J-Electre-v1.0 User Guide: An ELECTRE I, I_s, I_v, II, III, IV, TRI and TRI ME software.

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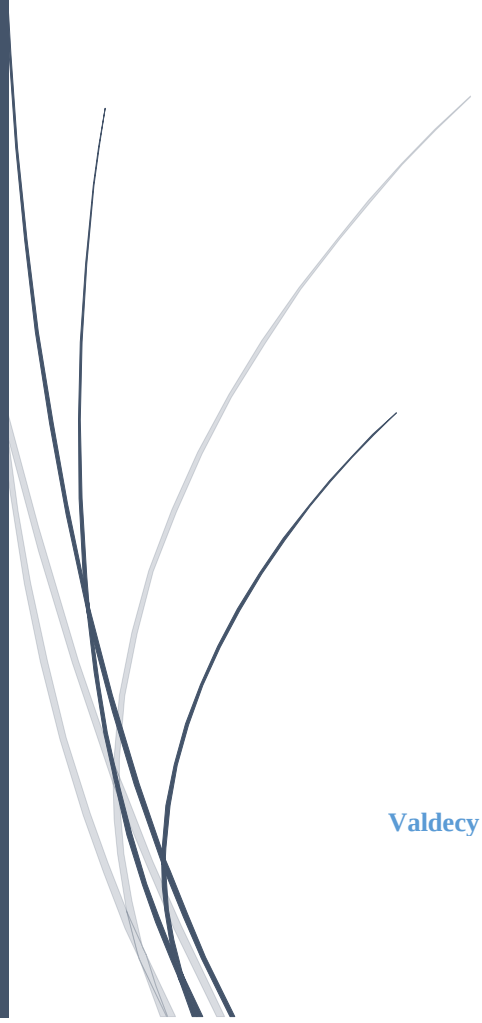
User Guide

J-Electre-v1.0

An ELECTRE I, I_s, I_v, II, III, IV, TRI and TRI ME software.



Valdecy Pereira, Helder Gomes Costa and Livia Dias de Oliveira Nepomuceno

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1- J-Electre-v1.0 - Installation Notes

The **J-Electre-v1.0 (jar)** is a runnable .jar file that does not need to be installed and it run in any OS. The unique requisite is the need to have the latest Java SE program installed. Check if your computer has the latest release, if not please download it (preferably Java SE 7 or superior) at: www.oracle.com

or www.oracle.com/technetwork/pt/java/javase/downloads/index.html?ssSourceSiteId=otnes

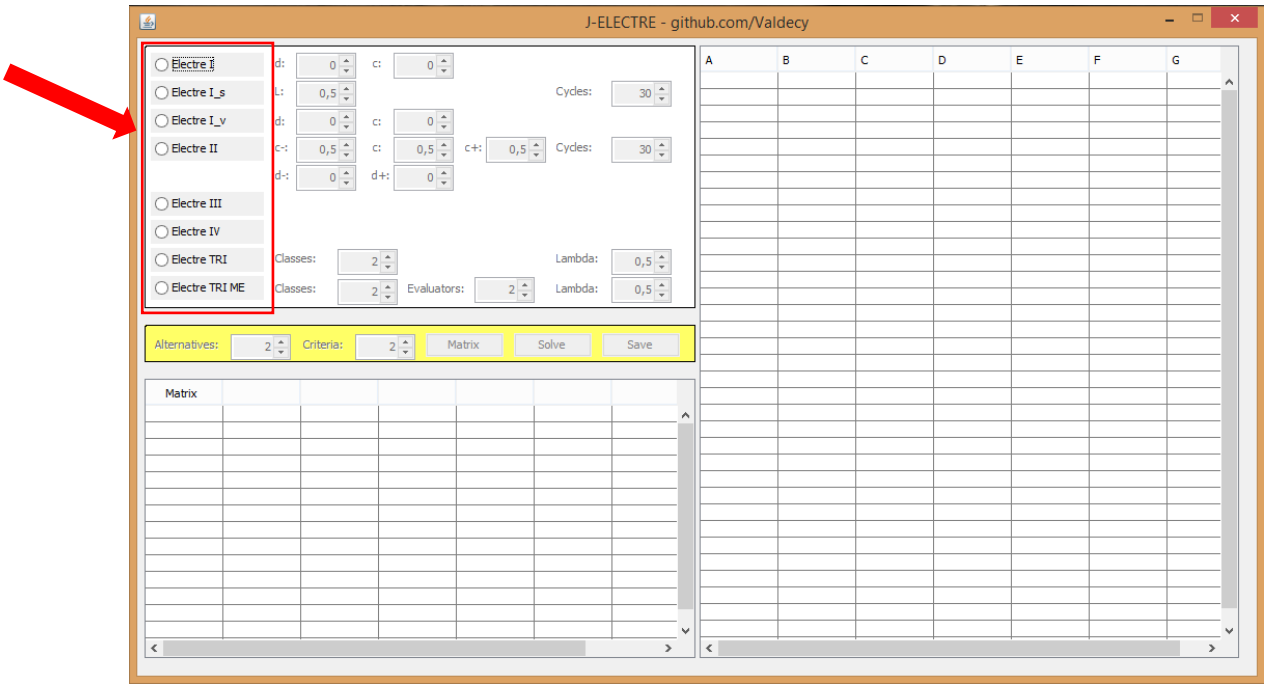
The **J-Electre-v1.0 (exe)** is a runnable .exe file that does not need to be installed and also do not need the installation of the latest Java SE program.

Download J-Electre-v1.0 at: **https://sourceforge.net/projects/j-electre/files/**

2- J-Electre-v1.0 - First Use

In the main screen choose the Electre Method between the following options:

a) Electre I
b) Electre I_s
c) Electre I_v
d) Electre II
e) Electre III
f) Electre IV
g) Electre TRI
h) Electre TRI ME (Multi-Evaluator)



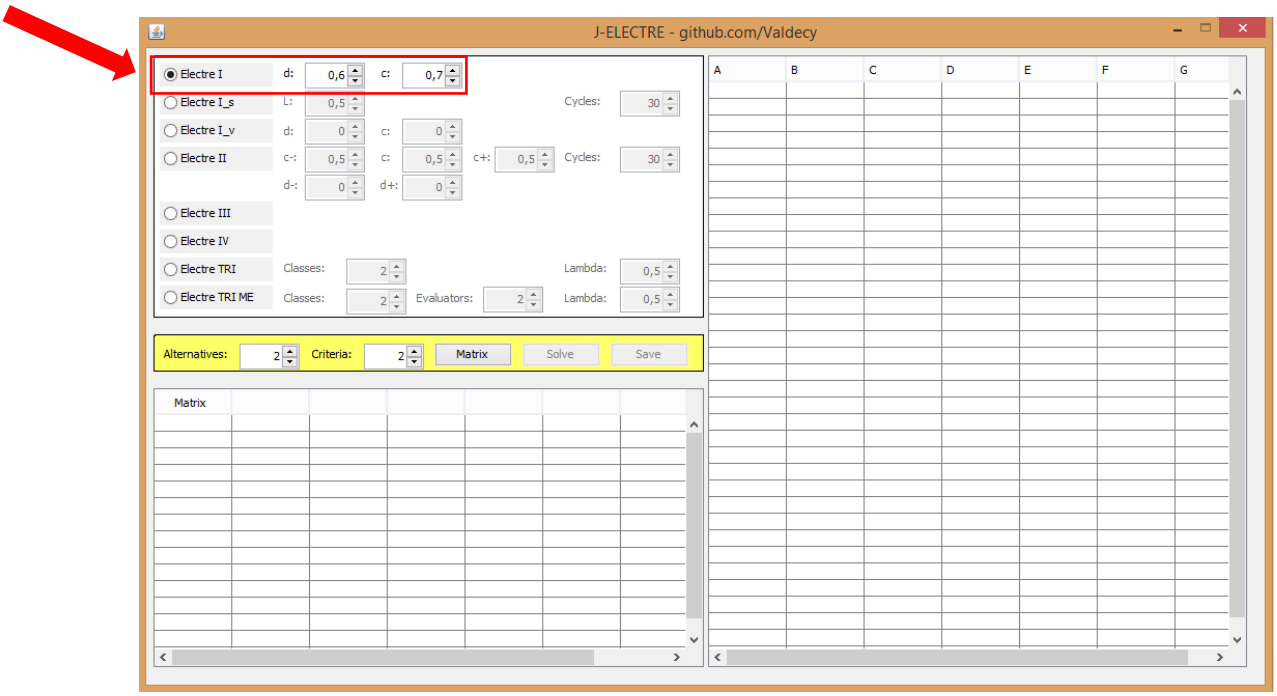
2.1 Electre I

To explain how to use the **J-Electre-v1.0** in order to solve **Electre I** problems, the following example will be used:

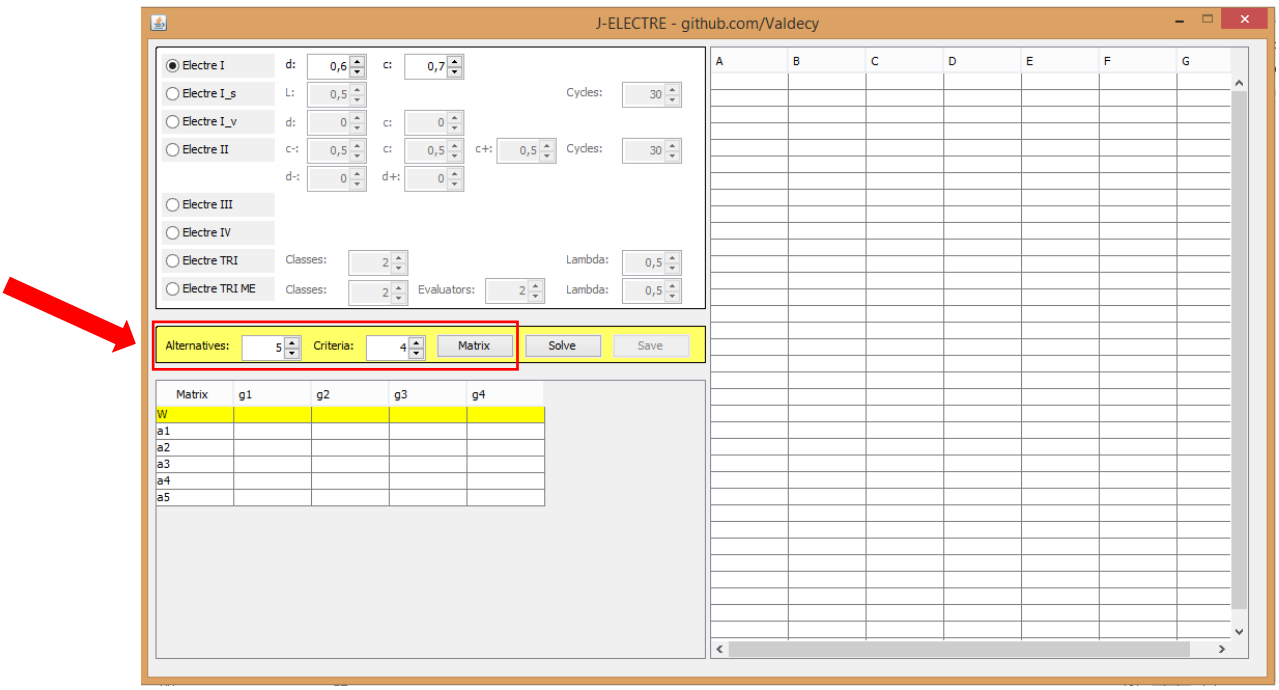
	g1	g2	g3	g4
W	2	1	5	3
a1	150	1	20	3000
a2	300	0	10	0
a3	250	0	10	2250
a4	110	1	20	2800
a5	120	1	50	1000

This problem has 5 alternatives (*a1, a2, a3, a4, a5*) and 4 criteria (*g1, g2, g3, g4*). The weights (importance) of each criterion is represented by the ***W*** row.

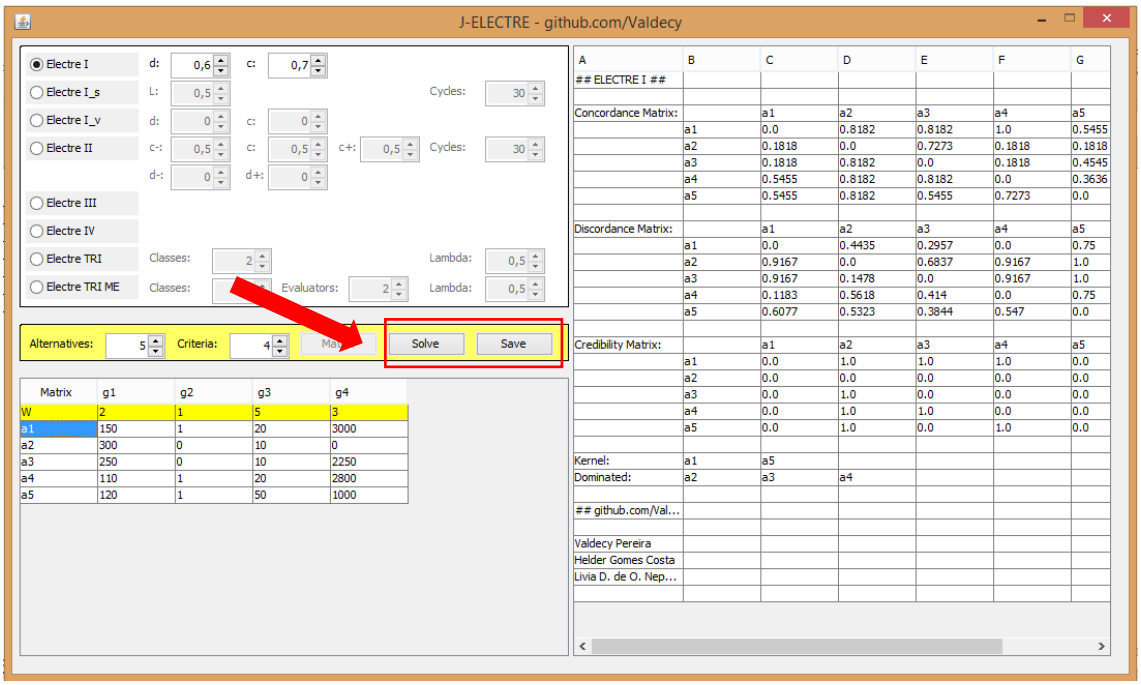
After Choosing ***Electre I*** method, two parameters need to be set: ***d*** (discordance index – varying from 0 to 1) and ***c*** (concordance index – varying from 0 to 1). For the given example ***d*** = 0.6 and ***c*** = 0.7.



Insert the number of ***Alternatives*** (varying from 2 to 1,000), ***Criteria*** (varying from 2 to 1,000) and press the ***Matrix*** button to build the performance matrix.



Insert the values in the performance matrix and then press the ***Solve*** button to solve the problem. To save (export) the results to a spreadsheet press the ***Save*** button.



The output contains: ***Concordance Matrix***, ***Discordance Matrix***, ***Credibility Matrix***, ***Kernel*** (set of alternatives that are not dominated) and ***Dominated*** (set of alternatives that are dominated by the alternatives in the Kernel set).

2.2 Electre I_s

To explain how to use the **J-Electre-v1.0** in order to solve **Electre I_s** problems, the following example (ROY & SKALKA, 1985) will be used:

	g1	g2	g3	g4	g5	g6	g7
Q	2000	2	1	1	1	50	0.1
P	3000	5	2	3	2	82	0.2
V	3500	7	3	5	6	90	0.5
W	0.3	0.1	0.3	0.1	0.2	0.2	0.1
a1	16000	201	8	40	5	378	31.3
a2	18000	199	8	35	5	474	33.0
a3	16000	195	8	36	1	480	33.9
a4	18000	199	8	35	5	430	33.1
a5	17000	191	8	34	1	430	34.4
a6	17000	199	8	35	4	494	32.0
a7	15000	194	8	37	3	452	33.8
a8	18000	200	8	36	6	475	33.8
a9	17000	209	7	37	3	440	30.9

This problem has 9 alternatives (*a1, a2, a3, a4, a5, a6, a7, a8, a9*) and 7 criteria (*g1, g2, g3, g4, g5, g6, g7*). The ***Q*** row represents the weak preference, the ***P*** row represents the strong

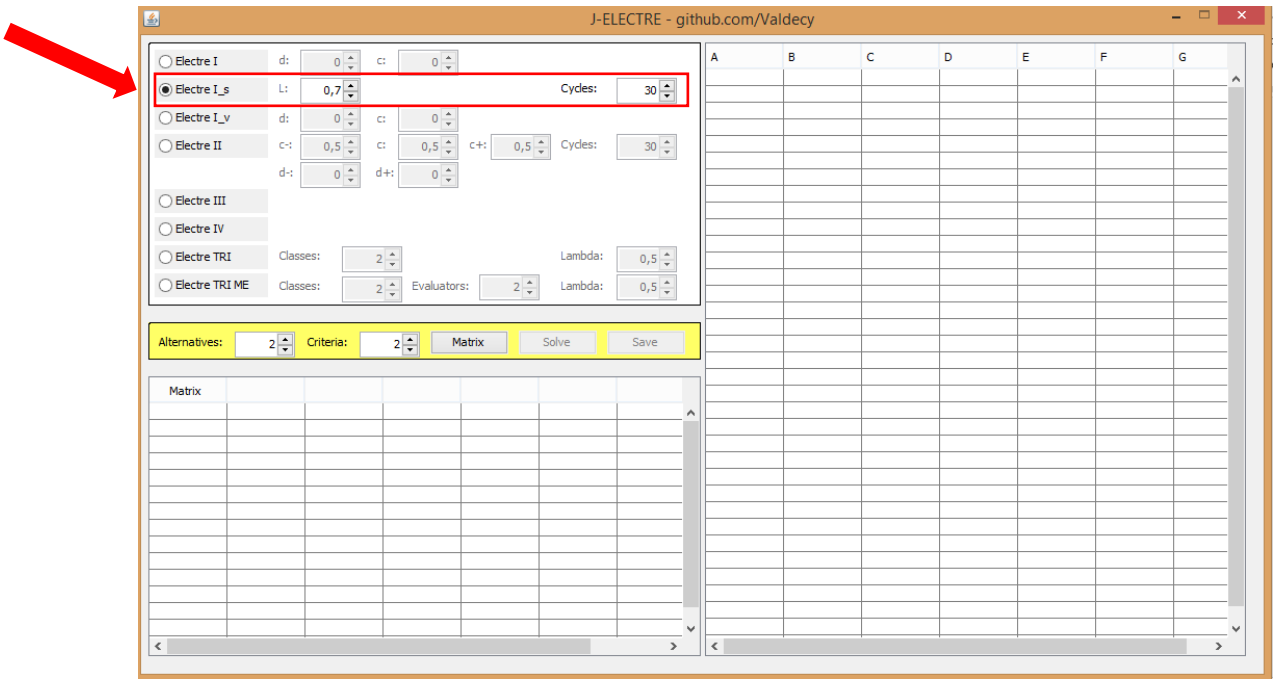
preference, the ***V*** row represents the Veto (respecting: $\boldsymbol{V} \geq \boldsymbol{P} \geq \boldsymbol{Q}$) and finally, the weights (importance) of each criterion is represented by the ***W*** row.

After Choosing ***Electre I_s*** method, two parameters need to be set: ***L*** (lambda index – varying from 0.5 to 1) and the maximum number of ***Cycles*** (varying from 0 to 9,000) that will be removed.

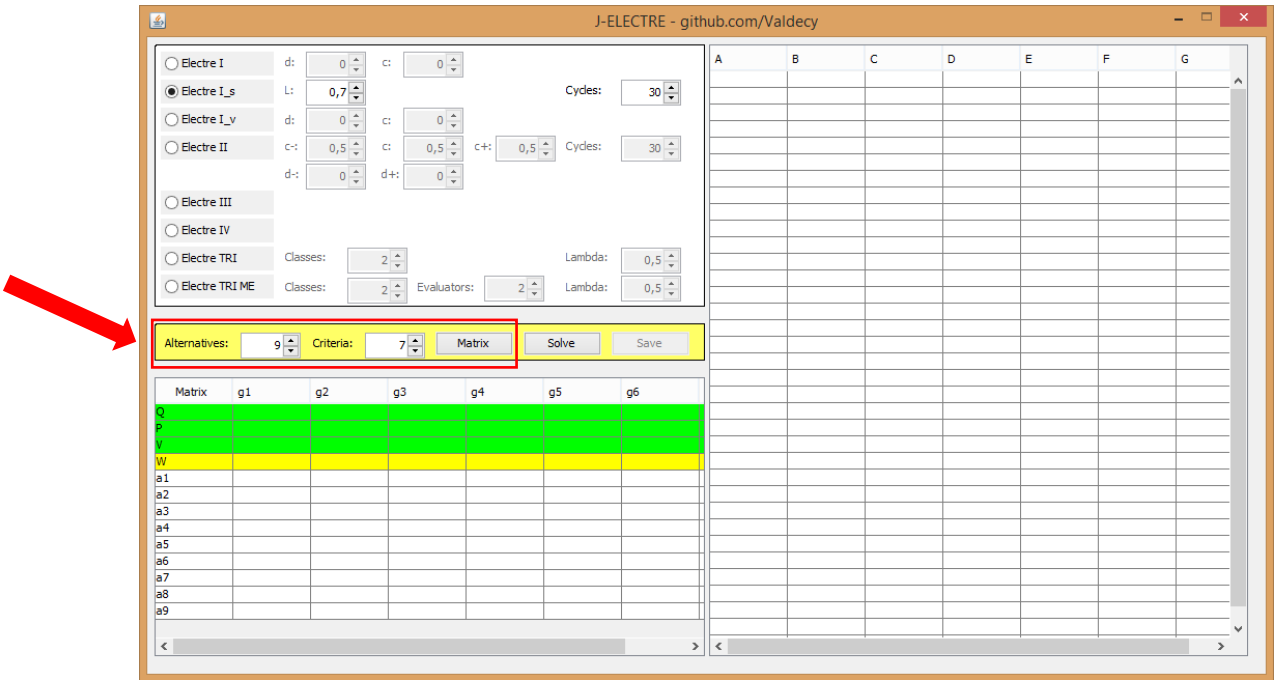
Cycles invalidate the solution obtained by the ***Electre I_s*** algorithm, and in order to deal with cycles we used the Johnson Algorithm (JOHNSON, 1975), implemented by Meyer (2012) and modified by us, that can find all cycles in a directed graph. Then we remove each found cycle in order to have a valid solution.

However, if a problem has to many cycles, as a rule of thumb above 30, consider first increasing the value of ***L*** and if there still too many cycles, consider removing an alternative (or alternatives – one at a time) that appears frequently in most cycles (all cycles are indicated in the output table and detecting them should not be difficult).

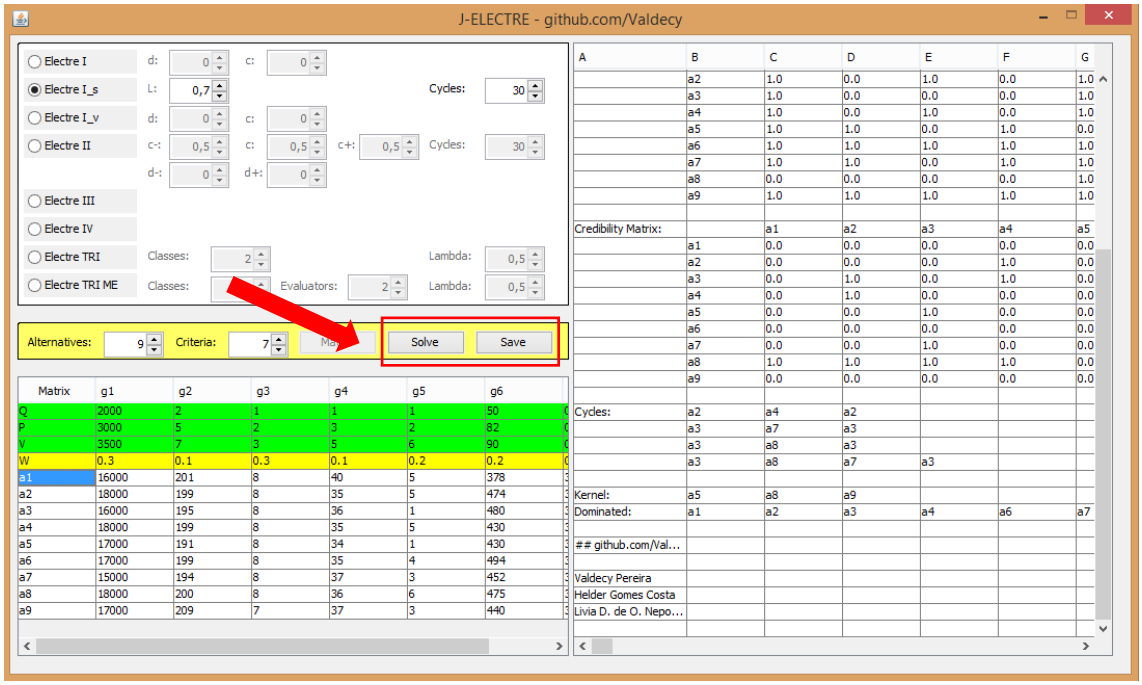
For the given example ***L*** = 0.7 and ***Cycles*** = 30.



Insert the number of ***Alternatives*** (varying from 2 to 1,000), ***Criteria*** (varying from 2 to 1,000) and press the ***Matrix*** button to build the performance matrix.



Insert the values in the performance matrix and then press the ***Solve*** button to solve the problem. To save (export) the results to a spreadsheet press the ***Save*** button.



The output contains: ***Concordance Matrix***, ***Discordance Matrix***, ***Credibility Matrix***, ***Cycles*** (first cycle: $a2 \rightarrow$a4$\rightarrow a2$; second cycle: $a3 \rightarrow a7 \rightarrow a3$ and the third cycle: $a3 \rightarrow a8 \rightarrow a7 \rightarrow a3$), ***Kernel*** (set of alternatives that are not dominated <u>after</u> the cycles are removed) and ***Dominated*** (set of alternatives that are dominated by the alternatives in the Kernel set <u>after</u> the cycles are removed).

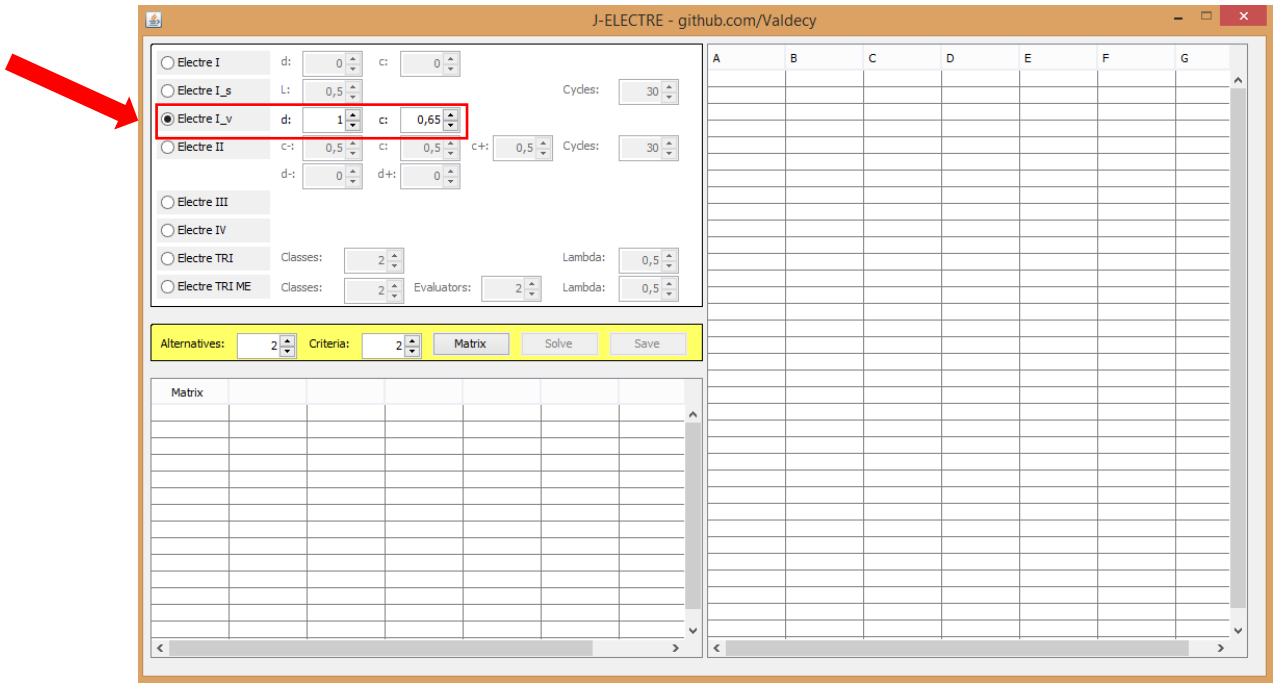
2.3 Electre I_v

To explain how to use the **J-Electre-v1.0** in order to solve **Electre I_v** problems, the following example will be used:

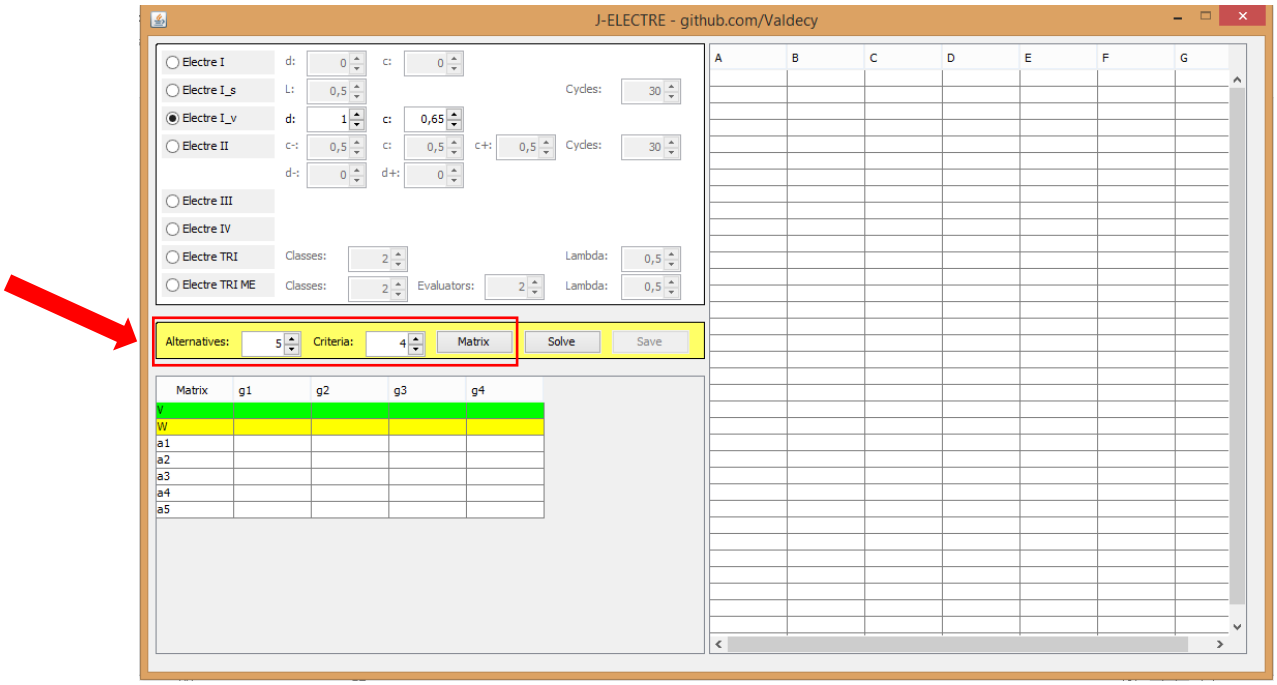
	g1	g2	g3	g4
V	2	2	2	2
W	7	3	5	6
a1	15	9	6	10
a2	10	5	7	8
a3	22	12	1	14
a4	31	10	6	18
a5	8	9	0	9

This problem has 5 alternatives (*a1, a2, a3, a4, a5*) and 4 criteria (*g1, g2, g3, g4*). The ***V*** row represents the Veto and the weights (importance) of each criterion is represented by the ***W*** row.

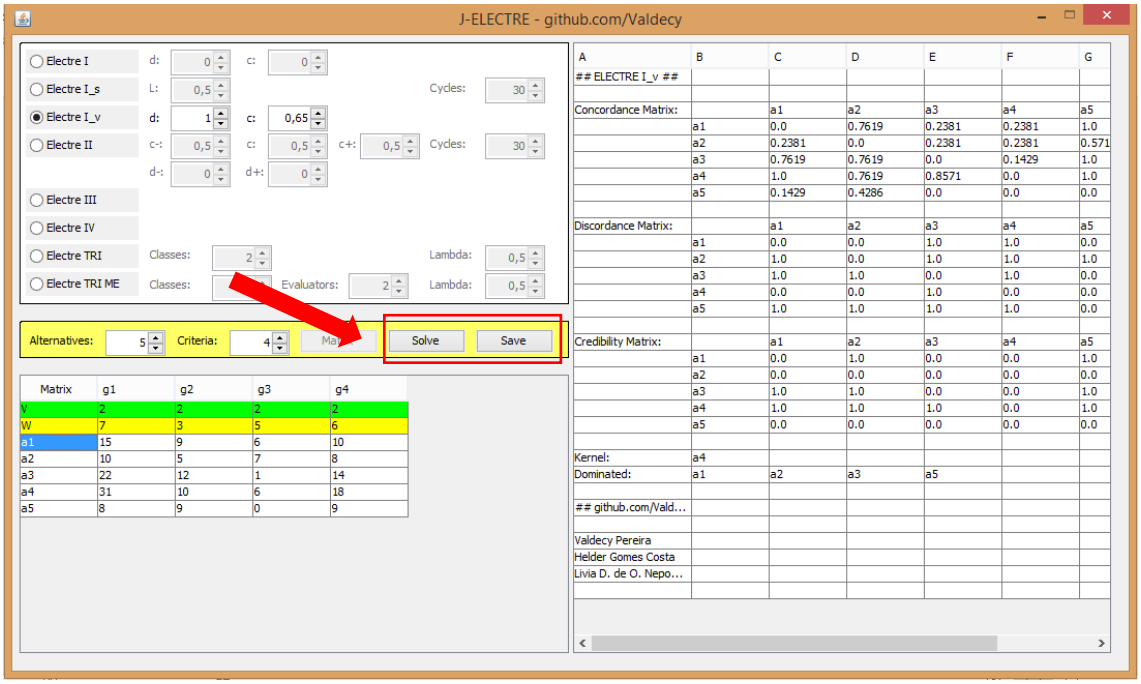
After Choosing ***Electre I_v*** method, two parameters need to be set: ***d*** (discordance index – with only two values 0 or 1) and ***c*** (concordance index – varying from 0 to 1). For the given example ***d*** = 1 and ***c*** = 0.65.



Insert the number of ***Alternatives*** (varying from 2 to 1,000), ***Criteria*** (varying from 2 to 1,000) and press the ***Matrix*** button to build the performance matrix.



Insert the values in the performance matrix and then press the ***Solve*** button to solve the problem. To save (export) the results to a spreadsheet press the ***Save*** button.



The output contains: ***Concordance Matrix***, ***Discordance Matrix***, ***Credibility Matrix***, ***Kernel*** (set of alternatives that are not dominated) and ***Dominated*** (set of alternatives that are dominated by the alternatives in the Kernel set).

2.4 Electre II

To explain how to use the **J-Electre-v1.0** in order to solve **Electre II** problems, the following example (WANG & TRIANTAPHYLLOU, 2006) will be used:

	g1	g2	g3	g4	g5	g6	g7
W	0.078	0.118	0.157	0.314	0.235	0.039	0.059
a1	1	2	1	5	2	2	4
a2	3	5	3	5	3	3	3
a3	3	5	3	5	3	2	2
a4	1	2	2	5	1	1	1
a5	1	1	3	5	4	1	5

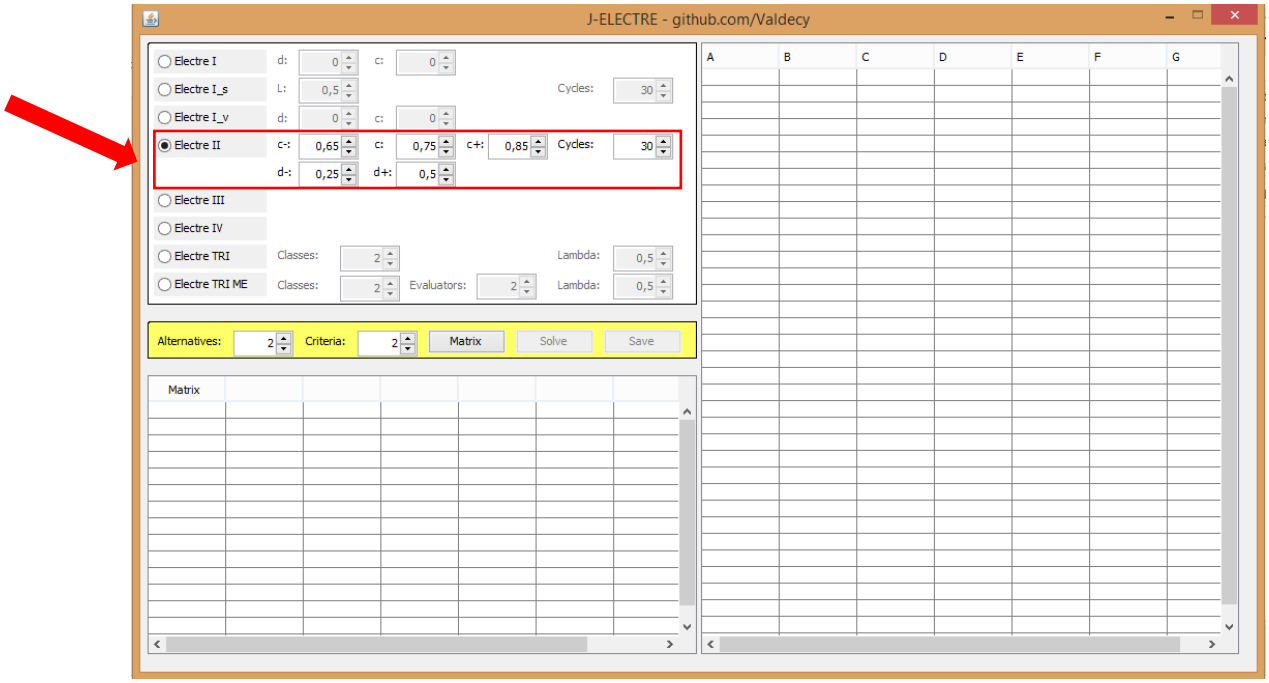
This problem has 5 alternatives (*a1, a2, a3, a4, a5*) and 7 criteria (*g1, g2, g3, g4, g5, g6, g7*). The weights (importance) of each criterion is represented by the ***W*** row.

After Choosing ***Electre II*** method, six parameters need to be set: three levels of concordance index ***c-***, ***c*** and ***c+*** (where $0.5 \leq c^- \leq c \leq c^+ \leq 1$), two levels of concordance ***d-*** and ***d+*** (where $0 \leq d^- \leq d^+ \leq 1$), and the maximum number of ***Cycles*** (varying from 0 to 9,000) that will be removed.

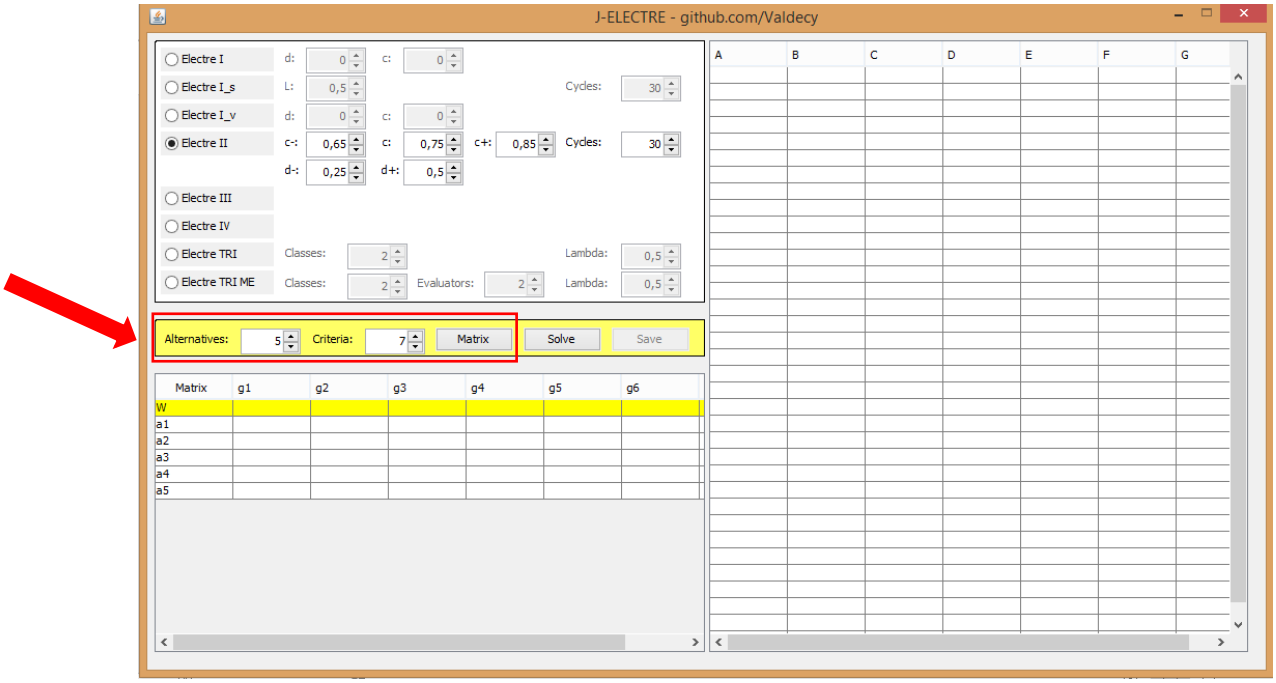
Cycles invalidate the solution obtained by the ***Electre II*** algorithm, and in order to deal with cycles we used the Johnson Algorithm (JOHNSON, 1975), implemented by Meyer (2012) and modified by us, that can find all cycles in a directed graph. Then we remove each found cycle in order to have a valid solution.

However, if a problem has to many cycles, as a rule of thumb above 30, consider first increasing the parameters values and if there still too many cycles, consider removing an alternative (or alternatives – one at a time) that appears frequently in most cycles (all cycles are indicated in the output table and detecting them should not be difficult).

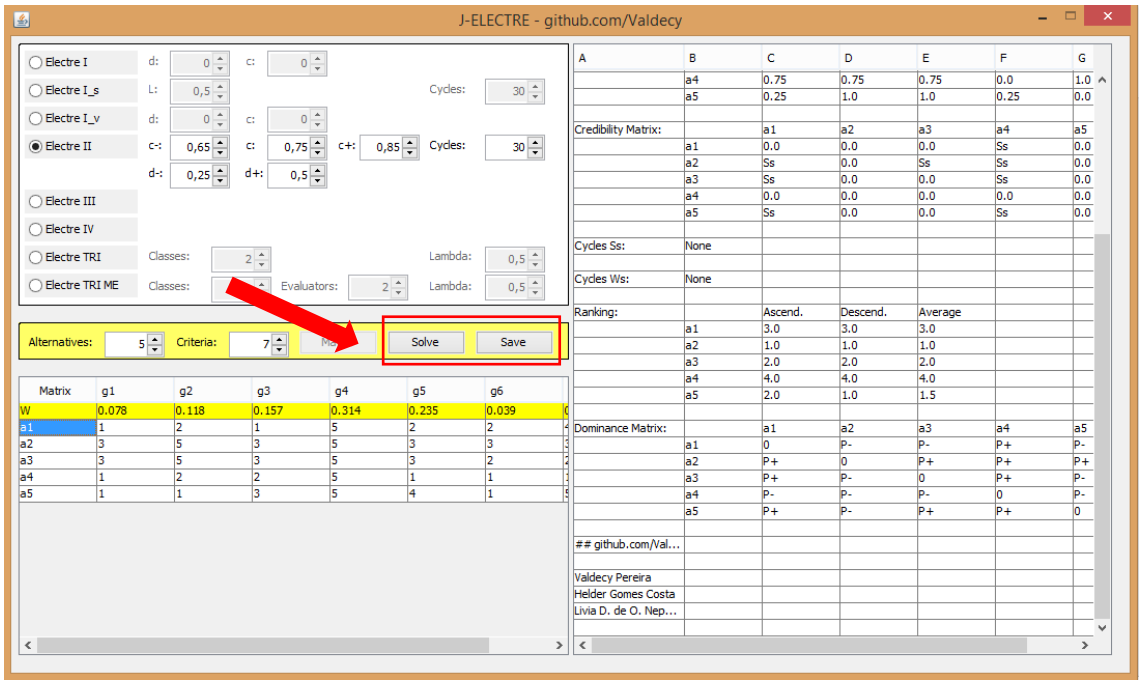
For the given example ***c-*** = 0.65, ***c*** = 0.75, ***c+*** = 0.85, ***d-*** = 0.25, ***d+*** = 0.5 and ***Cycles*** = 30.



Insert the number of ***Alternatives*** (varying from 2 to 1,000), ***Criteria*** (varying from 2 to 1,000) and press the ***Matrix*** button to build the performance matrix.



Insert the values in the performance matrix and then press the ***Solve*** button to solve the problem. To save (export) the results to a spreadsheet press the ***Save*** button.



The output contains: ***Concordance Matrix***, ***Discordance Matrix***, ***Credibility Matrix***, ***Cycles Ss*** (cycles from the strong graph), ***Cycles Ws*** (cycles from the weak graph), ***Ranking Ascending*** (from the worst alternative to the best), ***Ranking Descending*** (from the best alternative to the worst), ***Ranking Average*** (In order to have a complete ranking, we choose to build the final ranking as an average between the ascending and descending ranking) and ***Dominance Matrix*** (To build the classical pre-ordination or final ranking, the dominance matrix is provided)

2.5 Electre III

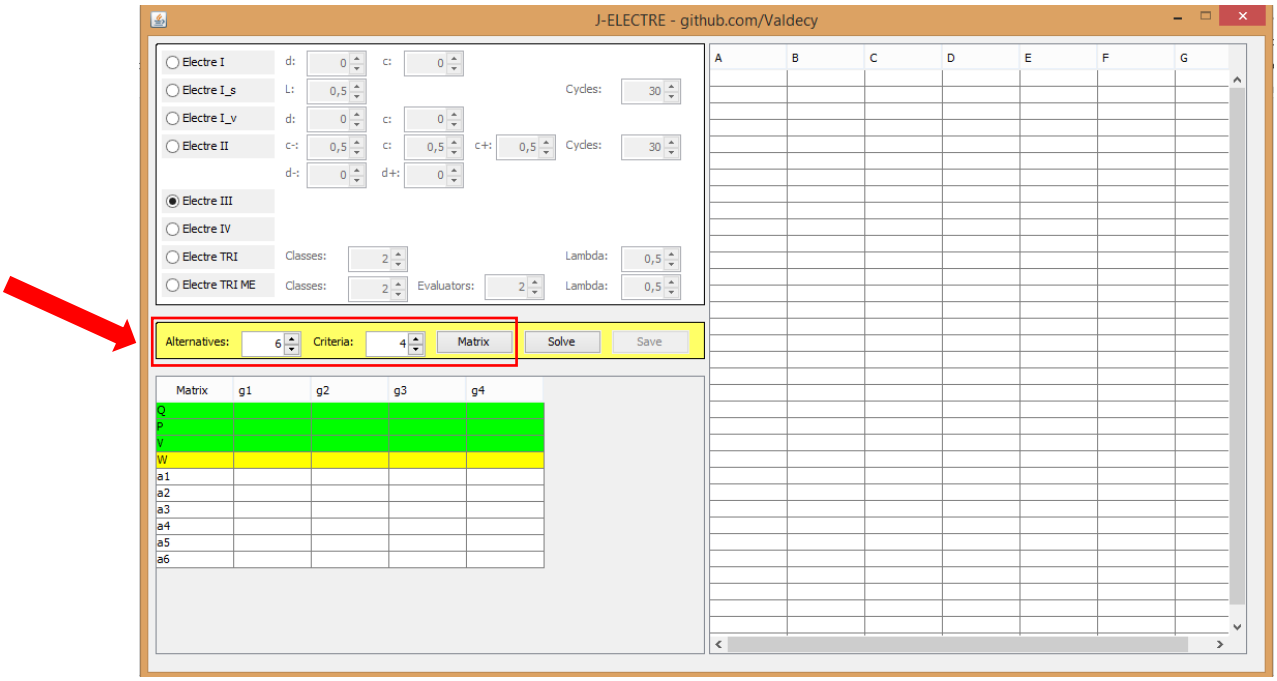
To explain how to use the **J-Electre-v1.0** in order to solve **Electre III** problems, the following example will be used:

	g1	g2	g3	g4
Q	0.3	0.3	0.3	0.3
P	0.5	0.5	0.5	0.5
V	0.7	0.7	0.7	0.7
W	0.2754741	0.2735455	0.1758277	0.2221151
a1	8.84	8.79	6.43	6.95
a2	8.57	8.51	5.47	6.91
a3	7.76	7.75	5.34	8.76
a4	7.97	9.12	5.93	8.09
a5	9.03	8.97	8.19	8.1
a6	7.41	7.87	6.77	7.23

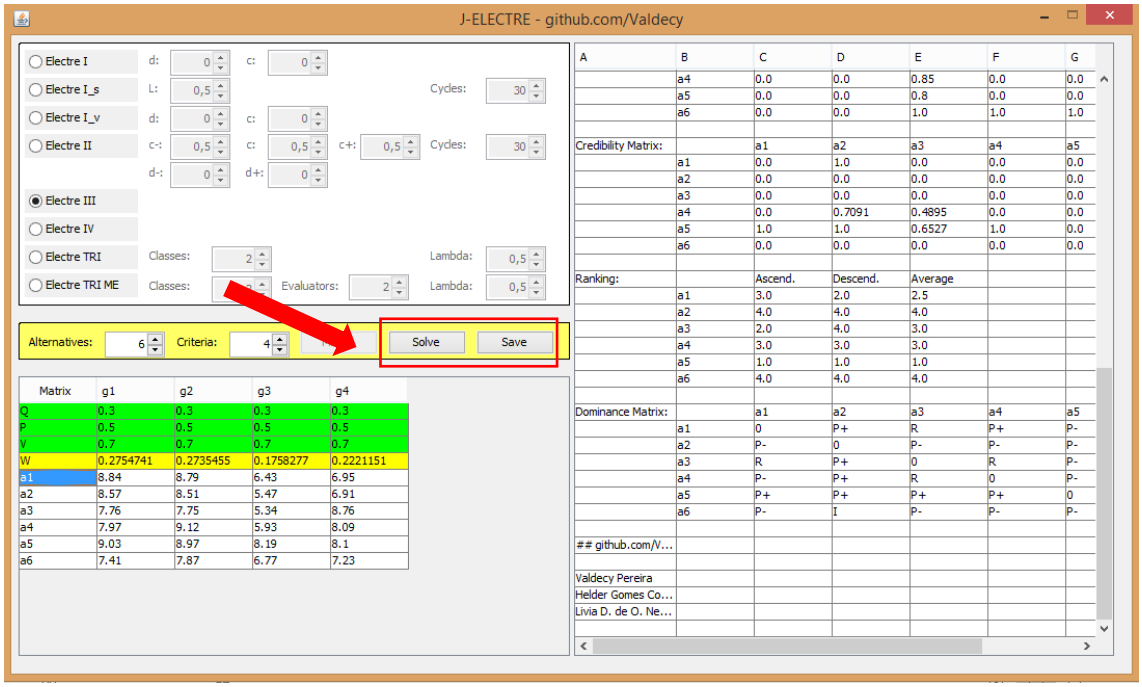
This problem has 6 alternatives (*a1, a2, a3, a4, a5, a6*) and 4 criteria (*g1, g2, g3, g4*). The ***Q*** row represents the weak preference (as constants), the ***P*** row represents the strong preference (as

constants), the ***V*** row represents the Veto (respecting: $\boldsymbol{V \geq P \geq Q}$) and finally, the weights (importance) of each criterion is represented by the ***W*** row.

Insert the number of ***Alternatives*** (varying from 2 to 1,000), ***Criteria*** (varying from 2 to 1,000) and press the ***Matrix*** button to build the performance matrix.



Insert the values in the performance matrix and then press the ***Solve*** button to solve the problem. To save (export) the results to a spreadsheet press the ***Save*** button.



The output contains: ***Concordance Matrix***, ***Discordance Matrix*** (one for each criterion), ***Credibility Matrix***, ***Ranking Ascending*** (from the worst alternative to the best), ***Ranking Descending*** (from the best alternative to the worst), ***Ranking Average*** (In order to have a complete ranking, we choose to build the final ranking as an average between the ascending

and descending ranking) and ***Dominance Matrix*** (To build the classical pre-ordination or final ranking, the dominance matrix is provided)

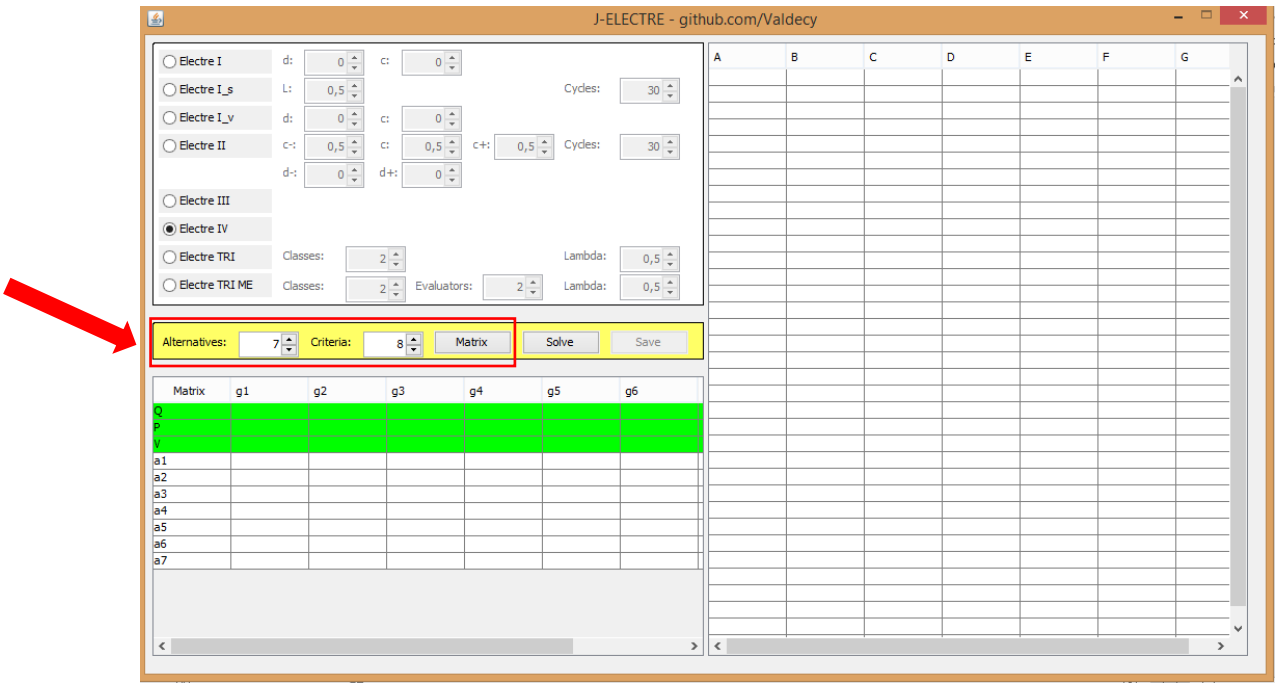
2.6 Electre IV

To explain how to use the **J-Electre-v1.0** in order to solve **Electre IV** problems, the following example will be used:

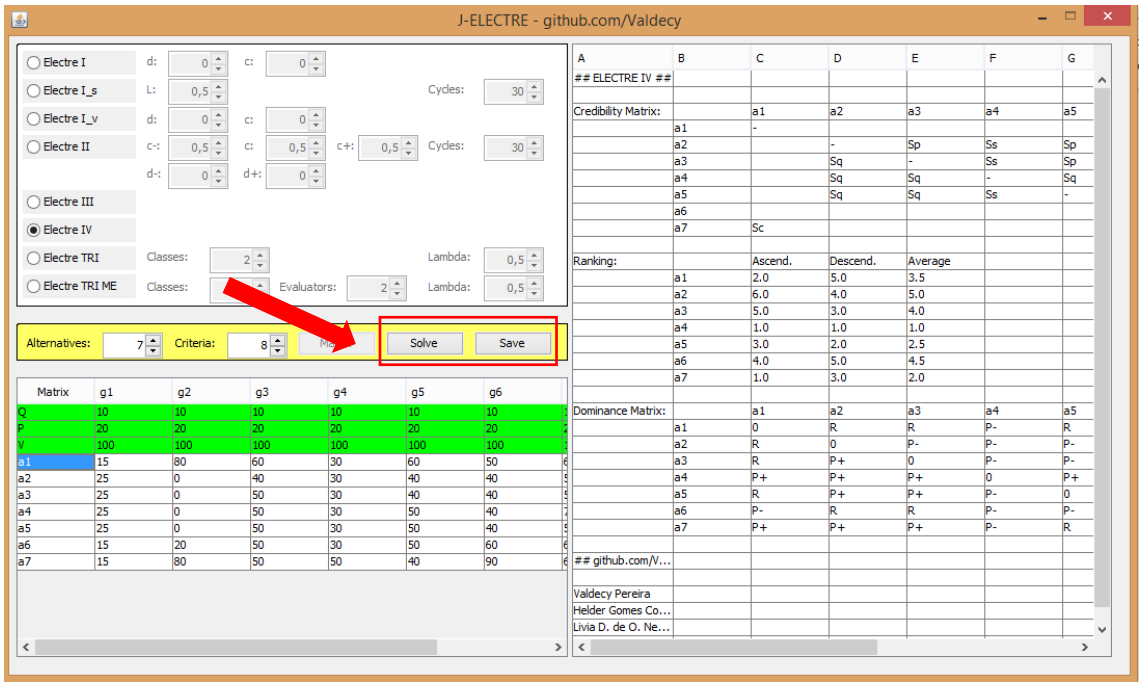
	g1	g2	g3	g4	g5	g6	g7	g8
Q	10	10	10	10	10	10	10	10
P	20	20	20	20	20	20	20	20
V	100	100	100	100	100	100	100	100
a1	15	80	60	30	60	50	60	70
a2	25	0	40	30	40	40	50	140
a3	25	0	50	30	40	40	50	140
a4	25	0	50	30	50	40	70	140
a5	25	0	50	30	50	40	50	140
a6	15	20	50	30	50	60	60	100
a7	15	80	50	50	40	90	60	100

This problem has 7 alternatives (*a1, a2, a3, a4, a5, a6, a7*) and 8 criteria (*g1, g2, g3, g4, g5, g6, g7, g8*). The ***Q*** row represents the weak preference, the ***P*** row represents the strong preference, the ***V*** row represents the Veto (respecting: $\boldsymbol{V \geq P \geq Q}$).

Insert the number of ***Alternatives*** (varying from 2 to 1,000), ***Criteria*** (varying from 2 to 1,000) and press the ***Matrix*** button to build the performance matrix.



Insert the values in the performance matrix and then press the ***Solve*** button to solve the problem. To save (export) the results to a spreadsheet press the ***Save*** button.



The output contains: ***Credibility Matrix***, ***Ranking Ascending*** (from the worst alternative to the best), ***Ranking Descending*** (from the best alternative to the worst), ***Ranking Average*** (In order to have a complete ranking, we choose to build the final ranking as an average between the ascending and descending ranking) and ***Dominance Matrix*** (To build the classical pre-ordination or final ranking, the dominance matrix is provided)

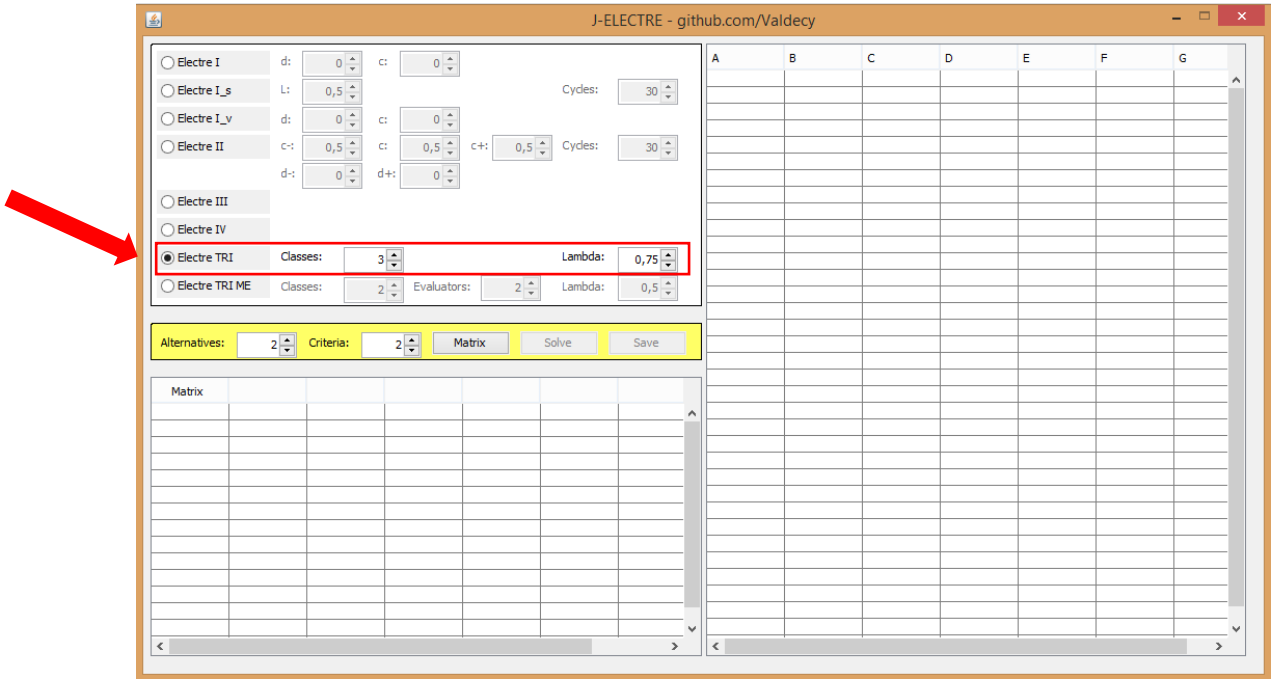
2.7 Electre TRI

To explain how to use the **J-Electre-v1.0** in order to solve **Electre TRI** problems, the following example (MOUSSEAU, 1999.) will be used:

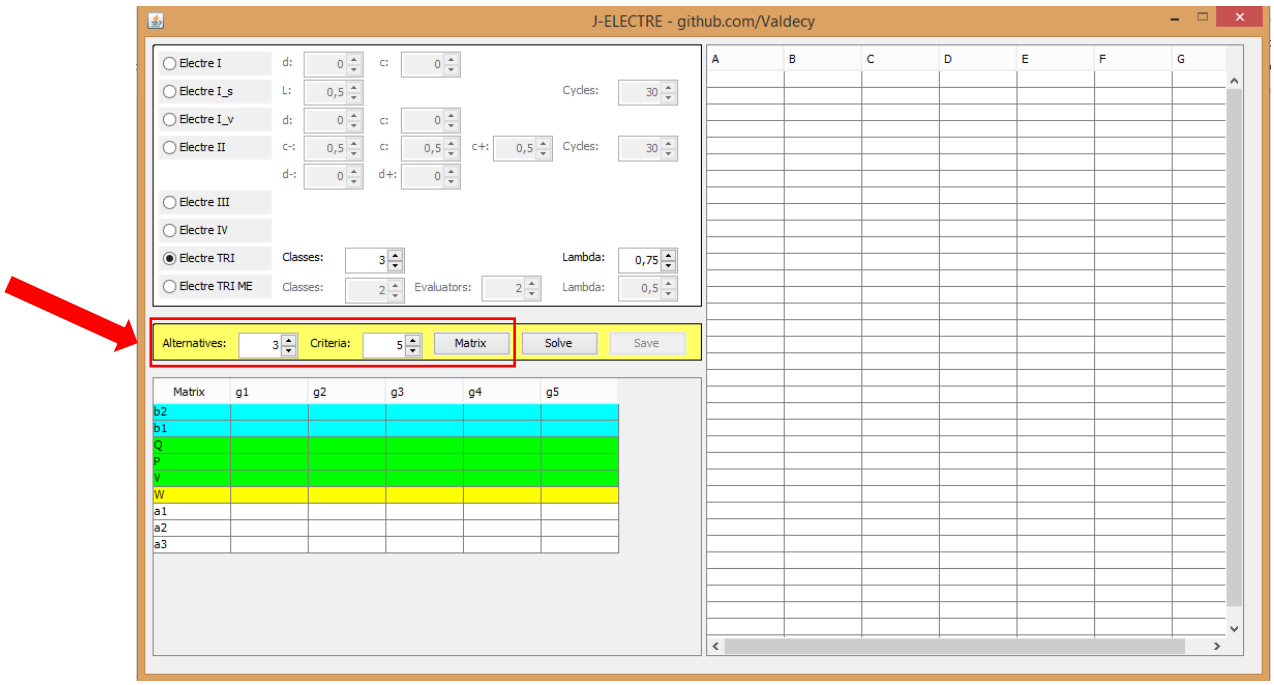
	g1	g2	g3	g4	g5
b2	70	75	80	75	85
b1	50	48	55	55	60
Q	5	5	5	5	5
P	10	10	10	10	10
V	30	30	30	30	30
W	1	1	1	1	1
a1	75	67	85	82	90
a2	28	35	70	90	95
a3	45	60	55	68	60

This problem has 3 alternatives (*a1, a2, a3, a4, a5*) and 4 criteria (*g1, g2, g3, g4*). The ***bn*** rows represents the profiles (respecting: $\boldsymbol{b_n \geq b_{n-1}}$). The ***Q*** row represents the weak preference, the ***P*** row represents the strong preference, the ***V*** row represents the Veto (respecting: $\boldsymbol{V \geq P \geq Q}$) and finally, the weights (importance) of each criterion is represented by the ***W*** row.

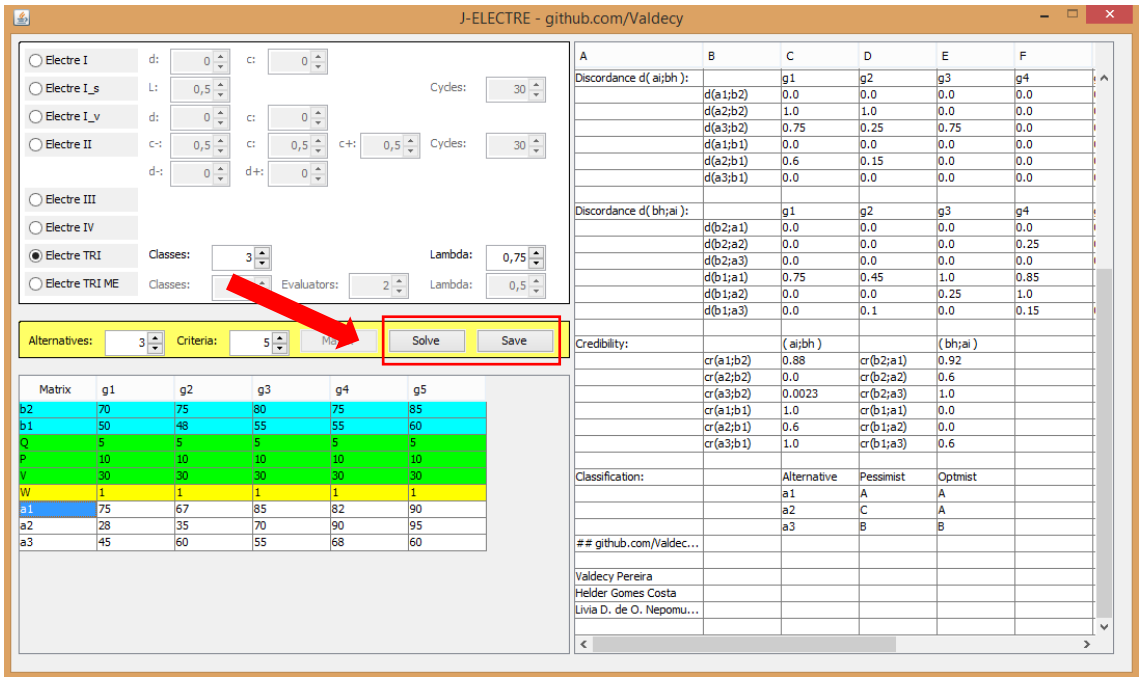
After Choosing ***Electre TRI*** method, two parameters need to be set: ***Classes*** (the total number of classes – varying from 2 to 100) and ***Lambda*** (cut-off level – varying from 0.5 to 1). For the given example ***Classes*** = 3 (hence we have two profiles: b2 and b1) and ***Lambda*** = 0.75.



Insert the number of ***Alternatives*** (varying from 2 to 1,000), ***Criteria*** (varying from 2 to 1,000) and press the ***Matrix*** button to build the performance matrix.



Insert the values in the performance matrix and then press the ***Solve*** button to solve the problem. To save (export) the results to a spreadsheet press the ***Save*** button.



The output contains: ***Concordance c(ai;bh)*** – (global concordance between alternative ***i*** and profile ***h***), ***Concordance c(bh;ai)*** – (global concordance between profile ***h*** and alternative ***i***), ***Discordance d(ai;bh)*** – (global discordance between alternative ***i*** and profile ***h***), ***Discordance d(bh;ai)*** – (global discordance between profile ***h*** and alternative ***i***), ***Credibility Matrix***, ***Classifcation Pessimist*** (from the upper profile ***bn*** to ***b1***, Class A > B > C...), ***Classification Optimist*** (from the lower profile ***b1*** to ***bn***, Class A > B > C...).

2.8 Electre TRI ME

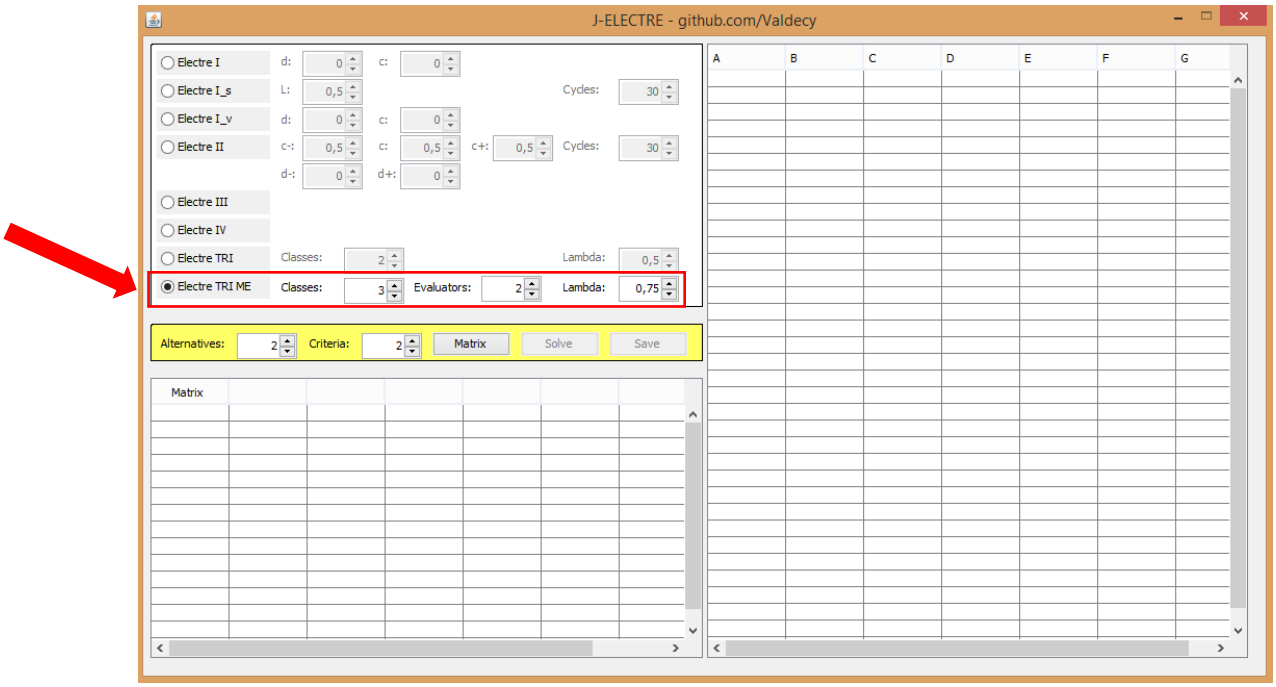
To explain how to use the **J-Electre-v1.0** in order to solve **Electre TRI ME** problems (developed by Livia Dias Nepomuceno and Helder Gomes Costa), the following example will be used:

	EV1(g1)	EV1(g2)	EV1(g3)	EV2(g1)	EV2(g2)	EV2(g3)
b2	2	3	3	3	3	2
b1	1	2	2	1	2	1
Q	0	0	0	0	0	0
P	0	0	0	0	0	0
V	5	5	5	5	5	5
W	0.1	0.2	0.2	0.3	0.3	0.1
a1	2	2	1	3	1	3
a2	0	2	1	0	0	0
a3	1	3	3	2	1	1

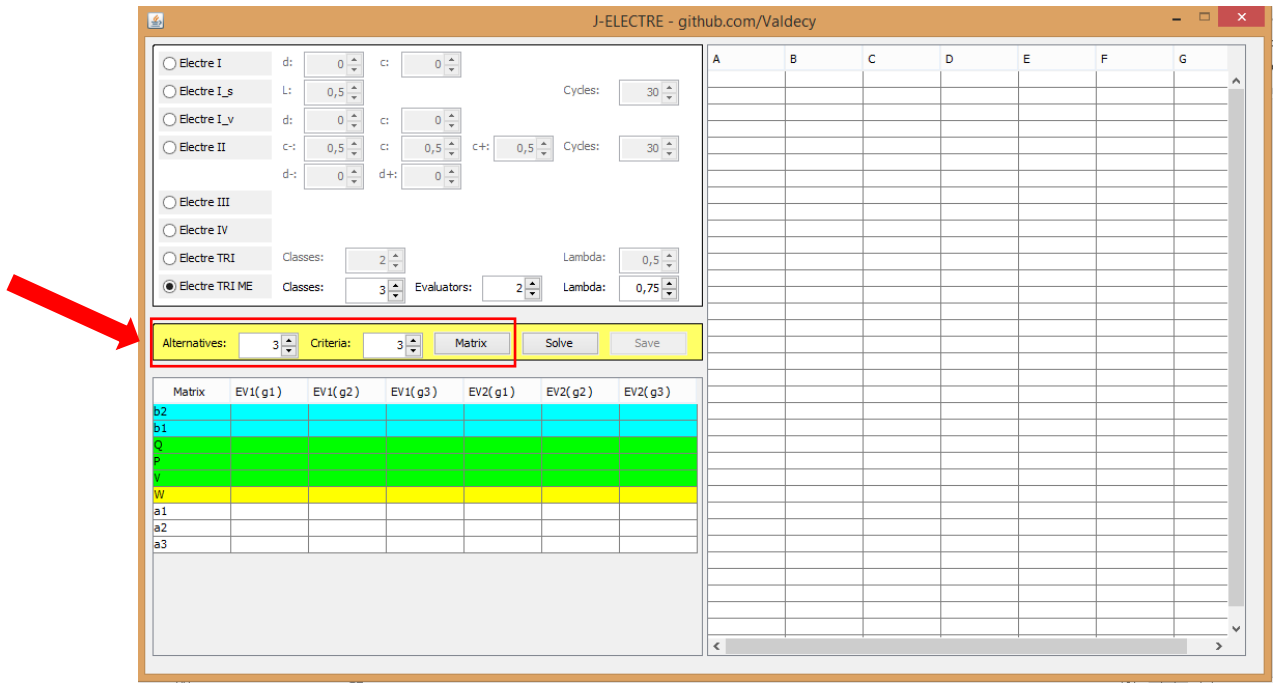
This problem has 3 alternatives (*a1, a2, a3*), 3 criteria (*g1, g2, g3, g4*) and two Evaluators (*EV1*, *EV2*). Each evaluator judges the same set of criteria and have their own set of weights (which may be the same). The ***bn*** rows represents the profiles (respecting: $\boldsymbol{b_n \geq b_{n-1}}$). The ***Q*** row represents the weak preference, the ***P*** row represents the strong preference, the ***V*** row

represents the Veto (respecting: $\boldsymbol{V \geq P \geq Q}$) and finally, the weights (importance) of each criterion is represented by the ***W*** row.

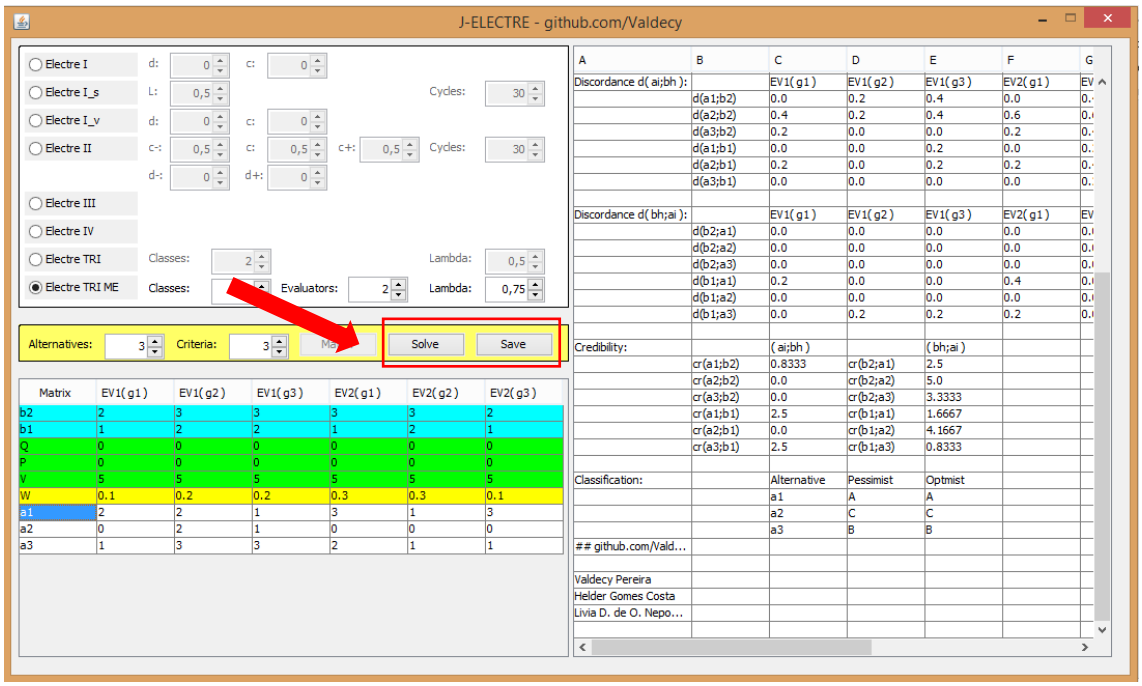
After Choosing ***Electre TRI ME*** method, three parameters need to be set: ***Classes*** (the total number of classes – varying from 2 to 100), Evaluators (the total number of evaluators, judges or decision makers – varying from 2 to 100) and ***Lambda*** (cut-off level – varying from 0.5 to 1). For the given example ***Classes*** = 3 (hence we have two profiles: b2 and b1), ***Evaluators*** = 2 and ***Lambda*** = 0.75.



Insert the number of ***Alternatives*** (varying from 2 to 1,000), ***Criteria*** (varying from 2 to 1,000) and press the ***Matrix*** button to build the performance matrix.



Insert the values in the performance matrix and then press the ***Solve*** button to solve the problem. To save (export) the results to a spreadsheet press the ***Save*** button.



The output contains: ***Concordance c(ai;bh)*** – (global concordance between alternative ***i*** and profile ***h***), ***Concordance c(bh;ai)*** – (global concordance between profile ***h*** and alternative ***i***), ***Discordance d(ai;bh)*** – (global discordance between alternative ***i*** and profile ***h***), ***Discordance d(bh;ai)*** – (global discordance between profile ***h*** and alternative ***i***), ***Credibility Matrix***, ***Classifcation Pessimist*** (from the upper profile ***bn*** to ***b1***, Class A > B > C…), ***Classification Optimist*** (from the lower profile ***b1*** to ***bn***, Class A > B > C…).

3- References

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