

## Front-end performance optimization research

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*Abstract: With the advent of the Web 3.0 era, the Internet has become a "data plaza" for free communication, which brings convenience to us and makes the page slower and slower. The front-end of the Web is responsible for information transmission and access to services. Therefore, the front-end development technology and its optimization direction have gradually become one of the research hotspots in the information age. In view of this, this paper analyzes and summarizes the front-end performance optimization factors in the process of browser rendering, B/S architecture, front-end development technology, and front-end separation development mode, and adopts a combination of theory and experiment to systematically propose Improve front-end performance optimization of web page request time, loading speed, user experience, page integrity, and versatility. The solution includes optimization of HTTP requests, reduction of resource size, optimization of caching, rendering and DOM operations, optimization of data interaction, optimization of mobile terminals, and more. And through the HTTP protocol debugging agent tool Fiddler and Chrome debugging tools for monitoring, the "Chinese online learning system" home page optimization performance before and after comparison. The comparison of TimeLine before and after optimization shows that the XHR request time has increased by 20.7% and the page load time has increased by 76.04%.*

*Keywords: WEB front end, performance optimization, optimization strategy, Fiddler.*

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### 1. INTRODUCTION

As of December 2018, the size of Chinese netizens reached 829 million, and the Internet penetration rate was 59.6% [1]. And according to Yahoo's survey, the background is only 5% in performance, but the front end accounts for 95%, of which 88% of the content can be optimized [2], front-end performance largely affects website performance. Therefore, the front-end development technology and its optimization direction have gradually become one of the research hotspots.

Poor website performance can have a number of negative effects, and sites with good front-end performance are more likely to achieve higher user retention and conversion rates. In the statistics released by the BBC and Amazon, every 10 milliseconds of uploading time of the BBC website will lose 10% of user traffic, and for every 100 milliseconds of uploading time of Amazon's official

website, the transaction volume will drop by 1%. 2]. Loss of users, declining conversion rates, and declining transaction volumes all directly contribute to the decline in corporate interests.

In view of this, this paper analyzes and summarizes the front-end performance optimization factors, and adopts a combination of theory and experiment to systematically propose front-end performance aimed at improving web page request time, loading speed, user experience, page integrity and versatility. Optimization. And before and after the comparative study of the homepage optimization performance of the "online learning system".

## **2. FRONT-END PERFORMANCE OPTIMIZATION SOLUTION**

For the front-end optimization problem, in 2016, Cao Haige further optimized the algorithm by further adjusting the virtual DOM's diff algorithm process, and further optimized the algorithm [3]. In 2018, Du Yanmei optimized the performance of the web front-end based on the Nginx-based load balancing algorithm [4]. However, these optimization schemes lack systemicity, and most of them are closely related to the project and do not form a complete solution. This article will present the famous "Yslow-23 rules" [5] and Yslow performance optimization based on Yahoo's performance team, from HTTP request, reduce resource size, cache, rendering and DOM operations, data interaction, and mobile side. A complete front-end optimization scheme is systematically proposed.

### **2.1 HTTP request optimization**

The optimization of HTTP requests is one of the optimization techniques of Web front-end development. A complete Http request includes DNS addressing, sending data from both parties, establishing a connection between the browser and the server and transmitting data, waiting for the server to respond, etc., such as common data transmission, resume server, and browser creation. Links and more. To complete the screening for the requested content, the request is generally necessary, so that it will really improve. The overall level of Web front-end development technology When the environment is different, the time taken by HTTP requests will be different, the number of requests will increase, the more broadband resources will be occupied, the response time will increase, and the speed of web page loading will decrease. Or it is prone to unloading.

The main goal of HTTP request optimization is to minimize the number of unnecessary, useless requests and rationalize using HTTP requests. Each link in the HTTP request takes a certain amount of time. Although the time spent on a single link is not long, the accumulation of links will inevitably increase the user's online time, thus significantly reducing the user's online experience. The specific method of reducing the request is as follows:

- (1) Merging JS files and merging CSS files;
- (2) Picture map: mapping different regions to map different links on one image;
- (3) Inline image: let the image be downloaded and displayed together with the text;
- (4) CSS Sprites: use the CSSbackground related elements to perform absolute positioning of the background image;
- (5) Embed the image directly into the web page by using the Base64 encoding method instead of loading it from the outside;

## **2.2 Reduce resource volume**

Excessive resource size can easily lead to slower loading speeds, affecting the response speed and interactive nature of web pages, and may lead to webpages, crashes, and unresponsiveness. Therefore, it is necessary to strengthen the rationalization of webpage files. At the same time, the size of resource files is often a key factor in determining the speed of page loading and the proportion of broadband resources. It is also an optimization method for Web front-end development technology that is easier to implement without replacing bandwidth.

The reduction of resource volume is mainly for CSS files, JS files, and image files. Optimize for specific situations to avoid the appearance of inline and affect the operation of the entire browser. Optimization is also to combine the web front-end development technology to correctly respond to customers' browsing habits and needs, and there should be no overcorrection in the development process. The specific method of reducing the resource volume is as follows:

- (1) HTML compression: Compressing characters that are meaningful in a text file but not displayed in HTML;
- (2) CSS compression: delete invalid code and CSS semantic merge;
- (3) JS compression and confusion: delete invalid characters and comments, reduce and optimize code semantics;
- (4) Image compression: discard color information;

## **2.3 Cache**

Using caching can reduce the number of requests to the server, save load time, and optimize web performance to a large extent. DNS is another important reason why consumers wait longer. Resolving DNS once takes about 20 to 120 milliseconds. If the DNS resolution request is too frequent, it will lead to an increase in user waiting time and a decrease in the quality of information transmission. Commonly used centralized local caching mechanisms are Cookie, LocalStorage, and SessionStorage. The data of the cookie is stored in the client's browser, and the session data is placed on the server. Client cache mainly includes three aspects: HTTP cache, DNS cache, CDN deployment and cache.

## **2.4 Optimization of data interaction**

Data interaction is one of the important contents of front-end optimization. User interaction with the interface is often accompanied by data interaction, processing and Ajax asynchronous processing. The optimization of data interaction mainly includes the following two aspects.

- (1) Image lazy loading: If the image is preloaded, it will often encounter a situation where the image resource is relatively large, and it is necessary to wait for a long time. Image lazy loading will display the image as the user scrolls the page;
- (2) Optimization of asynchronous request: Json interaction, Json data structure is simple, can greatly optimize front-end communication; some common data is cached, reducing Ajax request;

## **2.5 Mobile optimization**

According to the 43rd Statistical Report on Internet Development in China, as of December 2018, the number of mobile Internet users in China reached 871 million, and the number of mobile Internet users increased by 64.33 million. The proportion of Internet users using mobile phones is 98.6% [1]. The trend of mobileization also makes mobile front-end performance optimization a hot spot.

The PC-side front-end optimization method is also applicable on the mobile side, but due to the unique performance of the mobile terminal, some supplements of the front-end optimization scheme are needed.

- (1) Optimization of long list scrolling: the mobile terminal needs to face the problem of long list scrolling, the IOS side tries to use partial scrolling, and the Android side tries to use global scrolling as much as possible;
- (2) Anti-shake and throttling: The mobile terminal involves the DOM time that is triggered frequently, such as scrolling, etc. Note that anti-shake and throttling can reduce delay or jamming;
- (3) Turn on GPU (Graphics Processing Unit) rendering acceleration: a hardware acceleration method, which is used when 3D rendering is performed when the amount of calculation is large;
- (4) Use viewport settings: prevent page scaling;

### 3. FRONT-END PERFORMANCE OPTIMIZATION EXPERIMENT AND ANALYSIS

Based on the status quo of global Chinese learning, the HTML5 "Chinese online learning system" was developed to complete the Chinese online teaching function. By using the HTTP protocol debugging agent Fiddler and Chrome debugging tools [6] for monitoring, comparing data and analyzing front-end optimization. effect.

#### 3.1 Before optimization

The home page of the “Chinese Online Learning System” project is tested. Figure 3 shows the Timeline loaded for the first time before the homepage optimization.

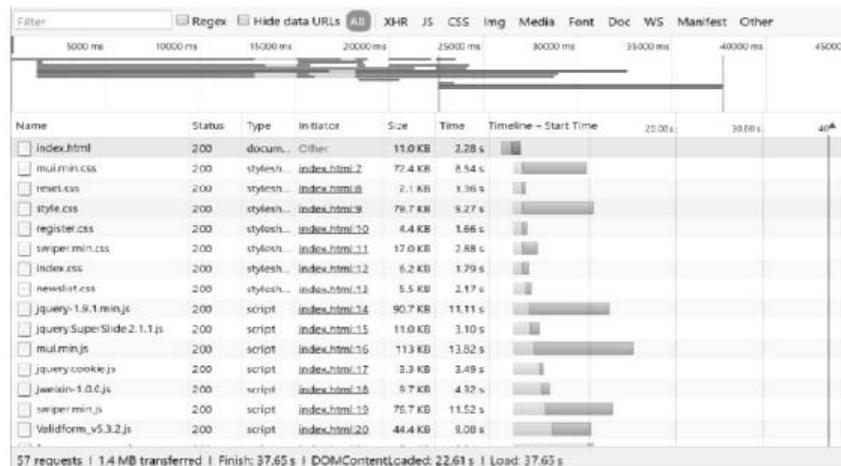


Figure 1 Timeline for the first time before the homepage optimization of the Chinese Online Learning System

#### 3.2 After optimization

Apply the optimization scheme to the “Chinese Online Learning System” and test the system homepage again. Figure 2 shows the Timeline loaded for the first time after system optimization.

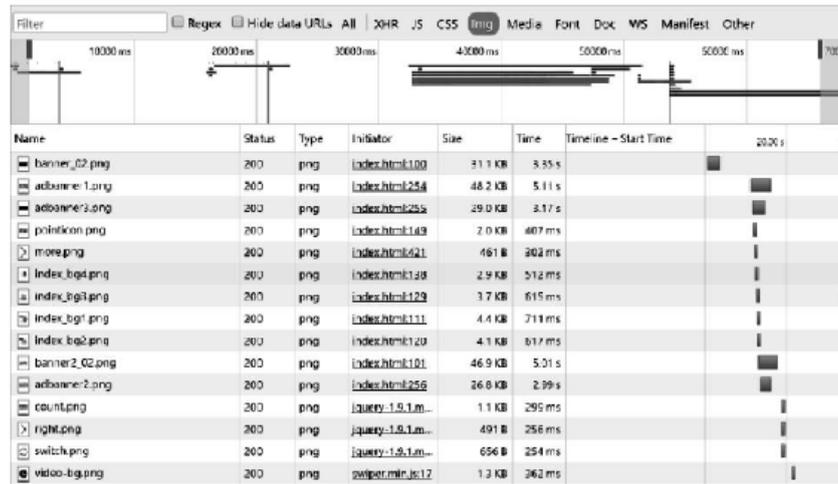


Figure 2 "Chinese online learning system" home page optimized after Timeline

#### 4. CONCLUSION

This paper analyzes and summarizes the front-end performance optimization factors, combines theory and experiment, and proposes the front-end performance optimization scheme completely and systematically, and systematically summarizes the front-end optimization scheme into six aspects: optimization of HTTP request and reduction of resources. Optimization of volume, caching, rendering and DOM operations, optimization of data interaction, and optimization of mobile. Finally, combined with the "Chinese online learning system" home page for optimization and testing, optimization before and after comparative analysis, thus improving the feasibility and authenticity of the front-end optimization project proposed in this paper.

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