Exploiting Apache Flink's Stateful Operators

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Berlin • 4 September 2018

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Agenda

- About ING
- About the Use Case
- Stateful example + code
- Advanced stateful example + code
- Conclusion

About ING

About ING

Almost 9 million customers in the Netherlands*

9 million transactions per month on ING machines*

1,45 million customer logins per day on Mijn ING website*

4,2 million customer logins per day on ING Banking App*

*per january 2018

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Use Case

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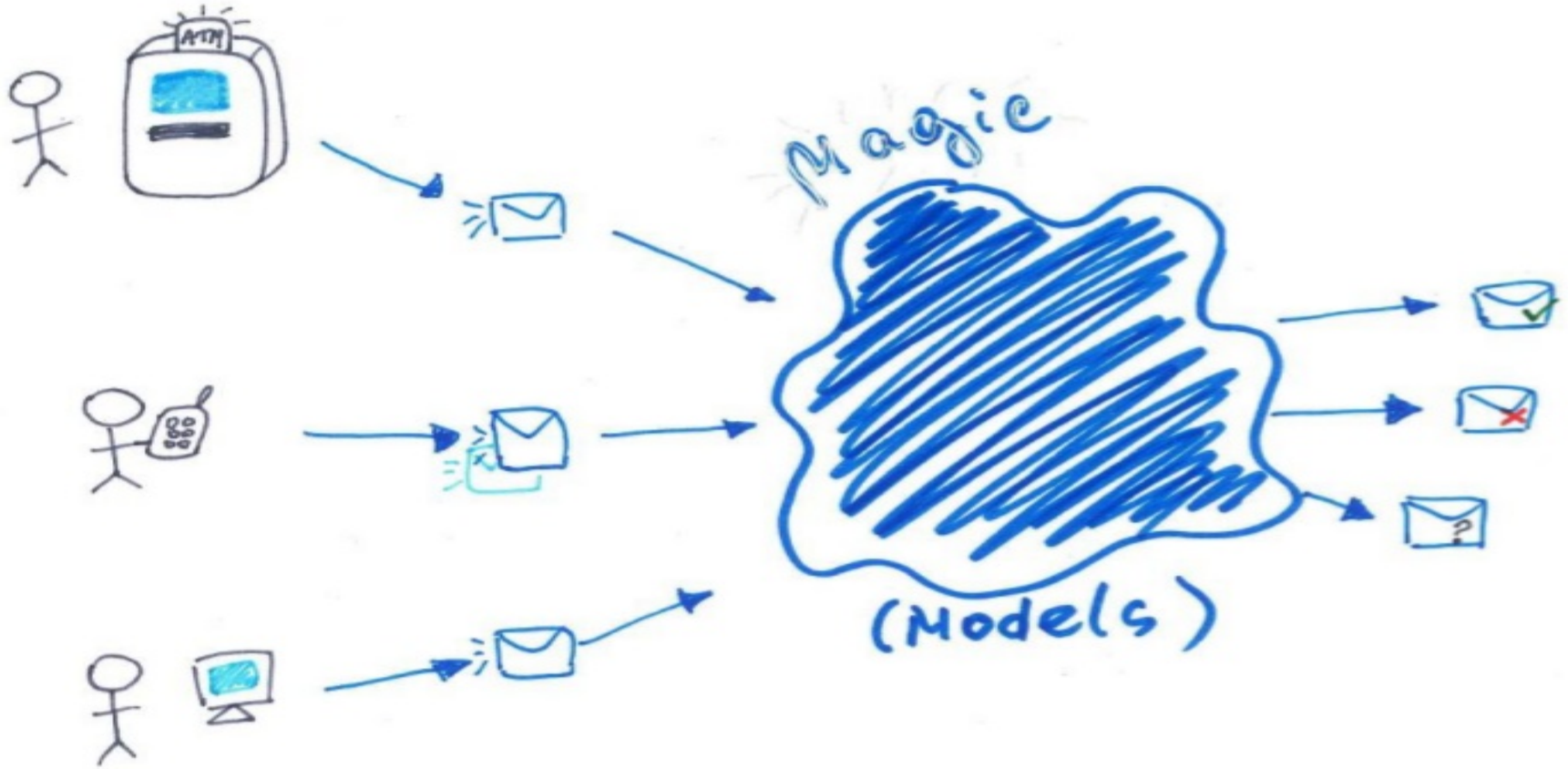
Use Case - Prevent Fraudulent Transactions



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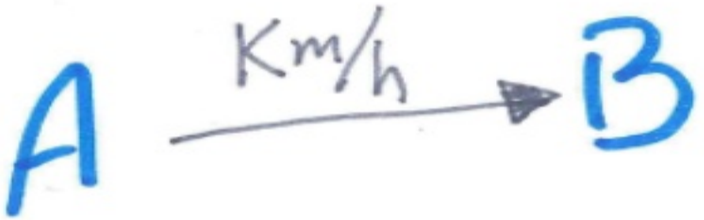
Model Input - Features

- Speed of the client (between transactions)
- The debit card has been reported broken or stolen
- The customer has been blocked



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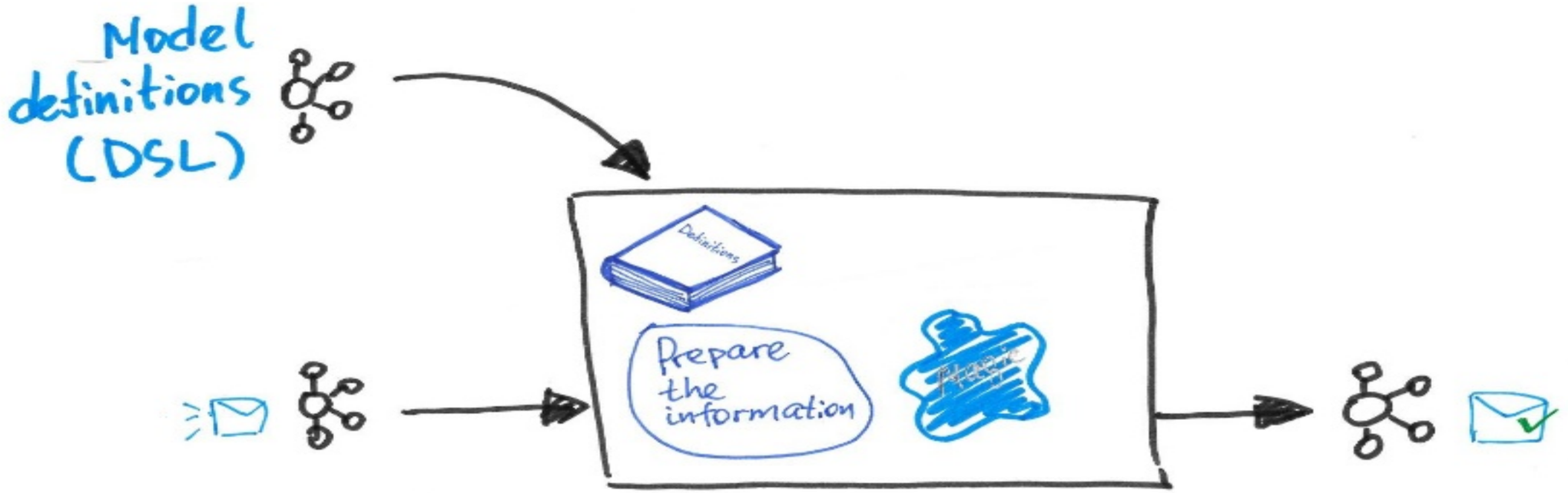
Use Case – Requirements

- **Dynamic behaviour -> DSL**
- Historical data (state)
- Real-time (< 100 ms)
- High volumes (10K+ tps)
- Scalability

Use Case – Architecture



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Scoring Example

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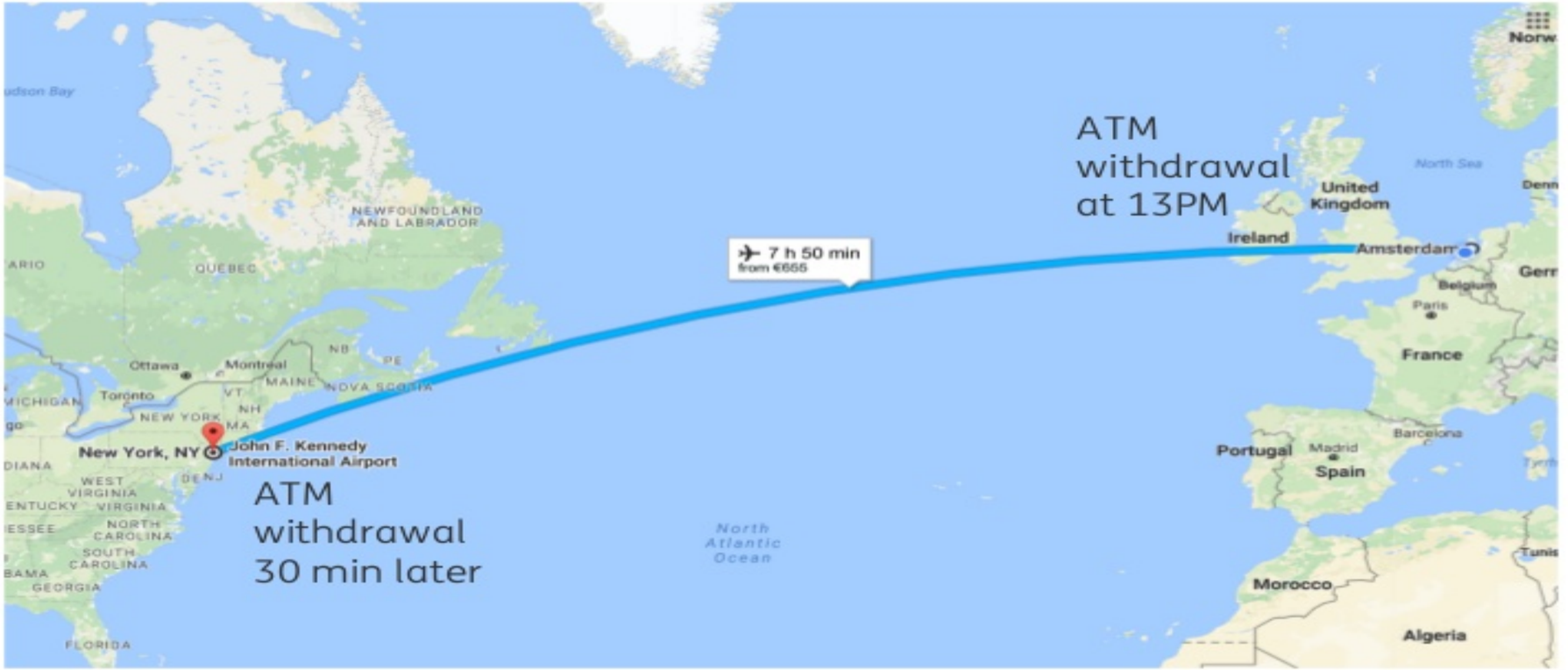
Flying Carpet Rule



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Need for State

To score we need:
Customer Speed ?

Event: Transaction

customerId
cardId
amount
location
eventTime

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Need for State

To score we need:
Customer Speed ?

Event: Transaction

customerId
cardId
amount
location
eventTime

+ prev.Location
prev.eventTime

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Need for State

To score we need:
Customer Speed ?

Event: Transaction

customerId
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location
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+ prev.Location
prev.eventTime
State

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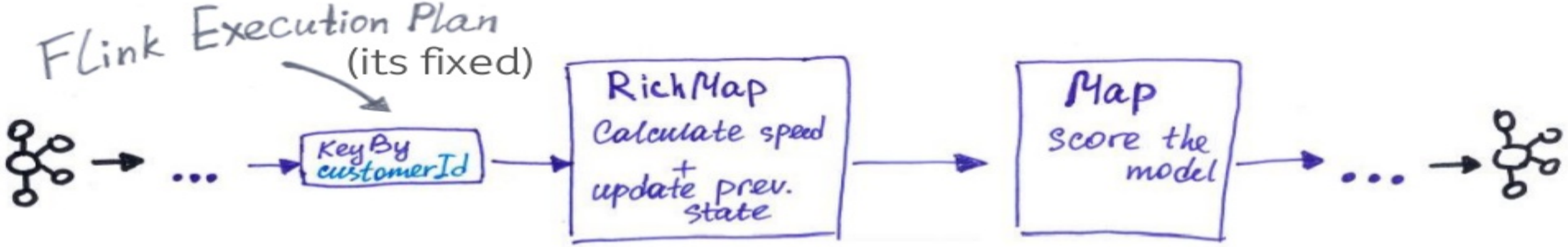
Stateful Flying Carpet



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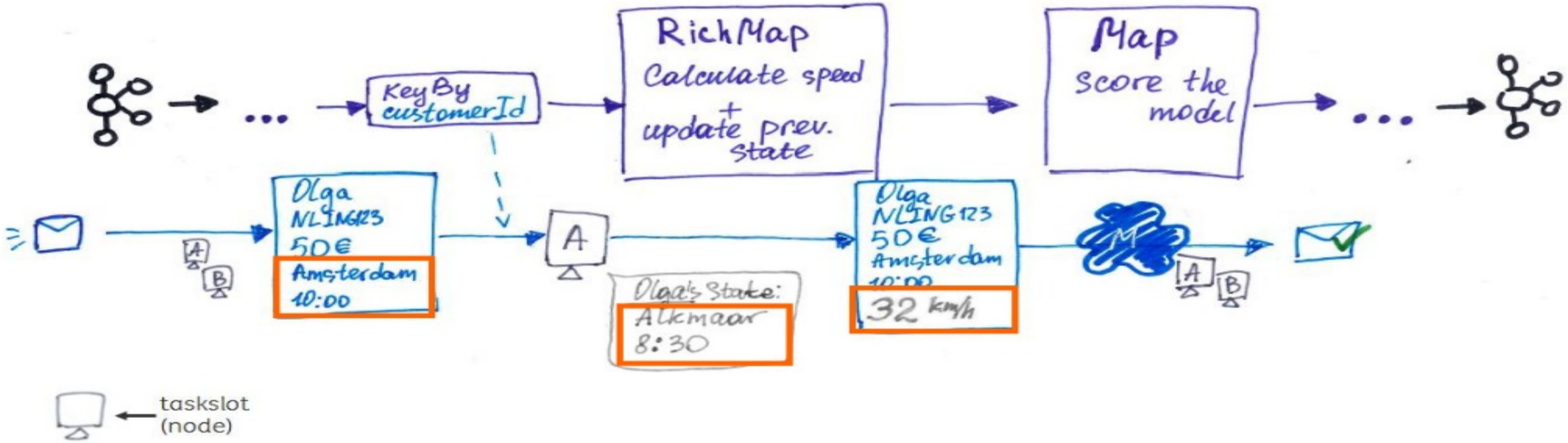
Stateful Flying Carpet



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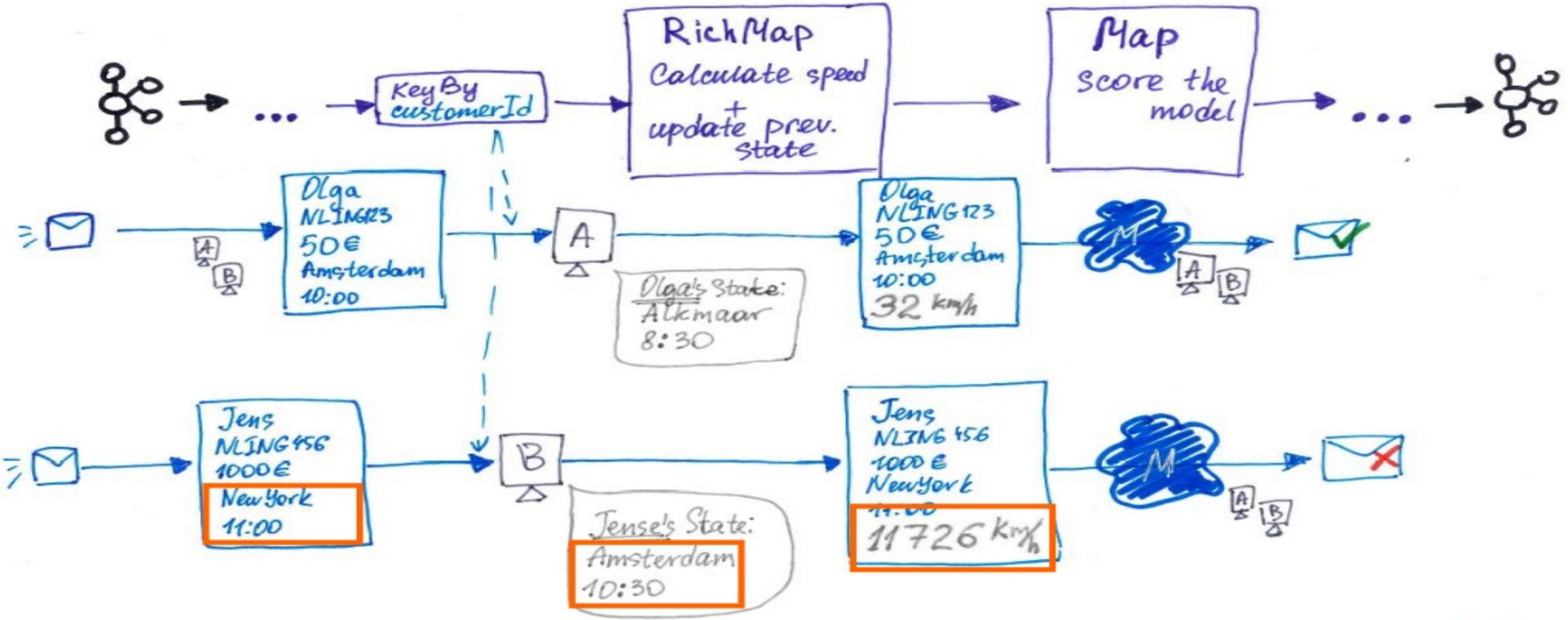
Stateful Flying Carpet



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Stateful Flying Carpet

CODE

Improved Stateful Example

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Flying Carpet Model Improved

To score better we need:

Customer Speed

Event: Transaction

...

+ prev. Location
prev. event Time

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Flying Carpet Model Improved

To score better we need:

Customer Speed
+ Av. amount per card

Event: Transaction
...

+ prev. Location
prev. event Time

+ total Amount
total nr. transactions

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Flying Carpet Model Improved

To score better we need:

Customer Speed
+ Av. amount per card

Event: Transaction
...

+ prev. Location
prev. event Time
← Customer state

+ total Amount
total nr. transactions

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Flying Carpet Model Improved

To score better we need:

Customer Speed
+ Av. amount per card

Event: Transaction
...

+ prev. Location
prev. event Time
← Customer state

+ total Amount
total nr. transactions
← Card state

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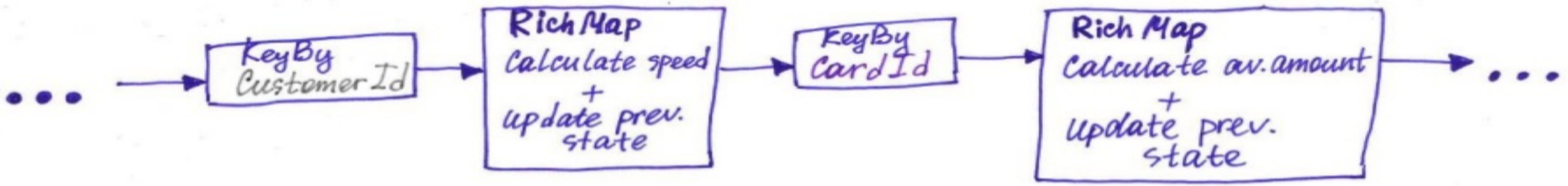
Flink - Sequential Approach



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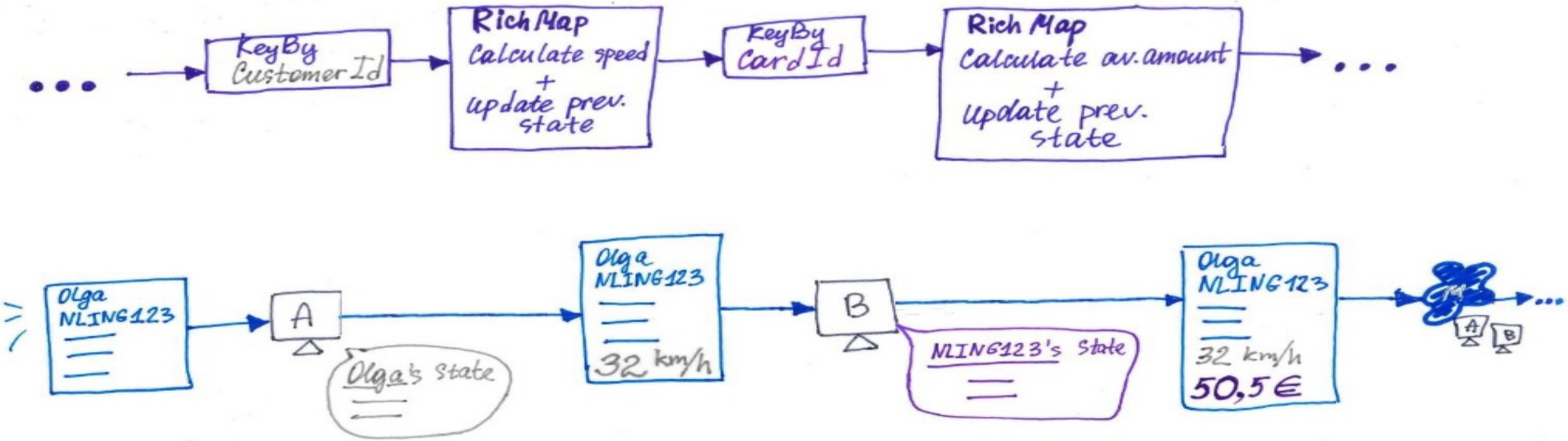
Flink - Sequential Approach



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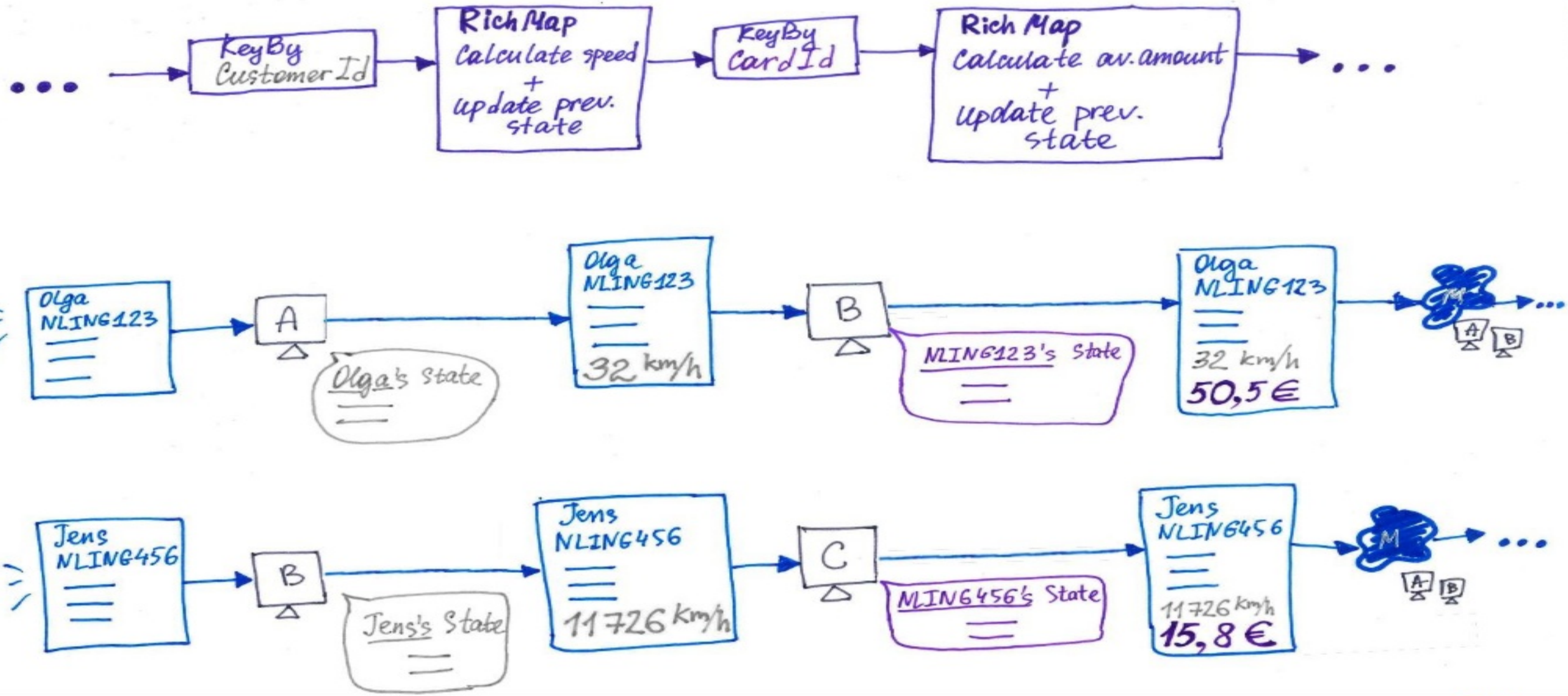
Flink - Sequential Approach



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Sequential Approach

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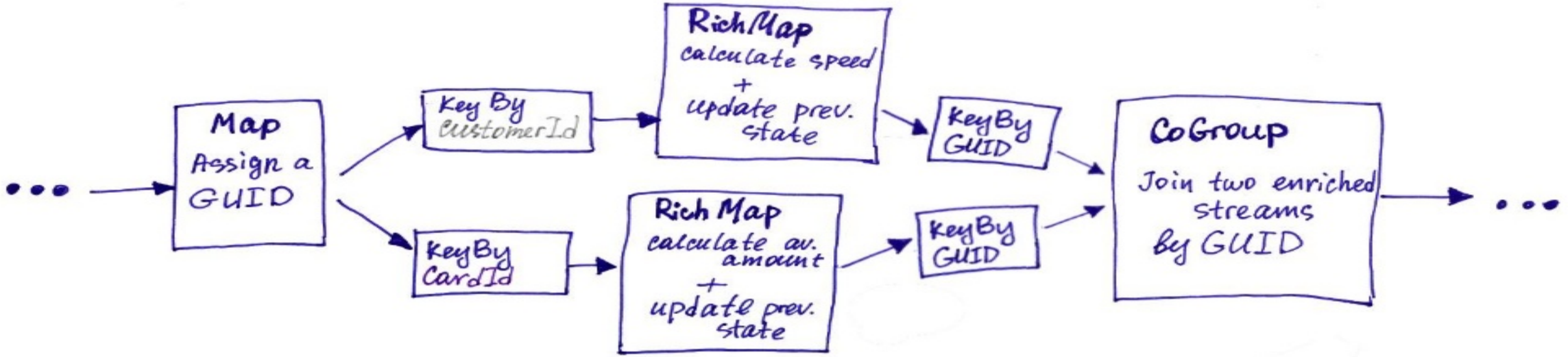
Sequential Approach - Evaluation

+ It works!
– Latency
– Not so scalable
– Event has to pass nodes even if their state is not required
  (could be solved with a filter)
– Cannot add new keys without restarting a job
  (remember: The execution plan is fixed)

Parallel Approach



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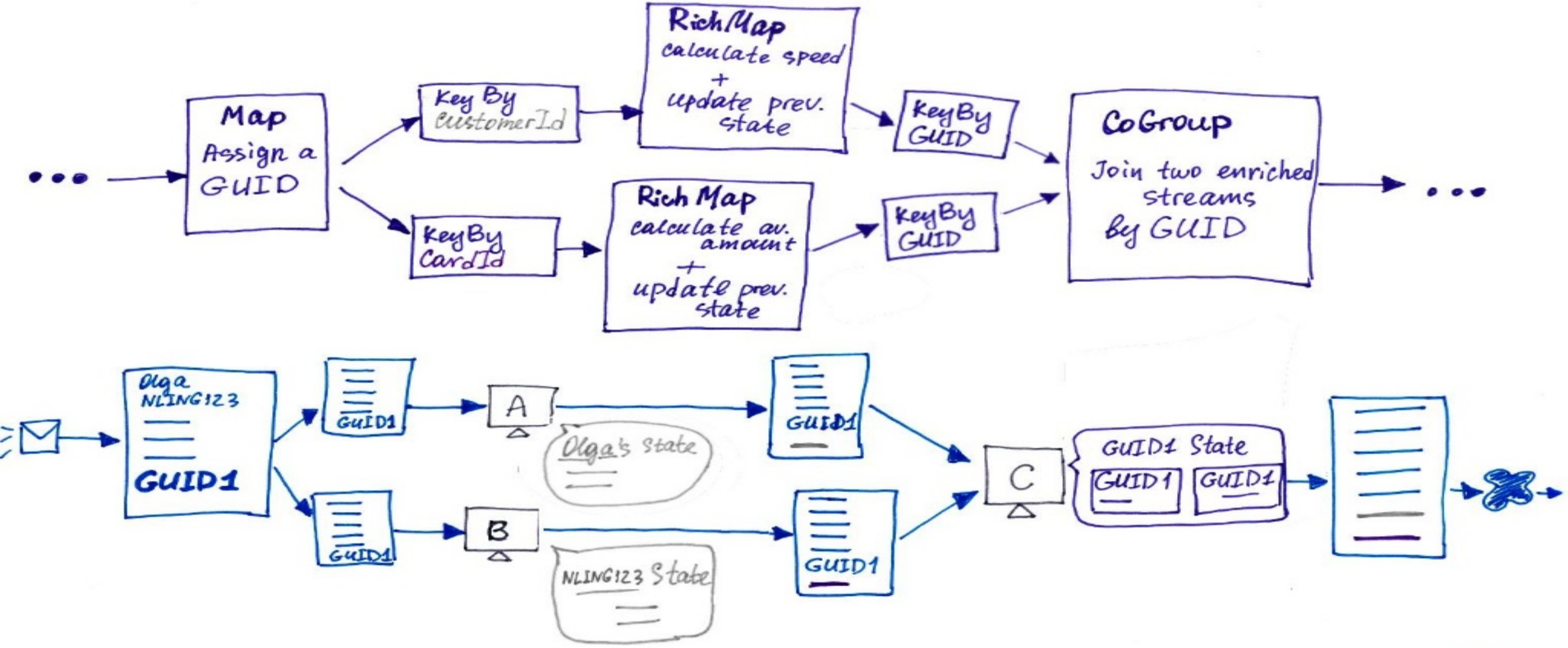
Parallel Approach



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Parallel Approach

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Parallel Approach - Evaluation

+ Less latency than when using sequential approach
+ More scalable
− Event has to pass nodes even if their state is not required
− Complex execution plan
− Cannot add new keys without restarting a job
  (remember: The execution plan is fixed)

Other Approach to Improved Stateful Example

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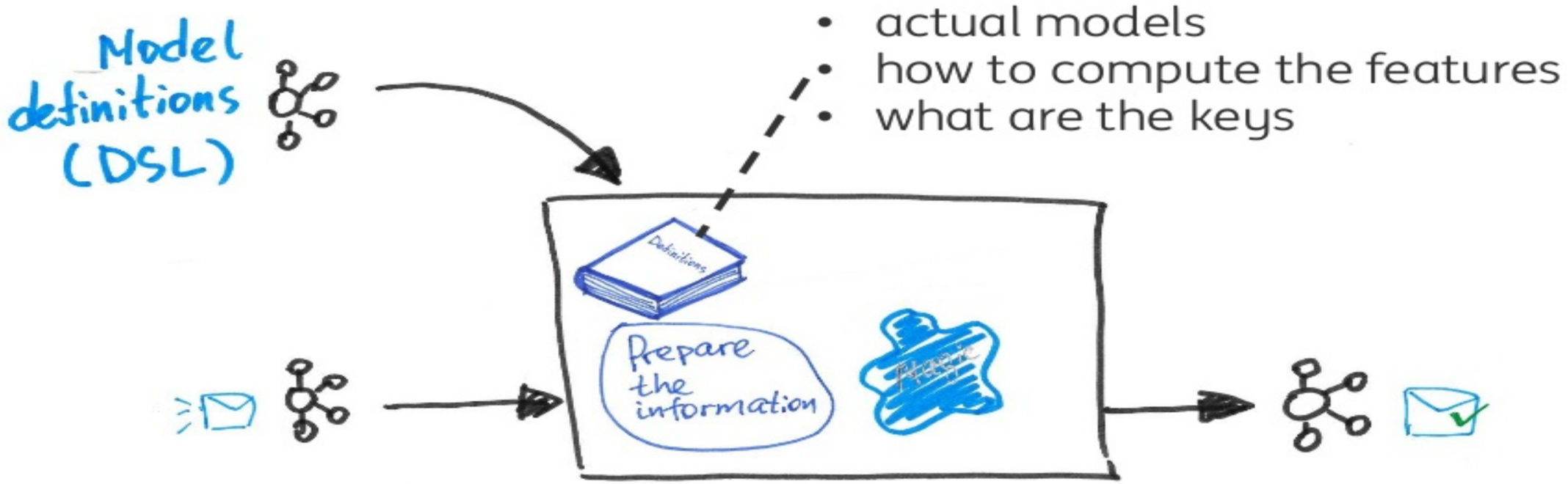
Architecture recap



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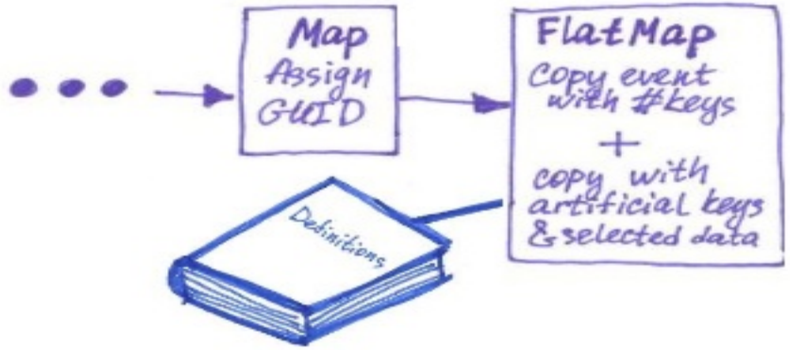
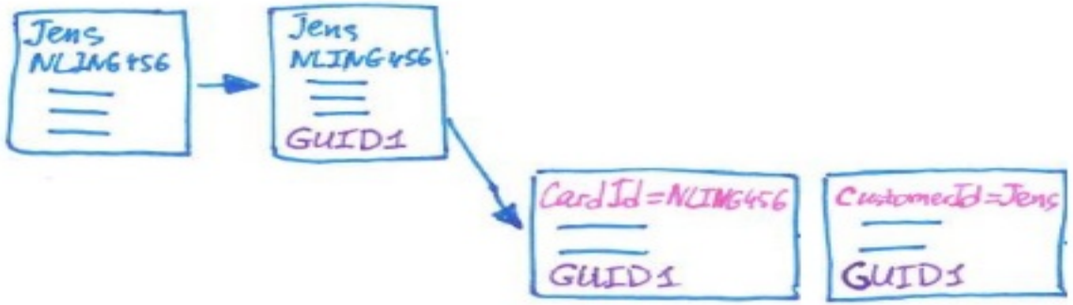
Advanced Approach





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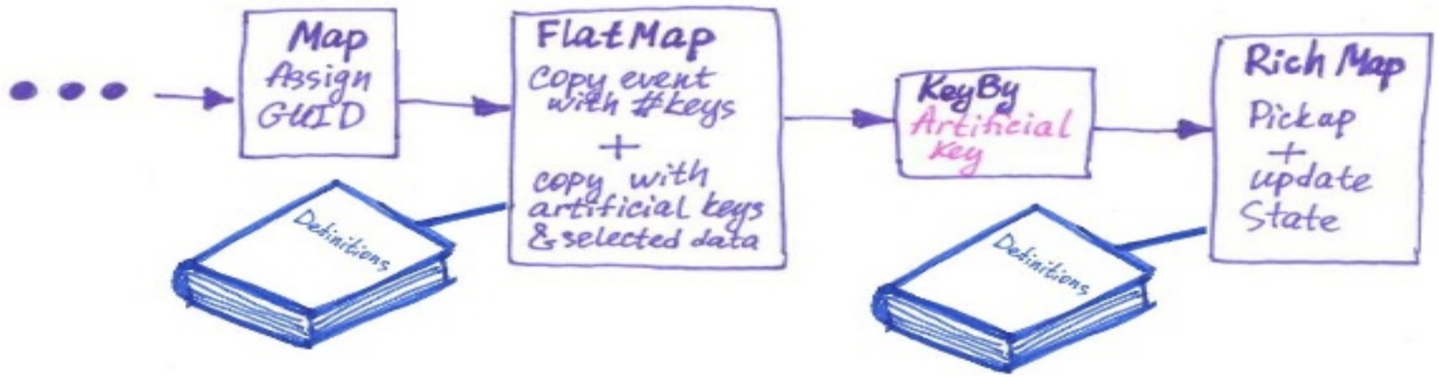
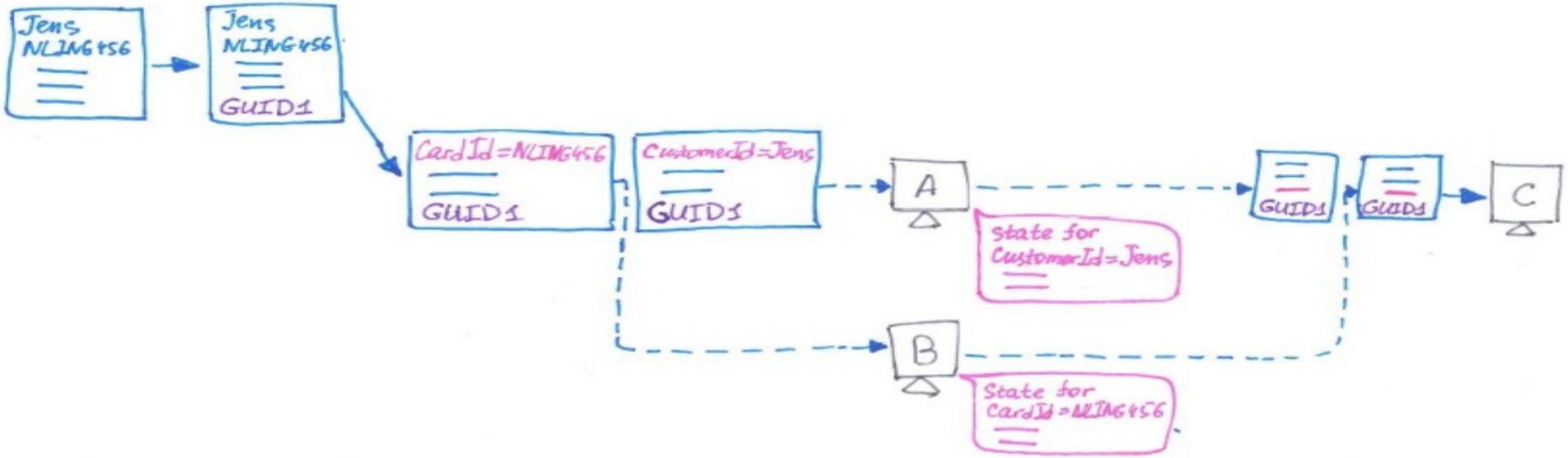
Advanced Approach





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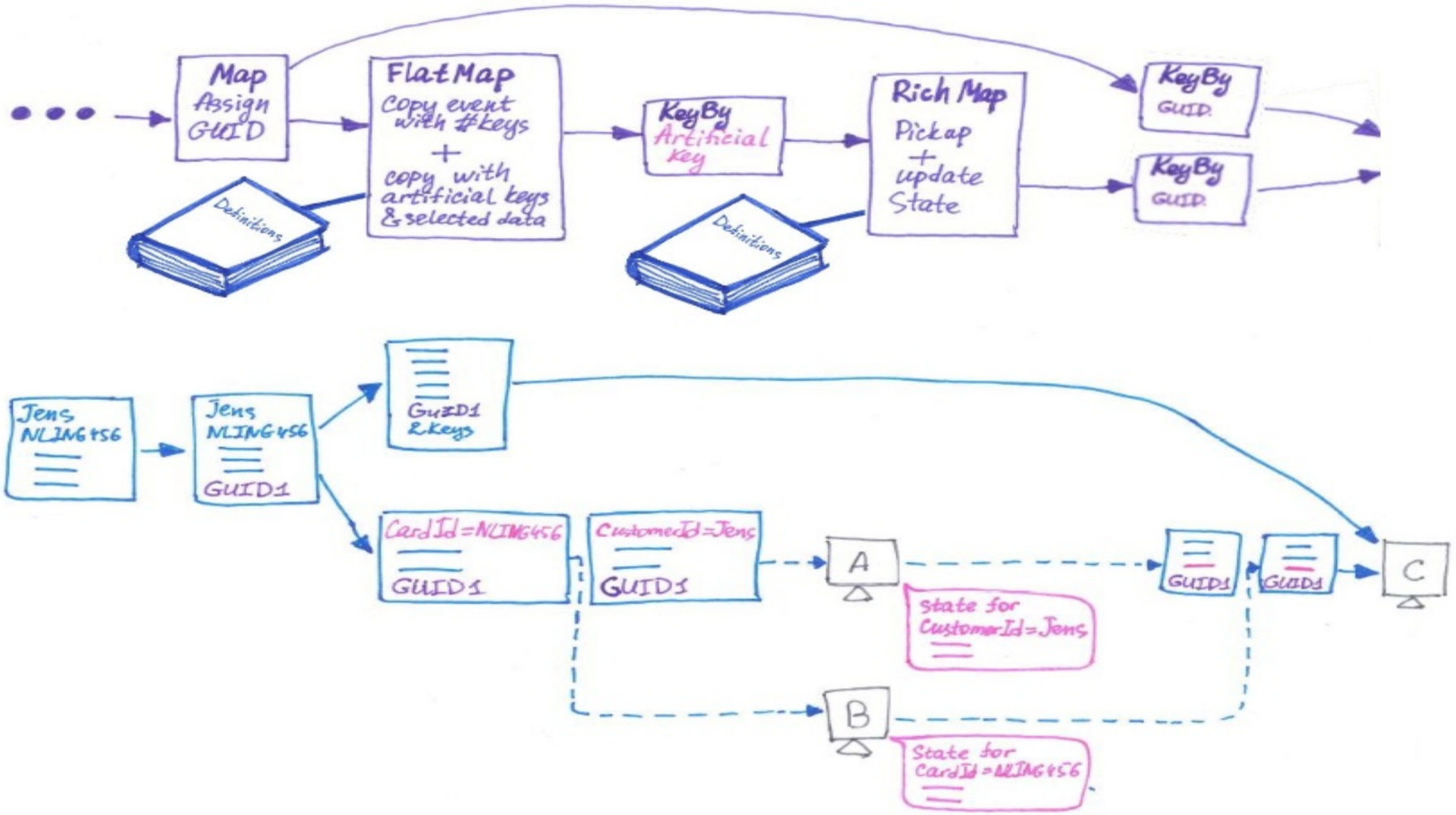
Advanced Approach



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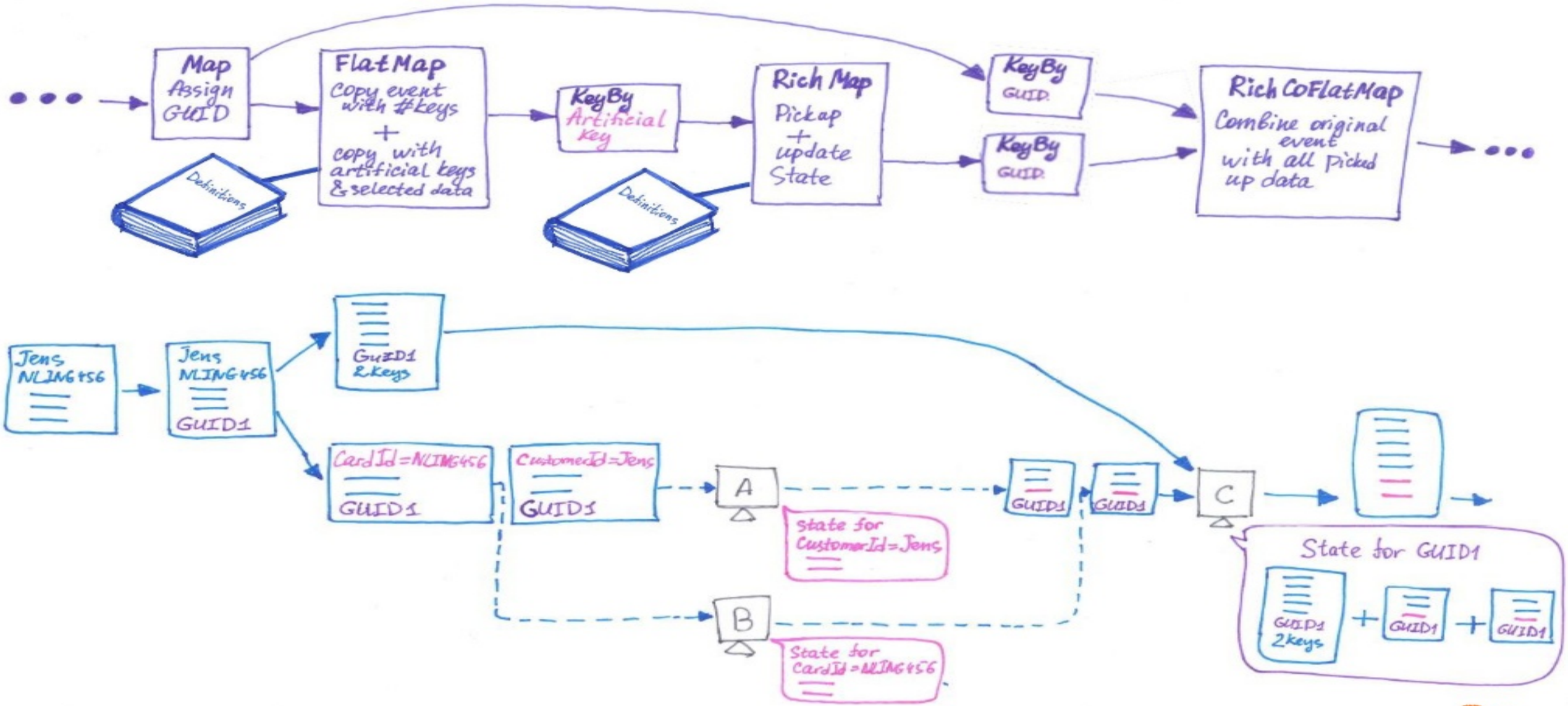
Advanced Approach



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Flink - Advanced Approach

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Advanced approach - evaluation

+ Can add new keys without restarting a job
+ Event is not passing through nodes that are not needed
+ Simple execution plan
– Quite complex implementation
– Requires a way to deliver a description of the behaviour in some way

Conclusion

Conclusion

Although the execution plan is fixed, your business logic does not have to be

The End

Thank you!

Check out the
demo code on GitHub:

github.com/rezolya/exploiting-flinks-stateful-operators

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