Argument Schemes and Critical Questions for Decision Aiding Process

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Outline

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Context and Motivations

Argumentation Scheme and Decision
    Argument in multi-criteria context
    Example

Conclusions

Motivation of the work

Context

- Most research in our Lab focused on Decision Aiding techniques;
- Existing (and used) tools based on multi-criteria decision theory;
- what we hear in our corridors: why would we need argumentation?

Our (modest) ambition

not to construct from scratch a new decision model but to integrate argumentation within some decision aiding tools.

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Decision Aiding Process(DAP)

In the DAP [1] we have :

- at least two actors, the client (Decision Maker) and the analyst;

- the aim is to help the client to find "a solution" to his decision problem.

A model of DAP

Four cognitive artifacts as products of the DAP :

1. A formulation of the problem situation;
2. A problem formulation;
3. An evaluation model;
4. A final recommendation.

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[1] D. Bouyssou, T. Marchant, M. Pirlot, A. Tsoukiàs and Ph. Vincke. Evaluation and decision models: stepping stones for the analyst. International Series in Operations Research and Management Science. Springer, 2006.

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Example of an Evaluation Model

Example

- Decision Problem: a choice problem;
- Alternatives (pair of shoes): a, b;
- Criteria: h_1 (color), h_2 (producer), h_3 (sort or style);
- DM's preferences: black $\succeq$ red, Italian $\succeq$ French, heels $\succeq$ brogues.

Example of an Evaluation Model

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- Decision Problem: a choice problem;
- Alternatives: a, b;
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Example: Performance Table

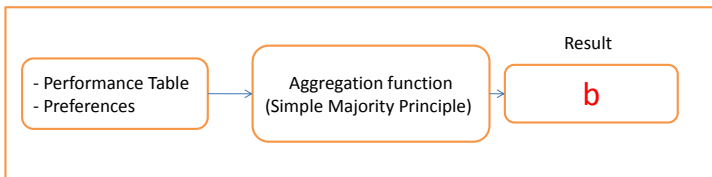|	h_1	h_2	h_3
a	red	Italian	brogues
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```
                                         Result
- Performance Table     Aggregation function        b
- Preferences           (Simple Majority Principle)
```

What happens in practice?

The DM can, for instance,

- come up with new criterion to consider;
- challenge the method used for resolving his problem;
- modify some of his preferences;
- express some doubts, request some explanation;
- . . .

- this is the job of the analyst to handle these situations;
- can argumentation be used to support (maybe automate) some of these?

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An argumentative perspective on DAP

Putting argumentation into DAP, but:

- What is an argument in favor and against an action in a multi-criteria context?

- How is this argument constructed?

- How are the element of multi-criteria evaluation (preferences, aggregation procedure,...) captured?

- How to inform the DM of the consequences of changing his preferences and/or objectives?

- . . .

Proposal

To accommodate the varieties of argument types, we use the notion of argument schemes and specify the related critical questions.

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Argument schemes

Argument Schemes

Argument schemes are forms of arguments that capture stereotypical patterns of humans reasoning, especially defeasible ones.

Two devices

- Schemes: used to identify the premises and conclusion.
- Critical questions: used to evaluate the argument by probing into its potentially weak points

D.N. Walton. Argumentation schemes for Presumptive Reasoning. Mahwah, N. J.,Erlbaum,1996.

Argument schemes and DAP

Why argument Scheme?

- by presenting the reasoning steps under the form of argument schemes, it makes justification possible, and offers the possibility to handle defeasible reasoning with incomplete models;

- by defining the set of attached critical questions, it establishes how the revision procedure can be handled.

Outline

Arguments in Multi-criteria context

Question?

What is exactly "an argument is in favour of an action *a*"
(Premises, conclusion)?

Conclusion of the argument

- intrinsic valuation — *C* = is *a* acceptable?
  comparison against a (sometimes implicit) neutral point:
  $a \succeq p$

- pairwise comparison — $C = a \succeq b$
  the proposition must be read as "*a* is at least as good as *b*".
  each criterion is an argument supporting or defeating *C*.

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Arguments in Multi-criteria context

Premises of the argument

In our context, the premises of the argument can only be based upon the information provided by the DM's preferences and the performance table: the scores of the alternatives on the criteria considered.
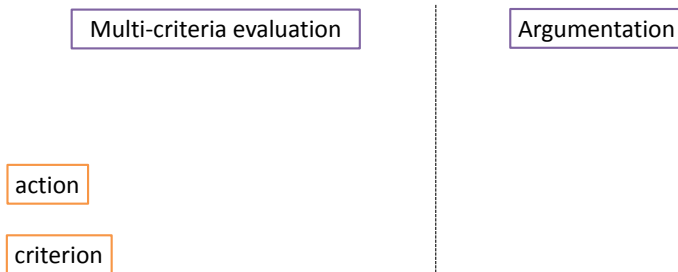
Example

$a \succeq b$ according to the criterion "price"
because price(a)=200 < price(b)=600
(criterion to be minimized)

Arguments in Multi-criteria context

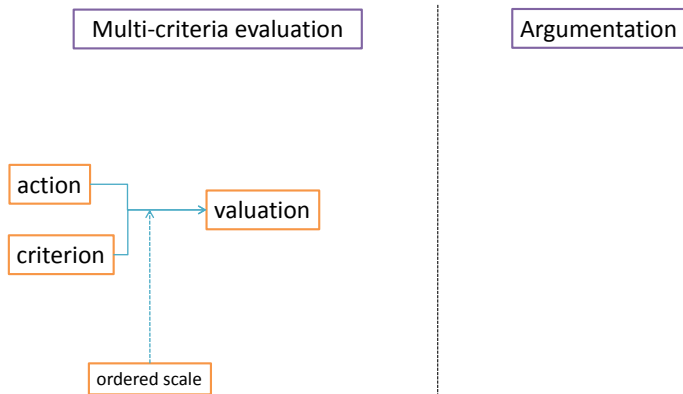**Intrinsic Evaluation**

| Multi-criteria evaluation |

| Argumentation |

| action |

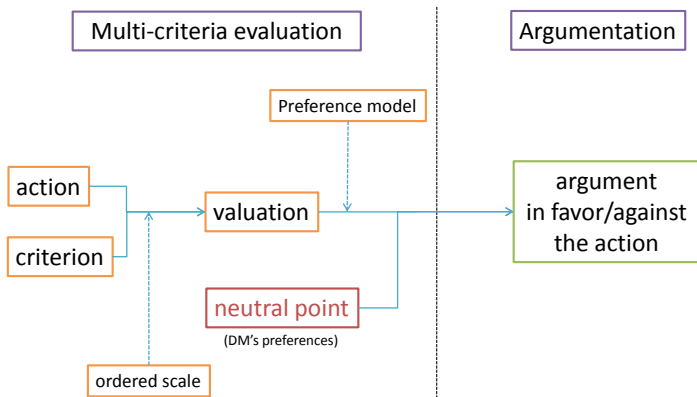| criterion |

Arguments in Multi-criteria context

Intrinsic Evaluation

Arguments in Multi-criteria context

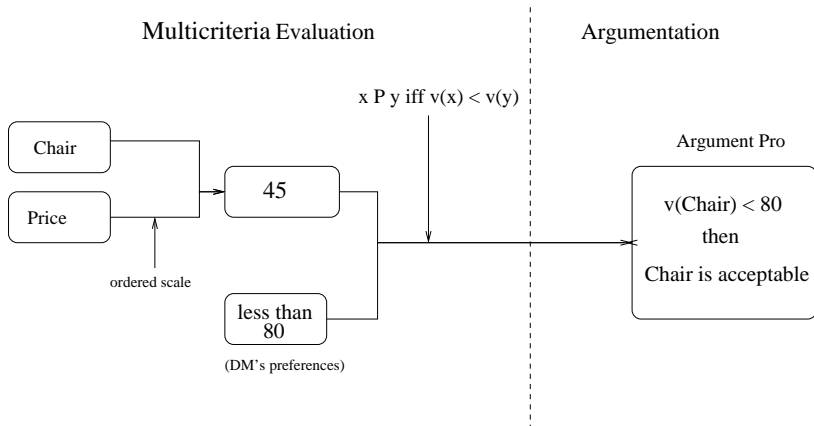**Intrinsic Evaluation**

Arguments in Multi-criteria context

Intrinsic Evaluation: Example

Arguments in Multi-criteria context

Scheme for Unicriteria Intrinsic Action Evaluation

Premises	an action	a
	whose performance is	$g_i(a)$
	along a criterion	h_i
	a neutral profile	p_i
	whose performance is	$g_i(p_i)$
	a preference relation	$\succeq_i$
Conclusion	a is acceptable according to h_i	$a \succeq_i p_i$

Critical Questions

1. action's performance: Is the performance correct?
2. preference relation: Is the preference relation appropriate?
3. . . .

Arguments in Multi-criteria context

Scheme for Unicriteria Pairwise evaluation

Premises	a criterion	h_i
	an action	a
	whose performance is	$g_i(a)$
	an action	b
	whose performance is	$g_i(b)$
	a preference relation	$\succeq_i$
Conclusion	a is at least as good as b	$a \succeq_i b$

Critical Questions

1. actions: Is the action possible?
2. criterion: Is the criterion relevant?
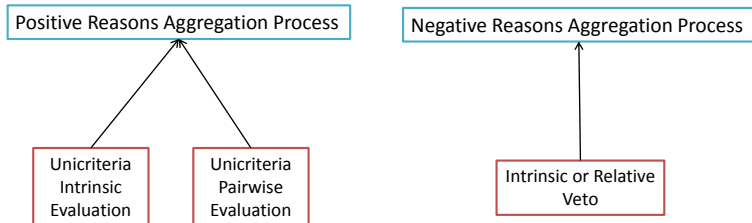3. . . .

Arguments in Multi-criteria context

| Unicriteria Intrinsic Evaluation | Unicriteria Pairwise Evaluation | | Intrinsic or Relative Veto |

Arguments in Multi-criteria context

Arguments in Multi-criteria context

## Scheme for Aggregation (Lexicographical Method)

Premises	a set of criteria	$\{h_1, \ldots, h_n\}$
	a linear order on the set of criteria	$h_1 > \cdots > h_n$
	a set of pairwise evaluation of actions a and b	
	a is strictly better than b on h_i	$a \succ_i b$
	a is indifferent to b on h_j for any $j < i$	$a \simeq_j b$ when $j < i$
Conclusion	there are good reasons to support a is at least as good as b	$a \succeq b$

Critical Questions

1. linear order: are the criteria of different importance?
2. ...

Arguments in Multi-criteria context
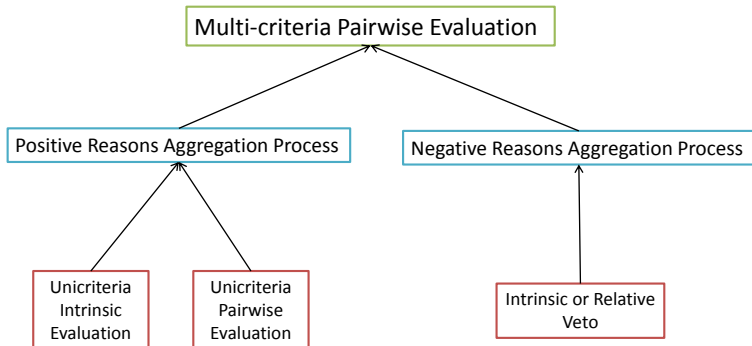
Arguments in Multi-criteria context

Scheme for pairwise evaluation multicriteria

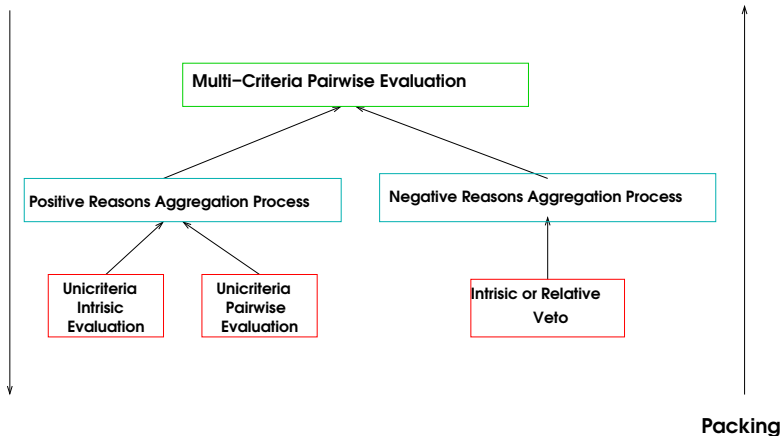| **Premises** | an action | a |
	an action	b
	a set of criteria	$\{h_1, h_2, \ldots, h_n\}$
	there are enough supportive reasons according to	$\mathcal{R}_P$
	there are no sufficiently strong reasons to oppose it	$\mathcal{R}_N$
Conclusion	a is at least as good as b	$a \succeq b$

Critical Questions

1. list of criteria: (i) Is this criteria relevant?, (ii) Should we introduce a new criteria?, (iii) Are these two criteria are in fact the same?

2. . . . (i) Are there enough positive reasons to support the claim? (ii) Is the aggregation technique relevant ?

Hierarchy of Argument Schemes

Unpacking

Multi−Criteria Pairwise Evaluation

Positive Reasons Aggregation Process   **Negative Reasons Aggregation Process**

Unicriteria Intrisic Evaluation   **Unicriteria Pairwise Evaluation**   **Intrisic or Relative Veto**

Packing

Outline

Example

Decision problem

- choice problem;
- $h_1 \succeq h_2 \succeq, \ldots, \succeq h_5$;

	h_1	h_2	h_3	h_4	h_5
a	7.5	6	2	3	5
b	7	4	8	4	7

Table: Performance Table

Example

	h_1	h_2	h_3	h_4	h_5
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b	7	4	8	4	7

Dialogue

1. System: Given your informations, a is at least as good as b. [Recommendation]

2. User: Why? [Challenge]

3. System: The most important criteria according to you defend this claim, so by comparing actions on the basis of criteria of decreasing importance, a should be prefered to b [Justified Recommendation]
(although the majority of arguments defend the opposite claim [Gen. counter-arguments])

AS/CQ

Turn 3:
Justification: Argument of the PR-AG(lex) scheme;

Counter-argument: relaxing some information (criteria have different importance).

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4. User: I still think that h_1 is the most important criteria so the majority makes little sense. [Reject counter-argument]
however, now I see that the difference between a and b is not significant enough...

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Justification: Argument of the PR-AG(lex) scheme;

Counter-argument: relaxing some information (criteria have different importance).

Turn 4:
Critical Question: relevance of the preference relation of the Argument scheme UC-PW-EV.

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Dialogue

4. User: I still think that h_1 is the most important criterion so the majority makes little sense. [Reject counter-argument]
however, now I see that the difference between a and b is not significant enough...

The system update the information

5. System: My recommendation remains the same because a is prefered to b on the second most important criterion

6. User: I agree but still a cannot be acceptable.

AS/CQ

Turn 4:
Critical Question: relevance of the preference relation of the Argument scheme UC-PW-EV.

$a \succeq b \Leftrightarrow v(a) > v(b) \rightsquigarrow$
$a \succeq b \Leftrightarrow v(a) - v(b) > 0.5$

Example

	h_1	h_2	h_3	h_4	h_5
a	7.5	6	2	3	5
b	7	4	8	4	7

Dialogue

6. User: I agree but still *a* cannot be acceptable.

7. System: Why? [Burden of proof shift]

8. User: *b* is way better than a on h_3, I could not justify this choice... [Argument Scheme for Relative acceptability]

9. System: Ok. [Revise the recommendation] But beware that applying this scheme for acceptability may have the following consequences... [Inform of consequences of this revision]

AS/CQ

Turn 8:
an attack on the ground of negative reasons

Outline

Conclusion

We presented

- a first approach to represent the steps of a multi-criteria evaluation model by means of argument scheme;
- a hierarchical structure of argument schemes and their associated critical questions;

Draft of the dialectical system

- dialogue type does not seem to be found in the typology of WK (maybe a mixture);
- challenging because has to deal with the different levels of abstraction of the hierarchy;

Current work

- specify in a more formal way the dialectical system;
- extend the model to take into account a larger set of alternatives;
- extend the model to take into account different decision problems (Ranking, Sorting,...);
- construct critical questions on the basis of the axiomatic characterisation of the aggregation procedures;
- ...