

“IN THE NAME OF GOD”

Security Issues in NoSQL Databases

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Abstract

Cassandra is a free and open-source, distributed, wide-column store, NoSQL database management system designed to handle large amounts of data across many commodity servers, providing high availability with no single point of failure. Cassandra offers support for clusters spanning multiple datacenters, with asynchronous masterless replication allowing low latency operations for all clients. In this report, we will describe installation and configuration steps and also other related parts.

Installation :

Dependencies:

Apache Cassandra requires Java 8 to run on a Windows system. Additionally, the Cassandra command-line shell (**cqlsh**) is dependent on Python 2.7 to work correctly.

To be able to **install Cassandra on Windows**, first, we need to:

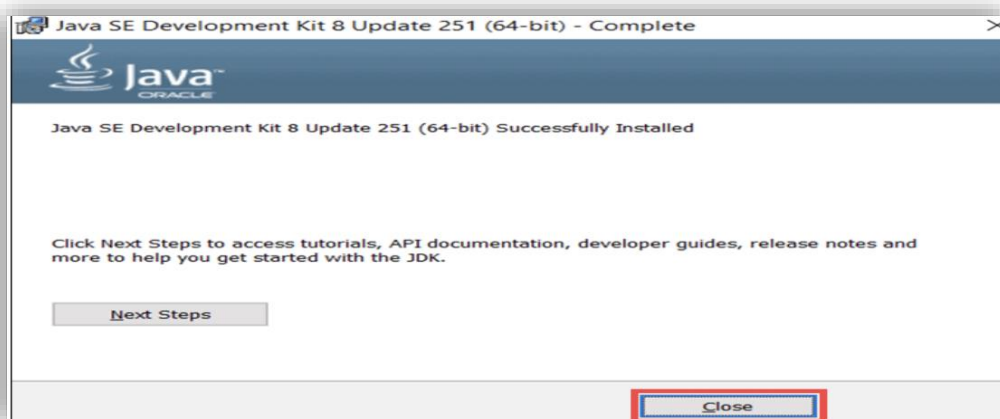
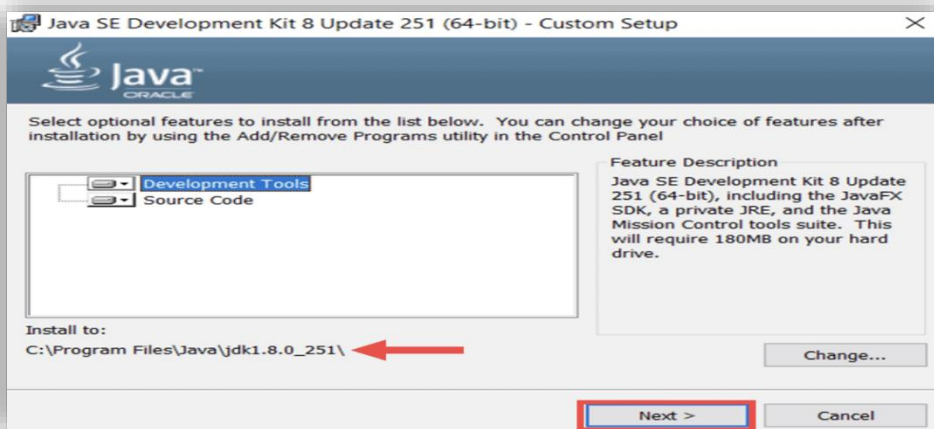
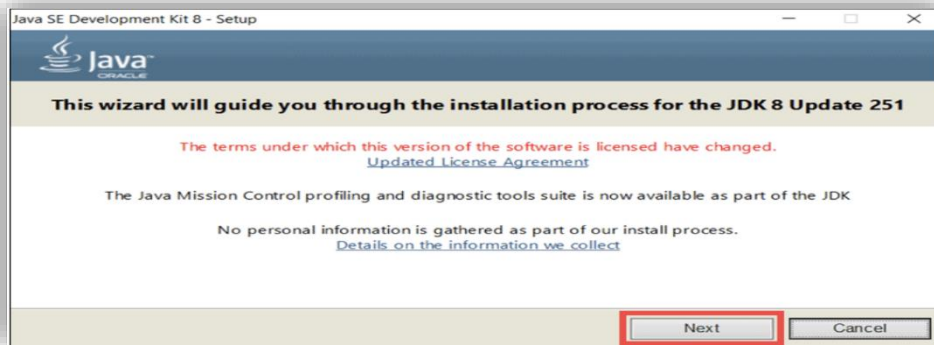
1. **Download and Install Java 8 and set environment variables**
2. **Download and install Python 2.7 and set environment variables**

Step 1: Install Java 8 on Windows

Visited the official oracle download page and download the Oracle JDK 8 software package.

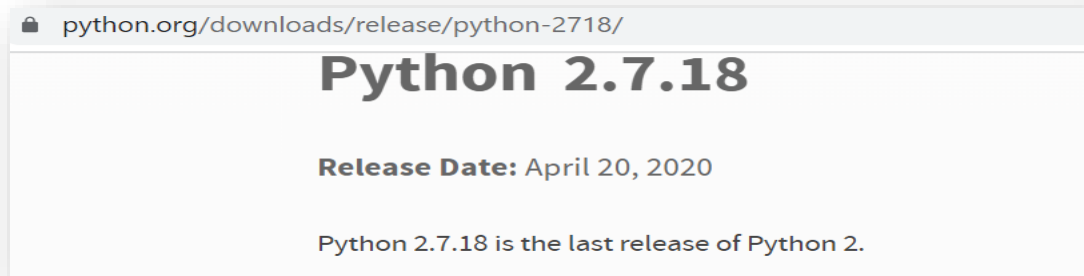
Product/file description	File size	Download
x86 Installer	159.21 MB	jdk-8u333-windows-i586.exe
x64 Installer	172.66 MB	jdk-8u333-windows-x64.exe

Installation steps :



Step 2: Install and Configure Python 2.7 on Windows

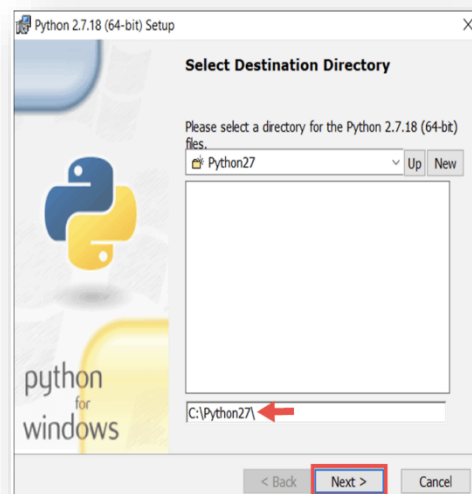
Visit the python official download page and select the Windows x64 version link.



Version	Operating System	Description	MD5 Sum	File Size	GPG
Gzipped source tarball	Source release		38c84292658ed4456157195f1c9bcbe1	17539408	SIG
XZ compressed source tarball	Source release		fd6cc8ec0a78c44036f825e739f36e5a	12854736	SIG
macOS 64-bit installer	macOS	for OS X 10.9 and later	ce98eeb7bdf806685adc265ec1444463	24889285	SIG
Windows debug information files	Windows		20b111ccfe8d06d2fe8c77679a86113d	25178278	SIG
Windows debug information files for 64-bit binaries	Windows		bb0897ea20fda343e5179d413d4a4a7c	26005670	SIG
Windows help file	Windows		b3b753dffe1c7930243c1c40ec3a72b1	6322188	SIG
Windows x86-64 MSI installer	Windows	for AMD64/EM64T/x64	a425c758d38f8e28b56f4724b499239a	20598784	SIG
Windows x86 MSI installer	Windows		db6ad9195b3086c6b4cefb9493d738d2	19632128	SIG

After completing the installation, extend PATH for Python as well. We use the Environment Variables screen and double-click on the existing Path system variable. Select New and then Browse for the installation path of Python, click Ok to finish.

Installation steps :

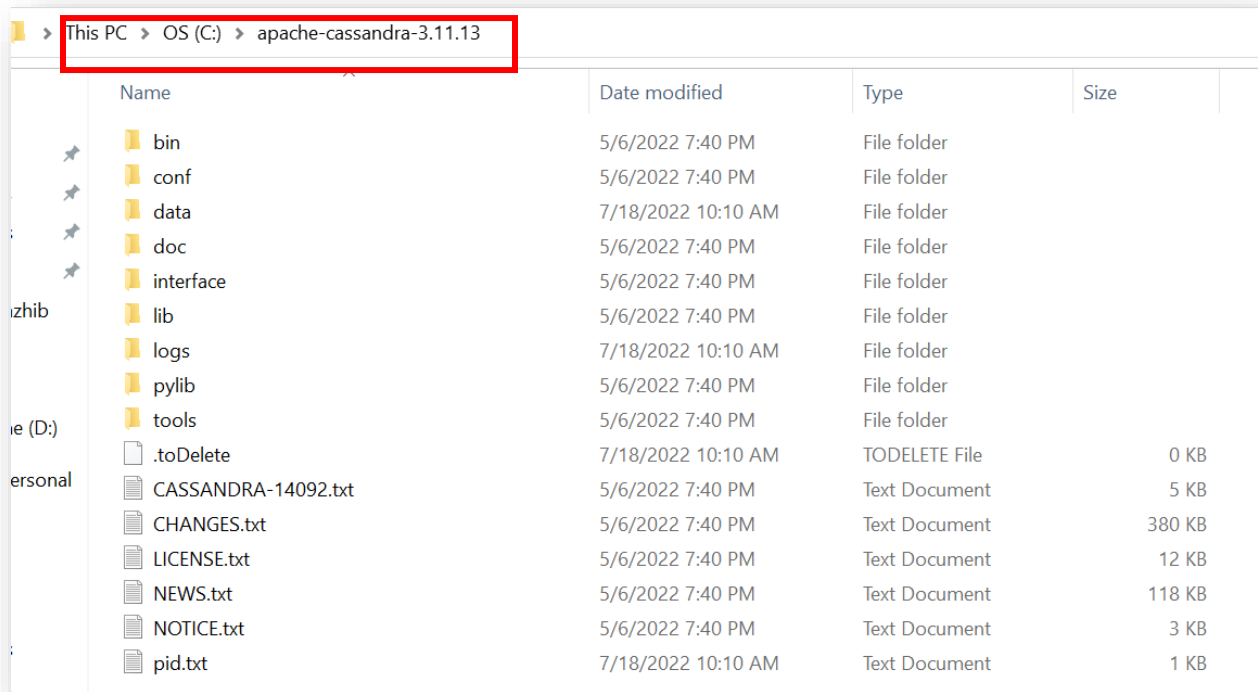


Step 3: Download and Set Up Apache Cassandra

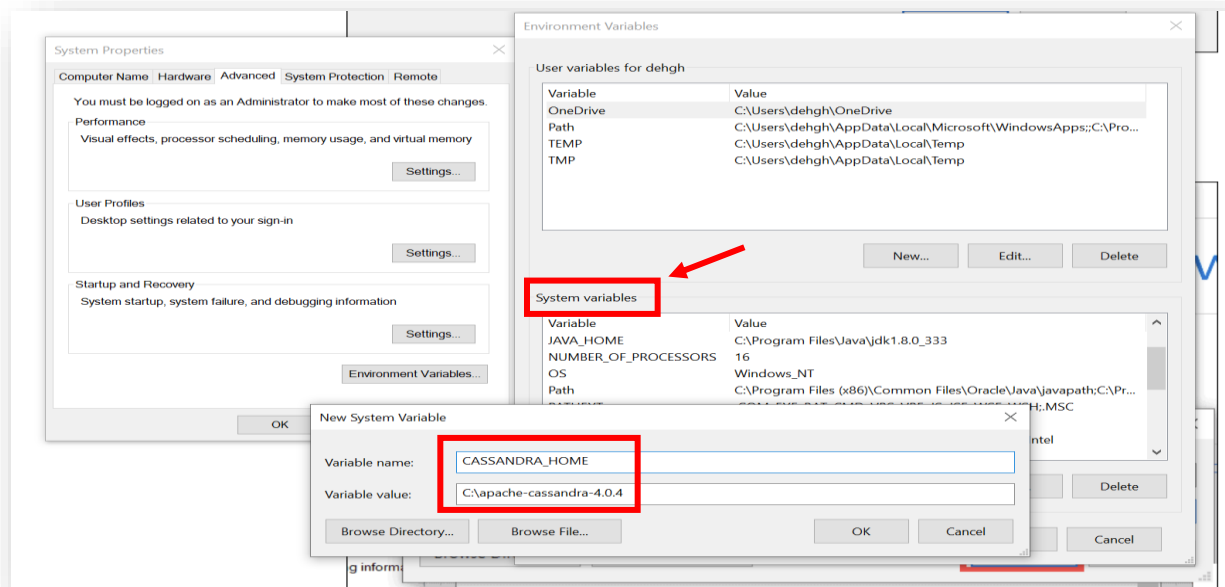
Visit the official Apache Cassandra Download page and select version 3.11.13 . Currently, the latest available version is 4.0.4 but the latest version doesn't work on windows.

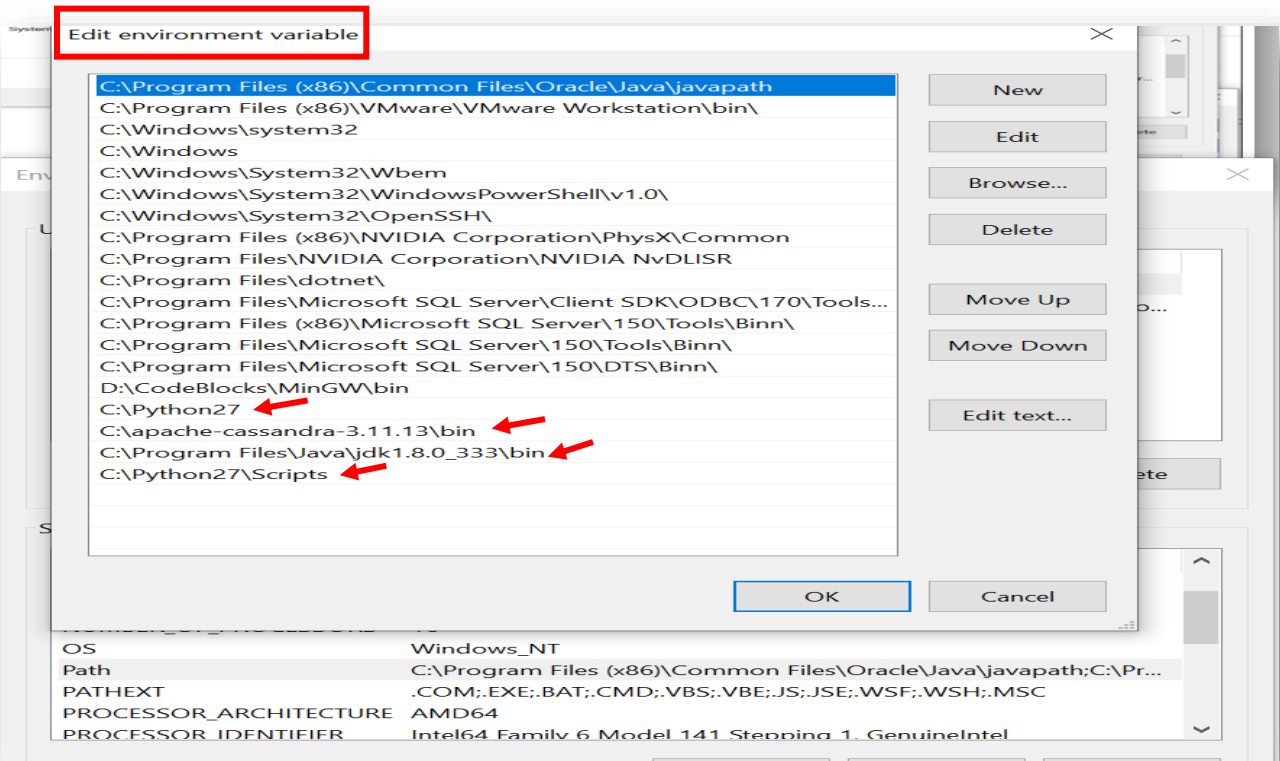


We have to unzip the compressed **tar.gz** folder using a compression tool such as 7-Zip , then again extract **bin.tar** file in **C** directory.



Now we set up the environment variables for Cassandra as we did for two others to enable the database to interact with other applications and operate on Windows.





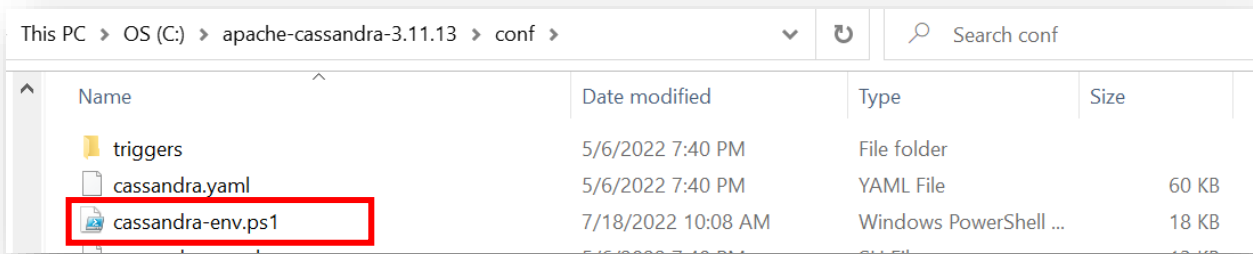
Now if check in the command prompt , we can see that they recognized.

```
C:\Users\dehgh>java -version
java version "1.8.0_333"
Java(TM) SE Runtime Environment (build 1.8.0_333-b02)
Java HotSpot(TM) 64-Bit Server VM (build 25.333-b02, mixed mode)

C:\Users\dehgh>python --version
Python 2.7.18

C:\Users\dehgh>_
```

If run cassandra we will receive error during installation so have to do some change as we did. First we change Cassandra env view to change it to .ps1 format then we comment one line of this file, for siger env error.



```
{
    $env:JVM_OPTS="$env:JVM_OPTS -XX:+UseCondCardMark"
}

# Add sigar env - see Cassandra-7838
#$env:JVM_OPTS = "$env:JVM_OPTS -Djava.library.path="$env:CASSANDRA_HOME\lib\sigar-bin"
```

For powershell error have to set execution policy for local machine in admin powershell env.

```
PS C:\Windows\system32> Get-ExecutionPolicy -list

Scope ExecutionPolicy
-----
MachinePolicy Undefined
UserPolicy Undefined
Process Undefined
CurrentUser Undefined
LocalMachine Unrestricted
```

After that installed C ++, and now it's ready. we changed the directory of the command prompt to Cassandra's directory, then enter Cassandra then press enter and installation started.

```

Microsoft Windows [Version 10.0.19044.1766]
(c) Microsoft Corporation. All rights reserved.

C:\Users\dehgh>cd C:\apache-cassandra-3.11.13\bin

C:\apache-cassandra-3.11.13\bin>cassandra
Detected powershell execution permissions. Running with enhanced startup scripts.
-----*
-----*

WARNING! Automatic page file configuration detected.
It is recommended that you disable swap when running Cassandra
for performance and stability reasons.

-----*
-----*
-----*
-----*

```

In the end, we have to receive “**finish joining ring**”, it’s means that Cassandra is correctly installed, then test “**cqlsh**” we can accessed directly.

```

INFO [MigrationStage:1] 2022-07-18 10:10:14,877 ColumnFamilyStore.java:432 - Initializing svstem_auth.roles
INFO [main] 2022-07-18 10:10:14,895 StorageService.java:1568 - JOINING: Finish joining ring

C:\apache-cassandra-3.11.13\bin>cqlsh

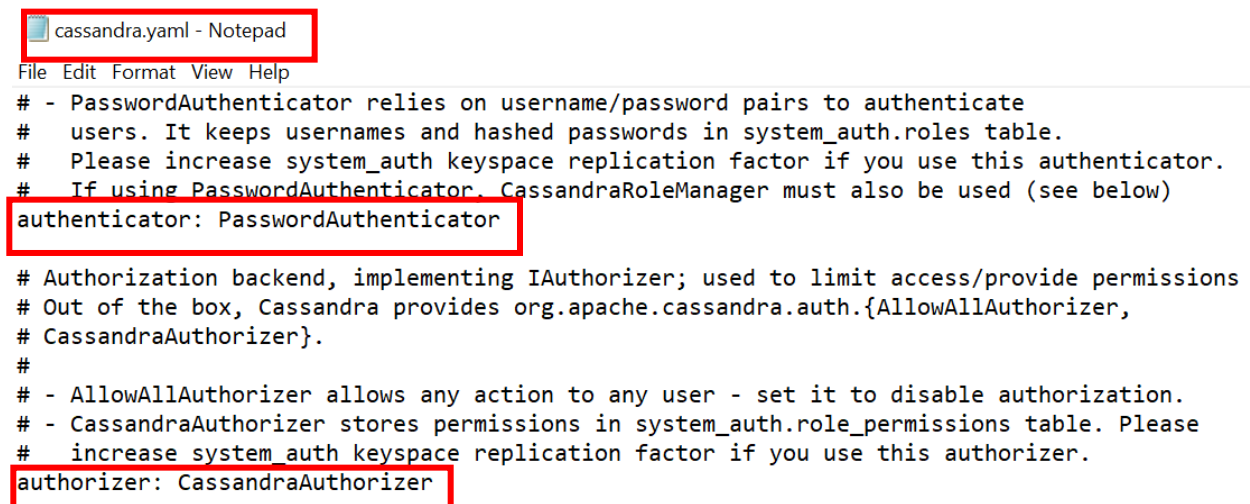
WARNING: console codepage must be set to cp65001 to support utf-8 encoding on Windows platforms.
If you experience encoding problems, change your console codepage with 'chcp 65001' before starting cqlsh.

Connected to Test Cluster at 127.0.0.1:9042.
[cqlsh 5.0.1 | Cassandra 3.11.13 | CQL spec 3.4.4 | Native protocol v4]
Use HELP for help.
WARNING: pyreadline dependency missing. Install to enable tab completion.
cqlsh>

```

Configuring authentication and authorization:

By default, the authenticator option is set to AllowAllAuthenticator for config it we first Change the authenticator option in Cassandra. yaml file to PasswordAuthnticator as illustrated belove. Also did it for authorizer and changed it .



```
File Edit Format View Help
# - PasswordAuthenticator relies on username/password pairs to authenticate
#   users. It keeps usernames and hashed passwords in system_auth.roles table.
#   Please increase system_auth keyspace replication factor if you use this authenticator.
#   If using PasswordAuthenticator, CassandraRoleManager must also be used (see below)
authenticator: PasswordAuthenticator

# Authorization backend, implementing IAuthorizer; used to limit access/provide permissions
# Out of the box, Cassandra provides org.apache.cassandra.auth.{AllowAllAuthorizer,
# CassandraAuthorizer}.
#
# - AllowAllAuthorizer allows any action to any user - set it to disable authorization.
# - CassandraAuthorizer stores permissions in system_auth.role_permissions table. Please
#   increase system_auth keyspace replication factor if you use this authorizer.
authorizer: CassandraAuthorizer
```

Then restart Cassandra , and after that run it again then as we show the result in the picture, if we enter “**cqlsh**” without user and password we receive an error then with username and password we can access it.

```

967914768885957421]
INFO [main] 2022-07-18 17:46:44,743 StorageService.java:1568 - JOINING Finish joining ring
INFO [main] 2022-07-18 17:46:44,785 StorageService.java:2484 - Node localhost/127.0.0.1 state jump to NORMAL
INFO [main] 2022-07-18 17:46:44,793 AuthCache.java:177 - (Re)initializing CredentialsCache (validity period/update interval/max entries) (2000/2000/1000)

C:\apache-cassandra-3.11.13\bin>cqlsh
Connection error: ('Unable to connect to any servers', {'127.0.0.1': AuthenticationFailed('Remote end requires authentication.',)})
C:\apache-cassandra-3.11.13\bin>cqlsh -u cassandra -p cassandra ← With user & pass

WARNING: console codepage must be set to cp65001 to support utf-8 encoding on Windows platforms.
If you experience encoding problems, change your console codepage with 'chcp 65001' before starting cqlsh.

Connected to Test Cluster at 127.0.0.1:9042.
[cqlsh 5.0.1 | Cassandra 3.11.13 | CQL spec 3.4.4 | Native protocol v4]
Use HELP for help.
WARNING: pyreadline dependency missing. Install to enable tab completion.
cassandra@cqlsh> .

```

Create users :

CREATE USER defines a new database user account. By default users accounts do not have superuser status. Only a superuser can issue CREATE USER requests. we did it as illustrated blow.

```

Connected to Test Cluster at 127.0.0.1:9042.
[cqlsh 5.0.1 | Cassandra 3.11.13 | CQL spec 3.4.4 | Native protocol v4]
Use HELP for help.
WARNING: pyreadline dependency missing. Install to enable tab completion.
cassandra@cqlsh> CREATE USER nargesdeghan WITH PASSWORD '40033756' SUPERUSER;
cassandra@cqlsh> CREATE USER tim WITH PASSWORD 'tim' NOSUPERUSER;
cassandra@cqlsh> CREATE USER jimi WITH PASSWORD 'jimi' NOSUPERUSER;
cassandra@cqlsh> CREATE USER simi WITH PASSWORD 'simi' NOSUPERUSER;
cassandra@cqlsh> .

```

Now we made a new user and then dropped it.

```

cassandra@cqlsh> CREATE USER mimi WITH PASSWORD 'mimi';
cassandra@cqlsh> DROP USER mimi; ←
cassandra@cqlsh>

```

Create KEYSPACE :

Creates a top-level namespace. Configure the replica placement strategy, replication factor, and durable writes setting. we have two types of class : 'SimpleStrategy' and 'NetworkTopologyStrategy', The replication map determines how many copies of the data are kept in a given data center. This setting impacts consistency, availability and request speed. we made it with **homework4** name in simple strategy class, and one time replication, also set durable as true .

```
synthexception: unknown property 'durable_writes' in ...
cassandra@cqlsh> CREATE KEYSPACE homework4 WITH REPLICATION = {'class' : 'SimpleStrategy', 'replication_factor' : 1} AND DURABLE_WRITES = true ;
cassandra@cqlsh>
```

After that we checked it.

```
cassandra@cqlsh> SELECT * FROM system_schema.keyspaces;

keyspace_name | durable_writes | replication
-----
system_auth   | True           | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
system_schema | True           | {'class': 'org.apache.cassandra.locator.LocalStrategy'}
system_distributed | True         | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '3'}
system        | True           | {'class': 'org.apache.cassandra.locator.LocalStrategy'}
system_traces | True           | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '2'}
homework4     | True           | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}

(6 rows)
cassandra@cqlsh> use homework4;
```

Now create a table with the name **homework4** and insert some user on it.

```
WARNING: pyreadline dependency missing. Install to enable tab completion.
cassandra@cqlsh> CREATE TABLE homework4 VALUES (id int PRIMARY KEY , 'username' text, userpassword int);
```

```
cassandra@cqlsh:homework4> SELECT * FROM homework4;
```

id	username	userpassword
-----+-----+-----		

```
(0 rows)
cassandra@cqlsh:homework4> INSERT INTO homework4 (id , username , userpassword ) VALUES (1 , titi , 111 );
SyntaxException: line 1:71 no viable alternative at input ' (...) VALUES (1 , [titi] ,...)'
cassandra@cqlsh:homework4> INSERT INTO homework4 (id , username , userpassword ) VALUES (1 , 'titi' , 111 );
cassandra@cqlsh:homework4> INSERT INTO homework4 (id , username , userpassword ) VALUES (2 , 'tidi' , 222 );
cassandra@cqlsh:homework4> INSERT INTO homework4 (id , username , userpassword ) VALUES (3 , 'tiki' , 333 );
cassandra@cqlsh:homework4> INSERT INTO homework4 (id , username , userpassword ) VALUES (4 , 'tipi' , 444);
cassandra@cqlsh:homework4> INSERT INTO homework4 (id , username , userpassword ) VALUES (5 , 'tigi' , 555);
cassandra@cqlsh:homework4> SELECT * FROM homework4;
```

id	username	userpassword
-----+-----+-----		
5	tigi	555
1	titi	111
2	tidi	222
4	tipi	444
3	tiki	333

Now did some query :

```
SyntaxException: line 1:21 mismatched input 'admin' expecting EOF (LIST ALL PERMI
cassandra@cqlsh> LIST ALL PERMISSIONS OF admin;
```

role	resource	permissions
-----+-----+-----		

```
(0 rows)
cassandra@cqlsh> GRANT ALL PERMISSIONS ON KEYSPACE homework4 TO admin;
cassandra@cqlsh> LIST ALL PERMISSIONS OF admin;
```

role	username	resource	permission
-----+-----+-----+-----			
admin	admin	<keyspace homework4>	CREATE
admin	admin	<keyspace homework4>	ALTER
admin	admin	<keyspace homework4>	DROP
admin	admin	<keyspace homework4>	SELECT
admin	admin	<keyspace homework4>	MODIFY
admin	admin	<keyspace homework4>	AUTHORIZE

```
(6 rows)
cassandra@cqlsh> REVOKE ALL PERMISSIONS ON KEYSPACE homework4 FROM admin;
cassandra@cqlsh> LIST ALL PERMISSIONS OF admin;
```

role	resource	permissions
-----+-----+-----		

Did some **GRANT** and **REVOKE** for a user then list all accesses :

```
cassandra@cqlsh> GRANT SELECT ON keyspace homework4 TO jimi;
cassandra@cqlsh> LIST ALL PERMISSIONS OF jimi;

role | username | resource          | permission
-----+-----+-----+-----
jimi | jimi | <keyspace homework4> | SELECT

(1 rows)
cassandra@cqlsh> REVOKE SELECT ON KEYSpace homework4 FROM jimi;
cassandra@cqlsh> LIST ALL PERMISSIONS OF jimi;

role | resource | permissions
-----+-----+-----
```

Permissions list :

ALL PERMISSIONS	ALTER	AUTHORIZE
CREATE	DESCRIBE	DROP
EXECUTE	MODIFY	PROXY.EXECUTE
PROXY.LOGIN	SEARCH.ALTER	SEARCH.COMMIT
SEARCH.CREATE	SEARCH.DROP	SEARCH.REBUILD
SEARCH.RELOAD	SELECT	

Now make 2 roles and **GRANT** one to another then **list roles** :

```
cassandra@cqlsh:homework4> CREATE ROLE admin;  
cassandra@cqlsh:homework4> CREATE ROLE employe;  
cassandra@cqlsh:homework4> _
```

```
cassandra@cqlsh> GRANT admin TO employe;  
cassandra@cqlsh> LIST ROLES;
```

role	super	login	options
admin	False	False	{}
cassandra	True	True	{}
dehghan	False	True	{}
employe	False	False	{}
homework	False	True	{}
jimi	False	True	{}
narges	True	True	{}
nargesdeghan	True	True	{}
simi	False	True	{}
tim	False	True	{}

(10 rows)

```
cassandra@cqlsh> _
```

Conclusion :

We have successfully installed Cassandra on Windows and did some queries in the command prompt. Large volumes of unstructured data can be an issue for traditional relational databases. This popular NoSQL database solution is going to allow us to capture and store a lot more increasingly valuable data.

References :

https://cassandra.apache.org/_/download.html

<https://www.python.org/downloads/release/python-2718/>

<https://www.oracle.com/java/technologies/downloads/#java8>