



Rediscover the known universe with NASA dataset

HelloExoWorld
@helloExoWorld

Pierre Zemb



Edit profile

Pierre Zemb

@PierreZ

I write code for [@OVHMetrics](#). Giving a hand to [@FinistDevs](#), [@SW_Brest](#) and [@Devovx4KidsBES](#). Teaching assistant [@isenbrest](#). Founder of [@helloexoworld](#)

📍 48.390394, -4.486076 🔗 pierrezemb.fr

Aurélien Hébert



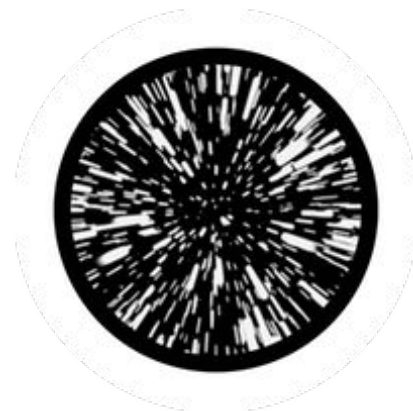
@AurrelH95

Local member as INSA
Rennes engineer graduated,
developer.

*Giving also an hand to @SW_Brest
and @Devovx4KidsBES*



INSA

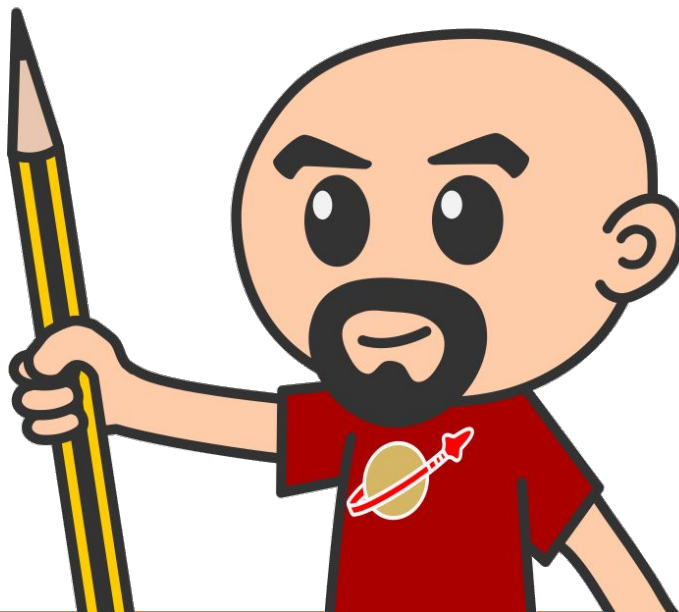


Horacio Gonzalez



@LostInBrittany

Spaniard lost in Brittany, developer,
dreamer and all-around geek



Schedule



- What are time-series?
- What are Warp10 and OVH Metrics?
- What is an exoplanet?
- How can I found an exoplanet?

The result





Time Series

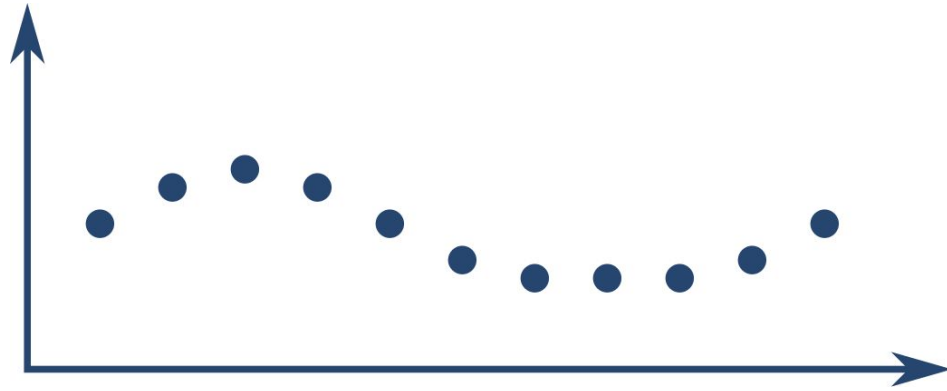
What are they?

Time Series



Definition of Time Series:

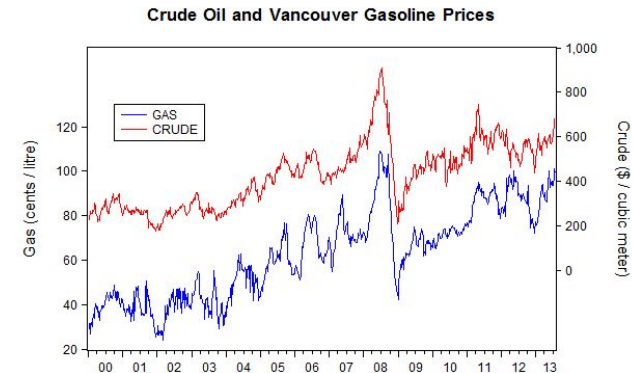
An ordered sequence of values of a variable at equally spaced (or not) time intervals.



Time Series



- Stock Market Analysis
- Economic Forecasting
- Budgetary Analysis
- Process and Quality Control
- Workload Projections
- Census Analysis
- ...

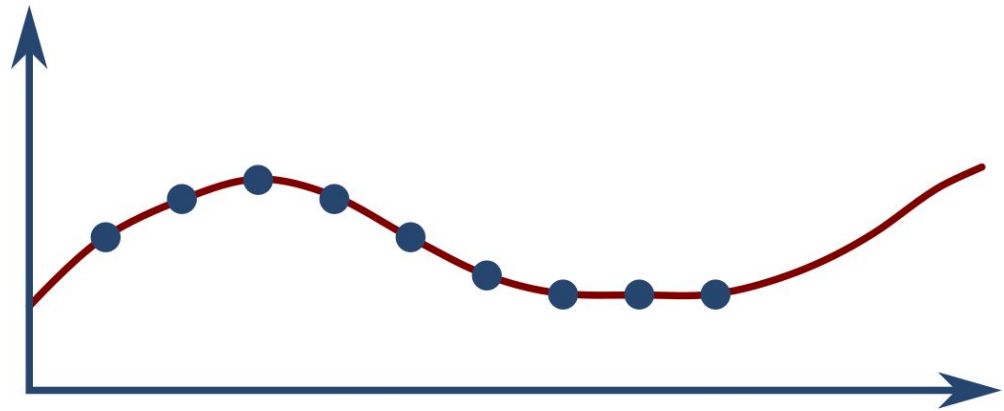


Time Series



Applications:

- Understanding the data
- Fit a model
 - Monitoring
 - Forecasting



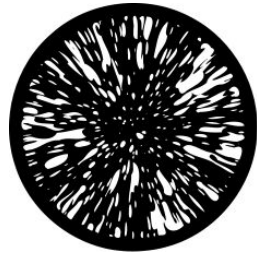
Time Series Databases



Many options



Time Series Databases



WARP 10



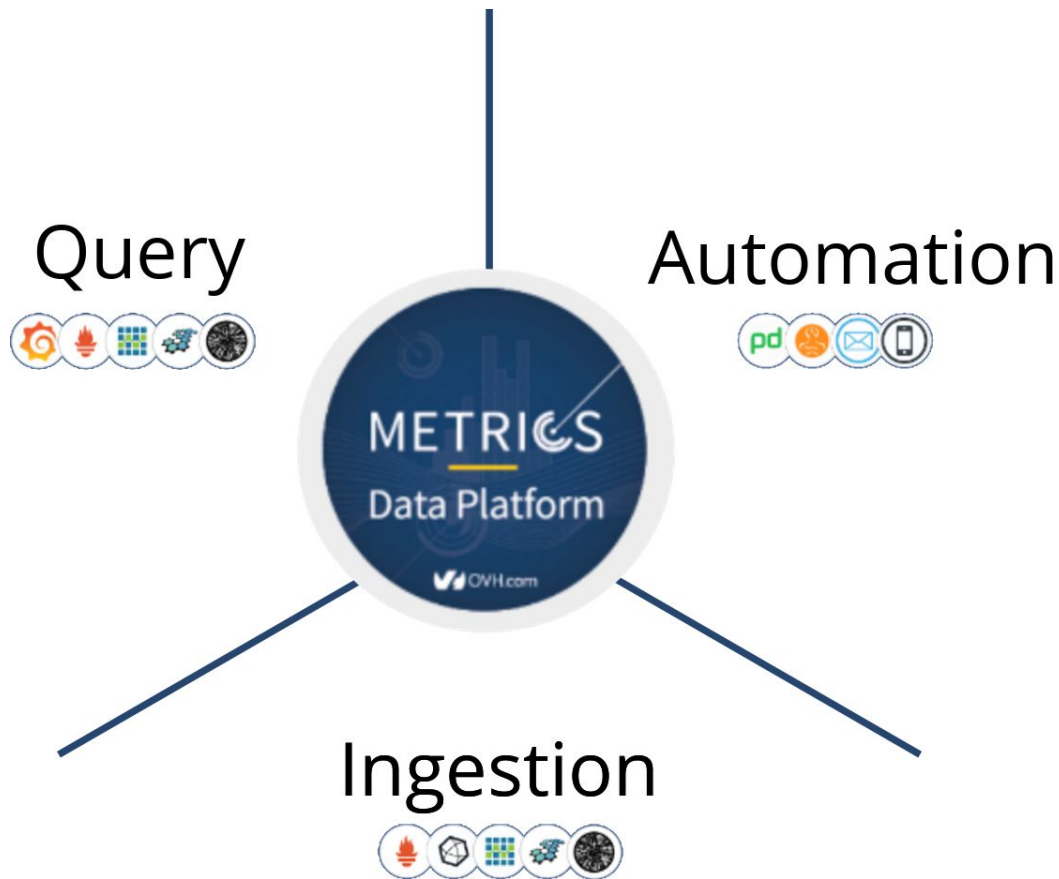
OVH Metrics

What is it?

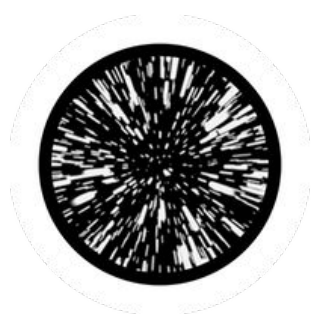


Managed Cloud Platform for Time Series

Metrics Data Platform



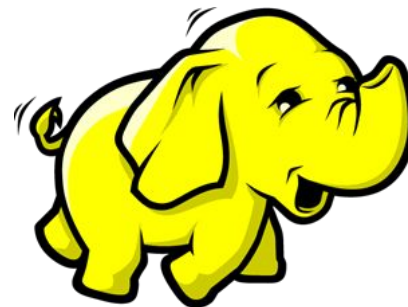
Metrics Data Platform



+



+







Some Metrics's metrics:

- 1.5M datapoints/s, 24h/7
- Peaks at ~10M datapoints/s
- 500M unique series
- Deleted (varying) up to 8M datapoints/s
- 2 Trillion deletes capacity per week



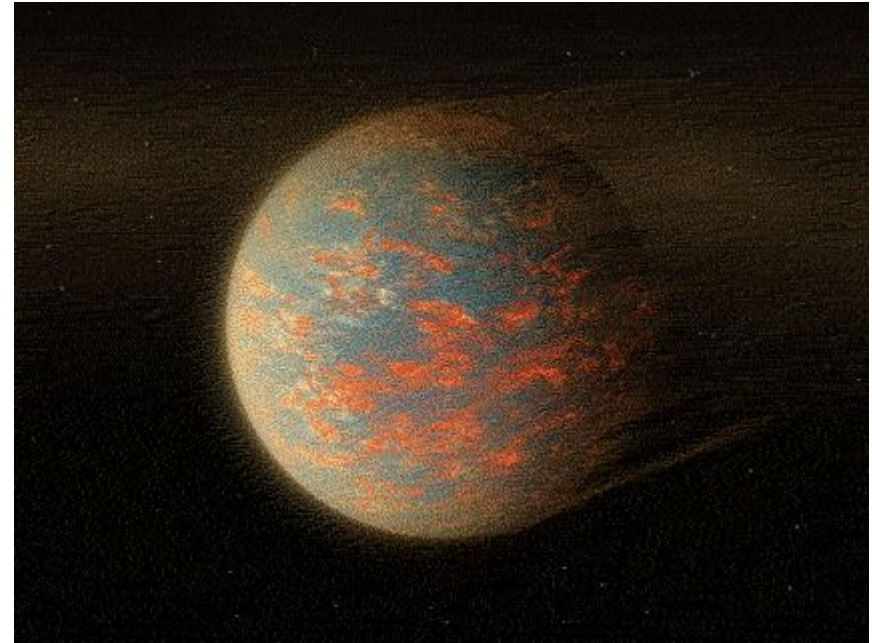
Exoplanets

What are they?

Exoplanet?



An exoplanet is a planet **outside** our solar system that orbits a star.



How many?



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PLANETQUEST

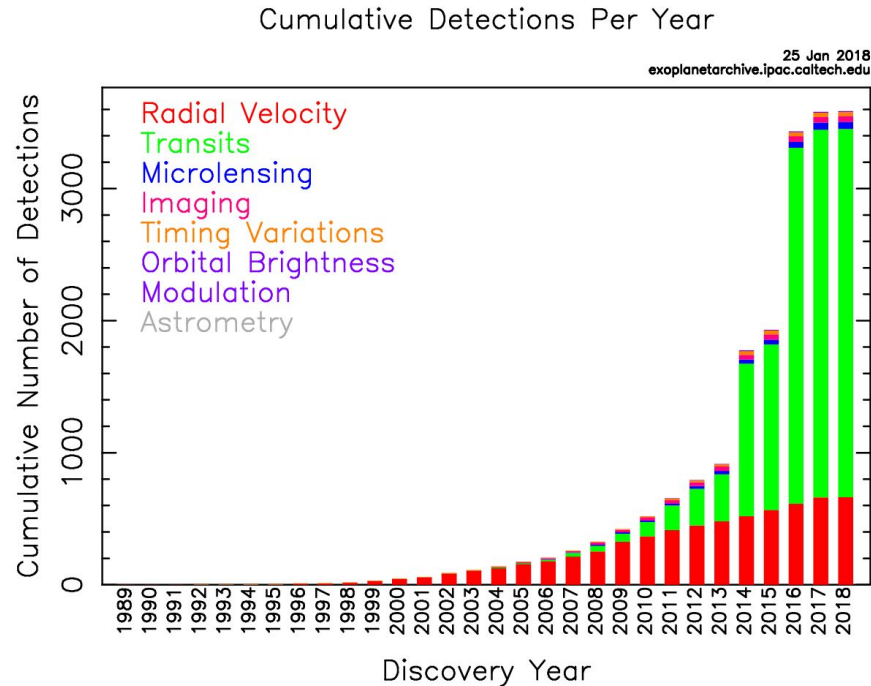
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3,708 Confirmed Planets 03/26/2018 →	612 Multi-Planet Systems 03/26/2018 →	4,496 Kepler Candidates 08/31/2017 →	View more Planet and Candidate statistics →
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<https://exoplanetarchive.ipac.caltech.edu/index.html>

Detection method



<https://exoplanetarchive.ipac.caltech.edu/exoplanetplots/>

Transit



Credits: NASA's Goddard Space Flight Center

Example



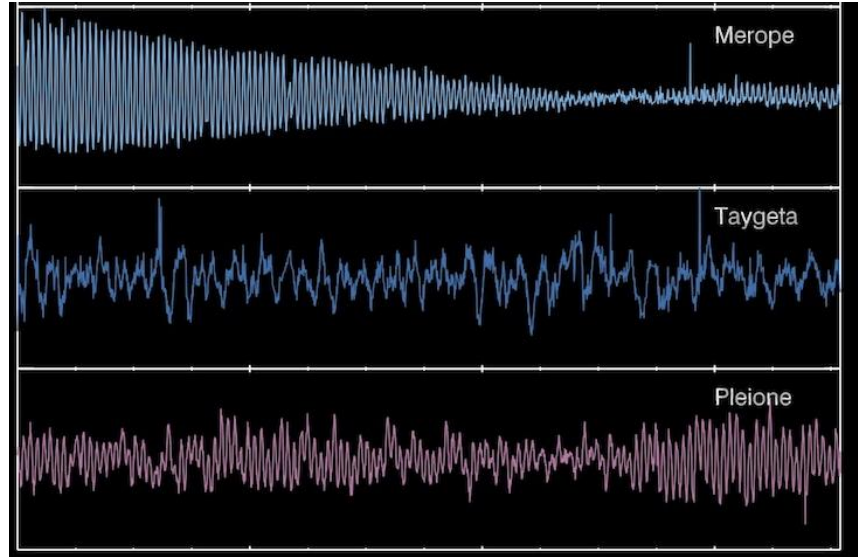
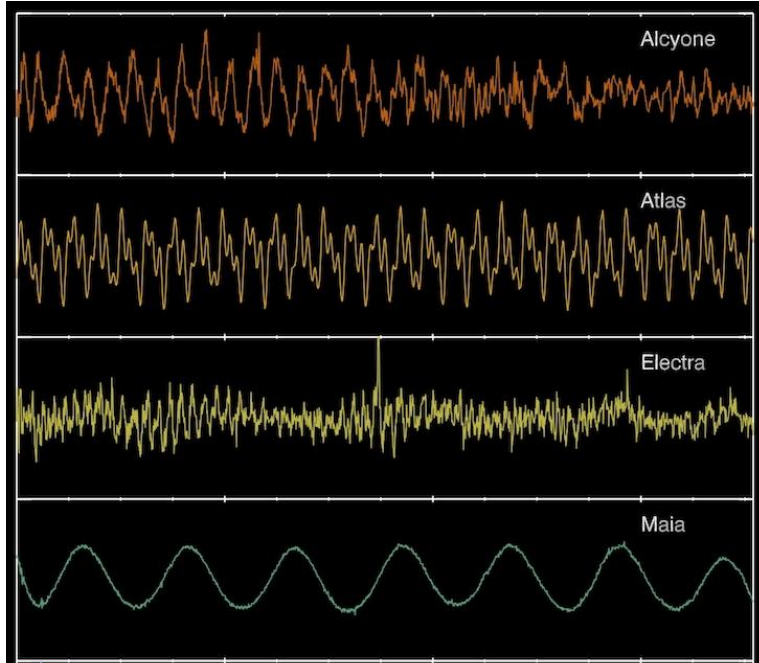
Pleiades By NASA, ESA, AURA/Caltech, Palomar Observatory. Via Wikimedia Commons

Example

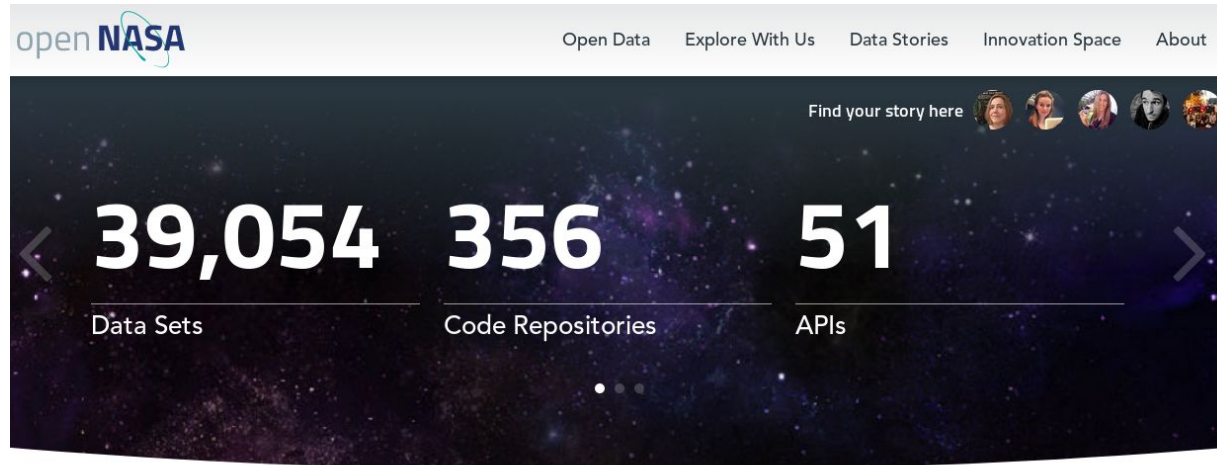


Pleiades By NASA, ESA, AURA/Caltech, Palomar Observatory. Via Wikimedia Commons

Not that easy



Credit: Aarhus University / T. White



What describes you best?



Citizen Scientist



Developer



Citizen Activist



Govvie



Curious

Kepler satellite

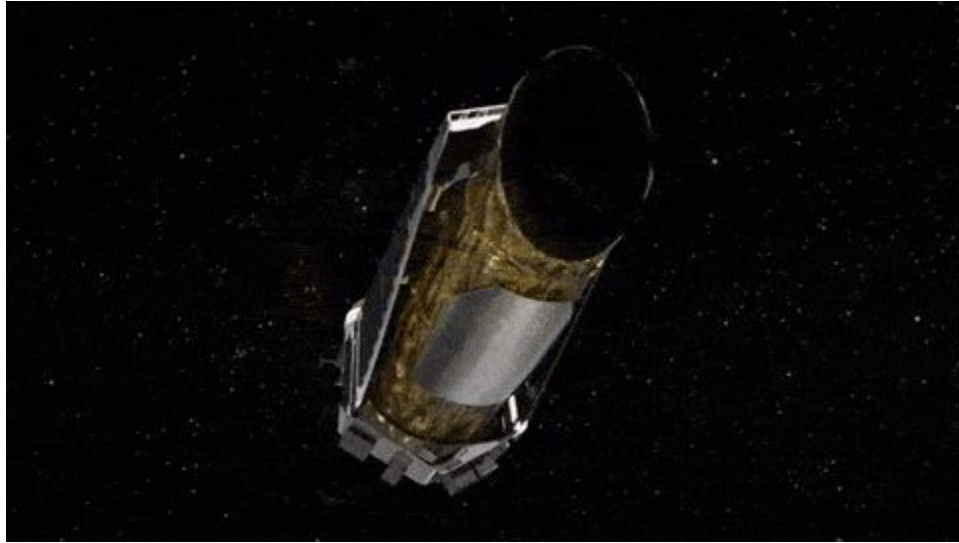
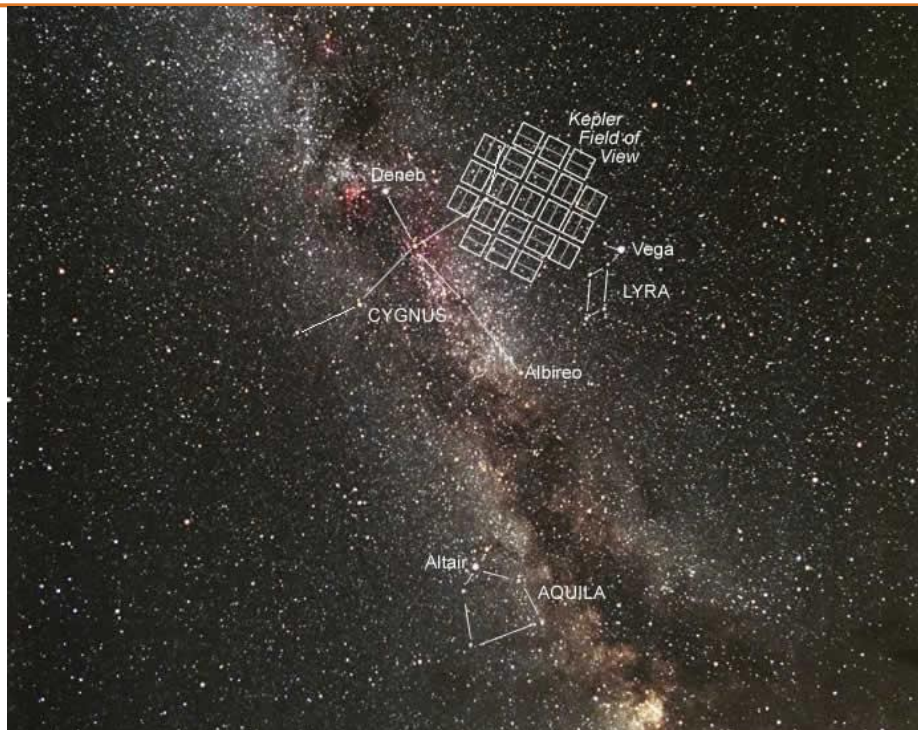


Image credit: NASA

Kepler satellite



By Carter Roberts [Public domain], via Wikimedia Commons

#BigData



Ben Montet

@benmontet

Following



The full [@NASAKepler](#) dataset (Kepler + K2) is ~25 TB in size. For comparison, the entire archive of the [@librarycongress](#) is 15 TB.

7:54 PM - 3 Mar 2017

7 Retweets 15 Likes



3



7



15



40,726,580 Light Curves

What we have done



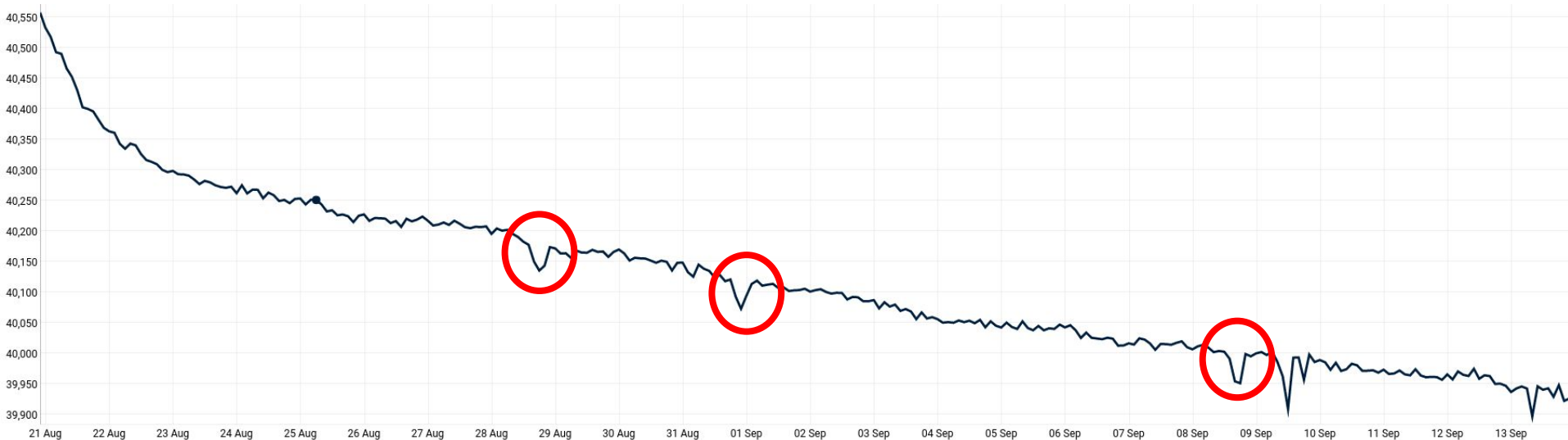
What we have done:

- Downloaded and parsed 40M of FITS files
- Pushed it to a Warp10 instance
- Select a cool subset for you

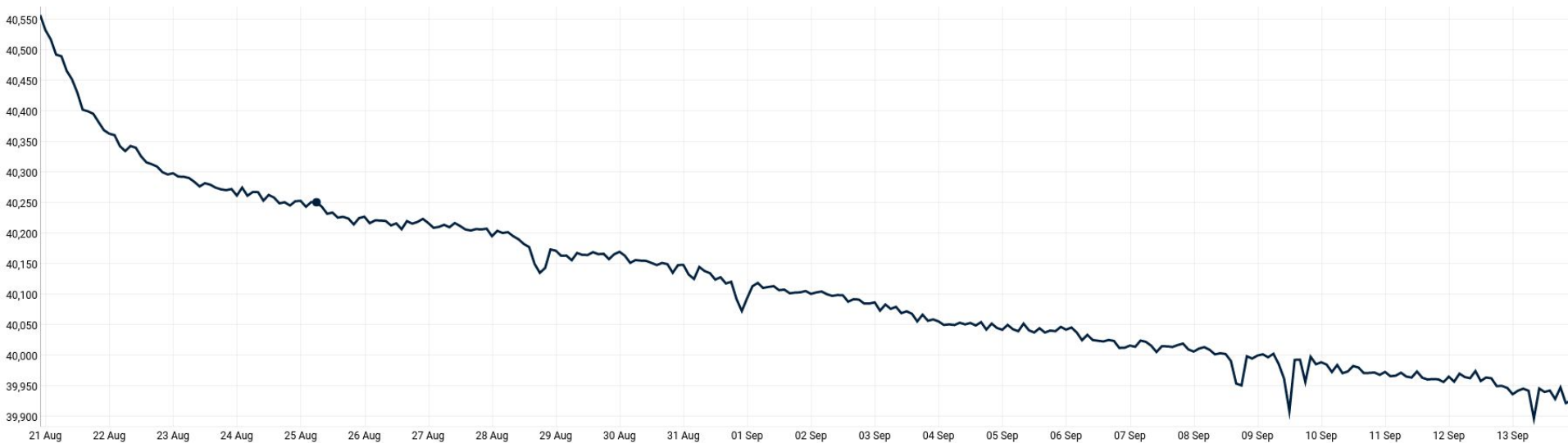
What you have to do:

- Find some exoplanets!

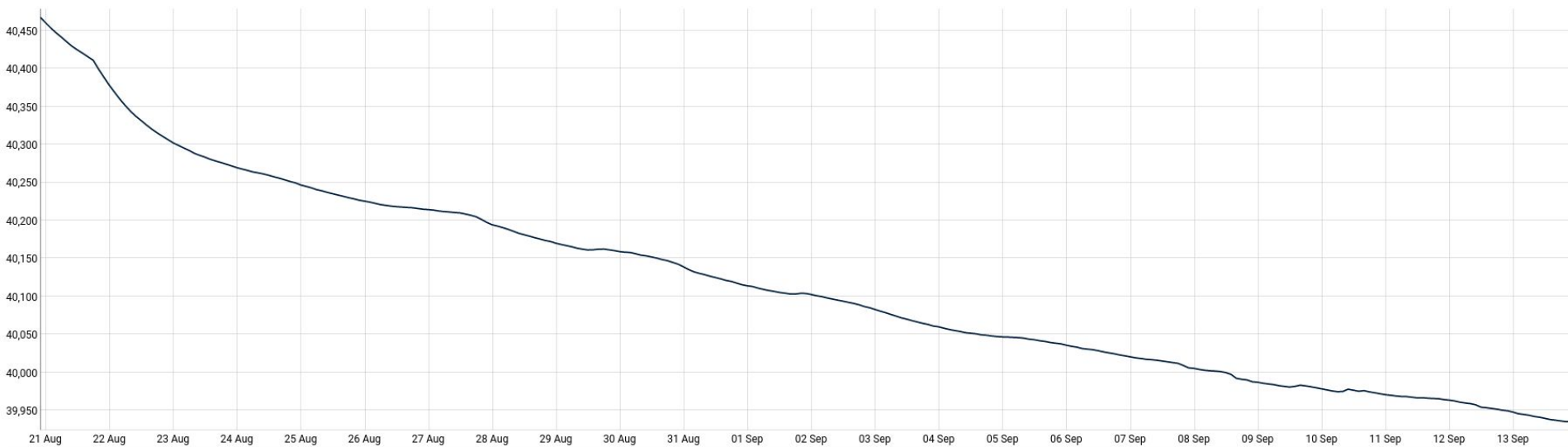
Goal: subtract GTSs



Actual



Trend



Actual - trend



Let's get started!



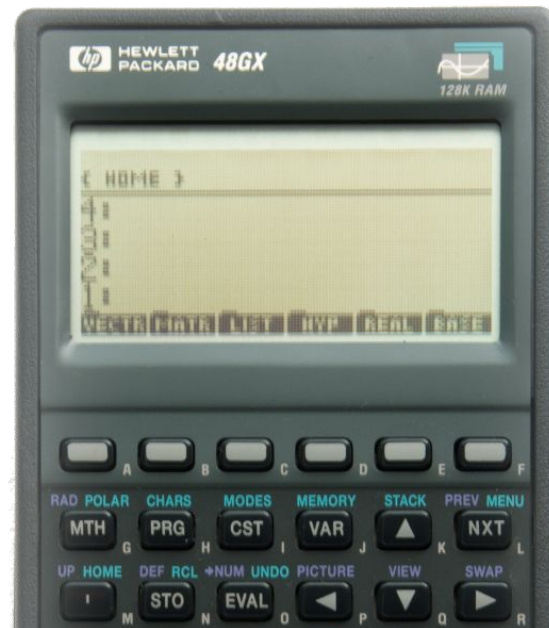
1. Connect to WIFI HELLOEXOWORLD-5G
2. Password is helloexoworld
3. Click on cancel on user password window
4. Open chrome/chromium on
 - a. 192.168.1.{2,4,5,6}
5. Click on README.md
6. Enjoy!

WarpScript



Reverse Polish Notation

Input	2	3	add	11	mul	1	add
Stack		3		11		1	
	2	2	5	5	55	55	56



Variables



'hello, world!'

'exo' STORE

\$exo

// Push Hello World String on the Stack

// Store it in a variable called exo

// Then push back exo variable on the stack

What are the available series?



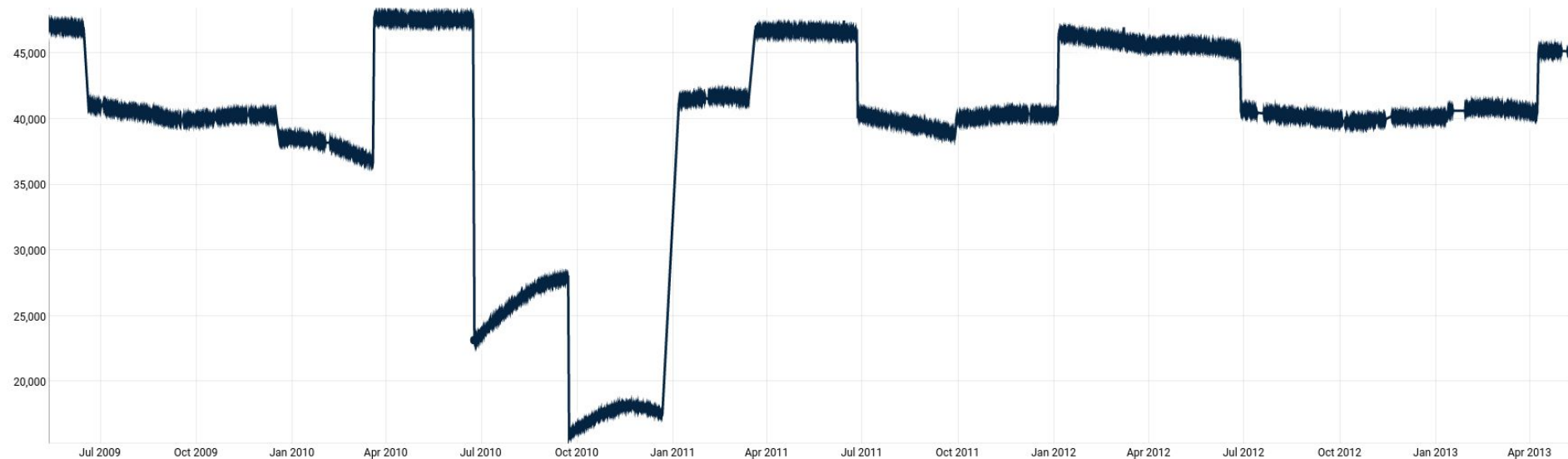
```
[
    $readToken           // Application authentication
    '~.*'                // selector for classname
    {}                   // Selector for labels
]
FIND
```

Get raw data



```
[
  $readToken // Application authentication
  'sap.flux' // selector for classname
  { 'KEPLERID' '6541920' } // Selector for labels
  '2009-05-02T00:56:10.000000Z' // Start date
  '2013-05-11T12:02:06.000000Z' // End date
]
FETCH
```

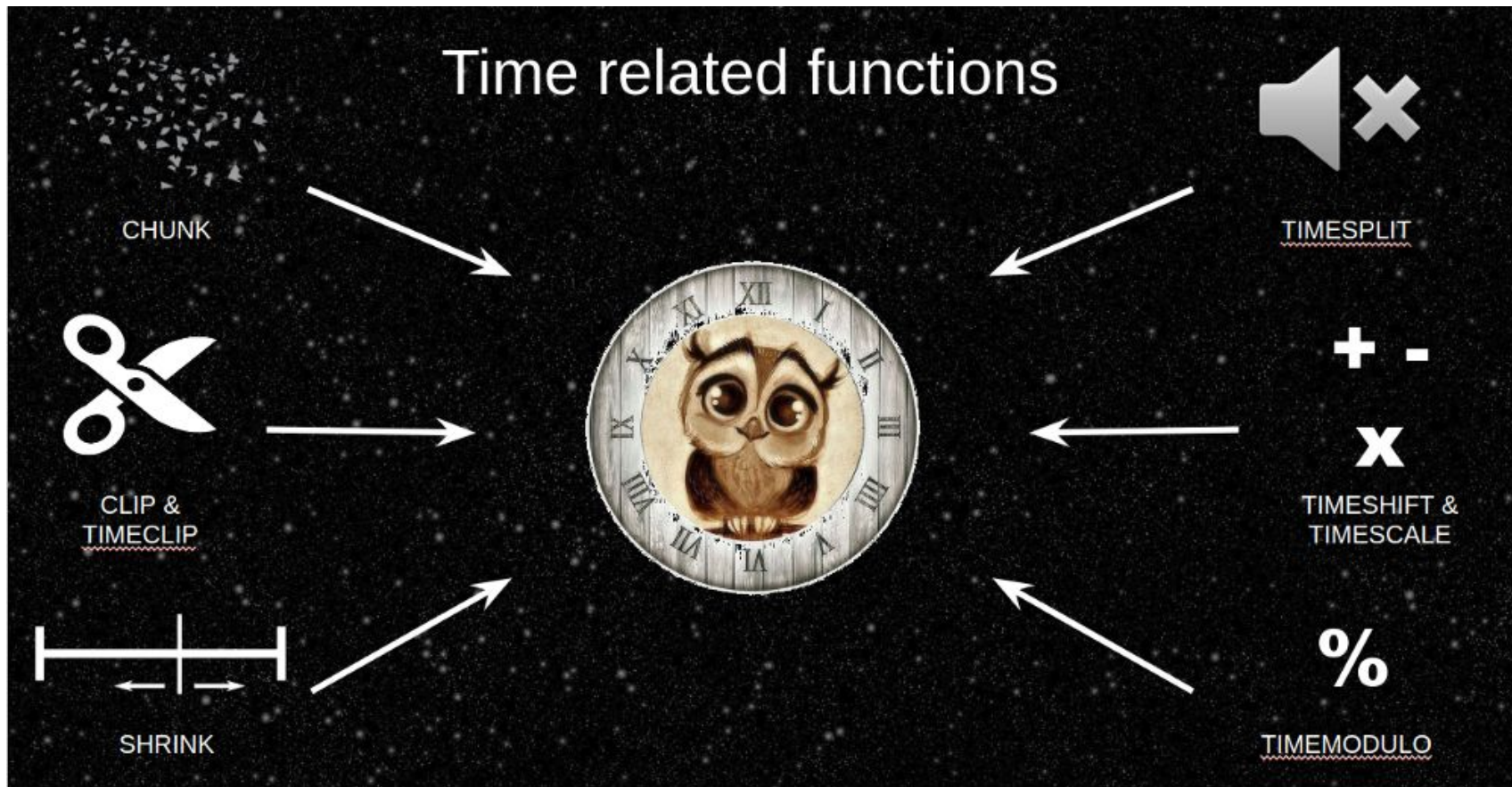

Kepler-11: Raw data



Time manipulation



Time related functions



How to split a Time series



\$gts

6 h

100

'record'

TIMESPLIT

// Singleton (or list of) GTS

// Minimum of time without data-points

// Minimum of data-points required

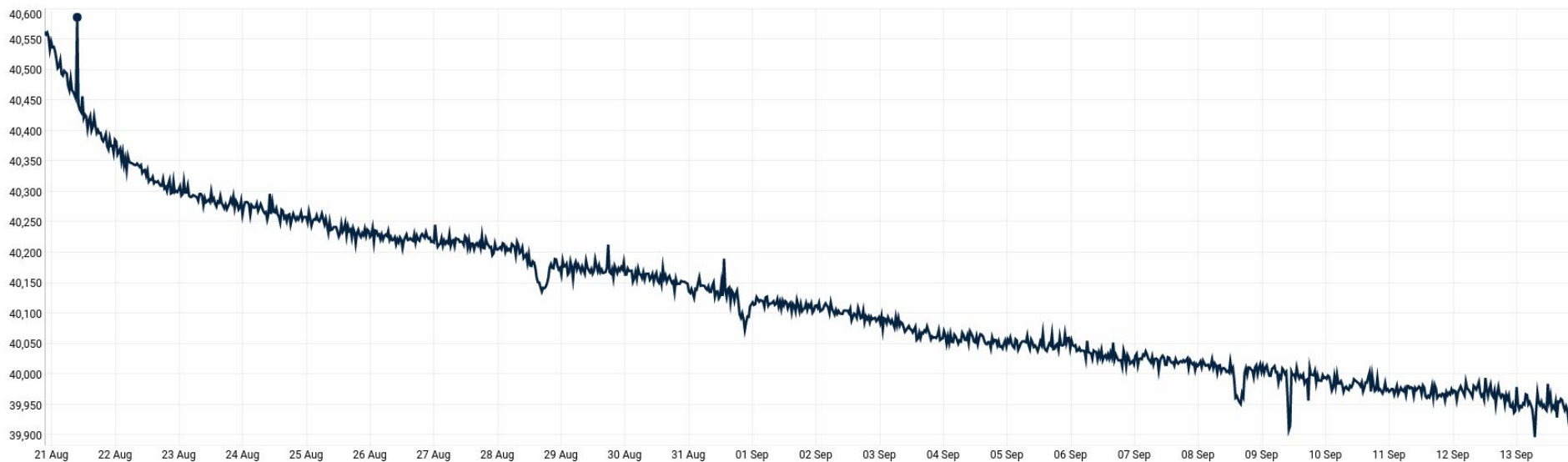
// New labels to subdivide the result

FILTERING

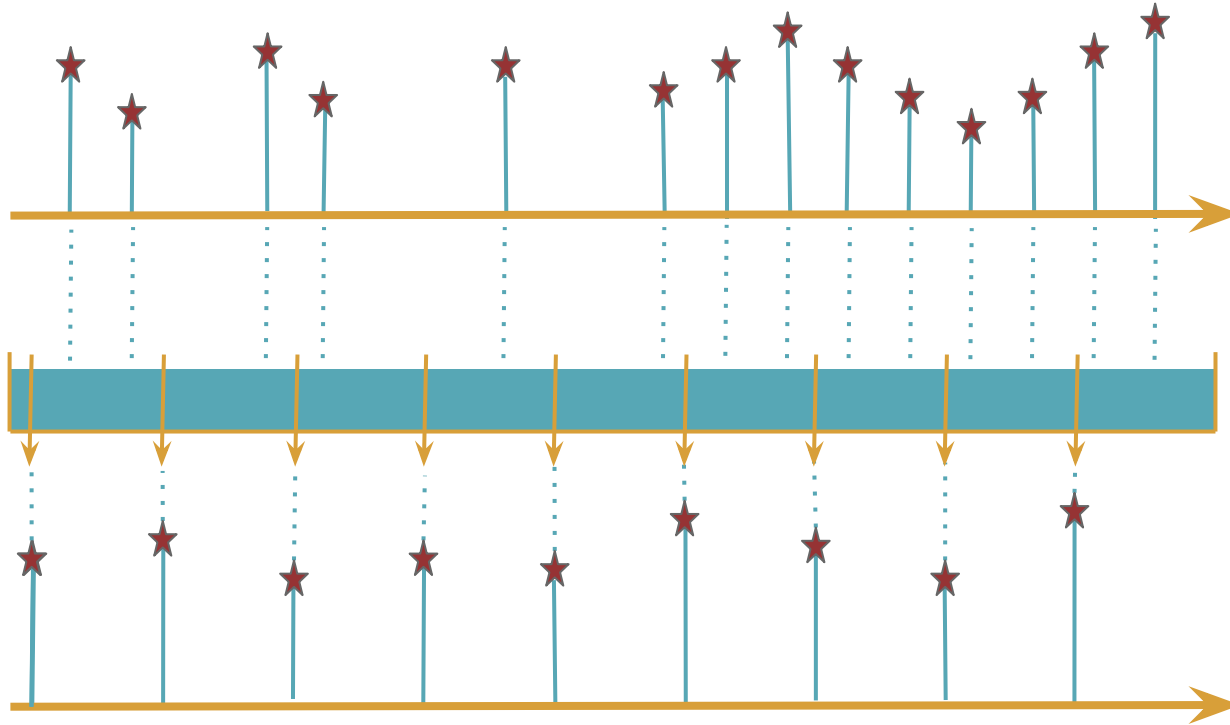


```
[  
    $gts                // Singleton (or list of) GTS  
    []                  // Equivalence classes  
    { 'record' '5' }    // Labels to select  
    filter.bylabels     // Type of filter  
]  
FILTER
```

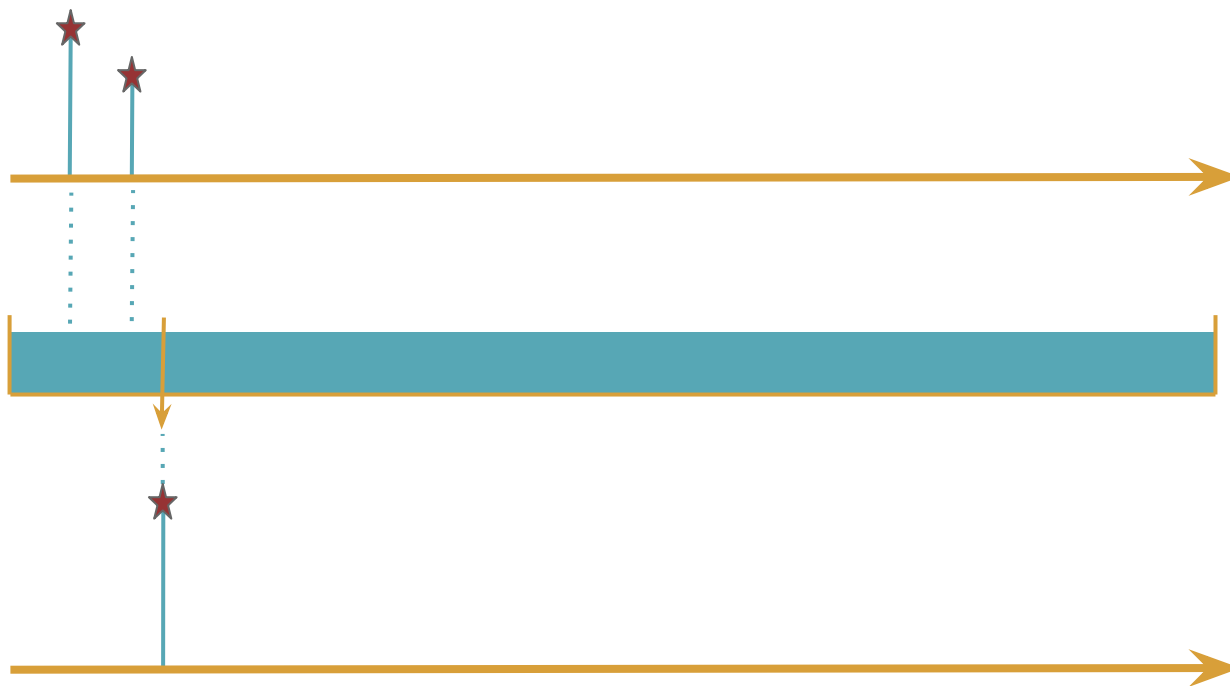
Reference record: 5



Downsampling



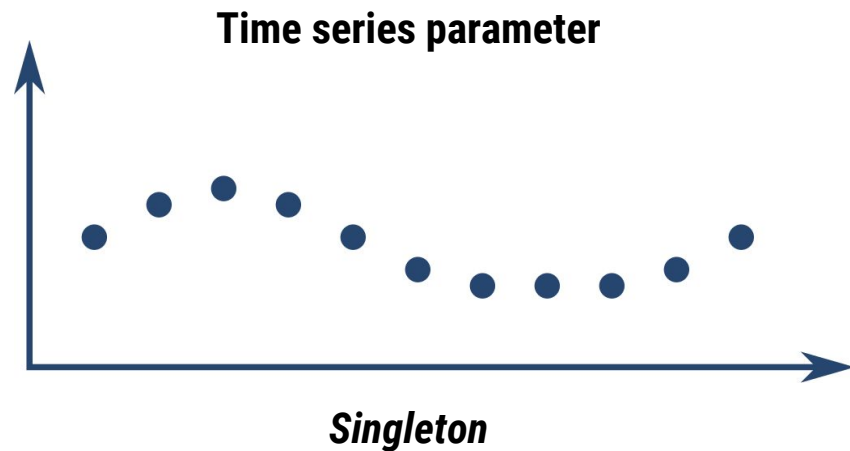
Bucketize



Syntax



```
[  
  $gts  
  bucketizer.min  
  0  
  2 h  
  0  
]  
BUCKETIZE
```

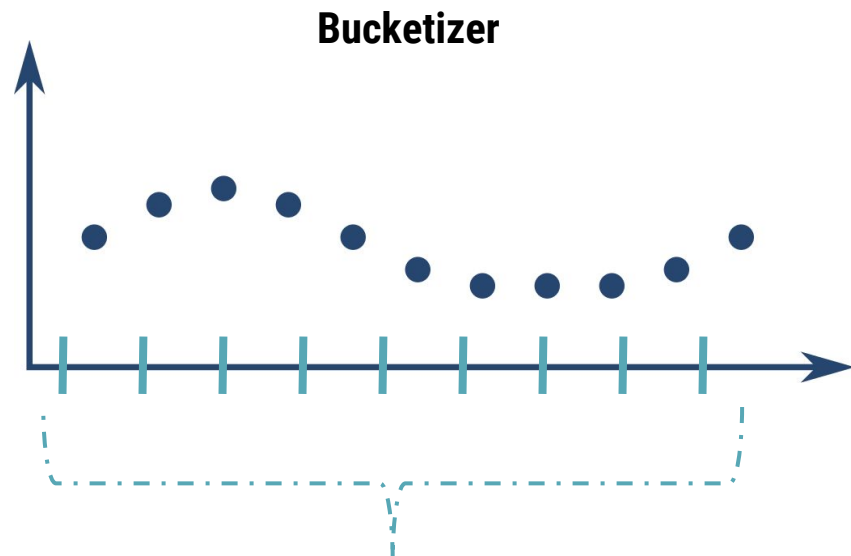


Syntax



```
[  
  $gts  
  bucketizer.min  
  0  
  2 h  
  0  
]
```

BUCKETIZE

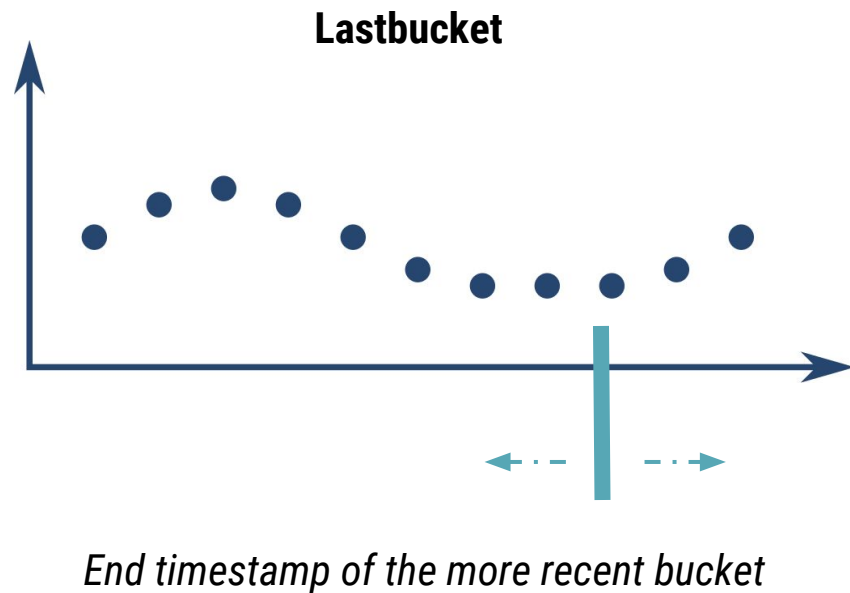


*Type of operator to apply on each **bucket**
last, max, mean, and, count ...*

Syntax



```
[  
  $gts  
  bucketizer.min  
  0  
  2 h  
  0  
]  
BUCKETIZE
```

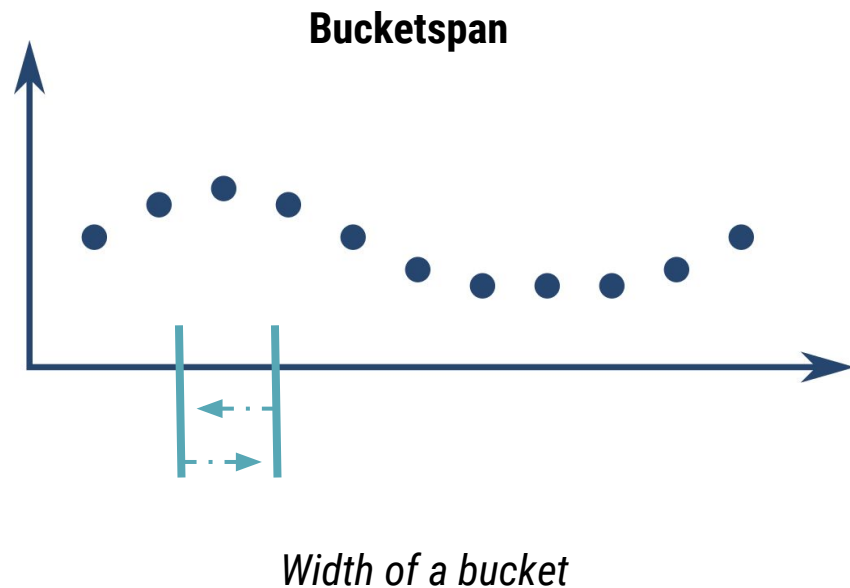


Syntax



```
[  
  $gts  
  bucketizer.min  
  0  
  2 h  
  0  
]
```

BUCKETIZE

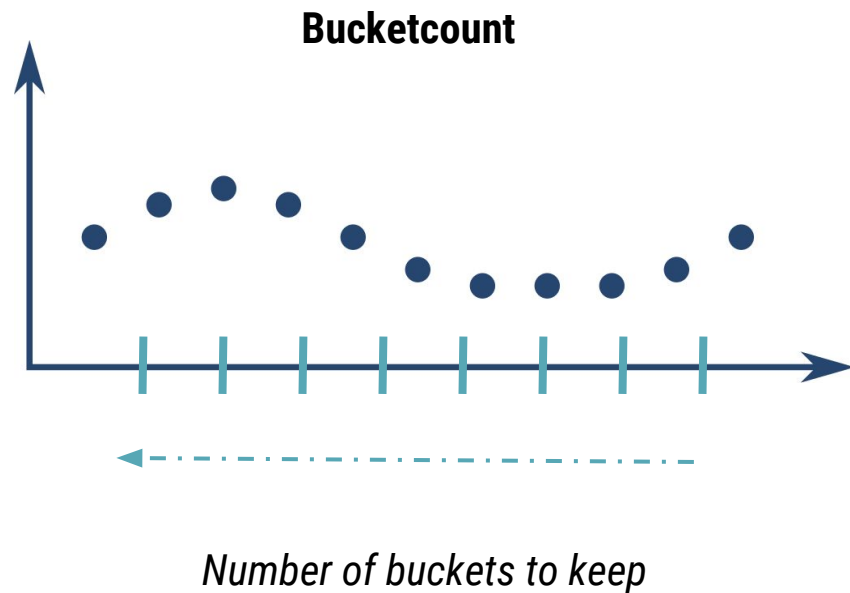


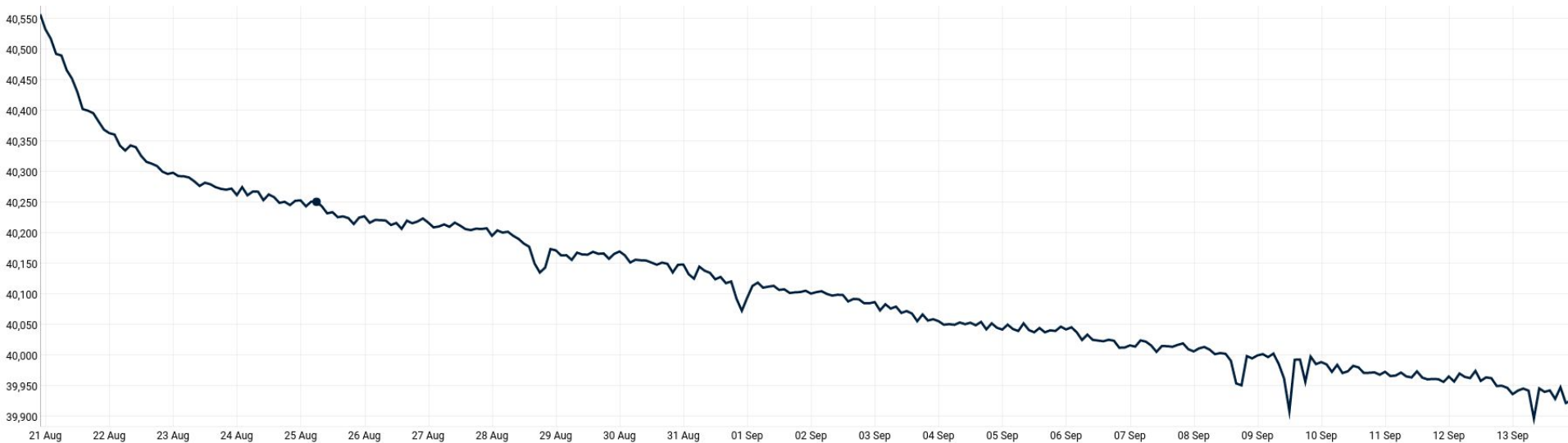
Syntax



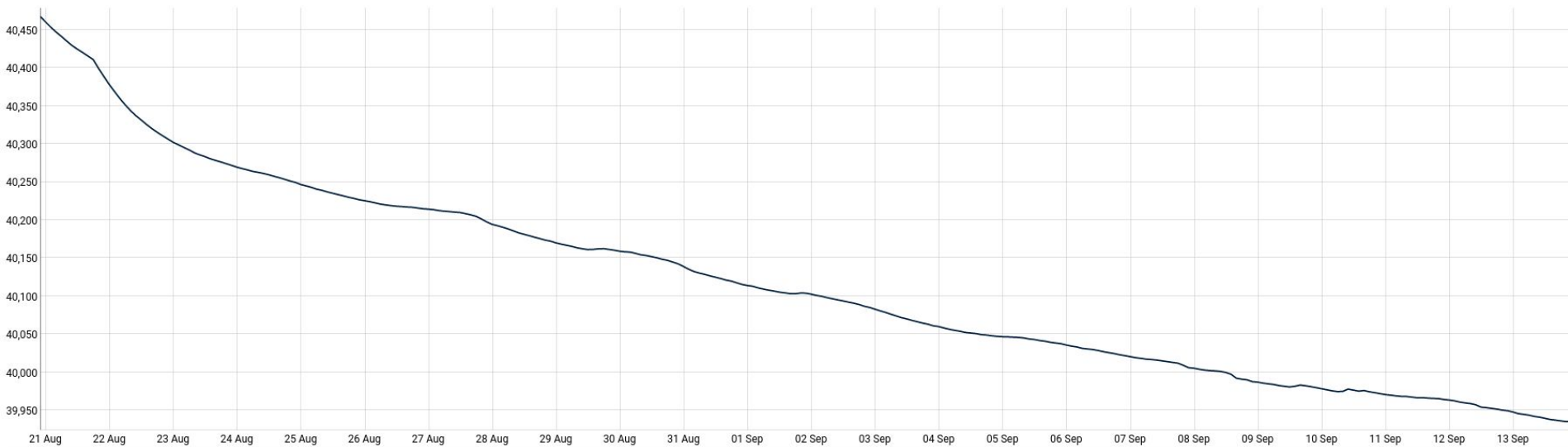
```
[  
  $gts  
  bucketizer.min  
  0  
  2 h  
  0  
]
```

BUCKETIZE

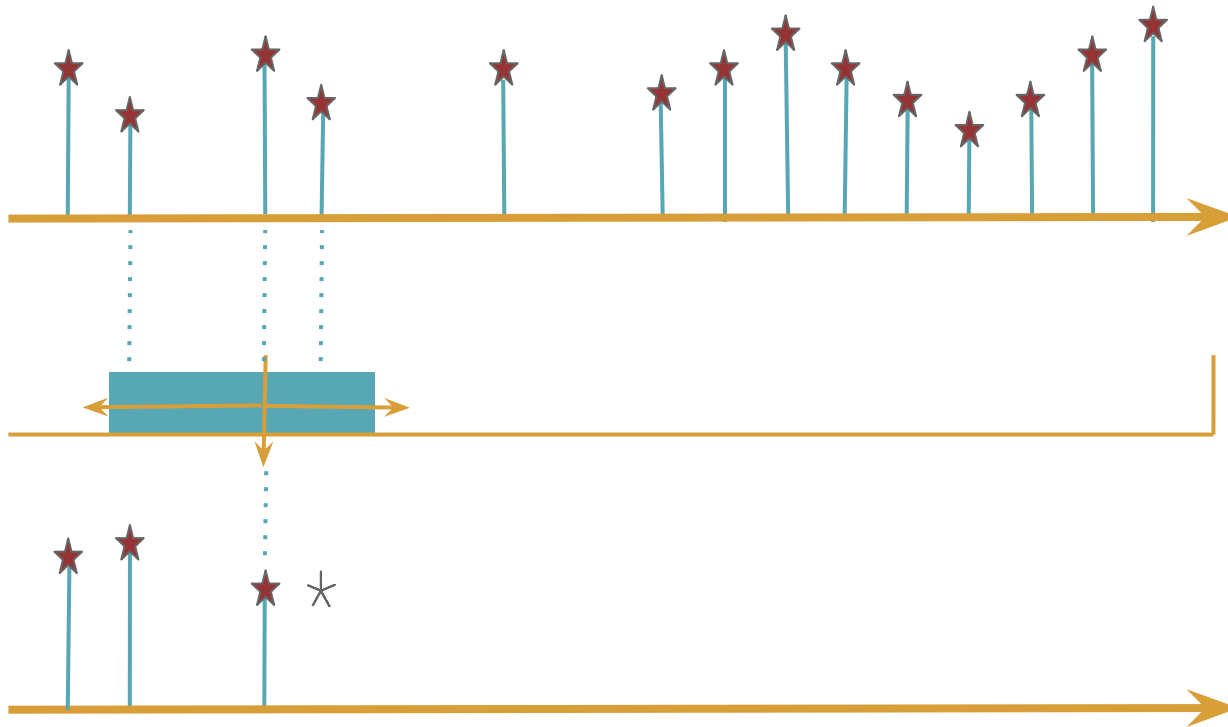




Trend



Mapper



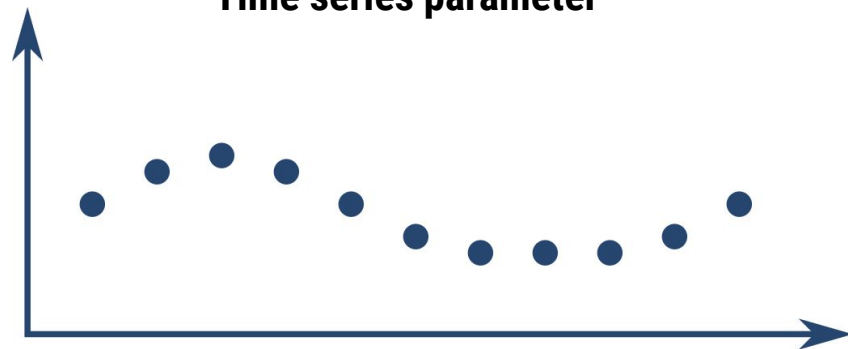
Syntax



```
[  
  $gts  
  mapper.mean  
  2  
  2  
  0  
]  
MAP
```



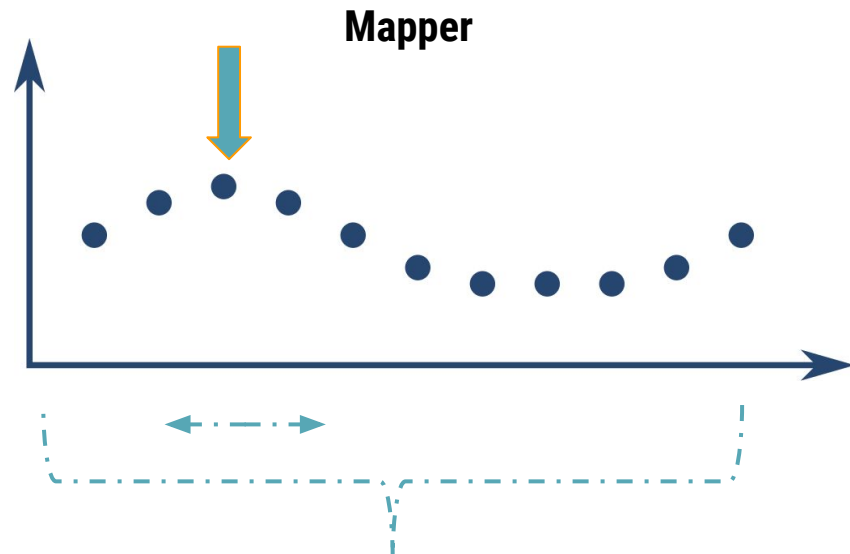
Time series parameter



Syntax



```
[  
  $gts  
  mapper.mean  
  2  
  2  
  0  
]  
MAP
```

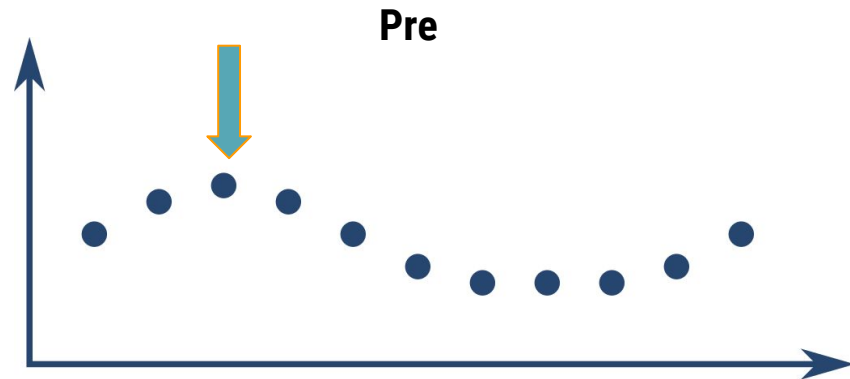


Type of operator to apply on each *window*
add, gt, rate, and, count...

Syntax



```
[  
  $gts  
  mapper.mean  
  2  
  2  
  0  
]  
MAP
```



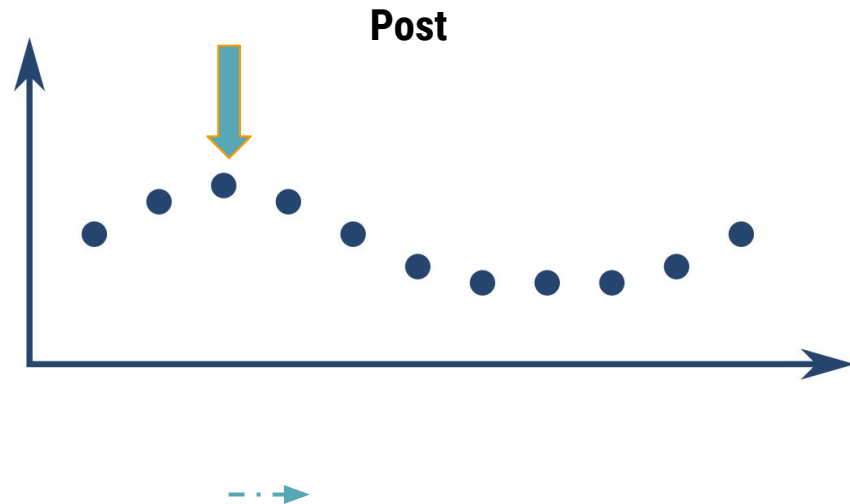
← ...

Number of data-points before

Syntax



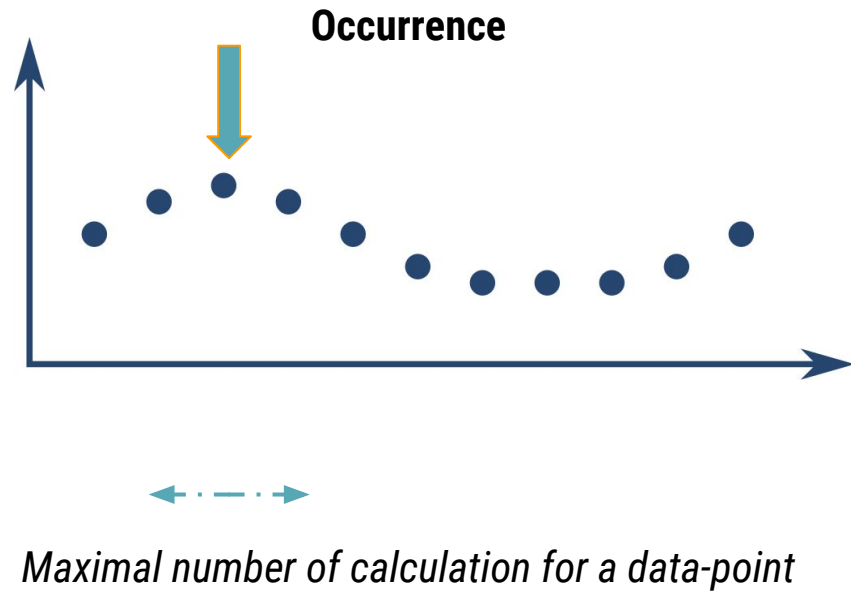
```
[  
  $gts  
  mapper.mean  
  2  
  2  
  0  
]  
MAP
```



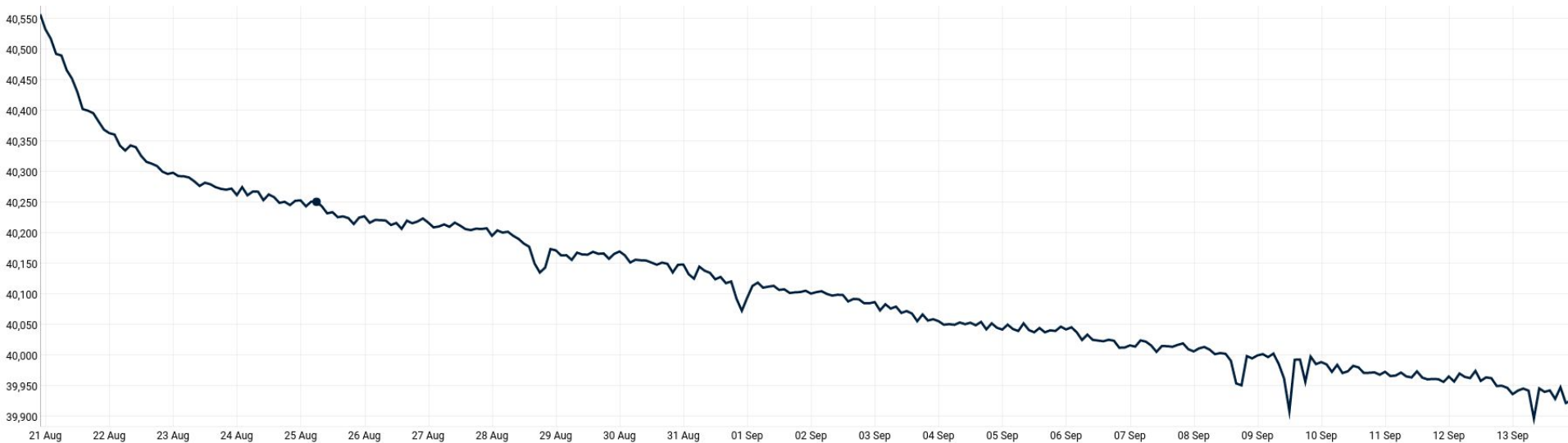
Syntax



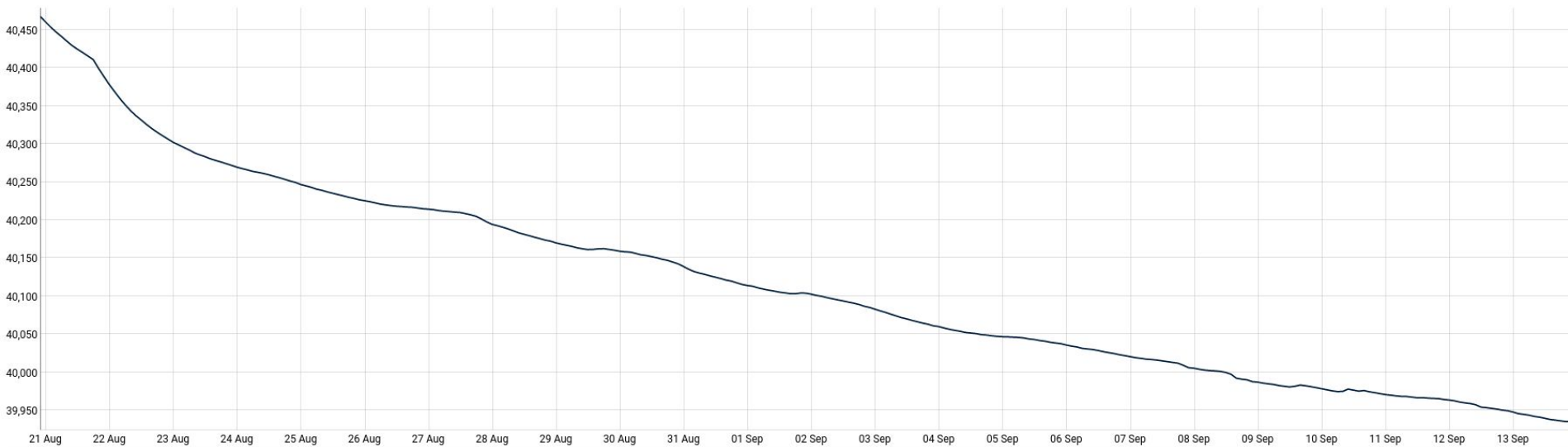
```
[  
  $gts  
  mapper.mean  
  2  
  2  
  0  
]  
MAP
```



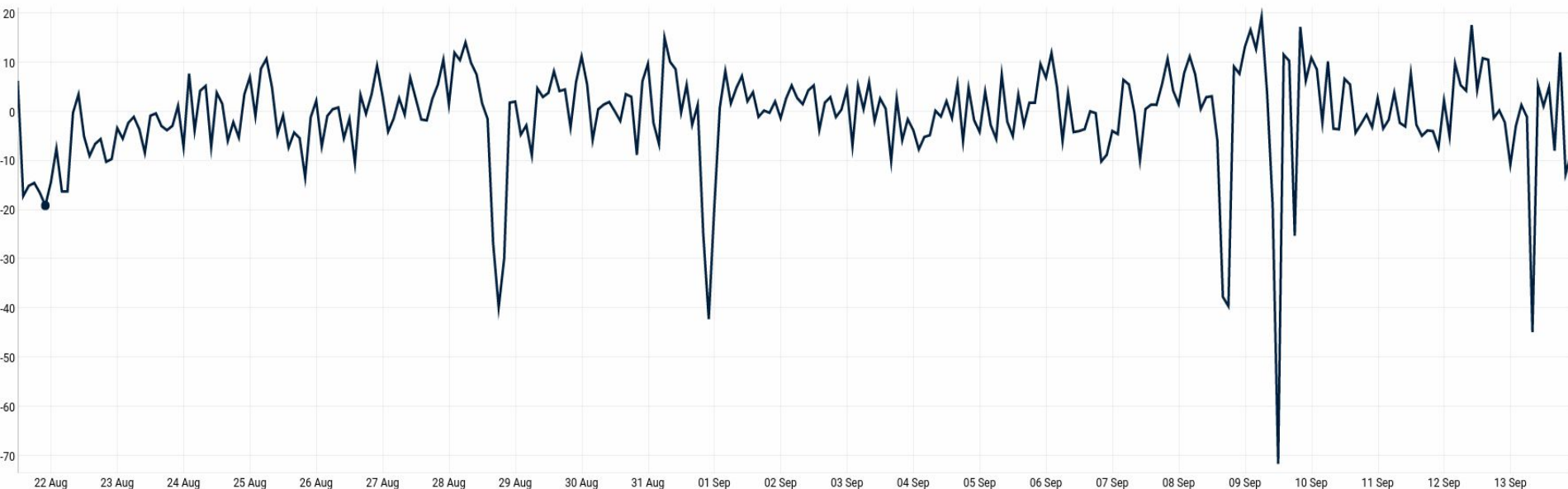
Actual



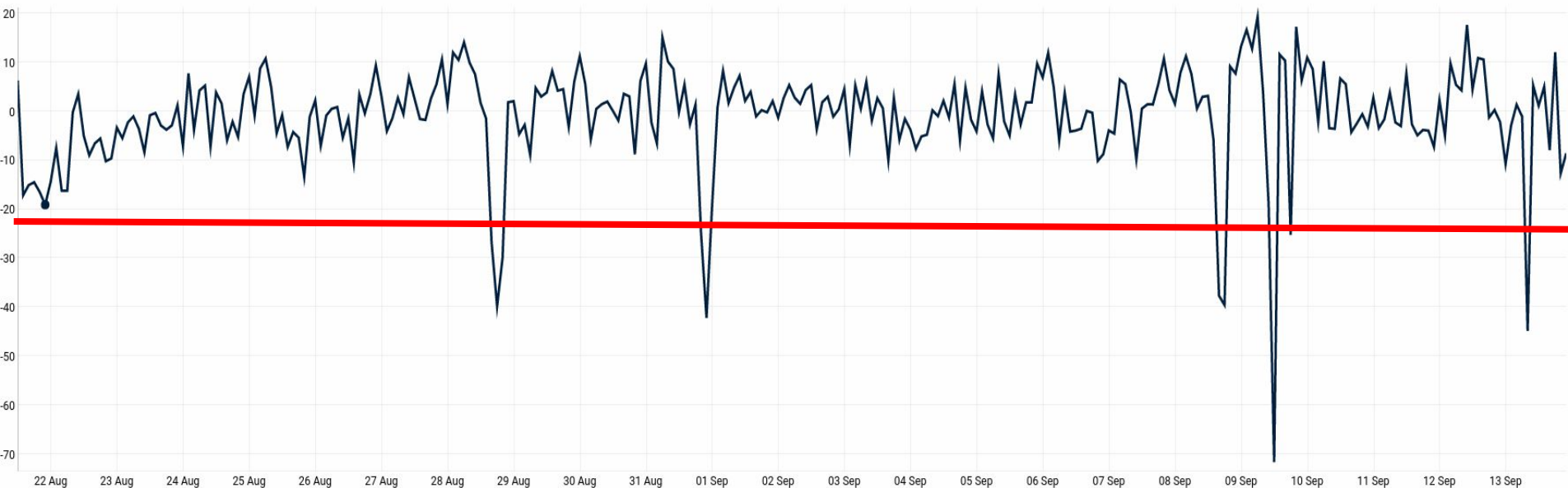
Trend



Actual - trend



Actual - trend



Time to level-up!



Time series operation

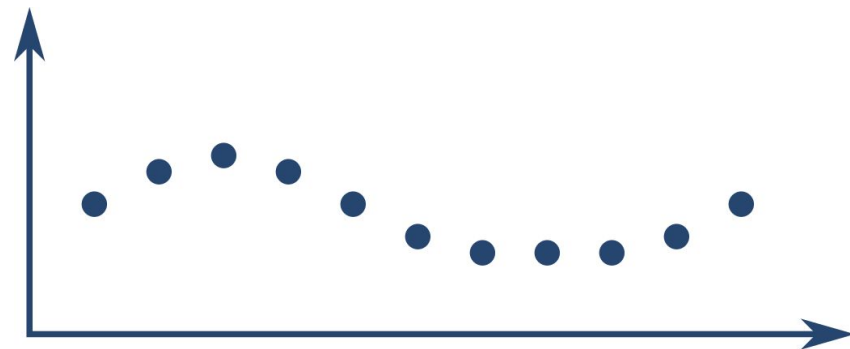
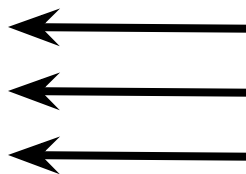


```
[  
    $gts0                // First series pull  
    ...                  // ...  
    $gtsN                // N series pull  
    [ 'record' ]         // Key labels list  
    op.add               // Type of operator  
]  
APPLY
```

Syntax



```
[  
  $gts0  
  ...  
  $gtsN  
  [ 'record' ]  
  op.add  
]  
APPLY
```



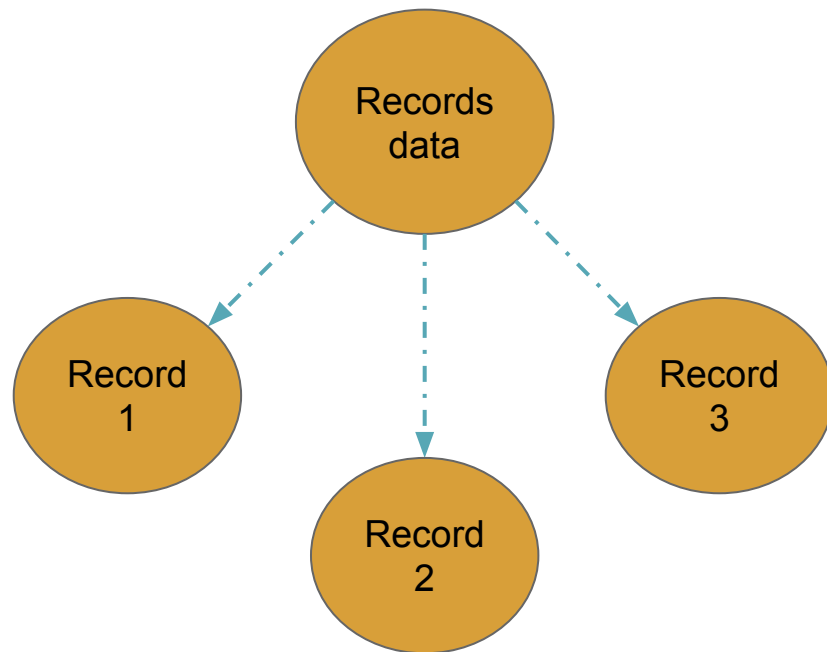
Singleton

Syntax



Equivalence class

```
[  
    $gts0  
    ...  
    $gtsN  
    [ 'record' ]  
    op.add  
]  
APPLY
```



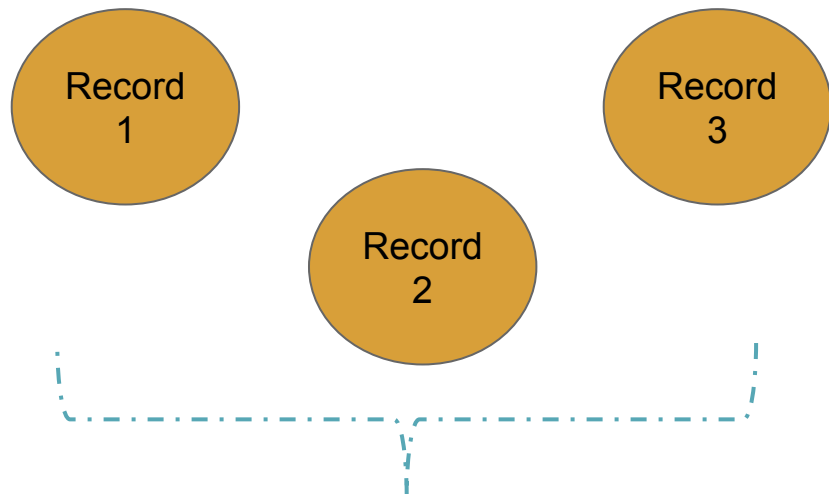
Syntax



```
[  
  $gts0  
  ...  
  $gtsN  
  [ 'record' ]  
  op.add  
]  
APPLY
```

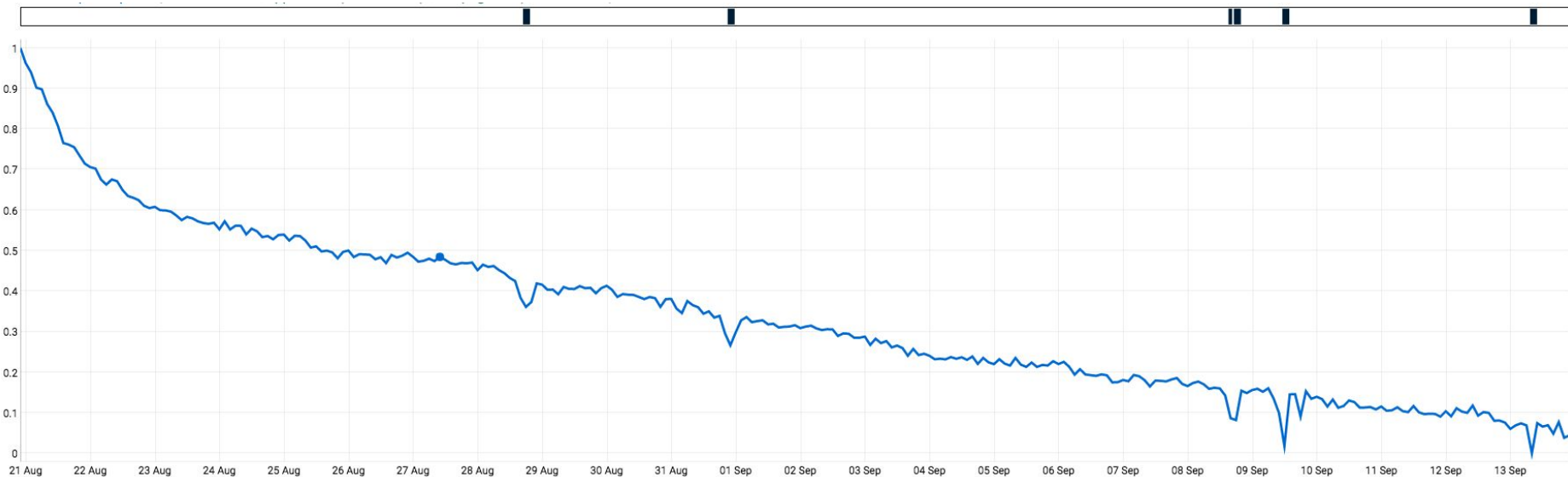


Operator



*Type of operator to apply on each **class**
sub, gt, mask, and, mul ...*

Final result



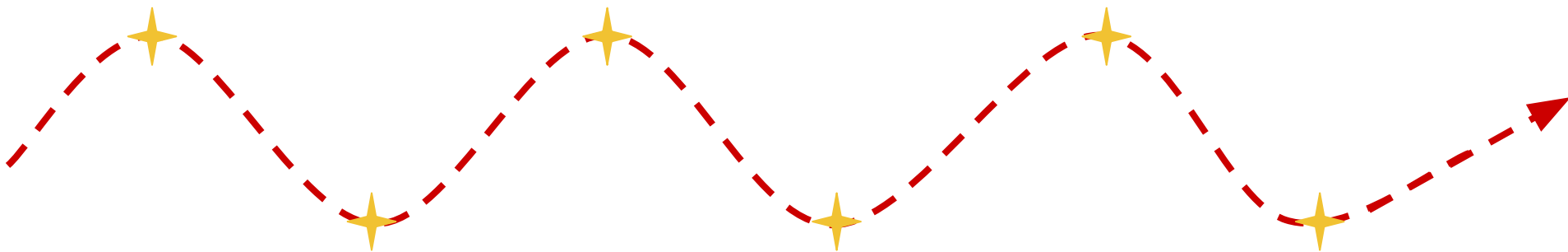
Only the beginning



New import method

Better detection

Deep learning

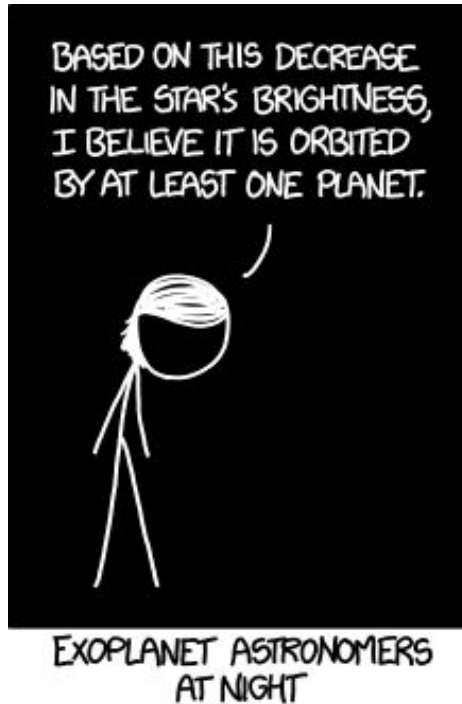


Explorer

satellite/star location

Yours?

The end!



<https://xkcd.com/1371/>

Join us!

<https://helloexo.world>