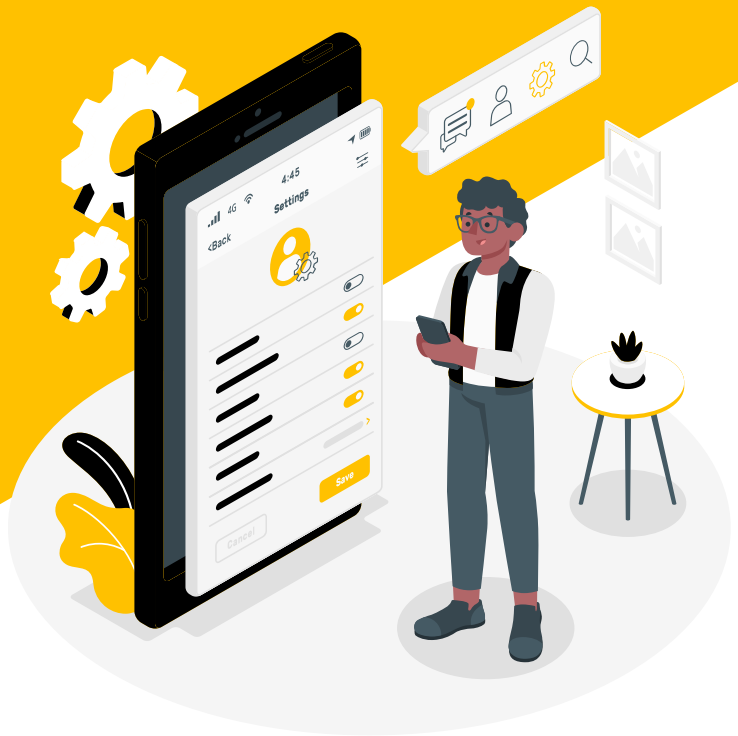
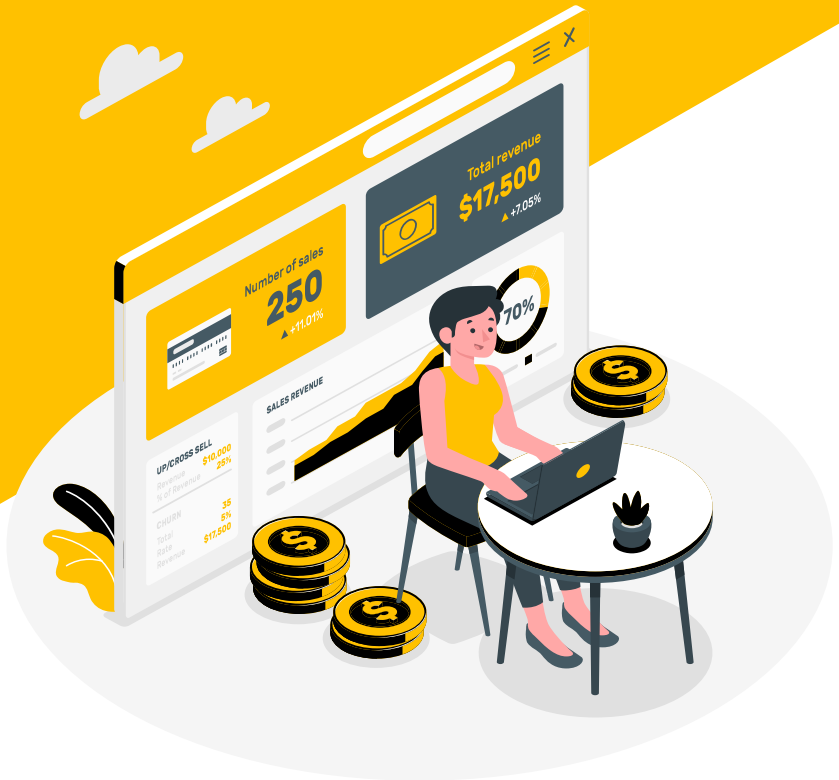
Hadoop

Group 4 - Pagi
Sistem Basis Data



Our Team

Farras Rafi Permana - 2106700990
Zaki Ananda - 2106705474
Andikha Wisanggeni - 2106731503
M Fathan Muhandis - 2106731623



What Is Hadoop?

Introduction to 

Hadoop adalah sebuah kerangka kerja (framework) open-source yang digunakan untuk pemrosesan dan penyimpanan data dalam skala besar secara terdistribusi. Hadoop dirancang untuk mengatasi tantangan dalam mengelola dan menganalisis data yang sangat besar (big data) yang tidak dapat ditangani dengan menggunakan sistem tradisional. Framework Hadoop hadir dan memungkinkan pengolahan data lebih banyak, menyimpan data heterogen dan mempercepat proses pengolahannya.

Dengan menggunakan Hadoop, perusahaan dan organisasi dapat memanfaatkan potensi data besar yang mereka miliki untuk mengambil wawasan bisnis yang berharga, melakukan analisis data yang kompleks, dan mengatasi tantangan pemrosesan data dalam skala besar. Hadoop juga memiliki ekosistem yang luas dengan berbagai komponen tambahan, seperti Apache Hive, Apache Pig, Apache HBase, Apache Spark, dan lainnya, yang memperluas kemampuan dan fungsionalitas Hadoop.

How does Hadoop work?

Dalam Hadoop, terdapat empat modul utama yakni **HDFS, YARN, MapReduce, dan Hadoop Common**, berikut penjelasannya:

- **Hadoop Distributed File System (HDFS)** merupakan sistem yang terdistribusi dan beroperasi di hardware standar maupun low-end.
- **Yet Another Resource Negotiator (YARN)** merupakan sistem yang mengatur dan memonitor cluster node dan resource usage.
- **MapReduce** merupakan framework yang membantu program untuk melakukan komputasi data secara paralel
- **Hadoop Common** merupakan penyedia library Java yang dapat digunakan oleh semua modul

Hadoop bekerja dengan mendistribusi dataset dalam jumlah besar ke beberapa mesin berbeda, untuk kemudian data-data ini diproses di waktu yang bersamaan. HDFS digunakan untuk menyimpan data dan MapReduce memproses data tersebut, sementara itu YARN berfungsi untuk membagi tugas. Dalam implementasinya, Hadoop memiliki ekosistem berupa berbagai tool dan aplikasi yang bisa membantu pengumpulan, penyimpanan, analisis, dan pengolahan Big Data.

Tools in Hadoop

1. **Spark**
   Spark merupakan processing system yang terdistribusi dan bersifat open source, dimana tools ini digunakan untuk melakukan batch processing, streaming analytics, machine learning, graph database, dan ad hoc query.

2. **Presto**
   Seperti halnya Spark, Presto juga salah satu software yang bersifat open source. Presto sendiri merupakan SQL query engine terdistribusi yang digunakan untuk analisis data ad hoc low-latency. Dengan Presto inilah, kita dapat memproses data dari sumber yang berbeda-beda, termasuk HDFS dan Amazon S3.

3. **Hive**
   Hive digunakan untuk MapReduce dengan interface SQL, sehingga tool ini cocok untuk analisis data dalam jumlah yang besar.

4. **HBase**
   HBase adalah database yang digunakan Amazon S3 dan HDFS. Tool ini dibuat untuk memproses tabel dengan baris dalam jumlah yang sangat banyak.

Hadoop Advantages

1. **Fleksibel**
   Data bisa disimpan dalam format apapun, baik secara structured maupun unstructured. Hal ini memungkinkan pengguna mengakses data dari sumber manapun dengan tipe apapun.

2. **Upgrade kapasitas**
   Hadoop merupakan teknologi yang memberikan solusi pada sistem tradisional. Sistem tradisional memiliki data storage yang terbatas, sementara Hadoop bisa ditingkatkan kapasitasnya, sebab framework ini bekerja secara terdistribusi.

3. **Ketahanan tinggi**
   HDFS merupakan bagian dari ekosistem Hadoop, yang dikenal memiliki ketahanan tinggi dan meminimalkan risiko kegagalan baik software maupun hardware. Meskipun satu node rusak atau mengalami masalah, HDFS bisa menyediakan backup data untuk melanjutkan proses.

How to Install Hadoop

Prerequisites that must be installed

Getting Started

To get started with Hadoop, these are the prerequisites that must be installed:

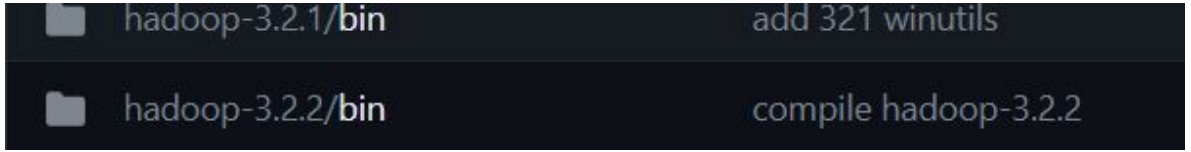
1. Java 8 (Recommended) / Java 11
    - https://www.oracle.com/id/java/technologies/javase/javase8-archive-downloads.html
2. Hadoop
    - https://archive.apache.org/dist/hadoop/common/
3. Additional Binaries (Sesuaikan versi Hadoop, binary terbaru hanya sampai v3.2.2
    - https://github.com/styxnanda/winutils

Prerequisites that must be installed

Index of /dist/hadoop/common/hadoop-3.2.2

Name	Last modified	Size	Description
Parent Directory		-	
CHANGELOG.md	2021-01-13 18:48	95K	
CHANGELOG.md.asc	2021-01-13 18:48	833	
CHANGELOG.md.sha512	2021-01-13 18:48	143	
RELEASENOTES.md	2021-01-13 18:48	5.2K	
RELEASENOTES.md.asc	2021-01-13 18:48	833	
RELEASENOTES.md.sha512	2021-01-13 18:48	146	
hadoop-3.2.2-rat.txt	2021-01-13 18:48	1.8M	
hadoop-3.2.2-rat.txt.asc	2021-01-13 18:48	833	
hadoop-3.2.2-rat.txt.sha512	2021-01-13 18:48	151	
hadoop-3.2.2-site.tar.gz	2021-01-13 18:48	43M	
hadoop-3.2.2-site.tar.gz.asc	2021-01-13 18:48	833	
hadoop-3.2.2-site.tar.gz.sha512	2021-01-13 18:48	155	
hadoop-3.2.2-src.tar.gz	2021-01-13 18:48	31M	
hadoop-3.2.2-src.tar.gz.asc	2021-01-13 18:48	833	
hadoop-3.2.2-src.tar.gz.sha512	2021-01-13 18:48	154	
hadoop-3.2.2.tar.gz	2021-01-13 18:48	377M	
hadoop-3.2.2.tar.gz.asc	2021-01-13 18:48	833	
hadoop-3.2.2.tar.gz.sha512	2021-01-13 18:48	150	

Windows x86	201.64 MB	jdk-8u202-windows-i586.exe
Windows x64	211.58 MB	jdk-8u202-windows-x64.exe



Configure System Variables
JAVA_HOME

NOTE:
Tambahkan system variable baru bernama JAVA_HOME
dan arahkan ke instalasi Java

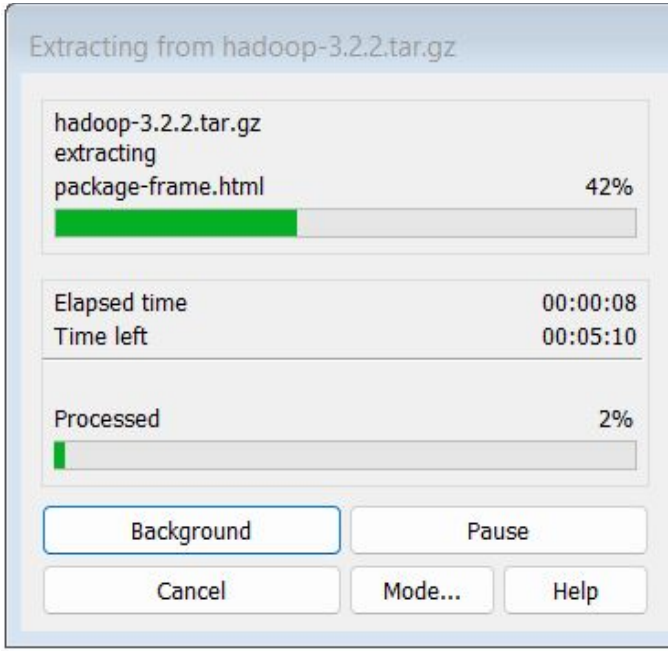
Configure New Path Variable

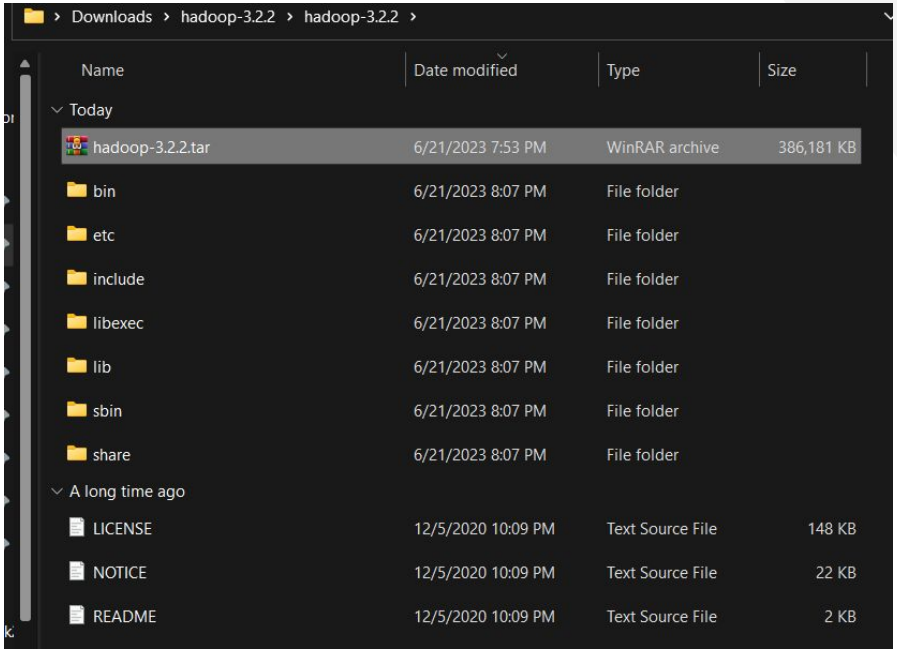
Cek versi java

```
C:\Users\Andikha Wisanggeni>java -version
java version "11.0.16.1" 2022-08-18 LTS
Java(TM) SE Runtime Environment 18.9 (build 11.0.16.1+1-LTS-1)
Java HotSpot(TM) 64-Bit Server VM 18.9 (build 11.0.16.1+1-LTS-1, mixed mode)
```

Tambahkan di path, ke directory java dan arahkan ke folder bin

Extract hadoop-3.2.2.tar.gz as admin





Edit \etc\hadoop\core-site.xml

Before

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<!--
  Licensed under the Apache License, Version 2.0 (the "License");
  you may not use this file except in compliance with the License.
  You may obtain a copy of the License at

    http://www.apache.org/licenses/LICENSE-2.0

  Unless required by applicable law or agreed to in writing, software
  distributed under the License is distributed on an "AS IS" BASIS,
  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License. See accompanying LICENSE file.
-->

<!-- Put site-specific property overrides in this file. -->

<configuration>
</configuration>

```

After

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<!--
  Licensed under the Apache License, Version 2.0 (the "License");
  you may not use this file except in compliance with the License.
  You may obtain a copy of the License at

    http://www.apache.org/licenses/LICENSE-2.0

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  distributed under the License is distributed on an "AS IS" BASIS,
  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License. See accompanying LICENSE file.
-->

<!-- Put site-specific property overrides in this file. -->

<configuration>
  <property>
    <name>fs.defaultFS</name>
    <value>hdfs://localhost:9000</value>
  </property>
</configuration>
```
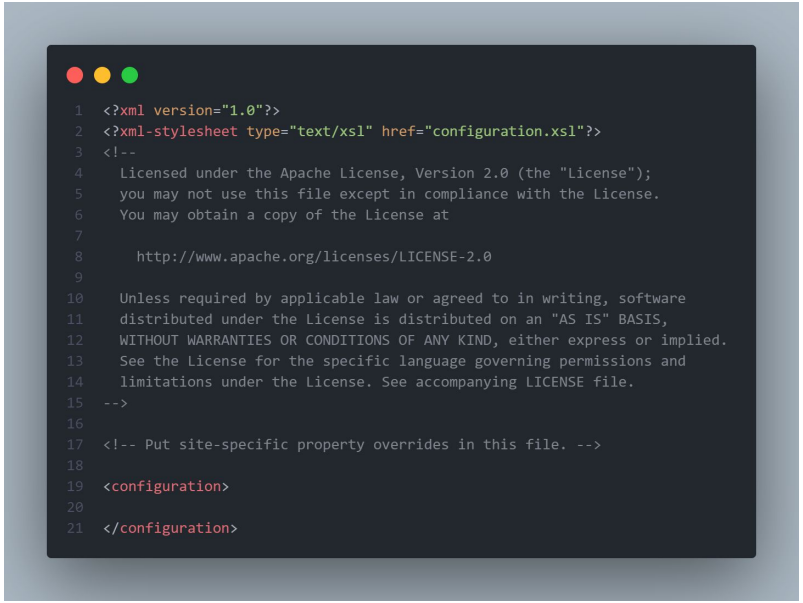

Edit \etc\hadoop\mapred-site.xml

Before



```
<?xml version="1.0"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<!--
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  you may not use this file except in compliance with the License.
  You may obtain a copy of the License at

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  distributed under the License is distributed on an "AS IS" BASIS,
  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License. See accompanying LICENSE file.
-->

<!-- Put site-specific property overrides in this file. -->

<configuration>

</configuration>
```

After

```
<?xml version="1.0"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<!--
  Licensed under the Apache License, Version 2.0 (the "License");
  you may not use this file except in compliance with the License.
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  distributed under the License is distributed on an "AS IS" BASIS,
  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License. See accompanying LICENSE file.
-->

<!-- Put site-specific property overrides in this file. -->

<configuration>
  <property>
    <name>mapreduce.framework.name</name>
    <value>yarn</value>
  </property>
</configuration>
```

Edit \etc\hadoop\yarn-site.xml

Before

```
<?xml version="1.0"?>
<!--
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  you may not use this file except in compliance with the License.
  You may obtain a copy of the License at

    http://www.apache.org/licenses/LICENSE-2.0

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  distributed under the License is distributed on an "AS IS" BASIS,
  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License. See accompanying LICENSE file.
-->
<configuration>

<!-- Site specific YARN configuration properties -->

</configuration>
```

After

```
<?xml version="1.0"?>
<!--
  Licensed under the Apache License, Version 2.0 (the "License");
  you may not use this file except in compliance with the License.
  You may obtain a copy of the License at

    http://www.apache.org/licenses/LICENSE-2.0

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  distributed under the License is distributed on an "AS IS" BASIS,
  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License. See accompanying LICENSE file.
-->
<configuration>

<!-- Site specific YARN configuration properties -->
  <property>
    <name>yarn.nodemanager.aux-services</name>
    <value>mapreduce_shuffle</value>
  </property>

  <property>
    <name>yarn.nodemanager.mapreduce.shuffle.class</name>
    <value>org.apache.hadoop.mapred.ShuffleHandler</value>
  </property>

</configuration>
```
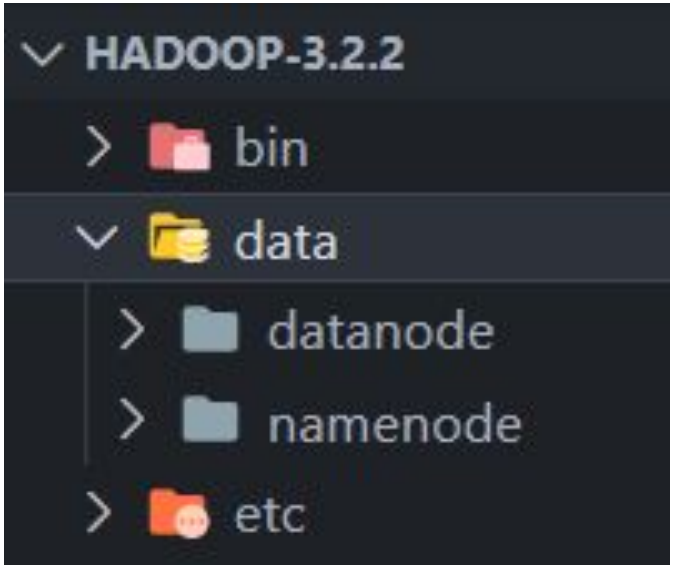

Create directory and subdirectory



Edit \etc\hadoop\hdfs-site.xml

Before

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<!--
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  you may not use this file except in compliance with the License.
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  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License. See accompanying LICENSE file.
-->

<!-- Put site-specific property overrides in this file. -->

<configuration>

</configuration>
```

After

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<!--
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  you may not use this file except in compliance with the License.
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  WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
  See the License for the specific language governing permissions and
  limitations under the License. See accompanying LICENSE file.
-->

<!-- Put site-specific property overrides in this file. -->

<configuration>
  <property>
    <name>dfs.replication</name>
    <value>1</value>
  </property>

  <property>
    <name>dfs.namenode.name.dir</name>
    <value>C:\Users\Andikha Wisanggeni\Downloads\hadoop-3.2.2\hadoop-3.2.2\data\namenode</value>
  </property>

  <property>
    <name>dfs.datanode.data.dir</name>
    <value>C:\Users\Andikha Wisanggeni\Downloads\hadoop-3.2.2\hadoop-3.2.2\data\datanode</value>
  </property>
</configuration>
```
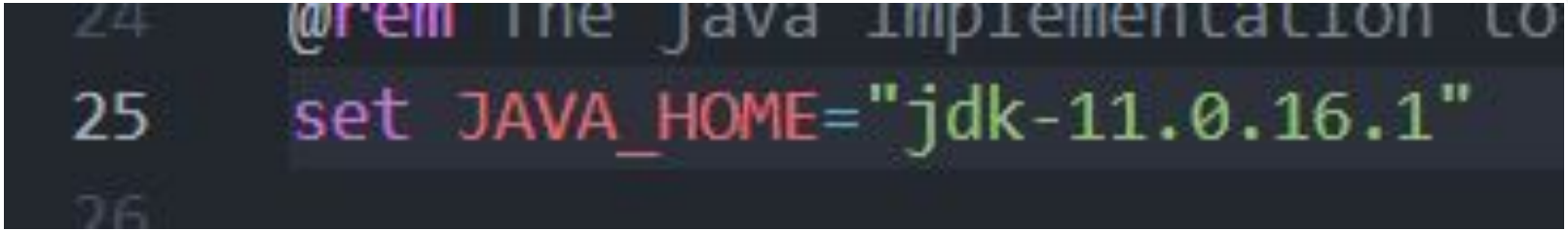
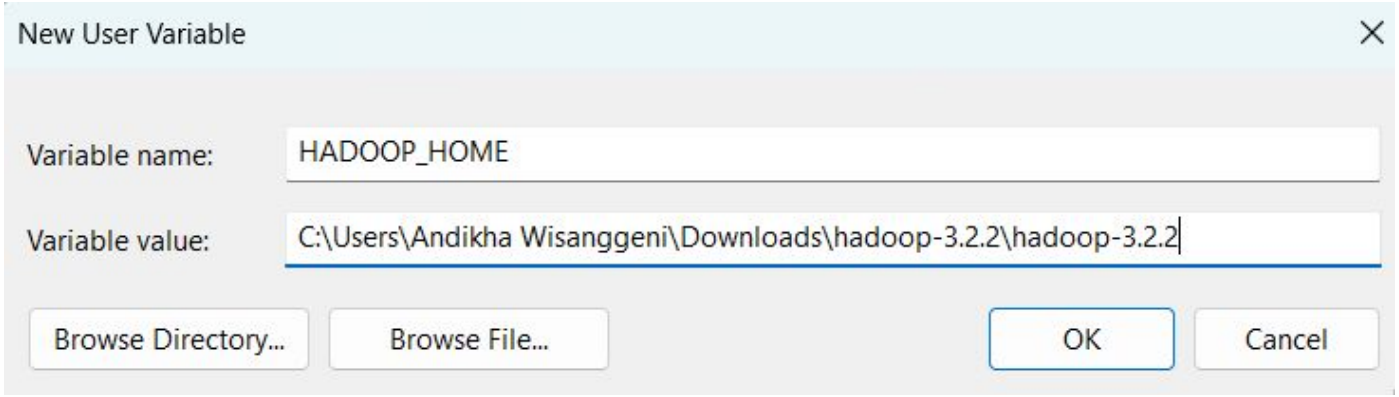
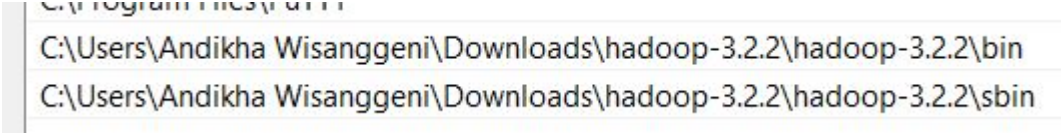

Edit \etc\hadoop\hadoop-env.cmd

Arahkan ke directory Java masing-masing



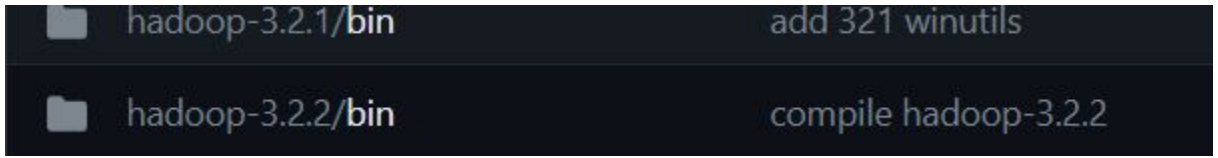
Create HADOOP_HOME and path for /bin dan /sbin



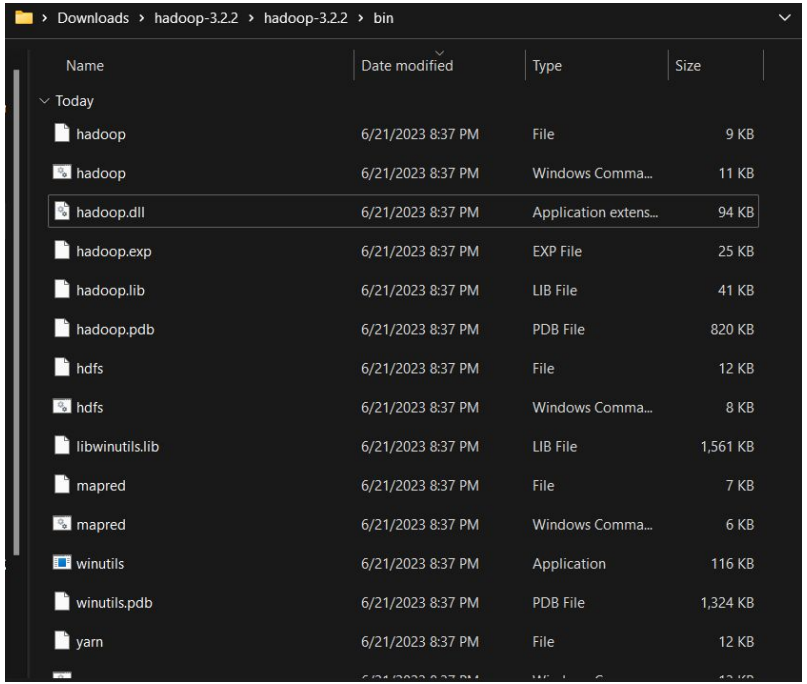


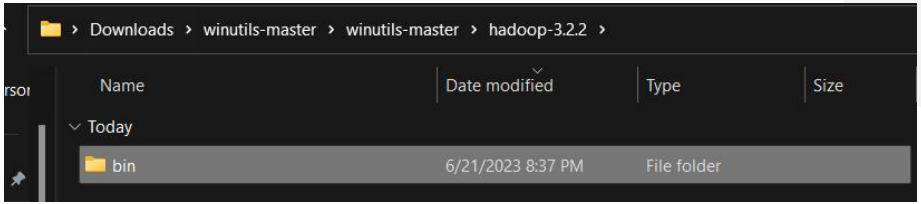
Download Additional Binaries

3. Additional Binaries (Sesuaikan versi Hadoop, binary terbaru hanya sampai v3.2.2
   - https://github.com/styxnanda/winutils



Move bin from additional binaries to file hadoop (local) /bin

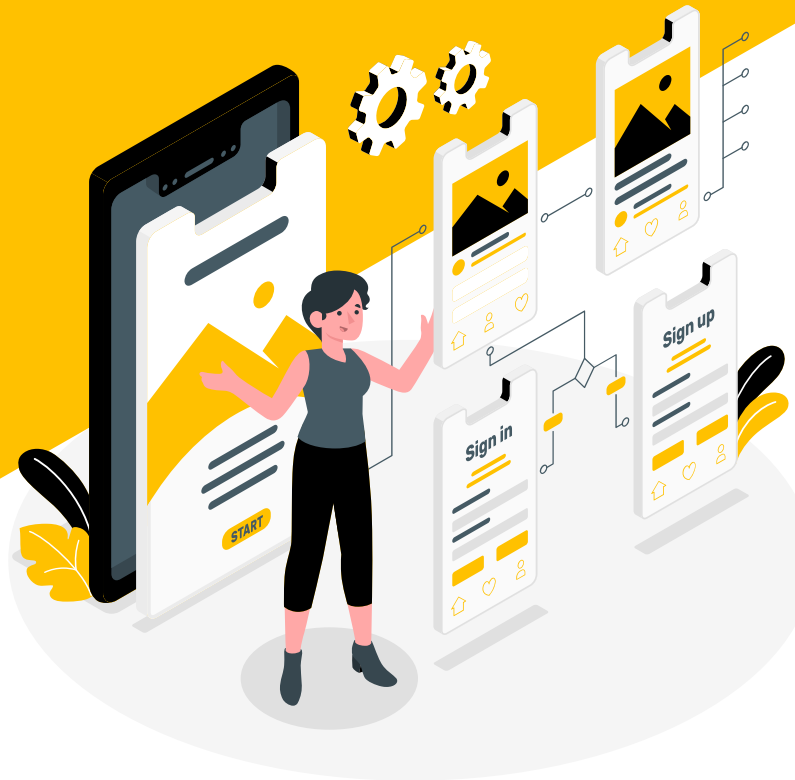




NOTE:
File yang sama di overwrite

Verify Hadoop

```
C:\Users\fatha>hadoop version
Hadoop 3.2.2
Source code repository Unknown -r 7a3bc90b05f257c8ace2f76d74264906f0f7a932
Compiled by hexiaoqiao on 2021-01-03T09:26Z
Compiled with protoc 2.5.0
From source with checksum 5a8f564f46624254b27f6a33126ff4
This command was run using /D:/hadoop/share/hadoop/common/hadoop-common-3.2.2.jar
```



How to Run Hadoop

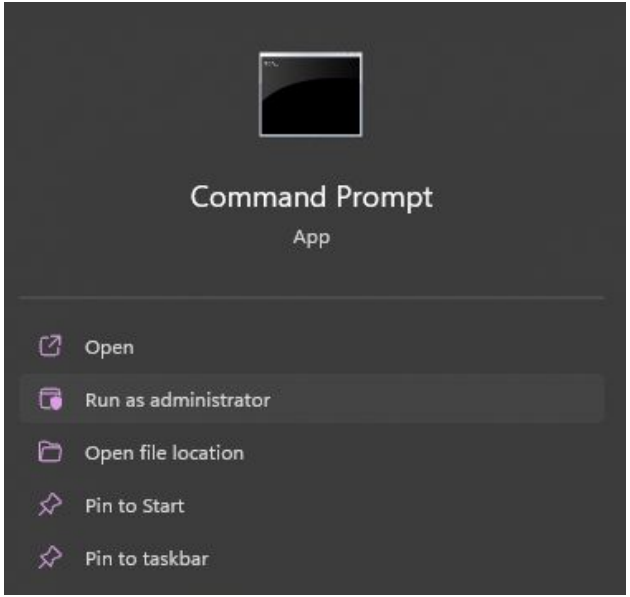
Format the namenode Folder

```
C:\hadoop-3.2.2\sbin>hdfs namenode -format
2023-06-20 19:34:12,020 INFO namenode.NameNode: STARTUP_MSG:
/************************************************************
```

```
2023-06-20 20:16:40,489 INFO namenode.NNStorageRetentionManager: Going to retain 1 images with txid >= 0
2023-06-20 20:16:40,494 INFO namenode.FSImage: FSImageSaver clean checkpoint: txid=0 when meet shutdown.
2023-06-20 20:16:40,494 INFO namenode.NameNode: SHUTDOWN_MSG:
/************************************************************
SHUTDOWN_MSG: Shutting down NameNode at noy/192.168.52.1
************************************************************/
```

Berguna untuk menghapus data
sebelumnya pada datanode dan namenode

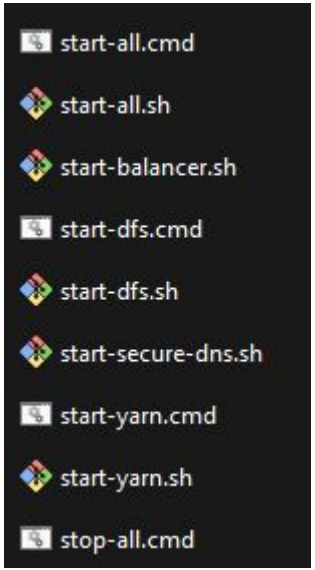
Open CMD



Buka atau jalankan Command Prompt dengan *__Run as Administrator__*

NOTE: Hal ini sangat penting!

Run Hadoop

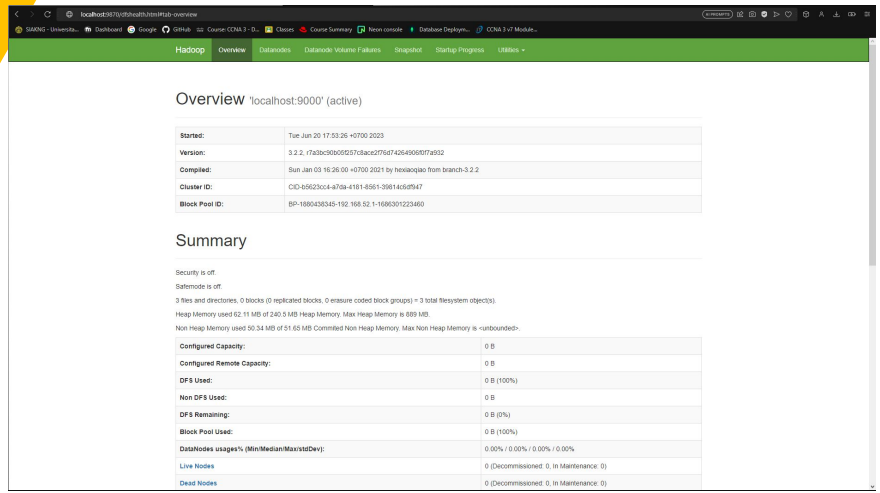


1. Untuk memulai Hadoop dan daemon-nya, jalankan **start-all.cmd**

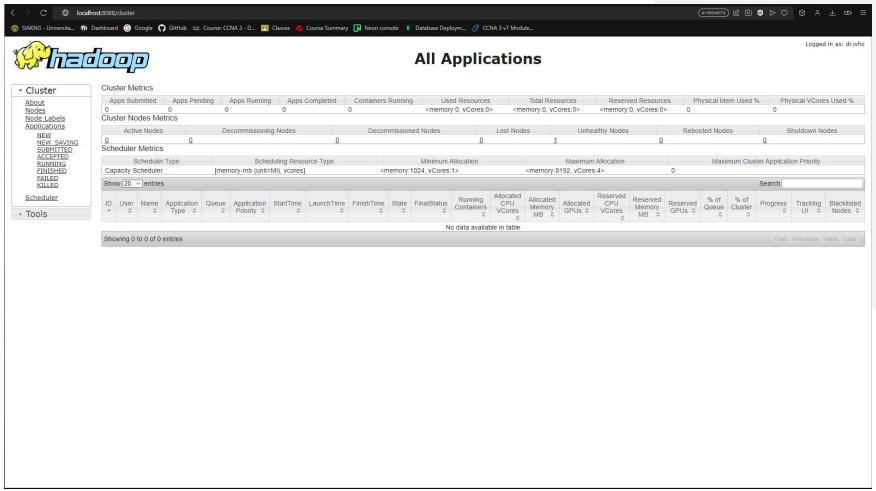
2. Untuk memberhentikan Hadoop dan daemon-nya, jalankan **stop-all.cmd**

3. Jika start-all.cmd dan stop-all.cmd sudah deprecated, jalankan **start-dfs.cmd** lalu **start-yarn.cmd**

Check the GUI and Resource Manager

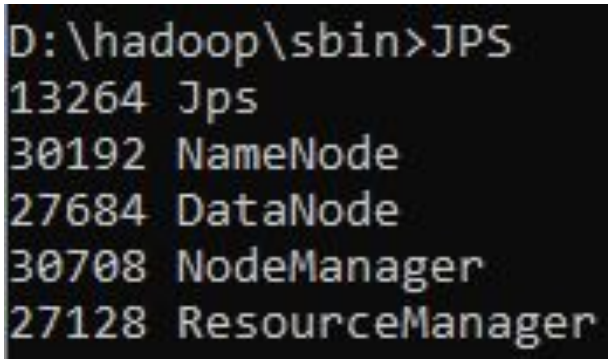


localhost:9870

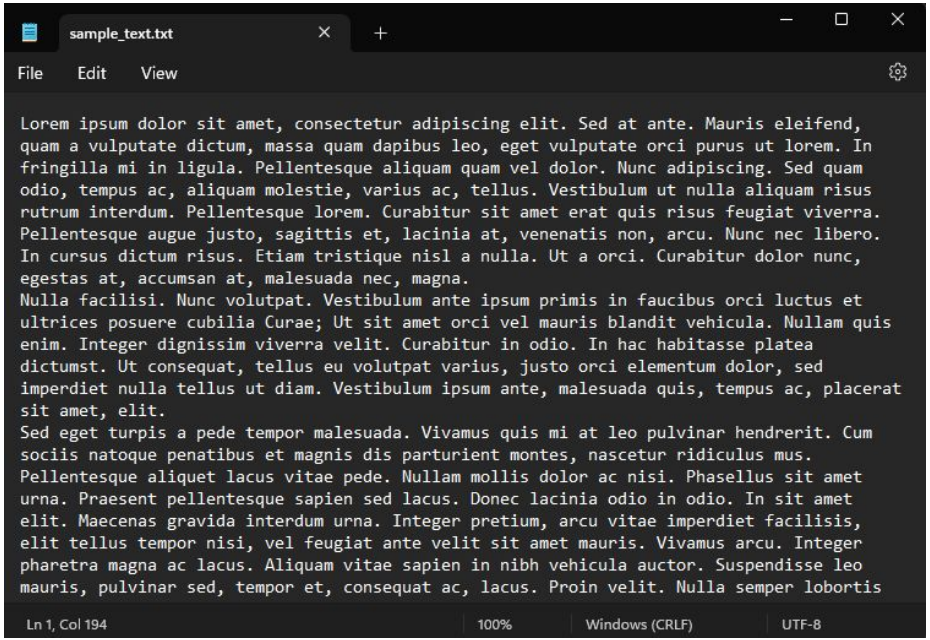


localhost:8088

Checking the Running Hadoop Daemons



Prepare the Input Text File



Moving Text File to Input Directory HDFS

```
D:\hadoop\sbin>hadoop fs -mkdir /input_dir

D:\hadoop\sbin>hadoop fs -put "D:\CoolYeah\Coolyeah - Semester 4\Sistem Basis Data-02\Hadoop\sample_text.txt" /input_dir
```

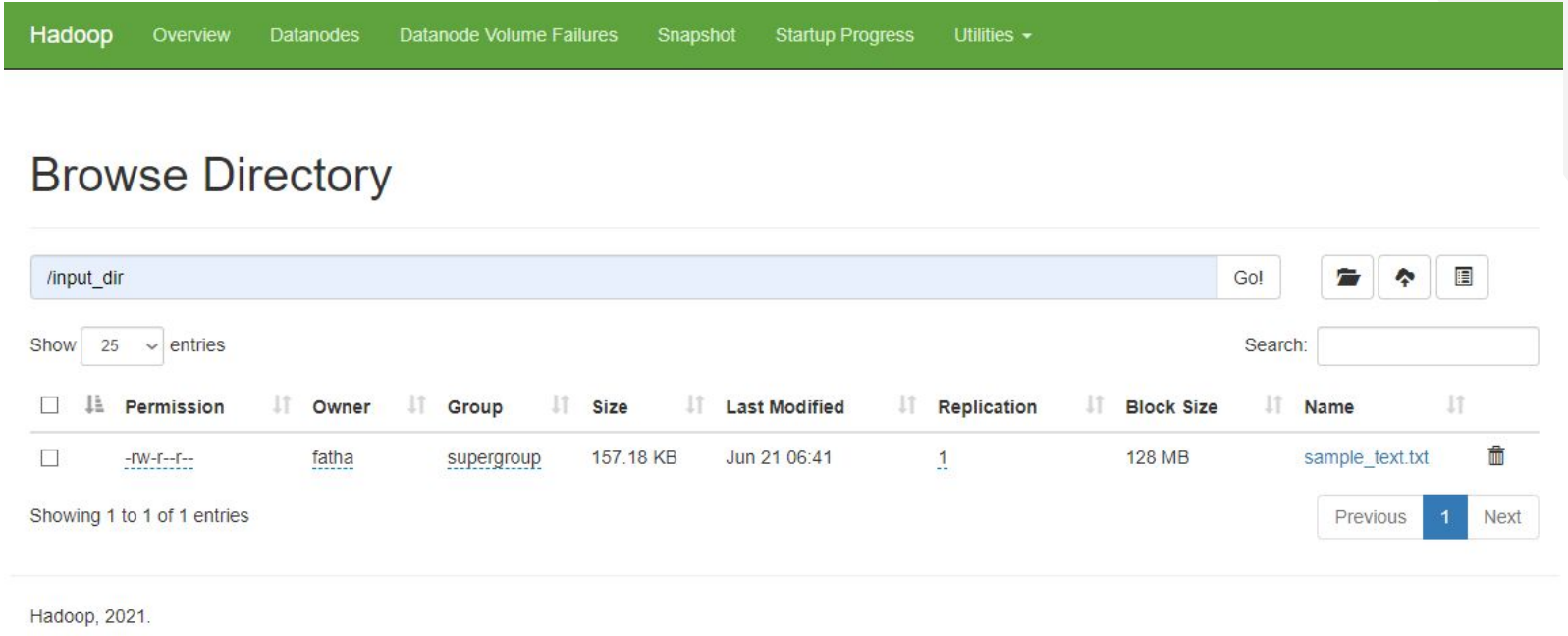
1. **hadoop fs -mkdir /input_directory**

   Membuat folder input pada HDFS

2. **hadoop fs -put “direct to file .txt” /input_directory**

   Meletakkan file text ke folder input HDFS

Verify Text File is in HDFS

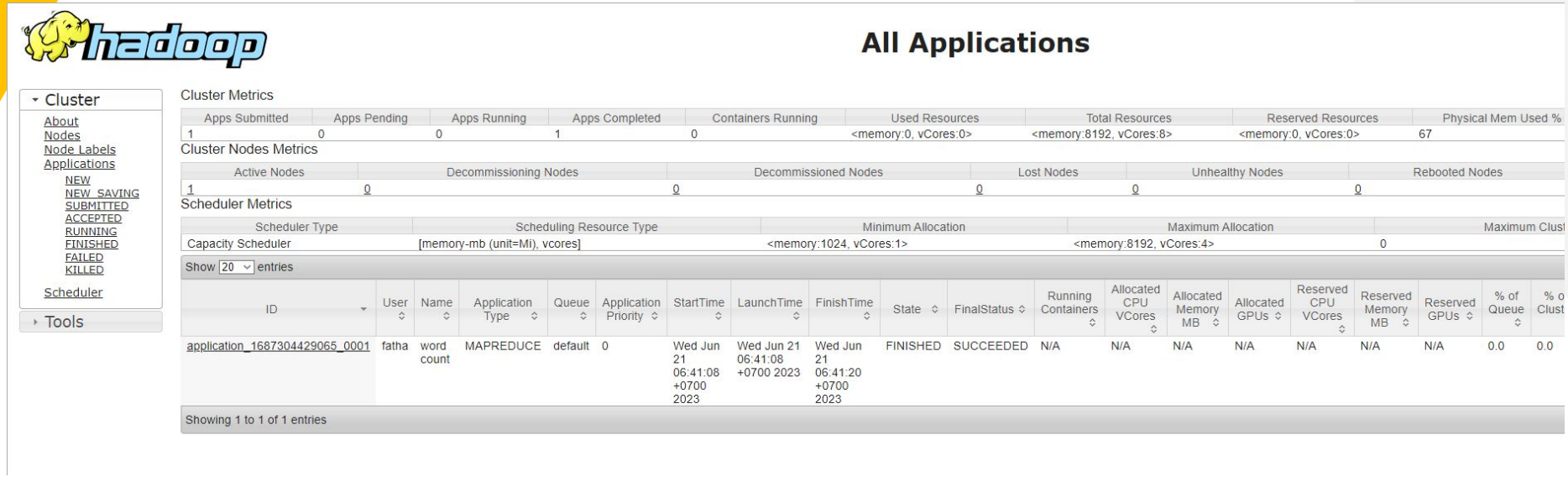


Executing WordCount Program

```
D:\hadoop\sbin>hadoop jar D:/hadoop/share/hadoop/mapreduce/hadoop-mapreduce-examples-3.2.2.jar wordcount /input_dir /output_dir
2023-06-21 06:41:07,222 INFO client.RMProxy: Connecting to ResourceManager at /0.0.0.0:8032
2023-06-21 06:41:07,628 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/fatha/.staging/
job_1687304429065_0001
2023-06-21 06:41:07,761 INFO input.FileInputFormat: Total input files to process : 1
2023-06-21 06:41:07,795 INFO mapreduce.JobSubmitter: number of splits:1
2023-06-21 06:41:07,860 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1687304429065_0001
2023-06-21 06:41:07,861 INFO mapreduce.JobSubmitter: Executing with tokens: []
2023-06-21 06:41:07,957 INFO conf.Configuration: resource-types.xml not found
2023-06-21 06:41:07,958 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
2023-06-21 06:41:08,112 INFO impl.YarnClientImpl: Submitted application application_1687304429065_0001
2023-06-21 06:41:08,150 INFO mapreduce.Job: The url to track the job: http://noy:8088/proxy/application_1687304429065_0001/
2023-06-21 06:41:08,151 INFO mapreduce.Job: Running job: job_1687304429065_0001
2023-06-21 06:41:14,260 INFO mapreduce.Job: Job job_1687304429065_0001 running in uber mode : false
2023-06-21 06:41:14,260 INFO mapreduce.Job:  map 0% reduce 0%
2023-06-21 06:41:17,307 INFO mapreduce.Job:  map 100% reduce 0%
2023-06-21 06:41:21,344 INFO mapreduce.Job:  map 100% reduce 100%
2023-06-21 06:41:22,358 INFO mapreduce.Job: Job job_1687304429065_0001 completed successfully
2023-06-21 06:41:22,408 INFO mapreduce.Job: Counters: 54
```

NOTE:
Semakin besar ukuran file input, maka akan semakin lama waktu yang dibutuhkan untuk memproses.

Check the Output



Check the Output

Browse Directory

/input_dir Go!

Show 25 entries Search:

Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
drwxr-xr-x	fatha	supergroup	0 B	Jun 21 06:41	0	0 B	input_dir
drwxr-xr-x	fatha	supergroup	0 B	Jun 21 06:41	0	0 B	output_dir
drwx------	fatha	supergroup	0 B	Jun 21 06:41	0	0 B	tmp

Showing 1 to 3 of 3 entries Previous 1 Next

Browse Directory

/output_dir Go!

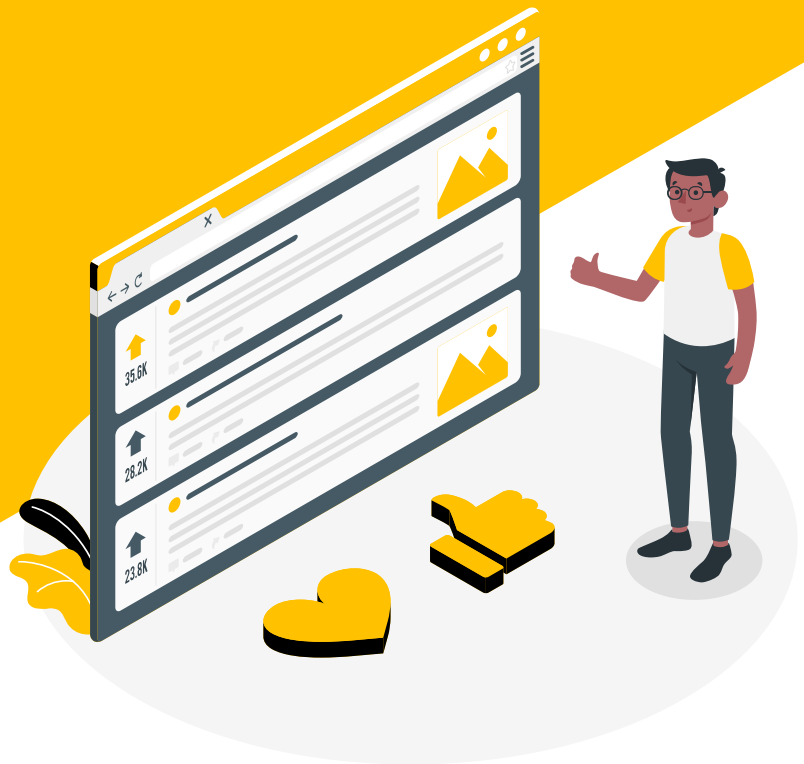
Show 25 entries Search:

Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
-rw-r--r--	fatha	supergroup	0 B	Jun 21 06:41	1	128 MB	_SUCCESS
-rw-r--r--	fatha	supergroup	2.42 KB	Jun 21 06:41	1	128 MB	part-r-00000

Showing 1 to 2 of 2 entries Previous 1 Next

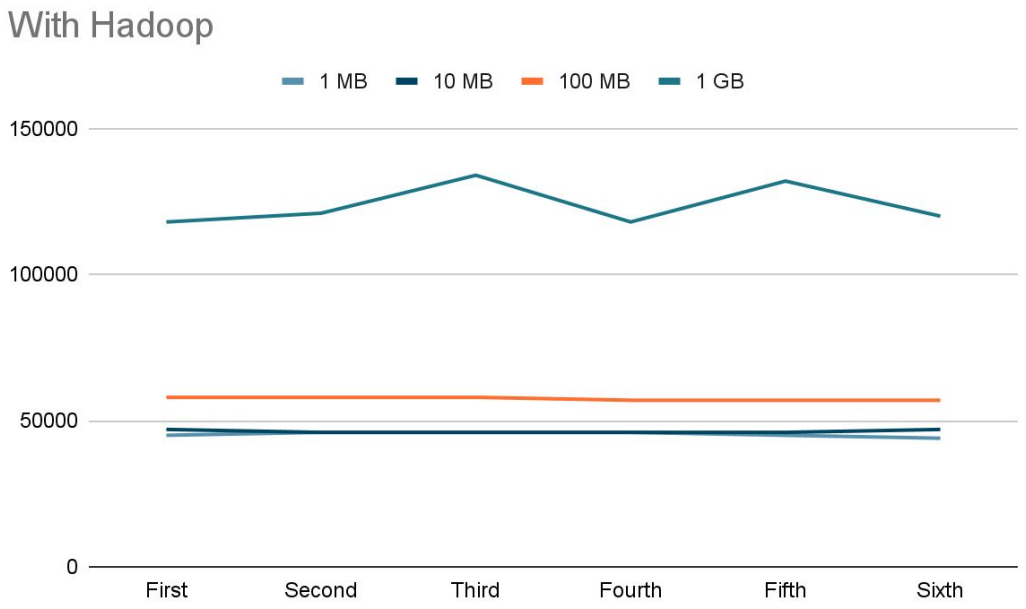
Check the Output

```
D:\hadoop\sbin>hadoop fs -cat /output_dir/part-r-00000
Aliquam 250
Cum     100
Curabitur       200
Curae;  50
Donec   200
Duis    150
Etiam   100
Fusce   100
In      350
Integer 300
Lorem   50
Maecenas        100
Mauris  50
Nulla   200
Nullam  100
Nunc    200
Pellentesque    200
Phasellus       100
Praesent        100
Proin   100
Sed     150
Suspendisse     200
Ut      250
Vestibulum      200
Vivamus 100
a       300
ac      100
ac,     200
accumsan        100
adipiscing      50
adipiscing,     50
adipiscing.     50
aliquam 200
aliquet 50
amet    300
amet,   150
ante    100
ante,   50
ante.   50
arcu    100
arcu.   100
at      150
at,     250
auctor. 50
augue   200
augue,  50
bibendum        50
blandit 50
commodo 50
condimentum     50
consectetur     50
consequat       50
consequat,      50
cubilia 50
cursus  100
cursus. 50
dapibus 100
diam.   100
dictum  50
dictum, 50
dictumst.       150
dignissim       100
dis     100
dolor   250
dolor,  50
dolor.  100
dui     50
dui.    50
egestas 100
eget    150
eleifend,       50
elementum       50
elit    150
elit.   250
enim    50
enim.   150
erat    150
erat,   50
eros    50
et      150
et,     150
eu      100
eu,     100
facilisi.       50
facilisis,      50
faucibus        50
faucibus.       50
felis   50
suscipit,       50
tellus  200
tellus. 100
tempor  250
tempus  100
tempus, 50
tincidunt       50
tristique       100
turpis  50
turpis. 50
ultrices        150
urna    100
urna.   100
ut      250
varius  150
varius, 50
vehicula        50
vehicula.       50
vel     250
velit   50
velit.  100
venenatis       50
vitae   200
vitae,  50
viverra 100
viverra.        50
volutpat        50
volutpat.       150
vulputate       100
```

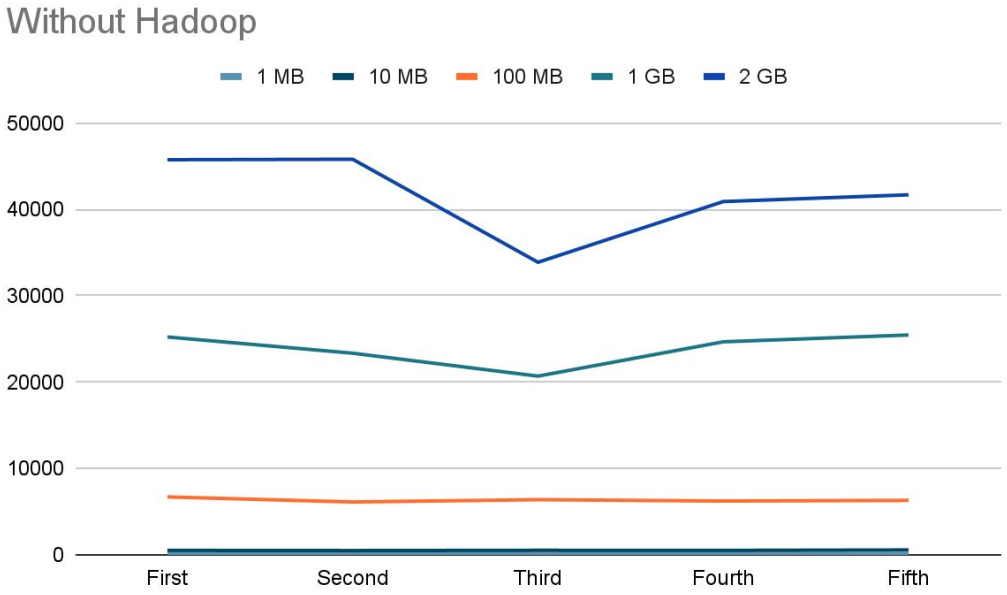


Hadoop
vs
No Hadoop

With Hadoop


With Hadoop
1 MB
10 MB
100 MB
1 GB
150000
100000
50000
0
First
Second
Third
Fourth
Fifth
Sixth

Without Hadoop



Test on Other Machine

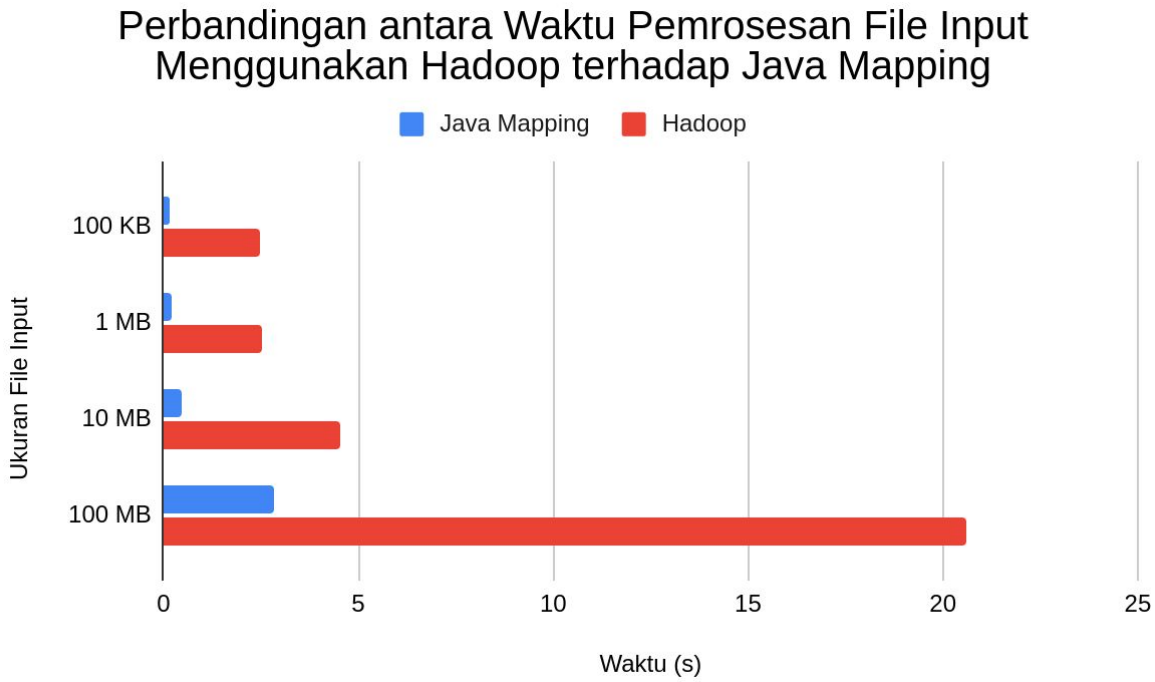
```
[airev@HP bin]$ time ( ./hadoop jar ../share/hadoop/mapreduce/hadoop-mapreduce-e
xamples-3.3.5.jar wordcount input out; cat out/part-r-00000; rm -rf out )
```

```
you?    22000
you?!   2000
your    130000
yourjob 2000
yours!  2000
yours?  2000
yourself        4000

real    0m26,420s
user    0m37,069s
sys     0m0,538s
```

```
[airev@HP bin]$ time java ordinarywordcount
```

```
daisies. = 2000
Oourt = 2000
bees.
Bees?
Specifically, = 2000
Jock.
Yeah. = 2000

real    0m2,957s
user    0m8,027s
sys     0m0,758s
```

Test on Other Machine



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[2] “Java Archive Downloads - Java SE 8 | Oracle Indonesia,” *Oracle.com*, 2019. Available: https://www.oracle.com/id/java/technologies/javase/javase8-archive-downloads.html.

[3] styxnanda, “GitHub - styxnanda/winutils: winutils.exe hadoop.dll and hdfs.dll binaries for hadoop windows,” GitHub, 2023. Available: https://github.com/styxnanda/winutils.

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