

# Node.js Tools: npm & npx

Node.js/JavaScript package manager

- **Node Package Manager** - JavaScript's package ecosystem
- **World's largest** software registry (2M+ packages)
- Comes bundled with Node.js
- **Think of it as:** App Store for JavaScript libraries

# Installing Node.js

Before using npm/npx, you need Node.js installed

## Method 1: Official Website (Recommended for Beginners)

Visit: <https://nodejs.org>

- **LTS version** (Long Term Support) - Stable, recommended
- **Current version** - Latest features, may be unstable

**For students:** Always choose the LTS version!

## Method 2: Package Managers (Advanced)

### Windows (using Chocolatey)

```
choco install nodejs
```

### macOS (using Homebrew)

```
brew install node
```

### Ubuntu/Debian Linux

```
sudo apt update  
sudo apt install nodejs npm
```

## Verify Installation

Check if Node.js is installed:

```
node --version  
# Should output: v18.17.0 (or similar)
```

Check if npm is installed:

```
npm --version  
# Should output: 9.6.7 (or similar)
```

If both commands work → You're ready to go! 🎉

# Package.json - Your Project's DNA

```
{
  "name": "my-web-app",
  "version": "1.0.0",
  "dependencies": {
    "express": "^4.18.0",
    "lodash": "^4.17.21"
  },
  "devDependencies": {
    "jest": "^29.0.0"
  },
  "scripts": {
    "start": "node app.js",
    "test": "jest"
  }
}
```

```
"express": "4.18.0"
```

- Installs exactly version 4.18.0
- No automatic updates - even for bug fixes

```
"express": "^4.18.0"
```

- Installs 4.18.0 or higher
- But stays within major version 4.x.x
- Allows: 4.18.1, 4.19.0, 4.20.5
- Blocks: 5.0.0 (major version change)



## Essential commands

```
# Initialize new project  
npm init
```

```
# Install packages
```

```
npm install express
```

```
npm install -D jest
```

```
npm install -g nodemon
```

```
# Save to dependencies
```

```
# Save to devDependencies
```

```
# Install globally
```

```
# Install from package.json
```

```
npm install
```

```
# Update packages
```

```
npm update
```

# Package-lock.json - The Exact Recipe

Think of it as: Detailed cooking instructions vs. general recipe

- **package.json**: "Add some flour" (flexible)
- **package-lock.json**: "Add exactly 2.5 cups of King Arthur flour" (precise)

*Automatically created when you run `npm install`*

## Why Package-lock.json Exists

**The Problem:** `^4.18.0` means "4.18.0 or higher"

- **Monday:** You install Express 4.18.0
- **Tuesday:** Your teammate installs Express 4.19.1 (newer version released)
- **Result:** Different versions = potential bugs! 🐛

**The Solution:** package-lock.json locks exact versions

# Real Example: package.json vs package-lock.json

## package.json (flexible)

```
{
  "dependencies": {
    "express": "^4.18.0",
    "lodash": "^4.17.21"
  }
}
```

## package-lock.json (exact)

```
{
  "dependencies": {
    "express": {
      "version": "4.18.2",
      "resolved": "https://registry.npmjs.org/express/-/express-4.18.2.tgz",
      "integrity": "sha512-5/psL6iGPdfQ/lKM1UuielYgv3BUoJfz1aUwU9vHZ+J7gyvwdQXFEBIEIaxeGf0GIcreATNyBExtalisDbuMqQ=="
    }
  }
}
```

# Key Benefits of Package-lock.json

## ✓ Reproducible Builds

- Everyone gets identical dependencies
- Same versions on dev, staging, production

## ✓ Faster Installs

- Skip version resolution (already solved)
- Download exact files from cache

## ✓ Security

- Prevents malicious package substitution
- Integrity checksums verify authenticity

# Best Practices with Package-lock.json

## ✓ DO:

- Commit `package-lock.json` to git
- Use `npm ci` in production/CI
- Let npm manage it automatically

## ✗ DON'T:

- Edit `package-lock.json` manually
- Delete it when facing conflicts
- Add it to `.gitignore`

# npm install vs npm ci

## npm install

- Uses `package.json` as source of truth
- Updates `package-lock.json` if needed
- Good for development

## npm ci

- Uses `package-lock.json` as source of truth
- Fails if the lock file is outdated
- Perfect for production/CI environments

# Dependencies vs DevDependencies

## Dependencies

- **Needed when app runs** (production)
- Without them, → app will break at runtime
- Saved to `"dependencies"` in `package.json`

## Examples

- React
- Express
- Axios

```
npm install express axios
```



# DevDependencies

## Needed only during development

- Without them, → app can still run, but dev/build/testing won't work
- Saved to `"devDependencies"` in `package.json`

## Examples

- Jest
- ESLint
- Webpack

```
npm install -D jest eslint nodemon
```

## Quick Analogy

Type	Role	Example
<b>dependencies</b>	Ingredients 🍲 (must be in dish)	React, Axios
<b>devDependencies</b>	Kitchen tools 🔪 (needed to prepare, not serve)	Jest, Webpack

## Local Installation (Default)

```
npm install express  
npm install lodash
```

- **Installed in:** `./node_modules/` folder
- **Available to:** Current project only
- **Saved to:** `package.json` dependencies
- **Think of it as:** Project-specific tools in your toolbox

my-project/

```
├── node_modules/
│   ├── express/
│   └── lodash/
├── package.json
└── app.js
```

← Packages here

← Dependencies listed

## Global Installation with -g

```
npm install -g nodemon  
npm install -g create-react-app
```

- **Installed in:** System-wide location
- **Available to:** All projects and command line
- **Not saved to:** `package.json`
- **Think of it as:** System tools in your workshop

Available everywhere in the terminal

For windows

```
C:\Users\YourName\AppData\Roaming\npm\node_modules
```

For Linux (WSL2)

```
~/.npm-global/lib/node_modules/ ← Packages here
├─ nodemon/
├─ create-react-app/
└─ eslint/
```

# **npx: Run packages without installing**

Real-World Analogy: Rental vs. Buying

- **npm install**: Buying a tool (permanent)
- **npx**: Renting a tool (temporary use)

*When we don't want to install the tool, but use it once and throw it away, we use `npx` instead of `npm` .*

## **npx replaces npm -g**

```
npm install -g create-react-app  
create-react-app my-app
```

*npm -g (Global Install)*

- Installs permanently on your system
- Available everywhere from the command line
- One version per system - can cause conflicts
- Takes up disk space permanently



```
npx create-react-app my-app
```

### *npx (Execute Without Installing)*

- Downloads temporarily and runs immediately
- No permanent installation
- Always gets the latest version
- No global pollution

npx is used for many applications, especially **React**.

```
# Create a React app without installing create-react-app
npx create-react-app my-app
# Run the latest version of a tool
npx cowsay "Hello Students!"
# Check if the website is up
npx is-up google.com
# Create a QR code
npx qrcode "https://github.com"
```