Generating a Controled Software Environment with Debian Snapshot Archive

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Software Environment Reproducibility, May 2021

Context

Personal History

The early days (1997) tried Redhat, Slackware, Debian

- Regularly compiled my kernel to have the right modules
- Feared everytime I had to reconfigure X
- Updates through a 56kbps modem or a Zip drive

Happy Debian User since ≈ 1998

- Switched to Ubuntu for a few months but I quickly got back to Debian!
- Debian stable versions are often outdated. I live on the edge with Debian unstable most of the time
- I install stuff whenever I need and upgrade every 2-3 months

Software Management

Open source by default (except for Nvidia drivers and video codecs)

> *Source is provided to this software because we believe users have a right to know exactly what a program is going to do before they run it.*
>
> *– Nmap Reference Guide*

Install everything through `apt` (since ≈ 1999)

- Several friends were Debian developpers

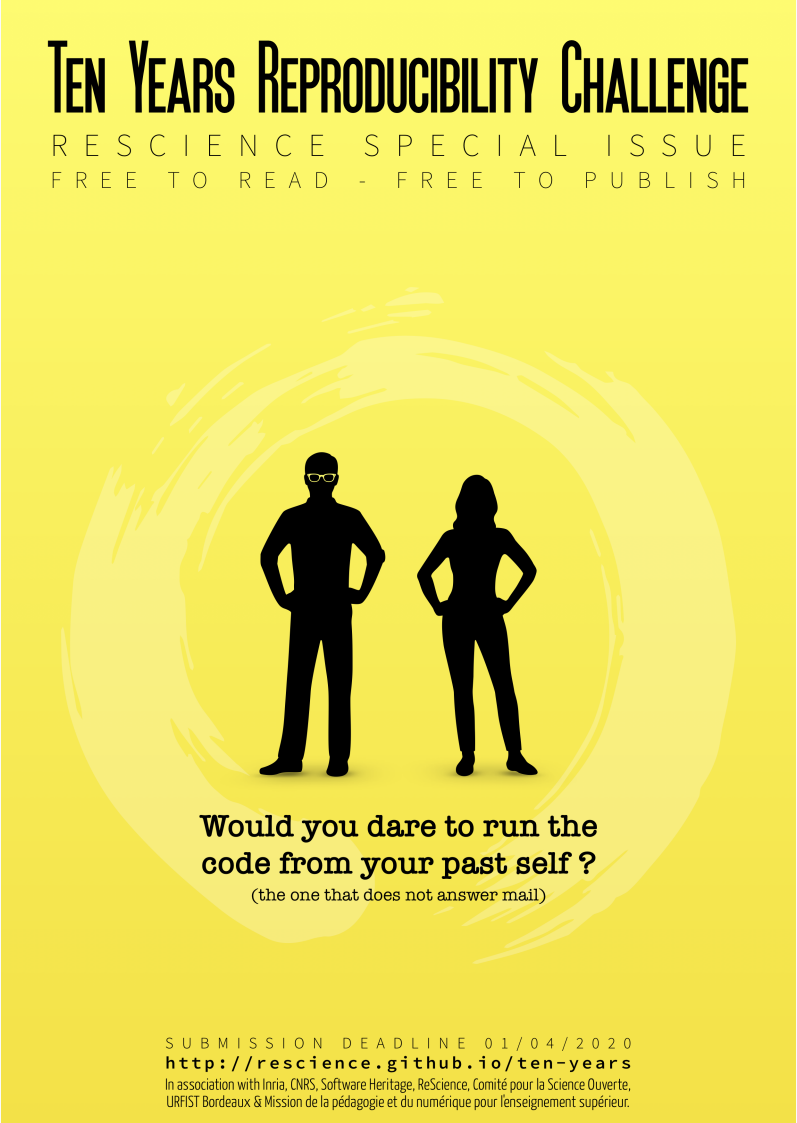
> *To what extent should one trust a statement that a program is free of Trojan horses? Perhaps it is more important to **trust** the people who wrote the software.*
>
> *– Ken Thompson, 1984*

- The only code I compile is mostly my own (in OCAML, C, perl)
- For a while, when using R, I had to install recent libraries with `install.packages`
  - Works well but this is bad practice
  - I generally "hate" python and the pip ecosystem

In my perspective software environment was never a real problem

- Just run `apt update; apt install`
- Enjoy all the most up-to-date software with bugfixes

10 YEARS REPRODUCIBILITY CHALLENGE



http://rescience.github.io/ten-years/

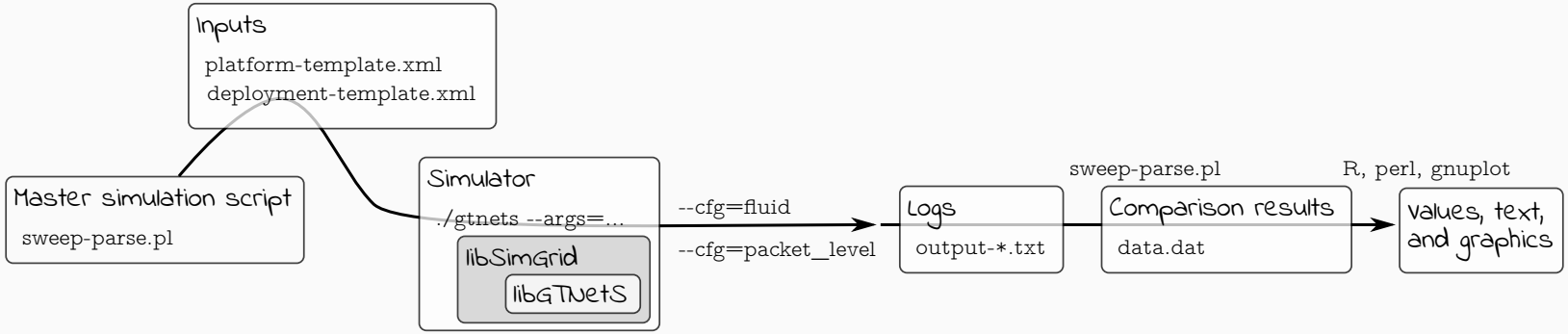
A 2009 Article

"Accuracy Study and Improvement of Network Simulation in the SimGrid Framework", Velho and Legrand, SimuTools 2009

Simulation comparison coarse-grain (SimGrid) vs. fine-grain (GTNetS)

- Compare a fluid bandwidth sharing model (`SimGrid`) with a packet-level model (`GTNetS`) of TCP
- Mostly simulations: 3 kind of network topologies, parameterized and randomized workload

Simulation workflow



Already a reproduction effort *"Speed and Accuracy of Network Simulation in the SimGrid Framework"*, Fujiwara and Casanova, ValueTools 2007

- We could not obtain the exact same results so we took notes and tried to make stuff available

Getting my Hands Dirty

Step 1: Getting the pieces together

Finding out data and instructions

- Do not trust your memory, ask the PhD student and his webpage!
- Provides `GTNetS`, the patches to apply and detailed instructions for SimGrid integration
- Experiments run in late 2008; previous SimGrid release $\approx$ 2007

Figuring out software versions

- GTNets: discontinued development since October 2008
- SimGrid dates from 2000 and Martin Quinson cares a lot:
  - Was hosted on `gforge.inria.fr`, then `github.com` (2010) and `gitlab.inria.fr`, and now `framagit`
  - SimGrid v3.3? Stable releases (`autotools`) are only on `gforge.inria.fr`

Step 2: Building an environment and compiling code

Shallow (but useful) description (README)

```
Author        : Pedro Velho
last modified : 03/11/2008

1. Disclaimer [...]
2. Short History [...]
3. Directory Structure [...]
4. Global System Requirements
   - GTNets patched simgrid version, we kindly provide GTNets with
     patches in the simgrid contrib svn repository [FIXME]
   - SimGrid, configured and compiled with GTNets support [FIXME]
   For plotting graphs and explore the data:
   - R - the gnu version of S [FIXME]
   - Gnuplot [FIXME]
```

Dependencies

- perl, R, gnuplot: easy!! ☺
- simgrid: easy (autotools, C, a bit of C++ for GTNets) ☺
- gtnets: Qt3!!! ☹

I really need a 2009 software environment!!!

Let's grab a docker image from a 10 years old distro and consider Pedro used Debian stable (codename Lenny back then)

```
docker search debian-lenny
```

```
NAME                        DESCRIPTION
pblaszczyk/debian-lenny     5.0.10 amd64
lpenz/debian-lenny-amd64    Debian 5.0.10 Released 10 March 2012 for amd…
lpenz/debian-lenny-i386     Debian 5.0.10 Released 10 March 2012 for i386
...
```

Then write the Dockerfile

Docker file (1/2)

```
FROM lpenz/debian-lenny-i386

# Software dependencies
RUN apt-get update \
        && apt-get install -y --force-yes gcc g++ make wget \
                   unzip subversion patch less libqt3-mt \
                   libqt3-headers libqt3-mt-dev qt3-dev-tools

# Downloading GTNetS
RUN cd /root; svn checkout \
                  svn://scm.gforge.inria.fr/svn/simgrid/contrib/trunk/GTNetS/
# Downloading SimGrid
RUN cd /root; wget \
    https://gforge.inria.fr/frs/download.php/file/21430/simgrid-3.3.tar.gz
```

Docker file (2/2)

```
# Building GTNetS
RUN cd /root/GTNetS/; unzip gtnets-current.zip ; tar zxvf gtnets-current-patch.tgz
RUN cd /root/GTNetS/gtnets-current; cat ../00*.patch | patch -p1
RUN cd /root/GTNetS/gtnets-current; ln -sf Makefile.linux Makefile && \
    make depend && make opt

# Installing GTNetS
RUN cd /root/GTNetS/gtnets-current/ && \
    mkdir -p /root/usr/lib/ &&         \
    ln -sf `pwd`/libgtsim-opt.so /root/usr/lib/libgtnets.so && \
    ln -sf `pwd`/libgtsim-opt.so /usr/lib/libgtnets.so &&      \
    mkdir -p /root/usr/include/ &&    \
    cp -fr SRC/*.h /root/usr/include/

# Building SimGrid
RUN cd /root/ && tar zxf simgrid-3.3.tar.gz
RUN cd /root/simgrid-3.3/ && \
    ./configure --with-gtnets=/root/usr/ && \
    export LD_LIBRARY_PATH=/root/usr/lib/libgtnets.so && \
    ldconfig && \
    make

RUN apt-get clean
```

Debian snapshot-archive...

It all went super smooth thanks to the instructions in the README ☺

What's broken in this Dockerfile?

- `gforge.inria.fr` will die in a few months
  - Use Software Heritage instead (zip files in an svn... shame ☹)
  - TODO: Save all simgrid stable archives (zenodo ?)
- `FROM lpenz/debian-lenny-i386`
  - `/etc/apt/sources.list` indicates:

    ```
    deb http://archive.debian.org/debian lenny main
    ```

    Last version (5.0.10) dates from March 2012
  - Debian Snapshot

    ```
    deb https://snapshot.debian.org/archive/debian/20091004T111800Z/
    lenny main
    ```

Discover the `debuerreotype`

```
debuerreotype-init rootfs testing 2009-05-01-T03:27:08Z
```

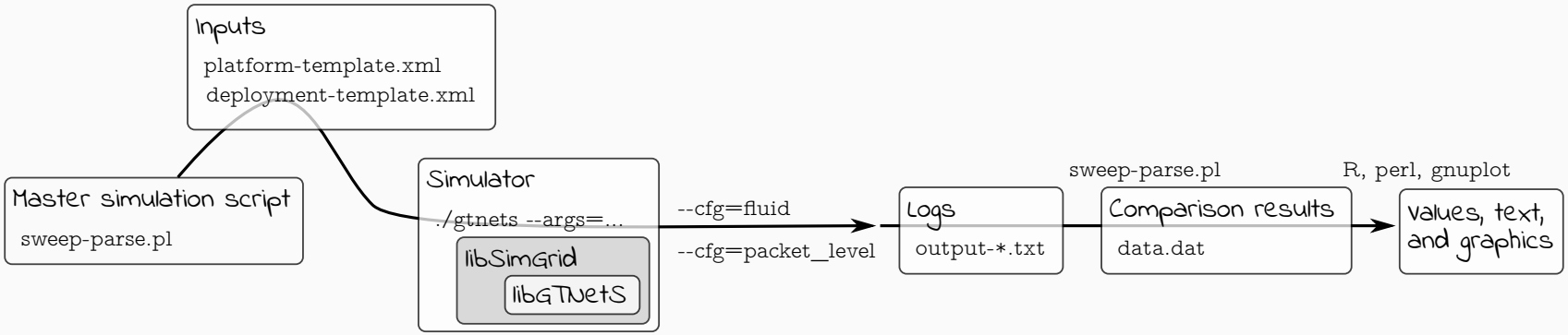
A few important things to know:

- Requires `root` privileges (see issue 66)
- `--keyring=/usr/share/keyrings/debian-archive-removed-keys.gpg`
- `vsyscall=emulate` (see issue 80)

This is the right way to proceed

but I was in the plane and fought against this `vsyscall=emulate` thing when I tried

Step 3: run stuff



- A home-made perl script with hard-coded paths (painful but worked)
- Obtained the same intermediate results (thanks to the `bin/ log/ dat/` organization)
- Long computation ⇝ stopped it before the end
  - But I could run the analysis and obtained similar output (linear regression, 3D plot)

- Only ran the simulation and the analysis
  - no workload generation (no information was given, but it would have required `Java` and no information on the seed was kept)

Conclusion

Conclusion on the challenge

I greatly underestimated:

1. Link rot (simgrid, gforge closure, webpage)
2. Lack of automation (org-mode or snakemake would have made everything much simpler)
3. Environment reconstruction (limited information)
   - Yet, I could easily rebuild a working environment (Debian)
   - Was it the exact same code ?
     - ¯_(°_o)_/¯ gave the same results for the parts I ran 😉

Conclusion on Docker

Docker is easy to use but does not provide with any help/warranty!

Docker can be quite helpful for the average scientist to build reproducible environments provided a few precautions are taken:

1. Regularly work in a container with minimal dependencies
   - Also separate the code from the data (, which can be painful)
2. Use high quality and trusted software packages (Debian)

   To what extent should one trust a statement that a program is free of Trojan horses? Perhaps it is more important to trust the people who wrote the software. – *Ken Thompson, 1984*
3. Freeze the sources (debian snapshot-archive)
4. Document the creation (the DockerHub is not an archive!)

What if I had to redo this today (e.g., with snakemake)

- ship snakemake in my docker image ? Nope!
- snakemake in docker running my code in singularity ?