The Decision Deck project

Tools you can use to make your life easier

Olivier Cailloux

École Centrale Paris
With support from Université Libre de Bruxelles
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Outline

Six real cars

- Our problem: help evaluate car models
- Six cars: Audi A3, A4, BMW 118d, 320d, Volvo C30, S40
- Five criteria: Price, Power, 0-100, Consumption, CO2
- Objective evaluations are given
- Criteria “weights” are given
- Other preferencial informations are given (e.g. thresholds)

More generally

- A set of alternatives, A
- A set of criteria indices, I
- Evaluations, $\forall a \in A, i \in I$: $z_i(a) \in \mathbb{R}$
- Weights, $\forall i \in I$: $\omega_i \in [0, 1]$
- Thresholds, when appropriate, $\forall i \in I$: p_i, q_i, v_i

PROMETHEE partial preference function

Partial preference function

The *partial preference function* P_i over $A \times A$, with $P_i(a,b) \in [0,1]$, indicates how strongly a is preferred to b according to the criterion i.

Case with a preference threshold $p_i > 0$

$$P_i^3(a,b) = \begin{cases} 1 \Leftrightarrow z_i(a) - z_i(b) > p_i, \\ \dfrac{z_i(a) - z_i(b)}{p_i} \Leftrightarrow 0 \leq z_i(a) - z_i(b) \leq p_i, \\ 0 \Leftrightarrow z_i(a) - z_i(b) < 0. \end{cases}$$

PROMETHEE global preference relation

Global preference relation

The *global preference relation* P over A, with $P(a,b) \in [0,1]$, indicates how strongly a is preferred to b.

$$P(a,b) = \sum_{i \in F} \omega_i P_i(a,b).$$

Example

	Audi A3	A4	BMW 118d	320d	Volvo C30	S40
Audi A3	0.00	0.65	0.33	0.60	0.27	0.65
Audi A4	0.30	0.00	0.13	0.40	0.19	0.00
BMW 118d	0.51	0.65	0.00	0.62	0.30	0.60
BMW 320d	0.30	0.39	0.25	0.00	0.48	0.24
Volvo C30	0.30	0.62	0.22	0.40	0.00	0.58
Volvo S40	0.30	0.41	0.25	0.42	0.27	0.00

PROMETHEE positive flow

Positive flow

The *positive flow* Q^+ is a real function over A where $Q^+(a)$ indicates how a is preferred to the other alternatives in the set A.

$$Q^+(a) = \frac{1}{|A| - 1} \sum_{b \in A \setminus \{a\}} P(a, b).$$

Example

Audi A3	0.50
Audi A4	0.20
BMW 118d	0.54
BMW 320d	0.33
Volvo C30	0.43
Volvo S40	0.33

ELECTRE concordance relation

Partial concordance relation

The *concordance relation* C_i over A, with $C_i(a,b) \in [0,1]$, indicates how the criterion i supports the outranking of a over b.

Case with thresholds $p_i > q_i > 0$

$$C_i(a,b) = \begin{cases} & 1 \Leftrightarrow z_i(b) - z_i(a) < q_i, \\ 1 - \dfrac{(z_i(b) - z_i(a)) - q_i}{p_i - q_i} & \Leftrightarrow q_i \leq z_i(b) - z_i(a) \leq p_i, \\ & 0 \Leftrightarrow z_i(b) - z_i(a) > p_i. \end{cases}$$

Global concordance relation

$$C(a,b) = \sum_{i \in F} \omega_i C_i(a,b).$$

ELECTRE discordance relations

Discordance relation

The *discordance relation* D_i over A, with $D_i(a,b) \in [0,1]$, indicates how the criterion i supports the claim that a should not outrank b.

Case with thresholds $v_i > p_i > 0$

$$D_i(a,b) = \begin{cases} 1 \Leftrightarrow & z_i(b) - z_i(a) \geq v_i, \\ \dfrac{(z_i(b) - z_i(a)) - p_i}{v_i - p_i} \Leftrightarrow & p_i \leq z_i(b) - z_i(a) < v_i, \\ 0 \Leftrightarrow & z_i(b) - z_i(a) < p_i. \end{cases}$$

ELECTRE outranking relation

Outranking relation

The *outranking relation* S over A, with $S(a,b) \in [0,1]$, indicates how strongly a outranks b.

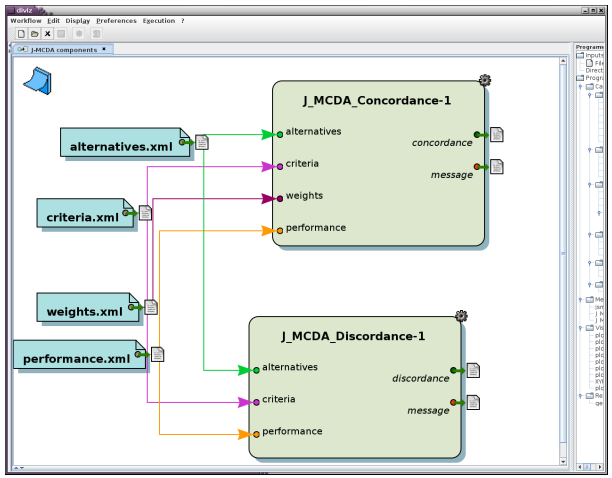
$$S(a,b) = \begin{cases} C(a,b) \Leftrightarrow \forall i \in I : D_i(a,b) \leq C(a,b), \\ C(a,b) \prod_{\{i | D_i(a,b) > C(a,b)\}} \frac{1 - D_i(a,b)}{1 - C(a,b)} \text{ otherwise.} \end{cases}$$

Example (part)

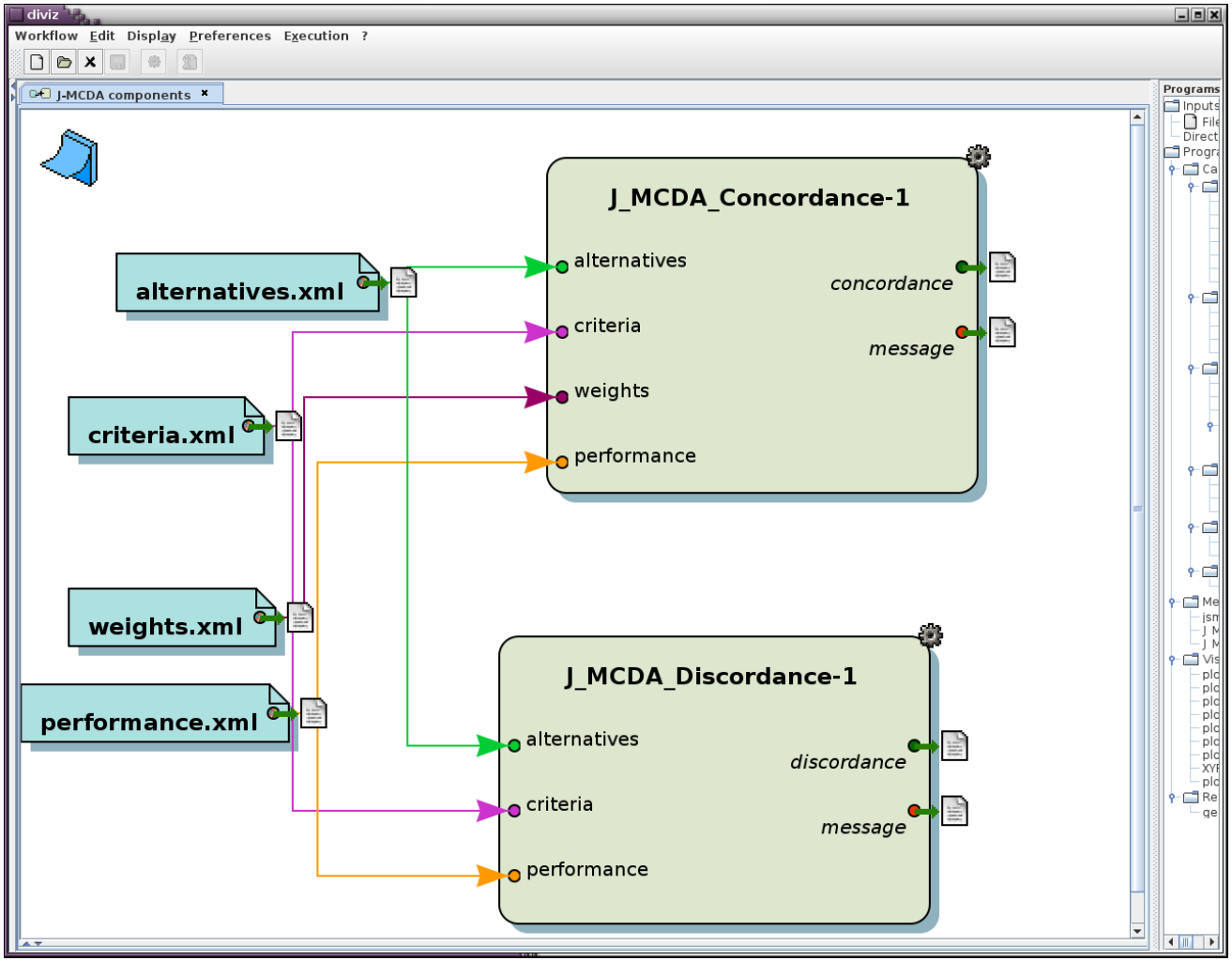
	Audi A3	A4	BMW 118d	320d	Volvo C30	S40
Audi A3	1.00	0.70	0.49	0.70	0.70	0.70
Audi A4	0.00	1.00	0.30	0.61	0.00	0.59
BMW 118d	0.67	0.87	1.00	0.75	0.78	0.75

The Decision Deck project

- Decision Deck aims to produce common frameworks and tools for implementing Multicriteria Decision Aid methods
- XMCDA initiative: an XML based file format for describing problem instances
- Cutting into small web services
- diviz: a software for using the XMCDA web services
- Tools to make building these easy



diviz software



What about you?

You can reuse

- XMCDA: applicable for e.g. social choice functions
- The web services tools and architecture
- Check the web! `http://www.decision-deck.org`

My current interest

- Preference modeling (going backwards!)
- Group decision contexts