Prometheus: Querying basics

DPTP Knowledge Talk

June 7, 2022

1. Data types
2. Metric types
3. Operators
4. Functions/queries

Expression language data types

1. Scalar - a simple numeric floating point value
2. String - a simple string value
3. Instant vector
4. Range vector

Instant vector

A set of time series containing a single sample for each time series, all sharing the same timestamp.

$$\text{CPU}_{\text{load}} = \begin{bmatrix} \text{CPU}_1 \\ \text{CPU}_2 \\ \text{CPU}_3 \\ \text{CPU}_4 \end{bmatrix} = \begin{bmatrix} 9.99 \\ 12.13 \\ 14.31 \\ 4.22 \end{bmatrix} \text{ for } T_{\text{now}}$$

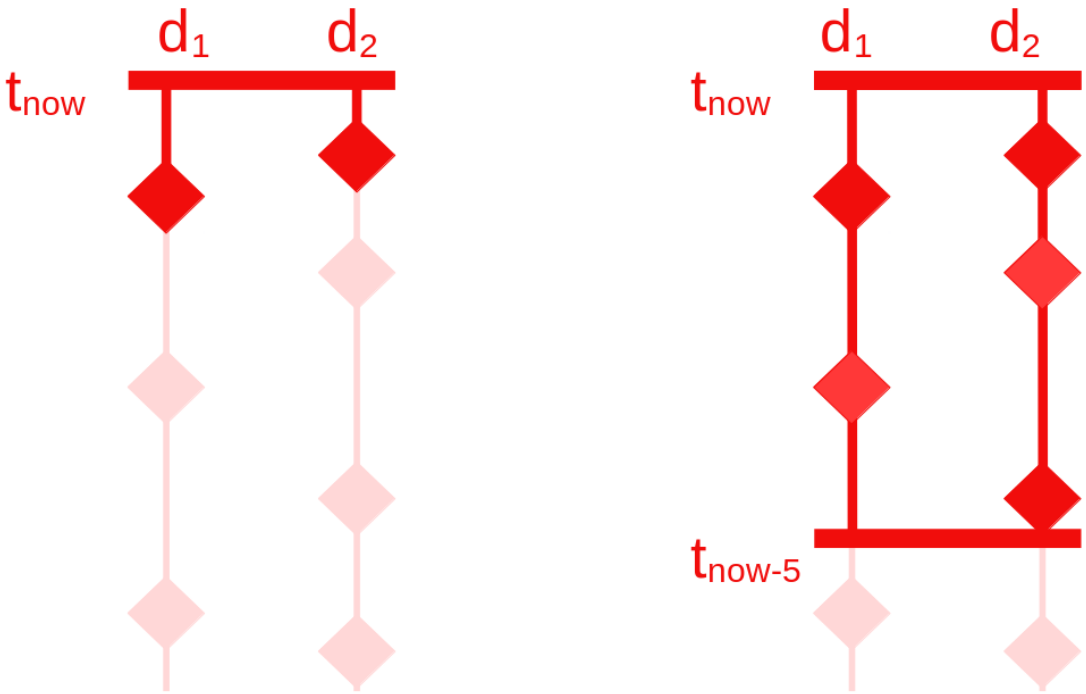
Range vector

A set of time series containing a range of data points over time for each time series.

$$\text{CPU}_{\text{load}} = \underbrace{\begin{bmatrix} 4.23 \\ 6.44 \\ 12.32 \\ 11.23 \end{bmatrix}}_{\text{CPU}_1} \underbrace{\begin{bmatrix} 3.13 \\ 5.74 \\ 11.92 \\ 2.43 \\ 32.43 \end{bmatrix}}_{\text{CPU}_2} \underbrace{\begin{bmatrix} 4.99 \\ 21.14 \\ 1.12 \end{bmatrix}}_{\text{CPU}_3} \underbrace{\begin{bmatrix} 5.15 \\ 19.24 \\ 9.42 \\ 21.87 \end{bmatrix}}_{\text{CPU}_4}$$

For the time range of last 5 minutes.

Instant vectors and range vectors



Instant vector guarantees at least one value per time series while range vector guarantees any number of values between two timestamps.

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Available metrics

1. Counter
2. Gague
3. Histogram
4. Summary

Counter

- monotonically increasing counter
- value can reset on restart

Gague

- a metric that represents a single numerical value that can arbitrarily go up and down
- used for temperature, load, memory usage, concurrent requests

Histogram & Summary

Histogram can be used for any calculated value which is counted based on bucket values. Bucket boundaries can be configured by the developer.

```
var cacheEntryAge = prometheus.NewHistogramVec(
    prometheus.HistogramOpts{
        Name:    "ghcache_cache_entry_age_seconds",
        Help:    "The age of cache entries by API path.",
        Buckets: []float64{5, 900, 1800, 3600, 7200, 14400},
    },
    []string{"token_hash", "path", "user_agent"},
)
```

Summary measures events and are an alternative to histograms. It is used when the buckets of a metric is not known beforehand, but it is highly recommended to use histogram over summary whenever possible.

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Binary operators

- arithmetic: +, -, /...
- comparison: !=, ==, <...
- set: and, or, unless

Binary operators accept scalars and instant vectors. **Labeling must be correct when using them with instatnt vectors.**

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Aggregation operators

- sum() calculate sum over dimensions
- min() select minimum over dimensions
- max() select maximum over dimensions
- avg() calculate the average over dimensions
- count() count number of elements in the vector
- ...

Aggregation operators take an instant vector as input and output also an instant vector.

They can be used together with without or by clause.

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Functions

Functions take an instant vector or a range vector as an input. The result always will be an instant vector.

rate()

- Input: range vector
- Output: instant vector
- Description: calculates the per-second average rate of increase in the counter

rate(http_requests_total[5m])

rate() function is special as breaks in monotonicity (like counter resets) are automatically adjusted for.

rate(), increase() and irate() are dedicated to use only with counters.

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Demo

Demo!

Sources

- Prometheus documentation
- robustperception Blog
- PromCon EU 2019: PromQL for Mere Mortals
- How to build a PromQL (Prometheus Query Language)