Make yourself into a work of art

Kiah Hardcastle* and Julie Makelberge**
Neuroscience PhD Program*, Graduate School of Business**
Stanford University
khardcas@stanford.edu*, juliemkb@stanford.edu**

Abstract

In this paper, we outline the implementation of a neural style transfer framework that will integrate a person's face in an artistic painting. For example, given a headshot and a picture of the Mona Lisa, this framework would inpaint the headshot face into the face of the Mona Lisa, while retaining the artistic style of the Mona Lisa. There are a number of existing applications that have focussed face swapping in recent years, however they have generally focussed on doing so for photograph images. Furthermore, the few methodologies that have used neural style transfer to adjusting such photos to an artistic style, have constrained their solution to well-aligned images that contain only a face (i.e., cropped images), without taking into account the pose of the face. Our approach is novel in that we aim to retaining the style and pose of the original work of art's face, regardless of the pose of the supplied image, and will reintroduce the face in the work of art as a whole.

1 Introduction

Neural style transfer is the technique of using deep neural networks to transfer the style of a given reference image to the content of another. Traditionally, such problems have been adressed with classic image processing techniques such as histogram matching [4]. However, in 2015 Gatys et all. [1] introduced a novel technique that leverages the power of Convolutional Neural Networks to emulate famous painting styles in natural images. In their seminal paper, they proposed to use the encoding from different layers of a pre-trained CNN, to capture the style elements and content elements of images. They then used an interative approach to optimise an image with the objective of minimizing the distance between the style elements of the image and the reference work of art, while keeping changes to the content as small as possible.

Their work has inspired a number of new neural transfer algorithms, ranging from general models such as the work of Li and Wand [3] that combined generative Markov random field models with deep convolutional neural networks, to highly specialised domain-specific models such as Jiang anf Fu's Fashion style generator [2]. While general models have shown great potential in a large number of applications, they have generally introduced visual artifacts which are especially striking in faces, given human's sensitivity for facial irregularities. The work of Selim et all. [5] introduced the first approach for single-example based head portrait painting not constrained to a specific style. Their approach was successful by introducing additional constraints that exploit human facial geometry through the notion of gains maps. However, their methodology focused on front-facing cropped facial images and does not yet generalise to different facial positions or introduction within the wider context of a full painting.

In this work, we aim to expand on the work of Selim et all by introducing a framework that combines different Neural Transfer techniques to tackle the challenge of introducing faces of slightly varing

CS230: Deep Learning, Winter 2018, Stanford University, CA. (LateX template borrowed from NIPS 2017.)

positions in a work of art. Our goal is to create a resulting image that looks similar to our reference work of art, but with the exception of having a different person in mind at the time of painting. This technique would be valuable in the world of generative art as it alows different and personalised renderings of the same types of art work.

2 Related work

You should find existing papers, group them into categories based on their approaches, and discuss their strengths and weaknesses, as well as how they are similar to and differ from your work. In your opinion, which approaches were clever/good? What is the stateof-the-art? Do most people perform the task by hand? You should aim to have at least 5 references in the related work. Include previous attempts by others at your problem, previous technical methods, or previous learning algorithms. Google Scholar is very useful for this: https://scholar.google.com/ (you can click "cite" and it generates MLA, APA, BibTeX, etc.)

3 Dataset and Features

Describe your dataset: how many training/validation/test examples do you have? Is there any preprocessing you did? What about normalization or data augmentation? What is the resolution of your images? How is your time-series data discretized? Include a citation on where you obtained your dataset from. Depending on available space, show some examples from your dataset. You should also talk about the features you used. If you extracted features using Fourier transforms, word2vec, PCA, ICA, etc. make sure to talk about it. Try to include examples of your data in the report (e.g. include an image, show a waveform, etc.).

4 Methods

Describe your learning algorithms, proposed algorithm(s), or theoretical proof(s). Make sure to include relevant mathematical notation. For example, you can include the loss function you are using. It is okay to use formulas from the lectures (online or in-class). For each algorithm, give a short description of how it works. Again, we are looking for your understanding of how these deep learning algorithms work. Although the teaching staff probably know the algorithms, future readers may not (reports will be posted on the class website). Additionally, if you are using a niche or cutting-edge algorithm (anything else not covered in the class), you may want to explain your algorithm using 1/2 paragraphs. Note: Theory/algorithms projects may have an appendix showing extended proofs (see Appendix section below).

5 Experiments/Results/Discussion

You should also give details about what (hyper)parameters you chose (e.g. why did you use X learning rate for gradient descent, what was your mini-batch size and why) and how you chose them. What your primary metrics are: accuracy, precision, AUC, etc. Provide equations for the metrics if necessary. For results, you want to have a mixture of tables and plots. If you are solving a classification problem, you should include a confusion matrix or AUC/AUPRC curves. Include performance metrics such as precision, recall, and accuracy. For regression problems, state the average error. You should have both quantitative and qualitative results. To reiterate, you must have both quantitative and qualitative results! If it applies: include visualizations of results, heatmaps, examples of where your algorithm failed and a discussion of why certain algorithms failed or succeeded. In addition, explain whether you think you have overfit to your training set and what, if anything, you did to mitigate that. Make sure to discuss the figures/tables in your main text throughout this section. Your plots should include legends, axis labels, and have font sizes that are legible when printed.

6 Conclusion/Future Work

Summarize your report and reiterate key points. Which algorithms were the highestperforming? Why do you think that some algorithms worked better than others? For future work, if you had more time, more team members, or more computational resources, what would you explore?

7 Contributions

The contributions section is not included in the 5 page limit. This section should describe what each team member worked on and contributed to the project.

References

This section should include citations for: (1) Any papers mentioned in the related work section. (2) Papers describing algorithms that you used which were not covered in class. (3) Code or libraries you downloaded and used. This includes libraries such as scikit-learn, Tensorflow, Pytorch, Keras etc. Acceptable formats include: MLA, APA, IEEE. If you do not use one of these formats, each reference entry must include the following (preferably in this order): author(s), title, conference/journal, publisher, year. If you are using TeX, you can use any bibliography format which includes the items mentioned above. We are excluding the references section from the page limit to encourage students to perform a thorough literature review/related work section without being space-penalized if they include more references. Any choice of citation style is acceptable as long as you are consistent.

References

[1] Leon A Gatys, Alexander S Ecker, and Matthias Bethge. A neural algorithm of artistic style. *arXiv preprint arXiv:1508.06576*, 2015.

[2] Shuhui Jiang and Yun Fu. Fashion style generator. In *IJCAI*, pages 3721–3727, 2017.

[3] Chuan Li and Michael Wand. Combining markov random fields and convolutional neural networks for image synthesis. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pages 2479–2486, 2016.

[4] László Neumann and Attila Neumann. Color style transfer techniques using hue, lightness and saturation histogram matching. In *Computational Aesthetics*, pages 111–122. Citeseer, 2005.

[5] Ahmed Selim, Mohamed Elgharib, and Linda Doyle. Painting style transfer for head portraits using convolutional neural networks. *ACM Transactions on Graphics (ToG)*, 35(4):129, 2016.