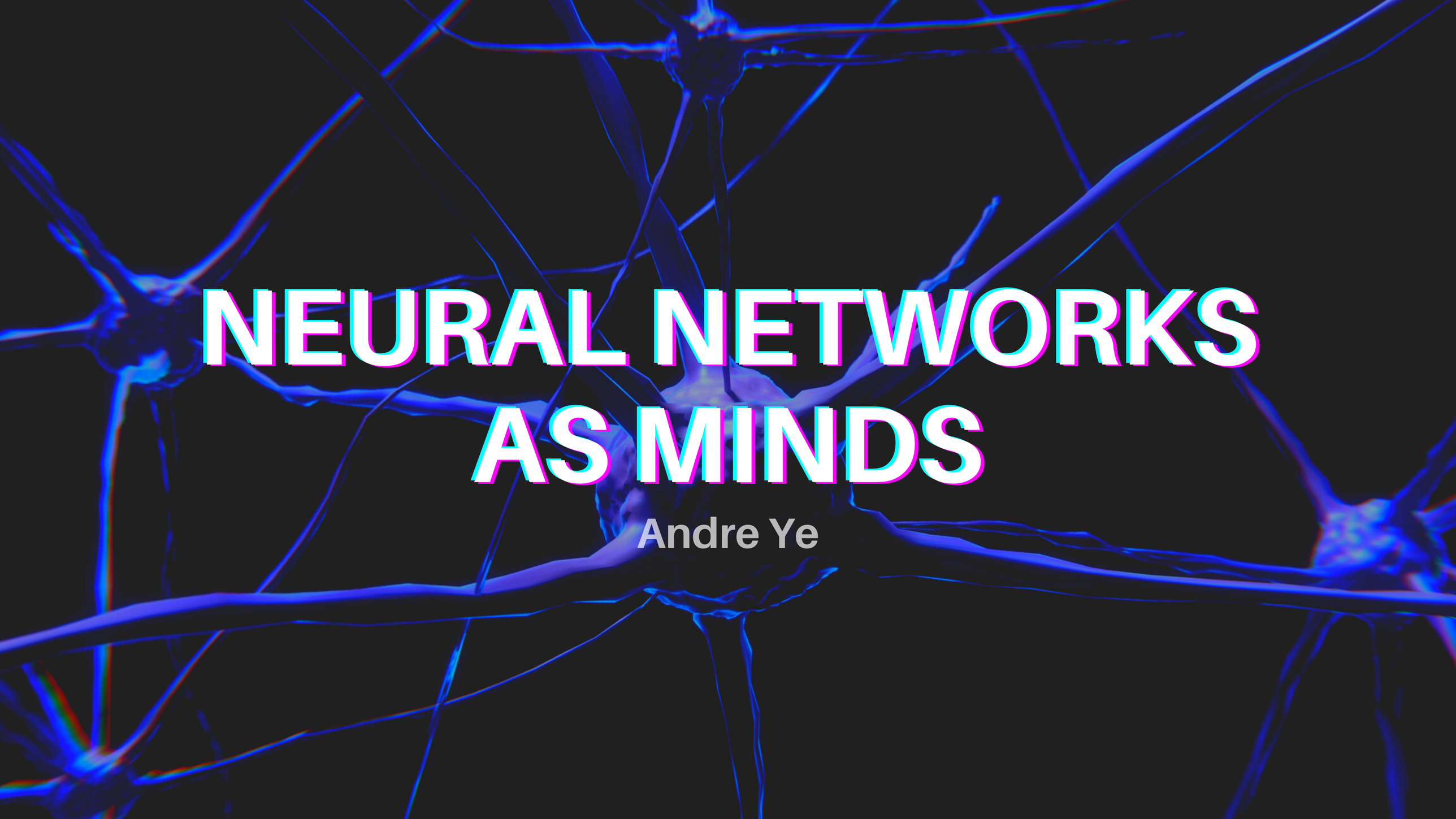

NEURAL NETWORKS
AS MINDS
Andre Ye

Agenda

To explore loose parallels between 9 deep learning research fields and traits of 'intelligence', starting from simple ideas to more complex ones

Objective

To inspire cross-disciplinary interest in neural network capability to exhibit "intelligent" behavior

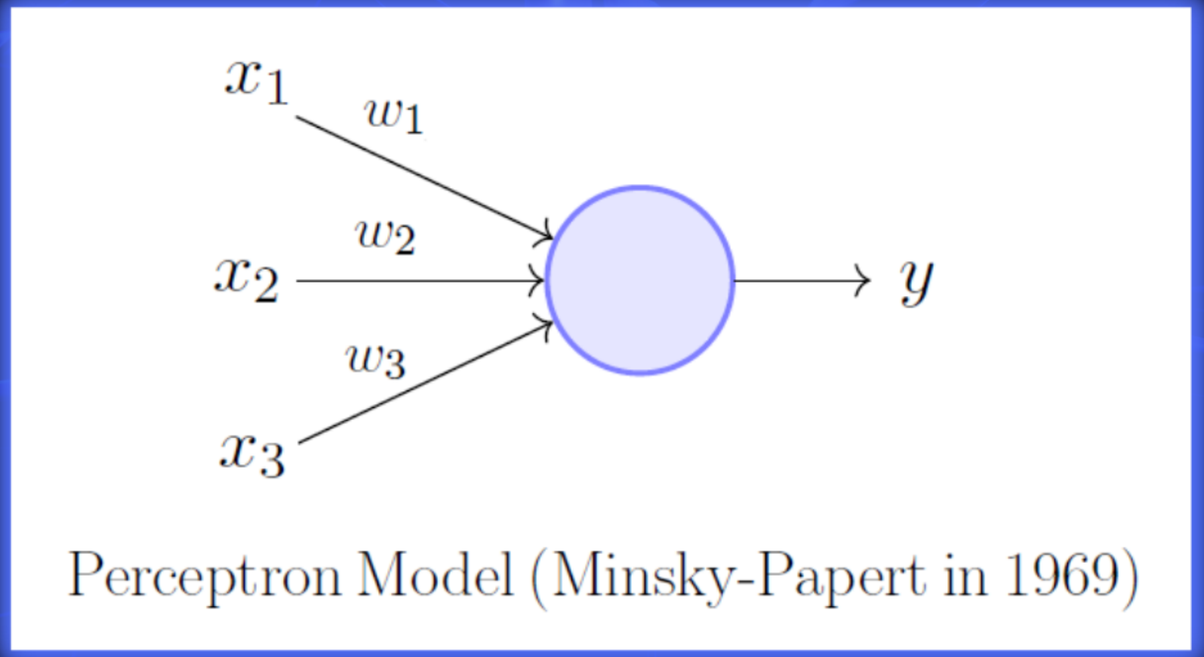
Quick Lingo Catch-Up

$$y = f(x)$$

The goal of supervised machine learning is to find a model *f* that produces a target/output/label *y* given an input *x* by learning from a dataset of *x*-*y* associations.

Perceptrons as Neurons

Perceptrons act as a unit of extraction. By stacking them together in intricate patterns, we can obtain sophisticated model output behavior.



Perceptron Model (Minsky-Papert in 1969)

Perceptrons as Neurons

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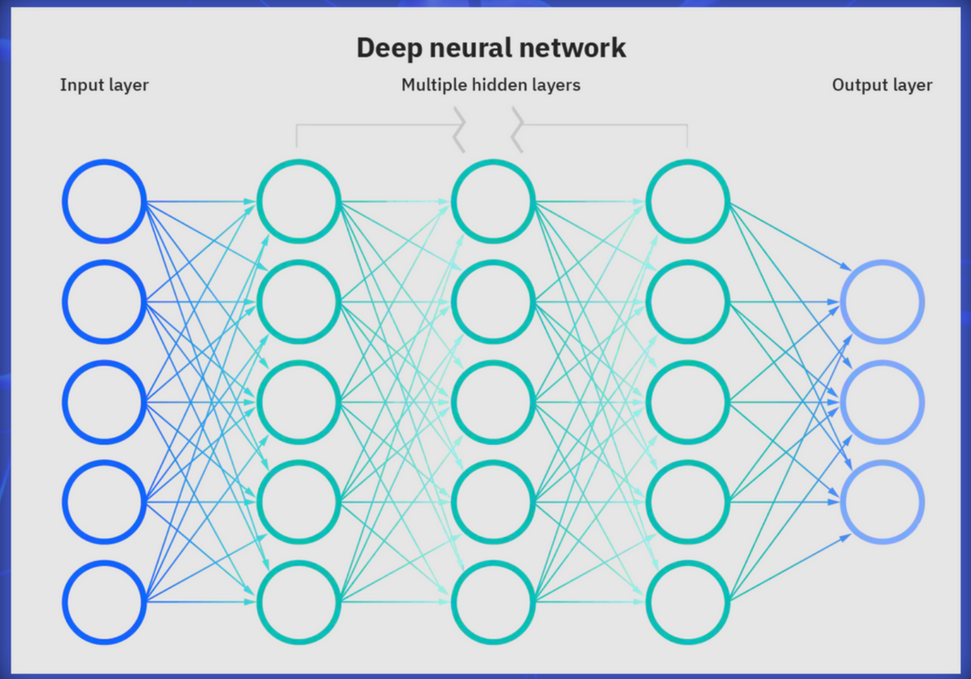
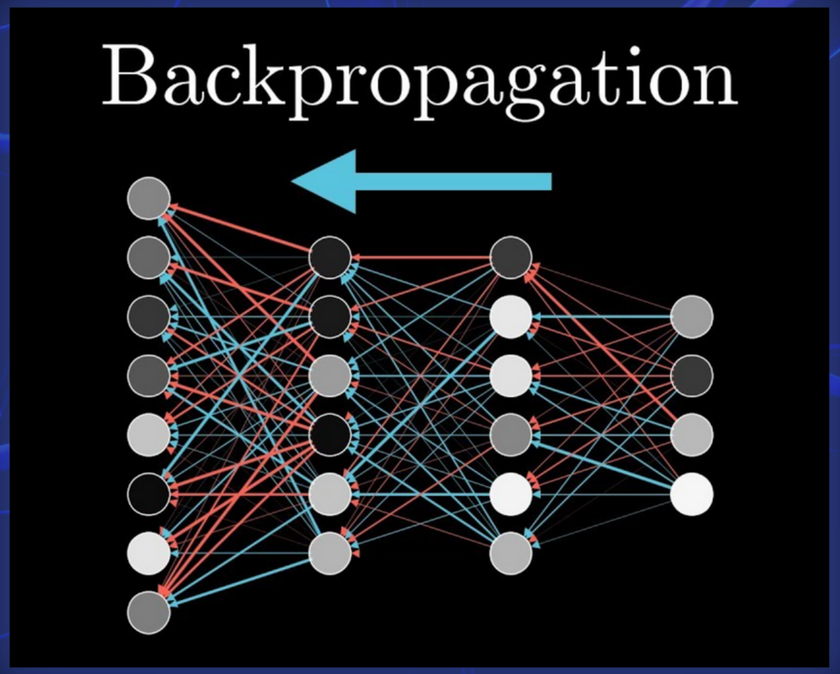


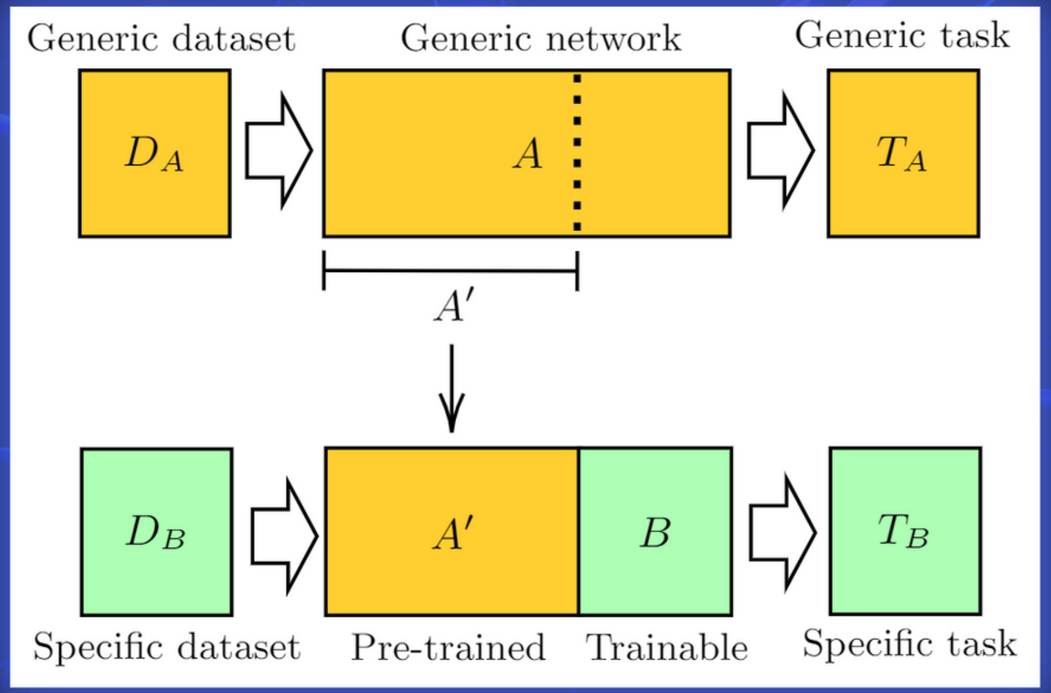
Backpropagation as Learning

Neural networks update internal weights with corresponding direction and magnitude in response to a feedback mechanism.



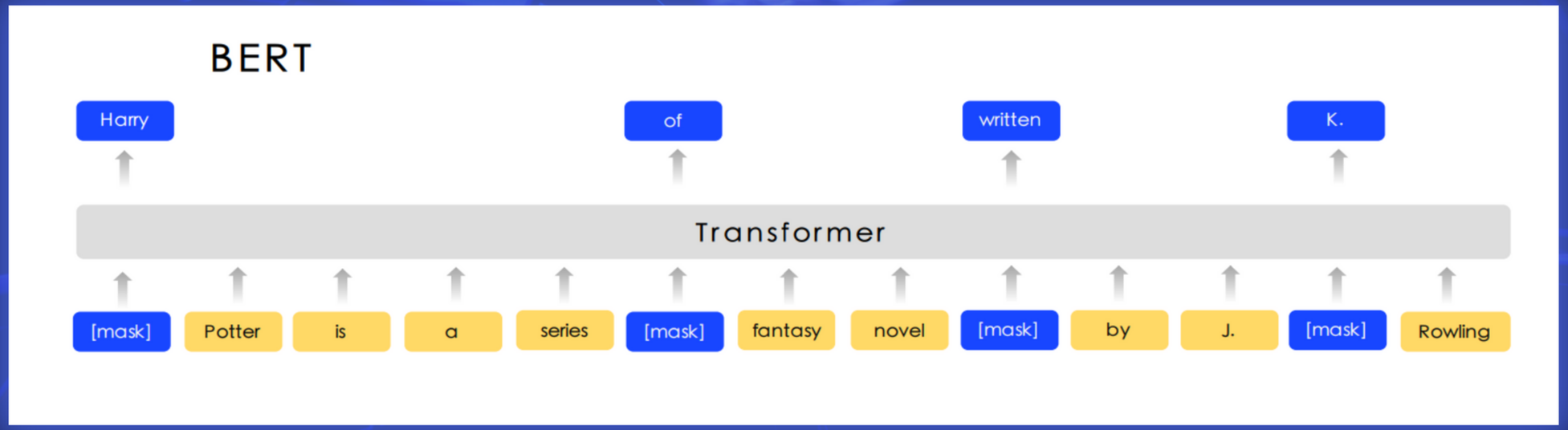
Transfer Learning as Skill Adaptation

Neural networks trained on one standard task can successfully be trained on another specialized task.

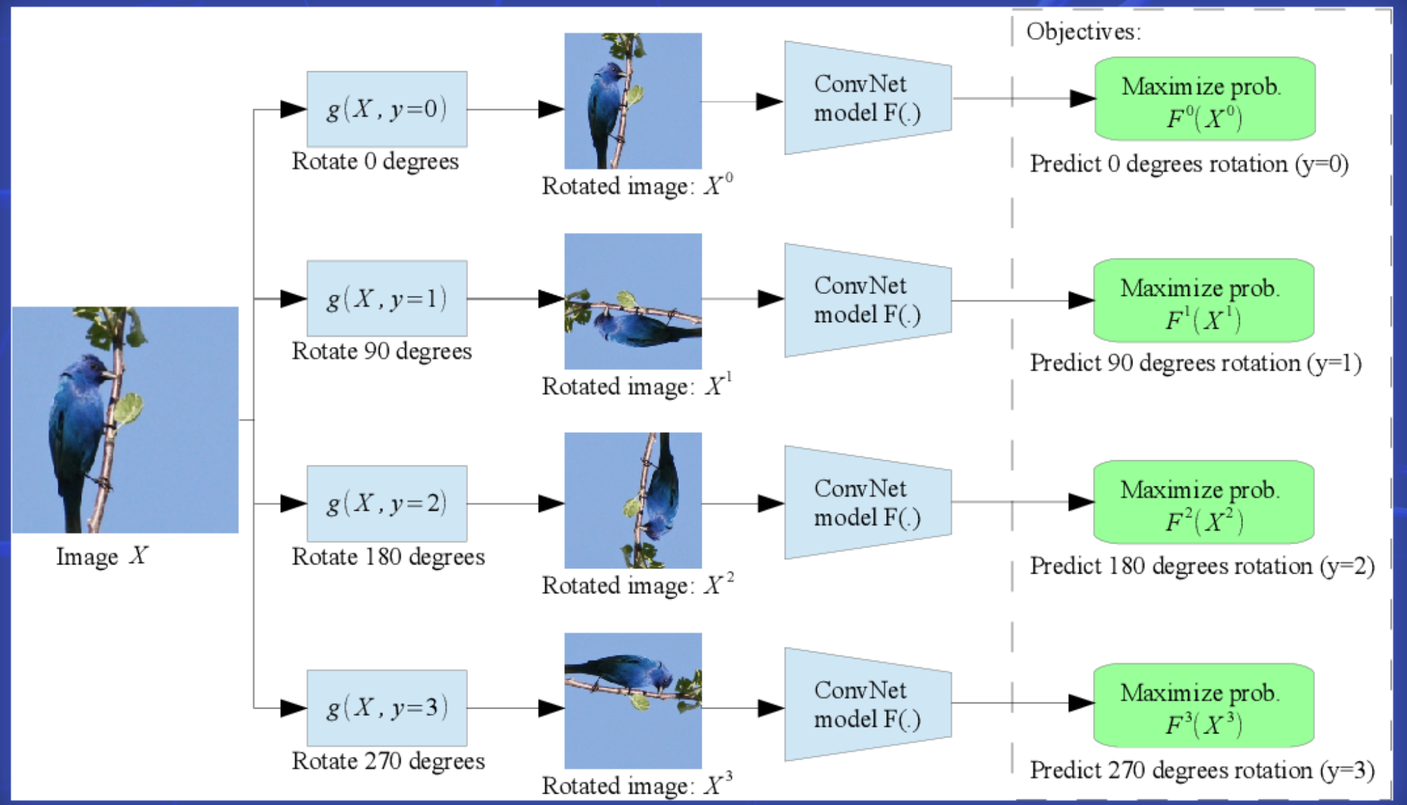


Self-Supervised Learning as Exploration Before Training

The model explores the data landscape without learning labels, then is trained on the specialized task with labels.

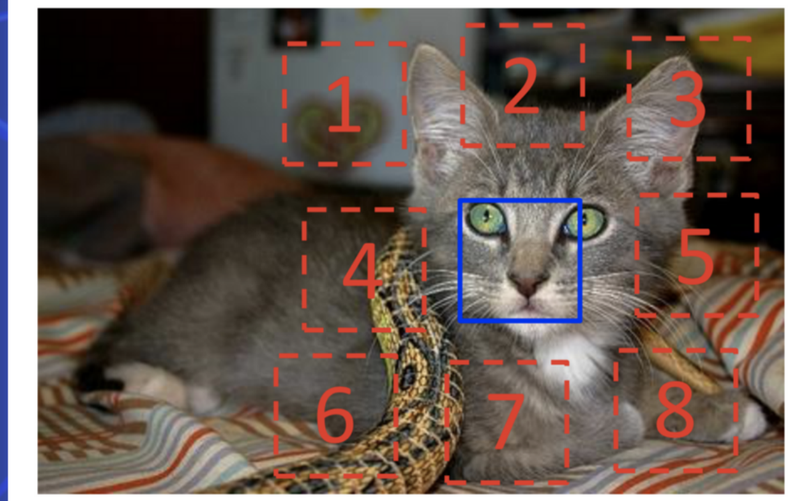


Self-Supervised Learning as Exploration Before Training



https://arxiv.org/abs/1803.07728

Self-Supervised Learning as Exploration Before Training



X = (,); Y = 3

Example:

Question 1:

?

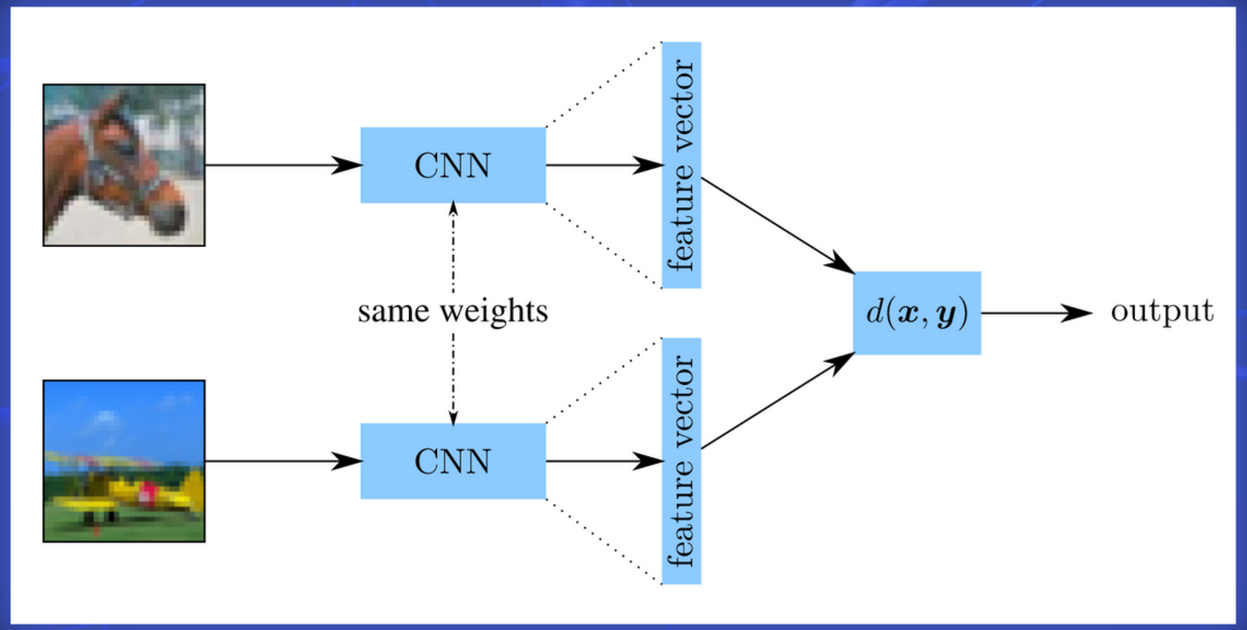
Question 2:

?

https://arxiv.org/abs/1505.05192

Few-Shot Learning as the "Realistic Learning Regime"

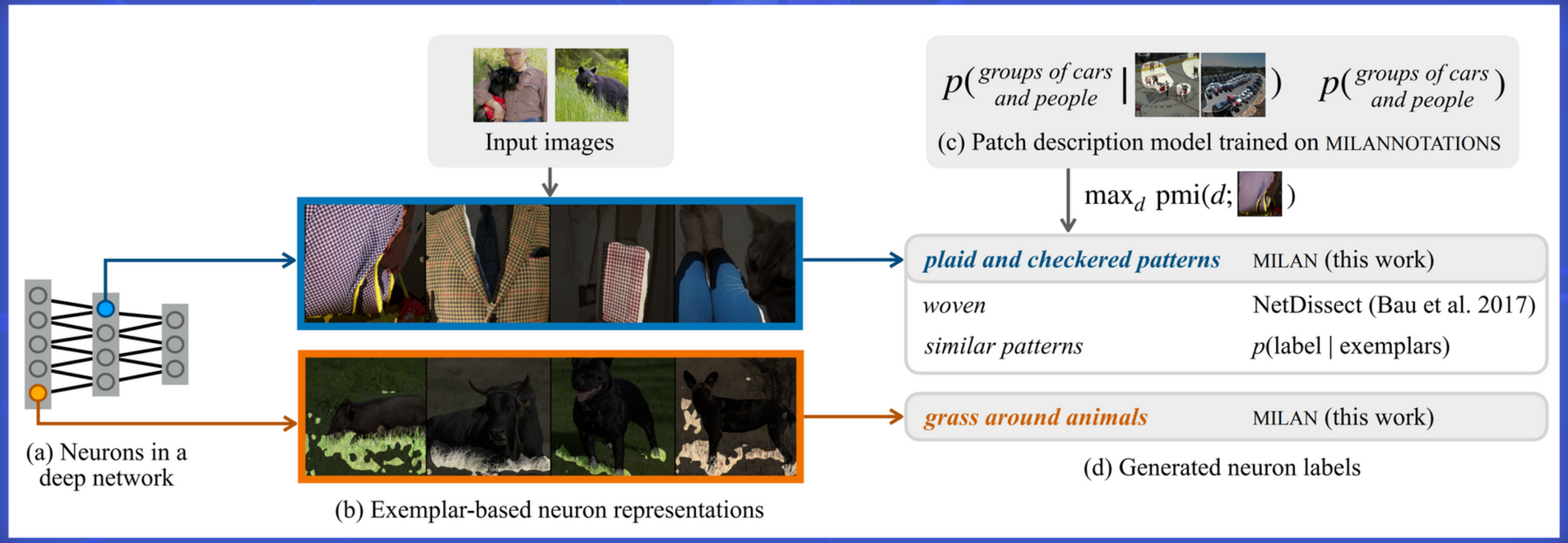
Few-Shot learning models generalize from few samples per class.



https://www.cs.cmu.edu/~rsalakhu/papers/oneshot1.pdf

NL Weight Interpretation as Decision Explanation

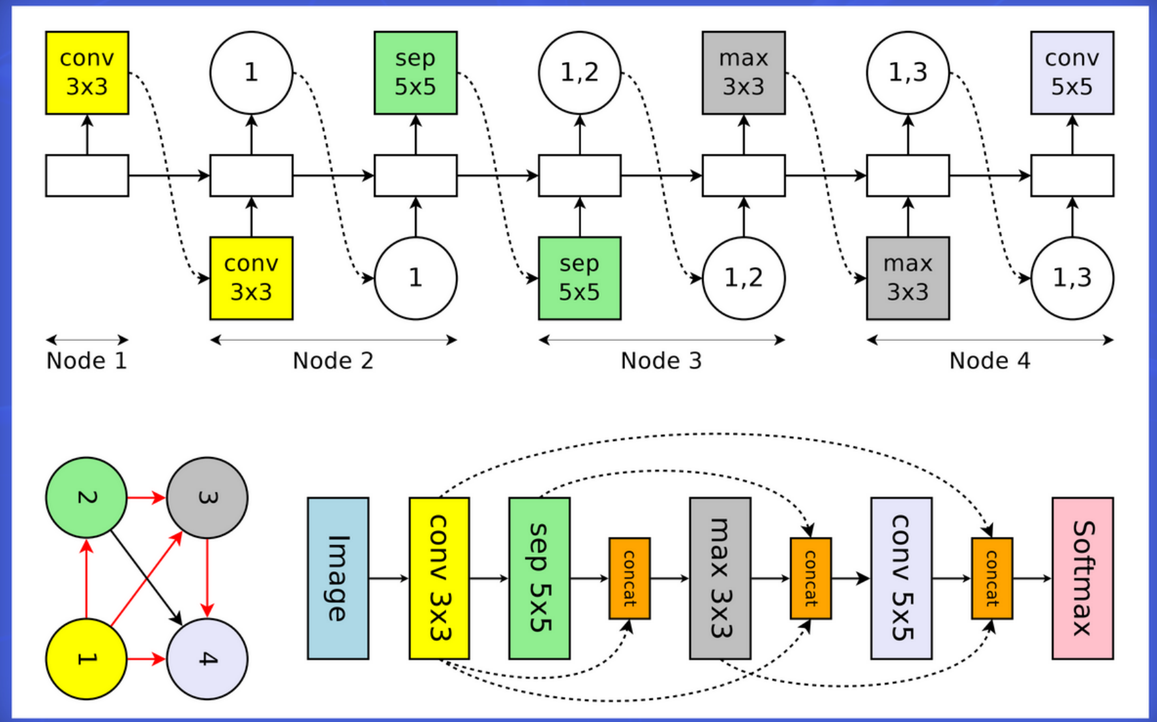
Natural language descr. are discovered from model weights.



https://arxiv.org/pdf/2201.11114.pdf

Neural Architecture Search as Meta-Reflection

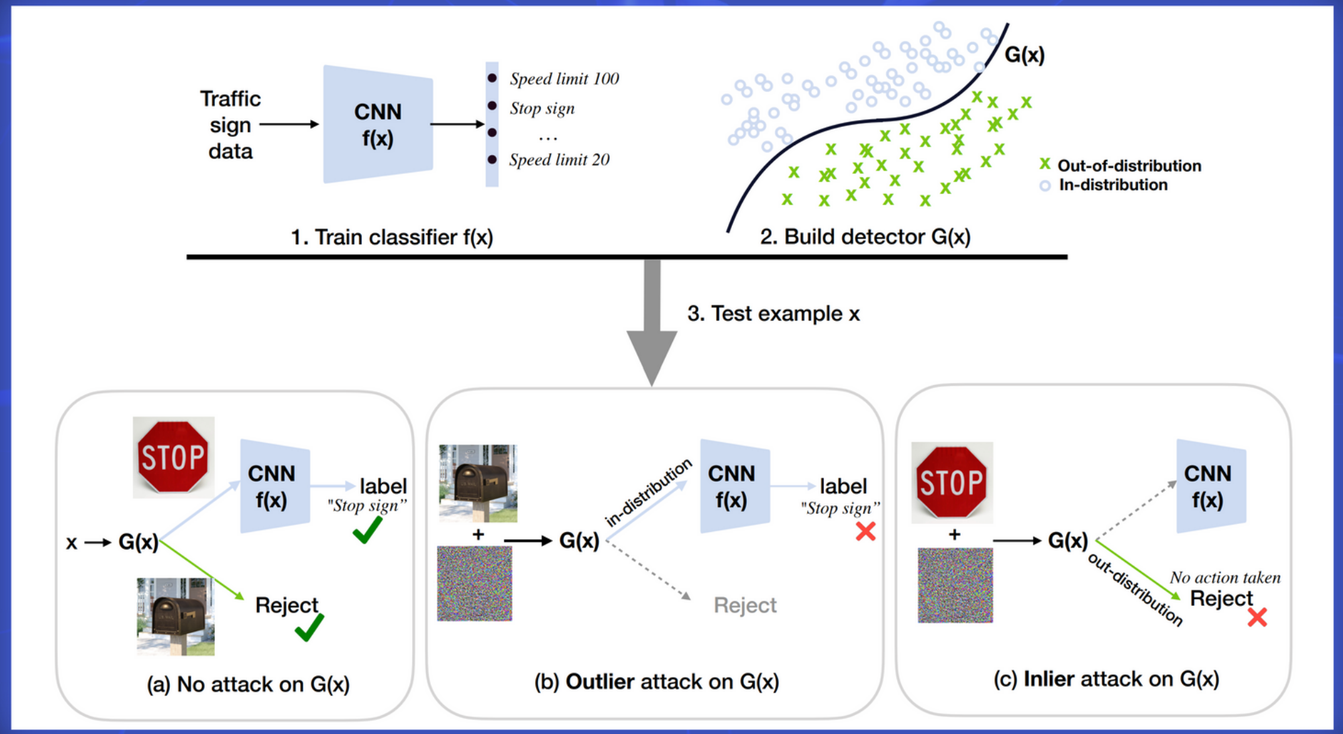
NNs can be used to generate successful NN architectures.



ENAS, https://arxiv.org/pdf/1802.03268.pdf

OOD Detection as Knowing When
You Have No F$(%ing Idea What The Answer Is

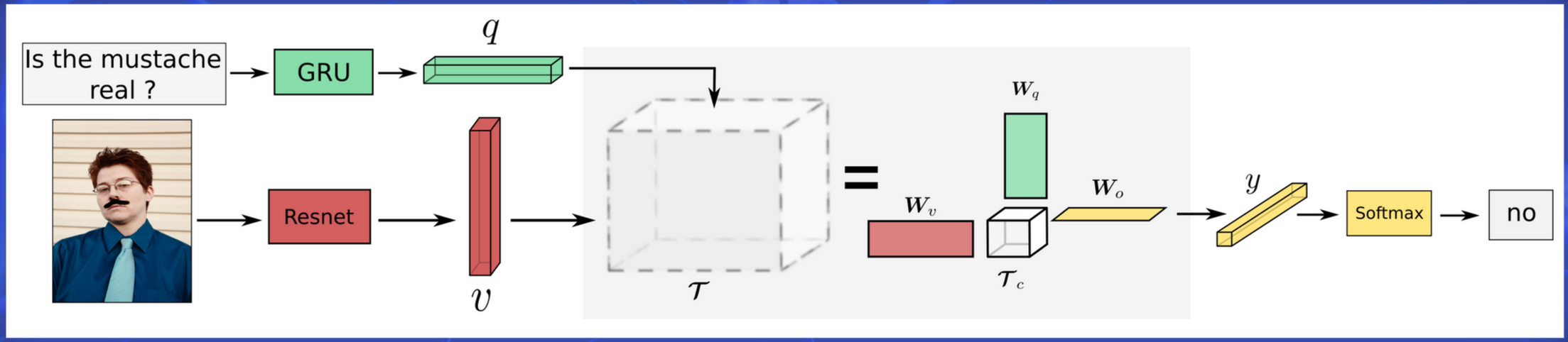
Out of Distribution (OOD) detection allows a system to be 'self-conscious' of its knowledge representation/prediction limits.



ALOE, https://arxiv.org/pdf/2003.09711.pdf

Multimodal Learning as Human-like Perception & Interaction

Models can take in and output multiple modalities at once.



MUTAN, https://arxiv.org/pdf/1705.06676.pdf

Summary of Discussed Ideas

1. **Perceptrons** as Neurons
2. **Backpropagation** as Learning
3. **Transfer Learning** as Skill Adaptation
4. **Self-Supervised Learning** as Exploring Before Training
5. **Few-Shot Learning** as the "Realistic Learning Regime"
6. **NL Weight Interpretation** as Decision Explanation
7. **Neural Architecture Search** as Meta-Reflection
8. **OOD Detection** as Knowing When You Don't Know
9. **Multimodal Detection** as Human-Like Perception & Interaction