GenFPL:
DSL-embeddable functional programming languages

Meinte Boersma (DSL Consultancy)

LangDev CON 2024

Seville 17-19 October, 2024

https://langdevcon.org

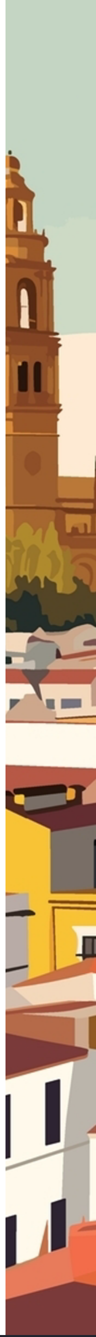
Accessibility

This presentation and its code available at:

https://github.com/dslmeinte/GenFPL-langdev2024

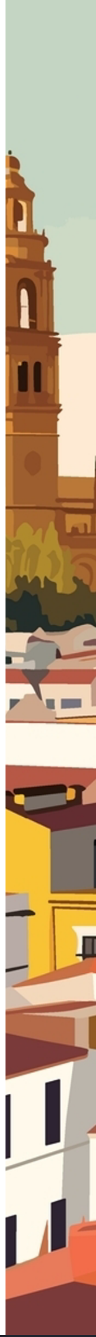
4ZMD

ProxyHands



Caveats

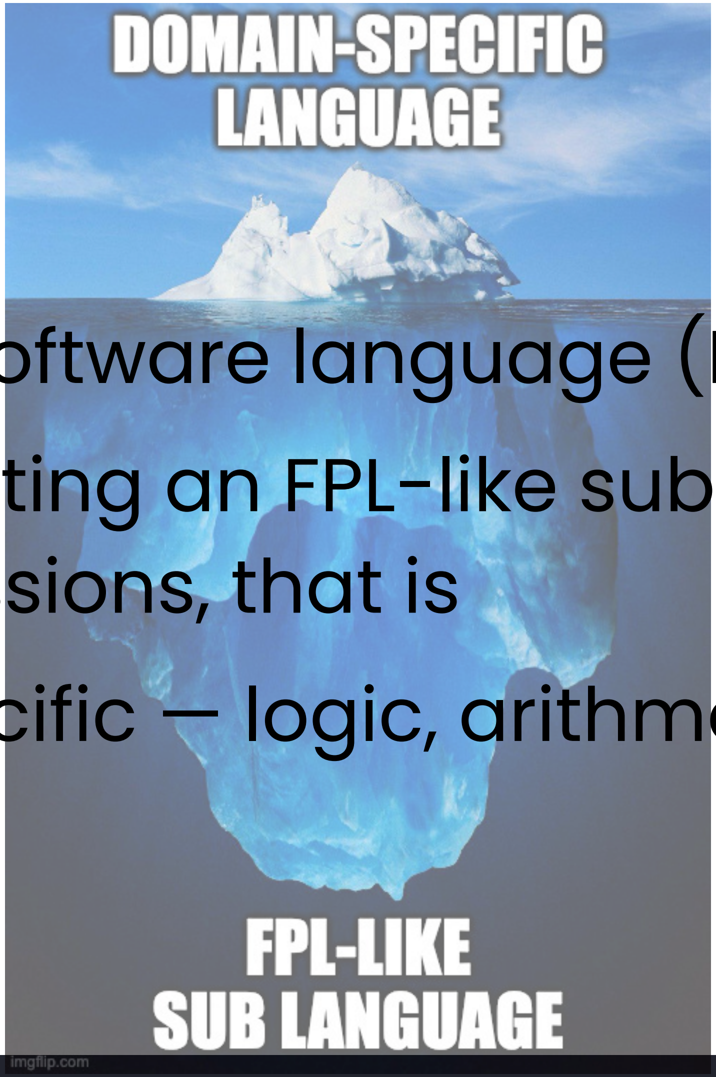
1. GenFPL = “generate FPL”, not “gener{al|ic} FPL”
2. GenFPL is in its ~~infancy~~ fetal stage



Quick quiz (AKA “market fit research”)

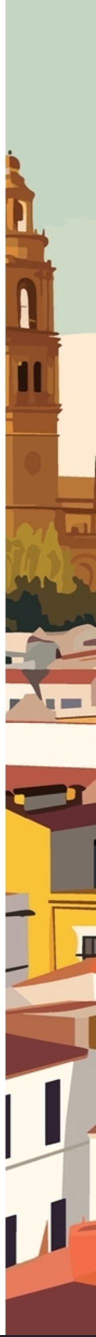
Who among us

1. Have developed a software language (DSL, etc.), and
2. Ended up implementing an FPL-like sub language for (declarative) expressions, that is
3. Quite domain-**a**specific — logic, arithmetic, etc.



What is GenFPL?

- JavaScript (Node.js/NPM) tooling…
- …to quickly implement FPL-like sub languages
- Located at: https://github.com/dslmeinte/GenFPL (license=Apache 2.0)
- *Powered by* LANGUAGE INTERFACES ON THE WEB LIONWEB



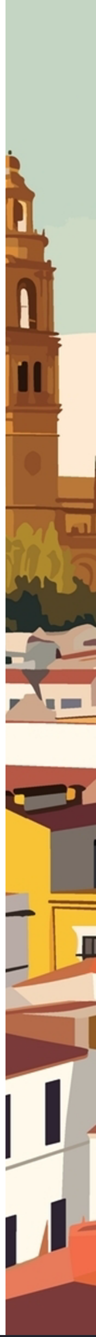
Why create GenFPL?

- Because there is a need for rapid, industrialized implementation of embeddable sub FPLs — (see quiz).
- But… *KernelF* ?! Not everything happens in MPS.
- Showcase and augment LionWeb.
- To challenge some PL-“traditions”.
- To scratch my FPL-itch without needing to have to deal with limitations/idiosyncrasies of an existing FPL.
- For fun!
- …this talk…

Powered by

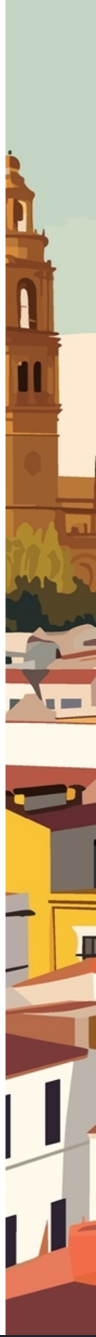
LANGUAGE INTERFACES ON THE WEB

LIONWEB



Contents (not in order)

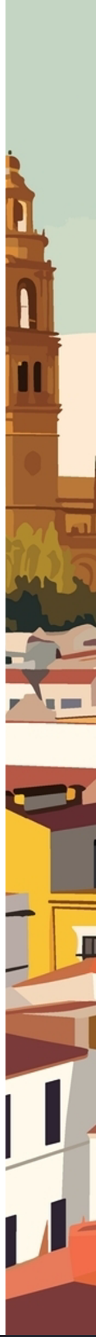
1. Demo GenFPL
   a. Installation and making a configuration
   b. Implementing and testing an interpreter
   c. Accessing records
2. Some(anti-)patterns for sub FPLs
   a. Typical *areas* and their meta-hierarchy
   b. To `stdlib`, or not to `stdlib`?



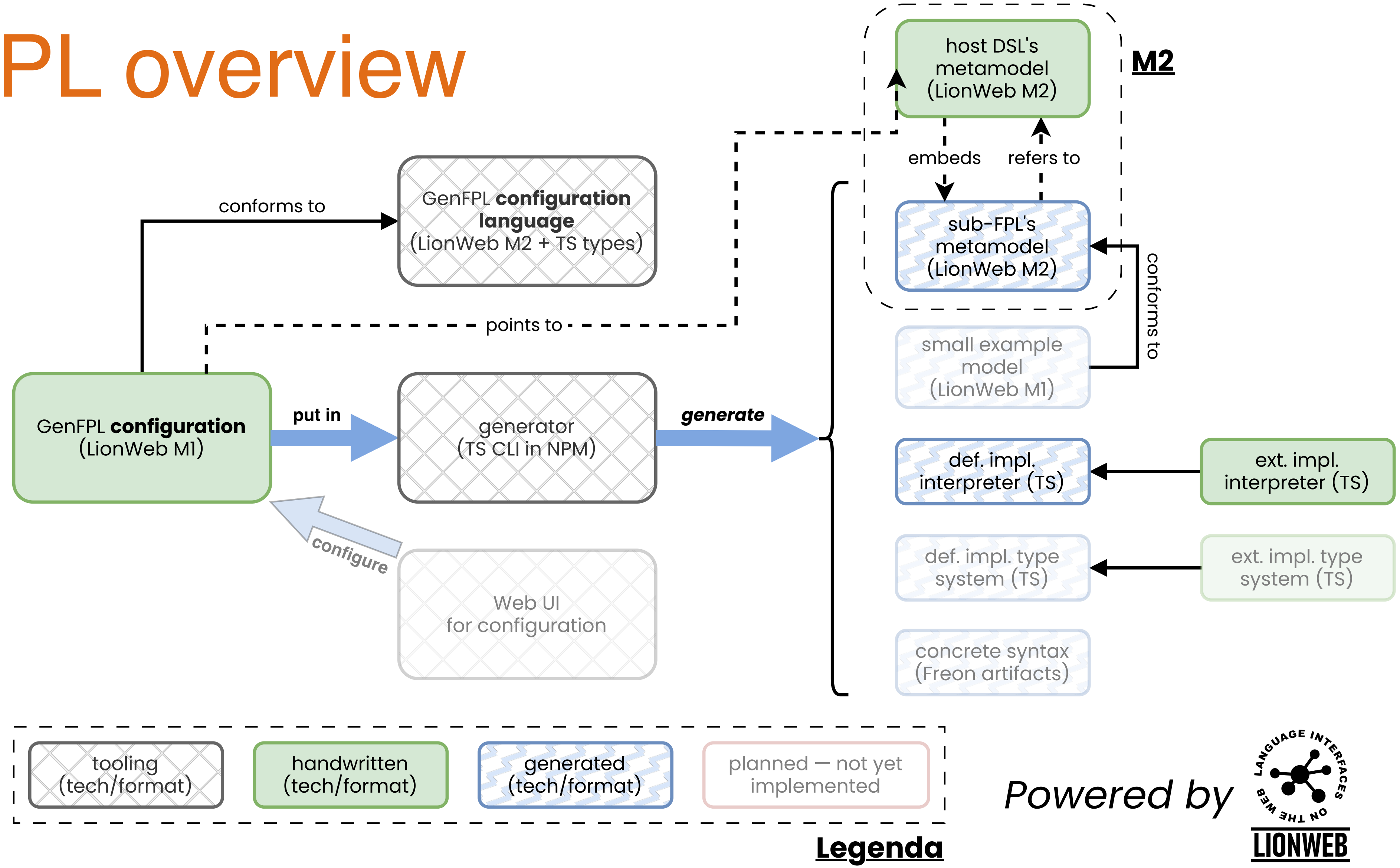
What is an FPL anyway?

- **Funclarative**[1] expressions language
- Governed by a substitution model, so admits to algebraic reasoning
  - Makes it simpler to reason about programs
- Quite simple to correctly implement semantics and type system

[1] term coined by: Markus Völter



GenFPL overview

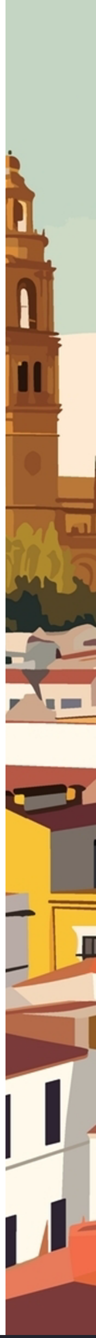


M2
host DSL's metamodel (LionWeb M2)
embeds
refers to
sub-FPL's metamodel (LionWeb M2)
conforms to
small example model (LionWeb M1)
conforms to
GenFPL **configuration language** (LionWeb M2 + TS types)
points to
GenFPL **configuration** (LionWeb M1)
put in
generator (TS CLI in NPM)
generate
configure
Web UI for configuration
def. impl. interpreter (TS)
ext. impl. interpreter (TS)
def. impl. type system (TS)
ext. impl. type system (TS)
concrete syntax (Freon artifacts)
tooling (tech/format)
handwritten (tech/format)
generated (tech/format)
planned — not yet implemented
Legenda

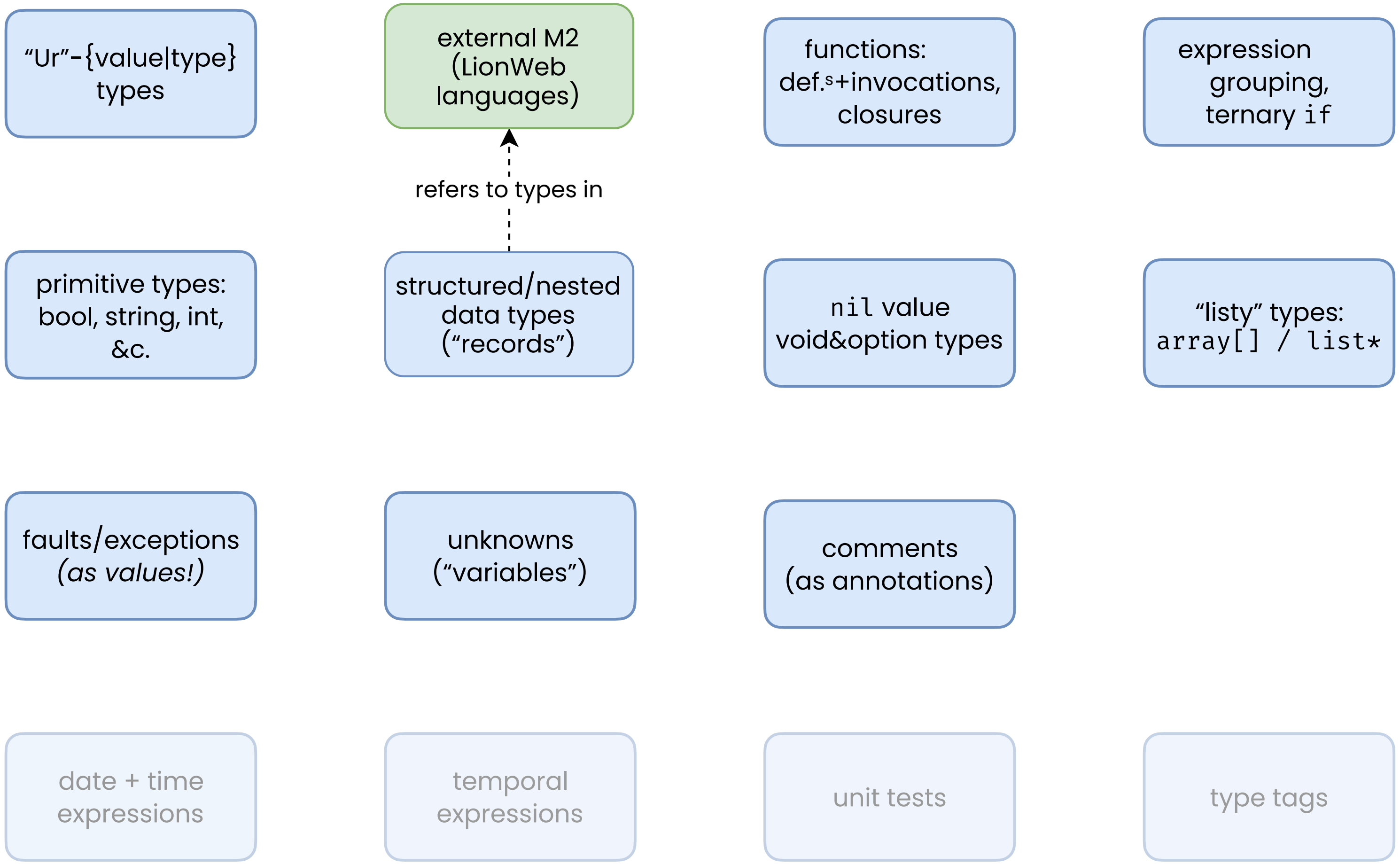
Powered by LANGUAGE INTERFACES ON THE WEB LIONWEB

Design choices

- Generate parts of sub FPL from a configuration:
  - Metamodel (M2)
  - Extensible default implementation of interpreter
  - (Future work: type system, Freon integration, etc.)
- Granularity: *areas* ~ modules



Areas of sub-FPLs



"Ur"-{value|type} types

external M2 (LionWeb languages)

functions: def.s+invocations, closures

expression grouping, ternary `if`

refers to types in

primitive types: bool, string, int, &c.

structured/nested data types ("records")

`nil` value void&option types

"listy" types: `array[] / list*`

faults/exceptions *(as values!)*

unknowns ("variables")

comments (as annotations)

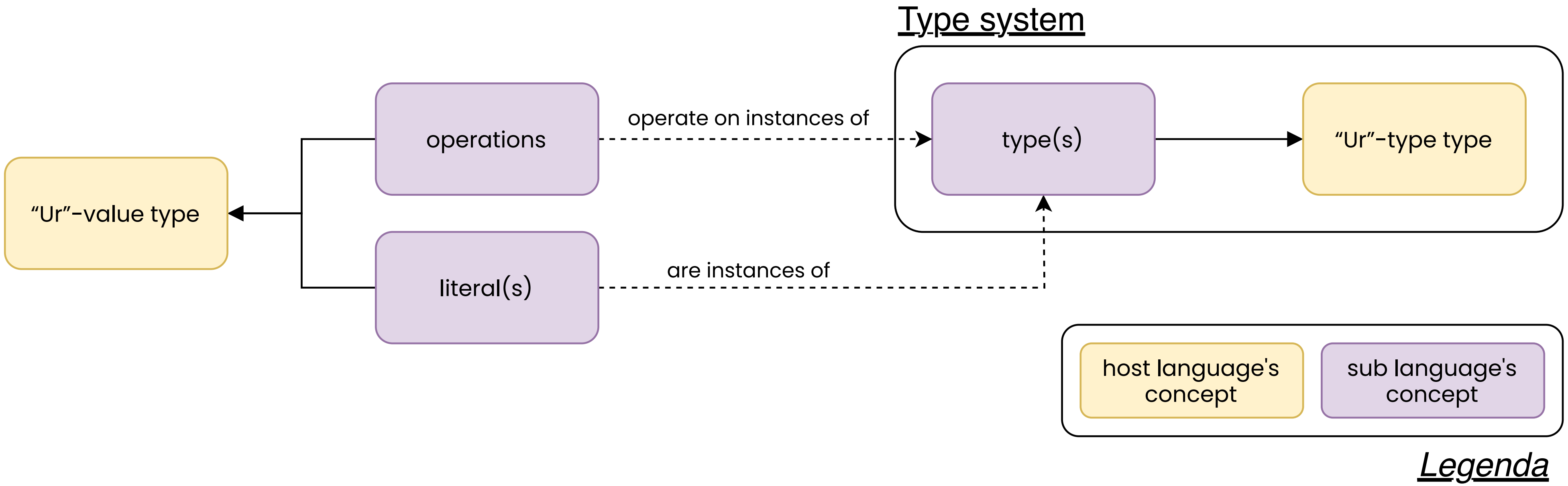
date + time expressions

temporal expressions

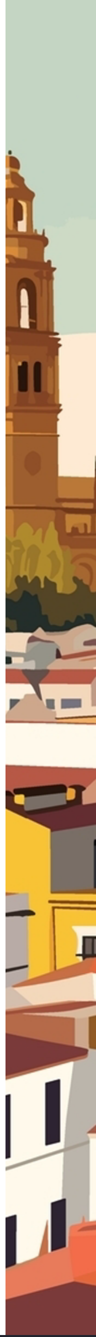
unit tests

type tags

Meta-hierarchy of an area

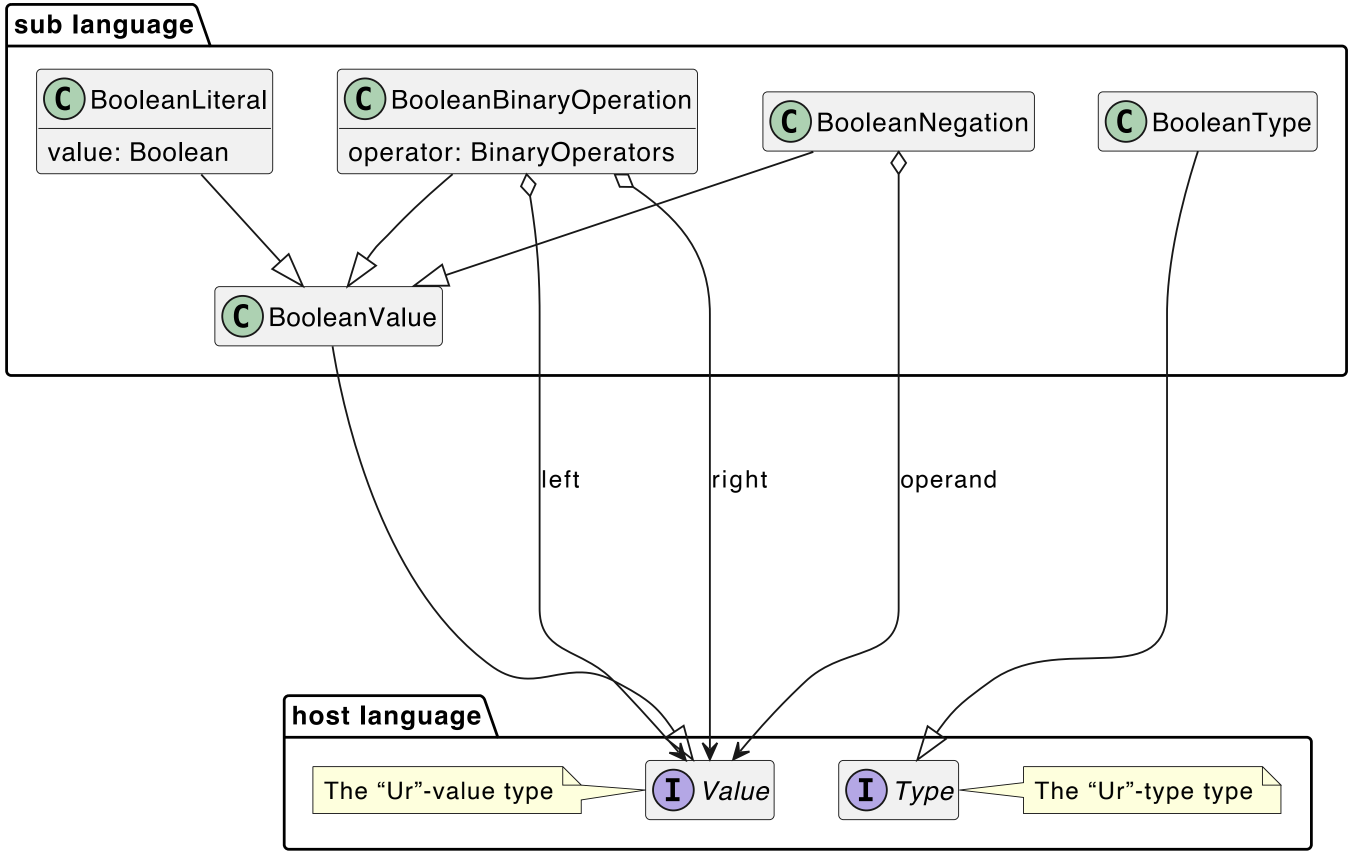


"Ur"-{type|value} types are specified in the GenFPL configuration

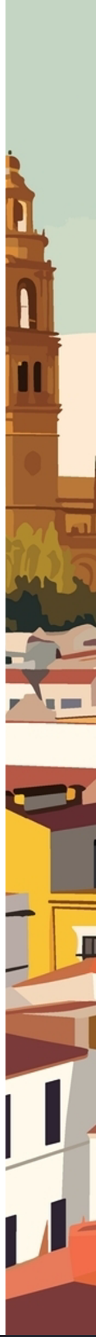


Meta-hierarchy of an area *(cont.^{d})*

Example: **boolean** area

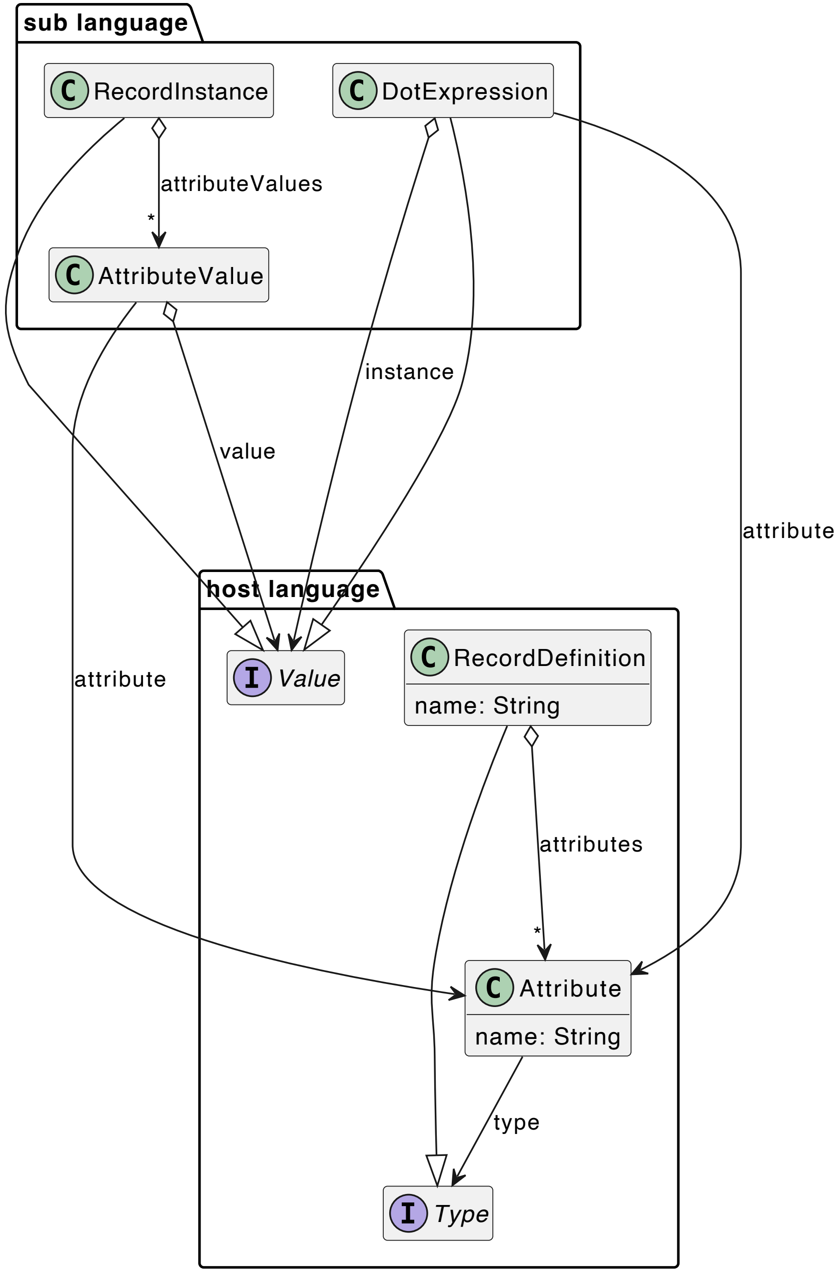


Demo (1/2)

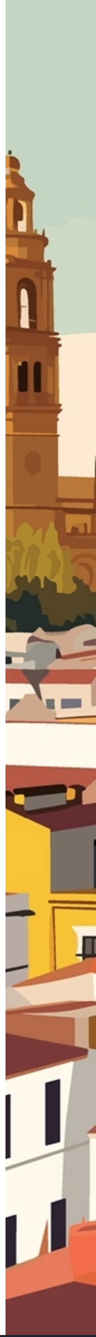


Accessing records

- Observation: host language often has concepts for (nested) data structures — e.g. "records".
- Want to be able to access attribute values on instances of those.
- Solution: configuration points to concepts in the host language, and generate appropriate concepts.

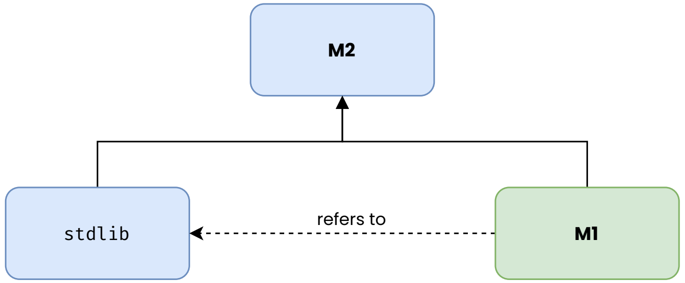


Demo (2/2)

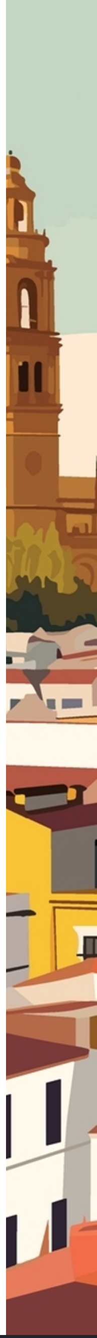


To `stdlib`, or not to `stdlib`?

- A `stdlib` adds features to a language without enlarging the M2. Idea:



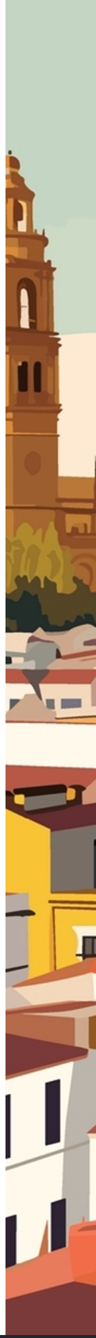
- Cost: need generic concepts to be able to define the `stdlib` *including type system* → an “inner metamodel”



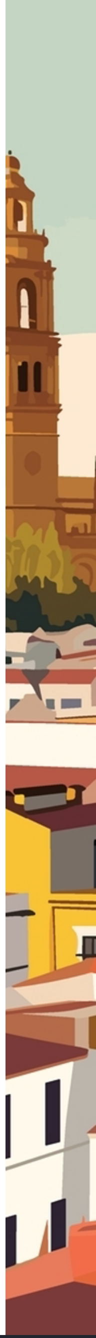
To `stdlib`, or not to `stdlib`? *(cont.^{d})*

- Pros:
  - Fewer concepts to deal with (eventually)
    - More malleable
  - Better abstractions and generalizations

- Cons:
  - No syntactic difference: “everything’s an ‹*X*›” ⇒ worse discoverability
  - More complex type system



To `stdlib`, or not to `stdlib`? *(cont.^{d})*

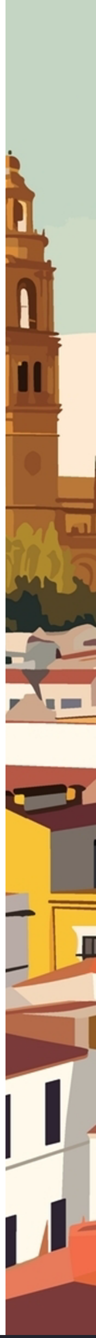


In the context of GenFPL:

- Generation is cheap
- ⇒ Pros of `stdlib` disappear, while cons would still be “hit”
- ⇒ Design choice: no `stdlib`

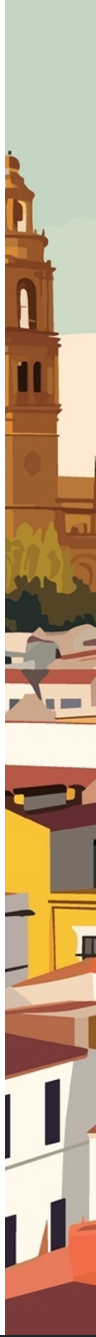
Conclusions

- Interesting to do this gener{atively|ically}
- Generating a language means keeps complexity of it down
- Good input for LionWeb
- Plenty of work to do

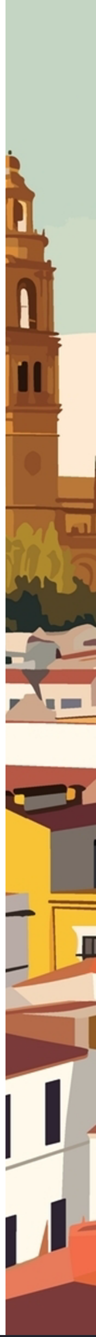


Future work — plans / ideas

- Integrate with Freon for a concrete syntax
- More areas
- A CLI tool
- Type system
- Nice UI for configuration
- Generate a generator



Questions?



Shameless advertising

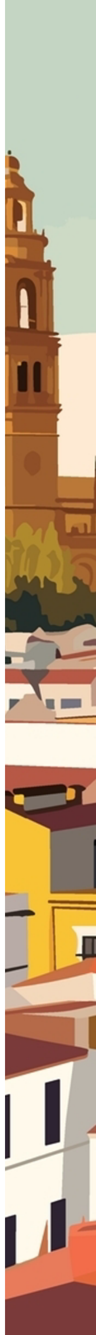
My book

Building User-Friendly DSLs

is out!

Use code **`langdev24mb`** *until 31/10* for 45% discount off of *all* Manning products

© N. Boersma



Thank you!

And generate your sub-FPL *today!*