



NEUROSCIENCE-INSPIRED AI

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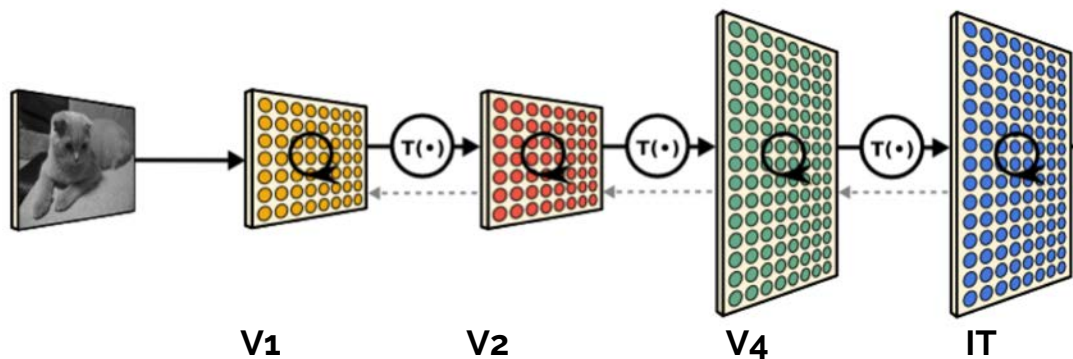
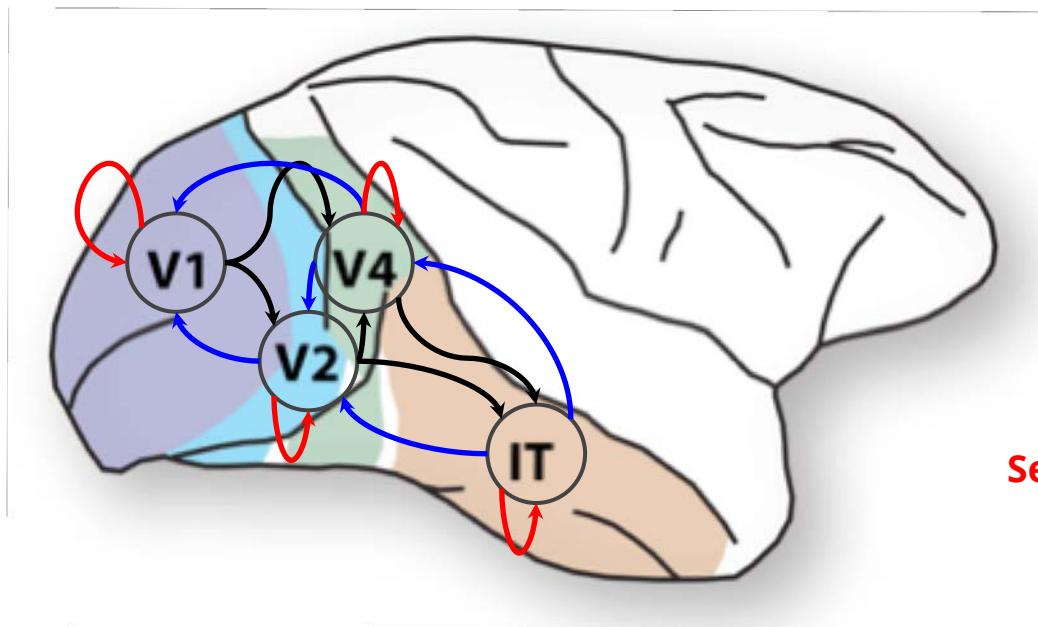


ANR-3IA Artificial and Natural Intelligence Toulouse Institute

Generalizing beyond training data: Primate vision



Feedforward and feedback mechanisms in cortex



Visual cortex builds “depth” dynamically through recurrent connections

VanRullen / Predictive coding theory

Top-down

Serre / Context and local interactions

Horizontal

Feedforward

To higher area

Neuroscience & AI

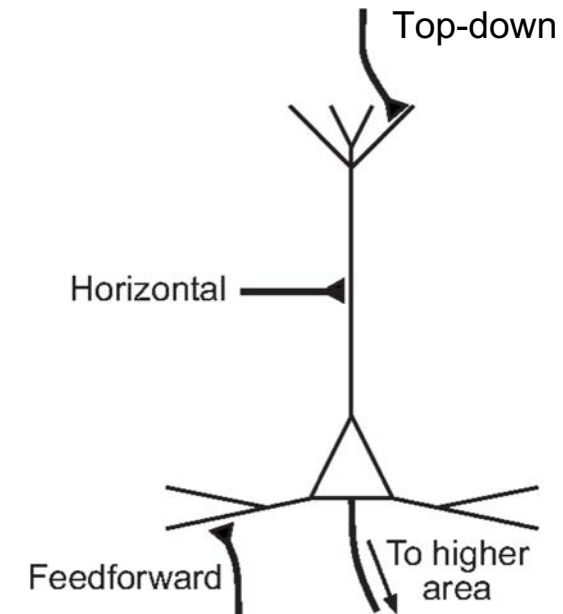
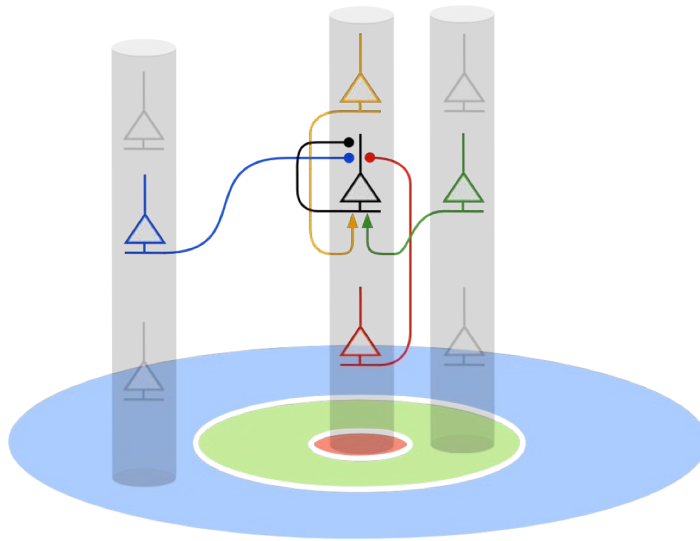
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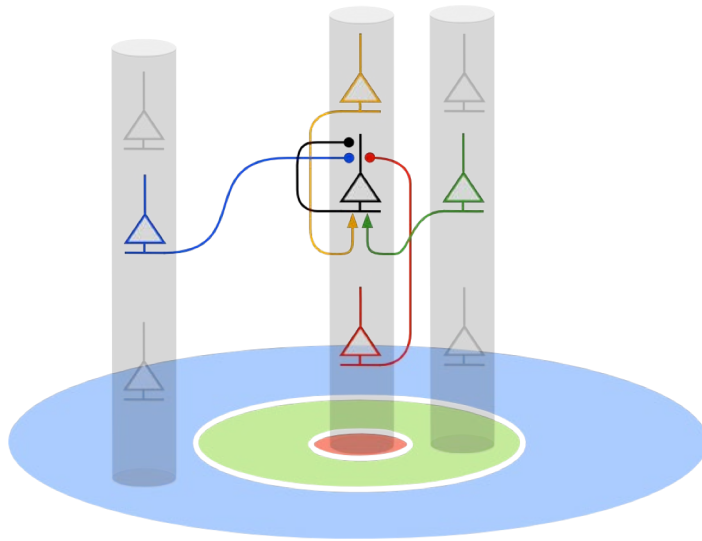
Université
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Midi-Pyrénées

Neuroscience-inspired RNNs

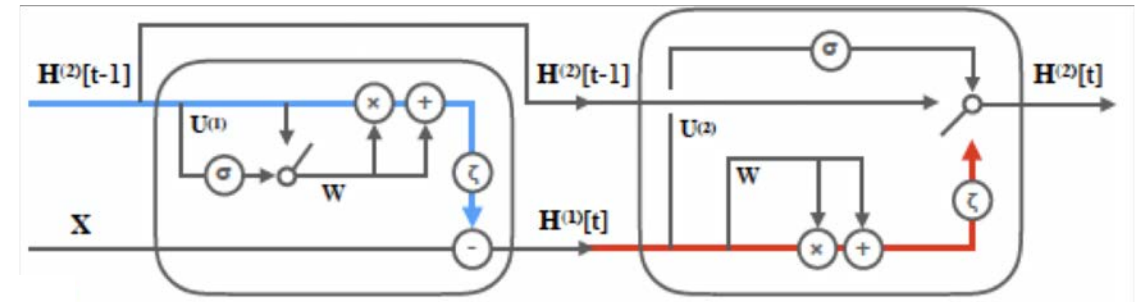
Visual cortex builds “depth” dynamically through recurrent connections



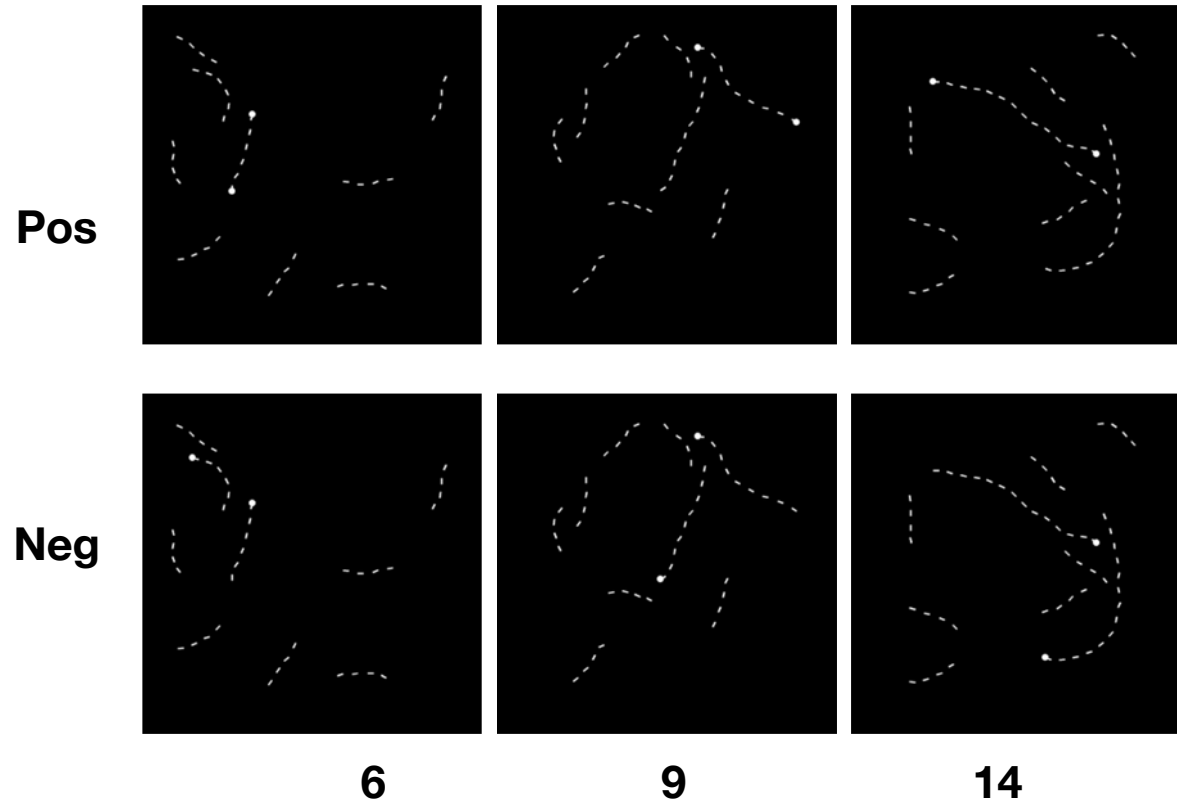
Neuroscience-inspired RNNs



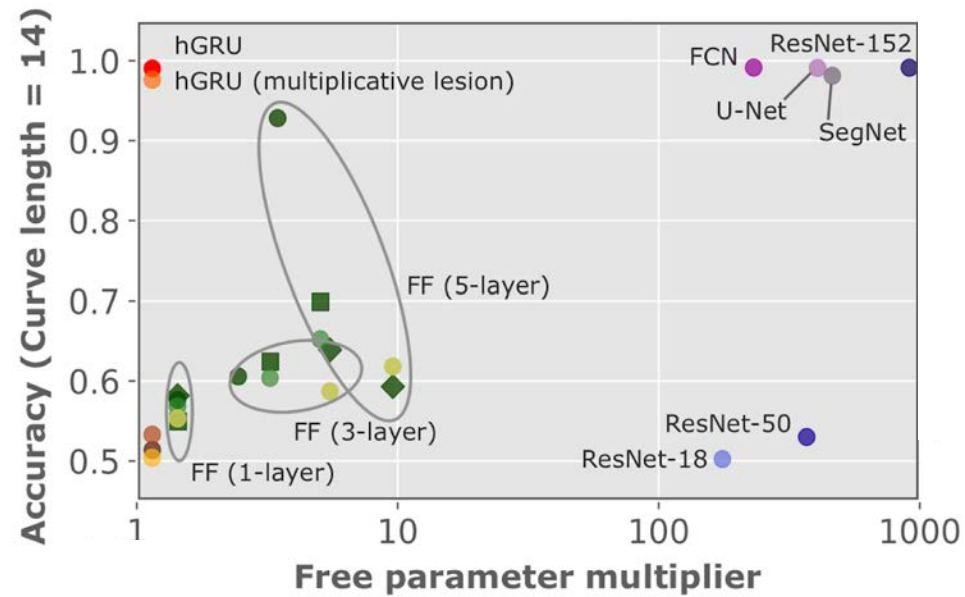
NeurIPS 2018; ICLR 2019; ICLR 2020;
NeurIPS 2020; NeurIPS 2021



The PathFinder task



The PathFinder task



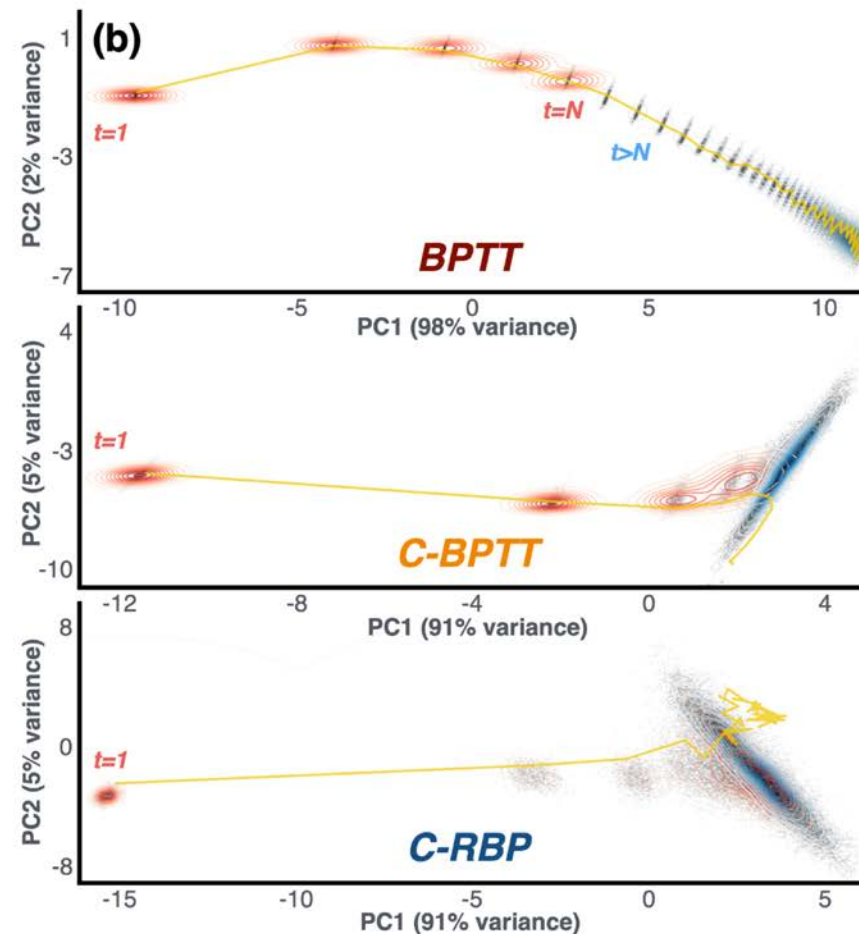
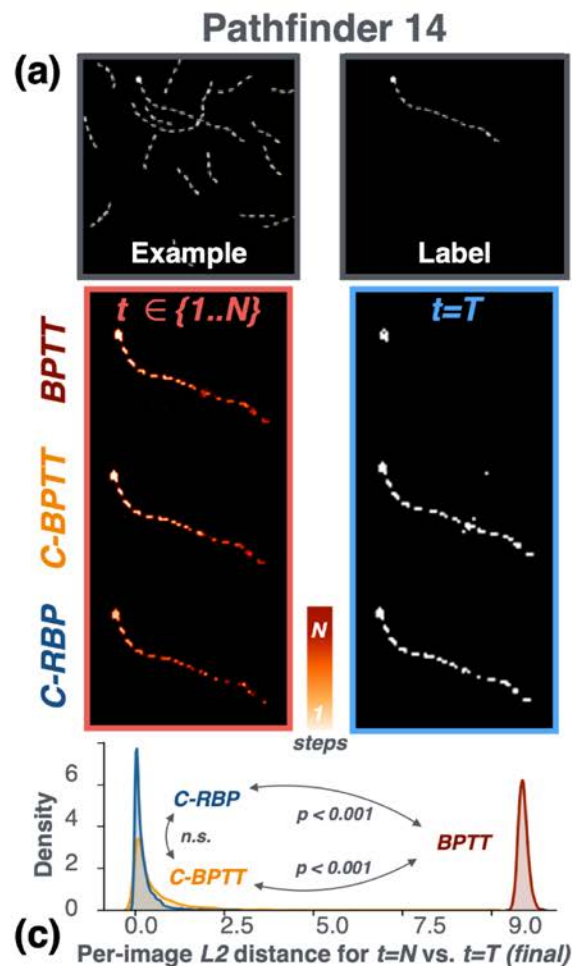
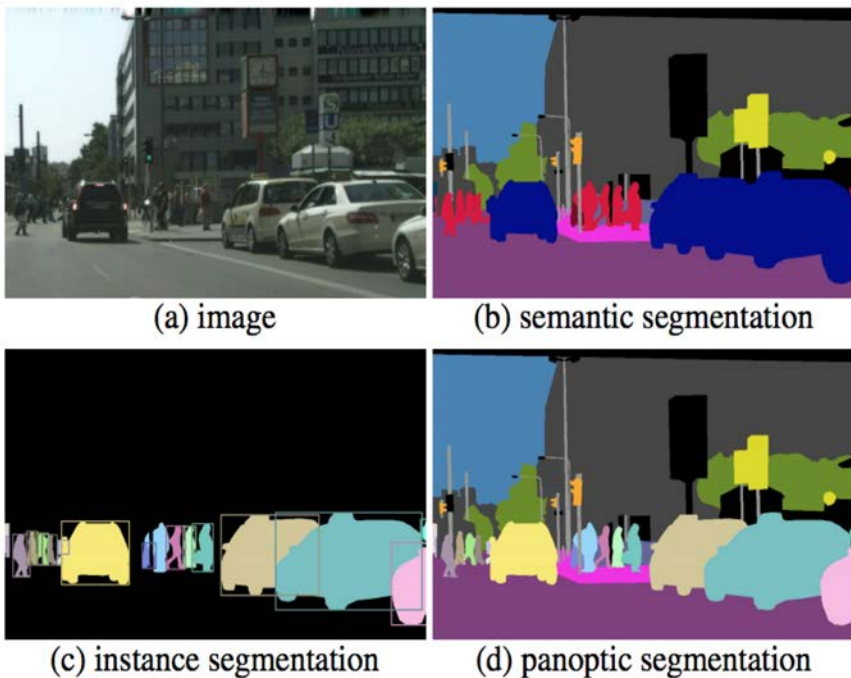
The PathFinder task

This is a low-res PathFinder (32x32)

Model	ListOps	Text	Retrieval	Image	Pathfinder	Path-X	Avg
Transformer	36.37	64.27	57.46	42.44	71.40	FAIL	<u>54.39</u>
Local Attention	15.82	52.98	53.39	41.46	66.63	FAIL	46.06
Sparse Trans.	17.07	63.58	59.59	44.24	71.71	FAIL	51.24
Longformer	35.63	62.85	56.89	42.22	69.71	FAIL	53.46
Linformer	35.70	53.94	52.27	38.56	<u>76.34</u>	FAIL	51.36
Reformer	37.27	56.10	53.40	38.07	68.50	FAIL	50.67
Sinkhorn Trans.	33.67	61.20	53.83	41.23	67.45	FAIL	51.39
Synthesizer	<u>36.99</u>	61.68	54.67	41.61	69.45	FAIL	52.88
BigBird	36.05	64.02	<u>59.29</u>	40.83	74.87	FAIL	55.01
Linear Trans.	16.13	65.90	53.09	42.34	75.30	FAIL	50.55
Performer	18.01	<u>65.40</u>	53.82	<u>42.77</u>	77.05	FAIL	51.41
Task Avg (Std)	29 (9.7)	61 (4.6)	55 (2.6)	41 (1.8)	72 (3.7)	FAIL	52 (2.4)

This is the real PathFinder (128x128)

Contrastive Recurrent backpropagation



Neuro-inspired RNNs



Video tracking

Circuit-TransT

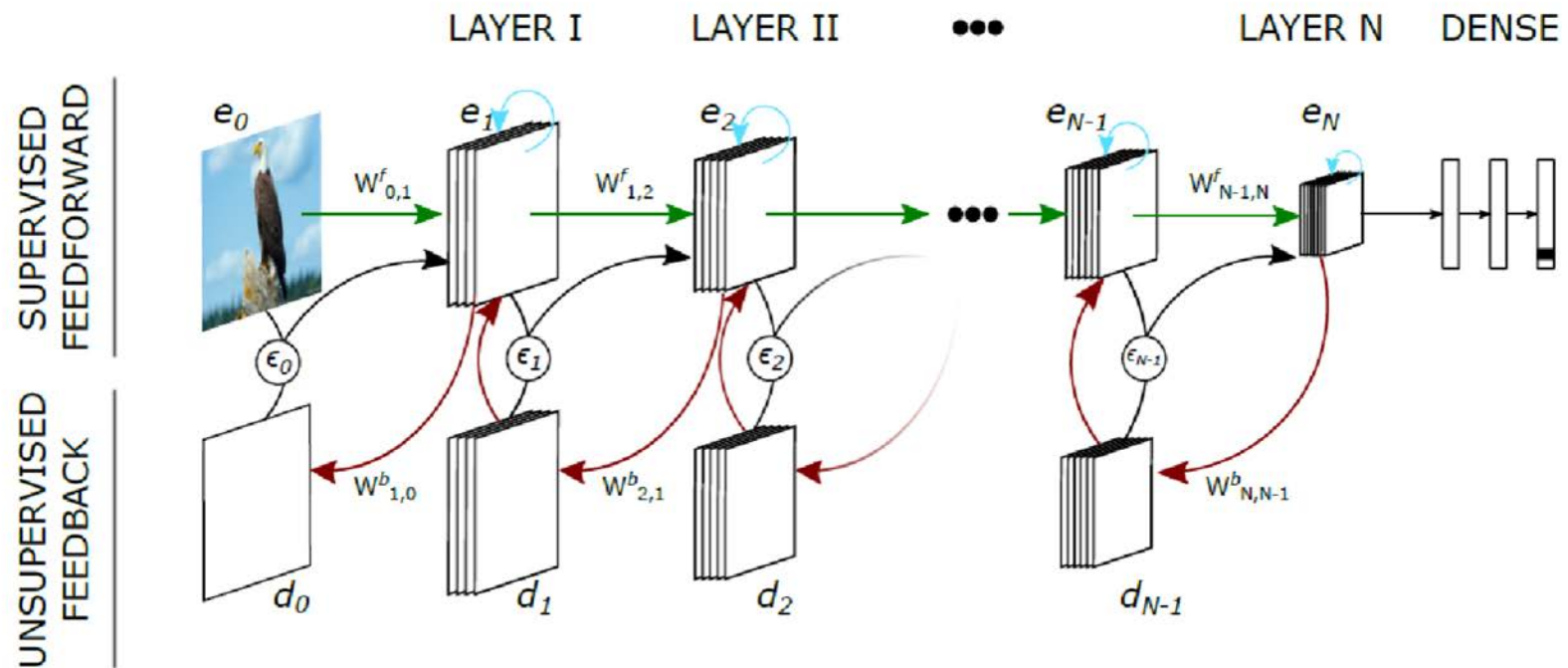


TransT



- #1 on TrackingNet
- Generalizes out-of-the-box to videos from BSDS

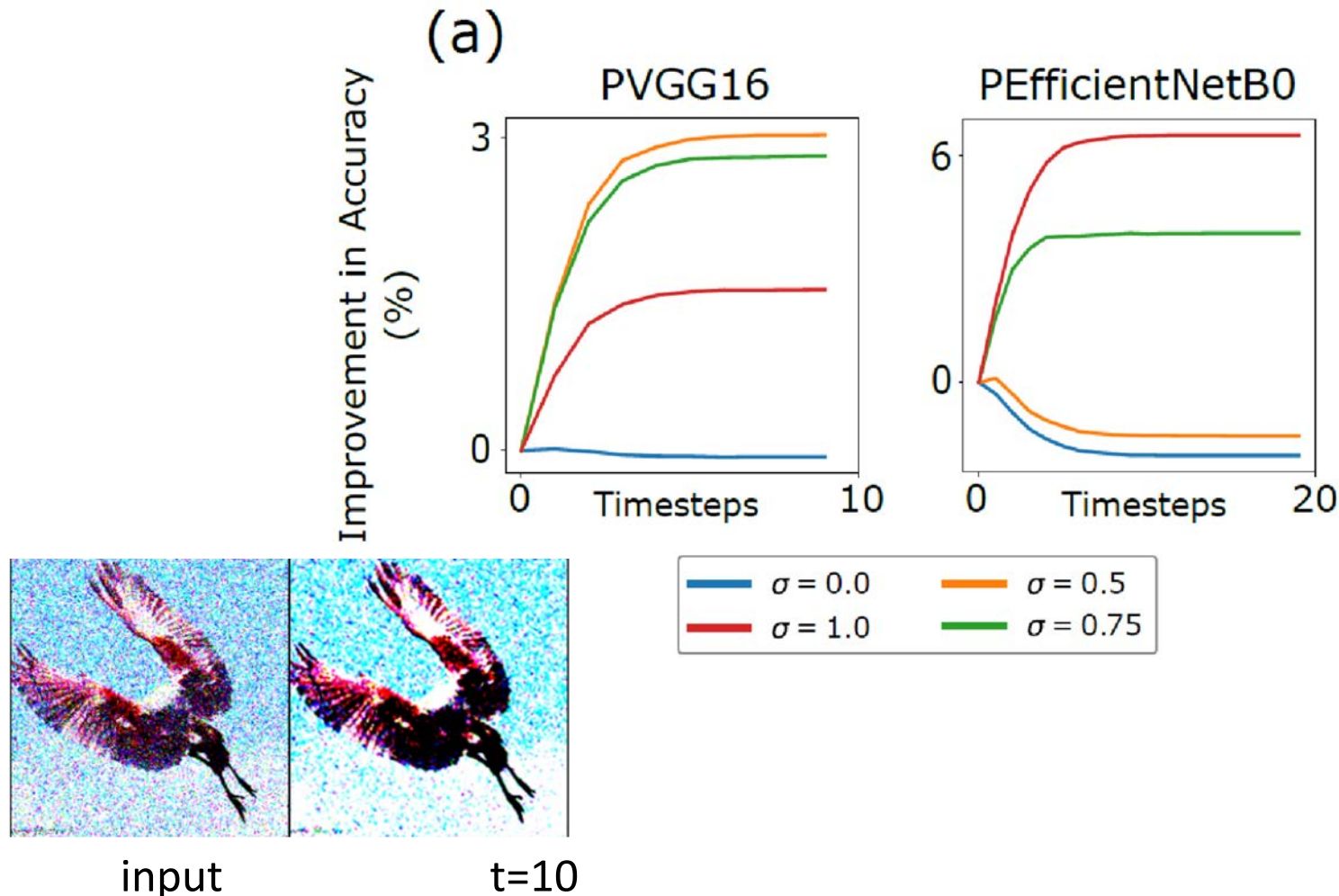
Predictive coding and top-down (feedback) connections



VanRullen chaire

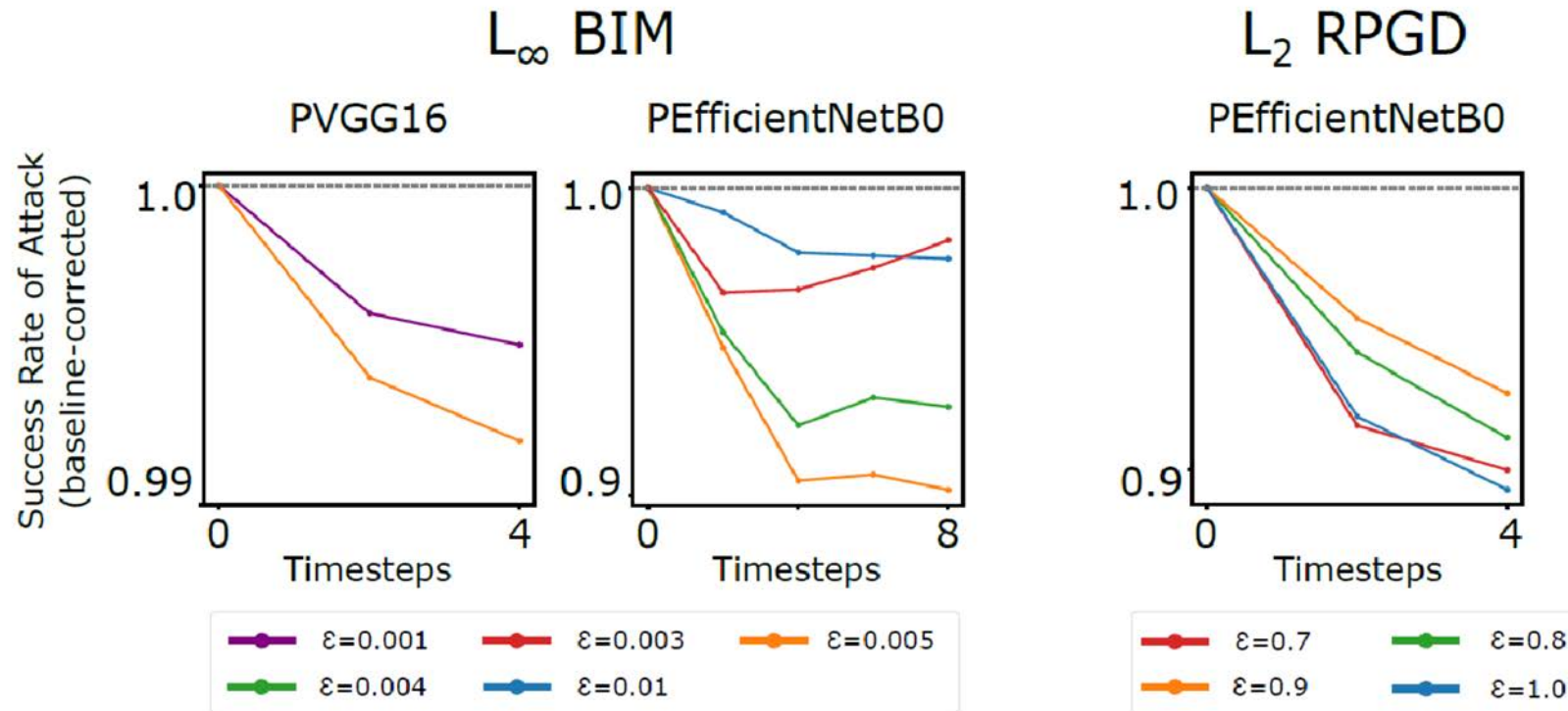
Predictive coding and top-down (feedback) connections

ImageNet accuracy:



Predictive coding and top-down (feedback) connections

Predictive coding iterations decrease the efficacy of attacks:



Predify software (for PyTorch):

<https://github.com/miladmozafari/predify>

Predified: VGG16, EfficientNetB0, ResNet18...