


A large, horizontal yellow rounded rectangle with a white border, containing the main title text.

ASYMPTOTE Manual

A dark blue rounded rectangle with a thin white border, containing the subtitle text.

ASYMPTOTE
Adaptive Synchronous Mathematics learning PaThs
for Online Teaching in Europe



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Chapter 1: Introduction

1.1. The ASYMPTOTE Idea



Motivation & Background

- COVID-19 pandemic
 - „Emergency Remote Teaching (ERT)“ (Hodges et al., 2020)
 - Teachers facing lack of technical training (Barlovits et al., 2021)
 - Increased use of basic reproduction tasks & lack of feedback (Barlovits, 2021; Drijvers et al. 2021)

ERT and its challenges:

- Technique & application
- Diagnosis & support
- No personal contact
- Reproduction tasks

(Aldon et al., 2021; Barlovits et al., 2021;
Drijvers et al. 2021)





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 - First concept for using MathCityMap for online teaching & learning

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MCM

(Ludwig & Jablonski, 2021)



MCM@Home

(Barlovits et al., 2021)





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- **MCM@Home concepts**
 - First concept for using MathCityMap for online teaching & learning
- **ASYMPTOTE-Projekt**
 - Consideration of criteria for the development of online learning platforms (Salmon, 2012)

ERT and its challenges:

- Technique & application
- Diagnosis & support
- No personal contact
- Reproduction tasks

(Aldon et al., 2021; Barlovits et al., 2021; Drijvers et al. 2021)

MCM

(Ludwig & Jablonski, 2021)



MCM@Home

(Barlovits et al., 2021)



ASYMPTOTE

- Complete distance learning
- "Blended Learning"
- Homework
- Exam preparation

(Barlovits et al, 2022)





The ASYMPTOTE concept

- **ASYMPTOTE**
 - Adaptive Synchronous Mathematics Learning Paths for Online Teaching in Europe
 - Erasmus+ project (DE, GR, IT, PT, ES)
- **2-component system**
 - Goal: creation and editing of learning graphs (LG)
 - Web portal: creation of adaptive LG by teacher
 - App: differentiated & gamified use of LG by learners
- **Synchronous handling of LG**
 - Use & further development of the MathCityMap Digital Classroom

ASYMPTOTE

- Complete distance learning
- "Blended Learning"
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(Barlovits et al, 2022)



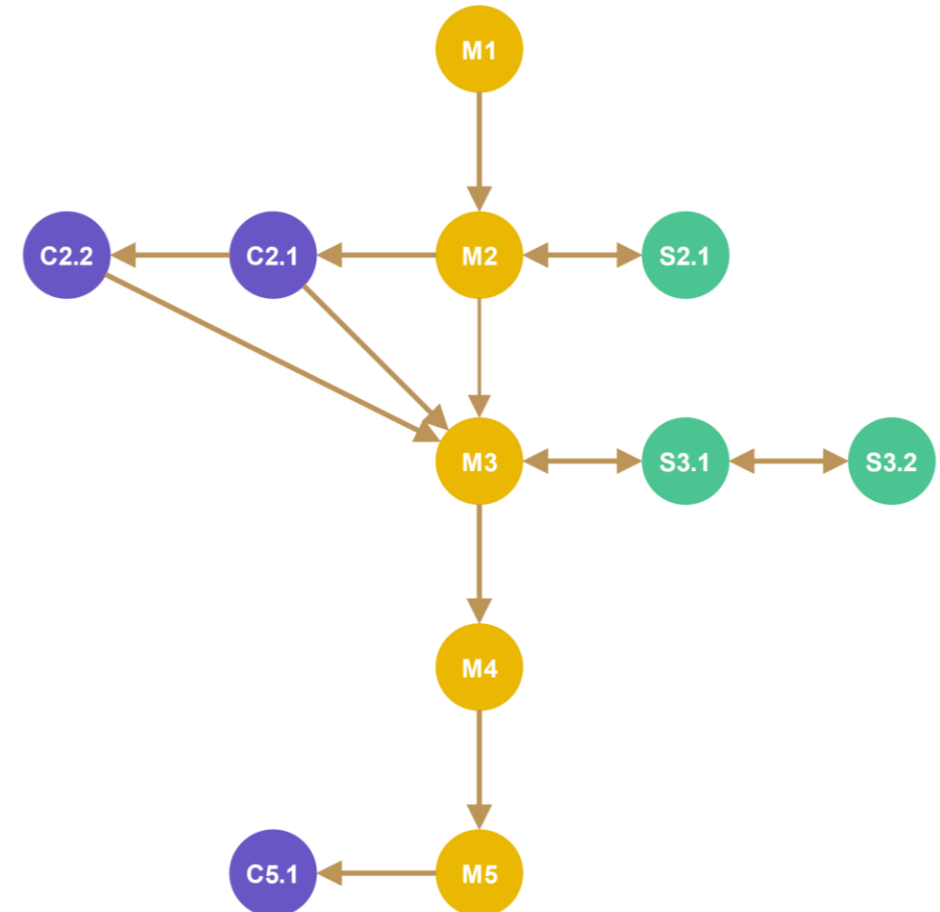
The ASYMPTOTE partners





The Learning Graph concept

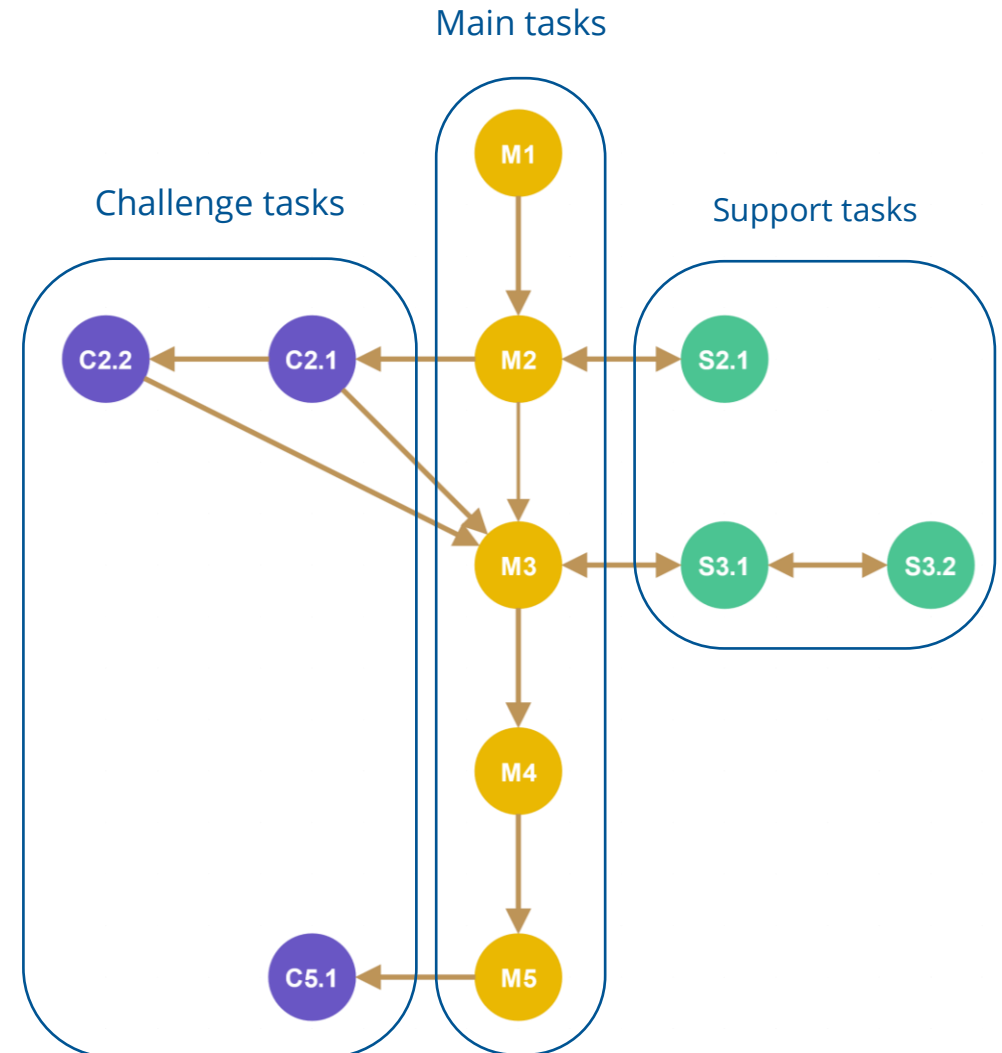
- **Computer-based learning environments** (Lichti & Roth, 2018; Greene et al., 2011):
 - Internet-based and pre-structured learning environment
 - Sequence of coordinated work assignments
 - Self-acting and self-responsible handling by learners
→ Enables choice of personal learning path
- **ASYMPTOTE Learning Graph**
 - Provision of a pre-structured learning environment
 - Learners can find their own way within the learning environment





The Learning Graph concept

- **Main tasks**
 - Compulsory part
 - Goal: "Solve as many main tasks as possible!"
- **Challenge tasks**
 - Unlock by solving the previous task
 - Voluntarily accessible
- **Support tasks**
 - Voluntarily accessible
- **Adaptivity & Autonomy**
 - LG unfolds according to work progress & performance level
 - At the same time, the idea of freedom of choice is preserved

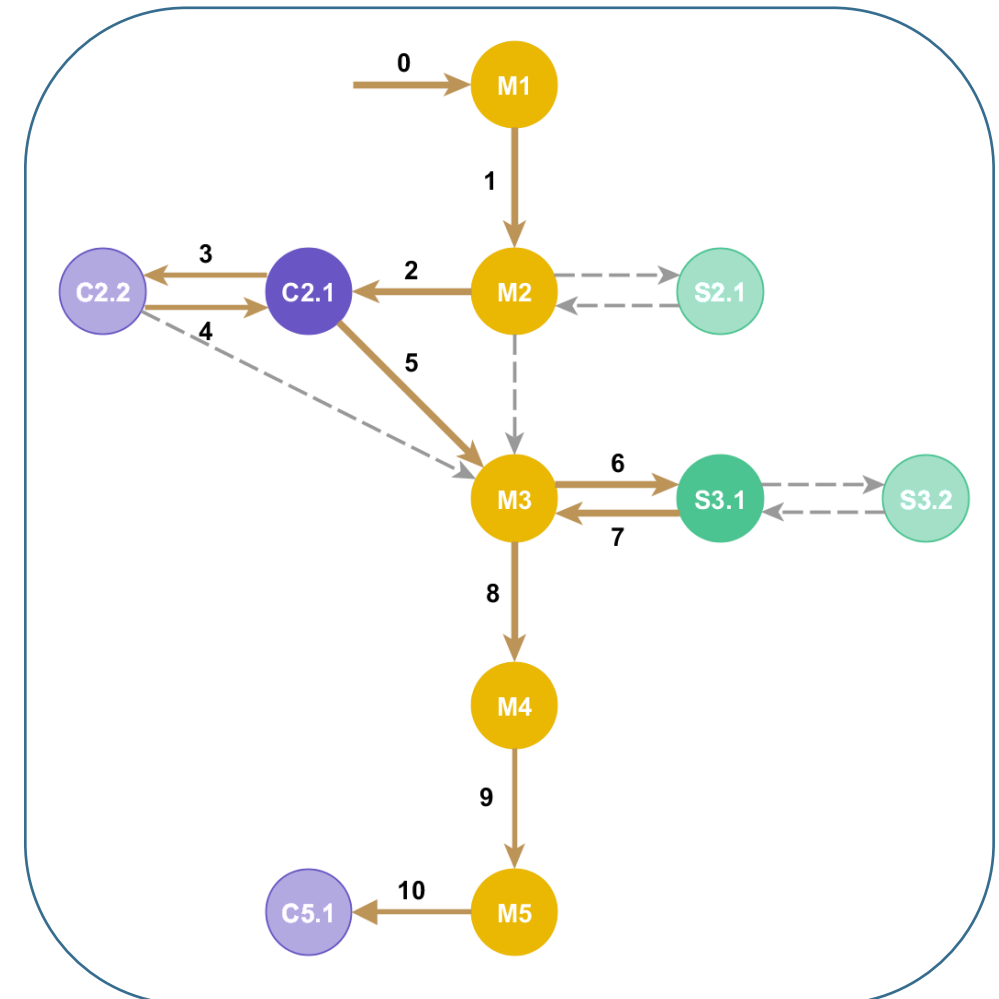




The Learning Graph concept

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Example of an individual learning path





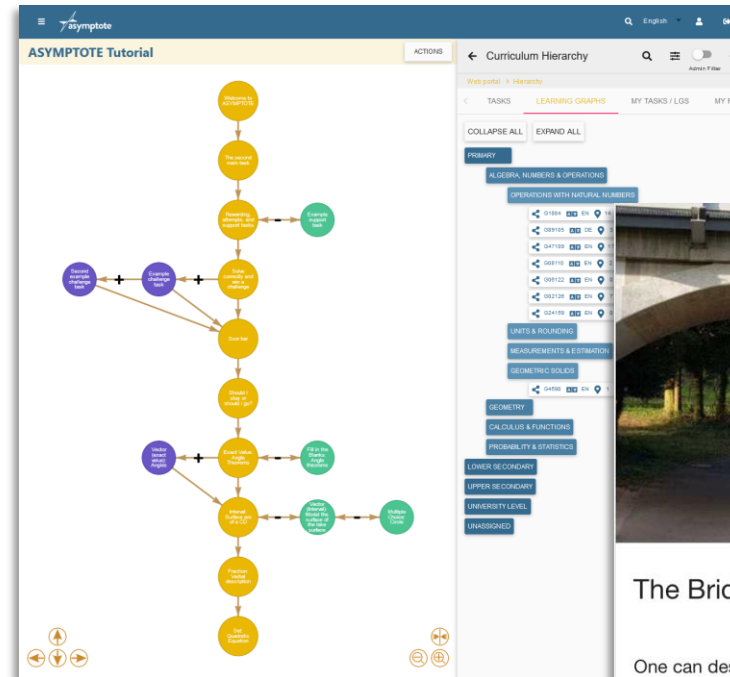
Chapter 1: Introduction

1.2. Key functionalities of ASYMPTOTE



The web portal

- Workspace of the teacher
- Selection & creation of tasks
 - 9 task formats, including exact value, multiple choice, fill-in-the-blank, ...
- Learning Graph selection & creation
- Community platform
 - Share & publish content you create
- Digital classroom



The screenshot shows the ASYMPOTTE Tutorial interface. On the left, a 'Curriculum Hierarchy' is displayed as a flowchart with yellow and green nodes. On the right, a 'Web portal' sidebar shows a list of tasks under various categories like 'ALGEBRA, NUMBERS & OPERATIONS', 'OPERATIONS WITH NATURAL NUMBERS', 'UNITS & ROUNDING', 'MEASUREMENTS & ESTIMATION', 'GEOMETRIC SOLIDS', 'GEOMETRY', 'CALCULUS & FUNCTIONS', 'PROBABILITY & STATISTICS', 'LOWER SECONDARY', 'UPPER SECONDARY', 'UNIVERSITY LEVEL', and 'UNASSIGNED'. Below the sidebar, a photograph of a railway bridge is visible.





The Bridge

One can describe the railway bridge as quadratic function $f(x) = ax^2 + bx + c$. Calculate the value of the factor a in the term of the quadratic function.

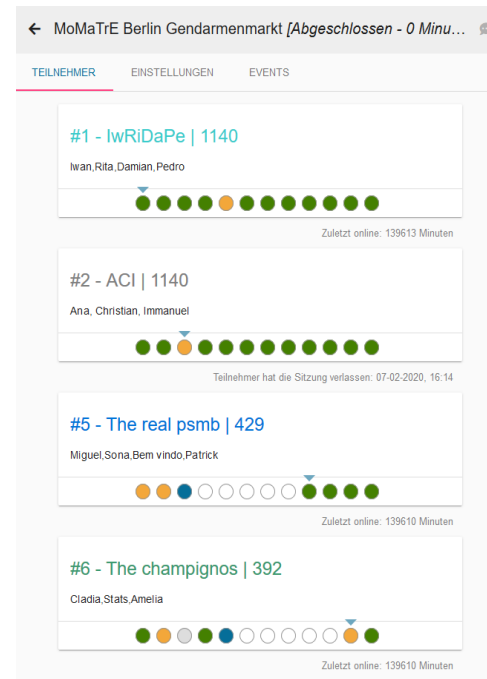
Note: One meter is equal to one unit of length. Round to two decimal numbers.

quadratic function modelling measure

Sprache
English (Default)  

The Digital Classroom

- Features
 - Class overview
 - Evaluation function
 - Communication function
- Update 2023
 - Digital classroom as a representation of the class unit
→ Handling of multiple LG possible
 - Advanced analyses for each LG
 - Long-term analyses by comparing multiple LGs within a Digital Classroom



MoMaTrE Berlin Gendarmenmarkt [Abgeschlossen - 0 Minu...]

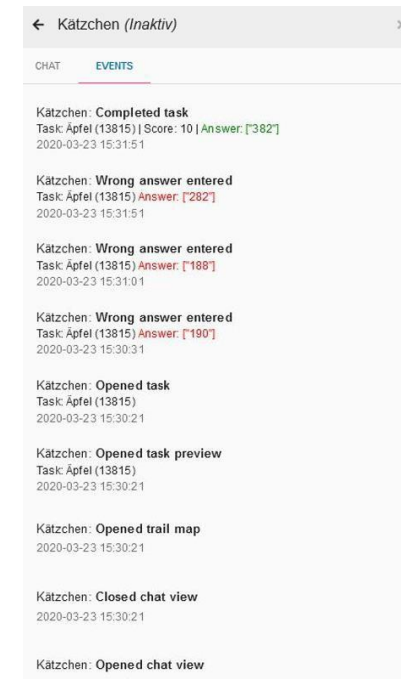
TEILNEHMER EINSTELLUNGEN EVENTS

#1 - IwRiDaPe | 1140
Iwan,Rita,Damian,Pedro
Zuletzt online: 139613 Minuten

#2 - ACI | 1140
Ana, Christian, Immanuel
Teilnehmer hat die Sitzung verlassen: 07-02-2020, 16:14

#5 - The real psmb | 429
Miguel,Sona,Bem vindo,Patrick
Zuletzt online: 139610 Minuten

#6 - The champignos | 392
Cladia,Stats,Amelia
Zuletzt online: 139610 Minuten



Kätzchen (Inaktiv)

CHAT EVENTS

Kätzchen: Completed task
Task: Äpfel (13815) | Score: 10 | Answer: [382]
2020-03-23 15:31:51

Kätzchen: Wrong answer entered
Task: Äpfel (13815) | Answer: [282]
2020-03-23 15:31:51

Kätzchen: Wrong answer entered
Task: Äpfel (13815) | Answer: [188]
2020-03-23 15:31:01

Kätzchen: Wrong answer entered
Task: Äpfel (13815) | Answer: [190]
2020-03-23 15:30:31

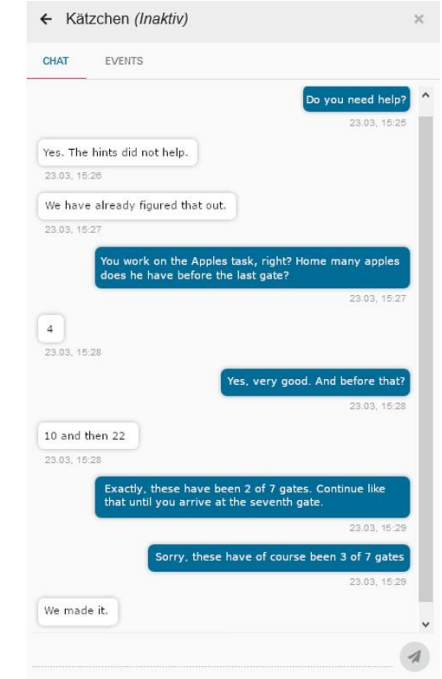
Kätzchen: Opened task
Task: Äpfel (13815)
2020-03-23 15:30:21

Kätzchen: Opened task preview
Task: Äpfel (13815)
2020-03-23 15:30:21

Kätzchen: Opened trail map
2020-03-23 15:30:21

Kätzchen: Closed chat view
2020-03-23 15:30:21

Kätzchen: Opened chat view



Kätzchen (Inaktiv)

CHAT EVENTS

Do you need help?
23.03, 15:25

Yes. The hints did not help.
23.03, 15:26

We have already figured that out.
23.03, 15:27

You work on the Apples task, right? Home many apples does he have before the last gate?
23.03, 15:28

4
23.03, 15:28

Yes, very good. And before that?
23.03, 15:28

10 and then 22
23.03, 15:28

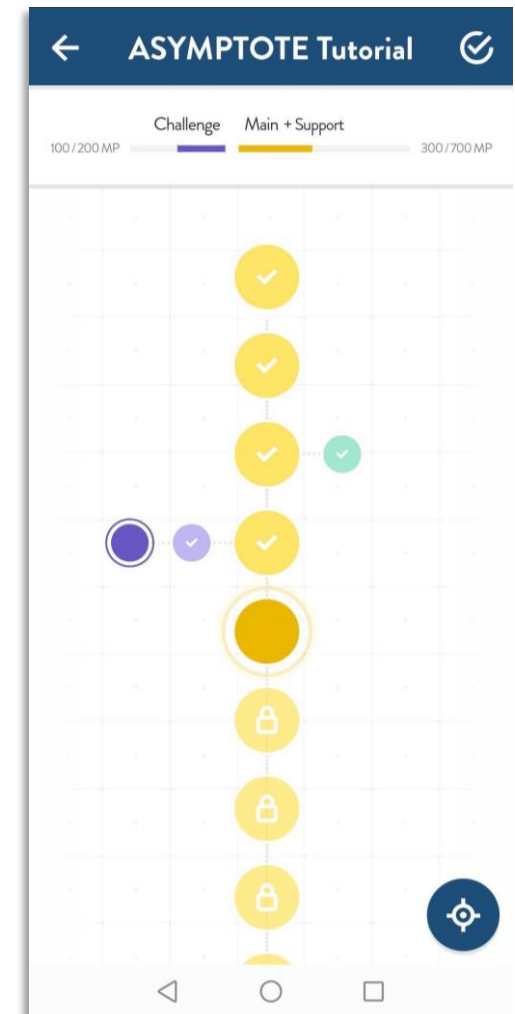
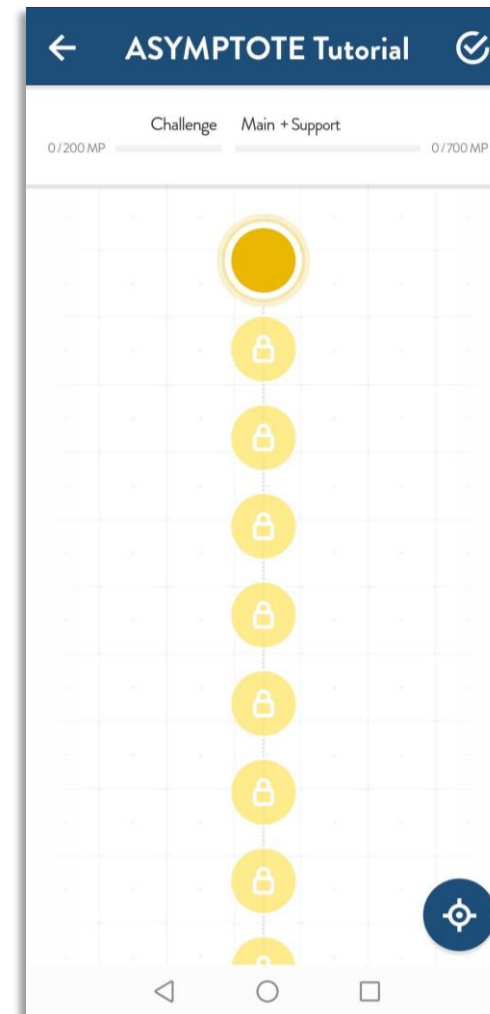
Exactly, these have been 2 of 7 gates. Continue like that until you arrive at the seventh gate.
23.03, 15:29

Sorry, these have of course been 3 of 7 gates
23.03, 15:29

We made it.

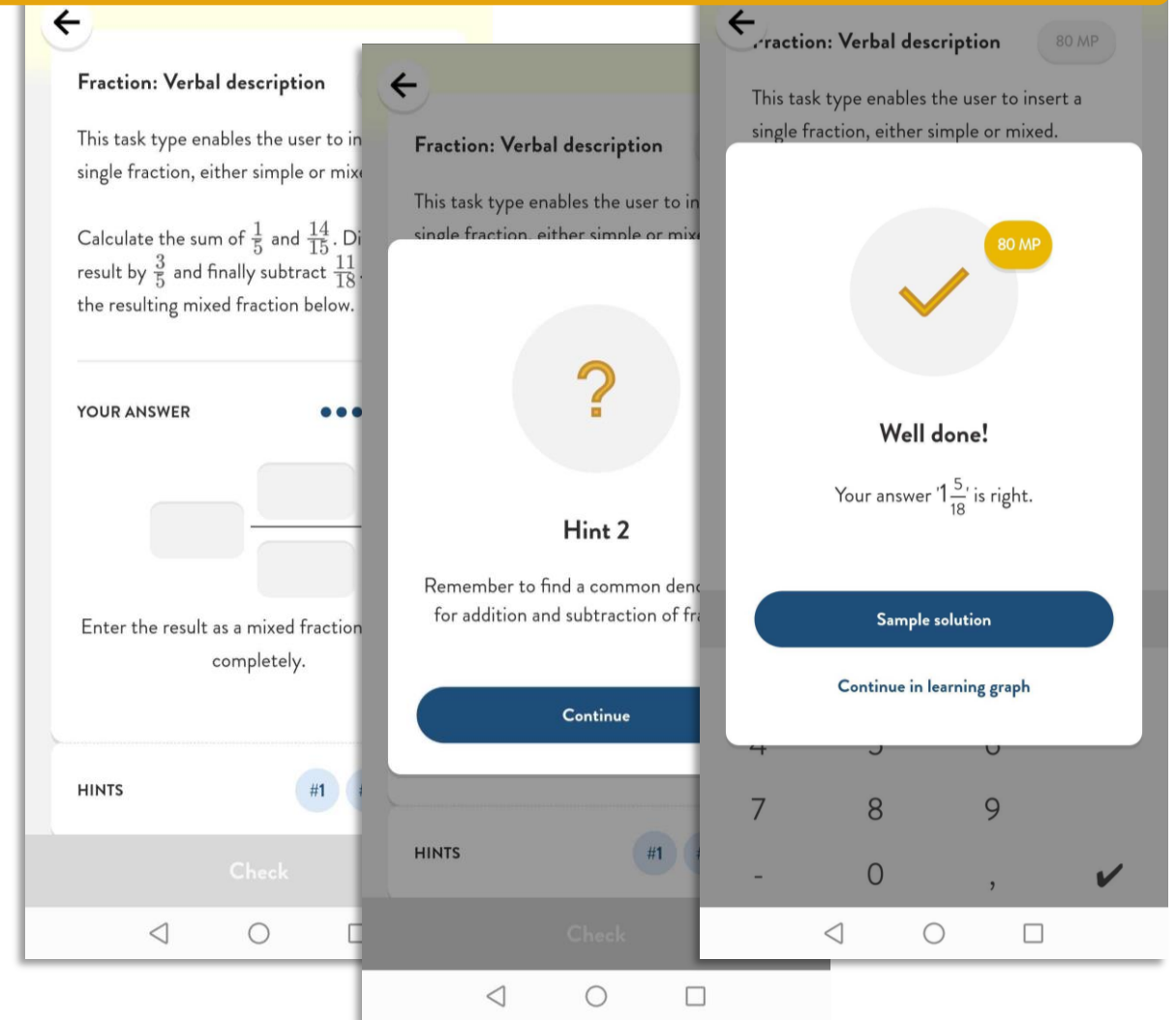
The app

- Workspace of the learner
- No registration necessary
 - Accessing an LG or Digital Classroom by code
- Working on a Learning Graph
 - Gamification: points
 - Can be interrupted and continued later
 - Several times possible



The app

- 4 answer attempts per task
 - of which 1 free attempt
- Stepped hints
- Answer validation
- Sample solutions
- ASYMPTOTE Tutorial LG:
Try out the app from the student perspective by entering the code **g47109**





Chapter 2:

The ASYMPTOTE web portal

2.1. How to create an account

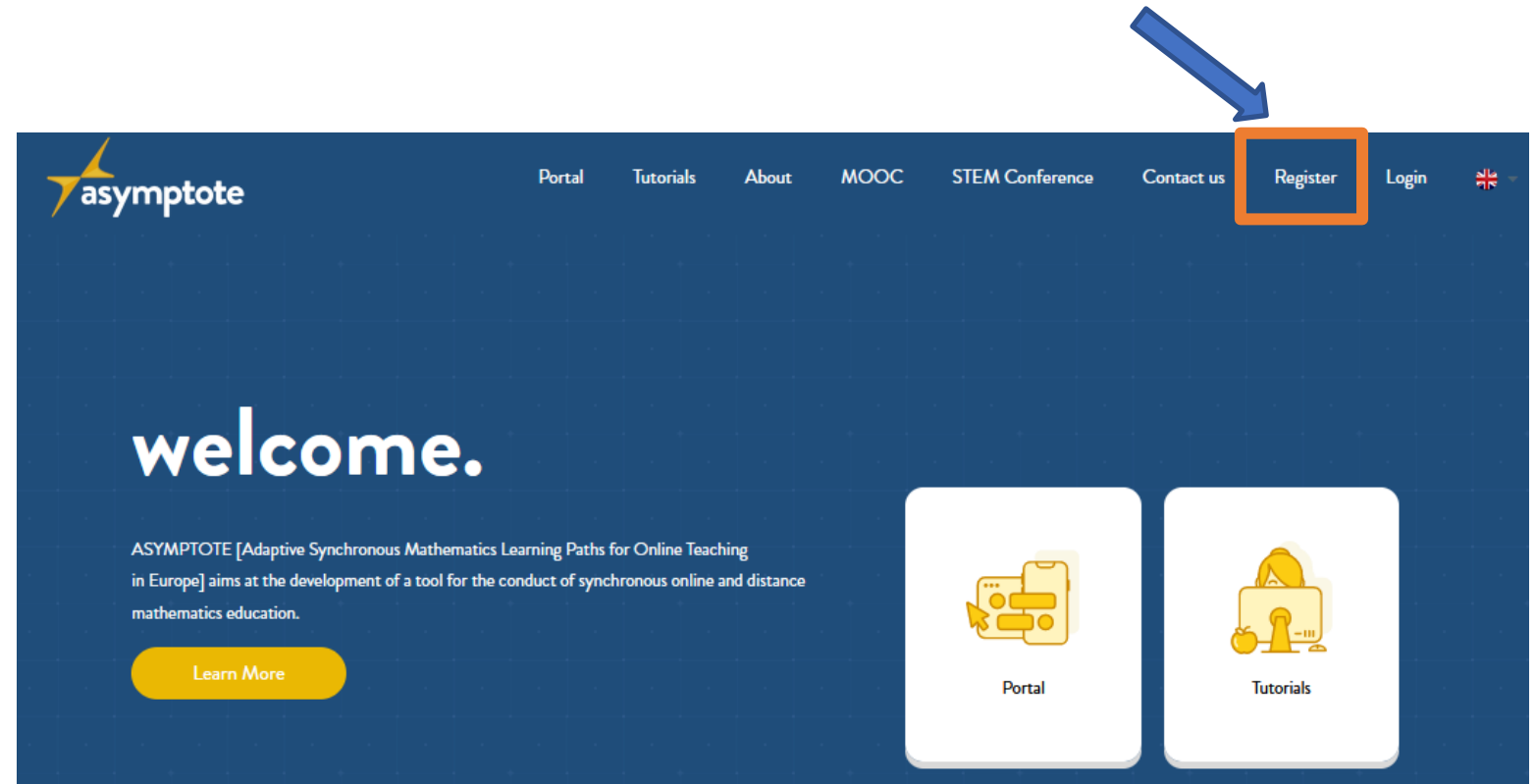
Web Portal Registration

Visit the ASYMPTOTE Web

Portal:

<https://www.asymptote-project.eu/en/welcome/>

1. Click on the “Register” button
2. Fill out the registration form



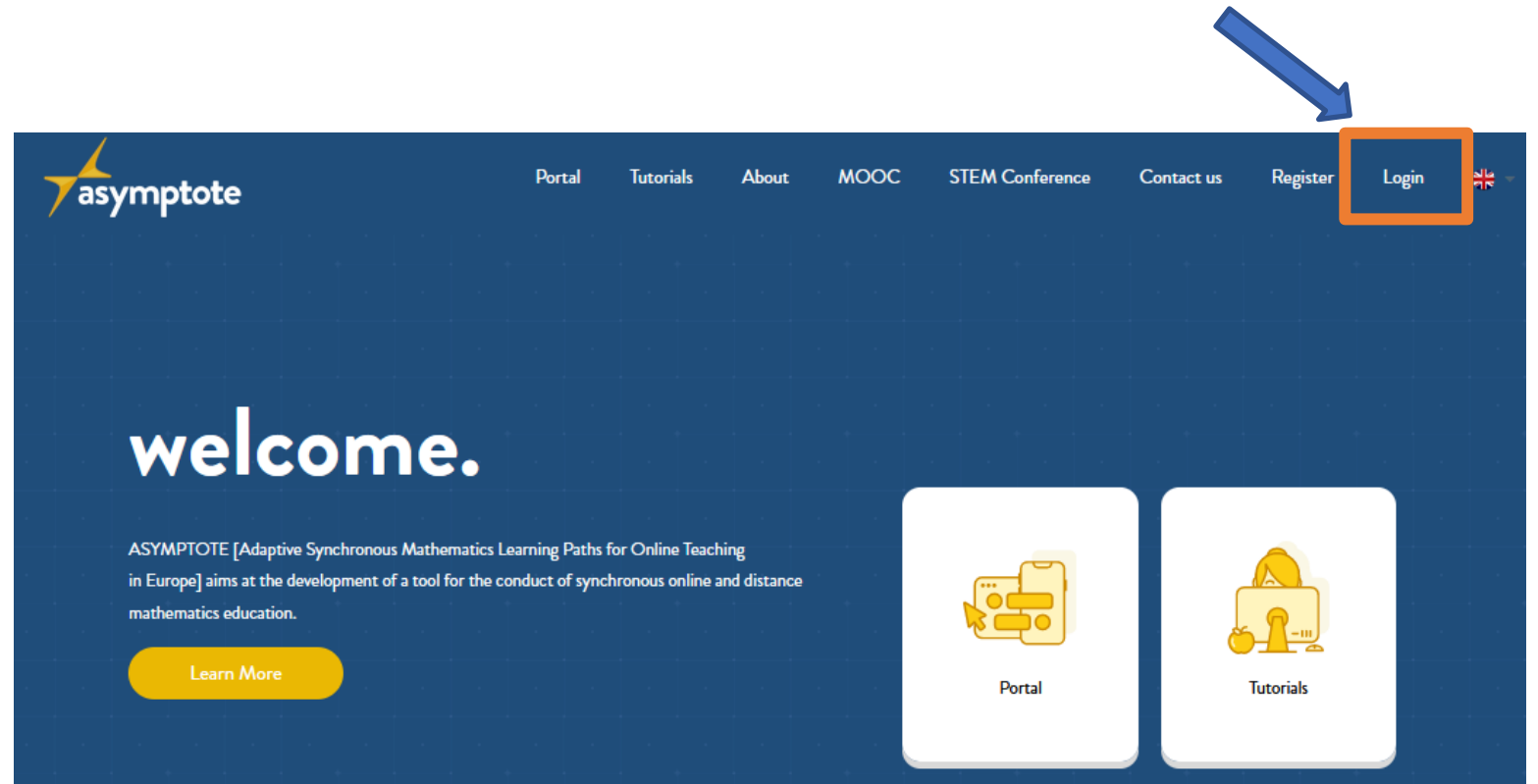
Web Portal Login

Visit the ASYMPTOTE Web

Portal:

<https://www.asymptote-project.eu/en/welcome/>

1. Click on the “Login” button and enter your username and password
2. Click on the “Portal” button





Chapter 2:

The ASYMPTOTE web portal

2.2. How to create tasks



Overview

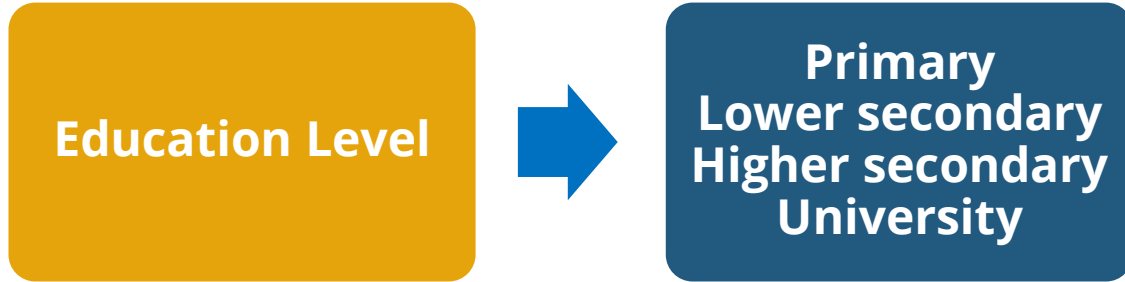
Let´s create a task!

1. Criteria to create tasks and task categories
2. Categories details
3. How to create a task in asymptote web portal

Criteria to create tasks and task categories

- Education Level**

Education level are an ordered set of categories, intended to group educational programs.



- Task Categories**

Learning	Training	Reasoning	Modeling
learning tasks, the aids must teach how to solve the task.	task for resolution of exercises of direct application of concepts.	task for solving exercises that are not direct application of concepts.	tasks that involve modeling the problem before solving it.



Task details

- **Title image:** a representative image for the task.
- **Basic data:**
 - **Title**
 - **Definition of task**
- **Task format:** task type and solution which is interval, exact value, multiple choice, fill in the blanks, vector(exact value), vector (interval), set and information station.
- **Sample solution:** Type of solution is text or picture. A solution plan should be added for every task. This plan will be visible for student/learner after solving the task.
- **Hints:** Type of hint is text, picture or video. Minimum: 2 hints.
- **Curriculum Hierarchy & Task Category:**
 - **Task category:** learning, training, reasoning and modeling.
 - **Curriculum association: Selection of the mathematical topic, e.g. linear functions**
- **Grade & Tags:**
 - **From grade: 1 to 13**
 - **Tags**



How to create a learning graph in ASYMPTOTE web portal

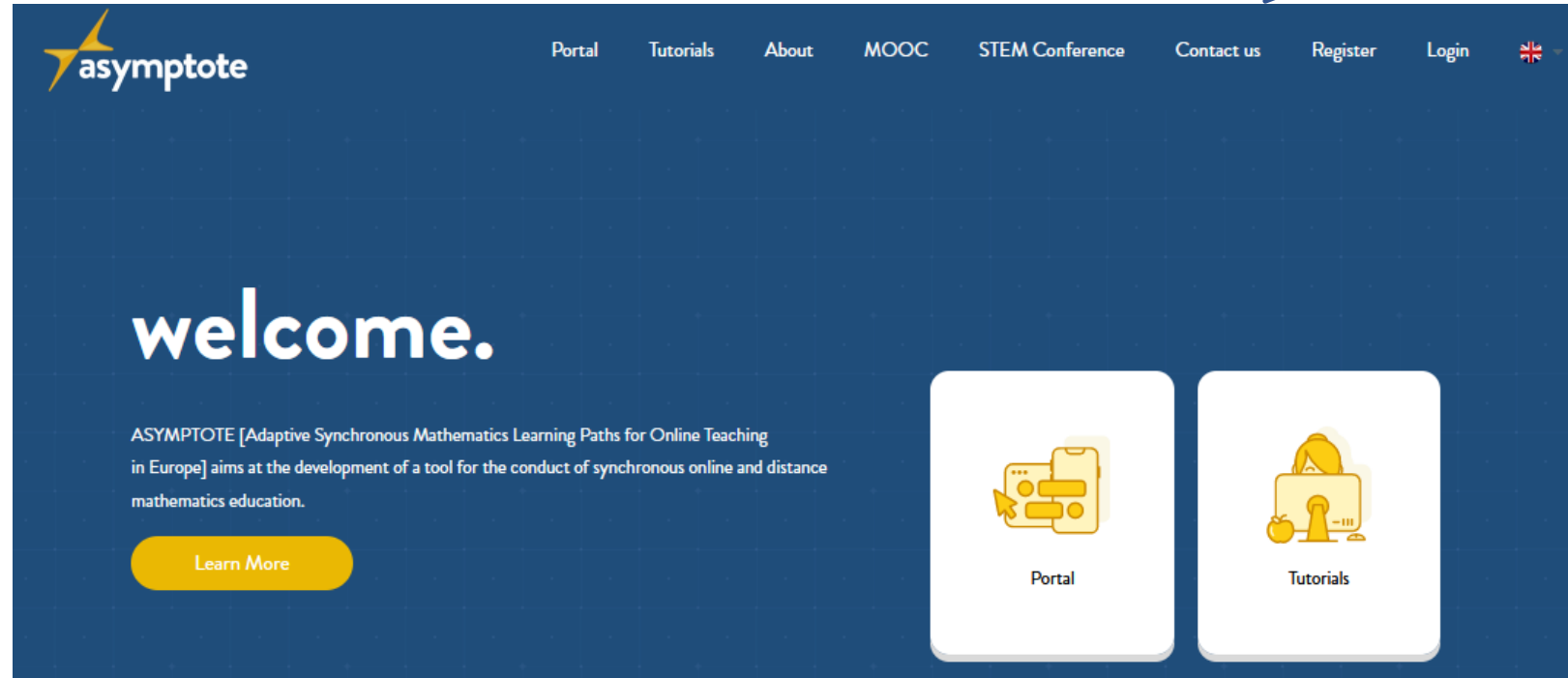
Login to the portal page

<https://www.asymptote-project.eu/en/welcome/>

(1) Register

(2) Login

(3) Enter at the portal



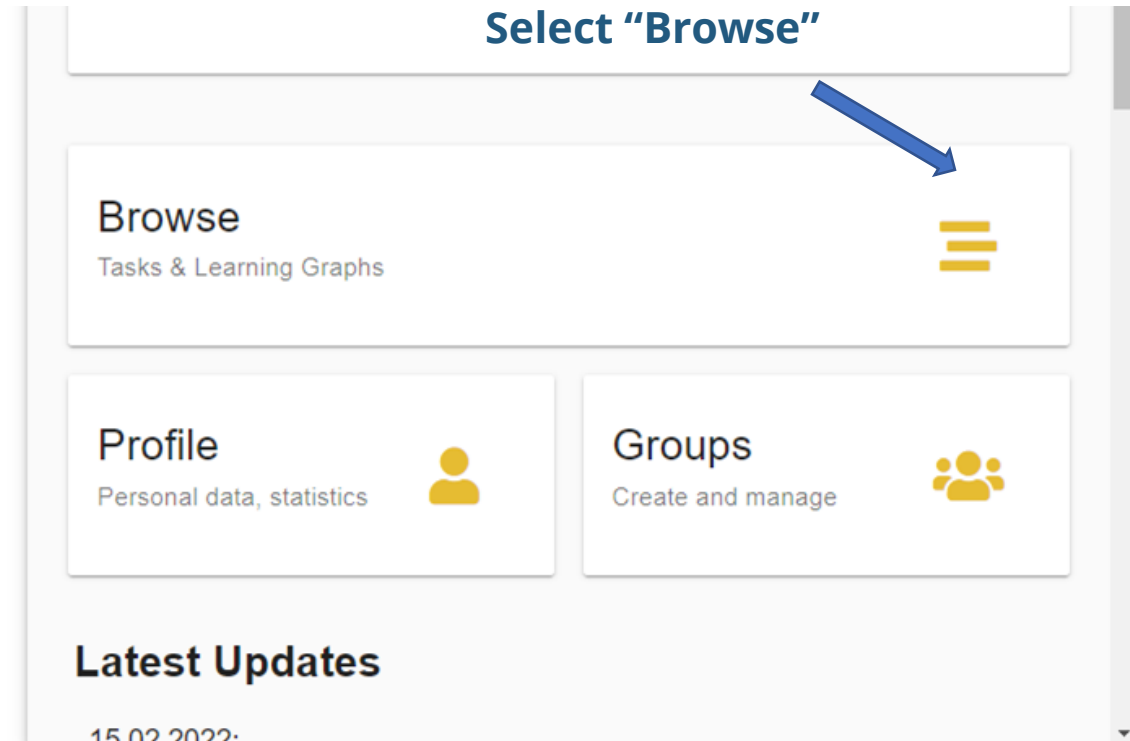
(3)



How to create a task in asymptote web portal



Select "Browse"



Browse
Tasks & Learning Graphs

Profile
Personal data, statistics

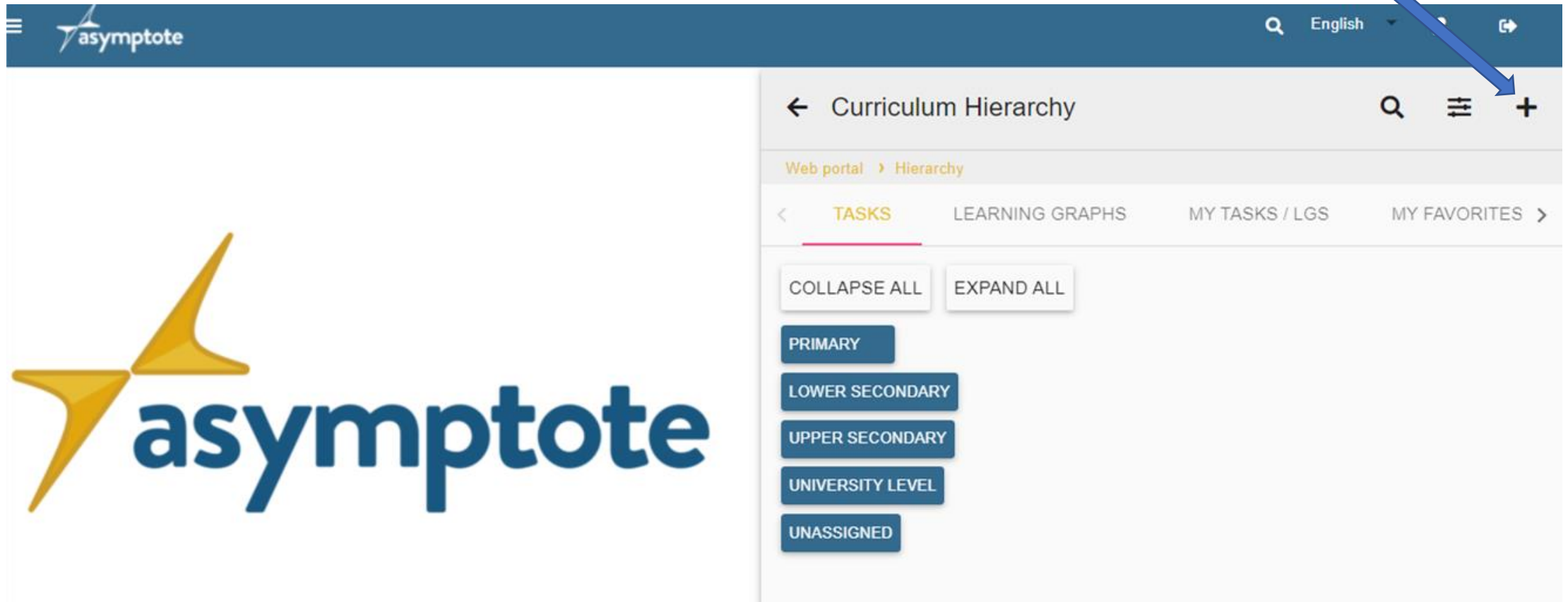
Groups
Create and manage

Latest Updates
15.02.2022



How to create a task in asymptote web portal

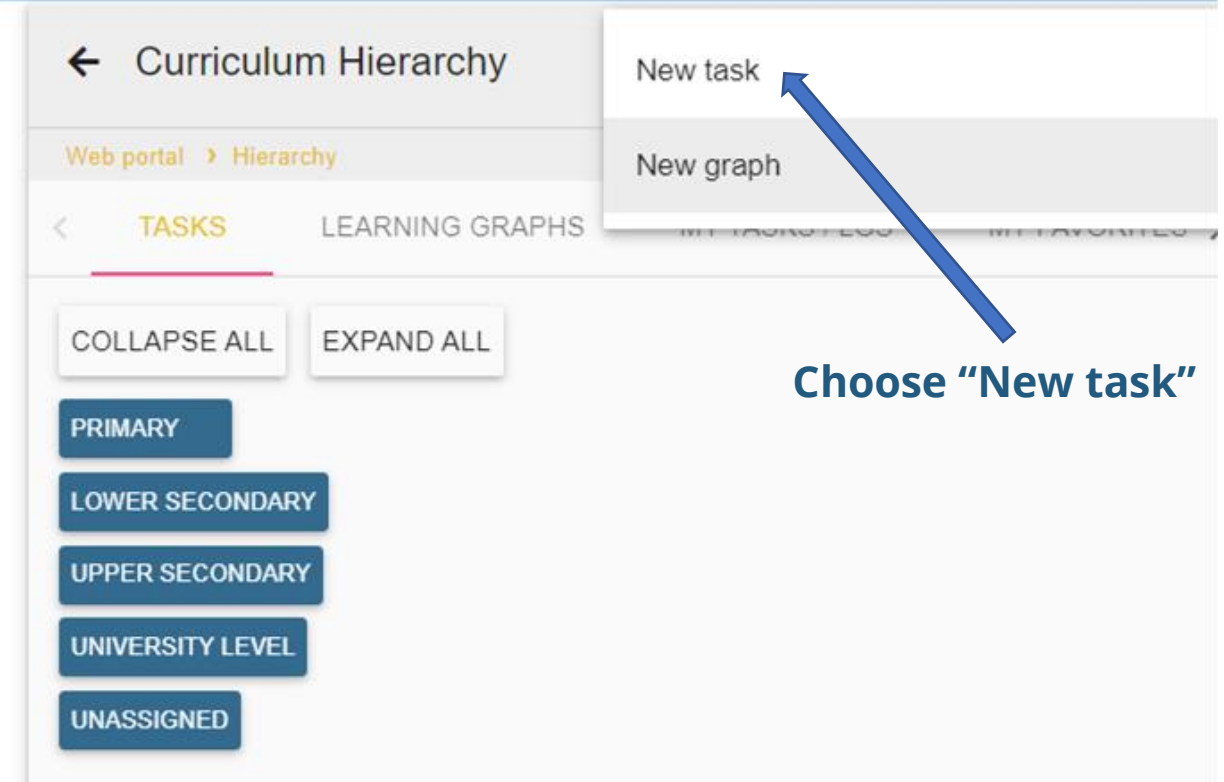
Click on the button “+”



The screenshot shows the asymptote web portal interface. The main content area displays the 'Curriculum Hierarchy' page. The page title is 'Curriculum Hierarchy'. Below the title, there are navigation tabs: 'TASKS' (selected), 'LEARNING GRAPHS', 'MY TASKS / LGS', and 'MY FAVORITES'. There are buttons for 'COLLAPSE ALL' and 'EXPAND ALL'. Below these are five level buttons: 'PRIMARY', 'LOWER SECONDARY', 'UPPER SECONDARY', 'UNIVERSITY LEVEL', and 'UNASSIGNED'. A blue arrow points to a '+' button in the top right corner of the page header.



How to create a task in asymptote web portal



The screenshot shows the 'Curriculum Hierarchy' page in the asymptote web portal. The page title is 'Curriculum Hierarchy' with a back arrow. Below the title, there is a breadcrumb trail: 'Web portal > Hierarchy'. The main content area has two tabs: 'TASKS' (which is active and underlined) and 'LEARNING GRAPHS'. Below the tabs, there are two buttons: 'COLLAPSE ALL' and 'EXPAND ALL'. A list of educational levels is displayed as blue buttons: 'PRIMARY', 'LOWER SECONDARY', 'UPPER SECONDARY', 'UNIVERSITY LEVEL', and 'UNASSIGNED'. A dropdown menu is open on the right side of the page, showing two options: 'New task' and 'New graph'. A blue arrow points from the text 'Choose "New task"' to the 'New task' option in the dropdown menu.

← Curriculum Hierarchy

Web portal > Hierarchy

< **TASKS** LEARNING GRAPHS

COLLAPSE ALL EXPAND ALL

PRIMARY

LOWER SECONDARY

UPPER SECONDARY

UNIVERSITY LEVEL

UNASSIGNED

New task

New graph

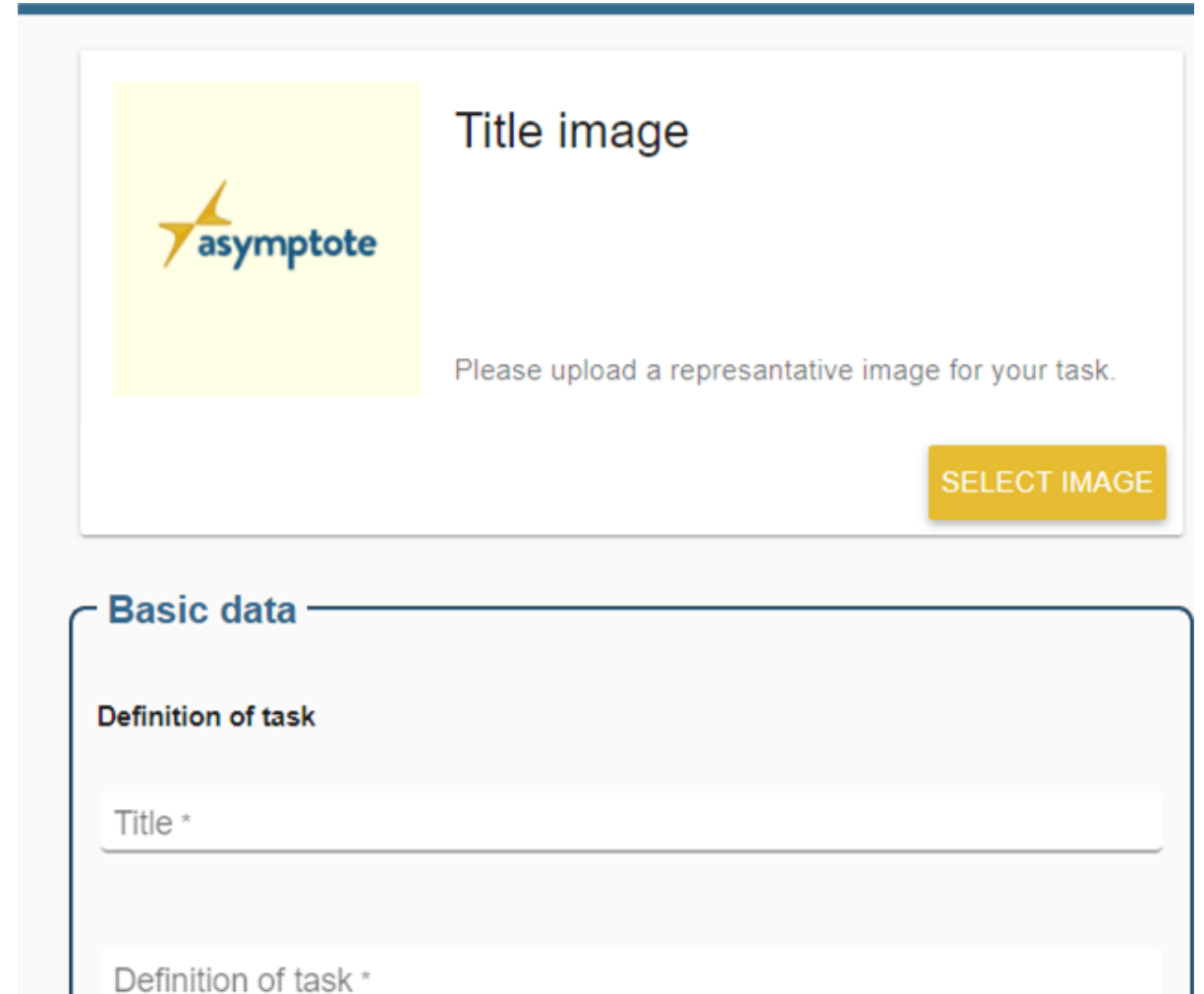
Choose "New task"



How to create a task in asymptote web portal

Fill the form:

- The image is only mandatory if the task is of the modeling type, otherwise it is optional.
- In the “Definition of task” describe what must be done in this task (task formulation).

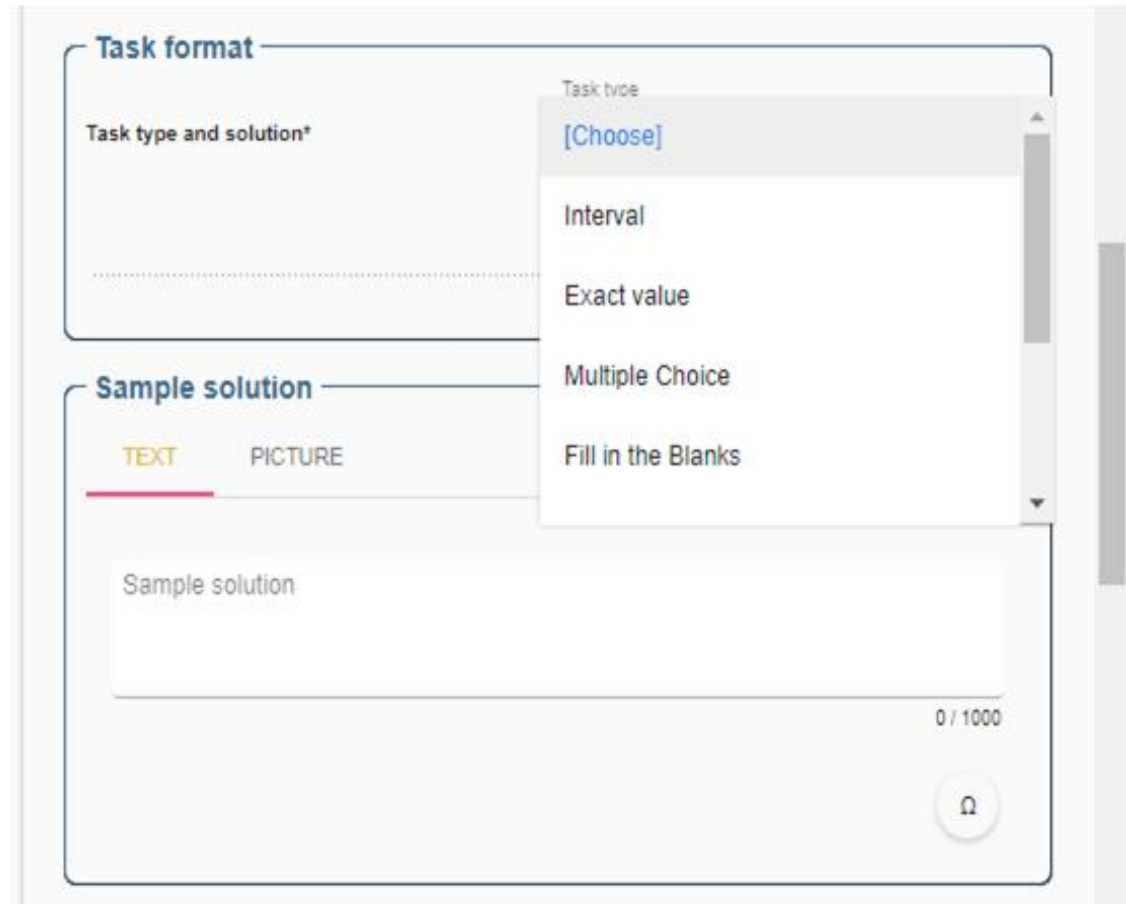


The screenshot shows a web form for creating a task. At the top, there is a section for a title image. On the left is a yellow square containing the asymptote logo. To its right, the text 'Title image' is displayed. Below this, a grey box contains the instruction 'Please upload a representative image for your task.' and a yellow button labeled 'SELECT IMAGE'. Below the image section is a section titled 'Basic data' which contains a 'Definition of task' section. This section has two input fields: 'Title *' and 'Definition of task *'.



How to create a task in asymptote web portal

- **Task format** – choose an appropriate answer type of the task.
- **Sample solution** - enter a task resolution.



Task format

Task type and solution*

Task type

- [Choose]
- Interval
- Exact value
- Multiple Choice
- Fill in the Blanks

Sample solution

TEXT PICTURE

Sample solution

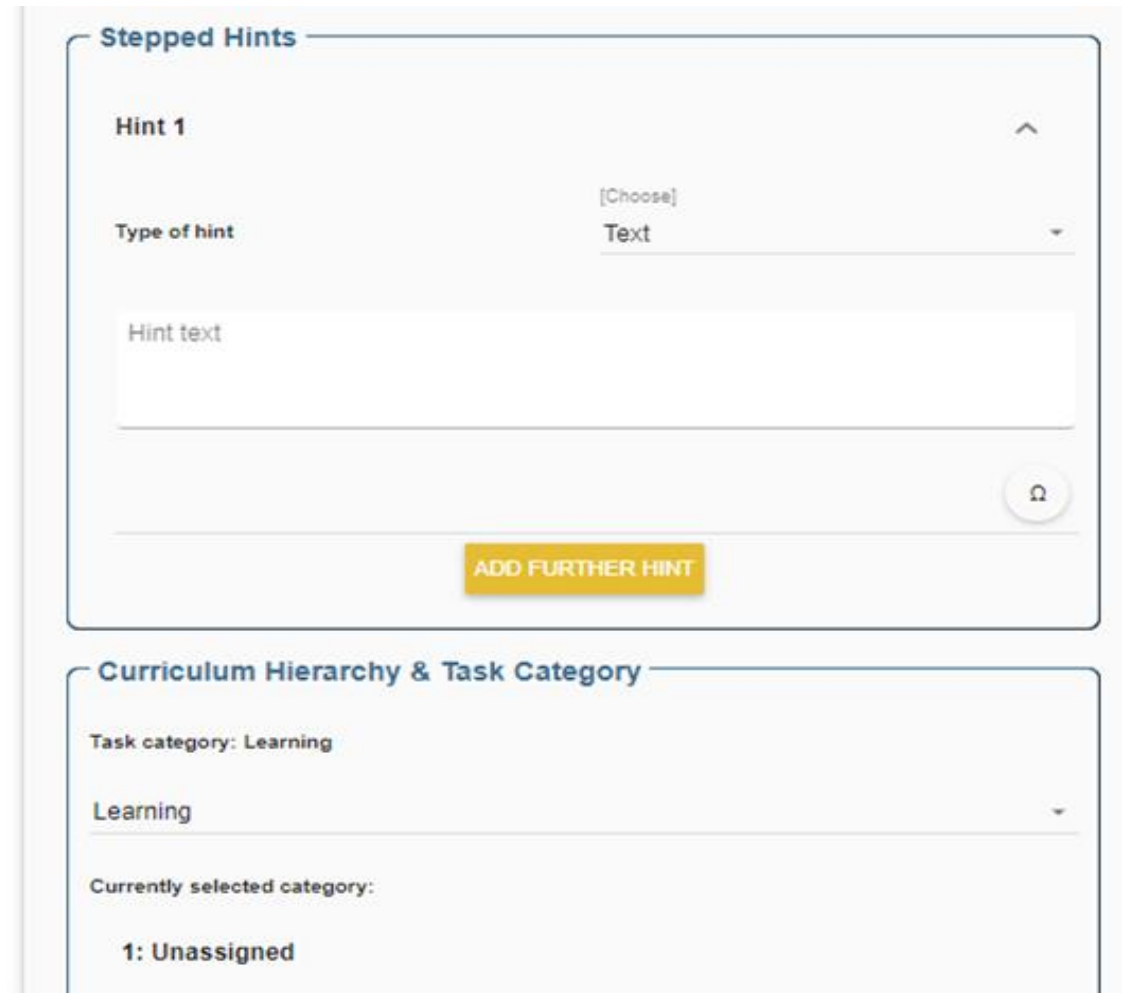
0 / 1000

Ω



How to create a task in asymptote web portal

- **Stepped Hints** - put at least 2 hints.
- **Curriculum Hierarchy & Task Category** - select the task category and the Education Level



The screenshot displays two sections of the task creation interface:

- Stepped Hints:** This section is titled "Stepped Hints" and contains a form for adding a hint. It includes a label "Hint 1" with an upward arrow icon, a "Type of hint" dropdown menu currently set to "Text" (with "[Choose]" above it), and a text input field labeled "Hint text". A yellow button labeled "ADD FURTHER HINT" is located at the bottom right of this section.
- Curriculum Hierarchy & Task Category:** This section is titled "Curriculum Hierarchy & Task Category" and shows the current selection. It includes a label "Task category: Learning", a dropdown menu currently set to "Learning", and a label "Currently selected category:" followed by the text "1: Unassigned".

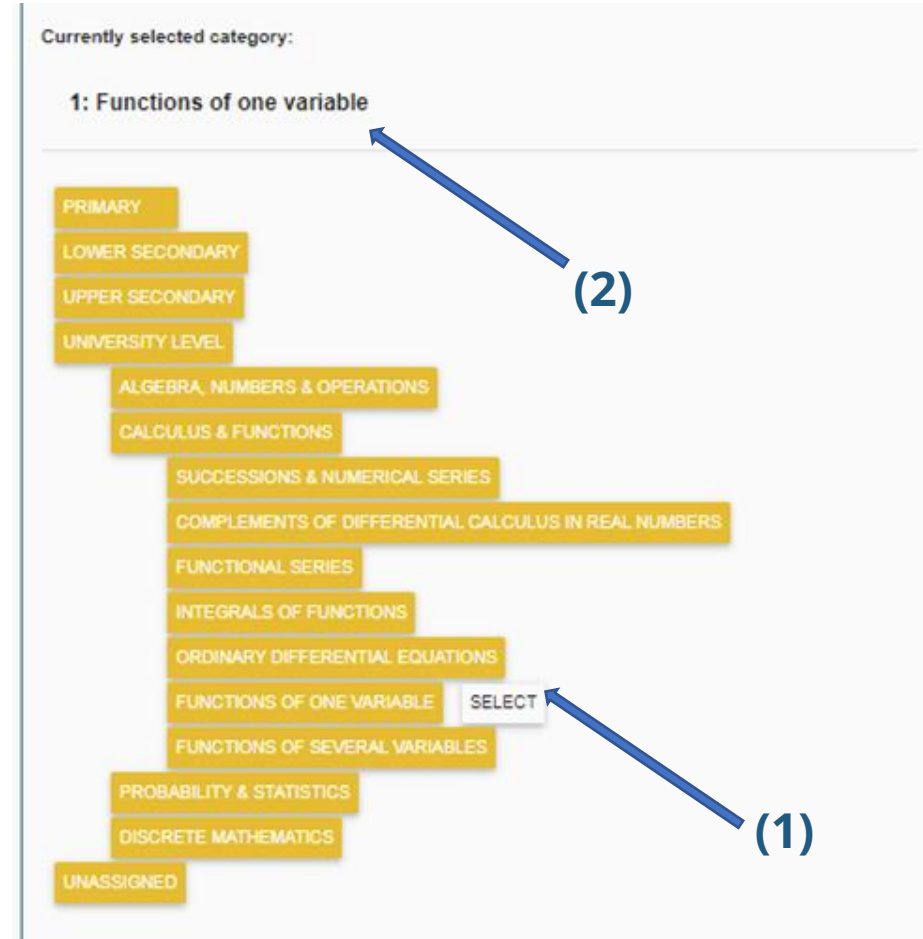


How to create a task in asymptote web portal

- In “Currently selected category” press “select” (1) and verify that the selected category is correct (2).
- Grade & Tags – select a grade from 1 to 13 and assign at least one topic-related tag.

Currently selected category:

1: Functions of one variable



PRIMARY

LOWER SECONDARY

UPPER SECONDARY

UNIVERSITY LEVEL

ALGEBRA, NUMBERS & OPERATIONS

CALCULUS & FUNCTIONS

SUCCESSIONS & NUMERICAL SERIES

COMPLEMENTS OF DIFFERENTIAL CALCULUS IN REAL NUMBERS

FUNCTIONAL SERIES

INTEGRALS OF FUNCTIONS

ORDINARY DIFFERENTIAL EQUATIONS

FUNCTIONS OF ONE VARIABLE **SELECT**

FUNCTIONS OF SEVERAL VARIABLES

PROBABILITY & STATISTICS

DISCRETE MATHEMATICS

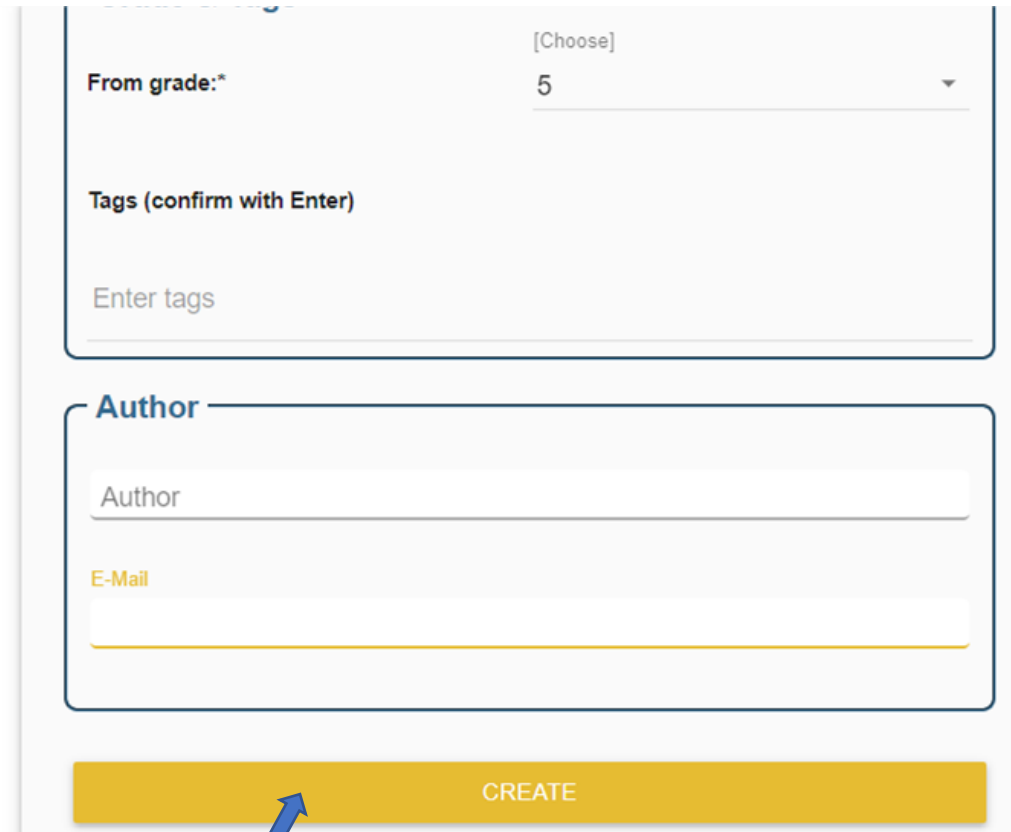
UNASSIGNED

(2)

(1)



How to create a task in asymptote web portal

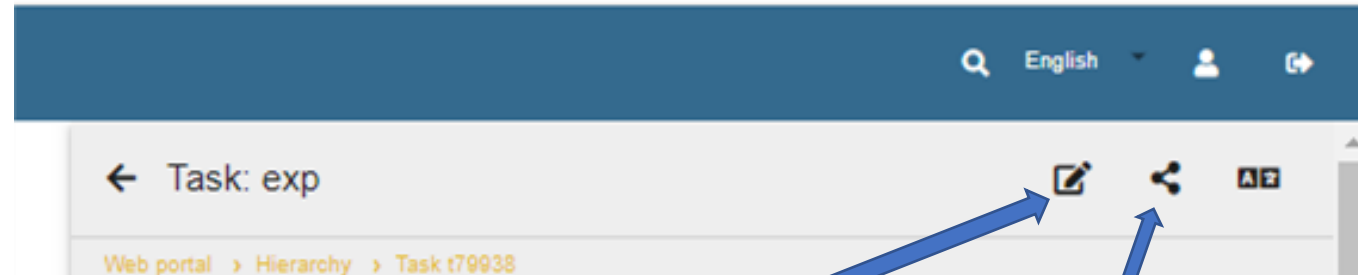


The screenshot shows a web form for creating a task. It includes a dropdown menu for 'From grade:' with the value '5' selected. Below it is a text input field for 'Tags (confirm with Enter)' with the placeholder text 'Enter tags'. The 'Author' section contains two text input fields, one for 'Author' and one for 'E-Mail'. At the bottom of the form is a yellow button labeled 'CREATE'. A blue arrow points from the text below to the 'CREATE' button.

After filling out the form select "create"



How to create a task in asymptote web portal



After creating a task, you can edit it

Share the task with a group



where to see tasks in asymptote web portal

Select "Tasks" and then choose a topic



asymptote



Web portal > Hierarchy

TASKS LEARNING GRAPHS MY TASKS / LGS MY FAVOR

COLLAPSE ALL EXPAND ALL

PRIMARY

LOWER SECONDARY

UPPER SECONDARY

UNIVERSITY LEVEL

ALGEBRA, NUMBERS & OPERATIONS

GEOMETRY

CALCULUS & FUNCTIONS

SUCCESSIONS & NUMERICAL SERIES

COMPLEMENTS OF DIFFERENTIAL CALCULUS IN REAL NUMBERS

FUNCTIONAL SERIES

INTEGRALS OF FUNCTIONS

ORDINARY DIFFERENTIAL EQUATIONS

FUNCTIONS OF ONE VARIABLE

T39689 EN THE LANDFILL COLLAPSE?

T47711 EN IS THE IMAGE GOOD?

T12712 EN TANGENT LINE OF ARCCOS

T34722 EN NORMAL LINE OF ARCCOS

T09723 EN NORMAL AND TANGENTE LINE OF ARCCOS

T15724 EN TANGENT LINE OF ARCCOT



Chapter 2:

The ASYMPTOTE web portal

2.3. Answer formats



The task view

A task consists of:

1. Title & Task
2. Image
3. Answer format & sample solution
4. Stepped hints
5. Task type (*learning/exercising/modeling/reasoning*)
6. Curricular hierachy
7. Grade & Tags

Task Category & Curriculum Hierarchy

Task category:

Modeling

Current hierarchy association:

1: Quadratic functions

The Bridge

One can describe the railway bridge as quadratic function $f(x) = ax^2 + bx + c$. Calculate the value of the factor a in the term of the quadratic function.

Note: One meter is equal to one unit of length. Round to two decimal numbers.

quadratic function

modelling

measure

Language



CODE: t57688

English (Default) ▾



9





Interval

- Tasks that require some latitude, such as modeling, estimating, or rounding.

Exact value

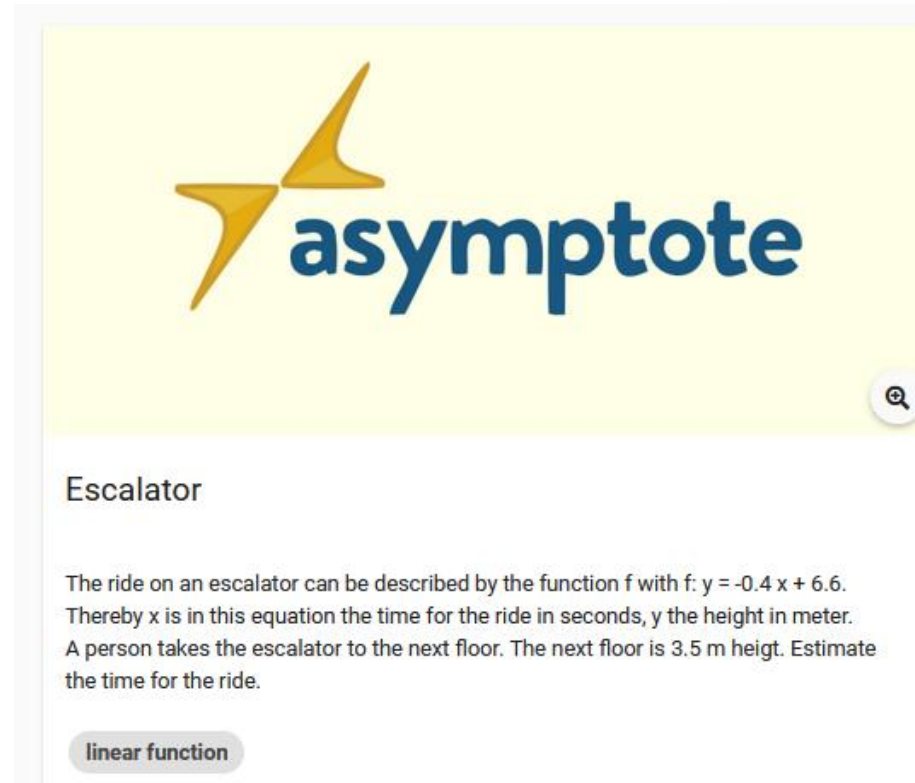
- Tasks with exact result, e.g. arithmetic problems & combinatorial problems.

Multiple Choice

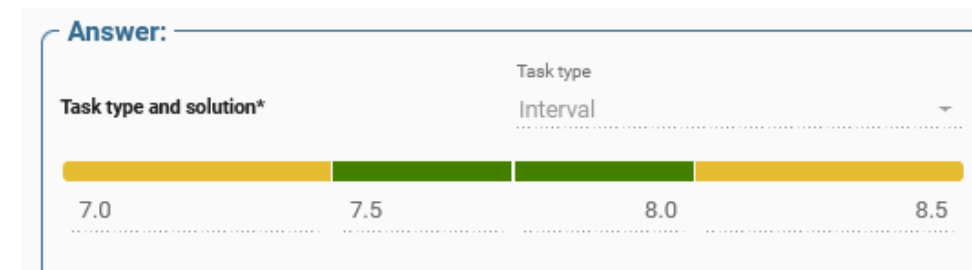
- Quiz tasks & true/false statement query

Fill in the Blanks

- Tasks for learning technical terms and language



The screenshot shows a task card from the Asymptote platform. At the top is the Asymptote logo. Below it, the title "Escalator" is displayed. The task description reads: "The ride on an escalator can be described by the function f with $f: y = -0.4x + 6.6$. Thereby x is in this equation the time for the ride in seconds, y the height in meter. A person takes the escalator to the next floor. The next floor is 3.5 m height. Estimate the time for the ride." Below the text is a tag labeled "linear function".





Interval

- Tasks that require some latitude, such as modeling, estimating, or rounding.

Exact value

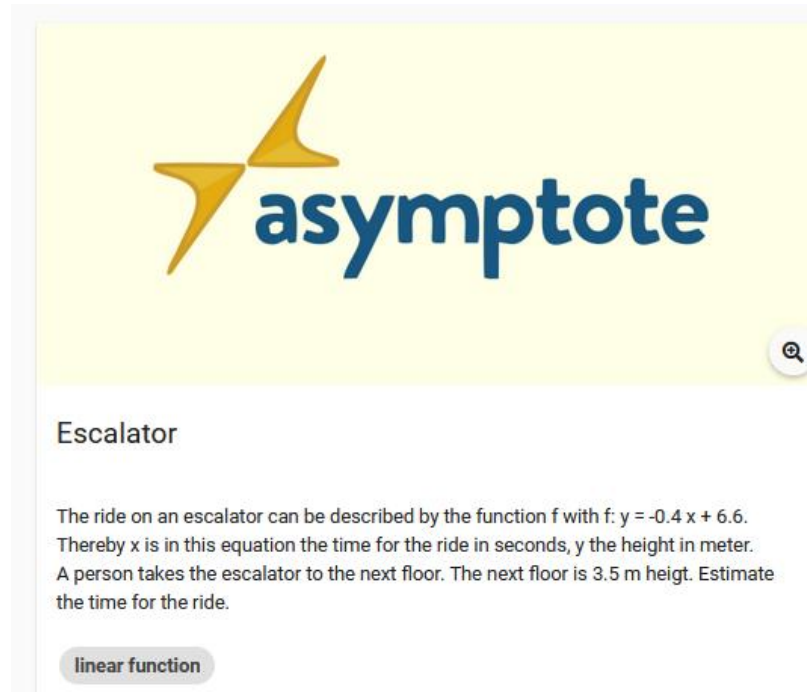
- Tasks with exact result, e.g. arithmetic problems & combinatorial problems.

Multiple Choice

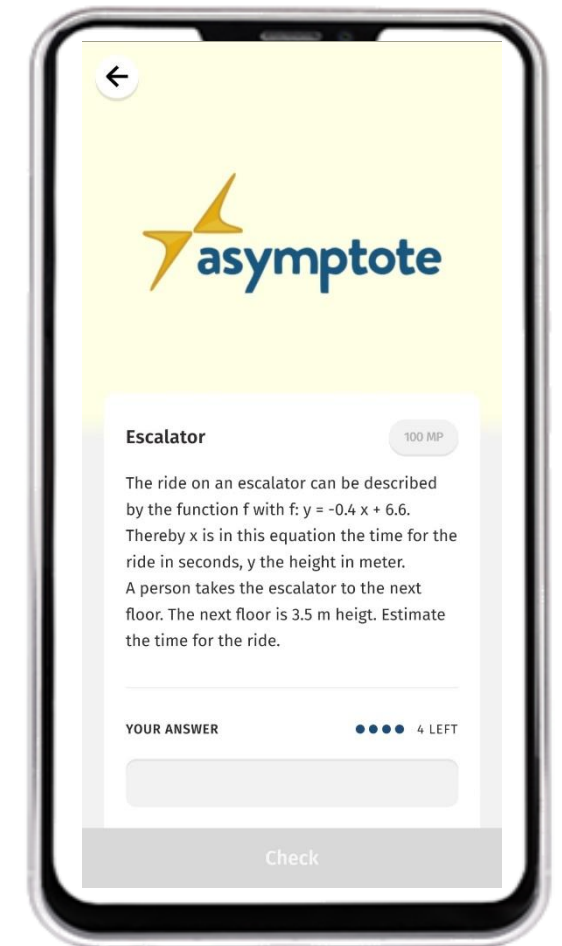
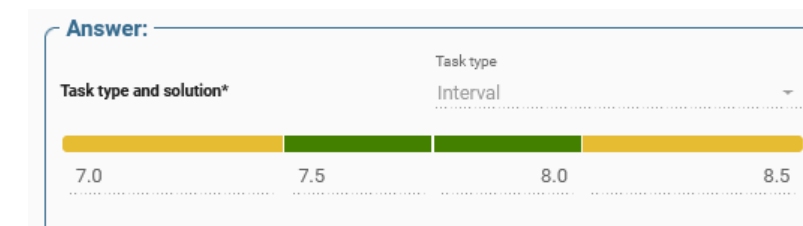
- Quiz tasks & true/false statement query

Fill in the Blanks

- Tasks for learning technical terms and language



The screenshot shows the Asymptote logo at the top. Below it, the title 'Escalator' is displayed. The task description reads: 'The ride on an escalator can be described by the function f with $f: y = -0.4x + 6.6$. Thereby x is in this equation the time for the ride in seconds, y the height in meter. A person takes the escalator to the next floor. The next floor is 3.5 m height. Estimate the time for the ride.' A tag 'linear function' is visible at the bottom left of the task area.





Interval

- Tasks that require some latitude, e.g., modeling & estimating.

Exact value

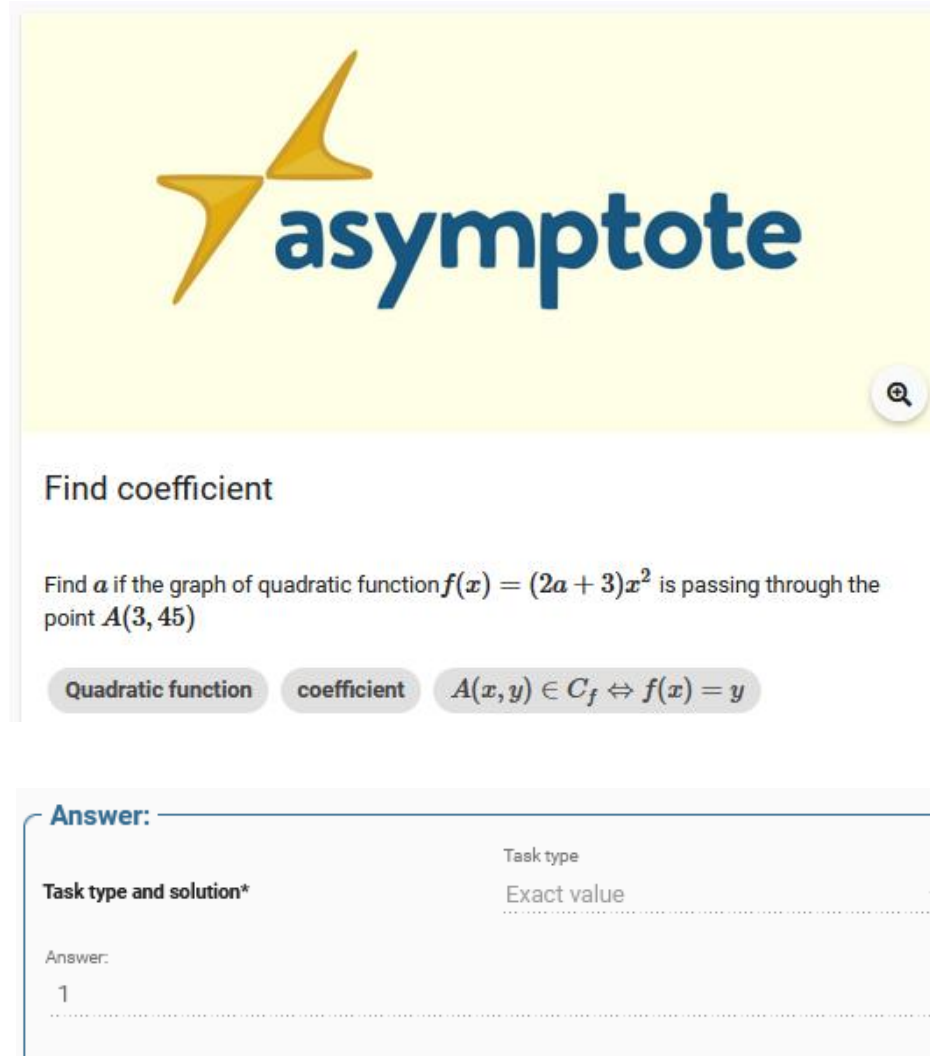
- Tasks with exact result, e.g. arithmetic problems & combinatorial problems.

Multiple Choice

- Quiz tasks & query true/false statements

Fill in the Blanks

- Tasks for learning technical terms and language



The screenshot shows the Asymptote task interface. At the top is the Asymptote logo. Below it, the task title "Find coefficient" is displayed. The task description reads: "Find a if the graph of quadratic function $f(x) = (2a + 3)x^2$ is passing through the point $A(3, 45)$ ". Below the description are three tags: "Quadratic function", "coefficient", and " $A(x, y) \in C_f \Leftrightarrow f(x) = y$ ". At the bottom, there is an "Answer:" section with a dropdown menu for "Task type" set to "Exact value" and a text input field containing the number "1".

Interval

- Tasks that require some latitude, e.g., modeling & estimating.

Exact value

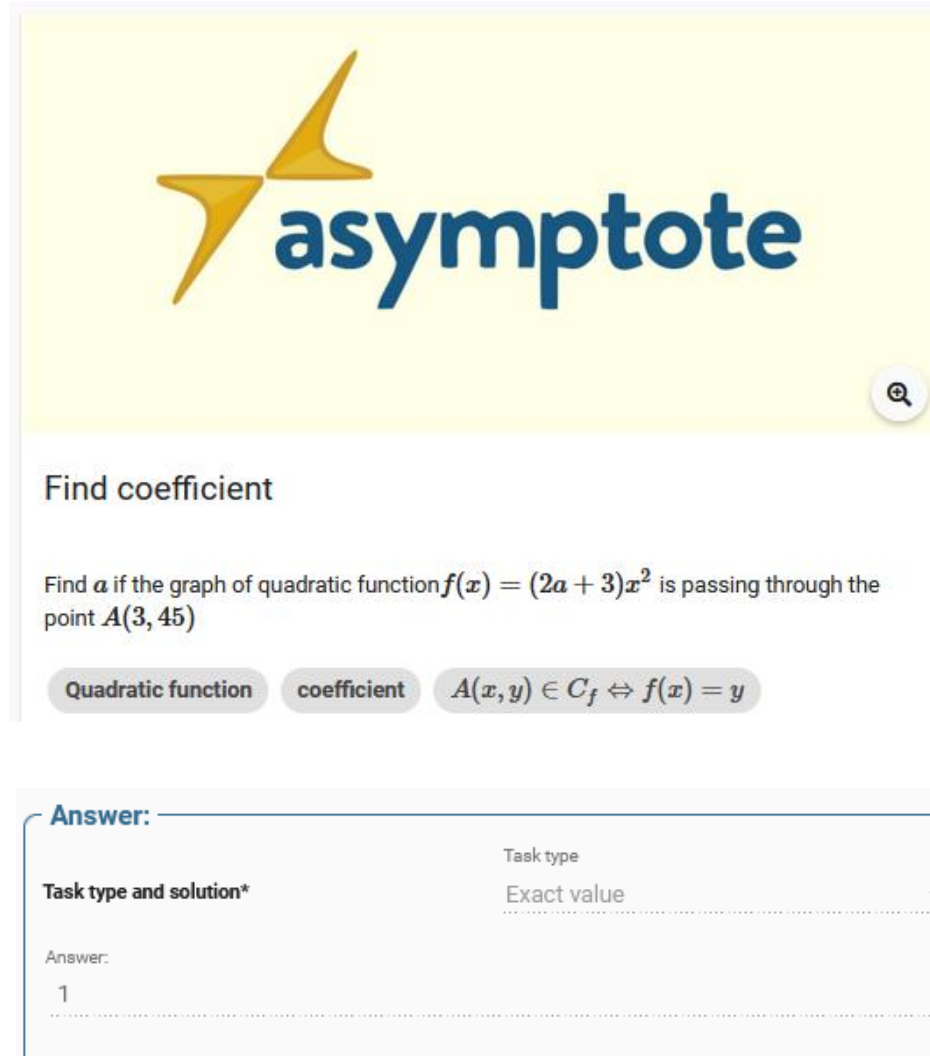
- Tasks with exact result, e.g. arithmetic problems & combinatorial problems.

Multiple Choice

- Quiz tasks & query true/false statements

Fill in the Blanks

- Tasks for learning technical terms and language



Find coefficient

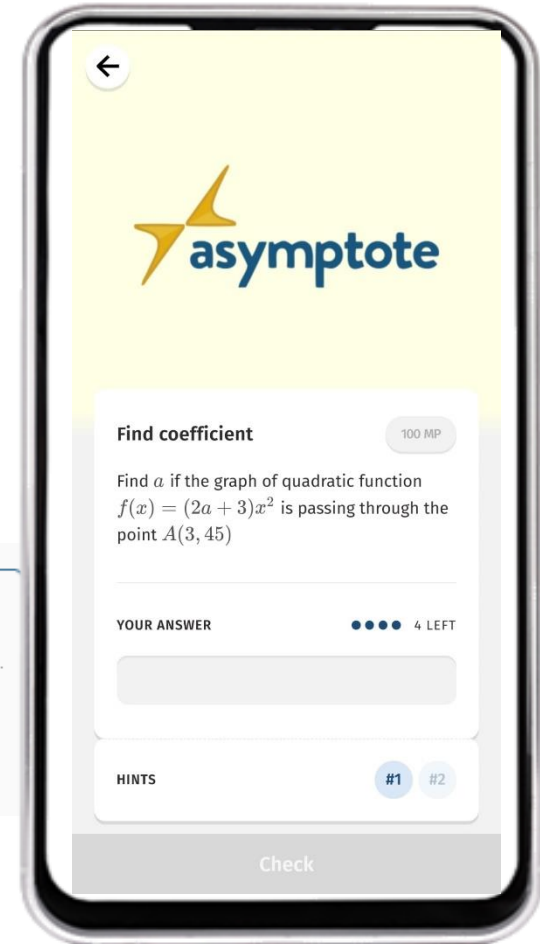
Find a if the graph of quadratic function $f(x) = (2a + 3)x^2$ is passing through the point $A(3, 45)$

Quadratic function coefficient $A(x, y) \in C_f \Leftrightarrow f(x) = y$

Answer:

Task type and solution* Task type: Exact value

Answer: 1



Find coefficient 100 MP

Find a if the graph of quadratic function $f(x) = (2a + 3)x^2$ is passing through the point $A(3, 45)$

YOUR ANSWER ●●●● 4 LEFT

HINTS #1 #2

Check

Interval

- Tasks that require some latitude, e.g., modeling & estimating.

Exact value

- Tasks with exact result, e.g. arithmetic problems & combinatorial problems.

Multiple Choice

- Quiz tasks & query true/false or irrational results.

Fill in the Blanks

- Tasks for learning technical terms and language



Tabletennis

The Chinese tabletennis player Ma Long is famous for his balloon defense. In one case, he make a ballon defense with 3.8 m height and a range of 10.6 m.
The flight path can be described by $f(x) = -0.14x^2 + 3.8$
Cross all correct answers for this description.

term quadratic function

Answer:

Task type

Task type and solution*

Multiple Choice

- The vertex of the graph is S(0/0)
- The vertex of the graph is S(0/3.8)
- The vertex of the graph is S(3.8/0)
- The graph intersect the x-axis at 5.2 and - 5.2
- The graph intersect the x-axis at 0 and 10.6
- The graph intersect the x-axis at 0 and 5.3

Interval

- Tasks that require some latitude, e.g., modeling & estimating.

Exact value

- Tasks with exact result, e.g. arithmetic problems & combinatorial problems.

Multiple Choice

- Quiz tasks & query true/false or irrational results.

Fill in the Blanks

- Tasks for learning technical terms and language



Tabletennis

The Chinese tabletennis player Ma Long is famous for his balloon defense. In one case, he make a ballon defense with 3.8 m height and a range of 10.6 m. The flight path can be described by $f(x) = -0.14x^2 + 3.8$. Cross all correct answers for this description.

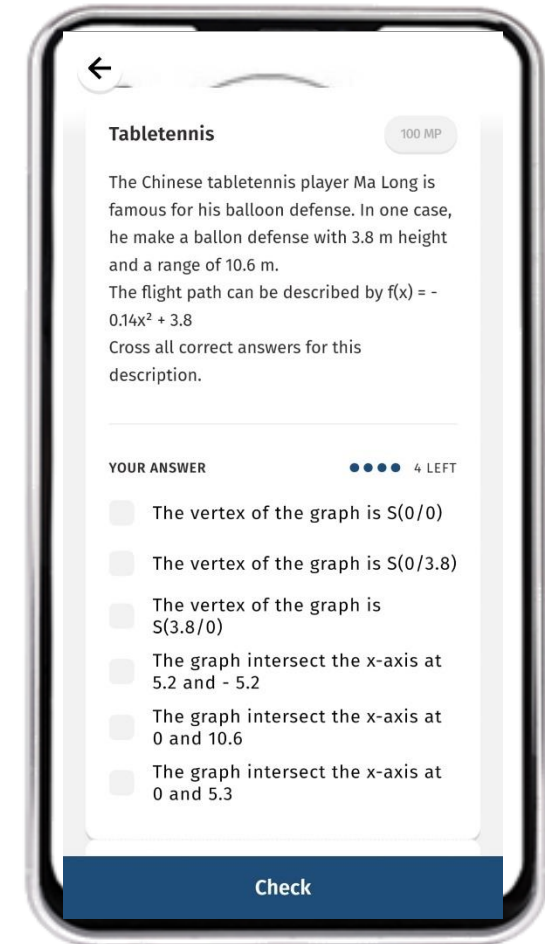
term quadratic function

Answer:

Task type and solution* Task type: Multiple Choice

- The vertex of the graph is S(0/0)
- The vertex of the graph is S(0/3.8)
- The vertex of the graph is S(3.8/0)
- The graph intersect the x-axis at 5.2 and - 5.2
- The graph intersect the x-axis at 0 and 10.6
- The graph intersect the x-axis at 0 and 5.3

43





Interval

- Tasks that require some latitude, e.g., modeling & estimating.

Exact value

- Tasks with exact result, e.g. arithmetic problems & combinatorial problems.

Multiple Choice

- Quiz tasks & true/false statement query

Fill in the Blanks

- Tasks for learning technical terms and language



Law of gravity

The Italian Galileo Galilei discovered the law of gravity. The distance s in meters that a body falls in t seconds is approximately $s = 5 t^2$.

He verified his law on the Pisa Sharp Tower, which is 54 m high (see picture).

- How long does the stone fall from the top to the bottom?
- From what height do you have to drop a stone so that it reaches the ground in 2s?

Round to 2 decimal places.

Pisa law of gravity

Answer:

Task type

Task type and solution*

Fill in the Blanks

Fill in the Blanks

- The stone falls **3.29/3.29/3.28/3.28** seconds from the top to the bottom.
- You have to drop the stone from a height of **20** m that it reaches the ground in 2 s.

Interval

- Tasks that require some latitude, e.g., modeling & estimating.

Exact value

- Tasks with exact result, e.g. arithmetic problems & combinatorial problems.

Multiple Choice

- Quiz tasks & true/false statement query

Fill in the Blanks

- Tasks for learning technical terms and language



Law of gravity

The Italian Galileo Galilei discovered the law of gravity. The distance s in meters that a body falls in t seconds is approximately $s = 5 t^2$.

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- How long does the stone fall from the top to the bottom?
- From what height do you have to drop a stone so that it reaches the ground in 2s?

Round to 2 decimal places.

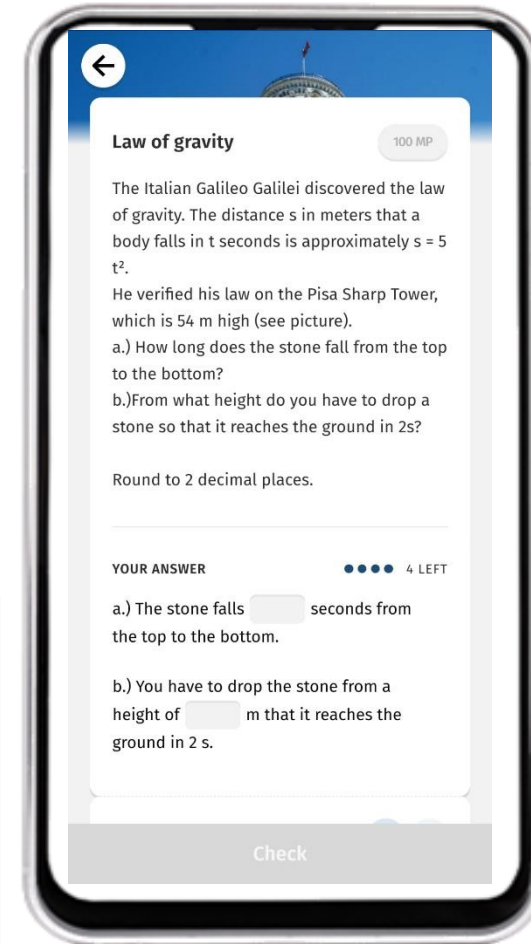
Pisa law of gravity

Answer:

Task type
Task type and solution* Fill in the Blanks

Fill in the Blanks

- The stone falls **3.29/3.29/3.28/3.28** seconds from the top to the bottom.
- You have to drop the stone from a height of **20** m that it reaches the ground in 2 s.



Vector (Interval and Exact Value)

- Tasks with solutions from several ordered components (multidimensional extension of the formats interval and exact value)

Set

- Tasks with solution from several unordered components

Fraction

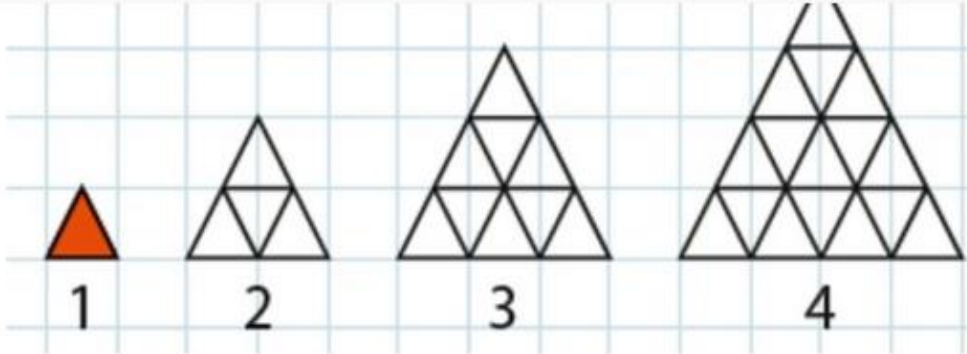
- Tasks with real or mixed fractions

Information station

- Possibility to introduce facts (without task and solution input) or to set research tasks

46

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Sequence of triangles 1

Determine the numbers of small triangles for the given step.

term linear function

The image shows a sequence of four triangles on a grid. Triangle 1 is a single orange triangle. Triangle 2 is composed of 4 smaller triangles. Triangle 3 is composed of 9 smaller triangles. Triangle 4 is composed of 16 smaller triangles. The number of small triangles for each step is 1, 4, 9, and 16 respectively.

Answer:

Task type and solution*	Task type
variable name* Step 5	Vector (exact value) Value of Step 5* 25
variable name* Step 8	Value of Step 8* 64

Vector (Interval and Exact Value)

- Tasks with solutions from several ordered components (multidimensional extension of the formats interval and exact value)

Set

- Tasks with solution from several unordered components

Fraction

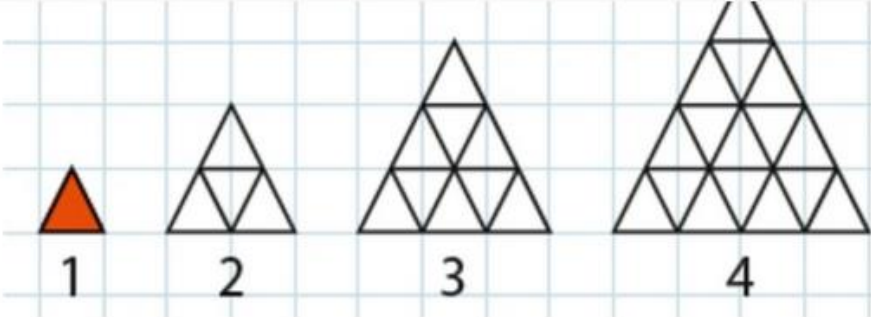
- Tasks with real or mixed fractions

Information station

- Possibility to introduce facts (without task and solution input) or to set research tasks

47

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Sequence of triangles 1

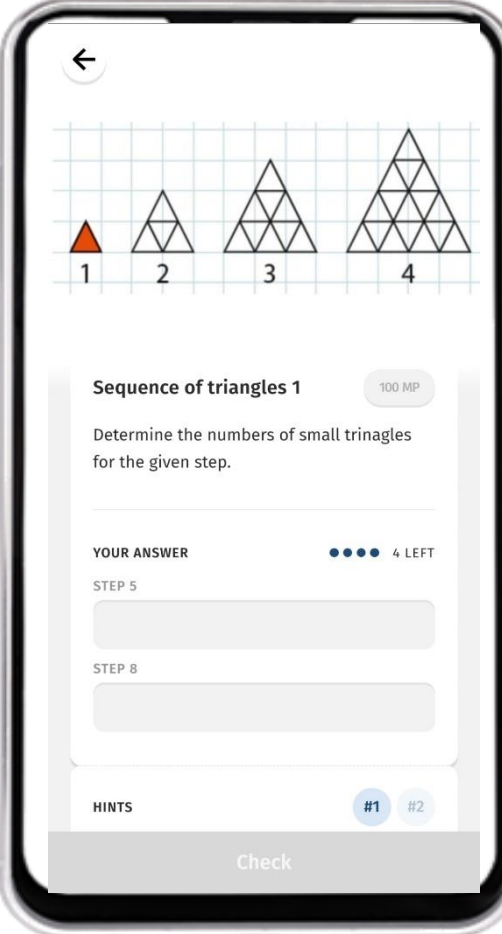
Determine the numbers of small triangles for the given step.

term linear function

The image shows a sequence of four triangles on a grid. Triangle 1 is a single orange triangle. Triangle 2 is a larger triangle composed of 4 smaller triangles. Triangle 3 is composed of 9 smaller triangles. Triangle 4 is composed of 16 smaller triangles. The triangles are arranged in a row and labeled 1, 2, 3, and 4 below them.

Answer:

Task type and solution*	Task type
variable name* Step 5	Vector (exact value) Value of Step 5* 25
variable name* Step 8	Value of Step 8* 64



Sequence of triangles 1 100 MP

Determine the numbers of small triangles for the given step.

YOUR ANSWER ●●●● 4 LEFT

STEP 5

STEP 8

HINTS #1 #2

Check

The smartphone interface displays the same sequence of triangles as the desktop version. It includes a back arrow, a search icon, and a progress indicator showing 4 out of 4 steps completed. There are input fields for the answer and a 'Check' button at the bottom.

Vector (Interval and Exact Value)

- Tasks with solutions from several ordered components (multidimensional extension of the formats interval and exact value)

Set

- Tasks with solution from several unordered components

Fraction


- Tasks with real or mixed fractions

Information station

- Possibility to introduce facts (without task and solution input) or to set research tasks

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Find the coefficients of terms in algebraic expression_3

Find the number a and b if the following algebraic expression is independent of x and y .

$$A = x(a + 3b) + y(2a - 6) + 2a + 5$$

Answer 1 is for a and Answer 2 is for b

linear equations algebraic expression

Answer:

Task type and solution*	Task type
Answer: 1	Set
	Value of Answer: 1
	3
Answer: 2	Value of Answer: 2
	-1

Vector (Interval and Exact Value)

- Tasks with solutions from several ordered components (multidimensional extension of the formats interval and exact value)

Set

- Tasks with solution from several unordered components

Fraction

- Tasks with real or mixed fractions

Information station

- Possibility to introduce facts (without task and solution input) or to set research tasks

49

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Find the coefficients of terms in algebraic expression_3

Find the number a and b if the following algebraic expression is independent of x and y .

$$A = x(a + 3b) + y(2a - 6) + 2a + 5$$

Answer 1 is for a and Answer 2 is for b

linear equations algebraic expression

Answer:

Task type and solution*	Task type
Answer: 1	Set
	Value of Answer: 1
	3
	Value of Answer: 2
Answer: 2	-1

Find the coefficients of terms in algebraic expression_3

Find the number a and b if the following algebraic expression is independent of x and y .

$$A = x(a + 3b) + y(2a - 6) + 2a + 5$$

Answer 1 is for a and Answer 2 is for b

YOUR ANSWER 4 LEFT

SOLUTION 1

SOLUTION 2

Check

Vector (Interval and Exact Value)

- Tasks with solutions from several ordered components (multidimensional extension of the formats interval and exact value)

Set

- Tasks with solution from several unordered components

Fraction

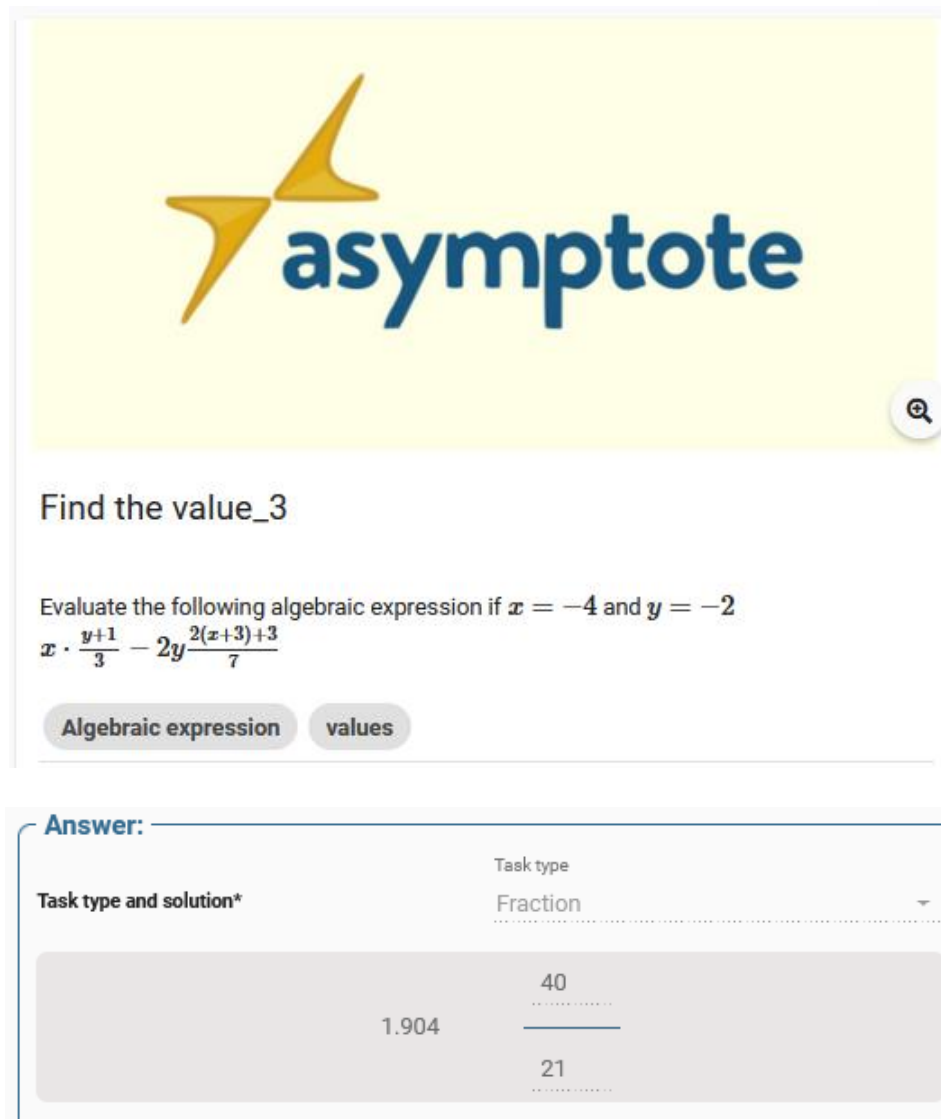
- Tasks with real or mixed fractions

Information station

- Possibility to introduce facts (without task and solution input) or to set research tasks

50

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The screenshot shows the Asymptote task interface. At the top is the Asymptote logo, which consists of a stylized yellow and orange arrow pointing right, followed by the word "asymptote" in a blue, sans-serif font. Below the logo is a search icon. The main content area contains the text "Find the value_3" and "Evaluate the following algebraic expression if $x = -4$ and $y = -2$ ". The algebraic expression is $x \cdot \frac{y+1}{3} - 2y \frac{2(x+3)+3}{7}$. Below the expression are two buttons: "Algebraic expression" and "values". At the bottom, there is an "Answer:" section with a dropdown menu for "Task type" set to "Fraction". The answer is displayed as a mixed fraction: 1.904 followed by a fraction with 40 over 21.

Find the value_3

Evaluate the following algebraic expression if $x = -4$ and $y = -2$

$$x \cdot \frac{y+1}{3} - 2y \frac{2(x+3)+3}{7}$$

Algebraic expression values

Answer:

Task type: Fraction

Task type and solution*

1.904	$\frac{40}{21}$
-------	-----------------

Vector (Interval and Exact Value)

- Tasks with solutions from several ordered components (multidimensional extension of the formats interval and exact value)

Set

- Tasks with solution from several unordered components

Fraction


- Tasks with real or mixed fractions

Information station

- Possibility to introduce facts (without task and solution input) or to set research tasks

51

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Find the value_3

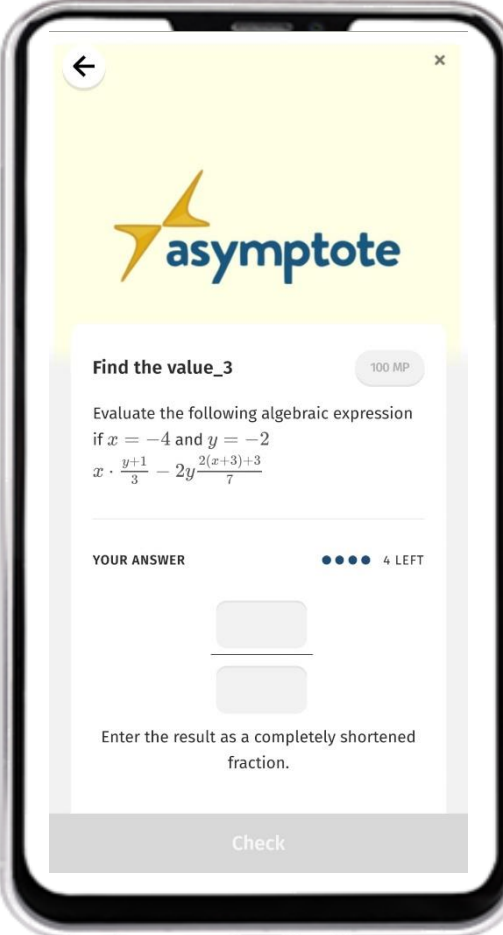
Evaluate the following algebraic expression if $x = -4$ and $y = -2$

$$x \cdot \frac{y+1}{3} - 2y \frac{2(x+3)+3}{7}$$

Algebraic expression values

Answer:

Task type and solution*	Task type
1.904	Fraction
	$\frac{40}{21}$



Find the value_3 100 MP

Evaluate the following algebraic expression if $x = -4$ and $y = -2$

$$x \cdot \frac{y+1}{3} - 2y \frac{2(x+3)+3}{7}$$

YOUR ANSWER 4 LEFT

Enter the result as a completely shortened fraction.

Check

Vector (Interval and Exact Value)

- Tasks with solutions from several ordered components (multidimensional extension of the formats interval and exact value)

Set

- Tasks with solution from several unordered components

Fraction

- Tasks with real or mixed fractions

Information station

- Possibility to introduce facts (without task and solution input) or to set research tasks





Chapter 2:

The ASYMPTOTE web portal

2.4. How to create a Learning Graph



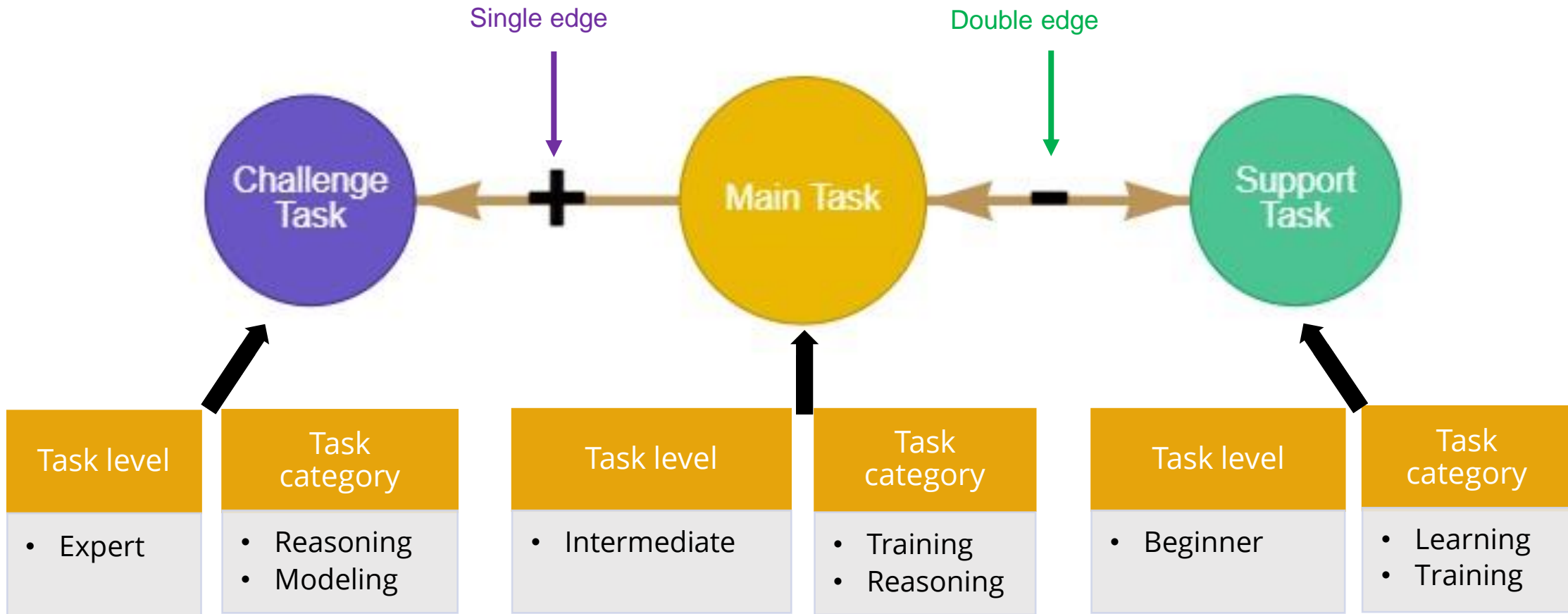
Overview

Let's create a learning graph!

Guiding in the learning process, organizing tasks in order to achieve success in learning.

1. One learning graph level for each subject to learn
2. Example of a learning graph
3. How to create a learning graph in ASYMPTOTE web portal

One learning graph level for each subject to learn



This level can be replicated for each learning subject.

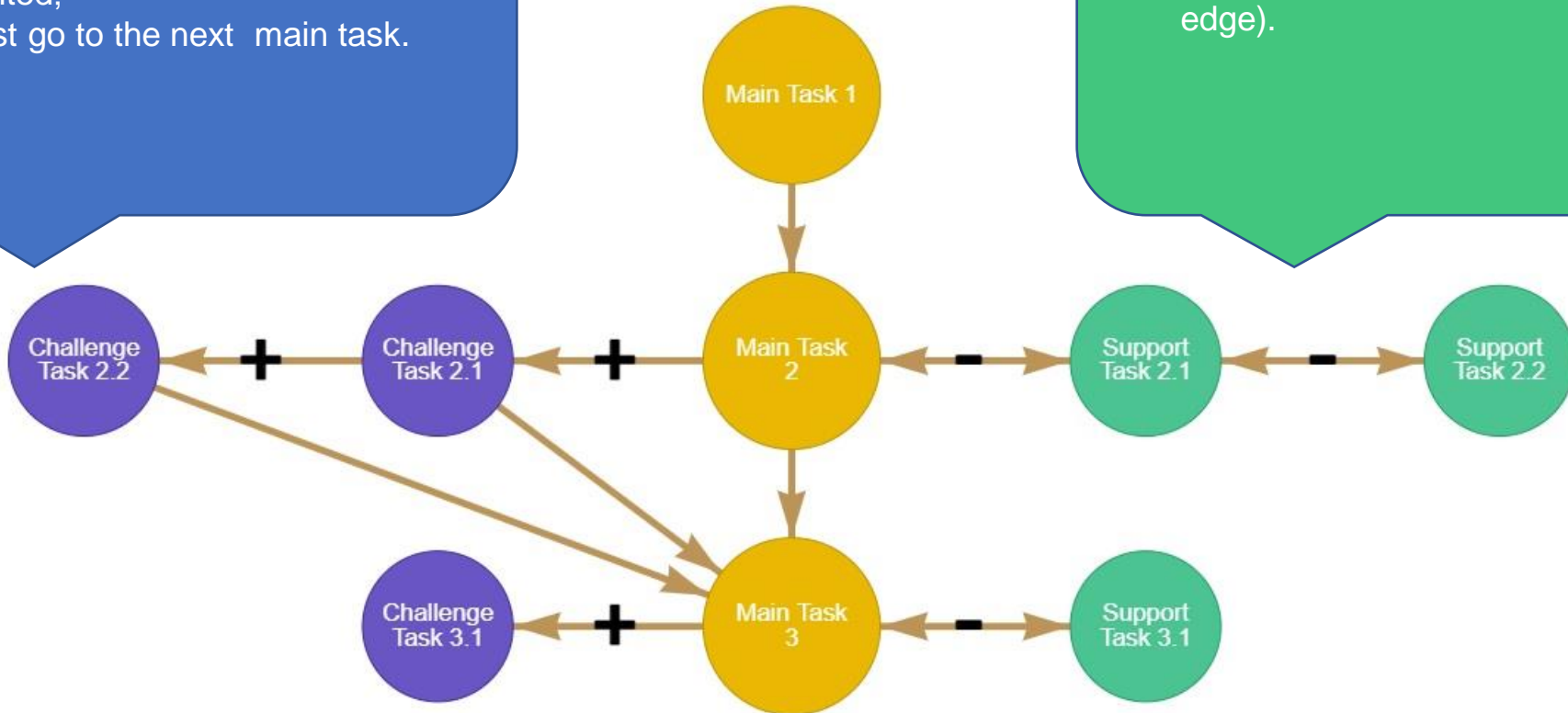


Example of a learning graph

- Optional after solving the main task;
- Number of challenger tasks as wanted;
- Must go to the next main task.

Mandatory

- Mandatory after 2nd incorrect entry on the main task;
- Number of support tasks as needed;
- Must return to the main task (double edge).





How to create a learning graph in ASYMPTOTE web portal



Select "LG & Tasks"

LG & Tasks

Learning Graph & Tasks



Profile

Personal data,
statistics



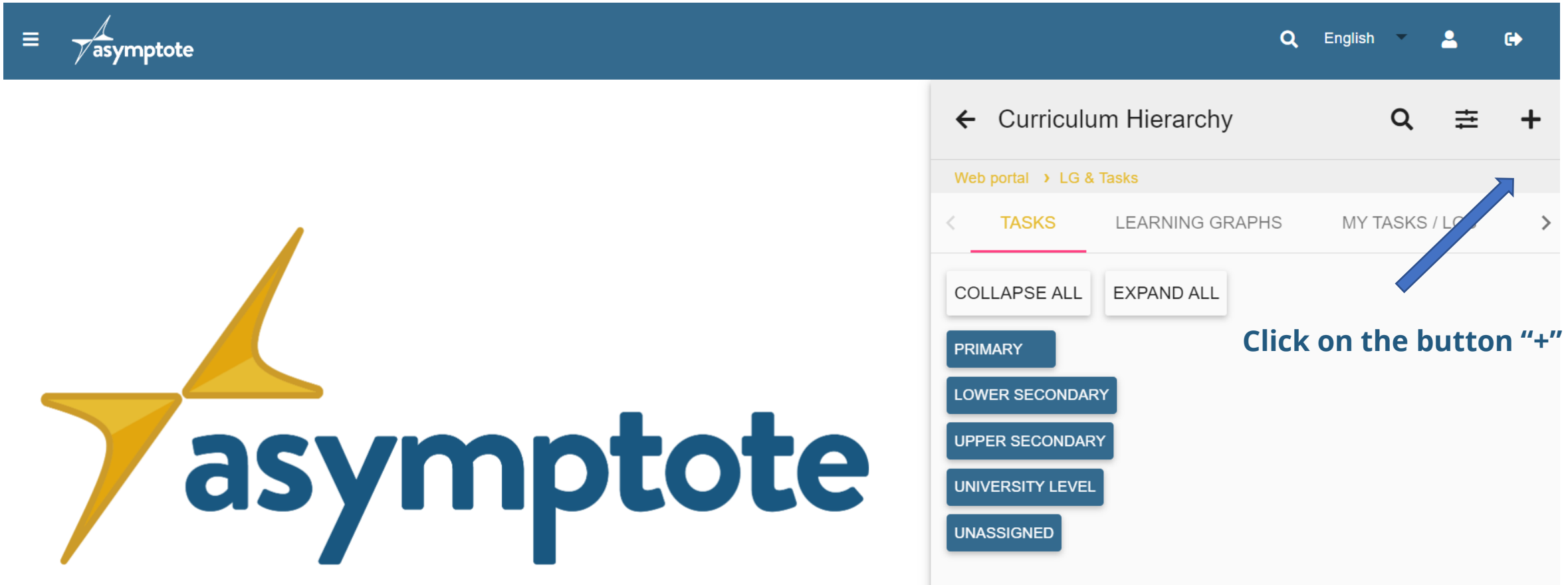
Groups

Create and
manage





How to create a learning graph in ASYMPTOTE web portal

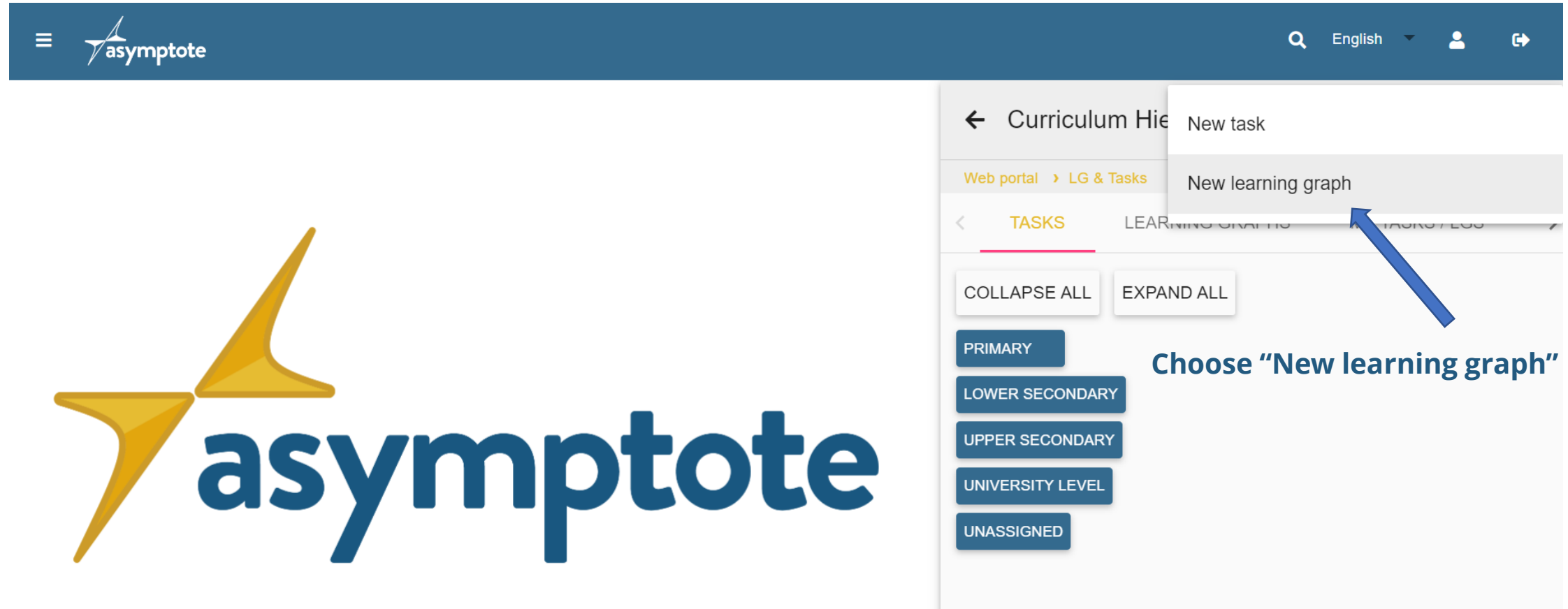


The screenshot displays the ASYMPTOTE web portal interface. At the top, there is a dark blue header with the ASYMPTOTE logo on the left, a search icon, the language 'English', a user profile icon, and a share icon. Below the header, the main content area shows a 'Curriculum Hierarchy' page. The breadcrumb trail is 'Web portal > LG & Tasks'. The page has three tabs: 'TASKS' (highlighted with a pink underline), 'LEARNING GRAPHS', and 'MY TASKS / LOG'. Below the tabs are two buttons: 'COLLAPSE ALL' and 'EXPAND ALL'. A list of educational levels is shown: 'PRIMARY', 'LOWER SECONDARY', 'UPPER SECONDARY', 'UNIVERSITY LEVEL', and 'UNASSIGNED'. A blue arrow points to a '+' button in the top right corner of the Curriculum Hierarchy section. A text label 'Click on the button "+"' is positioned next to the arrow.





How to create a learning graph in ASYMPTOTE web portal



The screenshot shows the ASYMPTOTE web portal interface. At the top, there is a dark blue header with the ASYMPTOTE logo on the left, a search icon, the text 'English', a user profile icon, and a share icon. Below the header, the main content area is divided into sections. On the left, there is a large ASYMPTOTE logo. On the right, there is a navigation menu with a back arrow and the text 'Curriculum Hierarchy'. Below this, there is a breadcrumb trail: 'Web portal > LG & Tasks'. A dropdown menu is open, showing two options: 'New task' and 'New learning graph'. A blue arrow points to the 'New learning graph' option. Below the dropdown, there are two buttons: 'COLLAPSE ALL' and 'EXPAND ALL'. Further down, there are five buttons representing educational levels: 'PRIMARY', 'LOWER SECONDARY', 'UPPER SECONDARY', 'UNIVERSITY LEVEL', and 'UNASSIGNED'. A text overlay on the right side of the screenshot reads 'Choose "New learning graph"'. The ASYMPTOTE logo is also visible in the bottom left corner of the screenshot.




How to create a learning graph in ASYMPTOTE web portal

Fill the form:

- The image is optional
- The learning graph must have a title and a description

← Create a learning graph

Web portal > LG & Tasks > Create



Title image

Please upload a representative image for your Learning Graph.

SELECT IMAGE

Basic data

Title *

Title is required

About this Learning Graph



How to create a learning graph in ASYMPTOTE web portal

- Learning graphs must be assigned to a curricular topic, e.g. linear functions

Curriculum Hierarchy

Currently selected category:

1: Unassigned

PRIMARY

LOWER SECONDARY

UPPER SECONDARY

UNIVERSITY LEVEL

UNASSIGNED








How to create a learning graph in ASYMPTOTE web portal

The tasks, previously created, will be added to the learning graph after it was created.

After filling out the form select "create"



Settings

-  Gamification
-  Display sample solutions
-  Display hints
-  Check Answers
-  Enter Answers

Notice: Tasks can be added to the trail after it was created.

CREATE



How to create a learning graph in ASYMPTOTE web portal



After creating a task, you can edit it

Share the task with a group



How to create a learning graph in ASYMPTOTE web portal

Learning graph

ACTIONS



Choose "ACTIONS"

Learning graph
display area

← Graph : Learning graph    

Web portal > LG & Tasks > Graph g79569

Add tasks to your Learning Graph

Currently, your Learning Graph does not contain any tasks.
Add your own or other public tasks.





How to create a learning graph in ASYMPTOTE web portal

Learning graph

Activate Edit Mode

Save changes

Undo Changes

Graph : Learning graph

portal > LG & Tasks > Graph g79569

Choose "Activate Edit Mode"

Add tasks to your Learning Graph

Currently, your Learning Graph does not contain any tasks.
Add your own or other public tasks.



English

Learning graph

EDIT MODE ACTIVE

ACTIONS

Graph : Learning graph

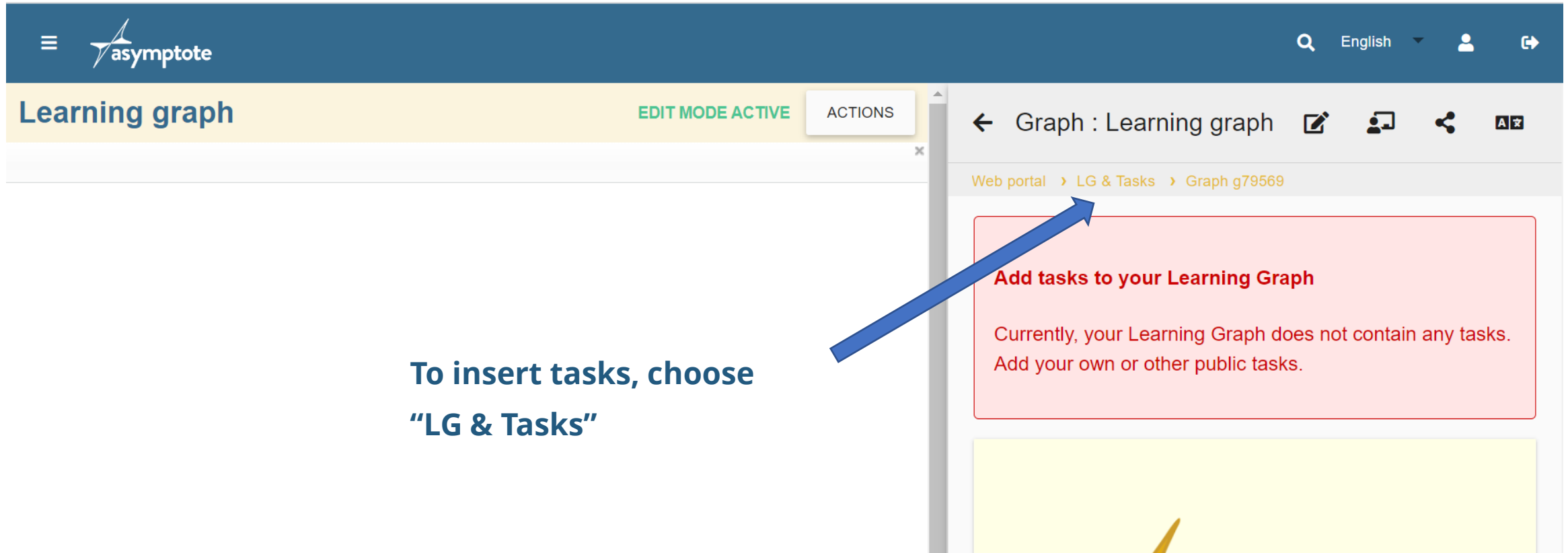
Web portal > LG & Tasks > Graph g79569

Add tasks to your Learning Graph

Currently, your Learning Graph does not contain any tasks.
Add your own or other public tasks.

Now we are ready to select
tasks to the learning graph.

How to create a learning graph in ASYMPTOTE web portal



Learning graph EDIT MODE ACTIVE ACTIONS

Web portal > LG & Tasks > Graph g79569

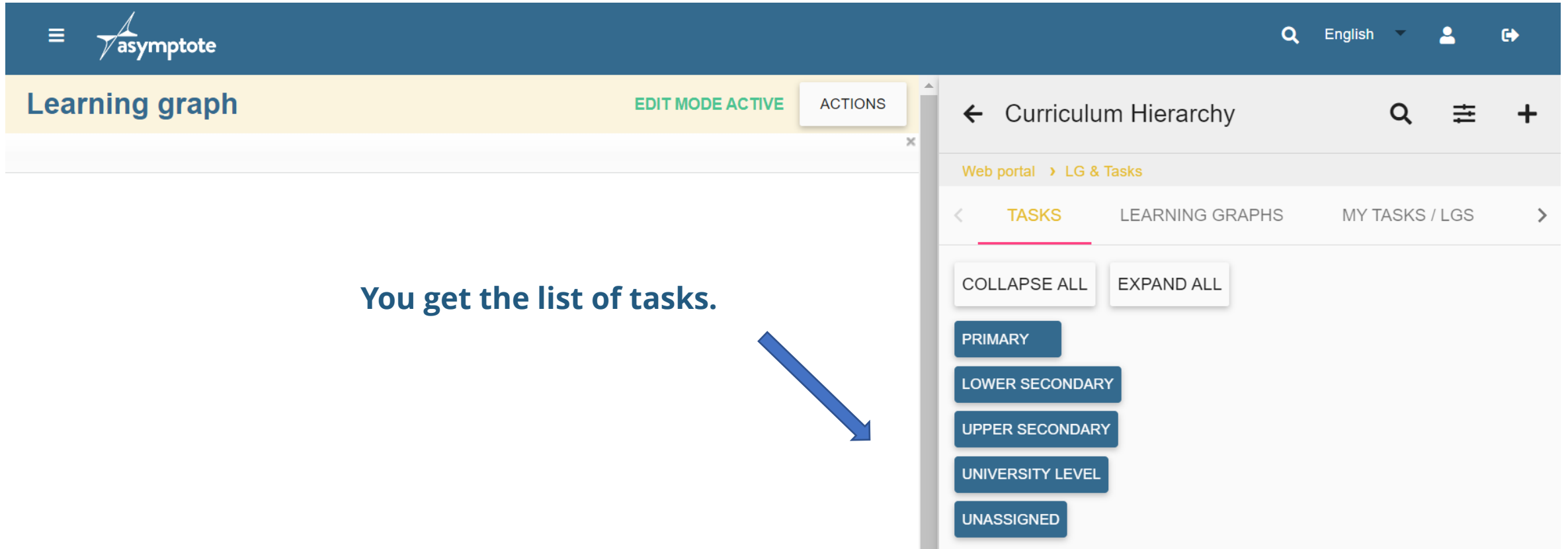
Add tasks to your Learning Graph

Currently, your Learning Graph does not contain any tasks.
Add your own or other public tasks.

**To insert tasks, choose
"LG & Tasks"**



How to create a learning graph in ASYMPTOTE web portal



You get the list of tasks.

Learning graph

EDIT MODE ACTIVE ACTIONS

Curriculum Hierarchy

Web portal > LG & Tasks

TASKS LEARNING GRAPHS MY TASKS / LGS

COLLAPSE ALL EXPAND ALL

PRIMARY

LOWER SECONDARY

UPPER SECONDARY

UNIVERSITY LEVEL

UNASSIGNED



How to create a learning graph in ASYMPTOTE web portal

Learning Graphs

EDIT MODE ACTIVE

UNSAVED CHANGES

ACTIONS



Main Task 1

Select a task

- 7872 A PT || BEBEDOURO
- 14101 A PT || TANQUE DE ÁGUA
- 34102 A PT || CAIXOTE PARA LIXO
- 78100 A PT || QUAL É A ESCALA?
- 0674 A PT || PAVILHÃO INCLINADO
- 0594 A PT || PINTAR ESFERAS
- 0499 A PT || CÍRCULO DE RELVA
- 03377 A DE || DER WEISSE PFEILER
- T17558 A EN || MATRIX EQUATION (TRAINING)
- T78559 A EN || MATRIX EQUATION (LEARNING)
- T59566 A EN || MATRIX OPERATIONS (LEARNING)
- T01567 A EN || MATRIX OPERATIONS (TRAINING)
- T56969 A EN || MAIN TASK 1
- T18970 A EN || MAIN TASK 2



How to create a learning graph in ASYMPTOTE web portal

Learning Graphs

For each new task, select:

- Its position related to the neighbor task already added to the learning graph;
- Assign the neighbor task for this new task.



EDIT MODE ACTIVE

ACTIONS

0499 A Z PT || CÍRCULO

Add Node: t39978

Where do you want to place the selected node:
"Support Task 1.1"?

Positioning

New Neighbor Node

NO

YES

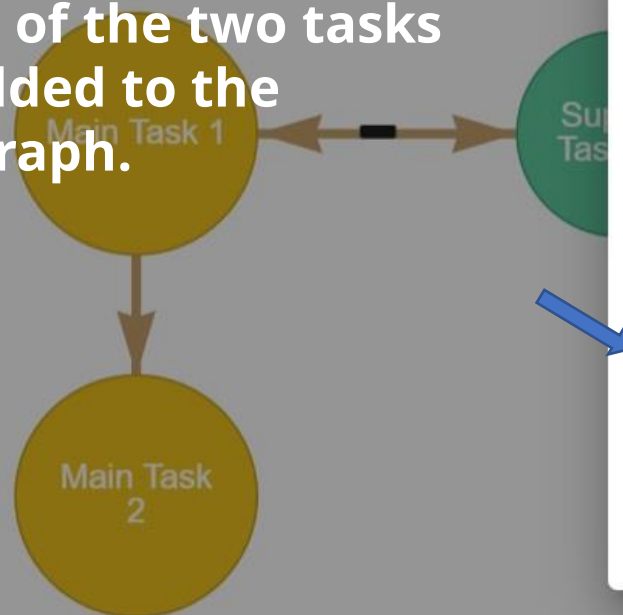


How to create a learning graph in ASYMPTOTE web portal

Learning Graphs

In this situation, we want to insert the new task on:

- Left of...;
- Select one of the two tasks already added to the learning graph.



Add Node: t48975

Where do you want to place the selected node:

"Challenge Task 2.1"?

Positioning

left of ...

t56969: Main Task 1

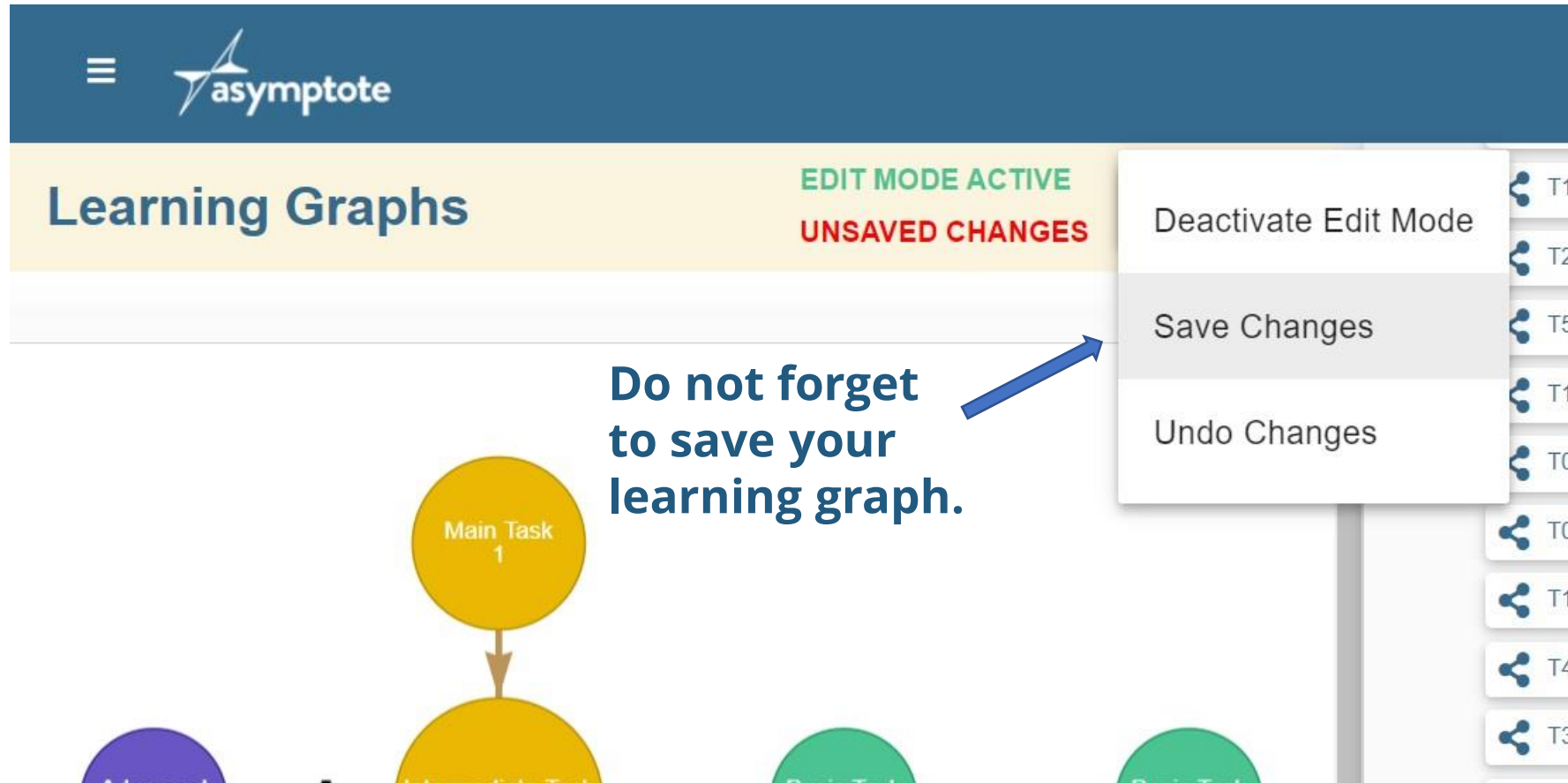
t18970: Main Task 2

NO

YES



How to create a learning graph in ASYMPTOTE web portal



Do not forget to save your learning graph.

- Deactivate Edit Mode
- Save Changes
- Undo Changes

Main Task 1

T19
T20
T51
T10
T09
T01
T10
T40
T30



Chapter 2:

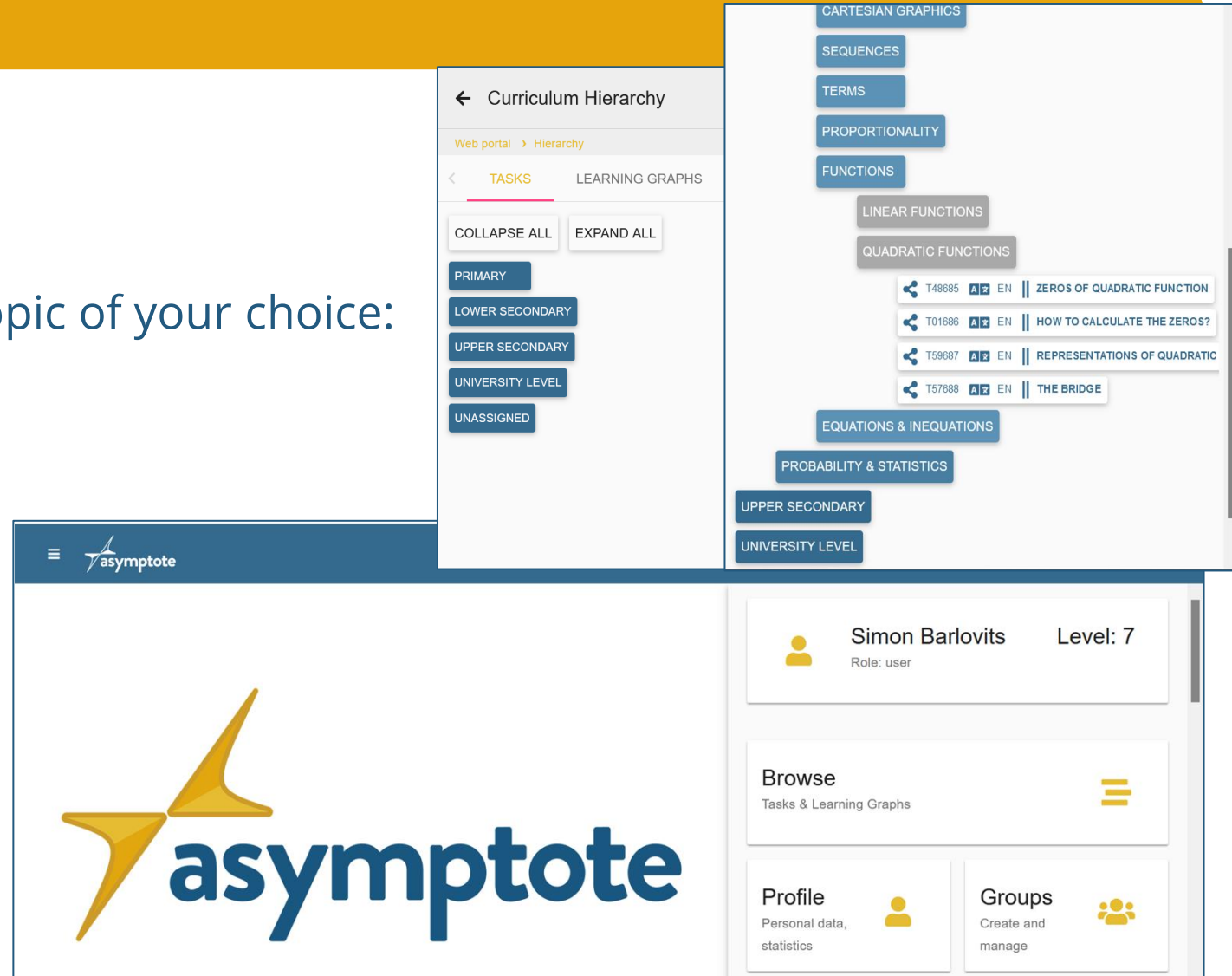
The ASYMPTOTE web portal

**2.5. How to search for tasks/Learning Graphs and
how to share them**



2.4.1 Selection of Tasks

1. Click on the “Browse” button
2. Search in the “Hierarchy” for the topic of your choice:
 - All tasks are marked in the hierarchy
 - The hierarchy is structured by level & curricular topics
 - You can filter for task languages
 - The task preview shows the code of the task, its language & title
3. Select and open a task



The screenshot displays the Asymptote web portal interface. At the top left, there is a navigation menu with a hamburger icon and the Asymptote logo. The main content area is titled "Curriculum Hierarchy" and shows a breadcrumb trail: "Web portal > Hierarchy". Below this, there are tabs for "TASKS" (selected) and "LEARNING GRAPHS". A filter section includes buttons for "COLLAPSE ALL" and "EXPAND ALL", and a list of levels: PRIMARY, LOWER SECONDARY, UPPER SECONDARY, UNIVERSITY LEVEL, and UNASSIGNED. The main area shows a hierarchical tree of topics:

- CARTESIAN GRAPHICS
- SEQUENCES
- TERMS
- PROPORTIONALITY
- FUNCTIONS
 - LINEAR FUNCTIONS
 - QUADRATIC FUNCTIONS
 - T48685 A2 EN || ZEROS OF QUADRATIC FUNCTION
 - T01686 A2 EN || HOW TO CALCULATE THE ZEROS?
 - T59687 A2 EN || REPRESENTATIONS OF QUADRATIC
 - T57688 A2 EN || THE BRIDGE
- EQUATIONS & INEQUALITIES
- PROBABILITY & STATISTICS
- UPPER SECONDARY
- UNIVERSITY LEVEL

At the bottom of the page, there is a user profile section for "Simon Barlovits" (Level: 7, Role: user). Below this are three main navigation buttons: "Browse" (Tasks & Learning Graphs), "Profile" (Personal data, statistics), and "Groups" (Create and manage).

The Task Formular

As an example, please invoke the task “The bridge” ([Link](#))

A task consists of:

1. Title & task instruction
2. Picture (optional)
3. Curriculum hierarchy
4. Task category: training/modeling/reasoning
5. Answer format
6. Stepped hints
7. Grade & Tags



The Bridge

One can describe the railway bridge as quadratic function $f(x) = ax^2 + bx + c$. Calculate the value of the factor a in the term of the quadratic function.

Note: One meter is equal to one unit of length. Round to two decimal numbers.

quadratic function modelling measure

Curriculum Hierarchy & Task Category

Task Category: **Modeling**

Current hierarchy association: **1: Quadratic functions**

Answer:

Task type and solution* Task type
Interval

-0.17 -0.14 -0.10 -0.07

Sample solution

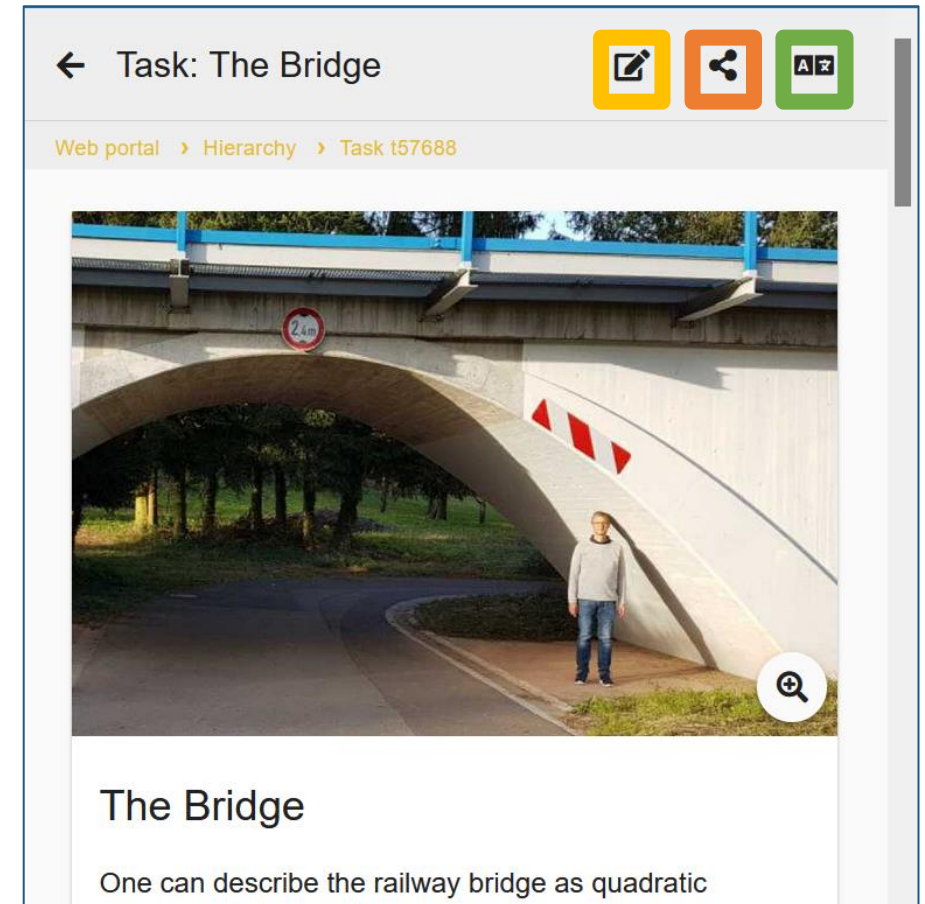
TEXT **PICTURE**

The Task Formular

As an example, please invoke the task “The bridge” ([Link](#))

Furthermore, the task formular allows:

1. to **edit** own or shared tasks
2. to **share** own tasks (*more on that later*)
3. to **translate** a task





The Task Formular

4. to **display** the translated tasks
5. to **copy & adapt** the task
6. to **add** it to the personal favorites
7. to **add** it to a learning graph (*more on that later*)

The Bridge


One can describe the railway bridge as quadratic function $f(x) = ax^2 + bx + c$. Calculate the value of the factor a in the term of the quadratic function.


Note: One meter is equal to one unit of length. Round to two decimal numbers.

quadratic function
modelling
measure

Language

English (Default) ▾



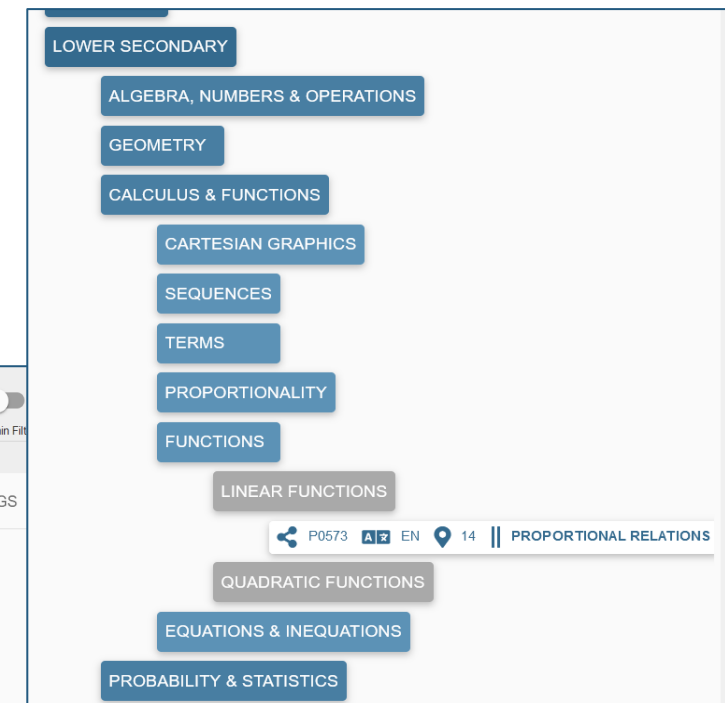
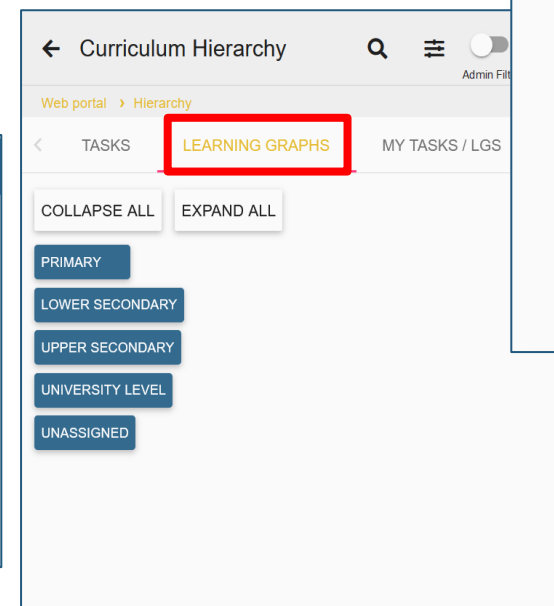
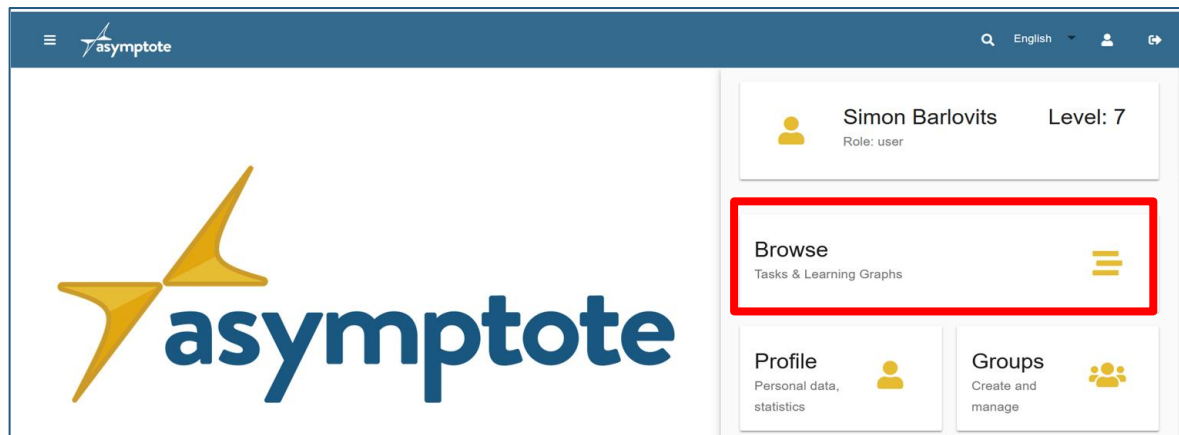


ADD TASK TO LEARNING GRAPH



2.4.2 Selection of Learning Graphs

1. Click on the “Browse” button
2. Select “Learning Graphs”
3. Search in the “Hierarchy” for the topic of your choice
4. Select and open a learning graph



The Learning Graph View

As an example, please invoke the LG “Proportional Relations” ([Link](#))

Furthermore, the LG formular allows:

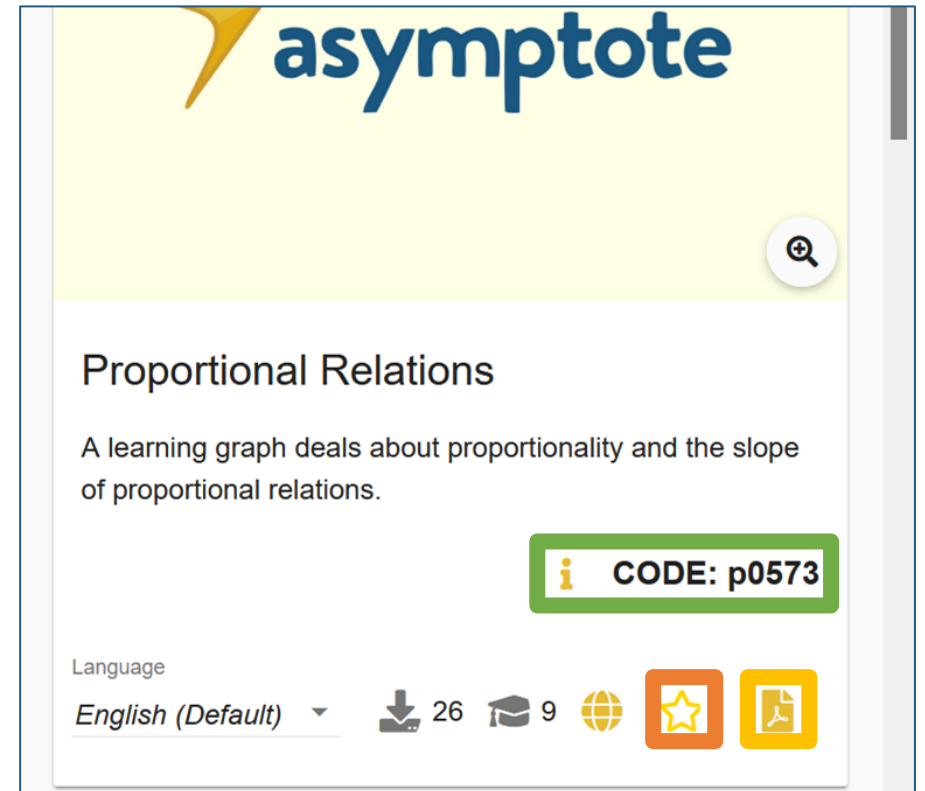
1. to **edit** the LG
2. to **create** a Digital Classroom (*more on that later*)
3. to **share** the LG (*more on that later*)
4. to **translate** the LG





The Learning Graph View

5. to **invoke** the LG in the ASYMPTOTE app (*via Code*)
6. to **add** it to the personal favorites
7. to **download** the LG as PDF (*in development*)



The screenshot shows the Asymptote app interface. At the top, the 'asymptote' logo is displayed in blue on a light yellow background. Below the logo, the title 'Proportional Relations' is shown in a large, bold, black font. Underneath the title, a short description reads: 'A learning graph deals about proportionality and the slope of proportional relations.' To the right of the description, there is a green box containing an information icon and the text 'CODE: p0573'. At the bottom of the interface, there is a 'Language' dropdown menu set to 'English (Default)', followed by icons for download (with the number 26), a graduation cap (with the number 9), a globe, a star icon, and a PDF icon.



Web Portal Functionalities

The ASYMPTOTE Web Portal offers the possibility ...

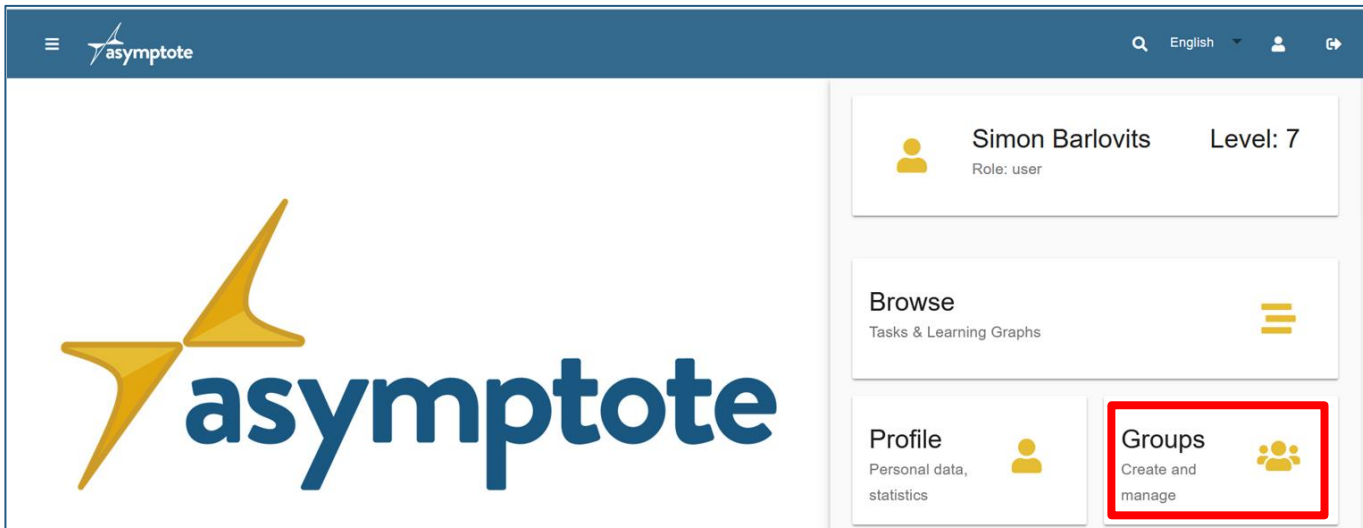
... to make own tasks and learning graphs available to other users

... by sharing own tasks and learning graphs with groups

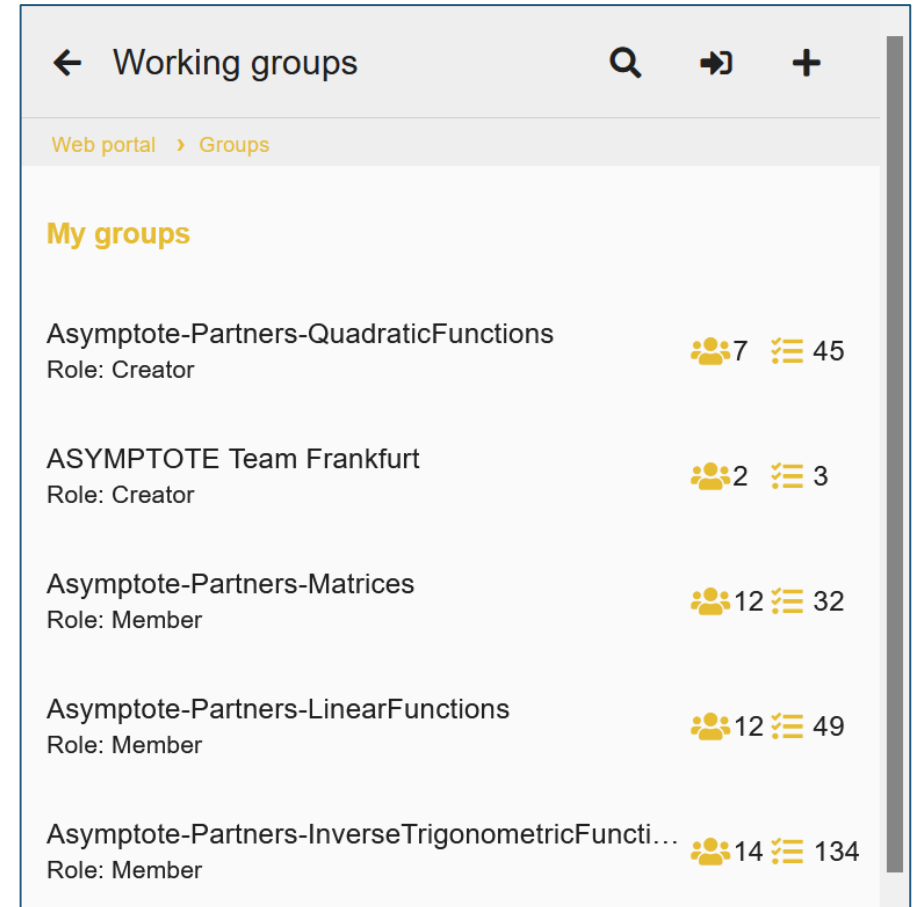


Manage my Groups

1. Click on the “Groups” button
2. Overview on your groups
3. Invoke shared tasks & LG
by clicking on a group



The screenshot shows the user profile page for Simon Barlovits. The user's role is 'user' and their level is 7. The page features a large Asymptote logo on the left. On the right, there are three main sections: 'Browse' (Tasks & Learning Graphs), 'Profile' (Personal data, statistics), and 'Groups' (Create and manage). The 'Groups' button is highlighted with a red box.

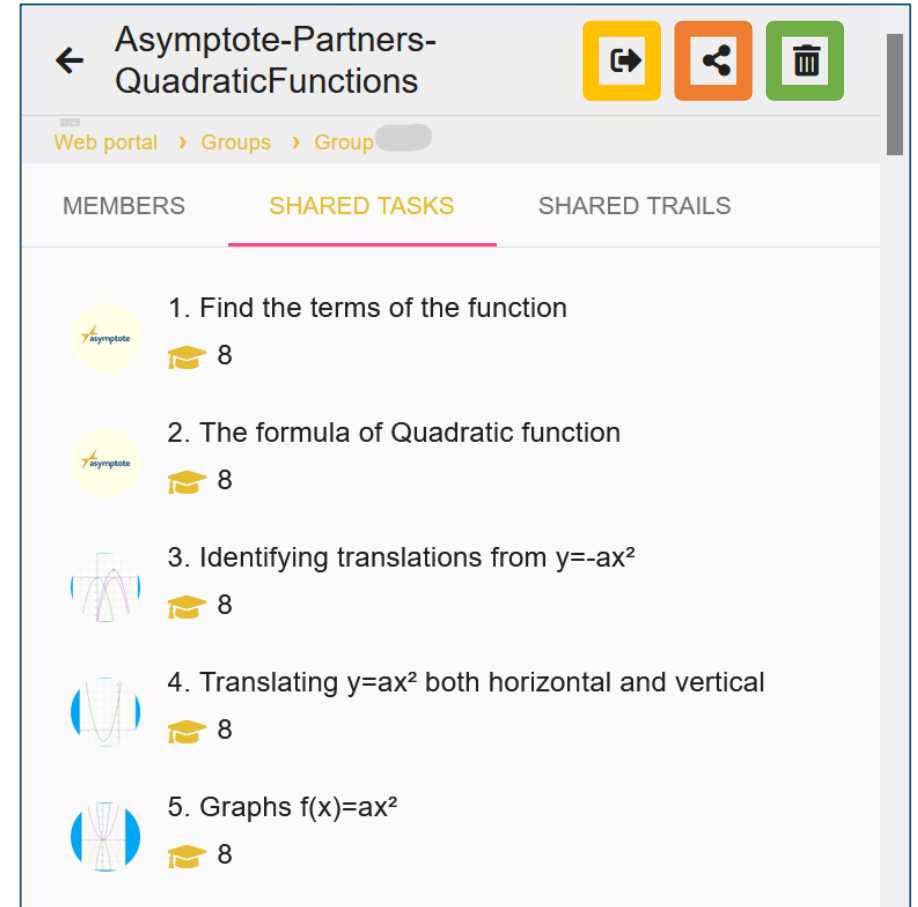


The screenshot shows the 'Working groups' overview page. The page title is 'Working groups' and it includes a search icon, a refresh icon, and a plus icon. Below the title, there is a breadcrumb trail: 'Web portal > Groups'. The main content area is titled 'My groups' and lists several groups with their respective roles, member counts, and task counts.




Group Name	Role	Members	Tasks
Asymptote-Partners-QuadraticFunctions	Creator	7	45
ASYMPTOTE Team Frankfurt	Creator	2	3
Asymptote-Partners-Matrices	Member	12	32
Asymptote-Partners-LinearFunctions	Member	12	49
Asymptote-Partners-InverseTrigonometricFunc...	Member	14	134

Manage my Groups

1. Possibility to **leave** or **share** group
(sharing via code = group no.)
2. Possibility to **delete** group
(only for group owners)













← Asymptote-Partners-QuadraticFunctions

Web portal > Groups > Group

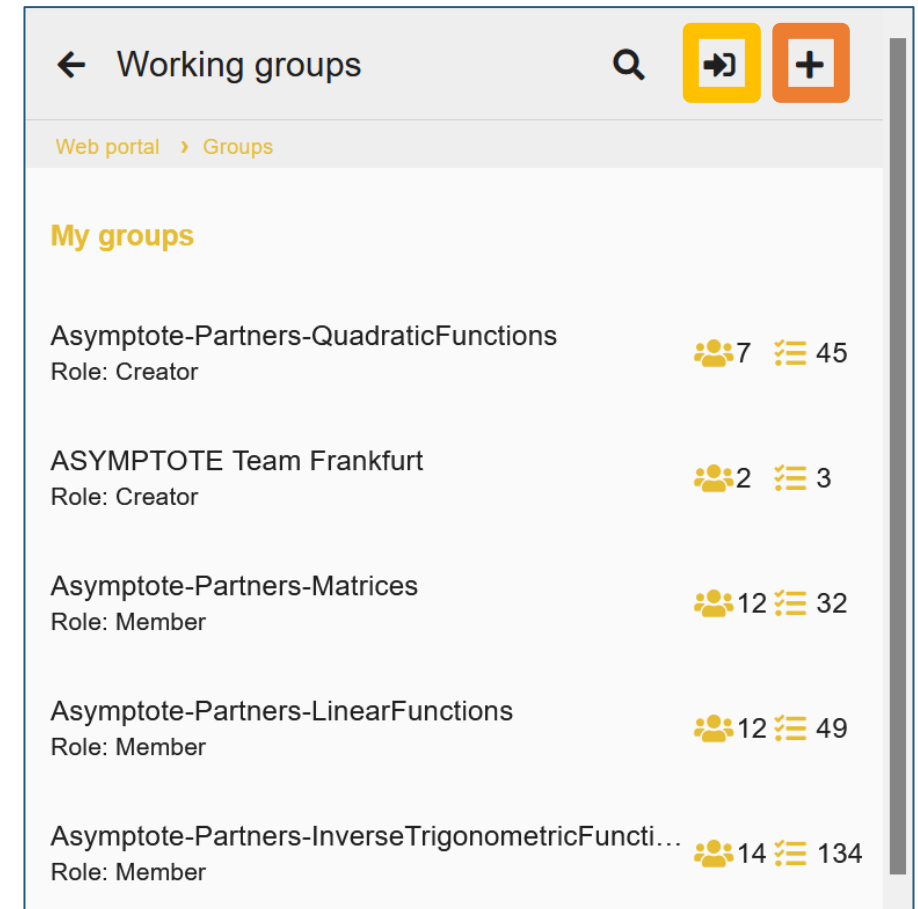
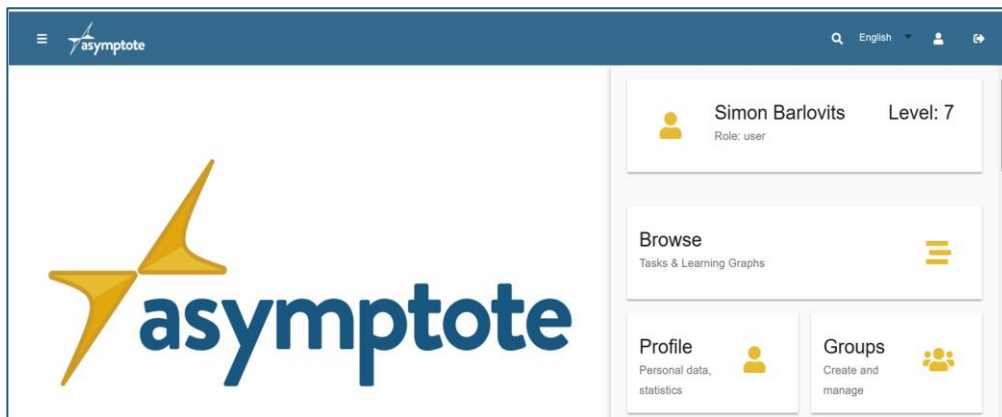
MEMBERS **SHARED TASKS** SHARED TRAILS

- 
 1. Find the terms of the function
 8
- 
 2. The formula of Quadratic function
 8
- 
 3. Identifying translations from $y=-ax^2$
 8
- 
 4. Translating $y=ax^2$ both horizontal and vertical
 8
- 
 5. Graphs $f(x)=ax^2$
 8



Create or Join a Groups

1. Click on the "Group" button
2. Click on the "Entrance" symbol to join a group via code (*code = group no.*)
3. Click on the "+" symbol to create a new group

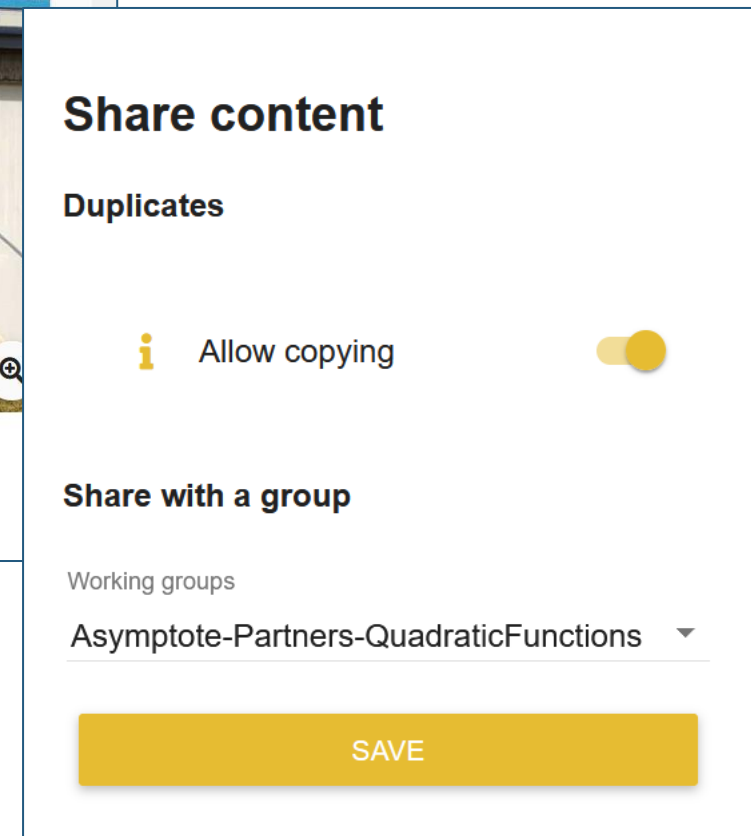
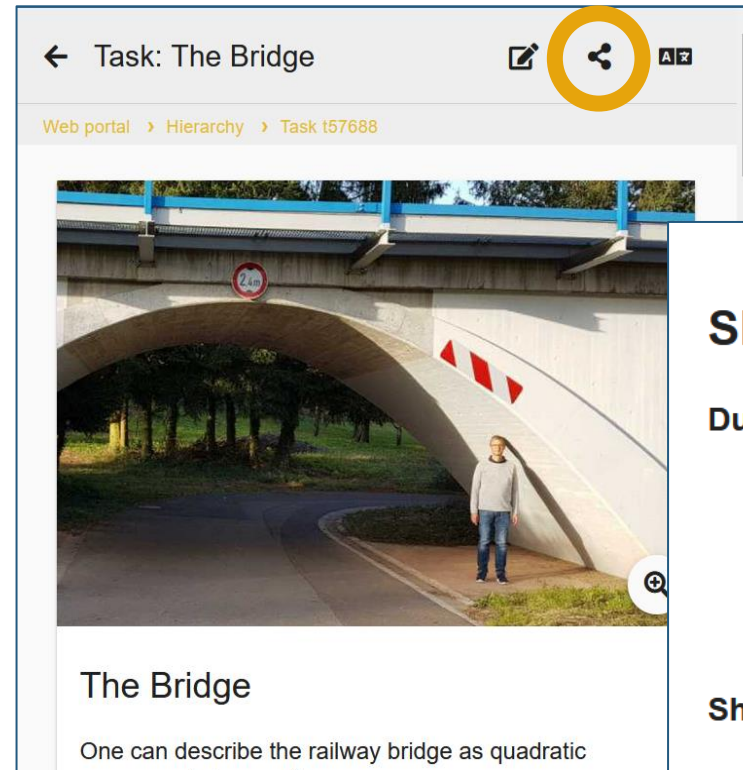




Share a Task or a Learning Graph with a Group

To share a task or a LG ...

1. invoke the task/LG
2. click on the “Share” button
3. select one of your groups



Information:

- a) each task/LG can only be shared with one group
- b) sharing a task/LG allows all group members its editing



Chapter 3:

The Digital Classroom

Monitoring & Evaluation Tool



The Digital Classroom

Features of the Digital Classroom:

- Virtual representation of the class
- Allocation of learning graphs to students
- Real-time monitoring of student's work process
- Student-teacher interaction via chat
- Evaluation on individual & class level

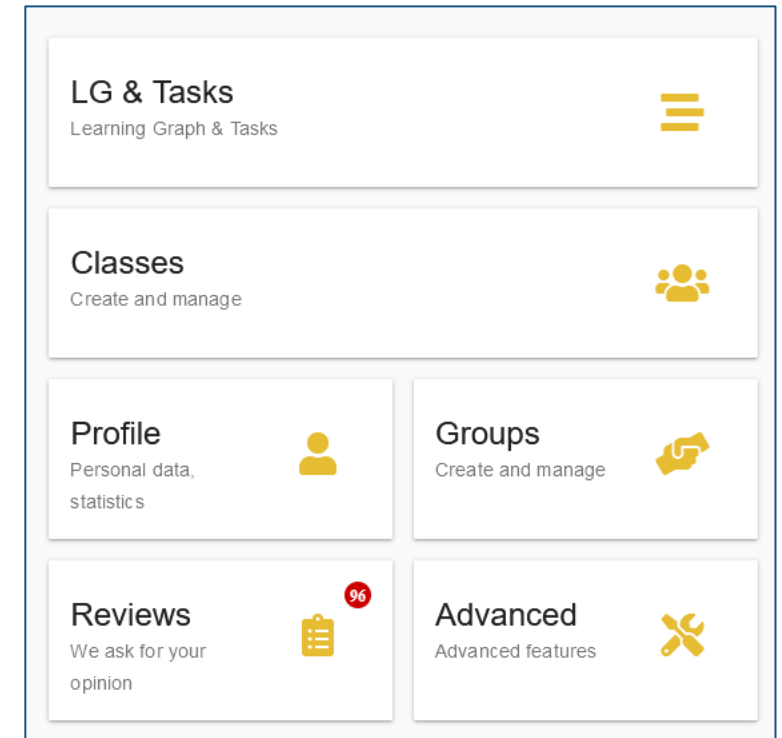
Note: To use the Digital Classroom feature, an active internet connection is required



The Digital Classroom

Virtual representation of the class:

- Click on the „Classes“ button

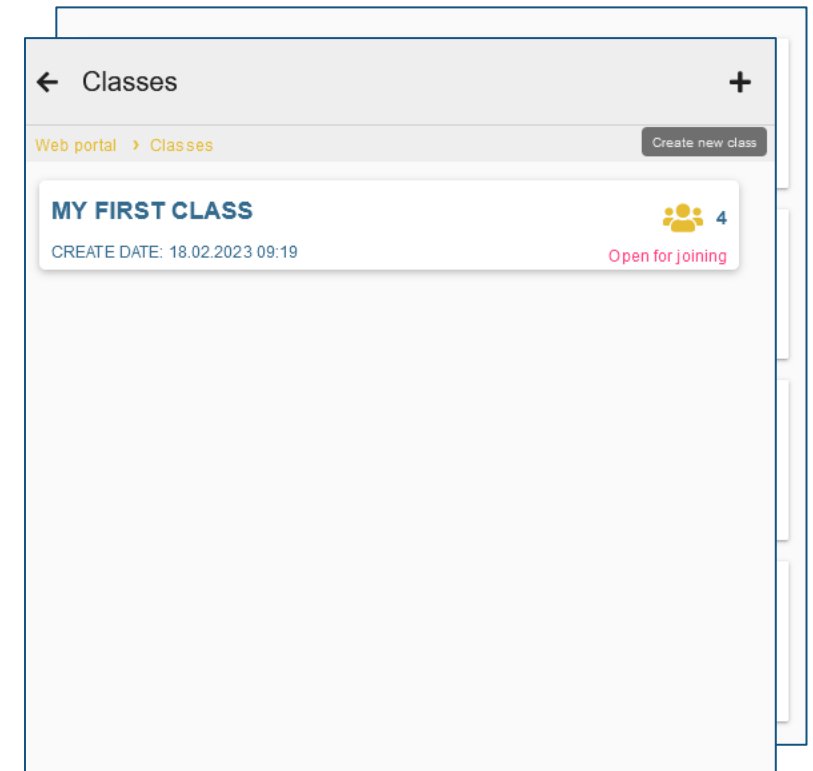




The Digital Classroom

Virtual representation of the class:

- Click on the „Classes“ button
- Click on „+“

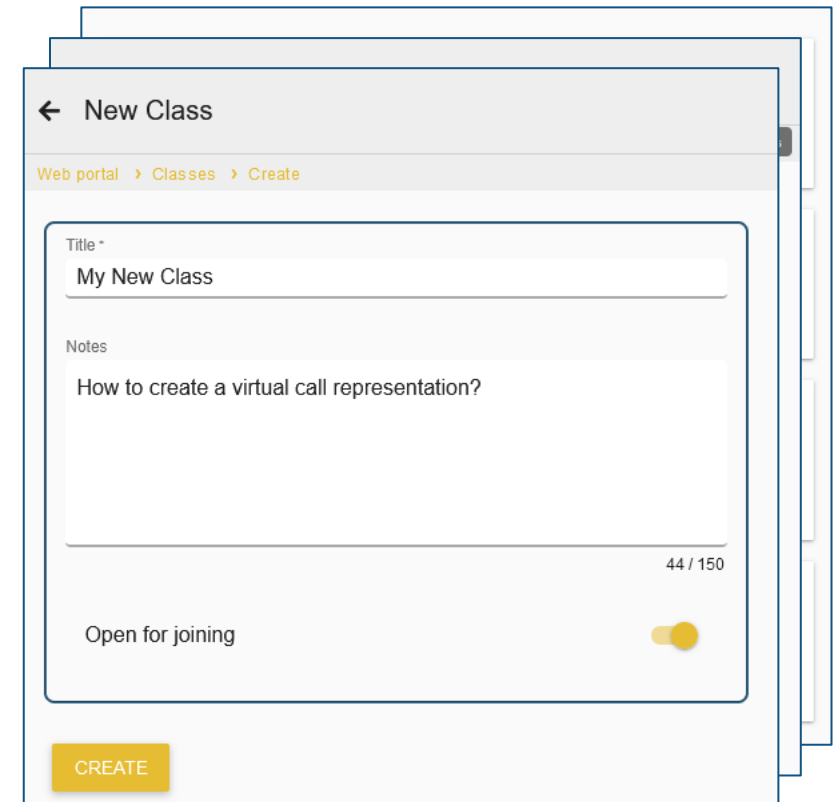




The Digital Classroom

Virtual representation of the class:

- Click on the „Classes“ button
- Click on „+“
- Enter a title for your class & a short description
- Click on „Create“



← New Class

Web portal > Classes > Create

Title *

My New Class

Notes

How to create a virtual call representation?

44 / 150

Open for joining

CREATE

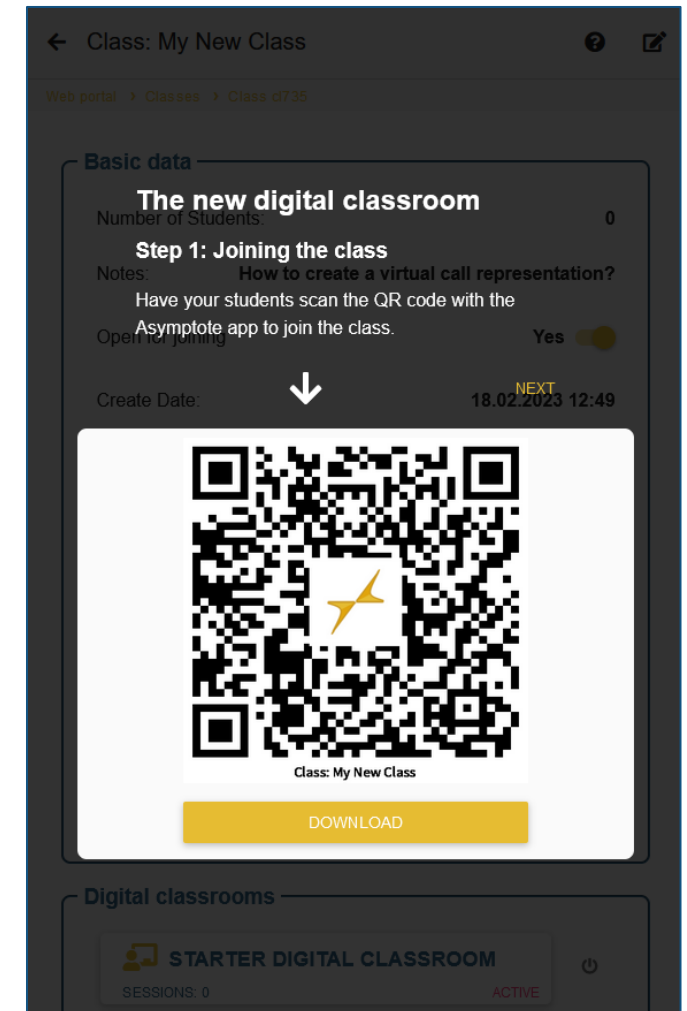
Perfect, your virtual class is set up. Now let your students join the class!



The Digital Classroom

Virtual representation of the class:

- Students can join the class via scanning the QR code once
→ No registration is needed on their side!

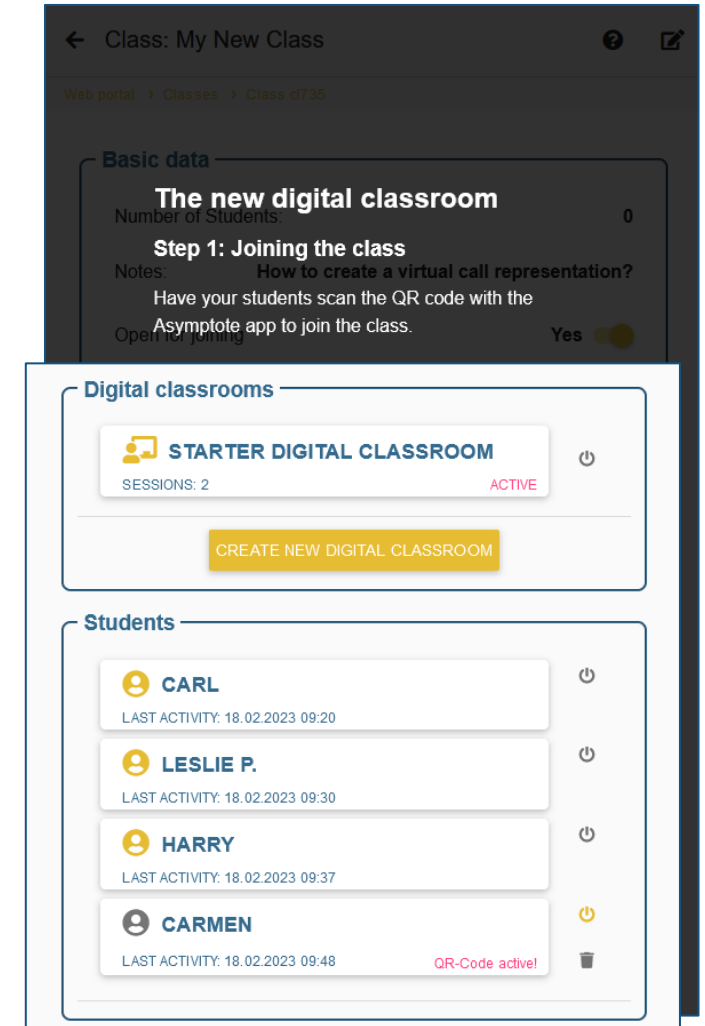




The Digital Classroom

Virtual representation of the class:

- Students can join the class via scanning the QR code once
→ No registration is needed on their side!
- Students are immediately listed in the class after joining

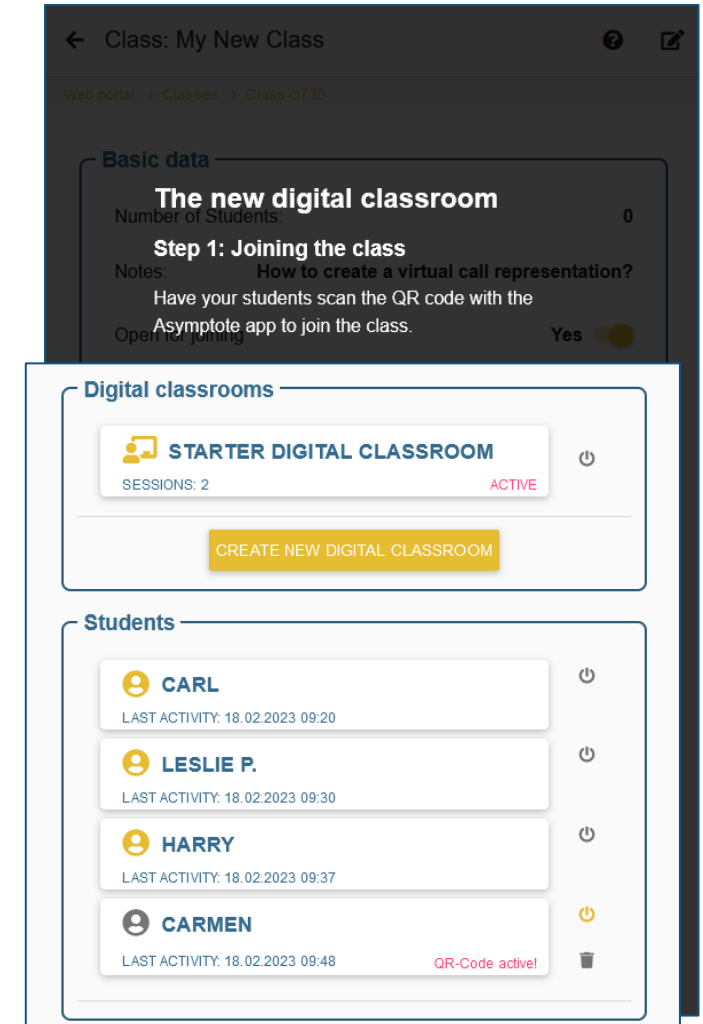




The Digital Classroom

Virtual representation of the class:

- Students can join the class via scanning the QR code once
→ No registration is needed on their side!
- Students are immediately listed in the class after joining
- You can change the status of a student
 - Active: student can access all allocated LG (see next slide; standard setting)
 - Inactive: student can view but not work on allocated LG (pause mode)
 - Delete: students are not longer part of the class



The screenshot shows the 'Class: My New Class' interface. At the top, it displays 'Web portal > Classes > Class 0735'. Under 'Basic data', it shows 'The new digital classroom' with 'Number of Students: 0'. A 'Step 1: Joining the class' section includes a note: 'How to create a virtual call representation? Have your students scan the QR code with the Asymptote app to join the class.' Below this, there are two main sections: 'Digital classrooms' and 'Students'. The 'Digital classrooms' section shows a 'STARTER DIGITAL CLASSROOM' with 'SESSIONS: 2' and an 'ACTIVE' status, along with a 'CREATE NEW DIGITAL CLASSROOM' button. The 'Students' section lists four students: CARL (LAST ACTIVITY: 18.02.2023 09:20), LESLIE P. (LAST ACTIVITY: 18.02.2023 09:30), HARRY (LAST ACTIVITY: 18.02.2023 09:37), and CARMEN (LAST ACTIVITY: 18.02.2023 09:48). The CARMEN entry has a 'QR-Code active!' indicator and a trash icon.



The Digital Classroom

Virtual representation of the class:

Reconnecting to existing work progress

- Student's can reconnect to their work progress in the app after the loss/change of the mobile device or deinstallation of the app
- An individualized student QR code is activated by the teacher and scanned by the student
- As if by magic, the previous work status appears in the app!

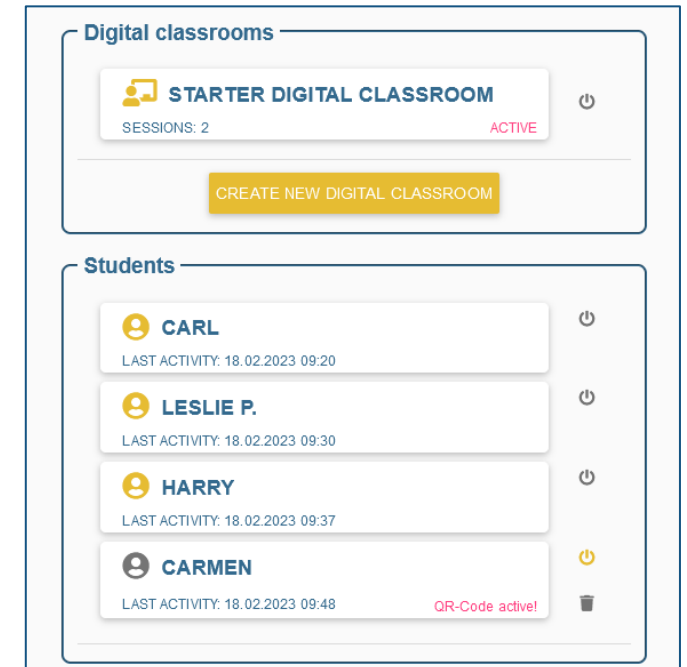


The Digital Classroom

Virtual representation of the class:

Reconnecting to existing work progress

- Carl has a new phone. How could he reconnect to his previous work progress?
- Click on the student account of Carl



The screenshot displays a digital classroom management interface. At the top, under the heading "Digital classrooms", there is a card for a "STARTER DIGITAL CLASSROOM" which is currently "ACTIVE" and has "SESSIONS: 2". Below this card is a yellow button labeled "CREATE NEW DIGITAL CLASSROOM".

Below the classrooms section is a "Students" section containing a list of four student profiles:

- CARL**: LAST ACTIVITY: 18.02.2023 09:20
- LESLIE P.**: LAST ACTIVITY: 18.02.2023 09:30
- HARRY**: LAST ACTIVITY: 18.02.2023 09:37
- CARMEN**: LAST ACTIVITY: 18.02.2023 09:48. This profile has a red status indicator that says "QR-Code active!" and a trash icon to its right.



The Digital Classroom

Virtual representation of the class:

Reconnecting to existing work progress

- Carl has a new phone. How could he reconnect to his previous work progress?
- Click on the student account of Carl
- Activate „Reconnection possible“
- Let Carl scan his individualized QR code
- His previous work process is automatically restored!

By clicking the „edit“ button (upright), teachers can change student’s pseudonyms.




← Student: Carl 

Web portal > Classes > Class cl194 > Students st53

Student Details and Settings

Pseudonym	Carl
code:	st53
Create Date:	18.02.2023 09:20
Last online:	18.02.2023 09:20
Reconnection possible	Yes <input checked="" type="checkbox"/>
Deactivated	No <input type="checkbox"/>



Student: Carl

[DOWNLOAD](#)

DELETE STUDENT



The Digital Classroom

Allocation of learning graphs to students:

- Click on „Starter Digital Classroom“

The new digital classroom

Step 2: Create a live session on a learning graph

Click on an existing digital classroom or create a new one to create a live session on one of your own or a variety of public learning graphs.

↓
DOWNLOAD
UNDERSTOOD

Digital classrooms

STARTER DIGITAL CLASSROOM

⏻

SESSIONS: 2

ACTIVE

CREATE NEW DIGITAL CLASSROOM

Students

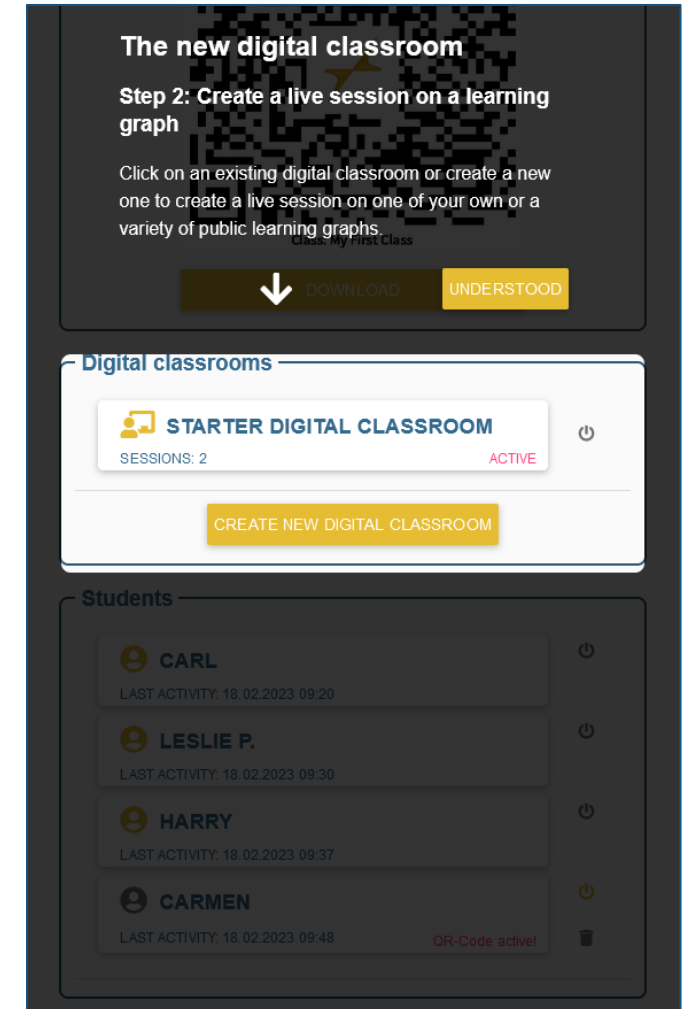
<div style="background-color: #34495e; color: white; padding: 5px; border-radius: 5px; display: flex; justify-content: space-between; align-items: center;"> <p>CARL</p> ⏻ </div> <p style="font-size: 0.8em; margin-top: 5px;">LAST ACTIVITY: 18.02.2023 09:20</p>
<div style="background-color: #34495e; color: white; padding: 5px; border-radius: 5px; display: flex; justify-content: space-between; align-items: center;"> <p>LESLIE P.</p> ⏻ </div> <p style="font-size: 0.8em; margin-top: 5px;">LAST ACTIVITY: 18.02.2023 09:30</p>
<div style="background-color: #34495e; color: white; padding: 5px; border-radius: 5px; display: flex; justify-content: space-between; align-items: center;"> <p>HARRY</p> ⏻ </div> <p style="font-size: 0.8em; margin-top: 5px;">LAST ACTIVITY: 18.02.2023 09:37</p>
<div style="background-color: #34495e; color: white; padding: 5px; border-radius: 5px; display: flex; justify-content: space-between; align-items: center;"> <p>CARMEN</p> ⏻ </div> <p style="font-size: 0.8em; margin-top: 5px;">LAST ACTIVITY: 18.02.2023 09:48</p> <p style="font-size: 0.8em; margin-top: 5px; color: #e91e63;">QR-Code active!</p> 🗑️



The Digital Classroom

Allocation of learning graphs to students:

- Click on „Starter Digital Classroom“
- One could also create further Digital Classrooms to conduct lessons based on ...
 - topics (e.g., “All about functions”),
 - terms (e.g., “2nd term of 2023”), or
 - methods (e.g., “Exam preparation”)



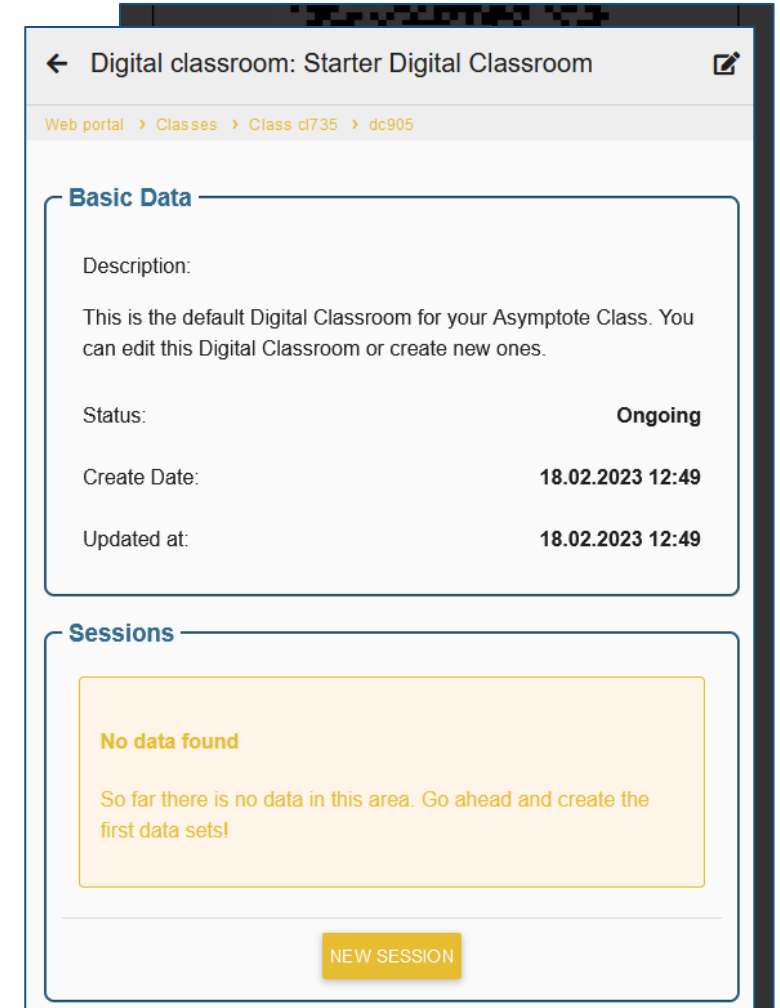
The screenshot shows the 'The new digital classroom' interface. At the top, it says 'Step 2: Create a live session on a learning graph'. Below this, there is a QR code and a text prompt: 'Click on an existing digital classroom or create a new one to create a live session on one of your own or a variety of public learning graphs.' There are two buttons: 'DOWNLOAD' and 'UNDERSTOOD'. Below this is a section titled 'Digital classrooms' which contains a card for 'STARTER DIGITAL CLASSROOM' with 'SESSIONS: 2' and 'ACTIVE' status, and a 'CREATE NEW DIGITAL CLASSROOM' button. At the bottom, there is a 'Students' section listing four students: CARL, LESLIE P., HARRY, and CARMEN, each with their last activity time and a power icon.



The Digital Classroom

Allocation of learning graphs to students:

- Click on „Starter Digital Classroom“
- Click on „New Session“



The screenshot shows the 'Digital classroom: Starter Digital Classroom' page. The breadcrumb trail is 'Web portal > Classes > Class d735 > dc905'. The 'Basic Data' section contains the following information:

Description:	This is the default Digital Classroom for your Asymptote Class. You can edit this Digital Classroom or create new ones.
Status:	Ongoing
Create Date:	18.02.2023 12:49
Updated at:	18.02.2023 12:49

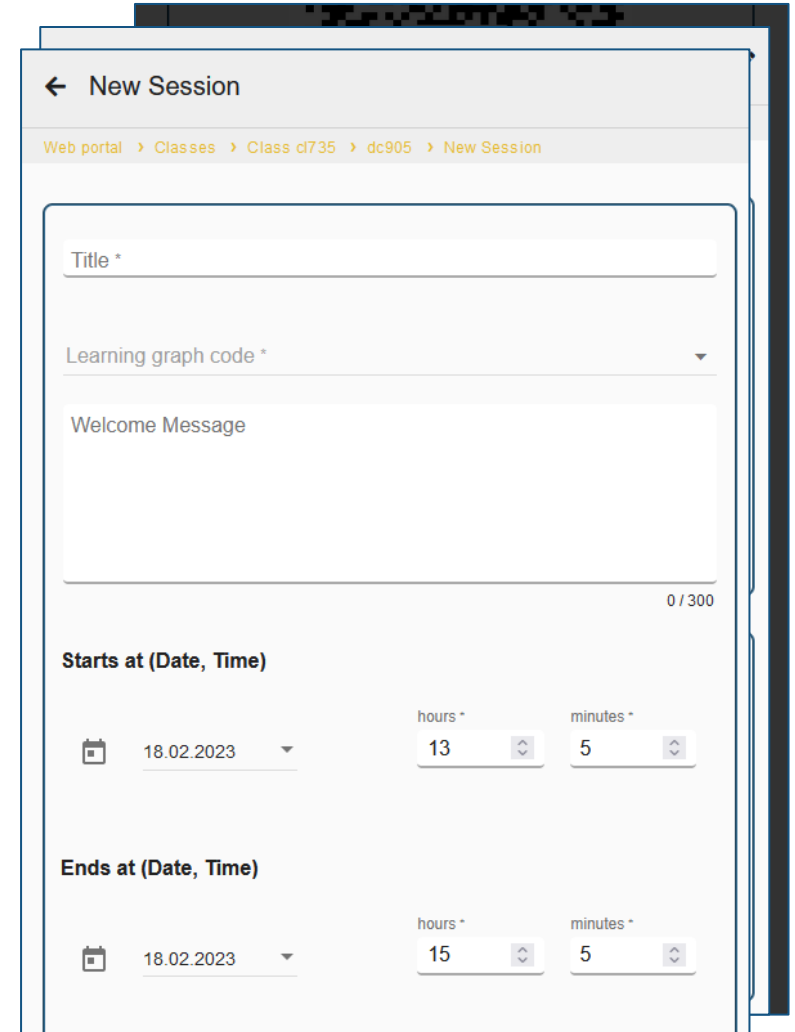
The 'Sessions' section displays a message: 'No data found. So far there is no data in this area. Go ahead and create the first data sets!'. A 'NEW SESSION' button is located at the bottom right of the page.



The Digital Classroom

Allocation of learning graphs to students:

- Click on „Starter Digital Classroom“
- Click on „New Session“
 - Enter a title for the new session
 - Select a learning graph of your choice
 - Add a short welcome message for students
 - Determine the time in which the LG is accessible



The screenshot shows a 'New Session' form with the following fields and values:

- Title ***: (empty text input field)
- Learning graph code ***: (dropdown menu)
- Welcome Message**: (text area with a character count of 0 / 300)
- Starts at (Date, Time)**:
 - Date: 18.02.2023
 - Hours: 13
 - Minutes: 5
- Ends at (Date, Time)**:
 - Date: 18.02.2023
 - Hours: 15
 - Minutes: 5



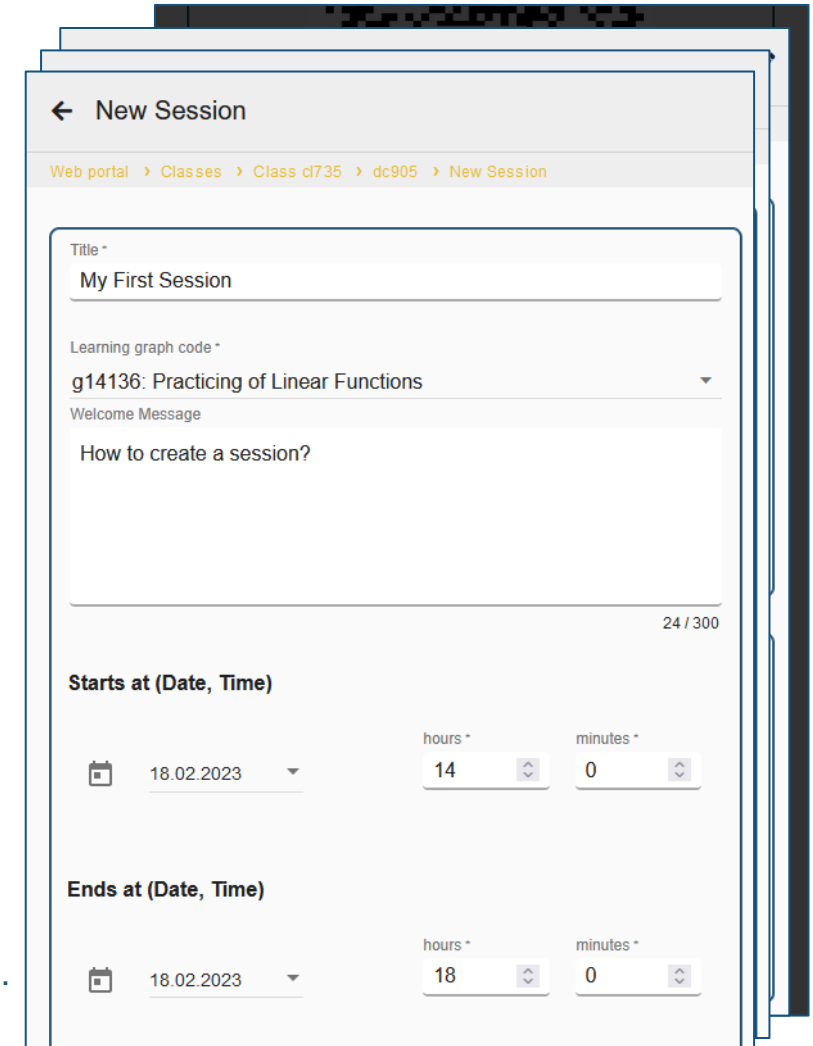
The Digital Classroom

Allocation of learning graphs to students:

- Click on „Starter Digital Classroom“
- Click on „New Session“
 - Enter a title for the new session
 - Select a learning graph of your choice
 - Add a short welcome message for students
 - Determine the time in which the LG is accessible

What is a session?

A session is the time period in which a specific LG can be completed by the students. All task processes & chat interactions are stored in the session for evaluation purposes. Within one Digital Classroom, multiple sessions can be created.



The screenshot shows the 'New Session' form with the following fields and values:

- Title:** My First Session
- Learning graph code:** g14136: Practicing of Linear Functions
- Welcome Message:** How to create a session? (24 / 300 characters)
- Starts at (Date, Time):** 18.02.2023, 14:00
- Ends at (Date, Time):** 18.02.2023, 18:00

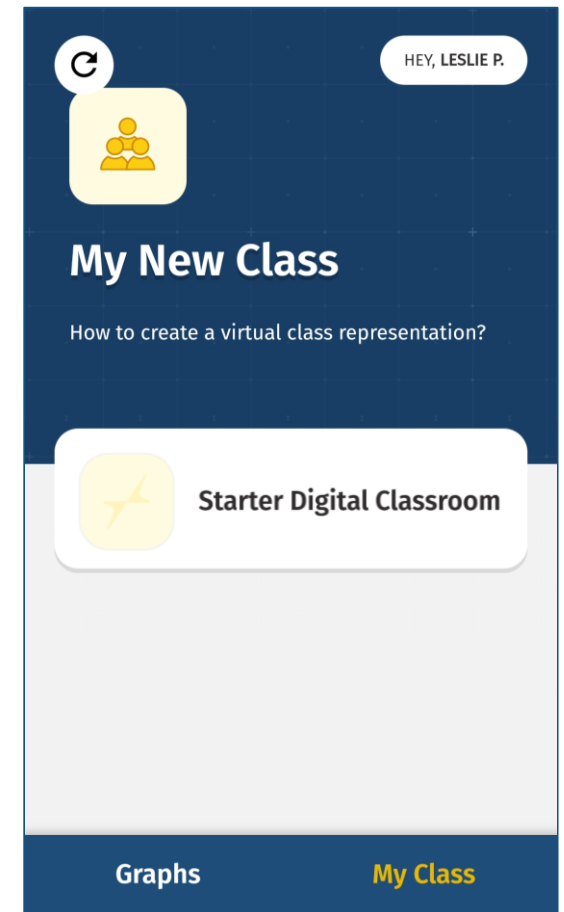


The Digital Classroom

Allocation of learning graphs to students:

The student's perspective (app)

- After entering the class via the QR code, the class is displayed under "My Class".
 - No registration is needed on student's side!
- All Digital Classrooms of this class are displayed here



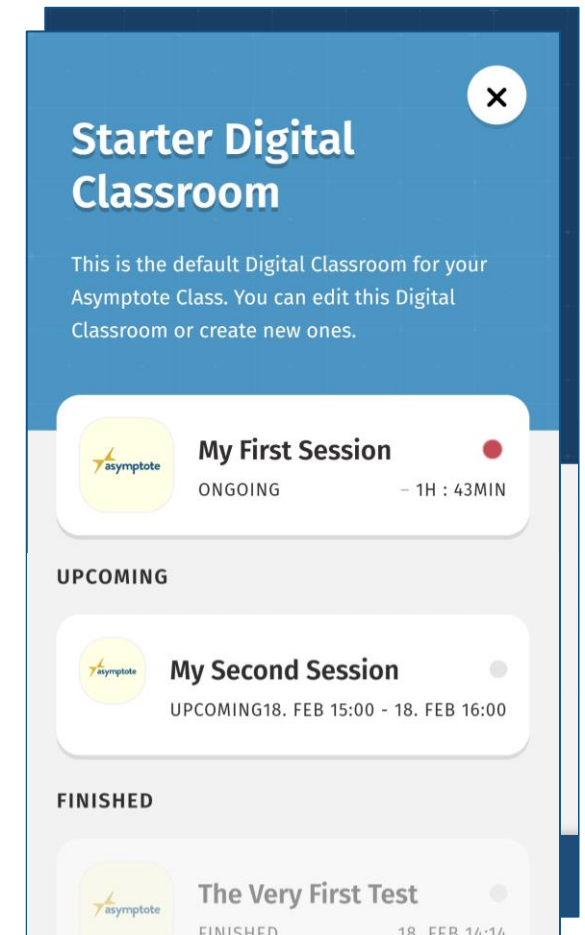


The Digital Classroom

Allocation of learning graphs to students:

The student's perspective (app)

- After entering the class via the QR code, the class is displayed under "My Class".
 - No registration is needed on student's side!
- All Digital Classrooms of this class are displayed here
- In a Digital Classroom, all sessions are shown
 - Currently available LG are marked by a red dot
 - „Upcoming“ shows already planned sessions
 - „Finished“ shows passed sessions



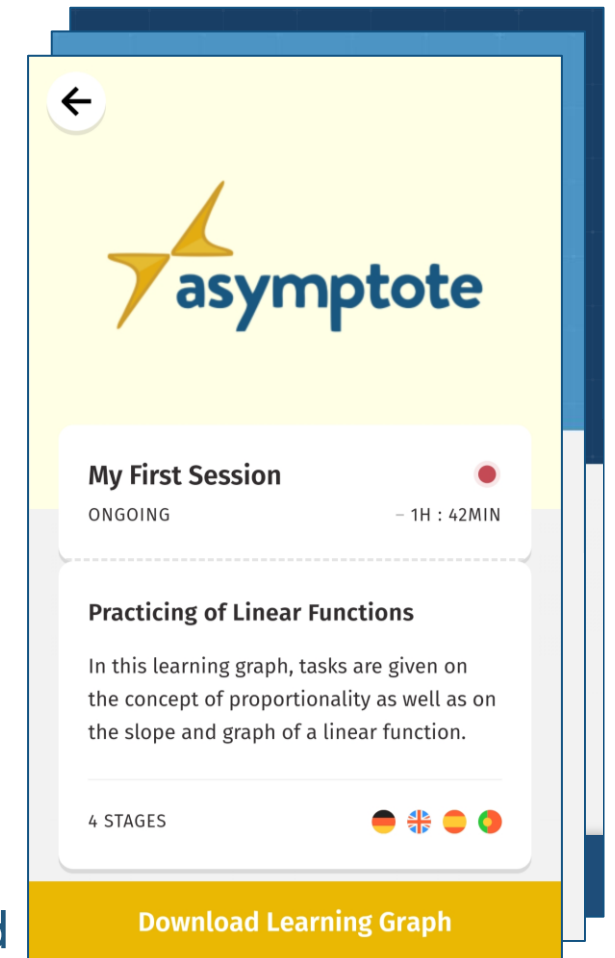


The Digital Classroom

Allocation of learning graphs to students:

The student's perspective (app)

- After entering the class via the QR code, the class is displayed under "My Class".
 - No registration is needed on student's side!
- All Digital Classrooms of this class are displayed here
- In a Digital Classroom, all sessions are shown
 - Currently available LG are marked by a red dot
 - „Upcoming“ shows already planned sessions
 - „Finished“ shows passed sessions
- By clicking on a current session, the related LG can be accessed

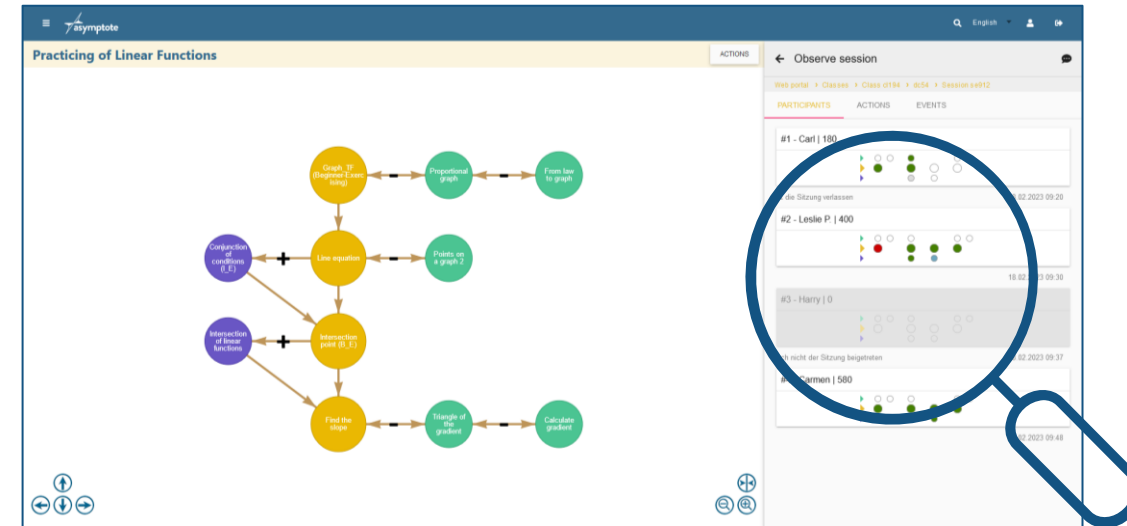




The Digital Classroom

Real-time monitoring of student's work process:

- Synchronously view of the work process:
 - How are the students doing progress?
 - Do they need support?



The screenshot displays the Asymptote software interface for "Practicing of Linear Functions". On the left, a flowchart outlines the learning process with nodes: "Graph 1st (Diagram Linear-ung)", "Proportional graph", "From text to graph", "Line equation", "Practice on a graph 2", "Intersection point (0, 1)", "Find the slope", "Triangle of the gradient", and "Calculate gradient". On the right, the "Observe session" dashboard shows a table of participants and their progress. A magnifying glass highlights the progress indicators for participants #1, #2, and #3.

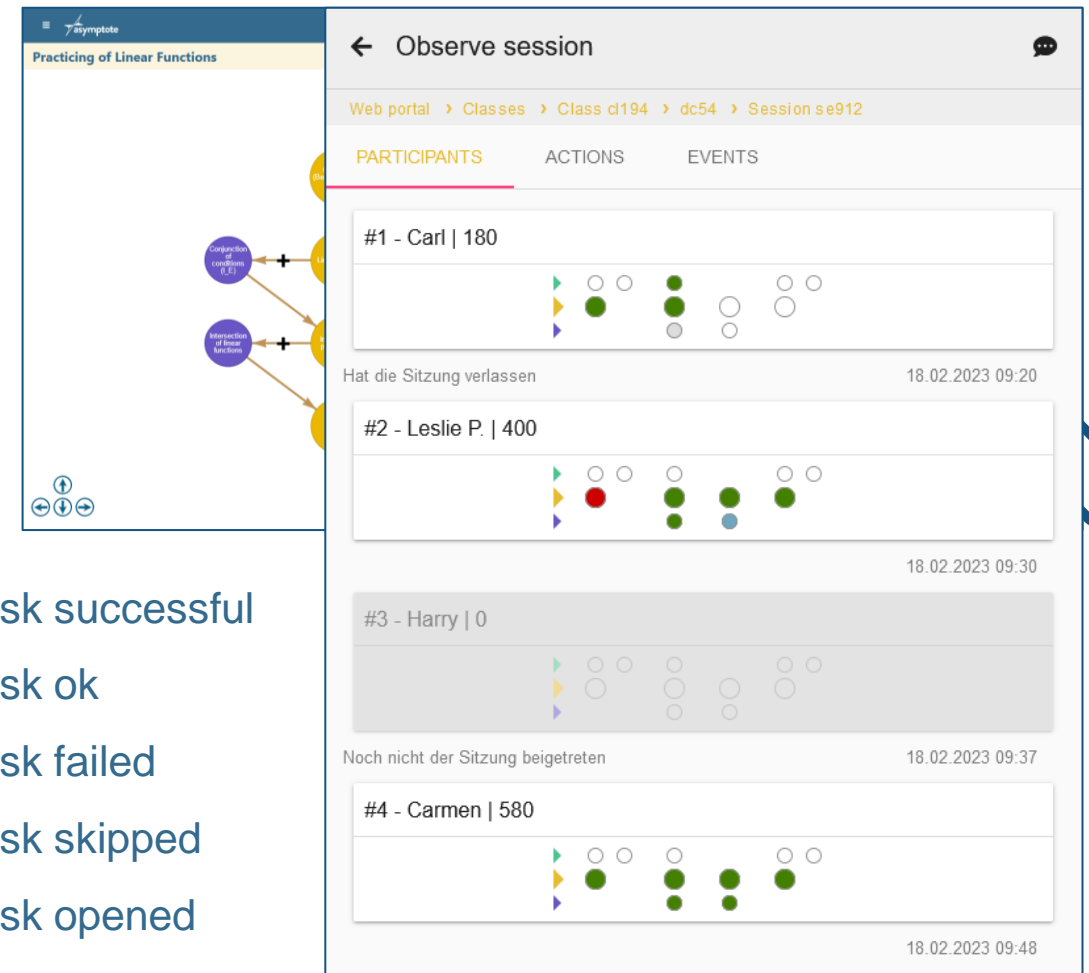
PARTICIPANTS	ACTIONS	EVENTS
#1 - Carl 190	die Sitzung verlassen	12.02.2023 09:20
#2 - Leslie P 400		18.02.2023 09:36
#3 - Harry 0	nicht der Sitzung beigetreten	12.02.2023 09:37
... 580		12.02.2023 09:48



The Digital Classroom

Real-time monitoring of student's work process:

- Synchronously view of the work process:
 - How are the students doing progress?
 - Do they need support?
- Monitoring on class level
 - Received points are displayed
 - LG & work process is represented



The screenshot shows the 'Observe session' interface for a class. The title is 'Practicing of Linear Functions'. The breadcrumb trail is 'Web portal > Classes > Class d194 > dc54 > Session se912'. There are three tabs: 'PARTICIPANTS', 'ACTIONS', and 'EVENTS'. The 'PARTICIPANTS' tab is active, showing a list of students with their names, IDs, and progress indicators. The progress indicators consist of a series of colored circles and a yellow triangle. A legend below the list explains the colors: green for 'Task successful', yellow for 'Task ok', red for 'Task failed', grey for 'Task skipped', and blue for 'Task opened'. The students listed are: #1 - Carl | 180 (left), #2 - Leslie P. | 400 (left), #3 - Harry | 0 (right), and #4 - Carmen | 580 (right). The interface also shows session status messages like 'Hat die Sitzung verlassen' and 'Noch nicht der Sitzung beigetreten' with timestamps.

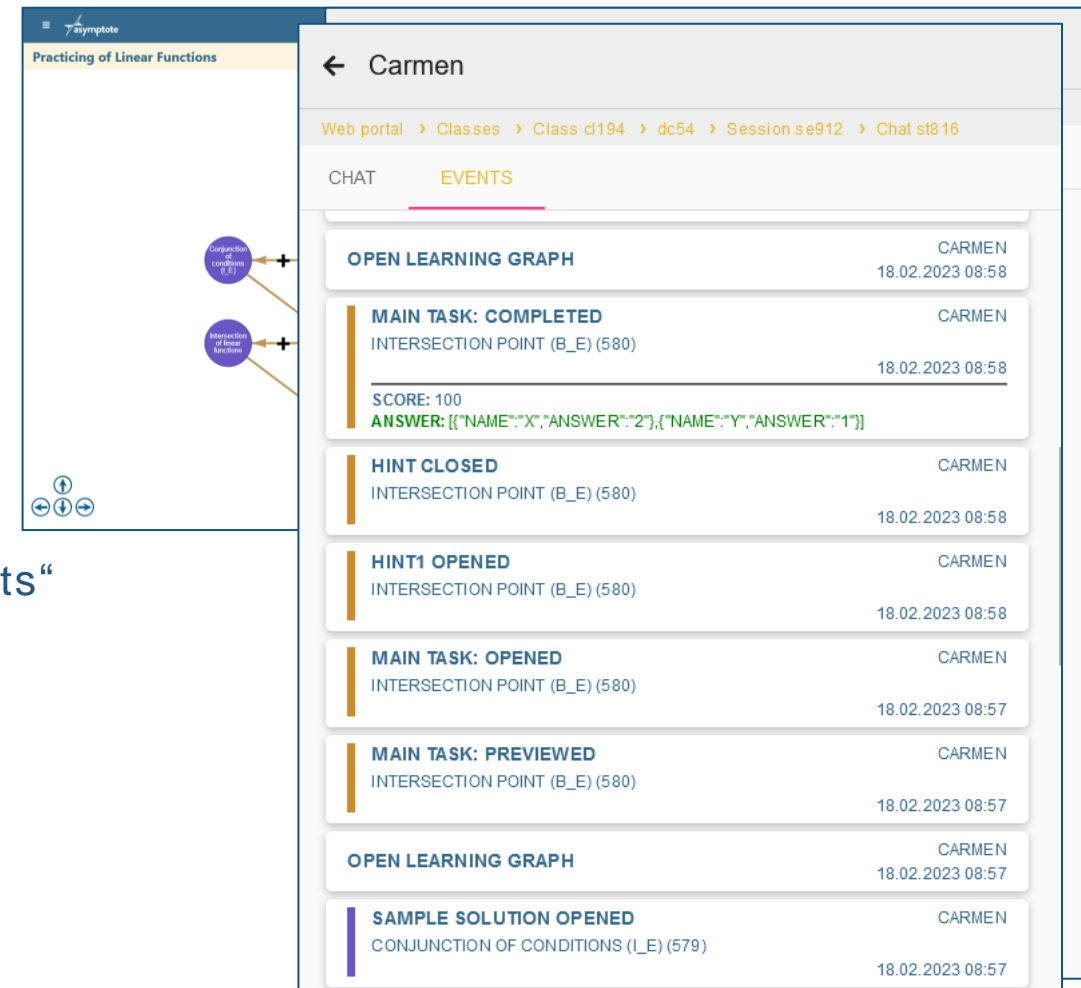
- Task successful
- Task ok
- Task failed
- Task skipped
- Task opened



The Digital Classroom

Real-time monitoring of student's work process:

- Synchronously view of the work process:
 - How are the students doing progress?
 - Do they need support?
- Monitoring on individual level
 - Student's interaction with app is stored under „events“
 - Get a detailed insight in student's work process



The screenshot displays the Asymptote app interface for a student named Carmen. The main window shows the title "Practicing of Linear Functions" and a list of events. Two purple callout boxes on the left side of the main window point to specific events in the list: "Conjunction of conditions (L_E)" and "Intersection of linear functions".

The events list is as follows:

Event	Time
OPEN LEARNING GRAPH	18.02.2023 08:58
MAIN TASK: COMPLETED INTERSECTION POINT (B_E) (580)	18.02.2023 08:58
SCORE: 100 ANSWER: [{"NAME":"X","ANSWER":"2"}, {"NAME":"Y","ANSWER":"1"}]	
HINT CLOSED INTERSECTION POINT (B_E) (580)	18.02.2023 08:58
HINT1 OPENED INTERSECTION POINT (B_E) (580)	18.02.2023 08:58
MAIN TASK: OPENED INTERSECTION POINT (B_E) (580)	18.02.2023 08:57
MAIN TASK: PREVIEWED INTERSECTION POINT (B_E) (580)	18.02.2023 08:57
OPEN LEARNING GRAPH	18.02.2023 08:57
SAMPLE SOLUTION OPENED CONJUNCTION OF CONDITIONS (L_E) (579)	18.02.2023 08:57

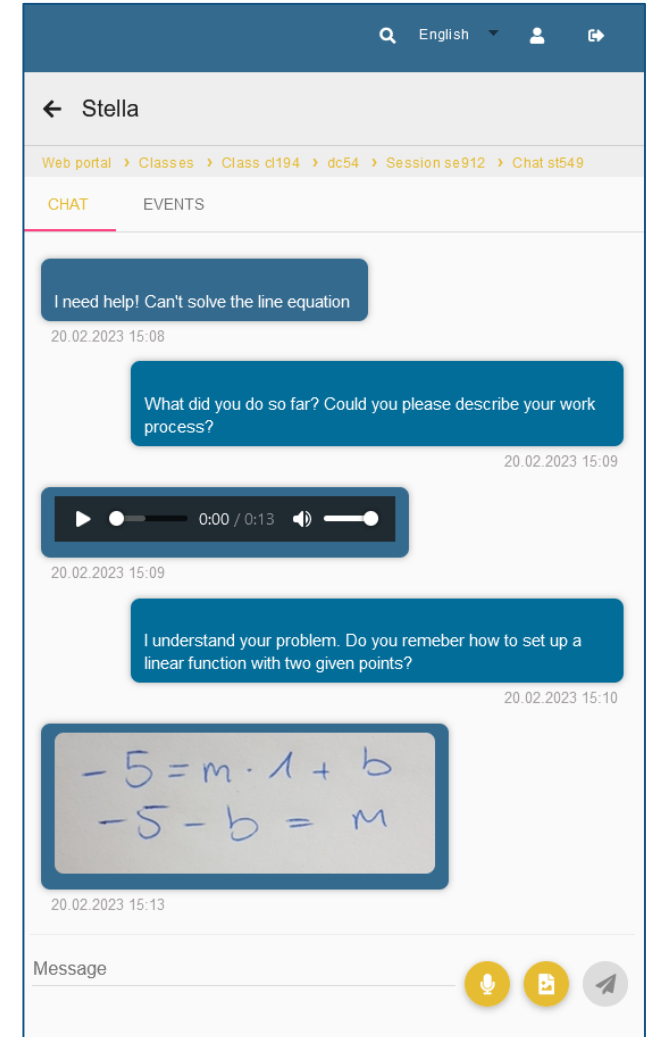


The Digital Classroom

Student-teacher interaction via chat:

- Synchronous communication via chat
 - Text messages
 - Images
 - Audio messages

Support your students & give individual feedback despite of the online setting!



The screenshot shows a chat window titled "Stella". The chat history includes:

- A student message: "I need help! Can't solve the line equation" (20.02.2023 15:08)
- A teacher message: "What did you do so far? Could you please describe your work process?" (20.02.2023 15:09)
- An audio message player showing a duration of 0:00 / 0:13 (20.02.2023 15:09)
- A teacher message: "I understand your problem. Do you remember how to set up a linear function with two given points?" (20.02.2023 15:10)
- A handwritten formula image:

$$\begin{aligned} -5 &= m \cdot 1 + b \\ -5 - b &= m \end{aligned}$$
 (20.02.2023 15:13)

The bottom of the chat shows a "Message" input field and icons for voice recording, image sharing, and sending.



The Digital Classroom

Evaluation on individual & class level:

- Use the monitoring function for an evaluation of the work session:
 - Which students performed very well?
 - Which students need further support?
 - Which task was perceived as difficult?

Note: By comparing student's performance on various LG within one Digital Classroom, you can perform a basic long-term analysis!



Data Protection within the Digital Classroom

Information on data privacy:

- The data is processed and stored in Germany (1&1 - Frankfurt site).
- The collected data is not personal
 - No registration for students necessary
 - No email addresses required
 - No clear name required: users choose a pseudonym
 - Identification is done temporarily via random key
 - Encrypted transmission of data (SSL)

ASYMPTOTE complies with the provisions of the GDPR



Chapter 4: The ASYMPTOTE App

How to use the ASYMPTOTE App

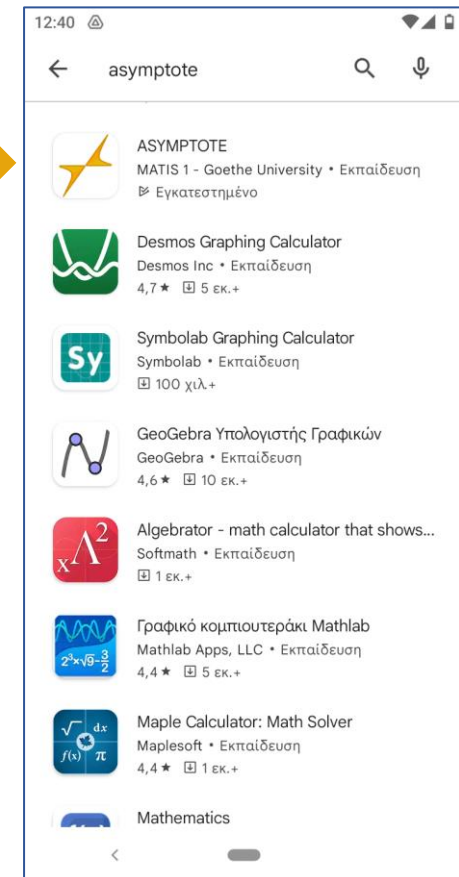
Application download

For **Android**:

1. Visit Google play
2. Search for “ASYMPTOTE”
3. Click on the download button

For **iOS**:

1. Visit AppStore
2. Search for “ASYMPTOTE”
3. Click on the download button

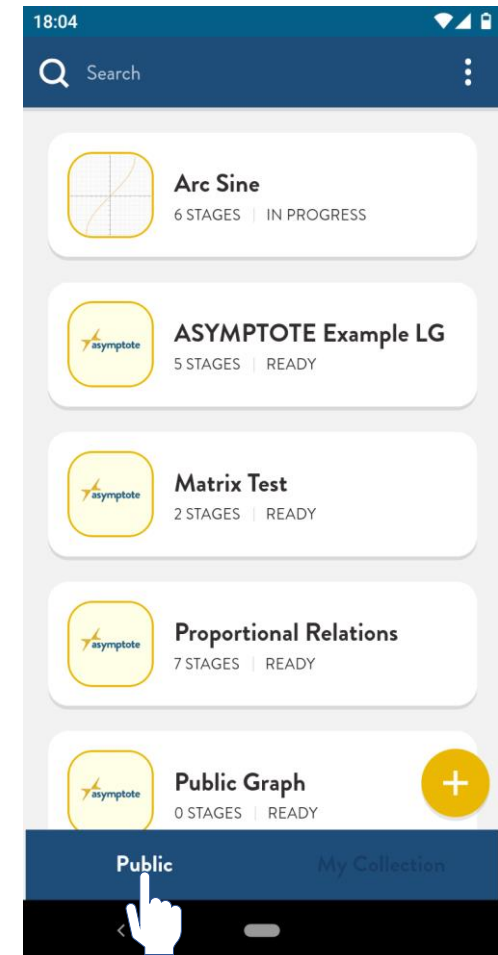




Application Functionalities

The ASYMPTOTE App offers the possibility ...

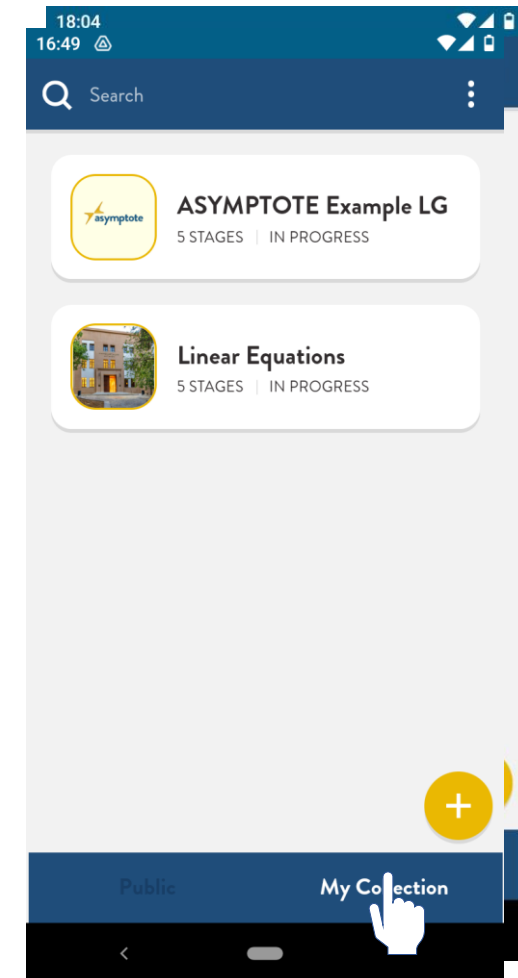
1. to select a **public Learning Graph** from a list available



Application Functionalities

The ASYMPTOTE App offers the possibility ...

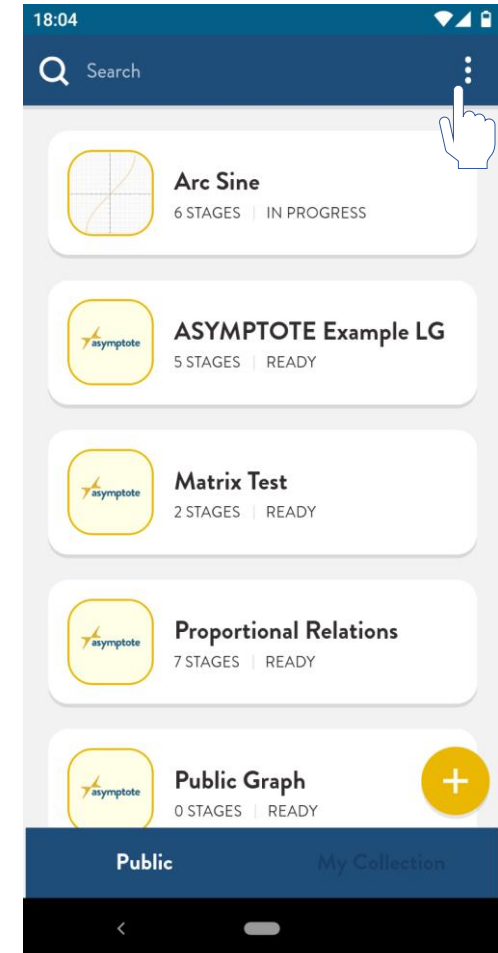
1. to select a **public Learning Graph** from a list available
2. to form a personal gallery of **Learning Graphs** in
 “My collection”





Before you start

1. Select the language you prefer
 - Click on the **three dots** button

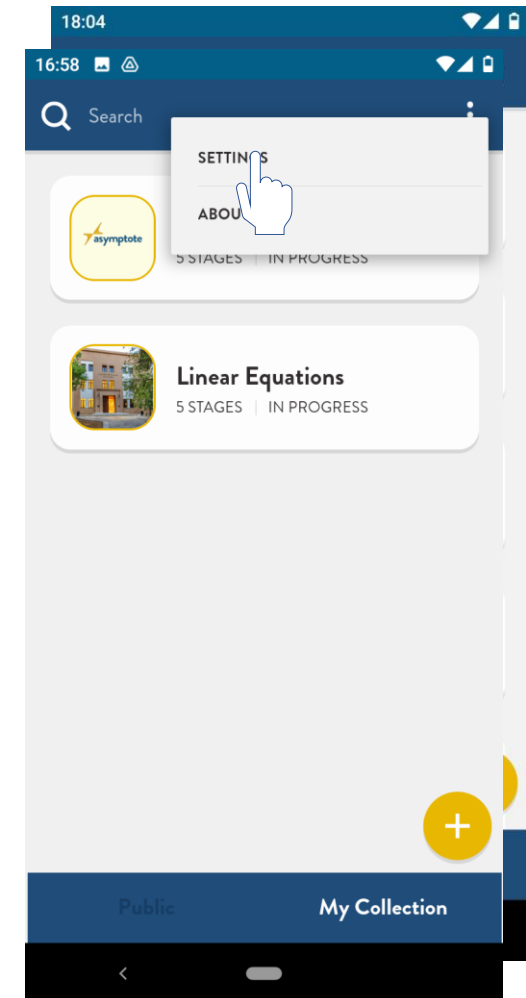




Before you start

1. Select the language you prefer

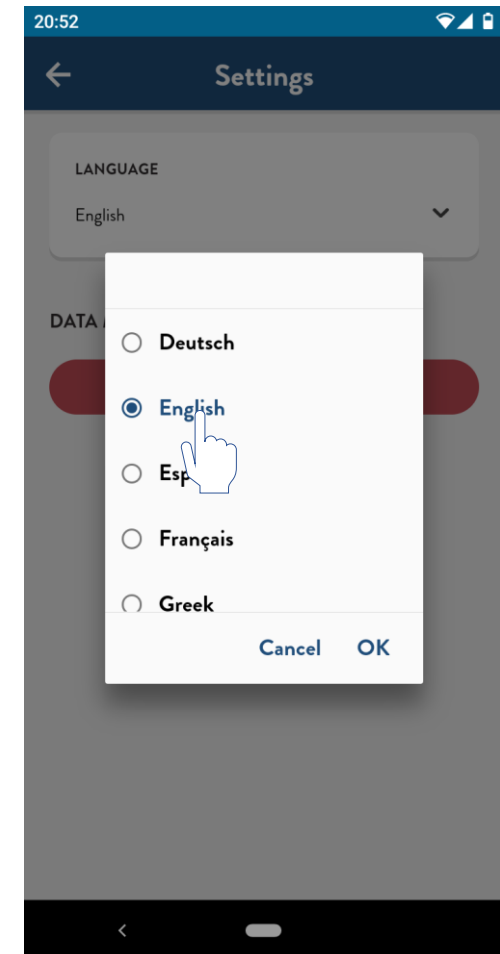
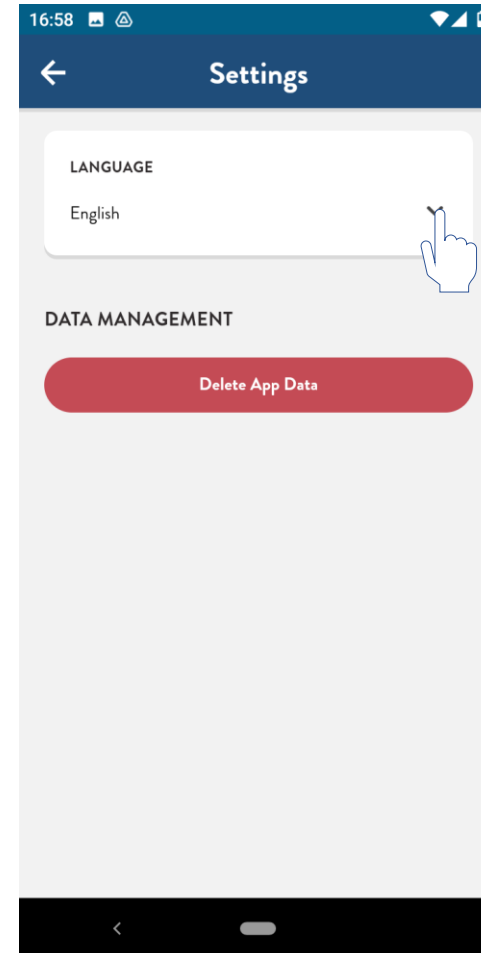
- Click on the **three dots** button
- Click on **“SETTINGS”**




Before you start

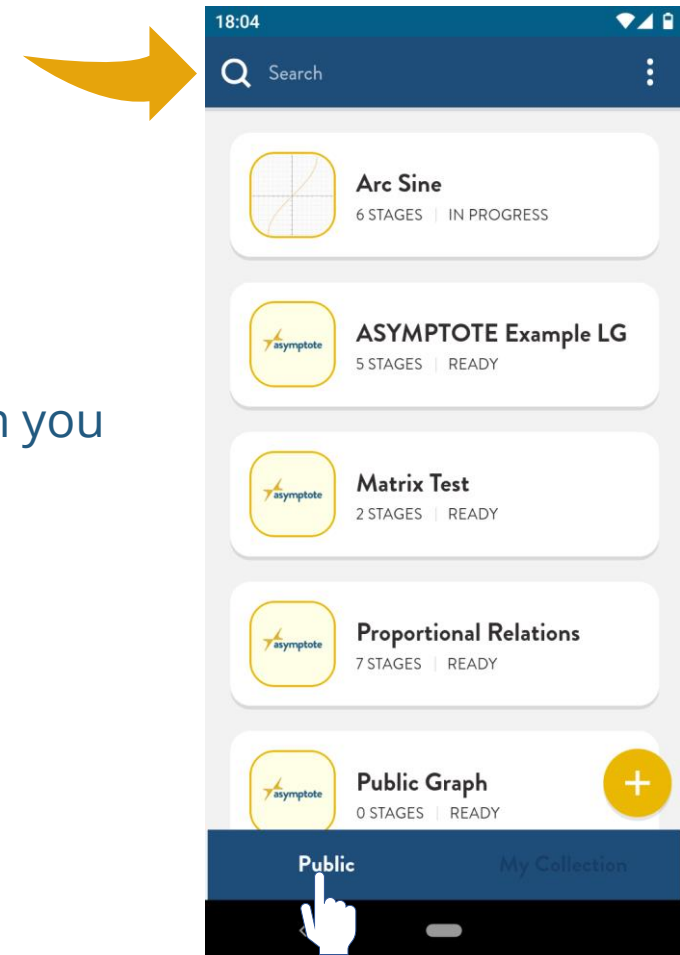
1. Select the language you prefer

- Click on the **three dots** button
- Click on **“SETTINGS”**
- Select your language




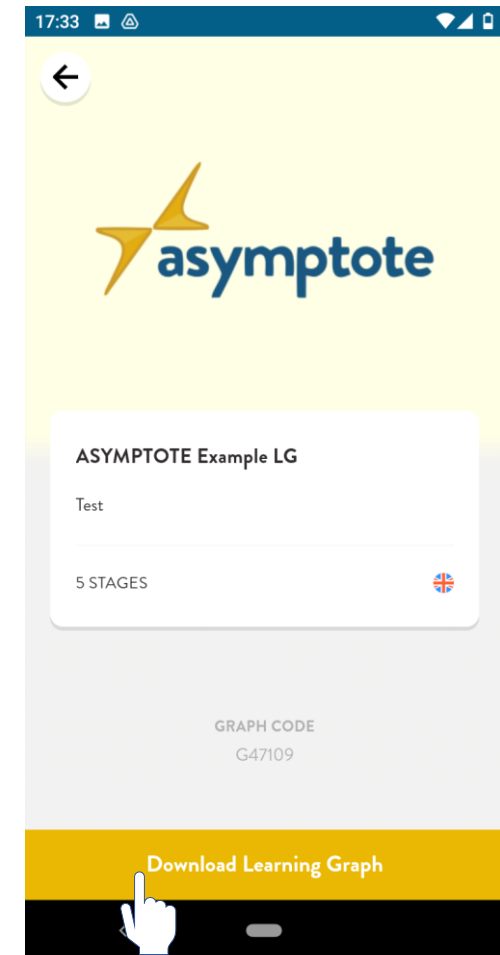
Select a public Learning Graph

1. Click on the **"Public"** button down on the left
 2. Choose a Learning Graph from the available list
- ✓ To search the list by name or code for a desired Learning Graph you can use the  **search** button



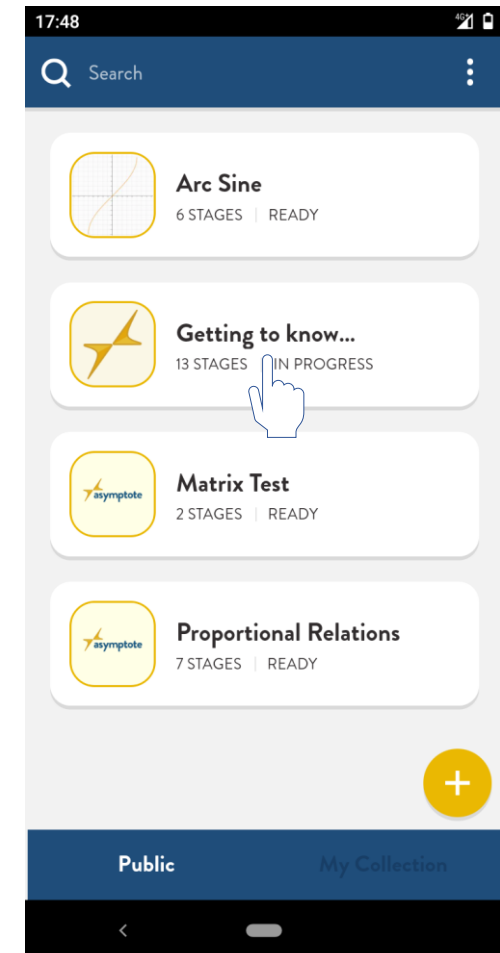
Select a public Learning Graph

1. Click on the **"Public"** button down on the left
2. Choose a Learning Graph from the available list
- ✓ To search the list by name or code for a desired Learning Graph you can use the  **search** button
3. Download the desired Learning Graph




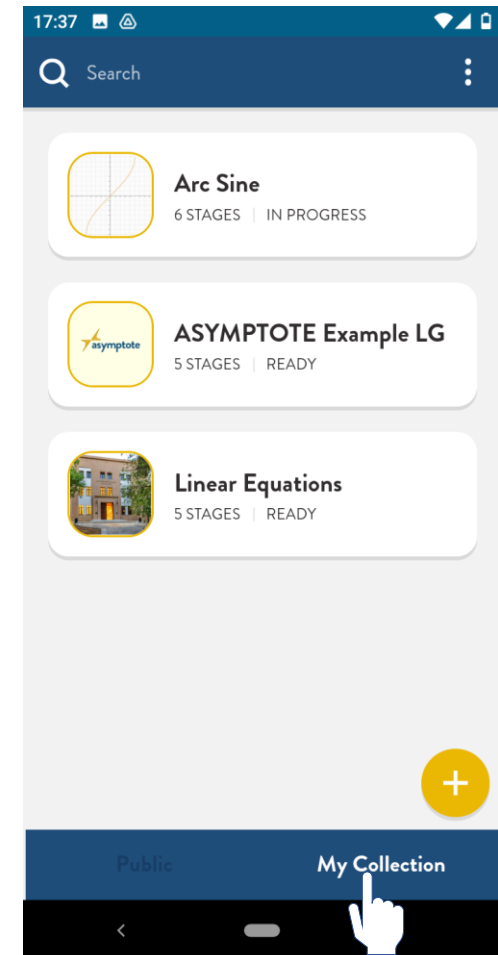
Getting to know ASYMPTOTE app

1. **Before you start** exploring the app by yourself it is recommended to choose the **Getting to know ASYMPTOTE** Learning Graph
2. This Learning Graph **presents the features** of the ASYMPTOTE app and **the multiple answer formats**.
3. You can also search this Learning Graph by code: **G47109**




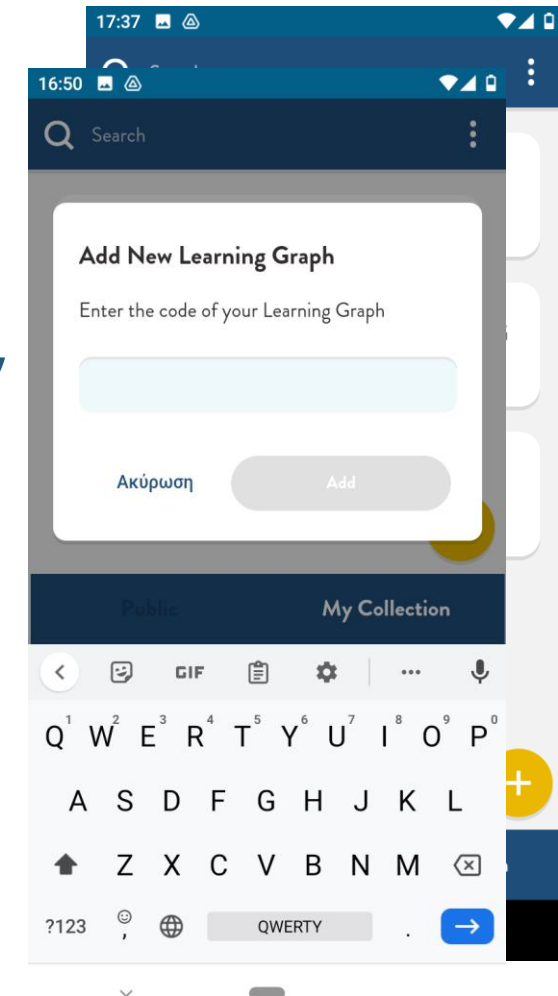
“My Collection” of Learning Graphs

1. Every downloaded Learning Graph is automatically added to your personal gallery “**My Collection**”
2. To **add** any desired Learning Graph to “My Collection” click on the  button (search by code)
3. You can also **remove** any Learning Graph that you don't need anymore from your collection




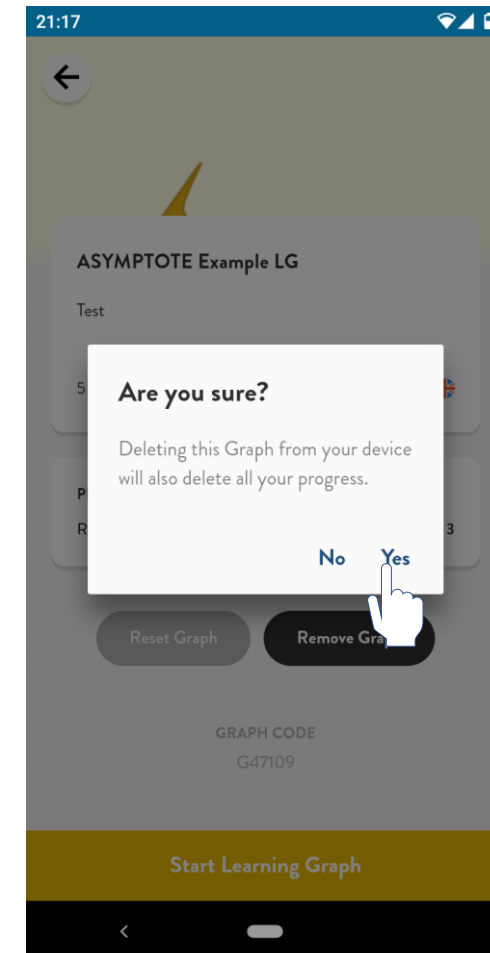
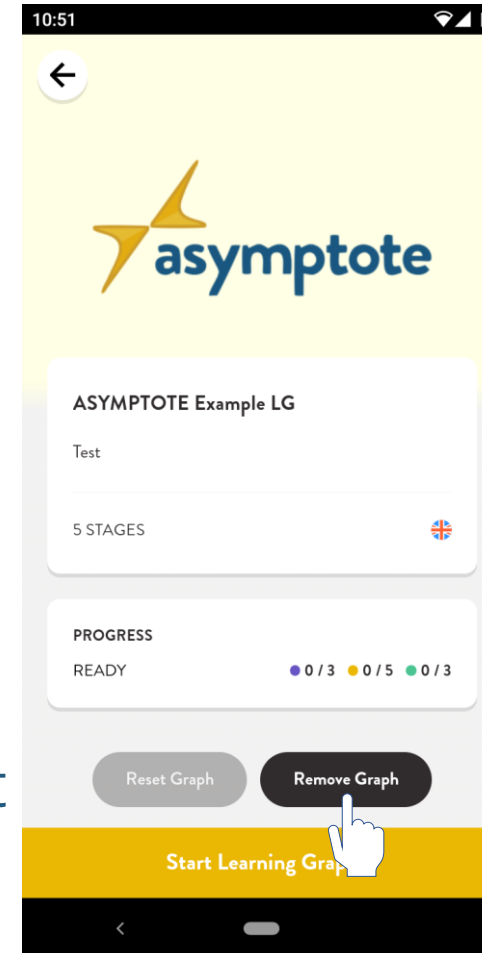
“My Collection” of Learning Graphs

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“My Collection” of Learning Graphs

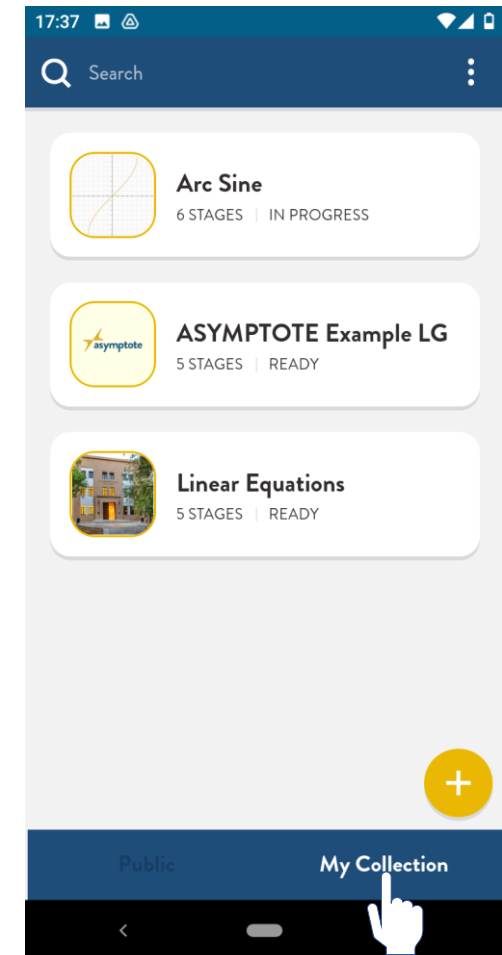
1. Every downloaded Learning Graph is automatically added to your personal gallery “My Collection”
2. To **add** any desired Learning Graph to “My Collection” click on the  button (search by code)
3. You can also **remove** any Learning Graph that you don’t need anymore from your collection





Start Learning Graph

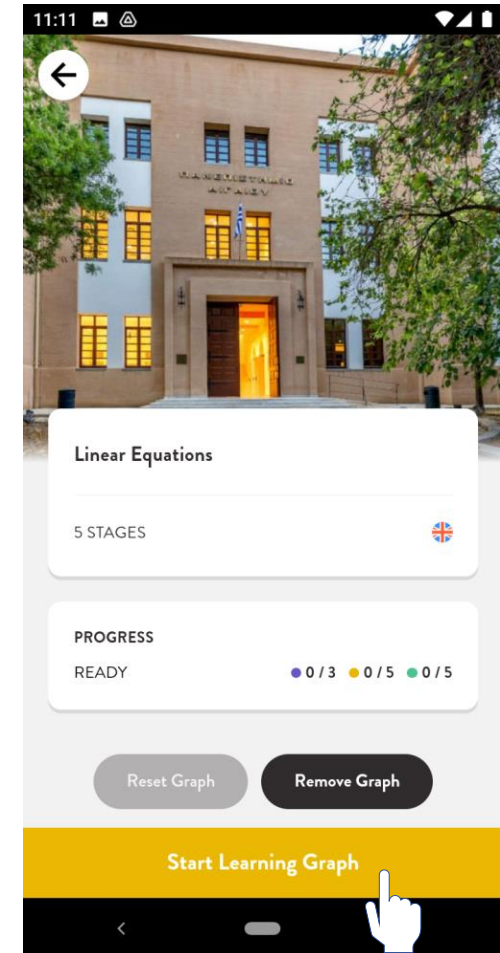
1. Choose a Learning Graph from **"My Collection"**





Start Learning Graph

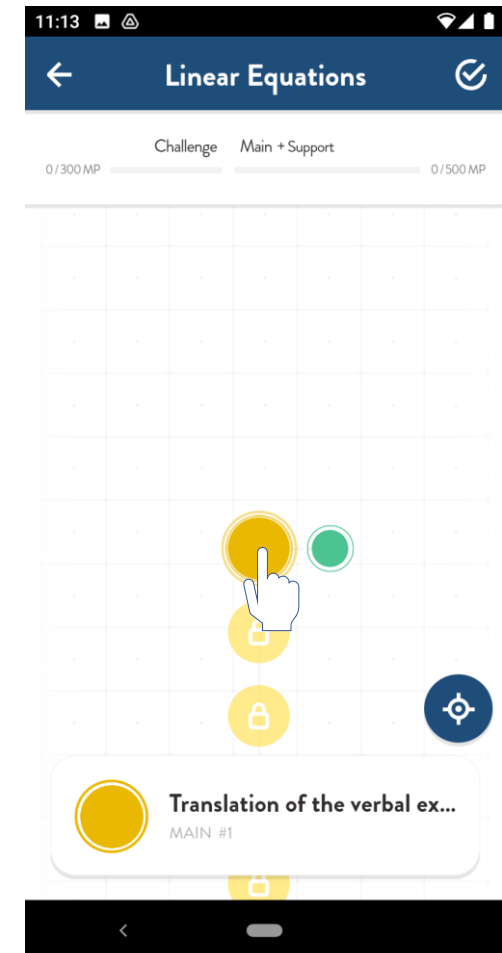
1. Choose a Learning Graph from **"My Collection"**
2. Click on the **"Start Learning Graph"** button down bellow





Start Learning Graph

1. Choose a Learning Graph from **"My Collection"**
2. Click on the **"Start Learning Graph"** button down bellow
3. Click on the **main task** (orange) or the **support task** (green) to start solving

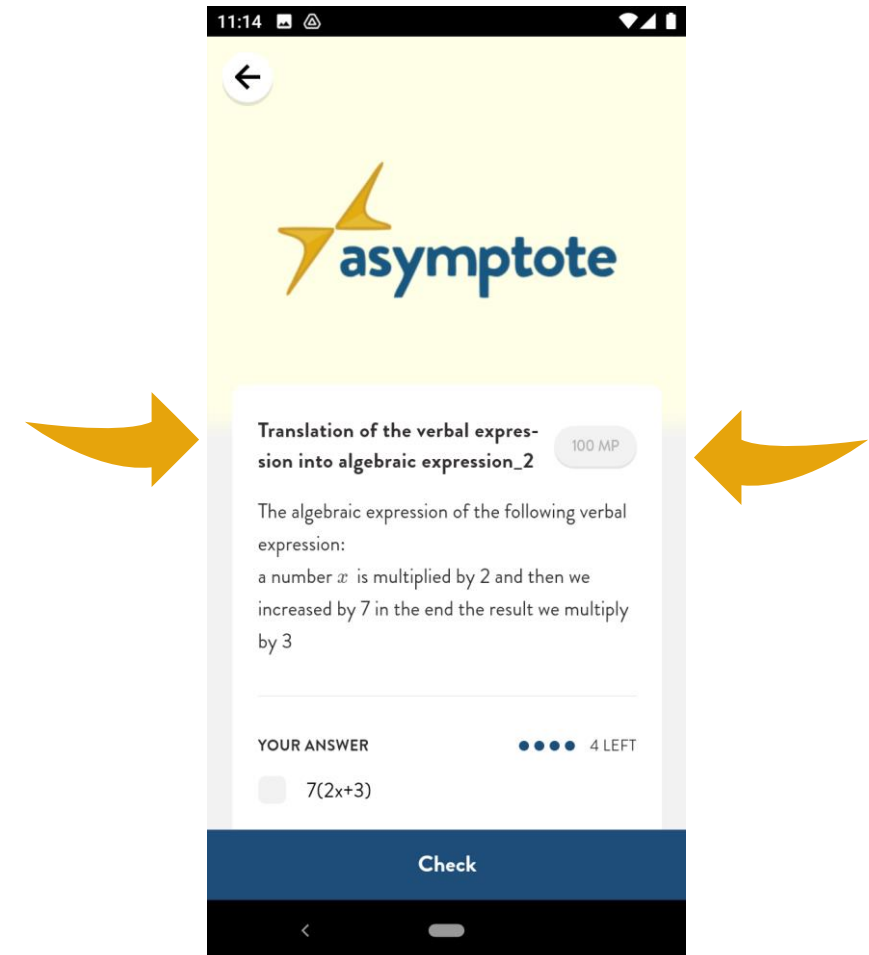




The task formular

On this interface you can see:

- The task **title**
- The task **definition**
- The **answer area**
- The task **points**
- How many **tries** you have left

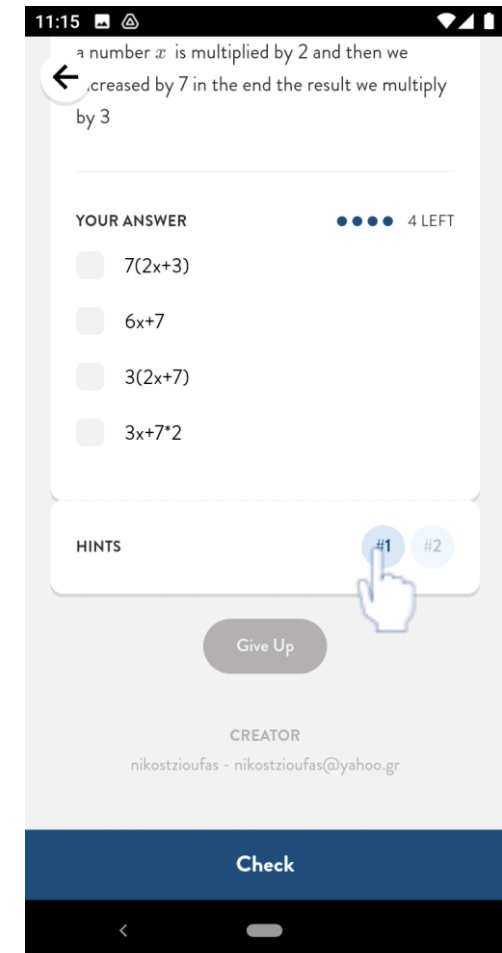




The task formular

Scrolling down on this interface you can see:

- The available **Hints**
- The **“Give up”** button



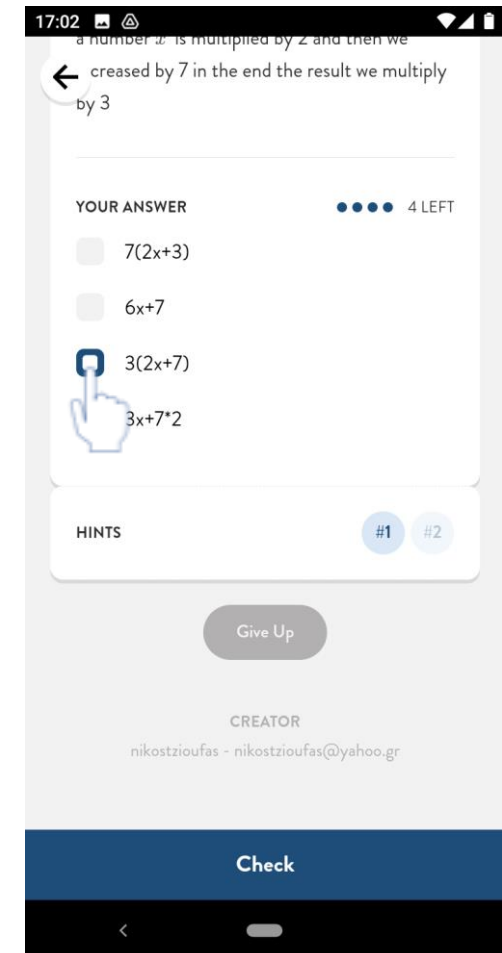


Answering the task

Choose an answer

1. If it is **correct**:

- You can see the **Sample solution** and you can **Continue**

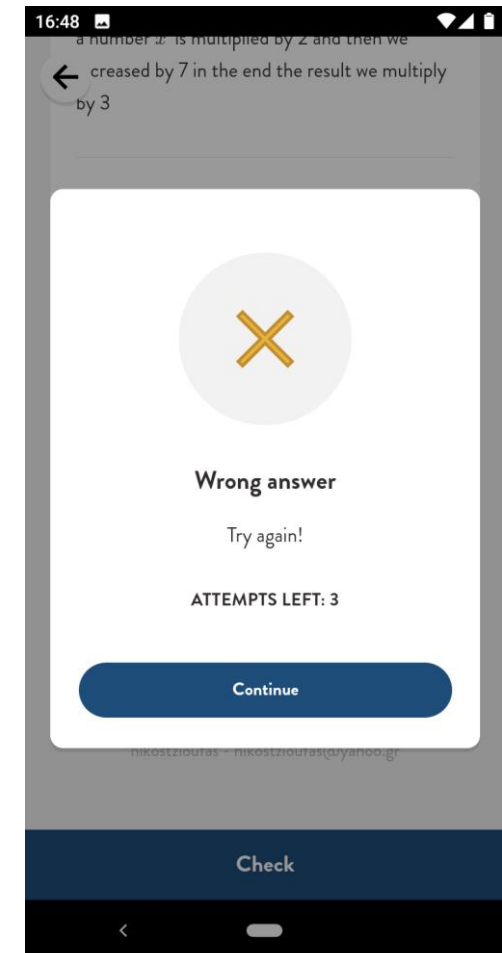


Answering the task

Choose an answer

1. If it is **correct**:
 - You can see the **Sample solution** and you can **Continue**
2. If it is **wrong**:
 - The first time **you don't get any help**
 - The second and third time **a Hint is suggested** by the system
 - The fourth time the **sample solution is available**
 - Then you should **return to the Learning Graph** to continue

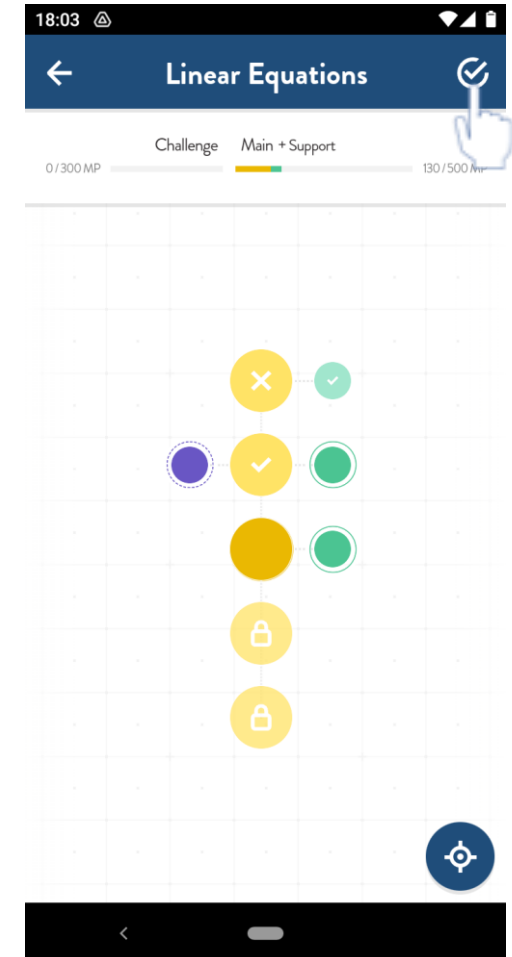
The System suggest to use support / challenge tasks after twice failing / solving a task





Other options

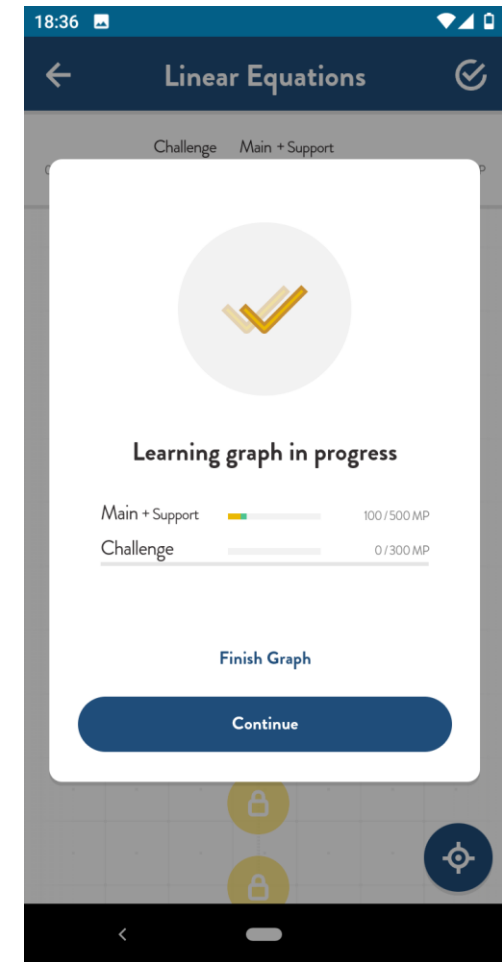
1. You can check the progress of a Learning Graph on the **top side of the screen**





Other options

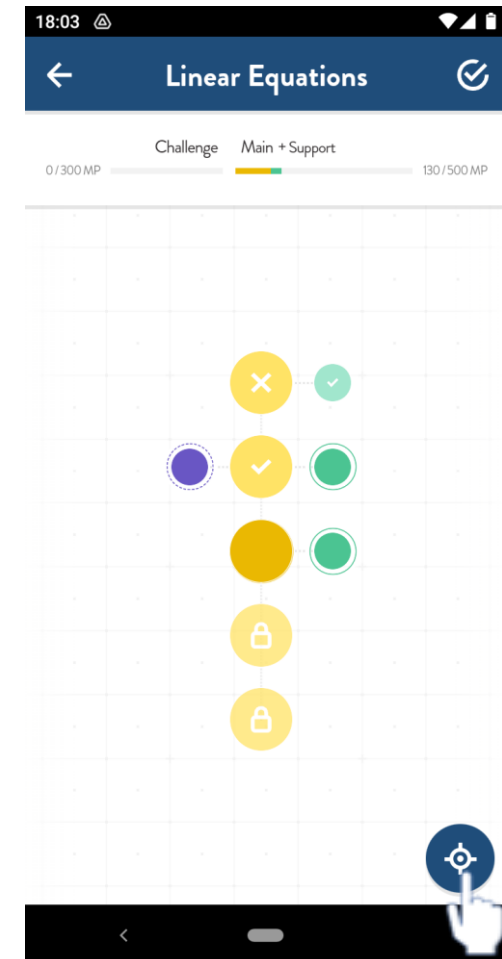
1. You can check the progress of a Learning Graph on the **top side of the screen**
2. You can also check the progress and/or finish a Learning Graph using the **check** button





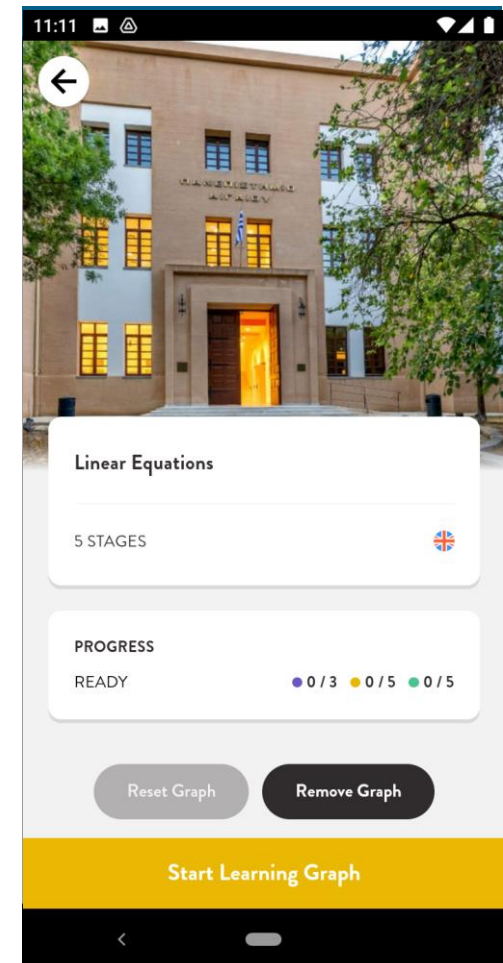
Other options

1. You can check the progress of a Learning Graph on the **top side of the screen**
2. You can also check the progress and/or finish a Learning Graph using the **check** button
3. With the **target** button you can bring back the Learning Graph in the center of the screen



Other options

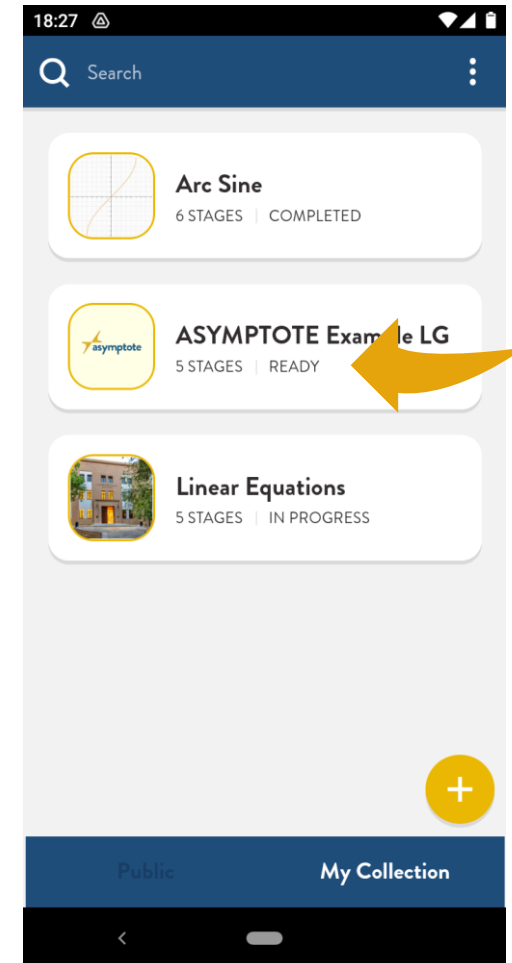
1. You can check the progress of a Learning Graph on the **top side of the screen**
2. You can also check the progress and/or finish a Learning Graph using the **check** button
3. With the **target** button you can bring back the Learning Graph in the center of the screen
4. You can exit the Learning Graph for a while using the **arrow** button





Other options

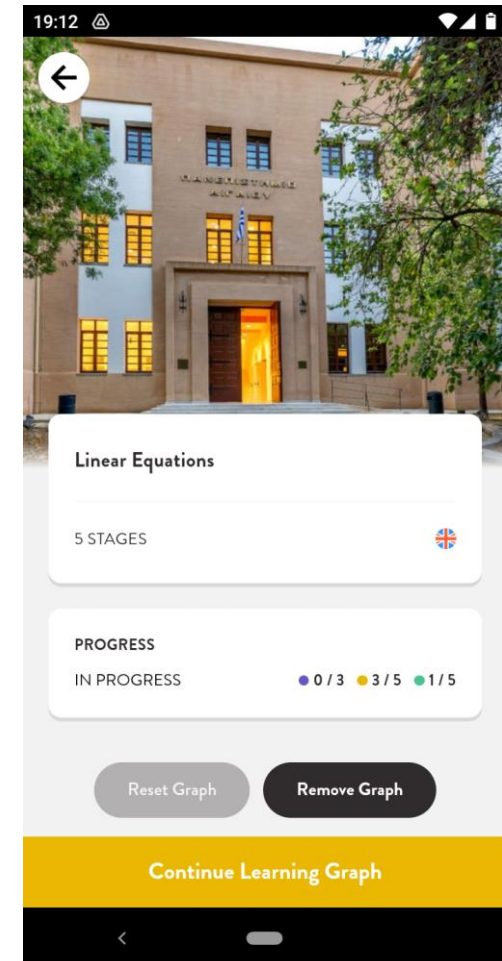
1. The Learning Graphs that you haven't started yet are marked with the indication **"READY"**





Other options

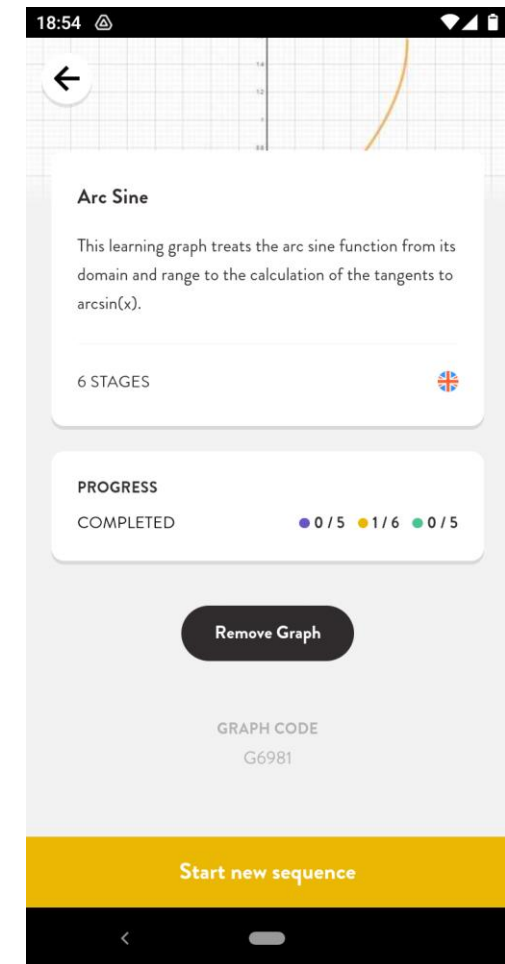
1. The Learning Graphs that you haven't started yet are marked with the indication **"READY"**
2. The unfinished Learning Graphs are marked with the indication **"IN PROGRESS"**
 - You can **reset** every unfinished Learning Graph to start again from the beginning





Other options

1. The Learning Graphs that you haven't started yet are marked with the indication "**READY**"
2. The unfinished Learning Graphs are marked with the indication "**IN PROGRESS**"
 - You can **reset** every unfinished Learning Graph to start again from the beginning
3. The finished Learning Graphs are marked with the indication "**COMPLETED**"
 - you can also **start a new sequence** of the finished Learning Graphs
 - or you can **Remove Graph** download it again and make a fresh start





Chapter 5:

Best practice examples

Learning Graphs in different fields of mathematics



Linear functions 1

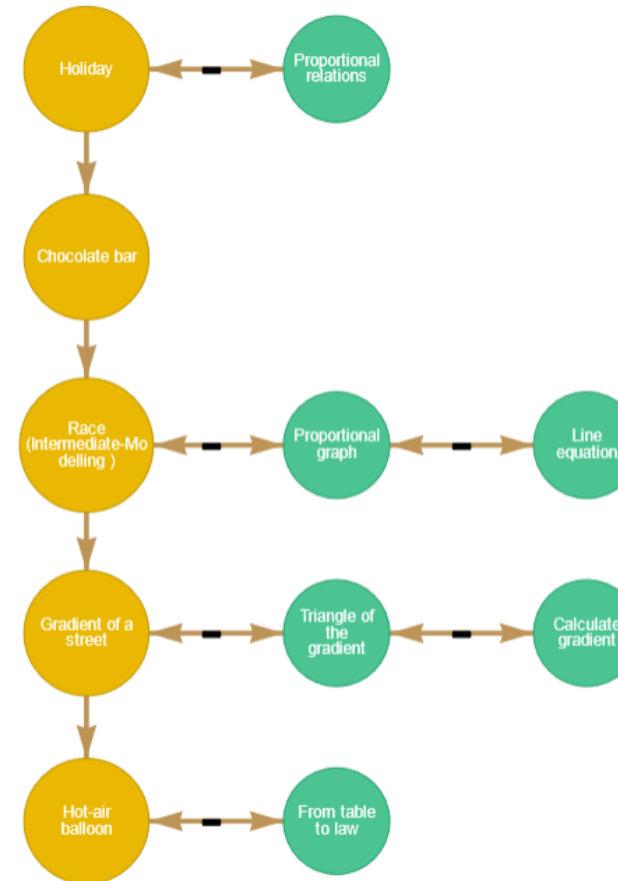
Linear functions (modelling)

In this learning graph, you can practice using and modeling linear functions.

Level: lower secondary level

Download LG via this code in the app: g89220

#Main Tasks	#Challenge Tasks	#Support Tasks
5	0	6





Linear functions 2

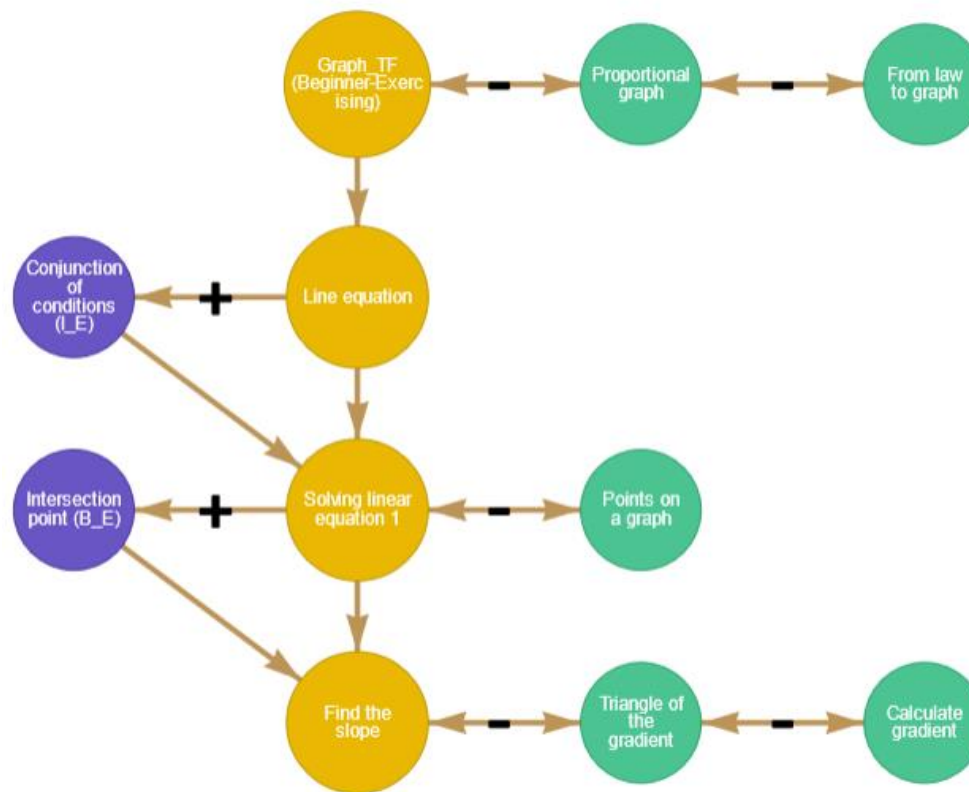
Practise linear functions

In this learning graph you can practise working with linear functions.

Level: lower secondary level

Download LG via this code in the app: g28219

#Main Tasks	#Challenge Tasks	#Support Tasks
4	2	5





Linear functions 3

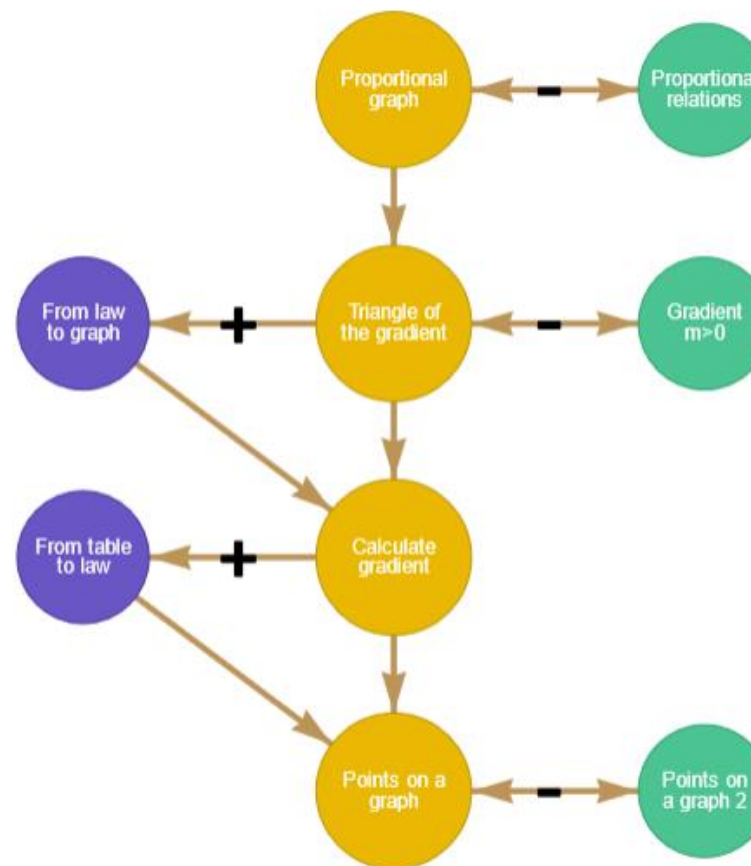
Proportional function

In this graph, you can practice and improve your knowledge about proportionality and proportional functions.

Level: lower secondary level

Download LG via this code in the app: g23218

#Main Tasks	#Challenge Tasks	#Support Tasks
4	2	3





Quadratic functions 1

Modeling with quadratic functions

This learning graph is about mathematical modeling. From basic to advanced tasks, mathematical backgrounds are embedded in factual contexts and complemented by appropriate challenges and supports. Have fun with this learning graph. It is suitable for grades 9 and up.

Level: lower secondary level

Download LG via this code in the app: g04348

#Main Tasks	#Challenge Tasks	#Support Tasks
6	2	4





Quadratic functions 2

Translations and the vertex of graphs of quadratic functions

This learning graph is suitable for grades 9 and up. It looks at translations of graphs of quadratic functions. There is a focus too on the vertex of quadratic functions.

Level: lower secondary level

Download LG via this code in the app: g14346

#Main Tasks	#Challenge Tasks	#Support Tasks
5	4	3





Quadratic functions 3

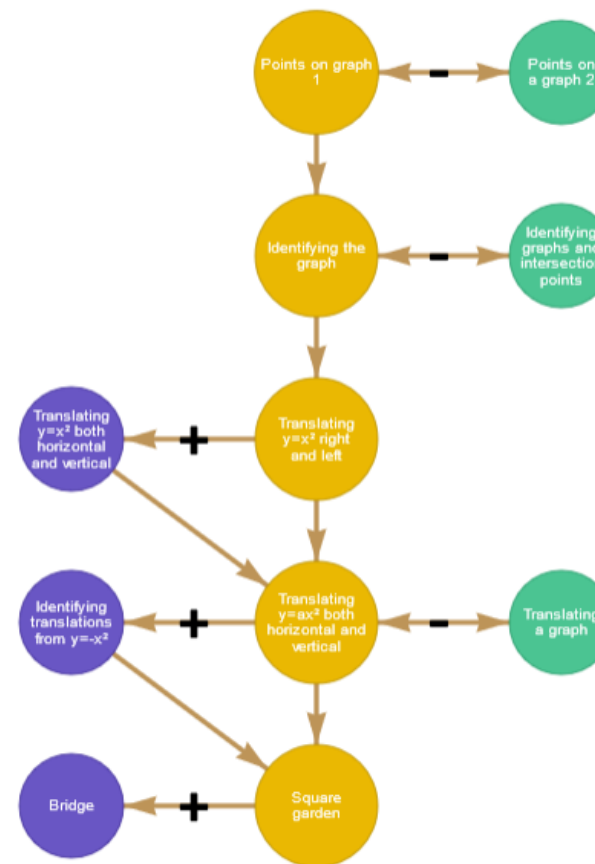
Properties of quadratic functions

In this learning graph, different tasks around the topic of quadratic functions are offered from easy to advanced difficulty level. In addition, challenges and supports are offered at different points. The Graph is for the 8th grade.

Level: lower secondary level

Download LG via this code in the app: g28345

#Main Tasks	#Challenge Tasks	#Support Tasks
5	3	3





Linear equations 1

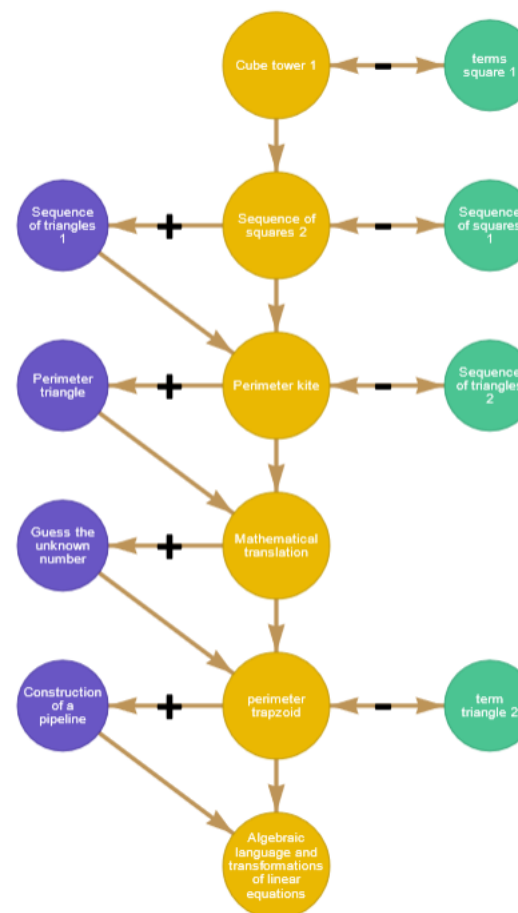
Modeling with linear equations:

This learning graph is about mathematical modeling. The main tasks consist of different modeling tasks. The respective challenges or supports are varying training tasks, which provide suitable learning opportunities due to structural similarities. Enjoy this learning graph. It is suitable for 8-9th grade.

Level: lower secondary level

Download LG via this code in the app: g19358

#Main Tasks	#Challenge Tasks	#Support Tasks
6	4	4





Linear equations 2

Reasoning and modeling with linear equations

This learning graph is about getting a deeper understanding of linear equations. The main tasks are not classical training tasks, but mainly consist of reasoning or modeling tasks. Training tasks find their application in the challenging or supporting tasks. Have fun and good luck! (LG for the 8th-9th grade)

Level: lower secondary level

Download LG via this code in the app: g17357

#Main Tasks	#Challenge Tasks	#Support Tasks
5	5	4





Linear equations 3

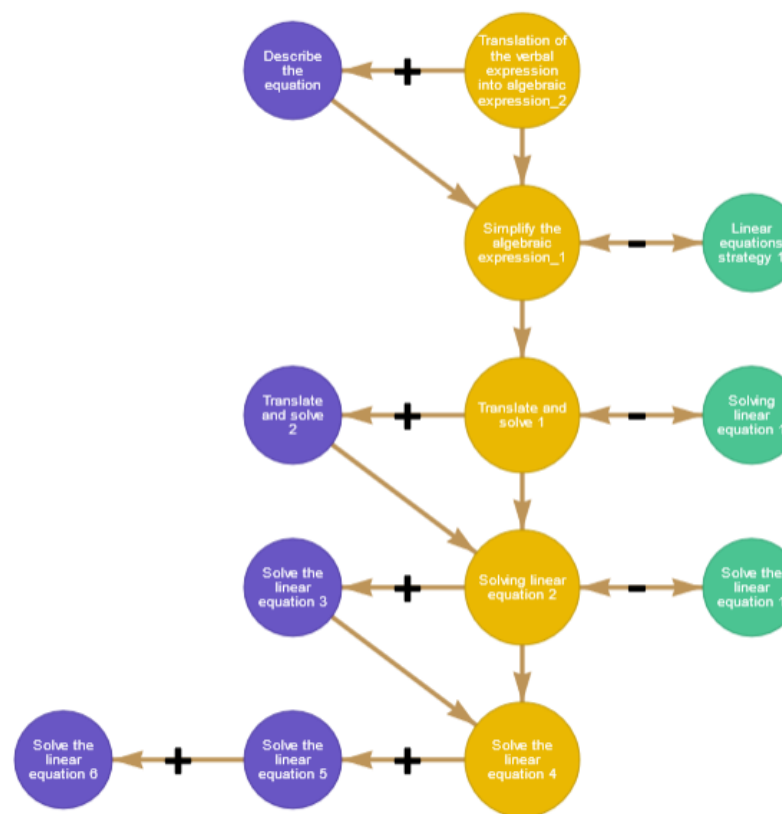
Solving linear equations

This learning graph is about practicing solving linear equations. It goes from simple exercises to real-life tasks. There is the possibility to accept challenges or to get support of supporting tasks. The graph is suitable for 7-8 grade.

Level: lower secondary level

Download LG via this code in the app: g25350

#Main Tasks	#Challenge Tasks	#Support Tasks
5	5	3





Integrals 1

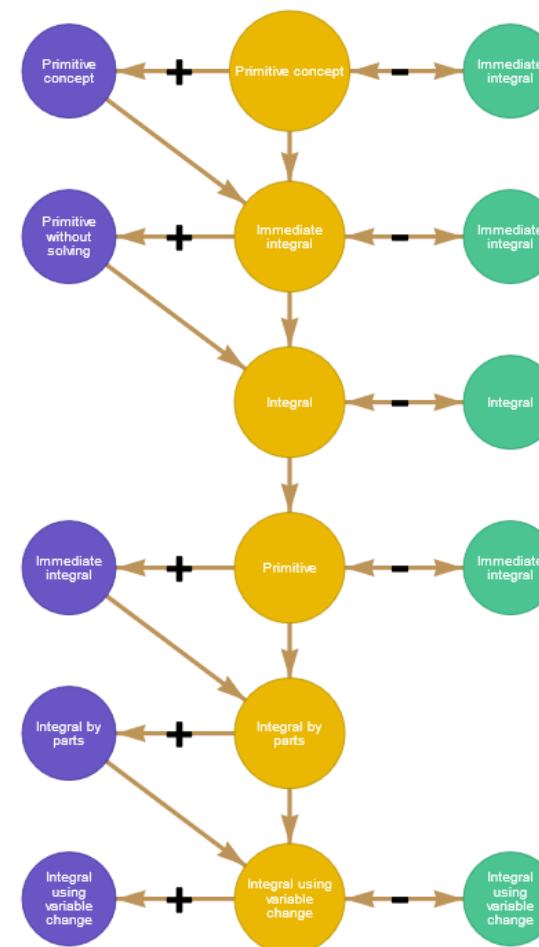
Indefinite integrals

In this learning graph, you can exercise primitive calculus, immediate integrals, quasi-immediate integrals, and integration by decomposition, parts, and substitution.

Level: higher secondary level & university level

Download LG via this code in the app: g47328

#Main Tasks	#Challenge Tasks	#Support Tasks
6	5	5





Integrals 2

LG - Definite integrals and application

The learning graph is about definite integral, integration techniques and application to the calculation of areas.

Level: higher secondary level & university level

Download LG via this code in the app: g28401

#Main Tasks	#Challenge Tasks	#Support Tasks
5	4	1





Inverse Trigonometric Functions 1

Inverse Trigonometric Function: arctan

Learning graph with several exercises about the arctan function that includes: domain; range of values; derivatives; inverse function; tangent and normal line; equations and inequations; differentials; approximate values.

Level: higher secondary level & university level

Download LG via this code in the app: g18222

#Main Tasks	#Challenge Tasks	#Support Tasks
7	5	8





Inverse Trigonometric Functions 2

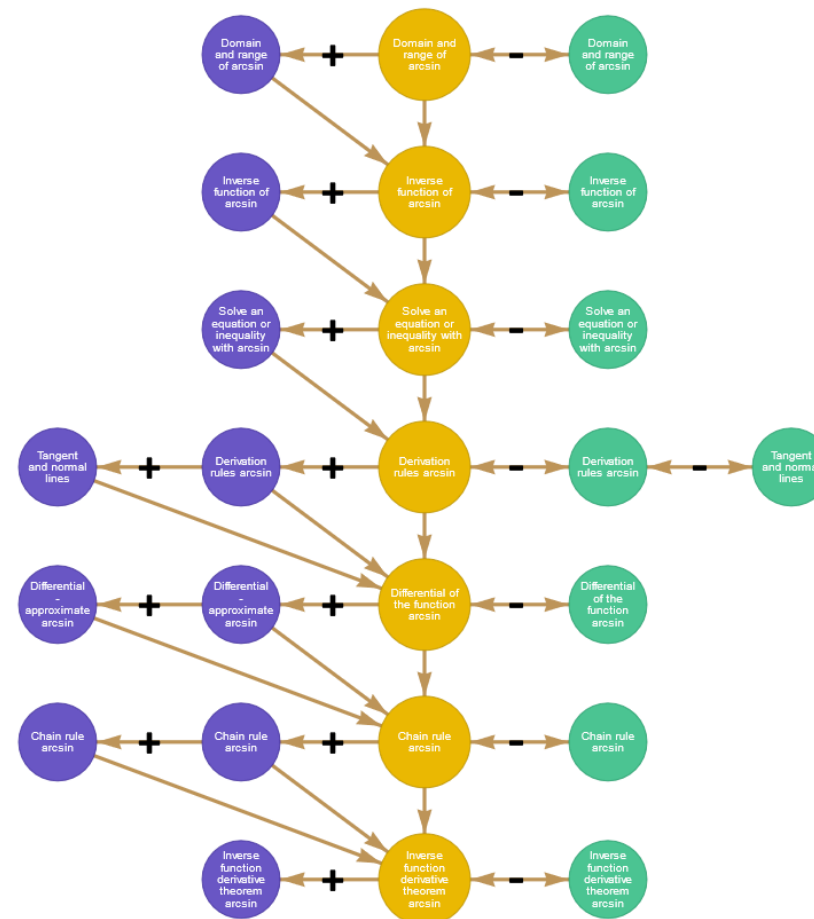
Inverse Trigonometric Function: arcsin

LearningGraph - inverse trigonometric function arcsin. Domain and range of values. Equations and inequalities. Tangent and normal line. Differential. Composite function derivative and inverse function derivative theorem.

Level: higher secondary level & university level

Download LG via this code in the app: g28248

#Main Tasks	#Challenge Tasks	#Support Tasks
7	10	8



Inverse Trigonometric Functions 3

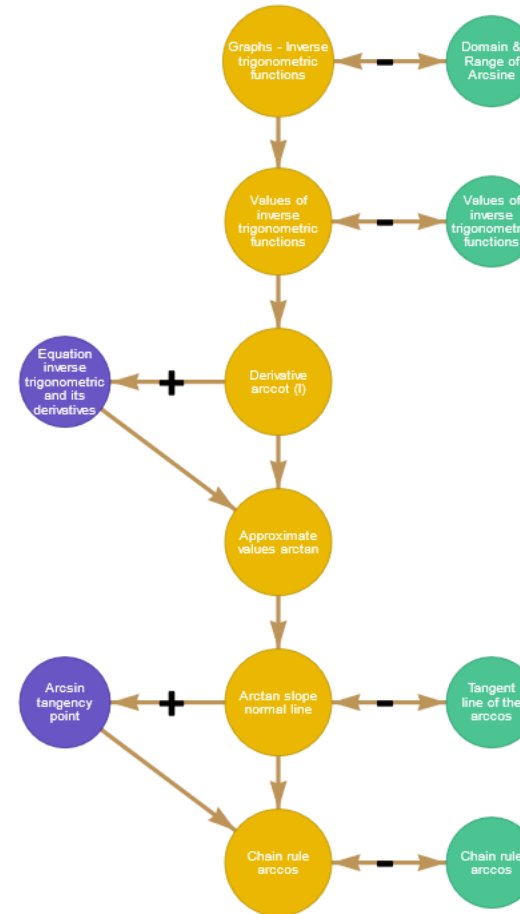
Inverse Trigonometric Functions

In this LG you can learn, train and reason about inverse trigonometric functions.

Level: higher secondary level & university level

Download LG via this code in the app: g67251

#Main Tasks	#Challenge Tasks	#Support Tasks
6	2	4





Inverse Trigonometric Functions 4

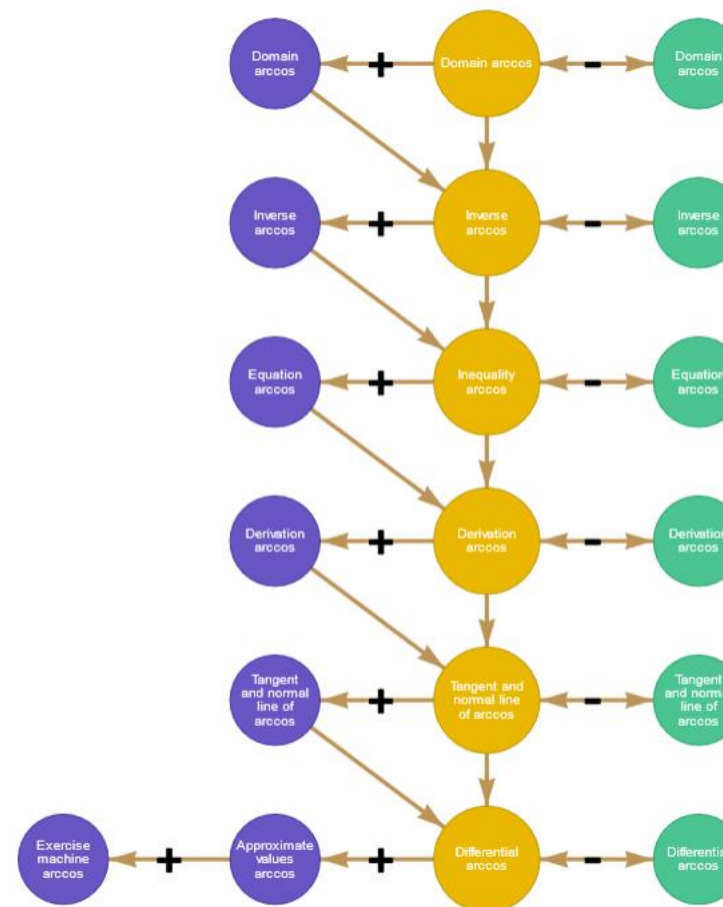
Inverse Trigonometric Function: arccos

Learning graph with several exercises about the arccos function that include: domain; range of values; derivatives; inverse function; tangent and normal line; equations and inequations; differentials; approximate values.

Level: higher secondary level & university level

Download LG via this code in the app: g03221

#Main Tasks	#Challenge Tasks	#Support Tasks
6	7	6





Inverse Trigonometric Functions 5

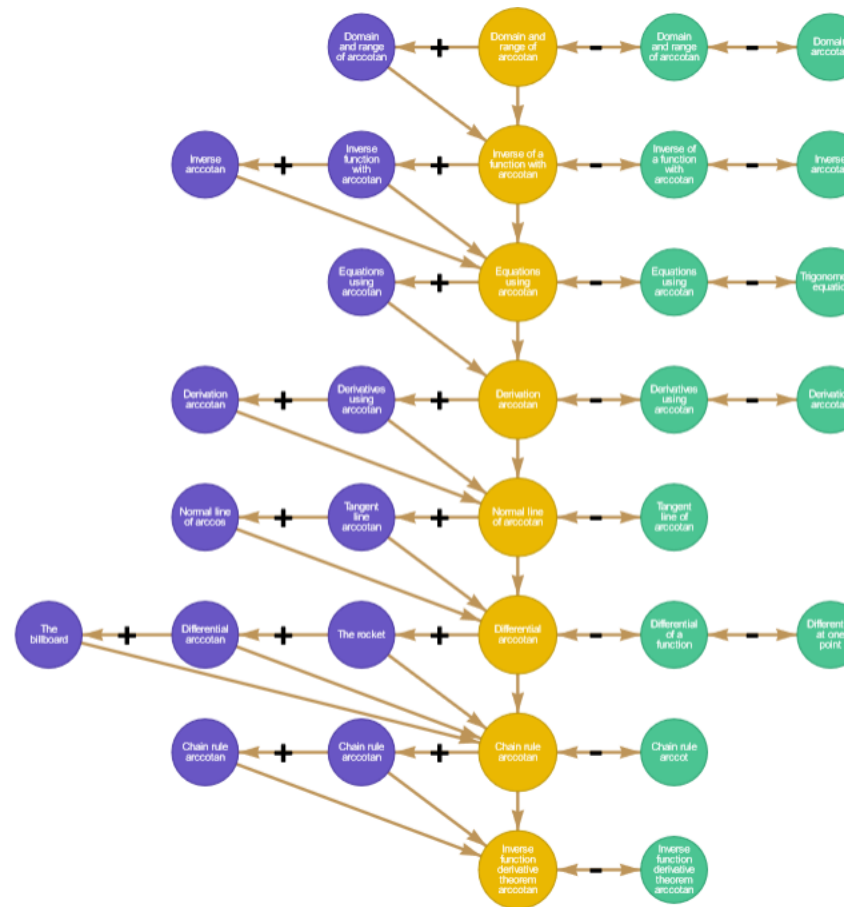
Inverse Trigonometric Function: arccot

This LG covers the topic of inverse trigonometric, arc-cotangent function. It is an LG with a high number of tasks for two main reasons: (1) The cotangent function is not part of the secondary school mathematics program, so students in higher education learn the cotangent function and then its inverse function, so students have a greater difficulty, compared to other inverse trigonometric functions. (2) This is the last inverse trigonometric function studied, so this LG is intended to function a bit as a review of the topics covered, in the context of inverse trigonometric functions.

Level: higher secondary level & university level

Download LG via this code in the app: g78228

#Main Tasks	#Challenge Tasks	#Support Tasks
8	13	13





Matrices 1

Matrix operations

The purpose of this learning graph is, to work with matrix operations. Matrix operation mainly involves three algebraic operations which are addition of matrices, subtraction of matrices, and multiplication of matrices. We can also multiply a matrix by any constants, it is called scalar multiplication.

Level: higher secondary level & university level

Download LG via this code in the app: g26196

#Main Tasks	#Challenge Tasks	#Support Tasks
5	3	4





Matrices 2

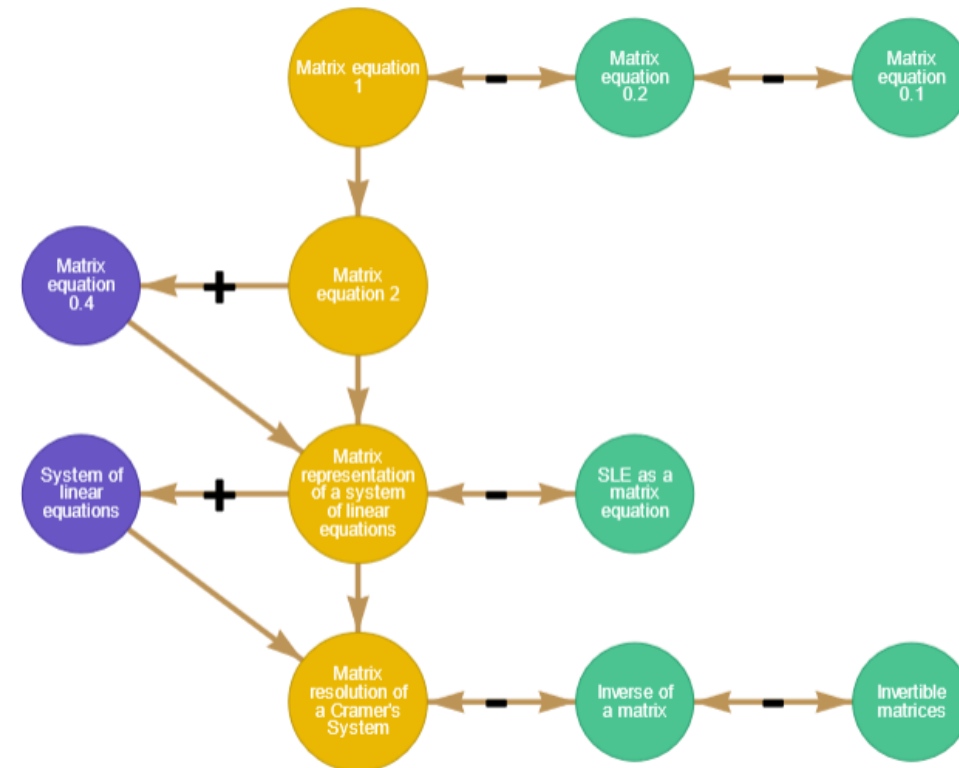
Matrix equations & systems of linear equations

The purpose of this learning graph is, on the one hand, to solve matrix equations and, on the other hand, to solve systems of linear equations, Matrices are the perfect tool for solving systems of equations. A very concise way of writing a system of linear equations is using the matrix equation: $AX = B$, where A is a $n \times m$ matrix, X is a $m \times 1$ matrix and B is a $n \times 1$ matrix.

Level: higher secondary level & university level

Download LG via this code in the app: g05197

#Main Tasks	#Challenge Tasks	#Support Tasks
4	2	5





Matrices 3

Elementary matrix operations, rank and inverse

Elementary matrix operations play a vital role in applications of algebra. It helps in solving linear equations in finding the inverse of a matrix and also finding the matrix rank.

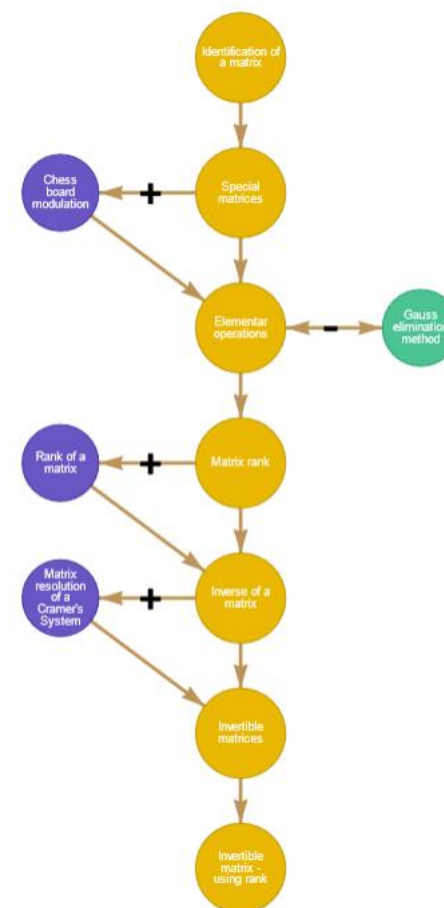
The three basic elementary operations or transformation of a matrix are:

- Interchange of any two rows or two columns.
- Multiplication of row or column by a non-zero number.
- Multiplication of row or column by a non-zero number and add the result to the other row or column.

Level: higher secondary level & university level

Download LG via this code in the app: g49195

#Main Tasks	#Challenge Tasks	#Support Tasks
7	3	1



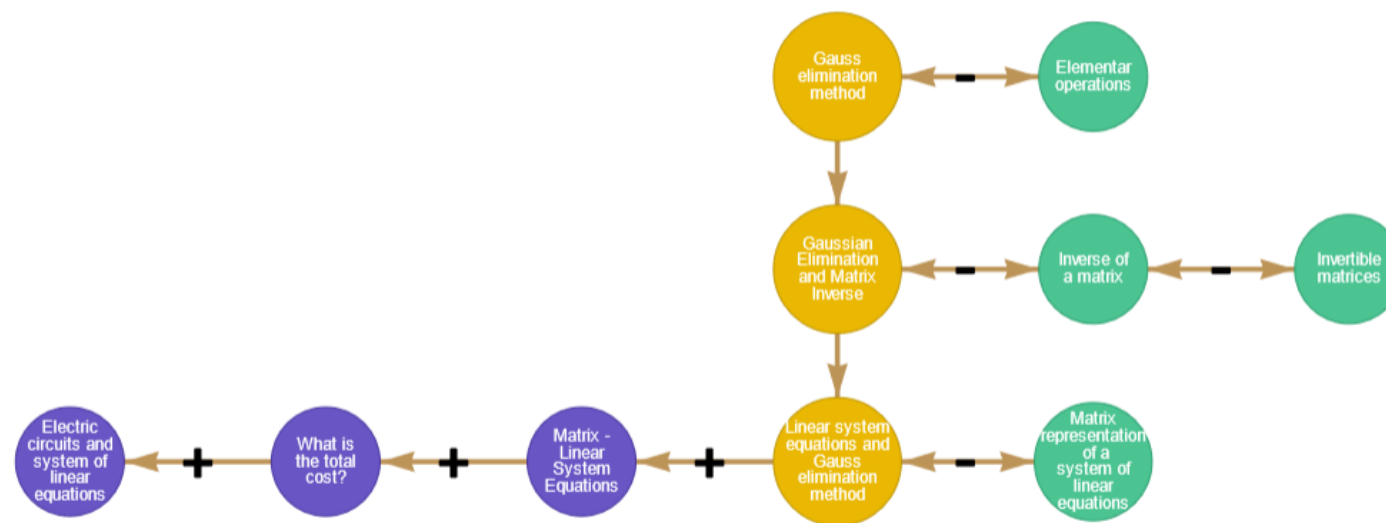


Matrices 4

Gauss Elimination Method and Applications

Gauss Elimination Method and Applications (to solve linear systems, to find the matrix rank, to find inverse of a matrix)

Level: higher secondary level & university level



Download LG via this code in the app: g17203

#Main Tasks	#Challenge Tasks	#Support Tasks
3	3	4



Chapter 6:

Video Tutorials and Theoretical Background



ASYMPTOTE Video Tutorials and Theoretical Background

Below this [link](#) you find a playlist of video tutorials developed for the ASYMPTOTE MOOC. The videos are in English with provided subtitles in English, German, Greek, Italian, Portuguese and Spanish.

Further, you have access to the ASYMPTOTE

Theoretical Background.





Chapter 7: References



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A yellow wireframe drawing of a complex, three-lobed geometric shape, resembling a stylized star or a complex curve, positioned on the left side of the slide.

Have fun to explore
the world of
ASYMPTOTE!