Kaggle "Drawing with LLMs" Competition

Systems Analysis

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1. Introduction & The Kaggle Challenge

- Kaggle's **"Drawing with LLMs"** competition challenges us to generate SVG images from text (prompts) using Large Language Models (LLMs).
- It involves the confluence of: Natural Language Understanding (NLU), automatic code generation, and graphics synthesis.
- It presents notable **systemic complexity** and is considered an open system.
- Previous analyses (Workshop 1) revealed critical sensitivities and the potential manifestation of chaotic behaviors ("butterfly effect" in prompts).

Central Problem:

Designing a robust system to translate prompts into valid and coherent SVGs, managing LLM variability.

2. Key Objectives & Core Requirements

The system design aims to achieve the following macro-objectives:

- **Functional Effectiveness:** Semantically coherent and syntactically valid SVGs.
- **Robustness and Reliability:** Predictable behavior and proper error/anomaly handling.
- **Operational Efficiency:** Meet performance constraints (latency, capacity).
- **Scalability and Maintainability:** Facilitate system adaptation and evolution.

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Main Requirements (Summary):

- **Crucial FRs:** Prompt ingestion and parsing, advanced semantic interpretation, valid SVG generation, flexible configuration, results persistence.
- **Key NFRs:** Performance (latency ¡1s is an ambitious goal), reliability (100% valid SVGs), scalability (up to 10k prompts), modular maintainability.

3. Proposed System Architecture

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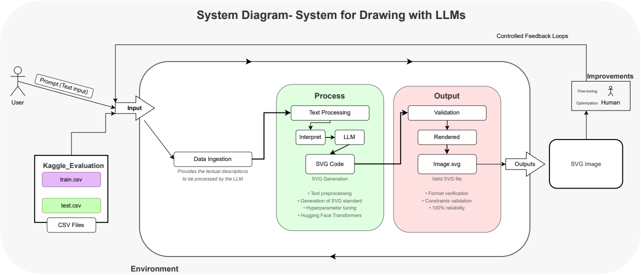
Conceptual System Diagram:



4. Key Strategies (Part 1): Prompts and LLM

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- *Normalization and Standardization:* Cleaning prompts.
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2. Control and Stabilization of LLM Generation (Module M3):

- *Fine-tuning of Inference Parameters:* Temperature, top-p, etc.
- *Multiple Sampling and Selection:* Generating several SVG candidates.
- *Intelligent Retry Mechanisms.*
- *Stop Sequences and Length Limits.*

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- *Multi-level Validation:* XML syntax, SVG profiles, attributes.
- *Heuristic Correction and Sanitization Rules.*
- *Complexity Limits (Circuit Breakers).*

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4. Continuous Monitoring, Detailed Logging, and Feedback Loops:

- *Structured Logging (JSON):* For analysis and debugging.
- *Process and Quality Metrics.*
- *Root Cause Analysis.*
- *Human-in-the-Loop (HITL) Evaluation.*

6. Technology Stack and Implementation Plan

Recommended Technology Stack (Main):

- *Main Language:* Python 3.9+ (robust AI/ML ecosystem).
- *NLP/LLMs:* Hugging Face Transformers, Sentence Transformers.
- *SVG Generation/Manipulation:* lxml, svgwrite.
- *Data Handling:* Pandas. *Testing:* PyTest.

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Summarized Implementation Plan (8 Weeks):

1. *Weeks 11:* Initialization and Core Prototyping.
2. *Weeks 12:* Development of Central Modules.
3. *Weeks 13-14:* Implementation of Robustness and Quality Strategies.
4. *Weeks 15-16:* Optimization and Documentation.
5. *Weeks 17-18:* Final Testing, Refinement, and Packaging.

7. Conclusion

Significant progress was made in defining the conceptual framework, system architecture, and strategies, setting a solid foundation for implementation. Workshops helped clarify requirements and develop methods to handle the sensitivity and chaotic behavior of LLMs in creative tasks.

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This comprehensive document reflects strong collaborative learning, supported by academic resources and professor guidance, positioning us confidently for the implementation phase.

Acknowledgements

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Q&A and Feedback

We are ready for your questions and ideas!