Experiment scoping

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LOOKING FURTHER

Roadmap

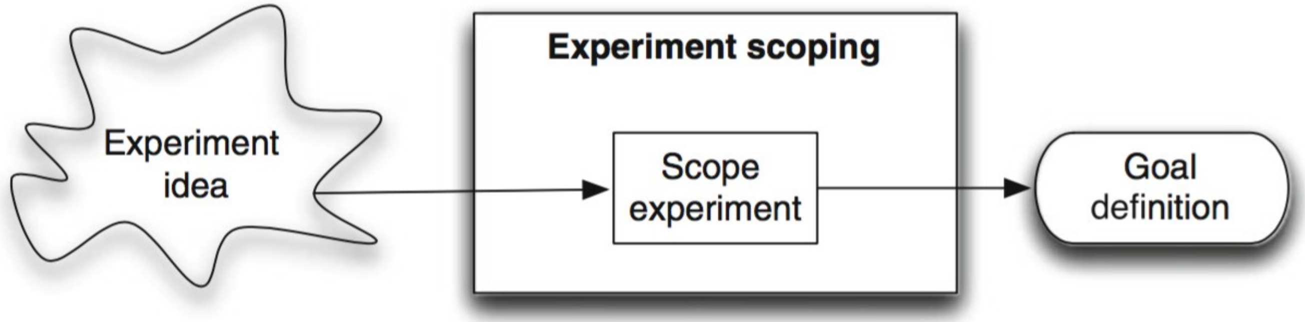
Experiment goal definition

The Goal-Question-Metric approach

A final Example

Experiment scoping

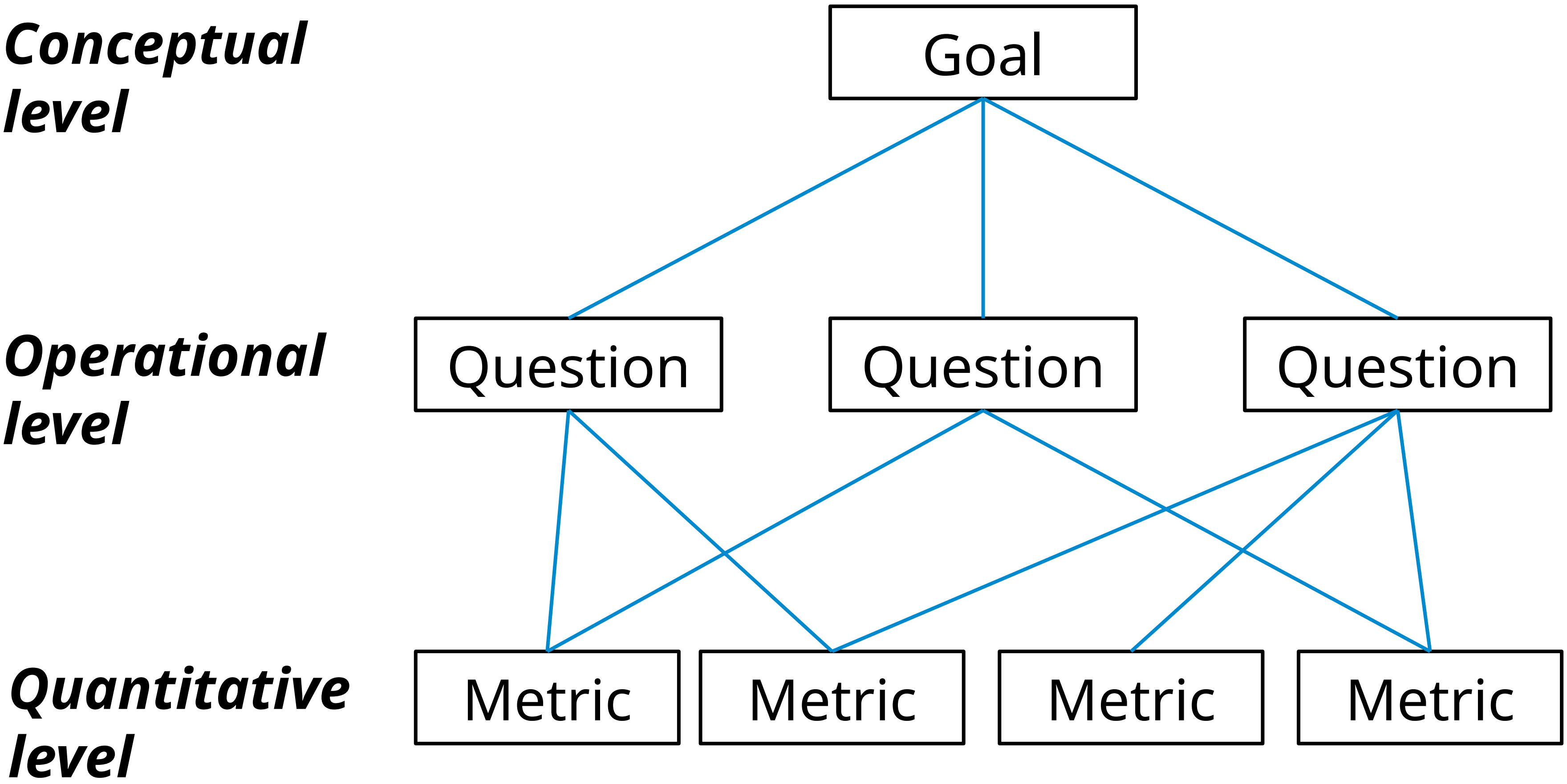
- Define the **goal** of the study



- Research approach: **Goal-Question-Metric** [1]

[1] V.R. Basili, "Software Modeling and Measurement: The Goal Question Metric Paradigm," Computer Science Technical Report Series, CS-TR-2956 (UMIACS-TR-92-96), University of Maryland, College Park, MD, September 1992.

Overview



Conceptual level

Goal

Operational level

Question

Question

Question

Quantitative level

Metric

Metric

Metric

Metric

Experiment goal definition

How to define a goal?

Analyze	**Object(s) of study**
for the purpose of	**Purpose**
with respect to their	**Quality focus**
from the point of view of	**Perspective**
in the context of	**Context**

Goal definition framework

Object of study	Purpose	Quality focus	Perspective	Context
Product Technology Technical choice Process Model Metric Theory	Characterize Monitor Evaluate Predict Control Change	Effectiveness Energy consumption Cost Reliability Maintainability Portability Performance Understandability	Developer Maintainer Project manager Corporate manager Customer User Researcher	<depends on experiment>

Image encoding example - goal

Analyze	
for the purpose of	
with respect to their	
from the point of view of	
in the context of	

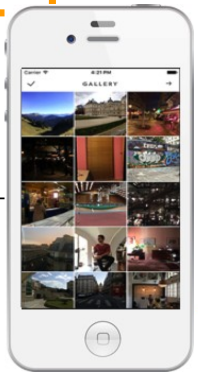


Image encoding example - goal

Analyze	**Image encoding algorithms**
for the purpose of	**evaluation**
with respect to their	**Energy efficiency**
from the point of view of	**Software developers**
in the context of	**Android mobile apps**

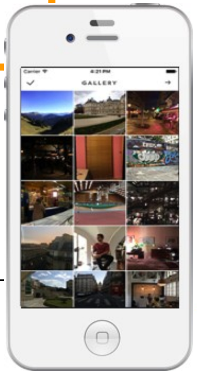
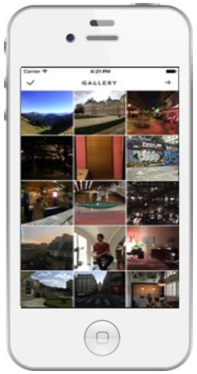


Image encoding example - goal

"Analyze image encoding algorithms for the purpose of evaluation with respect to their energy efficiency from the point of view of a software developer in the context of Android software apps".



From goals to questions

- Questions are at the **operational** level

- Answering a question should tell you if the goal has been reached

- Questions should be **quantifiable**

Question examples

Analyze	**Encoding algorithms**
for the purpose of	**Evaluation**
with respect to their	**Energy Efficiency**
from the point of view of	**Software Developer**
in the context of	**Android mobile apps**

- How does the *energy consumption* of a mobile device vary when using different image encoding algorithms? ✗
- What is the impact of using different image encoding algorithms on the energy *efficiency of mobile apps*? ✓
- Which algorithm provides the best *quality* of the image? ✗

Other examples…

Analyze	**Encoding algorithms**
for the purpose of	**Evaluation**
with respect to their	**Energy Efficiency**
from the point of view of	**Software Developer**
in the context of	**Mobile Software Applications**

- Which algorithm is most used in Android applications? ✗
- What is the *effort* of changing algorithm implementation? ✗
- How does the image encoding algorithm affect energy efficiency? ✓

From questions to metrics

- Metrics are at the **quantitative** level

- Metrics can be **objective** (e.g. energy consumption) or **subjective** (e.g. readability of code)

Examples of metrics

- How does the *energy consumption* of a mobile device vary when using different encoding algorithms?

  Metric: Energy Consumption (Joules)

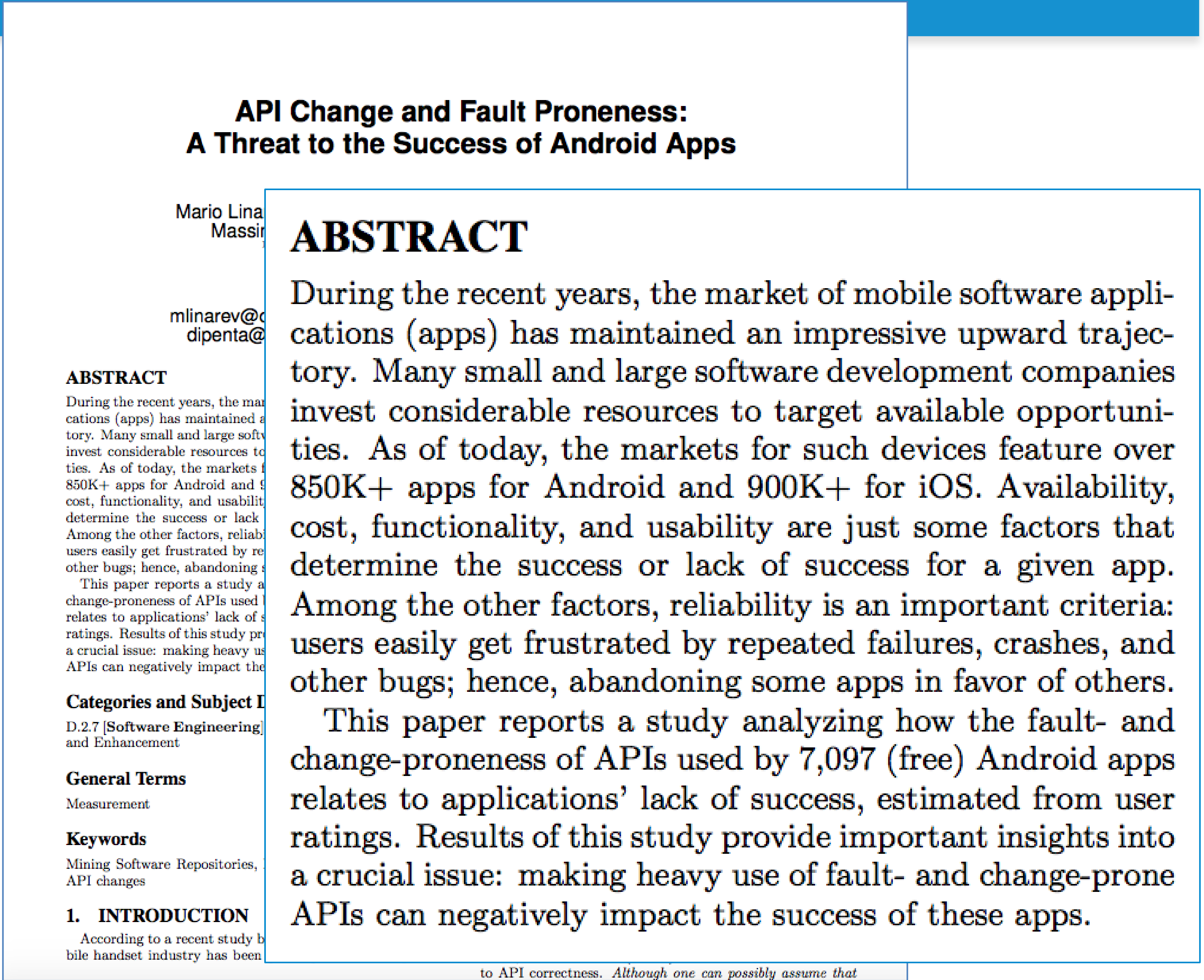
- What is the *efficiency* of the encoding algorithm?

  Metric: Amount of Joules used to render an image (joules/image)

- What is the *effort* of changing algorithm implementation?

  Metric: Effort (person/hours, money)

A final example



API Change and Fault Proneness: A Threat to the Success of Android Apps

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ABSTRACT

During the recent years, the mar
cations (apps) has maintained a
tory. Many small and large softw
invest considerable resources to
ties. As of today, the markets f
850K+ apps for Android and 9
cost, functionality, and usabilit
determine the success or lack
Among the other factors, reliabi
users easily get frustrated by re
other bugs; hence, abandoning s
This paper reports a study a
change-proneness of APIs used b
relates to applications' lack of s
ratings. Results of this study pr
a crucial issue: making heavy us
APIs can negatively impact the

Categories and Subject D

D.2.7 [**Software Engineering**]
and Enhancement

General Terms

Measurement

Keywords

Mining Software Repositories,
API changes

1. INTRODUCTION

According to a recent study b
bile handset industry has been

to API correctness. *Although one can possibly assume that*

ABSTRACT

During the recent years, the market of mobile software applications (apps) has maintained an impressive upward trajectory. Many small and large software development companies invest considerable resources to target available opportunities. As of today, the markets for such devices feature over 850K+ apps for Android and 900K+ for iOS. Availability, cost, functionality, and usability are just some factors that determine the success or lack of success for a given app. Among the other factors, reliability is an important criteria: users easily get frustrated by repeated failures, crashes, and other bugs; hence, abandoning some apps in favor of others.

This paper reports a study analyzing how the fault- and change-proneness of APIs used by 7,097 (free) Android apps relates to applications' lack of success, estimated from user ratings. Results of this study provide important insights into a crucial issue: making heavy use of fault- and change-prone APIs can negatively impact the success of these apps.

Goal

Objects of study: fault- and change-proneness of Android APIs

Purpose: to understand their impact

Quality focus: the success of Android apps

Perspective: app developers

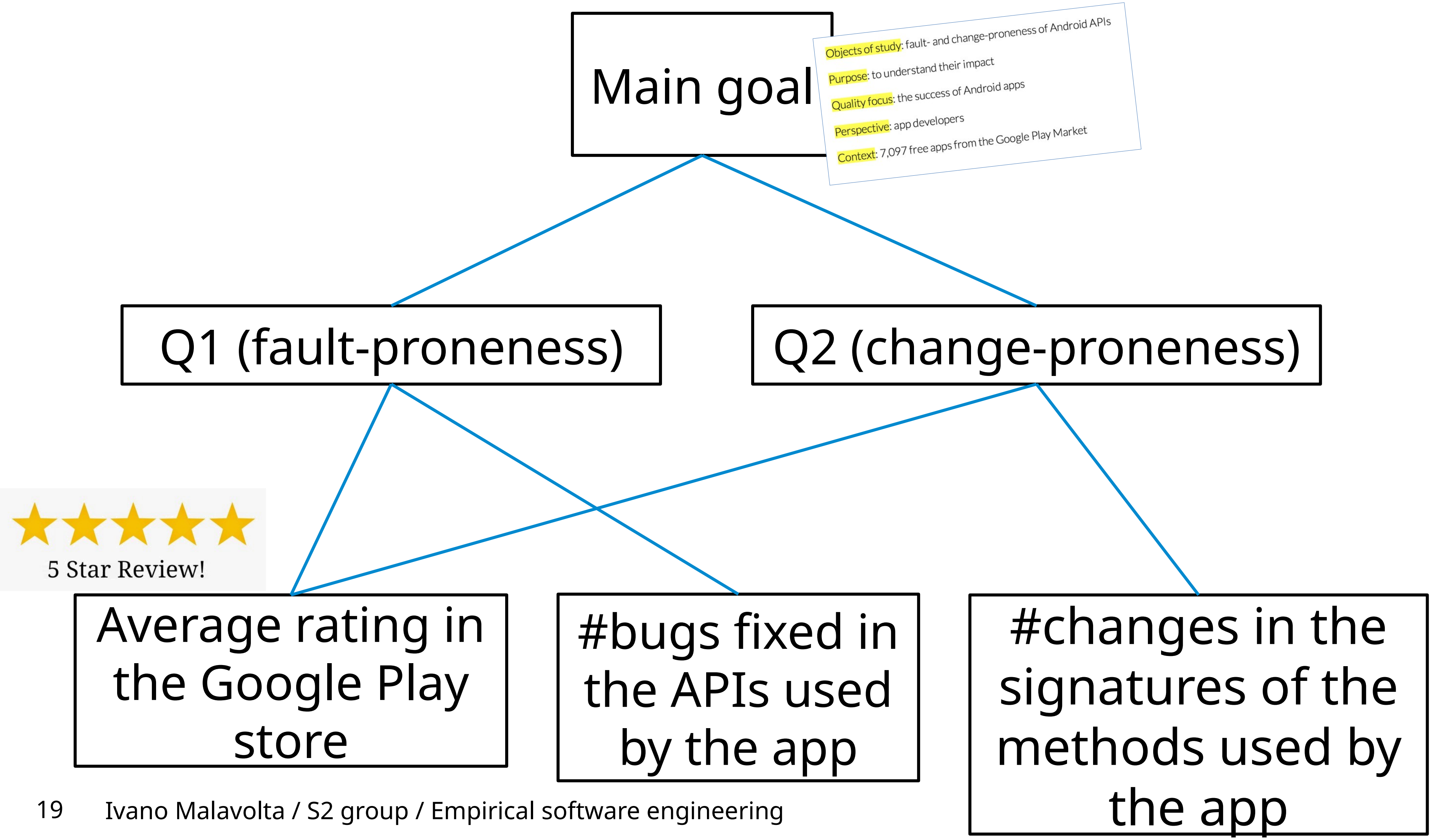
Context: 7,097 free apps from the Google Play Market

Questions

Q1: Does the **fault-proneness** of APIs affect the success of Android Apps?

Q2: Does the **change-proneness** of APIs affect the success of Android Apps?

Metrics



Main goal

Objects of study: fault- and change-proneness of Android APIs

Purpose: to understand their impact

Quality focus: the success of Android apps

Perspective: app developers

Context: 7,097 free apps from the Google Play Market

Q1 (fault-proneness)

Q2 (change-proneness)

Average rating in the Google Play store

#bugs fixed in the APIs used by the app

#changes in the signatures of the methods used by the app

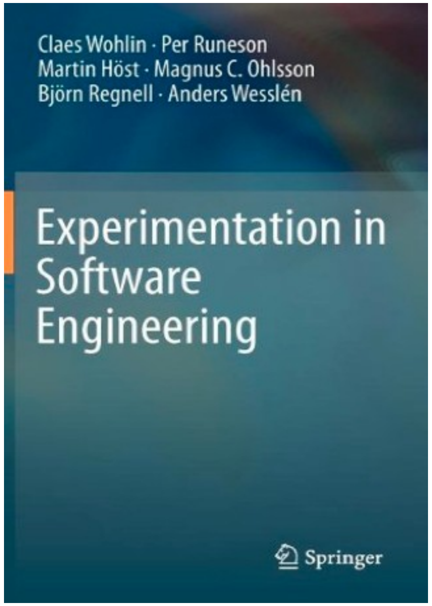
What this lecture means to you?

You know how to:

- define the goal of an experiment
- precisely scope an experiment
  - … and have a hint about how to plan it

- You are able to work on assignment 1:
  - Describe the motivation and high-level idea of your experiment
  - Report about related work (use Google Scholar, at least 4-5 studies)
  - Describe your goal using the provided template
  - Formalize the scope of your experiment via the GQM methodology

Readings



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Martin Höst · Magnus C. Ohlsson
Björn Regnell · Anders Wesslén

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Chapter 7

+ All papers in the “Articles on performed experiments” folder in Canvas (only the part related to Goal and research questions)

Acknowledgements

Some contents of this lecture extracted from:

- Giuseppe Procaccianti's lectures at VU in 2016