“IN THE NAME OF GOD”

Security Issues in NoSQL Databases

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Table of contents :

Abstract 3
Installation 4
Configuration 13
Create keyspace 15
Create table 15
Create role 18
Conclusion 19
References 20

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:

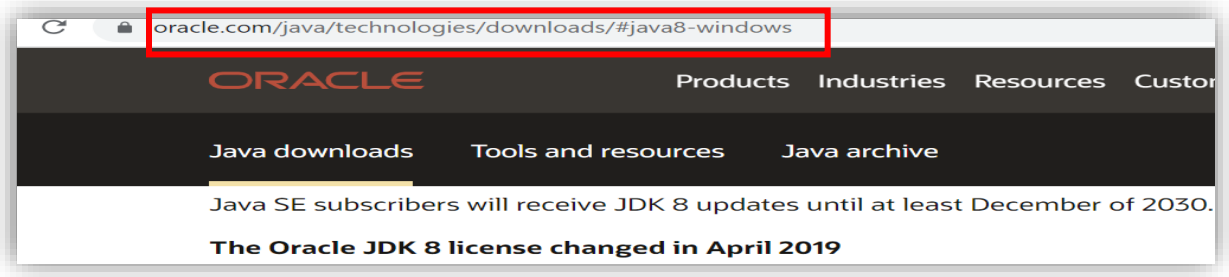
Apache Cassandra requires Java 8 to run on a Windows system. Additionally, the Cassandra command-line shell (**cqlsh**) is dependent on Python 2.7 to work correctly.

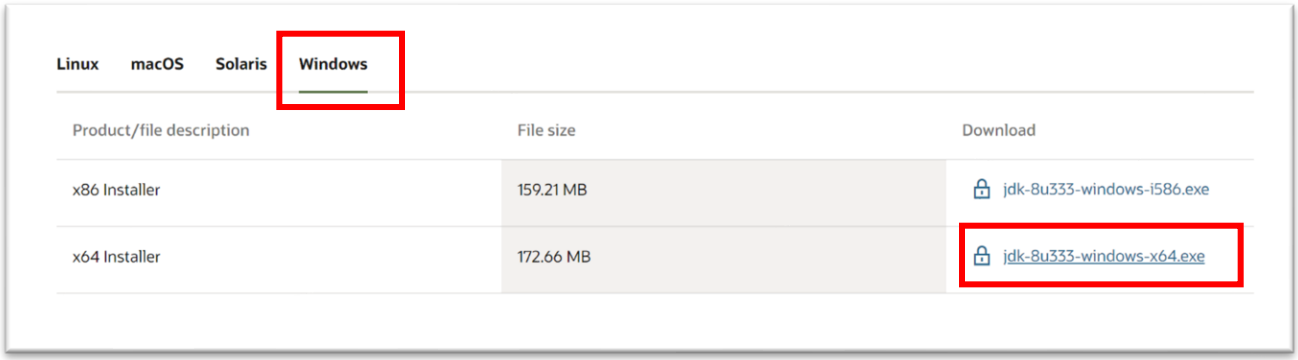
To be able to **install Cassandra** on **Windows,** first, we need to**:**

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

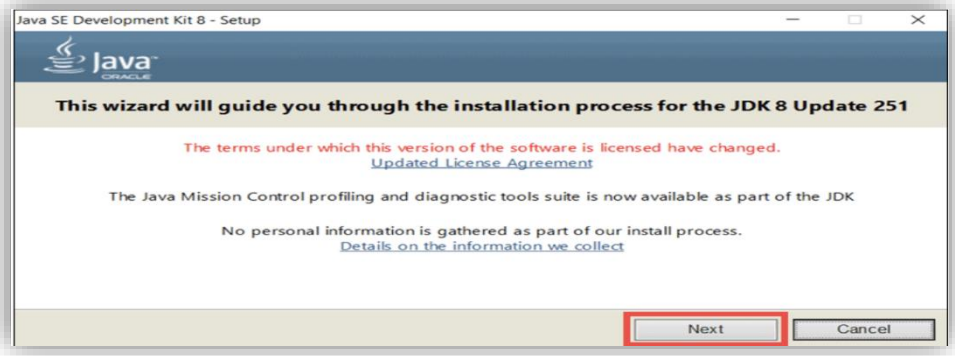
Step 1: Install Java 8 on Windows

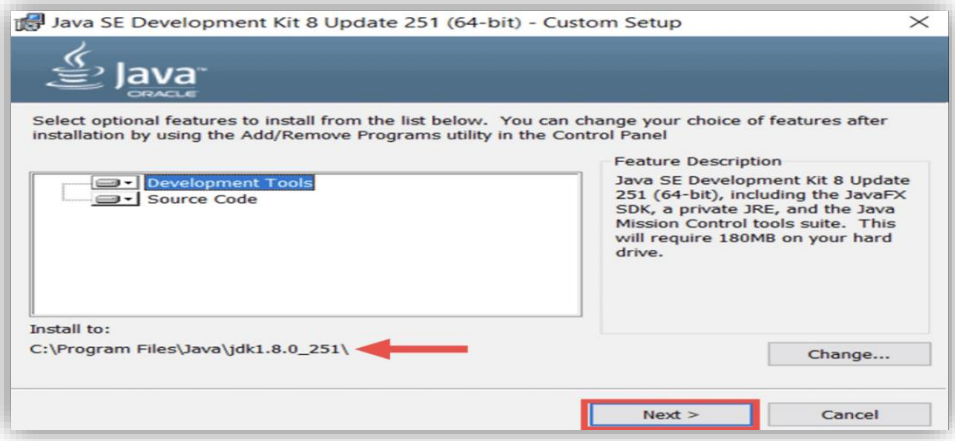
Visited the official oracle download page and download the Oracle JDK 8 software package.

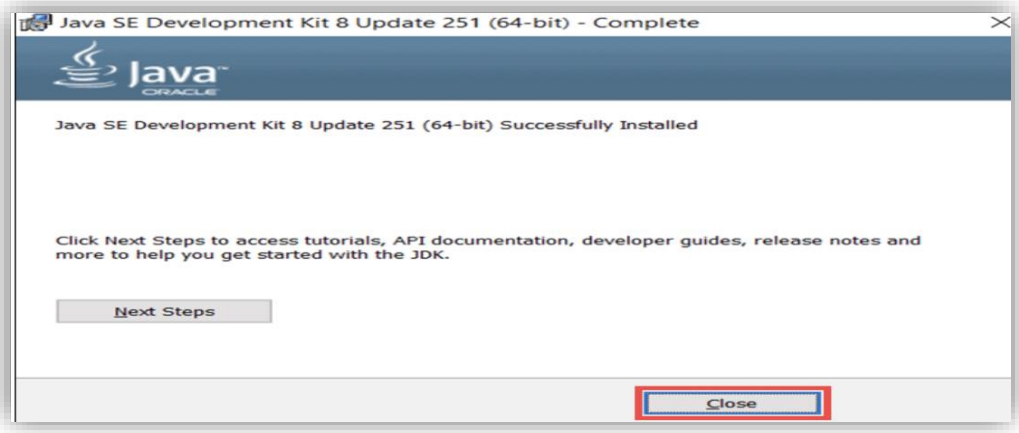




Installation steps :

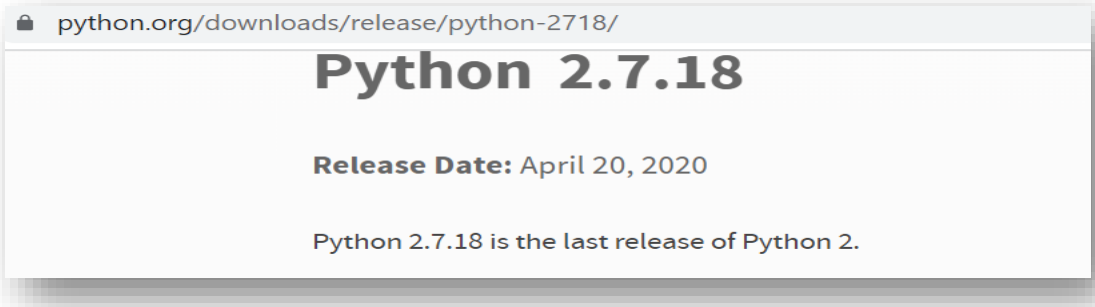






Step 2: Install and Configure Python 2.7 on Windows

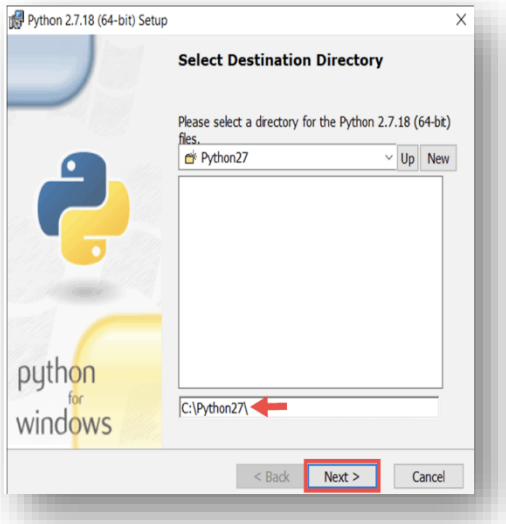
Visit the python official download page and select the Windows x64 version link.

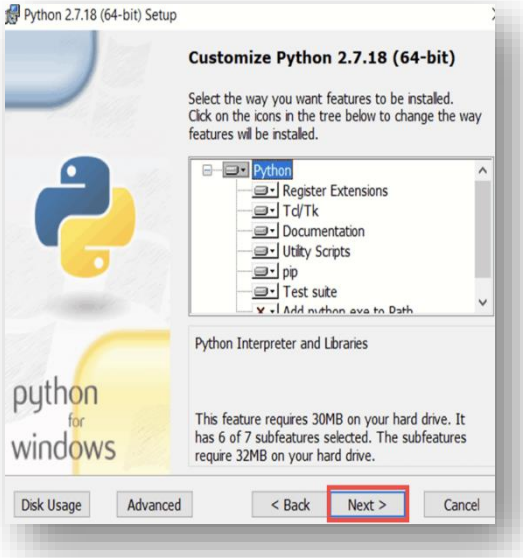


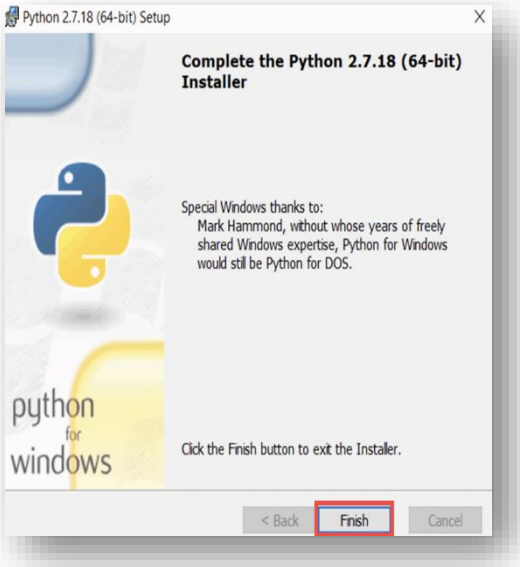
Version	Operating System	Description	MD5 Sum	File Size	GPG
Gzipped source tarball	Source release		38c84292658ed4456157195f1c9bcbe1	17539408	SIG
XZ compressed source tarball	Source release		fd6cc8ec0a78c44036f825e739f36e5a	12854736	SIG
macOS 64-bit installer	macOS	for OS X 10.9 and later	ce98eeb7bdf806685adc265ec1444463	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 :



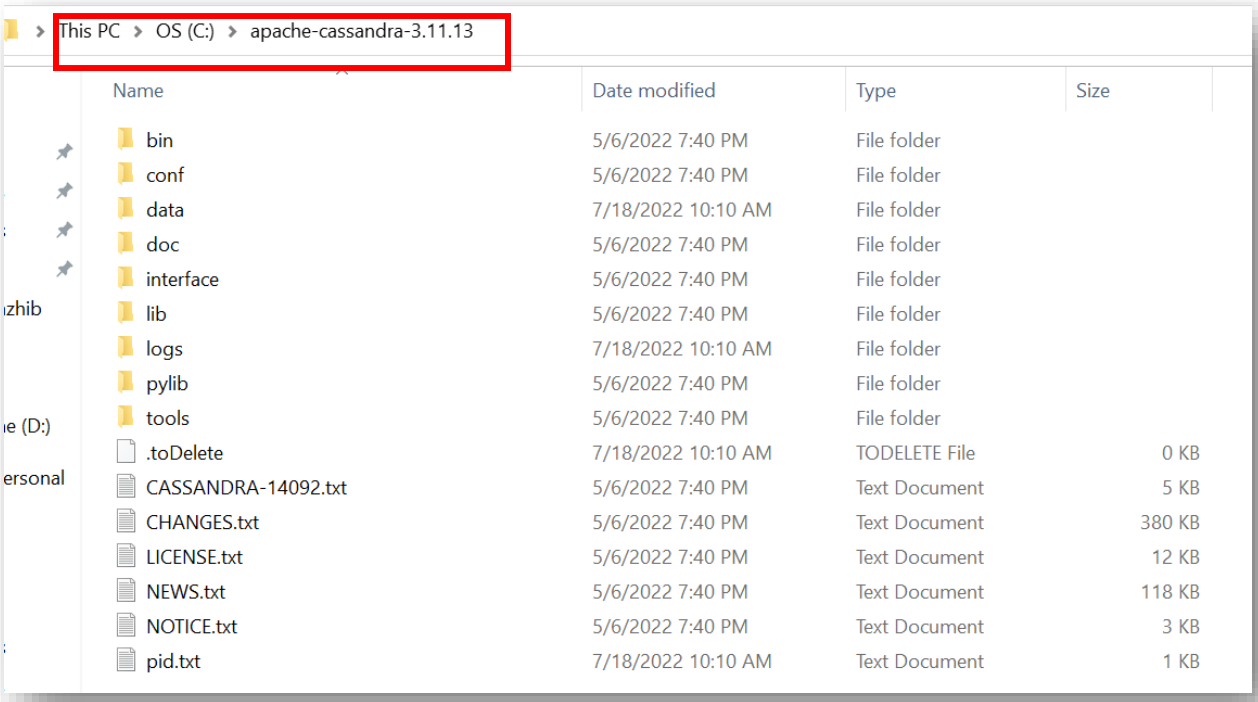




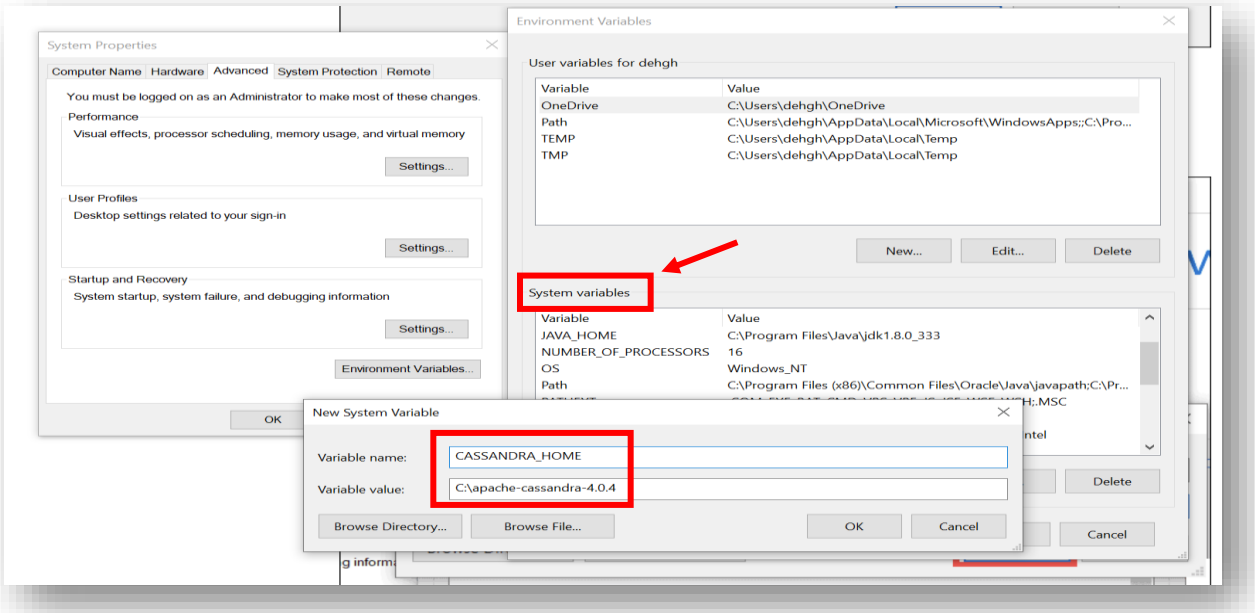
Step 3: Download and Set Up Apache Cassandra

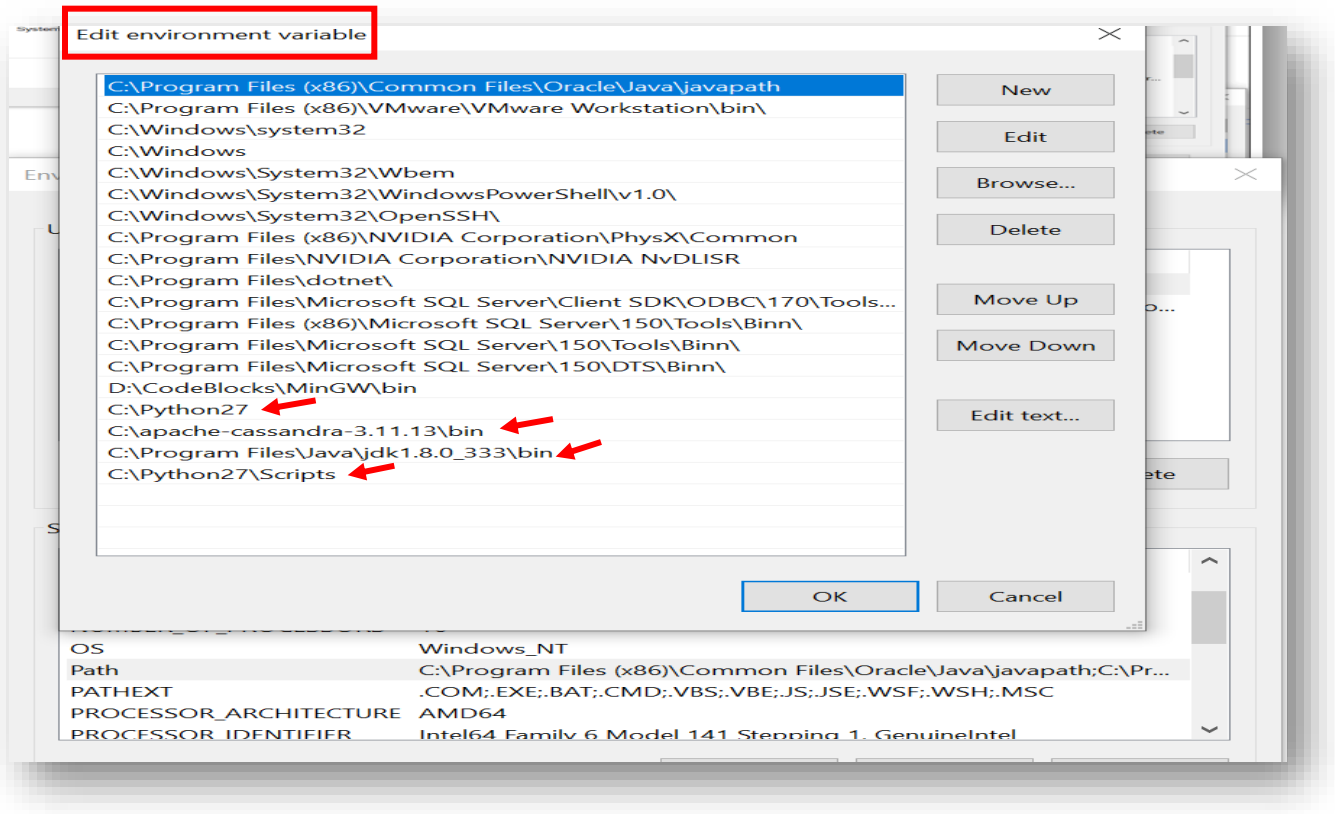
Visit the official Apache Cassandra Download page and select version 3.11.13 . Currently, the latest available version is 4.0.4 but the latest version doesn't work on windows.

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.

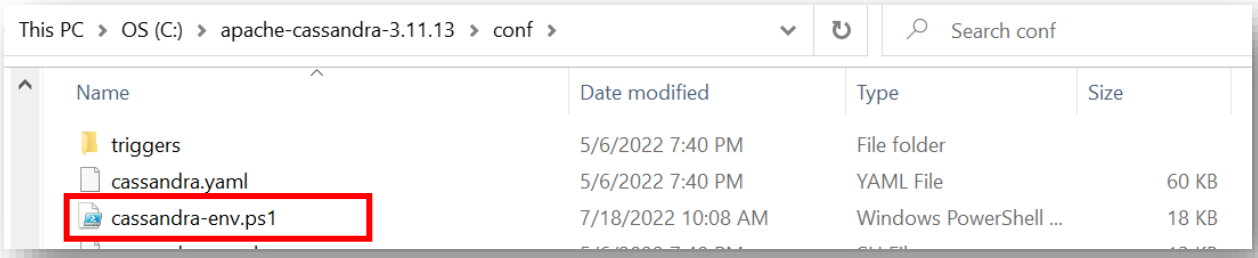


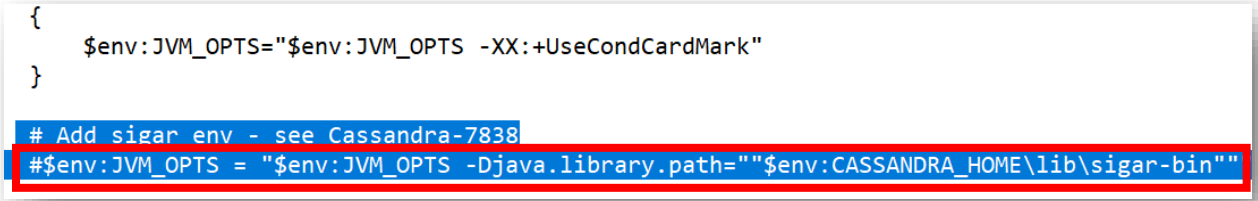


Now if check in the command prompt , we can see that they recognized.

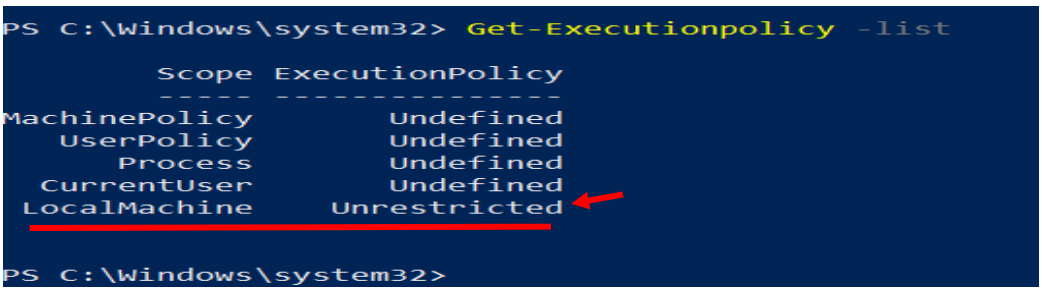
```
C:\Users\dehgh>java -version
java version "1.8.0_333"
Java(TM) SE Runtime Environment (build 1.8.0_333-b02)
Java HotSpot(TM) 64-Bit Server VM (build 25.333-b02, mixed mode)

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.





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



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.

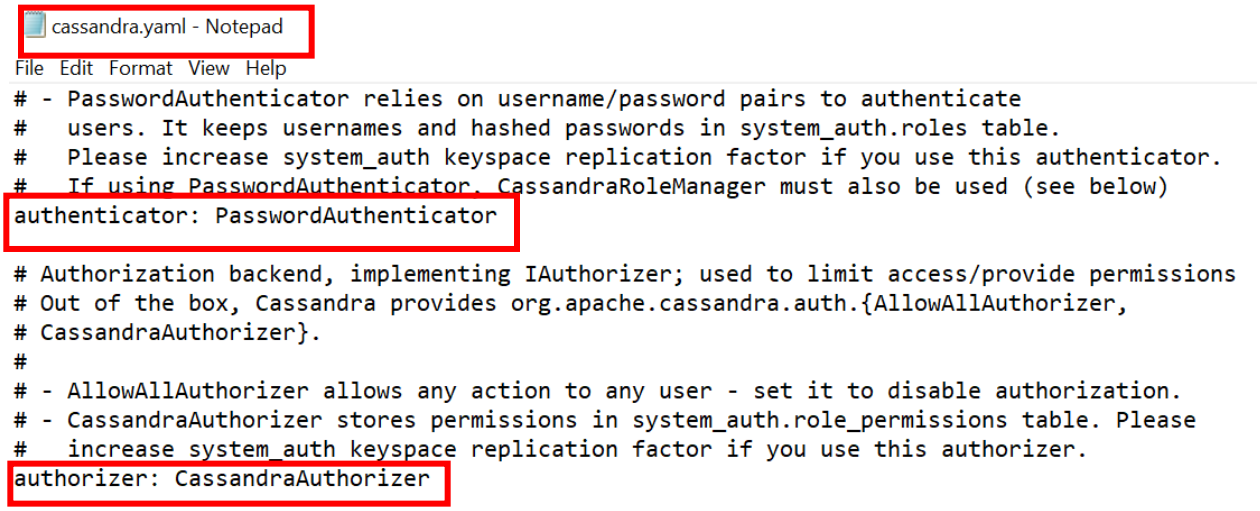
```
icrosoft Windows [Version 10.0.19044.1766]
c) Microsoft Corporation. All rights reserved.

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

:\apache-cassandra-3.11.13\bin>cassandra
etected 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.

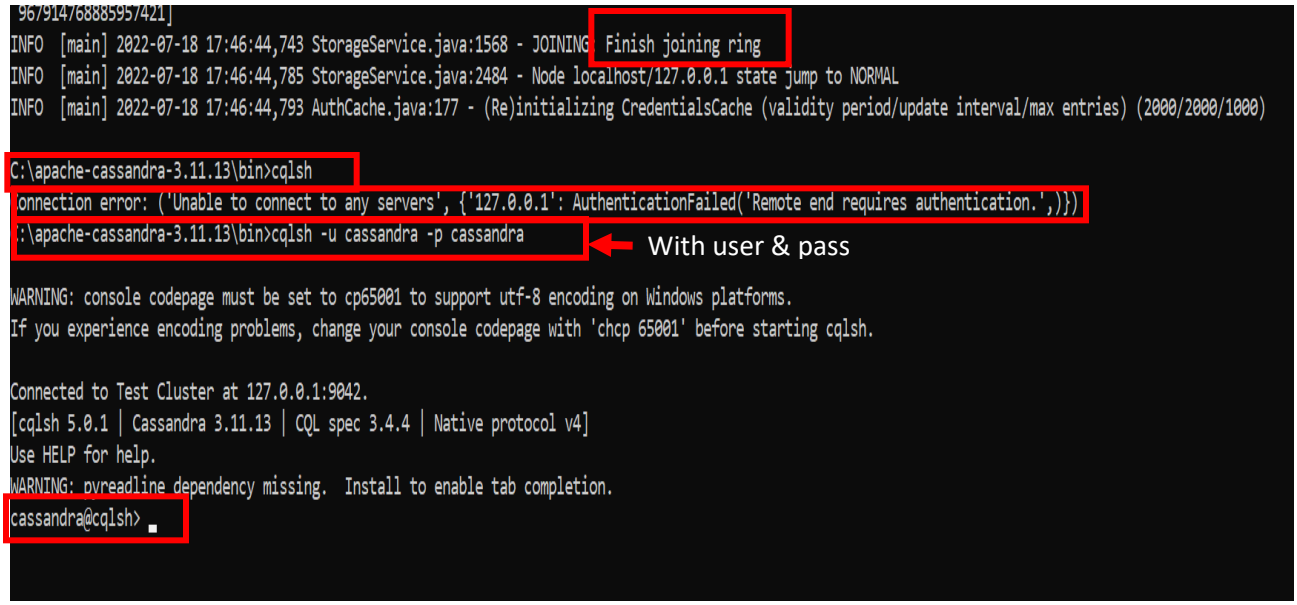
```
INFO  [MigrationStage:1] 2022-07-18 10:10:14,877 ColumnFamilyStore.java:432 - Initializing system_auth.roles
INFO  [main] 2022-07-18 10:10:14,895 StorageService.java:1568 - JOINING: Finish joining ring

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 .

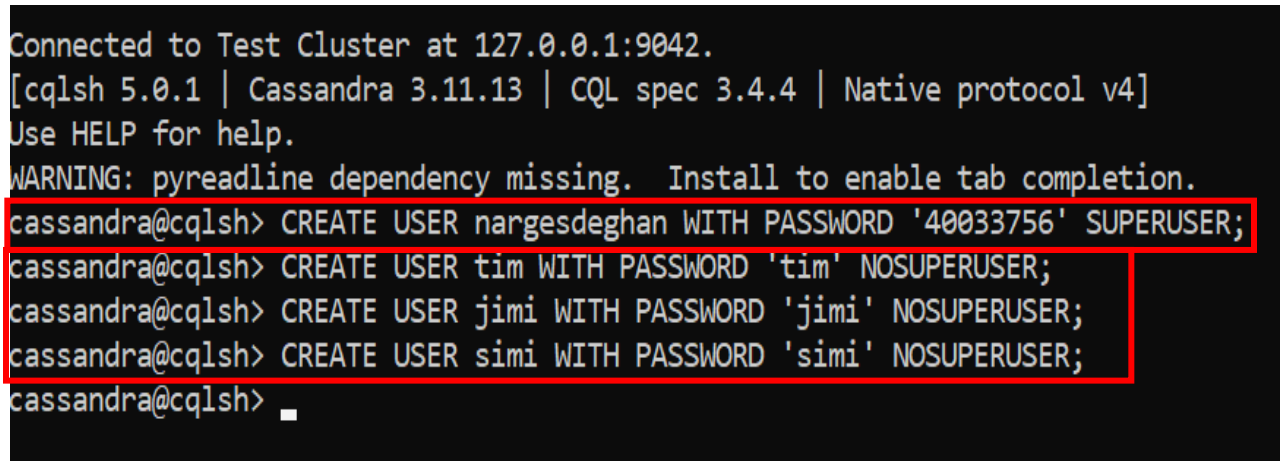


Then restart Cassandra , and after that run it again then as we show the result in the picture, if we enter "**cqlsh**" without user and password we receive an error then with username and password we can access it.

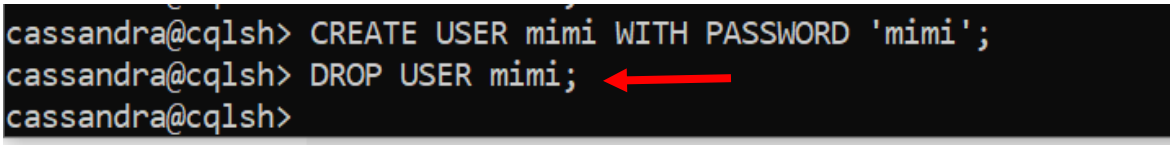


Create users :

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.

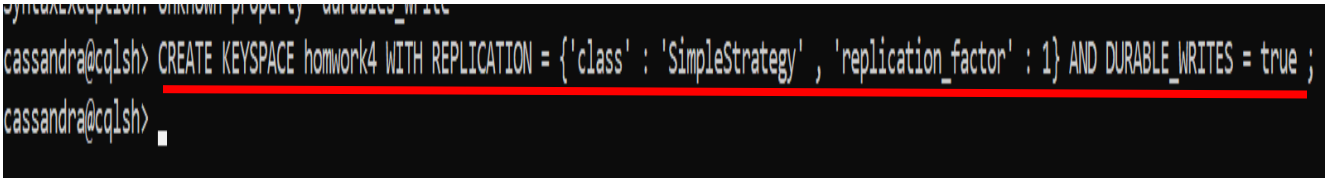


Now we made a new user and then dropped it.

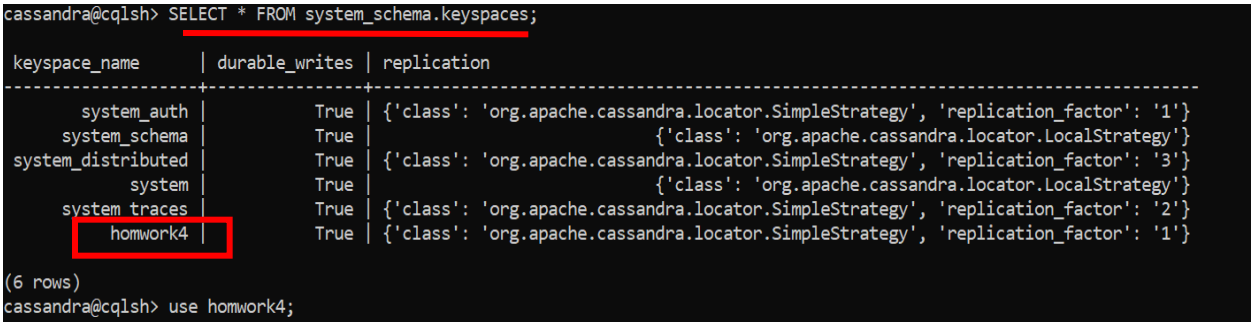


Create KEYSPACE :

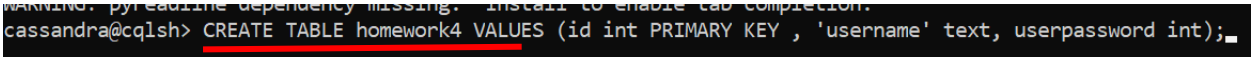
Creates a top-level namespace. Configure the replica placement strategy, replication factor, and durable writes setting.we have two types of class : ‘SimpleStrategy' and 'NetworkTopologyStrategy', The replication map determines how many copies of the data are kept in a given data center. This setting impacts consistency, availability and request speed.we made it with **homwork4** name in simple strategy class, and one time replication, also set durable as true .



After that we checked it.



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



```
cassandra@cqlsh:homwork4> SELECT * FROM homework4;

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

(0 rows)
cassandra@cqlsh:homwork4> INSERT INTO homework4 (id , username , userpassword ) VALUES (1 , titi , 111 );
SyntaxException: line 1:71 no viable alternative at input ' , ' (... ) VALUES (1 , [titi] ,...)
cassandra@cqlsh:homwork4> INSERT INTO homework4 (id , username , userpassword ) VALUES (1 , 'titi' , 111 );
cassandra@cqlsh:homwork4> INSERT INTO homework4 (id , username , userpassword ) VALUES (2 , 'tidi' , 222 );
cassandra@cqlsh:homwork4> INSERT INTO homework4 (id , username , userpassword ) VALUES (3 , 'tiki' , 333 );
cassandra@cqlsh:homwork4> INSERT INTO homework4 (id , username , userpassword ) VALUES (4 , 'tipi' , 444);
cassandra@cqlsh:homwork4> INSERT INTO homework4 (id , username , userpassword ) VALUES (5 , 'tigi' , 555);
cassandra@cqlsh:homwork4> 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 homwork4 TO admin;
cassandra@cqlsh> LIST ALL PERMISSIONS OF admin;

 role  | username | resource            | permission
-------+----------+---------------------+------------
 admin |    admin | <keyspace homwork4> |     CREATE
 admin |    admin | <keyspace homwork4> |      ALTER
 admin |    admin | <keyspace homwork4> |       DROP
 admin |    admin | <keyspace homwork4> |     SELECT
 admin |    admin | <keyspace homwork4> |     MODIFY
 admin |    admin | <keyspace homwork4> |  AUTHORIZE

(6 rows)
cassandra@cqlsh> REVOKE ALL PERMISSIONS ON KEYSPACE homwork4 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 homwork4 TO jimi;
cassandra@cqlsh> LIST ALL PERMISSIONS OF jimi;

 role | username | resource            | permission
------+----------+---------------------+------------
 jimi |     jimi | <keyspace homwork4> |     SELECT

(1 rows)
cassandra@cqlsh> REVOKE SELECT ON KEYSPACE homwork4 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:homwork4> CREATE ROLE admin;
cassandra@cqlsh:homwork4> CREATE ROLE employe;
cassandra@cqlsh:homwork4>
```

```
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