If you have done this at home, feel free to skip. Thank you!

Repository setup

Step 1: Clone repository (ONLINE method)

`git clone --recursive https://github.com/ros-realtime/roscon-2023-realtime-workshop.git code`

Step 1: Clone repository (OFFLINE method)

1. Borrow a Raspberry Pi and connect directly via Ethernet
2. Download http://192.168.10.1/data/repository.tar.gz
3. Extract the tarball: `tar xzf repository.tar.gz`

Step 2: Import and start Docker container

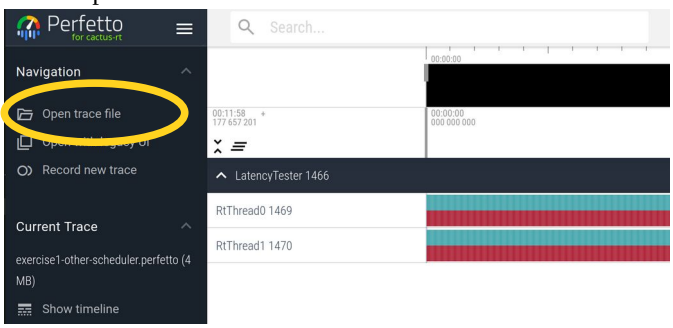
You need this for both laptop- and Raspberry-Pi-based workflows!

1. Borrow a Raspberry Pi and connect directly via Ethernet
2. `cd` into the downloaded repository
3. Run `docker/fetch`
4. Run `docker/start`
5. Run `docker/shell`

Step 3: Test compiling and running exercise 1

Run all commands inside the Docker shell started above

1. `cd /code/exercise1`
2. `colcon build`
3. `./run.sh`
4. This should create a file called `exercise1.perfetto`
5. Go to http://localhost:3100
6. Click Open trace file on top left
7. Open the `exercise1.perfetto` file
8. Consult with Perfetto trace viewer guide
9. Expected result:



If compilation fails with missing dependencies, check that you cloned with the `--recursive` flag, or simply clone the repository using the offline method.

Laptop workflow

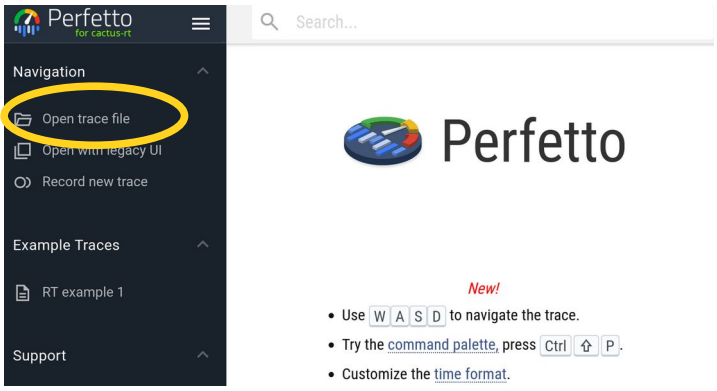
1. Edit the code in the repo with your preferred editor
2. `cd` to the repo in a terminal
3. Login to the Docker container via `docker/shell`
4. Inside the shell, `cd /code/exercise1`
5. Compile and run the exercise according to instructions on slides and/or exercise README. This will generate a file named `exercise<X>.perfetto` in the same directory. Example: `exercise1.perfetto`
6. Go to http://localhost:3100 and Open trace file with the file above.
7. Go back to step 1.

Raspberry Pi workflow

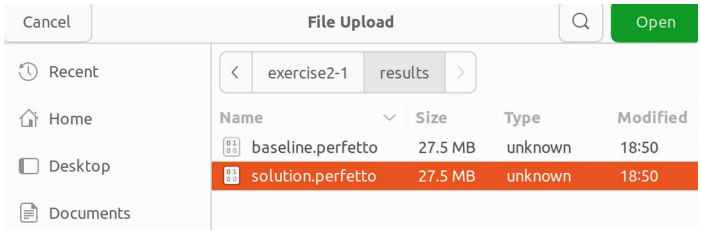
1. Connect Raspberry Pi directly to your laptop via Ethernet.
2. Edit the code in the repo with your preferred editor
3. Login to the Docker container via `docker/shell`
4. Run the command `upload-to-pi`
5. Login to the Raspberry Pi with:
   1. `ssh ubuntu@192.168.10.1`
   2. Password is `ubuntu`
6. After login, `cd /code/exercise1`
7. Compile and run the exercise according to instructions on slides and/or exercise README. This will generate a file named `exercise<X>.perfetto` in the same directory.
8. Download the trace file by browsing to http://192.168.10.1/repo/ and clicking on the right perfetto trace file
9. Go to http://localhost:3100 and Open trace file with the downloaded trace file above
10. Go back to step 2.

Loading data in Perfetto

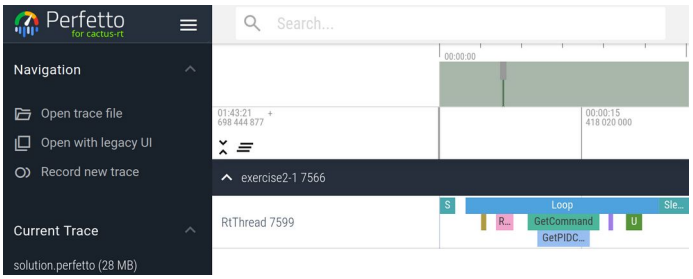
Step 1: A locally-hosted version of Perfetto is available with the Docker container, at http://localhost:3100. Go there and you will find the following interface:



Step 2: To open a trace file, click Open trace file and select a file:

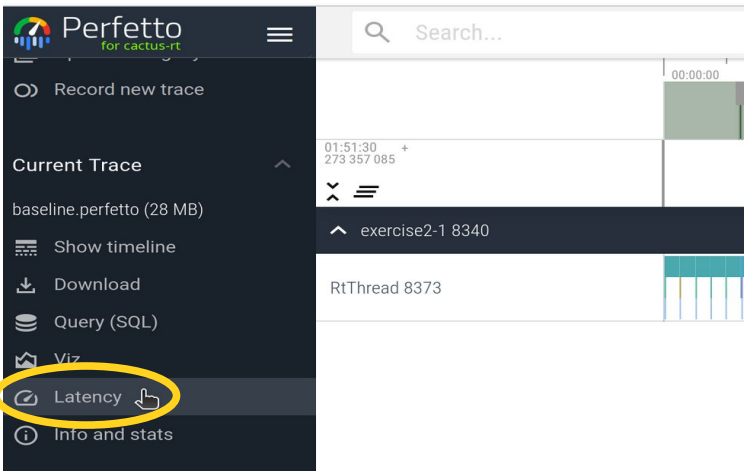


Step 3: Use **WASD** to navigate. **W**: zoom in; **S**: zoom out; **A**: pan left; **D**: pan right. Zoom and pan until you see the following:

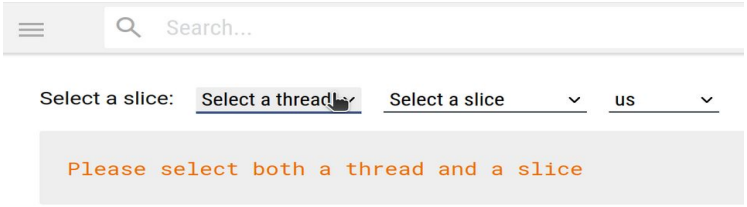


Using histogram visualization

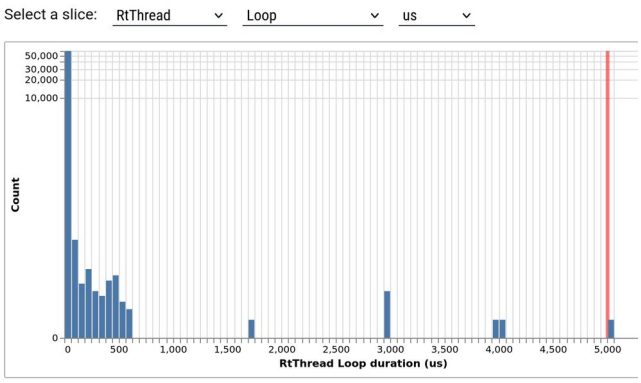
After loading data, on the left side bar, click on Latency:



Select a thread and a slice on the drop down:



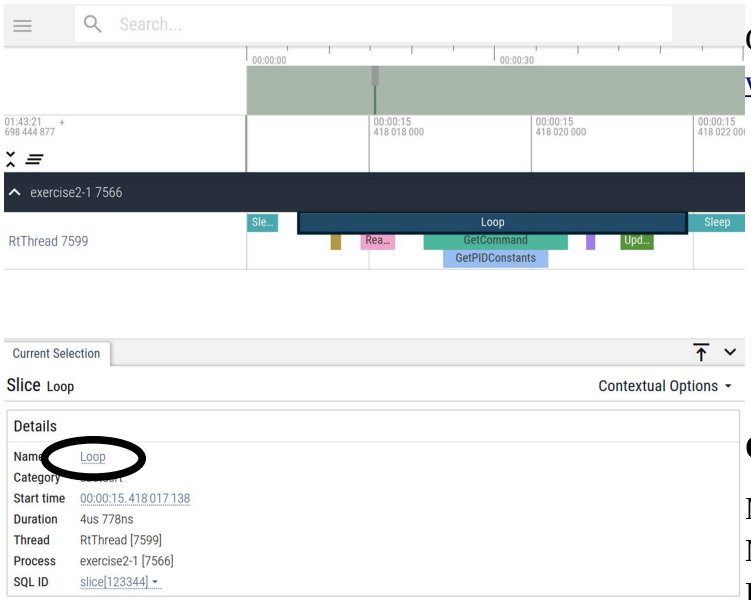
Visualize the latency histogram. Click on us to change the time scale if necessary. Min, average, max duration is also shown below. Red vertical line shows maximum latency:



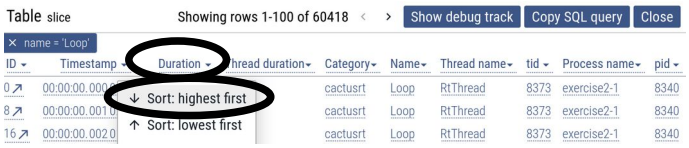

```
{
  "min_dur": 2,
  "avg_dur": 7.461470240656758,
  "max_dur": 5004,
  "count": 60418
}
```

Find the longest slice

Click on a slice such as **Loop**:

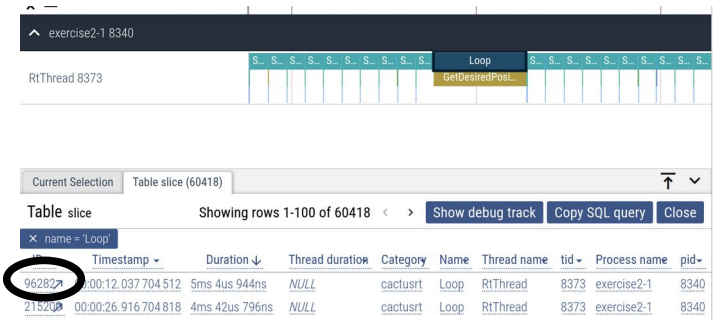


Click on the Loop link at the bottom then click Slices with same name in the popup menu



Clock on Duration in the table header then Sort: highest first:

Click on the the ID shown on the left most column (96282 in the above example) to bring the timeline view to the longest **Loop** instance:



FAQ and Troubleshooting

Q: How do I access the slides?

Go to https://ros-realtime.github.io/roscon-2023-realtime-workshop/pres/ or scan

Q: docker/shell doesn't work for me

Make sure you are not using sudo with docker/shell. Make sure you setup your user account to work with Docker without sudo. This is required for the workshop. Usually this can be done via:

```
$ sudo usermod -a -G docker $(whoami)
```

Then restart your computer.

Q: I can't use Perfetto via http://localhost:3100

There are two options:

- Use a Raspberry Pi and go to http://192.168.10.1/perfetto/
- Go to https://cactusdynamics.github.io/perfetto/

Q: My Raspberry Pi is not working (cannot login, random crashes, etc)

Check your Ethernet is plugged in correctly. If it is and you can login, run the following command:

```
$ sudo dmesg | grep BUG
```

If you see a line that says **BUG: scheduling while atomic**, then something is wrong with that Pi. You can try (1) power off the Pi, (2) reseat the SD card, (3) reboot.

If this doesn't work, you may have to follow the workshop on your laptop. There is a known issue where a kernel and/or hardware bug is causing some problems with the OS. Sorry about that.

FAQ and Troubleshooting

Q: How do I reset the repo?

Run the following in the repo:

```
$ git reset --hard HEAD
```

Q: How do I restart the Docker container?

Run the following in the repo

```
$ docker/stop && docker/start
```

Q: I see Could NOT find Protobuf (missing: Protobuf_LIBRARIES Protobuf_INCLUDE_DIR)

Make sure you are running the colcon build command inside the Docker container, not outside of it. To enter the Docker container, run `docker/shell` in the repo.