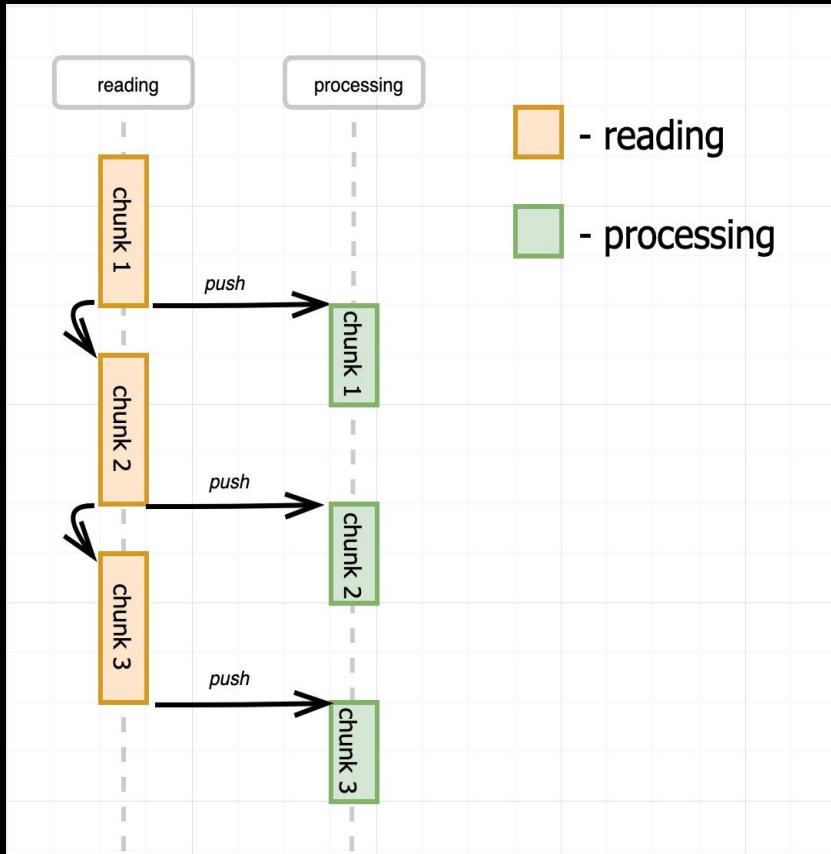


5.2 *Chunks*



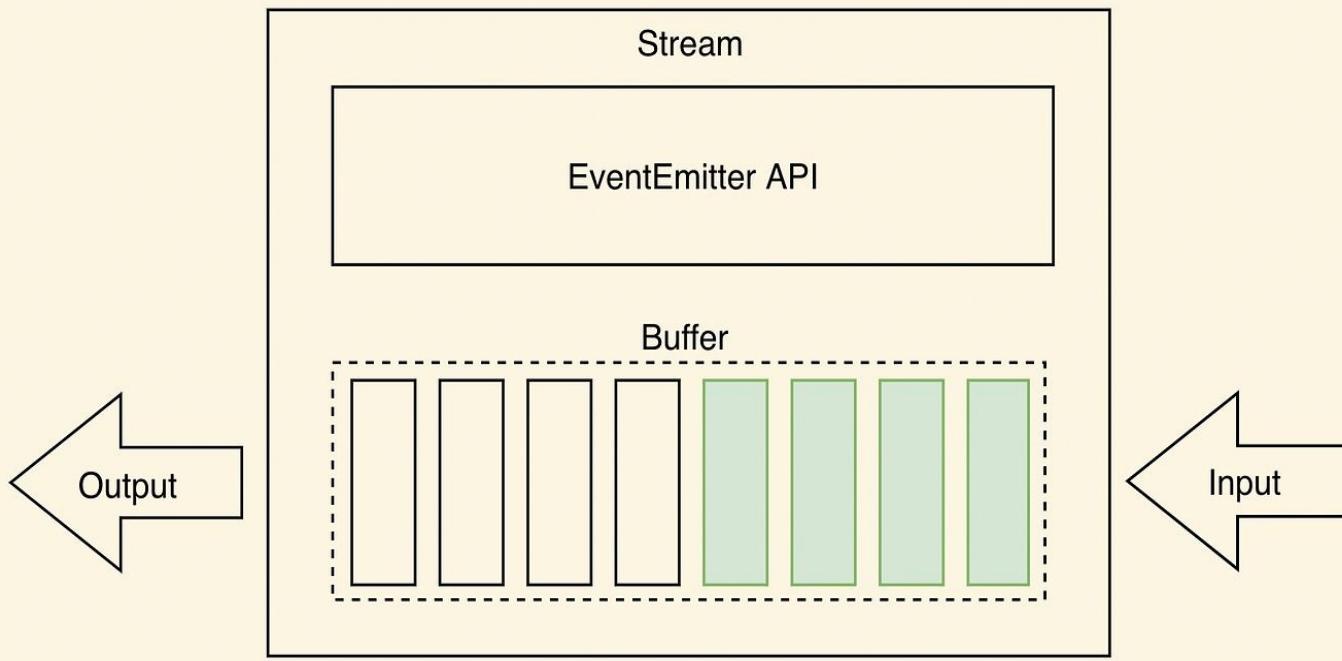


5.2 Chunks





5.3 *Buffers*





5.4 Reading Chunk

```
    } else if (
      req.method == "POST" &&
      req.url.toLowerCase() === "/submit-details"
    ) {
      req.on("data", (chunk) => {
        console.log(chunk);
      });
      fs.writeFileSync("user-details.txt", "Prashant Jain");
      res.setHeader("Location", "/");
      res.statusCode = 302;
      return res.end();
    }
  }
```

```
prashantjain@Prashants-Mac-mini node % node app.js
Server running at http://localhost:3000/
>Buffer { 6e, 61, 6d, 65, 3d, 50, 73, 61, 73, 68, 61, 6c, 74, 26, 67, 65, 6e, 64, 65, 72, 3d, 6d, 61, 6c, 65}
```



5.5 Buffering Chunks

```
const body = [];
req.on("data", (chunk) => {
  console.log(chunk);
  body.push(chunk);
});
req.on("end", () => {
  const parsedBody = Buffer.concat(body).toString();
  console.log(parsedBody);
});
fs.writeFileSync("user-details.txt", "Prashant Jain");
```

```
.prashantjain@Prashants-Mac-mini node % node app.js
Server running at http://localhost:3000/
<Buffer 6e 61 6d 65 3d 50 72 61 73 68 61 6e 74 26 67 65 6e 64 65 72 3d 6d 61 6c 65>
```



5.6 Parsing Request

```
req.on("end", () => {
  const parsedBody = Buffer.concat(body).toString();
  console.log(parsedBody);
  const params = new URLSearchParams(parsedBody);
  const jsonObject = {};
  for (const [key, value] of params.entries()) {
    jsonObject[key] = value;
  }
  console.log(jsonObject);
  // Output: { name: 'Prashant', gender: 'male' }
});
fs.writeFileSync("user-details.txt", "Prashant Jain");
res.setHeader("Location", "/");
res.statusCode = 302;
```



5.6 Parsing Request

```
req.on("end", () => {
  const parsedBody = Buffer.concat(body).toString();
  console.log(parsedBody);
  const params = new URLSearchParams(parsedBody);
  const jsonObject = {};
  for (const [key, value] of params.entries()) {
    jsonObject[key] = value;
  }
  const jsonString = JSON.stringify(jsonObject);
  console.log(jsonString);
  fs.writeFileSync("user-details.txt", jsonString);
});
res.setHeader("Location", "/");
res.statusCode = 302;
return res.end();
```

```
node > ≡ user-details.txt
```

```
1 [{"name": "Dynamis", "gender": "male"}]
```



5.7 Using Modules

JS app.js

JS handler.js

```
js handler.js > ...
const fs = require("fs");

const requestHandler = (req, res) => {
  if (req.url === "/") {
    res.setHeader("Content-Type", "text/html");
```

```
module.exports = requestHandler
```

```
js app.js > ...
// Simple NodeJS server
const http = require('http');
const requestHandler = require('./handler');

const server = http.createServer(requestHandler);
```



5.7 Using Modules

```
// Method 1: Multiple exports using object
module.exports = {
  handler: requestHandler,
  extra: "Extra"
};
```

```
// Method 2: Setting multiple properties
module.exports.handler = requestHandler;
module.exports.extra = "Extra";
```

```
// Method 3: Shortcut using exports
exports.handler = requestHandler;
exports.extra = "Extra";
```



Practise Set

Create a Calculator

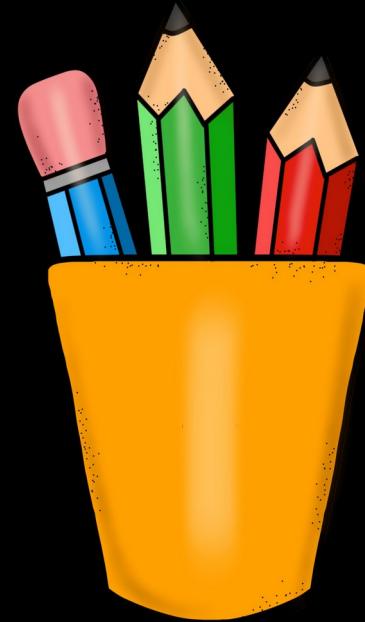
1. Create a new Node.js project named “Calculator”.
2. On the home page (`route “/”`), show a welcome message and a link to the calculator page.
3. On the “`/calculator`” page, display a form with two input fields and a “Sum” button.
4. When the user clicks the “Sum” button, they should be taken to the “`/calculate-result`” page, which shows the sum of the two numbers.
 - Make sure the request goes to the server.
 - Create a **separate module** for the addition function.
 - Create **another module** to handle incoming requests.
 - On the “`/calculate-result`” page, parse the user input, use the addition module to calculate the sum, and **display the result on a new HTML page**.

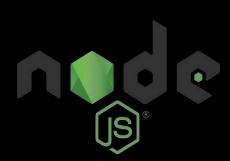




Revision

1. *Streams*
2. *Chunks*
3. *Buffers*
4. *Reading Chunk*
5. *Buffering Chunks*
6. *Parsing Request*
7. *Using Modules*





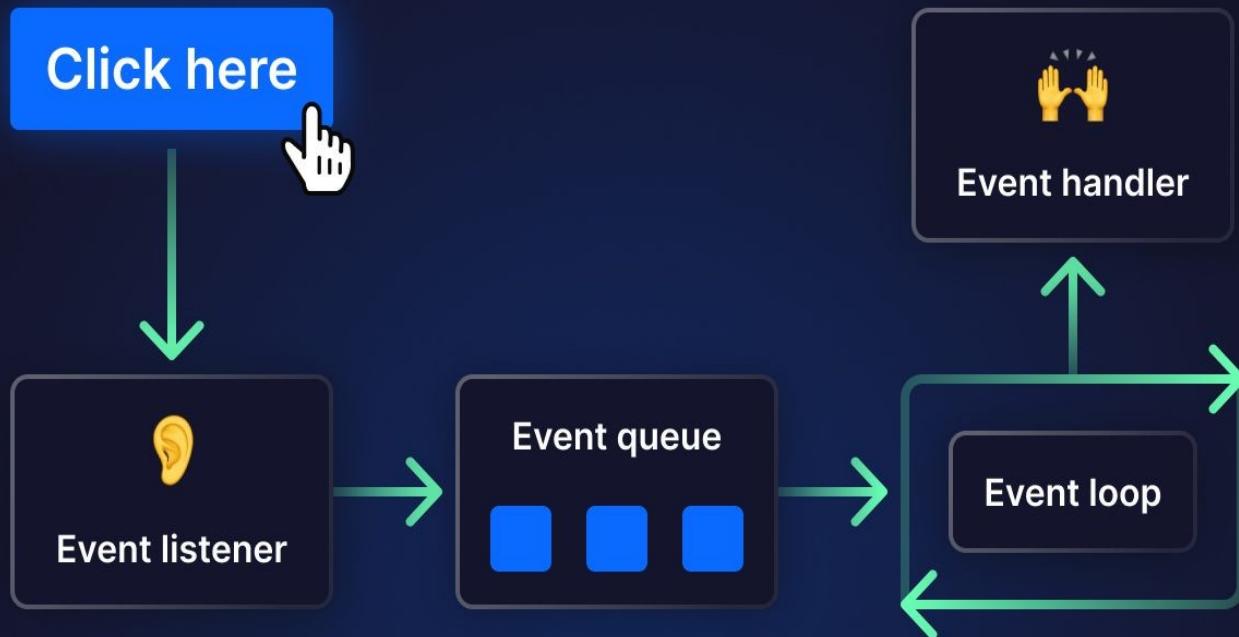


6. Event Loop

1. *Event Driven*
2. *Single Threaded*
3. *V8 vs libuv*
4. *Node Runtime*
5. *Event Loop*
6. *Async Code*
7. *Blocking Code*

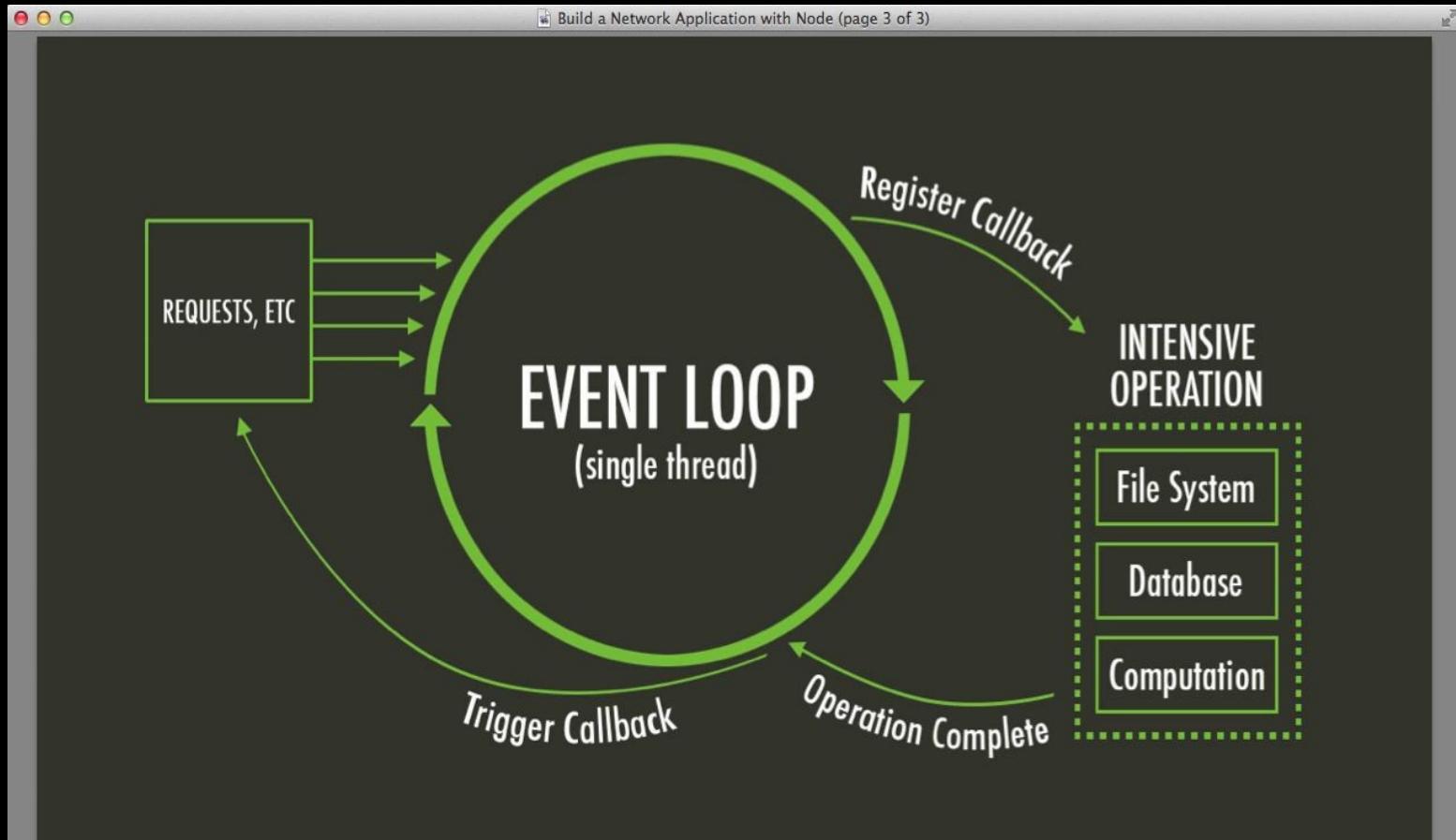


6.1 Event Driven





6.2 Single Threaded





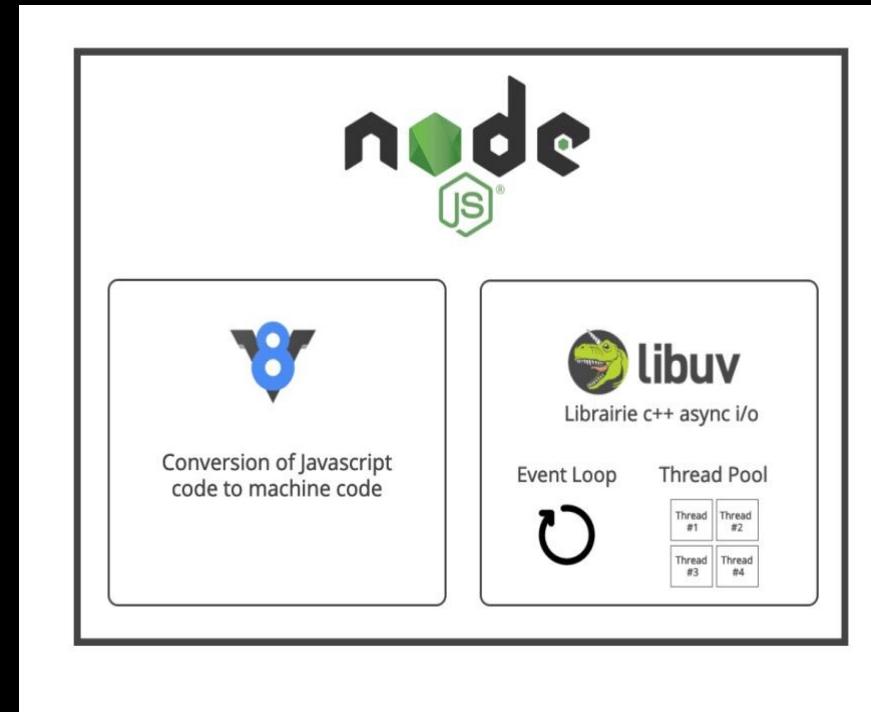
6.3 V8 vs libuv

V8:

1. Open-source JavaScript engine by Google.
2. Used in Chrome and Node.js.
3. Compiles JavaScript to native machine code.
4. Ensures high-performance JavaScript execution.

libuv:

1. Multi-platform support library for Node.js.
2. Handles asynchronous I/O operations.
3. Provides event-driven architecture.
4. Manages file system, networking, and timing related tasks.



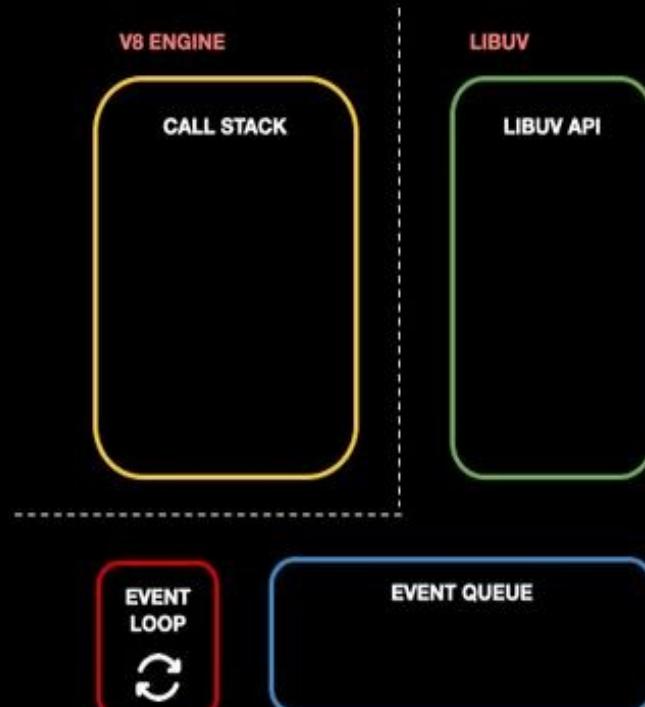


6.4 Node Runtime

An invoked function is added to the call stack. Once it returns a value, it is popped off.

```
● ● ●  
console.log("Starting Node.js");  
  
db.query("SELECT * FROM public.cars", function (err, res) {  
    console.log("Query executed");  
});  
  
console.log("Before query result");
```

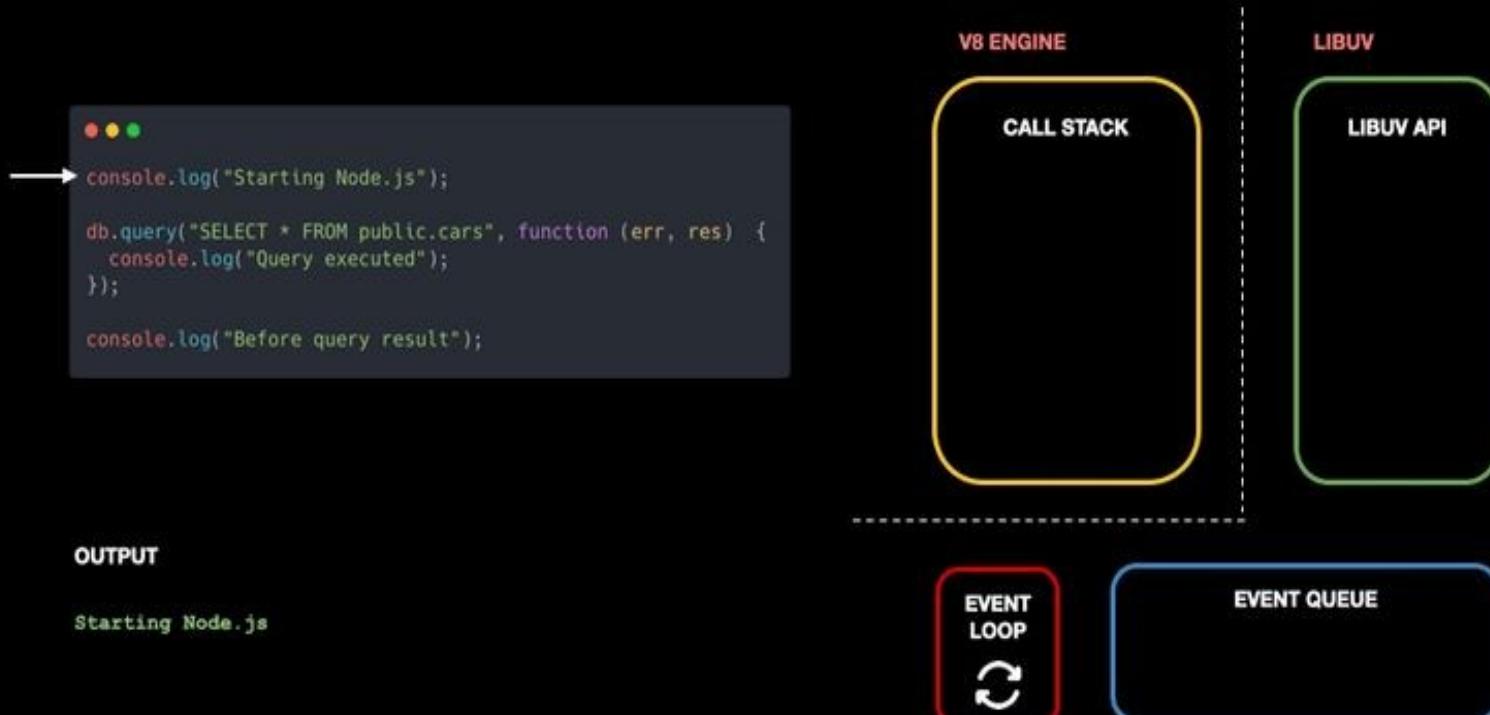
OUTPUT





6.4 Node Runtime

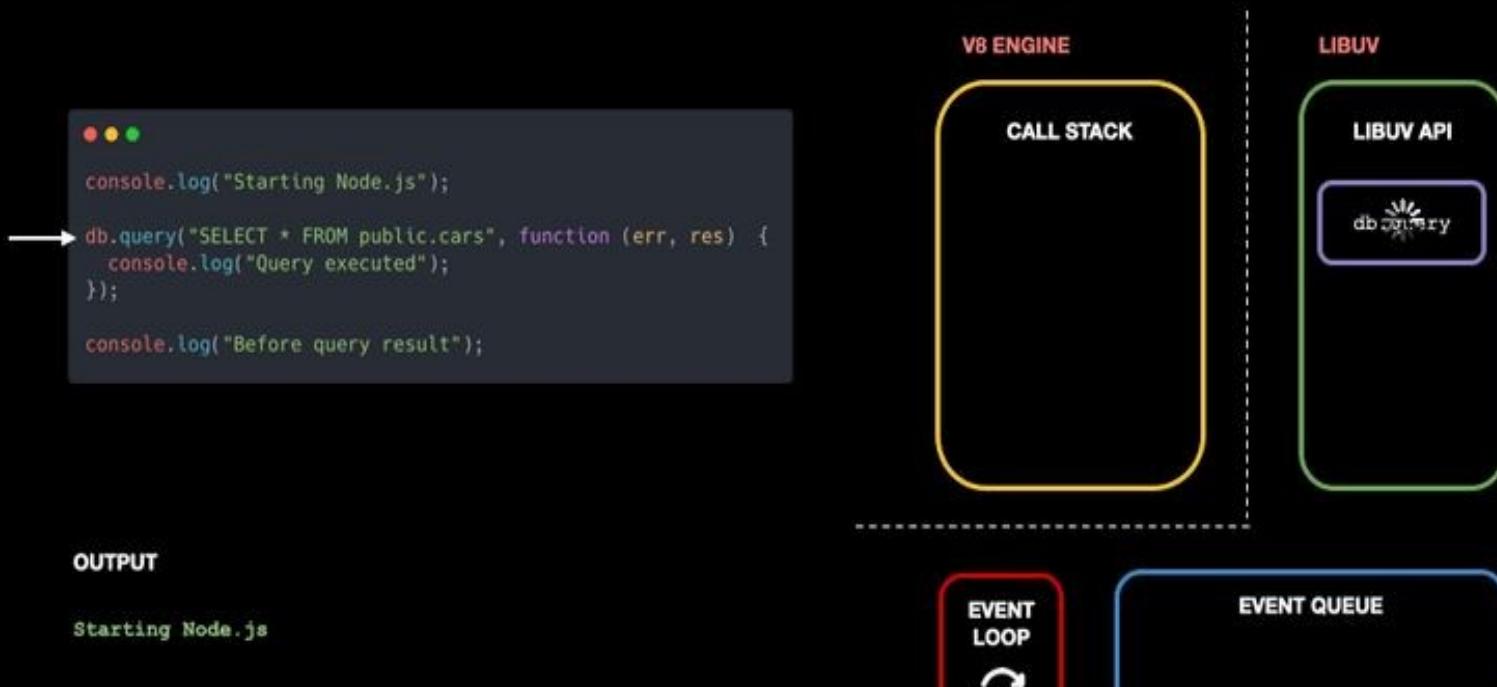
Database queries or other I/O ops do not block Node.js single thread because Libuv API handles them.





6.4 Node Runtime

While Libuv asynchronously handles I/O operations, Node.js single thread keeps running code.





6.4 Node Runtime

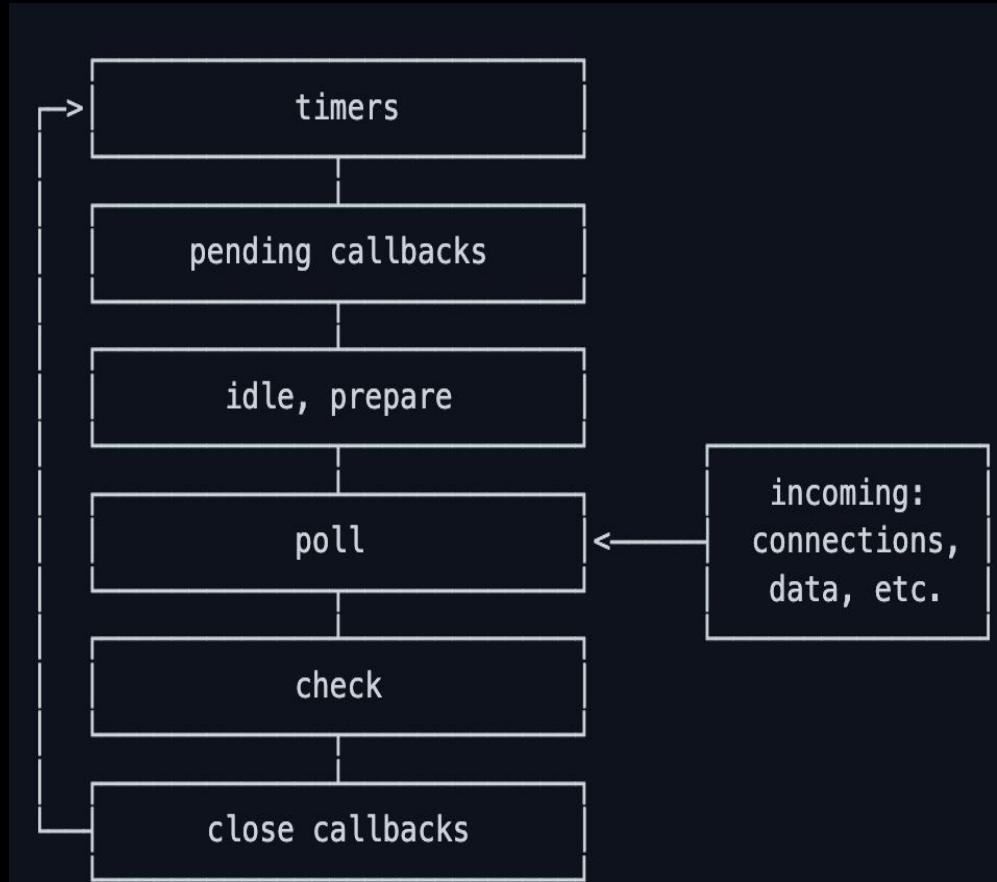
Callbacks of completed queries are moved to the event queue. If the call stack is empty, the event loop checks for callbacks and transfers the first.





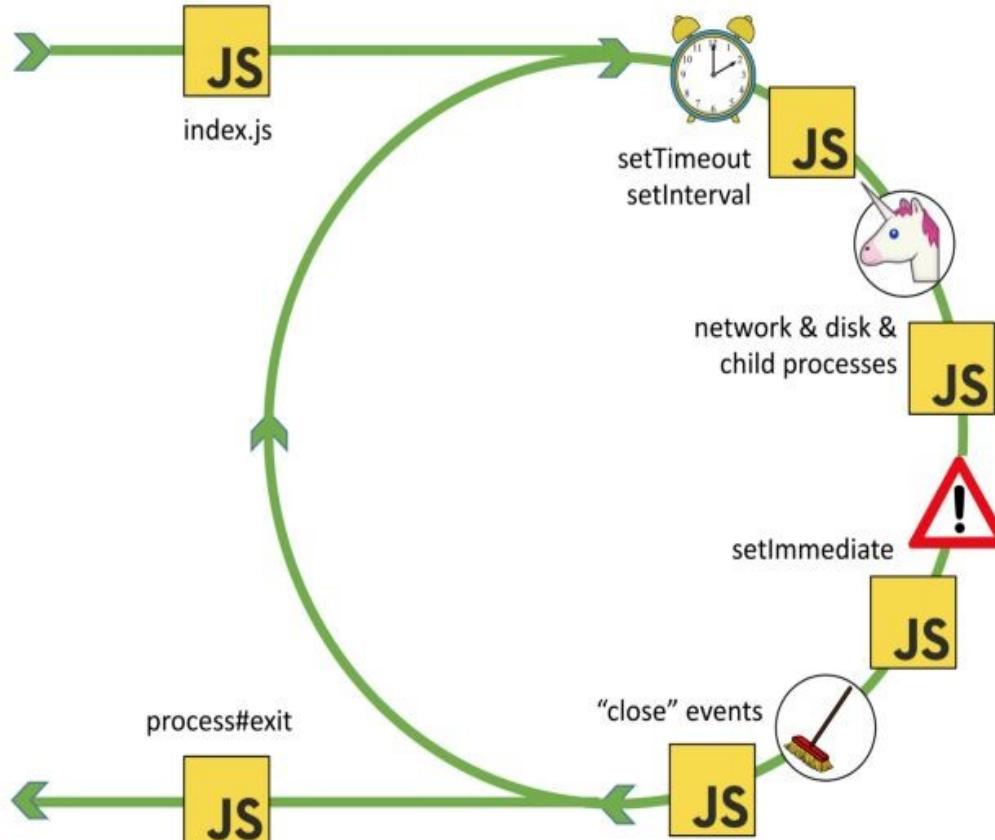
6.5 Event Loop

- **timers:** this phase executes callbacks scheduled by `setTimeout()` and `setInterval()`.
- **pending callbacks:** executes I/O callbacks deferred to the next loop iteration.
- **idle, prepare:** only used internally.
- **poll:** retrieve new I/O events; execute I/O related callbacks (almost all with the exception of close callbacks, the ones scheduled by **timers**, and `setImmediate()`); node will block here when appropriate.
- **check:** `setImmediate()` callbacks are invoked here.
- **close callbacks:** some close callbacks, e.g. `socket.on('close', ...)`.





6.5 Event Loop





6.6 Async Code

```
const jsonString = JSON.stringify(jsonObject);
console.log(jsonString);
fs.writeFileSync("user-details.txt", jsonString);
res.setHeader("Location", "/");
res.statusCode = 302;
res.end();
});

}

res.write('<body><h1>Like / Share / Subscribe</h1></
body>');
res.write('</html>');
return res.end();
```

```
Error [ERR_HTTP_HEADERS_SENT]: Cannot set headers after they are sent to the client
at ServerResponse.setHeader (node:_http_outgoing:699:11)
at IncomingMessage.<anonymous> (/Users/prashantjain/workspace/Test Project/node/app.js:44:11)
at IncomingMessage.emit (node:events:532:35)
at endReadableNT (node:internal/streams/readable:1696:12)
at process.processTicksAndRejections (node:internal/process/task_queues:82:21) {
```



6.6 Async Code

```
req.on("end", () => {
  const parsedBody = Buffer.concat(body).toString();
  console.log(parsedBody);
  const params = new URLSearchParams(parsedBody);
  const jsonObject = {};
  for (const [key, value] of params.entries()) {
    jsonObject[key] = value;
  }
  const jsonString = JSON.stringify(jsonObject);
  console.log(jsonString);
  fs.writeFileSync("user-details.txt", jsonString);
  res.setHeader("Location", "/");
  res.statusCode = 302;
  return res.end();
}
```



6.7 Blocking Code

```
const jsonString = JSON.stringify(jsonObject);
console.log(jsonString);
// BLOCKING EVERYTHING
fs.writeFileSync("user-details.txt", jsonString);
res.setHeader("Location", "/");
```



6.7 Blocking Code

```
console.log(jsonString);
// Async Operation
fs.writeFile("user-details.txt", jsonString, error => {
  res.setHeader("Location", "/");
  res.statusCode = 302;
  return res.end();
});
```



Run & Observe

Blocking vs Async

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

console.log('1. Start of script');

// Synchronous (blocking) operation
console.log('2. Reading file synchronously' );
const dataSync = fs.readFileSync('user-details.txt', 'utf8');
console.log('3. Synchronous read complete' );

// Asynchronous (non-blocking) operation
console.log('4. Reading file asynchronously' );
fs.readFile('user-details.txt', 'utf8', (err, dataAsync) => {
  if (err) throw err;
  console.log('6. Asynchronous read complete' );
});

console.log('5. End of script');
```



1. Start of script
2. Reading file synchronously
3. Synchronous read complete
4. Reading file asynchronously
5. End of script



Run & Observe

Event Loop Sequence

```
console.log('1. Start of script');

// Microtask queue (Promise)
Promise.resolve().then(() => console.log('2. Microtask 1'));

// Timer queue
setTimeout(() => console.log('3. Timer 1'), 0);

// I/O queue
const fs = require('fs');
fs.readFile('user-details.txt', () => console.log('4. I/O operation'));

// Check queue
setImmediate(() => console.log('5. Immediate 1'));

// Close queue
process.on('exit', (code) => {
  console.log('6. Exit event');
});
```

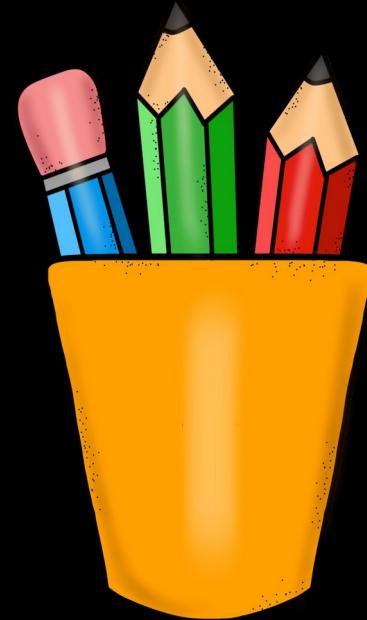


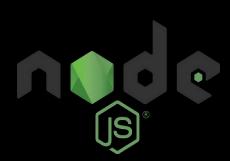
1. Start of script
2. Microtask 1
3. Timer 1
4. I/O operation
5. Immediate 1
7. End of script
6. Exit event



Revision

1. *Event Driven*
2. *Single Threaded*
3. *V8 vs libuv*
4. *Node Runtime*
5. *Event Loop*
6. *Async Code*
7. *Blocking Code*







7. *NPM & Tools*



1. *Install Material Icons*
2. *npm init*
3. *npm Scripts*
4. *npm Packages*
5. *Installing Packages*
6. *Installing nodemon*
7. *Using nodemon*





7.1 Install Material Icons



Material Icon Theme v5.11.1

Philipp Kief

25,491,060

★★★★★ (345)

Sponsor

Material Design Icons for Visual Studio Code

[Set File Icon Theme](#)

[Disable](#) ▾

[Uninstall](#) ▾

Auto Update



7.2 *npm init*

npm init

```
prashantjain@Prashants-Mac-mini user % npm init
```

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

See `npm help init` for definitive documentation on these fields
and exactly what they do.

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

Press ^C at any time to quit.

```
package name: (user) User Backend
```

Sorry, name can only contain URL-friendly characters and name can no longer contain capital letters.

```
package name: (user) user-backend
```

```
version: (1.0.0)
```

```
description: This project will have the backend code of our User project.
```

```
entry point: (user.js) app.js
```

```
test command:
```

```
git repository:
```

```
keywords:
```

```
author: Complete Coding
```

```
license: (ISC)
```



7.3 npm Scripts



```
{  
  "name": "user-backend",  
  "version": "1.0.0",  
  "description": "This project will have the backend code of our User  
project.",  
  "main": "app.js",  
  ▷ Debug  
  "scripts": {  
    "test": "echo \\\"Error: no test specified\\\" && exit 1",  
    "start": "node app.js",  
    "khul-ja-sim-sim": "node app.js"  
  },  
  "author": "Complete Coding",  
  "license": "ISC"
```

npm start

npm run khul-ja-sim-sim



7.4 *npm Packages*



1. npm: Node.js package manager for code sharing.
2. Package: Reusable code or library.
3. package.json: Defines package metadata and dependencies.
4. Versioning: Manages different package versions.
5. Local/Global: Install packages locally or globally.
6. Registry: Public storage for open-source package
7. Examples: Express, React, Lodash.



A Brief Guide to Node Package Manager (NPM) in Drupal



7.5 *Installing Packages*

`npm instal<package-name>`

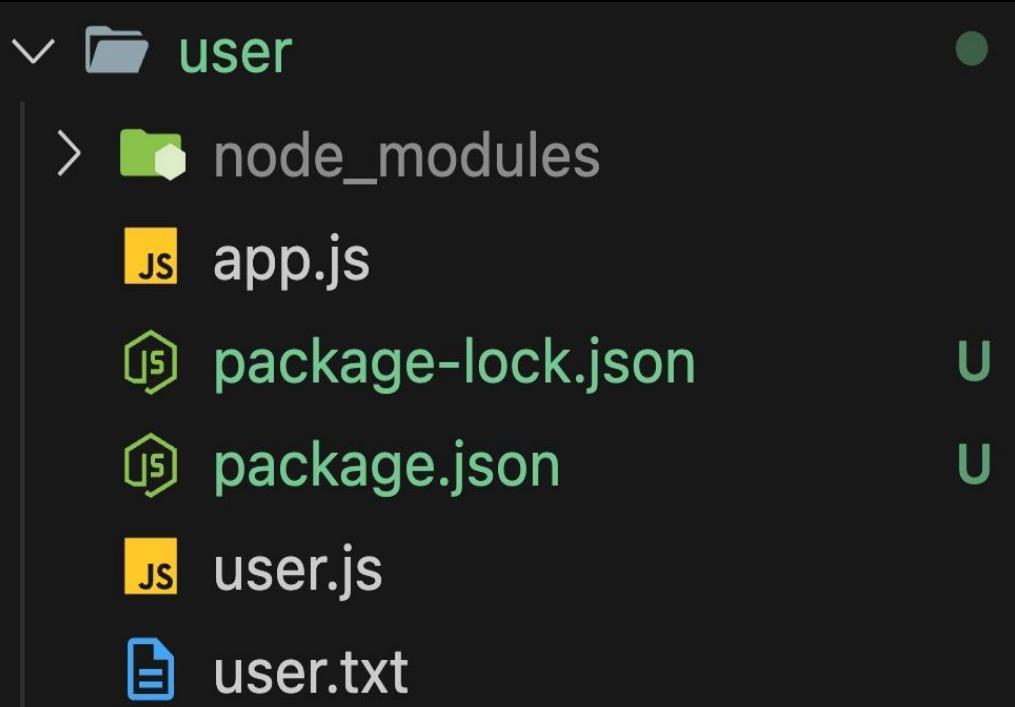
1. `-save`: Adds the package to the project's dependencies in `package.json`.
2. `-save-dev`: Adds the package to the project's `devDependencies` (used only in development) in `package.json`.
3. `-g`: Installs the package globally, making it available system-wide, not just in a specific project.
4. `-save-exact`: Installs the exact version specified without updating for newer versions.
5. `-force`: Forces npm to fetch and install packages even if they are already installed.



7.6 *Installing nodemon*



npm install nodemon --save-dev



```
"scripts": {  
  "test": "echo \"Error: no test specified\" && exit 1",  
  "start": "node app.js",  
  "khul-ja-sim-sim": "node app.js"  
},  
"author": "Complete Coding",  
"license": "ISC",  
"devDependencies": {  
  "nodemon": "^3.1.7"  
}
```

npm install

Recreates node_modules



7.7 Using nodemon



```
"scripts": {  
  "test": "echo \"Error: no test specified\" && exit 1",  
  "start": "nodemon app.js",  
  "khul-ja-sim-sim": "node app.js"  
},
```

```
prashantjain@Prashants-Mac-mini user % nodemon app.js  
zsh: command not found: nodemon  
prashantjain@Prashants-Mac-mini user % npm start
```

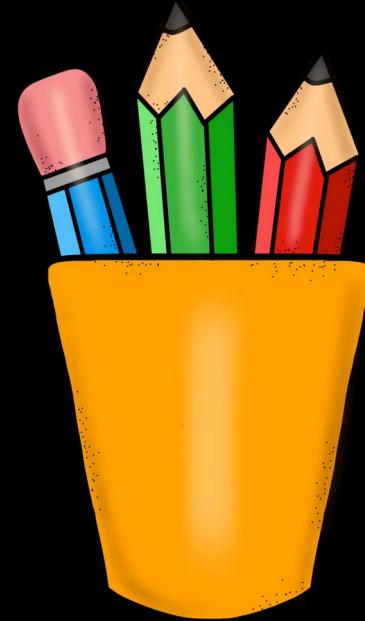
```
> user-backend@1.0.0 start  
> nodemon app.js  
  
[nodemon] 3.1.7  
[nodemon] to restart at any time, enter `rs`  
[nodemon] watching path(s): *.*  
[nodemon] watching extensions: js,mjs,cjs,json  
[nodemon] starting `node app.js`
```

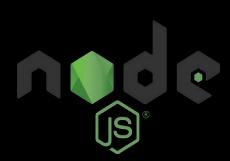
```
npm install nodemon -g
```



Revision

1. *Install Material Icons*
2. *npm init*
3. *npm Scripts*
4. *npm Packages*
5. *Installing Packages*
6. *Installing nodemon*
7. *Using nodemon*







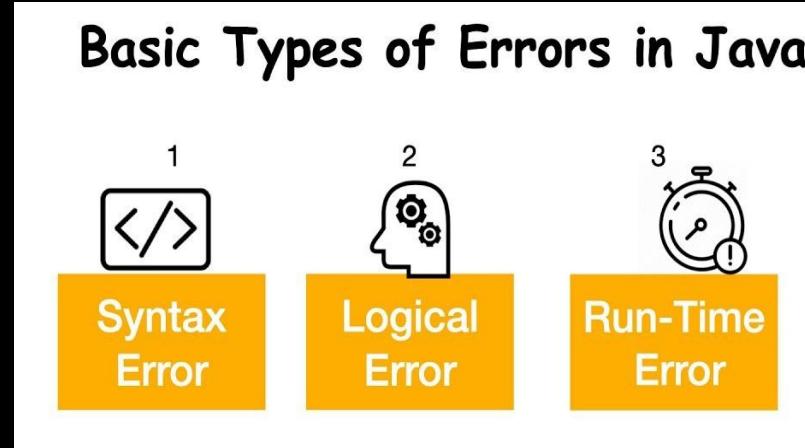
8. Errors & Debugging

1. *Types of Errors*
2. *Syntax Errors*
3. *Runtime Errors*
4. *Logical Errors*
5. *Using the Debugger*
6. *Debugger with Async Code*
7. *Restart Debug with nodemon*





8.1 Types of Errors



1. Syntax Error: An **error** in the **code's structure**, causing it to not compile or run (e.g., missing semicolon).
2. Logical Error: The code runs but **produces incorrect results** due to **faulty logic** (e.g., wrong formula).
3. Runtime Error: An **error** that occurs while the program is running, often due to **invalid operations**.



8.2 Syntax Errors

```
// Missing parenthesis in function call  
console.log("Hello, world"
```

```
// Unclosed string literal  
let message = "Welcome to Node.js; ~
```

```
// Improper use of reserved keywords  
let new = 5;
```

```
// Incorrect variable declaration (const needs an initial value)  
const myVar;
```



8.3 Runtime Errors

```
Error [ERR_HTTP_HEADERS_SENT]: Cannot set headers after they are sent to the client
  at ServerResponse.setHeader (node:_http_outgoing:699:11)
  at IncomingMessage.<anonymous> (/Users/prashantjain/workspace/Test Project/node/app.js:44:11)
  at IncomingMessage.emit (node:events:532:35)
  at endReadableNT (node:internal/streams/readable:1696:12)
  at process.processTicksAndRejections (node:internal/process/task_queues:82:21) {
  code: 'ERR_HTTP_HEADERS_SENT'
}
```

```
// Reference Error (x is not defined)
console.log(x);

// Type Error (num is not a function)
let num = 10;
num();

// Invalid JSON parse (SyntaxError)
let jsonString = "{ name: 'John' }"; // Invalid JSON (single quotes)
JSON.parse(jsonString);

// File not found error (fs module)
const fs = require('fs');
```



8.4 Logical Errors

```
let x = 5;
if (x = 10) { // Assignment instead of comparison
| console.log("x is 10"); // Incorrectly prints this
}

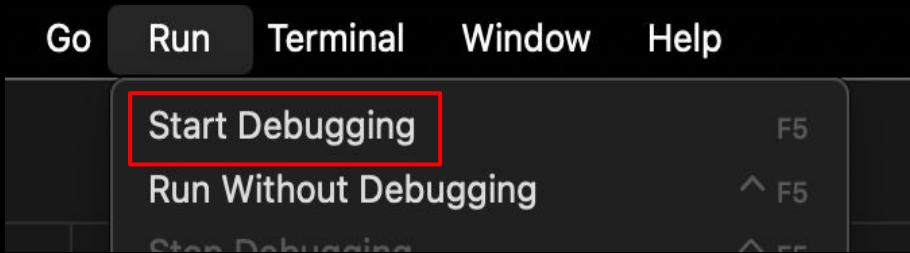
let arr = [1, 2, 3, 4, 5];
for (let i = 0; i <= arr.length; i++) {
| console.log(arr[i]); // Prints undefined at the end of the loop
}

let num = "10";
console.log(num + 5); // Expected result: 15, prints 105
```



8.5 Using the Debugger

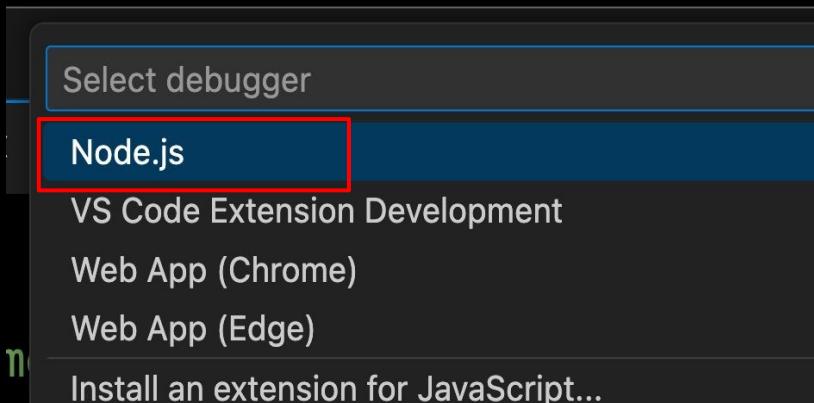
Step 1



Step 3: Put a breakpoint

```
1 let x = 5;
2 if (x = 10) { // Assignment instead of comparison
3 Dconsole.log("x is 10"); // Incorrectly prints this
4 }
5
```

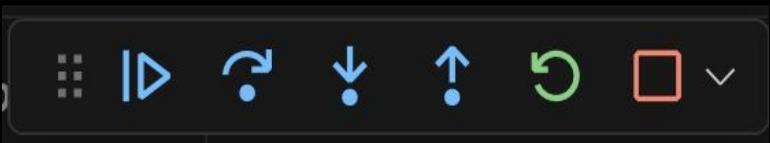
Step 2





8.5 Using the Debugger

Step 4: Use the tools



Step 5: Hover

```
test2.js
let arr = [1, 2, 3, 4, 5];
for (let i = 0; i <= arr.length; i++) {
    console.log(arr[i]); // Prints undefined
}

Hold Option key to switch to editor language hover
```

(5) [1, 2, 3, 4, 5]
0 = 1
1 = 2
2 = 3
3 = 4
4 = 5
length = 5
> [[Prototype]] = Array(0)
> [[Prototype]] = Object

Step 6: Debug Panel

RUN AND D... No Configur ...

VARIABLES

- Block
 - > this = Object
- Local
 - _dirname = '/Users/prashantjain/w...
 - _filename = '/Users/prashantjain/...
 - > arr = (5) [1, 2, 3, 4, 5]
 - > exports = {}
 - > module = Module {id: '.', path: '/...}
 - > require = f require(path) {
 - x = 10
- Global

WATCH

CALL STACK

- Launch Program: test2.j... PAUSED
- <anonymous> node/test2.js 7:14

Show 8 More: Skipped by skipFiles



8.5 Using the Debugger

Step 7: Using Debug Console

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```
/opt/homebrew/bin/node ./node/test2.js
```

```
→ x  
10  
→ x++  
10  
→ x === 15  
false
```

```
>
```



8.6 Debugger with Async Code

- 31 console.log("Here");
- 32 req.on("end", () => {
- 33 const parsedBody = Buffer.concat(body).toString();
- 34 console.log(parsedBody);
- 35 const params = new URLSearchParams(parsedBody);
- 36 const jsonObject = {};
- 37 for (const [key, value] of params.entries()) {
- 38 jsonObject[key] = value;
- 39 }
- 40 const jsonString = JSON.stringify(jsonObject);
- 41 console.log(jsonString);
- 42 // Async Operation
- 43 fs.writeFile("user-details.txt", jsonString, error => {
- 44 res.setHeader("Location", "/");
- 45 res.statusCode = 302;
- 46 return res.end();
- 47 });
- 48 });



node 8.7 Restart Debug with nodemon



Run Terminal Window Help

Start Debugging

Run Without Debugging

Stop Debugging

Restart Debugging

Open Configurations

Add Configuration...

Step Over

Step Into

```
"version": "0.2.0",
"configurations": [
  {
    "type": "node",
    "request": "launch",
    "name": "Launch Program",
    "skipFiles": [
      "<node_internals>/**"
    ],
    "program": "${workspaceFolder}/node/test2.js",
    "restart": true,
    "runtimeExecutable": "nodemon",
    "console": "integratedTerminal"
  }
]
```



Practise Set

Debug and fix Syntax, Runtime and Logical Errors

```
function calculateArea(width, height {  
    return width + height;  
}  
  
let width = 10 height = 5;  
  
if (area > 100) {  
    console.log("The area is large.");  
} else {  
    console.log("The area is small.");  
}  
  
if (width + height > 100) {  
    console.log("Area is greater than or equal to 100");
```





Revision

1. *Types of Errors*
2. *Syntax Errors*
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