CSE 114A: Fall 2021

Foundations of Programming Languages

Lecture 1: Course Overview

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A Programming Language

- Two variables
  - x, y
- Three operations
  - x++
  - x--
  - (x=0)? L1:L2;

```
L1: x++;
    y--;
    (y=0)?L2:L1
L2: …
```

Fact: This is "equivalent to" to every PL!

Good luck writing quicksort
… or Windows, Google, Spotify!

So why study PL ?

Programming language shapes
Programming thought

So why study PL ?

Language affects how:
- Ideas are expressed
- Computation is expressed

Course Goals

"Free your mind"
-Morpheus

Learn New Languages/Constructs

New ways to:
- describe
- organize
- think about

computation

Goal: Enable you to Program

- Readable
- Correct
- Extendable
- Modifiable
- Reusable

Goal: How to learn new PLs

No Java (C#) 15 (10) years ago
AJAX? Python? Ruby? Erlang? F#?...

Learn the anatomy of a PL
- Fundamental building blocks
- Different guises in different PLs

Re-learn the PLs you already know

#goals

Design new languages

Goal: How to design new PLs

…"who, me ?"

Buried in every extensible system is a PL
• Emacs, Android: Lisp
• Word, Powerpoint: Macros, VBScript
• Unreal: UnrealScript (Game Scripting)
• Facebook: FBML, FBJS
• SQL, Renderman, LaTeX, XML …

#goals

Choose right language

Enables you to choose right PL

"...but isn't that decided by
- libraries,
- standards,
- and my boss ?"
Yes.

*My goal: educate tomorrow's tech leaders
& bosses, so you'll make informed choices*

Speaking of **Right** and **Wrong**...

Imperative Programming

x = x+1

WTF?

x = x+1

Imperative = Mutation

Imperative = Mutation

Bad!

Don't take my word for it

John Carmack
Creator of FPS: Doom, Quake,...

> **John Carmack**
> @ID_AA_Carmack
>
> I am starting to remove op= operator overloads to discourage variable mutation.
>
> **39** RETWEETS **16** FAVORITES
>
> 2:55 PM - 28 Feb 12 via web · Embed this Tweet
>
> Reply Retweeted Favorite

Don't take my word for it

Tim Sweeney (Epic, Creator of UNREAL)

"In a concurrent world,
imperative is the wrong default"

Functional Programming

No Assignment.

No Mutation.

No Loops.

OMG! Who uses FP?!

So, Who Uses FP ?

MapReduce

So, Who Uses FP ?

Linq, F#

So, Who Uses FP ?

Erlang

Scala

Wall Street
(all of the above)

...CSE 116

Course Mechanics and Logistics

Logistics

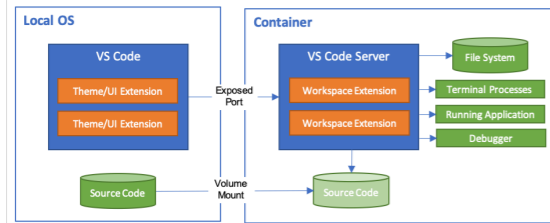**Course website:**

https://ucsc-cse-114a.github.io/fall21/

Resources

Course texts (optional):

- An Introduction to Functional Programming Through Lambda Calculus by Greg Michaelson. Free pre-print.
- Thinking Functionally with Haskell by Richard Bird. Available online (free via library).
- Programming in Haskell (2nd ed.) by Graham Hutton.
- Real World Haskell by Bryan O'Sullivan. Available online (free via library).
- Learn You a Haskell for Great Good by Miran Lipovača. Available free online
- Write You a Haskell by Stephen Diehl. (incomplete, but useful) Available free online

Resources

Haskell Dev Container

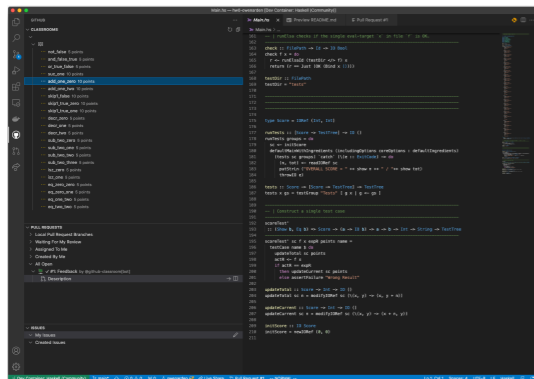– **https://github.com/UCSC-CSE-114A/cs114a-devcontainer**

Recommended IDE: VS Code

- New this year, legit IDE setup for Haskell!
  - Devcontainer: A Haskell dev environment is built in a container and VS Code automatically mounts the container volume
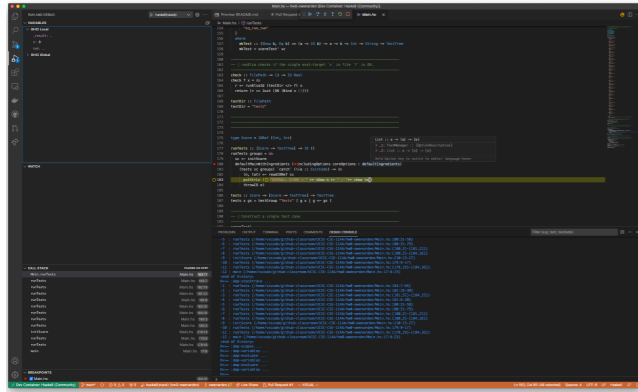 - Also some integrations with Git and GitHub Classroom

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VS Code

VS Code

Peer Instruction (ish)

Peer Instruction

- Make class interactive
  - Help YOU and ME understand whats tricky

- Respond to in-class quizzes
  - 5% of your grade
  - Respond to 75% questions

- Bring laptop/phone if you have one

In Class Exercises

1. Solo Vote: Think for yourself, select answer

2. Discuss: Analyze Problem with neighbors
   - Practice analyzing, talking about tricky notions
   - Reach consensus
   - Have questions, raise your hand!

3. Group Vote: Everyone in group votes

4. Class-wide Discussion:
   - What did you find easy/hard?
   - Questions from here show up in exams

In Class Exercises

Let's try it out (if you have a device):

http://tiny.cc/cse116-trial

Make your individual choice

In Class Exercises

Let's try it out (if you have a device):

http://tiny.cc/cse116-trial

Now "confer" with a neighbor and agree on a choice for your group

Requirements and Grading

- In-Class Exercises: 5%
- Midterm: 30%
- Programming Assignments (6):   30%
- Final: 35%

Two hints/rumors:

1. Lots of work
2. Don't worry (too much) about grade

Note: Regrades must be requested *within two weeks of receiving grade*

Resources

- Online lecture notes
- Readings and exercises
- Webcasts:
  - User: cse-116-1
  - Pass: lambda
- Pay attention to lecture and section!
- Do assignments yourself (+partner)!

Ask for help!

- Lots of help available, will be adding more soon. (watch website)
- Lab sessions 4 days/wk with tutors to help with assignments
- Discussion sections with TAs to help with lecture concepts

Programming Assignments

All assignments are managed through GitHub
    Classroom (link on course page).

– **You must *push* your submitted code.**

Deadline Extension:
– Four "late days", used as "whole unit"
– 5 mins late = 1 late day
– Plan ahead, **no other extensions**

See course webpage for HW deadlines

Programming Assignments

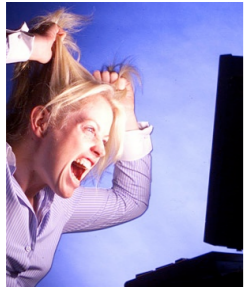Unfamiliar languages
+ Unfamiliar environments

Start Early!

Weekly Programming Assignments

Scoring = Test suite

No Compile, No Score
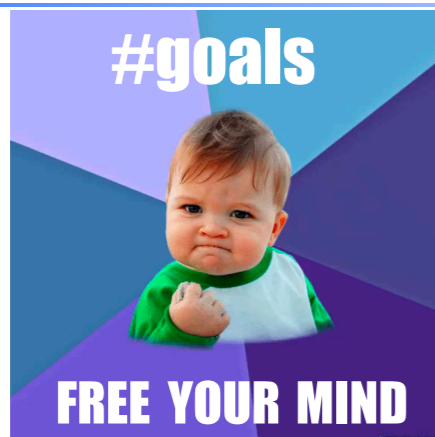
Weekly Programming Assignments

Forget Java, C, C++ ...
... other 20th century PLs

Don't complain
... that Haskell is hard
... that Haskell is @!%@#

Immerse yourself in new language

It is not.

Immerse yourself in new language

Word from our sponsor ...

- Programming Assignments done **ALONE** or in **(official) groups of two** (as permitted)

- We use plagiarism detection software
  - MOSS is fantastic, plagiarize at your own risk

- **Zero Tolerance**
  - offenders punished ruthlessly

- Please see academic integrity statement:
  - https://ue.ucsc.edu/academic-misconduct.html