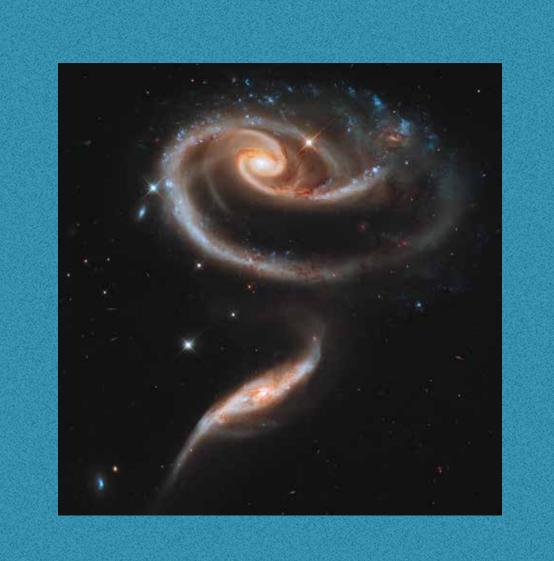


# Galaxy Classification with Deep Convolutional Neural Networks

# Honghui Shi Beckman Institute

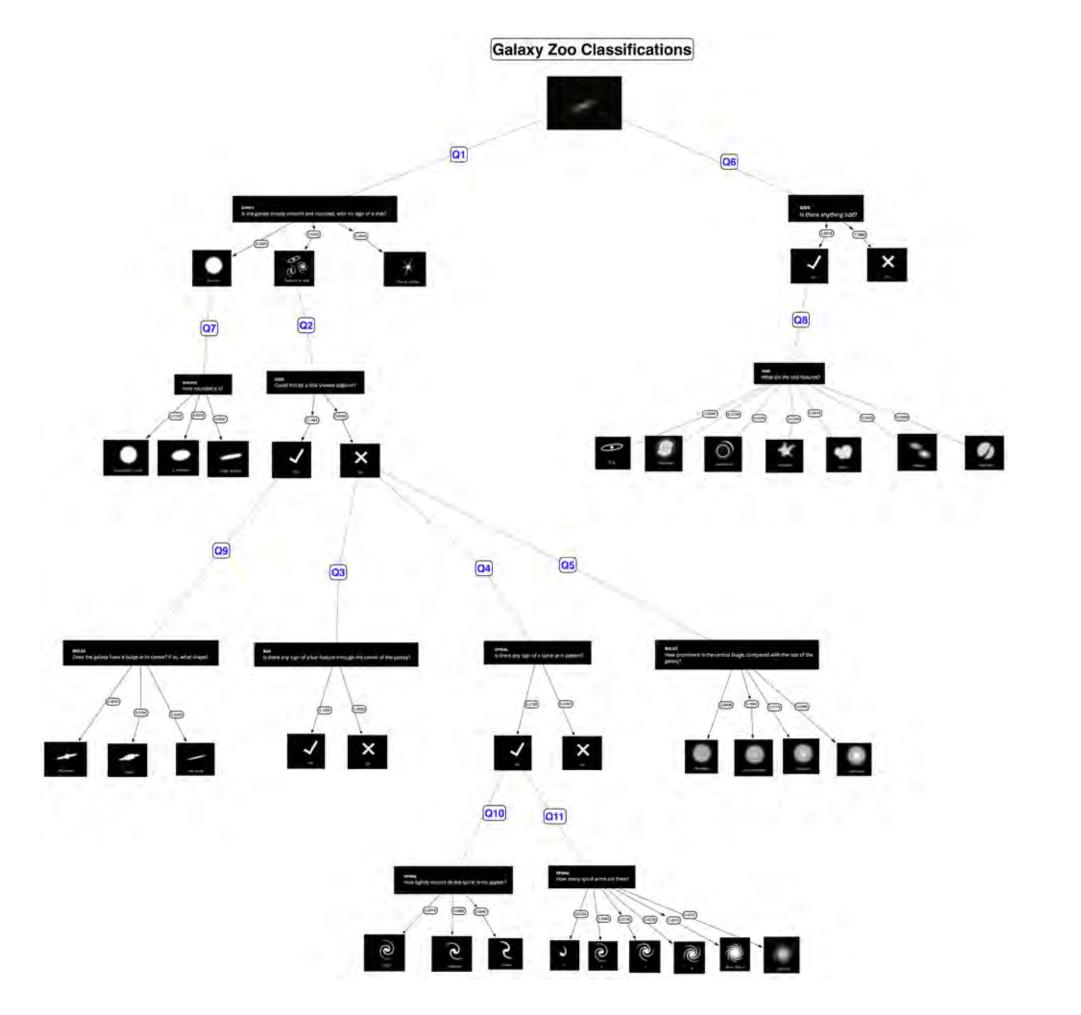


#### Galaxy Data

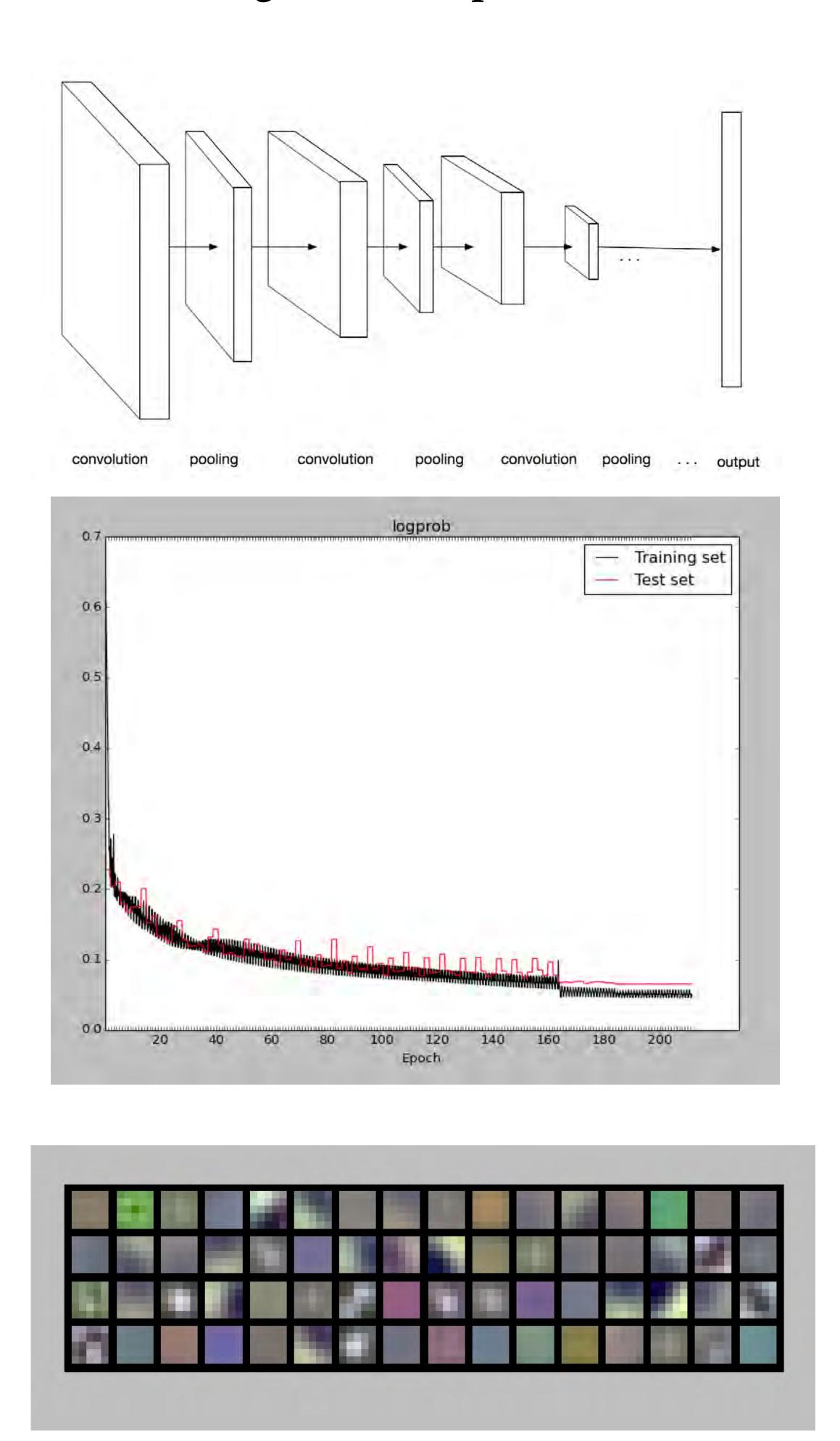


GalaxyID	Class1.1	Class 1.2	Class1.3	Class2.1	Class2.2	Class3.1	Class3.2	Class4.1	Class4.2	Class5,1	Class5.2	Class5.3	Class5.4	Class6.1	Class6.2	Class7.1
100008	0.383147	0.616853	0	0	0.616853	0.03845215	0.57840085	0.41839782	0.19845518	0	0.10475213	0.51210087	0	0.054453	0.945547	0.20146252
100023	0.327001	0.663777	0.009222	0.03117827	0.63259873	0.46736964	0.1652291	0.59132799	0.04127074	0	0.23678107	0.16094071	0.23487695	0.189149	0.810851	0
100053	0.765717	0.177352	0.056931	0	0.177352	0	0.177352	0	0.177352	0	0.11778975	0.05956225	0	0	1	0
100078	0.693377	0.238564	0.068059	0	0.238564	0.10949348	0.12907052	0.18909823	0.04946577	0	0	0.11328402	0.12527998	0.320398	0.679602	0.40859944
100090	0.933839	0	0.066161	0	0	0	0	0	0	0	0	0	0	0.029383	0.970617	0.49458728
100122	0.738832	0.238159	0.023009	0	0.238159	0	0.238159	0	0.238159	0	0	0.238159	0	0.19793	0.80207	0.06680667
100123	0.462492	0.456033	0.081475	0	0.456033	0	0.456033	0	0.456033	0	0	0.456033	0	0.687647	0.312353	0.38815751
100128	0.687783	0.288344	0.023873	0	0.288344	0.06909818	0.21924582	0	0.288344	0.06722827	0.12362461	0.02783558	0.06965555	0.473888	0.526112	0.48248253
100134	0.021834	0.976952	0.001214	0.02175086	0.95520114	0.31307673	0.64212442	0.54649063	0.40871051	0.16009649	0.7606878	0.03441685	0	0.611499	0.388501	0.010917
100143	0.269843	0.730157	0	0.730157	0	0	0	0	0	0	0	0	0	0.410635	0.589365	0
100150	0.429378	0.524901	0.045721	0	0.524901	0	0.524901	0	0.524901	0	0.13939009	0.22652733	0.15898359	0.037499	0.962501	0.09101654
100157	0.330462	0.669145	3.93E-04	0	0.669145	0.06001495	0.60913005	0.32399466	0.34515034	0.03297814	0.46537228	0.0978919	0.07290335	0.129321	0.870679	0.2568278
100187	0.448521	0.551479	0	0	0.551479	0.39538949	0.15608951	0.24989775	0.30158125	0	0.23214895	0.31933006	0	0.252285	0.747715	0.39001906
100204	0.467625	0.53148	8.95E-04	0	0.53148	0	0.53148	0.03604338	0.49543662	0.11845254	0.41302746	0	0	0.084531	0.915469	0
100237	0.164391	0,800759	0.03485	0.03079479	0.76996421	0.14903658	0.62092763	0.38774166	0.38222255	0.04905519	0.60938279	0.11152701	0	0.132726	0.867274	0
100259	0.338597	0.661403	0	0	0.661403	0.07350105	0.58790195	0.29984308	0.36155992	0	0	0.58123831	0.08016469	0.439053	0.560947	0.22384275
100263	0.179654	0.81853	0.001816	0.57379117	0.24473883	0.04732564	0.1974132	0.01662291	0.22811593	0.07109761	0.06740719	0.10623379	0	0.913055	0.086945	0
100288	0.64558	0.308559	0.045861				0.308559				0.05801218					0.10257298
100295	0.742621	0.191321		0	0.191321	0.07869626	0.11262474	0	0.191321	0	0	0.191321	0	0.382008	0.617992	0
100322	0.091987	0.908013	0	0.81680582	0.09120718	0	0.09120718	0	0.09120718	0.04466854	0	0	0.04653865	0	1	0
100335	0.165002	0.834998	0	0.23532498	0.59967302	0.14867393	0.45099909	0.37822577	0.22144725	0.30109342	0.13967164	0,15890795	0	0.313408	0.686592	0
100367	0.471429	0.512708	0.015863	0.02866192	0.48404609	0.21702061	0.26702548	0.26579648	0.2182496	0.12830271	0.12189055	0.15652163	0.0773312	0.43058	0.56942	0.0263378
100380	0.03	0.97	0	0.04365	0.92635	0.463175	0.463175	0.92635	0	0	0.5724843	0.32700155	0.02686415	0.101	0.899	0
100382	0.256861	0.74281	3.29E-04	0	0.74281	0.07798614	0.66482386	0.41290357	0.32990643	0.03983467	0.39794709	0.25778478	0.04724272	0.23701	0.76299	0.03246723
100383	0.3053	0.681721	0.012979	0.03613121	0.64558979	0.37765647	0.26793332	0.44360217	0.20198761	0	0.03053123	0.45047577	0.16458279	0.330713	0.669287	0.18290981

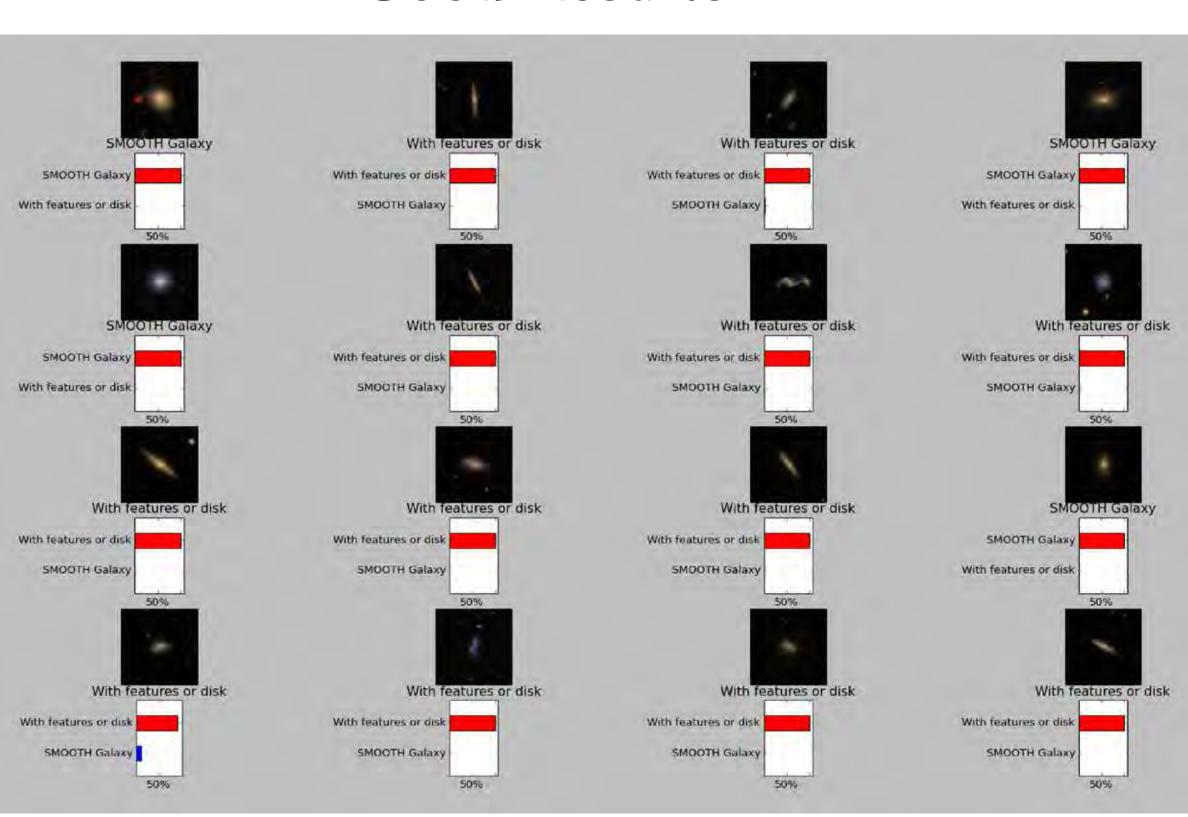
### Galaxy Classes



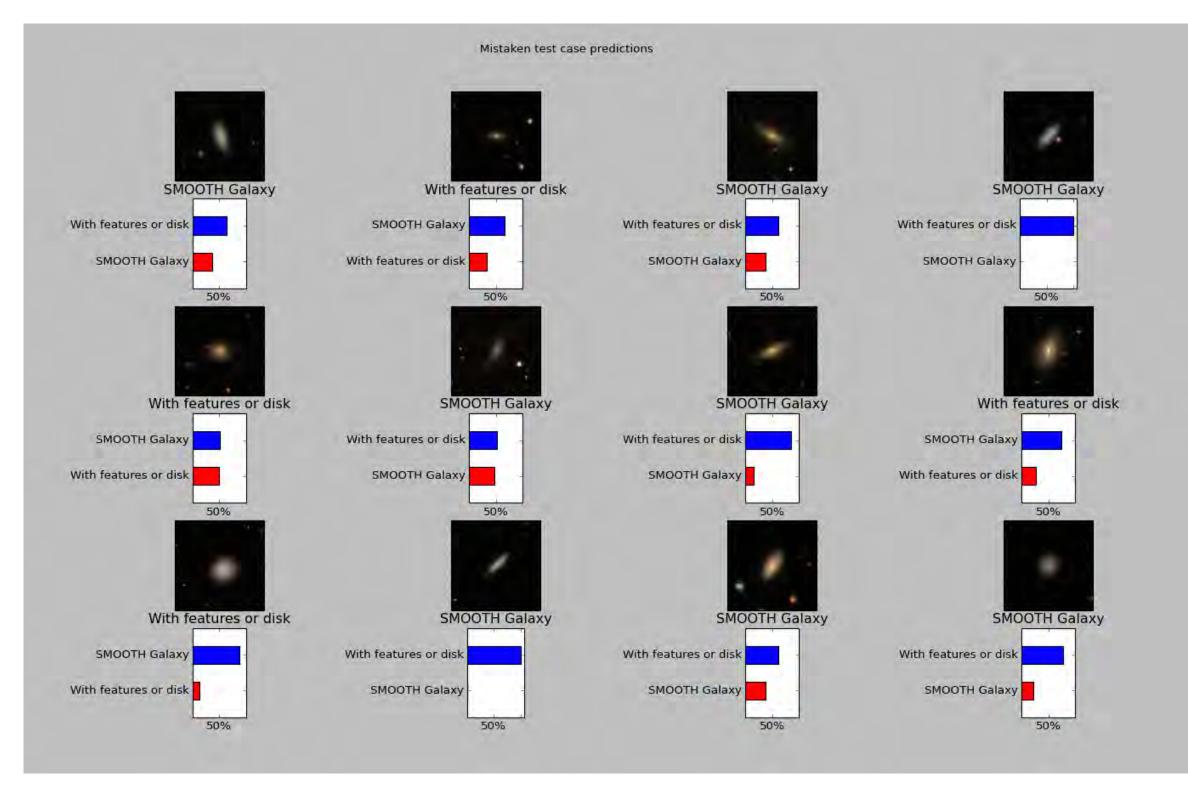
### Training with Deep CNN



#### **Good Results**



### Not-so-good Results?



## Just Intelligent like Human?

TEST P	TEST with learning from [0.5,1.0] 0.163	TEST with learning from [0.8,1.0], 0.023	TEST with learning from [0.5,0.6] 0.405	TEST with learning from [0.9,1.0] 0.024
0.5-0.6	0.40	0.39	0.415	0.410
0.6-0.7	0.25	0.20	0.290	0.261
0.7-0.8	0.13	0.10	0.180	0.136
0.8-0.9	0.06	0.025	0.122	0.060
0.9-1.0	0.03	0.008	0.090	0.012