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Leveraging Large Language Models for Marketing Analytics

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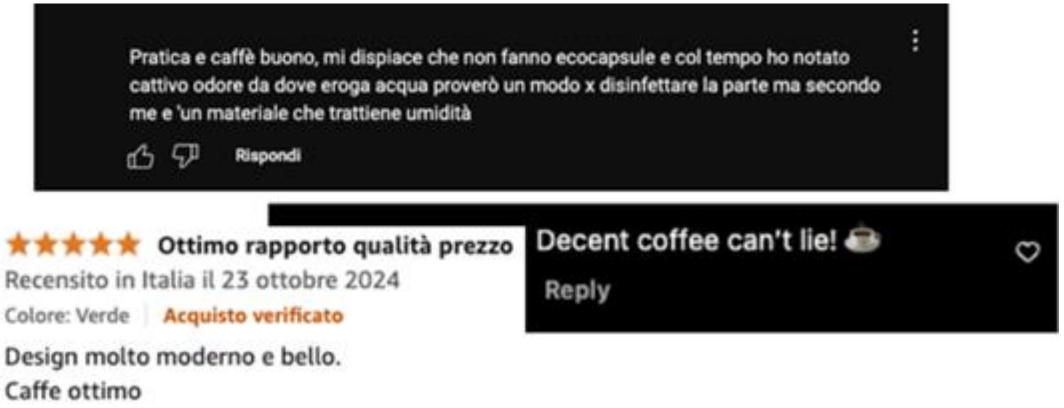
Final presentation

Project Value Proposition

For **marketers** seeking deeper **insights** on product launches, our **analytics software** transforms raw online comments and reviews into **actionable metrics**.



Project Goal

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Developing **AI software** to accurately assess the **real impact of a product launch** by analyzing **consumer sentiment** across social media **comments** and third-party **reviews**.

Sustainable Development Goal:

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Responsible

Consumption

and Production

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Hypothesis

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Large Language Models can be effectively used to extract valuable insights from consumer comments and reviews to enhance marketing strategies.

Specifically:

- **LLMs** can effectively identify **product-relevant comments**.
- **LLMs** can extract **key product aspects** from reviews sand comments and assign **appropriate sentiments** to each.
- **LLMs** can successfully assess **sentiment** in comments and assign **rating stars** to reviews.

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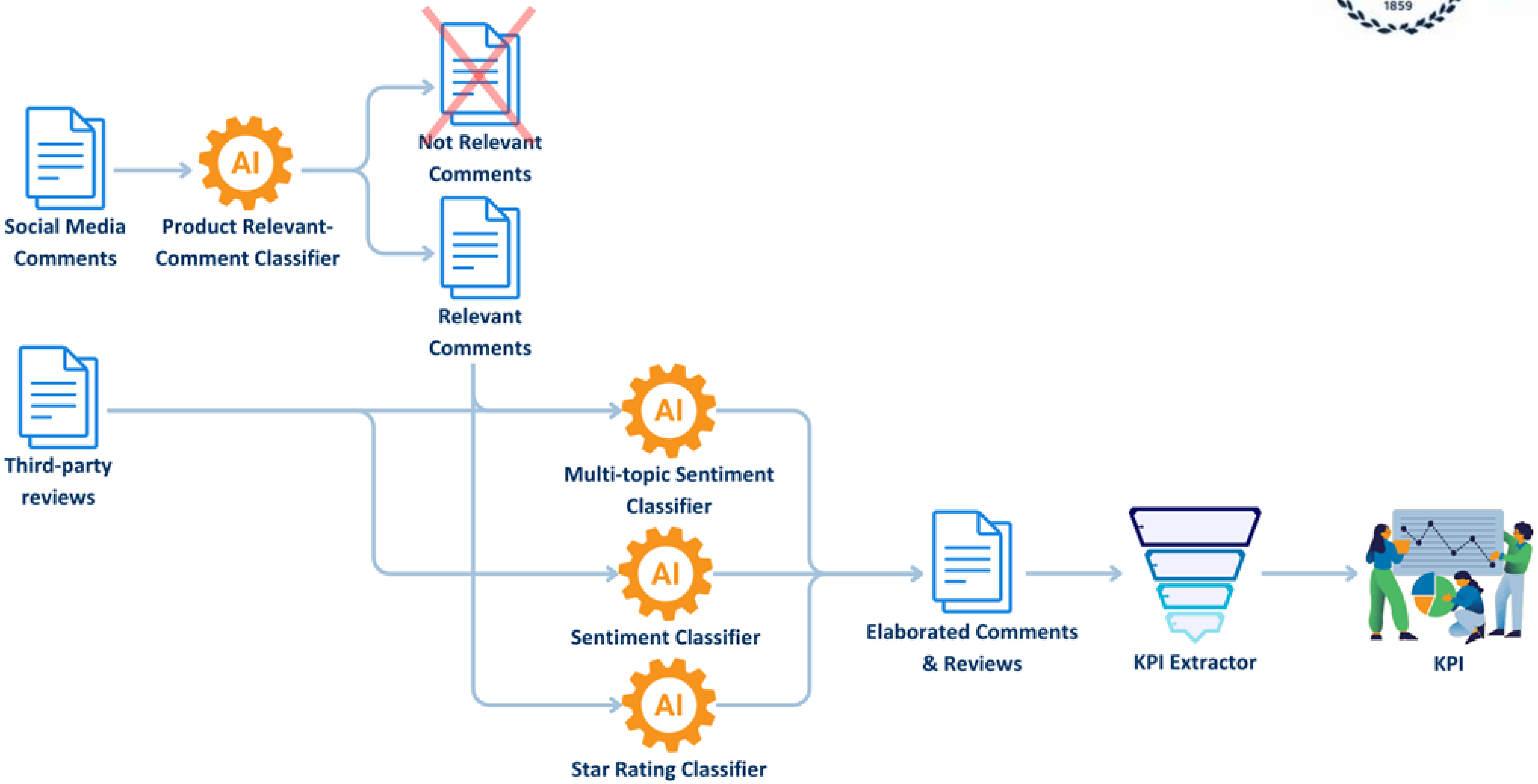
Method - Pipeline



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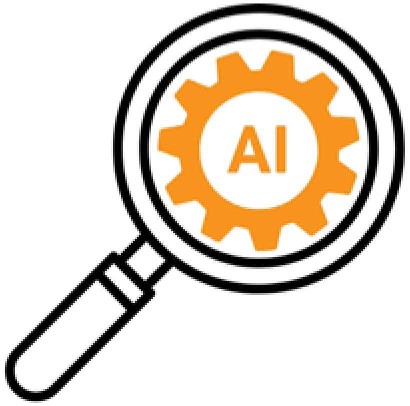
Method - Classification Block and Models

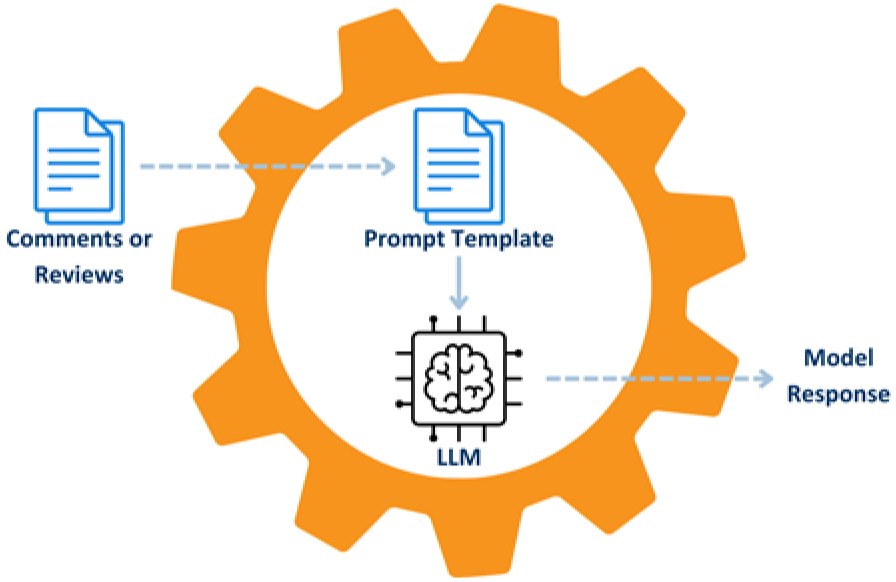


The **core** of the pipeline is the **classification block**, responsible for all classification tasks. Its structure adapts to the **model type** used:

- **General-Purpose Models (Chat-like LLMs):** Flexible and versatile for various tasks.
- **Specialized Task-Based Models:** Fine-tuned for specific tasks, offering higher precision in narrow domains.

Method - General Purpose Classification Block

The general purpose classification block comprises **two main components**:



Prompt Template:

- Clearly defines the **classification task**.
- Includes **examples** (few-shot prompting only).
- Specifies the **structured output format** for consistent model responses.

General-Purpose Model (LLM):

- **Processes** the **task-specific prompt** (combining prompt template and input data).
- Generates **task-specific responses**.

Method - General Purpose Models

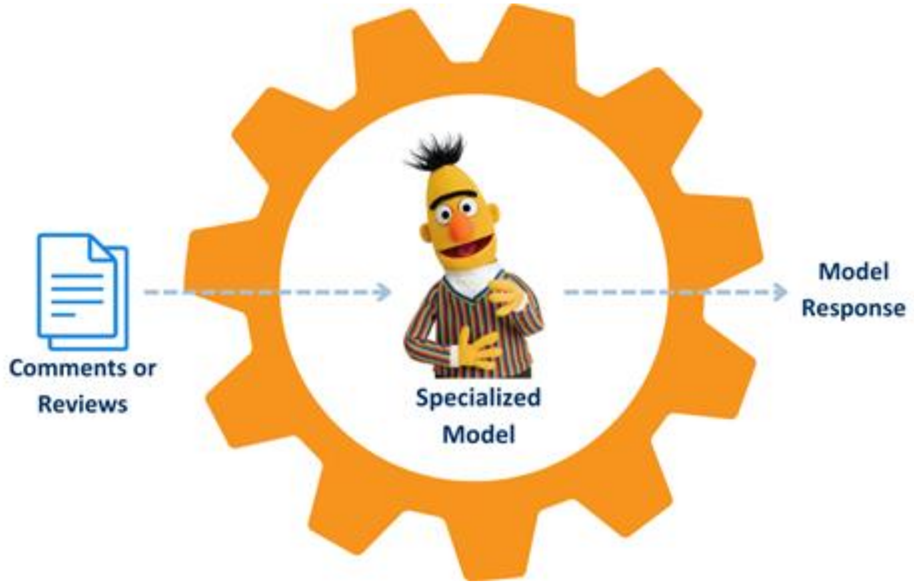
Gemma2: large language model from Google, different versions: 2B, 9B and 27B

Llama3: large language model from Meta, 8B, 70B and 405B

Mistral: large language model from Mistral AI

Method - Specialized Classification Block

The specialized model classification block comprises **two main components**:



Specialized BERT-base Model: Takes reviews or comments as input and generates a response based on the specific task.

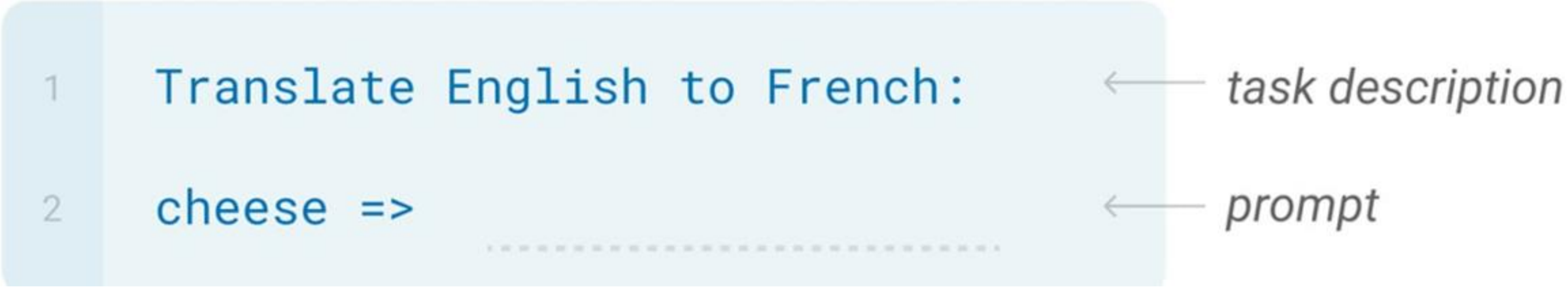
Method - Specialized Models

- **Sentiment Classification**
  - *distilbert-base-multilingual-cased-sentiments*
  - *twitter-xlm-roberta-base-sentiment-finetuned*
  - *twitter-roberta-base-sentiment-latest*
- **Star Rating Prediction**
  - *bert-base-multilingual-uncased-sentiment*
  - *multilingual-sentiment-analysis*

*from Hugging Face

Method - Prompting Approach

Zero-shot:
The model predicts the answer given only the description of the task in natural language.



Method - Prompting Approach

Few-shot: The model sees a few examples of the task.

```
Translate English to French:
sea otter => loutre de mer
peppermint => menthe poivrée
plush girafe => girafe peluche
cheese => ...............................
```

task description

examples

prompt

Experiments - Data

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Data Sources:

Wonderflow | Digiming | YouTube | Instagram | Generative Models

Datasets:

Reviews | Comments | Synthetic Data

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Experiments - Datasets

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Reviews:

- Records: **2930**
- Sampled records: **500**
- **Star Rating** label ration: **100%**
- **Multi-Topic Sentiment** label ratio: **95%**
- **Tiny Eco** Reviews**: 79**

Comments:

- Records: **577**
- **Labelled** Comments: **0%**
- **Tiny Eco** Comments**: 77**

Synthetic Data:

- **Comments** Records: **236**
- **Reviews** Records: **500**
- **Labelled** Comments and Reviews: **100%**

Some reviews may have incomplete labels, e.g.:

"Excellent machine. Fair price and guaranteed quality." **- Positive Aspects**: ["Price & worth"]

Where is "Coffee Quality"?

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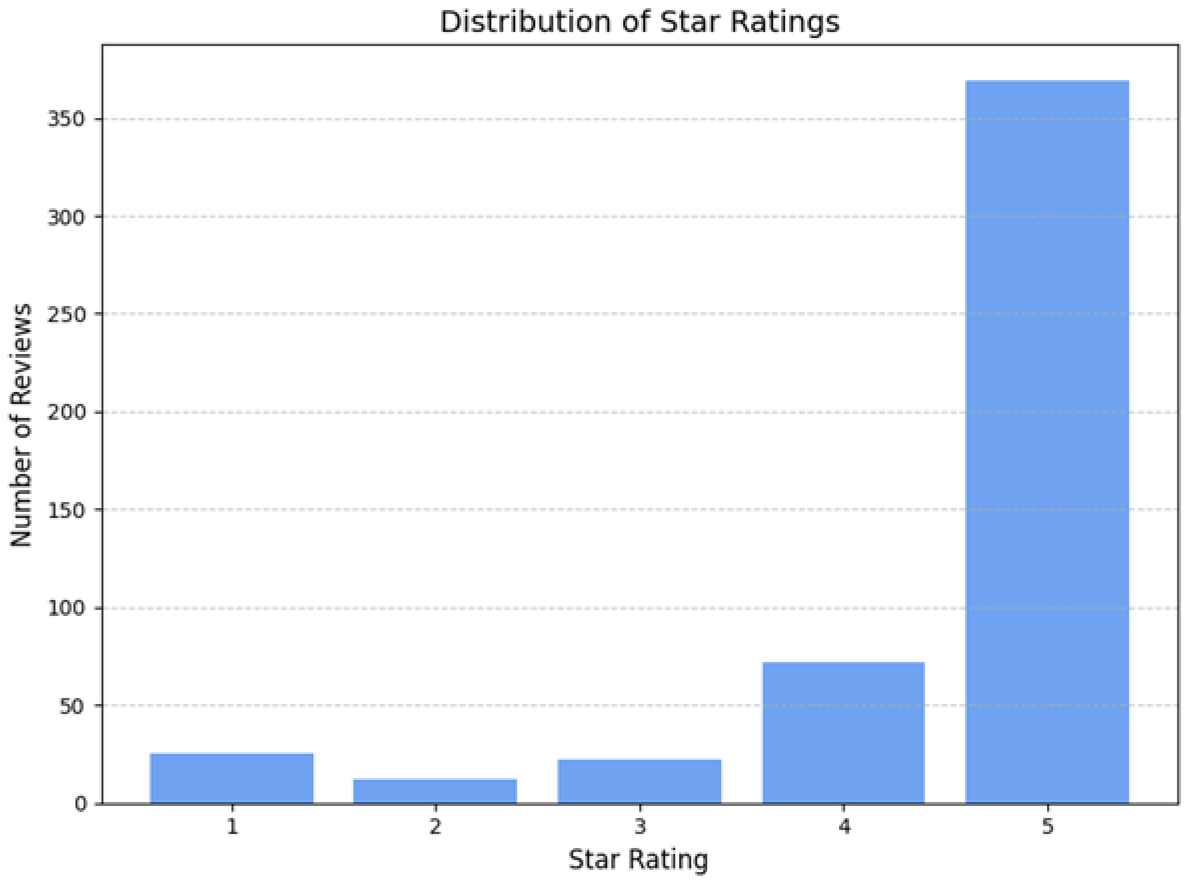
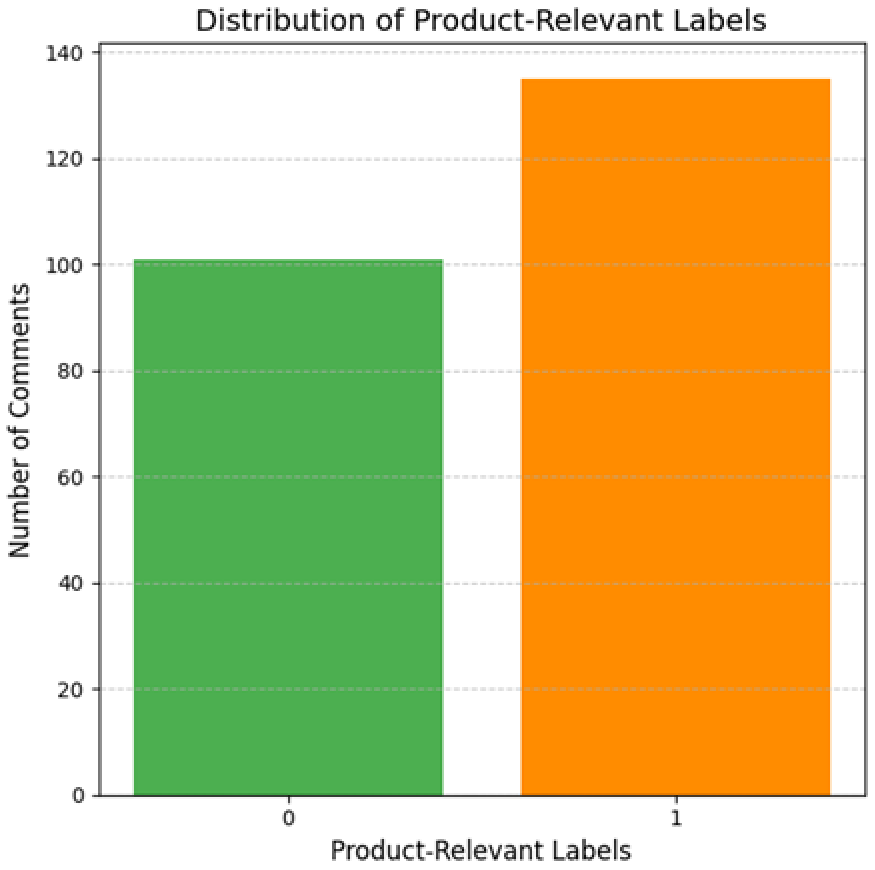
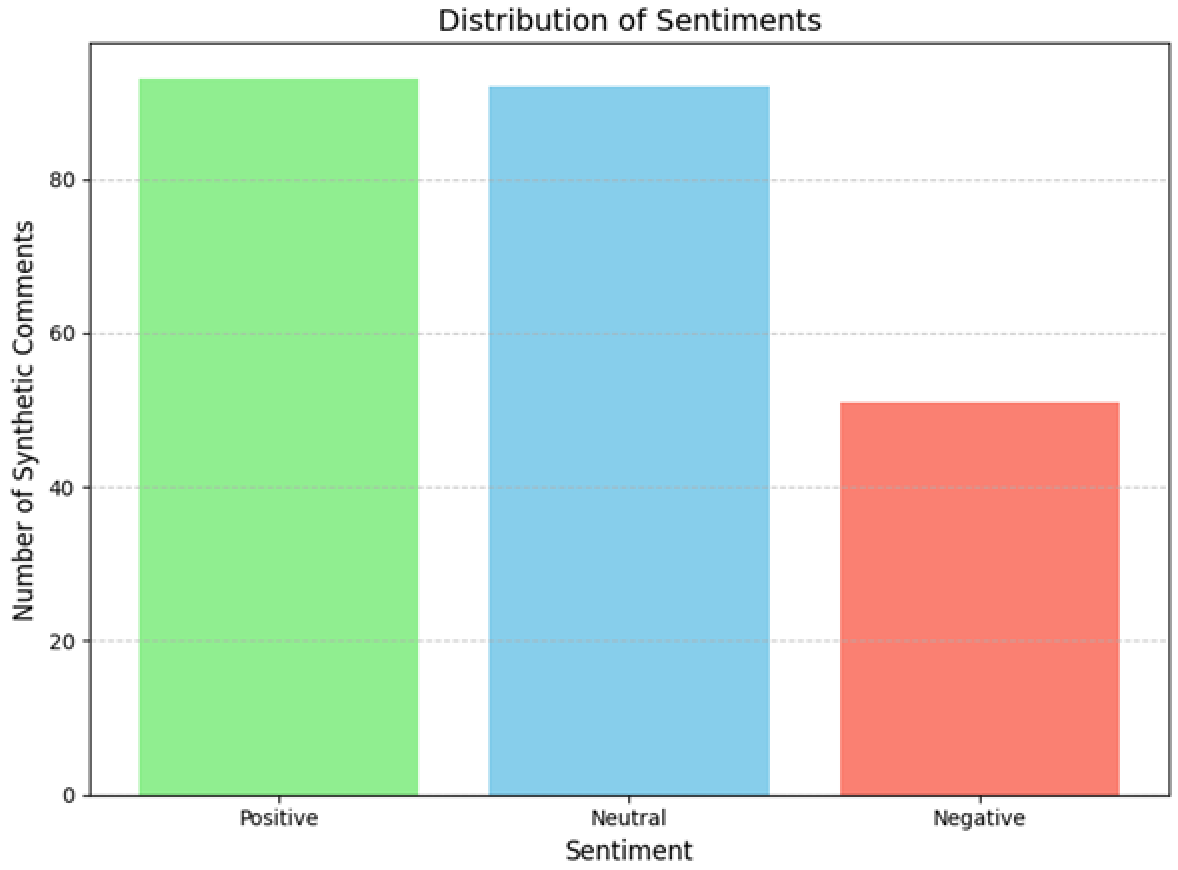
Experiments - Labels Distribution



Heavily skewed toward **higher ratings**!

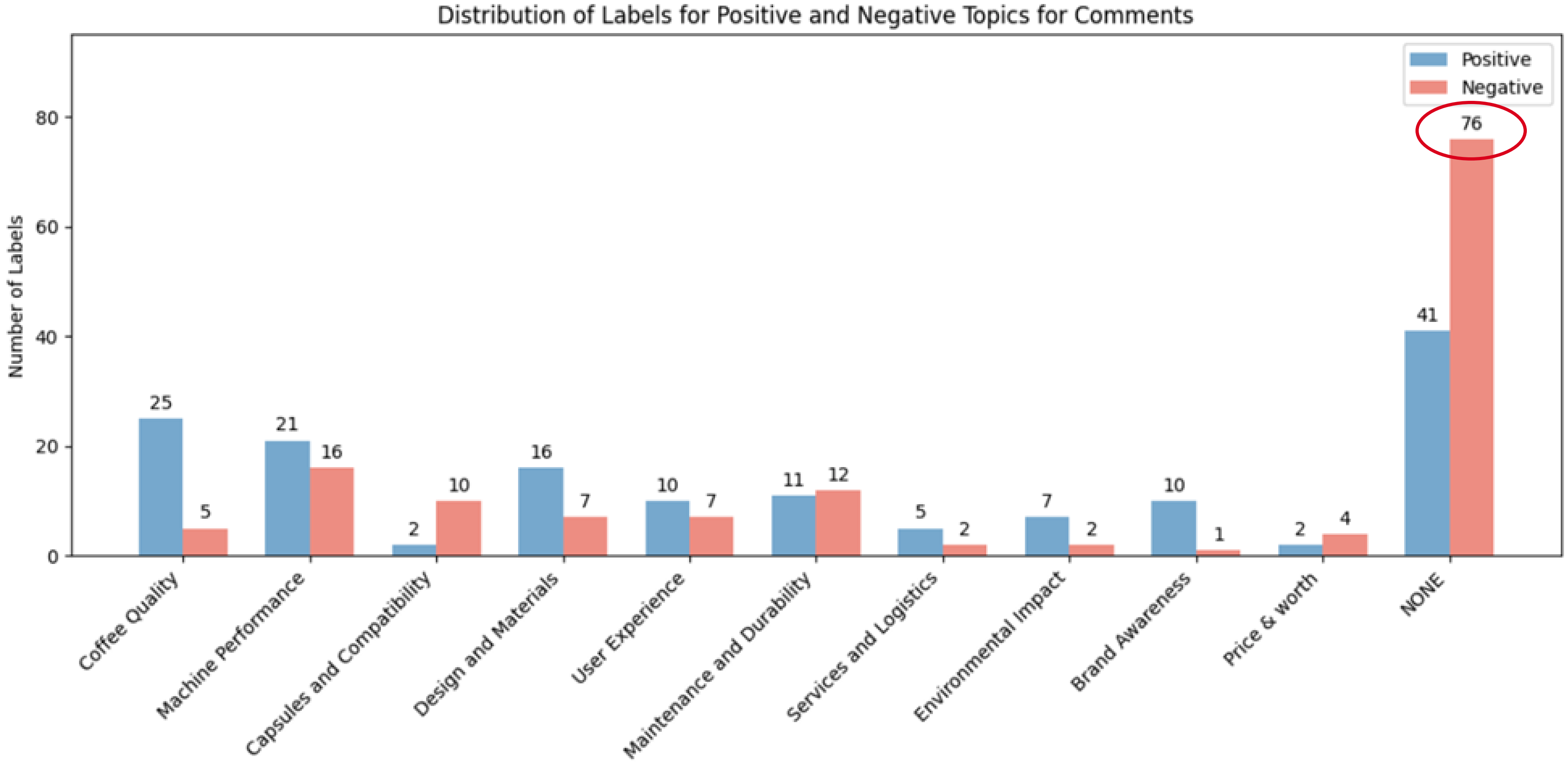
Experiments - Labels Distribution



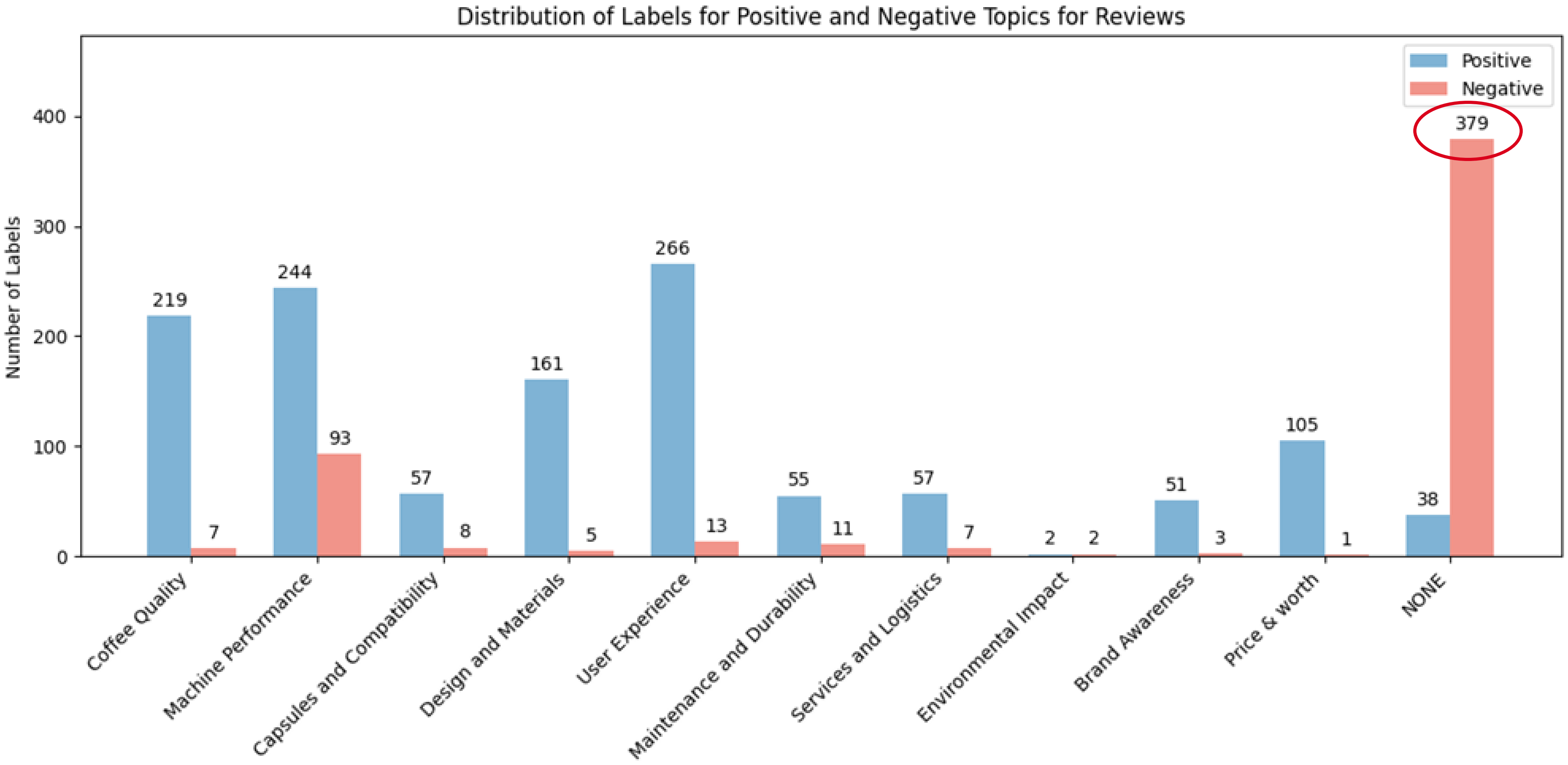


Much more balanced!

Experiments - Labels Distribution



Experiments - Labels Distribution



Experiments - Tasks

1. Product Relevant-Comment Classification

1. Multi-topic Sentiment Classification
- Positive Topics
- Negative Topics

3. Sentiment Classification
- Positive
- Negative
- Neutral

3. Star Rating Prediction:

⭐⭐⭐⭐⭐

Experiments - Product Relevant-Comment Classification

- **Data:** 236 synthetic comments
- **Batch-size:** 15 comments

Model	Acc.	Pre.	Rec.	F1	Time (s)
Gemma 0-shot	0.758	0.738	0.896	0.809	3.40
Gemma Few-shot	0.814	0.783	0.933	0.851	3.63
Llama 0-shot	0.763	0.737	0.911	0.815	**2.77**
Llama Few-shot	**0.826**	**0.794**	**0.941**	**0.861**	2.93
Mistral 0-shot	0.758	0.747	0.874	0.805	3.25
Mistral Few-shot	0.797	0.764	0.933	0.840	3.53

Table 1: Metrics and Execution Times for Models for Product Relevant-Comment Classification

Experiments - Multi-topic Sentiment Classification

- **Data:** 500 labeled reviews + 236 synthetic comments
- **Batch-size:** 5 comment/review

Model	F1 (Neg.)	F1 (Pos.)	Prec. (Neg.)	Prec. (Pos.)	Rec. (Neg.)	Rec. (Pos.)	Time (s)
Gemma 0-shot	0.895	0.732	0.901	0.834	0.900	0.705	12.10
Gemma Few-shot	**0.899**	0.732	**0.905**	**0.844**	**0.904**	0.694	12.82
Llama 0-shot	0.880	**0.745**	0.901	0.795	0.879	0.718	**8.27**
Llama Few-shot	0.878	0.730	0.895	0.811	0.874	0.694	9.55
Mistral 0-shot	0.873	0.738	0.885	0.761	0.873	**0.735**	11.12
Mistral Few-shot	0.880	0.715	**0.905**	0.789	0.873	0.679	20.96

Table 2: Weighted Metrics and Execution Times for Models for Multi-topic Sentiment Classification

Experiments - Sentiment Classification

- **Data:** 236 synthetic comments
- **Batch-size:** 20 (general purpose model) and 50 (specialized model)

Model	Acc.	Prec.	Rec.	F1	Time (s)
Gemma 0-shot	0.869	0.878	0.869	0.866	3.75
Gemma Few-shot	0.852	0.856	0.852	0.849	3.95
Llama 0-shot	0.818	0.818	0.818	0.815	2.76
Llama Few-shot	0.814	0.825	0.814	0.812	2.96
Mistral 0-shot	**0.877**	**0.880**	**0.877**	**0.876**	4.75
Mistral Few-shot	0.860	0.860	0.860	0.859	3.71
DB-sentimet	0.496	0.436	0.496	0.388	$\mathbf{6.52 \times 10^{-3}}$
TR-sentimet	0.682	0.751	0.682	0.680	6.77×10^{-3}
TRL-sentimet	0.831	0.837	0.831	0.829	8.41×10^{-3}

Table 3: Weighted Metrics and Execution Times for Models for Sentiment Classification

Experiments - Star Rating Prediction

- **Data:** 500 labeled reviews
- **Batch-size:** 20 (general purpose model) and 50 (specialized model)

Model	Acc.	Prec.	Rec.	F1	Off-1 Acc.	Time (s)
Gemma 0-shot	0.596	0.763	0.596	0.650	0.908	8.07
Gemma Few-shot	0.592	0.765	0.592	0.647	0.908	8.17
Llama 0-shot	0.682	0.764	0.682	0.713	0.948	5.73
Llama Few-shot	0.682	**0.777**	0.682	0.715	0.942	5.92
Mistral 0-shot	0.498	0.741	0.498	0.567	0.912	6.12
Mistral Few-shot	0.434	0.732	0.434	0.510	0.902	6.45
BBM-rating	**0.692**	0.757	**0.692**	**0.718**	**0.955**	0.158
MLA-rating	0.552	0.706	0.552	0.606	0.845	$\mathbf{10.45 \times 10^{-3}}$

Table 4: Weighted Metrics, Accuracy, Off-by-One Accuracy, and Execution Times for Models for Star Rating Classification

Conclusion

We can conclude by saying that:

- **LLMs** are able to identify **relevant product comments**, with an accuracy of up to **82.6%.**

- **LLMs** are able to extract **product aspects** from reviews and comments and **assign sentiment** to them, with an F1 score of up to **89.9%** for **negative** aspects and **74.5%** for **positive** aspects**.**

- **LLMs** are able to **assign sentiment** to comments and **rating stars** to reviews, with an accuracy of up to **87.7%** and **69.2% (95,5 off-by-one) respectively.**

Conclusion

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In conclusion we chose these models:

- **Gemma 2 few-shot:** for **Product Relevant-Comment Classification** and **Multi-topic Sentiment Classification**.

- **Twitter RoBERTa latest:** for **Sentiment Classification**.

- **BERT base multilingual:** for **Star Rating Prediction**.

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Thank you

Alessio Gioè - Catalano Vincenzo - Tommaso Mazzarini