Assessment of Question Quality using Bloom's Taxonomy

Domain: *ML and NLP in Education*

PW023

Members

Mohit Surana	1PI13CS092
Shiva K Deviah	1PI13CS147
Shrey Agarwal	1PI13CS150

Guides

Prof. Nitin V Pujari

Prof. Anantharaman Narayana

Recap (1): Project Synopsis

Assess the quality of questions by classifying them according to Bloom's Taxonomy. Build a machine learning classifier to label questions according to Bloom's Matrix with a reasonable accuracy.

Recap (2): Bloom's Taxonomy

- A hierarchical model which classifies educational learning objectives into different levels of complexity and specificity

- Multiple versions have been developed; the most generic model, and the one we are considering for our project is given below

Knowledge Dimension	Cognitive Process Dimension					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
Factual Knowledge						
Conceptual Knowledge						
Procedural Knowledge						
Metacognitive Knowledge						

- Published by Benjamin Bloom in 1956; revised by Anderson and Krathwohl in 2001

Recap (3): Motivation; USP of our Project

- **Existing work in this field has not considered the knowledge dimension**
  - Considering the knowledge field would lead to a better model for teachers and students alike

- **Diverse use cases to consider for an enhanced model**
  - ***Assess lecture delivery quality***; analyse students' doubts after a lecture
  - ***Weighted GPA system***; apply weightage to subject grade by analysing question papers set for that subject

- The main benefactors of this system would be:
  - **Teachers**
  - **Students**
  - **Companies and Recruiters**

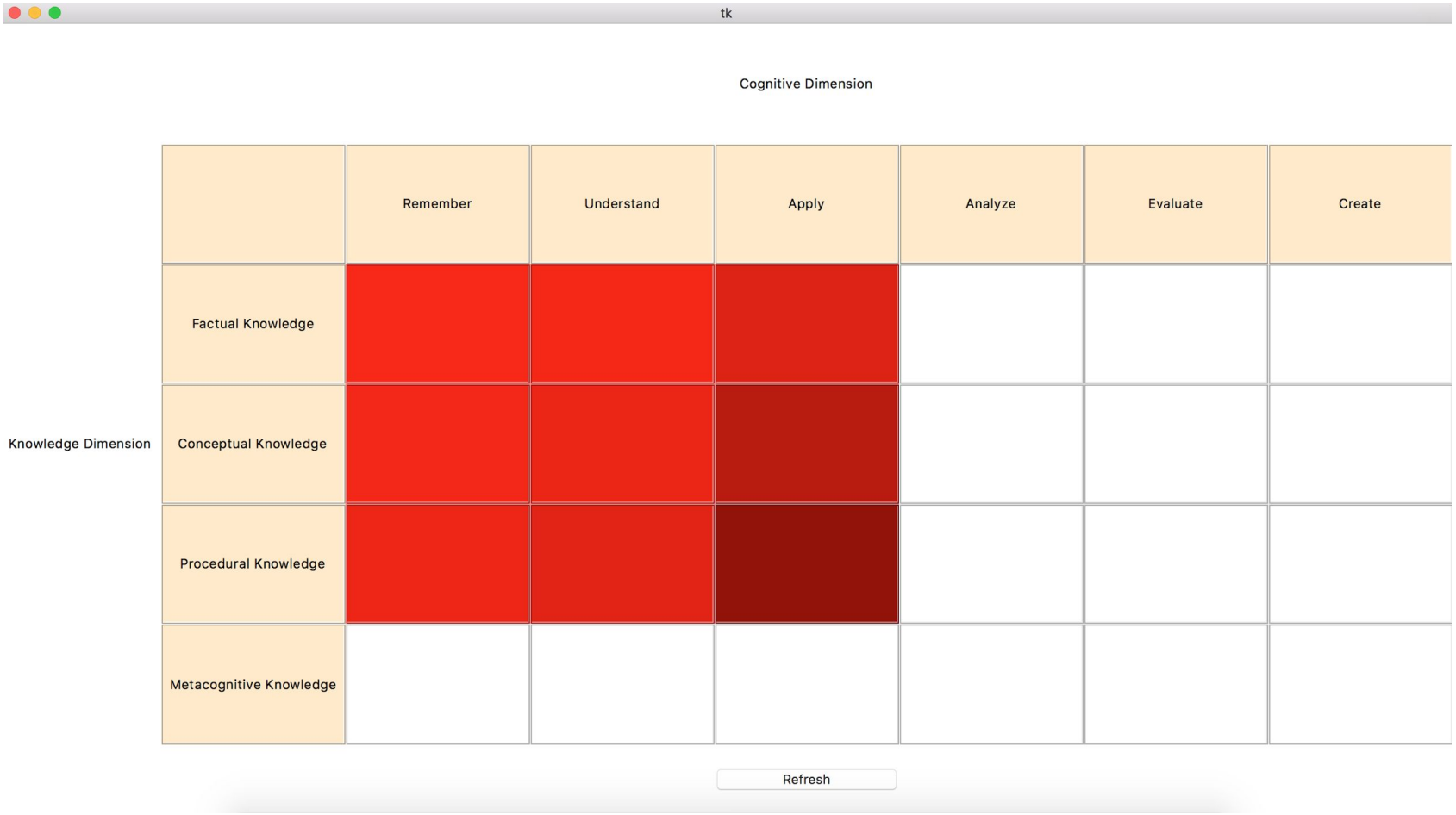
Current Progress (1): [Before 1st review]

- Wrote code to parse the two textbooks to extract
  a. Chapters and Sections
  b. Exercise questions
  c. Keywords
- Extracted keywords for ADA and OS were validated using dbpedia
- 2.5 million questions fetched from StackOverflow
- Hand labelled 200 questions from ADA textbook. Also have a dataset of 600 questions that was used by a group that previously worked on classification in the cognitive dimension

Current Progress (2): [After 1st review]

- Implemented an interactive GUI for visualizing outputs
- Implemented three classifiers for the cognitive dimension (trained on 200 question dataset)
  a. Bag-of-words NBC (53%)
  b. SVM (72%)
  c. Divisive hierarchical (top-down) clustering using K-means (not tested)
- Implemented four classifiers for the knowledge dimension (unsupervided learning models)
  a. **N-squared** (based on a paper by Professor Nitin V Pujari)
  b. doc2vec clustering
  c. **Word-based comparsion** with the SEMILAR toolkit and jython
  d. **LDA** with the gensim package
  e. **LSA** with the gensim package
- Used LSA to filter out superfluous questions from the SO question bank

Demo


tk
Cognitive Dimension
Remember
Understand
Apply
Analyze
Evaluate
Create
Knowledge Dimension
Factual Knowledge
Conceptual Knowledge
Procedural Knowledge
Metacognitive Knowledge
Refresh

Future Steps and Goals

- Supervised k-means clustering
- Using X-means for divisive hierarchical clustering
- Voting System
- Labelling and Testing for ADA and OS questions
- Get a model with 60% accuracy or higher, for both the dimensions (validated with human recall).
- Test on college Question Papers

Thank you!