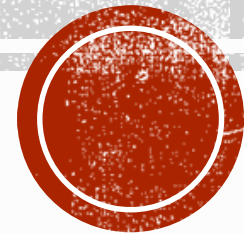# LOGIC REASONING USING PREDICTIVE CODING INSPIRED MEMORY-AUGMENTED NETWORK

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WHAT IS UNIVERSALITY OF NEURAL NETWORKS?

- Symbolic machines
  - Rule-based systems
  - Minimum information and fast access - Explainable
  - Faster communication

- Sub-symbolic machines
  - Neural networks
  - Large amount of data – Least explainable
  - Adaptation

- We want machines to represent, incorporate, process, adapt, and retrieve symbols efficiently with minimal resources – Artificial general intelligence (AGI) – **human like**

- Representational or neuro-symbolic AI: **Turing universal neural networks**

WHY IS MEMORY IMPORTANT FOR REASONING?

- Memory Augmented Neural Network – Memory + Feedback
  - Turing Complete with finite precision and Time (Stogin & Mali, Arxiv 22, Mali, Arxiv 23c)
  - Grammatical rules inserted into the weights of tensor network (Neural State PDA, Mali IEEE TAI 21)
  - Memory augmented NNs work well compared to Transformers and Long-short term memory (LSTM) for mathematical reasoning and Grammatical inference task (Mali, ICGI 21a, Mali, ICGI 21b, Mali, AAAI 21, Mali, Arxiv 23a, Mali Arxiv 23b, Mali Arxiv 23d)

- Predictive Coding - Bio-inspired approach to train Neural Networks
  - Faster convergence, robust, local learning and works with non-differentiable activation function (Ororbia and Mali, AAAI 19)
  - Ability to do lifelong or continual learning (Ororbia, NeurIPS 22, Ororbia, IEEE TNNLS 20)
  - Can work with sparse reward where SoTa RL agents generally struggle (Ororbia and Mali, AAAI 22, Ororbia and Mali, Arxiv 22)

QUESTIONS

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