Assessment of Question Quality using Bloom's Taxonomy

Domain: *ML and NLP in Education*

PW023

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Guides

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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.

- Explore the applications of our system for the following use cases:
  a. ***Assess lecture delivery quality***; analyse students' doubts after a lecture
  b. ***Weighted GPA system***; apply weightage to subject grade by analysing question papers set for that subject
  c. ***Automated question paper setting***; set question papers/assign marks to questions based on difficulty

Recap (2): Bloom's Taxonomy

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

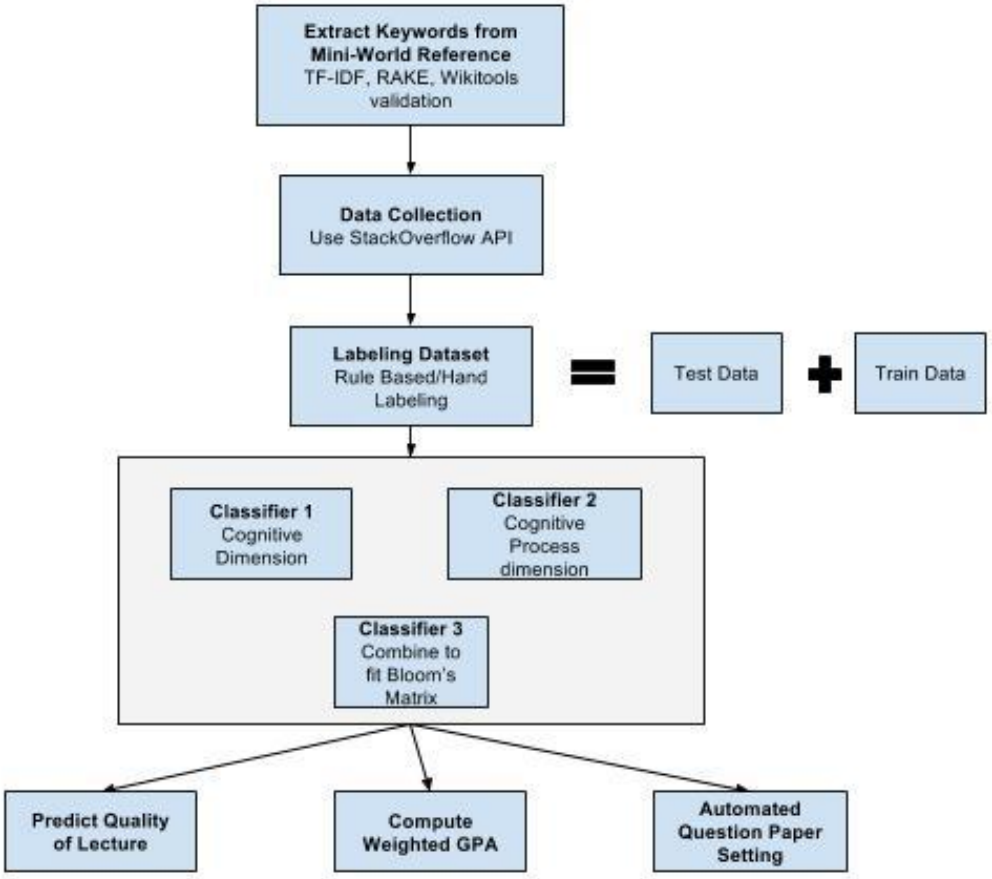
- Multiple versions have been developed; the most generic model, and the one we are considering for our project is given below

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

Current Progress (1)

- Carried out literature survey
- Designed a high level structure of the system, shown on the right:



Current Progress (2)

- Keyword extraction
  - Extracted valid keywords from the mini-world reference using RAKE and tfidf
  - Validated their context using DBpedia

```
1   (u'decision problem', 0)
2   ('differs', 0)
3   ('exponential algorithm', 0)
4   ('formal analysis', 0)
5   ('nearest integer', 0)
6   ('optimal algorithm', 0)
7   ('truncation error', 0)
8   ('dijkstra', 0)
9   ('mapping', 0)
10  ('josephus problem', 0)
11  ('java', 0)
12  ('lexicographic', 0)
13  ('master theorem', 0)
```

```
155   ('operating systems design', 0)
156   ('shell script', 0)
157   ('virtual page', 0)
158   ('compiled', 0)
159   (u'context switch', 0)
160   ('gnu project', 0)
161   ('processor affinity', 0)
```

- Extracted 2.5 million questions from StackOverflow using the keywords from

```
17668   32173090,Linked List Stack Implementation - Java,1
17669   30987299,Solving master theorem with log n: T(n) = 2T(n/4) + log n,2
```

```
1826   8761456,Degeneration from context switching to thrashing in the below model?,0
```

- Brainstormed to come up with possible solutions for labelling the dataset and also training the classifiers shown in the previous slide

Plan of Action

- Dataset noise filtering
- Labelling dataset for the cognitive processes (knowledge dimension)
  - Human recall for 600 question dataset
  - Use this set as the seed for labelling the rest of the dataset through clustering
- Perfect a model for the cognitive dimension (experiment with SVD, PCA, and neural networks)
- Assigning word and sentence representation from mini-world reference
  - experiment with word2vec and GloVe
  - Will provide better context to the classifier
- Collection of past question papers from the institute
  - Perform model validation with this data for improving our model

Thank you!