neuronal symbolic integration

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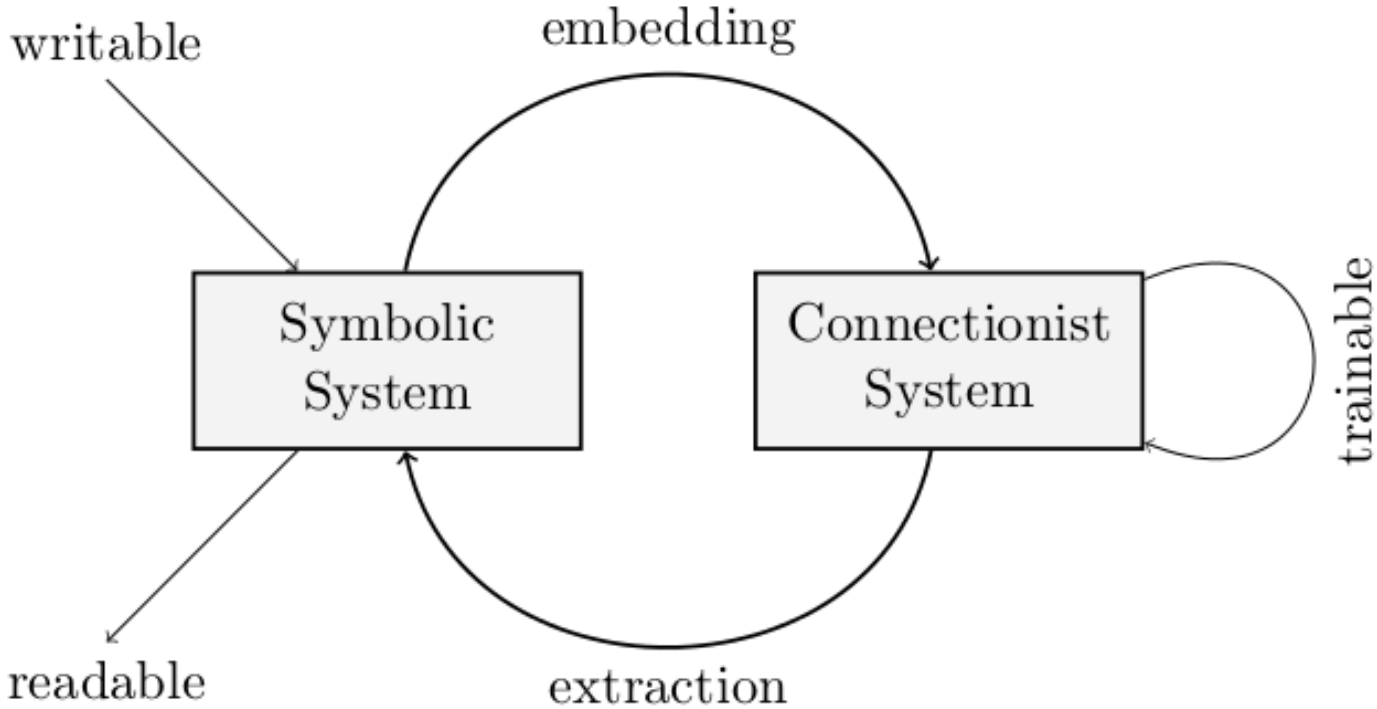

knowledge base

The knowledge base is a set of propositional logic rules.
A subset of these rules will be named as a program.

A rule is defined as follows:
$A \leftarrow L_1 \wedge \ldots \wedge L_n$ and A is an atom
L_i with $i \in \{1, \ldots, n\}$ and $n \geq 0$ is a set of Literals

if n is equal to 0 the rule will be called as a fakt. $A \leftarrow \top$

Literals and Fakts

Negativ fakts are also possible: $A \leftarrow \bot$
It follows that the head of a rule is not realy an atom.

A is equal to $A \leftarrow \top$
$\sim A$ is equal to $A \leftarrow \bot$

Classical negation is also allowed, we call the programs extended.

$$v4 < -v3\ ,\ v8 < -v2\& \sim v1\ ,\ v15 < -v7\& \sim -v11$$

embedding

At first our network has just one hidden layer with 20 hidden units. I call this the basic units.

If we add a program, for each rule of the program another unit will be added to our hidden layer.

After this we update the number of basic units as follows:

$$numBasic = numBasic + numRules$$

train and add

Our network is constructed and we can learn it with backprobagation.

We are able to add more programs and every time after a program is added the network will be trained.

results

Trained with trainingset-10.txt
The file contains 13107 vector pairs.

numBasic	**numRules**	η	α	**time needed**	**steps needed**
23	0	0.4	0.3	9.720 s	11
17	5	0.4	0.3	5.740 s	5
17	5	0.4	0.3	8.180 s	8

The first is the empty program, the second a program with 5 correct rules and the last has also 5 rules but some of them are incorrect.

results

Trained with testset-65.txt
The file contains 89785 vector pairs.

numBasic	**numRules**	η	α	**time needed**	**steps needed**
23	0	0.4	0.3	26.950 s	5
17	5	0.4	0.3	11.950 s	2
17	5	0.4	0.3	22.980 s	4

The first is the empty program, the second a program with 5 correct rules and the last has also 5 rules but some of them are incorrect.

rule extraction

This is actually the third assignment.

I tried to implement the naive approach. The procedure is realy easy, I construct the truth table and for every variable the DNF could be extrakted.

At the end, the rules should be minimized with the Quine–McCluskey algorithm. But i have not done the last step..

rule extraction

After the network has been trained with the trainingset-10.txt i got 911358 rules in the following form:

$$v4 <- \sim 0\&v1\&v2\&v3\& \sim v4\&v5\&v6\& \sim v7\&\ v8\&v9\& \sim v10\&v11\& \sim v12\&v13\&v14\&v15\&v16$$

questions

the hole program is written in C++