CNAPs: Fast and Flexible Multi-Task Classification Using Conditional Neural Adaptive Processes

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UNIVERSITY OF CAMBRIDGE
INVENIA LABS
Google Research
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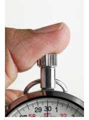
Training Images

Stop Watch

Digital Clock

Digital Watch

Parking Meter



Test Images

Training Images

CNAPs Predictions

Stop Watch


Digital Clock



Digital Watch


Wrist Computer Tells Time Without Hands

Parking Meter

0.69 ✓	0.02	0.07	0.24
0.04	0.13	0.11	0.32
0.27	0.85 ✗	0.80 ✓	0.35 ✗
0.00	0.01	0.02	0.10




Test Images

Training Images

CNAPs Predictions

Stop Watch


Digital Clock



Digital Watch


Wrist Computer Tells Time Without Hands

Parking Meter


0.63	0.02	0.04	0.11
0.04	0.09	0.13	0.11
0.29	0.70	0.61	0.24
0.04	0.19	0.22	0.54

Incorporate New Training Data




Test Images

Training Images

CNAPs Predictions

Stop Watch	0.63 ✓	0.02	0.04	0.11
Digital Clock	0.04	0.09	0.13	0.11
Digital Watch	0.29	0.70 ✗	0.61 ✓	0.24
Parking Meter	0.04	0.19	0.22	0.54 ✓




Test Images

Training Images

CNAPs Predictions

Stop Watch


Digital Clock



Digital Watch


Wrist Computer Tells Time Without Hands

Parking Meter


Sundial

Addition of Class

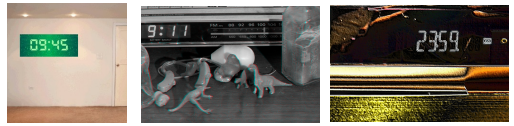




Test Images

Training Images

CNAPs Predictions

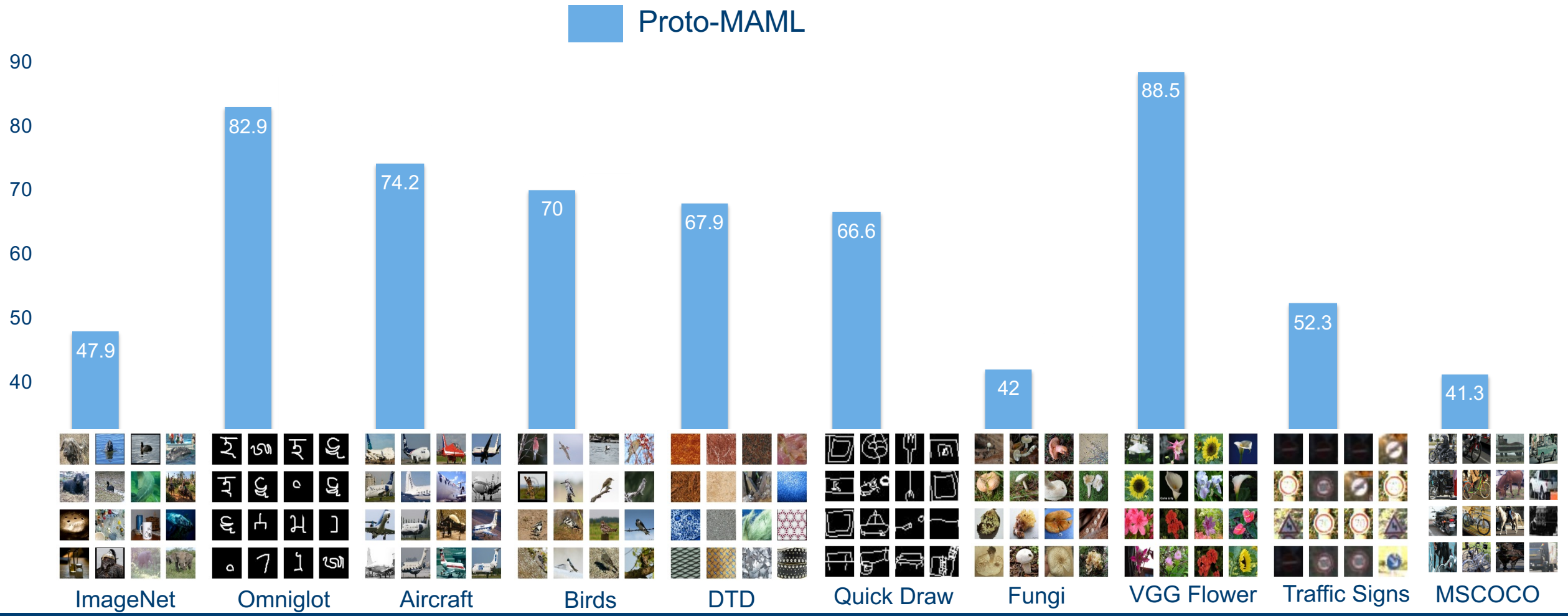
Stop Watch		**0.81** ✓	0.04	0.07	0.11	0.11
Digital Clock		0.01	0.12	0.09	0.12	0.16
Digital Watch		0.08	**0.68** ✗	**0.72** ✓	0.12	0.13
Parking Meter		0.02	0.16	0.12	**0.54** ✓	0.12
Sundial		0.07	0.00	0.00	0.12	**0.47** ✓

Test Images

State of the Art Results on Meta-dataset[1]

1. Triantafillou, Eleni, et al. ”Meta-dataset: A dataset of datasets for learning to learn from few examples.” arXiv preprint arXiv:1903.03096, 2019

State of the Art Results on Meta-dataset[1]



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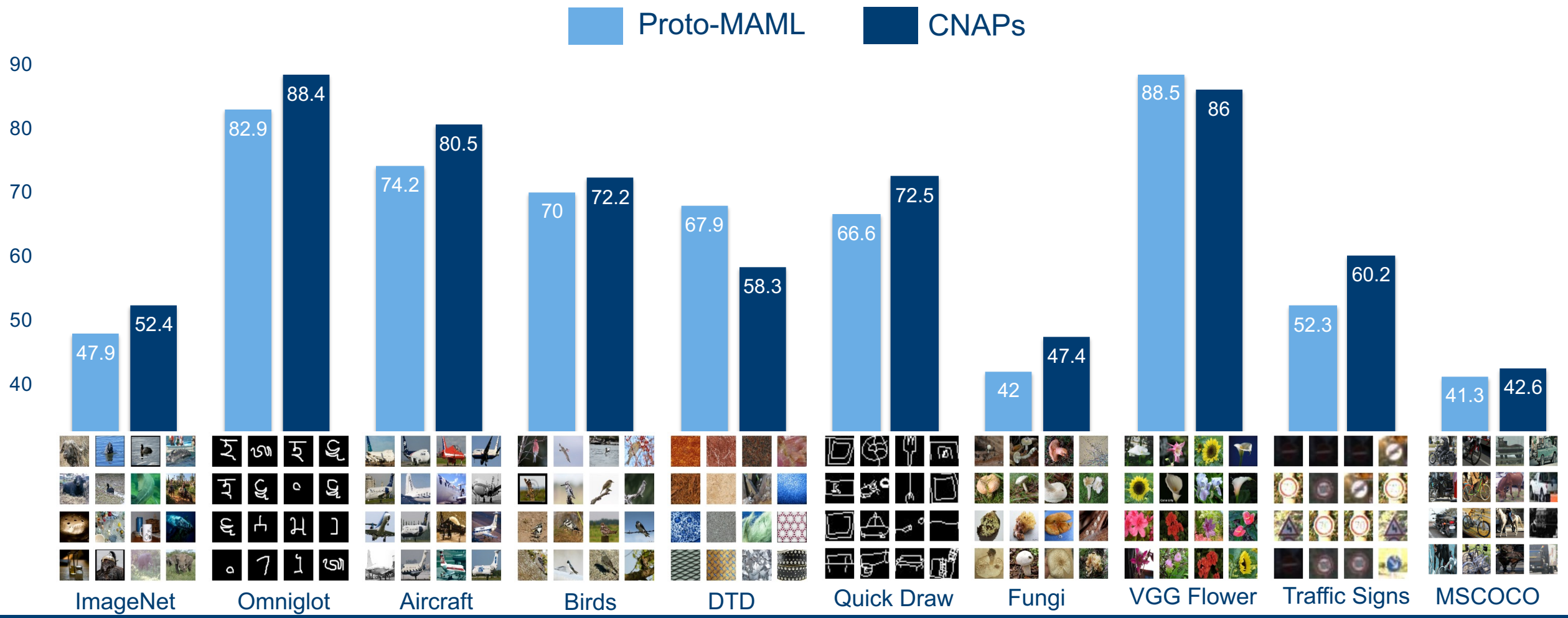
State of the Art Results on Meta-dataset[1]



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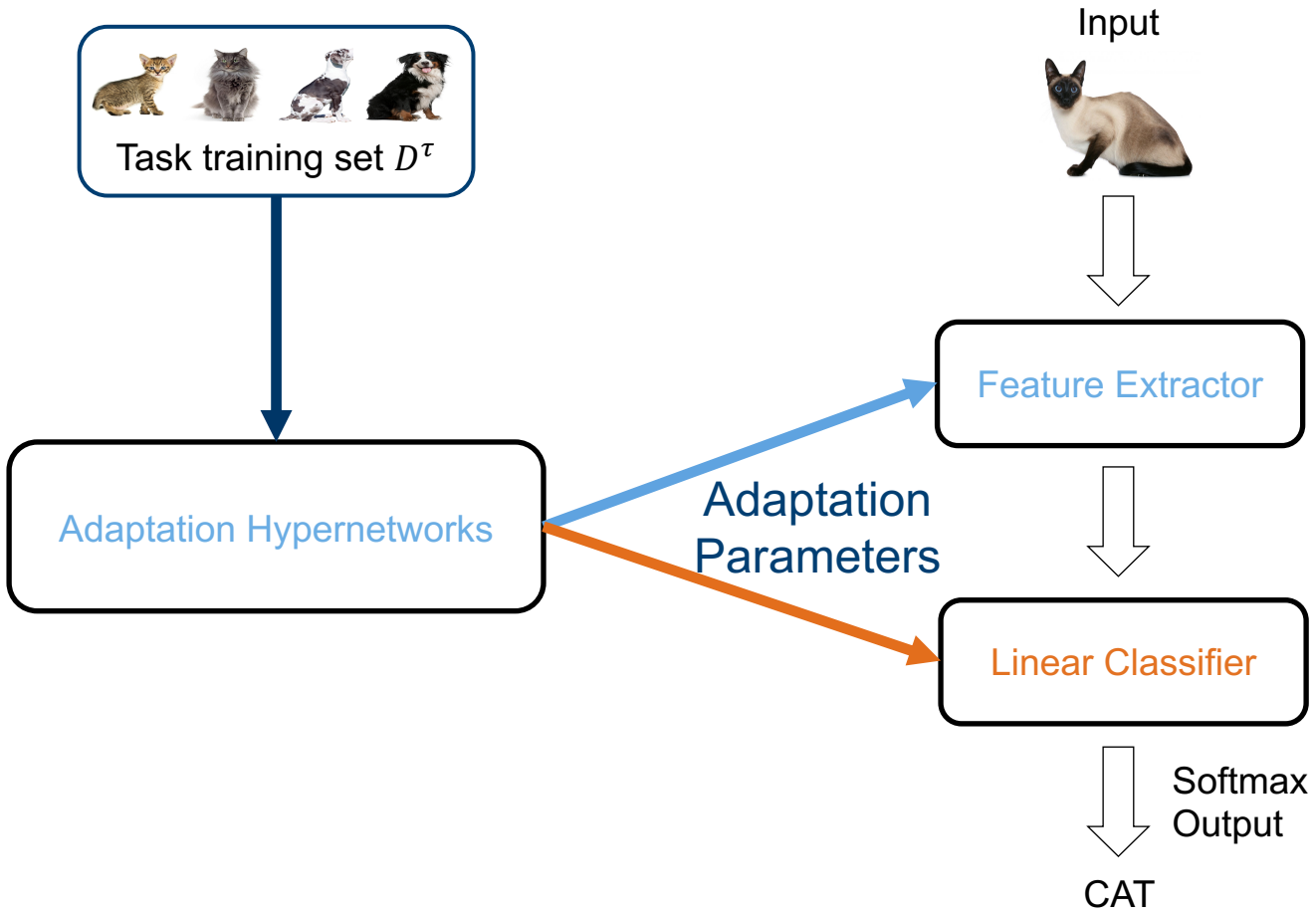
How did we do it?



- Small number of carefully selected adaptation parameters for efficiency and flexibility.
- FiLM^2 parameters adapt pre-trained feature extractor.
- Adaptation hypernetworks for robustness on small datasets.

2. Perez, Ethan, et al. ”Film: Visual reasoning with a general conditioning layer.” AAAI, 2018.

And there's more…

- Principled probabilistic approach based on **Conditional Neural Processes**[3]
- **Continual Learning** and **Active Learning** out of the box
- **Careful empirical comparison** to gradient based adaptation

3. Garnelo, Marta, et al. "Conditional neural processes." arXiv preprint arXiv:1807.01613, 2018.

Come to our poster!

Poster: Today 05:00 -- 07:00 PM @ East Exhibition Hall B + C #27

Paper: https://arxiv.org/abs/1906.07697

Code: https://github.com/cambridge-mlg/cnaps