SALSA: A success story of migrating research ideas into industry

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J2EE architecture analysis using relational algebra

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Lossy program analysis or Lies my extractor told me

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Research pre-history

- 2002 a research project called RAMP is born
  - RAMP == Rapid Assisted Migration Project
  - An industrial research collaboration with Sun Microsystems
  - Principal investigators:
    - UW: Profs Holt / Malton / Godfrey
    - Sun: Brian Down, Wai-Ming Wong
  - Part of the CSER research consortium:

    `http://www.cser.ca`

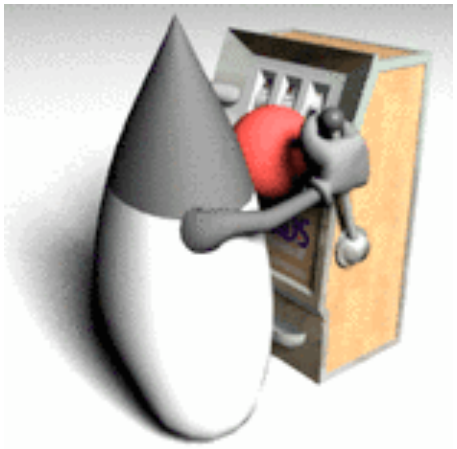
RAMP to Jackpot

- Contacts thru Sun / RAMP / conferences led to a sabbatical invitation
  - I spent Sept-03 to Aug-04 in Sun Research Labs in Mountain View, CA. It was awesome.

- I went to work on Jackpot, an AST-based analysis tool
  - Team members:
    - Michael Van De Vanter, James Gosling, Tom Ball, Tim Prinzing

Sun's Jackpot Tool

- AST-based analysis + transformation tool
  - Metrics summaries
  - "Bad smell" detection
  - Semi-automated source transformation
    - J++-to-Java migration, bad smell removal, …
  - Code visualization
  - "Smart" editor support



- Basic idea:
  1. Suck up *whole program* into memory
  2. "Play" with the AST
  3. Output transformed source code

Hello, Jackpot

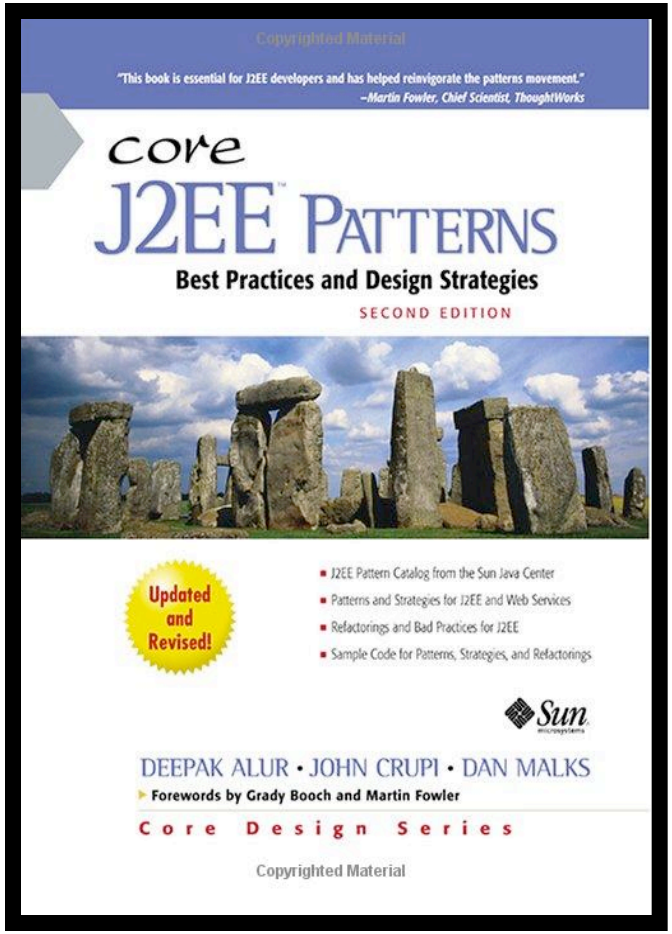
- When I arrived in Sept 2003:
  - Basic infrastructure works
  - Several bad smells can be detected automatically
  - Several automated transformations work
  - ...
- But
  - While the technology is very promising, it's hard for outsiders to pick up and adapt easily
    - Must understand both Jackpot and `javac` internals
    - Work is slow going and very detailed (AST hacking)

And then …

- Corporate re-org in early fall 2003
  - Oh no!
  - James Gosling becomes CTO of tools and the team moves with him, effectively putting Jackpot on back burner for now
  - I'm all alone in the lab with 10 months to go in my sabbatical …
- I continued to play around with Jackpot, writing a few small plugins for it.
  - For fun, I started to implement a Java "fact extractor" based around the **`javac`** AST

And then …

- Van De Vanter introduces me to Sun DE John Crupi, who has a problem:
  - *"We wrote the book on J2EE patterns (good and bad), but we're still using* ***`grep`*** *and* ***`perl`*** *to fix them !"*
- Van De Vanter, Crupi, and I meet several times to sketch out the design of a prototype J2EE architecture analysis tool based around Jackpot
- I was charged with finishing up the fact extractor and writing a few "smell detection" scripts



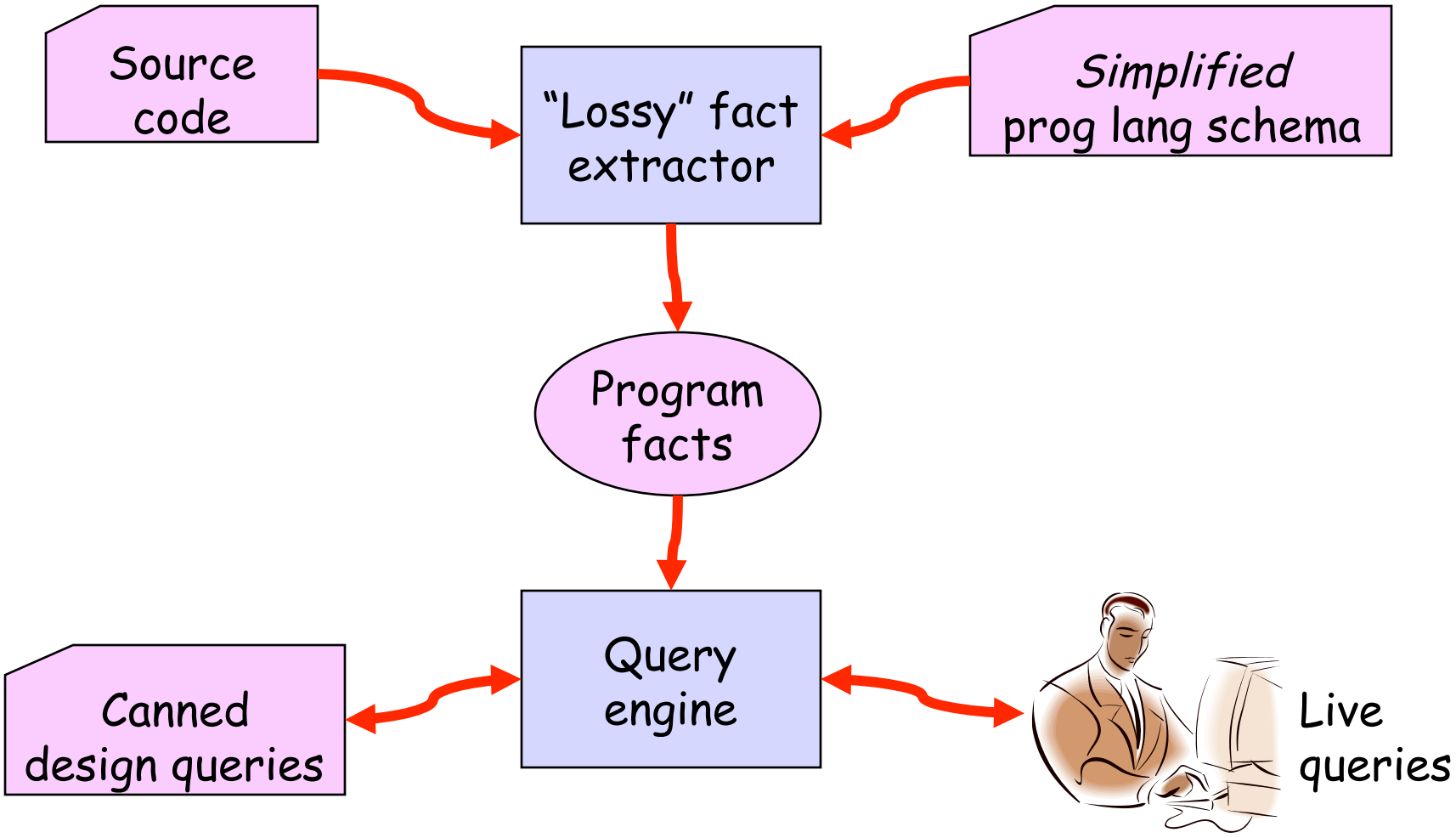
Kinds of program analysis tools

1. Special purpose, batch static analysis tools
   - Read in code, analyze, spit out (small) result set
     - Result set typically makes no sense on its own; need refs back to source code
   - Analysis goals hard-coded into tool
     - New goals? Write a new tool!

Kinds of program analysis tools

2. [Whole earth / big bang] [analysis / transform] tools:
   - Perform generic analysis (*e.g.,* compilation) and keep all of compilation "facts" in store
     - Then allow AST walkers to generate desired info
     - Source-to-source code transformation also possible
   - Analysis results can be customized via new tree walkers
     - Slow and detailed work
     - … but you can do just about anything to the source code
   - Each run requires a new compilation (or reading in saved AST / symbol table)

Lossy program analysis



Kinds of program analysis tools

3. "Lossy" program analysis
   - Generates a set of "facts" about the program
     - An abstracted ("lossy") view of the system, according to a defined schema
     - The facts are complete, relative to their defined abstraction level

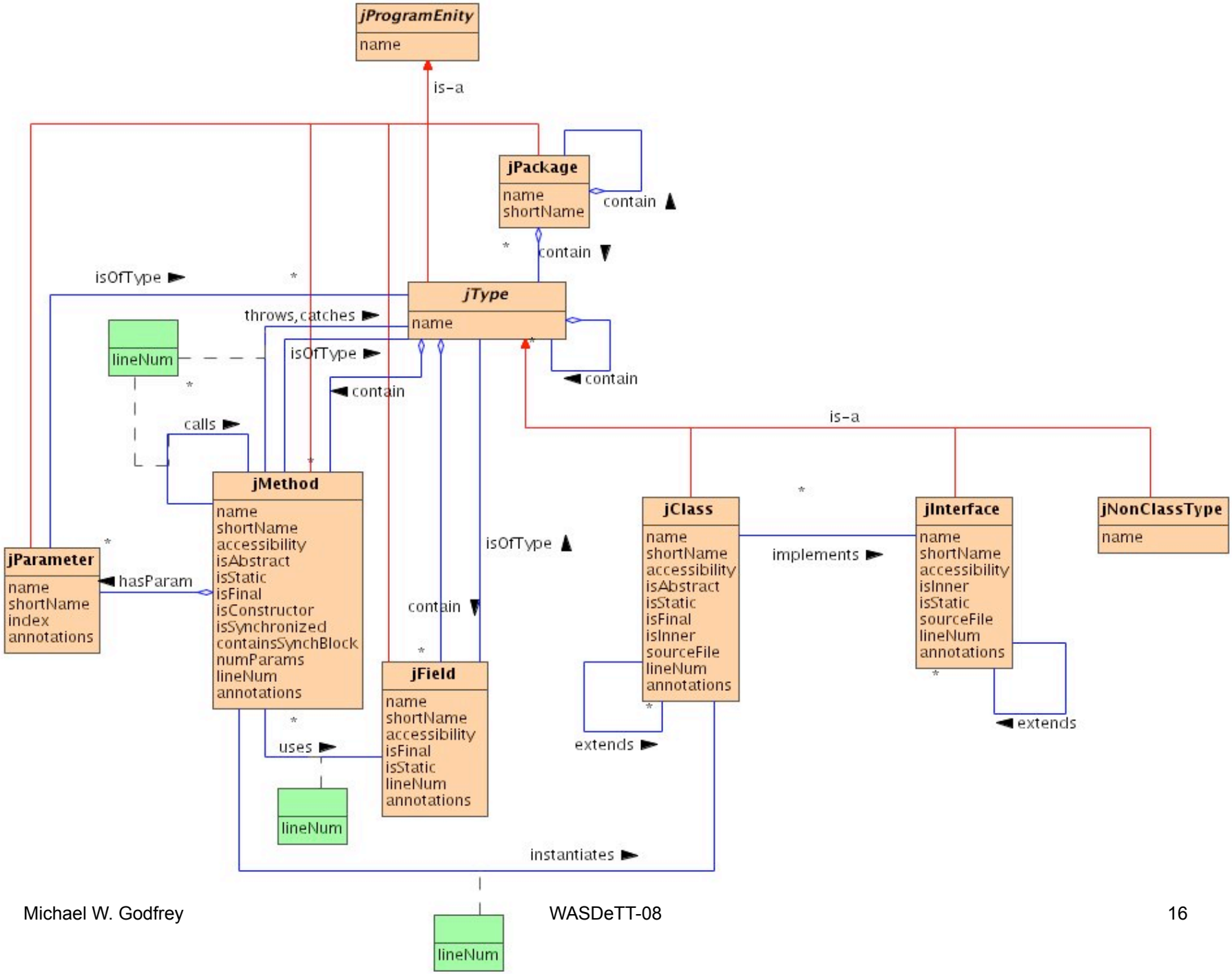
       e.g., can spot global variable uses across packages, but no information about how for loops are used
     - Source code examined only once
       - New run of the tool means only loading the "facts" into the query engine
       - Can add / refine queries using same factbase (since the facts don't change unless the code does)

“Lossy” program analysis

- Advantages:
  - Much easier to write canned queries, GUIs for navigation, experiment / go fishing with results
  - Model is self-contained, complete so no need to consult or link back to source code
  - Source code examined only once!
    - Loading factbase usually much faster than compilation

- Disadvantage:
  - Source-to-source code transformation not possible
    - But can feed results back into a whole-earth analsyis tool

    e.g., find known bad smells, feed fixes to a transformation engine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Jackpot-to-SALSA

- I “finish” my extractor (still part of Jackpot), and give a demo for Crupi’s group
  - I show how to define and run pattern queries they specify (using grok/QL) on source code they’ve provided

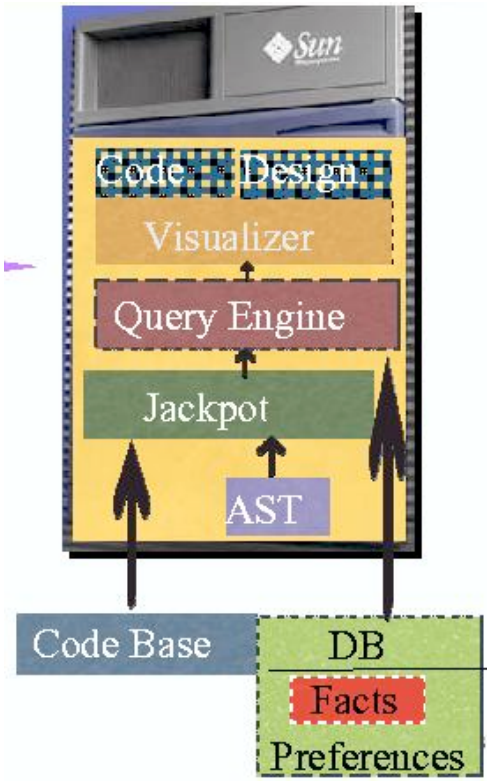
```
// Want to find all SessionBeans that call EntityBeans

extendsRTC = extends*
subtypeof = extendsRTC + extendsRTC o implements o extendsRTC
sessionsBeanClasses = classes ^
                      subtypeof . {"javax.ejb.SessionBean"}
entityBeanClasses = classes ^ subtypeof . {"javax.ejb.EntityBean"}
sessionBeansCallingEntityBeans = sessionsBeanClasses o calls
                                 o entityBeanClasses
```

SALSA goals *[Crupi]*

- Crupi pitches the idea to several big clients
  - It is very enthusiastically received!
  - The SALSA project (*Sun Appliance for Live Software Analysis*) is born!

- Main goal:
  - (Semi-) automate architectural assessment as much as possible
    - Aim for remote, collaborative, client-driven, early feedback
    - Build a library of known “J2EE bad patterns” + allow application/domain knowledge to be added
    - Feedback into the code (comments, annotations, transformed source code)



Later on …

- I finished the fact extractor
  - Now, a standalone Java 1.5 application
    - If `javac` can compile your code, I can extract it!
  - Extracts info about generic classes/methods, inner (non-local) classes, exceptions, initialization clauses, parameters, …
- Later work at UWaterloo
  - A co-op student who worked on Jackpot later completed a byte-code extractor using same schema
- Work on SALSA continued at Sun for a while after
  - Patterns library
  - GUI
  - Infrastructure enhancements
  - … then most of the the SALSA team left to join a startup ☹
  - … and later still Jackpot was resurrected and integrated into Netbeans

Things I learned

- Working code is better than an unproven but elegant idea
  - "Do the simplest thing that could possibly work!"
  - Don't over-engineer; get it working and get feedback
    - You probably got it wrong anyway
    - I spent weeks working on modelling inner classes …
- Don't expect to be able to compete with their development skills
  - You're a researcher, not a professional developer. There's a difference!
  - Ask for help when you need it … it will save a lot of time and build trust in your honesty

Things I learned

- Standards tools beat the pants off of elegant research prototypes
  e.g., grok vs. SQL … guess which one the developers were more comfortable with!

- Office politics is real
  - Sometimes, need to work in stealth mode
  - Good ideas get spiked for bad reasons … deal with it and move on
  - Good ideas get spiked for good reasons too

Things I learned

- Solving a real problem is what industry wants!
  - Any given research idea “might work”, but what are your clients actually interested in? What can’t they do well that you can?
  - Ask, then do a lot of listening.
  - Don’t expect new research to come from this … but keep in mind that the experience alone is probably a pretty good paper.

- Work towards them, don’t expect them to work towards you
  - They probably don’t understand what research is, and they don’t (and shouldn’t) really care
  - Don’t expect to meet them half way. You’re on their turf! When in Rome …

Things I learned

- You need a high-level champion
  - … who believes in the project, and will fight for it
    e.g., resources, personnel, access to infrastructure
  - … even if he/she doesn't really understand it

- You need a high-level technical interactor
  - … who can define goals, evaluate progress, suggest contacts, provide access
  - Or else: "Hey, it's your turn to babysit the researcher!"
  - Regular meetings are a must
    - I worked in a strange solo-world most of the time

Things I learned

- They need to understand that they will have to take ownership eventually
  - If it goes well, that is.
  - You should be so lucky!

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