Using deep learning to predict air quality from webcam images

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1 Introduction

Air pollution in developing countries is a serious problem due to urbanization. However, on-the-ground measurements are not widely available. The question is whether we can use ubiquitous sources of data, such as webcam images or social media images for measuring the outdoor air pollution.

Questions:

1) Do time-series of public images contain enough information for the deep learning models to predict the outdoor air quality?
2) If so, what architectures are the best suited?

2 Methods

Time-series of public images, reference air pollution labels, and meta-data:

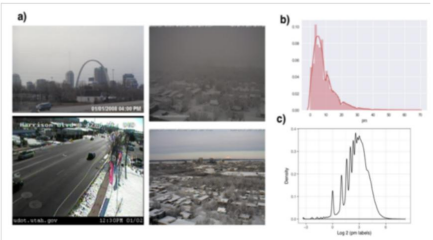

Figure 1. a) Example view points from webcams, b) original distribution of particulate matter (pm) labels, c) log base 2 transformation of the pm distribution.

Data set

- Time period considered

Daily hours : 9am – 6pm in 2008 - 2017

- Data set split : 60%/20%/20%

Training set : ~10,000 examples
Dev and test set : ~3,300 examples each

3 Results

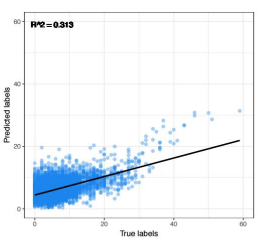

Figure 1: Simple baselines: Elastic Net, validation set

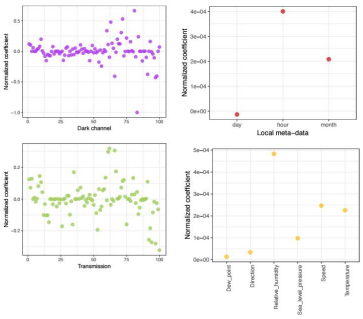

Figure 2-5: Simple baselines: Elastic Net – weights for the features used in the linear model

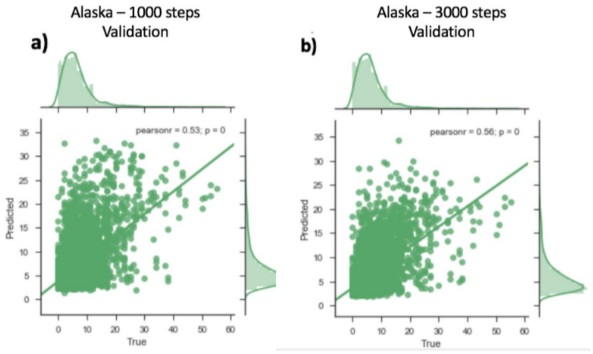

Figure 6: Deep learning models: ResNet 50 on the validation set

Model	Distribution	Training R^2	Validation R^2
ResNet 50*	original	0.39	0.33
ResNet 50*	Log base 2 transformation	0.45	0.35
Elastic Net	original	0.35	0.31
Elastic Net	Log base 2 transformation	0.39	0.35

* Parameters optimized: batch size, no.of epochs, no. of hidden layers, type of hidden layers, no. of neurons, dropout rates, type of optimization, learning rate

4 Conclusions

Since the original label distribution is right skewed and majority of values are very low [0, 10], applying logarithmic transform helps with learning representation for the deep learning models and simple linear baselines.

However, we can still improve the correlation coefficients by increasing the sample size (incorporating more data) or casting the problem as classification