

Personalized Treatment Plan Generation using Generative AI Guided by Reinforcement Learning

Summary: This project aims to develop a reinforcement learning-based control mechanism for generative AI systems, focusing on optimizing the quality, relevance, and efficiency of generated content. Specifically, the proposed work integrates a lightweight RL agent with existing text or image generation models to dynamically adjust generation parameters (e.g., length, resolution, style) based on user preferences, contextual goals, and resource constraints. A custom reward function will be designed to balance informativeness and efficiency, enabling adaptive content generation across varied scenarios. The project will result in a proof-of-concept prototype, validated through simulated and real usage, with potential for academic publication, patent filing, and future deployment in smart or resource-constrained devices.

Objectives:

1. Design a reinforcement learning-based framework to dynamically control parameters of generative AI models for optimized content generation.
2. Develop a custom reward function that balances informativeness, personalization, and resource efficiency.
3. Integrate the RL controller with pretrained generative models to guide output generation based on user preferences or context.
4. Evaluate the performance of the proposed system using quantitative metrics and qualitative assessments.
5. Demonstrate adaptability of the approach across different generative tasks and device environments.

Software Requirements:

1. **Programming Language:**
 - Python 3.8 or above
2. **Libraries & Frameworks:**
 - PyTorch (for model development)
 - Hugging Face Transformers & Diffusers (for text/image generation)
 - Stable-Baselines3 (for reinforcement learning)
 - Scikit-learn, NumPy, Matplotlib (for data handling and visualization)
 - ROUGE, BLEU libraries (for reward/evaluation)
3. **Development Tools:**
 - VS Code
 - Git (for version control)
4. **OS & Environment:**
 - Ubuntu 20.04+
 - virtualenv for environment management

Hardware Requirements:

1. **Processor:**
 - Minimum: Quad-core CPU
 - Recommended: Intel i7 / AMD Ryzen 7 or better
2. **Memory (RAM):**
 - Minimum: 16 GB
 - Recommended: 32 GB (for smooth training with large models)
3. **GPU (Optional but Recommended):**
 - NVIDIA GPU with CUDA support (e.g., RTX 3060 or above)
 - VRAM: 6–12 GB for working with mid-sized transformer or diffusion models
4. **Storage:**
 - At least 50 GB free space (for models, datasets, logs)
5. **Internet Access:**
 - Required for downloading pretrained models and datasets

Expected Outcomes:

The project is expected to yield the development of an intelligent reinforcement learning-based control framework integrated with generative AI models for adaptive content generation. The anticipated outcomes include:

- **1 functional prototype** of an RL-guided generation controller for text or image generation
- **15–25% improvement** in efficiency metrics (e.g., content relevance per token, reduced computational cost)
- **1–2 high-quality research publications** in reputed journals or conferences related to AI, ML, or human-computer interaction
- **At least 1 patent application** based on the novel integration of RL with generative model control
- Foundation for **future product-level integration** or commercialization in smart and resource-constrained devices