MongoDB Architecture

Data Model

- Stores data in form of BSON (binary JavaScript Object Notation) *documents*

```
{
        name: “travis”,
        salary: 30000,
        designation: “Computer Scientist”,
        teams: [ “front-end”,  “database” ]
}
```

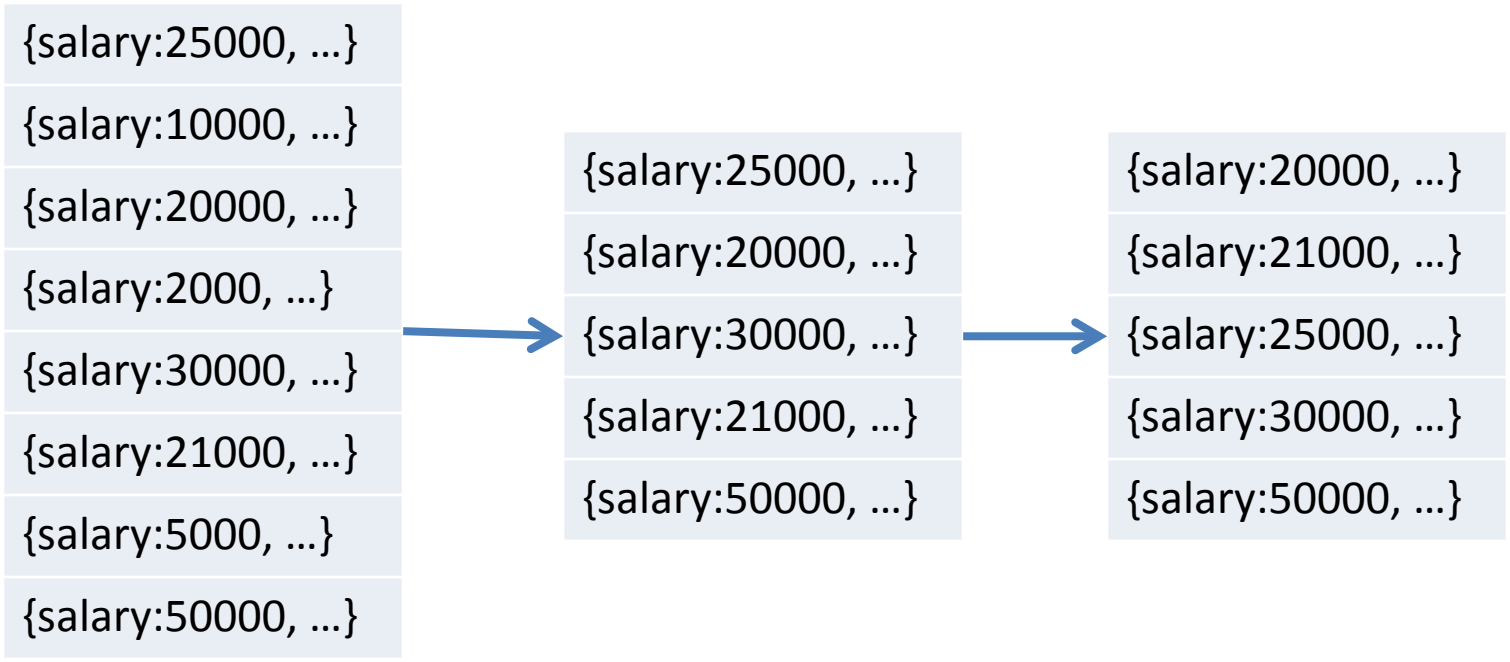
- Group of related *documents* with a shared common index is a *collection*

Query

Query all employee names with salary greater than 18000 sorted in ascending order

```
db.users.find({salary:{$gt:18000}, {name:1}}).sort({salary:1})
```

Collection | Condition | Projection | Modifier



Insert

Insert a row entry for new employee Sally

```
db.users.insert({
        name: “sally”,
        salary: 15000,
        designation: “MTS”,
        teams: [ “cluster-management” ]
        })
```

Update

All employees with salary greater than 18000 get a designation of Executive

```
                db.users.update(
Update Criteria     {salary:{$gt:18000}},
Update Action       {$set: {designation: “Manager”}},
Update Option       {multi: true}
                )
```

Multi option allows multiple document update

Delete

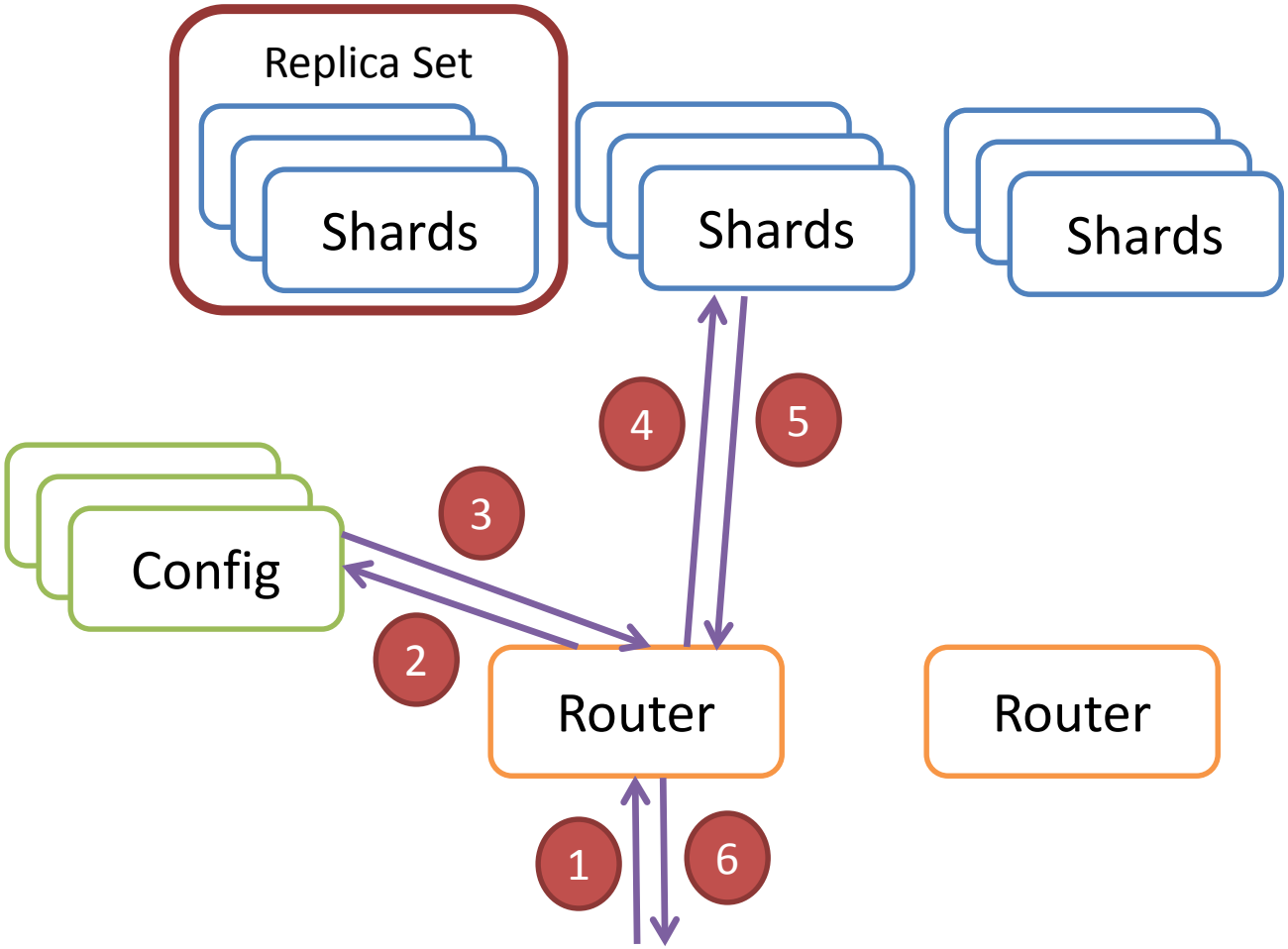
Remove all employees who earn less than 10000

```
db.users.remove(
    {salary:{$lt:10000}},
)
```

Remove Criteria

Can accept a flag to limit the number of document removal

Typical MongoDB Deployment



- Shards: mongod servers store the data
- Multiple shard servers form a *replica set*
- Replica set maintain same replica of data
- Routers: mongos interfaces with clients and routers operations to appropriate shards
- Config: Stores collection level metadata.

Read Preference

- Determine where to route read operation
- Default is primary. Possible options are secondary, primary-preferred, etc.
- Helps reduce latency, improve throughput
- Reads from secondary may fetch stale data

Write Concern

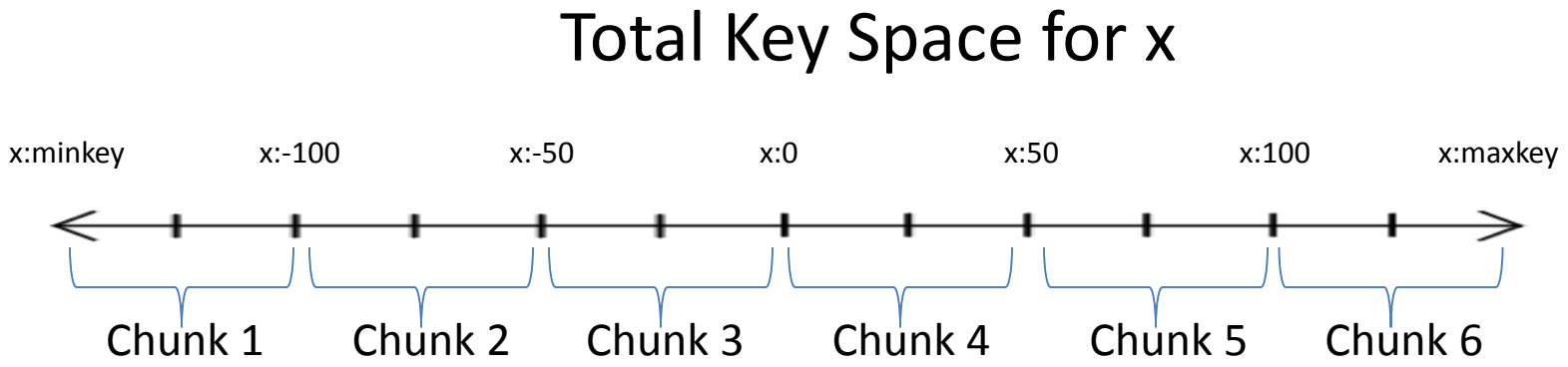
- Determines the guarantee that MongoDB provides on the success of a write operation
- Default is *acknowledged.* Others are unacknowledged, replica-acknowledged, etc
- For the default case, primary replicas acknowledge the success of a write operation
- Weaker write concern implies faster write time

Write operation performance

- Indexing: Every write needs to update every index associated with the collection
- Document Growth: When document grows beyond the current allocation, it is relocated on disk
- Hardware
- Journaling: Write-ahead logging to an on-disk journal for durability

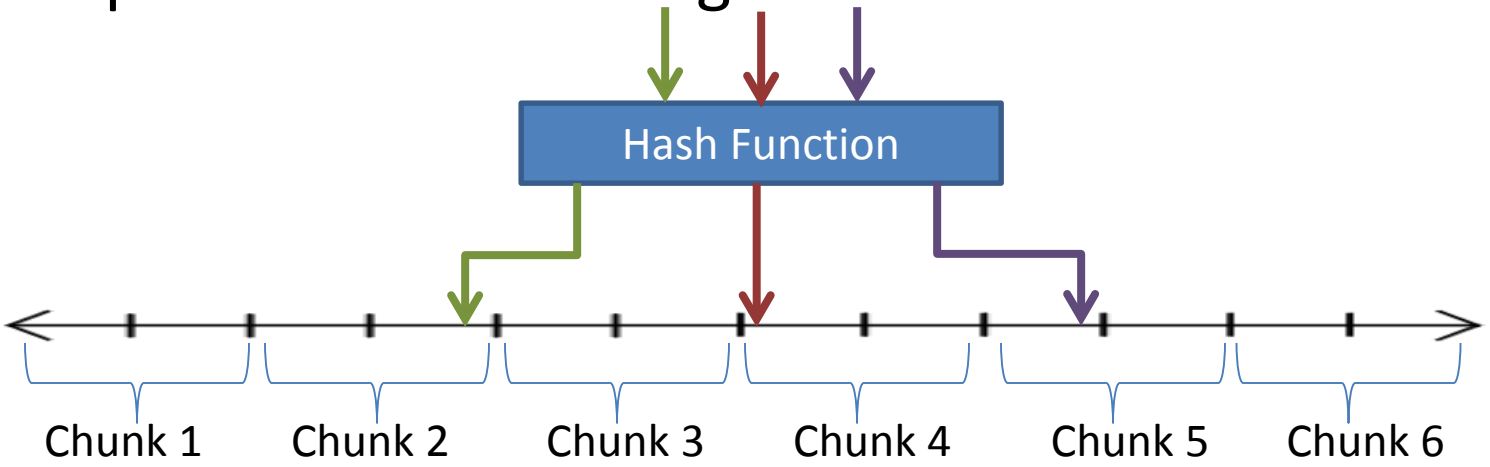
Partition

- Shard Key: Single or compound field in schema used for data partitioning
- Partitions are called *chunks.* Two strategies:
  - Range based: Shard Key Values are partitioned into ranges



Partition

– Hash based: Hash of shard key values are partitioned into ranges

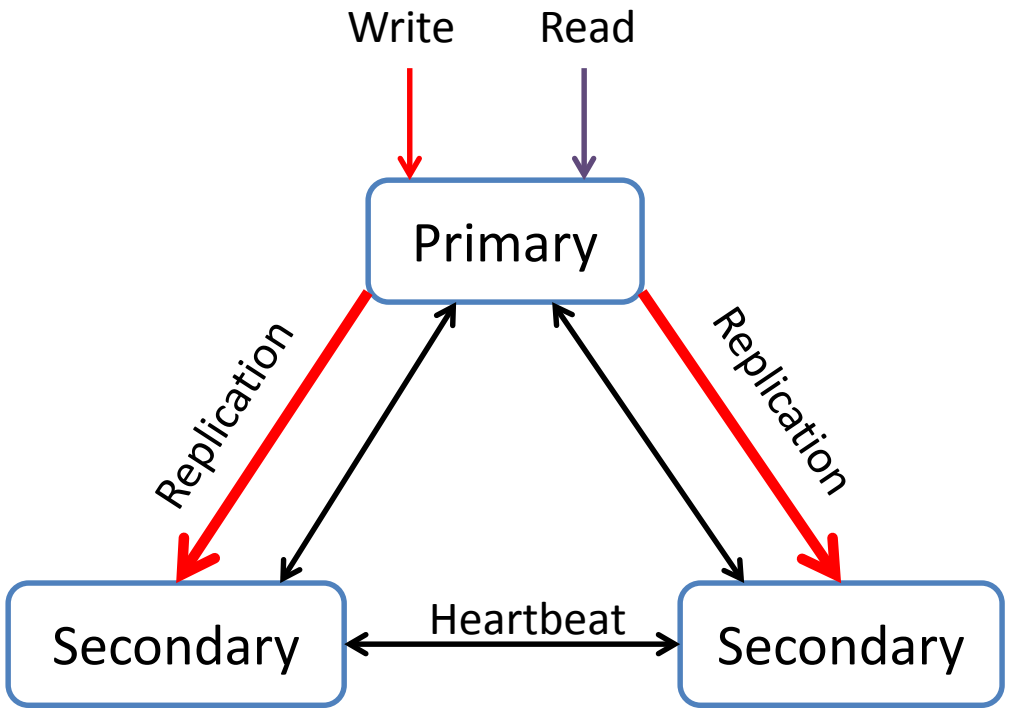


- Range Queries are efficient for the first strategy
- Hash Scheme leads to better data balancing

Balancing

- Splitting: Background process which splits when a chunks grows beyond a threshold
- Balancing: Migrates chunks among shards if there is an uneven distribution

Replication



Replication

- Oplog based data sync up
- Leader Election protocol elects a master
- Arbiters are mongod servers which do not maintain data but vote

Consistency

- Strongly Consistent: Read Preference is Master
- Eventually Consistent: Read Preference is Slave
- CAP Theorem: Under partition, MongoDB becomes write unavailable thereby ensuring consistency

Performance

- 30 – 50x faster than Sql Server 2008 for writes[1]
- At least 3x faster for reads[1]
- MongoDB 2.2.2 offers slower throughput for different YCSB workloads compared to Cassandra[2]

[1] http://blog.michaelckennedy.net/2010/04/29/mongodb-vs-sql-server-2008-performance-showdown/

[2] http://hyperdex.org/performance/

Demo

Insert

Insert a row entry for new employee Sally

use records -- Creates a database

```
db.employee.insert({
        name: “Sally”,
        salary: 15000,
        designation: “MTS”,
        teams: “cluster-management”
        })
```

Also can use save instead of insert

Bulk Load

- people = ["Marc", "Bill", "George", "Eliot", "Matt", "Trey", "Tracy", "Greg", “Steve", "Kristina", "Katie", "Jeff"];
- salary = [10000, 5000, 8000, 2000];
- designation = [“MTS”, “Computer Scientist”, “Manager”, “Director”];
- teams = [“cluster-management”, “human-resource”, “backend”, “ui”];

- for(var i=0; i<10000; i++){
  name = people[Math.floor(Math.random()*people.length)];
  salary = salary[Math.floor(Math.random()*salary.length)];
  designation = designation[Math.floor(Math.random() * designation.length)];
  teams = teams[Math.floor(Math.random()*teams.length)];
  db.employee.save({"name":name, salary:salary, “designation": designation, “teams":teams});
  }

Query

- db.users.find()
- db.users.find({name: “Sally”})
- var cursor = db.users.find({salary: {$in: [5000, 2000] } })
- Use next() to access the rest of the records

Query

- db.users.find({name: “Steve”, salary: {$lt: 3000} })
- db.inventory.find({ $or: [{ name: “Bill” }, { salary: { $gt: 9000 } }] })
- Find records of all managers who earn more than 5000

Aggregation Commands

- db.users.count()
- db.users.find({name: “Steve”}).count()
- db.users.find({name: “Steve”}).skip(10)
- db.users.find({name: “Steve”}).limit(10)

Modify/Remove

- db.users.update({ designation : “Manager” }, { $inc : { salary : 1000 } })
- db.users.update({ designation : “Manager” }, { $inc : { salary : 1000 } } , { multi: **true** })
- db.users.remove({ name : “Sally" })