Differentiable Neural Computers

Hybrid Computing using a neural network with dynamic external memory (Graves et al. 2016)

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Logic and Computation

Overview

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A recurrent neural network coupled with an external memory.

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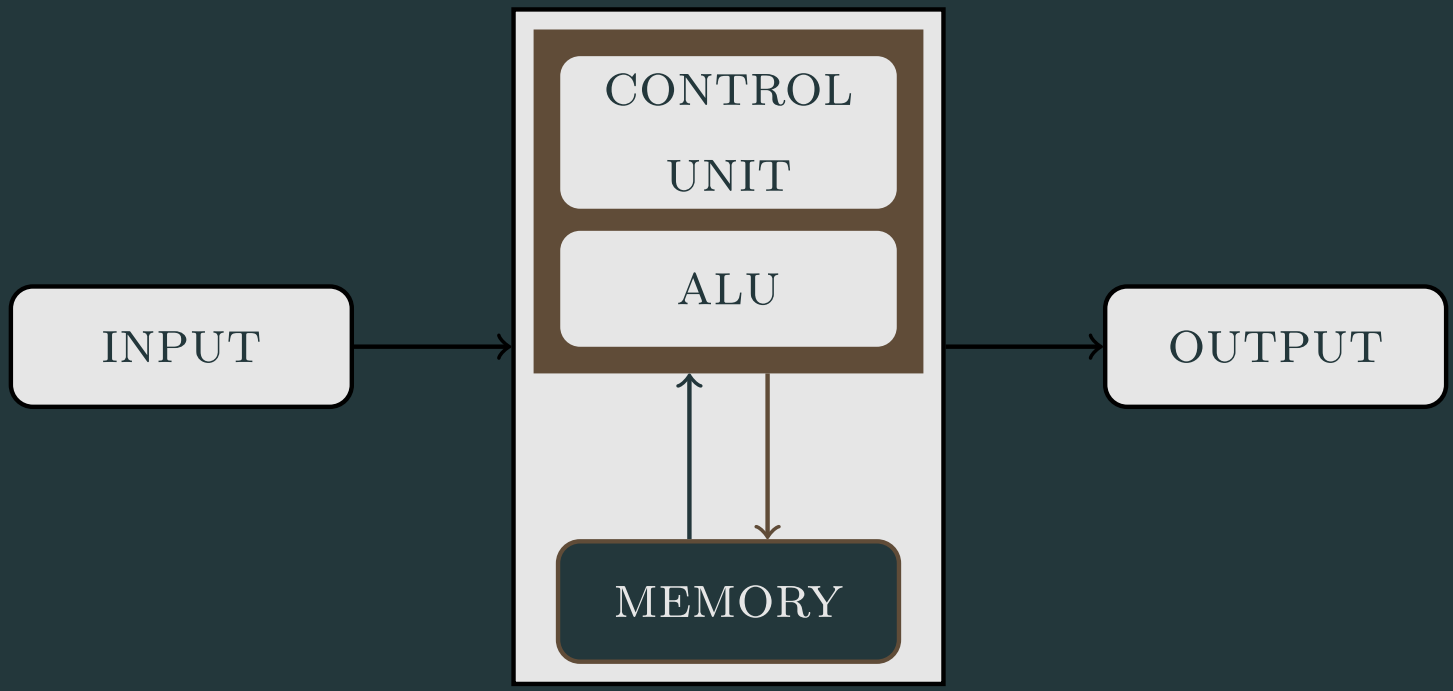
  - \+ Memory attention mechanisms
- Mimic mammalian biological memory
- Employ classical concepts of computation

Introduction: Motivation

Von Neumann architecture



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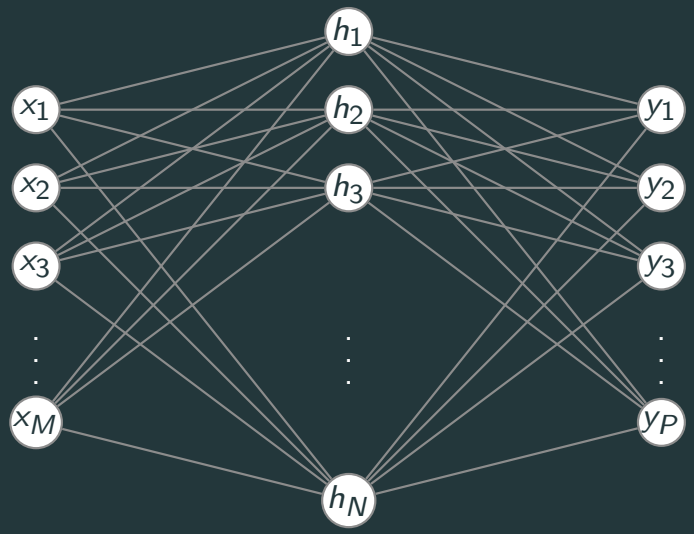
Simple Neural Net



$$y = g(h),\ h = f(x)$$

No memory

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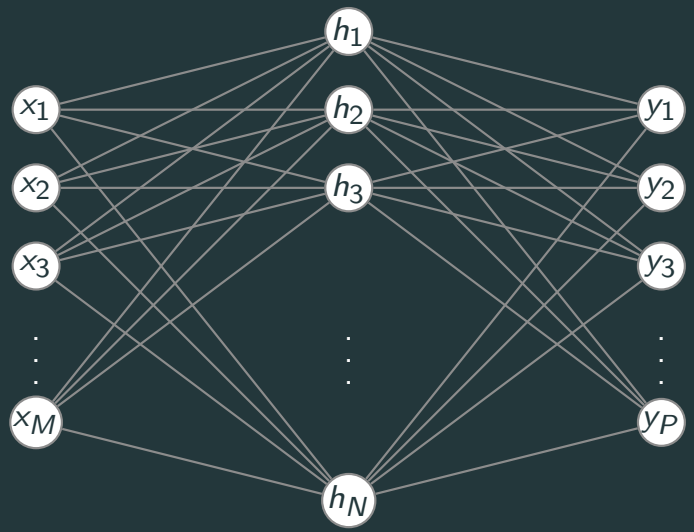

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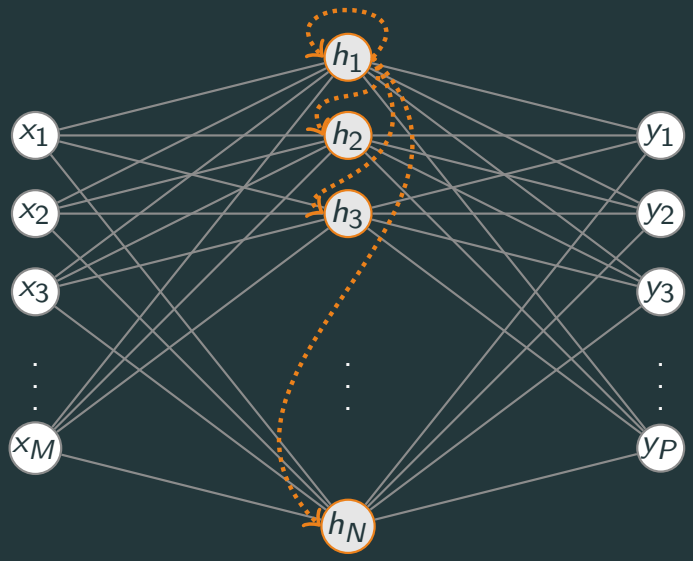
Recurrent Neural Net



$$h(t) = f([x(t); h(t-1)])$$

Finite, non-contiguous memory

Approach

Allow an RNN to act as a controller to interact with a memory matrix of N (arbitrary many) addresses.

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3. Dynamic Allocation
    - Mark memory locations with $\{0, 1\}$ to signal usage
    - Manipulate signals during R/W operations to enable reallocation
    - Generalization to unbounded memory

Controller

A deep long-short term memory unit receiving

$$\boldsymbol{\chi}_t = [\boldsymbol{x}_t; \boldsymbol{r}_{t-1}^1; \ldots \boldsymbol{r}_{t-1}^R]$$

and producing

$$\boldsymbol{a}$$