

CloudKon Design Document & Performance Evaluation

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1. CloudKon clone with Amazon EC2, S3, SQS, and DynamoDB Design

a. Problem

We were to implement a distributed task execution framework on Amazon EC2 using the SQS. The framework was supposed to have two separate components, Client (e.g. a command line tool which submits tasks to SQS or LOCAL (in-memory) queue) and workers (e.g. which retrieve tasks from SQS or LOCAL (in-memory) queue and executes them). The SQS service was to be used to handle the queue of requests to load balance across multiple workers. DynamoDB was to be used to avoid the duplication in processing of jobs.

i. Coding Highlights

- A common client for Remote as well as Local (in-memory) queue
- Separate threads for all the Client as well as Worker functions to ensure optimum performance and resource utilization
- Each functionality has a separate function ensuring the modularity
- Command Line interface and argument validation

ii. Client Design

- Client Program accepts Queue Name, Workload File, and No. of Threads (only in case of LOCAL Queue). As a first step, program validates the command line arguments passed. If the arguments passed are correct and are in right sequence, it initializes all the required variables
- Once the variables are initialized, Program starts reading the file and putting the data into either ArrayList (LOCAL Queue) or into SQS Queue specified by User
- Result Queue Name is assumed to be as “<Job Queue Name>_Results”
- DynamoDB Table Name is assumed to be same as “<Job Queue Name>”
- If the Message sent to SQS is successful, the same Job along with the Message ID returned by SQS is added into DynamoDB Table with Processing Status as False
- Once all the Messages are pushed to the Queue, Program checks if Queue name is “LOCAL”. If yes then it starts the Thread Pool to execute the Jobs from the Queue.
- Thread Pool is created with fixed number of threads based on the command line argument provided by user.

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- Threads in Thread Pools reads the Jobs from Queue and starts executing them as System Commands. Threads updates the DynamoDB table for appropriate Message ID to indicate that the Message is under processing
- The output of these System Commands executed by Threads is stored into another Result ArrayList.
- A separate thread is started from Main Program which keeps polling the Result Queue and puts them into Result ArrayList
- This helps to compare number of Jobs with number of Results received irrespective of the Local or Remote Worker architecture.
- If the number of Jobs is equal to number of Results then the Clients Program is terminated with required output like Total number of Jobs, Total number of Results and Total time taken for processing the Jobs.

iii. Worker Design

- Worker Program accepts Queue Name, Workload File (only in case of LOCAL Queue), and No. of Threads. As a first step, program validates the command line arguments passed. If the arguments passed are correct and are in right sequence, it initializes all the required variables
- Result Queue Name is assumed to be as "<Job Queue Name>_Results"
- DynamoDB Table Name is assumed to be same as "<Job Queue Name>"
- Once the variables are initialized, Program starts a separate Thread for pulling the messages from Queue. These messages are stored into an ArrayList for further processing.
- A separate Thread in parallel to receiving messages, creates a Thread Pool with fixed number of threads based on the command line argument provided by user.
- Threads in Thread Pools reads the Jobs from Queue and checks if the received Job is already processed by some other worker or Thread by checking the duplicate count from DynamoDB Table with the Message ID.
- If the Job is marked as processed, then the Job is skipped and next Job is processed.
- If the Job is not processed, then Thread starts executing it as System Command. Threads update the DynamoDB table for appropriate Message ID to indicate that the Message is under processing
- The output of these System Commands executed by Threads is stored into another Result ArrayList.
- A separate thread is started from Main Program which keeps polling the Result ArrayList and puts them into Result Queue

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- This helps to compare number of Jobs with number of Results received irrespective of the Local or Remote Worker architecture.
- If the number of Jobs is equal to number of Results then the Clients Program is terminated with required output like Total number of Jobs, Total number of Results and Total time taken for processing the Jobs.

b. Tradeoffs made

i. Generic

- No log file generation, only the output can be redirected to a text file
- Program would have been made more flexible & parametric by making minor changes & accepting inputs (like Result Queue Name, DynamoDB Table Name, etc.) from users

c. Possible Improvements

- Dynamic Provisioning of Instances
- Creating Queues programmatically
- Forecasting the Load on instances
- Running more realistic commands instead of Sleep commands

2. CloudKon clone Installation Manual

a. Installation Prerequisites

i. Software Prerequisites

- Java SE Runtime Environment 8
- Ubuntu nodes
- Access to Amazon EC2, SQS, DynamoDB

ii. Hardware Prerequisites

- Ubuntu nodes connected using TCP Network

b. Installation

i. Copy the System Code

- Create a folder in AWS t2.micro instance.
- Source Code can be copied into a folder and a Jar File can be prepared by exporting the Eclipse Project as Runnable Jar. The same can be also done by ANT script from the submission
- Copy the PA3_3.jar file into folder
- User can now generate the Workload File and run the Client, and Worker on from main node.
e.g.:
 - Command “java -classpath PA3_3.jar JobFileGenerator 10000 "sleep 0" sleep010k.txt” will generate a Workload file names “sleep010k.txt” with 10000 “sleep 0” tasks
 - Command “java -classpath PA3_3.jar SQSClient -s LOCAL -t 8 -w sleep10ms_1k.txt” will start the Local Client and Worker with 8 Threads with Workload File “sleep10ms_1k.txt”
 - Command “java -classpath PA3_2.jar SQSClient -s PA3Job -w sleep10ms_1k.txt” will start the Client with Workload File “sleep10ms_1k.txt”
 - Command “pssh -i -h 1Worker_PSSH_IP.txt -t 10000000 -x “-oStrictHostKeyChecking=no -i Niks_CS553S16.pem” -l ubuntu ‘java -classpath /home/ubuntu/Cloud_PA3/PA3_3.jar RemoteWorker -s PA3Job -t 8’” will start the

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Remote Worker with Queue Name as PA3Job to be processed and number of threads per worker as 8. It uses PSSH to start Remote Worker on multiple instances.

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3. CloudKon clone Performance Evaluation and Screenshots

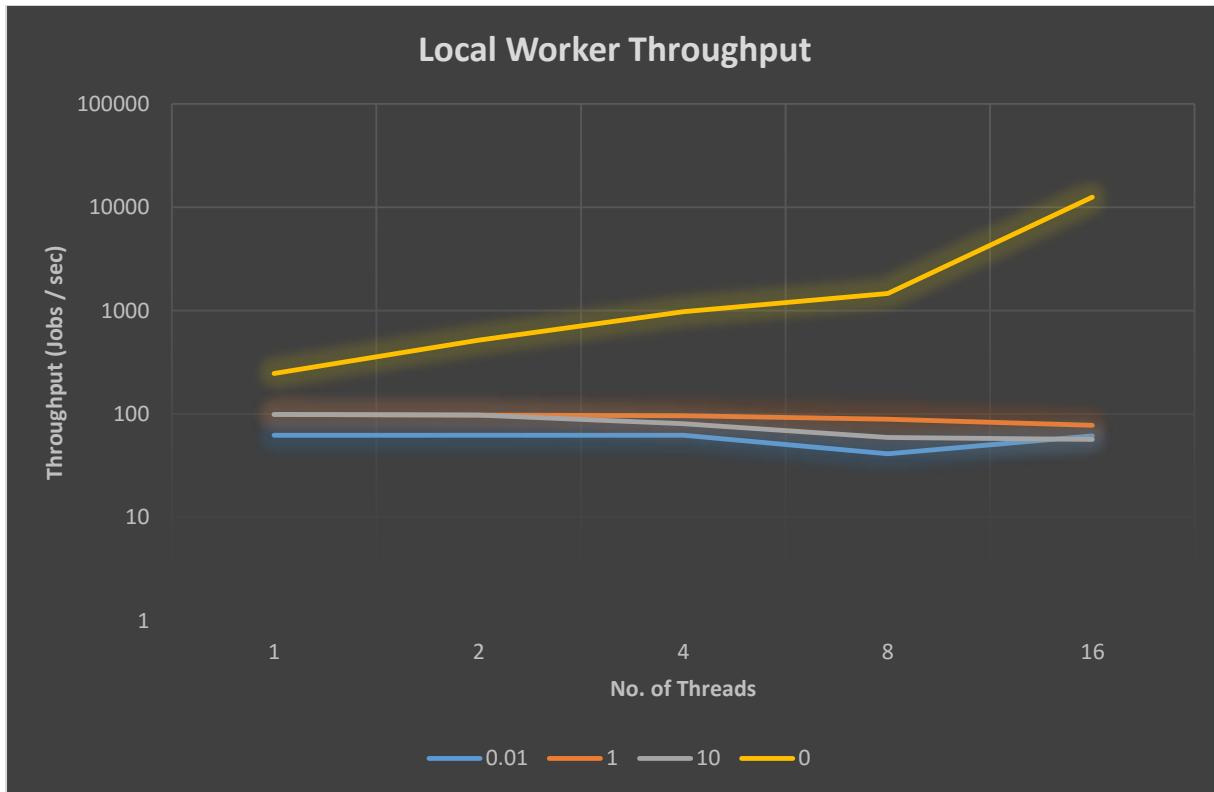
a. Performance Evaluation

Type of Worker	Workers	Threads / Worker	No. of Tasks	Sleep Duration (in seconds)	Time Taken (in Seconds)	Idle Time	Efficiency (in %)	Throughput
Local	1	1	1000	0.01	16.02	10	62.4220	62.4220
Local	1	2	1000	0.01	8.024	5	62.3131	124.6261
Local	1	4	1000	0.01	4.02	2.5	62.1891	248.7562
Local	1	8	1000	0.01	3.019	1.25	41.4044	331.2355
Local	1	16	1000	0.01	1.018	0.625	61.3949	982.3183
Local	1	1	100	1	101.017	100	98.9932	0.9899
Local	1	2	100	1	51.007	50	98.0258	1.9605
Local	1	4	100	1	26.005	25	96.1354	3.8454
Local	1	8	100	1	14.003	12.5	89.2666	7.1413
Local	1	16	100	1	8.004	6.25	78.0860	12.4938
Local	1	1	10	10	101.042	100	98.9687	0.0990
Local	1	2	10	10	51.016	50	98.0085	0.1960
Local	1	4	10	10	31.005	25	80.6322	0.3225
Local	1	8	10	10	21.005	12.5	59.5096	0.4761
Local	1	16	10	10	11.002	6.25	56.8079	0.9089
Local	1	1	10000	0	404.217	0	0.0000	247.3919
Local	1	2	10000	0	193.185	0	0.0000	517.6385
Local	1	4	10000	0	102.178	0	0.0000	978.6843

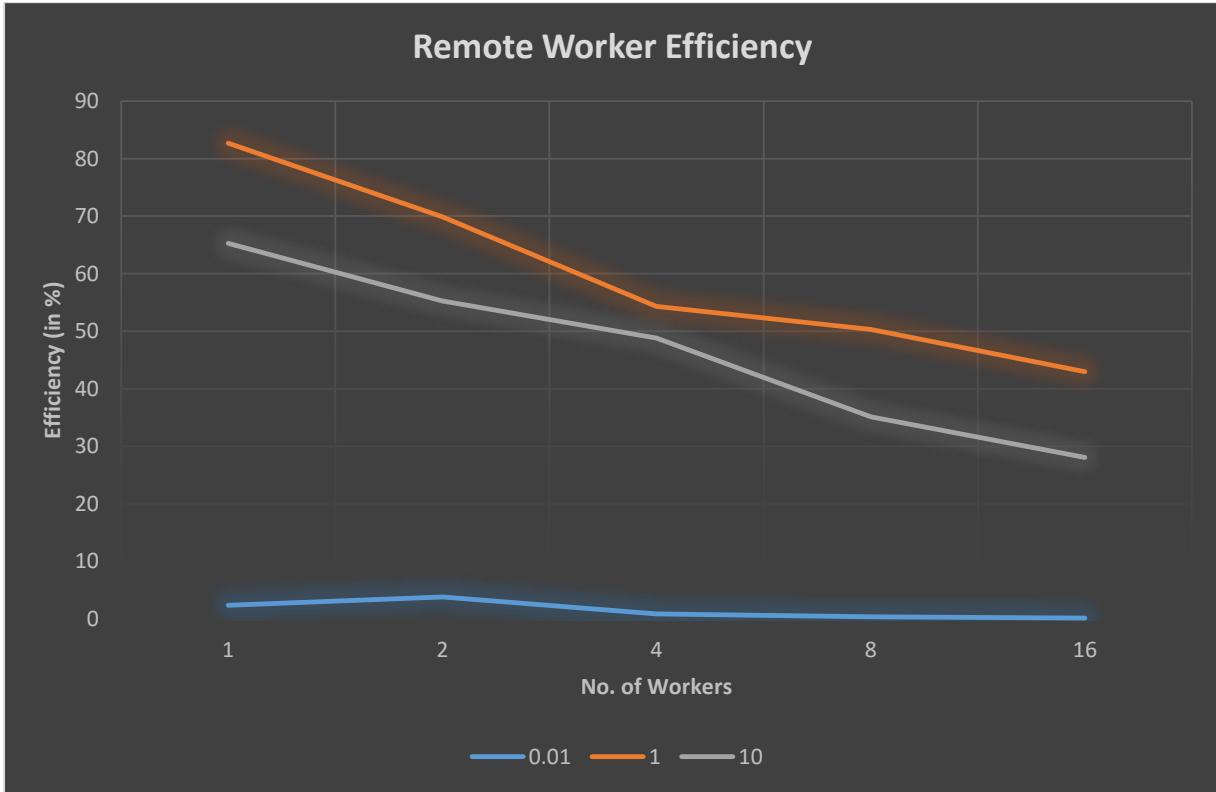
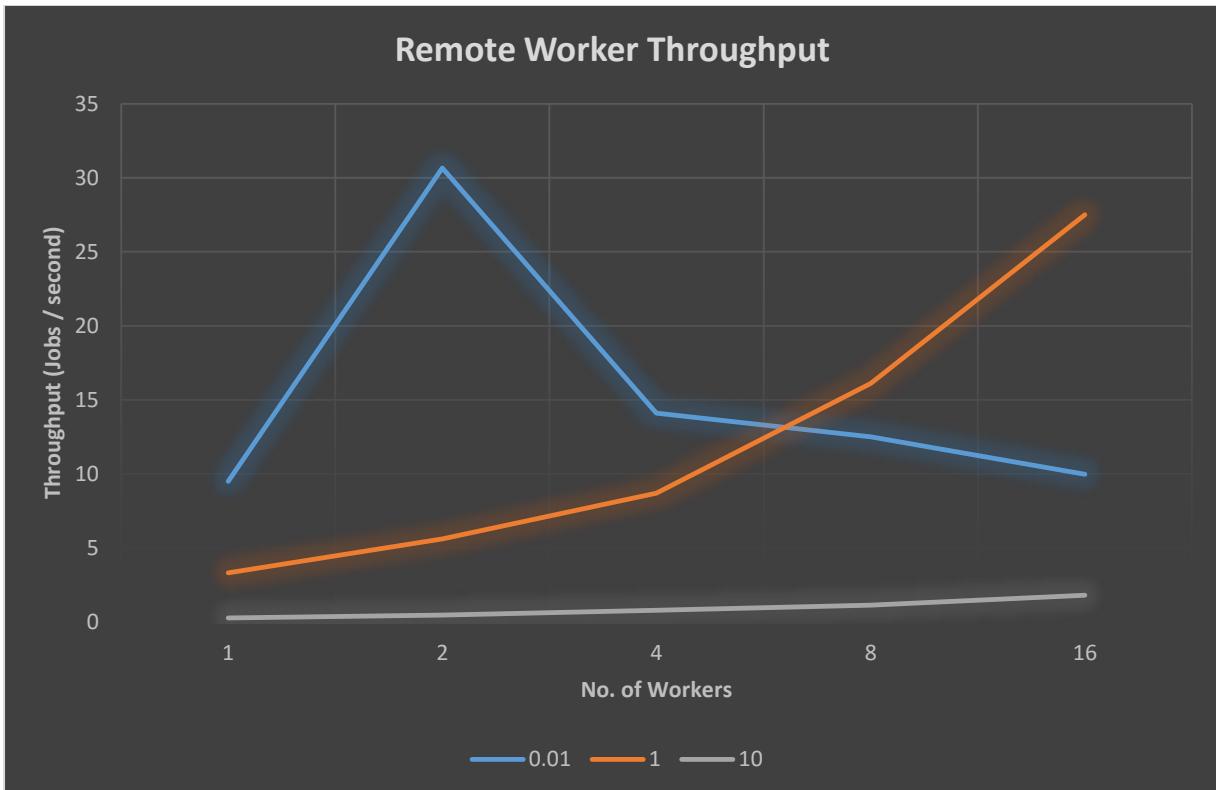
CloudKon Design Document & Performance Evaluation

Type of Worker	Workers	Threads / Worker	No. of Tasks	Sleep Duration (in seconds)	Time Taken (in Seconds)	Idle Time	Efficiency (in %)	Throughput
Local	1	8	10000	0	68.171	0	0.0000	1466.8994
Local	1	16	10000	0	8.004	0	0.0000	12493.7531
Remote	1	4	1000	0.01	105.236	2.5	2.3756	9.5025
Remote	2	4	2000	0.01	65.239	2.5	3.8321	30.6565
Remote	4	4	4000	0.01	283.69	2.5	0.8812	14.0999
Remote	8	4	8000	0.01	640.569	2.5	0.3903	12.4889
Remote	16	4	16000	0.01	1604.435	2.5	0.1558	9.9724
Remote	1	4	100	1	30.236	25	82.6829	3.3073
Remote	2	4	200	1	35.784	25	69.8636	5.5891
Remote	4	4	400	1	46.005	25	54.3419	8.6947
Remote	8	4	800	1	49.671	25	50.3312	16.1060
Remote	16	4	1600	1	58.17	25	42.9775	27.5056
Remote	1	4	10	10	38.296	25	65.2810	0.2611
Remote	2	4	20	10	45.257	25	55.2401	0.4419
Remote	4	4	40	10	51.235	25	48.7948	0.7807
Remote	8	4	80	10	71.129	25	35.1474	1.1247
Remote	16	4	160	10	89.139	25	28.0461	1.7949

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b. Screenshots

EC2 Management Console - Mozilla Firefox

Instance ID	Public DNS	Public IP	Private DNS Name	Private IP Addr
i-00c8160034f3c42f1	ec2-52-91-211-220.compute-1.amazonaws.com	52.91.211.220	ip-172-31-62-88.ec2.internal	172.31.62.88
i-012e45e2fd34d576e	ec2-52-91-48-179.compute-1.amazonaws.com	52.91.48.179	ip-172-31-56-181.ec2.internal	172.31.56.181
i-0464f0f06dc6e756	ec2-52-90-41-245.compute-1.amazonaws.com	52.90.41.245	ip-172-31-56-182.ec2.internal	172.31.56.182
i-0490add49d866528	ec2-52-91-255-112.compute-1.amazonaws.com	52.91.255.112	ip-172-31-56-186.ec2.internal	172.31.56.186
i-04e532d83f90fd3ea	ec2-52-90-114-116.compute-1.amazonaws.com	52.90.114.116	ip-172-31-56-187.ec2.internal	172.31.56.187
i-0504eb1b9fb2bafdf	ec2-52-87-208-2.compute-1.amazonaws.com	52.87.208.2	ip-172-31-56-180.ec2.internal	172.31.56.180
i-06931a9c713813938	ec2-54-87-129-227.compute-1.amazonaws.com	54.87.129.227	ip-172-31-56-183.ec2.internal	172.31.56.183
i-07601f4a0b628f327	ec2-52-91-254-209.compute-1.amazonaws.com	52.91.254.209	ip-172-31-56-191.ec2.internal	172.31.56.191
i-07bd24ee3fad1ab58	ec2-52-90-115-20.compute-1.amazonaws.com	52.90.115.20	ip-172-31-56-184.ec2.internal	172.31.56.184
i-094aea1eb10f94d4a	ec2-54-82-235-252.compute-1.amazonaws.com	54.82.235.252	ip-172-31-56-185.ec2.internal	172.31.56.185
i-0c7d7c10f60e38f3a	ec2-54-83-143-186.compute-1.amazonaws.com			
i-095f04b0f5c806ad	ec2-52-90-8-65.compute-1.amazonaws.com	52.90.8.65	ip-172-31-56-193.ec2.internal	172.31.56.193

Instance: **i-0c7d7c10f60e38f3a** Public DNS: **ec2-54-83-143-186.compute-1.amazonaws.com**

Description Status Checks Monitoring Tags

Feedback English

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EC2 Management Console - Mozilla Firefox

Instance ID	Public DNS	Public IP	Private DNS Name	Private IP Addr
i-0504eb1b9fb2bafdf	ec2-52-87-208-2.compute-1.amazonaws.com	52.87.208.2	ip-172-31-56-180.ec2.internal	172.31.56.180
i-06931a9c713813938	ec2-54-87-129-227.compute-1.amazonaws.com	54.87.129.227	ip-172-31-56-183.ec2.internal	172.31.56.183
i-07601f4a0b628f327	ec2-52-91-254-209.compute-1.amazonaws.com	52.91.254.209	ip-172-31-56-191.ec2.internal	172.31.56.191
i-07bd24ee3fad1ab58	ec2-52-90-115-20.compute-1.amazonaws.com	52.90.115.20	ip-172-31-56-184.ec2.internal	172.31.56.184
i-094aea1eb10f94d4a	ec2-54-82-235-252.compute-1.amazonaws.com	54.82.235.252	ip-172-31-56-185.ec2.internal	172.31.56.185
i-0c7d7c10f60e38f3a	ec2-54-83-143-186.compute-1.amazonaws.com			
i-095f04b0f5c806ad	ec2-52-90-8-65.compute-1.amazonaws.com	52.90.8.65	ip-172-31-56-193.ec2.internal	172.31.56.193
i-0d5c613d4d4e6b460	ec2-52-91-200-22.compute-1.amazonaws.com	52.91.200.22	ip-172-31-56-179.ec2.internal	172.31.56.179
i-0e2d9d89149e3b4a4	ec2-52-90-114-101.compute-1.amazonaws.com	52.90.114.101	ip-172-31-56-190.ec2.internal	172.31.56.190
i-0e9df1bb845e31d97	ec2-52-90-239-81.compute-1.amazonaws.com	52.90.239.81	ip-172-31-56-188.ec2.internal	172.31.56.188
i-0ed19f5b0eae2074	ec2-52-87-234-88.compute-1.amazonaws.com	52.87.234.88	ip-172-31-56-178.ec2.internal	172.31.56.178
i-0f2107e9edcef1ed5	ec2-52-91-87-18.compute-1.amazonaws.com	52.91.87.18	ip-172-31-56-189.ec2.internal	172.31.56.189

Instance: **i-0c7d7c10f60e38f3a** Public DNS: **ec2-54-83-143-186.compute-1.amazonaws.com**

Description Status Checks Monitoring Tags

Feedback English

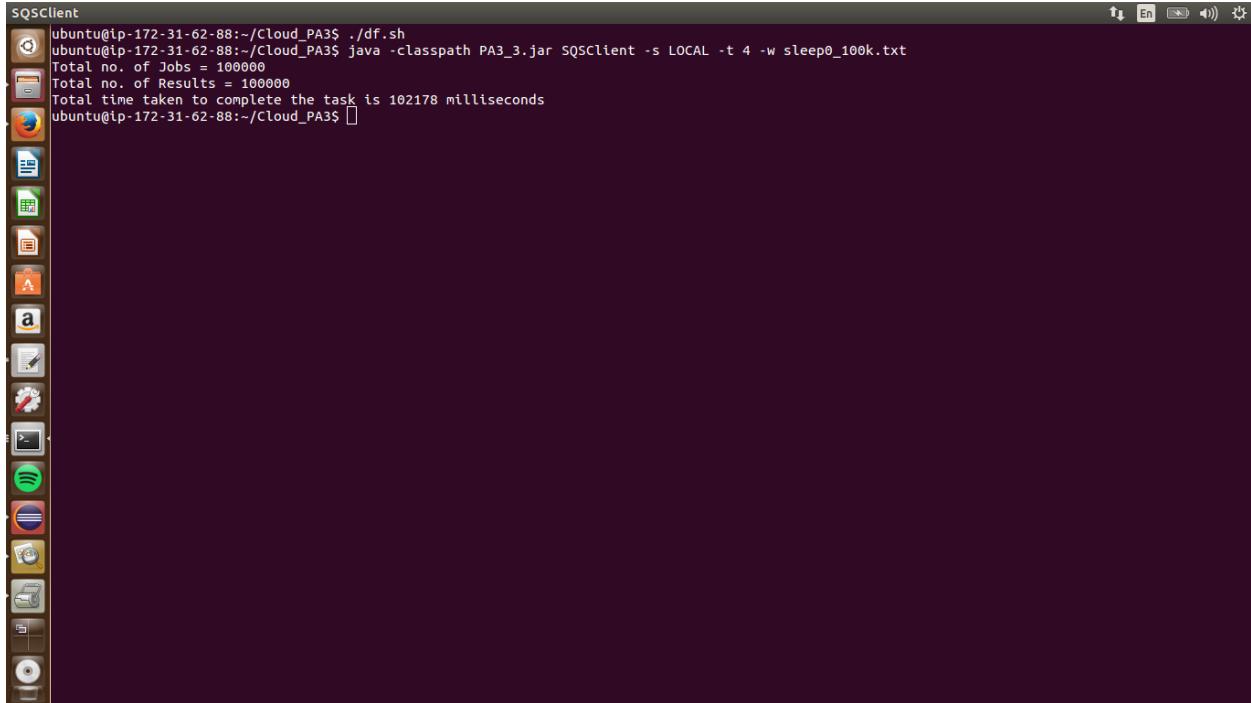
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```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 1 -w sleep0_100k.txt
Total no. of Jobs = 100000
Total no. of Results = 100000
Total time taken to complete the task is 404217 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

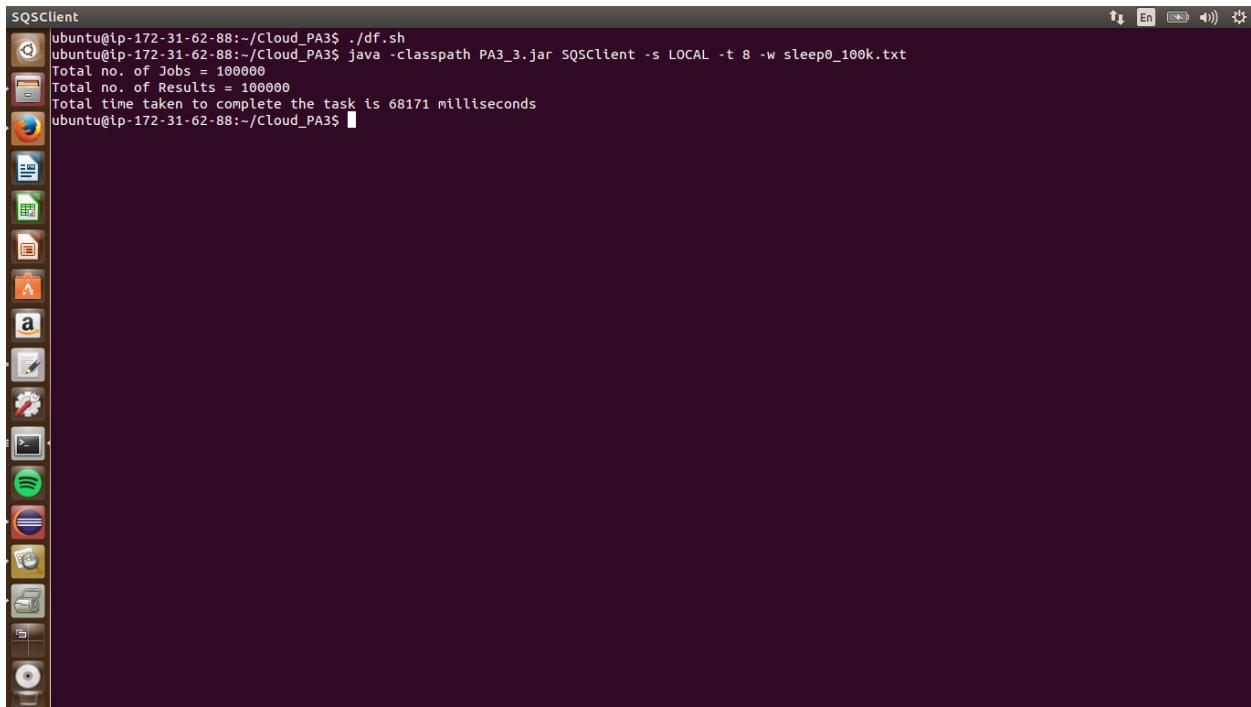
```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 2 -w sleep0_100k.txt
Total no. of Jobs = 100000
Total no. of Results = 100000
Total time taken to complete the task is 193185 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

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SQSClient

```
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 4 -w sleep0_100k.txt
Total no. of Jobs = 100000
Total no. of Results = 100000
Total time taken to complete the task is 102178 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```



SQSClient

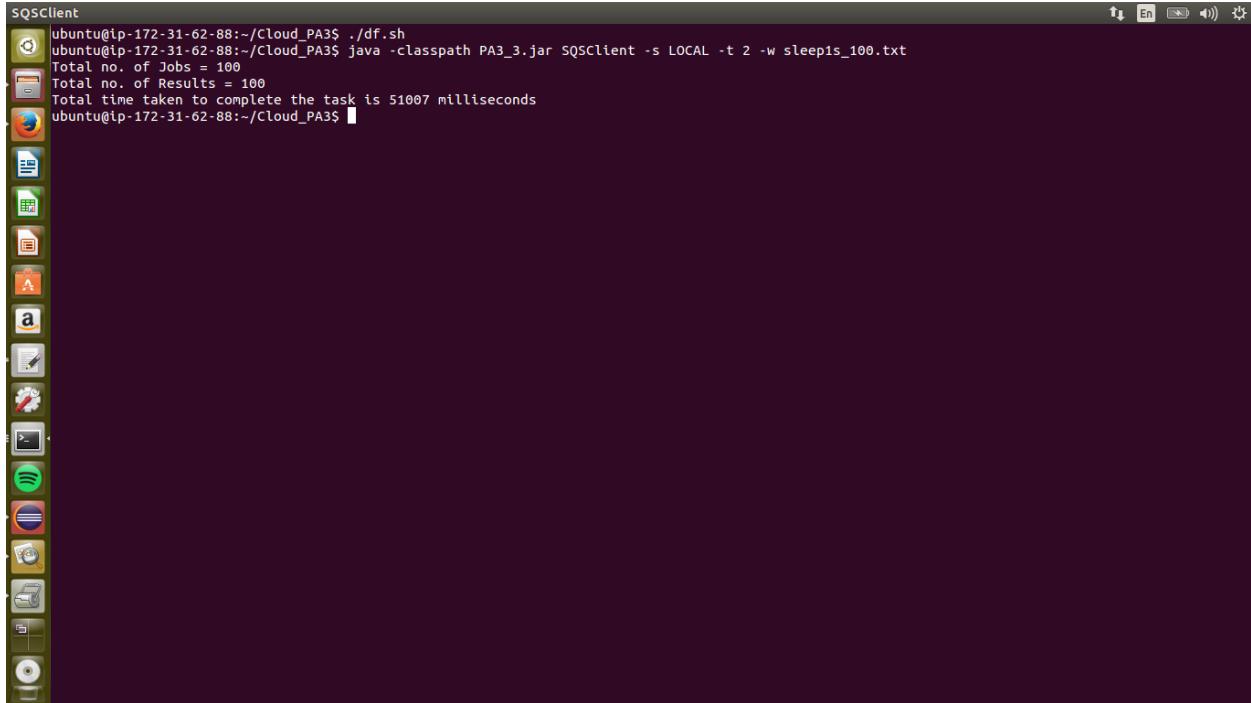
```
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 8 -w sleep0_100k.txt
Total no. of Jobs = 100000
Total no. of Results = 100000
Total time taken to complete the task is 68171 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

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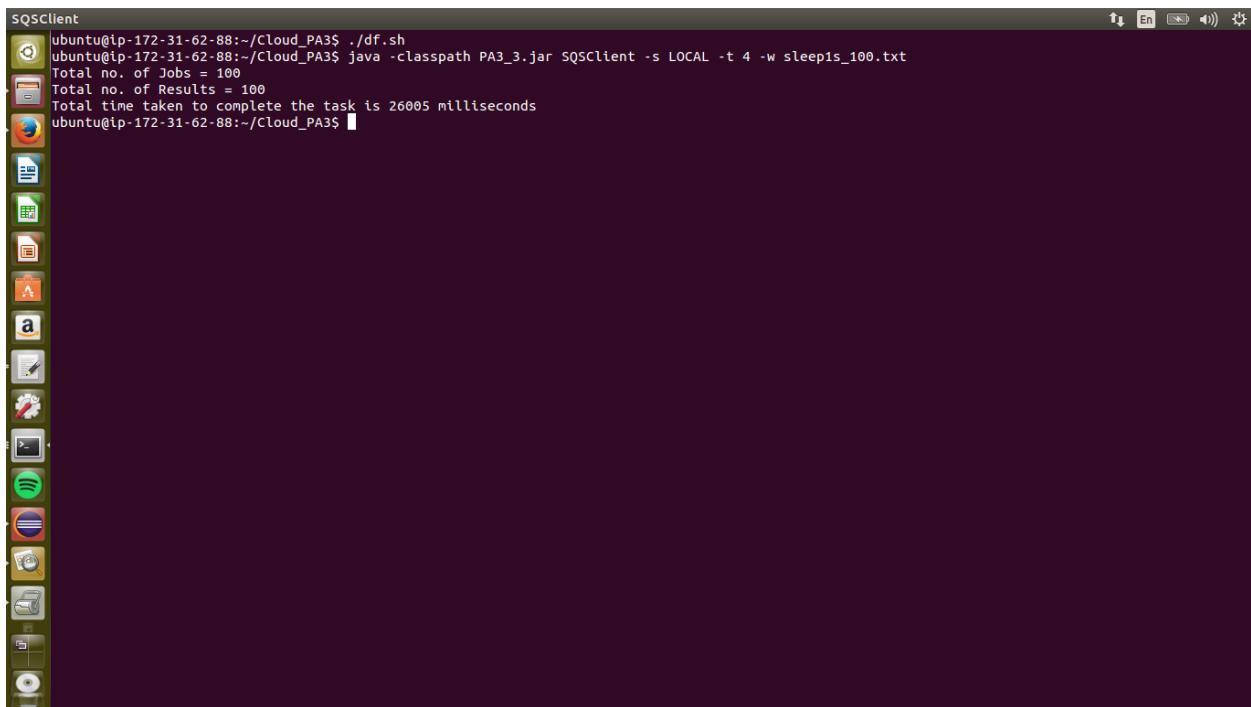
```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 16 -w sleep0_100k.txt
Total no. of Jobs = 100000
Total no. of Results = 100000
Total time taken to complete the task is 67169 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 1 -w sleep1s_100.txt
Total no. of Jobs = 100
Total no. of Results = 100
Total time taken to complete the task is 101017 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

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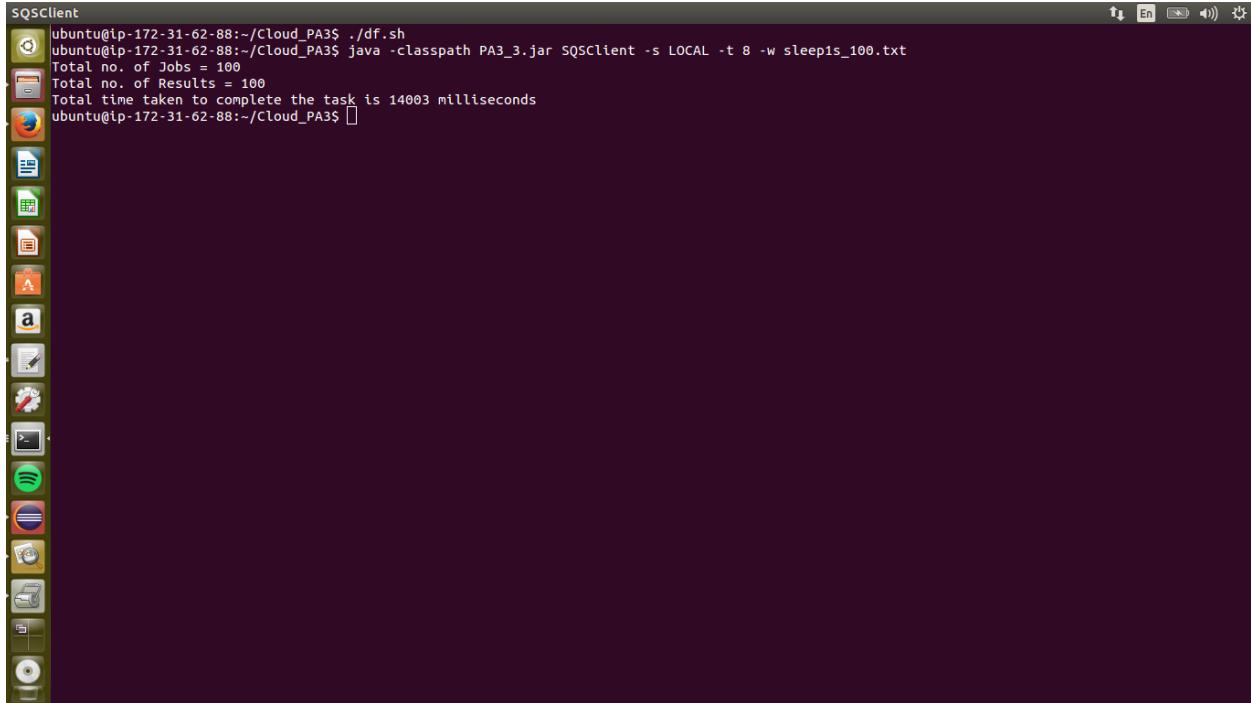


```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 2 -w sleep1s_100.txt
Total no. of Jobs = 100
Total no. of Results = 100
Total time taken to complete the task is 51007 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

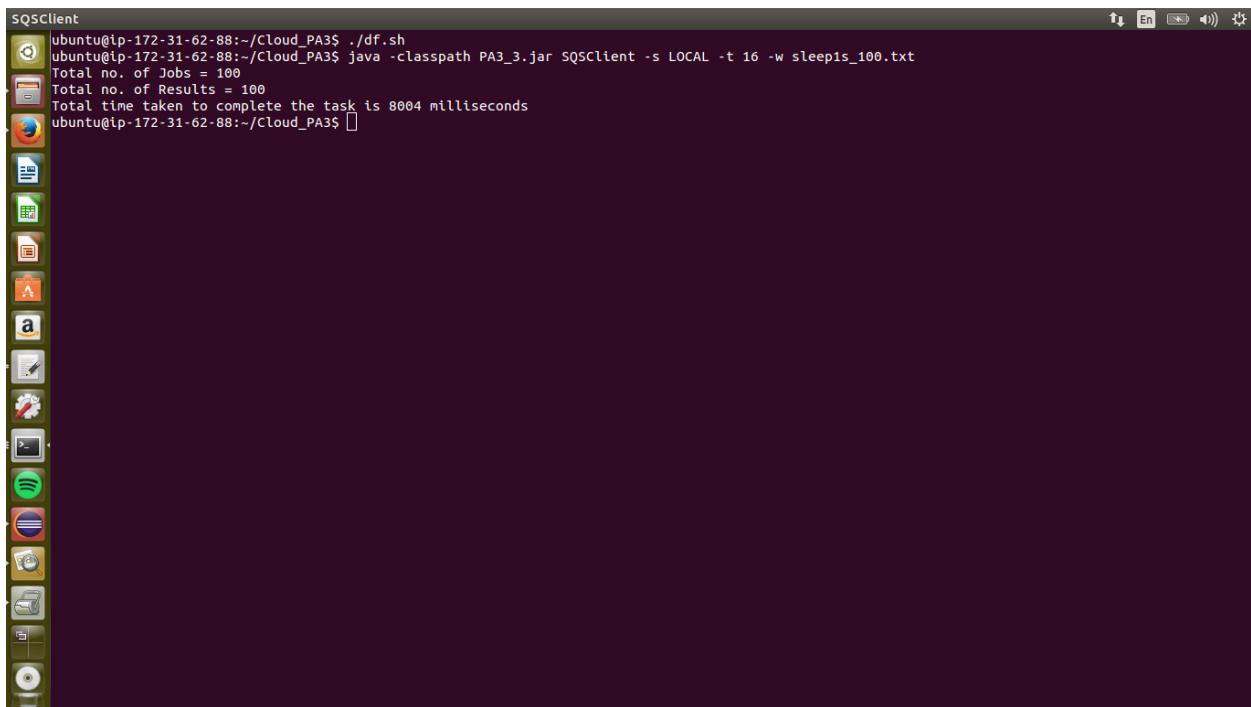


```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 4 -w sleep1s_100.txt
Total no. of Jobs = 100
Total no. of Results = 100
Total time taken to complete the task is 26005 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

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```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 8 -w sleepis_100.txt
Total no. of Jobs = 100
Total no. of Results = 100
Total time taken to complete the task is 14003 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```



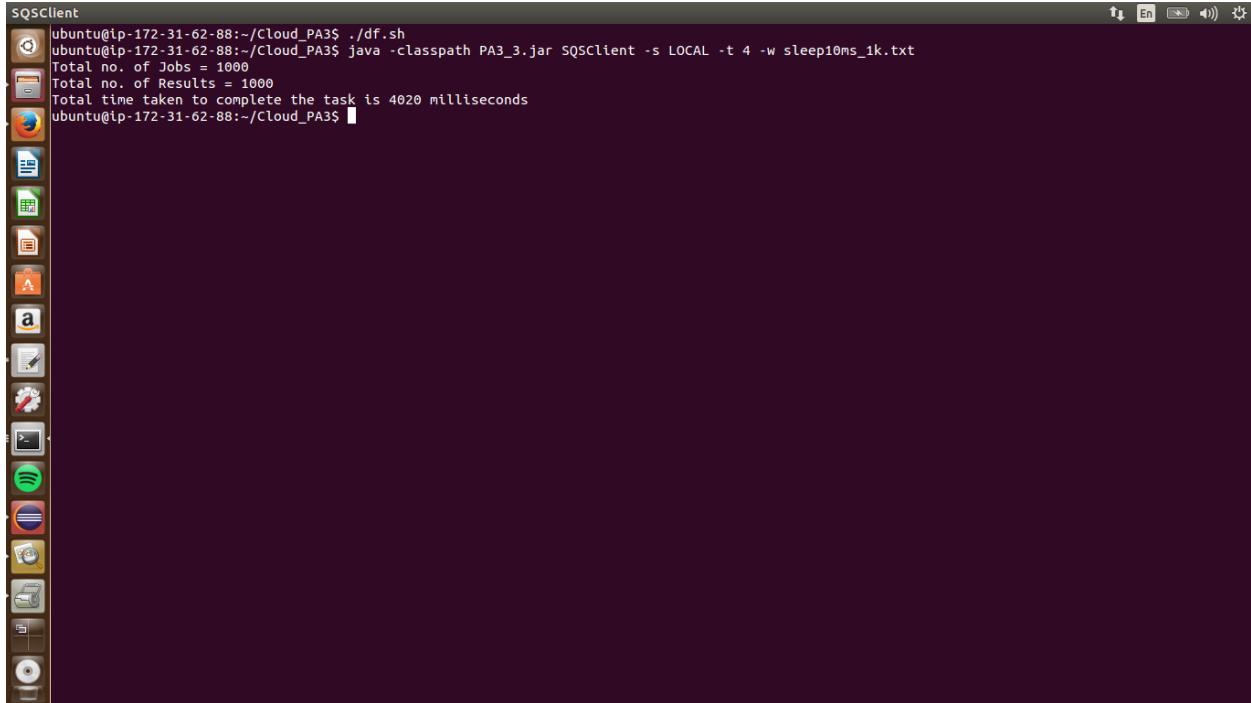
```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 16 -w sleepis_100.txt
Total no. of Jobs = 100
Total no. of Results = 100
Total time taken to complete the task is 8004 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

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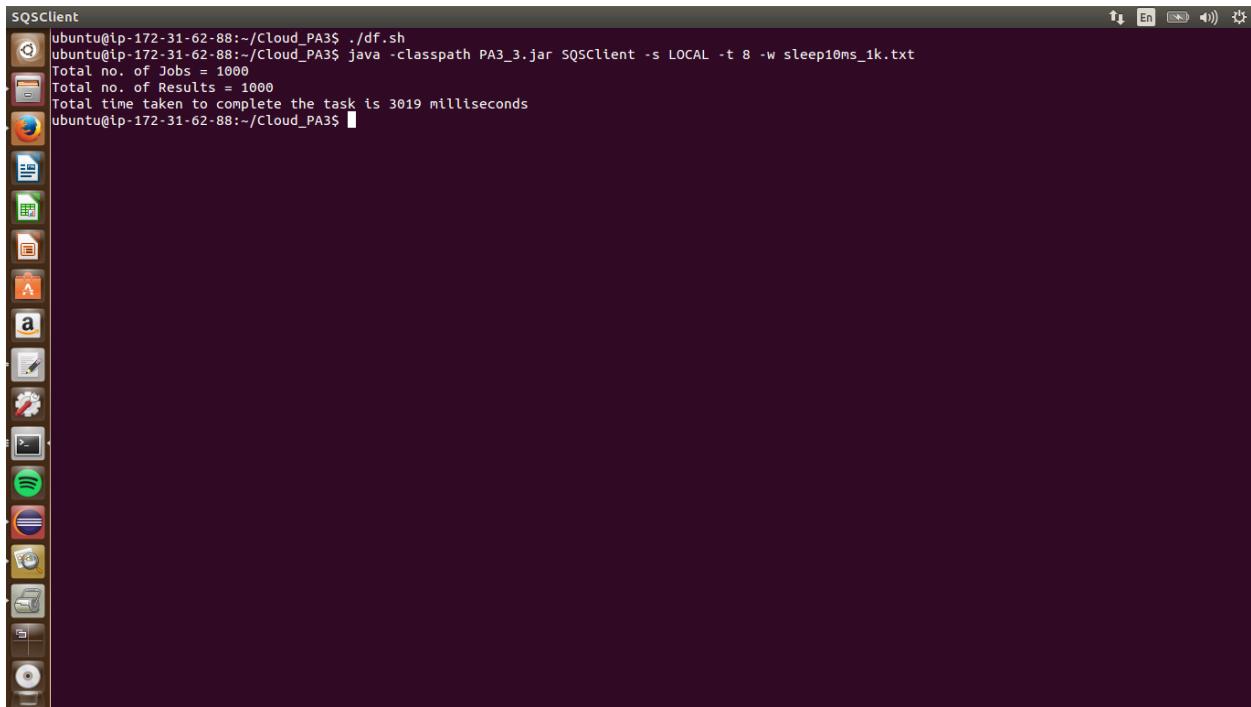
```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 1 -w sleep10ms_1k.txt
Total no. of Jobs = 1000
Total no. of Results = 1000
Total time taken to complete the task is 16020 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 2 -w sleep10ms_1k.txt
Total no. of Jobs = 1000
Total no. of Results = 1000
Total time taken to complete the task is 8024 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

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SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3\$./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3\$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 4 -w sleep10ms_1k.txt
Total no. of Jobs = 1000
Total no. of Results = 1000
Total time taken to complete the task is 4020 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3\$



SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3\$./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3\$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 8 -w sleep10ms_1k.txt
Total no. of Jobs = 1000
Total no. of Results = 1000
Total time taken to complete the task is 3019 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3\$

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```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 16 -w sleep10ms_1k.txt
Total no. of Jobs = 1000
Total no. of Results = 1000
Total time taken to complete the task is 1018 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

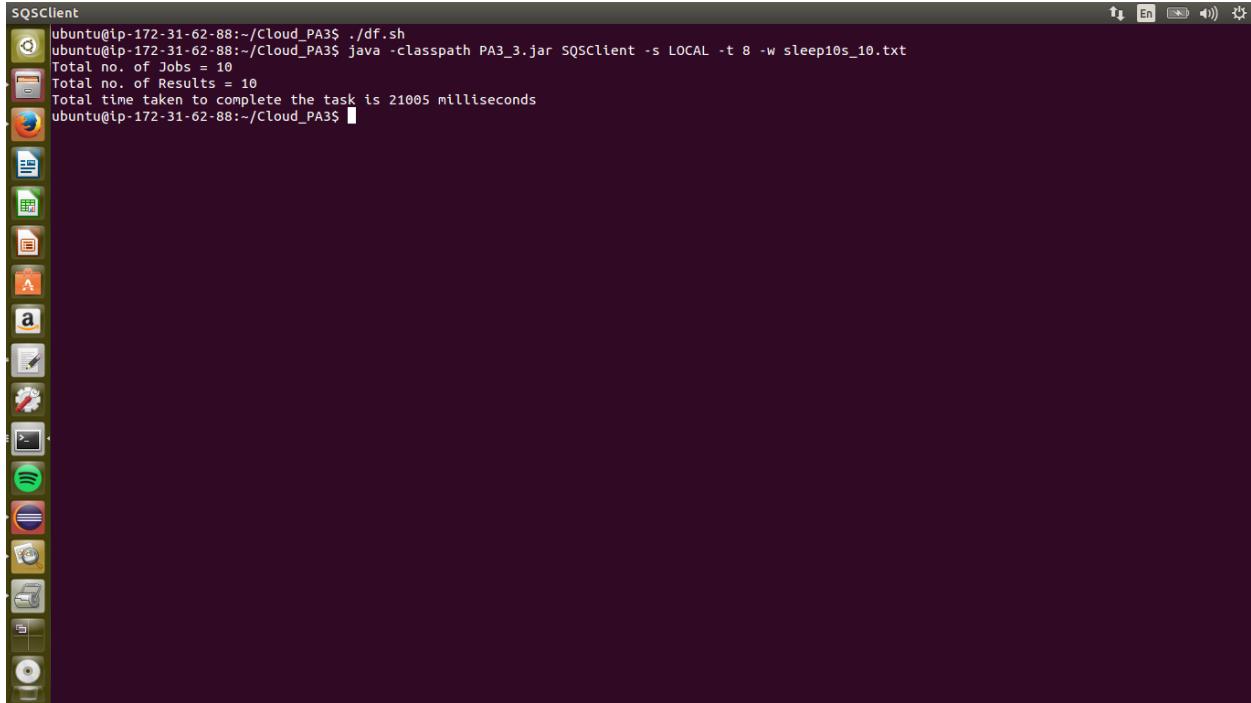
```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 1 -w sleep10s_10.txt
Total no. of Jobs = 10
Total no. of Results = 10
Total time taken to complete the task is 101042 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation

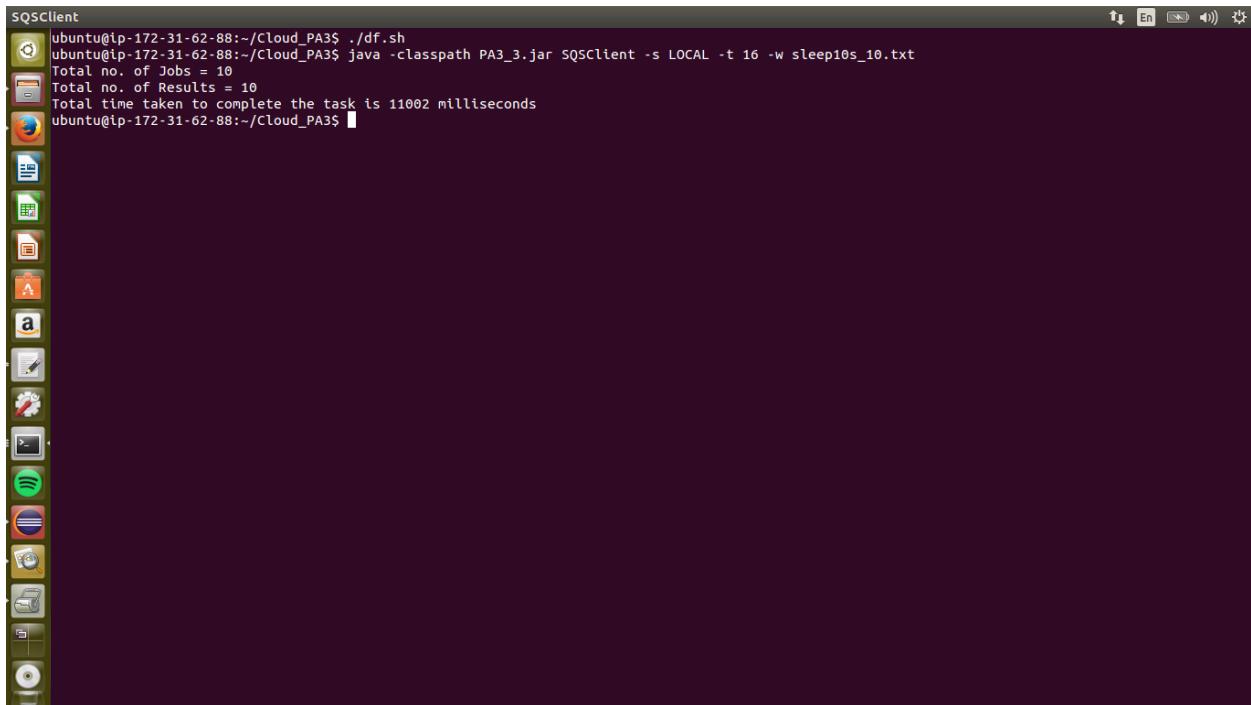
```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 2 -w sleep10s_10.txt
Total no. of Jobs = 10
Total no. of Results = 10
Total time taken to complete the task is 51016 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 4 -w sleep10s_10.txt
Total no. of Jobs = 10
Total no. of Results = 10
Total time taken to complete the task is 31005 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation

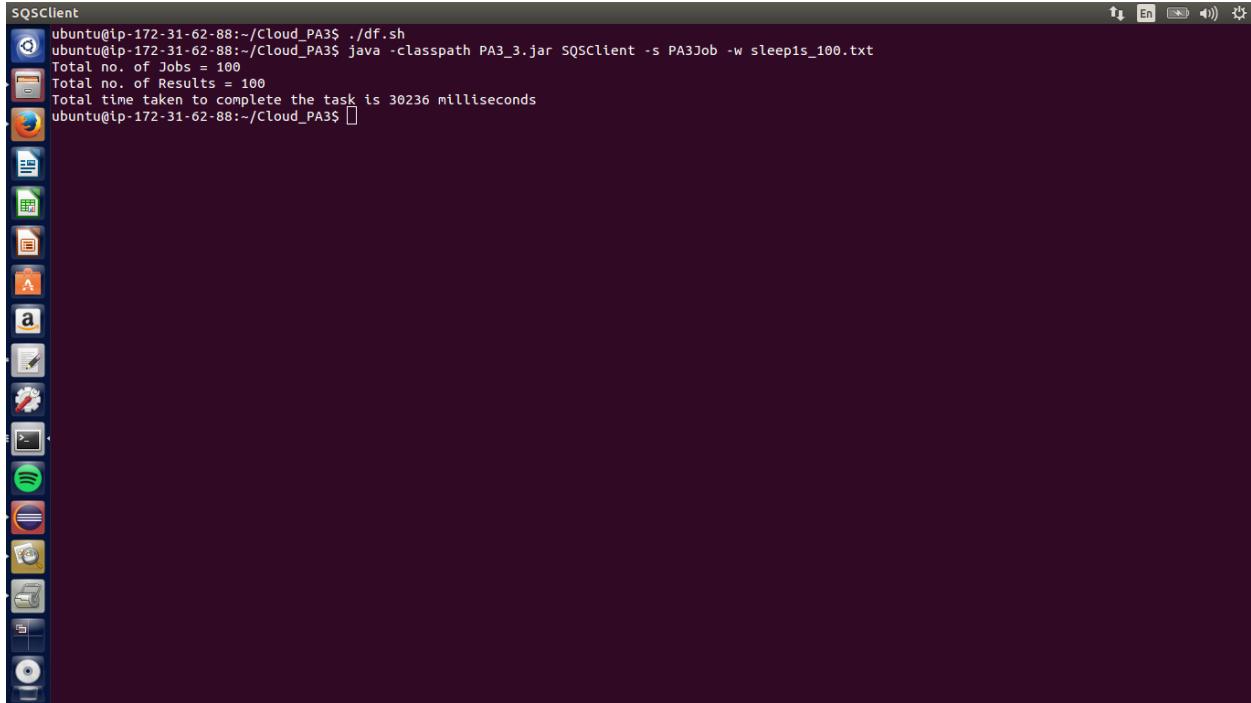


```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 8 -w sleep10s_10.txt
Total no. of Jobs = 10
Total no. of Results = 10
Total time taken to complete the task is 21005 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```



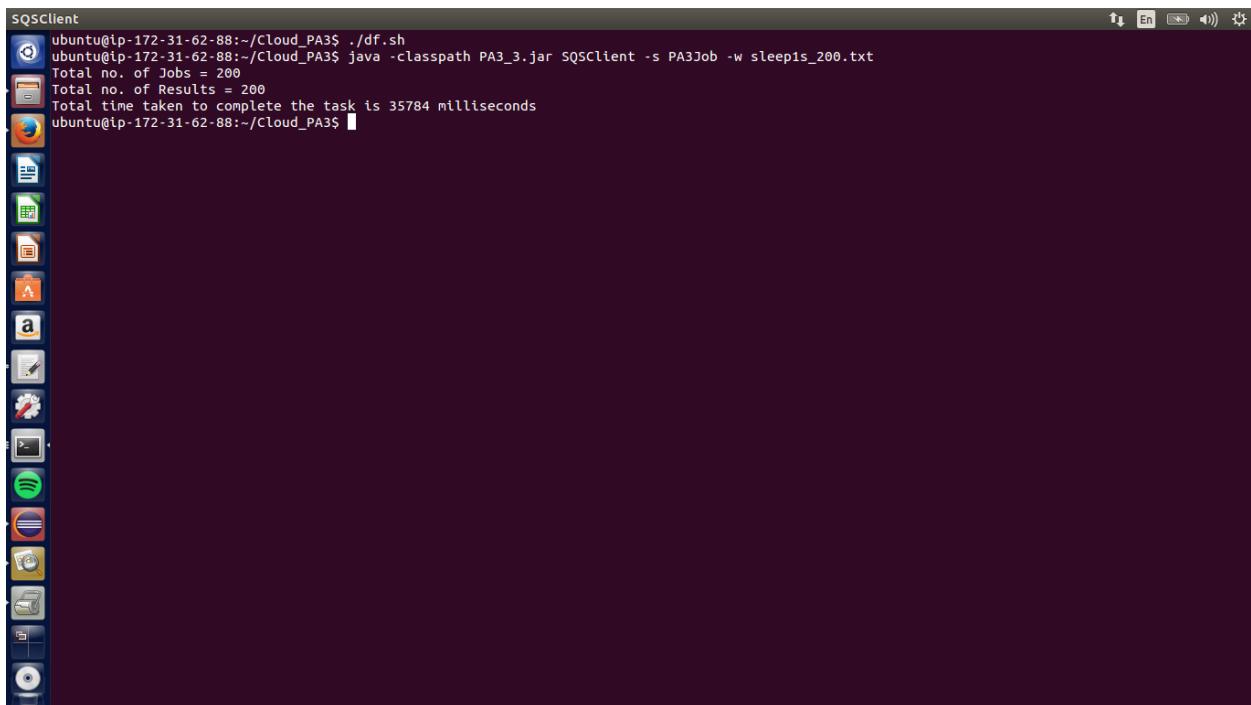
```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s LOCAL -t 16 -w sleep10s_10.txt
Total no. of Jobs = 10
Total no. of Results = 10
Total time taken to complete the task is 11002 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation



SQSClient

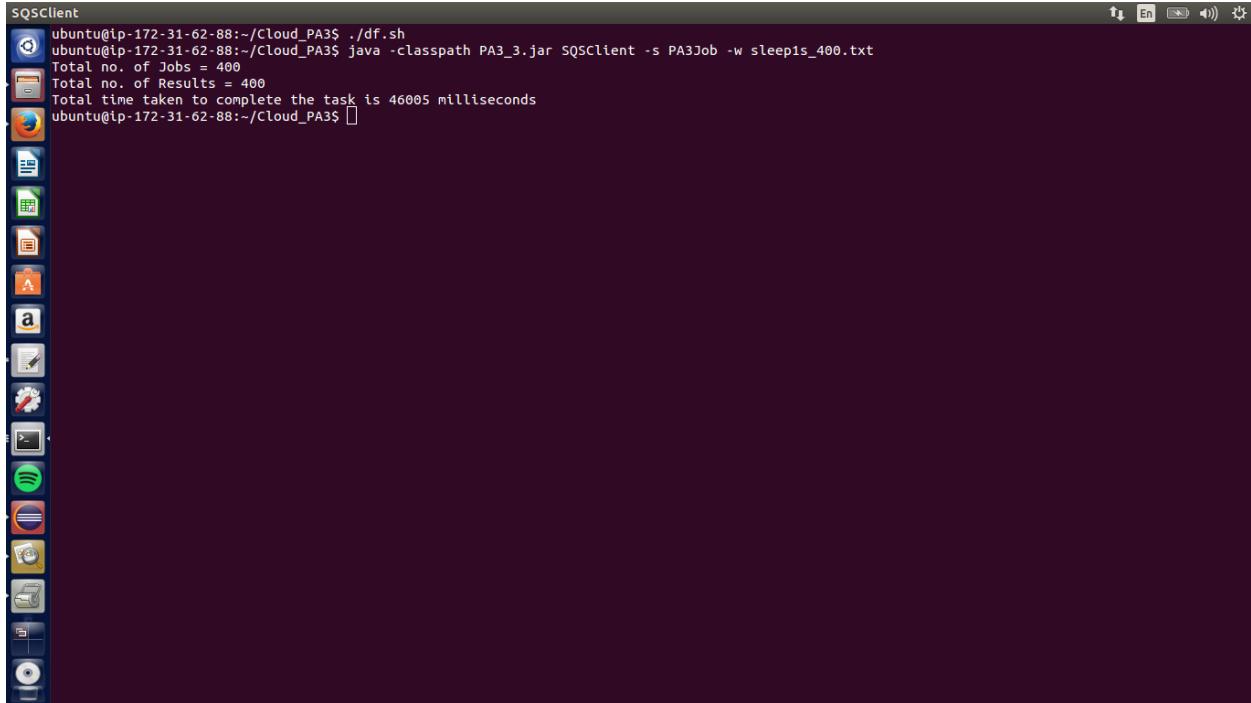
```
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleepis_100.txt
Total no. of Jobs = 100
Total no. of Results = 100
Total time taken to complete the task is 30236 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```



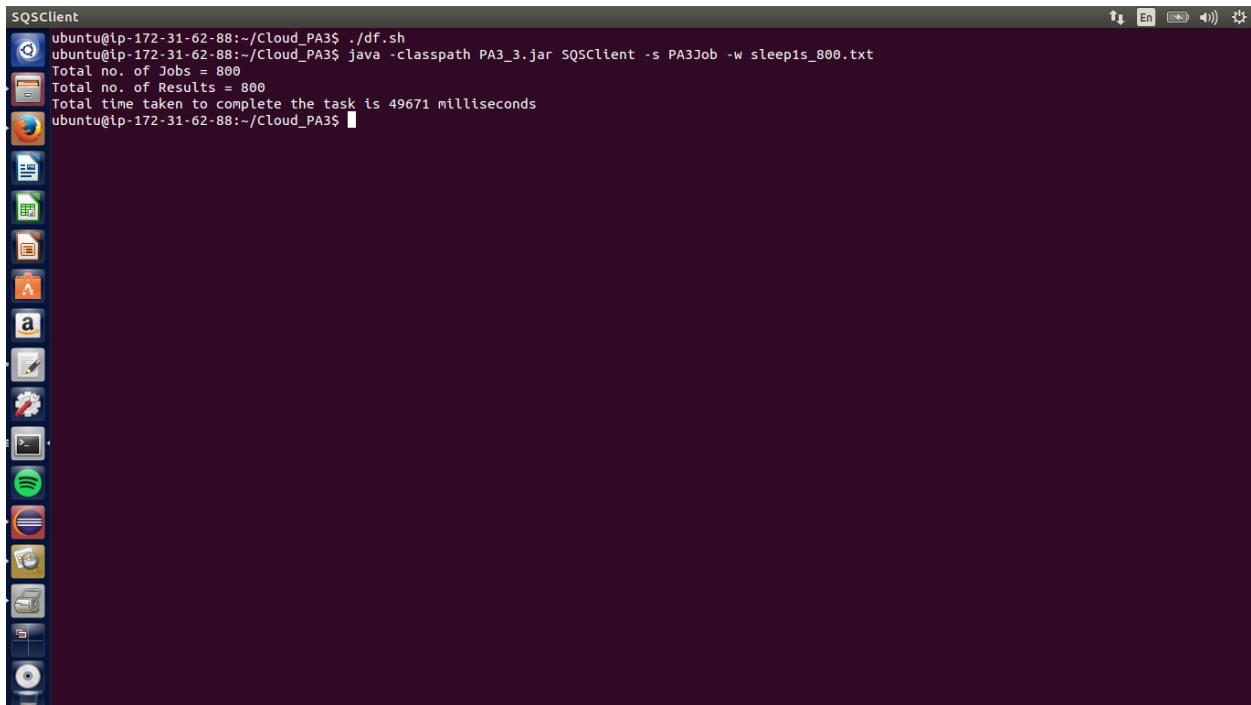
SQSClient

```
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleepis_200.txt
Total no. of Jobs = 200
Total no. of Results = 200
Total time taken to complete the task is 35784 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation

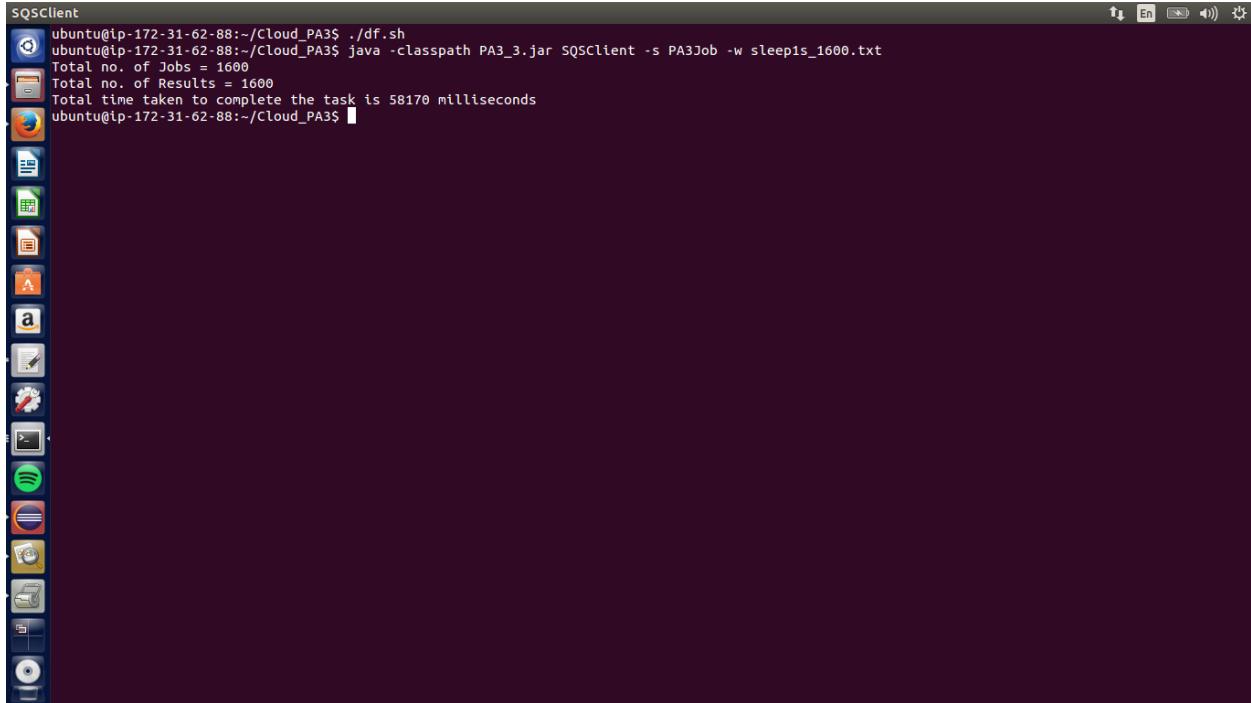


```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleepis_400.txt
Total no. of Jobs = 400
Total no. of Results = 400
Total time taken to complete the task is 46005 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

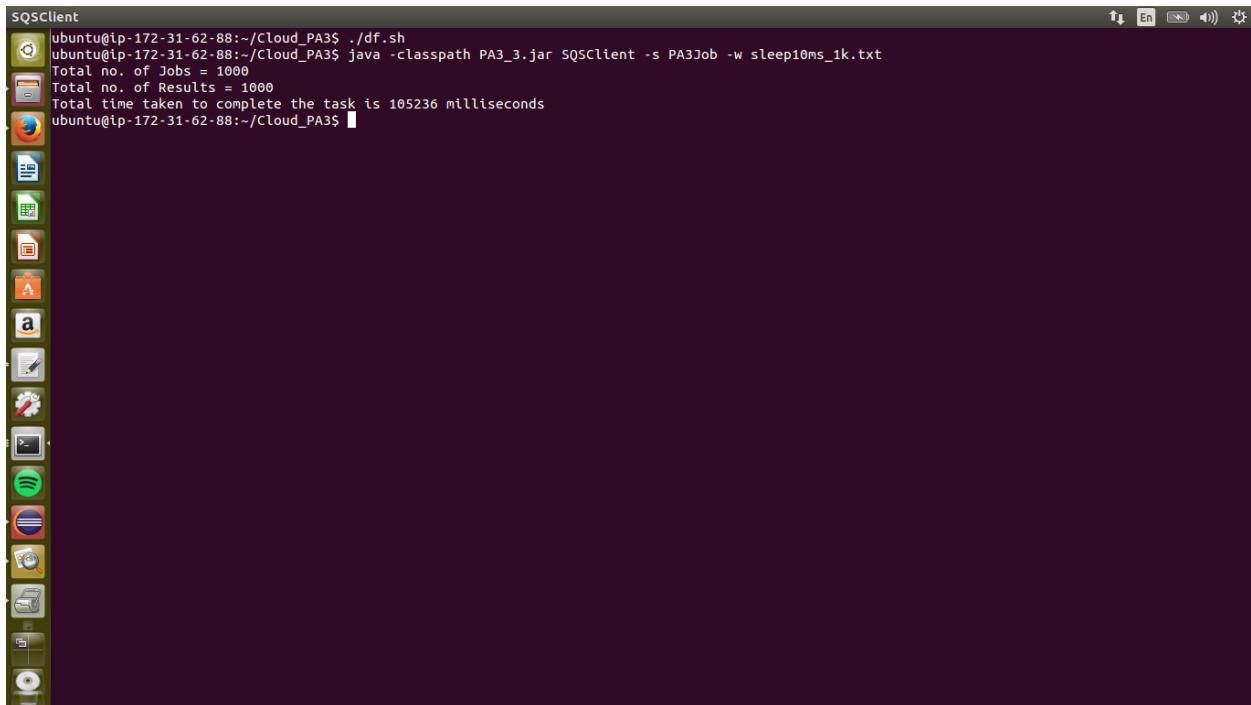


```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleepis_800.txt
Total no. of Jobs = 800
Total no. of Results = 800
Total time taken to complete the task is 49671 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation

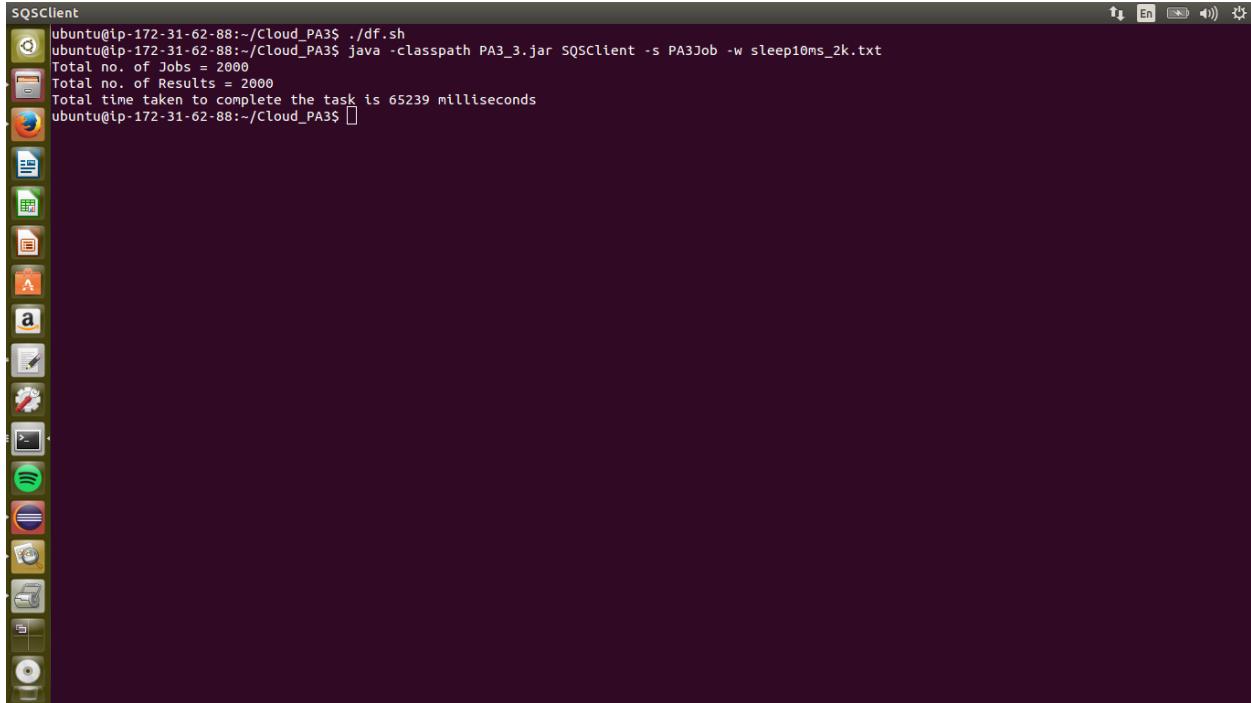


```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleepis_1600.txt
Total no. of Jobs = 1600
Total no. of Results = 1600
Total time taken to complete the task is 58170 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

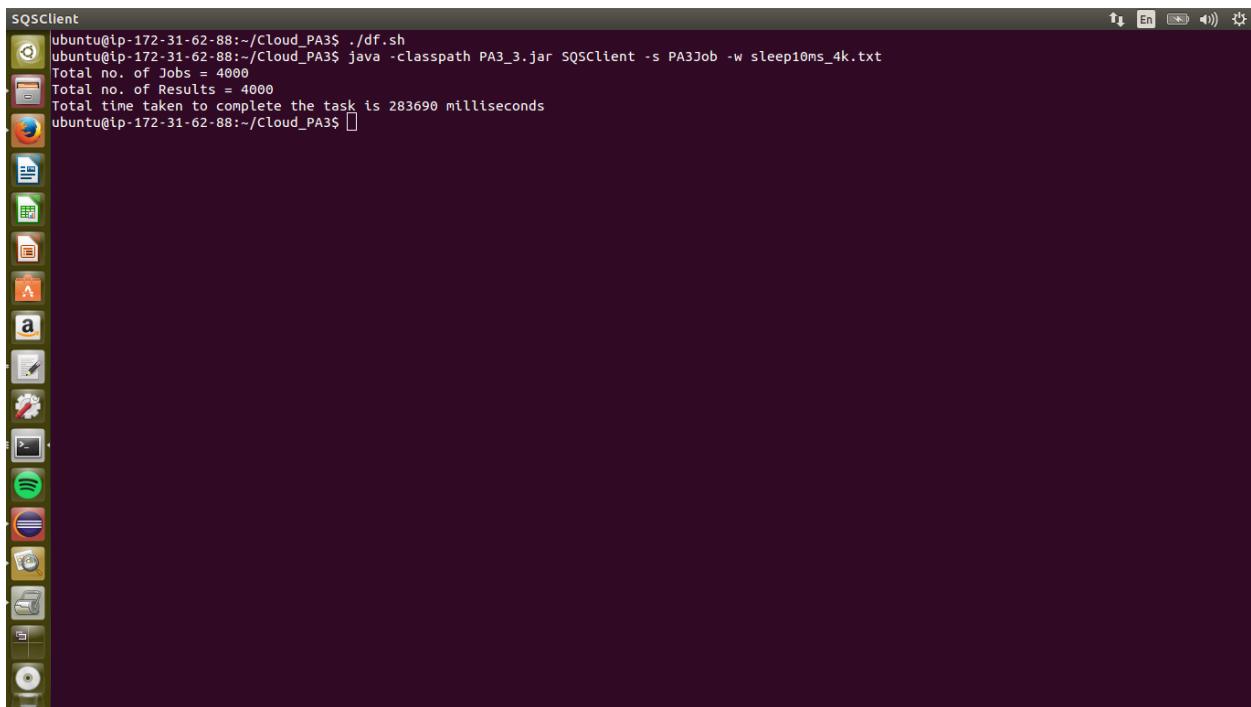


```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10ms_1k.txt
Total no. of Jobs = 1000
Total no. of Results = 1000
Total time taken to complete the task is 105236 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation



```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10ms_2k.txt
Total no. of Jobs = 2000
Total no. of Results = 2000
Total time taken to complete the task is 65239 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```



```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10ms_4k.txt
Total no. of Jobs = 4000
Total no. of Results = 4000
Total time taken to complete the task is 283690 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation

```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10ms_8k.txt
Total no. of Jobs = 8000
Total no. of Results = 8000
Total time taken to complete the task is 640569 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

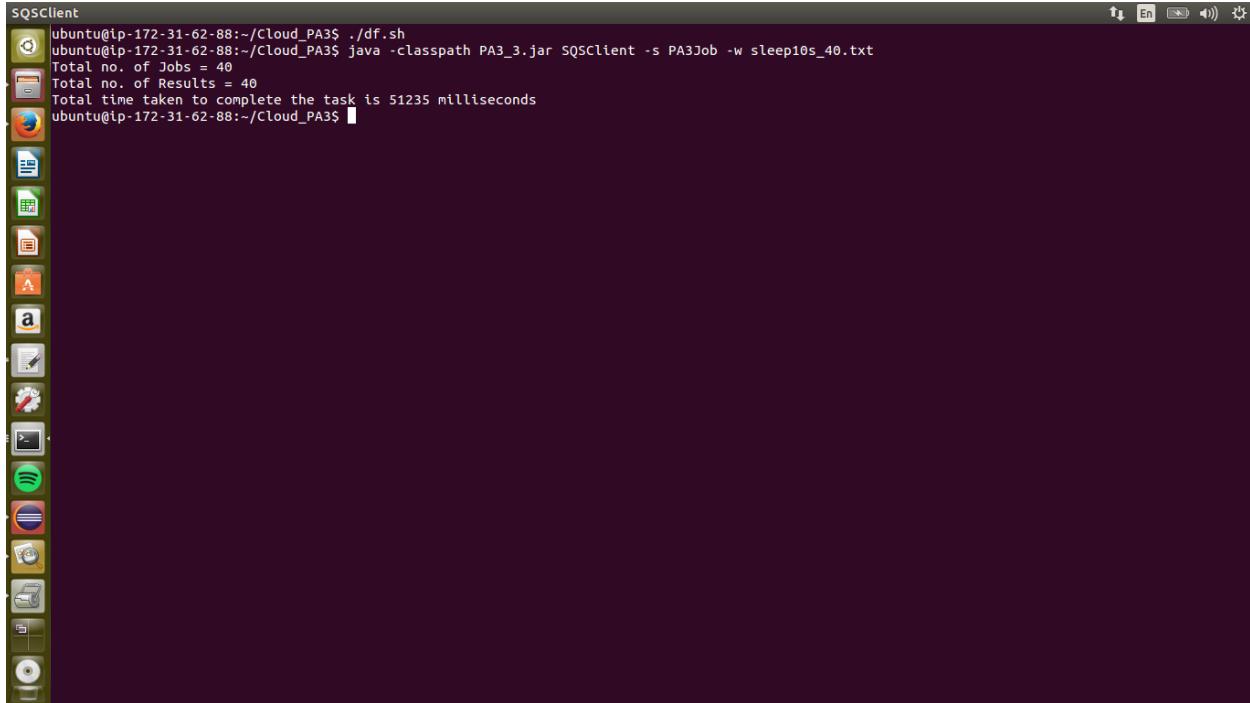
```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10ms_16k.txt
Total no. of Jobs = 16000
Total no. of Results = 16000
Total time taken to complete the task is 1604435 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation

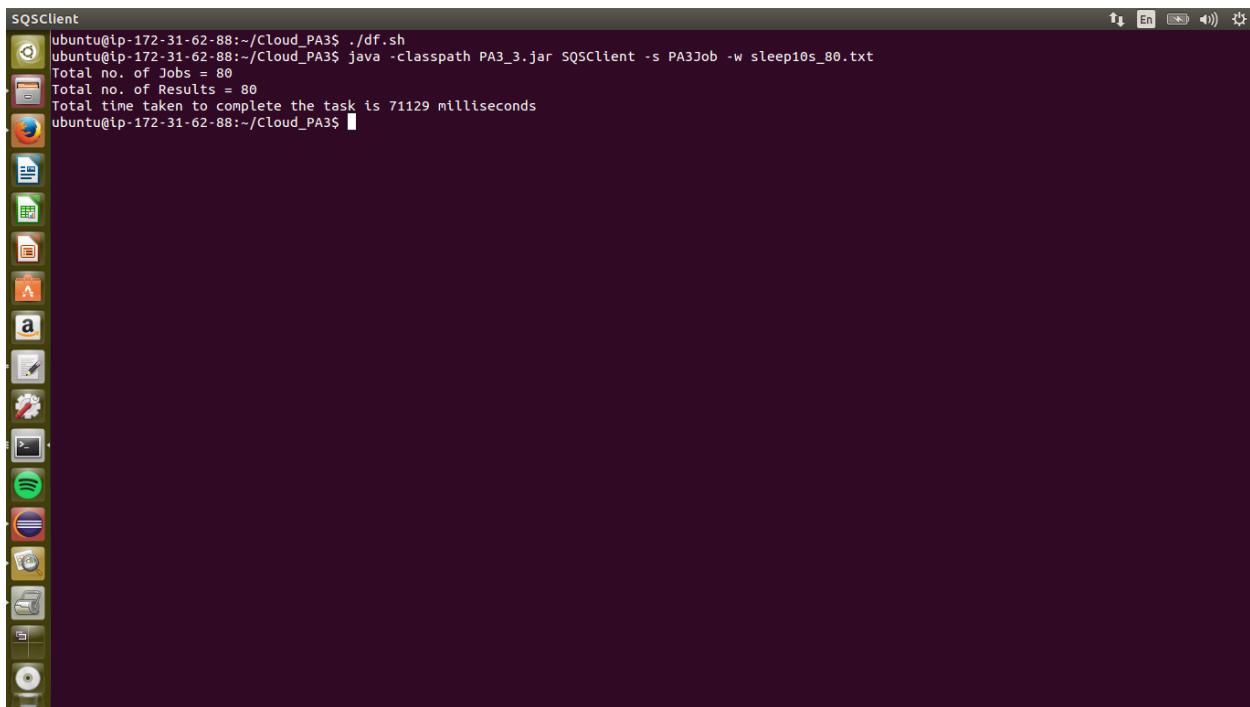
```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10s_10.txt
Total no. of Jobs = 10
Total no. of Results = 10
Total time taken to complete the task is 38296 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10s_20.txt
Total no. of Jobs = 20
Total no. of Results = 20
Total time taken to complete the task is 45257 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation

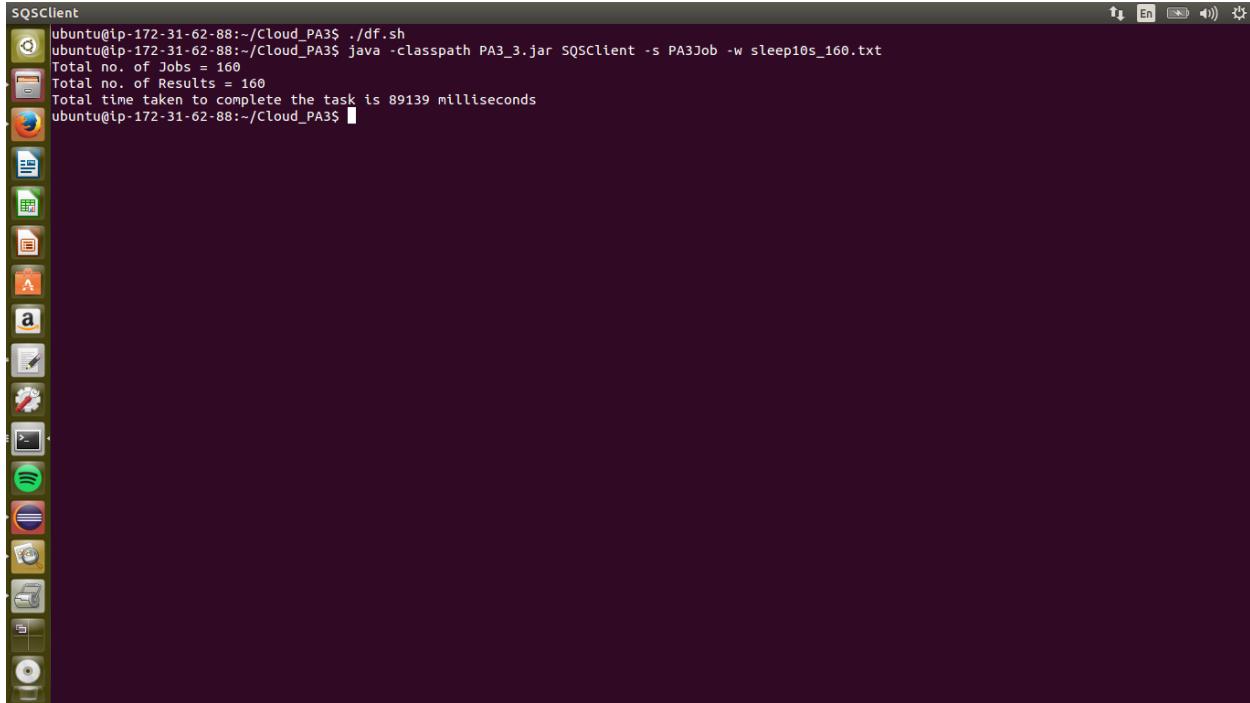


```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10s_40.txt
Total no. of Jobs = 40
Total no. of Results = 40
Total time taken to complete the task is 51235 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

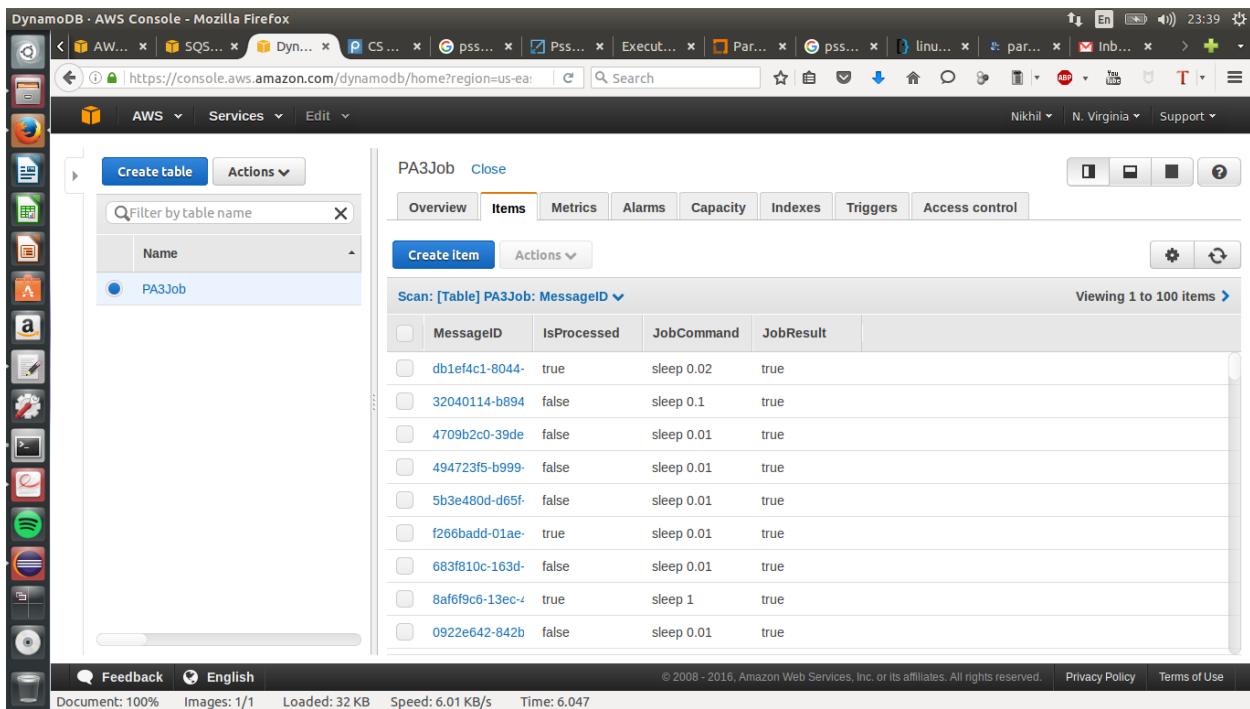


```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10s_80.txt
Total no. of Jobs = 80
Total no. of Results = 80
Total time taken to complete the task is 71129 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```

CloudKon Design Document & Performance Evaluation



```
SQSClient
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ ./df.sh
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ java -classpath PA3_3.jar SQSClient -s PA3Job -w sleep10s_160.txt
Total no. of Jobs = 160
Total no. of Results = 160
Total time taken to complete the task is 89139 milliseconds
ubuntu@ip-172-31-62-88:~/Cloud_PA3$
```



DynamoDB - AWS Console - Mozilla Firefox

PA3Job Close

MessageID	IsProcessed	JobCommand	JobResult
db1ef4c1-8044-	true	sleep 0.02	true
32040114-b894	false	sleep 0.1	true
4709b2c0-39de	false	sleep 0.01	true
494723f5-b999-	false	sleep 0.01	true
5b3e480d-d65f-	false	sleep 0.01	true
f266badd-01ae-	true	sleep 0.01	true
683f810c-163d-	false	sleep 0.01	true
8af6f9c6-13ec-4	true	sleep 1	true
0922e642-842b	false	sleep 0.01	true

CloudKon Design Document & Performance Evaluation

SQS Management Console - Mozilla Firefox

https://console.aws.amazon.com/sqs/home?region=us-east-1#queue

AWS Services Edit

Nikhil N. Virginia Support

Create New Queue Queue Actions

Filter by Prefix: Enter Text...

1 to 2 of 2 items

Name	Messages Available	Messages in Flight	Created
PA3Job	231	0	2016-04-29 13:41:36 GMT-05:00
PA3Job_Results	57	0	2016-04-29 13:41:46 GMT-05:00

1 SQS Queue selected

Details Permissions Redrive Policy Monitoring

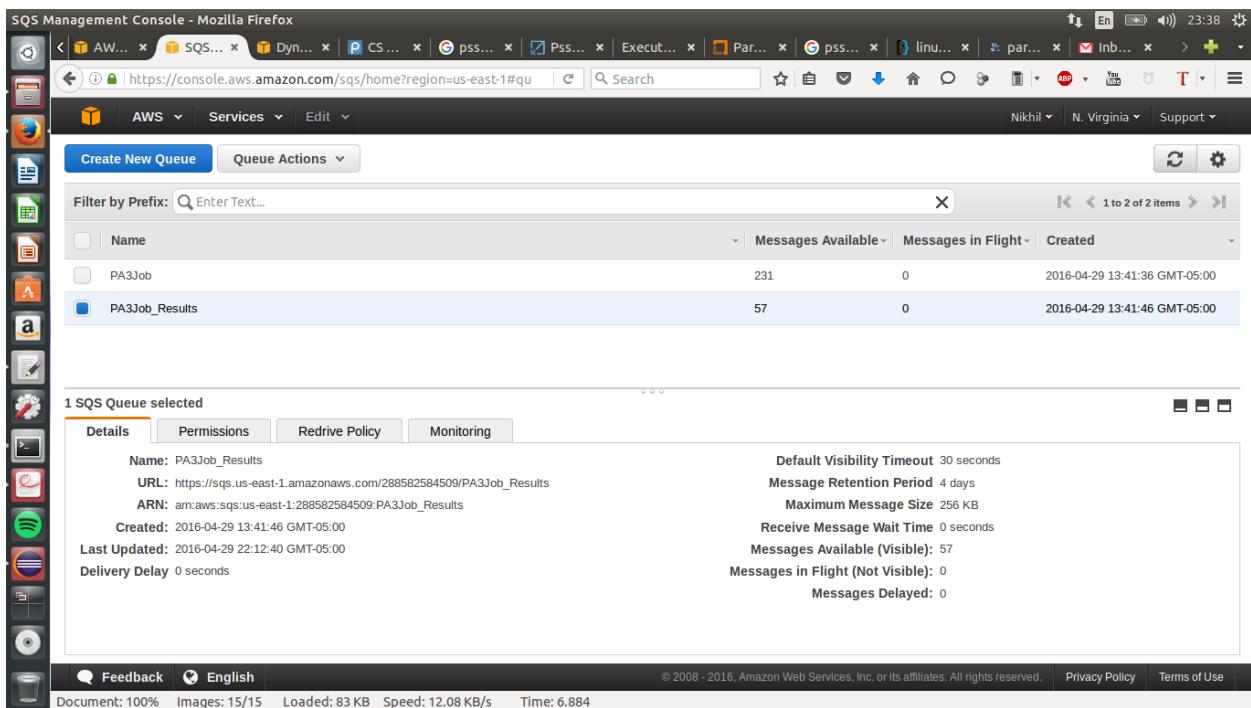
Name: PA3Job_Results
URL: https://sns.us-east-1.amazonaws.com/288582584509/PA3Job_Results
ARN: arn:aws:sns:us-east-1:288582584509:PA3Job_Results
Created: 2016-04-29 13:41:46 GMT-05:00
Last Updated: 2016-04-29 22:12:40 GMT-05:00
Delivery Delay: 0 seconds

Default Visibility Timeout: 30 seconds
Message Retention Period: 4 days
Maximum Message Size: 256 KB
Receive Message Wait Time: 0 seconds
Messages Available (Visible): 57
Messages in Flight (Not Visible): 0
Messages Delayed: 0

Feedback English

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Document: 100% Images: 15/15 Loaded: 83 KB Speed: 12.08 KB/s Time: 6.884



DynamoDB - AWS Console - Mozilla Firefox

https://console.aws.amazon.com/dynamodb/home?region=us-east-1#table

AWS Services Edit

Nikhil N. Virginia Support

DynamoDB Create table Actions

Tables

PA3Job

Overview Items Metrics Alarms Capacity Indexes Triggers Access control

Scan: [Table] PA3Job: MessageID ▾ Viewing 0 to 0 items

Scan [Table] PA3Job: MessageID + Add filter Start search

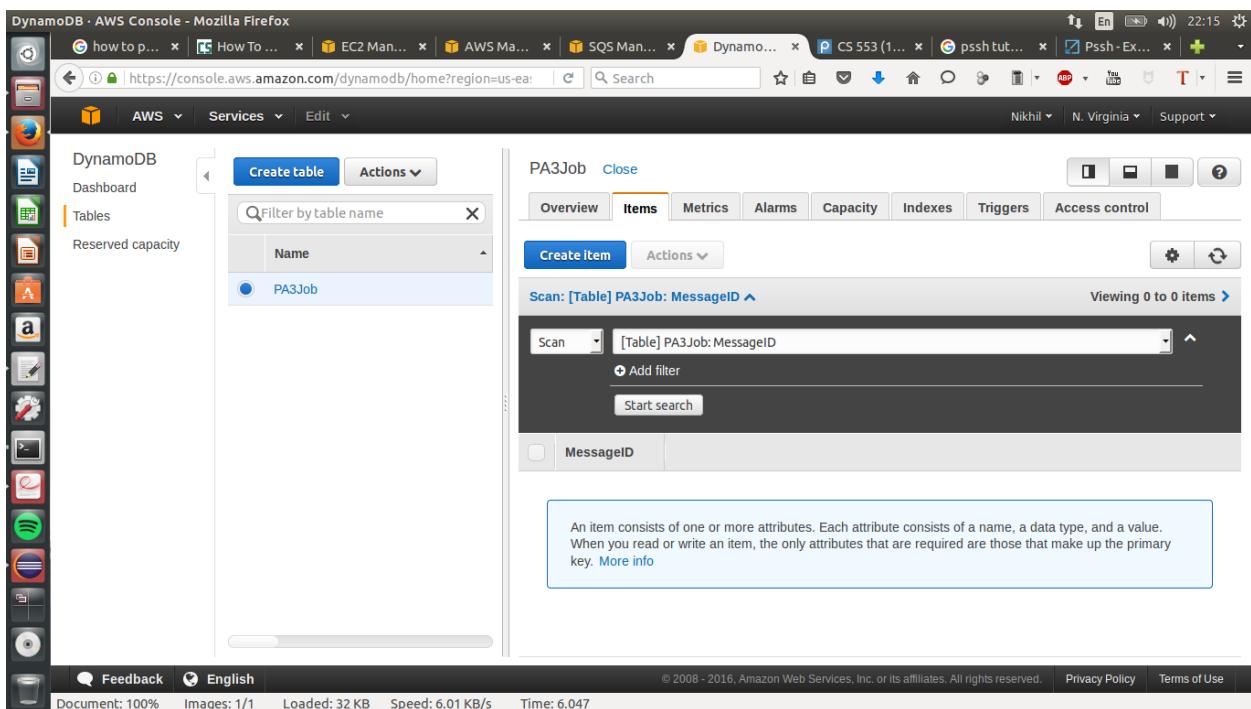
MessageID

An item consists of one or more attributes. Each attribute consists of a name, a data type, and a value. When you read or write an item, the only attributes that are required are those that make up the primary key. More info

Feedback English

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Document: 100% Images: 1/1 Loaded: 32 KB Speed: 6.01 KB/s Time: 6.047



CloudKon Design Document & Performance Evaluation

The screenshot shows the AWS SQS Management Console in Mozilla Firefox. The URL is <https://console.aws.amazon.com/sqs/home?region=us-east-1#queue>. The interface displays two SQS queues:

Name	Messages Available	Messages in Flight	Created
PA3Job	0	0	2016-04-29 13:41:36 GMT-05:00
PA3Job_Results	0	0	2016-04-29 13:41:46 GMT-05:00

Below the queue list, a detailed view of the PA3Job_Results queue is shown:

Details	Permissions	Redrive Policy	Monitoring
<p>Name: PA3Job_Results URL: https://sns.us-east-1.amazonaws.com/288582584509/PA3Job_Results ARN: arn:aws:sns:us-east-1:288582584509:PA3Job_Results Created: 2016-04-29 13:41:46 GMT-05:00 Last Updated: 2016-04-29 22:12:40 GMT-05:00 Delivery Delay: 0 seconds</p> <p>Default Visibility Timeout: 30 seconds Message Retention Period: 4 days Maximum Message Size: 256 KB Receive Message Wait Time: 0 seconds Messages Available (Visible): 0 Messages in Flight (Not Visible): 0 Messages Delayed: 0</p>			

At the bottom, there are links for Feedback, English, Privacy Policy, and Terms of Use.

The screenshot shows the AWS SQS Management Console in Mozilla Firefox. The URL is <https://console.aws.amazon.com/sqs/home?region=us-east-1#queue>. The interface displays two SQS queues:

Name	Messages Available	Messages in Flight	Created
PA3Job	7	0	2016-04-29 13:41:36 GMT-05:00
PA3Job_Results	280	0	2016-04-29 13:41:46 GMT-05:00

Below the queue list, a detailed view of the PA3Job_Results queue is shown:

Details	Permissions	Redrive Policy	Monitoring
Select a single queue to view its details.			

At the bottom, there are links for Feedback, English, Privacy Policy, and Terms of Use.

CloudKon Design Document & Performance Evaluation

The screenshot shows the AWS Management Console interface with the DynamoDB service selected. A table named 'PA3Job' is displayed, containing 100 items. The table structure includes columns for MessageID, IsProcessed, JobCommand, and JobResult. All items have IsProcessed set to true and JobResult set to true, with JobCommand all being 'sleep 0.01'. The screenshot also shows the AWS navigation bar and various service icons on the left.

MessageID	IsProcessed	JobCommand	JobResult
86d83d2c-4260	false	sleep 0.01	true
18f0d4b4-d10a-	true	sleep 0.01	true
5eb0231d-991f-	true	sleep 0.01	true
54e0d855-3bb0	false	sleep 0.01	true
9bc3e2db-85ae	true	sleep 0.01	true
6b28296b-5778	true	sleep 0.01	true
280da253-3d75	true	sleep 0.01	true
c6bcf91b-bafa-	true	sleep 0.01	true
37433d05-1b30	true	sleep 0.01	true
02d8e8a7ba-	true	sleep 0.01	true

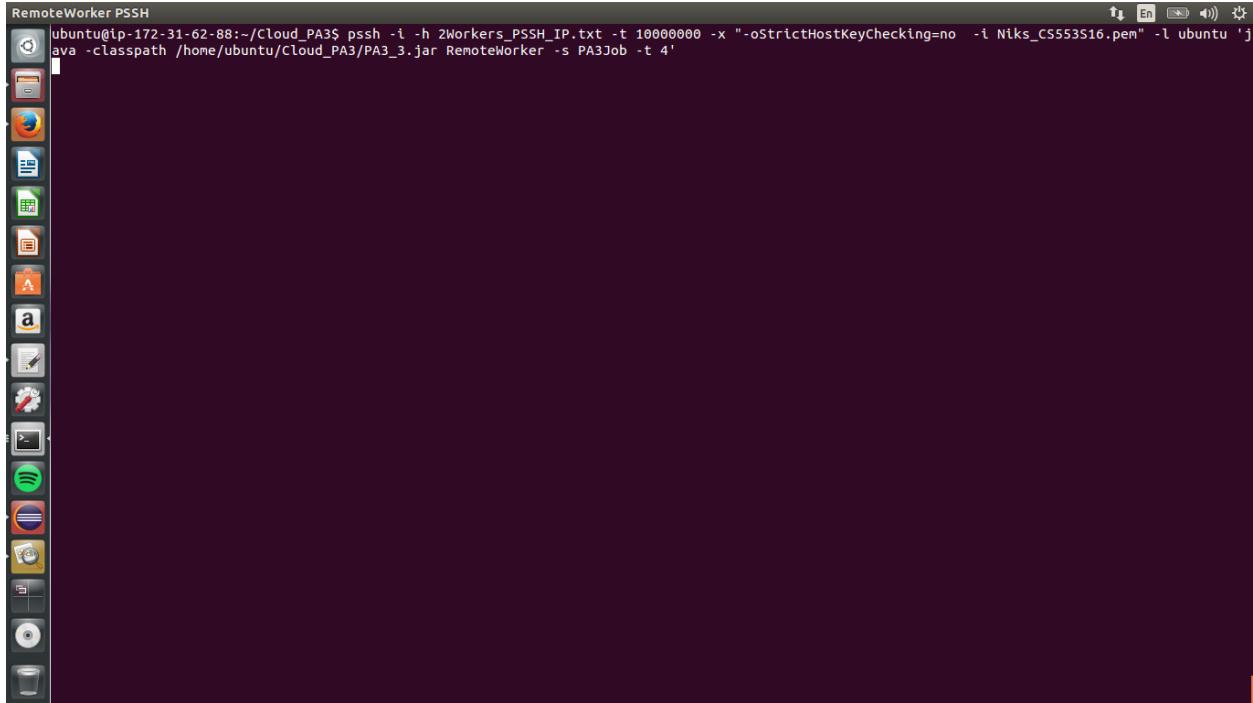
The screenshot shows a terminal window titled 'RemoteWorker PSSH'. The command entered is:

```
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ pssh -i -h 1Worker_PSSH_IP.txt -t 10000000 -x "-oStrictHostKeyChecking=no -i Niks_CS553S16.pem" -l ubuntu 'java -classpath /home/ubuntu/Cloud_PA3/PA3_3.jar RemoteWorker -s PA3Job -t 4'
```

CloudKon Design Document & Performance Evaluation

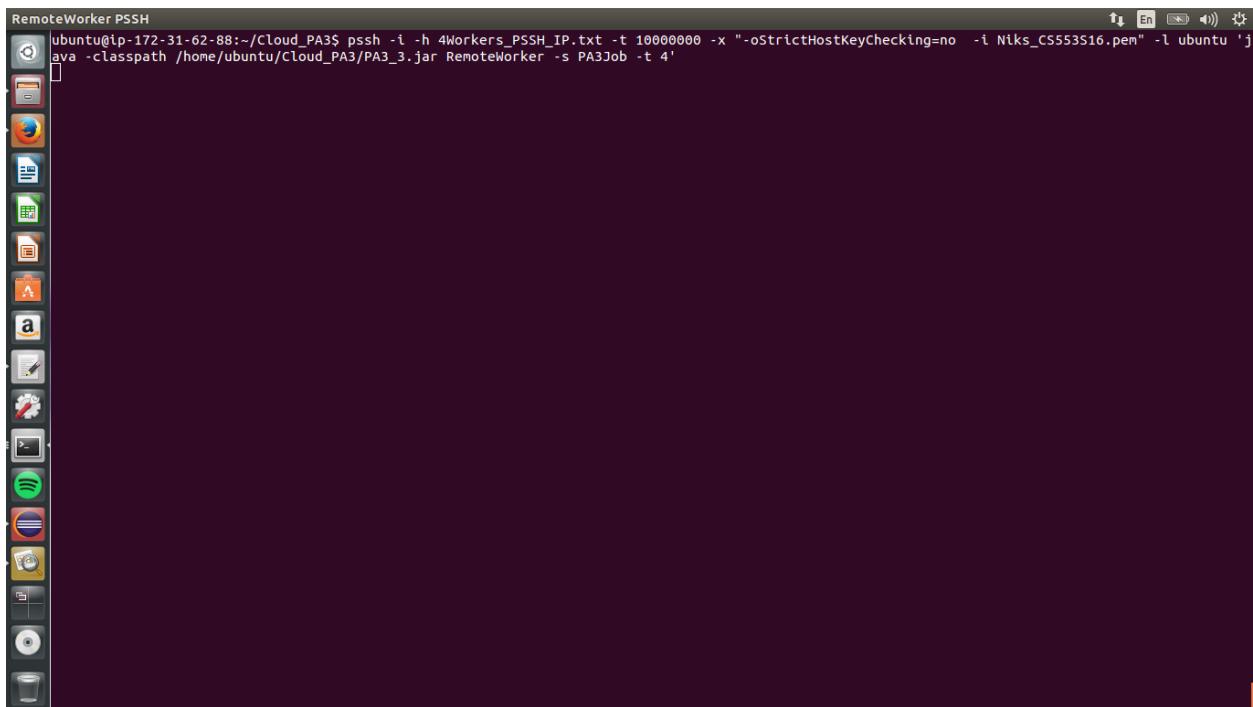
RemoteWorker PSSH

```
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ pssh -i -h 2Workers_PSSH_IP.txt -t 10000000 -x "-oStrictHostKeyChecking=no -i Ntks_CS553S16.pem" -l ubuntu 'java -classpath /home/ubuntu/Cloud_PA3/PA3_3.jar RemoteWorker -s PA3Job -t 4'
```

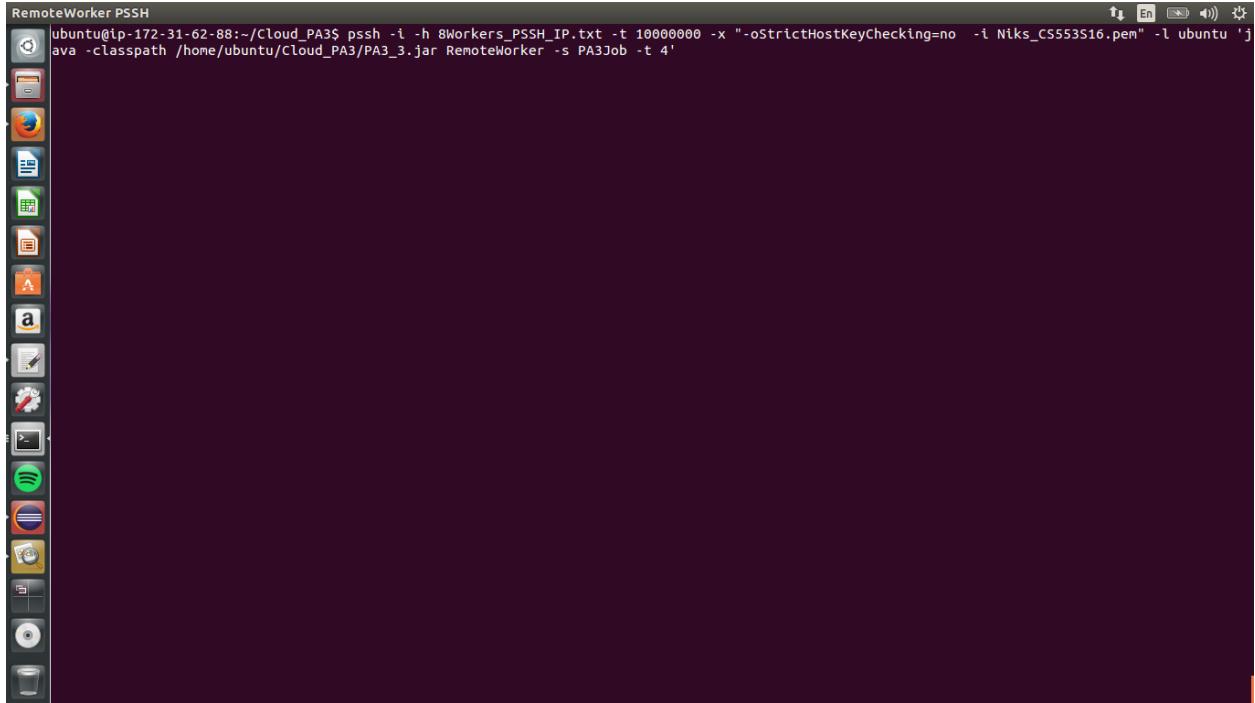


RemoteWorker PSSH

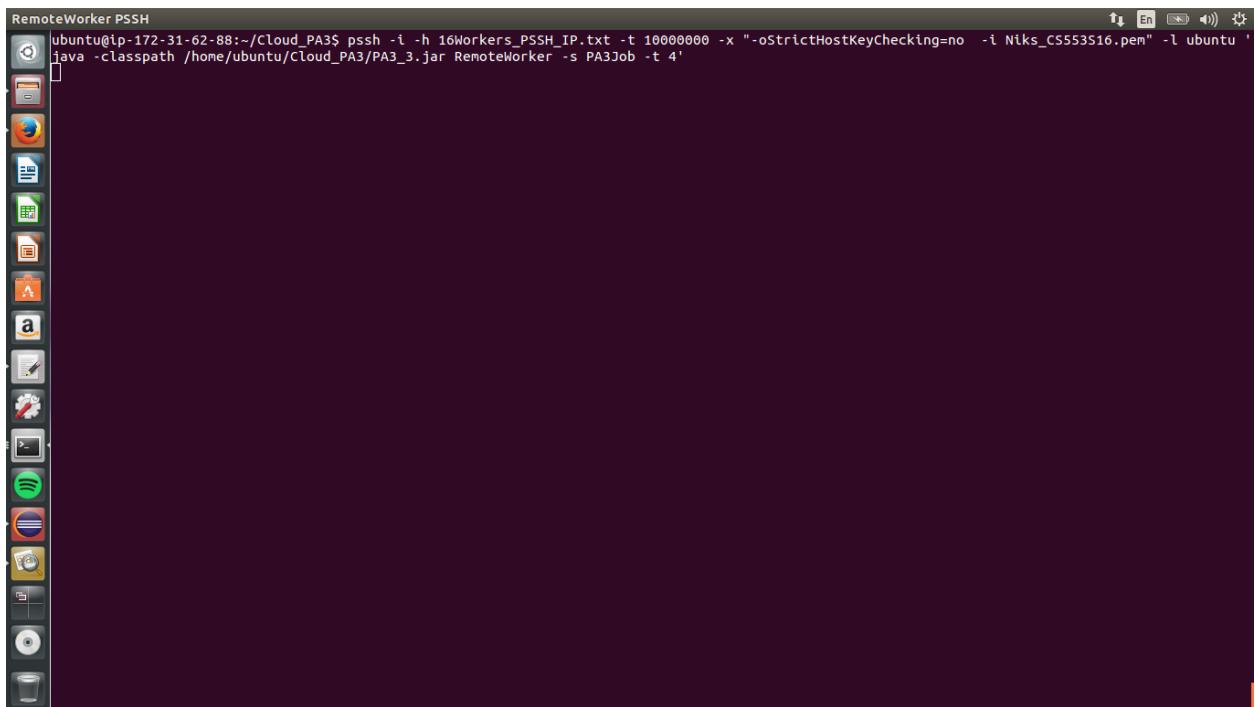
```
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ pssh -i -h 4Workers_PSSH_IP.txt -t 10000000 -x "-oStrictHostKeyChecking=no -i Ntks_CS553S16.pem" -l ubuntu 'java -classpath /home/ubuntu/Cloud_PA3/PA3_3.jar RemoteWorker -s PA3Job -t 4'
```



CloudKon Design Document & Performance Evaluation



```
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ pssh -i -h 8Workers_PSSH_IP.txt -t 10000000 -x "-oStrictHostKeyChecking=no -i Ntks_CS553S16.pem" -l ubuntu 'java -classpath /home/ubuntu/Cloud_PA3/PA3_3.jar RemoteWorker -s PA3Job -t 4'
```



```
ubuntu@ip-172-31-62-88:~/Cloud_PA3$ pssh -i -h 16Workers_PSSH_IP.txt -t 10000000 -x "-oStrictHostKeyChecking=no -i Ntks_CS553S16.pem" -l ubuntu 'java -classpath /home/ubuntu/Cloud_PA3/PA3_3.jar RemoteWorker -s PA3Job -t 4'
```

CloudKon Design Document & Performance Evaluation

The screenshot shows the AWS SQS Management Console interface. At the top, there are tabs for EC2 Management Console, SQS Management Console (which is active), and DynamoDB - AWS Console. The main content area is titled "View/Delete Messages in PA3Job_Results". It displays a table of messages with columns: Delete, Body, Size, Sent, and Receive Count. There are 10 messages listed, all of which are 38 bytes in size and were sent on April 30, 2016, at 17:32:51 GMT-05:00. The receive count for each message is 1. At the bottom of the table, it says "Stopped after polling the queue at 6.1 receives/second for 0.2 seconds. Messages shown above are now available to other consumers." Below the table are two buttons: "Close" and "Delete Messages". On the left sidebar, there are icons for various AWS services like Lambda, CloudWatch Metrics, and CloudWatch Logs. The bottom of the page includes standard links for Feedback, English, Privacy Policy, and Terms of Use, along with document statistics: Document: 100%, Images: 15/15, Loaded: 83 KB, Speed: 15.55 KB/s, Time: 5.345.

Delete	Body	Size	Sent	Receive Count	
<input type="checkbox"/>	6e31412a-6ced-444e-b99b-5a88de6e4c71 0	More Details	38 bytes	2016-04-30 17:32:51 GMT-05:00	1
<input type="checkbox"/>	d4d98198-c12f-4cdf-9ba9-a303423cb2c7 0	More Details	38 bytes	2016-04-30 17:32:51 GMT-05:00	1
<input type="checkbox"/>	a5b174af-54d3-4552-a5f2-39f7ec7296dd 0	More Details	38 bytes	2016-04-30 17:32:51 GMT-05:00	1
<input type="checkbox"/>	b42416c9-032a-495f-98ca-f7b39a40e5cd 0	More Details	38 bytes	2016-04-30 17:32:51 GMT-05:00	1
<input type="checkbox"/>	7ede4964-8399-46da-af3f-e509d9c58688 0	More Details	38 bytes	2016-04-30 17:32:51 GMT-05:00	1
<input type="checkbox"/>	3c3859f8-caf5-46b7-891d-077998194954 0	More Details	38 bytes	2016-04-30 17:32:52 GMT-05:00	1
<input type="checkbox"/>	3dfbe246-50aa-4bc3-9737-4cab635d27c0 0	More Details	38 bytes	2016-04-30 17:32:52 GMT-05:00	1
<input type="checkbox"/>	a36a105f-5ba1-44d9-bc03-0620a010a020 0	More Details	38 bytes	2016-04-30 17:32:52 GMT-05:00	1