

# Multiway Join - Usage Guide

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## Information

Student Name: Avinash Sorab | DAWG Tag: siu854709544 | Professor: Dr. Wen-Chi Hou

## System Requirements

The project was developed and tested on a laptop that had

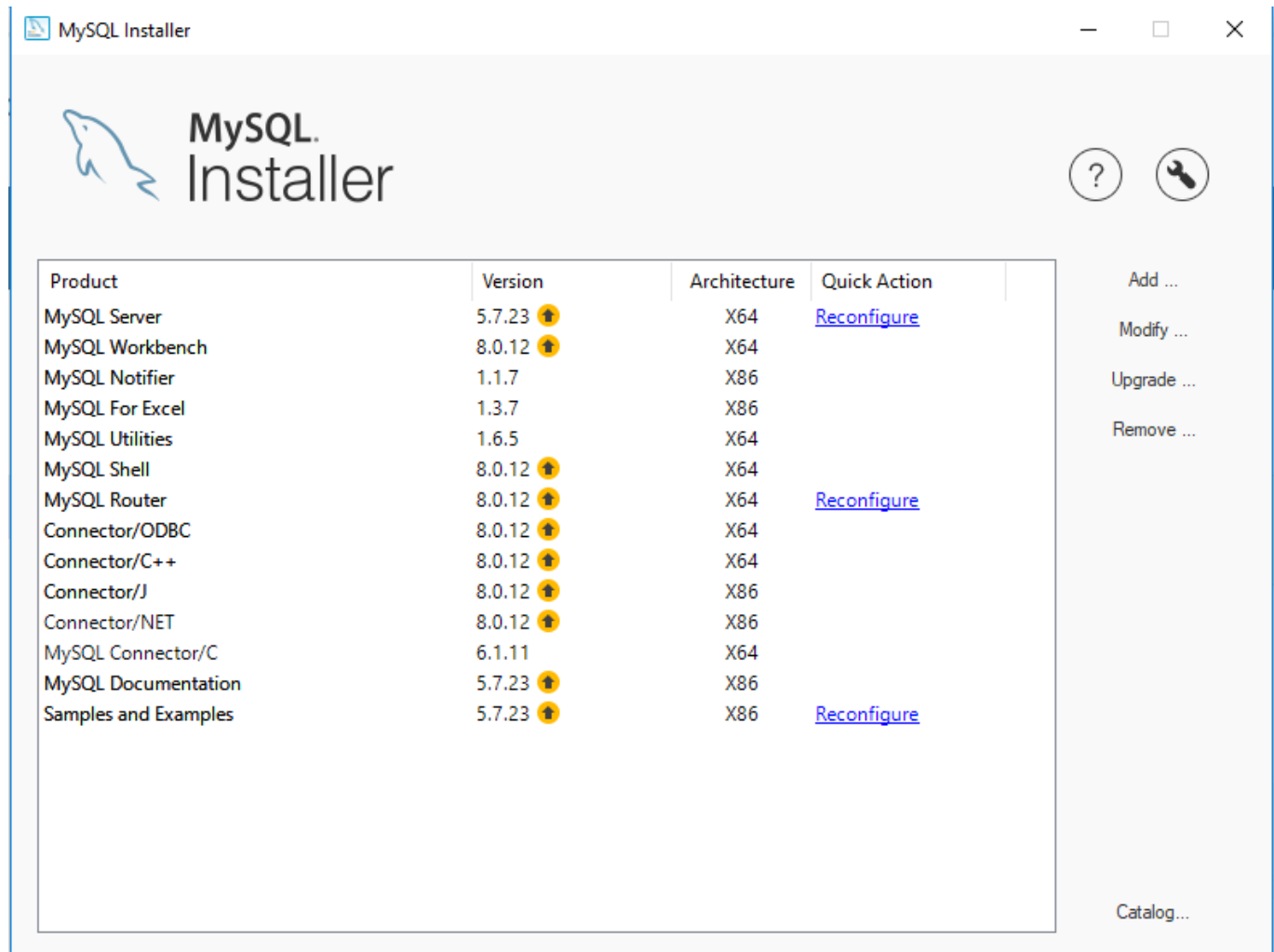
- **RAM:** 4GB
- **HDD:** 320GB
- **Processor:** Core i5
- **OS:** Windows 10 Pro

## Software Requirements

- **Visual Studio Code** - A light weight code editor that has command line integrated to it. Easy to write code, debugging as it enables us to install intellisense.  
<https://code.visualstudio.com/>
- **MySQL Installer 5.7.23** (Community Version)  
<https://downloads.mysql.com/archives/installer/>

Choose the product version from latest to 5.7.23

It'll let you install all the below softwares



- Make sure you've all these softwares installed below
  - Microsoft Visual C++ 2010 Redistributable (x86)
  - Microsoft Visual C++ 2010 Redistributable (x64)
  - Microsoft Visual C++ 2013 Redistributable (x86)
  - Microsoft Visual C++ 2013 Redistributable (x64)
  - Microsoft Visual C++ 2015 Redistributable (x86)
  - Microsoft Visual C++ 2015 Redistributable (x64)

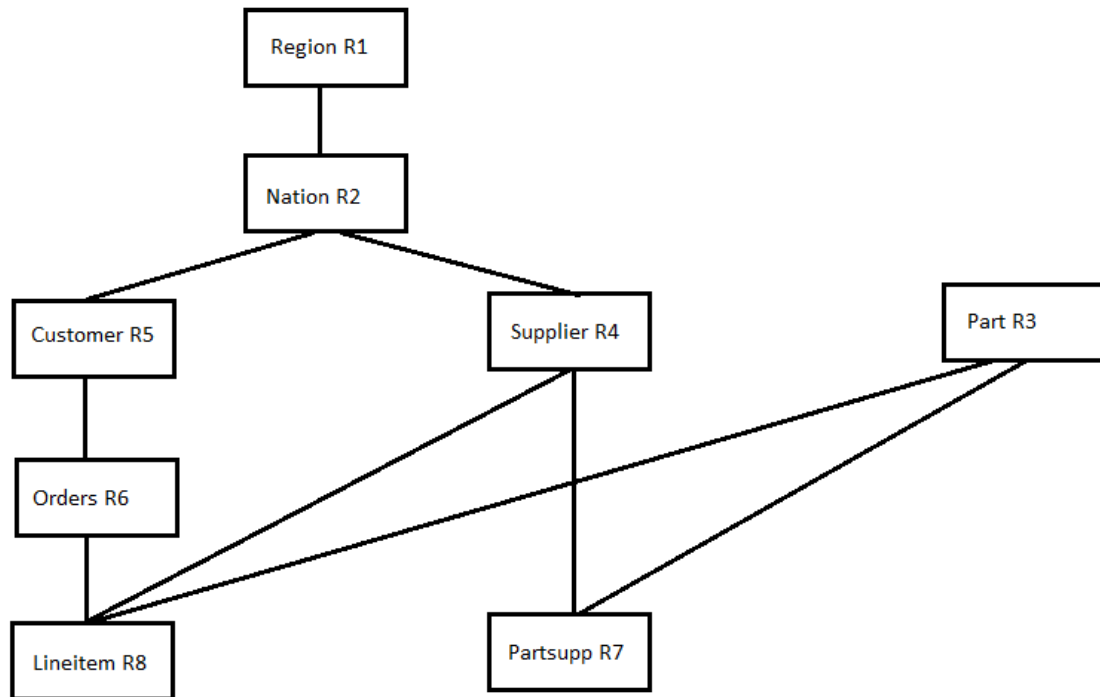
to support all the softwares present in the installer.

- **Python 3.7.0**  
<https://www.python.org/>
- **Git 2.19.2.windows.1**  
<https://git-scm.com/download/win>

## Algorithm

### Relation Overview

The TPCB benchmark relation used for this is as below



## Aligned Tables

There are 11 aligned tables possible in this

- ALIGNED\_REGION (R1)
- ALIGNED\_NATION (R1 -> R2)
- ALIGNED\_PART (R3)
- ALIGNED\_SUPPLIER (R2 -> R4)
- ALIGNED\_CUSTOMER (R2 -> R5)
- ALIGNED\_ORDERS (R5 -> R6)
- ALIGNED\_PARTSUPP (R4 -> R7, R3 -> R7)
- ALIGNED\_LINEITEM (R4 -> R8, R3 -> R8)

## Implementation

- Create aligned tables
- Allow the user to select the relation he wants to create join on
- Ex: if the user selects REGION -> NATION -> SUPPLIER,  
for every single tuple of region, select all the nations and following suppliers which belong to that region (DFS)
- Send it through the log\_linear\_result function that compares the self\_sid of one table with the parent\_sid of another table,
- In the below example it compares r1\_sid from aligned\_region table with r1\_sid from aligned\_nation table and r2\_sid from aligned\_nation is compared with r2\_sid in aligned\_supplier, if they are equal, they'll be logged into a file

```

for tuple1 in aligned_region:
    for tuple2 in aligned_nation:
        for tuple3 in aligned_supplier:

```

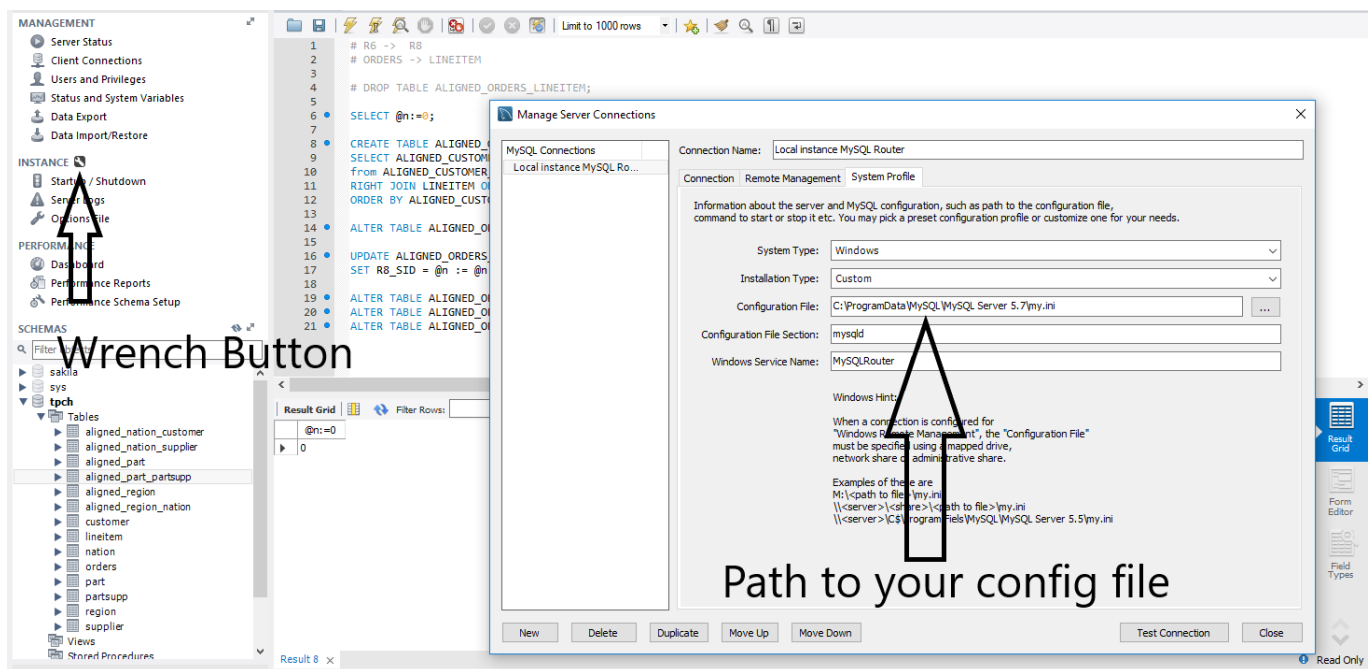
```
if(tuple1[1] == tuple2[0] && tuple2[1] == tuple3[0]):
    log_to_file()
```

- For Divergent Graphs, such as REGION -> NATION -> (SUPPLIER, CUSTOMER), Identify the shortest branch,
- Implement linear join for the shortest branch, then implement linear join for another branch and store the result
- Output the crossproduct of both the result.

## Project Setup

### MySQL

- Open MySQL WorkBench
- From the Main Menu -> Server -> Options File, if the file doesn't load then click on the Wrench button beside Instance in the left pane
- A window pops up



After this you should be able to open the options file

- Increase the InnoDB Buffer Pool Size from 8M to 1G by going to Main Menu -> Server -> Options File -> InnoDB tab -> Check innodb\_buffer\_pool\_size and change it to 1G

Query 1 Administration - Options File

Local Instance MySQL Router Options File

General Logging InnoDB Networking Advanced Other Security Replication MyISAM Performance

Datafiles

<input type="checkbox"/> innodb_data_file_path	bddata1:12M:autoextend	Path to individual files and their sizes
<input type="checkbox"/> innodb_data_home_dir		The common part for InnoDB table spaces
<input type="checkbox"/> innodb_file_format	Barracuda	The format for new InnoDB tables
<input checked="" type="checkbox"/> innodb_file_format_check		Whether InnoDB performs file format compatibility checking
<input type="checkbox"/> innodb_file_format_max	Barracuda	The file format tag in the shared tablespace

Buffer pool

<input type="checkbox"/> innodb_buffer_pool_chunk_size	134217728	Defines the chunk size that is used when resizing the buffer pool
<input checked="" type="checkbox"/> innodb_buffer_pool_dump_at_shutdown		Specifies whether to record the pages cached in the InnoDB buffer pool when the MySQL server is shut down, to shorten the warmup process at the next restart
<input type="checkbox"/> innodb_buffer_pool_dump_now		Immediately records the pages cached in the InnoDB buffer pool
<input type="checkbox"/> innodb_buffer_pool_filename	ib_buffer_pool	Specifies the file that holds the list of page numbers produced by innodb_buffer_pool_dump_at_shutdown or innodb_buffer_pool_dump_now
<input type="checkbox"/> innodb_buffer_pool_load_abort		Interrupts process of restoring InnoDB buffer pool contents triggered by innodb_buffer_pool_load_at_startup or innodb_buffer_pool_load_now
<input checked="" type="checkbox"/> innodb_buffer_pool_load_at_startup		Specifies that, on MySQL server startup, the InnoDB buffer pool is automatically "warmed up" by loading the same pages it held at an earlier time
<input type="checkbox"/> innodb_buffer_pool_load_now		Immediately "warms up" the InnoDB buffer pool by loading a set of data pages, without waiting for a server restart
<input checked="" type="checkbox"/> innodb_buffer_pool_size	1G	Size of the memory buffer InnoDB uses to cache data and indexes of its tables

- Go to Security Tab, scroll down till you find secure-file-priv, check it if it's unchecked and set it to "" (blank string)

Query 1 Administration - Options File

Local Instance MySQL Router Options File

General Logging InnoDB Networking Advanced Other Security Replication MyISAM Performance

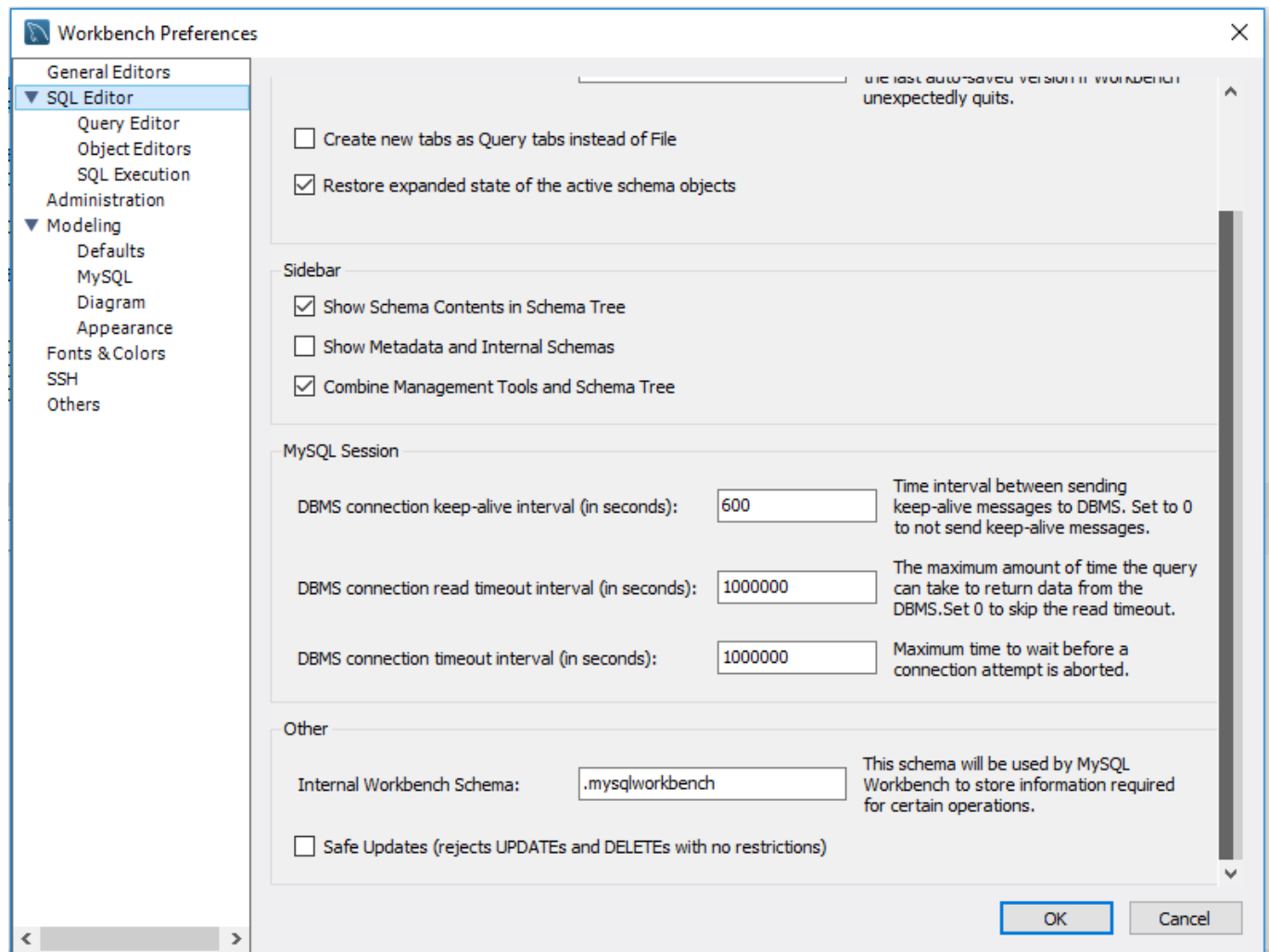
Security

<input type="checkbox"/> keyring_aws_data_file	platform specific	AWS keyring plugin storage file location
<input type="checkbox"/> keyring_aws_region	us-east-1	AWS keyring plugin region
<input type="checkbox"/> keyring_encrypted_file_data	platform specific	keyring_encrypted_file plugin data file
<input type="checkbox"/> keyring_file_data	platform specific	keyring_file plugin data file
<input type="checkbox"/> keyring_ockv_conf_dir		Oracle Key Vault keyring plugin configuration directory
<input type="checkbox"/> mysql_native_password_proxy_users		Whether the mysql_native_password authentication plugin does proxying
<input checked="" type="checkbox"/> sha256_password_auto_generate_rsa_keys		Whether to autogenerate RSA key-pair files
<input type="checkbox"/> sha256_password_private_key_path	private_key.pem	SHA256 authentication plugin private key path name
<input type="checkbox"/> sha256_password_proxy_users		Whether the sha256_password authentication plugin does proxying
<input type="checkbox"/> sha256_password_public_key_path	public_key.pem	SHA256 authentication plugin public key path name
<input type="checkbox"/> tls_version	TLSv1,TLSv1.1,TLSv1.2	Protocols permitted for encrypted connections
<input type="checkbox"/> validate_password	ON	Whether to activate the password validation plugin
<input type="checkbox"/> validate_password_check_user_name		Whether to check passwords against user name

Security

<input type="checkbox"/> allow-suspicious-udfs		Allows use of UDFs consisting of only one symbol xxx() without corresponding xxx_init() or xxx_deinit()
<input type="checkbox"/> authentication_windows_log_level	0	Windows authentication plugin logging level
<input checked="" type="checkbox"/> authentication_windows_use_principal_name		Whether to use Windows authentication plugin principal name
<input checked="" type="checkbox"/> auto_generate_certs		Whether to autogenerate SSL key and certificate files
<input type="checkbox"/> block_encryption_mode	aes-128-ecb	Mode for block-based encryption algorithms
<input type="checkbox"/> read_only		Prevent client updates except from clients with SUPER
<input type="checkbox"/> require_secure_transport		Whether client connections must use secure transport
<input type="checkbox"/> safe-user-create		Do not allow new user creation by the user who has no write privileges to the mysql.user table
<input checked="" type="checkbox"/> secure-auth		Disallow authentication for accounts that have old (pre-4.1) passwords
<input checked="" type="checkbox"/> secure-file-priv	""	Limit LOAD DATA, and SELECT ... INTO OUTFILE, and LOAD_FILE() to files in specified directory

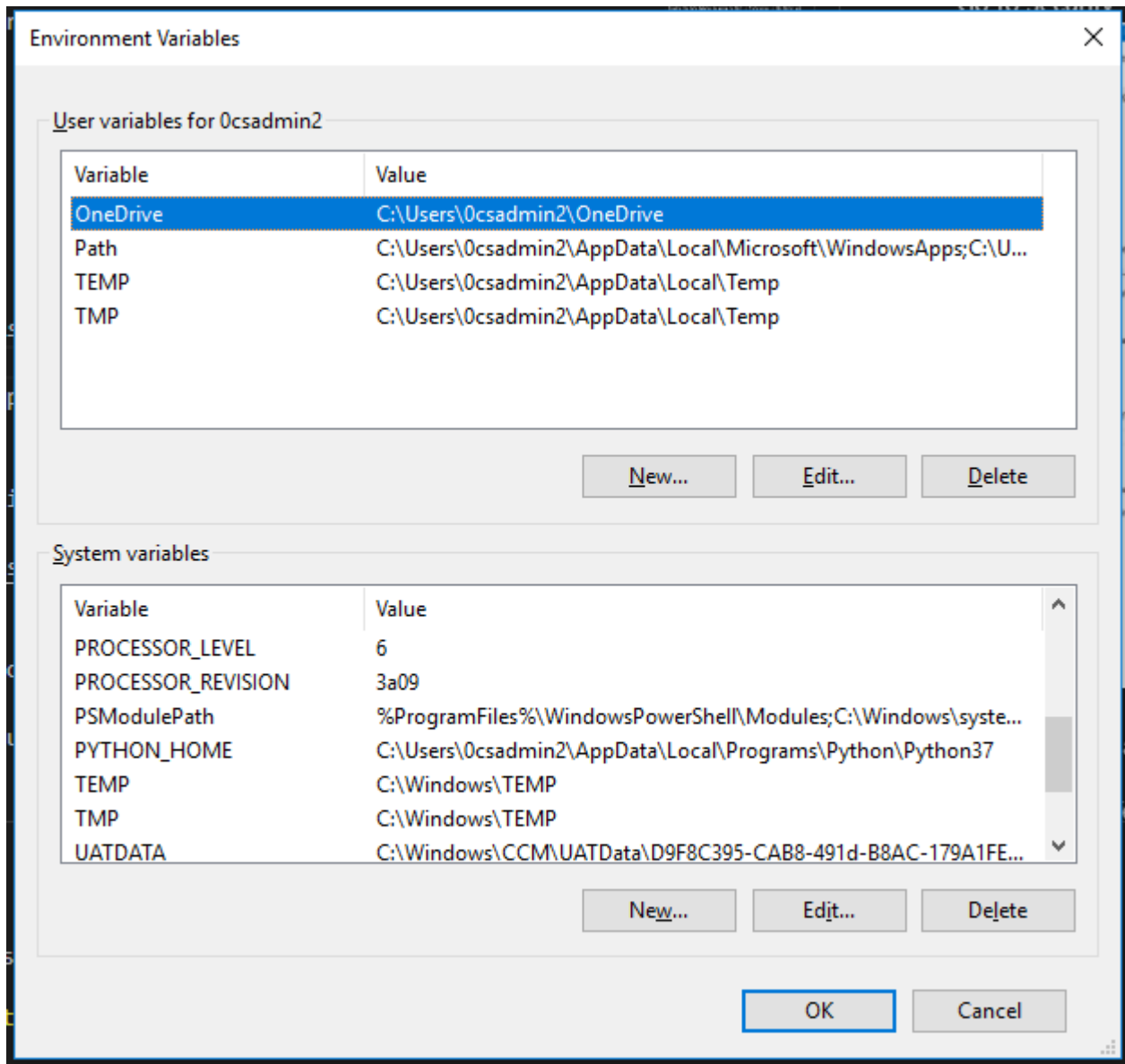
- Click on Apply and then close the window
- Disable the Safe Updates by going to Edit -> Preferences -> SQL Editor and scroll down and you'll find an option, uncheck it.



## Python

After you install python, add python to the ENVIRONMENT\_VARIABLES in your windows system.

- On your Windows machine, go to *System Properties* -> *Advanced Tab* -> *Environment Variables*



You can verify this by opening cmd from anywhere and type python to see if python command line opens up.

You need pip to install most of the python tools

## pip

- You can download the code **get-pip.py** from the below link.  
<https://bootstrap.pypa.io/get-pip.py>  
and run it on python command line
- Navigate to the location where you've downloaded get-pip.py file.

```
> python get-pip.py
```

- It will download and install pip
- Put python and pip executables into a common location  
**C:\Python\Scripts**  
and add this to the environment variables list so that pip can be run from anywhere

- Verify by typing

```
> pip freeze
```

from anywhere in the window.

## flask

- Install flask, the GUI tool that's required to get inputs from the User and show aligned relations

```
> pip install flask
```

- Clone the project from the below link into your system.

```
> git clone https://github.com/avinashsp93/multiwayjoin.git
```

- Open the folder in Visual Studio Code, Press **Ctrl + `**
- Install some important plugins required

```
> pip3 install pandas  
> pip3 install mysql-connector-python-rf
```

- Navigate to the `.\scripts` folder

```
> cd .\scripts
```

- Set the `FLASK_APP` environment variable

```
> $env:FLASK_APP="main"
```

## Project Execution

- Navigate to your project where you've cloned, using commandline
- Run the below command from the commandline

```
> flask run
```



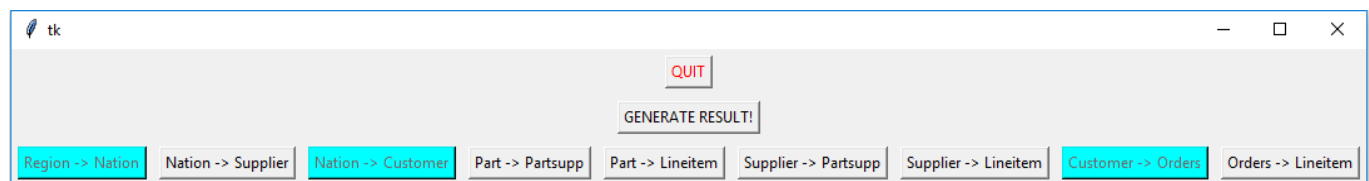
You should be getting below output

```
PS C:\Users\0csadmin2\Desktop\multiwayjoin\scripts> flask run
* Serving Flask app "main"
* Environment: production
  WARNING: Do not use the development server in a production environment.
  Use a production WSGI server instead.
* Debug mode: off
* Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

Click on the link <http://127.0.0.1:5000/> and open it in chrome browser

- At this state if you refresh the server, you'll be getting a new tkinter window where the user can specify inputs

## Input



- The highlighted cyan color indicates the aligned relation that's going to be created
- Click on **Generate Result** button and head back to command line

## Output

```
Process time : 16623.3985
Number of rows 1197064
SELECT * FROM ALIGNED_REGION_NATION WHERE R1_SID >= 2 AND R1_SID <= 2 ORDER BY R2_SID
SELECT * FROM ALIGNED_NATION_CUSTOMER WHERE R2_SID >= 6 AND R2_SID <= 10 ORDER BY R5_SID
SELECT * FROM ALIGNED_CUSTOMER_ORDERS WHERE R5_SID >= 29765 AND R5_SID <= 59716 ORDER BY R6_SID
SELECT * FROM ALIGNED_ORDERS_LINEITEM WHERE R6_SID >= 299121 AND R6_SID <= 597076 ORDER BY R8_SID
```

## Print File

The first few rows

```
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 1 | 8329 | Supplier#000008329 | jynJRhgz7g5Q5m | 0 | 10 - 705 - 8
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 2 | 7518 | Supplier#000007518 | 07kyNhCl11xjyBAlS1P | 0 | 1
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 3 | 9988 | Supplier#000009988 | BPMAQCYz71gyk yxQ Aio1N15
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 4 | 4238 | Supplier#000004238 | h3i MBChk1Jw | 0 | 10 - 689 - 87
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 5 | 1143 | Supplier#000001143 | Lx1m36n4xwz25xci4C7iz | 0
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 6 | 6907 | Supplier#000006907 | x1mY50G6A3LPLNPhg8xgRA8g
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 7 | 9418 | Supplier#000009418 | l15h4m1J3M2by5ih | 0 | 10 - 1
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 8 | 8784 | Supplier#000008784 | 6kNAX578XlQ1M7503m6xw A7/
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 9 | 1592 | Supplier#000001592 | y5zN7 RxC204LwRQ3 yollANd
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 10 | 6922 | Supplier#000006922 | kmzyR3f6867 6LOAQ0411 | 0
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 11 | 5894 | Supplier#000005894 | mg3Lnj5iC3Si5gACl0Bg8n15C
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 12 | 8591 | Supplier#000008591 | w2nM6hChh4yQZ1236kx mklM
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 13 | 1422 | Supplier#000001422 | MJ166g 251QCQ 1A10wzB20
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[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 16 | 8802 | Supplier#000008802 | R0M0YwL0m1C4zCiz4zwChCC
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[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 18 | 683 | Supplier#00000683 | Pjwy2y43Pw1B73Lg1N0mzAm7
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 19 | 4580 | Supplier#000004580 | 04wg0A214ni | 0 | 10 - 765 - 827
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[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 21 | 983 | Supplier#00000983 | hw26m7N3mMnoJ g0nAln5P
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[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 24 | 3316 | Supplier#000003316 | 12N85m2LkyQ05 10gw | 0 | 10
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 25 | 7935 | Supplier#000007935 | i3ASRA41AR402P545wQP | 0
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 26 | 9754 | Supplier#000009754 | hrk0756MCCL xz | 0 | 10 - 841 -
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 27 | 6300 | Supplier#000006300 | Ng7wgC Q0H8 | 0 | 10 - 134 - 364
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 28 | 800 | Supplier#00000800 | 11 30MqP5N4 0zzm17z | 0
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 29 | 2918 | Supplier#000002918 | C71wA0NQC6 | 0 | 10 - 114 - 167 -
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 30 | 3011 | Supplier#000009939 | MONky241wZ02M7N0R4MqJgw
[0] | AFRICA | n0mPRlkPRgzRk04 | jwxS0i | A4ngP16754Cg0 | iGcwCCPLy3L7071ny3L11 | 1 | 0 | ALGERIA | 0 | RgmBYmJ7RagzMB6CPSSAlwC5PRg3ng8z17znZB6k111 | 31 | 943 | Supplier#00000943 | 0lmy35g7K12PL4A30mP026
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