# Comparison of Javascript Frameworks for Single Page Web Application

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**ABSTRACT**:

For software developers, it's crucial to choose suitable javascript framework that not only serve their web project needs but also provides code quality and high application performance. Nowadays most modern web applications use popular javascript frameworks. The purpose of this study is to provide the brief performance evaluation of most widely used javascript framework for single page web applications, taking into account software performance and quality factors. The major possible outcome is that we can identify pros and cons in javascript framework for single page applications, that needs to be improved for next versions.

**INTRODUCTION**:

With the advancement of Web 2.0, web applications have evolved at most. Earlier for every user input like mouse or keyboard event change require the browser to reload the page from the backend(server). Then javascript code silently performs change management in DOM. With the help of AJAX and JQuery API, programmers can easily access AJAX and DOM modifications. More demand for user experience and performance have increased the amount of code handled in client-side browsers. The rise of the Web applications called as RIA(Rich Internet Applications) has improved javascript libraries and frameworks with more focus on client-side rendering.

Finally, we came across the "Single Page Applications" (SPA), applications that dynamically rewrites the current page rather than reloading the new page from the backend. SPA makes heavy use of AJAX to get the data from servers without doing a full page reload. As a result, the application renders pages on the client side. Single Page Applications are becoming very popular with the growth of the mobile web. Few drawbacks of SPA are browser performance of less capable mobile devices and SEO. With the help of rendering SPA on the server side, performance issues can be alleviated.

There is a number of Javascript Frameworks available for developing SPAs, such as Angular, React, Ember, Aurelia, Vue.js, Cycle.js, Backbone. The list is long but I am going to cover the most popular and widely used frameworks: Angular(V2 or higher) and React.

Angular is a TypeScript-based Javascript framework. Angular is a rewritten version of AngularJS. It is basically a client-side framework but capable of doing server-side functionalities too like Database Calls, Web-services etc. The current version of angular is 6.0.0. The key concepts of angular are Modules, Components, Services, Routes. One important aspect of the angular application is modularity. Every angular application has one root module named as AppModule. Angular applications contain component-based architecture. A component controls a view of the page. We define a component's application logic that support the view inside a class. The class interacts with the view via an API of properties and methods. A service provides any data, function, or feature that your application needs. A service is typically a class with a well-defined purpose; it does something specific and do it well.

React is a JavaScript library for building user interfaces. React is developed and maintained by the Facebook. According to Facebook, react is more used at FB rather that angular at Google. Famous companies like, Uber, Airbnb, Twitter, Netflix, Pinterest, Wix, Paypal, Imgur, Reddit, Udemy, Feedly, Stripe, Tumblr, Walmart uses React. React follows component-based architecture. These components are combined together to build robust applications. Components have their scope, either they have own data or they inherit from the parent component. React application can be written in both compiled and uncompiled version. A compiled version of react is simple javascript while an uncompiled version of react is written in JSX. JSX allow us to write HTML code into .jsx file and it gets transformed into lightweight javascript objects. React components have application logic, state, lifecycle methods, custom methods. States are transferred from one component to another. React has to rely on the other libraries to develop full web application but react is backed by the popular community-backed libraries.

## PERFORMANCE OF JAVASCRIPT FRAMEWORK ON SINGLE PAGE WEB APPLICATIONS:

Internet technologies are evolved. Web browsers have accepted JavaScript as a unique scripting language. Incorporation of AJAX with javascript has improved user experience and application performance. Each framework uses the different approach to fulfill a goal which leads to performance issue of the application. Nevertheless, this is only taken into consideration when deciding which frameworks should be used. The study shows that performance has an intense impact on end users. When it comes to performance then mobile devices are, in general slow than a desktop or a laptop computer and, of course, the performance of the application depends on the device where it runs.

Angular put JS into HTML. React puts HTML into JS. Angular templates are enhanced with specific angular directives and syntax. While react require knowledge of JavaScript. Angular is the framework and it provides a complete solution to build application structure. There are few rules with react libraries so it is easy to integrate with the application. JSX is a big advantage for react development, because it allows everything in one place, and code completion and compile-time checks work better. When you make a typo in JSX, React won't compile, and it prints out the line number where the typo occurred. Angular fails quietly at runtime. Regarding size, Angular has a bloated file size of **143k** while React stands at **43k**. With React, data flow is one-directional only. Two-way data binding is provided by Angular where model states change according to UI elemental states. React update the model first and then renders UI. Data flows only one way in react which makes debugging easier. Angular introduces dependency injection concept, a pattern in which one object supplies the dependency to another object. We are now advancing towards microservices and microapps.

React provides more control over the size of the application. It gives more control to size an application by selecting only the things which are really necessary. React offers more resilience to move from single page application to microservices using parts of the application. Angular is best but it's excessive in size to be used for microservices. Javascript grows fast and React allow us to change small pieces of the application for better libraries rather than waiting for the framework to innovate. When it comes to feature specific application then developers prefer to react over angular. Even Facebook uses react for specific page and features. React makes a use of Virtual DOM. Virtual DOM is the in-memory representation of Real DOM. It is a lightweight JavaScript object which is the copy of Real DOM. Updating Virtual DOM in react is faster because react uses Batched update operations, efficient diff algorithm, an efficient update of subtree only and observable instead of dirty checking to detect change. While Angular uses dirty checking to find updates in the model. Dirty checking process runs in a cycle after a specified time. As the application grows, checking the whole model reduces the performance and thus makes the application slow.

## RELATED WORK:

js-framework-benchmark is a simple benchmark for several javascript frameworks. The benchmarks creates a large table with randomized entries and measures the time for various operations including rendering duration.

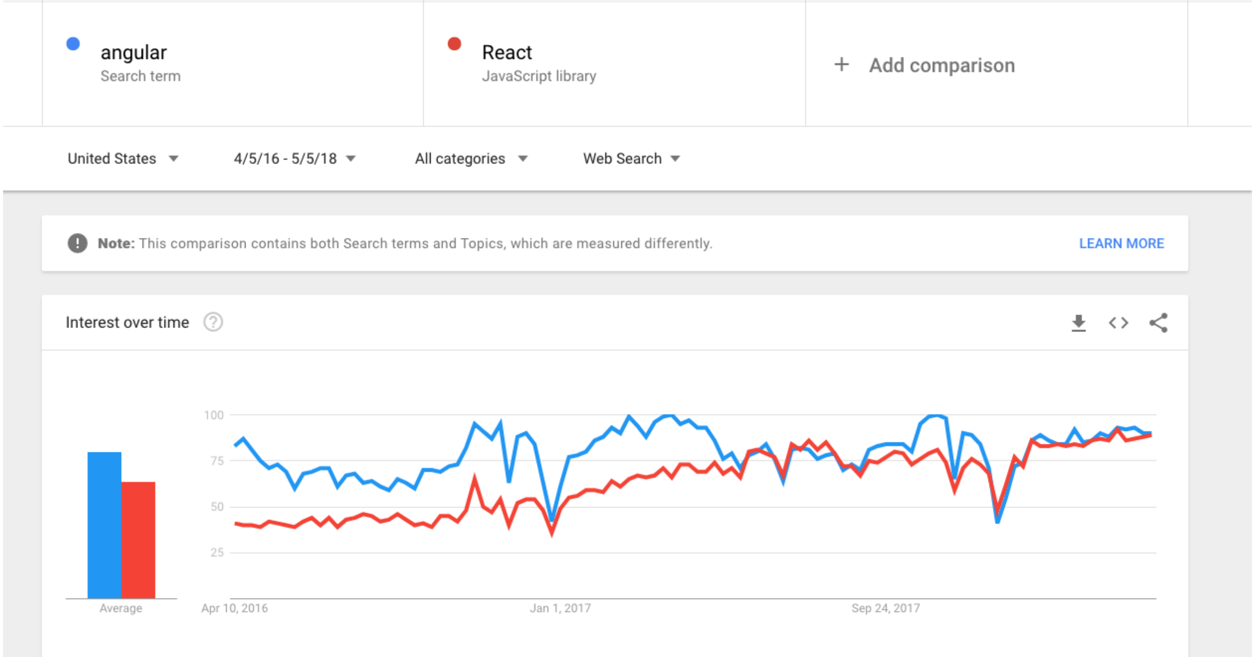
| Name | angular v4.1.2<br>(milliseconds ± standard deviation) | react v15.5.4- redux v3.6.0<br>(milliseconds ± standard deviation) |
|---|---|---|
| create rows<br>Duration of creating 1000 rows after page loaded | 193.1 +-7.9 | 212.2 +-14.2 |

| | | |
|---|---|---|
| replace all rows<br>Duration of updating all 1000 rows of the table | 197.4 +- 5.3 | 206.7 +-7.3 |
| partial update<br>time to update text of every 10th row | 13.0 +-4.5 | 18.0 +-1.6 |
| select row<br>duration to highlight a row in response to a click on the row | 3.4 +-2.3 | 8.7 +-2.9 |
| swap row<br>time to swap 2 rows on a 1k table | 13.4 +-1.0 | 17.1 +-1.3 |
| remove row<br>duration to remove a row | 46.1 +-3.2 | 52.4 +-1.7 |
| create many rows<br>duration to create 10,000 rows | 1946.0 +-41.8 | 1931.7 +-35.6 |
| clear rows<br>duration to clear rows with 10,000 rows | 379.9 +-11.3 | 410.9 +-9.8 |

(Source)

**CONCLUSION:**

React and Angular are really cool, none of them stand clearly above other. Each has its own strength and weakness. If you want to use TypeScript, object-oriented-programming (OOP), guidance, structure and large code set then angular is recommended. If you want flexibility, big ecosystems, dozens of packages, Javascript-approach, react-native then react is recommended.



angular
Search term

React
JavaScript library

United States | 4/5/16 - 5/5/18 | All categories | Web Search

**Note:** This comparison contains both Search terms and Topics, which are measured differently.

## REFERENCES:

Kerstin Altmanninger Linz, Austria. Innovations in modeling web applications. MoMM '12 Proceedings of the 10th International Conference on Advances in Mobile Computing & Multimedia

Barkmann, H., Lincke, R., Lowe, W., 2009. Quantitative evaluation of software quality metrics in open-source projects. In Proceedings of The 2009 IEEE International Workshop on Quantitative Evaluation of large-scale Systems and Technologies (QuEST09), (2009)UK, Bradford

Ratanaworabhan, P., Livshits, B., Zorn, B.G., 2010. JSMeter: Comparing the behavior of JavaScript benchmarks with real web applications. In USENIX Conference on Web Application Development (WebApps), (June 2010) 27–38

Jens Neuhaus
https://medium.com/@jensneuhaus?source=post_header_lockup

Gethyl George Kurian
https://medium.com/@gethylgeorge/how-virtual-dom-and-diffing-works-in-react-6fc805f9f84e

Rupesh Mishra
https://hackernoon.com/virtual-dom-in-reactjs-43a3fdb1d130