

Towards Parallel Detection of Moving Flock Patterns in Large Spatiotemporal Datasets

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Outline

1 Background

2 Flock Patterns

- BFE algorithm
- Finding the disks (a.k.a The Problem)

3 Proposal (a.k.a. The Solution)

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Trajectory Datasets

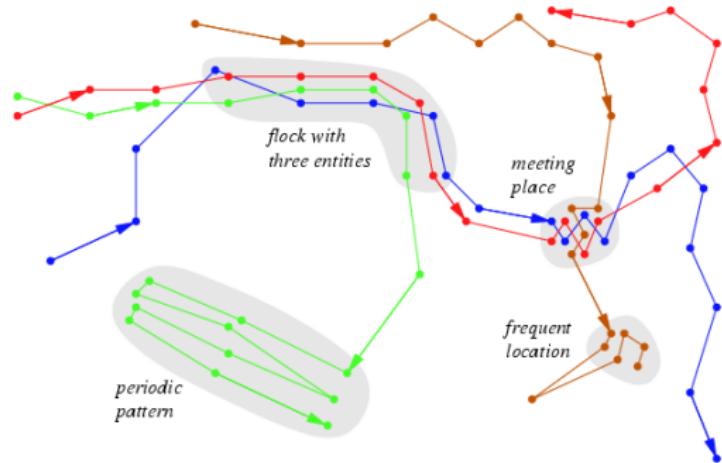
- They know where you are...
 - Smart phones, GPS, RFID, WiFi...



(Jing et al, 2013)

Movement patterns

- A new set of rich and interesting movement patterns...



(Gudmundsson et al, 2008)

Applications

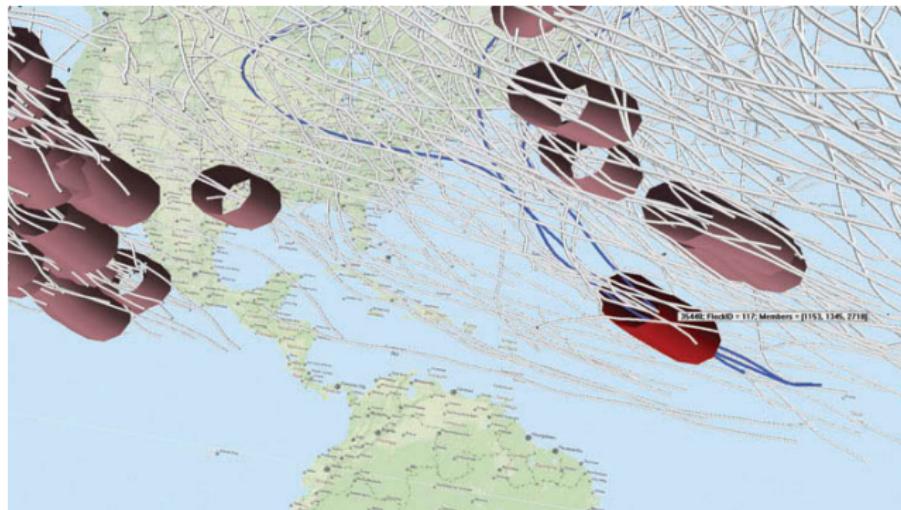
- Transportation...



(Zhang et al, 2016)

Applications

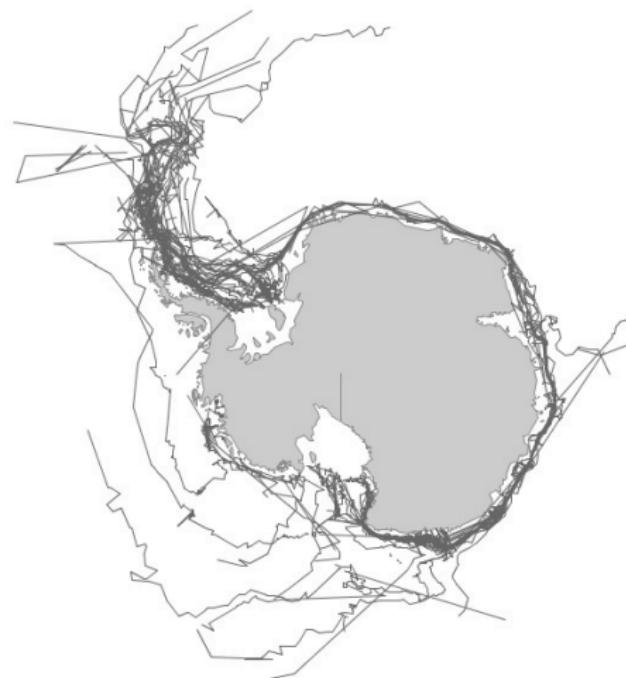
- Weather...



(Turdukulov et al, 2014)

Applications

- Climate change...



(Calderon, 2011)

Applications

- Ecology...



(Majka, 2016)

Applications

- Ecology...

(Fink et al, 2014)

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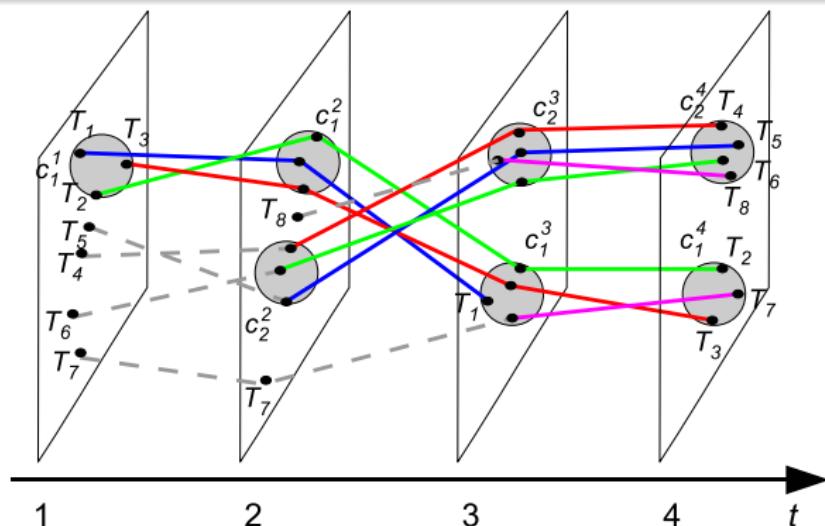
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Flock Patterns

Definition $((\mu, \varepsilon, \delta) - flock)$

Sets of at least μ objects moving close enough (ε) for at least δ time intervals (Benkert et al, 2008).



(Vieira et al, 2009)

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BFE algorithm

- Two steps algorithm:

- ① Find sets of disks at each time interval.
- ② Join consecutive time intervals detecting disks with same objects.

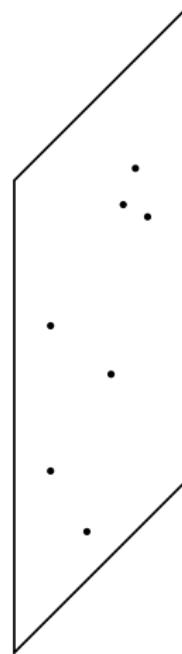
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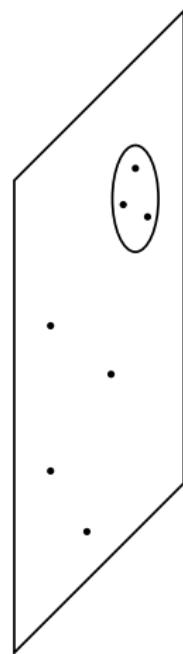
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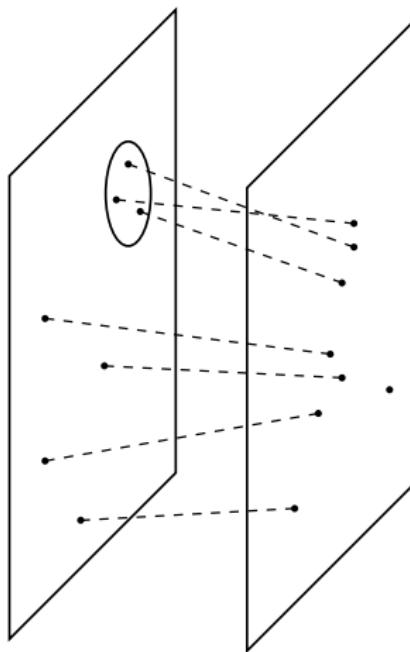
BFE algorithm



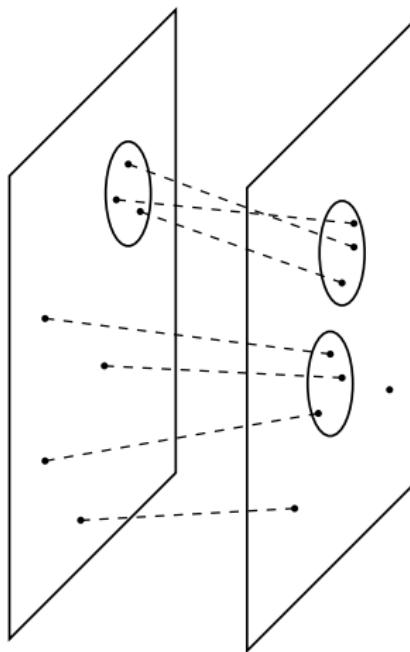
BFE algorithm



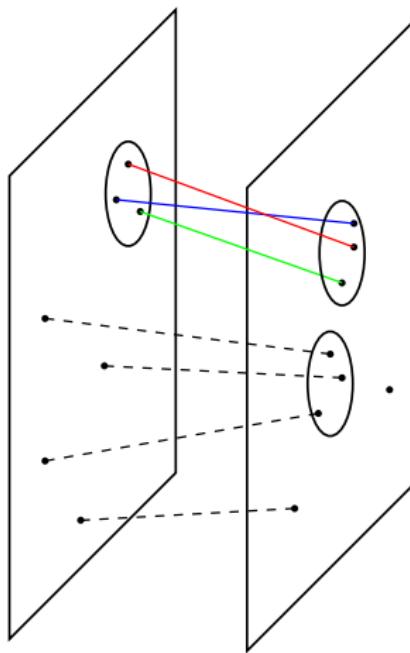
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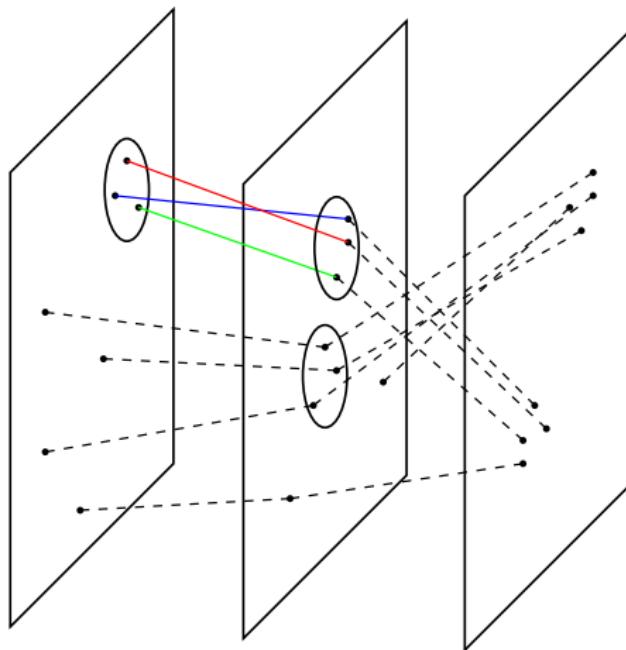
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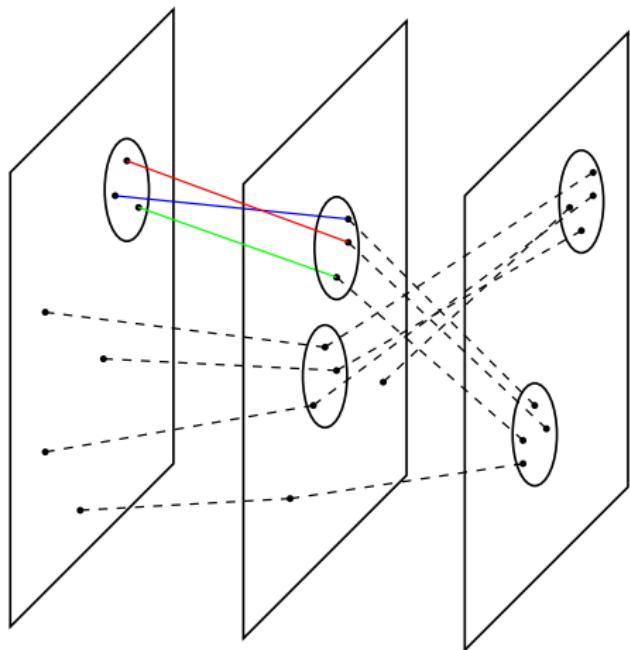
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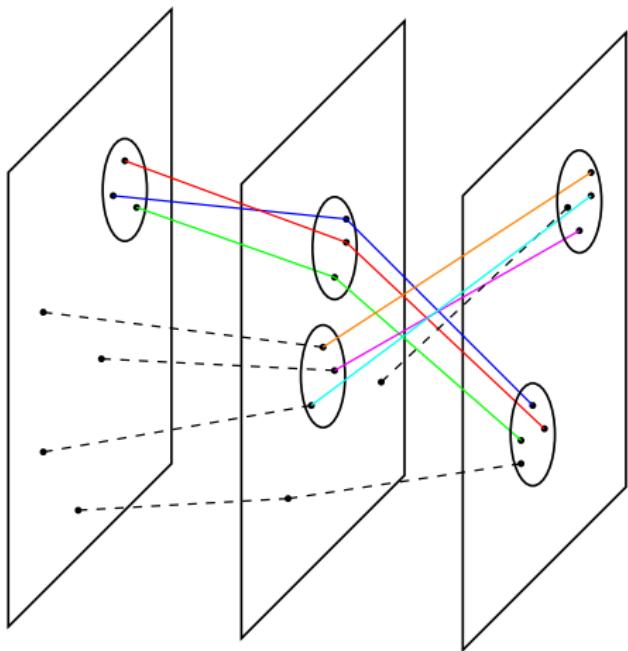
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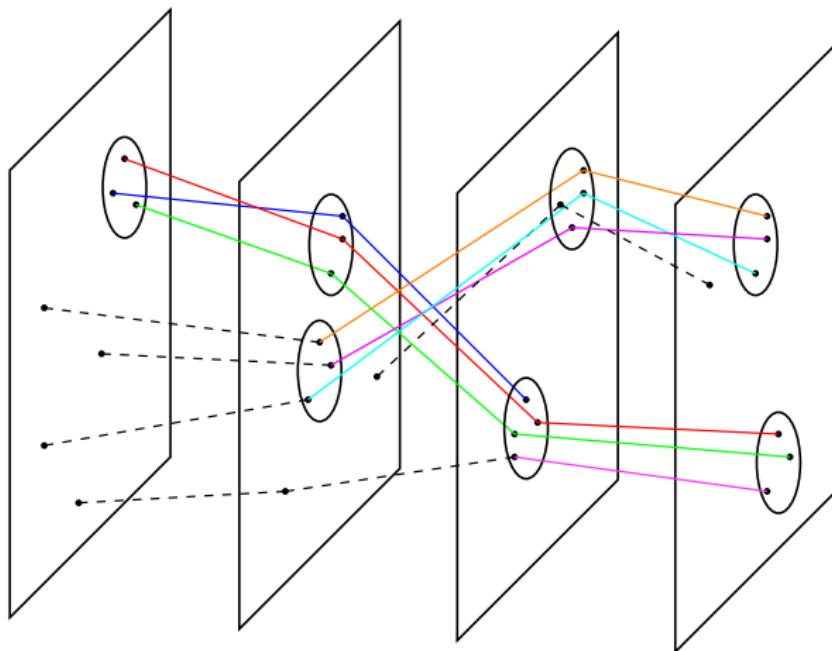
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BFE algorithm



BFE algorithm



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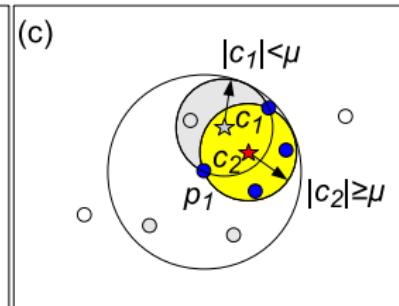
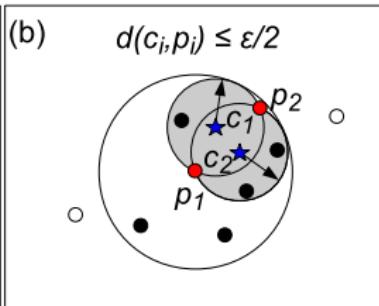
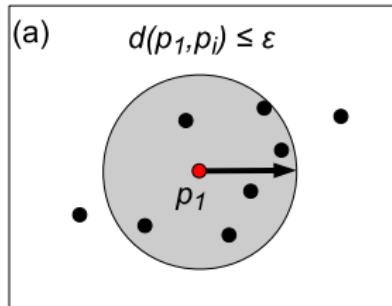
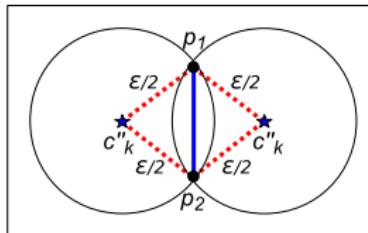
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Finding the disks...

- Finding the set of disks is no trivial.
- Vieira et al. (2009) proposed a polynomial solution ($O(2n^2)$).



Finding the disks...

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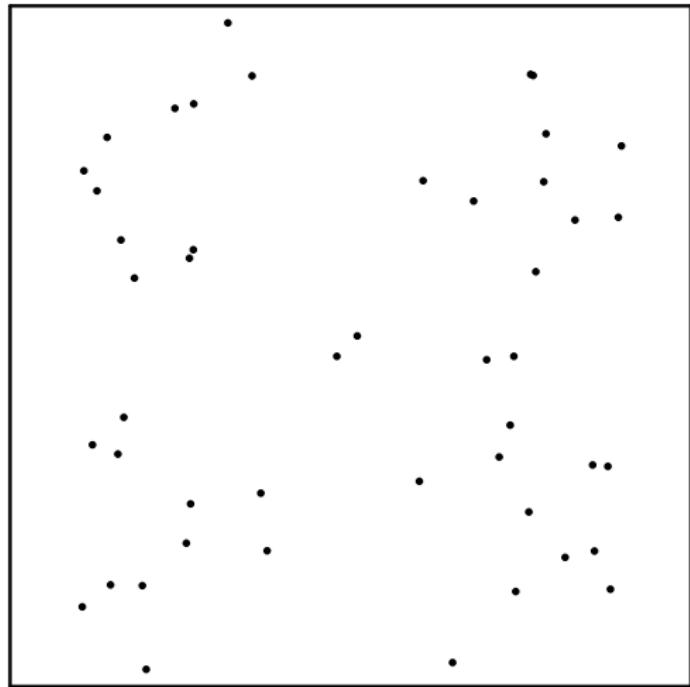
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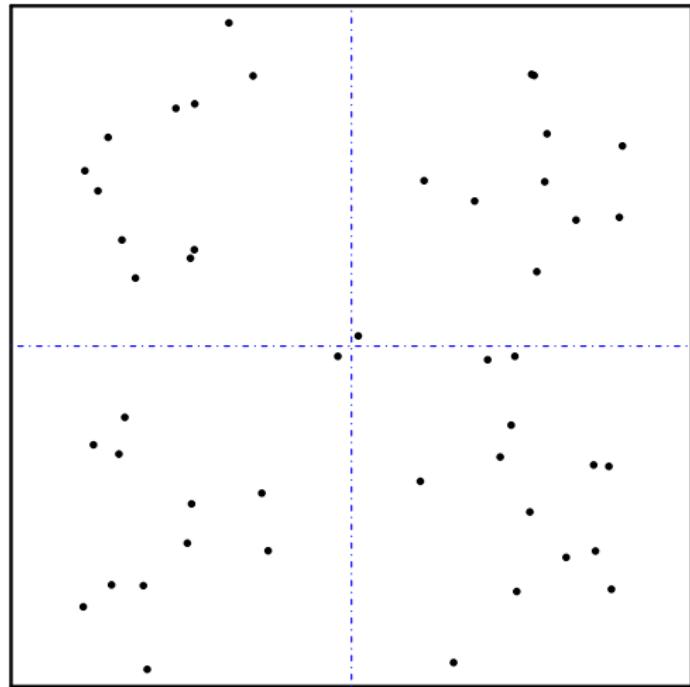
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Can be done in parallel?



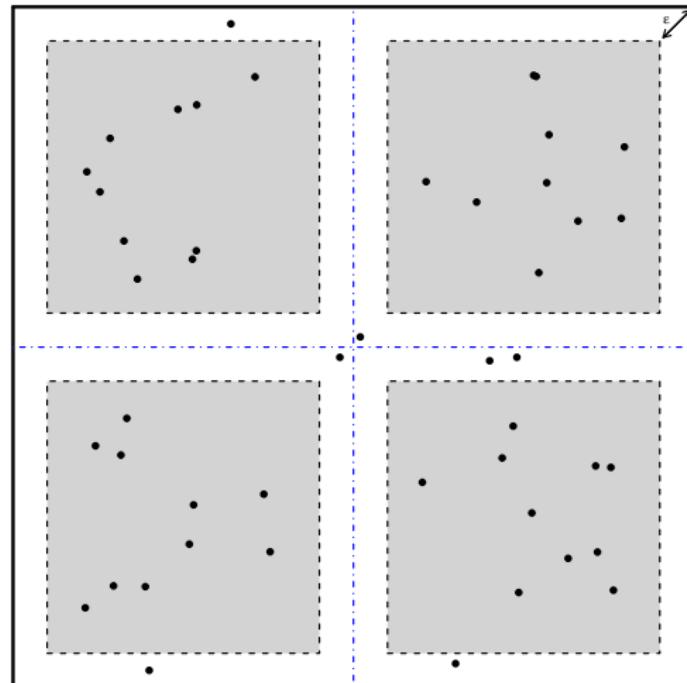
Partition
Local
Pruning
Global

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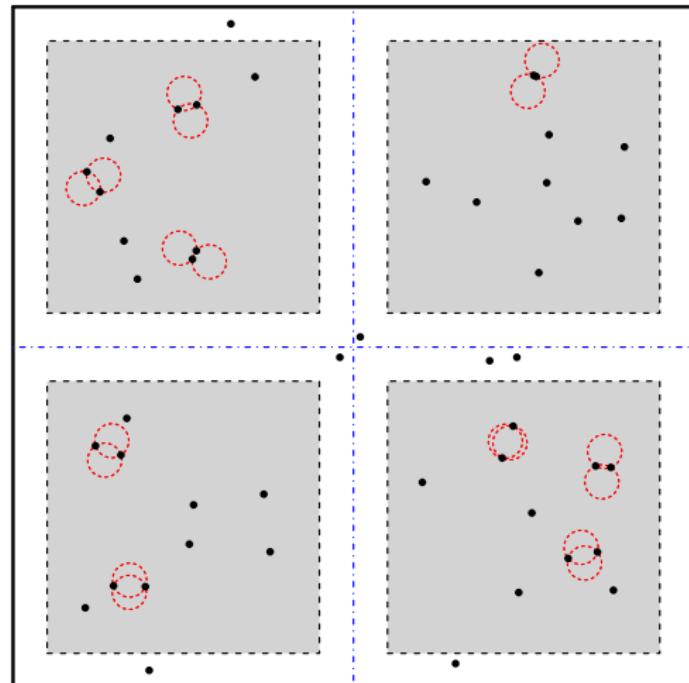
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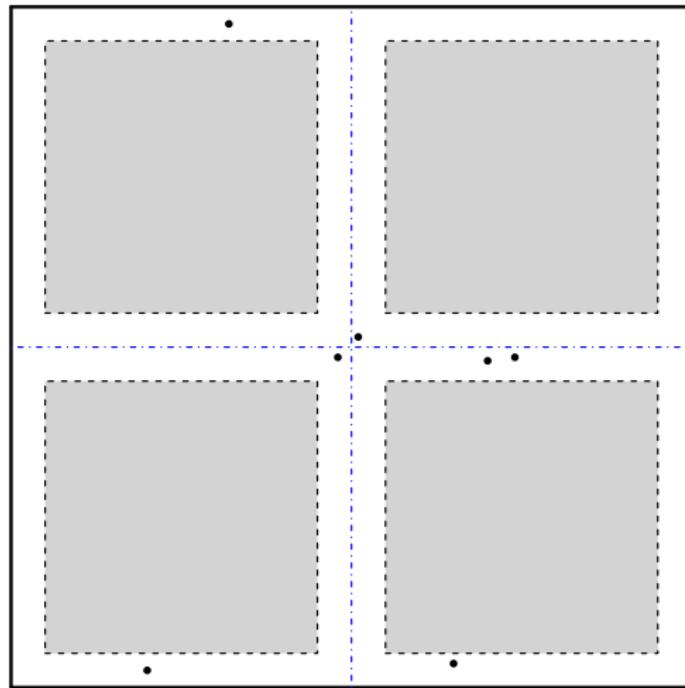
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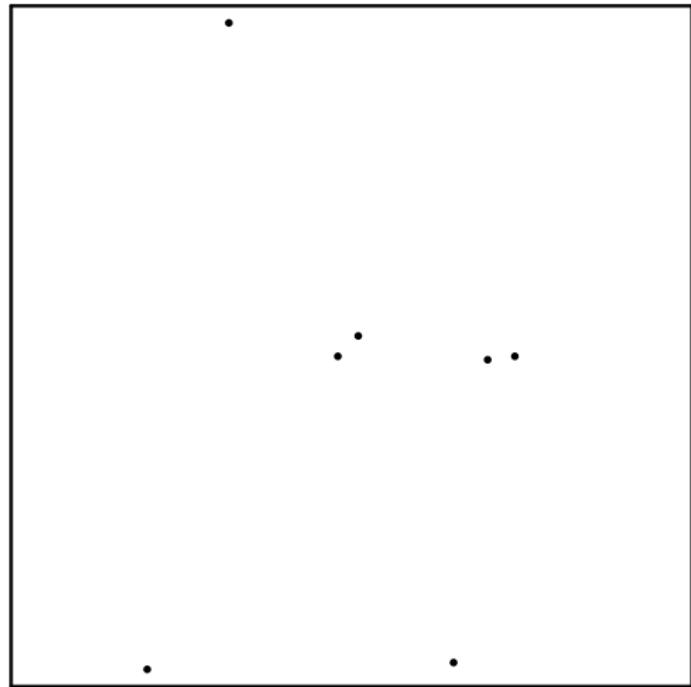
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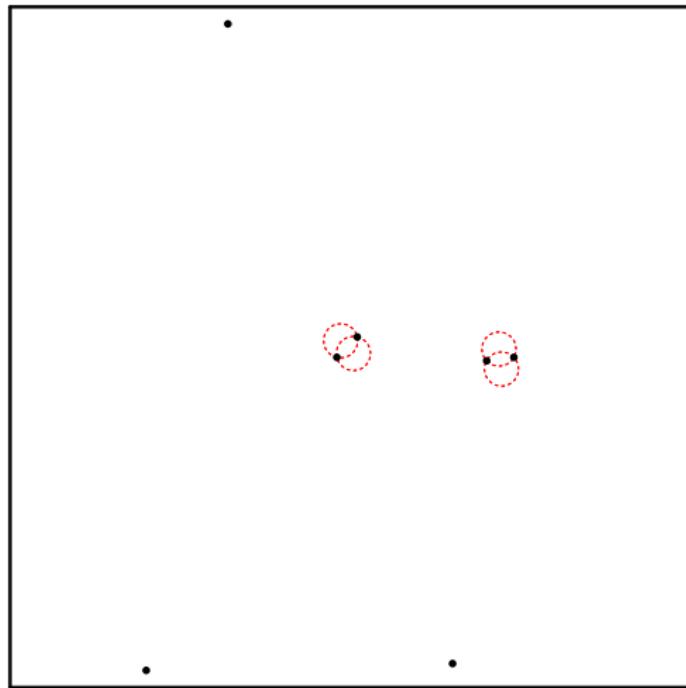
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Can be done in parallel?



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In Memory MapReduce Analytics



- Simba is a distributed in-memory spatial analytics engine based on Apache Spark (Xie et al, 2016).

In Memory MapReduce Analytics

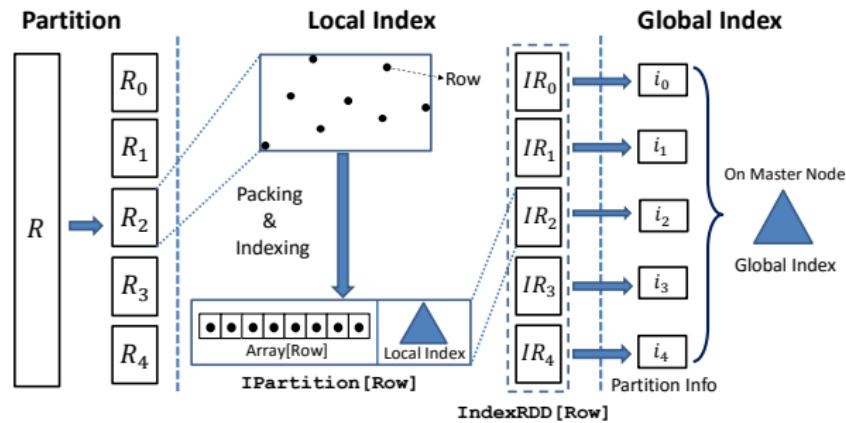


Figure 4: Two-level indexing strategy in Simba.

(Xie et al, 2016)

Goals...

- ① Design a parallel program to find the set of disk in a given time interval.
- ② Implement the new version in an In-Memory Distributed System (Simba).
- ③ Test the implementation using different settings and datasets.

Thank you!!!

Do you have any question?