

Redis: persistent collections as a service (and for fun)

A quick introduction to Redis, and why I really like it

By Tibs / Tony Ibbs

Presented at PyCon UK 2018

Written using reStructuredText.

Converted to PDF slides using pandoc and beamer.

Source and extended notes at <https://github.com/tibs/redis-talk>

So what is Redis?

Redis is an open source (BSD licensed), in-memory data structure store, used as a database, cache and message broker. It supports data structures such as strings, hashes, lists, sets, sorted sets with range queries, bitmaps, hyperloglogs and geospatial indexes with radius queries. Redis has built-in replication, Lua scripting, LRU eviction, transactions and different levels of on-disk persistence, and provides high availability via Redis Sentinel and automatic partitioning with Redis Cluster.

--- <https://redis.io/>

Connecting to a server using the command line

So, let's make a connection to a Redis server:

```
tonibb01@spoon ~/sw$ redis-cli  
127.0.0.1:6379>
```

Command line client: completion

The Redis command line client is rather nice, and can be very useful for exploring and testing.

```
tibs@digger ~$ redis-cli
```

```
127.0.0.1:6379> set key value [EX seconds] [PX milliseconds] [NX|XX]
```

Command line client: help

It also has nice help

```
127.0.0.1:6379> help @hash
```

```
HDEL key field [field ...]
```

```
summary: Delete one or more hash fields
```

```
since: 2.0.0
```

```
HEXISTS key field
```

```
summary: Determine if a hash field exists
```

```
since: 2.0.0
```

Once more, with Python

However, since we're Python programmers, let's use Python:

```
>>> import redis
>>> r = redis.StrictRedis(host='localhost')
```

Keys

Keys are what Redis refers to as *binary safe strings* - in Python we would call them byte-strings.

The byte-string is actually the basic datatype in Redis.

Redis does not address encodings - that has to be handled out-of-band, which is (in context) reasonable enough.

(but redis-py will try to do sensible things)

Traditionally, examples of Redis keys look like

b"<namespace>:<name>" (although they tend to say <server> instead of <namespace>).

Keys: example

```
>>> r.set(b'my:key', 'value')
True                                     # OK
>>> r.delete(b'my:key')
1                                       # The key existed
>>> r.exists(b'my:key')
False                                  # It's gone now
>>> r.delete(b'no:such:thing')
0                                       # The key didn't exist
>>> r.exists(b'no:such:thing')
False                                  # It's still gone
```


What can values be?

- ▶ binary safe strings (byte strings again)
- ▶ lists
- ▶ sets
- ▶ sorted sets
- ▶ hashes
- ▶ bit arrays (bitmaps)
- ▶ geospatial values
- ▶ hyperloglogs

String values

- ▶ binary safe strings, just like keys
- ▶ can be (e.g.) JSON
- ▶ again, encoding is out-of-band information

```
>>> r.set(b'my:string', b'some text')
```

```
True
```

```
>>> r.get(b'my:string')
```

```
b'some text'
```

```
>>> r.strlen(b'my:string')
```

```
9
```

```
>>> r.getrange(b'my:string', 5, -1)
```

```
b'text'
```

String values as numbers

```
>>> r.set(b'my:number', 1)  # NB: 1 -> b'1'
True
>>> r.get(b'my:number')
b'1'
>>> r.incr(b'my:number')
2
>>> r.get(b'my:number')
b'2'
```

So that gives us counters, and also semaphores.

So how does redis-py handle arguments?

- ▶ Byte string: nothing to do
- ▶ For a non-string, first convert to a string:
 - ▶ integer: call `str` on it, and encode the result as latin-1
 - ▶ float: call `repr` on it, and encode the result as latin-1
 - ▶ otherwise, call `str` on it
- ▶ String: default to encoding as utf-8, with strict encoder errors.

So, in general, use `b"..."` if you can, but otherwise the library should do something sensible.

List values

```
>>> r.lpush(b'my:list', 3, 2, 1)
```

```
3
```

```
>>> r.rpush(b'my:list', 4)
```

```
4
```

```
>>> r.lrange(b'my:list', 0, -1)
```

```
[b'1', b'2', b'3', b'4']
```

```
>>> r.lpop(b'my:list')
```

```
b'1'
```

```
>>> r.rpop(b'my:list')
```

```
b'4'
```

```
>>> r.lrange(b'my:list', 0, -1)
```

```
[b'2', b'3']
```

My favourite Redis instruction

```
brpoplpush(src, dst, timeout=0)
```

Pop a value off the tail of ``src``, push it on the head of ``dst`` and then return it.

This command blocks until a value is in ``src`` or until ``timeout`` seconds elapse, whichever is first. A ``timeout`` value of 0 blocks forever.

BRPOPLUSH example

```
>>> r.lpush('my:deque', 1, 2, 3, 4, 5)
5
>>> r.lrange(b'my:deque', 0, -1)
[b'5', b'4', b'3', b'2', b'1']
>>> r.brpoplpush(b'my:deque', b'my:deque')
b'1'
```

Note how it returns the value that was rotated.

```
>>> r.lrange(b'my:deque', 0, -1)
[b'1', b'5', b'4', b'3', b'2']
```

Set values

```
>>> r.sadd(b'my:set1', 'a', 'b', 'c')
3
>>> r.sadd(b'my:set2', 'x', 'b', 'z')
3
>>> r.sdiff(b'my:set1', b'my:set2')
{b'c', b'a'}
>>> r.sinterstore(b'my:set3', b'my:set1', b'my:set2')
1
>>> r.smembers(b'my:set3')
{b'b'}
```


Sorted set values

`<key> : <value> and <score>`

- ▶ Done by adding a *score* (a floating point number) to each element.
- ▶ Scores do not *need* to be unique.
- ▶ Set is ordered by that score.

Can extract by value, by score, by range of scores (including positive and negative infinity).

Sorted set values example

```
>>> r.zadd(b'my:zset', 0, 'a')
1
>>> r.zadd(b'my:zset', 1, 'b')
1
>>> r.zrange(b'my:zset', 0, -1)
[b'a', b'b']
>>> r.zrange(b'my:zset', 1, -1, withscores=True)
[(b'b', 1.0)]
```

Hash values

`<key> : <field> : <value>`

Just like the top-level `<key> : <value>`.

This is as far down as it goes though.

Hash values example

```
>>> r.hset(b'my:dict', b'k1', b'val1')
1
>>> r.hset(b'my:dict', b'k2', b'val2')
1
>>> r.hget(b'my:dict', b'k2')
b'val2'
>>> r.hget(b'my:dict', b'k3')
>>> # i.e., result is None
>>>
>>> r.hkeys(b'my:dict')
[b'k1', b'k2']
>>> r.hgetall(b'my:dict')
{b'k1': b'val1', b'k2': b'val2'}
```

My one grumble about redis-py

Redis says PING:

Returns PONG if no argument is provided, otherwise return a copy of the argument as a bulk.

```
redis> PING
```

```
"PONG"
```

```
redis> PING "hello world"
```

```
"hello world"
```

but redis-py doesn't work that way:

```
>>> r.ping()
```

```
True
```

```
>>> r.ping('Hello world')
```

```
Traceback (most recent call last):
```

```
  File "<stdin>", line 1, in <module>
```

```
TypeError: ping() takes 1 positional argument but 2 were given
```

The online documentation

Is generally excellent.

It's mostly organised as articles introducing useful parts of Redis, and specific pages for each of the individual commands.

The introductory tutorial Introduction to Redis data types is rather good.

Commands overview

APPEND key value

Append a value to a key

AUTH password

Authenticate to the server

BGSAVE

Asynchronously save the dataset to disk

BITCOUNT key [start end]

Count set bits in a string

This is laid out rather nicely, and you can select to show just the commands for a particular type of value or other topic ("Filter by group").

APPEND key value

Available since 2.0.0.

Time complexity: $O(1)$. The amortized time complexity is $O(1)$ assuming the appended value is small and the already present value is of any size, since the dynamic string library used by Redis will double the free space available on every reallocation.

If key already exists and is a string, this command appends the value at the end of the string. If key does not exist it is created and set as an empty string, so **APPEND** will be similar to **SET** in this special case.

Return value

Integer reply: the length of the string after the append operation.

Unit Testing

```
from fakeredis import FakeStrictRedis

def test_my_understanding_of_zadd():
    r = FakeStrictRedis.singleton=False

    now_timestamp = datetime(2018, 4, 23, 0, 0, 0).now()

    r.zadd(b'timeout', now_timestamp, b'text')

    assert r.zrange(b'timeout', 0, -1, withscores=True) \
        == [(b'text', now_timestamp)]
```

Asyncio Redis

For asyncio, I've been experimenting with aioredis which provides an API very like redis-py, but with `await` in appropriate places.

Asyncio Redis example

```
import asyncio
import aioredis

async def set_key():
    redis = await aioredis.create_redis(
        'redis://localhost', loop=loop)
    await redis.set('my:key', 'value')
    val = await redis.get('my:key')
    print(val)
    redis.close()
    await redis.wait_closed()

loop = asyncio.get_event_loop()
loop.run_until_complete(set_key())
```

Async unit testing - wrap FakeRedis

```
from fakeredis import FakeStrictRedis
from aioredis.util import _NOTSET

class JustEnoughAsyncRedis:

    def __init__(self):
        self.redis = FakeStrictRedis(singleton=False)

    async def brpoplpush(self, sourcekey, destkey,
                        timeout=0, encoding=_NOTSET):
        return self.redis.bpoplpush(sourcekey, destkey,
                                    timeout)

# and so on (only *with* docstrings, please!)
```

The asyncio version of our earlier test is very similar

```
@pytest.mark.asyncio
async def test_my_understanding_of_zadd(event_loop):
    ar = JustEnoughAsyncRedis()

    now_timestamp = datetime(2018, 4, 23, 0, 0, 0).now()

    await ar.zadd(b'timeout', now_timestamp, b'text')

    assert await ar.zrange(b'timeout',
                           0, -1, withscores=True) \
        == [(b'text', now_timestamp)]
```

Other cool things

- ▶ Redis server is single-threaded, which makes atomicity feasible
- ▶ Pub/sub (broadcast) messaging
- ▶ Transactions
- ▶ Programmable in Lua
- ▶ Command protocol is documented
- ▶ Geospatial values
- ▶ Streams

Fin

Written using reStructuredText.

Converted to PDF slides using pandoc and beamer.

Source and extended notes at <https://github.com/tibs/redis-talk>