

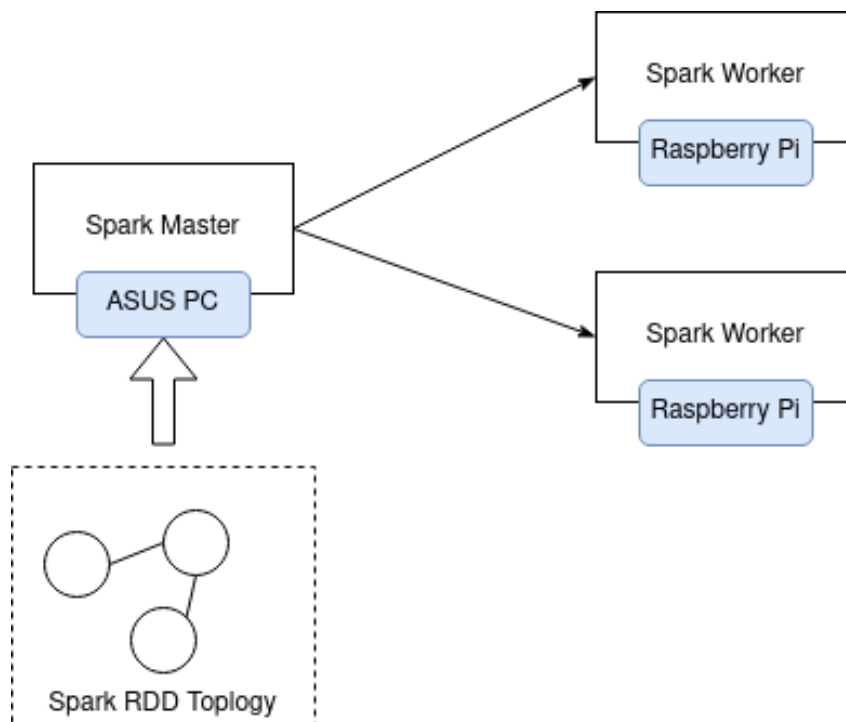
Big Data Mining Homework 1

Spark Platform:

The platform consists of:

1. Raspberry Pi 4 Model B x2
 - OS: Linux Ubuntu 20.04 Server
 - CPU architecture: aarch64
 - RAM: 8GB
 - CPU: Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
 - Number of CPU: 4C (CPU) 1T (Thread Per CPU)
2. Asus-vivobook notebook
 - OS: Linux Ubuntu 20.04 LTS
 - CPU architecture: x86_64
 - RAM: 8GB
 - CPU: Intel(R) Core(TM) i3-8130U CPU @ 2.20GHz
 - Number of CPU: 4C (CPU) 2T (Thread Per CPU)

The simple architecture of spark cluster:



The generated output:

Log the RDD (Resilient Distributed Dataset) output

```
maskertim@SandiskUbuntu: ~/schoolwork/bdm2021/hw1
tracker-extract-files:1000
tracker-extract-files:125
voltage
maskertim@SandiskUbuntu:~/schoolwork/bdm2021/hw1$ ls /tmp/voltage/
_SUCCESS
maskertim@SandiskUbuntu:~/schoolwork/bdm2021/hw1$ cat /tmp/App.log
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<DOCTYPE log SYSTEM "logger.dtd">
<log>
<record>
<date>2021-10-23T05:46:20.795688Z</date>
<millis>1634967980795</millis>
<nanos>688000</nanos>
<sequence>0</sequence>
<logger>com.bdm.App</logger>
<level>INFO</level>
<class>com.bdm.App</class>
<method>main</method>
<thread>1</thread>
<message>global_active_power max:11.122</message>
</record>
<record>
<date>2021-10-23T05:46:24.325268Z</date>
<millis>1634967984325</millis>
<nanos>268000</nanos>
<sequence>1</sequence>
<logger>com.bdm.App</logger>
<level>INFO</level>
<class>com.bdm.App</class>
<method>main</method>
<thread>1</thread>
<message>global_active_power min:0.076</message>
</record>
<record>
<date>2021-10-23T05:46:26.43441Z</date>
<millis>1634967986434</millis>
<nanos>41000</nanos>
<sequence>2</sequence>
<logger>com.bdm.App</logger>
<level>INFO</level>
<class>com.bdm.App</class>
<method>main</method>
<thread>1</thread>
<message>global_active_power count:2049280</message>
</record>
<record>
<date>2021-10-23T05:46:31.857563Z</date>
<millis>1634967991857</millis>
<nanos>563000</nanos>
<sequence>3</sequence>
<logger>com.bdm.App</logger>
<level>INFO</level>
<class>com.bdm.App</class>
<method>main</method>
```

```
maskertim@SandiskUbuntu: ~/schoolwork/bdm2021/hw1
<thread>1</thread>
<message>global_intensity max:48.4</message>
</record>
<record>
<date>2021-10-23T05:48:24.257131Z</date>
<millis>1634968104257</millis>
<nanos>131000</nanos>
<sequence>16</sequence>
<logger>com.bdm.App</logger>
<level>INFO</level>
<class>com.bdm.App</class>
<method>main</method>
<thread>1</thread>
<message>global_intensity min:0.2</message>
</record>
<record>
<date>2021-10-23T05:48:26.875809Z</date>
<millis>1634968106875</millis>
<nanos>809000</nanos>
<sequence>17</sequence>
<logger>com.bdm.App</logger>
<level>INFO</level>
<class>com.bdm.App</class>
<method>main</method>
<thread>1</thread>
<message>global_intensity count:2049280</message>
</record>
<record>
<date>2021-10-23T05:48:32.585630Z</date>
<millis>1634968112585</millis>
<nanos>630000</nanos>
<sequence>18</sequence>
<logger>com.bdm.App</logger>
<level>INFO</level>
<class>com.bdm.App</class>
<method>main</method>
<thread>1</thread>
<message>global_intensity mean:4.627759310588324</message>
</record>
<record>
<date>2021-10-23T05:48:37.088871Z</date>
<millis>1634968117088</millis>
<nanos>871000</nanos>
<sequence>19</sequence>
<logger>com.bdm.App</logger>
<level>INFO</level>
<class>com.bdm.App</class>
<method>main</method>
<thread>1</thread>
<message>global_intensity std:4.444395175407247</message>
</record>
</log>
maskertim@SandiskUbuntu:~/schoolwork/bdm2021/hw1$
```

Spark Web GUI and Logging of Spark Cluster

spark/pom.xml × tutorialkart.com × RDD (Spark 3.2.0) × AggregateFunction × Spark RDD Action × Spark RDD Transformation × Spark Master at 192.168.0.199:8080

192.168.0.199:8080

Spark Master at spark://SandiskUbuntu:7077

URL: spark://SandiskUbuntu:7077
Alive Workers: 2
Cores in use: 8 Total, 0 Used
Memory in use: 2.0 GiB Total, 0.0 B Used
Resources in use:
Applications: 0 Running, 1 Completed
Drivers: 0 Running, 0 Completed
Status: ALIVE

Workers (2)

Worker Id	Address	State	Cores	Memory	Resources
worker-20211023053328-192.168.0.201-45875	192.168.0.201:45875	ALIVE	4 (0 Used)	1024.0 MiB (0.0 B Used)	
worker-20211023053342-192.168.0.200-42707	192.168.0.200:42707	ALIVE	4 (0 Used)	1024.0 MiB (0.0 B Used)	

Running Applications (0)

Application ID	Name	Cores	Memory per Executor	Resources Per Executor	Submitted Time	User	State	Duration
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Completed Applications (1)

Application ID	Name	Cores	Memory per Executor	Resources Per Executor	Submitted Time	User	State	Duration
app-20211023134559-0000	power_consumption	8	1024.0 MiB		2021/10/23 13:45:59	maskertim	FINISHED	3.1 min

spark/pom.xml × tutorialkart.com × RDD (Spark 3.2.0) × AggregateFunction × Spark RDD Action × Spark RDD Transformation × Application: power_consumption × 分享在Linux下 × + - □ ×

192.168.0.199:8080/app/?appId=app-20211023134559-0000

Application: power_consumption

ID: app-20211023134559-0000
Name: power_consumption
User: maskertim
Cores: Unlimited (8 granted)
Executor Limit: Unlimited (2 granted)
Executor Memory: 1024.0 MiB
Executor Resources:
Submit Date: 2021/10/23 13:45:59
State: FINISHED

Executor Summary (2)

ExecutorID	Worker	Cores	Memory	Resources	State	Logs
------------	--------	-------	--------	-----------	-------	------

Removed Executors (2)

ExecutorID	Worker	Cores	Memory	Resources	State	Logs
1	worker-20211023053342-192.168.0.200-42707	4	1024		KILLED	stdout stderr
0	worker-20211023053328-192.168.0.201-45875	4	1024		KILLED	stdout stderr

spark/pom.xml × tutorialkart.com × RDD (Spark 3.2 × AggregateFunc × Spark RDD Actio × Spark RDD Transfo × stderr log page × 分享在Linux下 × + - □ ×

← → ↺ 192.168.0.200:8081/logPage/?appId=app-20211023134559-0000&executorId=1&logType=stderr

spark 3.1.2

stderr log page for app-20211023134559-0000/1

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```
Spark Executor Command: "/usr/lib/jvm/java-11-openjdk-arm64/bin/java" "-cp" "/opt/spark/conf:/opt/spark/jars/*" "-Xmx1024M" "--spark.driver.port=46297"
"org.apache.spark.executor.CoarseGrainedExecutorBackend" "--driver-url" "spark://CoarseGrainedScheduler@192.168.0.199:46297" "--executor-id" "1" "--hostname" "192.168.0.200" "--cores" "4" "--app-id"
"app-20211023134559-0000" "--worker-url" "spark://Worker@192.168.0.200:42707"
=====

Using Spark's default log4j profile: org/apache/spark/log4j-defaults.properties
21/10/23 05:46:03 INFO CoarseGrainedExecutorBackend: Started daemon with process name: 3211@ubuntu
21/10/23 05:46:03 INFO SignalUtils: Registering signal handler for TERM
21/10/23 05:46:03 INFO SignalUtils: Registering signal handler for HUP
21/10/23 05:46:03 INFO SignalUtils: Registering signal handler for INT
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.spark.unsafe.Platform (file:/opt/spark/jars/spark-unsafe_2.12-3.1.2.jar) to constructor java.nio.DirectByteBuffer(long,int)
WARNING: Please consider reporting this to the maintainers of org.apache.spark.unsafe.Platform
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operations
WARNING: All illegal access operations will be denied in a future release
21/10/23 05:46:05 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
21/10/23 05:46:05 INFO SecurityManager: Changing view acls to: ubuntu,maskrtim
21/10/23 05:46:05 INFO SecurityManager: Changing modify acls to: ubuntu,maskrtim
21/10/23 05:46:05 INFO SecurityManager: Changing view acls groups to:
21/10/23 05:46:05 INFO SecurityManager: Changing modify acls groups to:
21/10/23 05:46:05 INFO SecurityManager: SecurityManager: authentication disabled; ui acls disabled; users with view permissions: Set(ubuntu, maskrtim); groups with view permissions: Set(); users with
modify permissions: Set(ubuntu, maskrtim); groups with modify permissions: Set()
21/10/23 05:46:07 INFO TransportClientFactory: Successfully created connection to /192.168.0.199:46297 after 293 ms (0 ms spent in bootstraps)
21/10/23 05:46:07 INFO SecurityManager: Changing view acls to: ubuntu,maskrtim
21/10/23 05:46:07 INFO SecurityManager: Changing modify acls to: ubuntu,maskrtim
21/10/23 05:46:07 INFO SecurityManager: Changing view acls groups to:
21/10/23 05:46:07 INFO SecurityManager: Changing modify acls groups to:
21/10/23 05:46:07 INFO SecurityManager: SecurityManager: authentication disabled; ui acls disabled; users with view permissions: Set(ubuntu, maskrtim); groups with view permissions: Set(); users with
modify permissions: Set(ubuntu, maskrtim); groups with modify permissions: Set()
21/10/23 05:46:07 INFO TransportClientFactory: Successfully created connection to /192.168.0.199:46297 after 16 ms (0 ms spent in bootstraps)
21/10/23 05:46:08 INFO DiskBlockManager: Created local directory at /tmp/spark-cf951b75-848e-4d26-a4ed-b638c82f5477/executor-9471f6e3-263e-4fea-8f04-7036555185ab/blockmgr-ba8e079d-84cd-4ddc-a61c-5aeccd9163c7
21/10/23 05:46:08 INFO MemoryStore: MemoryStore started with capacity 434.4 MiB
21/10/23 05:46:09 INFO CoarseGrainedExecutorBackend: Connecting to driver: spark://CoarseGrainedScheduler@192.168.0.199:46297
21/10/23 05:46:09 INFO WorkerWatcher: Connecting to worker spark://Worker@192.168.0.200:42707
21/10/23 05:46:09 INFO TransportClientFactory: Successfully created connection to /192.168.0.200:42707 after 13 ms (0 ms spent in bootstraps)
21/10/23 05:46:09 INFO WorkerWatcher: Successfully connected to spark://Worker@192.168.0.200:42707
```

spark/pom.xml × tutorialkart.com × RDD (Spark 3.2 × AggregateFunc × Spark RDD Actio × Spark RDD Transfo × stderr log page × 分享在Linux下 × + - □ ×

← → ↺ 192.168.0.200:8081/logPage/?appId=app-20211023134559-0000&executorId=1&logType=stderr

spark 3.1.2

stderr log page for app-20211023134559-0000/1

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```
21/10/23 05:46:37 INFO CoarseGrainedExecutorBackend: Got assigned task 129
21/10/23 05:48:37 INFO Executor: Running task 1.0 in stage 35.0 (TID 129)
21/10/23 05:48:37 INFO CoarseGrainedExecutorBackend: Got assigned task 131
21/10/23 05:48:37 INFO Executor: Running task 3.0 in stage 35.0 (TID 131)
21/10/23 05:48:37 INFO TorrentBroadcast: Started reading broadcast variable 36 with 1 pieces (estimated total size 4.0 MiB)
21/10/23 05:48:37 INFO MemoryStore: Block broadcast_36_piece0 stored as bytes in memory (estimated size 3.3 KiB, free 434.1 MiB)
21/10/23 05:48:37 INFO TorrentBroadcast: Reading broadcast variable 36 took 46 ms
21/10/23 05:48:37 INFO MemoryStore: Block broadcast_36 stored as values in memory (estimated size 6.3 KiB, free 434.1 MiB)
21/10/23 05:48:37 INFO HadoopRDD: Input split: file:/tmp/household_power_consumption.txt:106663296+32297459
21/10/23 05:48:37 INFO HadoopRDD: Input split: file:/tmp/household_power_consumption.txt:33554432+33554432
21/10/23 05:48:40 INFO MemoryStore: Block taskresult_131 stored as bytes in memory (estimated size 6.0 MiB, free 427.5 MiB)
21/10/23 05:48:40 INFO Executor: Finished task 3.0 in stage 35.0 (TID 131). 6922960 bytes result sent via BlockManager
21/10/23 05:48:40 INFO MemoryStore: Block taskresult_129 stored as bytes in memory (estimated size 7.0 MiB, free 420.5 MiB)
21/10/23 05:48:40 INFO Executor: Finished task 1.0 in stage 35.0 (TID 129). 7324993 bytes result sent via BlockManager
21/10/23 05:48:46 INFO CoarseGrainedExecutorBackend: Got assigned task 132
21/10/23 05:48:46 INFO Executor: Running task 0.0 in stage 36.0 (TID 132)
21/10/23 05:48:46 INFO TorrentBroadcast: Started reading broadcast variable 37 with 1 pieces (estimated total size 4.0 MiB)
21/10/23 05:48:46 INFO MemoryStore: Block broadcast_37_piece0 stored as bytes in memory (estimated size 31.7 KiB, free 434.0 MiB)
21/10/23 05:48:46 INFO TorrentBroadcast: Reading broadcast variable 37 took 39 ms
21/10/23 05:48:46 INFO MemoryStore: Block broadcast_37 stored as values in memory (estimated size 87.7 KiB, free 434.0 MiB)
21/10/23 05:48:46 INFO HadoopMapRedCommitProtocol: Using output committer class org.apache.hadoop.mapred.FileOutputCommitter
21/10/23 05:48:46 INFO FileOutputCommitter: File Output Committer Algorithm version is 1
21/10/23 05:48:46 INFO FileOutputCommitter: FileOutputCommitter skip cleanup _temporary folders under output directory:false, ignore cleanup failures: false
21/10/23 05:48:46 INFO HadoopRDD: Input split: file:/tmp/household_power_consumption.txt:9+33554432
21/10/23 05:48:50 INFO HadoopRDD: Input split: file:/tmp/household_power_consumption.txt:33554432+33554432
21/10/23 05:48:54 INFO HadoopRDD: Input split: file:/tmp/household_power_consumption.txt:67180864+33554432
21/10/23 05:48:59 INFO HadoopRDD: Input split: file:/tmp/household_power_consumption.txt:106663296+32297459
21/10/23 05:49:03 INFO FileOutputCommitter: Saved output of task 'attempt_202110231348468574636488275428024_0029_m_000000_0' to file:/tmp/global_intensity/_temporary
/0/task_202110231348468574636488275428024_0029_m_000000
21/10/23 05:49:03 INFO SparkHadoopMapRedUtil: attempt_202110231348468574636488275428024_0029_m_000000_0: Committed
21/10/23 05:49:03 INFO Executor: Finished task 0.0 in stage 36.0 (TID 132). 1287 bytes result sent to driver
21/10/23 05:49:03 INFO CoarseGrainedExecutorBackend: Driver commanded a shutdown
21/10/23 05:49:03 INFO CoarseGrainedExecutorBackend: Driver from 192.168.0.199:46297 disconnected during shutdown
21/10/23 05:49:03 INFO CoarseGrainedExecutorBackend: Driver from 192.168.0.199:46297 disconnected during shutdown
21/10/23 05:49:03 ERROR CoarseGrainedExecutorBackend: RECEIVED SIGNAL TERM
199:46297 disconnected during shutdown
```

Load New

Report of min-max normalization (using formula of Z-Score)

The image shows a Visual Studio Code editor window titled "output.csv - hw1 - Visual Studio Code". The editor displays a CSV file with 30 rows of data. The first row contains headers: "global_intensity,global_reactive_power,global_active_power,voltage". The subsequent rows contain numerical values for these four metrics. The data is organized into a table with 30 rows and 4 columns.

global_intensity	global_reactive_power	global_active_power	voltage
1.133799988495254	2.770405568948946	4.037084627913639	-2.2252744989177864
4.133799988495254	3.320431529940906	4.050325979214916	-2.3302132275732714
4.133799988495254	3.355917075811355	4.063567330516195	-2.1913237337645373
2.5137820217321125	3.586573123969274	2.4348811204589444	-1.5925556937891296
2.3337800263139856	3.5333448051636003	2.296792742602755	-1.7962602847085976
2.5137820217321125	3.515602032228376	2.4689303095193744	-1.774655252338353
2.5137820217321125	3.515602032228376	2.467038687904906	-1.7345316207936103
2.5137820217321125	3.426888167552253	2.4367727420734124	-2.1141629038707799
2.5137820217321125	3.426888167552253	2.431097877230007	-2.1542865354155416
3.3687914999682147	3.320431529940906	3.1745051717160697	-2.4629298549904943
4.178800479349785	3.0720327088477624	4.086266789889815	-2.4876213205564945
3.998798483931658	3.1430038005886605	3.90845435812979	-2.422806223445752
4.04379898278619	2.4332928831796803	3.950070033648093	-2.447497689011752
2.918786511422898	2.646206158402374	2.8018557136658044	-1.7283587544021082
2.1537780308958587	1.4042120529366582	2.168162472818907	-1.141936447209705
2.0637770331867955	0.2509318121470652	2.0603400407942107	-1.2684802082354345
2.1987785297503906	0.2864173580175143	2.211669769951679	-1.1666279127756964
2.0637770331867955	-1.0975189309299975	2.056556797565274	-1.145022880405452
2.648783518295707	-1.0975189309299975	2.493521390507464	-1.5431727626571383
4.673805966749633	-1.0975189309299975	4.542147598976688	-2.5153992193182413
6.42882542207637	-1.0975189309299975	6.255956781685015	-3.043179295791413
5.843818936967458	-1.0975189309299975	5.612805432765775	-2.6635480127142155
3.908797486222595	-1.0975189309299975	3.8611638177680816	-2.052434239955812
3.3237910011136824	-1.0975189309299975	3.1990962527041584	-1.8147788838830956
2.018776534332264	-1.0975189309299975	2.039532203035059	-1.290085240605679
2.018776534332264	-1.0975189309299975	2.028182473348249	-1.5431727626571383
2.018776534332264	-1.0975189309299975	2.0206159868903755	-1.61724715935513
2.0637770331867955	-1.0975189309299975	2.0489903111074	-1.65119792450837
1.9737760354777235	-1.0975189309299975	1.973325446528666	-1.7160130216191125

The terminal window at the bottom shows a bash prompt with the command "python3 main.py" and its output, which includes the same data as the CSV file.

What the workflow of implementation using spark?

1. Start spark master by “start-master.sh” command.
2. Start spark worker by “start-worker.sh [your spark url]” command to connect spark master.

Spark Master at spark://SandiskUbuntu:7077

URL: spark://SandiskUbuntu:7077
Alive Workers: 2
Cores in use: 8 Total, 0 Used
Memory in use: 2.0 GiB Total, 0.0 B Used
Resources in use:
Applications: 0 Running, 1 Completed
Drivers: 0 Running, 0 Completed
Status: ALIVE

Workers (2)

Worker Id	Address	State	Cores	Memory	Resources
worker-20211023053328-192.168.0.201-45875	192.168.0.201:45875	ALIVE	4 (0 Used)	1024.0 MiB (0.0 B Used)	
worker-20211023053342-192.168.0.200-42707	192.168.0.200:42707	ALIVE	4 (0 Used)	1024.0 MiB (0.0 B Used)	

Running Applications (0)

Application ID	Name	Cores	Memory per Executor	Resources Per Executor	Submitted Time	User	State	Duration
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Completed Applications (1)

Application ID	Name	Cores	Memory per Executor	Resources Per Executor	Submitted Time	User	State	Duration
app-20211023134559-0000	power_consumption	8	1024.0 MiB		2021/10/23 13:45:59	maskertim	FINISHED	3.1 min

3. Writing the Spark API with any program (e.g., Java, R, Python, Scala) that spark provides, in this work, that uses Java Language.
4. If you finish to write a program, as follows:

```
package com.bdm;

import java.util.ArrayList;
import java.util.Comparator;
import java.util.logging.Logger;
import java.util.logging.FileHandler;
import java.util.logging.Level;

import org.apache.spark.SparkConf;
import org.apache.spark.api.java.JavaRDD;
import org.apache.spark.api.java.JavaSparkContext;

/**
 * The big data mining homework 1
 * Implementation of Spark
 */
public class App
{
    public static final String DELIMITER = ",";
    private static Logger logger = Logger.getLogger(App.class.getName());

    public static void main( String[] args )
    {
        System.out.println( "Hello World!" );
        org.apache.log4j.Logger.getLogger("bdm").setLevel(org.apache.log4j.Level.ERROR);

        // Log the stdout of main program
        try{
            FileHandler fileHandler = new FileHandler("/tmp/App.log");
            fileHandler.setLevel(Level.INFO); //Log的层级
            logger.addHandler(fileHandler);
        }catch(Exception e){
            e.printStackTrace();
        }

        // Create Spark Context
        SparkConf conf = new SparkConf().setAppName("power_consumption");
        JavaSparkContext sparkContext = new JavaSparkContext(conf);

        // Load Datasets
```


- The screenshot shows an IDE with a sidebar on the left displaying the project structure. The main area is a terminal window showing the output of a Maven build. The build process includes the following steps:

 - Dependency resolution: `powerconsumption:src>main>java>com>bdm>AppJava... 1. powerconsumption:src>main>java>com>bdm>AppJava...`
 - Scanning for projects: `[INFO] Scanning for projects...`
 - Building powerconsumption 1.0-SNAPSHOT: `[INFO] Building powerconsumption 1.0-SNAPSHOT`
 - Deleting /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target: `[INFO] Deleting /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target`
 - Using UTF-8 encoding for code filtered resources: `[INFO] Using 'UTF-8' encoding for code filtered resources`
 - Compiling 1 source file to /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target/classes: `[INFO] Compiling 1 source file to /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target/classes`
 - Using UTF-8 encoding for code filtered resources: `[INFO] Using 'UTF-8' encoding for code filtered resources`
 - Compiling 1 source file to /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target/test-classes: `[INFO] Compiling 1 source file to /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target/test-classes`
 - Running com.bdm.AppTest: `[INFO] Running com.bdm.AppTest`
 - Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.066 s - in com.bdm.AppTest: `[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.066 s - in com.bdm.AppTest`
 - Results: `[INFO] Results:`
 - Tests run: 1, Failures: 0, Errors: 0, Skipped: 0: `[INFO] Tests run: 1, Failures: 0, Errors: 0, Skipped: 0`
 - Building jar: /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target/powerconsumption-1.0-SNAPSHOT.jar: `[INFO] Building jar: /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target/powerconsumption-1.0-SNAPSHOT.jar`
 - Building jar: /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target/powerconsumption-1.0-SNAPSHOT-jar-with-dependencies.jar: `[INFO] Building jar: /home/maskerlin/schoolwork/bdm2021/hw1/powerconsumption/target/powerconsumption-1.0-SNAPSHOT-jar-with-dependencies.jar`
 - Build SUCCESS: `[INFO] BUILD SUCCESS`
 - Total time: 48.947 s: `[INFO] Total time: 48.947 s`
 - Finished at: 2021-10-23T16:34:43+08:00: `[INFO] Finished at: 2021-10-23T16:34:43+08:00`
 - maskerlin@maskerlin:~/schoolwork/bdm2021/hw1/powerconsumptions\$

The IDE interface includes a sidebar on the left with project structure, a top menu bar, and a status bar at the bottom showing the current file and project information.

- ```
“spark-submit --class "com.bdm.App" --master spark://192.168.0.199:7077
/home/maskertim/schoolwork/bdm2021/hw1/powerconsumption/target/powerconsumption-
1.0-SNAPSHOT.jar”.
```

```
maskertim@SandiskUbuntu: ~schoolwork... maskertim@SandiskUbuntu: ~schoolwork/bdm2021/hw1/powerconsumption$ spark-submit --class "com.bdn.app" --master spark://192.168.0.199:7077 /home/maskertim/schoolwork/bdm2021/hw1/powerconsumption/target/po
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.spark.unsafe.Platform (file:/opt/spark/jars/spark-unsafe-2.12-3.1.2.jar) to constructor java.nio.DirectByteBuffer(long,int)
WARNING: Please consider reporting this to the maintainers of org.apache.spark.unsafe.Platform
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operations
WARNING: All illegal access operations will be denied in a future release
13:45:57 MAIN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Hello world!
Using Spark's default log4j profile: org.apache.spark/log4j-defaults.properties
13:10/23 13:45:58 INFO SparkContext: Running Spark version 3.1.2
13:10/23 13:45:58 INFO ResourceUtils: =====
13:10/23 13:45:58 INFO ResourceUtils: No custom resources configured for spark.driver.
13:10/23 13:45:58 INFO ResourceUtils: =====
13:10/23 13:45:58 INFO SparkContext: Submitted application: power consumption
13:10/23 13:45:58 INFO ResourceProfile: Default ResourceProfile created, executor resources: Map(cores -> name: cores, amount: 1, script: , vendor: , memory -> name: memory, amount: 1024, script: , vendo
r: , offheap -> name: offheap, amount: 0, script: , vendor:), task resources: Map(cpus -> name: cpus, amount: 1.0)
13:10/23 13:45:58 INFO ResourceProfile: Limiting resource is cpus
13:10/23 13:45:58 INFO ResourceProfileManager: Added ResourceProfile id: 0
13:10/23 13:45:58 INFO SecurityManager: Changing view acls to: maskertim
13:10/23 13:45:58 INFO SecurityManager: Changing modify acls to: maskertim
13:10/23 13:45:58 INFO SecurityManager: Changing view acls groups to:
13:10/23 13:45:58 INFO SecurityManager: Changing modify acls groups to:
13:10/23 13:45:58 INFO SecurityManager: SecurityManager: authentication disabled; ui acls disabled; users with view permissions: Set(maskertim); groups with view permissions: Set(); users with modify p
ermissions: Set(maskertim); groups with modify permissions: Set()
13:10/23 13:45:58 INFO Utils: Successfully started service 'sparkDriver' on port 46297.
13:10/23 13:45:58 INFO SparkEnv: Registering MapOutputTracker
13:10/23 13:45:58 INFO SparkEnv: Registering BlockManagerMaster
13:10/23 13:45:58 INFO BlockManagerMasterEndpoint: Using org.apache.spark.storage.DefaultTopologyMapper for getting topology information
13:10/23 13:45:58 INFO BlockManagerMasterEndpoint: BlockManagerMasterEndpoint up
13:10/23 13:45:58 INFO SparkEnv: Registering BlockManagerMasterHeartbeat
13:10/23 13:45:58 INFO BlockManagerMasterEndpoint: Created local directory at /tmp/blockmgr-af64d75-7669-490b-9e07-3c65ab32db8
13:10/23 13:45:58 INFO MemoryStore: MemoryStore started with capacity 434.4 MiB
13:10/23 13:45:58 INFO SparkEnv: Registering OutputCommitCoordinator
13:10/23 13:45:58 INFO Utils: Successfully started service 'SparkUI' on port 4040.
13:10/23 13:45:58 INFO SparkUI: Bound Spark UI to 0.0.0.0, and started at http://192.168.0.199:4040
13:10/23 13:45:58 INFO SparkContext: Added JAR file:/home/maskertim/schoolwork/bdm2021/hw1/powerconsumption/target/powerconsumption-1.0-SNAPSHOT.jar at spark://192.168.0.199:46297/jars/powerconsumption-1
.0-SNAPSHOT.jar with timestam 163469658121
13:10/23 13:45:58 INFO StandaloneApplicationClientEndpoint: Connecting to master spark://192.168.0.199:7077...
13:10/23 13:45:58 INFO TransportClientFactory: Successfully created connection to /192.168.0.199:7077 for 38 ms (0 ms spent in bootstraps)
13:10/23 13:45:58 INFO StandaloneSchedulerBackend: Connected to Spark cluster with app ID app-20211023134559-0000
13:10/23 13:45:58 INFO Utils: Successfully started service 'org.apache.spark.network.netty.NettyBlockTransferService' on port 37617.
13:10/23 13:45:58 INFO NettyBlockTransferService: Server created on 192.168.0.199:37617
13:10/23 13:45:58 INFO StandaloneAppClient$ClientEndpoint: Executor added: app-20211023134559-0000/0 on worker-202110230353328-192.168.0.201-45875 (192.168.0.201:45875) with 4 core(s)
13:10/23 13:45:58 INFO BlockManager: Using org.apache.spark.storage.RandomBlockReplicationPolicy for block replication policy
13:10/23 13:45:58 INFO StandaloneSchedulerBackend: Granted executor ID app-20211023134559-0000/0 on hostPort 192.168.0.201:45875 with 4 core(s), 1024.0 MiB RAM
13:10/23 13:45:58 INFO StandaloneClientEndpoint: Executor added: app-20211023134559-0000/1 on worker-202110230353328-192.168.0.201-45875 with 4 core(s), 1024.0 MiB RAM
13:10/23 13:45:58 INFO StandaloneSchedulerBackend: Granted executor ID app-20211023134559-0000/1 on hostPort 192.168.0.201:42707 with 4 core(s), 1024.0 MiB RAM
13:10/23 13:45:58 INFO BlockManagerMaster: Registering BlockManager BlockManagerId(driver, 192.168.0.199, 37617, None)
13:10/23 13:45:58 INFO BlockManagerMaster: Registering BlockManager BlockManagerId(worker, 192.168.0.199, 37617, None)
13:10/23 13:45:58 INFO BlockManagerMaster: Registered BlockManager BlockManagerId(driver, 192.168.0.199, 37617, None)
13:10/23 13:45:58 INFO BlockManager: Initialized BlockManager: BlockManagerId(driver, 192.168.0.199, 37617, None)
```