Home of Redis

Redis Enterprise Developer Workshop
Modules Overview

Redis Labs – Home of Redis

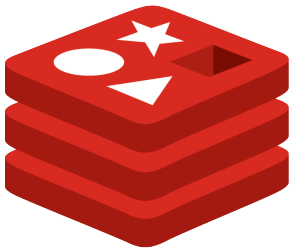
The commercial company behind Open Source Redis

Provider of the **Redis Enterprise (Redis^{e})** technology, platform and products

Founded in 2011
HQ in Mountain View CA, R&D center in Tel-Aviv IL

Topics

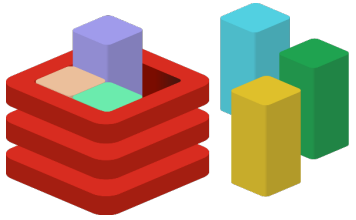
- Overview of the Redis Module System
- Redis-ML and Spark-ML modules
- reJSON
- Redisearch
- Redis Graph



Overview of Redis Modules

Redis Modules

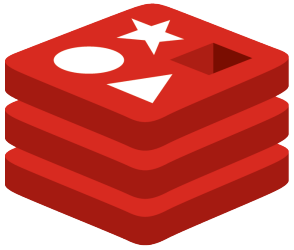
- Any C/C++ program can now run on Redis
- Use existing or add new data-structures
- Enjoy simplicity, infinite scalability and high availability while keeping the native speed of Redis
- Can be created by anyone



Modules : A Revolutionary Approach

Adapt your database to your data, not the other way around

Neural Redis	Redis-ML	RediSearch
Simple Neural Network Native to Redis	Machine Learning Model Serving	Full Text Search Engine in Redis
ReJSON	**Time Series**	**Graph**
JSON Engine on Redis. Pre-released	Time series values aggregation in Redis	Graph database on Redis based on Cypher language
Rate Limiter	**Crypto Engine Wrapper**	**Secondary Index/RQL**
Based on Generic Cell Rate Algorithm (GCRA)	Secure way to store data in Redis via encrypt/decrypt with various Themis primitives	Indexing + SQL -like syntax for querying indexes. Pre-released

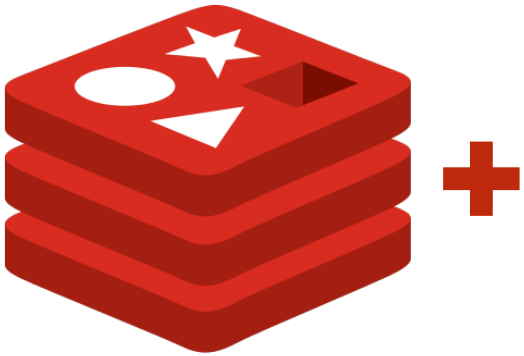


Redis-ML and Spark-ML

Redis-ML Module

- Predictive models as a native Redis Data Type (4.0 Modules API)
- Predictive model serving engine
- Multiple supported models
- Training framework independent

Redis ML Module



Redis Module

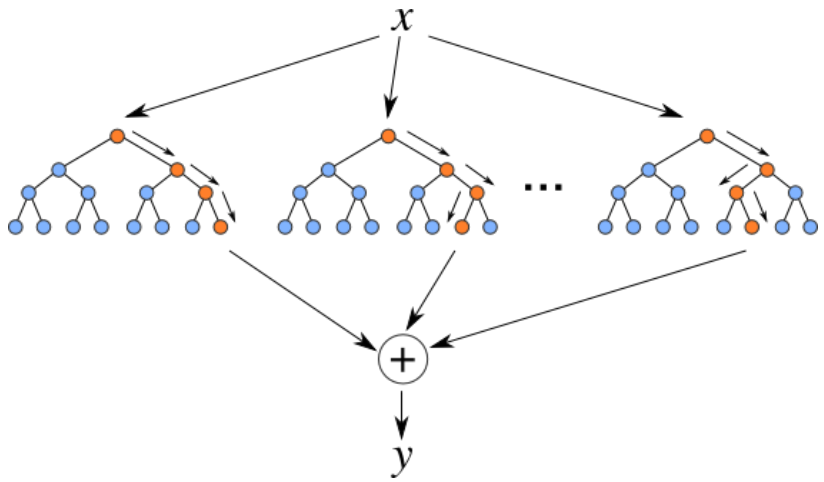
- Tree Ensembles
- Linear Regression
- Logistic Regression
- Matrix + Vector Operations
- More to come...

Redis-Spark Module

- Connector between Apache Spark and Redis-ML
- Train models using Apache Spark
- Load trained models into Redis

Example: Random Forest

- A collection of decision trees
- Splitter Node can be:
  - Categorical (e.g. day == “Sunday”)
  - Numerical (e.g. age < 43)
- Decision is taken by the majority of decision trees



Forest Data Type Commands

Add nodes to a tree in a forest:

```
ML.FOREST.ADD <forestId> <treeId> <path>
    [ [NUMERIC|CATEGORIC] <splitterAttr> <splitterVal> ] |
    [LEAF] <predVal>
```

Perform classification/regression of a feature vector:

```
ML.FOREST.RUN <forestId> <features>
    [CLASSIFICATION|REGRESSION]
```

Forest Data Type Example

```
> ML.FOREST.ADD myforest 0  . CATEGORIC sex “male” .L
  LEAF 1 .R LEAF 0
OK
> ML.FOREST.RUN myforest sex:male
"1"
> ML.FOREST.RUN myforest sex:something_else
"0"
```

Real World Challenge: Ad Serving

- Need to serve 20,000 ads/sec @ 50msec data-center latency
- Runs 1k campaigns → 1K random forest
- Each forest has 15K trees
- On average each tree has 7 levels (depth)

Real World Challenge

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Ad Model Serving: Infrastructure Cost Saving

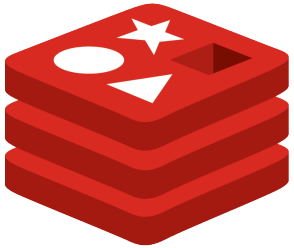
Cut computing infrastructure

by 97%

Homegrown

1,247 x c4.8xlarge

35 x c4.8xlarge



reJSON

What is JSON

- JavaScript Object Notion
- Data interchange format
  - Lightweight
  - Human Readable
  - Simple to Parse
  - Simple to Generate
- ECMA Standard
- Common web development format

```
{
    "userId": 0,
    "firstName": "Tague",
    "lastName": "Griffith",
    "userName": "tague"
}
```

Storing JSON in Redis

Serialized as Redis String

- GET/SET operations
- O(N) access
- Client deserialization
- No in-place updates

Deserialized in Hash

- Decode: HMSET
- Encode: HMGET
- O(1) Access
- Client deserialization
- No in-place updates

reJSON Module

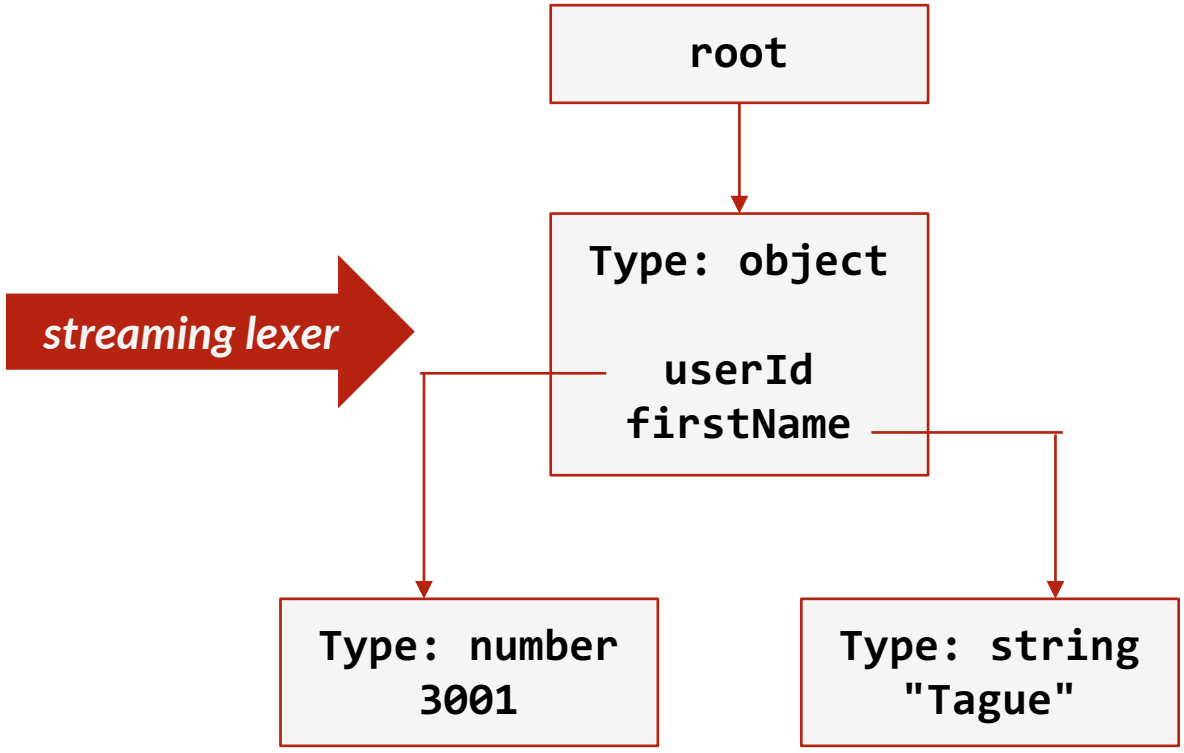
- JSON as a native Redis Data Type (4.0 Modules API)
- Keys map to JSON values
  - Scalars
  - Objects
  - Arrays
  - Nested or Not
- Stored as a document tree structure
- Path access to JSON elements
- Atomic, in-place updates

reJSON Basic Get/Set Operations

```
redis> JSON.SET json:scalar . '"Hello JSON!"'
OK
redis> JSON.SET json:object . '{"userId": 3001, "firstName": "Tague"}'
OK

redis> JSON.GET json:scalar
"Hello JSON!"
redis> JSON.GET json:object
{"userId":3001,"firstName":"Tague"}
redis> JSON.GET json:object .userId
3001

redis> JSON.SET json:object .userId 2001
OK
Redis> JSON.GET json:object
{"userId":2001,"firstName":"Tague"}
```

ReJSON tree data structure

```
JSON.SET key .
'{
    "userId": 3001,
    "firstName": "Tague"
}'
```



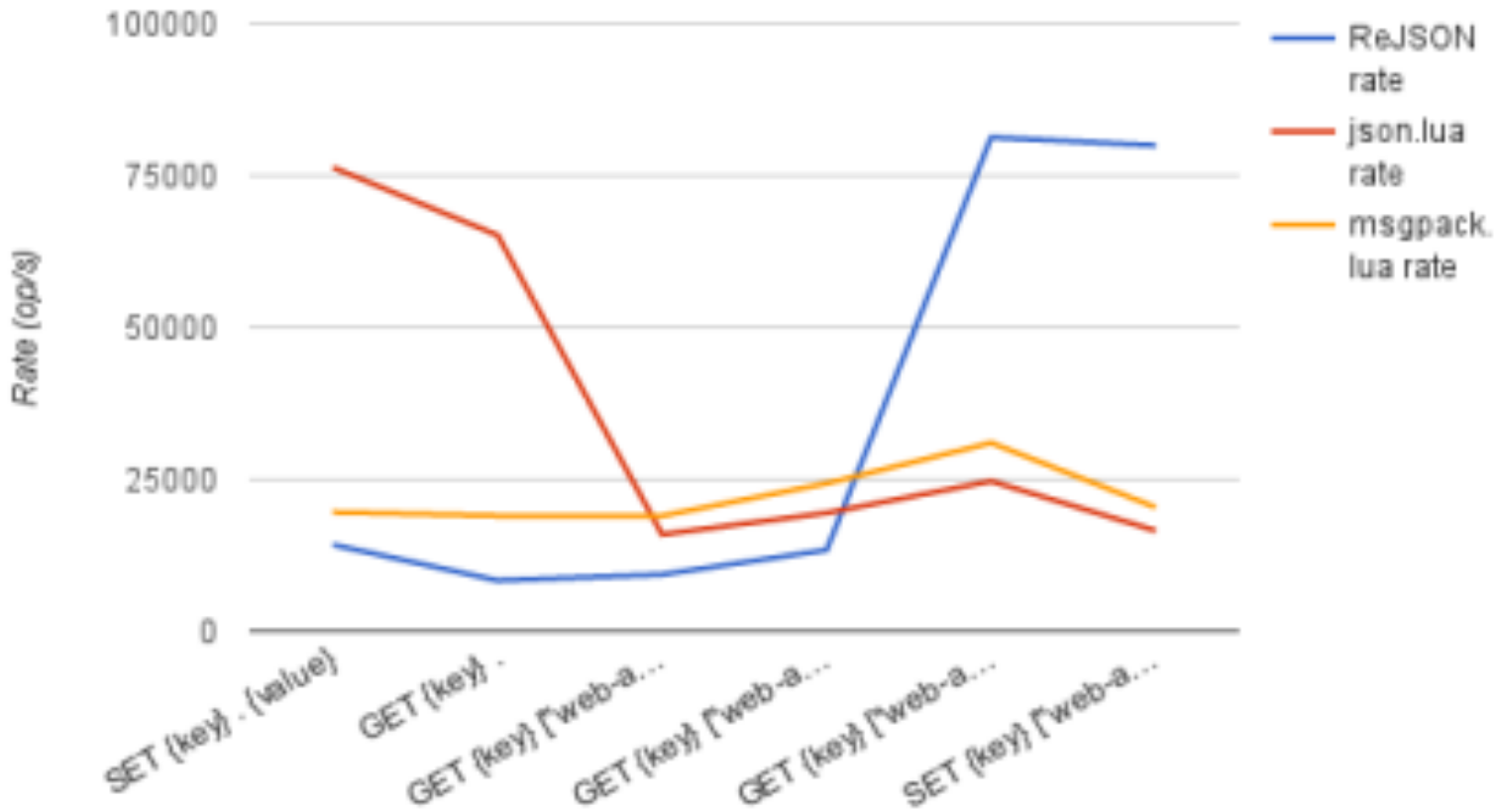
reJSON Commands

General	`JSON.DEL, JSON.GET, JSON.MGET,JSON.SET,JSON.TYPE`
Numbers	`JSON.NUMINCRBY, JSON.NUMMULTBY`
Strings	`JSON.STRAPPEND, JSON.STRLEN`
Objects	`JSON.OBJKEYS, JSON.OBJLEN`
Arrays	`JSON.ARRAPPEND, JSON.ARRINDEX, JSON.ARRINSERT, JSON.ARRLEN, JSON.ARRPOP, JSON.ARRTRIM, JSON.RESP`

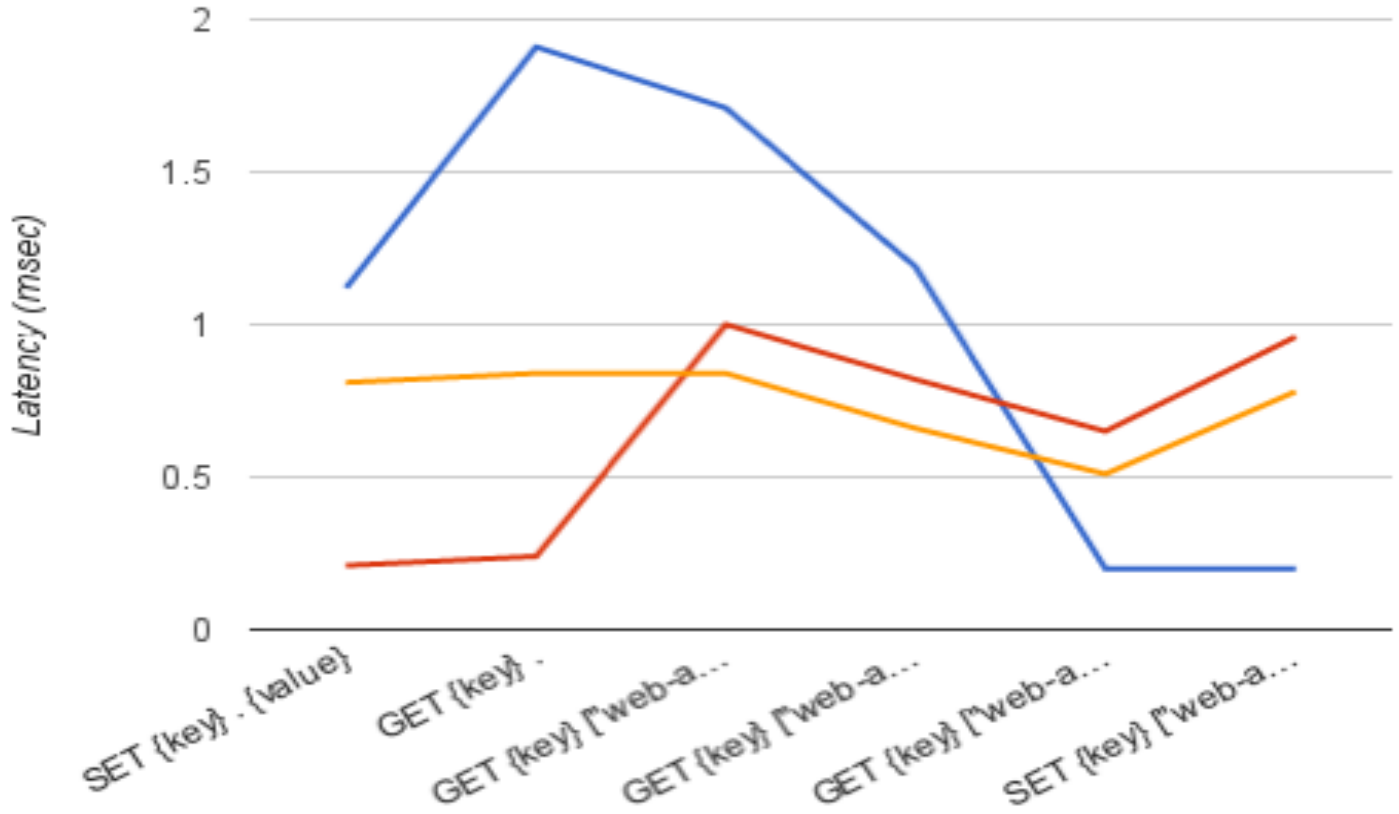
Access reJSON API

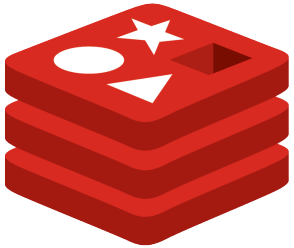
- Python
  - rejson-py
  - redis-py execute command
- Java
  - JReJSON
  - JedisConnection.execute

Throughput


100000
75000
50000
25000
0
Rate (op/s)
SET {key} - {value}
GET {key} -
GET {key} ["web-a...
GET {key} ["web-a...
GET {key} ["web-a...
SET {key} ["web-a...
ReJSON rate
json.lua rate
msgpack. lua rate

Latency


2
1.5
1
0.5
0
Latency (msec)
SET {key} . {value}
GET {key} .
GET {key} ["web-a...
GET {key} ["web-a...
GET {key} ["web-a...
SET {key} ["web-a...



Redisearch

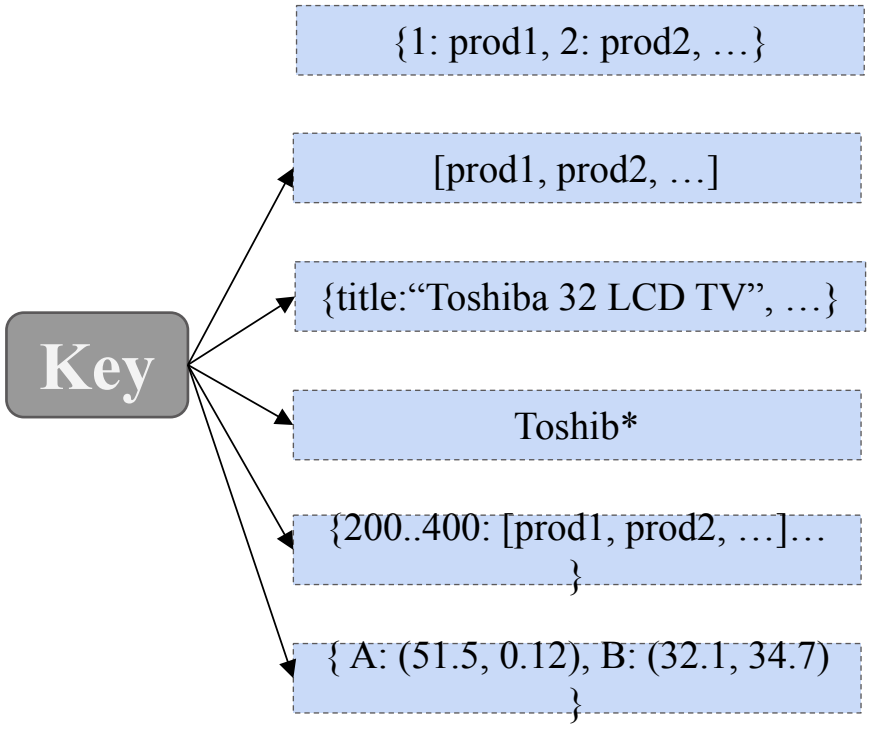
Redisearch Module

- Developed by Redis Labs using 4.0 Module API
- Optimized Data structures
- Fast index and search
- Text, numeric and geo filters
- Non-blocking updates and deletes
- Scale to billions of documents

RediSearch Fundamentals

```
> FT.CREATE products SCHEMA title TEXT price NUMERIC

> FT.ADD products prod1 1.0 FIELDS title "Toshiba 32 LCD TV" price 250
> FT.ADD products prod2 1.0 FIELDS title "Samsung 42 LCD TV" price 350

> FT.SEARCH products "lcd tv"
1) (integer) 2
2) "prod1"
      …
4) "prod2"
      …
> FT.SEARCH products "lcd tv" FILTER price 300 400
1) (integer) 1
"prod2"
```

RediSearch Data Structures



Document Table

Posting Lists (Inverted Index)

Documents (HASHes)

AutoComplete (Trie)

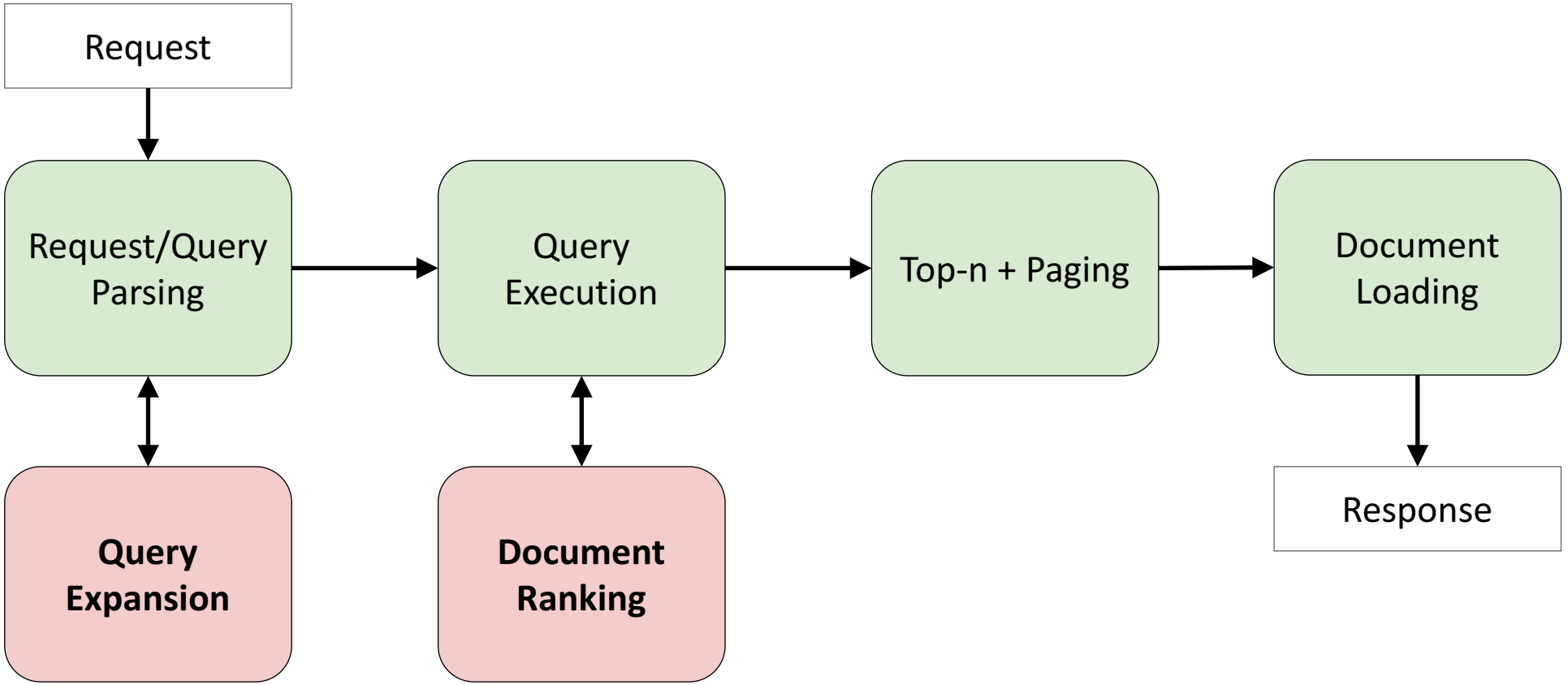
Numeric Index (Range tree)

Geo Sets

Redisearch Query

```
FT.SEARCH {index} {query} [NOCONTENT] [VERBATIM]
  [NOSTOPWORDS] [WITHSCORES] [WITHPAYLOADS]
  [FILTER {numeric_field} {min} {max}] ...
  [GEOFILTER {geo_field} {lon} {lat} {raius} m|km|mi|ft]
  [INKEYS {num} {key} ... ]
  [INFIELDS {num {field} ... ]
  [SLOP {slop}] [INORDER]
  [LANGUAGE {language}]
  [EXPANDER {expander}]
  [SCORER {scorer}]
  [PAYLOAD {payload}]
  [SORTBY {field} [ASC|DESC]]
  [LIMIT offset num]
```

RediSearch Search Request Processing



Evaluating Queries

- Document at-a-time approach
- Indexes are decoded as iterators, one object per round
- Top N results copied into a heap & sorted on the fly

Scoring Results

- Each document in the query's result is evaluated by a **Scoring Function**
- **Top-N** scored documents are selected
- The default uses:
  - Term Frequency–Inverse Document Frequency (TF-IDF)
  - User given a priori document score
  - Proximity boosting
- And you can write your own function!

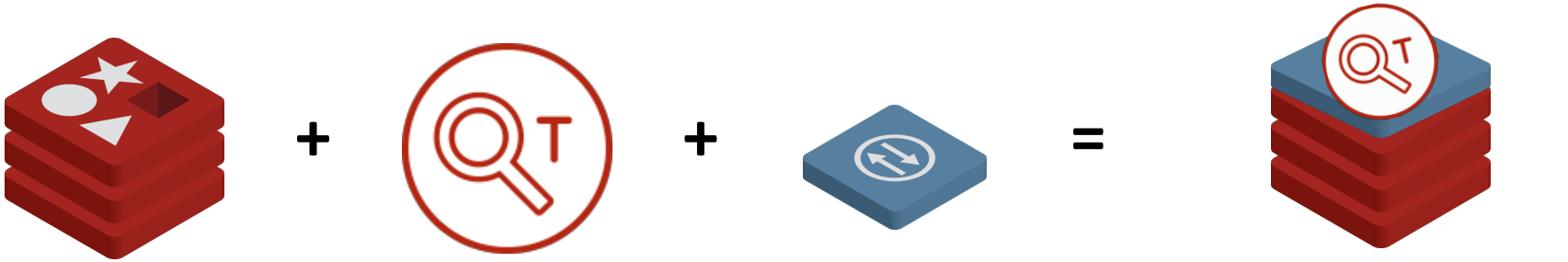
Auto Complete

- Custom data type - trie based
- Fuzzy completions
- Manual dictionary building and scoring
- Unicode aware case-folding

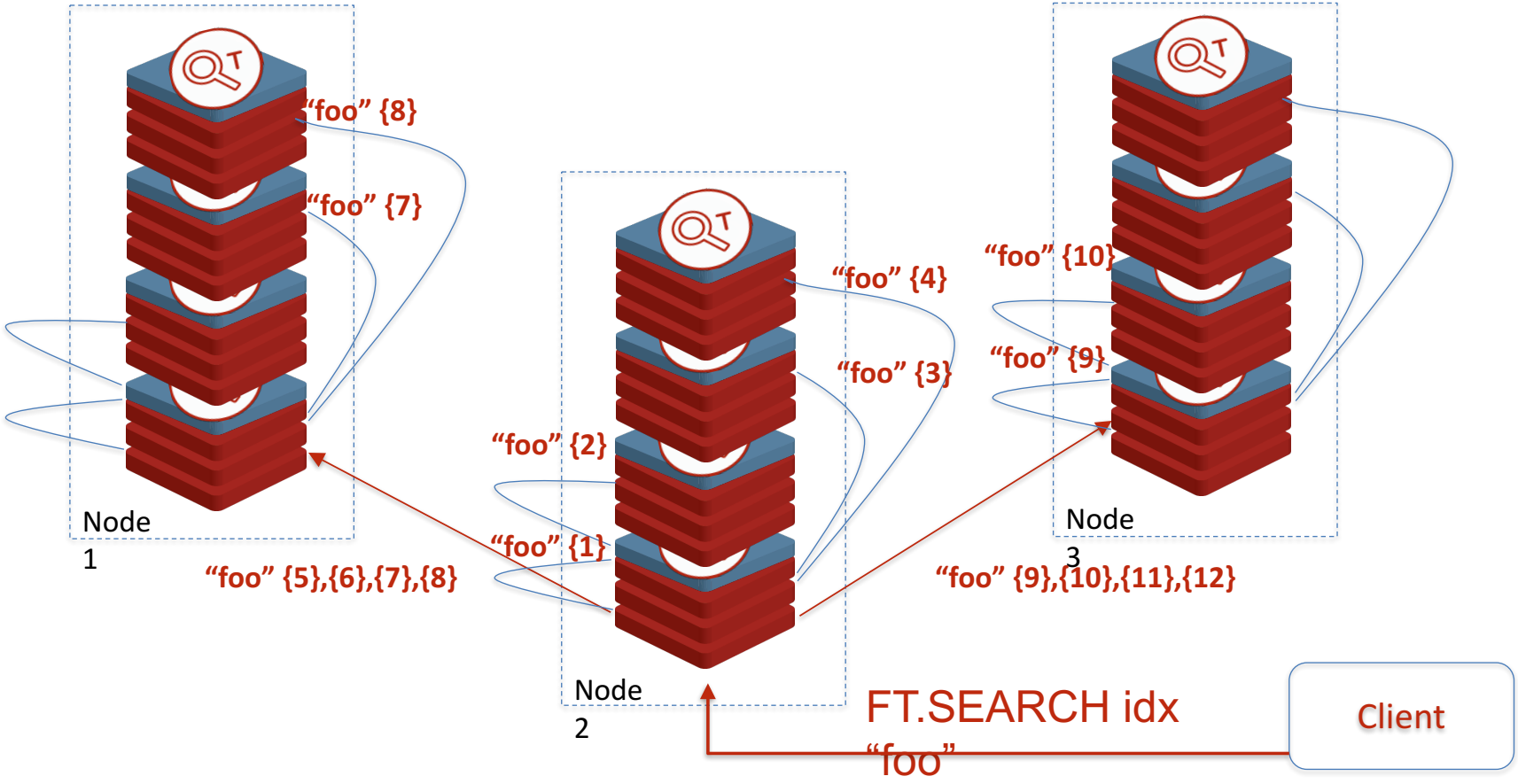
Scaling RediSearch

- Partition by document id
- Each partition contains a full index of 1/N of the documents
- All terms for a sub-index are stored on the same shard
- This means we need a query coordinator:
  - Distribute the queries to all shards
  - Merge the results

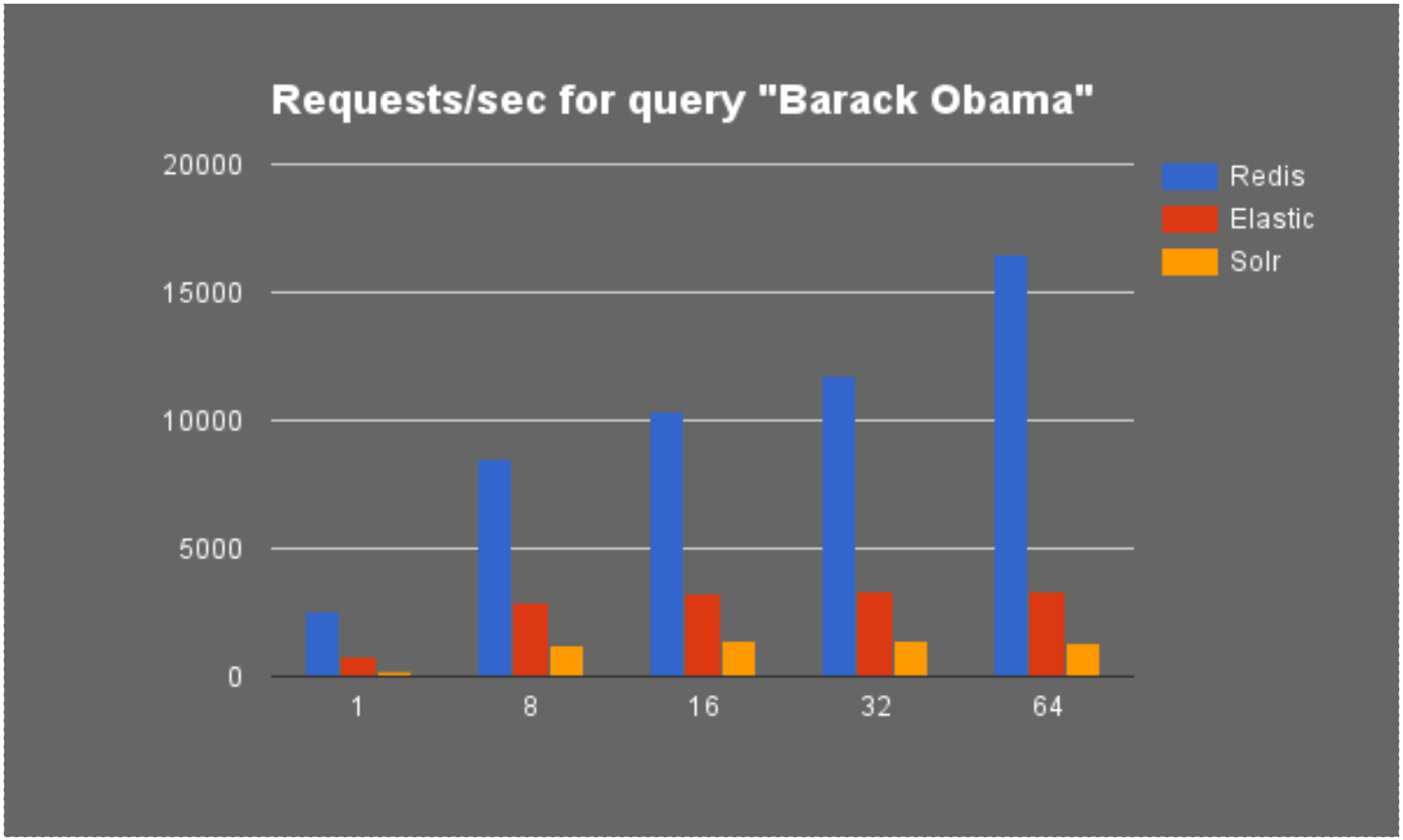
RediSearch Sharing

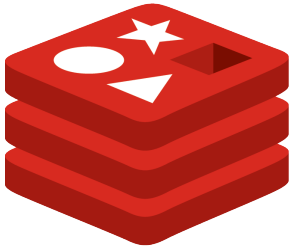


RediSearch Cluster Architecture



Performance

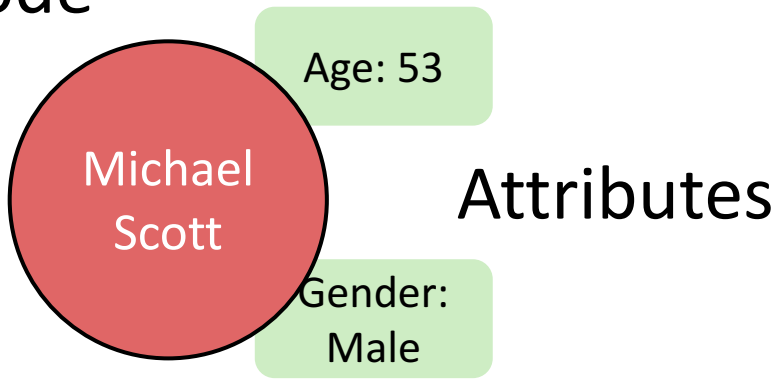




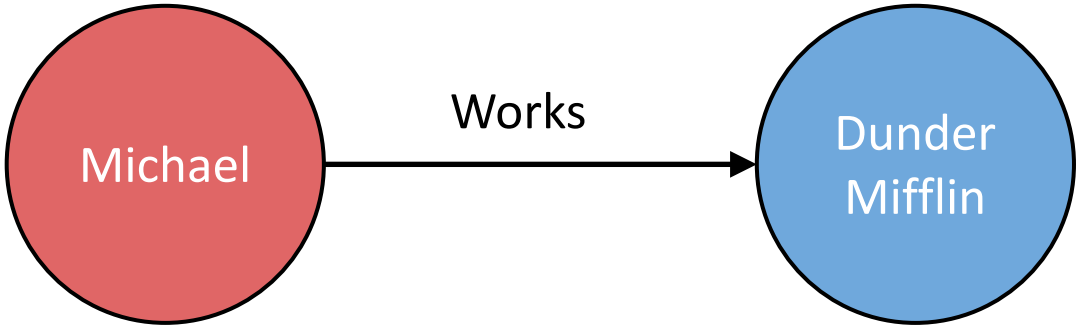
Redis Graph

Basic Graph Data Model

Node



Relation

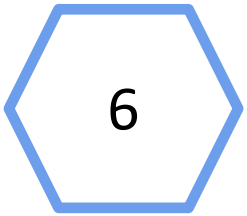


Adding Data

```
GRAPH.CREATENODE <Graph_Name> <Label> <Attributes>

GRAPH.CREATENODE the_office employee name "michael scott" age 53 gender male
status single

GRAPH.ADDEDGE <Graph_Name> <SRC_NODE> <Relation> <DEST_NODE> <Attributes>

GRAPH.ADDEDGE the_office michael scott boss jim halpert <Attributes>
```

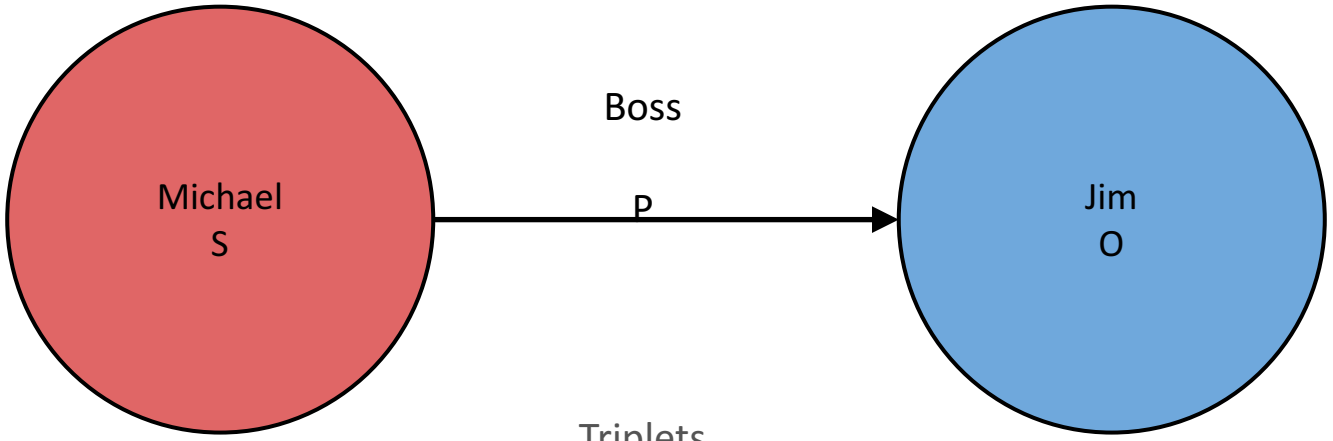
HexaStore Storage Format

S	P	O
Subject	Predicate	Object



SPO OSP
SOP PSO
OPS POS

HexaStore Example



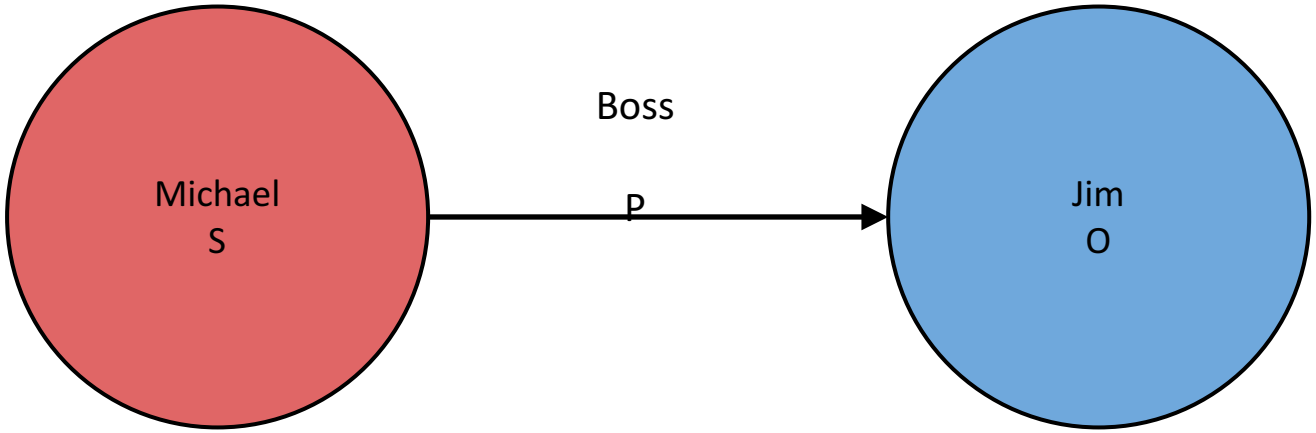
Triplets

SPO:Michael:Boss:Jim
SOP: Michael:Jim:Boss
OPS: Jim:Boss:Michael
OSP: Jim:Michael:Boss
PSO: Boss:Michael:Jim
POS: Boss:Jim:Michael

Converting Queries to Predicates

Who does Michael manages?
SPO:Michael:Boss:*
Who manages Jim?
OPS: Jim:Boss:*

Who manages who?
PSO: Boss:*



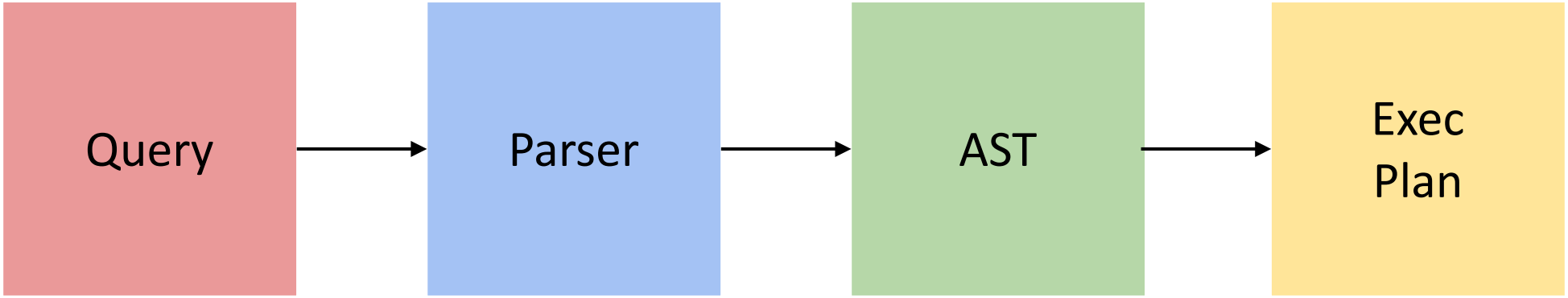
Query Language Cypher

```
MATCH <Graph_name> <graph_pattern>
WHERE <filters>
RETURN <entities>
ORDER BY <properties>
LIMIT <count>
```

Cypher Example

```
MATCH (Michael:employee {name:michael
scott})-[boss]->(E:employee)-[visit]->
(c:country)
WHERE (E.age > Michael.age AND c.continent
= Europe)
RETURN E.name, count(c.name) AS
countriesVisited
ORDER BY countriesVisited, E.age DESC
LIMIT 5
```

Query Execution



Benchmark

- 150K inserts per second
- 15K queries per second

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