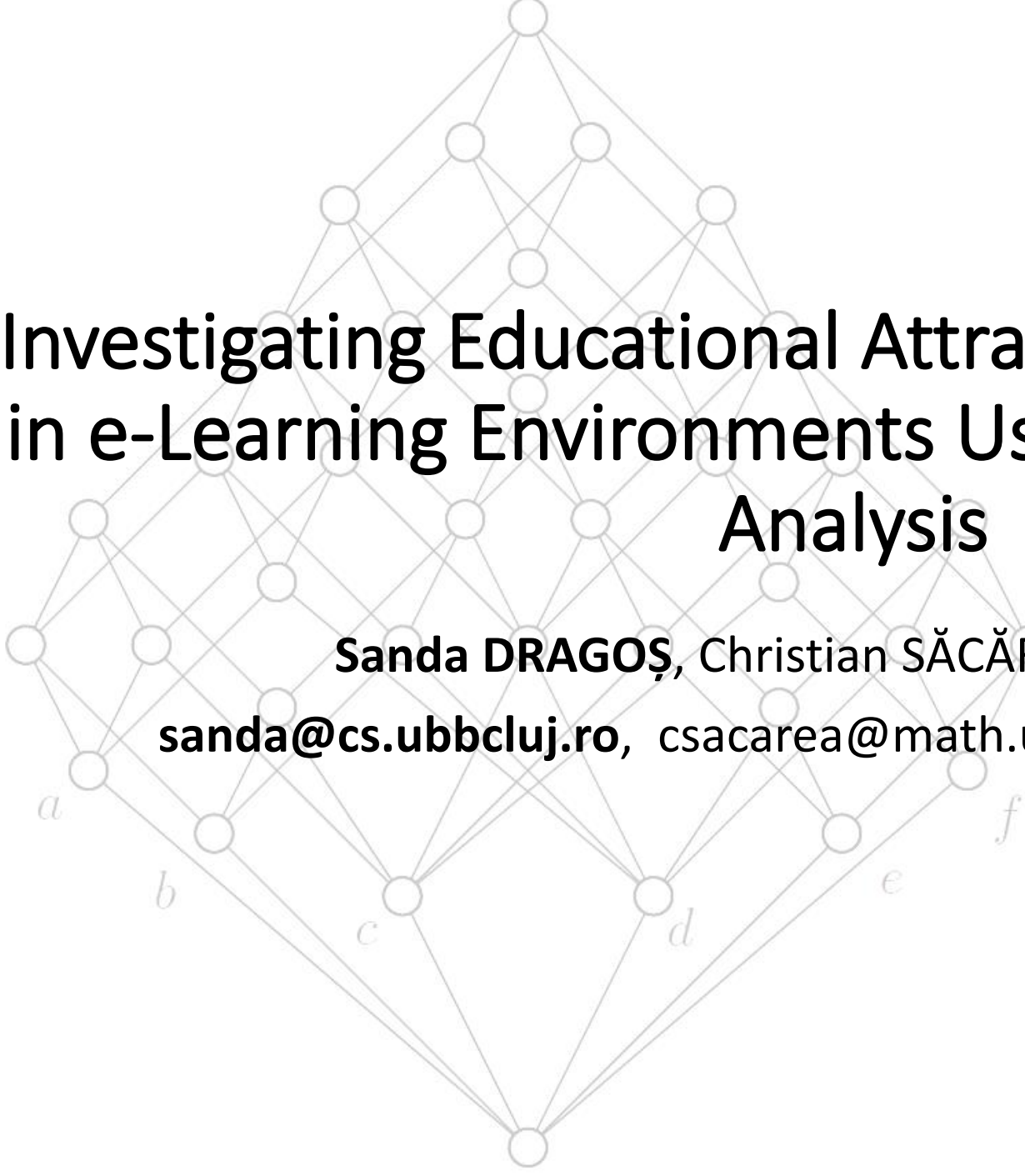




Investigating Educational Attractors and Life Tracks in e-Learning Environments Using Formal Concept Analysis

Sanda DRAGOȘ, Christian SĂCĂREA and Diana ȘOTROPA

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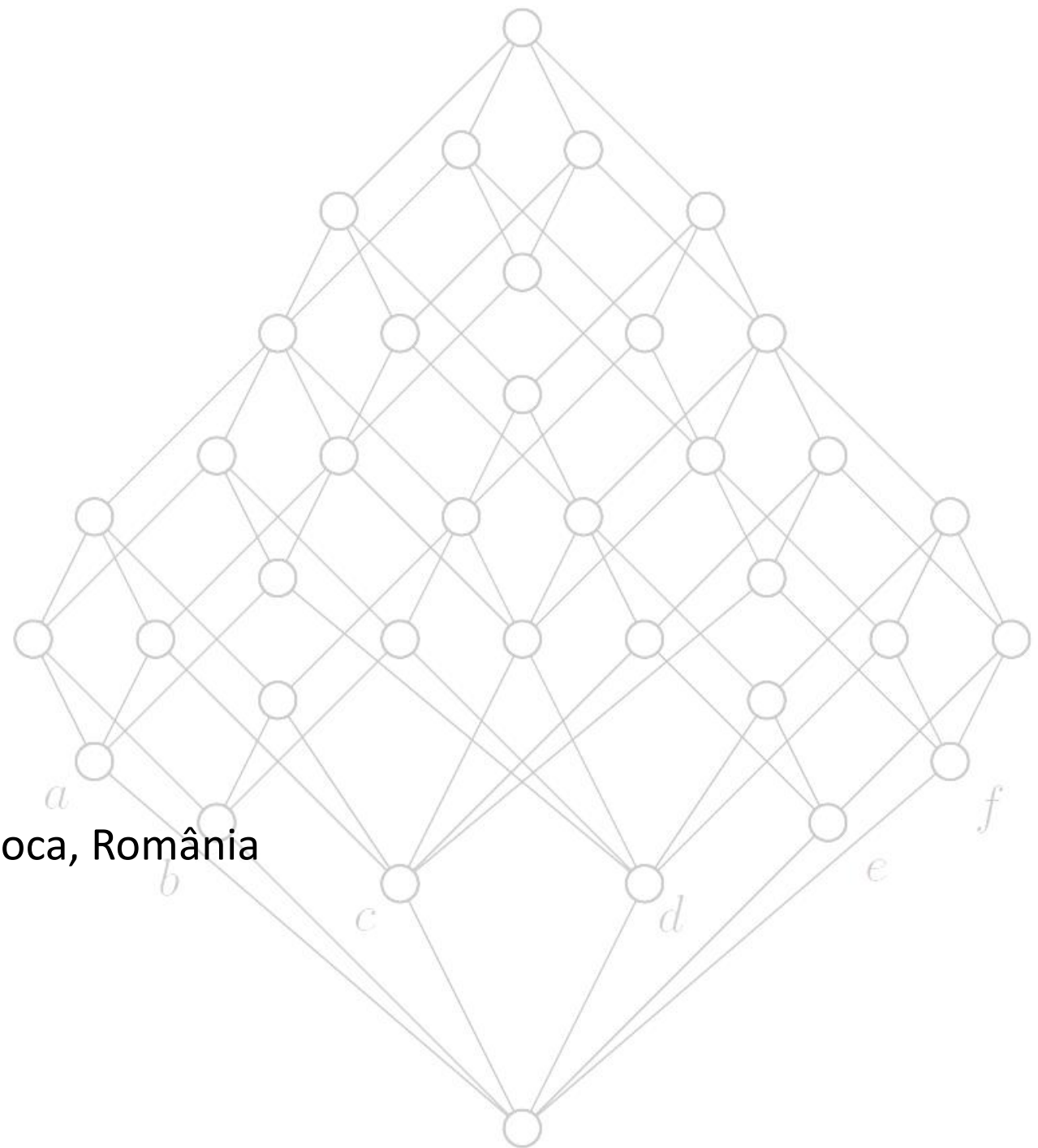
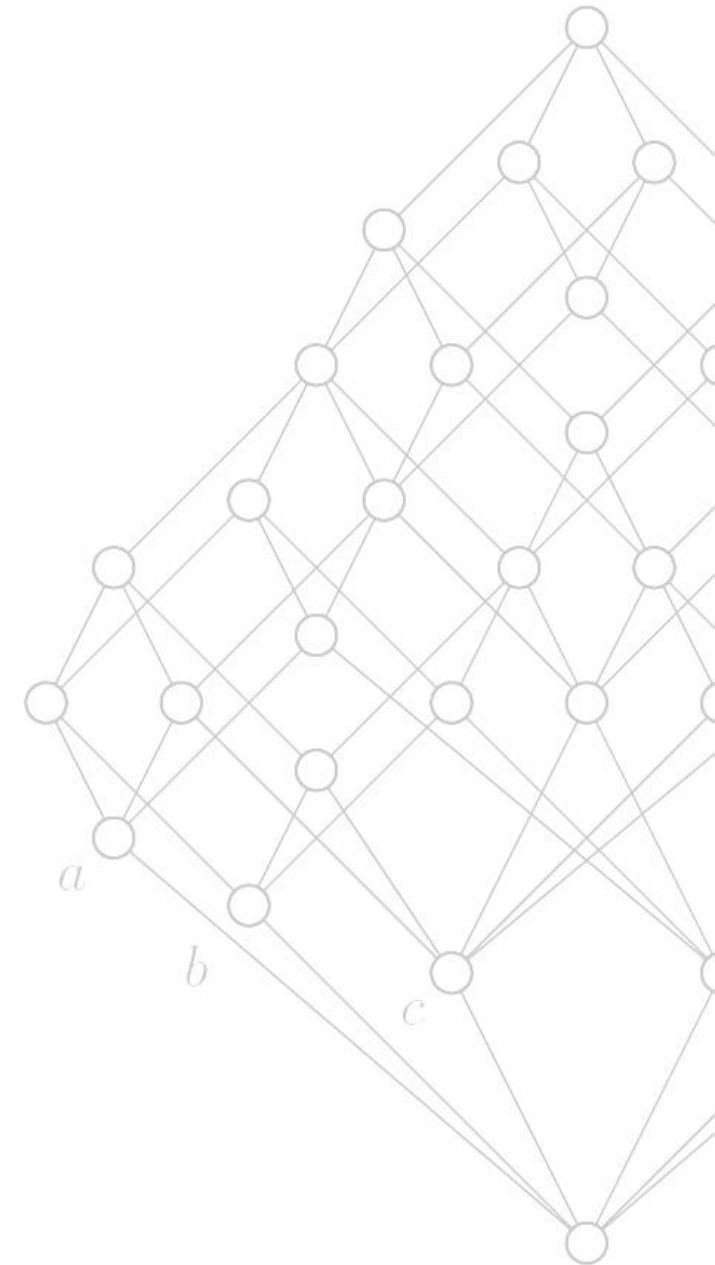


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 - Life tracks on handing assignments
 - Life tracks on educational attractors
- Conclusions and Future work



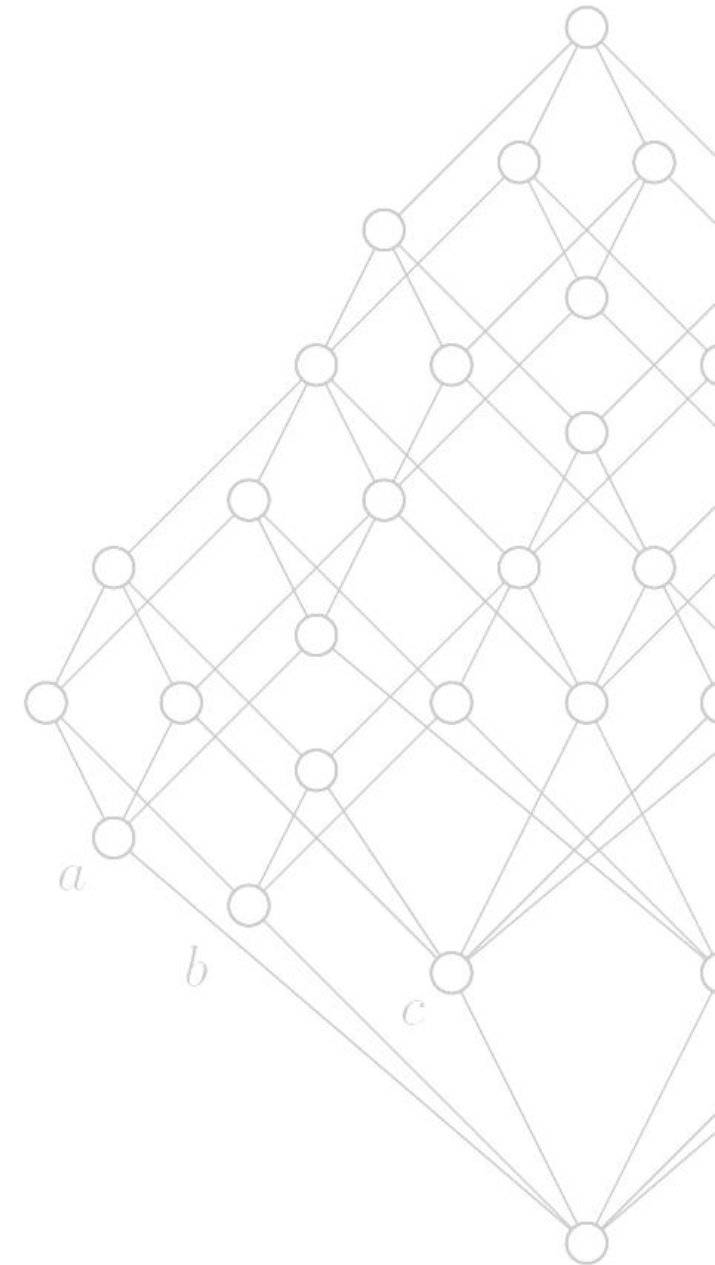
Motivation

- online educational platforms are an important part of the education system;
- discover user behavioral patterns in e-learning environments;
- understanding how the presentation of the learning content and the overall structure of the e-lesson is used.



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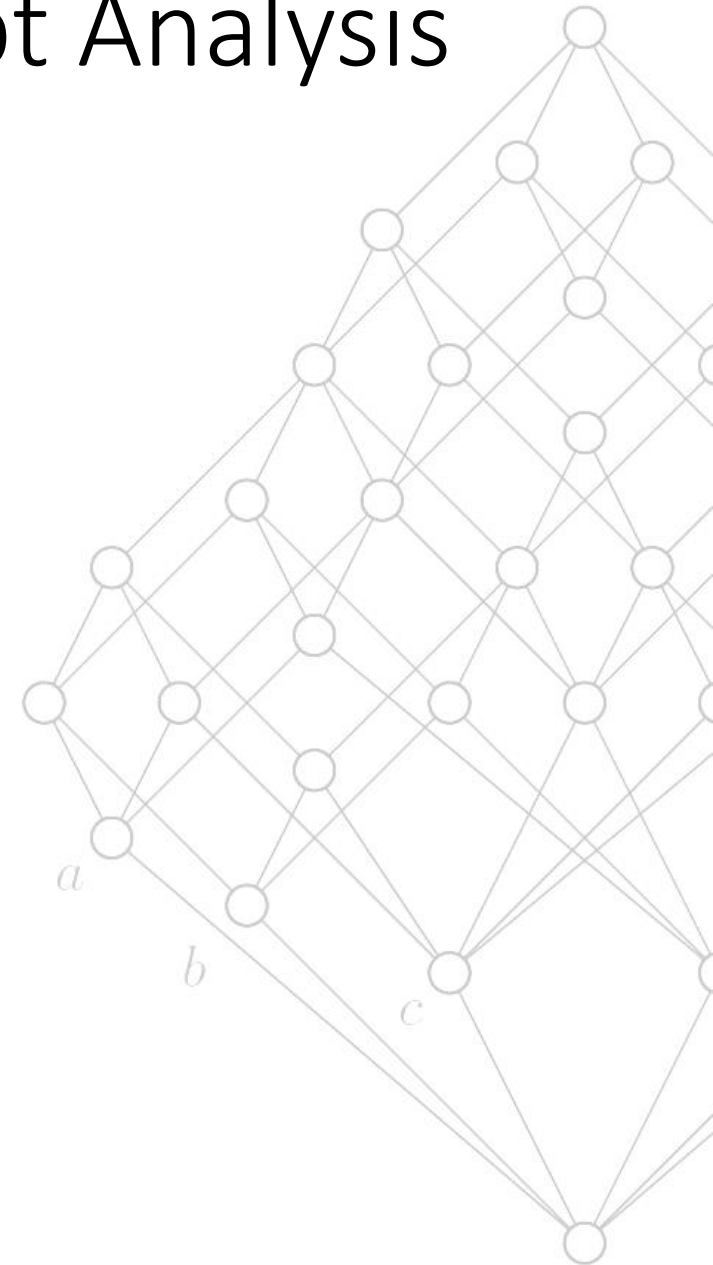
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Formal Concept Analysis

overview

- the Formal Context (**def**)
- the Context as cross-table representation (ex)
- the Formal Concept (**def**)
- all resulting Formal Concepts (ex)
- the Concept Lattice (ex)

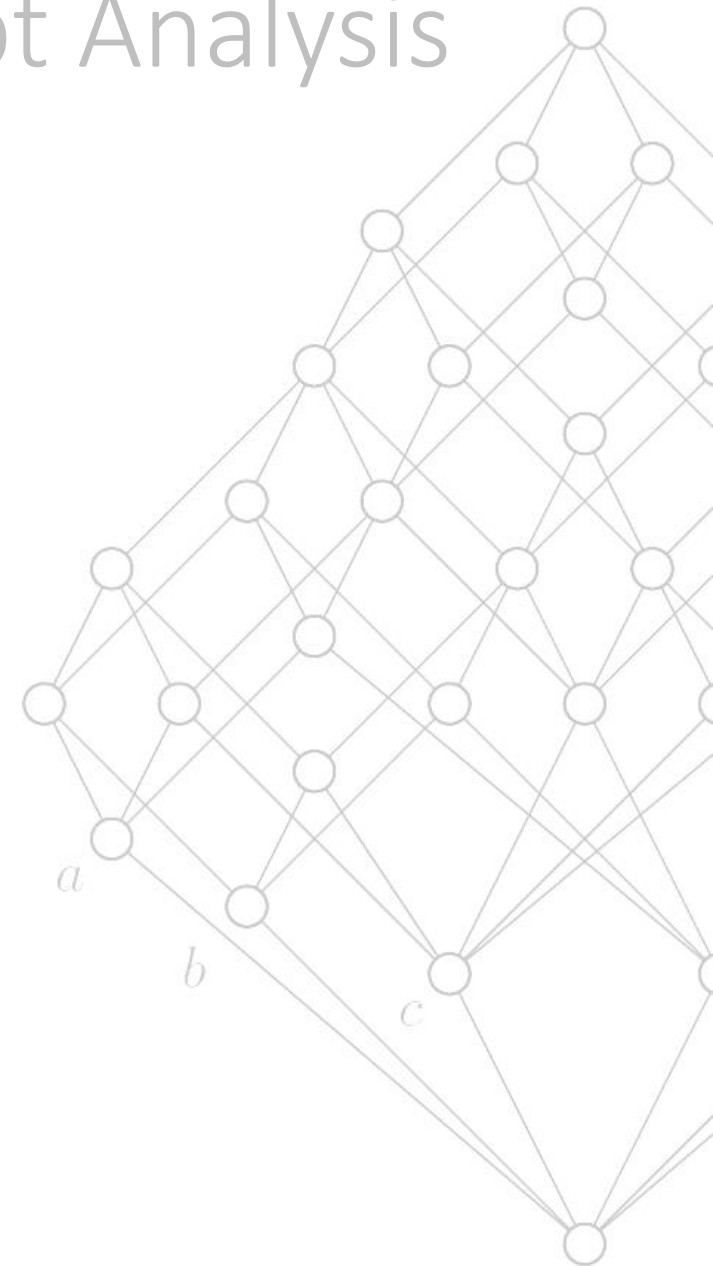


the Formal Context

Definition

Formal Context: triple $K = (G, M, I)$ with

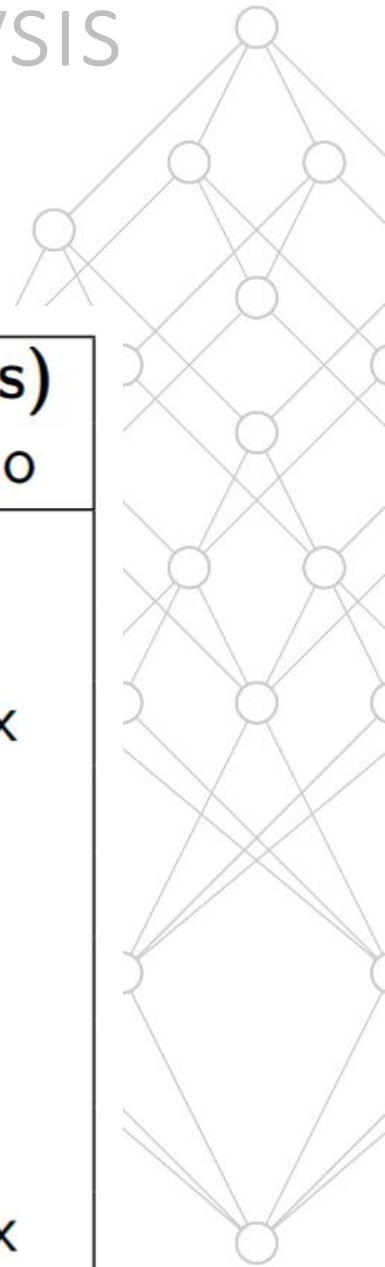
- set G of objects
- set M of attributes
- incidence relation $I \subseteq G \times M$



Formal Concept Analysis

the Context as cross-table representation

Planet	Size			Distance to Sun		Moon(s)	
	small	medium	large	near	far	yes	no
Jupiter			x		x	x	
Mars	x			x		x	
Mercury	x			x			x
Neptune		x			x	x	
Pluto	x				x	x	
Saturn			x		x	x	
Earth	x			x		x	
Uranus		x			x	x	
Venus	x			x			x

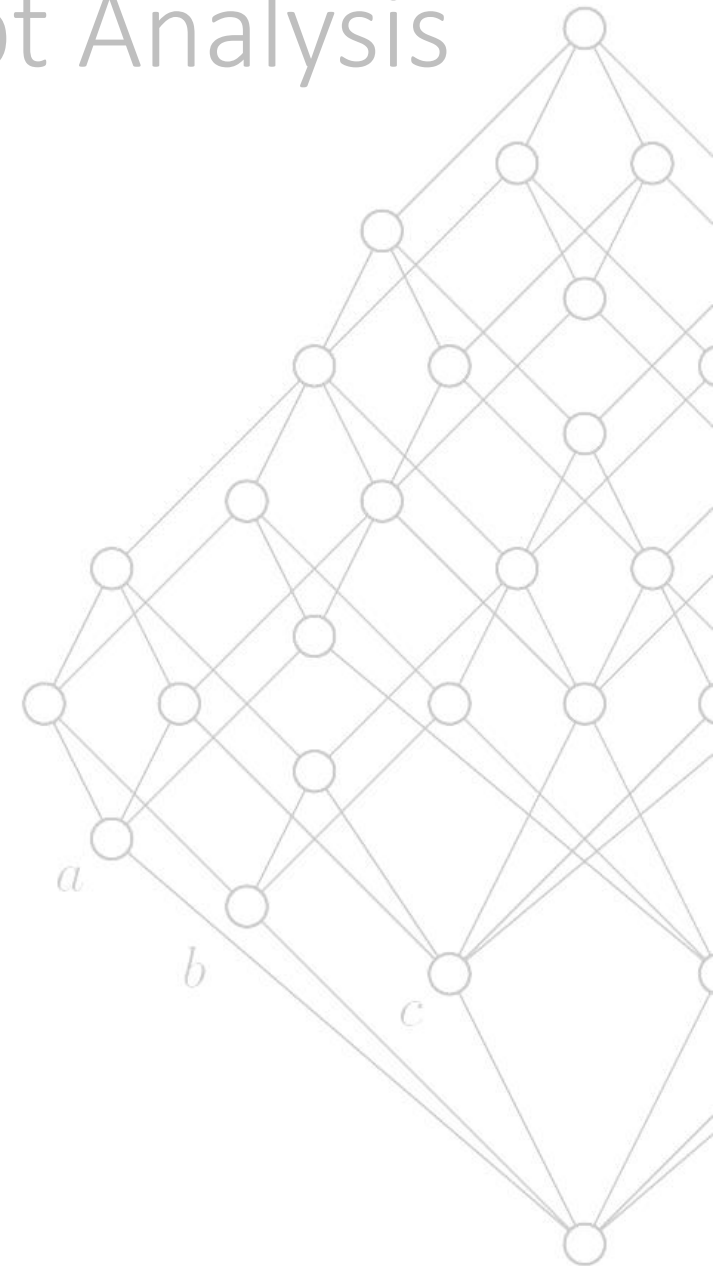


the Formal Concept

Definition

Formal Concept: pair (A, B) with

- extent $A \subseteq G$
- intent $B \subseteq M$
- $A \times B \subseteq I$
- maximal w.r.t. this property

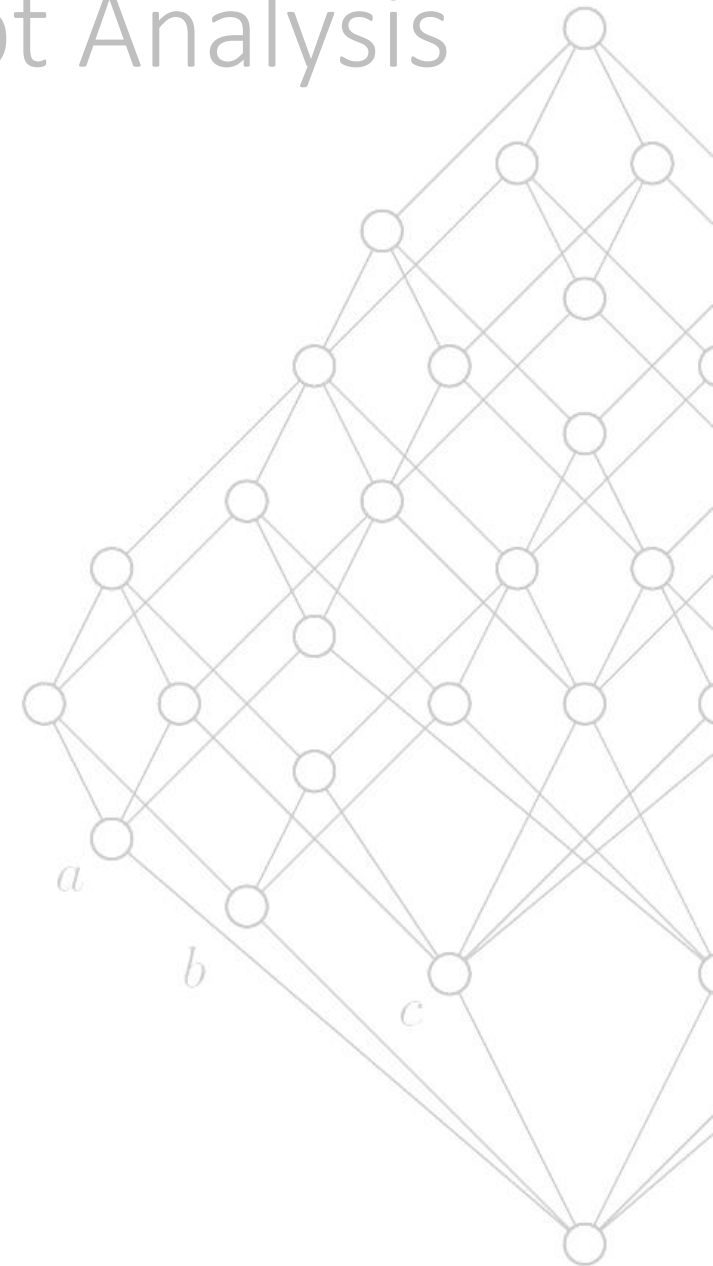


Formal Concept Analysis

all resulting Formal Concepts

The planet context has the following concepts:

- (Φ ; {Near; Far ; Small ; Medium; Large; yes; no})
- ({Jupiter; Saturn}; {Large; Far ; yes})
- ({Uranus; Neptun}; {Medium; Far ; yes})
- ({Earth; Mars}; {yes; Near; Small})
- ({Mercury; Venus}; {no; Near; Small})
- ({Jupiter; Saturn; Uranus; Neptun}; {Far ; yes})
- ({Earth; Mars; Mercury; Venus}; {Near; Small})
- ({Jupiter; Saturn; Uranus; Neptun; Earth; Mars}; {yes})
- ({Mercury; Venus; Earth; Mars; Jupiter; Saturn; Uranus; Neptune}; Φ)



Formal Concept Analysis

the Concept Lattice

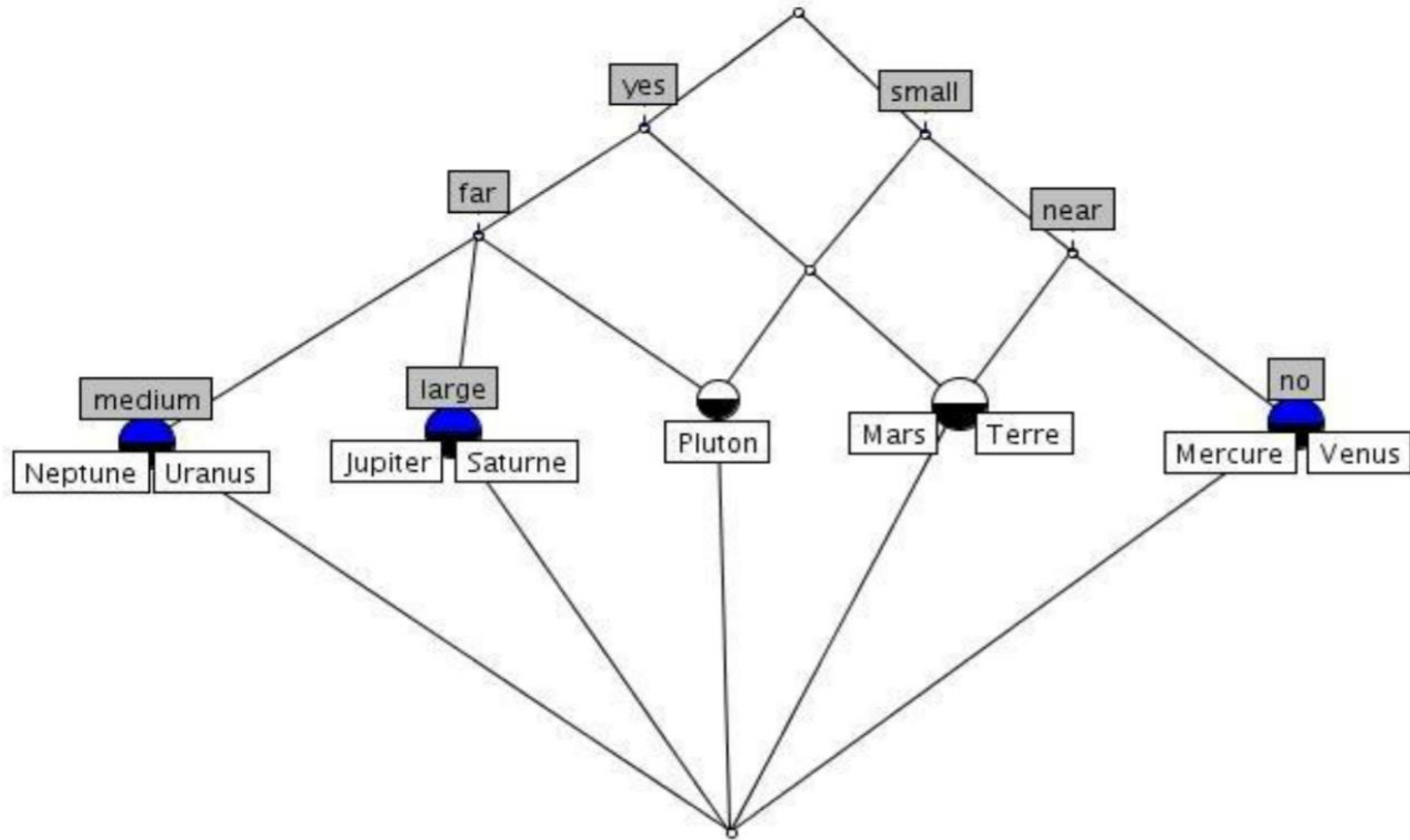
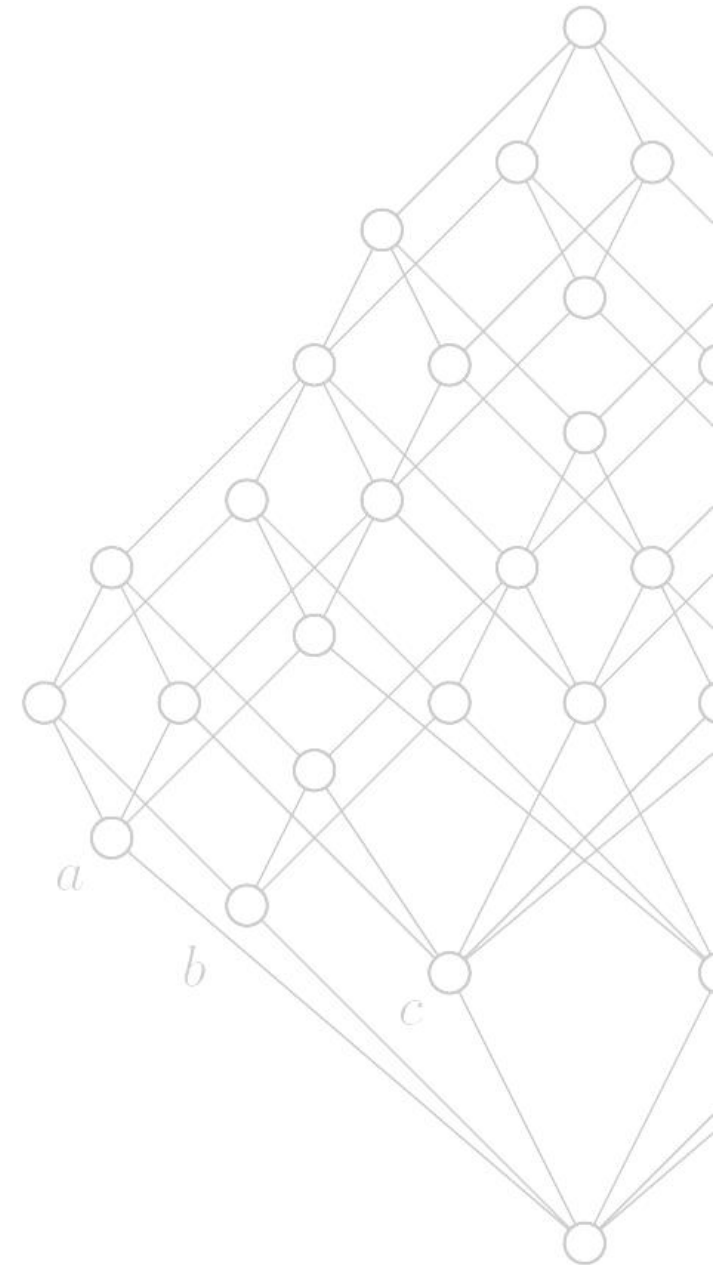


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Attractors

Sanda Dragos, Diana Halita, and Christian Sacarea,
*Attractors in Web Based Educational Systems. A Conceptual Knowledge Processing
Grounded Approach*,
The 8th International Conference on Knowledge Science, Engineering and Management (KSEM),
Chongqing, China, October, 2015, p. 190-195

*attractor = behavioral patterns to which users adhere
while using the educational/e-learning system*

*state what should users do and then evaluate if they
adhered to these views or they have found their own
ways to use the system*

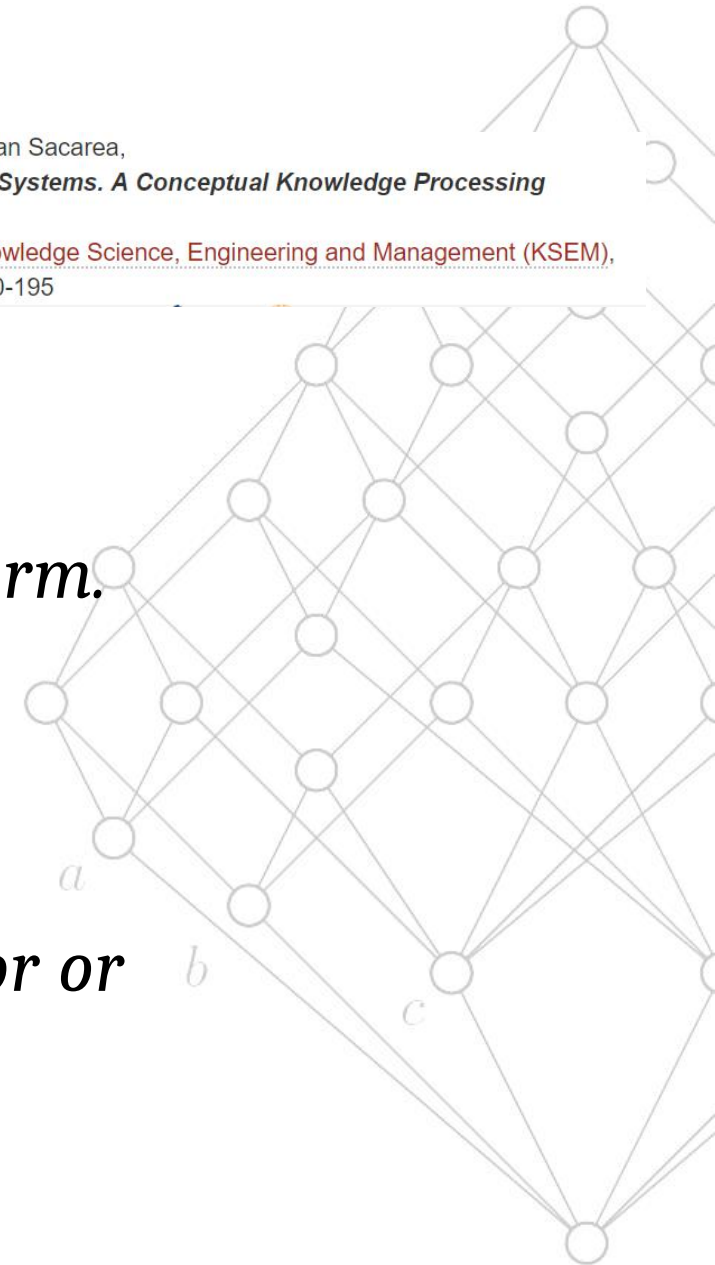


Educational attractors

Sanda Dragos, Diana Halita, and Christian Sacarea,
*Attractors in Web Based Educational Systems. A Conceptual Knowledge Processing
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The structure of an educational attractor reflects the intended educational purpose of the e-learning platform.

we can investigate if web usage behavioral patterns are fitting into the educational scopes of the instructor or there is place for improvement



Educational attractors

Example on Lab Theory per weeks:

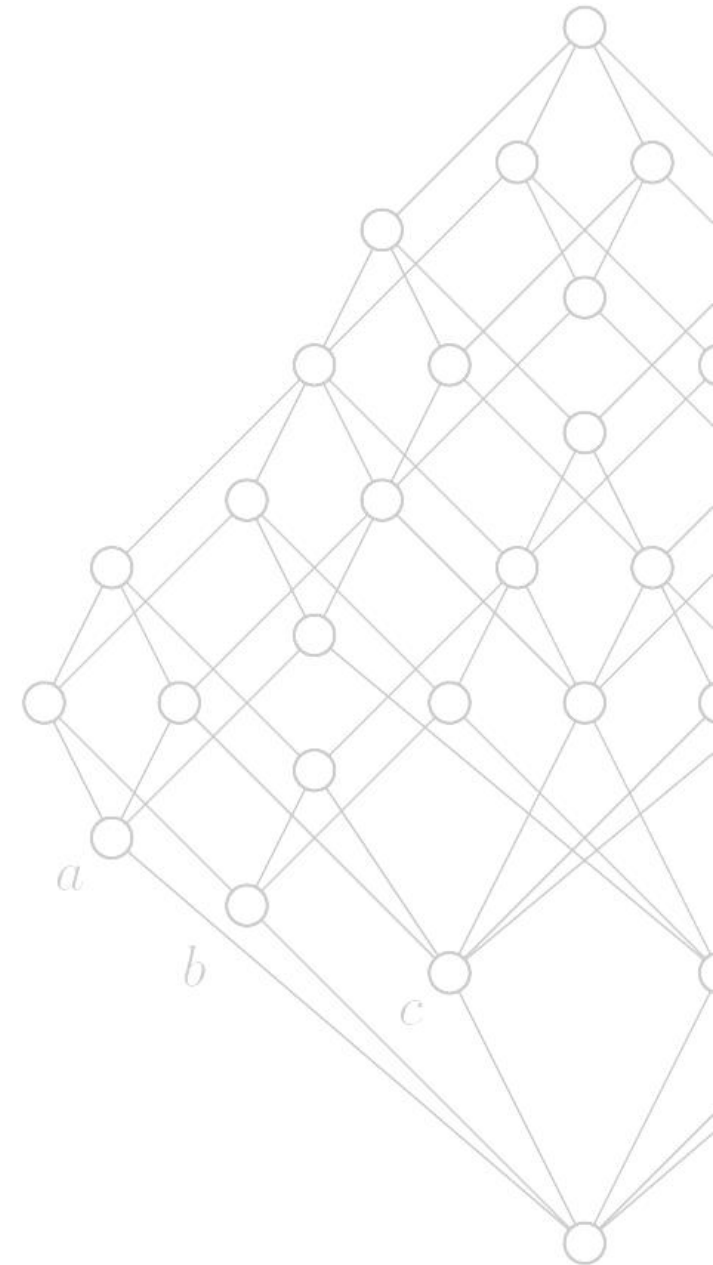
- LT1, LT2, ...
- The structure of the educational attractor is

displayed as an order diagram of the underlying concept set as it has been determined from the web-logs dataset by using FCA.



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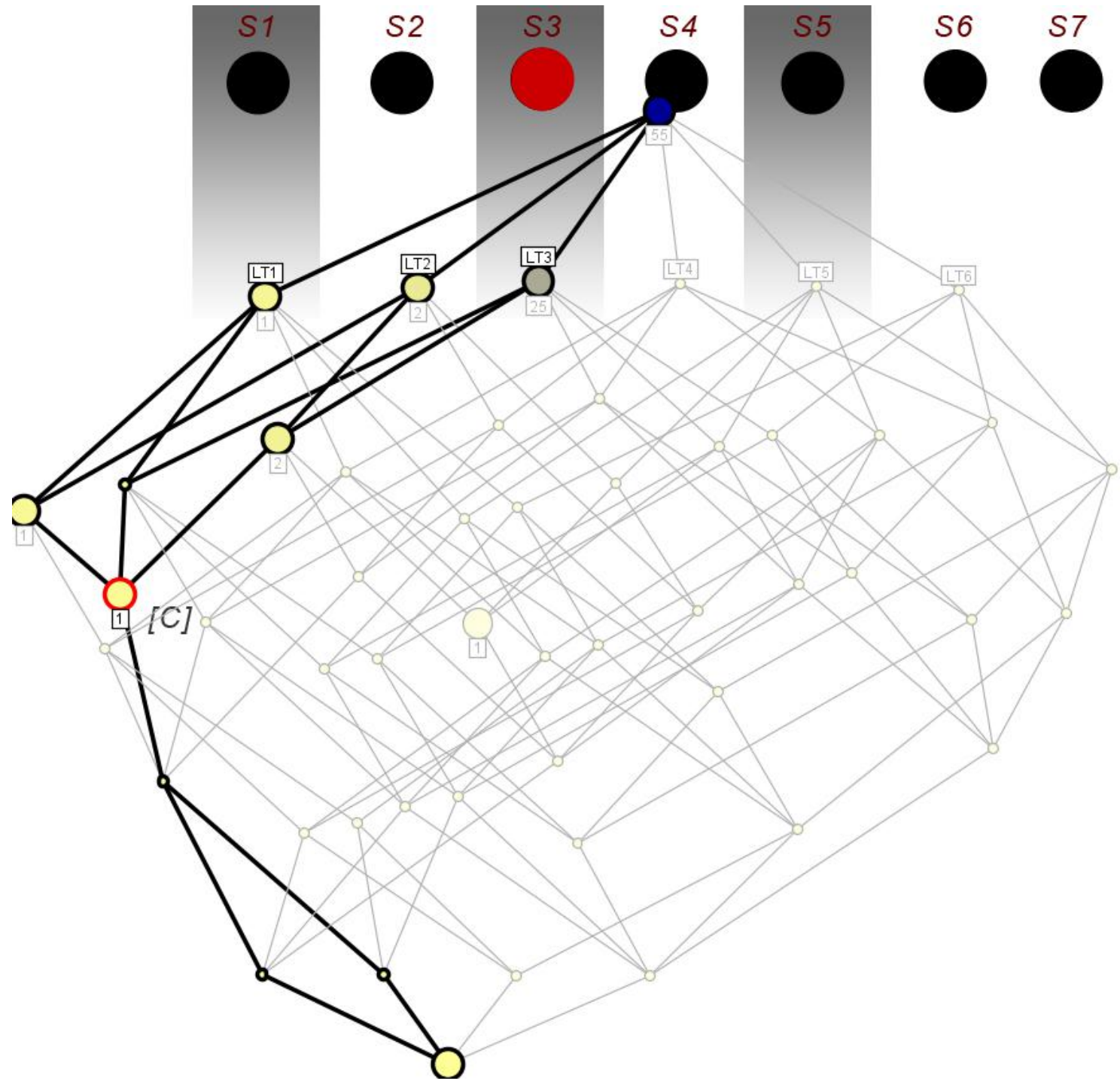
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Comprehensive behavior

User behavior of student C on week 3

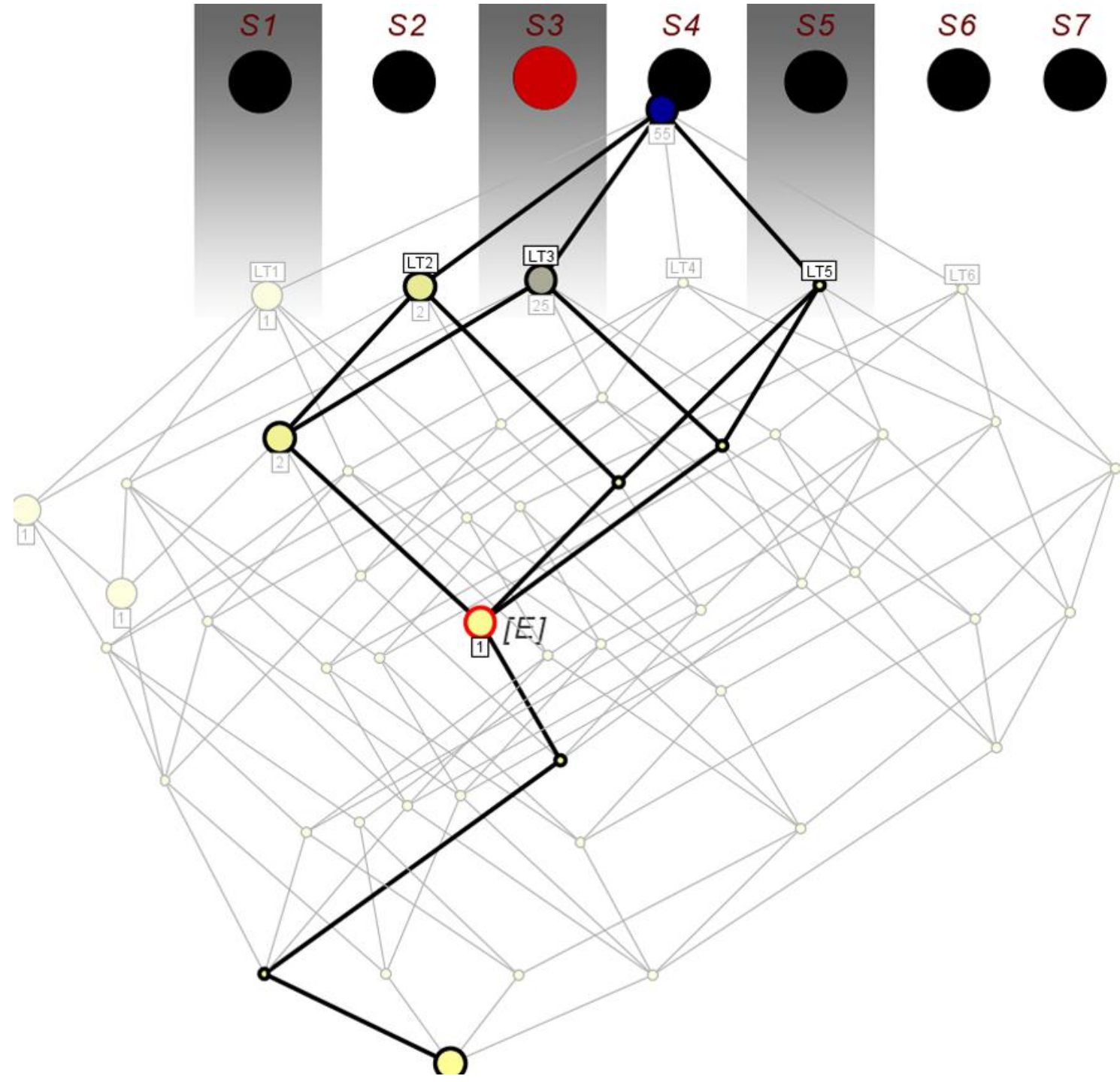
Lab Theory first 6 weeks



Comprehensive behavior

User behavior of **student E** on week 3

Lab Theory first 6 weeks



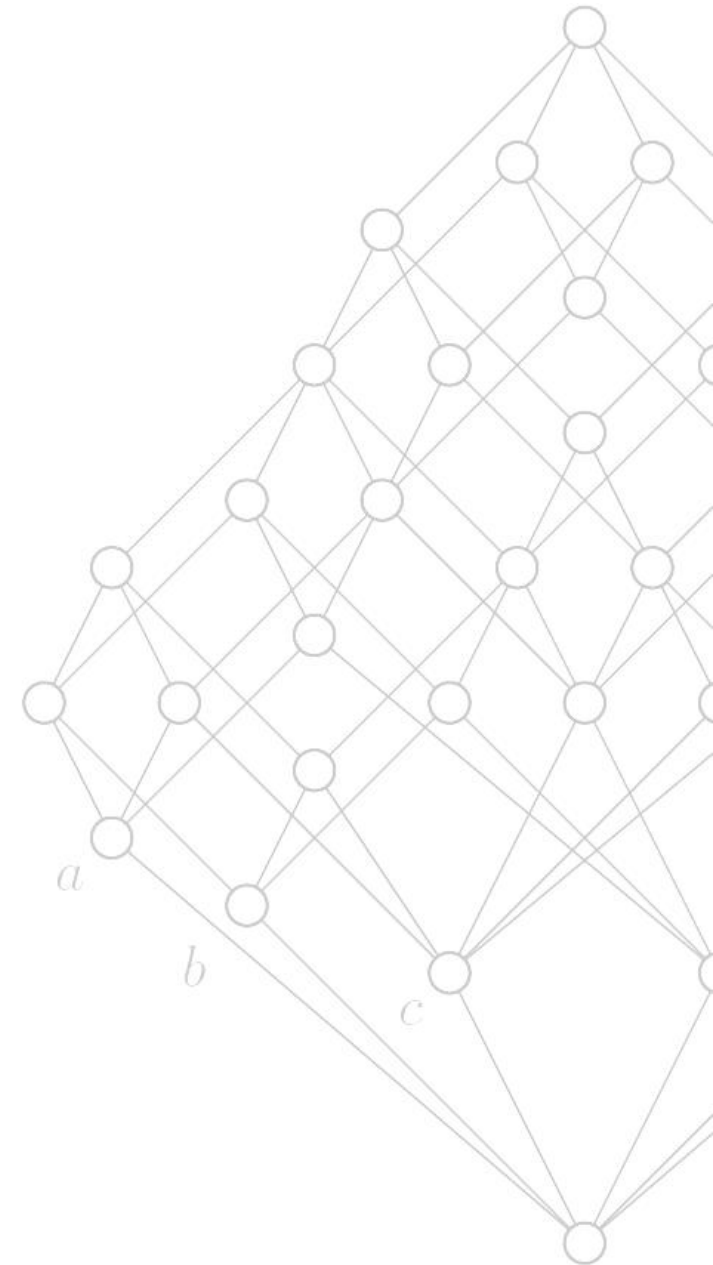
Comprehensive behavior students

- *Early birds* are students that have accessed the provided material before it was expected;
- *Common users* are students that behave as expected;
- *Late rise users* are students that visit the provided material later than expected.



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Distill user life tracks using Temporal Concept Analysis

Sanda Dragos, Christian Sacarea, and Diana Sotropa,

An investigation of user behavior in educational platforms using Temporal Concept Analysis,

The 14th International Conference on Formal Concept Analysis (ICFCA),

Rennes, France, 12-16 June, 2017,

Life tracks are built by setting time granularity at week level and marking the temporal trajectory of the student through the educational attractor Lab Theory or Lab Assignment.

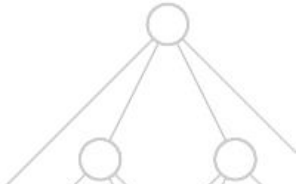
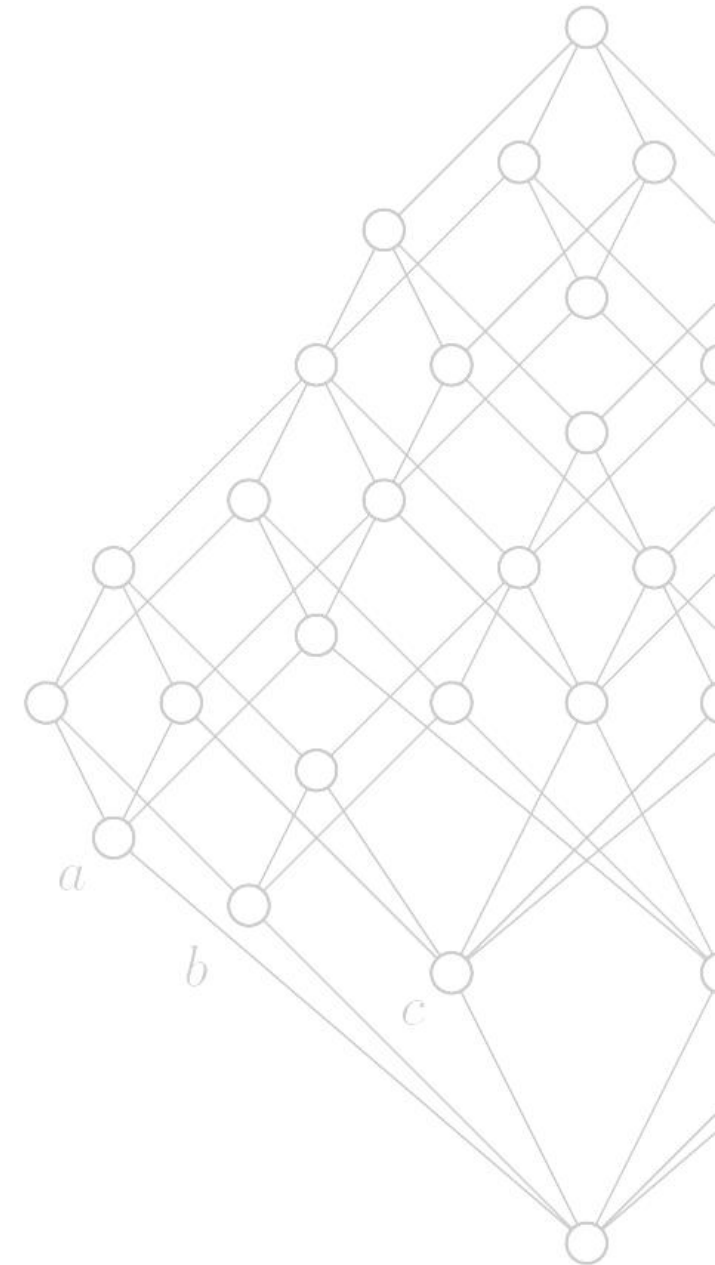


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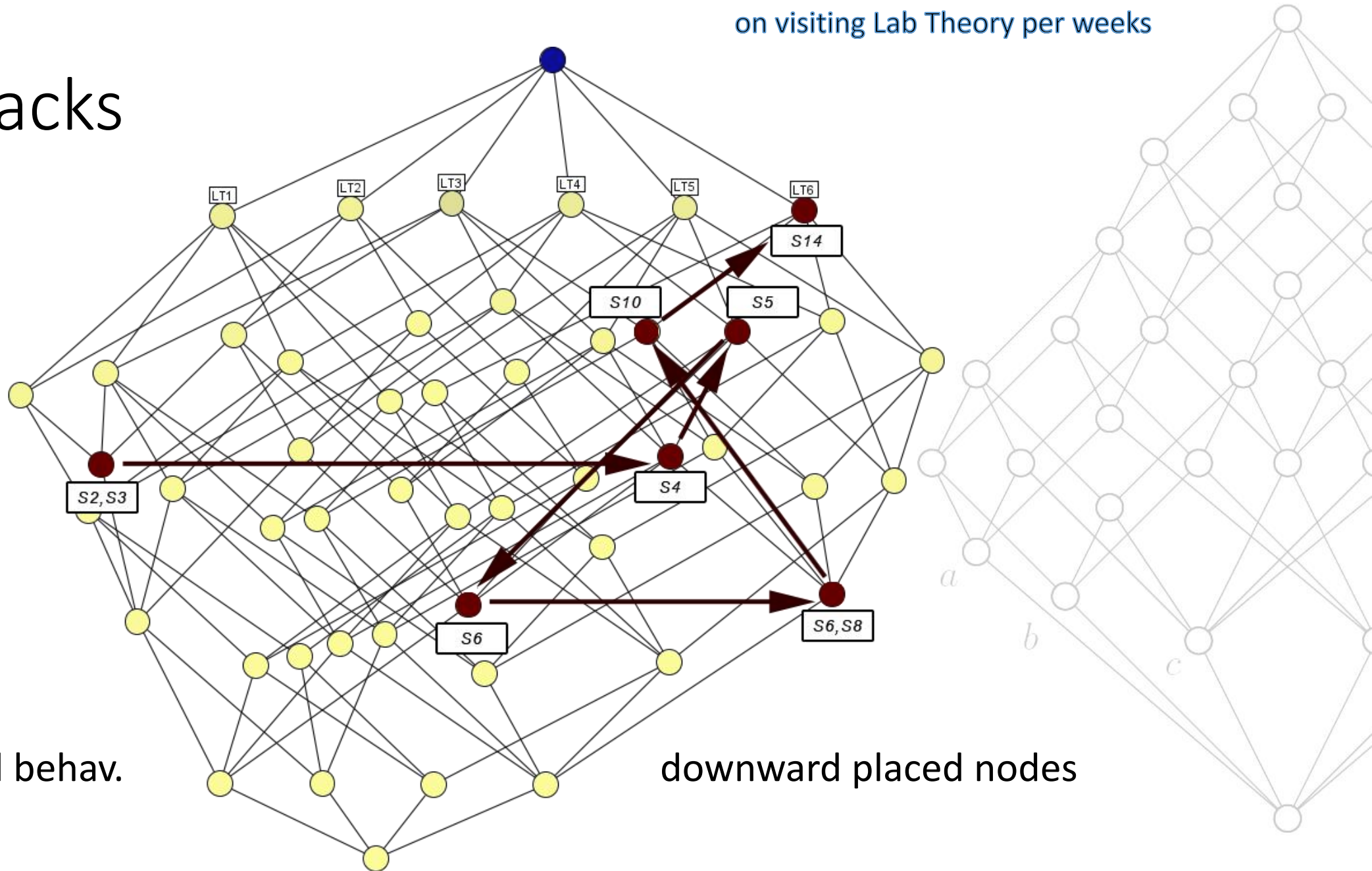
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Life tracks

on visiting Lab Theory per weeks

Early bird
student C



Life tracks

on visiting Lab Theory per weeks

Common user
student D

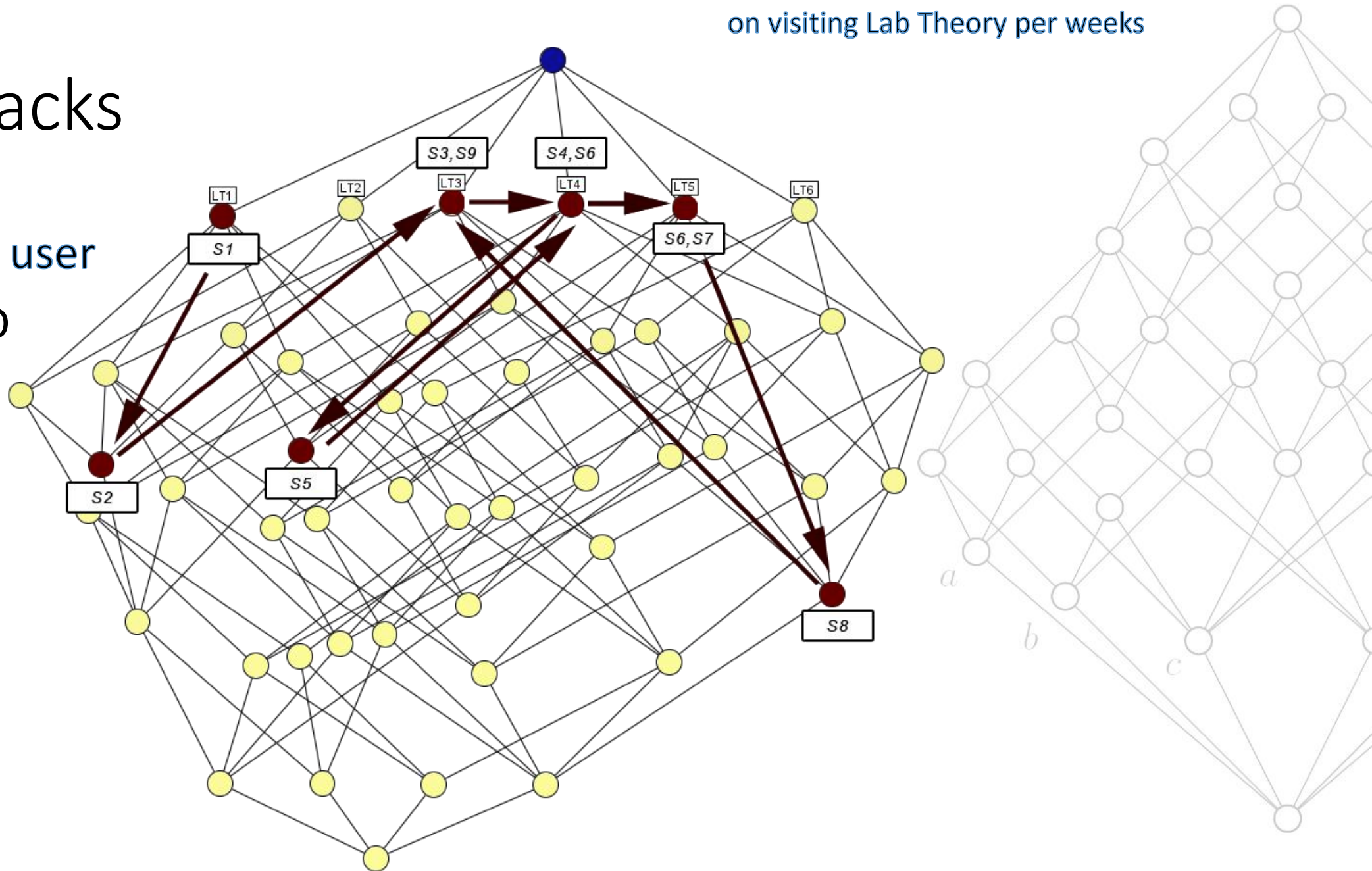
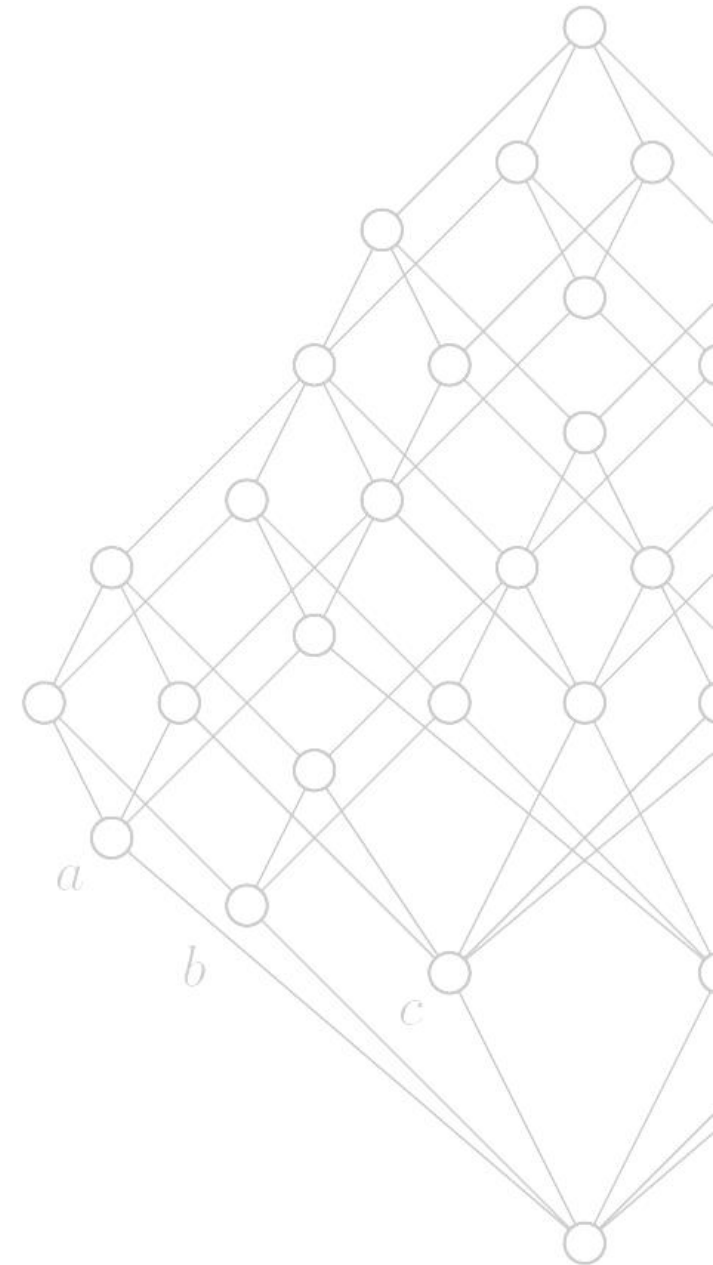


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Correlate comprehensive behavior with academic performance

- *Early birds* (e.g H, D, K) got the mark FB (very good);
- *Common users* (e.g I) got the mark B (good);
- *Late rise users* (e.g S, T) got the mark I (insufficient).
- exception *early bird C*

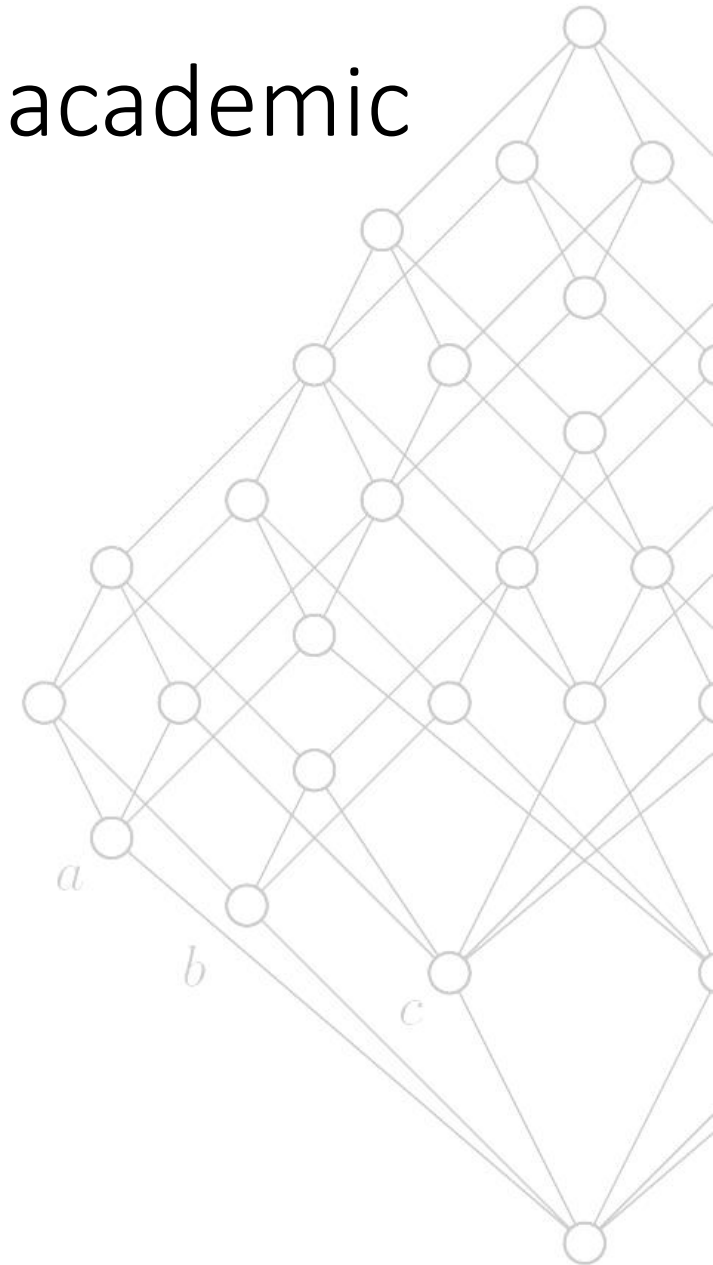
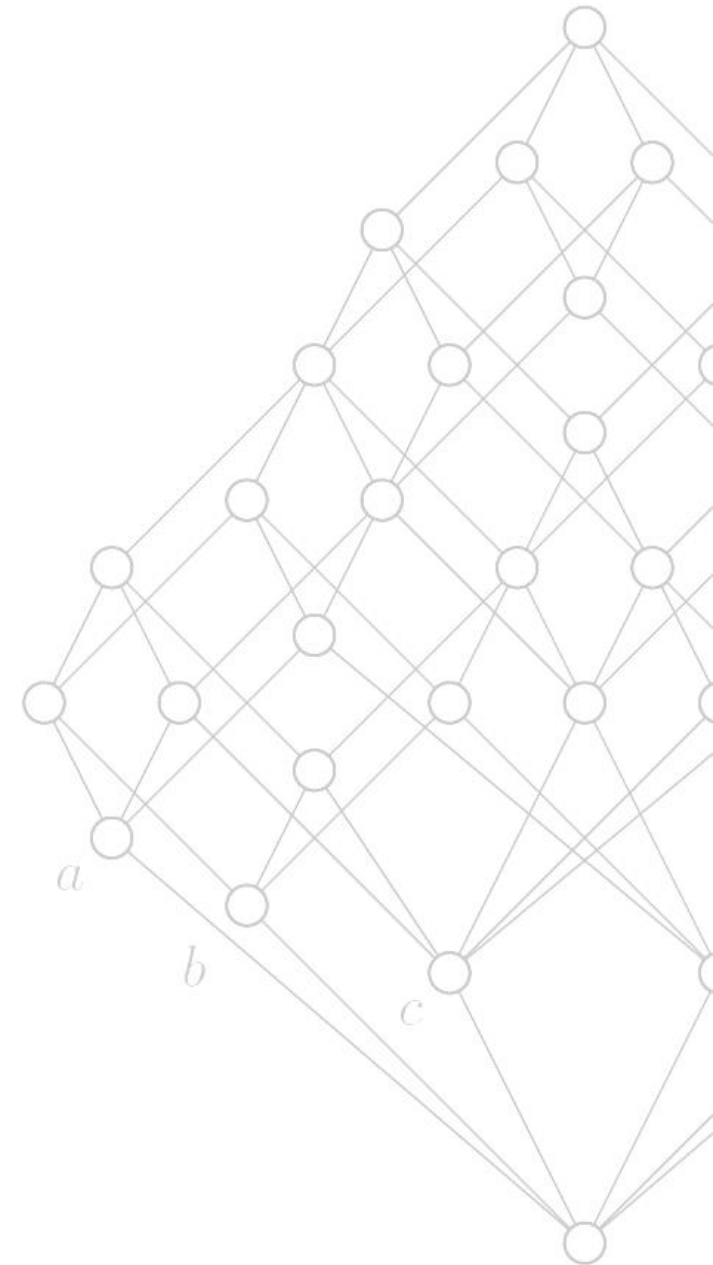
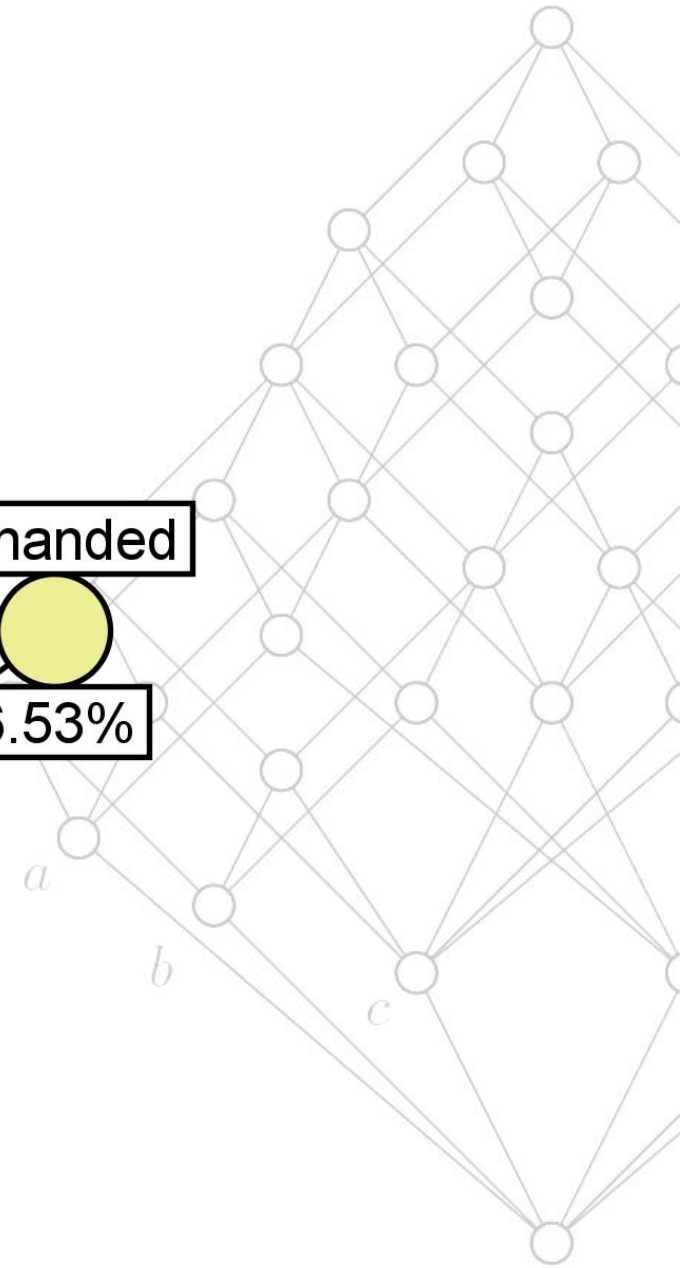
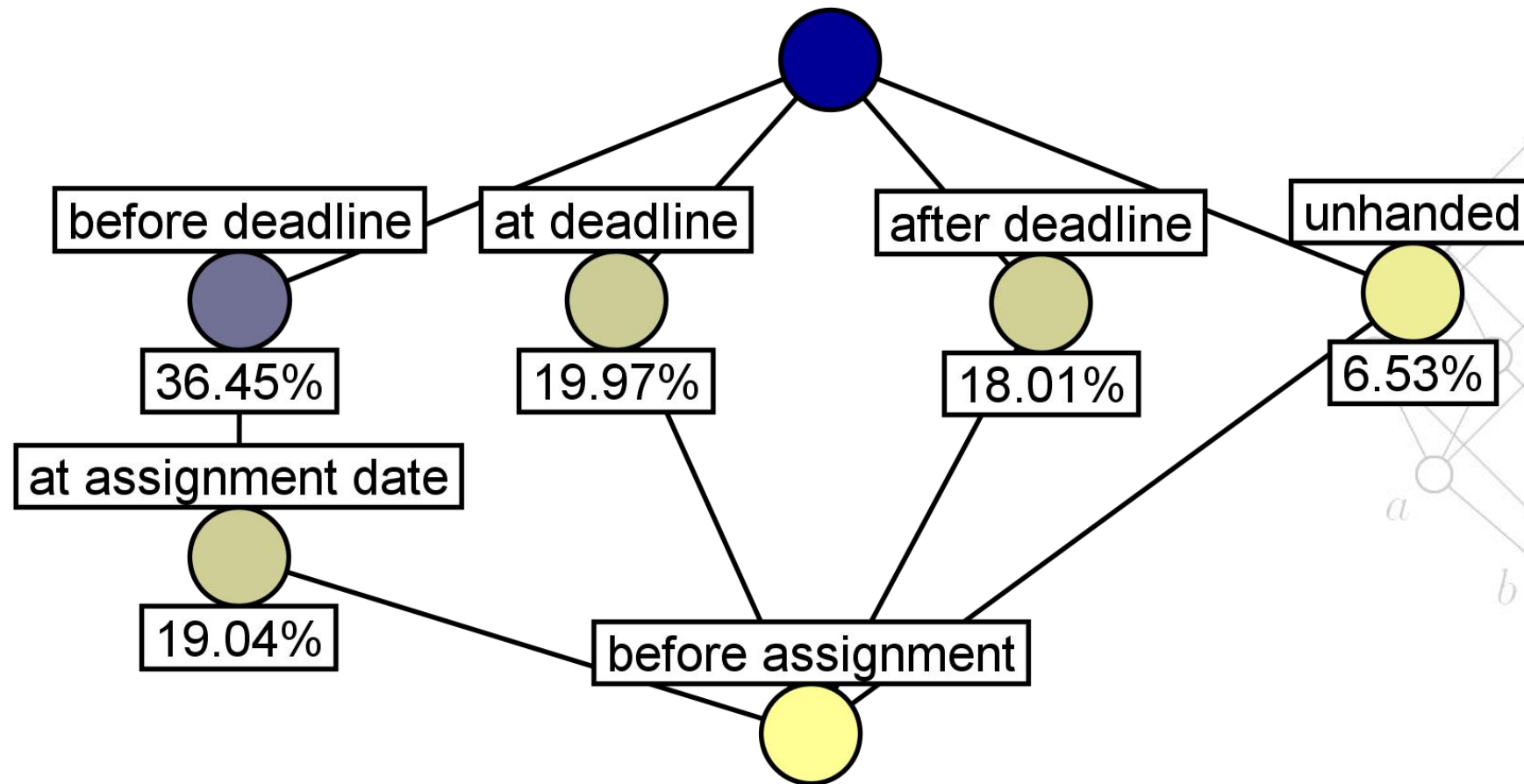


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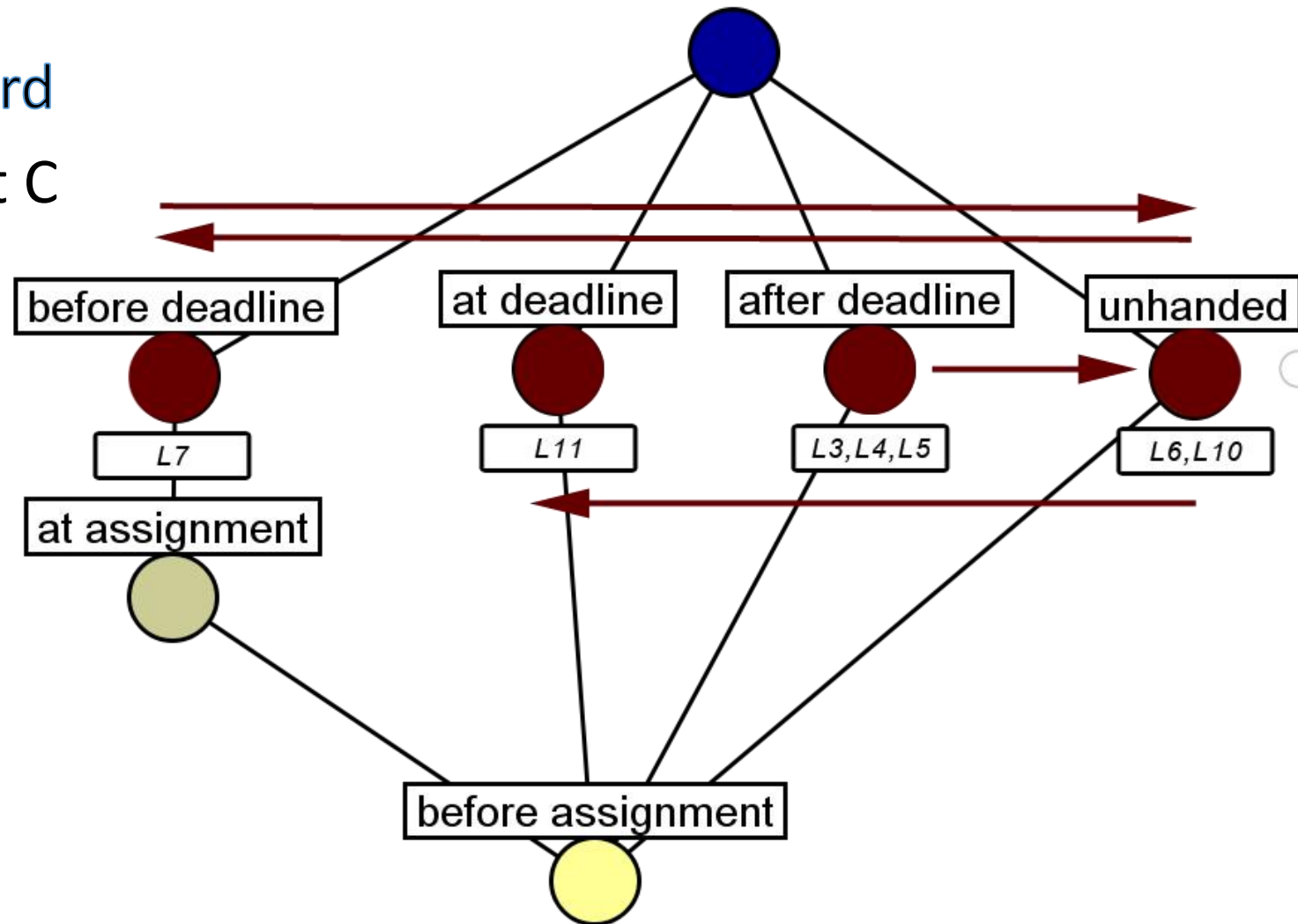


Handing assignments behavior



Life tracks on handing assignments

Early bird
student C



Life tracks on handing assignments

Common user
student K

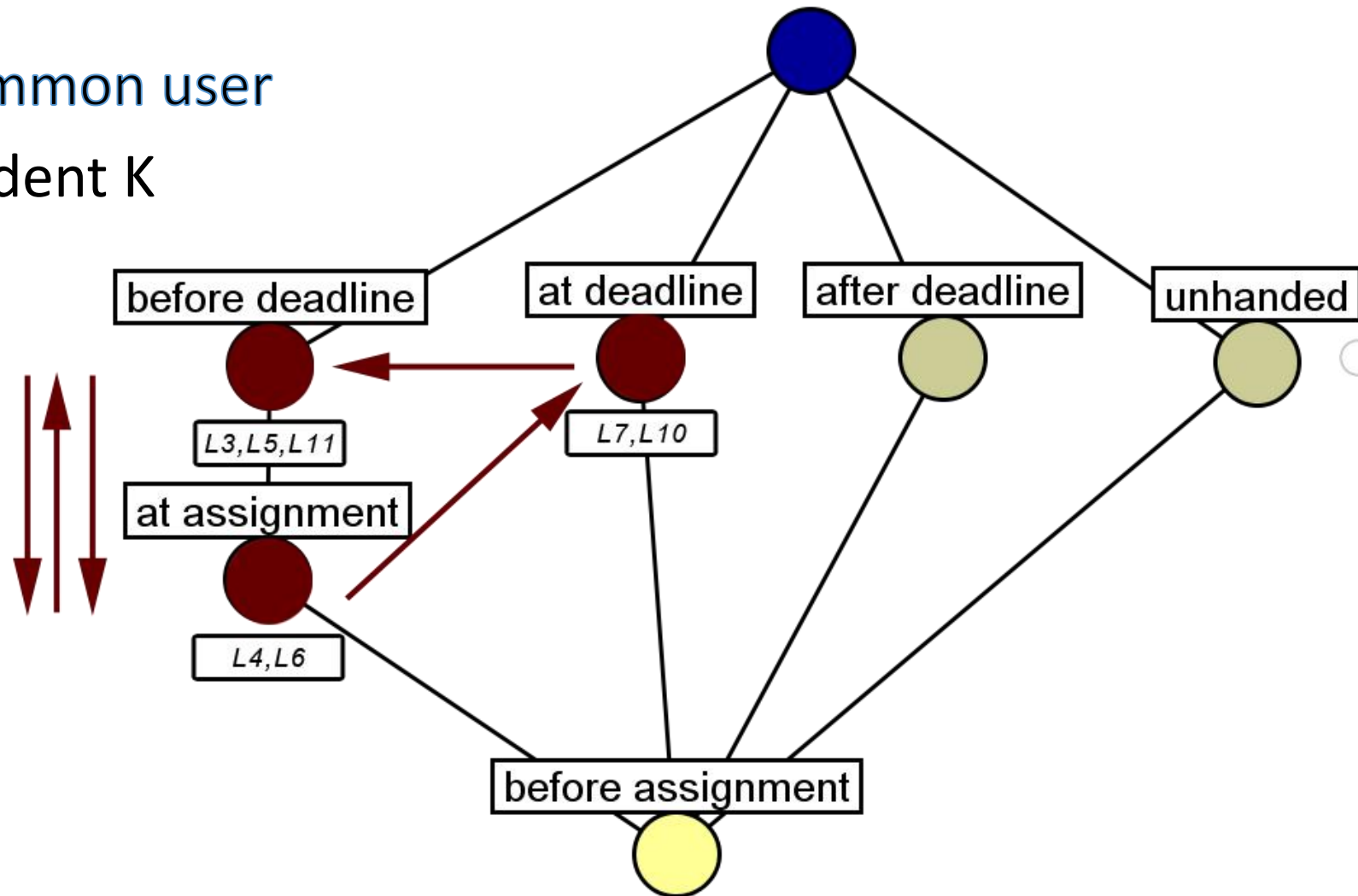
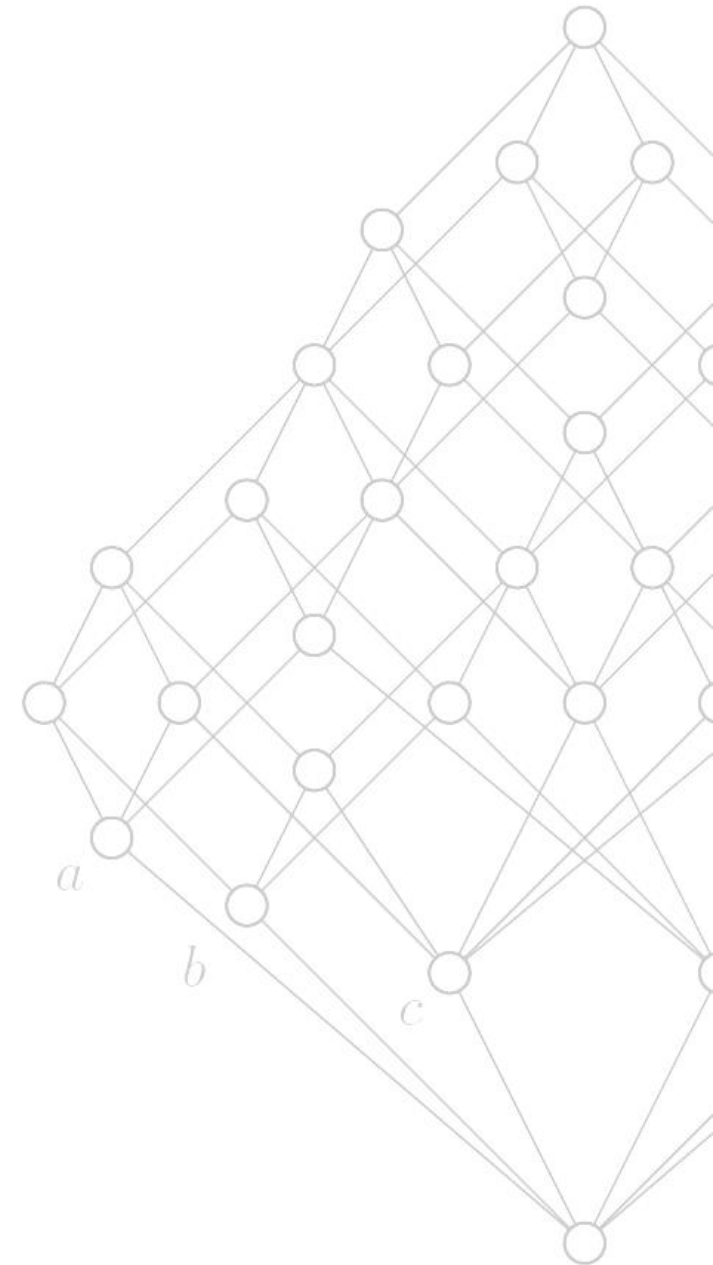


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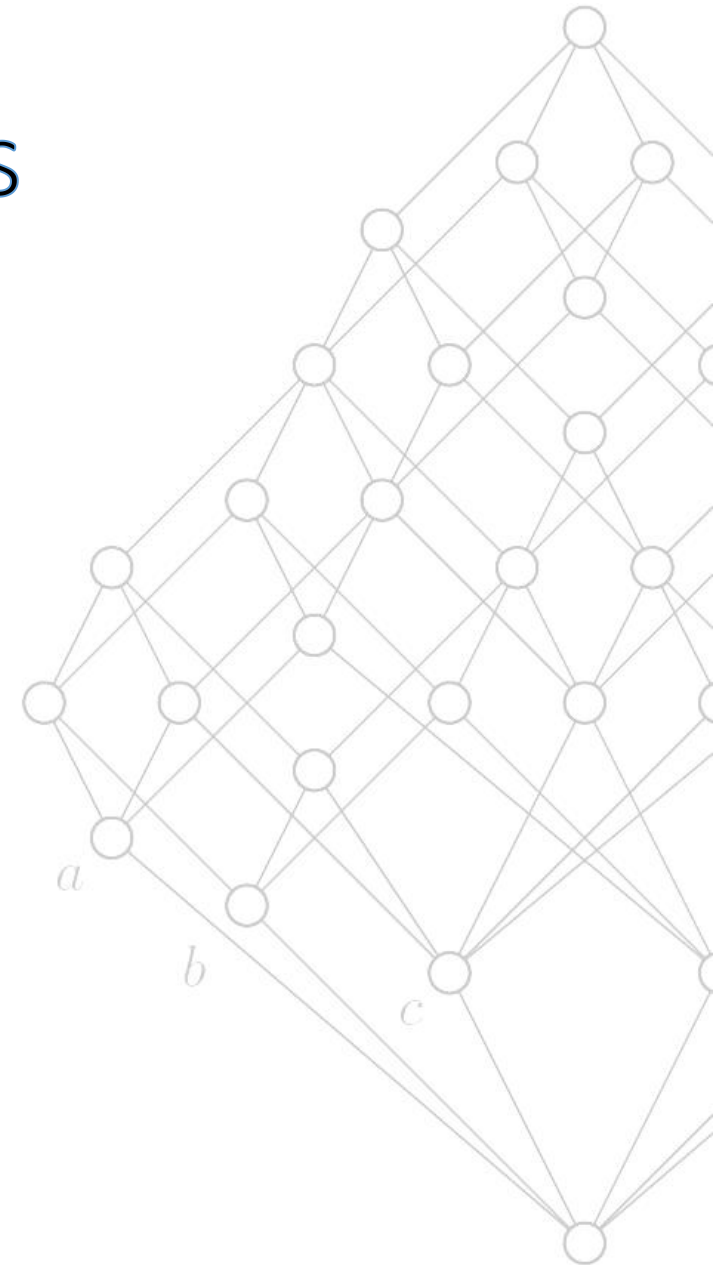
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Life tracks on educational attractors

For each assignment students are expected to:

- first read the [assignment](#),
- then to consult the laboratory support (i.e.,
 - the [theory](#) and
 - [example](#)) and
- then to check other related material (e.g.,
 - [lecture notes](#) and the
 - explanations on the [test papers](#)).

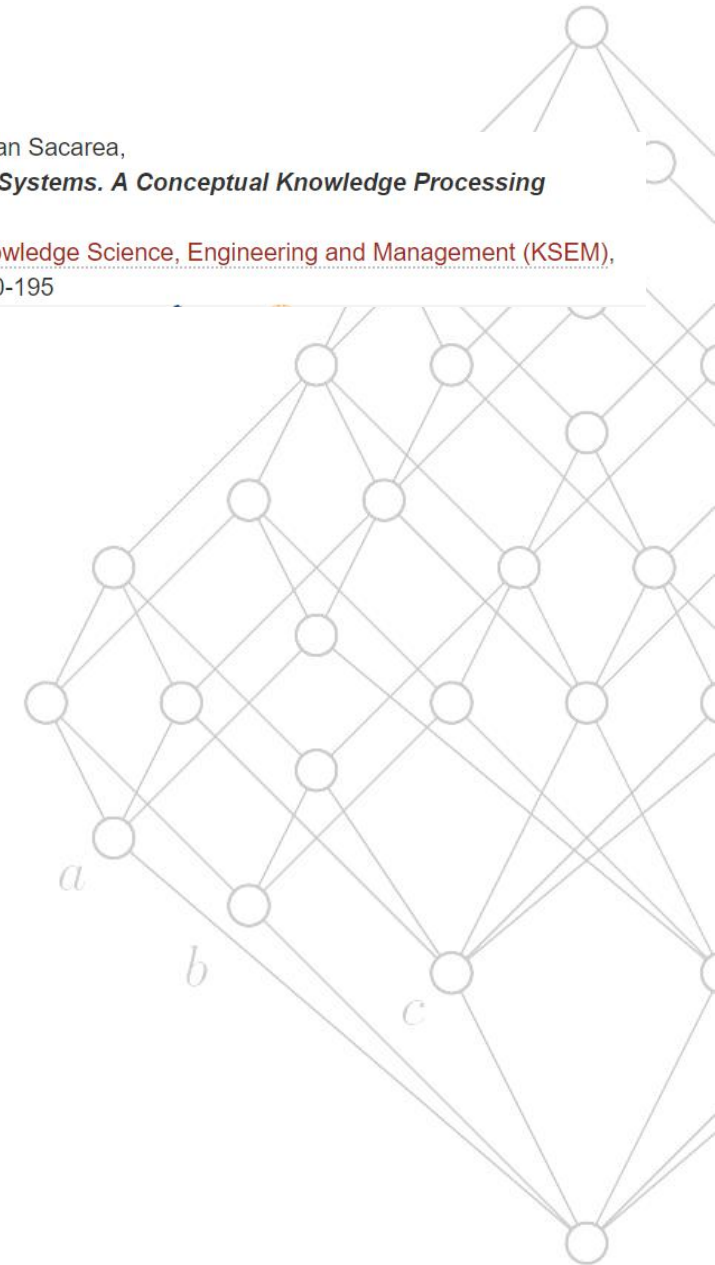


Educational attractors

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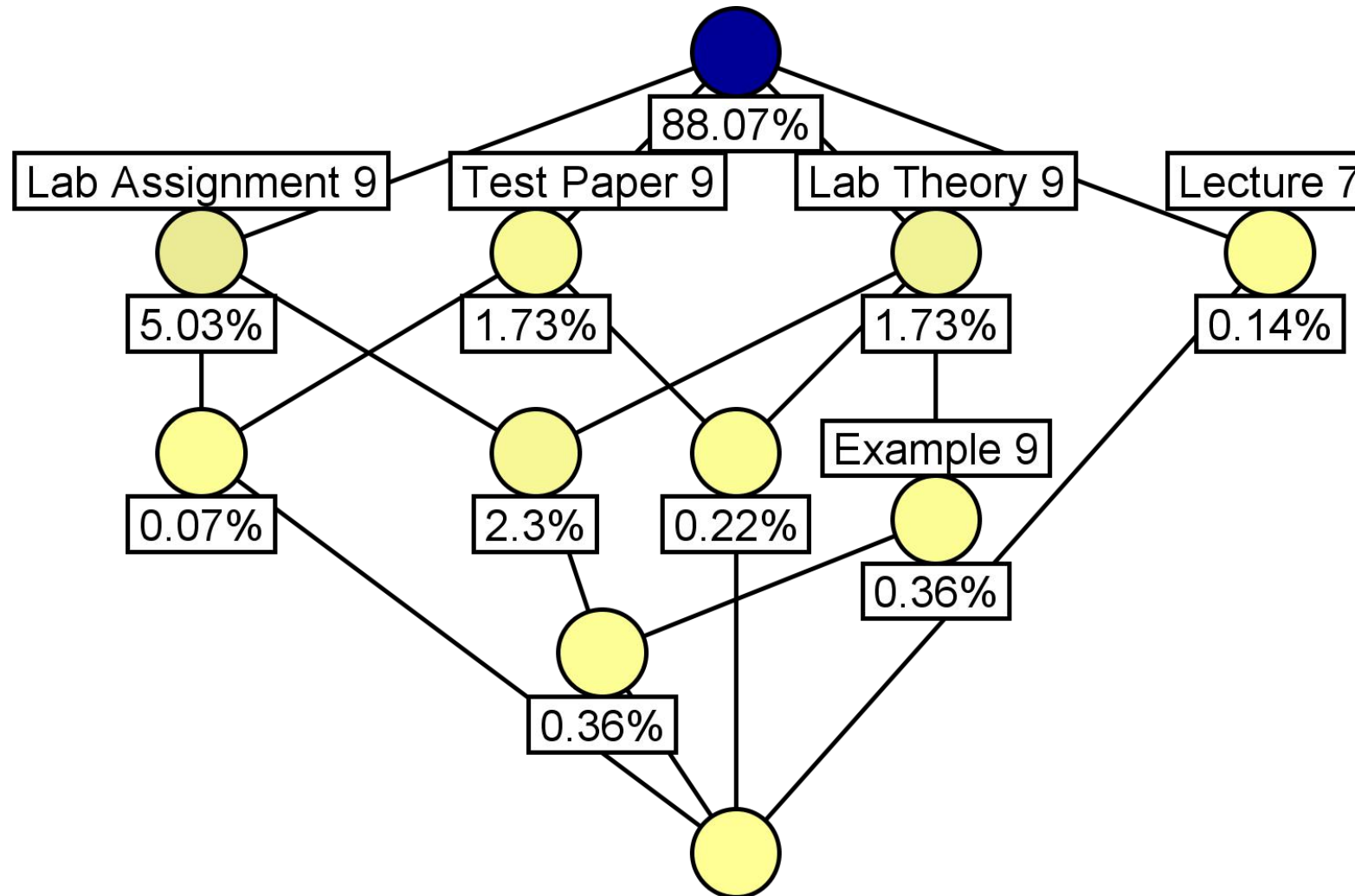
Example for the concept presented on week 9:

- Lecture 7
- Lab Theory 9
- Example 9
- Lab Assignment 9
- Test Paper 9



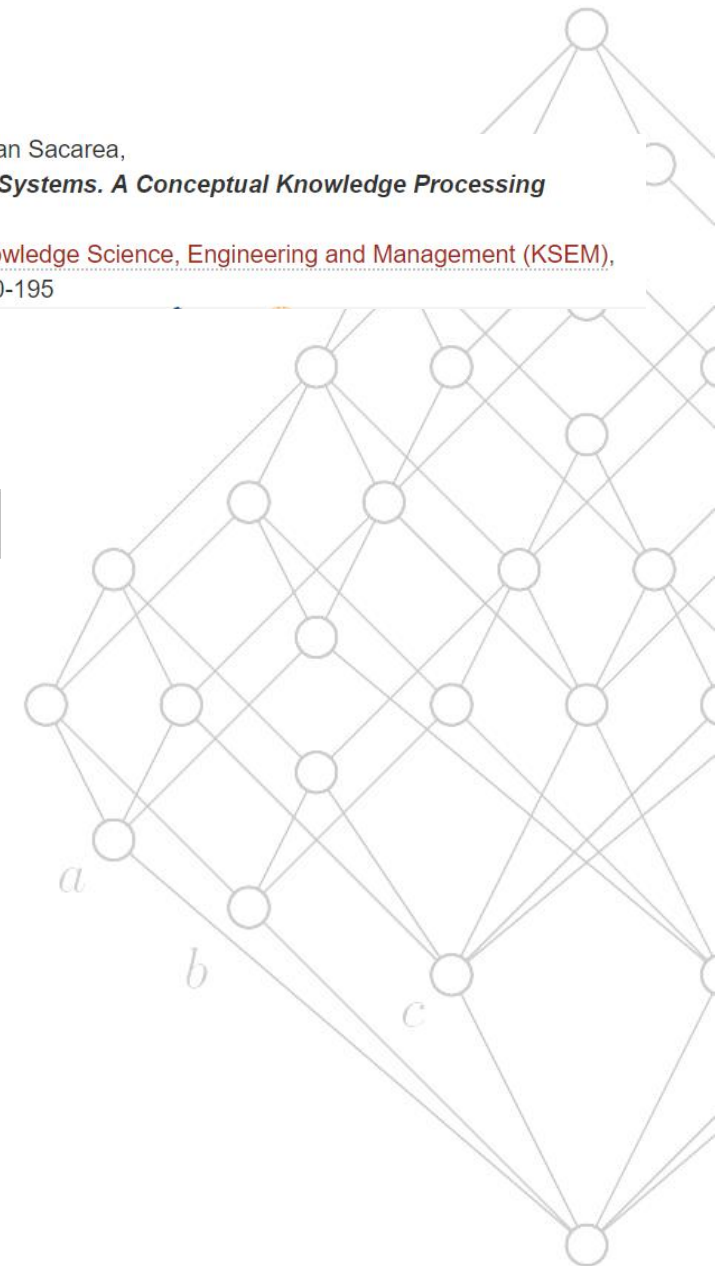
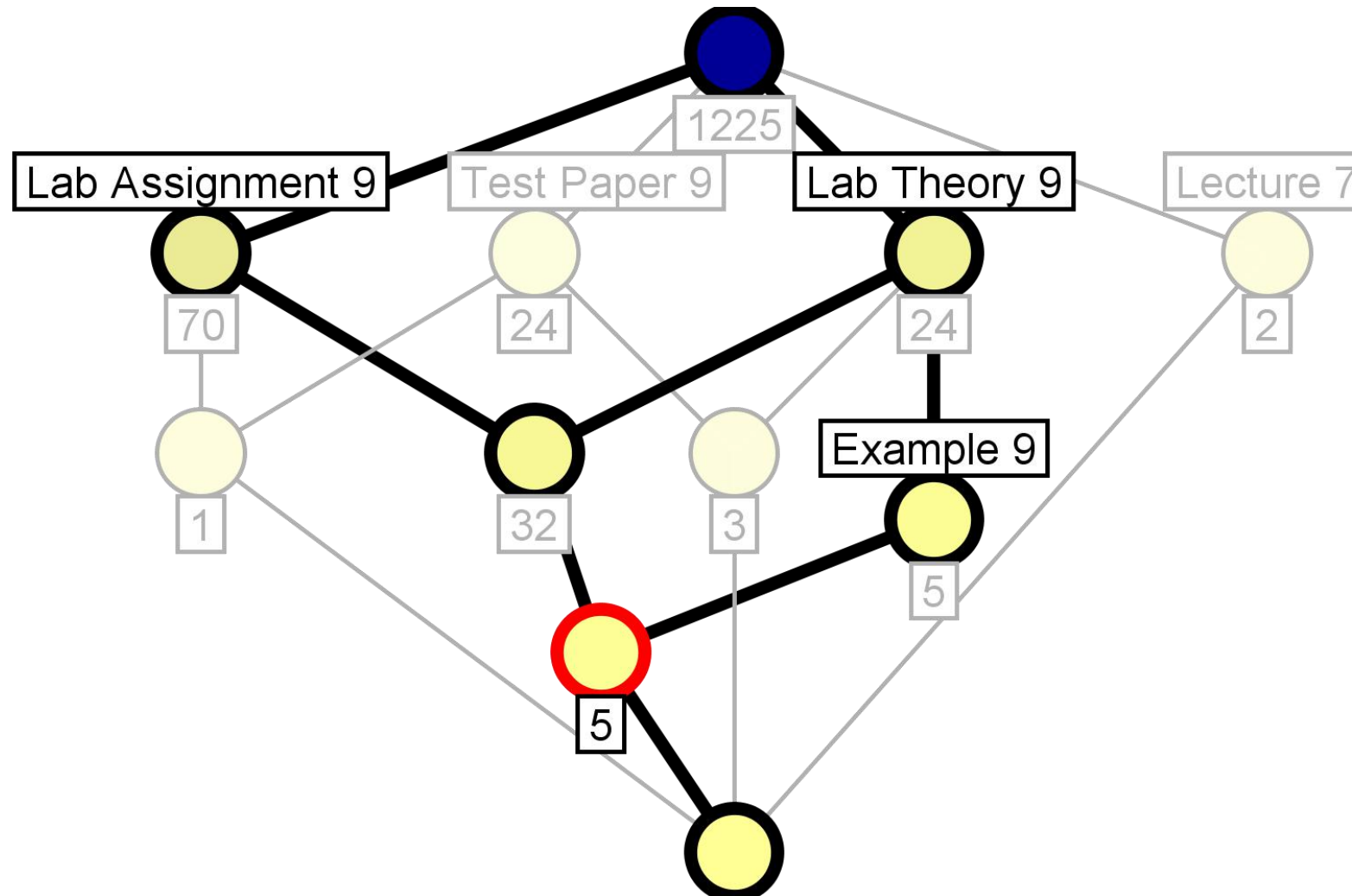
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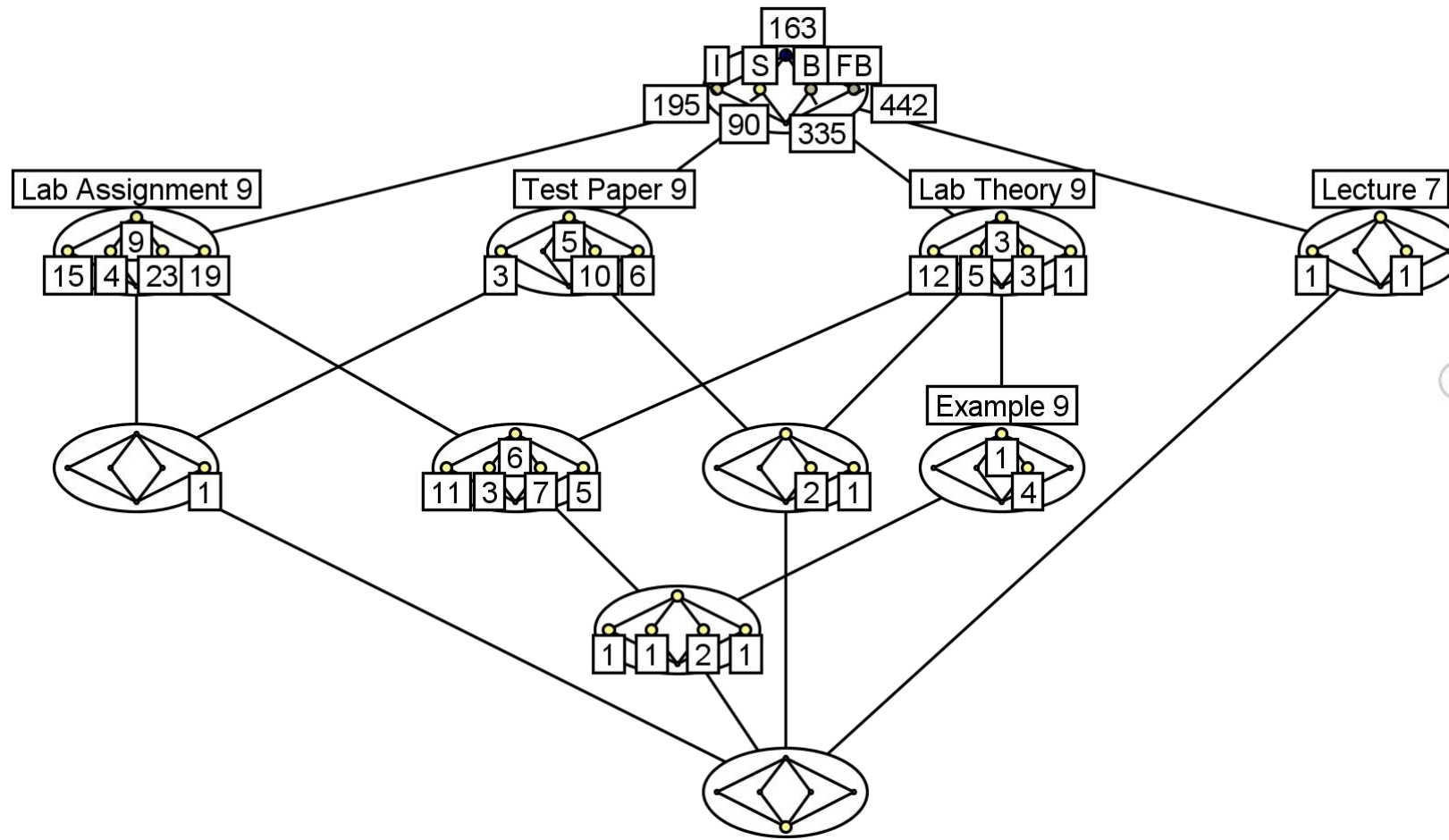


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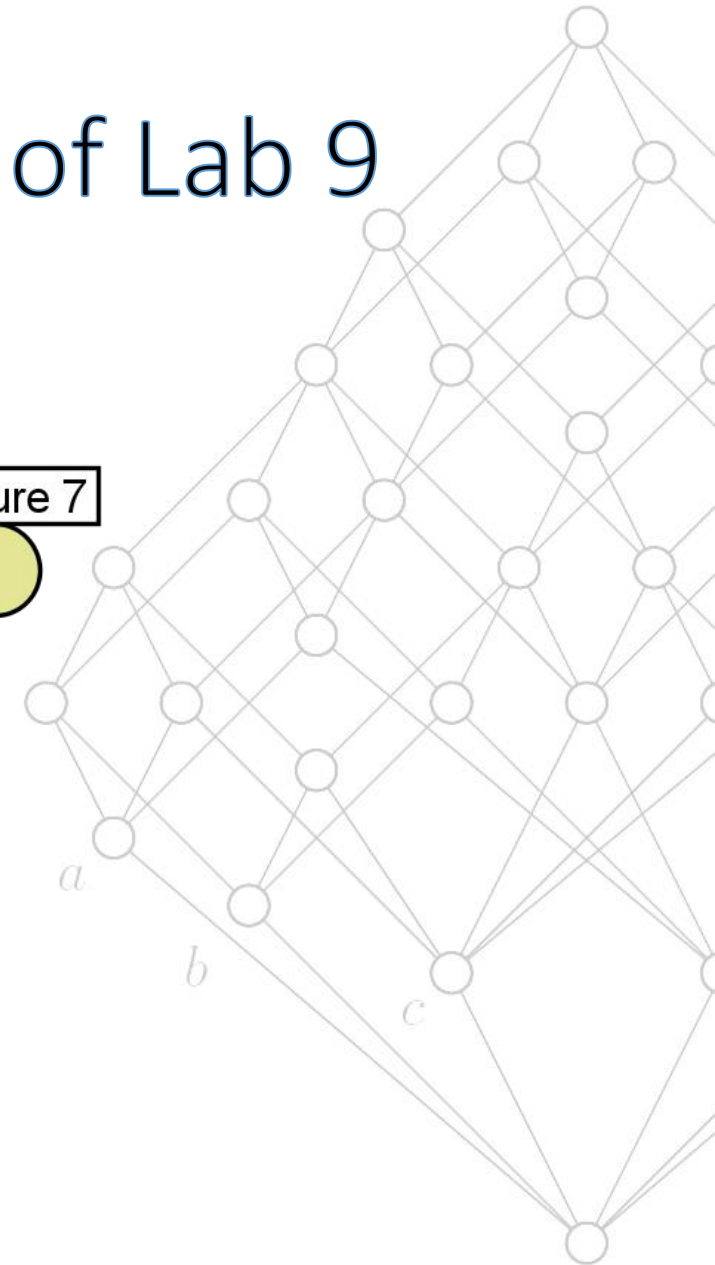
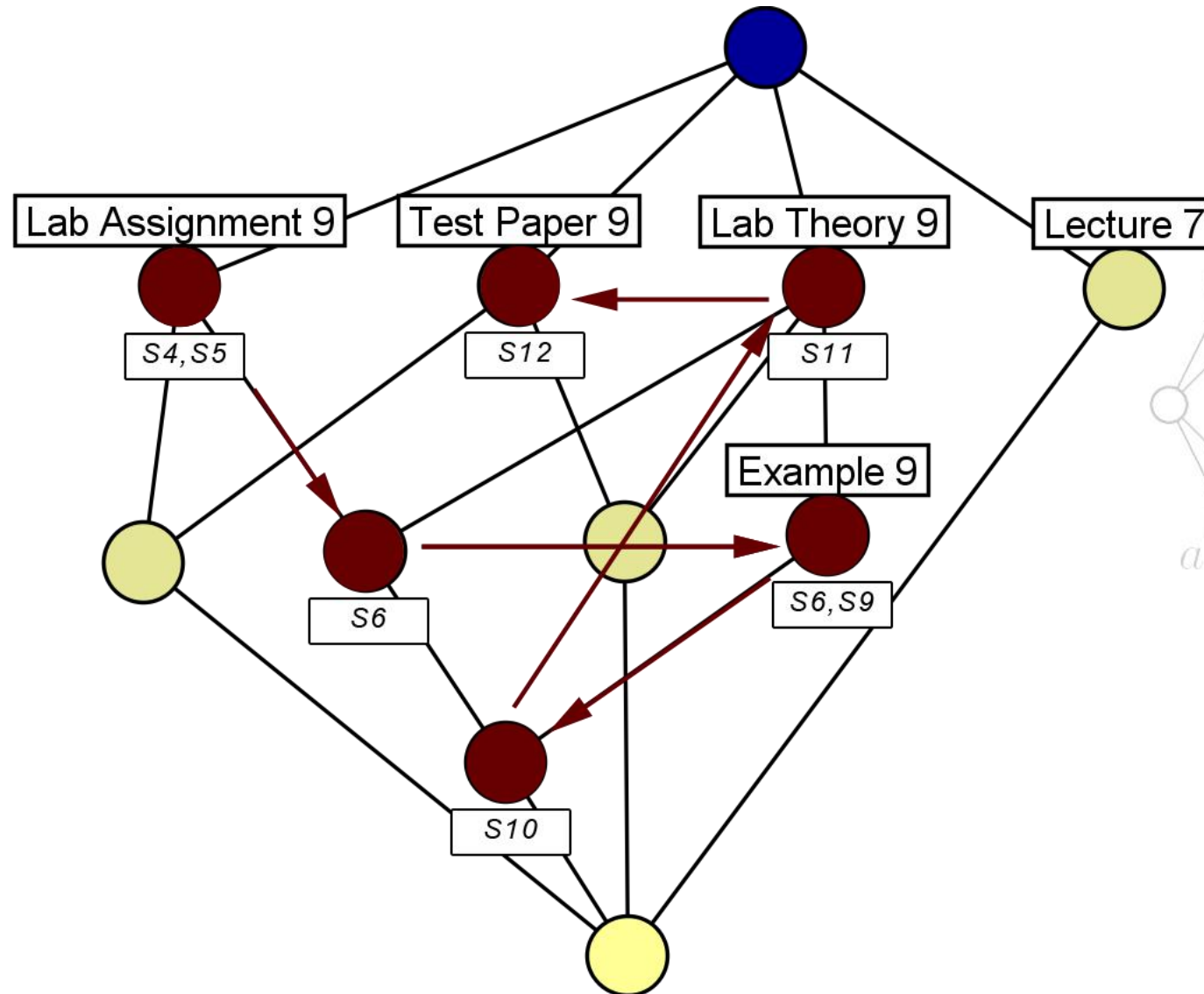


Educational attractor correlated with final marks



Life tracks on educational attractor of Lab 9

Early bird
student C



Life tracks on educational attractor of Lab 9

Common user
student D

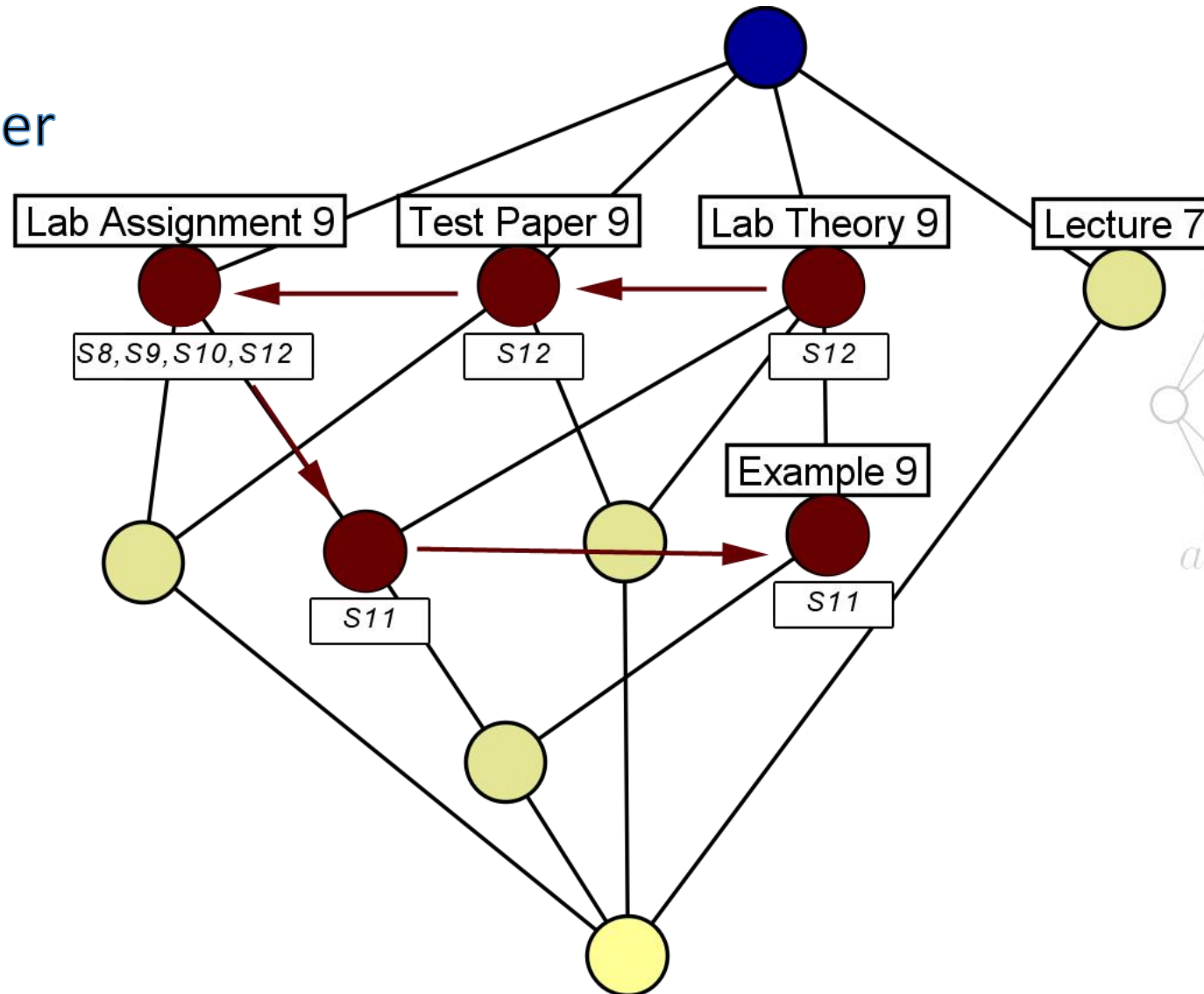
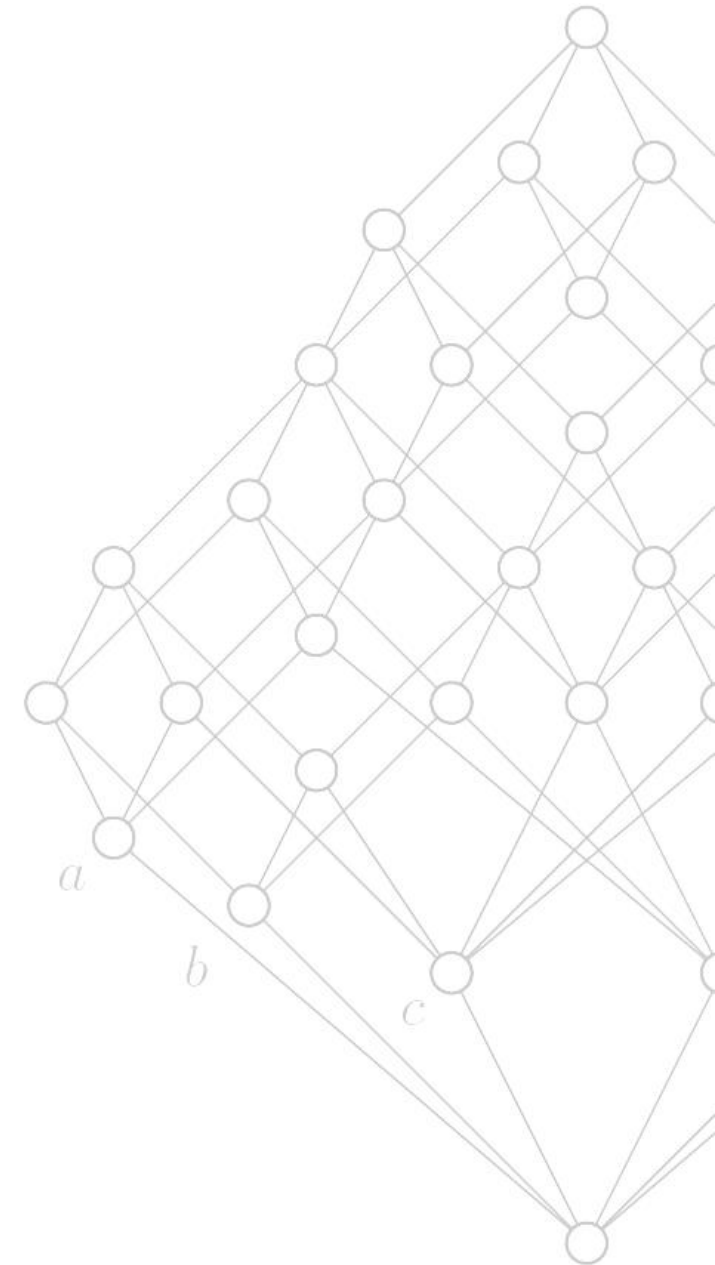


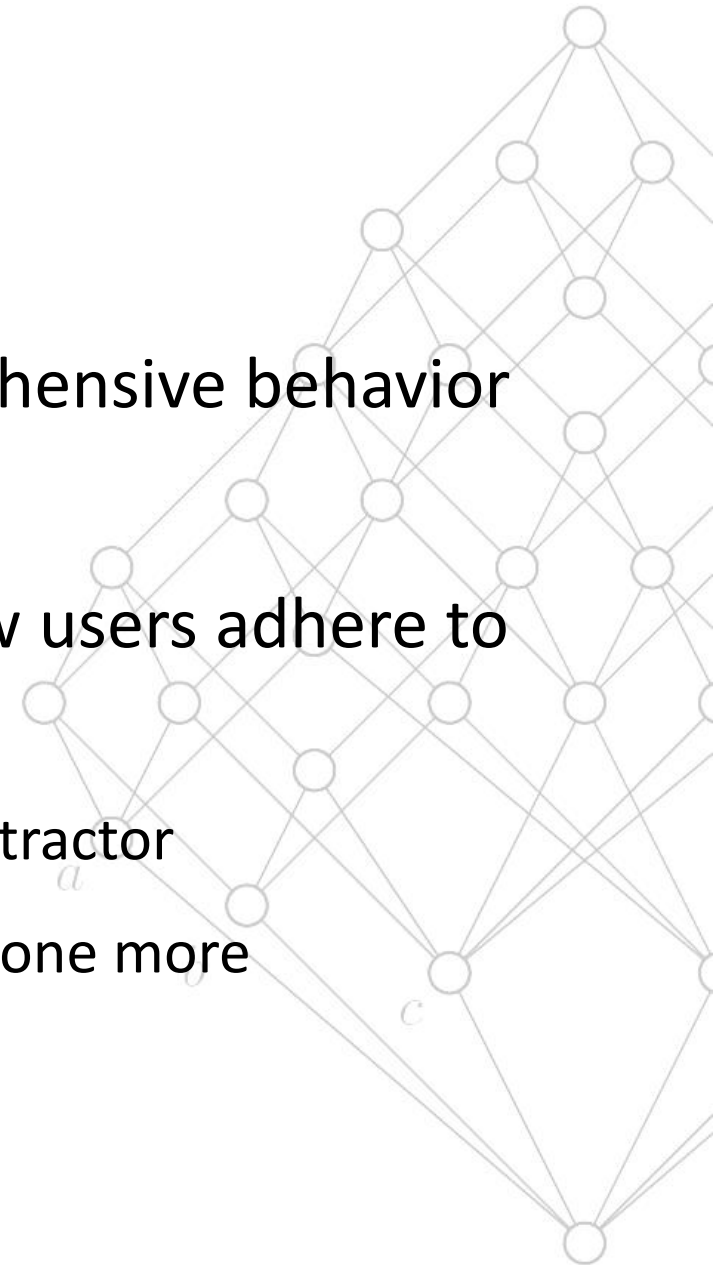
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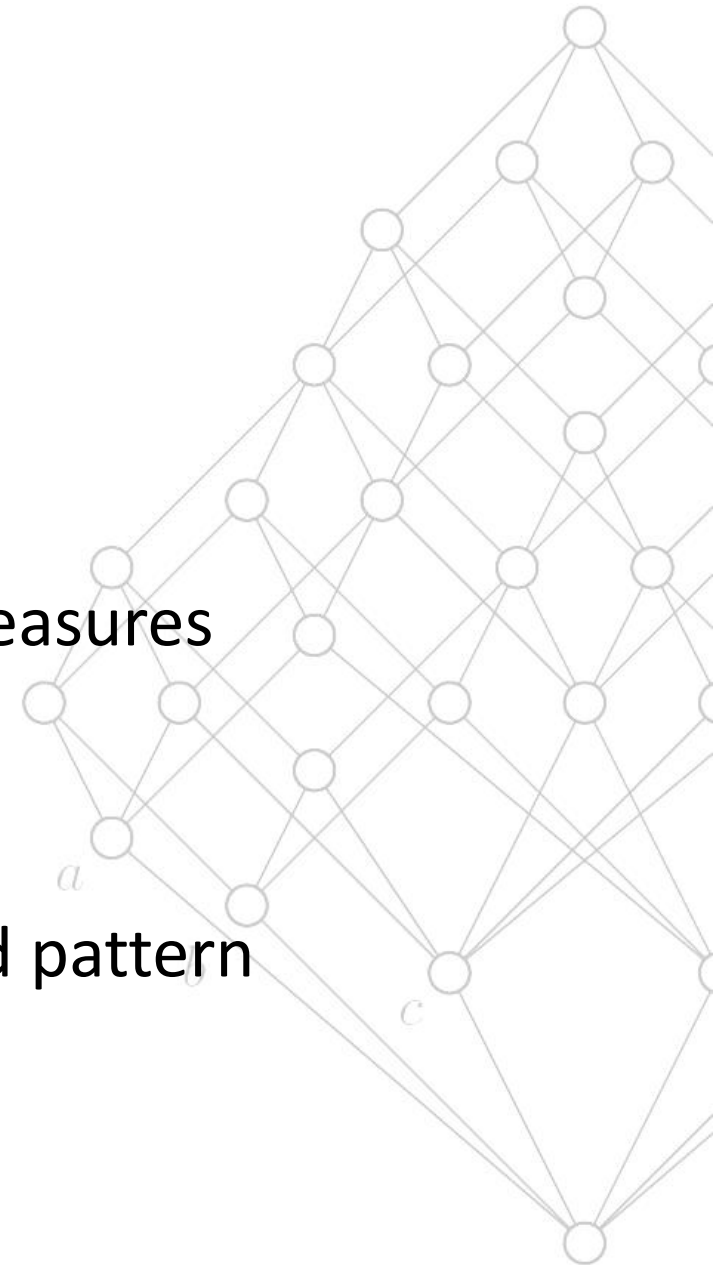
Conclusions

- we defined student behavioral pattern, called comprehensive behavior
- we used Temporal Concept Analysis to investigate how users adhere to educational attractors and we observed that:
 - early birds and common users adhere to the educational attractor
 - late rise users access only the assignment page and maybe one more

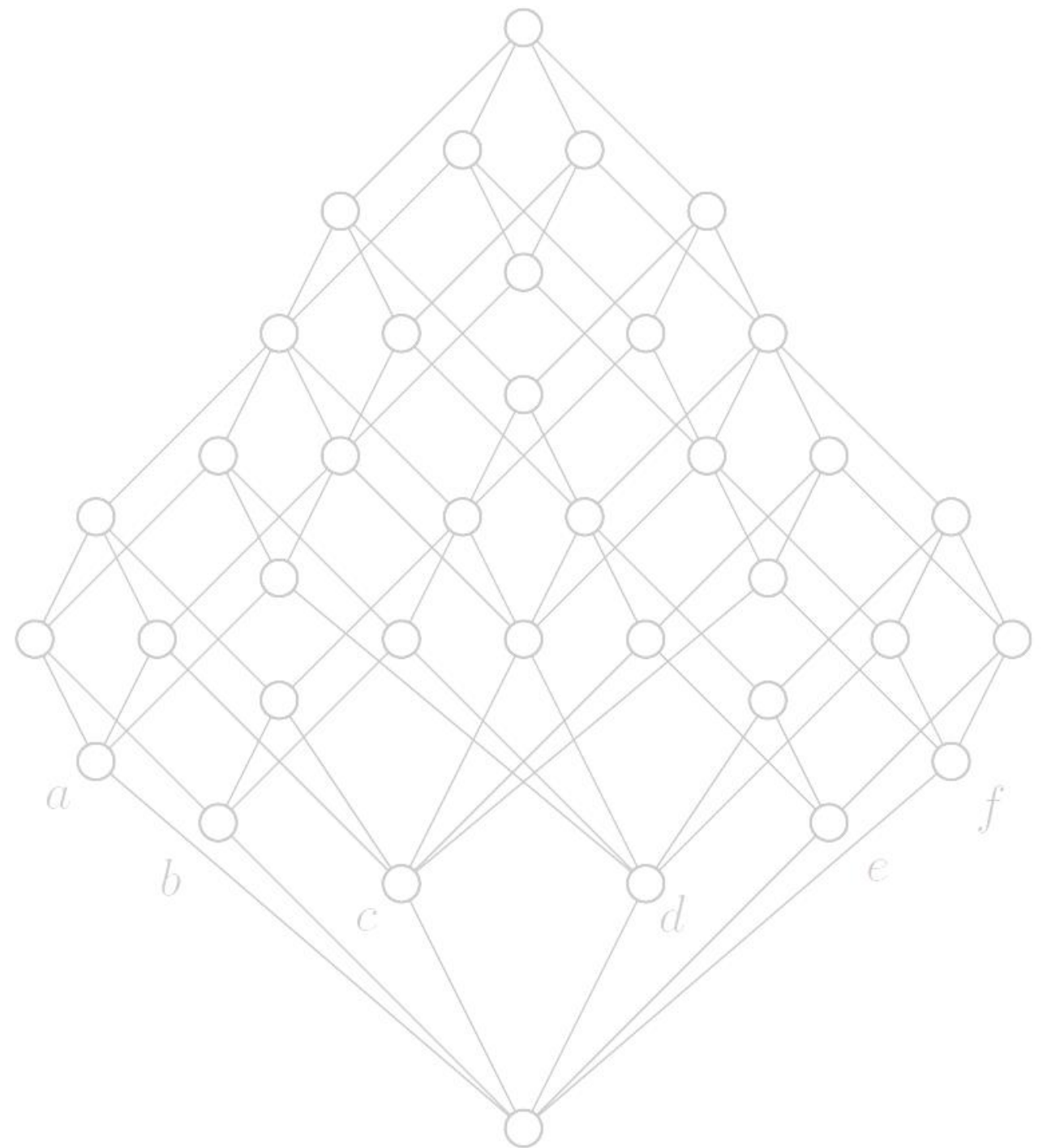


Future work

- detection of similar behavior using FCA similarity measures
- advanced pattern detection using relational FCA and pattern structures



Questions?



Thank you for your
attention!

