# Open Geometry Textbook

## A Case Study of Knowledge Acquisition via Collective Intelligence

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## MOTIVATIONS

<table>
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<th>Traditional textbook features</th>
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<td>Textbook contents are machine-readable rather than machine-comprehensible.</td>
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<td>Textbook authoring depends on individual intelligence.</td>
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<td>Textbook revision, update and improvement are time-consuming.</td>
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## OBJECTIVES

### Open Textbook

Design and develop a web-based platform for acquiring mathematical knowledge to form a textbook via the collective intelligence of a massive number of web users.

- Open Textbook is a dynamic running system freely accessible to netizens.
- Knowledge contents can be formalized to interface with software tools for automating knowledge processing.

### Open Geometry Textbook — a case study

- Geometry is a fundamental subject and rich in contents.
- Mechanical geometry reasoning methods are successful.
  - Wu’s method, area and full angle methods, deductive database approach, etc.
- Dynamic geometry software is powerful.
  - Cabri, Cinderella, GCLC, GeoGebra, GeoProof, JGEX, GEOTHER, MathXP, etc.

## PROBLEMS & METHODS

### Content Management

- Create a versioned structural database
- Develop assistant tools for
  - data management
    - adding
    - removing
    - retrieving
  - content authoring
    - formulae
    - figures
    - semantics
  - textbook rendering
    - HTML
    - LaTeX
    - PDF

### Knowledge Processing

- Design a formalized language for specifying geometric knowledge contents
  - Geometry Description Language (GDL) has been designed to formalize geometric concepts, instances, configurations, definitions, propositions and problems.
- Develop/integrate software tools for validating contributions
  - Automated problem solving and diagram generation
    - a geometric theorem prover — GEOTHER
    - dynamic geometry software — GeoGebra
    - a geometric problem solver — MathXP
  - Theory consistency checking
    - inconsistent theory
    - consistent candidate theories
    - select
    - a new consistent theory
  - Proof/Solution verification
    - Structural representations interspersed with snippets of GDL expressions
    - geometric automated theorem provers
    - interactive proof assistants
- Textbook structure soundness checking
  - Knowledge graph
  - Dependency graph

## MECHANISMS

### TIMELINES

- 2013: a prototype of the platform with a preliminary version of the textbook
- 2014: an initially released version of the textbook accessible to the public
- 2016: a milestone version of the textbook, 500+ active contributors

## ACKNOWLEDGEMENTS

The authors wish to thank Christoph Lange and the referees for many insightful comments which have helped bring the paper to the present form. This work has been supported by the SKLSDE Open Fund SKLSDE-2011KF-02.