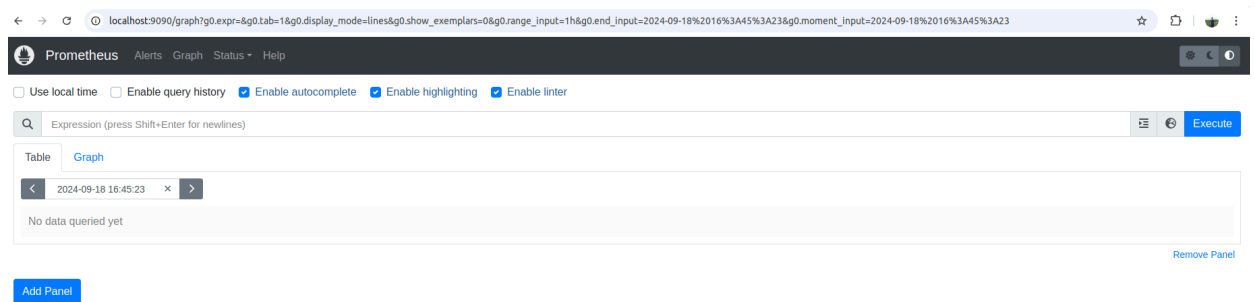


# Local Machine

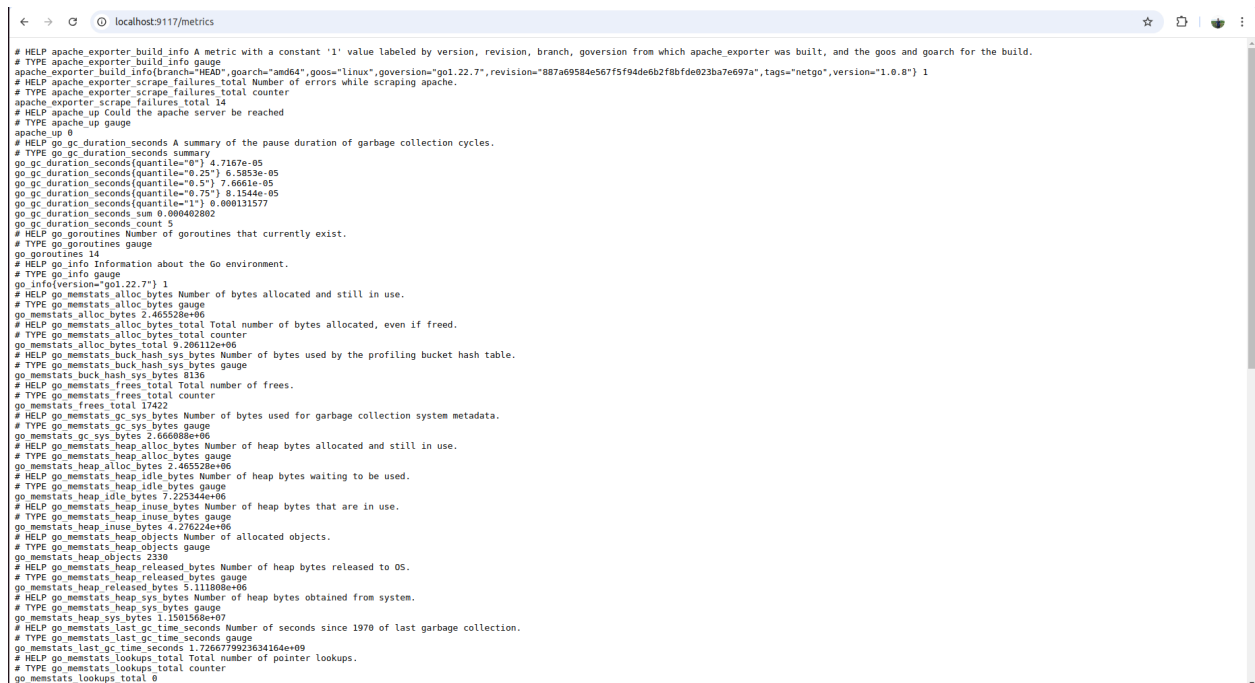
- Docker compose up/ps/down

```
(base) andre@andre-Z790-AORUS-ELITE:~/Desktop/CU_submission/Software_Defined_Systems/Activity_5/part_1_local$ docker compose up -d
[+] Running 4/4
✓ Container node-exporter   Started      0.3s
✓ Container prometheus     Started      0.4s
✓ Container grafana        Started      0.4s
✓ Container apache-exporter Started      0.4s
(base) andre@andre-Z790-AORUS-ELITE:~/Desktop/CU_submission/Software_Defined_Systems/Activity_5/part_1_local$ docker ps
CONTAINER ID   IMAGE                  COMMAND                  CREATED        STATUS        PORTS                               NAMES
6b9599b391c1   grafana/grafana       "/run.sh"               11 seconds ago Up 4 seconds  0.0.0.0:3000->3000/tcp, :::3000->3000/tcp   grafana
2f1689397ac3   prom/prometheus       "/bin/prometheus --c..." About a minute ago Up 4 seconds  0.0.0.0:9090->9090/tcp, :::9090->9090/tcp   prometheus
f19d0d0abc2df   bitnami/apache-exporter "apache_exporter"       3 minutes ago Up 4 seconds  0.0.0.0:9117->9117/tcp, :::9117->9117/tcp   apache-exporter
d279e391aaae   prom/node-exporter    "/bin/node_exporter"    3 minutes ago Up 4 seconds  0.0.0.0:9100->9100/tcp, :::9100->9100/tcp   node-exporter
(base) andre@andre-Z790-AORUS-ELITE:~/Desktop/CU_submission/Software_Defined_Systems/Activity_5/part_1_local$ docker compose down
[+] Running 7/7
✓ Container prometheus     Removed
✓ Container apache-exporter Removed
✓ Container node-exporter   Removed
✓ Container grafana        Removed
✓ Network part_1_local_mynet Removed
```

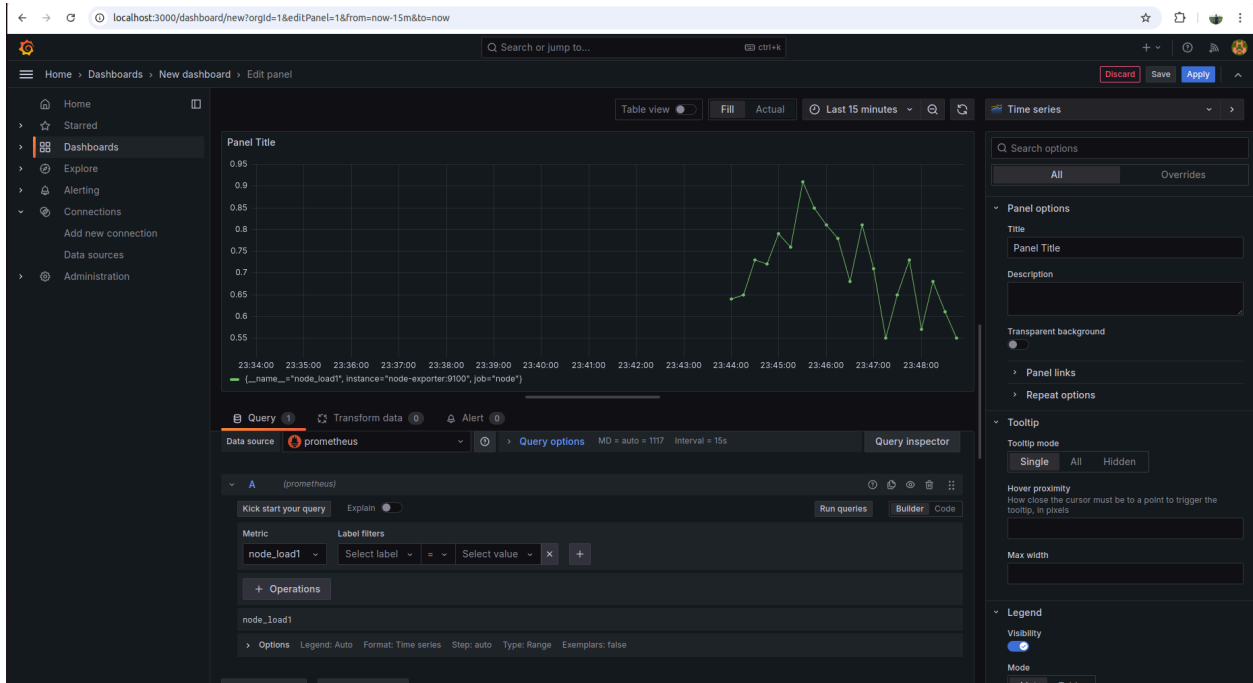
- Prometheus



- Apache-exporter



## • Grafana



## • Node-exporter

The screenshot shows the Node-exporter metrics page in a browser window. The address bar displays the URL: `localhost:9100/metrics`. The page contains a large block of text representing various system metrics and their values. The metrics are organized into sections, each starting with a comment line (e.g., `# HELP` or `# TYPE`). The metrics include garbage collection statistics, goroutine counts, environment information, memory usage (alloc, total, free, heap), and system-level statistics. The values are presented in scientific notation or as integers. The page is scrollable, and the bottom of the image shows the end of the metrics list.

# Raspberry Pi

- Local - Docker compose up/ps/down

```
(base) andre@andre-Z790-AORUS-ELITE:~/Desktop/CU_submission/Software_Defined_Systems/Activity_5/part_2_pi$ docker compose -f ./compose_local.yml up -d
[+] Running 2/2
 ✓ Container grafana Started
 ✓ Container prometheus Started
(base) andre@andre-Z790-AORUS-ELITE:~/Desktop/CU_submission/Software_Defined_Systems/Activity_5/part_2_pi$ docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED        STATUS        PORTS                               NAMES
c9803fb7c93a   grafana/grafana  "/run.sh"               4 seconds ago  Up 3 seconds  0.0.0.0:3000->3000/tcp, :::3000->3000/tcp  grafana
1870368f4bc0   prom/prometheus  "/bin/prometheus --c..." 4 seconds ago  Up 3 seconds  0.0.0.0:9090->9090/tcp, :::9090->9090/tcp  prometheus
(base) andre@andre-Z790-AORUS-ELITE:~/Desktop/CU_submission/Software_Defined_Systems/Activity_5/part_2_pi$ docker compose -f ./compose_local.yml down
[+] Running 3/3
 ✓ Container prometheus Removed
 ✓ Container grafana Removed
 ✓ Network part_2_pi_mynet Removed
```

- Pi - Docker compose up/ps/down

```
pi@raspberrypi:~/Desktop/Act_5 $ docker compose -f ./compose_pi.yml up -d
[+] Running 2/2
 ✓ Container node-exporter Started 3.4s
 ✓ Container apache-exporter Started 3.3s
pi@raspberrypi:~/Desktop/Act_5 $ docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED        STATUS        PORTS                               NAMES
36fbc3267697   bitnami/apache-exporter  "apache_exporter"       11 hours ago  Up 7 seconds  0.0.0.0:9117->9117/tcp, :::9117->9117/tcp  apache-exporter
507d439e2c45   prom/node-exporter  "/bin/node_exporter"    11 hours ago  Up 7 seconds  0.0.0.0:9100->9100/tcp, :::9100->9100/tcp  node-exporter
pi@raspberrypi:~/Desktop/Act_5 $ docker compose -f ./compose_pi.yml down
[+] Running 3/3
 ✓ Container node-exporter Removed
 ✓ Container apache-exporter Removed
 ✓ Network act_5_mynet Removed
```

- Pi - Apache-exporter

```
< → ↻ Not secure 172.20.10.2:9117/metrics ☆ ⓘ 🌐 ⓘ

# HELP apache_exporter_build_info A metric with a constant '1' value labeled by version, revision, branch, goversion from which apache_exporter was built, and the goos and goarch for the build.
# TYPE apache_exporter_build_info gauge
apache_exporter_build_info{branch="HEAD",goarch="arm64",goos="linux",goversion="go1.22.7",revision="887a69584e567f5f94de6b2f8bfe023ba7e697a",tags="netgo",version="1.0.0"} 1
# HELP apache_exporter_scrape_failures_total Number of errors while scraping apache.
# TYPE apache_exporter_scrape_failures_total counter
apache_exporter_scrape_failures_total 1
# HELP apache_up Could the apache server be reached
# TYPE apache_up gauge
apache_up 0
# HELP go_gc_duration_seconds A summary of the pause duration of garbage collection cycles.
# TYPE go_gc_duration_seconds summary
go_gc_duration_seconds{quantile="0"} 0
go_gc_duration_seconds{quantile="0.25"} 0
go_gc_duration_seconds{quantile="0.5"} 0
go_gc_duration_seconds{quantile="0.75"} 0
go_gc_duration_seconds{quantile="1"} 0
go_gc_duration_seconds_sum 0
go_gc_duration_seconds_count 0
# HELP go_goroutines Number of goroutines that currently exist.
# TYPE go_goroutines gauge
go_goroutines 12
# HELP go_info Information about the Go environment.
# TYPE go_info gauge
go_info{version="go1.22.7"} 1
# HELP go_memstats_alloc_bytes Number of bytes allocated and still in use.
# TYPE go_memstats_alloc_bytes gauge
go_memstats_alloc_bytes 250304
# HELP go_memstats_alloc_bytes_total Total number of bytes allocated, even if freed.
# TYPE go_memstats_alloc_bytes_total counter
go_memstats_alloc_bytes_total 250304
# HELP go_memstats_buck_hash_sys_bytes Number of bytes used by the profiling bucket hash table.
# TYPE go_memstats_buck_hash_sys_bytes gauge
go_memstats_buck_hash_sys_bytes 8527
# HELP go_memstats_frees_total Total number of frees.
# TYPE go_memstats_frees_total counter
go_memstats_frees_total 0
# HELP go_memstats_gc_sys_bytes Number of bytes used for garbage collection system metadata.
# TYPE go_memstats_gc_sys_bytes gauge
go_memstats_gc_sys_bytes 1.424902e+06
# HELP go_memstats_heap_alloc_bytes Number of heap bytes allocated and still in use.
# TYPE go_memstats_heap_alloc_bytes gauge
go_memstats_heap_alloc_bytes 250304
# HELP go_memstats_heap_idle_bytes Number of heap bytes waiting to be used.
# TYPE go_memstats_heap_idle_bytes gauge
go_memstats_heap_idle_bytes 1.785856e+06
# HELP go_memstats_heap_inuse_bytes Number of heap bytes that are in use.
# TYPE go_memstats_heap_inuse_bytes gauge
go_memstats_heap_inuse_bytes 1.785856e+06
# HELP go_memstats_heap_objects Number of allocated objects.
# TYPE go_memstats_heap_objects gauge
go_memstats_heap_objects 1990
# HELP go_memstats_heap_released_bytes Number of heap bytes released to OS.
# TYPE go_memstats_heap_released_bytes gauge
go_memstats_heap_released_bytes 1.785856e+06
# HELP go_memstats_heap_sys_bytes Number of heap bytes obtained from system.
# TYPE go_memstats_heap_sys_bytes gauge
go_memstats_heap_sys_bytes 3.571712e+06
# HELP go_memstats_last_gc_time_seconds Number of seconds since 1970 of last garbage collection.
# TYPE go_memstats_last_gc_time_seconds gauge
go_memstats_last_gc_time_seconds 0
# HELP go_memstats_lookups_total Total number of pointer lookups.
# TYPE go_memstats_lookups_total counter
go_memstats_lookups_total 0
# HELP go_memstats_malloc_total Total number of mallocs.
```

## ● Pi - Node-exporter

```
← → ↻ ⚠ Not secure 172.20.10.2:9100/metrics ☆ 📄 🖨 ⋮

# HELP go_gc_duration_seconds A summary of the pause duration of garbage collection cycles.
# TYPE go_gc_duration_seconds summary
go_gc_duration_seconds{quantile="0"} 0
go_gc_duration_seconds{quantile="0.25"} 0
go_gc_duration_seconds{quantile="0.5"} 0
go_gc_duration_seconds{quantile="0.75"} 0
go_gc_duration_seconds{quantile="1"} 0
go_gc_duration_seconds_sum 0
go_gc_duration_seconds_count 0
# HELP go_goroutines Number of goroutines that currently exist.
# TYPE go_goroutines gauge
go_goroutines 0
# HELP go_info Information about the Go environment.
# TYPE go_info gauge
go_info{version="go1.22.5"} 1
# HELP go_memstats_alloc_bytes Number of bytes allocated and still in use.
# TYPE go_memstats_alloc_bytes gauge
go_memstats_alloc_bytes 824800
# HELP go_memstats_alloc_bytes_total Total number of bytes allocated, even if freed.
# TYPE go_memstats_alloc_bytes_total counter
go_memstats_alloc_bytes_total 824800
# HELP go_memstats_buck_hash_sys_bytes Number of bytes used by the profiling bucket hash table.
# TYPE go_memstats_buck_hash_sys_bytes gauge
go_memstats_buck_hash_sys_bytes 1.449976e+06
# HELP go_memstats_frees_total Total number of frees.
# TYPE go_memstats_frees_total counter
go_memstats_frees_total 745
# HELP go_memstats_gc_sys_bytes Number of bytes used for garbage collection system metadata.
# TYPE go_memstats_gc_sys_bytes gauge
go_memstats_gc_sys_bytes 1.949272e+06
# HELP go_memstats_heap_alloc_bytes Number of heap bytes allocated and still in use.
# TYPE go_memstats_heap_alloc_bytes gauge
go_memstats_heap_alloc_bytes 824800
# HELP go_memstats_heap_idle_bytes Number of heap bytes waiting to be used.
# TYPE go_memstats_heap_idle_bytes gauge
go_memstats_heap_idle_bytes 1.441792e+06
# HELP go_memstats_heap_inuse_bytes Number of heap bytes that are in use.
# TYPE go_memstats_heap_inuse_bytes gauge
go_memstats_heap_inuse_bytes 2.392064e+06
# HELP go_memstats_heap_objects Number of allocated objects.
# TYPE go_memstats_heap_objects gauge
go_memstats_heap_objects 7222
# HELP go_memstats_heap_released_bytes Number of heap bytes released to OS.
# TYPE go_memstats_heap_released_bytes gauge
go_memstats_heap_released_bytes 1.376256e+06
# HELP go_memstats_heap_sys_bytes Number of heap bytes obtained from system.
# TYPE go_memstats_heap_sys_bytes gauge
go_memstats_heap_sys_bytes 3.833056e+06
# HELP go_memstats_last_gc_time_seconds Number of seconds since 1970 of last garbage collection.
# TYPE go_memstats_last_gc_time_seconds gauge
```

## ● Local - Prometheus

← → ↻ 🌐 localhost:9090/graph?g0.expr=&g0.tab=1&g0.display\_mode=lines&g0.show\_exemplars=0&g0.range\_input=1h ☆ 📄 🖨 ⋮

**Prometheus** Alerts Graph Status ▾ Help ⚙ 🌙

☐ Use local time ☐ Enable query history ☒ Enable autocomplete ☒ Enable highlighting ☒ Enable linter

🔍 Expression (press Shift+Enter for newlines) 📄 🌐 Execute

Table **Graph**

⏪ Evaluation time ⏩

No data queried yet

[Remove Panel](#)

[Add Panel](#)

## ● Local - Grafana

← → ↻ 🌐 localhost:3000/dashboard/new?orgId=1&editPanel=1&from=now-30m&to=now ☆ 📄 🖨 ⋮

Home ▾ Dashboards ▾ New dashboard ▾ Edit panel

🏠 Home ⚙ Starred 📄 Dashboards 🔍 Explore 🚨 Alerting 🔌 Connections ➕ Add new connection 📄 Data sources 🛠 Administration

Table view 🌐 Fill Actual ⌚ Last 30 minutes 🔍 🔍 Time series ▾

Panel Title

0 0.01 0.008 0.006 0.004 0.002

17:30 17:35 17:40 17:45 17:50 17:55

🟢 {\_\_name\_\_="node\_load1", instance="raspberrypi.local:9100", job="node"}

🔍 Query 🔍 Transform data 🔍 Alert 🔍

Data source **prometheus** 🔍 Query options MD = auto = 1187 Interval = 15s **Query inspector**

📄 (prometheus)

🔍 Click start your query Explain 🔍

Run queries Builder Code

Metric **node\_load1** Label filters Select label ▾ ▾ Select value ▾ × +

+ Operations

node\_load1

🔍 Search options

All Overrides

Panel options

Title

Panel Title

Description

Transparent background

Panel links

Repeat options

Tooltips

Tooltips mode

Single All Hidden

Hover proximity

How close the cursor must be to a point to trigger the tooltip, in pixels

Max width

Legend

Visibility

3. Ans.) Yes, but we should edit prometheus.yml scraping targets to ip-address:port instead of raspberrypi.local:port (might easier to debug) but if we do this manually will take too long time, all local machines and its correspond pi should attach (via ssh or something) to one main machine in that machine have program (can be some kind of run.sh) that will iterates each pi and gather ip-address, scp compose\_pi.yml to pi and compose up and also scp compose\_local.yml, prometheus.yml to correspond local machine, config ip-address in prometheus.yml and compose up. This program should store run-number of pair of local machine and pi to easily compose up/down specific server (pair of local machine and pi) and also can compose up/down all servers.