CSC 369: Distributed Computing

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April 29

Day 11: MongoDB Wrap-up
Transition to MapReduce


San Francisco

Housekeeping

Lab 4: mini-project now
Test cases
Will discuss today

- Grading:
  - Way behind.
  - Will prioritize for the rest of the week.
  - Friday lecture might suffer

Lab Period: no separate Zoom today. Office hour in between

Lab 4: How to.

```
{refresh: true,
 collection: "covid",
 aggregation: "usa",
 time: "month",
 analysis: {[{task: {track: "positive"},
             output: {graph:{ type: "line",
                              legend:"off",
                              combo:"combine"},
                      table:{row: "state",
                             column: "time",
                             title: "COVID cases in the USA this month"
                             }
                      }
              }
             ]
           }
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Report daily numbers of positive COVID-19 cases from the beginning of the current month through today for the entire US (including territories and possessions)

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                             title: "COVID ..."
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Report daily numbers of positive COVID-19 cases from the beginning of the current month through today for the entire US (including territories and possessions)

```
db.covid.aggregate({$match: {date: {$gte: 20200401, $lte: 20200429}}}
                   {$project: {_id:0, positive:1, date:1}},
                   {$group: {_id:"$date",
                             positive: {$sum: "$positive"}}
                   }
                   {$sort: {date:1}}
                  )
```

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                   }
                   {$sort: {date:1}}
                  )
```
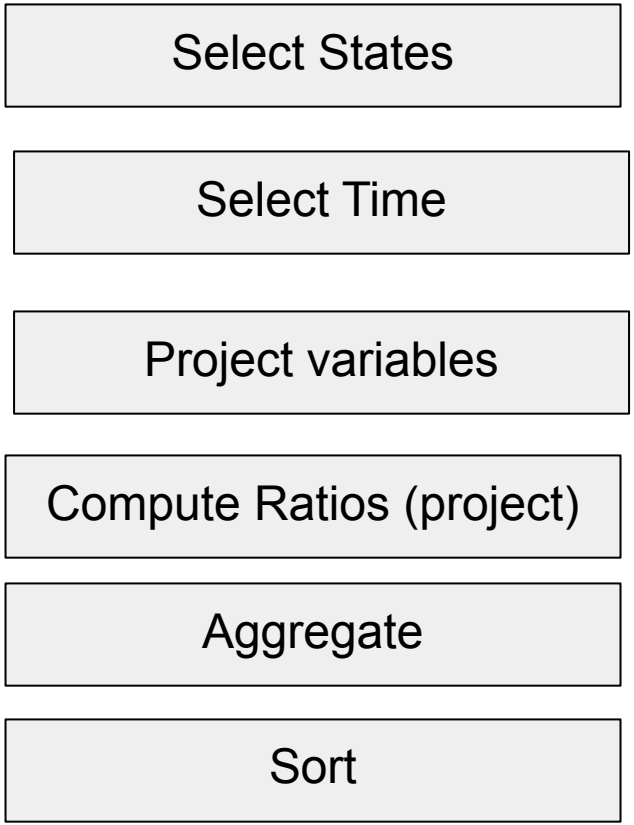

General Approach (covid collection)

```
{refresh: true|false,
 collection: <collection>,
 aggregation: <aggregationLevel>,
 time: <timeSpecification>,
 target: <states>,
 counties: <counties>
 analysis: [{task: <taskSpecification>,
             output: <outputSpecification>},
            ...
            {task: <taskSpecification>,
             output: <outputSpecification>},
           ],
Output: <filename>
}
```



General Approach (covid collection)

```
{refresh: true|false,
 collection: <collection>,
 aggregation: "50States",
 time: <timeSpecification>,
 target: <states>,
 counties: <counties>
 analysis: [{task: <taskSpecification>,
             output: <outputSpecification>},
            ...
            {task: <taskSpecification>,
             output: <outputSpecification>},
           ],
Output: <filename>
}
```

Select States

Select Time

Project variables

Compute Ratios (project)

Aggregate

Sort

General Approach (covid collection)

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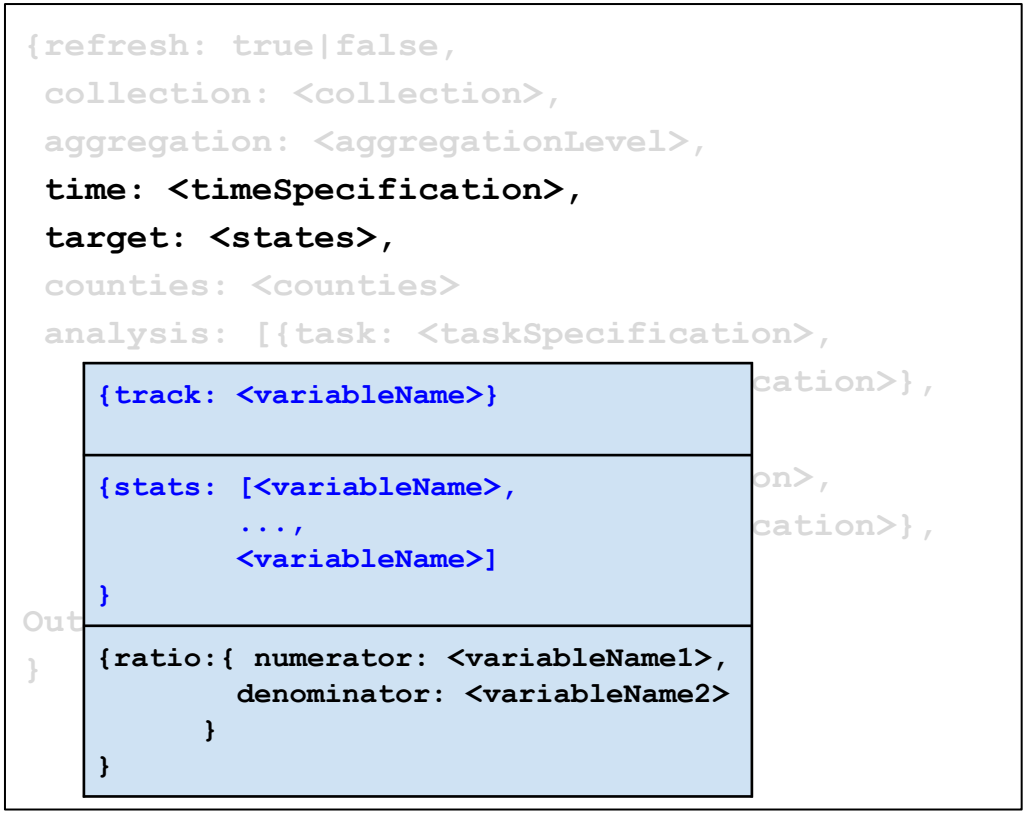

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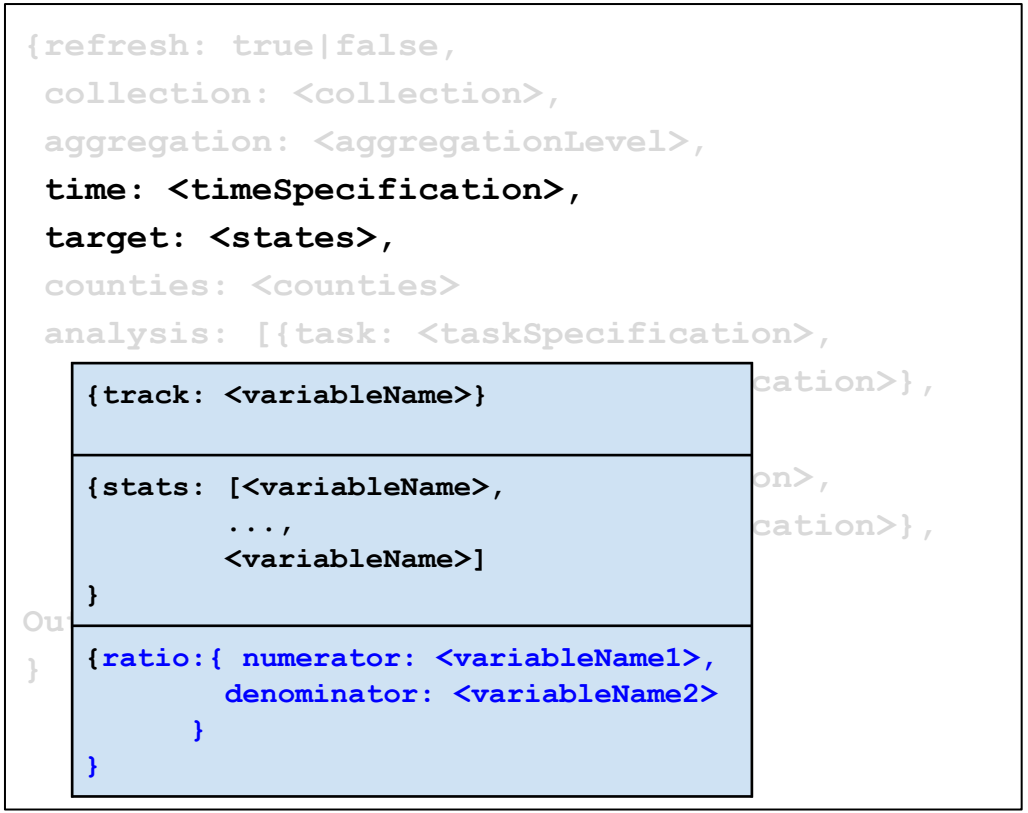

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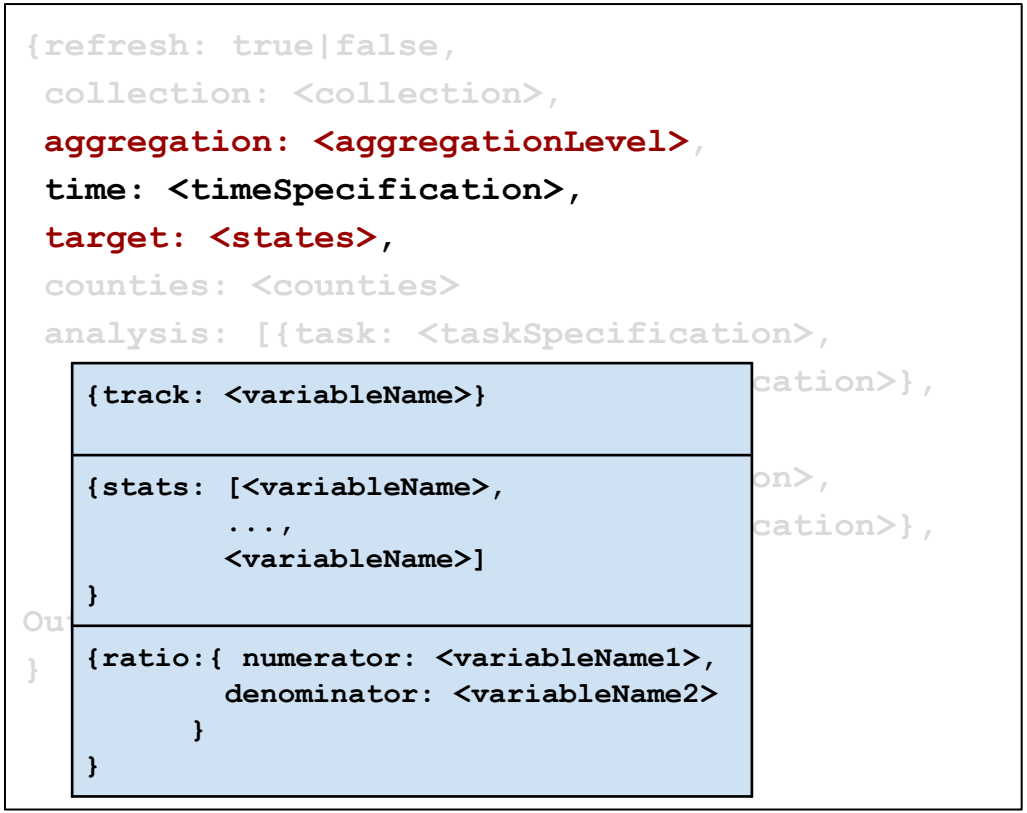
General Approach (covid collection)



Select States

Select Time

Project variables

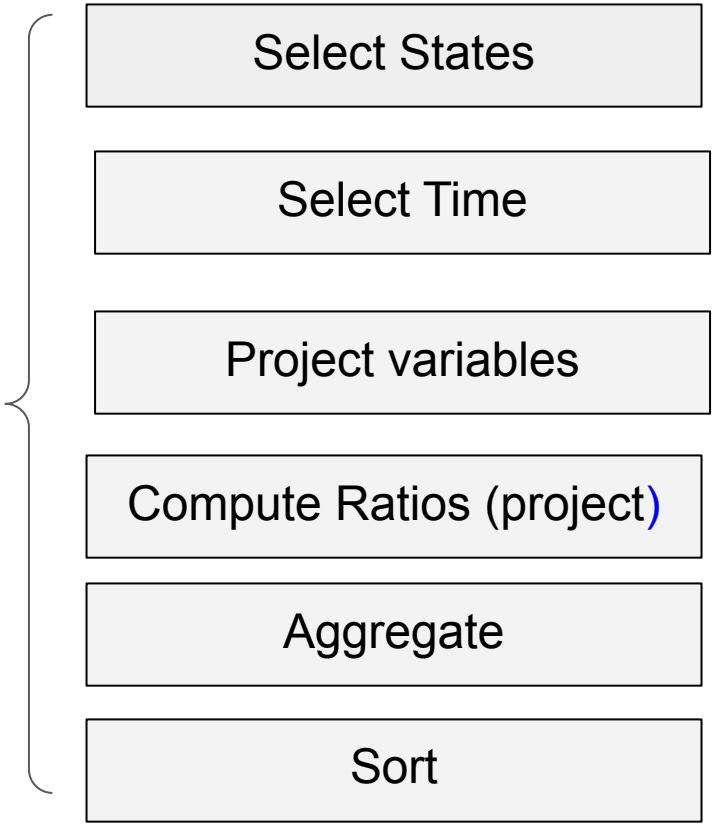
Compute Ratios (project)

Aggregate

Sort

General Approach (covid collection)

Create a data structure template



General Approach (covid collection)

Select States `$match: {state: {$in : <target>}}`

Select Time `$match: {date: {$gte:<start>, $lte:<end>}}`

Project variables `$project: {_id:0, <variable>:"$variable" }`

Compute Ratios `$project: {_id:0, ratio: {$divide: ["$numerator","$denominator"]}}`

Aggregate `$group: {_id:"$date", <variable>:{$sum: "$variable"}}`

Sort `$sort:{state:1, date:1}`

Switching to Distributed Systems Overview

CSC 469 in 20 minutes

Distributed system

- Multiple autonomous processing nodes
- Network connectivity between them
- Software for coordinating computing activities across autonomous processing nodes

Characteristics

- Autonomous components
- Different processors, different nodes.
- Runs concurrently
- Runs asynchronously
- Multiple points of control.
- Multiple points of failure.

Considerations

- Architecture of control points.
- Distribution of tasks and load balancing.
- Resource sharing between compute nodes.
- The CAP theorem.
- Consistency of data.
- Synchronization.
- Unreachability of resources.
- Communication between nodes.

Benefits

- Resource Sharing
- Concurrency
- Scalability
- Fault Tolerance