Techniken zur Entwicklung Korrekter Software 1

Vorlesung vom 29.10.2007: Einführung in CASL

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WS 07/08

Axiomatic Specfication

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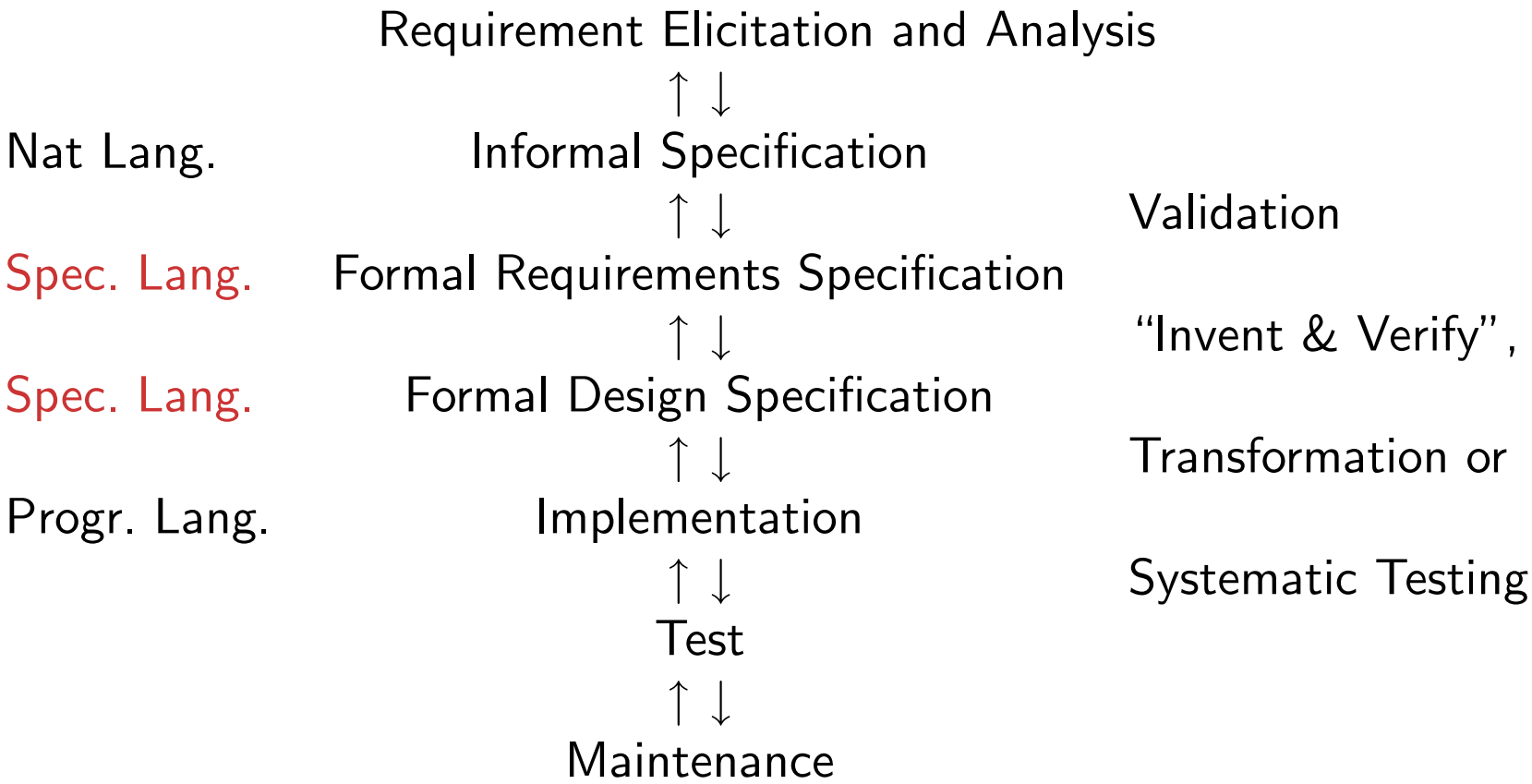
- design of algorithms and data structures independently of any implementation language
- CASL is a standard for axiomatic specification

Waterfall Model (slide by M. Roggenbach)



Example: sorting

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Formal requirements specification:

- $is\_ordered(sorter(L))$
- $is\_ordered(L) \Leftrightarrow \forall L1, L2 : List;\ x, y : Elem\,.$
  $$L = L1 + +[x, y] + +L2 \Rightarrow x \leq y$$
- $permutation(L, sorter(L))$
- $permutation(L1, L2) \Leftrightarrow$
  $$\forall x : Elem\,.\ count(x, L1) = count(x, L2)$$

Sorting (cont'd)

We want to show insert sort to enjoy these properties.
Formal design specification:

- $insert(x, []) = [x]$
- $insert(x, y :: L) =$
  $x :: y :: L)$ *when* $x \leq y$
  else $y :: insert(x, L)$
- $insert\_sort([]) = []$
- $insert\_sort(x :: L) = insert(x, insert\_sort(L))$

Implementation (in Haskell)

```
insert :: Ord a => (a,[a]) -> [a]
insert(x,[]) = [x]
insert(x,y:l) = if x <= y then x:y:l
                          else y:insert(x,l)

insertsort :: Ord a => [a] -> [a]
insertsort([]) = []
insertsort(x:l) = insert(x,insertsort(l))
```

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  "Foundations of Systems Specifications"
- CASL User Manual (Lecture Notes in Computer Science 2900) and
  Reference Manual (Lecture Notes in Computer Science 2960)

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- detailed language summary, with informal explantation

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All this is contained in the Reference Manual
— here, we will largely follow the User Manual

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- The semantics is largely indepdendent of the details of the logic (institution)
- The semantics is the ultimative reference for the meaning of CASL

CASL on the web

- CASL in general: `http://www.cofi.info`
- CASL tools: `http://www.tzi.de/hets`
- CASL libraries: `http://www.cofi.info/Libraries`

Layers of CASL

CASL consists of several major layers, which are quite independent and may be understood (and used) separately:

Basic specifications many-sorted first-order logic, subsorting, partial functions, induction, datatypes.

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Structured specifications translation, reduction, union, and extension of specifications; generic (parametrized) and named specifications

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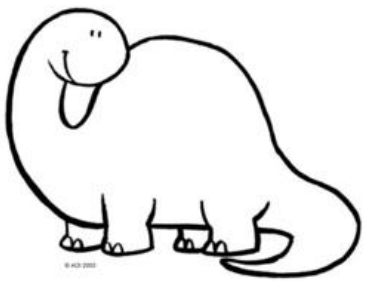

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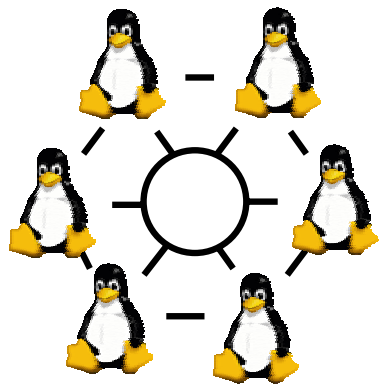

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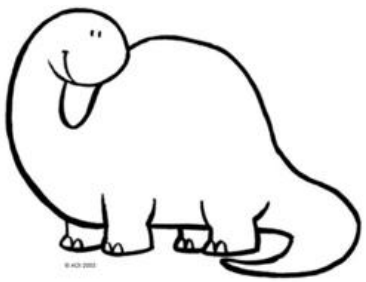

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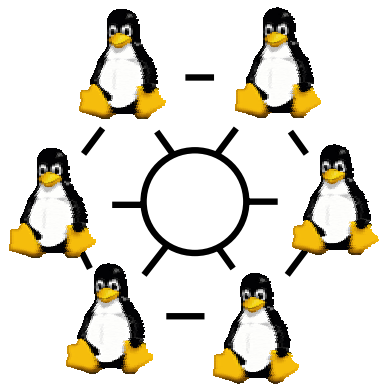

- better maintenance and possibilities of re-use

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Libraries allow the distributed (over the Internet) storage and retrieval of (particular versions of) named specifications.