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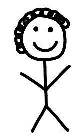
SO YOU WANT TO BE A WIZARD

by Julia Evans

Here's how I approach learning hard things and getting better at programming!

about this zine

Hi! I'm Julia.



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blog: jvns.ca

I don't always feel like a wizard. I'm not the most experienced member on my team, like most people I find my work difficult sometimes, and I have a TON TO LEARN.

But over the past 5 years I've learned a few things that have helped me. We'll talk about:

- how asking dumb questions is actually a superpower
- debugging tools that help you FEEL like a wizard
- how learning to write a design doc has helped me
- how to approach learning a complex system
- reading the source code to your dependencies and why that's useful

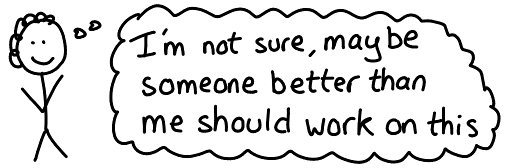
This zine definitely won't teach you to be a wizard by itself, but hopefully it has one or two useful tips!

A lot of it is aimed at me, a little earlier in my career ☺

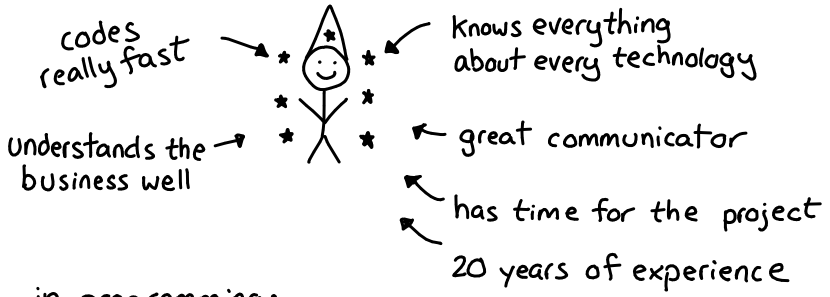
take on hard projects

To wrap up, let's talk about one last wizard skill: confidence

When there's a hard project, sometimes I think:


I'm not sure, maybe someone better than me should work on this

and I imagine this ★ magical ★ human:



in programming:

→ we're changing the tech we use all the time

→ every project is different and it's rarely obvious how to do it

→ there aren't many experts and they certainly don't have time to do everything.

So instead, I take myself:

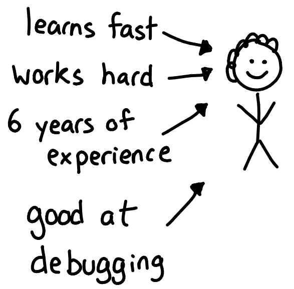
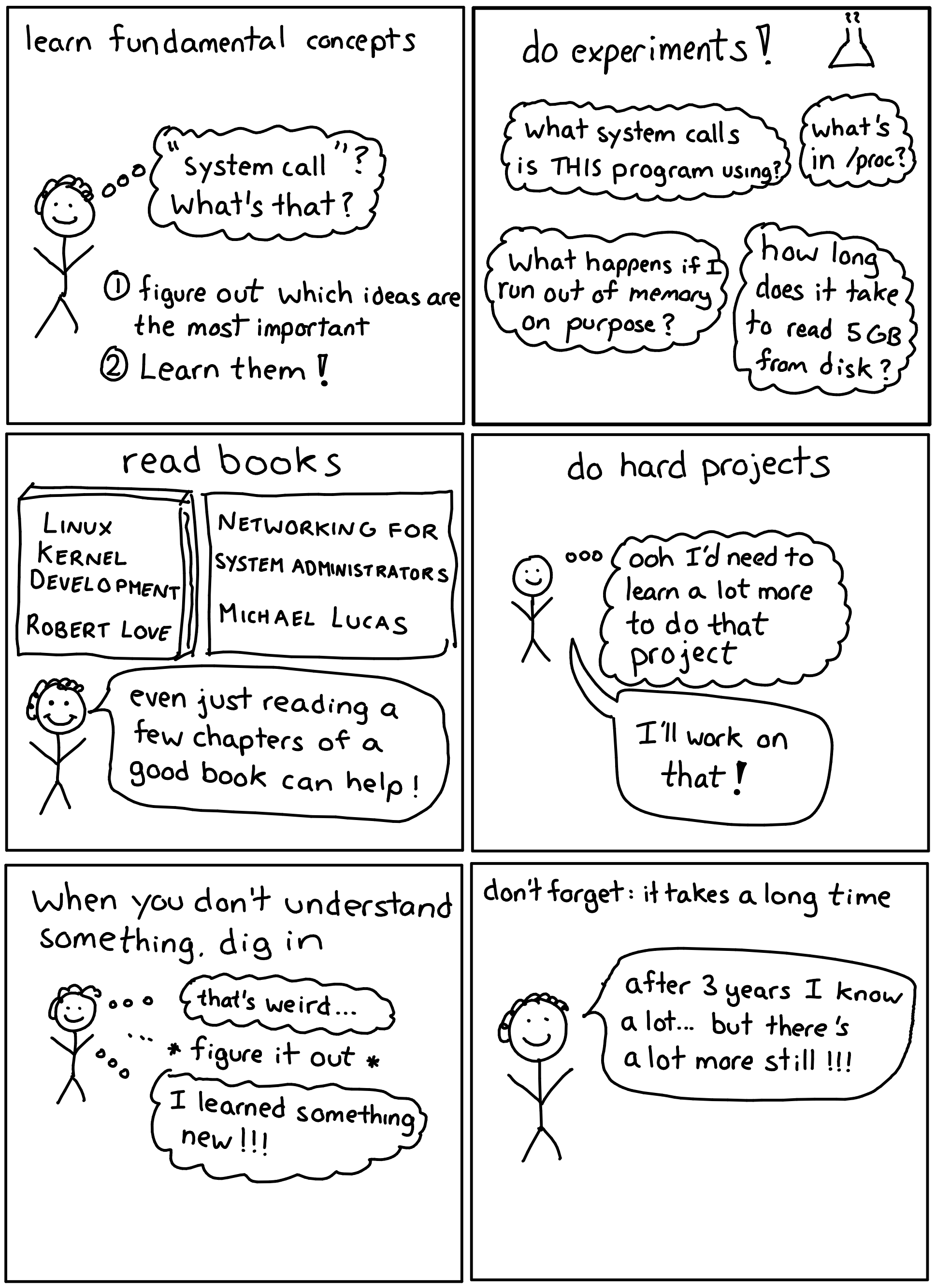


figure "someone's gotta do this", write down a plan, and get started! A lot of the time it turns out well, I learn something, and feel a little more like a wizard ♥

ways to build expertise


learn fundamental concepts
"system call"? What's that?
① figure out which ideas are the most important
② Learn them!
do experiments!
what system calls is THIS program using?
what's in /proc?
What happens if I run out of memory on purpose?
how long does it take to read 5GB from disk?
read books
Linux Kernel Development Robert Love
Networking for System Administrators Michael Lucas
even just reading a few chapters of a good book can help!
do hard projects
ooh I'd need to learn a lot more to do that project
I'll work on that!
when you don't understand something, dig in
that's weird...
... * figure it out *
I learned something new!!!
don't forget: it takes a long time
after 3 years I know a lot... but there's a lot more still !!!

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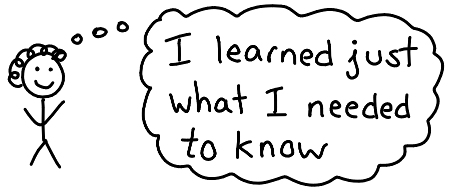
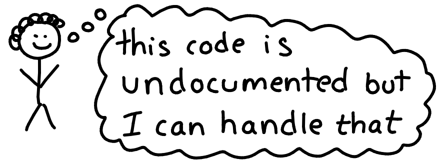
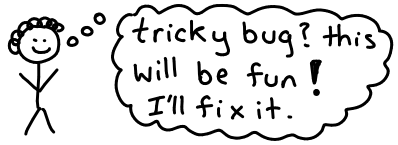
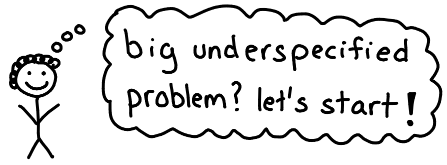
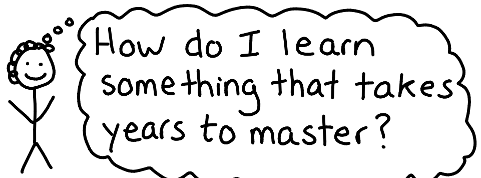
Here's what we'll cover!

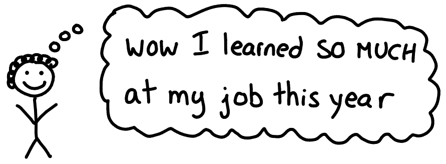












How to be a Wizard Programmer

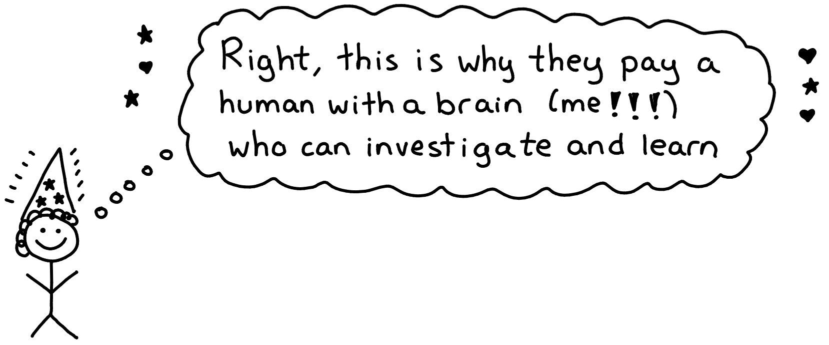
who can do anything (takes a very long time)

1. ASK QUESTIONS. As long as there are people around you who know things you don't, ask them how to do things. Dumb questions. Scary-to-ask questions. Your questions will get less dumb fast.
2. Run into a problem your coworkers don't know how to solve either.
3. DECIDE YOU WILL FIGURE OUT HOW TO SOLVE THE PROBLEM ANYWAY (this is very hard but sometimes it works ☺)

The more programming I do, the more issues I run into where:

- I don't know
- my colleagues don't know
- Google doesn't know
- we gotta figure it out anyway

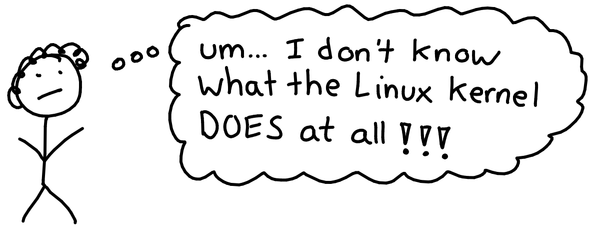
When this happens, I think:


Right, this is why they pay a human with a brain (me!!!) who can investigate and learn

This zine is about what the skill of "figure it out anyway" looks like.

it's not too late to start learning

I started learning Linux in high school, in 2003. In 2013, after using it every day for 10 years, I realized something kind of scary:



Julia, 2013

There were all KINDS of concepts that I either didn't understand or didn't even know existed:

virtual memory

system call

futex

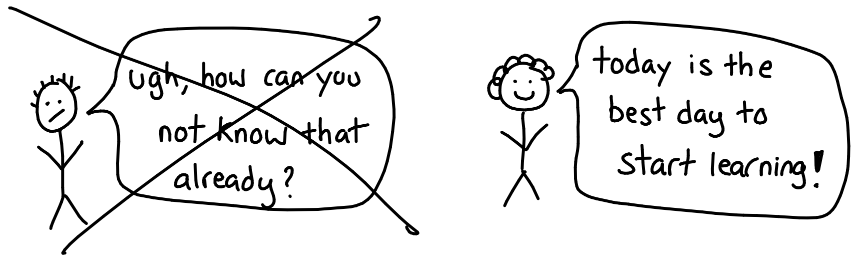
interrupts

file descriptor

TCP

CPU scheduling

Just today (in 2017!) I realized I don't fully understand how Linux users/groups work. No big deal! I picked up my copy of "The Linux Programming Interface", read Chapter 9, and now I understand.


~~ugh, how can you not know that already?~~
today is the best day to start learning!

let's build expertise!

Let's zoom out a bit. A lot of the people I admire the most have been working on getting better at what they do for ★ years ★.

I've found it useful to pick a few things I'm really interested in (like Linux!) and focus on those.

Things I've spent significant amounts of time (at least a year) working on getting better at:

- Linux networking!
- debugging + profiling tools!
- machine learning!
- planning projects at work!
- technical writing / speaking!

There are lots of things (Go! Databases! Javascript!) that are important and I know a little about but haven't spent that much time on. That's okay!

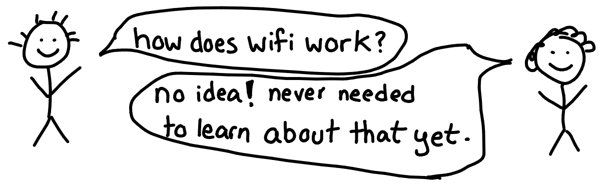
It's super fun to see a progression like

I'm going to learn about networking
... 6 months ... later
oh wow I'm a lot better at this now!

and I think a) picking something to focus on, and b) *actively* working on getting better at it is how all the people I admire got where they are.

When to invest in understanding?

We work with a lot of abstractions. You don't always need to spend time understanding how they all work under the hood.



But a huge part of becoming a wizard is understanding how a seemingly magical computer system works.
When is it useful to spend time learning how a thing works?

① When you're trying to debug a tricky problem

→ Sometimes the librairies you depend on have bugs
→ Often librairies/systems (like CSS, Linux) have complex abstractions ("the box model" "epoll" on Linux) that take time to learn

② When you're trying to push the limits / optimize performance

I don't always think about the hardware my code runs on.
But if you're writing data to a file, you're always limited by the speed of your disks!

③ When you're trying to innovate

If you're building a new abstraction (like an async library), you gotta understand how the next layer down works! (epoll, select, etc)

Asking good questions

One of my favourite tools for learning is asking questions of all the awesome people I know!

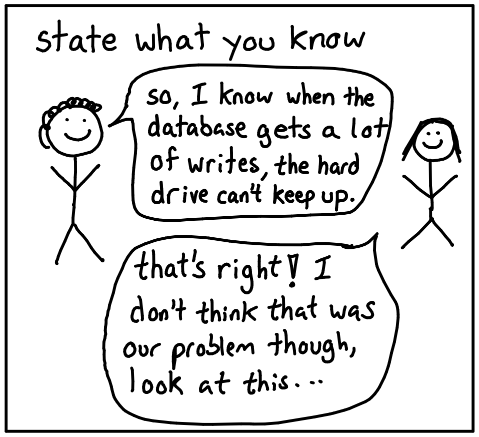
what's a good question?

good questions:

★ are easy for the person to answer

★ get you the information you're looking for

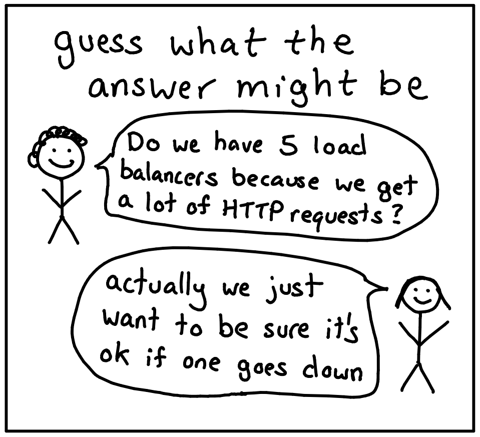
Here are some strategies for asking them:


state what you know
so, I know when the database gets a lot of writes, the hard drive can't keep up.
that's right! I don't think that was our problem though, look at this...

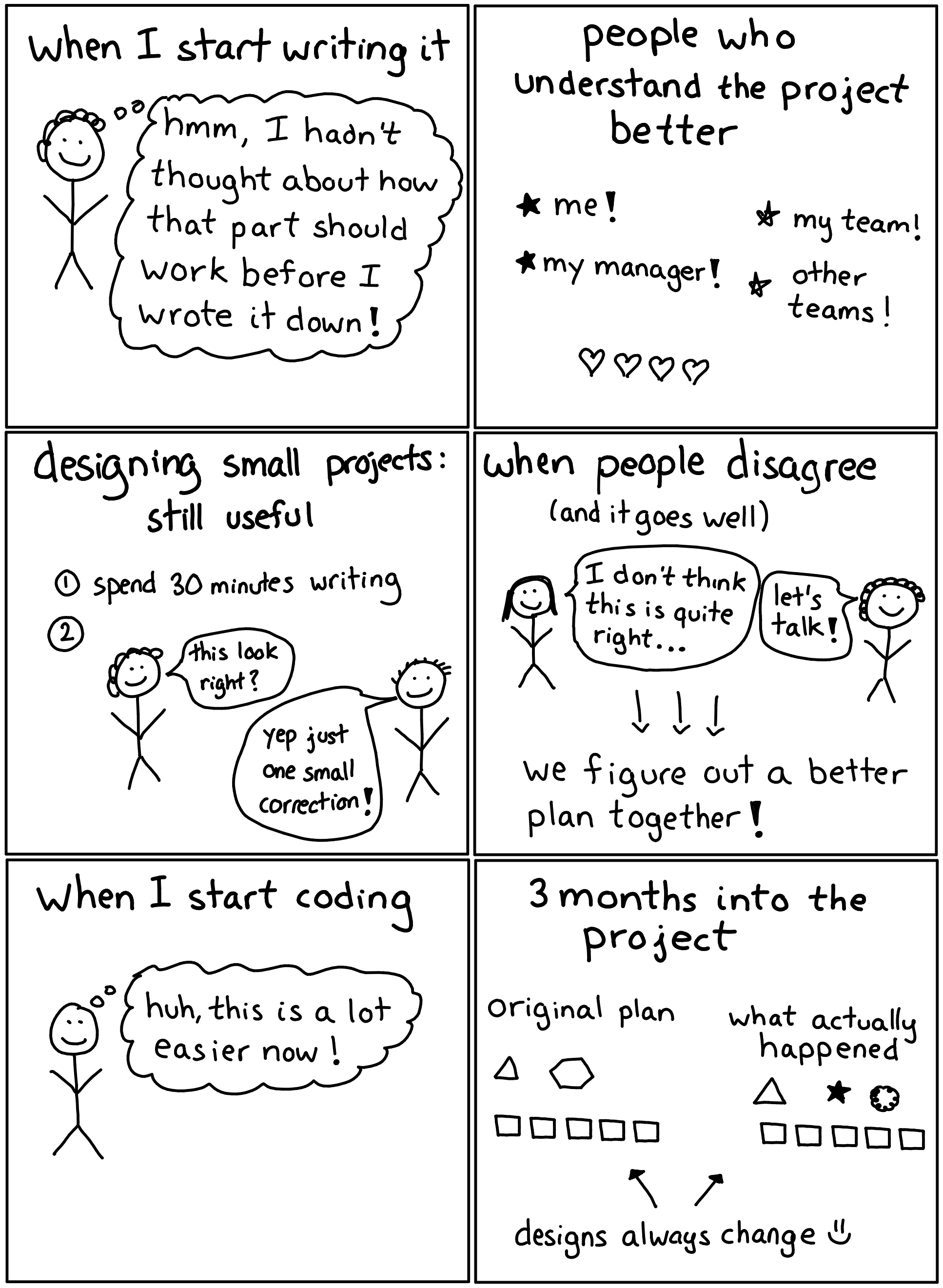
This helps because

- I'm forced to think about what I know
- I'm less likely to get answers that are too basic or too advanced

Trying to guess what the answer to the question might be makes me think and can sometimes help them see what kind of answer I'm looking for.

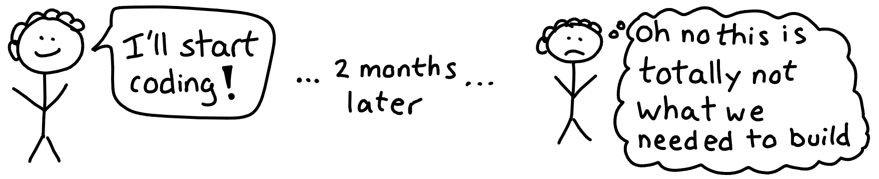

guess what the answer might be
Do we have 5 load balancers because we get a lot of HTTP requests?
actually we just want to be sure it's ok if one goes down

scenes from writing design docs


when I start writing it
hmm, I hadn't thought about how that part should work before I wrote it down!
people who understand the project better
★ me!
★ my team!
★ my manager!
★ other teams!
♡♡♡♡
designing small projects: still useful
① spend 30 minutes writing
②
this look right?
yep just one small correction!
when people disagree (and it goes well)
I don't think this is quite right...
let's talk!
↓↓↓
we figure out a better plan together!
When I start coding
huh, this is a lot easier now!
3 months into the project
original plan
what actually happened
designs always change ☺

learning to design software

It's surprisingly easy to end up in this situation:



A little bit of ♥ planning ♥ helps me make sure my hard work doesn't go to waste.

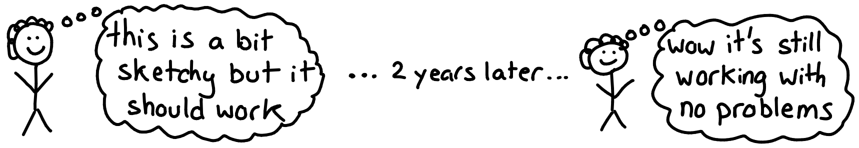
Here are a few things that help me to remember:

★ you can't predict how requirements will change

let's reprocess every record every day
... 2 years later ...
ok, doing that is way too expensive now

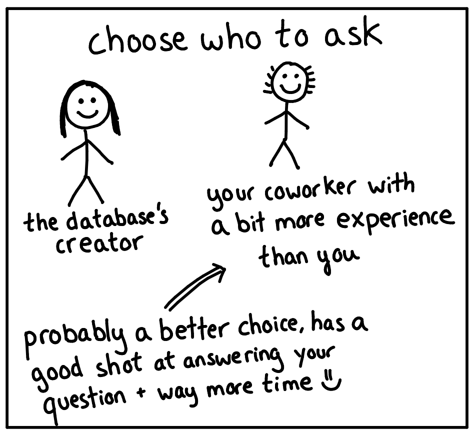
I just try my best and deal with changes when they come

★ "good enough" is often really awesome


this is a bit sketchy but it should work
... 2 years later ...
wow it's still working with no problems

★ making a proof of concept can really help

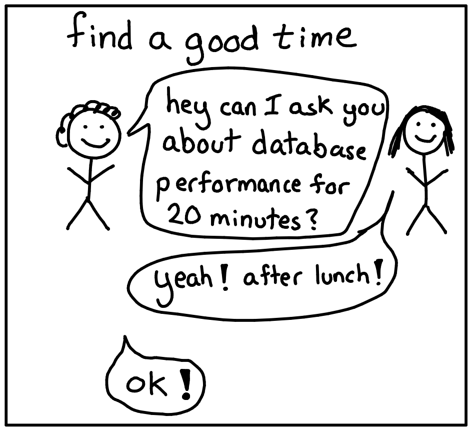
I bet we can make this 100x faster
show me a prototype and I'll believe it
coming right up!

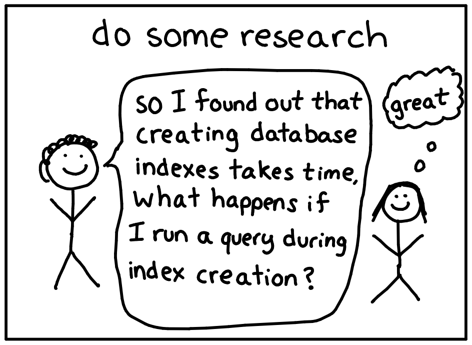

choose who to ask
the database's creator
your coworker with a bit more experience than you
probably a better choice, has a good shot at answering your question + way more time ‼

The person who knows the MOST isn't always the best person to ask!

Often someone who learned it more recently will remember better what it was like to not understand.

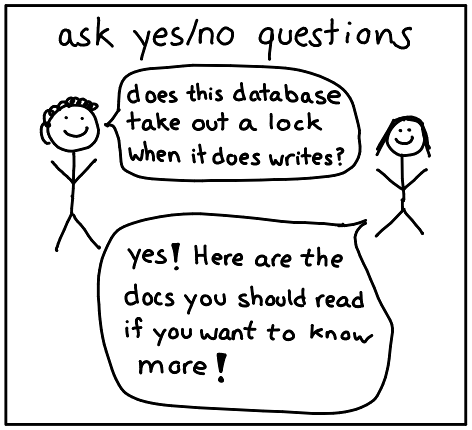
Especially if I have LOTS of questions, it's good to be respectful of their time ‼


find a good time
hey can I ask you about database performance for 20 minutes?
yeah! after lunch!
ok!


do some research
so I found out that creating database indexes takes time, what happens if I run a query during index creation?
great

If I spend some time doing research first, I can ask a WAY BETTER question ‼

I ♥ asking yes/no questions like this because they're easier to answer and it means I have to focus the question carefully


ask yes/no questions
does this database take out a lock when it does writes?
yes! Here are the docs you should read if you want to know more!

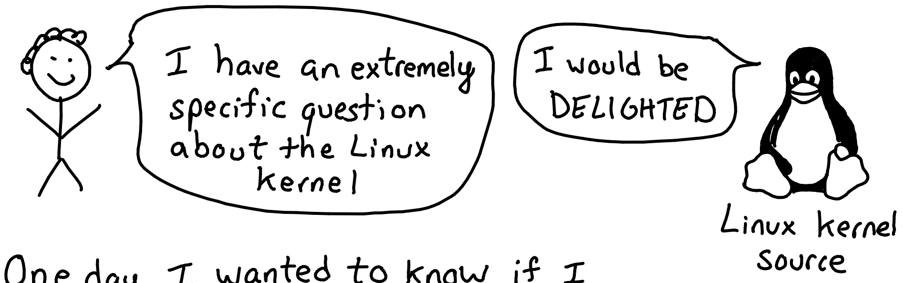
read the source code

Okay, but you can't ALWAYS ask people questions!

Sometimes:

→ there's no documentation
→ your coworkers are busy
→ or they don't know the answer
→ or you want to know A LOT more details than it is really reasonable to ask about

Luckily, we have open source!!!


I have an extremely specific question about the Linux kernel
I would be DELIGHTED
Linux kernel source

One day, I wanted to know if I could configure a socket on Linux to not queue connections. I Googled and got some conflicting answers. But one of the Stack Overflow answers linked directly to the KERNEL CODE!

It looked basically like:

```
backlog= max(backlog, 8)
```

hardcoded constant!

So it's impossible to set the backlog to 0. It'll always end up being at least 8 ☺

learning on my own

go to a conference

especially in an area I don't know well (like Linux kernel networking)

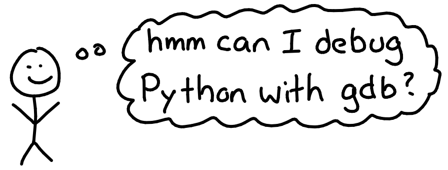
implement something that seems hard

gzip! tcp! keyboard driver! debugger!

pick a concept + spend 3 hours on it

b-trees! epoll! asyncio!

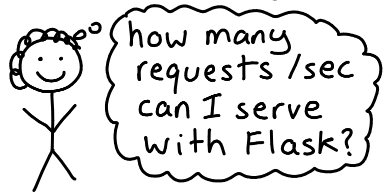
try a new tool



read a paper

Adrian Colyer's "The Morning Paper" has amazing paper summaries

do some experiments

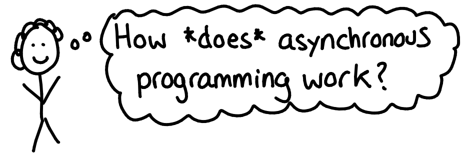


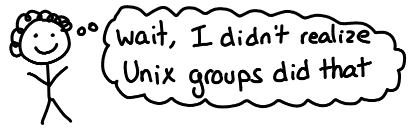
teach /blog it!

A huge part of my learning process is teaching as I learn! Reasons it helps:

→ revisiting basic questions is important

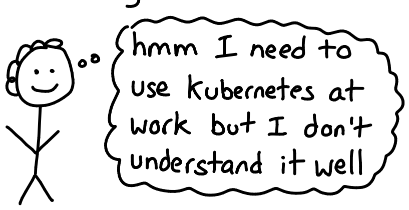
→ it forces me to realize when I don't actually understand something well yet





learning at work

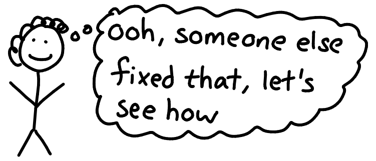
Almost everything I spend time on day to day is something I've learned on the job.


hmm I need to use kubernetes at work but I don't understand it well

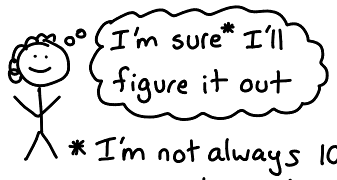
=> set aside work time to
- read source code
- ask questions
- watch talks
- read docs / blog posts
- do experiments

Debugging is one way to learn at work. Here are more ways!

follow up on bugs I couldn't figure out



volunteer to do work that seems hard



* I'm not always 100% sure, but it's worth trying!

pay attention to others' code

watch more senior people operate

"that person does AWESOME work how do they do it?"

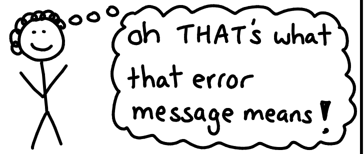
<u>don't</u>: advocate for using something at work just because I want to learn it

tips for reading code

what does this code do?
not sure, but nobody's touched it for a year & today it's broken
ok, time to find out

Here are some things I've found help when dealing with unfamiliar code:

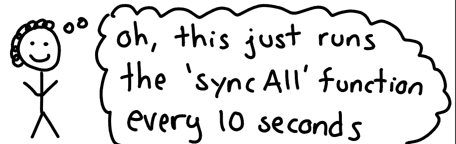
grep for the error message



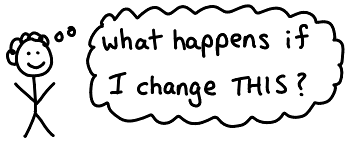
When I see an error message I don't understand, searching the source for it is really easy & sometimes helps

If the code I'm using is less than a few thousand lines, I like to quickly try to read it all to learn the basics of how it works

just read the whole source



edit the code

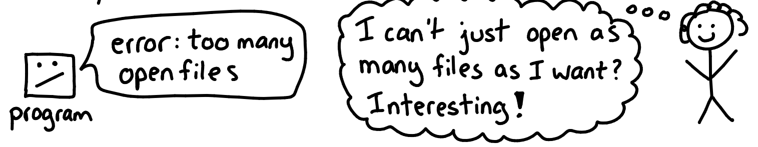


Get your hands dirty!
- step through with a debugger!
- add tests!
- add print statements!
- introduce bugs!
- experiment!
- don't always trust the comments ☺

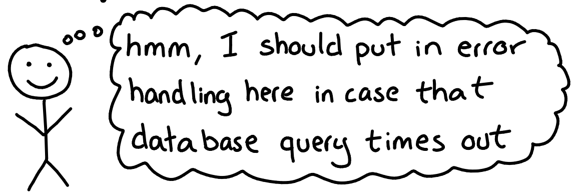
debugging: ♥ love your bugs ♥

(thanks to Allison Kaptur for teaching me this attitude! she has a great talk called Love Your Bugs)

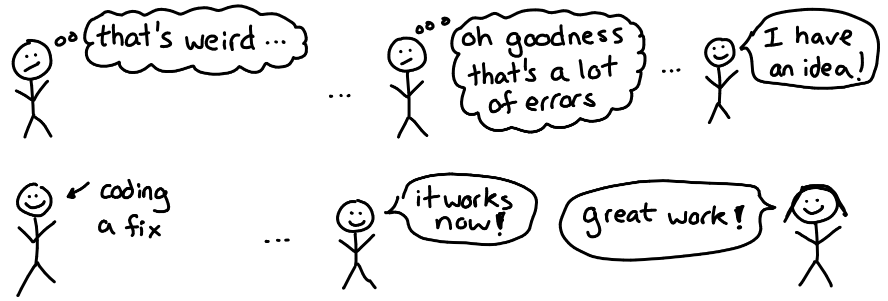
Debugging is a great way to learn. First: the harsh reality of bugs in your code is a good way to reveal problems with your mental model.


program
error: too many open files
I can't just open as many files as I want? Interesting!

Fixing bugs is also a good way to learn to write more reliable code!


hmm, I should put in error handling here in case that database query times out

Also, you get to solve a mystery and get immediate feedback about whether you were right or not.



Nobody writes great code without writing + fixing lots of bugs. So let's talk about debugging skills a bit!

how I got better at debugging

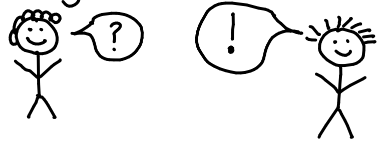
▨ Remember the bug is happening for a logical reason.

It's never magic. Really. Even when it makes no sense.

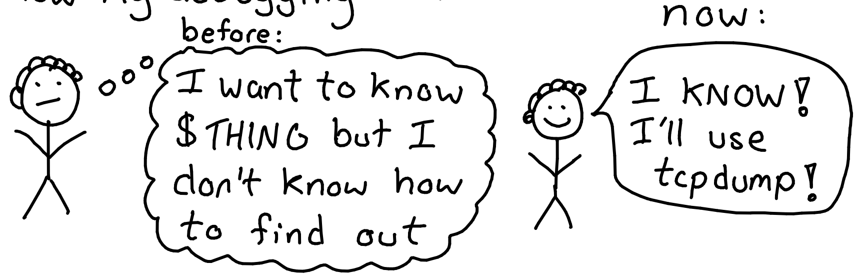
▨ Be confident I can fix it

before:
maybe this is too hard
now:
Well I've fixed a lot of hard bugs before

▨ Talk to my coworkers



▨ Know my debugging toolkit


before:
I want to know $THING but I don't know how to find out
now:
I KNOW! I'll use tcpdump!

▨ most importantly: I learned to like it

before:
oh no a bug
I think I'm about to learn something
facial expression: determination