Privacy Issues in Online Learning

Jim Greer

Professor of Computer Science
Director, University Learning Centre

Interdisciplinarity

is like having one foot firmly planted in each of two canoes!

Motivation

- Learners have little privacy and are susceptible to identity crimes
- While there is a clear requirement for privacy, there is the necessity of data collection to award credentials and to provide personalized online learning
- Privacy and Trust hold a symbiotic relationship – privacy builds trust, and trust eases privacy concerns
- Online learning is an ideal milieu in which to investigate issues of privacy

Part I

- Privacy: What , Why, and How

What is Privacy?

- Privacy is a subjective, fluid ever-changing concept (Lessig, 1998)
  - the right to be let alone (Warren & Brandeis, 1890)
  - solitude (Brierley-Newell, 1998)
  - control over what someone does (Gavison, 1984)
  - freely behave without risk of being observed (Altman & Chemers, 1980)
  - context-dependent selective disclosure of personal information (Altman, 1975)
  - when, how, and to what extent information is communicated to others (Westin, 1967)
- Ability of individuals to control collection, retention, and distribution of personal information (Goldberg et al., 1997)

What is Privacy?

- Privacy is an interaction, in which the information rights of different parties collide (Noam, 1997)
- Privacy as a function of the monitored and the searchable (Lessig, 1998)
- Ability to reveal information selectively to negotiate social relationships most advantageous to the users (Rao & Rohatgi, 2000)
- About access control, data integrity, identity management

Why Privacy?

- Like freedom, we do not recognize its importance until privacy is taken away (David Faherty)
- protects us from being misdefined and judged out of context (Cavoukian & Hamilton, 2002)
- performs four functions for us: (Westin, 1967)
  - Threat to **autonomy** puts an individual under the control of those who know his secrets
  - Privacy provides moments "off stage," when the individual can be: tender, angry, irritable, lustful, or dream-filled
  - privacy is essential for carrying on self-evaluation
  - Opportunity to share confidences and intimacies with a trustee—spouse, "the family," friends, etc. (protected communication)

Privacy Protection

- a process of finding an appropriate balance between privacy and multiple competing interests (Song et al., 2006) – personalization, security, trust, etc.
- can be realized through access control and authentication
- implementation of sound security practice does not guarantee that privacy will be achieved (Menard, 2006)
  - The use of authentication when it is not needed could threaten privacy

- Privacy is generally approached as a social consideration, whereas security is seen as a technical concern

Trust

- choice to expose oneself to a risk toward one's counterpart, in the expectation that the counterpart will not disappoint such expectation (Luhmann, 2000)
- a complex predictor of an entity's future behavior based on the past evidence
- Assess trustworthiness to decide what piece of information would be safe, with whom, and in what context
- Use of trust is often implicit – a user who downloads a file from an unfamiliar web site trusts the web site implicitly

Privacy & Trust

- In the world, trust is used to manage privacy:
  - we share personal information with those we trust
  - we collaborate with someone trustworthy
  - we confide in someone trustworthy

- In the digital realm,
  - the level of self-disclosure depends on the user's trust
  - Trust is influenced by the perceived level of privacy offered

Privacy & Trust

- Two important factors to build trust:
  - familiarity (Sheehan & Hoy, 2000), and
  - experiences (Doney & Cannon, 1997)

- To make the past experience positive, live up to the privacy and security expectations of the individual

Reputation-based Trust

- Reputation is a social notion of trust (Golbeck & Hendler, 2004)
  - we each maintain a set of reputations for the people we know
  - For an unknown person, we ask people with whom we already have relationships for information
- Though trust can be based upon many different sources (e.g. social rules, professional ethics, legal rules, etc.), reputation is the most effective source for measuring trust online
- In reputation-based trust, trust relationships grow based on longitudinal social behaviors of the actors

Trust, Privacy, Personalization

- Trust in the online transactions is closely related to issues of privacy (Friedman et al., 2000)
- In the online world, trust invokes the threat of privacy violation, identity theft, and threat to personal reputation
- In an asymmetric trust relationship, the weaker party trades privacy loss for a trust gain (Lilien & Bhargava, 2006)
  - How much of privacy is lost?
  - How much does a user benefit from certain trust gain?
- Trust promotes personalization: frank interactions → better data → better personalization

Trust, Privacy, Personalization

- Privacy and security can lead to trust (Andersson, 2005)
  - access control allows data disclosure only if the other party provides sufficient evidence of trustworthiness
  - secure access enhances users trust in the protection of personal data
- Privacy in the form of anonymity can diminish trust:
  - law enforcement difficult
  - individuals can behave in socially undesirable ways
  - cannot be sure who information is coming from (diminish integrity)
- Trust is both a pre-requisite and a consequence of good personalization practice (Briggs et al., 2004).

Privacy – Identity Management (IM)

- privacy is directly related to the knowledge of identity (Demchak & Fenstermacher, 2004)
- individuals reveal and conceal information selectively to maintain context-specific identity (Goffman, 1959)
- release all the information, but ensure the identities of the subjects are protected (Samarati, 2001; Sweeney, 2002)
- A teacher's or learner's privacy comes from their capacity to control the conditions were their identity information will be shared (Anwar, Greer, & Brooks, 2006)
- Contextual understanding and personal self-awareness help us properly control our identity and presentation during social interactions

Identity Management (IM)

- What is identity
  - A dataset of personal info (PI), (e.g. name, biometric information, behavioral pattern) used to model and thereby recognize an entity as distinct from others
  - An entity may be represented by many models ("partial identities") including their own ("true identity")
- Individuals hold multiple partial identity in multiple contexts:
  - A graduate student holds multiple partial identities based on the role they play: a student, a tutor, an instructor, or a marker
- privacy is about protecting identity →IM is a natural solution to privacy

IM : Anonymity or pseudonymity

- IM tools provide users with a desired control over their presentations of selves : anonymity, pseudonymity, or open identity
- In anonymity, actions may occur and be observed but identity is not disclosed
- Anonymity provides absolute privacy, but –
  - Does not allow personalization
  - Law enforcement difficult
  - Frees individuals to act in socially undesirable ways
  - Diminishes the integrity of information
  - Diminishes trust

Pseudonymity

- Selective PII is disclosed by associating a pseudonym with actions
- Allows us to attach longitudinal behavior records to an individual, but throws a blanket of secrecy over the true identity
- Supports reputation building (e.g. e-bay, slashdot, wikipedia)
- Good reputation gains trust, but reputation is associated with the pseudonym

Pseudonymity

- Digital identities and profiles are essential for personalization, but any kind of misuse causes violation of privacy, fraud, etc. (Mont et al., 2003)

- The pseudonym technology with unlinkability, accountability, and relative anonymity can give the user the ability to control the collection, retention, and distribution of personal information

Pseudonymity is effective, but–

- Explicit PII is hidden, but leaves information composite that may be fused to reveal full identify
- Need reputation transfer when merging/changing pseudonyms

- Information Giver (IG) should consider:
  - Benefit of revealing some PII
  - Intention of Information Seeker (IS)
  - What information Belongs to what context (as shown in context-specific identity model)
  - Sensitivity of each piece of information

Reputation Transfer (RT) model

- Anwar & Greer propose a model that supports
  - Generating contextual reputation
  - Vouching for a registered actor
  - Transferring reputation among multiple pseudonyms of an actor
- This model maintains privacy, but regulates bad actors

Reputation Transfer

- In RT model, there are 4 entities- actor, reputation, guarantor, and key-generator
  - An actor takes part in various e-learning activities
  - Reputation is the trustworthiness of an actor assessed over their past activities
  - A guarantor is a public actor who is a trusted witness of the past activities of a pseudonymous actor
  - A trusted key generator that facilitates Public Key Infrastructure

RT: Reputation Generation

- An actor registers its pseudonyms with a guarantor who would vouch for the actor and be credible in the community
- The guarantor periodically evaluates the reputation of the actor
- The actor gets an opportunity to contest any misrepresentation of their reputation to the guarantor
- The guarantor investigates the challenge and makes an appropriate adjustment to the reputation

RT: Vouching for an actor

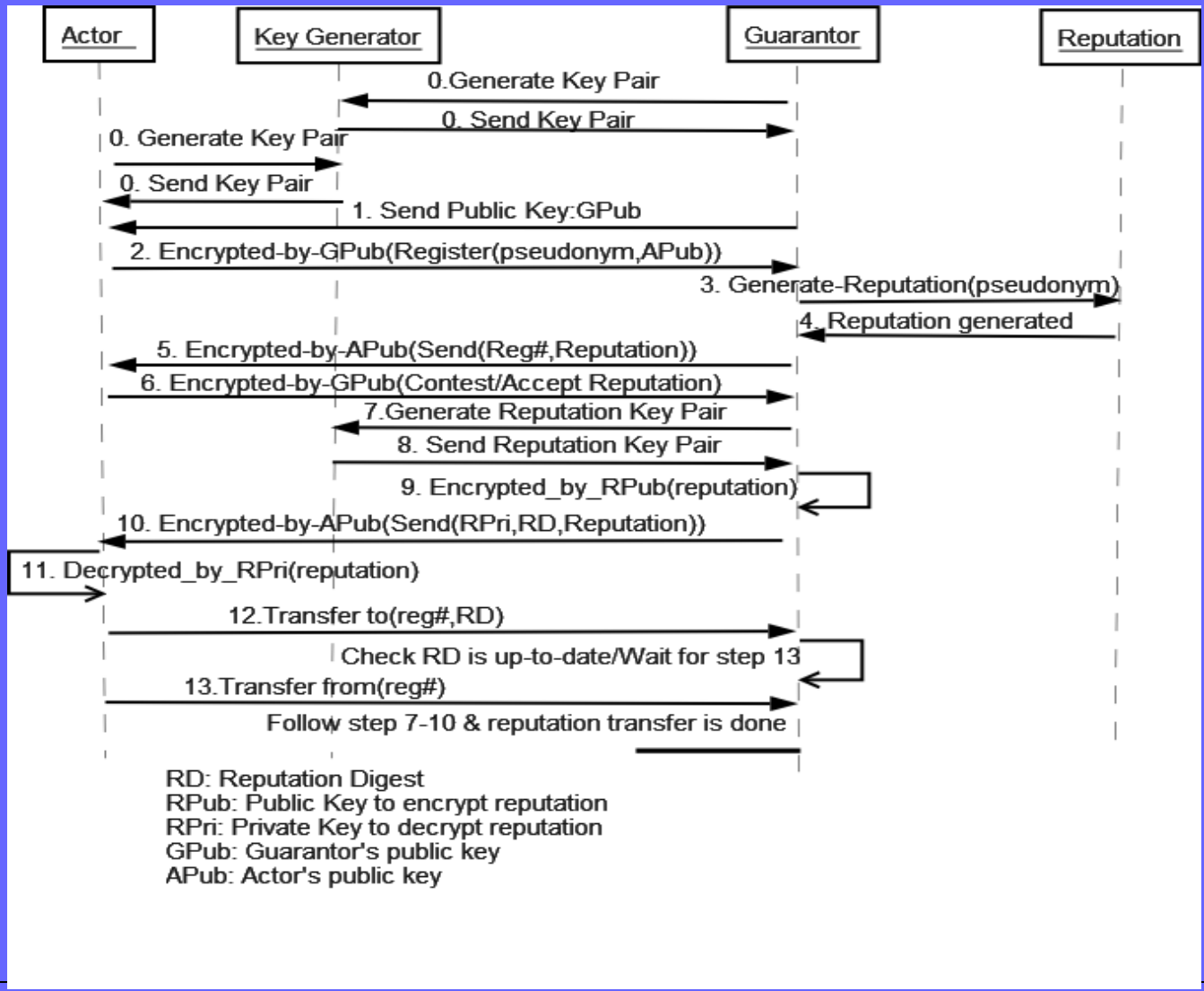
- Upon request, a guarantor vouches for actors to their partners based on their reputation
- Occasional uses of anonymity can be facilitated by having trusted guarantor vouch for an actor using an anonymous identity
- A guarantor vouches for an actor in two ways:
  - i) responding to the queries about the actor
  - ii) responding to the actor's reputation transfer request from one pseudonym to another

RT: Transferring Reputation

- The key-generator (KG) generates key-pair for both guarantor and actor
- The guarantor publishes the public key so that any actor can make encrypted service requests
- An actor registers with the guarantor –

  register (pseudonym, public-key)
- The guarantor gives a unique registration number (RN) for each of it clients
- The guarantor generates and finalizes reputation
- KG generates another key-pair for reputation

RT: Transferring Reputation



RT: Transferring reputation

- The guarantor sends the reputation private key, RPri and reputation certificate to the actor
- The guarantor also generates a reputation digest, RD (MD5 hash) to uniquely identify each certificate
- A reputation transfer is a two way process that has to be initiated by the transferring actor and followed by the receiving actor
- First, the transferring actor makes a request to the guarantor providing the receiving actor's secret RN and RD

Transferring reputation

- Then the receiving actor makes a similar request by providing the transferring actor's RN
- RD is checked to confirm a valid reputation transfer request
- Upon verifying non-repudiation, the guarantor requests a new reputation key pair from KG
- the guarantor encrypts transferring actor's reputation with the new public key and sends the corresponding RPri, RD, and reputation to the receiver

Private Transfer

- Since both the transferring and receiving actors are registered users of a guarantor, any bad acting can be traced and verified
- All the communication between an actor and the guarantor takes place using each other's public key
- the integrity of reputation can be checked using the reputation digest

Part 2

- Privacy in Online Learning
- Privacy in Social Networking

Online learning

- The realm of online learning has been expanded from academia, to industry, to cyber communities
- Due to participation and personalization, the Read-Web has transformed into a Read-Write-Web
- Online learning has become a personal learning center, where content is reused and remixed to cater to the students own needs and interests (Downes, 2005)
- Besides institutional or corporate learning, informal learning widely takes place in personal networks, or in the communities of practice

Online learning

- In most part, online learners' peers (and instructors) are strangers
- Interactions are often devoid of visual and verbal cues
- As a result, personalization is not possible without explicit learner modeling
- Lack of contextual cues – any interaction can be taken out of context and used to misrepresent the interlocutor
- learners should be able to separate acting within the online learning environment from other roles in their life

Personalization in online learning

- Personalization of learning involves the presentation of a learning experience that is customized to the preferences of the learner (Dagger et al., 2003).

- Personalization is a need in online learning, because of:
  - diverse learning objects,
  - different cognitive abilities,
  - different level of prerequisites, and
  - different learning styles (Borcea et al., 2005)

Personalization

- personalization can be based on multiple paradigms (Dagger et al., 2003):
  - Context personalization is adapting to the preferences of the learner
  - Competency personalization is adapting to the learner's prior knowledge
  - Prerequisite personalization is adapting to the currently required prerequisites of the learner

- learner modeling is the prerequisite for personalization

Personalization

- learner modeling involves: understanding the world view of the learner and tracking information about a learner (McCalla, 2000)

- "trust" is an important concern in elearning systems (Xu & Korba, 2002)
  - service provider must trust that a learner truly has legitimate credentials and authorization to participate
  - the learner must trust that the service provider will use private information appropriately

Personalization in Online Learning

- Learners typically have trust in the system
- An effective collaboration, whether synchronous (e.g. chat, conferencing) or asynchronous (email, blogs, threaded discussions), depends upon trust
- The primary privacy concern in collaborative work and collaborative learning is "impression management" (Patil & Kobsa, 2003)
- In online learning, little consideration is given to privacy and security

Privacy in e-learning

- Why privacy in online learning?
  - Learner rights
  - Establish an unbiased environment (Borcea et al., 2005)
  - Learner and instructor comfort

Privacy in e-learning

- Since an online learning application aims at assisting users, they cannot act in full anonymity (Borcea et al., 2005)

- Two aspects of personal data that pertain to privacy protection of learners (Borcea et al., 2005; Franz et. al, 2006):
  - Data parsimony: store as little personal data as possible
  - Data partitioning: partition data into context-specific partial identities

Social Networks

- The social networking sites (SNS) are another frontier for exploring learner's privacy

- Facebook, MySpace, Friendster
  - Millions of users
  - Gives the perception of the online space as a closed, trusted, and trustworthy community

- "Finding oneself" vs "Inventing oneself"

Social Networks

- SNS provides a fertile ground for identity development and cultural integration
- Individuals give away their "profile" and their own social networks
- Revealing personal information to vast networks of loosely defined acquaintances and complete strangers should be worrisome!!!

facebook

Social Networks

- In many occasions we want to share information with a small circle of close friends, and not strangers
- In other instances we want to share personal information with strangers, but not with those who know us better
- People are indicated as Friends even though the user does not particularly know or trust the person
  - In Facebook interactions, "there is no way to determine the metric used or the role or weight of the relationship" (Boyd, 2004)

Social Networks

- The factors that drive information revelation (Acquisti, 2004):
  - Peer pressure and herding behavior
  - relaxed attitudes towards (or lack of interest in) personal privacy
  - incomplete information (about the possible privacy implications of information revelation)
  - faith in the networking service or trust in its members
  - myopic evaluation of privacy risks
- provide opportunities to combine online and face-to-face interactions

Social Networks

- college-oriented networks offer a wealth of personal data to external observers
  - the Pentagon manages a database of 16-to-25-year-old US youth data, containing around 30 million records (Cave, 2005)
- Privacy expectations may not be matched by privacy reality
- By default, everyone in Facebook appears in searches of everyone else
  - users tend to not change default settings – Mackay, 1991)

Growing an Identity

- Blogging provides new ways for people to engage in self-expression and self-development
- Digital expressions have properties not normally considered in everyday life; they are easily copied, searched, or archived
- In digital environments, the lack of presence makes it difficult to know who is listening. Thus, *how are unknown audiences negotiated? (Danah & Heer)*
  - Fakesters in Friendster!!

Privacy in Social Networks

- Often, the topic of persistent conversations raises critical privacy issues. What happens when your future boss accesses your information? What happens when a big company buys your data? What happens when your social network is modelled?
- Public online is very different form public offline: persistence and exact copies are not something that people think to negotiate when they think about the nature of being public
- Teens and adults have developed different notions of privacy: young people feel relatively comfortable sharing aspects of their lives

Part 3

Recommendations for building privacy-enhanced and personalized online learning environments

Traditional Classroom: Privacy & Personalization

- Traditional classroom represents a closely knit group
- Yet some information is protected
- Physical presence warrants authenticity
- Instructor provides some degree of personalization by observing the visual cues of learners
- Contextual cues are available – teachers might say provocative things for pedagogical purpose

Recommendations in building privacy-enhanced online learning environment

- Allow pseudonymity: Allow users to use self-picked/ system generated identifiers when divulging part of their context appropriate identity
- Allow anonymity when possible: Allow users to perform low risk activities anonymously
- Facilitate information sharing based on trust: help users evaluate the trustworthiness of other actors and allow them to perform some degree of social commitment

Recommendations

- Allow attaching contextual cues: role-based access to information
- Allow attaching verbal and non-verbal cues with information: by providing tags or emoticons
- Detect/purge unnecessary personal information: warn users about privacy slips

Recommendations

- Allow information to expire: Attach "time to live" tags for each piece of information
- Promote privacy awareness: educate users about privacy and the risk of identity disclosure
- Punish bad actors: flag bad behaviors and recognize the good users with a higher reputation score

iHelp

- An e-learning system which doubles as a research platform in advanced ed. tech.
  - iHelp Courses (LMS)
  - iHelp Discussion (forum)
  - iHelp Chat (cohort-based chatrooms)
  - iHelp Share (messaging and co-annotation)
  - iHelp Lecture (video lecture capture)

- Detailed tracking and monitoring for personalization and research

Privacy in iHelp

- The iHelp system supports privacy
  - Role-based access control
  - Closed cohorts and groups
  - Pseudonymity: allows multiple pseudonyms – system default or user picked
  - Anonymity: instructors may enable the option of anonymous posting
  - Context Separation: provides context specific interaction channels

Privacy in i-Help

- Facilitation of Trust: As learners interact with one another, familiar pseudonyms emerge and attribution of personalities to pseudonyms quickly develops

- Detection and removal of unnecessary personal information: provides aggregate information to instructors. learners and researchers stripping off personal information where appropriate

Privacy in i-Help

- Promoting privacy awareness: the system presents its privacy policy to its users and raises privacy awareness

- Punishment for bad actors: administrators can trace the true identity of a pseudonymous or anonymous user, but only if need be

Conclusion

- Some recommendations are made in building privacy-enhanced and personalized online learning environments
- Implementation of some of these recommendations in iHelp concludes that it provides a reasonable degree of privacy protection for learners, facilitates trust, and allows personalization
- A reputation system (that transfers/merge reputation across multiple pseudonyms) together with an IM system facilitate both privacy & trust
- We plan to implement a protocol for information expiration that can be implemented within our systems using the time-to-live tag for each piece of information

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