Specifying Privacy Laws

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18734: Foundations of Privacy
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Problem Statement

Question: Is an organization's processes and practices compliant with privacy regulations and internal policies?

- Examples of organizations
  - Hospitals, financial institutions, universities, and other organizations that collect and use personal information
- Examples of privacy regulations
  - Health Insurance Portability and Accountability Act (HIPAA), Gramm-Leach-Bliley Act (GLBA), SB 1386

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Goal: Develop methods and tools to aid organizations in compliance activities

Making sense of real privacy laws

Observation: Real privacy laws are complex.

- Long, dense — HIPAA Privacy Rule has 84 operational clauses for transmissions on $\sim$30 pages
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Desiderata: Interactive tools for enforcement and analysis

- "Are actions by Hospital Y's employees compliant with HIPAA?"
- "Does GLBA permit Bank X to disclose Bob's info to Charlie?"

Our Results

1. Logics for specifying privacy policies informed by the philosophical theory of contextual integrity
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2. Complete formalizations of HIPAA and GLBA's operational requirements for transmissions

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3. Automated policy monitoring with minimal human input for enforcement of HIPAA, GLBA.

   (with D. Garg, L. Jia)

Outline

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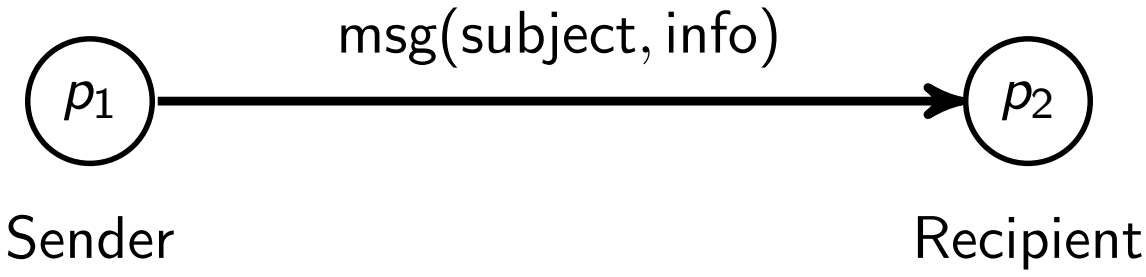
Transmission of protected information



Transmissions of this form are governed by contextual norms (Nissenbaum 2004)

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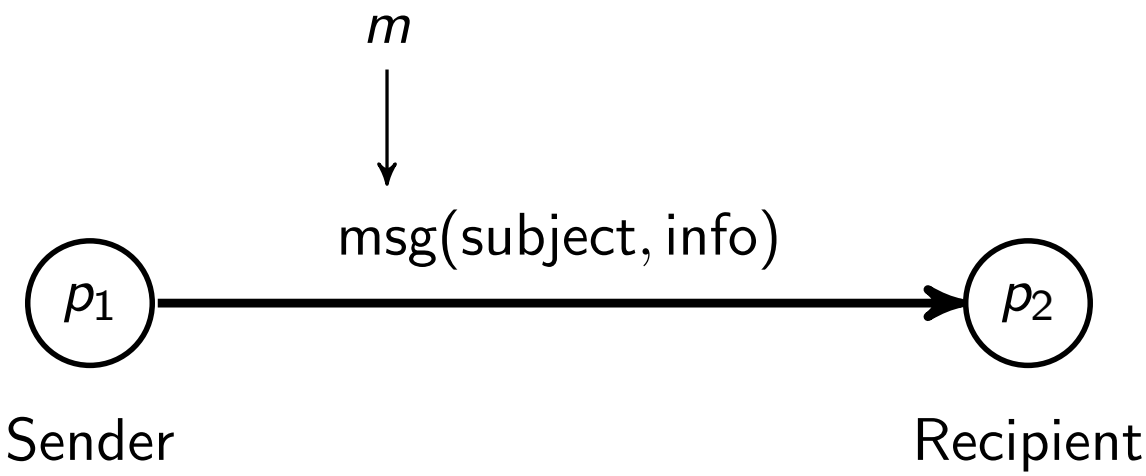

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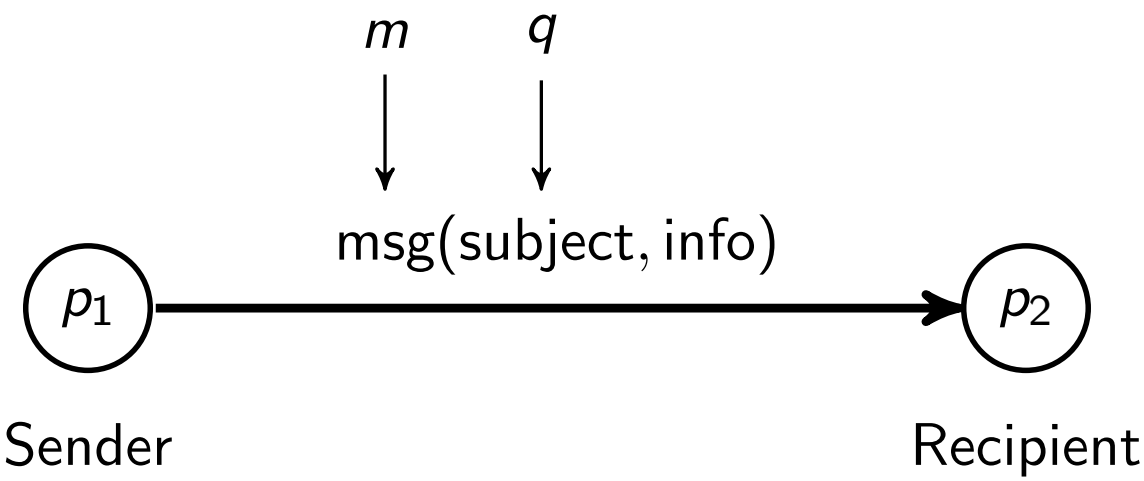

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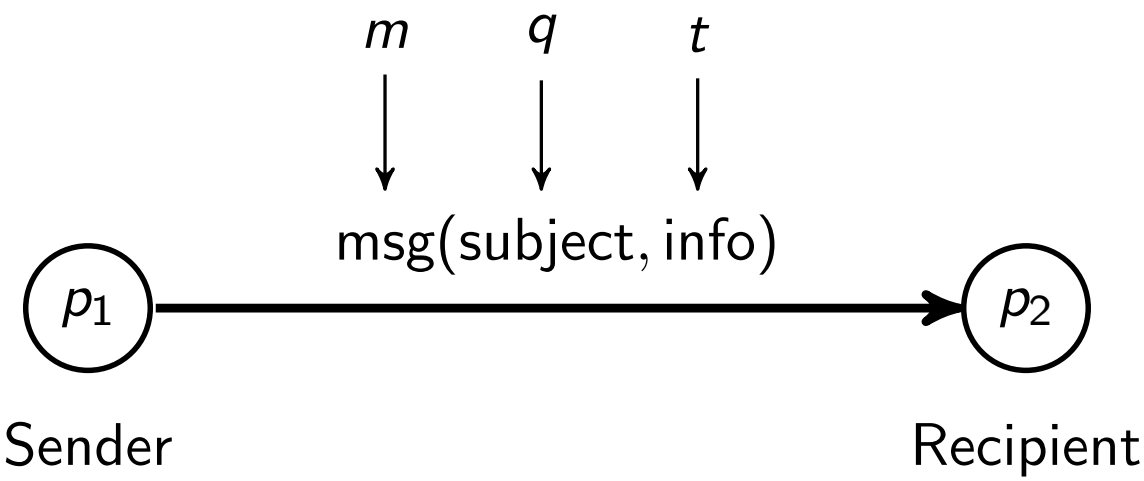

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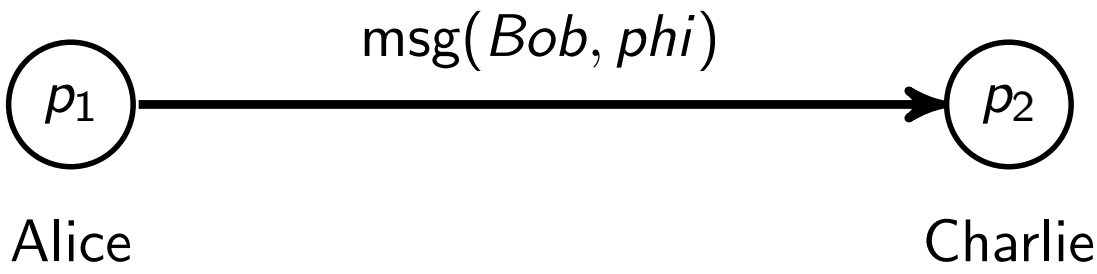

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Norms of transmission in privacy laws

Positive norms, φ_i^+: Transmission *may occur* if condition is satisfied.

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A transmission is lawful if and only if it satisfies at least one of the law's positive norms and all of the law's negative norms.

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Exceptions refine norms of transmission

Exceptions to negative norms:

"A covered entity must obtain an authorization for any use or disclosure of psychotherapy notes, except [...]."

Conclusion: Satisfy either the core or one of the exceptions.

$$\varphi^{-}_{\texttt{164.508a2}'} \triangleq \varphi^{-}_{\texttt{164.508a2}} \vee (\varphi^{e}_{\texttt{164.508a2iA}} \vee \cdots)$$

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"Exceptions" to positive norms:

- A covered entity may disclose information to report abuse.
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Structure of HIPAA and GLBA privacy laws

Health Insurance Portability and Accountability Act:

- Primarily positive norms
  - 56 positive norms, 7 negative norms, and 19 exceptions
  - Negative norms for patient consent or opt-out opportunity (§§164.508 and 164.510)
- Deny all transmissions not explicitly allowed

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Gramm-Leach-Bliley Act:

- Primarily negative norms
  - 5 negative norms and 10 exceptions
  - Negative norms require notices and opt-out opportunities (§§6802 and 6803)
- Allow all transmissions not explicitly denied

Important property of formalization:

- Traceability: Each clause in the law corresponds to one norm in formalization (roughly)

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HIPAA §164.506(c)(2)

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$$\begin{aligned}\varphi^{+}_{\texttt{164.506c2}} \triangleq\ & \mathit{activerole}(p_1, \mathit{covered\text{-}entity}) \wedge \\ & (t \in_{\mathcal{T}} \mathit{phi}) \wedge \\ & (u \in_{\mathcal{U}} \mathit{treatment}(p_2)) \wedge \\ & \mathit{activerole}(p_2, \mathit{provider})\end{aligned}$$

Principals' beliefs and professional judgement

HIPAA §164.512(f)(4)

"A covered entity may disclose protected health information about an individual who has died to a law enforcement official for the purpose of alerting law enforcement if the covered entity has a suspicion that the death may have resulted from criminal conduct."

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$$\begin{aligned}\varphi^{+}_{\texttt{164.512f4}} \triangleq\ & \mathit{activerole}(p_1, \mathit{covered\text{-}entity}) \wedge \\ & (t \in_{\mathcal{T}} \mathit{phi}) \wedge \\ & \mathit{belongstorole}(q, \mathit{deceased}) \wedge \\ & \mathit{activerole}(p_2, \mathit{law\text{-}enforcement\text{-}official}) \wedge \\ & (u \in_{\mathcal{U}} \mathit{death\text{-}notification}(q)) \wedge \\ & \mathit{believes\text{-}death\text{-}may\text{-}be\text{-}result\text{-}of\text{-}crime}(p_1, q)\end{aligned}$$

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Past and future temporal requirements

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Conclusion: Borrow operators from temporal logic.

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GLBA §6802(b)(1)

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$$
\begin{aligned}
\overline{\varphi_{\texttt{6802b1}}} \triangleq\ & \mathit{activerole}(p_1, \mathit{institution}) \wedge \\
& (t \in_{\mathcal{T}} \mathit{npi}) \wedge \\
& \neg \mathit{activerole}(p_2, \mathit{affiliate}(p_1)) \wedge \\
& \mathit{belongstorole}(q, \mathit{consumer}(p_1)) \\
& \supset \\
& \downarrow x.\ \Diamond\!\!\!\!-(\downarrow y.\ (x - y \geq 14) \wedge \\
& \qquad \exists m'.\ \mathit{send}(p_1, q, m') \wedge \\
& \qquad\quad \mathit{is\text{-}notice\text{-}of\text{-}potential} \\
& \qquad\quad\ \mathit{\text{-}disclosure}(m', p_1, p_2, (q, t), u))
\end{aligned}
$$

Syntax of the Policy Logic

Objective predicates	p_O		
Subjective predicates	p_S		
Objective atoms	P_O	$::=$	$p_O(t_1, \ldots, t_n)$
Subjective atoms	P_S	$::=$	$p_S(t_1, \ldots, t_n)$
Formulas	α, β	$::=$	$P_O \mid P_S \mid \top \mid \bot \mid$
			$\alpha_1 \wedge \alpha_2 \mid \alpha_1 \vee \alpha_2 \mid \neg\alpha \mid$
			$\forall\vec{x}.(c \supset \alpha) \mid \exists\vec{x}.(c \wedge \alpha) \mid$
			$\downarrow x.\alpha \mid \alpha\, \mathcal{S}\, \beta \mid \alpha\, \mathcal{U}\, \beta \mid \boxminus\alpha \mid \Box\, \alpha$
Restrictions	c	$::=$	$P_O \mid \top \mid \bot \mid c_1 \wedge c_2 \mid c_1 \vee c_2 \mid$
			$\exists x.c$

- Subjective predicates p_S model beliefs and purposes
- Restricted quantifiers $\forall\vec{x}.(c \supset \alpha)$, $\exists\vec{x}.(c \wedge \alpha)$
- Temporal operators $\downarrow x.\alpha$, $\alpha\, \mathcal{S}\, \beta$, $\alpha\, \mathcal{U}\, \beta$, $\boxminus\alpha$, $\Box\, \alpha$ ($\diamondminus\alpha$, $\Diamond\alpha$ defined)

Related Work on Privacy Policy Specification

- Logics and languages for specification of privacy policies
  - P3P [Cranor et al.], XACML [OASIS], EPAL [Backes et al.], requirements engineering [Breaux and Antón], LPU [Barth et al.], Privacy APIs [Gunter et al.], deontic logic [I. Lee et al.], SecPAL [Becker et al.], ...

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- Formal specification of privacy laws
  - LPU [Barth et al.]: Examples from HIPAA and GLBA
  - Datalog HIPAA [Lam et al.]: HIPAA §§164.502, 506, and 510
  - Privacy APIs [Gunter et al.]: HIPAA §164.506
  - Deontic logic [I. Lee et al.]: Examples from FDA CFR §610.40