What is Social Software?

Jan van Eijck, CWI Amsterdam and Uil-OTS Utrecht
Rineke Verbrugge, Institute of AI, University of Groningen

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Overview

- What is social software?
- Material for this course is based on: Jan van Eijck and Rineke Verbrugge (eds.) Discourses on Social Software, Texts in Logic and Games 5, Amsterdam University Press 2009 [3].
- Examples: The Judgement of Solomon, Vickrey Auctions, Divorce Mediation, Inheritance Division, ...
- A Bit of Game Theory
- Useful References ...

Overview, Day by Day

- Today: general intro, examples, a bit of game theory
- Tuesday: social choice theory and voting
- Wednesday: knowledge and ignorance
- Thursday: Common Knowledge and Common Belief
- Friday: Collective Rationality and Irrationality

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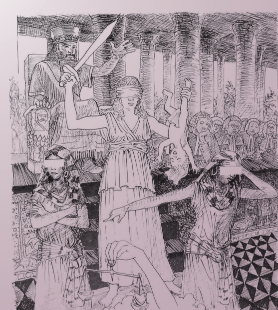
Discourses on Social Software

EDITED BY
JAN VAN EIJCK AND RINEKE VERBRUGGE



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Background

'Games, Action and Social Software' Project, NIAS, Wassenaar [3]

What is Social Software?

- term coined by Rohit Parikh in [9]
- used for the emerging discipline that investigates the logical, computational and strategic aspects of social mechanisms
- connected to game theory, action logic, epistemic logic, and social choice theory

Social Software and Social Institutions

- Social algorithms can only function in the context of social insti-tuttions.
- Example: auction procedures presuppose the social institution of money
- Analysis of Social Institutions: see, e.g., John Searle, The Construction of Social Reality [10].
- Institutional facts are often created by performative actions.
- Performatives can be analysed in terms of dynamic logic of public announcement and public action [1].

Social Procedures as Algorithms

- prototypical example of an algorithm is Euclid's recipe for finding the greatest common divisor of two positive whole numbers A and B:

  If A is larger than B, then replace A by $A - B$,
  otherwise, if B is larger than A, replace B by $B - A$.
  Continue to proceed like this until A equals B.

- This is a formal recipe, and it can be analysed by formal means. The correctness proof for Euclid's recipe is based on the insight that if you have two positive whole numbers, A and B, with A larger than B, then replacing the larger number by $A - B$ does not affect the set of common divisors of the pair.

- Similarly, social procedures are susceptible to formal analysis.

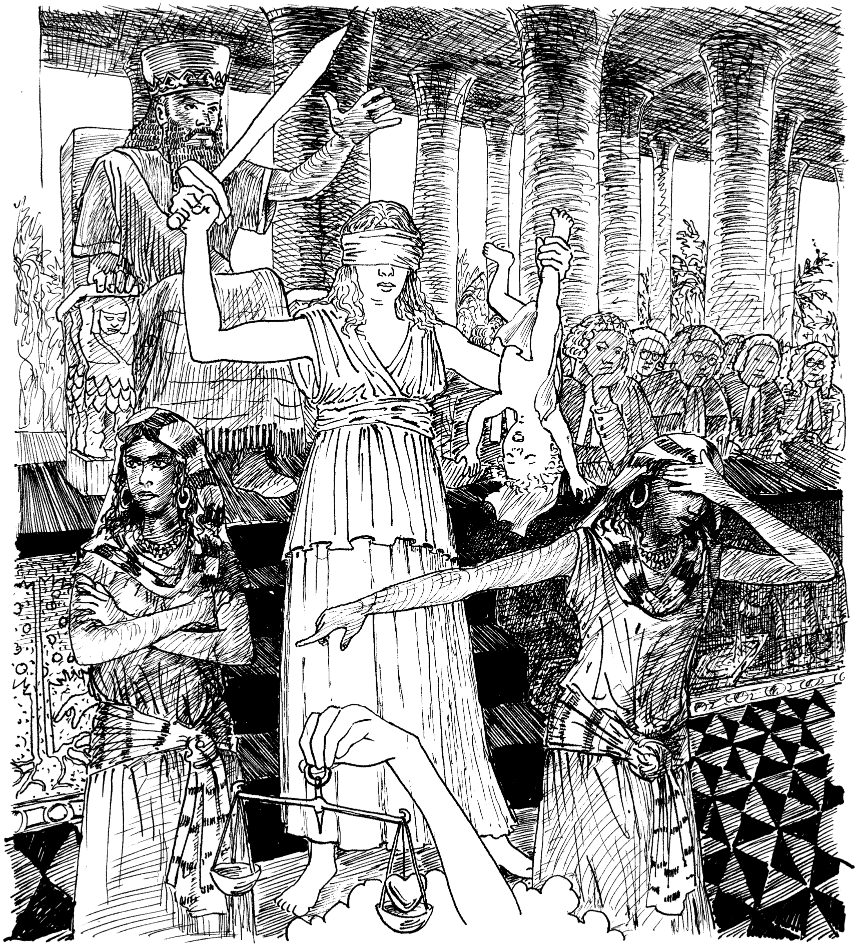
Example: The Judgement of Solomon

picture by
Barry Moser

16 Then there came two women that were harlots, to the king, and
stood before him. 17 And one of them said: I beseech thee, my lord, I
and this woman dwelt in one house, and I was delivered of a child with
her in the chamber. 18 And the third day after I was delivered, she also
was delivered; and we were together, and no other person with us in
the house; only we two. 19 And this woman's child died in the night:
for in her sleep she overlaid him. 20 And rising in the dead time of
the night, she took my child from my side, while I, thy handmaid, was
asleep, and laid it in her bosom: and laid her dead child in my bosom.
21 And when I arose in the morning, to give my child suck, behold it
was dead: but considering him more diligently, when it was clear day,
I found that it was not mine which I bore. 22 And the other woman
answered: It is not so as thou sayst, but thy child is dead, and mine
is alive. On the contrary, she said; Thou liest: for my child liveth, and
thy child is dead. And in this manner they strove before the king.

23 Then said the king: The one saith, My child is alive, and thy child
is dead. And the other answereth: Nay; but thy child is dead, and
mine liveth. 24 The king therefore said: Bring me a sword. And when
they had brought a sword before the king, 25 Divide, said he, the living
child in two, and give half to the one and half to the other. 26 But the
woman, whose child was alive, said to the king; (for her bowels were
moved upon her child) I beseech thee, my lord, give her the child alive,
and do not kill it. But the other said: Let it be neither mine nor thine;
but divide it. 27 The king answered, and said: Give the living child
to this woman, and let it not be killed; for she is the mother thereof.
28 And all Israel heard the judgment which the king had judged, and
they feared the king, seeing that the wisdom of God was in him to do
judgment.

From the First Book of Kings, Third Chapter



picture by
Marco Swaen

Questions

- The Solomon judgement hinges on the surprise effect. In a similar case between contestants who "heard the judgement which the king had judged" both would no doubt claim to prefer the contested item given to the other party rather than be destroyed.
- Is it possible to adjust the judgement procedure so that it becomes immune to the surprise effect?
- And does the adjusted procedure still work if one of the parties in the case is much wealthier than the other?

The Solomon Verdict: Rational Reconstruction [7]

Suppose the child is worth A to the real mother and B to the pretender. We can assume that A is much larger than B. The women make their bids in sealed envelopes.

Solomon makes the following announcement: "I will ask one of you if you are willing to give the child to the other. If the answer is yes, the case is settled. If not, I will ask the other. Again, if the answer is yes, the case is settled. If both of you refuse to give up the child, then I will have to sell it for what it is worth. I will toss a coin, and the one who gets the child will have to pay $\frac{A+B}{2}$, and the other pays a fine."

If the women act rationally, one of them will give up the child, which settles the case.

The fact that Solomon's announcement creates common knowledge is crucial.

Indian Version: an Akbar and Birbal story

Here is a story where Birbal acts exactly like Solomon.

In the Hindu version, Ramu and Shamu claimed ownership of the same mango tree, and decided to ask Birbal to settle the dispute.

Birbal's verdict: "Pick all the fruits from the tree and divide them equally. Then cut down the tree and divide the wood."

Ramu thought this was fair but Shamu was horrified, and Birbal declared Shamu the true owner.

Example: Vickrey Auctions

- A Vickrey auction is a sealed-bid auction in which the winner has to pay a price equal to the second highest bid.
- It is claimed that in a Vickrey auction no participant has an incentive to resort to strategic behaviour.
- Strategic behaviour is pretending to have different preferences from one's actual preferences, in order to get a better outcome.
- A mechanism that is designed in such way that strategic behaviour does not pay is called strategy proof.
- Why is it never in an agent's interest to bid more than they think the item is worth?
- Why is it never in an agent's interest to bid less than they think the item is worth?

- What are the similarities and differences with an ascending price open auction (English auction)?

Example: Cake Cutting with Knaster Tarski

I cut a piece intended for myself. All others consider it. If nobody objects, I get my piece. If someone raises an objection, she has the right to cut off a slice and put that back with the rest of the cake. She then asks if she can have the reduced piece. If nobody objects, she gets it, otherwise someone else takes the knife and reduces the piece a bit further, and so on, until someone gets the trimmed piece. Then on to the next round, with $n - 1$ players.

Analysis

Parikh shows how the methods of computer science can be used to argue that the procedure is fair. The key ingredient of the procedure is a loop operation:

> continue to trim the piece until there are no further objections about the size.

If r stands for the action of trimming, and if $F(m, k)$ is the proposition that the main part of the cake is large enough for k people, then we can see that $F(m, k)$ is invariant under the action r. If $F(m, k)$ is true before r, then it will still be true after r has occurred. Clearly, if one can show that $F(m, k)$ continues to hold through the algorithm, for k running through $n, \ldots, 1$, then this establishes that the division is fair, for surely $F(m, n)$ holds at the beginning: the whole cake is large enough for the whole group to begin with.

Fairness and Envy-Freeness

- A division algorithm between N participants is fair if each player feels she has received at least $1/N$-th of the goods, according to her own valuation.
- The typical result of fair division is that each player will feel they have received more than their fair share. Why?
- A division algorithm is envy-free if each player feels she has done at least as well as any of the others.
- Does the Parikh analysis of Knaster Tarski cake cutting establish that the algorithm is envy-free? Why (not)?
- How about the simplest cake cutting algorithm of all: I cut, you choose? Is this fair? Is this envy-free?

Example: Divorce Mediation Procedures

Steven Brams c.s.:

The starting point for the two ex partners is to divide 100 points over the common property items, reflecting their individual valuation of the items.

- How does it go on?
- How can you argue that this is fair?

[One of today's homework exercises.]

Example: Inheritance Division

- An inheritance has to be divided among N heirs. They are to receive equal shares.
- Up to us: devise a fair and envy-free procedure for this ...
- One might think in terms of an auction. The indivisible items in the inheritance are first auctioned among the heirs, and the money is put on a pile. Next, the pile of money is divided equally. Is this fair? Is this envy-free?
- Suppose some of the heirs are much wealthier than others, so they can afford to make higher bids during the auctioning. Is the procedure still envy-free in such circumstances? Can you improve the algorithm to get rid of this imbalance?

A Bit of Game Theory: The Prisoners' Dilemma

This is not about division, but about choice between actions.

This is in all game theory books. See for example Gibbons [5] or Straffin [11].

Other recommended introductions to game theory are Binmore [2] and Osborne [8].

The dilemma illustrates that perfect individual rationality may lead to a non-optimal outcome.

Keep silent or betray, that is the question.

	B Keeps Silent	B Betrays
A Keeps Silent	six months in jail for each	10 years in jail for A B goes free
A Betrays	A goes free 10 years in jail for B	2 years in jail for each

Abstract Representation

	Keep Silent	Betray
Keep Silent	(0,0)	(-2,1)
Betray	(1,-2)	(-1,-1)

This is a so-called non zero-sum game.

Analysis

- Betrayal pays off, whatever happens.
- Suppose I am prisoner A. If B keeps silent I get six months if I also keep silent, and I am free if I betray. So it is in my interest to betray.
- If B starts talking, I get 10 years if I keep silent, but only 2 years if I also talk. So again it is in my interest to betray.

What would you do? Assume there are no repercussions. Prisoner B will know that it is because of you that he is serving 10 years, but you will never see B again . . .

The Prisoner's Choice: Why is it a Dilemma?

- Usually, in strategic situations, it is important to predict what others will do. Not so here: whatever B does, it is always in A's interest to betray.
- This shows: betrayal is a dominant strategy. You are always better off by betraying. The other guy reasons as you do. He will also betray you.
- Here is the dilemma: by both acting rationally, i.e. by defecting, the two prisoners are worse off than if they had both stayed silent.

Pareto Optimum Versus Nash Equilibrium

- The prisoner's dilemma is a non zero-sum game where defection yields a Nash equilibrium that is not an optimal solution. It is not a Pareto optimum.
- A Pareto optimum is an outcome that cannot be improved upon without hurting at least one player.
- A Nash equilibrium is a set of strategies (one for each player) such that no player has an incentive to unilaterally change her action.

An Awkward Question

Consider the following quote from a collection of talks from the physicist Richard Feynman:

> From time to time, people suggest to me that scientists ought to give more consideration to social problems—especially that they should be more responsible in considering the impact of science upon society. This same suggestion must be made to many other scientists, and it seems to be generally believed that if the scientists would only look at these very difficult social problems and not spend so much time fooling with the less vital scientific ones, great success would come of it.
>
> It seems to me that we do think about these problems from time to time, but we don't put full-time effort into them—the reason being that we know we don't have any magic formula

> for solving problems, that social problems are very much harder than scientific ones, and that we usually don't get anywhere when we do think about them.
>
> I believe that a scientist looking at nonscientific problems is just as dumb as the next guy—and when he talks about a nonscientific matter, he will sound as naive as anyone untrained in the matter.
>
> Richard Feynman, The Pleasure of Finding Things Out [4, p. 141]

If one of the most eminent physicists of the twentieth century believes that he is as dumb as the next guy when it comes to curing the ills of society, is it reasonable for logicians, computer scientists, game theorists interested in the analysis of social software to think that they are smarter? Discuss. [One of the Exercises for today.]

Overview of What is to Come

Tomorrow Some Social Choice Theory: Arrow's Theorem and What it Means.

Wednesday Eating from the Tree of Ignorance

Thursday (Common) Knowledge and (Common) Belief

Friday Issues of Collective Rationality and Irrationality

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