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When Have You Learned Knowledge?

> An instance of knowledge is *learned* when a student has: understood it, memorized it, and can use it.

Definitions

- S_q - *The confidence that a student has solved a question q for a given knowledge k*
- S_k - *The confidence that a student has 'learned' a particular knowledge k.*

Method 1

Assumptions

- A given instance of knowledge is constant at a given point in time

Formulation

Question k Correctness

> The "correctness" of response R to question q is the average number of correct points in their response.

$$S_q = \frac{\#R_qCorrect}{(\#R_qCorrect + \#R_qIncorrect)}$$

Where

- S_q - is a given student's strength for a question q
- $\#R_qCorrect$ - is the number of correct points for Response R to question q
- $\#R_qIncorrect$ - is the number of incorrect points for Response R to question q

Knowledge k Strength

> A student's understanding of knowledge k based on their responses to questions q_i is the average strength to all their questions.

$$S_k = \frac{\sum_{i=1}^{q} S_{qi}}{\#q}$$

Where

- S_{qi} is the correctness of the ith question q
- $\#q$ is the number of questions for a particular knowledge k

Examples

```
# Question 1
correctPoints = 2
missedPoints = 0
Correctness = 2 / 2 = 100%

# Question 2
correctPoints = 0
missedPoints = 2
Correctness = 0 / 2 = 0%

# Question 3
correctPoints = 1
missedPoints = 1
Correctness = 1 / 2 = 50%
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k_s = (1 + 0 + 0.5) / 3 = 0.5
```

Limitations

- We're not weighting the individual points.
  - Ex. if there were 5 points that needed to be covered for a given piece of knowledge and they caught 4/5 of it, that might be summarised into a single correct point and a single missed point which would get them a correctness score of 50% which means the formulation deviates from the truth by 40%.
- Questions answered more recently are likely a better indicator of the student's *current* understanding of a given piece of knowledge.