AI-supported Study Planning and Cohort Monitoring

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Study Planning and Cohort Monitoring

- **Target Groups:**
  - Students (Planning)
  - Study Program Designers (Analysis)

- **Data-driven and rule-based Artificial Intelligence**

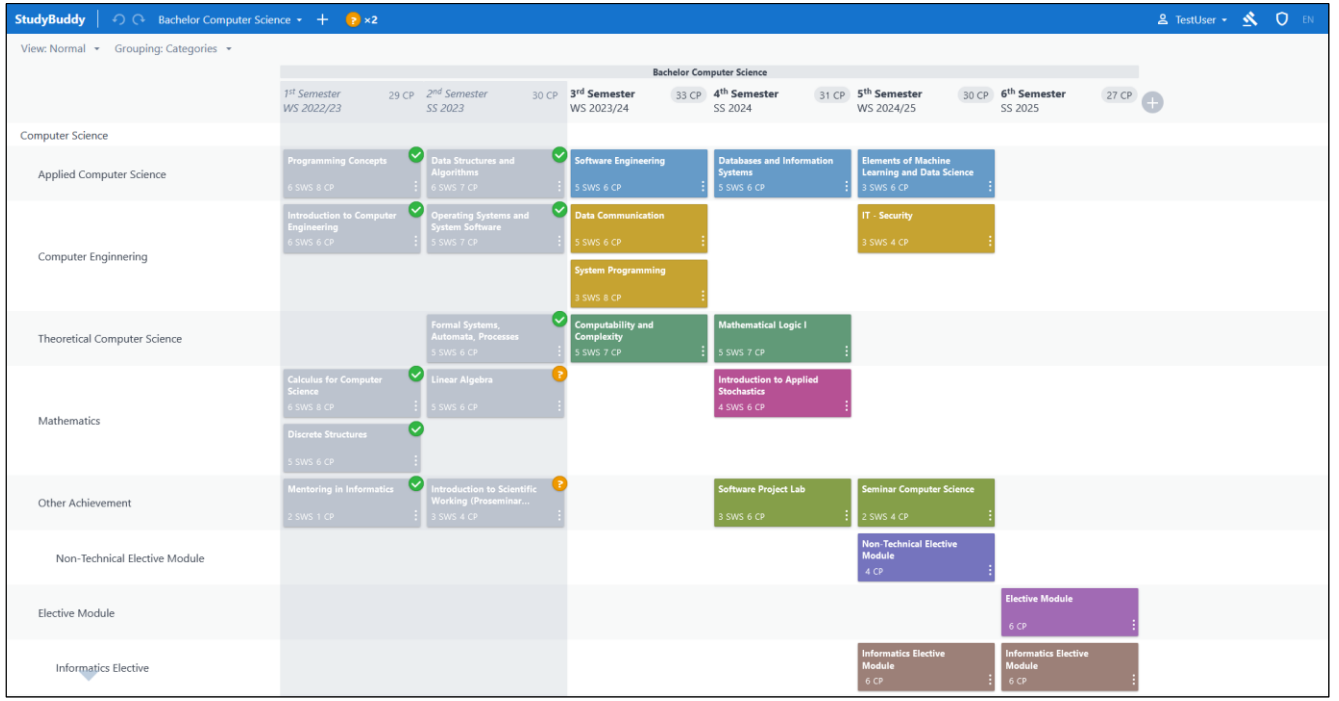
- **Access through user-centered web applications**
- **Joint Research Project in Research Program**
  - *AI in Higher Education*
- **Project timeframe:** 01.11.2021 – 30.04.2025

Study Planning Tool – StudyBuddy

– **Interactive Plan**
  - Based on recommended plan
  - Individual adjustments

– **Rule-based Feedback**

– **Data-driven Recommendations**



Fixed, unflexible recommended plan

- **Similarities**
  - Placement of modules in specific semesters
  - Information on Credit Points
    - Per Module
    - Per Semester
- **Problems:**
  - No alternatives to recommended plan
  - Module dependencies are not included
  - Rigid, fixed → one-fits-all

Modulcharakteristika		Fachsemester					
Kürzel	Modulbezeichnung	1	2	3	4	5	6
BM-SA	**Basismodul Sprachausbildung (9 LP)**						
	Übung: Hörverstehen und mündlicher Ausdruck I	3					
	Übung: Schriftlicher Ausdruck I		3				
	Übung: Übersetzen			3			
BM-LK	**Basismodul Literatur- und Kulturwissenschaft (6 LP)**						
	Seminar: Einführung in die Literaturwissenschaft	2					
	Seminar: Einführung in die Kulturwissenschaft	2					
	Modulprüfung	2					
BM-Lin	**Basismodul Linguistik (6 LP)**						
	Seminar: Einführung in die anglistische Linguistik I (Phonetik/Phonologie - Morphologie - Lexikalische Semantik)	3					
	Seminar: Einführung in die anglistische Linguistik II (Syntax)		2				
	Modulprüfung (Klausur)		1				
AM-SA	**Aufbaumodul Sprachausbildung (6 LP)**						
	Übung: Hörverstehen und mündlicher Ausdruck II						3
	Übung: Schriftlicher Ausdruck II					3	
AM-ALK-a	**Aufbaumodul Amerikanische Literatur und Kultur (6 LP)**						
	Vorlesung oder Seminar 1		3				
	Seminar 2			2			
	Modulprüfung			1			
AM-BL-a	**Aufbaumodul Britische Literatur (6 LP)**						
	Vorlesung oder Seminar 1			3			
	Seminar 2				2		
	Modulprüfung				1		
AM-BK-a	**Aufbaumodul Britische Kultur (6 LP)**						
	Vorlesung oder Seminar 1					3	
	Seminar 2						2
	Modulprüfung						1
AM-PLK-a	**Aufbaumodul Postkoloniale Literatur und Kultur (6 LP)**						
	Vorlesung oder Seminar 1						3
	Seminar 2						2
	Modulprüfung						1

Modulkürzel	*Modulbezeichnung (Pflicht/Wahlpflicht)*	*Sem.*	*LP*	*Typ*	*SWS*	*Veranstaltungsbezeichnung*	*Prüfung*	*Modul-beauftragte/r*	*Bemerkung/ Sprache*
1. Semester (Wi)									
BA3POL3501	M1: Grundlagen der Politikwissenschaft und ihrer Nachbardisziplinen (P)	Wi	5	V	2	Einführung in die Methoden der empirischen Politikwissenschaft		Cronqvist	Deutsch
				Ü	1	Propädeutikum			
				TUT	1	Methoden der Politikwissenschaft			
							Klausur (60 Min.)		
BA3POL3502	M2: Demokratie und Gesellschaft in Deutschland (P)	Wi	10	V	2	Politisches System der BRD		Jun	Deutsch
				V	2	Politische Geschichte im 19. und 20. Jahrhundert			
				S	2	Gesellschaft und Demokratie in Deutschland			
							Klausur (90 Min.)		
2. Semester (So)									
BA3POL3504	M4: Vergleich politischer Systeme (P)	So	10	V	2	Einführung in die Vergleichende Regierungslehre		Linden	Deutsch
				S	2	Politische Systeme			
							Klausur (120 Min.)		

Influences on Study Planning

Curriculum Conditions

Exams not attended/not passed

Module cycles

Prerequisites for modules

- Pass A before attending B

Prior Knowledge Recommendations

- Knowledge of C is recommended for D

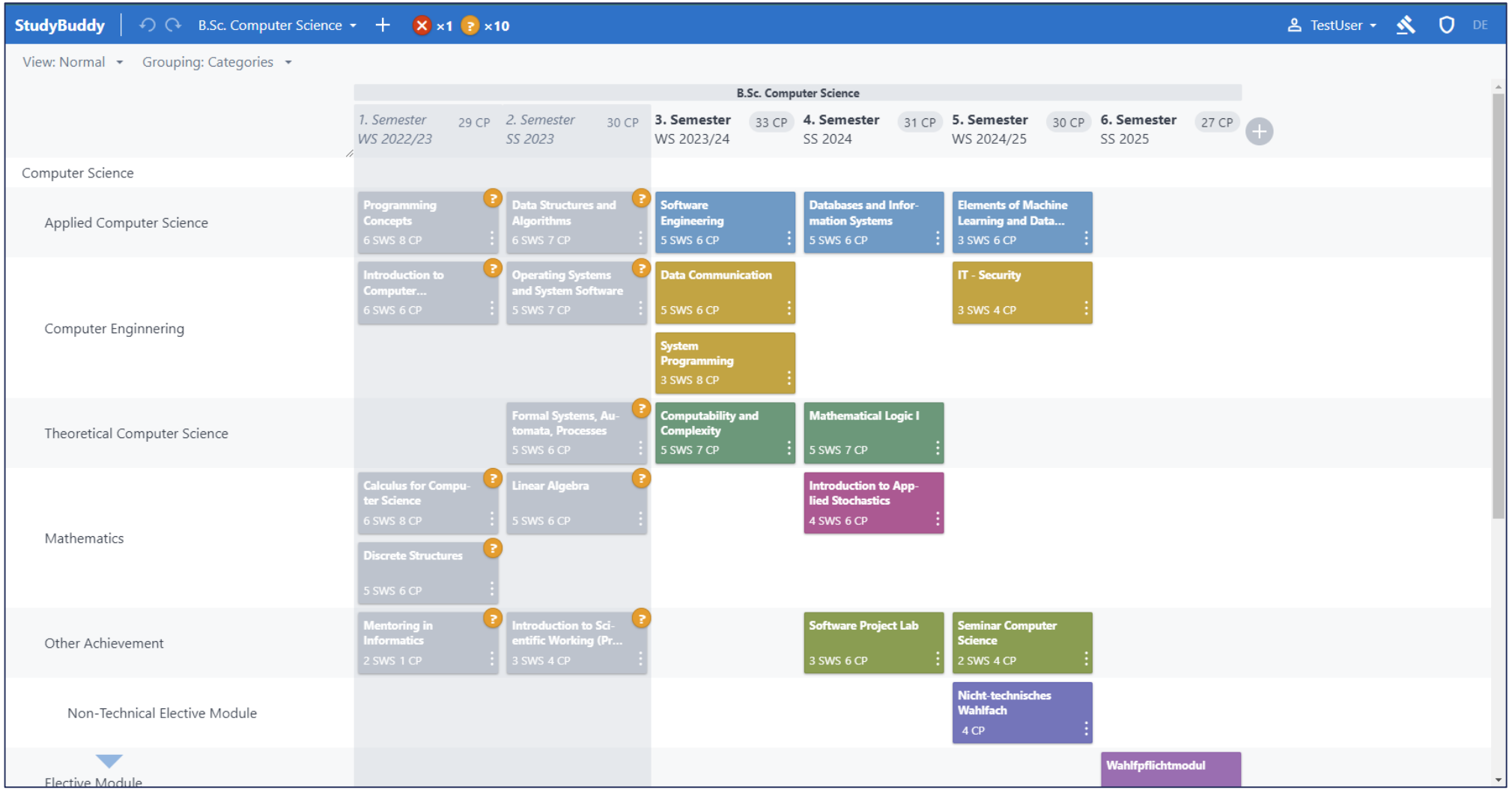
Private Conditions

Peers and Friends

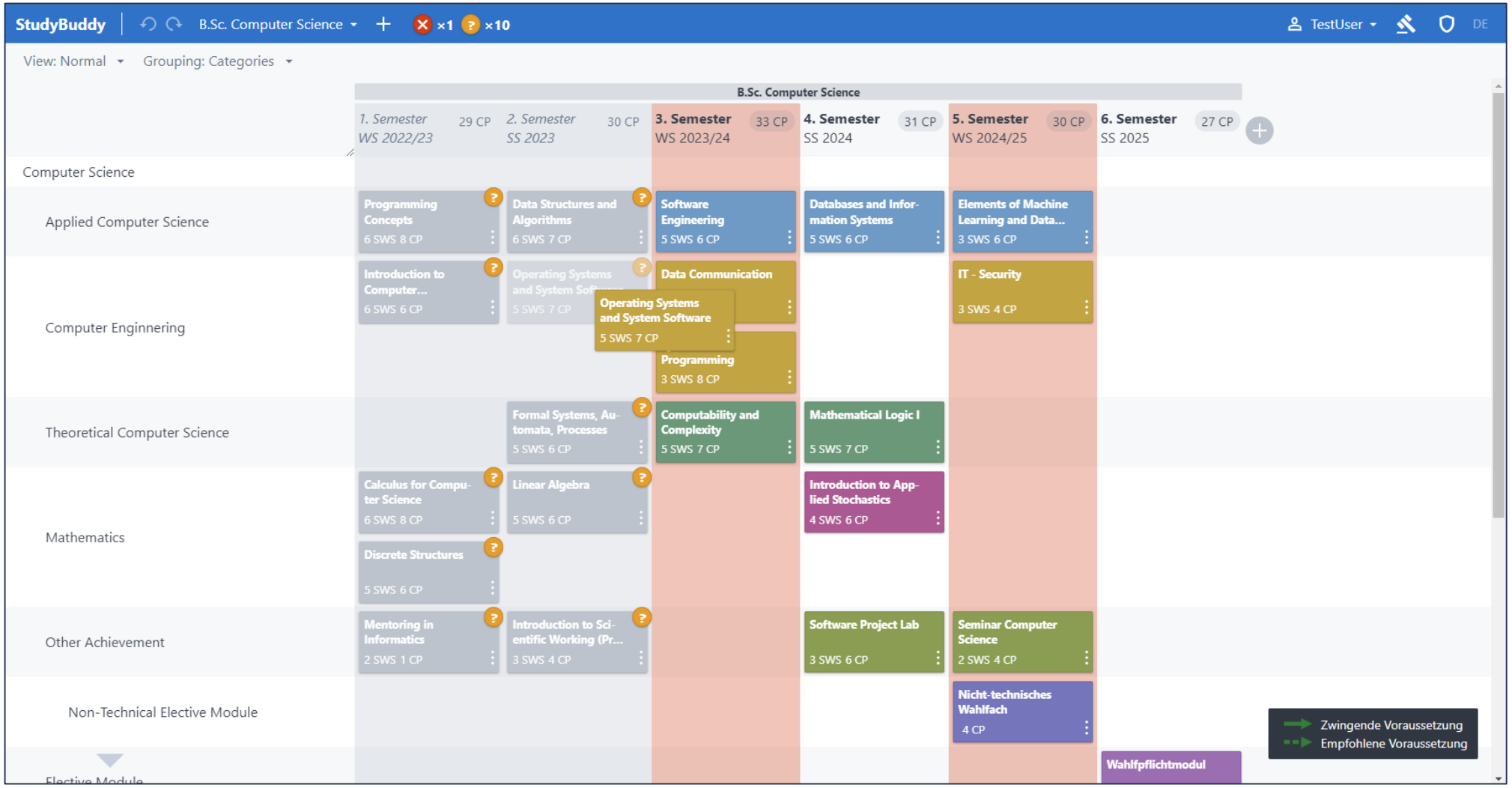
Job, side hustles

Family-related issues

Study Planning Tool – StudyBuddy



Study Planning Tool – StudyBuddy



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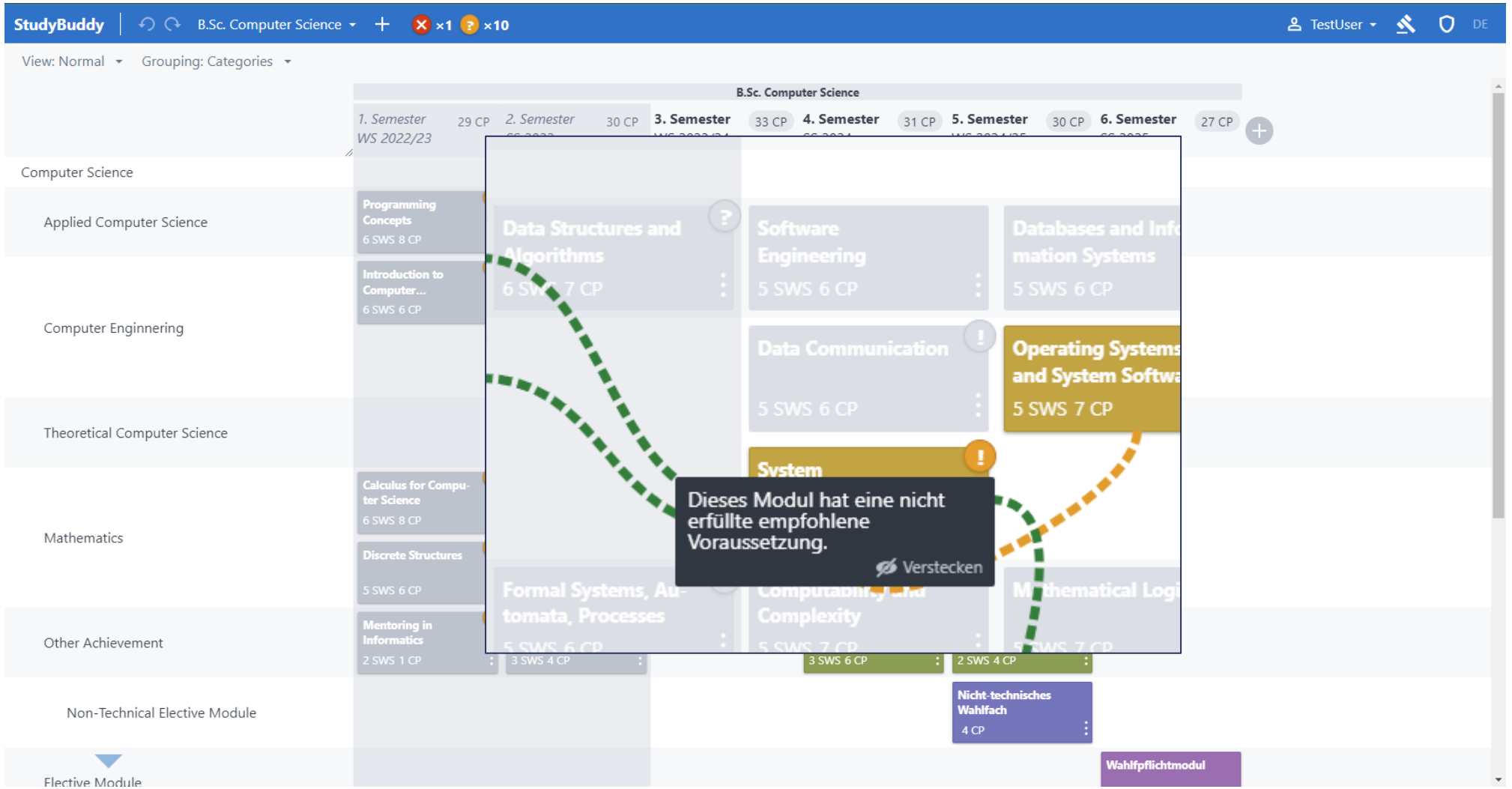

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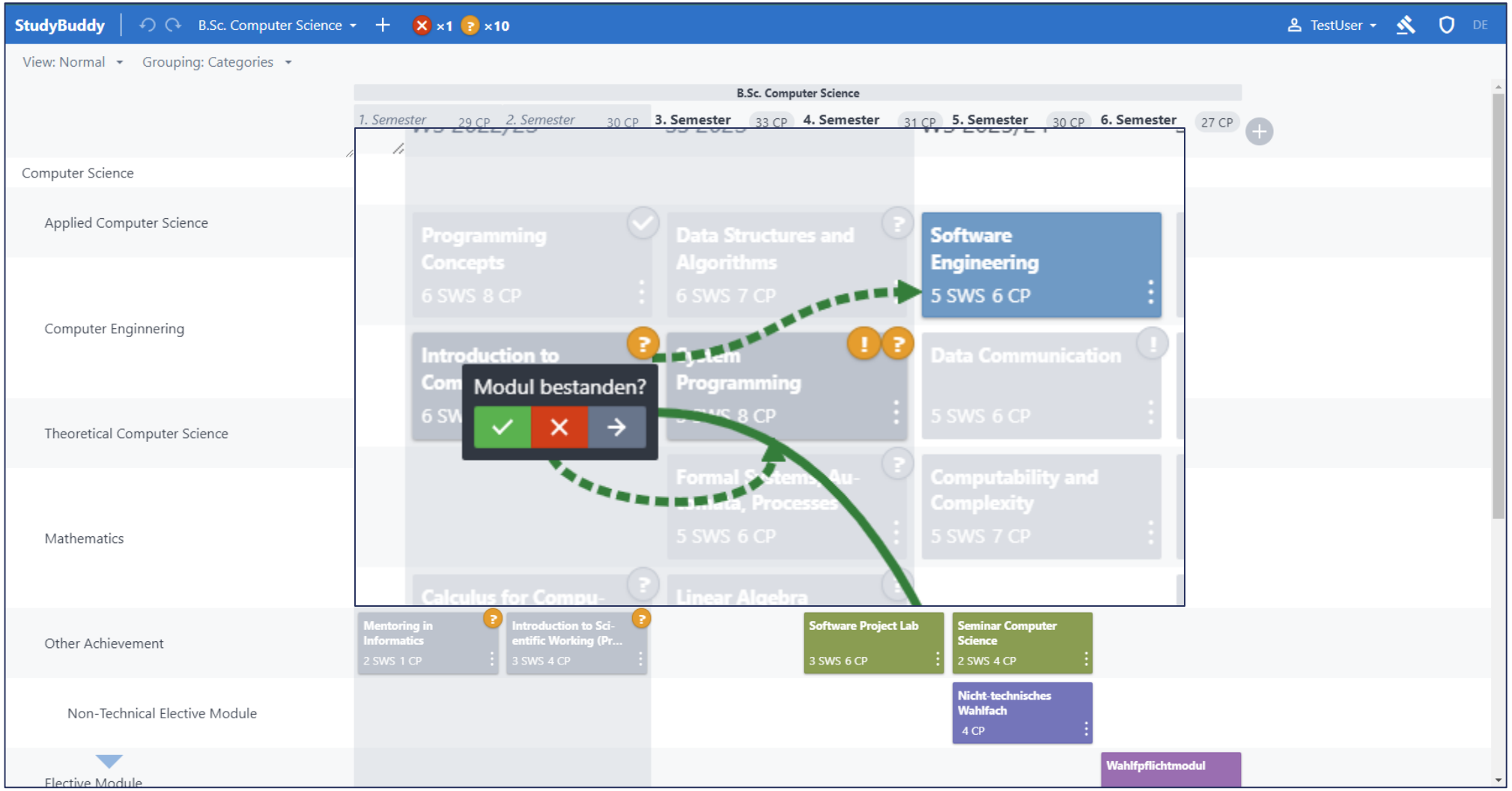
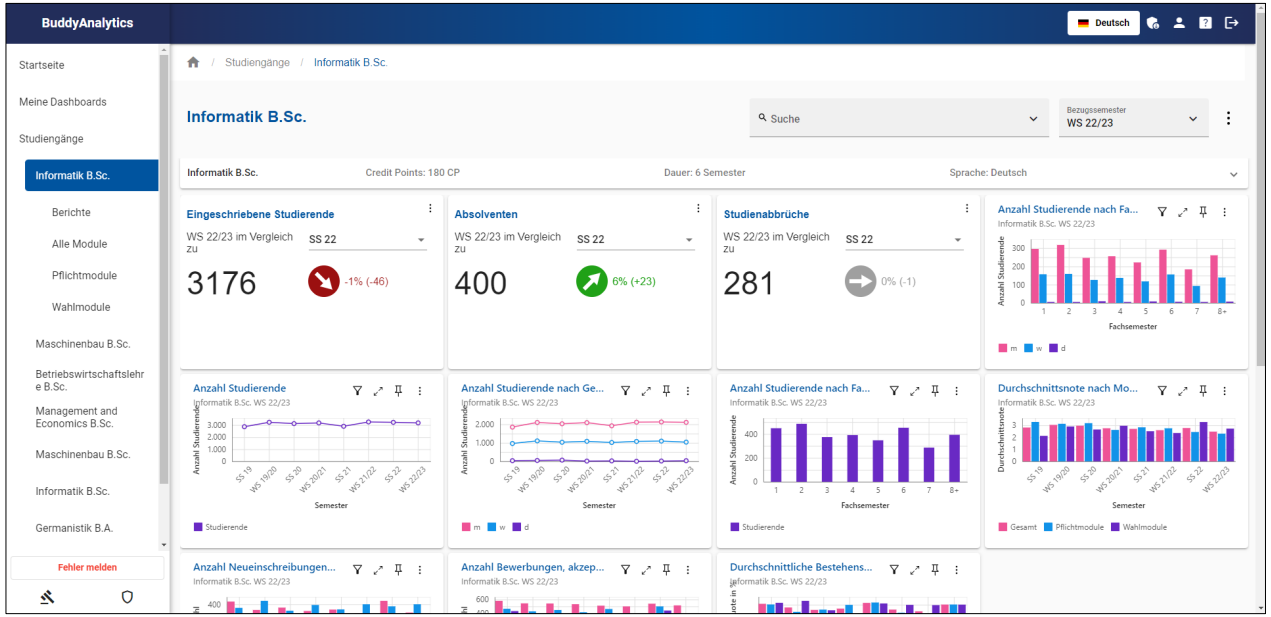


Study Path Analysis – BuddyAnalytics

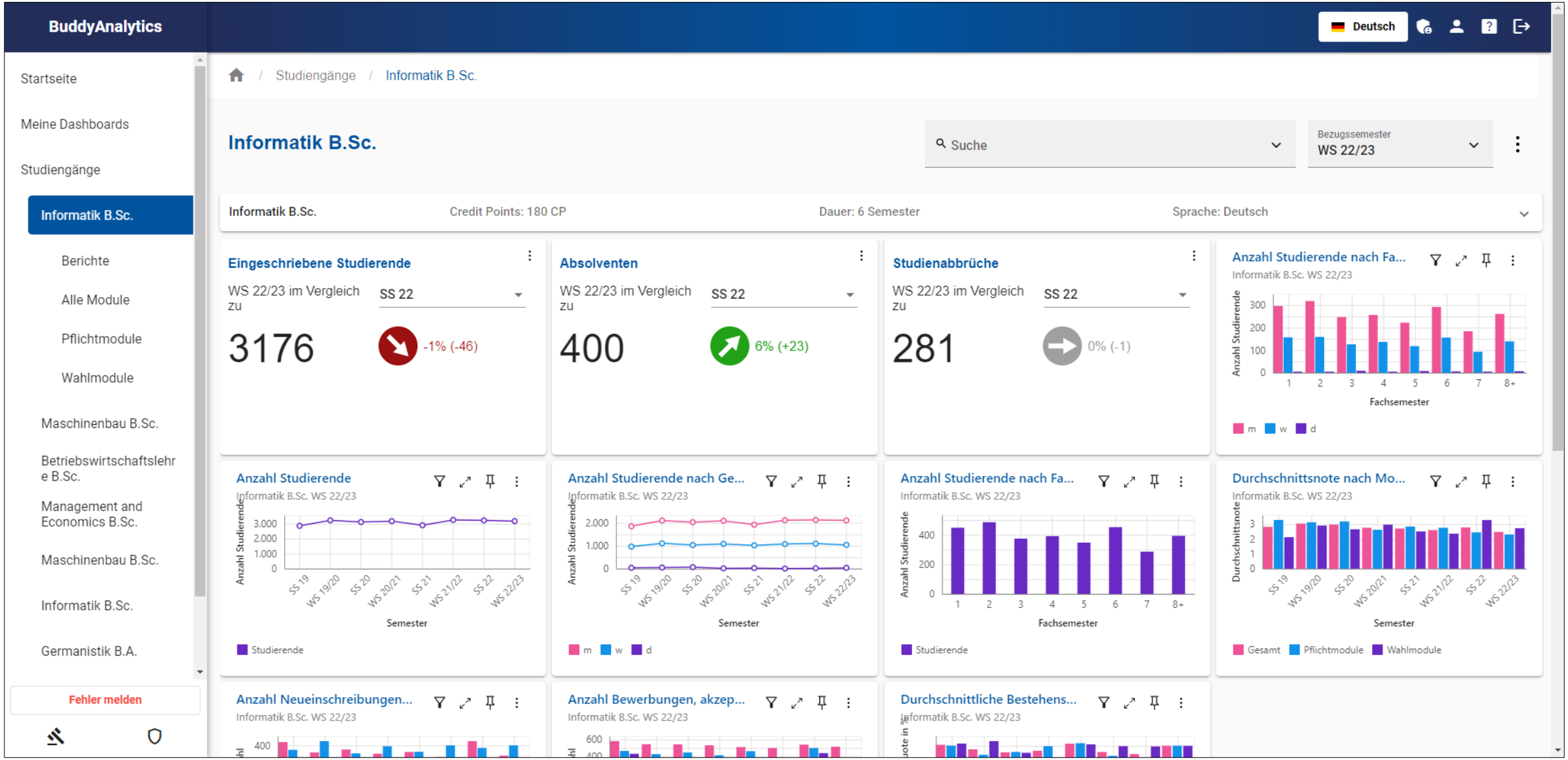
Web-based Monitoring Tool for Study Program Designers

- AI-based study monitoring
- Cohort tracking
- Analysis of study paths



Objectives

- Better understanding of study paths
- Evidence-based curriculum development
- Improvements in teaching and administration


BuddyAnalytics
Deutsch
Startseite
Meine Dashboards
Studiengänge
Informatik B.Sc.
Berichte
Alle Module
Pflichtmodule
Wahlmodule
Maschinenbau B.Sc.
Betriebswirtschaftslehre B.Sc.
Management and Economics B.Sc.
Maschinenbau B.Sc.
Informatik B.Sc.
Germanistik B.A.
Fehler melden
Studiengänge / Informatik B.Sc.
Informatik B.Sc.
Suche
Bezugssemester
WS 22/23
Informatik B.Sc.
Credit Points: 180 CP
Dauer: 6 Semester
Sprache: Deutsch
Eingeschriebene Studierende
WS 22/23 im Vergleich zu
SS 22
3176
-1% (-46)
Absolventen
WS 22/23 im Vergleich zu
SS 22
400
6% (+23)
Studienabbrüche
WS 22/23 im Vergleich zu
SS 22
281
0% (-1)
Anzahl Studierende nach Fa...
Informatik B.Sc. WS 22/23
Anzahl Studierende
Fachsemester
m w d
Anzahl Studierende
Informatik B.Sc. WS 22/23
Semester
Studierende
Anzahl Studierende nach Ge...
Informatik B.Sc. WS 22/23
Semester
m w d
Anzahl Studierende nach Fa...
Informatik B.Sc. WS 22/23
Anzahl Studierende
Fachsemester
Studierende
Durchschnittsnote nach Mo...
Informatik B.Sc. WS 22/23
Durchschnittsnote
Semester
Gesamt Pflichtmodule Wahlmodule
Anzahl Neueinschreibungen...
Informatik B.Sc. WS 22/23
Anzahl Bewerbungen, akzep...
Informatik B.Sc. WS 22/23
Durchschnittliche Bestehens...
Informatik B.Sc. WS 22/23

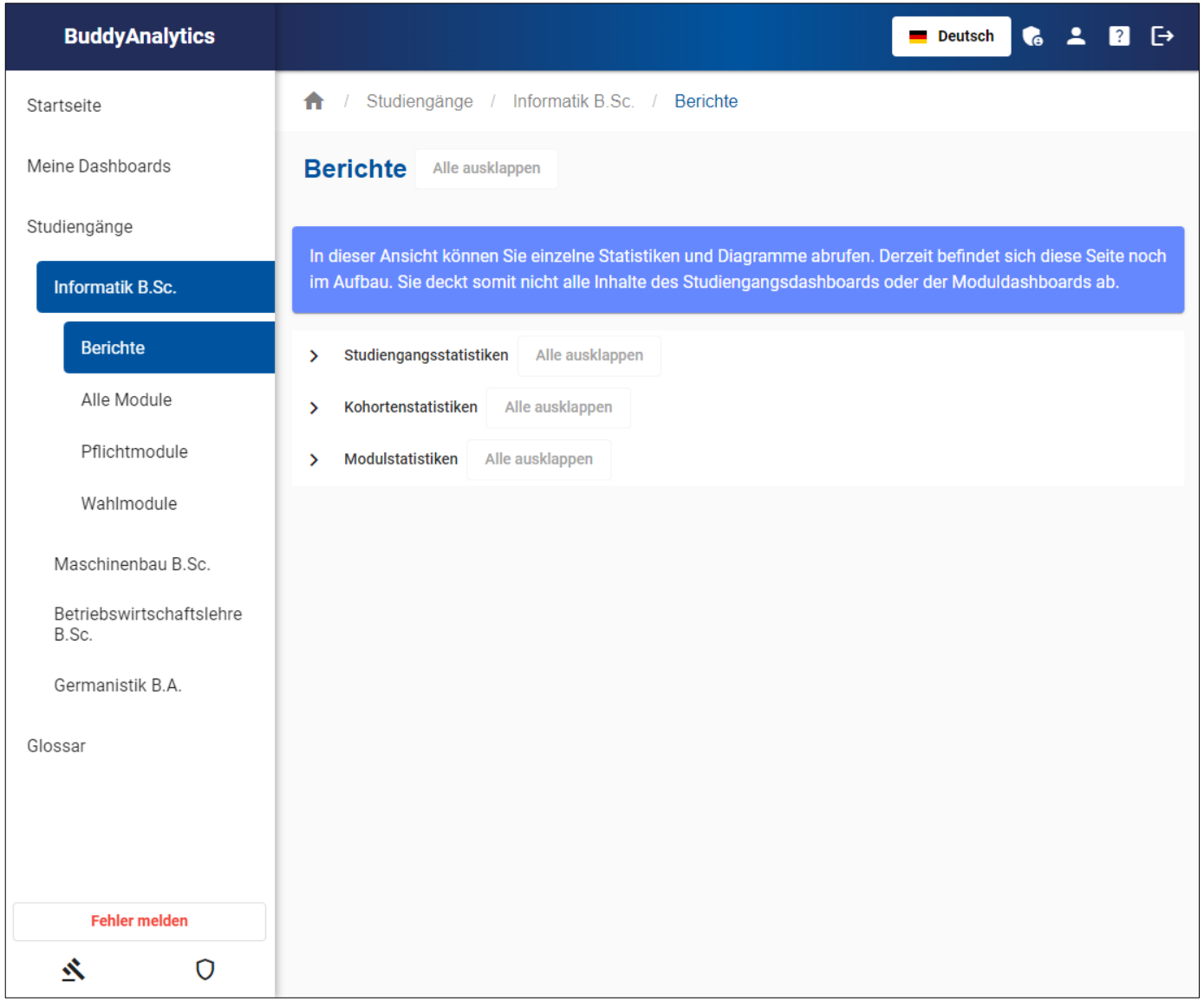
BuddyAnalytics

Current Progress

- Different indicators prepared and visualized
- Reporting and monitoring dashboards
- Filters and Export functionalities

Planned Features

- Customizable dashboards
- Process analysis of study cohorts
- Conformance checking and variants



Merging data in the joint project

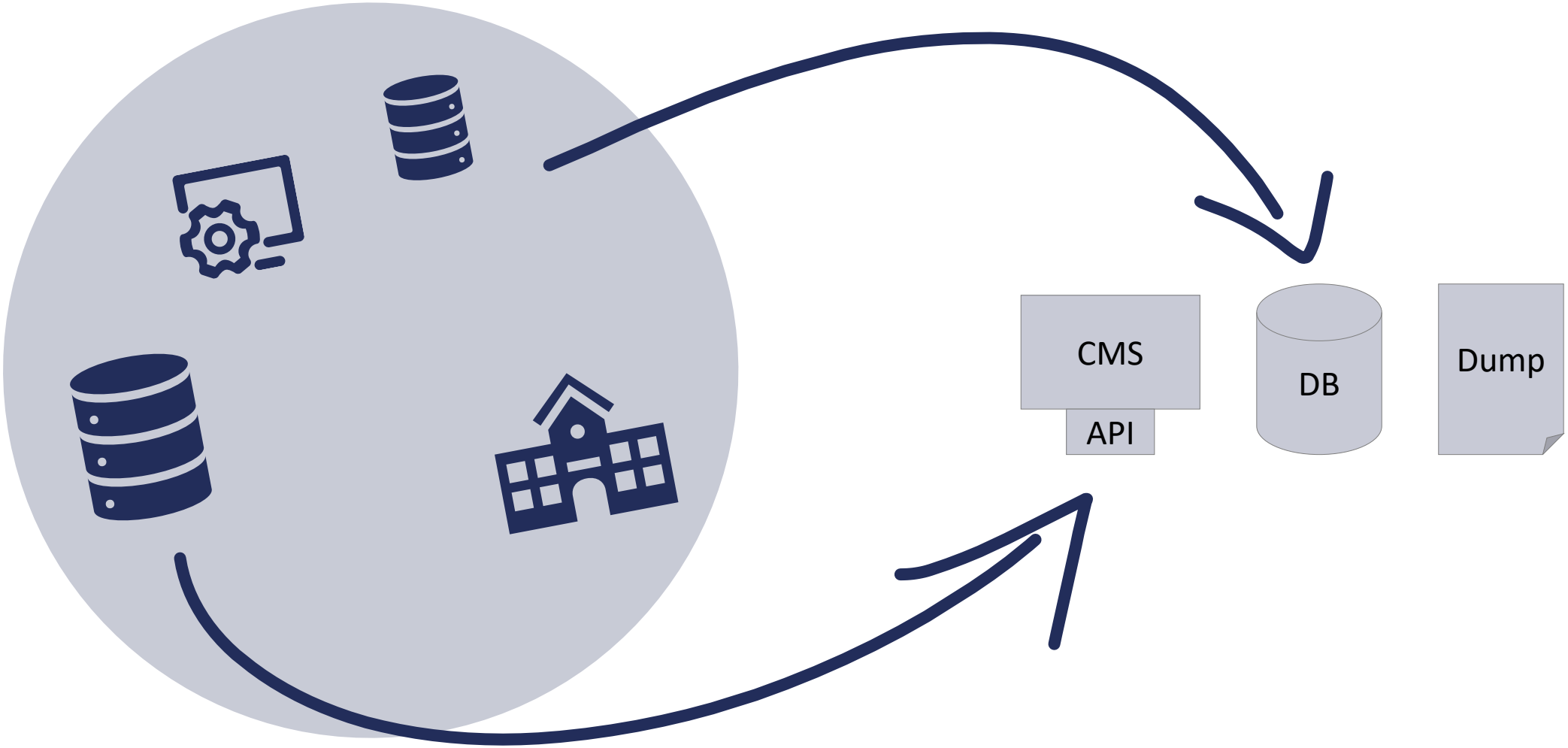
- **Joint Project ➡ Different institutions ➡ Different systems**

- **Necessary data might be distributed among systems**
  - Campus Management System vs.
    Student Information Systems + Examination systems

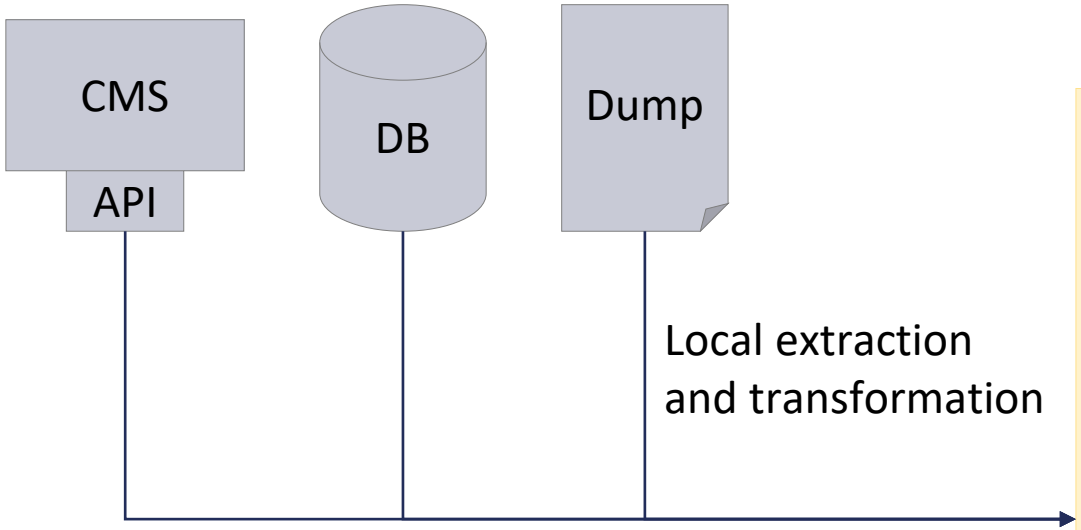
- **Approach: Data reference model + central data warehouse**

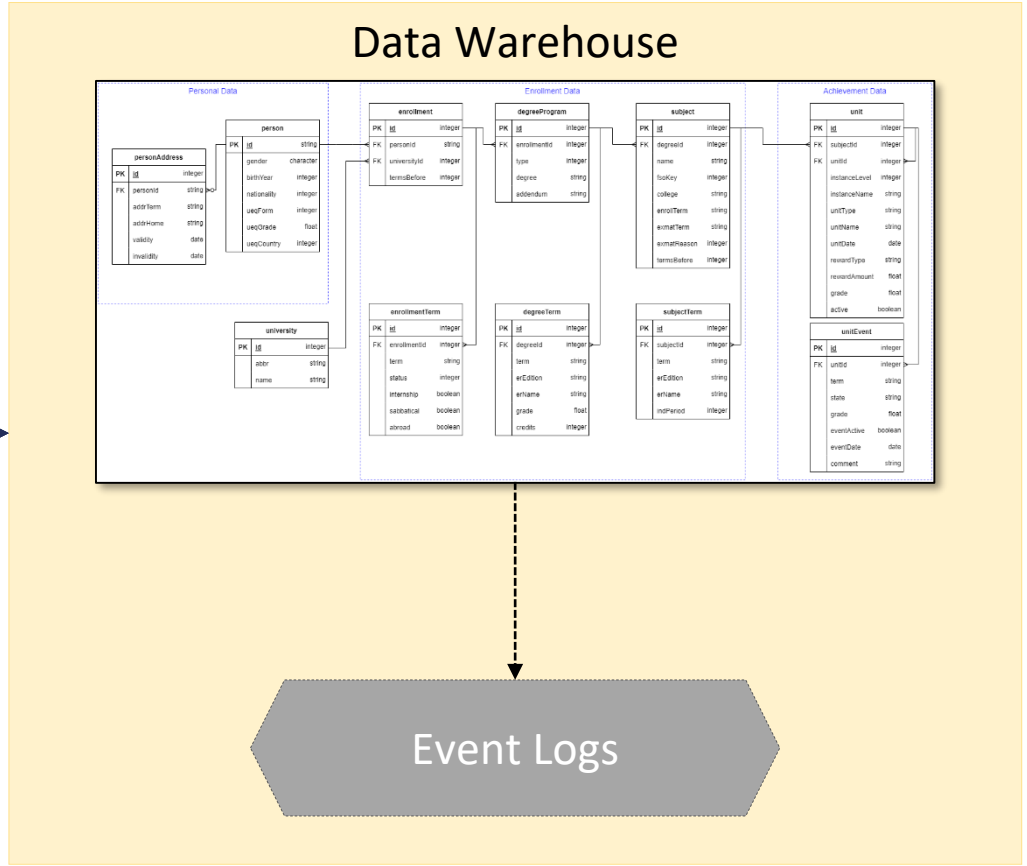
Merging data in the joint project

Merging data in the joint project

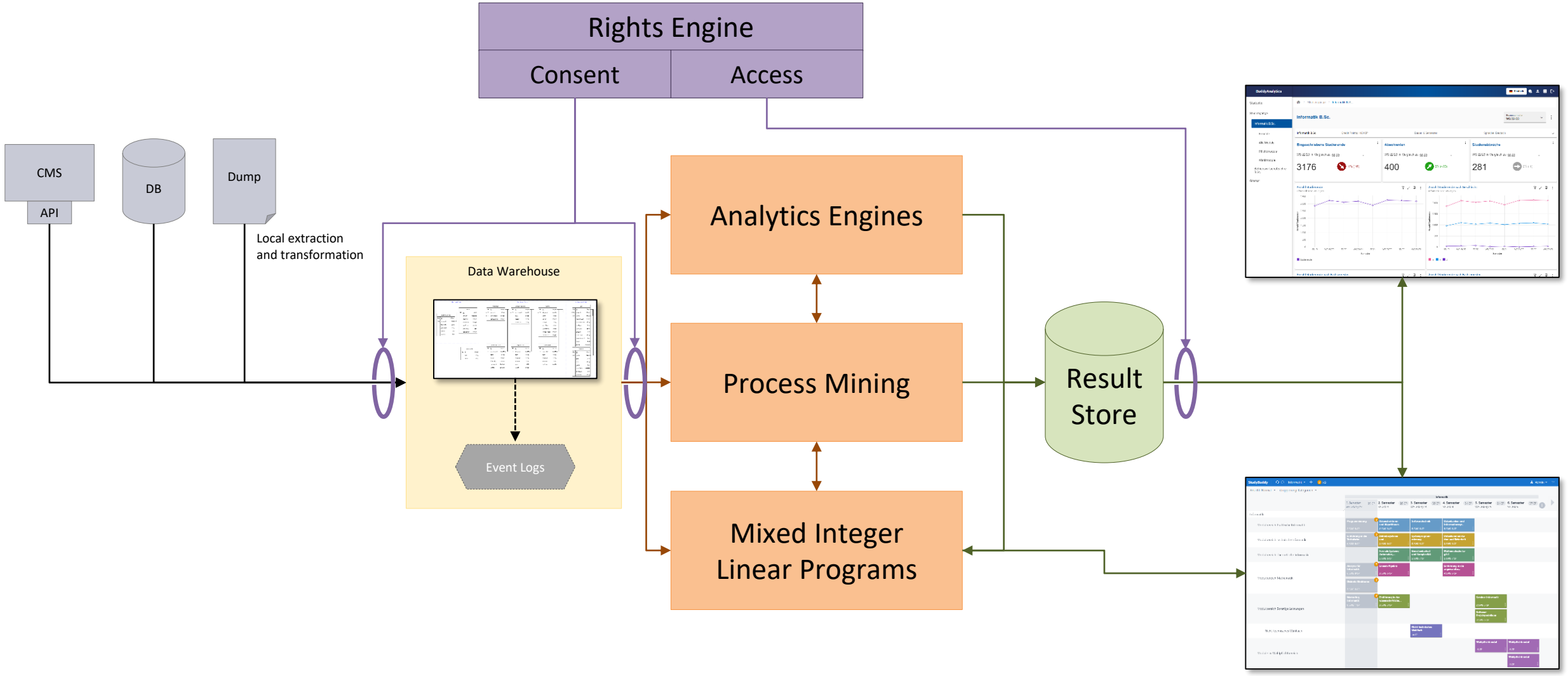


Central Data Warehouse

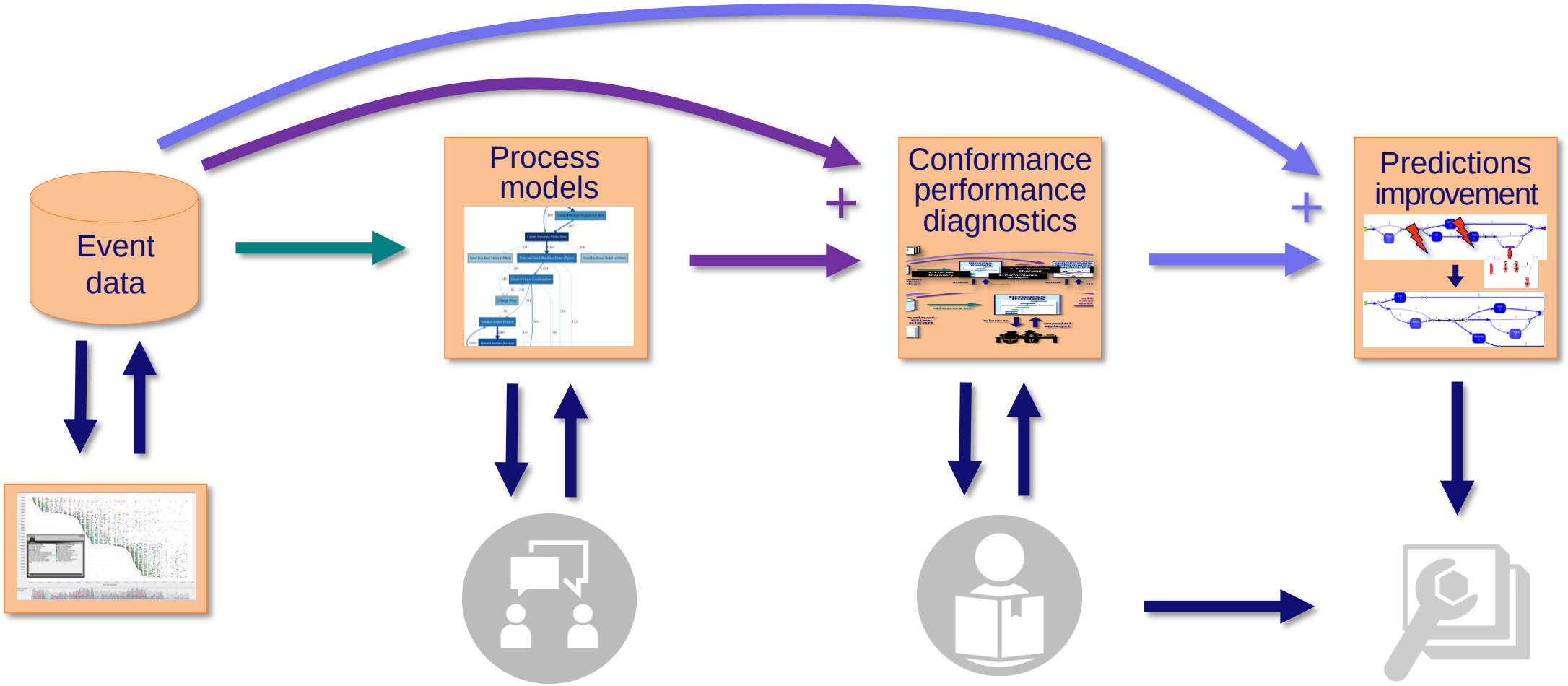




From data to AI support



Study paths as processes



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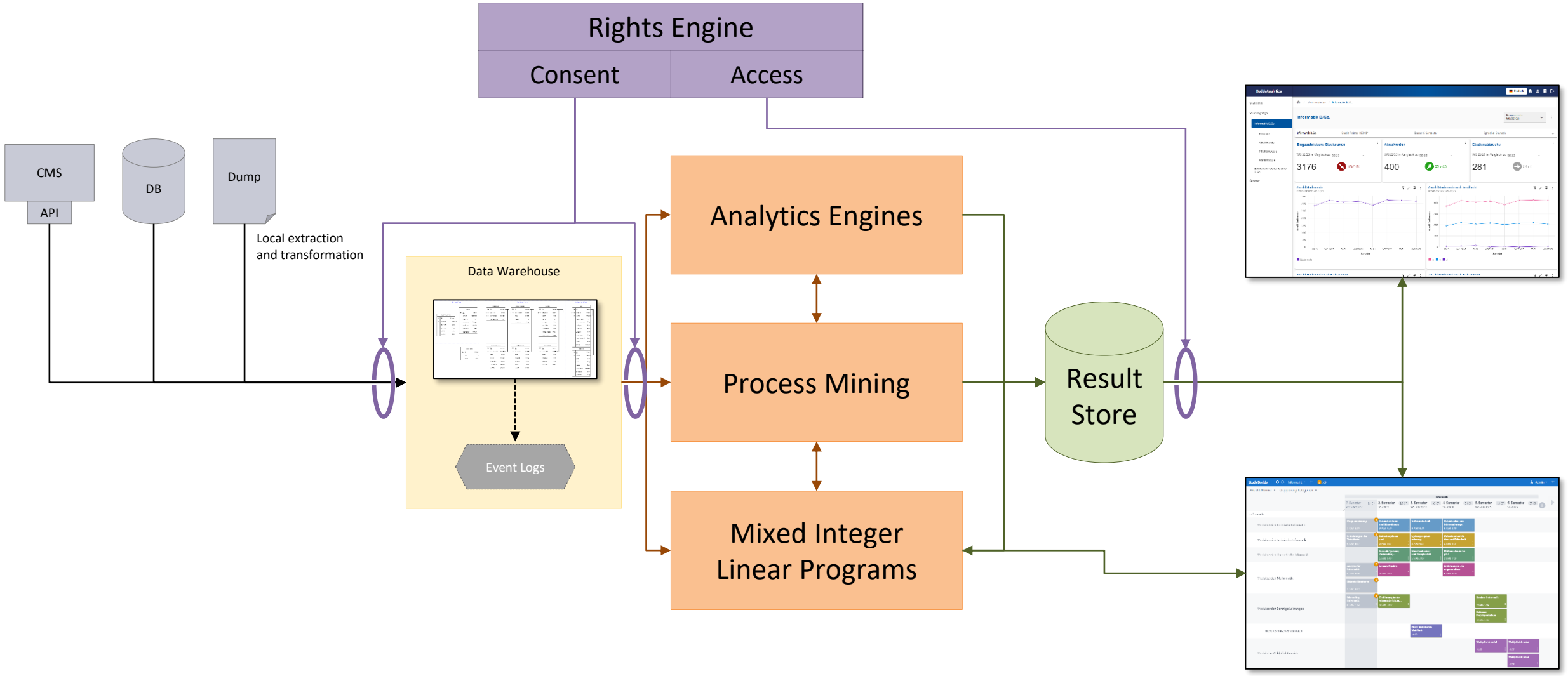


Representation of regulations and module handbooks

Machine-readable model

Examination regulations

– In Area XY, a minimum of 30 credits is required

Module handbooks

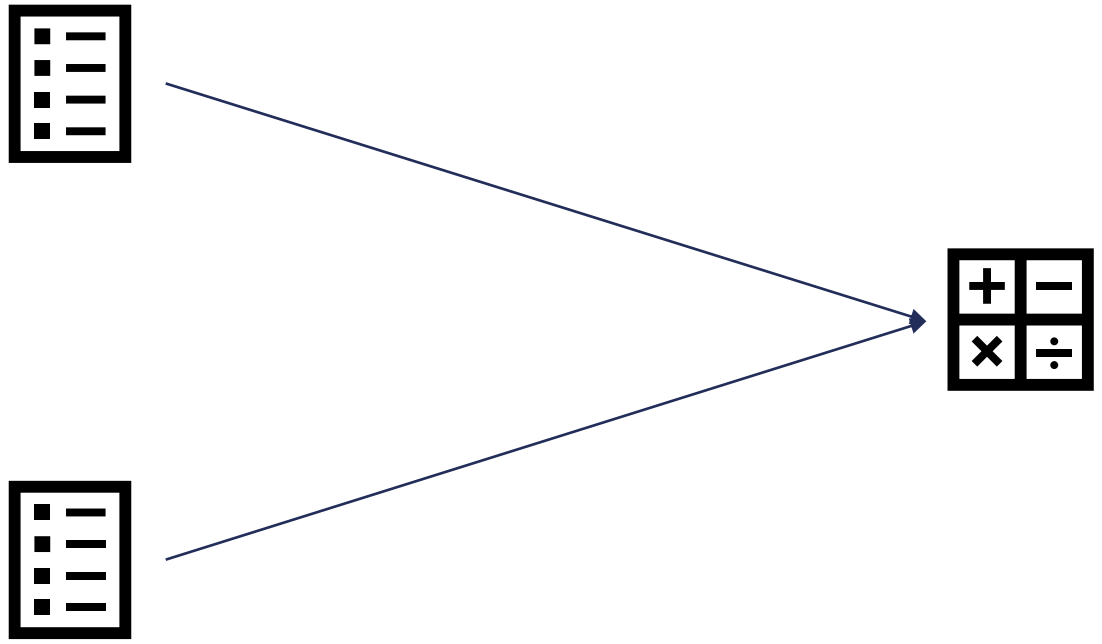
– Module A must be passed before attending module B.

– Module C is only offered in winter semesters.

Representation of regulations and module handbooks

Machine-readable model

Mathematical model



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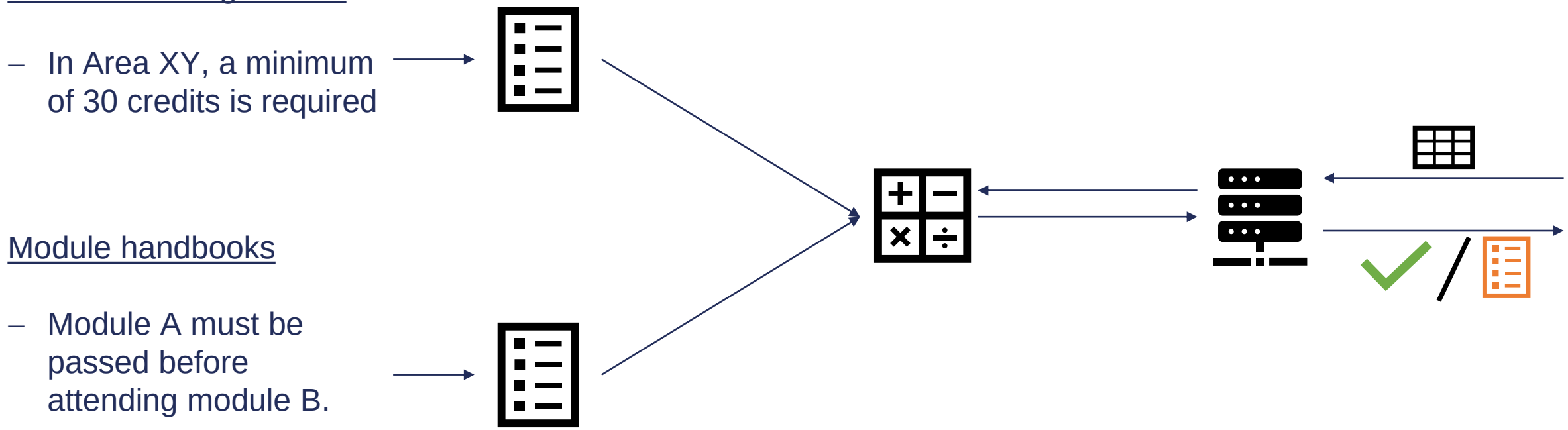
Machine-readable model Mathematical model Solver



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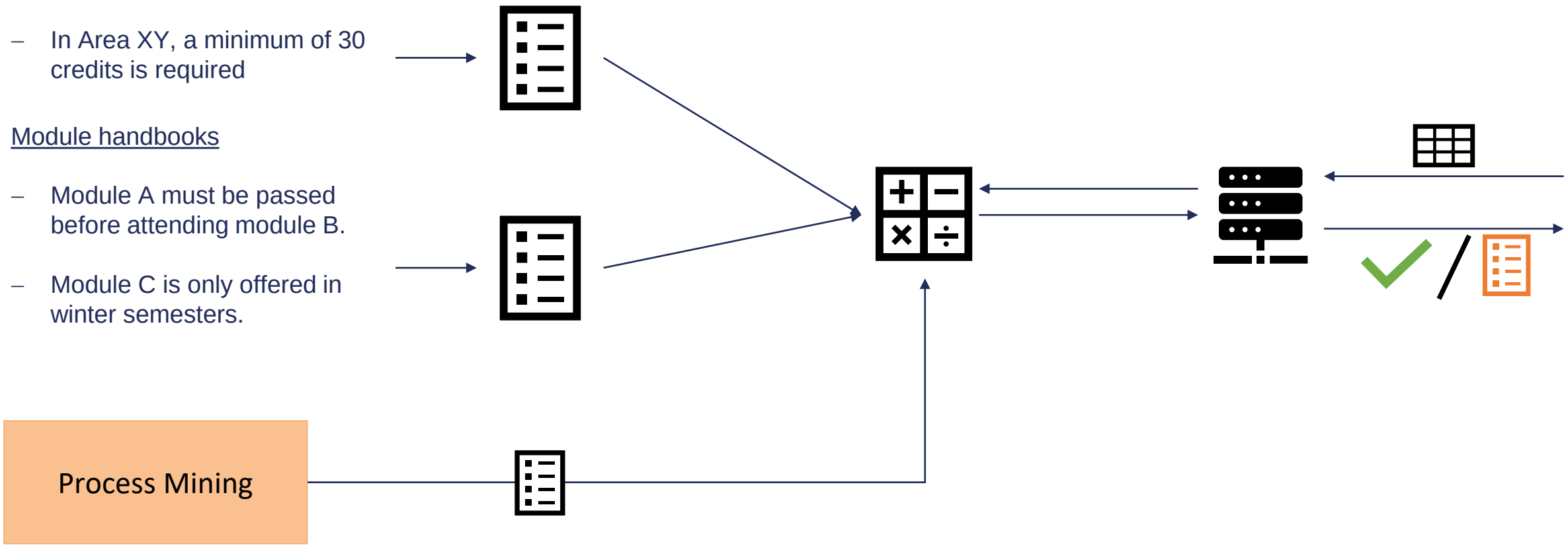
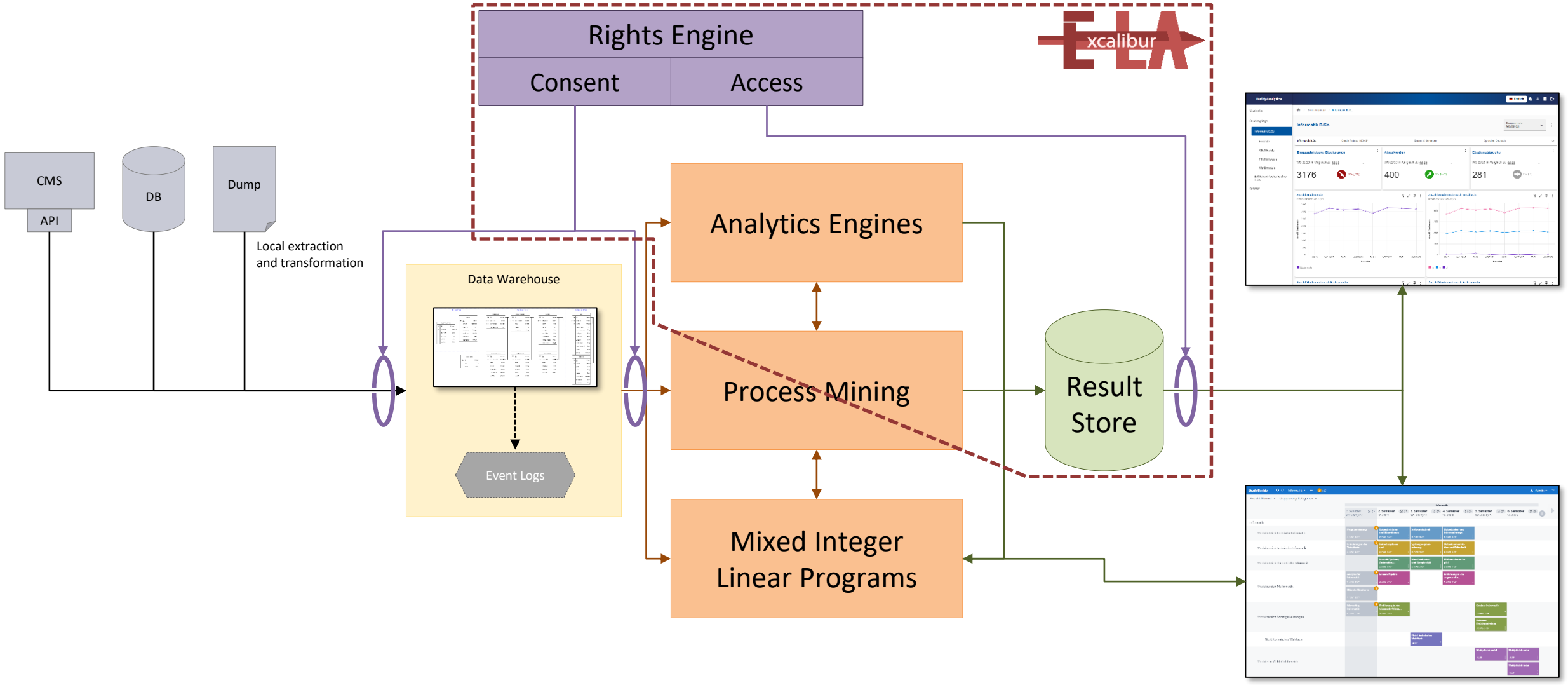
Extension with data-driven insights and recommendations

Machine-readable model Mathematical model Solver

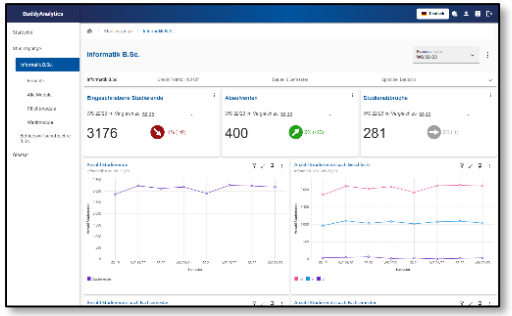


From data to AI support

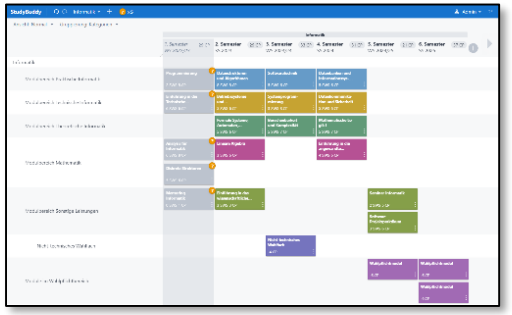


User-centered Application Development

- **BuddyAnalytics**
  - Workshop to collect requirements of study program designers
  - Generation of user stories and personas
  - Iterative development and evaluation



- **StudyBuddy**
  - Prototype of previous student project
    - feasibility, technical challenges, data requirements, …
  - Requirements analysis and evaluation with students
  - Iterative development and evaluation

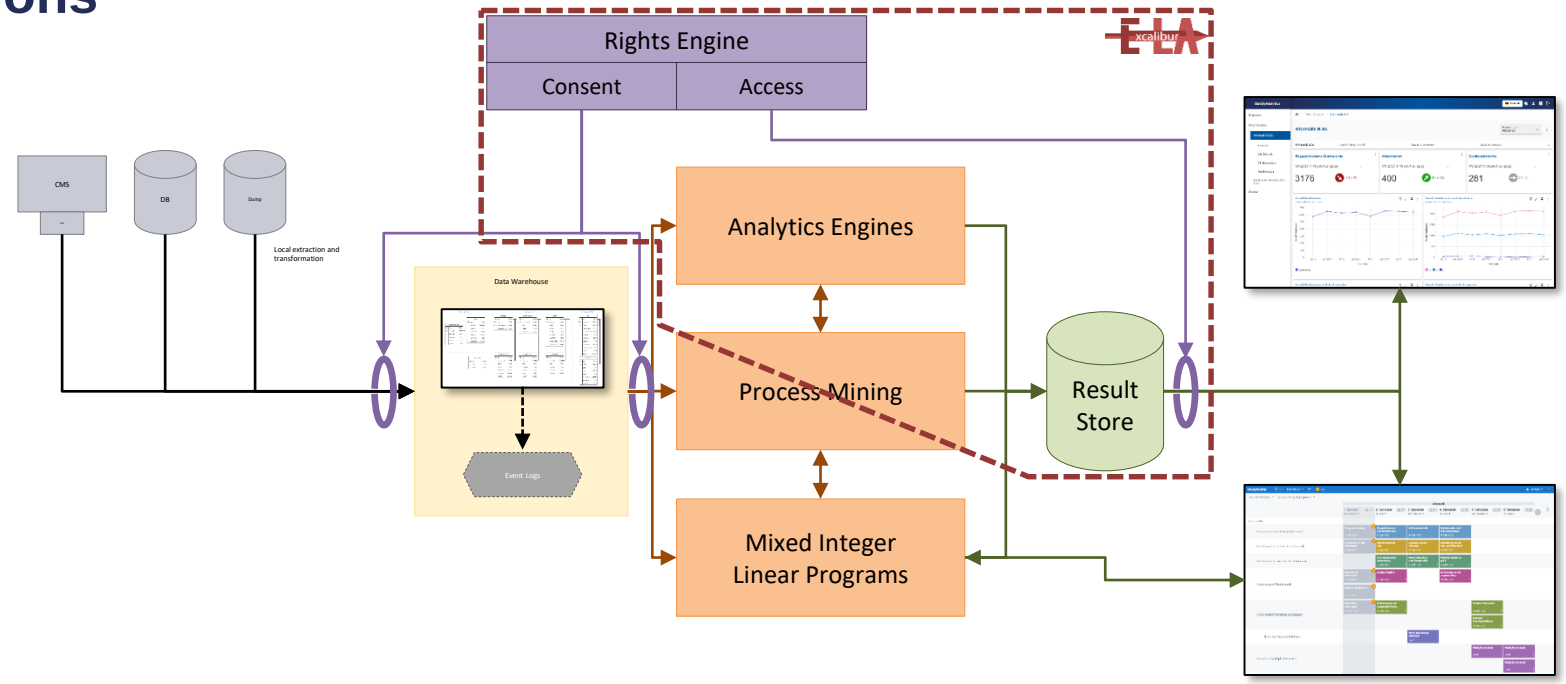


Outlook

- **Rule-based & Personalized Feedback using AI technology**
- **Combination of Process Mining and rule-based AI**
  - Learning from past study paths
  - Recommending successful paths
- **Publication of data reference model**
  - Extending the university network
- **User-centred Development of the Applications**
  - Tailored, supportive applications with impact

Conclusion

- **Supporting study planning and cohort monitoring**
  - Data-driven and rule-based AI technology
- **User-centred web applications**
- **Data reference model**



Further information and literature

1. Judel, S. et al. (2023): AI-supported Study Planning and Cohort Monitoring mit AIStudyBuddy. In: Workshops der 21. Fachtagung Bildungstechnologien (DELFI). Gesellschaft für Informatik e.V., Bonn. https://doi.org/10.18420/WSDELFI2023-55
2. Judel, S.; Roepke, R.; Azendorf, M.; Schroeder, U. (2023): Supporting Individualized Study Paths Using an Interactive Study Planning Tool. 21. Fachtagung Bildungstechnologien (DELFI). Gesellschaft für Informatik e.V., Bonn. https://doi.org/10.18420/delfi2023-36
3. Quakulinski, L.; Judel, S.; Wagner, M.; Schroeder, U. (2023): Anwendung von Process Mining zur kontinuierlichen Lernpfadidentifikation in Lernmanagementsystemen. 21. Fachtagung Bildungstechnologien (DELFI). Gesellschaft für Informatik e.V., Bonn. https://doi.org/10.18420/delfi2023-34
4. Wagner, M. *et al.* (2023). A Combined Approach of Process Mining and Rule-Based AI for Study Planning and Monitoring in Higher Education. In: Montali, M., Senderovich, A., Weidlich, M. (eds) Process Mining Workshops. ICPM 2022. Lecture Notes in Business Information Processing, vol 468. Springer, Cham. https://doi.org/10.1007/978-3-031-27815-0_37
5. Judel, S.; Schroeder, U. (2022). EXCALIBUR LA - An Extendable and Scalable Infrastructure Build for Learning Analytics. In: *2022 International Conference on Advanced Learning Technologies (ICALT)*, Bucharest, Romania, 2022, https://doi.org/10.1109/ICALT55010.2022.00053

Thank you!

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Sponsor:

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