Driving 3D Printers with Python

Lessons Learned

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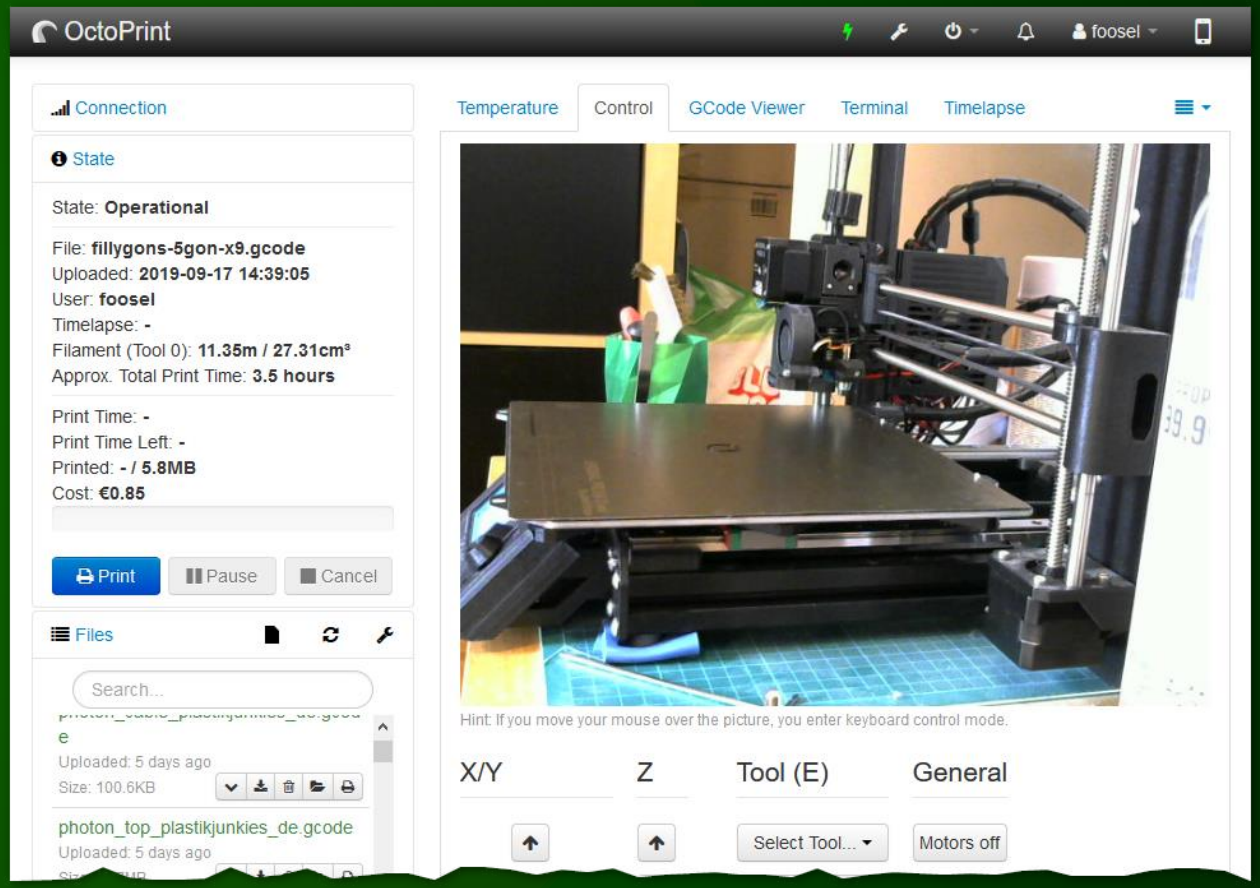
Gina Häußge

- Software engineer
- Maker
- Hobby baker
- 100% Nerd
- Full time OSS dev
- Creator & maintainer of **OctoPrint**

OctoPrint?

- “The snappy web interface for your 3D printer!”
- Open Source, AGPLv3
- ~100k confirmed users, unknown actual number
- Backend: **Python**
- Frontend: HTML & CSS & JS
- 👉 octoprint.org



Target audience & platform

- OctoPrint's audience: Owners of 3D Printers = makers & tinkerers, some businesses
  - end users
  - rarely developers themselves
- Platform: Small single PCB Linux computers
  - e.g. Raspberry Pi
  - but: platform agnostic!

Challenge #1

Initial installation and keeping things up to date

Initial installation

- Initial installation happens by the end user
  - 😱 Bootstrap Python & `pip install octoprint`
  - 😊 Preconfigured RaspberryPi image: download, flash, wizard, done
- And on something that is not a Pi?
  - There be dragons 🐉 but it's supported
  - Huge variety of encountered environments (Linux, Windows, Mac, FreeBSD, ...)
  - Code needs to anticipate that
    - E.g. IPv6 dual stack on Windows
    - E.g. file locking differences

Keeping things up to date

- OctoPrint
  - 😱 `pip install -U octoprint`
  - 😊 Built-in update mechanism for OctoPrint & plugins via pip
- pip
  - 😱 `You are using pip version X, however version Y is available. You should consider upgrading via the 'python -m pip install --upgrade pip' command.`
  - 😊 Scary message hidden, optional auto-update
- Operating system?
  - Some do, some don’t
  - Result: unknown environment, sometimes broken environment, hard to test, additional support overhead
- “Never touch a running system!” 👎

Lessons Learned

1. Try to control runtime environment but stay flexible.
2. Make updates easy.
3. Use features as motivator for touching a running system.

Challenge #2

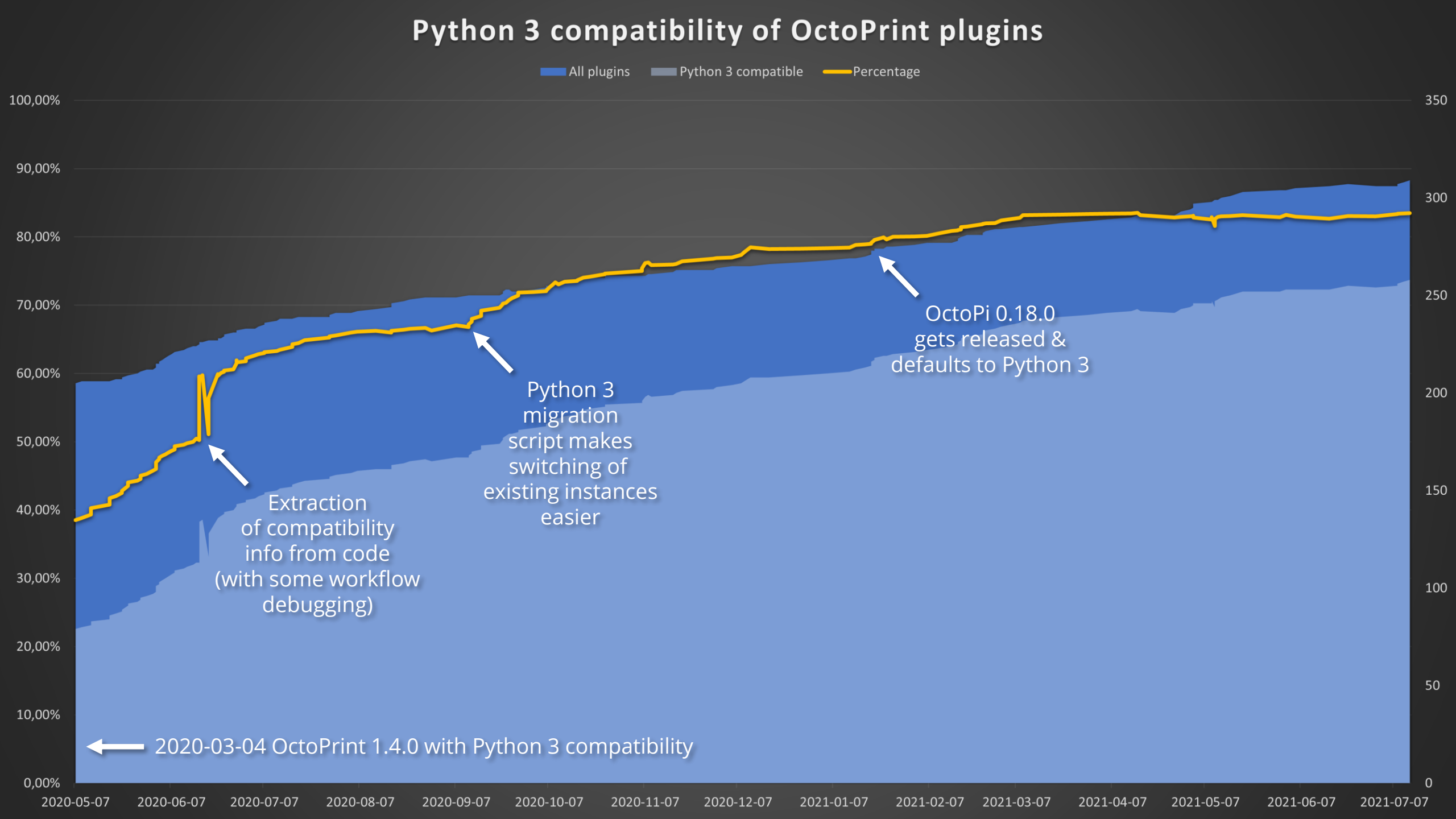
Maintaining backwards compatibility for a whole ecosystem

Maintaining backwards compatibility

- Plugin system since 2015 (1.2.0), over 300 plugins
- Established plugin ecosystem ⇥ this is suddenly a platform that needs stability
  - Disgruntled authors = no ecosystem = disgruntled users
- Problem: Dependency updates with breaking changes
- Problem: Code refactoring
- Problem: Python 2 vs 3 ⚡

Migrating an ecosystem to Python 3

- Preparation & briefing
  - Python compatibility information in plugins & repository
  - Migration guide for plugin authors
  - Early preview versions to test against
  - Enforcing Python 2 & 3 compatibility on newly registered plugins
- 🚀 OctoPrint 1.4.0 w/ Python 2&3: March 4th 2020
- Ongoing migration
  - Users asked to report incompatibilities to plugin authors
  - Migration script & new image
  - Motivation: Performance, shiny new plugins


Python 3 compatibility of OctoPrint plugins
All plugins
Python 3 compatible
Percentage
100,00%
90,00%
80,00%
70,00%
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
350
300
250
200
150
100
50
0
2020-05-07
2020-06-07
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2020-12-07
2021-01-07
2021-02-07
2021-03-07
2021-04-07
2021-05-07
2021-06-07
2021-07-07
Extraction of compatibility info from code (with some workflow debugging)
Python 3 migration script makes switching of existing instances easier
OctoPi 0.18.0 gets released & defaults to Python 3
2020-03-04 OctoPrint 1.4.0 with Python 3 compatibility

Lessons Learned

1. Read changelogs of dependencies (if you can find them) & use version pinning to your advantage.

2. Be prepared to work around breaking changes.

3. Most of all: Keep the eco system worth living in.

Challenge #3

Performance

Performance

- Webinterface + several clients + keeping a printer running + plugins + ... 🤪
- Locked to one thread at a time (GIL)
- Many CPU bound tasks (message parsing, checksums, file analysis, ...)
- Multiple processes? Not trivial due to needed data sharing (plugins) & cross platform difficulties
- Underlying platform often limited (RPi)

Lessons Learned

1. Extract CPU bound tasks if possible.
2. Be very conservative with resources.
3. Explore IPC options & native bindings.

Thank you for your attention!

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