

Self-improvement through Bayesian optimization: A conceptual experiment

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CONCEPT

A person's journey through life and their subsequent growth is a compelling topic that is used archetypically throughout humanity's history of story-telling and art. The idea that we can rise above adversity and become better than who we are is fascinating to us. I wanted to experiment with this idea of continuous self-improvement. I focus especially on the journey of personal growth rather than the final result.

This concept is what led me to develop an algorithm that evokes this journey of continuous self-improvement. Here I use a combination of emotion classifiers and Bayesian optimization to turn human portraits into abstract "avatars" of various virtues, and I use this algorithm to show that even the worst version of us can better ourselves and still rise above iniquity.

BACKGROUND

I wanted an algorithm that starts with a human portrait as an input and then modifies it iteratively. Style transfer^[1] (Figure 1) is well suited for image modification. Style transfer superimposes the style of one image onto a content image without changing the high-level features of the content image.

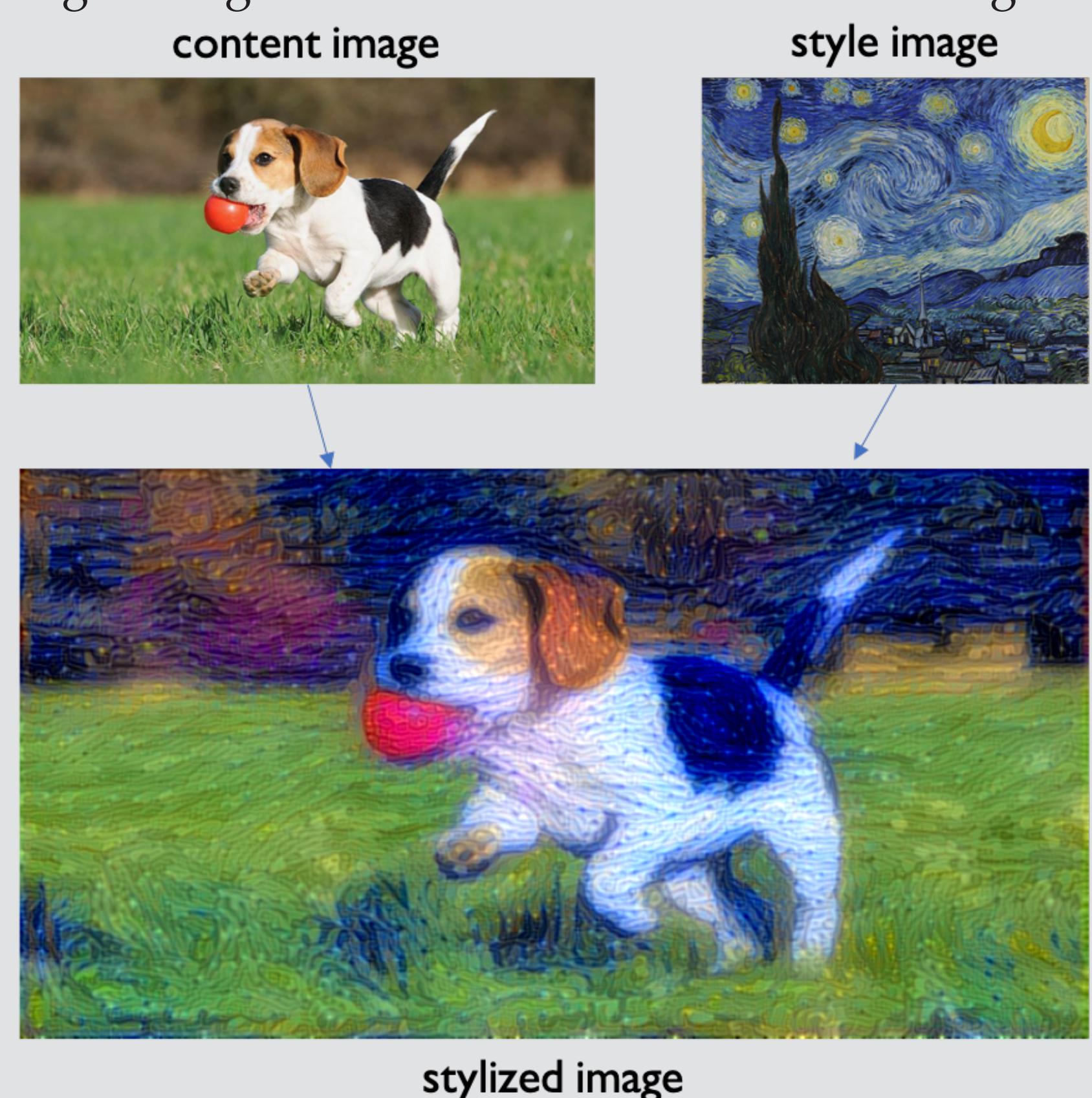


Figure 1: The style of "Starry Night" transferred onto an image of a puppy to make a "Starry Puppy". This method was used to modify human portraits given various style images.

But how do we know whether we are changing the images for better or for worse? Various convolutional neural networks exist for classifying the sentiment and/or emotion of an image,^[2, 3] but most seem closed source. Thankfully there are public datasets of images labeled with their associated emotions,^[4] which can be used to train our own "virtue/iniquity" classifiers.

We also need an iterative method for choosing which style images to use at each point in time. Bayesian optimization is well suited for this task (Figure 2). Many packages exist to perform Bayesian optimization, such as CMU's Dragonfly.^[5]

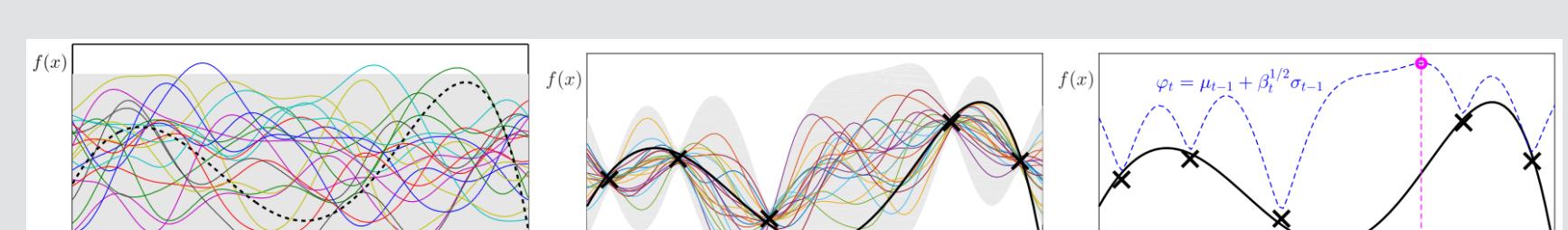


Figure 2: Bayesian optimization is the process of using a Gaussian process regressor to optimize some expensive, black-box objective function. In this case, we will be optimizing an image to fit a virtue. Figure taken from Kandasamy et al.^[5]

METHOD

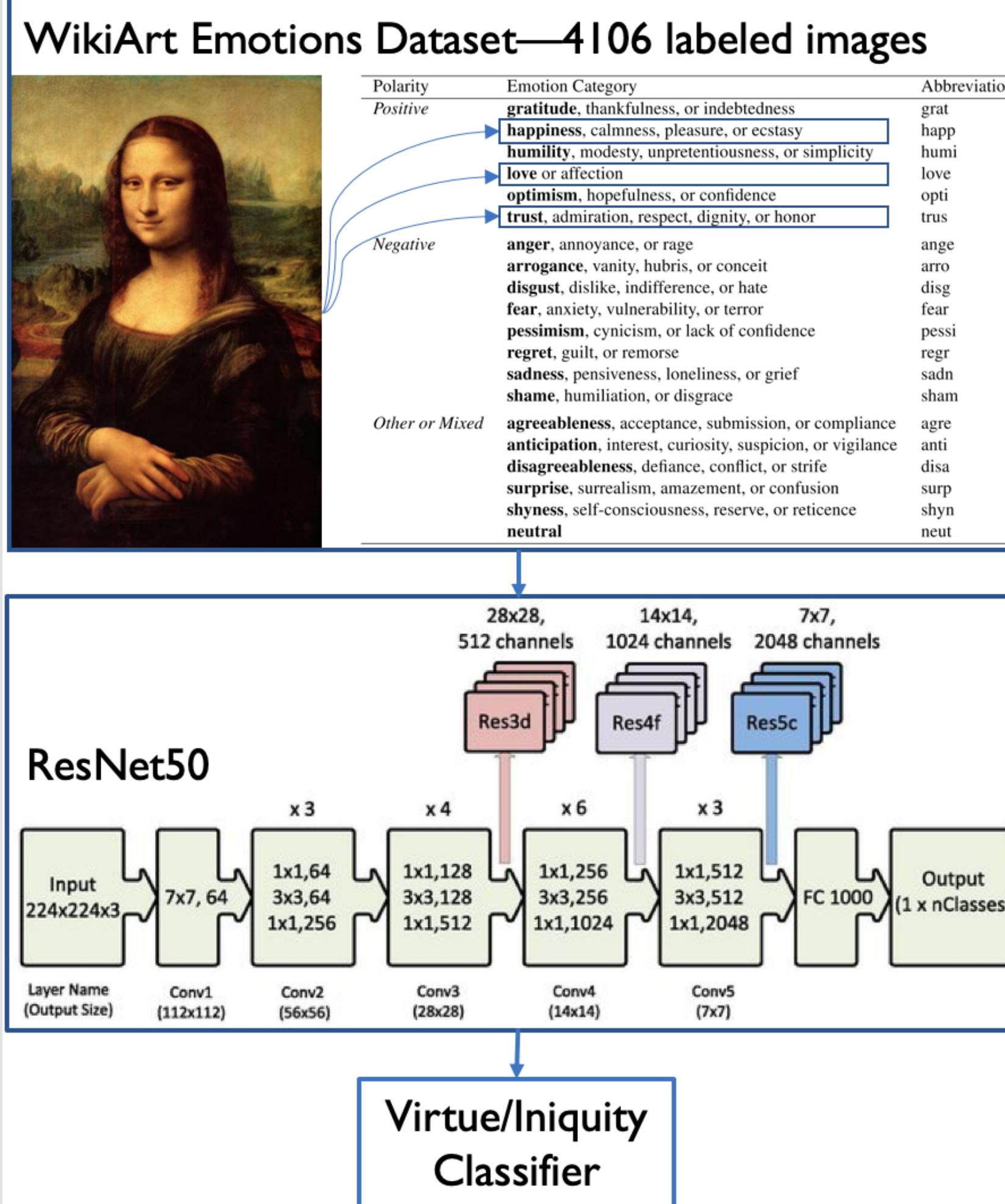


Figure 3: We use the WikiArt Emotions dataset^[4] to train ResNet50^[6], creating a neural network that can classify an image's virtue/iniquity.

I first trained a classifier (Figure 3) that can quantify an image's associated virtue/iniquity. I then incorporated the classifier within a Bayesian optimization framework to choose new images to perform style transfer with (Figure 4).

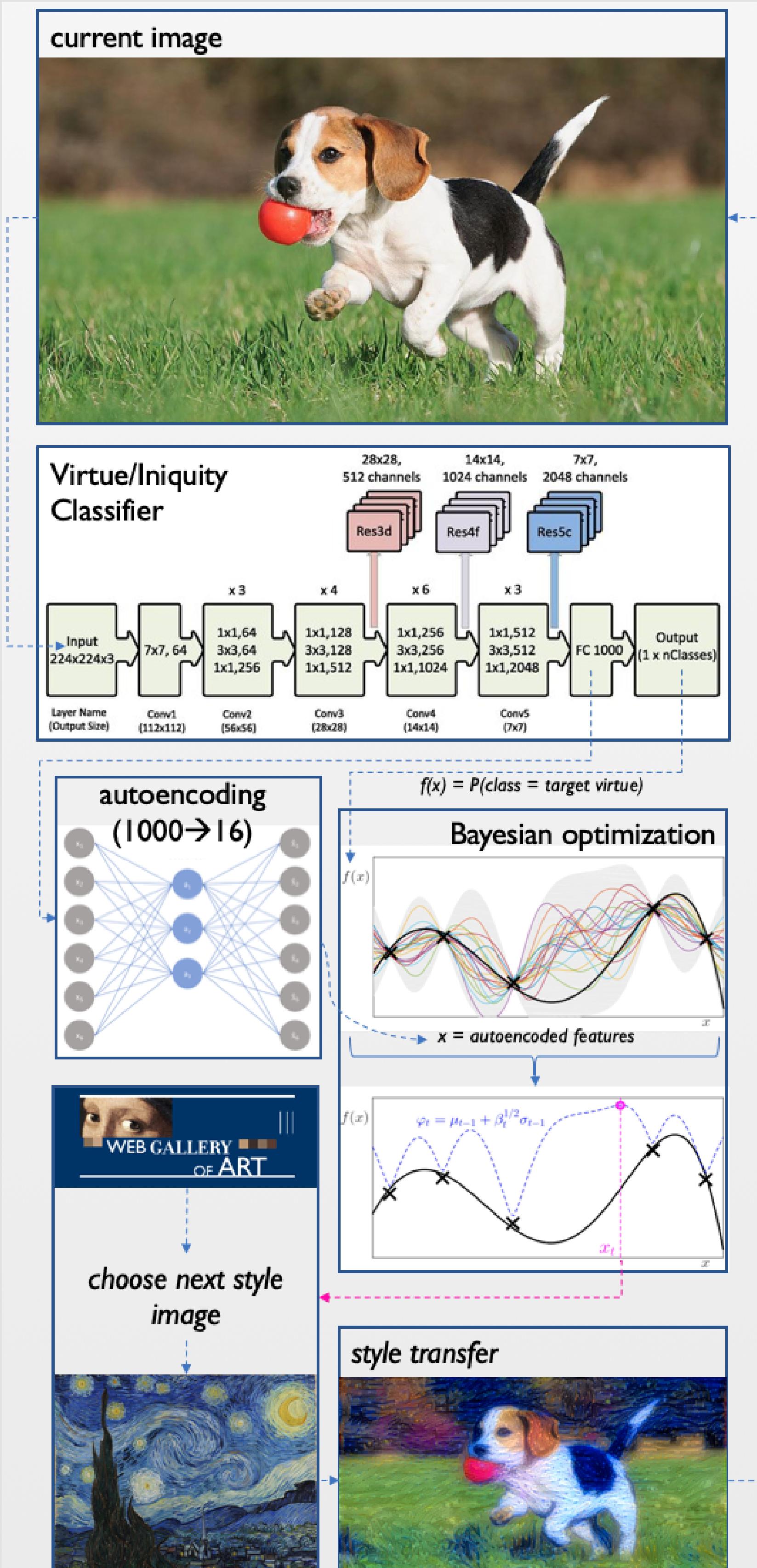


Figure 4: My algorithm for iterative style transfer. The goal is to modify an image such that it begins to match the target virtue more and more closely.

RESULTS

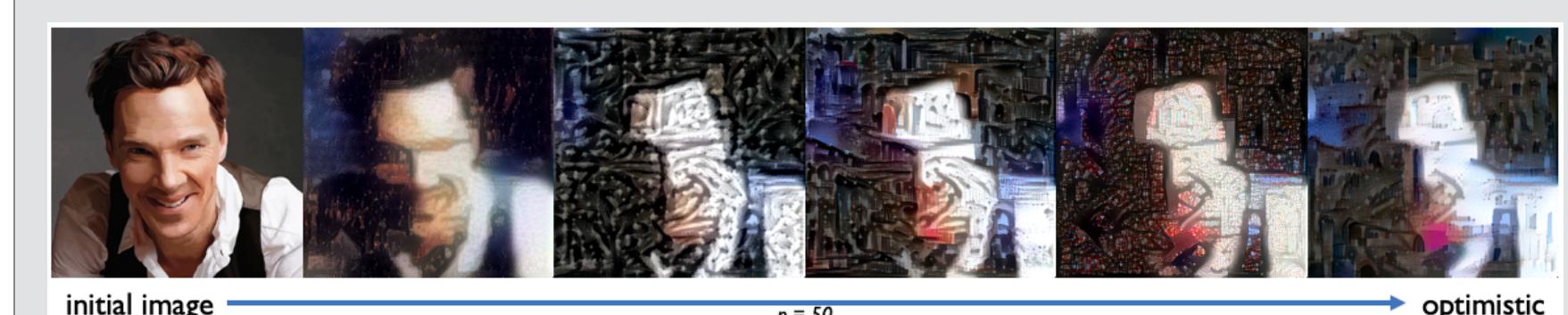


Figure 5: Turning Cumberbatch optimistic.

Figure 5 shows how the algorithm transforms a portrait using the "optimistic" virtue. As a conceptual experiment, I turned Gaius Baltar into both an avatar of both arrogance and humility. I then tried to see if I could transform an arrogant Baltar into a humble one (Figure 6).

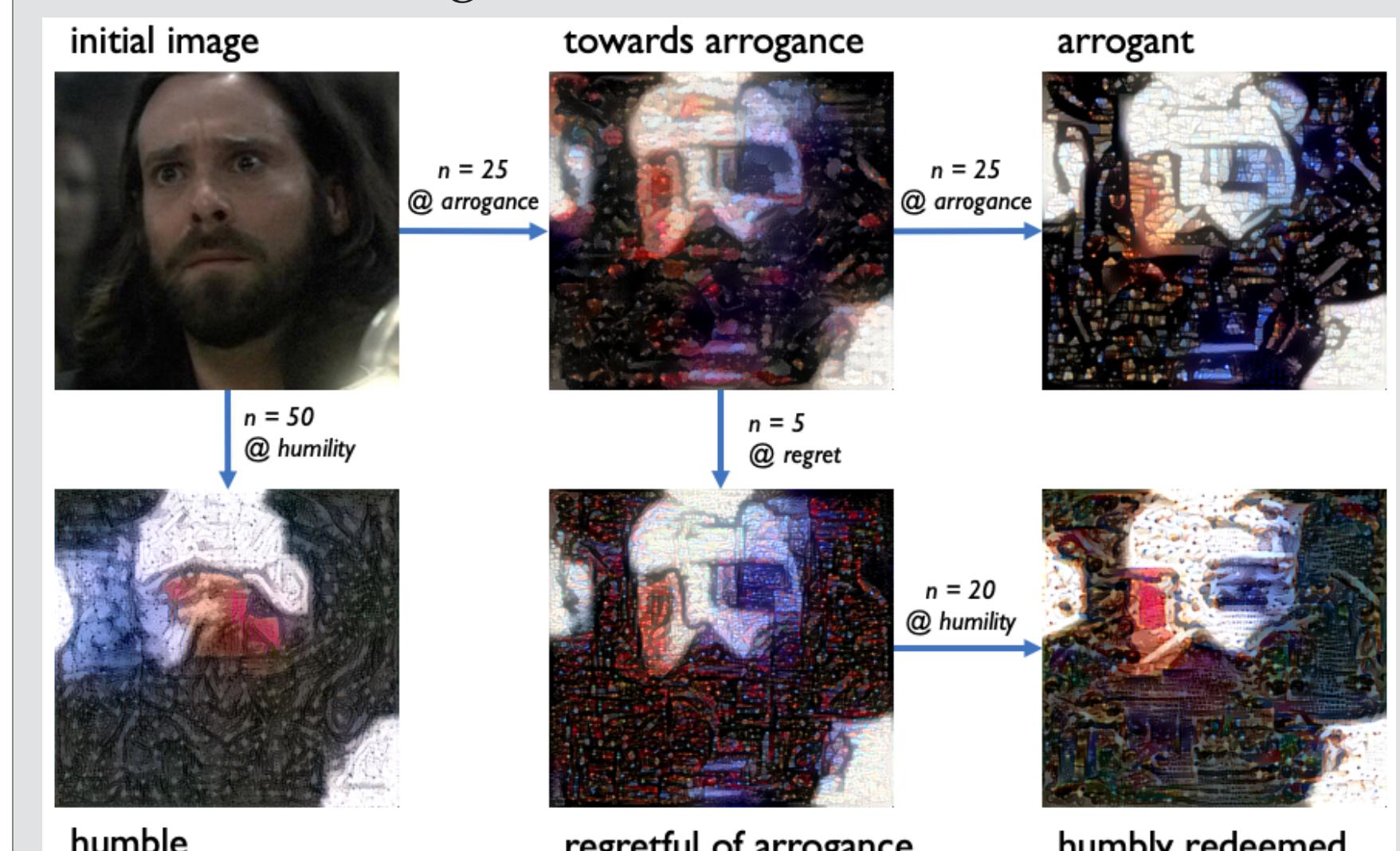


Figure 6: Possible paths of Gaius Baltar's character progression.

FUTURE WORK

The final result seems to be more dependent on the total number of iterations rather than the target attributes. This could be addressed by using a better set of candidate style images—e.g., instead of using The Web Gallery of Art, images created by an emotional GAN^[3] (Figure 7) might be more effective.

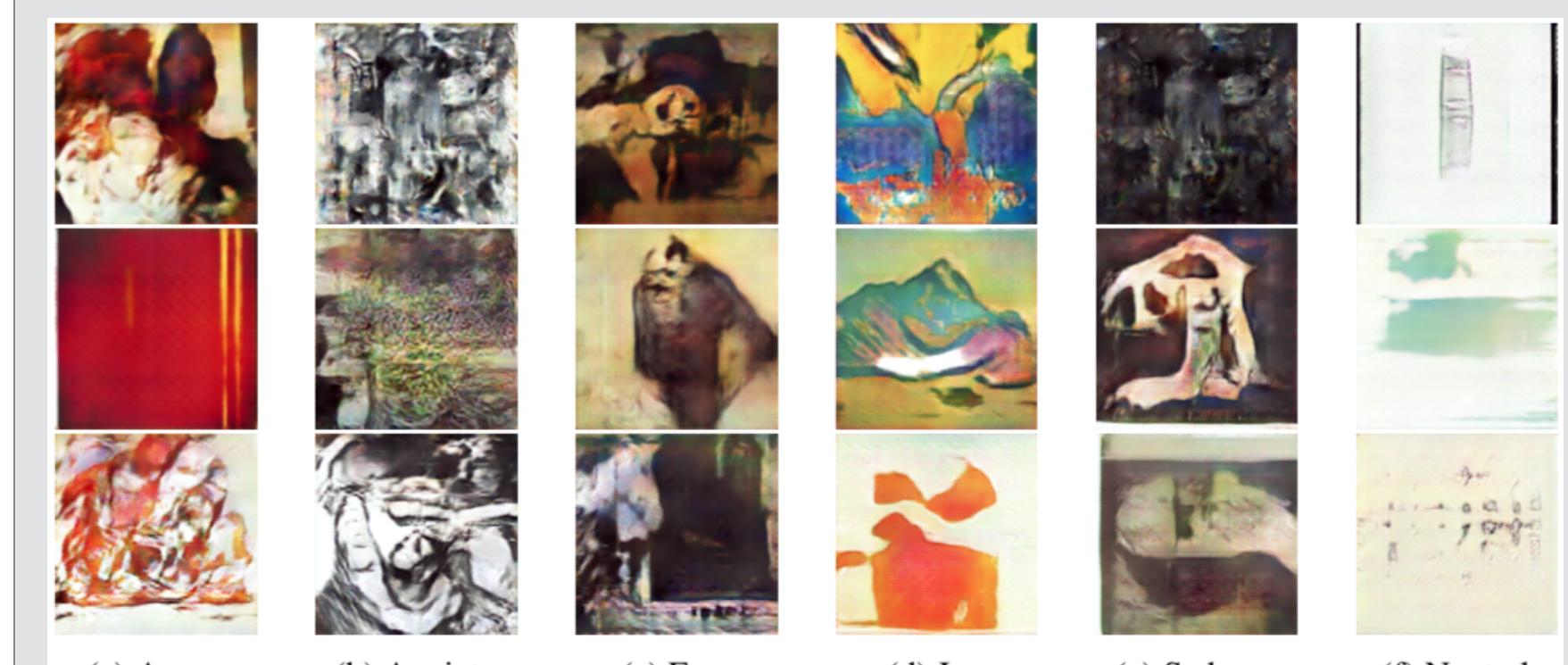


Figure 7: Example images created by a GAN^[3] that can create images that evoke particular emotions.

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