Eedi - Mining Misconceptions in Mathematics

Post-Competition Review

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Appendix

- Introduction
- Background
- Dataset
- Evaluation metrics
- Algorithm (data filling, Fine-tuning LLM)
- Retrieval
- Rerank
- Similarity Matching

Introduction

This competition aims to predict the correlation between incorrect options (distractors) and potential misconceptions in multiple-choice math questions by building natural language processing (NLP) models. Traditionally, manual annotation requires each incorrect option to be carefully matched with corresponding misconceptions, a process that is time-consuming and prone to inconsistency. The competition challenges participants to develop models that can automate or semi-automate this matching process. These models should not only cover known misconceptions but also generalize well to newly emerging ones, thereby effectively reducing the burden of manual annotation and improving educational quality.

Construct Name: Simplify an algebraic fraction by factorising the numerator

Subject Name: Simplifying Algebraic Fractions

Problem:

Simplify the following, if possible: $\frac{m^2+2m-3}{m-3}$

A. $m+1$

B. $m+2$

C. $m-1$

D. Does not simplify

Correct answer: D

Misconception A: Does not know that to factorise a quadratic expression, to find two numbers that add to give the coefficient of the x term, and multiply to give the non variable term

Misconception B: Thinks that when you cancel identical terms from the numerator and denominator, they just disappear

Misconception C: Does not know that to factorise a quadratic expression, to find two numbers that add to give the coefficient of the x term, and multiply to give the non variable term

Misconception D: No misconception/NaN

Construct Name: Calculate the range from a list of data

Subject Name: Range and Interquartile Range from a List of Data

Problem:

Tom and Katie are discussing the 5 plants with these heights: 24 cm, 17 cm, 42 cm, 26 cm, 13 cm Tom says if all the plants were cut in half, the range wouldn't change. Katie says if all the plants grew by 3 cm each, the range wouldn't change. Who do you agree with?

A. Only Tom

B. Only Katie

C. Both Tom and Katie

D. Neither is correct

Correct answer: B

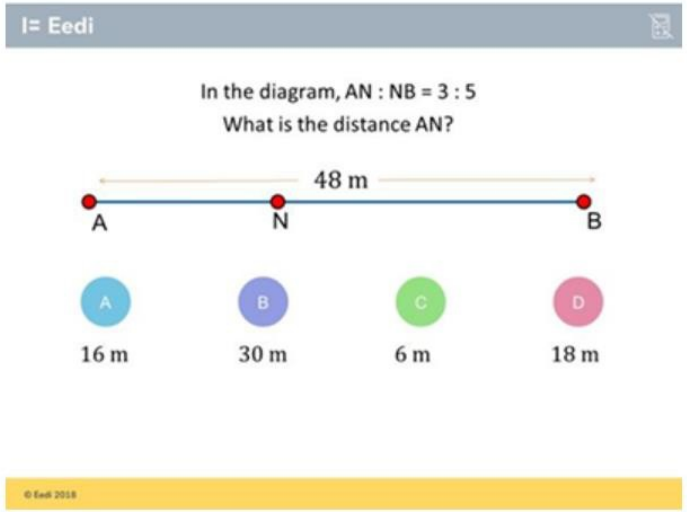
Misconception A: Believes if you changed all values by the same proportion the range would not change

Misconception B: No misconception/NaN

Misconception C: Believes if you changed all values by the same proportion the range would not change

Misconception D: Believes if you add the same value to all numbers in the dataset the range will change

Background – Competition Data



In this example, the options for the question are labeled with misconceptions as follows:

- **A**: Divides total amount by each side of the ratio instead of dividing by the sum of the parts
- **B**: Mixes up sides of a ratio
- **C**: Finds one part of a ratio but doesn't multiply that by the number of parts needed
- **D**: Correct answer

The Diagnostic Questions were originally presented in image format, and the text, including mathematical content, has been extracted using a human-in-the-loop OCR process.

File and Field Information

- **[train/test].csv**
  - `QuestionId` - Unique question identifier (`int`).
  - `ConstructId` - Unique construct identifier (`int`).
  - `ConstructName` - Most granular level of knowledge related to question (`str`).
  - `CorrectAnswer` - A, B, C or D (`char`).
  - `SubjectId` - Unique subject identifier (`int`).
  - `SubjectName` - More general context than the `construct` (`str`).
  - `QuestionText` - Question text extracted from the question image using human-in-the-loop OCR (`str`).
  - `Answer[A/B/C/D]Text` - Answer option A text extracted from the question image using human-in-the-loop OCR (`str`).
  - `Misconception[A/B/C/D]Id` - Unique misconception identifier (`int`). Ground truth labels in `train.csv`; your task is to predict these labels for `test.csv`.
- **misconception_mapping.csv** - maps `MisconceptionId` to its `MisconceptionName`
- **sample_submission.csv** - A submission file in the correct format.
  - `QuestionId_Answer` - Each question has three incorrect answers for which need you predict the `MisconceptionId`.
  - `MisconceptionId` - You can predict up to 25 values, space delimited.

Dataset: misconception_mapping.csv

Details of Misconception Matching with IDs


```
In [2]: data = pd.read_csv('misconception_mapping.csv')
```

```
In [3]: data
```

Out[3]:

	MisconceptionId	MisconceptionName
0	0	Does not know that angles in a triangle sum to...
1	1	Uses dividing fractions method for multiplying...
2	2	Believes there are 100 degrees in a full turn
3	3	Thinks a quadratic without a non variable term...
4	4	Believes addition of terms and powers of terms...
...	...	...
2582	2582	When multiplying numbers with the same base, m...
2583	2583	Does not know what a cube number is
2584	2584	Believes that any percentage of a larger numbe...
2585	2585	Believes a cubic expression should have three ...
2586	2586	Misunderstands order of operations in algebrai...

2587 rows × 2 columns

```
: for i in range(20):
      print(data['MisconceptionName'].iloc[i])
```

```
Does not know that angles in a triangle sum to 180 degrees
Uses dividing fractions method for multiplying fractions
Believes there are 100 degrees in a full turn
Thinks a quadratic without a non variable term, can not be factorised
Believes addition of terms and powers of terms are equivalent e.g. a + c = a^c
When measuring a reflex angle, gives the acute or obtuse angle that sums to 360 instead
Can identify the multiplier used to form an equivalent fraction but does not apply to the numerator
Believes gradient = change in y
Student thinks that any two angles along a straight line are equal
Thinks there are 180 degrees in a full turn
Believes duration can be read from a timetable, rather than calculating from start and end times
When reading value from graph, reads from the wrong axes.
Thinks that the side view does not include the furthest rows back
Does not subtract from the hours, when having to borrow for a time calculation
Does not understand how to create a multiple of an equation
Confuses the order of operations, believes addition comes before division
Believes that graphs of inverse proportion meet the axes
Confuses AM and PM when calculating time
Given the length of the sides, still does not recognise there is enough information to find the area
When multiplying a surd by an integer, adds the integer to the number under the surd
```

Dataset: train.csv


```
data = pd.read_csv('train.csv')
data
```

	QuestionId	ConstructId	ConstructName	SubjectId	SubjectName	CorrectAnswer	QuestionText	AnswerAText	AnswerBText	AnswerCText	AnswerDText
0	0	856	Use the order of operations to carry out calcu...	33	BIDMAS	A	\n$3 \times 2 + 4 - 5$\n \nWhere do the brackets ...	$3 \times (2 + 4) - 5$	$3 \times 2 + (4 - 5)$	$3 \times (2 + 4 - 5)$	Does not need brackets
1	1	1612	Simplify an algebraic fraction by factorising ...	1077	Simplifying Algebraic Fractions	D	Simplify the following, if possible: \(\frac{...	$m + 1$	$m + 2$	$m - 1$	Does not simplify
2	2	2774	Calculate the range from a list of data	339	Range and Interquartile Range from a List of Data	B	Tom and Katie are discussing the 5 plant...	Only\nTom	Only\nKatie	Both Tom and Katie	Neither is correct
3	3	2377	Recall and use the intersecting diagonals prop...	88	Properties of Quadrilaterals	C	The angles highlighted on this rectangle with ...	acute	obtuse	90°	Not enough information
4	4	3387	Substitute positive integer values into formul...	67	Substitution into Formula	A	The equation $f = 3r^2 + 3$ is used to find...	30	27	51	24
...	...	...	...	...	...	...	...	...	...	...	...
1864	1864	2774	Calculate the range from a list of data	339	Range and Interquartile Range from a List of Data	C	What is the range of the following numbers? \n\...	5	11	23	16
1865	1865	2695	Describe an enlargement, with no centre of enl...	90	Length Scale Factors in Similar Shapes	B	Shape Q is an enlargement of shape \(P ...	$3 \div 11$	$11 \div 3$	3×11	$11 - 3$
1866	1866	854	Use the order of operations to carry out calcu...	33	BIDMAS	B	What does the following equal?\n\[\n8-7+10 \ti...	36	31	−29	33
1867	1867	2634	Distinguish between congruency and similarity	274	Congruency in Other Shapes	B	Tom and Katie are discussing congruence and si...	Only\nTom	Only Katie	Both Tom and Katie	Neither is correct
1868	1868	2680	Describe a 90° or 270° rotation giving the ang...	93	Rotation	B	Jo and Paul are arguing about how to fully des...	Only\nJo	Only Paul	Both Jo and Paul	Neither is correct

1869 rows × 15 columns

```
dict(data.iloc[1])
```

```
{'QuestionId': 1,
 'ConstructId': 1612,
 'ConstructName': 'Simplify an algebraic fraction by factorising the numerator',
 'SubjectId': 1077,
 'SubjectName': 'Simplifying Algebraic Fractions',
 'CorrectAnswer': 'D',
 'QuestionText': 'Simplify the following, if possible: \\( \\frac{m^{2}+2 m-3}{m-3} \\)',
 'AnswerAText': '\\( m+1 \\)',
 'AnswerBText': '\\( m+2 \\)',
 'AnswerCText': '\\( m-1 \\)',
 'AnswerDText': 'Does not simplify',
 'MisconceptionAId': 2142.0,
 'MisconceptionBId': 143.0,
 'MisconceptionCId': 2142.0,
 'MisconceptionDId': nan}
```

```
dict(data.iloc[4])
```

```
{'QuestionId': 4,
 'ConstructId': 3387,
 'ConstructName': 'Substitute positive integer values into formulae involving powers or roots',
 'SubjectId': 67,
 'SubjectName': 'Substitution into Formula',
 'CorrectAnswer': 'A',
 'QuestionText': 'The equation \\( f=3 r^{2}+3 \\) is used to find values in the table below. What is the value covered by the star? \\begin{tabular}{|c|c|c|c|c|}\n\\hline\\( r \\) & \\( 1 \\) & \\( 2 \\) & \\( 3 \\) & \\( 4 \\) \\\\\n\\hline\\( f \\) & \\( 6 \\) & \\( 15 \\) & \\( \\color{gold}\\bigstar \\) & \\\\\n\\hline\n\\end{tabular}',
 'AnswerAText': '\\( 30 \\)',
 'AnswerBText': '\\( 27 \\)',
 'AnswerCText': '\\( 51 \\)',
 'AnswerDText': '\\( 24 \\)',
 'MisconceptionAId': nan,
 'MisconceptionBId': nan,
 'MisconceptionCId': nan,
 'MisconceptionDId': 1818.0}
```

Dataset: test.csv / sample_submission.csv


```
dict(data.iloc[0])
```

```
{'QuestionId': 1869,
 'ConstructId': 856,
 'ConstructName': 'Use the order of operations to carry out calculations involving powers',
 'SubjectId': 33,
 'SubjectName': 'BIDMAS',
 'CorrectAnswer': 'A',
 'QuestionText': '\\[\n3 \\times 2+4-5\n\\]\nWhere do the brackets need to go to make the answer equal \\( 13 \\) ?',
 'AnswerAText': '\\( 3 \\times(2+4)-5 \\)',
 'AnswerBText': '\\( 3 \\times 2+(4-5) \\)',
 'AnswerCText': '\\( 3 \\times(2+4-5) \\)',
 'AnswerDText': 'Does not need brackets'}
```

```
dict(data.iloc[1])
```

```
{'QuestionId': 1870,
 'ConstructId': 1612,
 'ConstructName': 'Simplify an algebraic fraction by factorising the numerator',
 'SubjectId': 1077,
 'SubjectName': 'Simplifying Algebraic Fractions',
 'CorrectAnswer': 'D',
 'QuestionText': 'Simplify the following, if possible: \\( \\frac{m^{2}+2 m-3}{m-3} \\)',
 'AnswerAText': '\\( m+1 \\)',
 'AnswerBText': '\\( m+2 \\)',
 'AnswerCText': '\\( m-1 \\)',
 'AnswerDText': 'Does not simplify'}
```

```
data = pd.read_csv('sample_submission.csv')
data
```

	QuestionId_Answer	MisconceptionId
0	1869_B	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 1...
1	1869_C	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 1...
2	1869_D	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 1...
3	1870_A	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 1...
4	1870_B	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 1...
5	1870_C	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 1...
6	1871_A	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 1...
7	1871_C	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 1...
8	1871_D	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 1...

By Bobby Lee 2025

Evaluation Metrics

Evaluation

Submissions are evaluated according to the Mean Average Precision @ 25 (MAP@25):

$$\text{MAP@25} = \frac{1}{U}\sum_{u=1}^{U}\sum_{k=1}^{min(n,25)} P(k) \times rel(k)$$

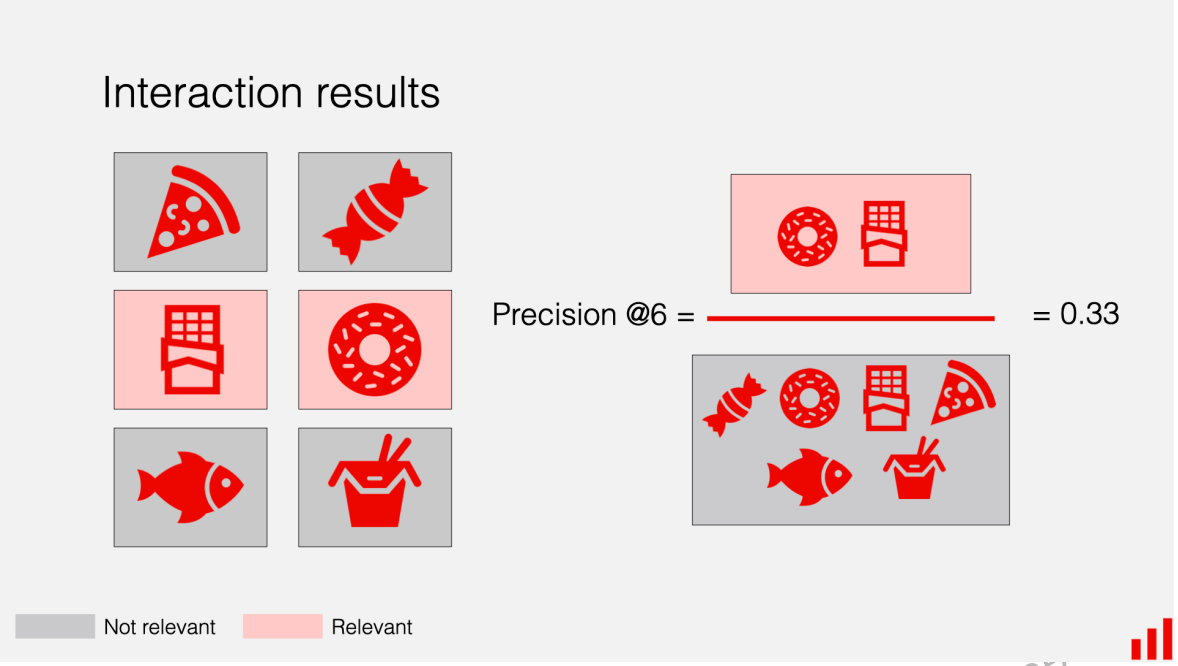
where U is the number of observations, $P(k)$ is the precision at cutoff k, n is the number predictions submitted per observation, and $rel(k)$ is an indicator function equaling 1 if the item at rank k is a relevant (correct) label, zero otherwise.

Once a correct label has been scored for *an observation*, that label is no longer considered relevant for that observation, and additional predictions of that label are skipped in the calculation. For example, if the correct label is `A` for an observation, the following predictions all score an average precision of `1.0`.

```
[A, B, C, D, E]
[A, A, A, A, A]
[A, B, A, C, A]
```

There is only one correct label per observation (hence no divisor term in front of the inner summation.)

$$\text{Precision at } K = \frac{\text{Number of relevant items in } K}{\text{Total number of items in } K}$$



Algorithm

This competition utilises fine-tuning of Large Language Models (LLMs) to perform retrieval and re-ranking to identify misconceptions in math problems. The algorithm workflow is as follows:

- **Data Generation and Model Training:** Initially, GPT-4o is employed to generate missing misconception data from the official dataset, constructing the sample information into training data. Based on the Qwen-14b-instruct and Qwen-32b-instruct large models, fine-tuning is conducted using contrastive learning. During this phase, a 4-bit quantised model version is used, with LoRA (Low-Rank Adaptation) techniques applied to train multiple linear modules.
- **Retrieval and Model Fusion:** In the retrieval stage, embeddings from three LLMs with different training methods or varying parameters are concatenated, followed by similarity-based retrieval to shortlist candidates.
- **Re-ranking:** The top 25 prediction results from the retrieval stage are re-ranked using Qwen-32b-instruct-AWQ. The re-ranking statements are input into Qwen-32b-instruct-AWQ, leveraging its zero-shot capability to output new ranking statements. The top 25 results are processed in batches; simultaneously, bge-large-en-v1.5 is used to search for the best results from a specified retrieval library based on similarity.

Algorithm

Data Generation: Filling Missing Misconceptions


```
dict(data.iloc[4])
```

```
{'QuestionId': 4,
 'ConstructId': 3387,
 'ConstructName': 'Substitute positive integer values into formulae invo
 'SubjectId': 67,
 'SubjectName': 'Substitution into Formula',
 'CorrectAnswer': 'A',
 'QuestionText': 'The equation \\( f=3 r^{2}+3 \\) is used to find value
covered by the star? \\begin{tabular}{|c|c|c|c|c|}\n\\hline\\( r \\) & \
\\) \\\\\n\\hline\\( f \\) & \\( 6 \\) & \\( 15 \\) & \\( \\color{gold}\
lar}',
 'AnswerAText': '\\( 30 \\)',
 'AnswerBText': '\\( 27 \\)',
 'AnswerCText': '\\( 51 \\)',
 'AnswerDText': '\\( 24 \\)',
 'MisconceptionAId': nan,
 'MisconceptionBId': nan,
 'MisconceptionCId': nan,
 'MisconceptionDId': 1818.0}
```

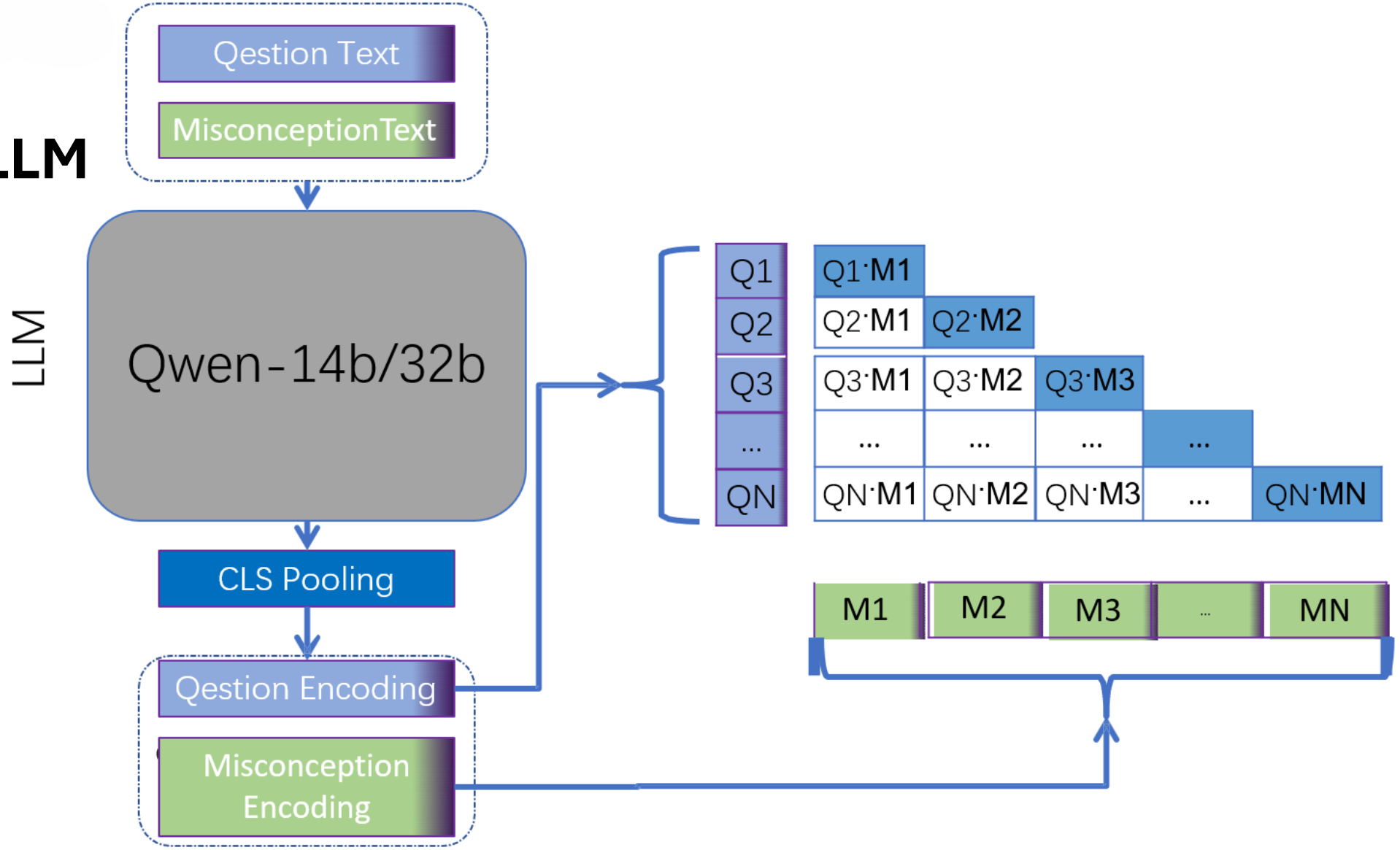
[6]

```
model_config = dict(
openai_api_base = "https://testshellapi.kimi.asia/v1", #host
api_key = "****", # model api key
model = "gpt-4o", # model name
default_system_prompt = """##Task
You are a Mathematics teacher. Your task is to reason and identify the ConstructName and SubjectName and then the misconception behind the user inpu
ConstructName is Most granular level of knowledge related to question, appears to describe the specific mathematical method or procedure used to sol
SubjectName is More general context than the construct, represents the broader mathematical topic or category that the question belongs to.
Misconceptions are a mistake in conceptual understanding and they have relations with all the applications of those concepts. For example, a single
Answer concisely what misconception it is to lead to getting the incorrect answer.
Do not use "The misconception is" to start your answers.
Do not mention the concrete details of the question or answers.

##User input
Question: The question text
A: multiple choice answer A text
B: multiple choice answer B text
C: multiple choice answer C text
D: multiple choice answer D text
Correct Answer: The correct answer text

##You should answer in the following JSON format
{
    "ConstructName": "here writes the constructName",
    "SubjectName": "here writes the SubjectName"
    "MisconceptionAName": "here writes the answer A's misconception.",
    "MisconceptionBName": "here writes the answer B's misconception.",
    "MisconceptionCName": "here writes the answer C's misconception.",
    "MisconceptionDName": "here writes the answer D's misconception.",
}
""", # system prompt
default_temperature=0.5, # model temperature 越高随机性越强。
max_tokens=256, # model 最大输出token数量
)
```

Python

Algorithm

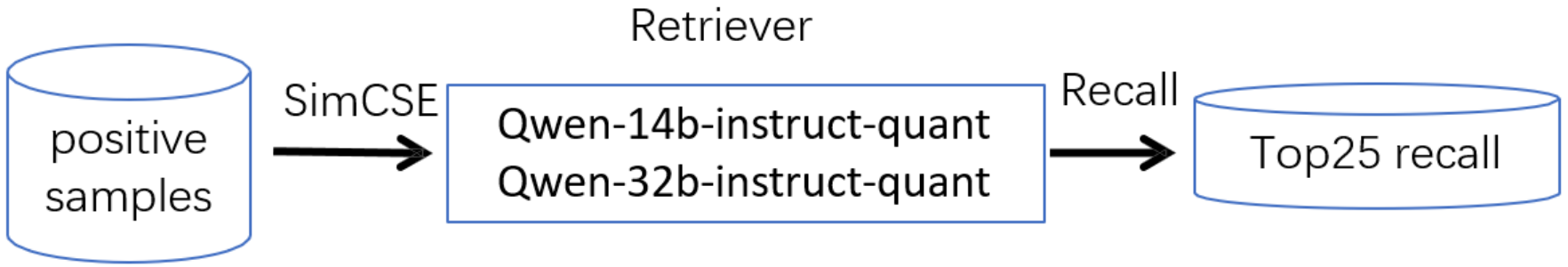
Contrastive Learning Fine-Tuning of LLM



Algorithm

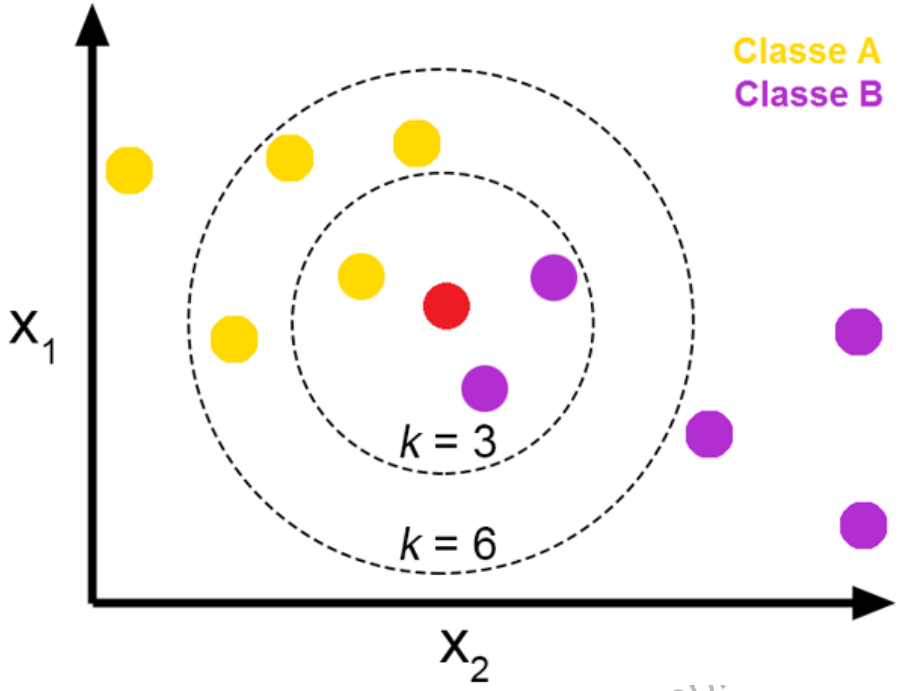
```
# %%
task_description = 'Given a math question and a misconcepte incorrect answer, please retrieve the most accurate reason for the misconception.'

def get_detailed_instruct(task_description: str, query: str) -> str:
    return f'Instruct: {task_description}\nQuery: {query}'

def create_train_df(train_df, misconception_mapping, is_train=True):
    train_data = []
    for _,row in train_df.iterrows():
        for c in ['A','B','C','D']:
            if is_train:
                misconception_id = row[f"Misconception{c}Id"]
                if np.isnan(misconception_id):
                    misconception_id = -1
                    doc_text = row[f'Misconception{c}Name']
                misconception_id = int(misconception_id)
            if c == row['CorrectAnswer']:
                continue
            if f'Answer{c}Text' not in row:
                continue
            real_answer_id = row['CorrectAnswer']
            real_text = row[f'Answer{real_answer_id}Text']
            query_text =f"###question###:{row['SubjectName']}-{row['ConstructName']}-{row['QuestionText']}\n###Correct Answer###:{
            real_text}\n###Misconcepte Incorrect answer###:{row[f'Answer{c}Text']}"
            row['query'] = get_detailed_instruct(task_description,query_text)
            row['answer_name'] = c
            if is_train and misconception_id != -1:
                doc_text = misconception_mapping.iloc[misconception_id]['MisconceptionName']
            row['doc'] = doc_text
            row['answer_id'] = misconception_id
            train_data.append(copy.deepcopy(row))
    new_train_df = pd.DataFrame(train_data)
    return new_train_df

```

Retrieval



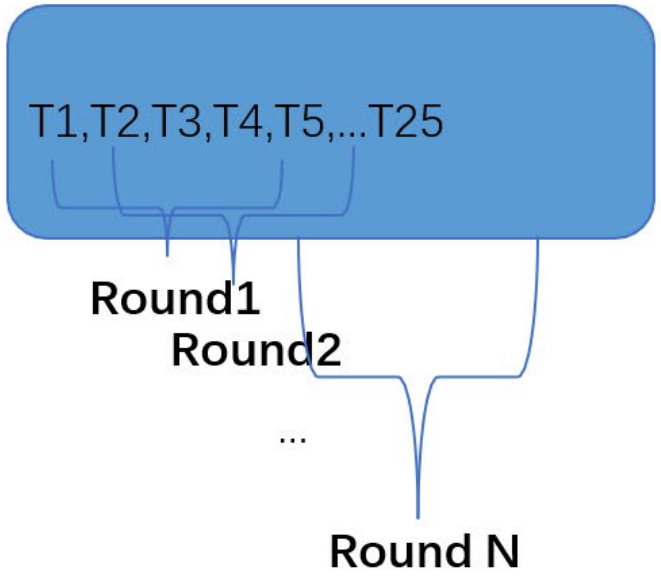
Selection of Three LLMs with Different Training Methods or Parameters for Ensemble

```
new_val_df = pd.read_parquet("df.parquet")
q_emb1 = np.load('/kaggle/working/qwen14b_awq_query_embeddings.npy').astype("float16")
q_emb2 = np.load('/kaggle/working/qwen32b_query_embeddings.npy').astype("float16")
q_emb3 = np.load('/kaggle/working/qwen14b_inst_query_embeddings.npy').astype("float16")

d_emb1 = np.load('/kaggle/working/qwen14b_awq_doc_embeddings.npy').astype("float16")
d_emb2 = np.load('/kaggle/working/qwen32b_doc_embeddings.npy').astype("float16")
d_emb3 = np.load('/kaggle/working/qwen14b_inst_doc_embeddings.npy').astype("float16")

query_embeddings = np.concatenate([q_emb1,q_emb2, q_emb3], axis=1)

doc_embeddings = np.concatenate([d_emb1, d_emb2, d_emb3], axis=1)

doc_embeddings.shape

top_k = min(top_k, len(doc_embeddings))
indices = get_matches(query_embeddings, doc_embeddings, n_neighbors=top_k)
misconception_mapping = pd.read_csv(f"{path_prefix}/misconception_mapping.csv")
np.save("indices.npy", indices)
```



Rerank

KNN Algorithm Relies on Vector Distance for Result Ranking, Which Is Overly Coarse, Requiring a More Advanced Re-ranking Approach.




```
def apply_template(row, tokenizer):
    PROMPT  = """Here is a mathematics question about
Curriculum knowledge: {constructName}({subjectName})
Question: {problem}
Incorrect Answer: {wrong_ans}
Correct Answer: {correctAnswerValue}

You are a Mathematics teacher. Your task is to reason and identify the misconception behind the Incorrect Answer with the Question.
Answer concisely what misconception it is to lead to getting the incorrect answer.
No need to give the reasoning process and do not use "The misconception is" to start your answers.
There are some relative and possible misconceptions below to help you make the decision:

{retrival}"""

    messages = [
      {
          "role": "user",
          "content": PROMPT.format(
              constructName=row["ConstructName"],
              problem=row["QuestionText"],
              correctAnswerValue=row["CorrectAnswerText"],
              wrong_ans=row["IncorrectAnswerText"],
              subjectName=row["SubjectName"],
              retrival=row["Retrival"]
          )}
  ]
```

Similarity Matching

label: misconception_mapping.csv

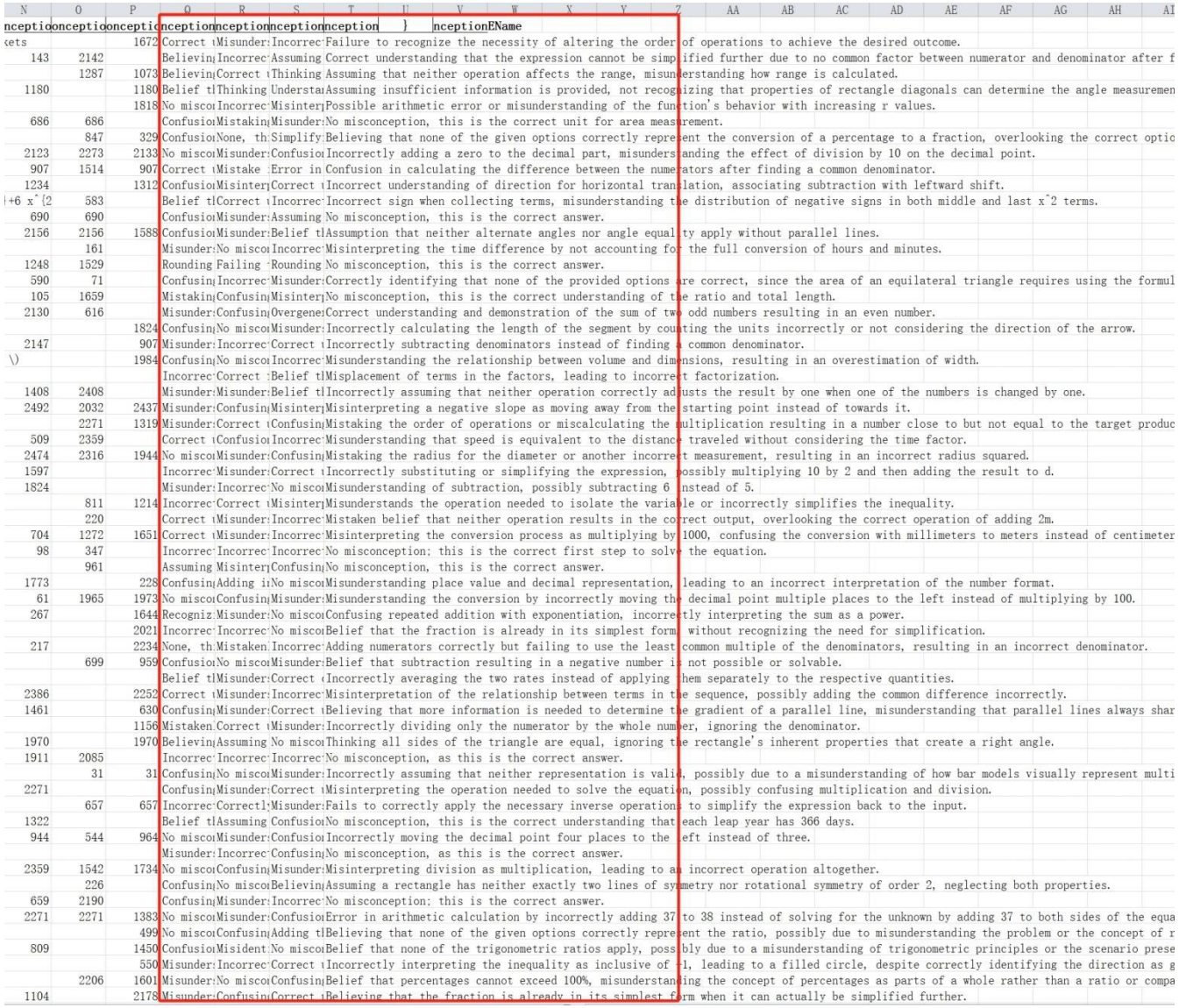
In [2]:
```
data = pd.read_csv('misconception_mapping.csv')
```

In [3]:
```
data
```

Out[3]:

	MisconceptionId	MisconceptionName
0	0	Does not know that angles in a triangle sum to...
1	1	Uses dividing fractions method for multiplying...
2	2	Believes there are 100 degrees in a full turn
3	3	Thinks a quadratic without a non variable term...
4	4	Believes addition of terms and powers of terms...
...	...	...
2582	2582	When multiplying numbers with the same base, m...
2583	2583	Does not know what a cube number is
2584	2584	Believes that any percentage of a larger numbe...
2585	2585	Believes a cubic expression should have three ...
2586	2586	Misunderstands order of operations in algebrai...

2587 rows × 2 columns

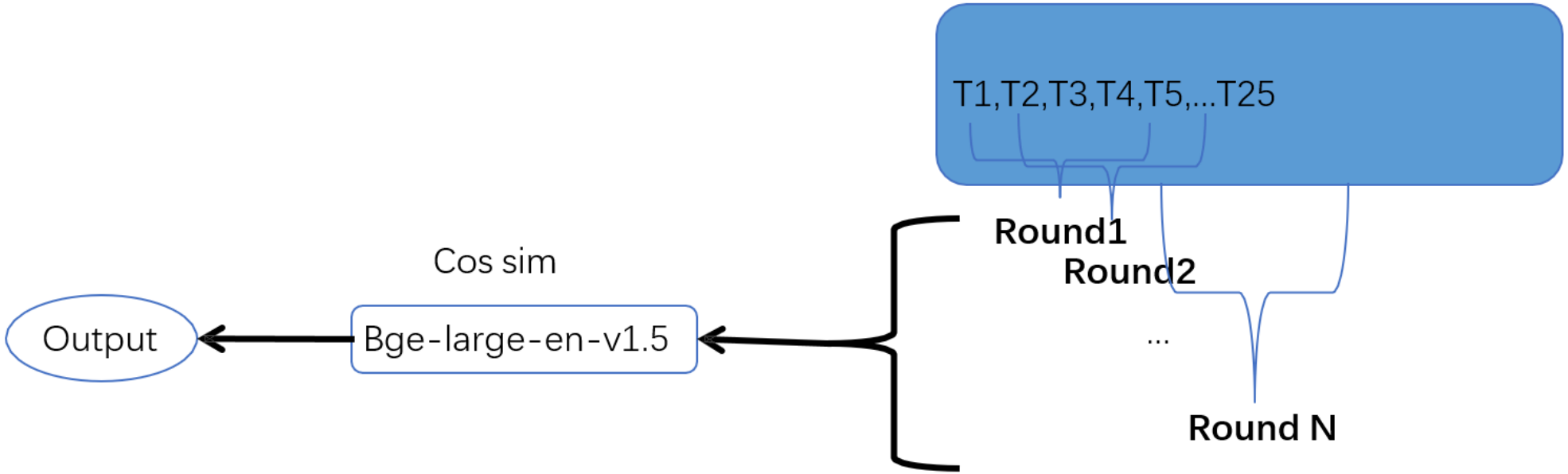


N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
nceptio	onceptio	onceptio	nception	nception	nception	nception	}	nceptionEName													
ets		1672	Correct t	Misunder	Incorrec	Failure to recognize the necessity of altering the order of operations to achieve the desired outcome.															
143	2142		Believin	Incorrec	Assuming	Correct understanding that the expression cannot be simplified further due to no common factor between numerator and denominator after f															
	1287	1073	Believin	Correct t	Thinking	Assuming that neither operation affects the range, misunderstanding how range is calculated.															
1180		1180	Belief th	Thinking	Understa	Assuming insufficient information is provided, not recognizing that properties of rectangle diagonals can determine the angle measuremen															
		1818	No misco	Incorrec	Misinter	Possible arithmetic error or misunderstanding of the function's behavior with increasing r values.															
686	686		Confusio	Mistakin	Misunder	No misconception, this is the correct unit for area measurement.															
	847	329	Confusio	None, th	Simplify	Believing that none of the given options correctly represent the conversion of a percentage to a fraction, overlooking the correct optio															
2123	2273	2133	No misco	Misunder	Confusio	Incorrectly adding a zero to the decimal part, misunderstanding the effect of division by 10 on the decimal point.															
907	1514	907	Correct t	Mistake	Error in	Confusion in calculating the difference between the numerators after finding a common denominator.															
1234		1312	Confusio	Misinter	Correct t	Incorrect understanding of direction for horizontal translation, associating subtraction with leftward shift.															
+6 x^{2	583		Belief th	Correct t	Incorrec	Incorrect sign when collecting terms, misunderstanding the distribution of negative signs in both middle and last x^2 terms.															
690	690		Confusio	Misunder	Assuming	No misconception, this is the correct answer.															
2156	2156	1588	Confusio	Misunder	Belief th	Assumption that neither alternate angles nor angle equality apply without parallel lines.															
	161		Misunder	No misco	Incorrec	Misinterpreting the time difference by not accounting for the full conversion of hours and minutes.															
1248	1529		Rounding	Failing	Rounding	No misconception, this is the correct answer.															
590	71		Confusin	Incorrec	Misunder	Correctly identifying that none of the provided options are correct, since the area of an equilateral triangle requires using the formul															
105	1659		Mistakin	Confusin	Misinter	No misconception, this is the correct understanding of the ratio and total length.															
2130	616		Misunder	Confusin	Overgene	Correct understanding and demonstration of the sum of two odd numbers resulting in an even number.															
		1824	Confusin	No misco	Misunder	Incorrectly calculating the length of the segment by counting the units incorrectly or not considering the direction of the arrow.															
2147		907	Misunder	Incorrec	Correct t	Incorrectly subtracting denominators instead of finding a common denominator.															
\)		1984	Confusin	No misco	Incorrec	Misunderstanding the relationship between volume and dimensions, resulting in an overestimation of width.															
			Incorrec	Correct t	Belief th	Misplacement of terms in the factors, leading to incorrect factorization.															
1408	2408		Misunder	Misunder	Belief th	Incorrectly assuming that neither operation correctly adjusts the result by one when one of the numbers is changed by one.															
2492	2032	2437	Misunder	Confusin	Misinter	Misinterpreting a negative slope as moving away from the starting point instead of towards it.															
	2271	1319	Misunder	Correct t	Confusin	Mistaking the order of operations or miscalculating the multiplication resulting in a number close to but not equal to the target produc															
509	2359		Correct t	Confusio	Incorrec	Misunderstanding that speed is equivalent to the distance traveled without considering the time factor.															
2474	2316	1944	No misco	Misunder	Confusin	Mistaking the radius for the diameter or another incorrect measurement, resulting in an incorrect radius squared.															
1597			Incorrec	Misunder	Correct t	Incorrectly substituting or simplifying the expression, possibly multiplying 10 by 2 and then adding the result to d.															
1824			Misunder	Incorrec	No misco	Misunderstanding of subtraction, possibly subtracting 6 instead of 5.															
	811	1214	Incorrec	Correct t	Misinter	Misunderstands the operation needed to isolate the variable or incorrectly simplifies the inequality.															
	220		Correct t	Misunder	Incorrec	Mistaken belief that neither operation results in the correct output, overlooking the correct operation of adding 2m.															
704	1272	1651	Correct t	Misunder	Incorrec	Misinterpreting the conversion process as multiplying by 1000, confusing the conversion with millimeters to meters instead of centimeter															
98	347		Incorrec	Incorrec	Incorrec	No misconception; this is the correct first step to solve the equation.															
	961		Assuming	Misinter	Confusin	No misconception, this is the correct answer.															
1773		228	Confusin	Adding it	No misco	Misunderstanding place value and decimal representation, leading to an incorrect interpretation of the number format.															
61	1965	1973	No misco	Confusin	Misunder	Misunderstanding the conversion by incorrectly moving the decimal point multiple places to the left instead of multiplying by 100.															
267		1644	Recogniz	Misunder	No misco	Confusing repeated addition with exponentiation, incorrectly interpreting the sum as a power.															
		2021	Incorrec	Incorrec	No misco	Belief that the fraction is already in its simplest form without recognizing the need for simplification.															
217		2234	None, th	Mistaken	Incorrec	Adding numerators correctly but failing to use the least common multiple of the denominators, resulting in an incorrect denominator.															
	699	959	Confusio	No misco	Misunder	Belief that subtraction resulting in a negative number is not possible or solvable.															
			Belief th	Misunder	Correct t	Incorrectly averaging the two rates instead of applying them separately to the respective quantities.															
2386		2252	Correct t	Misunder	Incorrec	Misinterpretation of the relationship between terms in the sequence, possibly adding the common difference incorrectly.															
1461		630	Confusin	Misunder	Correct t	Believing that more information is needed to determine the gradient of a parallel line, misunderstanding that parallel lines always shar															
		1156	Mistaken	Correct t	Misunder	Incorrectly dividing only the numerator by the whole number, ignoring the denominator.															
1970		1970	Believin	Assuming	No misco	Thinking all sides of the triangle are equal, ignoring the rectangle's inherent properties that create a right angle.															
1911	2085		Incorrec	Incorrec	Incorrec	No misconception, as this is the correct answer.															
	31	31	Confusin	No misco	Misunder	Incorrectly assuming that neither representation is valid, possibly due to a misunderstanding of how bar models visually represent multi															
2271			Confusin	Misunder	Correct t	Misinterpreting the operation needed to solve the equation, possibly confusing multiplication and division.															
	657	657	Incorrec	Correctly	Misunder	Fails to correctly apply the necessary inverse operations to simplify the expression back to the input.															
1322			Belief th	Assuming	Confusio	No misconception, this is the correct understanding that each leap year has 366 days.															
944	544	964	No misco	Misunder	Confusio	Incorrectly moving the decimal point four places to the left instead of three.															
			Misunder	Incorrec	Confusin	No misconception, as this is the correct answer.															
2359	1542	1734	No misco	Confusin	Misunder	Misinterpreting division as multiplication, leading to an incorrect operation altogether.															
	226		Confusin	No misco	Believin	Assuming a rectangle has neither exactly two lines of symmetry nor rotational symmetry of order 2, neglecting both properties.															
659	2190		Confusin	Misunder	Incorrec	No misconception; this is the correct answer.															
2271	2271	1383	No misco	Misunder	Confusio	Error in arithmetic calculation by incorrectly adding 37 to 38 instead of solving for the unknown by adding 37 to both sides of the equa															
		499	No misco	Confusin	Adding th	Believing that none of the given options correctly represent the ratio, possibly due to misunderstanding the problem or the concept of r															
809		1450	Confusio	Misident	No misco	Belief that none of the trigonometric ratios apply, possibly due to a misunderstanding of trigonometric principles or the scenario prese															
		550	Misunder	Incorrec	Correct t	Incorrectly interpreting the inequality as inclusive of -1, leading to a filled circle, despite correctly identifying the direction as g															
	2206	1601	Misunder	No misco	Confusin	Belief that percentages cannot exceed 100%, misunderstanding the concept of percentages as parts of a whole rather than a ratio or compa															
1104		2178	Misunder	Confusin	Correct t	Believing that the fraction is already in its simplest form when it can actually be simplified further.															

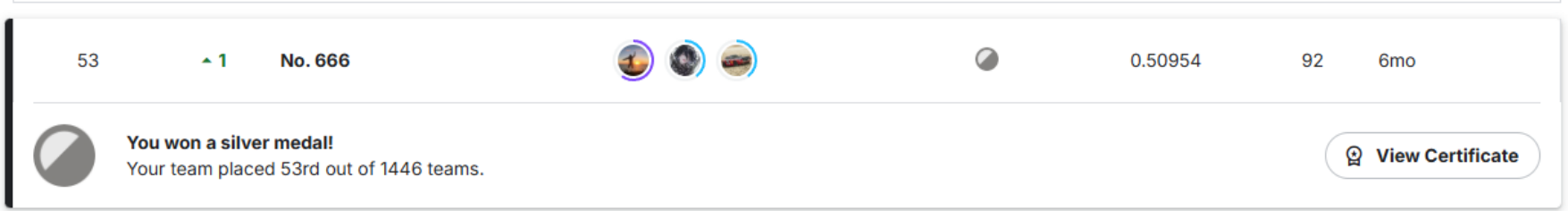
Similarity Matching

Utilizing Bge-large-en-v1.5 for Sentence Embedding


```
from sentence_transformers import SentenceTransformer
import torch

model = SentenceTransformer('/kaggle/input/bge-large-en-v1-5', trust_remote_code=True)

GROUP = args.GROUP
num_1 = args.NUM_1
num_2 = args.NUM_2
```



Results



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Retrieval & reranking is the key.

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By Bobby Lee 2025