Professur für
Didaktik der Informatik

FAU

Lernen mit ALeA

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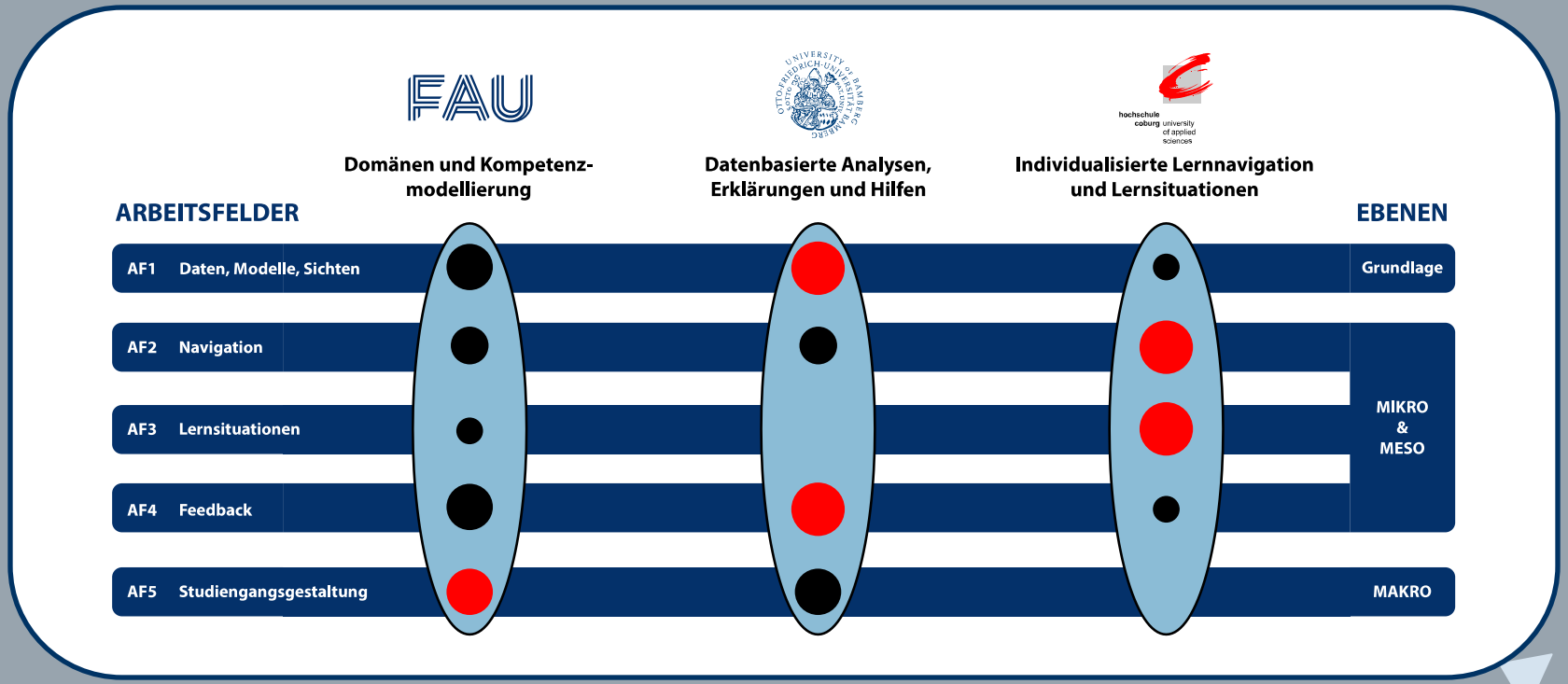
Bundesministerium
für Bildung
und Forschung

Ganzheitliche daten- und wissensunterstütze Hochschulbildung und deren Gestaltung

Weiterentwicklung der Hochschulbildung auf drei Ebenen mittels daten- & wissensbasierten Ansätzen von KI

IT-unterstütztes LERNEN → VoLL-KI → KI-unterstütztes LERNEN


FAU
Domänen und Kompetenz-modellierung
Datenbasierte Analysen, Erklärungen und Hilfen
hochschule coburg university of applied sciences
Individualisierte Lernnavigation und Lernsituationen
ARBEITSFELDER
EBENEN
AF1 Daten, Modelle, Sichten
AF2 Navigation
AF3 Lernsituationen
AF4 Feedback
AF5 Studiengangsgestaltung
Grundlage
MIKRO & MESO
MAKRO
Hauptverantwortlich
Flächeninhalt indiziert Umfang des inhaltlichen Beitrags

Personalisierte adaptive Lernumgebungen (ALUs)

Verfügen über:

Domänenmodell

Konkretisierung in annotiertem und strukturiertem Lernmaterial

wird auch Wissensmodell genannt

Lernendenmodell

Abschätzung des Wissenstandes und der Lernziele der Lernenden

Didaktikmodell

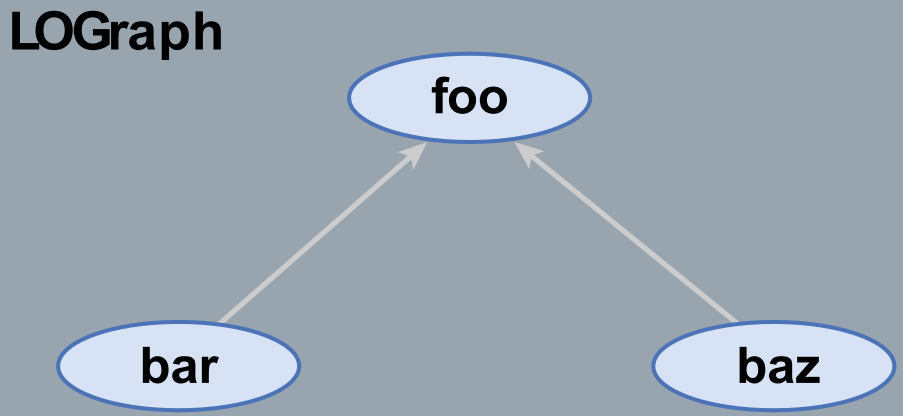
formalisiertes didaktisches Wissen um adaptiv auf individuelle Anforderungen der Lernenden reagieren zu können

passgenaue Unterstützung z.B. durch Vorschlagen von Lernpfaden und Inhalten oder durch dynamische Erstellung von Curricula möglich

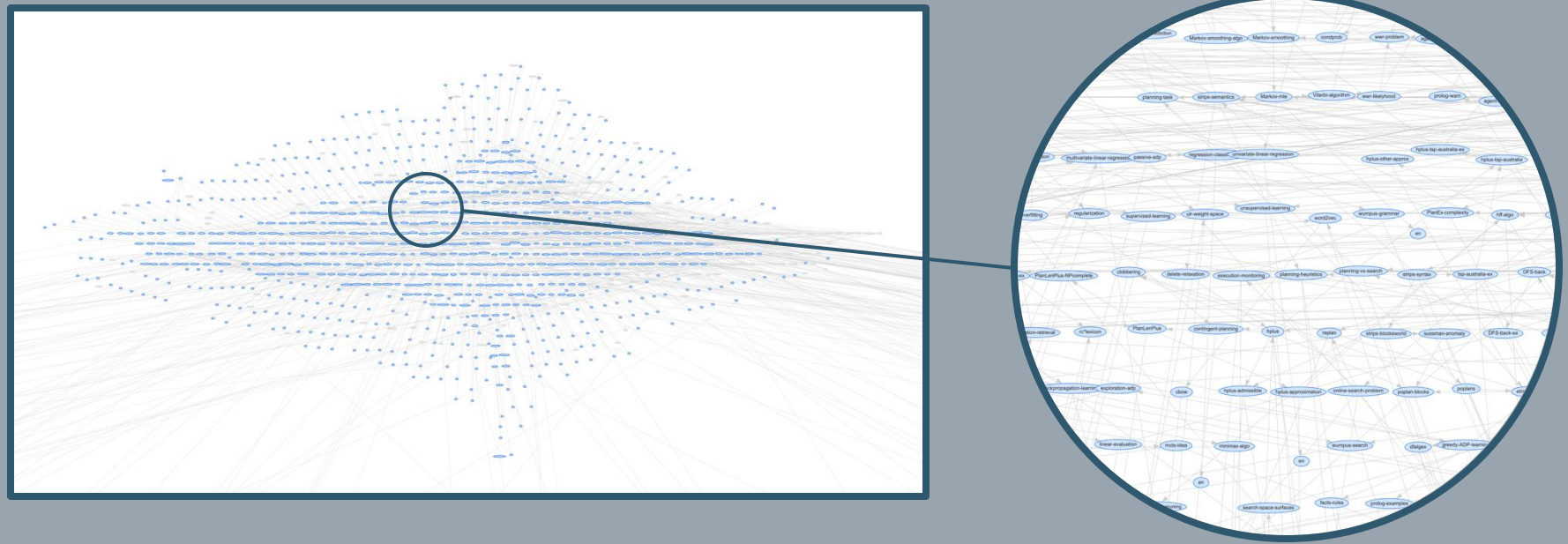
Domain Model

LOGraph

Definition 12.2.3. A foo is a bar with a baz.



LOGraph

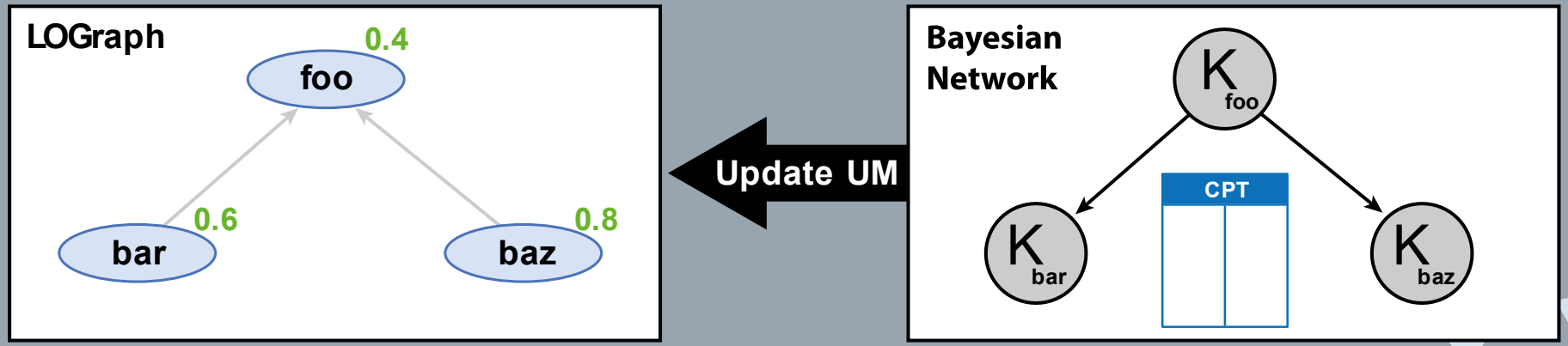


Learning Object

Learner Model

Learner Model

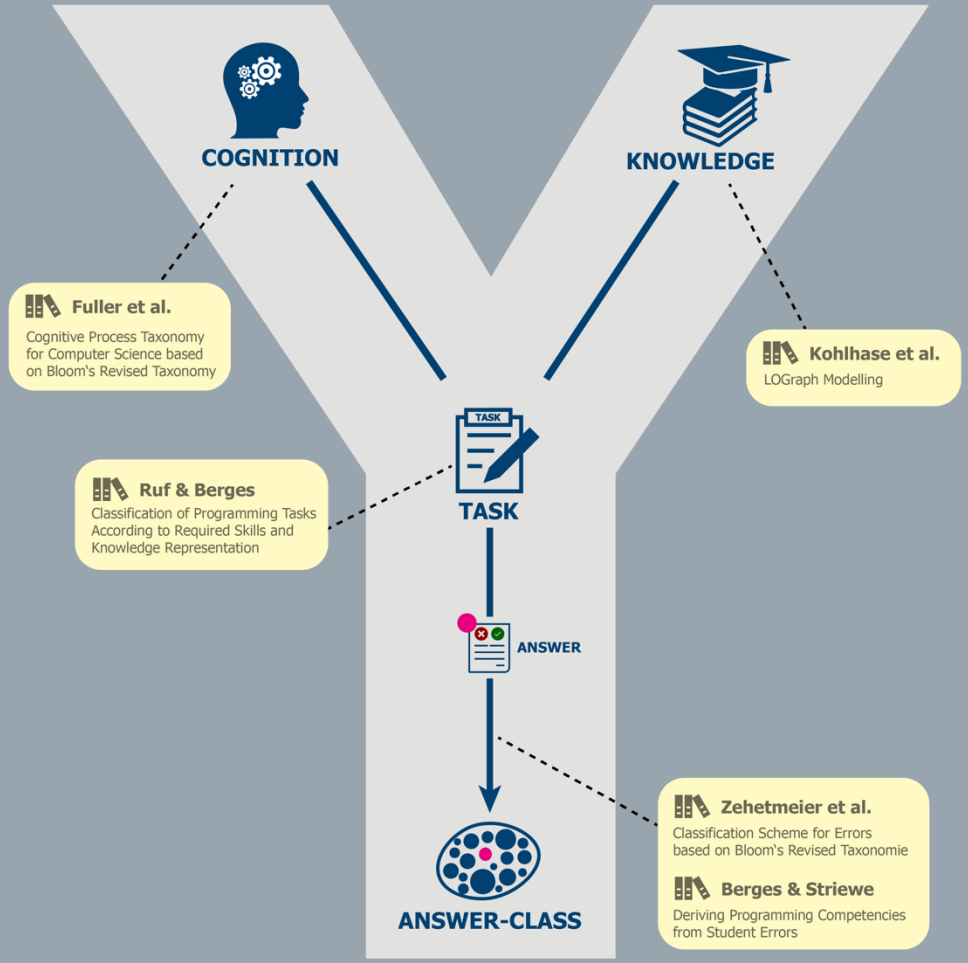
UM: V → [0,1]



Didaktik-Modell

Wie lassen sich Learning Objects formalisieren, sodass sie in adaptiven Lernplattformen (didaktisch sinnvoll) eingesetzt werden können?

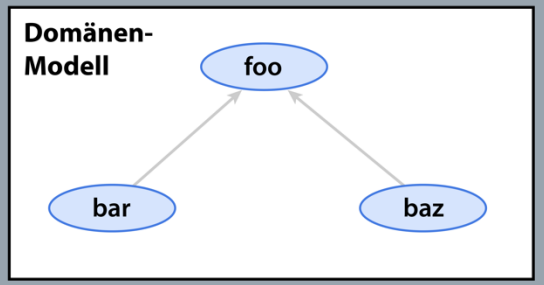
Y-Model

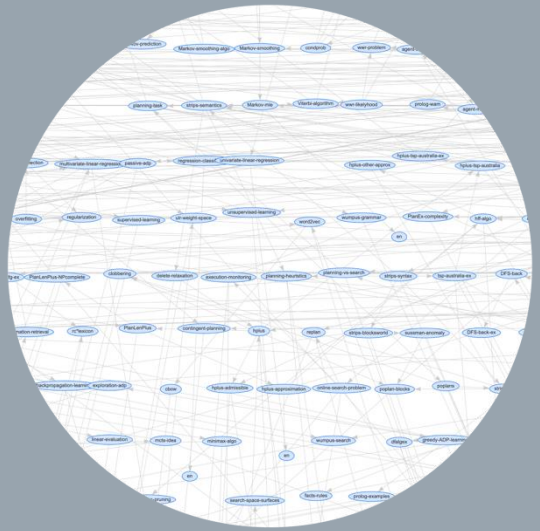


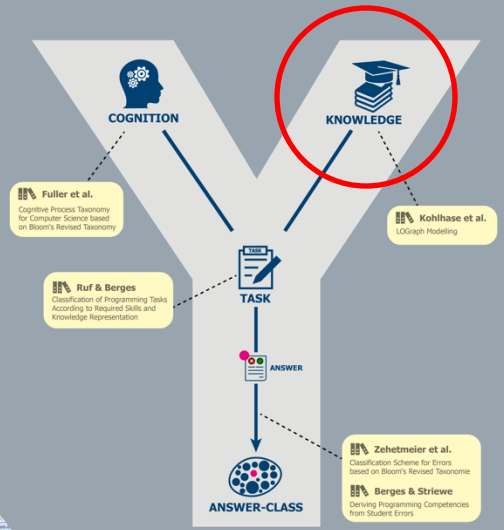
Lohr et al., 2023: *"The Y-Model – Formalization of Computer Science Tasks in the Context of Adaptive Learning Systems. IEEE GECon.*

Knowledge

Definition 12.2.3. A foo is a bar with a buz.







semantic TeX (sTeX)

ohne sTeX

```
\sum_{n=1}^{\infty} \frac{1}{2^n} \rightarrow 1
```

sTeX

```
\documentclass{article}
\usepackage{stex}
\usepackage{xcolor}

\begin{document}
  \usemodule[smglom/calculus]{series}
  \usemodule[smglom/arithmetics]{realarith}

  The \symref{series}{series} $\infinitesum{n}{1}{
    \realdivide[frac]{1}{
      \realpower{2}{n}
    }
  }$ \symref{converges}{converges} towards $1$.

\end{document}
```

Compiling this document with `pdflatex` should yield the output

The **series** $\sum_{n=1}^{\infty} \frac{1}{2^n}$ **converges** towards 1.

Natural Deduction with Equality

▷ **Definition 1.1.3 (First-Order Logic with Equality).** We extend PL^1 with a new logical constant for equality $= \in \Sigma_2^p$ and fix its interpretation to $\mathcal{I}(=) := \{(x, x) | x \in \mathcal{D}\}$. We call the extended logic first-order logic with eq

▷

▷

we

▷ **Definition 0.1.** A first-order signature consists of(all disjoint; $k \in \mathbb{N}$)

- ▷ connectives: $\Sigma_0 = \{T, F, \neg, \vee, \wedge, \Rightarrow, \Leftrightarrow, \ldots\}$(functions on truth values)
- ▷ function constants: $\Sigma_k^f = \{f, g, h, \ldots\}$($k$-ary functions on individuals)
- ▷ predicate constants: $\Sigma_k^p = \{p, q, r, \ldots\}$($k$-ary relations among individuals.)
- ▷ (Skolem constants: $\Sigma_k^{sk} = \{f_k^1, f_k^2, \ldots\}$)(witness constructors; countably ∞)
- ▷ We take Σ_1 to be all of these together: $\Sigma_1 := \Sigma^f \cup \Sigma^p \cup \Sigma^{sk}$ and define $\Sigma := \Sigma_1 \cup \Sigma_0$.

where $\mathbf{C}[\mathbf{A}]_p$ if the formula $\mathbf{C}$ has a subterm $\mathbf{A}$ at position p and $[\mathbf{B}/p]\mathbf{C}$ is the result of replacing that subterm with $\mathbf{B}$.

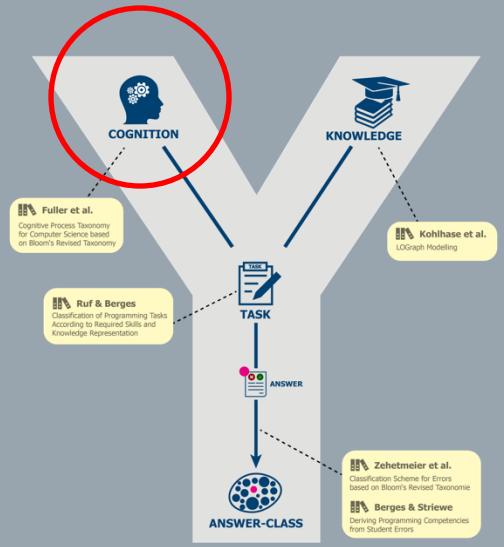
▷ In many ways equivalence behaves like equality, we will use the following rules in $\mathcal{ND}^1$

▷ **Definition 1.1.5.** $\Leftrightarrow I$ is derivable and $\Leftrightarrow E$ is admissible in $\mathcal{ND}^1$:

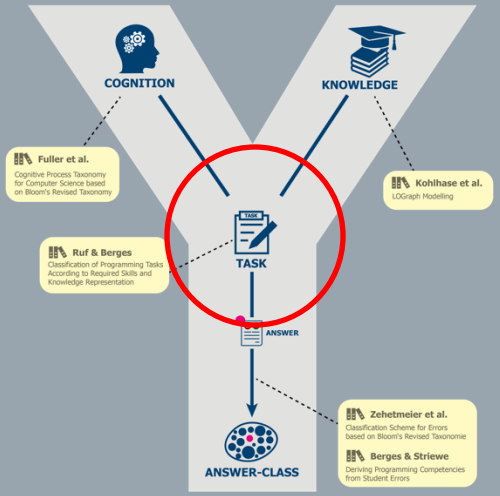
$$\frac{}{\mathbf{A} \Leftrightarrow \mathbf{A}}\ \Leftrightarrow I \qquad \frac{\mathbf{A} \Leftrightarrow \mathbf{B} \quad \mathbf{C}[\mathbf{A}]_p}{[\mathbf{B}/p]\mathbf{C}}\ \Leftrightarrow E$$

Kognition

BLOOM ORIGINAL	BLOOM REVISED	THE KNOWLEDGE DIMENSION			
		FACTUAL	CONCEPTUAL	PROCEDURAL	META-COGNITIVE
KNOWLEDGE →	REMEMBER				
COMPREHENSION →	UNDERSTAND				
APPLICATION →	APPLY				
ANALYSIS →	ANALYZE				
SYNTHESIS →	EVALUATE				
EVALUATION →	CREATE				

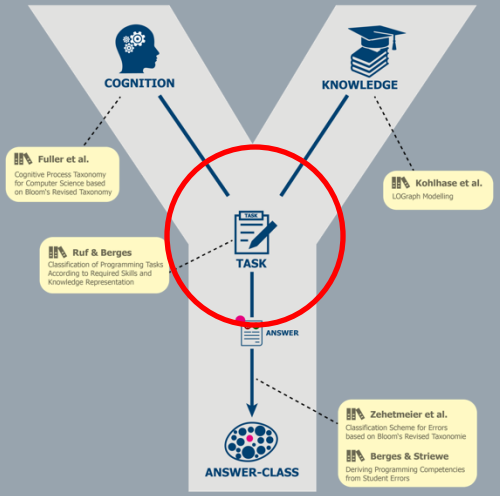


Tasks / Learning Objects




```
\usemodule{db/mod?db}

\precondition{understand}{none}{n1rel}
\precondition{understand}{none}{Chen-notation} % redundant with \symname[u]
\precondition{remember}{none}{entity}% redundant with \symname[r]
\precondition{remember}{none}{relation} % redundant ..

\objective{understand}{none}{n1rel}
\objective{understand}{none}{Chen-notation}
```

Tasks / Learning Objects



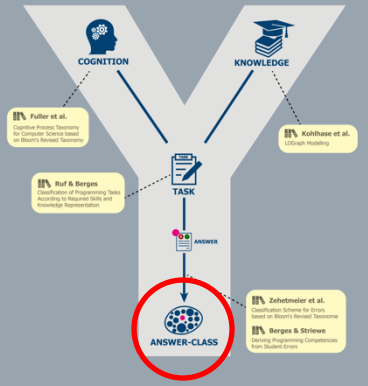

```
\answerclass{A1}{path to A1.tex}{Correct Solution}
\answerclass{A2}{path to A2.tex}{1:N instead of N:1}
\answerclass{A3}{path to A3.tex}{N:M instead of N:1}
\answerclass{A4}{path to A4.tex}{1:1 instead of N:1}
\answerclass{A99}{path to A99.tex}{Other} %Restklasse
```

Antworten auf Aufgaben

- *Ergebnis* der Anwendung kognitiver Prozesse auf Lerninhalte
- wertvolle *Informationsquelle* im Kontext Lehre
- geben Evidenz über aktuellen *Lernstand*

Antwortklasse (AC)

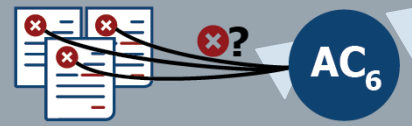
$$AC_x = \{R \mid R \text{ meets all the requirements of description } B\}$$



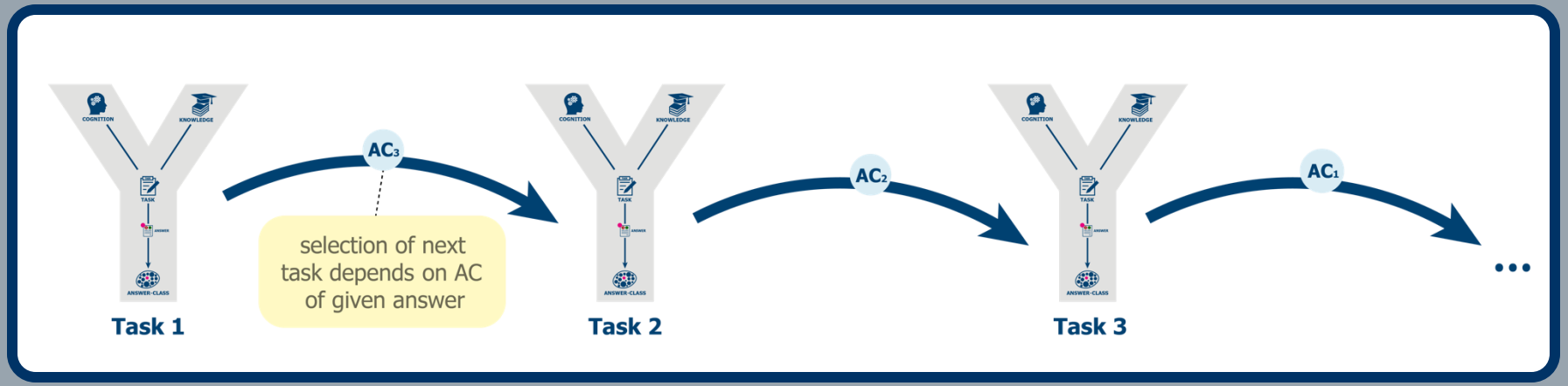
- Clustering von Antworten zu *Antwortklassen*
- *beobachtbare (objektive) Kriterien*
- Antwortklassen sind *nicht disjunkt*

  → Antworten können in mehreren verschiedenen Antwortklassen liegen

ID	answer class
AC_1	$\{R \mid R$ compiles with Java-Compiler Version X$\}$
AC_2	$\{R \mid R$ includes a syntax error$\}$
AC_3	$\{R \mid R$ outputs the minimum of an array correctly$\}$
AC_4	$\{R \mid R$ includes a while- or for-loop$\}$
AC_5	$\{R \mid$ use of `System.out.println` instead of `return`$\}$
AC_6	$\{R \mid$ use of Java API$\}$
AC_7	$\{R \mid$ edge case for empty array is missing$\}$



Selektion von (Folge-)Aufgaben

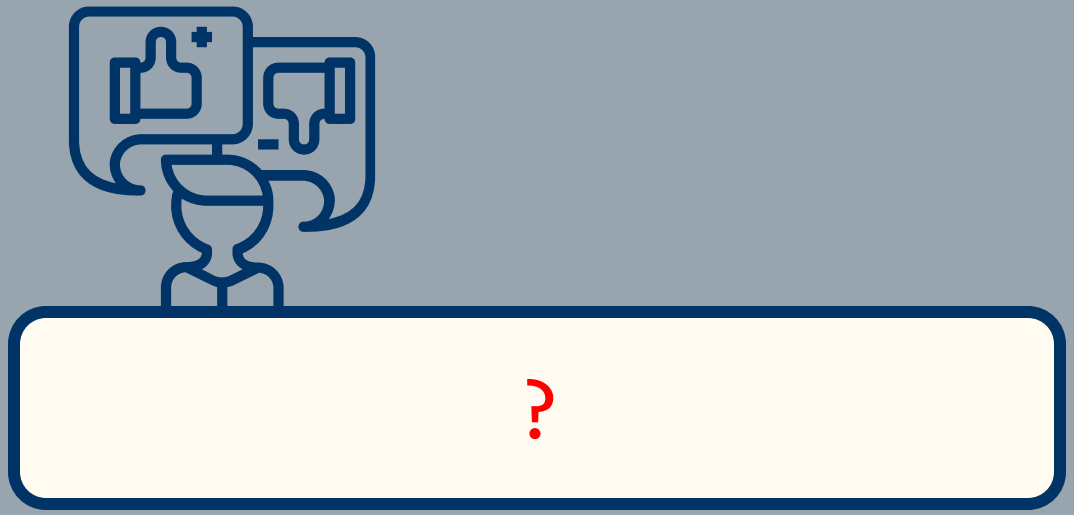


Feedback

```
AssertionError(Geometrie.umfangRegelmaessiges
Vieleck(42, 0.815_4711_666) => 34.2497889972
expected:<34.2497889972> but was:<-1.0>)
```

```java
public class Geometrie {
    // computes and returns the circumference of a
    // regular polygon with n edges of length a
    public static double umfangRegelmaessigesVieleck(int n, double a) {
        // TODO:
        double seitenlaenge = Math.abs(a);
        int seitenanzahl = n;
        double umfangRegekmaessigesVieleck = (seitenlaenge * seitenanzahl);

        System.out.println("Der Umfang ist:" + umfangRegelmaessigesVieleck);
        return -1;
    }

    // computes and returns the circumference of a circle with radius r
    // (hint: use Math.PI for a precise value of PI)
    public static double umfangKreis(double r) {
        // TODO:
        double durchmesser = 2*r;
        double umfangKreis = Math.PI * durchmesser;

        System.out.println("Der Umfang ist:" + umfangKreis);

        return -1;
    }

    // computes and returns the surface area of a trapezium (aka trapezoid)
    // with base edge a, opposite edge c, and height h
    public static double flaecheTrapez(double a, double c, double h) {
        // TODO:
        double edge = Math.abs(a);
        double oppositeEdge = Math.abs(c);
        double height = Math.abs(h);

        double flaecheTrapez = (((edge + oppositeEdge) / 2) * height);

        System.out.println("Die Flaeche ist:" + flaecheTrapez);

        return -1;
    }

    // computes and returns the volume of a square pyramid
    // with base length a and height h
    public static double volumenPyramide(double a, double h) {
        // TODO:
        double length = Math.abs(a);
        double height = Math.abs(h);

        double volumenPyramide = (((length * length) * height) / 3);

        System.out.println("Das Volumen ist:" + volumenPyramide);
        return -1;
    }
```

Feedback




```java
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    // computes and returns the circumference of a
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    public static double umfangRegelmaessigesVieleck(int n, double a) {
        // TODO:
        double seitenlaenge = Math.abs(a);
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        double umfangRegekmaessigesVieleck = (seitenlaenge * seitenanzahl);

        System.out.println("Der Umfang ist:" + umfangRegelmaessigesVieleck);
        return -1;
    }

    // computes and returns the circumference of a circle with radius r
    // (hint: use Math.PI for a precise value of PI)
    public static double umfangKreis(double r) {
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        double durchmesser = 2*r;
        double umfangKreis = Math.PI * durchmesser;

        System.out.println("Der Umfang ist:" + umfangKreis);

        return -1;
    }

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        double oppositeEdge = Math.abs(c);
        double height = Math.abs(h);

        double flaecheTrapez = (((edge + oppositeEdge) / 2) * height);

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    // computes and returns the volume of a square pyramid
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    public static double volumenPyramide(double a, double h) {
        // TODO:
        double length = Math.abs(a);
        double height = Math.abs(h);

        double volumenPyramide = (((length * length) * height) / 3);

        System.out.println("Das Volumen ist:" + volumenPyramide);
        return -1;
    }
```
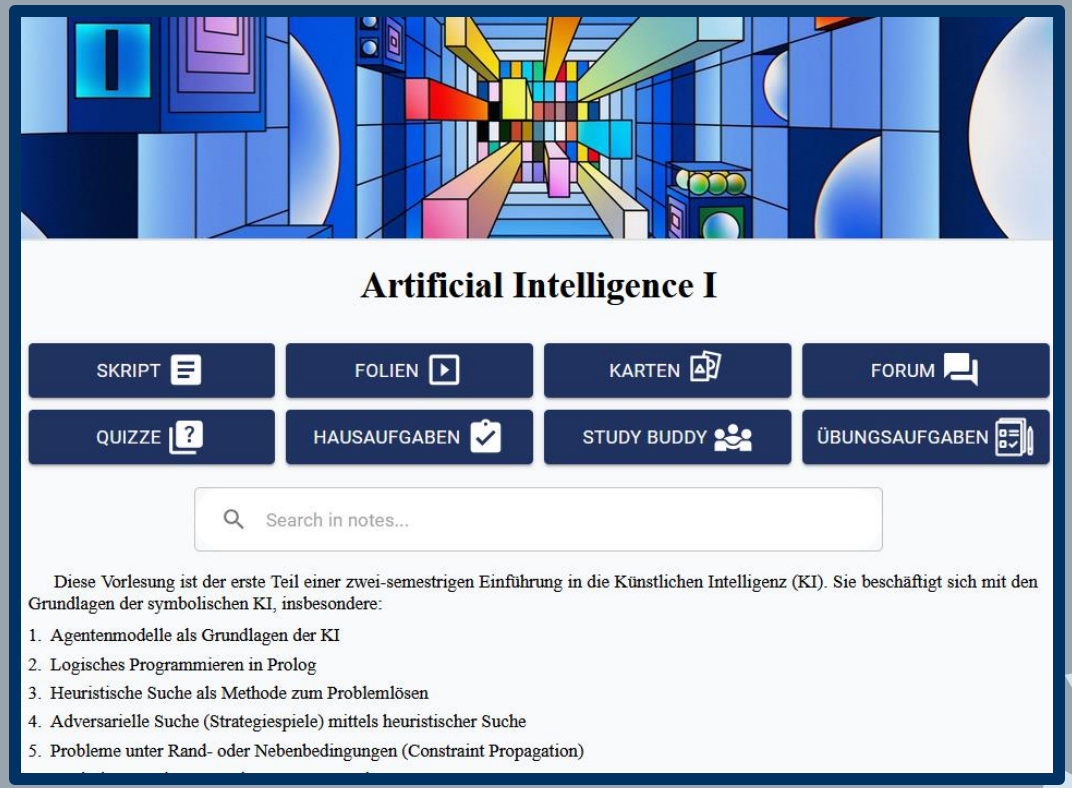

Adaptive Learning Assistant

alea.education

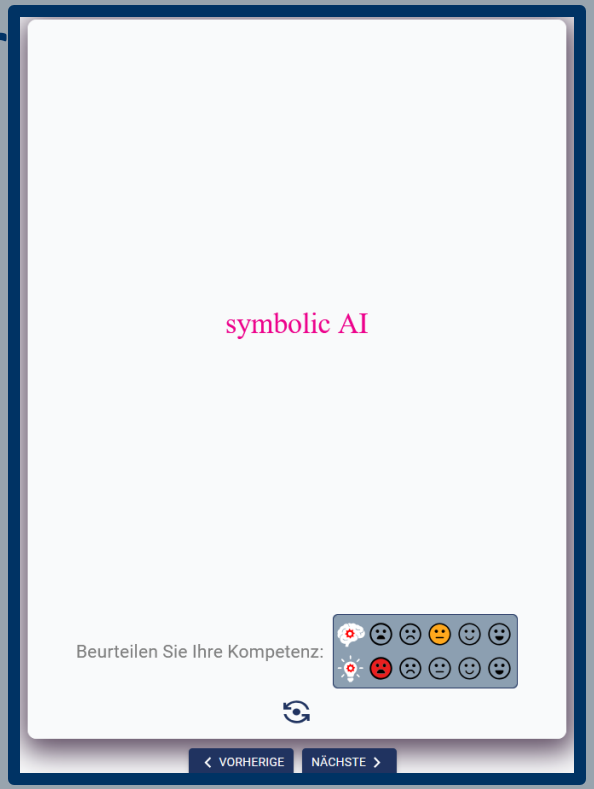
Features von ALeA (Auswahl)

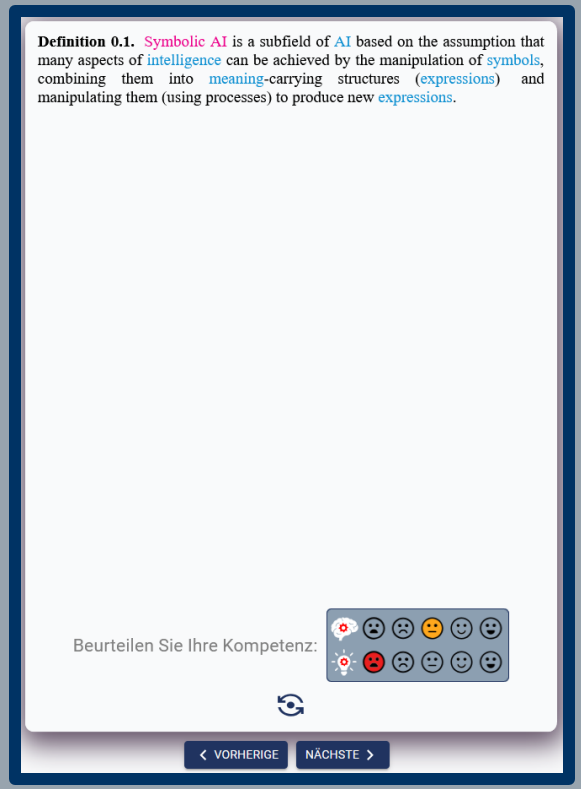
Interaktion mit Lernmaterialien



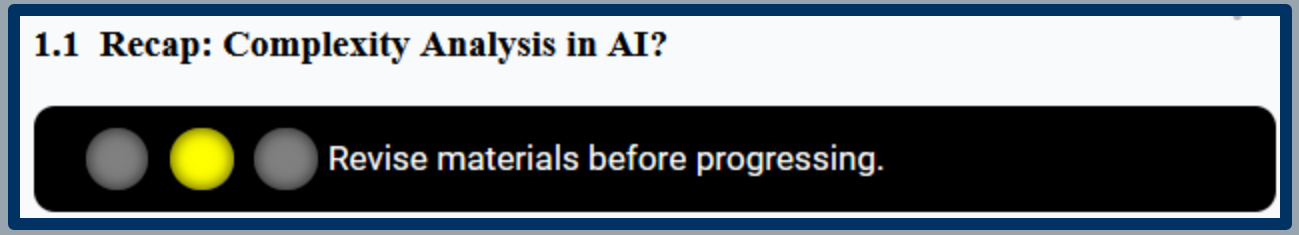
Interaktion mit Lernmaterialien (Ka

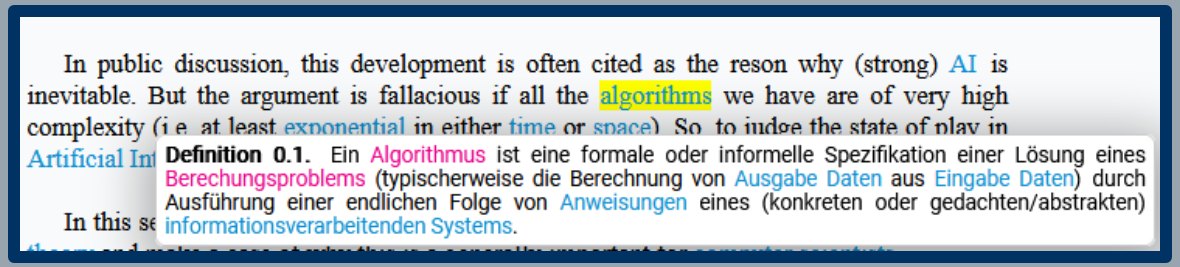
Interaktion mit Lernmaterialien (Kar



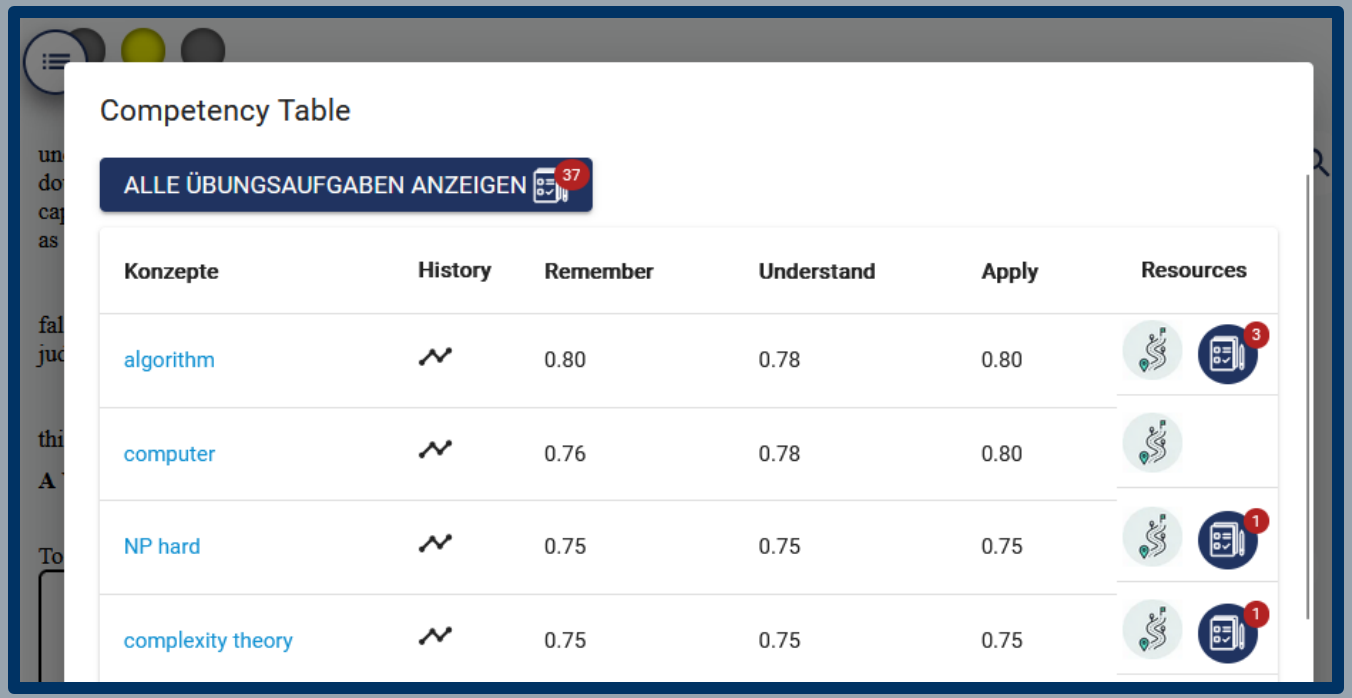


Interaktion mit Lernmaterialien (Skript)

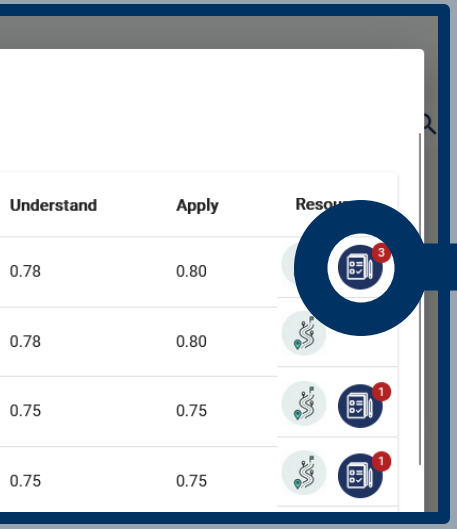


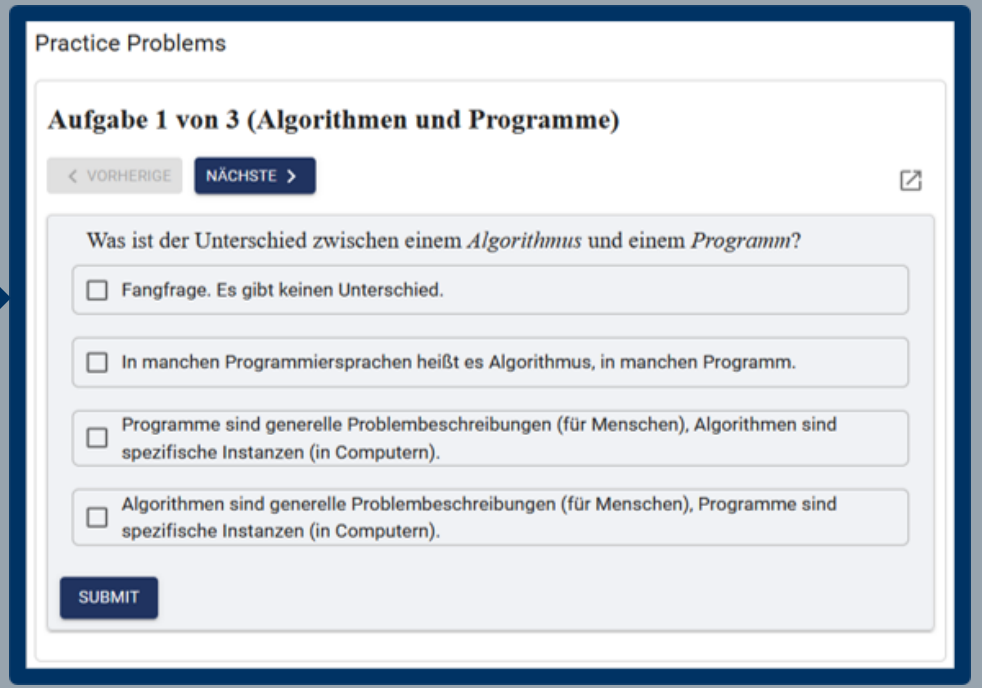


„Kompetenz“-Checks

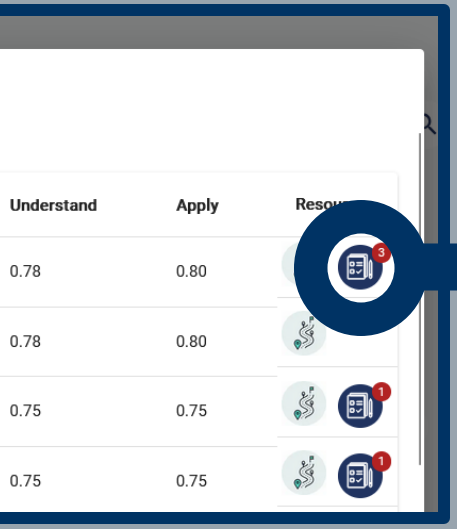


Quizzes


Understand
Apply
0.78
0.80
0.78
0.80
0.75
0.75
0.75
0.75


Practice Problems
Aufgabe 1 von 3 (Algorithmen und Programme)
VORHERIGE
NÄCHSTE
Was ist der Unterschied zwischen einem *Algorithmus* und einem *Programm*?
Fangfrage. Es gibt keinen Unterschied.
In manchen Programmiersprachen heißt es Algorithmus, in manchen Programm.
Programme sind generelle Problembeschreibungen (für Menschen), Algorithmen sind spezifische Instanzen (in Computern).
Algorithmen sind generelle Problembeschreibungen (für Menschen), Programme sind spezifische Instanzen (in Computern).
SUBMIT

Quizzes



Practice Problems

Aufgabe 1 von 3 (Algorithmen und Programme)

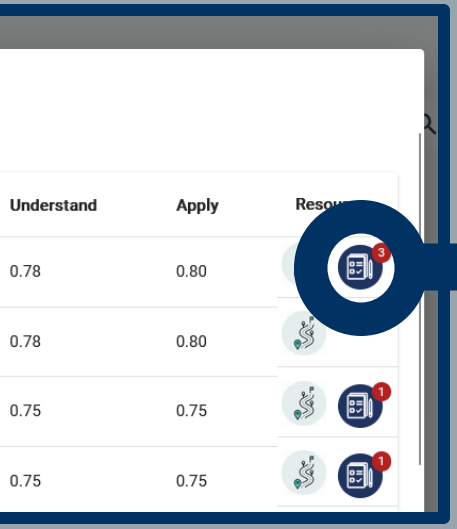
VORHERIGE NÄCHSTE

Was ist der Unterschied zwischen einem *Algorithmus* und einem *Programm*?

- [ ] Fangfrage. Es gibt keinen Unterschied.
- [x] In manchen Programmiersprachen heißt es Algorithmus, in manchen Programm.
- [x] Programme sind generelle Problembeschreibungen (für Menschen), Algorithmen sind spezifische Instanzen (in Computern).
- [ ] Algorithmen sind generelle Problembeschreibungen (für Menschen), Programme sind spezifische Instanzen (in Computern).

SUBMIT

Quizzes



Practice Problems

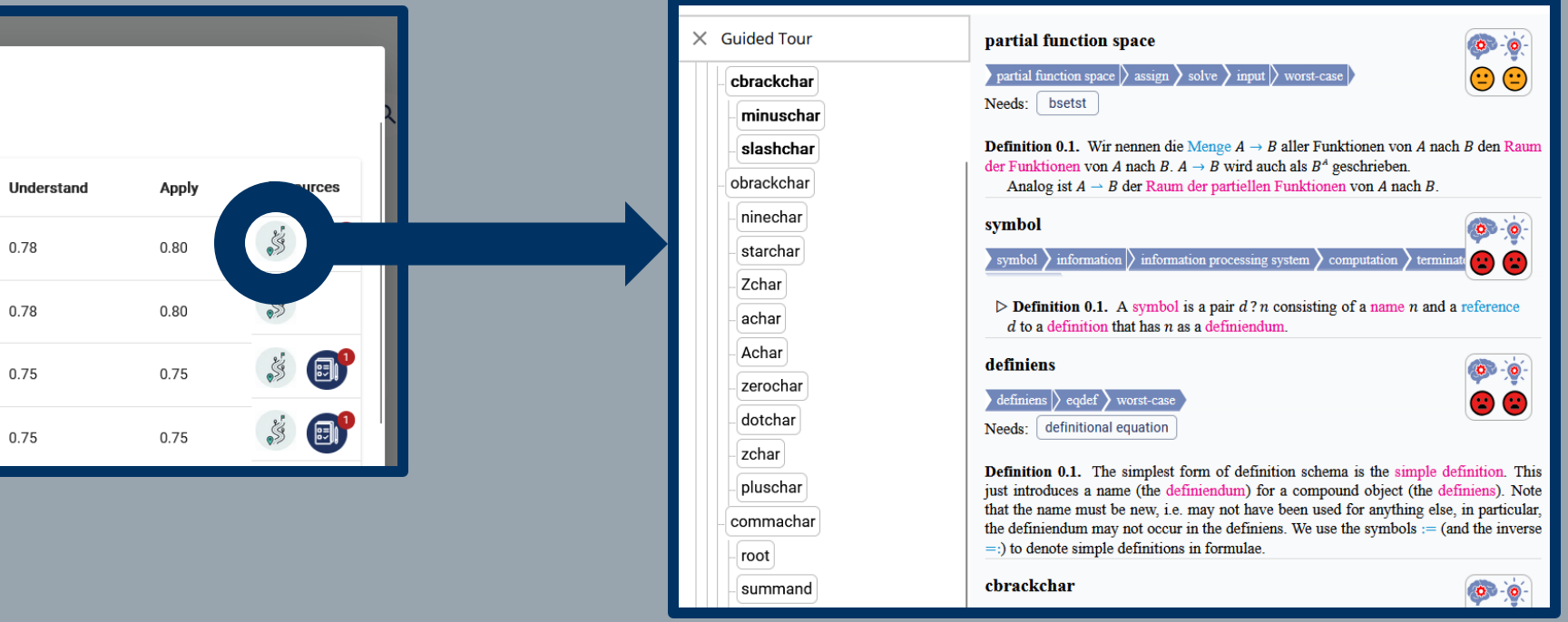
Aufgabe 1 von 3 (Algorithmen und Programme)

VORHERIGE NÄCHSTE

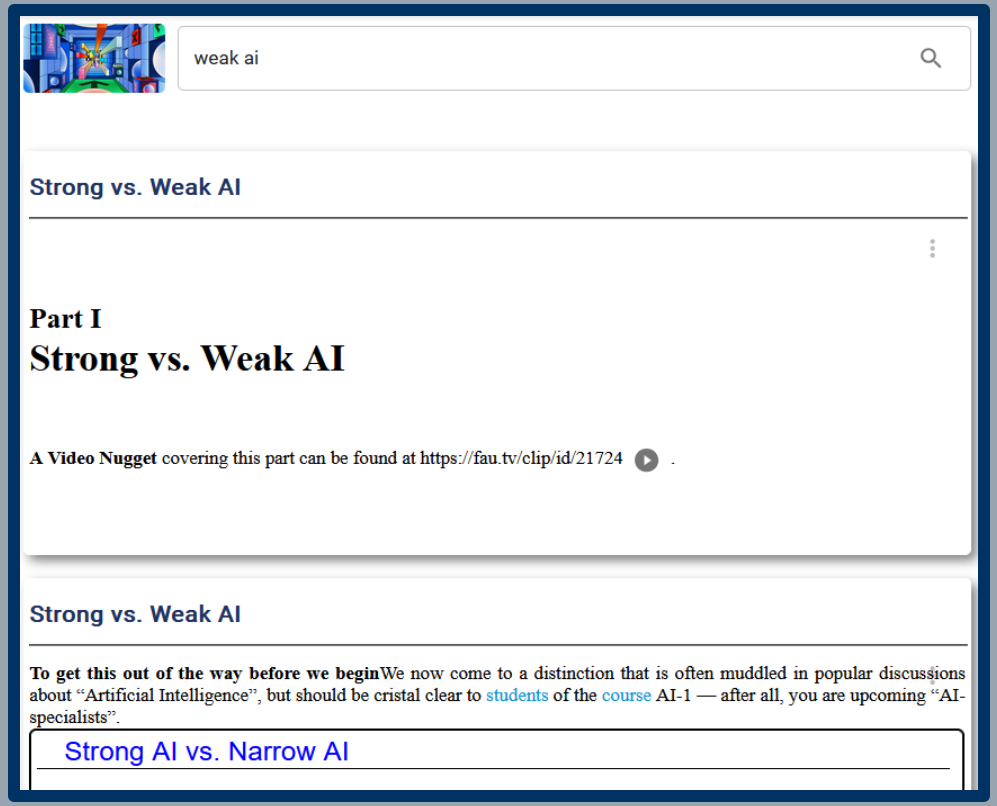
Was ist der Unterschied zwischen einem *Algorithmus* und einem *Programm*?

- ☐ Fangfrage. Es gibt keinen Unterschied.
- ☑ In manchen Programmiersprachen heißt es Algorithmus, in manchen Programm.
- ☑ Programme sind generelle Problembeschreibungen (für Menschen), Algorithmen sind spezifische Instanzen (in Computern).
- ☐ Algorithmen sind generelle Problembeschreibungen (für Menschen), Programme sind spezifische Instanzen (in Computern).

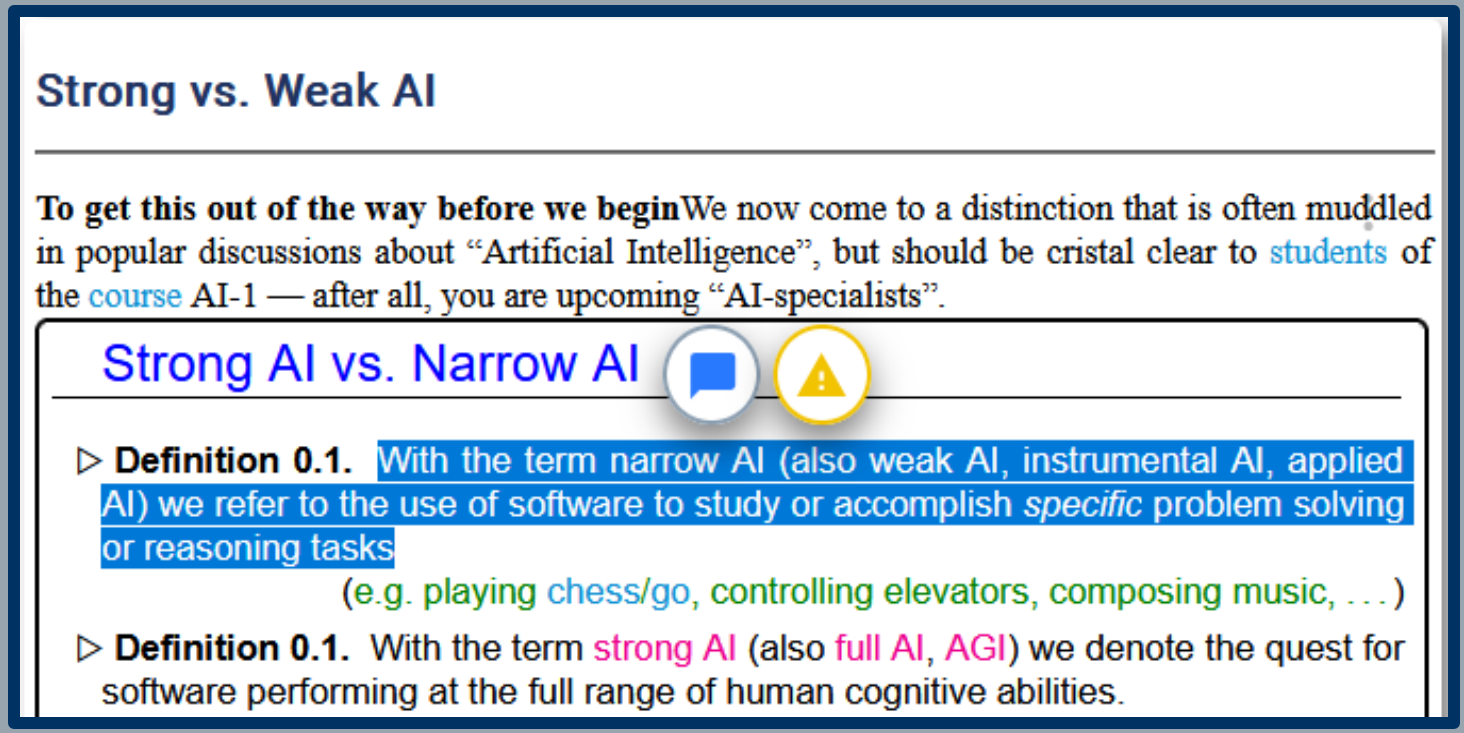
Guided Tours



Suche


weak ai
Strong vs. Weak AI
Part I
Strong vs. Weak AI
A Video Nugget covering this part can be found at https://fau.tv/clip/id/21724 .
Strong vs. Weak AI
To get this out of the way before we beginWe now come to a distinction that is often muddled in popular discussions about "Artificial Intelligence", but should be cristal clear to students of the course AI-1 — after all, you are upcoming "AI-specialists".
Strong AI vs. Narrow AI

Kommentare & Notizen



Strong vs. Weak AI

To get this out of the way before we begin We now come to a distinction that is often muddled in popular discussions about "Artificial Intelligence", but should be cristal clear to students of the course AI-1 — after all, you are upcoming "AI-specialists".

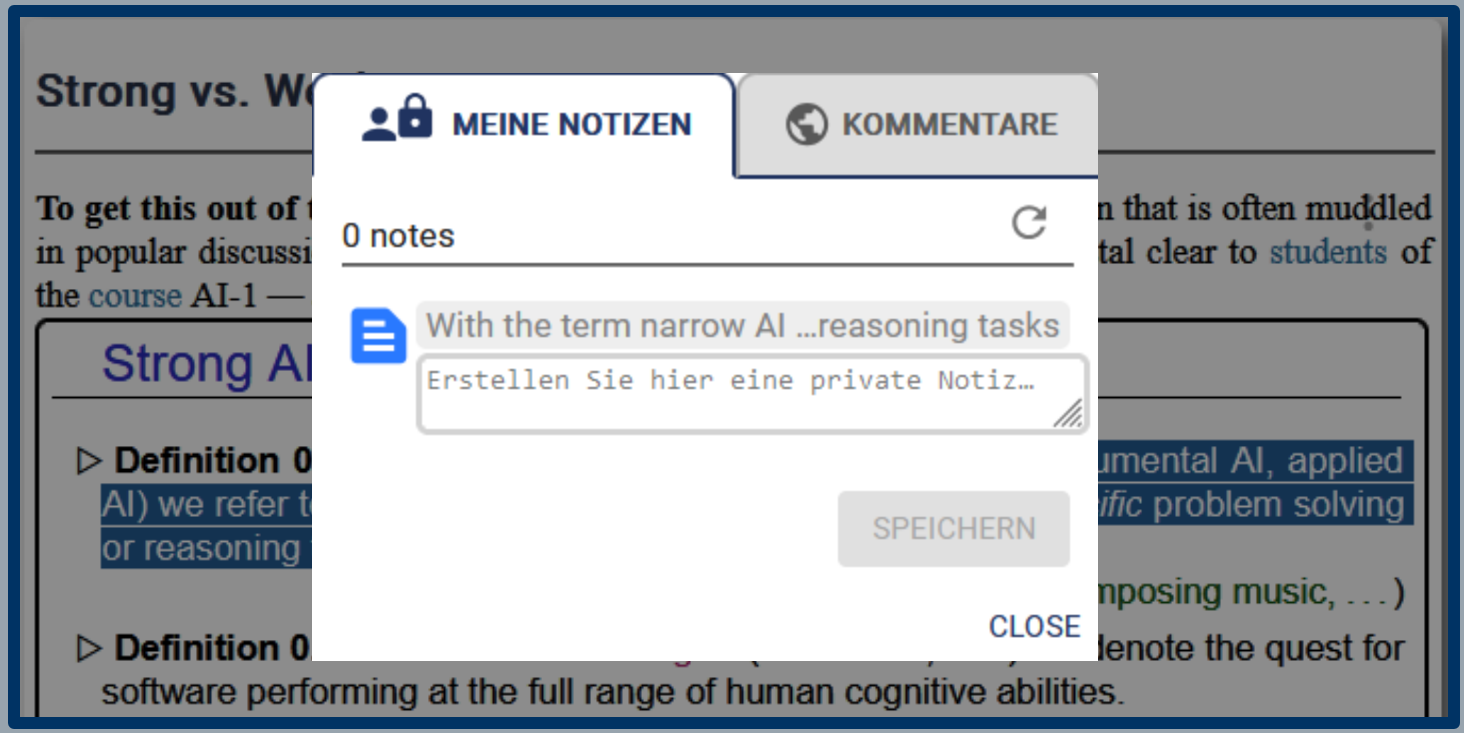
Strong AI vs. Narrow AI

▷ **Definition 0.1.** With the term narrow AI (also weak AI, instrumental AI, applied AI) we refer to the use of software to study or accomplish *specific* problem solving or reasoning tasks

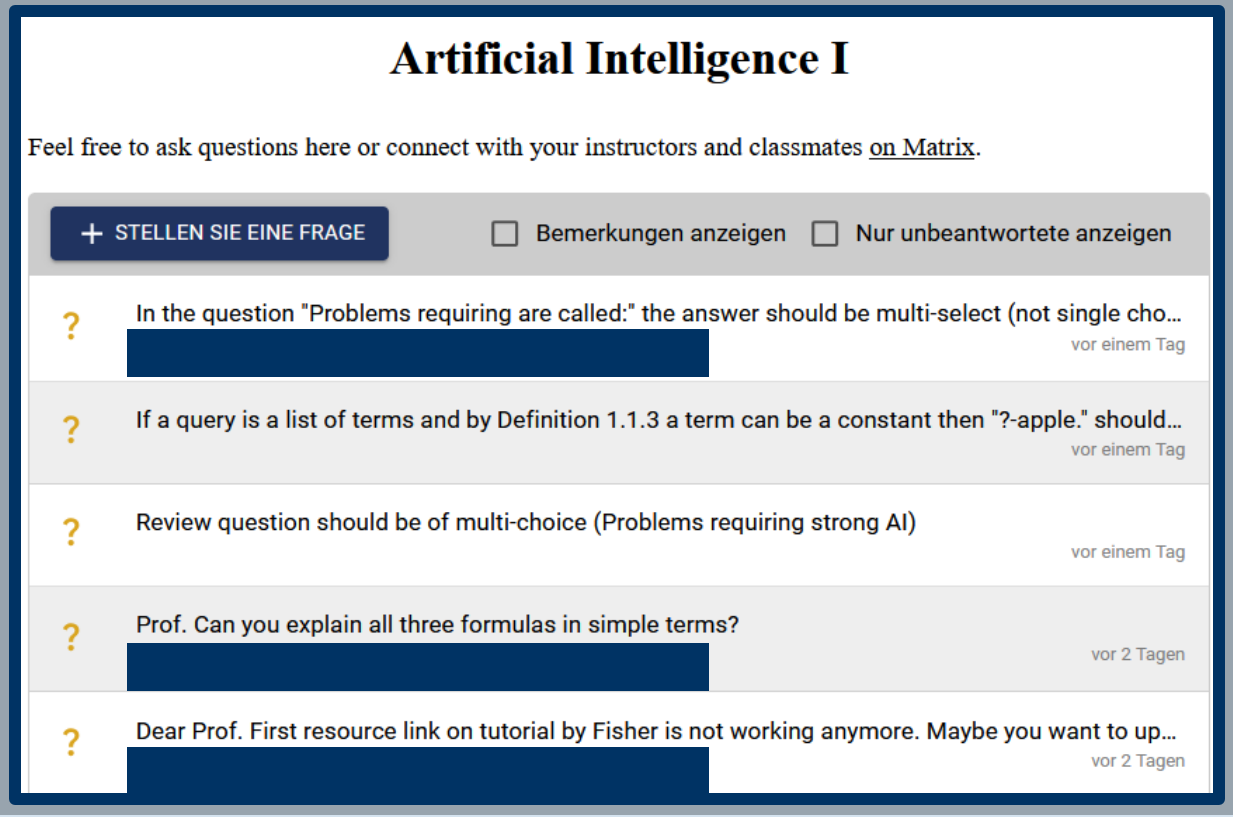
(e.g. playing chess/go, controlling elevators, composing music, . . .)

▷ **Definition 0.1.** With the term strong AI (also full AI, AGI) we denote the quest for software performing at the full range of human cognitive abilities.

Kommentare & Notizen



Forum & Karma



Artificial Intelligence I

Feel free to ask questions here or connect with your instructors and classmates on Matrix.

+ STELLEN SIE EINE FRAGE | Bemerkungen anzeigen | Nur unbeantwortete anzeigen

? In the question "Problems requiring are called:" the answer should be multi-select (not single cho... [redacted] vor einem Tag

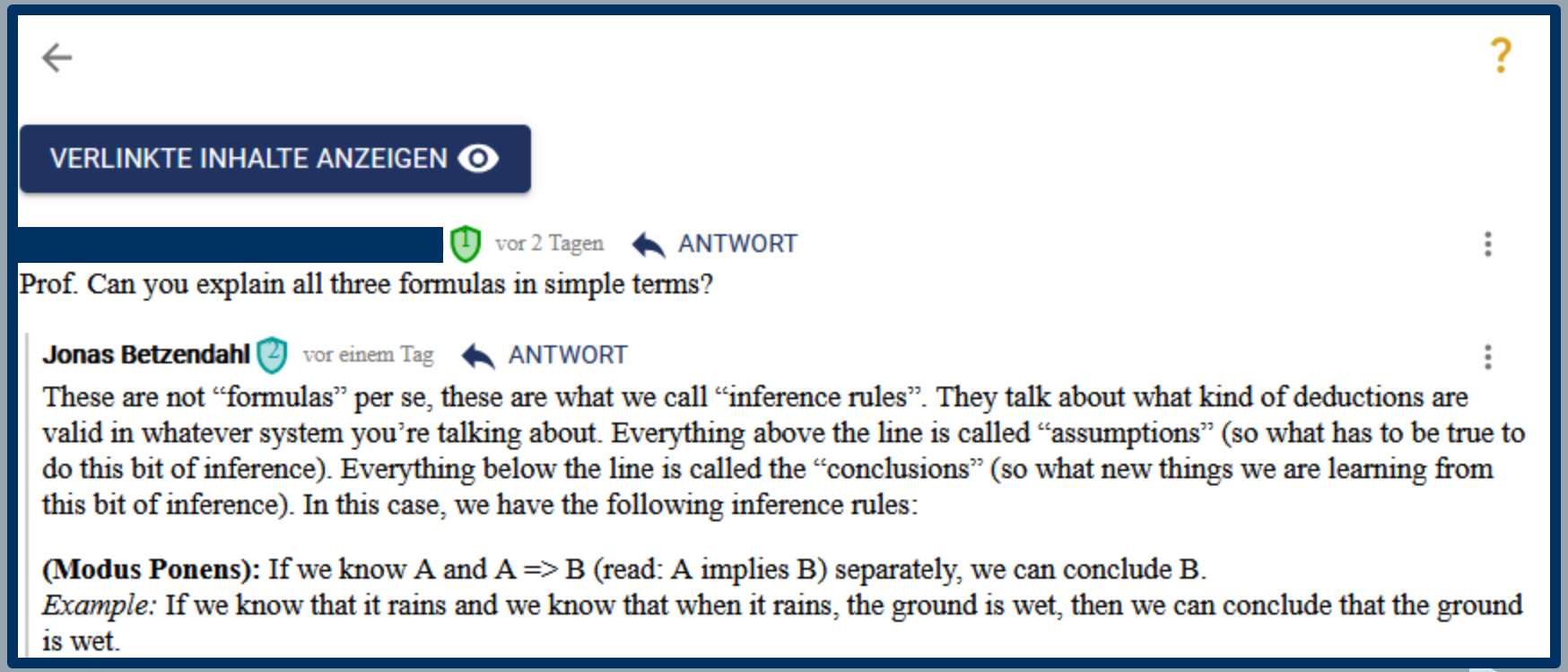
? If a query is a list of terms and by Definition 1.1.3 a term can be a constant then "?-apple." should... vor einem Tag

? Review question should be of multi-choice (Problems requiring strong AI) vor einem Tag

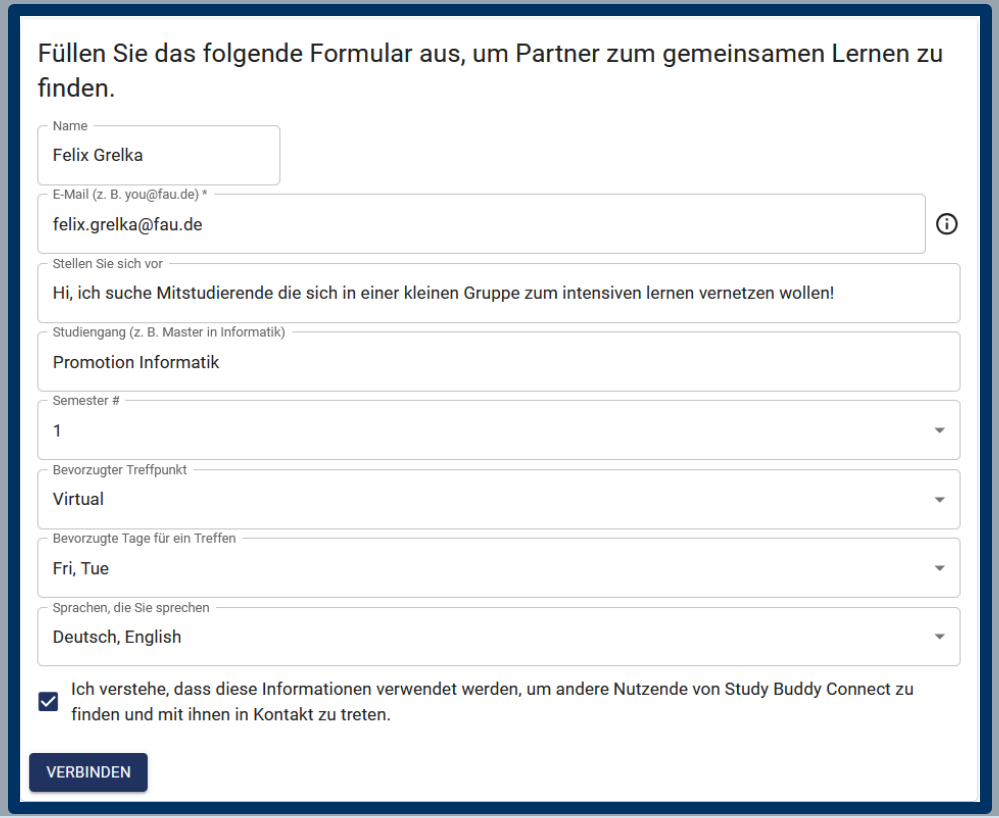
? Prof. Can you explain all three formulas in simple terms? [redacted] vor 2 Tagen

? Dear Prof. First resource link on tutorial by Fisher is not working anymore. Maybe you want to up... [redacted] vor 2 Tagen

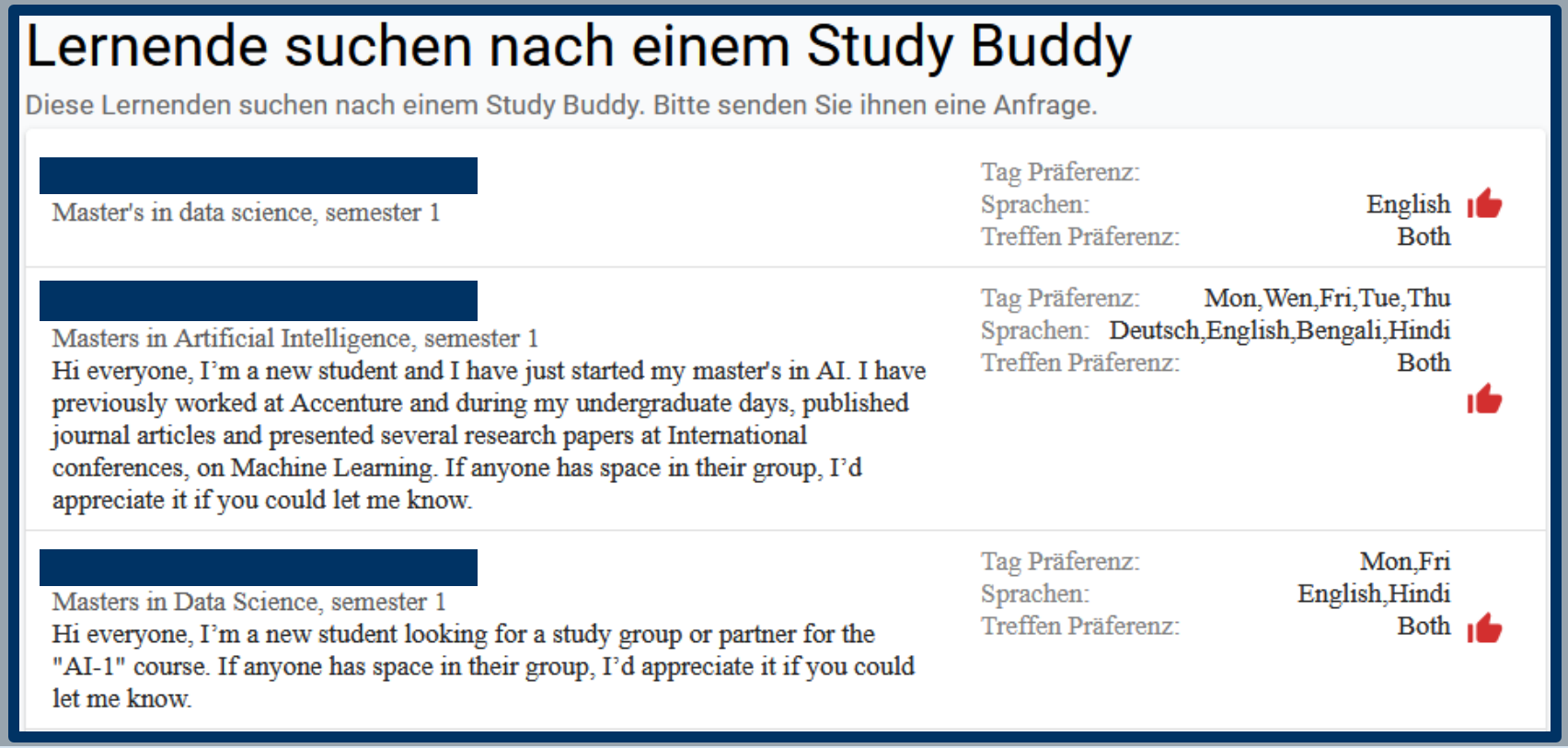
Forum & Karma


VERLINKTE INHALTE ANZEIGEN
vor 2 Tagen
ANTWORT
Prof. Can you explain all three formulas in simple terms?
Jonas Betzendahl
vor einem Tag
ANTWORT
These are not “formulas” per se, these are what we call “inference rules”. They talk about what kind of deductions are valid in whatever system you’re talking about. Everything above the line is called “assumptions” (so what has to be true to do this bit of inference). Everything below the line is called the “conclusions” (so what new things we are learning from this bit of inference). In this case, we have the following inference rules:
(Modus Ponens): If we know A and A => B (read: A implies B) separately, we can conclude B.
Example: If we know that it rains and we know that when it rains, the ground is wet, then we can conclude that the ground is wet.

Study Buddy


Füllen Sie das folgende Formular aus, um Partner zum gemeinsamen Lernen zu finden.
Name
Felix Grelka
E-Mail (z. B. you@fau.de) *
felix.grelka@fau.de
Stellen Sie sich vor
Hi, ich suche Mitstudierende die sich in einer kleinen Gruppe zum intensiven lernen vernetzen wollen!
Studiengang (z. B. Master in Informatik)
Promotion Informatik
Semester #
1
Bevorzugter Treffpunkt
Virtual
Bevorzugte Tage für ein Treffen
Fri, Tue
Sprachen, die Sie sprechen
Deutsch, English
Ich verstehe, dass diese Informationen verwendet werden, um andere Nutzende von Study Buddy Connect zu finden und mit ihnen in Kontakt zu treten.
VERBINDEN

Study Buddy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Diese Lernenden suchen nach einem Study Buddy. Bitte senden Sie ihnen eine Anfrage.
[redacted]
Master's in data science, semester 1
Tag Präferenz:
Sprachen: English
Treffen Präferenz: Both
[redacted]
Masters in Artificial Intelligence, semester 1
Hi everyone, I'm a new student and I have just started my master's in AI. I have previously worked at Accenture and during my undergraduate days, published journal articles and presented several research papers at International conferences, on Machine Learning. If anyone has space in their group, I'd appreciate it if you could let me know.
Tag Präferenz: Mon,Wen,Fri,Tue,Thu
Sprachen: Deutsch,English,Bengali,Hindi
Treffen Präferenz: Both
[redacted]
Masters in Data Science, semester 1
Hi everyone, I'm a new student looking for a study group or partner for the "AI-1" course. If anyone has space in their group, I'd appreciate it if you could let me know.
Tag Präferenz: Mon,Fri
Sprachen: English,Hindi
Treffen Präferenz: Both

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