

CS 4414/5416: Systems Programming

Lab 4: Profiling and Memory Layout

2026-09-18

Primary goal: Work together on something

- Fine to have small groups (up to 4)
- Work on the lab assignment during the hour
- Submit `lab_04-0.1.0.crate` on Gradescope

This lab is about getting going on Google Compute Engine and doing some timing and profiling.

- If you haven't yet, start by making a project
- Next steps: VPC and VM

- Go to the side menu: `VPC Network / VPC networks`
- Create a VPC (if you haven't already)
 - Name: `cs4414`
 - Subnet Name: `cs4414-[region]`
 - Subnet Region: e.g. `us-central1`
 - Subnet IPv4 range: e.g. `10.0.0.0/24`

- Create a VPC firewall rule:
 - Name: `allow-ingress-from-iap`
 - Direction: Ingress
 - IP range: `35.235.240.0/20`
 - Protocols and ports: `22, 3389`
- Optional: `0.0.0.0/0` IP filter for port 22
(allows gcloud CLI to ssh in)

- Go to side menu: **Compute Engine / VM instances**
- Click **Create Instance** at the top of the screen
- Choose a C4D instance type
- Use the **c4d-highcpu-2** preset

Standard provisioning, OS, and storage is fine

- Debian GNU/Linux 13 (trixie)

- This instance type is about \$58 / mo.
 - You have a \$50 credit (cashed in, I hope!)
 - The instance is running at creation
 - Make sure you shut down VMs when not in use!
- Can attach cheaper instances to the same disk!
- Or develop for correctness locally, tune on GCE

Setting Up the VM

SSH into the VM instance and set things up:

```
sudo apt update  
sudo apt install build-essential  
sudo apt install rustup  
rustup default stable
```

Add to `.profile`

```
PATH="$HOME/.cargo/bin:$PATH"  
CARGO_HOME="$HOME/.cargo"  
RUSTUP_HOME="$HOME/.rustup"
```

May want to exit and log back in to get these variables.

Installing SamplY

From the shell

```
cargo install --locked samply
```

Give samply access to performance events system:

```
sudo sysctl kernel.perf_event_paranoid=1
```

Set up an SSH Key

If you want to read-write Cornell Github:

```
ssh-keygen -t rsa  
cat .ssh/id_rsa.pub
```

Then go to <https://github.coecis.cornell.edu/>, go to your account settings, and under SSH and GPG keys, copy this text in place.

Cloning the Repo

Repo is at <https://github.coecis.cornell.edu/cs4414-f26/lab-04>

Can clone with `ssh` as:

```
git clone git@github.coecis.cornell.edu:cs4414-f26/lab-04.git
```

or via HTTPS via

```
git clone https://github.coecis.cornell.edu/cs4414-f26/lab-04.git
```

I default to the former (with an SSH key set up)

Can do this lab fully with the web interface, but may want CLI:

- SDK at <https://docs.cloud.google.com/sdk/docs/install-sdk>
- You can also use a package manager (e.g. `brew install --cask gcloud-cli`)

Then run `gcloud init` to set things up.

Set up a build profile for profiling

```
[profile.profiling]  
inherits = "release"  
debug = true
```

You probably want debug symbols! Try with just **release** profile to see why.

To run the profiler on `sluggy`:

```
cargo build --profile profiling
cd data; ./generate_points.py; cd ..
samplify record target/profiling/sluggy
```

You can Ctrl+C out (or hang on for the next slide)

Viewing the Profile

Basic setup:

- **samply** generates **profile.json.gz**
- Runs a web server pointed at <https://profiler.firefox.com/>

You can download **profile.json.gz** and view directly with the web app, or use the gcloud CLI to set up a tunnel:

```
gcloud compute ssh instance-name-here \  
  --zone=us-central1-a \  
  --project=cs-4414-f26 -- -L 3000:127.0.0.1:3000
```

Then point web browser to **127.0.0.1:3000**

The Rest of the Story

Repo: <https://github.coecis.cornell.edu/cs4414-f26/lab-04>

At the end of the hour

- Fill out **WRITEUP.md**
- Git commit **Cargo.toml** and **profile.json.gz** (you will need to do some git config steps)
- **cargo package** and submit the **crate** file on Gradescope