1A

$H_{total} = 2.524$

Hair
- $D_F = 2.601$
- $D_T = 0.631$
- $H = 1.760$
- $IG = 0.763$

Feathers
- $D_F = 2.222$
- $D_T = 0.286$
- $H = 1.838$
- $IG = 0.686$

Eggs
- $D_F = 2.550$
- $D_T = 0.165$
- $H = 1.582$
- $IG = 0.942$

Airborne
- $D_F = 2.271$
- $D_T = 1.492$
- $H = 2.086$
- $IG = 0.439$

Aquatic
- $D_F = 1.999$
- $D_T = 2.318$
- $H = 2.113$
- $IG = 0.411$

Predator
- $D_F = 2.331$
- $D_T = 2.484$
- $H = 2.416$
- $IG = 0.108$

Toothed
- $D_F = 1.980$
- $D_T = 1.500$
- $H = 1.690$
- $IG = 0.834$

Backbone
- $D_F = 1.382$
- $D_T = 1.997$
- $H = 1.888$
- $IG = 0.637$

Breathes
- $D_F = 1.165$
- $D_T = 2.081$
- $H = 1.891$
- $IG = 0.634$

Venomous
- $D_F = 2.388$
- $D_T = 2.5$
- $H = 2.397$
- $IG = 0.128$

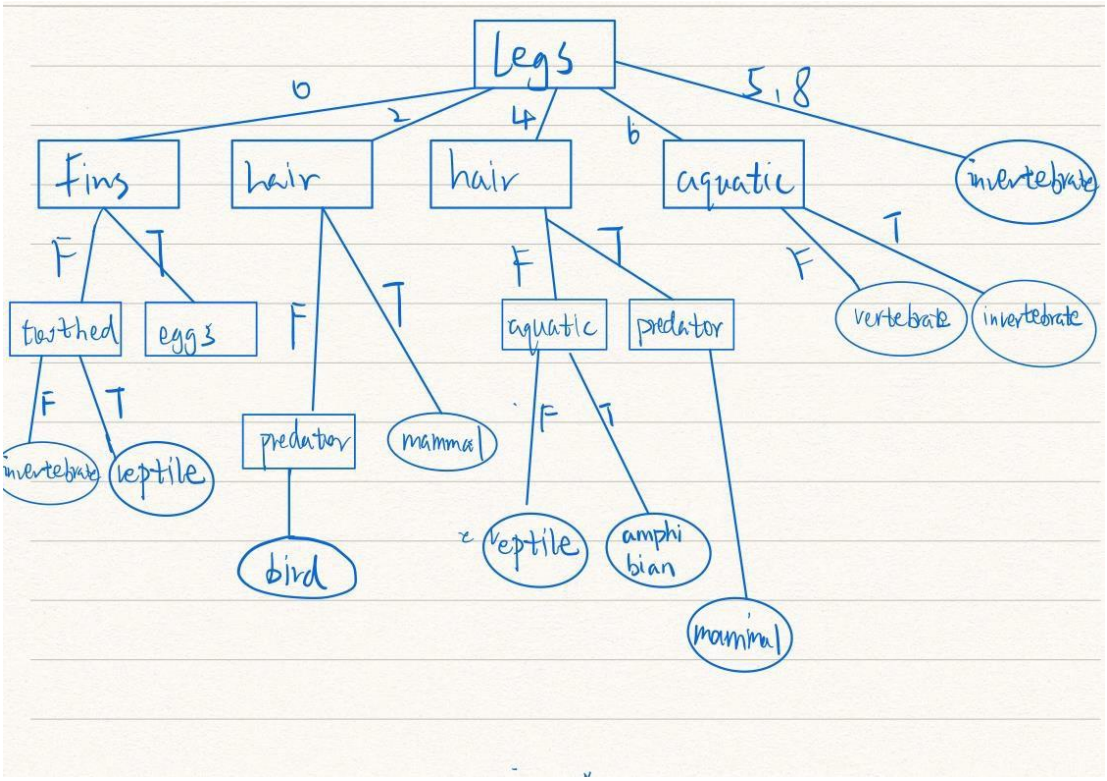
Fins
- $D_F = 2.313$
- $D_T = 0.787$
- $H = 2.056$
- $IG = 0.468$

Tail
- $D_F = 2.165$
- $D_T = 2.023$
- $H = 2.059$
- $IG = 0.465$

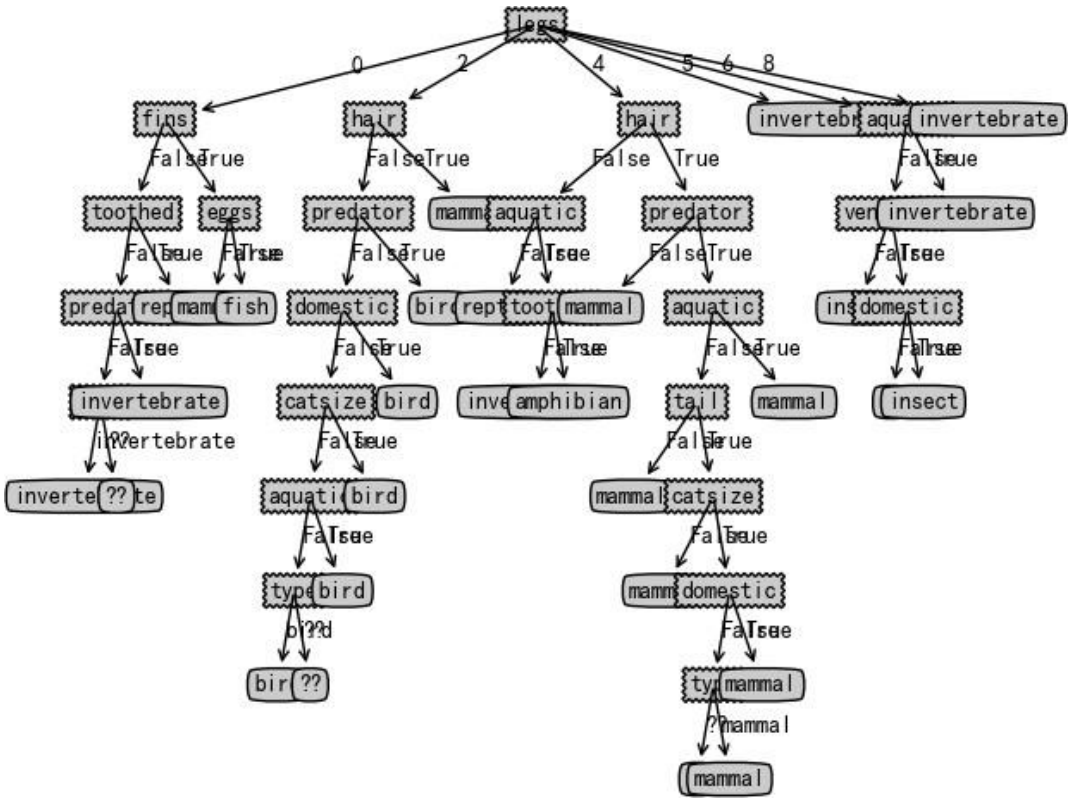
Domestic
- $D_F = 2.610$
- $D_T = 1.488$
- $H = 2.466$
- $IG = 0.058$

Catsize
- $D_F = 2.857$
- $D_T = 1.434$
- $H = 2.237$
- $IG = 0.287$

Legs
- $D_0 = 1.811$
- $D_2 = 1.037$
- $D_4 = 1.110$
- $D_5 = 0$
- $D_6 = 1.156$
- $D_8 = 0$
- $H = 1.222$
- $IG = 1.302$



1B: Program output



ID3desicionTree:

{'legs': {0: {'fins': {False: {'toothed': {False: {'predator': {False: {'type': {'invertebrate': 'invertebrate', '??': '??'}}, True: 'invertebrate'}}, True: 'reptile'}}, True: {'eggs': {False: 'mammal', True: 'fish'}}}}, 2: {'hair': {False: {'predator': {False: {'domestic': {False: {'catsize': {False: {'aquatic': {False: {'type': {'??': '??', 'bird': 'bird'}}, True: 'bird'}}, True: 'bird'}}, True: 'bird'}}, True: 'mammal'}}, 4: {'hair': {False: {'aquatic': {False: 'reptile', True: {'toothed': {False: 'invertebrate', True: 'amphibian'}}}}, True: {'predator': {False: 'mammal', True: {'aquatic': {False: {'tail': {False: 'mammal', True: {'catsize': {False: 'mammal', True: {'domestic': {False: {'type': {'??': '??', 'mammal': 'mammal'}}, True: 'mammal'}}}}}}}, True: 'mammal'}}}}}, 5: 'invertebrate', 6: {'aquatic': {False: {'venomous': {False: 'insect', True: {'domestic': {False: '??', True: 'insect'}}}}, True: 'invertebrate'}}, 8: 'invertebrate'}}

1C

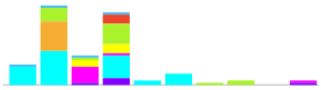
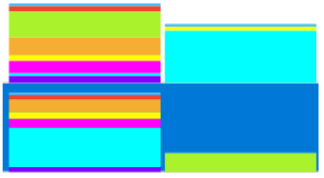
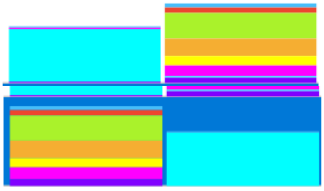
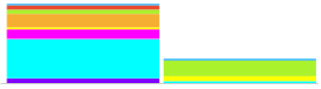
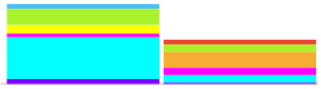
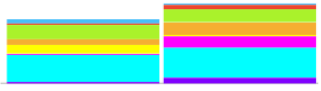
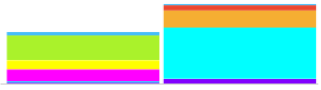
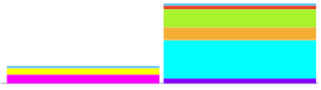
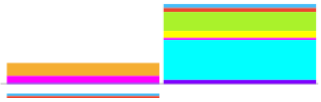
The CN2 algorithm combines the efficiency of the ID3 algorithm for data processing and the ability to process noisy data, as well as the flexibility of the AQ algorithm family. Through improvement, the dependence on specific data is removed, and through statistical analogy, it can reach and use the algorithm of the pruning method. The same effect. CN2 uses a heuristic method based on noise estimation to terminate its search process. Using this method can eliminate the need to correctly distinguish all training samples, but the rules out of the statute have a good performance in the processing of new data.

Evaluation Results

Model	AUC	CA	F1	Precision	Recall
CN2 rule inducer	0.949	0.911	0.897	0.899	0.911

Predicted

Actual	??	amphibian	bird	fish	insect	invertebrate	mammal	reptile	Σ
??	0	0	1	0	1	1	1	0	4
amphibian	0	4	0	0	0	0	0	0	4
bird	0	0	19	0	0	0	0	0	19
fish	0	0	0	13	0	0	0	0	13
insect	0	0	0	0	7	0	0	0	7
invertebrate	1	0	0	0	1	7	0	0	9
mammal	0	0	0	0	0	0	40	0	40
reptile	1	0	0	0	0	2	0	2	5
Σ	2	4	20	13	9	10	41	2	101

Name	Distribution	Mean	Median	Dispersion	Min.	Max.	Missing
N 14. legs		2.84	4	0.71	0	8	0 (0%)
N CN2 rule inducer (??)		0.0823747	0.0769231	0.494976	0.0243902	0.222222	0 (0%)
N CN2 rule inducer (amphibian)		0.0818645	0.0769231	0.69571	0.0243902	0.363636	0 (0%)
N CN2 rule inducer (bird)		0.146206	0.0769231	1.15411	0.0243902	0.666667	0 (0%)
N CN2 rule inducer (fish)		0.139413	0.0833333	1.23018	0.0243902	0.65	0 (0%)
N CN2 rule inducer (insect)		0.0964367	0.0769231	0.948311	0.0243902	0.461538	0 (0%)
N CN2 rule inducer (invertebra...		0.106474	0.0769231	1.06382	0.0243902	0.5	0 (0%)
N CN2 rule inducer (mammal)		0.270767	0.1	0.987539	0.047619	0.829268	0 (0%)
N CN2 rule inducer (reptile)		0.076464	0.0769231	0.53027	0.0243902	0.3	0 (0%)
C 2. hair			False	0.682			0 (0%)
C 3. feathers			False	0.498			0 (0%)
C 4. eggs			True	0.679			0 (0%)
C 5. milk			False	0.675			0 (0%)
C 6. airborne			False	0.548			0 (0%)
C 7. aquatic			False	0.651			0 (0%)
C 8. predator			True	0.687			0 (0%)
C 9. toothed			True	0.671			0 (0%)
C 10. backbone			True	0.469			0 (0%)
C 11. breathes			True	0.511			0 (0%)

12. venomous	False	0.277	0 (0%)
13. fins	False	0.453	0 (0%)
15. tail	True	0.57	0 (0%)
16. domestic	False	0.384	0 (0%)
17. catsize	False	0.685	0 (0%)
18. type	mammal	1.75	0 (0%)
CN2 rule inducer	mammal	1.68	0 (0%)
Fold	1	1.61	0 (0%)