

# Symbolic Manipulation and Computation in the Same Graph

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**Abstract**

General artificial intelligence refers to machine intelligence than performs a task as successfully as a human does. A fundamental difference between human neural network and current machine neural networks is that only human networks combine symbolic reasoning with computation. Here we show how a graph can ...

# 1 Background

## 1. What is symbolic computation?

A symbolic computation is a calculation performed with symbolic representations of values and operations. A simple example would be the expression  $(x + 1)(x - 1)$  which would evaluate to  $x^2 - 1$ , rather than to some numerical result.

## 2. What is calculation?

A calculation is a process by which one or more inputs is transformed into one or more results. One may calculate that the product of 5 and 4 is 20.

## 3. What is meant by a computational class? - do you mean complexity class?

Code for each subsection of this document can be found at [NeuralNetworkResearch](#).

# 2 Methods

## 2.1 Network Construction

Figure 2 illustrates a neuron that receives three ordered inputs.

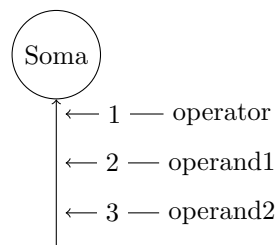


Figure 1: Single neuron receiving ordered inputs.

While this model is suitable for biological networks of neurons, a neural network in the computational sense would look more like an abstract syntax tree. In the following diagram, a network of operators and operands form a tree-like structure in which elements at lower levels represent values to manipulate which at higher levels interact with each other through arithmetic operations to produce a result. Any computation which involves a combination of operations on one or more values can be represented in this structure, such as logical operations or large-scale machine learning models.

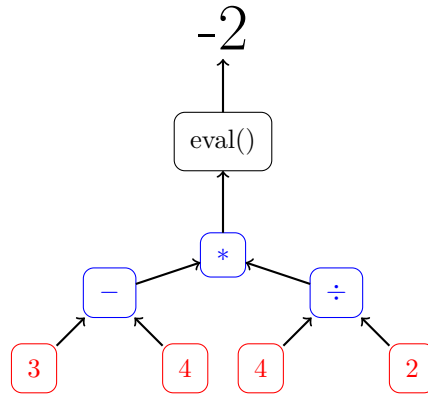


Figure 2: An Abstract Syntax Tree of arithmetic operations.

### 3 Results

### 4 Conclusions