Using Apache Cassandra from Python

Jeremiah Jordan

Morningstar, Inc.

MORNINGSTAR®

Who am I?

Software Engineer @ Morningstar, Inc.

Python 2.6/2.7 for 1.5 Years

Cassandra for 1.5 Years

What am I going to talk about?

What is Cassandra

Using Cassandra from Python

Indexing

Other stuff to consider

What am I not going to talk about?

Setting up and maintaining a production Cassandra cluster.

What is Apache Cassandra?

Column based key-value store (multi-level dictionary)

Combination of Dynamo (Amazon)and BigTable (Google)

Schema-optional

Buzz Word Description

"Cassandra is a highly scalable, eventually consistent, distributed, structured key-value store. Cassandra brings together the distributed systems technologies from Dynamo and the data model from Google's BigTable. Like Dynamo, Cassandra is eventually consistent. Like BigTable, Cassandra provides a ColumnFamily-based data model richer than typical key/value systems."

From the Cassandra Wiki: http://wiki.apache.org/cassandra/

Keyspace 1

Column Family 1

Key1	ColumnName1	ColumnName2	ColumnName3	ColumnName4
	Value1	Value2	Value3	Value4
Key2	ColumnName1	ColumnName2	ColumnName3	ColumnName4
	Value1	Value2	Value3	Value4

Column Family 2

Key1	ColumnName1	ColumnName2	ColumnName3	ColumnName4
	Value1	Value2	Value3	Value4

Keyspace 2

Keyspace: "ApplicationData"

Column Family: "UserInfo"

John	age	email	gender	state
	32	john@gmail.com	M	IL
Bill	email	gender	state	
	20	M	CA	
Jane	age	email	state	
	25	jane@python.org	VA	

Column Family: "ChangesOverTime"

2012-03-01	time-uuid-1	time-uuid-2	time-uuid-3	time-uuid-4
	John:state::CA	Bill:gender:F:M	John:state:CA:IL	Jane:age::25

Keyspace: "OtherData"

Keyspace: "ApplicationData"

Column Family: "UserInfo"

Keys

John	age	email	gender	state
	32	john@gmail.com	M	IL
Bill	email	gender	state	
	20	M	CA	
Jane	age	email	state	
	25	jane@python.org	VA	

Column Family: "ChangesOverTime"

2012-03-01	time-uuid-1	time-uuid-2	time-uuid-3	time-uuid-4
	John:state::CA	Bill:gender:F:M	John:state:CA:IL	Jane:age::25

Keyspace: "OtherData"

Keyspace: "ApplicationData"

Column Family: "UserInfo"

Column Names →

John	age	email	gender	state
	32	john@gmail.com	M	IL
Bill	email	gender	state	
	20	M	CA	
Jane	age	email	state	
	25	jane@python.org	VA	

Column Family: "ChangesOverTime"

2012-03-01	time-uuid-1	time-uuid-2	time-uuid-3	time-uuid-4
	John:state::CA	Bill:gender:F:M	John:state:CA:IL	Jane:age::25

Keyspace: "OtherData"

Keyspace: "ApplicationData"

Column Family: "UserInfo"

Column Values

John	age	email	gender	state
	32	john@gmail.com	M	IL
Bill	email	gender	state	
	20	M	CA	
Jane	age	email	state	
	25	jane@python.org	VA	

Column Family: "ChangesOverTime"

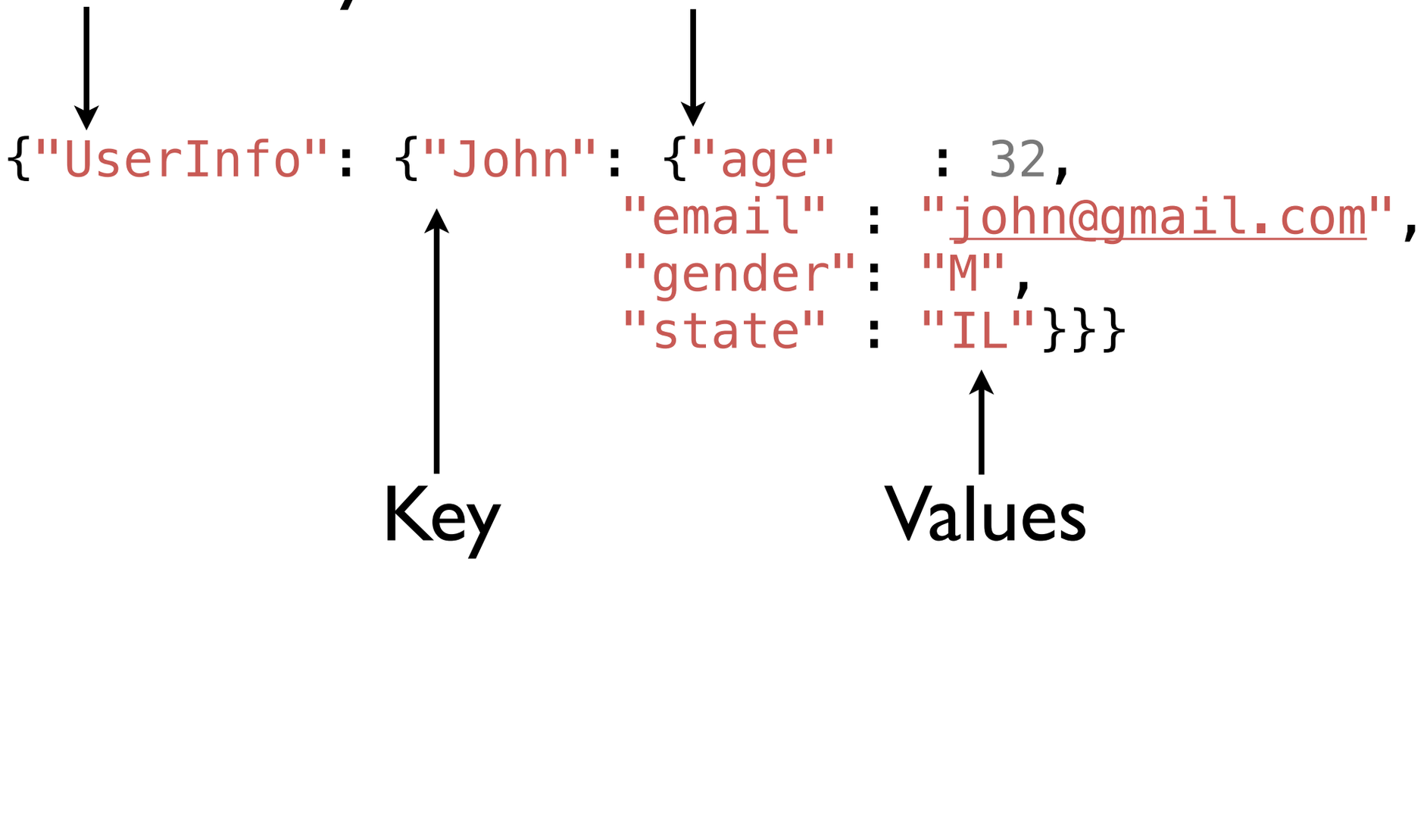
2012-03-01	time-uuid-1	time-uuid-2	time-uuid-3	time-uuid-4
	John:state::CA	Bill:gender:F:M	John:state:CA:IL	Jane:age::25

Keyspace: "OtherData"

Multi-level Dictionary

Column Family

Columns



Key

Values

Well really this

```
{"UserInfo": {"John": OrderedDict(
                [("age", 32),
                 ("email", "john@gmail.com"),
                 ("gender", "M"),
                 ("state", "IL")])}}
```

Where do I get it?

From the Apache Cassandra project:

http://cassandra.apache.org/

Or DataStax hosts some Debian and RedHat packages:

http://www.datastax.com/docs/1.0/install/install_package

How do I run it?

Edit cassandra.yaml

Change data/commit log locations

defaults: /var/cassandra/data and /var/cassandra/commitlog

Edit log4j-server.properties

Change the log location/levels

default /var/log/cassandra/system.log

How do I run it?

Foreground

```
$ ./cassandra -f
```

Setup tip for local instances

Make templates out of cassandra.yaml and log4j-server.properties

Update “cassandra” script to generate the actual files

(run them through “sed” or something)

Server is running, what now?

```
$ ./cassandra-cli
connect localhost/9160;

create keyspace ApplicationData
    with placement_strategy =
                'org.apache.cassandra.locator.SimpleStrategy'
    and strategy_options = [{replication_factor:1}];

use ApplicationData;

create column family UserInfo
    and comparator = 'AsciiType';

create column family ChangesOverTime
    and comparator = 'TimeUUIDType';
```

Connect from Python

http://wiki.apache.org/cassandra/ClientOptions

Thrift - See the “interface” directory

Pycassa - pip/easy_install pycassa

Telephus (twisted) - pip/easy_install telephus

DB-API 2.0 (CQL) - pip/easy_install cassandra-dbapi2

Thrift (don't use it)

```
from thrift.transport import TSocket, TTransport
from thrift.protocol import TBinaryProtocol
from pycassa.cassandra.c10 import Cassandra, ttypes

socket = TSocket.TSocket('localhost', 9160)
transport = TTransport.TFramedTransport(socket)
protocol = TBinaryProtocol.TBinaryProtocolAccelerated(transport)
client = Cassandra.Client(protocol)
transport.open()
client.set_keyspace('ApplicationData')
import time
client.batch_mutate(
  mutation_map=
      {'John': {'UserInfo':
              [ttypes.Mutation(
                 ttypes.ColumnOrSuperColumn(
                   ttypes.Column(name='email',
                                 value='john@gmail.com',
                                 timestamp= long(time.time()*1e6),
                                 ttl=None)))]}},
  consistency_level= ttypes.ConsistencyLevel.QUORUM)
```

Pycassa

```
import pycassa
from pycassa.pool import ConnectionPool
from pycassa.columnfamily import ColumnFamily

pool = ConnectionPool('ApplicationData',
                      ['localhost:9160'])
col_fam = ColumnFamily(pool, 'UserInfo')
col_fam.insert('John', {'email': 'john@gmail.com'})
```

Connect

Keyspace

```
pool = ConnectionPool('ApplicationData',
                      ['localhost:9160'])
```

Server List

Open Column Family

Connection Pool

```
col_fam = ColumnFamily(pool, 'UserInfo')
```

Column Family

Write

Key

Column Value

```
col_fam.insert('John',
               {'email': 'john@gmail.com'})
```

Column Name

Read

Key

```
readData = col_fam.get('John',
                       columns=['email'])
```

Column Names

Delete

Key

```
col_fam.remove('John',
               columns=['email'])
```

Column Names

Batch

Column Names

```
col_fam.batch_insert(
  {'John': {'email': 'john@gmail.com',
            'state': 'IL',
            'gender': 'M'},
'Jane': {'email': 'jane@python.org',
            'state': 'CA'}})
```

Keys

Column Values

Batch (streaming)

```
b = col_fam.batch(queue_size=10)

b.insert('John', {'email': 'john@gmail.com',
                  'state': 'IL',
                  'gender': 'F'})

b.insert('Jane', {'email': 'jane@python.org',
                  'state': 'CA'})

b.remove('John', ['gender'])
b.remove('Jane')
b.send()
```

Batch (Multi-CF)

```
from pycassa.batch import Mutator
import uuid
b = Mutator(pool)

b.insert(col_fam,
         'John', {'gender':'M'})

b.insert(index_fam,
         '2012-03-09', {uuid.uuid1().bytes:
                        'John:gender:F:M'})
b.send()
```

Batch Read

```
readData = col_fam.multiget(
                    ['John', 'Jane', 'Bill'])
```

Column Slice

```
readData = col_fam.get('Jane',
                       column_start='email',
                       column_finish='state')

readData = col_fam.get('Bill',
                       column_reversed=True,
                       column_count=2)
```

Types

```
from pycassa.types import *
col_fam.column_validators['age'] =
    IntegerType()
col_fam.column_validators['height'] =
    FloatType()

col_fam.insert('John', {'age':32,
                        'height':6.1})
```

Column Family Map

```
  from pycassa.types import *
class User(object):
      key = Utf8Type()
      email = Utf8Type()
      age = IntegerType()
      height = FloatType()
      joined = DateType()

from pycassa.columnfamilymap import
   ColumnFamilyMap
cfmap = ColumnFamilyMap(User, pool,
                        'UserInfo')
```

Write

```
   from datetime import datetime
user = User()
user.key = 'John'
user.email = 'john@gmail.com'
user.age = 32
user.height = 6.1
user.joined = datetime.now()
cfmap.insert(user)
```

Read/Delete

```
user = cfmap.get('John')

users = cfmap.multiget(['John', 'Jane'])

cfmap.remove(user)
```

Indexing

Native secondary indexes

Roll your own with wide rows

Indexing Links

Intro to indexing

http://www.datastax.com/dev/blog/whats-new-cassandra-07-secondary-indexes

Blog post and presentation going through some options

http://www.anuff.com/2011/02/indexing-in-cassandra.html

http://www.slideshare.net/edanuff/indexing-in-cassandra

Another blog post describing different patterns for indexing

http://pkghosh.wordpress.com/2011/03/02/cassandra-secondary-index-patterns/

Native Indexes

Easy to use

Let you use filtering queries

Not recommended for high cardinality values (i.e. timestamps, birth dates, keywords, etc.)

Make writes slower to indexed columns (read before write)

Native Indexes

```
from pycassa.index import *
state_expr = create_index_expression('state',
                                     'IL')
age_expr = create_index_expression('age',
                                   20,
                                   GT)
clause = create_index_clause([state_expr,
                              bday_expr],
                             count=20)
for key, userInfo in \
         col_fam.get_indexed_slices(clause):
    # Do Stuff
```

Rolling Your Own

Removing changed values yourself

Know the new value doesn't exists, no read before write

Index can be denormalized query, not just an index.

Can use things like composite columns, and other tricks to allow range like searches.

Lessons Learned

Use indexes. Don’t iterate over keys.

New Query == New Column Family

Don’t be afraid to write your data to multiple places (Batch)

Questions?