Limbo (programming language)

Limbo is a programming language for writing distributed systems and is the language used to write applications for the Inferno operating system. It was designed at Bell Labs by Sean Dorward, Phil Winterbottom, and Rob Pike.

The Limbo compiler generates architecture-independent object code which is then interpreted by the Dis virtual machine or compiled just before runtime to improve performance. Therefore all Limbo applications are completely portable across all Inferno platforms.

Limbo's approach to concurrency was inspired by Hoare's communicating sequential processes (CSP), as implemented and amended in Pike's earlier Newsqueak language and Winterbottom's Alef.

Limbo

Paradigm	Concurrent
Designed by	Sean Dorward, Phil Winterbottom, Rob Pike
Developer	Bell Labs / Vita Nuova Holdings
First appeared	1995
Typing discipline	Strong
OS	Inferno
License	Open source
Website	www.vitanuova.com/inferno/limbo.html (http://www.vitanuova.com/inferno/limbo.html)
Major implementations	
Dis virtual machine	
Influenced by	
C, Pascal, CSP, Alef, Newsqueak	
Influenced	
Stackless Python, Go, Rust	

Contents

Language features

Limbo supports the following features:

- modular programming
- concurrent programming
- strong type checking at compile and run-time
- interprocess communication over typed channels
- automatic garbage collection
- simple abstract data types

Virtual machine

The Dis virtual machine that executes Limbo code is a CISC-like VM, with instructions for arithmetic, control flow, data motion, process creation, synchronizing and communicating between processes, loading modules of code, and support for higher-level data-types: strings, arrays, lists, and communication channels.[1] It uses a hybrid of reference counting and a real-time garbage-collector for cyclic data.[2]

Aspects of the design of Dis were inspired by the AT&T Hobbit microprocessor, as used in the original BeBox.

Examples

Limbo uses Ada-style definitions as in:

```
name := type value;
name0,name1 : type = value;
name2,name3 : type;
name2 = value;
```

Hello world

```
implement Command;

include "sys.m";
    sys: Sys;

include "draw.m";

include "sh.m";

init(nil: ref Draw->Context, nil: list of string)
{
    sys = load Sys Sys->PATH;
    sys->print("Hello World!\n");
}
```

Books

The 3rd edition of the Inferno operating system and Limbo programming language are described in the textbook *Inferno Programming with Limbo* ISBN 0-470-84352-7 (Chichester: John Wiley & Sons, 2003), by Phillip Stanley-Marbell. Another textbook *The Inferno Programming Book: An Introduction to Programming for the Inferno Distributed System*, by Martin Atkins, Charles Forsyth, Rob Pike and Howard Trickey, was started, but never released.

See also

- The Inferno operating system
- Alef, the predecessor of Limbo
- Plan 9 from Bell Labs
- Go (programming language), similar language from Google
- AT&T Hobbit, a processor architecture which inspired the Dis VM

References

1. "Dis Virtual Machine Specification" (http://www.vitanuova.com/inferno/papers/dis.html). Vita Nuova. 2000. Retrieved 2 February 2015.
2. Lorenz Huelsbergen and Phil Winterbottom. "Very Concurrent Mark and Sweep Garbage Collection without Fine-Grain Synchronization" (http://doc.cat-v.org/inferno/concurrent_gc/concurrent_gc.pdf) (PDF).

External links

- Vita Nuova page on Limbo (http://www.vitanuova.com/inferno/limbo.html)
- A Descent into Limbo (http://doc.cat-v.org/inferno/4th_edition/limbo_language/descent) by Brian Kernighan
- The Limbo Programming Language (http://doc.cat-v.org/inferno/4th_edition/limbo_language/limbo) by Dennis M. Ritchie and Addendum (http://doc.cat-v.org/inferno/4th_edition/limbo_language/addendum) by Vita Nuova.
- Inferno Programming with Limbo (https://web.archive.org/web/20081011054044/http://www.gemusehaken.org/ipwl/) by Phillip Stanley-Marbell
- Threaded programming in the Bell Labs CSP style (http://swtch.com/~rsc/thread/)
- *Dis source code* (https://bitbucket.org/inferno-os/inferno-os/src/62ae0f75aa714c7bab5e714fcf90f4026b7ba911/limbo/?at=default)
- *The design of the Inferno virtual machine* (http://www.vitanuova.com/inferno/papers/hotchips.html), Vita nuova.
- "Dis VM design", *Inferno* (http://doc.cat-v.org/inferno/4th_edition/dis_VM_design) (4th ed.), Cat V.
- "Dis VM specification", *Inferno* (http://doc.cat-v.org/inferno/4th_edition/dis_VM_specification) (4th ed.), Cat V.