

OrigamiSet1.0: Two New Datasets for Origami Classification and Difficulty Estimation

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keywords: dataset, classification, difficulty estimation

Abstract

Motivation: Origami is becoming more and more relevant in research. However, there is no public dataset yet available and there hasn't been any research on this topic in machine learning. Datasets are crucial for new developments and major progress in machine learning. In particular, datasets of images have allowed researchers to make significant advances in the field of computer vision. For example, ImageNet, a dataset of millions of images and corresponding noun labels, has been a useful resource in creating and benchmarking large-scale algorithms for image classification. The German Traffic Sign Detection Benchmark Dataset has practical use for self-driving vehicles to detect traffic signs in order for them to act appropriately. The MNIST database, a vast database of handwritten numeric digits, has been used for training and testing various classification techniques on image recognition.

Methods: We constructed an origami dataset using images from the multimedia commons as well as from two other databases. It consists of two subsets: one for classification of origami images and the other for difficulty estimation.

Results: We obtained 16000 images for classification (half origami, half other objects) and 1509 for difficulty estimation with 3 different categories (easy: 764, intermediate: 427, complex: 318). The data can be downloaded at: <https://github.com/multimedia-berkeley/OriSet>. For defining a machine learning baseline, we used VGG16 features and compared different classification algorithms. The best classification performance was around 97%. The best difficulty estimation had a balanced accuracy of 79%, where 33% would be guessing.

Conclusion: We present the first large collection of origami images. The dataset is sufficiently large to perform analytics on it and first classification results on two different problems are promising. Future challenges are to estimate the number of folds that a model contains as well as to classify what an origami model is supposed to represent. However, this requires an extension of the dataset in size as well as information content. We hope this paper encourages the interested reader to contribute more data.

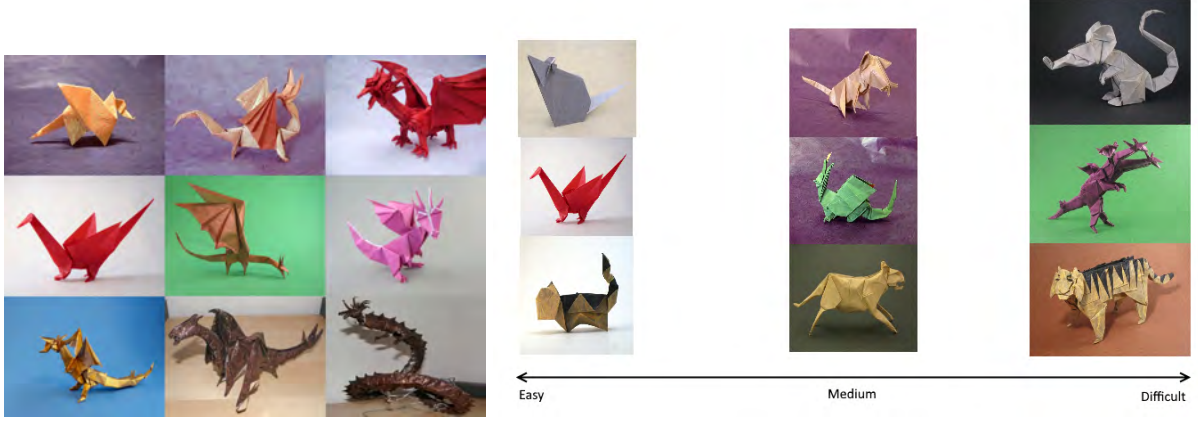


Figure 1: For some model topics, (such as dragons, Santa Claus, pandas, etc.), there are multiple models that were meant to represent the same topic. (left) This example contains 9 different dragon models. (right) Examples of images from the GiladOrigami database classified as easy, medium, and difficult from three different topics: tiger, dragon, and rat.

Table 1: Origami classification estimation: 5-fold cross-validation scores for different models on default settings

Classifier	Accuracy Score
SVC: Linear Kernel	0.9674 ± 0.0049
SVC: RBF Kernel	0.9705 ± 0.0051
SVC: Poly Kernel	0.9746 ± 0.0063
SVC: Sigmoid Kernel	0.9215 ± 0.0128
Logistic Regression	0.9707 ± 0.0071

Table 2: Difficulty Estimation: 5-fold CV Scores of Different Models using our Labels

Classifier	Balanced Accuracy Score	R^2 Score
SVC: Linear Kernel	0.7581 ± 0.0151	0.5631 ± 0.0716
SVC: RBF Kernel	0.7826 ± 0.0217	0.6293 ± 0.1323
SVC: Poly Kernel	0.7854 ± 0.0172	0.6158 ± 0.0948
SVC: Sigmoid Kernel	0.7223 ± 0.0281	0.5822 ± 0.1516
Logistic Regression	0.7625 ± 0.0101	0.5738 ± 0.0789