Building a programming language without the dependency on English

CMP6102 Individual Project: Literature Review

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1 Area Of Research

The fundamental aim of this project is to build an accessible programming language. To do so we will need to explore the base principals of programming language theory. We will look into some of the existing research in place for what has been defined as good programming practice. This shall be followed by a review of a subset of languages from various decades and compare how they have evolved from each other and improved on the ideas of previous generations of languages.

A second goal of the project is to make the language accessible to users who are not native english english speakers and have little to no programming experience. We will be taking a subjective look at the implementation of the languages and the symbols they use. We'll also take into account the country of origin of the main developers of the language to see if this has an effect on the symbols used. From this we may be able to deduce if there are indeed hints of linguistic culture within the design of languages which strengthens the case for a language which strives to be more generic in its choice of symbols.

2 If you See What I Mean

One of the earliest attempts at a programming language that attempted to make use of natural language to define more readable programs can be found in the design of ISWIM (If you See What I Mean). This language was first described in a 1966 edition the Association for Computing Machinery's journal titled "The Next 700 Programming Languages" (Landin, 1966).

In this paper the author describes the mistakes make by languages of the time, such as ALGOL60. They describe programming languages as a means to express things in terms of other things as well as existing as defining a basic set of given things that can be used. The author attempts to outline a language that better defines the given things defined by the language by utilising linguistic structure.

The author makes particular reference to mathematical communication in which he describes how naturally a *where* clause reads.

$$f(bA - 2c) + f(2b - c)$$
$$\textbf{where } f(x) = x(x + a)$$
$$\textbf{and } b = u/(u + l)$$
$$\textbf{and } c = v/(v - t - 1)$$

In the expression above it is very natural to follow the grammar of the equation and deduce what is happening. The where clause is naturally extended by adding **and**, which we can follow and logically determine that this is an addition to the previous statement.

This is the type of grammatical reliance we must aim to avoid in the design of our language. We cannot assume the end user of the language will be familiar with these grammatical primitives.

The design of ISWIM attempts to take this into consideration with multiple levels of abstraction in the design of the language itself. The abstraction we are most interested in is what the author characterises as logical ISWIM. This abstraction is defined as:

"uncommitted to character sets and type faces, but committed as to the sequence of textual elements, and the grammatical rules for grouping them"

This is in theory would allow ISWIM to be translated to a different language and grammar completely as long as the definition of ISWIM could be adapted to the end language's grammar. As it's definition is also character set agnostic, it would naturally make sense that we could build a unique series of characters which we assign meaning and grammar to in order to represent the language.

3 Naturalistic Programming

In (Lopes et al., 2003) the authors outline a future beyond aspect-oriented programming (AOP), a method of improving system modularity by modularizing crosscutting concerns (Murphy and Schwanninger, 2006). The authors propose that high level programming do not follow natural human communication patterns or the way that we think. The next breakthrough will be by taking aspects of natural language to make descriptions concise, effective and understandable.

There is a wide breadth of naturalistic type languages in use by programmers which are outlined in the survey (Pulido-Prieto and Juarez-Martinez,

2017). This is a fantastic survey of a wide array of high level languages that follow grammatical and natural english rules to provide programmers with what is ideally an easier understanding of code that is being written.

One such language which is among the most used languages in the world with multiple dialects is Structured Query Language (SQL) (*Stack Overflow Developer Survey 2018* n.d.). SQL is very expressive and can be read like a regular English sentence. Without much knowledge of SQL at all you can make deductions as to what the program will do by following its natural grammar rules.

Take the following expression for example:

```
SELECT id, name, age, grade
FROM students
WHERE grade > 90
```

Reading the expression we can deduce that this is accessing data by selecting various properties *from* some sort of students record *where* the individuals grade is greater than 90. Very natural to follow and conforms to some of Landin's ideas mentioned previously (Landin, 1966).

The programming language Pegasus is an example of the most complete naturalistic programming languages that have been designed (Knöll and Mezini, 2006).

The authors of this language highlight 4 major unsolved gaps in developer's expectations and programming techniques.

1. Mental problem. An idea must be adapted to a programming language, decomposing orgrouping its elements.

2. Programming language problem. An algorithm must be translated into several languages that use new technologies and concepts, meaning that old languages still have a strong presence.

3. Natural language problem. In the modern era, while people from all around the worldwork in teams, they generally have a different native language and their own particular regionalisms.

4. Technical problem. In system design, the developer's contribution and time is in-vested by programmers thinking about how to best adapt ideas to produce an efficient implementation.

We should pay particular attention to point number 3. The natural language and culture problem. With teams spanning the globe and working in increasingly more diverse and integrated environments this problem becomes more prevalent. Even things as simple as color vs colour throw off developers every day when working with CSS, a markup that distinctly american.

Pegasus actually tackles this problem head on and is able to generate programs in English and German languages. Using the definition of Pegasus proposed by the authors there has also been an extension to the language Ara Pegasus.

References

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