Nodejs Events

In Node.js, I/O (Input/Output) events are essential to its non-blocking, asynchronous architecture. Node.js uses an event-driven model, where asynchronous operations such as reading files, making HTTP requests, or interacting with databases trigger I/O events. The event loop then processes these events, executing callbacks once operations are complete. Here are some common I/O events in Node.js and how they work:

1. File System Events

- Operations like reading, writing, and deleting files are managed asynchronously by Node.js. These file system operations are typically executed using the fs module, and once they complete, callbacks are added to the event loop.
- Example:

```
fs.readFile('file.txt', (err, data) => console.log(data));
```

2. Network and HTTP Events

- Node.js handles network operations, such as creating servers or sending requests, through modules like http, https, and net. These operations are non-blocking, with events triggered once a request is received or a response is available.
- Example: An HTTP server in Node.js emits events like 'request' (when a client makes a request) and 'connection' (when a new connection is made).

3. Stream Events

- Node.js uses streams for handling I/O operations in a continuous manner (e.g., reading from a file or network socket). Streams emit various events based on their type: 'data', 'end', 'error', and 'close'.
- Example:

```
process.stdin.on('data', (chunk) => console.log(chunk.toString()));
```

4. Timers

- Node.js has timer functions like setTimeout, setInterval, and setImmediate that emit I/O events once the specified time elapses.
- Example:

```
setTimeout(() => console.log("Timeout reached"), 1000);
```

5. Process Events

- The process object has its own set of events, like 'exit', 'uncaughtException', and 'SIGINT' (interrupt signal), which handle system-level events.
- Example:

```
process.on('exit', (code) => console.log("Exiting with code:", code));
```

6. Database Events

- Database operations are asynchronous, with libraries like mysql, mongoose, and pg (PostgreSQL) emitting events upon connection, disconnection, and query completion.
- Example: In MongoDB,

```
mongoose.connection.on('connected', () => console.log("Connected to
database"));
```

7. User-Defined Events with EventEmitter

- Node.js allows you to create custom events using the events module and EventEmitter class. This is useful for managing custom asynchronous operations.

Example:
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```
const EventEmitter = require('events');
const myEmitter = new EventEmitter();
myEmitter.on('event', () => console.log("Event triggered!"));
myEmitter.emit('event');
```

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I/O Event Flow with the Event Loop

Node.js relies on its event loop and background threads (from the libuv library) to manage I/O events. When an I/O operation starts, it runs in the background. Once it completes, it places a callback in the event loop queue to be executed when the loop has available bandwidth, ensuring that I/O events are non-blocking and don't halt other operations.

This event-driven I/O model enables Node.js to be highly efficient, particularly for applications with many I/O-bound tasks, such as servers handling multiple concurrent requests.