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Comparative analysis of MEAN stack and MERN stack

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Abstract — **Most of today's world web applications are designed using a 'stack' of various technologies. MEAN stack and MERN stack are two of the most popular and extremely powerful stacks that are used for the development of modern web applications. MERN stands for MongoDB, ExpressJS, ReactJS, and NodeJS and MEAN being for MongoDB, ExpressJS, AngularJS, and NodeJS. The key factor is that both the stacks ushers under a single umbrella named JavaScript. This ensures faster development and helps developers quickly get products to market as the need of understanding different languages to contribute to both the front-end and back-end gets eliminated, and eventually leads to a huge cut in development costs and improves efficiency. This paper revolves around analyzing features, advantages and disadvantages of the two stacks and also throws light upon the key factors that play a major role during the selection of one out of the former two.**

Keywords— **MEAN, MERN, stack, AngularJS, ReactJS, MongoDB, ExpressJS, NodeJS, MVC, DOM.**

I. INTRODUCTION

These days, web-apps and websites are developed with widgets in order to enable them load quicker, be more interactive, and more mobile-responsive. High end experiences are demanded from websites and expect some way to be similar to what users would experience using a native mobile application. On the business side of things, it is the need of the hour to develop Dev-Ops techniques in order to deliver new applications readily while rolling out updates on a day-to-day basis. As a result, one can say that the evolution of web development has been driven and accelerated by the demands of the top users.

This means that the standard technique of mixing JavaScript, CSS, and hypertext markup language is not any longer sufficient (although it gets the work done). For huge enterprise web applications, development using a web stack has proven to be a sure shot solution to meet the demands of today's web audiences. JavaScript and its successors including JSX and ES6 are the key players that enables unification of multiple technologies all together.

Now days, developers are able to use JavaScript in implementation of application logic, front-end experiences, and are also able to access databases.

Multiple stacks are used now days, but the dominant two are as follows:

- MERN (MongoDB, Express.JS, React.JS, Node.JS)
- MEAN (MongoDB, Express.JS, Angular.JS, Node.JS)

II. THE MEAN STACK

MEAN is a combination of Open Source components that all-together, provide an end-to-end framework for developing dynamic web-applications, starting from the top (code running in the browser) to the bottom (i.e. database)[1]. A common entity in the MEAN stack is JavaScript. Using JS makes a developer intensively comfortable as everything is performed using common concepts such as JS objects and asynchronous calls.

The stack is made up of:

- AngularJS
- ExpressJS
- NodeJS
- MongoDB

A) AngularJS

AngularJS (commonly referred to as "Angular.js") is a JavaScript-based open-source front-end web application framework maintained by Google and by a community of individuals and corporations to address most of the challenges faced in developing single-page applications[6].In the front end of application, multiple components are designed each of which consists of Typescript code and an HTML template. Complex applications can be designed by integrating multiple such components.

Advantages of Angular

- Dynamic (Two-way) data binding: Enables automatic synchronization of data between the view ('V' in MVC) and model ('M' in MVC) components.

- REST friendly: Representation State Transfer enables the application to rapidly interact with the server and fetch the data required to interact with the web pages.
- MVC based Pattern: (Mobile-View-Controller) Most readily used industry-standard used to create scalable and extensible projects.
- Localization
- Dependency Injection
- Deep Linking

Disadvantages of Angular

- Angular is gigantic and complex. Mastering Angular over the very basic is definitely not a cakewalk.
- Varying coding techniques complicate integration of different components.
- Extremely complex life cycle.
- Poor scalability.
- UI lag issues on multiple user loads.
- No backward compatibility for Angular 1.*.

B) ExpressJS

Express is a blazing fast, un-opinionated minimalist web framework for Node.js and is a web application framework for Node.js. It provides numerous features that make web application development super fast and easy which otherwise takes more time using only Node.js [15]. Express.js is designed using Node.js middle ware module called connect which implements http module. Henceforth most of middleware modules support unification with ExpressJS.

Advantages of ExpressJS:

- Makes Node.js web application development blazing fast and ultra easy.
- Extremely easy to configure and customize.
- Allows one to define routes of the application based on HTTP methods and URLs.
- Includes various middle ware modules which one can use to perform additional routines upon request and response.
- Compatibility support of template engines like Jade, Vash, EJS etc.
- Supports error-handling procedures.
- Serve static files and resources of one's application a cake-walk.
- Enables RESTful API server generation.
- Easy connection with databases such as MySQL, MongoDB, Redis.

C) NodeJS

Node.js is a JavaScript runtime environment that runs back-end application (via Express) [16]. NodeJS is based on Google's V8 JS JavaScript engine. It provides a number of features essential for developing web applications – including networking protocols such as HTTP. It also supports installation of third party modules making the use of npm i.e. node package manager. Node.js is an asynchronous, event-driven engine where the application makes a request and then continues working on other useful routines rather than stalling while it waits for a response [16]. Once the requested task is completed, the results are pushed back via pushback functions thus enabling parallel computing.

Advantages of NodeJS

- It is blazing fast.
- Open source and ever expanding.
- Supports Real-Time applications development.—
- Enhances overall productivity.

Disadvantages of NodeJS

- Poor performance in case of CPU intensive queries.
- Poor performance with large scale applications.
- Inconsistency issue in the NodeJS API.
- Poor performance with relational databases.

D) MongoDB

MongoDB is an open-source, document database that provides persistence for app data and is designed with both scalability and developer agility in mind [14]. MongoDB fixes the gap between key-value stores, which are fast and scalable, and relational databases, which have rich functionality [14]. It is a type of NO-SQL database store where data is stored in form of key pair values instead of in a grid of rows and columns.

Advantages of MongoDB

- Schema less
- Clear object structure.
- Simple Joins.
- Supports deep queries.
- Tuning.
- Highly scalable.
- Non requirement of conversion/mapping of application objects.
- Use of internal memory to store working set, enabling faster data access.

Disadvantages of MongoDB

- Gigantic data size.
- Less flexibility in running queries.
- No transactional support.
- At the moment Map/Reduce (e.g. to do aggregations/data analysis) is not blazing fast.

III. THE MERN STACK

MERN is a scaffolding tool which makes it easy to build universal apps using Mongo, Express, React and NodeJS. It minimizes the setup time and gets you up to speed using proven technologies [8].

On comparing the two stacks, the flashing difference we see is the tech giant React.js replacing the former Angular.js.

A) ReactJS

React (sometimes styled React.js or ReactJS) is a JavaScript library for building user interfaces. It is maintained by Facebook, Instagram and a community of individual developers and corporations[17]. React enables development of large applications which supports the capability of loading new data without page refresh thus enabling speed of app and providing use a better surfing experience. This corresponds to View layer in the MVC pattern, and supports mingling with other JavaScript libraries and frameworks.

Advantages of ReactJs

- Lightweight DOM For Better Performance
- Easy Learning Curve
- JSX support
- Better performance
- Virtual DOM support
- Unidirectional data flow.

Limitations of ReactJS

- Covers only View layer in M-V-C.
- Needs extra tooling and external support to make a web-application work.

IV. ANGULAR VERSUS REACT

While most developers can agree that the MEAN stack is a great option for modern app development, a large number are starting to advocate the use of React over Angular. Developers are now starting to talk in terms of MEAN vs. MERN, although it seems that the only difference being Angular or React. In some ways, comparing React to Angular is apples and oranges. Angular is a front end JavaScript framework whereas React is simply a JavaScript library .So what is the difference? A framework is a structure for presenting code. It dictates a specific architecture for how the code is organized. Angular brings an M-V-C architecture to front-end development. It comes with additional helper functions and built in functionality for making http requests, etc. With that said, Angular and React are both used for the same reason, to organize and render the presentation layer of the application. Both options are used with MongoDB, Express, and Node to achieve the same results.

A. Performance

As shown in Table I, React is arguably better for performance reasons. AngularJS implements two way data binding and a digest cycle to enable view layer synchronization with the underlying data layer. This proves to be extensively costly when hundreds of data items are needed to be updated dynamically. State change is detected using unidirectional data flow. This plays better with larger data sets, where hundreds of thousands of records need to be rendered and updated. Although Angular 2 has introduced better state control, React is an easier and more intuitive way to handle change events.

B. Architecture

This goes back to the whole library vs. framework discussion. While React makes UI rendering a breeze, it's just a library. It's up to the developer, how one organizes his/her code to work with underlying data models, etc. As a framework, Angular enforces an MVC like design, forcing developers to better organized their code. Although React is more flexible, it leaves more up to the developer as to how the app is organized. This can make the code harder to maintain.

C. *Third Party Libraries*

As shown in Table I, React needs the support of a lot of third party libraries in order to enable proper functioning of web-apps, like in the case oh HTTP-Requests. React doesn't have an out of the box solution for making http calls to a backend server. Angular has a built in http service wrapper that makes http requests a breeze. Although libraries like Axios allow one to easily make requests in React, it requires more configurations.

D. *Trends*

According to Google Search Trends [26], during the initial years, Angular was in trend. But after year 2014, a huge alteration in trend is seen and even up to today, majority of people have shifter their interest towards development using ReactJS.

TABLE I
ANGULARJS VERSUS ANGULAR 2 VERSUS REACTJS

Attribute	**AngularJS**	**Angular 2**	**ReactJS**
Author	Google	Google	Facebook
Language	JavaScript/HTML	Typescript	JSX
Size	143k	746k	151k
MVC	Present	Present	View only
Performance	Good	Better	Best
Third party support	Low	Low	High

V. CHOOSING THE RIGHT STACK

Choosing between the MEAN stack and MERN stack mostly comes down to developer. It makes sense for a developer to opt for MERN stack if and only if the developer is proficient in ReactJS. But for small to medium projects, performance measures of two stacks may not introduce an huge impact. Reason for that is developer's experience and comfort decide the speed of development and quality of end product so formed. If someone chooses a MEAN stack, the considerable overlap between the features in the two stacks play a crucial role in order to decide who does what within the development team. Henceforth one would have to decide where the core phase of the application's build will take place. As both AngularJS and ReactJS are equipped with overlapping features, either one can be used to parse the business logic of the web project. But traditionally ReactJS is chosen in industry because of the following reasons:

- Security to sensitive data.
- Extremely low latency.
- Actual code is hidden from user, making application extremely secure.
- Increased performance with the use of powerful servers.

Although, changes in trend may occur as now day's functionality is being transferred towards AngularJS as it runs on the user's browser. This is happening as it is the need of the hour to reduce costly resources which empower backend. This is achieved by transferring tasks from server to the client machine .It is also logical as this approach gives a more scalable architecture as users tend to plug in power of their resources into the equation. This also leads to a drastic improvement in response time. But, there are other factors too that play a crucial role in the decision making process. Table II shows various factors that must be considered before choosing any one of the two stacks. MEAN stack has lower churn as compared to MERN. Tooling required too is low in case of MEAN stack. But when it comes to JavaScript fatigue, packaging, and abstraction, MERN proves to be an optimal choice due to its high efficiency. MERN uses a virtual DOM as compared to MEAN, which not only drastically improves performance, but also reduces machine power required as changes that need to be made are not too frequent. As far as rendering is concerned, Angular is rendered on client machine, which not only reduces the cost of server power, but also improves user experience by reducing latency. Thus, before any choice is made, all the factors must be carefully examined and tested according to the need of the project so that optimal use of features can be achieved.

TABLE III
MEAN STACK VERSUS MERN STACK

Attribute	**MEAN**	**MERN**
Churn	Reduced	High
Tooling	Low	High
Design	JS in HTML	JS only
JS Fatigue	Less	More
DOM	Regular	Virtual
Complexity	High	Low
Packaging	Weak	Strong
Abstraction	Weak	Strong
Failure	Run time	Compile time

VI. CONCLUSIONS

It can be said that both MEAN and MERN stack are extremely reliable frameworks for blazing fast front-end development. They result in light-weight JS-based

Binding	Two-way	Unidirectional
Template	In html	In JSX
Model	Strong	Medium
Rendering	Client side	Server side

applications. However major difference lies in the way both stacks are structured and built. This makes MEAN stack a better option for large-scale applications while MERN stack leads the race in the faster development of smaller applications. However, in spite of having great technical differences, choosing between the two sometimes boils down to personal preference too. While React is definitively more powerful than Angular 1, Angular 2 accounts for the pitfalls seen with its predecessor. Both options play equally well with other stack components (MongoDB, Express, Node). Deciding which one is best for someone comes down to an emphasis on architecture, code maintainability, etc. One must remember that Angular 2 is the only true competitor to React.js when considering things like performance and server side rendering. When choosing between MERN or MEAN, one must consider Angular 2 vs. React, not Angular 1.

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