Breaking out of PASE:

Access the rest of IBM i from Python

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Quick intro

“Getting Started” Resources

- Information on installing/managing general open source
  - http://ibm.biz/ibmi-rpms
- Examples repository on GitHub
  - http://github.com/IBM/ibmi-oss-examples
  -

What is it?

- "Python is a clear and powerful object-oriented programming language, comparable to Perl, Ruby, Scheme, or Java."
  - Python Wiki

- Elegant syntax
- Easy to use
- Easy to extend
- Embeddable
- Powerful
- Popular

The Zen of Python

- Beautiful is better than ugly.
- Explicit is better than implicit.
- Simple is better than complex.
- Complex is better than complicated.
- Flat is better than nested.
- Sparse is better than dense.
- Readability counts.
- Special cases aren't special enough to break the rules.
- Although practicality beats purity.
- Errors should never pass silently.
- Unless explicitly silenced.
- … and more at https://www.python.org/dev/peps/pep-0020/

High Level Language

- Built-in regular expression support
- No compiling needed
- Great at data storage and manipulation
  - Arrays
  - Hash maps
  - List comprehensions
- Easy to build web applications

Lots of Tools in the Toolbox

- Got a problem? Somebody's probably solved it already!!
- Additional packages on the Python Package Index (PyPI)
  - Over 212,000 projects available
- What tools available?
  - Data parsing: CSV, XML, JSON, HTML, Excel, …
  - Internet Protocols: HTTP, FTP, TELNET, SMTP, POP3
  - Web services: REST, SOAP, XML-RPC, JSON-RPC, ...
  - Web service wrappers: Twitter, Jenkins, GitHub, …
  - Message Queuing
  - Image manipulation
  - Data analytics
  - Database access
  - Web application serving

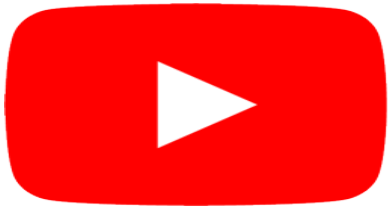
Why Else?

- Simple, straightforward language
- People know it!
  - used heavily in the industry
  - taught in Academia

Origin of the "Python" name?

- "Now, it's quite simple to defend yourself against a man armed with a banana. First of all you force him to drop the banana; then, second, you eat the banana, thus disarming him. You have now rendered him helpless."
- "This parrot is no more! He has ceased to be!"
- "I'm sorry to have kept you waiting, but I'm afraid my walk has become rather sillier recently."
- "I don't like Spam©!"
- "That rabbit's dynamite!"

Web Sites Using Python

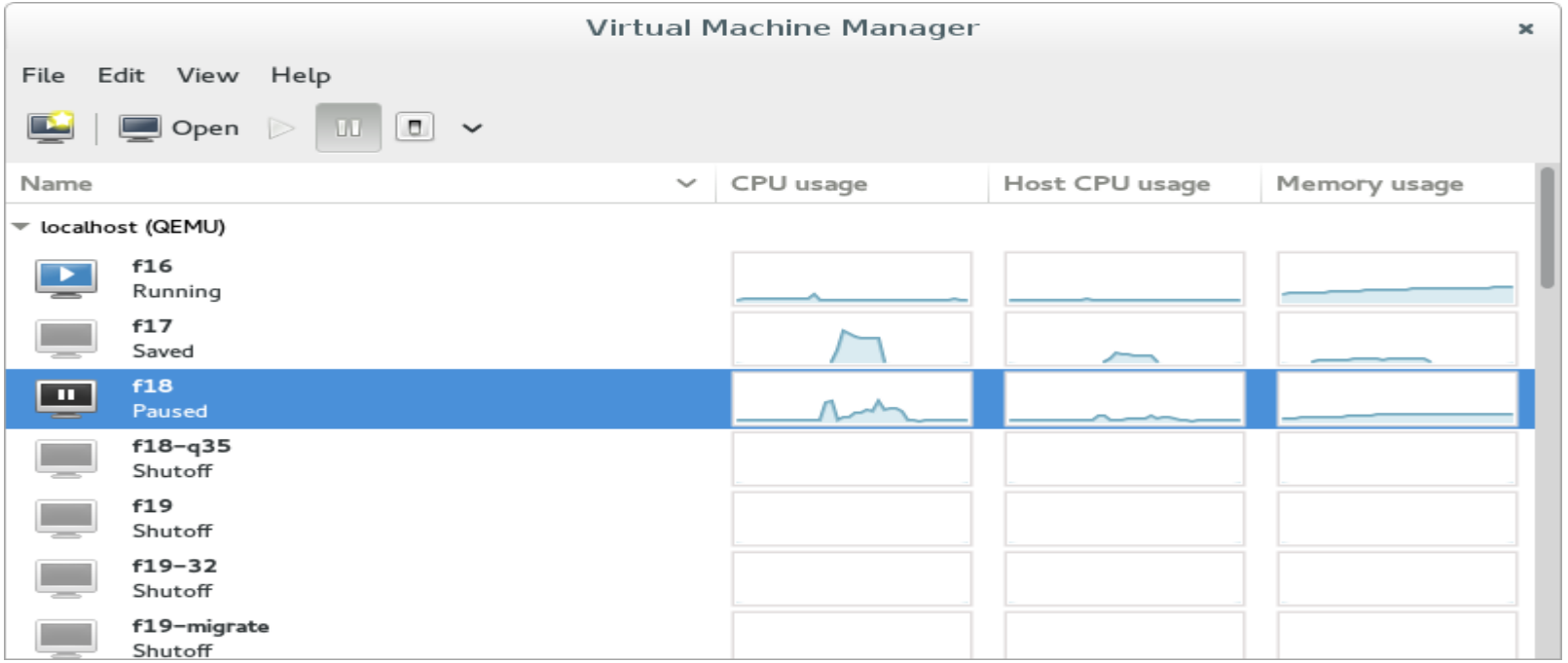


YouTube

moz://a

Bitbucket

Python GUI Applications: VM Manager

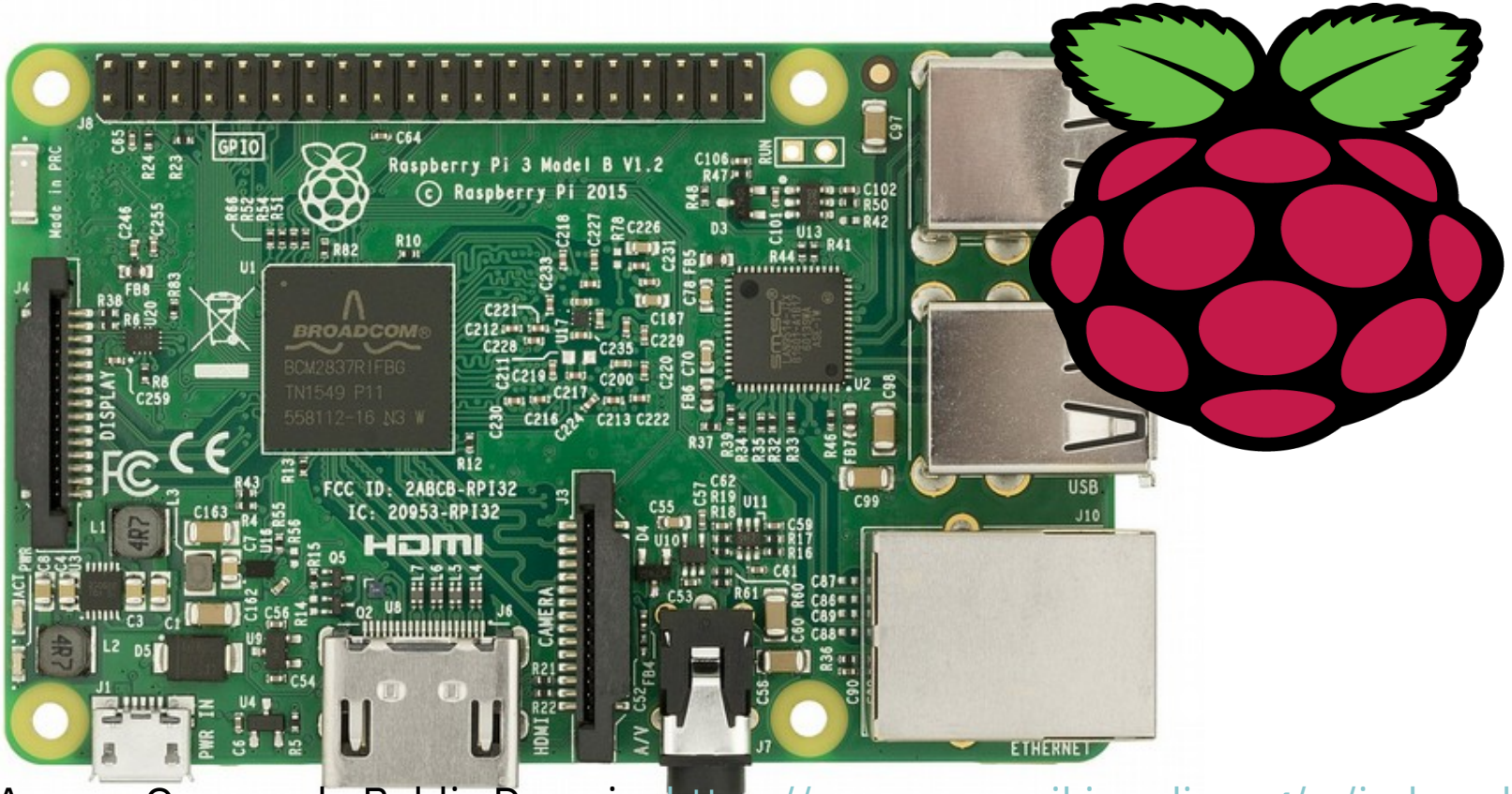


Other Applications Using Python

WebSphere®
Application Server

LibreOffice
The Document Foundation

Raspberry Pi



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Python success stories!

- https://www.python.org/about/success/

- 41 real-life success stories across multiple domains

Assistive Technologies

- Python in The Blind Audio Tactile mapping System
- A Custom Image Viewing Game for an Autistic Child

Code Generation

- Cog: A Code Generation Tool Written in Python

Computer Graphics

- Industrial Light & Magic Runs on Python

Configuration

- D-Link Australia Uses Python to Control Firmware Updates
- Python as Technology Enabler for TTTech's Development Software

Language Basics

Language basics

- Indentation matters!

- Typing
  - Java and other "traditional" compiled languages are statically typed
  - Python is dynamically typed

- Don't need to declare variables before using them

```
x = 7
```

- New objects constructed without 'new' keyword

```
thing = MyClass()
```

Language basics (sequences)

- Lists
  - Declared like this:
    [0, 1, 2, 3, 4]
  - Mutable
  - Can access items with positive or negative index
  - List comprehensions can be used (we'll learn about these)

- Tuples
  - Declared like this:
    (0, 1, 2, 3, 4)
  - Immutable
  - Can access items with positive or negative index

Language basics (data structures)

- Dictionaries
  - Key/value pairs
  - Declared like this:

    {'this':7, 'that': 12, 'the other thing': 42}
  - Mutable
  - Can access items via key

- Sets
  - Declared like this:

    set("Jesse G")

    set(['N', 'H', 'M', 'U', 'G'])
  - Mutable, but can only contain immutable objects
  - Methods for set operations (supersets, intersections, etc)

Database Access with ibm_db

Database Access Just a Pip Away

- ibm_db project: https://github.com/ibmdb/python-ibmdb
- Cross-platform, open source project sponsored by IBM
- Uses IBM i SQL CLI interface in PASE to access the database from IBM i.
  - Can be used with Db2 Connect from other platforms.
- The ibm_db_dbi module complies with the Python Database API version 2 specified in PEP-249: https://www.python.org/dev/peps/pep-0249/
- The lower-level ibm_db module is IBM-specific and more of a pain to use. **(Not recommended)**
- Install:
  - `yum install python3-ibm_db`

Dive In the Water's Fine

```
import ibm_db_dbi

conn = ibm_db_dbi.connect()
cursor = conn.cursor()

cursor.execute('select * from qiws.qcustcdt')
for row in cursor:
    print(row)

conn.disconnect()
```

Dive In the Water's Fine

```
import ibm_db_dbi as db2

conn = db2.connect()
cursor = conn.cursor()

cursor.execute('select * from qiws.qcustcdt')
for row in cursor:
    print(row)

conn.disconnect()
```

Dive In the Water's Fine

```
from ibm_db_dbi import connect


conn = connect()
cursor = conn.cursor()


cursor.execute('select * from qiws.qcustcdt')
for row in cursor:
    print(row)


conn.disconnect()
```

Where’s the Fetch?

- Cursor objects have 3, mostly unused fetch methods…
  - fetchone()
  - fetchmany(count)
  - fetchall()
- Because cursor objects are also iterators!

Dive In the Water's Fine

```
cur.execute('select * from qiws.qcustcdt')

one_row = cur.fetchone()
print(row)

five_rows = cur.fetchmany(5)
for row in five_rows:
    print(row)

remaining_rows = cur.fetchall()
for row in remaining_rows:
    print(row)
```

Connect (to the) Matrix

```
# *LOCAL w/ myuser
conn = db2.connect(user="myuser", password="Passw0rd")

# MyRDB w/ current user
conn = db2.connect(database="MyRDB")

# Same as above, but using connection string
conn = db2.connect("DATABASE=*LOCAL;UID=myuser;PWD=Passw0rd")
conn = db2.connect("DATABASE=MyRDB")
```

Execute All the Things!

```
cursor.execute("create table mytable(i int, d double, c char(10)")

cursor.execute("insert into mytable values(4, 32.5, 'foo')")

cursor.execute("update mytable set i=5 where i=4")

cursor.execute("delete from mytable where i<4")

cursor.execute(ANY SQL HERE)
```

Don’t Inject that SQL

```
sql = f"update mytable set phone='{phn}' where id={id}"
cursor.execute(sql)
```

Don’t Inject that SQL

```
sql = f"update mytable set phone='{phn}' where id={id}"

cursor.execute(sql)


phn = "876-5309', salary=200000 where id=1234 --"

id = 1234


cursor.execute(f"update mytable set phone='876-5309',
salary=200000 where id=1234 --' where id=1234")
```

Parameterize It

~~sql = f"update mytable set phone='{phn}' where id={id}"~~

```
sql = f"update mytable set phone=? where id=?"
cursor.execute(sql, (phn, id))
```

```
cursor.execute("""create or replace procedure myproc(in x int, out
y int, inout z int)
language sql
begin
  set y = x + z; set z = x * 5; set x = 10;
end""")


cursor.execute("call myproc(?,?,?)", (19,23,41))


# Where are output parameters?
```

```
cursor.execute("""create or replace procedure myproc(in x int, out
y int, inout z int)
language sql
begin
  set y = x + z; set z = x * 5; set x = 10;
end""")


(x, y, z) = cursor.callproc("myproc", (19, 23, 41))


print(x, y, z) # 19 60 95
```

Cursor objects

```
cur.callproc("proc_returns_3_rs")


rs = True
while rs:
    for row in cur:
        print(row)

    rs = cur.nextset()
```

```
cur.execute("insert into t(c) values('Huh?')")

conn.close()

conn = db2.connect();
cur = conn.cursor()

cur.execute("select * from t where c = 'Huh?'")
rows = cur.fetchall()

assert len(rows) == 1
```

```
cur.execute("insert into t(c) values('Aha!')")
conn.commit()
conn.close()

conn = db2.connect();
cur = conn.cursor()

cur.execute("select * from t where c = 'Aha!'")
rows = cur.fetchall()

assert len(rows) == 1
```

```
conn.set_autocommit(True)
cur.execute("insert into t(c) values('Aha!')")
conn.close()

conn = db2.connect();
cur = conn.cursor()

cur.execute("select * from t where c = 'Aha!'")
rows = cur.fetchall()

assert len(rows) >= 1
```

```
cur.execute("select 1 from sysibmi.sysdummy1")
print(cur.fetchone()[0])
```

```
cur.execute("select 1 from sysibmi.sysdummy1")
print(cur.fetchone()[0])

Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "/QOpenSys/pkgs/lib/python3.6/site-packages/ibm_db-2.0.5.6-
py3.6-os400-powerpc64.egg/ibm_db_dbi.py", line 1387, in execute
    self._prepare_helper(operation)
  File "/QOpenSys/pkgs/lib/python3.6/site-packages/ibm_db-2.0.5.6-
py3.6-os400-powerpc64.egg/ibm_db_dbi.py", line 1250, in
_prepare_helper
    raise self.messages[-1]
ibm_db_dbi.ProgrammingError: ibm_db_dbi::ProgrammingError: SYSDUMMY1
in SYSIBMI type *FILE not found. SQLSTATE=42704 SQLCODE=-204
```

```
try:
    cur.execute("select 1 from sysibmi.sysdummy1")
    print(cur.fetchone()[0])
except db2.ProgrammingError e:
    print(e)
```

```
cur.callproc('qcmdexc', ('ADDLIBLE QIWS',))
cur.execute("select * from qcustcdt")
for row in cur:
    print(row)
```

```
cur.callproc('qcmdexc', ('ADDLIBLE QIWS',))
cur.execute("select * from qcustcdt")
for row in cur:
    print(row)


# ibm_db_dbi::ProgrammingError: QCUSTCDT in KADLER type *FILE not
found. SQLSTATE=42704 SQLCODE=-204
```

```
from ibm_db import SQL_ATTR_DBC_SYS_NAMING, SQL_TRUE

options = { SQL_ATTR_DBC_SYS_NAMING: SQL_TRUE }
conn = db2.connect(conn_options=options)
cur = conn.cursor()

cur.callproc('qcmdexc', ('ADDLIBLE QIWS',))
cur.execute("select * from qcustcdt")
for row in cur:
    print(row)
```

```
cur.execute('create table qtemp.foo(i int)')
cur.execute('insert into qtemp.foo values(1)')
```

```
cur.execute('create table qtemp.foo(i int)')

cur.execute('insert into qtemp.foo values(1)')


# ibm_db_dbi::ProgrammingError: Statement Execute Failed: FOO in
QTEMP not valid for operation. SQLSTATE=55019 SQLCODE=-7008
```

```
from ibm_db import SQL_ATTR_TXN_ISOLATION, SQL_TXN_NO_COMMIT

conn.set_option({ SQL_ATTR_TXN_ISOLATION: SQL_TXN_NO_COMMIT })
cur = conn.cursor()

cur.execute('create table qtemp.foo(i int)')
cur.execute('insert into qtemp.foo values(1)')
```

```
import ibm_db_dbi as db2
from ibm_db import SQL_ATTR_DBC_SYS_NAMING, SQL_TRUE
from ibm_db import SQL_ATTR_TXN_ISOLATION, SQL_TXN_NO_COMMIT
options = {
    SQL_ATTR_TXN_ISOLATION: SQL_TXN_NO_COMMIT,
    SQL_ATTR_DBC_SYS_NAMING: SQL_TRUE,
}
conn = db2.connect()
conn.set_option(options)
```

Cursor description

- description – read-only attribute
  - “2d” sequence describing the columns
  - each index contains a 7-item sequence for that column in this order:
    - name – column name
    - type_code – ibm_db_dbi type object
    - display_size – how many characters needed to display
    - internal_size – how many bytes needed to store
    - precision – total digits for NUMERIC/DECIMAL columns
    - scale – digits after decimal for NUMERIC/DECIMAL/TIMESTAMP columns
    - null_ok – is the column nullable?

Example: Converting table to text table

```
from prettytable import from_db_cursor
import ibm_db_dbi as db2

conn = db2.connect()

cur = conn.cursor()
cur.execute("select * from qiws.qcustcdt")
print(from_db_cursor(cur))
```

Example: Converting table to text table

CUSNUM	LSTNAM	INIT	STREET	CITY	STATE	ZIPCOD	CDTLMT	CHGCOD	BALDUE	CDTDUE
938472	Henning	G K	4859 Elm Ave	Dallas	TX	75217	5000	3	37.00	0.00
839283	Jones	B D	21B NW 135 St	Clay	NY	13041	400	1	100.00	0.00
392859	Vine	S S	PO Box 79	Broton	VT	5046	700	1	439.00	0.00
938485	Johnson	J A	3 Alpine Way	Helen	GA	30545	9999	2	3987.50	33.50
397267	Tyron	W E	13 Myrtle Dr	Hector	NY	14841	1000	1	0.00	0.00
389572	Stevens	K L	208 Snow Pass	Denver	CO	80226	400	1	58.75	1.50
846283	Alison	J S	787 Lake Dr	Isle	MN	56342	5000	3	10.00	0.00
475938	Doe	J W	59 Archer Rd	Sutter	CA	95685	700	2	250.00	100.00
693829	Thomas	A N	3 Dove Circle	Casper	WY	82609	9999	2	0.00	0.00
593029	Williams	E D	485 SE 2 Ave	Dallas	TX	75218	200	1	25.00	0.00
192837	Lee	F L	5963 Oak St	Hector	NY	14841	700	2	489.50	0.50
583990	Abraham	M T	392 Mill St	Isle	MN	56342	9999	3	500.00	0.00

Example: Converting table to Excel spreadsheet

```
from xlsxwriter import Workbook
import ibm_db_dbi as db2

conn = db2.connect()
cur = conn.cursor()
cur.execute("select * from qiws.qcustcdt")

headers = [descr[0] for descr in cur.description]

with Workbook('qcustcdt.xlsx') as workbook:
    worksheet = workbook.add_worksheet()

    worksheet.write_row('A1', headers)
    for rownum, row in enumerate(cur, start=1):
        worksheet.write_row(rownum, 0, row)
```

Example: Converting table to Excel spreadsheet

	A	B	C	D	E	F	G	H	I	J	K
1	CUSNUM	LSTNAM	INIT	STREET	CITY	STATE	ZIPCOD	CDTLMT	CHGCOD	BALDUE	CDTDUE
2	938472	Henning	G K	4859 Elm	Dallas	TX	75217	5000	3	37	0
3	839283	Jones	B D	21B NW	Clay	NY	13041	400	1	100	0
4	392859	Vine	S S	PO Box 7	Broton	VT	5046	700	1	439	0
5	938485	Johnson	J A	3 Alpine V	Helen	GA	30545	9999	2	3987.5	33.5
6	397267	Tyron	W E	13 Myrtle	Hector	NY	14841	1000	1	0	0
7	389572	Stevens	K L	208 Snow	Denver	CO	80226	400	1	58.75	1.5
8	846283	Alison	J S	787 Lake	Isle	MN	56342	5000	3	10	0
9	475938	Doe	J W	59 Archer	Sutter	CA	95685	700	2	250	100
10	693829	Thomas	A N	3 Dove C	Casper	WY	82609	9999	2	0	0
11	593029	Williams	E D	485 SE 2	Dallas	TX	75218	200	1	25	0
12	192837	Lee	F L	5963 Oak	Hector	NY	14841	700	2	489.5	0.5
13	583990	Abraham	M T	392 Mill S	Isle	MN	56342	9999	3	500	0
14											
15											

Database Access with pyodbc

Can you ODBC me?

- pyodbc https://github.com/mkleehammer/pyodbc
- Python wrapper around ODBC
- Conforms to PEP-249 interface – same API as ibm_db_dbi*
- Works anywhere with an ODBC driver manager (macOS, Windows, Linux, PASE)
- Same interface for multiple drivers (Db2, MySQL, MS SQL, PostgreSQL, ...)
- Use IBM i Access ODBC driver on Linux and Windows... and now in PASE!
- Install:
  - `yum install python3-devel unixODBC-devel`
  - `pip3 install pyodbc`

Dive In the Water's Fine, Redux

```
import pyodbc

conn = pyodbc.connect("DSN=*LOCAL")
cursor = conn.cursor()

cursor.execute('select * from qiws.qcustcdt')
for row in cursor:
    print(row)

conn.disconnect()
```

DSN

- Data Source Names (DSN) are basically a collection of configuration options
  - What system (hostname)
  - What options (sytem naming, database, etc)
- System DSNs available to everyone
  - `/QOpenSys/etc/odbc.ini`
- User DSNs specific to a user
  - `~/.odbc.ini`

IBM i Access ODBC Driver for PASE

- Available from IBM i Access download site (soon!!)
- Provides System DSN *LOCAL out of the box
  - Needs 7.3 PTF SI68113 or 7.2 PTF SI69058 to use without a password
- Install with yum
  - `yum install ibm-iaccess-1.1.0.11-0.ibmi7.2.ppc64.rpm`

Configuring IBM i Access Driver

- Other configuration options documented here
  - https://www.ibm.com/support/knowledgecenter/en/ssw_ibm_i_74/rzaik/connectkeywords.htm
- Useful options
  - CommitMode – default isolation level *(*CHG)*
  - TrueAutoCommit – whether ODBC autocommit changes isolation level to *NONE *(yes)*
  - Naming – whether to use SQL or system naming *(SQL)*
  - DefaultLibraries – sets the connection's library list

```
cursor.execute("""create or replace procedure myproc(in x int, out
y int, inout z int)
language sql
begin
  set y = x + z; set z = x * 5; set x = 10;
end""")


(x, y, z) = cursor.callproc("myproc", (19, 23, 41))


print(x, y, z) # 19 60 95
```

```
cursor.execute("""create or replace procedure myproc(in x int, out
y int, inout z int)
language sql
begin
  set y = x + z; set z = x * 5; set x = 10;
end""")


(x, y, z) = cursor.callproc("myproc", (19, 23, 41))


print(x, y, z) # 19 60 95
```

Note: pyodbc doesn't support callproc or output parameters

Calling ILE with itoolkit

itoolkit – an XMLSERVICE wrapper

- itoolkit project: https://ibm.biz/itoolkitpython
- Python interface to XMLService: https://ibm.biz/xmlservice
- Let's you call
  - RPG programs and service programs
  - CL commands
  - PASE programs and shell scripts
  - SQL database access
- `yum install python3-itoolkit`
- `pip3 install itoolkit`

What Can We Do?

- Commands
  - iCmd – Call CL command (even with output parameters)
  - iCmd5250 – call CL command and get screen output
- Programs
  - iPgm – Call program
  - iSrvPgm – Call service program
- iSh – call PASE program or shell script
- iXml – anything else

Which Transport is Right for You?

- DirectTransport
- DatabaseTransport
- HttpTransport
- SshTransport

Requires itoolkit 1.6 or higher.
Previous transport classes still supported, but deprecated.

DatabaseTransport

- Stored procedure call over database connection
- Any* PEP-249 connection object can be used
  - ibm_db_dbi
  - pyodbc
- No configuration needed using ibm_db_dbi when used locally
- Can use pyodbc with IBM i Access driver
- Local and remote connections supported
  - Using ibm_db_dbi remotely requires Db2 Connect license

HttpTransport

- Calls using HTTP REST API
- Requires XMLSERVICE configured as a FastCGI endpoint in Apache
- Uses Apache TLS configuration for security
- Local and remote connections supported

DirectTransport

- No configuration needed
- Fastest call, runs in current job
- Some things don't work from chroot
- Currently broken with 64-bit Python (ie yum version)
- Local connection only

SshTransport

- Calls over SSH using Paramiko package
- Requires `xmlservice-cli` package installed on the target system
- Uses SSH for security
- Local and remote connections supported

Connecting

```
# DirectTransport example
from itoolkit import *
from itoolkit.transport import DirectTransport

itransport = DirectTransport()

# HttpTransport example
from itoolkit import *
from itoolkit.transport import HttpTransport

itransport = HttpTransport(url, user, password)
```

Connecting

```
# DatabaseTransport examples
from itoolkit import *
from itoolkit.transport import DatabaseTransport

# using ibm_db
import ibm_db_dbi
itransport = DatabaseTransport(ibm_db_dbi.connect())

# using pyodbc
import pyodbc
itransport = DatabaseTransport(pyodbc.connect("DSN=myDSN"))
```

Basics

```
from itoolkit import *
from itoolkit.transport import DatabaseTransport
import ibm_db_dbi
itransport = DatabaseTransport(ibm_db_dbi.connect())
itool = iToolKit()
itool.add(iFoo('op1’, ...))
itool.add(iBar('op2', ...))
itool.call(itransport)
op1 = itool.dict_out('op1')
if 'success' in op1:
    print (op1['success'])
else:
    print (op1['error'])
```

Calling Standard CL Commands

```
itool.add(iCmd('addlible', 'ADDLIBLE KADLER'))


itool.call(itransport)

rtvjoba = itool.dict_out('rtvjoba')

if 'error' in rtvjoba:
    print("Encountered an error")
```

Output Parameters from CL Commands

```
itool.add(iCmd('rtvjoba', \
               'RTVJOBA USRLIBL(?) SYSLIBL(?) CCSID(?N) OUTQ(?)'))
itool.call(itransport)
rtvjoba = itool.dict_out('rtvjoba')
if 'success' in rtvjoba:

    print(rtvjoba['row'][0]['USRLIBL'])
    print(rtvjoba['row'][1]['SYSLIBL'])
    print(rtvjoba['row'][2]['CCSID'])
    print(rtvjoba['row'][3]['OUTQ'])
```

Output Parameters, Sensible

```
itool.add(iCmd('rtvjoba', \
               'RTVJOBA USRLIBL(?) SYSLIBL(?) CCSID(?N) OUTQ(?)'))
itool.call(itransport)
rtvjoba = itool.dict_out('rtvjoba')
if 'success' in rtvjoba:
    rtvjoba = { k: v for d in rtvjoba['row'] for k, v in d.items() }
    print(rtvjoba['USRLIBL'])
    print(rtvjoba['SYSLIBL'])
    print(rtvjoba['CCSID'])
    print(rtvjoba['OUTQ'])
```

Command Display Output

```
itool.add(iCmd5250('wrkactjob_key', 'WRKACTJOB'))


itool.call(itransport)
wrkactjob = itool.dict_out('wrkactjob_key')
print(wrkactjob['wrkactjob_key'])
```

Command Display Output

```
                                    Work with Active Jobs                                                    Page    1
 5770SS1 V7R2M0 140418                                                                  DBCSB3P2  05/09/18  11:18:59 CDT
 Reset . . . . . . . . . . . . . . . . . :   *NO
 Subsystems  . . . . . . . . . . . . . . :   *ALL
 CPU Percent Limit . . . . . . . . . . . :   *NONE
 Response Time Limit . . . . . . . . . . :   *NONE
 Sequence  . . . . . . . . . . . . . . . :   *SBS
 Job name  . . . . . . . . . . . . . . . :   *ALL
 CPU %  . . . :      .0          Elapsed time . . . . . . . :   00:00:00          Active jobs . . . . . . :    233
                                     Current                            --------Elapsed---------
Temporary
 Subsystem/Job  User        Number   User        Type Pool Pty     CPU   Int    Rsp  AuxIO   CPU%  Function       Status   Threads    Storage
 QBATCH         QSYS        799117   QSYS        SBS    2   0        .4                 0     .0                  DEQW          2          3
   QDFTJOBD     JENKINS     846920   JENKINS     BCH    2  50        .0                 0     .0  CMD-QSH         EVTW          1          4
   QDFTJOBD     REDIS       846925   REDIS       BCH    2  50        .0                 0     .0  CMD-QSH         TIMW          1          4
   QZSHSH       JENKINS     846921   JENKINS     BCI    2  50     244.9                 0     .0  JVM-jenkins.wa  THDW         81        520
   QZSHSH       KADLER      846858   KADLER      BCI    2  50      14.6                 0     .0  PGM-python3     SELW          1         20
   QZSHSH       KADLER      849046   KADLER      BCI    2  50       1.0                 0     .0  PGM-python3     SELW          1         46
   QZSHSH       KADLER      849091   KADLER      BCI    2  50        .9                 0     .0  PGM-python3     SELW          1         45
   QZSHSH       KADLER      849106   KADLER      BCI    2  50        .9                 0     .0  PGM-python3     SELW          1         44
   QZSHSH       KADLER      849121   KADLER      BCI    2  50        .9                 0     .0  PGM-python3     SELW          1         45
   QZSHSH       REDIS       846926   REDIS       BCI    2  50      57.1                 0     .0  PGM-redis-serv  SELW          4
```

Calling an ILE program

```
itool.add(iPgm('my_key','MYPGM')
    .addParm(iData('a', '1a', 'a'))
    .addParm(iDS('ds')
        .addData(iData('b', '10i0', '1'))
        .addData(iData('c', '12p2', '3.33'))))
itool.call(itransport)
results = itool.dict_out('my_key')
print(results['a'])
print(results['ds']['b'])
print(results['ds']['c'])
```

Calling a Service Program

```
itool.add(iSrvPgm('my_key','MYSRVPGM', 'myfunction')
    .addParm(iData('a', '1a', 'a'))
    .addParm(iDS('ds')
        .addData(iData('b', '10i0', '1'))
        .addData(iData('c', '12p2', '3.33'))))
itool.call(itransport)
results = itool.dict_out('my_key')
print(results['a'])
print(results['ds']['b'])
print(results['ds']['c'])
```

Specifying the Program Library

```
itool.add(iPgm('my_key','MYPGM', {'lib': 'KADLER'})
    .addParm(iData('a', '1a', 'a'))
    .addParm(iDS('ds')
        .addData(iData('b', '10i0', '1'))
        .addData(iData('c', '12p2', '3.33'))))
itool.call(itransport)
```

Example: Calling an ILE program from Python

```
itool.add(iCmd('addlible', 'ADDLIBLE KADLER'))
itool.add(iPgm('my_key','MYPGM')
    .addParm(iData('a', '1a', 'a'))
    .addParm(iDS('ds')
        .addData(iData('b', '10i0', '1'))
        .addData(iData('c', '12p2', '3.33'))))
itool.call(itransport)
```

iSh

```
itool.add(iSh('mysh', 'curl http://google.com'))
itool.call(itransport)
mysh = itool.dict_out('mysh')
print(tools['mysh'])
```

Advanced Toolkit

- Scenario: RPG program to get back a list of objects that haven't been saved
- Two output parameters
  - NumObjs – number of objects returned in second parm (10i0)
  - Objects – array of 1000 object structures
    - Name – object name (10a)
    - Library – object library (10a)

Advanced Toolkit

```
itool.add(iPgm('unsaved', 'QUNSAVED')
 .addParm(iData('NumObjs','10i0',''))
 .addParm(iDS('Objects', {'dim':'1000'})
  .addData(iData('Name','10a',''))
  .addData(iData('Library','10a',''))))

data = itool.dict_out('unsaved')
print(len(data['Objects']))
for obj in data['Objects']
    print(obj)
```

Advanced Toolkit

```
1000
{'Name': 'OBJ001', 'Library': 'QGPL'}
{'Name': 'OBJ002', 'Library': 'QGPL'}
{'Name': 'OBJ003', 'Library': 'QGPL'}
{'Name': 'OBJ004', 'Library': 'QGPL'}
{'Name': '', 'Library': ''}
...
{'Name': '', 'Library': ''}
{'Name': '', 'Library': ''}
```

Advanced Toolkit

```
itool.add(iPgm('unsaved', 'QUNSAVED')
 .addParm(iData('NumObjs','10i0',''))
 .addParm(iDS('Objects', {'dim':'1000'})
  .addData(iData('Name','10a',''))
  .addData(iData('Library','10a',''))


data = itool.dict_out('unsaved')
num_objs = data['NumObjs']
print(num_objs)
for obj in data['Objects'][:num_objs]
    print(obj)
```

Advanced Toolkit

```
4
{'Name': 'OBJ001', 'Library': 'QGPL'}
{'Name': 'OBJ002', 'Library': 'QGPL'}
{'Name': 'OBJ003', 'Library': 'QGPL'}
{'Name': 'OBJ004', 'Library': 'QGPL'}
```

Advanced Toolkit

```
itool.add(iPgm('unsaved', 'QUNSAVED')
 .addParm(iData('NumObjs', '10i0', '', {'enddo':'count'}))
 .addParm(iDS('Objects', {'dim':'1000', 'dou':'count'})
  .addData(iData('Name','10a',''))
  .addData(iData('Library','10a',''))))
data = itool.dict_out('unsaved')
print(len(data['Objects']))
for obj in data['Objects']
    print(obj)
```

Advanced Toolkit

```
4
{'Name': 'OBJ001', 'Library': 'QGPL'}
{'Name': 'OBJ002', 'Library': 'QGPL'}
{'Name': 'OBJ003', 'Library': 'QGPL'}
{'Name': 'OBJ004', 'Library': 'QGPL'}
```

Advanced Toolkit

- Scenario: System API call that takes in a large buffer with variable sized output data and needs to know the size of the buffer passed in
- One output parameter
  - Buffer – API defined data structure with a header containing numerous fields, followed by an array of data structures
- One input parameter
  - Len – size of Buffer

Advanced Toolkit

```
itool.add(iPgm('apicall', 'QAPICALL')
 .addParm(
  iDS('API0001', { 'len': 'buflen' })
  .addData(iData('Fld1','4b',''))
  # ...
  .addData(iData('NumResults','10i0','', {'enddo':'count'}))
  .addData(iDS('results', {'dim':'1000', 'dou':'count'})
    .addData(iData('Res1','3i0','')))
    # ...
 .addParm(iData('BufSize','10i0','', { 'setlen': 'buflen' })))
```

Resources

- ibm_db links
  - Code: https://github.com/ibmdb/python-ibmdb
  - Wiki: https://github.com/ibmdb/python-ibmdb/wiki
  - Forum: https://groups.google.com/forum/#!forum/ibm_db
  - Python DB API (PEP 249): https://www.python.org/dev/peps/pep-0249/
  - `yum install python3-ibm_db`
- itoolkit links
  - Code: https://bitbucket.org/litmis/python-itoolkit
  - Docs: http://python-itoolkit.readthedocs.io/en/latest/
  - XMLSERVICE: http://yips.idevcloud.com/wiki/index.php/XMLService/XMLService
  - `yum install python3-itoolkit`

IBM TSS Support

- Git
- Jenkins
- rsync
- Node.js
- Apache Tomcat
- WordPress
- Python

- For more resources, see my blog post: http://ibmsystemsmag.com/blogs/open-your-i/december-2018/a-game-changer-for-open-source-support/

Questions?

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