PhD Dissertation, Mathematics for Economic Decisions
Leonardo Fibonacci School

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INTRODUCTION

Introduction

1. Introduction
   - The Thesis
   - Overview (Thesis) & main themes (presentation)
2. The preliminaries
   - The motivations
   - The actors
3. The main body
   - The auction models
   - The barter models
   - Coalitions for problem solving
   - Deciding within a competition
4. Conclusions

The Thesis

THE THESIS

- ⇒ Title
  Methods and Models for Environmental Conflicts Analysis and Resolution
- ⇒ Tutor
  Professor Giorgio Gallo

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The present Thesis:

⇒ defines and characterizes interactions among actors;

⇒ within different settings;

⇒ at different levels of abstraction and complexity;

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⇒ by using different (high level) methods;

⇒ within a unifying perspective (the environment and the conflicts).

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(2) to describe allocation (indivisible), distribution (shareable) and negotiation (redistribution, reallocation) tools that involve such actors;

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- ⇒ The deciders “drive” the procedures and bear the main responsibilities.
- ⇒ The stakeholders are part of the affected reactive environment of the deciders.
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- ⇒ Monolithic deciders: as single players, no inner dynamics.
- ⇒ Monolithic deciders: mainly decisions, competitive approaches.
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Reasons for auctioning

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We can use auctions :

- ⇒ to describe one-to-many relations auctioneer versus bidders;
- ⇒ to allocate single bads or chores;
- ⇒ to share benefits and costs, initial distribution proportional to the bids and redistribution (dissatisfaction, post auction);
- ⇒ to define initial endowments made of fractions of benefits and costs (link with barter mechanisms);
- ⇒ to compensate a lack of knowledge from the auctioneer of the capabilities of the bidders.

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- ⇒ bidders bid for not getting an item (bad or chore),
- ⇒ the less offering bidder gets it together with a compensation,
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(ph_3) *the bids are revealed;*

(ph_4) *the lowest bidding bidder b_1 gets ζ and x_1 as a compensation for this allocation;*

(ph_5) *each of the other bidders b_i pays to b_1 a fraction c_i of x_1 such that:*

$$\sum_{i \neq 1} c_i = x_1 \qquad c_i = x_1 \frac{x_i}{X} \quad X = \sum_{j \neq 1} x_j$$

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Features and uses:

- ⇒ the auctioned item involves a single bidder though it may benefit not only the auctioneer but also other bidders;
- ⇒ the influence (as a damage) on other bidders is negligible;
- ⇒ the influence (as a damage) on actors distinct from the bidders is negligible;
- ⇒ all the costs and damages can be summarized with m_i;
- ⇒ solid waste disposal plants, hazardous waste disposal plants, incinerators;
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⇒ the influence (as a damage) on actors distinct from the bidders is negligible;

⇒ all the costs and damages can be summarized with m_i;

⇒ solid waste disposal plants, hazardous waste disposal plants, incinerators;

⇒ energy production plants, chemical plants (point-wide allocations).

Introduction

Reasons for bartering

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- ⇒ describing one-to-one or many-to-many relations between actors;
- ⇒ describing the swap of sets of items (generally benefits and costs), either exogenous or endogenous, initial endowments from auction phases;
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Bilateral barters:

⇒ involve two actors each with a basket of items (endowments of benefits and costs),

⇒ explicit barter if each actor reveals his basket,

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Bilateral explicit barter, merge and split

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(1) $B^h_{i,j} = bk^h_i \oplus bk^h_j$

(2) if negotiation($B^h_{i,j}$) is successful then

- i takes $bk^{h+1}_i \succ_i bk^h_i$
- j takes $bk^{h+1}_j \succ_j bk^h_j$

else if negotiation($B^h_{i,j}$) fails

- i takes back bk^h_i
- j takes back bk^h_j

(3) end;

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(1) random selection to choose player 1;

(2) 1 proposes a split of the set $B^h_{i,j}$ as bk^{h+1}_1, bk^{h+1}_2;

(3) if 2 accepts then

- negotiation successful, go to (5);

(4) if 2 refuses then

(4a) 2 proposes a split of the set $B^h_{i,j}$ as bk^{h+1}_2, bk^{h+1}_1;

(4b) if 1 accepts then

- negotiation successful, go to (5);
  else
- negotiation fails, go to (5);

(5) end;

Bilateral explicit barter, negotiation

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Multilateral explicit barter, last modifier

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(1) a merge operation is executed so to define $B_S^h = \oplus_{i \in S} bk_i^h$;

(2) one of the players $i \in S$ is randomly selected;

(3) the selected player i proposes a basket $bk \subset B_S^h$ and passes it along to the others;

(4) if nobody modifies it in any way (so that i is conventionally the last modifier) then the basket is assigned to i and becomes bk_i^{h+1} so that i exits from S (and so from the game);

(5) if other players modify it and if j is the last modifier we have the following cases:

- (5a) if i accepts the modified basket he gets it so that it becomes bk_i^{h+1} and then i exits from S (and so from the game);
- (5b) if i refuses the modified basket j gets it so that it becomes bk_j^{h+1} and then j exits from S (and so from the game);

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Bilateral and multilateral barters may be:

- ⇒ executed in parallel,
- ⇒ executed in cascade among the same actors,
- ⇒ executed in cascade among at least partially different actors,
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THE EVALUATION CRITERIA, BASIC DEFINITIONS

The evaluation criteria, basic definitions

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We say a barter is fair if the following conditions are satisfied, otherwise it is unfair.

- ⇒ Envy-freeness: nobody would prefer the portion of somebody else to his own.
- ⇒ Proportionality: each of the n players thinks to have received at least $1/n$ of the total value.
- ⇒ Equitability: each player thinks he has received a portion that is worth the same in one's evaluation as the other's portion in the other's evaluation.
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The evaluation criteria, the parameters

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We define the following parameters for player i:

- $\Rightarrow$ a_i the value of what i gets from the barter,
- $\Rightarrow$ l_i the value of what i gives away in the barter,
- $\Rightarrow$ $(a_j)_i$ the value of what j gets from the barter in i's opinion,
- $\Rightarrow$ v_i^{h+1} and v_i^1 the worths (for i) of i's basket after and before the barter,
- $\Rightarrow$ $A = \sum_{j \neq i} (a_j)_i$.

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THE EVALUATION CRITERIA, MODIFIED DEFINITIONS (1)

$$v_i^{h+1} = v_i^h - l_i + a_i$$

so that player i accepts a proposed barter (since $v_i^{h+1} \geq v_i^h$) if and only if:

$$a_i \geq l_i$$

In the **case of two players** a barter is **envy-free** if we have for player i:

$$\frac{a_i}{l_i} \geq 1$$

In the **case of more than two players** if we consider player i we have that the following relation must hold for all $j \neq i$:

$$a_i \geq (a_j)_i$$

In the case of **two players** we want to maintain the equivalence between proportionality and envy-freeness

$$\frac{a_i}{a_i + l_i} \geq \frac{1}{2}$$

In the general case of **more than two players**

$$envy - freeness \Rightarrow proportionality$$

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If both relations hold we say that the barter is **equitable**.

$$v_i^{h+1} = v_i^h + a_i - l_i \qquad \bar{v} = v_i^{h+1} - a_i = v_i^h - l_i$$

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$$\frac{a_i}{\bar{v} + a_i} \geq \frac{l_i}{\bar{v} + l_i}$$ we can easily derive $a_i \geq l_i$

from equitability we derive envy-freeness

envy-freeness can be expressed as $a_i \geq l_i$ (and $v_i^{h+1} \geq v_i^h$)

$$1 \leq \frac{v_i^{h+1}}{v_i^h} = \frac{\bar{v} + a_i}{\bar{v} + l_i} \leq \frac{a_i}{l_i}$$

In this way we get that, in the case of two players, envy-freeness necessarily implies equitability and vice versa.

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bilaterally equitable if for a pair i, j:

$$\frac{a_{ij}}{v_i^{h+1}} \geq \frac{l_{ij}}{v_i^h}$$

If such relations (that scale easily to the two players case) are satisfied for every i and for every $j \neq i$ we say that the barter satisfies **bilateral equitability**.

If, for a given i, we sum all the relations over all the $j \neq i$ we get:

$$\frac{a_i}{v_i^{h+1}} \geq \frac{l_i}{v_i^h} \quad a_i = \sum_{j \neq i} a_{ij} \;\; l_i = \sum_{j \neq i} l_{ij} \;\; \text{an hypothesis of additivity}$$

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For the models of bilateral barter the following conditions are equivalent:

- $\Rightarrow$ occurrence of the barter,
- $\Rightarrow$ envy-freeness,
- $\Rightarrow$ proportionality,
- $\Rightarrow$ equitability.

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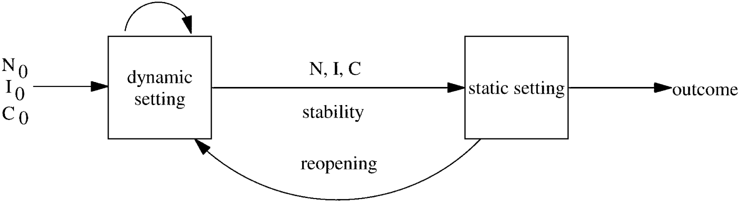

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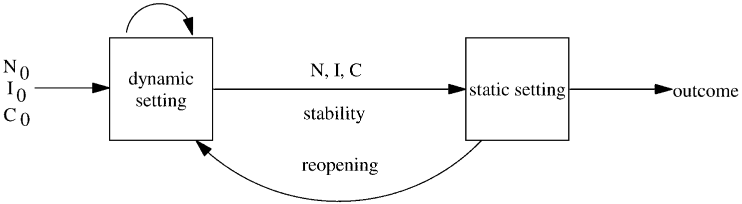

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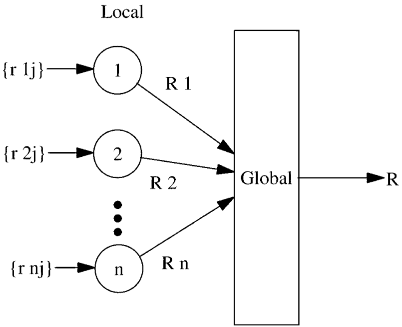

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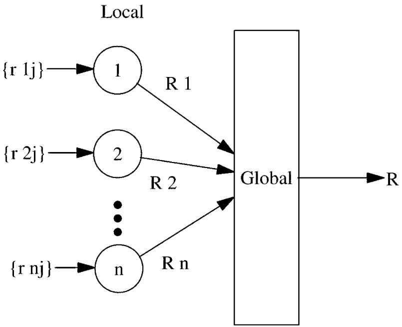

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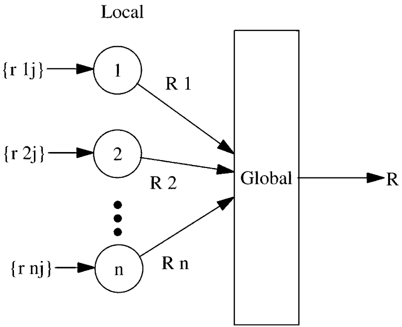

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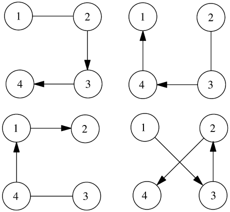

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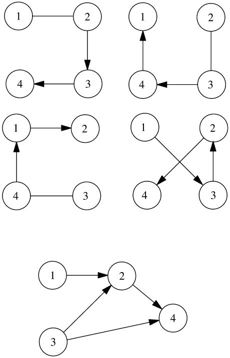

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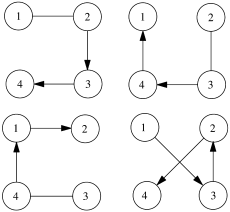

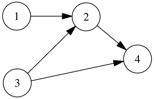

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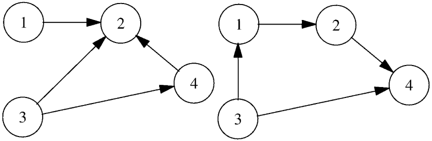

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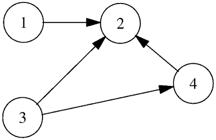

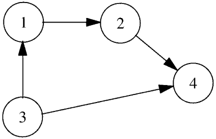

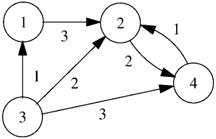

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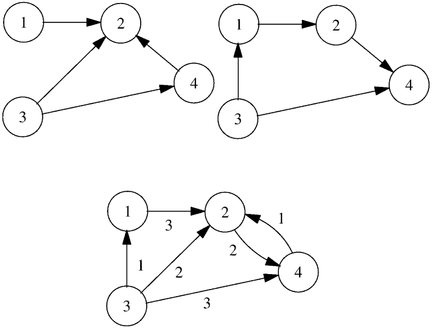

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   - The Thesis
   - Overview (Thesis) & main themes (presentation)
2. The preliminaries
   - The motivations
   - The actors
3. The main body
   - The auction models
   - The barter models
   - Coalitions for problem solving
   - Deciding within a competition
4. Conclusions

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ONE PROJECT, THE SETS

$$C_a = \{C_{a_i} \mid i \in I\}$$
$$B_a = \{B_{a_j} \mid j \in J\}$$
$$C_1 = \{\alpha_i C_{a_i} \mid i \in I\} \quad B_1 = \{\beta_j B_{a_j} \mid j \in J\}$$
$$C_2 = \{(1-\alpha_i) C_{a_i} \mid i \in I\} \quad B_2 = \{(1-\beta_j) B_{a_j} \mid j \in J\}$$

The negotiations involve the following sets:

- ⇒ the set C_a of the [shareable] costs (what),
- ⇒ the set B_a of the [shareable] benefits (what),
- ⇒ the sets C_1 and B_1 for one decider,
- ⇒ the sets C_2 and B_2 for the other decider,
- ⇒ a key role is played by the sets $\{\alpha_i\}$ and $\{\beta_i\}$ (how).

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$$C_a = \{C_{a_i} \mid i \in I\}$$
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The negotiations involve the following sets:

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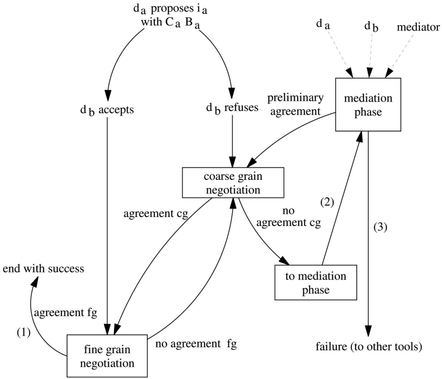
- ⇒ the sets C_2 and B_2 for the other decider,
- ⇒ a key role is played by the sets $\{\alpha_i\}$ and $\{\beta_i\}$ (how).

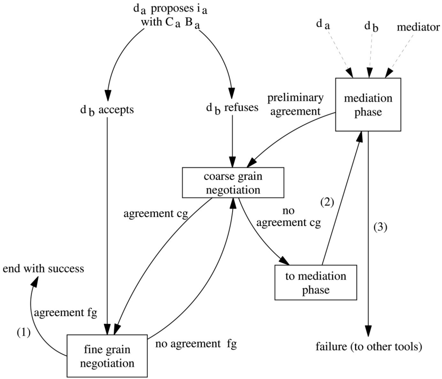
One project, the structure

One project, the structure

One project, the structure



ONE PROJECT, THE STRUCTURE



One project, the coarse grain negotiation

One project, the coarse grain negotiation

One project, the coarse grain negotiation

(1) d_b [refuses the sets B_a and C_a and] presents the sets B'_a and C'_a;
(2) d_a presents the sets B''_a and C''_a;
(3) we have the following cases:
  - (3.a) if $B''_a = B'_a$ and $C''_a = C'_a$ then go to (4);
  - (3.b) if $B''_a \neq B'_a$ or $C''_a \neq C'_a$ then:
    - (a) with a random device we define an ordering between the two players;
    - (b) the player who comes first in the ordering gets a token only if he declares he wishes to rethink about his proposal otherwise the token assignment procedure is repeated with the other player;
    - (c) if d_a has the token then:
      - (i) d_a presents the modified sets B''_a and C''_a;
      - (ii) go to (3);
    - (d) if d_b has the token then:
      - (i) d_b presents the modified sets B'_a and C'_a;
      - (ii) go to (3);
    - (e) if none of them has the token then go to (5);

(4) go to the **fine grain negotiation** algorithm;
(5) d_a and d_b may either agree to go on or to give up;
(6) if they agree to go on then go to (1);
(7) if they agree to give up then call **mediator procedure**;

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One project, the fine grain negotiation

One project, the fine grain negotiation

ONE PROJECT, THE FINE GRAIN NEGOTIATION

(1) d_a presents the sets α and β;
(2) d_b presents the sets α' and β';
(3) we have the following cases:
 (3.a) if $\alpha = \alpha'$ and $\beta = \beta'$ then go to (4);
 (3.b) if $\alpha \neq \alpha'$ or $\beta \neq \beta'$ then:
  (a) with a random device we define on ordering between the two players;
  (b) the player who comes first in the ordering gets a token only if he declares he wishes to rethink about his proposal otherwise the token assignment procedure is repeated with the other player;
  (c) if d_a has the token then:
   (i) d_a presents the modified sets α and β;
   (ii) go to (3);
  (d) if d_b has the token then:
   (i) d_b presents the modified sets α' and β';
   (ii) go to (3);
  (e) if none of them has the token then go to (5);
(4) end;
(5) go back to the **coarse grain negotiation procedure**;

One project, the fine grain negotiation

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Two projects, the structure

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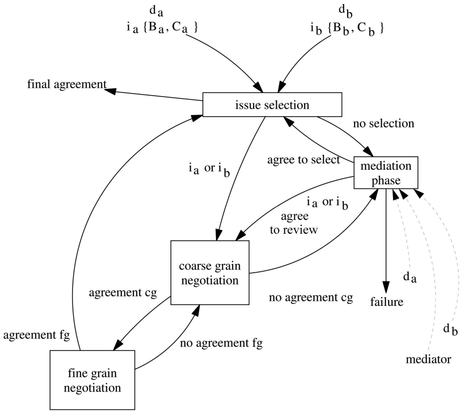

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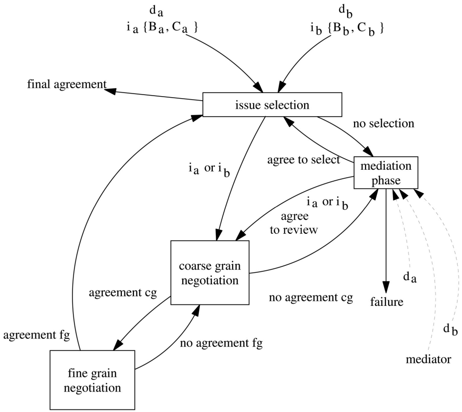

Many projects & many deciders

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In the thesis we have also examined the following cases:

- ⇒ one project and more than two deciders,
- ⇒ two projects and more than two deciders,
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- ⇒ the structured deciders (inner dynamics, two levels of negotiation and decision),
- ⇒ the presence of the stakeholders (pressures, reactive environment),
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- ⇒ Open issues: deeper and more complete formalization.

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Main Personal References

- L. Cioni
  Models of interaction
  Computer Science Department, June 2008, TR-08-12
- L. Cioni
  The roles of System Dynamics in environmental problem solving
  Computer Science Department, June 2008, TR-08-14
- L. Cioni
  Participative methods and consensus theory
  Computer Science Department, September 2008, TR-08-23
- L. Cioni
  Using a hierarchical properties ranking with AHP for the ranking of electoral systems
  Computer Science Department, September 2008, TR-08-26
- L. Cioni
  Auctions and barters
  Computer Science Department, October 2009, TR-09-19
- L. Cioni
  Introduzione alla System Dynamics
  Computer Science Department, May 2010, TR-10-09
- L. Cioni
  A few notes on the Borda and Condorcet methods
  Computer Science Department, November 2010, TR-10-16
- L. Cioni
  An inverse or negative auction
  Computer Science Department, November 2010, TR-10-17

MAIN PERSONAL REFERENCES

L. Cioni
Game theory as a tool for the management of environmental problems and agreements
AIRO 2006, Cesena, 12-15 September, 2006

L. Cioni
Ranking electoral systems through hierarchical properties ranking
Workshop "Simulation and other quantitative approaches to the assessment of electoral systems", 4-5 June, 2007, Università del Piemonte Orientale, published on "AUCO Czech Economic Review", 3/2009 pages 254-269

L. Cioni
Coalition dynamics in environmental problem solving
Conference "SING 3 III Spain Italy Netherlands Meeting On Game Theory and VII Spanish Meeting On Game Theory", 4-6 July 2007, Universidad Complutense de Madrid

L. Cioni
The roles of System Dynamics in environmental problem solving
2008 International System Dynamics Conference, Athens, Greece, July 20 - 24, 2008

L. Cioni
Bottom-up coalition construction and problem solving
Conference S.I.N.G.4, "Spain Italy Netherlands Meeting on Game Theory", June 26 - 28, Wroclaw, Poland, 2008

Main Personal References

L. Cioni
Using auctions to allocate chores
Conference S.I.N.G.4, "Spain Italy Netherlands Meeting on Game Theory", June 26 - 28, Wroclaw, Poland, 2008 and
"AIRO 2008", XXXIX Annual Conference of Italian Operational Research Society, September 7-11 2008, Ischia, Italy

L. Cioni
Barter models
Conference S.I.N.G.4, "Spain Italy Netherlands Meeting on Game Theory", June 26 - 28, Wroclaw, Poland, 2008

L. Cioni
The analysis and resolution of environmental conflicts: methods and models
CSEAR 2008 (Second Italian Conference on Social and Environmental Accounting Research), Rimini, Italy, 17-19 September, 2008, published on the on line issue 1/2009 of "Economia Aziendale Online"

L. Cioni
Methods and Models for Environmental Conflicts Analysis and Resolution
EAEPE (European Association for Evolutionary Political Economy) Annual Conference - "Labour, Institutions and Growth in a Global Knowledge Economy", Rome, Italy, University of "Roma Tre" 6-8 November, 2008, published on the conference web site

MAIN PERSONAL REFERENCES

L. Cioni and Giorgio Gallo
Goodwill hunting: how to allocate bads or disagreeable chores
Methodology of Societal Complexity, The 23rd European Conference on Operational Research, EURO XXIII, Bonn, Germany, July 5-8 2009

L. Cioni
Iterative barter models
Conference S.I.N.G.5, "Spain Italy Netherlands Meeting on Game Theory", July 1-3, Amsterdam, Holland, 2009

L. Cioni
Deciding within a competition
Conference "XL AIRO 2009", September 8-11, Siena, Italy, 2009

L. Cioni
Auctions and barters
Conference "EAEPE 2009", November 6-8, Amsterdam, Holland, 2009

MAIN PERSONAL REFERENCES

L. Cioni
Iterative procedures for the selection of competing projects
6th Annual International Conference on Computer Science & Information Systems, 25-28 June, Athens, Greece, 2010

L. Cioni
Auctions as allocation tools
AIRO 2010 41st Annual Conference Italian Operational Research Society, Altafiumara Resort Spa, Villa San Giovanni (RC) Italy September 7-10, 2010

L. Cioni
Candle auctions for the allocation of items
International Conference on Operations Research, Munich, Germany, September 1-3, 2010

L. Cioni
Random termination auctions as allocation tools
Workshop on "Dynamic Games in Economics", Rimini, Italy, December 13-14, 2010

At the end we were back to see again the stars...