Are Centaurs Actually Half Human and Half Horse?

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1. Introduction

A centaur, according to Greek mythology, is a creature said to be half human and half horse. But is that actually the case?

While there are numerous ways to judge if a centaur is half human and half horse (e.g., by mass, volume, genetics, etc.), it is obvious that *visually* they are not. Their appearance is simply that of a horse with its head replaced with the upper half of the human body. Proportionally, they are more horse than human. But just *how* much more horse than human are they? If I had to guess, I would say they are, like, 34% human and 66% horse, but that's kinda arbitrary, and as someone who is 100% human, I am not able to impartially judge. Clearly, the answer is to use *machine learning* to solve this problem. Machine learning models are trained using data, and thus make decisions based on evidence instead of being arbitrary. Moreover, machine learning models are 100% computer, removing any human error and making them (famously) unbiased.

In this paper, I show that by training an image classification model to categorize both humans and horses, we can determine the true human-to-horse ratio of centaurs.

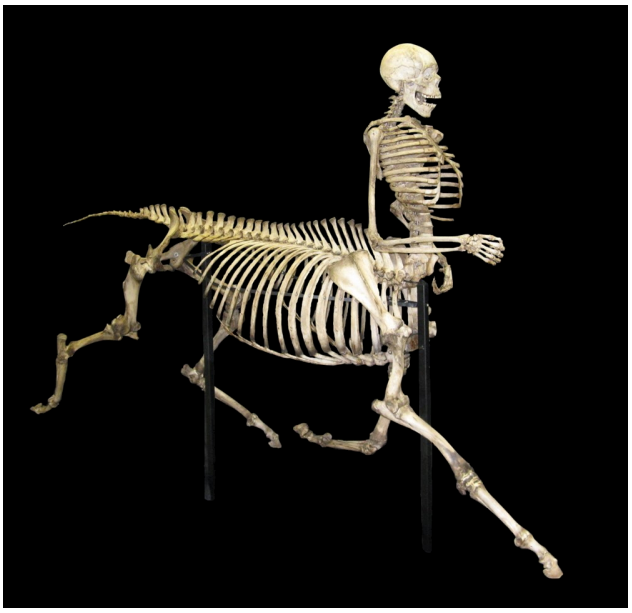

Figure 1. The skeletal remains of a centaur, dated to be from a few hundred thousand years ago.

2. Approach

2.1. Rationale

Image classification is the task of determining what learned object category is in an image. A typical image classification model is trained to recognize hundreds of different categories, giving a probability[1] of how likely an image contains a certain category for each category (with the one with the highest probability being the predicted category).

Our model will be concerned with identifying only two things: humans and horses. Ideally, this model should predict the correct category with a probability of 1.00, and 0.00 for the other category. For example, if the model were given an image of a horse, it should say that it is 100% of a horse, and not anything else. The same should also apply for an image of a human (i.e., it should say it is a human and not a horse).

[1]They are not actually probabilities, but don't think about it too much.

But what would happen if you gave this model an image of a centaur? If a centaur was truly half human and half horse, then the model should give a probability of 0.50 for both the human category and the horse category. If they are not, then the model should give a higher probability to the category that it is more of. By using this method, we can determine whether a centaur is more human or horse, and find the exact human and horse percentages of a centaur.

2.2. Training

To train the model, I used the *Horses or Humans* dataset (Moroney, 2019). It is not a large dataset (containing only 1283 images total), and the images are not even of real horses or humans (they are computer-generated models), but as we will see, this does not adversely affect the performance of the model. To test if the model works on more than CGI-based images, I created a very large dataset of real images (4 humans and 4 horses) sourced from Unsplash and had the model make predictions on them.

Speaking of the model, instead of creating my own model

from scratch, I decided to do fixed feature extraction on a preexisting model. Apparently doing it this way is the appropriate approach when the dataset you want to train on is not that big, but I just did it this way because I was lazy. I was not exactly sure what was a good model to use, so I decided on using EfficientNetV2-B0[2] (Tan & Le, 2021) because it sounded like it was efficient. The only modifications I did to the network were adding some data augmentation transformation layers at the beginning, replacing the top of the network with a global average pooling layer with a little bit of dropout, and attaching the end with a single output neuron[3]. Since we only have one output neuron, inputs with outputs close to 1 are categorized as humans, while outputs close to 0 are categorized as horses; however, to keep things simple, I will simply subtract the horse output from 1 to keep them on the same "scale".

2.3. Tensorflow Code

If, for some reason, you would like to reproduce this yourself, you can find the source code at `https://github.com/kylebatucal/centaur-classifier/`.

3. Results

Training the model was extremely fast. After just one epoch (which took a little less than three minutes), the model already achieved 100% accuracy on the validation dataset, confirming that I was right to pick a model solely based off of its name[4]. However, if I wanted to make my model as idealized in the *Rationale* section (where it scores 1.00 for one category and 0.00 for the other), then I would need to reduce my loss as close to zero as possible. To do this, I simply trained it on four more epochs. Doing this, I was able to bring my validation loss from 0.0645 to 0.0029, and it never seemed to overfit as it always achieved 100% validation accuracy. I could have trained it with more epochs, but I decided not to[5].

Although our model was trained using CGI-based images, it performed admirably well on real-life-based images. The model correctly classified everything, with the average output from the real dataset being 0.9933 for human images, and 0.9960 for horse images.

With our model calibrated, all that is left is to see what the output of the model is when given an image of a centaur, letting us see if a centaur is more human, or more horse. However, it was at this point I came to the dire realization that there are no "real" images of centaurs. Centaurs went extinct relatively recently (Figure 1), and thus there are no photos of centaurs, only depictions by artists which may not be entirely accurate.

Alas, all is not loss. We can simply just ask AI to generate an image of a centaur. As we have already established, AI is entirely evidence-driven and unbiased, meaning we should get only accurate depictions of centaurs. I decided to ask Meta AI because I did not feel like making an account to use the other ones. In Figure 2, we can see what the AI thinks a centaur looks like.

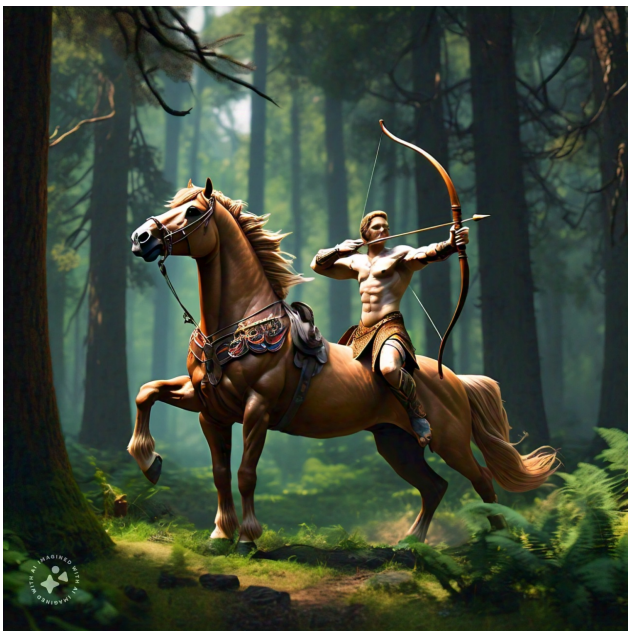

Figure 2. Biblically accurate centaur.

Perfect. When we give this image to the model, it outputs a human score of 0.0232, or in other words, a horse score of 0.9768. In other words, a centaur is about 98% horse, and 2% human. Since this AI-generated image is the culmination of millions of compute hours trained on a legally-sourced corpus, there is no need to test the model on other images of centaurs. It is, as said, the perfect depiction of a centaur.

4. Conclusion

Centaurs are not actually half human and half horse.

[2]Using the pretrained weights from ImageNet.

[3]Having a single output neuron with the sigmoid function is actually equivalent to having two output neurons with the softmax function (proof is left as exercise to reader).

[4]I am just kidding; I read the paper. And by "read", I mean skimmed.

[5]This decision is not related to the fact that this paper was submitted a few minutes before the deadline closed.

5. Future Work

This technique can be expanded on by using an object detection or segmentation model, allowing the model to more precisely identify what parts of a centaur make it human or horse. Furthermore, this technique can be applied to other mythological liminal creatures, such as satyrs, recursive centaurs, and Skibidi Toilet.

References

Moroney, L. Horses or humans dataset, Feb 2019. URL http://laurencemoroney.com/horses-or-humans-dataset.

Tan, M. and Le, Q. V. Efficientnetv2: Smaller models and faster training, 2021.