

An Analysis of Memory Usage in Web Browser Software

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Abstract—A RAM or formerly known as a memory is a primary memory which helps swift data availability without waiting the whole data processed by the hard disk. A memory is also used by all installed applications including web browsers but there have been disappointed in cases of memory usages. Researchers use a descriptive quantitative approach with an observation, a central tendency and a dispersion method. There are 15 browsers chosen by random to be tested with low, medium and high loads to get their memory usage logs. Researchers proceed to analyze the log by using descriptive statistics to measure the central tendency and dispersion of data. A standard reference value from web application memory usage has been found as much as 393.38 MB. From that point, this research is successful and has been found the result. The web browser with the lowest memory usage is Flock with 134.67 MB and the web browser with the highest memory usage is Baidu with 699.66 MB.

Keywords--*Memory usage; web browser; central tendency; dispersion*

I. INTRODUCTION

One of the most important computer devices is a RAM (Random Access Memory). A RAM is a computer storage that can be accessed in a random time and location. A RAM serves to store temporary data on a computer. When the computer is turned on, the device that first works is the Processor. The processor functions as a data processor and requests data to the hard disk. That is, the data is sent from the hard disk, but it is rather difficult to do because the hard disk data transfer speed is slow. If the processor waits for data supply from the hard disk, a "Bottle-Neck" will occur that is very severe [1].

To overcome this problem, the main memory device is needed, which is called the RAM, which serves to help the processor in providing data that can be accessed more quickly, both personal data and system data, such as browser applications.

Web browsers are software that is very close to the internet, the door to exploring the virtual world completely, but often the web browser is complained because of the large memory usage, the effect is that the system is slower than usual.

A web browser is software that runs on a computer that displays documents or information taken from a web server. The browser is a type of intermediary between the user and the most used web server [2].

A memory is a device used to store programs and temporary data so that it can improve the performance of applications that are being used during the process. The larger the memory of a computer, the faster the performance will be [3].

II. PURPOSE

The purpose of this research is:

- Determine the reference standard for memory usages of web browser software.
- Determine which software uses the lowest memory and the highest memory.

III. METHODOLOGY

A. Equipment Preparation

- Software
 - Windows 10 Pro N 32-bit Operating System
 - Process Hacker 2
 - Microsoft Excel 2010
 - SPSS 16.0
 - Tools Analysis System
- Hardware
 - Intel (R) Core (TM) i3-4030U CPU Processor @ 1.90GHz 1.90 GHz
 - 2000 MB RAM memory

B. Determination of Variable

This study takes several variables including independent variables. Independent Variables are stimulus variables or variables that affect other variables. An independent variable is a variable whose variables are measured, manipulated, or chosen by the researcher to determine the relationship with a observed phenomenon [4].

A collection of independent variables is done by entering the keyword "the most popular web browser", which are sites that provide reviews about several web browsers. After selecting a number of sites, fifteen web browsers with qualifications for web browsers are used by users and are best known to users. The fifteen web browser software are Mozilla Firefox, Chrome, Opera, Safari, Internet Explorer, Microsoft Edge, Flock, Baidu Browser, UC Browser, K-Meleon, Lunascape, Sea Monkey, Slim Browser, Maxthon and Netscape.

C. Data Recording

After repeated testing three times, the new memory usage data can be recorded more validly.

D. Processing and Analysis of Data

After recording the memory usage of 15 web browsers, whether they are given low, medium and high workloads, the data will be processed and analyzed using a simple analysis system tool created by the author. For data analysis methods use the central tendency method [5].

- Data Cleaning
 - Data cleaning is the activity of sorting some data that is not needed in research. This activity is also useful so that the process can run faster because the system does not have to sort which data must be taken and which data does not have to be taken.
- Entering data
 - Entering data is the activity of entering data that has been cleaned or sorted into a database that will be processed in the analysis tools.
- Data Output
 - Output data is the presentation of data after it has been processed in the tools analysis system. This study presents numeric output data in the form of frequency tables and bar charts
- Data Analyzing
 - Data analyzing is an activity of analyzing data that have been presented. Analysis of data processing is done by analysis of a variable or called univariate. The types of univariate analysis carried out include:
 - Normality Test



A normality test is a test to measure whether the data obtained has a normal distribution so that it can be used in statistical parametric (inferential statistics).

- Central Tendency

A central tendency is a measure that can be used to describe the tendency of the location of data collected. Almost every data set usually has a tendency to focus on a certain value called the central value. In statistics there are a number of concentration measures and the most commonly used are mean, middle (median), and the most frequent (mode) values [5].

- Dispersion

Dispersion is a measure of the extent to which the data is spread from its central value. The size of the spread includes a range, a quartile range, a variation, and a standard deviation. This study uses a standard deviation to determine the extent of the spread of data to the central value [5].

IV. RESULT AND DISCUSSION

A. Data Collection

Based on the research that has been done, the following are data from the research results of memory usages from 14 web browsers when given a light, medium, and heavy workload, as in Table 1.

TABLE I. RESULTS OF MEMORY USAGE

No	Web Browser	Workload		
		A	B	C
1	Baidu	251,45	569,54	1278,37
2	Chrome	107,28	479,19	855,43
3	Microsoft Edge	89,69	452,78	915,31
4	Firefox	130,15	405,07	478,34
5	Flock	89	100,14	214,88
6	Internet Explorer	124,74	425,59	853,71
7	K-Meleon	60,82	255,07	468,1
8	Lunaspape	98	295,55	717,53
9	Maxthon	287,41	549,01	1135,66

10	Opera	180,48	432,49	812,89
11	Safari	36,52	213,11	258,06
12	SeaMonkey	95,31	271,87	523,18
13	Slim Browser	53,91	220,84	602,6
14	UC Browser	175,34	420,6	556,32
	Minimum	36,52	100,13	214,88
	Maximum	287,41	569,53	1278,36
	Average	127,14	363,63	690,74
	St. Deviation	73,06	138,37	307,00

B. Descriptive analysis of statistics on web browser memory

- A normality test is a test to measure whether the data obtained have a normal distribution so that it can be used in parametric statistics (inferential statistics). The results of the normality test of the data tested using SPSS are presented in Table 2.

TABLE II. THE RESULTS OF THE NORMALITY TEST WITH SPSS

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
A	.198	14	.142	.898	14	.105
B	.189	14	.188	.952	14	.596
C	.113	14	.200	.970	14	.873

Description:

A: Samples with 1 tab

B: Samples with 5 tabs

C: Samples with 10 tabs

df: Number of respondents (web browser)

Sig: Significance Statistics.

Based on statistical values shown in Table 2, *df* or respondent is considered 14 because samples from Netscape are ignored. Because we use alpha values derived from the *p*-value table, values taken from the SPSS results are statistical values.

In this study the normality test used is the Shapiro Wilk normality test, because of $df \leq 50$.

- The normality test used is the Shapiro Wilk normality test, because *df* is less than or equal to 50. The value of α for the normality test is 5% or



0.05. The value of α for n 14 is 0.874. Data is said to be normal if the value of T is greater than the value of α ($T > \alpha$). Because all control variables are normally distributed, the light, medium and heavy workload control variable data are declared to be normally distributed and according to existing theoretical concepts, data that has a normal distribution has groupings based on average values and standard deviations and the data can be used for linear regression analysis to determine the pattern of memory usage [3].

- The central Tendency Analysis is used to find out the description of the data using the central tendency and the dispersion. Outputs from the central tendency is minimum values, maximum values and average values presented in Table 3. The output of the dispersion is a standard deviation value to measure the distribution of the data. Table 3 presents descriptive statistical data on memory usage of web browser software when given a low, moderate and heavy workload. Furthermore, the low workload by opening a tab will be defined with the letter *A*, the workload is being opened with five tabs will be defined with the letter *B*, and heavy workloads by opening ten tabs will be defined with the letter *C*. All memory usage results are displayed in MB.

TABLE III. DESCRIPTIVE STATISTICS ON WEB BROWSER MEMORY USAGE

Variabel Kontrol	N	Min	Max	Mean	Standar Deviasi
A	14	36,52	287,41	127,14	73,06
B	14	100,13	569,53	363,63	138,37
C	14	214,88	1278,36	690,74	307,00

TABLE IV. RESULTS OF DATA ANALYSIS FROM SPSS 16

Descriptive Statistics				
	N	Minimum	Maximum	Std. Deviation
A	14	36.52	287.41	73.06977
B	14	100.14	569.54	138.37585
C	14	214.88	1,278.37	307.00359
Valid N (listwise)	14			

Description:

A: Samples with 1 tab

B: Samples with 5 tabs

C: Samples with 10 tabs

N: Number of respondents (web browser)

Minimum: The smallest value of data

Maximum: The biggest value from the data

Std. Deviation: Standard Deviation Value

Table 4 explains the results of data analysis from the SPSS application. SPSS is a statistical analysis application. The results of this SPSS application will be used as a reference for the analysis application made by the author using the PHP programming language (Personal Home Page). From Table 4, the value of N or the number of web browser respondents is considered 14. Because in this study, a sample was found that could not load several websites that previously had been used as control variables. This browser is Netscape, this web browser cannot contain several websites, namely website youtube.com. Because the retrieval of the data must be sequential, when Netscape cannot load Youtube.com website then other web sites that become control variables cannot be executed, therefore Netscape is not used anymore in subsequent studies and for research light loads will be ignored.

C. Analysis of causes of high and low use of web browser memory

From the results of the research that has been done, there is a very significant difference between one browser and another browser. This difference can be seen from the amount of memory usage in Safari web browser, Slim Browser and k-meleon with the amount of memory usage ranging from 30 MB to 60 MB, while memory usage ranging from 80 MB to 130 MB is the Chrome web browser, Microsoft Edge, Firefox, Flock, Internet Explorer, Lunascape, Sea Monkey and UC browser. Memory usage with a range of 200MB to 300MB is the Baidu and Maxthon web browser. Table 4.4 shows the results of testing memory usage for light, medium and heavy loads.

According to statistical data after testing the browser that has the largest memory usage is Baidu and Maxthon, the memory usage at the opening of ten tabs reaches 1000 MB and even exceeds that number. This proves that browsing on the internet can consume more RAM than just playing games. While the web browser with the smallest memory usage is Safari and flock, these web browsers only spend around 250 MB when opening ten tabs.

D. Test of difference

The difference test is the parametric statistical test to find out whether there are differences in the mean of two independent or unrelated data groups. The independent t test in principle compares the averages of two groups that are not related to one another with the aim of whether the



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two groups have the same average or not. Decision making is seen from the sig value. If the sig value is above 0.05 then H_0 is accepted. If the value of sig is below 0.05 then H_0 is rejected.

There are two t values and the significance level is Equal Variance assumed and Equal Variance not assumed. Equal Variance assumed means that the two population variants are identical and Equal Variance not assumed that the two population variants are not identical. To determine it, the F level test is used. F is 0.006 means that H_0 is rejected that the two population variants are not identical (Equal Variance assumed).

F is 0.012 means that H_0 is rejected that the two population variants are not identical (Equal Variance assumed).

E. Comparison of research

Comparative research is important to see the results of each of the same studies. This research is also a study taken from several studies, but there is one study that is similar and can be used as a comparison.

Fig. 1 is a graph of the results of an analysis of the memory usage of web browser software.

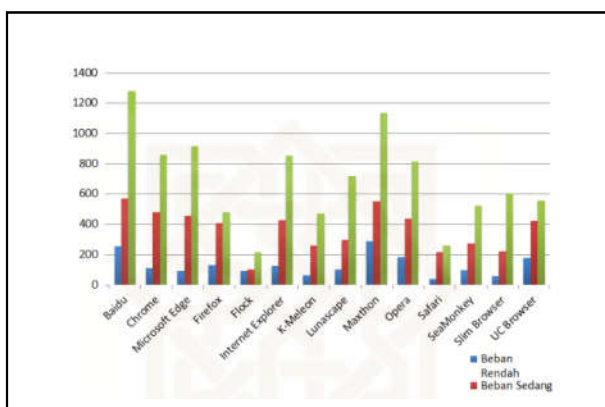


Figure 1 Result of Analysis of Memory Usage

V. CONCLUSION

From the results of data analysis research on memory usage in web browser software, conclusions can be taken as follows:

- The value of the web browser software memory reference standard is 393.83 MB.
- The lowest web browser software with memory usage is a flock web browser with an average usage with light, medium, and high loads is 134.67 MB. Web browser software with the highest memory usage is Baidu browser with light, medium, and high loads is 699.66MB

