Open source in-memory data structure store

Features – At a glance

- Atomicity
- Transactions
- Publish/Subscribe Messaging Paradigm

Atomic Operations

Atomicity *stipulates that it should be possible to place every operation at a singular point (linearization point) between its invocation and response*[1].

Atomic Operations – Explained

Atomicity gives us a guarantee that only one of two things can happen **before anything else happens**:

1. The operation succeeds and we are left with the expected result
2. The operation fails and no changes are made to the underlying data

Every command in Redis is performed atomically!

Redis Transactions

The execution of a group of commands in a single step, with two important guarantees:

1. All the commands are serialized and executed sequentially.

2. Either all of the commands or none are processed.

Does this look familiar? **Redis Transactions are atomic!**

Redis Transactions – Specifics

MULTI: Enters “transaction mode” where we can now list operations

EXEC: Executes the transaction, which now contains multiple operations

DISCARD: Flushes the transaction queue and exits the transaction

PubSub – Redis

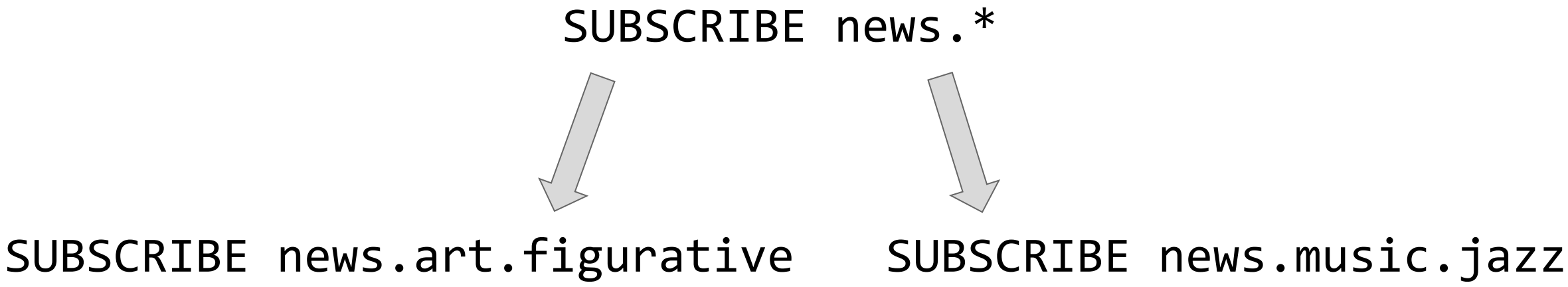
Redis allows you to easily implement the Publish/Subscribe Messaging Paradigm.

- SUBSCRIBE
- UNSUBSCRIBE
- PUBLISH

PubSub – Redis

In Redis, messages are organized into channels.

Very robust channel subscribing features:



Data Model

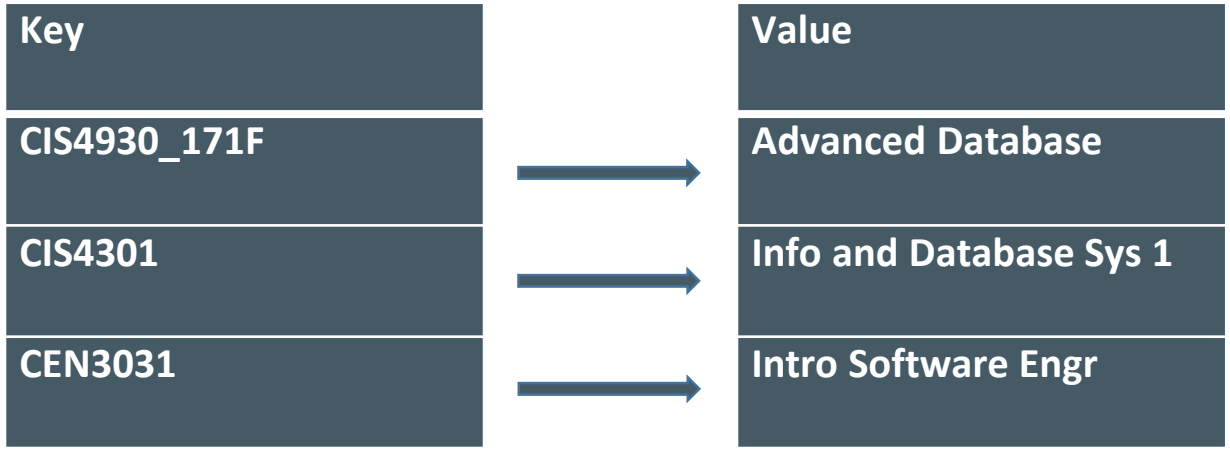
Key-Value Store

Vs

In-Memory Data Structure Store

Data Model - Basics

- Key-Value pairs
- Value usually string (other datatypes possible)



Data Model – RDBMS vs Key-Value

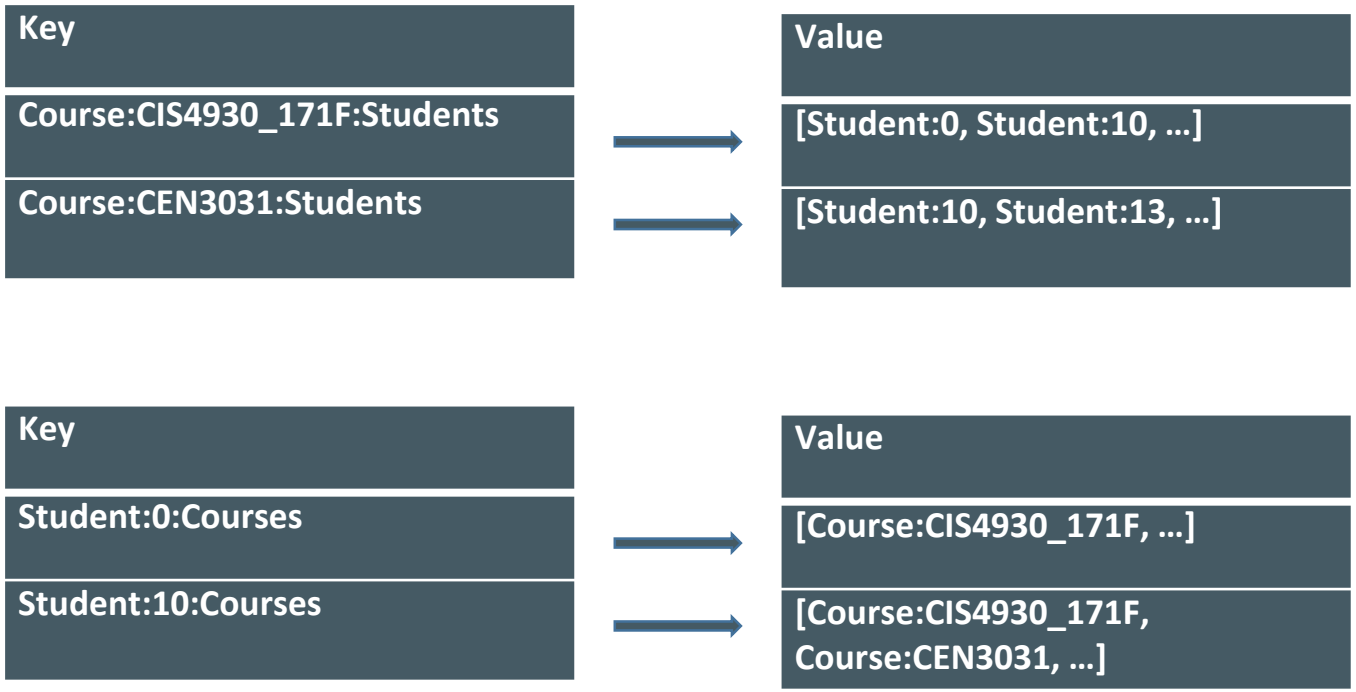
ID	Title	Cred
CIS4930_171F	Advanced Database	3
CIS4301	Info and Database Sys 1	3
CEN3031	Intro Software Engr	3

Key		Value
Course:CIS4930_171F:Title	→	Advanced Database
Course:CIS4301:Title	→	Info and Database Sys 1
Course:CEN3031:Title	→	Intro Software Engr

Key		Value
Course:CIS4930_171F:Cred	→	3
Course:CIS4301:Cred	→	3
Course:CEN3031:Cred	→	3

Data Model – Reverse Index

- Easy way to model relationships
- Reverse index acts as foreign key



Data Structures - Overview

- Strings
- Lists
- Sets
- Sorted Sets
- Hashes
- HyperLogLogs

Data structures - Strings

- Base type
- Maximum length is 512 MB
- Implemented using C-Strings (Append O(n) operation)
- Binary safe
- Can be used as:
  - Number (Increment, etc.)
  - Vector
  - Binary Data (Bitwise operations)

Data Structures - Lists

- Implemented as a doubly linked list
  - O(1) push and pop operations
  - O(n) accessing other nodes
- Can be used to build Queues or Stacks
- Maximum elements = 2^32-1= 4,294,967,295
- Can block retrieval until value is available (BLPOP)

Data Structures - Sets

- Unordered collection of Strings
- Implemented using a hash table
  - O(1) checking for existence
- Set Operations
  - Union, Intersection and Difference
- No duplicates allowed
- Maximum Number of Elements = 4,294,967,295
- Useful to represent relationships
- Randomized retrieval of members possible

Data Structures – Sorted Sets

- Ordered collection of Strings
- Implemented using a skip list
  - O(log(n)) operations
- No duplicates allowed
- Each member has a rank
- Retrieval by range possible
- Can be used to index key-value pairs for range retrieval

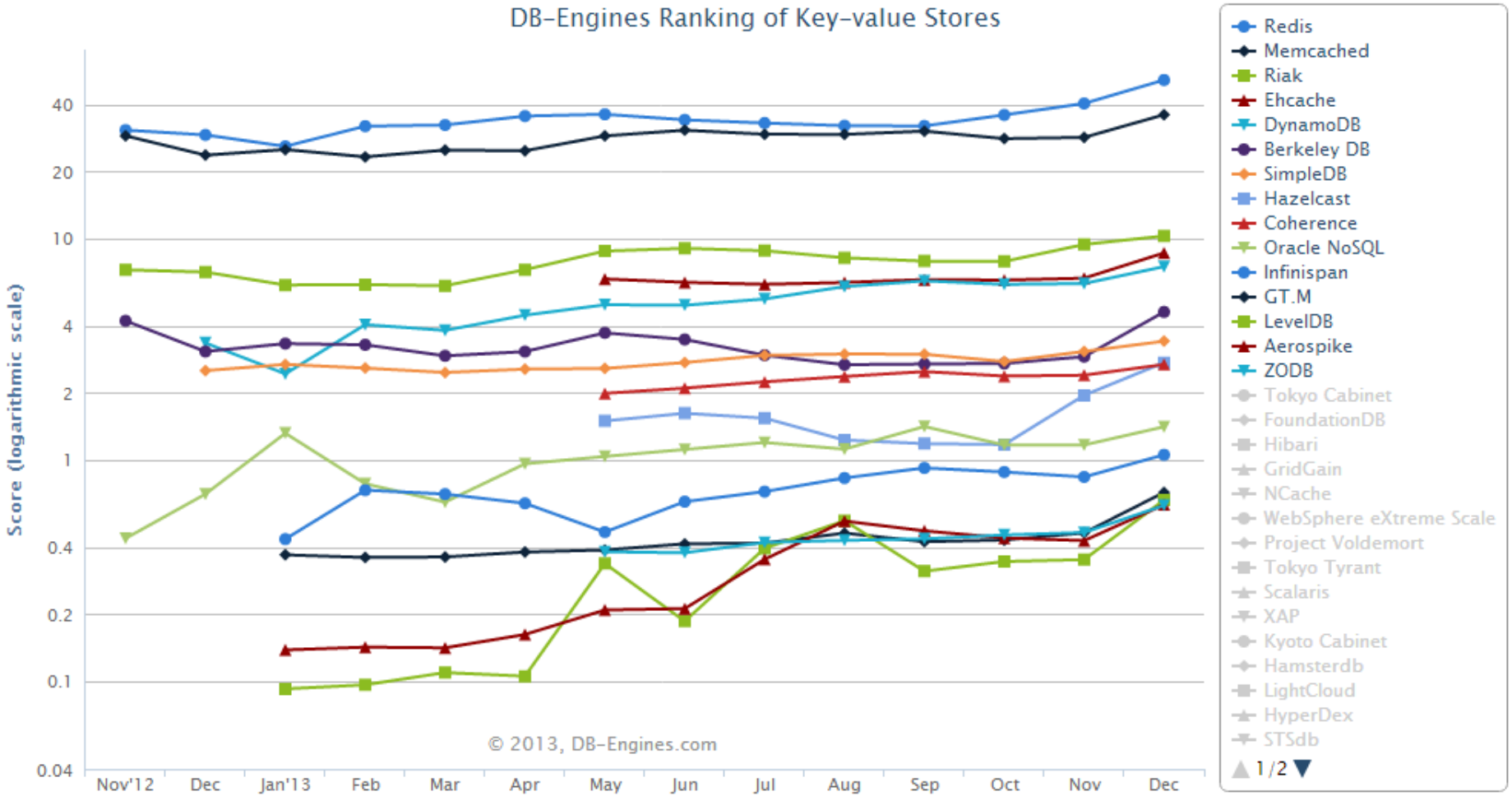
Data Structures - Hashes

- Maps between String fields
- Implemented using a hash table
  - O(1) retrieval/existence operations
- Used to represent objects
- Maximum Number of Elements = 4,294,967,295

Data Structures - HyperLogLogs

- Probabilistic data structure
  - HyperLogLog is a well known algorithm
- Used to estimate cardinality
- Trades memory for precision

Data Store Comparisons



Persistence

Two kinds of persistence:

- Append only files
- Redis database files

Append Only Files (AOF)

Pros:

Readability

No seeks or corruption problems if there’s an outage

Cons:

Larger than RDB files

Slower than RDB files

Redis Database File (RDB)

Pros:

Great for disaster recovery

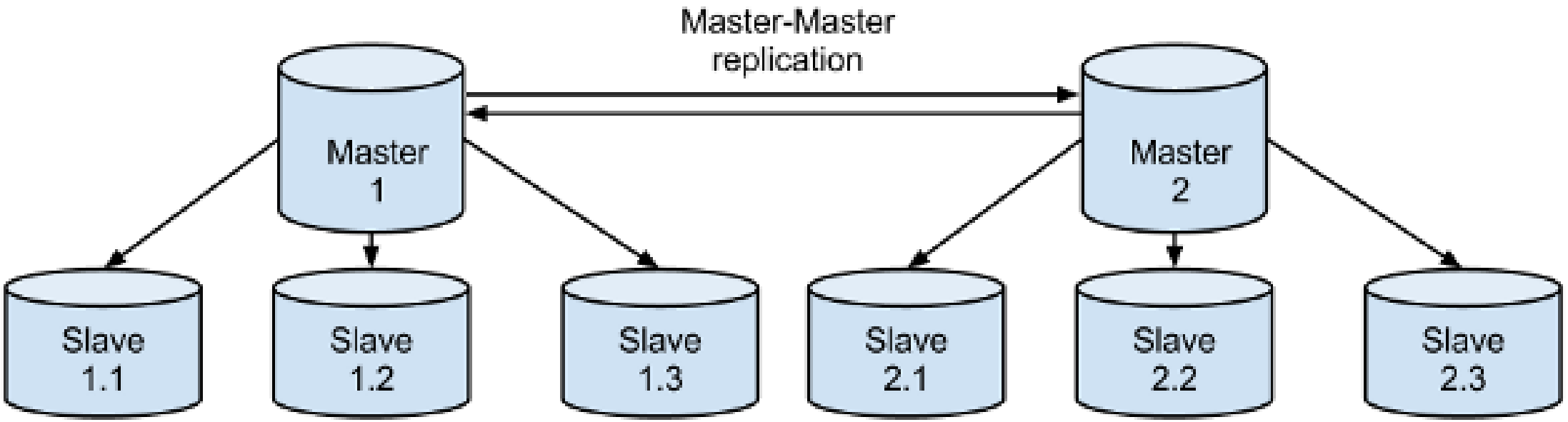
Small and compact

Cons:

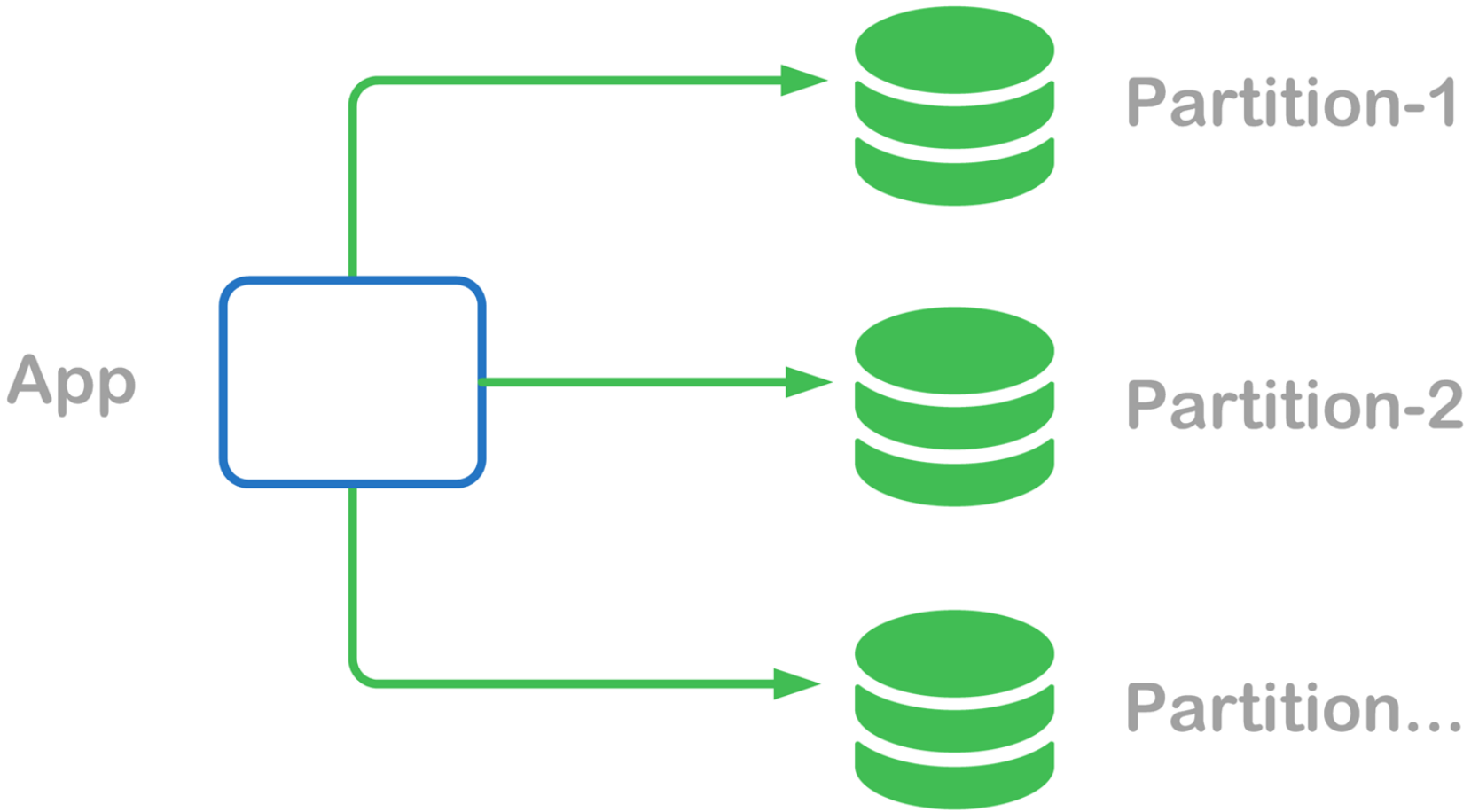
Poor if you need to minimize the change of data loss in case Redis stops working

Needs to fork() often to persist on disk using child process

Replication



Scaling



Partitioning

Advantages

- Can handle larger data sets
- Can scale to multiple cores and computers
- Not limited to single CPU's RAM

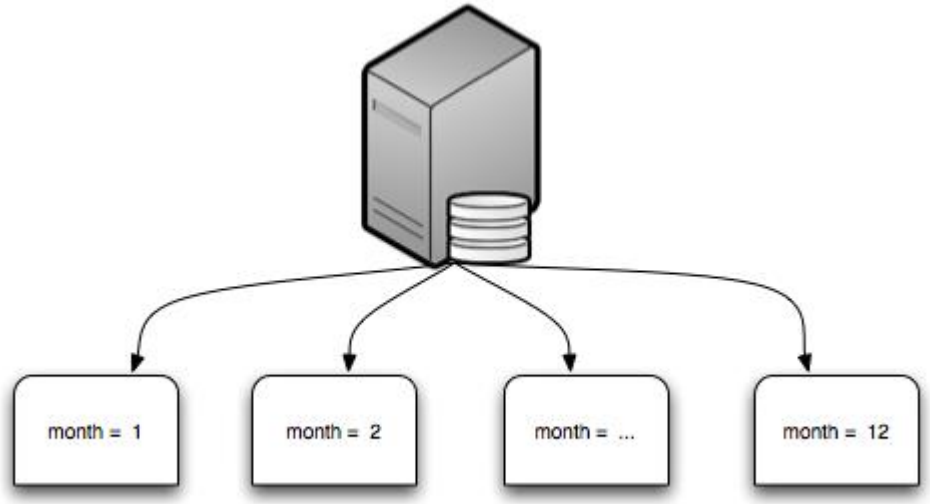
Disadvantages

- Can't partition if operations involve multiple keys
- Increased data handling complexity
- Altering capacity becomes difficult

How to Partition

3 Methods:

1. Client Side Partitioning
2. Proxy Assisted Partitioning
3. Query Routing



Partitioning Implementations

- Redis Cluster
- Twemproxy
- Clients supporting consistent hashing

Partitioning Implementations

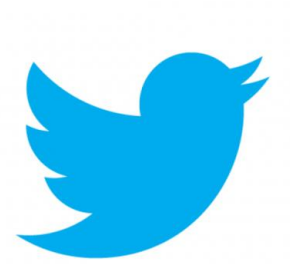
- **Redis Cluster**
- Twemproxy
- Clients supporting consistent hashing

Automatically splits dataset among multiple nodes

Will still operating when some of the nodes are failing

Partitioning Implementations

- Redis Cluster
- Twemproxy
- Clients supporting consistent hashing



Is a proxy between the clients and Redis instances

Can automatically shard data among instances

Supports consistent hashing

Partitioning Implementations

- Redis Cluster
- Twemproxy
- Clients supporting consistent hashing

Simply use a client that implements client side partitioning (via consistent hashing)

Examples: Redis-rb, Predis

Redis

Common Operations and Query Language

Popular Storage Commands

- SET
- APPEND
- PUSH

<SET> <Key> <Value>

Sets the value to the corresponding key. If key already exists, it is overwritten.

Returns String “OK” if successful, NULL otherwise.

Popular Storage Commands

- SET
- APPEND
- PUSH

<APPEND> <Key> <Value>

Appends the value to the corresponding key. If key doesn’t exist, it is created.

Returns Integer corresponding to new size of Value.

Popular Storage Commands

- SET
- APPEND
- PUSH

<PUSH> <Key> <Value>

Appends the value to the corresponding key. If key doesn't exist, it is created. Key must be a list.

Returns Integer corresponding to new size of Value.

Popular Retrieval Commands

- GET
- MGET

<GET> <Key>

Returns the value for the corresponding key.

Returns value of key or NULL if key does not exist.

Popular Retrieval Commands

- GET
- MGET

<MGET> <Key> [Keys…]

Returns all values for all the corresponding keys.

Returns values of keys in an array. Cell in array is NULL if corresponding key doesn’t exist.

Other Popular Commands

- DEL
- RENAME
- EXISTS
- DBSIZE

<DEL> <Key> [Keys…]

Deletes all keys and associated values.

Returns the number of keys deleted.

Other Popular Commands

- DEL
- RENAME
- EXISTS
- DBSIZE

<RENAME> <Key> [newKey]

Renames key to newKey.

Returns error if key does not exist. If newKey already exists it is overwritten.

Other Popular Commands

- DEL
- RENAME
- EXISTS
- DBSIZE

<EXISTS> <Key>

Determines whether or not key exists in database.

Returns True if key exists, False otherwise.

Other Popular Commands

- DEL
- RENAME
- EXISTS
- DBSIZE

<DBSIZE>

Returns number of keys in the database.

Redis supports different languages

Browse by language:

ActionScript	Bash	C	C#	C++	Clojure
Common Lisp	Crystal	D	Dart	Delphi	Elixir
emacs lisp	Erlang	Fancy	gawk	GNU Prolog	Go
Haskell	Haxe	Io	Java	Julia	Lasso
Lua	Matlab	mruby	Nim	Node.js	Objective-C
OCaml	Pascal	Perl	PHP	Pure Data	Python
R	Racket	Rebol	Ruby	Rust	Scala
Scheme	Smalltalk	Swift	Tcl	VB	VCL

Java-specific initialization

- Client to access Redis is called “Jedis”
- Jedis jedis = new Jedis(String host, int port)

Java-specific commands

- jedis.set(“key1”, “abc”)
- jedis.get(“key2”)

String “abc” is now associated with String “key1”.

Java-specific commands

- jedis.set(“key1”, “abc”)
- jedis.get(“key2”)

Returns value associated with key2 if it exists.

Companies that use Redis

- Github
- Craigslist
- Digg
- Amazon (AWS)

Uses Redis to find a user's route, defined to be "the hostname of the file server on which that user's repositories are kept."

Companies that use Redis

- Github
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- Digg
- Amazon (AWS)

Uses Redis to map hostname to port numbers of different users.

Companies that use Redis

- Github
- Craigslist
- Digg
- Amazon (AWS)

Uses Redis to keep track of page views and clicks.

“Redis rocks”

-Digg

Companies that use Redis

- Github
- Craigslist
- Digg
- Amazon (AWS)

Amazon Web Services (AWS) ElastiCache uses Redis.

My experience.

Other Companies that use Redis

- Twitter
- Snapchat
- Uber
- Instagram
- Slack
- Imgur
- Grooveshark
- Airbnb
- Tumblr

Sources

1:https://www.cs.cornell.edu/~ie53/publications/icDSN12.pdf

2:http://redis.io/topics/data-types

3:http://stackoverflow.com/questions/9625246/what-are-the-underlying-data-structures-used-for-redis

http://blog.avangardo.com/2013/12/comparison-of-most-popular-nosql-dbmses/

https://www.cl.cam.ac.uk/research/srg/opera/publications/papers/vargasbaconmoody_integrating.pdf