PROJECT

Bicycle classification

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Introduction

Text and results for this section, as per the individual journal's instructions for authors. [1]

Methods

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Dataset

For purposes of this project, we used web-scraped pictures from several bicycle e-shops. We separated them into 3 classes: Road, Mountain and City. In the end we ended up using only Road and Mountain bikes due to low amount of City bikes in training data.

Our dataset is composed of only a little over 200 images, making training our models challenging. We split 10% (25 images) for use as validation dataset, which we kept constant for training of all models.

We resized all immages to 64x64 pixels and converted them to monochrome. This has the effect of both making our models simpler and making color-based classification less likely to occur[1].

Convolutional neural network

Convolutional neural networks (CNNs) are

We implemented two different models for

In both models we use a kernel of size $(5, 5)$ for all layers when applicable. For activation function, we found that alternating ReLU and sigmoid provided best computational speed and accuracy. We experimented with different number of channels on each layer.

In the first model, we use only convolutional layers with a stride of (2, 2).

In the second model, we alternated typical convolutional layers with a stride of (1, 1) with MaxPool layers with a pool size of (2, 2).

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_1 (InputLayer)         (None, 64, 64, 1)         0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 30, 30, 1)         26
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 13, 13, 1)         26
```

[1] As bike color trends can vary over time, we did not want our models to assume that, for example, mountain bikes tend to be yellow.

```
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 5, 5, 1)          26
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 1, 1, 1)          26
_________________________________________________________________
flatten_1 (Flatten)          (None, 1)                0
_________________________________________________________________
dense_1 (Dense)              (None, 2)                4
=================================================================
Total params: 108
Trainable params: 108
Non-trainable params: 0
_________________________________________________________________
```

PCA

Principal component analysis

From eigenbikes we can clearly see that a simple

SVM

We used support vector machines on output of PCA

Results

Discussion

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Sub-sub-sub heading for section Text for this sub-sub-sub-heading ... In this section we examine the growth rate of the mean of Z_0, Z_1 and Z_2. In addition, we examine a common modeling assumption and note the importance of considering the tails of the extinction time T_x in studies of escape dynamics. We will first consider the expected resistant population at vT_x for some $v > 0$, (and temporarily assume $\alpha = 0$)

$$E\big[Z_1(vT_x)\big] = E\left[\mu T_x \int_0^{v \wedge 1} Z_0(uT_x) \exp\big(\lambda_1 T_x(v-u)\big)\, du\right].$$

If we assume that sensitive cells follow a deterministic decay $Z_0(t) = xe^{\lambda_0 t}$ and approximate their extinction time as $T_x \approx -\frac{1}{\lambda_0}\log x$, then we can heuristically estimate the expected value as

$$\begin{aligned} E\big[Z_1(vT_x)\big] &= \frac{\mu}{r}\log x \int_0^{v\wedge 1} x^{1-u} x^{(\lambda_1/r)(v-u)}\, du \\ &= \frac{\mu}{r} x^{1-\lambda_1/\lambda_0 v} \log x \int_0^{v\wedge 1} x^{-u(1+\lambda_1/r)}\, du \\ &= \frac{\mu}{\lambda_1 - \lambda_0} x^{1+\lambda_1/rv} \left(1 - \exp\left[-(v\wedge 1)\left(1+\frac{\lambda_1}{r}\right)\log x\right]\right). \quad (1) \end{aligned}$$

Thus we observe that this expected value is finite for all $v > 0$ (also see [2, 3, 4, 5, 6]).

Competing interests
The authors declare that they have no competing interests.

Author's contributions
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Figures

Figure 1 Sample figure title. A short description of the figure content should go here.

Figure 2 Sample figure title. Figure legend text.

Tables

Table 1 Sample table title. This is where the description of the table should go.

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A1	0.1	0.2	0.3
A2	...	..	.
A3	..	.	.

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Additional file 2 — Sample additional file title
Additional file descriptions text.