Natural Language Processing and Large Language Models

Corso di Laurea Magistrale in Ingegneria Informatica

Lesson 22

Guardrails for LLMs

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Outline

- Adding guardrails to LLMs
- Techniques for adding guardrails
- Frameworks for implementing guardrails

Adding guardrails to LLMs

Guardrails

- Guardrails are mechanisms or policies that regulate the behavior of LLMs. They help to ensure that responses are safe, accurate, and context-appropriate.

- They can:
  - Prevent harmful, biased, or inaccurate outputs.
  - Align responses with ethical and operational guidelines.
  - Build trust and reliability for real-world applications.

- Examples are:
  - Blocking harmful content
  - Restricting outputs to specific domains.

Types of guardrails

- **Safety Guardrails**: Prevent generation of harmful or offensive content.
- **Domain-Specific Guardrails**: Restrict responses to specific knowledge areas.
- **Ethical Guardrails**: Avoid bias, misinformation, and ensure fairness.
- **Operational Guardrails**: Limit outputs to align with business or user objectives.

Techniques for adding guardrails

Techniques for adding guardrails

- Rule based filters
- Fine tuning with custom data
- Prompt Engineering
- External validation layers
- Real-time monitoring and feedback

Rule based filters

- Predefined rules to block or modify certain outputs.
- Examples:
  - Keyword blocking (e.g., offensive terms).
  - Regex-based patterns for filtering sensitive information.
- Simple and efficient for basic content filtering.

Fine tuning with custom data

- Train the model on domain-specific, curated datasets.
- Adjust weights to produce outputs aligned with guidelines.
- Examples:
  - Fine-tune for medical advice to restrict responses to accurate and safe recommendations.
  - Fine-tune for question answering on the topics of the course

Prompt Engineering

- Craft and/or refine prompts to guide the LLM behavior within desired boundaries.
- Examples:
  - "Respond only with factual, non-controversial information.“
  - ”Avoid speculative or unverifiable statements."

External validation layers

- Additional systems or APIs that post-process the model's outputs.
- Examples:
  - Toxicity detection APIs.
  - Fact-checking models.
- Allows modular and scalable implementation of guardrails.

Real time monitoring and feedback

- Monitor outputs continuously for unsafe or incorrect content.
- Flag or block problematic outputs in real-time.
- Tools:
  - Human-in-the-loop systems.
  - Automated anomaly detection.

Best practices

- Combine multiple techniques for robust safeguards.
- Example: Rule-based filtering + External validation + Fine-tuning.

Frameworks for implementing guardrails

Frameworks for implementing guardrails

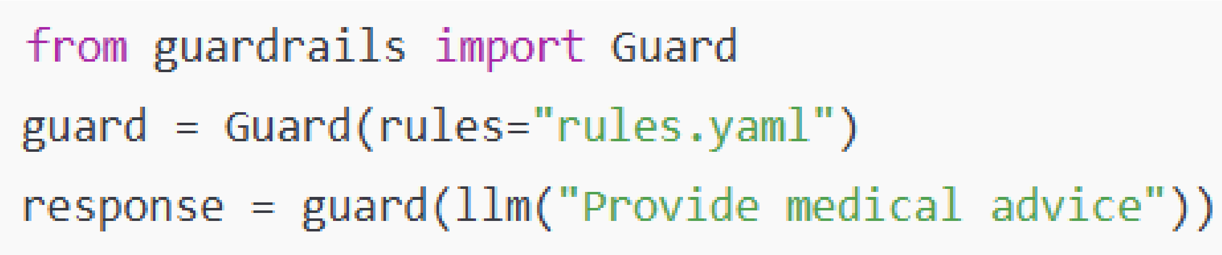
- The existing frameworks for implementing guardrails offer:
  - Easy integration with LLM APIs.
  - Predefined and customizable rulesets.

- Popular tools are:
  - **Guardrails AI**: A library for implementing safeguards.
  - **LangChain**: For chaining prompts and filtering outputs.
  - **OpenAI Moderation**: A prebuilt API to detect unsafe content.

Guardrails AI

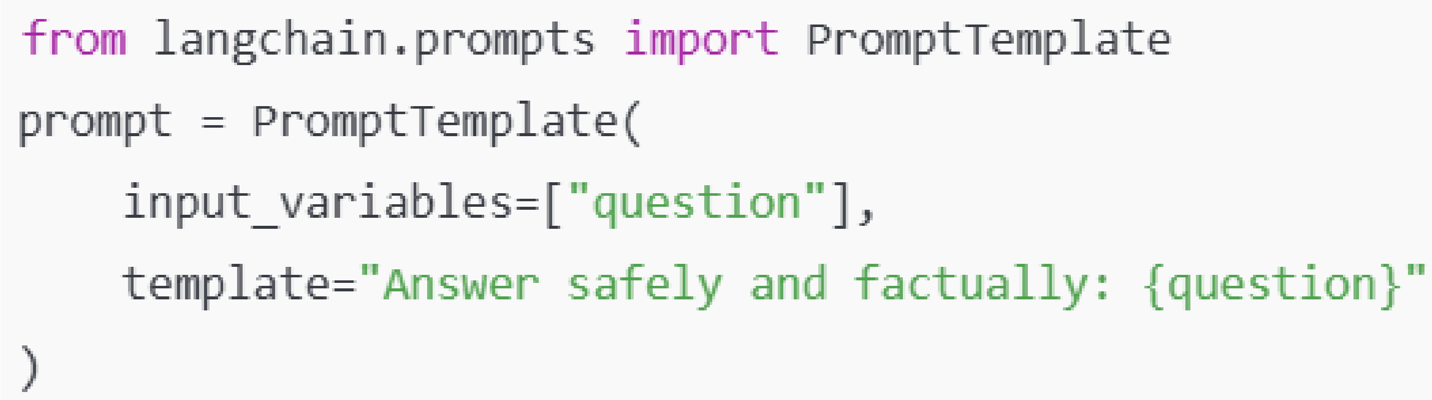
https://www.guardrailsai.com/

- **Validation**: Ensures outputs are within specified guidelines.
- **Formatting**: Controls the output structure.
- **Filters**: Removes or blocks unsafe content.



```
from guardrails import Guard
guard = Guard(rules="rules.yaml")
response = guard(llm("Provide medical advice"))
```

Langchain



```python
from langchain.prompts import PromptTemplate
prompt = PromptTemplate(
    input_variables=["question"],
    template="Answer safely and factually: {question}"
)
```

- Chains prompts with checks and filters.
- Verifies outputs against predefined criteria.

- Integrable with Guardrails: https://www.guardrailsai.com/docs/integrations/langchain

Try it yourself

Try it yourself

- Evaluate which are the techniques to add guardrails that are more suited for your purposes

- A possible suggestion may be to proceed by incrementally add complexity to the guardrails if you are not able to achieve a satisfying result with a simpler approach

- Give a careful look to the documentation of the existing frameworks

- Study similar examples that are available in the documentation of existing frameworks

- Try to apply guardrails to your project

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