FinTech R&D Innovation Conference

SnT securityandtrust.lu

Transparency, Verifiability and Privacy

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Prologo

General Data Protection Regulation (GDPR) is the awaited European piece of general legislation in data protection.

One certainty:

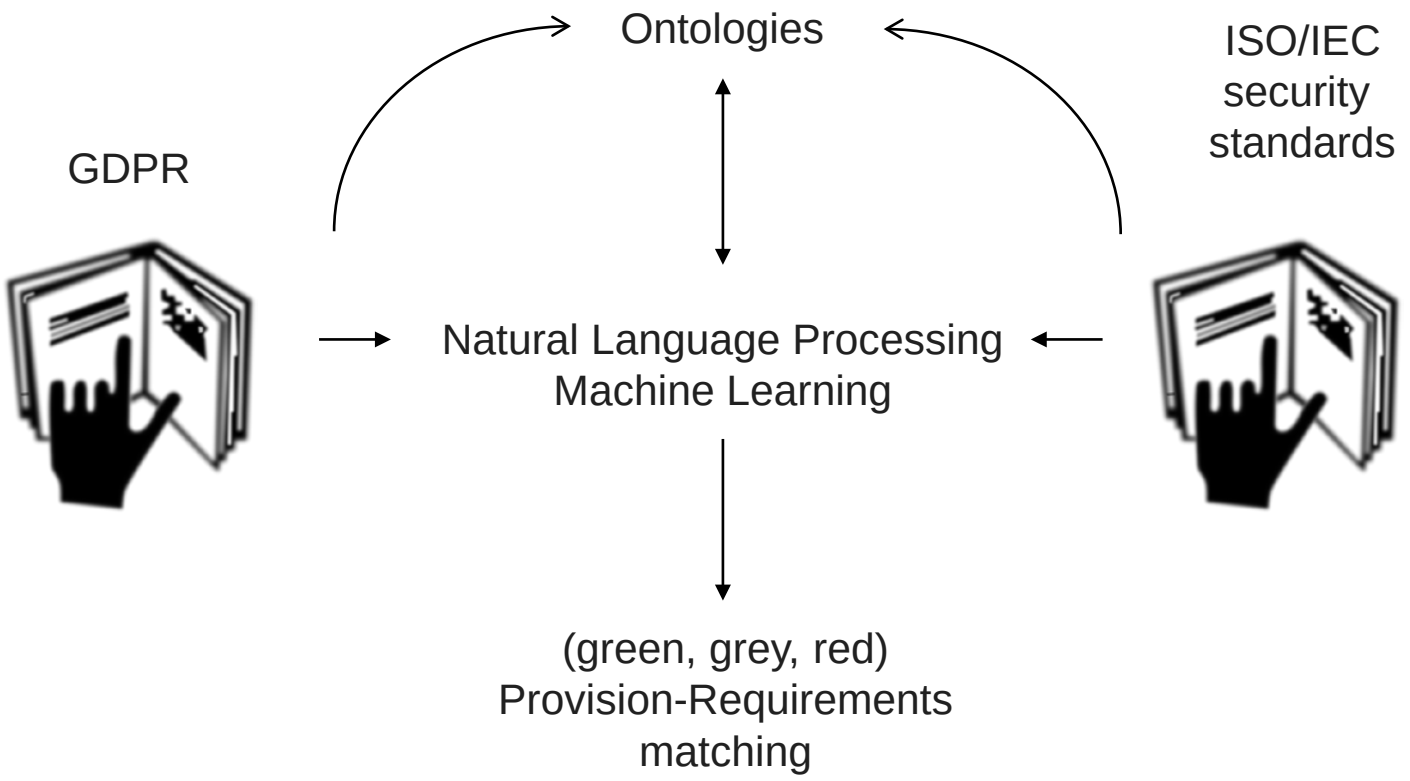
failure to comply → major financial losses
→ no more business for long

Research #1:
Data Privacy Requirements

Not to breach the GDPR, we need to be sure to adhere to data protection requirements.

This would be the role of (data privacy/protection) **standards**, certifications and auditors;

[But which ones among the plenty about security (e.g., ISO/IEC 27000), and what requirements for what provision?]



Interdisciplinary research: artificial intelligence, law and data protection regulators/

Challenge: Applying this research to Fintech and cloud computing

With: Dr. Bartolini, Dr. Giurgiu, Dr. Robaldo, and Prof. Cole

Research #2:
Transparency

Transparency, a general transversal principle, is believed to foster high quality of service provision.

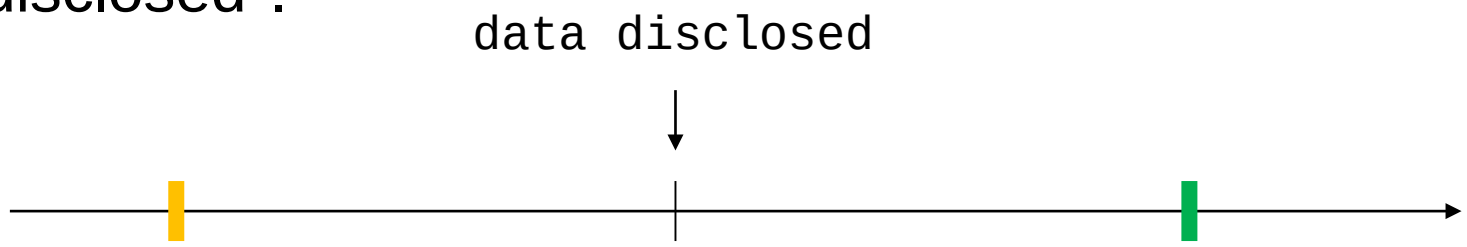
General Data Protection Regulation (GDPR) lists **transparency** as one of the driving (transversal) principles in processing personal data:

"data controllers are obliged to provide easily accessible information, [..] and procedures and mechanisms for exercising data subject's right"

Transparency: Definitions

[ex ante] - enables the anticipation of consequences before data are actually disclosed".

[ex post] – offers information about any consequences if data already have been revealed



≈ secure usability
(decision making)

≈ verifiability
(accountability/auditability)
≈ security design

Verifiability: basics

A **real system** (S)'s run (R), operated by agents (A^1,..,A^k) leaves traces, evidences (E).

They can be used to prove **security properties** about R.

One may want to check whether E,
even in the presence of malicious agents,
are enough to prove certain properties on R

Examples

e-Voting

- casted as voted
- counted as casted

e-Exams

- question secrecy
- mark anonymity

Concepts: Testable/Verifiable

A system is **testable** for a property P when it comes with (or allows) a test for a specific property

S is **verifiable** when T test is sound & complete

Test(E,S) ⇔ P holds on R

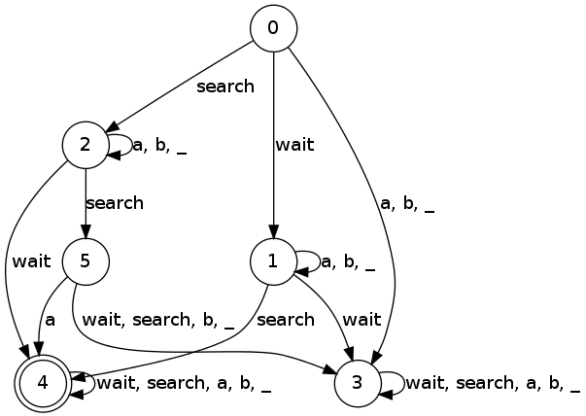
Universal **vs** Individual verifiability

Formalization

Real

System, Run, Evidences

Model



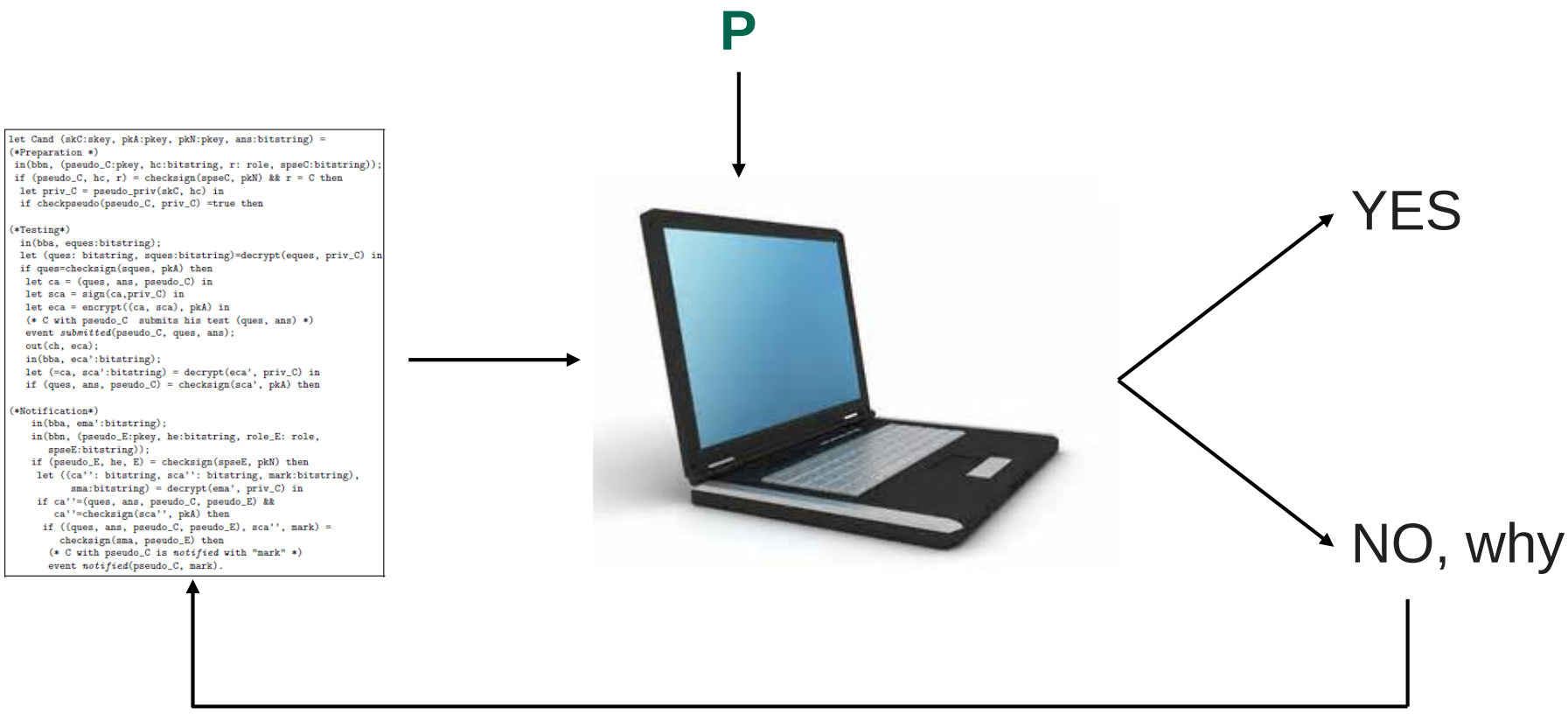
S $(A^1,..,A^k,I)$, *R*, *E* and *P*

We work with **formal models**

Examples

Requirement	Individual Verifiability	Universal Verifiability
Registration		$\mathtt{R}_{\mathtt{UV}}(e) \Leftrightarrow$ $I_r \supseteq \{i : (i,x) \in \mathtt{Accepted}\}$
Question Validity	$\mathtt{QV}_{\mathtt{IV}}(i,q,a,m,p) \Leftrightarrow (q \in Q_g)$	
Marking Correctness	$\mathtt{MC}_{\mathtt{IV}}(i,q,a,m,p) \Leftrightarrow$ $(\mathtt{Correct}(q,a) = m)$	$\mathtt{MC}_{\mathtt{UV}}(e) \Leftrightarrow$ $(\forall (i,x,m) \in \mathtt{Marked},$ $\mathtt{Correct}(x) = m$
Test Integrity	$\mathtt{ETI}_{\mathtt{IV}}(i,q,a,m,p) \Leftrightarrow$ $\big((i,(q,a)) \in \mathtt{Accepted}$ $\wedge \exists m' : (i,(q,a),m') \in \mathtt{Marked}\big)$	$\mathtt{ETI}_{\mathtt{UV}}(e) \Leftrightarrow \mathtt{Accepted} =$ $\{(i,x) : (i,x,m) \in \mathtt{Marked}\}$
Test Markedness	$\mathtt{ETM}_{\mathtt{IV}}(i,q,a,m,p) \Leftrightarrow$ $(\exists m' : (i,(q,a),m') \in \mathtt{Marked}))$	$\mathtt{ETM}_{\mathtt{UV}}(e) \Leftrightarrow \mathtt{Accepted} \supseteq$ $\{(i,x) : (i,x,m) \in \mathtt{Marked}\}$
Marking Integrity	$\mathtt{MI}_{\mathtt{IV}}(i,q,a,m,p) \Leftrightarrow$ $\exists m' : \big((i,(q,a),m') \in \mathtt{Marked}$ $\wedge (i,m') \in \mathtt{Assigned}\big)$	$\mathtt{MI}_{\mathtt{UV}}(e) \Leftrightarrow \mathtt{Assigned} =$ $\{(i,m) : (i,x,m) \in \mathtt{Marked}\}$
Marking Notification Integrity	$\mathtt{MNI}_{\mathtt{IV}}(i,q,a,m,p) \Leftrightarrow$ $(i,m) \in \mathtt{Assigned}$	

Automated Verifiability



We use **tools** to check whether a system has enough evidence to prove **P** even when malicious parties can compromised R

Examples

Requirement	Soundness	Completeness
Question Validity	✓ (EA)	✓(all)
Test Integrity	✓	✓(all)
Test Markedness	✓	✓(all)
Marking Correctness	✓ (EA)	✓(all)
Mark Integrity	✓	✓(all)
Mark Notification Integrity	✓	✓(all)

With: Dr. Giustolisi, and Prof. Ryan,

Towards Private Verifiability

Tests should have the minimal information disclosure and run on encrypted evidences enc(E),
without decrypting them
(e.g., using functional encryption)

With: Dr. Giustolisi, Dr. Iovino, and Prof. Ryan,

Towards verifiable Fintech protocols

Challenges: identifying security property relevant for Fintech; modelling and design Fintech verifiable protocols.

(e.g. verifiable authenticated transactions = all transactions are authenticated)

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Thanks

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