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Towards subconscious social intelligent computing

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Summary

- The aim: introducing a new (?) paradigm of social computation.
  - Intelligent: problem solving
  - Subconscious: hidden

- The approach: revise existing paradigms of social computing
  - crowdsourcing
  - computational social sciences
  - the SandS project

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Introduction

Fact

Social networks can be seen as a repository of information and knowledge that can be queried when needed to solve problems or to learn procedures.

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Introduction

> **Fact**
>
> *In the social sciences, social networks have been useful to spread educational innovations for the benefit of the social players*

- in health care training[2]
- management of product development programs, [3]
- engagement in agricultural innovations by farmers. [4]

[2] Jippes, E., Achterkamp, M.C., Brand, P.L., Kiewiet, D.J., Pols, J., van Engelen, J.M.: Disseminating educational innovations in health care practice: Training versus social networks. Social Science & Medicine 70(10) (2010) 1509 − 1517

[3] Kratzer, J., Leenders, R.T., van Engelen, J.M.: A social network perspective on the management of product development programs. The Journal of High Technology Management Research 20(2) (2009) 169 − 181

[4] Oreszczyn, S., Lane, A., Carr, S.: The role of networks of practice and webs of influencers on farmers' engagement with and learning about agricultural innovations. Journal of Rural Studies 26(4) (2010) 404 − 417

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Introduction

Fact

developments on Social and Personal Information processing have strong impact in

- *Economics*
- *Social structures*
- *Political*
- *others*

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Introductions: defs

Definition

Computational Social Science[a] aims to *understand* the dynamics of social systems from data that can be extracted from all existing sources of human behavior observation.

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[a]D. Lazer et al. Computational social science. Science, 323(5915):721– 723, 2009.

- The social players are subjects of observation and experimentation, searching for:
  - Communitiy detection (i.e. Louvain algorithm)
  - Diffusion processes
  - Affective states

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Introduction: defs

Definition

Social computing :[a] "intra-group social and business actions practiced through group consensus, group cooperation, and group authority, where such actions are made possible through the mediation of information technologies, and where group interaction causes members to conform and influences others to join the group".

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[a]W. Mao, A. Tuzhilin, and J. Gratch. Social and economic computing. IEEE Intelligent Systems, 26(6):19–21, 2011.

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Introduction: defs

Definition

Social computing can be termed *intelligent* when new solutions to new or old problems are generated when posed by the social players.
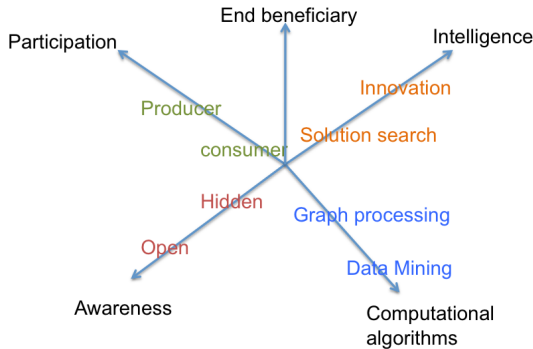
Fact

Social Computing is developing into a productive model where rewarding mechanisms are required to control the desired output of the system

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Introduction:defs

Definition

Social Intelligence is the emergence of problem solving behavior out of social interactions from the point of view of the social player.

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Taxonomy

End beneficiary

Participation

Intelligence

Innovation

Producer

Solution search

consumer

Hidden

Graph processing

Open

Data Mining

Awareness

Computational
algorithms

Axes of social computing

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Introduction: defs

- *Conscious* computing is defined by the decisions and actions performed by the social players on the basis of the information provided by the social service.

- Subconscious computing
  - intelligent data processing
  - performed automatically and autonomously by the web service
  - in order to search or produce the information requested by the social players,

- *Unconscious* social computing: a service providing company is milking the information generated by the users for its own profit.
  - the social player is unaware, and
  - the providing company wants him/her to stay so.
  - end beneficiary is the corporation

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Taxonomy

Crowdsourcing: the social players explicitly cooperate to build a knowledge object following some explicit and acknowledged rules. i.e: wikipedia.

Social_science: the interaction of the social players is observed and recorded. Conclusions and products are derived from the analysis of interaction data.

Social_intelligence: the social player asks for the solution of a problem, and the social framework provides (innovative) solutions based on previous reported experience from other social players.

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introduction

In subconscious intelligent social computing,

- the social players are the end beneficiaries of solutions and innovations, and
- all side value and uses of the social information is acknowledged and known by them, and
- There is a hidden intelligent layer boosting innovation

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Rewards and incentives

How to engage the social player to invest time and effort in the social computing system?[5]

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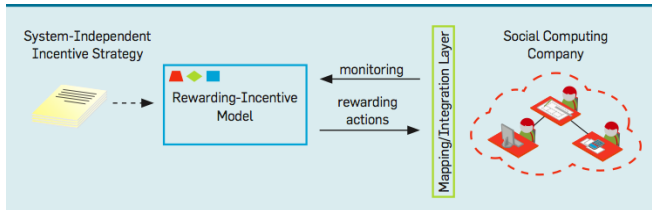
[5]Ognjen Scekic, Hong-Linh TruonG, Schahram Dustdar, Incentives and rewarding in social computing, CACM, (2013), 56:72-82

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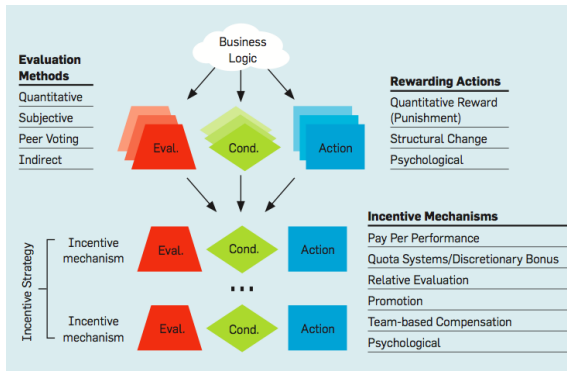
Incentives

| Mechanism | Usage Environments | | | Application Considerations | | | |
| | Traditional Company | | Social Computing | Positive Application Conditions | Negative Application Conditions | Advantages | Disadvantages |
	SME	Large Enterprise					
Pay Per Performance	++	+++	+++	quantitative evaluation possible	large, distributed, team-dependent tasks; measurement inaccuracy; when favoring quality over quantity	fairness; effort continuity	oversimplification; decreased solidarity among workers
Quota/ Discretionary Bonus	+	+++	+	recurrent evaluation intervals	constant level of effort needed	allows peaks/ intervals of increased performance	effort drops after evaluation
Deferred Compensation	+	+++	+	complex, risky, long-lasting tasks	subjective evaluation; short consideration interval	better assessment of achievements; paying only after successful completion	workers must accept risk and wait for compensation
Relative Evaluation	+	++	+++	cheap group-evaluation method available	subjective evaluation	no absolute performance targets; eliminates subjectivity	decreases solidarity; can discourage beginners
Promotion	++	+++	+	need to elicit loyalty and sustained effort; when subjective evaluation is unavoidable	flat hierarchical structure	forces positive selection; eliminates centrality bias	decreases solidarity
Team-based Compensation	+	++	+	complex, cooperative tasks; inability to measure individual contributions	when retaining the best individuals is priority	increases cooperation and solidarity	disfavors best individuals
Psychological	+	+	++	stimulate competition; stimulate personal satisfaction	when cooperation must be favored	cheap implementation	limited effect on best and worst workers (anchoring effect)

Evaluation

Evaluation Methods		Application Considerations			Composability			
		Advantages	Disadvantages	Active Human Participation	Issues	Alleviated By	Solving	Typical Use
Individual	Quantitative	fairness, simplicity, low cost	measurement inaccuracy	no	multitasking	peer evaluation; indirect evaluation; subjective evaluation	issues due to subjectivity	pay per performance; quota systems; promotion; deferred compensation
	Subjective	simplicity, low cost	subjectivity; inability to assess different aspects of contribution	yes	centrality bias; leniency bias; deliberate low-scoring; embellishment; rent-seeking activities	incentivizing decision maker to make honest decisions (such as through peer evaluation)	multitasking	relative evaluation; promotion
Group	Peer	fairness; low cost in social computing environment	active participation required	yes	preferential attachment; coordinated dysfunctional behavior of voters	incentivizing peers (such as also by peer evaluation)	multitasking; issues due to subjectivity	relative evaluation; team-based compensation; psychological
	Indirect	accounts for complex relations among agents and their artifacts	evaluation-algorithm cost of development and maintenance	no	depends on algorithm used; fitting data to the algorithm	peer voting; better implementation of algorithm	issues due to subjectivity; peer-implementation issues	relative evaluation; psychological; pay per performance

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Instances of incentive/evaluation

	Quantitative	Subjective	Peer	Indirect
Pay Per Performance	mturk.com	content.de	crowdflower.com	translationcloud.net
Quota/Discretionary Bonus	gild.com		carnetdemode.fr	
Deferred Compensation	advisemejobs.com	bluepatent.com	crowdcast.com	
Relative Evaluation	netflixprize.com	designcrowd.com	threadless.com	topcoder.com
Promotion	utest.com	scalableworkforce.com	kibin.com	
Psychological Incentives	crowdpark.de	battleofconcepts.nl	avvo.com	
Team-based Compensation		mercmob.com	geniuscrowds.com	

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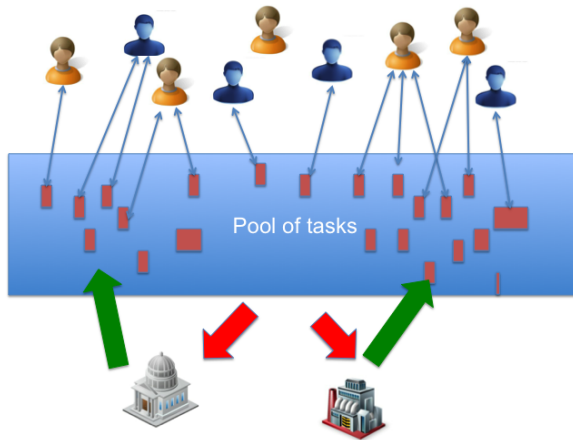
Crowdsourcing

Figure : Crowdsourcing paradigm

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Crowdsourcing

Crowdsourcing "enlists a crowd of users to explicitly collaborate to build a long-lasting artifact that is beneficial to the whole community"[6]

- how to recruit and retain users;
- what can users do;
- how to combine their inputs; and
- how to evaluate them

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[6]Anhai Doan, Raghu Ramakrishnan, and Alon Y. Halevy, Crowdsourcing systems in the World-Wide Web, CACM, (2011) 54:86-96

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Academic experiments

Kearns' academic experiments[7] involve groups of social players which

- must achieve an operation over a graph
- have partial view of the graph status
- are independent
- obtain monetary reward

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[7]M Kearns, Experiments in social computation, CACM (2012) 55:56-67

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Academic experiments

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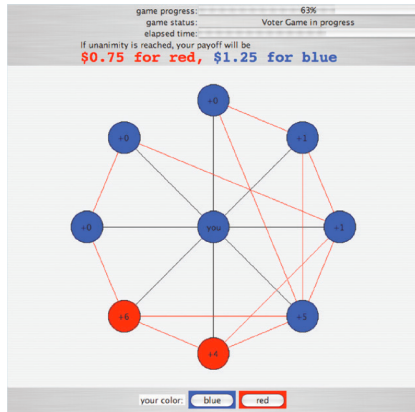
Academic experiments
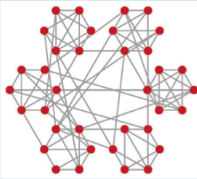
(a) from consensus and independent-set experiments, a chain of six cliques of size 6, with a fraction of the internal clique edges "rewired" to random vertices, thus allowing interpolation between a highly "tribal" network and effectively random networks.
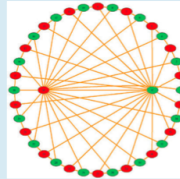
(b) from coloring experiments, an engineered structure with a cycle and two "leaders" in a two-colorable graph.
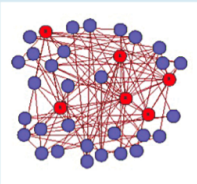
(c) from biased-voting experiments, a preferential attachment network with a minority of high-degree players preferring red.
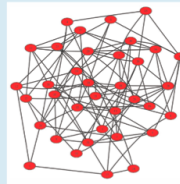
(d) from many tasks, a sample Erdös-Renyi network.

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Academic experiments: summary

Task Description	Networks	Incentives/Mechanism	Sample Findings
graph coloring[27]	cycle+chords; PA	differ with neighbors	chords help; importance of information view
coloring and consensus[10]	clique chain w/rewiring	differ/agree with neighbors	opposite structure/task effects
networked trade[13]	ER; PA; structured; all bipartite	limit orders for trades for opposing good	comparison to equilibrium theory; networked inequality aversion
networked bargaining[9]	assorted	Nash bargain on each edge	behavioral price of obstinacy
independent set[15]	assorted	kings and pawns with side payments	side payments help; conflict and fairness
biased voting[14]	ER and PA between types; minority power	consensus with competing individual preferences	well-connected minority rules
network formation[18]	endogenous to the game	biased voting minus edge expenditures	poor collective performance

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Academic experiments: coloring and consensus

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Academic experimens: sample exp.

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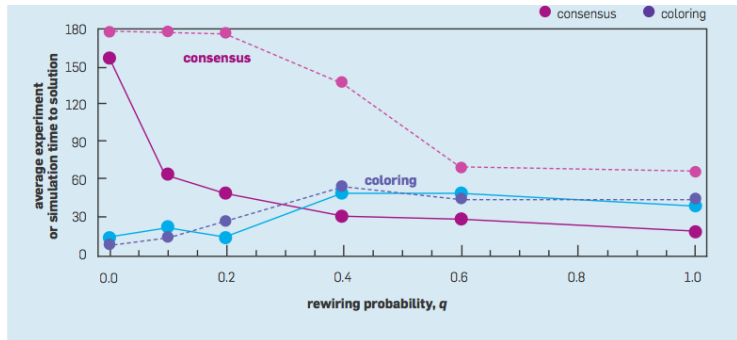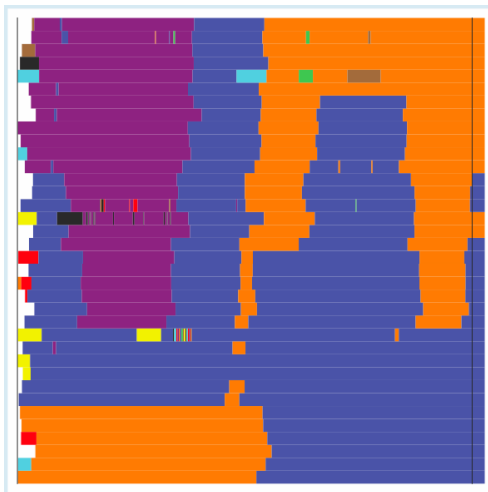
Academic research: conclusions

- Reproduce results in game economic theory
- Shows the effect of the information available to the social player
- Shows the relation between task and social player estrategy

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Amazon Mechanical Turk

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Amazon Mechnical Turk

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Amazon Mechanical Turk

Issues:

- Trust on the producer: scoring, marking, qualify
- Trust on the requester: evaluation, fair payment, labor rights (sweatshop)

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Other crowdsourcing efforts

- Galaxy Zoo [8]: classifying galaxy images
- FolfIt [9]: solving protein folding puzzles
- Image labeling [10]
- reCAPTCHA [11] for crowsourced OCR
- Wikipedia, sourceforge...

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[8] http://www.galaxyzoo.org
[9] http://fold.it/portal/
[10] http://www.artigo.org/about.html
[11] http://www.google.com/recaptcha/learnmore

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Computational Social Sciences
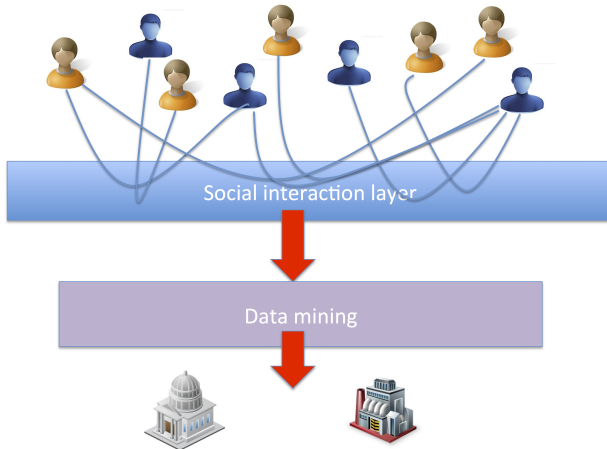
Social Computing and Computational Social Science paradigm

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Computational social sciences

- User profiling
    - Targeted marketing
- Community discovery
    - New product development
- Security
- Sentiment Analysis
- Process mining

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Sentiment Analysis

- Sentiment Analysis (or opinion mining): the task of ascertaining the opinions of authors (of social interaction documents) about specific entities[12].
- Companies monitor their reputation by looking at the social networks sentimental snippets
- Stock picking by sentiment analysis "can lead to superior returns"

---

[12]R Feldman, Techniques and applications for sentiment analysis

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Sentiment analysis

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Sentiment Analysis

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Sentiment Analysis

Figure 4. Drugs and symptoms (diabetes forums) based on extractions done by Visual Care (http://www.digititrowel.com).

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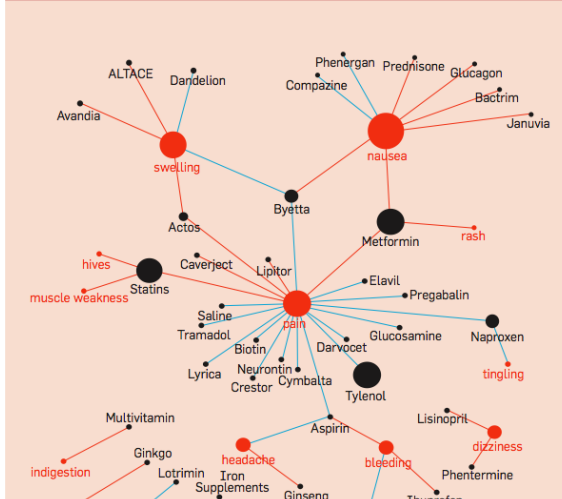
Process mining

Process mining deals with the extraction of actual processes from the logs of activities performed by users[13]

Figure 1. The three basic types of process mining in terms of input and output.

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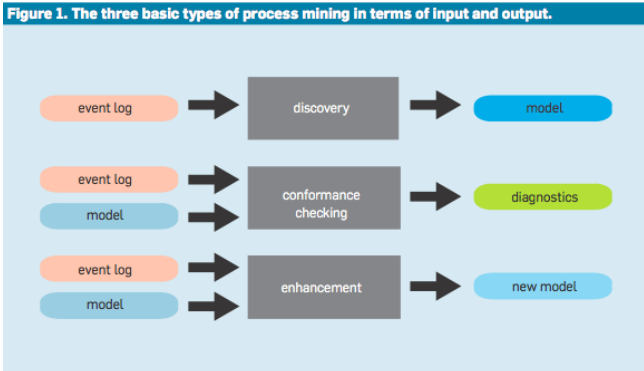
[13]W van der Aalst, Process Mining, CACM (2012) 55:76–83

Process discovery
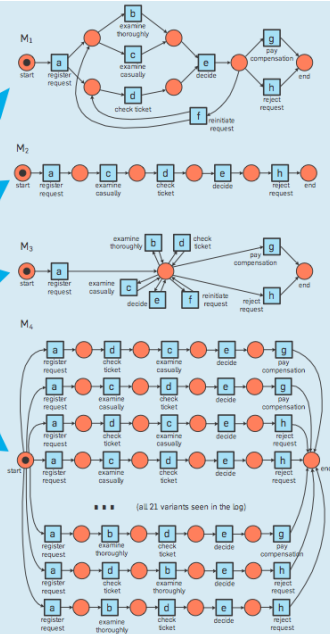
Process discovery

Figure 6. Process model discovered for a group of 627 gynecological oncology patients.

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Conformance checking

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Subconscious Social Intelligence paradigm

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SandS project

- The Social and Smart (SandS) project aims
  - to lay the foundations for a social network of home appliance users
  - endowed with a layer of intelligent systems
    - to produce new solutions to new problems
    - from knowledge accumulated by the social players.

- The system is not a symple recolection of tested appliance use recipes,
  - generate new recipes trying to satisfy user demands,
  - fine tuning of recipes on the basis of user satisfaction
    - by a hidden reinforcement learning process.

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SandS project partners

- Universities and research institutions
  - University of Milan
  - National Technical University of Athens
  - University of the Basque Country
  - Cartiff

- Companies
  - Arduino (boards)
  - Gorenje (appliances)
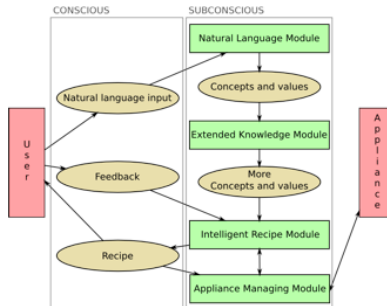 - Libelium (communication)
  - Amis (networking)

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The SandS architecture

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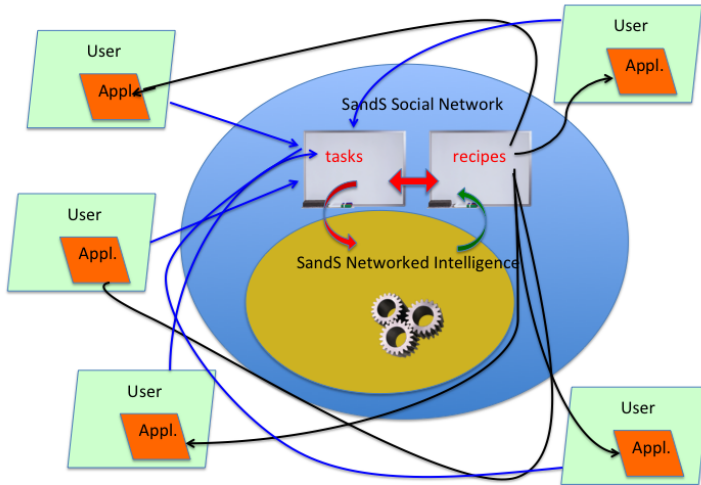
The SandS architecture

- Tasks
  - Specified by the user

- Recipes provided by
  - Appliance Manufacturer
  - User: conscious innovation
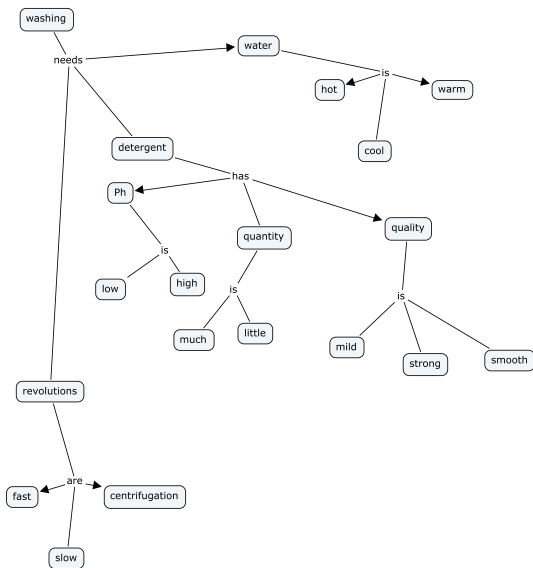 - Networked intelligence: subconscious innovation

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SandS service

Conscious and subconscious processes in SandS
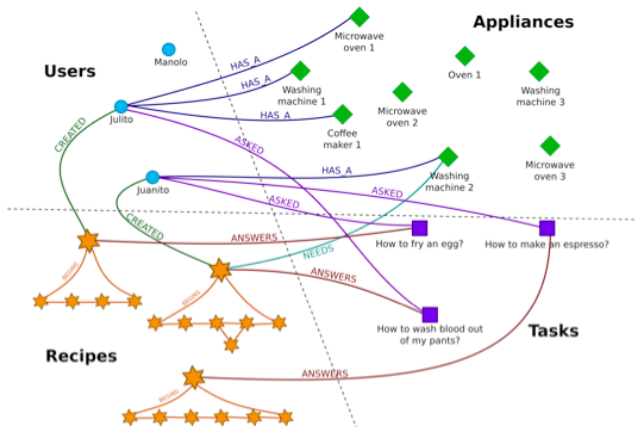
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SandS knowledge representation

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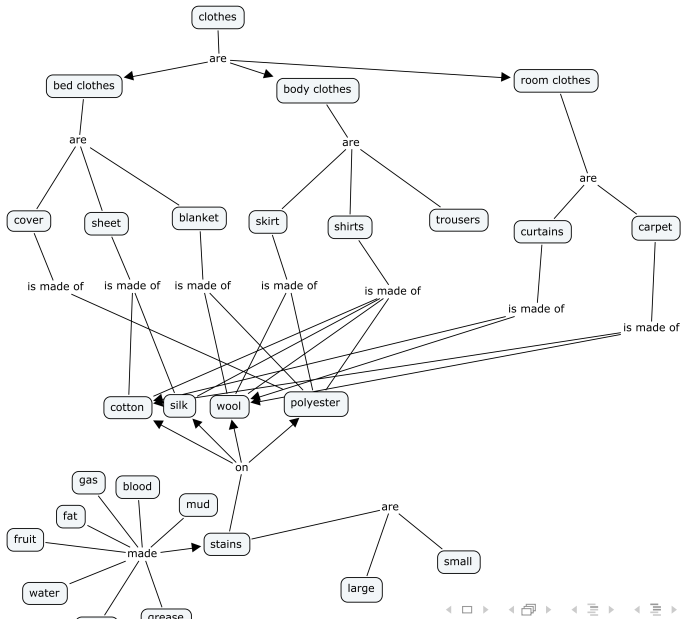
SandS knowledge representation
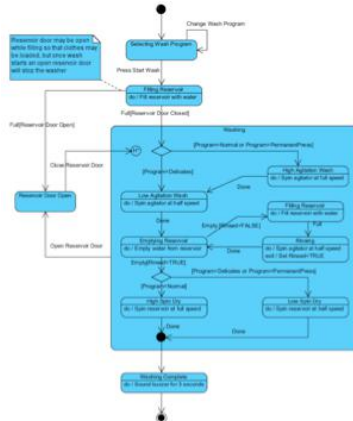
Recipe (washing) as a process
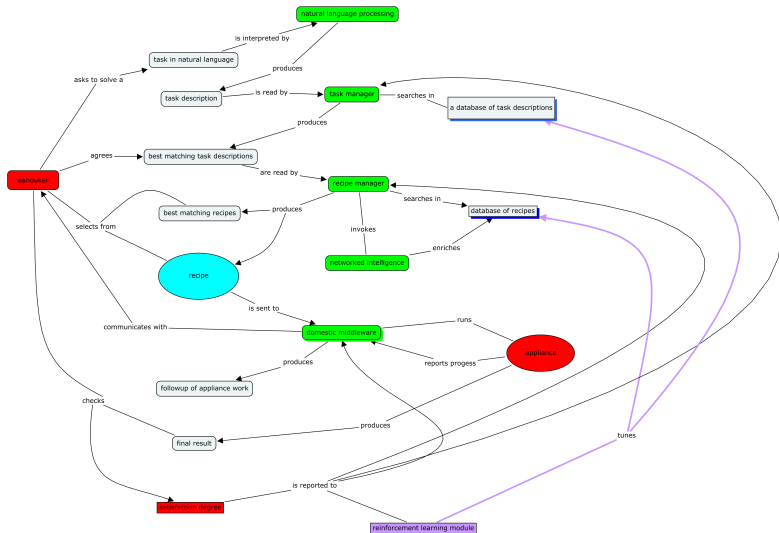
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SandS social network mockup

- Bare interaction cycle
- based on open source social network software solutions
- SandS Social Network mockup

SandS interaction

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SandS learning layer

- Requirements and current challenges:
  - Task & recipe specification languages
  - User satisfaction feedback
  - Database collection of task, recipe, satisfaction:
    - zero point start of learning processes
  - Training of classifier/regressor
    - incremental
    - life learning

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- Subconscious Social Intelligent Systems
    - A new field of research and development
    - Offers great opprotunities for Computational Intelligence research and development
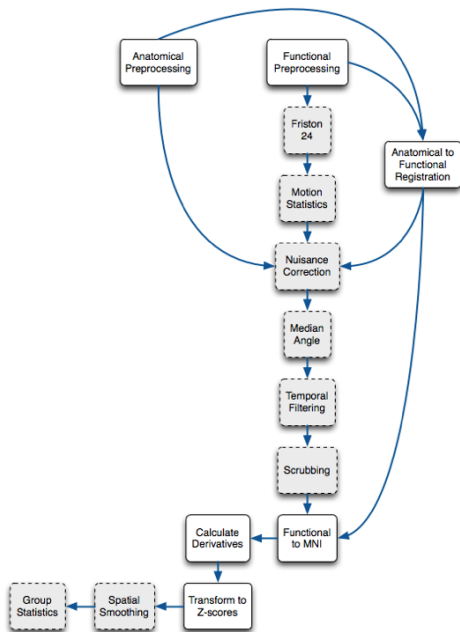   - It aims to empower the social player

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Challenges for learning systems

- Quick learning times that allow for quick adaptation to changing environments and supporting the effects of scale that potentially big social communities will introduce.
- Flexibility to cope with diverse data representations and desired outputs.
- Robust performance when dealing with multi-dimensional heterogenous output.
- Minimal uncertainty on system performance: One-shot training
- Robust incremental learning to process incoming batches of user feedback driving the adaptation process.
- Implementation/learning of forward and backward mappings.
- Hybridization of diverse computational paradigms to allow the composition of selection/classification/regression modules to cope with the complex landscape of user problem statement.

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Acknowledgments