Partial Order Ranking Tools
PyHasse

PyHasse software

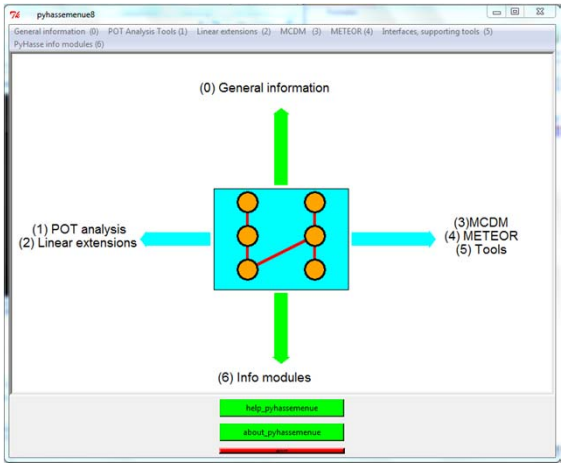
- for partial order ranking studies

Developed by Dr. Rainer Brüggemann, Berlin

Lars Carlsen

Partial Order Ranking Tools
PyHasse
pyhassemenu8_2

PyHasse MENU



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The PyHasse software package

POT analysis (POT: Partial Order Theory) with 16 modules

Linear Extensions with 7 modules, incl. approximate methods
to get a weak (linear) order

Multi-Criteria Decision Methods (MCDM) with 9 modules,
incl. a simple version of PROMETHEE

METEOR (METhod of Evaluation by Order theory) with 6 modules
Incl. a fuzzy-like concept

The module mainHD19 allows to obtain the results
of a partial order analysis directly suitable for graphviz

PyHasse modules included

	Module ID	
PyHasse MAIN	mainHD9_3_4	
HD info module	HDalter6	(contains a simple graphic editor)
Sensitity analysis	sensitivity18_3	
Avarage rank EXACT	avrank4	
Average rank LPOM	hdgt5	
Chain analysis	chain7	
Antichain analysis	antichain7excel	
Separability	sepanal15_3	
Similarity	similarity7	
Dominance analysis	dss11	
Fuzzy partial order	fuzzyHD13	
Stability	stability4	
HD vs Composite Indicators	HDCI6	
Discretization	discretiz2	

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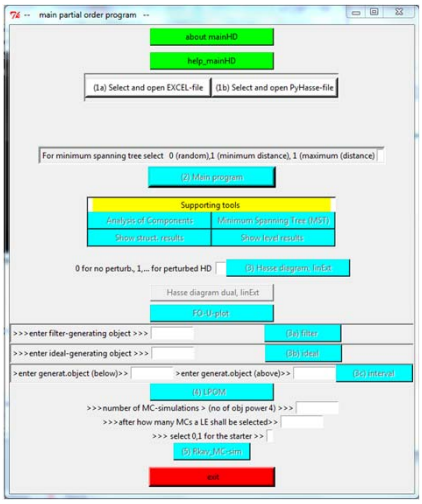
mainHD9_3_4

PyHasse MAIN



Main module in PyHasse

- Hasse diagrams
- down sets, up sets
- intervals
- structural information level
- linear extensions
- LPOM-Model
- minimum spanning tree
- components etc.

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An example

Objects

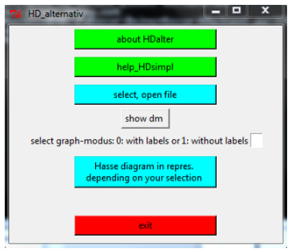
nt, ch, tt, tr, pe, at, ed, ph,

Properties

Volat, Sedim, Persist, Advec,

Data Matrix (DM)

	Volat	Sedim	Persist	Advec
nt	1.0	1.0	0.0	1.0
ch	4.0	1.0	2.0	2.0
tt	4.0	1.0	2.0	3.0
tr	4.0	2.0	2.0	2.0
pe	3.0	2.0	2.0	3.0
at	1.0	2.0	2.0	4.0
ed	1.0	1.0	1.0	3.0
ph	3.0	2.0	2.0	4.0



HDalter6

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The input file

Larseia GI Berlin.txt - Notesblok

Filer Rediger Formater Vis Hjælp

mainchem	Volat	Sedim	Persist	Advec
nt	1	1	0	1
ch	4	1	2	2
tt	4	1	2	3
tr	4	2	2	2
pe	3	2	2	3
at	1	2	2	4
ed	1	1	1	3
ph	3	2	2	4

Tab-separated *.txt file generated from *.xls

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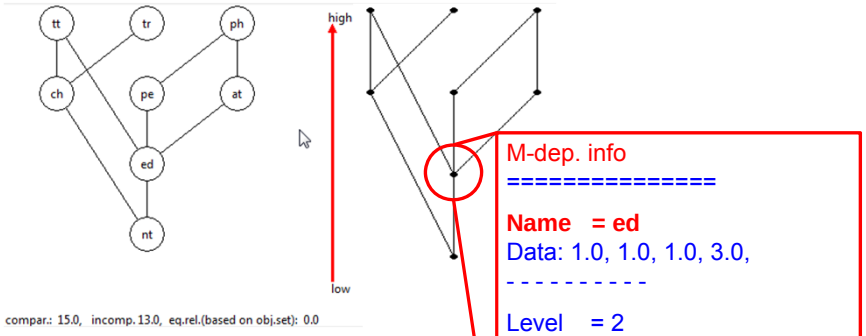
Hasse Diagram



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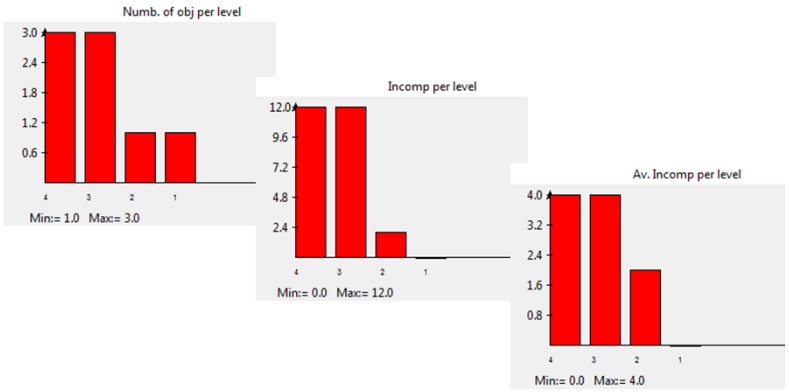
Hasse Diagram



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Hasse Diagram

Successors

object nt: (0)
object ch: (1) nt ,
object tt: (3) nt ,ch ,ed ,
object tr: (2) nt ,ch ,
object pe: (2) nt ,ed ,
object at: (2) nt ,ed ,
object ed: (1) nt ,
object ph: (4) nt ,pe ,at ,ed ,

Predecessors

object nt: (7) ch, tt, tr, pe, at, ed, ph,
object ch: (2) tt, tr,
object tt: (0)
object tr: (0)
object pe: (1) ph,
object at: (1) ph,
object ed: (4) tt, pe, at, ph,
object ph: (0)

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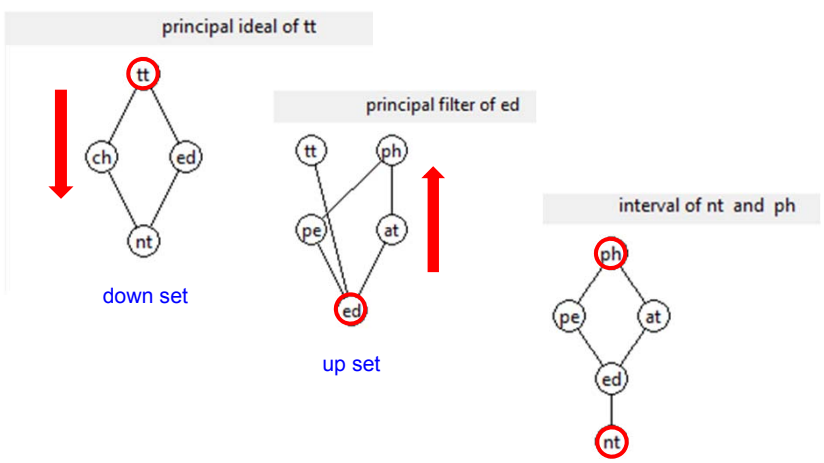
Hasse Diagram



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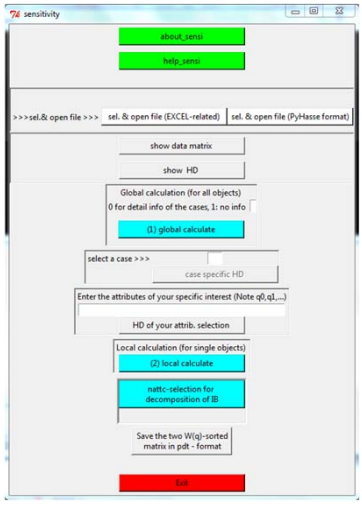
Sensitivity18_3

Sensitivity analysis



Which indicator s are the more important for the structure of the partial order ranking

1) Global sensitivity

2) Sensitivity with respect to single objects (local analysis)

3) Decomposition of IB

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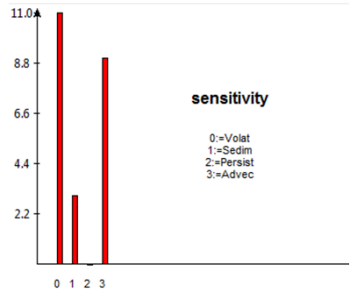
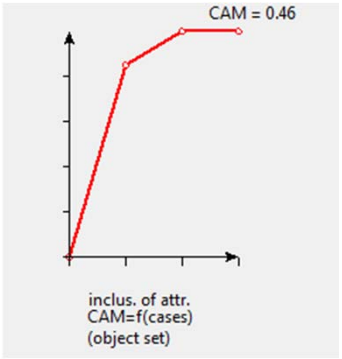
Sensitivity analysis an example

Global sensitivity





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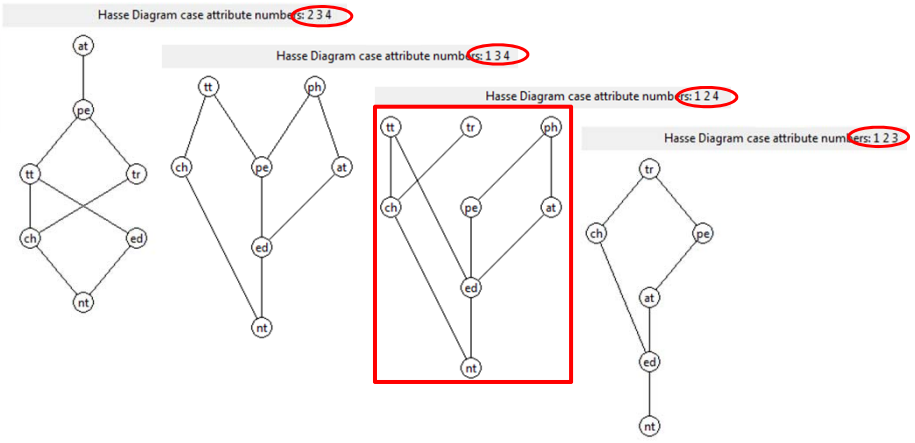
Sensitivity analysis an example

Global sensitivity



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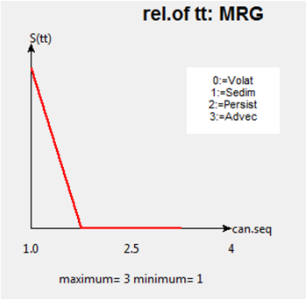
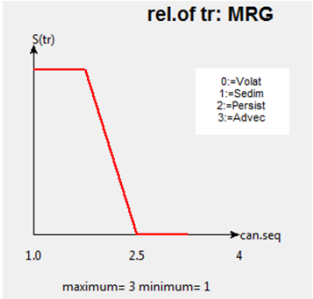
Sensitivity analysis an example

Local sensitivity





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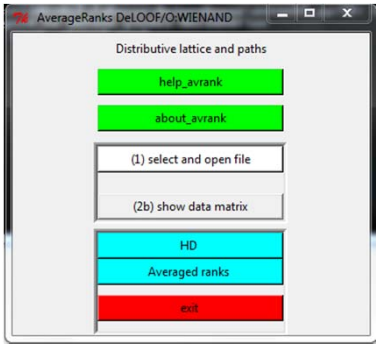
Averaged ranks EXACT



Calculation of exact averaged ranks due to distributive lattices.

works for low number of objects and attributes only

The program is based on the work of O. Wienand, whose program lcell.py (version 0.2 of 2006) was modified.

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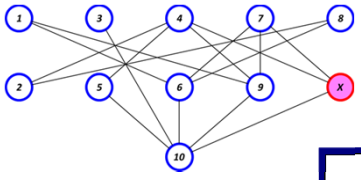
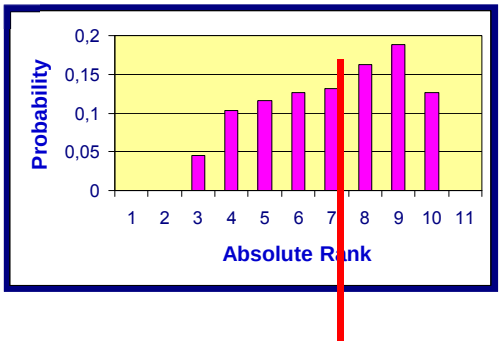
Averaged ranks

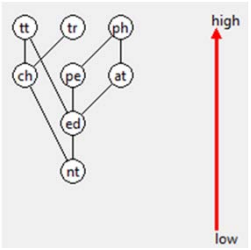




Average rank, *Rkav* = 7.2

Averaged ranks EXACT an example

```
averaged ranks : Method of Oliver Wienand
=========================================
```



nt:	1.0
ch:	3.094
tt:	6.266
tr:	6.047
pe:	4.898
at:	4.898
ed:	2.438
ph:	7.359

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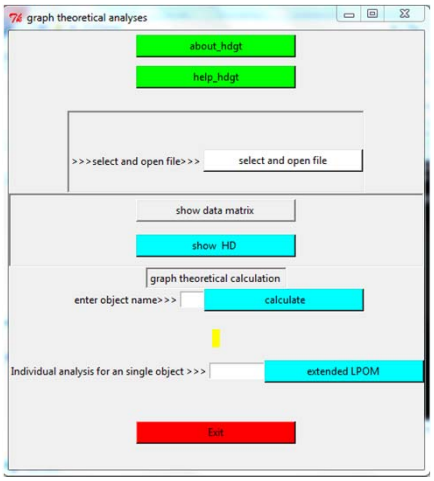
Averaged ranks – LPOM0 & LPOMext



Basic idea:

a) Finding equivalence classes for an object due to different graph theoretical distance-concepts (LPOMext).

b) LPOMext with analysis of the contributions to Rkav

c) Also calculates Rkav based on LPOM0

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Averaged ranks – LPOM0 - an example

Elements in principal	order ideal	order filter	incomparables	Rkav (LPOM0)
nt:	1	8	0	1.0
ch:	2	3	4	3.6
tt:	4	1	4	7.2
tr:	3	1	5	6.75
pe:	3	2	4	5.4
at:	3	2	4	5.4
ed:	2	5	2	2.571
ph:	5	1	3	7.5

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Averaged ranks – LPOMext - an example

Element	Rkav (LPOMext)	minRank	increment
nt:	1.0	1	0.0
ch:	3.083	2	1.083
tt:	6.667	4	2.667
tr:	6.167	3	3.167
pe:	4.833	3	1.833
at:	4.833	3	1.833
ed:	2.367	2	0.367
ph:	7.35	5	2.35

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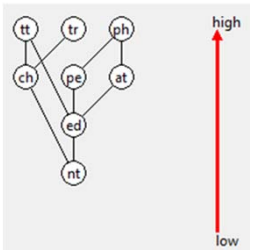
Averaged ranks – LPOM0, LPOMext & EXACT- an example

Element	Rkav (LPOM0)	Rkav (LPOMext)	Rkav (Exact)
nt:	1.0	1.0	1.0
ch:	3.6	3.083	3.094
tt:	7.2	6.667	6.266
tr:	6.75	6.167	6.047
pe:	5.4	4.833	4.898
at:	5.4	4.833	4.898
ed:	2.571	2.367	2.438
ph:	7.5	7.35	7.359



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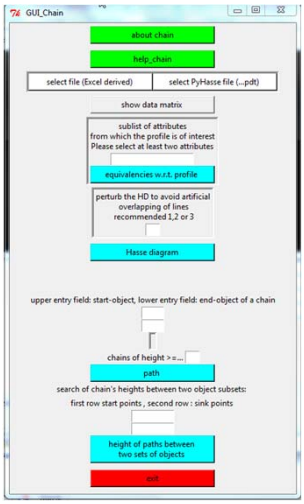
Chain analysis



Information about chains

a) in detail for two objects
(one as start (source) of the chain
and one as the end (sink) of a chain)

b) General information for two sets:
one of sources
and one of sinks

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Chain analysis – an example

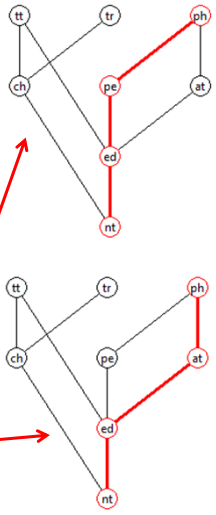
Selected start-point nt
Selected end-point ph
Selected min-height 1

General information:
there are chains with elements >= 1

Number of chains of height ≥ 1: 2
Average number of objects per chain: 4.0

The individual chains

count of elements in the chain: 4: nt, ed, pe, ph
count of elements in the chain: 4: nt, ed, at, ph



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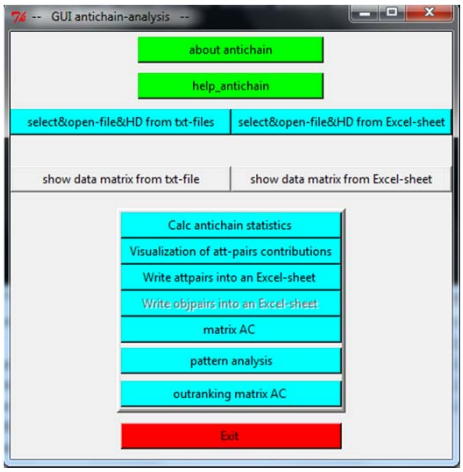
Antichain analysis



Analysis of antichains:

- Which object pair is most often separated by the attributes
- Which attribute pair is most often participating in the separation of the object pairs

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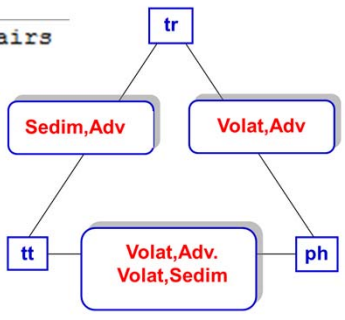
Antichain analysis - an example

```
Attributspair-characteristics
['Volat', 'Sedim']: 1  density (/d1):0.33
['Volat', 'Persist']: 0  density (/d1):0.0
['Volat', 'Advec']: 2  density (/d1):0.67
['Sedim', 'Persist']: 0  density (/d1):0.0
['Sedim', 'Advec']: 1  density (/d1):0.33
['Persist', 'Advec']: 0  density (/d1):0.0
```

```
Individual analysis: attribute pairs

Volat Sedim: tt ph,
Volat Persist:
Volat Advec: tt ph, tr ph,
Sedim Persist:
Sedim Advec: tt tr,
Persist Advec:
```



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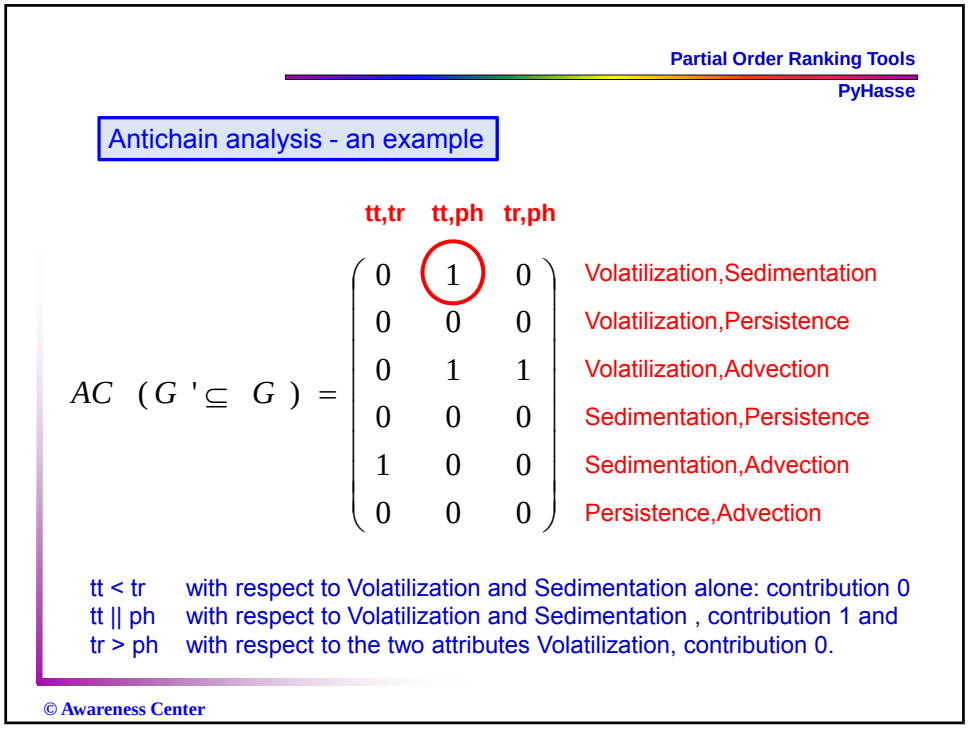

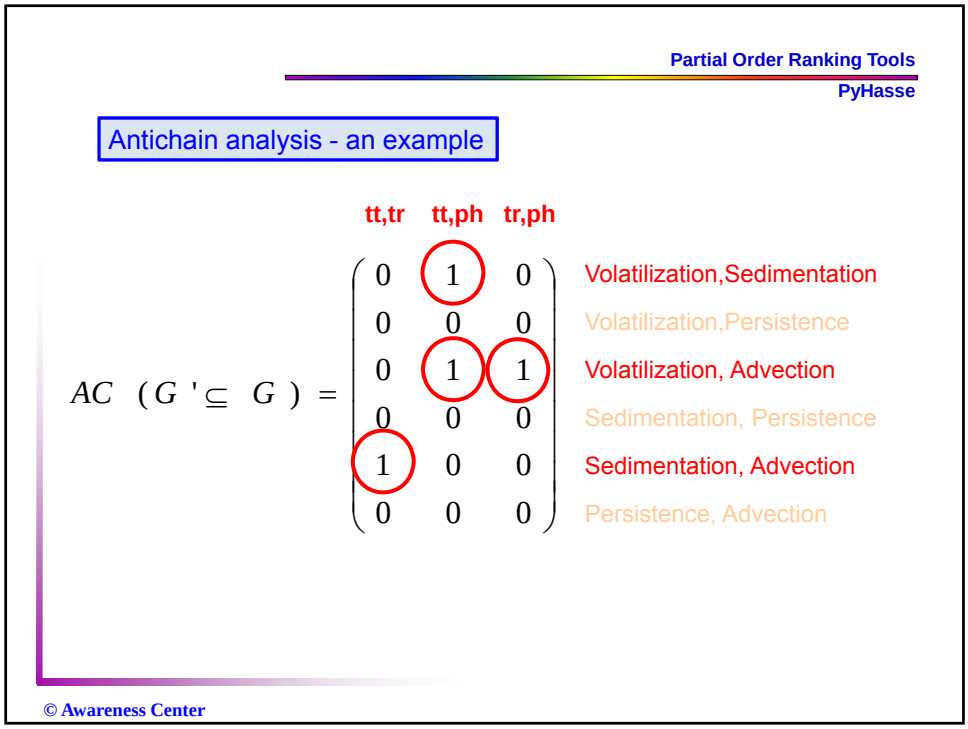

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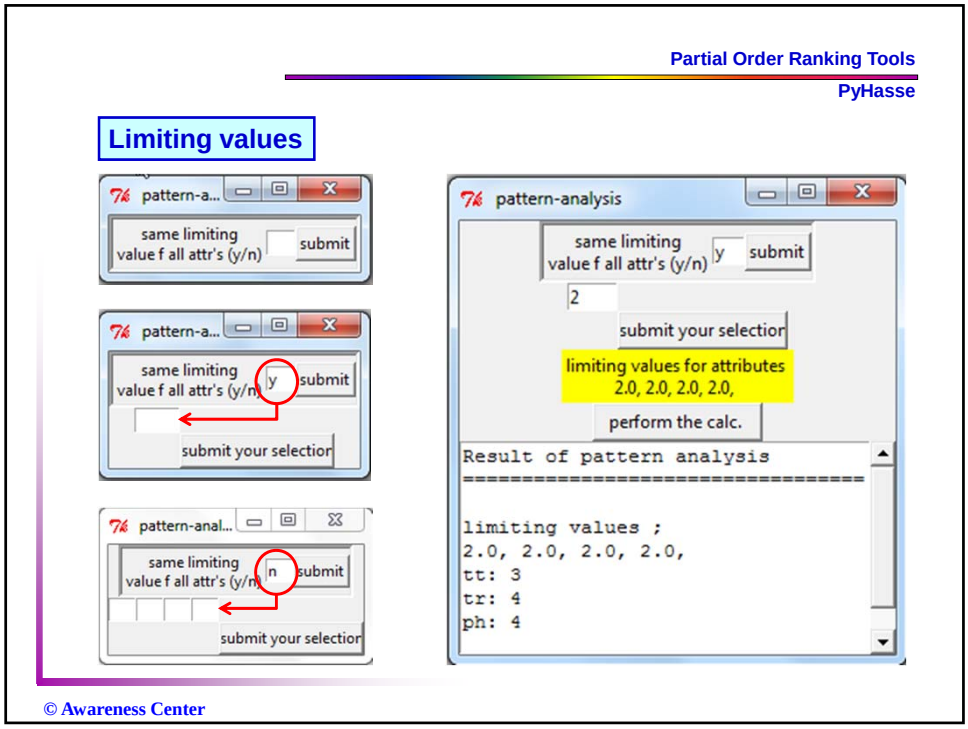

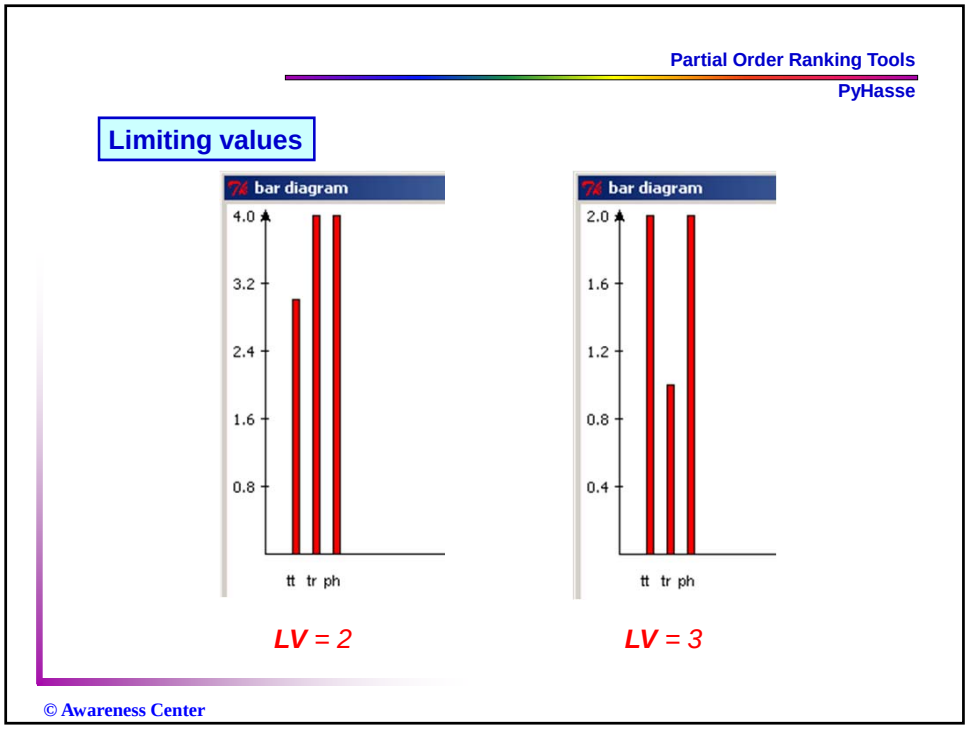

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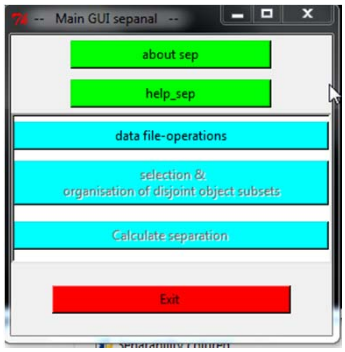
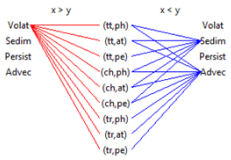
Separability analysis



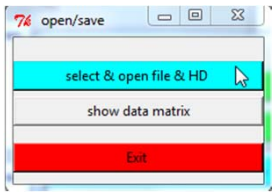
Subsets of objects may be separated.

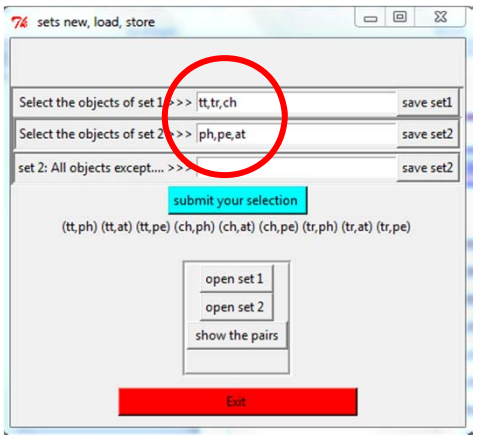
What is the configuration in terms of the attribute set

Returns among others tripartite graphs



Separability analysis





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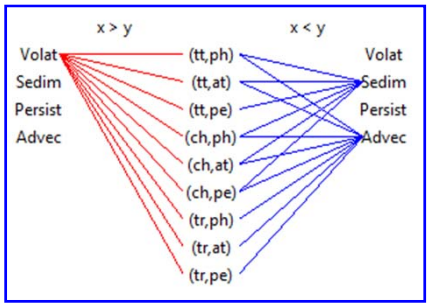
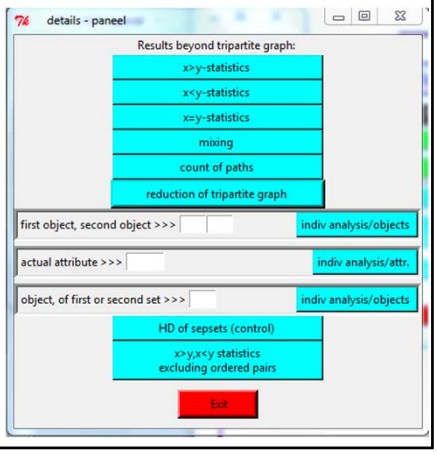
Separability analysis – the tripartite graph





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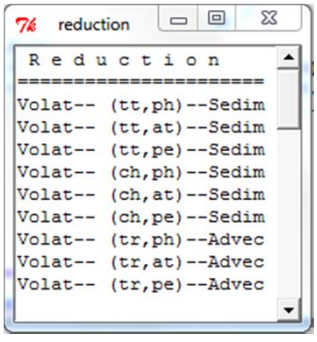
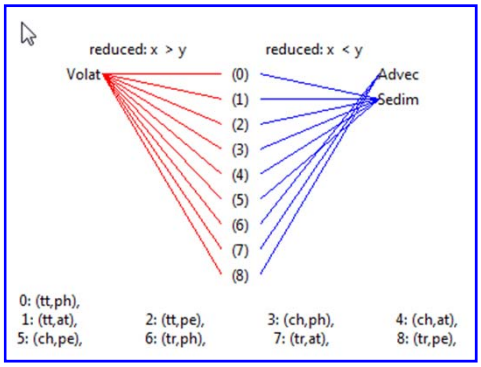
Separability analysis – the reduced tripartite graph





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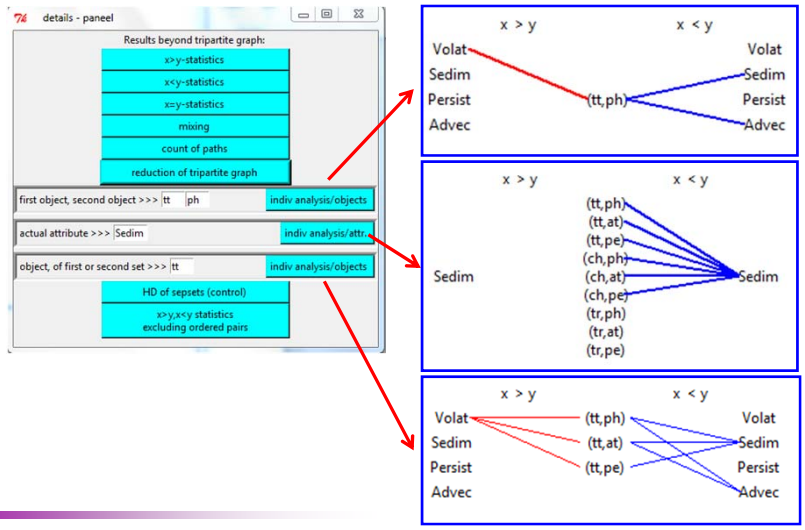
Separability analysis – individual objects pairs



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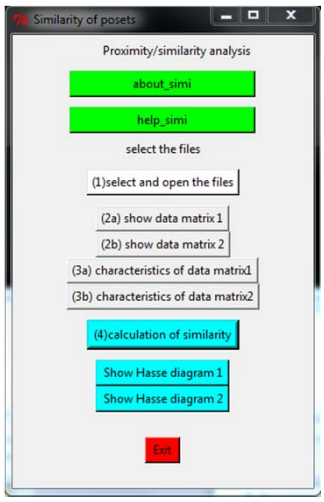
similarity7

Similarity analysis



A similarity profile will be calculated
and presented as a bar diagram

Calculation of 'similarity'

isotone	: >> or <<
antitone	: <> or ><
'wiso' (weak isoton)	: < or > meets =
indiff	: all combinations with ǁ
ident	: ==

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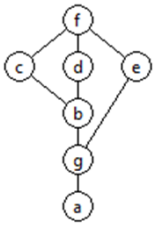
Similarity analysis – an example

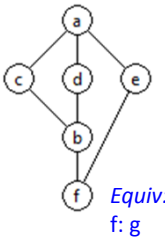
Data Matrix 1

	q1	q2
a	1.0	1.0
b	2.0	2.0
c	4.0	3.0
d	2.0	5.0
e	1.0	7.0
f	8.0	8.0
g	1.0	2.0



Data Matrix 2

	q1	q2
a	8.0	8.0
b	2.0	2.0
c	4.0	3.0
d	2.0	5.0
e	1.0	7.0
f	1.0	1.0
g	1.0	1.0



Equiv:
f: g

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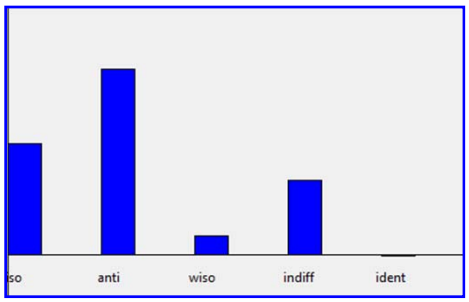
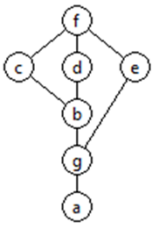
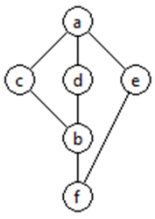
Similarity analysis – an example

Results of similariy analysis

isoton	antiton	wiso	indiff	ident
12	20	2	8	0
>> or <<	<> or ><	< or >	all ‖	==
		meets =		







Note the changed
position of a and f

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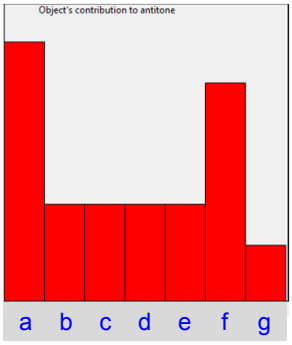
Partial Order Ranking Tools
PyHasse

Similarity analysis – an example

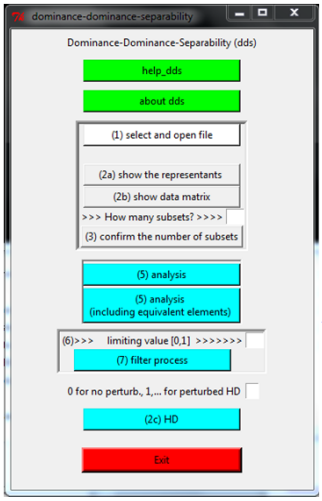
Contribution of objects to antitone

Object	#antitone	#degree_antitone
a	6	0.86
b	2	0.29
c	2	0.29
d	2	0.29
e	2	0.29
f	5	0.71
g	1	0.14
Total	20	



Partial Order Ranking Tools
PyHasse
dss11

Dominance analysis



Partition the object set (with or without equivalent Elements) relatively to the equality relation of Data matrix.

a) What is the dominance among the classes and what their separabilities.

b) The Dom-matrix will interpreted as an adjacency matrix in dependence of the limiting value for dominance degrees.

Taken the relation between x of set i and y of set j as given

(1) then a relation x > y counts for domination of set i over set j
(2) then a relation x < y counts for domination of set j over set i
(3) then a relation x ǁ y counts for separability of set i and set j
(4) the diagonal elements of the domination matrix count for...
  a) reflexivity of any element of the set and...
  b) the < relations among the elements of this set.

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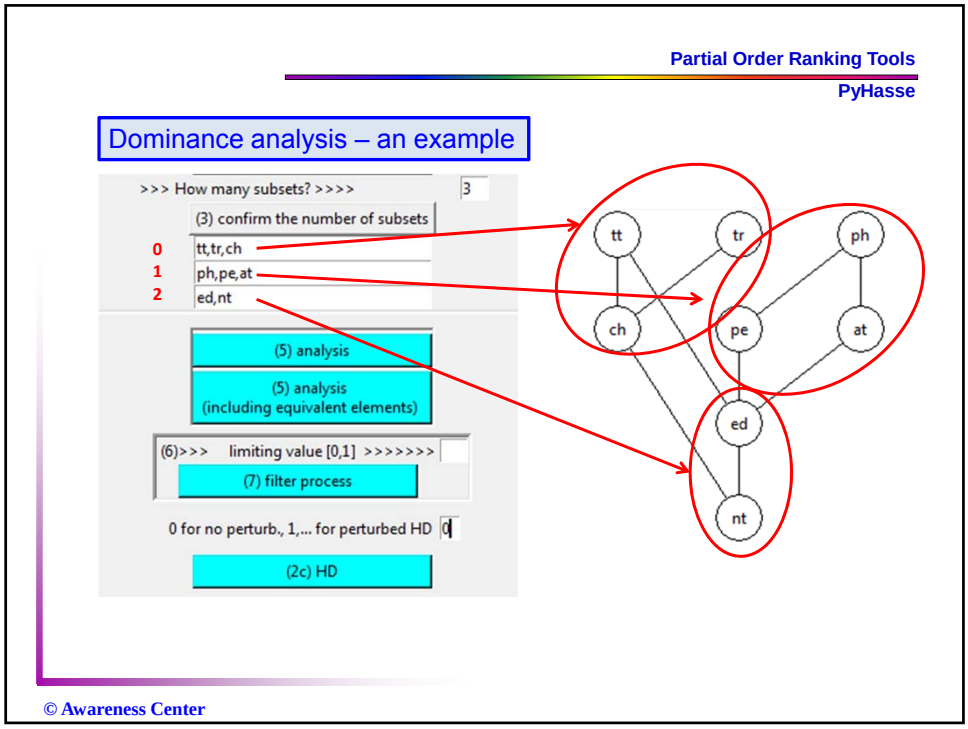

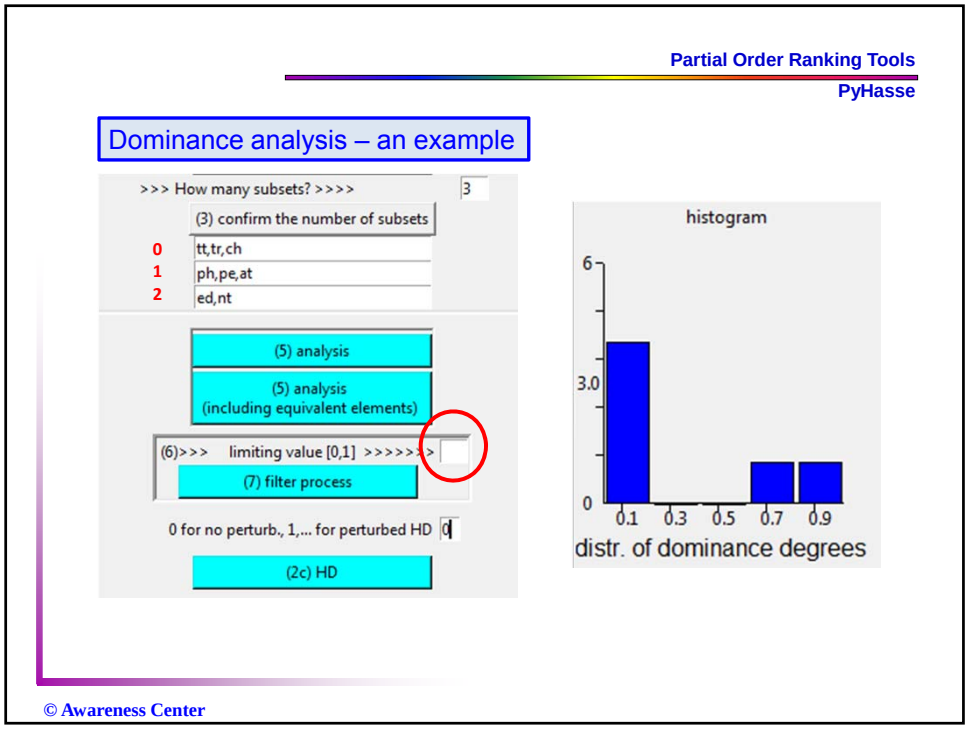

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Partial Order Ranking Tools
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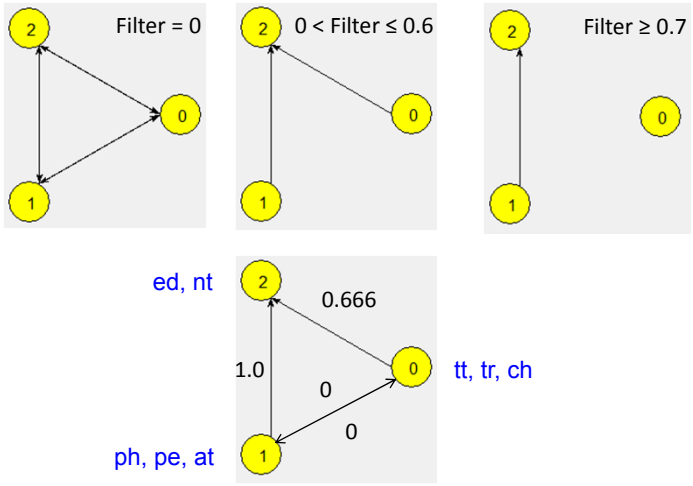
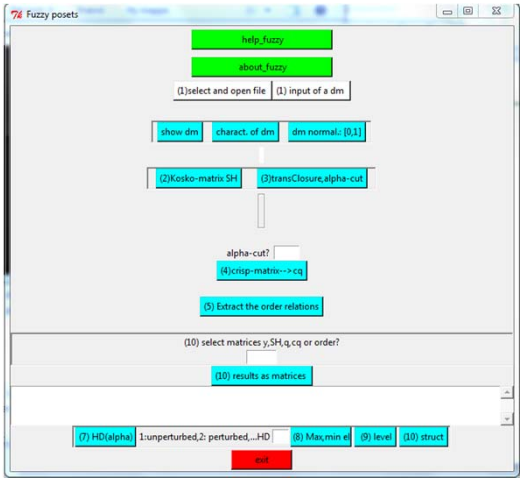
Dominance analysis – an example



Partial Order Ranking Tools
PyHasse
fuzzyHD13

Fuzzy Partial Order



Basic idea: Replace ≤-relation by a fuzzy subset - hood.

a) Installs an approximative transitive closure.

b) Perform a defuzzification

The ≤ - relation is replaced by the Kosko-Subsethood-Ansatz

Calculates the transitive closure of fuzzy relations alpha-cuts are determined

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Partial Order Ranking Tools
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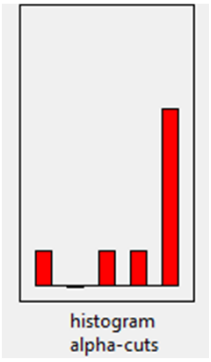
Fuzzy Partial Order – an example

Data of histogram

0	0.2	0.4	0.6	0.8	1
1	0	1	1	5	



histogram
alpha-cuts

alpha-cuts

0.0 No differences in data play a role
0.437
0.7
0.818 differences in data play an increasing role
0.875
0.9
0.909
1.0 All difference in data plays a role

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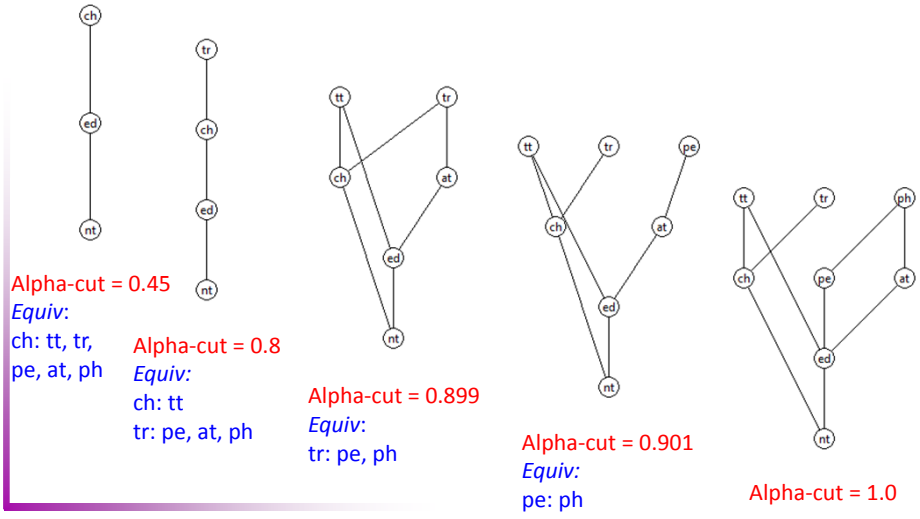
Partial Order Ranking Tools
PyHasse

Fuzzy Partial Order – an example



Alpha-cut = 0.45
Equiv:
ch: tt, tr,
pe, at, ph

Alpha-cut = 0.8
Equiv:
ch: tt
tr: pe, at, ph

Alpha-cut = 0.899
Equiv:
tr: pe, ph

Alpha-cut = 0.901
Equiv:
pe: ph

Alpha-cut = 1.0

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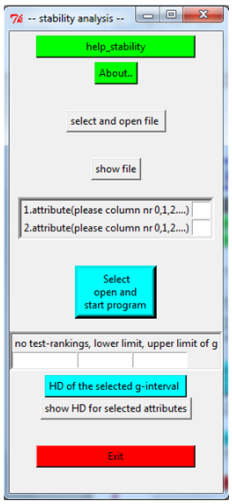
Partial Order Ranking Tools
PyHasse
stability4

Stability analysis



Stability calculates:

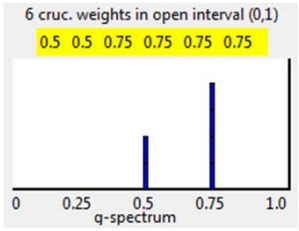
(1) values of crucial weights

(2) the g-spectrum

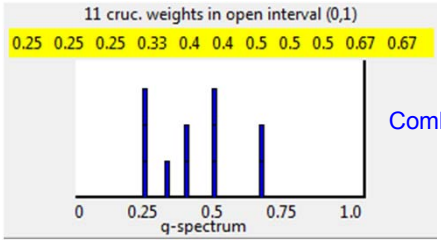
(3) linear orders (quotient set) in stability fields

Partial Order Ranking Tools
PyHasse

Stability analysis – an example



Combining the attributes: 'Volat' and 'Sedim'



Combining the attributes: 'Volat' and 'Advec'

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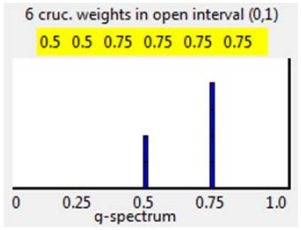
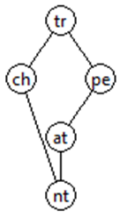
Partial Order Ranking Tools
PyHasse

Stability analysis – an example



Linear orders in stability fields

weight = 0.01 :nt ed ch tt at pe ph tr
weight = 0.51 :nt ed at ch tt pe ph tr
weight = 0.76 :nt ed at pe ph ch tt tr
weight = 1.01 :at nt ed pe ph tr ch tt



HD based on the attributes
'Volat' and 'Advec'

Equiv:
nt: ed
ch: tt
pe: ph

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Partial Order Ranking Tools
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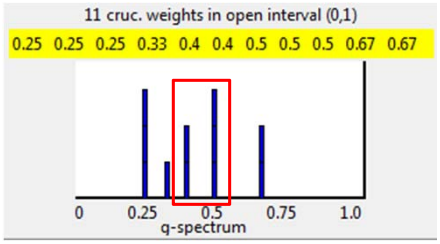
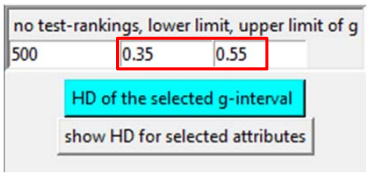
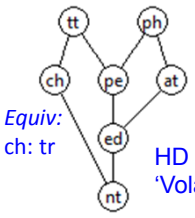
Stability analysis – an example

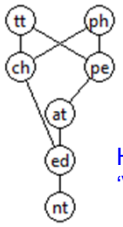






Equiv:
ch: tr

HD based on the attributes
'Volat' and 'Advec'



HD of selected g-range
'Volat' and 'Advec'

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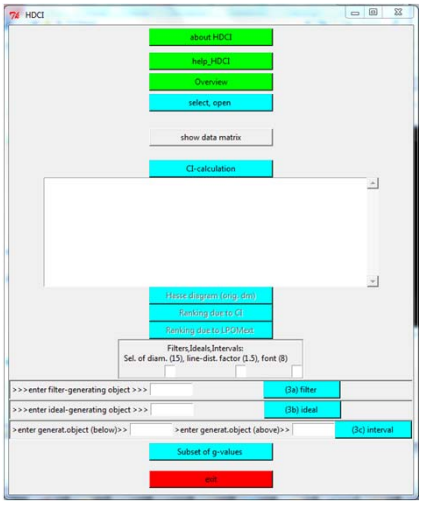
Partial Order Ranking Tools
PyHasse
HDCI6

Hasse Diagram vs Composite Indicator



Calculation of the CI with weights-input by the user.

1) Standard:
- Calculation of the CI
- HD is shown with the CI-values in the circles.

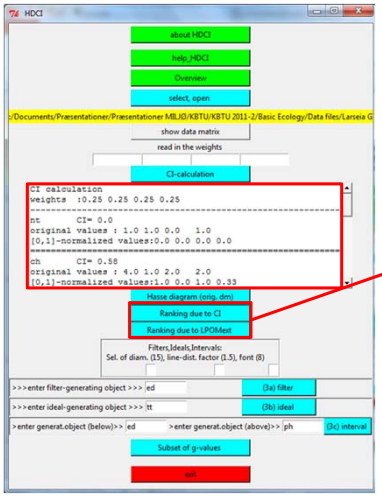
2) Analysis tools:
weight intervals and

a) what partial order is obtained

b) Let x < y or x > y: by which combinations of weights the order relation between x and y can be realized.

Partial Order Ranking Tools
PyHasse

Hasse Diagram vs Composite Indicator – an example



Sequence due to CI, increasing

Object	Rank due to CI	Rkav (LPOMext)
nt	0.0	1.0
ed	0.292	2.367
ch	0.583	3.083
tt	0.667	6.667
at	0.75	4.833
pe	0.833	4.833
tr	0.833	6.167
ph	0.917	7.35

Equivalences due to the CI-values
}{nt: }{ch: }{tt: }{tr: pe }{at: }{ed: }{ph:

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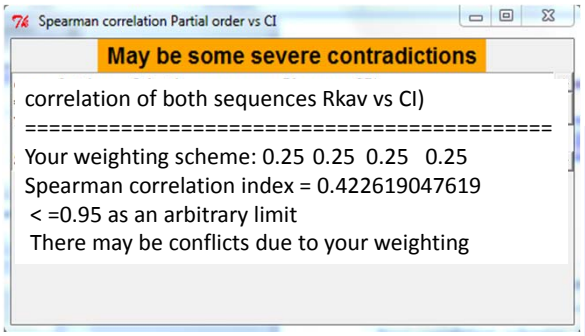
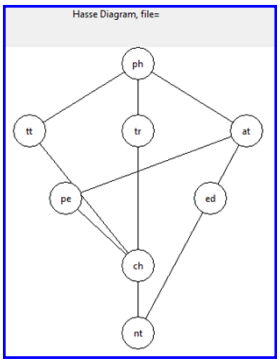
Partial Order Ranking Tools
PyHasse

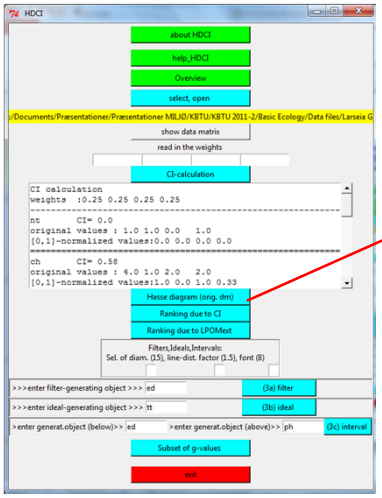
Hasse Diagram vs Composite Indicator – an example

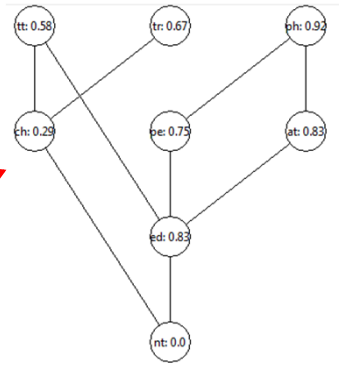




Partial Order Ranking Tools
PyHasse

Hasse Diagram vs Composite Indicator – an example





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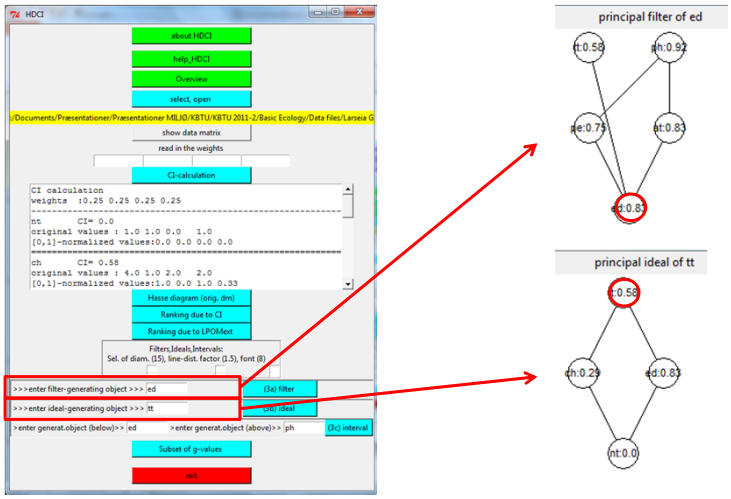
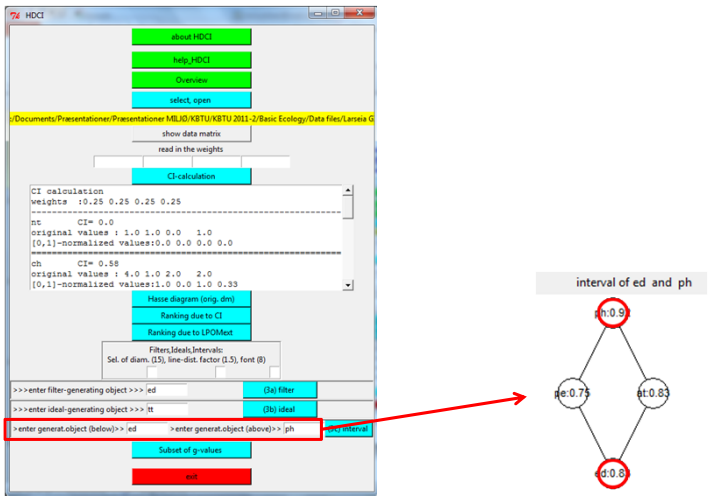
Partial Order Ranking Tools
PyHasse

Hasse Diagram vs Composite Indicator – an example



Partial Order Ranking Tools
PyHasse

Hasse Diagram vs Composite Indicator – an example



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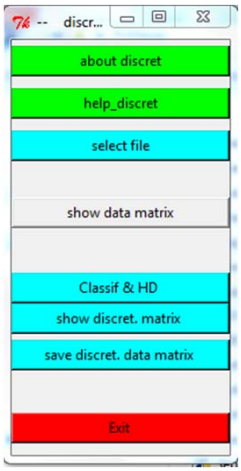
Discretization



Discretization of attributes, continuous in concept.

HD on the fly

Transfomed data matrix is available for PyHasse MAIN

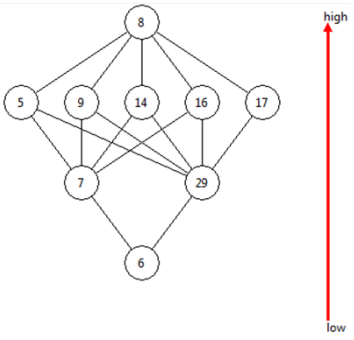
Discretization – an example

Data Matrix

	Pbn	Cdn	Znn
5	0.5	0.47	0.45
6	0.18	0.06	0.0
7	0.45	0.35	0.25
8	1.0	0.76	0.6
9	0.73	0.47	0.25
14	1.0	0.35	0.27
16	0.65	0.5	0.36
17	1.0	0.36	0.15
22	0.45	0.35	0.25
29	0.5	0.0	0.0

Min and Max of any column

q(0)	q(1)	q(2)
0.18	0.0	0.0
1.0	0.76	0.6



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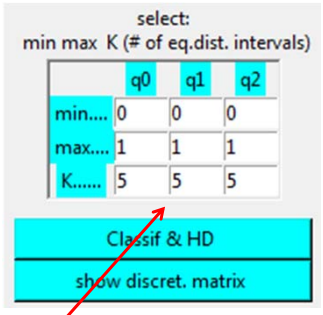
Partial Order Ranking Tools
PyHasse

Discretization – an example



5 equidistant levels are chosen

Discretized Data Matrix

	Pbn	Cdn	Znn
5	2.0	2.0	2.0
6	0.0	0.0	0.0
7	2.0	1.0	1.0
8	4.0	3.0	3.0
9	3.0	2.0	1.0
14	4.0	1.0	1.0
16	3.0	2.0	1.0
17	4.0	1.0	0.0
22	2.0	1.0	1.0
29	2.0	0.0	0.0

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Partial Order Ranking Tools
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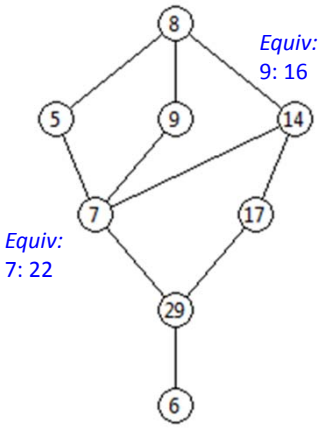
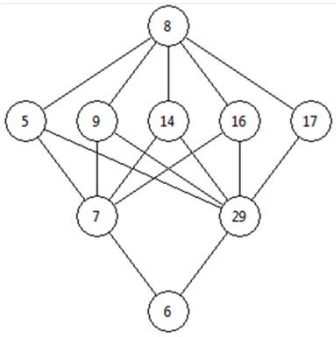
Discretization – an example



Equiv:
9: 16

Equiv:
7: 22



Loss of information / details
compared to the original HD

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Availability

The PyHasse software originates from Dr. Rainer Brüggemann,
retired senior scientist from
Leibniz - Institute of Freshwater Ecology and Inland Fisheries Berlin

The software has the prefix “Py” because the programming language is
(the freely downloadable) Python, presently version Python 2.6.6 is applied.

The software is continuously under further development.
The latest version is available upon request from
Dr. Brüggemann: BRG_home@web.de

Partial Order Ranking Tools
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