Guided Tours in ALeA

Assembling Tailored Educational Dialogues
from Semantically Annotated Learning Objects

Jonas Betzendahl, Michael Kohlhase, Dennis Müller
[firstname].[lastname]@fau.de

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Motivation

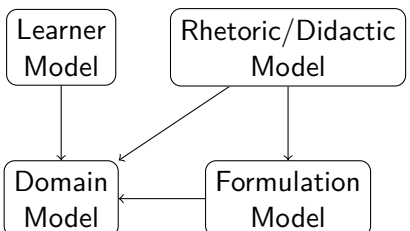
Education is becoming more diverse in terms of neurotypes, cultural and educational backgrounds as well as educational goals and more.

This is a good thing!

However, due to staffing and budget constraints, not all institutions can compensate. The shift to online delivery of course materials often does not address this.

Context: ALeA

In ALeA, our learning-platform-shaped answer to these problems[1], we contend that any good educator (human or not) relies on four different models for teaching:



[1] For details, please see: `https://url.mathhub.info/CICM23ALEA/`

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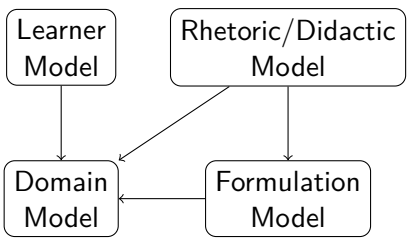

- Domain Model
  Information about concepts and their relations

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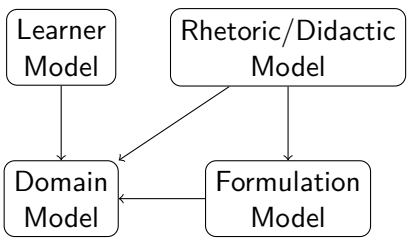

- Domain Model
  Information about concepts and their relations
- Formulation Model
  Learning objects of all varieties

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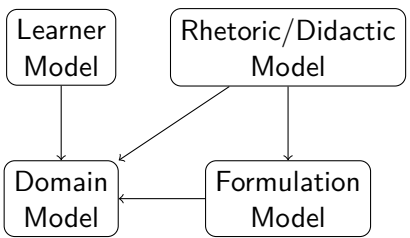

- Domain Model
  Information about concepts and their relations
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  Learning objects of all varieties
- Rhetoric Model
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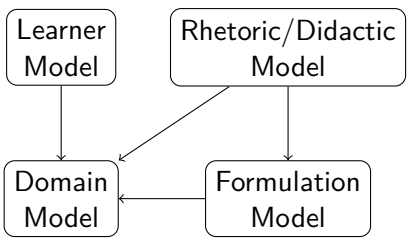

- Domain Model
  Information about concepts and their relations
- Formulation Model
  Learning objects of all varieties
- Rhetoric Model
  Didactic classification of learning objects
- Learner Model
  Estimation of educatee competency distribution

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How we do it: Semantic annotation on the *concept level* in course materials.

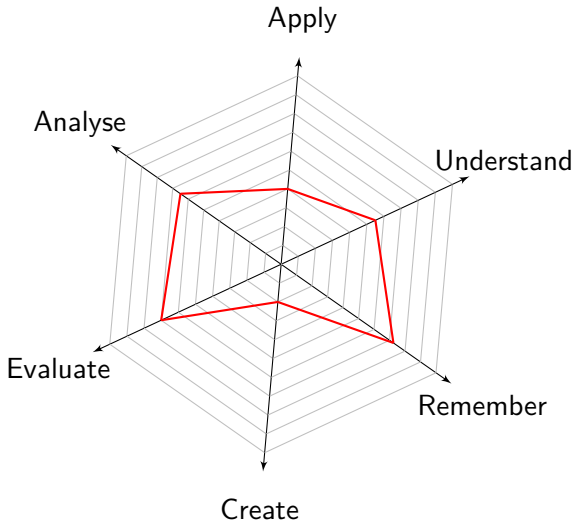
```
\begin{sassertion}[name=Pythagorean Theorem]
  \importmodule[geometry]{right-triangle}
  In a \symname{right triangle}, the \symname{square} of the
  \symname{hypotenuse} is \symname{equal} to the \symref{plus}{sum}
  of the \symnames{square} of the other two \symnames{side}.
  Often, this is expressed as the formula
  $\definiens{\equal{\plus{\square \a, \square \b}, \square \c}}$.

  \includegraphics{right_triangle.png}
\end{sassertion}
```

An Example sTEX Fragment

The Learner Model

Our learner model uses a revised version of Bloom's taxonomy of educational objectives. It tracks six cognitive dimensions for every student for every concept they have encountered.

The model is under full control of the learners and can be primed by them on initialisation with their educational history.



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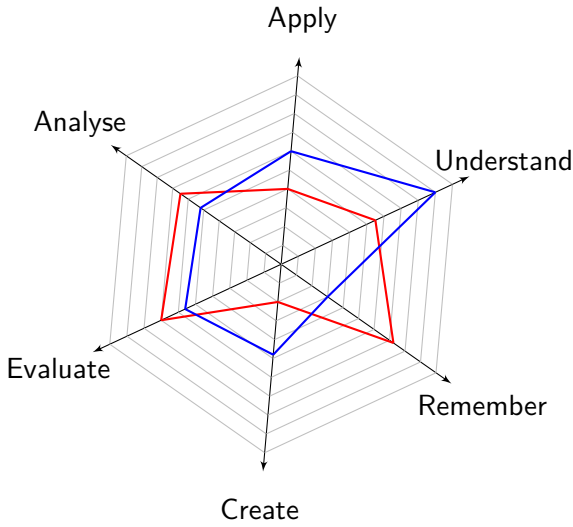

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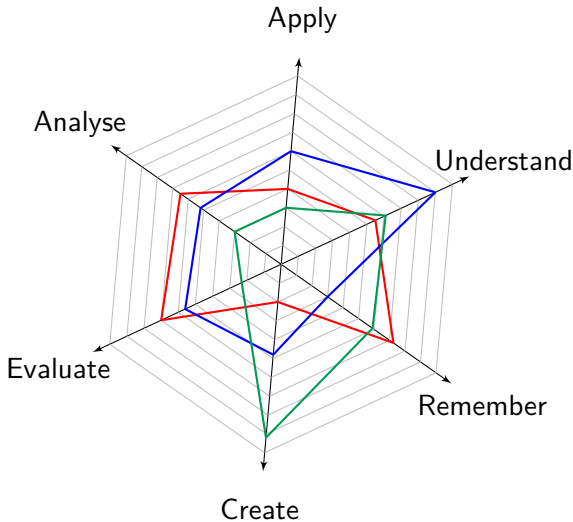

Educational Dialogues

This granular and precise learner model allows us to offer *tailored* educational services that take into account the knowledge state of the individual.

One such service are *guided tours*, mini-courses assembled on the fly, that students can request for any topic. They begin at precisely their current knowledge level and step-by-step work up to the concept they wanted to understand. This is presented in dialogue form to mimic one-on-one tutoring.

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Hello, Jonas. It seems like you want to learn more about the Pythagorean Theorem.

This topic concerns right-angled triangles. Do you already feel comfortable with that topic?

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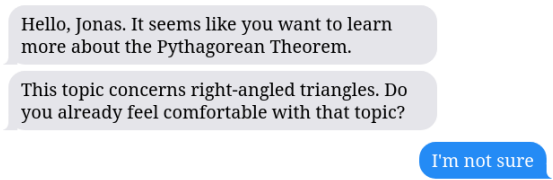

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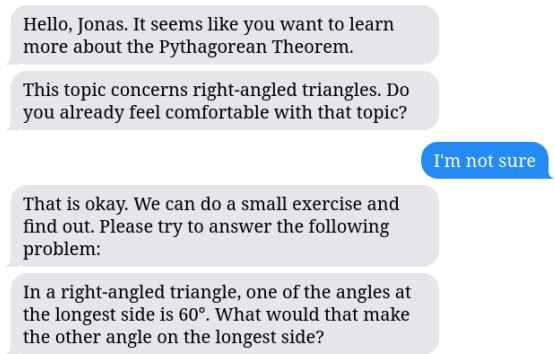

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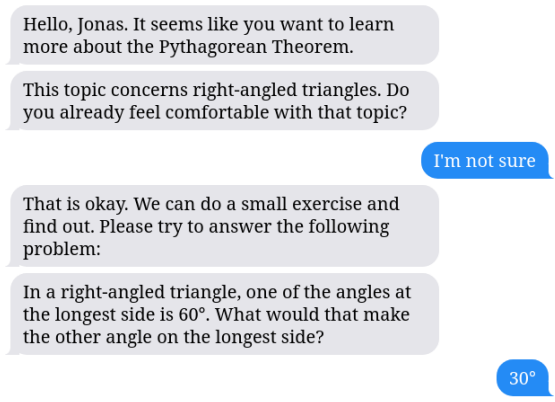

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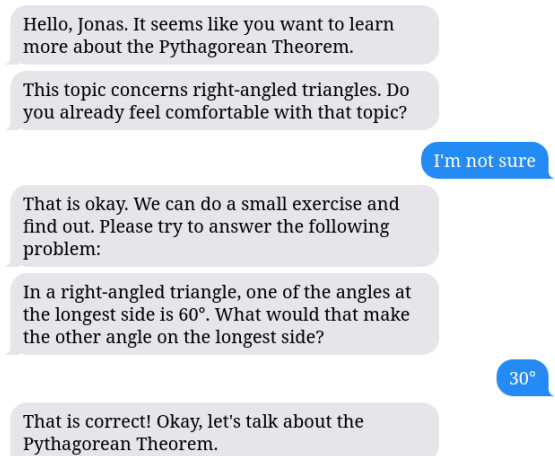
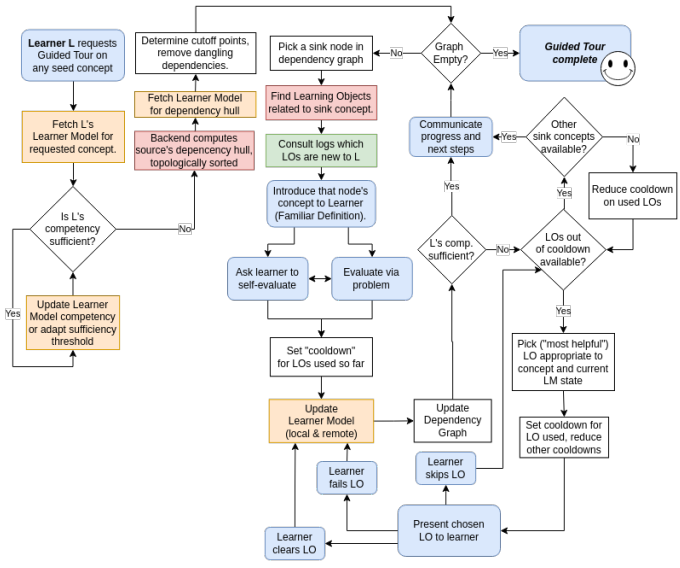
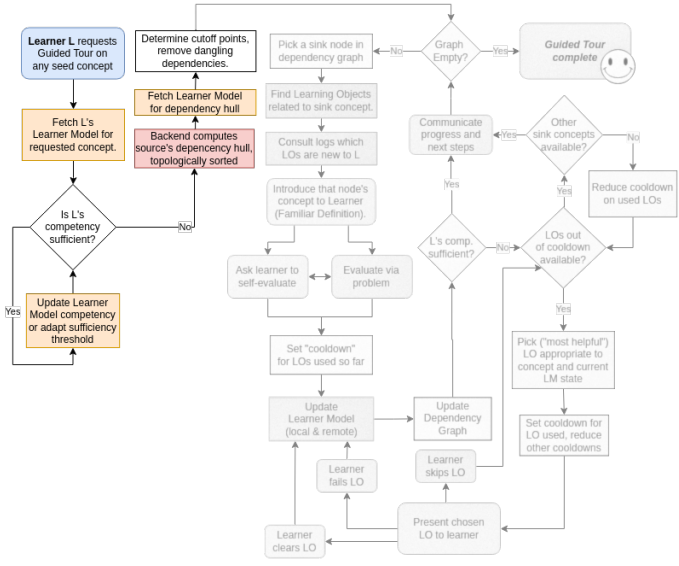


Overview



The complete algorithm for guided tours in ALEA.

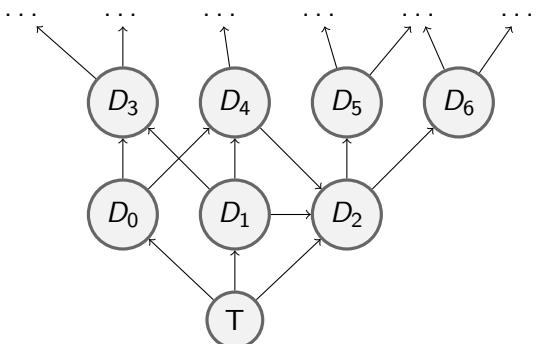
Initialisation



Important points:

- Assemble the dependency graph of domain concepts
- No trivial guided tours allowed

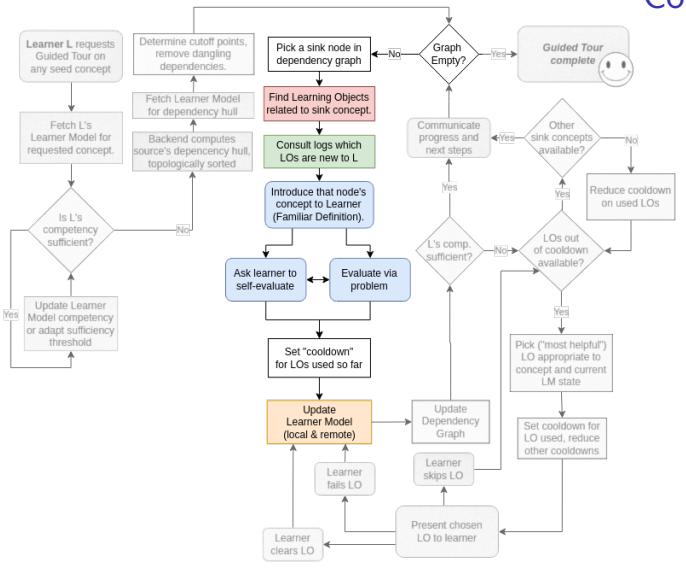
Aside: cut-off points



When we talk about *cut-off points*, we mean any concept in the dependency closure of our target that the educatee already understands "sufficiently".

We do not present them *or any of only their dependencies* to the learner, even if their dependencies are not yet "sufficiently" understood.

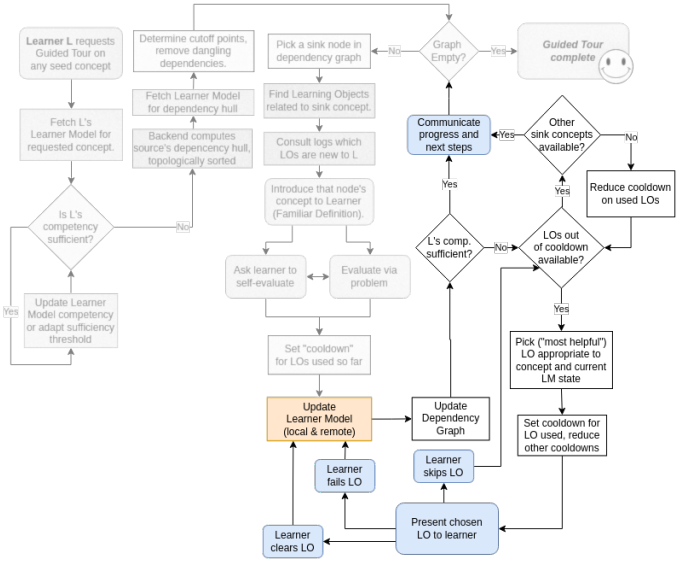
Concept Introduction



Important points:

- Always present familiar definition
- Cooldown to avoid LO doubling

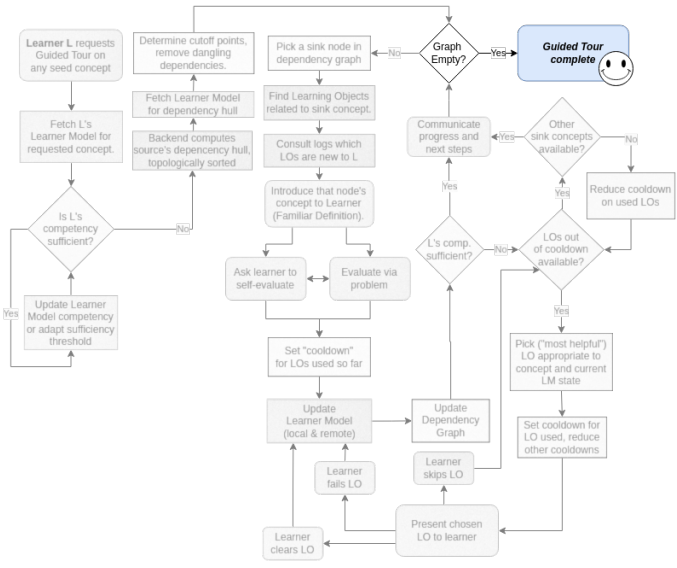
Learning



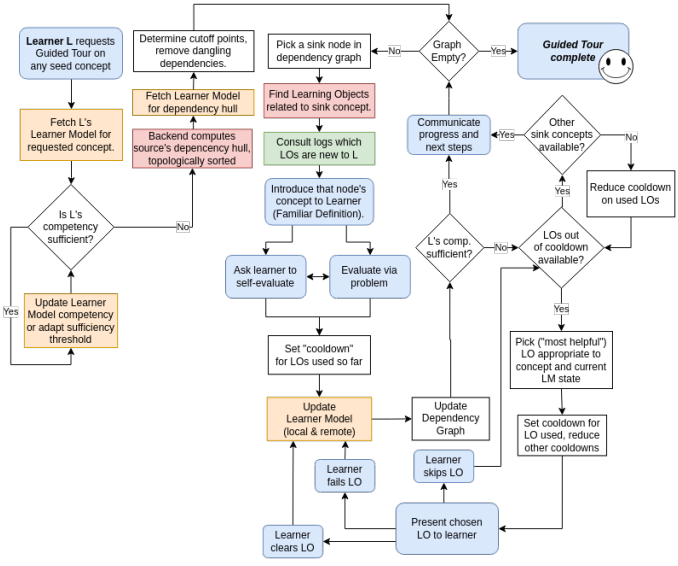
Important points:

- "Most Helpful" LO varies by context
- Updates to learner model can change graph.

Finish



When all relevant concepts in the dependency hull have been mastered, the guided tour concludes.



Recap

Diverse educational backgrounds demand solutions tailored to the individual.

Semantic annotations of course materials using STEX allow for granular learner models.

Guided tours in ALEA are educational dialogues that are assembled for where the student is and where they want to go.