Problem statement

Huge amount of data about individuals is collected, processed, shared, and communicated

- Growing concerns and demand for privacy by users
- Requires techniques addressing the different issues and threats that can put privacy at risk in the different stages of the information lifecycle

  $\Longrightarrow$ Need to invest on research to produce non technological solutions and fill the gap between needs for privacy and what today's technologies provide

Objectives

- Perform research for understanding open privacy problems and providing novel solutions to solve them
  - provide state of the art foundations
  - provide rigorous scientific analysis of privacy requirements and threats
  - provide novel techniques solving open problems
- Develop prototypal tools realizing the techniques
  - produce proof-of-concepts prototypal tools
  - make prototypal tools usable by other activities
  - make prototypal tools available to the community at large (via the open source activity)

Work packages in Activity 2

Broad in scope, touching different aspects of the complex privacy problem

- Cryptographic mechanisms (WP2.1)
- Mechanisms supporting users' privacy and trust (WP2.2)
- Privacy of data (WP2.3)
- Access control for the protection of user-generated data (WP2.4)

Results Activity 2

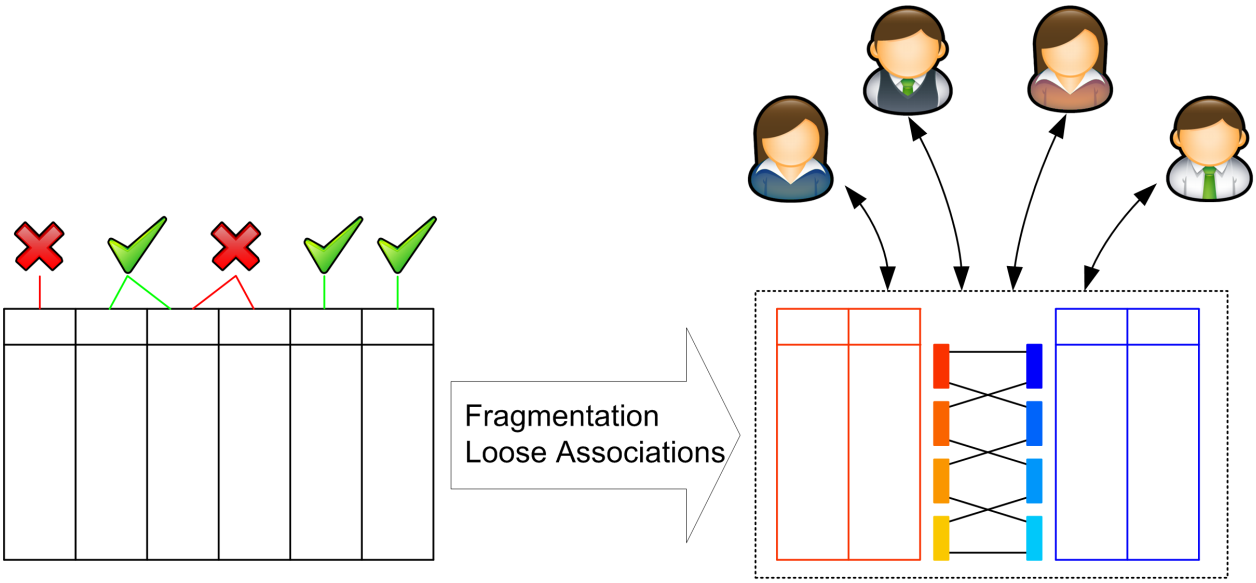
- Results presented at leading international journals and conferences
  - Around 100 publications overall
  - In year 3: 48 papers, among which
    - ACM TODS
    - ACM TISSEC
    - Journal of Computer Security
    - CRYPTO
    - VLDB
    - ESORICS
    - ICDCS
    - FC
    - PET
- Developed several prototypal tools

Fragments and loose associations

Allow data publishing and sharing

- preserving privacy
- guaranteeing necessary visibility over data
- maximize utility of released information

Scenario



Confidentiality constraints

- Sets of attributes such that the (joint) visibility of values of the attributes in the sets should be protected
  - sensitive attributes: some attributes are considered sensitive, their values should not be made visible
  - sensitive associations: associations among some attributes are considered sensitive; the attribute values should not be made jointly visible

Confidentiality constraints – Example

SSN	Patient	Birth	City	Illness	Doctor
123-45-6789	Page	56/12/9	Carpi	Itching	David
987-65-4321	Patrick	53/3/19	Crema	Iritis	Daisy
963-85-2741	Patty	58/5/18	Cork	Influenza	Damian
147-85-2369	Paul	53/12/9	Cork	Ichthyosis	Daniel
782-90-5280	Pearl	56/12/9	Carpi	Iritis	Dorothy
816-52-7272	Philip	57/6/25	Crema	Insomnia	Drew
872-62-5178	Phoebe	53/12/1	Chur	Ivemork	Dennis
712-81-7618	Piers	60/7/25	Carpi	Itching	Daisy

- SSN is sensitive
  - {SSN}
- Illness and Doctor are private and cannot be stored in association with the name of the patient
  - {Patient, Illness}, {Patient, Doctor}
- Birth and City can work as quasi-identifier
  - {Birth, City, Illness}, {Birth, City, Doctor}

Visibility requirements

- Required views over data expressed as monotonic boolean formulas over attributes
  - visible attributes: some attributes should be visible
  - visible associations: the association among values of given attributes should be visible
  - alternative views: at least one of the specified views should be visible

Visibility requirements – Example

SSN	Patient	Birth	City	Illness	Doctor
123-45-6789	Page	56/12/9	Carpi	Itching	David
987-65-4321	Patrick	53/3/19	Crema	Iritis	Daisy
963-85-2741	Patty	58/5/18	Cork	Influenza	Damian
147-85-2369	Paul	53/12/9	Cork	Ichthyosis	Daniel
782-90-5280	Pearl	56/12/9	Carpi	Iritis	Dorothy
816-52-7272	Philip	57/6/25	Crema	Insomnia	Drew
872-62-5178	Phoebe	53/12/1	Chur	Ivemork	Dennis
712-81-7618	Piers	60/7/25	Carpi	Itching	Daisy

- Either Patient or City should be released
  - Patient OR City
- Either Birth and City in association should be released or the SSN of patients should be released
  - (Birth AND City) OR SSN
- Illness and Doctor, as well as their association, should be released
  - Illness AND Doctor

Fragmentation

We apply fragmentation to provide data views that satisfy both confidentiality constraints and visibility requirements

- Publish/release to external parties only fragments that
  - do not include sensitive attributes and sensitive associations
  - include the requested attributes and/or associations (all the requirements should be satisfied, not necessarily by a single fragment)
- The problem of computing a correct and minimal fragmentation is NP-hard $\Longrightarrow$ modeled as a satisfiability problem and efficiently solved by a SAT solver

Fragmentation – Example

SSN	Patient	Birth	City	Illness	Doctor
123-45-6789	Page	56/12/9	Carpi	Itching	David
987-65-4321	Patrick	53/3/19	Crema	Iritis	Daisy
963-85-2741	Patty	58/5/18	Cork	Influenza	Damian
147-85-2369	Paul	53/12/9	Cork	Ichthyosis	Daniel
782-90-5280	Pearl	56/12/9	Carpi	Iritis	Dorothy
816-52-7272	Philip	57/6/25	Crema	Insomnia	Drew
872-62-5178	Phoebe	53/12/1	Chur	Ivemork	Dennis
712-81-7618	Piers	60/7/25	Carpi	Itching	Daisy

c_0={SSN}
c_1={Patient,Illness}
c_2={Patient,Doctor}
c_3={Birth,City,Illness}
c_4={Birth,City,Doctor}

v_1=Patient ∨ City
v_2=(Birth ∧ City)∨ SSN
v_3=Illness ∧ Doctor

F_l

Birth	City
56/12/9	Carpi
53/3/19	Crema
58/5/18	Cork
53/12/9	Cork
56/12/9	Carpi
57/6/25	Crema
53/12/1	Chur
60/7/25	Carpi

F_r

Illness	Doctor
Itching	David
Iritis	Daisy
Influenza	Damian
Ichthyosis	Daniel
Iritis	Dorothy
Insomnia	Drew
Ivemork	Dennis
Itching	Daisy

Publishing loose associations (1)

- Fragmenting data among non linkable fragments
  - provide protection since data in different fragments cannot be correlated
  - decrease information utility

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork	Iritis	Itching
		Daisy	David	Daniel	Damian	Drew	Dennis	Dorothy	Daisy
53/3/19	Crema	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
53/12/9	Cork	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
56/12/9	Carpi	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
57/6/25	Crema	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
58/5/18	Cork	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
56/12/9	Carpi	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
53/12/1	Chur	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
60/7/25	Carpi	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8

Publishing loose associations (2)

- Allow the specification of a protection degree to be satisfied for the association
  - publish associations in a loose form (among groups of values, in contrast to specific values)
- Given two fragments F_l and F_r containing sub-tuples involved in a sensitive association and a protection degree k:
  - partition the tuples of F_l and F_r in different groups of size greater than or equal to k_l and k_r ($k_l \cdot k_r \geq k$)
  - need to ensure that induced group associations guarantee a proper privacy degree

Group association – Example

Birth	City	Illness	Doctor
56/12/9	Carpi	Itching	David
53/3/19	Crema	Iritis	Daisy
58/5/18	Cork	Influenza	Damian
53/12/9	Cork	Ichthyosis	Daniel
56/12/9	Carpi	Iritis	Dorothy
57/6/25	Crema	Insomnia	Drew
53/12/1	Chur	Ivemork	Dennis
60/7/25	Carpi	Itching	Daisy

c_0={SSN}
c_1={Patient,Illness}
c_2={Patient,Doctor}
c_3={Birth,City,Illness}
c_4={Birth,City,Doctor}

F_l

Birth	City
56/12/9	Carpi
53/3/19	Crema
58/5/18	Cork
53/12/9	Cork
56/12/9	Carpi
57/6/25	Crema
53/12/1	Chur
60/7/25	Carpi

F_r

Illness	Doctor
Itching	David
Iritis	Daisy
Influenza	Damian
Ichthyosis	Daniel
Iritis	Dorothy
Insomnia	Drew
Ivemork	Dennis
Itching	Daisy

Group association – Example

Birth	City	Illness	Doctor
56/12/9	Carpi	Itching	David
53/3/19	Crema	Iritis	Daisy
58/5/18	Cork	Influenza	Damian
53/12/9	Cork	Ichthyosis	Daniel
56/12/9	Carpi	Iritis	Dorothy
57/6/25	Crema	Insomnia	Drew
53/12/1	Chur	Ivemork	Dennis
60/7/25	Carpi	Itching	Daisy

c_0={SSN}
c_1={Patient,Illness}
c_2={Patient,Doctor}
c_3={Birth,City,Illness}
c_4={Birth,City,Doctor}

F_l

Birth	City
53/3/19	Crema
53/12/9	Cork
56/12/9	Carpi
57/6/25	Crema
58/5/18	Cork
56/12/9	Carpi
53/12/1	Chur
60/7/25	Carpi

F_r

Illness	Doctor
Iritis	Daisy
Itching	David
Ichthyosis	Daniel
Influenza	Damian
Insomnia	Drew
Ivemork	Dennis
Iritis	Dorothy
Itching	Daisy

Group association – Example

Birth	City	Illness	Doctor
56/12/9	Carpi	Itching	David
53/3/19	Crema	Iritis	Daisy
58/5/18	Cork	Influenza	Damian
53/12/9	Cork	Ichthyosis	Daniel
56/12/9	Carpi	Iritis	Dorothy
57/6/25	Crema	Insomnia	Drew
53/12/1	Chur	Ivemork	Dennis
60/7/25	Carpi	Itching	Daisy

c_0={SSN}
c_1={Patient,Illness}
c_2={Patient,Doctor}
c_3={Birth,City,Illness}
c_4={Birth,City,Doctor}

F_l

Birth	City
53/3/19	Crema
53/12/9	Cork
56/12/9	Carpi
57/6/25	Crema
58/5/18	Cork
56/12/9	Carpi
53/12/1	Chur
60/7/25	Carpi

F_r

Illness	Doctor
Iritis	Daisy
Itching	David
Ichthyosis	Daniel
Influenza	Damian
Insomnia	Drew
Ivemork	Dennis
Iritis	Dorothy
Itching	Daisy

Group association – Example

Birth	City	Illness	Doctor
56/12/9	Carpi	Itching	David
53/3/19	Crema	Iritis	Daisy
58/5/18	Cork	Influenza	Damian
53/12/9	Cork	Ichthyosis	Daniel
56/12/9	Carpi	Iritis	Dorothy
57/6/25	Crema	Insomnia	Drew
53/12/1	Chur	Ivemork	Dennis
60/7/25	Carpi	Itching	Daisy

c_0={SSN}
c_1={Patient,Illness}
c_2={Patient,Doctor}
c_3={Birth,City,Illness}
c_4={Birth,City,Doctor}

F_l

Birth	City
53/3/19	Crema
53/12/9	Cork
56/12/9	Carpi
57/6/25	Crema
58/5/18	Cork
56/12/9	Carpi
53/12/1	Chur
60/7/25	Carpi

F_r

Illness	Doctor
Iritis	Daisy
Itching	David
Ichthyosis	Daniel
Influenza	Damian
Insomnia	Drew
Ivemork	Dennis
Iritis	Dorothy
Itching	Daisy

Group association – Example

Birth	City	Illness	Doctor
56/12/9	Carpi	Itching	David
53/3/19	Crema	Iritis	Daisy
58/5/18	Cork	Influenza	Damian
53/12/9	Cork	Ichthyosis	Daniel
56/12/9	Carpi	Iritis	Dorothy
57/6/25	Crema	Insomnia	Drew
53/12/1	Chur	Ivemork	Dennis
60/7/25	Carpi	Itching	Daisy

c_0={SSN}
c_1={Patient,Illness}
c_2={Patient,Doctor}
c_3={Birth,City,Illness}
c_4={Birth,City,Doctor}

F_l

Birth	City	G
53/3/19	Crema	bc1
53/12/9	Cork	bc1
56/12/9	Carpi	bc2
57/6/25	Crema	bc2
58/5/18	Cork	bc3
56/12/9	Carpi	bc3
53/12/1	Chur	bc4
60/7/25	Carpi	bc4

A

G_l	G_r
bc1	id1
bc1	id2
bc2	id1
bc2	id3
bc3	id2
bc3	id4
bc4	id3
bc4	id4

F_r

G	Illness	Doctor
id1	Iritis	Daisy
id1	Itching	David
id2	Ichthyosis	Daniel
id2	Influenza	Damian
id3	Insomnia	Drew
id3	Ivemork	Dennis
id4	Iritis	Dorothy
id4	Itching	Daisy

k-loose association

- An association is *k*-loose if every group association indistinguishably corresponds to at least *k* distinct associations among tuples
- The degree of looseness characterizes the privacy (and utility) of the associations
  - the probability of an association to exist in the original relation may change from 1/card(relation) to 1/*k*
- If grouping satisfies given heterogeneity properties, the group association is *k*-loose with $k=k_l \cdot k_r$
  - group heterogeneity
  - association heterogeneity
  - deep heterogeneity

Group heterogeneity

No group can contain tuples that have the same values for the attributes involved in constraints covered by F_l and F_r

- it ensures diversity of tuples within groups

c_1={Patient,Illness}
c_2={Patient,Doctor}
c_3={Birth,City,Illness}
c_4={Birth,City,Doctor}

F_l

Birth	City
53/3/19	Crema
53/12/9	Cork
56/12/9	Carpi
57/6/25	Crema
58/5/18	Cork
56/12/9	Carpi
53/12/1	Chur
60/7/25	Carpi

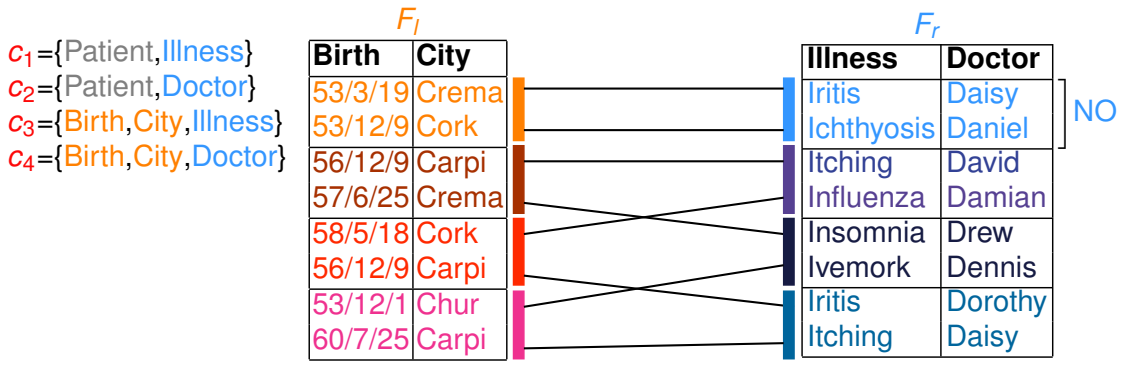
F_r

Illness	Doctor	
Iritis	Daisy	NO
Iritis	Dorothy	
Ichthyosis	Daniel	
Influenza	Damian	
Insomnia	Drew	
Ivemork	Dennis	
Itching	David	NO
Itching	Daisy	

Association heterogeneity

No group can be associated twice with another group (the group association cannot contain any duplicate)

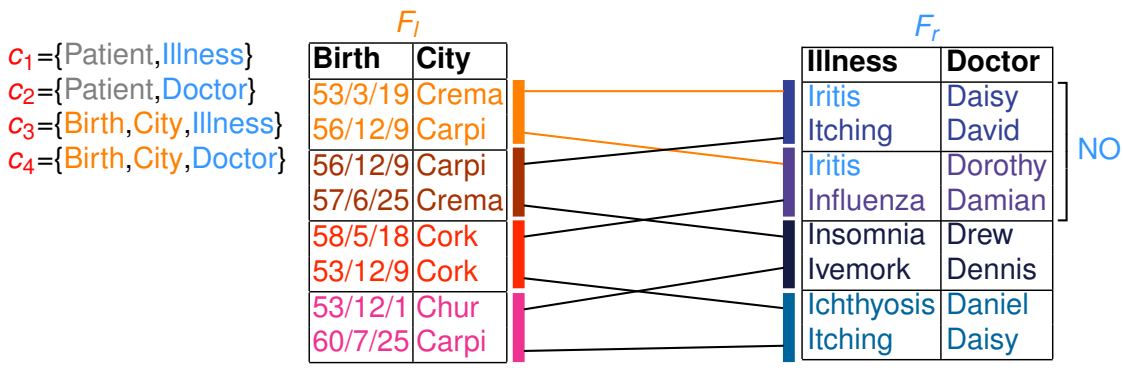
- it ensures that for each real tuple in the original relation there are at least $k_l \cdot k_r$ pairs in the group association that may correspond to it



Deep heterogeneity

No group can be associated with two groups that contain tuples with the same values for the attributes involved in a constraint covered by F_l and F_r

- it ensures that all $k_l \cdot k_r$ pairs in the group association to which each tuple could correspond contain diverse values for attributes involved in constraints



Privacy vs utility

- The publication of loose associations increases data utility
  - it makes it possible to evaluate queries more precisely than if only the fragments were published
- Increasing utility exposes more information (parameter *k* sets the privacy degree to be maintained)

Information exposure

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork	Iritis	Itching
		Daisy	David	Daniel	Damian	Drew	Dennis	Dorothy	Daisy
53/3/19	Crema	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
53/12/9	Cork	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
56/12/9	Carpi	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
57/6/25	Crema	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
58/5/18	Cork	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
56/12/9	Carpi	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
53/12/1	Chur	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
60/7/25	Carpi	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8

F_l

Birth	City
53/3/19	Crema
53/12/9	Cork
56/12/9	Carpi
57/6/25	Crema
58/5/18	Cork
56/12/9	Carpi
53/12/1	Chur
60/7/25	Carpi

F_r

Illness	Doctor
Iritis	Daisy
Itching	David
Ichthyosis	Daniel
Influenza	Damian
Insomnia	Drew
Ivemork	Dennis
Iritis	Dorothy
Itching	Daisy

Information exposure

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork	Iritis	Itching
		Daisy	David	Daniel	Damian	Drew	Dennis	Dorothy	Daisy
53/3/19	Crema	1/4	1/4	1/4	1/4	–	–	–	–
53/12/9	Cork	1/4	1/4	1/4	1/4	–	–	–	–
56/12/9	Carpi	1/4	1/4	–	–	1/4	1/4	–	–
57/6/25	Crema	1/4	1/4	–	–	1/4	1/4	–	–
58/5/18	Cork	–	–	1/4	1/4	–	–	1/4	1/4
56/12/9	Carpi	–	–	1/4	1/4	–	–	1/4	1/4
53/12/1	Chur	–	–	–	–	1/4	1/4	1/4	1/4
60/7/25	Carpi	–	–	–	–	1/4	1/4	1/4	1/4

F_l F_r

Birth	City
53/3/19	Crema
53/12/9	Cork
56/12/9	Carpi
57/6/25	Crema
58/5/18	Cork
56/12/9	Carpi
53/12/1	Chur
60/7/25	Carpi

Illness	Doctor
Iritis	Daisy
Itching	David
Ichthyosis	Daniel
Influenza	Damian
Insomnia	Drew
Ivemork	Dennis
Iritis	Dorothy
Itching	Daisy

Information exposure

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork	Iritis	Itching
		Daisy	David	Daniel	Damian	Drew	Dennis	Dorothy	Daisy
53/3/19	Crema	1/4	1/4	1/4	1/4	–	–	–	–
53/12/9	Cork	1/4	1/4	1/4	1/4	–	–	–	–
56/12/9	Carpi	1/4	1/4	–	–	1/4	1/4	–	–
57/6/25	Crema	1/4	1/4	–	–	1/4	1/4	–	–
58/5/18	Cork	–	–	1/4	1/4	–	–	1/4	1/4
56/12/9	Carpi	–	–	1/4	1/4	–	–	1/4	1/4
53/12/1	Chur	–	–	–	–	1/4	1/4	1/4	1/4
60/7/25	Carpi	–	–	–	–	1/4	1/4	1/4	1/4

c_3={Birth,City,Illness}

Information exposure

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork	Iritis	Itching
53/3/19	Crema	1/4	1/4	1/4	1/4	–	–	–	–
53/12/9	Cork	1/4	1/4	1/4	1/4	–	–	–	–
56/12/9	Carpi	1/4	1/4	–	–	1/4	1/4	–	–
57/6/25	Crema	1/4	1/4	–	–	1/4	1/4	–	–
58/5/18	Cork	–	–	1/4	1/4	–	–	1/4	1/4
56/12/9	Carpi	–	–	1/4	1/4	–	–	1/4	1/4
53/12/1	Chur	–	–	–	–	1/4	1/4	1/4	1/4
60/7/25	Carpi	–	–	–	–	1/4	1/4	1/4	1/4

$\simeq_{c_3}$

c_3={Birth,City,Illness}

$$P(A \text{ or } B) = P(A) + P(B) - P(A) \cdot P(B)$$

Information exposure

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork	Iritis	Itching
53/3/19	Crema	1/4	1/4	1/4	1/4	–	–	–	–
53/12/9	Cork	1/4	1/4	1/4	1/4	–	–	–	–
56/12/9	Carpi	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
57/6/25	Crema	1/4	1/4	–	–	1/4	1/4	–	–
58/5/18	Cork	–	–	1/4	1/4	–	–	1/4	1/4
53/12/1	Chur	–	–	–	–	1/4	1/4	1/4	1/4
60/7/25	Carpi	–	–	–	–	1/4	1/4	1/4	1/4

c_3={Birth,City,Illness}

$$P(A \text{ or } B) = P(A) + P(B) - P(A) \cdot P(B)$$

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Information exposure

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork	Iritis	Itching
		$\simeq_{c_3}$							
53/3/19	Crema	1/4	1/4	1/4	1/4	–	–	–	–
53/12/9	Cork	1/4	1/4	1/4	1/4	–	–	–	–
56/12/9	Carpi	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
57/6/25	Crema	1/4	1/4	–	–	1/4	1/4	–	–
58/5/18	Cork	–	–	1/4	1/4	–	–	1/4	1/4
53/12/1	Chur	–	–	–	–	1/4	1/4	1/4	1/4
60/7/25	Carpi	–	–	–	–	1/4	1/4	1/4	1/4

c_3={Birth,City,Illness}

$$P(A \text{ or } B) = P(A) + P(B) - P(A) \cdot P(B)$$

Information exposure

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork	Itching
53/3/19	Crema	1/4	1/4	1/4	1/4	–	–	–
53/12/9	Cork	1/4	1/4	1/4	1/4	–	–	–
56/12/9	Carpi	7/16	1/4	1/4	1/4	1/4	1/4	1/4
57/6/25	Crema	1/4	1/4	–	–	1/4	1/4	–
58/5/18	Cork	1/4	–	1/4	1/4	–	–	1/4
53/12/1	Chur	1/4	–	–	–	1/4	1/4	1/4
60/7/25	Carpi	1/4	–	–	–	1/4	1/4	1/4

c_3={Birth,City,Illness}

$$P(A \text{ or } B) = P(A) + P(B) - P(A) \cdot P(B)$$

Information exposure

			$\simeq_{c_3}$					
		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork	Itching
53/3/19	Crema	1/4	1/4	1/4	1/4	–	–	–
53/12/9	Cork	1/4	1/4	1/4	1/4	–	–	–
56/12/9	Carpi	7/16	1/4	1/4	1/4	1/4	1/4	1/4
57/6/25	Crema	1/4	1/4	–	–	1/4	1/4	–
58/5/18	Cork	1/4	–	1/4	1/4	–	–	1/4
53/12/1	Chur	1/4	–	–	–	1/4	1/4	1/4
60/7/25	Carpi	1/4	–	–	–	1/4	1/4	1/4

c_3={Birth,City,Illness}

$$P(A \text{ or } B) = P(A) + P(B) - P(A) \cdot P(B)$$

Information exposure

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork
53/3/19	Crema	1/4	1/4	1/4	1/4	–	–
53/12/9	Cork	1/4	1/4	1/4	1/4	–	–
56/12/9	Carpi	7/16	7/16	1/4	1/4	1/4	1/4
57/6/25	Crema	1/4	1/4	–	–	1/4	1/4
58/5/18	Cork	1/4	1/4	1/4	1/4	–	–
53/12/1	Chur	1/4	1/4	–	–	1/4	1/4
60/7/25	Carpi	1/4	1/4	–	–	1/4	1/4

c_3={Birth,City,Illness}

$$P(A \text{ or } B) = P(A) + P(B) - P(A) \cdot P(B)$$

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Measuring utility – Example

P^A

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork
53/3/19	Crema	1/4	1/4	1/4	1/4	–	–
53/12/9	Cork	1/4	1/4	1/4	1/4	–	–
56/12/9	Carpi	7/16	7/16	1/4	1/4	1/4	1/4
57/6/25	Crema	1/4	1/4	–	–	1/4	1/4
58/5/18	Cork	1/4	1/4	1/4	1/4	–	–
53/12/1	Chur	1/4	1/4	–	–	1/4	1/4
60/7/25	Carpi	1/4	1/4	–	–	1/4	1/4

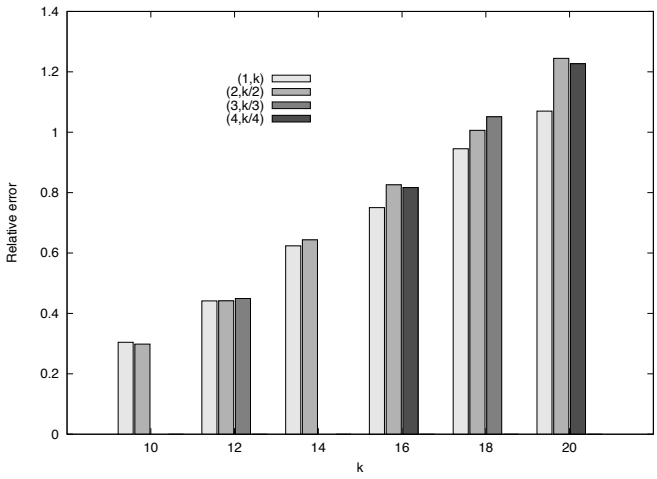
P

		Iritis	Itching	Ichthyosis	Influenza	Insomnia	Ivemork
53/3/19	Crema	15/64	15/64	1/8	1/8	1/8	1/8
53/12/9	Cork	15/64	15/64	1/8	1/8	1/8	1/8
56/12/9	Carpi	1695/4096	1695/4096	15/64	15/64	15/64	15/64
57/6/25	Crema	15/64	15/64	1/8	1/8	1/8	1/8
58/5/18	Cork	15/64	15/64	1/8	1/8	1/8	1/8
53/12/1	Chur	15/64	15/64	1/8	1/8	1/8	1/8
60/7/25	Carpi	15/64	15/64	1/8	1/8	1/8	1/8

Experimental evaluation

- Considered Census data (IPUMS-USA, www.ipums.org)
- Evaluated queries of the form
  - SELECT FROM WHERE returning a COUNT aggregation function
  - WHERE condition $\bigwedge_{i=1}^{n}(\bigvee_{j=1}^{m} a_i = v_{i_j})$
- Evaluated precision of queries
- Evaluated impact of k, k_l, and k_r on query precision

Experimental evaluation – Results



- Precision in query evaluation progressively decreases as k increases
- The critical parameter in the configuration is the overall privacy degree k, rather than individual values of k_l and k_r

Summary

- Novel approach to the problem of protecting privacy when publishing data
- Generic setting of the privacy problem that explicitly takes into consideration both privacy needs and visibility requirements
- Definition of loose associations for increasing data utility while preserving a given degree of privacy