DeepScribble

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Introduction

DeepScribble

- The goal of our project is to mimic human writing/drawing in the most efficient way while also allowing for "unique" handwritings.
- Through this we will teach an AI to develop its own writing ability by having it learn how to write words.
- This will be implemented with the use of Reinforcement Learning and Machine Learning.

Introduction

DeepScribble

Real World Applications

- Create or extend written datasets by generating the motion through our end to end framework.
- Understand how well a human can learn to write in a different language by having the AI learn a language then write another.
- "Write" letters to colleagues, family, and friends without actually writing them.

Literature Review

- Tao Zhou et al. "Learning to Sketch with Deep Q Networks and Demonstrated Strokes". In: *CoRR* abs/1810.05977 (2018). arXiv: 1810.05977. URL: http://arxiv.org/abs/1810.05977
- Volodymyr Mnih et al. "Playing Atari with Deep Reinforcement Learning". In: *CoRR* abs/1312.5602 (2013). arXiv: 1312.5602. URL: http://arxiv.org/abs/1312.5602

Literature Review

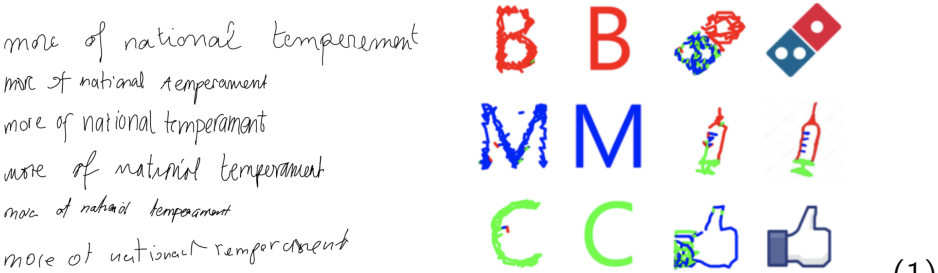
- Alex Graves. "Generating Sequences With Recurrent Neural Networks". In: *CoRR* abs/1308.0850 (2013). arXiv: 1308.0850. URL: http://arxiv.org/abs/1308.0850
- David Hershey and Blake Wulfe. *Comparing Generative Adversarial Networks to Deep RNN Language Models*. URL: https://wulfebw.github.io/assets/CS224d_Final_Paper.pdf

Current Limit

- The current algorithm using recurrent neural networks does not generate the optimal way to write characters - DBLP:journals/corr/Graves13
- Current methods in Reinforcement Learning are limited to writing characters in a given dataset, so new ways of writing a letter are not generated diversely enough - DBLP:journals/corr/abs-1810-05977

Possible Approaches

We will use RNN to generate an image of handwriting based on the user input and use a trained Deep Q Networks to copy the handwriting.



(1)

Possible Approaches

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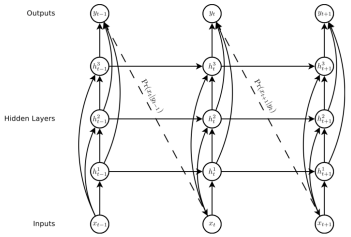
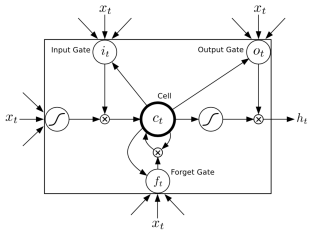
RNN Architecture

- Generating sequences
- LSTM instead of regular sigmoid activation



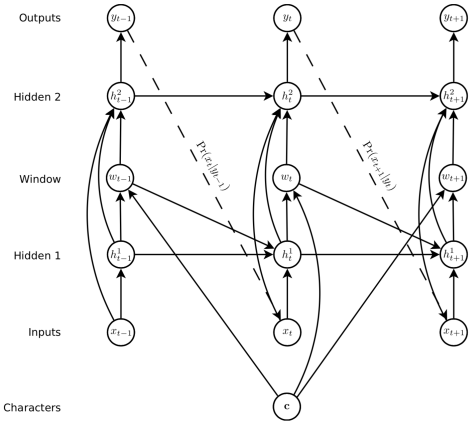


(2)

https://github.com/Jbwasse2/DeepScribble

Possible Approaches

RNN Architecture



(3)

Possible Approaches

Reinforcement Learning

- Will use a DQN model.
- When the pen is down, it can move horizontally or vertically up to an offset of 5 pixels from its initial position in either direction, so there are 121 actions. The state of the pen can also be "up" or "down", which makes for 242 actions.
- The canvas state is the state that we care about to get an action, the canvas is a 81x81 pixel area that the pen can draw in.
- The reward is a function of the correctness of the canvas to the reference image and the size of the steps.

Possible Approaches

Reinforcement Learning

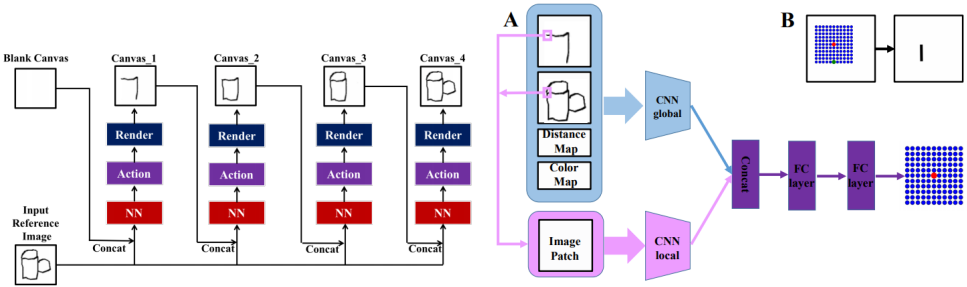


Figure: Overall model of RL system

Possible Approaches

Risks

- A possible risk is that since we are training a lot of neural networks, it will take awhile. It is hard to estimate how much this project will cost, but the cost of two engineers working on a project will cost more than renting space on the biocluster.
- It is hard to train a deep reinforcement learning model Zhou et al., "Learning to Sketch with Deep Q Networks and Demonstrated Strokes".
- The approach given in Zhou et al., "Learning to Sketch with Deep Q Networks and Demonstrated Strokes" would perform best on individual characters, and maybe not on full words.

https://github.com/Jbwasse2/DeepScribble

Possible Approaches

Timeline

- This project will take around two months to complete.
- Our first midterm check will be to build a neural network that can generate character data in a similar manner to DBLP:journals/corr/Graves13.
- The final test of whether this works will be looking at the end to end results.

Resource & Dataset

- IAM Online Handwriting Database (86,272 labeled words)
- Biocluster and/or PC (1070 GPU) for training

Figure: Example from IAM Handwriting Database (boom)

Conclusion

- Through our work we hope to create an AI that can generate unique handwriting and then learn how to scribble it.
- We will be using RNN to create unique words and DQN and CNNs to learn how to write them.

References

Graves, Alex. "Generating Sequences With Recurrent Neural Networks". In: *CoRR* abs/1308.0850 (2013). arXiv: 1308.0850. URL: http://arxiv.org/abs/1308.0850.

Hershey, David and Blake Wulfe. *Comparing Generative Adversarial Networks to Deep RNN Language Models*. URL: https://wulfebw.github.io/assets/CS224d_Final_Paper.pdf.

Mnih, Volodymyr et al. "Playing Atari with Deep Reinforcement Learning". In: *CoRR* abs/1312.5602 (2013). arXiv: 1312.5602. URL: http://arxiv.org/abs/1312.5602.

Zhou, Tao et al. "Learning to Sketch with Deep Q Networks and Demonstrated Strokes". In: *CoRR* abs/1810.05977 (2018). arXiv: 1810.05977. URL:

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