Reliable e-Assessment with GIT – Practical Considerations and Implementation
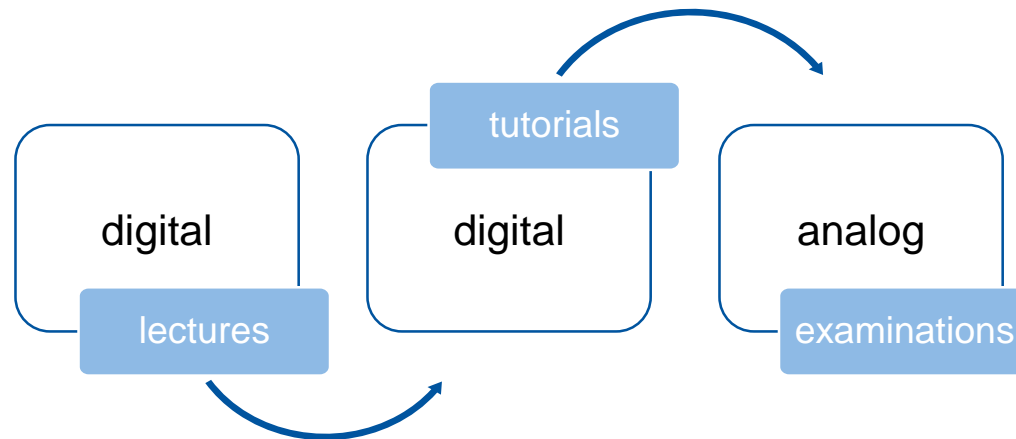
Bastian Küppers, Marius Politze, Ulrik Schroeder

Statement of the Problem

- e-Assessment is not yet well established in higher education (in Germany)
  - Reservations against e-Assessment
    - Security
    - ***Reliability***
  - Financial reasons

Reliability

- Reliability is key in order to establish e-Assessment successfully
  - Authorship of results
  - Integrity of results

- Public-key cryptography can be used to ensure both
  - Certificate Authority (CA) needed to verify certificates
  - For example DFN-PKI

public   private

E-Assessment

Versioning

- In addition to integrity of final results, versioning of different stages of the results adds another layer of reliability

- git can be used to provide versioning
  - Merkle tree ("blockchain") provides integrity of versioning history
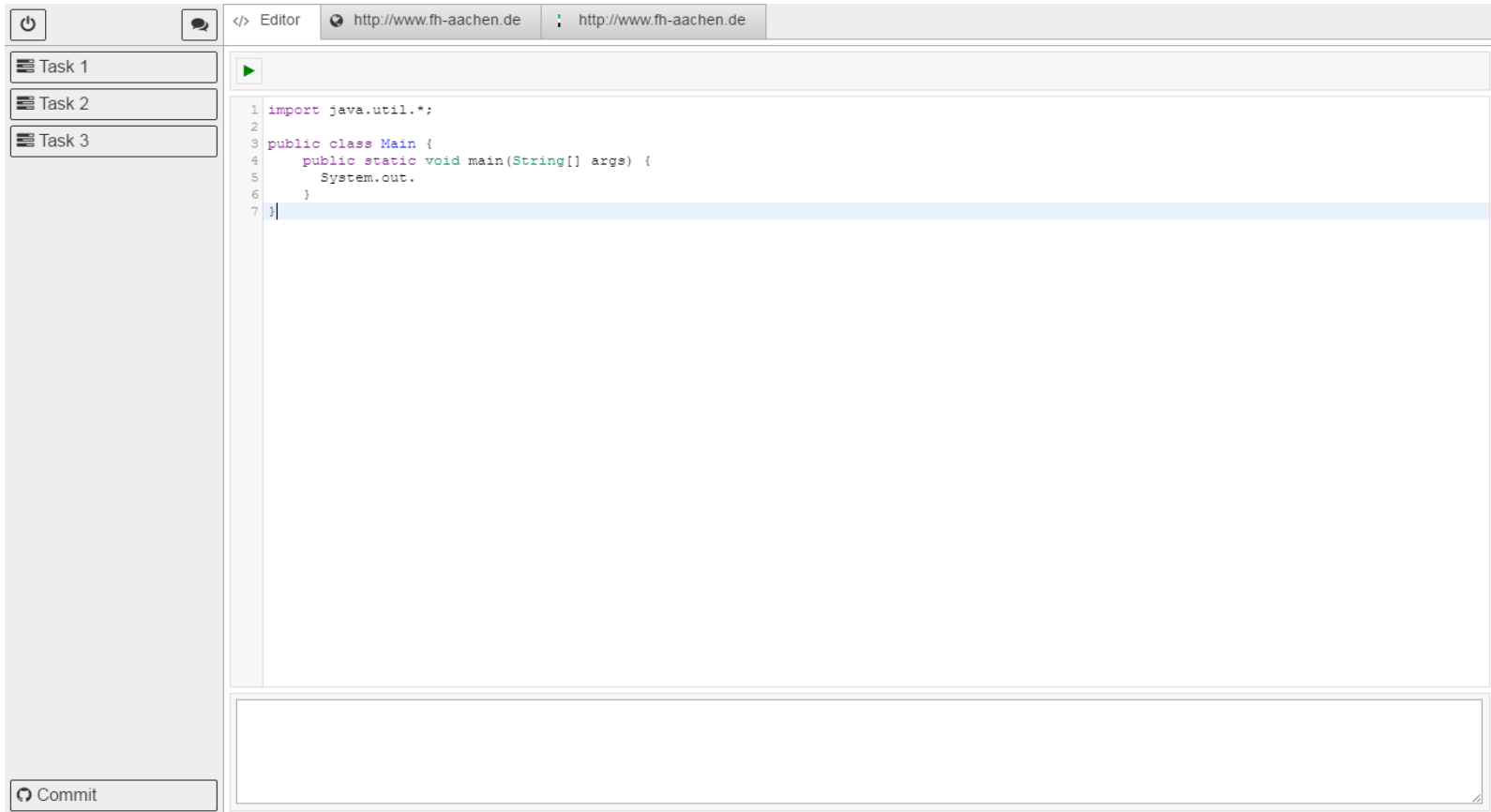 - Digital signature provides authorship of each commit

Source: https://git-scm.com/downloads/logos

Implementation – Frontend 1

- Electron Framework
  - Based on NodeJS
  - Lightweight
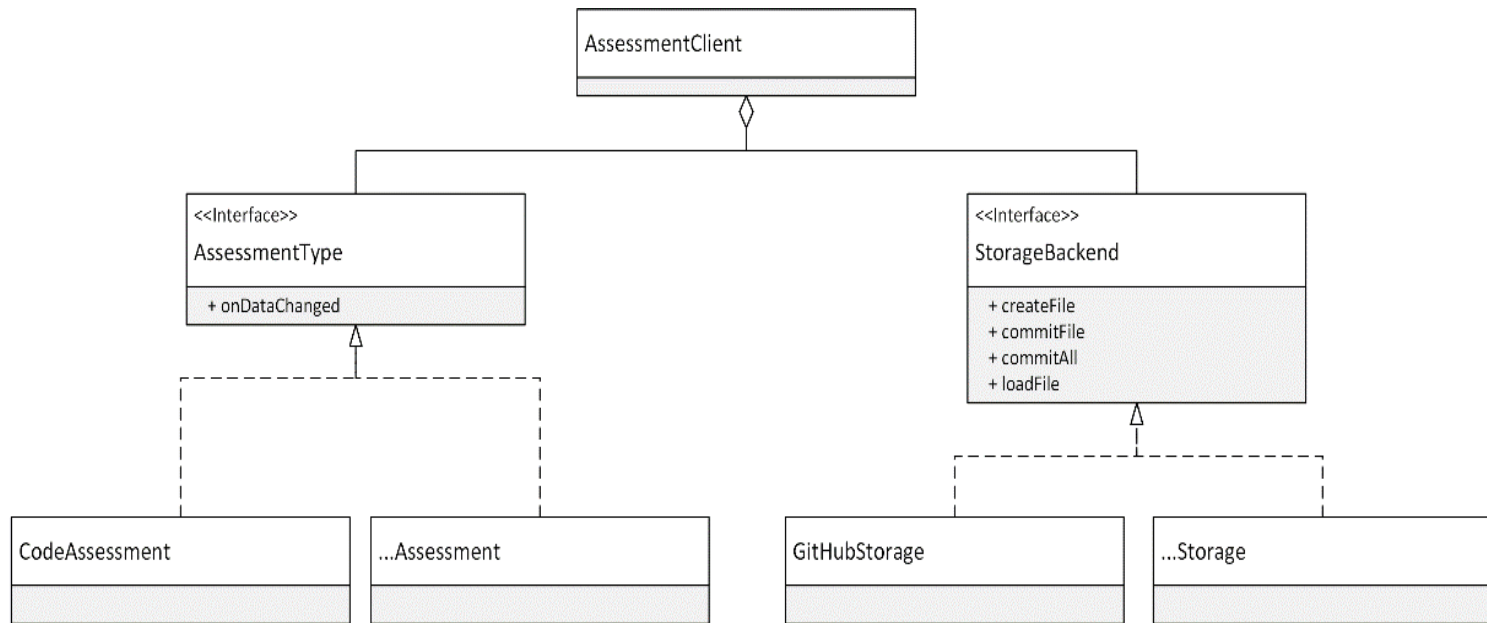 - Supports multiple platforms

ELECTRON

Source: https://github.com/electron/electron

E-Assessment

Implementation – Frontend 2

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Implementation – Frontend 3

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Implementation – Storage Backend

- Different storage backends possible due to modular structure

- GitHub as proof-of-concept
  - Use of public API
  - GitHub Classroom (https://classroom.github.com/)
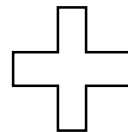
Source: https://github.com/logos

Implementation – Certificate Management

- Students to manage their public keys
  - Can use browser or e-mail based workflow
  - Ensures that the private key is available

- Applications can query public keys for validation

- Microservice based on Express
  - Fast prototyping and extensibility
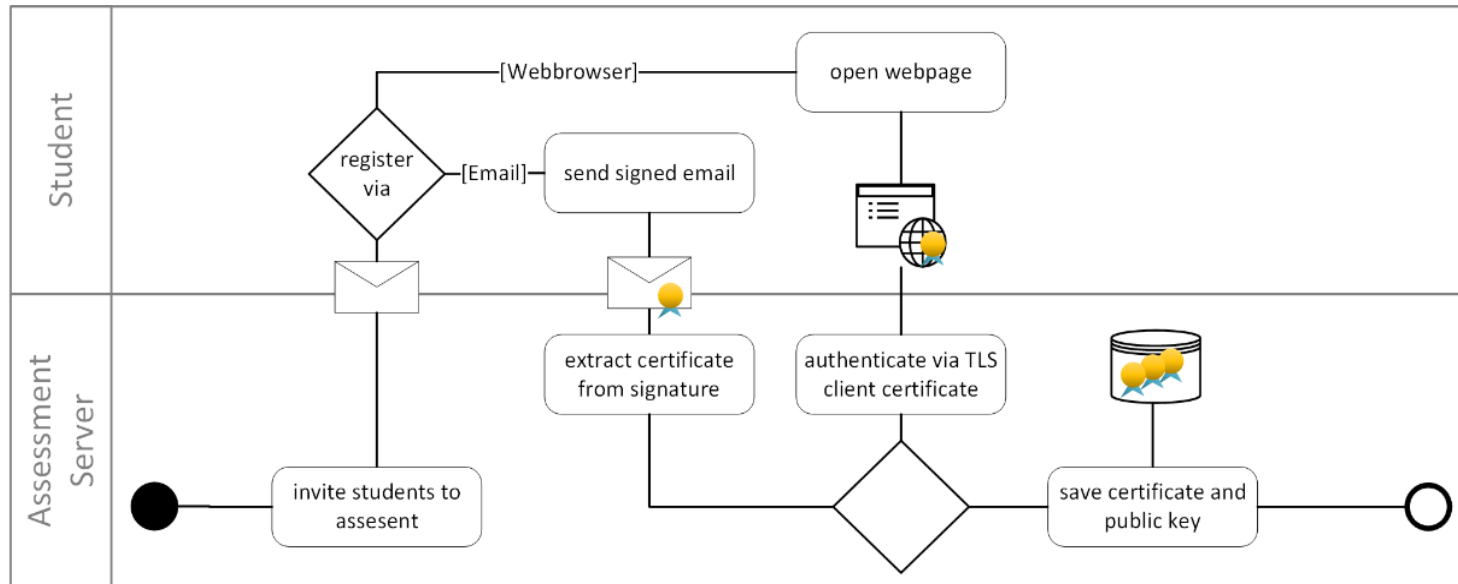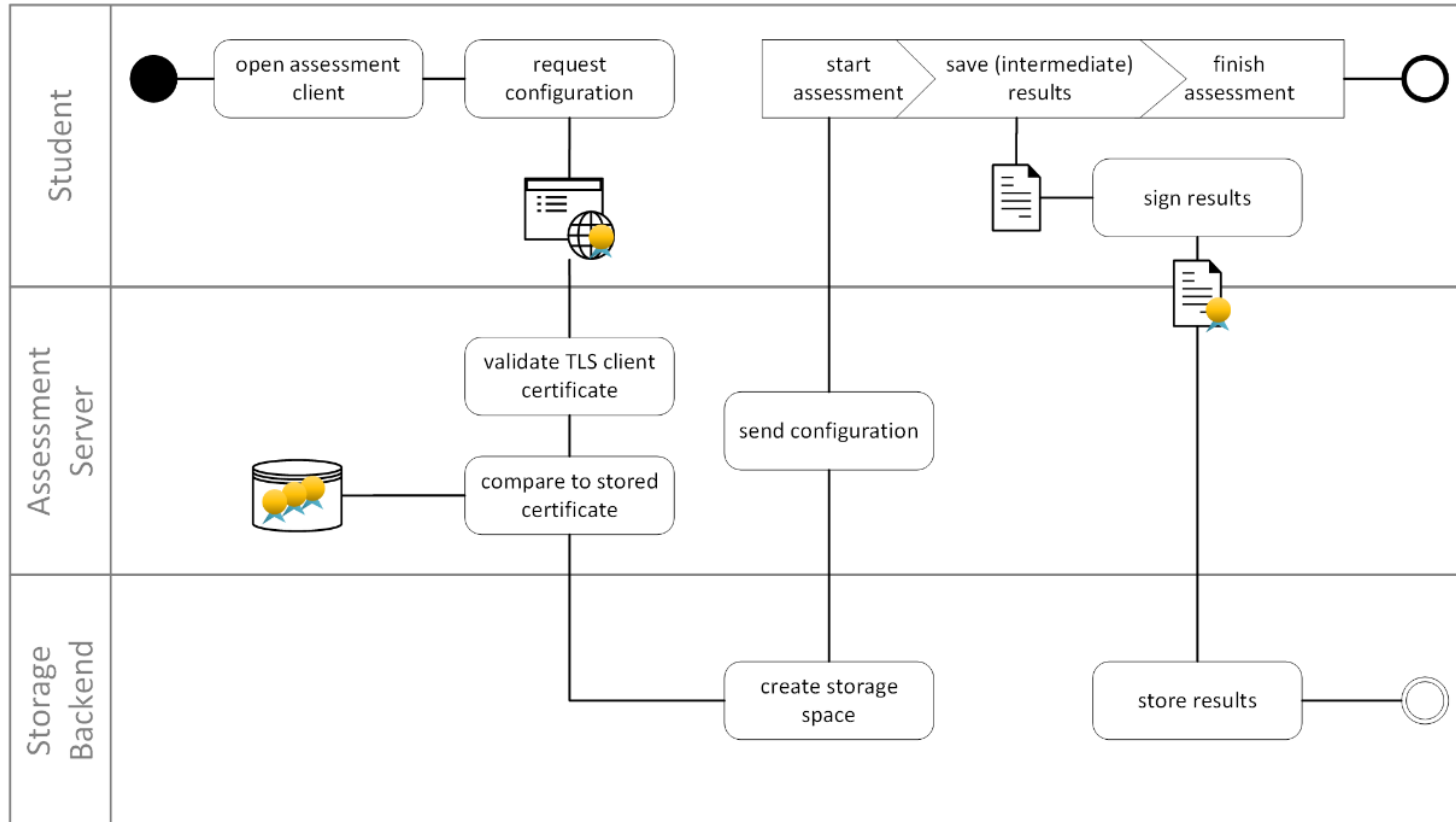 - Scales on production infrastructure

Source: https://github.com/expressjs/express

Source: https://pouchdb.com/

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E-Assessment

Workflow - Registration

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E-Assessment

Workflow – Taking an Exam

E-Assessment

Summary

- Utilization of public-key cryptography and git in order to ensure reliability of e-Assessment

- Working prototype exists

- git satisfies requirements of the storage of examination results for e-Assessment

- Remark: git uses SHA1 for its blockchain, which has been broken quite recently
  - In theory that makes the integrity of a versioning attackable
  - In practice the risk is negligible at the moment