BHARATIYA VIDYA BHAVAN'S
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Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai – 400058-India
Department of Computer Engineering

Name	Rishabh Santosh Shenoy
UID no.	2023300222
Experiment No.	2

AIM:	Analyze network performance parameters using chrome devtool

WEBSITES:	1) https://www.flipkart.com/ 2) https://www.amazon.in/ 3) https://leetcode.com/ 4) https://www.geeksforgeeks.org/dynamic-programming/ 5) https://pieces.app/ 6) https://www.sciencedirect.com/journal/computer-communications
QUESTION 1:	What is the purpose of network throttling in Chrome DevTools, and how does it simulate real-world conditions ?
ANSWER:	Network throttling in Chrome DevTools is used to check how a website performs under different network conditions. It helps in debugging slow loading times and optimizing performance. It simulates real-world network conditions like slow 3G, fast 3G, or even custom speeds. It works by limiting download/upload speeds, increasing latency, and even adding packet loss (in custom settings). Useful for testing how a site behaves when a user has a poor or unstable internet connection. Helps in identifying issues like large assets, too many requests, or scripts taking too long to execute.

QUESTION 2:	How does the "Waterfall" view in the Network tab help in understanding resource loading times?
ANSWER:	The "Waterfall" view in the Network tab of Chrome DevTools provides a detailed timeline of how different resources (like images, scripts, CSS files, etc.) are loaded by the browser when a page is requested. It helps in understanding how each resource loads over time and how they interact with each other.

	How it helps in understanding resource loading times: Loading Order: Shows the sequence in which resources are loaded. This helps identify if some resources are blocking others and causing delays.Start and End Time: Displays the exact start and end times for each request, helping you see how long each resource takes to load.Request Duration: The length of each bar in the waterfall represents how long a particular resource takes to load. This makes it easy to spot which resource is taking too long.Dependencies: The bars are stacked in a way that shows how some resources depend on others (e.g., a script might depend on an image). It helps in identifying if certain resources are delayed due to others.Latency and Download Times: You can see the delay between the request being made and the resource being fetched, along with the actual download time. This helps in identifying network issues.Connection and Response Times: Helps in understanding if server response time, DNS resolution, or connection setup is taking longer than expected.

QUESTION 3:	What is the difference between the "Online" and "Offline" network throttling options?
ANSWER:	The "Online" and "Offline" network throttling options in Chrome DevTools simulate different network conditions to test how a website performs when there's a real connection versus when there's no connection at all. Here's the difference: Online Simulates a working network connection but can be limited to specific speeds (e.g., Slow 3G, Fast 3G). Allows you to test how the website behaves under various network conditions (speed, latency). The site is still accessible, but resources may load slower based on the selected throttle profile. Useful for testing how your site performs on slower or unstable networks, while still being connected. Offline Simulates no network connection at all. All resources fail to load because the browser is pretending that the user has lost internet connectivity. This helps test how the site behaves when the user is offline (e.g., if the site has proper offline support, like cached content or fallback mechanisms). It's useful for testing PWA (Progressive Web App) behavior or checking if your site has any issues when no internet is available.

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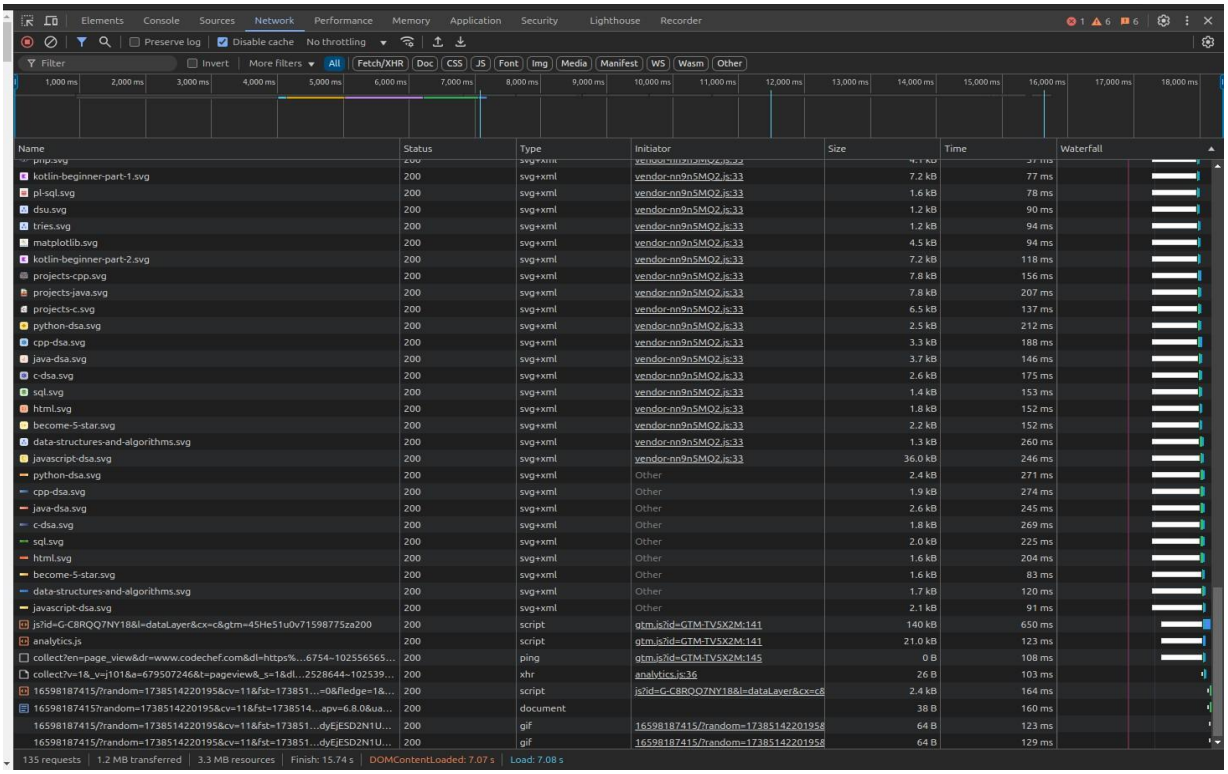
QUESTION 4:	Explain what happens when you choose different network profiles like "Fast 3G," "Regular 3G," and "Slow 3G." How do these profiles affect page load times?
ANSWER:	When we choose different network profiles like "Fast 3G", "Regular 3G", and "Slow 3G" in Chrome DevTools, we're simulating mobile network speeds. These profiles impactpage load times based on download/upload speeds and latency: **Fast 3G** Faster download speed (1.6 Mbps) and lower latency (~100 ms). Pages load slower than on high-speed connections but faster than Regular or Slow 3G. **Regular 3G** Slower download speed (750 Kbps) and higher latency (~300 ms). Pages take longer to load, especially with large resources. **Slow 3G** Very slow download speed (300 Kbps) and higher latency (~400 ms). Pages load much slower, highlighting resource optimization issues. As we move from Fast 3G to Slow 3G, load times increase due to slower speeds and higher latency. These profiles help identify performance bottlenecks.

Question 5 : What is the average load time of the webpage without any network throttling?



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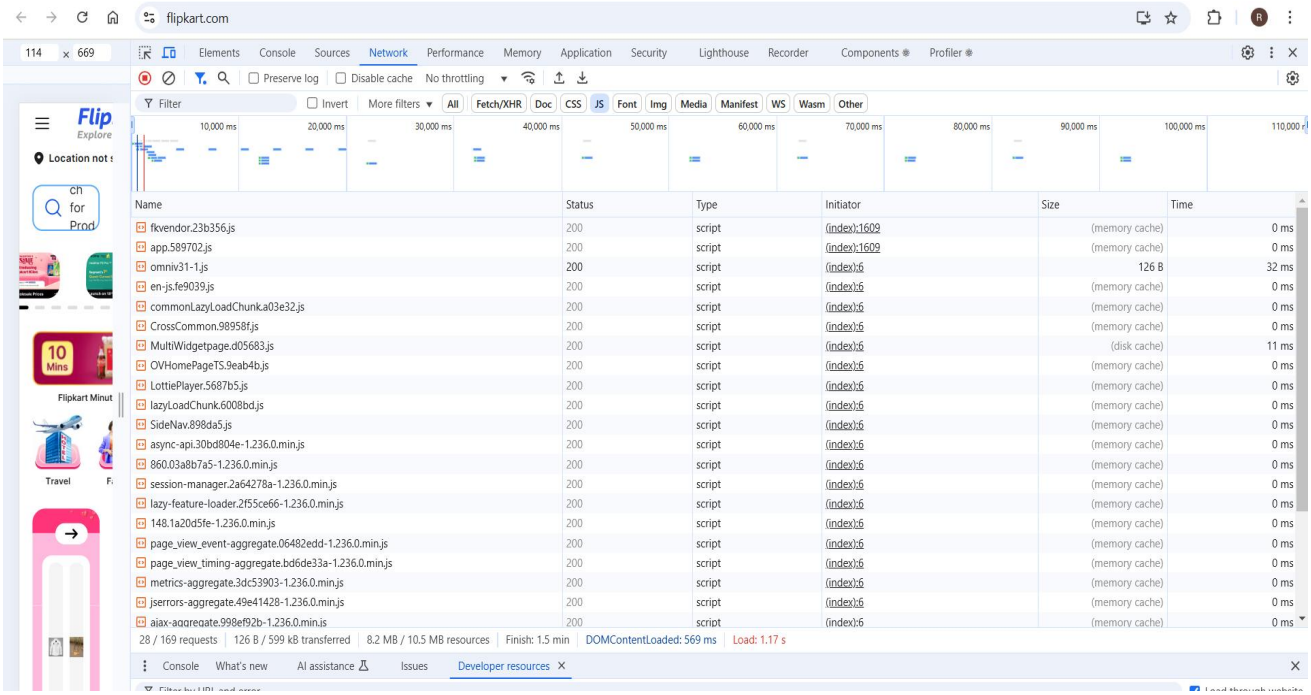
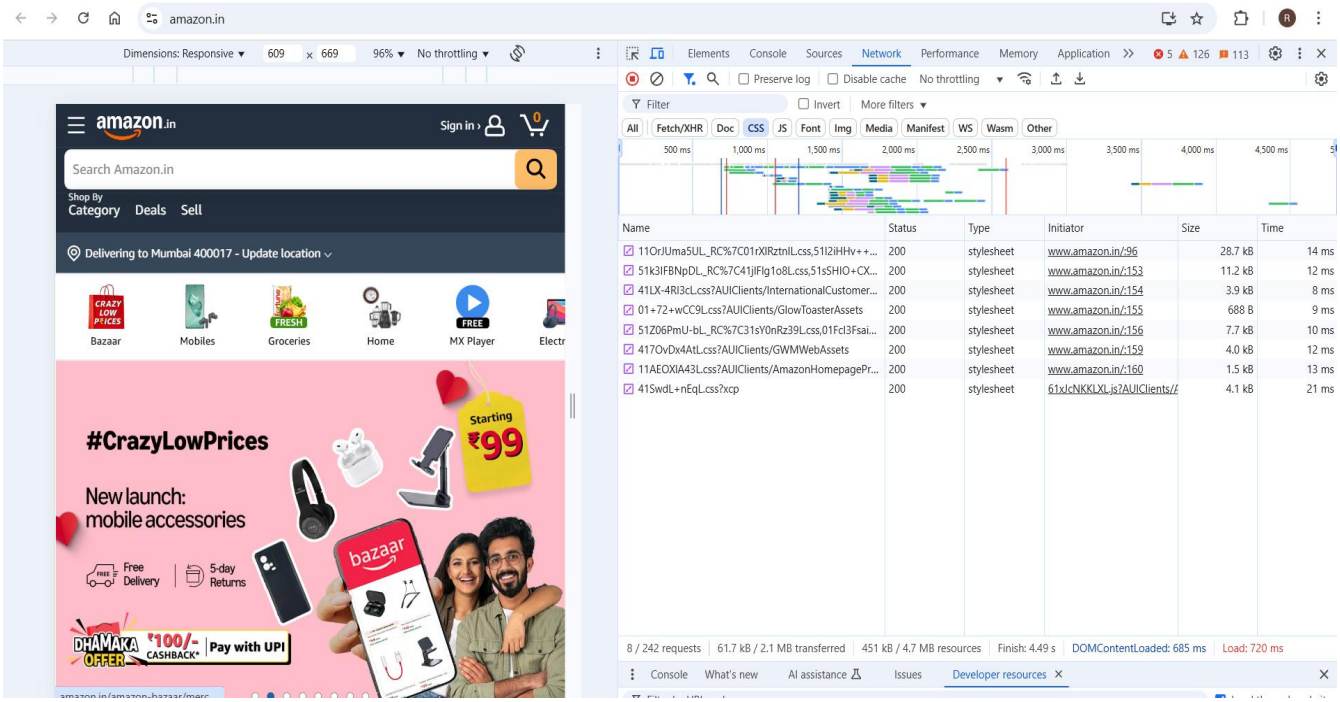
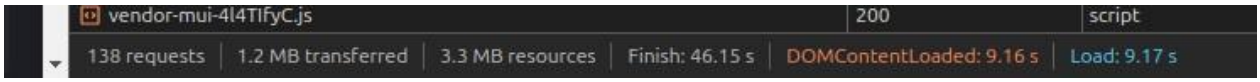
The average load time of a webpage without network throttling varies based on factors such as internet speed, server response time, and the number of resources being loaded. For the current website, the load time was **7 seconds**, meaning that under normal network conditions, all necessary resources, including images, scripts, and stylesheets, were fetched and rendered within this time frame.



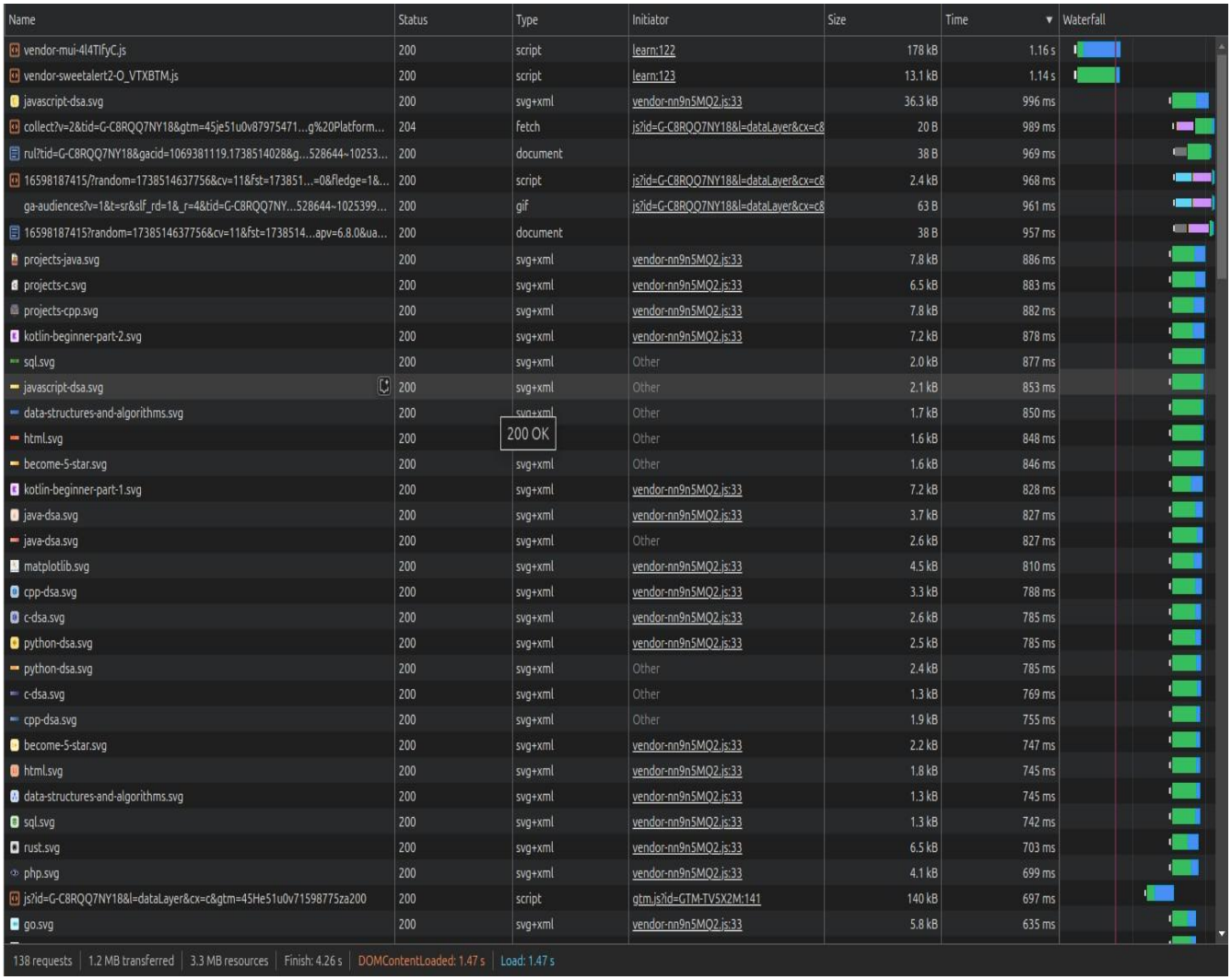


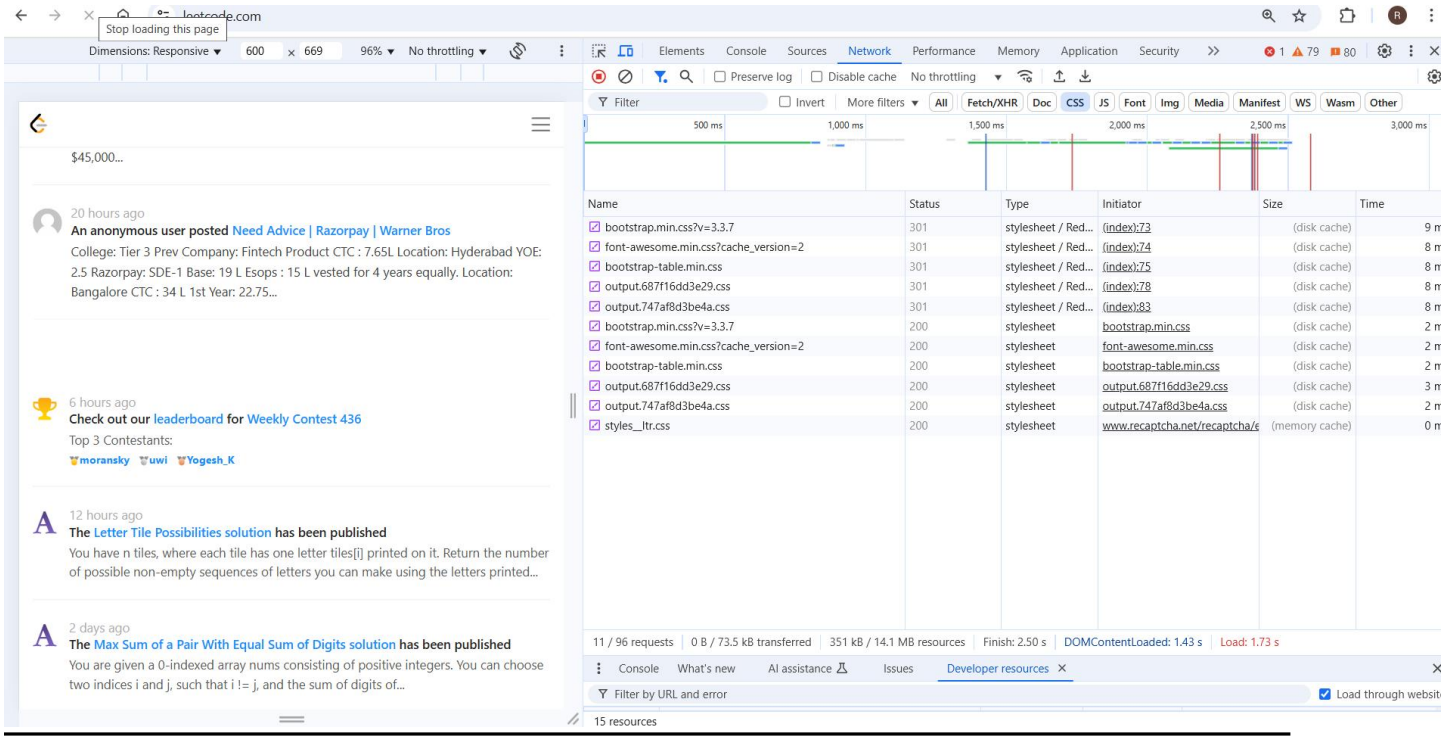
Question 6 : After applying the "Slow 4G" network profile, how does the page load time change compared to the normal network ?



Without throttling, the page loaded in 7 seconds. After applying the Slow 4G network profile, the load time increased to 9 seconds due to reduced bandwidth and higher latency. The slower data transfer rate causes resources like images, scripts, and stylesheets to take longer to load, resulting in a noticeable delay in page rendering.

Question 7 : Which resources (e.g., images, scripts, CSS files) take the longest to load when thepage is throttled with "Regular 4G"?




leetcode.com
Stop loading this page
Dimensions: Responsive 600 x 669 96% No throttling
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20 hours ago
An anonymous user posted Need Advice | Razorpay | Warner Bros
College: Tier 3 Prev Company: Fintech Product CTC : 7.65L Location: Hyderabad YOE: 2.5 Razorpay: SDE-1 Base: 19 L Esops : 15 L vested for 4 years equally. Location: Bangalore CTC : 34 L 1st Year: 22.75...
6 hours ago
Check out our leaderboard for Weekly Contest 436
Top 3 Contestants:
moransky uwi Yogesh_K
12 hours ago
The Letter Tile Possibilities solution has been published
You have n tiles, where each tile has one letter tiles[i] printed on it. Return the number of possible non-empty sequences of letters you can make using the letters printed...
2 days ago
The Max Sum of a Pair With Equal Sum of Digits solution has been published
You are given a 0-indexed array nums consisting of positive integers. You can choose two indices i and j, such that i != j, and the sum of digits of...
Elements Console Sources Network Performance Memory Application Security
Preserve log Disable cache No throttling
Filter Invert More filters All Fetch/XHR Doc CSS JS Font Img Media Manifest WS Wasm Other
Name Status Type Initiator Size Time
bootstrap.min.css?v=3.3.7 301 stylesheet / Red... (index):73 (disk cache)
font-awesome.min.css?cache_version=2 301 stylesheet / Red... (index):74 (disk cache)
bootstrap-table.min.css 301 stylesheet / Red... (index):75 (disk cache)
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output.747af8d3be4a.css 301 stylesheet / Red... (index):83 (disk cache)
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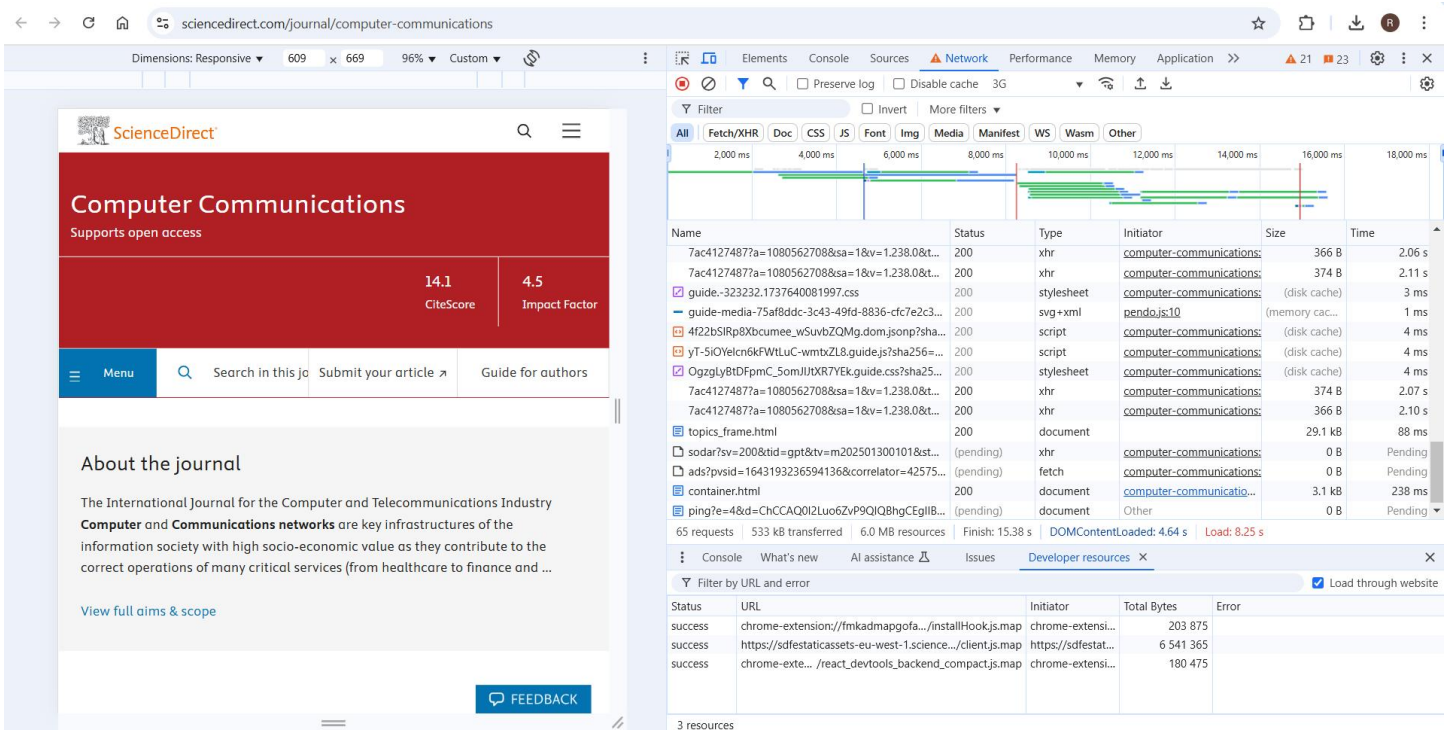
11 / 96 requests 0 B / 73.5 kB transferred 351 kB / 14.1 MB resources Finish: 2.50 s DOMContentLoaded: 1.43 s Load: 1.73 s
Console What's new AI assistance Issues Developer resources
Filter by URL and error
15 resources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All Fetch/XHR Doc CSS JS Font Img Media Manifest WS Wasm Other
Name Status Type Initiator Size Time
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container.html 200 document computer-communicatio... 3.1 kB 238 ms
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65 requests 533 kB transferred 6.0 MB resources Finish: 15.38 s DOMContentLoaded: 4.64 s Load: 8.25 s
Console What's new AI assistance Issues Developer resources
Filter by URL and error
Load through website
Status URL Initiator Total Bytes Error
success chrome-extension://fmkadmapgofa.../installHook.js.map chrome-extensi... 203 875
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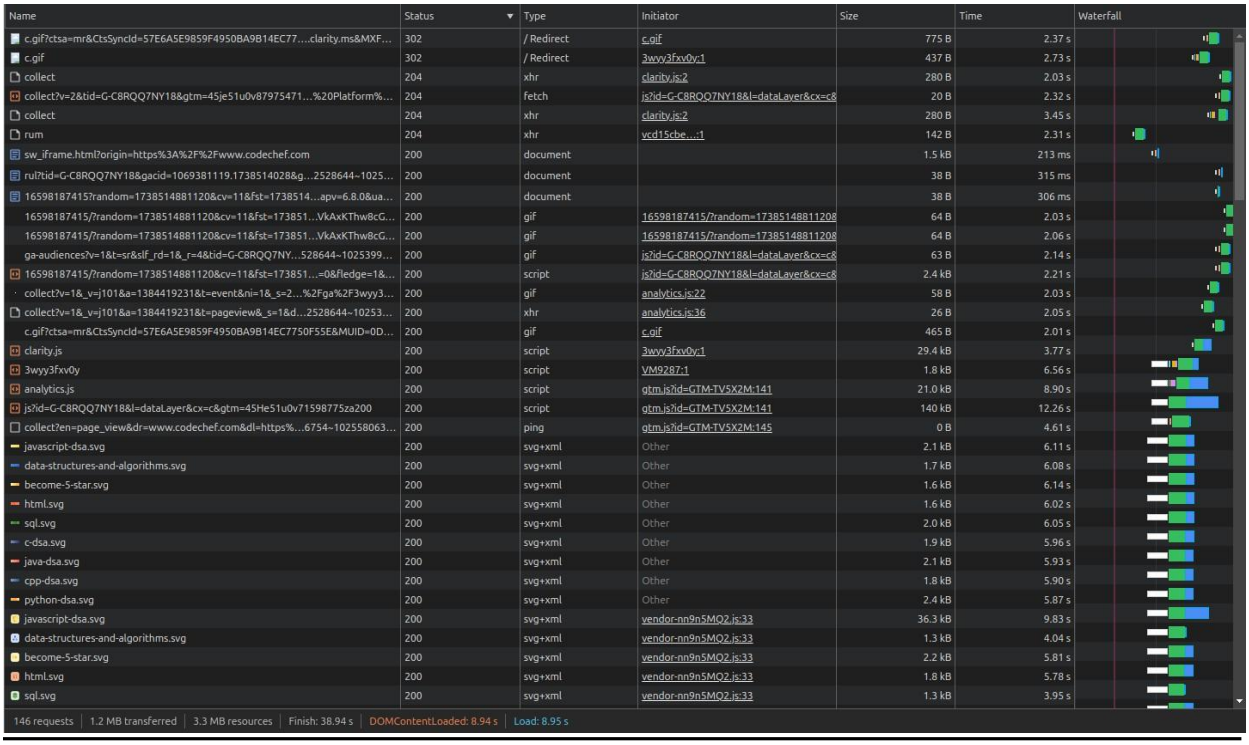
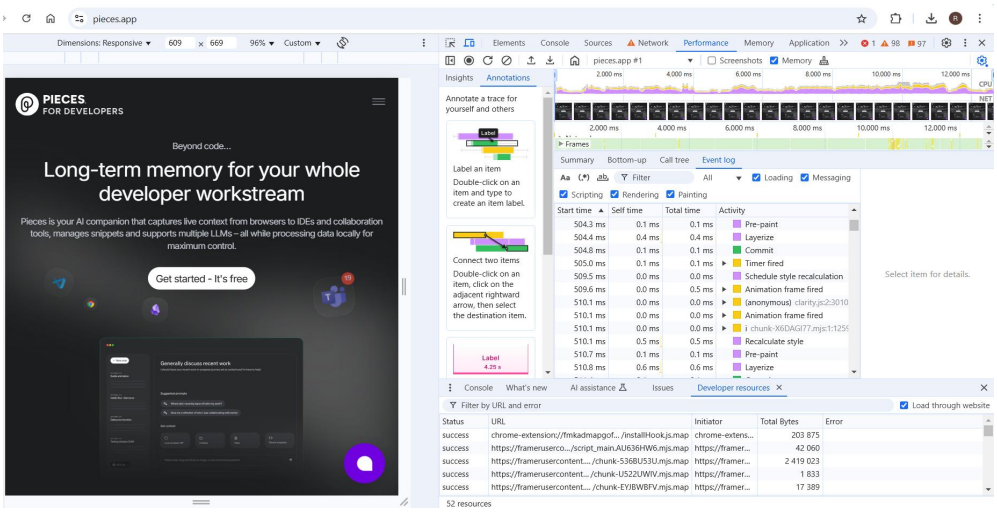
3 resources

When the page is throttled with Regular 4G, the JPEG image files take the longest to load. These high-resolution images require more time due to their large file size and network bandwidth limitations. Additionally, external CSS files and JavaScript scripts may also contribute to the delay, as they need to be fetched from the server before the page can render completely.

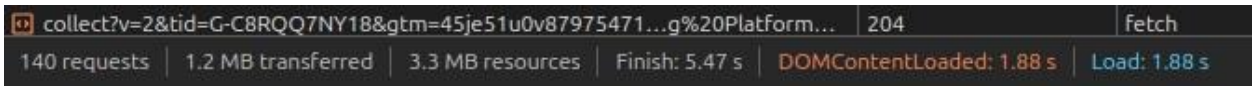
Question 8 : identify any 404 or other errors in the network log when loading the page with "3G" applied. What might cause these errors?

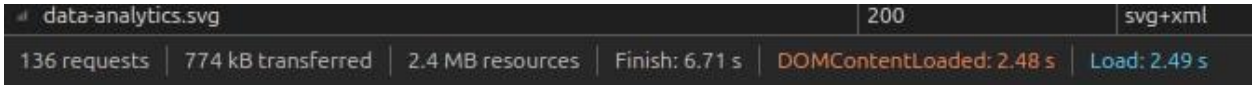




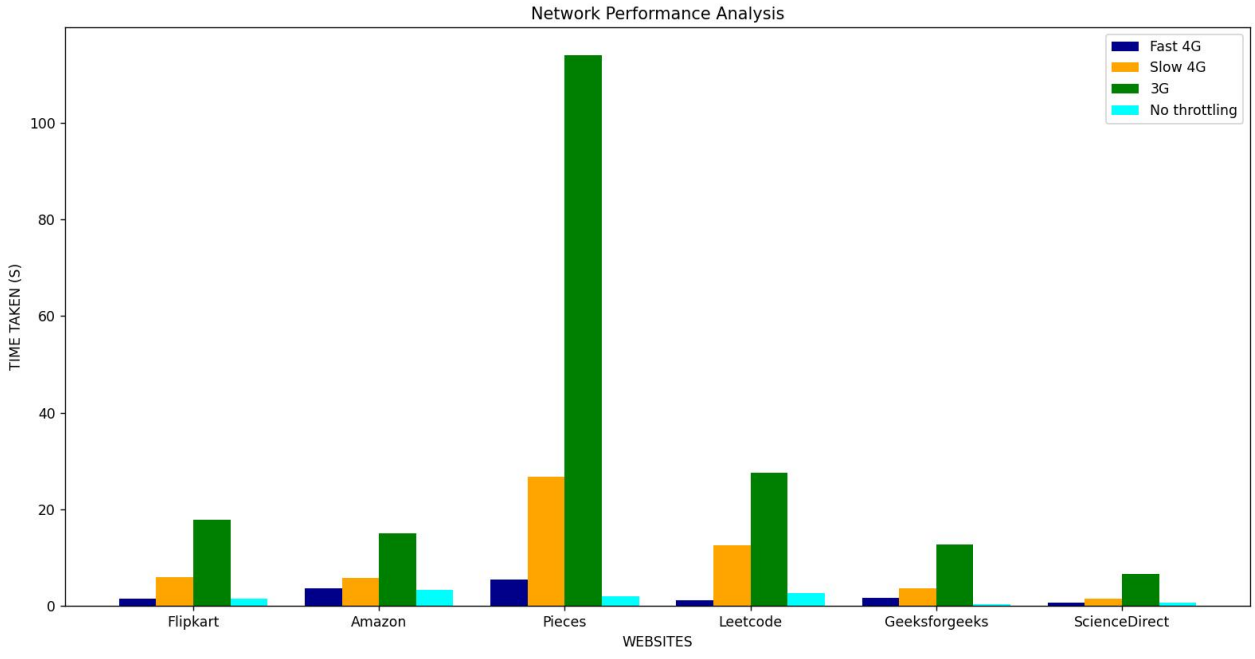
When switched to Slow 3G, no errors were observed in this case. However, errors like 404 (Not Found) or failed resource loads can occur due to page optimization techniques. Some websites intentionally defer or cancel the loading of large assets (like high-resolution images or heavy scripts) to improve performance under slow network conditions. Additionally, network timeouts or failed requests can happen if a server takes too long to respond due to the limited bandwidth.

Question 9:Does the page load faster or slower with "Fast 4G" compared to "Slow 4G"? What are the reasons for the differences ?





The page loads faster on Fast 4G compared to Slow 4G due to the difference in bandwidth and latency. Fast 4G provides higher bandwidth, allowing resources like images, scripts, and stylesheets to download more quickly, resulting in a shorter load time. In contrast, Slow 4G has lower bandwidth and higher latency, causing a delay in resource fetching and increasing overall page load time. For instance, the page might load in 1.8s on Fast 4G, while it takes 2.5s on Slow 4G due to the slower data transfer rate.



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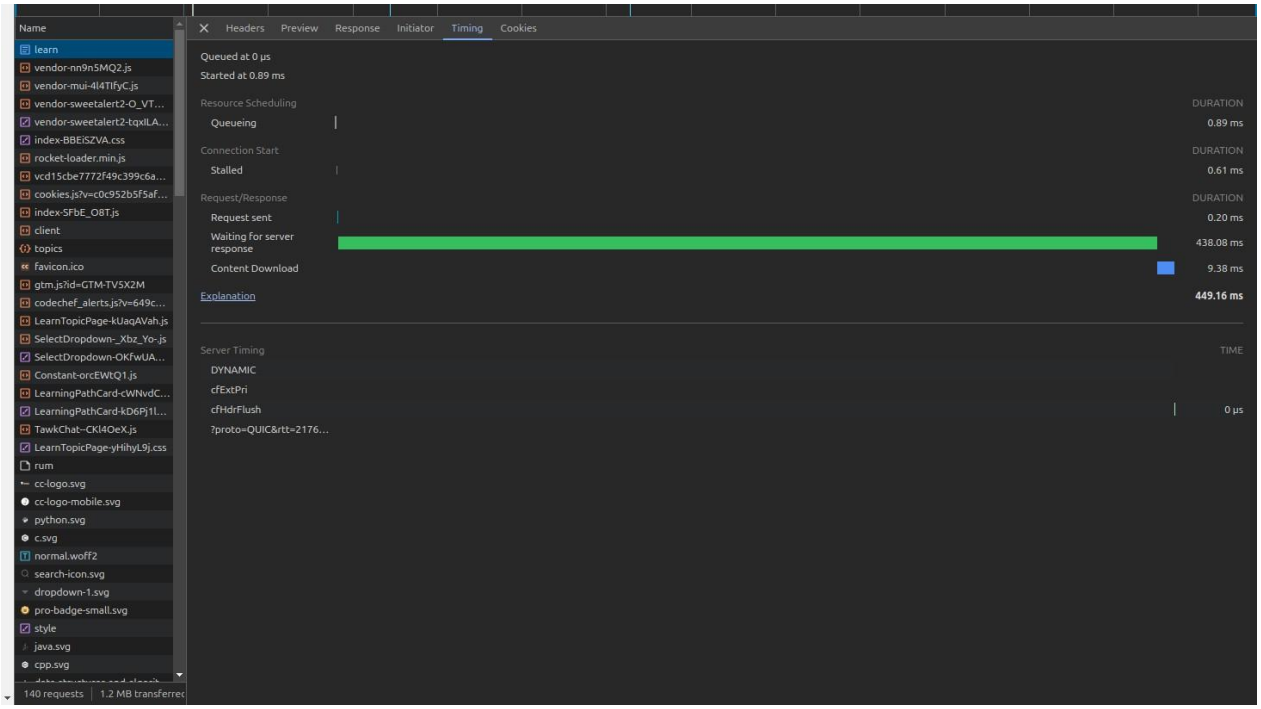
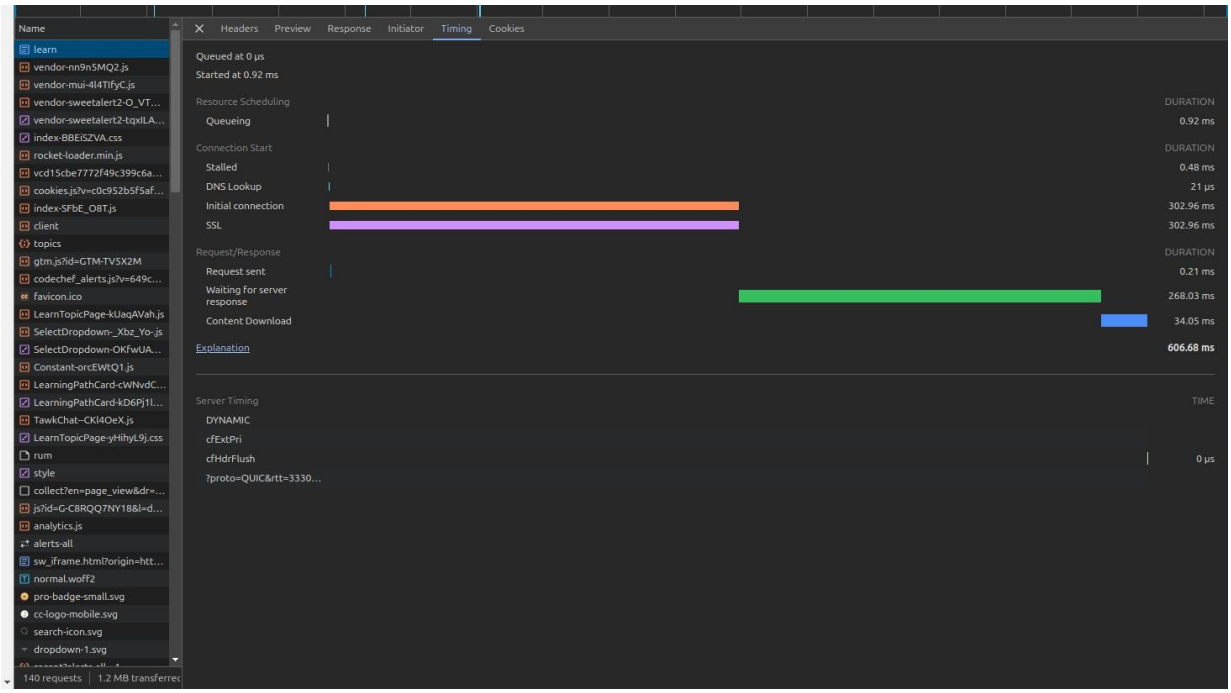
Question 10 : What is the "Time to First Byte (TTFB)" for the webpage under different throttling profiles? How does network throttling affect TTFB?

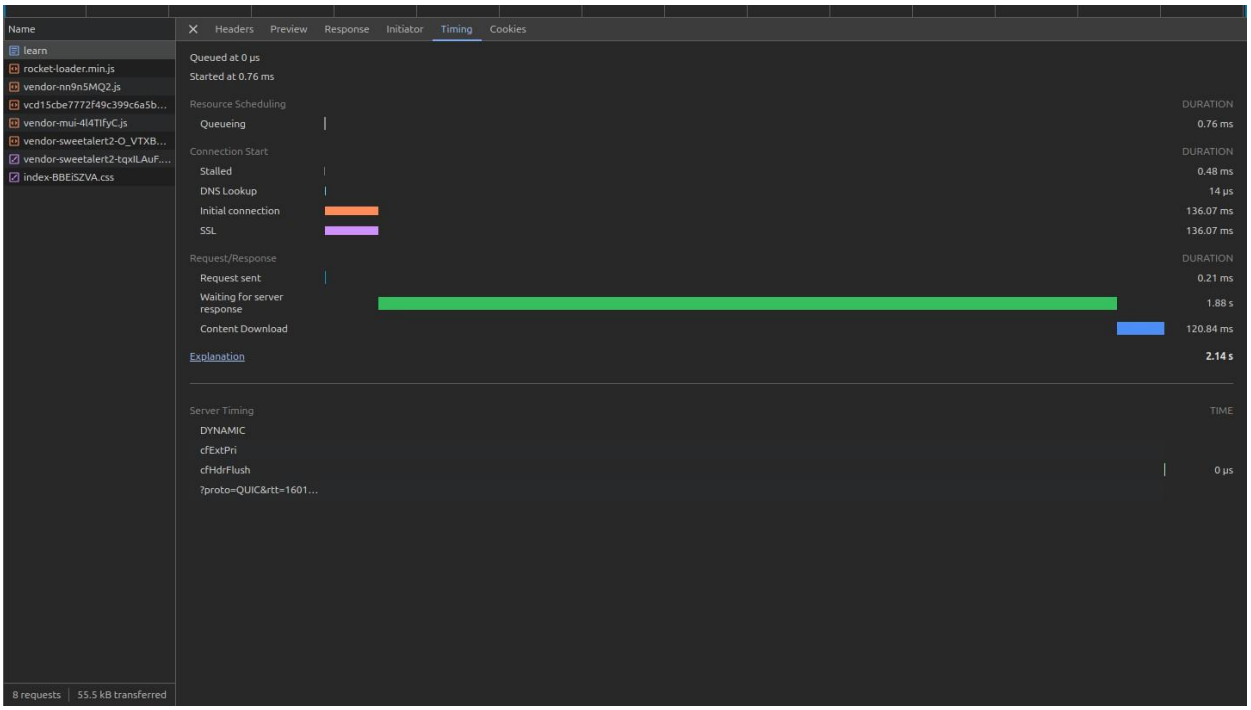




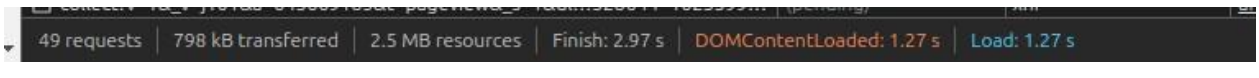
The Time to First Byte (TTFB) for the webpage under different throttling profiles is:

- Fast 4G: 450ms
- Slow 4G: 600ms
- 3G: 2s

Network throttling impacts TTFB by increasing the time required for the browser to receive the first byte of data from the server. On slower networks like Slow 4G and 3G, the higher latency and lower bandwidth cause delays in establishing connections and retrieving responses from the server. As a result, the TTFB increases, leading to slower initial loading times.



Question 11 : How does the "DOMContentLoaded" time change when testing under different throttling profiles?

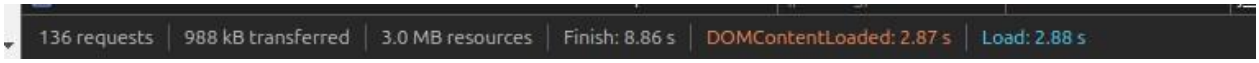


The "DOMContentLoaded" time changes under different throttling profiles as follows:

Fast 4G: 1.27s
Slow 4G: 2.87s
3G: 8.93s

This time primarily measures how long it takes for the HTML document to be fully parsed, but it also depends on network speed. While DOMContentLoaded is triggered when the HTML structure is ready, slower networks cause delays in downloading the HTML file itself, leading to increased load times. Therefore, the time is influenced not just by the document structure but also by the network's bandwidth and latency.

Question 12 : What is the impact of throttling on the "Load" event timing (when the page is fully loaded)?

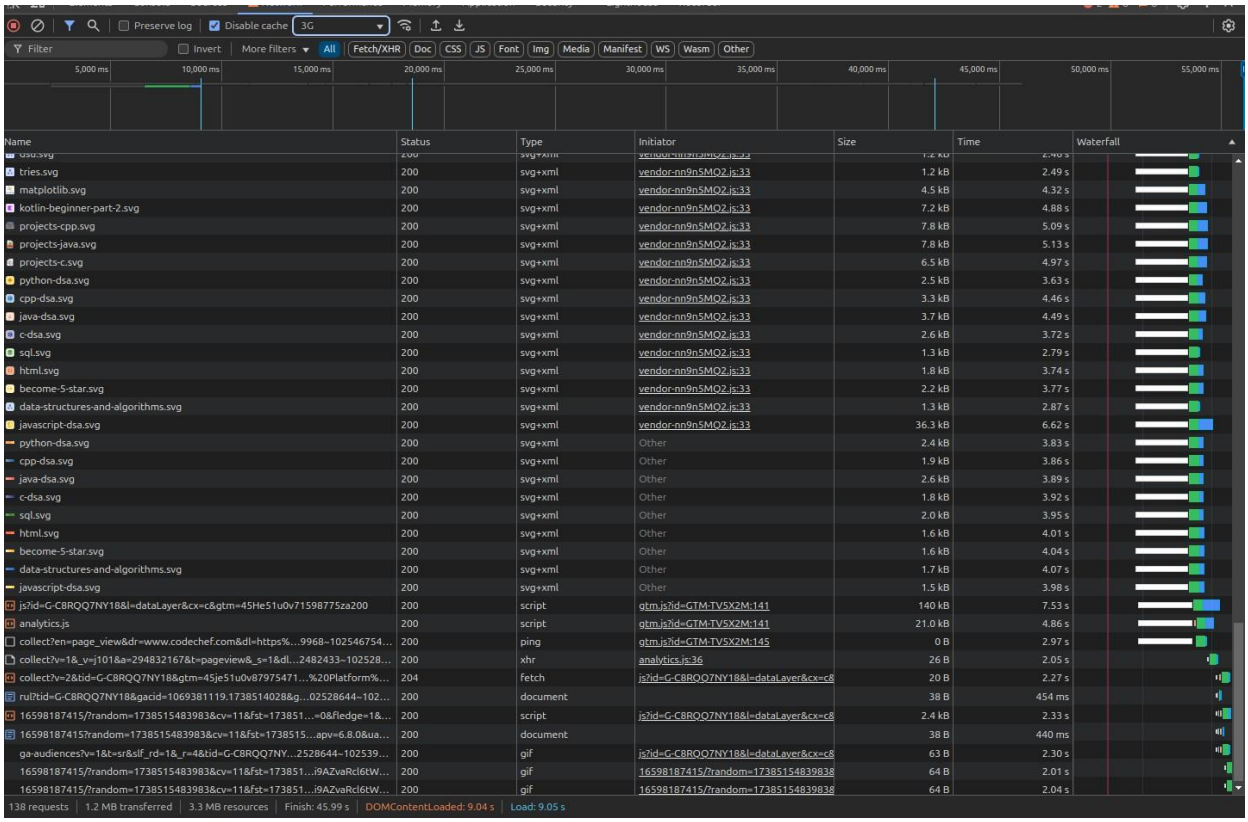


The impact of throttling on the "Load" event timing (when the page is fully loaded) is evident in the following load times:

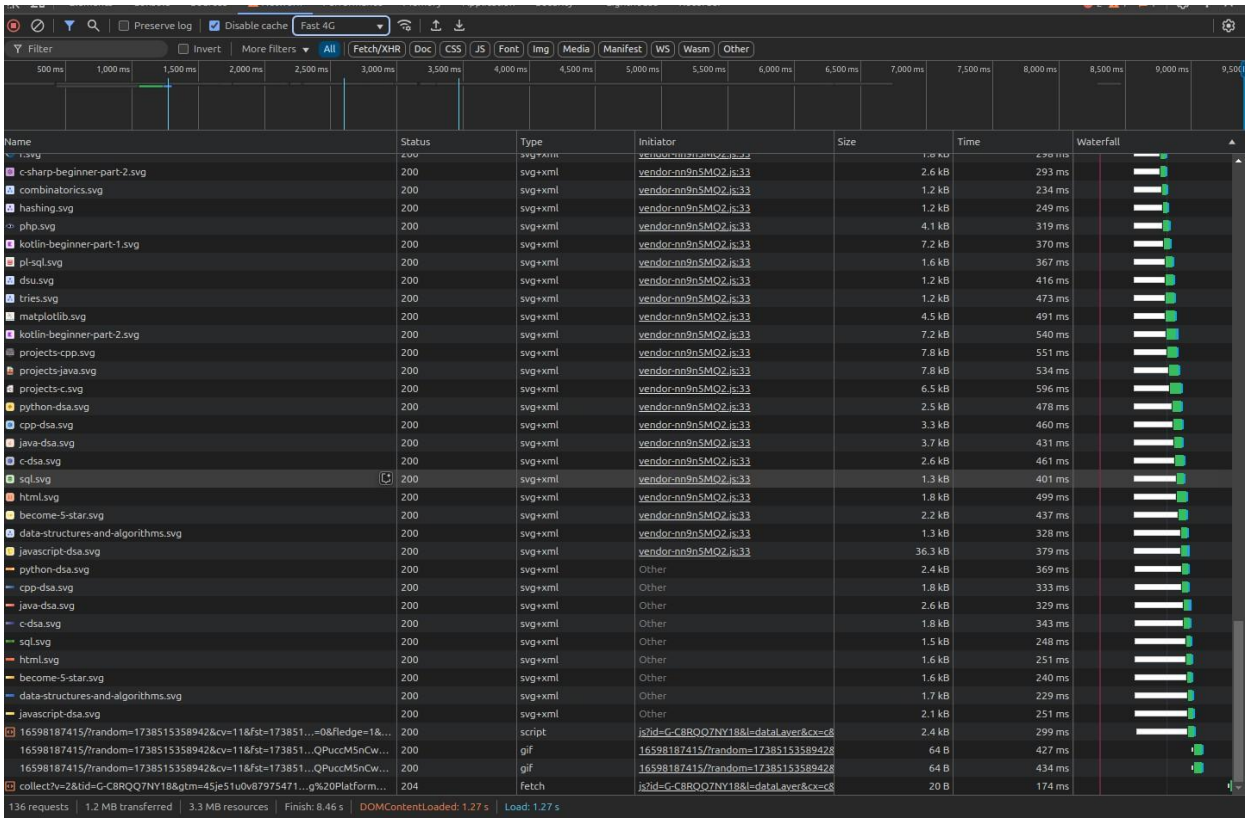
- Fast 4G: 1.27s
- Slow 4G: 2.88s
- 3G: 8.94s

As observed, network throttling impacts the load time significantly. With Fast 4G, the page loads quickly, but as the network speed slows down (to Slow 4G or 3G), the load time increases drastically. This is because slower networks take longer to fetch resources, resulting in delayed Load event timing.

Question 13 : Is there any noticeable delay in rendering when the page is loaded under "3G"conditions? If so, what resources are responsible for the delay?



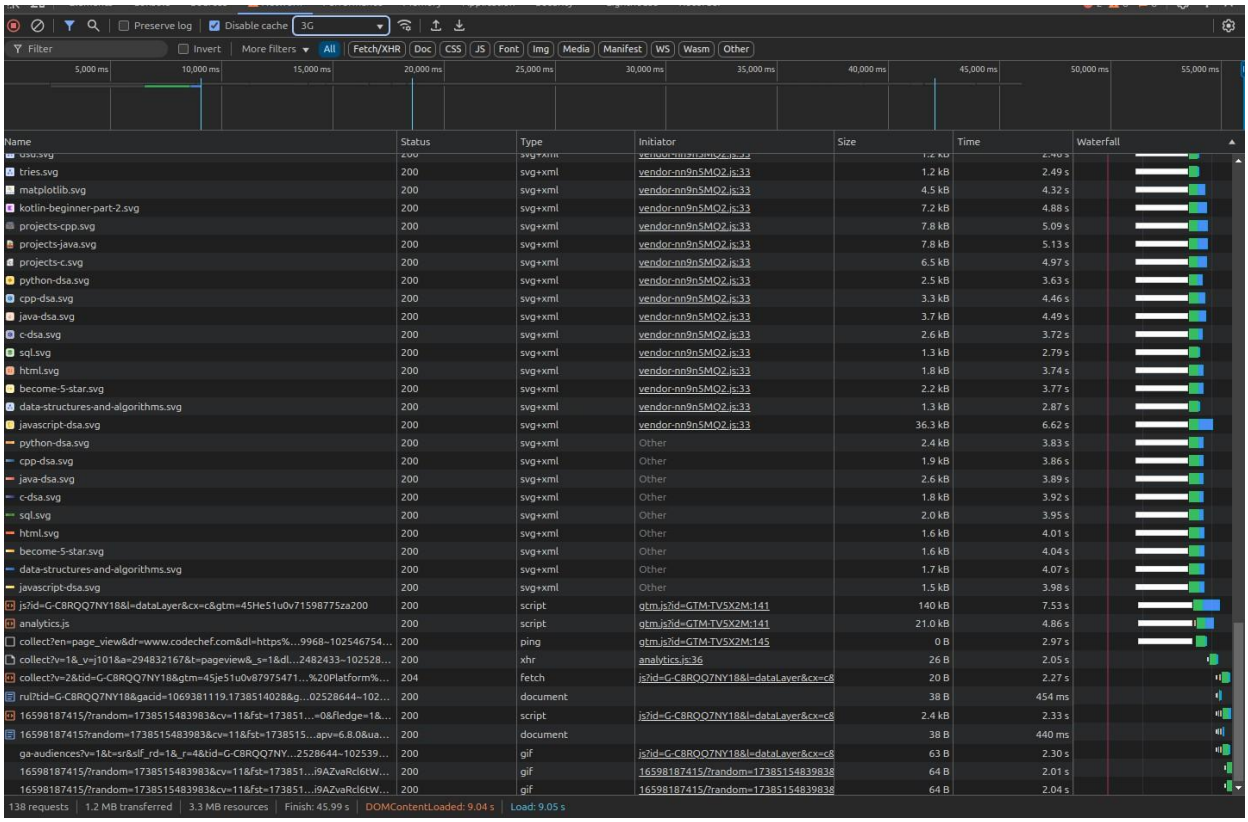
This is 3g(SLOW)



This is fast 4g.

Yes, there is a noticeable delay in rendering when the page is loaded under 3g conditions. The large JS file takes significantly more time to load on 3G compared to Fast 4G, causing the page to render slower. This is because slow network conditions result in longer download times for large files, such as JavaScript, which delay the execution and rendering of the page. The large size of the JS file is likely the primary resource responsible for the delay.

Question 14 : Are there any large resources (e.g., images, scripts) that cause the page to load slowly under network throttling? Identify them



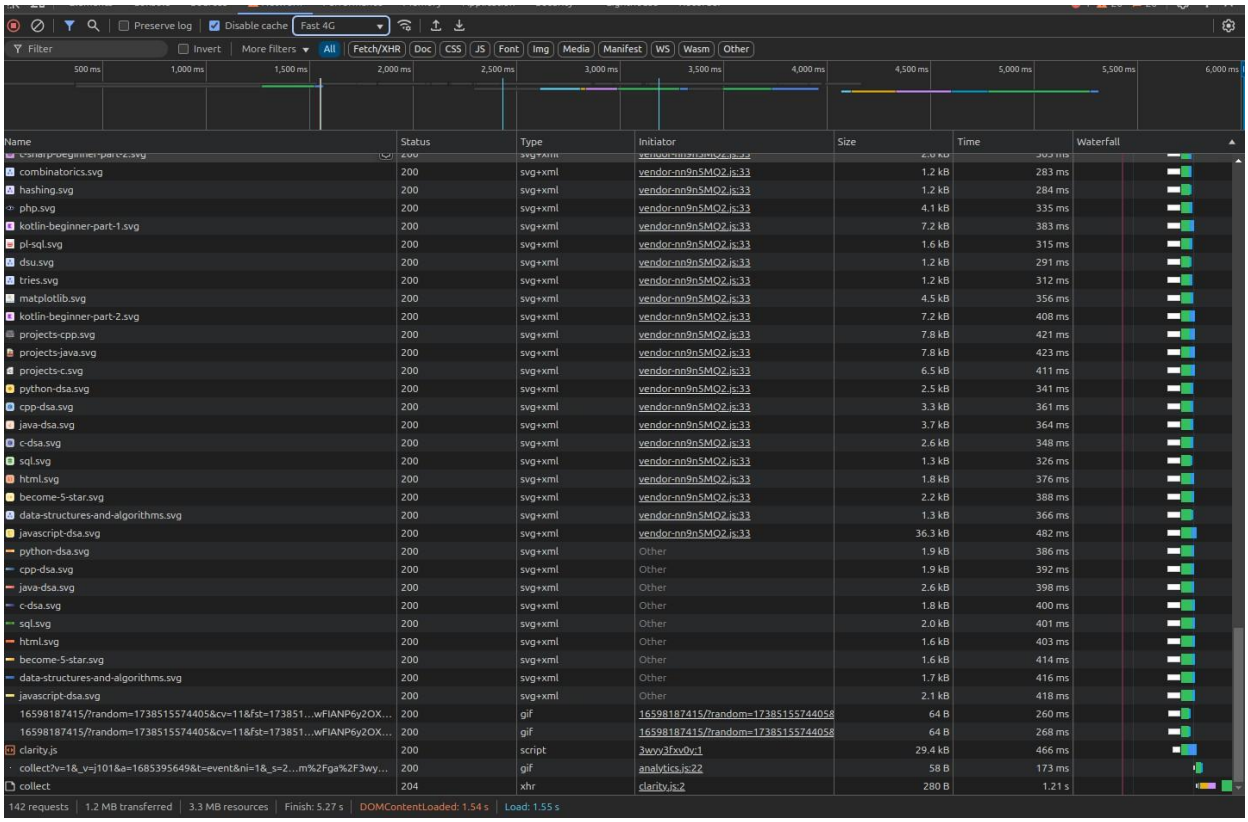
Yes, large resources like images and scripts significantly slow down page loading under network throttling.

Key Resources Causing Slow Load Times:

- JavaScript Files: Large or third-party JS files increase load time due to extra network requests.
- Image Files (PNG, JPEG): High-resolution images take longer to download, especially under "3G."

These resources can be identified in the network log, where they show longer loading times, contributing to overall delays under throttled conditions.

Question 15 : What effect does using the "Cache" have on performance when throttling is applied?Does the page load faster on subsequent visits



Name	Status	Type	Initiator	Size	Time
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hashing.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	1.2 kB	284 ms
php.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	4.1 kB	335 ms
kotlin-beginner-part-1.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	7.2 kB	383 ms
pl-sql.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	1.6 kB	315 ms
dsu.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	1.2 kB	291 ms
tries.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	1.2 kB	312 ms
matplotlib.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	4.5 kB	356 ms
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python-dsa.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	2.5 kB	341 ms
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java-dsa.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	3.7 kB	364 ms
c-dsa.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	2.6 kB	348 ms
sql.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	1.3 kB	326 ms
html.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	1.8 kB	376 ms
become-5-star.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	2.2 kB	388 ms
data-structures-and-algorithms.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	1.3 kB	366 ms
javascript-dsa.svg	200	svg+xml	vendor-nn9n5MQ2.js:33	36.3 kB	482 ms
python-dsa.svg	200	svg+xml	Other	1.9 kB	386 ms
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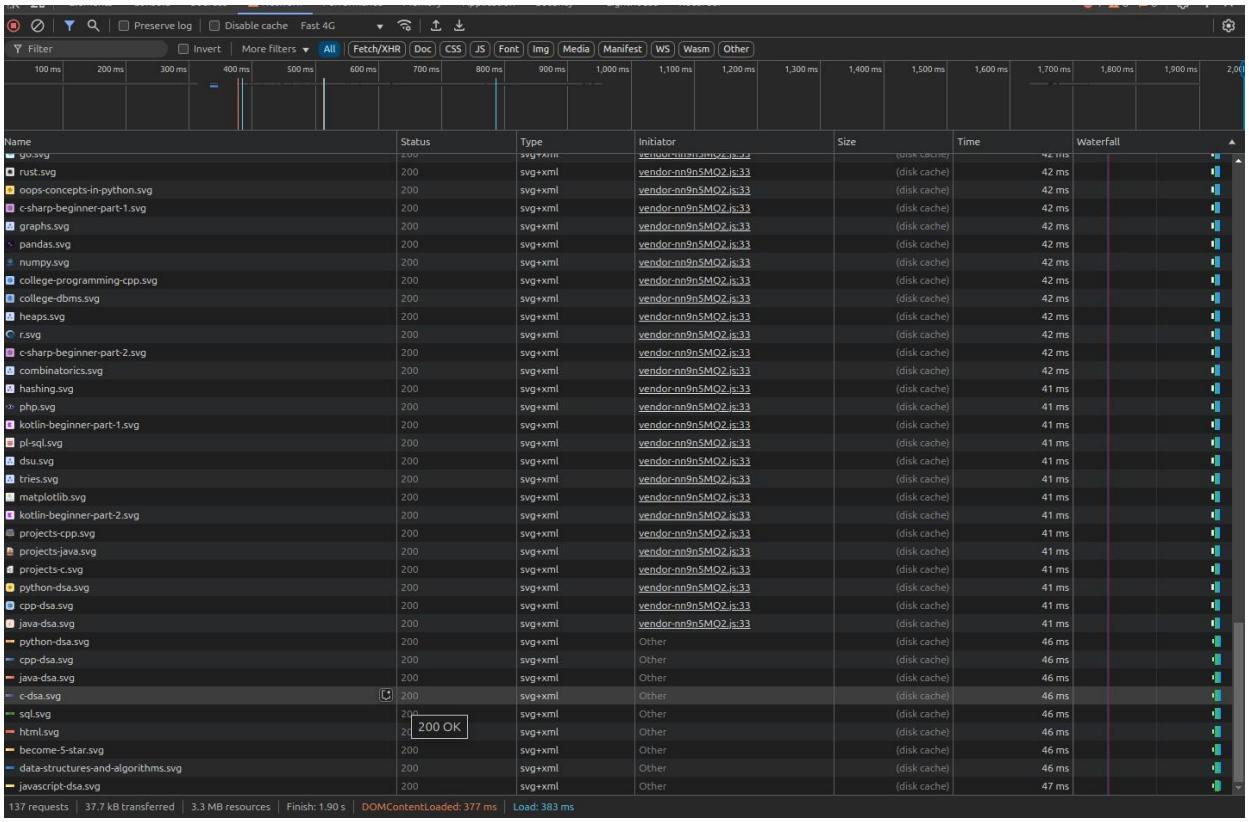
collect?v=1&_v=j101&a=1685395649&t=event&ni=1&_s=2…m%2Fga%2F3wy…	200	gif	analytics.js:22	58 B	173 ms
collect	204	xhr	clarity.js:2	280 B	1.21 s

142 requests | 1.2 MB transferred | 3.3 MB resources | Finish: 5.27 s | DOMContentLoaded: 1.54 s | Load: 1.55 s



Yes, using the "Cache" significantly improves performance under throttling.

Effect of Cache on Performance:

- Faster Loading: Cached resources (like images, CSS, and JS files) are stored locally, so the browser doesn't need to re-download them on subsequent visits. This leads to faster page loads.
- Fewer Network Requests: Cached files reduce the number of network requests needed, which is especially helpful under slow network conditions. This speeds up rendering and reduces load times.

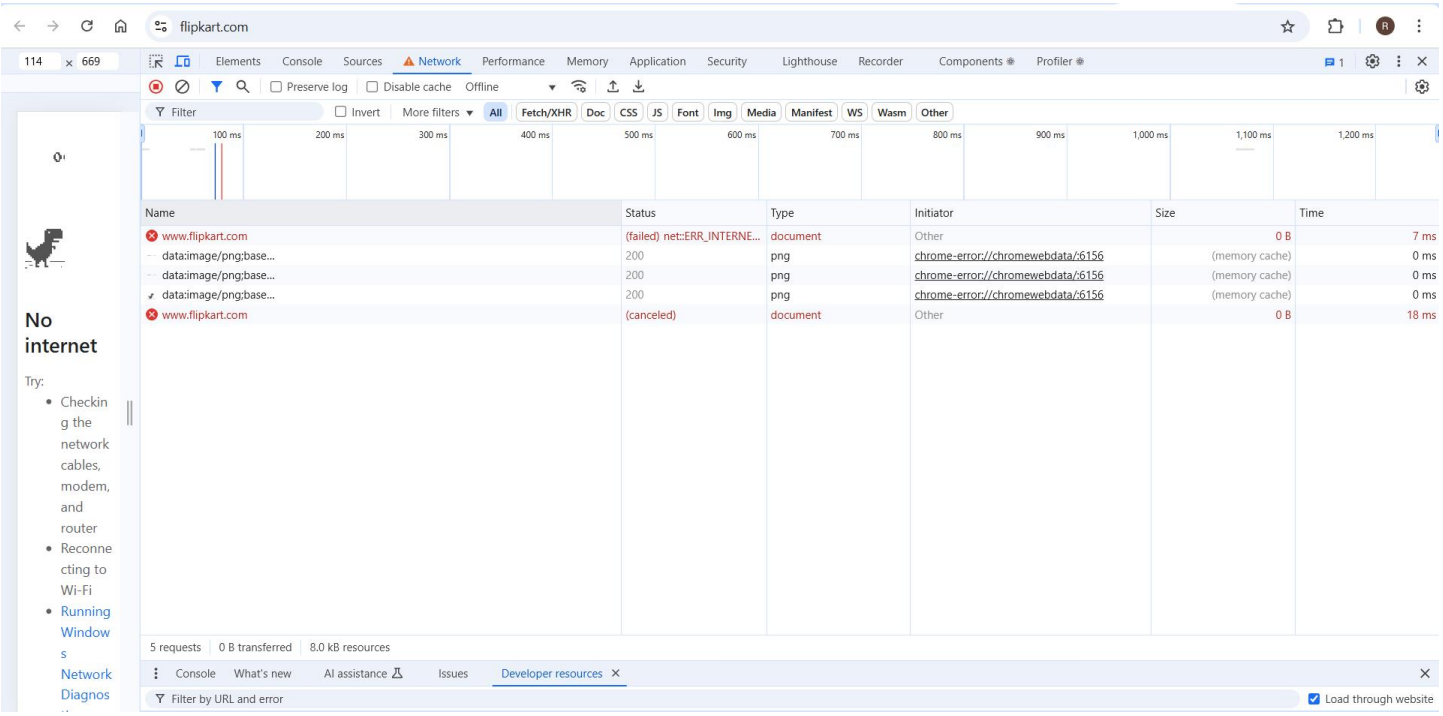
Example:

- Initial load: 1.55s
- After caching: 383ms

Caching makes a big difference by reducing load times, especially under throttled conditions, as the browser fetches fewer resources from the network.

Question 16 :What happens to page load time when you simulate no connection

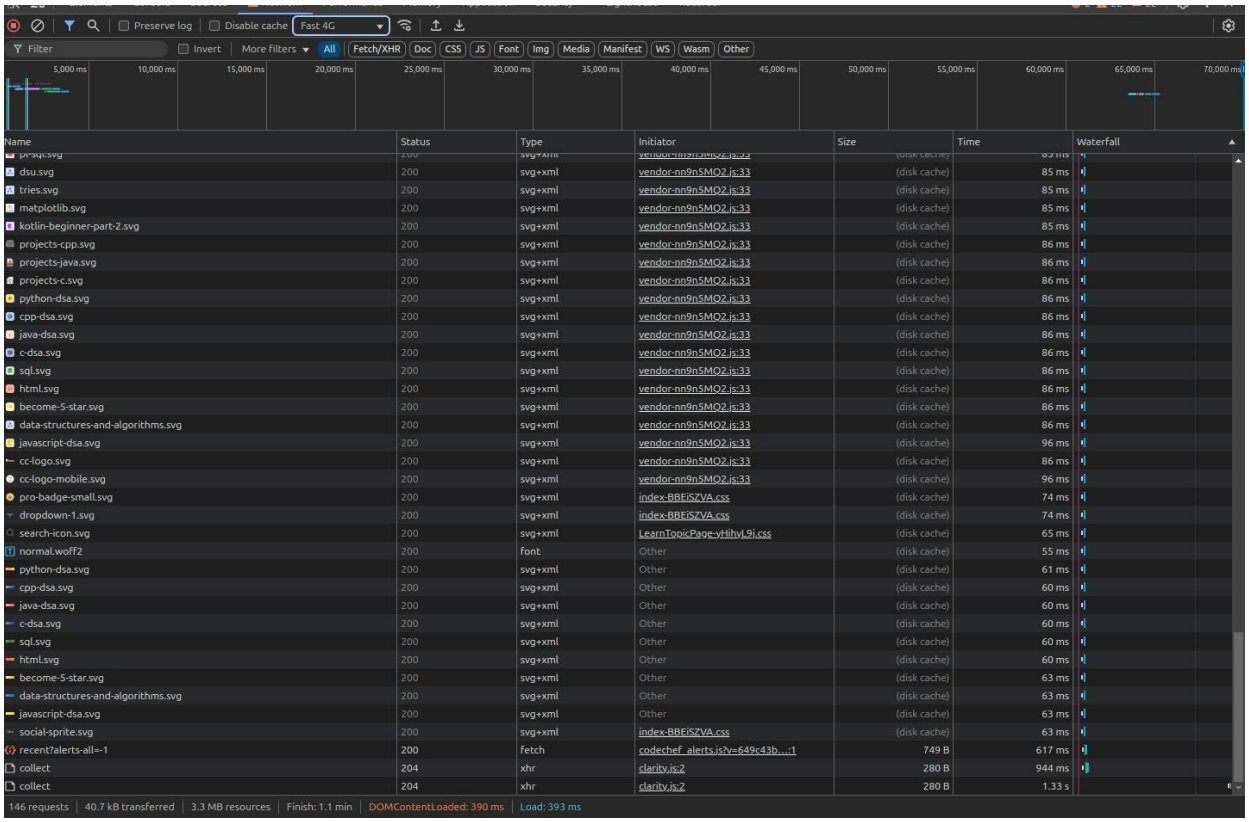
("Offline")? Which resources fail to load?

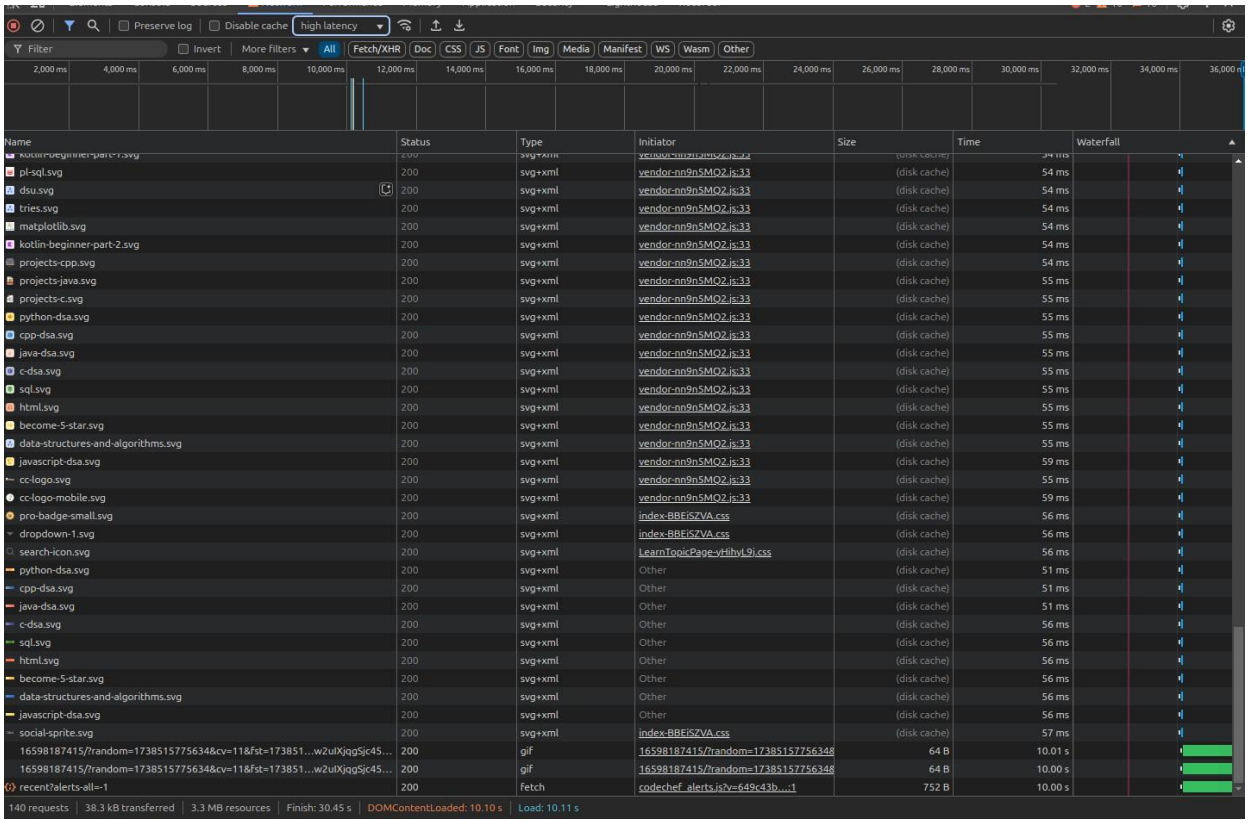


When simulating "Offline," the page load time becomes extremely slow or the page may not load at all, as no network connection is available to fetch any new resources.

Resources that fail to load:
External Scripts: JavaScript files from external sources (e.g., CDN or third-party libraries).
Images: Images that are hosted externally and not cached will fail to load.
CSS Files: External CSS files that aren't cached or stored locally will fail to load.
API Requests: Any dynamic data or content fetched from online APIs will not be available.
Web Fonts: Custom fonts hosted externally will not load.
Only cached resources (like previously downloaded images, CSS, or scripts) will be available if they're stored in the browser cache. Anything that needs to be fetched over the network will fail.

Question 17 : How does switching to a custom throttling profile with a higher latency (e.g., 200ms) affect the loading of the page compared to " fast 4G"?

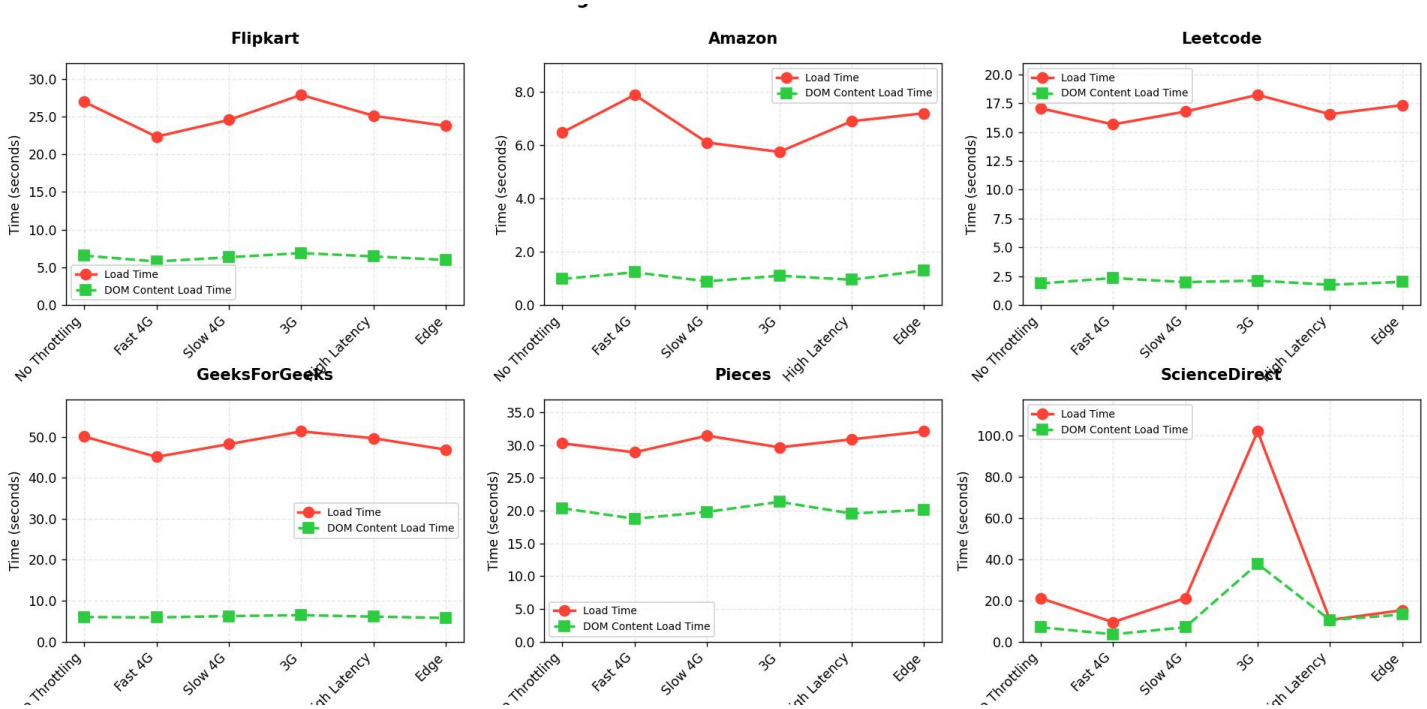

Preserve log
Disable cache
Fast 4G
Filter
Invert
More filters
All
Fetch/XHR
Doc
CSS
JS
Font
Img
Media
Manifest
WS
Wasm
Other
Name
Status
Type
Initiator
Size
Time
Waterfall
146 requests
40.7 kB transferred
3.3 MB resources
Finish: 1.1 min
DOMContentLoaded: 390 ms
Load: 393 ms


Preserve log
Disable cache
high latency
Filter
Invert
More filters
All
Fetch/XHR
Doc
CSS
JS
Font
Img
Media
Manifest
WS
Wasm
Other
Name
Status
Type
Initiator
Size
Time
Waterfall
140 requests
38.3 kB transferred
3.3 MB resources
Finish: 30.45 s
DOMContentLoaded: 10.10 s
Load: 10.11 s

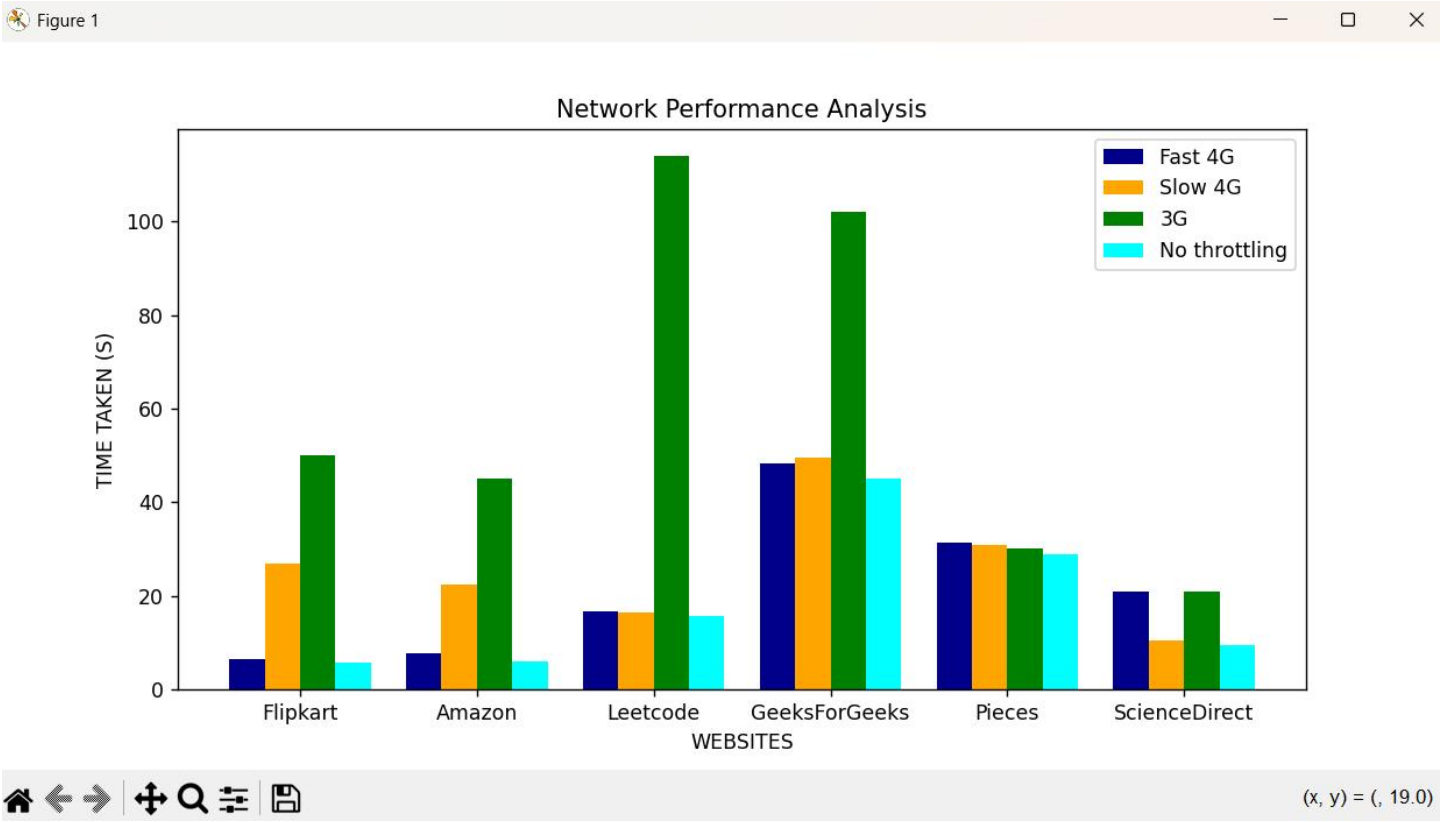
Switching to a custom throttling profile with a higher latency (e.g., 200ms) compared to "Fast 4G" has the following effects on page loading:

- Increased Delay: The higher latency causes longer wait times for the initial connection and for each request, delaying the fetching of resources.
- Slower Resource Fetching: Resources like images, scripts, and CSS files take longer to download due to the added round-trip communication delay.
- Potential Delay in Rendering: As resources take longer to load, the page rendering is delayed, resulting in an overall slower load time.

THE FINAL GRAPH TO DRAW CONCLUSION ON DIFFERENT WEBSITES PERFORMANCE PARAMETER IS SHOWN ALONGSIDE : MADE WITH HELP OF PYTHON CODE



COMBINED COMPARISON SHOWN BELOW :



CONCLUSION :

From this experiment , I understood that analyzing network performance using Chrome DevTools provided insights into how websites load under different network conditions. By testing five websites on Fast 4G, Slow 4G, and 3G, I was able to observe variations in load times and identify bottlenecks. Heavy scripts, media content, and server response times played a crucial role in website speed. Creating a graph helped visualize these differences effectively.

I was able to recognize the need for optimizations like reducing large scripts, compressing images, and improving caching. I understood that such improvements significantly enhance user experience, making websites faster and more efficient across all network conditions.
