# Data Processing and Analysis in Python
# Lecture 12
# Databases

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# Different Ways to Execute Python Programs

- Use python console (e.g. IDLE), but with limited functionality:

```
>>> print("Hello!!!")
Hello!!!
```

- Call .py program via python interpreter from command line:

```
% python hello.py
```

- Make .py directly executable, with additional header lines:

```
#!/usr/bin/env python
```

- Use interactive console (e.g. IPython, Jupyter):

```
In [1]: print("Hello!!!")
Out [1]: Hello!!!
In [2]: %run hello.py
```

# Relational Databases

- A collection of data items organized as a set of formally described relations from which data can be accessed easily
- Use **SQL (Structured Query Language)** to define and manipulate relational databases
- Each database consists of a number of **relations** (a.k.a. tables) and each relation has its own **primary key (PK)**
- Relations are connected by **foreign keys (FKs)**

# SQL

- CREATE TABLE …
- INSERT INTO <table> VALUES …
- SELECT … FROM <table> …
- UPDATE <table> SET …
- DELETE FROM <table> WHERE …
- DROP TABLE …

# Relational Database Management Systems

| RDBMS | Vendor | First release | Latest release |
|---|---|---|---|
| Db2 | IBM | 1993 | 2019 |
| Access | Microsoft | 1992 | 2020 |
| SQL Server | Microsoft | 1989 | 2019 |
| MySQL | Oracle | 1995 | 2020 |
| Oracle | Oracle | 1979 | 2019 |
| PostgreSQL | PostgreSQL | 1996 | 2020 |
| SQL Anywhere | SAP | 1992 | 2015 |
| Adaptive Server Enterprise (ASE) | SAP | 1987 | 2020 |

# Optional: Install MySQL on Microsoft Windows

- Download and execute MySQL Installer from https://dev.mysql.com/downloads/installer/
- Determine the setup type:
  - Developer Default: Server and other tools, such as Workbench
  - Server Only: Server without other products
  - Custom: Enables you to select Server and other products
- To install the server instance:
  - Standalone Server / Classic Replication (default)
  - InnoDB cluster: Configure on the local host or add a new server instance to an existing InnoDB Cluster
- Complete the configuration process

# Optional: Install MySQL on MacOS

- MacOS versions that the MySQL server supports https://mysql.com/support/supportedplatforms/database.html
- General Notes on Installing MySQL on MacOS https://dev.mysql.com/doc/refman/8.0/en/osx-installation-notes.html
- MySQL for MacOS is available in different forms:
  - Native Package Installer (i.e. DMG) to walk you through the installation https://dev.mysql.com/doc/refman/8.0/en/osx-installation-pkg.html
  - Compressed TAR archive, you do not need administrator privileges https://dev.mysql.com/doc/refman/8.0/en/binary-installation.html
  - Package Installer, to simplify the management of installation https://dev.mysql.com/doc/refman/8.0/en/osx-installation-launchd.html

# Install Anaconda

- Anaconda Individual Edition
  https://anaconda.com/products/individual

## Anaconda Installers

**Windows**

Python 3.8

64-Bit Graphical Installer (466 MB)

32-Bit Graphical Installer (397 MB)

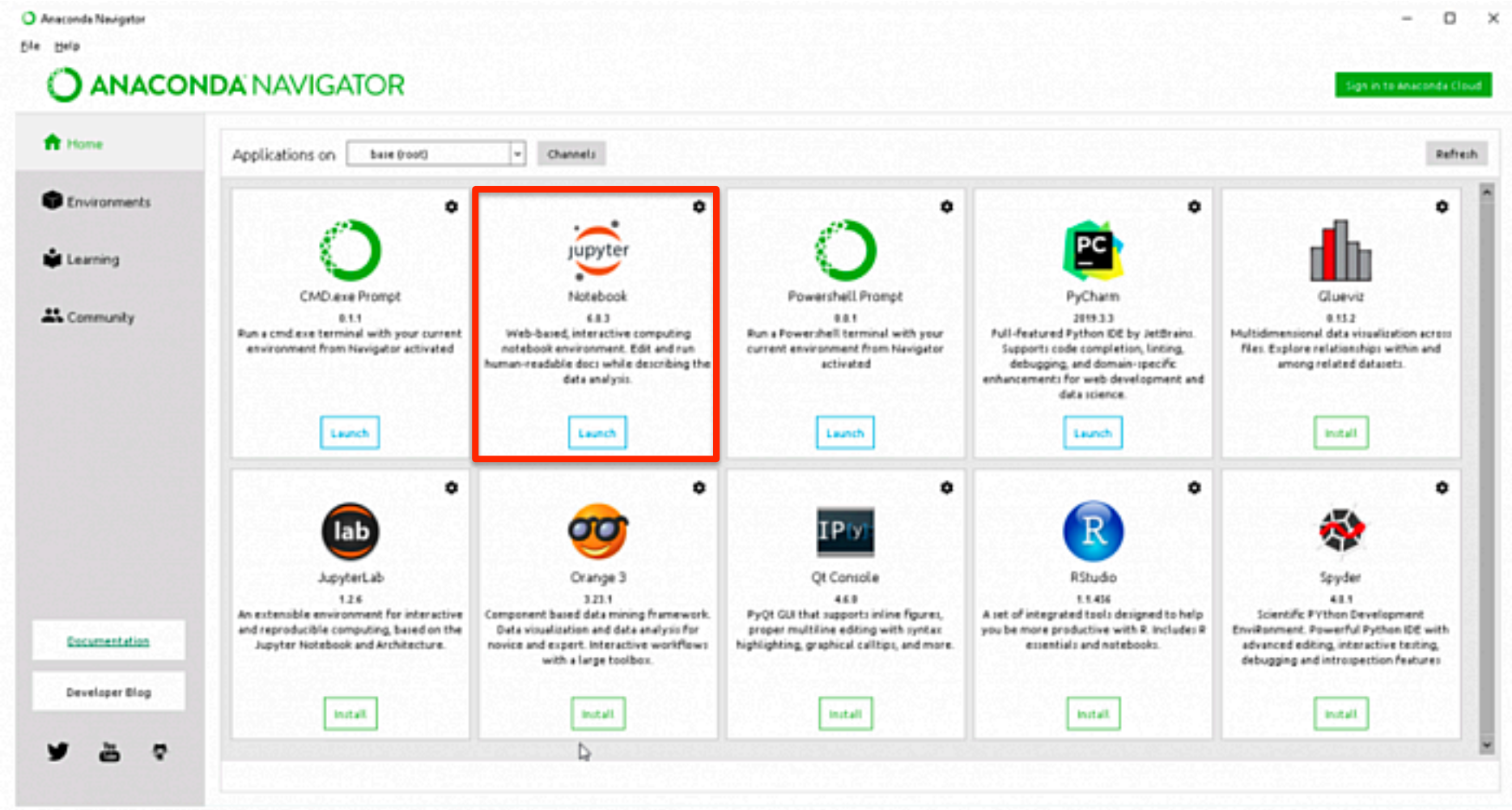
**MacOS**

Python 3.8

64-Bit Graphical Installer (462 MB)

64-Bit Command Line Installer (454 MB)

# Anaconda Navigator and Jupyter Notebook

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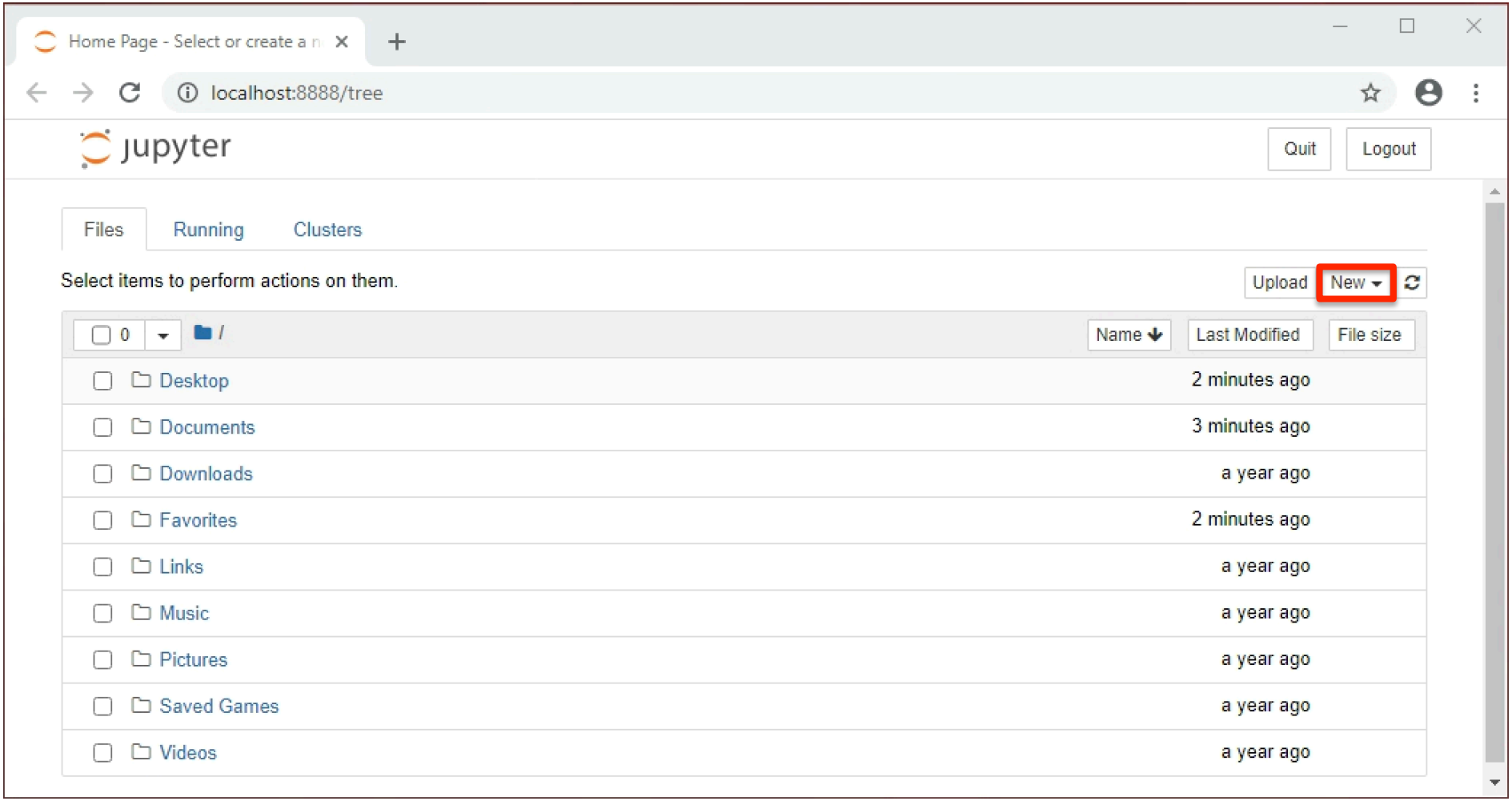
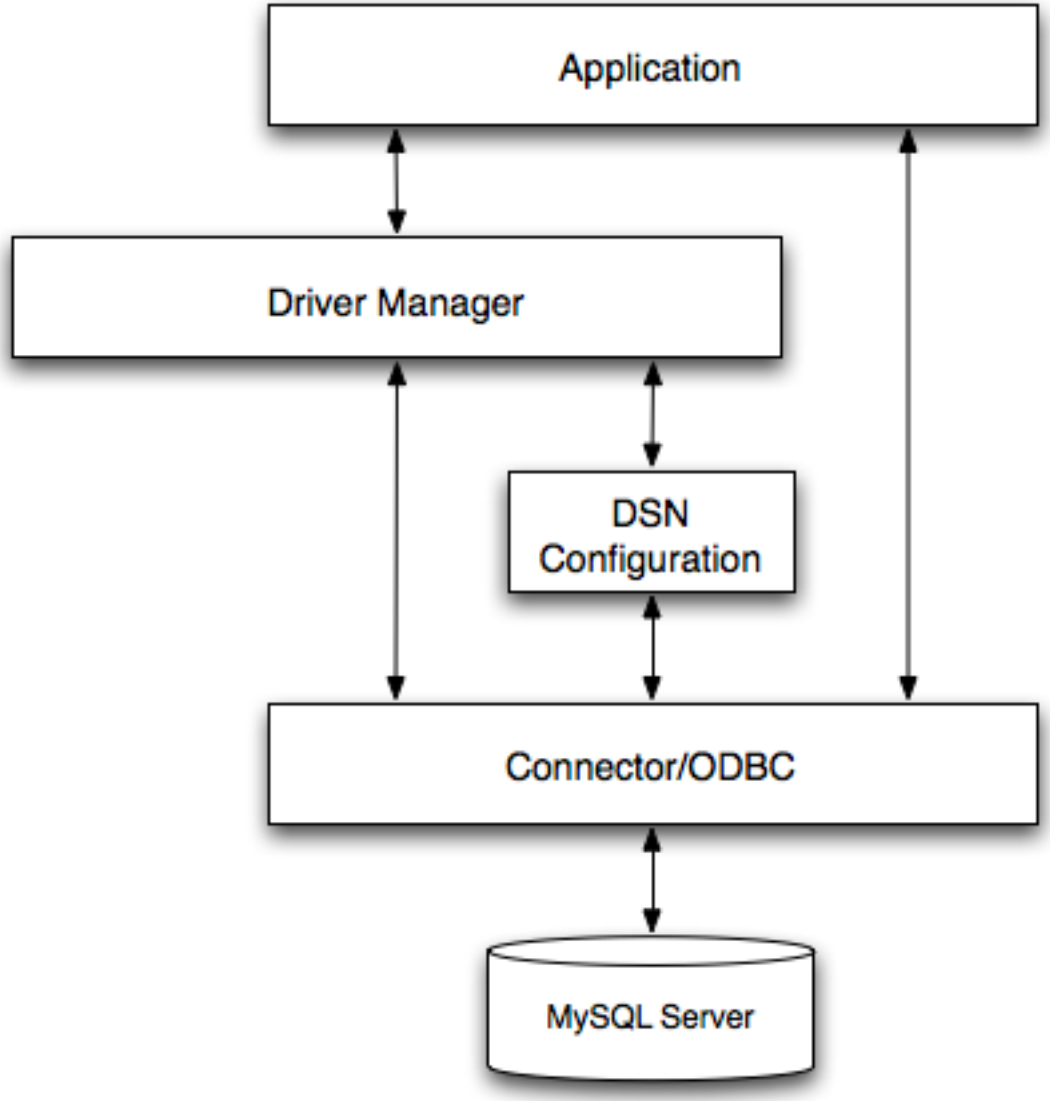
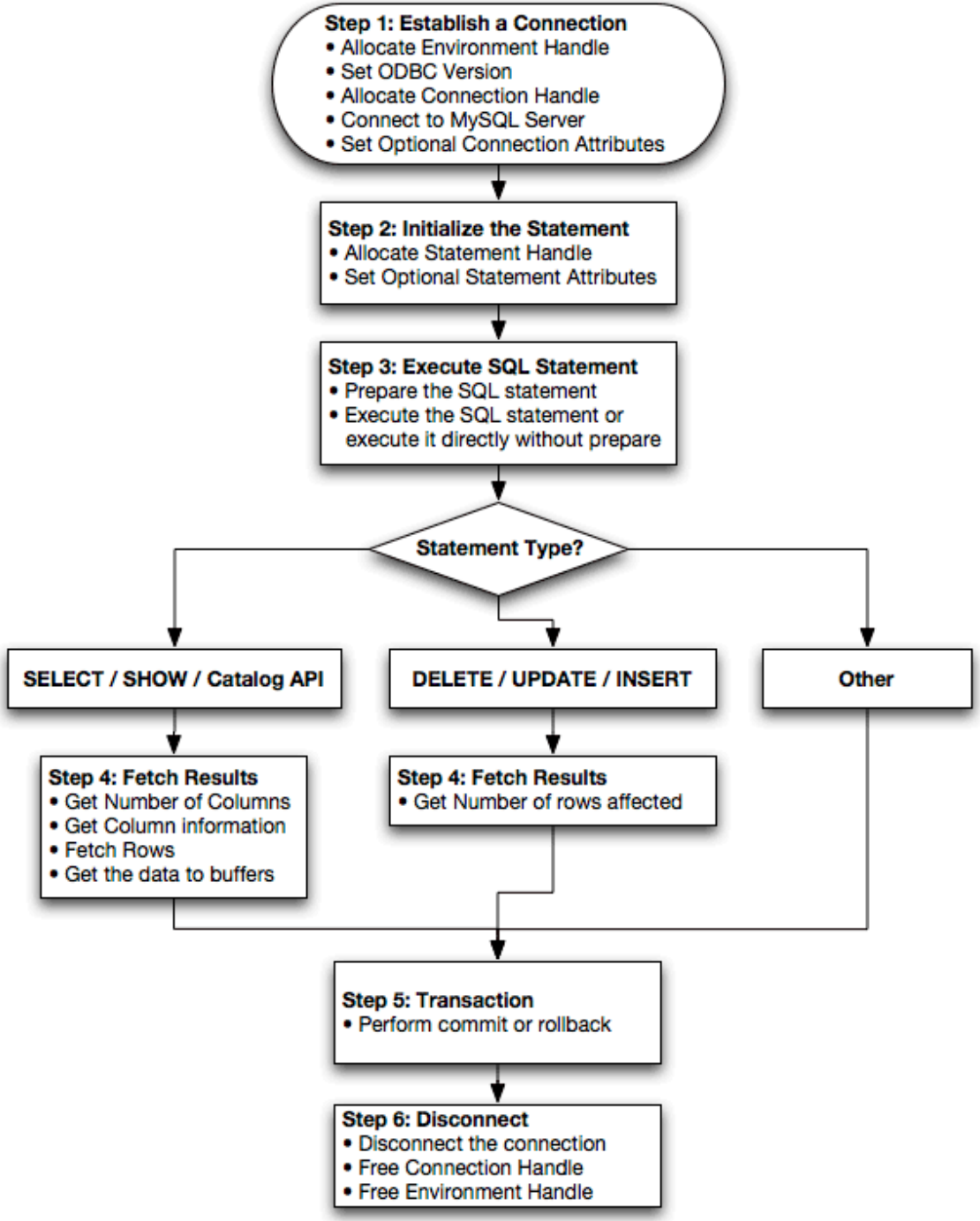
# Jupyter Notebook on vSmith



# MySQL Connector Architecture





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# Interact with MySQL Server

| | |
|---|---|
| Step 0: Configure the connection | **import ...** |
| Step 1: Establish a connection to MySQL server | **connect()** |
| Step 2: Initialize operations in SQL statement | **cursor()** |
| Step 3: Execute the SQL statement | **execute(...)** |
| Step 4: Fetch results | **fetch...()** |
| Step 5: Perform transactions | **close()** |
| Step 6: Disconnect from the server | **close()** |

# MySQL Connector Example

```
!pip install mysql-connector-python
import mysql.connector
conn = mysql.connector.connect(
host="bmgt406.rhsmith.umd.edu", user="budt703",
password="budt703", database="budt703_db")
curs = conn.cursor()
curs.execute("SELECT * FROM Employee_T")
for row in curs.fetchall():
    print(row)
curs.close()
conn.close()
```

```
('000-00-000', 'Laura Ellenburg', '5342 Picklied Trout Lane', 'Nashville', 'TN', '38010', None, None, '454-56-768')
('123-44-345', 'Phil Morris', '2134 Hilltop Rd', 'Knoxville', 'TN', '37920', None, None, '454-56-768')
('334-45-667', 'Lawrence Haley', '5970 Spring Crest Rd', 'Nashville', 'TN', '54545', None, None, '454-56-768')
('454-56-768', 'Robert Lewis', '17834 Deerfield Ln', 'Knoxville', 'TN', '55555', None, None, '123-44-345')
('559-55-585', 'Mary Smith', '75 Jane Lane', 'Clearwater', 'FL', '33879', None, None, '334-45-667')
```

# Choose Database Server Connector

- `import` **`mysql.connector`**
  `conn = mysql.connector.connect(...)`
- `import` **`mysqldb`**
  `conn = mysqldb.connect(...)`
- `import` **`sqlite3`**
  `conn = sqlite3.connect(...)`
- `import` **`pyodbc`**
  `conn = pyodbc.connect(...)`
- `import` **`cx_Oracle`**
  `conn = cx_Oracle.connect(...)`
- `...`

# Microsoft SQL Server Connector Example

```
import pyodbc
server = "doitsqlx.rhsmith.umd.edu,9703"
database = "BUDT703_DB_Student_nnn"
username = "BUDT703_Student_nnn"
password = "BUDT703_Student_nnn"
conn = pyodbc.connect("DRIVER={ODBC Driver 17
for SQL Server};SERVER=" + server +
";DATABASE=" + database + ";UID=" + username +
";PWD=" + password)
curs = conn.cursor()
curs.execute("SELECT * FROM Employee_T")
for row in curs.fetchall():
    print(row)
curs.close()
conn.close()
```

# SQLite Connector Example

- Database in memory:

```
import sqlite3
conn = sqlite3.connect(":memory:")
...
conn.close()
```

- Database in file:

```
import sqlite3
conn = sqlite3.connect("personal.db")
...
conn.close()
```

# Error Exception

```
try:
    conn = mysql.connector.connect(...)
    curs = conn.cursor()
    curs.execute(...)
    ...
    curs.close()
    conn.close()
except mysql.connector.Error as err:
    print("Error:", err)
else:
    ...
finally:
    print("Bye!")
```

# Python MySQL CREATE TABLE

- Check if a table exist:

```
curs.execute("SHOW TABLES")
for row in curs:
    print(row)
```

- Create table:

```
curs.execute("""CREATE TABLE Student(
studentId CHAR(3) NOT NULL,
studentName VARCHAR(50),
CONSTRAINT pk_Student_studentId PRIMARY KEY
(studentId) )""")
```

# Python MySQL INSERT INTO

```
curs.execute("INSERT INTO Student VALUES
('S01','First Last')")
conn.commit()

curs.execute("INSERT INTO Student VALUES (%s,
%s)" %("S02","Second Last"))
conn.commit()

try:
   sql = "INSERT INTO Student VALUES (%s,%s)"
   val = ("S03","Third Last")
   curs.execute(sql % val)
   conn.commit()
except:
   conn.rollback()
```

# Python MySQL SELECT FROM

- fetchall(): return all rows from the last executed statement

```
curs.execute("SELECT * FROM Student")
for row in curs.fetchall():
    print(row)
```

- fetchone(): return the first row from remaining of the last executed statement

```
curs.execute("SELECT * FROM Student")
print(curs.fetchone())
...
```

- rowcount: number of rows fetched

```
print(curs.rowcount)
```

# Python MySQL UPDATE SET

```
try:
    curs.execute("UPDATE Student SET
studentName = 'Bob Smith' WHERE studentId =
'S03'")
    conn.commit()
except:
    conn.rollback()
```

# Python MySQL DELETE FROM

```
try:
    curs.execute("DELETE FROM Student WHERE
studentId = 'S03'")
    conn.commit()
except:
    conn.rollback()
```

# Python MySQL DROP TABLE

- Delete a table:

```
curs.execute("DROP TABLE Student")
```

- Delete table only if exists:

```
curs.execute("DROP TABLE IF EXISTS Student")
```