Ranking big performance tableaux with multiple incommensurable criteria and missing data

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In the context of the ongoing GDRI-Algodec "Algorithmic Decision Theory", supported o.a. by the CNRS (France) and the FNR (Luxembourg), we develop multicriteria ranking algorithms for large sets of potential decision alternatives : up to several thousand of alternatives evaluated on multiple incommensurable ordinal performance criteria. This research is motivated by the development of a visualization tool - a **heat map** - for performance tableaux showing the decision alternatives linearly ordered form the best to the worst, and the individual performances colored by quantiles equivalence classes [1] as shown in Figure 1.

criteria	Rcv	dwT	upT	MTBF	RspT	stoC	auD	enC	auT	snpC	Thrpt	Lat	LB	ouT
weights	2.00	2.00	2.00	2.00	2.00	3.00	1.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00
tau(*)	0.53	0.53	0.44	0.35	0.18	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.58
MS	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	NA	NA	NA	4.00	0.00
Ela	4.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00	NA	NA	4.00	0.00
Sig	4.00	4.00	4.00	4.00	3.00	3.00	4.00	4.00	4.00	4.00	NA	NA	4.00	0.00
Cen	4.00	4.00	4.00	4.00	2.00	3.00	4.00	4.00	4.00	NA	NA	NA	4.00	0.00
Cit	4.00	4.00	2.00	3.00	2.00	3.00	4.00	4.00	4.00	4.00	NA	NA	4.00	2.00
Ggl	3.00	2.00	4.00	2.00	2.00	4.00	4.00	4.00	4.00	4.00	NA	NA	4.00	1.00
HP	3.00	3.00	3.00	4.00	4.00	3.00	4.00	4.00	4.00	4.00	NA	NA	4.00	2.00
GMO	2.00	3.00	1.00	3.00	4.00	3.00	4.00	4.00	4.00	NA	NA	NA	4.00	4.00
Rsp	3.00	NA	NA	NA	NA	3.00	4.00	4.00	4.00	4.00	NA	NA	4.00	NA
Amz	3.00	2.00	2.00	3.00	3.00	4.00	4.00	4.00	4.00	NA	NA	NA	4.00	5.00
Dig	3.00	1.00	2.00	3.00	2.00	3.00	4.00	4.00	4.00	NA	NA	NA	4.00	5.00

Color legend:

quantile	0.14%	0.29%	0.43%	0.57%	0.71%	0.86%	1.00%

(*) tau: Ordinal (Kendall) correlation between marginal criterion and global ranking relation.

FIGURE 1 – Example heat map from a CloudCom 2015 conference paper by Shyam Wagele et al. [2]

By using Python3.5 multiprocessing resources and the Digraph3 multicriteria software library [3], it is possible, on the UL HPC cluster [4], and more specifically on the gaia-80 machine with 120 single threaded cores and a CPU memory of 1.5 TB, to linearly rank (without ties) in less than an hour (see Figure 2) a huge set of 250000 alternatives evaluated on 21 performance criteria by balancing economic, ecological and societal decision objectives.

Data input is, on the one side, a 250000x21 performance tableau of size 825 MB, and on the other side, a theoretical preference space consisting of 62 000 000 000 (billions) of pairwise outranking comparisons [5, 6].

A "small" set of 1000 decision alternatives, in a similar setting, may thus be ranked typically in less than 5 seconds.

FIGURE 2 – UL HCP gaia cluster console session trace [4]

Références

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