Typed Functional Genetic Programming

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April 2013

Chapter 1

Introduction

Chapter 2

Definitions

Let us first say some basic definitions.

2.1 Lambda term

Let V be set of *variable names*.
Let C be set of *constant names*.
Then Λ is set of λ-*terms* inductively defined as follows:

$$x \in V \Rightarrow x \in \Lambda$$
$$c \in C \Rightarrow c \in \Lambda$$
$$M, N \in \Lambda \Rightarrow (MN) \in \Lambda$$
$$x \in V, M \in \Lambda \Rightarrow (\lambda x.M) \in \Lambda$$

2.2 Type

Let A be set of *atomic types*.
Then $\mathbb{T}$ is set of *types* inductively defined as follows:

$$\alpha \in A \Rightarrow \alpha \in \mathbb{T}$$
$$\sigma, \tau \in \mathbb{T} \Rightarrow (\sigma \to \tau) \in \mathbb{T}$$

2.3 Statement with :

Let Λ be set of λ-*terms*.
Let $\mathbb{T}$ be set of *types*.
A *statement* is a pair $(M, \sigma) \in \Lambda \times \mathbb{T}$.
Notation $M : \sigma$.
The type σ is the *predicate* and the term M is the *subject* of the statement.

2.4 Context

Let Γ be a set of *statements*.
Then Γ is *context* if it obeys following conditions:

$$\forall (x, \sigma) \in \Gamma : x \in V \cup C$$
$$\forall s_1, s_2 \in \Gamma : s_1 \neq s_2 \Rightarrow fst(s_1) \neq fst(s_2)$$

In other words context is a set of statements with distinct variables as subjects.

2.5 Statement with $\vdash$

By writing $\Gamma \vdash M : \sigma$ we say *statement* $M : \sigma$ *is derivable from context* Γ .

2.6 Inference rule

We construct valid *statements with* $\vdash$ by using inference rules.

Chapter 3

Designed system

3.1 Top level view

3.2 Term generating

3.2.1 A* algorithm

3.3 Crossover

3.3.1 Finding same types

3.3.2 Two basic options

Resolve problems with free variables or avoid variables completely.

3.4 Mutation

3.4.1 Using term generation

Chapter 4

Problems

In this section will be presented usage of the system in order to solve specific problems.

4.1 Even Parity Problem

4.2 Big Context

4.3 Fly

4.4 Simple Symbolic Regression

4.5 Artificial Ant

4.6 Boolean Alternate

Chapter 5

Conclusion

Chapter 6

Sandbox ..

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$$E = mc^2 \tag{6.1}$$

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{6.2}$$