Automated Analysis of Students' Responses to Short-Answer Physics Questions

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Project Goals

Pathway Active Learning Environment

- Develop an interactive online synthetic tutor
  - Targeted at high school & intro college physics students
  - Designed for supplemental instruction at home
  - Investigates interactive multimedia lessons and tutors
- Seek to exploit benefits of human tutoring[1]
  - Interaction is mostly student-centered[2]
  - Students must build explanations[2]
  - Students must challenge their explanations[2]

[1] Bloom (1984) [2] Chi et. al (2004)

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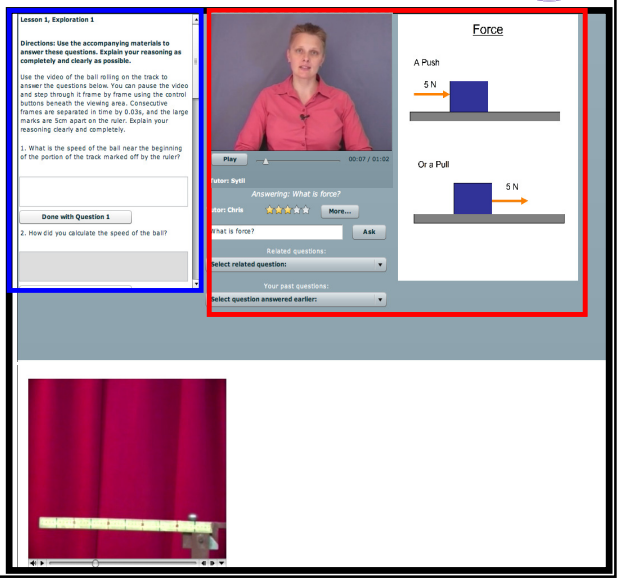
Active Learning Environment

Key Functions

- Lesson Activities
- Synthetic Tutor (SI)

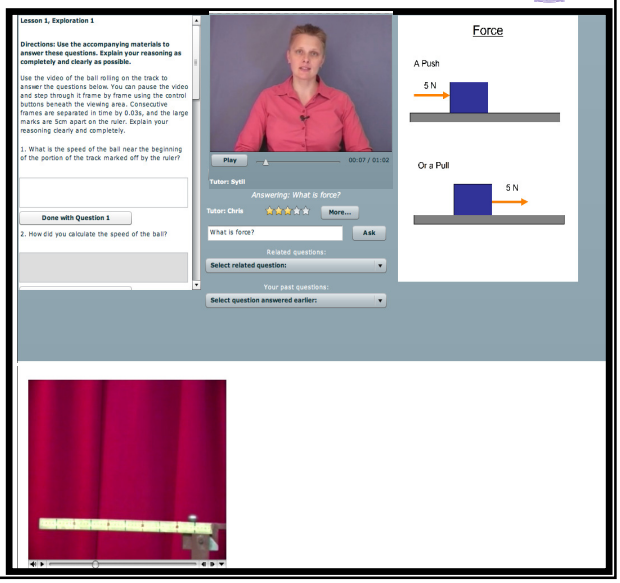


Active Learning Environment

The System

- Three lessons cover Newton's Laws
- Uses 3-stage Learning Cycle[3]
- Focuses both on calculation and concepts

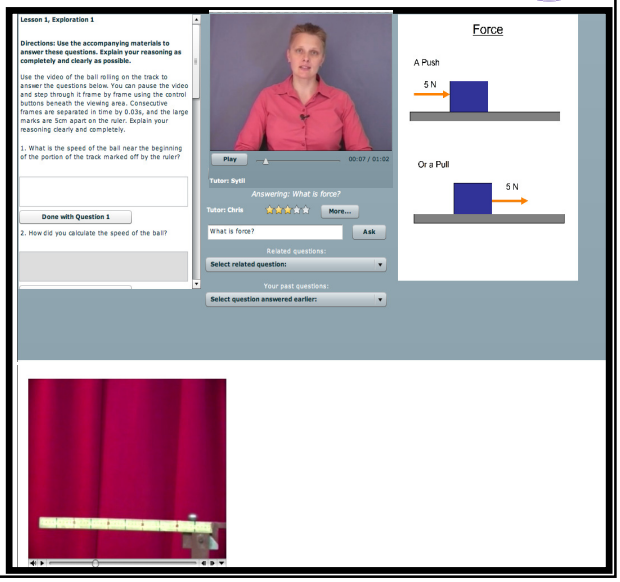
[3] Karplus (1977)



Active Learning Environment

The System

- Collects a lot of lesson responses
- Can't provide response-specific feedback



Active Learning Environment

The System

- Collects a lot of lesson responses
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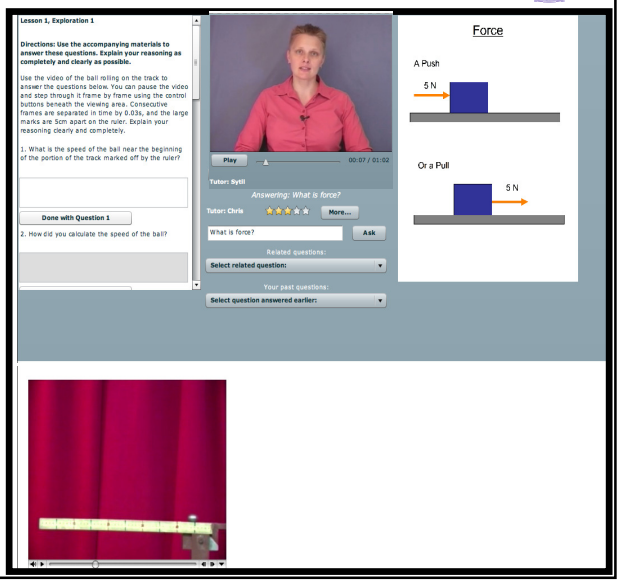
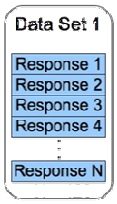
Can we use responses we have to provide feedback?



Analysis Procedure



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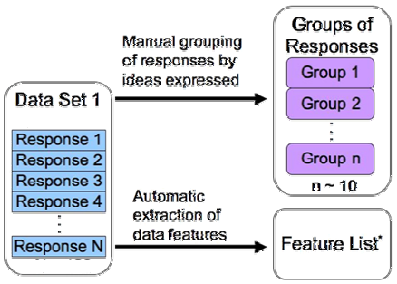
Analysis Procedure



* Here a Feature List is a list of all the words in the response set.

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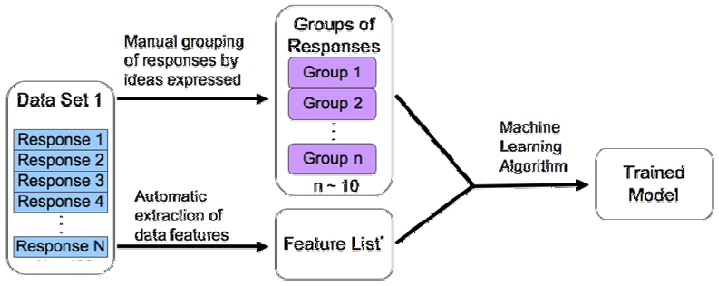
Analysis Procedure



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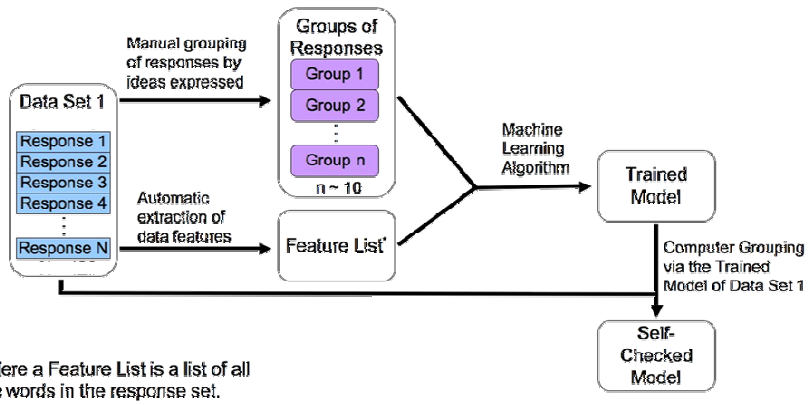
Tool used: Summarization IDE: 4. Rosé et. al (2008)

Analysis Procedure



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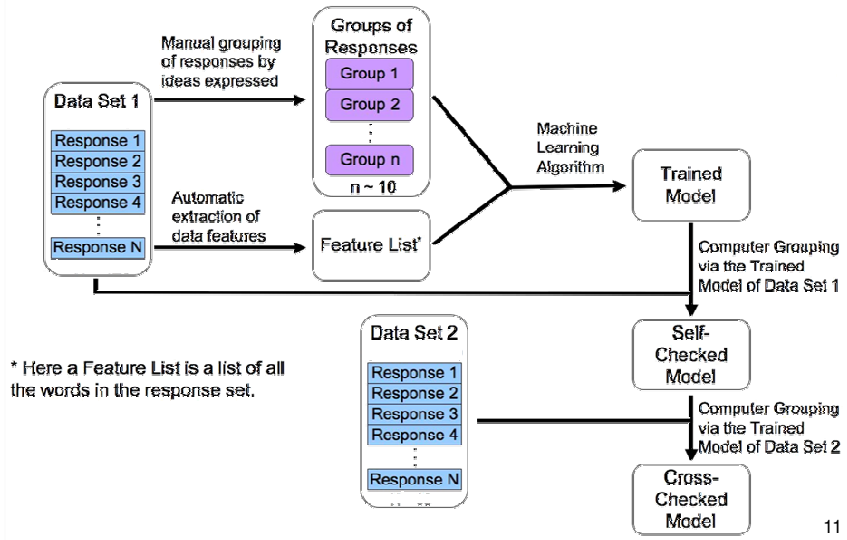

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Tool used: Summarization IDE: 4. Rosé et. al (2008)

Results

- Process has shown promise (~60-75% match rate)[8]
- Further results are mixed (50%-90%); work is ongoing
- Larger groups match better
- Approach reveals coherence; also divergence
- Properties of good lesson problems?

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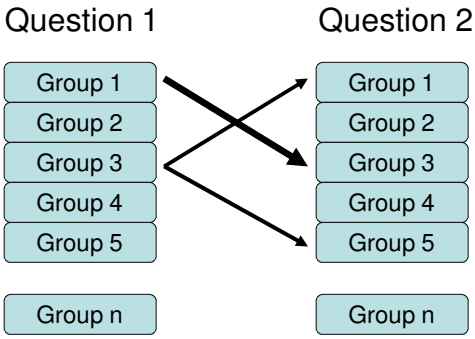
5. Nakamura et. al (2011)

Response Prediction



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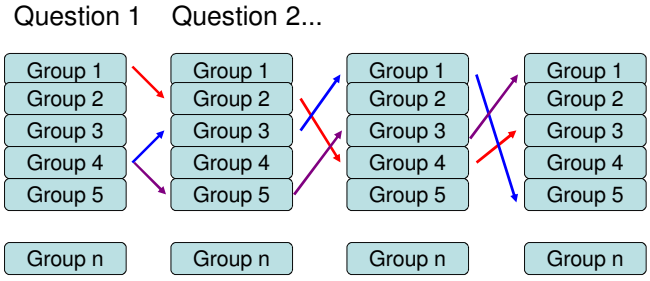
Student Pathways



- Relationships may reveal common response patterns
- Response patterns could indicate constructive or non-constructive usage

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Conclusions

- Investigating ways to provide automated feedback in a synthetic tutoring system
- Machine learning provided promising results; more analysis is needed
- Looking for connections across activities and concepts

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The End

Thank you.

For more information:

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