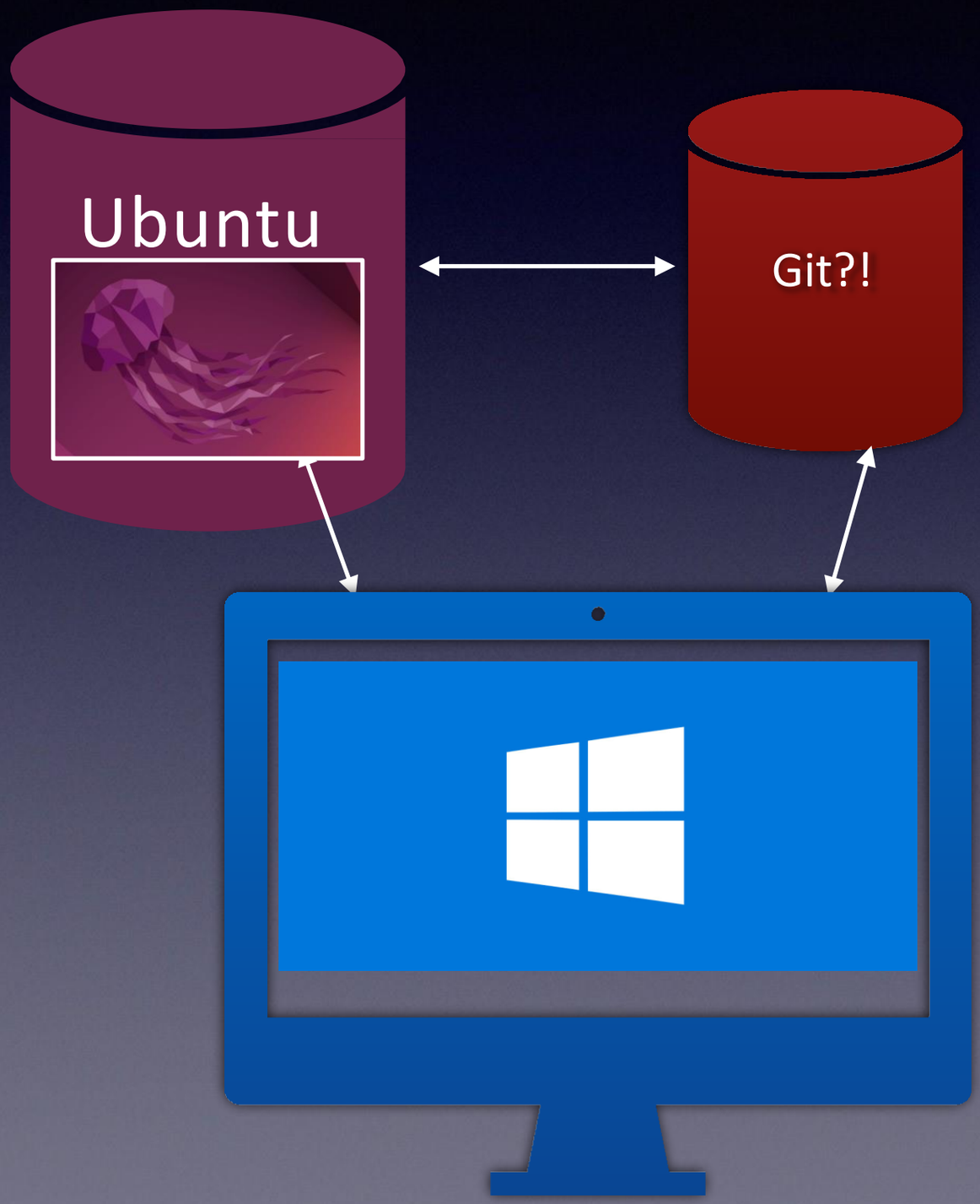
ENI Summer School
Lecture 3

Stacks and stack choices

This lecture covers:

- A little about lab 2
- Stacks (lots of structures and speeds)
- Selecting a stack (how Pam does it and you might)
- A little bit about this week's lab

Last Lab



Which computer?

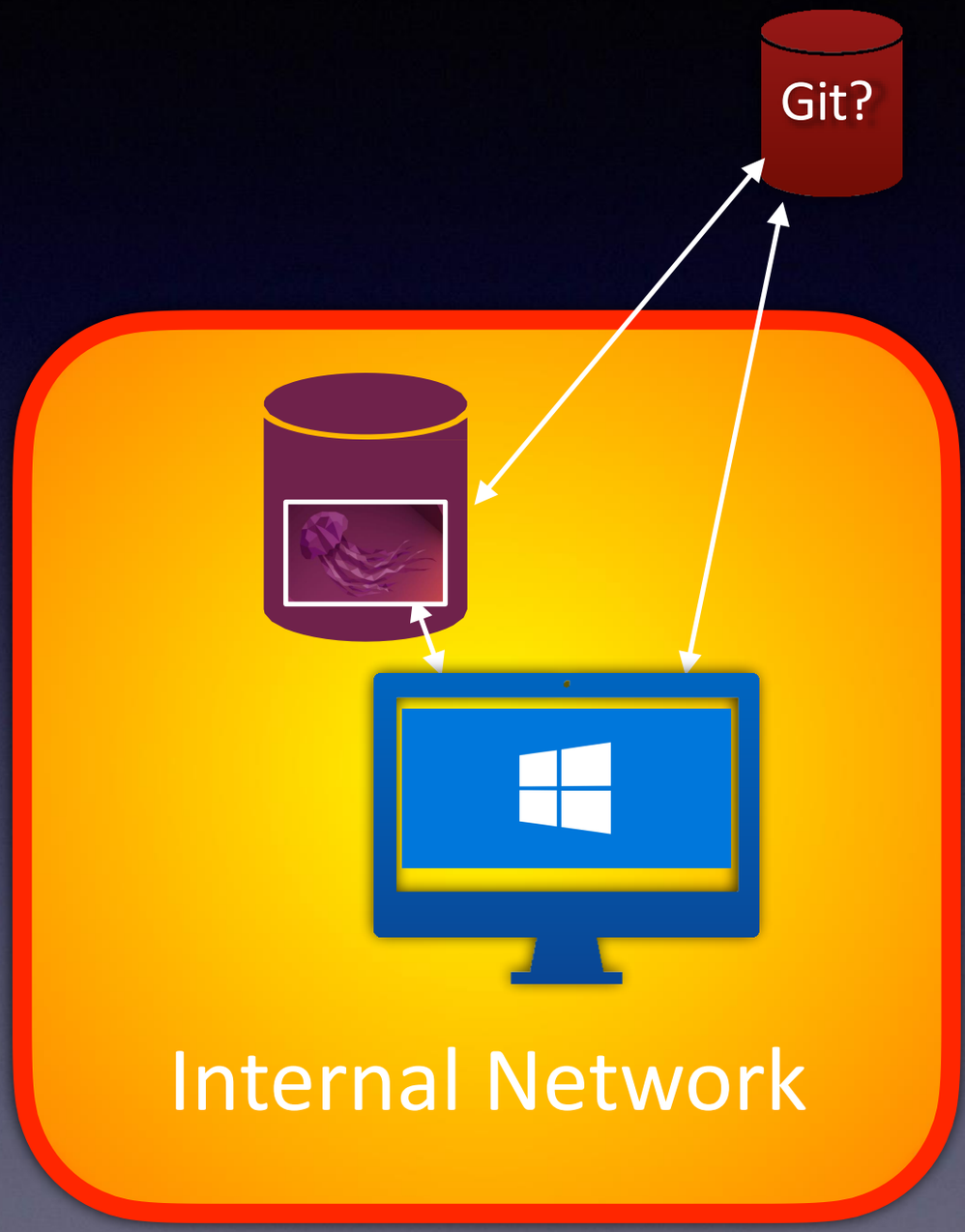
Sometimes a “window” on your monitor is a far away computer.

Last Lab

- You had a plain Ubuntu install
- **history**
- Which machine is which?

Firewalls and networks

- Ubuntu had a firewall (ufw)
- Windows has a firewall
- RGU network has a firewall
- GitHub lives out on the open web

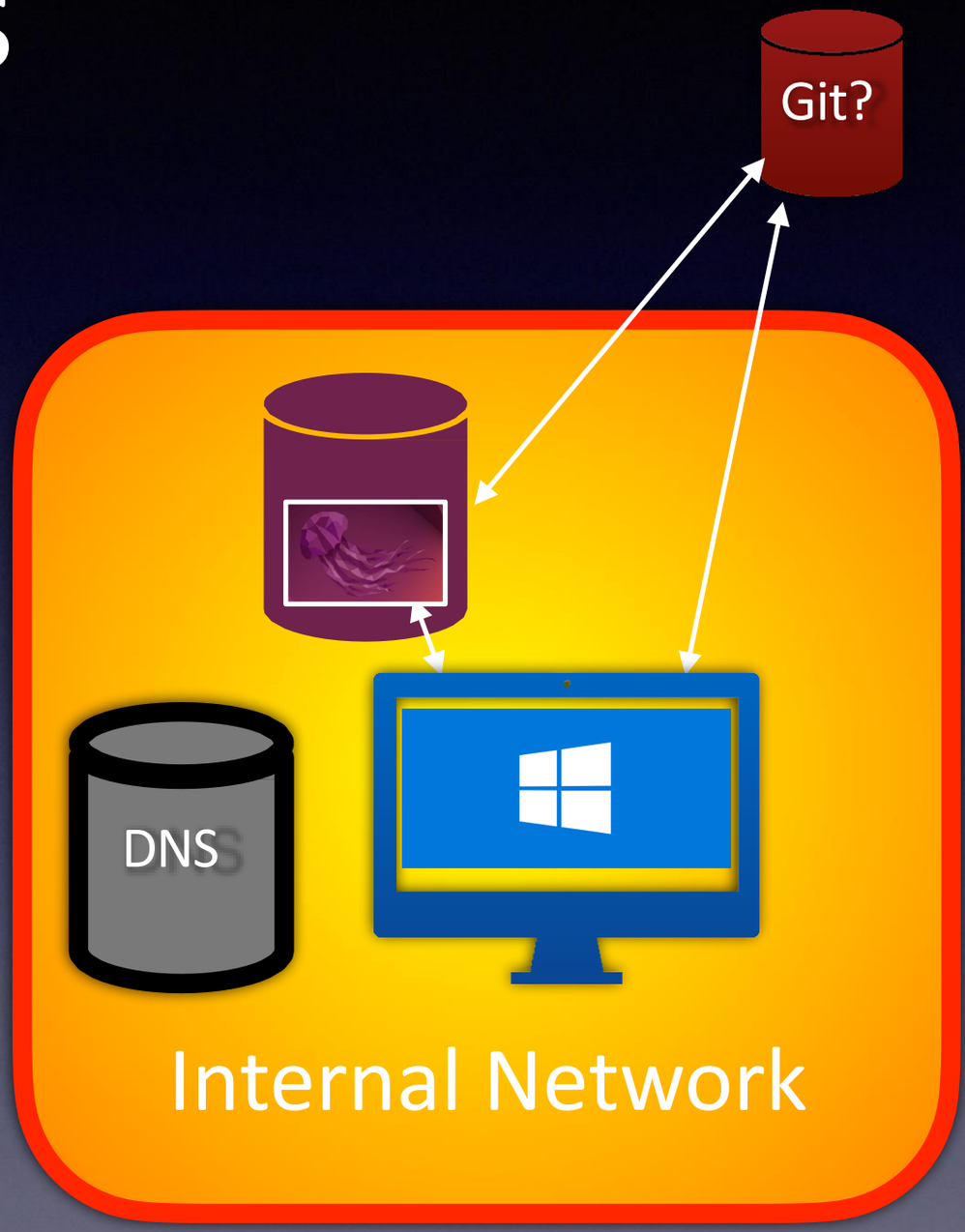


RGU's Firewall

URLs, Names and IP addresses

- DNS turns URLs (or computer names) into IP addresses

- Internal IP addresses start *10.xxx.xxx.xxx* or *192.168.xxx.xxx*



RGU's network has DNS

https://www.okta.com/identity-101/internal-ip/

localhost (127.0.0.1)

npm install express -s

Every computer thinks it’s localhost

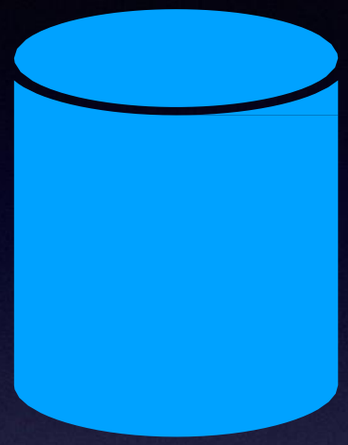
Four Letter Stacks?

- XAMP….LAMP….LEMP….WAMP…WIMP?
- MEAN….MERN….MEEN….MEVN?
- What’s with all the four letters?

What is a stack anyway?

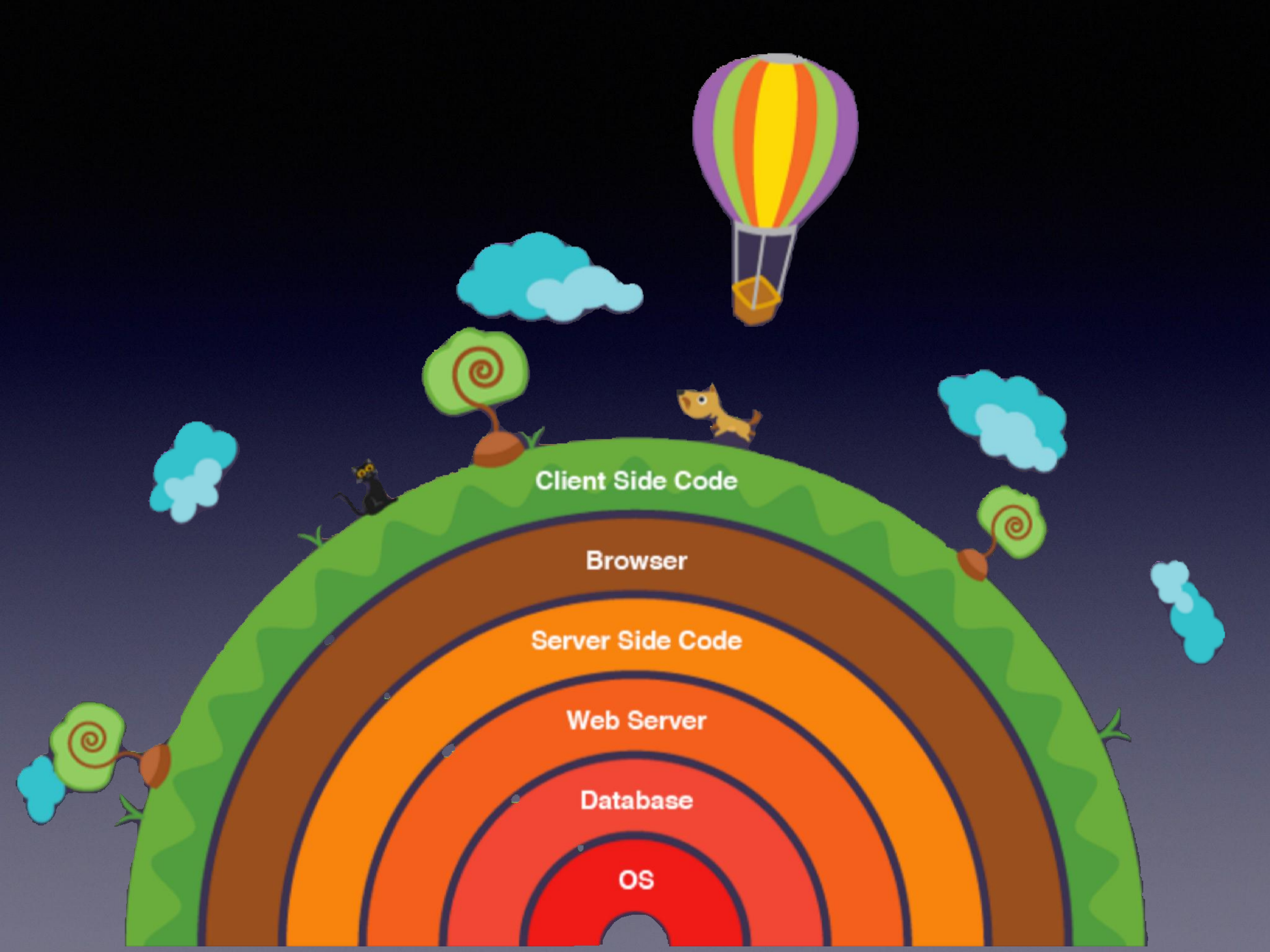
A software stack is a set of components that are required to make a complete platform.

What is a server?

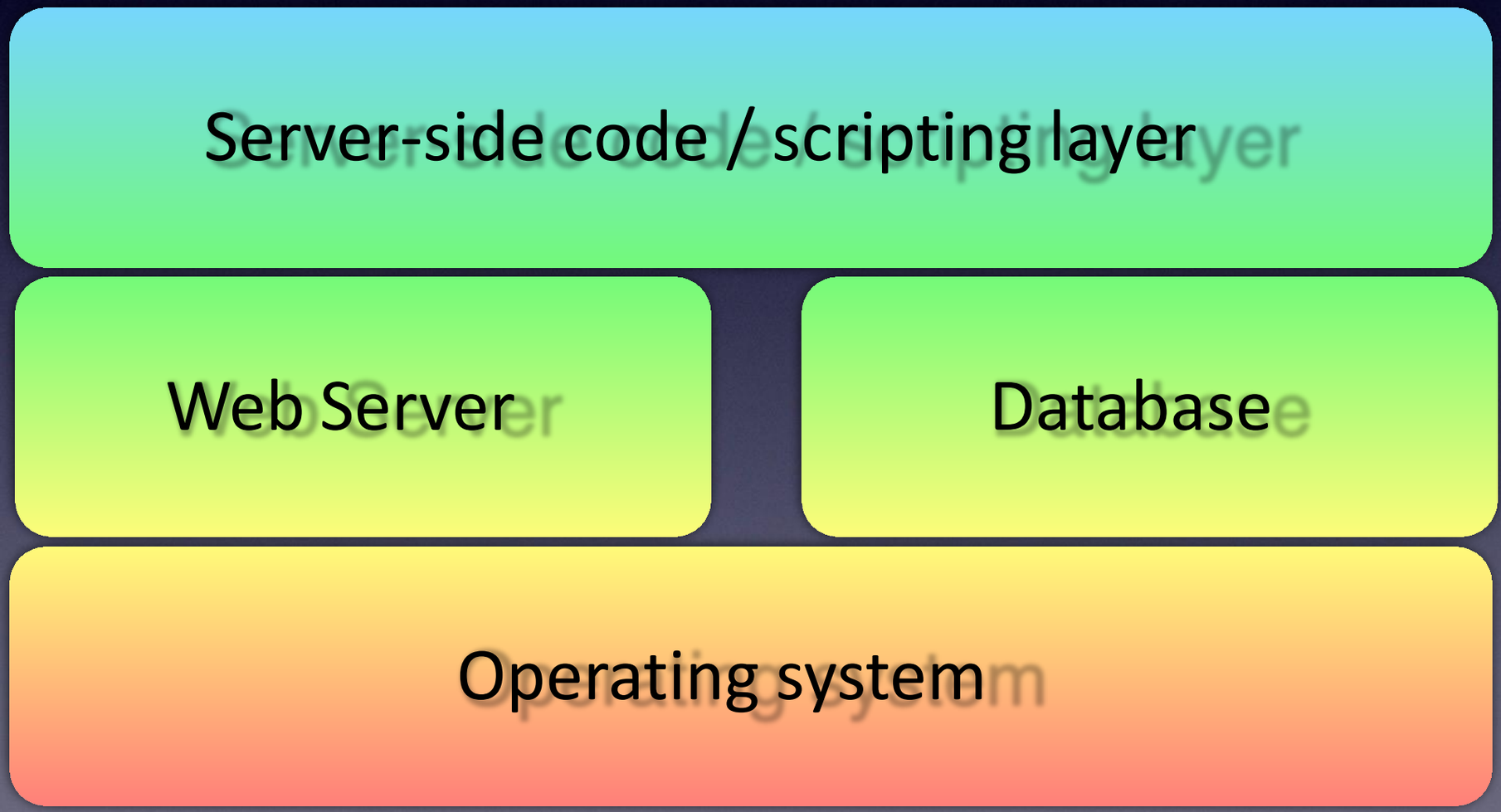


Physically, it’s just a computer!

or a network of computers or a virtual computer and it comes with a stack


Client Side Code
Browser
Server Side Code
Web Server
Database
OS

Traditional Web Stack



LAMP

PHP

Apache

MySQL

Linux

LEMP

PHP

nginx

MySQL

Linux

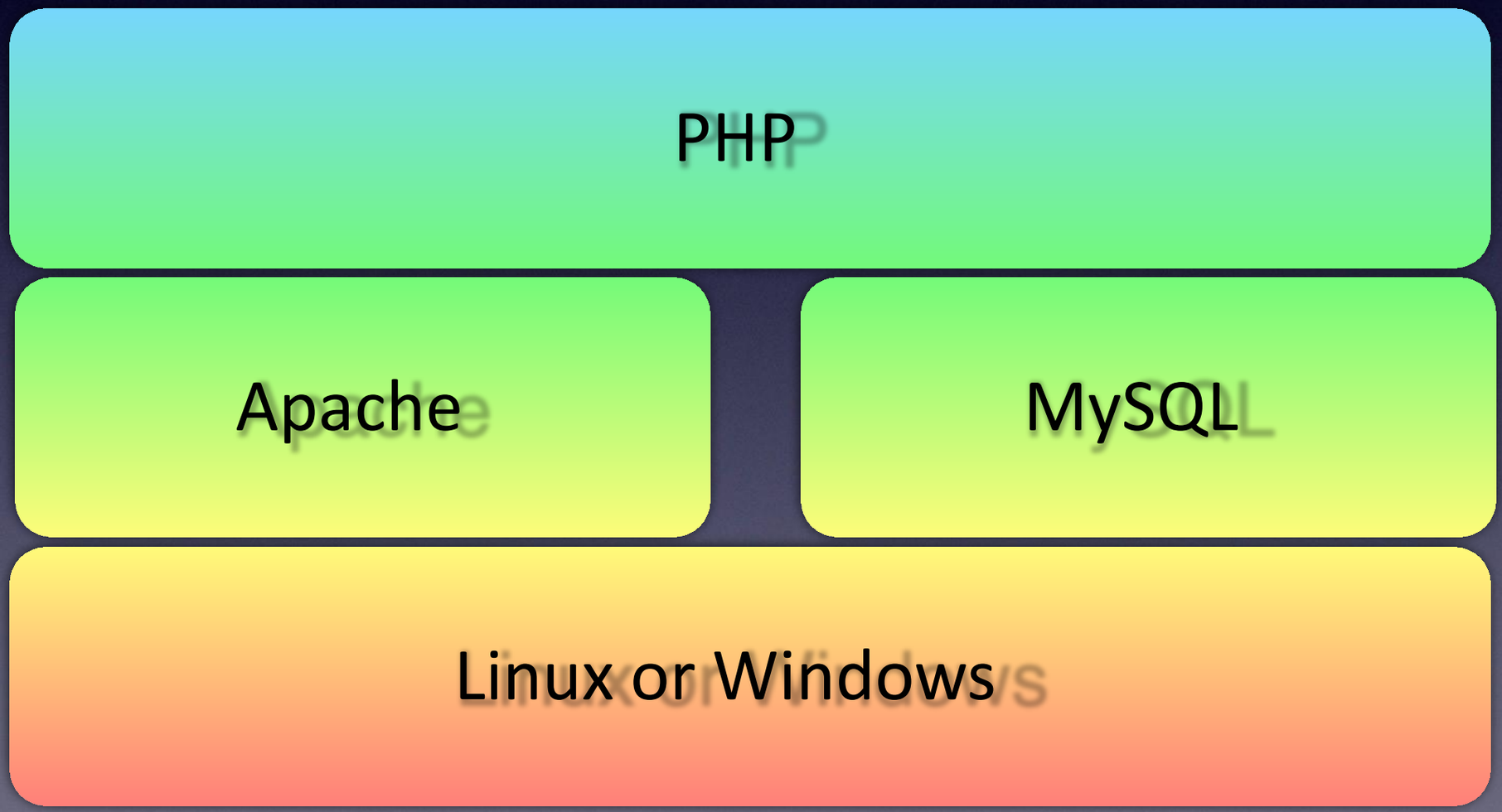
WAMP

PHP

MySQL

Windows (but Windows **Server**)

XAMP



XAMPP is different; sometimes the ‘M’ stands for MariaDB

WIMP

PHP

IIS

MySQL

Windows (but Windows **Server**)

Traditional 4 letter stacks

Said nothing about what goes on the front end.

Because at that point, it was HTML, JavaScript, CSS.

What more can we say?

But there are other stacks

- MERN
- MEAN
- MEEN
- MEVN

What is ME_N?

Mongo DB, **E**xpress,_____, **N**ode

- MERN -> React.js
- MEAN -> Angular.js (but should mean Angular)
- MEEN -> Ejs (but could mean Ember)
- MEVN -> Vue.js

What? No operating system?

It’s operating system independent.

And the web server?

Node (with help from Express).

Comparison

	LAMP	MEAN
Server side script	PHP	node.js applications (maybe angular client side)
Database	MySQL	mongoDB
Web Server	Apache	Node has its own server. Express helps.
Operating System	Linux	Cross platform

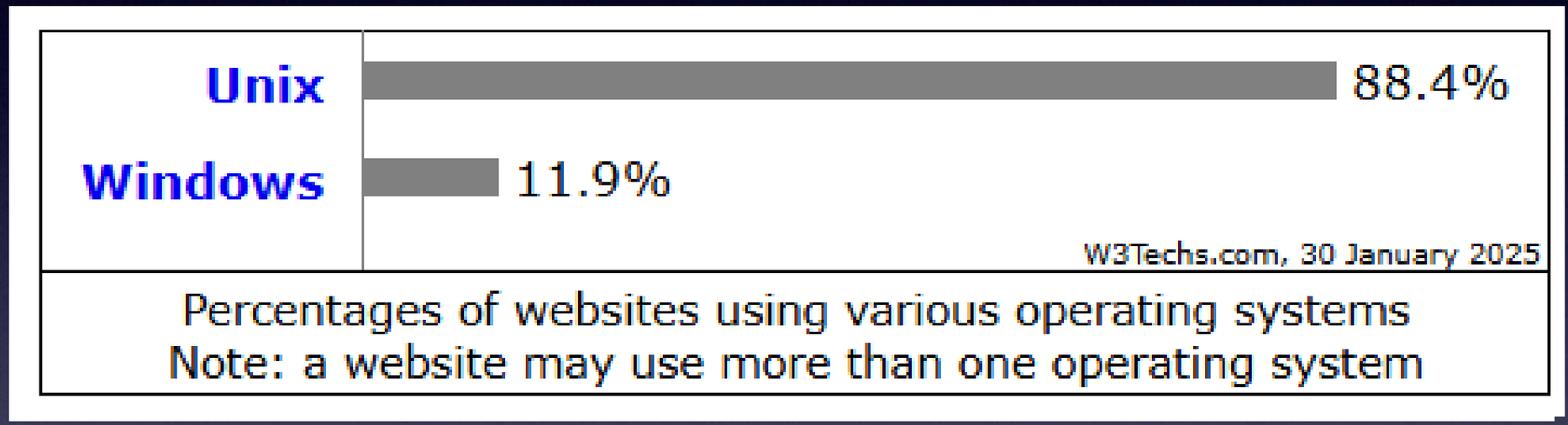
In short…

- MERN, MEAN, MEVN, MEEN….all specify node and express for server side
- MERN, MEAN, MEVN, MEEN….are platform independent
- LAMP, LEMP, WAMP, WIMP….all specify an operating system
- LAMP, LEMP, WAMP, WIMP….do not specify client side javascript libraries

But really…

- You don’t need to use four letters to specify a stack.
- It’s just the software/programs that comprise your complete web system.

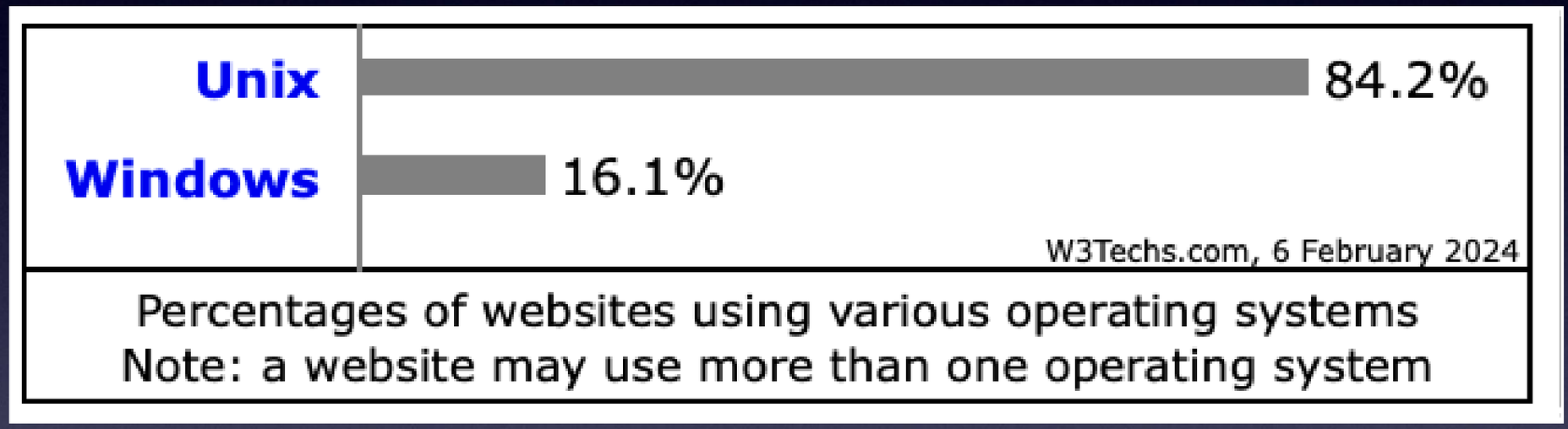
Server



Unix-based systems are much more popular than Windows

https://w3techs.com/technologies/overview/operating_system

Server 2024



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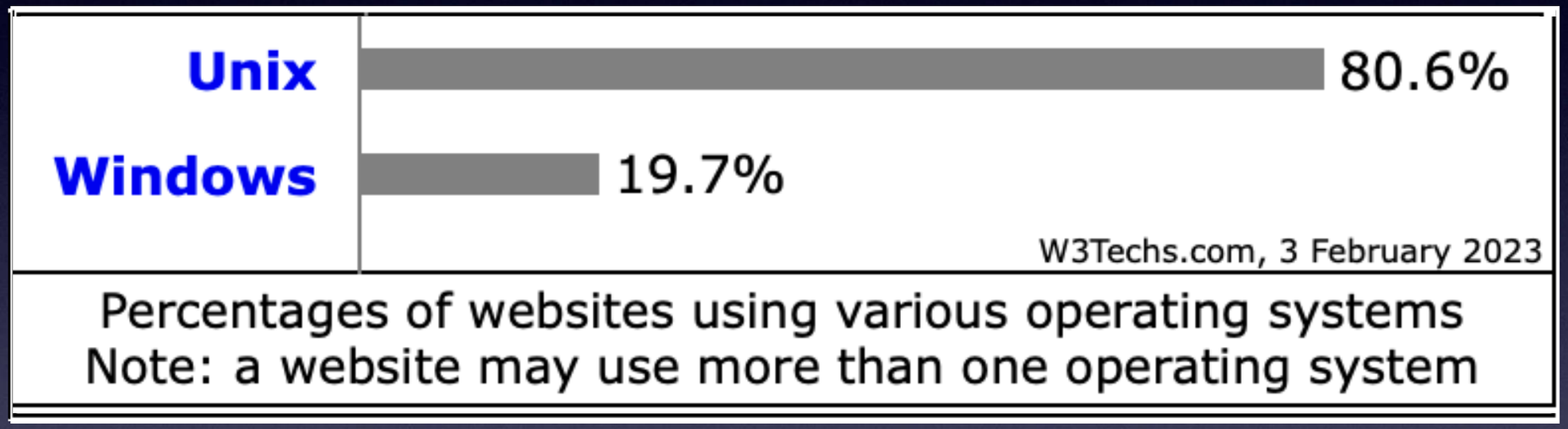

Percentages of websites using various operating systems
Note: a website may use more than one operating system

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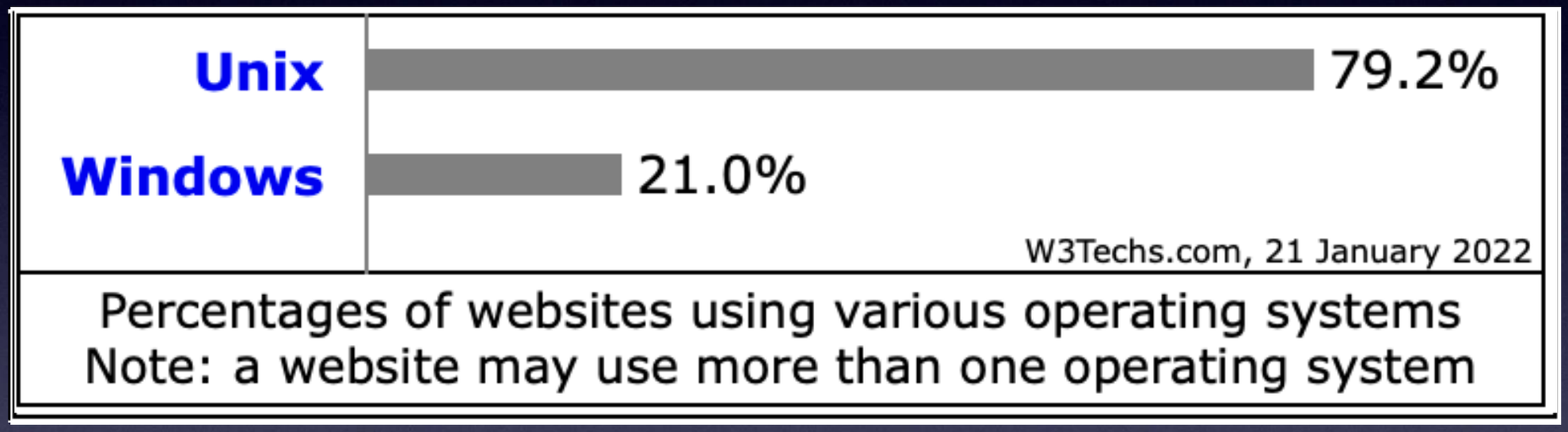
Server 2022



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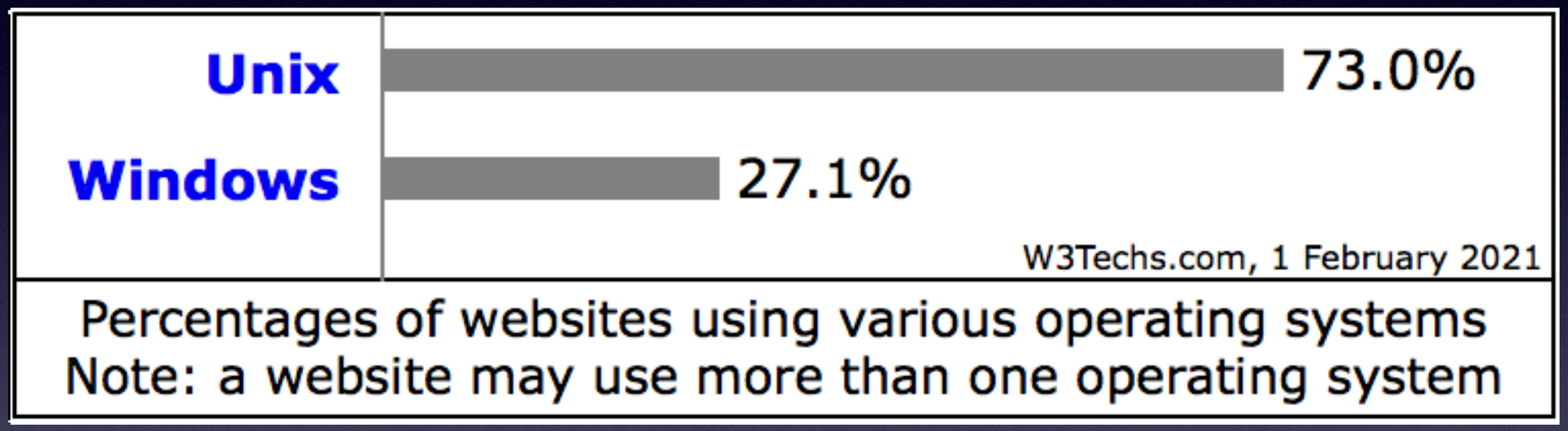
Server OS 2021



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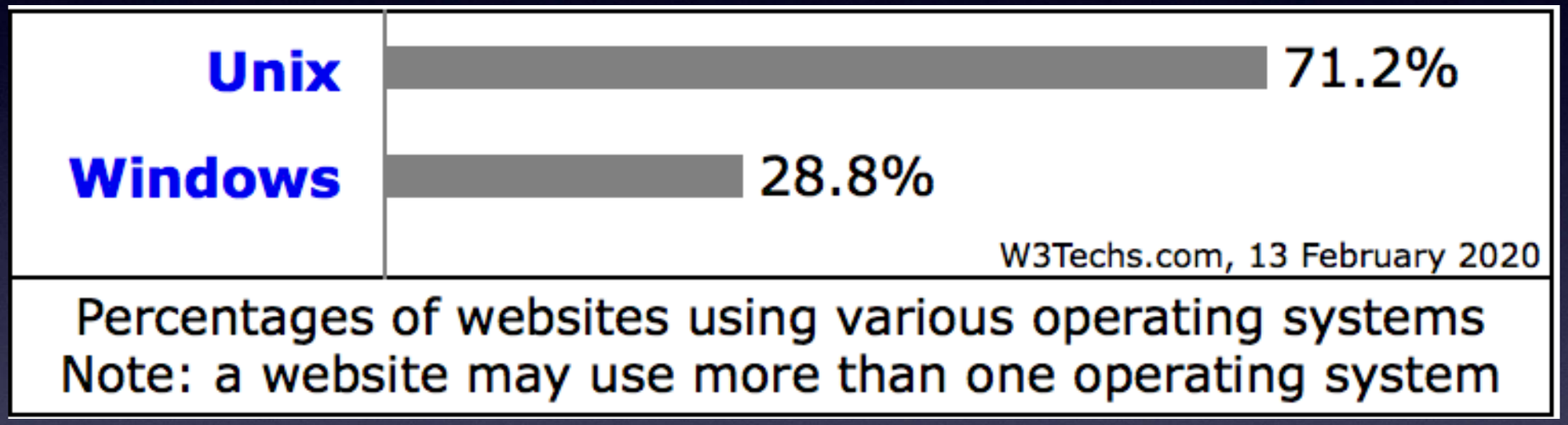
Server OS 2020…



Unix-based systems are much more popular than Windows

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Cross Platform Stacks

- A few years (or decades) ago this wouldn’t have mattered. You would purchase a host and stick with it. You were tied to their infrastructure

- Nowadays you will probably host in the cloud

- If you host in the cloud, you are in control and the companies that you use may change as prices fluctuate

- Don’t need to rewrite code to change host

IaaS

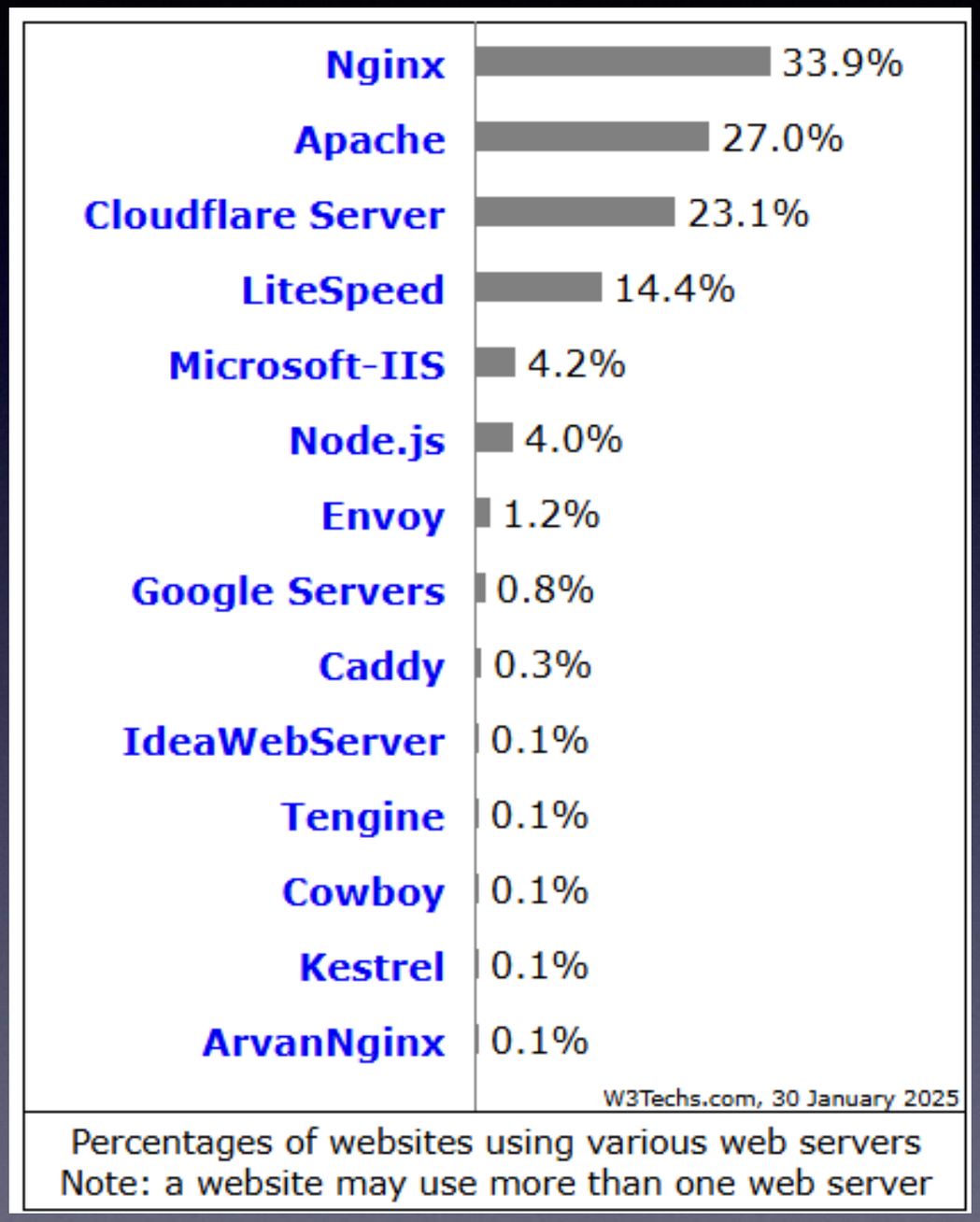
- You can pick any “Infrastructure as a Service” cloud provider you like and get a blank server to tie to a domain name.
- How much work is it to migrate your website to a new host?
- And to migrate all your data to a new host?

And PaaS

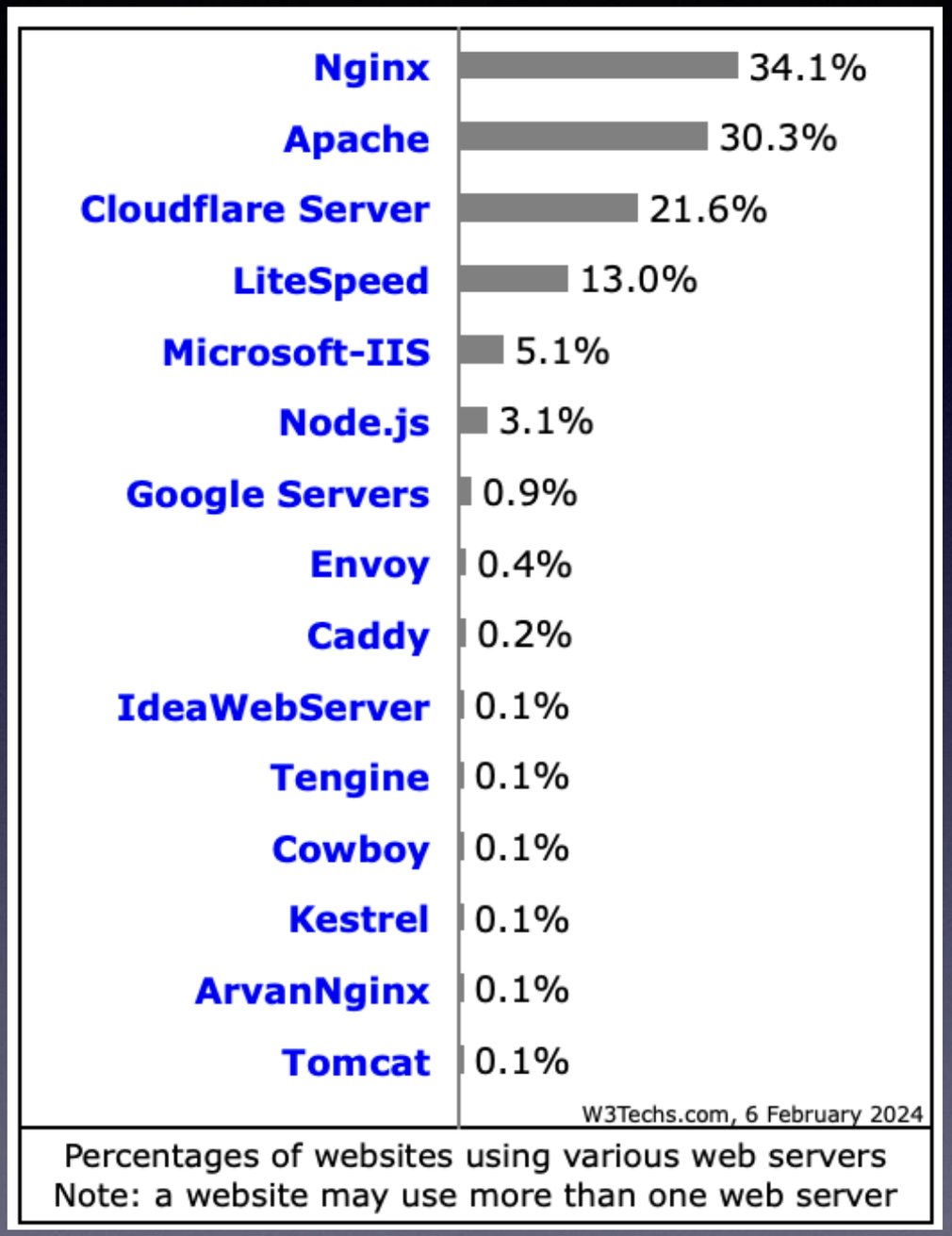
- If you used PaaS (like Heroku or Vercel), there was no server configuration necessary but you were tied to using the platform's server choices (nginx, probably Linux)
- You could make some choices
- Your web system **code** was actually on git

Web Server

2025



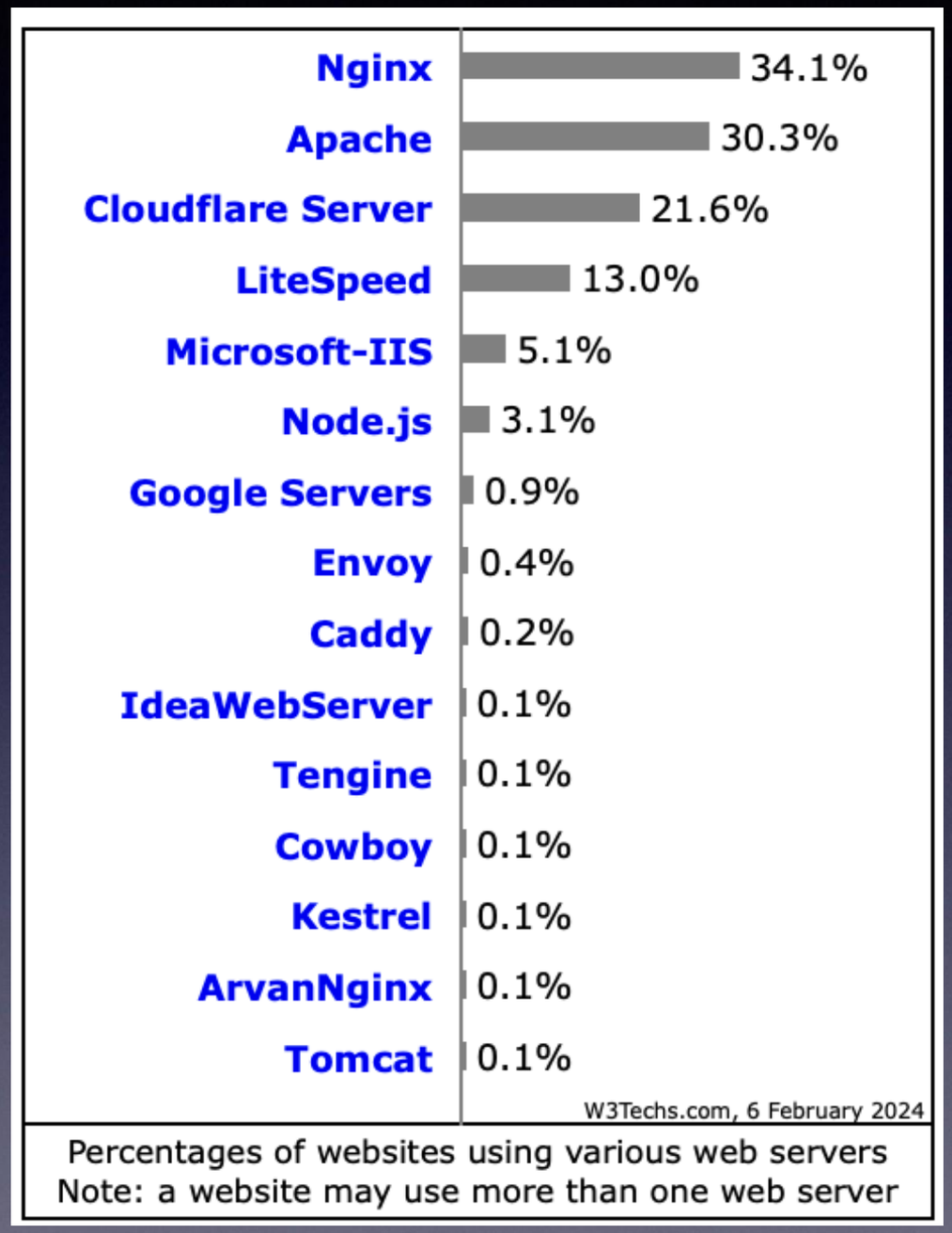
2024



https://w3techs.com/technologies/overview/web_server

Web Server

2024



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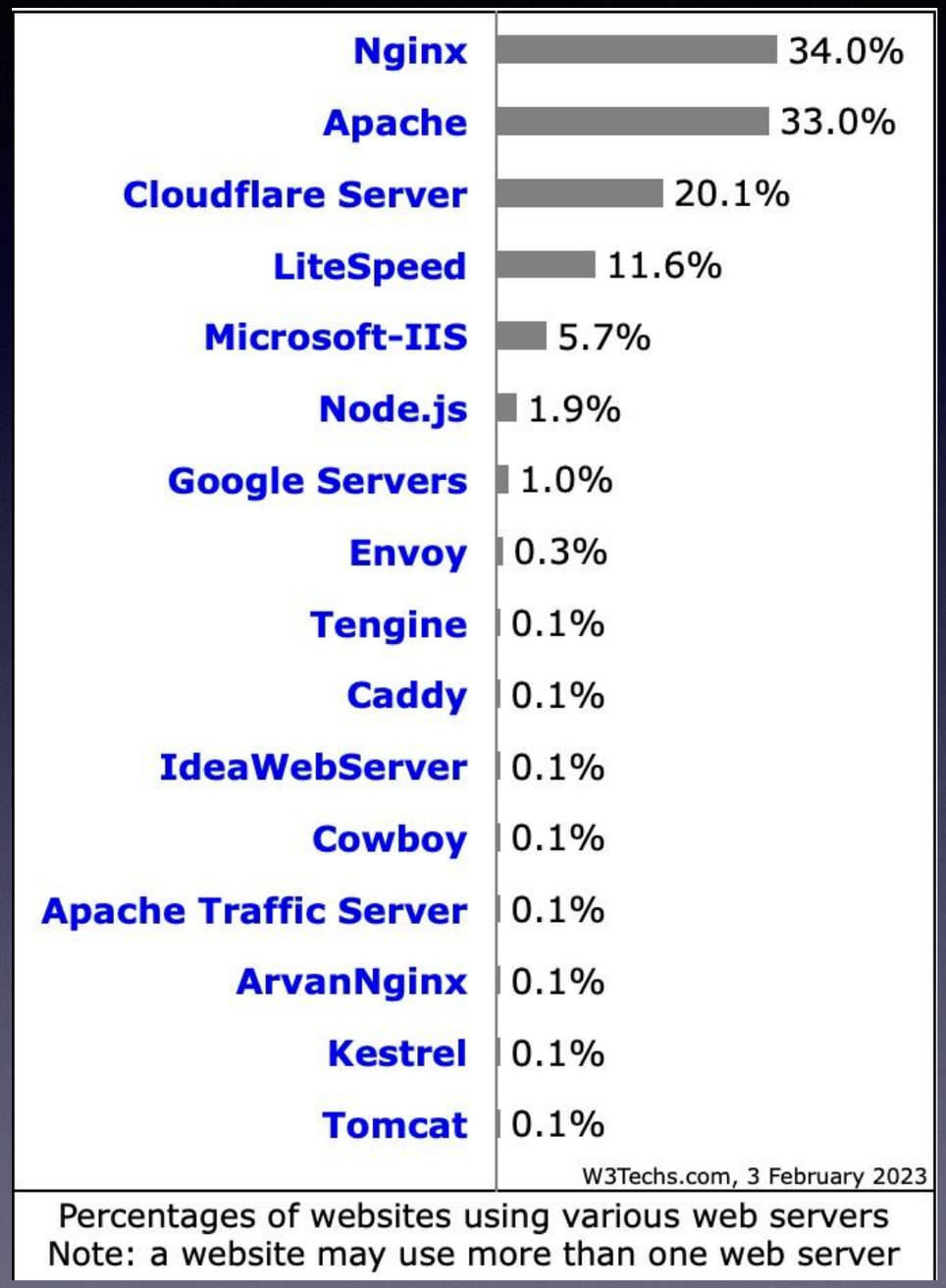

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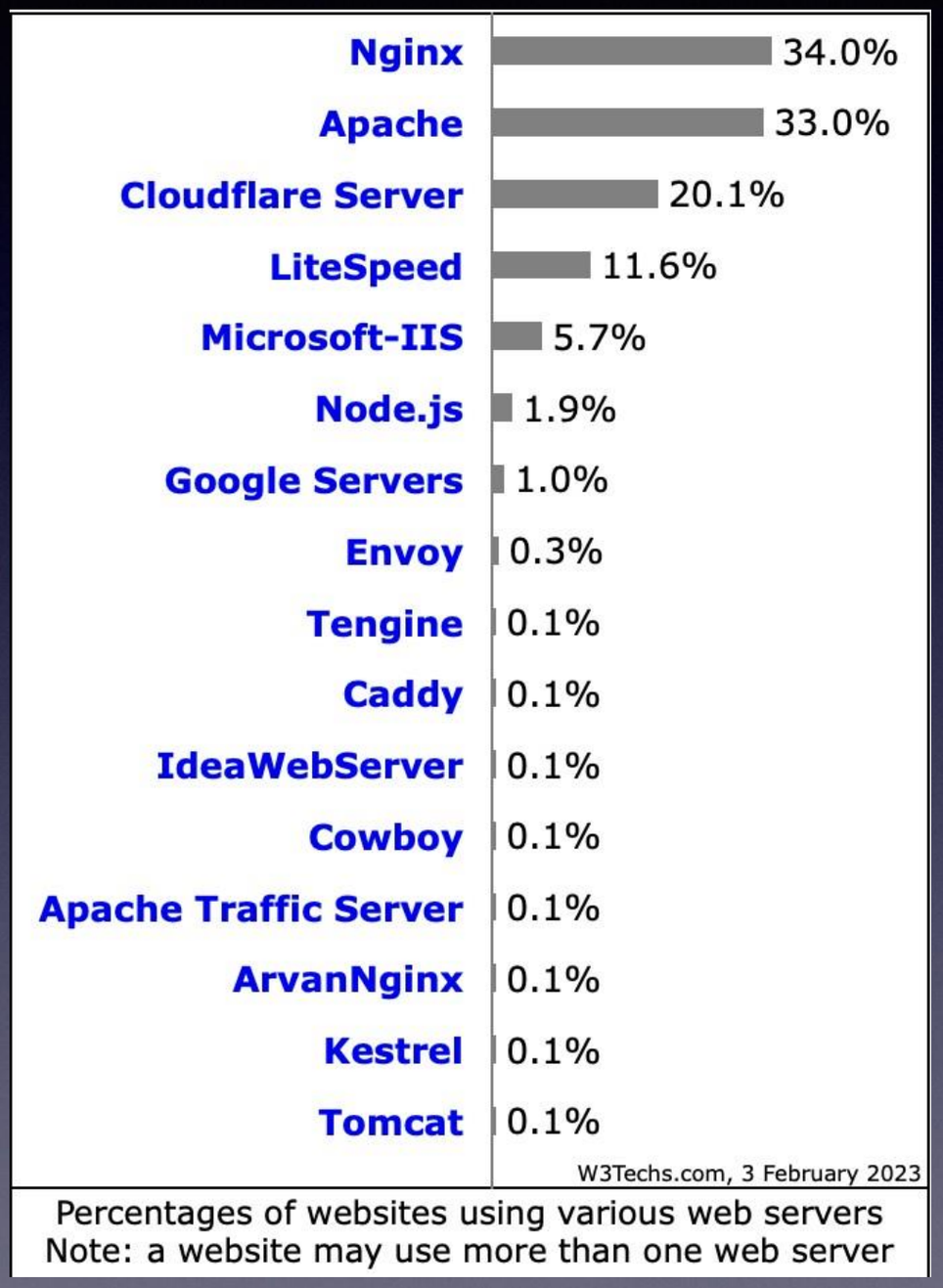
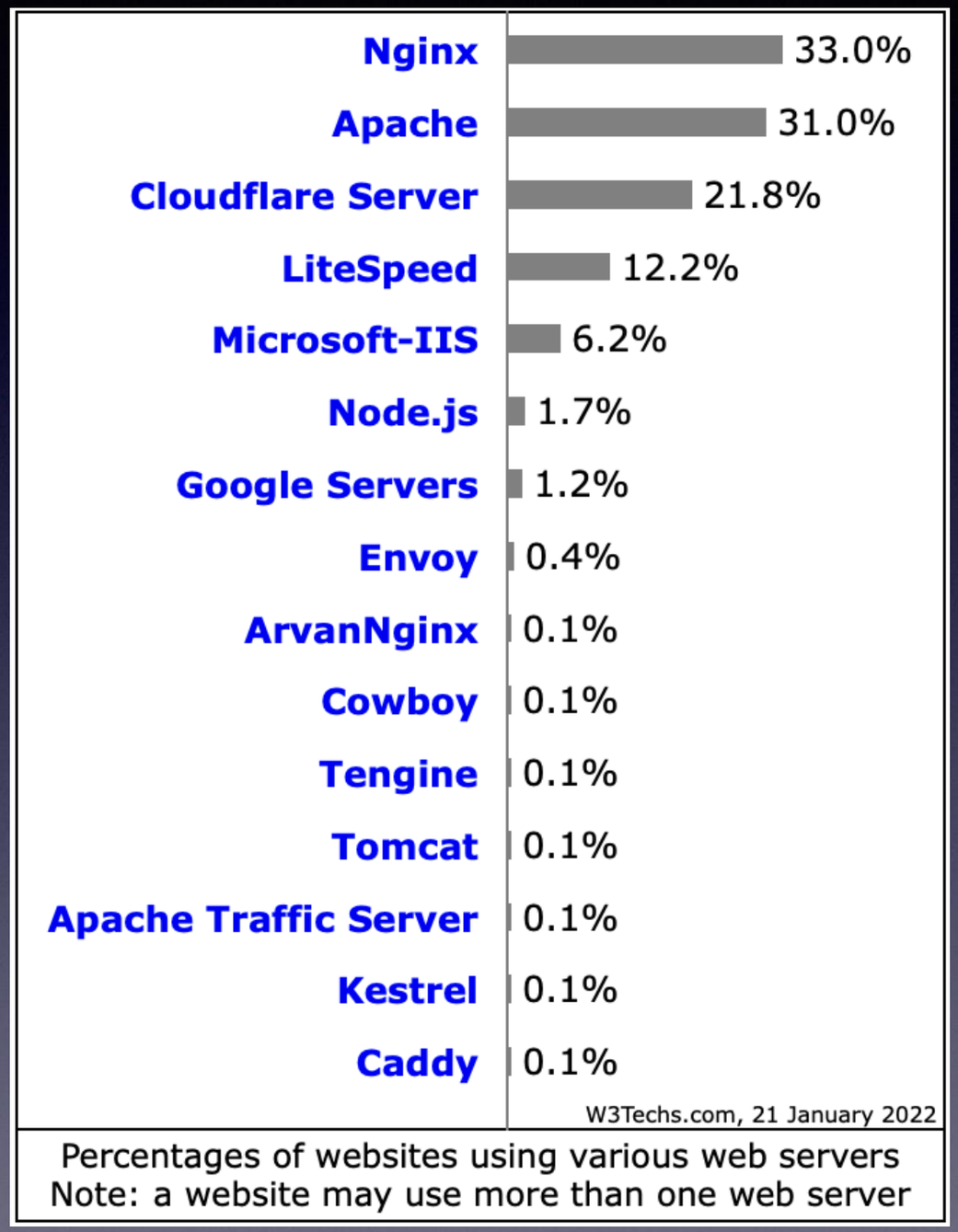
Web Server

2023

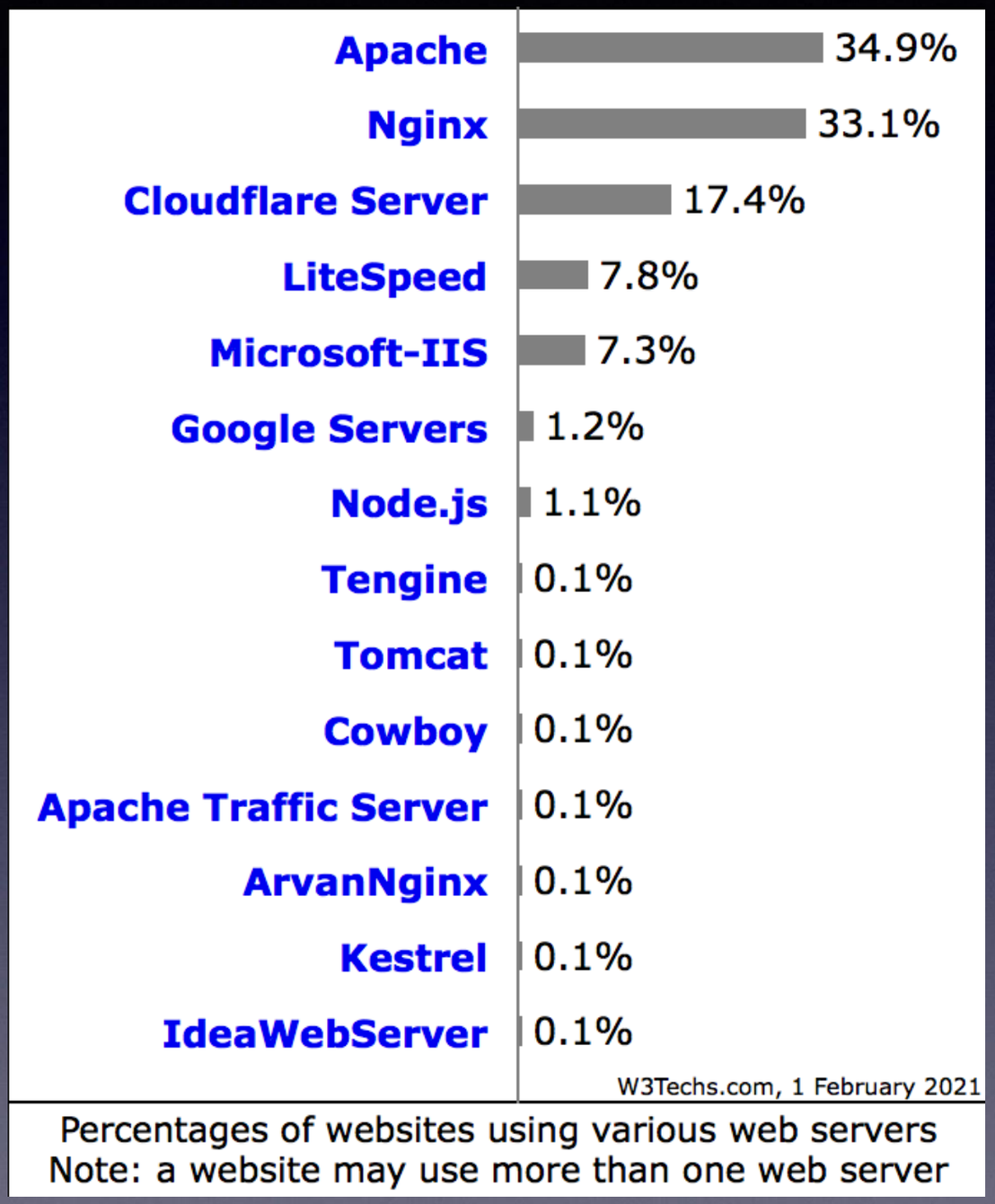


2022



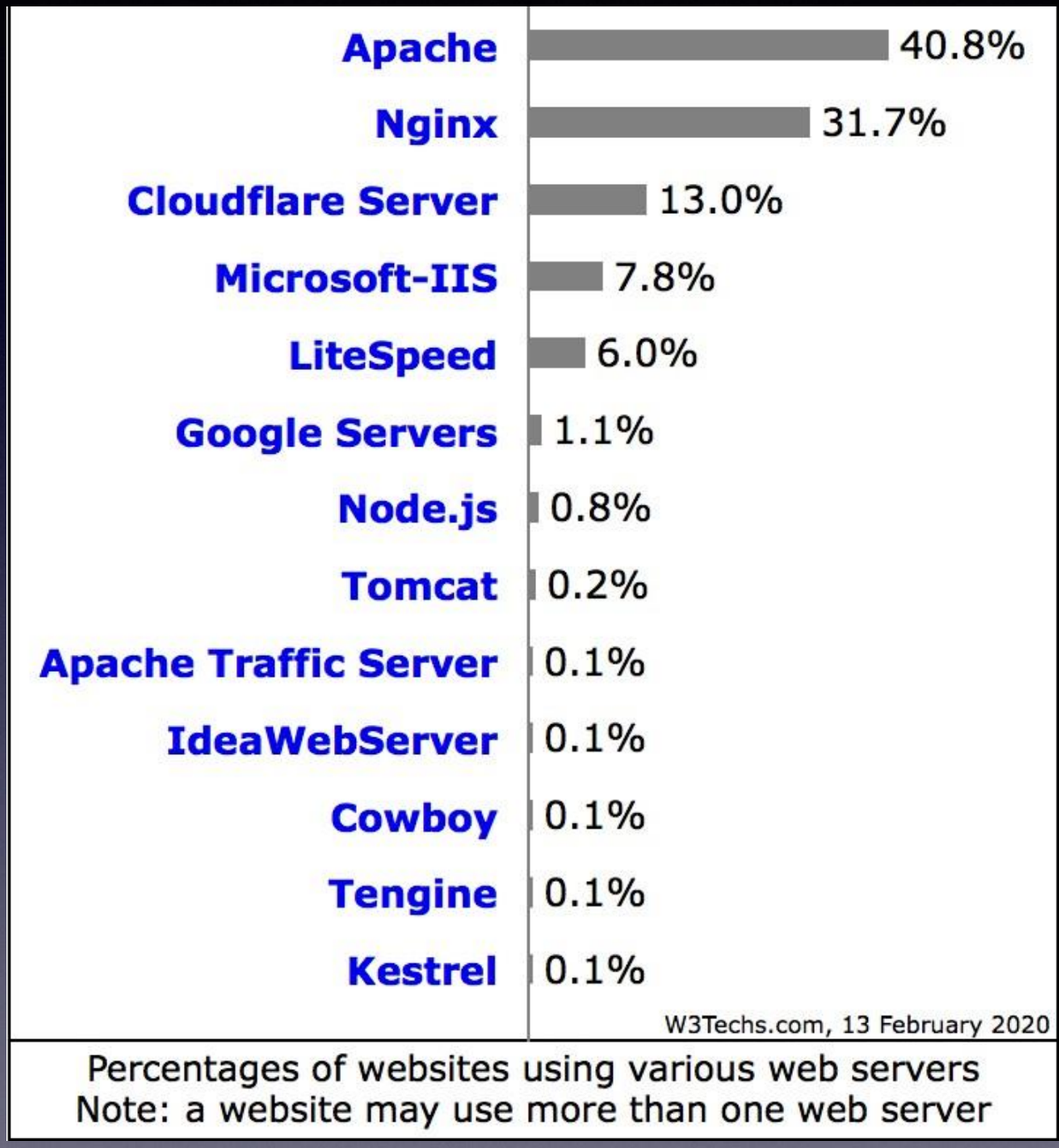
https://w3techs.com/technologies/overview/web_server

2021



Percentages of websites using various web servers
Note: a website may use more than one web server

2020



Percentages of websites using various web servers
Note: a website may use more than one web server

https://w3techs.com/technologies/overview/web_server

Not the whole story, though

- The W3tech graphs display details for “ALL” websites (or the top 10 million, see link below).
- Not all websites have the same number of users.
- Which server do you think comes out on top for the sites with the highest traffic?

https://w3techs.com/technologies

What is server software

- Examples: Apache, nginx, node.js
- It is a piece of software that responds to network traffic (e.g. http)
- The response depends on some sort of script (in JavaScript or in PHP or in Python or C# or …)
- It can respond by calling another server

Apache

- An open source http web server
- Launched in 1995
- Multi-threaded - connections start in a new thread
- Has modules for handling PHP and load balancing

Nginx

- Was written to beat Apache (and is better for static websites or websites high in traffic)
- Is an event-driven web server (multi-threaded)
- Can do load balancing and mail server
- Is bigger and more versatile than node (but can call node scripts)

Node.js

- Is a JavaScript runtime environment (can be configured as a web server)
- Is asynchronous and single threaded.
- Instead of using multiple threads that sit around waiting for a function or event to finish executing, Node uses only one thread to handle all requests.
- Node handles multiple requests by using callbacks.

What is Asynchronous?

- Asynchronous events are independent of program “flow”
- Events are passed to an event handler queue and the main program continues.
- Once the event is ready, the program returns to it with a callback, executes the code, then returns to the main flow of the program.
- Asynchronous Callbacks are functions that are passed as an argument to be executed at a later time (when it is ready).
- Callbacks are used when a function may need more time to execute in order to return the correct return values.

Shout out to Python

- Similar to node.js, run-time environment that can be configured as a web server
- Django or PyFlask (or even Streamlit)
- Is single threaded, but things like gunicorn can make it so it accepts many connections (i.e. many instances, multi-threaded)

And newcomer Next.js

- Now the “back-end” for React.
- Provides server-side rendering
- Runs on node.js

Side quest: Evaluating Server Software

- How fast is it?
- How many concurrent connections can it handle?
- What is it good for? Front end or Back end?
- What do you really need?
- What do your developers like? Is it current?

Server doesn’t always dictate server side language

- Nginx, Apache can both run PHP using some php interpreter

- They can also both serve static html files

- But if your server is node.js, then you will probably be using JavaScript on your back end (although you can force node to run PHP by using it as a command line option)

Server Side Languages

PHP is still the most popular server side language by far

	2014 1 Jan	2015 1 Jan	2016 1 Jan	2017 1 Jan	2018 1 Jan	2019 1 Jan	2020 1 Jan	2021 1 Jan	2022 1 Jan	2023 1 Jan	2024 1 Jan	2025 1 Jan	2025 12 Jun
PHP	80.3%	80.6%	80.0%	80.0%	80.2%	78.9%	78.9%	79.1%	78.1%	77.7%	76.7%	75.2%	74.0%
Ruby	0.6%	0.9%	1.1%	1.3%	1.6%	2.4%	3.0%	4.3%	6.0%	5.3%	5.6%	6.2%	6.3%
Java	2.6%	2.8%	3.1%	3.3%	3.4%	4.0%	3.7%	3.2%	3.7%	4.6%	4.7%	5.0%	5.2%
ASP.NET	17.8%	16.7%	15.6%	14.8%	13.5%	11.8%	10.6%	9.3%	8.0%	7.4%	6.6%	5.4%	5.0%
JavaScript	0.1%	0.1%	0.2%	0.3%	0.4%	0.7%	0.8%	1.2%	1.8%	2.3%	3.1%	4.0%	4.6%
Scala		0.2%	0.2%	0.3%	0.5%	1.2%	1.6%	1.8%	2.3%	2.8%	3.0%	3.8%	4.5%
static files			1.5%	1.5%	1.6%	2.1%	1.8%	1.6%	1.5%	1.9%	1.8%	1.7%	1.7%
Python	1.7%	1.6%	1.7%	1.6%	1.3%	1.1%	1.3%	1.4%	1.4%	1.3%	1.4%	1.3%	1.2%
ColdFusion	0.8%	0.7%	0.7%	0.6%	0.6%	0.5%	0.5%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%
Perl	0.6%	0.5%	0.5%	0.4%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%
Erlang		0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Miva Script			0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%

https://w3techs.com/technologies/history_overview/programming_language/ms/y

Again, not the whole story…

- W3tech table shows the top 10 million sites, no repeats
- Some sites may be busier than others

Speaking of node vs PHP…

- PHP is old...really old! This isn’t a bad thing, it means that the code is stable
- But we like new shiny things that give us the edge! Node isn’t as widely used yet but its being used by a lot of the big boys
- Netflix, NASA, Trello, Paypal, Medium, LinkedIn, Uber, eBay

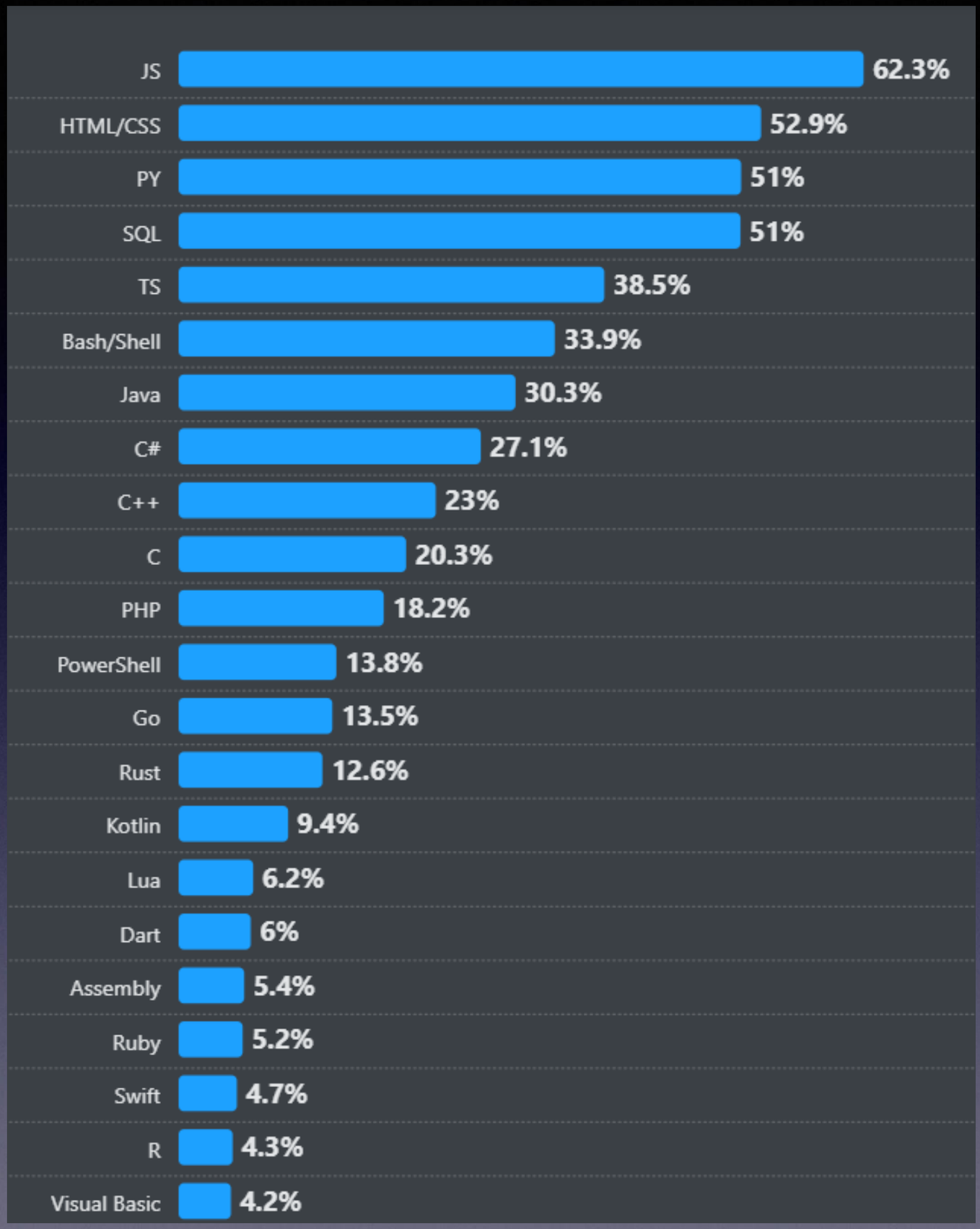
15+ Popular Companies Using Node.js in 2024

Node is faster (maybe)

- On average JavaScript is faster than PHP, uses a little bit more memory, and the same amount of code
- Longer code seems faster in JavaScript than in PHP so this suggests that speed is a result of faster interpretation.

https://www.geeksforgeeks.org/php-vs-node-js/

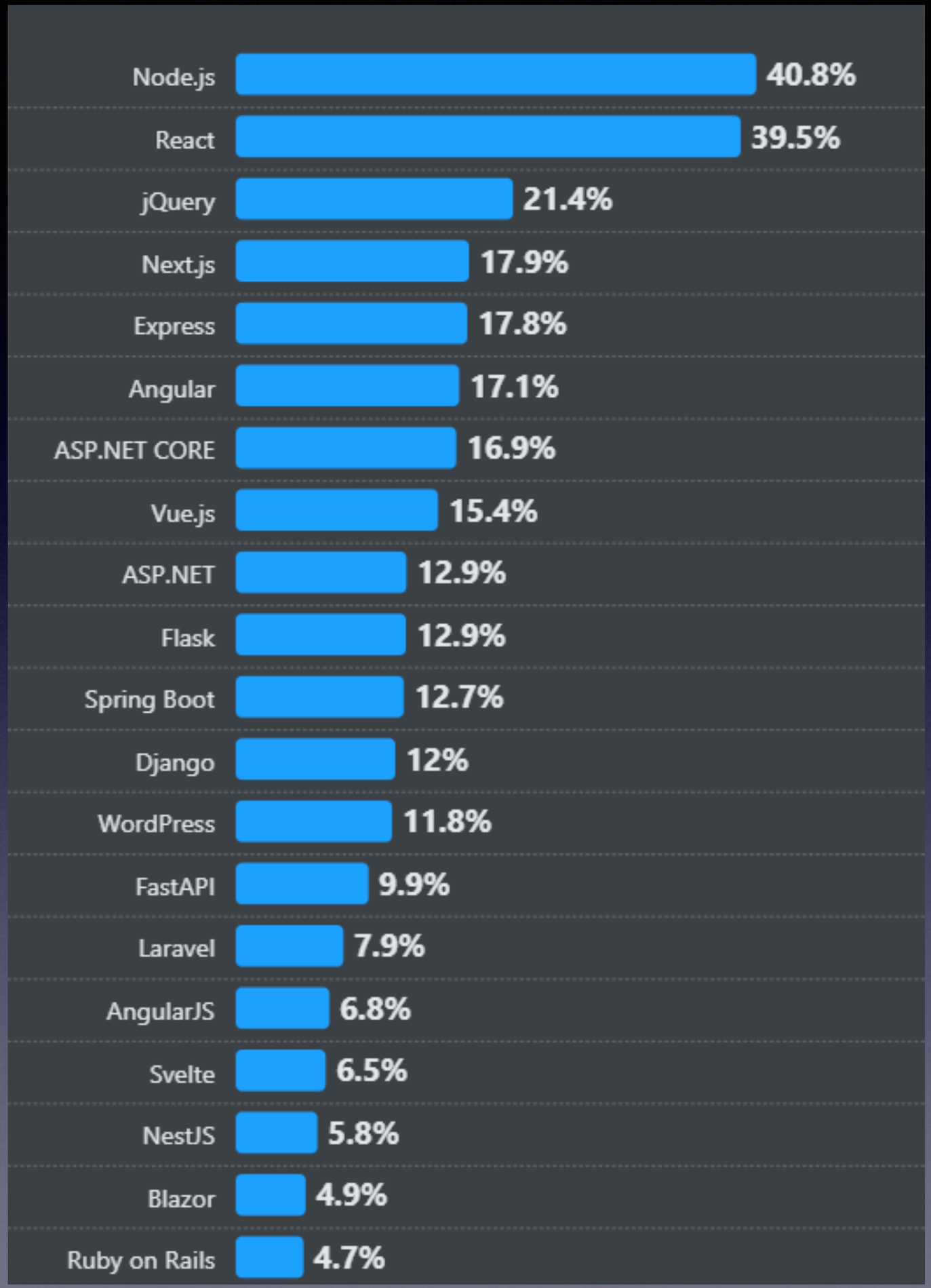
Stack overflow popular technologies



Technology | 2024 Stack Overflow Developer Survey

Web tec

h from 2024



Web tec

h from 2023

Technology | 2024 Stack Overflow Developer Survey

Databases

Rank			DBMS	Database Model	Score		
Jun 2025	May 2025	Jun 2024			Jun 2025	May 2025	Jun 2024
1.	1.	1.	Oracle	Relational, Multi-model	1230.38	+3.82	-13.70
2.	2.	2.	MySQL	Relational, Multi-model	953.57	-11.41	-107.77
3.	3.	3.	Microsoft SQL Server	Relational, Multi-model	776.75	+1.86	-44.81
4.	4.	4.	PostgreSQL	Relational, Multi-model	680.65	+6.34	+44.41
5.	5.	5.	MongoDB	Document, Multi-model	402.85	+0.33	-18.23
6.	6.	↑ 8.	Snowflake	Relational	174.49	+2.48	+44.13
7.	7.	↓ 6.	Redis	Key-value, Multi-model	151.72	-0.47	-4.22
8.	8.	↑ 9.	IBM Db2	Relational, Multi-model	125.13	-1.27	-0.77
9.	9.	↓ 7.	Elasticsearch	Multi-model	121.28	-2.53	-11.55
10.	10.	10.	SQLite	Relational	117.03	-0.74	+5.63

[DB-Engines Ranking - popularity ranking of database management systems]

How to select a database?

- What will it be used for?
- What comes with the PaaS?
- Do you have a database administrator?
- Will you change your mind later?

MongoDB

- Scalable document based noSQL database
- JSON based model persistence

Not MongoDB

Cat	Colour	Owner
Garfield	orange	Jon
Crookshanks	ginger	Hermione
Macavity	black	Macavity
Goose	orange	Nick Fury

- SQL databases are highly structured
- Data sits in clear rows with unique IDs
- Fields are defined (columns)
- Relationships between data are defined when the database is made (private and foreign keys)
- When you add new data it has to fit into this pre-defined structure

Structured Database

Cat	Colour	Owner
Garfield	orange	Jon
Crookshanks	ginger	Hermione
Macavity	black	Macavity
Goose	orange	Nick Fury

MongoDB

You can add new data attributes without the need for adding (and populating) a specific column:

```
db.cat.insert({name:“Garfield”, colour:“orange”});
db.cat.insert({name:“Goose”, colour:“orange”, breed:“Flerkin”});
```

The new data is instantly searchable. If there are no matches for a particular attribute, nothing is returned.

Results are returned in JSON, perfect for javascript.

On to front end frameworks…

Quick note about Angular

Angular and AngularJS are **different things**

Angular

- is a **framework** for writing web systems (components)
- uses TypeScript (owned by Microsoft)
- superseded AngularJS
- is considered faster than AngularJS
- is under current development (AngularJS is LTS)

https://angularjs.org

Angular practicalities

- Angular 2.0 onwards is a **framework**
- That means it already has a defined code structure associated with it - if you use it, sticking to the default file structure is optimal
- You run your code using **ng serve**

React vs Angular

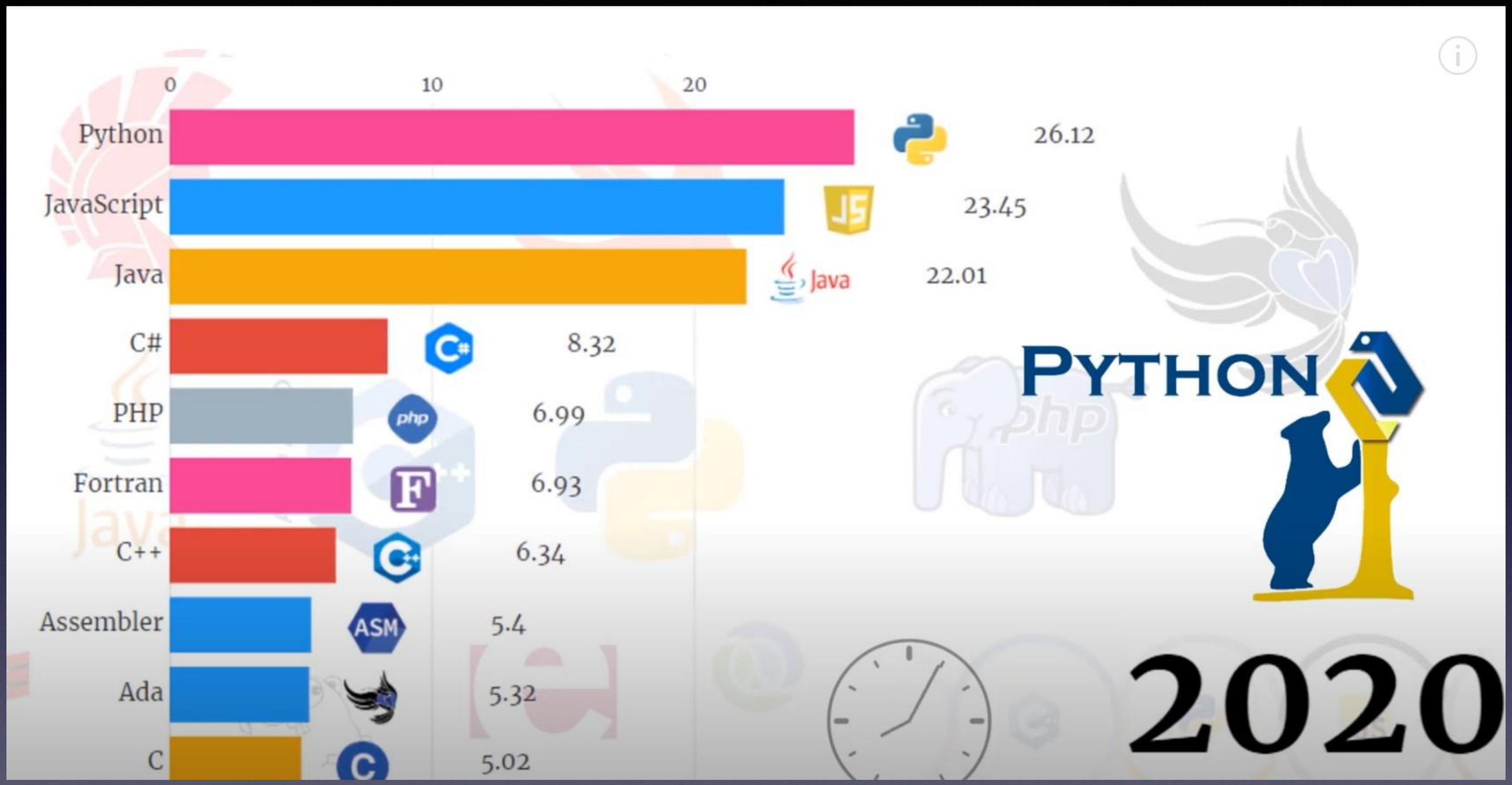
Angular	React
A full framework	A small view library
Large and complete	Smaller and more compact
Free open source licence	MIT licence
Complex and complete	Simple to understand

“Evolution” of React

- Single page app (SPA) with components, JSX.
- Multiple pages: React Router + Redux
- Next.js

History and Evolution of React - GeeksforGeeks

One Development Language



Data source: aggregated statistics from several indexes, GitHub repository access, multiple surveys

https://www.youtube.com/watch?v=7Hll55GCyvI from “Data is Beautiful"

More details on Node

- Server-side javascript platform
- What javascript has done for the web browser, node.js is doing for the back end
- Learn more at nodejs.org

More details on Node

- Node comes with a package manager (npm)
- Like Python, there is already a module available for most things.
- npm commands include:
  - install
  - remove
  - update

Express

- Simple and robust web application framework for node.js

- Gives you everything you would expect to build a modern web server

- Middleware, routing, templating, static-files, cookies, mime-types…

This lab

- Is expanding last lab to include a database

- We’re using MongoDB (locally) and you will set it up on whatever server you’re running

- We’d like to use MongoAtlas (remotely - it’s free to sign up), but RGU’s firewall gets in the way.

Help, it's gone wrong!

- Are you on the right computer?
- Check your syntax (semi colons, variable names)
- Check it locally (all on one computer)
- Load the developer tools and check the client side console
- Learn how to use console.log in your code
- Check the git status (have you added your files?)
- Check your URL (remember POST, GET, PUT etc.)

A Quick Word on JSON

- A lot of APIs return JSON (or XML)
- Lightweight data-interchangeable format
- Designed to be easy to read and write
- Also easy for computers to parse and generate

JSON Structure

- Objects
- Arrays
- Values

Objects

Unordered set of key-value pairs e.g.:

{ “Name” : “Frodo”, “Job”: “ring bearer”}

- Begins and ends with { } (braces)
- Each key is followed by a : (colon)
- Each key-value pair is separated by a , (comma)

Arrays

[“Sleepy”, “Dopey”, “Grumpy”, “Sneezy”, “Doc”]

- Begins and ends with [ ] (brackets)
- Values separated by a , (comma)

Value

The information that we're after. The **value** in key-**value** pair; the **values** inside the array. Can be:

- String ("Bob")
- Number (42)
- Boolean (True)
- Null
- Array