FCAvizIR: Exploring Relational Data Set's Implications Using Metrics and Topics

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CONCEPTS'24

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Context

Analyzing data through implications in FCA/RCA setting

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- “What can we remember and gather from the data forgetting the objects? Answers to this question would help in abstracting the meaning of things” [Duquenne, 2013]

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- Digital Debate domain: Stimulating debates and enriching the lexico-semantic KB [Ben Sassi et al., 2024]

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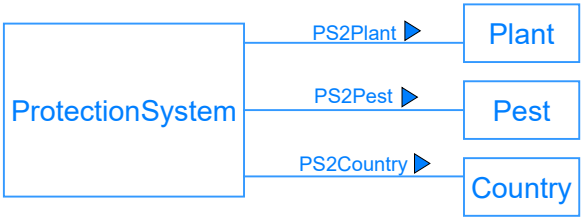
RCA in a nutshell

Dataset model: Several formal contexts (4) and relational contexts (3)

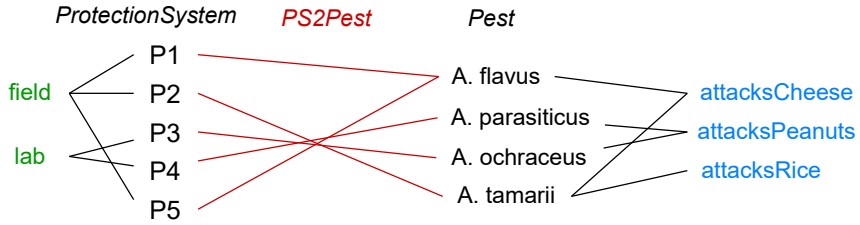


Excerpt from Knomana [Silvie et al., 2021]

P1 (Protection System in the field) developed in Namibia (Country): Cinnamomum zeylanicum (Plant) is used to control Aspergillus flavus (Pest)

A protection system indicates
a plant usage to control a pest (bioagressor) in a given country

From the dataset to Pest concept CP11



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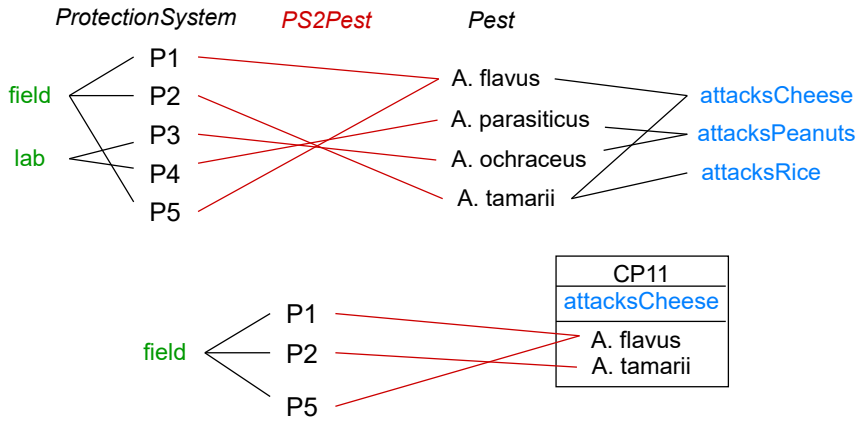
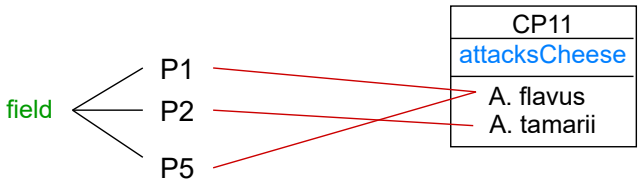


From Pest concept CP11 to Relational Attribute ∃PS2Pest(CP11) and Protection System concept CPS2



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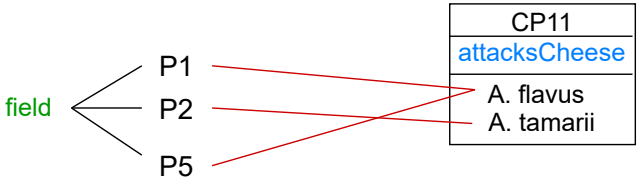
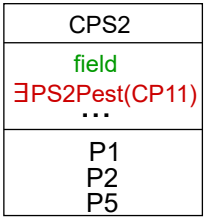
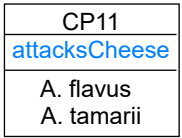


CPS2
field ∃PS2Pest(CP11) …
P1 P2 P5

CP11
attacksCheese
A. flavus A. tamarii

Simplification of Relational Attribute ∃PS2Pest(CP11) using simplified intent attacksCheese





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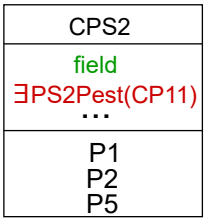

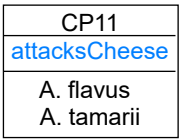

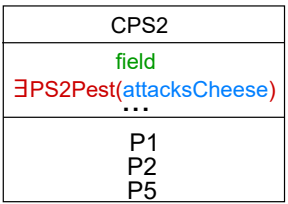

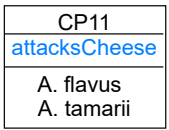

Application to the whole model (4 formal contexts and 3 relational contexts): extended formal context Protection System

ProtSyst	field	lab	∃PS2Pest(attacksRice)	∃PS2Pest(attacksCheese)	∃PS2Pest(attacksPeanuts)	∃PS2Pest(aspergillus)	∃PS2Country(australAfrica)	∃PS2Country(westernAfrica)	∃PS2Plant(contraceptive)	∃PS2Plant(antidysenteric)	∃PS2Plant(lauraceae*)	∃PS2Plant(asteraceae**)	∃PS2Plant(aromatic&evergreen)
P1	x			x		x	x				x		x
P2	x		x	x		x	x				x		x
P3		x			x	x		x				x	x
P4		x			x	x		x	x			x	x
P5	x			x		x	x			x		x	x

Implications are computed from the extended formal context Protection System

A few implications of the Duquenne-Guigues base of implications [Guigues and Duquenne, 1986]:

∃PS2Pest(aspergillus),∃PS2Plant(lauraceae&comestible&applicOil),∃PS2Plant(aromatic&evergreen) ⇒ field,∃PS2Pest(attacksCheese),∃PS2Country(australAfrica)

∃PS2Pest(aspergillus),∃PS2Country(westernAfrica),∃PS2Plant(aromatic&evergreen) ⇒ lab,∃PS2Pest(attacksPeanuts),∃PS2Plant(asteraceae&toxic&applicEssentialOil&applicExtract)

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(...)

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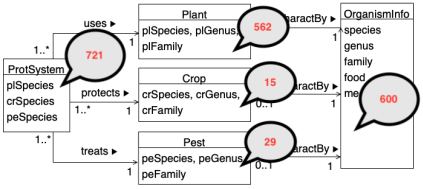
Facing the number and complexity of implications

Example on a real data model [Mahrach et al., 2021]



Duquenne-Guigues bases of implications (# implications with support $\neq 0$)

- 1391 on protection systems
- 1815 on plants
- 70 on crops
- 80 on pests
- 1168 on organism information

Facing the number and complexity of implications

Principles

- Visualization to support result exploration

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- Separate relations and their targets in relational attributes
- Use the content of the implications

Requirements

- **R0** Filtering with various metrics to rapidly localize implications with certain values of these metrics

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- **R0** Filtering with various metrics to rapidly localize implications with certain values of these metrics
- **R1** Clustering based on common elements (relations or attributes) in their premise or conclusion.
- **R2** Estimating the quantity of implications in the formed groups.
- **R3** Navigating among topic-based implication groups by refining/enlarging the selection step-by-step.

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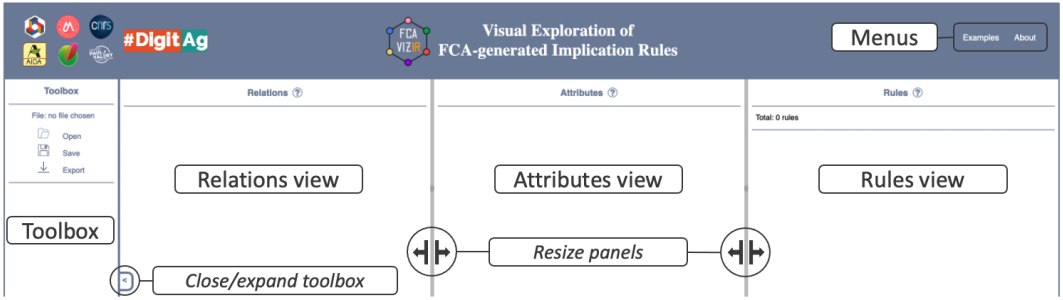
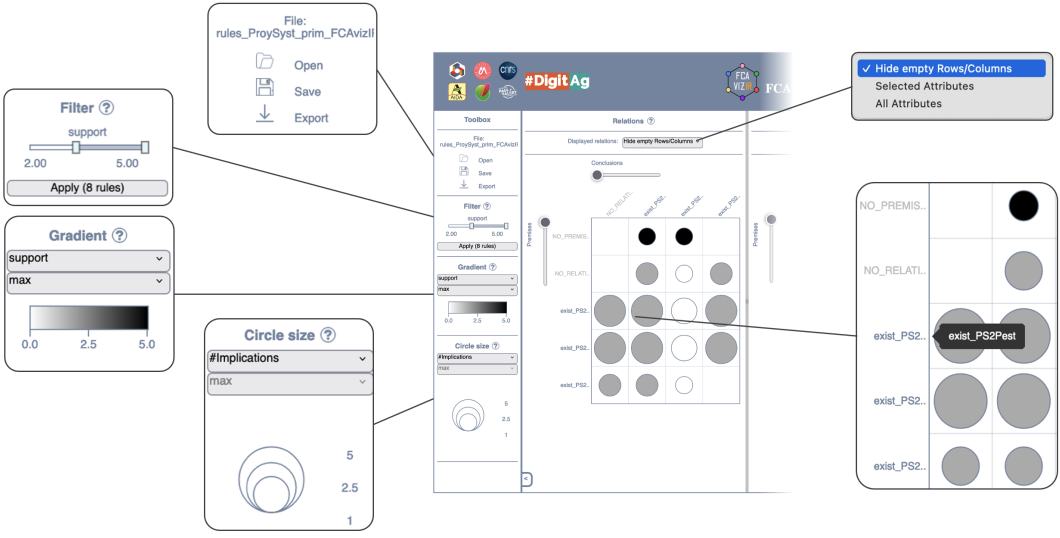
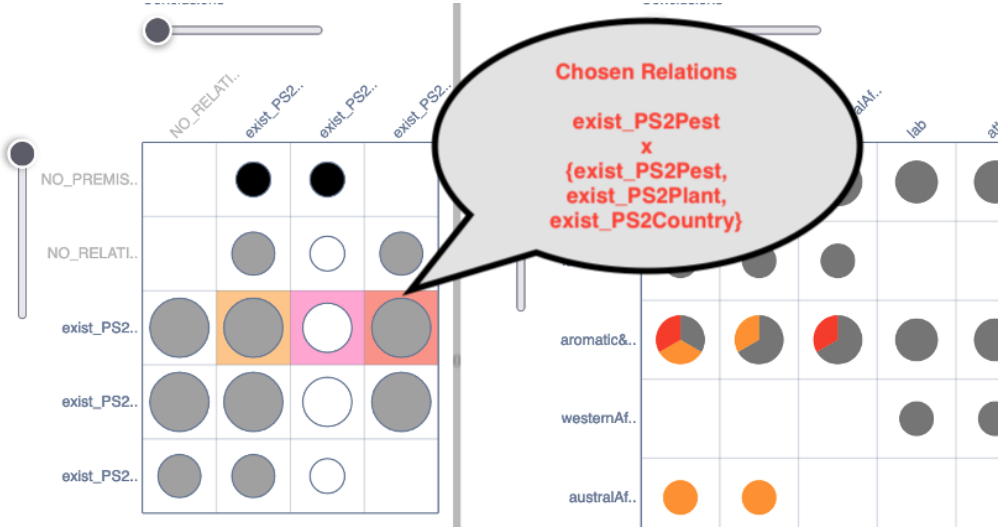
Overview


#DigitAg
Visual Exploration of
FCA-generated Implication Rules
Menus
Examples
About
Toolbox
File: no file chosen
Open
Save
Export
Relations
Attributes
Rules
Total: 0 rules
Relations view
Attributes view
Rules view
Toolbox
Resize panels
Close/expand toolbox

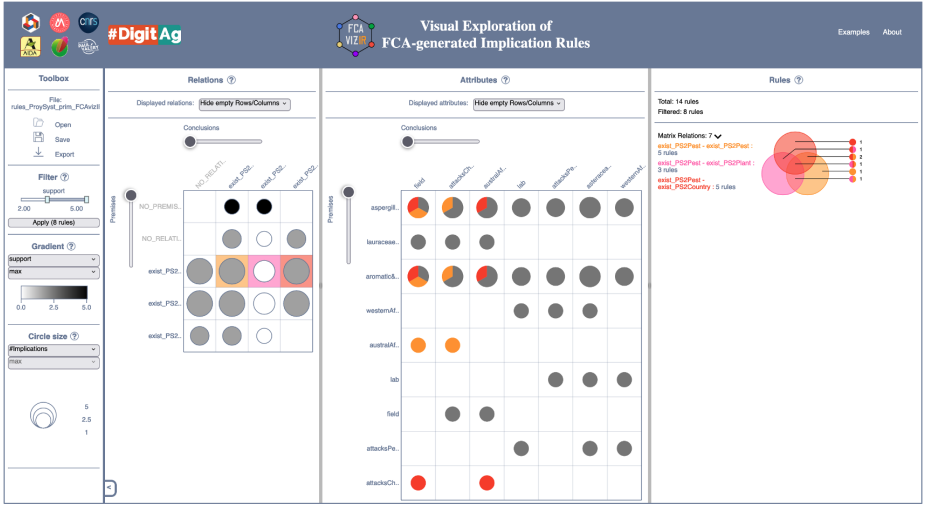
Toolbox / Parameters



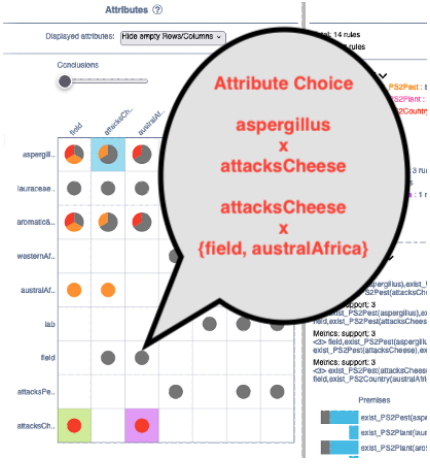
Relation Selection



Relation Selection (result)



Attribute Selection



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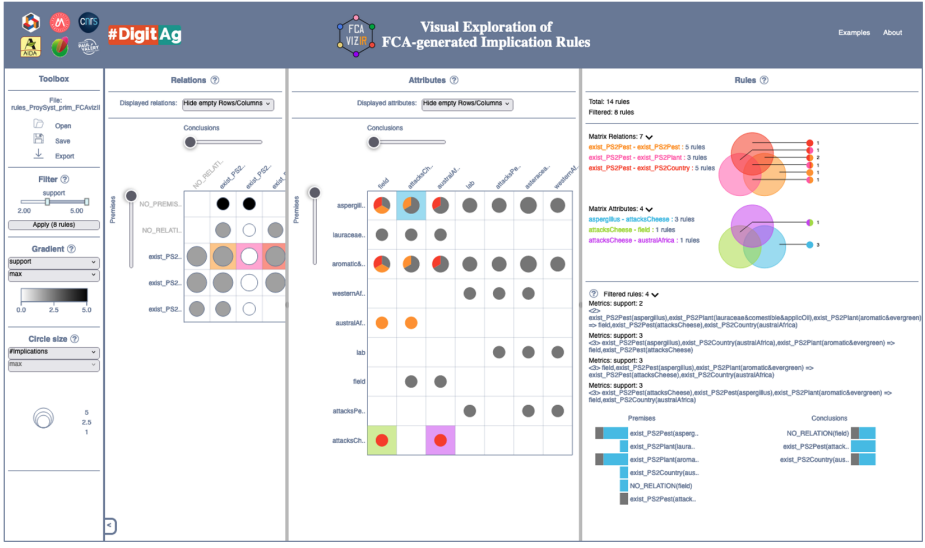
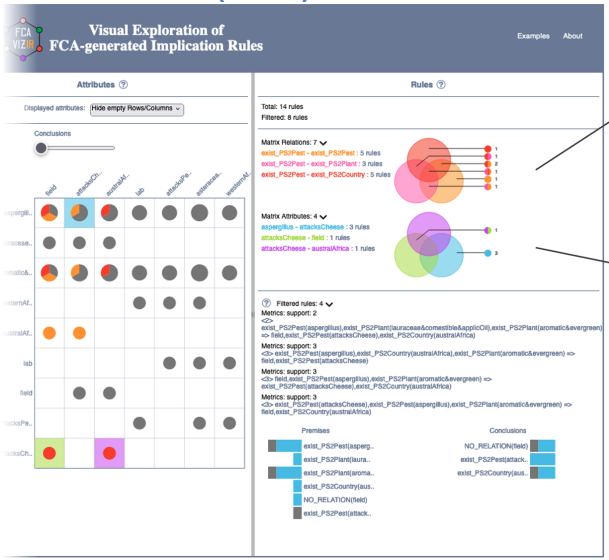
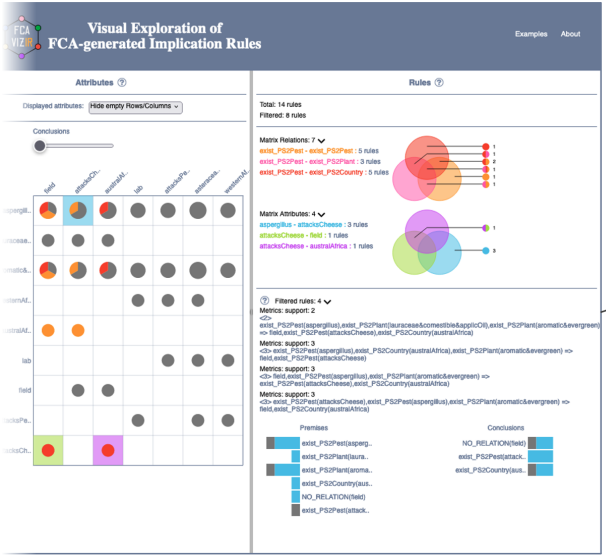
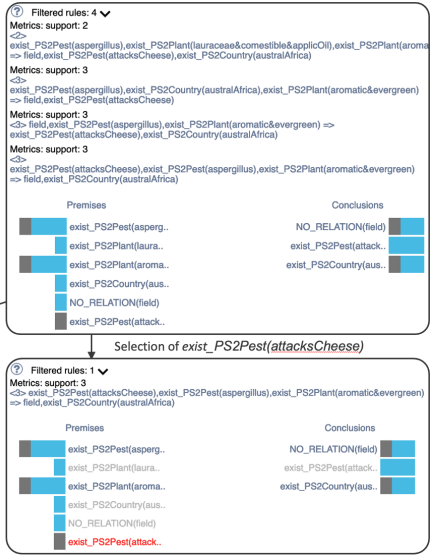


Attribute Selection (detail)

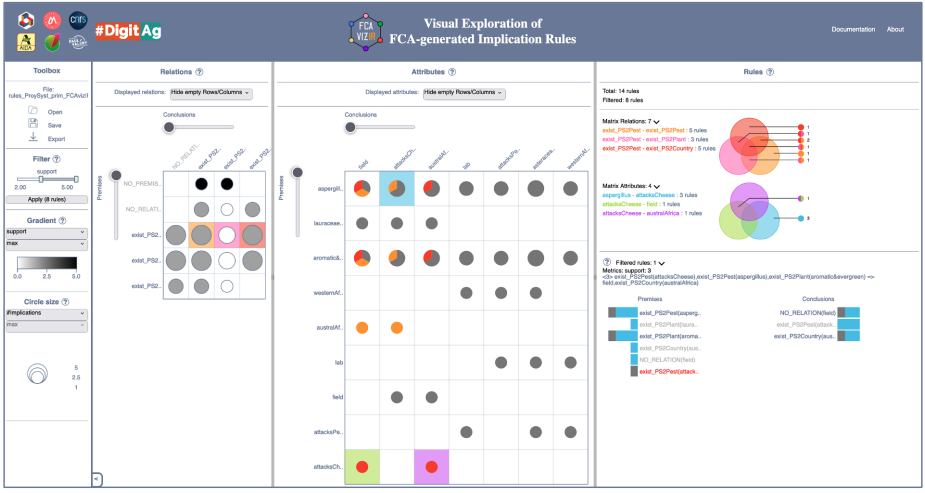


Premise Selection





Premise Selection (result)



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Conclusion

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- Interactive views, filtering (R0), group by shared items (R1), group size visualization (R2), topic-based navigation (R3)

Future work

Implications and models specificities

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- Focus on particular cases: cyclic models, models with long paths

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Back to applications for full scale application with experts and end-users

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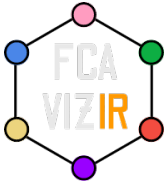
Back to applications for full scale application with experts and end-users

- Knomana
- Software Product Lines
- Digital debate

¡Gracias por su atención!



https://fcavizir.lirmm.fr/

Implication files prepared with https://www.lirmm.fr/fca4j/

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ANR Program Investments for the Future
Grant ANR-16-CONV-0004 anr®

ANR SmartFCA project
Grant ANR-21-CE23-0023 anr®

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