CSE 505
Programming Languages

Intro

Today: Introduction

Administrivia

Motivation and Goals

Overview

Caml Crash Course

Hello! My name is...

Zach Tatlock

ztatlock@cs

CSE 546

door is open!

New faculty ⇒ first ever course!

Resources

Web:

`http://courses.cs.washington.edu/`
`courses/cse505/13au/`

Mailing List:

`cse505a_au13@u.washington.edu`

Piazza:

`(your course email will be subscribed)`

Structure

4-5 Individual Homeworks:

- “pen & paper” (TeX) proofs
- implementations in OCaml
- challenge problems optional

Midterm & Final

Useful, Optional Reference

Pierce’s *Types and Programming Languages*

© Alamy

Academic Integrity

Do. Not. Cheat.

Erodes the very foundation of academia.

Absolutely not worth the risk.

Roughly:

Discuss problem and *sketch* ideas together.

Write your own solutions, note discussion partners.

When in doubt, ask!

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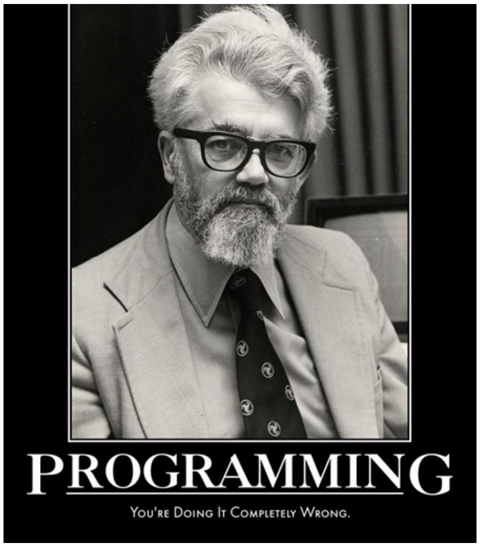
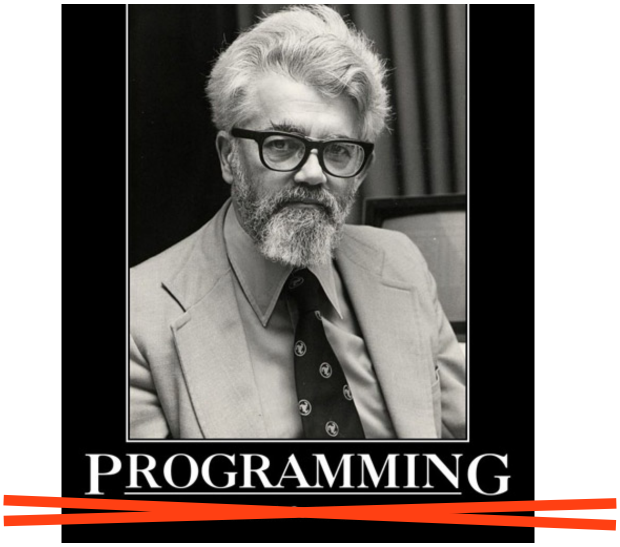


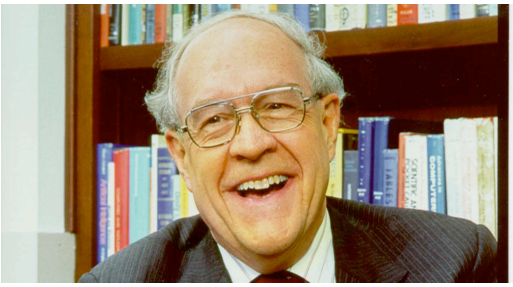


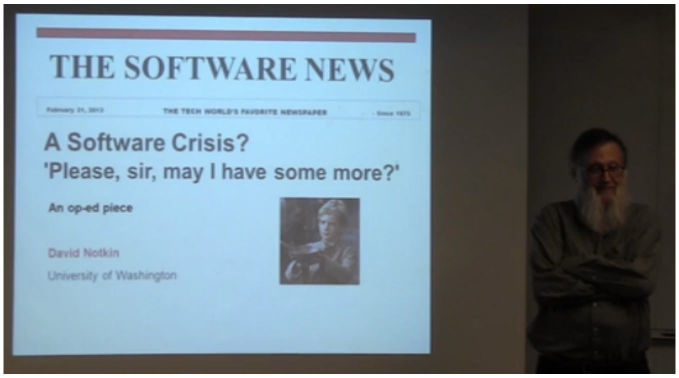
SOFTWARE

IS

GREAT!!!

> *The magic of myth and legend has been realized in our time. One simply types the correct incantation on a keyboard, and a display screen comes to life, showing things that never were nor could be.*
>
> *Fred Brooks*





THE SOFTWARE NEWS

February 21, 2013 THE TECH WORLD'S FAVORITE NEWSPAPER - Since 1970

A Software Crisis?

'Please, sir, may I have some more?'

An op-ed piece

David Notkin

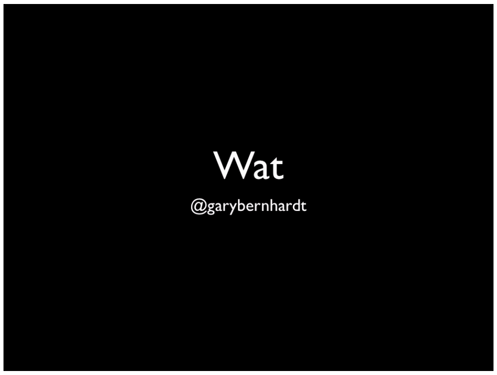
University of Washington

http://cs.brown.edu/events/talks/notkin.html

SOFTWARE IS GREAT!!!

... but (often) still poorly understood!

wat



Wat

@garybernhardt

https://www.destroyallsoftware.com/talks/wat

Room For Improvement

Development

quickly produce high quality code in teams

Maintenance

comprehend, extend, fix bugs, tune

Reliability

avionics, medicine, finance, nuclear power

Require reasoning!

What do these do?

```
a=0?(3>2?23:(2>5?(7<6?34:48):64)):1;
printf("%d",a);
```

```
 printf("%d", printf("%d",
   printf("%d", printf("%s", "husky"))));
```

Realistic?

Safe to optimize / refactor?

```
class A { int f() { return 0; } }
class B {
  int g(A x) {
    try { return x.f(); }
    finally { foo(); }
  }
}
```

⇓

```
class A { int f() { return 0; } }
class B {
  int g(A x) {
    return 0;
  }
}
```

Safe to optimize / refactor?
... nope.

A could be extended
x could be null
s could have "side effects"

How can we handle general case?
How can we be sure it's right?
How do we automate?

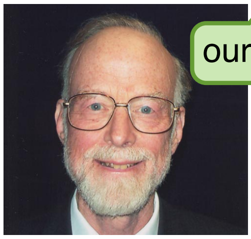
Goal

Develop tools to **rigorously** study what programs mean.

semantics

equivalence, termination, determinism, ...

> *... [rigorous proofs about programs] are an absolute scientific ideal, like purity of materials in chemistry or accuracy of measurement in mechanics. The value of purity and accuracy (just like correctness) are often not appreciated until after the scientist has built the tools that make them achievable.*
>
> *Sir C.A.R. Hoare*



our goal is noble!

Benefits

Writing a PL-ish thing is inevitable
extensible systems, rich data structures, optimizer

Build skill with "Theory B" formalisms
all research needs precision, expressiveness, clarity

Become better programmers
travel to understand where you're from

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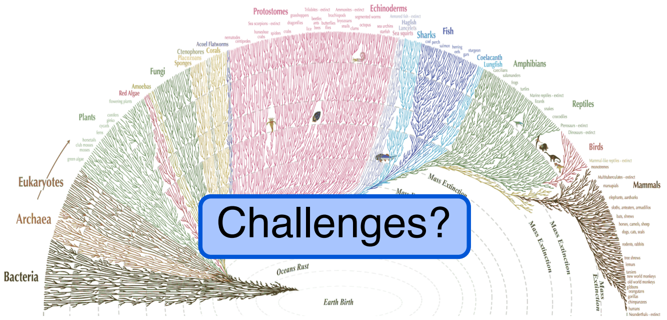
Which PL to Study?

Well... which is the best? Depends.

Aren’t they all the same? Yes and no.



Challenges?

Approach

10 weeks is short!

Define small, tractable languages

Turing complete, but not for “real” programming

Extend with increasingly rich features

extend reasoning techniques in parallel

Sketch application to “real” PLs

implement programs to connect theory with code

Subgoals

Develop tools for studying program behavior

inductive defns, structural induction, inference rules

Investigate core PL concepts

types, functions, scope, mutation, iteration

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