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Integration of Multiple Static Analysis Tools in a Single Interface

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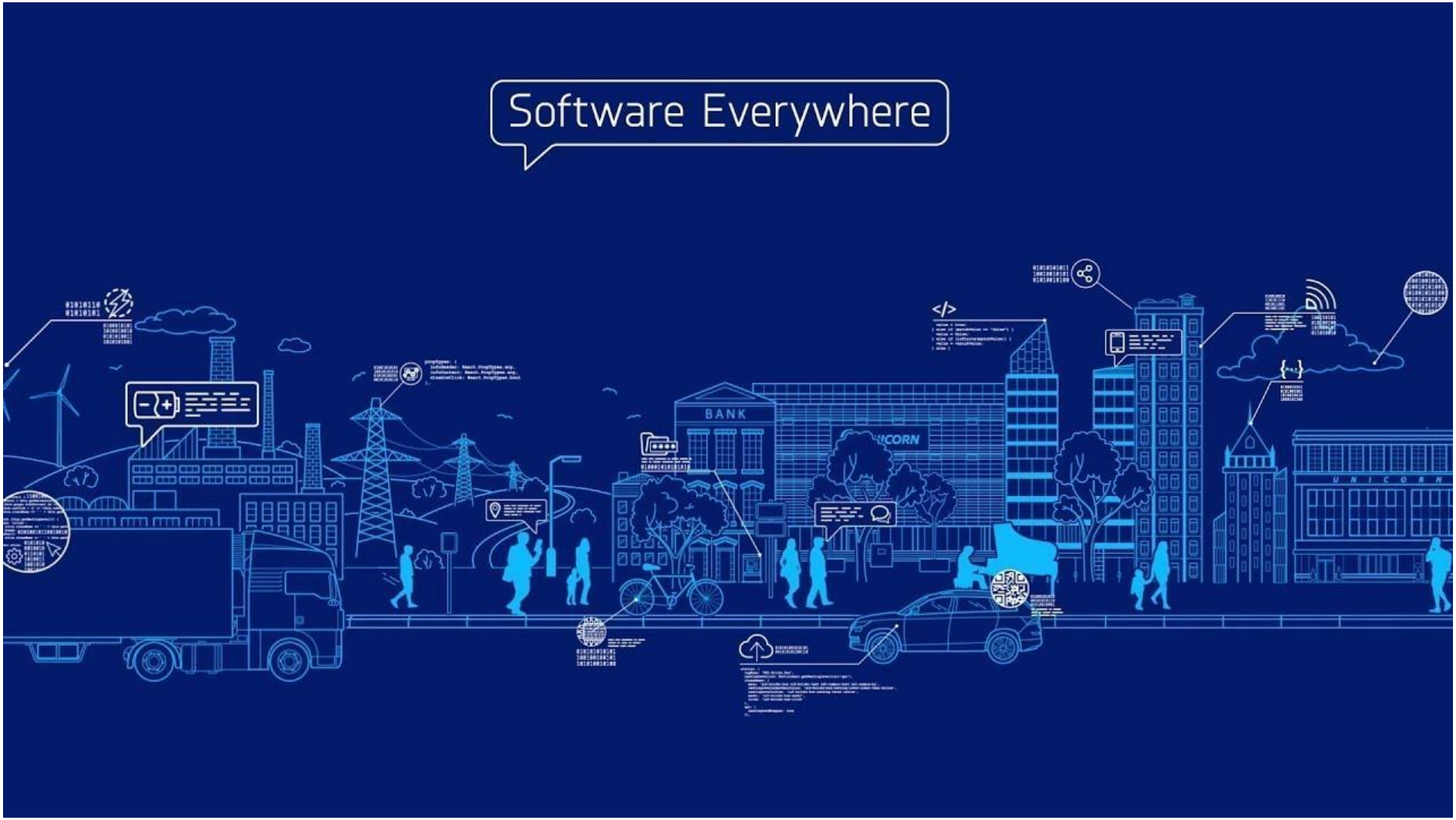

Software Everywhere
BANK

- “ $1.1 Trillion in Assets Affected by Software Bugs in **2016** “

  - Software Fail Watch Annual Report, Tricentis

Static Code Analysis

- It helps in prevention of bugs.
- It examines code without execution.

- Detects Vulnerabilities :

  - Injections
  - Cross Site Scripting (XSS)
  - Buffer Overflow, and Dead Code etc

Static Code Analysis

- Tools :
  - IDE Notifications,
  - IDE tools,
  - Dedicated tools,
  - Linters
  - CLI tools.

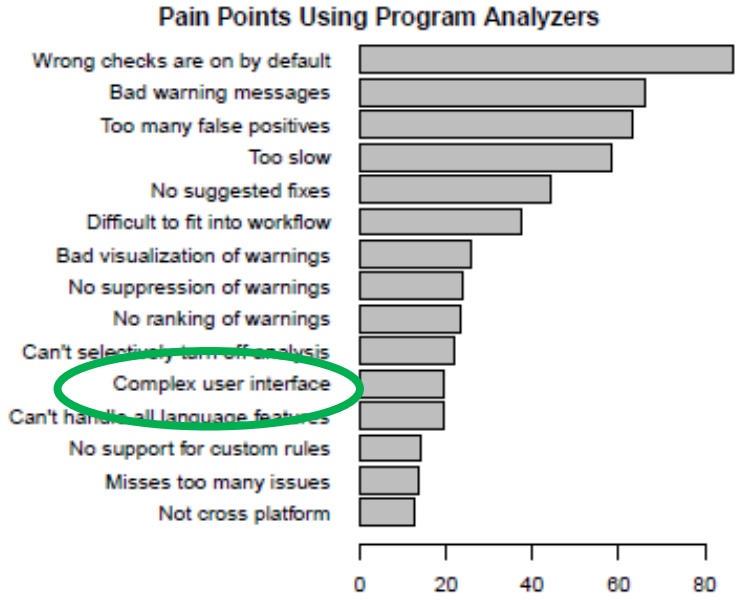
- Research Papers:

  - Christakis, Maria; Bird, Christian (2016): What developers want and need from program analysis: an empirical study.

  - Johnson, Brittany; Song, Yoonki; Murphy-Hill, Emerson; Bowdidge, Robert (2013): Why don't software developers use static analysis tools to find bugs?

  - Found: developers facing issues in using tools

  - Most importantly, USABILITY issue.



SARIF

- Static Analysis Results Interchange Format (SARIF)
- Standard representation of bug warnings in a JSON format

Multiple Tools

- Developers seem to use multiple static analysis tools each having own coverage.
- Research trends:
  - Using multiple static analysis tools in order to prioritise the bug warning alerts
  - Using results of three different static analysis tools for a programming language, Java and merges them together in order to show warnings to the developer

But USABILITY is not addressed…

Multiple Tools

- **SARIF** scope - different analysis tools results can be integrated
- Need for addressing Usability issue

Thesis Work Plan

- Problem Statement
- Research Questions
- What Current Tools do?
- Our Approaches
- Evaluation
- Time Plan

Problem Statement

- How to integrate the results of multiple static analysis tools

  in a unified user interface?

Research Questions

1. How to display results of the same codebase from different analysis tools?
2. What feedback works to know that the bug fixing is on-going?
3. How to carry traceability of bug fixing?

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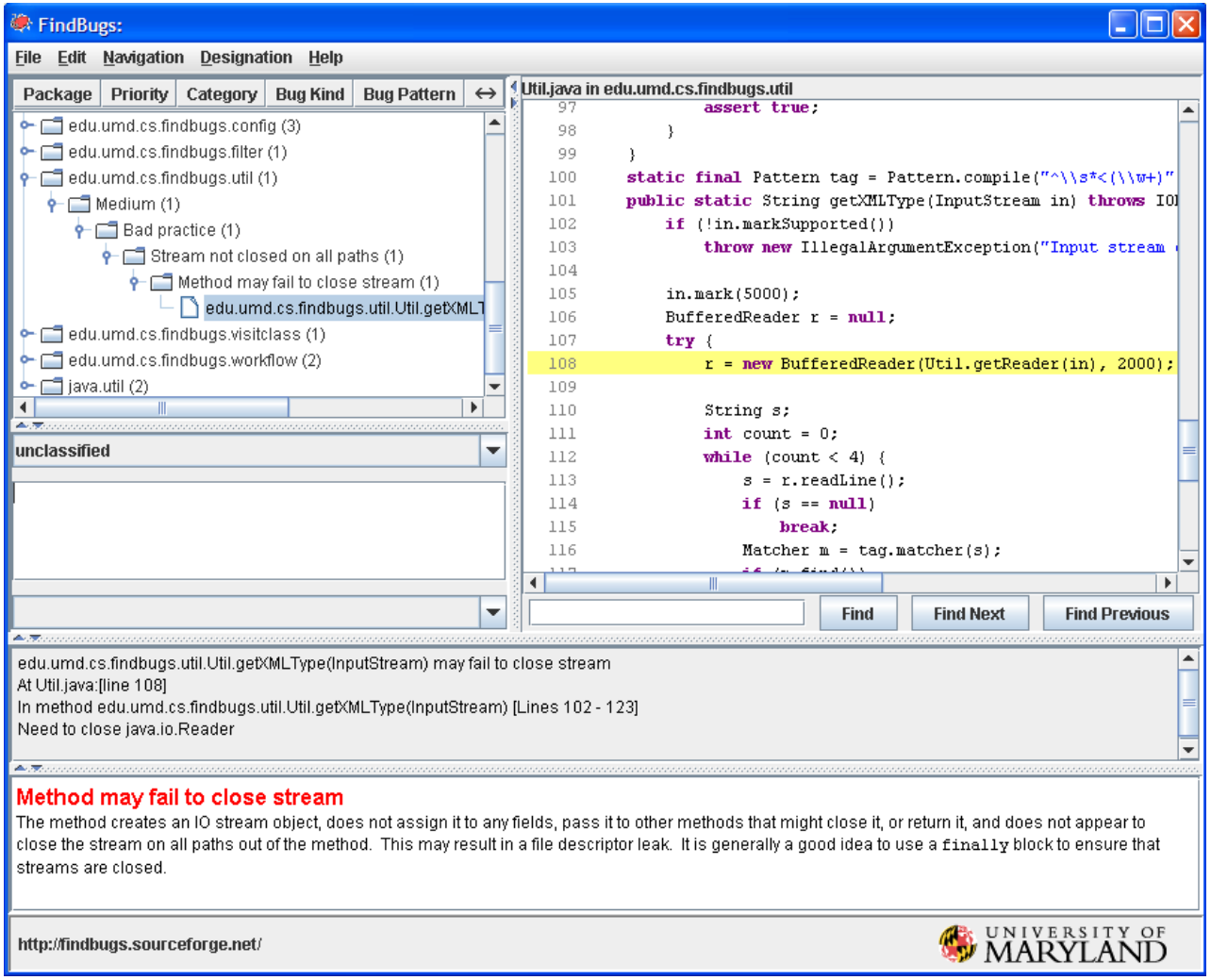
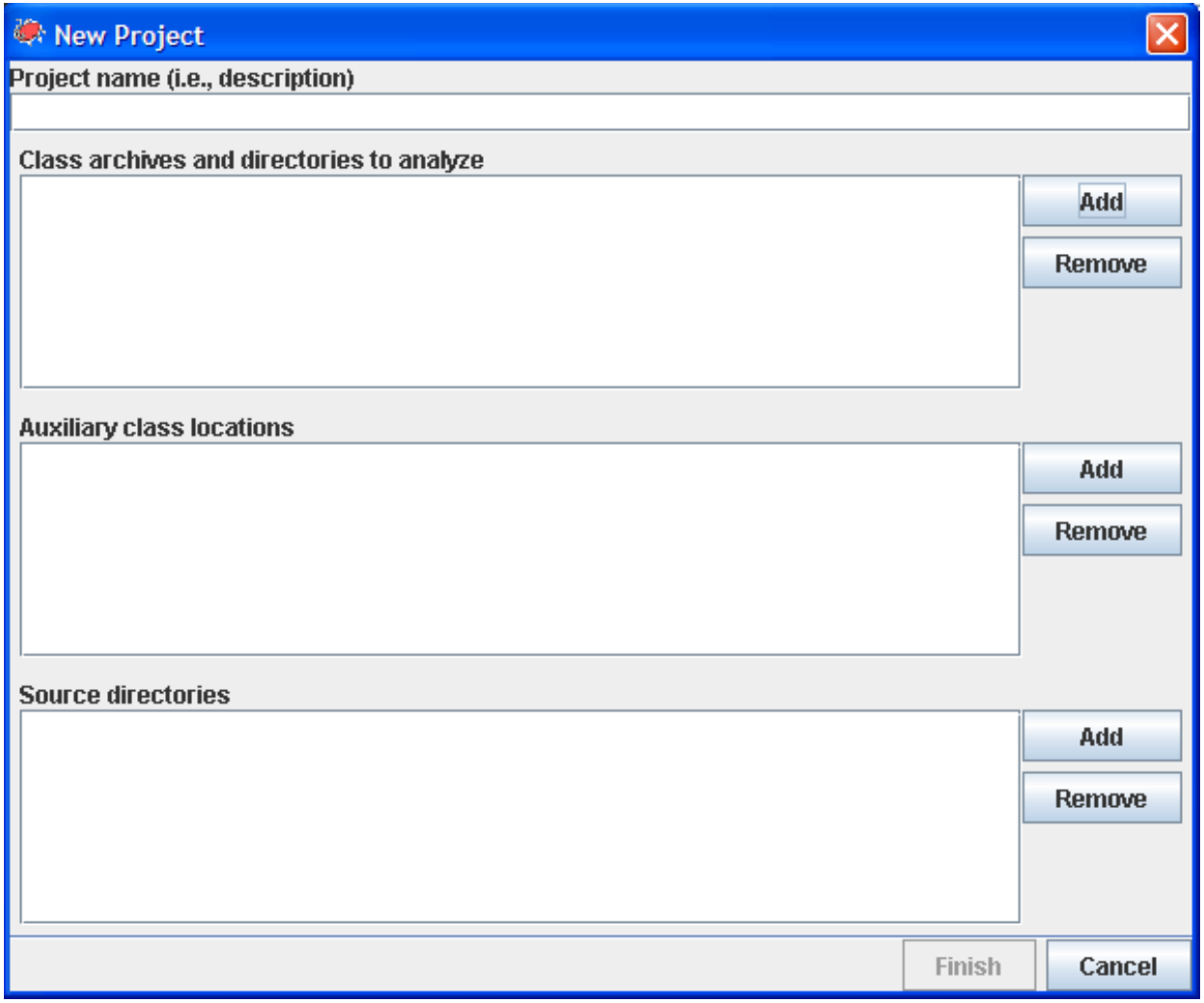
What Current Tools do? - RQ 1

- FindBugs



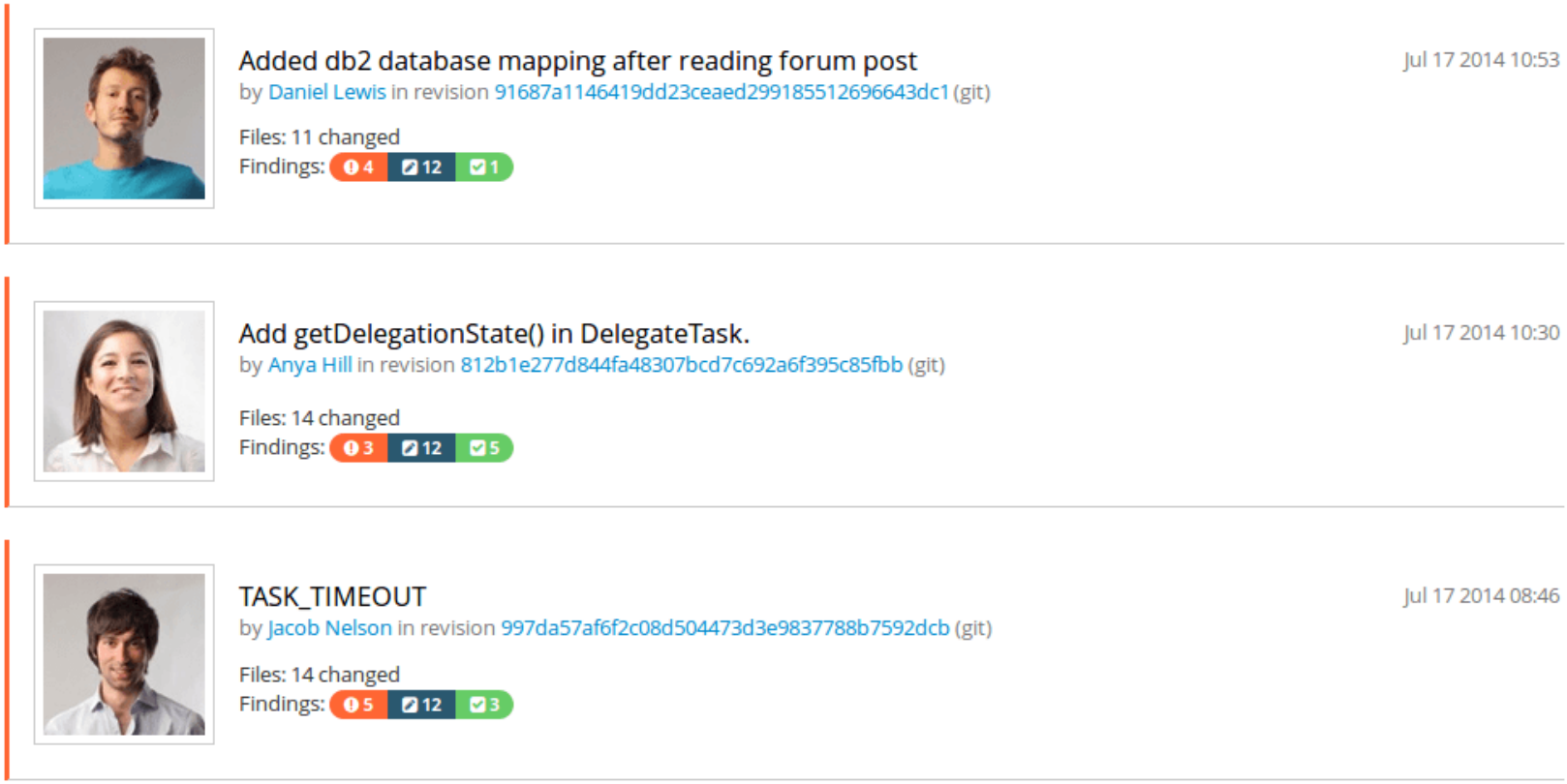
What Current Tools do? - RQ 2

- FindBugs



What Current Tools do? - RQ 3

- TeamScale



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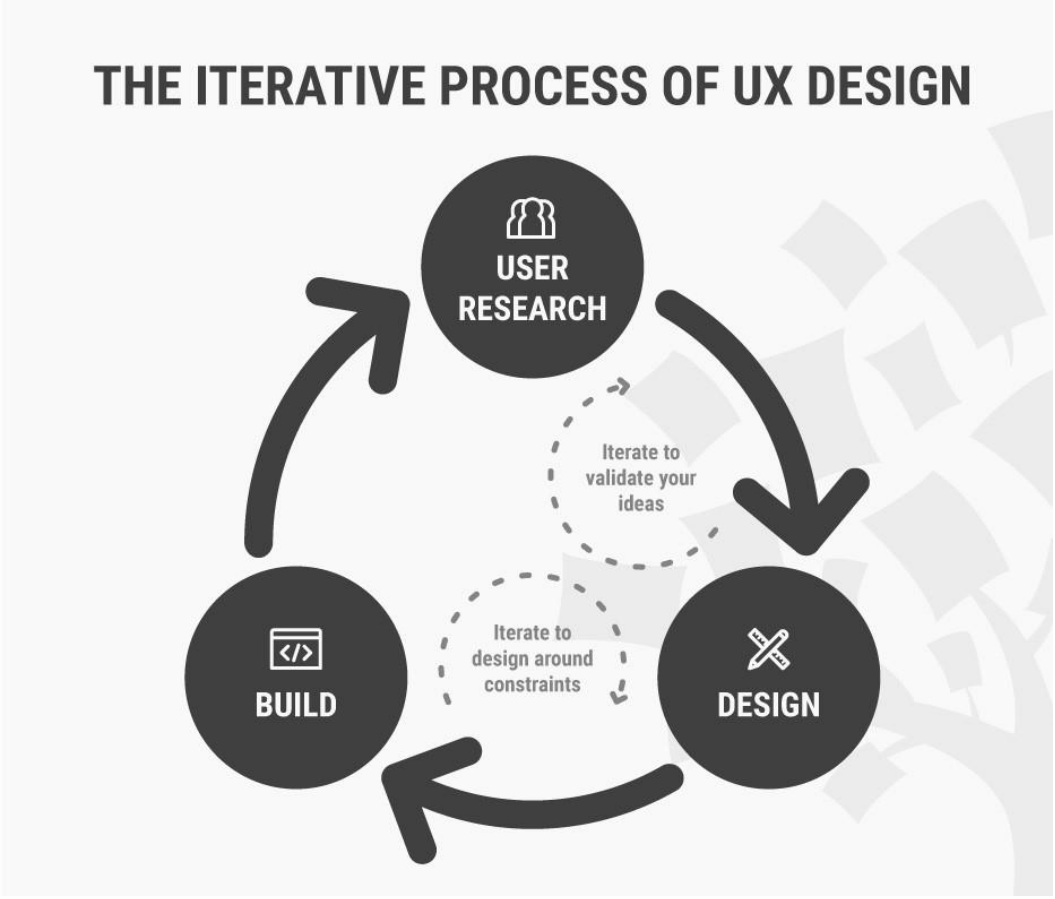
Our Approaches

UX Design Cycle

- Research Methodology



Our Approaches

- Software Engineering disciplines:
  - Complex datasets
  - Compiler reporting
  - Continuous integration
  - Refactoring tools
  - Issue tracker
  - Stack Overflow
  - Gamification
  - Usability Engineering

Our Approaches

- Complex datasets:

  - Dix et. al. - more complex grouping and linking of datasets in the context of a user interface of Spreadsheets application.

    Design lesson : extensibility of columns  **RQ 1**

  - Gaur et. al.

    - linear search problem in indexing as it takes more time for large volumes of data. So, different parameters are introduced to decrease computation time.

    Example: Searching for toy  **RQ 2**

Our Approaches

- Compiler reporting

Horning et. al

- error logging with statistics

RQ 1

- stating what kind of bugs are not found along with bugs found

Our Approaches

- Refactoring tools

Dustinca

- barrier of discoverability
- introduced a smart tag for code can be refactored.
- 'on-board' phase _ **Gamification**

RQ 3

Hayashi et. al. - task level commits in order to maintain edit history

RQ 3

Our Approaches

- Issue tracker

Baysal et. al. :

  - Information overload
  - Expressiveness

Ideal to describe the priory as per team decision instead of personal choice.

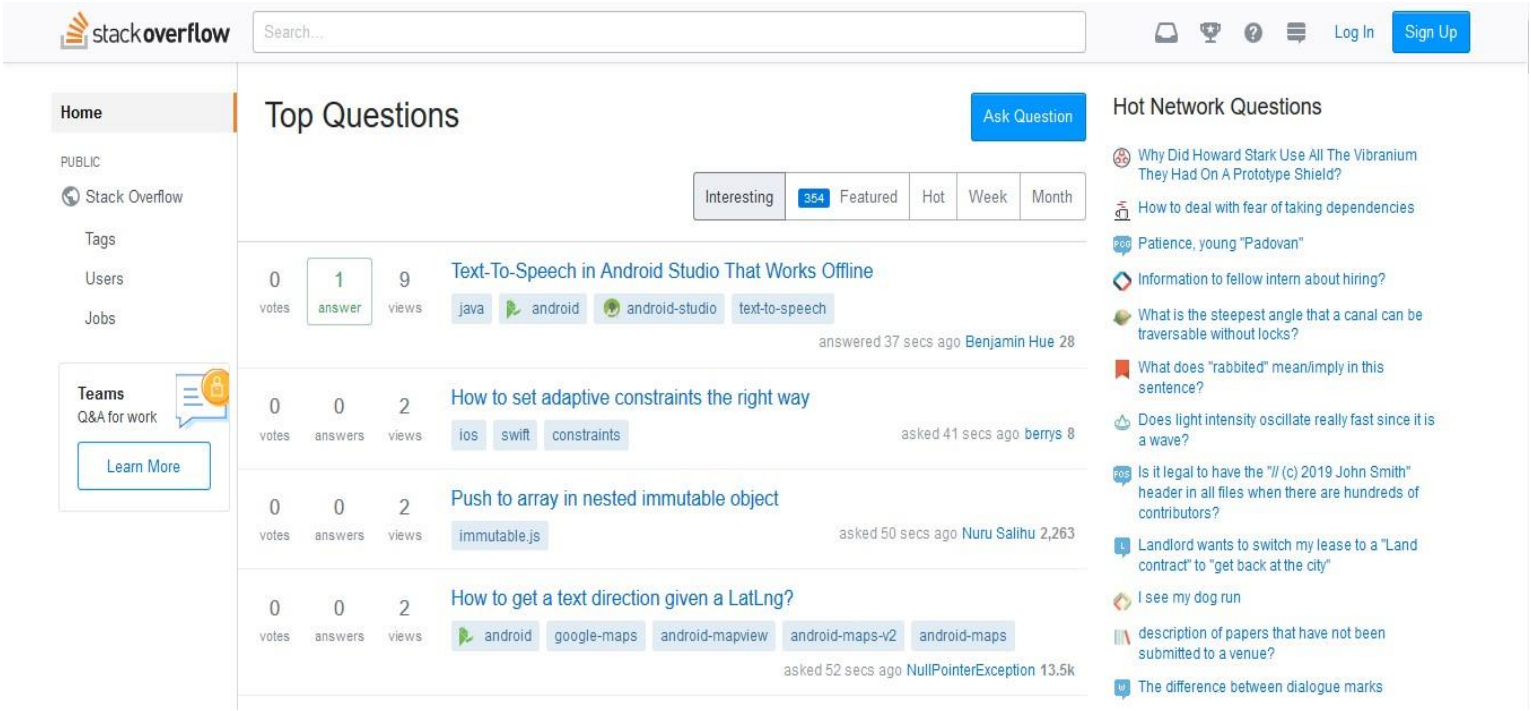
RQ 1

Our Approaches

- Stack Overflow

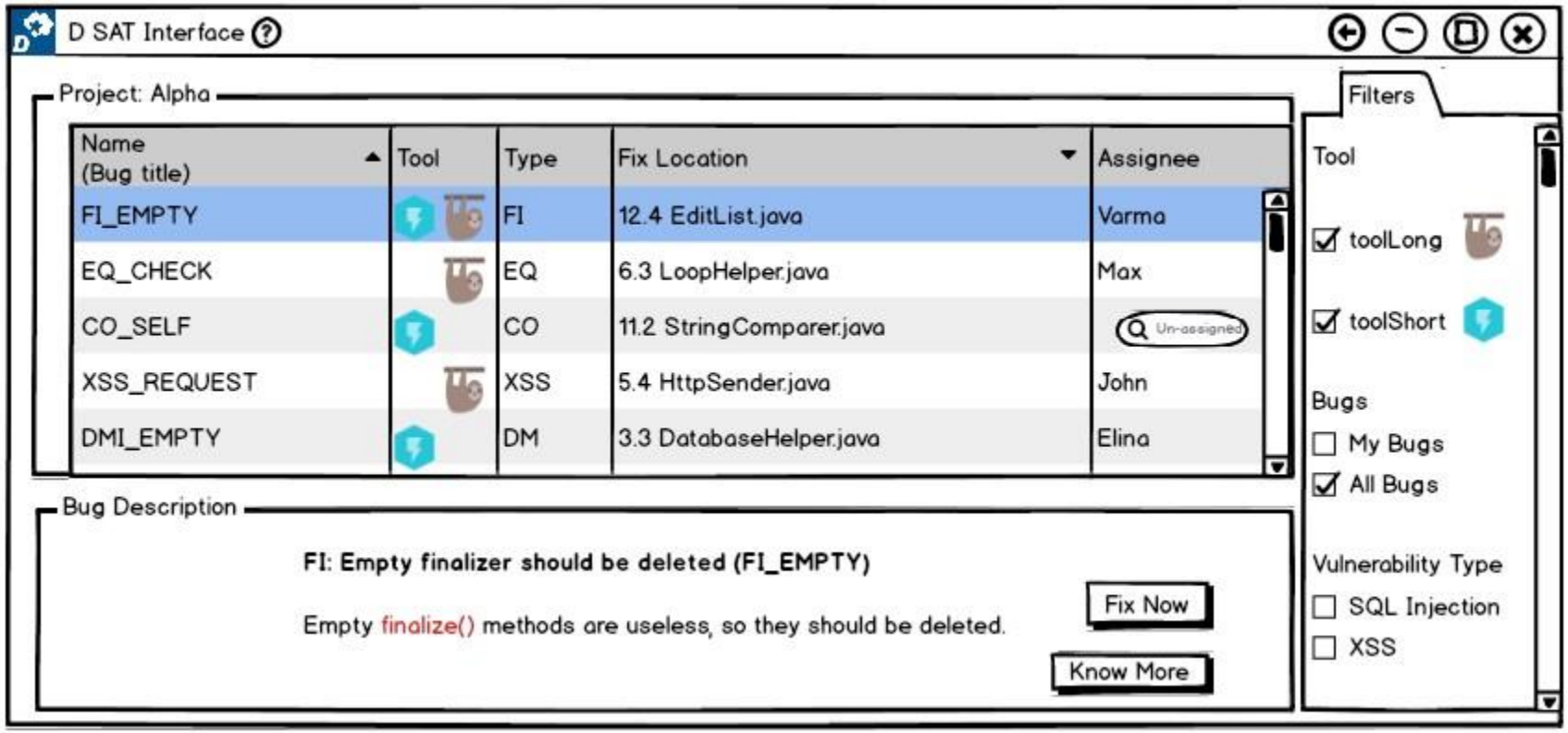
- Wang et. al. : 10934198 questions on a 'User Interface' topic
- Treude et. al. : 72.30 % questions have between 2 and 4 tags

RQ 1



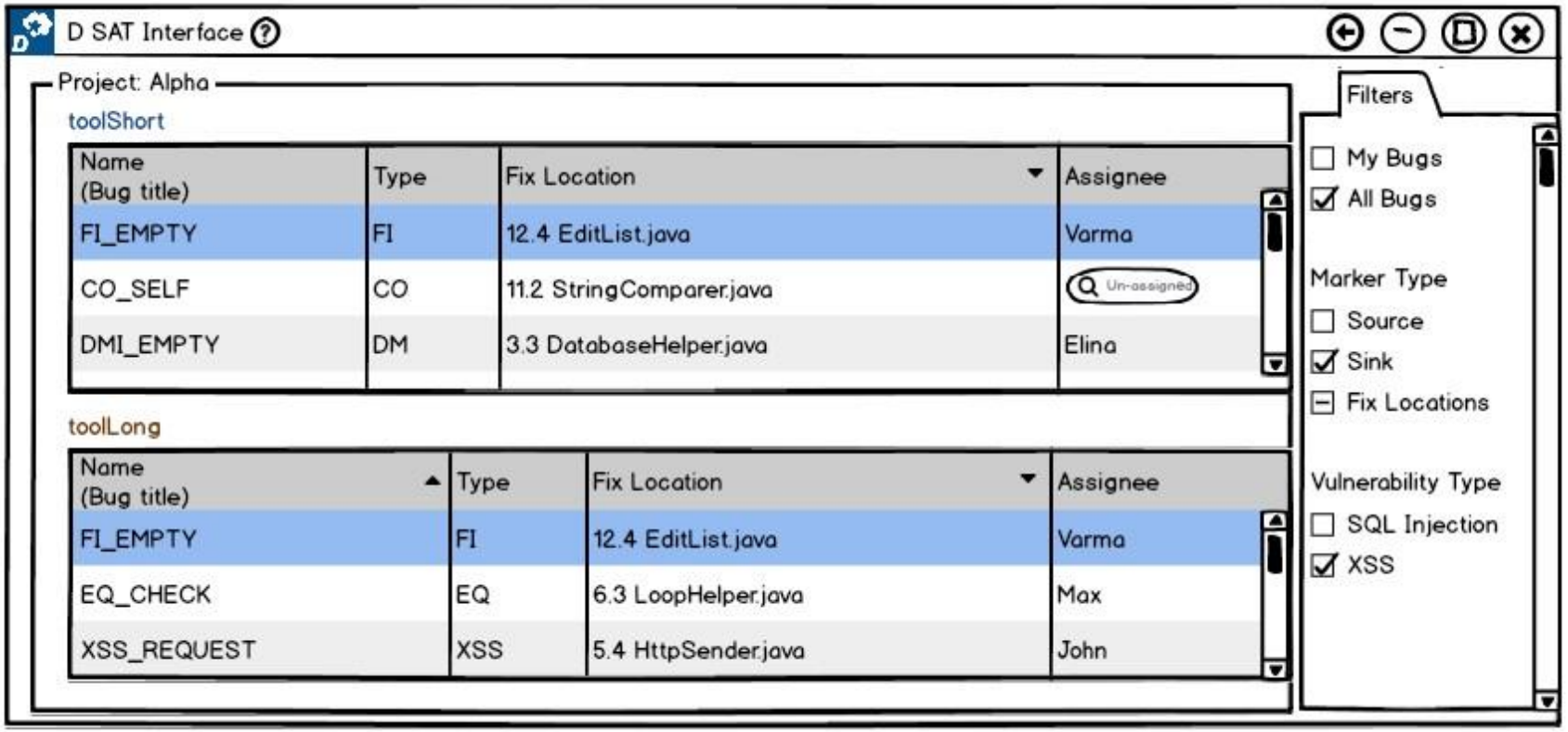
Example: RQ 1

- Prototype 1



Example: RQ 1

- Prototype 2



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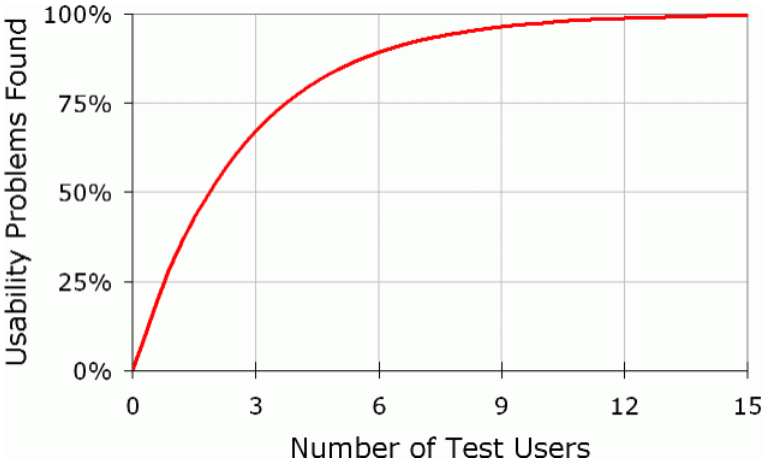
Evaluation

- Experimental Design

- Number of Test Users:



Dr. Nielsen recommends – **5**

Nielsen, Jakob, and Landauer, Thomas K.:
"A mathematical model of the finding of usability problems,"

- Order of evaluation:

Users tend to learn – order of presenting prototyes is altered

Evaluation – Usability Inspection Methods

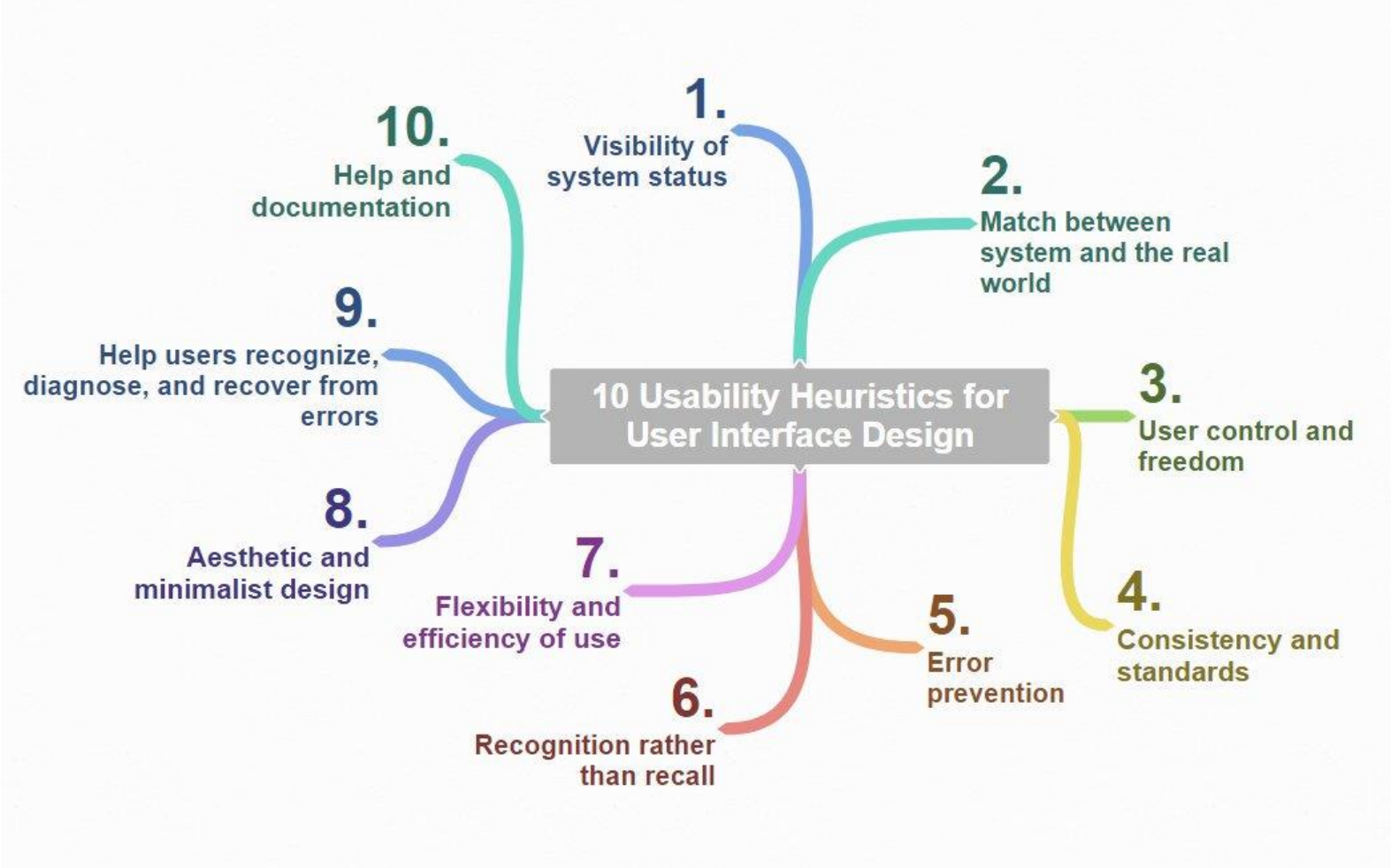
- Cognitive Walkthrough

For each step to a predefined task, the following aspects are analysed.

- Will the user try and achieve the right outcome?
- Will the user notice that the correct action is available to them?
- Will the user associate the correct action with the outcome they expect to achieve?
- If the correct action is performed; will the user see that progress is being made towards their intended outcome?

Evaluation – Usability Inspection Methods

- Heuristic Evaluation



Evaluation – Usability Inspection Methods

- Heuristic Evaluation

Each problem w.r.t. a heuristic is rated accordingly; 0 – 4

0 - do not agree this is a usability problem

1 - cosmetic problem

2 - minor usability problem

3 - major usability problem (important to fix)

4 - usability catastrophe (imperative to fix)

Comparative Study

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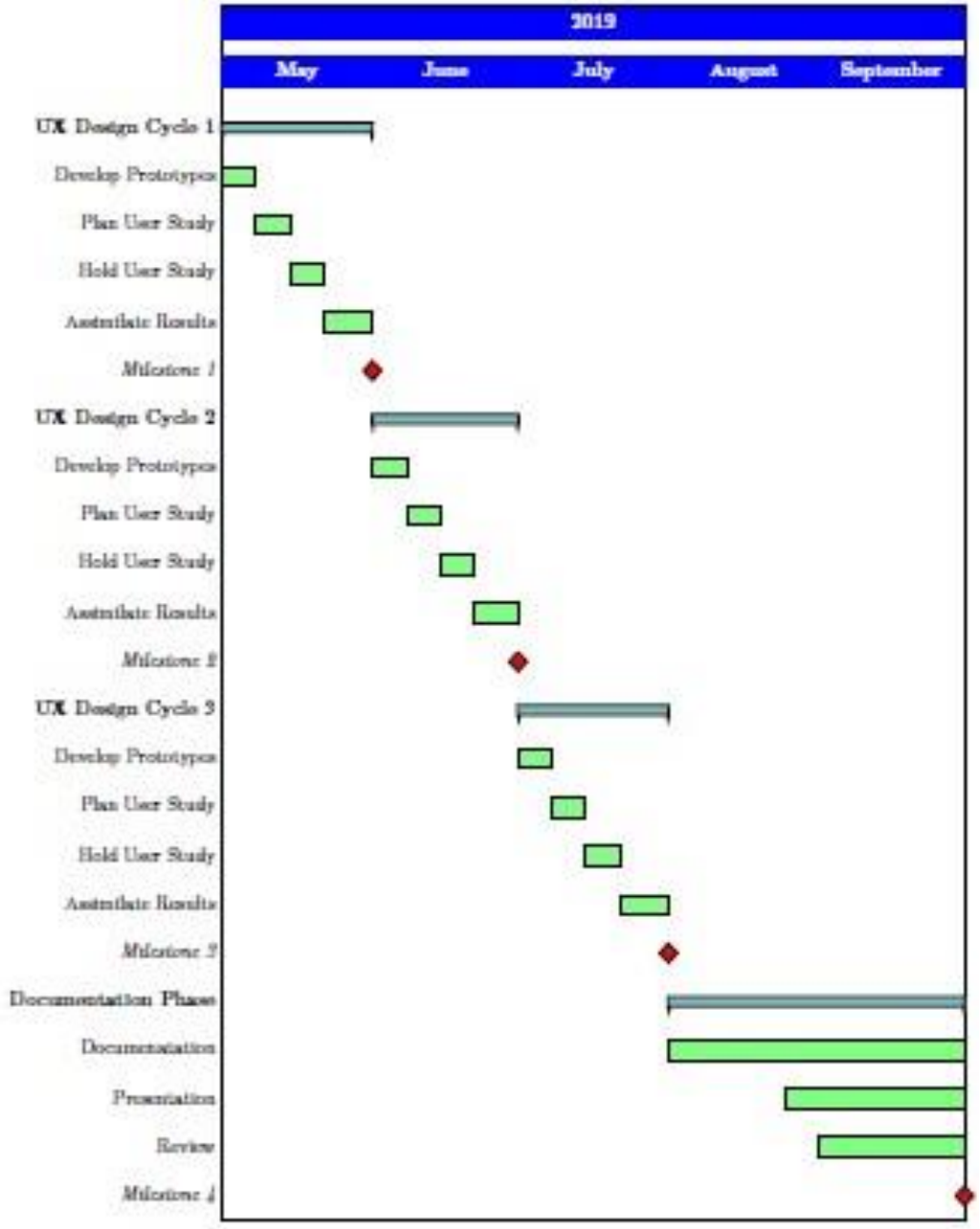
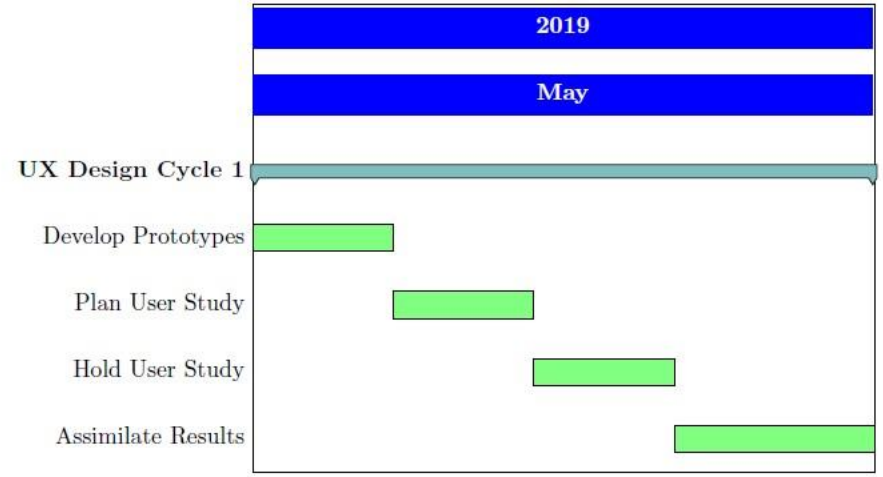
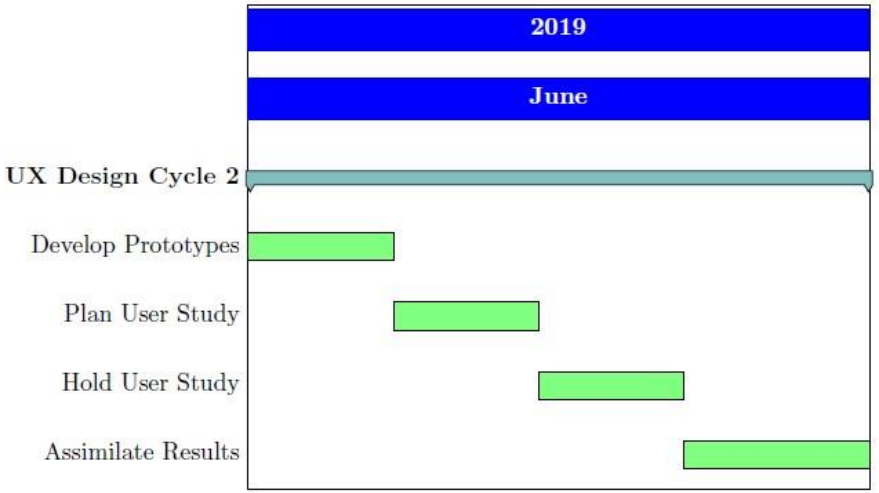
Time Plan

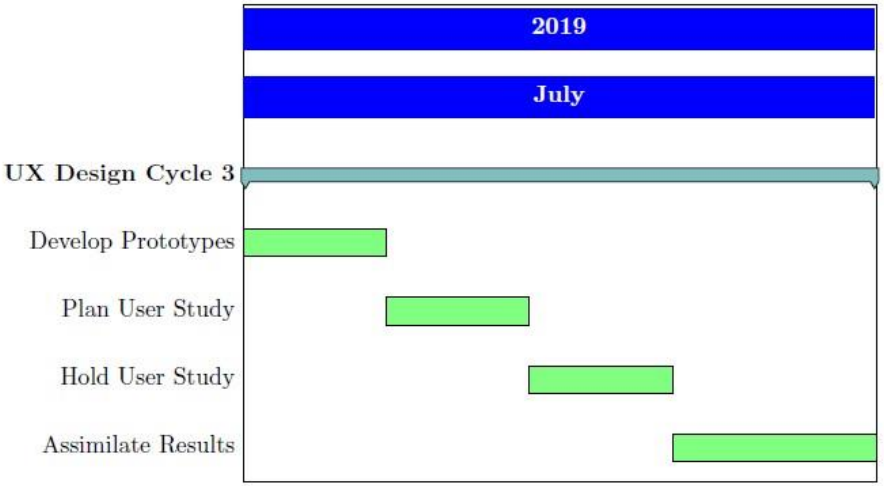
- Official Time: 5 Months
- Milestones: 4



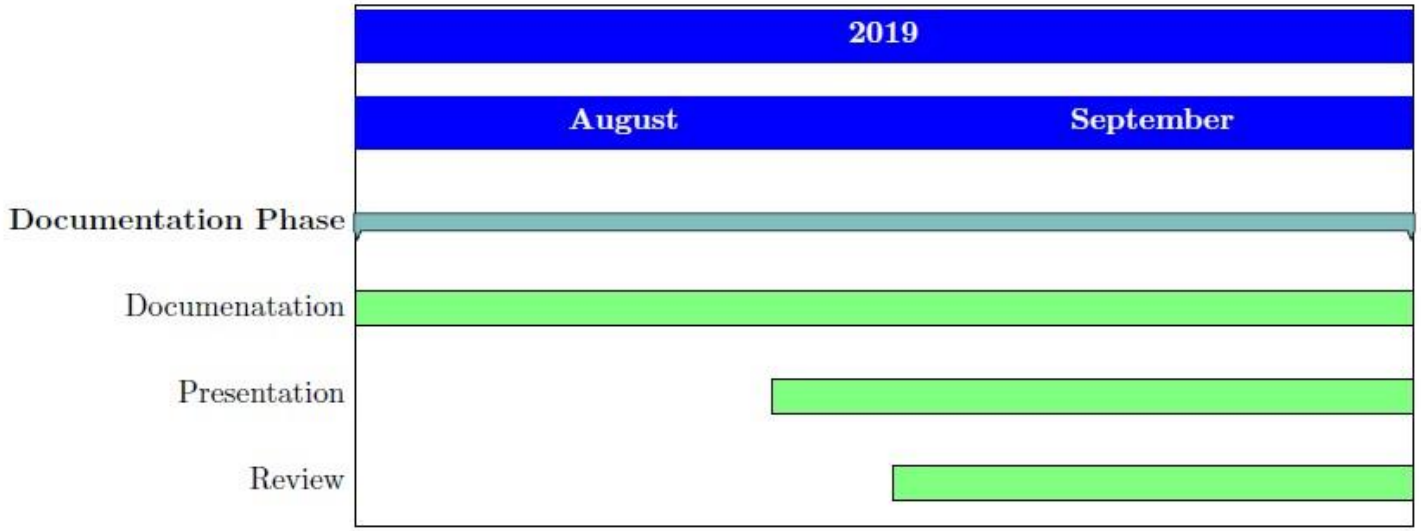
Milestones 1 2 3







Milestone 4


2019
August
September
Documentation Phase
Documenatation
Presentation
Review

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Thank you for listening...

G. S. Varma

Summary

- Importance of Static Analysis tools
- Usage of Multiple Static Analysis tools
- Future scope of SARIF

- Need for a single user interface for multiple tools
- It should be Usable

- This Thesis follows UX Design Cycle to achieve usable prototypes.