



**UTM**  
UNIVERSITI TEKNOLOGI MALAYSIA

**FACULTY OF COMPUTING**  
UTM Johor Bahru

## **SECV2233-05 Web Programming**

### **Assignment 1:**

### **Web Performance and Accessibility Benchmarking of Top Global Tourism Websites via Google Lighthouse**



**Lecturer: Dr Aida Ali**

**Group: Misty**

<b>Group member</b>	<b>Matric No</b>
<b>TAN ZHENG YU (Representative)</b>	<b>A23CS5017</b>
<b>BENJAMIN CHEW JUN JIE</b>	<b>A23CS0210</b>
<b>TEOW ZI XIAN</b>	<b>A23CS0279</b>
<b>TAN ZHEN LI</b>	<b>A23CS5025</b>

# Web Performance and Accessibility Benchmarking of Top Global Tourism Websites via Google Lighthouse

TAN ZHEN LI

Faculty of Computing, UTM JB  
[tan.li@graduate.utm.my](mailto:tan.li@graduate.utm.my)

BENJAMIN CHEW JUN JIE

Faculty of Computing, UTM JB  
[jun00@graduate.utm.my](mailto:jun00@graduate.utm.my)

TEOW ZI XIAN

Faculty of Computing, UTM JB  
[teow@graduate.utm.my](mailto:teow@graduate.utm.my)

TAN ZHENG YU

Faculty of Computing, UTM JB  
[tanzhengyu@graduate.utm.my](mailto:tanzhengyu@graduate.utm.my)

## ABSTRACT

*In the digital tourism industry, web performance, accessibility, and search engine optimization (SEO) are critical for enhancing user experience and increasing website engagement. This study conducts a comparative evaluation of the top five most visited tourism websites using Google Lighthouse, an open-source auditing tool developed by Google. Each website is assessed based on performance, accessibility, best practices and SEO. The resulting reports are analyzed to identify key strengths, performance bottlenecks, and areas for improvement for each website. This paper will also discuss the characteristics of a high-quality tourism website and provides quality insights for web developers to be able to improve web performance and usability. The findings aim to support better design and development practices in the tourism sector's digital landscape.*

## KEYWORDS

Web Performance Evaluation, Google Lighthouse, Tourism Websites, SEO Optimization, Core Web Vitals

## 1. INTRODUCTION

In today's digital era, web performance and accessibility are crucial elements in capturing users. An accessible and highly optimized website not only enhances user experience but also leads to high consumer satisfaction and engagement [5][11]. To ensure a web application is developed with certainty, developers must utilize effective web auditing and performance testing measures by leveraging professional tools.

Google Lighthouse, which is an open-source auditing tool created by Google. It has the capacity to compare web pages against major determining factors like performance, accessibility, Search Engine Optimization (SEO), and best practices. It allows developers to find areas of improvement and enhance websites for better user engagement, better search engine rankings, and quicker loading [4][20].

In this case, we provide a review of the world's top five most popular tourism websites based on Google Lighthouse as our main audit program. We shall create comprehensive reports and compare the performance, accessibility, and SEO scores of each website. The procedure involves identification of probable weaknesses, explanation of audit

metrics, and discussion of probable solutions or best practices for achieving overall web quality.

Moreover, this study aims to provide insight into how one can identify the characteristics of a quality website. Hence, stakeholders, designers, and developers can be advised on how to create optimized websites for the tourism industry.

## 2. METHOD

The research analyzes the performance of the five most popular tourism websites which include Booking.com, Tripadvisor.com, Airbnb.com, Trip.com, Americanexpress.com. We use Google Lighthouse as an open-source auditing tool for web auditing. The performance audits covered each website homepage through tests that run on mobile and desktop platforms to achieve complete assessment.

To ensure the credibility of the results, Google Lighthouse reports were generated in Incognito mode within Google Chrome, which helps eliminate potential interference from browser extensions or cached data. [6]

The reports evaluated websites through four essential categories which included Performance, Accessibility together with Best Practices and Search Engine Optimization (SEO). The gathered data go through analysis to determine both positive and negative aspects and necessary improvements for the five websites.

### 3. RESULTS

**Table 1. Google Lighthouse Analysis Result  
Recapitulation of top 5 most visited tourism websites**

NO	Platform(Website)	Performance	Accessibility	Best Practices	SEO
1	Tripadvisor.com	84	100	93	100
2	Booking.com	50	83	93	92
3	Airbnb.com	39	97	96	100
4	Trip.com	33	79	74	92
5	Americanexpress.com	50	100	56	85

The audit results from Google Lighthouse demonstrate that Tripadvisor.com is the leading website because it excels in performance and overall optimization while earning flawless scores for accessibility and SEO.

The website Booking.com presents good scores in best practices and SEO but needs better performance optimization. The 50 score indicates technical problems which need resolution to enhance loading speed and system responsiveness.

Airbnb.com delivers outstanding performance in accessibility and best practices yet its poor performance metrics make it the lowest ranking site among the five websites evaluated. The refined user experience of the platform seems to be affected by slower page loading times and potentially heavier content.

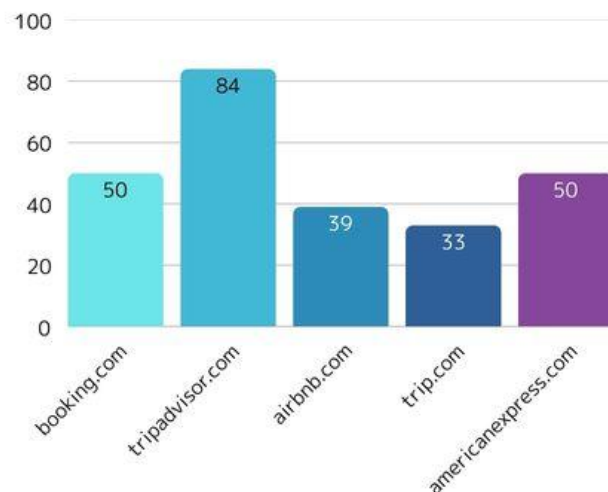
Trip.com displays the worst performance and best practice scores which indicates possible usability or code-related issues that require attention. The platform demonstrates comparable search visibility to Booking.com as proven by their matching SEO scores.

Americanexpress.com demonstrates identical performance levels to Booking.com while providing the best accessibility options yet maintains the worst best practices among all sites. The site requires modernization of coding standards and user safety protocols to meet current standards.

The website Tripadvisor.com demonstrates balanced leadership across all categories and performs well with SEO and best practices together with Booking.com and Airbnb.com. Trip.com along with Americanexpress.com would achieve better results by making specific improvements to their platforms to improve both user experience and technical performance.

#### 3.1 Performance Scores

The performance scores for each website obtained from Google Lighthouse are shown as below chart:



*figure 1. Comparison of Performance Scores between 5 tourism websites*

The scores vary from 33 to 84 which indicate significant difference in the degree of optimization for delivering contents to users between the 5 websites.

Tripadvisor.com leads with a score of 84, indicating it has the best strategy in minimizing page load delays, image delivery. Followed by Booking.com and Americanexpress.com which have the same score of 50. The remaining websites, airbnb.com and trip.com have poor performance in this section which is 39 and 33 respectively.

### 3.2 Accessibility Scores

An assessment of accessibility performance was conducted on the five platforms Airbnb.com, Tripadvisor.com, Booking.com, Trip.com and Americanexpress.com through Google Lighthouse metrics. The scores achieved by the Accessibility category appear in Table 2.

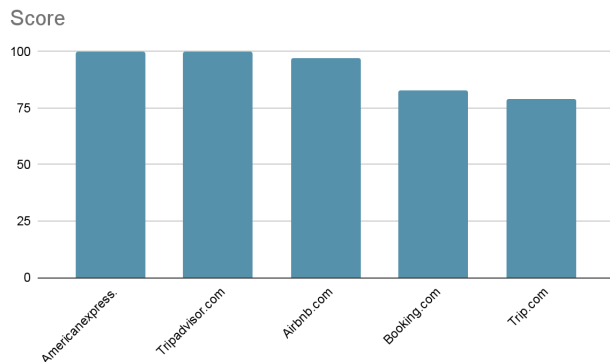


figure 2. Comparison of Accessibility Scores between 5 tourism websites

The analysis shows that Americanexpress.com and Tripadvisor.com reached 100 points which represents full compliance with contemporary accessibility standards. Airbnb.com scored 97 points in the evaluation. Modern accessibility guidelines showed the sites Booking.com and Trip.com scoring 83 and 79 points lower than Americanexpress.com and Tripadvisor.com.

### 3.3 Best Practice Scores

In this research, we analyzed the Google Lighthouse Best Practices scores of five highly visited travel websites: Booking.com, Tripadvisor.com, Airbnb.com, Trip.com, and AmericanExpress.com (Travel section). The Lighthouse audit focused on two main areas: User Trust and Security, and User Experience.

Table 2. Google Lighthouse Best Practices Analysis  
Result of top 5 most visited tourism websites

NO	Website	Best Practices Score	Key Issues Identified
1	Airbnb.com	96	None significant
2	Booking.com	93	Vulnerable JS libraries, console errors
3	Tripadvisor.com	93	Missing source maps
4	Trip.com	74	Third-party cookie detected
5	AmericanExpress.com	56	Deprecated APIs, third-party ad cookies

In this study, all five websites analyzed enforce HTTPS protocols, which secure communication channels and increase trust of users. Nevertheless, they failed to adhere to modern web security and development standards. And on the AmericanExpress.com, we find that they use deprecated APIs, namely, Dynatrace, which is deprecated in future versions of Chrome. This creates a problem with the website's long term compatibility and stability. In addition, third party tracking cookies were found on Trip.com (originating from naver.com) and AmericanExpress.com (served by iSpot.tv) which may compromise user privacy.

In terms of user experience, Airbnb.com performed excellently because it did not use third party cookies, had correctly optimized images in terms of aspect ratio and resolution, and did not ask for unsolicited permission to do so during initial page load. In contrast, Tripadvisor.com exhibited deficiencies in development practices, particularly the absence of source maps for substantial first-party JavaScript files, which may impede debugging and maintainability. Booking.com was found to incorporate vulnerable JavaScript libraries and generated browser console errors, indicating unresolved technical issues that could affect user interaction and functionality.

### 3.4 SEO Scores

In this research,

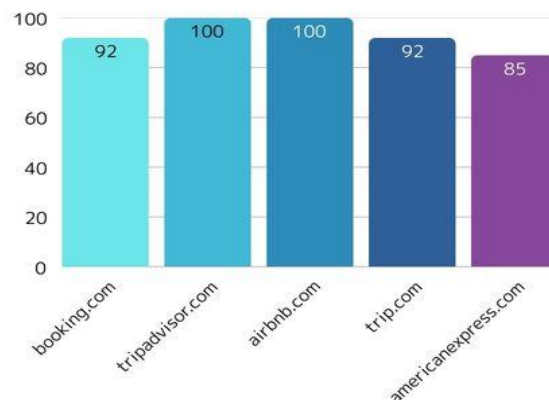


figure 3. Comparison of SEO Scores between 5 tourism websites

Based on the SEO analysis conducted on five travel-related websites, Tripadvisor.com and Airbnb.com achieved perfect scores of 100/100, indicating full compliance with SEO best practices including descriptive links, crawlable content, and valid structured data. Booking.com and My.trip.com both scored 92/100, showing strong SEO performance with minor issues—Booking.com had one non-descriptive link, while My.trip.com had some uncrawlable links. Americanexpress.com received the lowest score of 85/100 due to multiple non-descriptive and uncrawlable links, which can significantly impact the site's visibility on search engines. Overall, the results highlight that while most of the sites follow standard SEO guidelines, improvements in link structure and crawlability can enhance their search performance further.

## 4. DISCUSSION

### 4.1 Performance

The performance score obtained from Google Lighthouse is calculated from 5 metrics: First Contentful Paint(FCP), Largest Contentful Paint(LCP), Total Blocking Time(TBT), Speed Index(SI) and Cumulative Layout Shift(CLS). Each metric has different weighting in the performance score, TBT weighting the most which is 30%. LCP, CLS weighting 25% and FCP and SI weighting 10%.

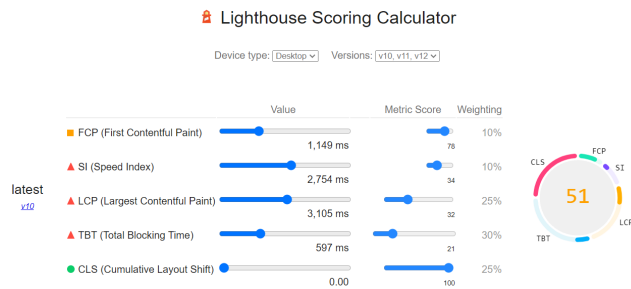


figure 4. Weighting of metrics in Lighthouse Scoring Calculator

Below shows the comparison of performance metrics between the 5 websites:

**Table 3. Comparison Table of Performance Metrics Scores between 5 tourism websites**

Platform(Website)	FCP	LCP	TBT	SI	CLS
Booking.com	1.1s	3.1s	0.6s	2.8s	0
Tripadvisor.com	0.8s	1.8s	0.13s	2.3s	0
Airbnb.com	0.9s	2.3s	1.17s	2.7s	0.25
Trip.com	1.0s	3.3s	0.78s	2.4s	0.303
Americanexpress.com	0.7s	1.4s	1.39s	2.5s	0.207

#### 4.1.1 Total Blocking Time (TBT)

Total Blocking Time (TBT) measures the total amount of time after First Contentful Paint (FCP) where the main thread was blocked for long enough to prevent input responsiveness.[18] TBT is mainly affected by the javascript performance and main-thread work time. Third-party code also can significantly impact TBT negatively. Limiting the number of redundant third-party providers and try to load third-party code after your page has primarily finished loading can minimize the third-party impact.

Tripadvisor.com has the best result of 0.13s, indicating users can responsively interact with the website soon after the page started loading.

Booking.com and Trip.com have moderate performance in TBT which are 0.6s and 0.78s respectively.

Airbnb.com and Americanexpress.com perform poorly, 1.17s and 1.39s. Suggesting that they have inefficient use of client-side script or complex interactions.

TBT delivers the most obvious performance differences between websites. The website Tripadvisor.com delivers exceptional interactivity yet Airbnb.com and Americanexpress.com face delays when users try to input data.

According to the diagnosis of Google Lighthouse, we found that Tripadvisor.com achieves the shortest TBT by reducing JavaScript execution time and optimization of main-thread work. On the other hand, Americanexpress.com has significantly longer JavaScript execution time and main-thread work, combining the delay from the usage of third-party code causing it having the longest TBT among the 5 websites.

#### 4.1.2 Large Contentful Paint (LCP)

The LCP metric indicates the time when all visible largest elements finish their rendering process. The ideal LCP should be lower than 2.5 seconds.[15]

The target threshold of 2.5 seconds is achieved by Tripadvisor.com (1.8s) and Americanexpress.com (1.4s) showing that they show rapid display of important content.

The LCP of Airbnb.com reaches 2.3 seconds while Booking.com (3.1s) and Trip.com (3.3s) did not meet the target threshold possibly due to potential large media content and deferred rendering practices.

Analysis of LCP indicates the major content of Tripadvisor.com loads fastest while users who visit Booking.com and Trip.com might experience slower perceived speeds. To improve LCP performance, well formatting the large image to Webp or AVIF can provide better compression compared to PNG or JPEG to reduce download-delay and data consumption. For example, there is a potential savings of 3040 KiB by serving images in next-gen formats for Trip.com according to the diagnosis of Google Lighthouse, showing that Trip.com can possibly improve performance by formatting the large image into Webp or AVIF format.

#### 4.1.3 Cumulative Layout Shift (CLS)

Cumulative Layout Shift (CLS), a unitless metric that measures the magnitude and impact of unexpected layout shifts that users encountered. Ideally, the value should be lower than 0.1, acceptable between 0.1 and 0.25, anything over 0.25 is considered poor which will greatly affect user experience caused by the distraction of unexpected layout shifts.[21]

Booking.com and Tripadvisor.com have excellent layout stability, scoring 0 CLS.

Americanexpress.com (0.207) and Airbnb.com (0.25) have acceptable CLS scores but need some improvement. However Trip.com (0.303) is poor in CLS.



By observing the diagnosis of Google Lighthouse, Trip.com has 4 large layout shifts causing it to have poor CLS while Booking.com and Tripadvisor.com avoided large layout shifts which make them perform excellent in CLS. To improve CLS, we should avoid implementing images, Ads, embeds, and iframes without dimensions which will possibly causing unexpected large layout shifts.[21]

#### 4.1.4 First Contentful Paint (FCP)

First Contentful Paint (FCP) quantifies how long a page's initial visual content takes to be rendered. Fast FCP reassures the users that the site is loading. The ideal FCP should be lower than 1.8 seconds.

All the 5 websites are performing well in FCP, their scores ranging from 0.7s to 1.1s which are within the ideal range. Americanexpress.com has the fastest FCP (0.7s) while Booking.com has the slowest FCP (1.1s).

Similar to LCP, well formatting the images to next-gen formats (Webp or AVIF) can improve the FCP performance. This furtherly proves that Booking.com and Trip.com might need to serve their images into next-gen formats as the two of them are having poor performance in FCP and LCP compared to the others.

#### 4.1.5 Speed Index (SI)

Speed Index (SI), indicating the speed of visual content fills the page during load. The ideal SI should be lower than 3.4 seconds.

All the 5 websites are within the ideal range of SI with Tripadvisor.com leading by 2.3s while Booking.com has the slowest 2.8s. Although there is less variation between websites, Tripadvisor.com still maintains a slightly better performance in visual completeness speed.

#### 4.1.6 Overall Performance

Among all the 5 websites, Tripadvisor.com consistently delivers the most optimized and responsive performance, having the best scores in nearly all metrics. Booking.com provides decent performance although it needs some improvement for LCP and TBT. Airbnb.com and Americanexpress.com receive penalties because of their blocked scripts and unstable layouts causing poor performance for TBT and CLS. Trip.com struggles the most with both layout and responsiveness issues. The comparison reveals that maintaining balance between interactivity, visual richness and technical optimization is essential for a website to be successful and user-friendly.

### 4.2 Accessibility

The evaluation scores indicate how well platforms implement principles of inclusive design at different levels.

The accessibility implementation models of **Americanexpress.com** and **Tripadvisor.com** serve as examples of best practices because they achieve perfect

scores. The platforms provide satisfactory accessibility services for users with visual and auditory and mobility impairments by using semantic HTML and proper color contrast and ARIA roles and accessible navigational structure methods [8][12]. The flawless scores indicate organizations follow an all-encompassing approach to develop accessible user experiences.

The accessibility scores of **Airbnb.com** reach 97 points because of its efficient accessibility practices. The platform maintains its markup structure in good condition while users can navigate effectively with their keyboards and it applies proper labeling and alternative text.[19] The score indicates slight imperfection because the platform lacks labels on specific form elements and some user interface sections have inadequate contrast levels [11].

The accessibility evaluation of **Booking.com** shows a score of 83 which represents a moderate level of compliance. The website has interfaces that most users can navigate easily yet it presents accessibility challenges because of inconsistent color contrast together with unlabeled form elements and restricted keyboard options in particular sections. The usability of the site faces problems regardless of assistive technology requirements or sensory disabilities [9].

The accessibility requirements of **Trip.com** require immediate focus because its accessibility score stands at 79. The platform has accessibility problems because it lacks complete form control labels and has complex components with poor keyboard navigation and multiple visual element color contrast issues. The design and development process shows a systematic absence of accessibility attention because of the identified deficiencies. The site remains difficult to navigate for users with disabilities until developers execute specific accessibility enhancements that will additionally prevent legal and usability standard violations [8][10].

The three accessible platforms—**Americanexpress.com**, **Tripadvisor.com**, and **Airbnb.com**—showcase the advantages of proactive design for inclusivity. **Booking.com** and **Trip.com** illustrate the necessity of accessibility improvement work to make services equally available to every user. Long-term user inclusivity reaches maximum effectiveness, together with regulatory compliance, through implementing accessibility as an essential development principle [11].

### 4.3 Best Practice

The platforms demonstrate different resources allocated to contemporary web development practices through their observed best practice score results. At the top of our observed scores, Airbnb.com demonstrates exceptional

dedication to secure and modern efficient code maintenance. The platform implements secure API integrations together with HTTPS consistency and it uses minimal outdated or vulnerable libraries to maintain security. Its superior score represents extensive technical bases that provide users with both safe and smooth service delivery [8][11].

According to our ratings, Tripadvisor.com and Booking.com demonstrate very good adherence to industry best practices guidelines by achieving 93 points. The platforms achieve security through robust protocols and show contemporary user interface practices. The platforms currently show minor possibilities for enhancement related to script performance or security aspects that stem from third-party tool utilization [8]. These websites demonstrate professional development strategies which follow leading industry performance measures [9].

The lower score of 74 received by Trip.com shows that multiple components need enhancement work. The site conducts essential security practices including HTTPS and image optimization but demonstrates unreliability with outdated JavaScript libraries together with inconsistent API management and user interaction control. Technical debt currently exists in the platform which could lead to scalability reduction and loss of user trust in the long-term even though these shortcomings do not present immediate threats [10].

The website Americanexpress.com stands apart from modern benchmarked standards because its evaluation score stands at 56. Secure connections exist on the platform, yet its outdated libraries and problems with component management and potential risks from legacy code lead to vulnerabilities [8][10]. Unresolved technical issues lead to both reduced user satisfaction and security vulnerabilities unless the codebase receives modernization updates and technical evaluation.

Platforms that focus on technical health receive high best practice scores according to the study findings. Organizations that delay their transition toward modern development standards tend to reduce their efficiency levels alongside increased vulnerability to operational risks. Code and deployment strategy maintenance as well as regular dependency updates must continue through continuous assessment to achieve and sustain compliance with developing web standards[8][11].

#### 4.4 SEO

Search Engine Optimization or SEO makes your website perform better in web search results of major search engines such as Google or Bing.[17] Search engines show web results based on their content quality and suitable

optimization when users seek "cheap hotels in Tokyo". The best SEO helps websites show better in results to get more visitors who can reach your site.[3][16]

This report evaluates and compares SEO features for five travel websites. Our analysis evaluates SEO performance by inspecting website features such as search engine accessibility, link descriptions, data organization, title tags and total SEO quality.

Tripadvisor.com and Airbnb.com have perfect SEO scores of 100, meaning they are following all the SEO best practices. Both websites have fully descriptive links, are crawlable by search engines and use valid structured data. All the HTML elements are correctly implemented, such as the <title>, meta description, hreflang, and rel=canonical. Proper alt attributes on images also makes the images more accessible and helps with image indexing. While they passed all audits, both sites are encouraged to continue to validate their structured data using Google's Rich Results Test in order to maximize visibility in search engines.

Booking.com and my.trip.com both scored 92, which is good for SEO performance with a few issues. The main drawback for Booking.com is a single link without descriptive anchor text, which can make the page inaccessible and less comprehensible to search engines. The rest of the elements (crawlability, valid structured data, well formed meta tags) are all handled properly, except for the first one. On the other hand, my.trip.com has links that are not crawlable, and this may prevent search engines to find out all the parts of the site. However, the site passes other SEO checks such as valid robots.txt, image alt attributes and structured data, and it has descriptive link text.

Americanexpress.com scored the lowest at 85, primarily due to two major issues. Firstly, the site uses vague anchor text such as "Learn More" without context, which diminishes clarity for both users and search engines. Secondly, several links are uncrawlable due to their reliance on javascript:void(0) instead of proper href values. These issues can hinder the website's visibility and indexing performance. However, the site does maintain valid meta elements and structured data, which helps retain some SEO effectiveness.

In conclusion, Tripadvisor and Airbnb lead with exemplary SEO implementations, making their content highly accessible and search engine-friendly. Booking.com and my.trip.com follow closely behind with strong foundations but small issues that, if corrected, could lead to perfect scores. Americanexpress.com, while still functional, requires more attention to link formatting and crawlability to improve its search performance. Overall, the analysis emphasizes the importance of clear link structure, proper HTML elements, and accessible content in achieving strong SEO results.

#### 4.5 Overall discussion

In general, the comparison of performance, accessibility, best practices and SEO of five largest travel and commerce platforms (Booking.com, Tripadvisor.com, Airbnb.com, Trip.com and Americanexpress.com) shows significant

differences. Tripadvisor.com is a winning example, always being among the top in terms of interactivity (TBT 0.13 s), rendering of the content (LCP 1.8 s), accessibility, following modern development rules and perfect SEO score. Solid performance (LCP 2.3 s) is also there, followed by near perfect accessibility (97 points), and perfect best practice compliance, and perfect SEO. Booking.com and Trip.com are not performing well at moderate levels (LCPs of 3.1 s and 3.3 s, respectively), have inconsistent accessibility implementation (scores of 83 and 79), and vary in best practice maturity (93 for Booking.com vs. 74 for Trip.com), but both have good SEO foundations (scores of 92). While being very good at performance (LCP 1.4 s), Americanexpress.com misses the mark on interactivity (TBT 1.39 s) and SEO (score 85) while also being very modernized in best practice (score 56) and accessible (A). This underlines the significance of balancing the technology performance, inclusive design, secure development, and search friendly architecture to give outstanding user experiences and maintain leadership visibility.

## 5. CONCLUSION

In this research, we provide a comprehensive evaluation of the five leading travel and commerce websites—Booking.com, Tripadvisor.com, Airbnb.com, Trip.com, and Americanexpress.com—on several performance, accessibility, best practices, and SEO parameters. Integrating automated Lighthouse scores with targeted manual inspections, we determined clear levels of performance, highlighted inclusive design success stories, uncovered technical debt hotspots and SEO gaps. Top performers such as Tripadvisor.com and Airbnb.com illustrate how balanced optimization can yield fast, accessible, secure, and search-friendly experiences, but others such as Trip.com and Americanexpress.com illustrate the actual impact of legacy code, script inefficiencies, and link semantics on user experience and visibility. The suggestions are tailored to offer actionable recommendations for each platform to make loads faster, make interactivity more effective, improve accessibility, bring codebases up to date, and optimize SEO hierarchies. Lastly, this study emphasizes the interconnectedness of technical performance and user-driven design, necessitating ongoing, unified audits to ensure competitive advantage and conform to shifting web standards.

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## 7. AUTHOR PROFILE



C++ and SQL programming skills.



**BENJAMIN CHEW JUN JIE** born in Kulai, Johor, Malaysia, taking a degree programme: Bachelor of Computer Science (Software Engineering) with Honours in University Technology Malaysia [2023- ]. He is equipped with several computing skills such as, c++, python language, and also has skills in other fields including Japanese proficiency, video editing, etc. He took the JLPT N2 certificate when studying in highschool [2018] and also have IELTS certificate taken in 2020.



**TEOW ZI XIAN** born in Johor Bahru, Johor, Malaysia, is studying for a Bachelor of Computer Science (Software Engineering) with Honours at University Technology Malaysia. He has programming skills in C++, R programming, and SQL.



**TAN ZHENG YU** born in Kulai, Johor, Malaysia, taking a degree programme: Bachelor of Computer Science (Software Engineering) with Honours in University Technology Malaysia. He specializes in Machine Learning, with research interests in Computer Vision and Large Language Models (LLMs). He has participated in national hackathons such as MyHackathons and KitaHacks, and is the lead developer of *HearWay*, an AI-powered navigation system designed to assist the visually impaired.