

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 ~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

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2. Complete formalizations of HIPAA and GLBA's operational requirements for transmissions
(with H. DeYoung, D. Garg, L. Jia, D. Kaynar)
3. Automated policy monitoring with minimal human input for enforcement of HIPAA, GLBA.
(with D. Garg, L. Jia)

Outline

Structure of privacy laws

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Privacy Concepts

- Subjective concepts

- Mechanically Enforceable Concepts

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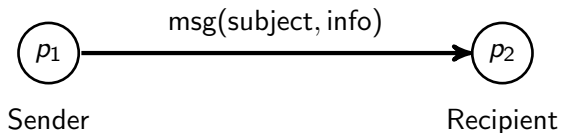
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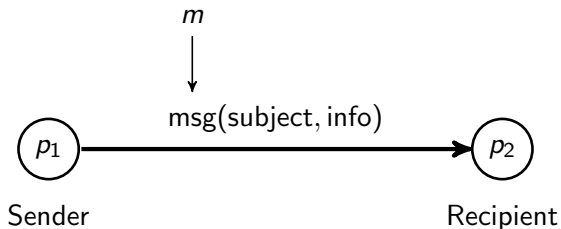
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Transmission of protected information



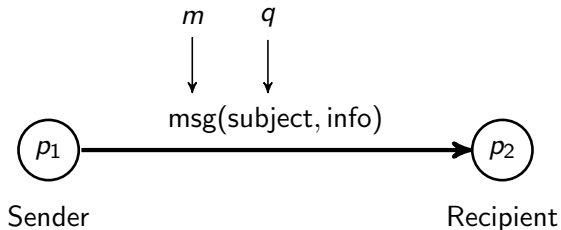
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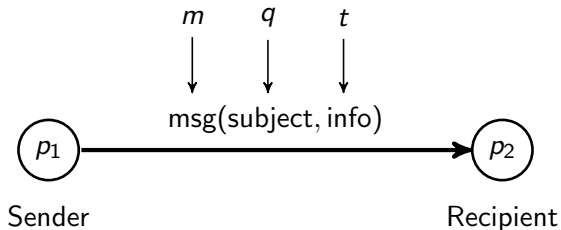
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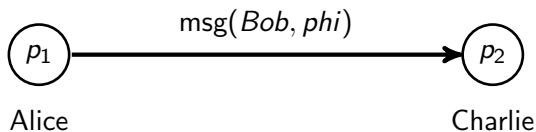
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A transmission is lawful if and only if it satisfies at least one of the law’s positive norms and all of the law’s negative norms.

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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.

$$\varphi_{164.508a2'}^- \triangleq \varphi_{164.508a2}^- \vee (\varphi_{164.508a2iA}^e \vee \dots)$$

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- ▶ 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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$$\varphi_{164.506c2}^+ \triangleq \text{activerole}(p_1, \text{covered-entity}) \wedge (t \in_{\mathcal{T}} \text{phi}) \wedge (u \in_{\mathcal{U}} \text{treatment}(p_2)) \wedge \text{activerole}(p_2, \text{provider})$$

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

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Past and future temporal requirements

GLBA §6802(b)(1)

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GLBA §6803(a)

“At the time of establishing a customer relationship and not less than **annually** during such relationship, a financial institution shall provide a disclosure to such customer, of such institution’s policies and practices with respect to [disclosing nonpublic personal info].”

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Conclusion: Borrow operators from temporal logic.

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GLBA §6802(b)(1)

“A financial institution may not disclose nonpublic personal information unless the consumer is given the opportunity to [opt-out], **before the time that such information is disclosed.**”

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

Syntax of the Policy Logic

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

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