Section: A

Team Name: Taskforce

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1. Test Scenarios and Classification

1.1 Part A:

1. **Ignoring the specific number of days, how many valid combinations of input variables are there to determine the price per mile per trip?**

   Answer:

   These are some of the combinations of input variables to determine the price per mile per trip.

   Base price with Insurance = $1500 per/route
   Base price = $1000 per/route
   Additional price per delivery = $20 per/trip
   Discount for each trip to first-time price = 10% discount
   Priority delivery with special charge = $50 per/mile.

   By analysing the input variables we got to know the system has 3 variables and 2 values. So, we can get 2*2*2 = 8 combinations to test the price per mile per trip.

2. **Are there any equivalence classes that you could use to reduce the number of test cases? If so, what?**

   Answer:

   Below table contains the equivalence classes to reduce the number of tests cases with combinations of 2*2*2 = 8 test cases.

Equivalence Classes	Test Cases
1. Price of the products	Price of the products depends on two parts 1 Base price - $1000 per/route 2 Base price with insurance - $1500 per/route
2 Delivery Charges	Delivery charges is $20 per/mile. If customers' needs priority delivery then additional $50 extra charge (total = $20+$50).

3 Discounts to the products	For repeated orders 10% discount from the first time price, otherwise no discount

3. Are there any external boundary conditions you think you should test? If so, what are they?

Answer:

There are external boundary conditions available to test for the above system. We have to make all the conditions of the system is satisfying by pushing the boundary of the system to extreme. By providing some external conditions we can test the system conditions is appropriate or not. *For example:* Here in the system the base price is $1000 with insurance it is $1500. We can ensure it with our external conditional by keeping the price value to negative or empty value to check the system response and also for $2000 to check system behaviour. Same way we will check it for the discount and for the priority truck delivery process.

Boundary Conditions	Test cases results
1. To check negative numbers and $0 for pricing module.	System must deny
2. If the input value is anything like 50% or -10% to discount.	System must deny
3. Special priority charge must not be empty	System must deny
4. Checking with empty value for charge per mile.	System must deny
5. Checking with negative value to delivery charge per mile	System must deny
6. Priority order with additional charge inputs as $200 along delivery charge of -$50.	System must deny
7. Providing special surcharge with negative numbers	System must deny
8. Reducing additional priority charge to $30	System must deny

4. Are there any internal boundary conditions you think you should test? If so, what?

Answer:

Below are some the internal boundary conditions to find the system behavior by providing the valid range of internal input values as conditions to the system to check its response.

Boundary Conditions	Test cases results
1. To check $1000 < price <$1500	System must accept
2. All pricing values must be numbers or floating points.	System must accept
2. If price value is $1070 and $2520 with insurance	System must accept
3. To check 10% discount or not	System must accept
4. To check $20 per/mile delivery charge	System must accept
5. To check discount is applying to every second time buyers price or not by adding 10% discount to repeated order.	System must accept
7. To check for special priority charge $50	System must accept

5. **Assuming you use the equivalence classes in your analysis, what would be the number of possible unique combinations of input variables that you would need to test for complete coverage?**

   Answer:

   - Assuming the equivalence classes as the above analysis, the number of possible unique combinations of input variables that would need to test complete coverage are: **8 combinations.**

6. **If you used a decision table to determine the test cases, how many columns would you need? How many test cases does this result in?**

   Answer:

   - If we use a decision table to determine the test cases, we require **10 columns**.
   - This results in **8 test cases.**

7. **If you used an orthogonal array to test, which array would you use? How many test cases does this result in?**

   Answer:

   We would like to use L4 orthogonal array that is (L_4 (2^3)) orthogonal array, since the system has 3 variables each with 2 values. The number of test cases = 2*2*2 = 8 test cases.

8. **If the number between 6 and 7 is different, why is it different? If it isn't, why is it the same?**

   Answer:

   The number between the 6 and 7 are same, in which we reduced the number of test cases by using orthogonal array compared to exhaustive testing. When it comes to decision table which provides cause and effects, also has the same 3 variables with 2 values each like orthogonal array leading us total 8 test cases. But, we can't able to reduce the number of test cases in decision table, because all the test case must be performed to know the system effects according to requirement in terms of testing.

9. **Create the decision table.**

   Answer:

Inputs	**Values**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Base price (without or with insurance)	{Y, N}	Y	Y	Y	Y	N	N	N	N
Orders(with or without discount)	{Y, N}	Y	Y	N	N	Y	Y	N	N
Priority Deliveries(with or without)	{Y, N}	Y	N	Y	N	Y	N	Y	N

Outputs									
Pay $1000 per/route		Y	Y	Y	Y				
Pay $1500 per/route						Y	Y	Y	Y
10% price discount		Y	Y			Y	Y		
$20 per/mile delivery chargers			Y		Y		Y		Y
$20 + $50 extra priority delivery charges		Y		Y		Y		Y	
Check Sum		1	1	1	1	1	1	1	1

10. List the test cases based on the orthogonal array.

Answer:

Variables	Values	Values
A	A0	A1
B	B0	B1
C	C0	C1

L_4 (2^3) orthogonal array

Number of combinations	Variable A	Variable B	Variable C
1	A0	B0	C0
2	A0	B1	C1
3	A1	B0	C1
4	A1	B1	C0

1.2 Part B:

1. What would be a reasonable sanity test of the system?

Answer:

After the system made changes in code or functionality due to bugs or due to lack of inconsistency in system functional behaviour. Now, after system build we have to ensure that the system behaviour is proper and bug fixing is working properly. So, we use sanity testing. Here in the project we check for the changes or cancellation in the user's orders and changes in the users address.

2. What would be two reasonable test scenarios?

Answer:

1) The First scenario where user can update the order made before the shipping truck.
2) The second scenario where user can cancel the orders made before the shipping truck.

3. **What might be a good negative test of the system?**

   Answer:

   Test Case 3.1: Users balance
   - Sometimes users tries to make payment without any balance in their debit or credit cards.

   Test Case 3.2: Order cancellation after shipment
   - Sometimes users may have to cancel their order after shipment due to some reasons.

   Test Case 3.3: Order update after shipment
   - Sometimes users can change their mind and can update or change the order after shipment.

4. **What do you think might be two or more areas of higher risk? Why? How would you test those?**

   Answer:

   1) There may be a high chance of risk, if the user changes or update order at the time of shipping or just few hours before shipping. By this time it is hard to change or update order and it takes more workers and time. It can be tested using soap-opera testing and negative testing.
   2) There may be a chance that users can change their shipping address 1-2 hours before or at the time of shipping or may be sometimes after the shipping process. This can also be tested using soap-opera testing and negative testing.
   3) Users trying to place order without sufficient balance there may be chance that order might be placed. This can be tested using negative testing
   4) There may be a risk the system for the user they order with normal delivery, then they might ask for priority delivery in the middle of the delivery. This can be tested using fault injection testing.

5. **Map your scenarios to the pricing requirements. What is the use case coverage?**

   Answer:

   The basic equation for the pricing requirements is ($A*B) + ($20+C),
   Where, A= base price with or without insurance
   B= orders with or without discount
   C= orders with or without priorities

Scenarios	Case Coverage
Users can order a truck without priority for the first time	$1000+$20 =$1020

Users can order a truck with insurance for the first time.	$1500+$20 =$1520
Users can order truck for the second time	($1000*.1)+$20 = $920
Users can order truck for the second time with insurance.	($1500*.1)+$20 = $1370
Users can order truck with priority for the first time	($1000+$20+$50) = $1070
Users can order truck with priority with insurance for the first time	($1500+$20+$50) = $1570
Users can order truck with priority for the second time	($1000*.1)+($20+$50) =$970
Users can order truck with priority with insurance for the second time or more	($1500*.1)+($20+$50) = $1420

2. Performance Measurement

2.2 Performance Requirements Engineering

A graduate-level software engineering class has 20 students. At the beginning of a two-hour class, the instructor asks the students to download and install a software development environment package such as Eclipse from the university's web site. The students will be asked to practice actions demonstrated by the instructor in class. The size of the download file is 50 Mbytes.

1) Do you think that the file would be downloaded quickly? What do you think will happen if the entire class starts downloading the tool simultaneously?

Answer:

It depends on the download speed of the university's Wi-Fi. If downloading speed is enough then it will not be a problem even if the entire class starts to download it simultaneously. However, downloading it simultaneously will have an effect on speed for each. For example, if there is 1Gbps then each student will get 50Mbps.

2) How might the instructor schedule the downloads in class so that everyone is ready to install the software with 15 minutes of the start of the lecture?

Answer:

As already said in the previous answer that it depends on the internet speed. Let's for the sake of this question imagine that the Wi-Fi speed of University is 500Mbps then each student will get 25 Mbps. This will make sure that each downloads the file even if they start it together within seconds.

3) Assume that the WIFI card in your PC has a bandwidth of 1 Gbps. For the purpose of this exercise, assume that data is transported in TCP packets containing a header field with its source and destination addresses and a payload field containing the data to be transported. Assuming a TCP

packet header size of 24 bytes and an average payload size of 256 bytes, what is the shortest time needed to download the file? Please show your work.

Answer:

Bandwidth speed = 1Gbps

TCP header size = 24 bytes

Payload Size = 256 bytes

File size = 50 Mbytes

First, we will calculate total packets to be sent using TCP which are

$$50 * 10^6 / 256 = 195313 \text{ packets approx.}$$

Now multiplying it with TCP header size we will get total bytes

$$195313 * 24 * 8(\text{for bits conversion}) = 37500{,}000 \text{ approx.}$$

In the end, to get the total time we will divide it by bandwidth speed

$$37500{,}000/10^9 = 0.0375 \text{ sec} \sim 0.04 \text{ sec approx.}$$

Therefore, it will take **37.5 msec ~ 40 msec** to download file.

4) Using your answer to the previous question, is a download time requirement of 1 second achievable (a) if you are using a private WIFI at home with 5 Mbps bandwidth from your broadband provider, (b) if 20 students are in the class, all downloading the file at the same time with 20 Mbps bandwidth available in the classroom, (c) you are using cellular WIFI at 1 Gbps? When answering this question, assume that the download server and the students' PCs are not limiting factors.

Answer:

a – if we are using 5 Mbps:

We can calculate time by using calculations from the previous question, as it was calculated that total bits to be sent are 37500,000 so

$$37500{,}000/ 5* 10^6 = 7.5 \text{ sec}$$

This means that with 5Mbps speed it will take 7.5 seconds to download the file

b- if 20 students are using at the same time with 20 Mbps speed:

If 20 students are using at the same time, we can assume that each person gets 1Mbps

$$37500{,}000/1*10^6 = 37.5 \text{ sec}$$

In total, it will take 37.5 seconds for each student to download the file

c- We are using Wi-Fi cellular speed of 1Gpbs:

If we have 1Gbps then it will take 37.5 msec to download the file as already shown in the previous question so it is less than 1 seconds.

Performance Testing and Measurement

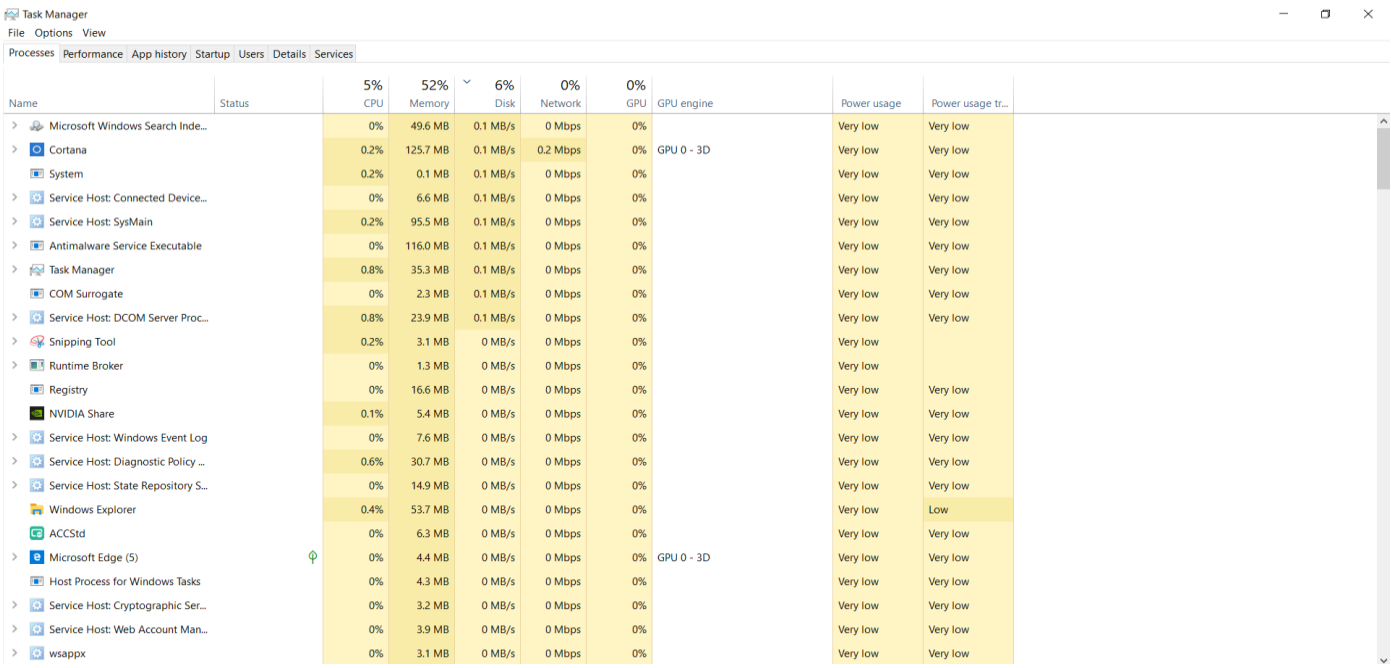
Local Measurement:

5) We will begin with some local monitoring of resource usage so that you can get a feel for how instrumentation works and what it tells you about the system and the application. Windows users can bring up the Task Manager by typing CTL-ATL-Del and clicking on Task Manager. Apple users can bring up the Activity Monitor, which is described here: https://support.apple.com/en-au/HT201464 (Links to an external site.). Their capabilities are not identical, but these tools serve the same purpose. Different versions of Windows have different interfaces for the Task Manager. In this exercise, the resource monitor refers to the Apple or Windows versions. Your focus should be on CPU, Disk, Memory, GPU usage if your laptop has a GPU, and Wi-Fi, or other network usages. Some resource monitors display all of these at once.

6) Close all browsers and open the resource monitor. Keep the resource monitor visible throughout the rest of this exercise. Immediately open the resources usage windows. What has happened to the CPU usage in the last few seconds? Move the mouse around and see what happens to the various resources. Describe what you see.

Answer:

This screenshot shows the condition of the resource manager when everything else is closed.



Name	Status	5% CPU	52% Memory	6% Disk	0% Network	0% GPU	GPU engine	Power usage	Power usage tr...
Microsoft Windows Search Inde...		0%	49.6 MB	0.1 MB/s	0 Mbps	0%		Very low	Very low
Cortana		0.2%	125.7 MB	0.1 MB/s	0.2 Mbps	0%	GPU 0 - 3D	Very low	Very low
System		0.2%	0.1 MB	0.1 MB/s	0 Mbps	0%		Very low	Very low
Service Host: Connected Device...		0%	6.6 MB	0.1 MB/s	0 Mbps	0%		Very low	Very low
Service Host: SysMain		0.2%	95.5 MB	0.1 MB/s	0 Mbps	0%		Very low	Very low
Antimalware Service Executable		0%	116.0 MB	0.1 MB/s	0 Mbps	0%		Very low	Very low
Task Manager		0.8%	35.3 MB	0.1 MB/s	0 Mbps	0%		Very low	Very low
COM Surrogate		0%	2.3 MB	0.1 MB/s	0 Mbps	0%		Very low	Very low
Service Host: DCOM Server Proc...		0.8%	23.9 MB	0.1 MB/s	0 Mbps	0%		Very low	Very low
Snipping Tool		0.2%	3.1 MB	0 MB/s	0 Mbps	0%		Very low	
Runtime Broker		0%	1.3 MB	0 MB/s	0 Mbps	0%		Very low	
Registry		0%	16.6 MB	0 MB/s	0 Mbps	0%		Very low	Very low
NVIDIA Share		0.1%	5.4 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Service Host: Windows Event Log		0%	7.6 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Service Host: Diagnostic Policy ...		0.6%	30.7 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Service Host: State Repository S...		0%	14.9 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Windows Explorer		0.4%	53.7 MB	0 MB/s	0 Mbps	0%		Very low	Low
ACCStd		0%	6.3 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Microsoft Edge (5)		0%	4.4 MB	0 MB/s	0 Mbps	0%	GPU 0 - 3D	Very low	Very low
Host Process for Windows Tasks		0%	4.3 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Service Host: Cryptographic Ser...		0%	3.2 MB	0 MB/s	0 Mbps	0%		Very low	Very low
Service Host: Web Account Man...		0%	3.9 MB	0 MB/s	0 Mbps	0%		Very low	Very low
wsappx		0%	3.1 MB	0 MB/s	0 Mbps	0%		Very low	Very low

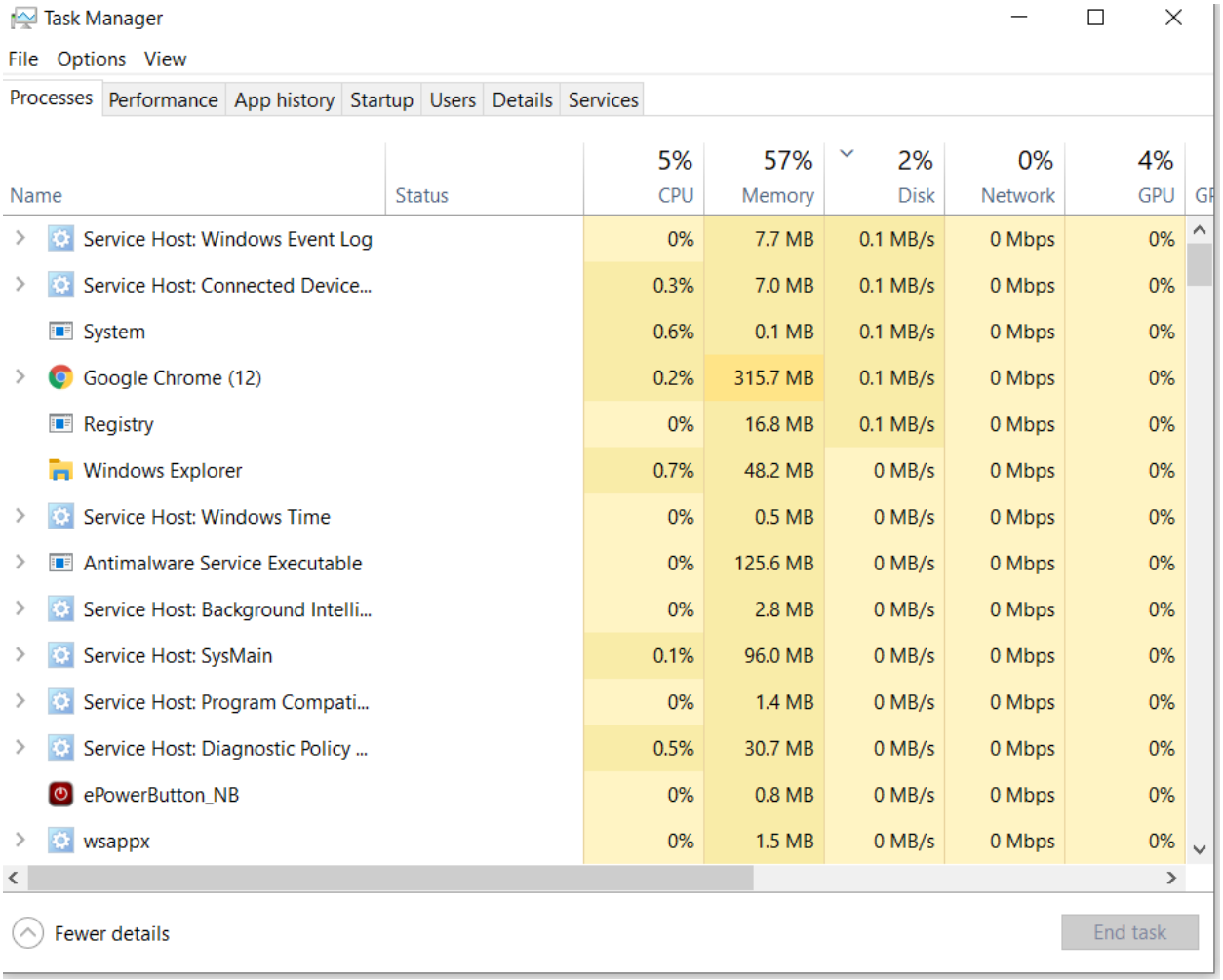
As you can see CPU usage is down to 5%. When we moved the mouse, it had a little impact on CPU, Memory, and GPU. Each of them increased by 1% approximately.

7) Open a browser while keeping the resource monitor visible. Open a tab with[https://www.youtube.com/watch?v=TX0qN6QEvGg (Links to an external site.)](https://www.youtube.com/watch?v=TX0qN6QEvGg)

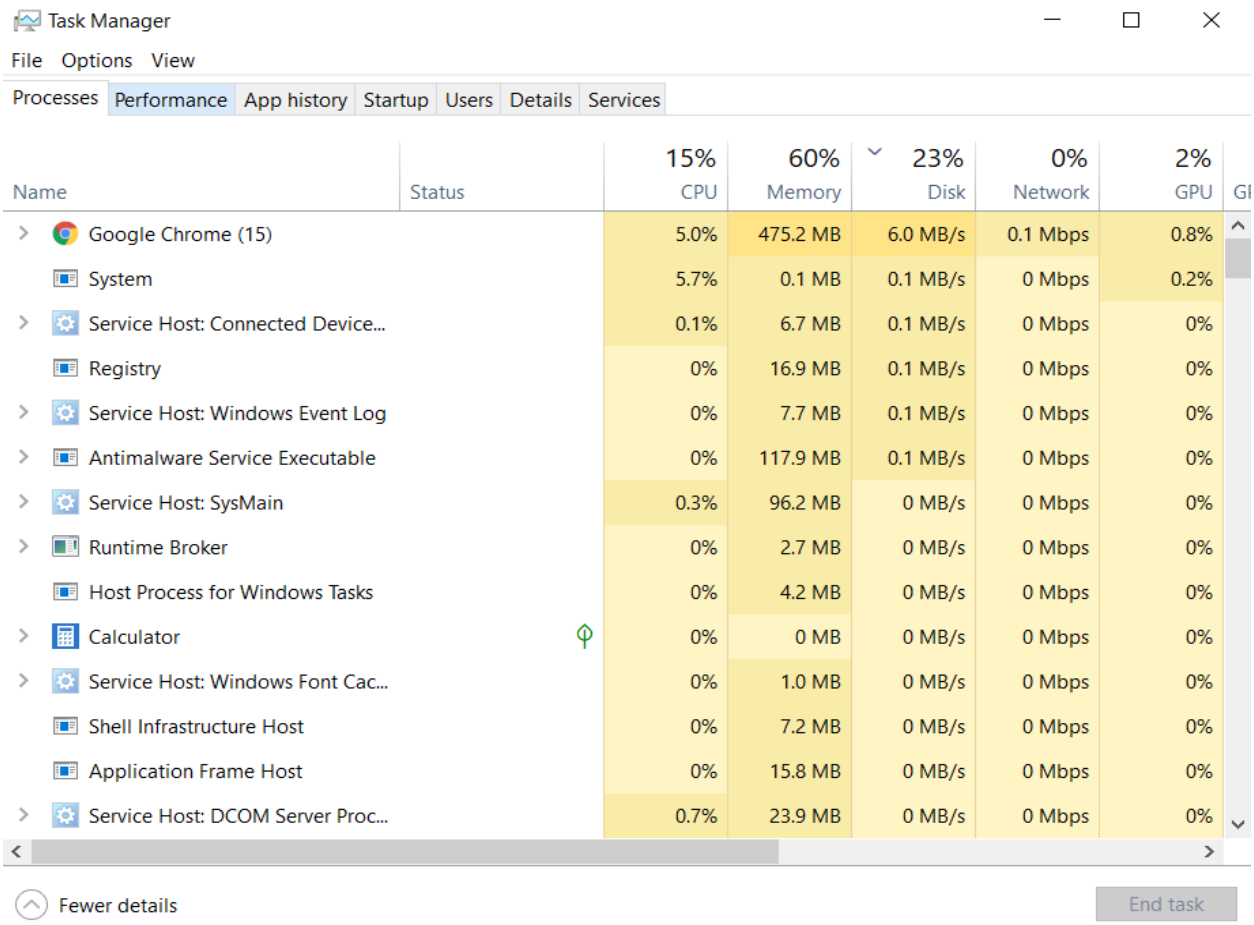
Grand March from Verdi's Aida, without video). Add another tab with[https://www.youtube.com/watch?v=JXMdei-UTfw (Links to an external site.)](https://www.youtube.com/watch?v=JXMdei-UTfw)(Aida with video/ Play these one at a time. Comment on what you see in the resource monitor while opening the tabs, playing these excerpts, stopping them, and closing the tabs. Observe your measurements while the videos are downloading, are being played, and after you stop them. Describe what you see and explain it. For the video excerpt, comment on any changes you might see after the curtain goes up.

Answer:

The following is the screenshot which shows the resource manager **before opening any tabs.**

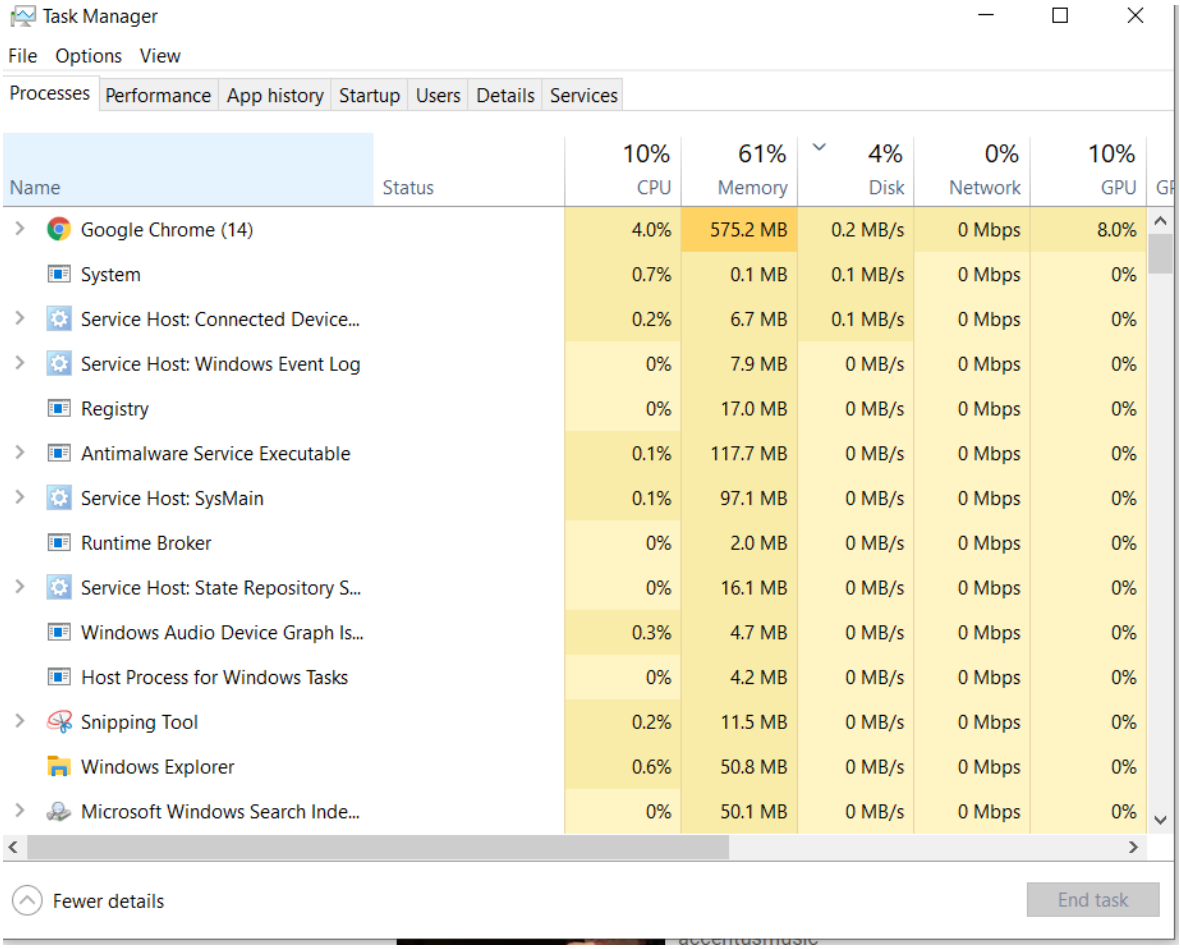


As we can see before opening tabs, CPU, and GPU utilization is very low. Now following is the screenshot **after opening both the tabs**.



Now by analyzing this image, we observe that both CPU and GPU utilization go up a little. We can also see that memory usage goes from 57% to 60%.

However, the following shows a screenshot of the resource manager when the **curtain goes up**.

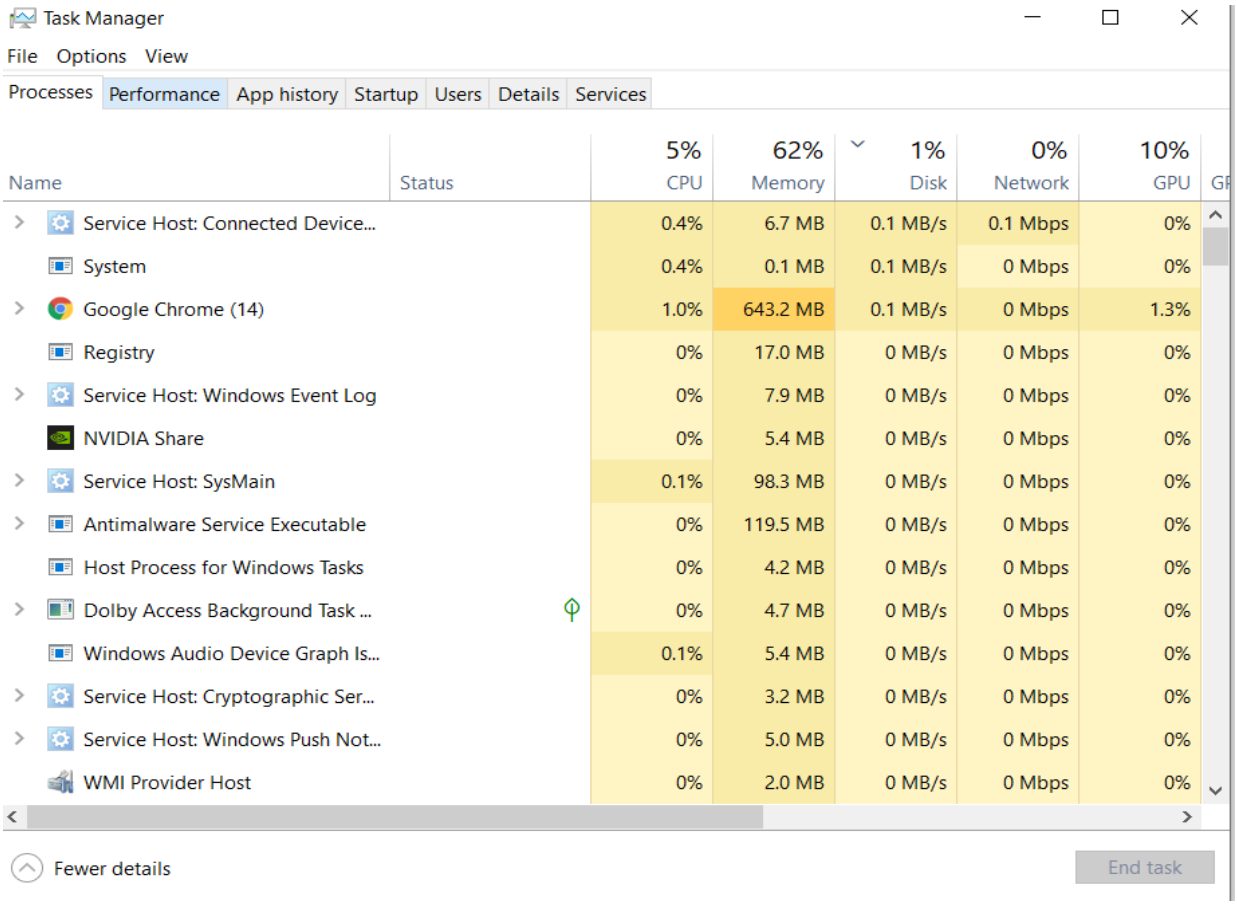


This shows a clear increase in GPU utilization which goes from 2% to 10% in total. If we only look at GPU usage by Google Chrome it reaches 8% while it was 0.8% before.

8) Pause playing the opera with the video, and then restart after a few seconds. Why might resource usage not climb immediately as you might intuitively expect? What does this tell you about how the video playing program works?

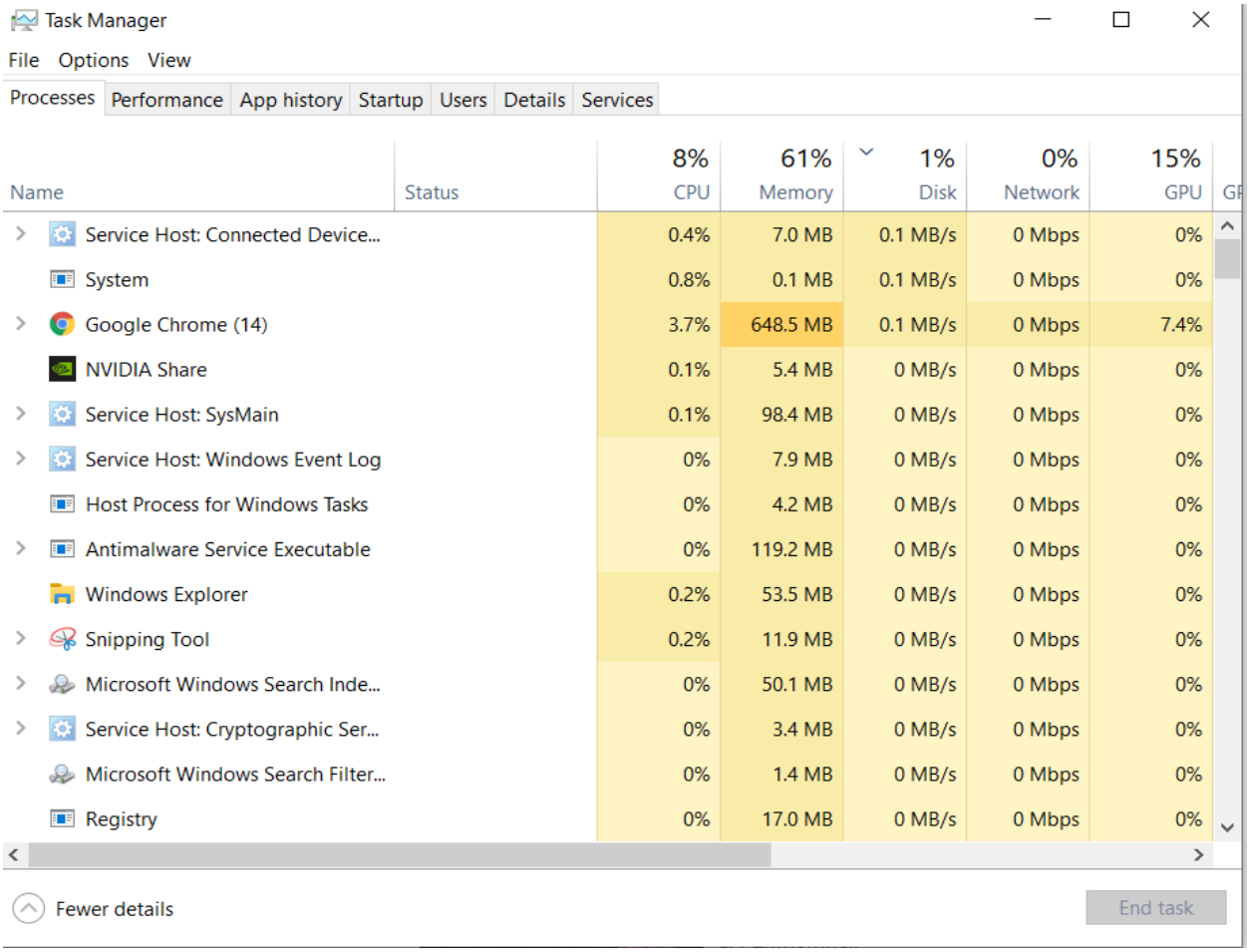
Answer:

Following is the picture after pausing the opera video.



We can examine that both GPU and CPU usage goes down for Google Chrome but overall GPU utilization is still 10%.

After playing opera video again, following is the screenshot

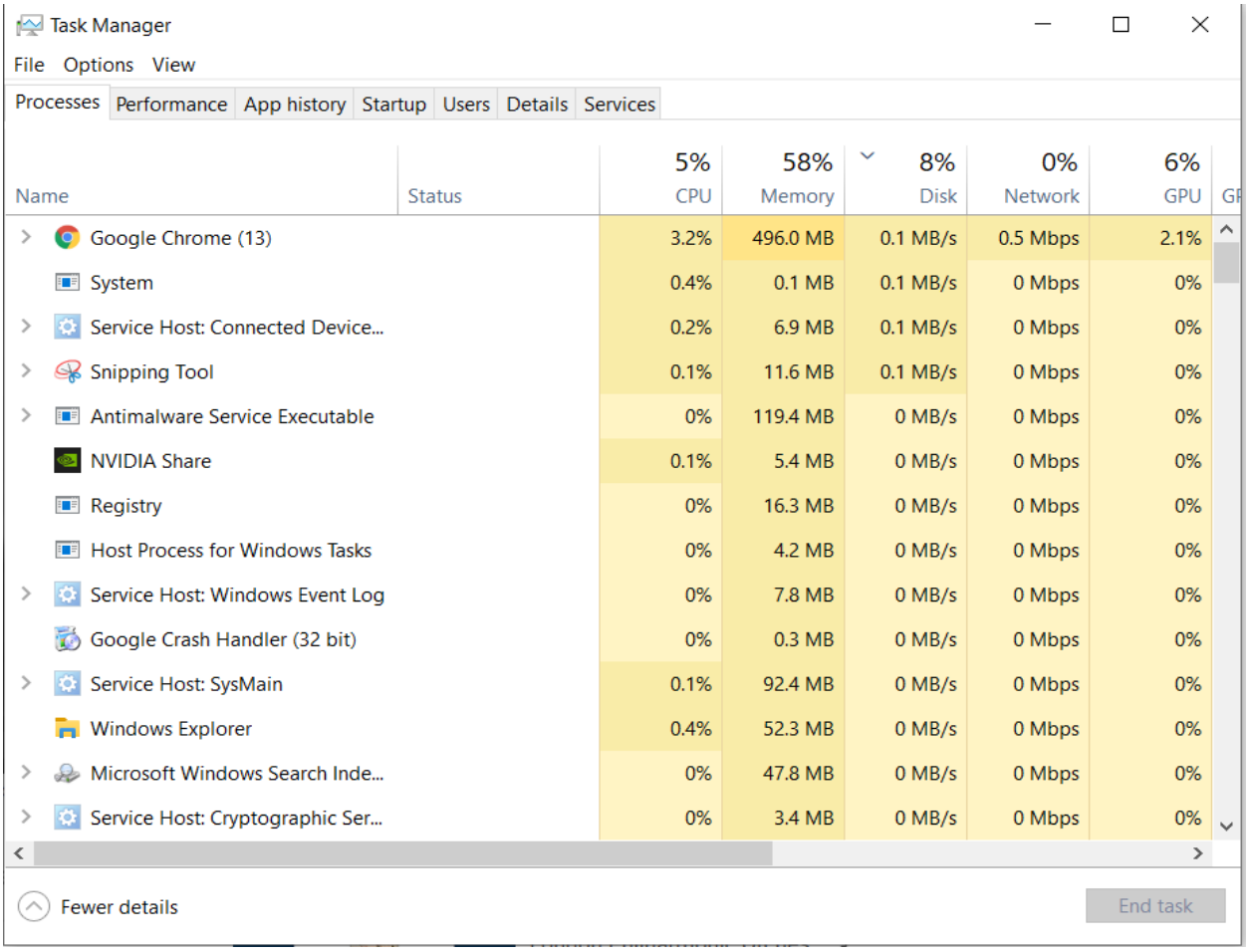


We can watch that CPU and GPU usage by Google Chrome goes up, but Memory usage is almost the same. This tells that browser still takes memory space even if we stop videos.

9) Close the opera tabs one at a time, without stopping the music, 30 seconds apart. Describe what you see in the resource monitor windows while you are making these changes.

Answer:

Following is the condition of the resource monitor after closing the opera video.



As we can see clearly that both CPU and GPU usage is now down. Memory utilization is also down as one of the tabs of the browser is closed.

10) Did taking screenshots to cause changes in what you saw in the resource monitor? Explain. Justify using or not using screenshots in future measurements of a laptop.

Answer:

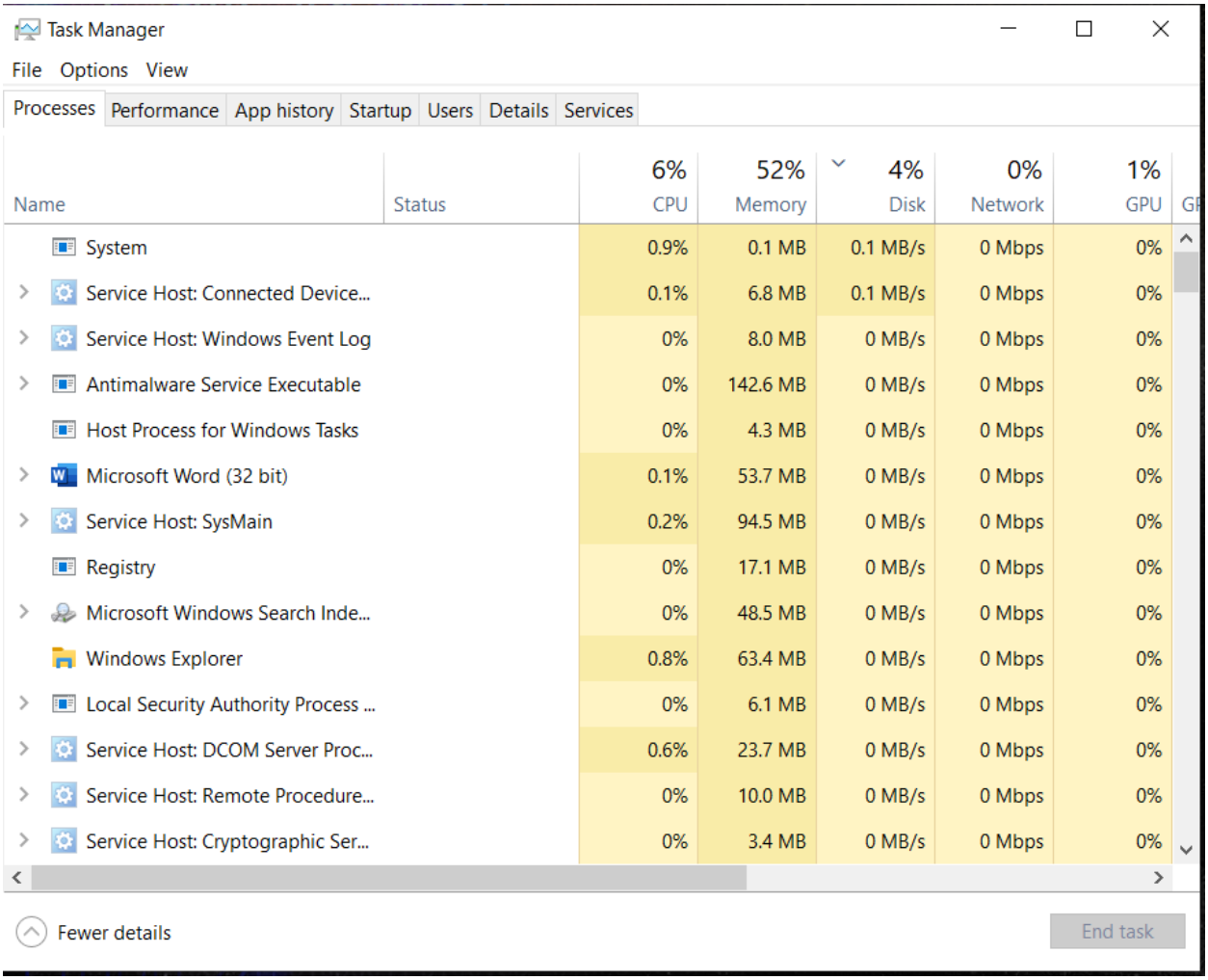
Taking screenshots did cause changes in the resource monitor as it was using CPU, Memory, and Disk. Although it was small as compared to other applications, it still had an impact. I would suggest taking pictures of your phone is a better option than taking screenshots from a laptop.

Now, let us think about the experimental setup. Close your browser and all applications except the resource monitor and the PDF or Word application you are using to read this exercise. Take a look at resource usage by individual processes, including the resource monitor. Describe what you see.

[2 points] What resources does the resource monitor use?

Answer:

After **closing all tabs on Google Chrome**. Following is the screenshot was taken

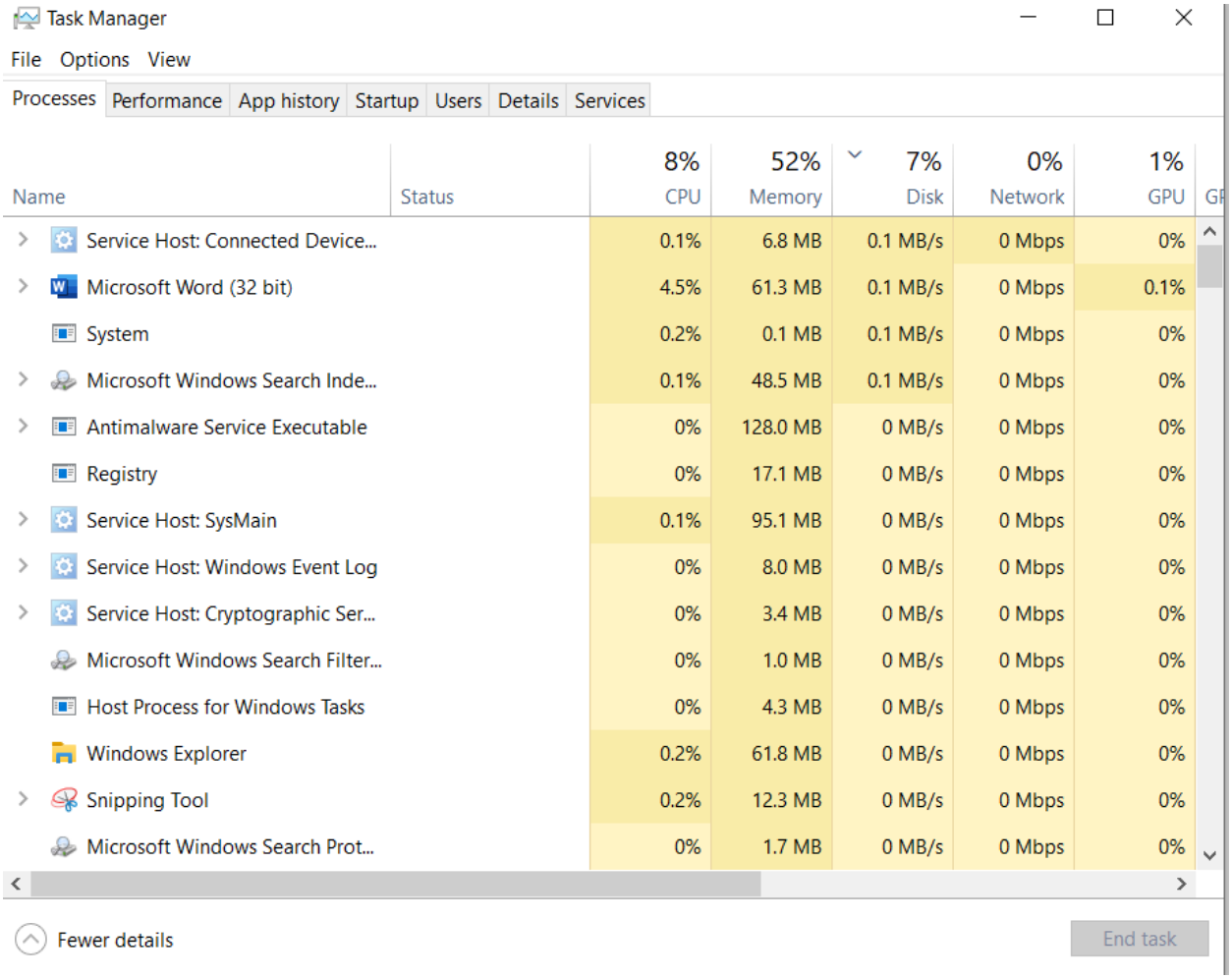


As seen CPU usage by the document is 0.1%, Memory used by it is 53.7 MB. Overall, CPU, GPU and Memory utilization have decreased because of exiting Chrome

11) What resources does the document reader use, when you do nothing, when you search, and when you move the mouse? Do you see any spikes?

Answer:

This screenshot shows a **resource monitor while using the Word document**.



We see Word document usage is increased in CPU, Memory, Disk, and also in the GPU. These increases are recorded as I was moving my mouse and typing into the Word document.

12) Think about the impact of this on the analysis of your performance measurements. Discuss.

Answer:

This word document did not have an impact on previous performance measurements. As I was not using it on my laptop at that time. I used my phone to read the questions of the project to complete the assignment.

Test Planning and Analysis

13) Describe a test plan from whose results you would compute the mean CPU time per transaction using the Utilization Law.

Answer:

Utilization Law is

$$U = XS$$

Where X is throughput and S is service demanded.

Now we can imagine a test plan for an ATM system whose utilization is 95% with a transaction rate of 150 jobs per second. Putting it into the formula

$$S = U/X = 0.95/150 = 6 * 10^{-3}$$

Hence, the average service time is 6 msec per job.

14) Table 1 shows the results of resource usage measurements for various numbers of transactions per second.

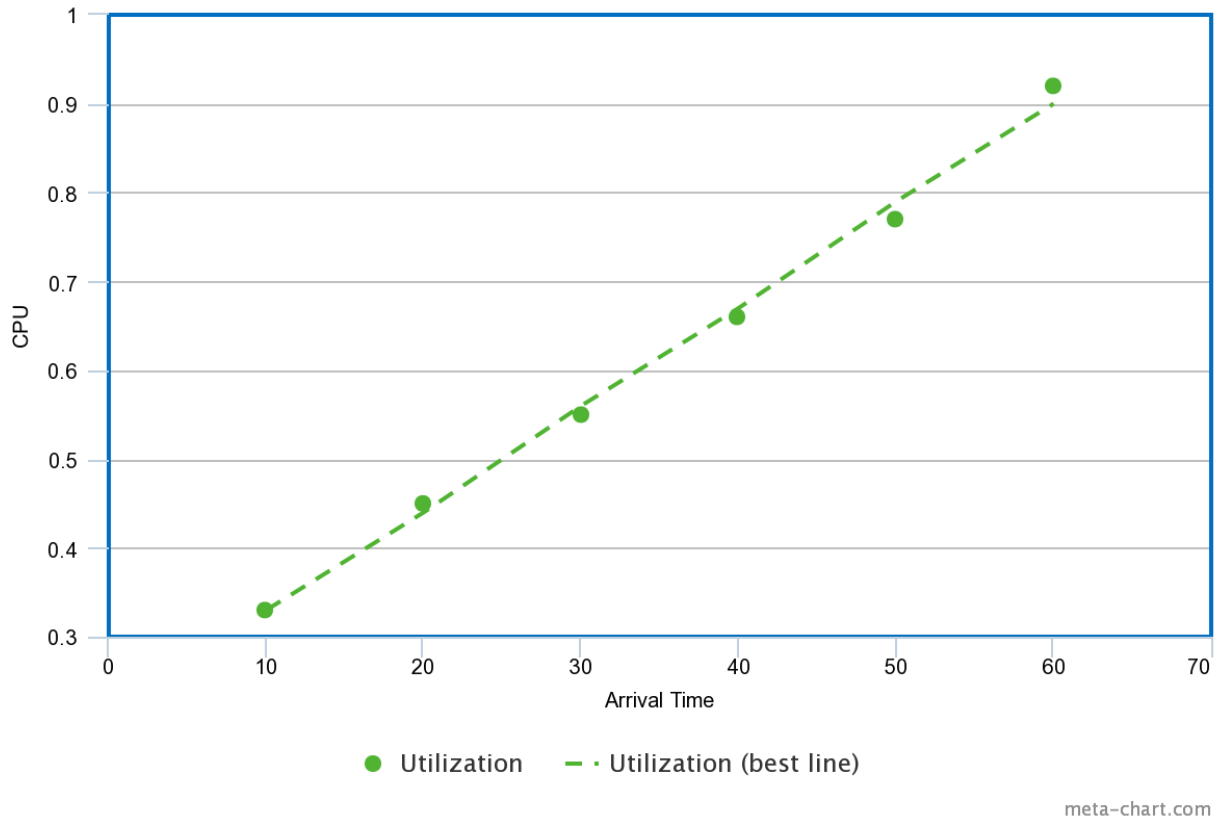
Table 1. CPU utilization vs. arrival rate

Arrival Rate - TPS	CPU Utilization
10	**0.15**
20	**0.33**
30	**0.41**
40	**0.63**
50	**0.72**
60	**0.92**

15) Using Excel or otherwise, plot the CPU utilization against transactions per second as a scatter plot. Fit a straight line to these points. What is the meaning of the slope?

Answer:

We have made a scatter of both CPU and Arrival Time which is as follows



There is also a fitting line which shows both CPU and Arrival time grows linearly and creates a slope. This slope shows that points are increasing positively and also that with time both CPU utilization and Arrival time increases. This slope means that there is no saturation for the system. Because they are dependent on each other and with Arrival time rising linearly CPU utilization also grows.

16) What is the meaning of the Y-intercept from a system standpoint? When can you assume that the Y-intercept is zero? Why?

Answer:

Y-intercept on any graph is observed when x = 0. It either means that the system has just started or that it is only growing in one direction.

Y-intercept can be assumed to be zero for a system when it is only expanding vertically and not horizontally. For example, if we take to see the previous graph of CPU and Arrival Time. If all Arrival time were zero, then the graph would have gone only in a vertical direction.