Joins and aggregations in a distributed NoSQL DB

Max Neunhöffer

NoSQLmatters, Dublin, 4 September 2014

Documents and collections

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 "_id": "chars/123456",
 "name": "Duck",
 "firstname": "Donald",
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 "hobbies": ["Golf",
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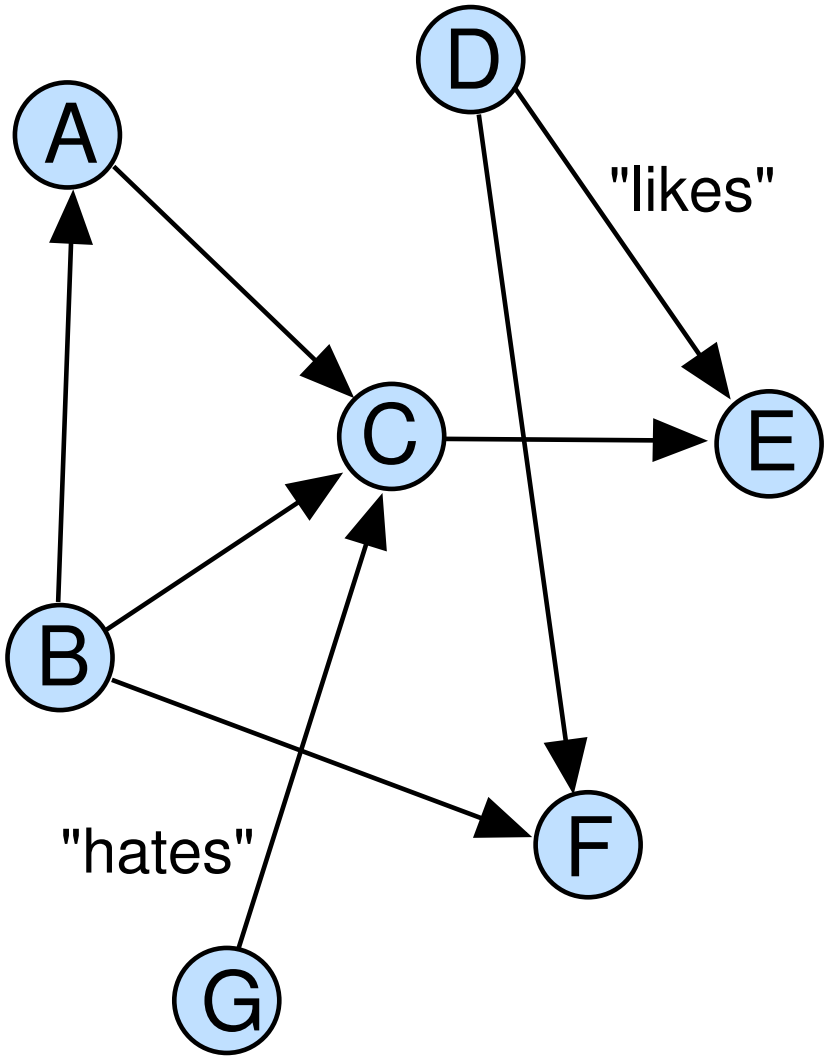
Or one can just treat the DB as a key/value store.

Sharding: the data of a collection is distributed between multiple servers.

Graphs



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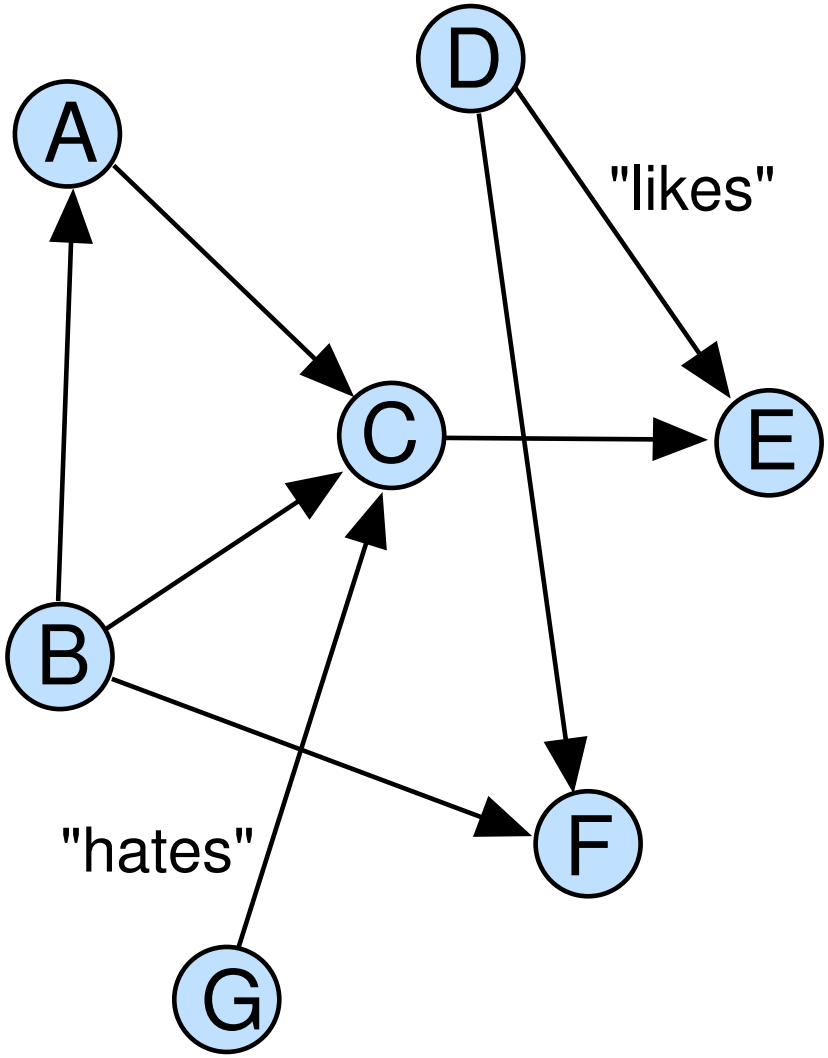

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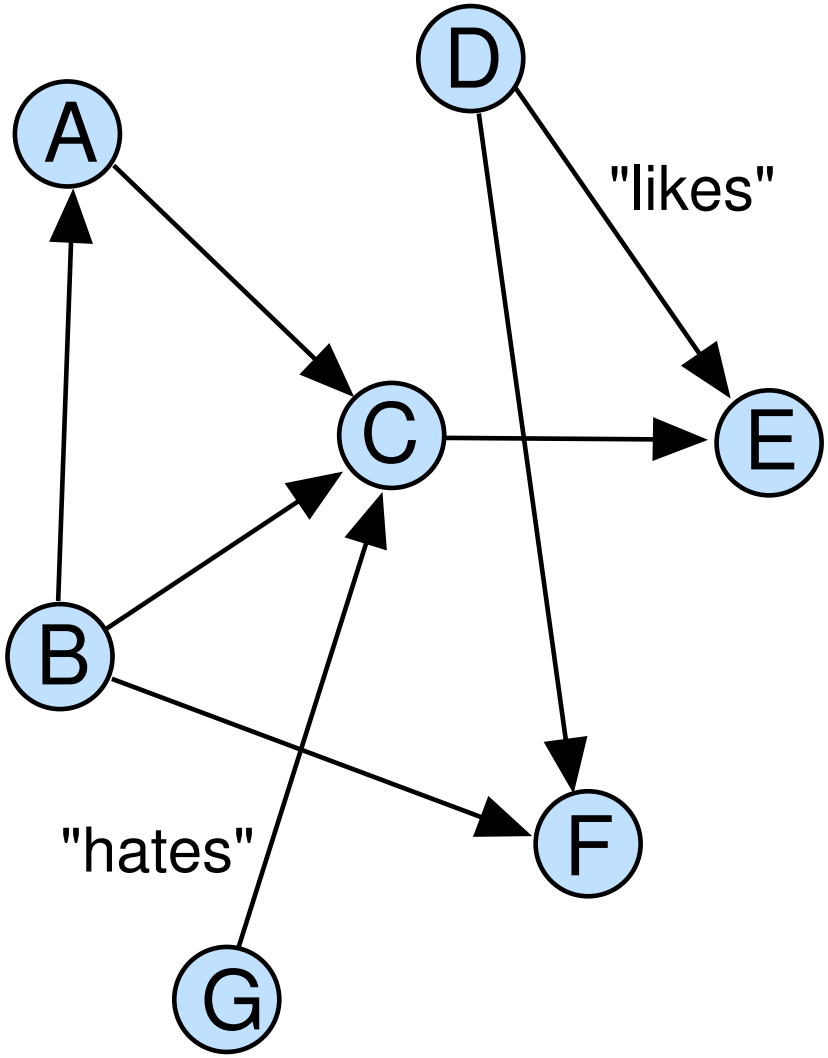
Graphs



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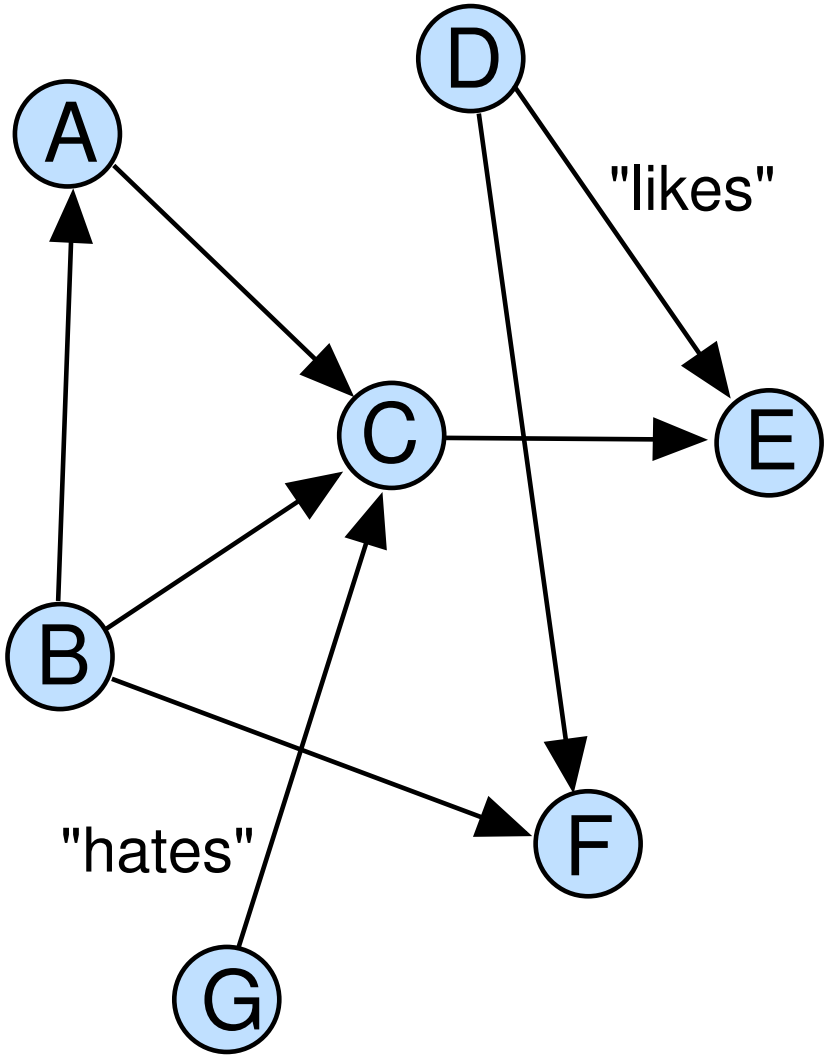

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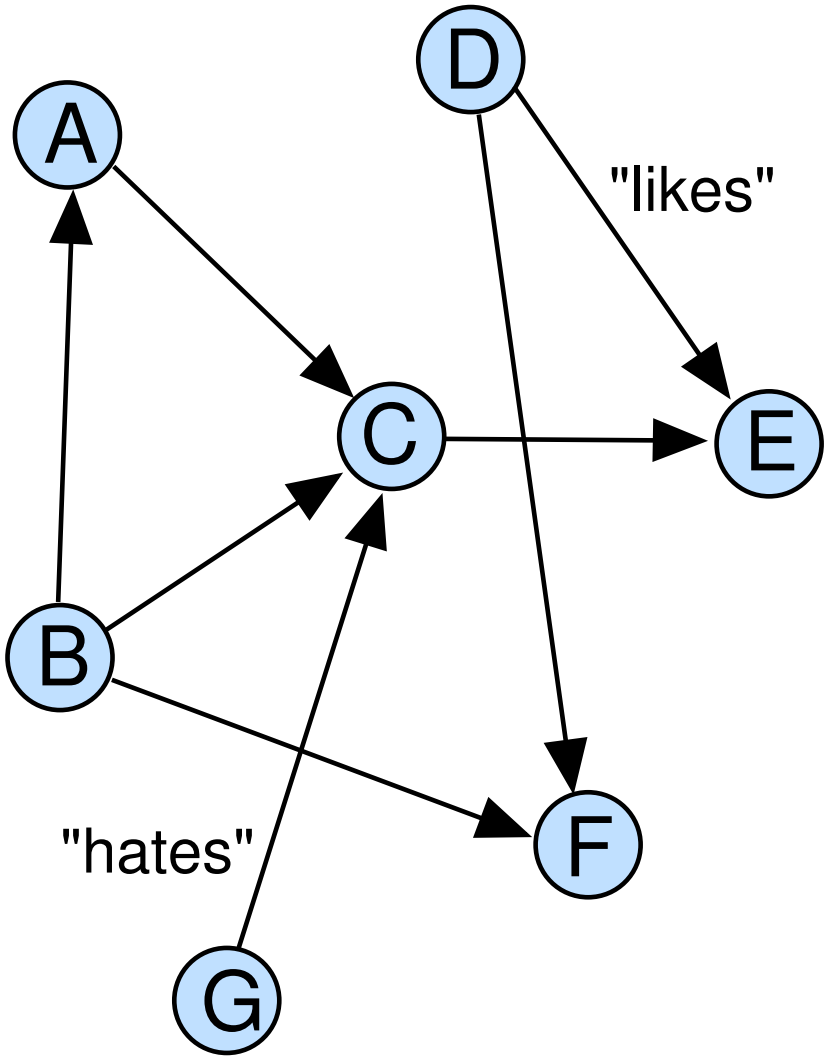

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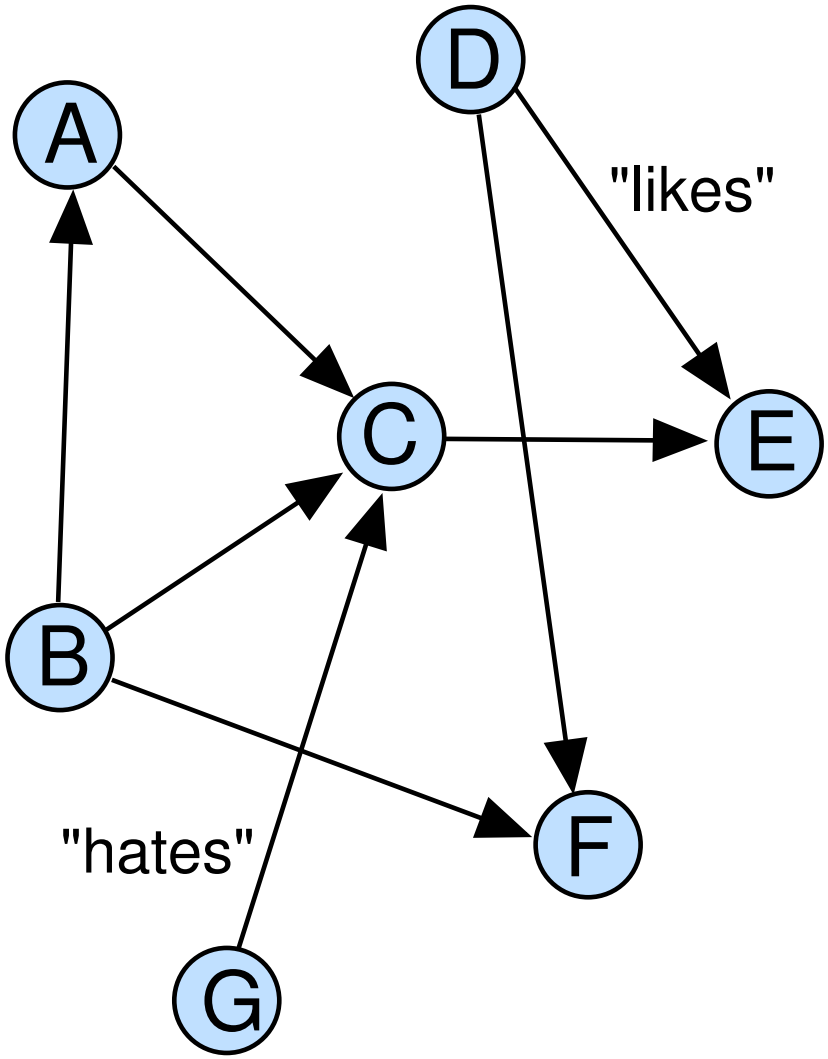

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The database offers queries and transactions dealing with graphs.

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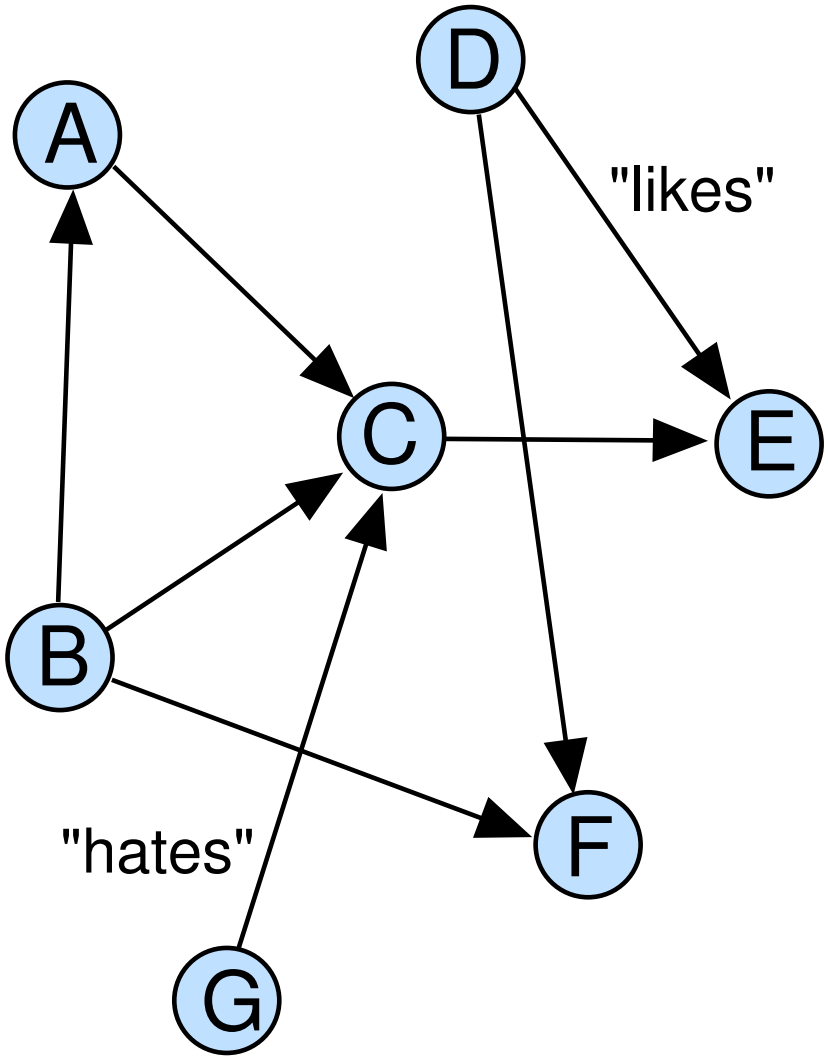

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For example, paths in the graph are interesting.

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Fetch all documents in a collection

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  ...
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]
```

(Actually, a cursor is returned.)

Query 2

Use filtering, sorting and limit

```
FOR p IN people
 FILTER p.age >= @minage
 SORT p.name, p.firstname
 LIMIT @nrlimit
 RETURN { name: CONCAT(p.name, ", ", p.firstname),
          age : p.age }
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```

```
[ { "name": "Neunhöffer, Max", "age": 44 },
  { "name": "Schmidt, Helmut", "age": 95 },
  ...
]
```

Query 3

Aggregation and functions

```
FOR p IN people
  COLLECT a = p.age INTO L
  FILTER a >= @minage
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```
[ { "age": 18, "number": 10 },
  { "age": 19, "number": 17 },
  { "age": 20, "number": 12 },
  ...
]
```

Query 4

Joins

```
FOR p IN @@peoplecollection
  FOR h IN houses
    FILTER p._key == h.owner
    SORT h.streetname, h.housename
    RETURN { housename: h.housename,
             streetname: h.streetname,
             owner: p.name,
             value: h.value }
```

Query 4

Joins

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FOR p IN @@peoplecollection
  FOR h IN houses
    FILTER p._key == h.owner
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    RETURN { housename: h.housename,
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```

```
[ { "housename": "Firlefanz",
    "streetname": "Meyer street",
    "owner": "Hans Schmidt", "value": 423000
  },
  ...
]
```

Query 5

Modifying data

```
FOR e IN events
  FILTER e.timestamp < "2014-09-01T09:53+0200"
  INSERT e IN oldevents

FOR e IN events
  FILTER e.timestamp < "2014-09-01T09:53+0200"
  REMOVE e._key IN events
```

Query 6

Graph queries

```
FOR x IN GRAPH_SHORTEST_PATH(
    "routeplanner", "germanCity/Cologne",
    "frenchCity/Paris", {weight: "distance"} )
  RETURN { begin    : x.startVertex,
           end      : x.vertex,
           distance : x.distance,
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           nrPaths  : LENGTH(x.paths) }
```

```
[ { "begin": "germanCity/Cologne",
    "end"  : {"_id": "frenchCity/Paris", ... },
    "distance": 550,
    "nrPaths": 10 },
  ...
]
```

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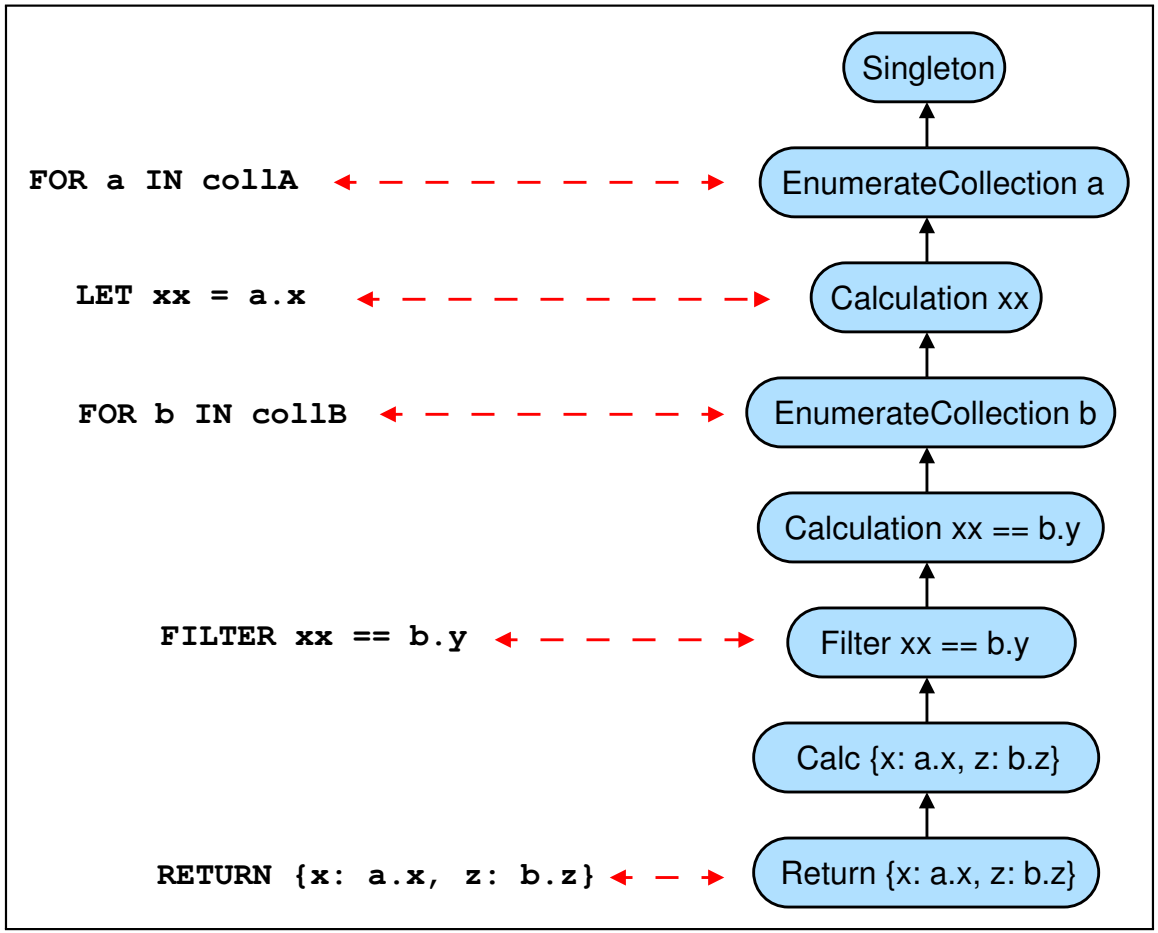
12. Execute plan, provide cursor API

Execution plans



Query $\rightarrow$ EXP

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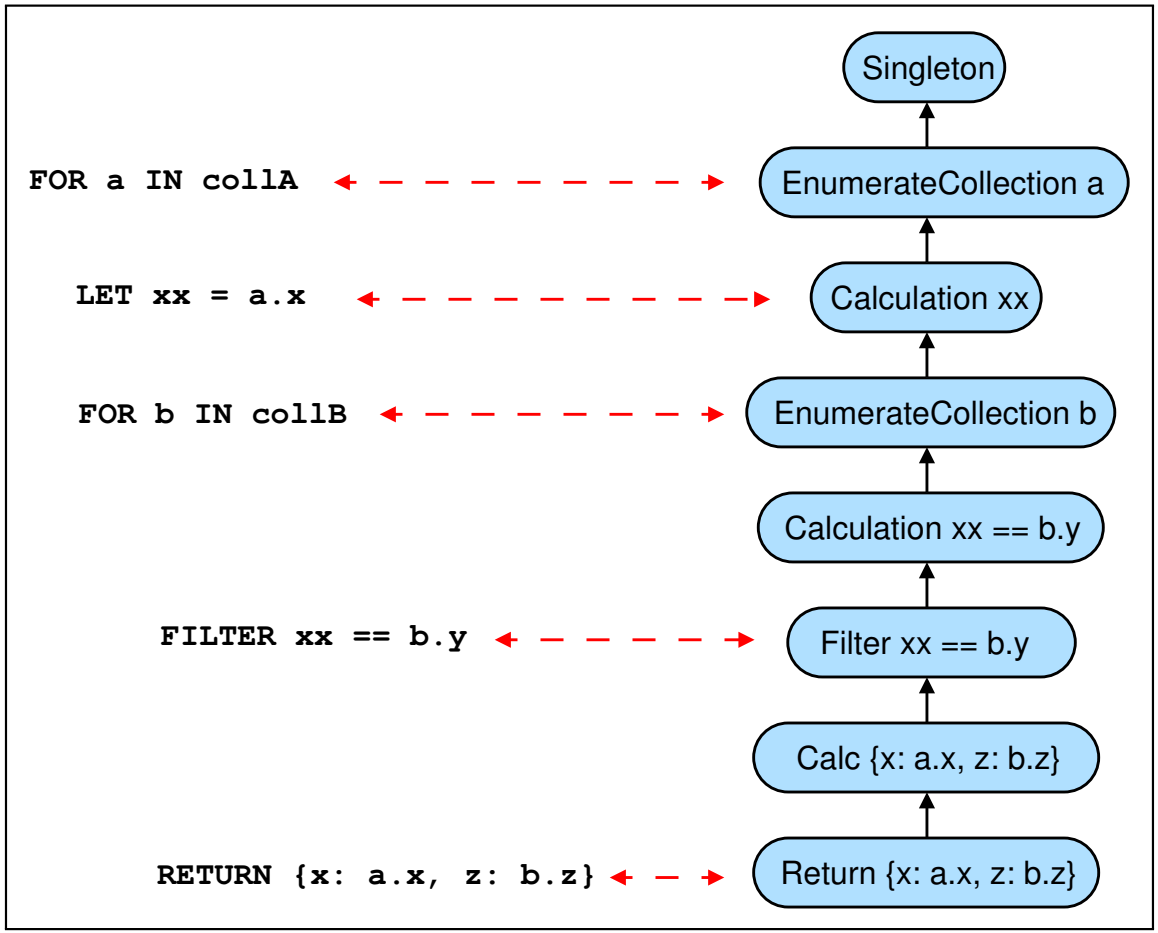

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Black arrows are dependencies

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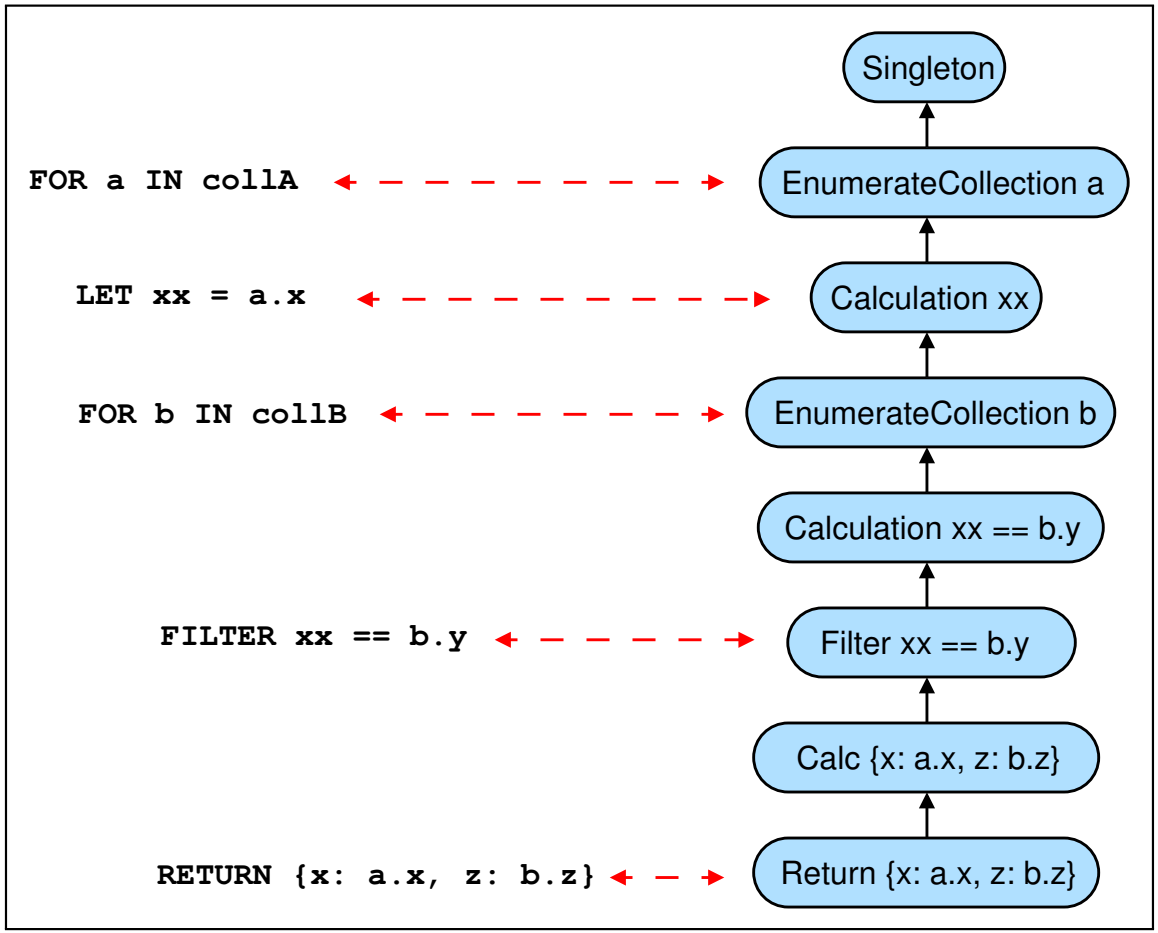

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Think of a pipeline

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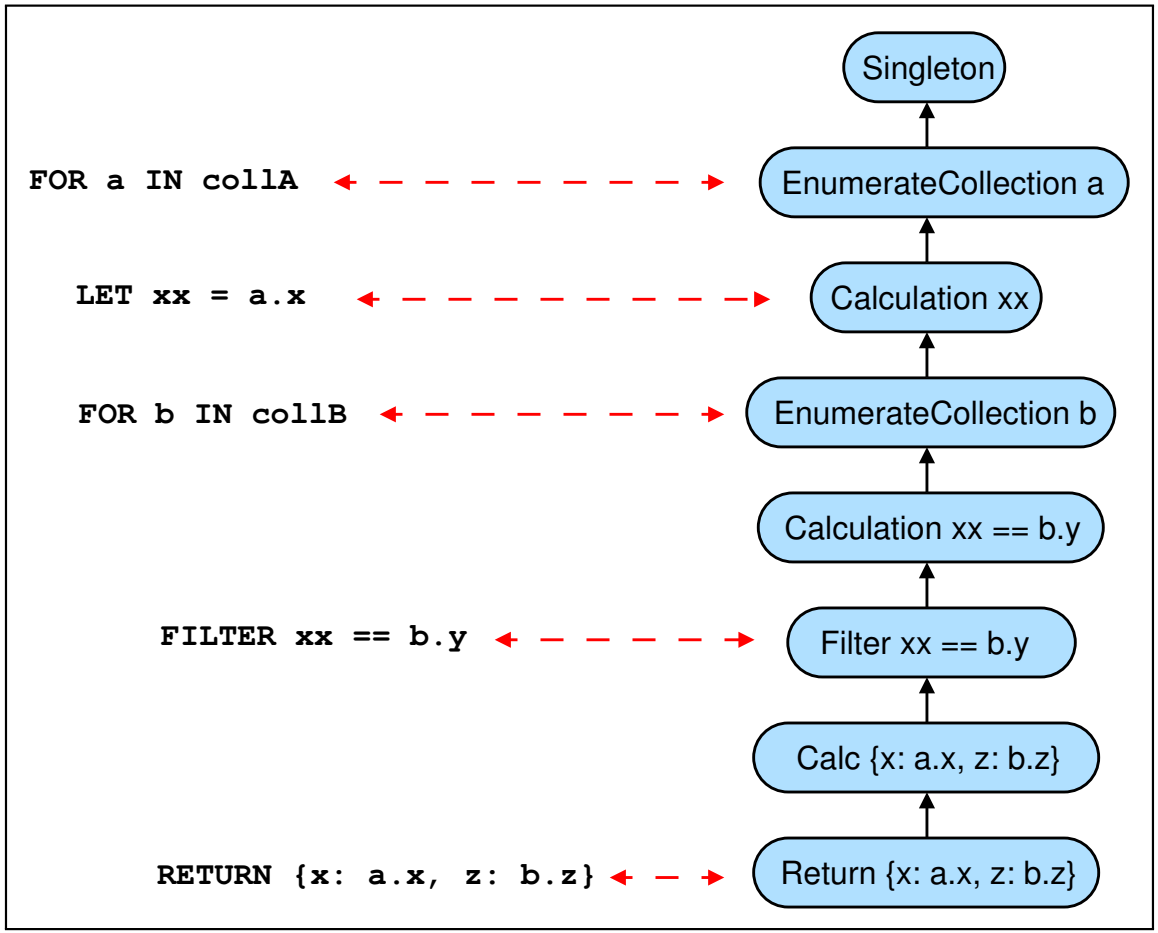

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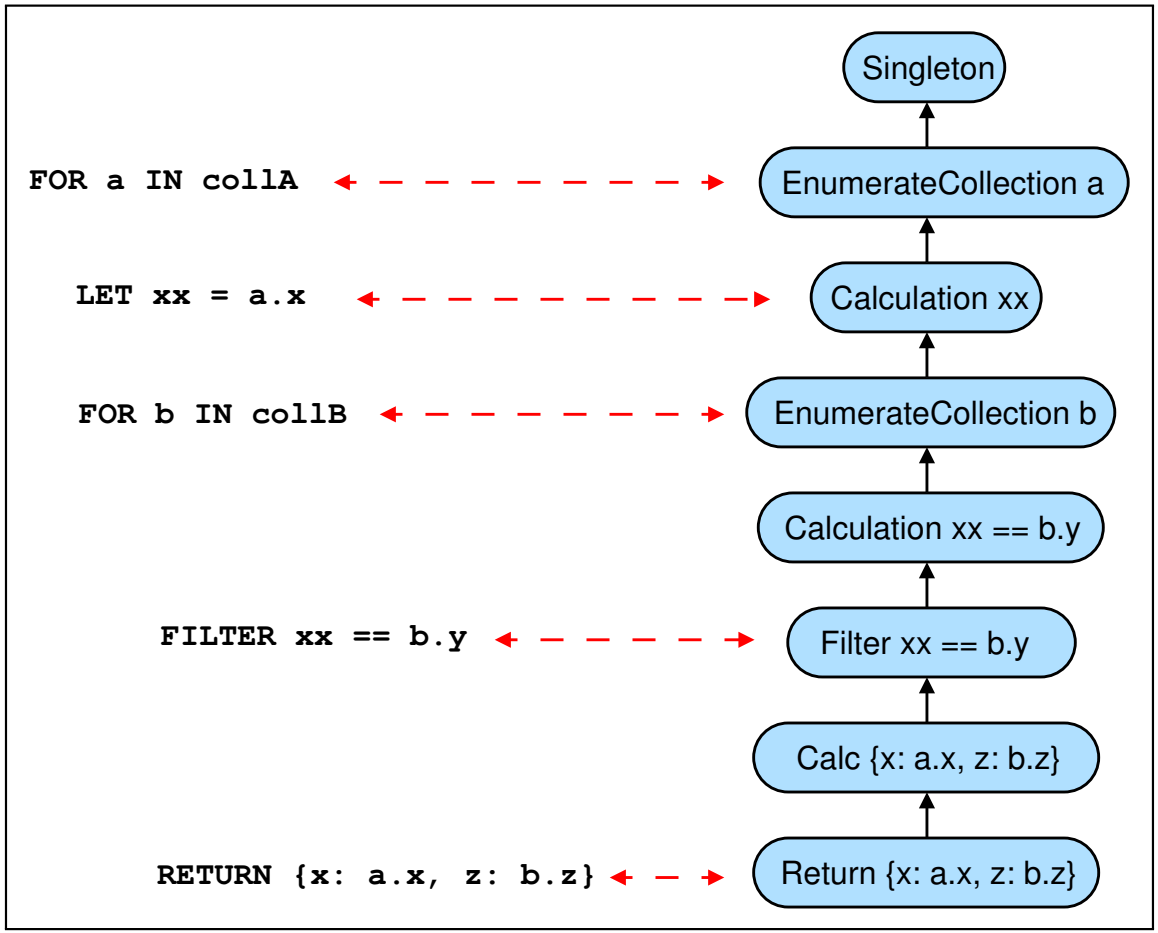

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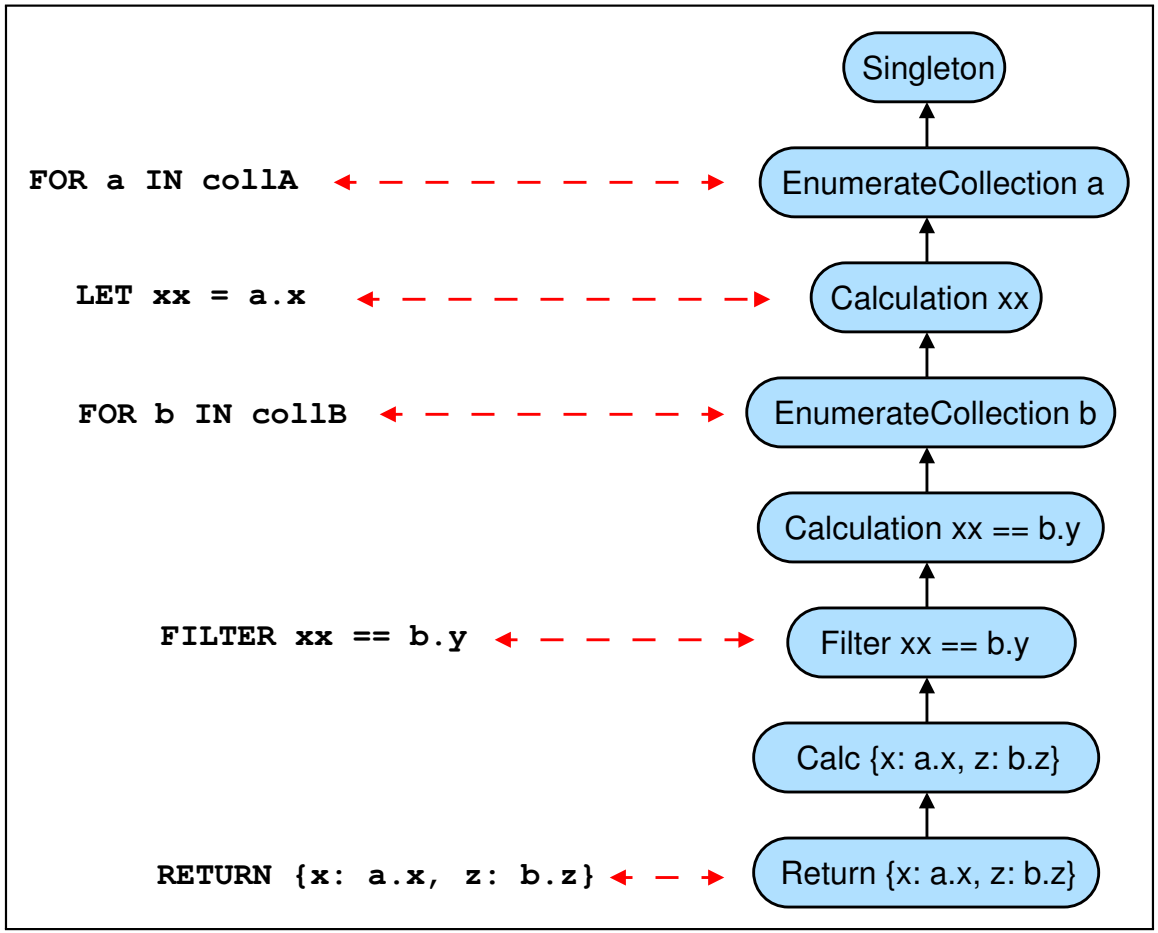

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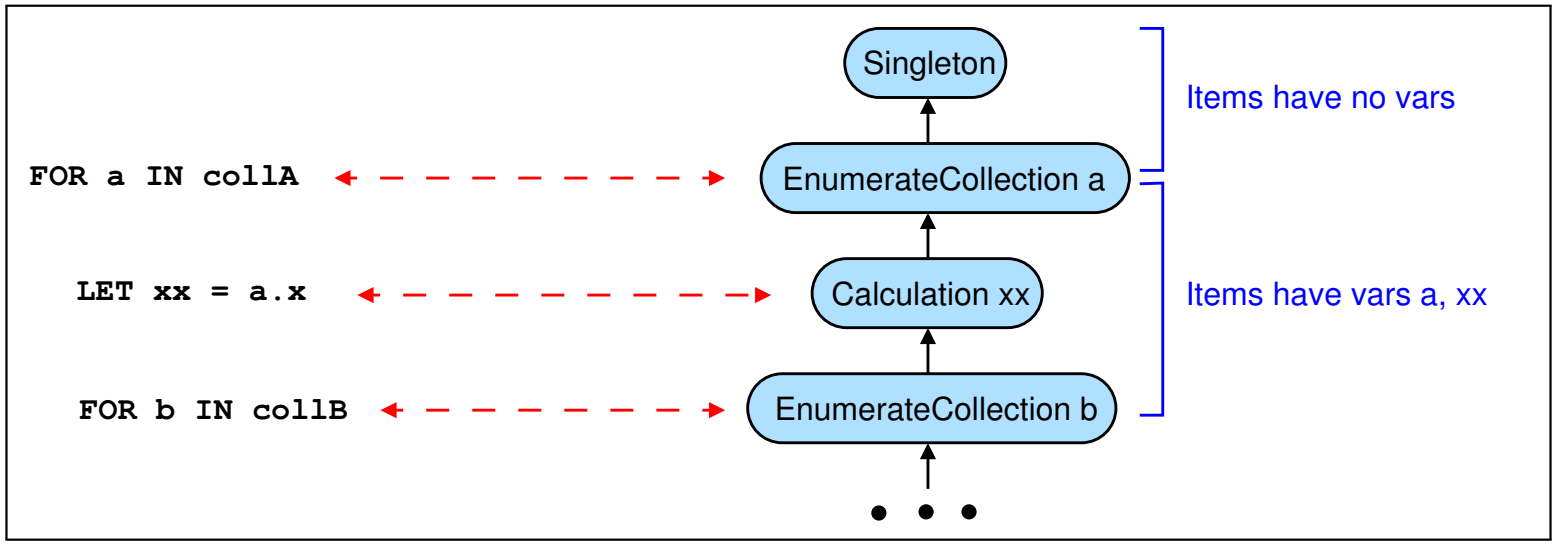
What is an "item"???

Pipeline and items



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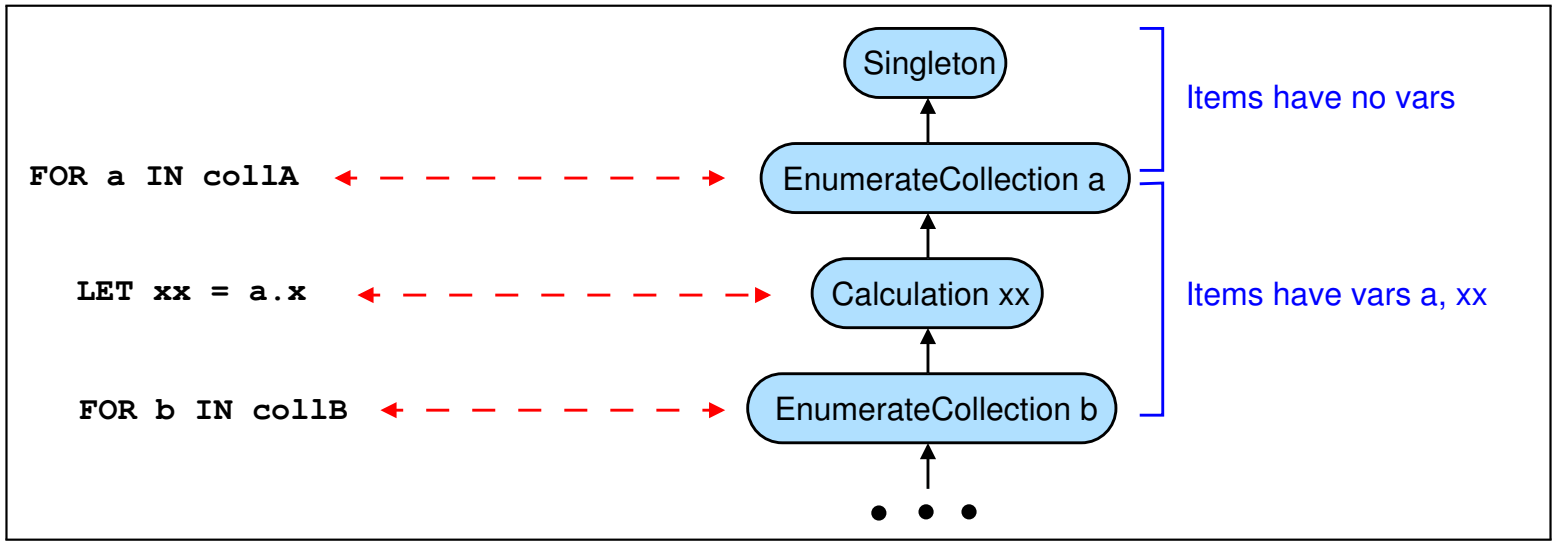

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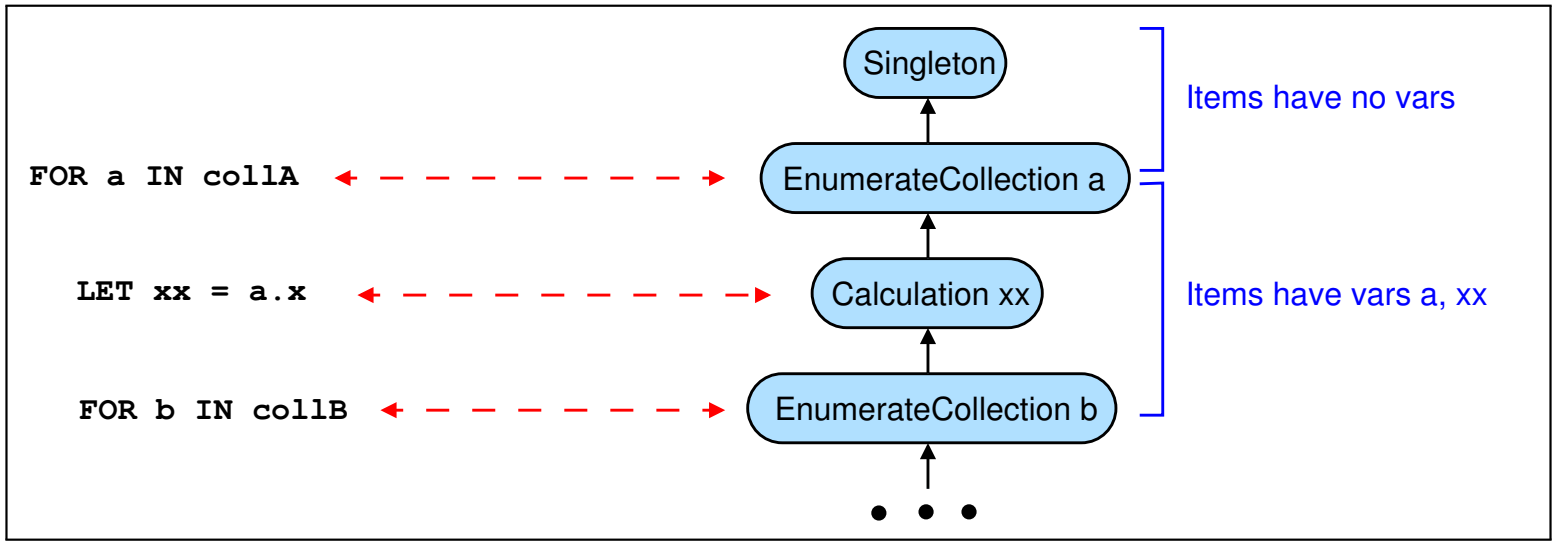

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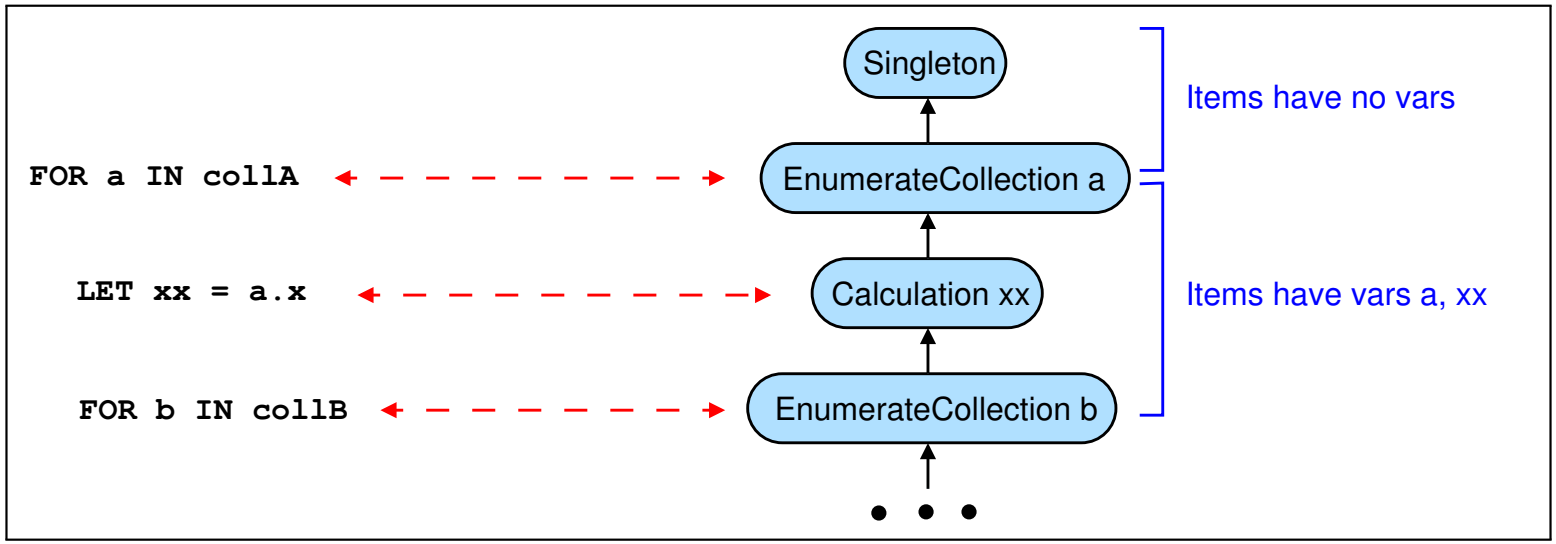
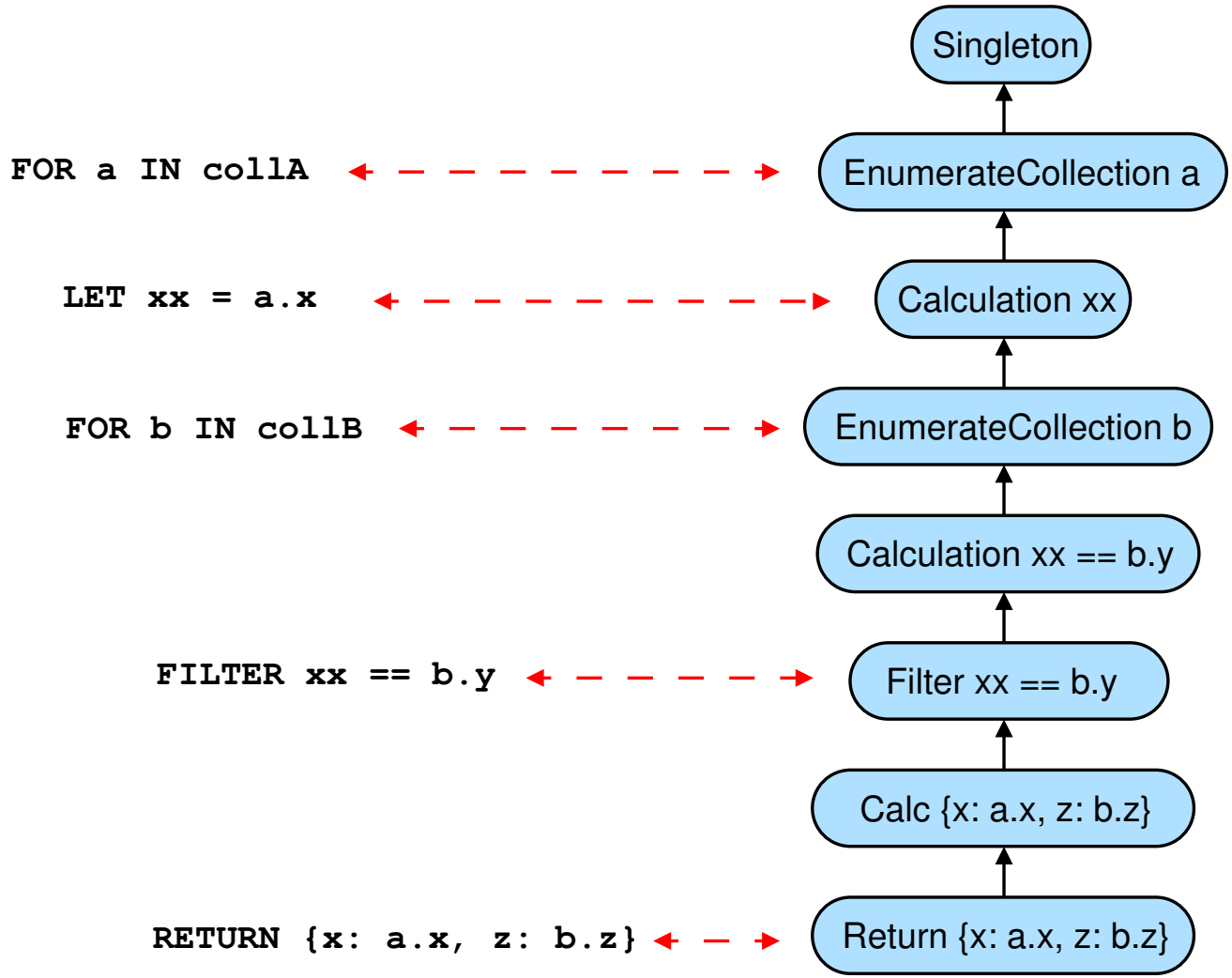


- Items are the thingies traveling through the pipeline.
- An item holds values of those variables in the current frame
- **Thus:** Items look differently in different parts of the plan
- We always deal with blocks of items for performance reasons

Execution plans



Move filters up

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FOR a IN collA
  FOR b IN collB
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    FILTER a.u == b.v
    RETURN {u:a.u,w:b.w}
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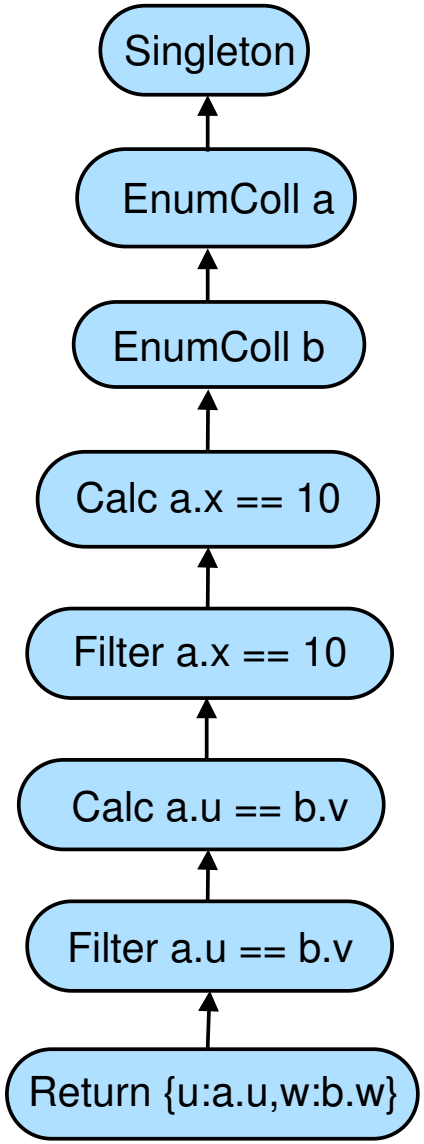

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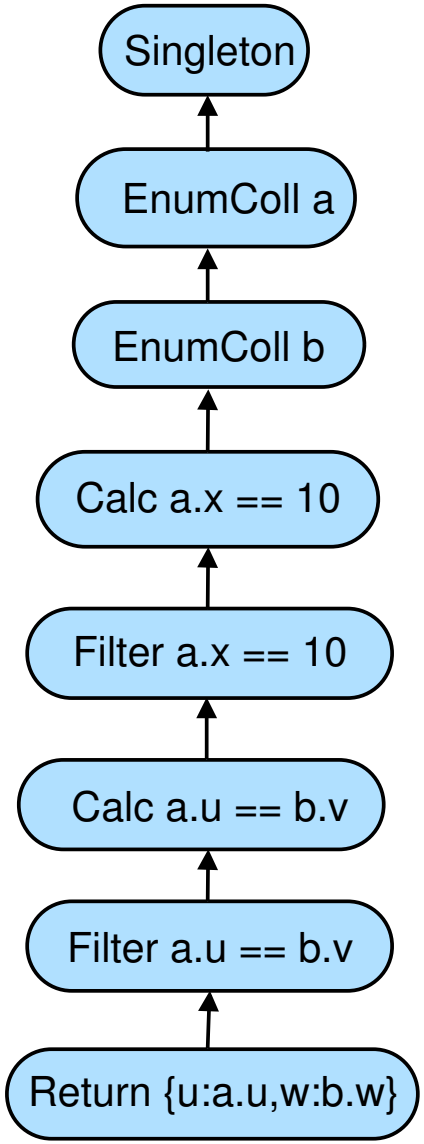

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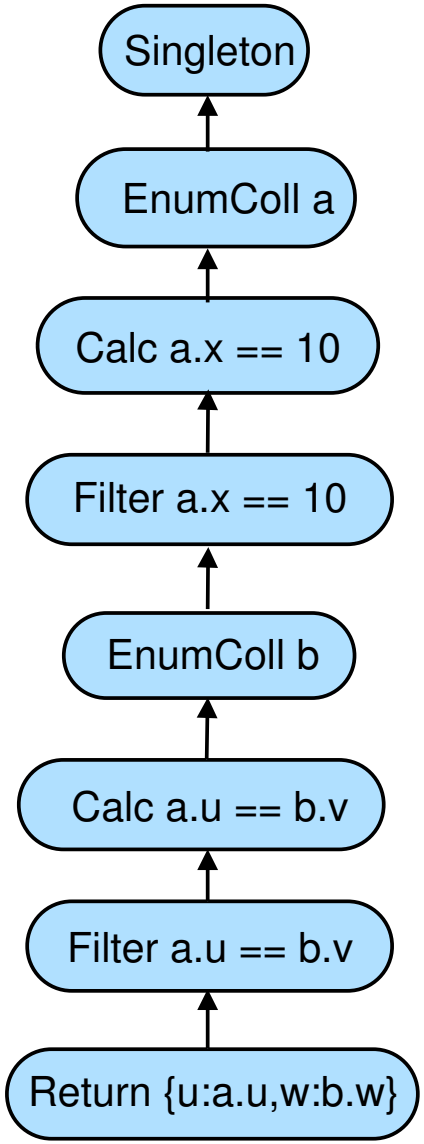

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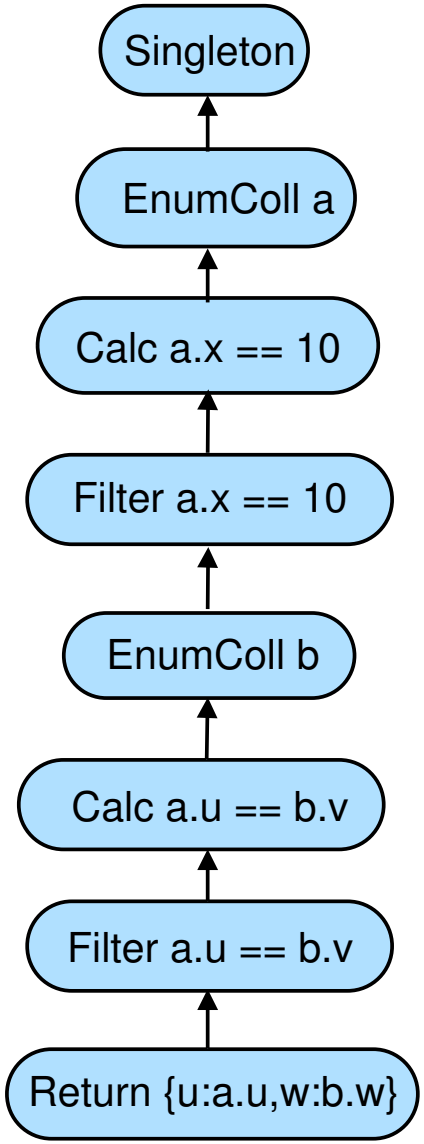
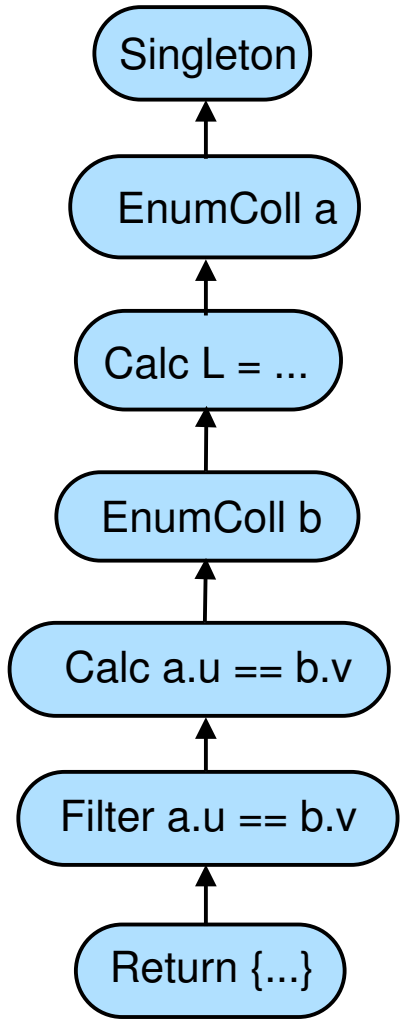
Note that the two FOR statements could be interchanged!



Remove unnecessary calculations

```
FOR a IN collA
  LET L = LENGTH(a.hobbies)
  FOR b IN collB
    FILTER a.u == b.v
    RETURN {h:a.hobbies,w:b.w}
```



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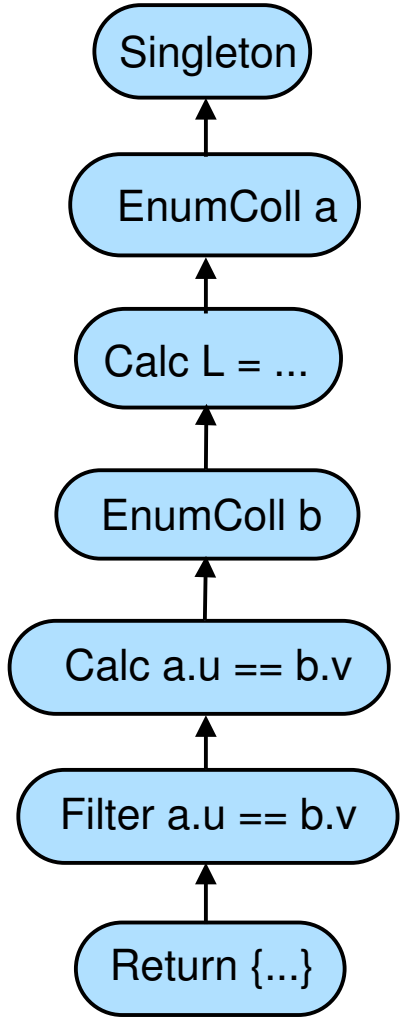

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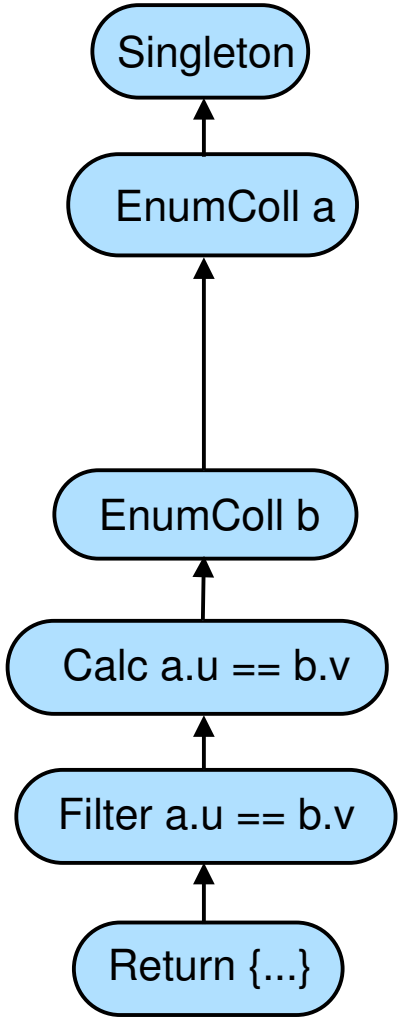
(since it cannot throw an exception).



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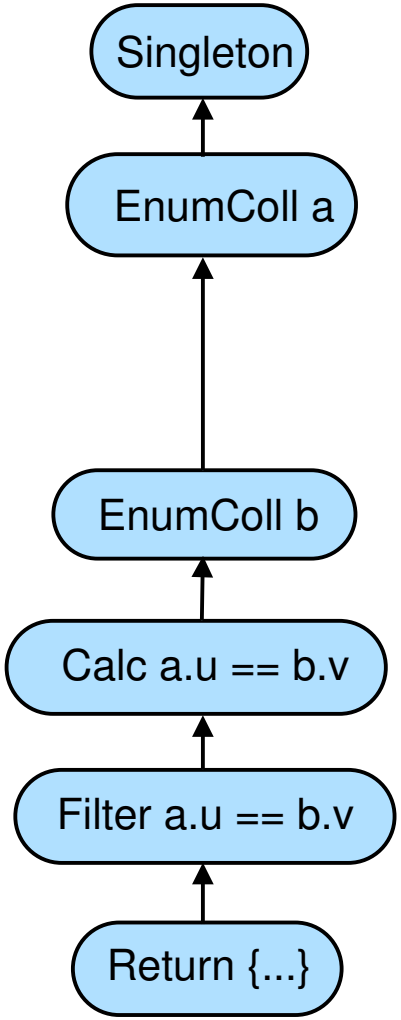
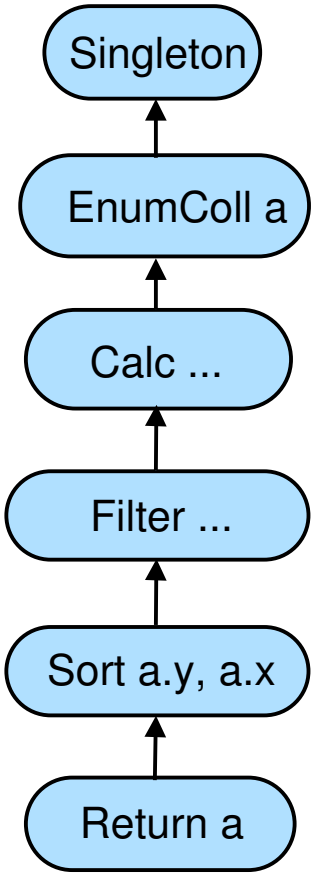
Therefore we can just leave it out.



Use index for FILTER and SORT

```
FOR a IN collA
  FILTER a.x > 17 &&
         a.x <= 23 &&
         a.y == 10
  SORT a.y, a.x
  RETURN a
```



Use index for FILTER and SORT

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FOR a IN collA
  FILTER a.x > 17 &&
         a.x <= 23 &&
         a.y == 10
  SORT a.y, a.x
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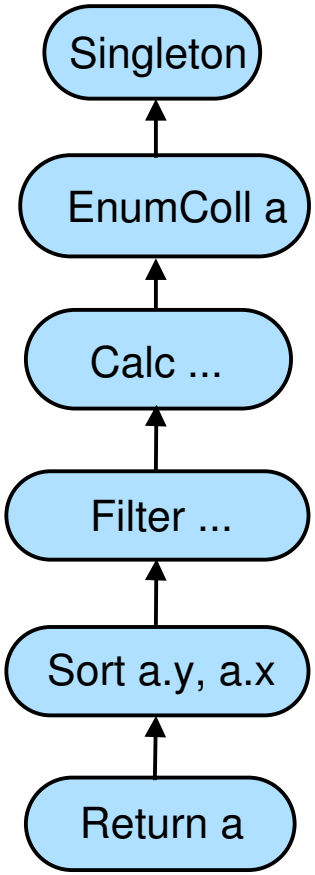
Assume `collA` has a skiplist index on “y” and “x” (in this order),



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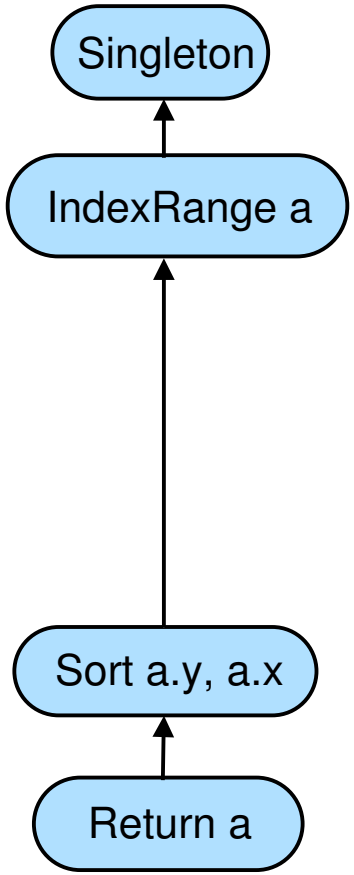

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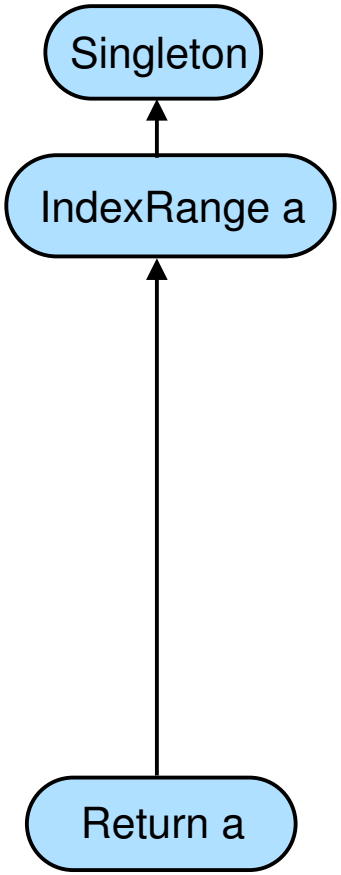
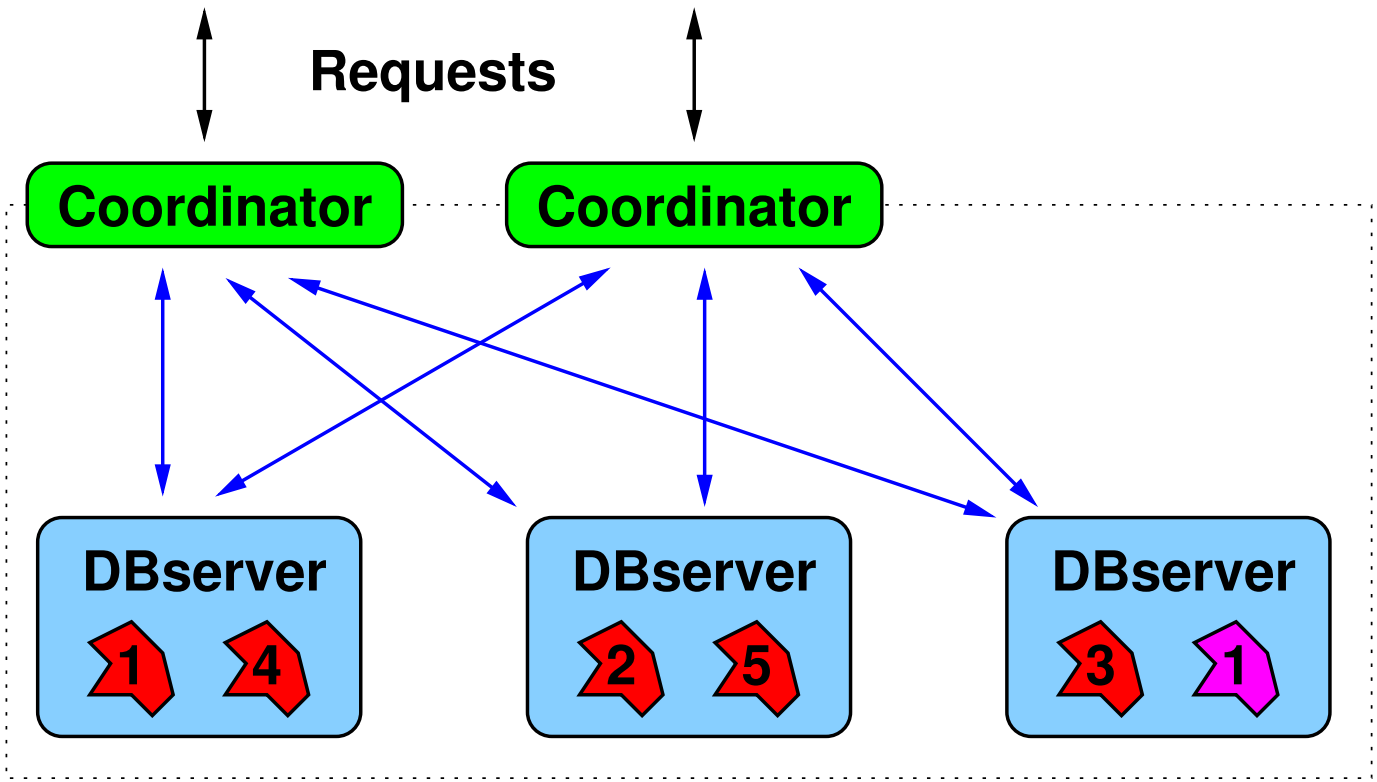
The result will automatically be sorted by `y` and then by `x`.



Data distribution in a cluster



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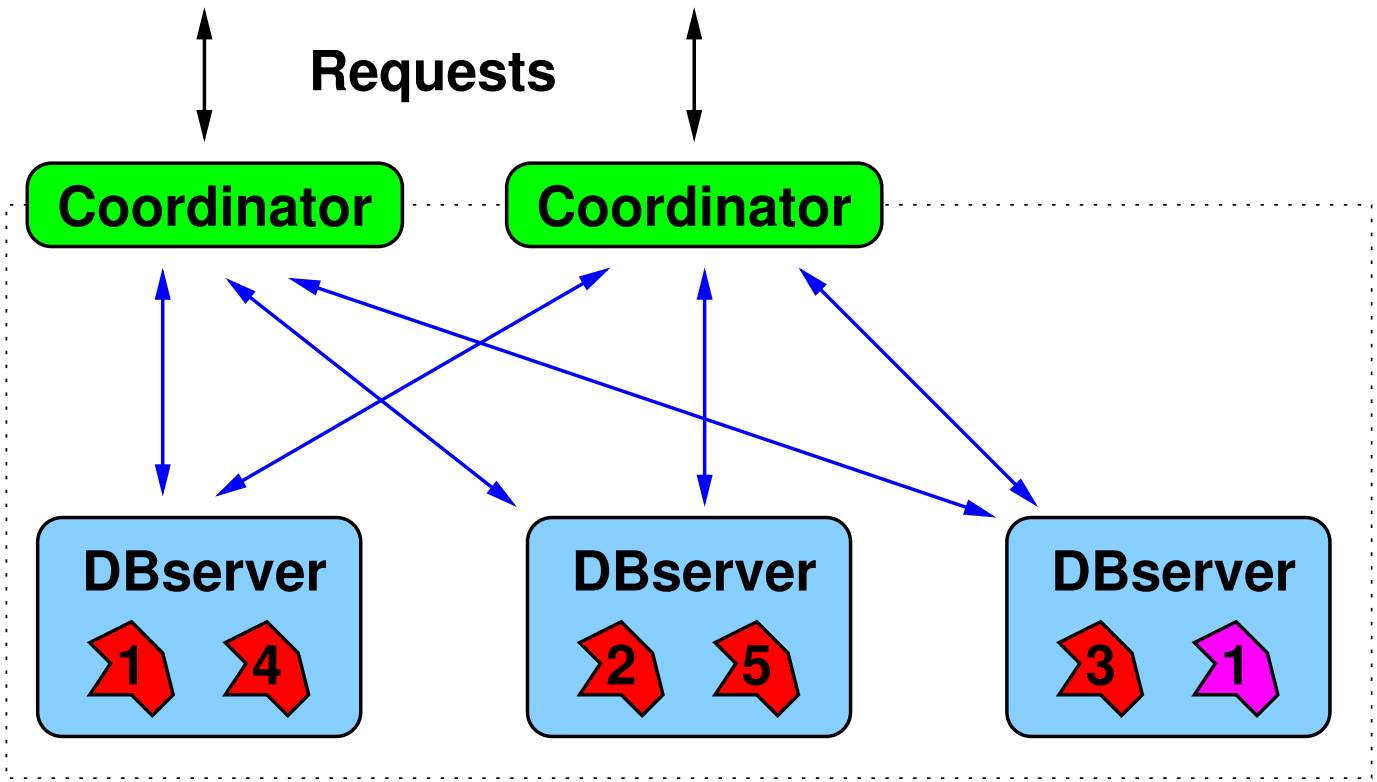
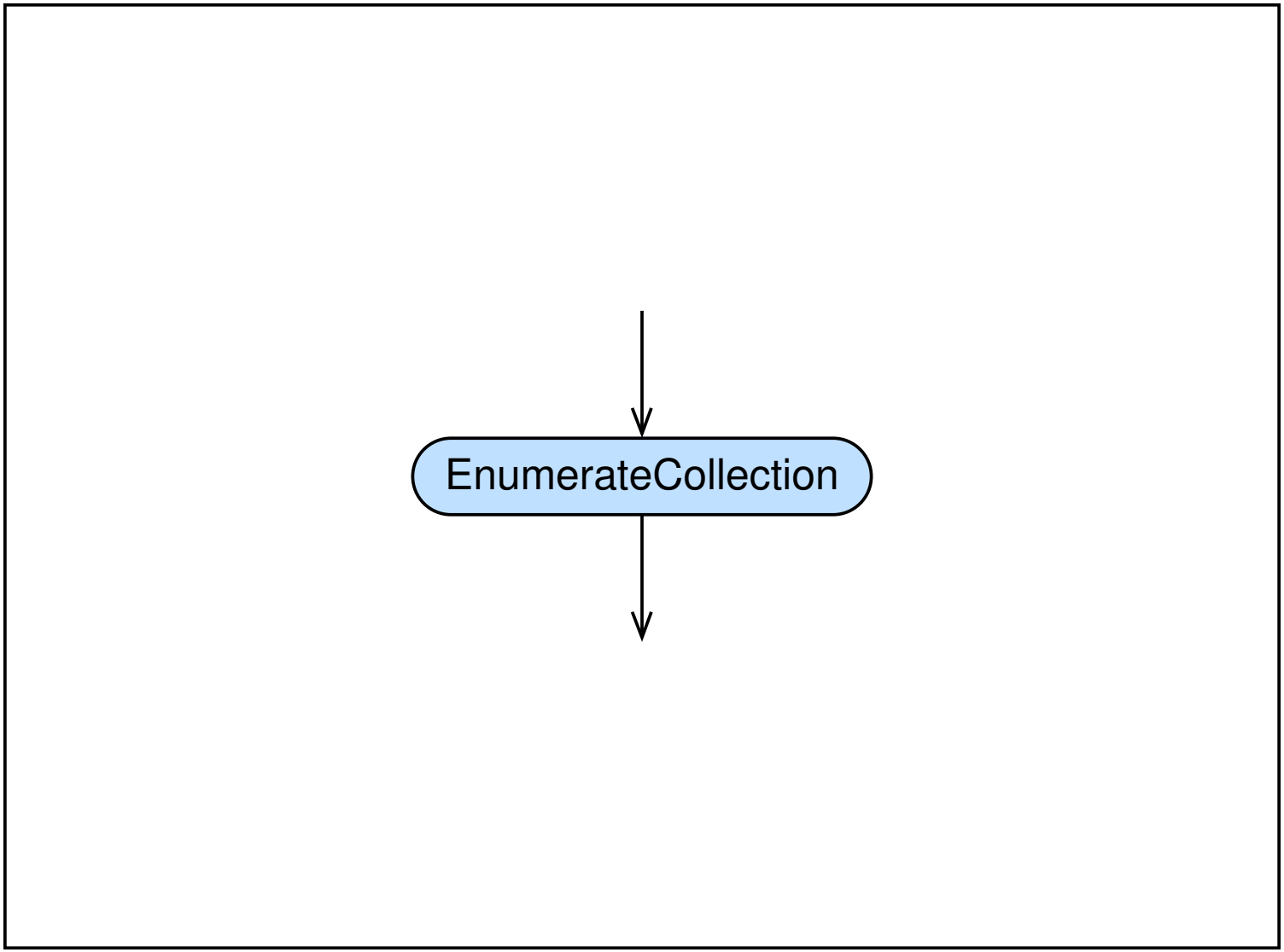


- The shards of a collection are distributed across the DB servers.
- The coordinators receive queries and organise their execution

Scatter/gather



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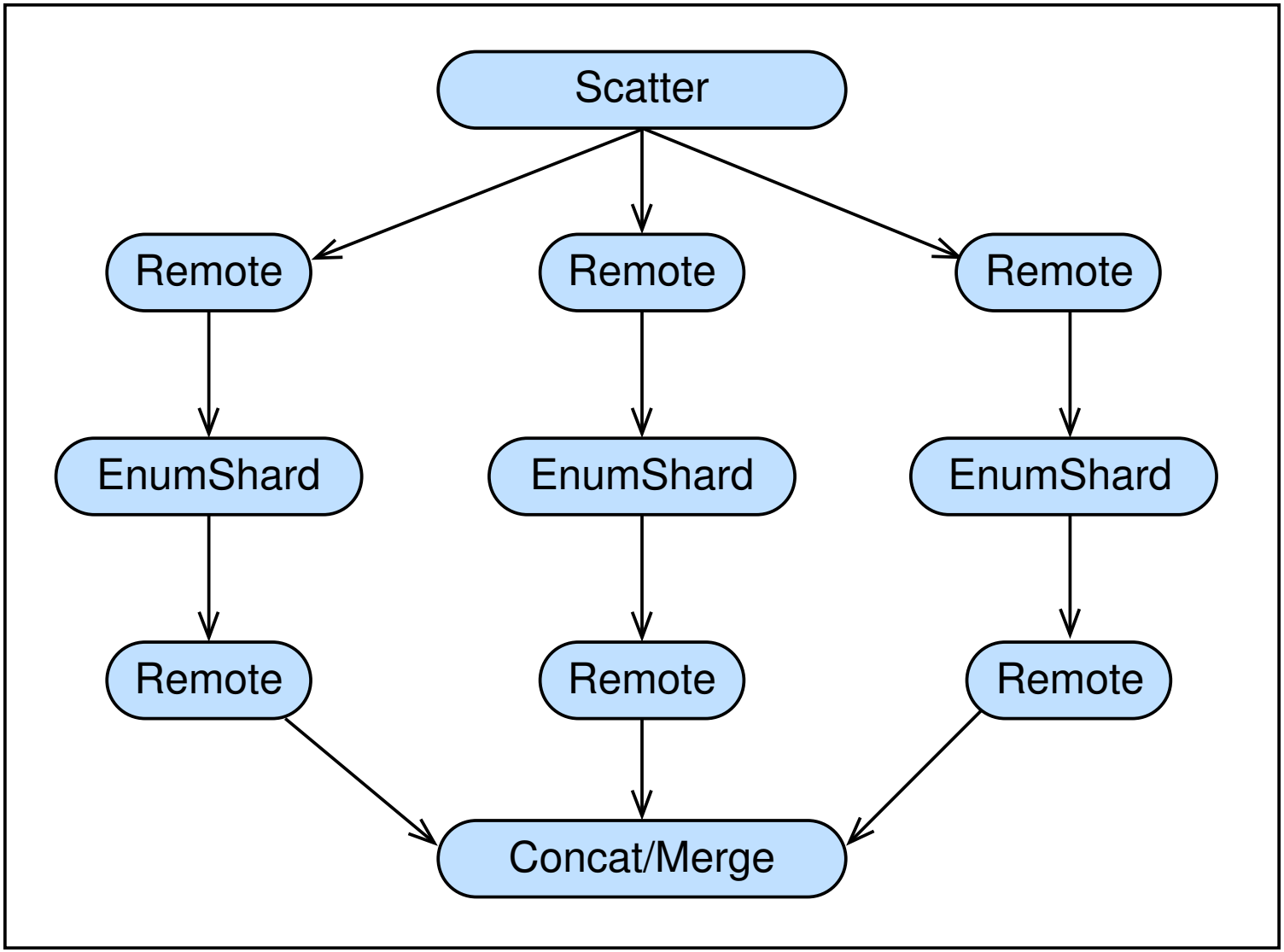

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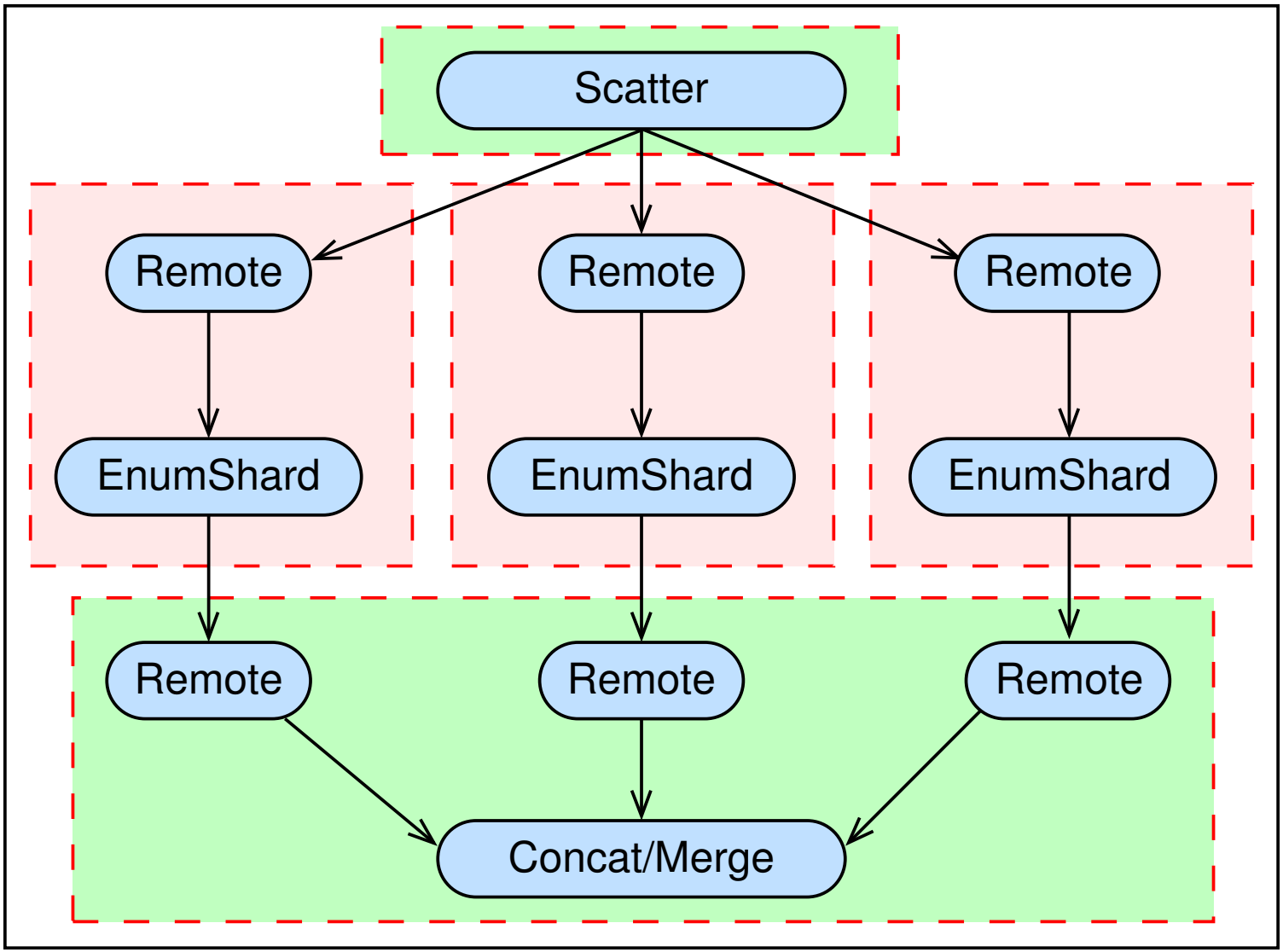

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- is executed on the coordinator,
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- and can therefore collect data for the shards and send bulk requests to the DB servers.