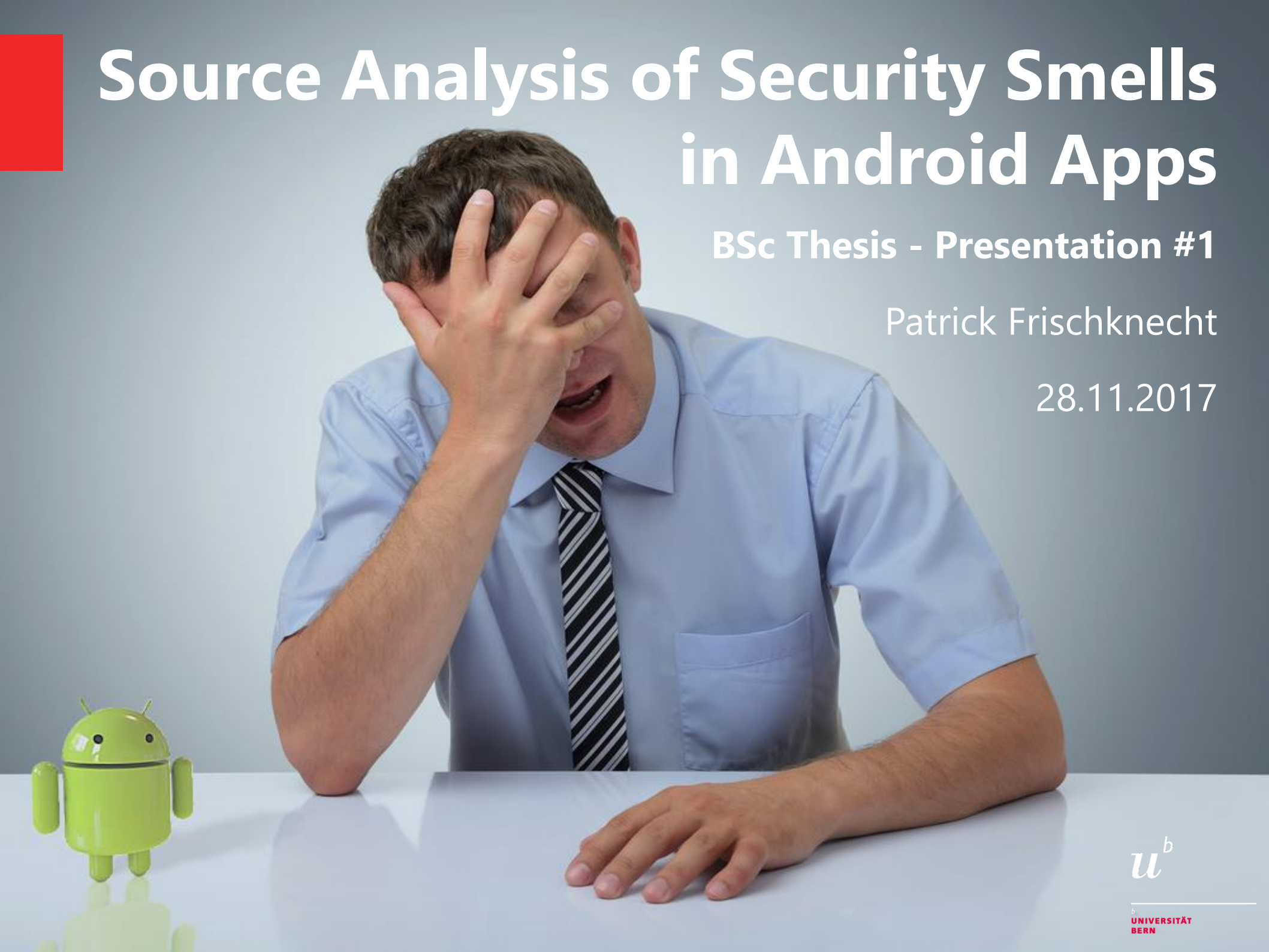
Source Analysis of Security Smells in Android Apps

BSc Thesis - Presentation #1

Patrick Frischknecht

28.11.2017



UNIVERSITÄT BERN

Agenda

1) Relevance of mobile security
2) Android security smells
3) Bachelors thesis
   - *Familiarization with state-of-the-art*
   - *Implementation of detectors*
   - *Evaluation*

Relevance of Android Security

- 85% of the smartphone market [1]
- More than three million apps [2]

Issues emerge:

- Privacy
- Data sensitivity
  - *E-commerce*
  - *E-banking*
  - *Healthcare*

Android Security Smells

Symptoms in the code
that indicate the prospect of
security and privacy vulnerabilities

[03]

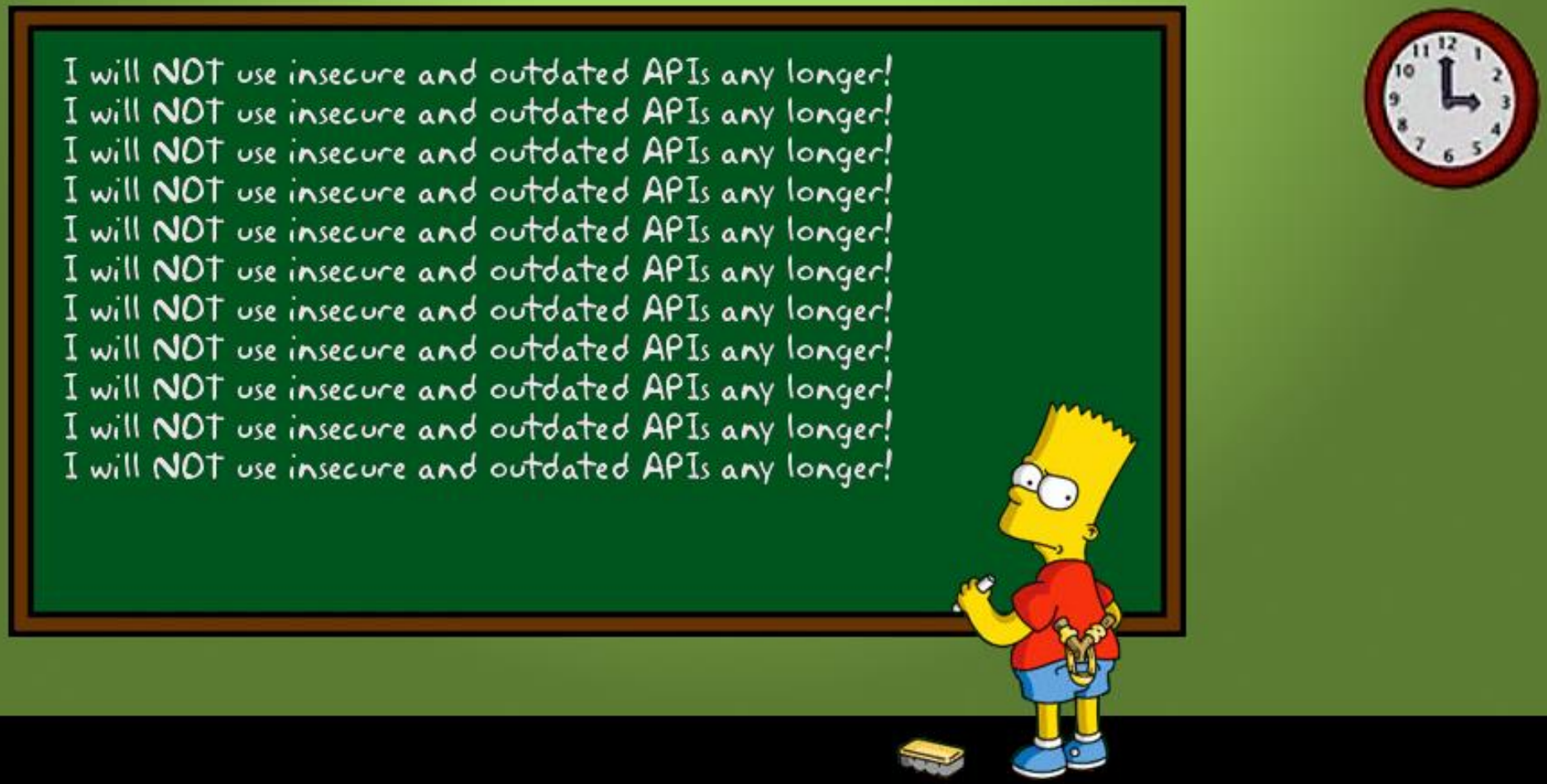
Android Security Smells #2

- Exposed Persistent Data

  using MODE_WORLD_READABLE/WRITEABLE

- Dynamic Code Loading

Bachelors Thesis



Ambitions

1) Creation of an easy to use IDE tool

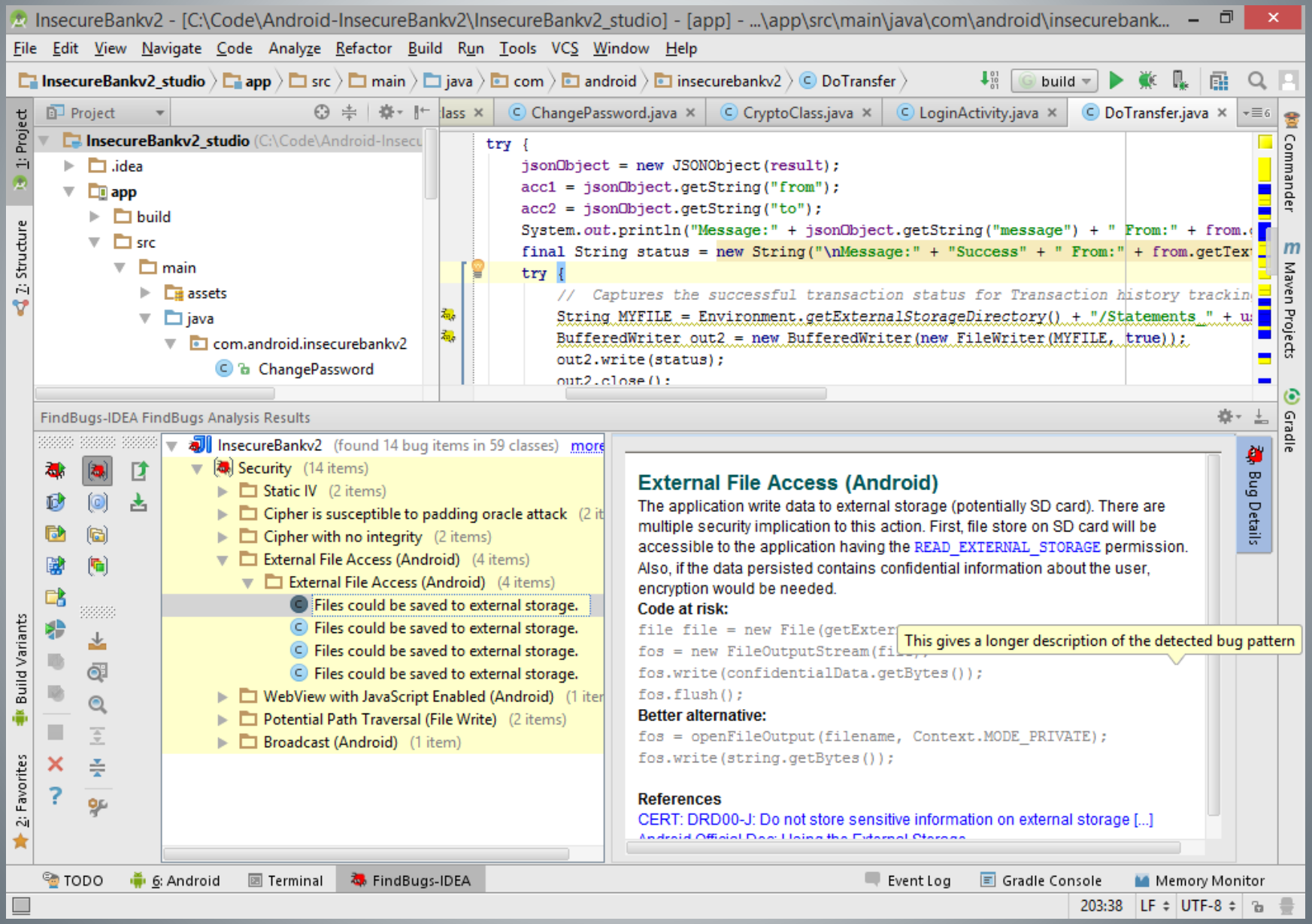
2) Detection of a security smells subset

3) Evaluation on a set of Android projects

Project Plan

- Existing tools evaluation
  - *Android Lint*
  - *Findbugs Security*
  - *Amandroid*
  - …
- Selection and extension of a tool
- Automated analysis on a larger set of Android projects

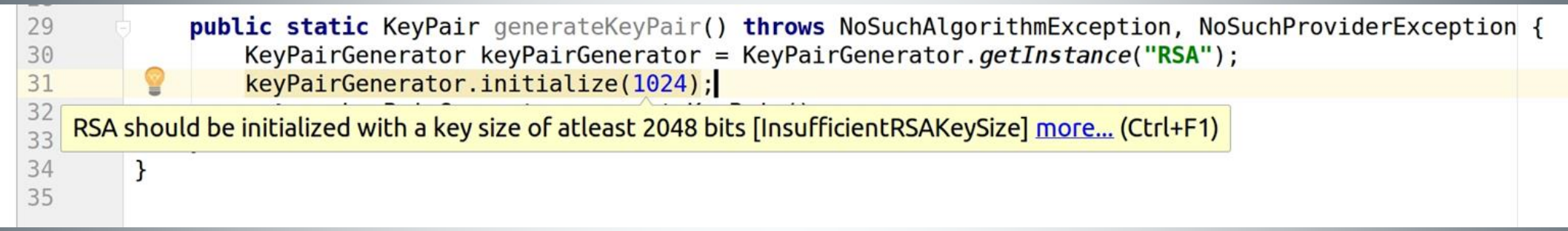
Tool: Findbugs Security



Tool: Android Lint

- Static source code analysis ***tool for Android***
- Integrated in ***Android Studio***
- Provides ***a lot of built in security checks***
  - *14 different security smells checks built-in*
  - *Especially manifest smells are well covered*

Android Lint: In Action



- Code highlighting
- Tooltips
- Quickfixes

Android Lint: Extension

- Creation of a new detector class

  XML or JavaDetector

- Registration in a registry class

- JAR repackaging and copying to Lint folder

Android Lint: Example
Weak Hash Function Detector

- Smell: Weak Crypto Algorithm
- Finds usages of MD5 hash function

  MD5 is vulnerable to collision attack

Android Lint: Example
Weak Hash Function Detector

```
public void visitMethod(@NonNull JavaContext context, @Nullable AstVisitor visitor,
                        @NonNull MethodInvocation methodInvocation) {
    JavaParser.ResolvedNode resolved = context.resolve(methodInvocation);
    if (!(resolved instanceof JavaParser.ResolvedMethod)) {
        return;
    }
    JavaParser.ResolvedMethod method = (JavaParser.ResolvedMethod) resolved;
    if (!method.getContainingClass().isSubclassOf(MESSAGE_DIGEST, strict: false)) {
        return;
    }
```

```
@Override
public List<String> getApplicableMethodNames() { return Collections.singletonList("getInstance"); }
```

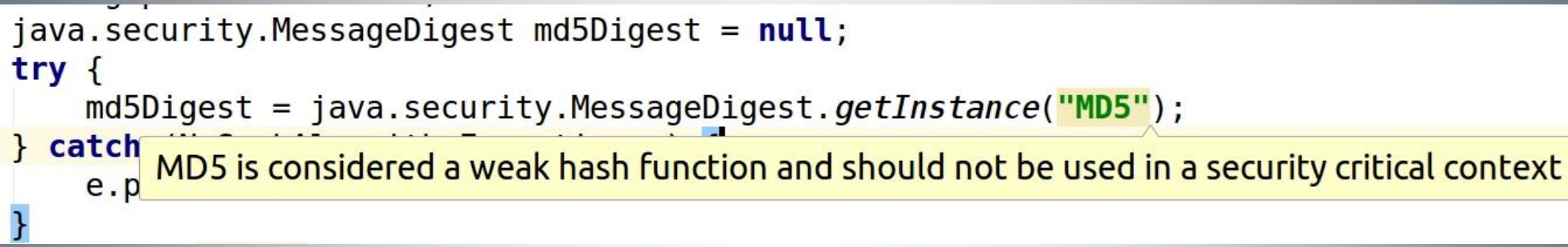
- New JavaScanner looking for **MessageDigest.getInstance("MD5")**

Android Lint: Example
Weak Hash Function Detector

```
private static void checkRequestedHashFunction(@NonNull JavaContext context,
                                               @NonNull MethodInvocation call, @NonNull Node r
    if (WEAK_HASH_FUNCTIONS.contains(value)) {
        String message = ""+value+" is considered a weak hash function and should
        context.report(ISSUE, call, context.getLocation(node), message);
    }
}
```

- Adds a report

Android Lint: Example
Weak Hash Function Detector



- Visible in Android Studio
- … and in the HTML report

Android Lint: Evaluation

- Execution on a subset of Android open-source projects
- Manual execution
- Fast & Scalable!

Roadmap

- Investigation of the relation between security smells and required detectors
- Implementation of more detectors
- Expansion of the Android app test set

References

[01]
IDC Annual Smartphone Market Share Report, accessed on 26.11.2017
https://www.idc.com/promo/smartphone-market-share/os

[02]
AppBrain Report, accessed on 26.11.2017
https://www.appbrain.com/stats/number-of-android-apps

[03]
Ghafari, Mohammad, Pascal Gadient, and Oscar Nierstrasz. "Security Smells in Android." Source Code Analysis and Manipulation (SCAM), 2017 IEEE 17th International Working Conference on. IEEE, 2017.

Android Lint: Issues

- Only plain static analysis
  - *no taint analysis*
  - *no dynamic analysis*
- Android Lint API is unstable
- Projects must be compiled

  (some detectors require class files)
- Executes on source code, thus we need
  - *Open-source projects*
  - *… or decompiled byte-code*

Android Lint: Preliminary Results