A Difference Boosting Approach For The Detection Of Point Sources From Multi-Band Survey

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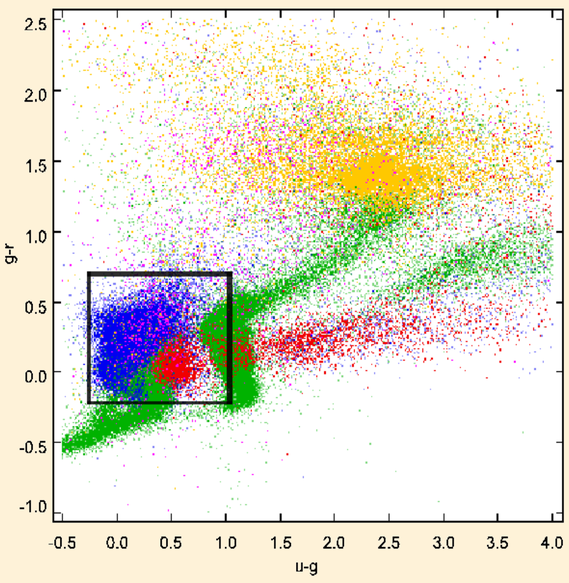
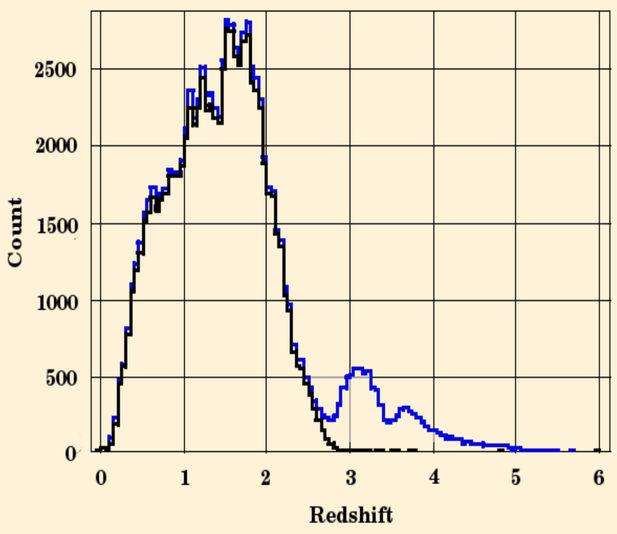
Abstract

We present the classification of about 6 million unresolved photometric detection from Sloan Digital Sky Survey Data Release 7, using an efficient Bayesian classifier. These objects are classified as stars, galaxies and quasars from a region of colour space that is selected for the study. Our algorithm recovers 99.96% of spectroscopically confirmed quasars and 99.51% of stars to SDSS i-band ~ 21.3 in the colour window that we study. This method has predicted about 2 times more quasar candidate and have also identified a few redshift patches at which SDSS colours of quasars and some stars are almost indistinguishable.

Data

The data used for the study are unresolved objects from SDSS DR7 photometric catalogue. A small set of spectroscopically confirmed objects are used to train the classifier. The colour window region shown as black box in Fig. 1 is used for this study. This region occupies all known quasars up to a limiting redshift of ~ 2.6 as shown in Fig. 2.

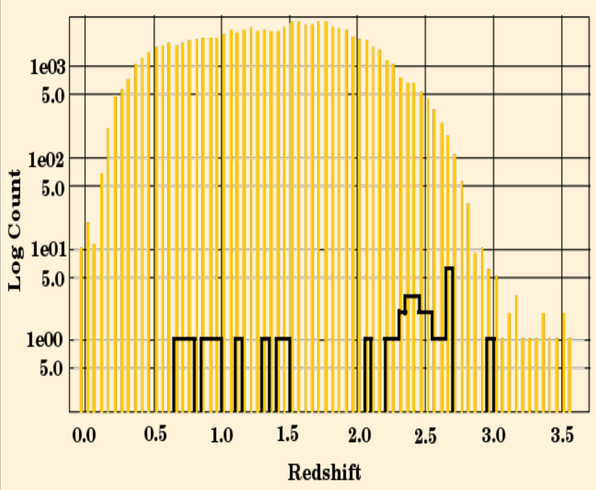




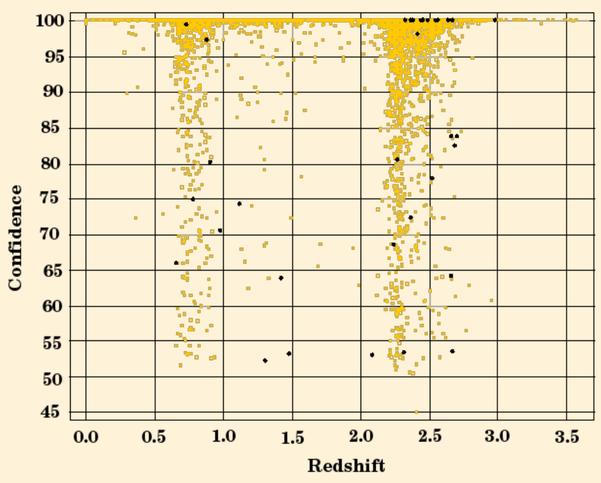
Comparison of our predictions with SDSS Spectroscopy

Object Type	Completeness	Contamination
Star	99.51%	0.47%
Galaxy	82.74%	0.00%
Quasar	99.96%	0.28%
Star-Late	80.40%	0.00%
Total	99.69%	0.31%

Colour merges at specific patches of redshift between different spectral classes



Prediction confidence reduces at colour merging regions



Reference

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2. Croom, S. M., et al. 2009, *MNRAS*, **399**, 1755
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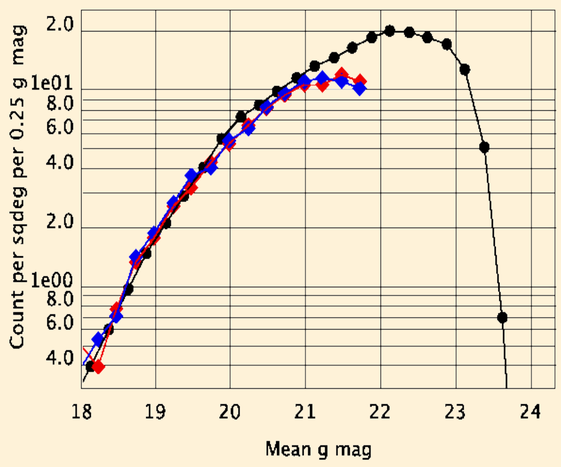
Motivation

With the advent of new detector technology and many large scale sky surveys, automated classification tools are required to analyse objects. This is more relevant at fainter magnitudes where noise is large and samples with confirmed nature are fewer. We use a Bayesian classifier that use the colour relation of each type of object to distinguish them. (Fig.1.)

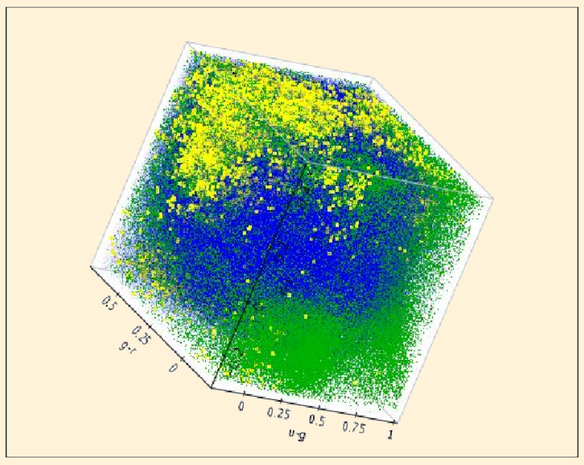
Summary of the catalogue predictions with other spectroscopic surveys

Cat Code	DBNN Prediction			Failure As Per Catalogue			Accuracy In %	I mag range
	Quasar	Galaxy	Star	Quasar	Galaxy	Star		
2DF	5976	238	1535	122	0	52	98	17.0 – 22.0
XBH	212	0	0	0	0	0	100	15.8 – 20.5
ASFS	1088	12	31	0	12	31	96	14.5 – 22.1
BATCS	21	0	0	3	0	0	86	18.1 – 20.5
CGRBS	265	1	0	0	1	0	100	14.7 – 21.5
DLyaQ	21	0	1	0	0	1	95	16.5 – 19.4
F2QZ	186	1	3	0	1	3	98	16.6 – 21.0
KFQS	144	2	13	3	1	7	94	16.8 – 20.6
LQAC	61504	17	267	0	17	267	100	14.7 – 22.3
LQRF	60280	14	219	0	14	219	100	14.7 – 21.7
BZC	249	4	2	0	4	2	98	15.0 – 21.0
PCS	53	0	2	0	0	2	96	15.1 – 18.5
ROSA	1134	0	1	0	0	1	100	15.5 – 20.5
SQ13	65223	55	395	0	55	395	99	14.7 – 22.8
SQR13	7	0	21	7	0	0	75	16.3 – 20.3
DR7Q	79140	17	341	0	17	341	100	14.9 – 21.8
SSSC	82	2	1171	82	2	0	93	14.9 – 21.5
SSA13	5	0	1	0	0	0	83	17.8 – 20.8
XMMSS	37	0	5	1	0	2	93	14.9 – 20.7
SDSS/XMM	580	0	0	0	0	0	100	15.2 – 20.5
RASS/2MASS	6	0	0	0	0	0	100	15.5 – 18.4
CAIXA	16	0	0	0	0	0	100	15.1 – 17.8
WDMB	20	0	106	20	0	0	84	15.3 – 20.5
PMS	639	6	19596	639	6	0	97	14.8 – 20.2
GLQ	2	0	0	0	0	0	100	18.8 – 19.1

Comparison of number density of quasars with 2dF-SDSS LRG and QSO (2SLAQ) survey



3D colour cube of 6 million predictions in the catalogue



Results

- We have identified and provided a catalogue of about 2,430,625 probable quasars, 3,544,036 stars and 63,586 galaxies covering the SDSS i-band magnitude range 14 to 24.
- Our algorithm recovers 99.96% of spectroscopically confirmed quasars and 99.51% of stars to SDSS i - band ~ 21.3 in the colour window.
- Our catalogue covers most quasars with redshift < 2.6 and magnitude brighter than SDSS i ~ 24 in the SDSS footprint area.
- We compare our predictions with 24 other spectroscopic surveys (about 100 thousand) and find that the predictions closely agree with observations.
- We show that the number density of quasars in our predictions closely agree with the theoretical estimates.
- We identify specific redshift patches where the colours of quasars and some stars becomes indistinguishable.

Paper Link : http://arxiv.org/abs/1011.2173
MNRAS Ref No. : MN-10-2382-MJ.R2