INTRODUCTION TO ARTIFICIAL INTELLIGENCE – LECTURE 5 – MCDA AND ELECTRE I

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I. Given the outranking relation matrix (see below to the left), determine the relations (P - preference, I - indifference, or ? – incomparability) that hold for the four pairs of alternatives given to the right.

S	a_1	a_2	a_3	a_4
a_1	1	1	0	1
a_2	0	1	1	1
a_3	0	1	1	0
a_4	1	0	0	1

a_1 I a_1

a_1 P a_2

a_1 ? a_3

a_1 I a_4

II. Given the performance matrix for three alternatives (*a, b, c*) on a pair of criteria: g_1 of gain-type and g_2 of cost-type, a set of preference-related parameters, and a majority threshold (cutting level) λ = 0.6, verify the truth of an outranking relation for the following pairs of alternatives (*a,b*), (*a,c*) and (*b,c*) (for (*a,b*) - the calculations have been already done). Present all intermediate results in the below table, including the marginal concordance and discordance indices and the comprehensive concordance and discordance indices (note: if the concordance test is failed, you do not need to perform a discordance test).

	$g_1 \uparrow$	$g_2 \downarrow$
a	20	25
b	19	19
c	22	2

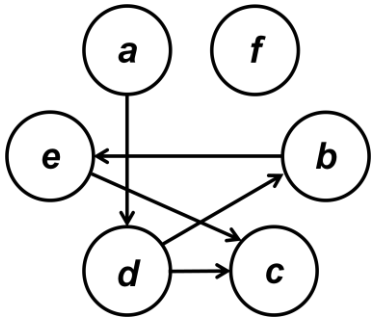
	g_1	g_2
indifference q_i	2	5
preference p_i	4	9
veto v_i	10	20
weight w_i	6	4

(*x*,*y*)	$c_1(x,y)$	$c_2(x,y)$	$C(x,y)$	conc?	$d_1(x,y)$	$d_2(x,y)$	$D(x,y)$	***xSy?***
(*a*,*b*)	1	3/4	(6·1 + 4·3/4)/10 = 0.9	1 (yes)	0	0	0 (no)	*YES* (1)
(*a*,*c*)	1	0	(6*1 + 4*0)/10 = 0,6	1(yes)	0	1	1(yes)	NO(0)
(*b*,*c*)	1/2	0	(6*1/2 + 4*0)/10 = 0,3	0(no)	-	-	-	NO(0)

III. Given the outranking relation graph (to the right), fill in an outranking matrix (be careful with the main diagonal) and find the graph's kernel (you do not need to present the steps of the algorithm).

S	*a*	*b*	*c*	*d*	*e*	*f*
a	1	0	0	1	0	0
b	0	1	0	0	1	0
c	0	0	1	0	0	0
d	0	1	1	1	0	0
e	0	0	1	0	1	0
f	0	0	0	0	0	1

Outranking graph:

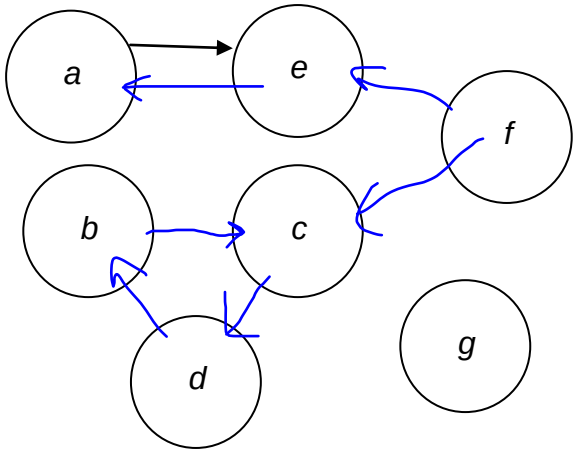


Answer: Kernel = {a, b, c, f}

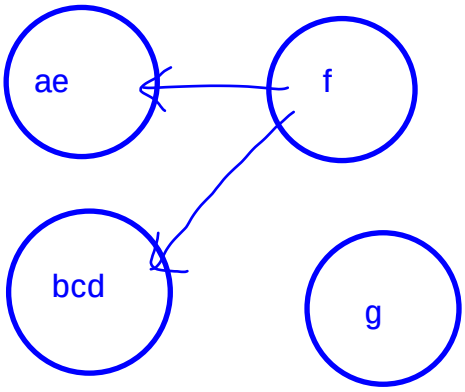
IV. Given the outranking relation matrix (to the left), draw an outranking graph (the nodes and a single arc are already drawn to the right), eliminate the potential cycle(s), draw a new acyclic graph, and find its kernel.

S	*a*	*b*	*c*	*d*	*e*	*f*	*g*
a	1	0	0	0	1	0	0
b	0	1	1	0	0	0	0
c	0	0	1	1	0	0	0
d	0	1	0	1	0	0	0
e	1	0	0	0	1	0	0
f	0	0	1	0	1	1	0
g	0	0	0	0	0	0	1

Outranking graph:



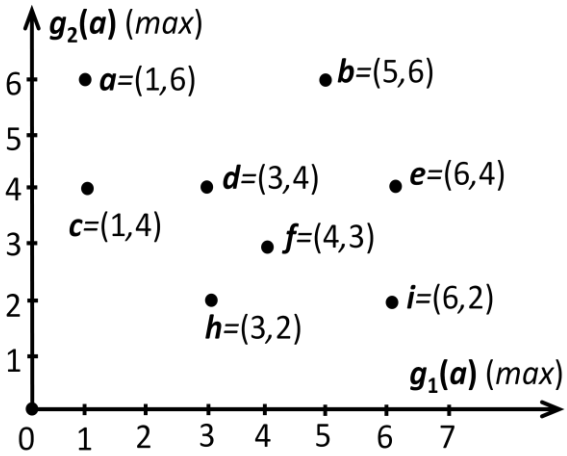
New graph:



Answer (based on the new graph):

Kernel = {f, g}

V. Given a set of alternatives *a-i* evaluated in terms of two gain-type criteria g_1 and g_2, identify the non-dominated (Pareto optimal) and weakly non-dominated alternatives.



Answer: Non-dominated alternatives: b, e

Weakly non-dominated alternatives: i, d, a