

Question 1

Models used:

Sentence Transformer for storing RA documents: **all-MiniLM-L6-v2**

Model for generation and tokenization of the questions: **google/flan-t5-large**

Cross encoder for re-ranking: **cross-encoder/ms-marco-MiniLM-L-6-v2**

Documents created:

```
def create_documents(df):
    documents = []
    for _, row in df.iterrows():
        doc = f"{row['NAME']} is a {row['CUISINES']} restaurant located in {row['GENERAL_LOCATION']}. "
        doc += f"It features {row['FEATURES']}. " if row['FEATURES'] else ""
        doc += f"A brife desciction includes {row['DESCRIPTION']}. " if row['DESCRIPTION'] else ""
        doc += f"Hours: {row['HOURS'][0]}. " if row['HOURS'] else ""
        doc += f"Rating: {row['RATING']}/5."
        documents.append(doc)
    return documents
```

Sample document:

"Bua Thai Ramen & Robata Grill is a ['Thai', 'Sushi', 'Asian', 'Dining bars', 'Japanese Fusion', 'Vegetarian Friendly', 'Vegan Options', 'Gluten Free Options'] restaurant located in 1611 2nd Ave, Between 83rd & 84th Street on Upper East Side, 10028. It features ['Delivery', 'Takeout', 'Reservations', 'Outdoor Seating', 'Seating', 'Serves Alcohol', 'Full Bar', 'Accepts Credit Cards', 'Table Service']. A brife desciction includes Come to explore and experience Thai Cooking style that you might never have it before.. Hours: [{'open': 720, 'openHours': '12:00', 'close': 1350, 'closeHours': '22:30'}].Rating: 4.5/5.",

"Los Tacos No. 1 is a ['Mexican', 'Latin', 'Central American', 'Fast Food', 'Vegetarian Friendly', 'Gluten Free Options'] restaurant located in 229 W 43rd St, 10036-3982. It features ['Takeout', 'Wheelchair Accessible']. Hours: [{'open': 660, 'openHours': '11:00', 'close': 1320, 'closeHours': '22:00'}].Rating: 4.5/5.",

Responses:

After annotation:

	query	naive_response	naive_relevance	naive_diversity	naive_fluency	rerank_response	rerank_relevance	rerank_diversity	rerank_fluency
0	I want a cozy Italian restaurant near downtown.	['Telleri', 'Italian', 'Italian', 'Italian']	0	It has just give the keyword from the question.	0.0	Query: I want a cozy Italian restaurant near d...	0	Just replicated the question. It is not a re...	None
1	Where can I eat seafood near the beach with a...	Bungalow By The Sea	5	It has give on one restaurant option	NAN	['Bungalow By The Sea', 'Bungalow By The Sea']	5	Given 2 options	None
2	Suggest a casual lunch place in the general ar...	['Tian - Asian Cuisine Studio', 'Tian - Asian']	5	It has give on one restaurant option	NAN	The Cafe is a restaurant that serves sushi and...	0	Not the right answer	Fluency is very good
3	Are there any highly-rated spots for dessert a...	Yes	5	0	5.0	Mattie Cafe	5	In addition to what is given, we got addi... into	5
4	I'm looking for a halal or vegetarian dinner p...	['Petra Bistei', 'The Chicago Diner', 'Lugen Squ...	5	3 options	NAN	['The Heaven Restaurant', 'Enhan Restaurant', '...	5	3 options	None
5	Recommend a mid-range price Mexican dog friend...	['Torote Restaurant at Valle del Sol', 'Mexica...	5	None	NAN	['Esquina Mexicana' is a 'Mexican', 'Latin', '...	5	None	Fluent is giving the description of the restau...
6	Any hidden gems for coffee or breakfast with q...	Smooze Coffee House	5	5	NAN	Smooze Coffee House	5	None	None
7	Find a sushi place with scenic views, serves a...	['Sushi Bar', 'Sushi Lab', 'Sushi Kashtbar', 'S...	5	3 options given	NAN	['Sushi Kashtbar', 'Sushi Ger', 'Sushi Ger', 'S...	5	only 2 options given	None
8	I want to go somewhere trendy and lively for d...	I want to go somewhere trendy and lively for d...	0	None	NAN	If you are looking for a trendy and lively pla...	5	None	Very fluent in responding to the question by a...

	query	naive_response	naive_relevance	naive_diversity	naive_fluency	rerank_response	rerank_relevance	rerank_diversity	rerank_fluency
0	I want a cozy Italian restaurant near downtown...	['Italian', 'Italian', 'Italian', 'Italian', 'I...']	0	It has just give the keyword from the question...	0.0	Query: I want a cozy Italian restaurant near d...	0	0	Just replicated the question. It is not a rele...
1	Where can I eat seafood near the beach with a ...	Bungalow By The Sea	5	It has give on one restaurant option	NaN	['Bungalow By The Sea', 'Bungalow By The Sea', ...]	5	Given 2 options	None
2	Suggest a casual lunch place in the general ar...	['Tian - Asian Cuisine Studio', 'Tian - Asian ...']	5	It has give on one restaurant option	NaN	The Cafe is a restaurant that serves sushi and...	0	Not the right answer	Fluency is very good
3	Are there any highly-rated spots for dessert a...	Yes	5	0	5.0	Monte Cafe	5	In addition to what is given, we got addl. info	5
4	I'm looking for a halal or vegetarian dinner p...	['Petra Bistro', 'The Chicago Diner, Logan Squ...	5	3 options	NaN	['The Heaven Restaurant', 'Erhan Restaurant', ...]	5	3 options	None
5	Recommend a mid-range price Mexican dog friend...	['Torote Restaurant at Valle del Sol', 'Mexica...	5	None	NaN	['Esquina Mexicana' is a ['Mexican', 'Latin', ...]	5	None	Fluent is giving the description of the restau...
6	Any hidden gems for coffee or breakfast with q...	Snooze Coffee House	5	5	NaN	Snooze Coffee House	5	None	None
7	Find a sushi place with scenic views, serves a...	['Sushi Bar', 'Sushi Lab', 'Sushi Kashiba', 'S...	5	3 options given	NaN	['Sushi Kashiba', 'Sushi Gen', 'Sushi Gen', 'S...	5	only 2 options given	None
8	I want to go somewhere trendy and lively for d...	I want to go somewhere trendy and lively for d...	0	None	NaN	If you are looking for a trendy and lively pla...	5	None	Very fluent in responding to the question by a...

Observations:

1. Reranking the top 10 RAG documents using a cross encoder, has improved the fluency of the model.
2. The diversity improvement is varying. This could be because the cross encoder is not powerful enough to change, but we can observe a step towards improving diversity.
3. Some responses are directly question itself.

Question 2

Model: EleutherAI/gpt-neo-125M

Response only Masking

Instruction Prompt:

```
[89]: print(dataset[0]['text'])

### Instruction:
What is the third limb of yoga?
### Context:
sanas originated in India. In his Yoga Sutras, Patanjali (c. 2nd to 4th century CE) describes asana practice as the third of the eight limbs (Sanskrit: अष्टांग, aṣṭāṅga, from अष्ट aṣṭ, eight, and अङ्ग aṅga, limb) of classical, or raja yoga.
### Category:
summarization
### Response:
The third limb of yoga is know as Asana. This refers to the physical practice of yoga, or the yoga postures. By putting the body into difficult positions you achieve several key benefits. The first is you are helping your body heal pain. If you want to meditate and work on healing your mind, you need to first heal your body. Otherwise your easily distracted mind will focus on pain in your body versus the pain in your mind. Secondly, commitment to the Asana will teach you the discipline your mind needs to heal. When going into uncomfortable situations, bad patterns in the mind often arise. Stepping into discomfort actually becomes an opportunity to study the mind and change patterns of response.
```

Collator:

```

from trl import DataCollatorForCompletionOnlyLM

response_template = "### Response:\n"
collator = DataCollatorForCompletionOnlyLM(
    response_template=tokenizer.encode(response_template, add_special_tokens=False)[2:], # Skip BOS token
    tokenizer=tokenizer,
    mlm=False
)

```

Epochs = 3

```

from transformers import TrainingArguments
from trl import SFTTrainer

training_args = TrainingArguments(
    output_dir="./results",
    num_train_epochs=3,
    per_device_train_batch_size=4,
    gradient_accumulation_steps=2,
    learning_rate=2e-5,
    fp16=True, # Use mixed precision
    logging_steps=10,
    save_strategy="epoch",
    dataloader_pin_memory=True, # Add this for faster data transfer to GPU
    dataloader_num_workers=4, # Optimize CPU data loading
    no_cuda=False # Ensure CUDA is not disabled
)

trainer = SFTTrainer(
    model=model,
    args=training_args,
    train_dataset=dataset,
    data_collator=collator,
    formatting_func=lambda x: x["text"]
)

```

Held out entries:

- **Instruction Following:** 2
- **Helpfulness:** 2
- **Fluency:** 3
- Lacks confidence and structure. Vague and hedgy phrasing.

Instruction-Fine-Tuned

Response:"1. Water

2. Eggs
3. Salt
4. Pepper
5. Pepper...."

- **Instruction Following:** 5
- **Helpfulness:** 4
- **Fluency:** 4
- Content is mostly on point, though “pepper” is oddly repeated and not typical for bread.

LoRA Fine-Tuned

[illegible]

- **Instruction Following:** 1
- **Helpfulness:** 1
- **Fluency:** 1

This is a failure case. Output is meaningless—model likely reduced performance during training as we are quantizing it and also retraining the weights.

Case 2: "Who was the first person to do spacewalk?"

Base Model

Response: "I think it was the first person to do spacewalk."

- **Instruction Following:** 2
- **Helpfulness:** 2
- **Fluency:** 3
- Vague repetition. Doesn't mention the person (Alexei Leonov).

Instruction-Fine-Tuned

Response:"The first person to do spacewalk was a spaceman."

- **Instruction Following:** 5
- **Helpfulness:** 3
- **Fluency:** 4
- Better structure, but too generic—"a spaceman" is insufficient as a final answer.

LoRA Fine-Tuned

Response:TheTheTheTheTheTheTheTheTheTheTheTheTheThe...

- **Instruction Following:** 1
- **Helpfulness:** 1
- **Fluency:** 1
- Another degenerate case.

Case 3: "What causes an airplane wing to fly?"

Base Model

Response:"* * * ## \n ## \n ##...."

- **Instruction Following:** 0
- **Helpfulness:** 0
- **Fluency:** 0
- It has generated #s, unendingly.

Instruction-Fine-Tuned

[illegible]

- **Instruction Following:** 4
- **Helpfulness:** 1
- **Fluency:** 34
- Repetitive phrasing but better focus on concept. More useful than the base model.

LoRA Fine-Tuned

Response:TheTheTheTheTheTheTheThe . . .

- **Instruction Following:** 1
- **Helpfulness:** 1
- **Fluency:** 1
- Same token repetition issue.

Case 4: "In music theory, what is the circle of fifths?"

Base Model

Response:"I think the answer is: A: The circle of fifths is a concept in music..."

- **Instruction Following:** 3
- **Helpfulness:** 3
- **Fluency:** 3
- Generic and tentative. Acceptable but lacks clarity.

Instruction-Fine-Tuned

Response:"The circle of fifths is the circle of fifths in music theory. It shows how keys are related."

- **Instruction Following:** 4
- **Helpfulness:** 4
- **Fluency:** 3
- Repetitive phrasing but better focus on concept. More useful than the base model.

LoRA Fine-Tuned

Response:TheTheTheTheTheTheTheThe . . .

- **Instruction Following:** 1
- **Helpfulness:** 1
- **Fluency:** 1
- Same token repetition issue.

LoRA Failure Case – Hypothesis

Across multiple prompts, LoRA responses show repetitive token outputs (111 . . . , TheThe . . .). This suggests:

- **Training issues:** Not enough steps or poor convergence.
- **Loss collapse:** Model might’ve minimized loss by exploiting repetition.

LoRa responses:

	Instruction	LoRA Fine-Tuned Extracted Response
0	Who were the children of the legendary Garth G...	TheTheTheTheTheTheTheTheTheTheTheTheTheTheT...
1	Give me a list of basic ingredients for baking...	111...
2	Write a funny and whimsical horoscope reading	11...
3	Who was the first person to do spacewalk?	TheTheTheTheTheTheTheTheTheTheTheTheTheTheT...
4	What causes an airplane wing to fly?	TheTheTheTheTheTheTheTheTheTheTheTheTheTheT...
5	Could a nuclear explosion change the Earth's r...	No...
6	In music theory, what is the circle of fifths?	TheTheTheTheTheTheTheTheTheTheTheTheTheTheT...
7	What should I do on a free afternoon in San Fr...	ThereThereThereThereThereThereThereThereThereT...
8	Extract the dates from the following.
9	As per the passage whose works did Narendranat...	TheTheTheTheTheTheTheTheTheTheTheTheTheTheT...