

Psycopg2 tutorial pdf

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here are any number of programming languages available for you to use with PostgreSQL. One could argue that PostgreSQL as an Open Source database has one of the largest libraries of Application Programmable Interfaces (API) available for various languages. One such language is Python and it happens to be one of my favored languages. I use for almost all hacking that I do. Why? Well to be honest it is because I am not that great of a programmer. I am a database administrator and operating system consultant by trade. Python ensures that the code that I write is readable by other more talented programmers 6 months from when I stopped working on it. Nine times out of ten, when I am using Python, I am using the language to communicate with a PostgreSQL database. My driver of choice when doing so is called Psycopg. Recently Psycopg2 has been under heavy development and is currently in Beta 4. It is said that this will be the last Beta. Like the first release of Psycopg the driver is designed to be lightweight, fast. The following article discusses how to connect to PostgreSQL with Psycopg2 and also illustrates some of the nice features that come with the driver. The test platform for this article is Psycopg2, Python 2.4, and PostgreSQL 8.1dev. Psycopg2 is a DB API 2.0 compliant PostgreSQL driver that is actively developed. It is designed for multi-threaded applications and manages its own connection pool. Other interesting features of the adapter are that if you are using the PostgreSQL array data type, Psycopg will automatically convert a result using that data type to a Python list. The following discusses specific use of Psycopg. It does not try to implement a lot of Object Orientated goodness but to provide clear and concise syntactical examples of uses the driver with PostgreSQL. Making the initial connection: #!/usr/bin/python2.4 # # Small script to show PostgreSQL and Psycopg together # import psycopg2 try: conn = psycopg2.connect("dbname='template1' user='dbuser' host='localhost' password='dbpass'") except: print "I am unable to connect to the database" The above will import the adapter and try to connect to the database. If the connection fails a print statement will occur to STDOUT. You could also use the exception to try the connection again with different parameters if you like. The next step is to define a cursor to work with. It is important to note that Python/Psycopg cursors are not cursors as defined by PostgreSQL. They are completely different beasts. cur = conn.cursor() Now that we have the cursor defined we can execute a query. cur.execute("""SELECT datname from pg_database""") When you have executed your query you need to have a list [variable?] to put your results in. rows = cur.fetchall() Now all the results from our query are within the variable named rows. Using this variable you can start processing the results. To print the screen you could do the following. print "Show me the databases:" for row in rows: print " ", row[0] Everything we just covered should work with any database that Python can access. Now let's review some of the finer points available. PostgreSQL does not have an autocommit facility which means that all queries will execute within a transaction. Execution within a transaction is a very good thing, it ensures data integrity and allows for appropriate error handling. However there are queries that can not be run from within a transaction. Take the following example. #!/usr/bin/python2.4 # # import psycopg2 # Try to connect try: conn=psycopg2.connect("dbname='template1' user='dbuser' password='mypass'") except: print "I am unable to connect to the database." cur = conn.cursor() try: cur.execute("""DROP DATABASE foo_test""") except: print "I can't drop our test database!" This code would actually fail with the printed message of "I can't drop our test database!" PostgreSQL can not drop databases within a transaction, it is an all or nothing command. If you want to drop the database you would need to change the isolation level of the database this is done using the following. conn.set_isolation_level(0) You would place the above immediately preceding the DROP DATABASE cursor execution. The psycopg2 adapter also has the ability to deal with some of the special data types that PostgreSQL has available. One such example is arrays. Let's review the table below: Table "public.bar" Column | Type | Modifiers -----+-----+----- id | bigint | not null default extval('public.bar_id_seq':text) notes | text[] | Indexes: "bar_pkey" PRIMARY KEY, btree (id) The notes column in the bar table is of type text[]. The [] has special meaning in PostgreSQL. The [] represents that the type is not just text but an array of text. To insert values into this table you would use a statement like the following. foo=# insert into bar(notes) values ('{An array of text, Another array of text}') Which when selected from the table would have the following representation. foo=# select * from bar; id | notes -----+----- 2 | {"An array of text", "Another array of text"} (1 row) Some languages and database drivers would insist that you manually create a routine to parse the above array output. Psycopg2 does not force you to do that. Instead it converts the array into a Python list. #!/usr/bin/python2.4 # # import psycopg2 # Try to connect try: conn=psycopg2.connect("dbname='foo' user='dbuser' password='mypass'") except: print "I am unable to connect to the database." cur = conn.cursor() try: cur.execute("""SELECT * from bar""") except: print "I can't SELECT from bar" rows = cur.fetchall() print "Rows: " for row in rows: print " ", row[1] When the script was executed the following output would be presented. [jd@jd ~]\$ python test.py Rows: ['An array of text', 'Another array of text'] You could then access the list in Python with something similar to the following. #!/usr/bin/python2.4 # # import psycopg2 # Try to connect try: conn=psycopg2.connect("dbname='foo' user='dbuser' password='mypass'") except: print "I am unable to connect to the database." cur = conn.cursor() try: cur.execute("""SELECT * from bar""") except: print "I can't SELECT from bar" rows = cur.fetchall() for row in rows: print " ", row[1][1] The above would output the following. Rows: Another array of text Some programmers would prefer to not use the numeric representation of the column. For example row[1][1], instead it can be easier to use a dictionary. Using the example with slight modification. #!/usr/bin/python2.4 # # # load the adapter import psycopg2 # load the psycopg extras module import psycopg2.extras # Try to connect try: conn=psycopg2.connect("dbname='foo' user='dbuser' password='mypass'") except: print "I am unable to connect to the database." # If we are accessing the rows via column name instead of position we # need to add the arguments to conn.cursor. cur = conn.cursor(cursor_factory=psycopg2.extras.DictCursor) try: cur.execute("""SELECT * from bar""") except: print "I can't SELECT from bar" # Note that below we are accessing the row via the column name. rows = cur.fetchall() for row in rows: print " ", row['notes'][1] The above would output the following. Rows: Another array of text Notice that we did not use row[1] but instead used row['notes'] which signifies the notes column within the bar table. A last item I would like to show you is how to insert multiple rows using a dictionary. If you had the following: namedict = {"first_name": "Joshua", "last_name": "Drake"}, {"first_name": "Steven", "last_name": "Foo"}, {"first_name": "David", "last_name": "Bar"}) You could easily insert all three rows within the dictionary by using: cur = conn.cursor() cur.executemany("""INSERT INTO bar(first_name,last_name) VALUES (%(first_name)s, %(last_name)s)""", namedict) The cur.executemany statement will automatically iterate through the dictionary and execute the INSERT query for each row. The only downside that I run into with Psycopg2 and PostgreSQL is it is a little behind in terms of server side support functions like server side prepared queries but it is said that the author is expecting to implement these features in the near future. Resources Psycopg website Python website Python DB API 2.0 This article was originally published as Accessing PostgreSQL with Python and Psycopg2: The combination of Python and PostgreSQL is potent, particularly when you use the Psycopg2 driver. By Joshua D. Drake. August 26, 2005 To develop an application beyond a simple script, it is necessary to persist data outside of memory into a database. There are many possible choices for a database, but PostgreSQL is a robust open source platform that can easily scale to production. Python and PostgreSQL can be interfaced to develop powerful applications quickly. Psycopg is a PostgreSQL adapter that can be used to harness PostgreSQL through the Python based library. This tutorial will walk through the install of Psycopg2 and some Python code to demonstrate its use. You can install Psycopg2 through the below terminal pip command. When installing you should see the terminal output below. Collecting psycopg2 Downloading psycopg2-2.7.3.2-cp27-cp27m-macosx_10_6_intel.macosx_10_9_x86_64.macosx_10_10_x86_64.whl (1.7MB) 100% |██████████| 1.7MB 397kB/s Installing collected packages: psycopg2 Successfully installed psycopg2-2.7.3.2 Bradleys-Mini:~ BradleyPatton\$ To import the Psycopg2 package into your Python application you use the below line of code. In order to get some data to load into our database, I have borrowed some code from a previous tutorial on pandas. The below code will create a pandas DataFrame with historical data. This will then be leveraged to create a table in PostgreSQL table. def get_data(symbols, start_date, end_date): panel = data.DataReader(symbols, 'yahoo', start_date, end_date) df = panel['Close'] df.columns = map(str.lower, df.columns) hd = list(df) print df.head() return df I will now set up some housekeeping code used to run the tutorial. These two methods will be used to call the Psycopg2 methods that we create. def tutorial_run(): symbols = ['SPY', 'AAPL', 'GOOG'] df = get_data(symbols, '2006-01-03', '2017-12-31') if __name__ == "__main__": tutorial_run() In order to connect to the PostgreSQL database, we will need to add the below method. The Try\Except provides some error handling in the event that the local database is not running, or incorrect connection parameters are passed to the database. The connect method in the Psycopg2 library connects to the database with the parameters passed in the connection string. Your parameters for dbname, user, and password may differ. If the connection fails for some reason, the error message will be written to the console. This method returns the connection object back to our call method where it can be used for further database operations. def connect(): cons = psycopg2.connect(dbname='tutorial' user='postgres' host='localhost' password='password') try: conn = psycopg2.connect(cons) print "Connected" except: print "I am unable to connect to the database" return conn Once we have established the connection to the PostgreSQL database, we can load our data from the get_data() method into our database. Psycopg2 and pandas make this a very simple process. The first line defines the method that pandas should use to connect to the database in order to copy the DataFrame. You will provide the same parameters as your connection method. The second line of code persists the DataFrame to the PostgreSQL database with the to_sql() method. def create_table(table, df): engine = create_engine('postgresql+psycopg2://postgres::5432/tutorial') df.to_sql(table, engine, if_exists='replace') A quick look in our PostgreSQL pgAdmin terminal shows that the code successfully loaded the DataFrame into the table "close". Now that we have some data loaded into our database. We can use psycopg to run some queries on the data. The below method is constructed to take the connection established in our first method and run a query on our PostgreSQL database. In order to create the 4 SQL objects we need to add another import statement. In order to create dynamic SQL commands, psycopg uses string formatting to populate variables into the string using the %s and {} operators. PostgreSQL is case sensitive. In the get_data() method we forced our column headers to lowercase. The index was not included in this instruction. In order to pass the capital "Data" column header in the query, we need to pass it to PostgreSQL in double quotes. To do this in a string in Python, you need to send the escape character \" before the double quotes. We can replace the "%s" in the string using the python string formatting syntax below. This replaces the %s with our date parameter dt. To execute the SQL query that was created. You then need to pass it to the cursor's .execute() method. By calling the .fetchall() method, you return the results of the query. When printed to the console you can display the results. def get_row(dt, conn): cr = conn.cursor() query = sql.SQL("SELECT aapl from close WHERE \"Date\" = '%s'" % dt) cr.execute(query) print cr.fetchall() To run this function we add the below line of code to the tutorial_run() method. You should get similar results to the below. get_row("2017-12-29",conn) In the next method, we will utilize the string format methods to pass in multiple parameters into our query. This query will take a date and three columns. In addition to using the %s operator, we will utilize the {} operator to join string variables into our query string. Our query string now uses the join below with a "," separator to pass multiple column names into our query. def get_cols(dt, col1, col2, col3, conn): cr = conn.cursor() query = sql.SQL("SELECT {} from close WHERE \"Date\" = '%s'" % dt).format(sql.SQL(',').join([sql.Identifier(col1), sql.Identifier(col2), sql.Identifier(col3)])) cr.execute(query) print cr.fetchall() In order to use our new method I will add the below line to our tutorial_run() method. You should see the results below. get_cols("2017-12-29", "aapl", "spy", "goog", conn) The next method that we write will use two {} string replacements to pull all of the data in our table with the exception of our index. This method builds on our previous method by adding a second replace bracket notation "{}". This time the brackets are numbered so that they are replaced in the order format notion code. Our new method joins the three column parameters with comma separator. In addition, the second parameter in the format method is the table variable. The query string is then constructed by replacing the brackets with the parameters in the format method in order. That is {0} = columns and {1} = table name. def get_tab(table, col1, col2, col3, conn): cr = conn.cursor() query = sql.SQL("SELECT {0} from {1}").format(sql.SQL(',').join([sql.Identifier(col1), sql.Identifier(col2), sql.Identifier(col3)]), sql.Identifier(table)) cr.execute(query) print cr.fetchall() In order to use our new method I will add the below line to our tutorial_run() method. You should see the results below. get_tab("close", "aapl", "spy", "goog", conn) There are many more methods to explore in the psycopg library. This should get you started with a good understanding of psycopg functions. I have provided some more resources below in documentation pages that will allow you to more extensively explore the library. Full Code import psycopg2 from psycopg2 import sql import pandas_datareader as data def get_data(symbols, start_date, end_date): panel = data.DataReader(symbols, 'yahoo', start_date, end_date) df = panel['Close'] df.columns = map(str.lower, df.columns) hd = list(df) print df.head() return df def connect(): cons = psycopg2.connect(dbname='tutorial' user='postgres' host='localhost' password='password') try: conn = psycopg2.connect(cons) print "Connected" except: print "I am unable to connect to the database" return conn def create_table(table, df): engine = create_engine('postgresql+psycopg2://postgres::5432/tutorial') df.to_sql(table, engine, if_exists='replace') def get_row(dt, conn): cr = conn.cursor() query = sql.SQL("SELECT aapl from close WHERE \"Date\" = '%s'" % dt) cr.execute(query) print cr.fetchall() def get_cols(dt, col1, col2, col3, conn): cr = conn.cursor() query = sql.SQL("SELECT {} from close WHERE \"Date\" = '%s'" % dt).format(sql.SQL(',').join([sql.Identifier(col1), sql.Identifier(col2), sql.Identifier(col3)])) cr.execute(query) print cr.fetchall() def get_tab(table, col1, col2, col3, conn): cr = conn.cursor() query = sql.SQL("SELECT {0} from {1}").format(sql.SQL(',').join([sql.Identifier(col1), sql.Identifier(col2), sql.Identifier(col3)]), sql.Identifier(table)) cr.execute(query) print cr.fetchall() def tutorial_run(): conn = connect() symbols = ['SPY', 'AAPL', 'GOOG'] df = get_data(symbols, '2006-01-03', '2017-12-31') create_table("close", df) get_row("2017-12-29", conn) get_cols("2017-12-29", "aapl", "spy", "goog", conn) get_tab("close", "aapl", "spy", "goog", conn) if __name__ == "__main__": tutorial_run() References initd.org/psycopg initd.org/psycopg/docs/install.html wiki.postgresql.org/wiki/PostgreSQL_Tutorial

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