Using Redis

For a Distributed Observable Collection<T>

Anthony.Abate@Gmail.com

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What Are We Trying To Do?

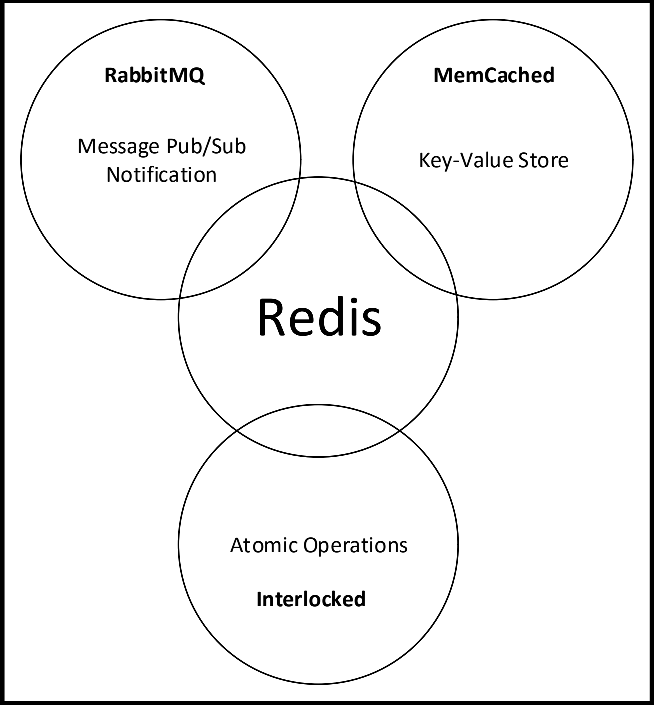
- Demonstrate some features of Redis
  - Designing a DistributedObservableCollection<T>
- Should You Do this?
  - Yes… because we can ☺
  - In all seriousness, for special low volume scenarios, sure.…
  - It won’t scale with many data, ’updates’
  - … but that is not the point

What is a Distributed Observable Collection?

- Distributed
  - Multiple Clients can read/write simultaneously
  - Notifications published to clients
- ‘Observable Collection’
  - Bindable into WPF / MVVM
  - INotifyPropertyChanged
  - OnCollectionChanged
- Concurrency
  - Row Level Versioning / Conflict Detection

Why Redis?

- Open Source (BSD License)
- Fast (ANSI-C) and In-memory Cache
- Key-Value based store
- Designed for Distributed Algorithms
- Set based operations (Data Relationships)
- Built-in Notifications Pub/Sub



Demo

- Full Featured Demonstration of Distributed Collection ‘In Action’
- As Presentation progresses, dive into the relevant code

DistributredObesrvableCollection<T> Data Requirements

- Row ViewModel
  - Unique Identifier
  - Property Storage
  - Load/Restore Initial State

- Observable Collection
  - Store Members of Collection
  - Load/Restore Initial State

DistributredObesrvableCollection<T> Notification Requirements

- Row ViewModel
  - Local Changes
    - Fire PropertyChange
    - Set in Redis
    - Publish Event
  - Remote Changes
    - Event Notification
    - Get From Redis
    - Fire PropertyChange

- Observable Collection
  - Local Changes
    - Add/Remove
    - Fire OnCollectionChanged
    - Update Redis
    - Publish Event
  - RemoteChange
    - Event Notification
    - Get Data From Redis
    - Add/Remove
    - Fire OnCollectionChanged

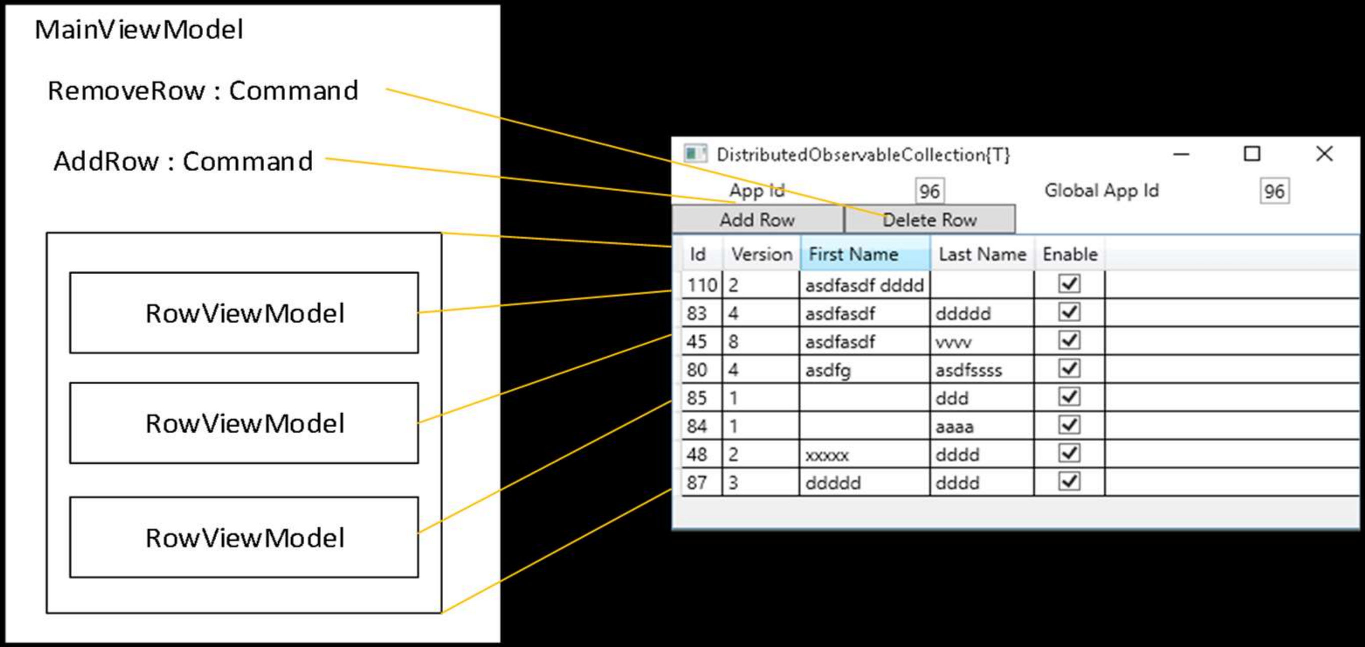
DistributredObesrvableCollection<T> Concurrency Requirements

- Row ViewModel
  - When 2 writes to the same Property are attempted, notify user of collision
  - Similar to Database row versioning

- Observable Collection
  - Set Operations are Atomic

WPF / MVVM : ViewModel <-> View

- Just an Overview



Id	Version	First Name	Last Name	Enable
110	2	asdfasdf dddd		✓
83	4	asdfasdf	ddddd	✓
45	8	asdfasdf	vvvv	✓
80	4	asdfg	asdfssss	✓
85	1		ddd	✓
84	1		aaaa	✓
48	2	xxxxx	dddd	✓
87	3	ddddd	dddd	✓

Redis High-Level Features

- Key Value Storage
- Set Operations
- Atomic Operations
- Pub/Sub Notifications
- Lua Scripts / Extensions

What Redis Is Not

- Its not a Message Queue
  - Only connected clients get messages, they do not queue up
  - Does not have message reliability / auto-redelivery / acknowledgements / etc
- It does not replace the need for long term storage with data integrity
- Not a Search / Reporting Engine
  - You are already using keys and indexes for lookups
  - Its single threaded, long running searches (SCAN operations) will slow it down

Running Redis

- Redis officially is non-windows
- But there is a windows port maintained by (MS Open Tech)
- Azure has Redis support
- Client Libraries – MANY
  - StackExchange ☺
  - ServiceStack ☹
- Many operational aspects of Redis (not shown in this presentation)
  - Clusters, Replication, disk persistence, transactions

Different Key Types

- String
- List
- Set
- Sorted Set
- Hash
- Hyperloglog

Basic Command Types

- Usually Come in Pairs
  - SET / GET
  - INCR / DECR

- [PREFIX][OPERATION][SUFFIX]
  - MSETNX
    (set multiple if none exist)
  - PSETEX
    (set expire in Milliseconds)

- PREFIX1

M	Multi
P (used with EX)	Milliseconds

- PREFIX2 – Key Type
- L – List
  S – Set
  Z – Sorted Set
  H – Hash
- SUFFIX

NX	Not Exist
EX	Expiration

Prefix/Suffix vary by key type

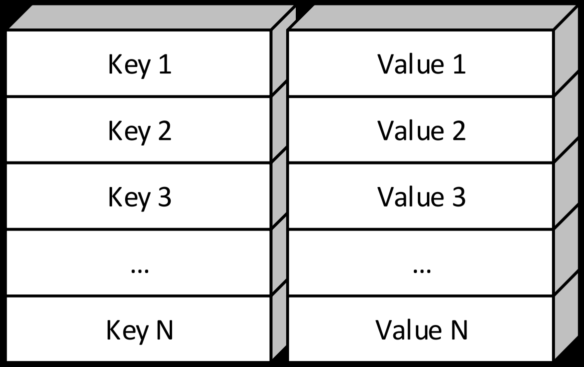
Other Command Types

- EXISTS
- DEL
- EXPIRE / EXPIREAT
- PERSIST – prevent expiration
- DUMP / RESTORE

- Searching
  - SCAN
    - Patterns / Regex
- Some Commands Can Block
  - They wait for data to become available
  - Lists – Remove Or Block Until something is available

String Key

- One Key to One Value
- Not Just For "strings"
  - Integer
  - Float
  - Bitmaps / Binary
- Max Size of 512MB

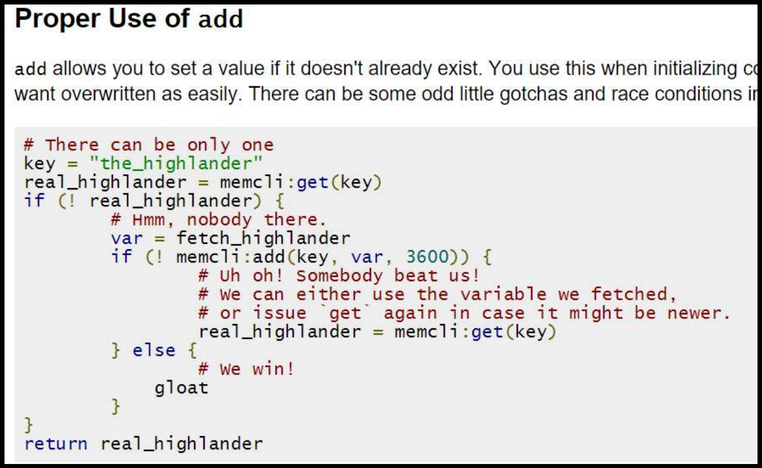


‘Some’ String Specific Operations

- String Operations
  - STRLEN
  - APPEND
  - GETRANGE (Substring)
  - SETRANGE (Replace)
- BIT Operations
  - BITCOUNT
  - BITOP
  - GETBIT / SETBIT
- GETSET – get old value / set new
- Integer/Float Operations
  - INCR/DECR
  - INCRBY/DECRBY
  - INCRBYFLOAT/DECRBYFLOAT

Atomic Operations

MemCache



Proper Use of add

add allows you to set a value if it doesn't already exist. You use this when initializing co
want overwritten as easily. There can be some odd little gotchas and race conditions ir

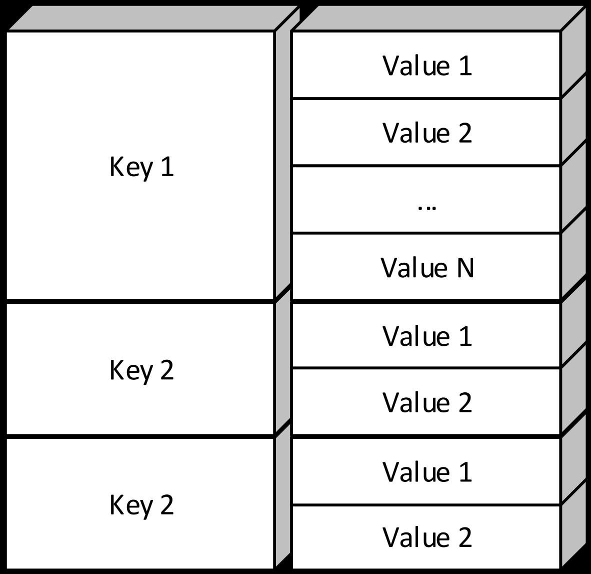
```
# There can be only one
key = "the_highlander"
real_highlander = memcli:get(key)
if (! real_highlander) {
        # Hmm, nobody there.
        var = fetch_highlander
        if (! memcli:add(key, var, 3600)) {
                # Uh oh! Somebody beat us!
                # We can either use the variable we fetched,
                # or issue `get` again in case it might be newer.
                real_highlander = memcli:get(key)
        } else {
                # We win!
            gloat
        }
}
return real_highlander
```

Redis

- INCRBY "key" 5

List Key

- One to Many Values
- “Linked List”
- Insertion Order Preserved
- Insert at Head or Tail
- Intra List Operations

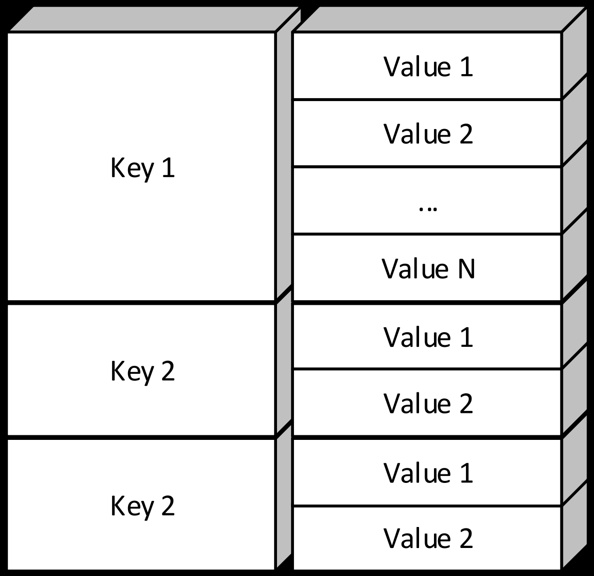


‘Some’ List Specific Operations

- Insert Operations
  - LINSERT/RINSERT
  - LPUSH,RPUSH
- Remove Operations
  - LPOP/RPOP
  - LREM/RREM
  - SPOP
- Move
  - RPOPLPUSH
  - SDIFFSTORE / SINTERSTORE / SUNIONSTORE
- Searching
  - SSCAN

Set Key

- One to Many Values
- Unordered
- Intra-Set Operations

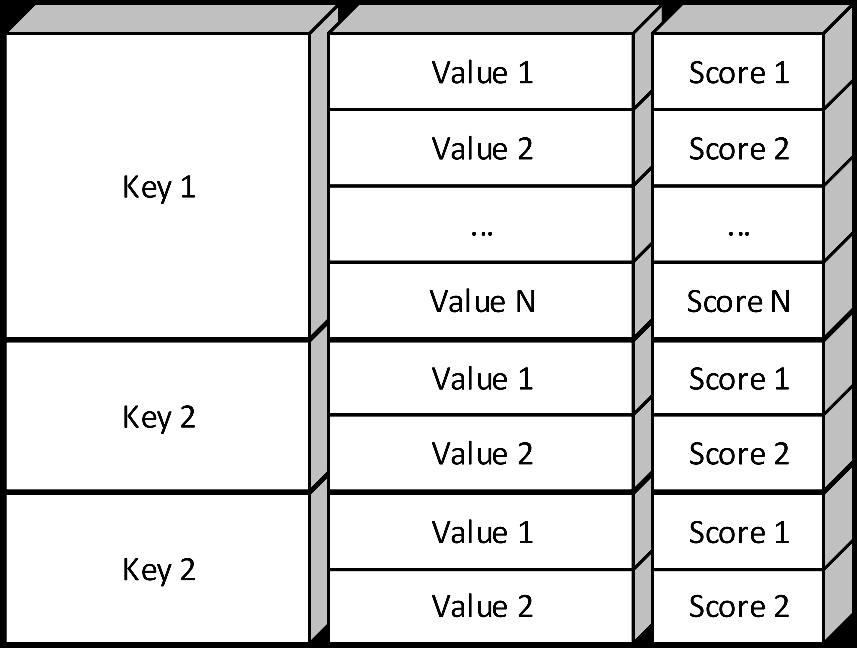


‘Some’ Set Specific Operations

- Set Operations
  - SCARD (cardinality/Size)
  - SMEMBERS
  - SISMEMBER
  - SRANDMEMER
- Changing Set
  - SADD / SREM
  - SMOVE
  - SPOP
- Intersect/Diff/Union
  - SDIFF / SINTER / SUNION
  - SDIFFSTORE / SINTERSTORE / SUNIONSTORE
- Searching
  - SSCAN

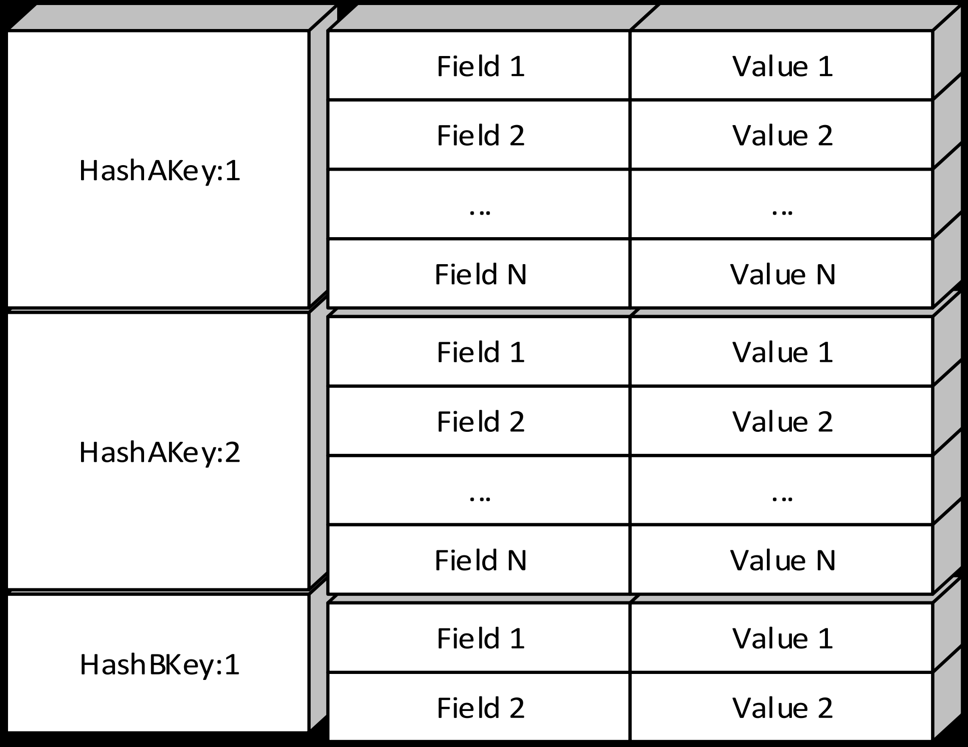
Sorted Set Key

- One Key to Many Values
- Ordered by Score / Weight
- Can update value or score
- Intra-Set Operations



Hash Key

- One Key to many Field/Values Pairs
- "HashType : ID" Naming Convention
- Each key is like a mini dictionary
  - Hash Fields have string commands
  - Atomic operations on field



Code Review / Demo

- Row ViewModel
  - Unique Identifier
  - Property Storage
  - Load/Restore Initial State

- Observable Collection
  - Store Members of Collection
  - Load/Restore Initial State

Pub / Sub - Notifications

- Simple but easy to use way of sending messages / notifications
- Up to user to create customization
- Client Libraries make it easy
- SUBSCRIBE / UNSUBSCRIBE
  - “channel”
- PUBLISH
  - “channel” “message”

Pub / Sub - Notifications

- PSUBSCRIBE / PUNSUBSCRIBE
  - Pattern Based channel name
  - h?llo -> hello, hallo and hxllo
  - h*llo -> hllo and heeeello
  - h[ae]llo -> hello and hallo, but not hillo

- PUBSUB
  - Inspect channels / subscriptions

Pub / Sub – Message Filtering

- we are publishing and receiving on the same channel
- We don’t want a feedback loop up updates
- Prefix all message with a unique client id
- Filter messages produced by the current client

Code Review / Demo

- Row ViewModel
  - Local Changes (publish)
    - Fire PropertyChange
    - Set in Redis
    - Publish Event
  - Remote Changes (subscribe)
    - Event Notification
    - Get From Redis
    - Fire PropertyChange

- Observable Collection
  - Local Changes (publish)
    - Add/Remove
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Lua Scripts

- Allow you to create custom logic executed on the Redis server
- Atomic – Only 1 script executed at a time.
- Simple C-Like style language
- Pseudo Stored Procedures
- More Like parameterized queries
- Scripts can be ‘compiled’ to save parse time and referred to by a SHA1

Lua Scripts (syntax)

- Some what strange at first:
  - 1 based array for arguments
- EVAL “SCRIPT” #Keys KEYS ARGS
  - EVAL “SCRIPT” 2 KEY1 KEY2 ARG1 ARG2 ARG3
- To execute a redis server command
  - redis.call(‘command’, ‘key’, ‘arg’)
- All Together
  - eval "return redis.call('incrby',KEYS[1], ARGV[1])" 1 newkey 5

Lua Script – Concurrecy Check

- Our version in memory = N
- user changes a field value
- Send Version # and new Field Value
- If version #'s are the same, the data wasn't modified in transit
- 'VERY SMALL' window of time for this to occur
- If versions don't match, user will be notified their change did not go through
  - They refresh and see new data
  - Can try update again.. Or maybe they decide to do something else now

Lua Script – Pseudo Code

```
if (Redis.Version = OurVersion)
        Set Field = NewValue
        return (++Version)
else
        return error
```

Lua Script – Actual Code!

```
local current = redis.call('HGET', KEYS[1], KEYS[2]);

if current == ARGV[1] then

       redis.call('HSET', KEYS[1], KEYS[3], ARGV[2])

       return redis.call('HINCRBY', KEYS[1], KEYS[2], 1)

else

       return redis.error_reply(string.format('Version Mismatch:
Expected:%s Actual:%s', ARGV[1], current))

end
```

Code Review / Demo

- Concurrency Conflict Detection