

Deep Learning Course Project

Shakespeare Text Generation using VAE + Transformer



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Introduction

- **Background:** Using deep learning to create human-like text.
- **Why It Matters:** Powers chatbots, creative writing, and content tools.
- **Real-World Examples:** ChatGPT, auto-completion, AI assistants.

Project Goal

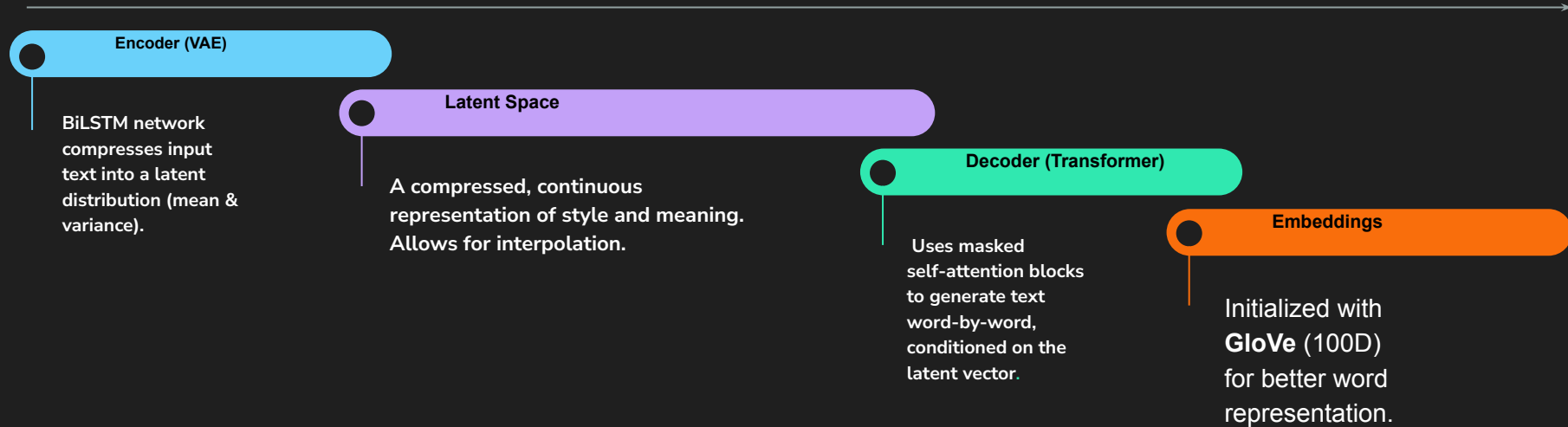
- **Objective:** Generate original text in Shakespeare's poetic style.
- **Core Idea:** Combine a **VAE** (for structured latent space) with a **Transformer Decoder** (for powerful text generation).
- **Dataset:** Shakespeare's complete works (plays & sonnets).

Dataset & Preprocessing

- **Source:** Shakespeare text dataset.
- **Cleaning Steps:**
 - Converted to lowercase.
 - Removed speaker names and special characters.
 - Added start_token and end_token for sequence control.
- **Vectorization:** Used Keras TextVectorization to convert words to integer sequences (Vocabulary: 20K tokens).

Model Architecture (VAE + Transformer)

Our Hybrid Approach



Training Pipeline



1. Data Processing



2. Model Architecture



3. Training Strategy



4. Key Techniques



5. Generation Process



Raw Text → *Numerical Sequences*

- Clean & lowercase text
- Add start/end tokens
- Map words to IDs (20K vocabulary)

VAE + Transformer Hybrid:

- **Encoder:** Text → Latent distribution (mean + variance)
- **Sampling:** Reparameterization trick
- **Decoder:** Latent vector → Generated text (Transformer blocks)

Two-Part Loss Function:

Total Loss = Reconstruction Loss + $\beta \times$ KL Loss

- **Reconstruction:** Match original text (cross-entropy)
- **KL Loss:** Regularize latent space
- **β -annealing:** Gradually increase KL weight

- **Word Dropout:**

Force diversity (30% rate)

- **Cosine LR Decay:** Smooth convergence
- **Teacher Forcing:** Use previous predictions as input

Autoregressive Decoding:

1. Encode prompt → Latent vector
2. Start with token
3. Repeat: Predict next word → Append → Continue
4. Stop at token or max length

Complete



6. Quality Control →

Temperature Scaling:

- **Low (0.2):** Coherent but repetitive
- **Medium (0.7):** Balanced (our choice)
- **High (1.5):** Creative but less coherent
- **+ Top-P Sampling:** Filter unlikely words

Results & Generated Text

- **Sample Output (Shakespeare-style):**

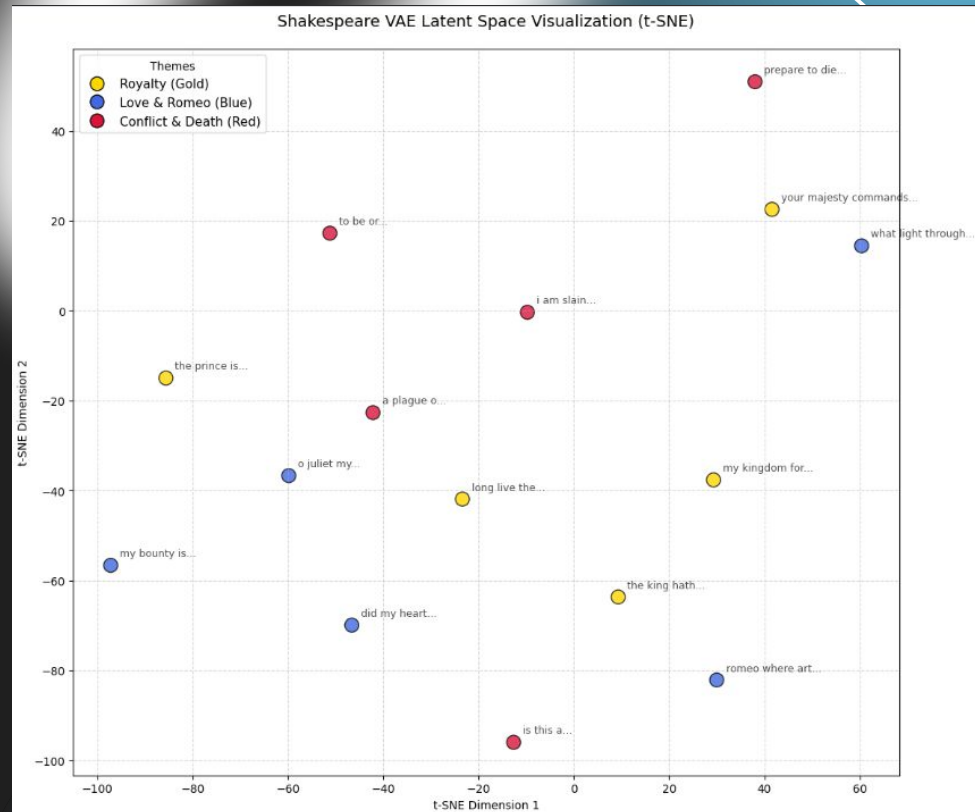
"the king hath sent his grace to thee and thou art dead a noble mind is here o'erthrown..."

- **Observations:**

- **Coherence:** Text maintains grammatical structure and thematic consistency.
- **Diversity:** Model generates varied sentences, not just repetitions.
- **Style:** Successfully captures archaic vocabulary and poetic rhythm.

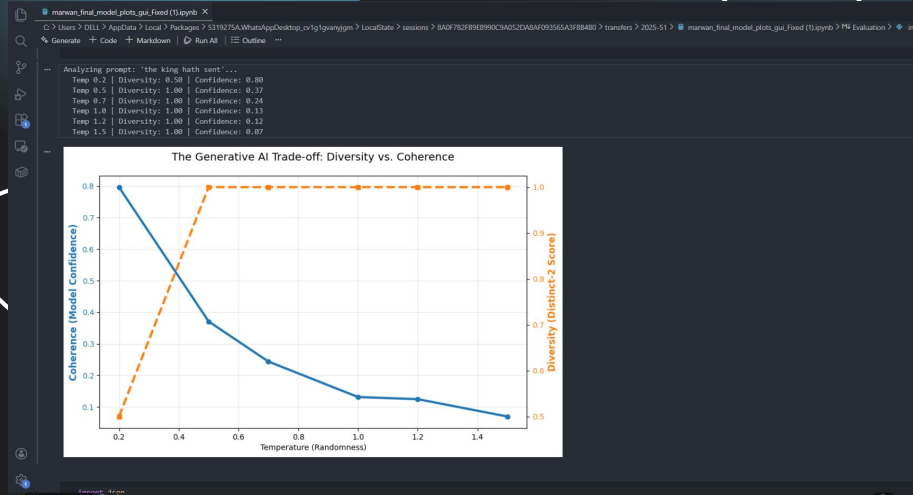
Latent Space Exploration

- **Interpolation:** Smoothly morphs between two prompts (e.g., "the king hath sent" → "romeo where art thou").
- **Visualization (t-SNE):** Shows the model clusters similar themes (love, royalty, conflict) in different regions of the latent space.
- **Controlled Generation:** By navigating the latent space, we can control the style and content of the output.



The Coherence-Diversity Trade-off

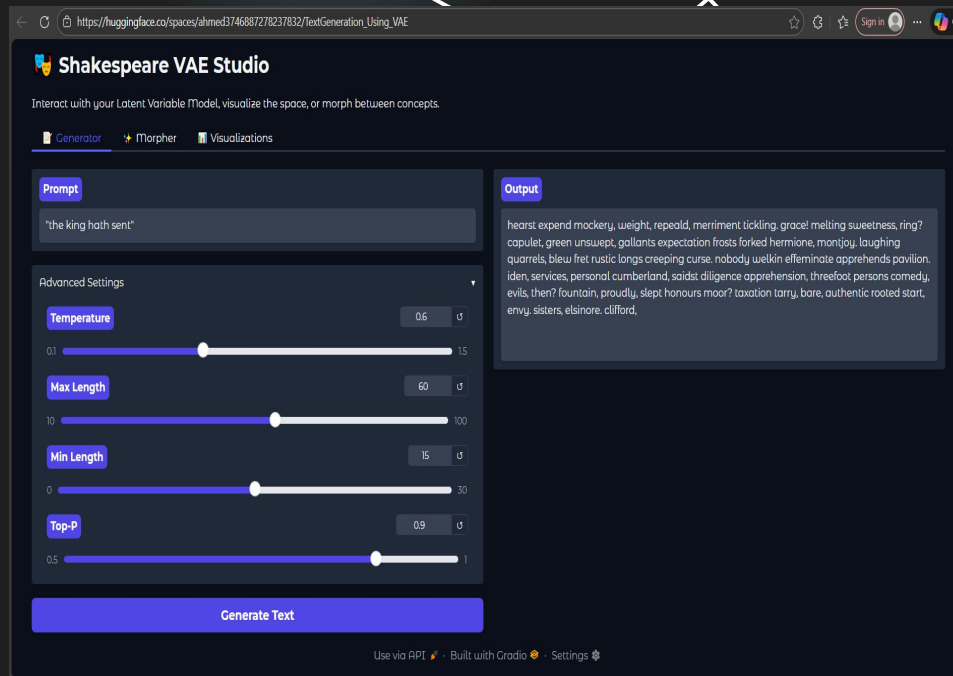
- **Finding:** The **Temperature** parameter controls a key trade-off:
 - **Low Temp (e.g., 0.2):** High coherence, but repetitive and safe.
 - **High Temp (e.g., 1.5):** High diversity and creativity, but lower coherence.
- **Our Choice:** Used a balanced temperature (~0.7) with **Top-P (Nucleus) Sampling** for the best mix.



Interactive Demo (Gradio)

We built a web interface to interact with our model:

- **Feature 1: Text Generator** – Input a prompt, get a Shakespearean continuation.
- **Feature 2: Sentence Morpher** – Visually interpolate between two ideas in the latent space.
- **Live Demo:** Users can experiment with temperature and length settings.



Conclusion & Learnings

- **Summary:** Successfully built a hybrid model that generates coherent, Shakespeare-style text.
- **VAE + Transformer Synergy:** VAE provides a structured, interpolatable latent space; the Transformer enables high-quality sequence generation. The combination is powerful for controlled creativity.
- **Future Work:**
 - Scale up model size and dataset.
 - Incorporate more control (e.g., control emotion, rhyme scheme).
 - Extend to a full encoder-decoder Transformer for more complex tasks.

Links



DataSet

<https://www.kaggle.com/datasets/kingburrito666/shakespeare-plays>

GUI

https://huggingface.co/spaces/ahmed3746887278237832/TextGeneration_Using_VAE



Thank you!