App Dev

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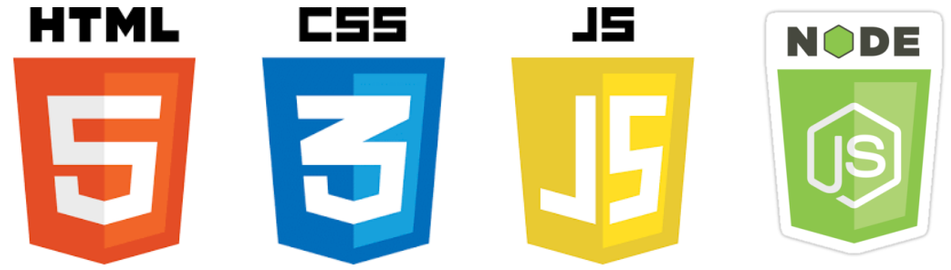
Building Digital Skills: 5-14 May 2021, University of Luzern



Single-Page Application (SPA) Frameworks

A fairly recent trend involves web-applications that are fully loaded in the browser on the first page-load, and then every operation is carried out via AJAX or similar fetch requests.

These applications are called Single-Page Application (SPA)

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Among the most popular are:

- **Angular**
- **React**
- **Vue**

Angular

https://angular.io/

Angular is a framework originally implemented by Google

Follows Model-View-Controller (MVC) pattern (now MVVM).

Amongst the first SPA frameworks implemented

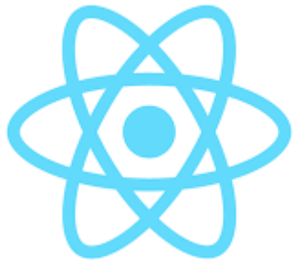
In decline?

The update from Angular 1 (AngularJS) to Angular 2 left many developers unsatisfied.

Now in **TypeScript**

Hard learning curve, appropriate for large projects with several developers.

React



https://reactjs.org/

```
ReactDOM.render(
  <h1>Hello, world!</h1>,
  document.getElementById('root')
);
```

Originally created at Facebook

One of the first frameworks to make use of a **Virtual DOM**

Virtual DOM is a lightweight representation of the browser's DOM.

Whenever one variable is changed, a new Virtual DOM is created and compared with its previous version, the **diff** is then updated in the DOM.

Uses **JSX**: XHTML mixed within the JavaScript code, therefore requires a compiler that transform this JS and XHTML mix into HTML

Largest developer community amongst the big SPA frameworks (unlike to change in the near future)

Easier to get started, but requires several plugins (e.g., for global state management).

Vue

https://vuejs.org/

Newest (of the three)

Similar to Angular, but more flexible, does not enforce a coding pattern

Uses **SFCs** (Single File Components) where JS, CSS, and HTML are combined together.

Easiest to get started, allows for faster prototyping and later extensions via components

Small size and higher performance

Image source

Which one?

In technology, **network effects** are king. You want to build your app on a technological stack/framework that has a large and thriving community. *Which one?*

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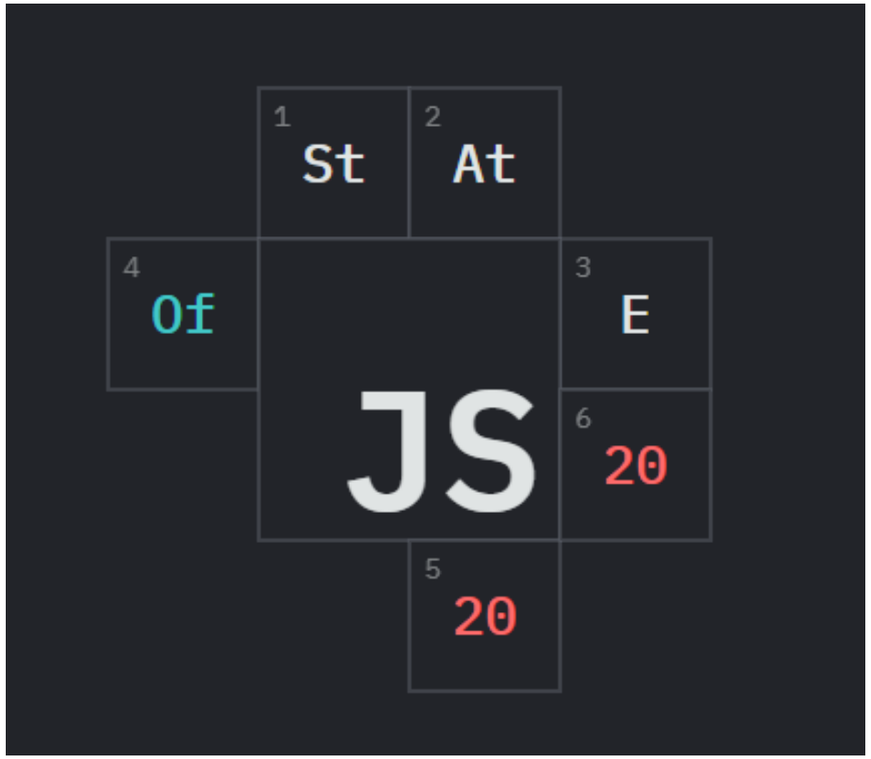
Let's look at the data in 2020:

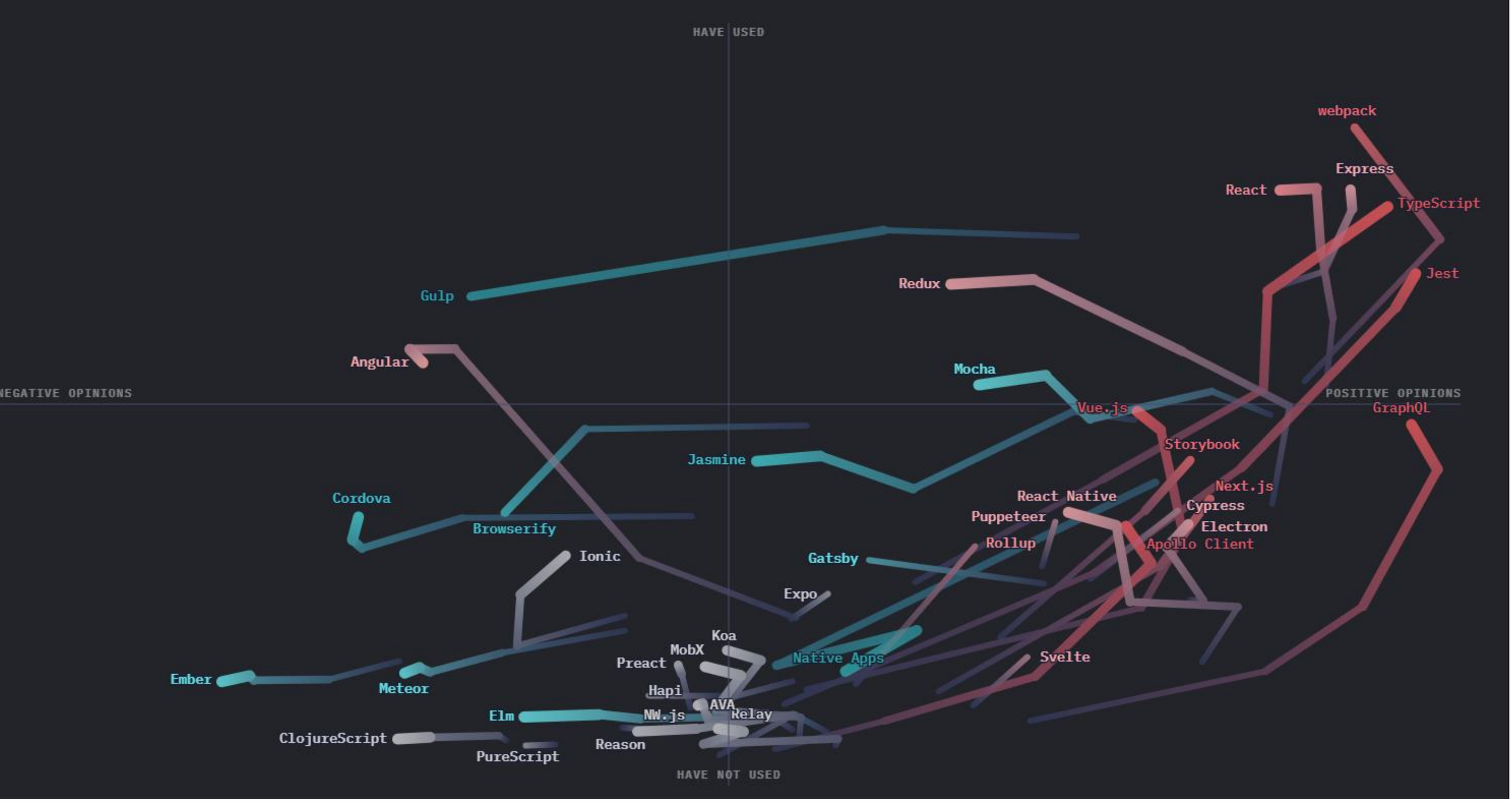
- State of JS Survey
- State of CSS Survey
- NPM Trends
- Stack Overflow Insights Survey
- Stack Overflow Insights Trends

State of JS Survey 2020



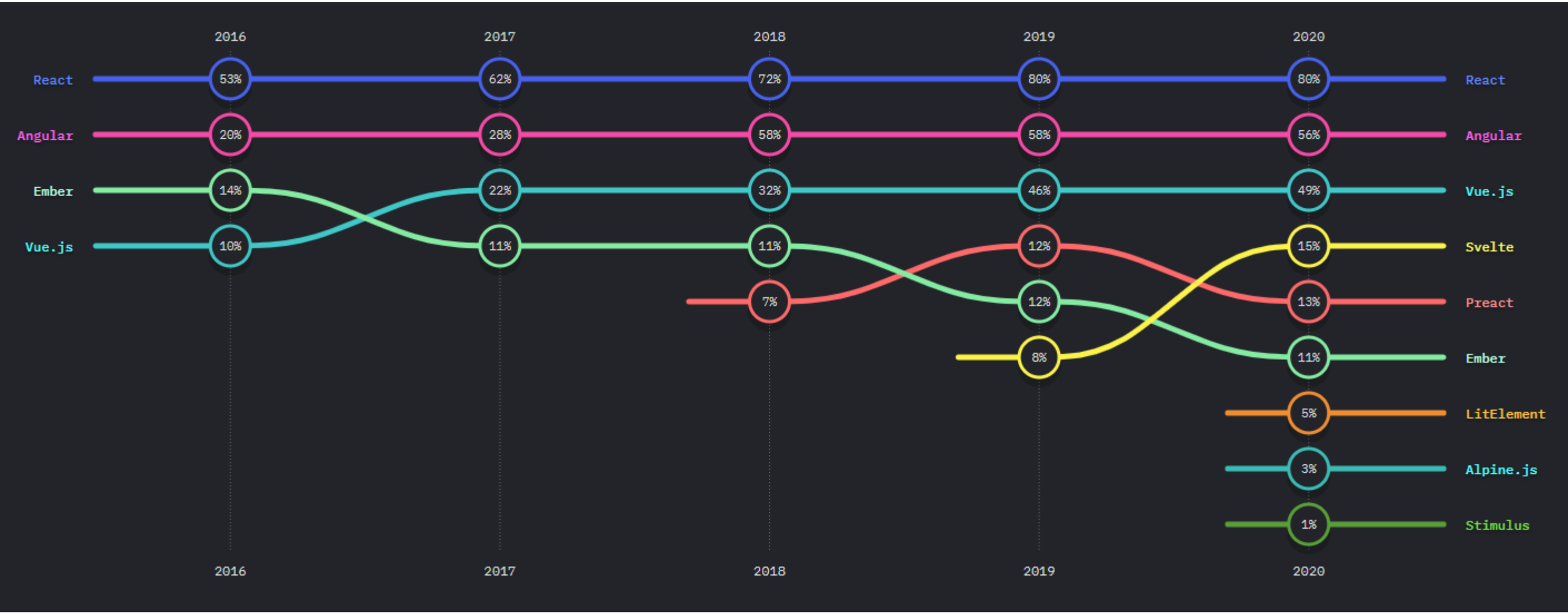
23,765 people in 137 countries.

https://2020.stateofjs.com/



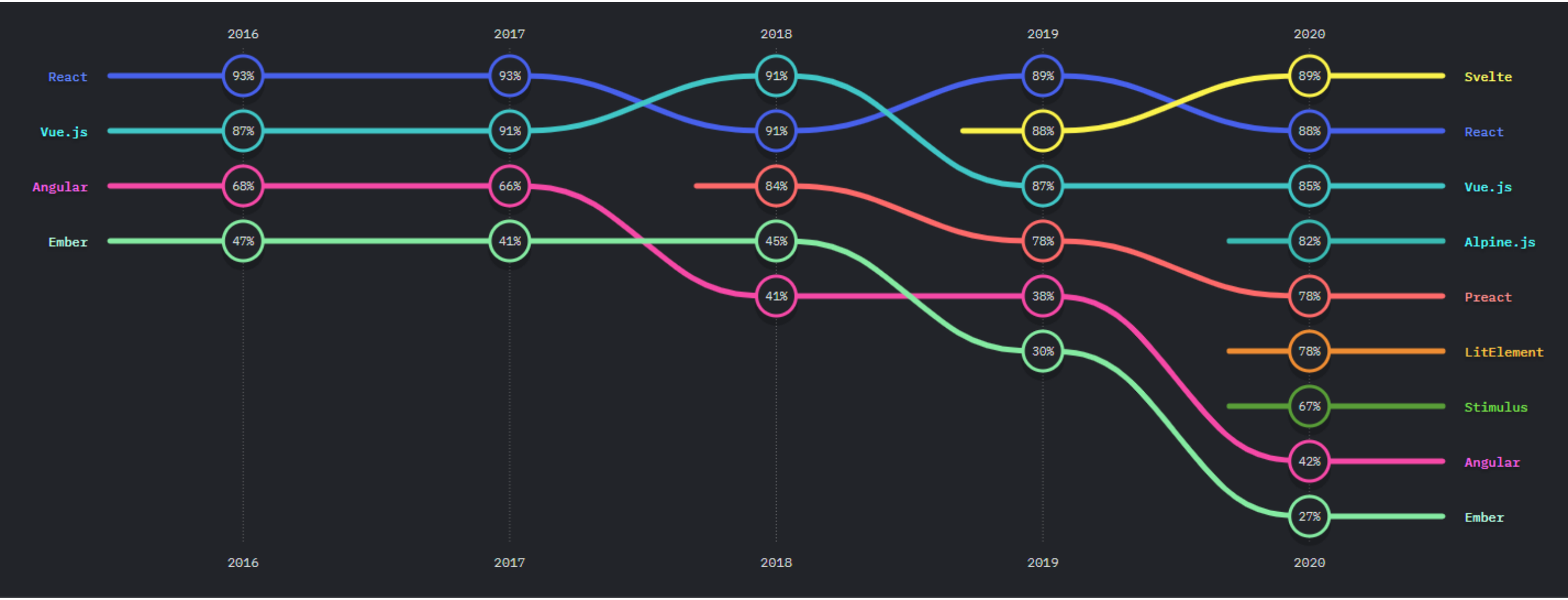
https://2020.stateofjs.com/en-US/technologies/

State of JS: Front End Frameworks Usage



https://2020.stateofjs.com/en-US/technologies/front-end-frameworks/

State of JS: Front End Frameworks Satisfaction

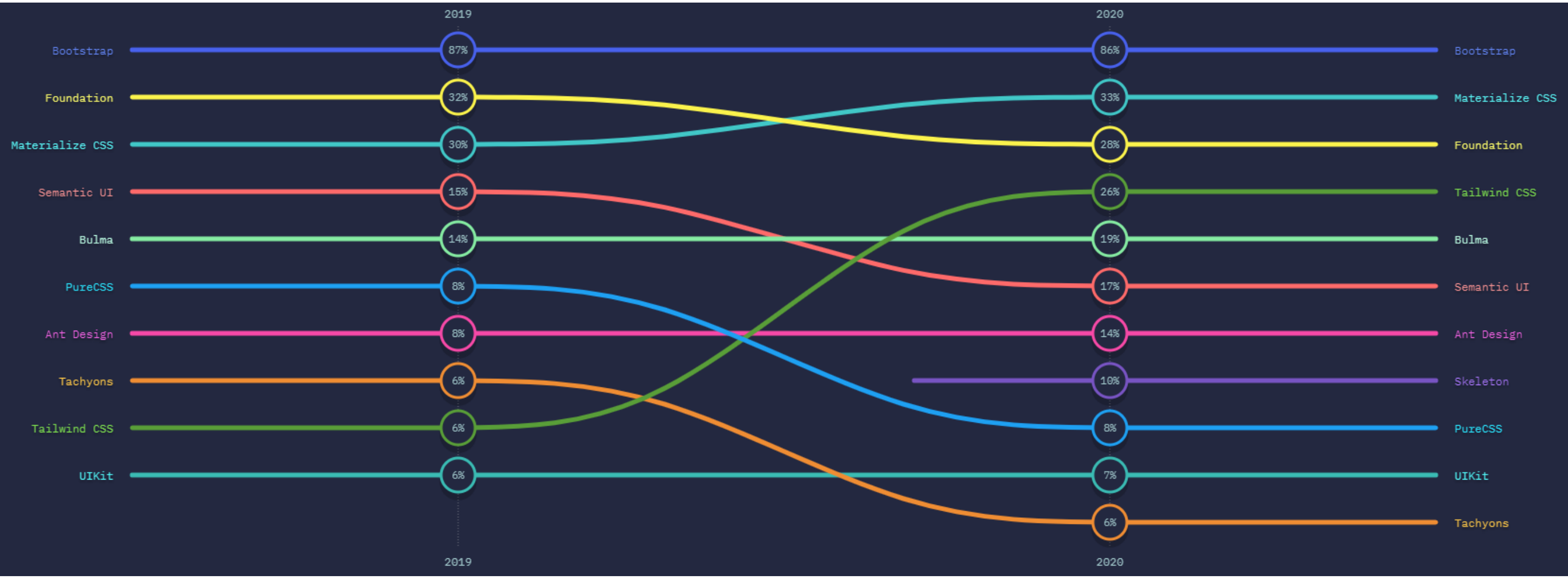


https://2020.stateofjs.com/en-US/technologies/front-end-frameworks/

11,000 respondents from 102 countries

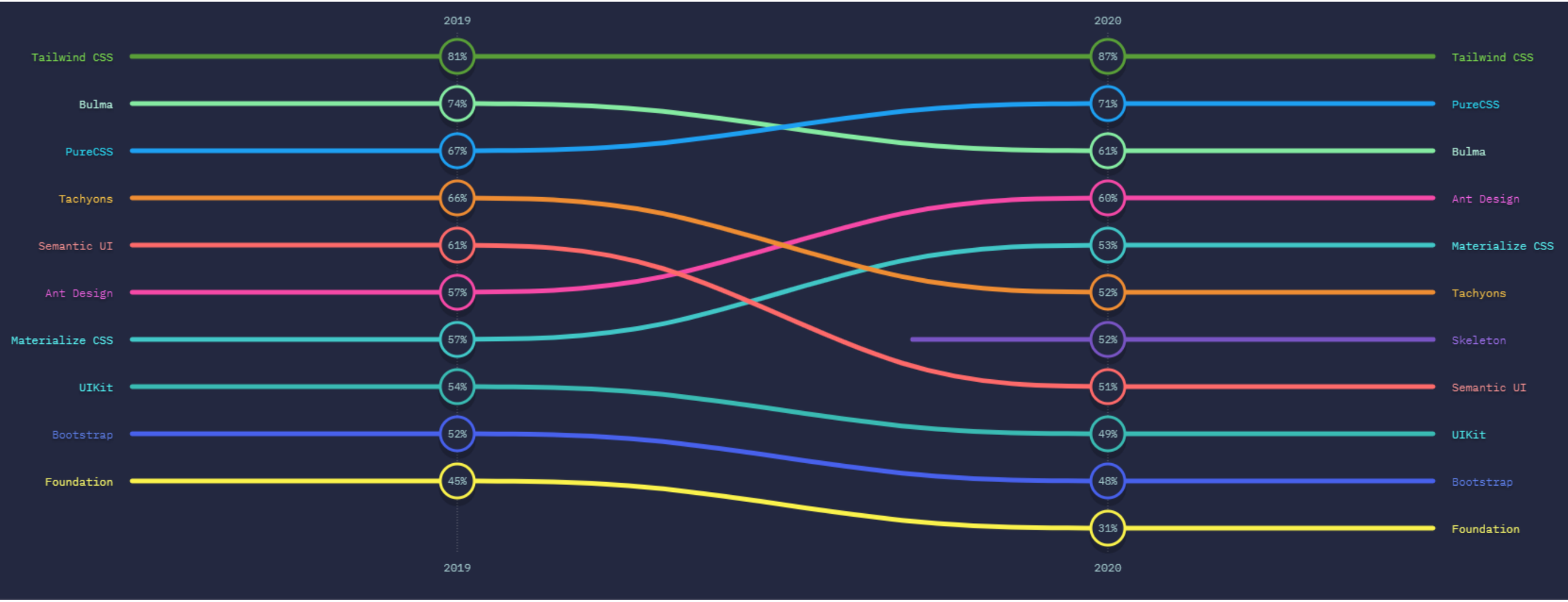
https://2020.stateofcss.com/en-US/report/

State of CSS: Frameworks Usage



https://2020.stateofcss.com/en-US/report/

State of CSS: Frameworks Satisfaction



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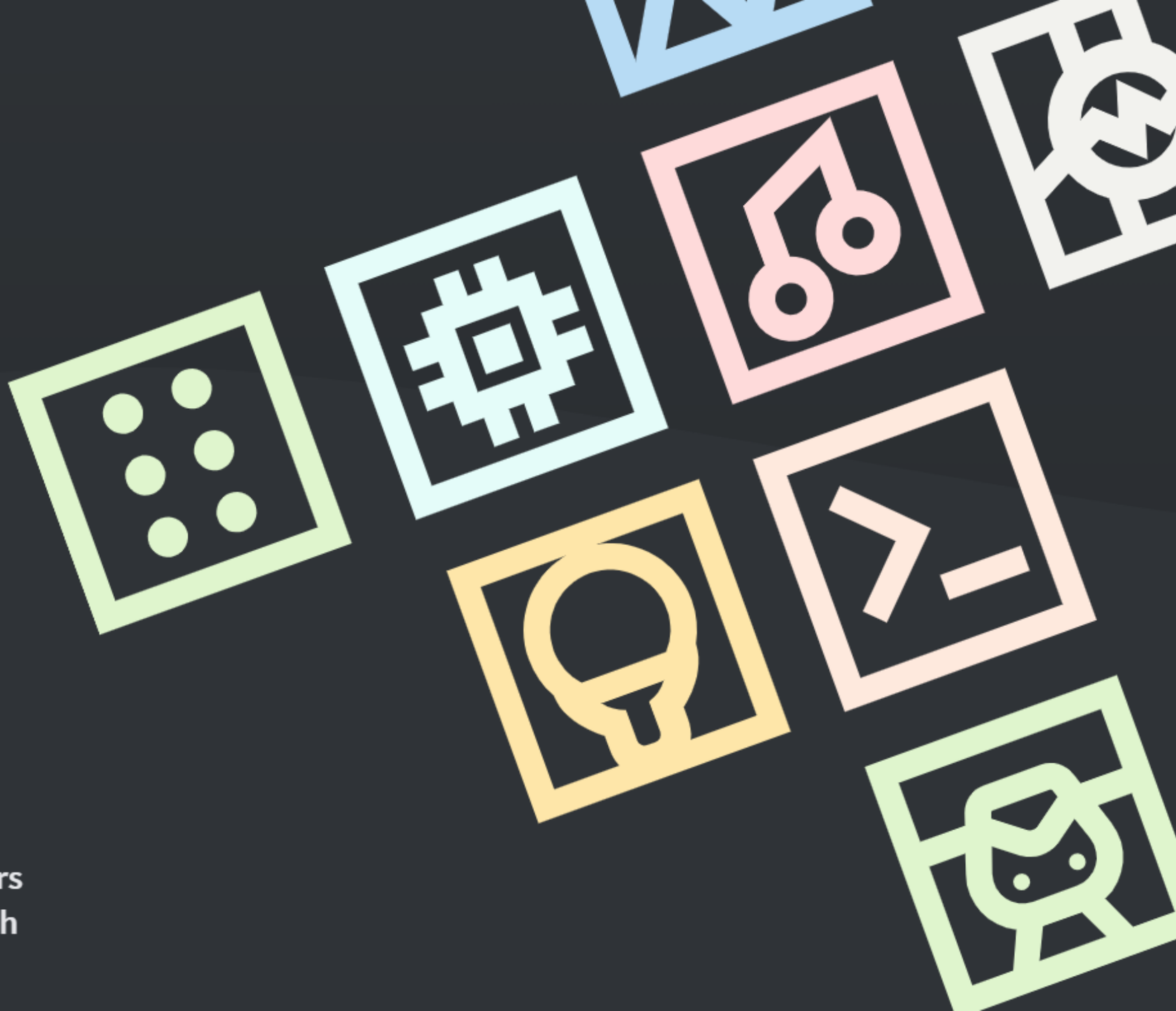
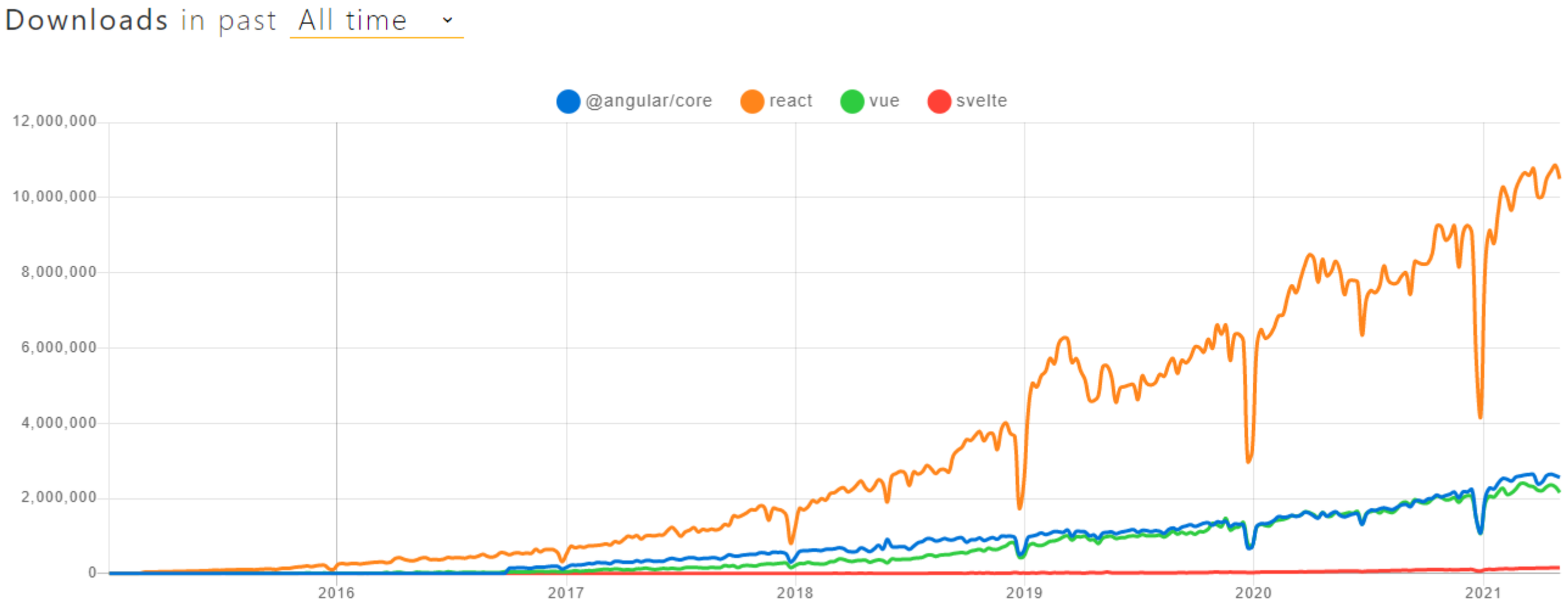


2020 Developer Survey

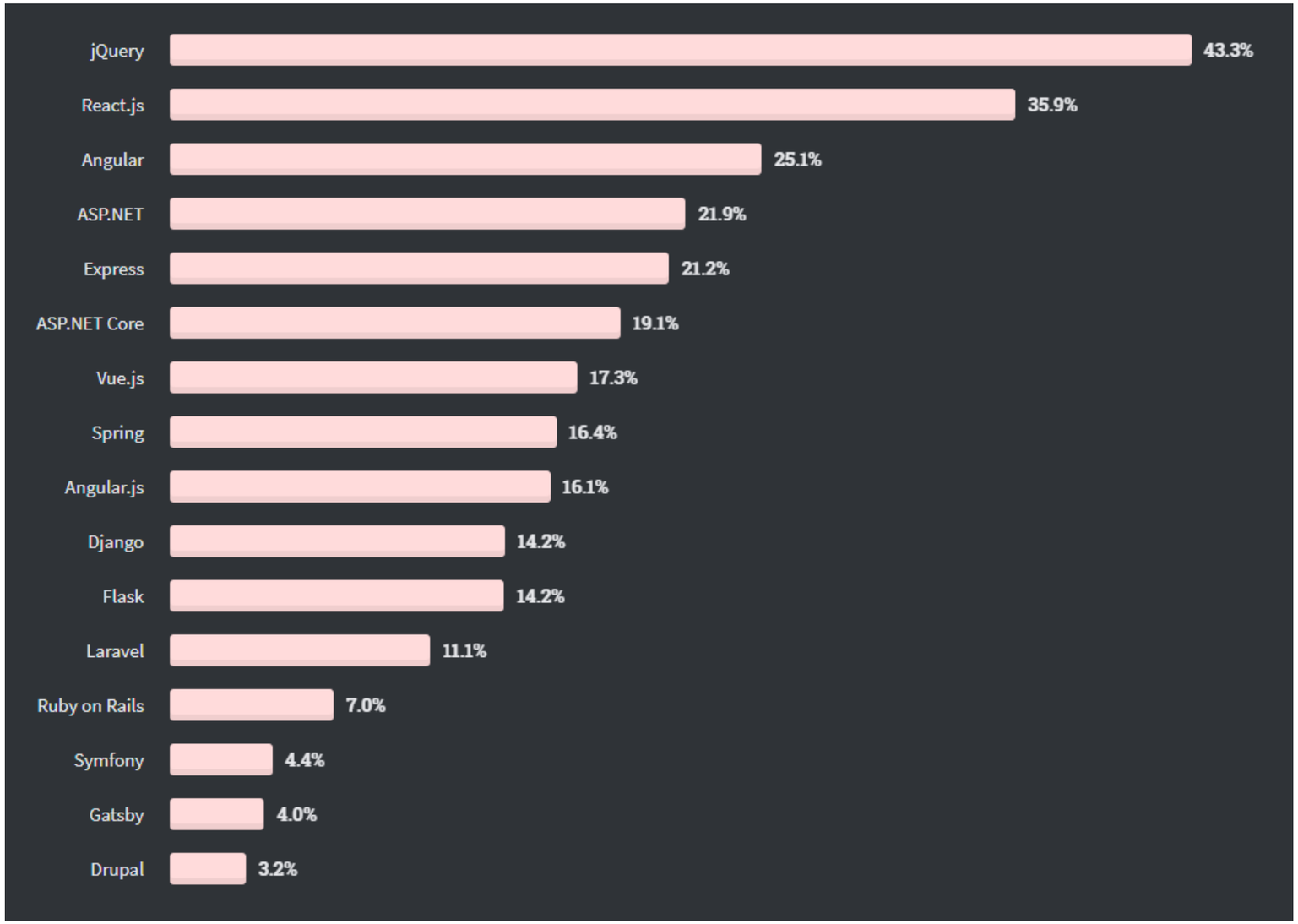
In February 2020 nearly 65,000 developers told us how they learn and level up, which tools they're using, and what they want.

NPM Trends



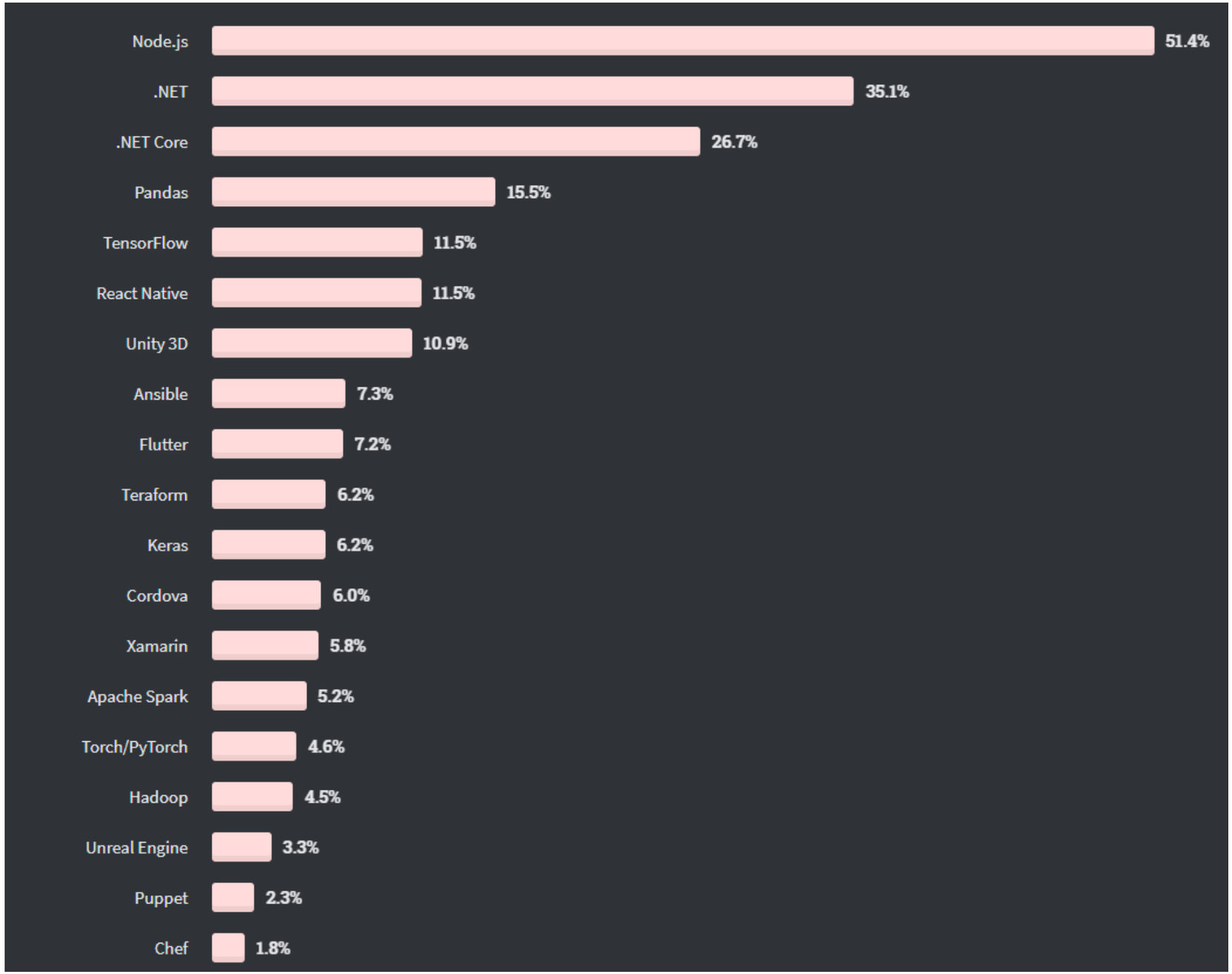
https://www.npmtrends.com/@angular/core-vs-react-vs-vue-vs-svelte

Stack Overflow Survey: Web Frameworks



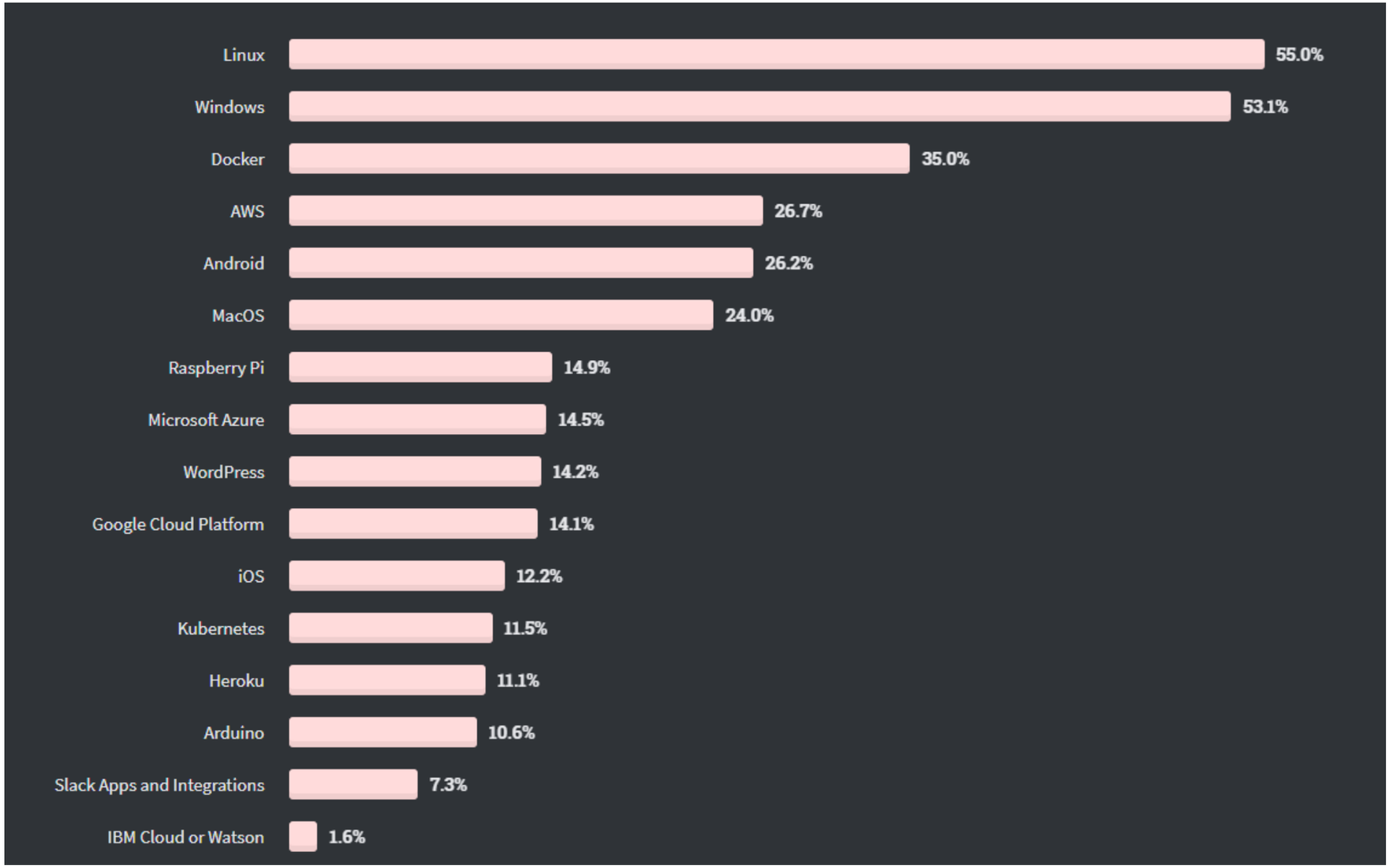
https://insights.stackoverflow.com/survey/2020#technology-web-frameworks-all-respondents2

Stack Overflow Survey: Other Tools



https://insights.stackoverflow.com/survey/2020#technology-web-frameworks-all-respondents2

Stack Overflow Survey: Platforms



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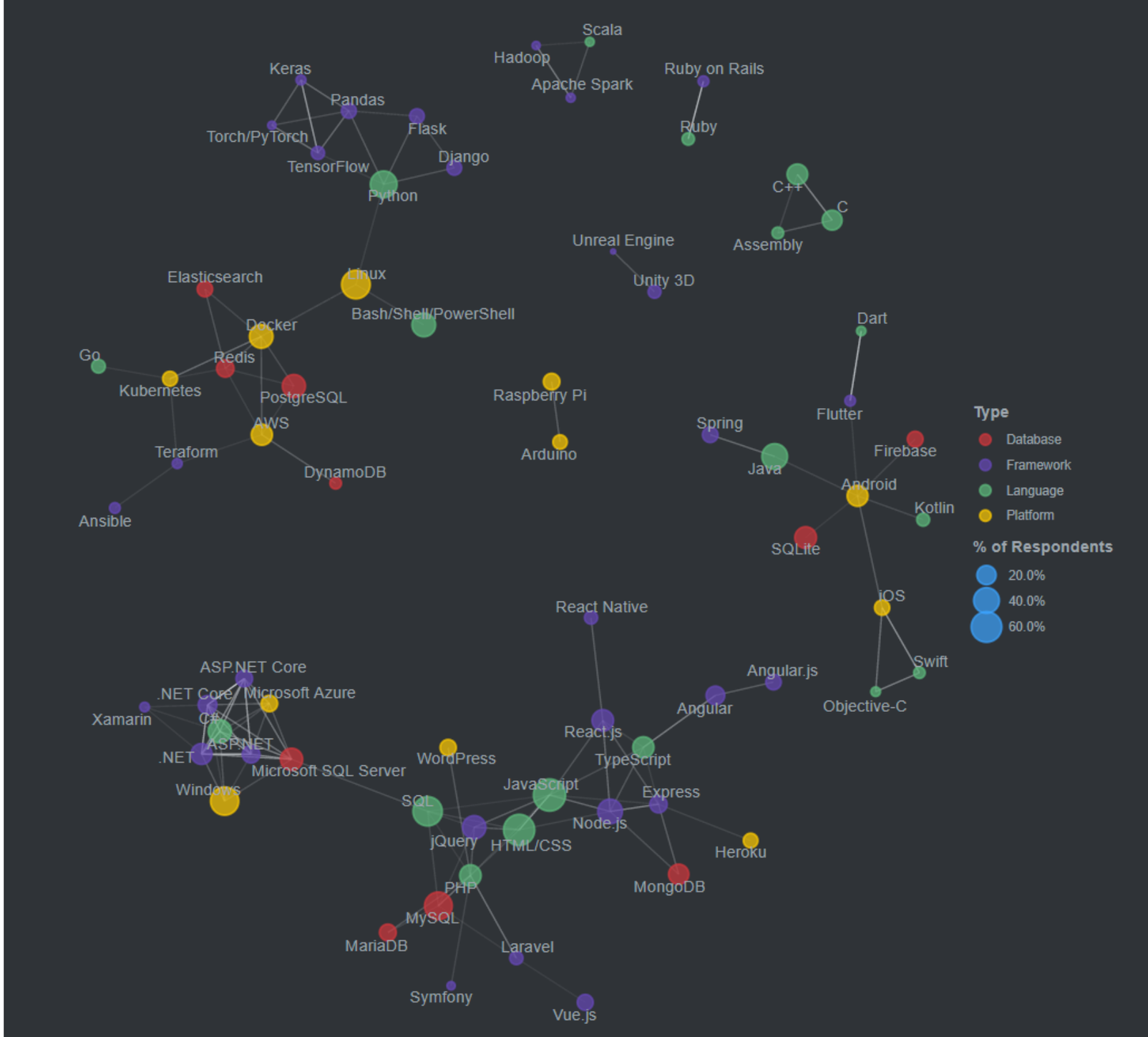
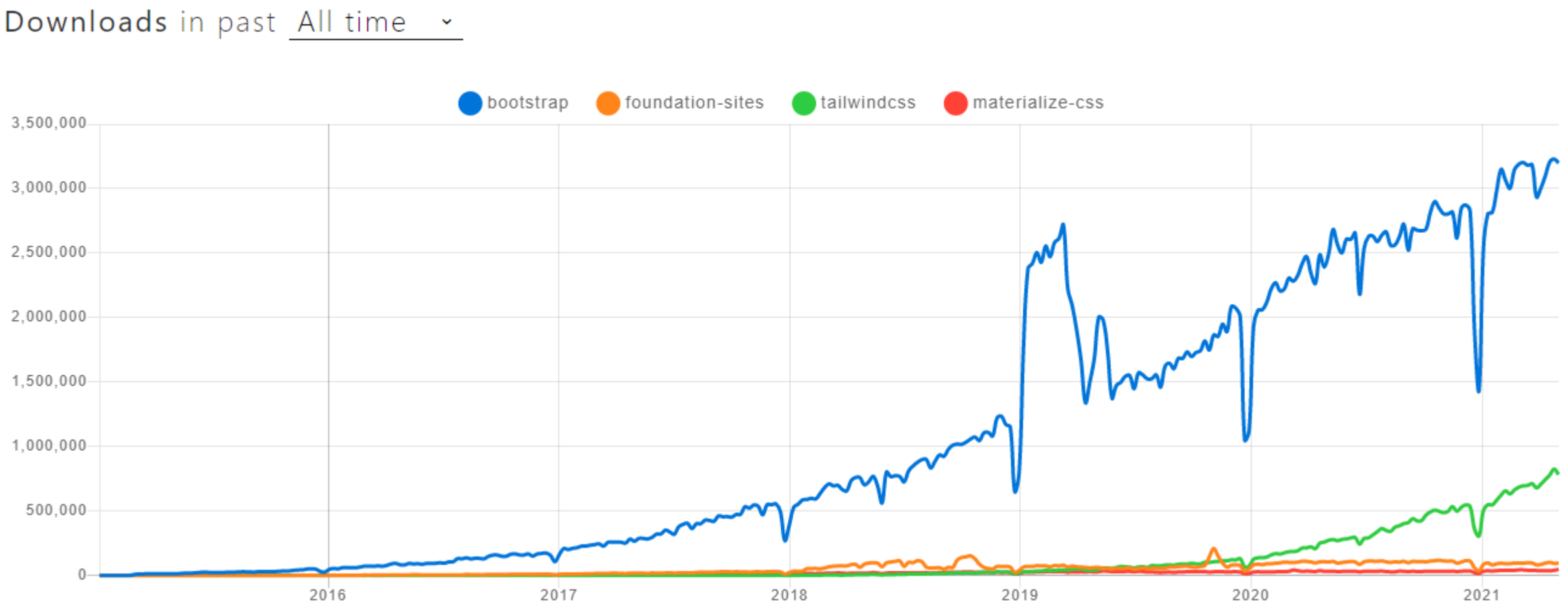
Stack Overflow Survey: Platforms



NPM Trends



https://www.npmtrends.com/bootstrap-vs-foundation-sites-vs-tailwindcss-vs-materialize-css

Stack Overflow Trends

See how technologies have trended over time based on use of their tags since 2008, when Stack Overflow was founded. Enter up to 15 tags to compare growth and decline.

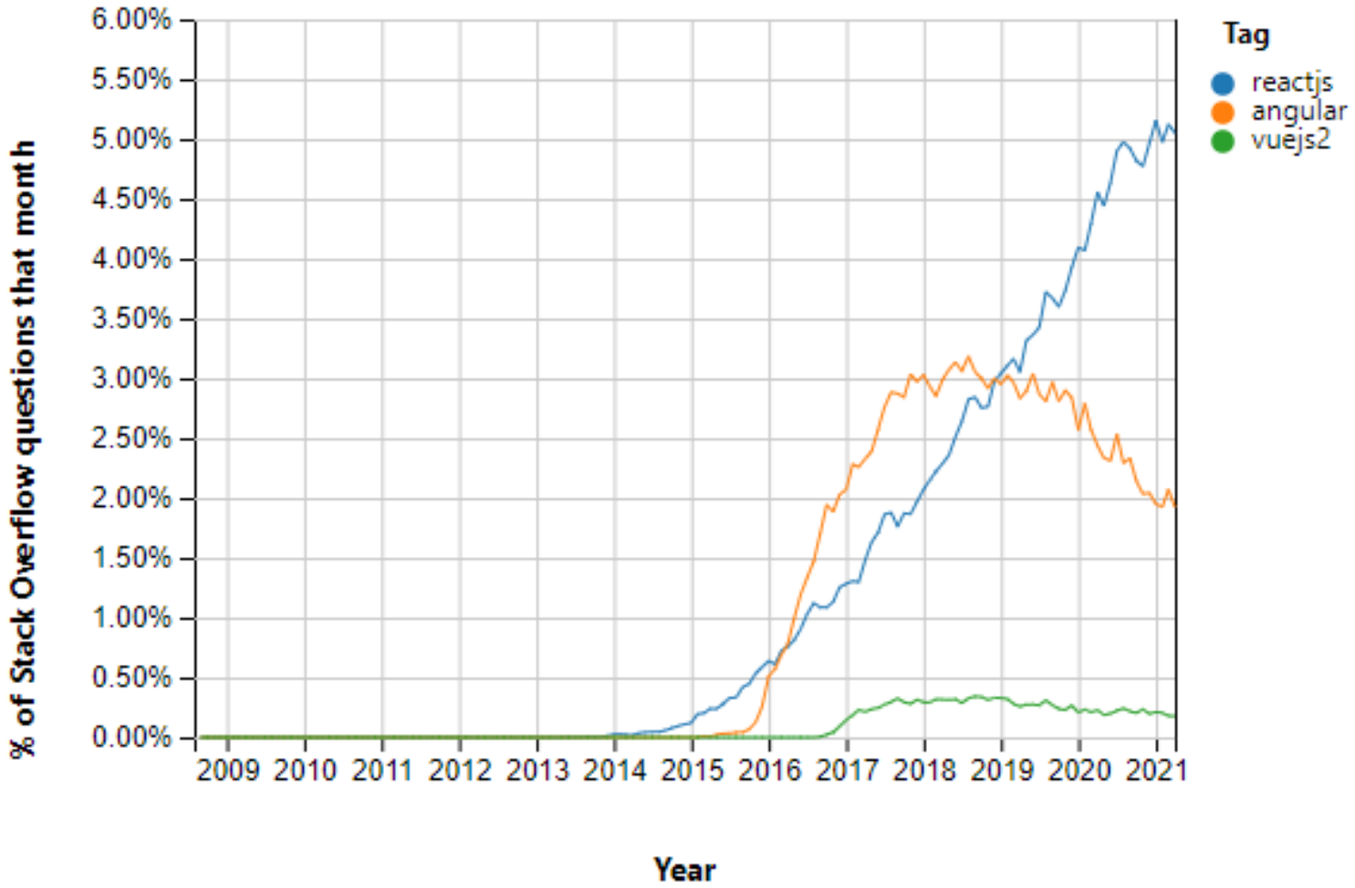
svelte not found!

Tags:

reactjs × angular × vuejs2 ×

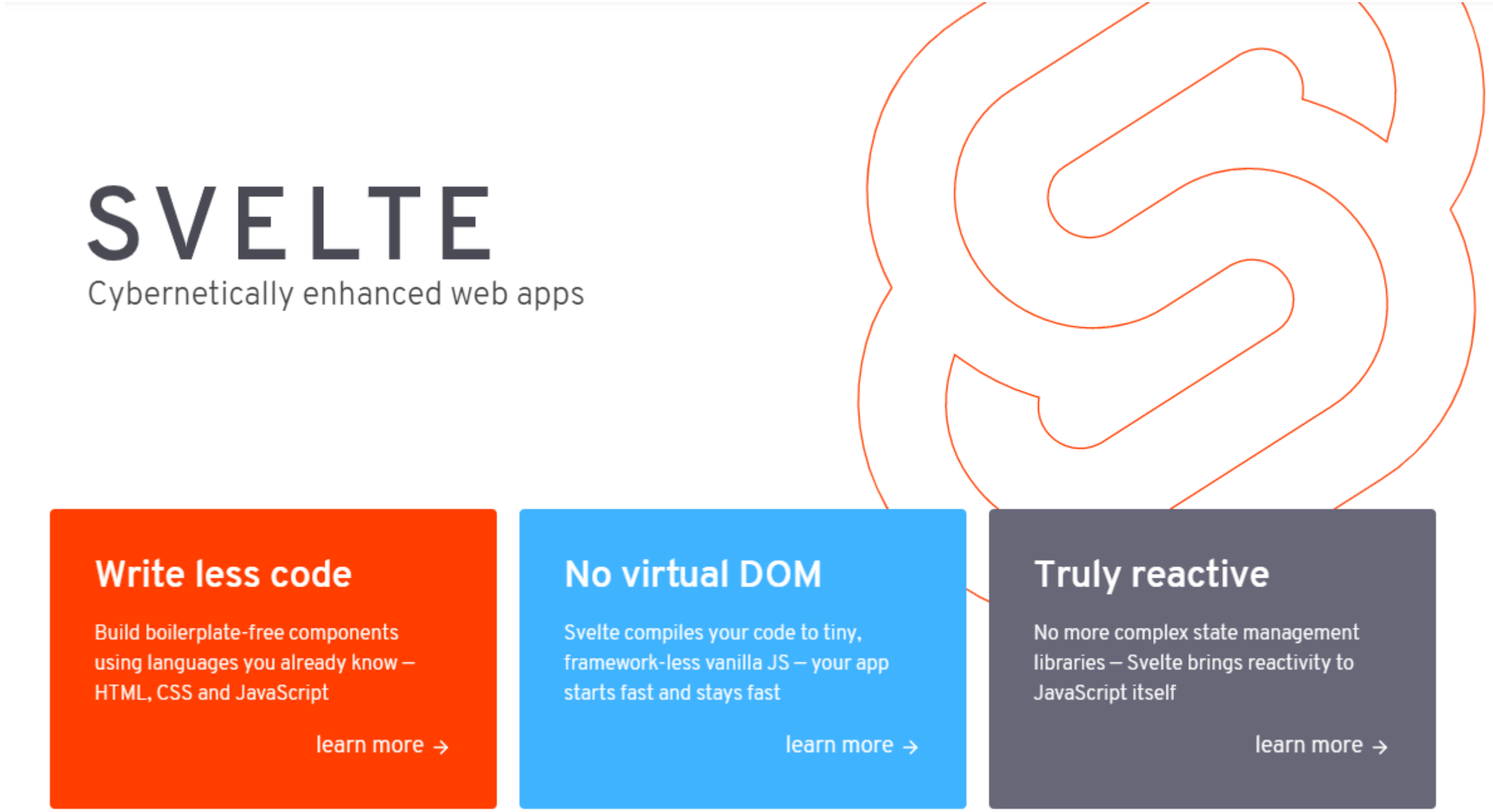
.htaccess
.net
.net-2.0
.net-3.5
2d
32bit-64bit
3d
64-bit
abap
abstract-class
accessibility

For more on this tool and what you can learn from it, see our blog post.



https://insights.stackoverflow.com/trends?tags=reactjs%2Cangular%2Cvuejs2

SVELTE: The "Disappearing Framework" compiles to vanilla JS



Performance Benchmark

https://krausest.github.io/js-framework-benchmark/current.html

https://javascript.plainenglish.io/javascript-frameworks-performance-comparison-2020-cd881ac21fce

Fast Group
Svelte

Avg. Group
Vue

Slowest Group
React
Angular

Name Duration for...	vanillajs-1	vanillajs	mikado-v0.7.64	wasm-bindgen-v0.2.47	vanillajs-wc	fullweb-helpers-v0.1.0	solid-v0.20.0	1more-v0.1.5	fullweb-template-v0.1.0	solid-state-v0.20.0	domdiff-v2.2.2	sinuous-v0.27.12	sifrr-v0.0.5	fntags-v0.4.7	ko-jsx-v0.16.1	stdweb-v0.4.17	vuerx-jsx-v0.2.0	attodom-v0.12.0	doohtml	ivi-v0.27.1	mimbl-v0.6.5	scarlets-frame-v0.34.6	petit-dom-v0.2.0	s2-v1.0.0	inferno-v7.4.8	san-v3.10.1	mobx-jsx-v0.14.0	dominator-v0.5.0	uhtml-v1.8.1
Implementation notes	772	772		772	772	772			772		772	800 801	800 801			772		772	772					800		800			801
create rows creating 1,000 rows	77.9 ±0.8 (1.00)	78.7 ±1.3 (1.01)	84.0 ±0.6 (1.08)	85.7 ±1.0 (1.10)	88.9 ±0.7 (1.14)	89.7 ±1.0 (1.15)	83.5 ±0.7 (1.07)	84.7 ±1.5 (1.09)	93.4 ±1.4 (1.20)	85.6 ±1.1 (1.10)	86.3 ±1.1 (1.11)	97.7 ±1.5 (1.25)	85.4 ±0.9 (1.10)	98.8 ±1.1 (1.27)	93.4 ±1.5 (1.20)	98.4 ±1.2 (1.26)	91.8 ±1.5 (1.18)	90.7 ±1.0 (1.16)	86.3 ±0.4 (1.11)	94.0 ±2.4 (1.21)	110.4 ±2.6 (1.42)	99.2 ±1.5 (1.27)	100.5 ±1.5 (1.29)	104.3 ±2.1 (1.34)	94.0 ±1.9 (1.21)	92.7 ±1.6 (1.19)	103.7 ±1.2 (1.33)	109.6 ±0.8 (1.41)	93.5 ±1.1 (1.20)
replace all rows updating all 1,000 rows (5 warmup runs).	83.6 ±0.7 (1.00)	83.7 ±1.4 (1.00)	85.4 ±1.1 (1.02)	88.5 ±0.6 (1.06)	90.7 ±1.0 (1.09)	90.1 ±0.5 (1.08)	89.3 ±1.6 (1.07)	84.3 ±0.7 (1.01)	93.9 ±1.3 (1.12)	88.9 ±0.9 (1.06)	92.9 ±0.5 (1.11)	97.2 ±1.6 (1.16)	86.2 ±1.0 (1.03)	101.6 ±1.0 (1.22)	89.1 ±0.9 (1.07)	94.9 ±0.6 (1.14)	95.1 ±2.1 (1.14)	92.4 ±0.8 (1.11)	131.1 ±0.6 (1.57)	88.7 ±1.0 (1.06)	97.0 ±1.0 (1.16)	94.4 ±1.0 (1.13)	95.9 ±1.0 (1.15)	101.7 ±1.2 (1.22)	88.0 ±1.6 (1.05)	89.5 ±0.7 (1.07)	94.5 ±1.2 (1.13)	103.8 ±0.6 (1.24)	92.8 ±1.4 (1.11)
partial update updating every 10th row for 1,000 rows (3 warmup runs). 16x CPU slowdown.	121.6 ±2.4 (1.04)	123.5 ±2.0 (1.05)	117.3 ±2.1 (1.00)	123.8 ±1.3 (1.06)	124.6 ±2.4 (1.06)	125.1 ±2.0 (1.07)	119.8 ±2.3 (1.02)	124.7 ±3.5 (1.06)	118.6 ±1.4 (1.01)	125.4 ±2.3 (1.07)	126.7 ±1.4 (1.08)	122.5 ±1.0 (1.04)	127.5 ±1.7 (1.09)	126.6 ±2.4 (1.08)	138.6 ±1.8 (1.18)	124.3 ±1.5 (1.06)	134.2 ±2.1 (1.14)	133.9 ±1.4 (1.14)	139.7 ±1.3 (1.19)	159.4 ±2.8 (1.36)	121.7 ±1.3 (1.04)	127.3 ±1.5 (1.09)	132.7 ±2.0 (1.13)	128.1 ±1.7 (1.09)	133.0 ±1.4 (1.13)	158.6 ±5.9 (1.35)	156.2 ±2.1 (1.33)	125.0 ±2.4 (1.07)	128.2 ±3.1 (1.09)
select row highlighting a selected row. (no warmup runs). 16x CPU slowdown.	18.7 ±1.3 (1.12)	19.7 ±1.4 (1.18)	20.3 ±1.4 (1.21)	21.6 ±0.8 (1.29)	19.3 ±1.5 (1.15)	18.3 ±1.5 (1.09)	21.2 ±1.5 (1.26)	25.4 ±1.8 (1.51)	19.7 ±1.6 (1.18)	23.4 ±1.6 (1.39)	24.7 ±1.2 (1.47)	18.0 ±1.5 (1.07)	35.8 ±1.1 (2.13)	18.8 ±1.4 (1.12)	20.5 ±1.9 (1.22)	21.9 ±1.4 (1.30)	24.2 ±1.3 (1.44)	36.7 ±1.1 (2.19)	18.1 ±1.2 (1.08)	28.4 ±1.7 (1.69)	19.8 ±1.2 (1.18)	33.1 ±1.8 (1.97)	34.9 ±2.4 (2.08)	24.9 ±1.4 (1.48)	45.5 ±1.9 (2.71)	33.8 ±0.7 (2.01)	21.4 ±1.9 (1.27)	21.7 ±1.6 (1.29)	41.3 ±1.7 (2.46)
swap rows swap 2 rows for table with 1,000 rows. (5 warmup runs). 4x CPU slowdown.	40.7 ±0.4 (1.01)	41.2 ±0.5 (1.02)	40.5 ±0.4 (1.00)	40.8 ±0.4 (1.01)	41.7 ±0.4 (1.03)	41.9 ±0.5 (1.04)	42.6 ±0.6 (1.05)	42.1 ±0.3 (1.04)	42.4 ±0.6 (1.05)	43.9 ±0.4 (1.08)	43.8 ±0.5 (1.08)	43.1 ±0.4 (1.07)	44.0 ±0.6 (1.09)	43.2 ±0.4 (1.07)	42.1 ±0.3 (1.04)	41.3 ±0.4 (1.02)	48.2 ±0.8 (1.19)	43.2 ±0.4 (1.07)	42.7 ±0.8 (1.05)	44.1 ±0.4 (1.09)	42.1 ±0.4 (1.04)	42.5 ±0.4 (1.05)	42.9 ±0.5 (1.06)	42.3 ±0.9 (1.04)	41.7 ±0.4 (1.03)	41.9 ±0.2 (1.04)	46.3 ±0.4 (1.14)	41.9 ±0.3 (1.03)	43.5 ±0.5 (1.08)
remove row removing one row. (5 warmup runs).	19.0 ±0.2 (1.00)	19.1 ±0.3 (1.00)	19.1 ±0.3 (1.00)	19.0 ±0.2 (1.00)	19.5 ±0.4 (1.03)	19.5 ±0.7 (1.03)	20.6 ±0.8 (1.08)	19.1 ±0.6 (1.01)	19.6 ±0.2 (1.03)	20.5 ±0.1 (1.08)	19.8 ±0.8 (1.04)	19.8 ±0.2 (1.04)	19.8 ±0.5 (1.04)	20.6 ±1.0 (1.09)	20.0 ±0.5 (1.05)	20.2 ±0.5 (1.06)	21.1 ±0.2 (1.11)	19.5 ±0.2 (1.02)	19.4 ±0.3 (1.02)	22.5 ±0.2 (1.18)	19.3 ±0.5 (1.02)	19.9 ±0.3 (1.05)	19.6 ±0.6 (1.03)	19.7 ±0.5 (1.04)	19.4 ±0.6 (1.02)	19.6 ±0.6 (1.04)	21.2 ±0.5 (1.12)	19.3 ±0.6 (1.02)	20.3 ±0.3 (1.07)
create many rows creating 10,000 rows	767.0 ±8.4 (1.00)	773.1 ±7.6 (1.01)	795.2 ±3.1 (1.04)	811.8 ±7.2 (1.06)	847.7 ±17.1 (1.11)	885.9 ±3.6 (1.16)	816.3 ±4.6 (1.06)	791.2 ±9.0 (1.03)	937.4 ±4.0 (1.22)	830.5 ±6.1 (1.08)	838.8 ±16.9 (1.09)	956.1 ±6.4 (1.25)	790.9 ±13.0 (1.03)	985.8 ±3.8 (1.29)	870.2 ±3.5 (1.13)	961.9 ±8.7 (1.25)	877.3 ±9.0 (1.14)	892.9 ±6.4 (1.16)	1,425.1 ±10.1 (1.86)	848.1 ±4.3 (1.11)	1,051.2 ±10.0 (1.37)	947.0 ±15.2 (1.23)	927.6 ±4.8 (1.21)	999.5 ±3.2 (1.30)	837.8 ±13.0 (1.09)	860.9 ±15.1 (1.12)	1,059.9 ±29.7 (1.38)	1,244.7 ±50.4 (1.62)	929.9 ±2.4 (1.21)
append rows to large table appending 1,000 to a table of 10,000 rows. 2x CPU slowdown	169.6 ±1.4 (1.00)	171.0 ±1.7 (1.01)	177.8 ±0.9 (1.05)	184.5 ±1.2 (1.09)	188.5 ±1.2 (1.11)	188.6 ±1.6 (1.11)	179.0 ±1.2 (1.06)	175.2 ±1.2 (1.03)	190.5 ±1.5 (1.12)	185.5 ±1.6 (1.09)	184.5 ±0.9 (1.09)	199.3 ±2.3 (1.17)	180.3 ±1.4 (1.06)	206.8 ±2.1 (1.22)	194.6 ±3.2 (1.15)	204.4 ±2.0 (1.21)	197.7 ±1.3 (1.17)	188.3 ±0.6 (1.11)	177.4 ±1.0 (1.05)	195.7 ±1.8 (1.15)	217.3 ±2.9 (1.28)	191.1 ±3.0 (1.13)	196.6 ±1.7 (1.16)	207.6 ±1.0 (1.22)	184.6 ±1.5 (1.09)	189.2 ±1.3 (1.12)	210.1 ±1.8 (1.24)	215.1 ±0.6 (1.27)	207.3 ±1.9 (1.22)
clear rows clearing a table with 1,000 rows. 8x CPU slowdown	81.8 ±0.7 (1.00)	83.9 ±0.5 (1.03)	82.3 ±0.7 (1.01)	88.7 ±0.7 (1.09)	83.6 ±0.6 (1.02)	84.9 ±0.5 (1.04)	89.0 ±0.4 (1.09)	85.9 ±0.6 (1.05)	83.2 ±0.5 (1.02)	90.1 ±1.1 (1.10)	92.8 ±0.6 (1.14)	102.3 ±0.8 (1.25)	84.5 ±1.1 (1.04)	85.4 ±0.8 (1.05)	112.5 ±1.1 (1.38)	93.0 ±0.7 (1.14)	91.9 ±0.8 (1.13)	85.7 ±0.7 (1.05)	87.3 ±0.8 (1.07)	84.4 ±0.5 (1.03)	111.7 ±0.7 (1.37)	91.1 ±0.7 (1.12)	85.6 ±0.7 (1.05)	107.0 ±0.7 (1.31)	101.4 ±0.9 (1.24)	107.4 ±0.6 (1.32)	96.2 ±0.8 (1.18)	105.1 ±1.1 (1.29)	93.6 ±0.5 (1.15)
geometric mean of all factors in the table	1.02	1.03	1.04	1.08	1.08	1.08	1.08	1.08	1.10	1.12	1.13	1.14	1.14	1.15	1.15	1.16	1.18	1.19	1.20	1.20	1.20	1.20	1.21	1.22	1.22	1.22	1.23	1.24	1.24

Check Them Out

https://todomvc.com/

Some References

https://www.imaginarycloud.com/blog/a-javascript-ecosystem-overview/

https://codeburst.io/stack-choices-react-vs-vue-vs-angular-vs-svelte-49aa0170c634

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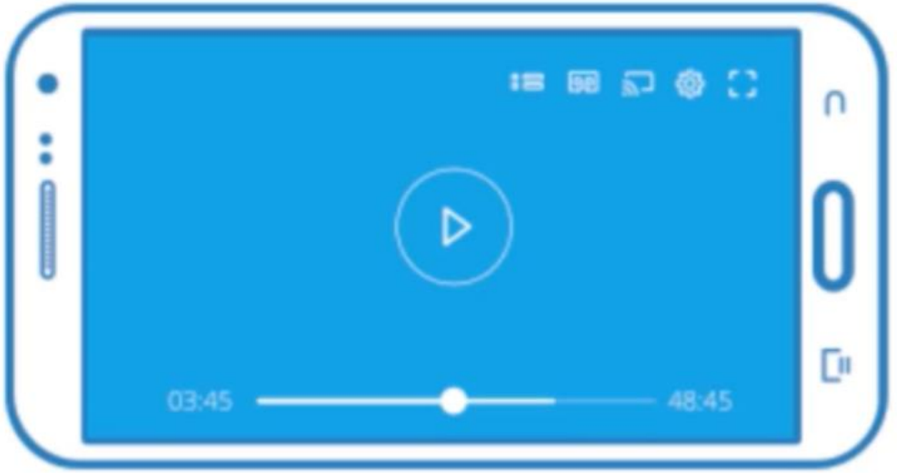
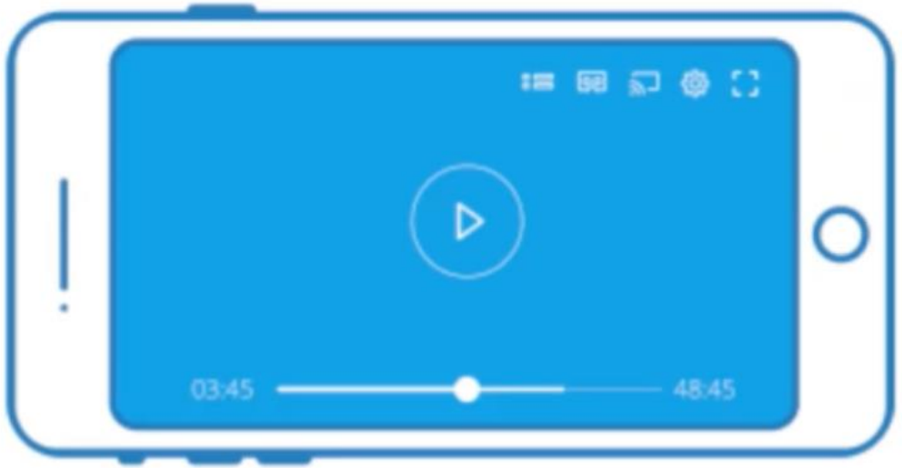
Mobile Dev Frameworks





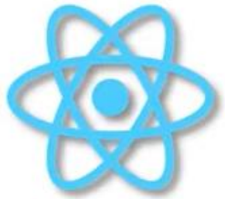
Android SDK

iOS SDK

Overview of Technologies

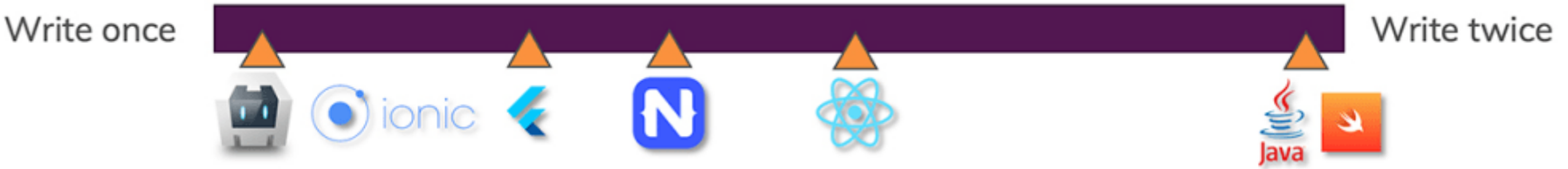
	Native iOS, Android	React Native	Xamarin	Flutter	Ionic	Capacitor	Cordova
Language(s)	Swift, Kotlin Objective C, Java, C++	JavaScript	C#	Dart	HTML, CSS, JavaScript	HTML, CSS, JavaScript	HTML, CSS, JavaScript
UI	Native UI	Native UI	Native UI	Custom	Web UI	Web UI	Web UI
Mobile UI toolkit	Yes	Yes	Yes	Yes	Yes		
Access to native SDK	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Framework(s) supported		React	.NET		Angular, React, Vue	Any JS Framework	Any JS Framework
Use custom UI libraries or Web Components					Yes	Yes	Yes
Convert web app to mobile						Yes	Yes
Access to dedicated support team					Yes	Yes	
Premium mobile security, storage, and integrations					Yes	Yes	
Cloud app publishing and CI/CD			Yes		Yes	Yes	

Table source

React Native	Flutter	NativeScript	Ionic Framework
			
Uses JavaScript	Uses Dart	Uses JavaScript	Uses JavaScript
Partly Compiled to Native Code	Compiled to ARM C/C++ Library	Partly Compiled to Native Code	Not Compiled to Native Code (Wrapped Web App)
JS was not invented for this (but turns out to work really well...)	Dart was also not invented for this BUT is developed by the same company (Google)	JS was not invented for this (but turns out to work really well...)	JS was not invented for this (but turns out to work really well...)
Ships with some pre-built, partly adaptive components	Ships with a lot of pre-built, partly adaptive components	Ships with some pre-built, mostly adaptive components	Ships with loads of pre-built, fully adaptive components

https://academind.com/tutorials/react-native-vs-flutter-vs-ionic-vs-nativescript-vs-pwa/

"Write once, use everywhere"



Rich pre-styled Component Library

Performance

Accessing Native Device Features

https://academind.com/tutorials/react-native-vs-flutter-vs-ionic-vs-nativescript-vs-pwa/

Apache Cordova

https://cordova.apache.org/

Cordova

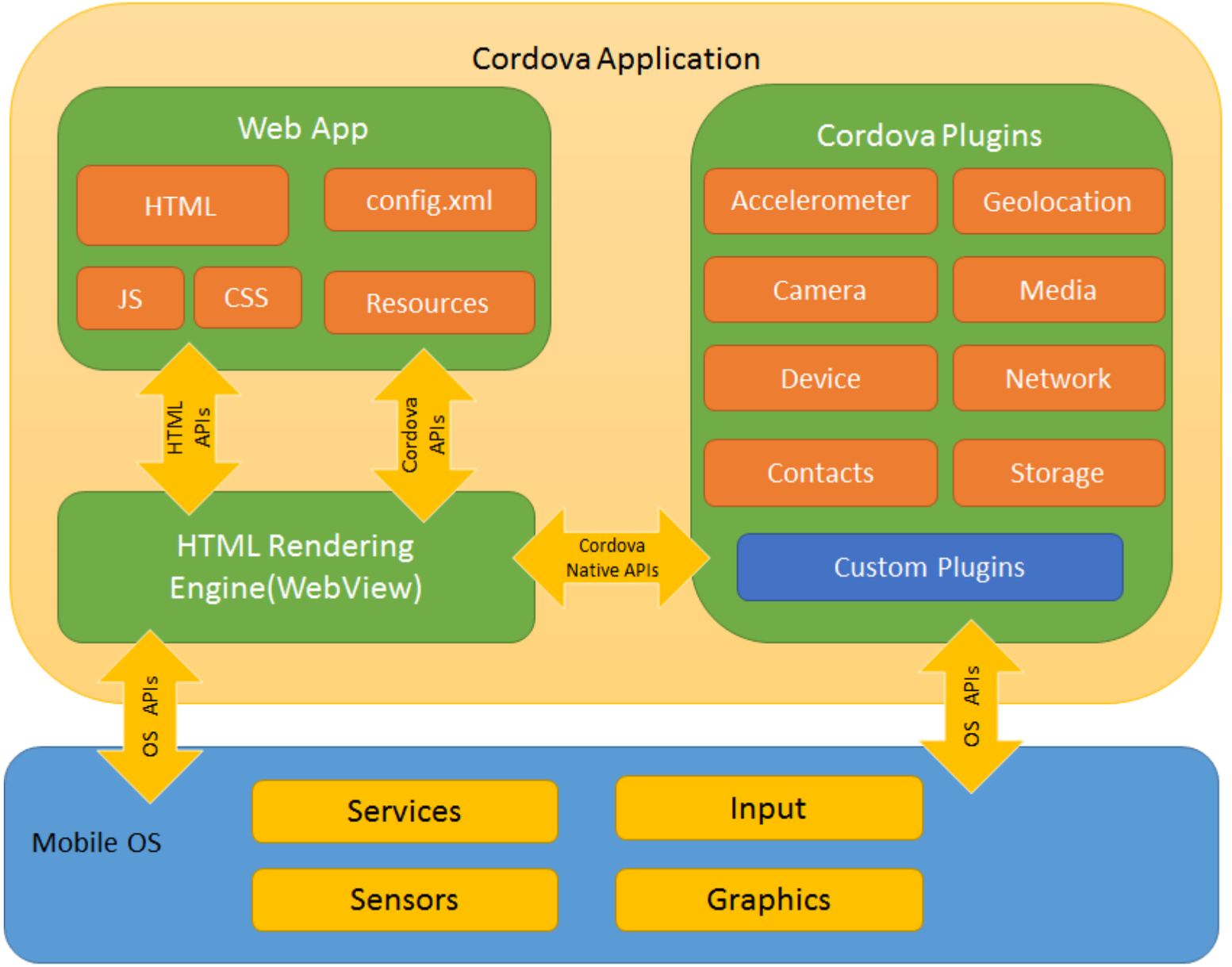
- Allows developers to create web pages that are run inside a device's browser instance called **WebView**

Image source

Cordova

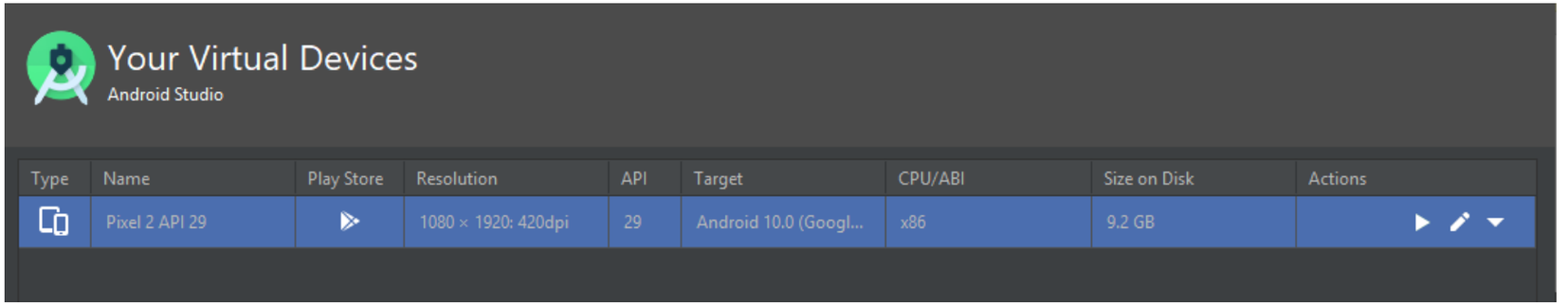
- 2008 Nitobi, a web development company from Canada created the PhoneGap framework to run web application in a mobile phone inside WebView
- 2011, Adobe bought Nitobi, and the PhoneGap framework was donated to the Apache Foundation
- Project was renamed Cordova (after the street name of Nitobi's office in Vancouver, Canada).

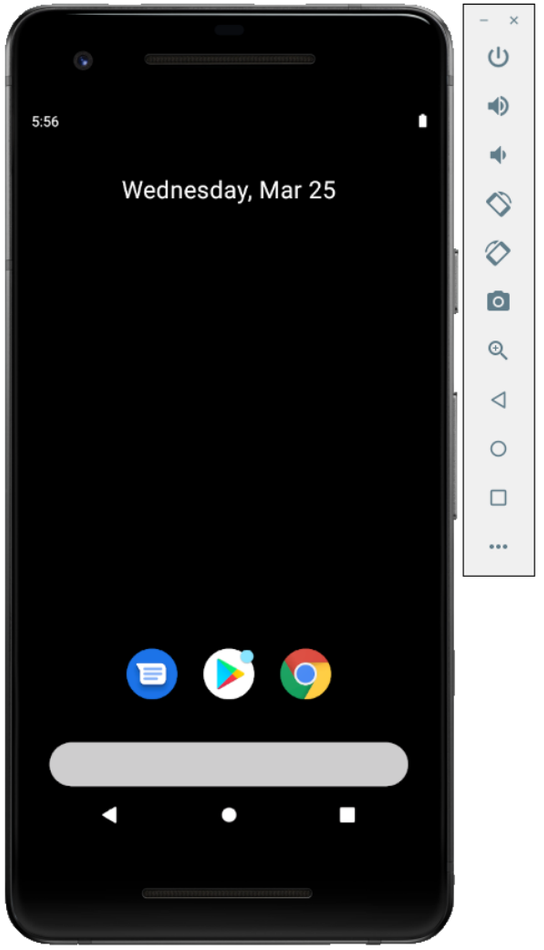
- Adobe ~~has~~ had some paid services such as the PhoneGap Build service
- **Adobe discontinued PhoneGap Build Services and investments in Apache Cordova on Oct 2020**


Cordova Application
Web App
HTML
config.xml
JS
CSS
Resources
Cordova Plugins
Accelerometer
Geolocation
Camera
Media
Device
Network
Contacts
Storage
Custom Plugins
HTML APIs
Cordova APIs
HTML Rendering Engine(WebView)
Cordova Native APIs
OS APIs
OS APIs
Mobile OS
Services
Input
Sensors
Graphics

Cordova Installation and Configuration

- Follow steps in separate slide deck (include installing Android Studio)





Running and Debugging (Android)

- After creating a Cordova project

To test in emulator

```
cordova run android
```

To test on your phone:

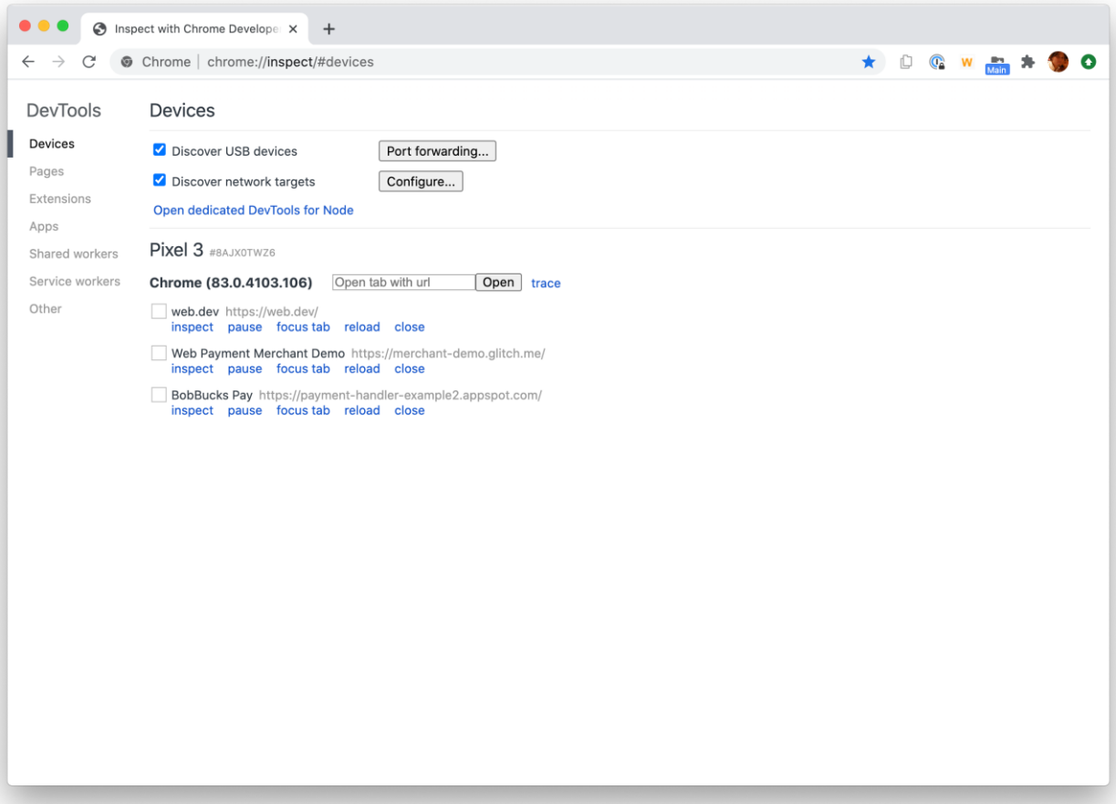
```
cordova run android --device
```

(device must be connected, developer mode enabled, USB debugging enabled)

Debugging Android Phone

- Follow this guide:
- https://developer.chrome.com/docs/devtools/remote-debugging/
- But remember to enable **Port Forwarding.** For instance:
- If you are running an Express server on your machine on localhost:3000, you need to add port forwarding to localhost:3000
- Then your phone can access your server and vice versa

chrome://inspect#devices



Ionic Framework

Quick intro

Ionic is...

The leading cross-platform dev solution

Powering >15% of apps in the app stores

5 Million developers worldwide

A web-first approach

https://ionicframework.com/

Ionic

- Open source for hybrid mobile app development.
- Originally released in 2013 and built on top of AngularJS and Apache Cordova.
- Since 2019 introduced Web Components, allowing the user to choose any user interface framework, such as Angular, React or Vue.js, as well as vanilla JS.
- Web Components make use of (i) **custom elements**, (ii) rendered by the browser in the **shadow DOM**, (iii) using **HTML templates**.
- Uses native functionality based on Apache Cordova plugins
- It is introducing an alternative to Cordova, named Capacitor

Design Guidelines

To design a user interface design you need to keep up to users expectations, which are different across different platforms.

For example, an Android application that has an iOS-style UI will probably not go over well.

It is important to respect the conventions of each platform and the various Human Interface guidelines:

- https://developer.apple.com/design/human-interface-guidelines/ios/overview/themes/
- https://developer.android.com/design/

Ionic has got you covered: it automatically adapts the UI to the platform in which it runs.

Ionic Components Overview

Output	Layout	Input
<ion-img> <ion-badge> <ion-loading> <ion-label> <ion-title> <ion-thumbnail> <ion-toolbar> <ion-alert> <ion-toast> <ion-modal> …	<ion-grid> <ion-row> <ion-col> <ion-list> <ion-card> <ion-infinite-scroll> <ion-tabs> …	<ion-button> <ion-input> <ion-textarea> <ion-menu> <ion-select> <ion-datetime> <ion-fab> <ion-toggle> …

Progressive Web Apps (PWAs)

Progressive Web Apps (PWAs)

- **Reliable**: Through caching it is available offline
- **Engaging:** Has access to native features (some of them)
- **Installable**: create a link/shortcut that looks like a native app/program on devices

PWAs vs Native App vs Traditional Web Apps

	Features	Reach
Native Apps	**Full** access to OS and device	**Limited,** Top 3 apps win
Traditional Web Apps	**Highly limited** access to OS	**High** reach
Progressive Web Apps	**Good** access to OS and device	**High** reach

Avg. mobile user spend on 80% of time on top 3 mobile apps and install 0 apps.

PWAs Stats: A New Trend

- At the end of 2020, approximately **1% of websites included a Service Worker, and 2.2%** had an installable Web App Manifest file.
- In 2021, 18% of page loads have a Service Worker controlling them.
- It's also good to compare the platform's growth: **Service Workers' usage has increased 38% in the last year**.
- Number of origins with PWAs has grown **170**% in 2020

Source: https://firt.dev/pwa-2021/

PWAs Building Blocks

Manifest
Makes App installable

Service Worker
Offline caching, Web Push

Other Principles and API
Geolocation, Responsive Design, Media API

Can I Use PWAs?

Add to home screen (A2HS) - WD

The ability for a user to "install" a website and use it as if it was a natively installed app. To enable this behaviour, a website must serve a valid Web App Manifest and load it's assets through a Service Worker.

Usage: Global — % of all users: 73.48% + 13.29% = 86.77%

Current aligned | Usage relative | Date relative | Filtered | All

IE	Edge *	Firefox	Chrome	Safari	Opera	Safari on iOS *	Opera Mini *	Android Browser *	Opera Mobile *	Chrome for Android	Firefox for Android	UC Browser for Android	Samsung Internet	QQ Browser	Baidu Browser	KaiOS Browser
	12-16	2-75														
	1 17-18	3 76-85	4-38			3.2-11.2										
6-10	79-89	86-87	39-89	3.1-14	10-74	2 11.3-14.4		2.1-4.4.4	12-12.1				4-13.0			
11	90	88	90	14.1	75	2 14.5	all	90	62	90	87	12.12	14.0	10.4	7.12	2.5
		89-90	91-93	TP												

https://caniuse.com/web-app-manifest

Check How Much PWA Your Site Is

Lighthouse

https://developers.google.com/web/tools/lighthouse

Lighthouse is an open-source, automated tool for improving the quality of web pages. You can run it against any web page, public or requiring authentication. It has audits for performance, accessibility, progressive web apps, SEO and more.

You can run Lighthouse in Chrome DevTools, from the command line, or as a Node module. You give Lighthouse a URL to audit, it runs a series of audits against the page, and then it generates a report on how well the page did. From there, use the failing audits as indicators on how to improve the page. Each audit has a reference doc explaining why the audit is important, as well as how to fix it.

You can also use Lighthouse CI to prevent regressions on your sites.

For instance, you may check: https://app.ft.com/stream/home

Some References

https://medium.com/@firt/progressive-web-apps-in-2020-c15018c9931c

https://firt.dev/pwa-2021/

https://brainhub.eu/library/is-pwa-the-future/

https://web.dev/customize-install/

https://web.dev/add-manifest/

chrome://apps/

Thank You Slide ☺

HTML, JS, CSS
Bootstrap
jQuery
Node.JS
Express
Heroku
Chrome Extensions
nodeGame
Cordova
Ionic Framework
PWAs
…