ARQMath-3: Answer Retrieval for Questions on Math

https://www.cs.rit.edu/~dprl/ARQMath

Task 1. Answer Retrieval

Given a **Math Question,** Find **Answers**

Answer Retrieval(Task 1)

QUESTION (TOPIC A.239) Let R be a symmetric, transitive relation. If (x, y) then the symmetric property implies that (y, x). Using the the transitive property upon (x, y) and (y, x) we can conclude (x, x).
Is this fair logic or is it flawed?

RELEVANT
Symmetric means we can represent the relation as an undirected graph. Transitive means this graph is composed of connected components which either look like a point or K_n with each point connected to itself. Reflexivity means each point is connected to itself. Thus, a necessary and sufficient condition is that one component is a point (i.e.- one element is not related to any other). In exactly these cases your proof fails because it requires each x to be related to another y.

NON-RELEVANT
You should start with $(x, y) \in R$ and $(y, z) \in R$ and from these two statements show that $(x, z) \in R$.
This shows transitivity. Now, the two statements show that indeed $(x, z) \in RR$ by definition (using y as intermediate).

Task 2. Formula Retrieval

Given a **Math Formula,** Find **Formulas**

Formula Retrieval (Task 2)

FORMULA QUERY (TOPIC B.220) I'm having a difficult time understanding how to give a combinatorics proof of the identity

$$\sum_{k=0}^{n} \binom{x+k}{k} = \binom{x+n+1}{n}$$

RELEVANT
Question: prove by induction on n+m the combinatoric identity:

$$\sum_{k=0}^{n} \binom{m+k}{k} = \binom{m+n+1}{n}$$

I've tried to do on both n and m
...

NON-RELEVANT
Hint

$$\sum_{k=0}^{n} \binom{n}{k} x^k = (1+x)^n$$

Integrate twice both rhs and lhs with respect to x and when finished, plug $x = 1$ in your result.

Task 3. Question Answering (NEW!)

Given a **Math Question,** Generate **Answers**

Question Answering(Task 3)

QUESTION (TOPIC A.100) Is it correct to say that this set $E = (0, 1]$ where $E \subseteq R$ (Where R is the set of real numbers) is not closed?

RELEVANT
Yes. Closed sets are the complements of open sets. An open set is a set for all points there exists a neighborhood contained in the set with positive radius.

NON-RELEVANT
think this method can by reduced using three coefficients (1,2,3) to know if a number is a multiple of seven or not. We multiply the last number by 1, the second from the right by 3, and finally by 2. Then next three digits by (1,3,2) and again by positive.

Test Collection

Posts from Math Stack Exchange (2010-2018)
Formulas Index with LaTeX and MathML Representations

Task 1/3 Topics: 100 Questions from Posts in 2021
Task 2 Topics: 100 Formulas from Questions in Task 1

Evaluation

Task 1: Top-1000 answers for each question
Task 2: Top-1000 formulas for each query
Task 3: 5 answers for each question

NDCG' as primary measure, with P'@10 and MAP'
De-duplication for Task 2 with Visually distinct formulas

Available Tools

Baseline: **Terrier** (text search) and **Tangent-S** (formula search)
Training data for Tasks 1 and 2 from ARQMath-1 and -2
Runs and Systems from ARQMath-1 and -2

Code for generating test collection + reading data available at ARQMath GitHub: **github.com/ARQMath/ARQMathCode**

#ARQMath

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