

Recent Results from Deep Learning

May 18, 2017 Jun Nakano Kanazawa Institute of Technology http://nakanolab.net/

Predicting z from 5-Band Flux of Subaru HSC



Photoz Workshop for Large Surveys

Degeneracy makes prediction hard!

t-SNE (t-Distributed Stochastic Neighbor Embedding) plot of (G, R, I, Z, Y) data points

t-SNE Plot of Test Data (after 1,000 iterations)



Predicting z from 5-Band Flux of Subaru HSC



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7 =

Predicting z from 5-Band Images of HSC



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Data processing pipeline (1)



Data Preparation

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Data processing pipeline (2)



K.I.T.

Convolutional Neural Network (CNN)



Random forest vs. CNN



	Random Forest	CNN	
RMSE	0.52	0.58	+12%
Dispersion	0.11	0.07	-36%
Outlier Rate	0.29	0.15	-48%

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Raw outputs from CNN

Our CNN model outputs "probability distribution" of z

object: 43158747673006938 object: 43158455615233255 object: 43158455615249353 Almost right 0.15 5 0.12 ò 0.10 0.10 0.08 0.05 0.05 0.04 8 8 8 0 0.7 1.6 2.5 3.4 4.3 0 0.7 1.6 2.5 3.4 4.3 0 0.7 1.6 2.5 3.4 4.3 ref_photoz = 0.65 ref_photoz = 0.35 ref_photoz = 1.45 Hugely overestimated object: 43158189327274435 object: 43158331061202040 object: 43158588759245335 0.06 80.0 0.06 0.04 0.04 0.04 0.02 0.02 8 80 8 0 0.7 1.6 2.5 3.4 4.3 0 0.7 1.6 2.5 3.4 4.3 0 0.7 1.6 2.5 3.4 4.3 Hugely underestimated ref_photoz = 0.11 ref_photoz = 0.05 ref_photoz = 0.18 object: 43158318176293340 object: 43158588759235059 object: 43158747673026766 0.0 0.06 80 0.04 0.04 0.04 0.02 0.02 8 8 8 0 0.7 1.6 2.5 3.4 4.3 0 0.7 1.6 2.5 3.4 4.3 0 0.7 1.6 2.5 3.4 4.3 ref_photoz = 4.35 ref_photoz = 4.40 ref_photoz = 4.36

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How does it perform on different seeings?



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Images from different seeings

Model trained on median seeing Worst seeing (13% outliers)
Be

Best seeing (15% outliers)



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K.

Summary

- Convolutional Neural Network: Powerful tool for predicting photo-z (especially for reducing outlier rates)
- Raw output of CNN can be considered as a probability distribution of photo-z and may be used for identifying could-be outliers (e.g., double peaks)
- Future Plan

More extensive hyper-parameter search in design space (# of layers, size of filters, activation functions, etc.)

Stacking with predictors based on physics