Lab session 1

Machine Learning for Behavioral Data (CS-421)

February 20, 2023

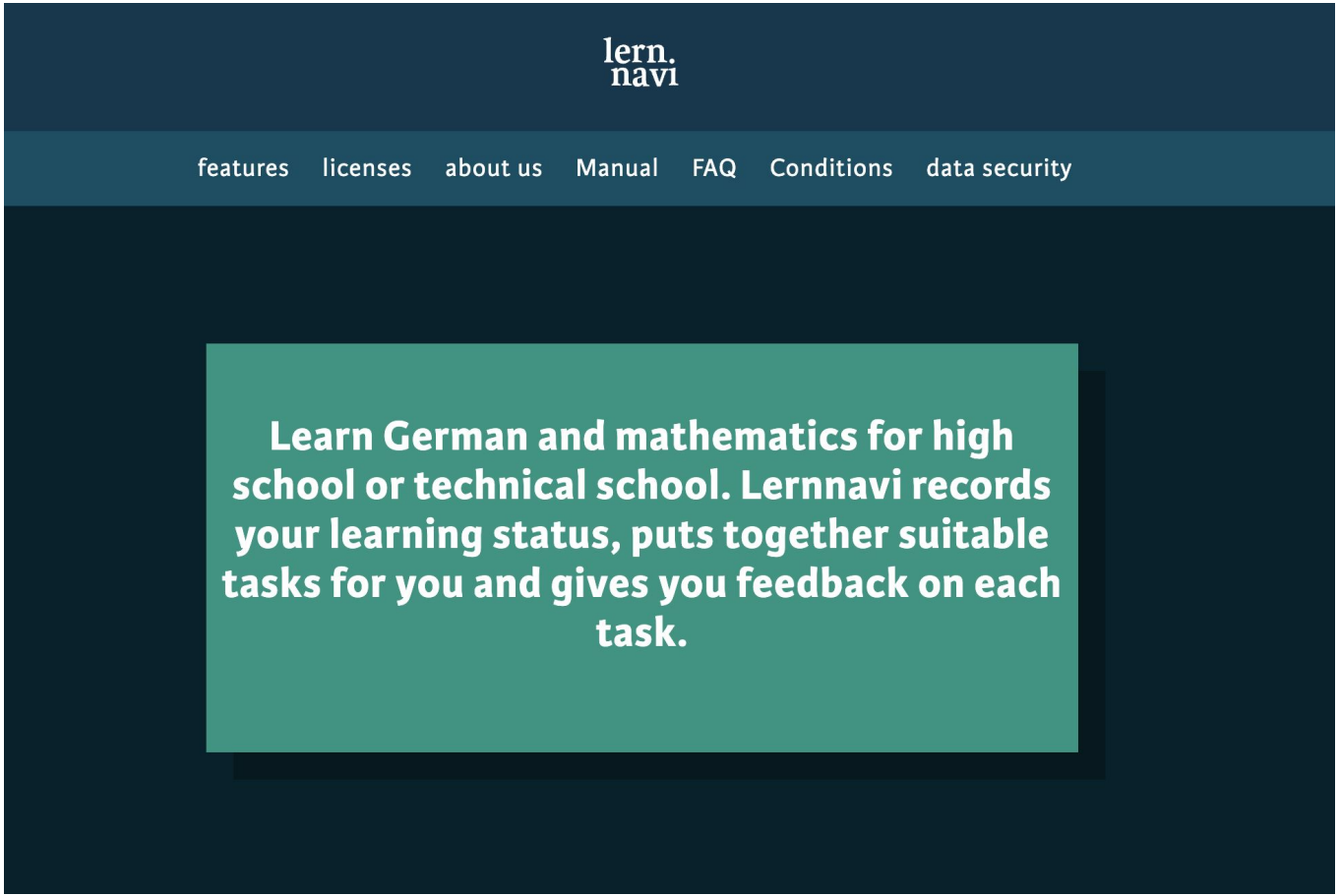
Project

- Teams of 3 people
- We will provide data sets
- We will provide example research questions
- You will suggest an additional analysis/extension to the selected research question
- We will give feedback during the semester (see milestones)
- We will do project office hours (during lab sessions)
- You will do a presentation in the last week of the semester
- Final project (Code + Report)

Start-up Presentations

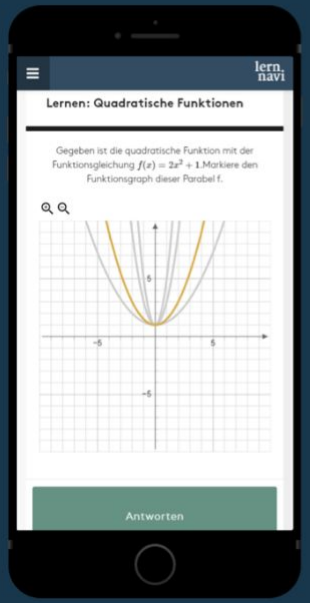
Two EdTechCollider start-ups have provided us with real-world data:

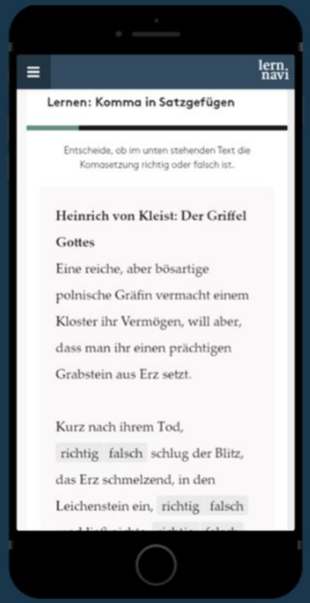
- Lernnavi
- Calcularis



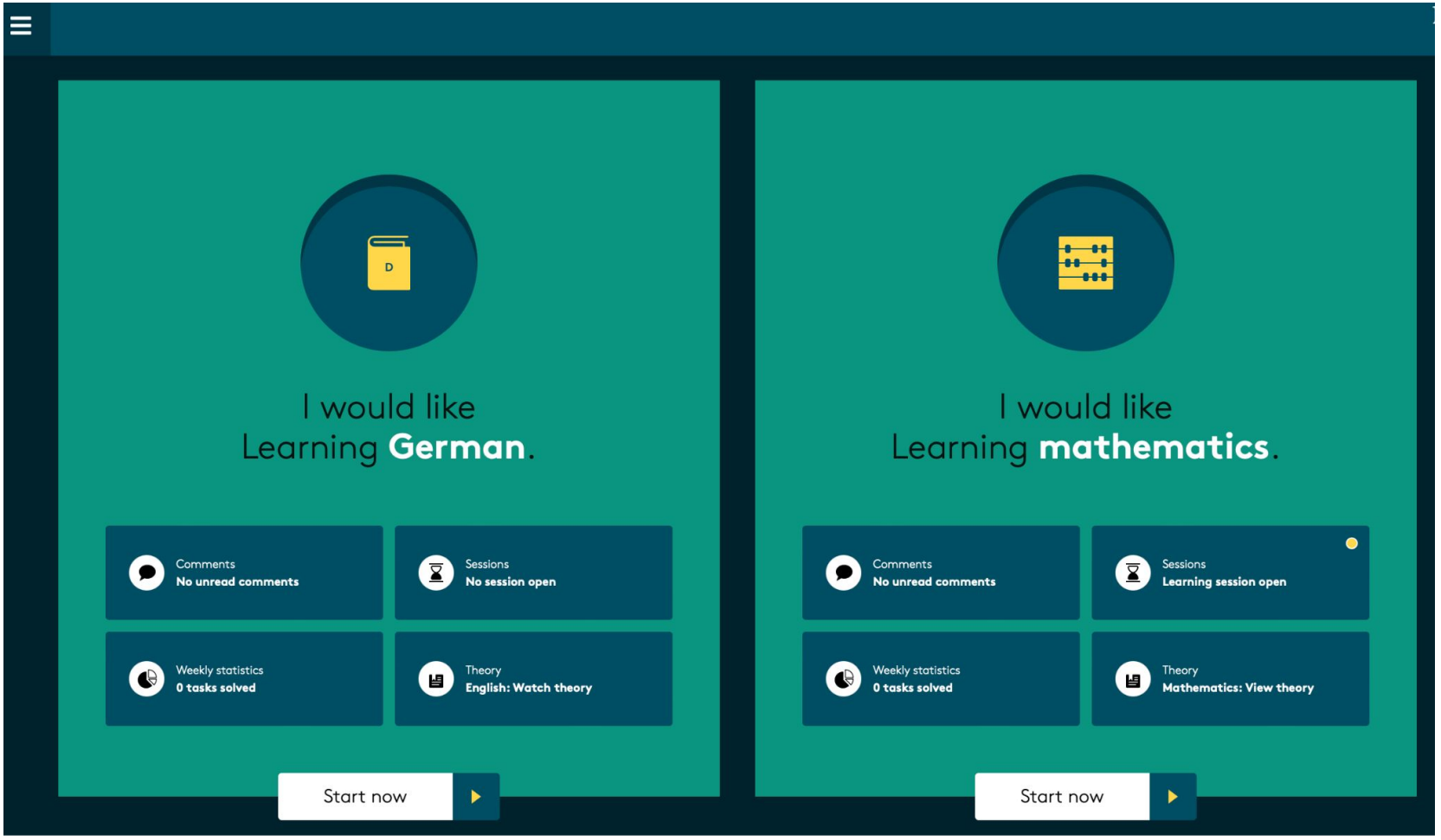
https://www.lernnavi.ch/

German and mathematics





Lernnavi is an instrument for promoting part of the basic subject-related study skills in German and mathematics. The development teams created the reference framework for German and mathematics based on the appendix to the framework curriculum. The cantonal student councils and the VSDL (Association of Swiss German teachers) or the DMK (German-Swiss Mathematics Commission) and the core group for canon mathematics were able to comment on these in the consultation process. Thanks to this approach and the broad support, a good fit with the framework curriculum is ensured.


I would like
Learning German.
Comments
No unread comments
Sessions
No session open
Weekly statistics
0 tasks solved
Theory
English: Watch theory
Start now
I would like
Learning mathematics.
Comments
No unread comments
Sessions
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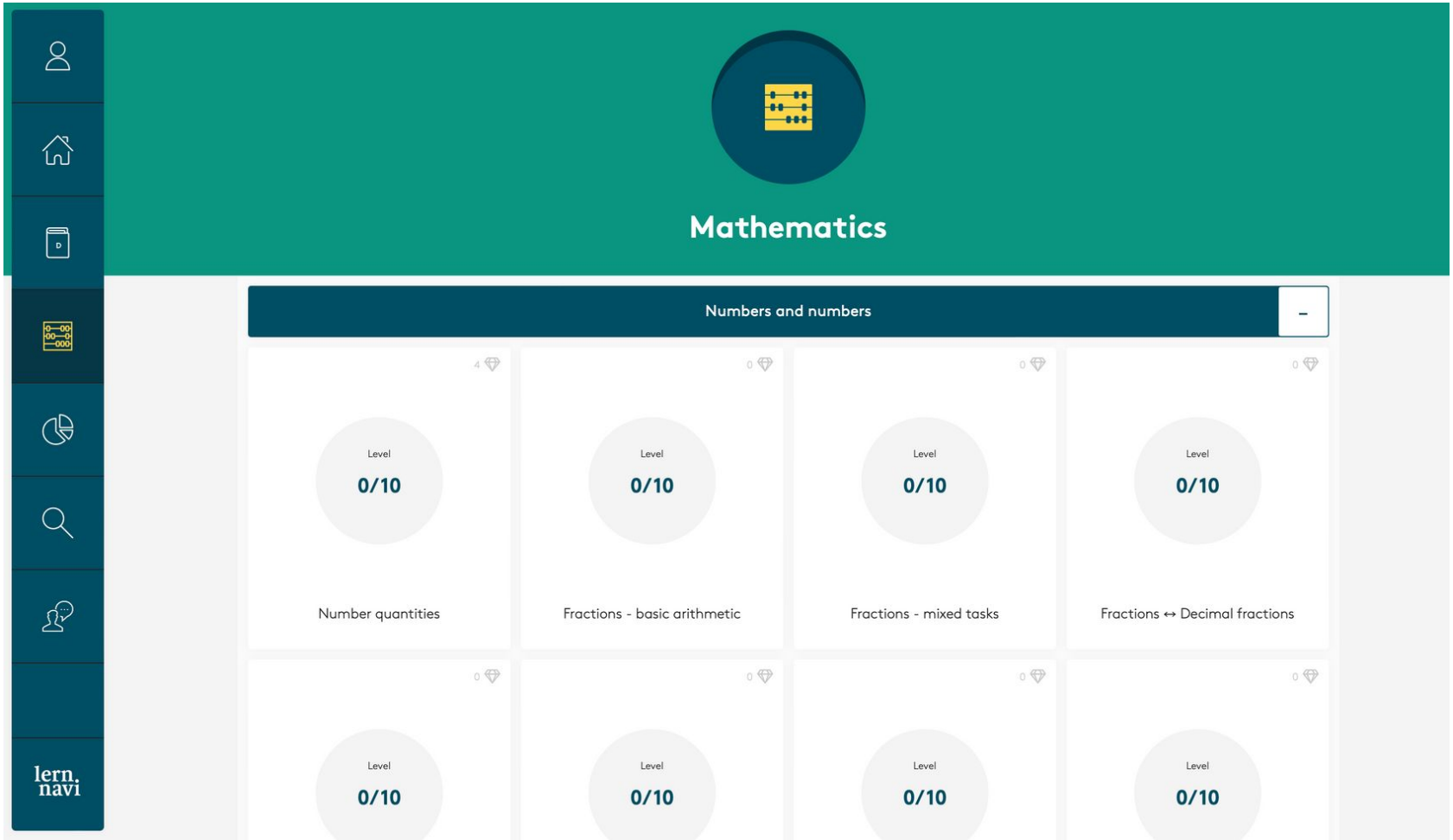
0 tasks solved
Theory
Mathematics: View theory
Start now


Mathematics
Numbers and numbers
Level
0/10
Number quantities
Fractions - basic arithmetic
Fractions - mixed tasks
Fractions ↔ Decimal fractions
lern. navi

Learning:
Number sets

Arrange the set of numbers so that the lower set is always a subset of the upper set.

$\mathbb{Q}$ $\mathbb{N}$ $\mathbb{R}$ $\mathbb{Z}$

0 Comments

skip

nd numbers

Number quantities

Rule

Payment quantities

$\mathbb{N} = \{1, 2, 3, 4, 5, ...\}$= set of natural numbers

$\mathbb{N}_0 = \{0, 1, 2, 3, 4, 5, ...\}$= Set of natural numbers with zero

$\mathbb{Z} = \{..., -2, -1, 0, 1, 2, ...\}$= Amount of integers

$\mathbb{Q} = \{\frac{p}{q} | p \ominus \mathbb{Z}, q \ominus \mathbb{N}\}$= set of rational numbers = set of fractions (quantities)

$\mathbb{R}$= Set of all real numbers (decimal numbers)

The following applies:

$\mathbb{N} \,.\, \mathbb{Z} \,.\, \mathbb{Q} \,.\, \mathbb{R}$

Lernnavi | Overview

- ~31,000 students
- ~11,000,000 events
- Detailed table description

- Controlled study
  - ~300 students
  - 10 weeks
  - Pre-post test and questionnaire.

Demo

- Demo accounts (send email or raise hand)

Lernnavi | Project Ideas

- **Time series analysis** of students.
- Prediction of **students' knowledge gain**
- Does **gender / geographic region** have considerable differences in student performance?
- Prediction of students' engagement.
- What are the traits of the most successful students?

1st grade through high school, mathematics program that helps students with dyscalculia overcome their arithmetic weaknesses!

Looking through with calcularis

Test here for free

WITH MATH TO SUCCESS

The mathematics learning program Calcularis was developed with neuroscientists and computer scientists from ETH Zurich. It promotes the development and interaction of the different areas of the brain that are responsible for processing numbers and quantities and solving mathematical tasks. Calcularis can be used from 1st grade to high school. Children with dyscalculia also benefit in the long term and overcome their arithmetic weakness.

neuropsychology and computer science

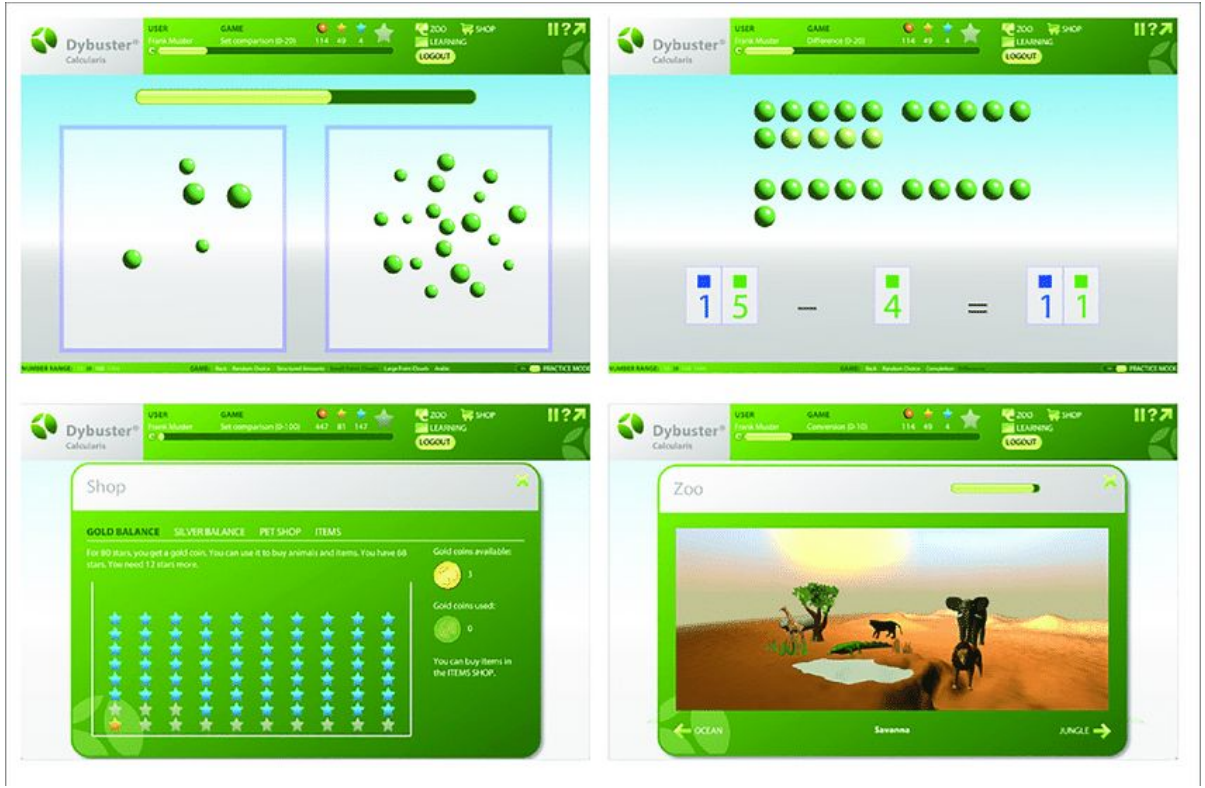
Multi-sensory learning through neuroscience and computer science at ETH Zurich

Proven success

Up to 45% more correctly solved tasks after just three months of training.

Individual learning

Individually tailored learning content ensures the greatest possible learning success.


Dybuster
Calcularis
Shop
GOLD BALANCE
SILVER BALANCE
PET SHOP
ITEMS
Zoo
Savanna
OCEAN
JUNGLE

Demo

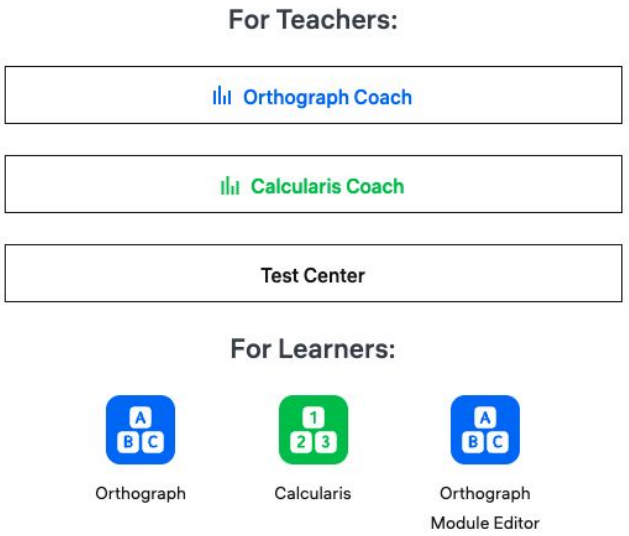
http://go.alemira.com/

- U: DemoTeacher
- P: DemoTeacher

Full access to all exercises of the free training and the reward system

Learn session will not be stored; every time you log in, you'll have the same progress

Teacher mode and student mode!



Tables

users: meta information about users (i.e. total time spent learning with Calcularis, geographic location).

user_id	learning_time_ms	start	end	logged_in_time_ms	ui_locale
3152	304025	2023-01-19T07:51:44.380Z	2023-01-19T08:19:04.047Z	1639666	nl-nl
3153	308710	2023-01-19T09:09:22.447Z	2023-01-19T09:34:57.184Z	1534736	nl-nl
3154	1280566	2023-01-20T08:15:28.898Z	2023-01-20T09:03:59.179Z	2910281	nl-nl

events: events done by the users in the platform (i.e. playing a game, selecting a new animal in the zoo simulation).

event_id	user_id	mode	game_name	learning_time_ms
116988	3161	NORMAL	Landing	6052.0
116989	3161	NORMAL	Landing	6053.0

Tables

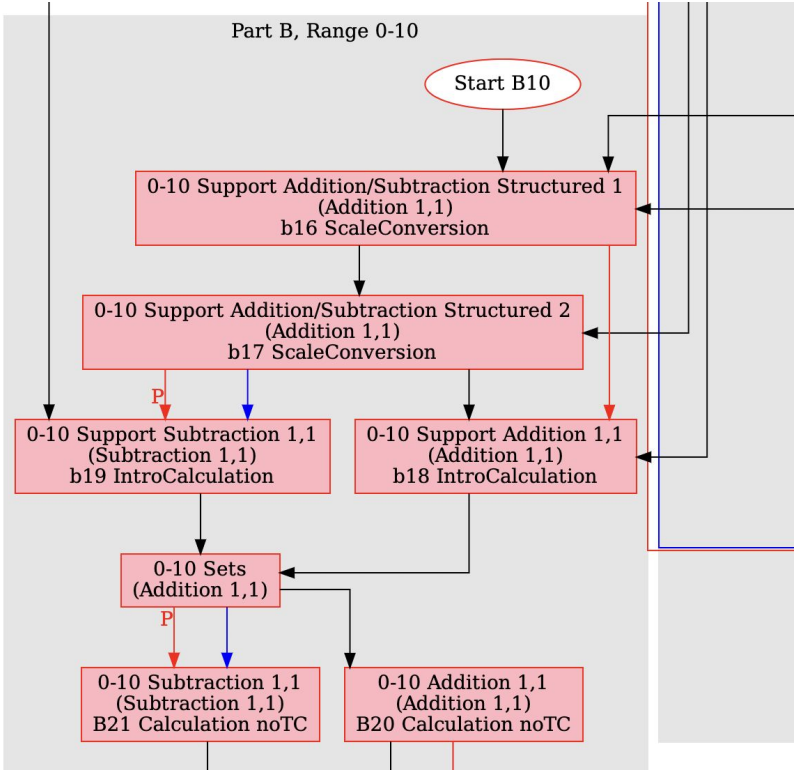
subtasks: sub-tasks with answer attempts solved by users, primarily in the context of game events.

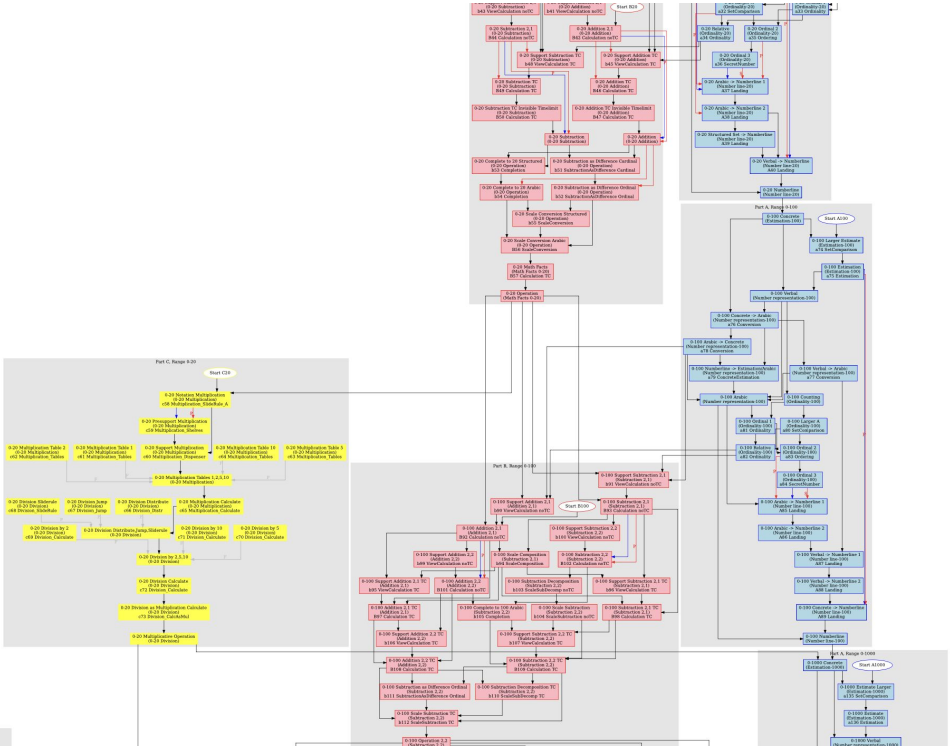
subtask_id	event_id	user_id	aim	answer	answerMode	availableNumbers	correct	correctAnswerObject	correctNumber
131801	116987	3161	30.0	{'a': 38, 'b': 38.485863}	NaN	NaN	False	{'a': 30, 'b': 30}	NaN
131802	116988	3161	47.0	{'a': 45, 'b': 44.945316}	NaN	NaN	True	{'a': 47, 'b': 47}	NaN
131803	116989	3161	98.0	{'a': 97, 'b': 96.775314}	NaN	NaN	True	{'a': 98, 'b': 98}	NaN

destination	distance	hasProperResult	interval	lowerBound	maxHeight	minHeight	mode	multiplier	number	numberRepresentations
NaN	NaN	True	NaN	25.0	NaN	NaN	NaN	NaN	NaN	NaN
NaN	NaN	True	NaN	42.0	NaN	NaN	NaN	NaN	NaN	NaN
NaN	NaN	True	NaN	93.0	NaN	NaN	NaN	NaN	NaN	NaN

...

Skill Map


Part B, Range 0-10
Start B10
0-10 Support Addition/Subtraction Structured 1
(Addition 1,1)
b16 ScaleConversion
0-10 Support Addition/Subtraction Structured 2
(Addition 1,1)
b17 ScaleConversion
P
0-10 Support Subtraction 1,1
(Subtraction 1,1)
b19 IntroCalculation
0-10 Support Addition 1,1
(Addition 1,1)
b18 IntroCalculation
0-10 Sets
(Addition 1,1)
P
0-10 Subtraction 1,1
(Subtraction 1,1)
B21 Calculation noTC
0-10 Addition 1,1
(Addition 1,1)
B20 Calculation noTC



Calcularis | Overview

- 88,932 students (1000 student sample)
- 29 games
- 45 subtask attributes
- guided-training, free-play, zoo

Calcularis | Project Ideas

- **Time series analysis** of students in sessions
- Does **language / geographic region** have considerable differences in student performance?
- Do **specific games** have high student engagement? What are the traits of the most successful games?
- **Wheel spinning**: when do students get stuck and why?
- How do students behave with the Zoo? (**rewards**)
- How effective is **guided training**?

Milestone M1

https://go.epfl.ch/mlbd-m1-2023

Fill out with team and start-up preference

Deadline: Monday, Feb 27th, 23:59

Feedback

We are actively looking for feedback to improve

https://go.epfl.ch/mlbd-feedback

Questions?