Basic Data Analysis

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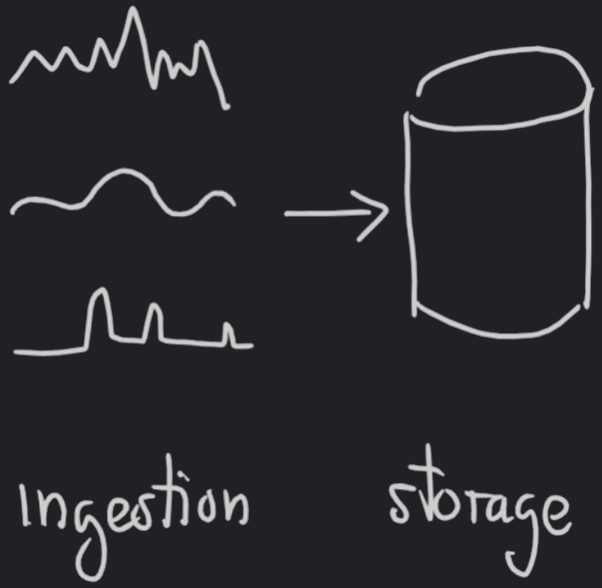
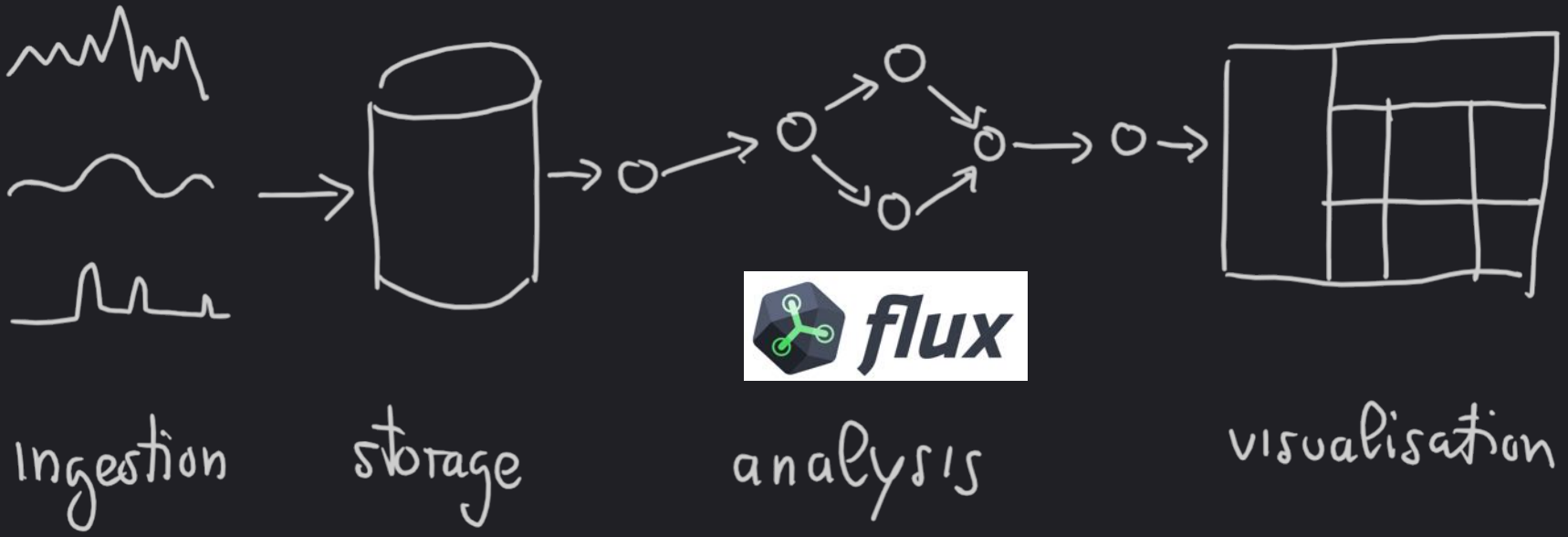
Introduction

Data Lifecycle



Data Lifecycle




flux

Why Flux?

I don't want to have to write query code in one language and processing code in another language.

– Paul Dix - CTO InfluxData

What Is Flux?

~~Flux Query Language?~~

Query + Process + Act

Flux Data Scripting Language

What Is Flux?

- Written to be:
  - Useable: easy to learn
  - Readable: developers read more code than we write
  - Extensible: developers can extend the language
  - Composable: developers can build onto the language
  - Testable: queries are code
  - Contributable: open source contributions matter

What is Flux? (cont.)

- Open Source (MIT)
- Data-first mentality
- Streaming Data
- Planner-optimized
- Compatible with multiple sources and sinks

Flux vs. InfluxQL

- Flux is an alternative to InfluxQL with additional functionality like:
  - Joins
  - Math across measurements
  - Sort by any column
  - Pivot
  - Histograms
  - Covariance

- Reference: https://v2.docs.influxdata.com/v2.0/query-data/

Exploring flux
Basics

Basic Flux Language Elements

- Anatomy of a Flux query:
  - data source
  - time range
  - data filters

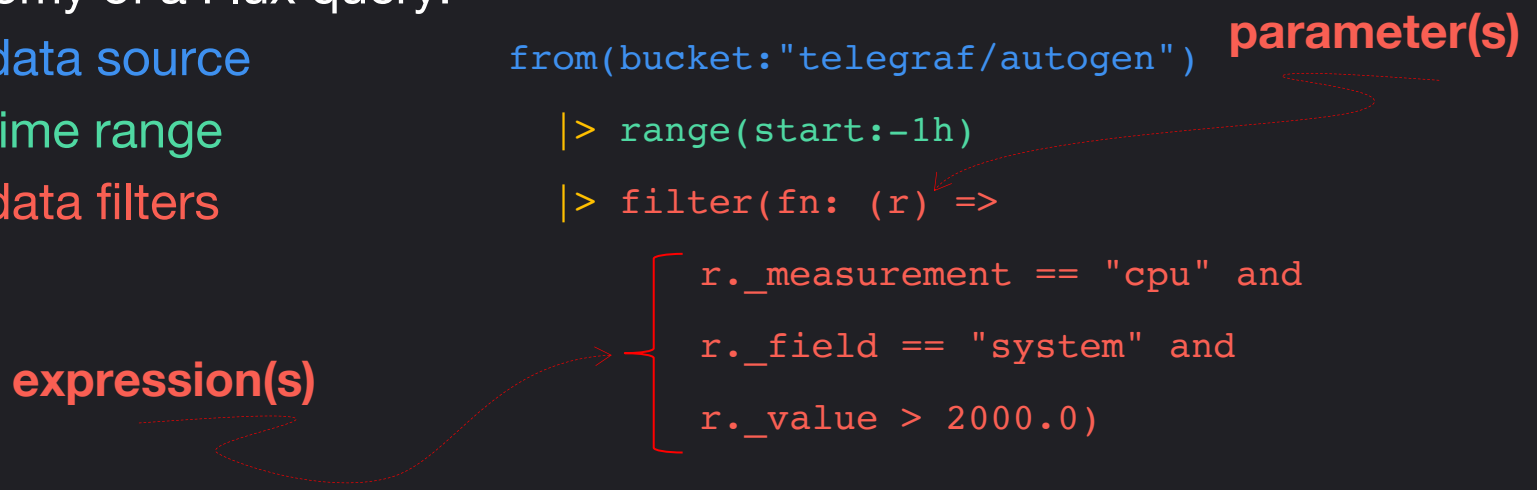
Anonymous function

```
from(bucket:"telegraf/autogen")
  |> range(start:-1h)
  |> filter(fn: (r) =>
       r._measurement == "cpu" and
       r._field == "system" and
       r._value > 2000.0)
```

Pipe-forward operator: chain operations together

Basic Flux Language Elements

- Anatomy of a Flux query:
  - data source
  - time range
  - data filters



Flux Data Model

An infinite stream…

of finite tables…

identified by the GroupKey

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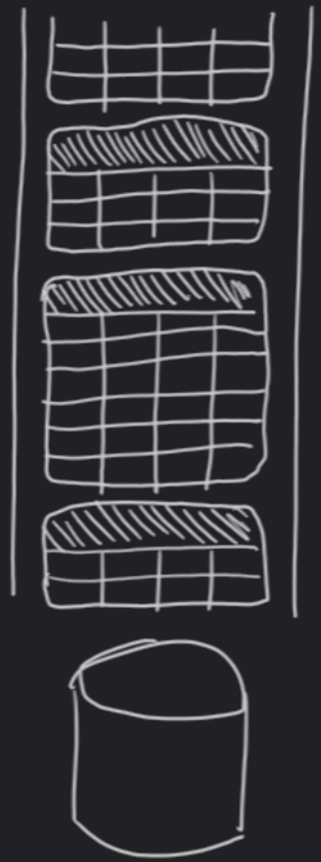

From bucket to tables

_time	_m	host	_field	_value
14…0	cpu	serverA	system	2342
14…2	cpu	serverA	system	477
GroupKey[cpu, serverA, system]				

_time	_m	host	_field	_value
14…1	cpu	serverB	system	2779
14…3	cpu	serverB	system	1274
GroupKey[cpu, serverB, system]				

[…]

_time	_m	host	_field	_value
14…1	cpu	serverB	idle	1789
14…2	cpu	serverB	idle	2475
GroupKey[cpu, serverB, idle]				

```
from(bucket:"telegraf/autogen")
  |> range(start:-1s)
```

_time	_m	host	idle	system
14…0 … 14…1	cpu … cpu	serverA … serverB	1667 … 1789	2342 … 2779

_m = _measurement

Query Process

For Each Table:

1. Convert incoming rows into 0 or more outgoing rows
2. Map outgoing rows to tables

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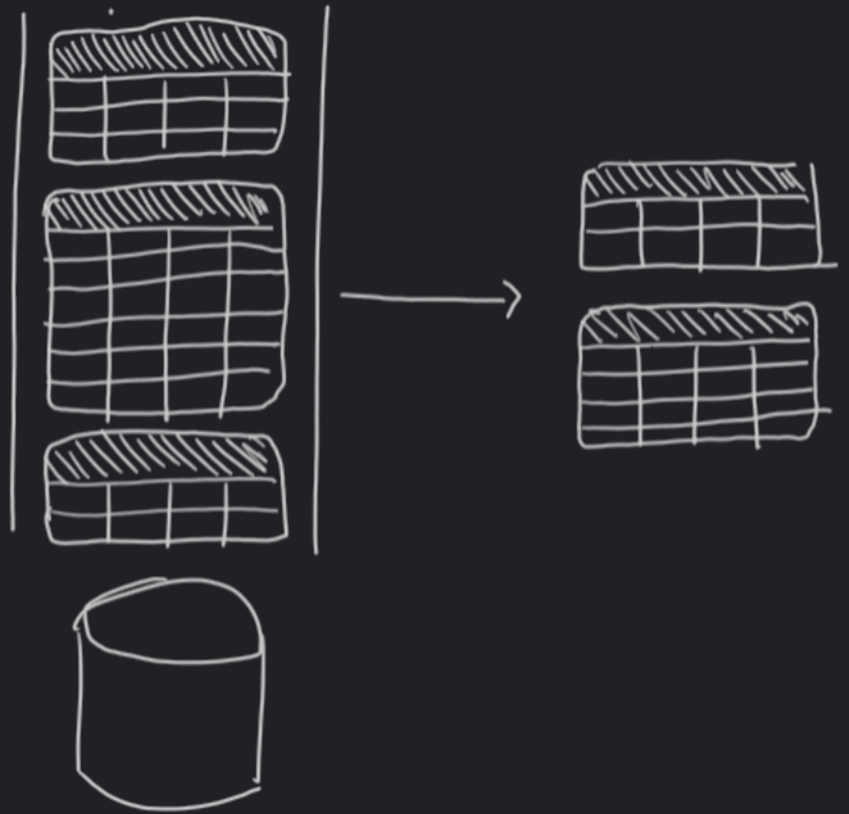

_time	_m	host	_field	_value
14…1	cpu	serverB	idle	1789
14…2	cpu	serverB	idle	2475
GroupKey[cpu, serverB, idle]				

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GroupKey[cpu, serverB, system]				

[…]

_time	_m	host	_field	_value
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GroupKey[cpu, serverA, system]				

```
|> filter(fn: (r) =>
    r._measurement == "cpu" and
    r._field == "system" and
    r._value > 2000.0)
```

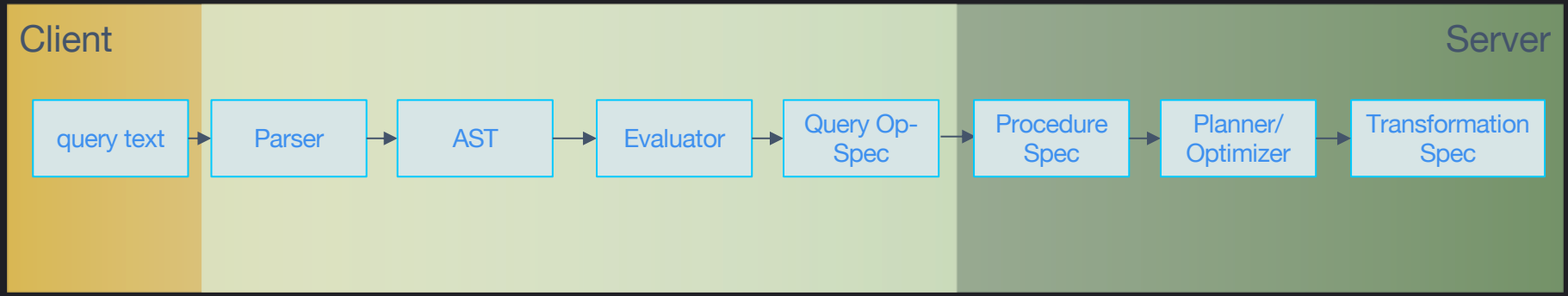
Ø

_time	_m	host	_field	_value
14…1	cpu	serverB	system	2779
GroupKey[cpu, serverB, system]				

[…]

_time	_m	host	_field	_value
14…0	cpu	serverA	system	2342
GroupKey[cpu, serverA, system]				

The Life of a Flux Query



:)

Quiz

1. What's a Bucket?
2. What's the Pipe-forward operator |> for?
3. What's a Table in Flux?
4. What's a Group Key in Flux?

A. List of columns for which every row in a table has the same value

B. A named data source with retention policy

C. Chains operations

D. A part of a result

Quiz answer

1. What's a Bucket?
2. What's the Pipe-forward operator |> for?
3. What's a Table in Flux?
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A. List of columns for which every row in a table has the same value

B. A named data source with retention policy

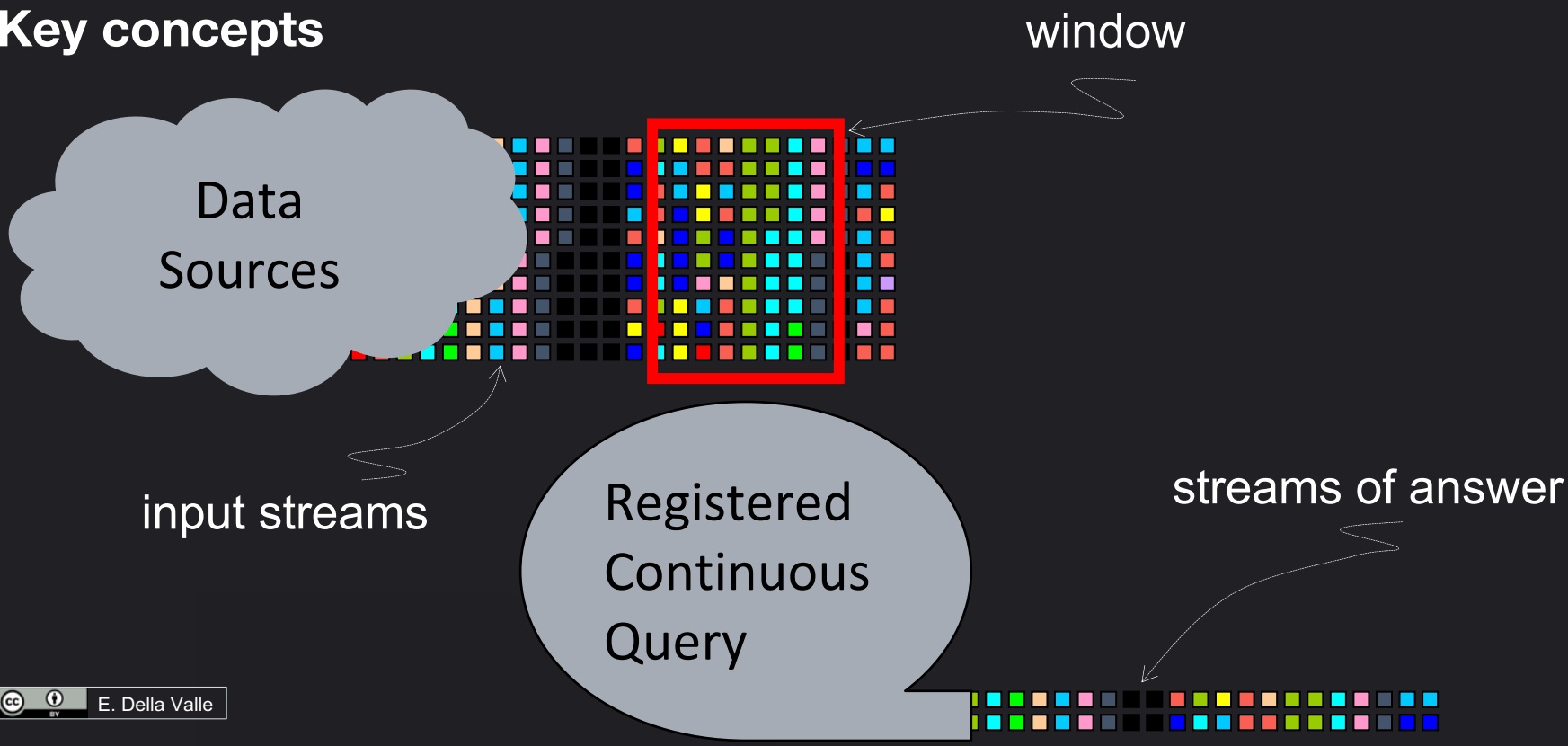
C. Chains operations

D. A part of a result

[1:B, 2:C, 3:D, 4:A]

Exploring flux
Windowing

Key concepts



Windows

- Streams are infinite in nature
- Processing can end only if the input is finite
- A **window operator** selects a finite portion of a stream
  - **Time range** is a window operator whose input is a time interval specified either stating an absolute start and end time

```
range(start: 2019-10-01T00:00:00Z,
      stop: 2019-10-01T00:05:00Z)
```

  - or stating a relative time period relative

```
range(start:-2h, stop: -1h)
range(start:-1h)
```

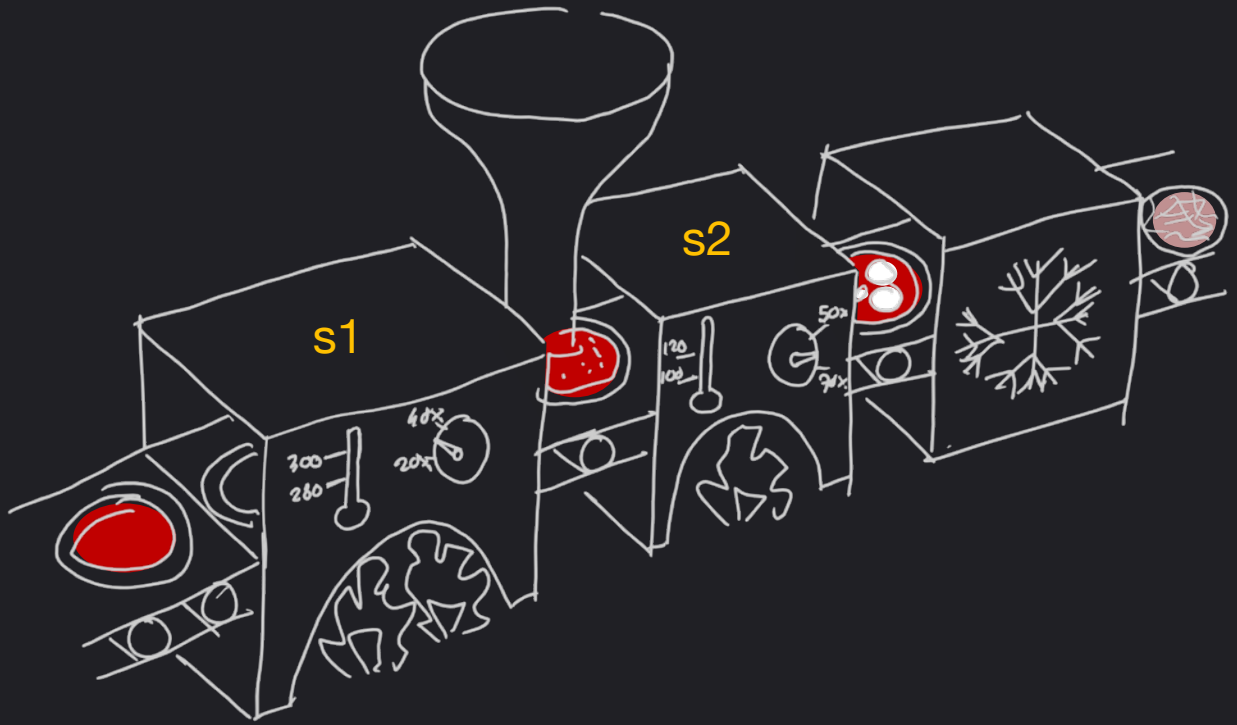
Let’s get dirty!

2

Continuous Linear Pizza Oven

Learning goals:

- Data source
- Window
- Tables



Task

Extract all the measurements in a given range

- Absolute: from 2020-04-30T10:00:00Z to 2020-04-30T10:05:00Z
- Relative: in the last 24 hours

Take home message

The range() function **extracts** from the named bucket all the possible **tables in the given time range**

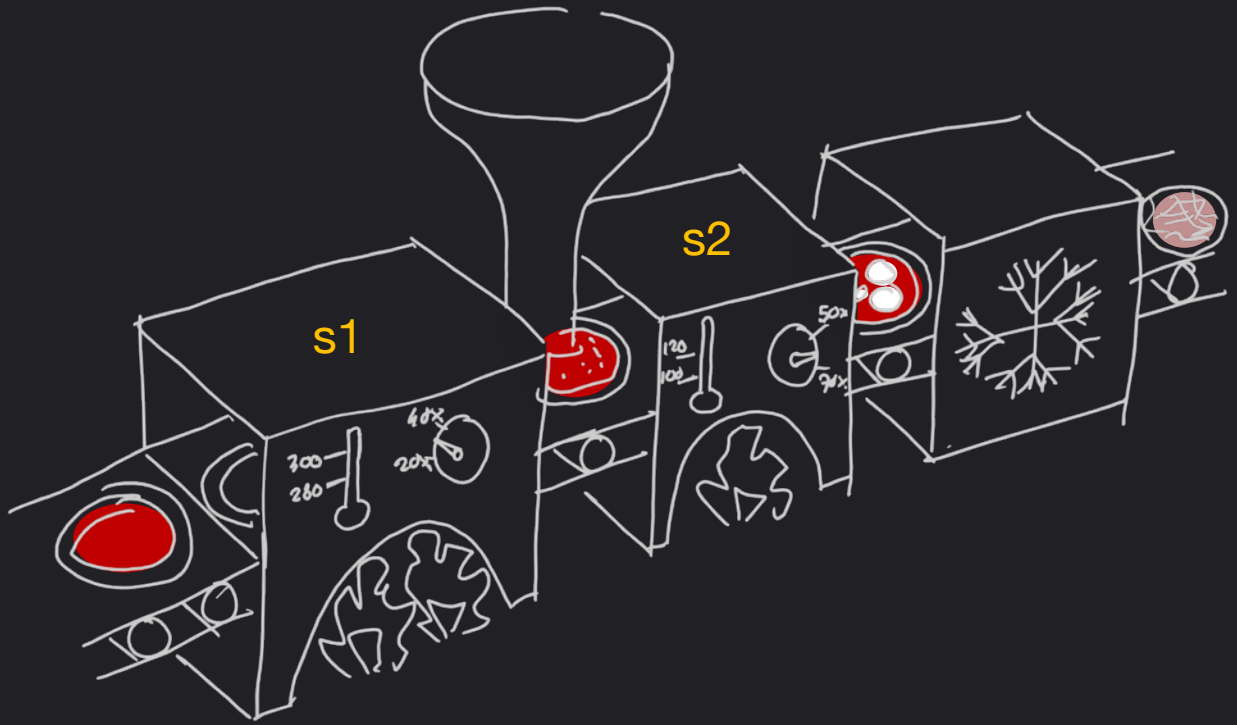
Let’s get dirty!

3

Continuous Linear Pizza Oven

Learning goals:

- Filter by tag



Task

Extract the temperature data from the cooking base area (sensor S1)

Take home message

The filter() function **applied to tags selects** only the **table(s)** of your interest from all the possible tables

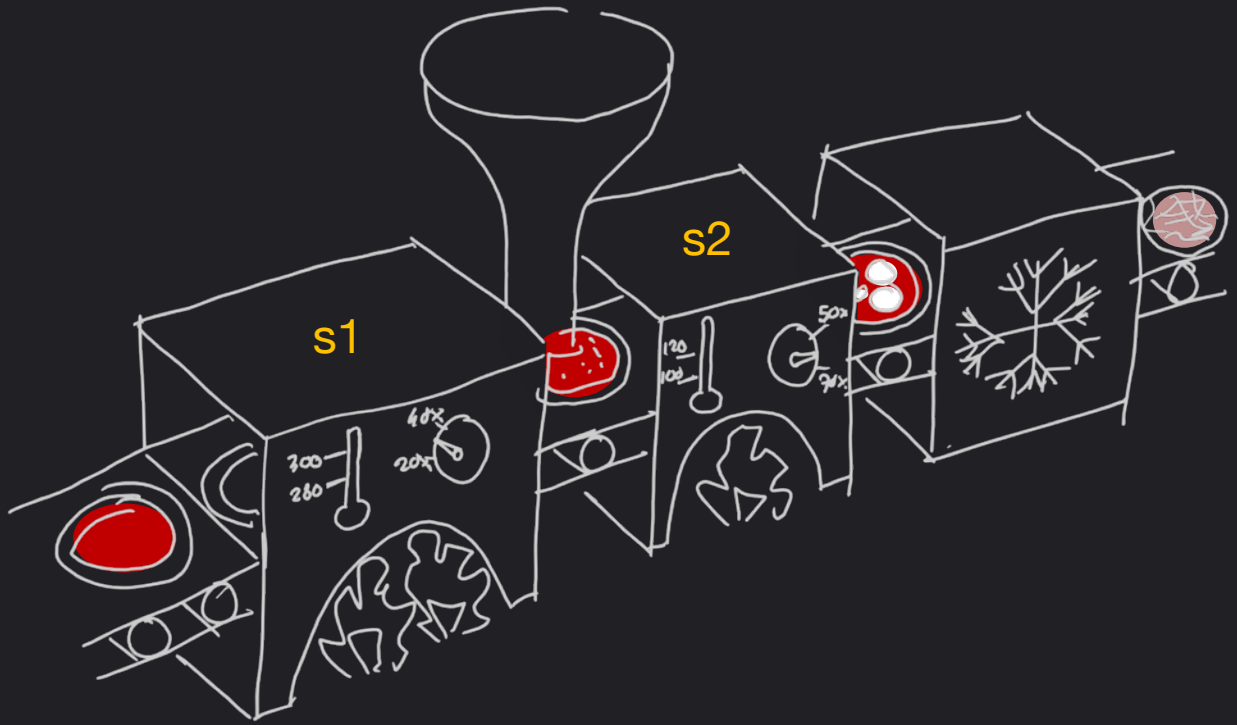
Let’s get dirty!

4

Continuous Linear Pizza Oven

Learning goals:

- Filter by value



Task

Extract the measurements from the cooking base area (sensor S1) with a temperature under 300°

Take home message

The filter() function **applied to values selects** only the **row(s)** of your interest from all the possible tables

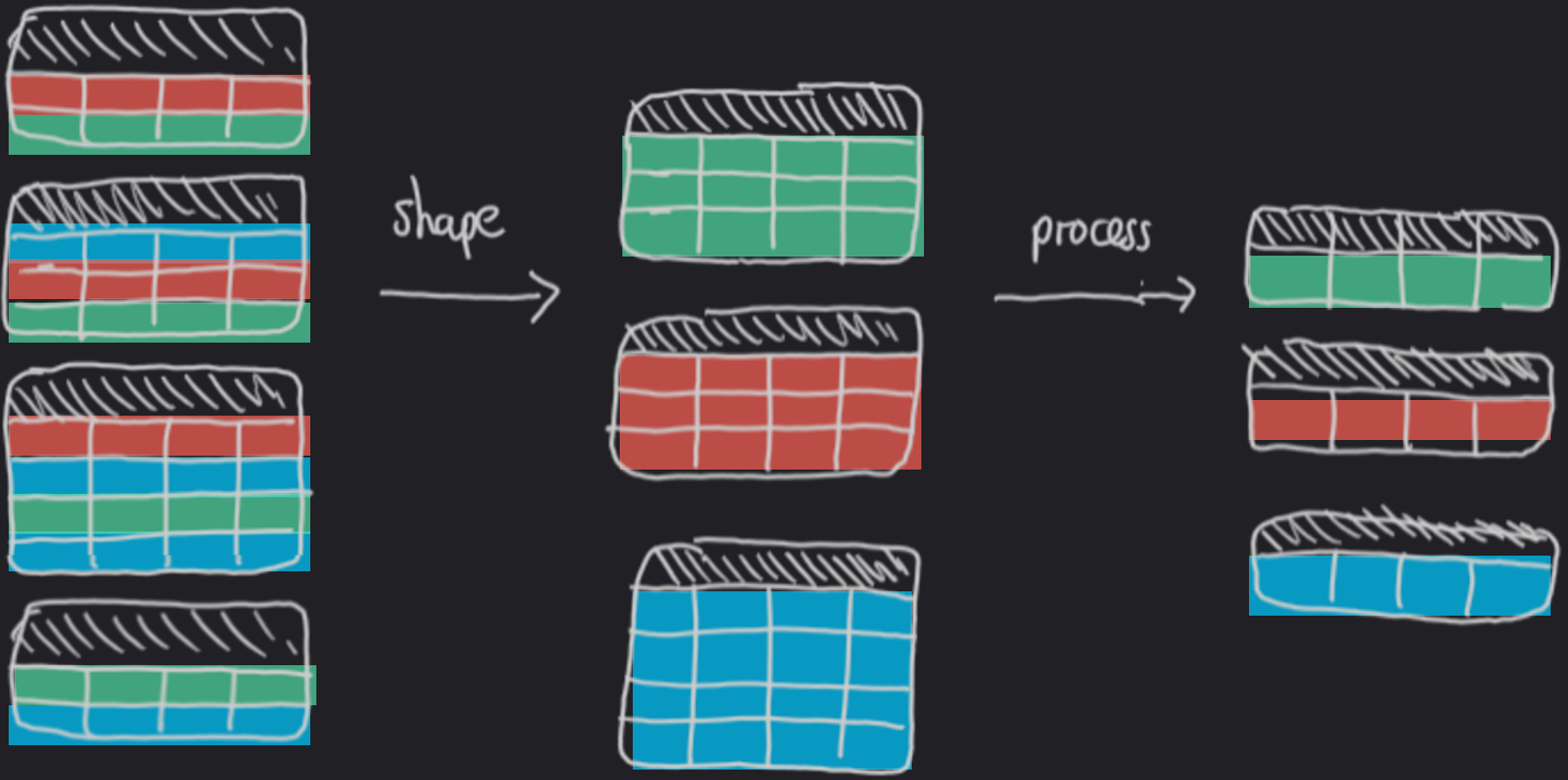
Exploring flux

Shaping and Processing

All Flux Language Elements

- Anatomy of a Flux query:
  - data source
  - time range
  - data filters
  - shaping
  - processing

```
from(bucket:"telegraf/autogen")
  |> range(start:-1h)
  |> filter(fn: (r) =>
        r._measurement == "cpu" and
        r._field == "system" and
        r._value > 2000.0)
  |> group(columns: ["_field"])
  |> mean()
```


shape
process

Exploring flux

Shaping with group Processing with aggregators and selectors

_time	_m	host	_field	_value
10:45	cpu	serverA	system	1000
11:45	cpu	serverA	system	3000
GroupKey[cpu, serverA, system]				

_time	_m	host	_field	_value
11:00	cpu	serverB	system	2000
11:30	cpu	serverB	system	2000
GroupKey[cpu, serverB, system]				

_time	_m	host	_field	_value
10:35	cpu	serverA	idle	100
GroupKey[cpu, serverA, idle]				

_time	_m	host	_field	_value
11:15	cpu	serverB	idle	200
11:50	cpu	serverB	idle	400
GroupKey[cpu, serverB, idle]				

```
group(columns: ["_field"])
```

_time	_m	host	_field	_value
10:45	cpu	serverA	system	1000
11:00	cpu	serverB	system	2000
11:30	cpu	serverB	system	2000
11:45	cpu	serverA	system	3000
GroupKey[cpu, system]				

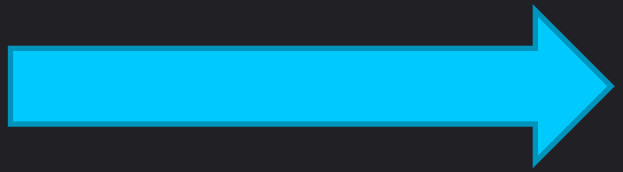
_time	_m	host	_field	_value
10:35	cpu	serverA	idle	100
11:15	cpu	serverB	idle	200
11:50	cpu	serverB	idle	400
GroupKey[cpu, idle]				

Example of aggregator

_time	_m	host	_field	_value
10:45	cpu	serverA	system	1000
11:00	cpu	serverB	system	2000
11:30	cpu	serverB	system	2000
11:45	cpu	serverA	system	3000
GroupKey[cpu, system]				

_time	_m	host	_field	_value
10:35	cpu	serverA	idle	100
11:15	cpu	serverB	idle	200
11:50	cpu	serverB	idle	400
GroupKey[cpu, idle]				

```
|> mean()
```



_m	_field	_value
cpu	system	2000
GroupKey[cpu, system]		

_m	_field	_value
cpu	idle	233,33
GroupKey[cpu, idle]		

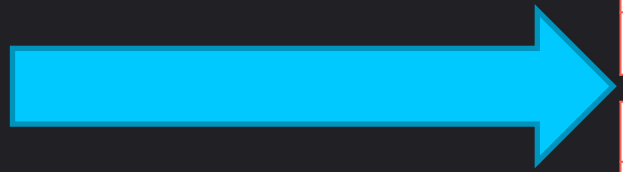
NOTE: time and host columns get deleted

Example of selector

_time	_m	host	_field	_value
10:45	cpu	serverA	system	1000
11:00	cpu	serverB	system	2000
11:30	cpu	serverB	system	2000
11:45	cpu	serverA	system	3000
GroupKey[cpu, system]				

_time	_m	host	_field	_value
10:35	cpu	serverA	idle	100
11:15	cpu	serverB	idle	200
11:50	cpu	serverB	idle	400
GroupKey[cpu, idle]				

```
|> last()
```



_time	_m	host	_field	_value
11:45	cpu	serverA	system	3000
GroupKey[cpu, system]				

_time	_m	host	_field	_value
11:50	cpu	serverB	idle	400
GroupKey[cpu, idle]				

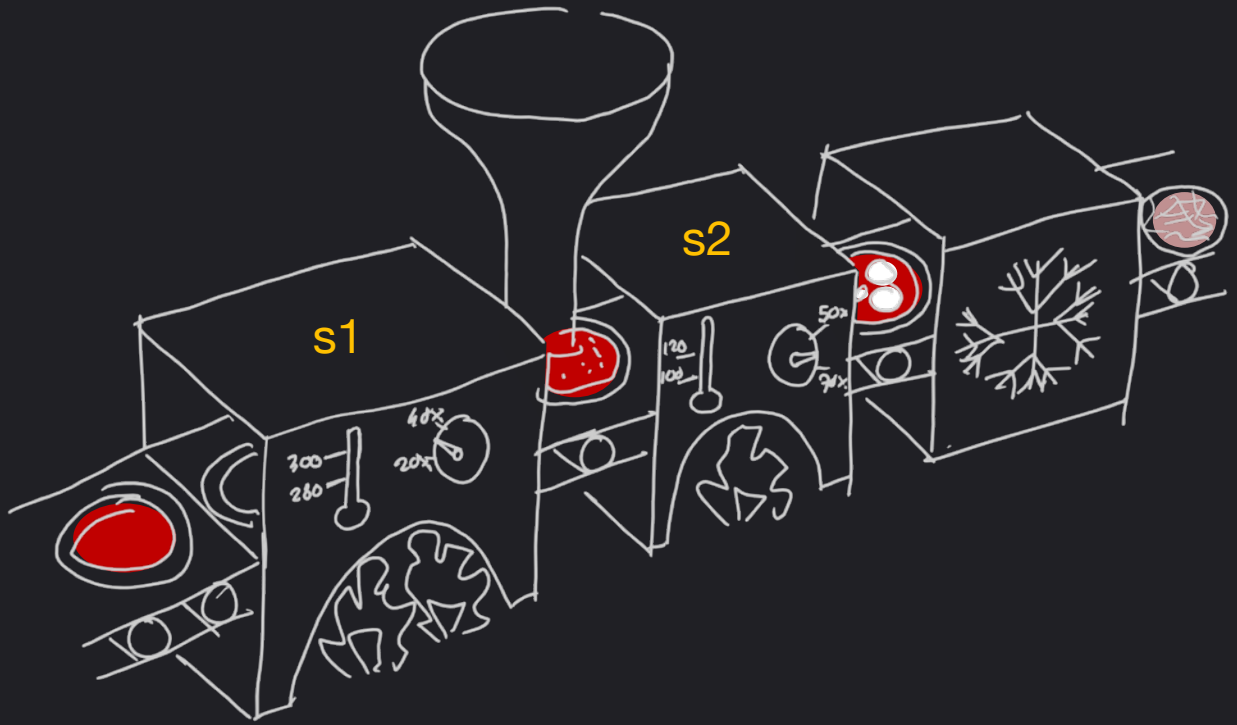
Let’s get dirty!

5

Continuous Linear Pizza Oven

Learning goals:

- Function
  - group()
  - Aggregates
  - Selectors



Task

- **Grouping + Aggregator** - Extract the average temperature and the average humidity along the different stages of the linear pizza oven
- **Selector** - Extract the last humidity observation from the cooking base area

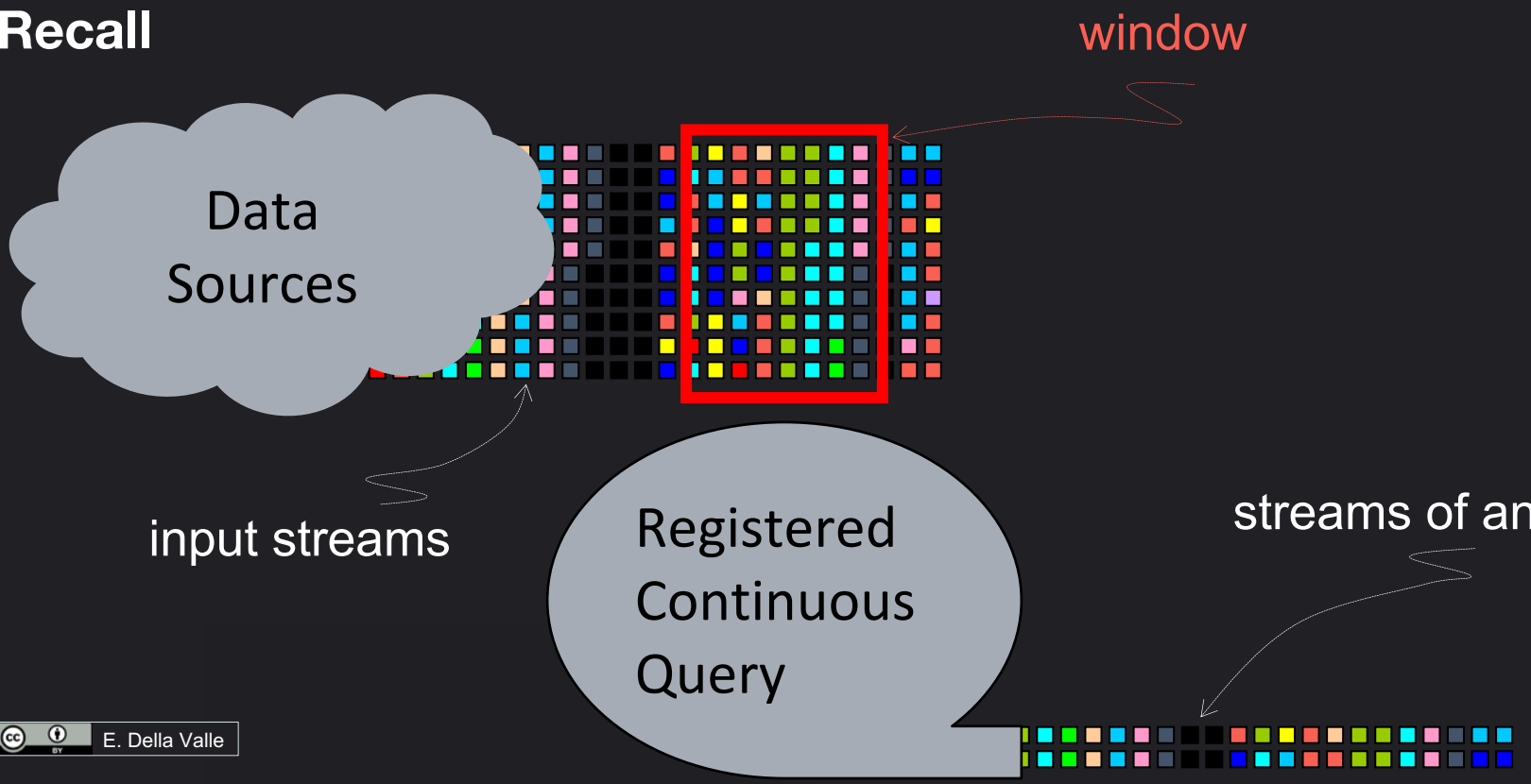
Take home message

- **Grouping** **shape** tables
- **Aggregators** (e.g. mean) **compress** each table **in a row**
- **Selectors** (e.g. last) select **specific row(s)** from each table

Exploring flux

Advanced Windowing

Recall



Windows

- Streams are infinite in nature
- Processing can end only if the input is finite
- A **window operator** selects a finite portion of a stream
- We have seen the time range operator
- Flux includes a window operator that builds table **tumbling** across the results of the time range operator
  - e.g. `aggregateWindow(every: 60m, fn: mean)`

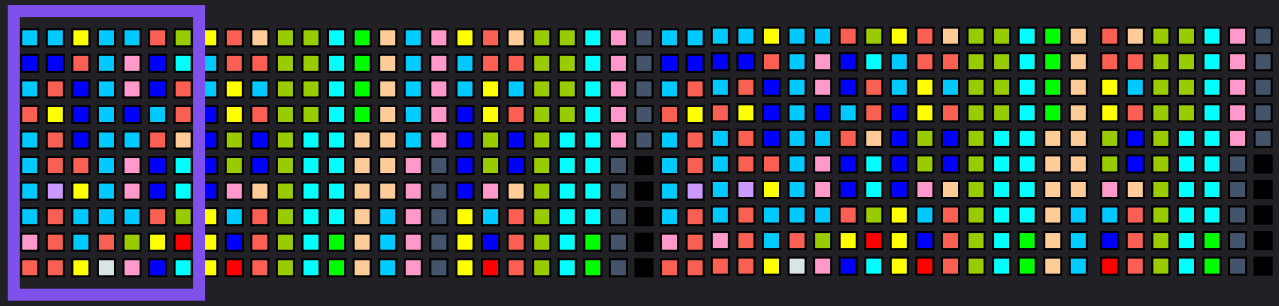
Example of tumbling window

- Anatomy of a Flux query:
  - data source
  - time range
  - data filters
  - shaping
  - processing

```
from(bucket:"telegraf/autogen")
  |> range(start:-1h)
  |> filter(fn: (r) =>
        r._measurement == "cpu" and
        r._field == "system" and
        r._value > 2000.0)
  |> aggregateWindow(every: 60m, fn: mean)
```

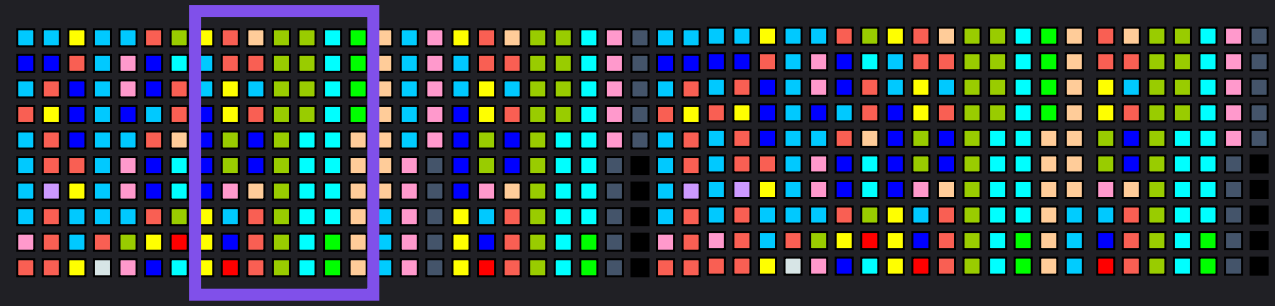
Tumbling?

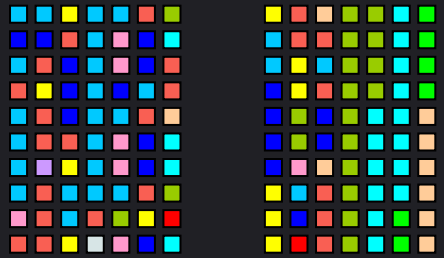
Tumbling windows



[1]

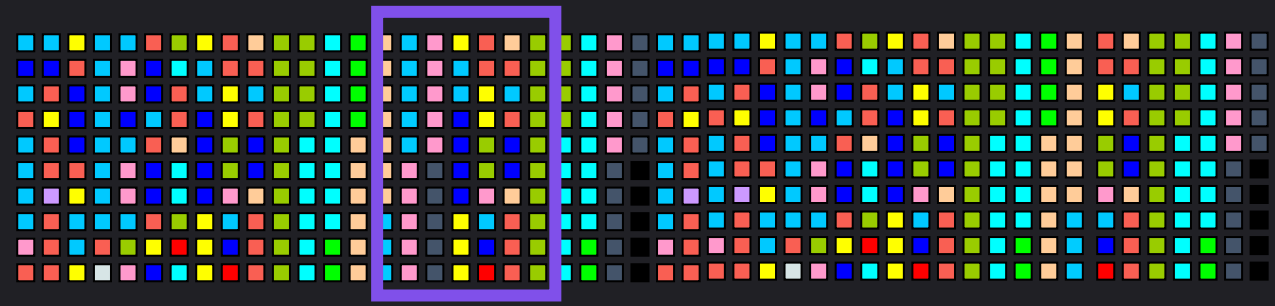
Tumbling windows





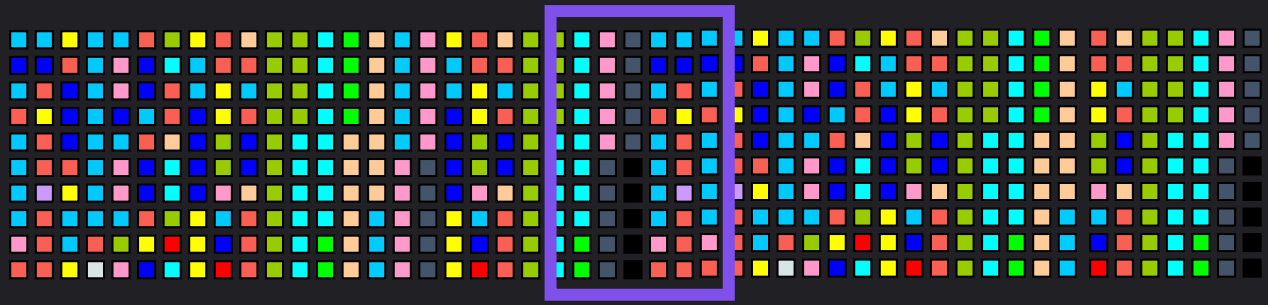
[1] **[2]**

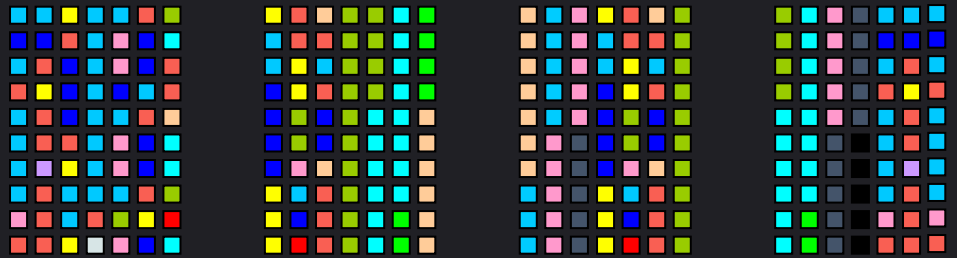
Tumbling windows



[1] [2] **[3]**

Tumbling windows





[1] [2] [3] **[4]**

NOTE: host column gets deleted

_time	_m	host	_field	_value
10:45	cpu	serverA	system	1000
11:00	cpu	serverB	system	2000
11:30	cpu	serverB	system	2000
11:45	cpu	serverA	system	3000
GroupKey[cpu, system]				

```
|> aggregateWindow(
     every: 60m,
     fn: mean)
```

_time	_m	_field	_value
11:00	cpu	system	1000
GroupKey[cpu, system]			

_time	_m	host	_field	_value
10:35	cpu	serverA	idle	100
11:15	cpu	serverB	idle	200
11:50	cpu	serverB	idle	400
GroupKey[cpu, idle]				

NOTE: The start time is not included, the stop time is

_time	_m	_field	_value
11:00	cpu	idle	100
GroupKey[cpu, idle]			

NOTE: host column gets deleted

_time	_m	host	_field	_value
10:45	cpu	serverA	system	1000
11:00	cpu	serverB	system	2000
11:30	cpu	serverB	system	2000
11:45	cpu	serverA	system	3000

GroupKey[cpu, system]

_time	_m	host	_field	_value
10:35	cpu	serverA	idle	100
11:15	cpu	serverB	idle	200
11:50	cpu	serverB	idle	400

GroupKey[cpu, idle]

```
|> aggregateWindow(
    every: 60m,
    fn: mean)
```

NOTE: The start time is not included, the stop time is

_time	_m	_field	_value
11:00	cpu	system	1000

GroupKey[cpu, system]

_time	_m	_field	_value
12:00	cpu	system	2333.3

GroupKey[cpu, system]

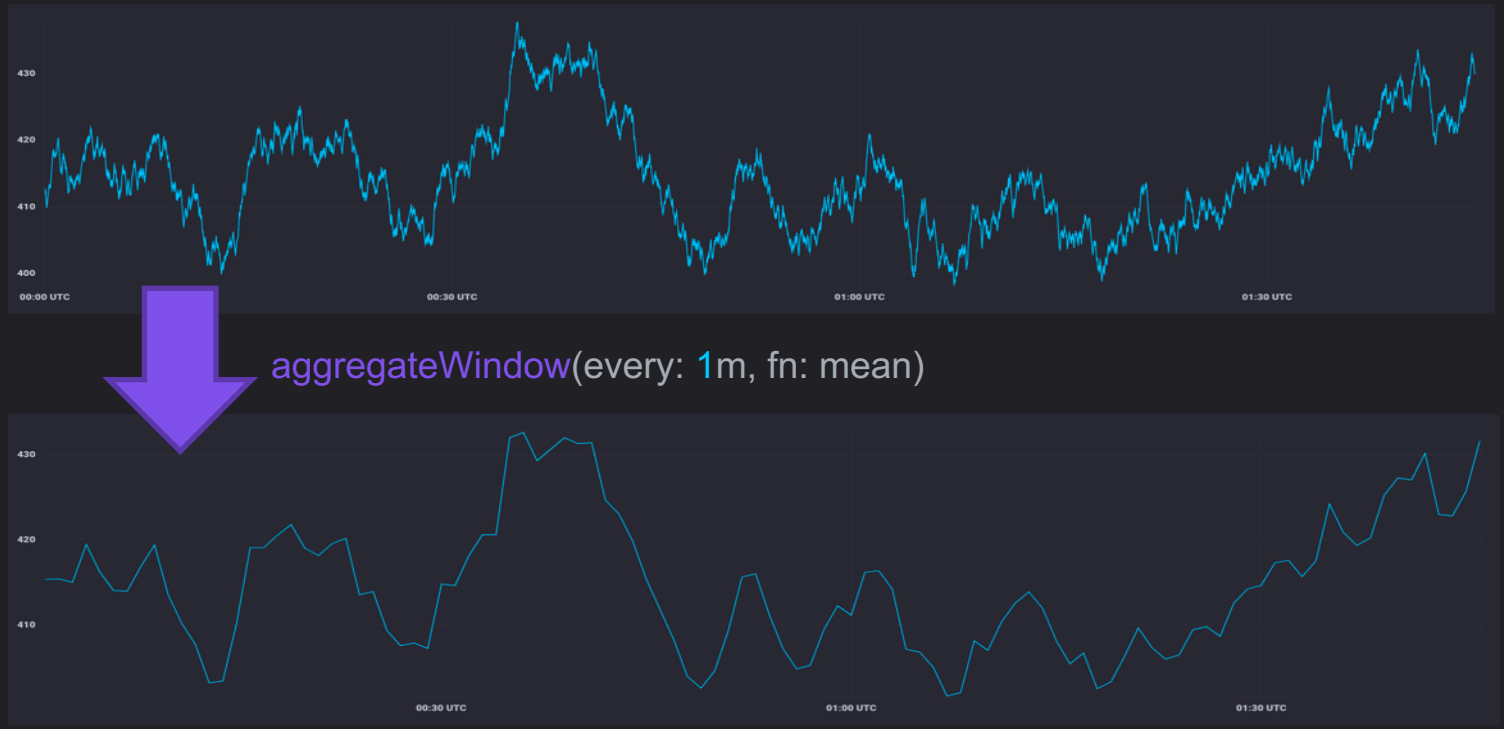
_time	_m	_field	_value
11:00	cpu	idle	100

GroupKey[cpu, idle]

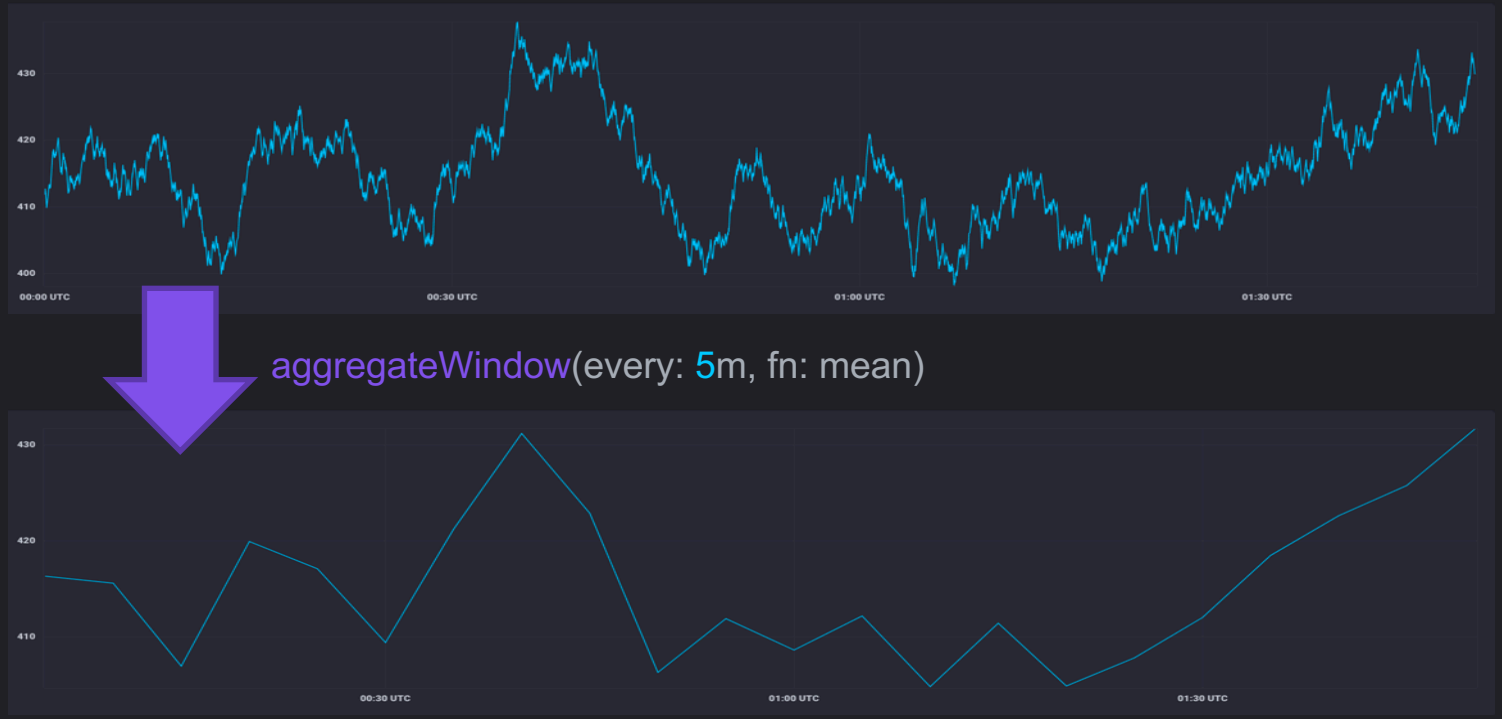
_time	_m	_field	_value
12:00	cpu	idle	300

GroupKey[cpu, idle]

Typical use case: downsampling data



Typical use case: downsampling data (cont.)



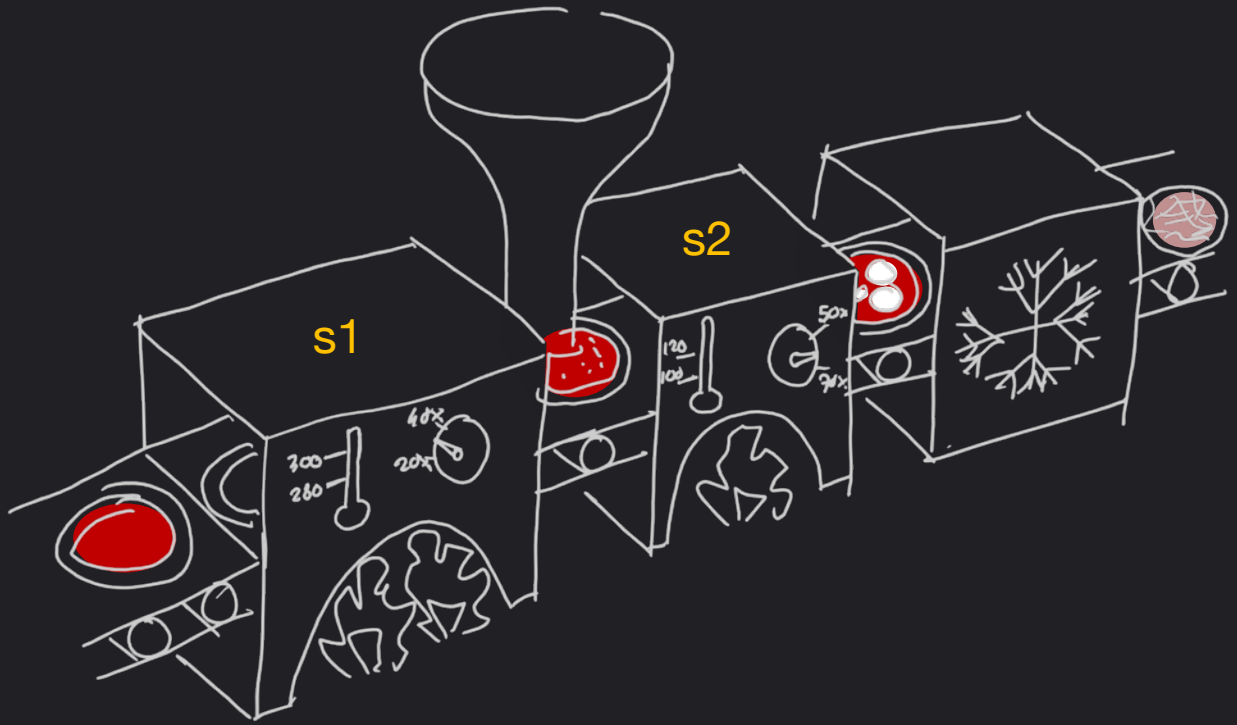
Let’s get dirty!

6

Continuous Linear Pizza Oven

Learning goals:

- aggregateWindow



Task

- Extract the moving average of the temperatures observed in the cooking base area over a window of 2 minutes
- Extract the moving average of the temperatures observed by S2 over a window of 3 minutes

Quiz

- True or false
  - you can omit the range clause – ?
  - filtering can change the number of tables in the result – ?
  - shaping always changes the number of tables in the result – ?
  - processing can change the number of tables in the result – ?
  - aggregateWindow function is just a process step – ?
  - aggregateWindow function eases the downsampling task – ?
  - the parameter createEmpty of the aggregateWindow function can change the number of tables in the result – ?

Quiz answer

- True or false
  - you can omit the range clause – F
  - filtering can change the number of tables in the result – T (empty tables)
  - shaping always changes the number of tables in the result – F
  - processing can change the number of tables in the result – F
  - aggregateWindow function is just a process step – F
  - aggregateWindow function eases the downsampling task – T
  - the parameter createEmpty of the aggregateWindow function can change the number of tables in the result – T

Basic Data Analysis

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