COMP 333 Introduction

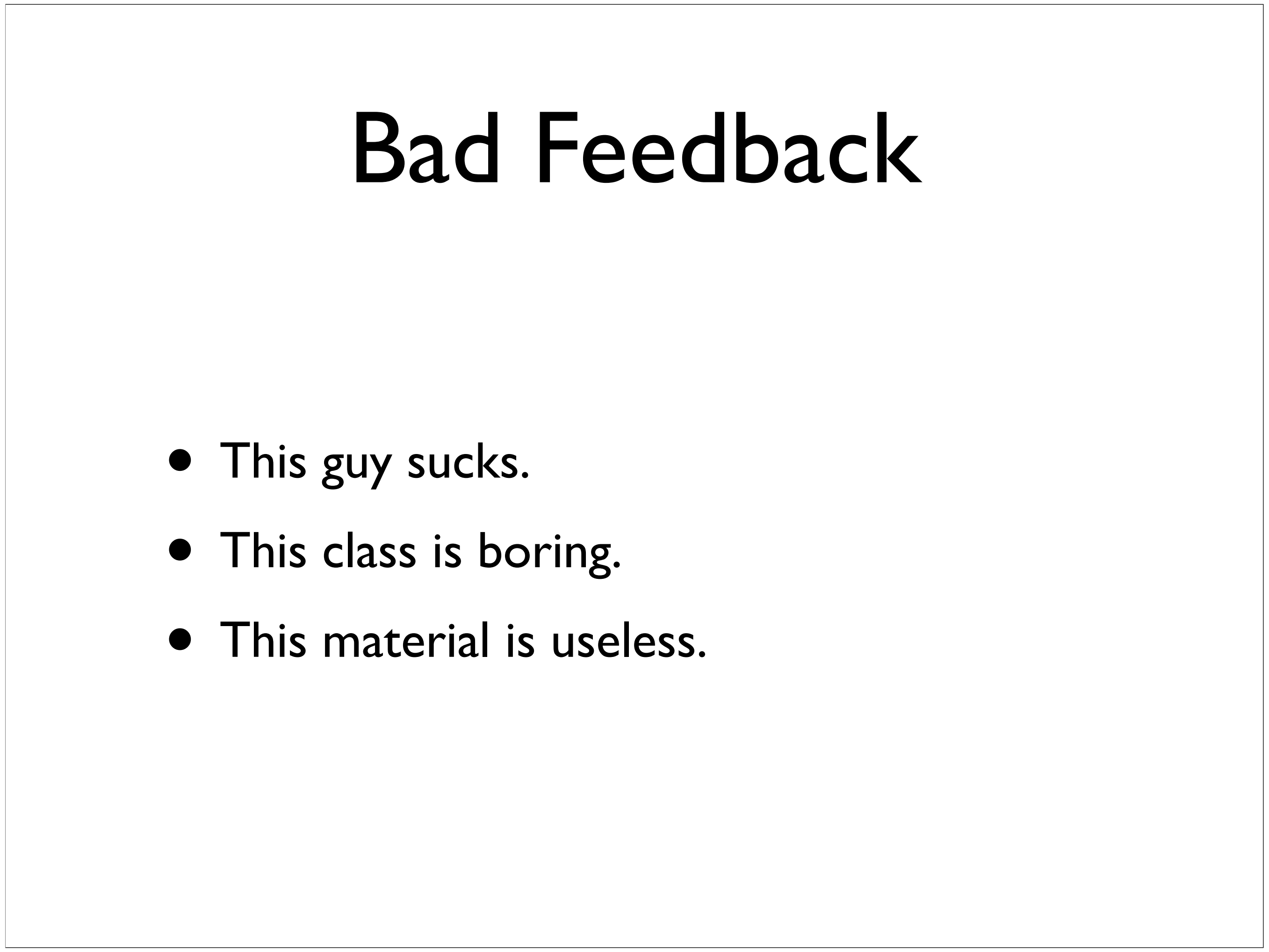
Kyle Dewey

About Me

- My research:
  - Automated program testing + CS education
  - Programming language design
- Lots of experience with functional and logic programming
- Taught this class a bunch

About this Class

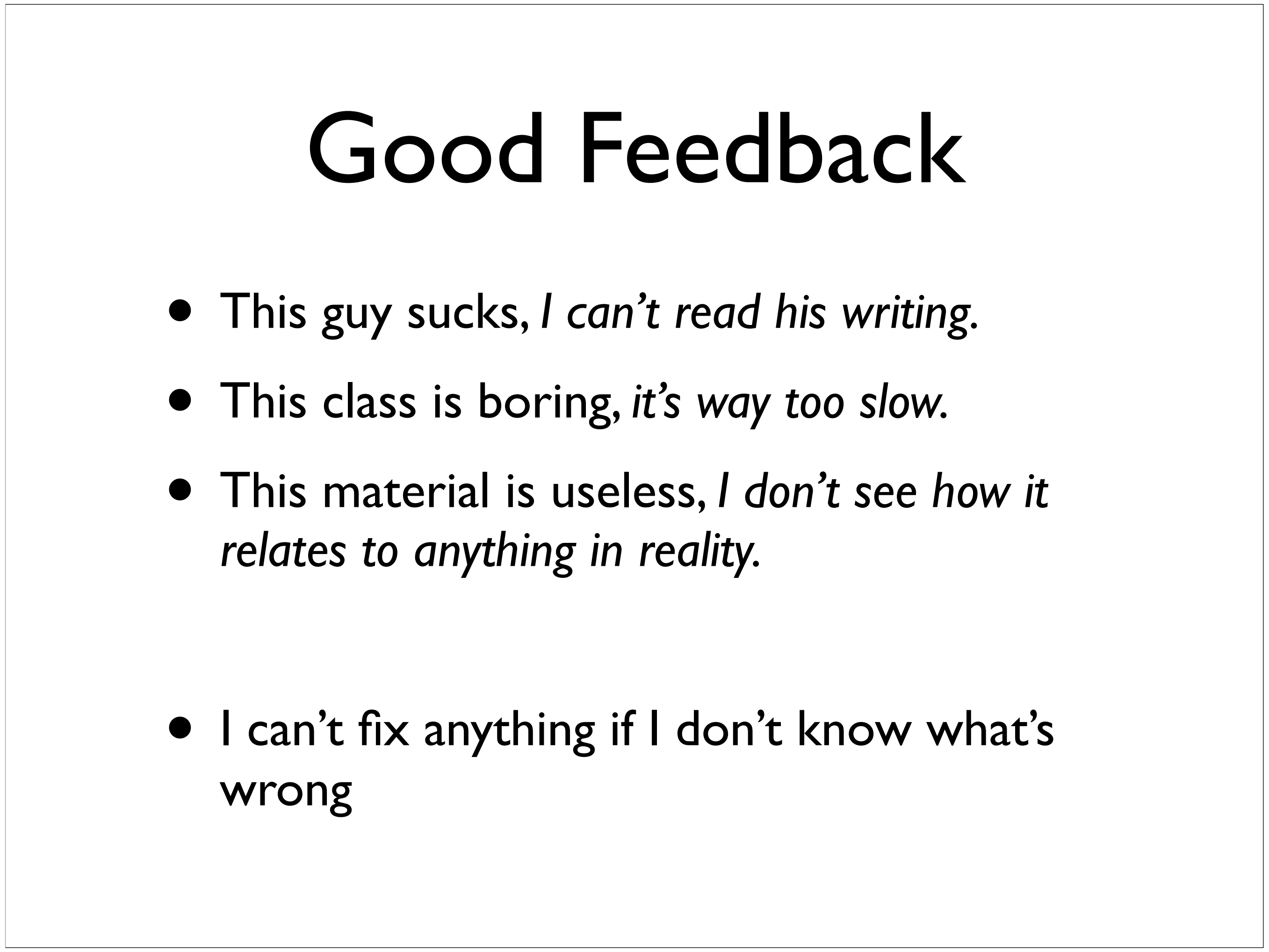
- See something wrong? Want something improved? Email me about it! (kyle.dewey@csun.edu)
- I generally operate based on feedback



Bad Feedback

- This guy sucks.
- This class is boring.
- This material is useless.

-I can’t do anything in response to this



Good Feedback

- This guy sucks, *I can’t read his writing.*
- This class is boring, *it’s way too slow.*
- This material is useless, *I don’t see how it relates to anything in reality.*
- I can’t fix anything if I don’t know what’s wrong

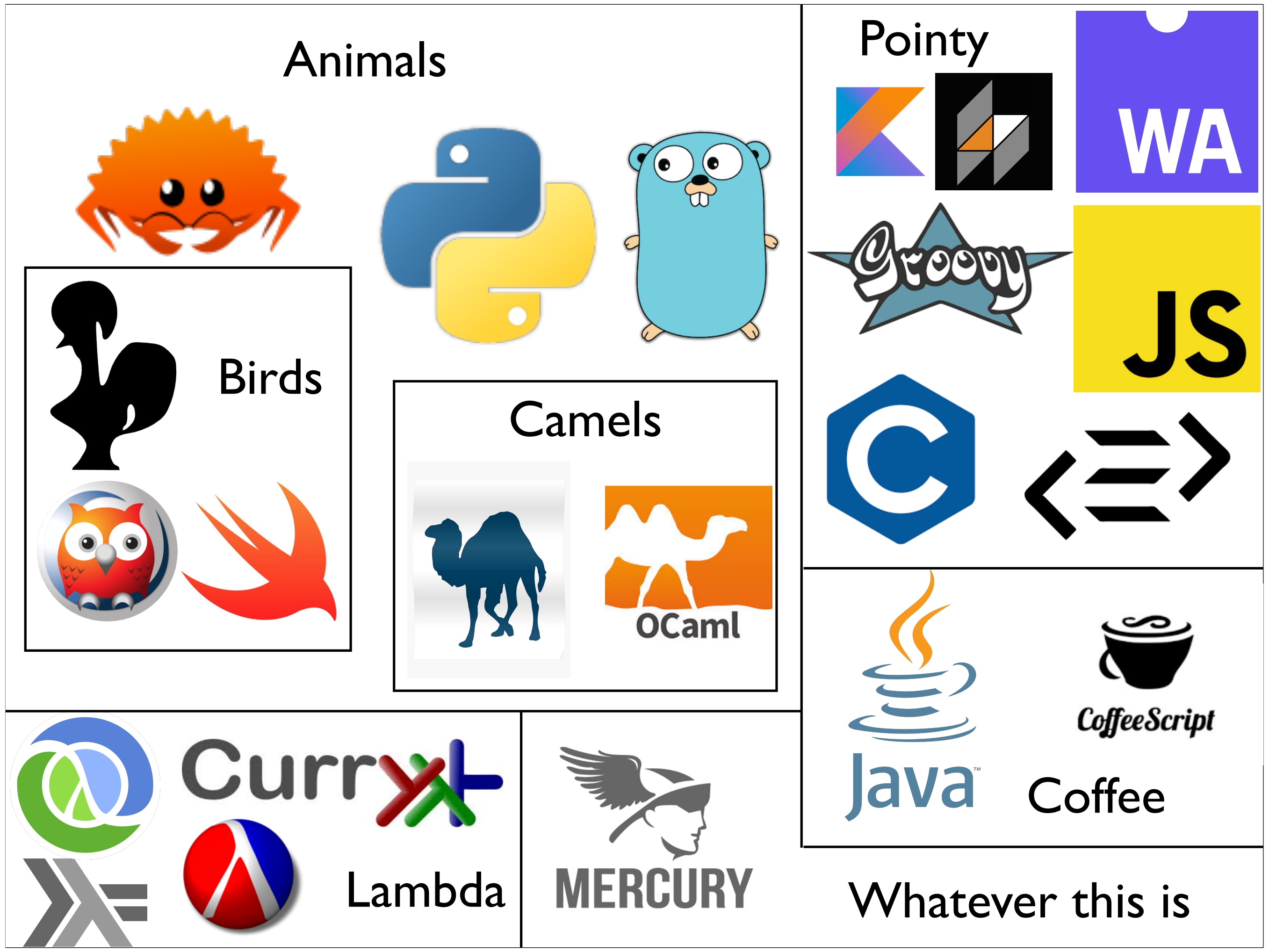
-I can actually do something about this!

Why this Course?

- Navigating programming languages
- Understanding how programming languages work
- Shaping how you think about programming

Navigating Languages

-There are a LOT of different programming languages.
-Many of these are similar to each other, and many are different
-Basic question: which should you use?



Animals

Birds

Camels

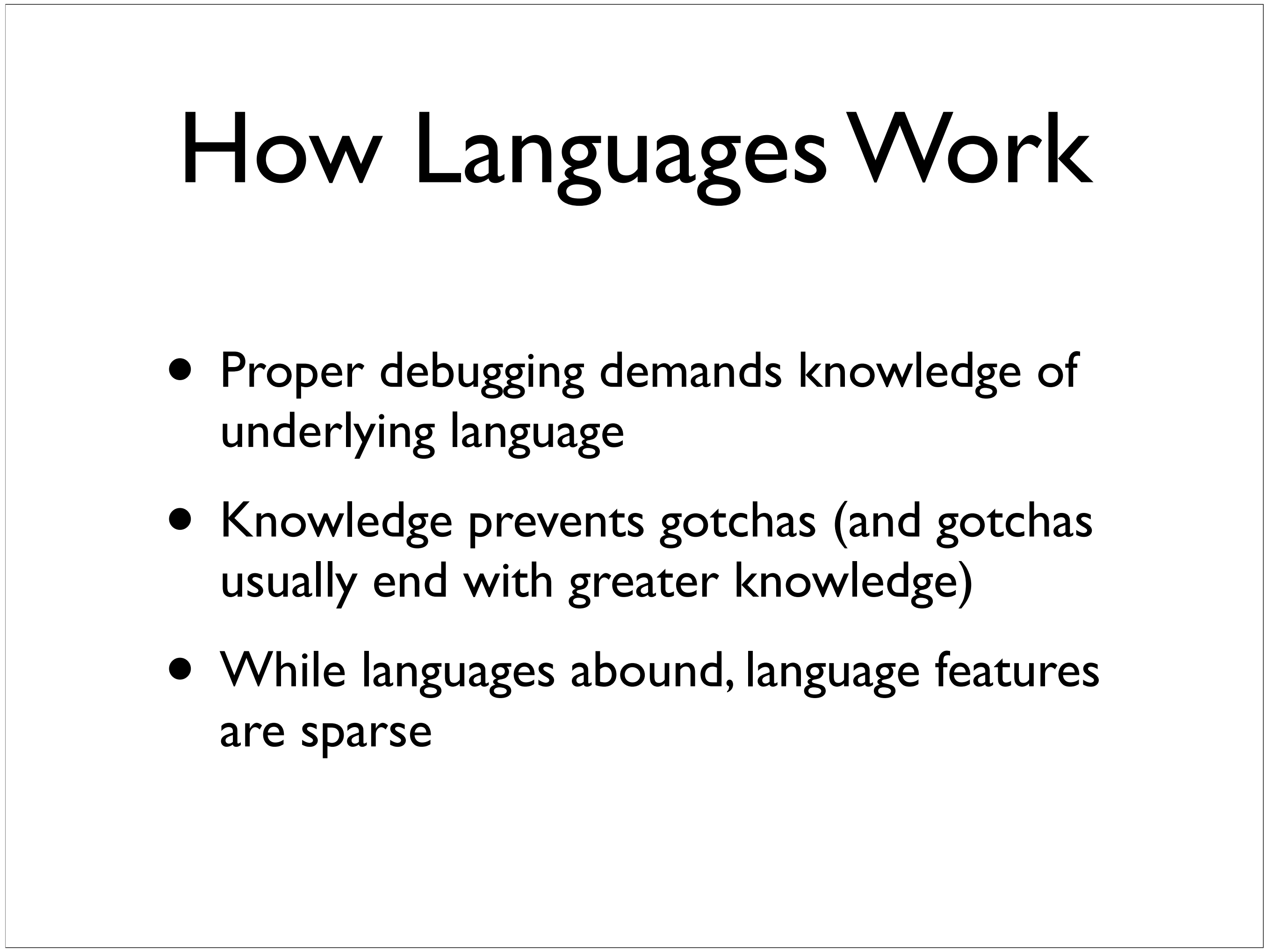
Pointy

Coffee

Lambda

Whatever this is

-Without knowing about language features, we can't properly classify them
-If we can't classify them, we don't understand them, and we can't select the right tool for the job



How Languages Work

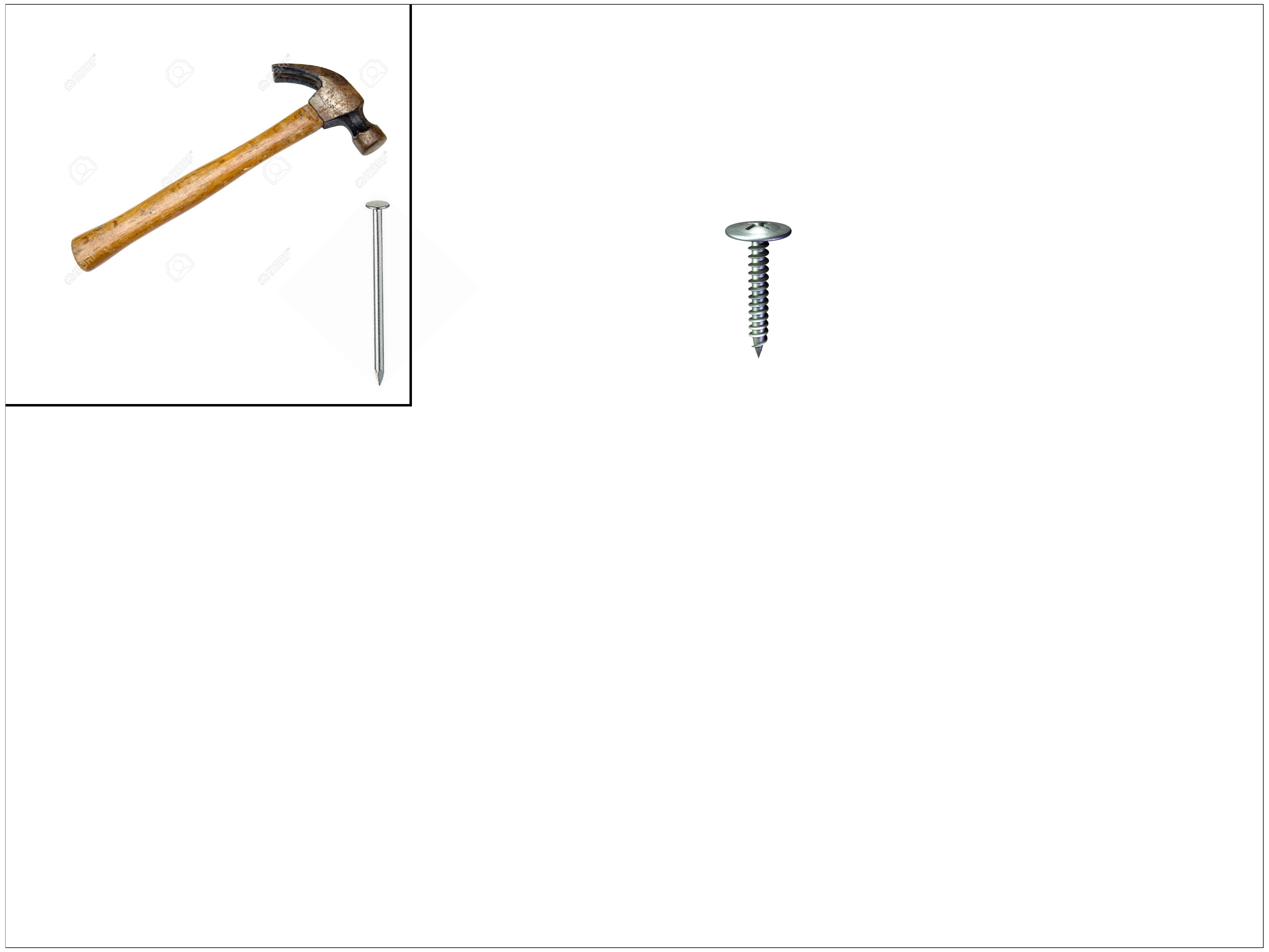
- Proper debugging demands knowledge of underlying language
- Knowledge prevents gotchas (and gotchas usually end with greater knowledge)
- While languages abound, language features are sparse

-"Gotchas", meaning completely unintuitive behavior, usually leading to subtle bugs
-Surprisingly, there aren't that many language features out there. This is good for learning languages, but somewhat depressing (most features were developed in the 60's)

Thinking About Programming

-Old adage: if all you have is a hammer, then every problem is a nail

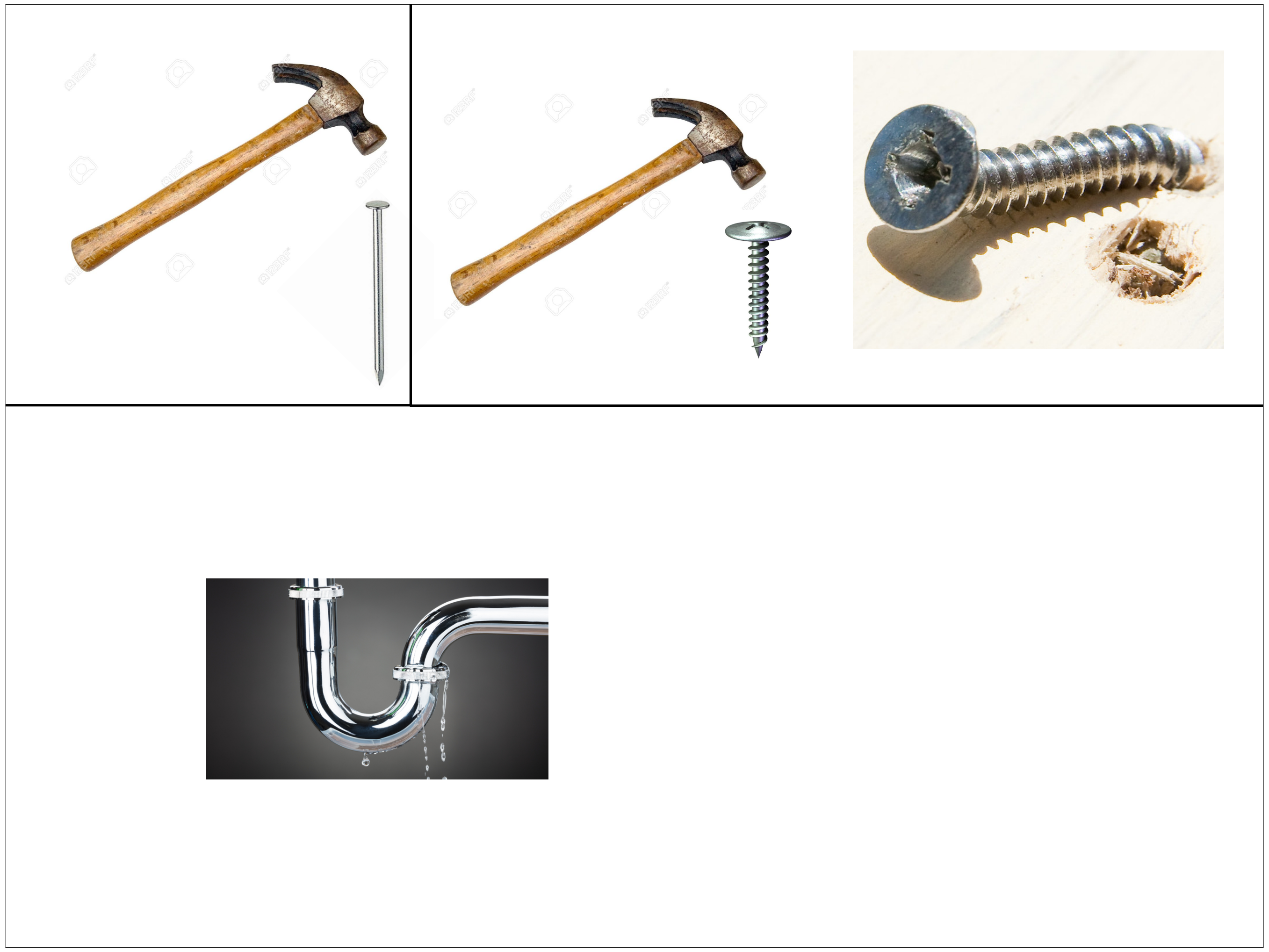
-This is great if you have a nail



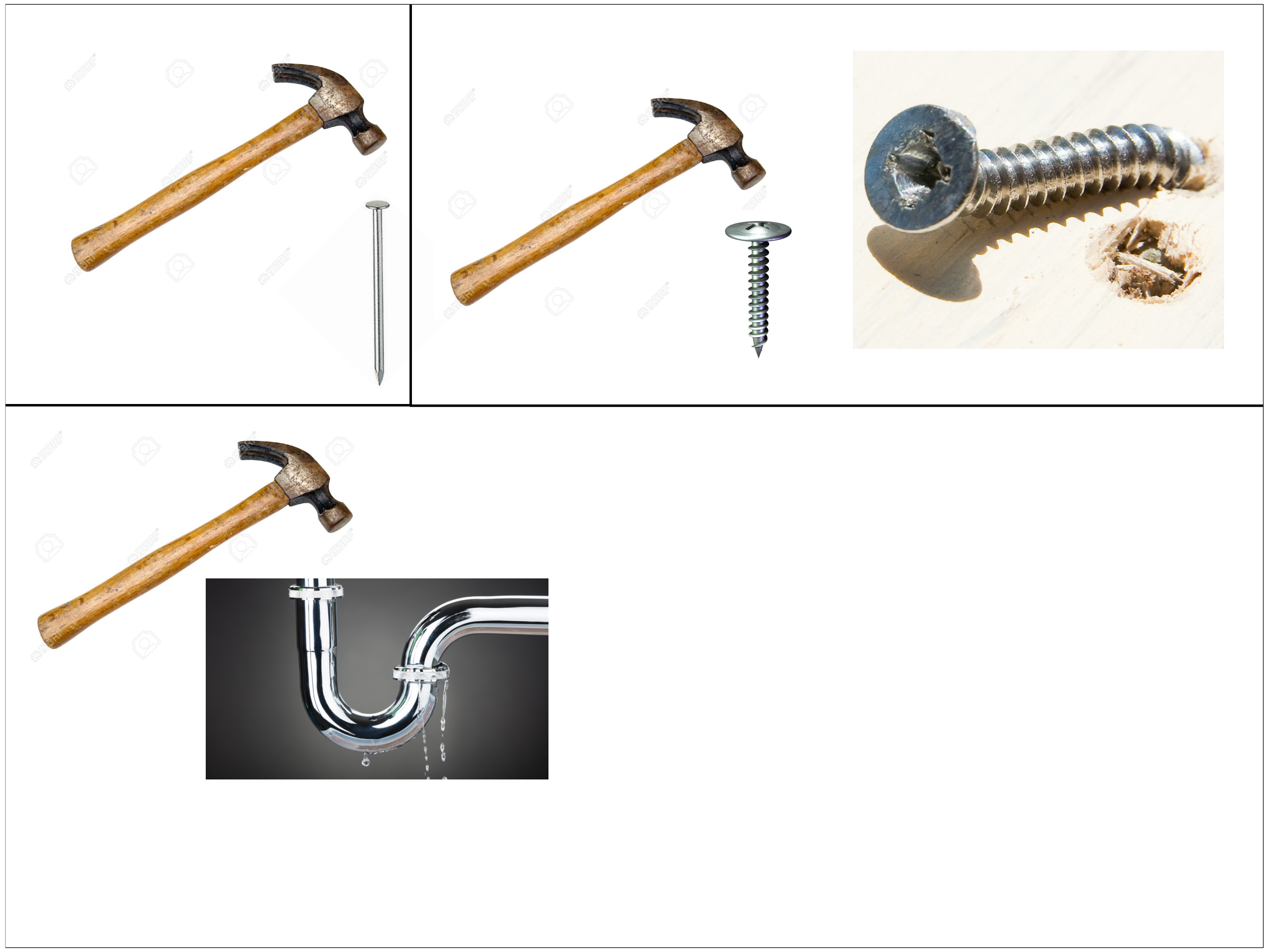
-If you have a screw?

-You hit it with the hammer

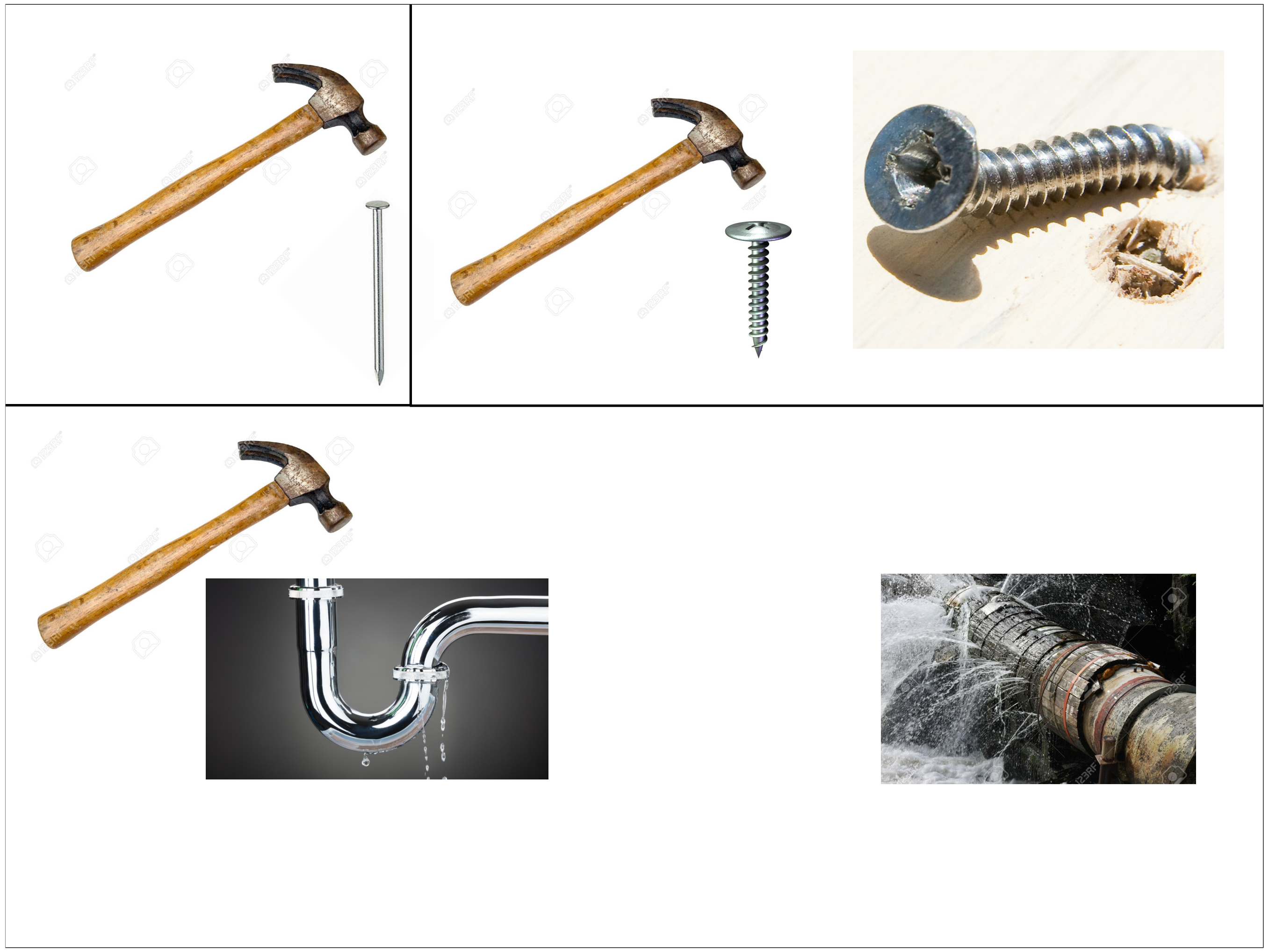
-Ehh success?



-Leaky pipe?



-You hit it with the hammer!



-Leaks more?

-NEEDS MORE HAMMER

–Still leaking?

–HAMMER

The Point

- Languages influence how you think and approach problems
- The same problem can be MUCH simpler to solve in a different language

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Scala

```
for {
  a <- Seq(1, 2, 3)
  b <- Seq("foo", "bar")
} yield (a, b)
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- The same problem can be MUCH simpler to solve in a different language

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```
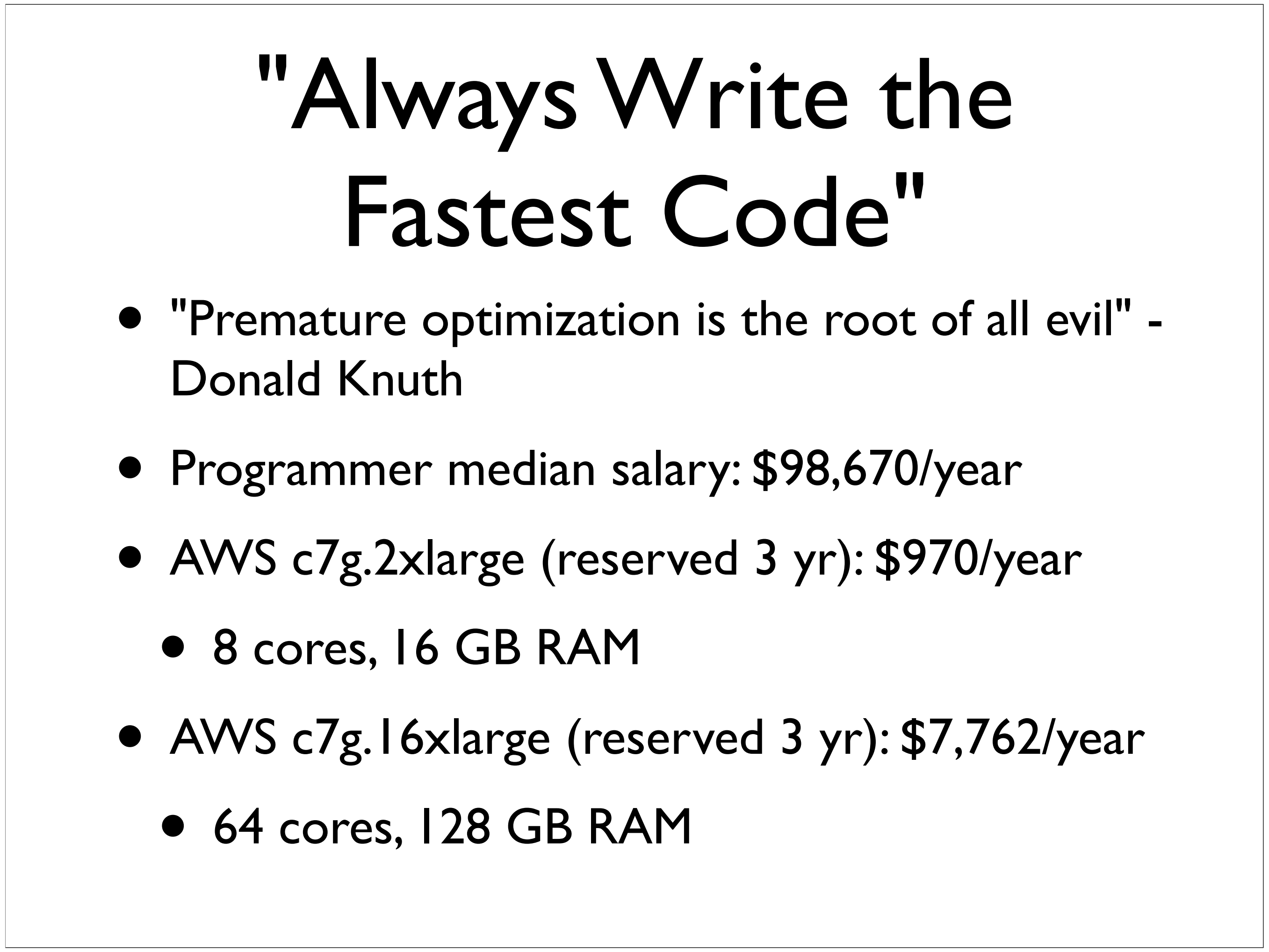

Java

- Bulk of Summer
- Bulk of semester

-"Bulk of Summer": a student worked on something that did this for the bulk of a Summer
-"Bulk of semester": another student did a big part of this as part of a class project
-Four lines of code in Scala

Common Misconceptions: Performance



"Always Write the Fastest Code"

- "Premature optimization is the root of all evil" - Donald Knuth
- Programmer median salary: $98,670/year
- AWS c7g.2xlarge (reserved 3 yr): $970/year
  - 8 cores, 16 GB RAM
- AWS c7g.16xlarge (reserved 3 yr): $7,762/year
  - 64 cores, 128 GB RAM

-This gets pushed to sell low-level, imperative languages
-Programmer median salary (2024): https://www.bls.gov/ooh/computer-and-information-technology/computer-programmers.htm

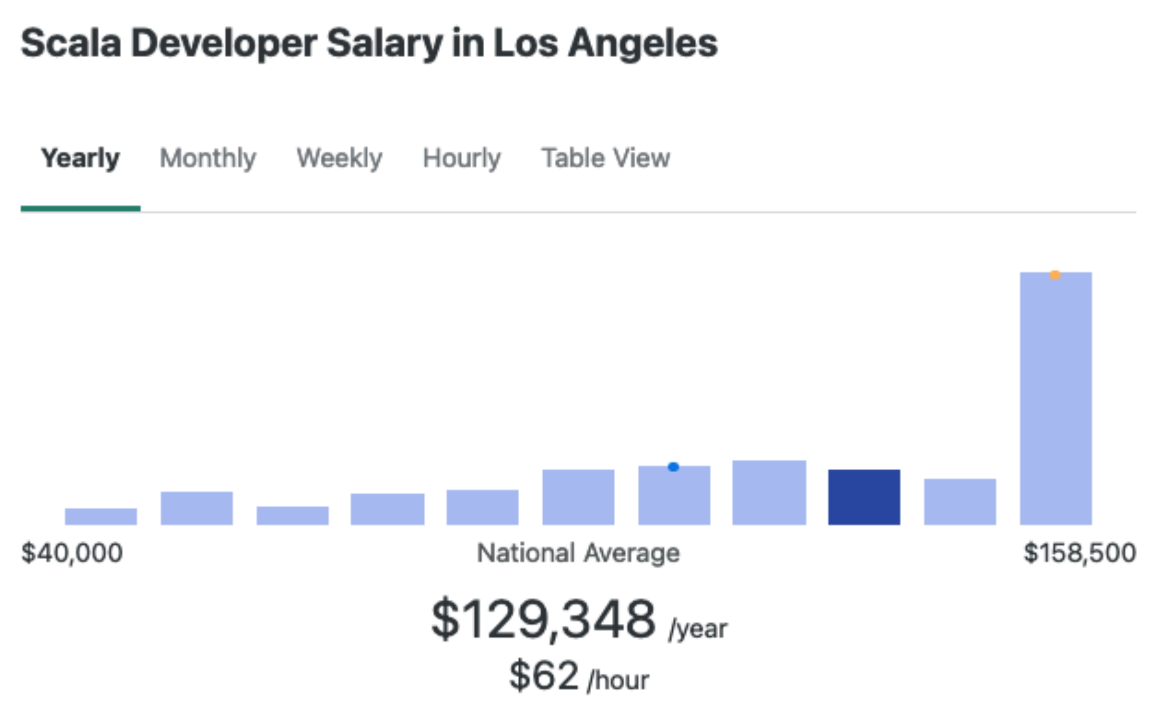
"High-Level Languages are Slow"

- Java can outperform C
- Choice of algorithm usually WAY more important
    - I have written Prolog that dramatically outperformed Java (thousands - millions of times faster)

Common Misconceptions: Utility

"FP is Purely Academic"

- Functional programming makes concurrency much simpler
- Good software engineering practices tend to enforce functional styles
- Most modern languages now support functional programming features



Scala Developer Salary in Los Angeles

$129,348 /year

$62 /hour

(Via Ziprecruiter)

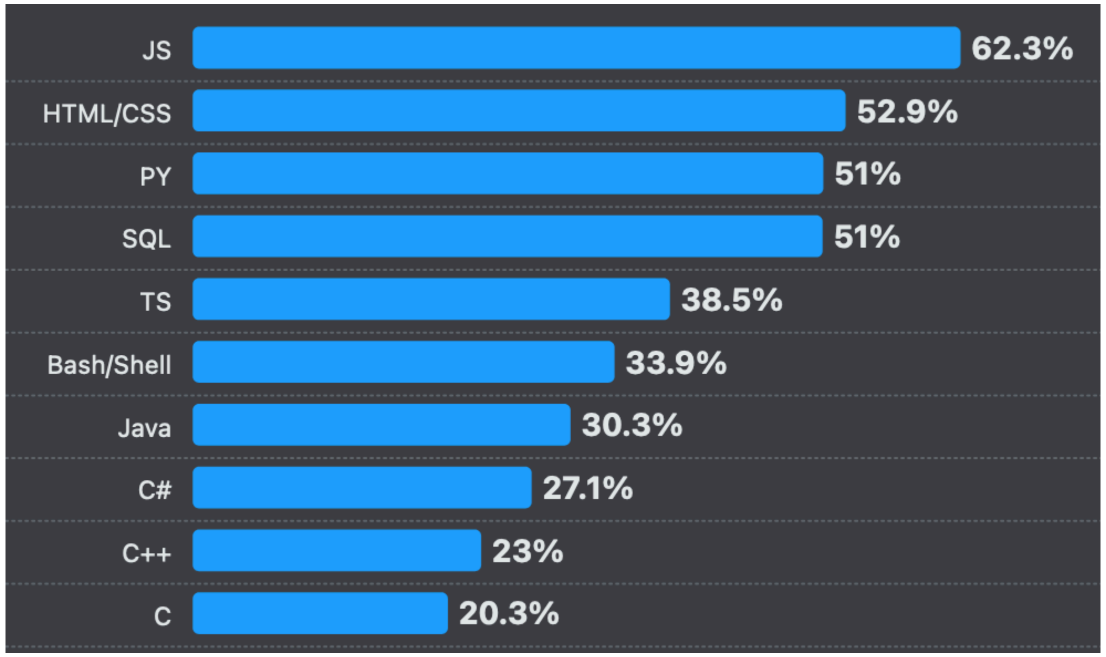
-Via Ziprecruiter - August 2024

Common Misconceptions: Stagnation

"Industry Moves Slowly"

- COBOL was once a vital language
- Perl was once the champion of the Internet
- Java was once most popular
- Companies that cannot adapt, die

"Industry Moves Slowly"



StackOverflow 2024 Developer Popularity Survey

Same ranking as 2023...but definitely not for 2013

Staying in a Comfort Zone

- "I know Python *and* Ruby, so I already am pretty flexible"

Staying in a Comfort Zone

- "I know Python *and* Ruby, so I already am pretty flexible"

-This is kind of like saying I know hammer and other hammer

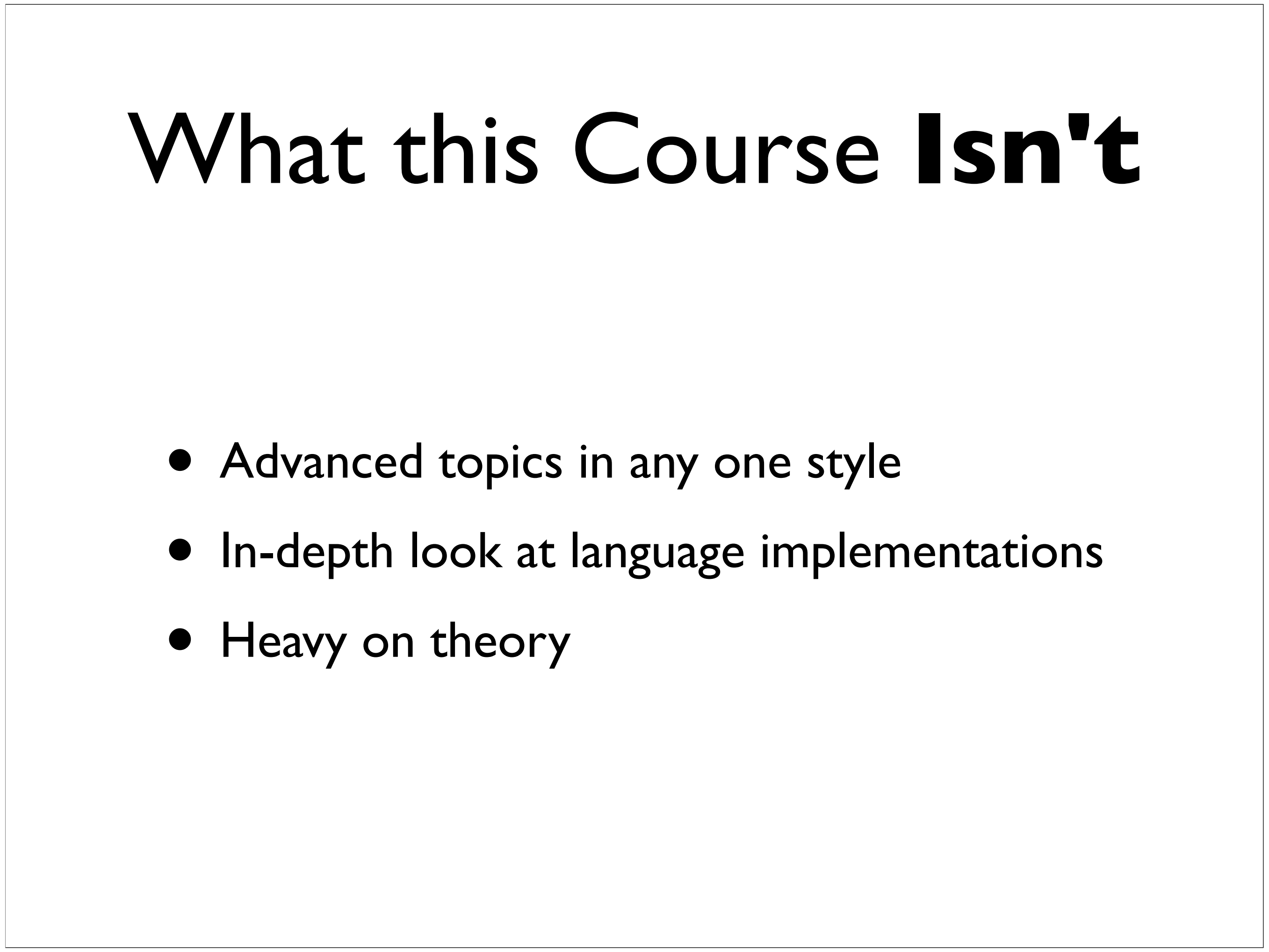
Staying in a Comfort Zone

- "I know Python *and* Ruby, so I already am pretty flexible"

-Pick up a screwdriver, already

What this Course Is

- Heavy on programming
- Exposure to object-oriented, functional, and a little low-level programming
- Exposure to various language features in the context of the languages you'll use



What this Course **Isn't**

- Advanced topics in any one style
- In-depth look at language implementations
- Heavy on theory

-We don't have enough time to become experts on any of these topics; each one needs their own course (and hint hint there is a Logic Programming course (COMP 410))
-If you want language implementations, take compilers and language design (COMP 430)

Languages We Will Use

- Java (class-based object-oriented programming)
- JavaScript (prototype-based object-oriented programming, functional programming)
- Rust (imperative programming, functional programming)

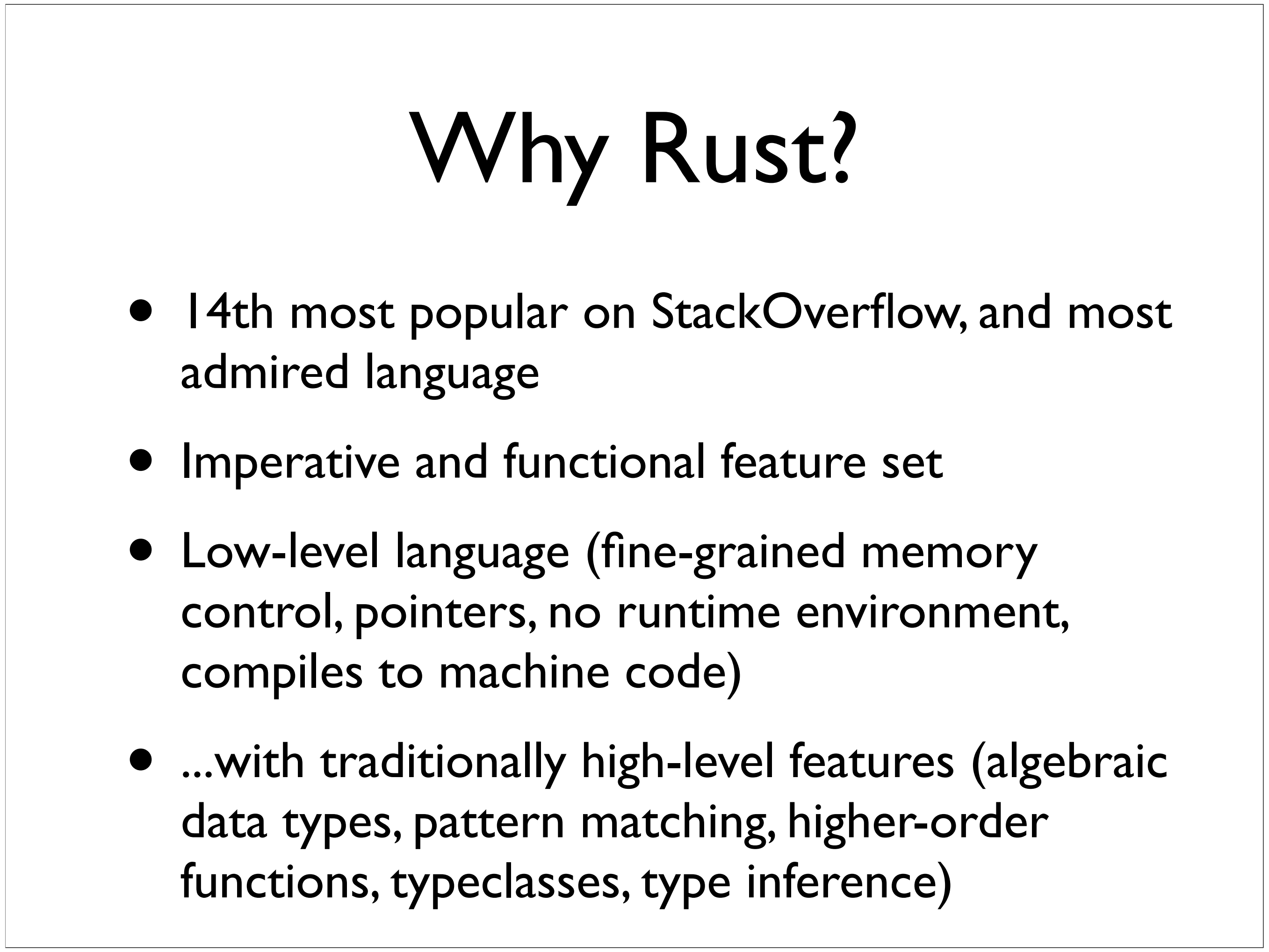
Why Java?

- 7th most popular language on StackOverflow
- OOP with class-based inheritance
- Even if you have used it, you may be rusty, and you might not have used all the relevant functionality
- Statically typed, garbage collected, just-in-time compilation

Why JavaScript?

- Most popular language on StackOverflow
- OOP with prototype-based inheritance
- Dynamically typed, garbage collected, (typically bytecode) interpreted, just-in-time compilers available

-It's prototype-based instead of class based, which is a different kind of object-oriented. Though classes are now a thing



Why Rust?

- 14th most popular on StackOverflow, and most admired language
- Imperative and functional feature set
- Low-level language (fine-grained memory control, pointers, no runtime environment, compiles to machine code)
- ...with traditionally high-level features (algebraic data types, pattern matching, higher-order functions, typeclasses, type inference)

-Has consistently been most admired for years (category formerly called "most loved" on StackOverflow)
-Over the past couple years, it has begun to supplant C/C++ code in major projects. Can be used in Linux kernel code, has Linus Torvalds' blessing, and is used for some device drivers. This is HUGE because even C++ was considered too high-level and overall non-viable for this.
-From my own experiences: I'm willing to bet that Rust will eventually overtake C/C++, but it will take a long time to do so (likely ~20 years)

Syllabus