PREP: Prerequisite Relationship Extraction using Position-Biased Burst Analysis

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MOTIVATION

- ITSs must be able to accurately determine a student's knowledge level by studying their interactions with the system.
- Thus, student knowledge modelling is an important part of ITSs but it typically relies upon models of the structure of the content in a domain.
- Currently, these models require experts to create a map of the topics and their dependence on each other. This becomes increasingly tedious as the number of topics grow.
- We aim to automate this step so that tutoring systems can be deployed without the need of expert intervention.

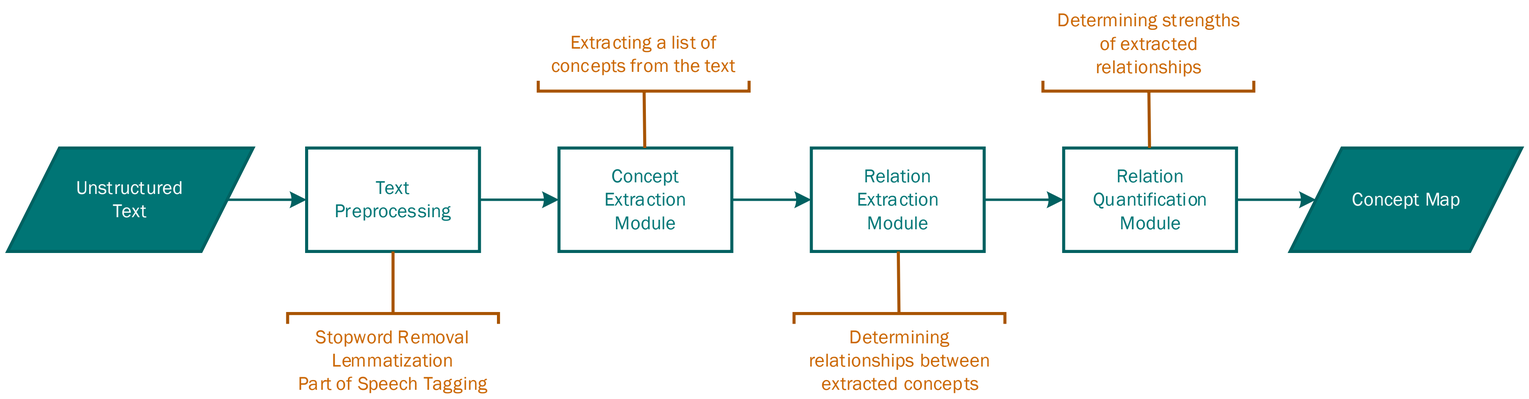
SCOPE

- We propose a method "Prerequisite Relationship Extraction using Position-Biased Burst Analysis" (PREP) that determines prerequisite relationships between concepts in a domain.
- The method extracts these relationships from unstructured text.
- The method can handle textbooks from multiple domains in the English language.
- Our work is focused on improving the precision of existing state-of-the-art methods.
- We have evaluated the method on multiple domains and different input sizes.
- We have also performed hypothesis testing to validate our results.

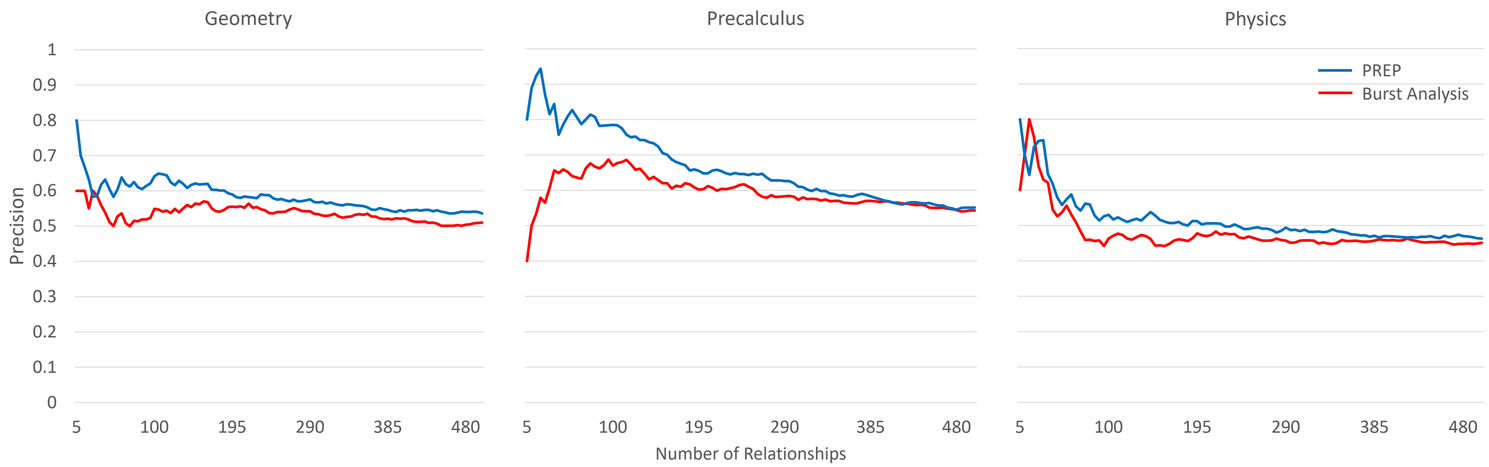
CONTRIBUTION

- Proposed a novel method to extract prerequisite relationships from unstructured text using the order of occurrence of concepts.
- PREP provides as much as a 17% improvement in precision compared to the state-of-the-art Burst Analysis method.
- PREP provides state-of-the-art precision across domains like Data Mining, Geometry, Precalculus and Physics.
- Determined the impact of input size over relationship extraction.
- Implemented two state-of-the-art concept extraction methods and a relationship extraction method.

FLOW



RESULTS

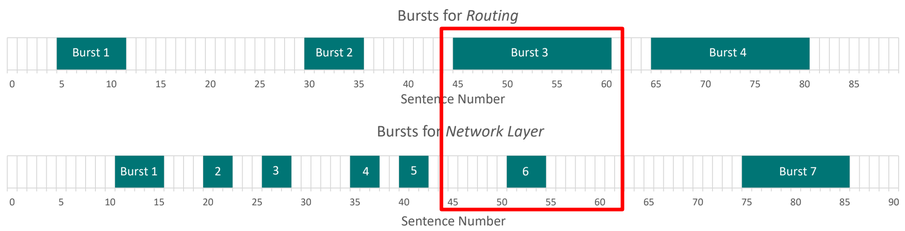


- The above graphs show the comparison of precision between PREP and Burst Analysis.
- PREP yields as much as a 17% improvement in precision over the state-of-the-art Burst Analysis method.
- PREP consistently overperforms Burst Analysis across multiple domains like Data Mining, Geometry, Precalculus and Physics.
- The improvement in precision is also observed across different document input sizes.

WORKING

- An unstructured text document is given as input to the system.
- Concepts are extracted from the document.
- For every concept, bursts are extracted from the document. The burst of a concept refers to a surge in the frequency of a concept in text.

- Patterns are found between the bursts of every pair of concepts.



- The patterns are used to determine the strength of prerequisite relationship between the pair of concepts.
- The direction of this prerequisite relationship is then identified.
- A concept map is generated using the extracted relationships.