CS 220: Survey of Programming Languages

Lecture Slides

Concurrent Programming Languages

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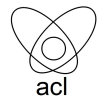
Session 8



Concurrent Programming Languages

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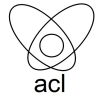
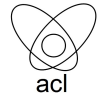


Concurrent programming



Concurrent programming

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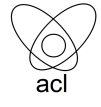

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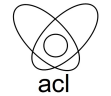
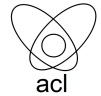
- This can be done either with computations sharing common memory pool (parallel) or with each computation having their own memory pool (distributed)



Characteristics of concurrent PL



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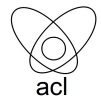
- Language/syntax structure heavily borrows from imperative, functional, and /or OO paradigms
  - And oftentimes, built on top of those paradigms



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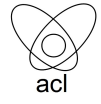

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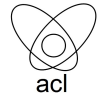

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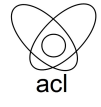

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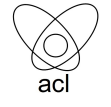
  - An alternative to using semaphores and critical sections us via the use of monitors



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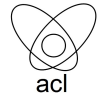

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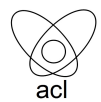

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http://www.erlang.org/course/history.html

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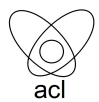

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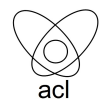

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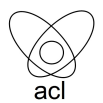

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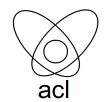

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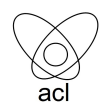

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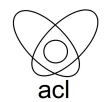

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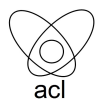
  - "It must also have a granularity of concurrency such that one asyncronous telephony process is represented by one process in the language."



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- Data types[1,2]

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  - Erlang adheres to functional programming paradigm concepts, and thus is a very orthogonal language, and the structure of statements and expressions have (little to) no special cases as per the grammar
    - Reminiscent of Haskell language (though probably unintentional)

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- Expressivity: Has a rich set of functions in the core module, most pertinent are optimization functions for handling data structures and concurrency [7]

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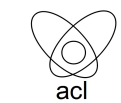

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- Restricted aliasing: "Erlang uses pass-by-value."[9]

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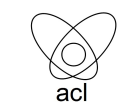

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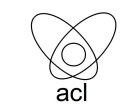

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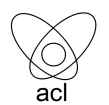

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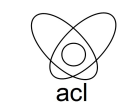

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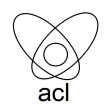

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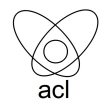
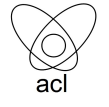


Concurrent Programming Languages



Background

[13] http://doc.cat-v.org/inferno/4th_edition/limbo_language/limbo
[14] http://www.vitanuova.com/inferno/index.html
[15] http://doc.cat-v.org/inferno/4th_edition/limbo_language/descent

Background

- "Limbo is a programming language intended for applications running distributed systems on small computers."[13]

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- Used to develop the Inferno operating system, which is meant for building cross-platform distributed systems[14]
- Built on top of C, and adopts a couple of C functionalities[15]

[13] http://doc.cat-v.org/inferno/4th_edition/limbo_language/limbo
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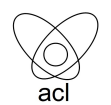
[15] http://doc.cat-v.org/inferno/4th_edition/limbo_language/descent

Evaluation

- Data types[16]

[16] http://doc.cat-v.org/inferno/4th_edition/limbo_language/limbo
[17] Manually counted
[18] https://bitbucket.org/inferno-os/inferno-os/src/83c37ad129003670023ebe2f8c318627ee4e84b0/limbo/lex.c?at=default
[19] http://www.vitanuova.com/inferno/limbo.html





Evaluation

- Data types[16]
  - Integers, 64-bit long floating point real numbers, and strings as primitive types

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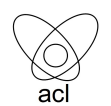

Evaluation

- Data types[16]
  - Integers, 64-bit long floating point real numbers, and strings as primitive types
  - Arrays, tuples, and lists as derived types
  - A channel type pertains to " a communication mechanism capable of sending and receiving objects of the specified type to another agent in the system"

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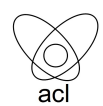
Evaluation

- Abstraction: Functions and other resources one wishes to be made public must be listed inside a `module` declaration



http://doc.cat-v.org/inferno/4th_edition/limbo_language/descent

Evaluation

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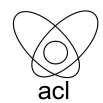

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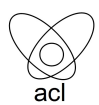

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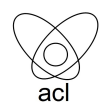

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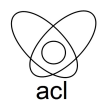

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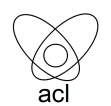

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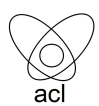

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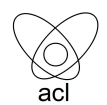
http://doc.cat-v.org/inferno/4th_edition/limbo_language/descent

Evaluation

- Restricted aliasing:



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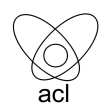
Evaluation

- Restricted aliasing:
  - Employs pass-by-value and pass-by-reference



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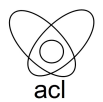

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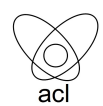

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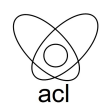
  - "Arrays are also reference types, however, and since array slicing is supported, that replaces many of C's pointer constructions."



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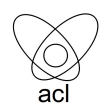

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http://doc.cat-v.org/inferno/4th_edition/limbo_language/descent

Evaluation

- Efficiency:
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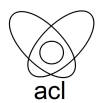

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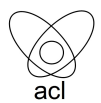

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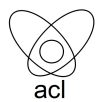

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    - "Inferno and its accompanying virtual machine run either stand-alone on bare hardware or as an application under conventional operating systems"
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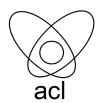

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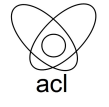
Concurrent Programming Languages



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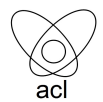
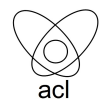


http://orc.csres.utexas.edu/documentation/OrcReferenceCard.pdf

Background

- Orc is a concurrent and distributed programming language "which provides uniform access to computational services, including distributed communication and data manipulation, through sites"



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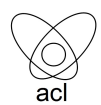
- Orc is a concurrent and distributed programming language "which provides uniform access to computational services, including distributed communication and data manipulation, through sites"
- Orchestration, i.e. the integration and synchronization of sites, is performed such that computations with "delays associated with communication, unreliability of servers, and competition for resources from multiple clients" efficiently performed



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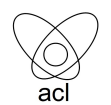

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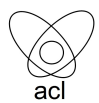
- It can be used as a general purpose, web scripting, and executable specification language.
- Borrows some elements from, and is built on top of, Java



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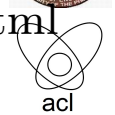

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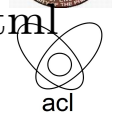

Evaluation

- Data types[21]
  - Integer, string, logical, and signals as primitive data types
  - Tuples, lists, and patterns as derived types
- Syntax design:
  - Production rules: 69[22,23]
  - Keywords: 20

[21] https://orc.csres.utexas.edu/documentation/html/userguide/userguide.html
[22] http://orc.csres.utexas.edu/documentation/html/refmanual/ref.syntax.EBNF.html
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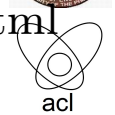

Evaluation

- Data types[21]
  - Integer, string, logical, and signals as primitive data types
  - Tuples, lists, and patterns as derived types
- Syntax design:
  - Production rules: 69[22,23]
  - Keywords: 20
  - Design is very simple, with emphasis on facilitating concurrent computations [24]

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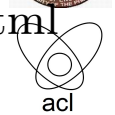
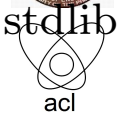


Evaluation

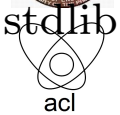
- Abstraction:



[25] http://orc.csres.utexas.edu/documentation/html/refmanual/ref.declarations.defclass.h
[26] http://orc.csres.utexas.edu/documentation/html/refmanual/ref.sites.custom.html#ref.
[27] http://orc.csres.utexas.edu/documentation/html/refmanual/ref.stdlib.html#ref.stdlib
[28] https://orc.csres.utexas.edu/papers/OrcExceptionSemantics.pdf
[29] https://orc.csres.utexas.edu/documentation/html/refmanual/index.html

Evaluation

- Abstraction:
  - Definition of classes, ala-OOPL supported[25]



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[26] http://orc.csres.utexas.edu/documentation/html/refmanual/ref.sites.custom.html#ref.
[27] http://orc.csres.utexas.edu/documentation/html/refmanual/ref.stdlib.html#ref.stdlib
[28] https://orc.csres.utexas.edu/papers/OrcExceptionSemantics.pdf
[29] https://orc.csres.utexas.edu/documentation/html/refmanual/index.html

Evaluation

- Abstraction:
  - Definition of classes, ala-OOPL supported[25]
  - Definition of sites, which are the primary interface of a program to its environment, is done similarly as definition of classes[26]

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[27] http://orc.csres.utexas.edu/documentation/html/refmanual/ref.stdlib.html#ref.stdlib
[28] https://orc.csres.utexas.edu/papers/OrcExceptionSemantics.pdf
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[27] http://orc.csres.utexas.edu/documentation/html/refmanual/ref.stdlib.html#ref.stdlib
[28] https://orc.csres.utexas.edu/papers/OrcExceptionSemantics.pdf
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- Expressivity: Standard library consists mostly of facilitating data structure construction, and resource synchronization utilities, as well as Web/network programming utilities[27]
- Exception handling: Operational semantics for exception handling was proposed for Orc[28], but seems unimplemented as of current version (see Reference Manual[29]).

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[26] http://orc.csres.utexas.edu/documentation/html/refmanual/ref.sites.custom.html#ref.
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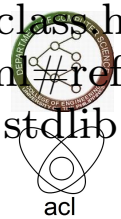

Evaluation

- Restricted aliasing: Employs pass-by-value (in the same manner as Java)[30]

[30] https://orc.csres.utexas.edu/papers/OrcJSSM.pdf
[31] https://orc.csres.utexas.edu/download.shtml

Evaluation

- Restricted aliasing: Employs pass-by-value (in the same manner as Java)[30]
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Evaluation

- Restricted aliasing: Employs pass-by-value (in the same manner as Java)[30]
- Efficiency[31]
  - Employs dynamic type-checking by default, but can enforce static type-checking

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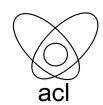

Evaluation

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  - Employs dynamic type-checking by default, but can enforce static type-checking
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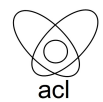

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  - Employs dynamic type-checking by default, but can enforce static type-checking
  - Orc is an interpreted language
  - No significant delays in the executions, and concurrency runs properly

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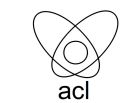

Evaluation

- Restricted aliasing: Employs pass-by-value (in the same manner as Java)[30]
- Efficiency[31]
  - Employs dynamic type-checking by default, but can enforce static type-checking
  - Orc is an interpreted language
  - No significant delays in the executions, and concurrency runs properly
  - Interpreter is developed using Java

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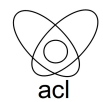
[31] https://orc.csres.utexas.edu/download.shtml





END OF SESSION 8