Proposal for an Evaluation Framework for Compliance Checkers for Long-term Digital Preservation

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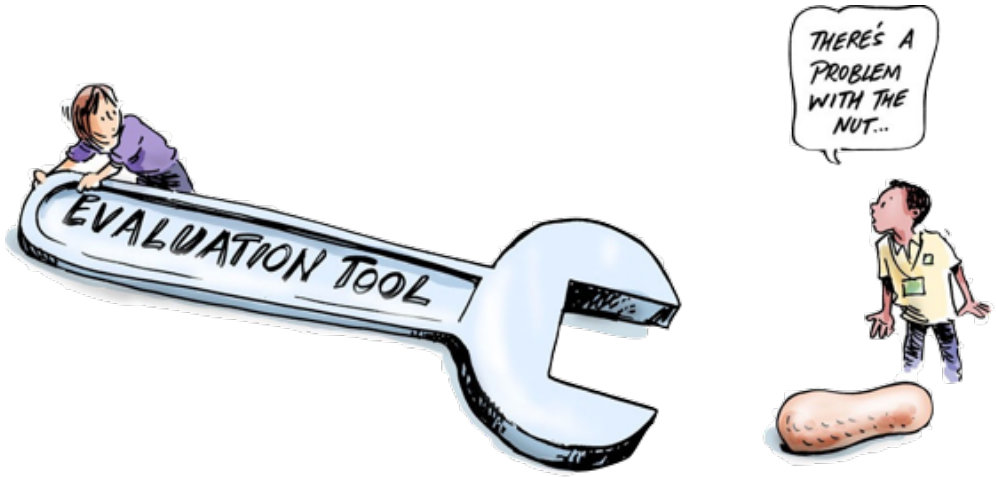

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UNIVERSITÀ DEGLI STUDI DI PADOVA

SEVENTH FRAMEWORK PROGRAMME

Project Identity Card

- PREFORMA is a **Pre-Commercial Procurement** project co-funded by the European Commission under its FP7-ICT Programme.
- **Start date**: 1 January 2014
- **Duration**: 48 month (end date: 31 December 2017)
- **Website**: www.preforma-project.eu
- **Contacts**
  - Project Coordinator: Borje Justrell, Riksarkivet, borje.justrell@riksarkivet.se
  - Technical Coordinator: Antonella Fresa, Promoter Srl, fresa@promoter.it
  - Communication Coordinator: Claudio Prandoni, Promoter Srl, prandoni@promoter.it

Project Aim and Objectives

- **The aim:** to address the challenge of implementing various good quality standardised file formats for preserving data content in the long term.

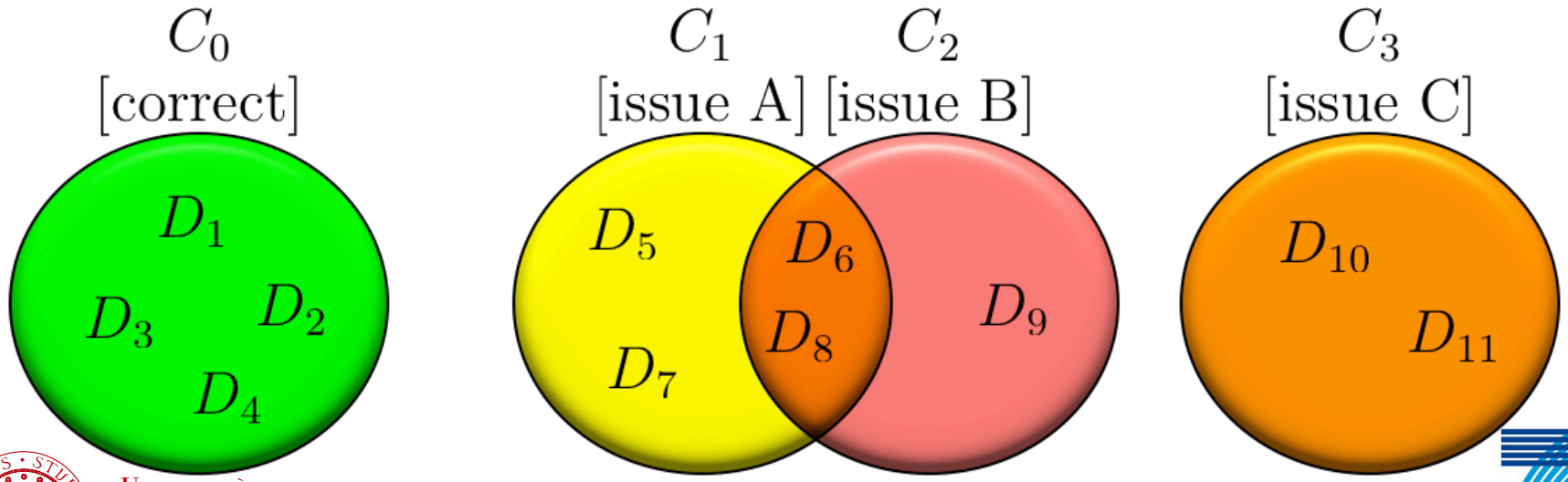
- **The main objective:** to give memory institutions full control of the process of conformity tests of files to be ingested into archives.

- **The main objective of the PCP launched by PREFORMA:** to develop and deploy an open source software licensed reference implementation for various file format standards, aimed for any memory institution (or other organisation with a preservation task) that wish to check conformance with a specific standard.

PREFORMA: A classification task

- The goal of PREFORMA is to **validate documents** (files) against their respective standards
  - this turns into determining for each document (file) whether it is correct, it has issue A, issue B, and so on

- We can frame this as a **classification** task where you label documents according to their characteristics
  - each label (correct, issue A, issue B, …) is a **class**
  - in general **classes** may **intersect** but the **correct** class must be **separate**



Critical Issues in Evaluation

- It must be scientifically valid
  - valid metrics, methodology, and statistics
  - large-enough scale to be statistically valid
  - must be "repeatable" if possible
- It must be realistic
- It must be understandable to your audience/client

How Does Experimental Evaluation Work

- Cranfield Paradigm
  - Dates back to mid 1960s
- Makes use of **experimental collections**
  - documents (corpora)
  - information needs
  - ground-truth
- Ensures **comparability** and **repeatability** of the experiments

Evaluation@PREFORMA: Information Needs/**Classes**

- For each media type, we need **domain experts** who determine the list of classes for that media type
  - known validation issues, potential validation issues, preservation issues, …
  - asking for classes to our suppliers may introduce a bias

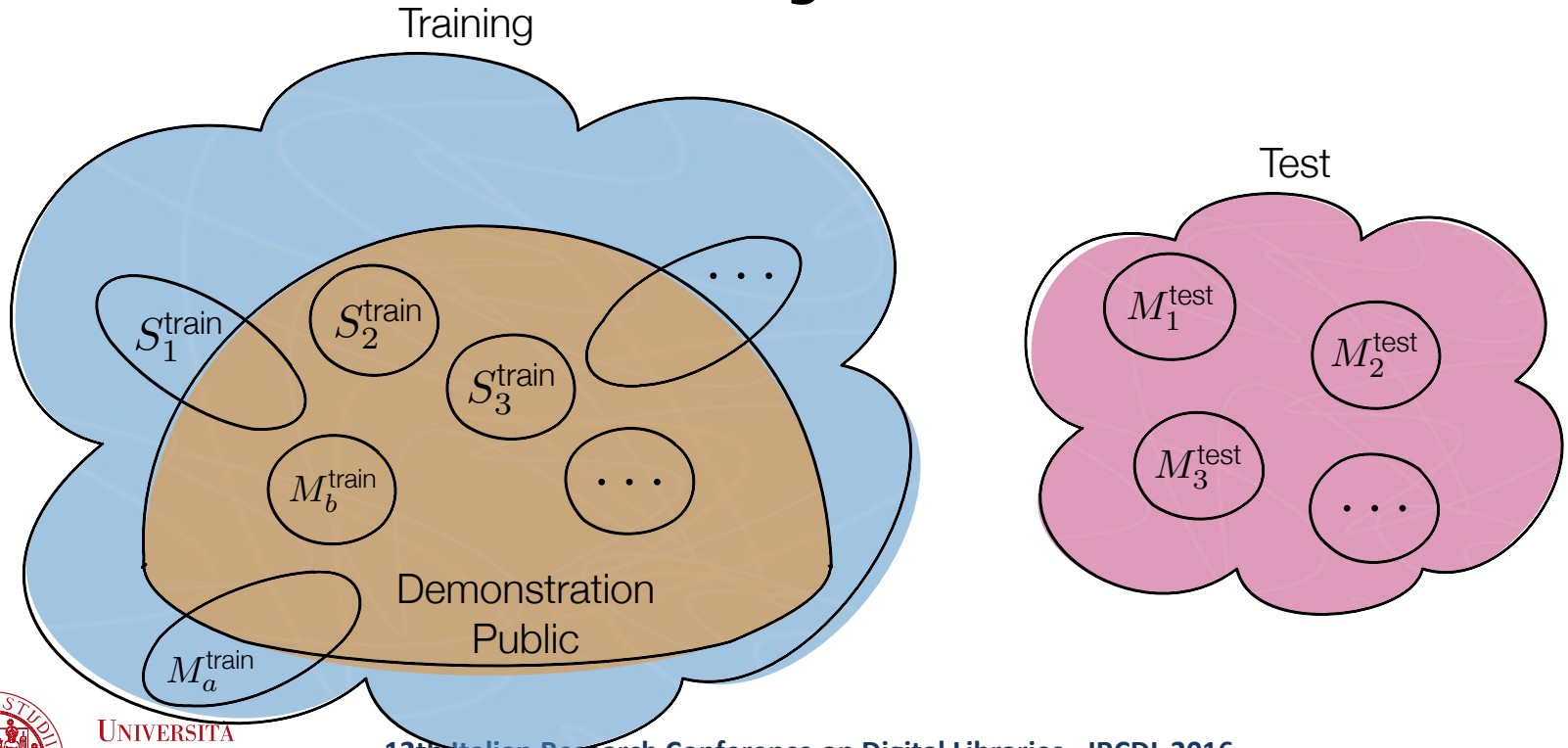
- We may also attach a **severity** to each class
  - some issues are errors, some others are warnings, some others are mis-conformances to policies and best practices

Evaluation@PREFORMA: Documents (1/2)

- **Huge sample** (ten thousands) for each media type (text, image, audio)
  - memory institutions, suppliers, community
  - each document must be uniquely identified
- Documents can be **real** or **synthetic**
  - see, e.g. Becker and Duretec JCDL 2013 templating approach
- Documents must be **representative** of the different classes we experiment
  - we cannot have empty class
  - the cardinality of each class should make sense
- The whole process must be driven by **domain experts**

Evaluation@PREFORMA: Documents (2/2)

- Critical split: **training** vs **test** set
  - to avoid bias, supplier should not provide documents for testing



Evaluation@PREFORMA: Ground Truth

- **Manual assessment**, i.e. determining for each document to which classes it belongs to, is typically **not avoidable**
- **Domain experts** are crucial
- **Automatic assessment** is often hoped for but it risks to introduce **bias** towards existing tools and suppliers tools

Evaluation@PREFORMA
What to Measure?

- Evaluating suppliers tools is not just going through an expected feature list and check it

Evaluation@PREFORMA Confusion Matrix

Class C_i		Ground-Truth	
		Positive	Negative
Conformance Checker	Positive	True Positive (TP_i)	False Positive (FP_i)
	Negative	False Negative (FN_i)	True Negative (TN_i)

Evaluation@PREFORMA Typical Measures

- The confusion matrix allows us to compute several measures, e.g.
  - **Accuracy**: overall effectiveness of a supplier tool

$$\text{Accuracy}_i = \frac{|TP_i| + |TN_i|}{|TP_i| + |TN_i| + |FP_i| + |FN_i|}$$

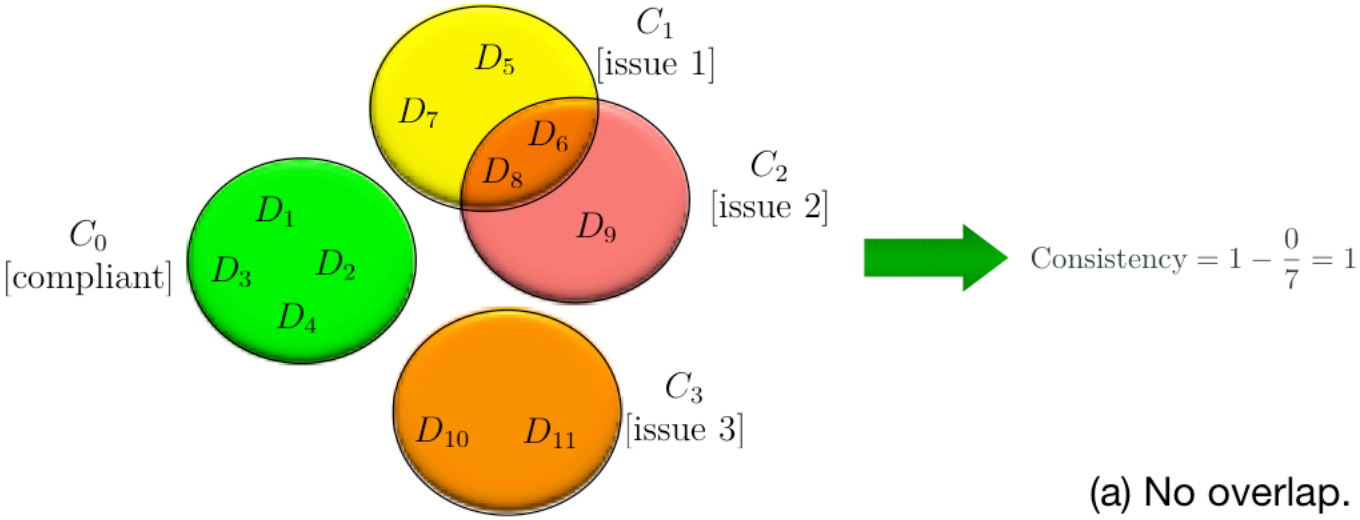
  - **Area Under the Curve (AUC)**: supplier tool's ability to avoid false classification

$$\text{AUC}_i = \frac{1}{2}\left(\frac{|TP_i|}{|TP_i| + |FN_i|} + \frac{|TN_i|}{|TN_i| + |FP_i|}\right)$$

Evaluation@PREFORMA Consistency

$$\text{Consistency} = 1 - \frac{\sum_{i=1}^{N} |(TP_0 \cup FP_0) \cap (TP_i \cup FP_i)|}{\sum_{i=1}^{N} |(TP_i \cup FP_i)|}$$

$$= 1 - \frac{\sum_{i=1}^{N} |C_0 \cap C_i|}{\sum_{i=1}^{N} |C_i|}$$



(a) No overlap.

Evaluation@PREFORMA Consistency

$$\text{Consistency} = 1 - \frac{\sum_{i=1}^{N} |(TP_0 \cup FP_0) \cap (TP_i \cup FP_i)|}{\sum_{i=1}^{N} |(TP_i \cup FP_i)|}$$

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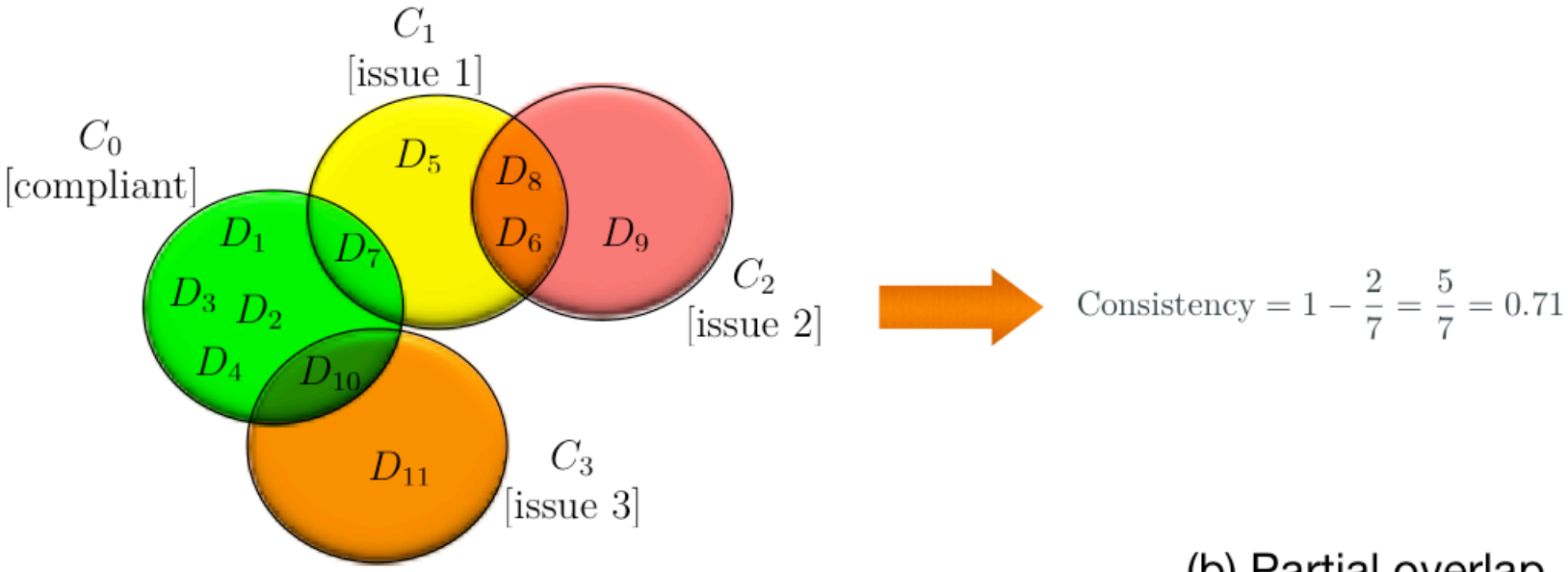

(b) Partial overlap.

Evaluation@PREFORMA Consistency

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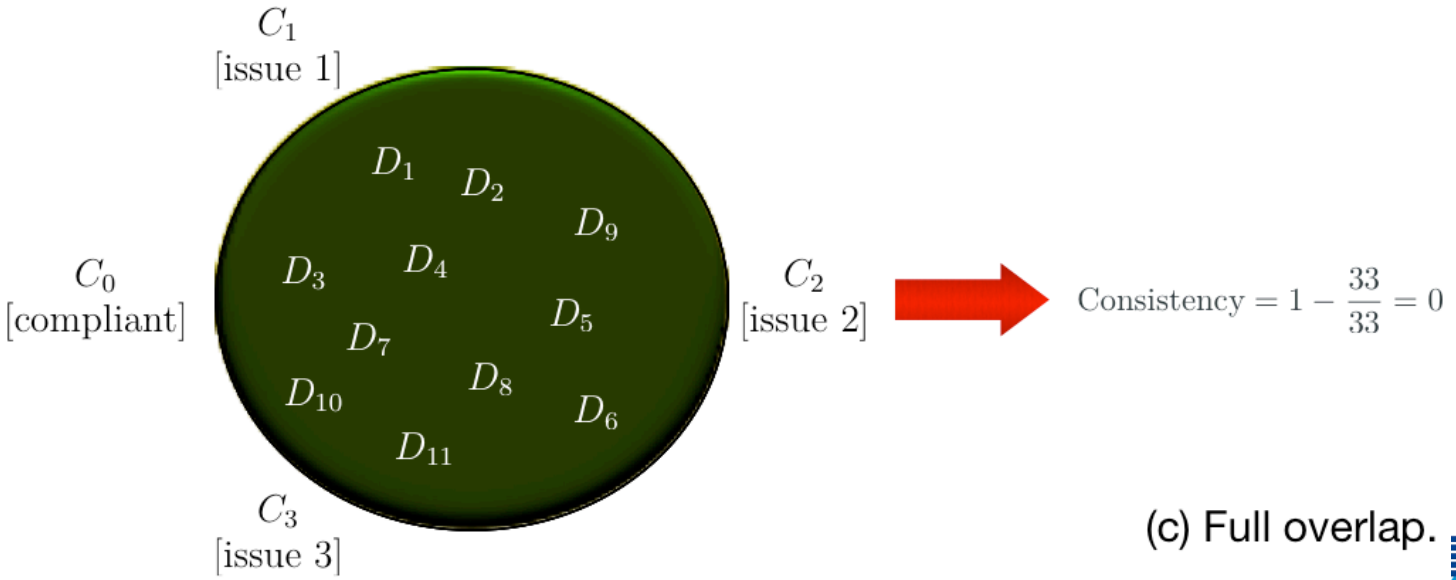

(c) Full overlap.

Conclusions

- We discussed how to model the process of conformance checking for long-term digital preservation and, consequently how to evaluate it
- We then discussed how to instantiate the Cranfield paradigm for the specific purpose of evaluating conformance checkers
- Feedback from the research community is much appreciated before we take the next step, which is to instantiate the proposed approach to evaluate PREFORMA suppliers

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ANY
QUESTIONS
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