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

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Traditional development of e-courses

laborious activity for the instructor

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Traditional development of e-courses

laborious activity for the instructor

- choose the contents that will be shown;
- decide on the structure of the contents;
- determine the most appropriate content elements for each type of potential user of the course.

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The application of data mining in e-learning systems is an iterative cycle:

- collect data;

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- collect data;
- pre-process the data;
- apply data mining and interpret;
- evaluate and deploy the results.

Preliminaries

Web logs

created and maintained by a web server:

- personal information about the users (profile);

The structure of a log record:

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- indirect feedback (assessments, examinations or interaction with students).

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- web logs might provide a complete landscape of their on-line activity;
- how students are using certain educational contents;
- why are students behaving in a way or another;
- silent observation of what they are doing, at which particular time and in what particular order;
- detect relevant behavioral patterns distilling them directly from the stored web logs.

Preliminaries

Create user profile

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Create user profile

- gather information specific to each visitor:
  - users interests on the information presented on the platform;
  - users behavior while navigating the platform.
- customize the content and the structure of a web site to serve the visitors specific needs.

Related Work

- social dimension of the navigation on the Internet;

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- a very effective mechanism for acquiring knowledge;
- adapt the content and make it more feasible with the expectations of the visitors;
- study the impact of the Internet on our daily life, the cultural transformations which come along with it.

Related Work

Definition

- **Conceptual Time Systems**
  - scaled many-valued contexts:
    $T := ((G, M, W, I_T), (S_m \mid m \in M))$,
    $C := ((G, E, V, I_e), (S_e \mid e \in E))$;

- **Conceptual Time Systems with a Time Relation**
- **Transitions in Conceptual Time Systems with a Time Relation**
- **Conceptual Time Systems with Actual Objects and Time Relation** (P, G, Π, T, C, R)

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Attractors

- qualitative behaviors distilled from web logs;

Classification:

Investigating user behaviors

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- intended: encoded in the conceptual structure by the educator itself;
- not intended: occur at some particular points in time.

Investigating user behaviors

Users behavior

- early birds: they have accessed the provided material before it was expected;

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- common users: they behave as expected;

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Users behavior

- early birds: they have accessed the provided material before it was expected;
- common users: they behave as expected;
- late rise users: they visit the provided material later that expected.

Investigating user behaviors

Navigational attractors

- intended conceptual structure;

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- intended conceptual structure;
- reflects the educational purpose of the instructor;

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- intended conceptual structure;
- reflects the educational purpose of the instructor;
- suggest users to follow specific navigational patterns;

Investigating user behaviors

Navigational attractors

- intended conceptual structure;
- reflects the educational purpose of the instructor;
- suggest users to follow specific navigational patterns;
- is comprising the event part of a conceptual time system at the specific time granule.

Investigating user behaviors

Navigational attractors

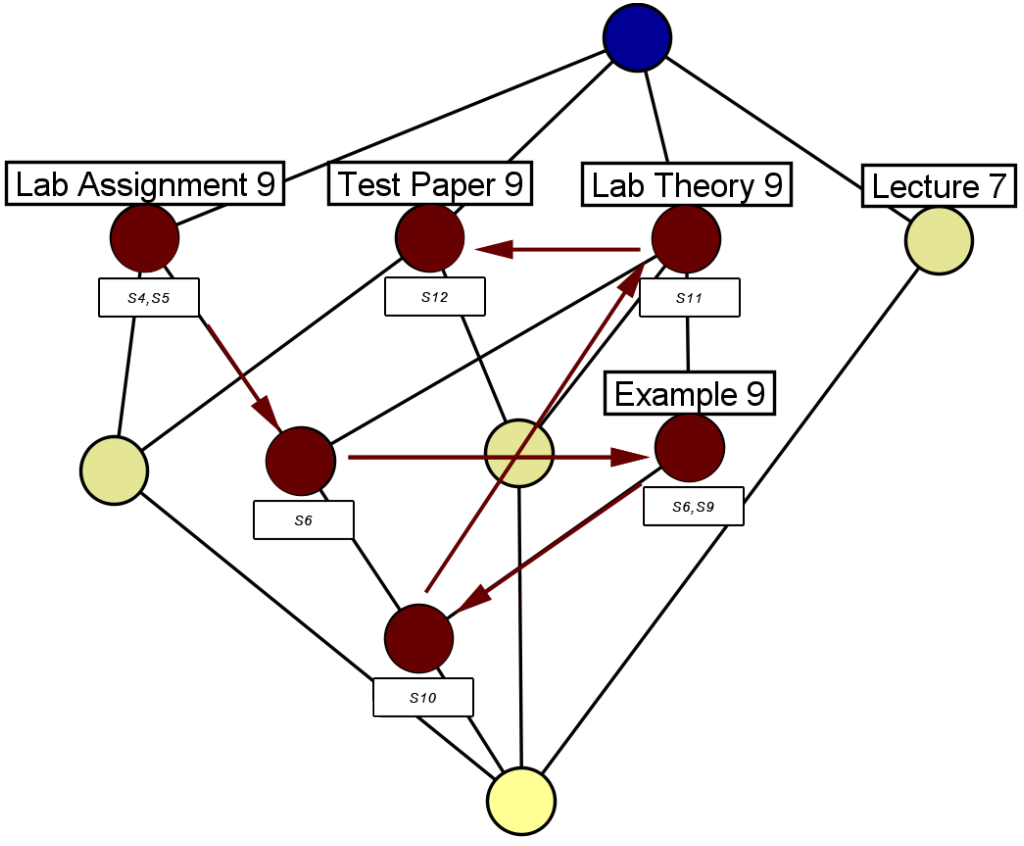

Figure: Navigational attractor - early bird user

Investigating user behaviors

Navigational attractors

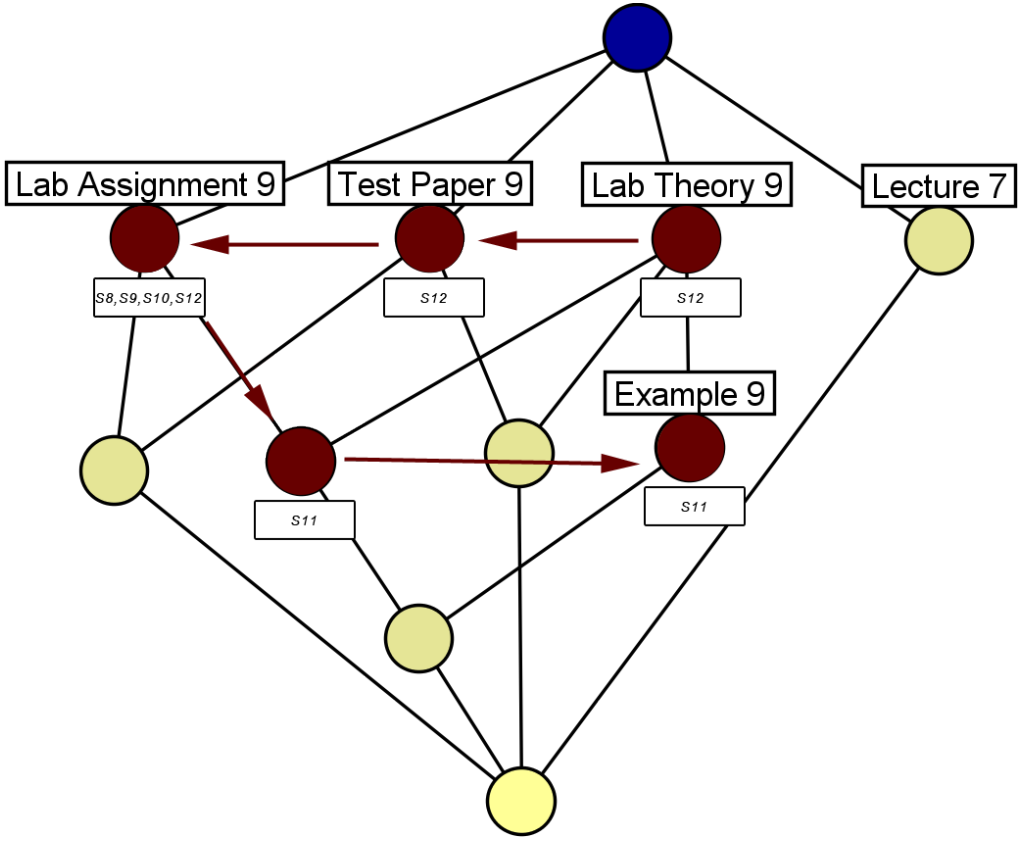

Figure: Navigational attractor - common user

Investigating user behaviors

Navigational attractors

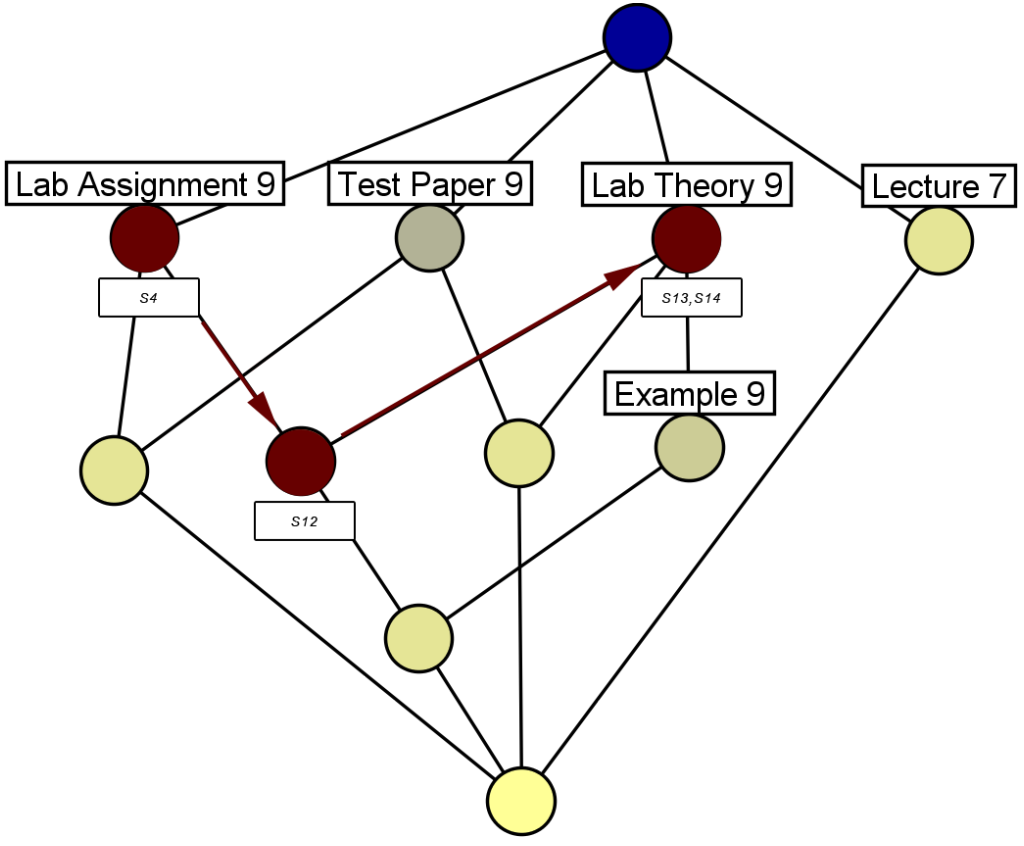

Figure: Navigational attractor - late user

Investigating user behaviors

Habitual attractors

- conceptual scale on a given time granule;

Investigating user behaviors

Habitual attractors

- conceptual scale on a given time granule;
- reflects the branching behavior;

Investigating user behaviors

Habitual attractors

- conceptual scale on a given time granule;
- reflects the branching behavior;
- reveals clues about restructuring information on the e-learning platform or some other unintended patterns showed off by the users.

Investigating user behaviors

Habitual attractors

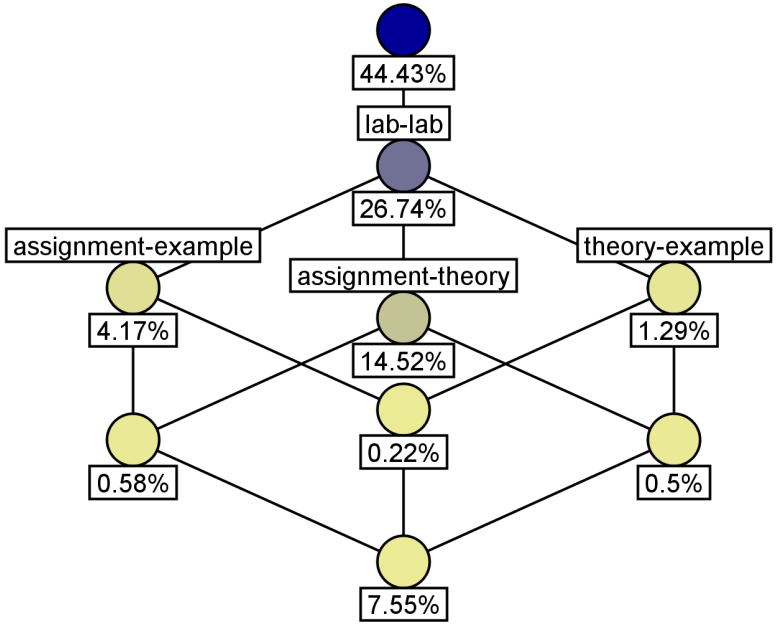

Figure: Habitual attractor - users make branches in their chain of visited pages to/from the classes of pages labeled in the nodes

Investigating user behaviors

Critical attractors

- habitual attractor on a critical time granule;

Investigating user behaviors

Critical attractors

- habitual attractor on a critical time granule;
- conceptual scale;

Investigating user behaviors

Critical attractors

- habitual attractor on a critical time granule;
- conceptual scale;
- reflects users behavior around critical events.

Investigating user behaviors

Critical attractors

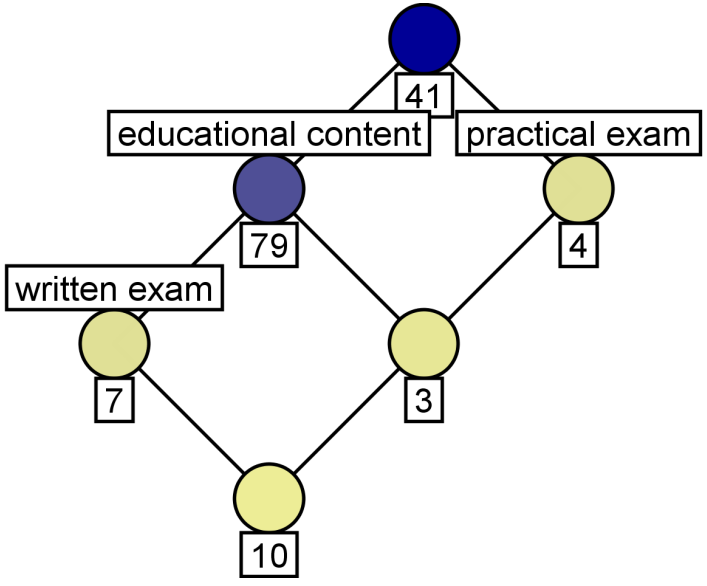

Figure: Critical attractor - users visit educational content on examination period

Students life tracks

Discussion

- (T,C) - conceptual time system on G;

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- (T,C) - conceptual time system on G;
- time granule - one week;
- build users life tracks.

Students life tracks

Discussion

- set of enrolled students: $P = \{student_1, student_2, ..., student_x\}$;

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- set of weeks: $p^{\Pi} = \{g \in G | (p, g) \in \Pi\} = \{w_{p_1}, ...w_{p_q}\}$;
- set of pairs of weeks: $R_p = \{(g, h) | ((p, g), (p, h)) \in R\}$.

Students life tracks

The set of R transitions for each class of users

$$Early_p = \{g \in G | (p, g) \in \Pi, g < n\} \quad (1)$$

$$Common_p = \{g \in G | (p, g) \in \Pi, n \leq g \leq n + 2\} \quad (2)$$

$$Late_p = \{g \in G | (p, g) \in \Pi, g > n + 2\} \quad (3)$$

Students life tracks

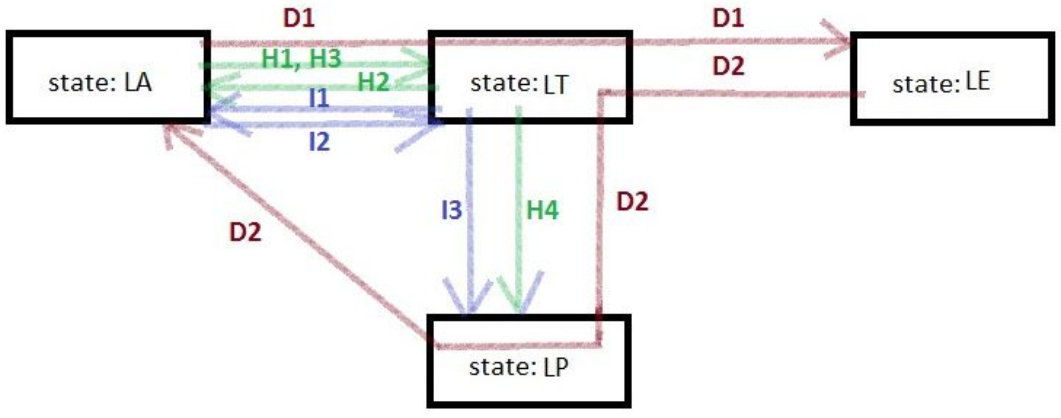

Figure: Common user - transitions through the platform

Conclusions

- emphasize the effectiveness of combining conceptual scale building with TCA;

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- emphasize the effectiveness of combining conceptual scale building with TCA;
- extract lots of valuable knowledge from web logs;
- customize the content and structure of the web site.

Further Research

- build efficient tools supporting FCA grounded data analysis;

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- build efficient tools supporting FCA grounded data analysis;
- considering pattern structures, relational FCA and other FCA varieties.

Thank you!


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