so you want to be a Wizard

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bad news:

computers aren't magic
learning hard things
&
understanding complex systems
about me

engineer at Stripe
things my team is in charge of

- deployment
- CDN
- nginx
- Puppet
- service discovery
- load balancing
- managing AWS instances
- OS versions
- ... and MORE
technologies to know about

- **Linux** (what swap settings should we use?)
- **TCP/IP** (how should we set up this proxy tier?)
- **AWS** (one million services)
- **HTTP** (the Cache-Control header)
we need to do some work on $UNFAMILIAR-SYSTEM

Okay!
Wizard skills

- understand your systems
- ask great questions
- read the code
- debug like a wizard
- write down a design
- understand the big picture
wizard skill:

understand your systems
applications! business!

higher level

lower level

me

we'll spend most of our time here

Linux!

computer networking!
NETWORK iNG!

A COMPUTER NETWORKING ZINE!

BY JULIA EVANS!
why understand?
★ understand jargon
   "OOM Killer" "layer 4 proxy" "userspace"
★ debug really hard problems
   See: rachelbythebay's posts ❤️❤️
★ innovate
let's chip away!
learn fundamental concepts

“System call”? what's that?

❤ packets ❤
★ TCP ★
Recurse Center

12 week programming retreat

NYC
 Homework!

build a (very bad) TCP stack from scratch

I did it in Python!

time taken: ~1 week
do experiments!

Write a tiny operating system

What happens if I run out of memory on purpose?
run out of memory on purpose

LINUX

[oom killer]

OH NO! There is no more memory!
Time to start killing things!
try to write
an operating system

how do you write a keyboard
driver from scratch?
things that are missing when you have no OS

- files
- programs
- hard drive
- keyboard
- threads
- virtual memory
- networking
Rules of programming experiments

- It doesn’t have to be good
- It doesn’t have to work
- You have to learn something
read books

Linux Kernel Development
Robert Love

Networking for System Administrators
Michael Lucas
read things that are too hard
Work with it in your job

I can do some work with that HTTP proxy!
When you don't understand something, dig in

---

*That's weird...*

*figure it out*

*I learned something new!!!
Reasons a computer might swap

- actually no free RAM
- it's "mostly" out of RAM (see vm.swappiness)
- a cgroup is out of RAM
- bad vm.overcommit_ratio

$$\text{allocation limit} = \text{Swap} + \text{RAM} \times \text{overcommit ratio}$$
“Understanding the Linux Virtual Memory Manager”

200 pages docs + 400 pages code

Mel Gorman, 2007

sysctl/vm.txt
don't forget: it takes a long time

“learn to program in 10 years”
2003

my mom

here is an awesome new computer

2013

me, 15

I will install 100 different Linux distros!

2017

what's a system call?

still a ways to go! 😊
wizard skill:
ask great questions
knows lots about databases

wants to help

wants to know more

me
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! but...
stating what I know

→ helps organize my thoughts
→ reveals misunderstandings
→ avoids answers that are too basic/too advanced
don’t ask the most experienced person

probably a better choice

your coworker with a bit more experience than you
why this is great

- less load on more experienced person
- lower bus factor
- less exp. person gets to grow/establish knowledge
do some research

so I found out that creating database indexes takes time and I have questions about how that affects performance...

great
ask yes/no questions

does $DATABASE do hash joins?

yes! but only in this specific situation...
"how did you do that"

I fixed it!

ok how?

Can I watch you do that?
ask in public

I don't understand, ...

Senior engineer
wizard skill:

read the code
understand a mystery error message

print("it's broken")
no docs? no problem!

what does this code do?!

let's go find out
even hard codebases are possible to read sometimes!

how does this Drupal thing work?

read the code!
debug like a wizard
a story!

client

... 40 ms passes ...

server

hello !!!

oh hi!
that shouldn't take 40 ms!!!
40 ms = 25 requests/second
wireshark

client → HTTP headers

... 40 ms passes ...

rest of request

response

Server
client: “packet 1”
Server: “Waiting for packet 2”
client: “Waiting for ACK”

Server: “Ok I’m bored here’s an ACK”
client: YAY! Here’s your second packet
Server: all done!
Setting TCP_NODELAY makes the client stop waiting
how I got better at debugging
Remember the bug is happening for a logical reason.

- That's impossible.
- Well... it happened, so... why?
Be confident I can fix it

before: 

now: 

maybe this is too hard

well I've fixed a lot of hard bugs before
this Hadoop job is way too slow

... 3 weeks later...

it's fast now!
things I learned

→ 1000 records / second
isn't a lot

→ floating point exponentiation
is slow
train my intuitions

1000 records/second ... that seems slow
computers are fast

computers-are-fast.github.io
indexed database table
10 million rows

how many times per second can you
select * from table where id=1

1 10 100 1000 10000 100000 (mil) 10 mil 100 mil
55 000

computers-are-fast.github.io
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!
A small wizard tool handbook for anyone who writes (or runs!!) programs on Linux computers.

I know! I'll use tcpdump!
most importantly: I learned to like it

before:

now:

facial expression: determination

I think I'm about to learn something

oh no a bug
wizard skill:

write down a design

(let's zoom out!)
many names:

- design doc
- project brief
- tech spec
- architecture doc
- RFC
my stripe career

year 1

year 2

year 3

what's a design doc? seems like a waste of time

these are so useful
what I was scared of

DESIGN DOC

here are 10,000 things that are wrong with this

or

<total Silence>

everyone
design small projects

30 minutes

What we'll do

Thank you so much

other team's manager
Write the announcement email first

- why is this important?
- how does it impact other teams?
- how do we know it's working?
write a “premortem”

imagine the project failed. Why?

HBR article from 2007
track changes

what if things change?

yes that is normal
wizard skill:

understand the big picture
why am I doing this.
approach project planning with excitement and curiosity
① figure out why it's important

② do something else
understanding the big picture

better technical decisions
working on projects people care about is AWESOME
okay now
we're WIZARDS
Wizard skills

- understand your systems
- ask great questions
- read the code
- debug like a wizard
- write down a design
- understand the big picture
★ ask questions ★
(in public)

★ read something hard for you ★
thanks

blog: jvns.ca
zines: jvns.ca/zines
twitter: @b0rk

drawing by Liz Baillie
come get a zine!

Networking!
A Computer Networking Zine!
By Julia Evans!

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