
Research Methods

SWE233: Intelligent User Interfaces

<https://dayenam.com/teaching/swe233-fall2025/>

Daye Nam

Fall 2025

Learning Goals

After today's class, you should be able to

Describe and distinguish contextual inquiry, interview, survey, log analysis, and user study methods

Explain the pros and cons of different methods

Employ different methods in answering research questions

Methods!!!

Usability Methods

Contextual Inquiry
Contextual Analysis (Design)
Paper prototypes
Think-aloud protocols
Heuristic Evaluation
Affinity diagrams (WAAD)
Personas
Wizard of Oz
Task analysis
Cognitive Walkthrough
KLM and GOMS (CogTool)
Video prototyping
Body storming
Expert interviews
Information Architecture Diagrams

A/B studies
Questionnaires
Surveys
Storyboards
Journey maps
Prioritization Matrices
Log analysis
Focus groups
Card sorting
Diary studies
Improvisation
Use cases
Scenarios
Cognitive Dimensions
“Speed Dating”
Journey Maps

...

Steps

- 1. Defining the research questions**
- 2. Creating a protocol/questionnaire**
- 3. Recruiting participants**
- 4. Carrying out the study**
- 5. Analyzing the data**

Activity

As a group of 2-3,
pick 1 product idea (ideally for developers)
utilizing AI/LLM that is very new

Example: A brain computer interface (like Neuralink) that can infer programmers' intent perfectly so that LLM can provide them the perfect software

Contextual Inquiry

Interpretive field research method

Depends on conversations with users in the context of their work

Used to discover real requirements, plans and designs

User decides the tasks instead of you asking users to do a specific task
Investigate real-world tasks, needs & context

Interview

Introduction

Background / History

Opening questions e.g., satisfactions, frustrations

Follow-up questions Specific areas to elaborate on

Other important points ‘Anything to add?’ / ‘Anything we missed?’

Wrap-up Express appreciation

Logs Analysis

Logs Analysis

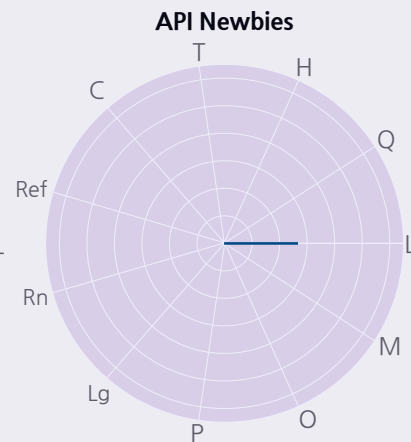
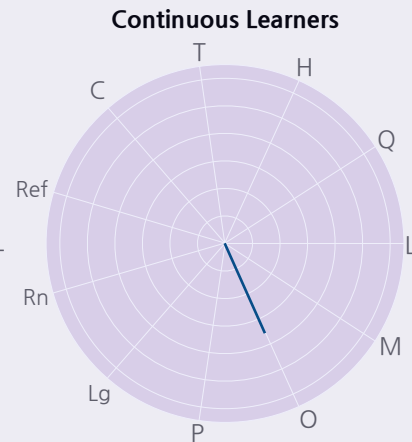
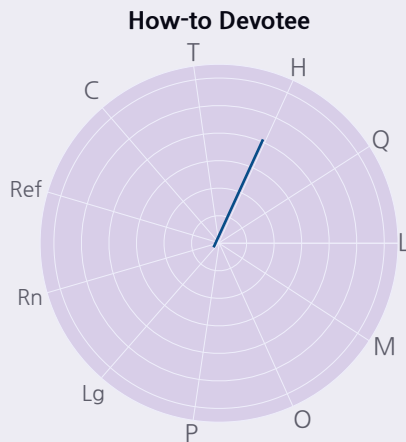
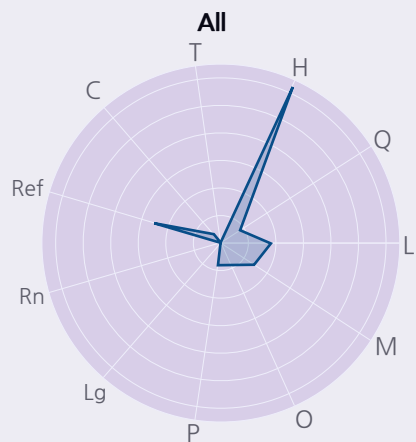
You analyze user logs, instead of observing users

Not every research questions can be answered with logs analysis

Minimizes response biases

RQ1:

What are the different documentation type usage patterns?



Challenges in effectively communicating needs to intelligent tools

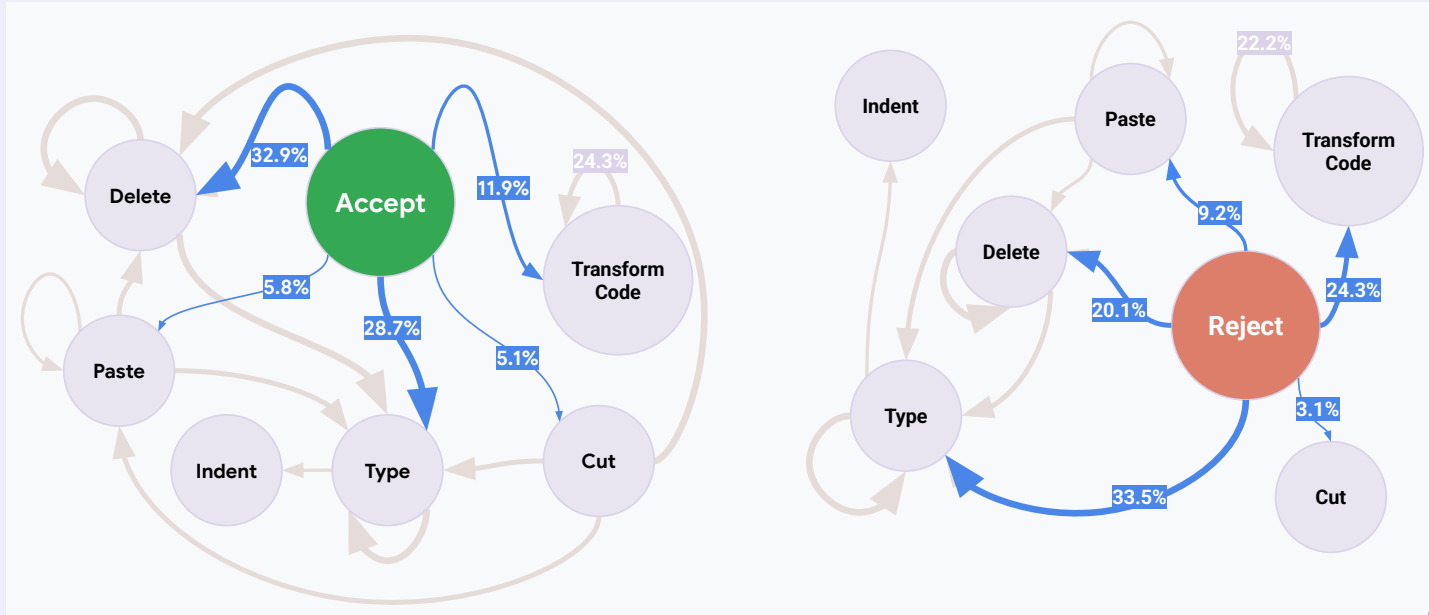
```
1 // Copyright 2024 Google LLC
2 //
3 // Licensed under the Apache License, Version 2.0 (the "License");
4 // you may not use this file except in compliance with the License.
5 // You may obtain a copy of the License at
6 //
7 // https://www.apache.org/licenses/LICENSE-2.0
8 //
9 // Unless required by applicable law or agreed to in writing, software
10 // distributed under the License is distributed on an "AS IS" BASIS,
11 // WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
12 // See the License for the specific language governing permissions and
13 // limitations under the License.
14
15 #include
16 #include <string>
17
18 #include "devtools/c/portability/wasm/marshalling.h"
19 #include "third_party/cel/cpp/tools/wasm/wasm_parser_wrapper.h"
20
21 using ::cel::wasm::internal::ParseResult;
22 using ::cel::wasm::internal::WasmParserWrapper;
23
24 emscripten::val PayloadGet(ParseResult& result) {
25   return portability_wasm::CopyToJsHeapArrayBuffer(result.payload());
26 }
27
28 EMSCRIPTEN_BINDINGS(parser) {
29   emscripten::class_<ParseResult>("ParseResult")
30     .constructor<bool, std::string>()
31     .function("success", &ParseResult::success)
32     .function("payload", &PayloadGet);
33
34   emscripten::class_<WasmParserWrapper>("Parser").function(
35     "Parse", &WasmParserWrapper::Parse);
36
37   emscripten::function("NewParser", &WasmParserWrapper::Create);
38 }
39
```



Edit by Transform Code

"Fix code" x 3

Challenges in effectively communicating needs to intelligent tools



Challenges in Logs Analysis

It is extremely hard to get access to logs data unless you own the product

There are a lot of noise in the data

You can infer the user needs and challenges, but additional studies are necessary to fully confirm them

Activity

With your group, discuss and submit

- 1) research questions to answer
- 2) log data to analyze
- 3) analysis plan

Survey

Survey

Ask questions in an easier-to-answer format

Send survey invitations to a lot of people and ask them to participate

Email, mail, paper questionnaire, social networks, posters, ...

Typically collect quantitative data

Survey Design

Increase the benefits of survey participation

Compensation, make it interesting, gamification, and explain the goal

Decrease the costs of participation

Keep it short and simple, show respect

Collect general demographic information that may be relevant

Age, gender, experience, role

Potential Errors

Coverage error

e.g., Internet survey among US population vs UCI students

Sampling error

e.g., use 5 students to represent UCI students

Nonresponse error

e.g., survey about survey response rates

Measurement error

e.g., household income for the previous year as a measure of household wealth

Survey Design

Important to design the questionnaire carefully

Users may find questions confusing

Make questions simple and easy to answer

e.g., Likert scale

	agree					disagree			
I think AI tools make me more productive:	1	..	2	..	3	..	4	..	5

Avoid biased/leading questions

AI is increasing developer productivity. Do you think your company should adopt more AI developer tools?

Survey Examples

Stack Overflow Developer Survey

<https://survey.stackoverflow.co/2025/>

GitHub Open Source Survey

<https://opensourcesurvey.org/2024/>

JetBrains Developer Ecosystem Survey

<https://www.jetbrains.com/lp/devecosystem-2024/>

Activity

With your group, discuss and submit

- 1) research questions to answer
- 2) how you will recruit your participants
- 3) 3 survey questions (not background related)

User Study

User (Lab) Study

You invite people and let them use your product

Typically, you provide users with some tasks to work on

Set up a realistic situation and tasks that can be finished within a reasonable time limit

Can be used for finding usability issues

Can be used for evaluation

Compare participants who use your products vs who do not

Measurements

Objective

Time, number of tasks completed, number of errors, severity of errors, number of times help needed, quality of results, emotions, etc.
Can be measured automatically / manually

Subjective

User-perceived usefulness, emotions, preferences, and frustration
Through a questionnaire

Think aloud

Get participants to continuously verbalize their thoughts
Find out why the user does things
Interferes with objective measurements (e.g., timing)

Participants recruitment

A study with only a few participants can still be valuable

Can find usability problems

For any evaluation with statistical results, generally, 20-30

Randomized Controlled Study

If you can recruit MANY participants, this is going to be the most rigorous

You randomly assign participants to contro/treatment group

Pilot Study

Preliminary evaluations to check materials, look for bugs, etc.

Evaluate the instructions, timing

Ethical Considerations

No harm to the users

- Emotional distress

- Emphasize the system being evaluated, not the user

- Results of evaluation and users' identities kept secret

- Stop evaluation if the user is too upset

Have an “Institutional Review Board” (IRB)

Activity

With your group, discuss and submit

- 1) research questions to answer
- 2) a task participants will work on
- 3) 3 things to measure/collect

Recap

Goals of studies

Needs finding

What are interesting/important problems to solve?

Contextual Inquiry, Interview, Log analysis, ...

Formative

What are potential solutions for the problems?

Survey, Prototyping, User study

Evaluation

How well do our solutions work for the problems?

User study, A/B testing, Log analysis

Key distinctions

Contextual Inquiry / Logs Analysis

Ongoing experience & concrete data

What users **do**

User intent & rationale **inferred**

Spontaneous, as it happens

What users actually **need**

Interviews, Surveys

Summary data & abstractions

What customers **say**

User intent & rationale **described**

Limited by the reliability of human memory

What customers **think** they want

Things we haven't covered

Theory Building

Qualitative analysis

Statistical analysis

IRB

Design

...

Administrivia

Problem Identification (due: Oct 8)

Submit a short abstract (300 words)
that covers the following:

Problem Definition

Target Users

Intelligent Solutions

Please talk to me if you need help!

ABSTRACT

Code-generating large language models map natural language to code. However, only a small portion of the infinite space of naturalistic utterances is effective at guiding code generation. For non-expert end-user programmers, learning this is the challenge of *abstraction matching*. We examine this challenge in the specific context of data analysis in spreadsheets, in a system that maps the user's natural language query to Python code using the Codex generator, executes the code, and shows the result. We propose *grounded* abstraction matching, which bridges the abstraction gap by translating the code back into a systematic and predictable naturalistic utterance. In a between-subjects, think-aloud study (n=24), we compare grounded abstraction matching to an ungrounded alternative based on previously established query framing principles. We find that the grounded approach improves end-users' understanding of the scope and capabilities of the code-generating model, and the kind of language needed to use it effectively.

Paper Presentation

Summarize main research questions, proposed methods, and key contributions

Focus on the used methodologies; if not covered in the previous classes, please delve deeper into the details

Slide upload deadline is the 1 am of the day you're presenting the paper

e.g., if you're presenting a paper on Oct 8, you should finalize your slides by October 8 1 am

Upload your slides to #presentation-slides channel on Slack

Prepare 3 discussion questions

References

- CMU's 05-863 (Fall 2018) Lecture 6
- CMU's 17-803 (Fall 2022) Sep 13 Lecture
- Creswell, John W., and J. David Creswell. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, 2017.