



# Time series

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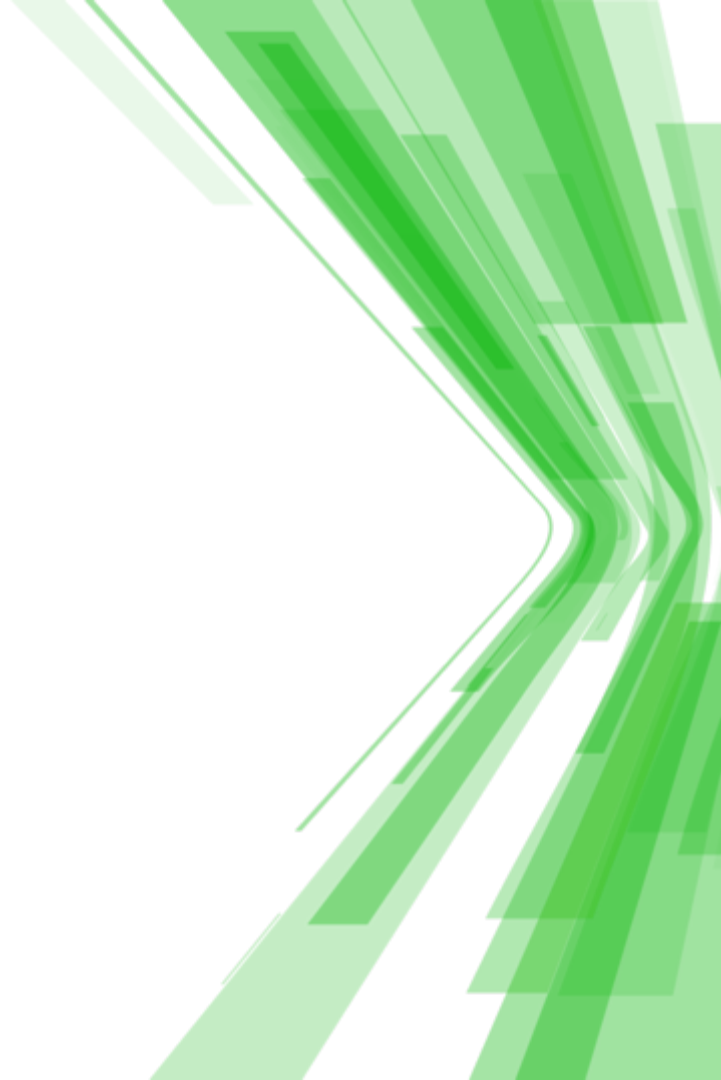
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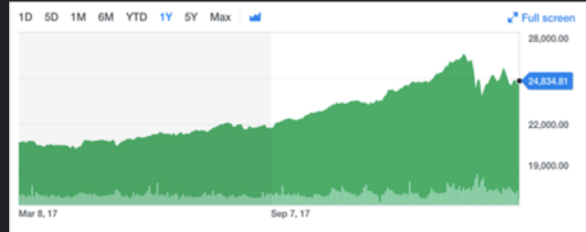
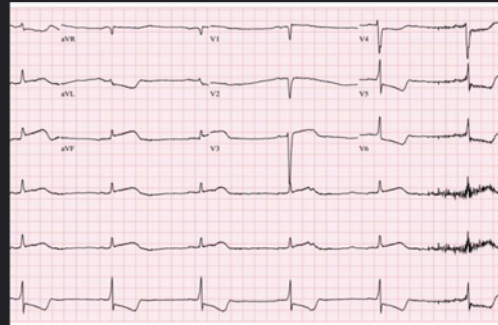
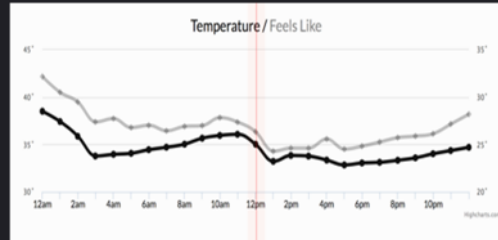


What are time series?



# Let's start by example

- Weather conditions
- Stock exchange
- Cluster monitoring
- Healthcare



- Logs
- Traces

- Logs
- Traces

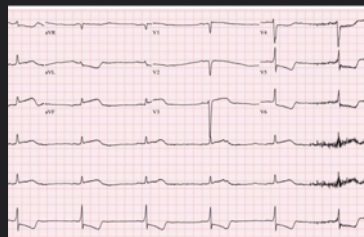
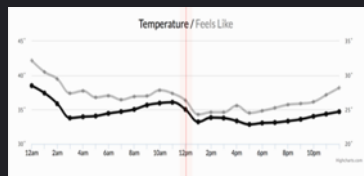
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Jun 24 13:45:38 haproxy epo-http.txt dd14-834.compuserve.com [30:01:46:54] GET /logos/small_ftp.gif HTTP/1.0" 200 124
Jun 24 13:45:40 haproxy epo-http.txt ix-eve-ma-82.ic.netcom.com [30:01:46:55] GET /docs/EPA-WASTE/1994/October/Day-05 HTTP/1.0" 302 -
Jun 24 13:45:40 haproxy epo-http.txt dd14-834.compuserve.com [30:01:46:56] GET /icons/book.gif HTTP/1.0" 200 156
Jun 24 13:45:41 haproxy epo-http.txt ix-eve-ma-82.ic.netcom.com [30:01:46:56] GET /EPA-WASTE/1994/October/Day-05/ HTTP/1.0" 200 623
Jun 24 13:45:42 haproxy epo-http.txt dd14-834.compuserve.com [30:01:46:58] GET /logos/us-flag.gif HTTP/1.0" 200 2788
Jun 24 13:45:43 haproxy epo-http.txt ix-eve-ma-82.ic.netcom.com [30:01:47:12] GET /docs/EPA-WASTE/1994/October/Day-03 HTTP/1.0" 302 -
Jun 24 13:45:45 haproxy epo-http.txt ix-eve-ma-82.ic.netcom.com [30:01:47:14] GET /EPA-WASTE/1994/October/Day-03/ HTTP/1.0" 200 785
Jun 24 13:45:46 haproxy epo-http.txt dd14-834.compuserve.com [30:01:47:19] GET /icons/ok2-o.gif HTTP/1.0" 200 231
Jun 24 13:45:48 haproxy epo-http.txt betting.client.uz.az.az [30:01:47:24] GET /enviro/html/emc/emc_overview.html HTTP/1.0" 200 2352
Jun 24 13:45:49 haproxy epo-http.txt betting.client.uz.az.az [30:01:47:31] GET /enviro/gif/efacts.gif HTTP/1.0" 200 1367
Jun 24 13:45:50 haproxy epo-http.txt 202.96.29.111 [30:01:47:34] GET /PressReleases/ HTTP/1.0" 200 1241
Jun 24 13:45:51 haproxy epo-http.txt betting.client.uz.az.az [30:01:47:37] GET /enviro/gif/blueball.gif HTTP/1.0" 200 903
Jun 24 13:45:53 haproxy epo-http.txt ix-eve-ma-82.ic.netcom.com [30:01:47:37] GET /Rules.html HTTP/1.0" 200 3273
Jun 24 13:45:53 haproxy epo-http.txt 202.96.29.111 [30:01:47:38] GET /icons/circle_logo_small.gif HTTP/1.0" 200 2624
Jun 24 13:45:54 haproxy epo-http.txt 202.96.29.111 [30:01:48:04] POST /cgi-bin/waisgate/134.67.99.11-earth1.epo.gov/218-usr1/coma/is/indexes/PressReleases-gopher40earth1-0.00:/free HTTP/1.0" 200 3993
Jun 24 13:45:54 haproxy epo-http.txt 202.96.29.111 [30:01:48:16] GET /waisicons/text_xbm HTTP/1.0" 200 527
Jun 24 13:45:55 haproxy epo-http.txt dd14-834.compuserve.com [30:01:48:22] GET /Rules.html HTTP/1.0" 200 3273

```



# What's the difference?



VS.

```
Jun 24 13:45:36 httpoxy app-http-tx1: d414-834.compuserve.com [30-81:46:58] "GET /logos/amlLgopher.gif HTTP/1.0" 200 935
Jun 24 13:45:38 httpoxy app-http-tx1: d414-834.compuserve.com [30-81:46:54] "GET /logos/amlLgopher.gif HTTP/1.0" 200 124
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Jun 24 13:45:40 httpoxy app-http-tx1: d414-834.compuserve.com [30-81:46:50] "GET /icons/book.gif HTTP/1.0" 200 156
Jun 24 13:45:41 httpoxy app-http-tx1: ix-eve-mid-02.ix.netcom.com [30-81:46:56] "GET /CDA-BASTI/1994/October/Day-85 HTTP/1.0" 302 623
Jun 24 13:45:42 httpoxy app-http-tx1: d414-834.compuserve.com [30-81:46:54] "GET /logos/us-flag.gif HTTP/1.0" 200 2788
Jun 24 13:45:43 httpoxy app-http-tx1: ix-eve-mid-02.ix.netcom.com [30-81:47:12] "GET /docs/EPA-BASTI/1994/October/Day-83 HTTP/1.0" 302 -
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Jun 24 13:45:46 httpoxy app-http-tx1: d414-834.compuserve.com [30-81:47:13] "GET /icons/ok2-8.gif HTTP/1.0" 200 231
Jun 24 13:45:48 httpoxy app-http-tx1: betting.client.us-qa.au [30-81:47:24] "GET /Amviro.html?mc1=mc1_oxyerve.html HTTP/1.0" 200 2352
Jun 24 13:45:49 httpoxy app-http-tx1: betting.client.us-qa.au [30-81:47:33] "GET /enviro/gif/effects.gif HTTP/1.0" 200 1367
Jun 24 13:45:50 httpoxy app-http-tx1: 202-96-29-111 [30-81:47:34] "GET /Presale/esset/ HTTP/1.0" 200 1241
Jun 24 13:45:51 httpoxy app-http-tx1: betting.client.us-qa.au [30-81:47:37] "GET /enviro/gif/psuball.gif HTTP/1.0" 200 303
Jun 24 13:45:53 httpoxy app-http-tx1: ix-eve-mid-02.ix.netcom.com [30-81:47:37] "GET /Rules.html HTTP/1.0" 200 3273
Jun 24 13:45:53 httpoxy app-http-tx1: 202-96-29-111 [30-81:47:38] "GET /fictor/circle_log_small.gif HTTP/1.0" 200 2624
Jun 24 13:45:54 httpoxy app-http-tx1: 202-96-29-111 [30-81:48:04] "POST /cgi-bin/wetgate/134.67.99.11+earth2.epa.gov+20b+us+comet+indexes/Presale/esset-gopherMdbearth=0-00-free HTTP/1.0" 200 3993
Jun 24 13:45:54 httpoxy app-http-tx1: 202-96-29-111 [30-81:48:16] "GET /music/com/tes-ue HTTP/1.0" 200 327
Jun 24 13:45:55 httpoxy app-http-tx1: d414-834.compuserve.com [30-81:48:22] "GET /Rules.html HTTP/1.0" 200 3273
```



# What's the difference?

both of them are time series, but ...

We monitor the  
phenomena

regular



**metrics**

The phenomena happen  
and we observe them

irregular



VS.

**events**

Metrics

## Regular Time Series

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Measurements  
**gathered** at *regular*  
time intervals

Events

## Irregular Time Series

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Measurements  
**observed** at *irregular*  
time intervals

## Summarization of Events

Events become regular time intervals, for example

Summarizing the average  
trade price of Apple stock  
every 10 minutes over the  
course of a day

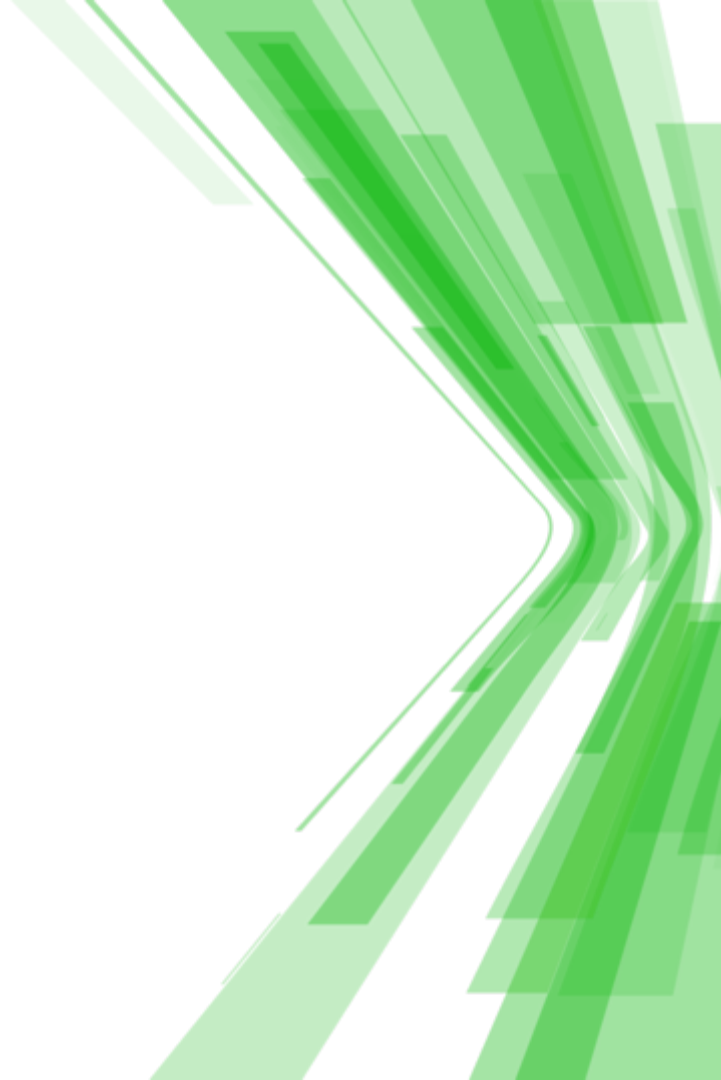
Summarizing the average  
response time for requests  
in an application over 1  
minute intervals



# Characteristics of the time series

- All Time-stamped data
- Generated in
  - regular (Metric) and
  - irregular (Event) time periods
- Huge volumes of data
- High variety of semi-structured data
- Real-time
- Time sensitive

Who uses time series  
and how?



## Primary Use Cases

### IoT

**Industrial settings:** factories, oil & gas, agriculture, smart roads & infrastructure

**Consumer:** wearables, consumer devices & trackers

### DevOps

**Custom monitoring solutions to track** servers, VMs, applications, users or events

### Real-Time Analytics

**Apps that instrument** business, social or development metrics in real-time

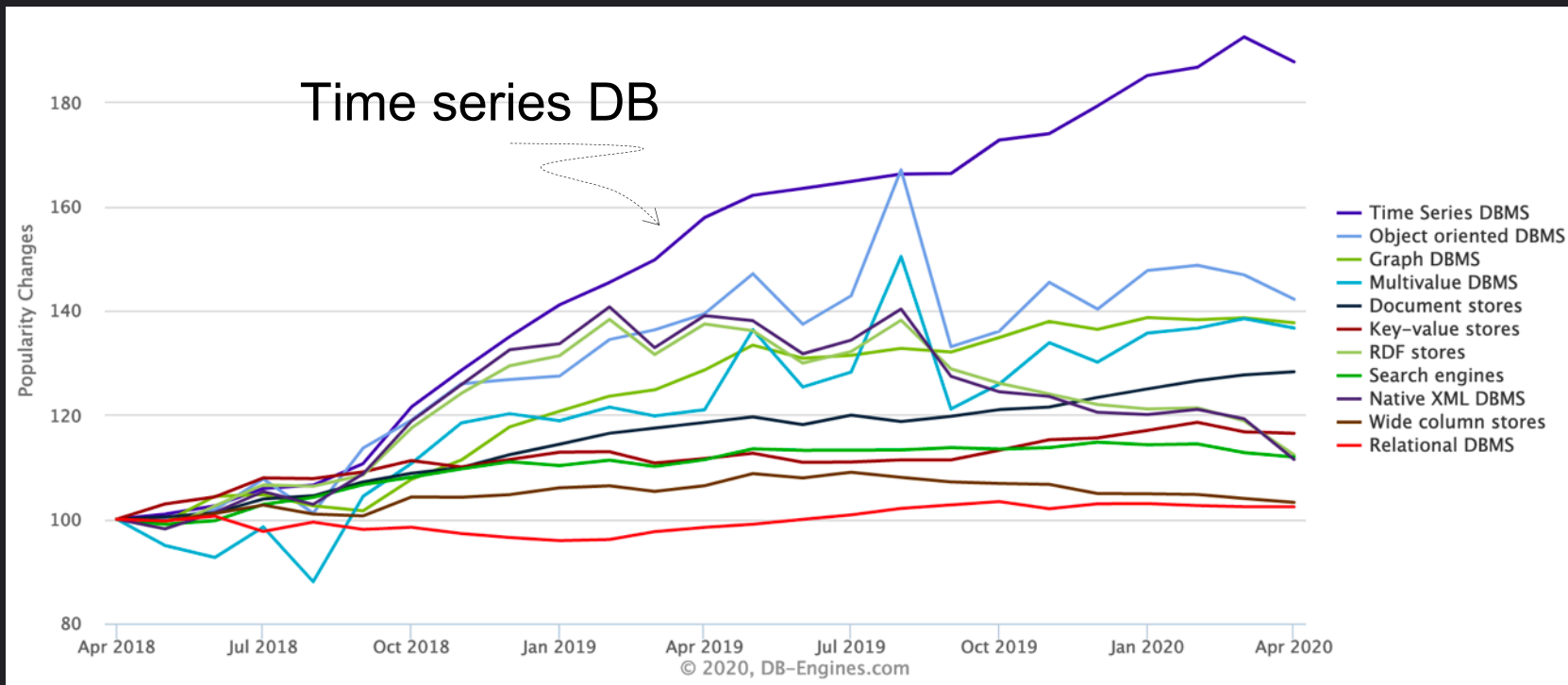
So what's a time series DB?



Time series DB	Other DBs
<p>optimized for</p> <ul style="list-style-type: none"><li>• collecting</li><li>• storing</li><li>• retrieving</li><li>• processing (historical and real-time)</li></ul> <p>timestamped &amp; semi-structured data</p>	<p><b>Traditional relational</b> Databases optimized for storing and querying structured data</p> <hr/> <p><b>Document databases</b> Optimized for storing and retrieving semi-structured JSON documents</p> <hr/> <p><b>Search databases</b> Optimized for storing and retrieving unstructured data (e.g., full-text searches)</p>

# The interest about time series data bases is growing

[https://db-engines.com/en/ranking\\_categories](https://db-engines.com/en/ranking_categories)





## Time series

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