

CSE 190 / 291 A00: Usability of Programming Languages ("Programmers Are People Too")

Michael Coblenz

About Me

- Spent eight years as a software engineer at Apple
- But: no one knows how to design programming languages that are known to benefit people!
- Can we develop a science of PL design?
- Completed a PhD on PL usability at Carnegie Mellon (designed a new smart contract language; showed it benefits people)
- Postdoc at UMD

Learning Goals

- After successfully completing this course you will be able to:
 - Apply qualitative and quantitative research methods to obtain insights about programming language design choices;
 - Critically analyze design questions in the context of languages and programming systems;
 - Read and interpret research papers in the area of usability of programming languages, and summarize major findings to date.

Course Content

- Three categories of material: methods, theory, results
- Three categories of work
 - Reading assignments (w/ reading responses due)
 - Project: a small language study
 - Theory homework
- The schedule is a little irregular.

Grading

Assignment	Weight	Due Date
Project	45%	Various; 12/12 final presentation
Theory	5%	
Reading responses	30%*	Before lecture
Methods Exam	20%	10/27 in class

* We'll drop the lowest reading response grade.

On Reading Papers

	Textbook chapter	Academic paper
Reading order	Start at the beginning, finish at the end	Read the whole thing, but use random access to enhance understanding and focus your reading
Comprehension expected	Everything (could be on a test)	Main ideas; answer your own questions; identify areas for future study
Comprehension strategies when confused	Read all previous chapters first	Write down questions in the margins, continue reading, and re-visit questions after seeing more of the paper
Schedule	Read night before class, or after class, or not at all (instructor will present)	Read in advance and come to office hours with questions

TA: Shaokang Jiang

- MS student; took this course last year
- Just submitted an FSE paper with his results from this course (+ followup work)!
- Office hours: CSE B270a Mondays 9:30-10:30

Schedule

- I unfortunately have upcoming conference travel
- Several classes will be on Zoom
 - including next Wednesday and Friday
 - Midterm will be while I'm out of town
 - HOWEVER: I realize that in-person classes are better for discussion
 - Zoom is an emergency backup plan (e.g., if you are sick)
 - Office hours: Fridays 3-4 PM (or by appointment; appointment only this week and next)

Welcome To Undergrads

- Undergrads belong in research too!
- 190 and 291 are the same class
- This class may require more *independence* than you are accustomed to
- Papers can draw on the *entirety of human knowledge*; do not expect to understand everything
- Please come to me with questions!

Resources

- Come to office hours!
 - Even just to say hello
- *Research Methods in Human-Computer Interaction* online (library) and in library course reserves
- *Types and Programming Languages* by Benjamin C. Pierce (for theory); available online through library

Collaboration

- Collaboration is encouraged! But *write your own answers*.
- Whiteboard discussion policy: discuss at a whiteboard, erase it, and write your own answers
 - Applies to ChatGPT, etc. as well.

Technology Policy

- Screens are distracting to others [1] and decrease learning outcomes
- Laptops, tablets, and phones may not be used in class except for note-taking, emergencies, and for disability accommodations

[1] <https://blueprintcdn.com/wp-content/uploads/2016/05/Blueprint-Research-2016-Carter-Greenberg-and-Walker.pdf>

TODAY

- What is usability?
- How might I measure usability?
- (Next time: more ways of assessing usability)

WHAT IS USABILITY?

- "The extent to which a product can be used by *specified users* to achieve *specified goals* with *effectiveness, efficiency* and *satisfaction* in a *specified context of use*." (ISO 9241-11, Ergonomics of human-system interaction)

USABILITY



USABILITY

- Who are the users?
- What are the users trying to do?
- In what context are they doing it?
- How well do they do it?
- How much work does it take them to do it?
- Do they like it?

WHO ARE THE USERS?

- Scope your target audience
 - Education
 - Experience
 - Knowledge
 - Skills
 - Work context

PERSONAS

- Help you think like the user
- Build empathy

CHARLIE



Charlie is in her late 20s to mid 30s. She has a Bachelor's degree but not necessarily in IT. She's a self-taught developer. Her coding is unconventional and she mixes genius lines with simple errors. She seeks to reinvent her software development career but the how is still unclear. Charlie has a family, which makes financial stability and work-life balance essential. She's new to the industry and thus looks for a company that offers a supportive, people-oriented environment, where she can learn and improve her skills.

ROBIN



Robin is in his mid 20s and has completed his formal education, such as a Bachelor's degree in computer science. He is probably on his second or third job but has reached the ceiling in his current job, as in, he has learnt a lot and gained experience but would be keen on taking the next step to further his career. Even though he probably hasn't taken any steps to find a new job (applied), he is on the lookout for something challenging as well as purposeful. In his current role, he can be found working in a specialized programming area (front-end/back-end/mobile). On a personal level, he is probably in a relationship, he is also quite introverted and self-aware. He enjoys working on complicated tasks and really wants to be involved and feel a part of the company. He values transparency and is happy working with inspiring leaders. He's keen to know what is going on and where the company is headed. Salary isn't his top priority (as long as it is not too far below average). Instead, Robin appreciates non-financial rewards, especially those that make him feel valued for his work.

MICROSOFT PERSONAS (CLARKE)

THE SYSTEMATIC DEVELOPER

Writes code defensively. Does everything they can to protect their code from unstable and untrustworthy processes running in parallel with their code.

Develops a deep understanding of a technology before using it.

Prides themselves on building elegant solutions.

THE PRAGMATIC DEVELOPER

Writes code methodically.

Develops a sufficient understanding of a technology to enable them to use it. Prides themselves on building robust applications.

THE OPPORTUNISTIC DEVELOPER

Writes code in an exploratory fashion.

Develops a sufficient understanding of a technology to understand how it can solve a business problem.

Prides themselves on solving business problems.

GOALS

- What does the user want to achieve?
- Start vague, and then drill down
- What does a C programmer want to achieve?
 - Fix a bug — what kind?
 - Implement something — what?
 - Understand code — for what purpose?

CONTEXT

- Starting from scratch, maintaining a system, or legacy code?
- Large team, or lone developer?
- Beginning of project, or near shipping (risk-averseness)?
- One-off, or repeated task?

HOW WELL DO THEY DO IT?

- Count and describe bugs/errors
- How readable is their code?
 - What does "readable" mean, anyway?
- What fraction of target population can do it?

HOW HARD WAS IT?

- What fraction of participants succeeded?
- How long does it take?
- What obstacles did they encounter along the way?
- Other measures?
 - Galvanic skin response (emotional response)
 - EEG (cognitive load)

DO THEY LIKE IT?

- Of course they do, if it's YOUR system!
- "We find that respondents are about 2.5x more likely to prefer a technological artifact they believe to be developed by the interviewer, even when the alternative is identical." [Dell et al., CHI 2012]
- "When the interviewer is a foreign researcher requiring a translator, the bias towards the interviewer's artifact increases to 5x."

SO WHAT IF THEY LIKE IT?

- Maybe there are factors you didn't measure
- Adoption
- "Why not?"
- But maybe you don't care!

VARIETIES OF USABILITY

- My "more usable" system might be better because:
- Learnability: it's easier/faster to learn
- Task performance: people finish tasks faster or more people finish tasks
- Audience: a new kind of person can do the task
- (Not an exhaustive list)

YOUR TURN

- Identify a usability question YOU have about a COMMON PL.
 - With a partner.
 - Share afterward.

"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use."

RESEARCH QUESTIONS AND METHODS

- How can I understand this situation better? (*ethnography, contextual inquiry*)
- I think P is a problem. What fraction of people in a population want it fixed? (*survey*)
- I designed a tool. What challenges do people face when doing task X with my tool? (*usability study*)
- Can most people use my tool successfully to do task T? (*usability study + quantitative analysis*)
- Is my tool better than an existing one for task T? (*quantitative study: randomized controlled trial*)

ARGUMENTS

- Which do you find convincing?
- What form *should* evidence take?

READING ASSIGNMENT

- The article introduces the "language wars"
- Read it *critically*
- I don't agree with everything in there
- But it's key contextual information for the rest of the course

NEXT TIME

- Discuss the paper
- How to run a usability study