Co-utility: Conciliating individual freedom and common good in the information society

-Rovira i Virgili University and Templeton World Charity Foundation-
Motivation

The scenario:

We have:

We should implement:
Motivation

The scenario:

• Peers only and no central authority.
• Rational peers interested in optimizing own benefit.

We should implement:
Motivation

The scenario:

• Peers only and no central authority.
• Rational peers interested in optimizing own benefit.
• Protocols regulating peers interaction should be easy to use and efficient to implement.
• Protocols should foster collaboration of peers.
Motivation

The scenario:

• Peers only and no central authority.
• Rational peers interested in optimizing own benefit.
• Protocols regulating peers interaction should be easy to use and efficient to implement.
• Protocols should foster collaboration of peers.

Simplified example: Matching offer and demand.
In general: P2P systems and everywhere in daily life.
Motivation

The scenario:

- Peers only and no central authority.
- Rational peers interested in optimizing own benefit.
- Protocols regulating peers interaction should be easy to use and efficient to implement.
- Protocols should foster collaboration of peers.

We present the first rigorous and comprehensive study!
Self-Enforcing Protocols

• Central concept for rationality: achieve equilibrium.
• If additionally, all agents get positive utility:
   the protocol is called self-enforcing.
• We propose classification of self-enforcing protocols:
  – Coordination (intuition): agents’ utilities depend on the private types that others report to the protocol.
  – Co-utility (our notion; intuition): agents utilities do not depend on the private types of others.
• We detail next co-utility.
Co-utility: P2P Anonymous Queries

Agents’ utilities do not depend on others’ private types:

Database D

Agent B
No query

Agent A
Query q
Co-utility: P2P Anonymous Queries

Agents’ utilities do not depend on others’ private types:

Database D
- Creates agents’ profiles

Agent B
- No query
- Privacy towards database

Agent A
- Query q
- Privacy towards database
- Functionality: the quick answer to query q
Co-utility: P2P Anonymous Queries

Agents’ utilities do not depend on others’ private types:

Database D

Agent B

Agent A

Privacy towards database

No query

Query q

Privacy towards database + Functionality: the quick answer to query q

A values privacy $\alpha$ times more than functionality. $\alpha$ is the private type!
Co-utility: P2P Anonymous Queries

Agents’ utilities do not depend on others’ private types:

- **Database D**: Creates agents’ profiles
- **Agent B**: No query
  - Privacy towards database
- **Agent A**: Query q
  - Privacy towards database
  - Functionality: the quick answer to query q
  - A values privacy $\alpha$ times more than functionality. $\alpha$ is the private type!

The utility of an agent (e.g., A) is:

$$H(\text{Profile of A}) + \alpha \times (\text{maximum time allowed} - \text{time lapsed}) \times (1 - \text{functionality}),$$

where functionality is 0 if query not answered and 1 if query was answered.
Co-Utile Protocols: Formal Definition

• Co-utility-amenable games: the utility of any agent is independent of the secret types of the other agents.

• It holds true for the anonymous query example

  Indeed, the utility of an agent is:
  \[ H(\text{Profile of A}) + \alpha (\text{maximum time allowed} - \text{time lapsed}) (1 - \text{functionality}) \]

• Co-utile protocols: protocols for co-utility-amenable games where at least one agent maximizes his utility. Easy to reach if types match.
Conclusions

• Defined co-utility.
• Described anonymous query submission in relation with co-utility.
• *Future work*: how to deal with games that are not co-utility amenable.
• This will be achieved by adding artificial utilities to the game, e.g., costs for forwarding.
• The artificial utilities can be enforced using punishments and rewards, e.g., reputation systems.
Thank you!