Free and Open-source Software

Martin Kellogg

Free and Open-source Software

Today's agenda:

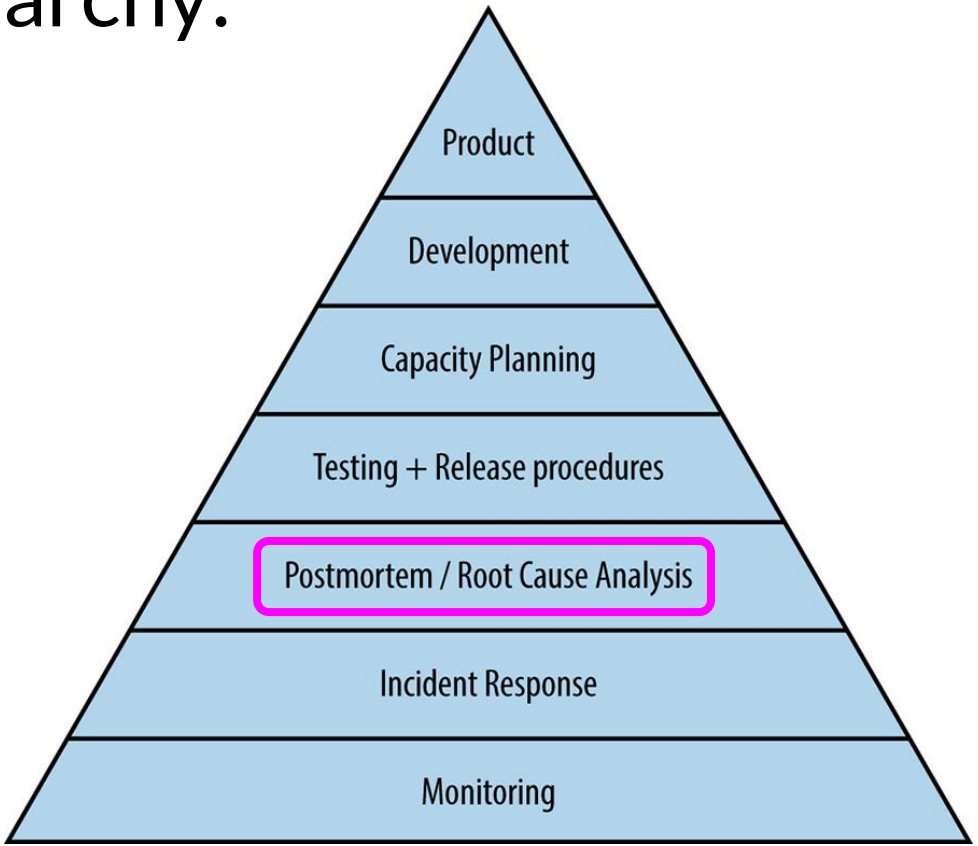
- **Finish devops slides**
- History + the "free software" philosophy
- Open-source: licenses and business models
- Mid-semester survey: how am I doing?

DevOps (2/2)

Today's agenda:

- The service reliability hierarchy + SLAs/targets
- Monitoring
- Incident/emergency response
- **Post-mortems + learning from failure**

Service Reliability Hierarchy: Post-mortems



[Image credit: https://sre.google/sre-book/part-III-practices/]

Post-mortems

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- good postmortems are **blameless** and **actionable**:
  - “**blameless**” = find the faults in the process, not the people
  - “**actionable**” = give specific guidance for how to avoid the problem in the future (these become tickets)

Post-mortems: blameless

- Why not assign blame after an incident?
  - After all, **someone** should be responsible, right?

Post-mortems: blameless

- Why not assign blame after an incident?
  - After all, **someone** should be responsible, right?
- Some reasons:
  - Gives people **confidence to escalate** issues without fear
  - Avoids creating a culture in which incidents and issues are **swept under the rug** (which is worse long-term!)
  - **Learning experience**: engineers who have experienced an incident won't make the same mistakes again
  - You can't "fix" people, but you can fix **systems and processes**

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Historically, software engineering adopted a lot of "blameless culture" from **aviation and medicine**, where mistakes can be fatal! We might not have the same stakes, but **all complex systems are similar** in a lot of ways.

Post-mortems: peer review

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- Peer review **raises the bar**: senior engineers on other teams will expect you to **explain and justify** the changes you are proposing in response to an incident
  - leads to more actionable takeaways and better understanding of what went wrong
  - also enables engineers on different teams to learn from each others' mistakes

Post-mortems: example

Shakespeare Sonnet++ Postmortem (incident #465)

Date: 2015-10-21

Authors: jennifer, martym, agoogler

Status: Complete, action items in progress

Summary: Shakespeare Search down for 66 minutes during period of very high interest in Shakespeare due to discovery of a new sonnet.

Impact:[163] Estimated 1.21B queries lost, no revenue impact.

Root Causes:[164] Cascading failure due to combination of exceptionally high load and a resource leak when searches failed due to terms not being in the Shakespeare corpus. The newly discovered sonnet used a word that had never before appeared in one of Shakespeare's works, which happened to be the term users searched for. Under normal circumstances, the rate of task failures due to resource leaks is low enough to be unnoticed.

Trigger: Latent bug triggered by sudden increase in traffic.

[source: https://sre.google/sre-book/example-postmortem/]

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Summary: Sha
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Resolution: Directed traffic to sacrificial cluster and added 10x capacity to mitigate cascading failure. Updated index deployed, resolving interaction with latent bug. Maintaining extra capacity until surge in public interest in new sonnet passes. Resource leak identified and fix deployed.

Detection: Borgmon detected high level of HTTP 500s and paged on-call.

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Post-mortems: example

Action Item	Type	Owner	Bug
Update playbook with instructions for responding to cascading failure	mitigate	jennifer	n/a DONE
Use flux capacitor to balance load between clusters	prevent	martym	Bug 5554823 TODO
Schedule cascading failure test during next DiRT	process	docbrown	n/a TODO
Investigate running index MR/fusion continuously	prevent	jennifer	Bug 5554824 TODO
Plug file descriptor leak in search ranking	prevent	agoogler	Bug 5554825 DONE

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and 5 more…

[source: https://sre.google/sre-book/example-postmortem/]

Post-mortems: example

Lessons Learned

What went well

- Monitoring quickly alerted us to high rate (reaching ~100%) of HTTP 500s
- Rapidly distributed updated Shakespeare corpus to all clusters

What went wrong

- We're out of practice in responding to cascading failure
- We exceeded our availability error budget (by several orders of magnitude) due to the exceptional surge of traffic that essentially all resulted in failures

Where we got lucky[166]

- Mailing list of Shakespeare aficionados had a copy of new sonnet available
- Server logs had stack traces pointing to file descriptor exhaustion as cause for crash
- Query-of-death was resolved by pushing new index containing popular search term

[source: https://sre.google/sre-book/example-postmortem/]

Post-mortems: example

Timeline[167]

2015-10-21 **(all times UTC)**

- 14:51 News reports that a new Shakespearean sonnet has been discovered in a Delorean's glove compartment
- 14:53 Traffic to Shakespeare search increases by 88x after post to **/r/shakespeare** points to Shakespeare search engine as place to find new sonnet (except we don't have the sonnet yet)
- 14:54 **OUTAGE BEGINS** — Search backends start melting down under load
- 14:55 docbrown receives pager storm, `ManyHttp500s` from all clusters
- 14:57 All traffic to Shakespeare search is failing: see **https://monitor**
- 14:58 docbrown starts investigating, finds backend crash rate very high
- 15:01 **INCIDENT BEGINS** docbrown declares incident #465 due to cascading failure, coordination on `#shakespeare`, names jennifer incident commander
- 15:02 someone coincidentally sends email to **shakespeare-discuss@** re sonnet discovery, which happens to be at top of martym's inbox

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this goes on for several pages!

- **shows importance of keeping records**

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DevOps: takeaways

- Many modern engineering organizations prefer to combine, rather than separate, development and operations
  - this works best when most systems are services
- Major benefit of DevOps approach is elimination of toil
  - developers are best at building automation
- Planning for incidents/emergencies is critical
  - Monitoring allows on-call to quickly identify problems
  - Have a plan (ideally, in a playbook) for incidents
  - Use post-mortems to learn from prior emergencies
    - not to blame people for causing them!

Free and Open-source Software

Today's agenda:

- Finish devops slides
- **History + the "free software" philosophy**
- Open-source: licenses and business models

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- Part of being a **software engineer** (vs just a programmer) is understanding the context of your work
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- This debate has **consequences** for both how you build and how you use software that, as a software engineer, you should understand
    - plus, it’s the sort of thing that other, more senior engineers will expect you to have an **informed opinion** about

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- “open source” != “open source software” (we’ll talk about why later)
- I’ll abbreviate “open source software” as **OSS**

The Case against Open Source

[Variation of popular meme, original source unknown]

The Case against Open Source

- “Open-Source Doomsday”: Once all software is free, we’ll stop making more software and have a market collapse
- Innovation will be stifled by the risk that software will be copied
- Making source code public means easier to attack
- “Anarchistic” licensing prevents companies from profiting from open source software

[Variation of popular meme, original source unknown]

The Case for Open Source

[Screenshot, 2022, opensource.microsoft.com]

The Case for Open Source

- “Many eyes make all bugs shallow”
- End-users can improve and customize software to their needs
- New features can be proposed and developed organically
- Greater productivity when more code is reused (easier with open source)
    - i.e., DRY on an industry-wide scale

[Screenshot, 2022, opensource.microsoft.com]

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    - Bell Labs practically gave it away to universities

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- Also 1983: “Starting this Thanksgiving I am going to write a complete Unix-compatible software system called GNU (Gnu’s Not Unix), and give it away free to everyone who can use it”

GNU logo (a gnu wildebeest)

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"Free as in speech, not as in beer"

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Difference between GPL v2 and GPL v3: is tivoization banned?

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  - Can you redistribute executable binaries, or only source?
  - Are you allowed to use the software in a restrictive hardware environment? ("***tivoization***")
- Popular alternative: "Do whatever you want with this software, but don't blame me if it doesn't work" ("***freeware***")

History: GNU/Linux (1991-Today)

- Stallman (FSF founder) set out to build an operating system in 1983, ended up building a **tremendous set of utilities** (“**GNU coreutils**”) that are needed by an OS (compiler, utilities, etc)

History: GNU/Linux

Remember: 1983 = Unix licensing changed because of AT&T breakup

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- Companies began **adopting and supporting** Linux for enterprise customers: e.g., IBM committed over $1B; Red Hat and others

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How did the bazaar model become dominant is OSS?

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  - also sued by US DoJ for antitrust bundling (!)
- January 1998: Netscape becomes first (?) company to make **source code for proprietary product open** (Mozilla)

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  - Publisher Tim O'Reilly organizes a "Freeware Summit" later in 1998, soon rebranded as "Open Source Summit"
  - "Open Source is a development methodology; free software is a social movement" - Richard Stallman, FSF founder

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Today's agenda:

- Finish static analysis slides
- Reading Quiz
- History + the "free software" philosophy
- **Open-source: licenses and business models**

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- Contributors bring **more than code**: also documentation, testing, support, and outreach
- Community/ownership models:
  - Corporate owner, community outreach (MySQL, MongoDB)
  - Foundation owner, corporate sponsors (GNU, Linux)

Is Open Source a Good Business Model?

Is Open Source a Good Business Model?

February 3, 1976

An Open Letter to Hobbyists

To me, the most critical thing in the hobby market right now is the lack of good software courses, books and software itself. Without good software and an owner who understands programming, a hobby computer is wasted. Will quality software be written for the hobby market?

Almost a year ago, Paul Allen and myself, expecting the hobby market to expand, hired Monte Davidoff and developed Altair BASIC. Though the initial work took only two months, the three of us have spent most of the last year documenting, improving and adding features to BASIC. Now we have 4K, 8K, EXTENDED, ROM and DISK BASIC. The value of the computer time we have used exceeds $40,000.

The feedback we have gotten from the hundreds of people who say they are using BASIC has all been positive. Two surprising things are apparent, however. 1) Most of these "users" never bought BASIC (less than 10% of all Altair owners have bought BASIC), and 2) The amount of royalties we have received from sales to hobbyists makes the time spent of Altair BASIC worth less than $2 an hour.

Why is this? As the majority of hobbyists must be aware, most of you steal your software. Hardware must be paid for, but software is something to share. Who cares if the people who worked on it get paid?

Is this fair? One thing you don't do by stealing software is get back at MITS for some problem you may have had. MITS doesn't make money selling software. The royalty paid to us, the manual, the tape and the overhead make it a break-even operation. One thing you do do is prevent good software from being written. Who can afford to do professional work for nothing? What hobbyist can put 3-man years into programming, finding all bugs, documenting his product and distribute for free? The fact is, no one besides us has invested a lot of money in hobby software. We have written 6800 BASIC, and are writing 8080 APL and 6800 APL, but there is very little incentive to make this software available to hobbyists. Most directly, the thing you do is theft.

What about the guys who re-sell Altair BASIC, aren't they making money on hobby software? Yes, but those who have been reported to us may lose in the end. They are the ones who give hobbyists a bad name, and should be kicked out of any club meeting they show up at.

I would appreciate letters from any one who wants to pay up, or has a suggestion or comment. Just write me at 1180 Alvarado SE, #114, Albuquerque, New Mexico, 87108. Nothing would please me more than being able to hire ten programmers and deluge the hobby market with good software.

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Graham Lea — Mon 31 Jul 2000 10:10 UTC

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20 Oct 2014 at 23:45, Neil McAllister

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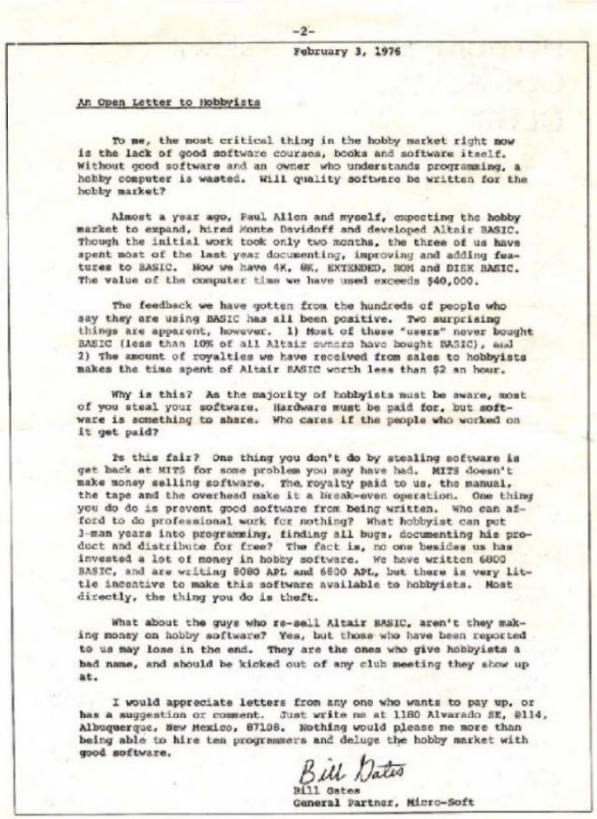
Microsoft Buys GitHub for $7.5 Billion, Moving to Grow in Coding's New Era

Give this article

A GitHub billboard being installed in San Francisco in 2014. Microsoft said on Monday that it would acquire the company for $7.5 billion. David Paul Morris/Bloomberg

By Steve Lohr

Is Open Source a Good Business Model?



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February 3, 1976

An Open Letter to Hobbyists

To me, the most critical thing in the hobby market right now is the lack of good software courses, books and software itself. Without good software and an owner who understands programming, a hobby computer is wasted. Will quality software be written for the hobby market?

Almost a year ago, Paul Allen and myself, expecting the hobby market to expand, hired Monte Davidoff and developed Altair BASIC. Though the initial work took only two months, the three of us have spent most of the last year documenting, improving and adding features to BASIC. Now we have 4K, 8K, EXTENDED, ROM and DISK BASIC. The value of the computer time we have used exceeds $40,000.

The feedback we have gotten from the hundreds of people who say they are using BASIC has all been positive. Two surprising things are apparent, however. 1) Most of these "users" never bought BASIC (less than 10% of all Altair owners have bought BASIC), and 2) The amount of royalties we have received from sales to hobbyists makes the time spent of Altair BASIC worth less than $2 an hour.

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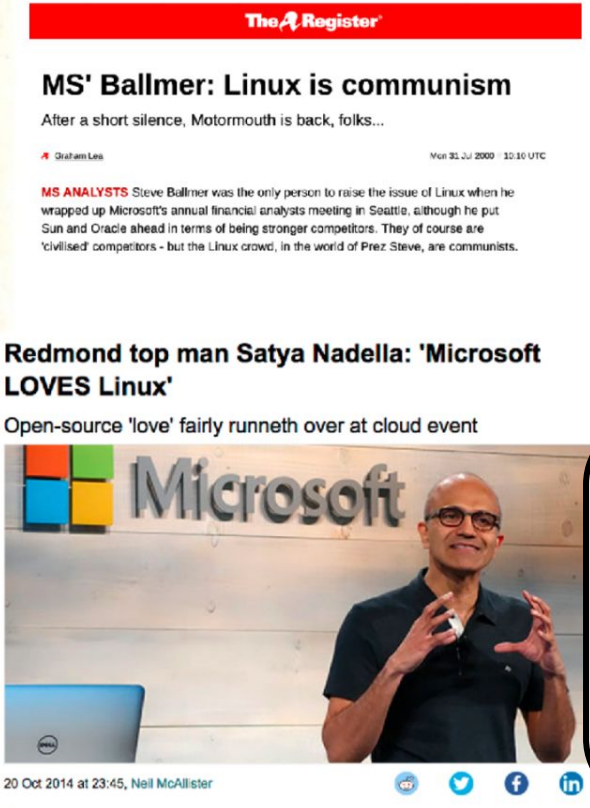

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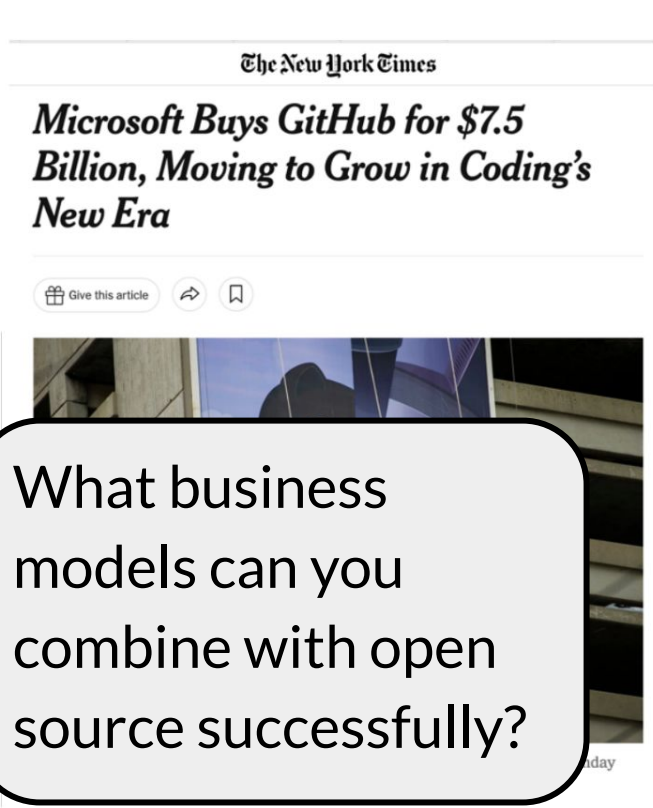

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Give this article

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What business models can you combine with open source successfully?

Model: “Open Core”, closed plugins

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- “**Open Core**” model: core component of a product is an open source utility; **premium plugins** available for a fee
- Example: Apache Kafka, a distributed message broker (glue in an event-based system)
  - Product is open source, maintained by Apache foundation, supported by company “Confluent”
  - Confluent provides plugins to connect Kafka to many different systems out-of-the-box

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  - many companies provide specialized “distributions” of these open source infrastructure and specialized tools to improve them; support the upstream project

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- Open source software is **generally copyrighted**, with copyright retained by contributors or assigned to a foundation/corporation that maintains the product
- Copyright holder can grant a ***license*** for use, placing restrictions on how it can be used (perhaps for a fee)
  - Common open source licenses: MIT, BSD, Apache, GPL

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Philosophy: do we force participation, or try to grow/incentivize it in other ways?

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- Examples: MySQL, Qt

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  - 2011: Community forms a foundation, creates fork LibreOffice, OpenOffice dies off (Oracle transfers to Apache)

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- Oracle v Google: Oracle asserted that Java APIs were their property (copyright) and Google misused that; judge ruled that **APIs specifications cannot be copyrighted**

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Industry must balance these risks against the **clear benefit** of OSS: reusing existing code

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Many companies **forbid** their developers from using Copilot or similar tools because of the risks from these legal battles!

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Possible future workflow:

1. LLMs generate code
2. deductive verification tools check for correctness
3. SDE reviews final code

Takeaways: free and open-source software

- Free software and open-source software represent different **philosophies** about how code should be shared:
  - Free software: if I share with you, you need to share with me
  - Open source software: I share with you, you do what you want
- Because software is copyrightable, licenses enforce philosophy
  - **copyleft** licenses enforce free software principles
- Many viable open source business models, but all have risks
- **Licensing concerns** are the main reason to avoid open-source code in industry (industry loves permissive licenses)

Course announcements

- The class has used all free GitHub private-repo CI minutes
  - to continue to run CI, you will need to make your repo public
- I am traveling next week (for a research conference):
  - class on Wednesday is “project time”. If your whole group shows up to the classroom, you’ll all get bonus reading quiz points
  - office hours (but not class) on Friday are cancelled
- Our last class (Wednesday 12/13) will be project demos. Expect to present for ~5 minutes to the class
- Please fill out the course evaluation (I read them carefully!)
- On the final exam, RQ redux will be new (not repeated) questions

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B. NSA backdoors (PRISM/Snowden leaks)
C. Digital Rights Management (DRM)
D. Google ads

Q2: The author argues that both of the terms “free software” (**A**) and “open source software” (**B**) can be misunderstood. Which of these two (**A** or **B**) does the author claim has an “obvious meaning” that is different than the meaning that its advocates intend?

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C. Digital Rights Management (DRM)
D. Google ads

Q2: The author argues that both of the terms “free software” (**A**) and “open source software” (**B**) can be misunderstood. Which of these two (**A** or **B**) does the author claim has an “obvious meaning” that is different than the meaning that its advocates intend?