

Using Small Language Models For Local Email Categorization Into Variable Number Of User-Defined Labels

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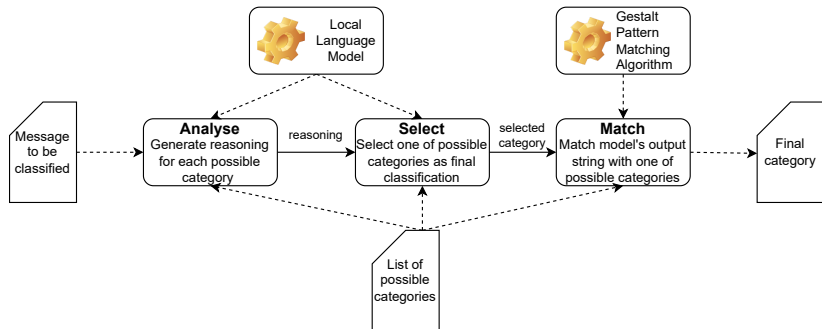
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Introduction

- ▶ Overview of the project's goal: Local email categorization empowering users.
- ▶ Key feature: User-defined labels of variable quantity and quality.
- ▶ Description of the methodology: Analysis, Selection, and Matching (ASM).

Graph of ASM method's data processing



Methods

- ▶ Creation of a custom dataset to suit project requirements.
- ▶ Utilization of small language models tailored for consumer computers.
- ▶ Testing of five distinct models with various prompt engineering techniques.
- ▶ Overview of default inference parameters used in experiments.

Example Record

Message:

“Explore new recipes and ensure your diet is well-balanced with a mix of fruits, vegetables, and proteins. Your nutrition is the foundation of good health.”

Actual Category:

nutrition

Possible Categories:

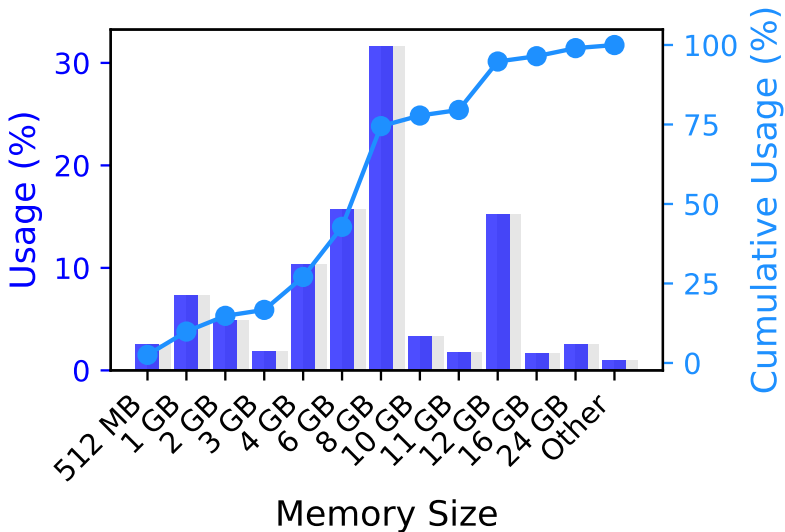
- ▶ professional_development
- ▶ financial_education
- ▶ nutrition
- ▶ conflict_resolution
- ▶ formal_education
- ▶ empathy_and_understanding

Technical details of used language models

Model Name	Quantization	Context Length	Parameters
ehartford_dolphin-2.0 -mistral-7b	Q6_K	32768	7B
teknium_openhermes -2.5-mistral-7b	Q6_K	32768	7B
Phi2	Q6_K	2048	3B
mistralai_mistral-7b -instruct-v0.2	Q6_K	32768	7B
open-orca_mistral-7b -openorca	Q6_K	32768	7B

Distribution of VRAM amount on Steam users' computers

VRAM Memory Usage Distribution



Example COT 1 Prompt and Response

Example COT 1 Prompt:

"Q: You are a message **expert**. You have seen many of them. You are always able to **guess** what the main topic of a message is. You are always shown a **list of possible categories** and you always **explain** why each one of them is or is not **related** to the original message. You are **precise and professional**. You do only what you are expected to do. You say **no redundant words**. You are given a message with the **following content**:

"Explore new recipes and ensure your diet is well-balanced with a mix of fruits, vegetables, and proteins. Your nutrition is the foundation of good health."

This message can be categorized as only one of the following **potential topics**:

1. **professional development**
2. **financial education**
3. **nutrition**
4. **conflict resolution**
5. **formal education**
6. **empathy and understanding.**

A: For each of the possible categories **I will think** if it could be the correct one for the message."

Example COT 1 Response:

"1. **professional development**: This message is not about professional development. It is not about improving one's skills or knowledge for a job or career.

2. **financial education**: This message is not about financial education. It is not about learning about money or how to manage it.

3. **nutrition**: This message is about nutrition. It is about the importance of a well-balanced diet for good health. This is the correct category.

4. **conflict resolution**: This message is not about conflict resolution. It is not about how to manage or resolve conflicts.

5. **formal education**: This message is not about formal education. It is not about learning in a structured educational setting.

6. **empathy and understanding**: This message is not about empathy and understanding. It is not about learning to understand or care about others.

In conclusion, the message is about **nutrition**."

COT 1 Prompt:

"Q: **Thank you** for your reasoning! We need an answer in very **strict format** so that our automatic systems will be able to process it. It is very important. Please tell what is the final verdict of your expert categorization. Answer in one word. Only **use a word from the potential topics**. Any deviation from these rules will result in system crash.

A: The **final verdict** in a single word is: "

Example COT 1 Response:

"Nutrition."

Results

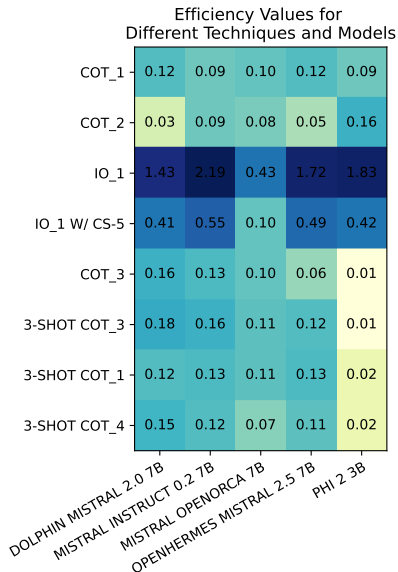
- ▶ Average metrics for different querying techniques across models.
- ▶ Heat map depicting experimental accuracies in various model-query combinations.
- ▶ Analysis of query processing times and efficiencies for different approaches.
- ▶ Identification of the best-performing model-query combination.

Accuracies in different approaches

Accuracy Values for
Different Techniques and Models

	DOLPHIN MISTRAL 2.0 7B	MISTRAL INSTRUCT 0.2 7B	MISTRAL OPENORCA 7B	OPENHERMES MISTRAL 2.5 7B	PHI 2 3B
COT_1	0.89	0.90	0.88	0.97	0.54
COT_2	0.37	0.74	0.65	0.44	0.72
IO_1	0.53	0.79	0.16	0.62	0.55
IO_1 W/ CS-5	0.59	0.76	0.14	0.67	0.56
COT_3	0.84	0.92	0.89	0.78	0.13
3-SHOT COT_3	0.91	0.91	0.77	0.88	0.12
3-SHOT COT_1	0.84	0.92	0.82	0.93	0.20
3-SHOT COT_4	0.93	0.89	0.69	0.91	0.18

Efficiencies in different approaches



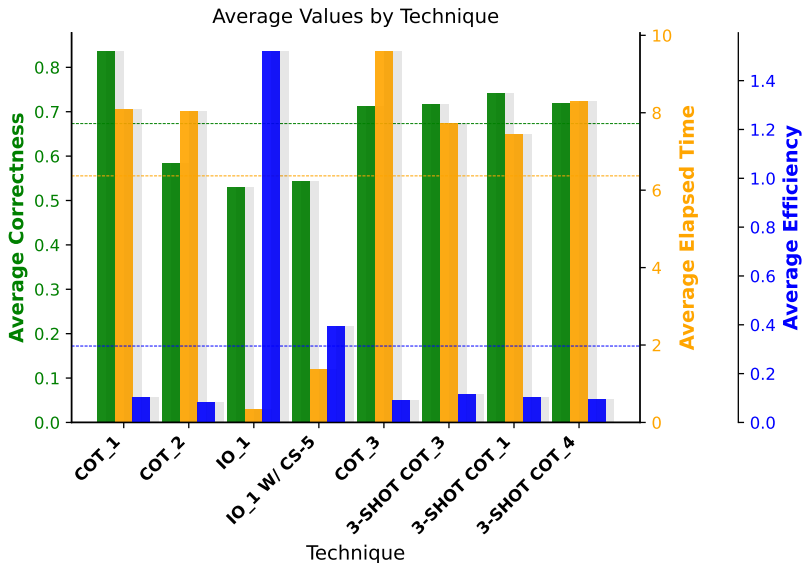
Average processing times of single message in different approaches

Processing Time Values for Different Techniques and Models

COT_1	7.73	9.88	8.71	8.40	5.70
COT_2	10.82	8.17	8.62	8.26	4.38
IO_1	0.37	0.36	0.37	0.36	0.30
IO_1 W/ CS-5	1.45	1.38	1.42	1.36	1.32
COT_3	5.28	7.28	8.94	12.46	13.97
3-SHOT COT_3	5.03	5.72	7.22	7.06	13.67
3-SHOT COT_1	7.12	7.16	7.52	7.07	8.36
3-SHOT COT_4	6.11	7.31	9.40	8.41	10.32

DOLPHIN MISTRAL 2.0 7B
MISTRAL INSTRUCT 0.2 7B
MISTRAL OPENORCA 7B
OPENHERMES MISTRAL 2.5 7B
PHI 2 3B

Average metrics of different prompting techniques in different models



Conclusions

- ▶ Success metrics: High accuracy, efficiency, and resilience.
- ▶ Seamless transitions between tasks without fine-tuning.
- ▶ Easy integration into production environments with minimal resource usage.
- ▶ Emphasis on user customization and excellent accuracy-performance balance.

Future Work

- ▶ Focus on cybersecurity.
- ▶ User experience enhancement.
- ▶ Energy efficiency.
- ▶ Expanding dataset size.
- ▶ Exploring advanced NLP algorithms.

Prompts and Other Details

- ▶ Information about the project's repository, example prompts, dataset, and experiment configuration file:
 - ▶ Project's Repository
 - ▶ Example Prompts
 - ▶ Dataset
 - ▶ Experiment's Configuration File