Argument Schemes and Critical Questions for Decision Aiding Process

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COMMA’08
Outline

Context and Motivations

Argumentation Scheme and Decision
  Argument in multi-criteria context
  Example

Conclusions
Context and Motivations

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Argument in multi-criteria context
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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 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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2. A problem formulation;
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4. A final recommendation.
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;
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Example: Performance Table

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<tr>
<td>( a )</td>
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Result: \( b \)
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;
- ...
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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Argumnet in multi-criteria context
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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.
An argumentative perspective on DAP

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Proposal

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

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.
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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** — $C = a \text{ is acceptable?}$
  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 $C$. 
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** — \( C = \text{is } a \text{ acceptable?} \)
  comparison against a (sometimes implicit) neutral point:
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- **pairwise comparison** — \( C = a \succeq b \)
  the proposition must be read as “\( a \text{ is at least as good as } b \)".
  each criterion is an argument supporting or defeating \( C \).
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

\[ a \succeq b \text{ according to the criterion "price" because } \text{price}(a)=200 < \text{price}(b)=600 \text{ (criterion to be minimized)} \]
Arguments in Multi-criteria context

Intrinsic Evaluation

Multi-criteria evaluation

Argumentation

action
criterion
Arguments in Multi-criteria context

Intrinsic Evaluation

Multi-criteria evaluation

Argumentation

action

criterion

valuation

ordered scale
Intrinsic Evaluation

Multi-criteria evaluation

Argumentation

Preference model

argument in favor/against the action

action

criterion

valuation

neutral point

ordered scale

(DM’s preferences)
Arguments in Multi-criteria context

Intrinsic Evaluation: Example

Multicriteria Evaluation

- Chair
- Price
  - 45
  - less than 80
    - (DM’s preferences)

Argumentation

- \( x \ P \ y \iff v(x) < v(y) \)
- \( v(\text{Chair}) < 80 \)
  - then
  - Chair is acceptable

Argument Pro
Arguments in Multi-criteria context

Scheme for Unicriteria Intrinsic Action Evaluation

<table>
<thead>
<tr>
<th>Premises</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>an action whose performance is along a criterion a neutral profile whose performance is a preference relation</td>
<td>a is acceptable according to ( h_i )</td>
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<td>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 )</td>
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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

<table>
<thead>
<tr>
<th>Premises</th>
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</table>
| 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 $\succeq_i$ | $a$ 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

Positive Reasons Aggregation Process
- Unicriteria Intrinsic Evaluation
- Unicriteria Pairwise Evaluation

Negative Reasons Aggregation Process
- Intrinsic or Relative Veto
Arguments in Multi-criteria context

Scheme for Aggregation (Lexicographical Method)

<table>
<thead>
<tr>
<th>Premises</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>a set of criteria</td>
<td>there are good reasons to support a is at least as good as b</td>
</tr>
<tr>
<td>a linear order on the set of criteria</td>
<td></td>
</tr>
<tr>
<td>a set of pairwise evaluation of actions a and b</td>
<td></td>
</tr>
<tr>
<td>a is strictly better than b on $h_i$</td>
<td>$a \succ_i b$</td>
</tr>
<tr>
<td>a is indifferent to b on $h_j$ for any $j &lt; i$</td>
<td>$a \simeq_j b$ when $j &lt; i$</td>
</tr>
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Critical Questions

1. linear order: are the criteria of different importance?
2. ...
Arguments in Multi-criteria context

- Multi-criteria Pairwise Evaluation
  - Positive Reasons Aggregation Process
    - Unicriteria Intrinsic Evaluation
    - Unicriteria Pairwise Evaluation
  - Negative Reasons Aggregation Process
    - Intrinsic or Relative Veto
Arguments in Multi-criteria context

**Scheme for pairwise evaluation multicriteria**

<table>
<thead>
<tr>
<th>Premises</th>
<th>an action</th>
<th>$a$</th>
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<tbody>
<tr>
<td></td>
<td>an action</td>
<td>$b$</td>
</tr>
<tr>
<td></td>
<td>a set of criteria</td>
<td>${h_1, h_2, \ldots, h_n}$</td>
</tr>
<tr>
<td></td>
<td>there are enough supportive reasons according to $R_P$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>there are no sufficiently strong reasons to oppose it $R_N$</td>
<td></td>
</tr>
<tr>
<td>Conclusion</td>
<td>$a$ is at least as good as $b$</td>
<td>$a \succeq b$</td>
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**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

- Positive Reasons Aggregation Process
  - Unicriteria Intrinsic Evaluation
  - Unicriteria Pairwise Evaluation

- Negative Reasons Aggregation Process
  - Intrinsic or Relative Veto

Packing

Multi-Criteria Pairwise Evaluation
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Decision problem

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

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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 preferred 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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Dialogue

3. System: The most important criterion 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])

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...

AS/CQ

Turn 3:
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.

$$a \succeq b \iff v(a) > v(b) \quad \iff \quad a \succeq b \iff v(a) - v(b) > 0.5$$
Table:

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<th>h₄</th>
<th>h₅</th>
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**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 h₃, 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
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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;
- ...