From Software Engineering To Linguistic Engineering

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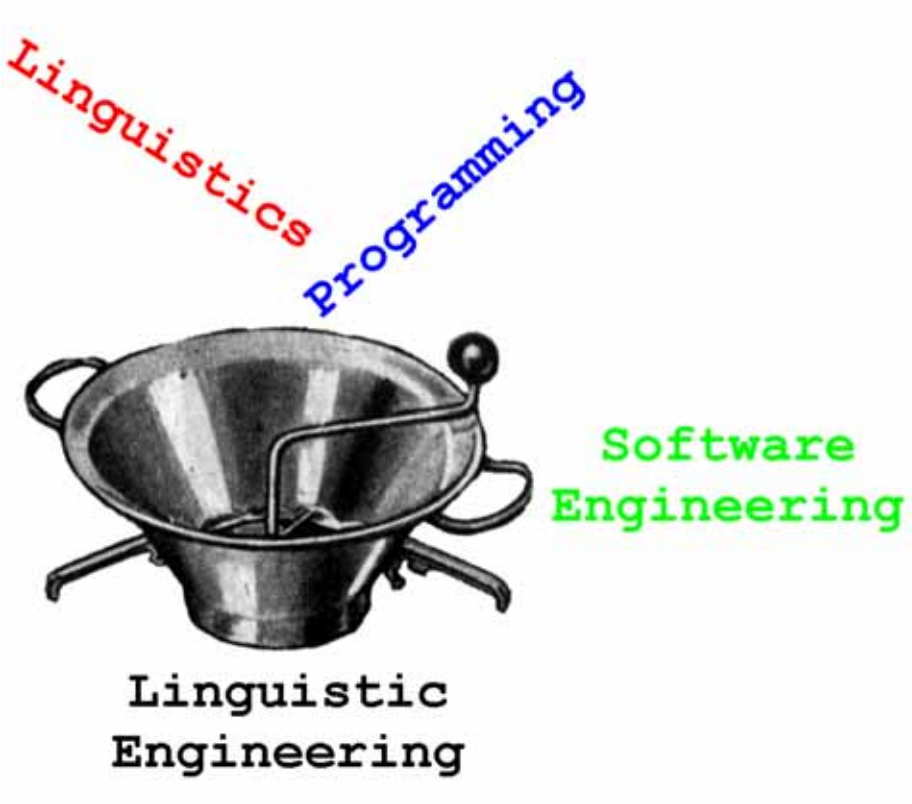
Plan

Goals

Focus

Elements of solution

Introduction



Goals: Modelization

- Near from the theory to strictly respect its semantics
- Near from the real world to naturally handle data

$$\mathsf{plus}(\mathsf{succ}(\mathsf{succ}(\mathsf{succ}(\mathsf{zero}))), \mathsf{succ}(\mathsf{succ}(\mathsf{zero}))) = \mathsf{succ}(\mathsf{succ}(\mathsf{succ}(\mathsf{succ}(\mathsf{succ}(\mathsf{zero})))))$$

$$3 + 2 = 5$$

Goals: Expressiveness (1)

- Higher-level concepts

print_integers_tree(An_integers_tree)
print_reals_tree(A_reals_tree)
print_trees_tree(A_trees_tree)
...
⇓
print_tree(A_tree, An_element_printing_routine)

Goals: Expressiveness (2)

- Active constraints

Passive constraints	Active constraints
X is a free variable	
X $<$ 4 ?	X $<$ 4 !
Success: X is free	*Success: X $<$ 4*
X $\geq$ 2 ?	X $\geq$ 2 !
Success: X is free	*Success: 2 $\leq$ X $<$ 4*
X $=$ 7 ?	X $=$ 7 !
Success: X $=$ 7	*Failure: 2 $\leq$ X $<$ 4*

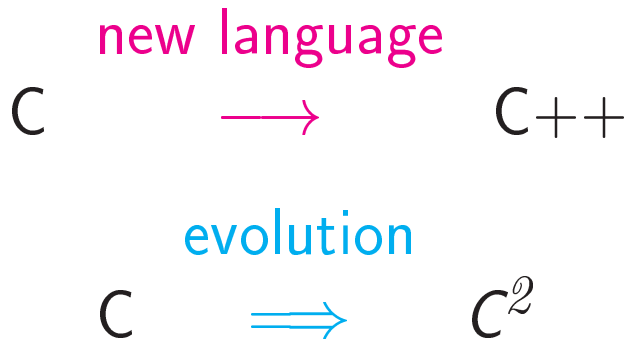
Goals: Expressiveness (3)

- Query language
- Logic relations
- Type relations

A noun is a word.
A verbal phrase is at least constituted of a verb.

Goals: Evolutivity

- To add concepts or to follow linguistic-theories evolutions
- To correct **Anima**'s imperfections
- To be used as test bed



Goals: Integration, Introspection and Control (1)

- Tools (debugger, profiler, ...) must be at `Anima`'s level

C++ (source level)	**C (target level)**

O = new Circle;	if(!(_23 = (T_42 *)malloc(sizeof(T_42) + 15))) {
	__cpp_errno = _NONEW_12;
	_internal(_ERROR_PRINT, _NONEW);
	}

Logic (source level)	**Prolog (target level)**
$p(a) \vee p(b) \rightarrow p(c)$	p(a) :- p(c). p(b) :- p(c).

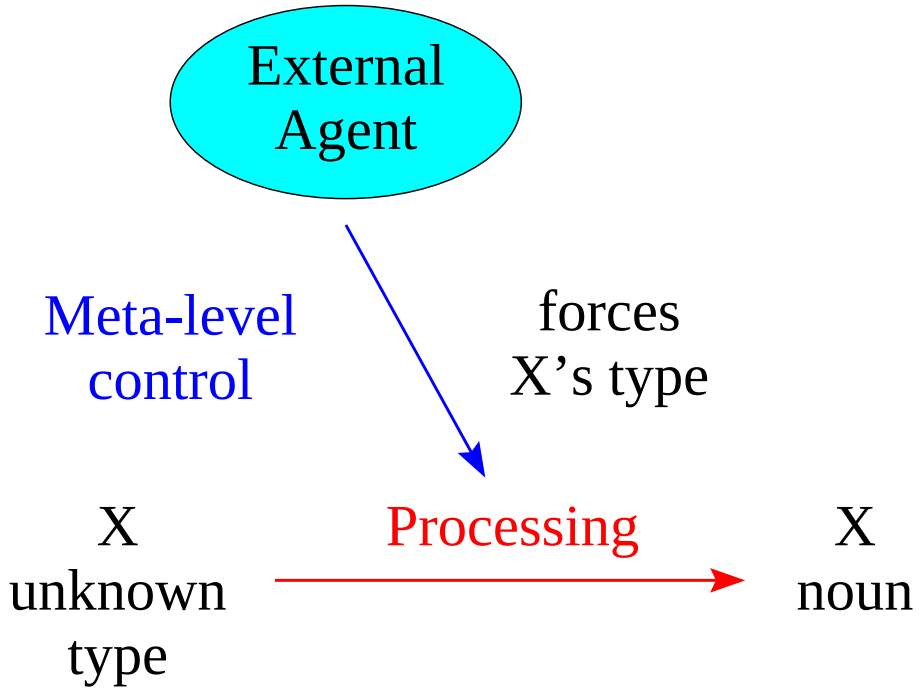
Goals: Integration, Introspection and Control (2)

- Programmers' tools have to exist as well as users' ones

Programmer level	User level
Debugger	Inspector
Profiler	Statistics
Controller	Tracer

Goals: Integration, Introspection and Control (3)

- Control meta-level is desirable



Goals: Software Engineering (1)

- Legibility
  - Natural syntax
  - Users' knowledge respect
  - Other Software-Engineering principles respect
- Reliability
  - Validity
  - Robustness

Goals: Software Engineering (2)

- Extensibility
  - Easy adaptability on changing
- Reusability
- Compatibility
  - Interfacing ability
- Performance

Goals: Software Engineering (3)

- Portability
- Verifiability
  - Easier collection procedures
  - Easier guarantee procedures
  - Easier prooving
  - Easier testing
  - Easier debugging

Goals: Software Engineering (4)

- Integrity
  - Components (programs, data, documents, ...) protection
- Usage simplicity
  - Easy **Anima** learning and operating
  - Easy results interpretation

  → Cause and consequence of all other Software-Engineering principles

Focus: Prolog

- Not very legible but NLP-widely-used syntax
- No type system and sometimes no constraint solver
- Not very configurable and extensible
- No appropriateness with recent grammatical theories
- No control meta-level
- In relation to software engineering: not very maintenable, a bit reusable (but not reused), reliable

Focus: LIFE

- Complex and not very legible syntax
- Good expressiveness and higher-level concepts
- Existing type system and constraint solver
- Not very configurable and extensible
- Enough appropriateness with recent grammatical theories
- Disused and not very performant interpreter and compiler
- No control meta-level
- In relation to software engineering: not very maintenable, a bit reusable (but not reused), not reliable

Focus: Oz

- Disconcerting but clear syntax
- Good expressiveness and higher-level concepts
- Existing inadequate type system but good constraint solver
- Configurable and extensible but at C++ level
- No appropriateness with recent grammatical theories
- No control meta-level
- In relation to software engineering: enough maintenable, a bit reusable (but not reused), reliable

Elements of solution: Modelization

- Good expressiveness
  depends on higher-level concepts
  The most important: constraints
- Encapsulation
  provides good control and autonomy

→ Constrained objects

Elements of solution: Expressiveness

Good expressiveness relies on

- Higher-level concepts
- Active constraints
- Query language
- Logic relations
- Type relations (Inheritance link, *Clientèle* link, . . .)

and is implemented by

- Objects
- First-order discipline

Elements of solution: Evolutivity

- Meta-Object Protocol
  - Basic-mecanisms transparent box
  - Basic-mecanisms modification ability

Elements of solution: Integration, Introspection and Control

Analysis + Time + Work

=

Debugger, Profiler, ...

⇓

Integration + Introspection + Control

Elements of solution: Software Engineering (1)

- Legibility
  - Encapsulation
  - Overloading
  - Polymorphism
  - Modularity
- Reliability
  - Specification definition and implementation
  - Designers' experience and appraisal

Elements of solution: Software Engineering (2)

- Extensibility
  - Modularity
  - Autonomy
- Reusability
  - Of existing languages
  - Relies on object technology

Elements of solution: Software Engineering (3)

- Compatibility
  - Objects as exchange standard
  - Autonomy
- Performance and Portability
  - Well-known solutions
- Verifiability
  - Well-known and well-tried algorithms
  - Helped with good tools (debugger, profiler, ...)

Elements of solution: Software Engineering (4)

- Integrity
  - Robustness
  - Designers' talent
- Usage simplicity
  - Application-domain (NLP) knowledge

  But few direct control

Conclusion and Future

Many existing partial solutions but no integration

$\Downarrow$

Integration under control of Software-Engineering through a coherent multi-paradigm language: `Anima`