ARQMath

Answer Retrieval for Questions on Math

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

#ARQMath

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— Goals —

Advance math-aware search
Advance semantic analysis of mathematical notation and text

— Collection —

Archived posts from **Math Stack Exchange** (community QA forum)
(~1 million questions; ~28 million LaTeX formulas)
Stored in linked XML files

Tools to parse data into question threads provided (python)
HTML for threads provided (for study, checking, and evaluation)

Separate Formula Indices (TSV files):
appearance encodings: *LaTeX, Presentation MathML*
semantic encoding: *Content MathML*

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Task 1: Find Answers to Math Questions
(98 Topics)

Given a posted question (in 2019) as a query:
search answer posts (2010-2018)
return relevant answers

Query

How can I evaluate $\sum_{n=0}^{\infty}(n+1)x^n$?

Asked 8 years, 5 months ago Active 4 months ago Viewed 34k times

384

146

How can I evaluate

$$\sum_{n=1}^{\infty}\frac{2n}{3^{n+1}}$$

I know the answer thanks to Wolfram Alpha, but I'm more concerned with how I can derive that answer. It cites tests to prove that it is convergent, but my class has never learned these before so I feel that there must be a simpler method.

In general, how can I evaluate

$$\sum_{n=0}^{\infty}(n+1)x^n?$$

sequences-and-series convergence power-series faq

edited Sep 24 '17 at 12:09
Parcly Taxel
51.7k 13 80 120

asked Apr 3 '11 at 21:41
Backus
2,072 3 12 8

Search Results

1

No need to use Taylor series, this can be derived in a similar way to the formula for geometric series. Let's find a general formula for the following sum:

$$S_m = \sum_{n=1}^{m} nr^n.$$

...

2

It is equivalent to $x(x+1)(x+5)(x+6)+96=0$

Now

...

$$(x^2+6x)(x^2+6x+5)+96=0$$

3

If you want a solution that doesn't require derivatives or integrals, notice that

$$\begin{aligned}1+2x+3x^2+4x^3+\cdots = 1+x+x^2+x^3+\ldots\\ +x+x^2+x^3+\ldots\\ +x^2+x^3+\ldots\end{aligned}$$

...

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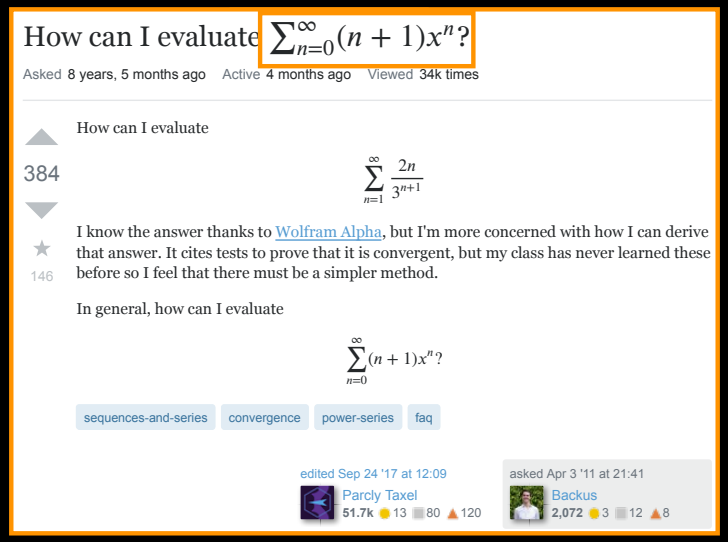
Task 2: Formula Search (in-context)

(87 Topics)

Given formula in a question post from Task 1 (2019):
search formulas in question and answer posts (2010-2018)
return relevant formulas w. associated posts

Query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Search Results

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

2 $\sum_{n=0}^{\infty}(n+1)x^n$

3 $\int_0^1 \frac{\ln(x+1)}{x^2+1}dx$

.
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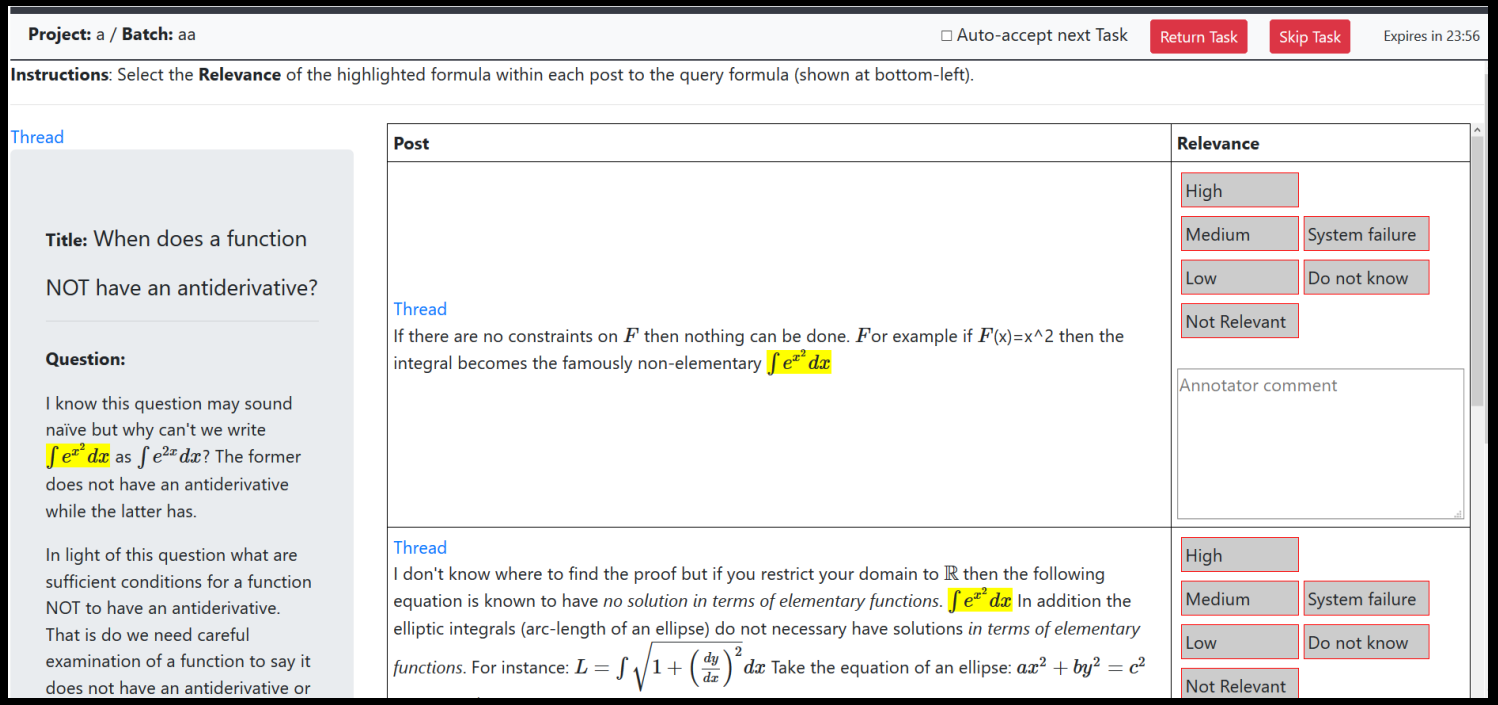
Evaluation for Task 2: Formula Search (in-context)



Multi-level relevance

Evaluation tools built with Turkle: https://github.com/hltcoe/turkle

Per topic: Unique formulas pooled by appearance; posts sampled from threads
Formulas in sampled posts evaluated separately (i.e., in-context)
Runs for both tasks ranked via nDCG′ (nDCG using only evaluated hits)

Sakai, T. & Kando, N. (2008). On information retrieval metrics designed for evaluation with incomplete relevance assessments. *Information Retrieval.*

— Baseline Systems —

Our baseline systems are open-source
Each will be configured to index the ARQMath collection

Task 1: Approach0 (Zhong et al., https://approach0.xyz/search)
Ad-hoc math-aware search engine (text + math)
formulas: semantic encoding

Task 2: Tangent-s (Davila et al., https://www.cs.rit.edu/~dprl/software.html)
Formula search engine (math only)
formulas: appearance + semantic encodings

Wei Zhong, Hui Fang: OPMES: A Similarity Search Engine for Mathematical Content. ECIR 2016: 849-852

Kenny Davila, Richard Zanibbi: Layout and Semantics: Combining Representations for Mathematical Formula Search. SIGIR 2017: 1165-1168

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Please join us!

Send Email to: **rxzvcs@rit.edu**

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