

# Properties and Applications of Wrong Answers in Online Educational Systems

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## Wrong answer

Learner input to wrongly answered question

## Feedback for teachers

common mistakes of a class

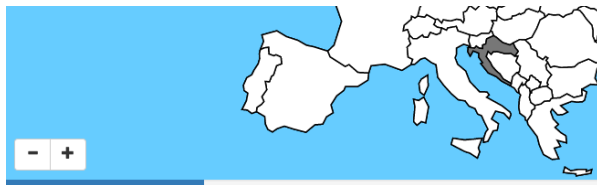
## Detecting level of knowledge

$$5 \times 5 \neq 30$$

$$5 \times 5 \neq 24$$

$$5 \times 5 \neq 17$$

## Question construction



What is highlighted?



Albania



Bulgaria



Croatia



Italy

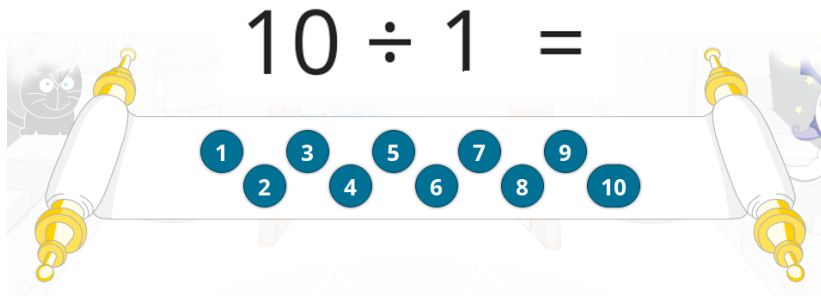


Luxembourg



Serbia

## Problem in user interface



... and much more

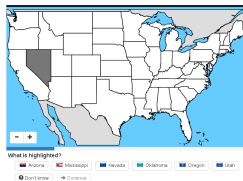
# Systems



matmat.cz

basic arithmetic

elementary school



outlinemaps.org

geography

high school



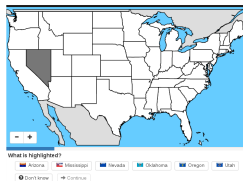
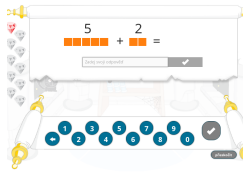
practiceanatomy.com

human anatomy

university



# Systems



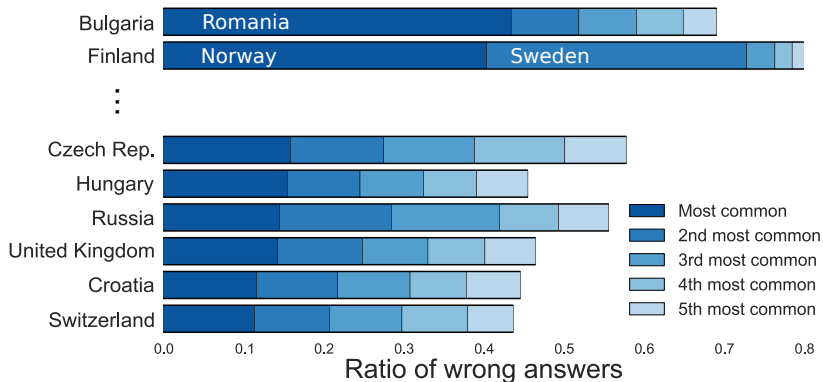
- simple tasks
- adaptivity - selection of questions
- $> 200\,000$  answers

# Wrong Answers - Geography

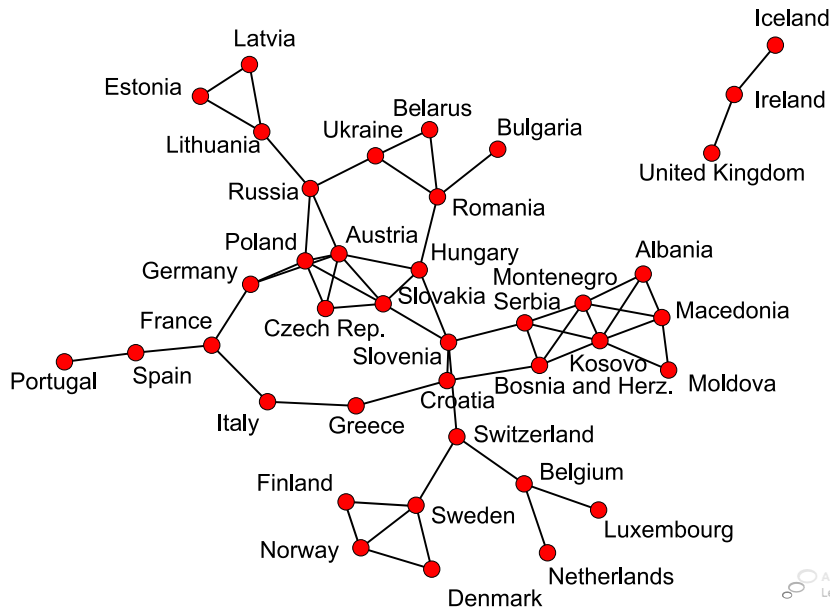
## Countries

- common border, similar size, same first letter
- importance of practice context - Madagascar

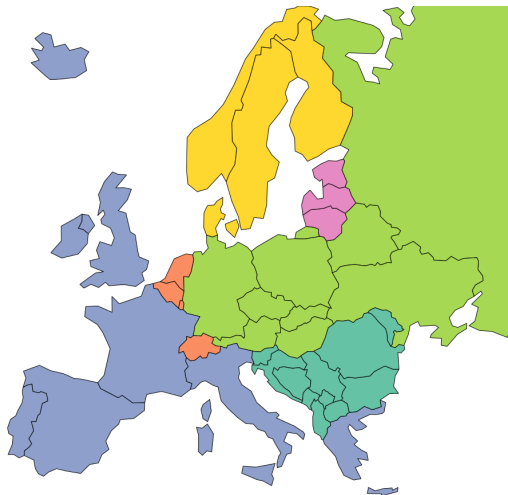
# Common Wrong Answers - Geography



# Confusion Graph



# Item Clustering



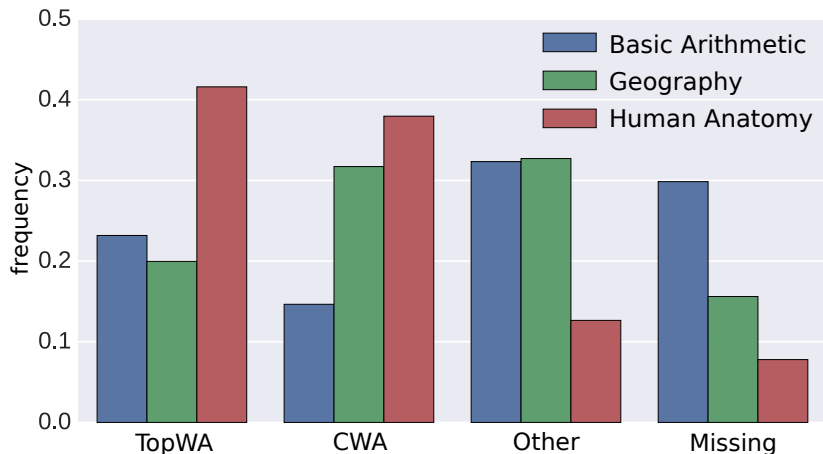
# Cross-system Comparison

# Categories of Wrong Answers

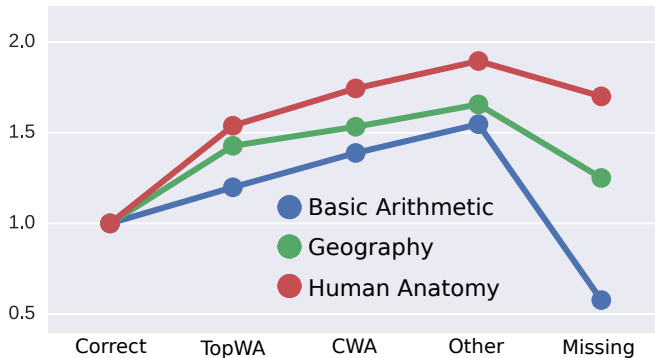
- **TopWA** - most common wrong answer
- **CWA** - other common wrong answers -  $> 5\%$
- **Other**
- **Missing** - question skipped by learner



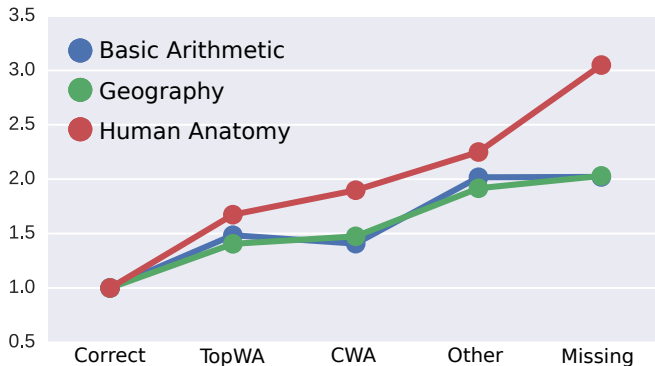
# System comparison



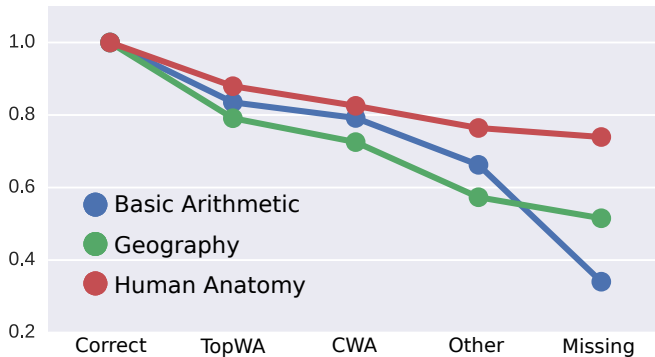
# System comparison - Response time



# System comparison - Probability of Leaving



# System comparison - Future Success



- **TopWA, CWA, Other, Missing**
- equally distributed
- linear behaviour
- similar behaviour in different domains
- good measure of wrongness - interval variable

## Wrong answers

- are **easy to collect**
- has **many applications**: question and hint construction, feedback and inspiration, ...

## Contributions

- **item clustering**
- **measure of wrongness**